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COMPARATIVE EVALUATION OF MINE-SHAFT WIRE-ROPE NDT INSTRUMENTS: A SEARCH FOR, AND ANALYSIS OF, BACKGROUND INFORMATION —CONTRIBUTION TO THE CANADA/USBM/ONTARIO MOL JOINT R&D PROGRAM

L.B. Geller and J.E. Udd MRL 88-78(TR) E

Mining Research Laboratories, CANMET, Ottawa, and

E.W. Mitchell, Ontario Ministry of Labour, Toronto **— July 1988**

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July 1988

MINING RESEARCH LABORATORIES
DIVISION REPORT MRL 88-78 (TR)

FOREWORD

The Ontario Ministry of Labour, as one member of the US/Canada research project on Wire-rope and Hoisting Technology, fully supports the aims and work of this group.

It is, therefore, a pleasure to join CANMET's extensive efforts, and provide Ontario's contribution in the form described in this report. While Ontario's involvement in the mine-shaft hoisting field is both longstanding and substantial, renewed efforts are now necessary in order to fully benefit from past work, and also to remedy existing shortcomings. The authors' report is an important element in these endeavours.

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ABSTRACT

Although in situ non-destructive testing of mine-shaft wire-ropes, with electromagnetic (EM) type instruments, has been practiced in Canada for several decades, on a mandatory basis, relatively little has been published about the extensive test results that have been obtained. Researchers, with links to the appropriate laboratories and mining operations, were aware of these. Consequently, they knew about both the undoubted benefits of the procedure as well as the manifest shortcomings under certain circumstances. In general, though, a detailed analysis of past results was not available.

The present report has been written (a) to make this valuable information more readily available, for the first time, and (b) to provide a solid point of departure for CANMET's* forthcoming contractual project, undertaken to evaluate the sensitivity, reliability, and practicability of the range of currently available EM rope testers.

The report is based, almost exclusively, upon the uniquely comprehensive databank accumulated by the Ontario Ministry of Labour's (Ontario MOL) Rope Testing Laboratory, in Toronto. In fact, only a limited amount of the available data were used: those that made it possible to present an analysis of the safety aspects of this non-destructive test procedure. Specifically, the authors compared the maximum breaking strength losses at the time of a rope's retirement as obtained (1) on the basis of NDT measurements with EM instruments, and (2) on the basis of destructive testing. It was found that, on the whole, no more than some 50% of the NDT estimates were within the ±4% accuracy range specified by Ontario's "Performance Requirements". Moreover, it was found that, in a number of cases, the rope breaking strengths seemed to have diminished well beyond the amount permitted by the relevant provincial mine regulations.

In addition to containing a collation and analysis of the abovementioned rope strength data, the present report also represents a first time effort to present (a) the relevant regulatory details of a range of mining acts, and (b) the size and construction details of mine-shaft wire-ropes used in a number of Canadian provinces. The authors' primary reasons for providing this additional information was (1) so that questions may be posed as to how far extant regulations can, in fact, be reasonably satisfied by currently available state-of-the-art instruments, and (2) to determine whether certain rope sizes and constructions might, perhaps, predominate to the extent that instrument capabilities need be oriented towards them. As to the latter point: none were found to predominate to a critical extent. As to point (1): a clearcut answer will have to await further experimental results.

* CANMET = The Canada Centre for Mineral and Energy Technology (of Energy, Mines and Resources Canada, in Ottawa).

ACKNOWLEDGEMENT

The kind cooperation received during the course of a number of personal meetings and discussions with J.J. Lazurko, Chief Electrical-Mechanical Engineer, Ontario Ministry of Labour, Mining Health and Safety Branch; K.E. Daniel, Manager, Mines Safety, Occupational Health and Safety Commission, New Brunswick; Walter O.J. Skelly, Manager, Mine Safety Unit, Saskatchewan Labour, Occupational Health and Safety Branch; and Largo Albert, Chairman, Ontario Mining Association Hoist Plant Committee, is gratefully acknowledged.

The unstinting assistance and cooperation of Dave Geddes, Superintendent, Wire Rope Testing Laboratory, Ontario Ministry of Labour, in helping to assemble information from the laboratory's extensive data-bank, needs special recognition.

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R&D Program
On Wire-Rope And Hoisting Technology

by

L.B. Geller*, J.E. Udd**, and E.W. Mitchell†

BACKGROUND

The need for a commercially viable, as well as technically reliable, method to non-destructively test mine-shaft wire-ropes was dramatically illustrated by a major accident on February 2, 1945, at the Paymaster gold mine at Timmins, Ontario. On this occasion a badly corroded 1 in. 6×27 (12/12/3) flattened strand Lang's lay hoisting rope broke above a double-deck cage, while lowering 16 men. The safety dogs engaged the guides immediately, but were torn out. These then worked ineffectively as the cage fell more than 1700 ft to the bottom of the shaft. All of the men were killed. Subsequent destructive tests on a number of samples from the failed rope showed a maximum breaking strength loss of 61.9% (Figure 1).

As a result of this accident a Royal Commission was set up. Its report — together with those of the Ontario Mining Association Committee and of Ontario's Inspector of Mines — was published in 1947 (1). Among the Commission's eight recommendations, number four asked "*that the Department of Mines and the mining industry of Ontario continue to encourage investigation of the merits of electro-magnetic methods of examination of mine hoisting ropes.*"

This recommendation was effectively implemented by the establishment of basic investigations under the direction of Dr. A. Semmelink and Mr. J.G. Lang (2, 3), and jointly funded by the Ontario Mining Association (OMA) and the Ontario Department of Mines. Hundreds of tests were carried out with the instrument thus developed, over

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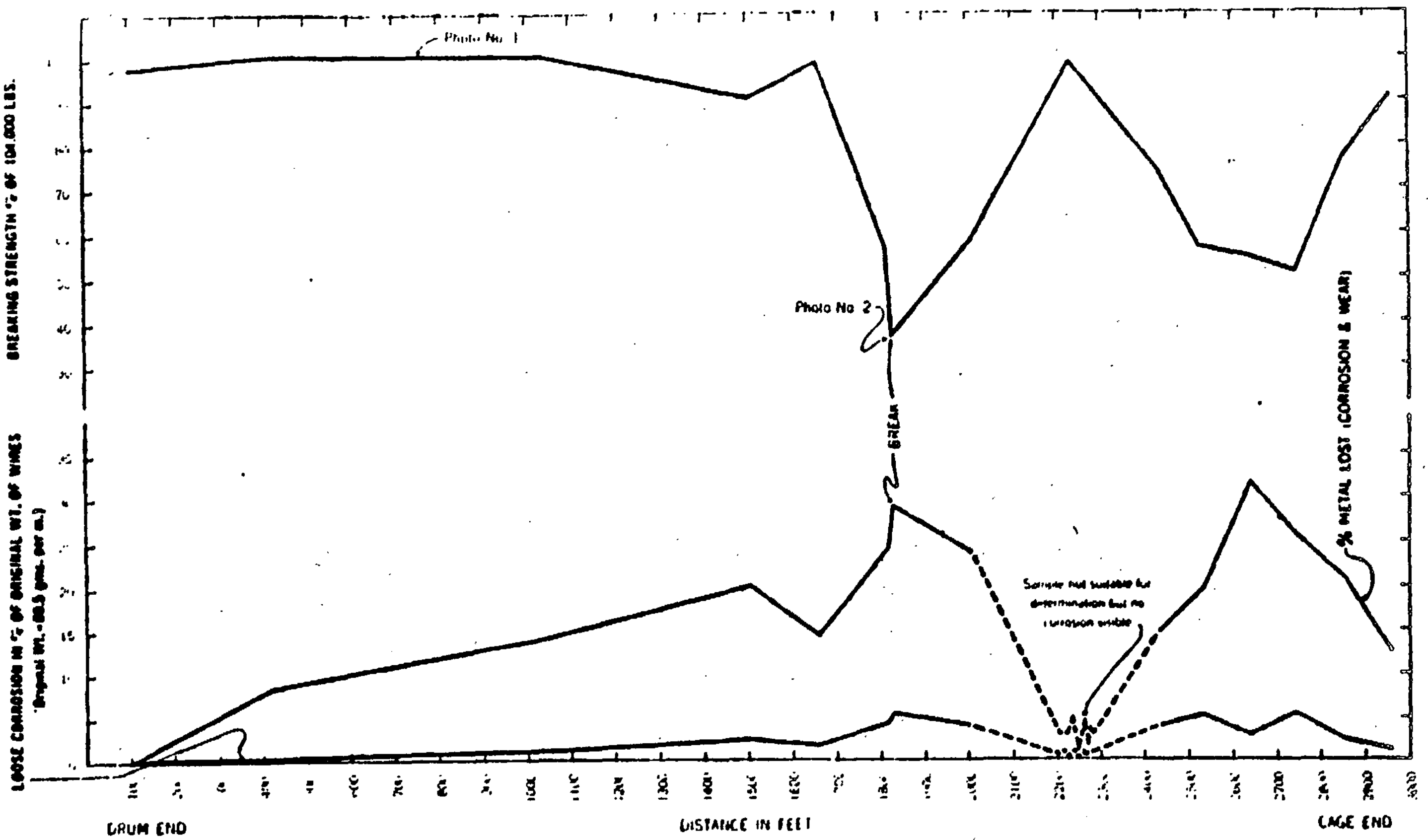

Fig. 1 — Test results with failed Paymaster hoist rope (from ref. 1)

a period of four years, at a number of Ontario mines. A selection of the results, namely those of 11 *"Special Tests"*, was published in 1964 by Barrett (2).

One of the many figures given by Barrett is reproduced here as Figure 2, partly in order to illustrate the type of charts the Rotesco AC instrument in question produced, and partly to illustrate the type of graphical method chosen by the Ontario Department of Mines at that time (and still in use today) for presenting comparisons between non-destructive strength loss estimates and the corresponding destructive results. It will be noted that these graphs tacitly assume, as valid, the postulated correspondence of the rope samples to which the foregoing strength loss comparisons have been assigned — an assumption no longer accepted, without more rigorous proof, by the present authors. The tacit assumptions:

(a) that strength losses vary linearly between the measured values, and that
(b) the "worst" piece in the rope is the one found to be so by destructively testing a given, strictly limited, number of rope samples, are also open to discussion.

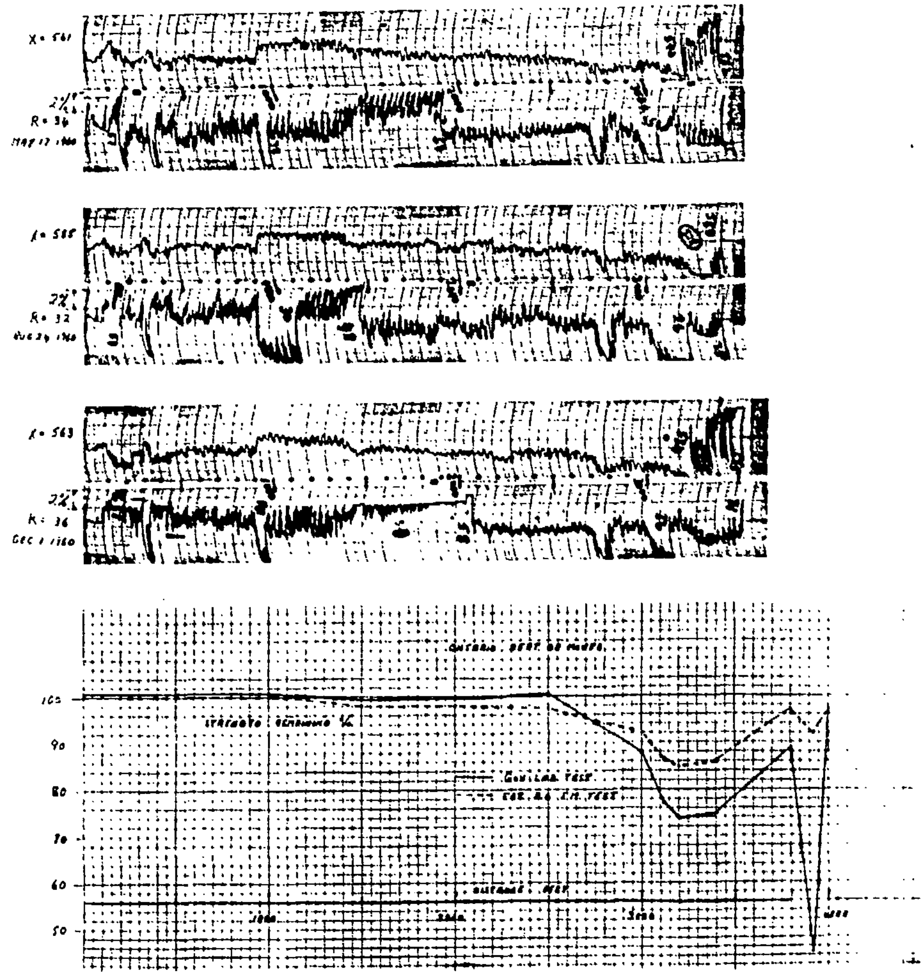

Fig. 2 — Ontario MOL "Special Test" #330 (item 60 STR in Appendix C)

At any rate, the above-mentioned test results were, at the time, considered to be so satisfactory that a recommendation was submitted to the directors of the OMA and to officials of the Ontario Department of Mines — whose duties in this respect have now been assumed by the Mining Health and Safety Branch of the Ontario Ministry of Labour (Ontario MOL) — suggesting that the testing device be accepted for the regular inspection of round and flattened strand hoisting ropes. This recommendation was put into effect under a directive issued by the Chief Engineer of Mines of Ontario on January 1, 1963; it approved the device (referred to in this report as the Rotesco

AC instrument) for use in Ontario, and established testing procedures, on a mandatory basis, for all round and flattened strand ropes (2). Relevant regulatory details are included in the provincial Occupational Health and Safety Act (4). An earlier overview is given by Barrett (2).

The Rotesco AC instrument has now been used across Canada for more than two decades in hundreds, if not thousands, of tests. It proved to be very useful in establishing an acceptable basis for assessing whether or not a rope could continue in service. In fact, experience has identified several internal rope anomalies which, under normal inspection conditions, could only be detected by using this type of test instrument. Thus, the use of this electro-magnetic tester has resulted in a great improvement in the safety of hoisting.

Nevertheless, several factors indicate that it is now time to undertake a renewed effort to evaluate the relative merits and shortcomings of the various EM testers in current use. These factors include:

(1) practical experience, showing that certain critical internal rope defects still elude positive detection under certain circumstances;

(2) recent rope failures which occurred despite routine NDT rope testing in accordance with statutory requirements;

(3) the development, both in Canada and abroad, of newer, and in some respects perhaps more versatile, EM rope testers;

(4) Ontario's "Performance Requirements" (Appendix A), which specify that *"application for verification of a previously approved device is to be made after any major modification, or every 5 years, whichever occurs first"*;

(5) the limiting nature of Ontario's previous "approvals", restricting the use of both the Rotesco AC and Magnograph testers to stranded ropes only;

(6) the great interest, expressed by both the mining industry and by provincial regulatory authorities, in having such a study undertaken. As an example, a June 1986 letter to CANMET's Director General by the Chairman of the Canadian Association of Chief Inspectors of Mines, states that *"The Provincial Chief Inspectors of Mines are deeply concerned about the lack of research in non-destructive testing of mine shaft ropes"*, and concludes with *"We believe this problem to be of national concern and that CANMET should undertake research in this area."*

INTRODUCTION

The involvement of CANMET's Mining Research Laboratories (MRL) in the study of mine-shaft wire-ropes began in September 1983, when it was agreed that MRL staff would participate, as one of three voting members, in the work of a tripartite

US Bureau of Mines/CANMET/Ontario MOL Advisory Committee. As in case of other joint CANMET/USBM/Ontario MOL projects, the cooperation proved to be both harmonious and fruitful. One of the projects agreed upon is an in-depth study of electromagnetic wire-rope testing instruments. So far, much of the basic laboratory work in this area has been done by the USBM, whose Pittsburgh and Spokane laboratories are equipped with both specialized rope testing machines, and with a number of the EM testers of current interest.

Canada's contributions have, however, also been noteworthy. These include:

- a study trip to France, Britain, West Germany, Poland and Hungary, to examine, analyse, and report on (5) the testing procedures and regulatory aspects in those countries;
- sharing of experiences — and in particular those of Mr. Largo Albert (6, 7, 8), Chairman of the OMA's Hoist Plant Committee — in the area of operational mine-hoisting practice;
- provision of the uniquely comprehensive test results obtained, since 1922, by the Ontario Ministry of Labour's Rope Testing Laboratory in Toronto (2, 9);
- CANMET's present efforts.

As to details of CANMET's aforementioned efforts, it should be noted that its Mining Research Laboratories division is active:

(a) in advisory, liaison and observer roles (as a member of the "Review Committee") on a contractual project initiated and directed by the Province of Manitoba, with funding from Canada/Manitoba Mineral Development (MDA) sources;

(b) in preparing, directing, and executing contractual work (see Appendix A), with funding from Canada/New Brunswick MDA sources. This work is due to commence in the near future and to be completed by November 30, 1989 (10, 11, 12), and

(c) in the non-contractual work area, by searching for and analysing (as described in this report) the extensive amount of background information relating to the upcoming contract. The primary purpose of this work is to elaborate and underpin CANMET's contractual efforts by documenting both the need for the contract-work, as well as the reasons for proceeding with the methodology chosen. Particular attention is paid to the need to avoid duplication, and to achieve a fair certainty of success.

To achieve the goals set out in point (c) above, the authors undertook:

(1) discussions with provincial mining authorities, regarding details of the proposed contract;

(2) a survey of previous similar "round robin" test work;

(3) a review, and analysis, of relevant publications in the field of EM rope testing instruments;
(4) a review, and analysis, of the pertinent regulatory ordinances;
(5) a review, and analysis, of Canadian data-banks (provincial and industrial) providing results of previous destructive/non-destructive mine-shaft wire-rope tests;
(6) a survey and listing of mine-shaft wire-ropes currently in use in Canada.

The results of the aforementioned efforts are reported herewith.

CONTRACTUAL EFFORTS

The complete results of CANMET's contractual efforts will eventually be available, on completion of the work mentioned in 1989. At this point, we merely wish to state that all of the preliminary work has been completed (as described in the following report section), and that the contract awarding process is near completion at the time of writing. Details of the proposed contract are given in Appendix A.

NON-CONTRACTUAL EFFORTS

Details of CANMET's contractual work plan

Perhaps the most urgent of the in-house tasks for CANMET's MRL was to finalize details of the contractual work which it is organizing. This had to be done well before issuing the necessary *"Request for Proposal"* (RFP), so that cooperating organizations would be given sufficient time to express opinions about the RFP's *Work Statement* (see Appendix A). Copies of the latter were sent to the mining authorities in New Brunswick and Ontario, and to colleagues at the USBM. Moreover, a general outline of the proposed contract-work (10, 11, 12) was sent to a number of interested parties, e.g., to Saskatchewan Labour, and to the New Brunswick Department of Natural Resources and Energy, who circulated it to executives of mines in their provinces, for comments. The response to these steps was most positive and encouraging.

Previous "Round Robin" instrument evaluations

An important and very extensive "Round Robin" testing program was conducted in 1978 by British Coal's Safety in Mines Research Establishment (SMRE) in Sheffield, England. This work involved the examination, under laboratory conditions, of seven ropes (five locked-coil and two stranded) with six different European (German, Swiss, Belgian, French, British and Polish) EM testers. Rope sizes ranged from 29mm to 42mm, and contained both artificial and operational defects. The work was initiated by the Directorate General, Mines Safety and Health Commission, of the Commission of European Communities.

The results were described elsewhere, both in detail (13), as well as in a summarised form (14). Additional valuable information and advice was obtained from the SMRE during a personal visit to Sheffield by L. Geller — on the occasion of the 1986 study trip previously mentioned — and through subsequent correspondence with Dr. C.E. Nicholson and Dr. C.H.H. Corden. Some of the salient points made by Dr. Corden in the course of these personal contacts are quoted, in italics, hereunder:

<u>*Artificial defects*</u>

— *It is very difficult to make any artificial defect other than a break. Multiple breaks are very useful to see if the instruments can distinguish between the single and multiple breaks, and if multiple breaks can be assessed quantitatively. The original 2m defect spacing was made to suit the test length we were using. A smaller spacing, say 1m, could be used. An advantage of having groups of artificial defects at a fixed distance apart is that it helps in analysing the traces when the defects are of very small order, and near the resolution limit of the instrument (i.e., when defect signals become lost in the background signals from the rope).*

It is also useful if the instrument trace "settles down" between defects. If multiple defects are made in one place, then a reasonable gap before the next defect helps to identify the defects. Several runs with an instrument should produce identical charts — in our tests with some instruments only signals from the largest defects were consistently recorded with regard to their amplitude and characteristics.

<u>*Re-examination*</u>

— *In our case the loads applied were needed to lift the horizontal ropes far enough from the bed of the test rig for the instrument to pass along them. Some of the instruments showed a DC drift pattern on the traces where the instrument passed close to any magnetic member of the rig, i.e., magnetic flux paths up to about $\frac{1}{2}$m from the rope axis could affect the flux inside the instrument. Our rig is made of cast iron sections bolted together, but has large solid steel beams on either side near one end, used for locating the adjustable cross-head in various positions; these beams were picked up by several of the instruments which could monitor rope steel area using Hall-effect or magnetometer sensors.*

With regard to simulated usage — this would lengthen any programme a great deal. I would prefer to monitor several ropes in service periodically over many months — then on discard, to select specific lengths for laboratory NDT and finally destructive visual examination.

Rig orientation

— *A vertical rig has both advantages and disadvantages. Vertical rigs would not have problems with catenary sag and the high load necessary to hold the ropes reasonably straight. Horizontal rigs make it much easier to walk alongside an instrument during a test and to alter control setting, etc. If you are only concerned with stranded ropes, then a spliced endless loop has many advantages — i.e., leave the instrument stationary and move the rope (gives shorter testing time and much easier adjustment of the instrument). Size of ropes to be tested may be a dominant factor if a loop rig is to be considered.*

Evaluation of performance

— *I agree that the detector heads and back-up instrumentation should both receive attention. In our tests most of the records were produced using a Gould-Brush 222 chart recorder. By using a common recorder for most of the tests it was possible to compare the resolution of the different detector heads directly.*

Electronic signal processing can radically improve apparent performance of a detector head, e.g., the use of a log-amplifier to blow up the defect signals relative to the background signals. Detector heads: some instruments produce signals when they bounce on the rope, or vice versa — such movement often occurs during both in situ and laboratory testing, and can make analysis very difficult.

Instrument performance comparison

— *The "Performance Requirements" given in Appendix A of your report #87-38 seem a good basis for comparison in general terms. I had some doubts about your accuracy targets, especially in the initial tests. If possible, the assessment of the records should be carried out by the same person in each case, to reduce the effects of some persons marking consistently "high", while others mark consistently "low".*

Fault location should be better than "within 1ft" with any automatic fault marking system. We produced a prototype delay line processor to operate a paint spray when a fault had reached a position exactly 1m downstream from the defect sensors in the centre of the instrument. It could mark defects to within ±2cm.

Field and laboratory testing

— *In our experience the performance of instruments can be assessed both on test ropes with artificial defects, and on ropes in service.*

Ropes with artificial defects tend to have too small a range of defects. One of our test ropes had very large defects, giving 5, 10, and 15% loss in strength, also narrow and wide defects. The wide defects consisted of 18 grooves, cut into one of the inner layers of the locked-coil rope to simulate 18 narrow defects close together. In our tests only one instrument was able to identify all 18 grooves *in the second layer (the half-lock layer) of the rope, most of the others simply lumped the signals together. These defects bore no resemblance to any fault which might be encountered in service but it was noted that the instrument that could separate the 18 grooves into 18 defect signals also out-performed all the others in detecting in-service internal breaks in locked-coil ropes, so the tests on artificial defects pointed a clear indicator towards the performance on service defects.*

<u>*Other comments*</u>

— *Our own programme consumed a larger staff effort than we originally envisaged. In situ testing at mines generally gave better defect signals than laboratory testing, but it is difficult to arrange the testing of several instruments over the same piece of rope.*

The destructive visual examination of rope samples in the laboratory, after NDT work is complete, is extremely time consuming if the defects are to be located with sufficient accuracy for chart analysis.

While we consider the Sheffield work to be very relevant, from both an organizational and technical point of view, we are aware that major differences exist between it and the project proposed by CANMET. In particular:

(a) at Sheffield the investigation was concerned with determining how well the different instruments could pinpoint the location and the exact nature of the defects. Questions about "loss of metallic area", and about "loss of rope breaking strength" were of little interest,

(b) different instruments were tested on different rope sizes/constructions, than are of present concern, and

(c) destructive tests, to corroborate any NDT strength loss predictions, were not performed (in view of point (a) above).

Apart from the abovementioned work at Sheffield, we are not aware of any other previous major effort in this area. The present study in Manitoba is well known to us. It is, however, limited to fewer ropes and to fewer instruments than planned for CANMET's forthcoming contract. A limited effort, to evaluate the specification claims of Rotesco and NDT Technologies, has also been reported by Hanson Materials Engineering (15). The results, however, were obtained for in-house use only and are not generally available.

Although in the public domain, the results obtained with various EM testers by provincial mining authorities on comparable or identical ropes, have also not been compiled for easy reference. We attempt to address this situation in this report.

Review of EM wire-rope testers

It is both impractical, and unnecessary, to prepare and append a complete list of publications describing the EM testers of current interest. Instead, it is considered adequate to refer to only a few articles describing some basic aspects of the instruments that either will, or might, be included in the forthcoming contractual work. These include the Canadian Rotesco AC (3, 16) Rotesco DC (17), and Magnograph (18, 19), and the American NDT Technologies LMA (20, 21) testers, as well as French, German, Swiss and Polish (13, 14, 22, 23, 24, 25, 26) instruments.

Tutorial material is combined with applications material in two concise, well written articles by Weischedel (20, 21), covering three of the North American instruments (the Rotescograph, Magnograph, and LMA-250 System) to be included in CANMET's forthcoming contracted project. His Table 1, comparing the technical features of these instruments, is reproduced here, in Figure 3.

	LMA-250 System	Magnograph	Rotescograph
Instrument Type	LMA/LF Main Flux	LMA/LF Return Flux	LMA/LF Return Flux
Magnetization	Rare Earth (Samarium Cobalt) Permanent Magnets	Rare Earth (Samarium Cobalt) Permanent Magnets	Ferrite Permanent Magnets
Sensors	Coils	Hall Generators	Flux Sensors (Coils)
Quantitative Resolution	2 in.	20 in.	20 in.
Electrical Power	Battery or AC Line (selectable)	Battery or AC Line (selectable)	AC Line
Rope Measurement			
Rope Diameter	3/8" to 2 1/2"	3/8" to 2 1/2"	3/8" to 2 1/2"
Rope Speed	0-600 ft/min.	0-600 ft/min.	0-600 ft/min.
Weight			
Sensor Head	60 lbs.	105 lbs.	98 lbs.
Console including Strip Chart Recorder	39 lbs. (includes batteries)	80 lbs. (includes batteries)	45 lbs. (batteries not available)
Accessories	Footage Counter Tape Recorder	Footage Counter Tape Recorder	Footage Counter

Fig. 3 — Comparison of LMA, Magnograph and Rotescograph instruments (from ref. 20)

His comment (20) to the effect that *"AC testing has been practised in North America by a Canadian company for many years. It suffers from serious deficiencies such as complicated operation, insufficient quantitative resolution, bad signal-to-noise ratio, and therefore, unreliability. A recent study* demonstrated the relative ineffectiveness of this method."* is noted.

Instrument design details and performance characteristics can be obtained from the literature. Those features are not summarized in this report:

(a) because they will, *eo ipso* manifest themselves in the test results of the forthcoming "round robin" examination, and

(b) because, to the extent that they might influence the results of the proposed contractual work, they will have to be considered by the principal contractor in any case.

Moreover, in the authors' opinion, design details are only one of the aspects of current interest. So are, inter alia, practical considerations. Consequently, they too will have to be discussed in the contractor's final report, including:

(1) <u>economic matters</u>, such as first costs, maintenance expenses, ease of handling and of operation, ease and flexibility of chart evaluation techniques, and the like,

(2) <u>corollary matters</u>, such as operator training; the cost of, and satisfaction with, the service provided by the companies offering rope inspections; the degree to which test results and regulatory requirements conform; and the amount of burden any new test instrument related regulations might impose upon the mining industry.

Although the previously referred to extensive report (1) does not, strictly speaking, deal with any of the EM rope testers of current interest (and, in fact, antedates their development), it is referred to in this report section as well:

(1) because of the amount of valuable information it contains about mine hoisting practices, accidents, and relevant problems in general, and

(2) because it was instrumental in establishing the solid foundations upon which subsequent developments, in both the research and regulatory fields, were based — primarily in Ontario, but also in all of Canada and to a certain extent perhaps even in the USA.

Review of regulatory aspects

While, in some respects, the objectives of CANMET's forthcoming contractual work are no different from those of the 1978 "round robin" tests at Sheffield (13, 14), as well as of those of the ongoing work in the laboratories of the USBM, in other

* <u>Note</u>: reference no. 38 in this report.

respects they go beyond them. They do so by specifying that the prospective contractor examine, and analyse the extent to which the various EM instruments may enable their operators to accurately predict any loss in original rope breaking strength. Since this requirement is by no means universal, or even expressed uniformly in the different Canadian provincial regulations, and since it is said to be open to some criticism, a detailed review of the most pertinent regulatory requirements, both in Canada and abroad, is given in Appendix B. Points of particular interest are summarised.

As in case of the EM wire-rope test instruments, it again appears both unnecessary and impractical to append a verbatim copy of all the relevant sections of the various Mining Acts that regulate the use of mine-shaft wire-rope testing. However, a reference listing of the regulations examined is provided (references 4, 27 to 36, inclusive). It will be noted that in the cases of Ontario, New Brunswick and Quebec this list includes two sets of regulations. The purpose in doing this is to give the reader an indication of a trend in the thinking of Canadian provincial mine-regulators. It will also be noted that we limit our comparison of the various regulations to those sections and points which, in our view, are most germane to the matter in hand.

Readers of this report will wish to draw their own conclusions. Without wishing to unduly influence them, it may perhaps still be in order to comment upon the apparent trend in Canada to move away from the one "extreme" of the Ontario position (where both EM instruments and the service/operators must be approved provincially), towards — but not to — the other "extreme", represented, for example by Britain. There, EM examinations do not influence regulatory aspects. Instead mine-shaft wire-ropes have to be retired no later than after a permissible length of time in service. Some relevant comments should, perhaps, be quoted here, to the effect that:

— *"Only the Canadian government requires approval of rope inspection equipment. Neither the US government, nor any other government, worldwide, requires or grants instrument certification (21)";* and that

— *"It is notable that specific approval of method, equipment and operator are cited in these* regulations. In most other fields of NDT the problem is dealt with by defining carefully the physical basis of the method, in proprietary or concensus standards for test methods, and by widely recognized inspector qualification schemes. The general principles of quality assurance are then used to ensure that qualified personnel (whose qualifications depend in part on a fundamental understanding of the physical basis of the test method) use test methods that can be demonstrated to conform to the relevant standards. Reliance is still placed on operator judgement, but steps have thus been taken to ensure that the inspection*

* *__Note:__ here Dr. Dixon refers to Ontario Regulation 694 Section 220 (4), and to the New Brunswick Mining Act, Reg. 77-58, Section 171 (4)*

is done in a recognized manner, and the operator had somewhat more than a superficial training in equipment adjustment and matching observations to examples (15)".

These comments, including the ones about operator training, refer to matters that have, in fact, been of concern to the tripartite USBM/CANMET/Ontario MOL joint Advisory Committee in the past. Reference was made to them, as an example, during the previously mentioned European study trip (5). As to some of the other matters raised, the authors suggest that regulations judiciously combining the rope's service-life history with results of its EM examination might be a practical solution.

Review of the Ontario MOL data-bank results

As mentioned in the INTRODUCTION, a uniquely comprehensive data-bank on mine-shaft wire-rope testing results is available at the Ontario Ministry of Labour. Both US and Canadian publications — such as those by Barrett (2, 9), Mitchell (37), Rice and Jentgen (38) and Jentgen et al. (39) — have been based on these data before. These authors were concerned with the results of the full range of NDT examinations performed on the mine-shaft ropes.

In particular, Barrett and Mitchell compared the rope strength values predicted by the EM instruments (the Rotesco AC and the Magnograph, respectively) with the corresponding destructive test results.

Rice, Jentgen and Anderson's reports are based upon some 1670 detailed report-data (out of more than 5500 available), obtained from 359 ropes. They assessed all the directly measured variables (over 60 in number) by a stepwise discriminant analysis methodology, involving the so-called *Automatic Interaction Detector (AID)* and *Discriminant* analyses, and the *Statistical Package for the Social Sciences (SPSS)*. Theirs was a major, as well as a "first", effort to statistically analyse the mass of available data. Some of their observations are noted hereunder.

Completing one of their first AID analyses (38, Fig. 18), by using strength loss as the dependent variable, several independent variables were conspicuous by their absence. The most surprising of these omissions was the EM predicted strength, reflecting the initially poor fidelity of the early tester model, and the vicissitudes of a newly emerging technology (38, p. 52). All the same, they showed that rope remaining-strength can be predicted with good accuracy if a number of non-destructive measures of rope damage are assessed. Of these the outer wire corrosion rating, the electro-magnetic (EM) non-destructive inspection technique, and the rope diameter reduction, were found to be the most important ones. They found little evidence to support the belief that the conveyance end of the rope is <u>the</u> critical damage site (38, p. 88).

After reviewing the abovementioned reports, we believe that a renewed effort is required, and that this should be an important part of a contracted external study. The main reasons for suggesting another review of Ontario MOL's data-bank, are that:

(1) many more *"Special Tests"* have been performed since the reports mentioned were published;
(2) Barrett's (2) and Mitchell's (37) instrument analyses were based on the assumption that the destructive and non-destructive strength loss data were comparable, because both test results were based on identical rope sample segments — although they too noted inconsistencies in a few cases;
(3) their reports were published in 1964 and 1982, respectively: Ontario's present test requirements specify that approvals are valid for only five years;
(4) the 1964 and 1982 Ontario approvals limit the use of the instruments to stranded ropes only;
(5) the 1964 and 1982 Ontario approvals are limited to two types of EM testers, while many others have been marketed since.

Therefore, on evaluating the foregoing situation, we decided to proceed with an updated data analysis.

(a) In this, we do not accept that destructive rope strength results, and their non-destructive counterparts, are based on truly identical rope segments — unless this has been rigorously proven. Instead, the assumption in this analysis is that errors, previously acknowledged in a few cases, could have occurred much more often. Therefore, this report is not primarily concerned with the question of general instrument accuracy. Instead, it addresses the question of <u>safety</u>.
By doing so, the data can be assessed unequivocally, since only the greatest strength loss values, as predicted by the NDT instrument and actually obtained by destructive testing, have to be compared. The questions: (1) whether or not these data-pairs occurred in truly identical rope elements, and (2) whether these data do, in fact, represent the weakest link in the rope, are of secondary importance at this point. These can be investigated after completion of the contracted study which is proposed.
(b) We also make a point: (1) of compiling, and analysing, only those strength loss estimates that were obtained with EM instruments (preferably, but not necessarily, with more than one make) during the final examinations before the ropes were discarded, and (2) of comparing these with the subsequent destructive test results (in line with the view expounded in point (a) above).
All other pertinent data, documenting the rope's characteristics and in-service performance, have also been recorded, but have not been analysed this time.

(c) Next we made a special point of compiling, and analysing, data as per point (b) above, in cases where rope failures are known to have occurred in spite of EM testing on a routine basis (as per the relevant regulations).

In this context, it is of interest to note that this problem has been of great concern to a number of provincial mining authorities for some time. As an example, a report prepared by Saskatchewan's Chief Mines Inspector in January, 1981, included five cases of balance rope failures, as well as three of rope-removals involving potential failures (e.g., in one of these destructive testing indicated a 47% loss of strength vs. a prediction of 5-7%). A paraphrased version of this report is considered of great interest and is, therefore, quoted:

> *"Over the last ten years there have been a number of cases where balance ropes under conveyances have failed due to corrosion and/or corrosion fatigue, contrary to the expectation of potential rope life derived from electro-magnetic testing. This failure usually occurs in a very short length of rope, subject to severe internal corrosion, often only some 20cm long, about 50m from the conveyance.*
>
> *Fortunately, so far the failure of the rope has either been noted, and the rope changed before it has parted, or the rope has parted and there has been no injury. However, the potential for a serious incident is obvious.*
>
> *In confirmation of discussion with mine officials it is proposed: (1) that the maintenance of balance ropes in the areas adjacent to the conveyance and loop position during loading (say 120m from the conveyance) be substantially improved; (2) that the AC electro-magnetic testing for corrosion is supplemented by DC testing for broken wires. DC tests should be carried out every six months after the initial twelve month period.*
>
> *In summary the past experience has shown that potentially hazardous situations can arise unexpectedly from premature failure of balance ropes."*

(d) In our analysis, we have separated test results by grouping these on the basis of rope constructions (namely, whether these are stranded, non-rotating, or locked coil designs), and of rope sizes.

(e) We have also distinguished between results according to the background of the instrument chart evaluator, and the degree to which results obtained with one instrument may have influenced the ones obtained with another.

(f) Finally, we have included results not only from the Ontario rope laboratory's data bank, but also from other provincial and industrial sources.

Full details of the data analysed, as well as points of particular interest are listed in Appendix C. An overview of the authors' analysis is given in the SUMMARY. A statistical analysis of the test results is provided in the next report section.

Statistical analysis of the Ontario MOL data

In order to reduce the test data range to a more easily manageable proportion, and to give a clearer over-all picture of the results, the test results have been grouped and plotted. It is the usual statistical procedure to fit experimental data to normal distribution whenever possible, because statistical theory is most developed for this distribution curve. It gives an indication of how well the normal distribution approximates the experimental data. The statistics used by us are based on the premise that the data follow the normal distribution. Although it may appear that the normal distribution is not a precise descriptor of the data, it should be understood that the statistical functions used in the analysis below are not significantly affected by moderate deviations from the normal distribution.

One important parameter is the mean, or average value, $\overline{X}$, of the data, which indicates where the % accuracy range (i.e., the Error% per Appendix C) is centered. In other words if X_1, $X_2, \ldots\ldots, X_i, \ldots\ldots X_n$ are the %Errors (see Tables (C-1), (C-2), and (C-3) of Appendix C) of the n data points, then

$$\overline{X} = \frac{1}{n}\left(X_1 + X_2 + \ldots\ldots + X_i + \ldots\ldots + X_n\right)$$

Another important parameter is the *Standard Deviation (S)* of a sample of n data points. Its value is:

$$S = \left[\frac{1}{(n-1)} \sum_{i=1}^{n} (X_i - \overline{X})^2\right]^{\frac{1}{2}}$$

Its square (S^2) is the Variance of the sample values in statistical terms.

Perhaps it might be useful to illustrate the meaning of these basic terms in a simple form, by noting that:

(1) in case of data points 5, 4, and 3, $\overline{X} = 4$ and S=1.000;
(2) in case of data points 12, 10, and 8, $\overline{X} = 10.000$ and S=2.000;
(3) in case of data points 4, 4, 4, 4, 4, and 4 (somewhat in line with values of current interest) $\overline{X} = 4.000$ and S=0.000; and
(4) in case of data points 4, 3, 2, -2, -3, and -4, $\overline{X} = 0.000$ and S=3.405877.

It can also be shown that:

(a) 50% of all random samples, that come from a population that has a normal distribution, fall within $\pm 0.674S$ of $\overline{X}$;
(b) 68.3% of all random samples, that come from a population that has a normal distribution, fall within $\pm 1S$ of $\overline{X}$;
(c) 95.4% of all random samples, that come from a population that has a normal distribution, fall within $\pm 2S$ of $\overline{X}$; and
(d) 99.7% of all random samples, that come from a population that has a normal distribution, fall within $\pm 3S$ of $\overline{X}$.

TABLE 1

Parameters $\overline{X}$ (%) and S (%)

EM Instr. used	Rope construction		
	Locked coil	Non rotating	Stranded
Rotesco AC			
# of data points —	50	25	141
$\overline{X}$ —	–2.8	–18.1	-6.3
S —	10.4	17.5	11.1
Rotescograph			
# of data points —	6	—	8
$\overline{X}$ —	3.2	—	–2.7
S —	3.3	—	13.7
Magnograph			
# of data points —	7	—	26
$\overline{X}$ —	1.9	—	0.23
S —	10.4	—	10.0

The actual values obtaining are listed in Table 1. The corresponding histograms and approximating normal curves (i.e., the curves that correspond to a population that has a normal distribution, with the same $\overline{X}$ and S values as the actual sample) are shown in Figures 4 to 10, inclusive. The curves clearly indicate that Ontario's ±4% Performance Requirement (Appendix A) is far from being satisfied.

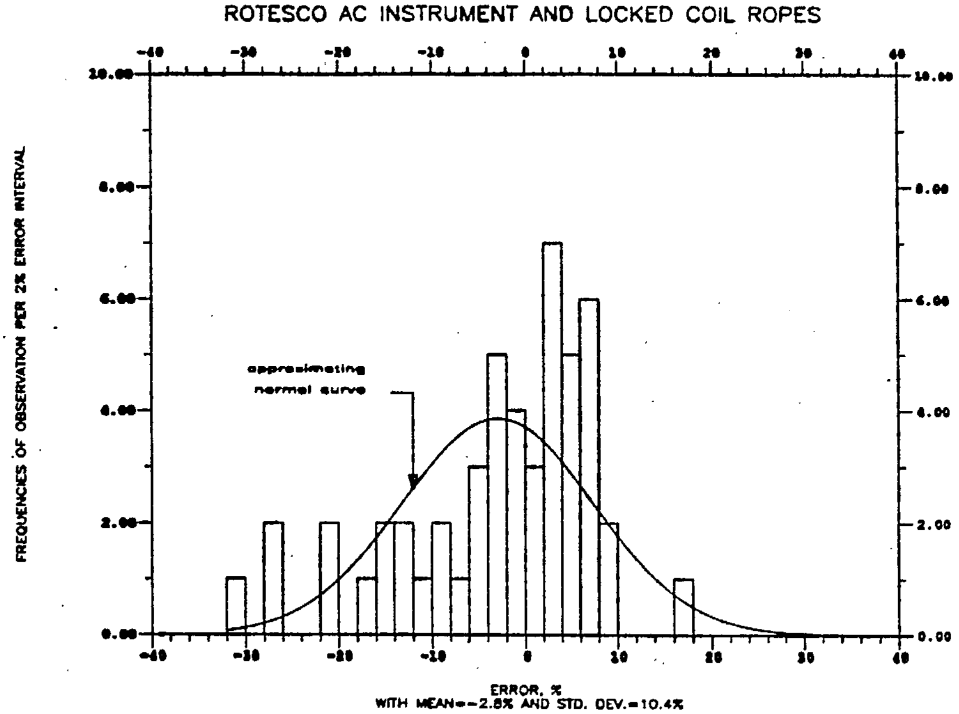

Fig. 4 — Error% vs frequencies of observation (50 altogether), and the approximating normal curve — locked coil ropes and Rotesco AC instrument

The relatively low number of data points available in case of the Magnograph and Rotescograph instruments makes their analysis somewhat less meaningful than that of the Rotesco AC tester. On the basis of tables contained in authoritative publications by eminent statisticians (40) it may be said though — about the results with stranded ropes, and at a 95% level of confidence — that:

(a) even if all 8 of the 8 Rotescograph test results had been "acceptable" (i.e., within the "permissible" ±4% accuracy range), some 0% to 37% of all future random test results would still have been "defective";

(b) even if all 26 of the 26 Magnograph test results had been "acceptable" (i.e., within the "permissible" ±4% accuracy range), some 0% to 13% of all future random test results would still have been "defective". In this particular case actually 13 (50%) of the results were outside the "permissible" ±4% accuracy range. On this basis it can be predicted (again at a 95% confidence level) that some 30% to 70% of all future random test results will be "defective".

ROTESCOGRAPH INSTRUMENT AND LOCKED COIL ROPES

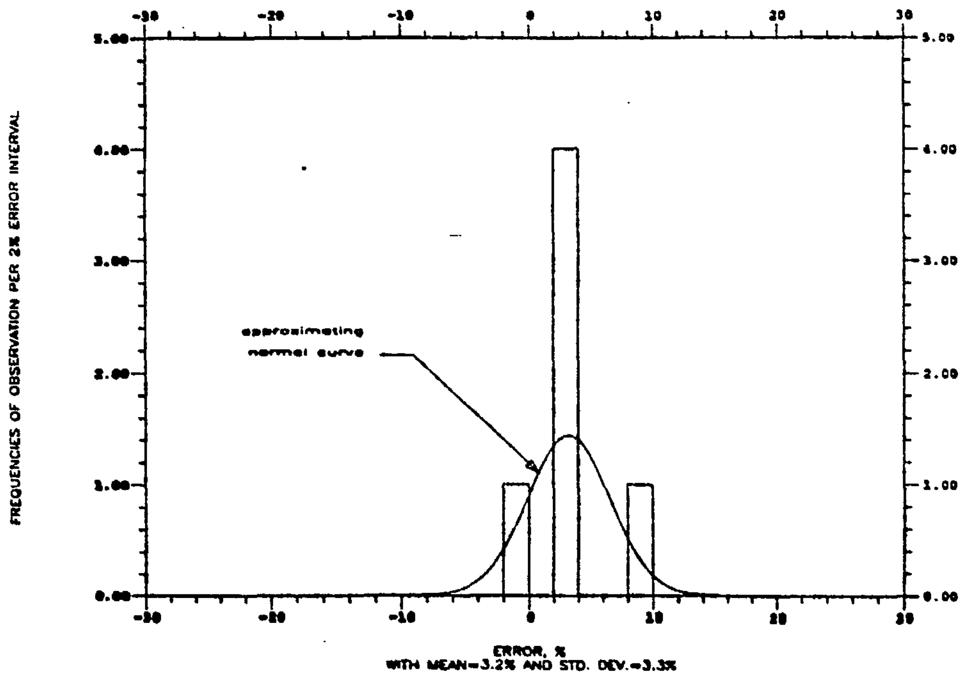

Fig. 5 — Error% vs frequencies of observation (6 altogether), and the approximating normal curve — locked coil ropes and Rotescograph instrument

MAGNOGRAPH INSTRUMENT AND LOCKED COIL ROPES

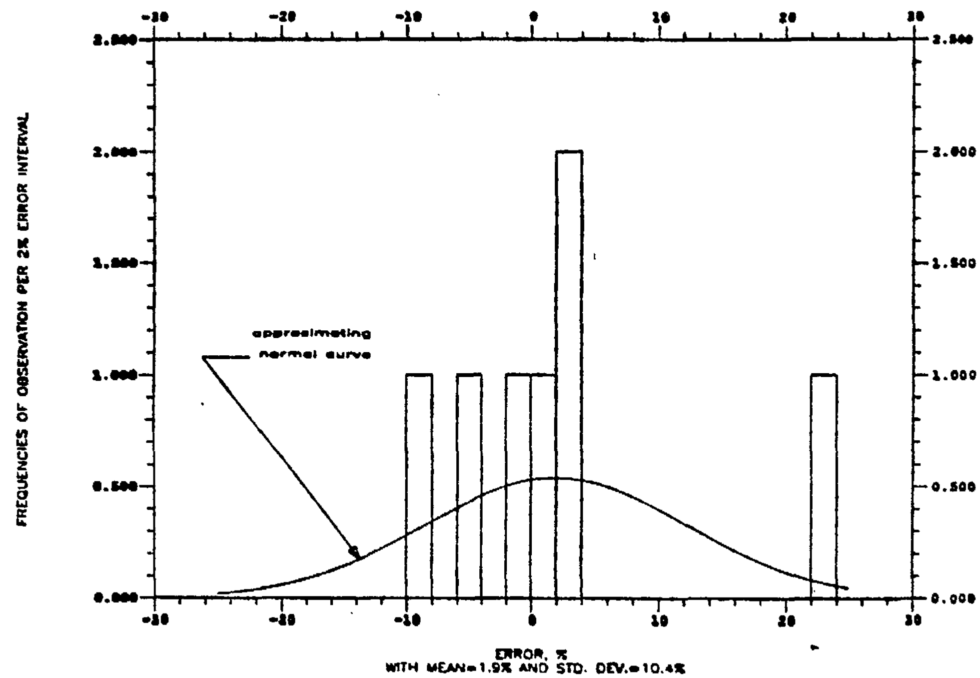

Fig. 6 — Error% vs frequencies of observation (7 altogether), and the approximating normal curve — locked coil ropes and Magnograph instrument

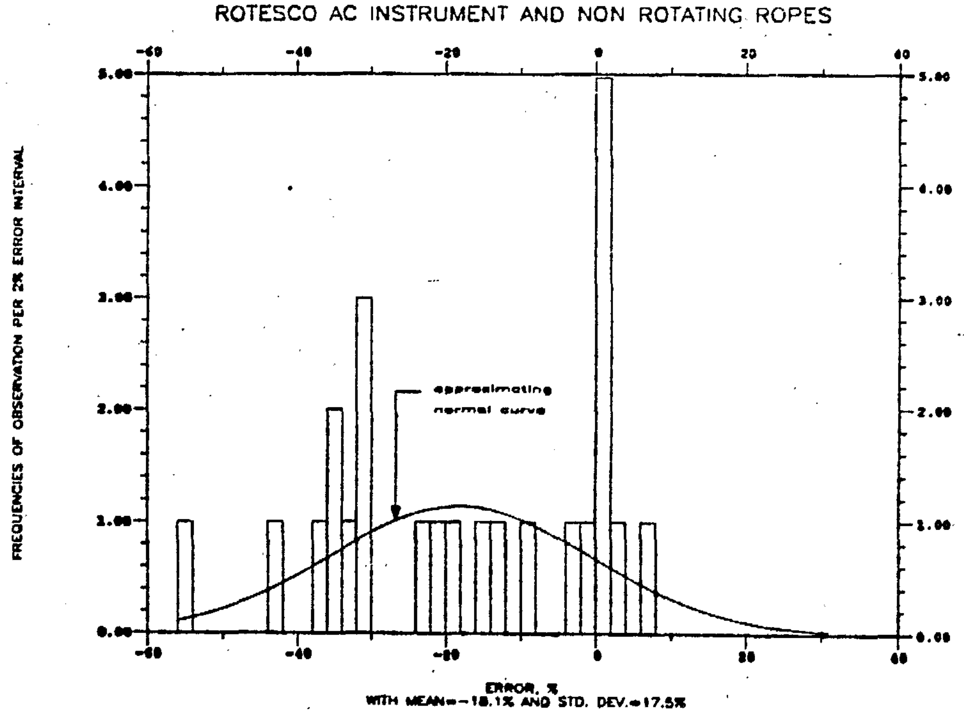

Fig. 7 — Error% vs frequencies of observation (25 altogether), and the approximating normal curve — non-rotating ropes and Rotesco AC instrument

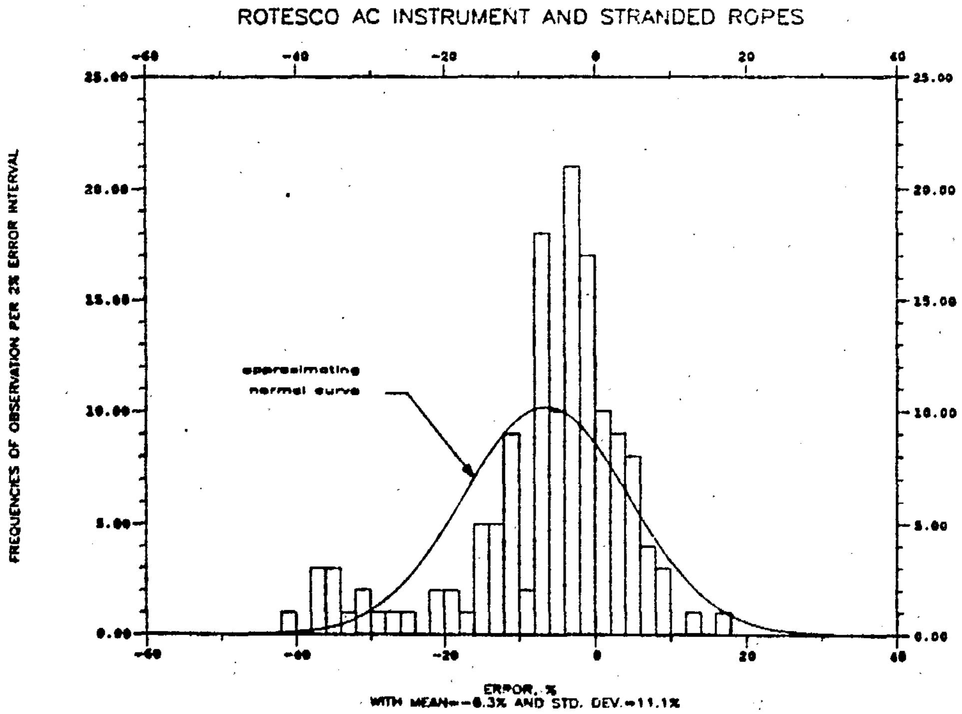

Fig. 8 — Error% vs frequencies of observation (141 altogether), and the approximating normal curve — stranded ropes and Rotesco AC instrument

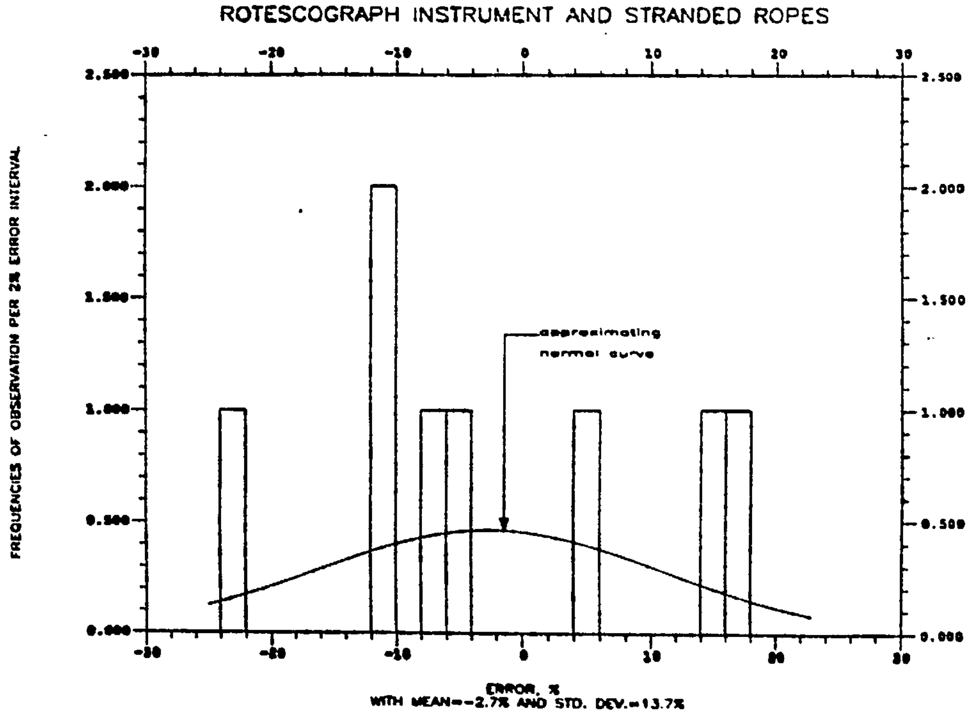

Fig. 9 — Error% vs frequencies of observation (8 altogether), and the approximating normal curve — stranded ropes and Rotescograph instrument

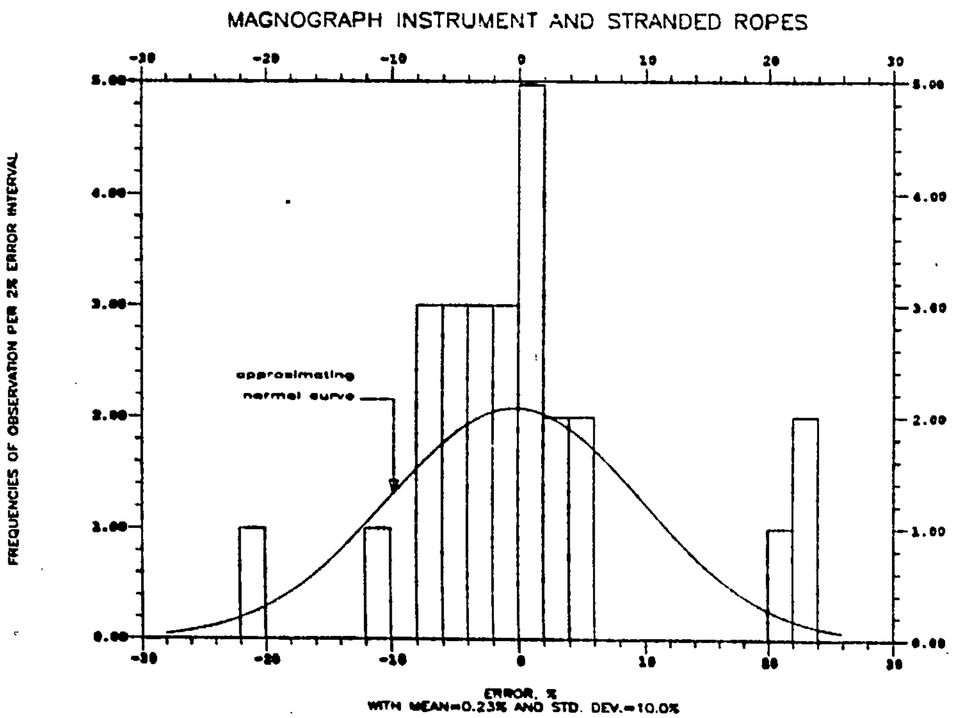

Fig. 10 — Error% vs frequencies of observation (26 altogether), and the approximating normal curve — stranded ropes and Magnograph instrument

A similar prediction can be made for the Rotesco AC instrument as well, namely: that if all 141 of the 141 Rotesco AC test results had been "acceptable" (i.e., within the "permissible" ±4% accuracy range), some 0% to 3% of all future random test results would have been "defective". In this particular case actually 84 (60%) of the results were outside the "permissible" ±4% accuracy range. On this basis it can be predicted (again at a 95% confidence level) that some 53% to 68% of all future random test results will be "defective". It should be noted that the terms "acceptable" and "defective" are used in the sense of Ontario's Performance Requirements. Consequently, whenever a comparable pair of mine-shaft rope strength-loss measurements — in our case the greatest "true" (i.e., destructive) and the greatest "estimated" (i.e., non-destructive) losses — do not differ by more than ±4%, the test is called "acceptable"; otherwise it is called "defective".

Listing of mine-shaft wire-ropes

The authors have compiled a complete list of mine-shaft wire-ropes in use, as of December 1987, in Ontario, New Brunswick, Manitoba, and Saskatchewan (Appendix D). A less complete listing of the ropes in Québec, Nova Scotia, and British Columbia is also given.

It is of interest to note:

(a) the prevalence of stranded ropes in Ontario (54% of a total of 479) and in Manitoba (56% of a total 85), while

(b) in New Brunswick 65% (of a total of 95), and in Saskatchewan 77% (of a total of 254) ropes are of the locked coil construction (as a reflection of the hoist types in use);

(c) that no fewer than 23% of the 257 stranded ropes in Ontario [Table (D-3)] are of $1\frac{3}{4}$ in. nominal size, while in Saskatchewan (Appendix D, section III) 62% of the locked coil ropes are $1\frac{3}{4}$ in. ones (as a reflection of the hoist capacities in use).

The primary purpose of this listing is to indicate the type of rope constructions most often used in Canadian mines. While this information is of general interest, its most immediate use will be in the context of CANMET's proposed contract work. It will provide one basis for evaluating the importance of whatever strengths and weaknesses the different EM instruments are found to exhibit in case of specific rope constructions.

While it is both inopportune and unnecessary to provide in this report a complete listing of all the rope-data the authors examined, in most cases sufficient information is given (such as the Ontario MOL test numbers, for example) to uniquely identify the ropes. Further data can, therefore, be obtained by those who may require these.

SUMMARY

Major sections of this report are concerned:

(a) with a review of the regulatory aspects governing non destructive testing of mine-shaft wire-ropes,

(b) with an analysis of available comparisons between "true" and "estimated" rope strength data, and

(c) with a listing of mine-shaft wire-ropes, installed in several Canadian provinces.

Regulatory aspects:

A comparison of a number of relevant regulations is given in Appendix B. It is noted how tightly some provinces (e.g., Ontario) control approval of both the EM instruments and of their operators, while others (e.g., Québec) seem to be moving away from this philosophy. It would be useful to examine the advantages and disadvantages of these two approaches, possibly in the research project proposed by CANMET.

It is also noted that, while the rope discard criteria in most regulations are based on "Breaking Strength Losses", others refer to "Area Losses" as well. Of these two losses only the latter can be measured directly by present day EM testers.

Further points of interest are listed as "Summary observations" in Appendix B.

Analysis of test data:

A statistical data analysis is included in the foregoing report sections. Full details of the complete analysis are given in Appendix C. A summary of the analysis is provided in Table 2. Consideration of all results indicates:

(1) that in a considerable number of cases destructive testing has identified rope segments with strength losses much greater than the limits allowed for by provincial regulations — while at least some of the corresponding EM estimates were either below this limit or, at any rate, far below the "true" losses. These results are of particular significance in view of the actual strength losses recorded in case of (a) the 1945 accident (Fig. 1), and (b) other, more recent, rope failure situations. In this context, the following test results may be noted: items 39 LC and 42 LC in Table I(b); items 16 NR to 21 NR (inclusive) in Table II(b); and items 58 STR, 60 STR, 67 STR, 76 STR, 94 STR, 108 STR, 120 STR, 129 STR, 131 STR, 132 STR, 140 STR, and 147 STR in Table III(b).

(2) that a considerable number of NDT estimates are outside the permissible ±4% (see Appendix A) accuracy range. Figures (C-1a) to (C-3d) of Appendix C graphically illustrate this situation. Table 2 quantifies it. The large scatter of the test results will be noted. In particular, it is seen that even in case of the Rotesco AC instrument — i.e., the only one represented by a fair number of data points —

TABLE 2

Analysis of test data — a summary

	Locked Coil Ropes; TABLE (C-1)				Non Rotating; TABLE (C-2)			Stranded Ropes; TABLE (C-3)				
	Sec. I(a)	Section I(b)			Sec. II(a)	Section II(b)		Sec. III(a)	Section III(b)			
Item	AC	AC	ROTGR	MAGGR	AC	AC	ROTGR	AC	AC	ROTGR	AC+DC	MAGGR
# of data points (Σ)	31	19	6	7	14*	11	1	100*	41	7	1	26*
% of Σ with + error	42	58	83	57	31	18	100	25	24	43	—	42
% of Σ with - error	58	42	17	43	69	82	—	73	76	57	100	58
Of Σ with + error:												
% in DT<10% range	92	90	100	75	100	100	None	84	100	100	None	55
% in DT≥10% range	8	10	None	25	None	None	100	16	None	None	None	45
Of Σ with – error:												
% in DT<10% range	39	50	100	33	None	11	None	26	88	None	None	14
% in DT≥10% range	61	50	None	67	100	78	None	74	12	100	100	86
Of total DT points:												
% with DT≥10%	42	⟵ 26 ⟶			64	⟵ 70 ⟶		60	⟵ 66 ⟶			
% with DT<10%	58	⟵ 74 ⟶			36	⟵ 30 ⟶		40	⟵ 34 ⟶			
Of total NDT points:												
% with NDT=0	26	5	None	None	None	10	None	8	2	None	None	None
of these: — % with +DT	100	100				100		25	—			
— % with –DT	—	—				—		75	100			
% of estimates** within (or close to) the ±4% limit, with DT≥10%	None	None	N/A	33	None	14	0	31	27	None	None	44
% of estimates** within (or close to) the ±4% limit, with DT<10%	55•	46•	83	75	80	100•	N/A	70	40	None	N/A	56

•: considering the NDT=0 values elsewhere *: one test with 0% variance **: of total examined with indicated NDT instrument only some 52% of all estimates with locked coil ropes, 32% of all estimates with non-rotating ropes, and 48% of all estimates with stranded ropes, lie within (or close to) the permissible ±4% accuracy range specified by Ontario (Appendix A);

(3) that, on the whole, NDT results seem to be no better, or worse, whether obtained by mine operators, or by service companies, or by the instrument makers themselves;

(4) that NDT tests, conducted with different instruments on identical ropes, should be performed "blind", i.e., completely independently of each other;

(5) that the EM results obtained on "lower rope ends" and on "best pieces" usually show no strength loss, while the corresponding destructive tests often indicate work hardening. Consequently, in these cases, as in those of fatigue situations and of single wire testing, the test results must be evaluated on the basis of other parameters as well, besides strength losses — e.g., as to the significance of the loss of extension, loss of torsional rotation resistance, and for the amount of observable corrosion. The amount of wire hardening is also most enlightening, as has been shown elsewhere, for example in case of the 6 × 7 balance rope failures (41);

(6) that closer cooperation among, and better information exchange within, the mine-shaft hoisting fraternity is most desirable;

(7) that the research which CANMET has proposed is urgent, and that its methodology is correct, at any rate as a point of departure for additional follow-up work.

Further points of interest are listed as "Summary Observations" in Appendix C.

Listing of mine shaft ropes:

While there is a clear preponderance of stranded ropes in Ontario and in Manitoba, locked-coil ropes predominate in New Brunswick and in Saskatchewan (Appendix D). Non-rotating designs also represent a sizeable percentage (some 20% on average) in these four provinces. Consequently, it follows that the "ideal" EM rope tester must be equally responsive to all of these rope constructions.

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APPENDIX A

"Work Statement" of CANMET's Contractual Project
and
Ontario's "Performance Requirements for EM Testers"

"Work Statement" of CANMET's Contractual Project

TITLE

Evaluation of Improved Methods for the Non-Destructive Testing of Mine-Shaft Wire-Ropes

BACKGROUND

In 1946 a major accident occurred in a shaft of the Paymaster gold mine at Timmins, Ontario. A wire hoisting rope failed, resulting in the loss of 16 lives. As a result, an Ontario Royal Commission was set up. Its report contained a number of recommendations for the improved care, inspection, and maintenance of mine-shaft wire-ropes.

As one perceived method for an adequate, continuous, in situ examination of these ropes, the report recommended that electro-magnetic (EM) examination, as developed in South African mines, should be pursued and further perfected. As a result, several instruments were developed in Canada; in particular those known as the Rotesco AC and the Magnograph. The Rotesco AC has now been used by the Ontario mining industry (and elsewhere) for about three decades. It has been proven to be a very useful tool for determining a rope's current operating condition. It has, thereby, helped to establish an acceptable basis for assessing whether or not a rope could safely continue in service. In fact, experience over the years has identified several internal rope anomalies which, under normal inspection conditions, could only be detected by using this type of instrument.

Nevertheless, practical experience has also shown that certain critical internal rope conditions can not be positively identified. As an example, the accuracy of the Rotesco AC instrument suffers when certain types of ropes are severely corroded and when many broken wires are present in a localized area.

Moreover, two unexpected mine wire-rope failures occurred recently; one with a balance rope, and one with a hoist rope. Both of these ropes had been subjected to regular EM testing; yet there was no indication of any need for concern.

Consequently, it has been recognized that it is essential to further improve, as urgently as possible, the non-destructive testing techniques used for mine-shaft wire-ropes. This is so for both safety and economic reasons; a fact which is self-evident considering the central role a mine hoist plays in the day-to-day functions of the entire operation. In addition, an accurate NDT system could also assist management by providing a reliable basis upon which to establish rope-replacement criteria.

In this context it should be noted that several new concepts are, at present, in stages of further development, both in Canada and abroad. The Rotescograph represents a promising Canadian evolution of the afore-mentioned Rotesco AC instrument. In Germany, some DM1.6 million have been spent recently in a multiyear effort to improve their model of the EM tester.

It is recommended that these, as well as other currently 'recognized' instruments, should be comparatively tested under strictly controlled conditions. That is the framework of the program involved in this proposed Research and Technology Contract.

RESEARCH OBJECTIVES

The principal objective of the proposed contractual work is to enhance the understanding of the basic capabilities of various mine-shaft wire-rope non destructive test (NDT) instruments, and of the associated chart evaluation techniques, by means of a carefully controlled and well documented series of laboratory, as well as in situ, tests.

Secondary, and quasi-corollary, objectives involve questions pertaining to the regulatory aspects of NDT wire-rope testing in mine-shafts. These include such matters as certification of instrument operators and of instruments, rope retirement criteria, and the like.

TECHNICAL APPROACH

The objectives of this research project are to be attained by performing a series of Laboratory and In Situ non-destructive wire-rope examinations, with a range of 'recognized' NDT instruments, on a range of ropes that characterize the sizes and constructions most widely used in Canadian mines. Many of the characteristic samples needed are to be found at mine shafts in the Province of New Brunswick. One, or more, of the test sites for the in situ rope examinations must, therefore, be located in New Brunswick.

LOCATIONS OF ALL PROPOSED TEST SITES MUST BE DETAILED IN THE PROPOSAL.

The laboratory rope samples should include both artificial and operational anomalies. All samples must also be tested destructively, in accordance with the appropriate provincial regulations. Specifically, the proposed contractual work should include the following features:

1) A Wide Range of Test-instruments

- the prospective contractor is to specify the range of 'recognized' test instruments that are included in his contract proposal, and substantiate the reasons for choosing them. As a minimum , this range must include: Canadian Rotesco AC, Rotescograph, and Magnograph testers; the American LMA series instrument of NDT Technologies Inc.; the latest version of the German WBK-Seilprüfstelle instrument; and the Polish MD model.

2) A Representative Range of Wire-ropes

- the prospective contractor is to specify the range of rope sizes that are included in his contract proposal. The laboratory ones with artifical defects must include both FLC and Stranded constructions, in sizes exceeding 1 in. (exact sizes & constructions must be specified by the Contractor). The operational ones should, as a minimum , include the nominal sizes:

  (a) ½ to 1 inch
  (b) 1 1/8 to 1¾ inch, and
  (c) 1 7/8 to 2½ inch,

  and the following types:

  - Locked Coil, in sizes (a) and (b),
  - Flattened Strand, in sizes (a), (b), and (c),
  - Regular Round Strand, in sizes (a), (b), and (c),
  - Round Strand, multi-layer and multi-strand, in sizes (a), (b), and (c).

3) Examples Of Rope Anomalies

- The wire-ropes to be examined within the proposed project must contain examples of both artifical and operational defects. In case of the operational ones, records of periodic destructive (as applicable) and NDT measurements must be available, documenting the wire-rope's previous in-service performance. The prospective Contractor is to specify the steps to be taken to ensure that these records are available.

- in case of artificial defects, these are to be introduced in such a manner that they in no way affect neighbouring rope sections. Moreover, they are to be chosen in a way that will test the EM instruments' basic capabilities;

- the prospective contractor is to specify the range of artificial rope defects (to be examined in the laboratory tests) that are included in his contract proposal, as well as the proposed manner of introducing them. The range of artificial anomalies must include defects that will, as a minimum, be instrumental in evaluating the following test instrument capabilities:

  (1) detection of broken wires; even when the broken ends are not visible, and when they remain in relatively close contact (i.e., with a separation of, say, less than 1mm), as is the case, for example, with half-lock wires in the inner layers of locked-coil ropes

  (2) detection of the distribution of breaks, i.e., whether several breaks are in the same, or in different wires

  (3) detection of the density of the broken wires, i.e., differentiation, in cases of high peak densities, between groups of broken wires (i.e., several wires broken at the same point) and multiple breaks in a single wire (i.e., the chart should have several peaks instead of just one)

  (4) quantitative measurement of actual cross-sectional rope area, without requiring a considerable rope-length (say of some 3ft) to do this

  (5) measurement of a gradual change in the rope's cross-sectional area (i.e. a change that occurs over several m instead of cm)

  (6) clearly distinguishing between corrosion and broken wires

  (7) ensuring that the instrument's air gap is less than or equal to 5mm for most, if not all, of the ropes of interest.

4) **Minimum Numbers of Samples**

- the prospective contractor is to specify the number of samples to be examined within the scope of his contract proposal in the laboratory and the in situ tests. As a minimum it is necessary that the number of operational rope samples tested be in accordance with the 'Performance Requirements for Electro-Magnetic Mine Shaft Rope Testing Devices' of the Ontario Ministry of Labour, Mining Health and Safety Branch (J.J. Lazurko, 4pp. revised May 24, 1984). The appropriate number of laboratory samples (with artificial defects) must be specified by the Contractor, with reasons for choosing this number.

5) **Instrument Performance Standards**

- it is desirable that the Instrument Performance Standards also be in line with the above mentioned 'Performance Requirements', (i.e., that the loss in rope breaking strength should be estimated within 4 percentage points of actual loss; with a confidence level of better than 95%; etc.);

- it is desirable that for a proper evaluation of the comparative merits and/or shortcomings of the various EM instruments tested (1) their performance criteria - such as their resolution, penetration, sensitivity, calibration, and the like - be documented in the test reports; (2) the most appropriate choice of electronic circuitry design, including that of sophisticated signal processors and high performance chart amplifiers/recorders, be considered as carefully as that of the detector head proper; (3) the methods by means of which the rope losses have been calculated be properly documented in the test reports; (4) a detailed description of the type of anomalies detected on the charts also be provided in the test reports;

- the prospective contractor is to list the contractual steps to be taken for ensuring that the foregoing requirements are met.

- in the event that the bidder cannot meet one or any of the desirable criteria in this clause, he must state what alternative criteria will be used.

6) Instrument Operators

- in view of the importance of the results to be obtained by the proposed Research and Technology Contract, the instrument operators MUST be approved by the instrument makers/designers themselves, so that none be able to suggest later that the test results are of doubtful validity because of inexperienced operators;

- the prospective Contractor is to specify what arrangements he has made in this respect;

- the prospective Contractor is to specify the locations of and arrangements made for, the proposed field and laboratory (both destructive and non-destructive) tests. The proposed methodology to be used is also to be described (such as mounting of the ropes and of the instruments in the laboratory; the possibility of extended simulated rope usage procedures, and the like).

7) Destructive Testing

- destructive tests must be performed on both the in situ and the laboratory rope samples, on equipment and in a manner designated by provincial regulations. Careful and timely selection, identification, tagging, indelible marking, cutting, documentation, protection, and shipment of rope-samples are, therefore, of great concern, as is the choice of adequate sample numbers;

- the prospective contractor is to specify the steps to be taken within the framework of his contract proposal, to ensure:that samples are properly selected,marked, protected, documented, and shipped:that the samples tested destructively accurately match the ones selected on the basis of the NDT instrument chart: that destructive tests will be performed in line with regulations and in and in good time. His prior experience in conducting these tests, and means of access to the necessary laboratory equipment, is also to be described.

8) **Reporting**

- individual test reports of both the in situ and the laboratory rope examinations are to be submitted by the instrument operators (see also point 6) to the principal contractor. These reports are to be fully documented with charts, calculations, etc. (see also point 5);

- project progress reports must be submitted, by the principal contractor, in letter format on a regular 3 monthly basis to the contractually specified addresses, including CANMET's Scientific Authority, and DSS's Scientific Procurement Manager. These reports are to contain a summary of developments achieved during the previous period, including copies of the sub-contractor reports. The principal contractor's views on potential problem areas and anticipated developments for the next period must also be included;

- a final report in twenty (20) copies, plus one (1) microfiche version, is to be submitted by the principal contractor to the Scientific Authority (SA) by March 31, 1989, in accordance with good scientific research practices. As a minimum this report is to contain: a list of contents, an abstract and executive summary (in both official languages), introduction, detailed technical discussion, conclusions, and all necessary supporting graphs, tables and figures. Graphs are to be supplied complete with background grids. Correlations between corresponding graphs, figures, and/or tables are to be clearly indicated.

  The front page of the report must indicate that the work was funded by the Canada/New Brunswick Mineral Development Agreement.

  The final report is to provide an in depth evaluation of the series of comparative test-results, on the basis of the stated Research Objectives. The original sub-contractor reports, including all supporting documentation (e.g., see point 5) are to be included, complete with translations, should these be required. The overall conclusions are to analyse the results from both technical and regulatory points of view, including: (a) the type of rope anomalies detected; (b) the instruments' basic ability to respond to various regulatory requirements; (c) the type of improvements that might be recommended, from both mechanical and electronic points of view; and the like;

- a draft of the final report is to be submitted to the Scientific Authority for approval before completing the final report.

9) Overlapping

- based on CANMET's present knowledge of developments elsewhere, little overlapping should occur between this proposed contractual project and work that is either being, or might already have been, performed elsewhere. The prospective contractor is to enlarge upon this point, in accordance with his most up-to-date information.

10) Debriefing Workshop

- a final De-briefing Workshop is to be organized and conducted, for a maximum of two-days, by the principal contractor, at a time and location mutually agreeable to him, to the NB representative of the Canada/NB MDA Management Committee, and to CANMET's SA.

11) General Remarks

While certain specific requirements have been outlined above, the prospective contractor's proposal must address, as clearly and concisely as possible:

(a) the specific approach and proposed methodology to be used in order to meet the stated requirements, the degree of success expected, and any major difficulties that may be anticipated. It is suggested that sufficient detail be provided to demonstrate proper grasp of the problems, and competence to solve them;

(b) the personnel and subcontractors, who will be assigned to the proposed contract work, showing their experience, education, and qualifications, and their involvement in each individual task. A prior written consent of the Department of Supply and Services is to be obtained for sourcing, selecting, and approving of any subcontracts;

(c) the identity of the principal author of the final report, and the associated authors;

(d) the work plan, wherever possible, including 'go/no go' decision points for all tasks which are to be identified as part of the technical contract proposal;

APPENDIX A
PERFORMANCE REQUIREMENTS FOR ELECTRO-MAGNETIC MINE SHAFT ROPE TESTING DEVICES

Revised May 24, 1984, by
J.J. Lazurko, P. Eng.
Ontario Ministry of Labour
Mining Health and Safety Branch

Ontario's "Performance Requirements for Electro-Magnetic Mine Shaft Rope Testing Devices"

PERFORMANCE REQUIREMENT

Subsection 220 (4) of the Ontario Regulations for Mines and Mining Plants states that any device used for the non-destructive testing of mine shaft ropes shall be of a type approved by the Director.

The following requirements apply in order to gain and maintain such approval:

1. Sufficient background information is to be supplied to indicate the device has the potential to meet the performance standards specified.

2. (a) The applicant is required to prove to the Director that the device meets performance standards as here-in set forth.

   (b) Seperate application for testing of stranded, locked coil, or balance ropes will be considered.

   (c) The operators of the rope testing device shall be fully trained in the operation of the device and in the interpretation of the test charts.

3. (a) Each approved device is to be tested for accuracy:

      1. after receiving harsh or potentially damaging treatment, and

      2. after every year of use.

   (b) Application for recertification of a previously approved device is to be made after any major modification or every 5 years, whichever occurs first.

4. Result of field tests are to be reported as noted.

Note:

The Director may permit the cost of destructive tests for proof of performance to be conducted at the ministry expense, as per subsection 220 (9).

PERFORMANCE STANDARD

1. (a) The tester shall be capable of determining the loss in the breaking strength of a mine shaft rope within 4 percentage points of actual.

   (b) The confidence level for this accuracy shall exceed 95%.

   (c) The loss in breaking strength is to be determined with the shaft rope in situ.

2. The unit is to be capable of identifying within 1 ft. of actual, the location on the rope of noteworthy anomalies such as broken wires, severe corrosion, localized wear, or other deterioration which may produce a significant loss in breaking strength.

3. The unit shall provide repeatable traces in successive tests which do not alter the indicated loss in breaking strength by more than 1.0% ; ie If the original trace shows a loss in breaking strength of 8%, the unit should show a loss no greater than 9% or less than 7%.

PROOF OF PERFORMANCE

The applicant will be required to prove the unit meets the performance standards by conducting tests on the specimens noted below.

The onus will be on the applicant to arrange for appropriate samples and testing schedules.

Ontario's "Performance Requirements for Electro-Magnetic Mine Shaft Rope Testing Devices" (continued)

List of Specimens Required

GROUP	TYPE OF ROPE	SIZE	MINIMUM NUMBER of SAMPLE REQUIRED
1. (a)	Stranded	1 1/4" and smaller	15 samples - consisting of 2 + BP from 5 different ropes, involving at least 3 different sizes.
(b)	Stranded	over 1 1/4" dia	same
2. (a)	Locked Coil	1 1/4" " and smaller	same
(b)	Locked Coil	over 1 1/4" dia	same
3.	Special Ropes (such as ropes with high tensile steel, extra large wires, etc)	all sizes	To be determined when required.

Note 1 BP means Best Piece as determined by the tester.

Note 2 When samples are chosen they shall be from different sections of the rope and those having the greatest loss being chosen first.

Note 3 Samples will be tested at the Wire Rope Lab but only after a strength loss estimate has been submitted in writing.

Note 4 The onus will be on the applicant to confirm at the Lab that the proper pieces have been supplied.

Note 5 The Breaking Strength of the Best Piece will be adjusted to reflect the strength at the initial test.

Note 6 For each size group there shall be test samples from a minimum of 5 ropes.

Note 7 Each 2+ BP group of samples shall be from one rope.

Note 8 Stranded ropes - include round strand, flattened strand and non-rotating types. (When used as balance ropes they are included in Group 3.)

Note 9 Locked coil ropes - includes full & half lock types.

Note 10 Balance ropes - are ropes used as balance ropes on friction hoists and may be of any construction. They are included in Group 3.

REPORTING OF RESULTS

1. Preliminary results showing loss in Breaking Strength and location of the loss are to be given to the mine operator in writing at the time of test.

2. A Report of each test on which are shown any significant losses and anomalies is to be submitted to the mine operator, the field and Head office of the Branch within the time span specified in the regulation. The Report is to contain test charts and an explanation of any anomalies on the charts.

3. The Branch staff is to be advised of the method used to determine loss in strength and interpretation of anomalies on the charts.

4. The Branch is to be advised of the routine schedules for field testing.

5. The field office of the Branch is to be notified immediately if the loss is significant, say 7% or greater in the case of a hoisting rope.

It will be noted that the foregoing Performance Requirements specify that at least three rope samples have to be tested from each rope, when dealing with EM instrument verification procedures. The authors consider it of interest to note that the NRW (West German) mining "Code of Practice" also calls for a minimum of three samples, in order to establish the "true" Breaking Strength Loss of a retired mine shaft rope. This must be done for ropes that had a lifetime production record of 4,000 MNm/kg, or more. In this case the three samples, of at least 3.50 m length each, must be cut from specified rope locations (that are different from those specified by Ontario), and destructively tested.

APPENDIX B

Review of Regulatory Aspects

Review of Regulatory Aspects

General remarks:

In Appendix C of this report the authors review a large number of test results, recorded in the files of the Ontario Ministry of Labour's (OMOL) Rope Testing Laboratory.

This review gives rise to several conclusions, summarised elsewhere in this report. One of them concerns the various mining regulations governing the use of non-destructive instruments for examining mine-shaft wire-ropes. In particular, the question is raised, as to how far the EM instrument operators can possibly be expected to satisfy the regulatory demands, in view of the present level of instrument development, and of the presently available operator instruction facilities in Canada.

An authoritative answer to the foregoing question awaits the results of a project proposed by CANMET (referred to elsewhere in this report). A paraphrased overview of the stipulations of the relevant sections of the Canadian mining acts, in the narrow field of interest is, however, provided hereunder. In the cases of Ontario, New Brunswick, and Québec, two versions of these regulations are given, so as to indicate the trend of developments in Canada. Excerpts are also quoted from sections of the NRW (West German), Hungarian, and Swiss regulations, to provide further information of interest .

Non-destructive testing:

The parameters (such as Ø, etc.) involved in the regulations on non-destructive rope testing of the various mining acts examined by us are listed in Table (B-1).

As an example, it is seen that following is the current situation:

(1) in case of *hoisting ropes* in Ontario

A *hoisting rope* being used as a shaft rope shall be tested thoughout its working length by a "Ø=competent" person using an "⊕=electromagnetic" testing device "⊙=approved" by the Director.

(a) within "ⓐi.) =six months" of being put into service;

(b) thereafter at regular intervals not exceeding "ⓑi.) =four months"; or

(c) at intervals shorter than "ⓑi.) =four months", where, by interpolation of past tests, the loss in breaking strength will exceed "ⓒi.) =10 percent" before the next prescibed test.

(2) <u>in case of *balance ropes* in Ontario</u>

A *balance rope* and, where practical, a *guide* and a *rubbing rope* in use, shall be tested throughout its working length by a "Ø=competent" person using an "⊕=electromagnetic" testing device "⊙=approved" by the Director.

(a) within "ⓐii.) =twelve months" of being put into service; and

(b) thereafter at regular intervals not exceeding "ⓑii.) =eight months" except where a test discloses a loss exceeding "ⓒii.) =5 percent" of the breaking strength recorded on the Certificate of Test, in which case the regular intervals shall not exceed "ⓓ=four months".

In either case:

Where the loss is greater than "ⓔ=7.5 percent", a record of the electromagnetic test, including the graphs and interpretations signed by the person making such interpretations, shall be sent, in duplicate, to an inspector within "ⓕ=fourteen calendar days" of the completion of the test.

In general terms these regulations can, therefore, be referred to as follows:

"A shaft *hoisting rope* {*balance, guide,* and *rubbing ropes*} shall be tested throughout its {their} working length {where practical} by a Ø person, using an ⊕ device, ⊙ by the Director,

(a) within the first ⓐi.) months {ⓐii.) months in case of *balance/guide/rubbing* ropes} of service;

(b) thereafter at regular intervals not exceeding ⓑi.) months {ⓑii.) months in case of *balance/guide/rubbing* ropes} — except where a test discloses a loss exceeding ⓒii.) of the tail/guide/rubbing rope's original breaking strength, in which case the regular intervals shall not exceed ⓓ months;

(c) at intervals shorter than ⓑi.) months, if by interpolation of past tests breaking strength loss will exceed ⓒi.) of the head rope's original breaking strength, before the next prescribed test.

(d) where the abovementioned loss is greater than ⓔ a mine inspector is to be notified within ⓕ days".

Rope removal criteria:

The parameters (such as ⊗, etc.) involved in the regulations on rope removal criteria of the various mining acts examined by us are listed in Table (B-2).

As an example, following is the current situation in case of mine shaft ropes in Ontario:

No rope shall be used as a shaft rope where the breaking strength of the rope, as determined by "⊗=unspecified" means, has dropped below the breaking strength set out in the Certificate of Test as follows:

(1) In any part of a hoisting rope, "ⓖ=90 percent".

(2) In any part of a multi-layer, multi-strand balance rope, "ⓗ=90 percent".

(3) In any part of a single layer stranded balance rope, "ⓘ=85 percent".

(4) In any part of a guide or rubbing rope, "ⓙ=75 percent".

Notwithstanding the Breaking Strength Losses specified in the foregoing section, no rope shall be used as a shaft rope where,

(a) the extension of a test piece has decreased to less than "ⓚ=60 percent" of its original extension when tested to destruction and marked corrosion or considerable loss in wire torsions has occurred;

(b) the number of broken wires, excluding filler wires, in any section equal to one lay length exceeds "ⓛ=5 percent" of the total; or

(c) the rate of stretch in a friction hoisting rope shows a rapid increase over its normal stretch recorded during its service.

In general terms the regulations can, therefore, be referred to as follows:

"No rope shall be used as a shaft rope where the breaking strength in any part of the rope, as determined by ⊗, has dropped below the following percentage of the original breaking strength:

(1.) in a hoisting rope, ⓖ

(2.) in a multi-layer, multi-stranded balance rope, ⓗ

(3.) in a single layer stranded balance rope, ⓘ

(4.) in a guide or rubbing rope, ⓙ

Notwithstanding the foregoing section, no rope shall be used as a shaft-rope:

(a.) where the extension of a test piece has decreased to less than ⓚ of its original extension when tested to destruction, and marked corrosion or considerable loss in wire torsions has occurred;

(b.) where the number of broken wires, excluding filler wires, in any section equal to one lay length, exceeds ⓛ; or

(c.) where the rate of stretch in a friction hoisting rope shows a rapid increase over its normal stretch recorded during its service;

(d.) where, in case of head ropes, the ropes have been in service for ⓜ years, and where, in case of balance ropes, they have been in service for ⓝ years;

(e.) where the rope-wires' capacity to resist torsion has decreased to at least ⓞ of their capacity when new;

(f.) where an outer wire of a guide or rubbing rope has lost ⓟ of its radial depth (29), or of its metallic cross-sectional area (33);

(g.) where — in case of N.B. (27), Manitoba (30), and West Germany (33) — a visual examination, or other examination (30), or suitable non-destructive testing, indicates a marked defect which may endanger the safety of any person;

(h.) where — in case of Quebec (31) — in the opinion of the mine inspector the condition of the cable is such that it constitutes a potential cause of danger".

In addition to the Provincial and German mining regulations summarized in Tables (B-1) and (B-2), it is of interest to briefly refer to sections of two other codes as well, namely: (1) to the Coal Mines Regulation Act of 1972, which currently affects operations at the DEVCO mines in Sydney, N.S., and to the relevant mining regulations of Hungary.

<u>Coal mines regulation act (35)</u>:

— <u>Present</u> regulations make no reference to "Non Destructive Testing";

— As for "Rope Removal Criteria", they specify:

(a) a maximum permissible breaking strength loss of 15%;

(b) a maximum permissible loss in rope extension of 60% of the original extension value;

TABLE (B-1)
Non-destructive rope testing regulation parameters

Para-meters	Ont. previous (ref. 36)	Ont. current (ref. 4)	N.B. future (ref. 28)	N.B. current† (ref. 27)	Que. current (ref. 31)		Que. future (ref. (32)	Man. current (ref. 30)	Sask. current (ref. 29)		NRW (W. Germany) current (ref. 33)
Ø	competent	competent	competent	unspecified	approved org.		unspecified	unspecified	competent		approved expert(s)††
⊕	EM	EM	EM	approved non destr. method	approved non destr. method		EM	suitable non destr. test	approved EM or other method/service		suitable non-destr. test and/or visual exam.
⊙	approved	approved	approved				unspecified				
					drum	frictn.			drum	frictn.	
ⓐ i.)	6	6	6	6	6	6	6	6	6	6	12 (1 for EM)
ii.)	12	12	12	after 12		12	12	after 12		12	24 (for tail; others 60)
ⓑ i.)	4	4	6	6	6	6	6	4	6⋈	6⋈	to be spec. by expert
ii.)	8	8	12	**		**	6	8		12∃	on occ. of 1st exam.
ⓒ i.)	10	10	10	N/A	N/A		5	10	N/A		N/A
ii.)	5	5	5	N/A	N/A		7/10∇	5	N/A		N/A
ⓓ	4	4	4	N/A	N/A		3	4	N/A		N/A
ⓔ	7.5	7.5	7.5	N/A	N/A		N/A	N/A	N/A		N/A
ⓕ	14	14	immediately	N/A	N/A		N/A	N/A	N/A		N/A

EM: "Electro-Magnetic"; N/A: "Not Applicable"

ⓐ, ⓑ, and ⓓ in "months"; ⓒ and ⓔ in "%"; ⓕ in "days"

i.): head ropes; ii.) tail, guide, and rubbing ropes

†: applies to friction hoists; for drum hoists destructive testing specified

**: unspecified time intervals, that will ensure safe conditions ∇: 7% for tail ropes; 10% for guide and rubbing ropes

∃: 12 for tail ropes; unspecified time intervals, that will ensure safety otherwise

⋈: or, in case of tail ropes, as required by the inspector; in case of guide and rubbing ropes, unspecified time intervals, that will ensure safe conditions

††: in practice it is a group from one particular organization. The Swiss Federal Laboratories also require inspection by more than one expert

TABLE (B-2)

Rope removal criteria parameters

Para-meters	Ont. previous (ref. 36)	Ont. current (ref. 4)	N.B. future (ref. 28)	N.B. current† (ref. 27)	Que. current (ref. 31)	Que. future (ref. (32)	Man. current (ref. 30)	Sask. current (ref. 29)	W. Germany current (ref. 33)
⊗	unspecified	unspecified	unspecified	unspecified†	unspecified‡	EM*	unspecified†	EM/calc.♠	unspecified†
ⓖ%	90	90	90	90	90	90∇	90	90	85
ⓗ%	90	90	90	70	75	88∇∇	85	85	70††
ⓘ%	85	85	85	70	75	88∇∇	85	85	70††
ⓙ%	75	75	75	N/A	N/A	75∇∇	75	75	85
ⓚ%	60	60	60	60	60	60	60	60	unspecified
ⓛ	5%**	5%**	5%**	6	6	5%**	6	6	unspecified
ⓜ years	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2	N/A
ⓝ years	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3	N/A
ⓞ%	N/A	N/A	N/A	N/A	N/A	40%	N/A	N/A	N/A
ⓟ%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	40%	40%

EM: "Electro-Magnetic"; N/A: "Not Applicable"

†: point (g.) applies; note: visual examination is a major element at the Swiss Federal Laboratories as well ‡: point (h.) applies

††: while the Factor of Safety, with respect to the installed weight, must remain in excess of 5

*: EM and destructive testing for head ropes; EM testing for tail, rubbing, and guide ropes

**: 5% of the total applies

∇: by strength, or by cross-sectional area ∇∇: by cross-sectional area; note: the Swiss regulations are also based on loss of area

♠: by an approved EM test, or by calculation based on reduction of diameter, or by a destructive test, whichever is the least

(c) a maximum of 6 broken wires in a lay-length long rope sample; and

(d) concern about the amount of corrosion and lack of proper rope lubrication that may be present.

— The draft of this code's future version is said to make only the following reference to non-destructive rope examination: "Endless ropes larger than 19 mm diameter, or used to transport persons on grades exceeding 4%, shall be non-destructively tested at least once every three months."

Mining regulations in Hungary (34):

Excerpts of this "Code" are given hereunder.

(1) Non destructive testing.

(a) Non destructive testing must be performed with an "approved" instrument;
(b) this instrument must be able to reliably record a 1% sudden change in the rope's cross-sectional area, besides satisfying other specific requirements;
c) the tests must be performed by an expert, who has successfully completed an "approved" lecture course;
(d) a shaft rope must be non destructively tested within 10 days of its installation;
(e) the non destructive testing must be performed in situ, along the entire rope length;
(f) the non destructive testing must be performed at regular intervals, as specified by the code. These intervals are a function: (a) of the shaft's loading cycle, and (b) of the rope's length of service.
For hoist ropes the foregoing inspection frequencies vary from a maximum of 6 months to a minimum of 1 month; for balance ropes these values range from 6 to 2 months, respectively.

(2) Rope removal criteria:

(a) no rope shall be used as a hoist rope: (1) whose putative F.S. — as established by regular non destructive testing — has decreased to 85% of the original value, and (2) where the number of breaks in individual wires — along a 10 m continuous rope length — exceed 10% of the overall number of load carrying wires, and (3) if the inspector forbids further use of the rope;

(b) no rope shall be used as a balance rope where the foregoing parameters are as follows: (1) not applicable, and (2) where the number of breaks in individual wires — along a 10 m continuous rope length — reach 15% of the overall number of individual wires, and (3) if the inspector gives instructions for the rope to be replaced.

The Hungarian "Code of Practice" lists a number of "Performance Requirements" which must be satisfied by an acceptable EM instrument. These include the following points:

(a) the minimum distance between distinguishable defects must not exceed the rope's diameter;
(b) prior to performing routine testing, the instrument must be calibrated by means of a benchmark rope sample, which must be of the same size and construction as the rope to be tested;
(c) testing must be repeated at least twice, with the same instrument settings;
(d) the same expert operator must perform both the rope testing and the instrument chart evaluation procedures.

The Hungarian "Code of Practice" also makes very specific recomendations as to how the instrument chart ist to be properly evaluated. These recomendations cover the evaluation of wire breaks, of wear, and of corrosion. As an example:

(a) it is assumed that broken wire-ends must be at least 1 mm apart, if they are to be separately distinguishable on the chart;
(b) it is stated that as far as wire-break dependent breaking strength losses are concerned, only a certain rope diameter dependent rope length adjacent to the break needs to be examined;
(c) it is stated that loss of breaking strength can be estimated on the basis of the ratio: "average noise level – to – height of chart deflection brought about by an outer-wire break" — the instrument setting being such that the latter deflection amounts to some 60-80% of the maximum possible chart deflection;
(d) it is stated that a shaft rope should be retired once its non destructively determined breaking strength has dropped to 85%, or less, of its original breaking strength;
(e) it is stated that the non destructive test frequency is to be increased if the rate of rope deterioration, operational conditions, or other specified circumstances warrant this;
(f) it is stated that the rope's operational condition should be judged on the basis of several circumstances, including: (1) the decrease of breaking strength, (2) the rope's size and construction, (3) the general operating conditions that prevail, and (4) other relevant information that may be obtained by visual inspection, or from the "Rope Record Book".

Summary observations:

Points of particular interest include the following:

(a) the wide variation of the existing regulatory requirements (parameters Ø, ⨀, ⊗, ⊕) ranging from the current Manitoba (30), through Quebec's draft (32), to the current Ontario (4) rules.

(b) the ⓔ situation in Table (B-1), presumably due to a lack of confidence in the accuracy of the EM predictions, and/or because the regulatory discard limit of a 10% loss is here approached to within approximately 4%.

(c) the reference to "area loss" values — apart from the more usual "strength loss" basis — in the Saskatchewan (29) and Quebec (32) regulations.

(d) the reference to "calculations" as a rope discard criterion, in the current Saskatchewan (29) regulations.

APPENDIX C

Analysis of Available Test Data

Analysis of Available Test Data

General remarks

In this Appendix the authors review the considerable amount of information on complementary destructive/non-destructive test results that has been assembled by the Ontario Ministry of Labour's (OMOL) Rope Testing Laboratory over a period of many years, in the course of their "Special Test" program. A particular feature of these special tests is that they provide a unique source of information as to how destructively tested "true" mine-shaft wire-rope breaking strengths compare with the equivalent "estimated" ones at the time the ropes were retired from service. While previous reports (37, 38) considered the entire series of available comparative results, the present authors elected to consider only the maximum strength loss values. In other words, they concentrated on one fundamental question: how safe were these ropes, on the basis of the relevant EM estimates, when discarded?

The authors are leaving open the question of:

(a) whether the "worst" rope-segment tested was, in fact, the weakest one in the entire rope, and

(b) whether the destructive/non-destructive test results were, in fact, obtained from identical rope segments.

While the safety aspect is of paramount interest, sufficient details are provided — by quoting the "Special Test" and the "Regular OMOL Test" numbers — to uniquely identify the ropes and tests in question. Thus, if required and if non-proprietary, further information can be obtained about such matters as: the ropes' makers, date of manufacture, individual wire sizes and strand construction details, and much else. The range of available data is briefly described in the following section of this Appendix.

The results of the authors' review are listed in Tables (C-1), (C-2), and (C-3), and illustrated in Figures (C-1a) to (C-3d) inclusive. Their conclusions are given in both this Appendix, and in the SUMMARY of this report.

Explanation of terms, abbreviations and symbols

†: OMOL Special Tests ; these special tests are part of an ongoing test series undertaken by the Ontario Ministry of Labour at their rope testing laboratory. The objective is to provide "true" rope strength data (i.e., destructive test values) on occasions other than the "routine" ones prescribed by the mining regulations. Special tests are undertaken:

(a) in order to assist NDT instrument makers/designers with the calibration and development of new or improved testers;

(b) in order to assist mine management who, whether for safety or economic reasons, may wish to verify non destructive test results;

(c) in order to assist the regulatory authorities themselves in situations of special concern — e.g., in cases of rope failures, or on occasions when the question of instrument "approval" arises (such as the comparative studies being presently undertaken by the Province of Manitoba, and proposed by CANMET); or

(d) in order to assist in the evaluation of ropes that have been in service for extensive periods of time, or ropes that provide special service (such as guide ropes).

A "Special Test" file carries a single identifying number, but contains much information relevant to a rope's service life, and, in particular, to the series of comparative destructive/non destructive tests performed on the occasion of the rope's retirement from service. A sample report card is reproduced [Figure (C-1)].

Regular OMOL tests

These tests are the basic ones performed at OMOL's rope laboratory. They are undertaken to provide the information specified by the mining regulations, such as the original rope performance data, destructive test data on all other statutory occasions, rope extension values, wire torsional resistance data, corrosion and wear information, etc. Information about the individual wires, strand construction, etc. is also recorded. A sample "Test Certificate" is reproduced [Figure (C-2)].

The identification numbers of the OMOL "Test Certificates" are assembled on the shaft rope's master file card. It contains information relevant to a rope's entire service life, inluding the rope's basic characteristics (such as size, construction, reel number, etc.), installation details (e.g., on and off dates, company and mine names, rope number, conveyance weight, and much else). A sample "Testing Record" is reproduced [Figure (C-3)].

Dates

All dates are recorded in the following order: "day; month; year"

§: DT%= Destructive Test %.

These values express the "true" loss in rope breaking strength, as a percentage of the rope's original breaking strength. In this report only the maximum losses are

SPECIAL TEST No. 493

Ontario Ministry of Labour — Mining Health and Safety Branch — Government of Ontario Cable Testing Laboratory

HEATH & SHERWOOD (1964) LIMITED.

Special Tests

RIO ALGOM MINES 905935

Date Sept 16/82 Name PANEL Rope No. 30 Shaft No. 1 Compartment No. 1 Skip Manufacturer's Reel No. 020566 Maker WIRE ROPE IND. Construction 1 1/2" Ø 6×30

Test Piece No.	Location: Distance from Rope Socket	Location: Distance from Conveyance	Diameter of Rope taken at: No Load	Wt. of Conveyance	Total Static Load	1/3 Strength	Breaking Load	% Strength Remaining	Extension	Length of Test Piece	Number of Strands Broken	Location of Break – Distance from Socket	General External Appearance of Rope				Lubrication Rating & Character of Lubricant: Exterior of Strand	Character	Interior of Strand	Character	Core	Character	Corrosion Rating: OW	IW	Other	Torsion Tests: OW	IW	Other	Length of lay inches	Remarks
							252,000		3.7	62			57676 AUG. 25 1977													23	45			
													HS E. Coll		Extension 75%	90%														
S-1		1075											Heath & Sherwood Visual Sample																	
S-2		1135					228,400	93.0	2.1	62	3	1/2 Way	89.2	Worn	1.09	1.63	3	C	3	C	C	C	III	III	III	12	16		12 5/8	Wires began breaking 206,000 # slight nicking
S-3		1205					208,000	83.6	2.0	62	4	1/2 Way	83.2	Worn	1.03	1.41	4	C	4	C	D	G	IV	IV	IV	4	2		12 3/8	198,400 # nicking
S-4		1320					197,200	79.8	1.7	62 1/2	5	1/2 Way	80.4	Badly Worn	0.91	1.35	4	C	4	C	D	C	III	IV	IV	4	3		11 7/8	181,500 # nicking, & Broken Centre
S-5		1360					220,500	88.6	2.0	62	5	1/2 Way	83.2	Badly Worn	1.14	1.42	4	C	3	C	C	C	IV	III	III	3	7		12 5/8	206,000 nicking
S-6		1390					203,200	83.0	1.9	62	4	10"	77.0	Badly Worn	1.02	1.44	4	C	4	C	D	—	IV	IV	IV	3	2		12 1/4	190,000 nicking
S-7		1440					206,100	83.0	1.8	61 1/2	5	1"	81.3	Worn	1.01	1.37	4	C	4	C	D	C	IV	IV	IV	3	4		12 1/8	194,500 nicking
S-8		1520											Heath & Sherwood Visual Sample																	
S-9		1620											ROTESCO Visual Sample																	
S-10		1640					242,000	98.0	2.2	62	4	2"	98.6	Worn	0.99	1.55	2	G	1	V	B	G	II	I	I	4	31		12	[illegible] nicking
S-11		1650					247,000	99.0	2.4	62 1/2	5	2"	98.7	Worn	1.27	1.71	2	G	1	V	B	G	II	I	I	5	35		12	237,000 nicking
S-12		1810					248,750	100.0	2.4	62	4	2"	100.	Worn	1.13	1.67	2	G	1	V	B	G	II	I	I	9	32		12 1/8	234,000 nicking

Fig. (C-1) — Sample of "Special Test" report

Ontario Ministry of Labour / Ministère du Travail de l'Ontario
Mining Health and Safety Branch / Direction de la santé et de la sécurité dans les mines
Wire Rope Testing Laboratory / Laboratoire d'essai des câbles métalliques
Whitney Block, Queen's Park, Toronto M7A 1W3 / Edifice Whitney, Queen's Park, Toronto M7A 1W3

Wire Rope Test Certificate
Certificat d'essai de câble métallique

Test No./Essai Nº	Date	Original Test No./Essai initial Nº	Date
67754	January 19, 1989	65545	September 24, 1985

Test for/Essai pour	Mine
	Sample 65

Rope No./Cable Nº	Reel No./Bobine Nº	Shaft/Puits	Compt.No./Comp. Nº
909845-119	447730-1	—	—

Nominal Diameter/Diamètre nominal	No. of Strands/Nbre de torons	No. Wires per Strand/Nbre de fils par toron	External Appearance of Rope/Apparence extérieure du câble
1.515" (1.500")	1	182	Fair

Construction: 42 / 38 / 25 / 28 / 16 / 16 / 8 / 8 / 1

Internal Appearance/Apparence Intérieure (Explanation on Reverse/Explication au Verso)

Lubrication/Lubrification	Visual Rating/Evaluation visuelle	Character/Caractère
Exterior of Strands/Extérieur des torons	4	—
Interior of Strands/Intérieur des torons	3	C
Rope Core/Âme du câble	2	G

Corrosion and Erosion — Visual Rating/Corrosion et érosion — évaluation visuelle

Outer Wires/Fils extérieurs	Inner Wires/Fils intérieurs	Filler Wires/Fils de remplissage
IV	III / III	III

Torsion Tests/Essais de torsion *	Original/Initiale Average/Moyen	Present/Actuelle Average/Moyen	Present/Actuelle Minimum
Outer Wires/Fils extérieurs	16 21 / 17 28	15 15 / 6 14	- - / 4 4
Inner Wires/Fils intérieurs	—	—	—

	Breaking Strength/Résistance à la rupture	Extension Total/Totale	Extension Lay Length	Test Piece Length/Longueur soumise à l'essai
Original/Initiale	305,000 Lbs.	4.65"	—	63"
Present/Actuelle	271,000 Lbs.	2.1"	—	63"

Percent Remaining Strength/Pourcentage de résistance résiduelle	Strands Broken/Torons rompus	Break Location/Position de la rupture
88.9	150	1" from socket

Remarks/Remarques

* TORSION TESTS - no. of turns per 100 wire diameters for 8" specimen.
Diameter at 15% load: 1.490"
wires began breaking at 245,000 Lbs.
Some nicking on inner wires.
Note lubrication, torsion's corrosion and remaining strength.

TEST FEE: $ | Invoice No./Nº de facture: A-17807 | Signature

Fig. (C-2) — Sample of "Wire Rope Test Certificate"

recorded, as negative percentage values. However, when all samples tested destructively show work hardening, i.e., a gain rather than a loss of strength (positive percentage values), then the authors elected to report the maximum of these positive test results.

Ministry of Natural Resources
Ontario

Wire Rope Testing Record (Ontario)

Company					Mine
Rope: 810-XL-01	Reel: G-7635	Shaft: 1	Compt.: 3	Conv.: SKIP	Manf. and Date: GREENING DONALD LTD JUNE 27/83
Size & Const.: 1 1/8" 6 x 30		Dia. of Wires: 12-.079-.080 12-.047-.048 3-.023-.024 3-.077-.078			Wt. of Conv.: 8,450 lbs. / Total Load: 25,582 lbs.
Break Str.: 159,000 lbs.		Installed: Nov.17/83		Taken Off and Reason:	F. of S.: 6.22

Test No.	Date	Br. Load	Ext.	Length	Lub.	Corr.	Torsions Out	Torsions In	F. or S.	Rem. Str.	Remarks	Date Due
63463	June 23/83	159,000 lbs	3.0"	62½"	V V V 1 1 A	0 0 0	~~26~~ 26	~~46~~ 27	---	100%	ALL 9/8 POLY? (HEMP) GOOD	–
65420	Aug 2/85	155,400 LBS	2.5"	63"	G V V 2 1 A	II I I	22	48	—	97.7%	GOOD · SOME INT. WEAR · SLT. NICKING ON INNER WIRES	
65917	JAN 21/86	154,600 LBS	2.3"	63"	G V V 2 1 A	II I I	21	53	—	98.5%	GOOD · SOME INT. WEAR SOME NICKING ON OUTER WIRES	
66320	JULY 25/86	151,000 LBS	2.3"	62"	G V V 2 1 A	II I I	15	43	—	95.0%	SOME WEAR SOME INT WEAR · SOME NICK ON OUT. WIRES WIRES BEGAN BREAK 141,150 LBS	
67098	MAY 20/87	151,000 LBS	2.4"	62½"	G V G 2 1 B	II I I	6	24	—	95.0%	GOOD · INT. WEAR SOME NICKING ON INNER WIRES.	
67694	JAN. 15/88	143,400 LBS	2.0"	62½"	G V G 2 1 B	II I I	14	24	—	90.2%	WIRES BEGIN BREAKING @ 117,250 INT. WEAR · NICKING ON INNER WIRES · RESULTS PHONED TO BOB RENAULT JAN 15/88	
67834	FEB 1/88	145,750 LBS	2.2"	62"	G V G 2 1 B	II I I	10	23	—	91.7%	WIRES BEGAN BREAKING @ 120,000 INT. WEAR · NICKING ON INNER WIRES.	

Electro Magnetic Testing

Test Due	Test Done	Results	Test Due	Test Done	Results
	Feb.20/84	O.K.			
	June 18/84	O.K.			
	Oct.15/84	O.K.			
	Feb.28/85	Loss of 1.5-2.0% between 1320' and 1480' above the skip.			
	June 20/85	Loss of 1.5-2.0% at 880',1660', and 2100' above the skip.			
	Nov.7/85	Loss of 1.0% between 30' and 240' and 3020' ~~andx~~ to 3520' above the skip/cwt.			
	Mar.7/86	Loss of 3.0-3.5% over the first 75' and between 230' -240' above cage/skip.			
	Jully2/86	Loss of 3.0-3.5% over the fist 180' above the skip.			
	Nov.7/86	Loss of 3.0-3.5% over the first 60' above the skip.			
	Feb.27/87	Lloss of 3.5-4.0% over the first 170' & between 1330'-1340' and 1360'-1365' above the skip.			
	June 26/87	Loss of 4.0-4.5% at about 1415';above the conv.			
	Oct.30/87	Loss of 4.0-5.0% between 1415'-1425' and 1445'-1440' from start of test above the cwt.			

Fig. (C-3) — Sample of "Wire Rope Testing Record (Ontario)"

¶: NDT%= Non-destructive Test%.

These values express the "estimated" loss, as negative values, in rope breaking strength, as a percentage of the rope's original breaking strength. In this report only the maximum losses are recorded, as reported by the different EM instrument operators, namely by:

(1) AC= Rotesco's AC instrument; test results obtained before June 4, 1980, are referred to as AC(a) in Figures (C-1a) to (C-3d), and are listed in sections (a) of Tables (C-1) to (C-3); the later tests are referred to as AC(b) in the respective Figures, and are listed in sections (b) in the respective Tables;
(2) ROTGR= Rotesco's *Rotescograph* instrument;
(3) AC+DC= Rotesco's AC and DC instruments;
(4) MAGGR= Heath & Sherwood's *Magnograph* instrument.

*: Error%= (DT% – NDT%).

A positive error% means that NDT%>DT%, i.e., that the EM instrument operator overestimated the true loss of rope strength; a negative error% means that NDT%<DT%, i.e., that the instrument operator underestimated the true loss of rope strength.

**: Mine (all in Ontario, unless noted otherwise by a ♣ superscript); the mine-abbreviations are as follows:

AGNCO: Agnico Eagle Mines Ltd.
ALGOM: Algoma Ore Properties Ltd.
AUNOR: Aunor Gold Mines
BLRA: Bulora Corporation (Madsen)
BMS♣: Brunswick Mining and Smelting (New Brunswick)
CDNJM: Canadian Johns-Manville Co.
CDNRS: Canadian Rock Salt Co. Ltd.
CLND: Caland Ore Co. Ltd.
COCNR: Cochenour Williams Gold Mines Ltd.
CRL: Campbell Red Lake Mines
DICKN: Dickenson Mines Ltd.
DLNT: Delnite Mines Ltd.
DMTR: Domtar Chemicals Ltd.
DOME: Dome Mines
DNSN: Denison Mines Ltd.

FLCN: Falconbridge — Onaping mine
FLCN1: — Falconbridge mine
FLCN2: — Strathcona mine
FLCN3: — Fecunis mine
FLCN4: — East mine
FLCN5: — Boundry mine
FLCN6: — Hardy mine
FLCN7: — Lockerby mine
FRY: R.F. Fry and Associates Ltd.
GECO: Geco Mines Ltd.
HIHO: Hiho Silver Mines Ltd.
HLLGR: Hollinger Consolidated Gold Mines
INCO: International Nickel Co. — Frood-Stobie mine
INCO1: — Little Stobie mine
INCO2: — Shebandowan mine
INCO3: — Levack mine
INCO4: — Creighton mine
INCO5: — Coleman mine
INCO6: — Garson mine
INCO7: — Murray mine
KAM-K: Kam-Kotia Porcupine Mines Ltd.
KAM: Kerr Addison Mines Ltd.
LAKE: Lake Shore Mines Ltd.
LEITCH: Leitch Gold Mines Ltd.
McINT: McIntyre Porcupine Mines Ltd.
McLEOD: MacLeod Cockshutt Gold Mines Ltd.
METM: Metal Mines Ltd. — Gordon Lake Div.
MDSN: Madsen Red Lake Gold Mines Ltd.
NRDA: Noranda Mines Ltd.
NRTHS: Northspan Uranium Mines Ltd.
PAMR: Pamour Porcupine Mines Ltd.
PCA♣: Potash Co. of America (Saskatchewan)
PRSTN: Preston Mines Ltd.
RIOA: Rio Algom Mines — Stanleigh mine
RIOA1: — New Quirke mine
RIOA2: — Panel mine
RIOA3: — Milliken mine

RIOA4: — Pater mine
SIFTO: Sifto Salt (Goderich Mine)
SISC: Sisco Metals of Ontario Ltd.
STPR: Steep Rock Iron Mine
TECK: Teck Hughes Gold Mines Ltd. — Teck Corporation
UCM: Upper Canada Mines Ltd.
WILLR: Willroy Mines Ltd.
WRGHT: Wright-Hargreaves Mines Ltd.

‡: All NDT% results were obtained by the makers of the instruments used, or by operators appointed/approved by them. The latter case obtains at INCO and at DEVCO, who use their own Rotesco AC and Rotescograph instruments, respectively, and their own staff to operate them.

Summary observations:

Points of particular interest include:

(a) the EM testers' inability to distinguish between no (or low) strength losses and work hardening situations. Consequently, in cases of no (or low) losses, coupled with an extensive service history, the true picture can only be obtained by examining other test results as well, in particular the rope's loss of extension, loss of rotation resistance, and, whenever possible, hardening of the wires;
(b) the considerable number of samples in this report with recorded "true" strength losses in the order of 35% to 60%, and with respective EM estimates nowhere near these values;
(c) the considerable number of samples in this report with their estimated losses more than ±4% in error, especially in the DT≥10% range. Of the latter a majority of data points has been underestimated;
(d) the AC instrument's tendency to underestimate, rather than to overestimate, the "true" rope strength losses;
(e) the tendency of the underestimates of point (d) — especially outside the ±4% limit — to be mostly in the DT≥10% range, and the corresponding overestimates to be mostly in the DT<10% range;
(f) the fact that: (1) a majority of test results was obtained with the Rotesco AC instrument, and (2) that, although too few in number for a statistically valid judgement, results with the other Canadian instruments appear to be closer to the desired accuracy;

(g) the conclusion that it is both appropriate and urgent to proceed with the type of project proposed by CANMET (see Appendix A);

(h) the conclusion that it is advisable to examine the relevant sections of the various mining regulations — in particular as to their "technical", "competency", and "approval" requirements — so as to assess how far these can be accomodated in light of present day technical developments and educational facilities in Canada (see Appendix B).

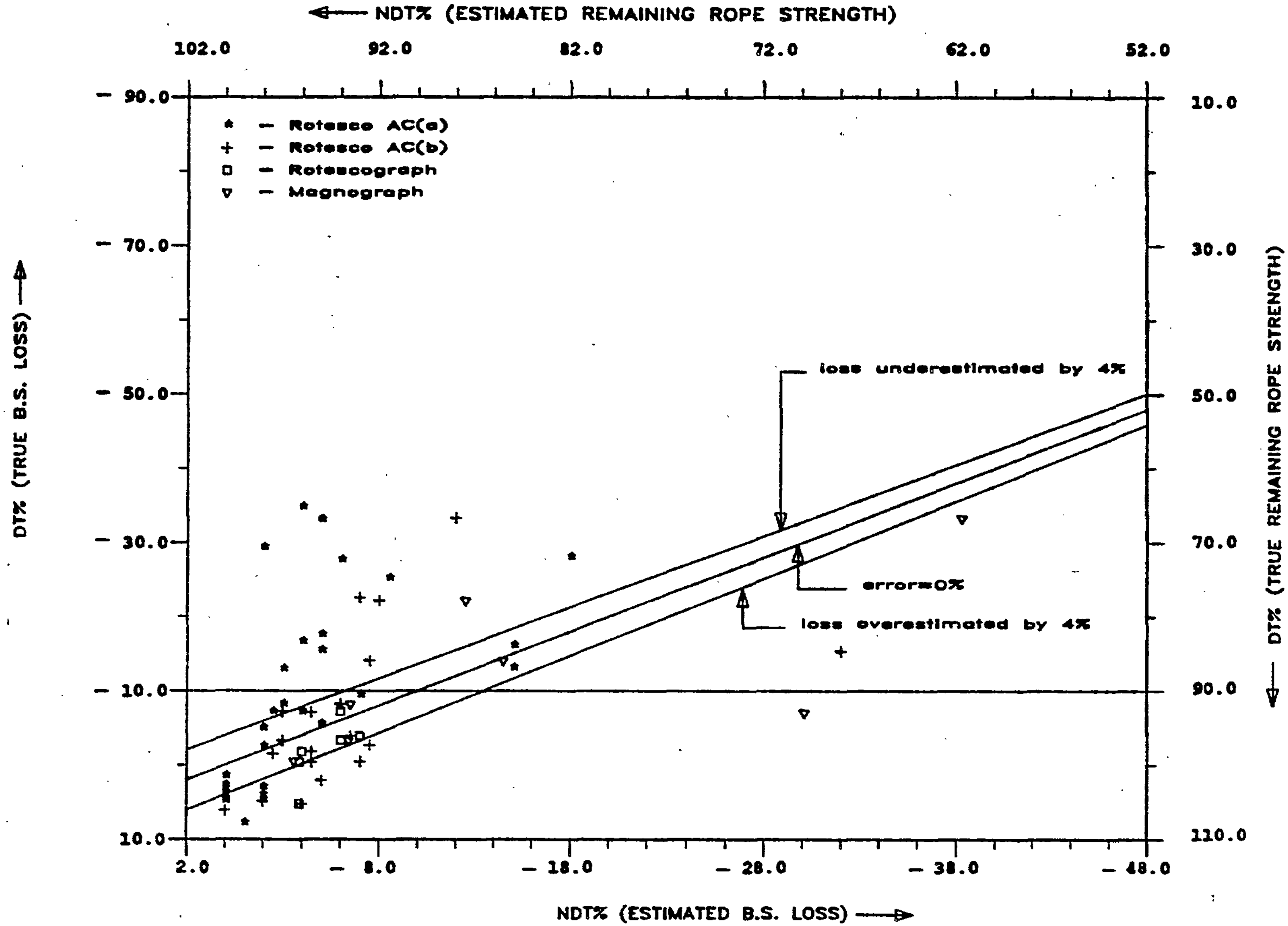

Fig. (C-1a) — Locked coil ropes

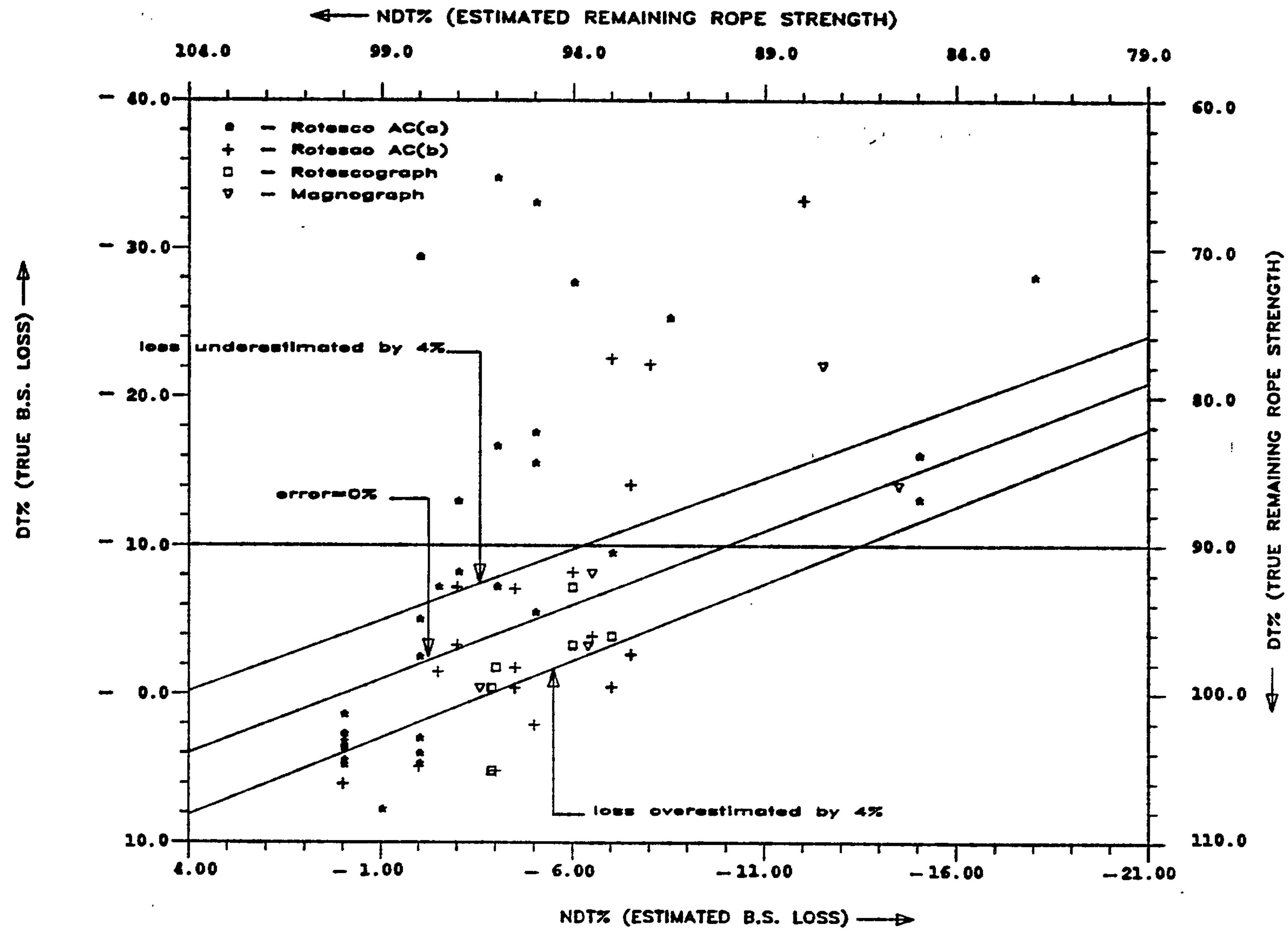

Fig. (C-1b) — Locked coil ropes; the critical loss range

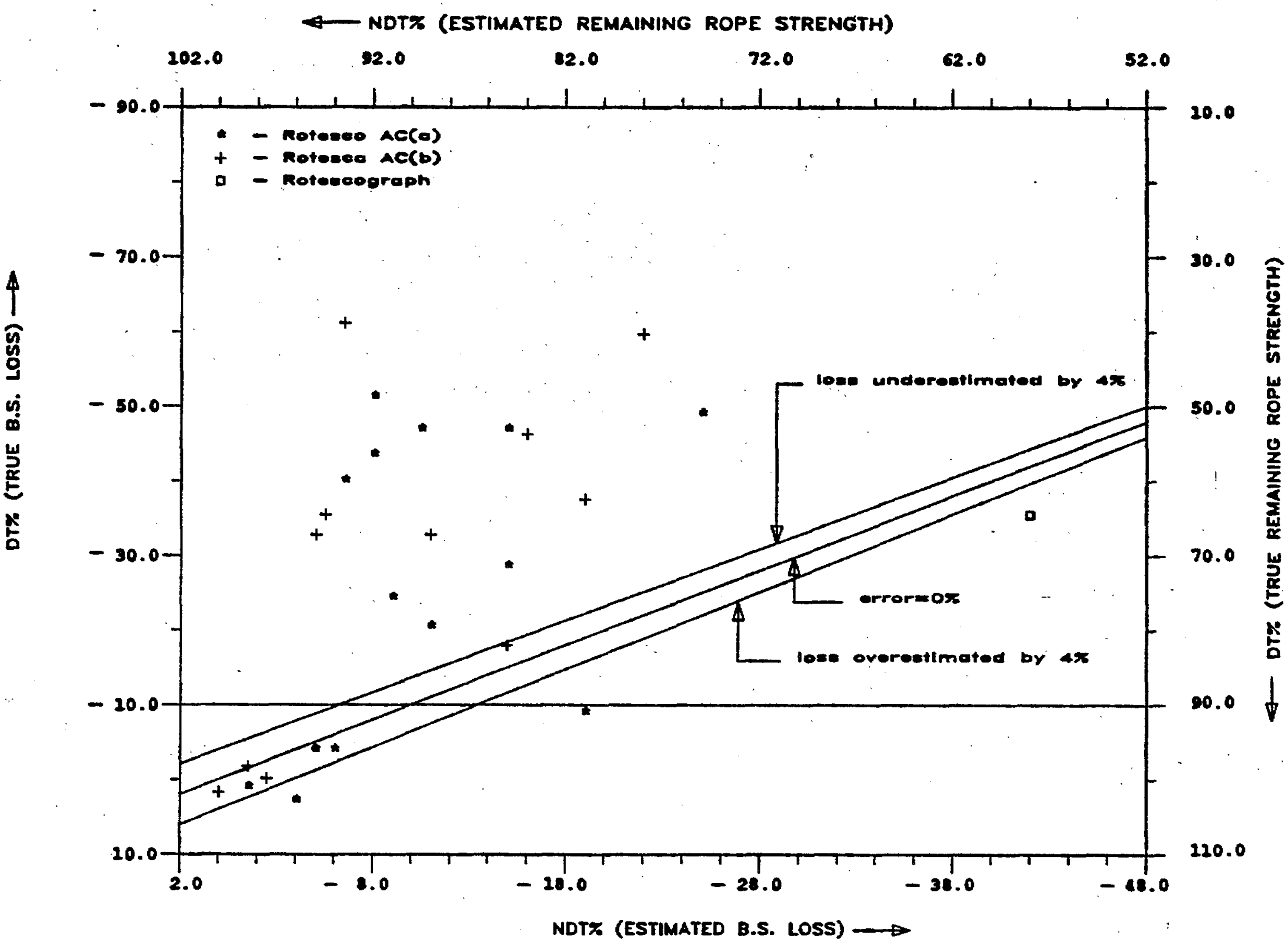

Fig. (C-2) — Non rotating ropes

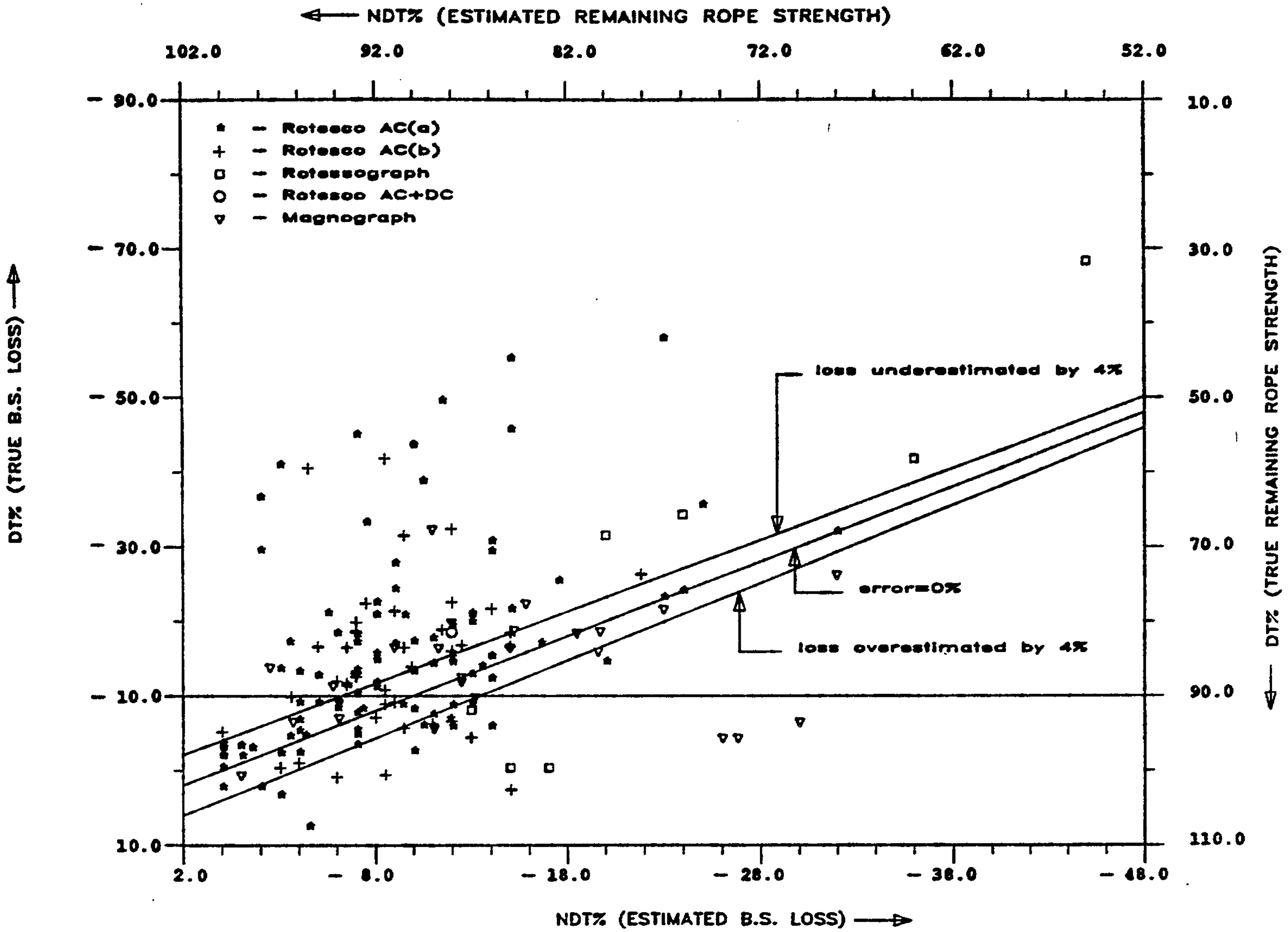

Fig. (C-3a) — Stranded ropes; all instruments

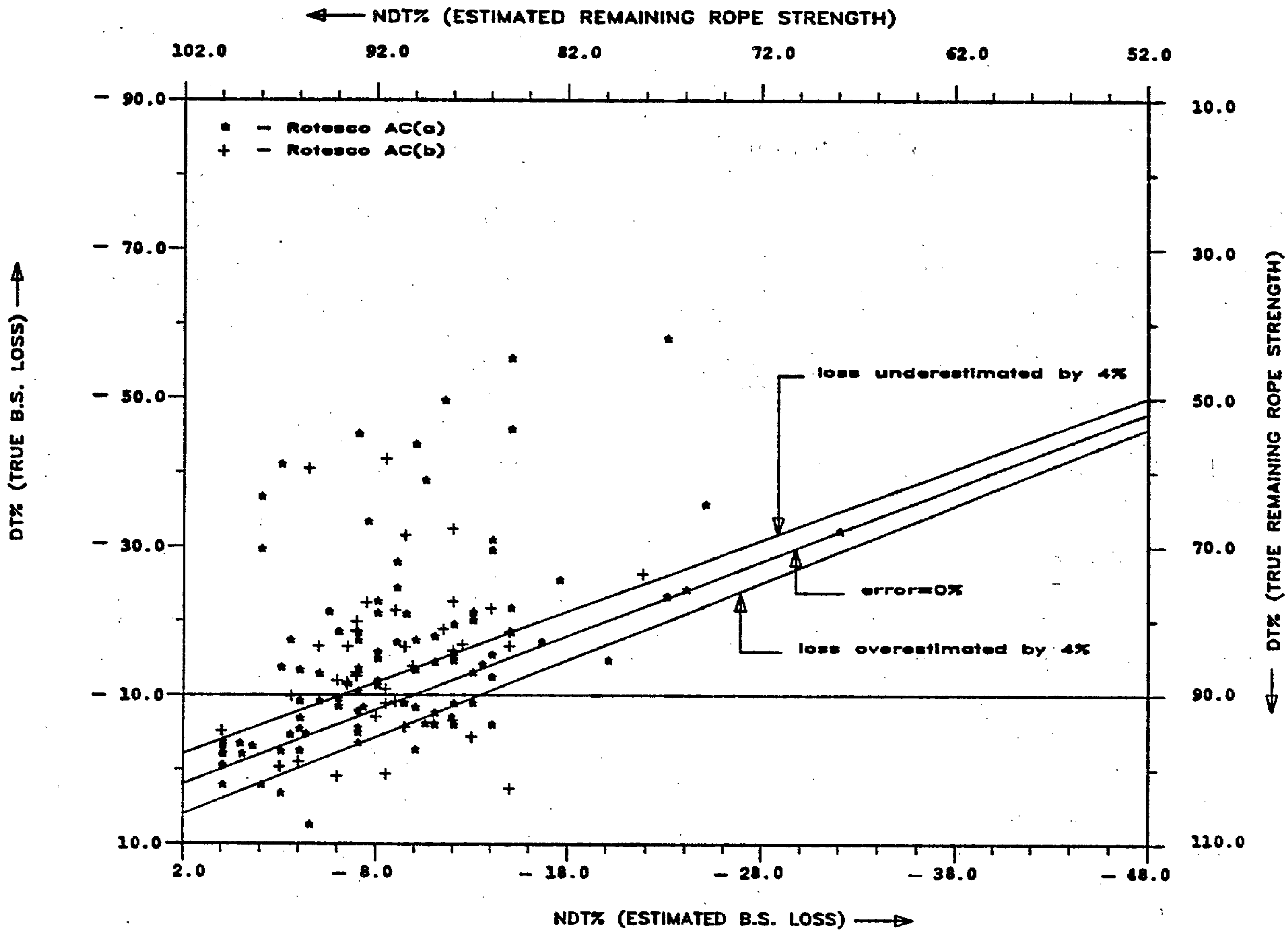

Fig. (C-3b) — Stranded ropes; the Rotesco AC instrument

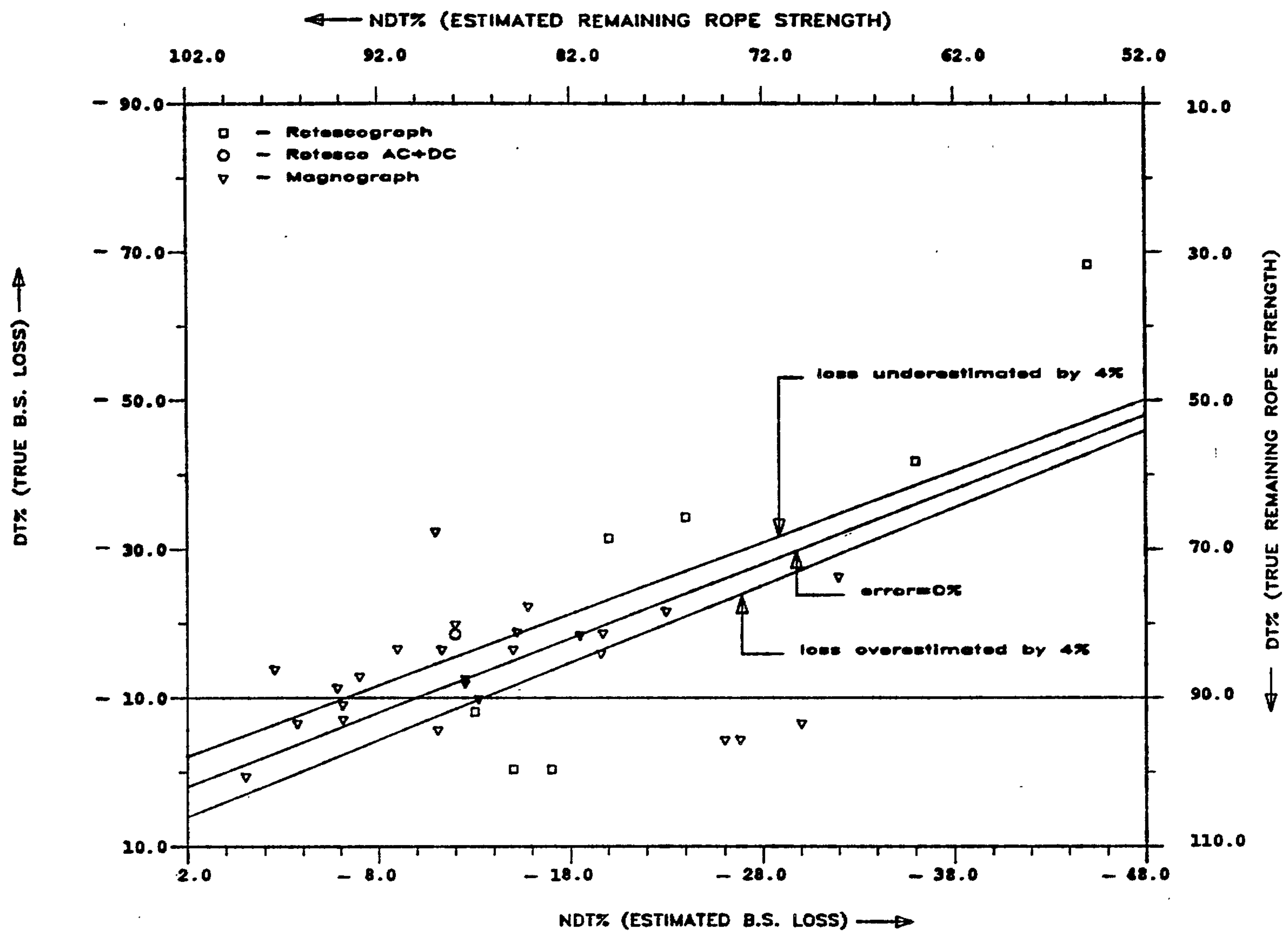

Fig. (C-3c) — Stranded ropes; the Rotescograph and Magnograph testers

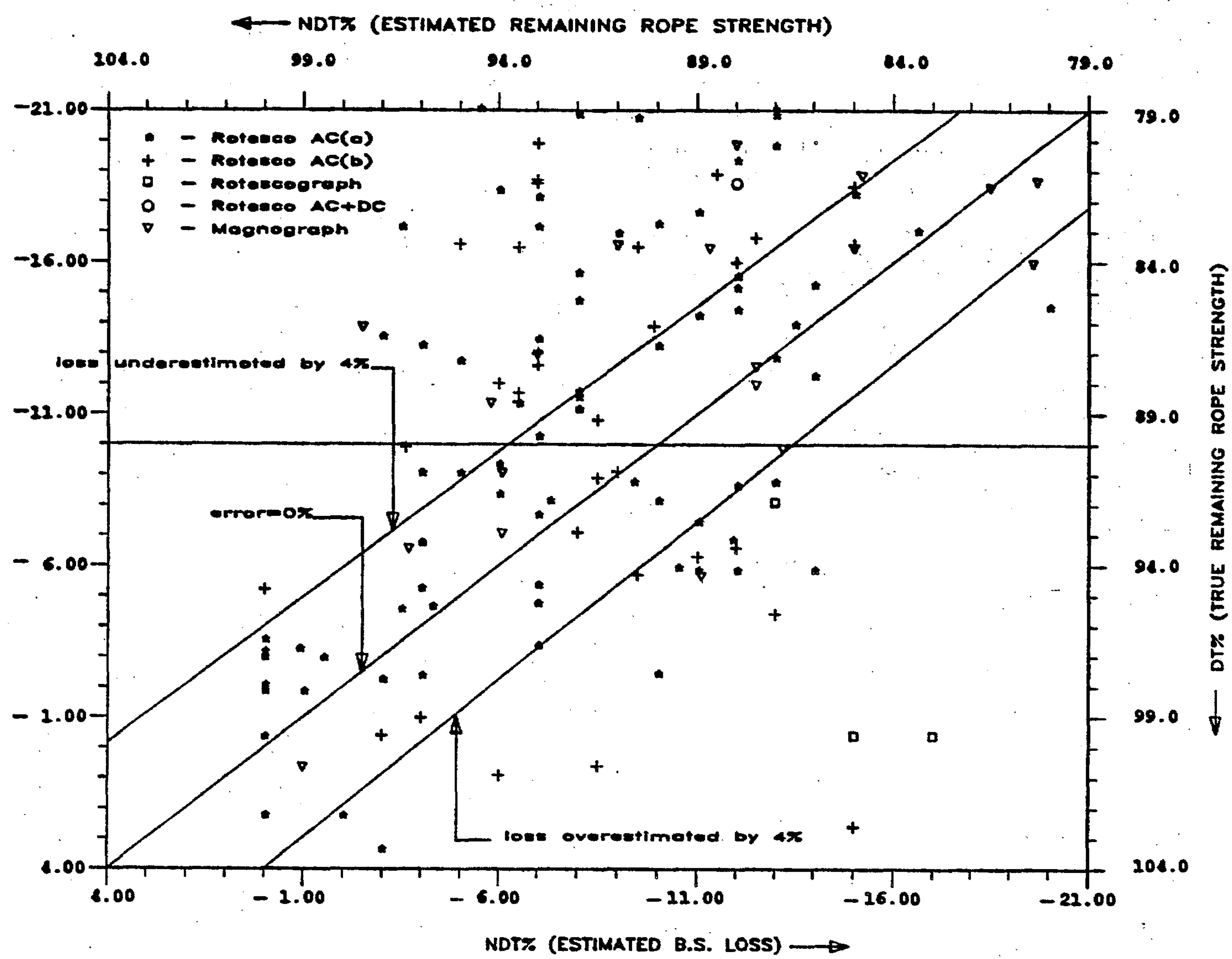

Fig. (C-3d) — Stranded ropes; the critical loss range

TABLE (C-1)
Analysis of Available Test Data; I(a) — Locked Coil Ropes
NDT Testing With The Rotesco AC Instrument¶¶

Item	Sp. Test#	Mine**	Size	Constr.	Reel#	MOL DT Date	MOL DT#	DT%§	NDT%¶	Error%*
1 LC	409A	PCA	$\frac{7}{8}$	—	cwt	13.1.66	43731	−22.0	—	—
2 LC	346	MDSN	1	1 × 109	C-1482	13.11.61	36911	−34.7	−4.0	−30.7
3 LC	348	FLCN3	1	1 × 115	G6890A7	28.11.61	37009	−8.1	−3.0	−5.1
4 LC	349	FLCN3	1	1 × 105	K8549-2	5.12.61	37065	+3.7	0.0	+3.7
5 LC	410	FLCN3	1	1 × 105	K8549-7	11.3.66	43927	+7.9	−1.0	+8.9
6 LC	414	MDSN	1	1 × 105	C-2825	21.4.67	45570	+3.1	−2.0	+1.1
7 LC	417	MDSN	1	1 × 105	A2380-8	28.5.68	47092	+4.6	0.0	+4.6
8 LC	426	FLCN3	1	1 × 104	C-2492	24.8.70	50008	−12.9	−3.0	−9.9
9 LC	432	FLCN3	1	1 × 104	E1406A4	16.7.73	53349	−17.1	—	—
10 LC	442	BLRA	1	1 × 105	A2380-10	1.10.76	56743	−7.1	−2.5	−4.6
11 LC	401	FLCN4	1.02	1 × 106	C-1300	30.12.64	—	−29.3	−2.0	−27.3
12 LC	409	FLCN4	1.02	1 × 106	C-1961	13.1.66	43683	−7.1	−4.0	−3.1
13 LC	387	CLND	$1\frac{1}{16}$	1 × 104	8-5228	1.5.64	41133	+1.5	0.0	+1.5
14 LC	395	FLCN4	$1\frac{1}{16}$	1 × 107	9-2415	18.9.64	41710	+3.3	0.0	+3.3
15 LC	405	WILLR	$1\frac{1}{8}$	1 × 110	Q2867-1	20.5.65	—	−28.0	−18.0	−10.0
16 LC	411	PCA	$1\frac{1}{8}$	1 × 112	D-4541	27.1.65	44385	−13.0	−15.0	+2.0
17 LC	412	PCA	$1\frac{1}{8}$	1 × 112	D-4542	20.6.66	44391	−16.0	−15.0	−1.0
18 LC	445	INCO1	$1\frac{3}{16}$	1 × 136	L029960	9.3.78	58152	−25.2	−8.5	−16.7
19 LC	458	INCO5	$1\frac{3}{16}$	1 × 136	L00270	10.12.79	59841	+4.8	−2.0	+6.8
20 LC	353	CLND	$1\frac{5}{16}$	1 × 103	8-5241	12.1.61	37277	−27.6	−6.0	−21.6
21 LC	396	GECO	$1\frac{5}{16}$	1 × 135	B-2435	1.10.64		−17.5	−5.0	−12.5

¶¶: the authors were unable to verify the NDT% values, or establish the relevant test dates.

Note: see Appendix C, "Explanation of terms, abbreviations and symbols" for details of other superscipts.

I(a) — Locked Coil Ropes (continued)

NDT Testing With The Rotesco AC Instrument¶¶

Item	Sp. Test#	Mine**	Size	Constr.	Reel#	MOL DT Date	MOL DT#	DT%§	NDT%¶	Error%*
22 LC	403	CLND	$1\frac{5}{16}$	1 × 103	8-5234	19.3.65	42450	+2.8	0.0	+2.8
23 LC	407	FLCN1	$1\frac{5}{16}$	1 × 131	9-0384	30.6.65	42941	–4.9	–2.0	–2.9
24 LC	399	FLCN	$1\frac{3}{8}$	1 × 176	Q5041-2	1.12.64	42055	+4.9	0.0	+4.9
25 LC	400	FLCN	$1\frac{3}{8}$	1 × 176	C-2135	7.12.64	42081	+4.9	0.0	+4.9
26 LC	427	FLCN2	$1\frac{3}{8}$	1 × 176	C4921	10.3.72		–5.4	–5.0	–0.4
27 LC	434	NRDA	$1\frac{7}{16}$	1 × 176	C5245	22.8.73	53460	+4.1	–2.0	+6.1
28 LC	354	SIFTO	$1\frac{9}{16}$	1 × 171	9-1075	19.1.62	37299	–15.4	–5.0	–10.4
29 LC	386	DMTR	$1\frac{9}{16}$	1 × 173	N-1066	22.4.64	—	–2.4	–2.0	–0.4
30 LC	413	FLCN2	$1\frac{9}{16}$	1 × 169	C-1813	9.3.67	—	–33.0	–5.0	–27.0
31 LC	419	DMTR	$1\frac{9}{16}$	1 × 173	C-2497	14.2.69	48005	–9.4	–7.0	–2.4
32 LC	423	FLCN2	$1\frac{9}{16}$	1 × 173	C-2681	20.3.70	49455	–16.6	–4.0	–12.6
33 LC	378	RIOA3	$1\frac{5}{8}$	1 × 187	R1938-1	11.10.63	40255	+3.8	0.0	+3.8

¶¶: the authors were unable to verify the NDT% values, or establish the relevant test dates.

TABLE (C-1)

Analysis of Available Test Data; I(b) — Locked Coil Ropes NDT Testing with Different Types of Instruments

<table>
<tr><th rowspan="3">Item</th><th rowspan="3">OMOL† Sp. Test#</th><th rowspan="3">Mine**</th><th colspan="3">Rope Service Data</th><th colspan="3">Rope Catalogue Data</th><th rowspan="3">Error%*</th></tr>
<tr><th colspan="2">Dates</th><th rowspan="2">Months in Use</th><th rowspan="2">Size (in.)</th><th rowspan="2">Constr.</th><th rowspan="2">Reel No.</th></tr>
<tr><th>On:</th><th>Off:</th></tr>
<tr><td rowspan="5">34 LC</td><td rowspan="5">501</td><td rowspan="5">FLCN3</td><td>7.11.76</td><td>5.3.83</td><td>76</td><td>1</td><td>1 × 104</td><td>55014</td><td rowspan="3"></td></tr>
<tr><td colspan="3">Non-destructive Test</td><td colspan="3">Destructive Test</td></tr>
<tr><td>Instr.</td><td>Date</td><td>NDT(%)¶</td><td>DT(%)§</td><td>Date</td><td>OMOL#</td></tr>
<tr><td>AC</td><td>3.11.82</td><td>−6.0</td><td rowspan="2">−8.2</td><td rowspan="2">22.9.83</td><td rowspan="2">63719</td><td>−2.2</td></tr>
<tr><td>MAGGR</td><td>16.8.83</td><td>−6.5</td><td>−1.7</td></tr>
</table>

<table>
<tr><th rowspan="3">Item</th><th rowspan="3">OMOL† Sp. Test#</th><th rowspan="3">Mine**</th><th colspan="3">Rope Service Data</th><th colspan="3">Rope Catalogue Data</th><th rowspan="3">Error%</th></tr>
<tr><th colspan="2">Dates</th><th rowspan="2">Months in Use</th><th rowspan="2">Size (in.)</th><th rowspan="2">Constr.</th><th rowspan="2">Reel No.</th></tr>
<tr><th>On:</th><th>Off:</th></tr>
<tr><td rowspan="5">35 LC</td><td rowspan="5">504</td><td rowspan="5">FLCN3</td><td>Jan. 75</td><td>19.3.83</td><td>96</td><td>1</td><td>1 × 104</td><td>02709</td><td rowspan="3"></td></tr>
<tr><td colspan="3">Non-destructive Test</td><td colspan="3">Destructive Test</td></tr>
<tr><td>Instr.</td><td>Date</td><td>NDT(%)¶</td><td>DT(%)§</td><td>Date</td><td>OMOL#</td></tr>
<tr><td>AC</td><td>21.2.83</td><td>−7.0</td><td rowspan="2">−0.5</td><td rowspan="2">21.9.83</td><td rowspan="2">63714</td><td>+6.5</td></tr>
<tr><td>MAGGR</td><td>8.6.83</td><td>−3.6</td><td>+3.1</td></tr>
</table>

<table>
<tr><th rowspan="3">Item</th><th rowspan="3">OMOL† Sp. Test#</th><th rowspan="3">Mine**</th><th colspan="3">Rope Service Data</th><th colspan="3">Rope Catalogue Data</th><th rowspan="3">Error%*</th></tr>
<tr><th colspan="2">Dates</th><th rowspan="2">Months in Use</th><th rowspan="2">Size (in.)</th><th rowspan="2">Constr.</th><th rowspan="2">Reel No.</th></tr>
<tr><th>On:</th><th>Off:</th></tr>
<tr><td rowspan="4">36 LC</td><td rowspan="4">440</td><td rowspan="4">INCO1</td><td>19.3.71</td><td>13.9.75</td><td>54</td><td>$1\frac{3}{16}$</td><td>1 × 136</td><td>L00469</td><td rowspan="3"></td></tr>
<tr><td colspan="3">Non-destructive Test</td><td colspan="3">Destructive Test</td></tr>
<tr><td>Instr.</td><td>Date</td><td>NDT(%)¶</td><td>DT(%)§</td><td>Date</td><td>OMOL#</td></tr>
<tr><td>AC</td><td>19.5.76</td><td>−7.5</td><td>−2.7</td><td>18.5.76</td><td>56381</td><td>+4.8</td></tr>
</table>

<table>
<tr><th rowspan="3">Item</th><th rowspan="3">OMOL† Sp. Test#</th><th rowspan="3">Mine**</th><th colspan="3">Rope Service Data</th><th colspan="3">Rope Catalogue Data</th><th rowspan="3">Error%*</th></tr>
<tr><th colspan="2">Dates</th><th rowspan="2">Months in Use</th><th rowspan="2">Size (in.)</th><th rowspan="2">Constr.</th><th rowspan="2">Reel No.</th></tr>
<tr><th>On:</th><th>Off:</th></tr>
<tr><td rowspan="4">37 LC</td><td rowspan="4">464</td><td rowspan="4">INCO5‡</td><td>8.5.73</td><td>4.10.80</td><td>89</td><td>$1\frac{3}{16}$</td><td>1 × 136</td><td>L00271</td><td rowspan="3"></td></tr>
<tr><td colspan="3">Non-destructive Test</td><td colspan="3">Destructive Test</td></tr>
<tr><td>Instr.</td><td>Date</td><td>NDT(%)¶</td><td>DT(%)§</td><td>Date</td><td>OMOL#</td></tr>
<tr><td>AC‡</td><td>18.9.80</td><td>0.0</td><td>+6.1</td><td>4.5.82</td><td>61088</td><td>+6.1</td></tr>
</table>

I(b) — Locked Coil Ropes (continued)
NDT Testing with Different Types of Instruments

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
38 LC	506	INCO1‡	25.5.79	24.9.83	52	$1\frac{3}{16}$	1 × 136	L-06364	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	15.9.83	-7.5	-14.1	13.10.83	63779	-6.6
			MAGGR	3.10.83	-14.5				+0.4

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
39 LC	507	INCO1‡	4.2.78	21.9.83	$67\frac{1}{2}$	$1\frac{3}{16}$	1 × 136	L-046662	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	15.9.83	-8.0	-22.2	25.11.83	63879	-14.2
			MAGGR	22.11.83	-12.5				-9.7

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
40 LC	513	INCO2‡	19.7.78	10.5.85	82	$1\frac{3}{16}$	1 × 136	L-11158	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	25.10.84	≤-2.0	+4.9	7.8.85	65442	+6.9

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
41 LC	517	INCO1‡	3.4.81	19.10.85	54	$1\frac{3}{16}$	1 × 136	106376	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	23.8.85	-5.0	+2.1	21.11.85	65734	+7.1

I(b) — Locked Coil Ropes (continued)
NDT Testing with Different Types of Instruments

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
42 LC	518	INCO1‡	23.5.79	20.10.85	77	$1\frac{3}{16}$	1 × 136	L-046673	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	23.8.85	-7.0	-22.6	21.11.85	65735	-15.6

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
43 LC	524	BMS	1.10.79	28.4.86	79	1.31	1 × 144	010257	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	15.4.86	-4.5	-1.8	26.8.86	66390	+2.7
			ROTGR	8.8.86	-4.0				+2.2

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
44 LC	525	BMS	1.10.79	28.4.86	79	1.31	1 × 144	010254	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	15.4.86	-4.0	+5.2	20.10.86	59090	+9.2
			ROTGR	18.9.86	-3.9				+9.1

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
45 LC	526	BMS	1.10.79	28.4.86	79	1.31	1 × 144	010256	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	15.4.86	-4.5	-0.4	20.10.86	66550	+4.1
			ROTGR	18.9.86	-3.9				+3.5

I(b) — Locked Coil Ropes (continued)
NDT Testing with Different Types of Instruments

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
46 LC	460	DMTR	Apr. 68	9.4.80	144	$1\frac{1}{2}$	1 × 35∇	C-5392	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	28.3.80	−32.0	−15.4	4.6.80	60264	+16.6

∇: half-lock guide rope

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
47 LC	441	KAM	1.3.72	18.5.76	50	1.515	1 × 182	L-08220	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	4.4.76	−2.5	−1.5	15.9.76	56674	+1.0

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
48 LC	509	Kidd Creek Mines	4.1.79	10.5.84	64	1.515	1 × 182	020754	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	9.12.83	−3.0	−3.3	19.6.84	64402	−0.3
			ROTGR	18.6.84	−6.0				+2.7
			MAGGR	9.5.84	−6.4				+3.1

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
49 LC	508	FLCN2	16.10.78	15.10.83	60	$1\frac{9}{16}$	1 × 173	—	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	12.6.83	−4.5	−7.1	27.1.84	64074	−2.6
			MAGGR	23.11.83	−30.1				+23.0

I(b) — Locked Coil Ropes (continued)
NDT Testing with Different Types of Instruments

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
50 LC	500	FLCN2	16.10.78	18.11.82	49	$1\frac{9}{16}$	1 × 173	L-05874	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	29.10.82	−12.0	−33.3	15.2.83	63129	−20.1
			MAGGR	26.1.83	−38.3				−5.0

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
51 LC	529	BMS	19.6.79	28.6.86	84	$1\frac{5}{8}$	1 × 173	010227	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC††	14.1.86	−3.0	−7.2	27.2.87	66934	−4.2
			ROTGR	16.4.86	−6.0				−1.2

††: same results reported, on same date, with Rotescograph instrument

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
52 LC	530	BMS	19.6.79	16.5.86	83	$1\frac{5}{8}$	1 × 173	010229	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC††	14.1.86	−6.5	−3.9	12.3.87	66946	+2.6
			ROTGR	16.4.86	−7.0				+3.1

††: same results reported, on same date, with Rotescograph instrument

TABLE (C-2)

Analysis of Available Test Data; II(a) — Non Rotating Ropes

NDT Testing With The Rotesco AC Instrument¶¶

Item	Sp. Test#	Mine**	Size	Constr.	Reel#	MOL DT Date	MOL DT#	DT%§	NDT%¶	Error%*
1 NR	347	FLCN	$1\frac{3}{16}$	34 x 6/1	9-6890B7	24.11.61	36982	-28.6	-15.0	-13.6
2 NR	449	FLCN3	$1\frac{7}{32}$	34 x 7	P990-2	15.6.78		-49.0	-25.0	-24.0
3 NR	450	FLCN3	$1\frac{7}{32}$	34 x 7	P990-4	15.6.78		-4.0	-6.0	+2.0
4 NR	451	FLCN3	$1\frac{7}{32}$	34 x 7	L029656	15.6.78		-40.0	-6.5	-33.5
5 NR	454	RIOA	$1\frac{5}{16}$	34 x 7	L029277	9.8.78		-46.9	-15.0	-31.9
6 NR	452	INCO1	$1\frac{3}{8}$	34 x 7	L00195	3.8.78		-4.0	-5.0	+1.0
7 NR	453	INCO1	$1\frac{3}{8}$	34 x 7	L00199	2.8.78		-1.0	-1.5	+0.5
8 NR	448	NRDA	$1\frac{1}{2}$	34 x 7	010068	15.6.78		-20.5	-11.0	-9.5
9 NR	443	INCO2	$1\frac{5}{8}$	18 x 7	L11195	16.1.78	58039	-46.9	-10.5$^{\triangledown}$	-36.4
10 NR	443	INCO2	$1\frac{5}{8}$	18 x 7	L11196	16.1.78	58041	+2.8	-4.0$^{\triangledown}$	+6.8
11 NR	443	INCO2	$1\frac{5}{8}$	18 x 7	L11197	16.1.78	58040	-24.4	-9.0$^{\triangledown}$	-15.4
12 NR	446	FLCN2	$1\frac{5}{8}$	34 x 7	H9169C2	Feb. 78		-9.0	-9.0$^{\triangledown\triangledown}$	0.0
13 NR	456	FLCN2	$1\frac{5}{8}$	34 x 7	H9169K2	25.1.79	58932	-51.3	-8.0	-43.3
14 NR	457	FLCN2	$1\frac{5}{8}$	34 x 7	C4552	25.1.79	58925	-43.5	-8.0	-35.5
15 NR	455	KAM	$1\frac{3}{4}$	34 x 7	063305	13.9.78	58618	+0.8	—	—

¶¶: the authors were unable to locate the original reports to verify the NDT% values, and to establish the relevant test dates.

$^{\triangledown}$: tested on 17.10.77. $^{\triangledown\triangledown}$: tested on 17.2.78.

TABLE (C-2)
Analysis of Available Test Data; II(b) — Non Rotating Ropes NDT Testing with Different Types of Instruments

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
16 NR	532	Renabie Gold Mines•	29.3.86	10.10.87•	$18\frac{1}{2}$	1	18 × 7	6-310	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	30.6.87	–5.5	–35.5	17.11.87	67556	–30.0
			ROTGR	16.11.87	–42.0				+6.5

•: this rope failed

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
17 NR	479	FLCN1	30.9.78	13.10.81	$36\frac{1}{2}$	$1\frac{3}{16}$	34 × 7	L-10465	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	21.6.81	–6.5	–61.1	13.1.82	61929	–54.6

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
18 NR	431	McINT	17.6.70	21.3.72•	21	$1\frac{1}{4}$	34 × 7	C-5191	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	4.1.72	–5.0	–32.8	14.5.73	53136	–27.8
			AC	19.2.73	–11.0				–21.8

•: this rope removed as safety measure, pending examination of its failed companion rope (#T-18, on 8.3.72)

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
19 NR	473	PAMR	8.2.80	29.4.81	$14\frac{1}{2}$	$1\frac{1}{4}$	34 × 7	L-046836	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	15.4.81	–22.0	–59.7	11.8.81	61670	–37.7

II(b) — Non Rotating Ropes (continued)
NDT Testing with Different Types of Instruments

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
20 NR	430	FLCN3	20.11.68	24.11.72∇	48	$1\frac{7}{32}$	34 × 7	I-4467-1	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	—	–16.0	–46.3	9.5.73	53120	–30.3

∇: this rope damaged when companion rope failed

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
21 NR	429	DMTR	24.8.71	25.1.73	17	$1\frac{3}{8}$	34 × 7	D-2000	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	23.1.73	–19.0	–37.5	9.4.73	52274	–18.5

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
22 NR	519	INCO1‡	5.3.78	17.8.85	$89\frac{1}{2}$	$1\frac{3}{8}$	34 × 7	L-00193	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	7.2.85	–2.5	–0.2	9.10.85	65617	+2.3

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
23 NR	447	NRDA	14.5.76	31.1.78	$20\frac{1}{2}$	$1\frac{1}{2}$	34 × 7	010070	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	31.1.78	–15.0	–18.0	15.6.78	—	–3.0

II(b) — Non Rotating Ropes (continued)
NDT Testing with Different Types of Instruments

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
24 NR	511	INCO2‡	23.9.80	19.4.85	55	$1\frac{5}{8}$	18 × 7	033532	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	26.10.84	0.0	+1.7	8.8.85	65435	+1.7

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
25 NR	512	INCO2‡	13.6.79	12.4.85	58	$1\frac{5}{8}$	18 × 7	030989	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	15.6.84	−1.5	−1.8	8.8.85	65439	−0.3

TABLE (C-3)

Analysis of Available Test Data; III(a) — Stranded Ropes

NDT Testing With The Rotesco AC Instrument¶¶

Item	Sp. Test#	Mine**	Size	Constr.	Reel#	MOL DT Date	MOL DT#	DT%§	NDT%¶	Error%*
1 STR	316	SISC	$\frac{5}{8}$	6 x 25	J5888	5.4.61	35653	-21.5	-15.0	**-6.5**
2 STR	351	McINT	$\frac{5}{8}$	6 x 25	D7850	24.12.61	37189	-25.3	-17.5	**-7.8**
3 STR	366	CDNRS	$\frac{5}{8}$	6 x 25	D7375	12.6.62	38044	-4.7	-7.0	**+2.3**
4 STR	435	CDNRS	$\frac{5}{8}$	6 x 25	4494	22.10.73	53612	-14.2	-11.0	**-3.2**
5 STR	438	CDNRS	$\frac{5}{8}$	6 x 25	4493	25.2.74	53957	-18.1	-7.0	**-11.1**
6 STR	314	McINT	$\frac{3}{4}$	6 x 27	D5615	8.3.61	35522	-33.1	-7.5	**-25.6**
7 STR	317	TECK	$\frac{3}{4}$	6 x 27	8-2535	11.4.61	35682	-40.8	-3.0	**-37.8**
8 STR	352	McINT	$\frac{3}{4}$	6 x 27	D7177	29.12.61	37191	-36.5	-2.0	**-34.5**
9 STR	415	HIHO	$\frac{3}{4}$	6 x 27	H5974	30.8.67	45360	-31.9	-32.0	**+0.1**
10 STR	420	SISC	$\frac{3}{4}$	6 x 27	E2587	1.5.69	48278	-9.3	-6.0	**-3.3**
11 STR	428	INCO3	$\frac{3}{4}$	6 x 27	760	26.7.72	52274	-29.4	-2.0	**-27.4**
12 STR	439	TECK	$\frac{3}{4}$	6 x 30	L021414	21.5.75	55219	-17.0	-16.6	**-0.4**
13 STR	310	ALGOM	$\frac{7}{8}$	6 x 27	13775	7.2.61	35372	-5.9	-10.5	**+4.6**
14 STR	315	WRGHT	$\frac{7}{8}$	6 x 27	6-6210	29.3.61	35626	-38.7	-10.5	**-28.2**
15 STR	329	PAMR	$\frac{7}{8}$	6 x 27	11828	11.8.61	36369	-57.8	-23.0	**-34.8**
16 STR	333	FRY	$\frac{7}{8}$	6 x 27	L-6410	29.8.61	36475	-44.9	-7.0	**-37.9**
17 STR	336	ALGOM	$\frac{7}{8}$	6 x 27	6-5370	6.9.61	36533	-13.4	-7.0	**-6.4**
18 STR	357	ALGOM	$\frac{7}{8}$	6 x 27	6-5371	16.2.62	37453	-22.4	-8.0	**-14.4**
19 STR	382	AUNOR	$\frac{7}{8}$	6 x 27	24290	5.3.64	40871	-11.5	-8.0	**-3.5**
20 STR	319	COCNR	1	6 x 27	8-4524	5.6.61	35959	-1.8	0.0	**-1.8**
21 STR	326	McLEOD	1	6 x 27	E-161	26.7.61	36272	-5.2	- 4.0	**-1.2**
22 STR	337	LEITCH	1	6 x 27	15784	8.9.61	36546	+2.3	0.0	**+2.3**
23 STR	355	GECO	1	6 x 27	6-5844	5.2.62		-2.3	-4.0	**+1.7**
24 STR	356	ALGOM	1	6 x 22	B-9461	16.2.62	37448	-6.8	-11.9	**+5.1**
25 STR	361	McINT	1	6 x 27	A-5750	19.3.62	37676	-2.2	-3.0	**+0.8**

¶¶: the authors were unable to verify the NDT% values, or establish the relevant test dates.

III(a) — Stranded Ropes (continued)

NDT Testing With The Rotesco AC Instrument¶¶

Item	Sp. Test#	Mine**	Size	Constr.	Reel#	MOL DT Date	MOL DT#	DT%§	NDT%¶	Error%*
26 STR	365	McLEOD	1	6 × 27	E-335	8.6.62		-14.7	-8.0	-6.7
27 STR	379	DNSN	1	6 × 27	6-2730	29.11.63		-5.8	-11.0	+5.2
28 STR	381	FLCN5	1	6 × 27	5-3414	20.2.64		-2.9	0.0	-2.9
29 STR	393	DNSN	1	6 × 27	K-5118	8.9.64	41651	-5.3	-7.0	+1.7
30 STR	394	WRGHT	1	6 × 27	9-4140	14.9.64	41676	-15.6	-8.0	-7.6
31 STR	418	UCM	1	6 × 27	E-3566	24.10.68		-35.5⋈	-25.0	-10.5
32 STR	436	WILLR	1	6 × 30	7236-1	6.11.73		-14.5	-20.0	+5.5
33 STR	272	AUNOR	1$\frac{1}{8}$	6 × 25	18755	15.10.59	32609	-23.1	-23.0	-0.1
34 STR	313	UCM	1$\frac{1}{8}$	6 × 27	J6906-1	6.3.61	35508	-18.3	-6.0	-12.3
35 STR	322	DLNT	1$\frac{1}{8}$	6 × 27	D-7825	15.6.61	36038	-6.7	-4.0	-2.7
36 STR	334	KAM	1$\frac{1}{8}$	6 × 27	9-1060	31.5.61	36497	-11.3	-6.5	-4.8
37 STR	335	KAM	1$\frac{1}{8}$	6 × 27	9-1061	14.7.61	36505	-4.6	-4.3	-0.3
38 STR	350	DICKN	1$\frac{1}{8}$	6 × 27	MH-151	18.12.61	37141	-20.7	-9.5	-11.2
39 STR	367	AUNOR	1$\frac{1}{8}$	6 × 27	28687	21.6.62	38097	+2.3	0.0	+2.3
40 STR	383	LAKE	1$\frac{1}{8}$	6 × 22	A-553	12.3.64	40902	-45.6	-15.0	-30.6
41 STR	391	HLLGR	1$\frac{1}{8}$	6 × 27	S3202-3	18.8.64	41572	-12.2	-14.0	+1.8
42 STR	398	INCO	1$\frac{1}{8}$	6 × 27	M-5732	18.11.64	41983	-19.8	-13.0	-6.8
43 STR	421	INCO4	1$\frac{1}{8}$	6 × 27	E4346-2	27.8.69	41312	-17.1	-3.5	-13.6
44 STR	437	DOME	1$\frac{1}{8}$	6 × 22	1979-2	18.1.74	53840	-1.8	-1.0	-0.8
45 STR	275	PAMR	1$\frac{1}{4}$	6 × 25	08373	13.1.60	33132	-12.8	-13.0	+0.2
46 STR	308	WRGHT	1$\frac{1}{4}$	6 × 27	6/2919	12.1.61	35224	-20.8	-8.0	-12.8
47 STR	339	PRSTN	1$\frac{1}{4}$	6 × 27	J3642	25.9.61	36629	-0.3	0.0	-0.3
48 STR	376	RIOA4	1$\frac{1}{4}$	6 × 27	Q8990-1	9.8.63	39993	-17.2	-10.0	-7.2
49 STR	406	KAM-K	1$\frac{1}{4}$	6 × 27	E2843	4.6.65		-11.1	-8.0	-3.1

¶¶: the authors were unable to locate the original reports to verify the NDT% values, and to establish the relevant test dates.

⋈: with sample cut 1800 ft from conveyance end of rope; another sample, from dead-end turns on drum, tested with a breaking strength loss of 65.4%!

III(a) — Stranded Ropes (continued)

NDT Testing With The Rotesco AC Instrument¶¶

Item	Sp. Test#	Mine**	Size	Constr.	Reel#	MOL DT Date	MOL DT#	DT%§	NDT%¶	Error%*
50 STR	408	PRSTN	$1\frac{1}{4}$	6 × 27	MH74488	16.7.65	42992	-9.0	-4.0	-5.0
51 STR	444	STPR	$1\frac{1}{4}$	6 × 30	I9023A2			+7.6	-4.5∇	+12.1
52 STR	345	CRL	$1\frac{3}{8}$	6 × 30	C1756	30.10.61	36837	-16.9	-9.0	-7.9
53 STR	372	FLCN6	$1\frac{3}{8}$	6 × 30	9-0192	24.9.62	38525	-17.6	-11.0	-6.6
54 STR	373	FLCN6	$1\frac{3}{8}$	6 × 30	9-0193	24.9.62	38530	-10.2	-7.0	-3.2
55 STR	374	CDNJM	$1\frac{3}{8}$	6 × 30	D3875	2.10.62	38570	-19.3	-12.0	-7.3
56 STR	390	PAMR	$1\frac{3}{8}$	6 × 30	31984	28.7.64	41496	-15.2	-14.0	-1.2
57 STR	309	HLLGR	$1\frac{1}{2}$	6 × 27	22235	19.1.61	35277	-30.7	-14.0	-16.7
58 STR	320	GECO	$1\frac{1}{2}$	6 × 32	6-5857	9.6.61	35993	-43.5	-10.0	-33.5
59 STR	321	GECO	$1\frac{1}{2}$	6 × 32	6-5853	6.6.61	36000	-15.5	-12.0	-3.5
60 STR	330	TECK	$1\frac{1}{2}$	6 × 27	18829	17.8.61	36392	-55.1	-15.0	-40.1
61 STR	341	HLLGR	$1\frac{1}{2}$	6 × 27	E3325	12.10.61	36737	-3.3	-7.0	+3.7
62 STR	371	McINT	$1\frac{1}{2}$	6 × 27	J-8411	14.9.62	38483	-38.1	—	—
63 STR	392	HLLGR	$1\frac{1}{2}$	6 × 27	0-5867A	31.8.64	41621	-7.6	-7.0	-0.6
64 STR	402	METM	$1\frac{1}{2}$	6 × 27	C2430	24.2.65	42376	-8.1	-7.3	-0.8
65 STR	331	TECK	$1\frac{5}{8}$	6 × 27	01-1332	18.8.61	36411	-49.5	-11.5	-38.0
66 STR	267	NRTHS	$1\frac{3}{4}$	6 × 30	7/0370	9.7.59	32104	-24.0	-24.0	0.0
67 STR	318	INCO4	$1\frac{3}{4}$	6 × 27	6-6008	19.4.61	35729	-24.2	-9.0	-15.2
68 STR	323	DNSN	$1\frac{3}{4}$	6 × 27	7-1695	13.7.61	36183	-13.5	-3.0	-10.5
69 STR	324	DNSN	$1\frac{3}{4}$	6 × 27	7-1692	13.7.61	36188	-20.8	-13.0	-7.8
70 STR	325	INCO	$1\frac{3}{4}$	6 × 27	D30495	20.7.61	36243	-2.0	0.0	-2.0
71 STR	327	INCO	$1\frac{3}{4}$	6 × 27	22657	1.8.61	36318	-8.7	-13.0	+4.3
72 STR	328	INCO	$1\frac{3}{4}$	6 × 27	15298	3.8.61	36339	-5.8	-12.0	+6.2
73 STR	342	INCO6	$1\frac{3}{4}$	6 × 25	1-2268E1	17.10.61	36760	-2.5	—	—
74 STR	343	INCO6	$1\frac{3}{4}$	6 × 25	1-2268E2	17.10.61	36763	-9.7	—	—
75 STR	359	FLCN	$1\frac{3}{4}$	6 × 25	5-5935	7.3.62	37549	-3.1	0.0	-3.1
76 STR	360	INCO4	$1\frac{3}{4}$	6 × 25	7-5508	15.3.62	37597	-27.7	-9.0	-18.7

¶¶: the authors were unable to verify the NDT% values, or establish the relevant test dates.

∇: tested on 17.2.78

III(a) — Stranded Ropes (continued)

NDT Testing With The Rotesco AC Instrument¶¶

Item	Sp. Test#	Mine**	Size	Constr.	Reel#	MOL DT Date	MOL DT#	DT%§	NDT%¶	Error%*
77 STR	362	INCO	$1\frac{3}{4}$	6 × 25	7-1693	30.4.62	37834	–3.5	0.0	**–3.5**
78 STR	363	INCO3	$1\frac{3}{4}$	6 × 25	07662	10.5.62	37877	–14.4	–12.0	**–2.4**
79 STR	364	INCO4	$1\frac{3}{4}$	6 × 27	6/6007	18.5.62	37920	–15.1	–12.0	**–3.1**
80 STR	368	CDNRS	$1\frac{3}{4}$	6 × 27	D7382	27.6.62	38130	–17.1	–7.0	**–10.1**
81 STR	369	DNSN	$1\frac{3}{4}$	6 × 27	M9901B1	10.7.62	38197	–7.4	–11.0	**+3.6**
82 STR	370	DNSN	$1\frac{3}{4}$	6 × 27	H1626-2	7.9.62	38452	–3.2	–0.9	**–2.3**
83 STR	375	INCO6	$1\frac{3}{4}$	6 × 27	14240	9.10.62	38596	+2.3	–2.0	**+4.3**
84 STR	384	INCO6	$1\frac{3}{4}$	6 × 27	9-5753	1.4.64		–8.7	–9.4	**+0.7**
85 STR	377	McINT	$1\frac{3}{4}$	6 × 27	9-5794	3.10.63		–29.3	–14.0	**–15.3**
86 STR	385	INCO	$1\frac{3}{4}$	6 × 27	B-2937	7.4.64	41005	–2.4	–10.0	**+7.6**
87 STR	388	INCO	$1\frac{3}{4}$	6 × 27	7-5510	13.5.64	41182	–14.4	–12.0	**–2.4**
88 STR	389	CDNRS	$1\frac{3}{4}$	6 × 27	E-782	12.6.64		–9.0	–5.0	**–4.0**
89 STR	404	FLCN	$1\frac{3}{4}$	6 × 27	A-2998	15.4.65	42576	–13.2	–10.0	**–3.2**
90 STR	416	INCO	$1\frac{3}{4}$	6 × 27	I5114-1	8.3.68	46804	–8.6	–12.0	**+3.4**
91 STR	425	McINT	$1\frac{3}{4}$	6 × 30	M-5778	23.7.70	49909	–2.9	–1.5	**–1.4**
92 STR	433	INCO4	$1\frac{3}{4}$	6 × 25	P2141-1	8.8.73	53420	–21.0	–13.0	**–8.0**
93 STR	397	INCO	$1\frac{7}{8}$	6 × 30	Q-7453	19.10.64	41852	–8.3	–6.0	**–2.3**
94 STR	340	INCO	2	6 × 30	J8917C1	27.7.61	36675	–21.0	–5.5	**–15.5**
95 STR	380	INCO	2	6 × 30	R2379-2	30.1.64	40699	–8.1	–10.0	**+1.9**
96 STR	311	INCO7	$2\frac{1}{16}$	6 × 30	6-6014	17.2.61	35421	–18.2	–15.0	**–3.2**
97 STR	312	INCO7	$2\frac{1}{16}$	6 × 27	6-6013	14.2.61	35398	–5.8	–14.0	**+8.2**
98 STR	338	INCO	$2\frac{1}{16}$	6 × 27	7-5507	15.9.61	36590	+3.4	–3.0	**+6.4**
99 STR	344	INCO3	$2\frac{1}{16}$	6 × 30	9-5754	24.10.61	36808	–4.5	–3.5	**–1.0**
100 STR	358	INCO7	$2\frac{1}{16}$	6 × 30	6-6015	2.3.62	37522	–13.2	–4.0	**–9.2**
101 STR	422	INCO	$2\frac{1}{16}$	6 × 30	I-6599	21.1.70	49214	–12.7	–5.0	**–7.2**
102 STR	424	INCO	$2\frac{1}{16}$	6 × 30	C-5399	8.4.70	49521	–11.7	–8.0	**–3.7**
103 STR	332	KAM	$2\frac{1}{8}$	6 × 27	8-703	25.8.61	36462	–13.9	–13.5	**–0.4**

¶¶: the authors were unable to verify the NDT% values, or establish the relevant test dates.

TABLE (C-3)

Analysis of Available Test Data: III(b) — Stranded Ropes NDT Testing with Different Types of Instruments

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
104 STR	459	AGNCO	29.3.78	12.1.80	$21\frac{1}{2}$	$\frac{3}{4}$	6 × 25	L-03084	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	9.10.79	−5.0	−16.6	7.2.80	—	−11.6
			MAGGR	Jan. 80	−9.0				−7.6

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
105 STR	505	INCO3‡	7.4.82	22.6.83	$14\frac{1}{2}$	$\frac{3}{4}$	6 × 30	14171	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	28.6.83	−4.0	−1.0	16.9.83	63670	+3.0

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
106 STR	499	Willroy Mines Ltd. — Macassa	24.10.79	6.11.82	$36\frac{1}{2}$	$\frac{7}{8}$	6 × 27	G-3473	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	16.10.82	−11.5	−18.9	5.4.83	63249	−7.4
			MAGGR	1.12.82	−15.2				−3.7

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
107 STR	516	Ron Bush (USA)				1	6 × 26		
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			ROTGR	22.10.85	−45.0	−68.3	30.10.85	65707	−23.3

III(b) — Stranded Ropes (continued)

NDT Testing with Different Types of Instruments

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
108 STR	463	WILLR	2.12.78	10.4.80	$17\frac{1}{2}$	$1\frac{1}{8}$	6 × 30	G-3543	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	9.4.80	-12.0	-32.4	7.8.80	60510	-20.4
			MAGGR	25.4.80	-11.0				-21.4

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
109 STR	477	KAM	11.7.79	18.9.81	26	$1\frac{1}{8}$	6 × 30	020588	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	10.9.81	-12.0	-16.0	9.12.81	61993	-4.0
			MAGGR	28.8.81	-19.6				+3.6

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
110 STR	487	RIOA	29.3.80	21.2.82	23	$1\frac{1}{8}$	6 × 30	033932	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	9.1.82	-3.6	-9.9	12.5.82	62605	-6.3
			MAGGR	21.2.82	-13.2				+3.3

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
111 STR	486	RIOA	30.3.80	21.2.82	23	$1\frac{1}{8}$	6 × 30	010321	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	9.1.82	-7.0	-18.6	10.6.82	62635	-11.6
			AC + DC	20.2.82	-12.0				-6.6

III(b) — Stranded Ropes (continued)

NDT Testing with Different Types of Instruments

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
112 STR	488	DOME	25.3.81	24.4.82	13	$1\frac{1}{8}$	6 × 30	156053	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	13.4.82	−7.0	−12.6	14.6.82	62631	−5.6
			MAGGR	24.4.82	−12.5				−0.1

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
113 STR	476	PAMR	16.12.77	15.10.81	46	$1\frac{1}{8}$	6 × 30	06081	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	10.8.81	−7.5	−22.4	9.12.81	62003	−14.9
			MAGGR	15.10.81	−15.8				−6.6

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
114 STR	475	Madawaska Mines Ltd. — Faraday Mine	13.4.80	9.8.81	16	$1\frac{1}{4}$	6 × 30	037650	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	8.9.81	−12.5	−16.8	10.9.81	61728	−4.3

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
115 STR	472	PAMR	6.6.78	17.7.80	$25\frac{1}{2}$	$1\frac{3}{8}$	6 × 30	020414	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	10.4.80	−7.0	−13.0	10.8.81	61664	−6.0
			MAGGR	27.8.80	−7.0				−6.0

III(b) — Stranded Ropes (continued)

NDT Testing with Different Types of Instruments

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
116 STR	—	PAMR	11.2.83	23.4.85	$26\frac{1}{2}$	$1\frac{3}{8}$	6 × 30	24005-2	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	18.4.85	-8.5	+0.6	20.3.85	65140	+9.1
			MAGGR	2.5.83	-1.0				+1.6

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
117 STR	481	PAMR	17.7.80	21.12.81	17	$1\frac{3}{8}$	6 × 30	056265	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	15.12.81	-15.0	-18.5	3.3.82	62232	-3.5
			MAGGR	21.12.81	-18.5				0.0

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
118 STR	—	PAMR	21.12.81	11.2.83	$13\frac{1}{2}$	$1\frac{3}{8}$	6 × 30	04237-2/#116	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	8.2.83	-11.5	0.0∞	14.1.81∞	60925∞	

∞: the authors were unable to locate any DT results, other than the original one

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
119 STR	—	PAMR	21.12.81	11.2.83	$13\frac{1}{2}$	$1\frac{3}{8}$	6 × 30	04237-2(#115)	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	11.2.83	-17.0	0.0∞	14.1.81∞	60924	

∞: the authors were unable to locate any DT results, other than the original one

III(b) — Stranded Ropes (continued)

NDT Testing with Different Types of Instruments

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
120 STR	—	PAMR	23.4.85	2.9.86	$16\frac{1}{2}$	$1\frac{3}{8}$	6 × 30	340650-1(#123)	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	27.8.86	−12.0	−22.6	8.10.86	66518	−10.6

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
121 STR	489	Campbell Red Lake— Campbell Mine	15.6.80	8.5.82	23	$1\frac{3}{8}$	6 × 30	052807	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	20.4.82	−7.0	−18.7	24.8.82	62713	−11.7
			MAGGR	8.5.82	−19.7				+1.0

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
122 STR	490	Campbell Red Lake— Campbell Mine	27.4.80	8.5.82	$24\frac{1}{2}$	$1\frac{3}{8}$	6 × 30	010546	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	20.4.82	−9.5	−16.5	25.8.82	62710	−7.0
			MAGGR	18.5.82	−15.0				−1.5

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
123 STR	470	INCO5‡	3.4.76	29.5.81	$61\frac{1}{2}$	$1\frac{1}{2}$	6 × 7	L-00221	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	26.2.81	−6.0	+0.9	7.8.81	61654	+6.9

III(b) — Stranded Ropes (continued)
NDT Testing with Different Types of Instruments

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
124 STR	480	FLCN	20.1.79	7.12.81	$22\frac{1}{2}$	$1\frac{1}{2}$	6 × 30	L-00263	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	26.10.81	0.0	–5.2	1.2.82	62138	–5.2

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
125 STR	493	RIOA2	26.6.80	13.2.82	20	$1\frac{1}{2}$	6 × 30	020566	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	25.8.82	–14.0	–21.7	16.9.82	62718	–7.7
			MAGGR	14.5.82	–23.0				+1.3

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
126 STR	461	INCO6‡	8.6.78	27.4.80	$22\frac{1}{2}$	$1\frac{3}{4}$	6 × 25	M-1427A	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	17.4.80	–9.9	–13.9	29.5.80	60267	–4.0
			MAGGR	—	–2.5				–11.4

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
127 STR	462	RIOA1	1.4.79	15.12.79	$8\frac{1}{2}$	$1\frac{3}{4}$	6 × 30	010525	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	8.11.79	–7.0	–19.9	30.5.80	60268	–12.9
			MAGGR	—	–12.0				–7.9

III(b) — Stranded Ropes (continued)

NDT Testing with Different Types of Instruments

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
			27.4.80	9.5.82	$12\frac{1}{2}$	$1\frac{3}{4}$	6 × 25	035144	
			Non-destructive Test			Destructive Test			
128 STR	469	INCO6‡	Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	23.4.81	-8.5	-8.9	13.8.81	61681	-0.4

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
			11.5.77	6.5.81	48	$1\frac{3}{4}$	6 × 7	L-046345	
			Non-destructive Test			Destructive Test			
129 STR	471	INCO‡	Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	24.4.81	-9.0	-21.4	6.8.81	61653	-12.4

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
			29.11.80	27.10.82	23	$1\frac{3}{4}$	6 × 25	020967	
			Non-destructive Test			Destructive Test			
130 STR	—	FLCN1	Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	28.10.82	-15.0	+2.6∇	17.6.82	62521∇	+17.6∇

∇: DT sample from conveyance end of the rope

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
			27.10.82	14.4.85	30	$1\frac{3}{4}$	6 × 25	020968	
			Non-destructive Test			Destructive Test			
131 STR	515	FLCN1	Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	16.2.85	-8.5	-41.8	3.9.85	65504	-33.3
			ROTGR	28.8.85	-36.0				-5.8

III(b) — Stranded Ropes (continued)

NDT Testing with Different Types of Instruments

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
132 STR	514	FLCN1	27.10.82	21.4.85	30	$1\frac{3}{4}$	6 × 25	04196-2	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	16.2.85	–9.5	–31.5	21.8.85	65481	–22.0
			ROTGR	16.8.85	–20.0				–11.5

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
133 STR	—	FLCN1	21.4.85	1.11.86	$18\frac{1}{2}$	$1\frac{3}{4}$	6 × 25	014087	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	19.10.86	–11.0	–6.3	4.12.86	66705	+4.7

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
134 STR	478	INCO‡	21.3.81	10.10.81	$7\frac{1}{2}$	$1\frac{3}{4}$	6 × 25	010191	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	14.9.81	–6.0	–12.0	10.12.81	61904	–6.0
			MAGGR	10.10.81	–12.5				+0.5

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
135 STR	482	INCO‡	2.5.81	27.2.82	$9\frac{1}{2}$	$1\frac{3}{4}$	6 × 25	010190	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	22.2.82	–9.5	–5.7	9.6.82	62617	+3.8
			MAGGR	26.2.82	–11.1				+5.4

III(b) — Stranded Ropes (continued)
NDT Testing with Different Types of Instruments

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
136 STR	491	RIOA1	14.11.81	27.6.82	$7\frac{1}{2}$	$1\frac{3}{4}$	6 × 30	04104-1	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	17.6.82	−6.5	−11.4	15.9.82	62701	−4.9
			MAGGR	25.6.82	−5.8				−5.6

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
137 STR	492	RIOA1	15.11.81	26.6.82	$7\frac{1}{2}$	$1\frac{3}{4}$	6 × 30	04104-2	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	17.6.82	−6.5	−16.5	6.10.82	62831	−10.0
			MAGGR	25.6.82	−11.3				−5.2

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
138 STR	510	St. Joe Resources (USA)	13.10.79	14.7.84	57	$1\frac{3}{4}$	6 × 30	—	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			ROTGR	17.10.84	−13.0	−8.1	8.11.84	64615	+4.9

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
139 STR	522	RIOA1	1.12.84	2.3.86	15	$1\frac{3}{4}$	6 × 30	343350/1	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	6.11.85	−8.5	−10.8▽	7.5.86	66113▽	−2.3▽

▽: thimble test; DT sample from conveyance end of the rope

III(b) — Stranded Ropes (continued)
NDT Testing with Different Types of Instruments

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
140 STR	—	FLCN7	16.3.80	18.6.83	39	$1\frac{13}{16}$	6 × 30	020571	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	18.2.83	−4.5	−26.3	16.9.83	63681	−21.8
			MAGGR	17.6.83	−32.0				+5.7

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
141 STR	523	INCO1‡	20.6.84	22.3.86	21	$1\frac{7}{8}$	6 × 30	020366	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	12.5.86	−15.0	−16.6	13.6.86	66240	−1.6

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
142 STR	483	INCO1‡	13.5.80	18.3.82	22	$2\frac{1}{16}$	6 × 30	010513	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	18.2.82	−8.0	−7.1	2.9.82	62627	+0.9
			MAGGR	18.3.82	−6.1				−1.0

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates On:	Dates Off:	Months in Use	Size (in.)	Constr.	Reel No.	
143 STR	484	INCO1‡	12.5.80	4.3.82	22	$2\frac{1}{16}$	6 × 30	010321	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	18.2.82	−9.0	−9.1	16.7.82	62621	−0.1
			MAGGR	18.3.82	−6.1				−3.0

III(b) — Stranded Ropes (continued)
NDT Testing with Different Types of Instruments

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
144 STR	502	BMS	11.5.81	18.2.83	21	$2\frac{1}{8}$	6 × 7	010342	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	5.11.82	-12.0	-6.6	17.6.83	63444	+5.4
			MAGGR	9.6.83	-3.7				-2.9
			MAGGR	11.11.82	-30.0				+23.4

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
145 STR	503	BMS	20.2.81	18.2.83	24	$2\frac{1}{8}$	6 × 7	020583A	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	5.11.82	-13.0	-4.4	25.5.83	63347	+8.6
			MAGGR	9.5.83	-26.8				+22.4
			MAGGR	11.11.82	-26.0				+21.6

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
146 STR	467	INCO4‡	17.7.79	9.3.81	20	$2\frac{3}{16}$	6 × 30	020006	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	9.3.81	-6.5	-11.7	10.6.81	61475	-5.2

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
147 STR	485	Kidd Creek Mines•	20.1.79	9.4.82•	$38\frac{1}{2}$	$2\frac{1}{4}$	6 × 7	010505	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	12.12.81	-4.5	-40.5	21.5.82	62609	-36.0

•: this rope's companion rope failed on 7.4.82

III(b) — Stranded Ropes (continued)
NDT Testing with Different Types of Instruments

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
148 STR	520	Internatl. Mining Corpn. (Canada) Ltd.				$2\frac{1}{4}$	6 × 30		
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC	—	—	-34.3	8.1.86	65881	
			ROTGR	30.12.85	-24.0				-10.3

Item	OMOL† Sp. Test#	Mine**	Rope Service Data			Rope Catalogue Data			Error%*
			Dates		Months in Use	Size (in.)	Constr.	Reel No.	
			On:	Off:					
149 STR	521	INCO4‡	10.3.84	23.11.85	$20\frac{1}{2}$	$2\frac{1}{4}$	6 × 30	140950	
			Non-destructive Test			Destructive Test			
			Instr.	Date	NDT(%)¶	DT(%)§	Date	OMOL#	
			AC‡	9.1.85	-3.0	-0.4	9.1.86	65884	+2.6
			ROTGR	23.11.85	-15.0				+14.6
			ROTGR	30.12.85	-17.0				+16.6

APPENDIX D

Listing of Canadian Mine Shaft Wire Ropes — as of December, 1987

Listing of Canadian Mine Shaft Wire Ropes
Section I — In Ontario

<u>Summary</u>

Altogether there are 479 mine shaft wire ropes, of which:

125 (26%) are Locked Coil ropes,

97 (20%) are Non Rotating ropes, and

257 (54%) are Stranded ropes.

TABLE (D-1)

Listing of Locked Coil Ropes

in use in Ontario — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Manuf. Date
On. 1 LC	PAMR	L038138	$\frac{5}{8}$	1 × 57	14.8.78	7.2.74	53893	48,850	—
On. 2 LC	SIFTO	343730-1	$\frac{11}{16}$	1 × 60	10.10.87	21.3.84	64164	60,400	29.2.84
On. 3 LC	DMTR	010139	$\frac{11}{16}$	1 × 60	4.10.83	14.4.76	56260	60,500	9.3.76
On. 4 LC	DMTR	010140	$\frac{11}{16}$	1 × 60	5.10.83	14.4.76	56260	60,500	19.3.76
On. 5 LC	DMTR	010138	$\frac{11}{16}$	1 × 60	5.10.83	14.3.76	56259	60,450	19.3.76
On. 6 LC	SIFTO	343740-2	$\frac{11}{16}$	1 × 60	10.10.87	21.3.84	64164	60,400	27.2.84
On. 7 LC	PAMR	020793	$\frac{3}{4}$	1 × 92	4.2.80	1.2.78	58082	73,000	6.1.78
On. 8 LC	PAMR	020794	$\frac{3}{4}$	1 × 92	5.2.80	1.2.78	58082	73,000	9.1.78
On. 9 LC	PAMR	020796	$\frac{3}{4}$	1 × 92	5.2.80	1.2.78	58083	74,100	10.1.78
On. 10 LC	PAMR	020795	$\frac{3}{4}$	1 × 92	6.2.80	1.2.78	58083	74,100	9.1.78
On. 11 LC	KCML	010272	$\frac{3}{4}$	1 × 92	5.2.86	18.9.79	59562	72,100	8.8.79
On. 12 LC	KCML	010273	$\frac{3}{4}$	1 × 92	6.2.86	18.9.79	59563	71,450	Aug., 79
On. 13 LC	NRDA	010137	$\frac{13}{16}$	1 × 87	17.8.83	1.6.76	56435	87,250	17.5.76
On. 14 LC	NRDA	546290-1	$\frac{13}{16}$	1 × 87	26.9.87	5.8.86	66359	88,900	8.7.86
On. 15 LC	NRDA	14074-2	$\frac{13}{16}$	1 × 87	20.8.83	24.9.81	61778	85,550	16.9.81
On. 16 LC	NRDA	344000-1	$\frac{13}{16}$	1 × 87	25.1.86	28.5.84	64215	89,500	21.3.84
On. 17 LC	NRDA	544390-1	$\frac{13}{16}$	1 × 87	24.10.87	15.1.86	65840	92,250	21.11.85
On. 18 LC	FLCN1	L029973	1.000	1 × 104	27.4.86	12.6.73	53231	133,550	15.5.73
On. 19 LC	FLCN1	L029972	1.000	1 × 104	11.1.87	12.6.73	53231	133,550	15.5.73
On. 20 LC	FLCN1	010246	1.000	1 × 104	19.2.86	18.9.79	59564	134,000	30.10.78
On. 21 LC	FLCN3	013992/93	1.000	1 × 104	5.3.83	29.4.77	57384	133,550	20.4.77
On. 22 LC	FLCN3	033723	1.000	1 × 104	19.3.83	20.2.80	60012	131,850	7.2.80
On. 23 LC	FLCN3	722510-2	1.000	1 × 105	24.10.87	10.11.87	67550	142,200	29.10.85
On. 24 LC	FLCN3	042830-1	1.000	1 × 105	16.11.85	25.6.85	65390	136,,000	3.6.85
On. 25 LC	FLCN3	644090-1	1.000	1 × 105	7.11.87	25.3.87	66953	143,300	10.2.87
On. 26 LC	FLCN3	042820-1	1.000	1 × 105	12.4.86	25.6.85	65389	135,600	3.5.85
On. 27 LC	FLCN3	042830-1	1.000	1 × 105	7.11.87	25.6.85	65390	136,000	June 85

TABLE (D-1) — (continued)

Listing of Locked Coil Ropes

in use in Ontario — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Manuf. Date
On. 28 LC	FLCN3	445830-1	1.000	1 × 104	15.9.85	26.2.85	65068	134,400	6.2.85
On. 29 LC	FLCN7	00051	1.000	1 × 105	3.3.75	29.8.74	54474	137,350	Sept., 74
On. 30 LC	FLCN7	00064	1.000	1 × 105	3.3.75	29.8.74	54475	137,500	Sept., 74
On. 31 LC	FLCN7	00082	1.000	1 × 105	3.3.75	29.8.74	54476	136,750	Sept., 74
On. 32 LC	FLCN7	00083	1.000	1 × 105	3.3.75	29.8.74	54477	136,800	Sept., 74
On. 33 LC	FLCN2	H9169M3	1.000	1 × 104	7.2.81	5.2.73	52767	135,150	Dec., 72
On. 34 LC	FLCN2	H9169M4	1.000	1 × 104	7.2.81	5.2.73	52768	135,150	Dec., 72
On. 35 LC	FLCN2	L11101	1.000	1 × 104	7.2.81	5.2.73	52767	135,450	Dec., 72
On. 36 LC	FLCN2	L11102	1.000	1 × 104	7.2.81	5.2.73	52767	135,450	Dec., 72
On. 37 LC	FLCN4	04291-1	1.020	1 × 106	29.2.84	7.1.82	62092	155,300	6.11.81
On. 38 LC	FLCN4	441210-1	1.020	1 × 106	24.4.87	13.11.85	65692	150,600	3.9.85
On. 39 LC	FLCN4	06253/63	1.020	1 × 106	28.4.85	12.5.75	55271	146,350	May, 75
On. 40 LC	FLCN4	L036401-2	1.020	1 × 106	25.2.84	17.6.74	54269	148,050	May, 74
On. 41 LC	FLCN1	020958	1.020	1 × 106	26.5.85	26.5.78	58321	149,250	1.5.78
On. 42 LC	FLCN11	L04214	$1\frac{1}{16}$	1 × 109	20.9.86	20.2.75	55017	153,000	Feb., 75
On. 43 LC	FLCN11	04175	$1\frac{1}{16}$	1 × 109	27.9.86	4.2.75	54963	152,000	Feb., 75
On. 44 LC	FLCN11	L04215	$1\frac{1}{16}$	1 × 109	20.9.86	20.2.75	55017	153,000	Feb., 75
On. 45 LC	FLCN11	04194	$1\frac{1}{16}$	1 × 109	27.9.86	4.2.75	54964	151,500	Feb., 75
On. 46 LC	INCO	04284-1	$1\frac{1}{16}$	1 × 176	27.4.85	13.3.81	61122	271,500	18.2.81
On. 47 LC	NRDA	L11133	$1\frac{1}{16}$	1 × 109	29.7.84	7.11.72	52517	151,500	Oct., 72
On. 48 LC	NRDA	L11136	$1\frac{1}{16}$	1 × 109	29.7.84	7.11.72	52518	149,300	Oct., 72
On. 49 LC	NRDA	L11134	$1\frac{1}{16}$	1 × 109	29.7.84	7.11.72	52517	151,500	Oct., 72
On. 50 LC	NRDA	L11135	$1\frac{1}{16}$	1 × 109	29.7.84	7.11.72	52518	149,300	Oct., 72
On. 51 LC	REDP	446430-1	$1\frac{1}{8}$	1 × 113	—	16.1.85	64930	178,500	—
On. 52 LC	FLCN	L4600-1A	$1\frac{1}{8}$	1 × 110	10.12.74	13.6.67	45803	164,100	June 67
On. 53 LC	FLCN	L4600-2A	$1\frac{1}{8}$	1 × 110	Dec., 74	13.6.67	45803	164,100	June 67
On. 54 LC	INCO1	020767	$1\frac{3}{16}$	1 × 136	19.10.85	6.3.78	58143	186,150	31.1.78

TABLE (D-1) — (continued)

Listing of Locked Coil Ropes

in use in Ontario — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Manuf. Date
On. 55 LC	INCO1	042030-1	$1\frac{3}{16}$	1 × 136	18.10.86	16.11.83	63882	191,500	4.11.83
On. 56 LC	INCO1	020769	$1\frac{3}{16}$	1 × 136	19.10.86	6.3.78	58144	186,350	14.2.78
On. 57 LC	INCO1	031807	$1\frac{3}{16}$	1 × 136	7.11.87	11.3.80	60057	190,300	1.2.80
On. 58 LC	INCO2	L11151/52	$1\frac{3}{16}$	1 × 136	17.7.78	23.3.72	51912	188,000	7.3.72
On. 59 LC	INCO2	L11157/58	$1\frac{3}{16}$	1 × 136	18.7.78	23.3.72	51915	187,600	30.9.70
On. 60 LC	INCO2	L11153/54	$1\frac{3}{16}$	1 × 136	17.7.78	23.3.72	51913	188,550	7.3.72
On. 61 LC	INCO2	013997	$1\frac{3}{16}$	1 × 136	11.5.85	18.5.77	57445	188,750	3.5.77
On. 62 LC	INCO5	545400-1	$1\frac{3}{16}$	1 × 136	29.10.87	20.11.86	66628	188,700	27.10.86
On. 63 LC	INCO5	545390-1	$1\frac{3}{16}$	1 × 136	29.10.87	20.11.86	66620	188,700	28.10.86
On. 64 LC	INCO5	L039410	$1\frac{3}{16}$	1 × 136	26.10.87	10.4.74	54094	183,500	March 74
On. 65 LC	FLCN1	L036336	$1\frac{5}{16}$	1 × 144	15.2.81	23.5.74	54225	231,150	May, 74
On. 66 LC	FLCN1	04288-1	$1\frac{5}{16}$	1 × 144	2.3.86	3.6.81	61398	244,750	8.5.81
On. 67 LC	NRDA	04153	$1\frac{5}{16}$	1 × 144	26.6.84	13.5.81	61342	220,000	21.4.81
On. 68 LC	NRDA	04154	$1\frac{5}{16}$	1 × 144	15.10.84	13.5.81	61341	219,500	21.4.81
On. 69 LC	NRDA	M241460	$1\frac{5}{16}$	1 × 144	17.10.84	29.9.82	62769	217,000	26.8.82
On. 70 LC	NRDA	013979	$1\frac{5}{16}$	1 × 144	10.10.84	30.3.77	57292	225,000	16.3.77
On. 71 LC	FLCN2	L021497	$1\frac{3}{8}$	1 × 176	6.2.82	8.3.73	52877	267,200	2.8.72
On. 72 LC	FLCN2	L021497	$1\frac{3}{8}$	1 × 176	6.2.82	8.3.73	52877	267,200	2.8.72
On. 73 LC	INCO	04284-2	$1\frac{7}{16}$	1 × 176	28.4.85	13.3.81	61123	272,000	18.2.81
On. 74 LC	INCO	540150-2	$1\frac{7}{16}$	1 × 176	7.9.86	15.11.86	65695	272,000	18.9.85
On. 75 LC	INCO2	L11173	$1\frac{7}{16}$	1 × 176	9.6.79	29.5.72	52126	262,600	May 72
On. 76 LC	INCO2	L11177	$1\frac{7}{16}$	1 × 176	10.6.73	5.6.72	52140	262,400	May 72
On. 77 LC	INCO2	L11172	$1\frac{7}{16}$	1 × 176	12.6.79	29.5.72	52126	262,600	May 72
On. 78 LC	INCO	540150-1	$1\frac{7}{16}$	1 × 176	2.2.86	31.10.85	65595	276,000	20.9.85
On. 79 LC	NRDA	020771	$1\frac{7}{16}$	1 × 176	19.8.84	6.4.78	58196	266,550	6.3.78
On. 80 LC	NRDA	020966	$1\frac{7}{16}$	1 × 176	10.8.84	26.5.84	58329	266,150	15.3.78
On. 81 LC	NRDA	020772	$1\frac{7}{16}$	1 × 176	19.8.84	6.4.78	58197	265,350	6.3.78

TABLE (D-1) — (continued)

Listing of Locked Coil Ropes

in use in Ontario — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Manuf. Date
On. 82 LC	NRDA	020965	$1\frac{7}{16}$	1 × 176	19.8.84	14.4.78	58222	265,050	15.3.78
On. 83 LC	SIFTO	C5304	$1\frac{1}{2}$	1 × 35	Apr. 68	30.8.67	46075	182,900	16.8.67
On. 84 LC	SIFTO	C5391	$1\frac{1}{2}$	1 × 35	Apr. 68	30.8.67	46074	183,000	16.8.67
On. 85 LC	SIFTO	C5396	$1\frac{1}{2}$	1 × 35	Apr. 68	30.8.67	46076	183,550	17.8.67
On. 86 LC	SIFTO	C5395	$1\frac{1}{2}$	1 × 35	Apr. 68	30.8.67	46076	183,550	17.8.67
On. 87 LC	SIFTO	020685	$1\frac{1}{2}$	1 × 35	10.4.80	17.1.78	58045	180,000	16.12.77
On. 88 LC	SIFTO	C5393	$1\frac{1}{2}$	1 × 35	Apr. 68	30.8.67	46075	182,900	16.8.67
On. 89 LC	FLCN11	544710-1	1.515	1 × 182	16.4.87	24.1.86	65907	314,000	20.12.85
On. 90 LC	KCML	052606	1.515	1 × 182	20.9.85	17.9.80	60585	308,000	23.8.80
On. 91 LC	KCML	052604	1.515	1 × 182	19.9.85	9.9.80	60563	307,100	23.8.80
On. 92 LC	KCML	052605	1.515	1 × 182	26.6.85	17.9.80	60586	307,600	23.8.80
On. 93 LC	FLCN11	244130-1	1.515	1 × 182	9.5.87	11.7.84	64417	314,000	28.5.84
On. 94 LC	FLCN11	244130-2	1.515	1 × 182	9.5.87	11.7.84	64418	314,000	28.5.84
On. 95 LC	FLCN11	244130-3	1.515	1 × 182	9.5.87	17.7.84	64419	315,000	24.5.84
On. 96 LC	KCML	010244	1.515	1 × 182	3.11.82	23.11.78	58787	317,650	30.10.78
On. 97 LC	KCML	010294	1.515	1 × 182	18.8.82	6.4.79	59093	320,000	—
On. 98 LC	KCML	010245	1.515	1 × 182	29.10.82	23.11.78	58788	318,750	30.10.78
On. 99 LC	KCML	010243	1.515	1 × 182	10.5.84	23.11.78	58786	323,150	23.10.78
On. 100 LC	KCML	010293	1.515	1 × 182	10.5.84	6.4.79	59092	315,650	28.2.79
On. 101 LC	KCML	010295	1.515	1 × 182	10.5.84	6.4.79	59094	318,750	26.2.79
On. 102 LC	TCC	L08242	$1\frac{3}{4}$	1 × 37	23.2.72	22.11.71	51517	296,100	8.11.71
On. 103 LC	TCC	L08248	$1\frac{3}{4}$	1 × 37	22.2.72	22.11.71	51520	285,500	8.11.71
On. 104 LC	TCC	L08244	$1\frac{3}{4}$	1 × 37	20.2.72	22.11.71	51518	286,150	8.11.71
On. 105 LC	TCC	L08252	$1\frac{3}{4}$	1 × 37	21.2.72	22.11.71	51522	282,800	8.11.71
On. 106 LC	TCC	L08250	$1\frac{3}{4}$	1 × 37	17.2.72	22.11.71	51521	286,200	8.11.71
On. 107 LC	TCC	L08243	$1\frac{3}{4}$	1 × 37	6.2.72	22.11.71	51517	296,100	8.11.71
On. 108 LC	TCC	L08251	$1\frac{3}{4}$	1 × 37	17.2.72	22.11.71	51521	286,200	8.11.71

TABLE (D-1) — (continued)

Listing of Locked Coil Ropes

in use in Ontario — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Manuf. Date
On. 109 LC	TGC	L08249	$1\frac{3}{4}$	1 × 37	18.2.72	22.11.71	51519	286,000	8.11.71
On. 110 LC	TGC	L08247	$1\frac{3}{4}$	1 × 37	18.2.72	22.11.71	51520	285,500	8.11.71
On. 111 LC	TGC	L08246	$1\frac{3}{4}$	1 × 37	19.2.72	22.11.71	51519	286,000	8.11.71
On. 112 LC	TGC	L08245	$1\frac{3}{4}$	1 × 37	20.2.72	22.11.72	51518	286,150	8.11.71
On. 113 LC	TGC	L08253	$1\frac{3}{4}$	1 × 37	22.2.72	8.12.71	51584	289,100	1.11.71
On. 114 LC	FLCN2	H9169E1	$1\frac{3}{4}$	1 × 33	22.11.66	9.3.66	43903	259,200	11.2.66
On. 115 LC	FLCN2	H9169E2	$1\frac{3}{4}$	1 × 33	22.11.66	9.3.66	43903	259,200	11.2.66
On. 116 LC	FLCN2	F9622	$1\frac{3}{4}$	1 × 33	3.11.67	2.6.67	45763	246,150	Jan., 67
On. 117 LC	FLCN2	F9623	$1\frac{3}{4}$	1 × 33	3.11.67	2.6.67	45764	257,350	Jan., 67
On. 118 LC	FLCN2	F9619	$1\frac{3}{4}$	1 × 33	3.11.67	2.6.67	45757	250,500	Oct., 66
On. 119 LC	FLCN2	F9617	$1\frac{3}{4}$	1 × 33	3.11.67	2.6.67	45758	252,100	Oct., 66
On. 120 LC	FLCN2	9618	$1\frac{3}{4}$	1 × 33	3.11.67	2.6.67	45759	251,350	Oct., 66
On. 121 LC	FLCN2	H9169L6	$1\frac{3}{4}$	1 × 33	3.11.67	27.6.67	45760	252,000	Nov., 66
On. 122 LC	FLCN2	F9614	$1\frac{3}{4}$	1 × 33	3.11.67	2.6.67	45755	250,650	Oct., 66
On. 123 LC	FLCN2	F9613	$1\frac{3}{4}$	1 × 33	3.11.67	2.6.67	45754	250,150	Oct., 66
On. 124 LC	FLCN7	902033D1	2.000	1 × 37	3.3.75	30.8.74	54485	346,000	Sept., 74
On. 125 LC	FLCN7	902033D2	2.000	1 × 37	3.3.75	30.8.74	54485	346,000	Sept., 74

TABLE (D-2)

Listing of Non Rotating Ropes
in use in Ontario — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Manuf. Date
On. 1 NR	WESTR	510700-1	$\frac{5}{8}$	18 × 7	11.10.85	5.11.85	65646	36,800	3.7.85
On. 2 NR	TECK	032643A	$\frac{3}{4}$	18 × 7	26.11.77	5.6.75	55380	53,250	10.3.74
On. 3 NR	DOME	11029-1	$\frac{3}{4}$	18 × 7	21.3.86	3.12.81	61980	50,800	23.8.81
On. 4 NR	CTLC	511240-3	$\frac{3}{4}$	18 × 7	26.9.86	5.11.86	65671	49,900	—
On. 5 NR	KCML	031364	$\frac{7}{8}$	18 × 7	21.6.84	28.3.79	59081	62,100	23.1.79
On. 6 NR	KCML	031363	$\frac{7}{8}$	18 × 7	9.9.85	28.3.79	59080	61,350	23.1.79
On. 7 NR	KCML	446000-1	$\frac{7}{8}$	18 × 7	20.12.85	17.1.86	65837	63,350	6.11.85
On. 8 NR	DYNTC	311090-1	$\frac{7}{8}$	18 × 7	28.9.83	18.8.83	63597	73,900	16.6.83
On. 9 NR	ECO	058045	$\frac{7}{8}$	18 × 7	9.9.80	23.9.80	60603	67,900	9.9.80
On. 10 NR	DYNTC	5-1154A	$\frac{7}{8}$	19 × 7	23.2.86	21.2.86	65969	66,600	3.12.85
On. 11 NR	CDNRS	L021625	$\frac{7}{8}$	34 × 7	15.2.73	5.2.73	52765	72,750	Jan., 73
On. 12 NR	GOLDL	312652-2	$\frac{7}{8}$	18 × 7	8.3.84	1.12.83	63939	64,950	1.11.82
On. 13 NR	GOLDL	312652-1	$\frac{7}{8}$	18 × 7	9.3.84	1.12.83	63938	65,100	1.11.83
On. 14 NR	HCR	7-142-1	$\frac{7}{8}$	18 × 7	15.3.87	2.3.87	66929	75,100	Jan., 87
On. 15 NR	REDP	344350	$\frac{7}{8}$	18 × 7	18.2.84	26.1.84	64056	87,400	—
On. 16 NR	REDP	E1-504	$\frac{7}{8}$	19 × 7	27.9.85	4.1.80	59855	76,400	3.4.76
On. 17 NR	REDP	1-9560	$\frac{7}{8}$	18 × 7	Nov., 85	10.12.85	65795	62,000	27.1.82
On. 18 NR	REDP	3575-55	$\frac{7}{8}$	19 × 7	30.9.87	14.7.87	67258	70,500	24.7.87
On. 19 NR	REDP	3575-55	$\frac{7}{8}$	19 × 7	30.9.87	14.7.87	67258	70,500	24.7.87
On. 20 NR	FRML	G5461	$\frac{7}{8}$	19 × 7	2.5.86	16.1.86	65871	76,450	—
On. 21 NR	FRML	G5463	$\frac{7}{8}$	19 × 7	9.6.86	16.5.86	66162	73,350	—
On. 22 NR	FRML	P8780	$\frac{7}{8}$	40 × 7	10.12.85	4.12.85	65806	104,000	—
On. 23 NR	ROSSF	410010-1	1.000	18 × 7	13.9.84	19.9.84	64624	94,000	6.9.84
On. 24 NR	LACM	441660-1	1.000	18 × 7	22.6.84	7.6.84	64360	101,500	18.5.84
On. 25 NR	LACM	341130-2	1.000	18 × 7	20.4.83	28.4.83	63305	100,000	13.4.83
On. 26 NR	PHC	443780-1	1.000	18 × 7	4.1.85	16.11.84	64799	100,000	23.10.84
On. 27 NR	PHC	443780-2	1.000	18 × 7	5.1.85	16.11.84	64790	100,000	23.10.84

TABLE (D-2) — (continued)

Listing of Non Rotating Ropes

in use in Ontario — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Manuf. Date
On. 28 NR	REDP	000624	1.000	19 × 7	23.9.87	20.8.87	67358	101,250	14.8.87
On. 29 NR	RENB	4-1027B	1.000	18 × 7	28.3.86	15.1.85	64947	116,000	Nov., 84
On. 30 NR	ROSSF	411950-1	1.000	18 × 7	4.10.84	16.10.84	64685	99,000	19.9.84
On. 31 NR	MATB	341490-1	$1\frac{1}{8}$	18 × 7	—	3.6.83	63398	119,300	—
On. 32 NR	TECKC	24128-1-2	$1\frac{1}{8}$	18 × 7	15.7.86	21.5.82	62414	123,500	Apr. 82
On. 33 NR	CRL	444720-1	$1\frac{1}{8}$	18 × 7	16.8.86	30.11.84	64864	122,000	20.11.84
On. 34 NR	FLCN1	04192	$1\frac{3}{16}$	34 × 7	7.3.83	28.8.81	61700	110,250	Aug., 81
On. 35 NR	FLCN1	L021225	$1\frac{7}{32}$	34 × 7	21.12.85	3.1.73	52672	115,400	Dec., 72
On. 36 NR	FLCN1	033972	$1\frac{7}{32}$	34 × 7	18.1.86	4.1.80	59863	116,850	Dec., 79
On. 37 NR	FLCN1	040860-2	$1\frac{7}{32}$	34 × 7	6.7.86	2.2.84	64065	113,000	10.1.84
On. 38 NR	FLCN3	052608	$1\frac{7}{32}$	34 × 7	11.4.81	3.3.81	61078	111,000	Apr., 80
On. 39 NR	FLCN3	6-1122-2	$1\frac{7}{32}$	34 × 7	11.7.87	30.1.87	66795	110,600	Nov., 86
On. 40 NR	FLCN3	052607	$1\frac{7}{32}$	34 × 7	15.10.83	3.3.81	61077	114,100	4.9.80
On. 41 NR	FLCN3	5-473A	$1\frac{7}{32}$	34 × 7	21.6.86	20.6.85	65368	112,000	Apr., 85
On. 42 NR	FLCN3	6-1122-1	$1\frac{7}{32}$	34 × 7	5.2.87	30.1.87	66794	117,200	Nov., 86
On. 43 NR	FLCN3	044060-2	$1\frac{7}{32}$	34 × 7	10.7.87	16.9.86	66428	106,000	27.8.86
On. 44 NR	FLCN3	5-473B	$1\frac{7}{32}$	34 × 7	13.8.86	18.6.85	65367	109,200	Apr., 85
On. 45 NR	FLCN3	040860-1	$1\frac{7}{32}$	34 × 7	13.8.86	2.2.84	64064	110,800	10.1.86
On. 46 NR	CDNS	340060-1	$1\frac{1}{4}$	34 × 7	28.10.85	14.6.83	63406	129,800	31.5.83
On. 47 NR	PAMR	052642	$1\frac{1}{4}$	34 × 7	16.4.84	30.10.80	60708	144,900	10.10.80
On. 48 N SR	ALGOM	051305	1.35	34 × 7	20.6.82	2.5.80	60176	136,000	9.4.80
On. 49 NR	DMTR	546710-1	$1\frac{3}{8}$	34 × 7	22.7.86	26.5.86	66179	142,200	2.5.86
On. 50 NR	PAMR	052643	$1\frac{1}{4}$	34 × 7	29.4.81	30.8.80	60709	131,900	16.10.80
On. 51 NR	NRDA	14469-1	$1\frac{3}{8}$	34 × 7	24.5.86	29.3.82	62259	150,500	23.2.82
On. 52 NR	NRDA	14076	$1\frac{3}{8}$	34 × 7	15.5.84	26.8.81	61694	164,400	27.7.81
On. 53 NR	INCO1	041890-2	$1\frac{3}{8}$	34 × 7	20.11.85	2.5.85	65251	150,800	18.4.85
On. 54 NR	INCO1	041890-1	$1\frac{3}{8}$	34 × 7	20.11.85	2.5.85	65250	149,000	18.4.85

TABLE (D-2) — (continued)

Listing of Non Rotating Ropes in use in Ontario — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Manuf. Date
On. 55 NR	INCO1	540820-1	$1\frac{3}{8}$	34 × 7	21.11.85	13.8.85	65427	147,000	19.6.85
On. 56 NR	INCO1	540820-2	$1\frac{3}{8}$	34 × 7	22.11.85	9.8.85	65428	150,000	19.6.85
On. 57 NR	NRDA	14459-1	$1\frac{1}{2}$	34 × 7	31.10.86	15.7.82	62531	174,500	6.1.82
On. 58 NR	NRDA	14459-4	$1\frac{1}{2}$	34 × 7	18.10.85	16.3.82	62198	175,000	6.1.82
On. 59 NR	DETL	441920-3	$1\frac{1}{2}$	18 × 7	29.7.87	22.8.84	64512	228,500	4.7.84
On. 60 NR	DETL	642480-1	$1\frac{1}{2}$	18 × 7	7.9.87	4.11.86	66581	229,000	17.10.86
On. 61 NR	LACM	013822	$1\frac{1}{2}$	34 × 7	31.5.83	6.1.77	57031	229,050	5.11.77
On. 62 NR	NRDA	04168-1	$1\frac{1}{2}$	34 × 7	1.10.81	23.4.81	61256	166,000	17.3.81
On. 63 NR	NRDA	04258-1	$1\frac{1}{2}$	34 × 7	20.1.82	10.3.81	61114	175,000	22.12.80
On. 64 NR	FLCN2	P6704-1	$1\frac{5}{8}$	34 × 7	5.2.78	23.7.69	48545	232,650	19.6.69
On. 65 NR	FLCN2	P6704-2	$1\frac{5}{8}$	34 × 7	5.2.78	23.7.69	48545	232,650	19.6.69
On. 66 NR	FLCN2	242680-1	$1\frac{5}{8}$	34 × 7	16.3.86	15.11.85	65688	218,100	14.10.85
On. 67 NR	FLCN2	L020697	$1\frac{5}{8}$	34 × 7	16.3.86	24.2.78	58127	232,550	9.4.73
On. 68 NR	FLCN2	033438	$1\frac{5}{8}$	34 × 7	30.1.82	4.6.79	59265	223,450	5.5.79
On. 69 NR	FLCN2	033527	$1\frac{5}{8}$	34 × 7	16.3.86	2.10.79	59610	222,000	Sept., 79
On. 70 NR	INCO2	242090-1	$1\frac{5}{8}$	18 × 7	17.4.85	1.9.83	63591	230,500	7.7.83
On. 71 NR	INCO2	020990	$1\frac{5}{8}$	18 × 7	21.5.82	30.5.77	57468	220,150	21.4.77
On. 72 NR	INCO2	020991	$1\frac{5}{8}$	18 × 7	6.2.81	30.5.77	57469	222,450	21.4.77
On. 73 NR	INCO2	04198-2	$1\frac{5}{8}$	18 × 7	12.4.85	22.4.81	61262	216,750	20.3.81
On. 74 NR	INCO2	04198-1	$1\frac{5}{8}$	18 × 7	28.5.82	22.4.81	61261	216,800	20.3.81
On. 75 NR	INCO2	033533	$1\frac{5}{8}$	18 × 7	7.2.81	4.9.79	59565	217,150	19.8.79
On. 76 NR	FLCN7	00104	1.67	34 × 7	3.3.75	11.10.74	54628	240,300	Sept., 74
On. 77 NR	FLCN7	00084	1.67	34 × 7	3.3.75	11.10.74	54627	242,200	Sept., 74
On. 78 NR	NRDA	04437-1	$1\frac{11}{16}$	34 × 7	2.6.82	16.6.81	61426	261,750	27.5.81
On. 79 NR	NRDA	24218-1	$1\frac{11}{16}$	34 × 7	5.9.84	14.9.82	62757	253,000	23.8.82
On. 80 NR	NRDA	14078-2	$1\frac{11}{16}$	34 × 7	9.5.87	13.7.81	61583	231,600	17.6.81
On. 81 NR	NRDA	M243850-1	$1\frac{11}{16}$	34 × 7	10.10.87	16.2.83	63115	219,500	10.1.83

TABLE (D-2) — (continued)

Listing of Non Rotating Ropes

in use in Ontario — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Manuf. Date
On. 82 NR	NRDA	643080-1	$1\frac{11}{16}$	34 × 7	17.10.87	3.11.86	66586	227,500	16.10.86
On. 83 NR	NRDA	14078-1	$1\frac{11}{16}$	34 × 7	17.6.86	13.6.81	61582	237,500	17.6.81
On. 84 NR	RIOA1	786	$1\frac{3}{4}$	34 × 7	23.8.87	1.11.85	65631	283,000	30.9.85
On. 85 NR	KCML	14040-4	$1\frac{3}{4}$	34 × 7	10.1.85	6.6.81	61455	281,600	May 81
On. 86 NR	KCML	14040-1	$1\frac{3}{4}$	34 × 7	2.5.85	9.6.81	61458	281,600	May 81
On. 87 NR	FLCN11	440460-2	$1\frac{3}{4}$	34 × 7	24.1.87	16.11.84	64788	267,500	3.6.84
On. 88 NR	14040-2	14040-2	$1\frac{3}{4}$	34 × 7	21.1.87	21.6.81	61457	283,100	13.5.81
On. 89 NR	TGC	020715	$1\frac{3}{4}$	34 × 7	28.12.78	16.9.77	57731	255,000	8.8.77
On. 90 NR	FLCN11	031382	$1\frac{3}{4}$	34 × 7	8.4.87	1.2.79	58044	248,650	27.12.78
On. 91 NR	KCML	031378	$1\frac{3}{4}$	34 × 7	5.10.85	1.2.79	58043	260,100	3.1.79
On. 92 NR	KCML	052630	$1\frac{3}{4}$	34 × 7	14.12.83	60734	60734	291,000	21.10.80
On. 93 NR	KCML	052638	$1\frac{3}{4}$	34 × 7	15.12.83	5.11.80	60735	281,750	21.10.80
On. 94 NR	KCML	440780-1	$2\frac{1}{4}$	18 × 7	29.12.84	17.7.84	64421	360,000	May 84
On. 95 NR	KCML	440780-4	$2\frac{1}{4}$	18 × 7	30.12.84	26.10.84	64686	360,000	June 84
On. 96 NR	KCML	440780-2	$2\frac{1}{4}$	18 × 7	10.12.84	17.7.84	64422	358,000	May 84
On. 97 NR	KCML	440780-3	$2\frac{1}{4}$	18 × 7	11.12.84	16.10.84	64687	357,500	June 84

TABLE (D-3)

Listing of Stranded Ropes

in use in Ontario — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Manuf. date
On. 1 SR	CDNS	G4544	$\frac{5}{8}$	6 × 27	20.7.84	28.5.79	59239	38,550	Apr., 79
On. 2 SR	CDNS	G4546	$\frac{5}{8}$	6 × 27	20.7.84	28.5.79	59241	37,650	Apr., 79
On. 3 SR	CDNS	G4547	$\frac{5}{8}$	6 × 27	20.7.84	28.5.79	59242	39,500	Apr., 79
On. 4 SR	CDNS	G4545	$\frac{5}{8}$	6 × 27	20.7.84	5.5.79	59240	38,950	Apr., 79
On. 5 SR	CTLC	413610-5	$\frac{5}{8}$	6 × 25	5.8.87	2.5.85	65253	35,000	—
On. 6 SR	PAMR	L030664	$\frac{3}{4}$	6 × 25	12.11.73	21.8.73	53450	50,700	30.8.70
On. 7 SR	PAMR	14097-1	$\frac{3}{4}$	12 str.*	19.3.87	31.8.81	61706	64,000	11.8.81
On. 8 SR	PHC	—	$\frac{3}{4}$	6 × 19	29.11.84	12.3.85	65116	60,400	—
On. 9 SR	JRI	11215-3	$\frac{3}{4}$	6 × 36	10.6.86	25.3.82	62243	50,000	1981
On. 10 SR	WILLAR	G5450	$\frac{3}{4}$	6 × 27	7.10.81	8.2.81	60980	59,600	5.9.80
On. 11 SR	MURG	061780	$\frac{3}{4}$	6 × 25	15.4.81	23.3.81	61149	58,600	10.2.81
On. 12 SR	WILLAR	G5451	$\frac{3}{4}$	6 × 27	7.10.81	8.2.81	60980	59,600	5.9.80
On. 13 SR	AGNCO	G5454	$\frac{3}{4}$	6 × 27	5.8.82	25.3.82	62242	60,300	26.2.82
On. 14 SR	AGNCO	L03214	$\frac{3}{4}$	6 × 25	15.2.87	12.12.74	54820	52,000	Nov. 74
On. 15 SR	AGNCO	214210-1	$\frac{3}{4}$	6 × 25	31.7.84	18.7.83	63522	63,300	23.2.83
On. 16 SR	CNDKA	6-105	$\frac{3}{4}$	6 × 26	6.2.86	6.2.86	65945	60,000	Jan. 86
On. 17 SR	CNDKA	137	$\frac{3}{4}$	6 × 26	16.11.76	14.5.74	54190	57,750	—
On. 18 SR	CNDKA	L038159	$\frac{3}{4}$	6 × 25	17.10.79	15.2.74	53926	52,500	25.5.73
On. 19 SR	CNDKA	E7500	$\frac{3}{4}$	6 × 25	Aug., 78	7.8.74	54425	52,300	1969
On. 20 SR	CDNCG	025096	$\frac{3}{4}$	6 × 25	May, 78	3.2.78	58090	51,450	17.2.78
On. 21 SR	INCO1	341910-1	$\frac{3}{4}$	12 str.*	6.1.84	1.9.83	63592	61,000	6.7.83
On. 22 SR	EMLR	6-808	$\frac{3}{4}$	6 × 26	Nov. 86	5.11.86	66599	62,400	Aug. 86
On. 23 SR	INCO3	447430-1	$\frac{3}{4}$	6 × 30	10.11.87	1.2.85	64981	63,000	21.12.84
On. 24 SR	INCO	447420-1A	$\frac{3}{4}$	12 str.*	19.5.87	1.2.85	64976	59,000	4.1.85
On. 25 SR	JFR	1650B	$\frac{3}{4}$	6 × 36	20.10.76	20.10.76	56810	53,100	—
On. 26 SR	JFR	610960-1	$\frac{3}{4}$	6 × 25	28.4.87	29.4.87	67070	64,300	29.4.87
On. 27 SR	CITCM	039091	$\frac{7}{8}$	6 × 30	2.11.86	17.9.74	54520	83,000	17.9.74

***: 12 strands, composed of 6×16 outer strands, and 6×10 inner strands**

TABLE (D-3) — (continued)

Listing of Stranded Ropes

in use in Ontario — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Manuf. Date
On. 28 SR	LACM	644230-1	7/8	6 × 30	6.4.87	6.2.87	66843	97,400	12.1.87
On. 29 SR	FLCN11	641930-1	7/8	6 × 30	12.8.86	6.8.86	66356	80,250	9.6.86
On. 30 SR	PAMR	020012	7/8	6 × 30	12.3.83	28.3.79	59085	81,900	5.8.79
On. 31 SR	CITGM	030090	7/8	6 × 30	2.11.86	17.9.74	54520	83,000	23.9.74
On. 32 SR	ECO	062082	7/8	6 × 25	10.4.81	23.4.81	61258	87,400	1.12.80
On. 33 SR	GETTY	059160	7/8	6 × 25	18.6.82	17.10.80	60652	81,700	—
On. 34 SR	GETTY	059161	7/8	6 × 25	18.6.82	17.10.80	60652	81,700	—
On. 35 SR	INCO	010685	7/8	6 × 19	27.9.84	14.4.78	58224	73,600	17.3.78
On. 36 SR	LACM	020361	7/8	6 × 30	16.9.80	12.3.80	60074	83,000	20.2.80
On. 37 SR	LACM	M242870-1	7/8	6 × 30	6.11.82	3.11.82	62874	82,400	—
On. 38 SR	ALGOM	340220-1	1.000	6 × 25	1.12.85	13.7.83	63518	100,500	6.6.83
On. 39 SR	NRDA	046743	1.000	6 × 30	19.3.80	16.12.75	55847	110,000	12.11.75
On. 40 SR	PAMR	C2512	1.000	6 × 25	May 68	27.3.62	37658	84,250	19.3.62
On. 41 SR	PAMR	020462	1.000	6 × 25	26.10.80	11.12.78	58824	91,950	15.11.78
On. 42 SR	PAMR	020463	1.000	6 × 25	26.10.80	11.12.78	58825	91,550	15.11.78
On. 43 SR	LACM	541290-1-1	1.000	6 × 30	11.7.86	22.8.85	65455	104,000	5.7.85
On. 44 SR	LACM	643220-1	1.000	6 × 30	27.11.86	11.12.86	66693	110,400	—
On. 45 SR	LACM	511490-1	1.000	6 × 30	18.11.86	30.1.86	65922	106,350	2.7.85
On. 46 SR	LACM	511490-1	1.000	6 × 30	12.8.87	30.1.86	65922	106,350	5.7.85
On. 47 SR	McFIN	411820-1	1.000	6 × 30	—	17.10.84	64690	109,800	—
On. 48 SR	McFIN	314230-1	1.000	6 × 30	—	17.10.84	64689	106,000	—
On. 49 SR	NRDA	046744	1.000	6 × 30	30.9.81	16.12.75	55847	110,000	12.11.75
On. 50 SR	DNSN	060253	1.000	6 × 30	5.11.85	14.1.81	60884	101,750	27.9.80
On. 51 SR	DNSN	012825	1.000	6 × 30	7.12.80	12.4.76	56249	108,050	March, 76
On. 52 SR	DIEPD	11210-1	1.000	6 × 30	18.5.82	25.3.82	62245	107,000	18.2.82
On. 53 SR	DIEPD	04115	1.000	6 × 30	15.6.81	23.6.81	61467	102,500	2.6.81
On. 54 SR	ALGOM	340230-1	1.000	6 × 25	1.12.85	13.7.83	63520	101,100	6.6.83

TABLE (D-3) — (continued)

Listing of Stranded Ropes

in use in Ontario — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Manuf. Date
On. 55 SR	REDP	314230-1	1.000	6 × 30	29.10.84	17.10.84	64689	106,000	5.3.84
On. 56 SR	ALGOM	340230-2	1.000	6 × 25	1.12.85	13.7.83	63521	101,000	6.6.83
On. 57 SR	ALGOM	340220-2	1.000	6 × 25	1.12.85	13.7.83	63519	100,700	6.6.83
On. 58 SR	CDNG	312470-2	1.000	6 × 25	8.4.86	1.12.83	63940	98,400	5.10.83
On. 59 SR	DOME	11305-1	1.000	6 × 30	4.9.87	21.5.82	62421	110,000	30.3.82
On. 60 SR	AGNCO	411820-1A	1.000	6 × 30	11.4.86	17.10.84	64688	106,300	18.9.84
On. 61 SR	AGNCO	411820-1B	1.000	6 × 30	12.4.86	7.9.84	64579	116,300	15.7.84
On. 62 SR	WILLAR	G5178	1.000	6 × 27	12.5.80	11.6.80	60302	96,400	5.5.80
On. 63 SR	WILLAR	G5177	1.000	6 × 27	12.5.80	11.6.80	60303	97,250	5.5.80
On. 64 SR	PAMR	04115	1.000	6 × 30	23.6.84	30.1.81	60954	103,300	27.11.80
On. 65 SR	PAMR	C5066	1.000	6 × 25	27.5.67	28.12.66	45117	85,200	16.12.66
On. 66 SR	PHC	443840-2	1.000	6 × 30	25.11.85	25.10.84	64724	122,200	3.10.84
On. 67 SR	PHC	544580-1	1.000	6 × 30	18.3.86	15.1.86	65870	125,000	—
On. 68 SR	LACD	415670-1	1.000	6 × 30	14.8.87	12.8.87	67330	108,050	21.7.87
On. 69 SR	REDP	411820-1	1.000	6 × 30	3.11.84	17.10.84	64690	109,800	15.7.84
On. 70 SR	DSJV	040301-1	$1\frac{1}{8}$	6 × 30	19.6.85	13.1.81	60888	141,300	19.11.80
On. 71 SR	PAMR	05969	$1\frac{1}{8}$	6 × 30	16.3.79	4.4.75	55142	155,750	March 73
On. 72 SR	PAMR	033930	$1\frac{1}{8}$	6 × 30	15.10.81	20.9.79	59580	154,100	25.8.79
On. 73 SR	PAMR	033584	$1\frac{1}{8}$	6 × 30	22.11.80	12.11.80	60729	152,100	26.10.80
On. 74 SR	PAMR	033583	$1\frac{1}{8}$	6 × 30	22.11.80	7.11.80	60730	151,500	26.10.80
On. 75 SR	PAMR	14186-1	$1\frac{1}{8}$	6 × 30	30.5.83	21.10.81	61851	146,100	1.10.81
On. 76 SR	ROSSF	D4986	$1\frac{1}{8}$	12 × 24	24.8.86	15.11.63	40414	129,800	—
On. 77 SR	CRL	052819	$1\frac{1}{8}$	6 × 25	23.6.84	26.9.80	60619	118,400	11.9.80
On. 78 SR	FLCN8	010309	$1\frac{1}{8}$	6 × 30	—	7.3.77	57215	132,000	—
On. 79 SR	LACM	446240-1	$1\frac{1}{8}$	6 × 30	1.2.85	29.11.84	64860	132,500	9.11.84
On. 80 SR	LACM	446240-2	$1\frac{1}{8}$	6 × 30	1.2.85	30.11.84	64861	132,500	9.11.84
On. 81 SR	DSJV	442280-1	$1\frac{1}{8}$	6 × 30	27.9.86	22.11.84	64819	148,000	1.11.84

TABLE (D-3) — (continued)

Listing of Stranded Ropes

in use in Ontario — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Manuf. Date
On. 82 SR	PAMR	440190-1	$1\frac{1}{8}$	6 × 30	1.7.87	10.4.84	64203	130,000	15.3.84
On. 83 SR	DICKN	04152	$1\frac{1}{8}$	6 × 25	29.2.84	8.7.81	61524	128,750	28.1.81
On. 84 SR	DOME	G9869	$1\frac{1}{8}$	6 × 30	21.10.86	26.5.86	66184	153,800	7.5.86
On. 85 SR	DOME	G9870	$1\frac{1}{8}$	6 × 30	22.10.86	26.5.86	66185	152,800	7.5.86
On. 86 SR	INCO4	020580	$1\frac{1}{8}$	6 × 30	21.6.79	29.6.77	57571	169,350	17.6.77
On. 87 SR	INCO4	L03681	$1\frac{1}{8}$	6 × 30	21.9.77	5.1.71	50477	171,100	4.12.70
On. 88 SR	KAM	544400-1	$1\frac{1}{8}$	6 × 30	6.11.85	21.11.85	65719	145,600	15.10.85
On. 89 SR	KAM	544400-2	$1\frac{1}{8}$	6 × 30	7.11.85	21.11.85	65719	145,600	15.10.85
On. 90 SR	LACM	443150	$1\frac{1}{8}$	6 × 30	17.11.85	24.8.84	64521	133,800	13.7.84
On. 91 SR	LACM	442390-1	$1\frac{1}{8}$	6 × 30	22.7.86	31.8.84	64577	134,000	24.7.84
On. 92 SR	ROSSF	D4986	$1\frac{1}{8}$	12 str.*	24.8.86	15.11.63	40414	129,800	11.11.63
On. 93 SR	TECK	6-704	$1\frac{1}{8}$	6 × 27	3.7.87	17.7.87	66328	153,550	July 86
On. 94 SR	PAMR	052816	$1\frac{1}{8}$	6 × 30	23.8.80	2.9.80	60540	131,850	1.8.80
On. 95 SR	PAMR	G301	$1\frac{1}{8}$	6 × 30	23.8.80	4.1.71	50471	126,500	Dec., 70
On. 96 SR	PAMR	M243320-1	$1\frac{1}{8}$	6 × 25	26.11.82	11.11.82	62913	118,000	19.10.82
On. 97 SR	RENB	547780-1	$1\frac{1}{8}$	6 × 30	12.12.86	16.9.86	66433	160,000	20.8.86
On. 98 SR	RENB	6-671	$1\frac{1}{8}$	6 × 27	18.12.86	31.7.86	66332	155,900	June 86
On. 99 SR	RIOA	G6348	$1\frac{1}{8}$	6 × 30	20.4.83	3.11.82	62886	158,000	12.9.83
On. 100 SR	RIOA	G7635	$1\frac{1}{8}$	6 × 30	17.11.83	23.6.83	63463	150,000	27.6.83
On. 101 SR	PAMR	243540-1	$1\frac{1}{8}$	6 × 30	27.5.83	2.2.83	63081	152,500	—
On. 102 SR	PAMR	L06074	$1\frac{1}{8}$	6 × 30	26.2.84	1975	—	157,450	Apr., 75
On. 103 SR	PAMR	020464	$1\frac{1}{4}$	6 × 25	19.2.83	30.8.78	58587	152,200	—
On. 104 SR	DSJV	642960-1	$1\frac{1}{4}$	6 × 30	18.6.87	4.12.86	66666	171,750	11.11.86
On. 105 SR	DSJV	442270-1	$1\frac{1}{4}$	6 × 30	25.7.87	24.8.84	64520	171,500	12.7.84
On. 106 SR	PLDOM	04244	$1\frac{1}{4}$	6 × 30	27.9.87	26.3.81	61163	180,750	9.12.80
On. 107 SR	DOME	G4824	$1\frac{1}{4}$	6 × 25	14.4.84	18.5.84	64315	142,000	Aug., 79
On. 108 SR	PAMR	14243	$1\frac{1}{4}$	6 × 30	30.4.83	24.9.81	61783	169,250	15.9.81

*: 12 strands, composed of 6×16 outer strands, and 6×10 inner strands

TABLE (D-3) — (continued)

Listing of Stranded Ropes

in use in Ontario — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Manuf. Date
On. 109 SR	MDWK	037649	$1\frac{1}{4}$	6 × 30	9.8.81	4.9.79	59524	163,150	6.6.79
On. 110 SR	MDWK	058366	$1\frac{1}{4}$	6 × 30	30.11.80	23.9.80	60601	163,000	12.6.80
On. 111 SR	PLDOM	542080-2	$1\frac{3}{8}$	6 × 30	27.9.87	3.10.85	65594	185,000	8.8.85
On. 112 SR	PAMR	010386	$1\frac{3}{8}$	6 × 30	6.6.78	15.12.76	56987	198,550	Nov., 76
On. 113 SR	PAMR	542840-1	$1\frac{3}{8}$	6 × 30	29.3.86	13.11.85	65690	206,400	15.10.85
On. 114 SR	PAMR	542840-2	$1\frac{3}{8}$	6 × 30	15.5.86	13.11.85	65691	206,700	15.10.85
On. 115 SR	PAMR	04411-1	$1\frac{3}{8}$	6 × 30	14.7.81	26.5.81	61377	191,000	5.4.81
On. 116 SR	PAMR	04411-2	$1\frac{3}{8}$	6 × 30	14.7.81	26.5.81	61378	194,250	5.4.81
On. 117 SR	PAMR	6-622	$1\frac{3}{8}$	6 × 27	2.9.86	18.7.86	66295	201,500	June 86
On. 118 SR	FLCN	L00447	$1\frac{3}{8}$	6 × 30	30.8.87	21.9.70	50094	200,750	Sept., 70
On. 119 SR	FLCN	L032255	$1\frac{3}{8}$	6 × 30	12.8.84	12.10.73	53596	195,000	25.9.73
On. 120 SR	PLDOM	542080-1	$1\frac{3}{8}$	6 × 30	27.9.87	3.10.85	65593	185,000	8.8.85
On. 121 SR	FLCN10	033942	$1\frac{7}{16}$	6 × 30	1.5.86	8.11.79	59730	232,750	23.10.79
On. 122 SR	PAMR	344360-2	$1\frac{3}{8}$	6 × 30	2.9.86	7.3.84	64125	182,000	16.2.84
On. 123 SR	FLCN10	445060-1	$1\frac{7}{16}$	6 × 30	11.5.86	20.12.84	64904	232,500	14.11.84
On. 124 SR	AMBR	646000-2	$1\frac{1}{2}$	6 × 30	1.5.87	9.4.87	67020	247,500	16.3.87
On. 125 SR	NRDA	344500-1	$1\frac{1}{2}$	6 × 30	17.8.86	29.11.84	64858	265,800	13.11.84
On. 126 SR	NRDA	545730-1	$1\frac{1}{2}$	6 × 30	16.8.86	11.2.86	65941	260,850	17.1.86
On. 127 SR	INCO5	04233-2	$1\frac{1}{2}$	6 × 7	10.11.87	24.2.87	61034	172,100	27.1.81
On. 128 SR	INCO5	04234	$1\frac{1}{2}$	6 × 7	12.11.87	13.4.81	61223	179,000	9.3.81
On. 129 SR	INCO5	04233-1	$1\frac{1}{2}$	6 × 7	6.11.87	24.2.87	61033	172,100	27.1.81
On. 130 SR	RIOA2	546640-1	$1\frac{1}{2}$	6 × 30	3.5.86	16.4.86	66070	253,250	10.2.86
On. 131 SR	RIOA2	546640-2	$1\frac{1}{2}$	6 × 30	3.5.86	16.4.86	66071	253,500	10.2.86
On. 132 SR	KAM	24094-2	$1\frac{1}{2}$	6 × 30	5.3.85	21.7.82	62666	238,800	16.6.82
On. 133 SR	KAM	052821	$1\frac{1}{2}$	6 × 25	12.9.84	1.10.80	60632	209,400	12.9.80
On. 134 SR	MINN	642310-2	$1\frac{1}{2}$	6 × 30	—	19.11.86	66605	240,750	—
On. 135 SR	AMBR	646000-1	$1\frac{1}{2}$	6 × 30	1.5.87	9.4.87	67019	248,250	16.3.87

TABLE (D-3) — (continued)

Listing of Stranded Ropes

in use in Ontario — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Manuf. Date
On. 136 SR	RIOA2	344800-2	$1\frac{1}{2}$	6 × 30	20.10.85	11.4.84	64211	247,000	20.3.84
On. 137 SR	DNSN	14366-1	$1\frac{1}{2}$	6 × 30	29.6.83	26.1.82	62130	261,000	17.12.81
On. 138 SR	DNSN	14366-2	$1\frac{1}{2}$	6 × 30	29.6.83	26.1.82	62130	261,000	17.12.81
On. 139 SR	DETL	740590-1	$1\frac{1}{2}$	6 × 30	30.7.87	13.4.87	67033	269,750	23.3.87
On. 140 SR	DETL	740590-2	$1\frac{1}{2}$	6 × 30	30.7.87	13.4.87	67034	273,000	23.3.87
On. 141 SR	FLCN	144871-1	$1\frac{1}{2}$	6 × 30	—	1.11.84	64740	277,500	—
On. 142 SR	FLCN	546360-1	$1\frac{1}{2}$	6 × 30	20.8.87	28.4.87	67068	278,000	26.3.87
On. 143 SR	FLCN	144871-1	$1\frac{1}{2}$	6 × 30	1.3.87	1.11.84	64740	277,500	11.10.84
On. 144 SR	PAMR	541570-1	$1\frac{1}{2}$	6 × 30	5.10.85	30.10.85	65698	232,500	22.6.82
On. 145 SR	PAMR	24094-1	$1\frac{1}{2}$	6 × 30	10.6.85	20.7.82	62665	238,500	16.6.82
On. 146 SR	RIOA1	C6116	$1\frac{1}{2}$	6 × 30	7.4.77	4.12.68	47784	251,200	20.11.68
On. 147 SR	RIOA1	C6115	$1\frac{1}{2}$	6 × 30	6.4.77	4.12.68	47784	251,200	20.11.68
On. 148 SR	RIOA2	344800-1	$1\frac{1}{2}$	6 × 30	24.8.85	11.4.84	64210	246,000	28.3.84
On. 149 SR	TECK	543480-2	$1\frac{1}{2}$	6 × 30	3.5.87	31.10.85	65649	243,500	4.10.85
On. 150 SR	TECK	645720-1	$1\frac{1}{2}$	6 × 30	2.5.87	19.3.87	66949	247,000	19.2.87
On. 151 SR	WESTR	4-12-42A	$1\frac{1}{2}$	6 × 25	23.2.85	1.2.85	65011	214,000	Dec., 84
On. 152 SR	WESTR	4-12-42B	$1\frac{1}{2}$	6 × 25	23.2.85	1.2.85	65011	214,000	Dec., 84
On. 153 SR	LACM	448960-2	$1\frac{5}{8}$	6 × 30	27.5.86	22.8.85	65430	312,000	19.6.85
On. 154 SR	INCO10	441580-1	$1\frac{5}{8}$	6 × 30	16.1.87	1.11.84	64759	302,500	23.8.84
On. 155 SR	FLCN2	6-471A	$1\frac{5}{8}$	6 × 27	10.6.86	11.6.86	66252	316,850	—
On. 156 SR	INCO10	441580-2	$1\frac{5}{8}$	6 × 30	19.1.87	1.11.84	64759	302,500	23.8.84
On. 157 SR	LACM	448960-1	$1\frac{5}{8}$	6 × 30	27.5.86	22.8.85	65429	312,000	19.6.85
On. 158 SR	INCO	MB230	$1\frac{3}{4}$	6 × 25	15.9.84	8.6.71	51006	331,000	17.5.71
On. 159 SR	FLCN1	442291-1	$1\frac{3}{4}$	6 × 25	2.11.86	8.10.86	66467	306,900	Sept. 86
On. 160 SR	FLCN1	342610	$1\frac{3}{4}$	6 × 25	1.11.86	27.6.86	65398	316,000	14.6.85
On. 161 SR	DOME	14188-3	$1\frac{3}{4}$	6 × 30	27.6.84	17.8.82	62677	332,800	17.11.81
On. 162 SR	INCO	M274-B	$1\frac{3}{4}$	6 × 25	25.10.82	3.5.77	57398	332,050	—

TABLE (D-3) — (continued)

Listing of Stranded Ropes

in use in Ontario — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Manuf. Date
On. 163 SR	INCO9	6-856	$1\frac{3}{4}$	6 × 25	31.1.87	6.10.86	66490	318,750	Aug., 86
On. 164 SR	INCO3	010597	$1\frac{3}{4}$	6 × 25	28.10.82	31.10.77	57861	300,450	18.11.77
On. 165 SR	INCO3	010598	$1\frac{3}{4}$	6 × 25	2.6.84	31.10.77	57862	303,700	13.10.77
On. 166 SR	PAMR	440200-1	$1\frac{3}{4}$	6 × 30	26.4.86	11.4.84	64214	316,000	9.3.84
On. 167 SR	PAMR	04308-1	$1\frac{3}{4}$	6 × 30	13.3.82	7.5.81	61316	315,800	27.3.81
On. 168 SR	CDNS	541580	$1\frac{3}{4}$	6 × 30	7.6.86	2.10.85	65579	326,000	12.9.85
On. 169 SR	DNSN	242970-1	$1\frac{3}{4}$	6 × 30	22.3.86	3.2.83	53097	338,250	2.12.82
On. 170 SR	CDNS	542830	$1\frac{3}{4}$	6 × 30	23.11.85	2.10.85	65576	325,000	11.9.85
On. 171 SR	DNSN	M24290-2	$1\frac{3}{4}$	6 × 30	27.6.84	16.12.82	62991	332,500	3.12.82
On. 172 SR	DNSN	M24290-1	$1\frac{3}{4}$	6 × 30	27.6.84	16.12.82	62990	332,500	8.12.82
On. 173 SR	DNSN	642990-1	$1\frac{3}{4}$	6 × 30	2.3.87	2.12.86	66667	367,250	12.11.86
On. 174 SR	DNSN	642290-2	$1\frac{3}{4}$	6 × 30	2.3.87	28.11.86	66668	367,000	12.11.86
On. 175 SR	DNSN	546120-1	$1\frac{3}{4}$	6 × 30	27.10.86	24.12.85	65841	353,000	28.11.85
On. 176 SR	INCO	04035-2	$1\frac{3}{4}$	6 × 25	8.5.82	22.4.81	61250	308,200	23.3.81
On. 177 SR	INCO	540080-1	$1\frac{3}{4}$	6 × 25	2.3.87	15.11.86	65686	313,500	18.4.85
On. 178 SR	DNSN	546120-2	$1\frac{3}{4}$	6 × 30	27.10.86	24.12.85	65841	253,000	28.11.85
On. 179 SR	DNSN	448270-4	$1\frac{3}{4}$	6 × 30	19.7.86	19.3.85	65138	354,500	4.3.85
On. 180 SR	DNSN	052805	$1\frac{3}{4}$	6 × 30	12.2.81	25.6.80	60347	338,500	8.5.80
On. 181 SR	DNSN	052806	$1\frac{3}{4}$	6 × 30	12.2.81	18.6.80	60334	337,000	8.5.80
On. 182 SR	PLDOM	444000-1	$1\frac{3}{4}$	6 × 30	10.10.87	7.12.84	64851	326,000	25.9.84
On. 183 SR	DMTR	341820-1	$1\frac{3}{4}$	6 × 30	11.9.84	23.9.83	63675	334,500	24.8.83
On. 184 SR	DMTR	446570-2	$1\frac{3}{4}$	6 × 30	16.1.86	25.2.85	65070	330,500	18.1.85
On. 185 SR	DMTR	446570-1	$1\frac{3}{4}$	6 × 30	21.7.86	25.2.85	65069	329,500	21.1.85
On. 186 SR	FLCN1	04196-1	$1\frac{3}{4}$	6 × 25	9.7.83	9.6.81	61478	318,300	18.5.81
On. 187 SR	FLCN9	04203-1	$1\frac{3}{4}$	6 × 30	14.9.86	21.7.81	61636	344,200	17.7.81
On. 188 SR	FLCN9	5-936A	$1\frac{3}{4}$	6 × 30	14.9.86	4.12.85	65787	366,000	Oct., 85
On. 189 SR	FLCN1	442290-1	$1\frac{3}{4}$	6 × 25	11.8.87	20.8.87	67357	311,000	4.8.87

TABLE (D-3) — (continued)

Listing of Stranded Ropes

in use in Ontario — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Manuf. Date
On. 190 SR	LACM	540770-1	$1\frac{3}{4}$	6 × 30	25.6.86	15.11.85	65709	372,000	4.12.85
On. 191 SR	INCO9	046290	$1\frac{3}{4}$	6 × 25	7.2.87	2.10.75	55650	106,000	Sept., 75
On. 192 SR	INCO10	041860-1	$1\frac{3}{4}$	6 × 25	12.11.86	11.5.83	63332	307,500	June 82
On. 193 SR	INCO10	M8606	$1\frac{3}{4}$	6 × 25	13.11.86	29.4.76	56319	332,500	12.4.76
On. 194 SR	RIOA1	644110-2	$1\frac{3}{4}$	6 × 30	17.1.87	20.1.87	66791	367,000	17.12.86
On. 195 SR	RIOA1	644110-1	$1\frac{3}{4}$	6 × 30	18.1.87	9.1.87	66790	361,500	17.12.86
On. 196 SR	INCO4	L044123	$1\frac{3}{4}$	6 × 25	1.4.84	13.8.84	54434	311,950	Aug., 74
On. 197 SR	INCO4	L044605	$1\frac{3}{4}$	6 × 25	2.4.84	13.8.74	54434	311,950	Aug., 74
On. 198 SR	INCO4	010172	$1\frac{3}{4}$	6 × 25	22.10.82	21.4.77	57361	307,050	3.4.77
On. 199 SR	INCO4	010173	$1\frac{3}{4}$	6 × 25	9.3.82	21.4.77	57362	305,150	25.3.77
On. 200 SR	INCO4	010361	$1\frac{3}{4}$	6 × 25	22.6.84	30.3.77	57290	309,150	16.3.77
On. 201 SR	INCO4	010360	$1\frac{3}{4}$	6 × 25	25.11.80	30.3.77	57289	308,750	16.3.77
On. 202 SR	INCO4	L010171	$1\frac{3}{4}$	6 × 25	2.6.77	12.11.76	56868	327,100	17.10.76
On. 203 SR	INCO	342520-1	$1\frac{3}{4}$	6 × 25	2.9.86	14.12.83	63050	301,250	4.10.83
On. 204 SR	INCO	056559	$1\frac{3}{4}$	6 × 25	22.2.86	1.10.80	60633	312,500	19.9.80
On. 205 SR	INCO	042280-1	$1\frac{3}{4}$	6 × 25	12.4.87	23.12.83	63091	306,250	20.11.83
On. 206 SR	INCO	042050-1	$1\frac{3}{4}$	6 × 7	21.9.86	16.1.85	64052	225,00	17.12.84
On. 207 SR	INCO	052846	$1\frac{3}{4}$	6 × 7	15.12.84	23.9.80	60600	237,000	26.8.80
On. 208 SR	INCO	447450-1	$1\frac{3}{4}$	6 × 7	28.10.87	26.2.85	65085	255,000	8.2.85
On. 209 SR	INCO	042050-2	$1\frac{3}{4}$	6 × 7	27.4.87	16.1.85	64053	225,000	17.12.84
On. 210 SR	INCO6	L08805	$1\frac{3}{4}$	6 × 25	1.10.83	25.8.75	55569	328,750	19.8.75
On. 211 SR	INCO6	L08888	$1\frac{3}{4}$	6 × 25	2.10.83	25.8.75	55569	328,750	19.8.75
On. 212 SR	INCO6	447570-1	$1\frac{3}{4}$	6 × 25	29.12.85	19.3.85	65119	308,500	14.2.85
On. 213 SR	INCO6	447570-2	$1\frac{3}{4}$	6 × 25	30.12.85	19.3.85	65120	315,000	28.2.85
On. 214 SR	INCO3	L039698	$1\frac{3}{4}$	6 × 25	30.1.83	12.1.76	55915	302,500	10.11.75
On. 215 SR	INCO3	L044023	$1\frac{3}{4}$	6 × 25	30.1.83	12.1.76	55916	301,000	10.11.75
On. 216 SR	LACM	540770-2	$1\frac{3}{4}$	6 × 30	25.6.86	15.11.85	65710	371,500	4.12.85

TABLE (D-3) — (continued)

Listing of Stranded Ropes

in use in Ontario — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Manuf. Date
On. 217 SR	RIOA1	G5802	$1\frac{3}{4}$	6 × 30	14.9.86	27.5.81	61395	343,000	May 81
On. 218 SR	FLCN7	056164	$1\frac{13}{16}$	6 × 30	10.11.85	15.8.80	60514	346,100	Aug., 80
On. 219 SR	FLCN7	042420-1	$1\frac{13}{16}$	6 × 30	17.11.85	4.11.83	63810	352,000	12.12.83
On. 220 SR	INCO1	042110-1	$1\frac{7}{8}$	6 × 30	23.3.86	20.12.84	64897	381,500	23.11.84
On. 221 SR	MATB	446860-1	$1\frac{7}{8}$	6 × 30	23.5.87	25.2.85	65088	367,000	4.2.85
On. 222 SR	MATB	446860-2	$1\frac{7}{8}$	6 × 30	23.5.87	26.2.85	65089	366,000	4.2.85
On. 223 SR	NRDA	446850-2	$1\frac{7}{8}$	6 × 30	13.7.87	19.3.87	65127	363,000	21.2.85
On. 224 SR	NRDA	033026-2	$1\frac{7}{8}$	6 × 30	16.12.84	6.9.84	59542	366,500	11.7.79
On. 225 SR	INCO	540070-1	$1\frac{7}{8}$	6 × 30	16.8.87	23.1.87	65897	361,000	4.12.86
On. 226 SR	INCO4	440180-2	2.000	6 × 30	2.5.87	9.3.84	64127	414,000	17.2.84
On. 227 SR	INCO4	440180-1	2.000	6 × 30	2.5.87	9.3.84	64126	415,000	17.2.84
On. 228 SR	RIOA	441370-2	2.000	6 × 30	24.3.85	20.7.84	64459	466,000	18.5.84
On. 229 SR	RIOA	020316	2.000	6 × 30	26.2.84	28.4.80	60153	483,000	12.12.79
On. 230 SR	INCO8	010586	$2\frac{1}{16}$	6 × 30	24.5.87	6.3.78	58142	487,350	15.2.78
On. 231 SR	INCO8	041900-1	$2\frac{1}{16}$	6 × 30	7.3.87	22.2.84	64106	498,000	6.2.84
On. 232 SR	INCO8	741590-2	$2\frac{1}{16}$	6 × 30	17.10.87	14.8.87	67295	521,000	29.6.87
On. 233 SR	INCO8	010365	$2\frac{1}{16}$	6 × 30	24.4.79	11.3.77	57262	505,000	2.3.77
On. 234 SR	INCO8	041850-2	$2\frac{1}{16}$	6 × 30	11.4.87	30.3.83	63230	499,000	3.3.83
On. 235 SR	INCO8	041850-1	$2\frac{1}{16}$	6 × 30	12.4.87	30.3.83	63229	494,000	3.3.83
On. 236 SR	INCO	545380-2	$2\frac{1}{16}$	6 × 30	29.6.87	22.1.86	65903	478,500	6.12.85
On. 237 SR	INCO	545380-1	$2\frac{1}{16}$	6 × 30	3.9.87	22.1.86	65902	478,150	6.12.85
On. 238 SR	INCO3	446290-1	$2\frac{1}{16}$	6 × 30	11.4.87	21.11.85	65712	434,000	22.1.85
On. 239 SR	INCO3	446290-2	$2\frac{1}{16}$	6 × 30	12.4.87	22.11.85	65713	435,000	22.1.85
On. 240 SR	KAM	740610-1	$2\frac{1}{8}$	6 × 30	19.3.87	7.4.87	66989	455,000	10.3.87
On. 241 SR	KAM	740610-2	$2\frac{1}{8}$	6 × 30	18.3.87	7.4.87	66990	456,000	10.3.87
On. 242 SR	UMX	010013	$2\frac{1}{8}$	6 × 30	13.10.80	27.2.76	56071	486,250	15.1.76
On. 243 SR	UMX	010012	$2\frac{1}{8}$	6 × 30	11.12.78	27.2.76	56070	482,050	15.1.76

TABLE (D-3) — (continued)

Listing of Stranded Ropes

in use in Ontario — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Manuf. Date
On. 244 SR	PLDOM	14187-3	$2\frac{3}{16}$	6 × 30	5.10.87	26.1.82	62061	515,000	3.12.81
On. 245 SR	PLDOM	14187-4	$2\frac{3}{16}$	6 × 30	4.10.87	26.1.82	62062	520,000	3.12.81
On. 246 SR	LACM	741240-1	$2\frac{1}{4}$	6 × 30	7.5.87	26.5.87	67128	589,000	29.4.87
On. 247 SR	LACM	741240-2	$2\frac{1}{4}$	6 × 30	6.5.87	26.5.87	67129	592,500	29.4.87
On. 248 SR	INCO4	14095-2	$2\frac{1}{4}$	6 × 30	15.4.84	8.8.81	61721	549,500	20.8.81
On. 249 SR	INCO4	441640-1	$2\frac{1}{4}$	6 × 30	18.4.87	1.11.87	64742	555,000	12.10.84
On. 250 SR	INCO4	14095-3	$2\frac{1}{4}$	6 × 30	18.4.87	26.1.82	62094	551,000	16.12.81
On. 251 SR	INCO4	440000-2	$2\frac{1}{4}$	6 × 30	24.10.87	11.4.85	65183	566,400	23.11.84
On. 252 SR	LACM	300449-2	$2\frac{1}{4}$	16 str.	9.9.85	15.8.85	65466	609,000	18.4.85
On. 253 SR	McISC	544600-1	$2\frac{1}{4}$	6 × 30	25.6.86	11.2.86	65942	563,000	16.1.86
On. 254 SR	McISC	344491-1	$2\frac{1}{4}$	6 × 30	25.6.86	27.3.84	64168	556,500	17.2.84
On. 255 SR	NRDA	6444170-1	$2\frac{1}{4}$	6 × 30	15.11.87	6.2.87	66838	553,500	9.1.87
On. 256 SR	RIOA	542660-1	$2\frac{1}{4}$	6 × 30	9.3.86	20.11.85	65714	556,500	10.10.85
On. 257 SR	RIOA	542660-2	$2\frac{1}{4}$	6 × 30	8.3.86	20.11.85	65715	556,000	10.10.85

List of abbreviations of Ontario mines

AGNCO: Agnico Eagle Mines Ltd.

ALGOM: Algoma Ore Properties Ltd.

AMBR: American Barick Resources Ltd.

AUNOR: Aunor Gold Mines

BLRA: Bulora Corporation (Madsen)

CDNCG: Canadian Crest Gold

CDNJM: Canadian Johns-Manville Co.

CDNG: Canadian Gypsum

CDNRS: Canadian Rock Salt Co. Ltd.

CDNS: Canadian Salt Co.

CITGM: Citadel Gold Mines Ltd.

CLND: Caland Ore Co. Ltd.

CNDKA: Canadaka Mining Ltd.

COCNR: Cochenour Williams Gold Mines Ltd.

CRL: Campbell Red Lake Mines

CTLC: Canada Talc Industries

DICKN: Dickenson Mines Ltd.

DETL: Detour Lake Mines Ltd.

DIEPD: Diepdaume Mines Ltd.

DLNT: Delnite Mines Ltd.

DMTR: Domtar Chemicals Ltd.

DOME: Dome Mines

DNSN: Denison Mines Ltd.

DSJV: Dickenson-Sullivan Joint Venture

DYNTC: Dynatec Mining Ltd.

ECO: ECO Exploration

EMLR: Emerald Lake Resources Ltd.

FLCN: Falconbridge — Onaping mine

FLCN1: — Falconbridge mine

FLCN2: — Strathcona mine

FLCN3: — Fecunis mine

FLCN4: — East mine

FLCN5: — Boundry mine

FLCN6: — Hardy mine

FLCN7: — Lockerby mine

FLCN8: — Openiska mine

FLCN9: — Fraser mine

FLCN10: — Winston Lake mine

FLCN11: — Kidd Creek mine

FRML: Forage R. M. Lteé

FRY: R.F. Fry and Associates Ltd.

GECO: Geco Mines Ltd.

GETTY: Getty Canadian Metals Ltd.

GOLDL: Goldlund Mines Ltd.

HCR: Highland Crow Resources Ltd.

HIHO: Hiho Silver Mines Ltd.

HLLGR: Hollinger Consolidated Gold Mines

INCO: International Nickel Co. — Frood-Stobie mine

INCO1: — Little Stobie mine

INCO2: — Shebandowan mine

INCO3: — Levack mine

INCO4: — Creighton mine

INCO5: — Coleman mine

INCO6: — Garson mine

INCO7: — Murray mine

INCO8: — South mine

INCO9: — North mine

INCO10: — Cream Hill mine

JFR: Jamie Frontier Resources Inc.

JRI: Jascan Resources Inc.

KAM-K: Kam-Kotia Porcupine Mines Ltd.

KAM: Kerr Addison Mines Ltd.

KCML: Kidd Creek Mines Ltd.

LACD: Lac D'Amiante Canada

LACM: Lac Minerals Ltd.

LAKE: Lake Shore Mines Ltd.

LEITCH: Leitch Gold Mines Ltd.

MATB: Mattabi Mines Ltd.

McFIN: McFinlay Red Lake Mines Ltd.

McISC: MacIsaac Mining and Tunelling Co.

MDWK: Madawaska Mines Ltd.

MURG: Murgold Resources Inc.

McINT: McIntyre Porcupine Mines Ltd.

McLEOD: MacLeod Cockshutt Gold Mines Ltd.

METM: Metal Mines Ltd. — Gordon Lake Div.

MDSN: Madsen Red Lake Gold Mines Ltd.

MINN: Minnova Inc.

NRDA: Noranda Mines Ltd.

NRTHS: Northspan Uranium Mines Ltd.

PAMR: Pamour Porcupine Mines Ltd.

PHC: Patrick Harrison & Co. Ltd.

PLDOM: Placer Dome Inc.

PRSTN: Preston Mines Ltd.

REDP: J. S. Redpath Ltd.

RENB: Renabie Gold Mines Ltd.

RIOA: Rio Algom Mines — Stanleigh mine

RIOA1: — New Quirke mine

RIOA2: — Panel mine

RIOA3: — Milliken mine

RIOA4: — Pater mine

ROSSF: Ross Finlay — St. Andrew Goldfields

SIFTO: Sifto Salt (Goderich Mine)

SISC: Sisco Metals of Ontario Ltd.

STPR: Steep Rock Iron Mine

TECK: Teck Hughes Gold Mines Ltd. — Teck Corporation

TECKC: Teck Corona

TGC: Texas Gulf Canada Ltd.

UCM: Upper Canada Mines Ltd.

UMX: Umex Mines

WESTR: Westroc Industries Ltd.

WILLAR: Willanour Resources Ltd.

WILLR: Willroy Mines Ltd.

WRGHT: Wright-Hargreaves Mines Ltd.

Listing of Canadian Mine Shaft Wire Ropes
Section II — In New Brunswick

__Summary__

Altogether there are 95 mine shaft wire ropes, of which:

66 (69%) are Locked Coil ropes,

12 (13%) are Non Rotating ropes, and

17 (18%) are Stranded ropes.

TABLE (D-4)

Listing of Locked Coil Ropes

in use in New Brunswick — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Suppl. by
N.B. 1 LC	PCA	R1PFH237	$1\frac{1}{8}$	1 × 104	28.2.87	—	—	—	—
N.B. 2 LC	PCA	R2PFH238	$1\frac{1}{8}$	1 × 104	2.3.87	—	—	—	—
N.B. 3 LC	PCA	L3PFH241	$1\frac{1}{8}$	1 × 104	3.3.87	—	—	—	—
N.B. 4 LC	PCA	L4PFH2427	$1\frac{1}{8}$	1 × 104	4.3.87	—	—	—	—
N.B. 5 LC	DPPC	R27P8391 FH193	32mm ($1\frac{1}{8}$)	1 × 148	18.3.87	—	—	—	—
N.B. 6 LC	DPPC	L30P8391 FH196	32mm ($1\frac{1}{8}$)	1 × 148	4.3.87	—	—	—	—
N.B. 7 LC	DPPC	R28P8391 FH194	32mm ($1\frac{1}{8}$)	1 × 148	15.4.87	—	—	—	—
N.B. 8 LC	DPPC	L32P8391 FH198	32mm ($1\frac{1}{8}$)	1 × 148	11.1.87	—	—	—	—
N.B. 9 LC	DPPC	L31P8391 FH197	32mm ($1\frac{1}{8}$)	1 × 148	1.4.87	—	—	—	—
N.B. 10 LC	DPPC	R3P8380 FH185	32mm ($1\frac{1}{8}$)	1 × 148	12.6.85	—	—	—	—
N.B. 11 LC	DPPC	R7P8380 FH189	32mm ($1\frac{1}{8}$)	1 × 148	9.11.85	—	—	—	—
N.B. 12 LC	DPPC	R8P8380 FH190	32mm ($1\frac{1}{8}$)	1 × 148	10.11.85	—	—	—	—
N.B. 13 LC	DPPC	L0P8380 FH191	32mm ($1\frac{1}{8}$)	1 × 148	7.11.85	—	—	—	—
N.B. 14 LC	DPPC	L10P8380 FH192	32mm ($1\frac{1}{8}$)	1 × 148	9.11.85	—	—	—	—
N.B. 15 LC	BMSC	033715	1.31	1 × 144	28.4.86	—	—	—	—
N.B. 16 LC	BMSC	033716	1.31	1 × 144	28.4.86	—	—	—	—
N.B. 17 LC	BMSC	033717	1.31	1 × 144	28.4.86	—	—	—	—

TABLE (D-4) — (continued)

Listing of Locked Coil Ropes

in use in New Brunswick — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Suppl. by
N.B. 18 LC	BMSC	033717	1.31	1 × 144	28.4.86	—	—	—	—
N.B. 19 LC	DPPC	83E-1	34.9mm ($1\frac{3}{8}$)	1 × 38	4.11.85	—	—	—	—
N.B. 20 LC	DPPC	83E-2	34.9mm ($1\frac{3}{8}$)	1 × 38	4.11.85	—	—	—	—
N.B. 21 LC	PCA	R1P8737 FH233	$1\frac{7}{16}$	1 × 148	31.7.86	—	—	—	—
N.B. 22 LC	PCA	R2P8737 FH236	$1\frac{7}{16}$	1 × 148	29.7.86	—	—	—	—
N.B. 23 LC	PCA	L3P8737 FH235	$1\frac{7}{16}$	1 × 148	30.7.86	—	—	—	—
N.B. 24 LC	PCA	L4P8737 FH234	$1\frac{7}{16}$	1 × 148	29.7.86	—	—	—	—
N.B. 25 LC	BMSC	033719	$1\frac{5}{8}$	1 × 173	19.4.81	—	—	—	—
N.B. 26 LC	BMSC	033720	$1\frac{5}{8}$	1 × 173	14.4.81	—	—	—	—
N.B. 27 LC	BMSC	033721	$1\frac{5}{8}$	1 × 173	3.4.81	—	—	—	—
N.B. 28 LC	BMSC	033722	$1\frac{5}{8}$	1 × 173	6.6.81	—	—	—	—
N.B. 29 LC	BMSC	031386	$1\frac{5}{8}$	1 × 173	16.5.86	—	—	—	—
N.B. 30 LC	BMSC	031387	$1\frac{5}{8}$	1 × 173	20.5.86	—	—	—	—
N.B. 31 LC	BMSC	031388	$1\frac{5}{8}$	1 × 173	26.6.86	—	—	—	—
N.B. 32 LC	BMSC	031389	$1\frac{5}{8}$	1 × 173	28.6.86	—	—	—	—
N.B. 33 LC	DPPC	R11P8380 H6111	41.3mm ($1\frac{5}{8}$)	1 × 35	30.5.85	—	—	—	—
N.B. 34 LC	DPPC	R12P8380 H6112	41.3mm ($1\frac{5}{8}$)	1 × 35	1.6.85	—	—	—	—
N.B. 35 LC	DPPC	R13P8380 H6113	41.3mm ($1\frac{5}{8}$)	1 × 35	31.5.85	—	—	—	—
N.B. 36 LC	DPPC	R14P8380 H6114	41.3mm ($1\frac{5}{8}$)	1 × 35	1.6.85	—	—	—	—

TABLE (D-4) — (continued)

Listing of Locked Coil Ropes

in use in New Brunswick — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Suppl. by
N.B. 37 LC	DPPC	R15P8380	41.3mm	1 × 35	2.6.85	—	—	—	—
		H6115	($1\frac{5}{8}$)						
N.B. 38 LC	DPPC	R16P8380	41.3mm	1 × 35	2.6.85	—	—	—	—
		H6116	1($\frac{5}{8}$)						
N.B. 39 LC	DPPC	R17P8380	41.3mm	1 × 35	3.6.85	—	—	—	—
		H6117	($1\frac{5}{8}$)						
N.B. 40 LC	DPPC	R18P8380	41.3mm	1 × 35	3.6.85	—	—	—	—
		H6118	($1\frac{5}{8}$)						
N.B. 41 LC	DPPC	R20P8380	41.3mm	1 × 35	30.10.85	—	—	—	—
		H6119	($1\frac{5}{8}$)						
N.B. 42 LC	DPPC	R20P8380	41.3mm	1 × 35	2.11.85	—	—	—	—
		H6120	($1\frac{5}{8}$)						
N.B. 43 LC	DPPC	R21P8380	41.3mm	1 × 35	3.11.85	—	—	—	—
		H6121	($1\frac{5}{8}$)						
N.B. 44 LC	DPPC	R22P8380	41.3mm	1 × 35	3.11.85	—	—	—	—
		H6122	($1\frac{5}{8}$)						
N.B. 45 LC	DPPC	R23P8380	41.3mm	1 × 35	2.11.85	—	—	—	—
		H6123	($1\frac{5}{8}$)						
N.B. 46 LC	DPPC	R24P8380	41.3mm	1 × 35	1.11.85	—	—	—	—
		H6124	($1\frac{5}{8}$)						
N.B. 47 LC	PCA	M142030-1	$1\frac{3}{4}$	1 × 37	22.7.83	—	—	—	—
N.B. 48 LC	PCA	M142030-2	$1\frac{3}{4}$	1 × 37	29.7.83	—	—	—	—
N.B. 49 LC	PCA	M142030-3	$1\frac{3}{4}$	1 × 37	23.7.83	—	—	—	—
N.B. 50 LC	PCA	M142030-4	$1\frac{3}{4}$	1 × 37	28.7.83	—	—	—	—
N.B. 51 LC	PCA	M142030-5	$1\frac{3}{4}$	1 × 37	25.7.83	—	—	—	—
N.B. 52 LC	PCA	M142030-6	$1\frac{3}{4}$	1 × 37	26.7.83	—	—	—	—
N.B. 53 LC	PCA	M142030-7	$1\frac{3}{4}$	1 × 37	24.7.83	—	—	—	—

TABLE (D-4) — (continued)

Listing of Locked Coil Ropes

in use in New Brunswick — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Suppl. by
N.B. 54 LC	PCA	M142030-8	$1\frac{3}{4}$	1 × 37	27.7.83	—	—	—	—
N.B. 55 LC	PCA	M14207-1	$1\frac{3}{4}$	1 × 37	12.8.82	—	—	—	—
N.B. 56 LC	PCA	M14207-1	$1\frac{3}{4}$	1 × 37	12.8.82	—	—	—	—
N.B. 57 LC	PCA	M14207-1	$1\frac{3}{4}$	1 × 37	12.8.82	—	—	—	—
N.B. 58 LC	PCA	M14207-2	$1\frac{3}{4}$	1 × 37	3.12.82	—	—	—	—
N.B. 59 LC	PCA	M14207-3	$1\frac{3}{4}$	1 × 37	6.12.82	—	—	—	—
N.B. 60 LC	PCA	M14207-4	$1\frac{3}{4}$	1 × 37	1.12.82	—	—	—	—
N.B. 61 LC	PCA	M14207-5	$1\frac{3}{4}$	1 × 37	7.12.82	—	—	—	—
N.B. 62 LC	PCA	M14207-6	$1\frac{3}{4}$	1 × 37	1.12.82	—	—	—	—
N.B. 63 LC	PCA	M14207-7	$1\frac{3}{4}$	1 × 37	10.8.82	—	—	—	—
N.B. 64 LC	PCA	M14207-8	$1\frac{3}{4}$	1 × 37	9.8.82	—	—	—	—
N.B. 65 LC	PCA	M14207-9	$1\frac{3}{4}$	1 × 37	13.8.82	—	—	—	—
N.B. 66 LC	PCA	M14207-10	$1\frac{3}{4}$	1 × 37	2.12.82	—	—	—	—

TABLE (D-5)

Listing of Non Rotating Ropes

in use in New Brunswick — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Suppl. by
N.B. 1 NR	PCA	14213-1	1.90	34 × 7	12.6.85	—	—	—	—
N.B. 2 NR	PCA	14213-2	1.90	34 × 7	14.6.85	—	—	—	—
N.B. 3 NR	PCA	RL3P8656 -34B109	1.96	34 × 7	9.4.87	—	—	—	—
N.B. 4 NR	PCA	RL4P8656 -34B110	1.96	34 × 7	19.10.87	—	—	—	—
N.B. 5 NR	PCA	RL5P8656 -34B111	1.96	34 × 7	19.10.87	—	—	—	—
N.B. 6 NR	BMSC	010683	$2\frac{1}{8}$	34 × 7	2.7.85	—	—	—	—
N.B. 7 NR	BMSC	010684	$2\frac{1}{8}$	34 × 7	15.7.85	—	—	—	—
N.B. 8 NR	DPPC	G1073	54mm ($2\frac{1}{8}$)	34 × 7	7.6.85	—	—	—	—
N.B. 9 NR	DPPC	G1074	54mm ($2\frac{1}{8}$)	34 × 7	7.6.85	—	—	—	—
N.B. 10 NR	DPPC	R25P8380 -34B93	55.6mm ($2\frac{3}{16}$)	34 × 17	6.11.85	—	—	—	—
N.B. 11 NR	DPPC	R26P8380 -34B94	55.6mm ($2\frac{3}{16}$)	34 × 17	6.11.85	—	—	—	—
N.B. 12 NR	DPPC	J-24	58.7mm ($2\frac{5}{16}$)	34 × 7	8.6.85	—	—	—	—

TABLE (D-6)

Listing of Stranded Ropes

in use in New Brunswick — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Suppl. by
N.B. 1 SR	BMSC	010038	$\frac{7}{8}$	6 × 27	17.1.87	—	—	—	—
N.B. 2 SR	DRI	744510-1	1.000	6 × 8	13.10.87	—	—	—	—
N.B. 3 SR	DRI	744510-2	1.000	6 × 8	13.10.87	—	—	—	—
N.B. 4 SR	BMSC	L029447	$1\frac{1}{8}$	6 × 27	Feb. 83	—	—	—	—
N.B. 5 SR	HSML	020020	$1\frac{3}{8}$	6 × 27	26.6.86	—	—	—	—
N.B. 6 SR	HSML	020021	$1\frac{3}{8}$	6 × 27	26.6.86	—	—	—	—
N.B. 7 SR	BMSC	543860-2	$1\frac{3}{4}$	6 × 27	14.4.86	—	—	—	—
N.B. 8 SR	BMSC	14057	$1\frac{3}{4}$	6 × 27	29.5.86	—	—	—	—
N.B. 9 SR	BMSC	052804	$1\frac{3}{4}$	6 × 27	26.5.86	—	—	—	—
N.B. 10 SR	HSML	04113-1	$1\frac{7}{8}$	6 × 30	4.8.82	—	—	—	—
N.B. 11 SR	HSML	04113-2	$1\frac{7}{8}$	6 × 30	4.8.82	—	—	—	—
N.B. 12 SR	BMSC	545270-1	2.29	6 × 7	4.2.86	—	—	—	—
N.B. 13 SR	BMSC	545270-2	2.29	6 × 7	11.2.86	—	—	—	—
N.B. 14 SR	BMSC	545270-3	2.29	6 × 7	3.3.86	—	—	—	—
N.B. 15 SR	BMSC	540500-1	2.33	6 × 7	16.7.86	—	—	—	—
N.B. 16 SR	BMSC	540590-2	2.33	6 × 7	20.7.86	—	—	—	—
N.B. 17 SR	BMSC	540590-3	2.33	6 × 7	24.7.86	—	—	—	—

List of abbreviations of New Brunswick mines

BMSC: Brunswick Mining and Smelting Corporation Ltd.

DPPC: Denison-Potacan Potash Company

DRI: Durham Resources Inc.

HSML: Heath Steele Mines Ltd.

PCA: Potash Company of America Inc.

Listing of Canadian Mine Shaft Wire Ropes
Section III — In Saskatchewan

<u>Locked Coil Ropes (full and semi)</u>

Four — $\frac{7}{8}$ in. size at IMCC and PCA

Twelve — 1.03 in. size at PCS Cory, Rocanville and Allan

Six — $1\frac{1}{16}$ in. size at PCA

Eight — $1\frac{1}{8}$ in. size at Cominco; IMCC; and PCS Lanigan

Four — $1\frac{1}{4}$ in. size at PCS Lanigan

Four — 1.44 in. size at PCS Lanigan

Twenty-eight — 1.515 in. size at Cominco; PCS Cory, Rocanville, and Allan; CCP; and IMCC

Eight — $1\frac{5}{8}$ in. size at Cominco

Hundred-twenty-one — $1\frac{3}{4}$ in. size at Cominco; PCS Cory, Allan, Lanigan, Rocanville; PCA; CCP; and IMCC

<u>Non Rotating Ropes</u>

One — $\frac{3}{4}$ in. size, 18 × 7 constr., at PCS Lanigan

Four — 1.000 in. size, 34 × 7 constr., at PCA and IMCC

One — $1\frac{1}{8}$ in. size, 18 × 7 constr., at Cominco

Two — $1\frac{1}{2}$ in. size, 12 × 7 constr., at PCA

Three — $1\frac{1}{2}$ in. size, 34 × 7 constr., at Cominco

Two — $1\frac{9}{16}$ in. size, 34 × 7 constr., at IMCC

Two — $1\frac{5}{8}$ in. size, 34 × 7 constr., at PCS Cory

Fourteen — $1\frac{11}{16}$ in. size ropes, 34 × 7 constr., at Cominco; and PCS Cory and Allan

Eighteen — $1\frac{3}{4}$ in. size, 34 × 7 constr., at PCS Rocanville; CCP; and IMCC

Two — $2\frac{3}{32}$ in. size, 34 × 7 constr., at PCS Lanigan

Four — $2\frac{3}{8}$ in. size, 34 × 17 constr., at PCS Lanigan

Stranded Ropes

Four — $1\frac{7}{8}$ in. size, 6 × 21 ropes at HBMS

Two — $2\frac{1}{4}$ in. size, 6 × 27 ropes at IMCC

Summary

Altogether there are 254 mine shaft wire ropes, of which:

195 (77%) are Locked Coil ropes,

53 (21%) are Non Rotating ropes, and

6 (2%) are Stranded ropes.

List of abbreviations of Saskatchewan mines

CCP: Central Canada Potash Division, Noranda Minerals Inc.
Cominco: Cominco Ltd.
HBMS: Hudson Bay Mining and Smelting Co. Ltd.
IMCC: International Minerals and Chemical Corporation (Canada) Ltd.
PCA: Potash Co. of America
PCS: Potash Corporation of Saskatchewan Ltd.

Listing of Canadian Mine Shaft Wire Ropes
Section IV — In Manitoba

Summary

Altogether there are 85 mine shaft wire ropes, of which:

17 (20%) are Locked Coil ropes,

20 (24%) are Non Rotating ropes, and

48 (56%) are Stranded ropes.

TABLE (D-7)

Listing of Locked Coil Ropes in use in Manitoba — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Suppl. by
Man. 1 LC	INCO	8502FH225	$\frac{15}{16}$	1 × 79	29.4.87	24.9.85	65546	129,600	CHIERS
Man. 2 LC	INCO	8502FH227	$\frac{15}{16}$	1 × 79	29.4.87	24.9.85	65547	129,000	CHIERS
Man. 3 LC	INCO	8592FH226	$\frac{15}{16}$	1 × 79	29.4.87	24.9.85	65546	129,600	CHIERS
Man. 4 LC	INCO	8592FH228	$\frac{15}{16}$	1 × 79	27.4.87	24.9.85	65547	129,000	CHIERS
Man. 5 LC	HBMS	020751	$\frac{15}{16}$	1 × 109	—	23.6.87	67221	117,650	WRI
Man. 6 LC	HBMS	020752	$\frac{15}{16}$	1 × 109	—	23.6.87	67222	117,750	WRI
Man. 7 LC	INCO	7553FH152	1.000	1 × 96	23.5.87	8.11.82	62896	140,000	CHIERS
Man. 8 LC	INCO	7553FH151	1.000	1 × 96	23.5.87	8.11.82	62896	140,000	CHIERS
Man. 9 LC	INCO	7553FH149	1.000	1 × 96	23.5.87	8.11.82	62895	138,800	CHIERS
Man. 10 LC	INCO	7553FH150	1.000	1 × 96	23.5.87	8.11.82	62895	138,800	CHIERS
Man. 11 LC	INCO	M1-80146	1.20	1 × 112	19.12.80	13.2.81	60990	191,850	NOR-STR
Man. 12 LC	INCO	C-330	1.20	1 × 112	19.12.80	13.2.81	60991	109,250	NOR-STR
Man. 13 LC	INCO	M1-80146.3	1.20	1 × 112	19.12.80	12.2.81	60991	193,250	NOR-STR
Man. 14 LC	INCO	909041-01-1	1.27	1 × 138	25.7.86	3.10.86	66483	222,000	WRI
Man. 15 LC	INCO	344160-4	1.27	1 × 138	25.7.86	3.10.86	66484	221,250	WRI
Man. 16 LC	INCO	344160-3	1.27	1 × 138	25.7.86	3.10.86	66485	221,750	WRI
Man. 17 LC	INCO	344160-2	1.27	1 × 138	25.7.86	3.10.86	66486	218,250	WRI

TABLE (D-8)

Listing of Non Rotating Ropes

in use in Manitoba — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Suppl. by
Man. 1 NR	INCO	G5884	$1\frac{1}{8}$	18 × 7	1.6.85	11.6.81	61415	97,200	GR-DO
Man. 2 NR	INCO	051304	$1\frac{1}{8}$	18 × 7	1.6.85	16.9.83	63661	109,600	WRI
Man. 3 NR	INCO	8104-18B17	$1\frac{1}{8}$	18 × 7	1.6.85	7.3.84	64117	117,800	CHIERS
Man. 4 NR	INCO	G5885	$1\frac{1}{8}$	18 × 7	1.6.85	5.11.85	65630	170,000	GR-DO
Man. 5 NR	INCO	1616-4	$1\frac{1}{8}$	18 × 7	17.8.74	30.9.74	54582	101,750	MAR
Man. 6 NR	INCO	1616-11	$1\frac{1}{8}$	18 × 7	5.7.79	30.9.74	54580	105,550	MAR
Man. 7 NR	INCO	1616-2	$1\frac{1}{8}$	18 × 7	5.7.79	30.9.74	54581	106,650	MAR
Man. 8 NR	INCO	1616-3	$1\frac{1}{8}$	18 × 7	5.7.79	23.2.76	56030	115,450	MAR
Man. 9 NR	INCO	915-8	$1\frac{3}{16}$	18 × 7	14.8.83	15.9.83	63658	117,000	MAR
Man. 10 NR	INCO	915-8	$1\frac{3}{16}$	18 × 7	14.8.83	15.9.83	63659	116,000	MAR
Man. 11 NR	INCO	915-8	$1\frac{3}{16}$	18 × 7	14.8.83	16.9.83	63660	120,000	MAR
Man. 12 NR	INCO	915-8M8630	$1\frac{3}{16}$	18 × 7	14.8.83	12.9.80	60574	115,100	MAR
Man. 13 NR	INCO	8096-18B11	$1\frac{1}{2}$	18 × 7	4.6.86	30.7.86	66312	210,900	CHIERS
Man. 14 NR	INCO	8096-18B13	$1\frac{1}{2}$	18 × 7	26.7.86	3.10.86	66482	230,750	CHIERS
Man. 15 NR	INCO	8096-18B12	1.543	18 × 7	16.2.86	7.3.84	64114	211,500	CHIERS
Man. 16 NR	INCO	8096-18B10	1.543	18 × 7	16.2.86	7.3.84	64113	213,000	CHIERS
Man. 17 NR	HBMS	644400-2	$1\frac{9}{16}$	34 × 7	—	6.2.87	66842	178,250	WRI
Man. 18 NR	HBMS	644400-1	$1\frac{9}{16}$	34 × 7	—	6.2.87	66841	184,000	WRI
Man. 19 NR	INCO	010073	$1\frac{11}{16}$	18 × 7	8.5.77	1.4.76	56218	230,750	WRI
Man. 20 NR	INCO	010072	$1\frac{11}{16}$	18 × 7	6.4.75	1.4.76	56217	220,000	WRI

TABLE (D-9)

Listing of Stranded Ropes

in use in Manitoba — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Suppl. by
Man. 1 SR	SAJV	14372	7/8	6 × 30	—	14.1.86	65860	80,600	WRI
Man. 2 SR	SAJV	14428	7/8	6 × 30	—	14.1.86	65861	80,250	WRI
Man. 3 SR	SAJV	211480-02	7/8	6 × 25	—	23.12.85	65862	80,500	WRI
Man. 4 SR	SAJV	4-3987	7/8	6 × 30	22.9.81	7.10.80	60640	80,500	WRI
Man. 5 SR	SAJV	907739-01	7/8	6 × 30	11.11.82	1.4.76	56214	77,650	WRI
Man. 6 SR	SHGM	6-721	7/8	6 × 27	2.5.87	7.8.86	66350	103,800	WRCR
Man. 7 SR	SHGM	5-1116-1	7/8	6 × 27	—	18.6.87	67198	99,000	WRCR
Man. 8 SR	HBMS	722450-1	1.000	6 × 30	23.5.87	26.3.87	83-353	—	WRI
Man. 9 SR	HBMS	412740-1	1.000	6 × 30	1.3.86	7.8.86	66339	108,800	WRI
Man. 10 SR	HBMS	020017	1.000	6 × 30	28.10.84	17.6.87	67207	104,250	WRI
Man. 11 SR	HBMS	022277	1.000	6 × 30	28.10.84	16.6.87	64810	106,000	WRI
Man. 12 SR	HBMS	545580-001	1.000	6 × 30	8.2.86	—	—	—	WRI
Man. 13 SR	HBMS	24093-1	1.000	6 × 30	—	15.6.85	64944	120,000	WRI
Man. 14 SR	HBMS	020016	1.000	6 × 30	—	6.6.85	65312	104,300	WRI
Man. 15 SR	HBMS	906719-01-1	1.000	6 × 30	—	6.6.85	65311	104,000	WRI
Man. 16 SR	HBMS	642450-2	1.000	6 × 30	24.10.87	12.12.86	86-301	—	WRI
Man. 17 SR	HBMS	642450-1	1.000	6 × 30	25.10.87	12.12.86	86-300	—	WRI
Man. 18 SR	HBMS3	908341-01-3	1.000	6 × 30	30.1.85	16.3.85	—	—	WRI
Man. 19 SR	HBMS	908997-01-2	1.000	6 × 30	—	22.7.86	66281	132,000	WRI
Man. 20 SR	HBMS	343660-1	1.000	6 × 30	—	27.4.87	67058	132,000	WRI
Man. 21 SR	TMC	909252-01	1.000	6 × 30	11.7.87	27.8.87	67323	109,400	WRI
Man. 22 SR	TMC	910362-01-1	1.000	6 × 30	1.7.87	19.6.87	87-239	—	WRI
Man. 23 SR	HBMS	641380-1	1 1/8	6 × 30	23.2.87	—	—	—	WRI
Man. 24 SR	HBMS	447670-2	1 1/8	6 × 30	20.2.87	14.4.87	67008	150,000	WRI
Man. 25 SR	AECL	909353-01-1	1 1/8	6 × 30	—	8.1.87	66735	151,000	WRI
Man. 26 SR	AECL	909353-01-2	1 1/8	6 × 30	—	8.1.87	66736	150,000	WRI
Man. 27 SR	SAJV	010304-2	1 1/8	6 × 30	13.7.82	27.8.82	62734	131,700	WRI

TABLE (D-9) — (continued)

Listing of Stranded Ropes

in use in Manitoba — as of December, 1987

List #	Mine	Reel #	Size (in.)	Constr.	Inst. Date	First MOL DT Date	First MOL DT#	Break Load (lb)	Suppl. by
Man. 28 SR	SAJV	010304-1	$1\frac{1}{8}$	6 × 30	13.7.82	27.8.82	62734	131,700	WRI
Man. 29 SR	INCO	P6794FLH21	$1\frac{1}{8}$	6 × 30	12.10.85	8.7.80	60387	133,850	CHIERS
Man. 30 SR	INCO	P6794FLH19	$1\frac{1}{8}$	6 × 30	1.6.85	8.7.80	60386	133,100	CHIERS
Man. 31 SR	INCO	P6794FLH22	$1\frac{1}{8}$	6 × 30	4.1.85	8.7.80	60387	133,850	CHIERS
Man. 32 SR	INCO	P6794FLH20	$1\frac{1}{8}$	6 × 30	1.6.85	8.7.80	60386	133,100	CHIERS
Man. 33 SR	HBMS	GD-3968	$1\frac{1}{4}$	6 × 30	—	12.12.80	60795	158,400	GR-DO
Man. 34 SR	HBMS	033018	$1\frac{1}{4}$	6 × 30	—	11.3.82	62248	165,750	WRI
Man. 35 SR	HBMS	343620-1-1	$1\frac{1}{4}$	6 × 30	19.4.86	15.5.86	66145	177,000	WRI
Man. 36 SR	HBMS	037466	$1\frac{1}{4}$	6 × 30	9.11.85	12.12.85	65826	162,800	WRI
Man. 37 SR	HBMS	343640-1	$1\frac{1}{4}$	6 × 30	10.8.85	1.5.87	67057	180,000	WRI
Man. 38 SR	HBMS	010362	$1\frac{1}{4}$	6 × 30	—	15.8.79	59460	166,350	WRI
Man. 39 SR	HBMS	243400-1	$1\frac{3}{8}$	6 × 30	4.10.86	28.11.86	66645	163,800	WRI
Man. 40 SR	HBMS	243400-2	$1\frac{3}{8}$	6 × 30	21.10.86	1.5.87	67060	163,500	WRI
Man. 41 SR	SHGM	6-940A	$1\frac{3}{8}$	6 × 27	17.4.87	28.10.86	66568	226,800	WRCR
Man. 42 SR	SHGM	6-940-B	$1\frac{3}{8}$	6 × 27	—	28.10.86	66568	226,800	WRCR
Man. 43 SR	SHGM	4-1048	$1\frac{3}{8}$	6 × 27	—	26.2.87	66924	203,400	WRCR
Man. 44 SR	SHGM	6-866-1	$1\frac{3}{8}$	6 × 31	29.1.87	4.9.86	66424	223,250	WRCR
Man. 45 SR	HBMS	M243360-1	$1\frac{1}{2}$	6 × 30	—	4.5.84	64254	234,500	WRI
Man. 46 SR	HBMS	442950-1	$1\frac{1}{2}$	6 × 30	26.2.85	6.12.82	62961	234,000	WRI
Man. 47 SR	HBMS	L04416	$1\frac{3}{4}$	6 × 30	—	18.6.80	60328	329,400	WRI
Man. 48 SR	HBMS	G4150	$1\frac{3}{4}$	6 × 30	—	18.6.80	60327	318,250	GR-DO

List of abbreviations of Manitoba mines and of rope sources

AECL: Atomic Energy of Canada Ltd.
HBMS: Hudson Bay Mining and Smelting
INCO: International Nickel Company Ltd.
SAJV: San Antonio Joint Venture Ltd.
SHGM: Sherritt Gordon Mines
TMC: Tantalum Mining Corporation

CHIERS: Trefileries & Cableries Chiers Chatillon Gorcy
GR-DO: Greening Donald Ltd.
NOR-STAR: Northern Strands
MAR: Martin Black Wire Ropes Ltd.
WRCR: Wright's Canadian Rope Ltd.
WRI: Wire Rope Industries Ltd.

Listing of Some of the Mine Shaft Wire Ropes
Section V — In Québec, Nova Scotia, and British Columbia

Listing of Some of the Mine Shaft Wire Ropes
Section V— In Québec

Locked Coil Ropes

Eight — $1\frac{3}{4}$ in. size, 1 × 37 constr., at Soquem

Non Rotating Ropes

Two — $1\frac{3}{4}$ in. size, 34 × 7 constr., at Soquem

Stranded Ropes

Four — $\frac{7}{8}$ in. size, 6 × 12 constr., at Sigma

Two — 1.000 in. size, 6 × 27 constr., at Sigma

Six — $1\frac{1}{16}$ in. size, 6 × 25 constr., at Soquem

Six — $1\frac{1}{8}$ in. size, 6 × 25, and 6 × 27, and 6 × 30 constr., at Soquem, RMR, and Cambior

Two — $1\frac{1}{4}$ in. size, 6 × 27 constr., at Sigma

Two — $1\frac{5}{16}$ in. size, 6 × 23 constr., at Teck

Two — $1\frac{3}{8}$ in. size, 6 × 25 constr., at Sigma

Four — $1\frac{1}{2}$ in. size, 6 × 27 constr., at TMG and SMB

Two — $1\frac{5}{16}$ in. size, 6 × 23 constr., at Teck

Two — $1\frac{5}{16}$ in. size, 6 × 23 constr., at Teck

Summary

Altogether 38 mine shaft ropes are listed, of which:

8 (21 %) are Locked Coil ropes,

2 (5 %) are Non Rotating ropes, and

28 (74 %) are Stranded ropes.

List of abbreviations of Québec mines

TMG: Les Services TMG Inc.

SMB: Société Minière Barrick (Canada) Inc.

TECK: Corporation TECK Corporation
RMR: Ressources Minière Rouyn Inc.
SIGMA: Les Mines Sigma (Québec) Ltée.
SOQUEM: Mines Seleine Inc.; Soquem
CAMBIOR: Cambior Inc.; Project Eldrich

Listing of Some of the Mine Shaft Wire Ropes Section V— In Nova Scotia

Non Rotating Ropes

One — 1.000 in. size, 18 × 7 constr., at CCC

Stranded Ropes

One — 1.000 in. size, 6 × 27 constr., at CDNS

One — $1\frac{1}{8}$ in. size, 6 × 27 constr., at ECC

Nine — $1\frac{1}{4}$ in. size, 6 × 8 constr., at Devco

One — $1\frac{1}{2}$ in. size, 6 × 27 constr., at CDNS

One — 60mm ($2\frac{3}{8}$) in. size, 6 × 36 constr., at Devco

Summary

Altogether 14 mine shaft ropes are listed, of which:

1 (7 %) is Non Rotating, and

13 (93 %) are Stranded ropes.

List of abbreviations of Nova Scotia mines

CCC: The Cementation Co. (Canada) Ltd.
CDNS: Canadian Salt Co.
DEVCO: Cape Breton Development Corporation
ECC: Evans Coal Co. (Canada) Ltd.

Listing of Some of the Mine Shaft Wire Ropes
Section V— In British Columbia

Stranded Ropes

One — $\frac{3}{4}$ in. size, 6 × 25 constr., at DENT

Two — $\frac{7}{8}$ in. size, 6 × 25 and 6 × 26 constr., at Cominco and PBAR

Four — 1.000 in. size, 6 × 26 and 6 × 27 constr., at BRL and MOS

Two — $1\frac{1}{8}$ in. size, 6 × 21 constr., at WESTM

Two — $1\frac{1}{4}$ in. size, 6 × 30 constr., at WESTM

Three — $1\frac{3}{8}$ in. size, 6 × 17 and 6 × 21 constr., at WESTM and Cominco

Two — $1\frac{7}{8}$ in. size, 6 × 30 constr., at WESTM

Summary

Altogether 16 mine shaft ropes are listed, all of them of stranded construction.

List of abbreviations of British Columbia mines

BRL: Bralorne Resources Ltd.
COMINCO: Cominco Ltd.; Sullivan
DENT: Dentonia
MOS: Mosquito Creek GM Co. Ltd.
PBAR: Parson Barite
WESTM: Western Mines Ltd.; Lynx and HW #2 shaft