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An Evaluation of Side-Loading Bundle Hooks in Coastal B.C. Bundling, Dumping and Towing Conditions

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PREFACE

Bundling of water transported logs is used extensively on the B.C. coast to reduce log loss. For many years, these bundles have been secured by recycled bundle wires and wedge hook connectors. It is still a common system.

This report describes the testing of a new wedge hook connector designed to reduce overall cost.

FERIC wishes to acknowledge the assistance of MacMillan Bloedel staff, especially Janice Brown, Peter Chaston, Alec Moffat and Dr. Don Wensley; Baker Cable Ltd. and Scarr Industries Ltd. The author wishes to thank Alex Sinclair and Kristi Francoeur of FERIC for their assistance.

AUTHOR

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SUMMARY

The objective of this study was to test a new side-loading bundle hook in B.C. Coastal conditions. These hooks join the two ends of a bundle wire which secures logs into a bundle for water transportation.

The side-loading bundle hooks are different from the standard center-loading type because they have one open side which allows the wire to be "side loaded" rather than threaded through the body. This feature also allows wire which is damaged, or has been repaired in the first 4.6 m, to be used.

Two side-loading bundle hook brands were tested. The Baker side-loading bundle hooks ("Baker Bundling Hooks") received a full scale field test while the preproduction Scarr hook received a limited test. The full scale test monitored the test bundles during makeup, dumping, transportation and breakdown at the mill. The test bundle hooks performed similarly to the control group in all phases except for a quality control problem. The manufacturer indicates that corrective action has been taken on all new hooks.

The increased price of side-loading hooks ($3.50 more per unit than the standard center-loading hook) would be justified by one extra cycle (trip) or by one less repair.

SOMMAIRE

L'objectif de cette étude fut de mettre à l'essai un nouveau crochet à chargement latéral pour paquets de billes dans des conditions de la côte de la Colombie-Britanique. Ces crochets joignent les deux bouts d'un câble à empaquetage qui attache solidement les billes en paquets pour fin de transport par voie d'eau.

Les crochets à chargement latéral diffèrent des crochets conventionnels à chargement central car ils ont un côté ouvert qui permet au câble d'être chargé par le côté plutôt que d'être enfilé dans le corps du crochet. Cette charactéristique permet aussi d'utiliser un câble endommagé ou de le réparé dans les premiers 4.6 m.

Deux marques de crochets furent mis à l'essai. Les crochets à chargement latéral Baker ("crochets à empaquetage Baker") ont été soumis à des essais exhaustifs sur le terrain, tandis que le crochet de type avant-production Scarr a été soumis à des essais limités. Les essais exhaustifs ont permit d'observer les paquets lors de l'assemblage, de la jetée à l'eau, du transport et de l'ouverture des paquets à l'usine. Les crochets soumis aux essais se sont comportés de façon semblable au groupe témoin dans toutes les phases à l'exception d'un problême de contrôle de qualité. Le manufacturier indique que des corrections ont été faites à toutes les nouvelles crochets.

Le coût supplémentaire des crochets à chargement latéral ($3.50 de plus l'unité qu'un crochet conventionnel à chargement central) serait justifié par un voyage allé-retour additionnel ou par une réparation en moins.

INTRODUCTION

1. Objective

The objective of this study was to test a new side-loading bundle hook under typical B.C. Coastal conditions.

2. Concept

The hooks join the wires that secure logs into bundles before they are dumped into the water for transport from the logging camp to the mill. The bundle hook traditionally requires that the wire be threaded through the hook (Figure A). If there is a kink or repair joint in the bundle wire, it is difficult or impossible to thread the wire through the hook. Typically, bundle wires are between 10.7 m (35 ft) and 15.2 m (50 ft) long. The first 4.6 m of wire is threaded through the hook in order to make a tight, secure bundle. As a result, broken wires cannot be repaired if a joint is needed in the first 4.6 m of wire and wires that are damaged or kinked in this section are often thrown away. (An efficient repair depot will reuse sound wire sections to repair other bundle wires that are damaged in locations outside of the first 4.6 m.)

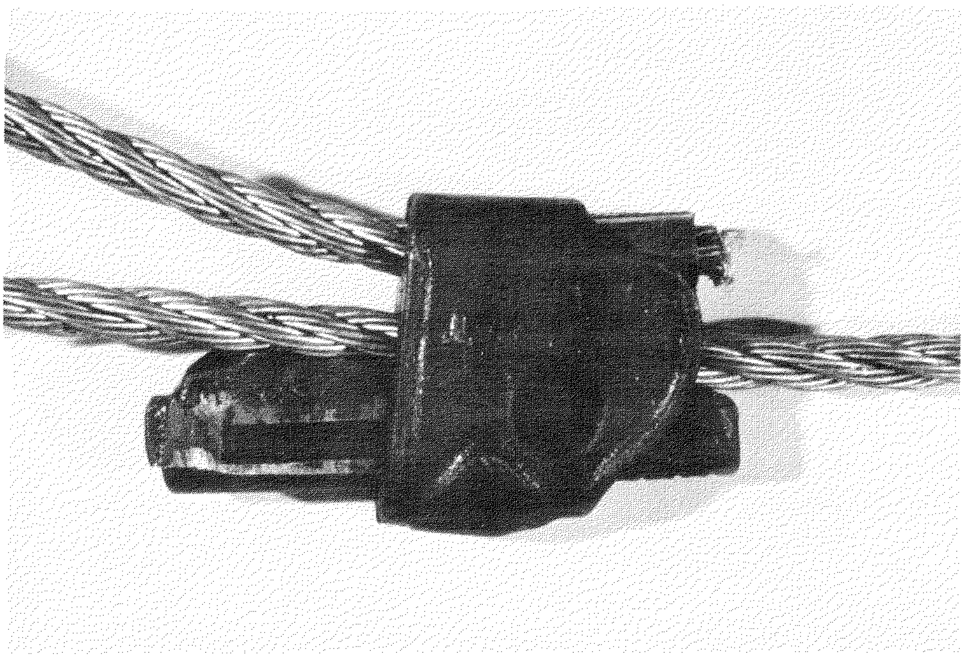

Figure A. Traditional Bundle Hook.

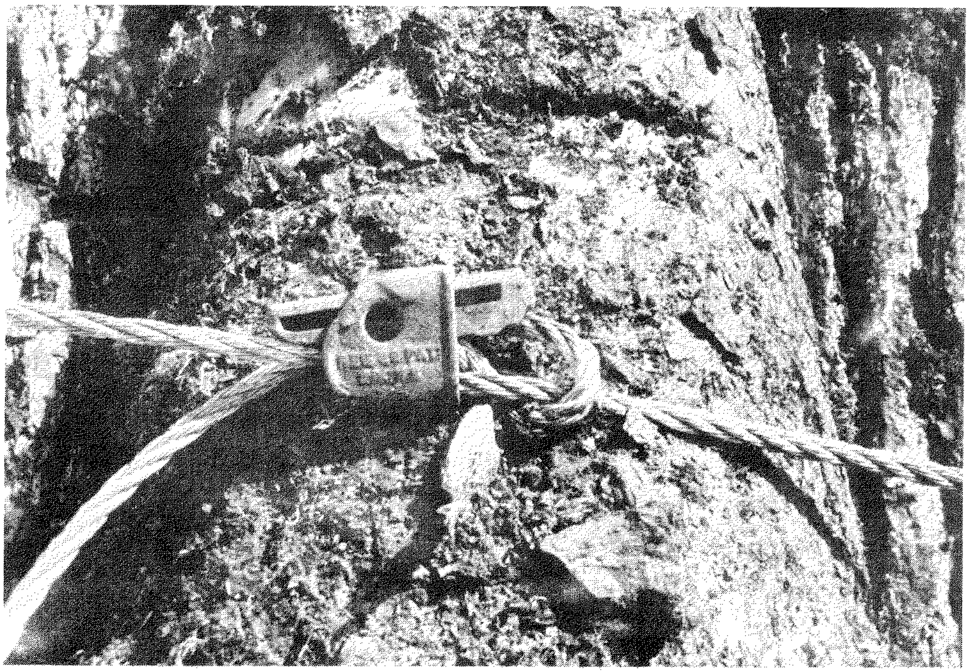

Figure B. Kinked Bundle Wire.

The side-loading bundle hook was designed to allow the free end of the bundle wire to be side-loaded through a slot in the side of the hook body rather than threaded through the body (Figure C).

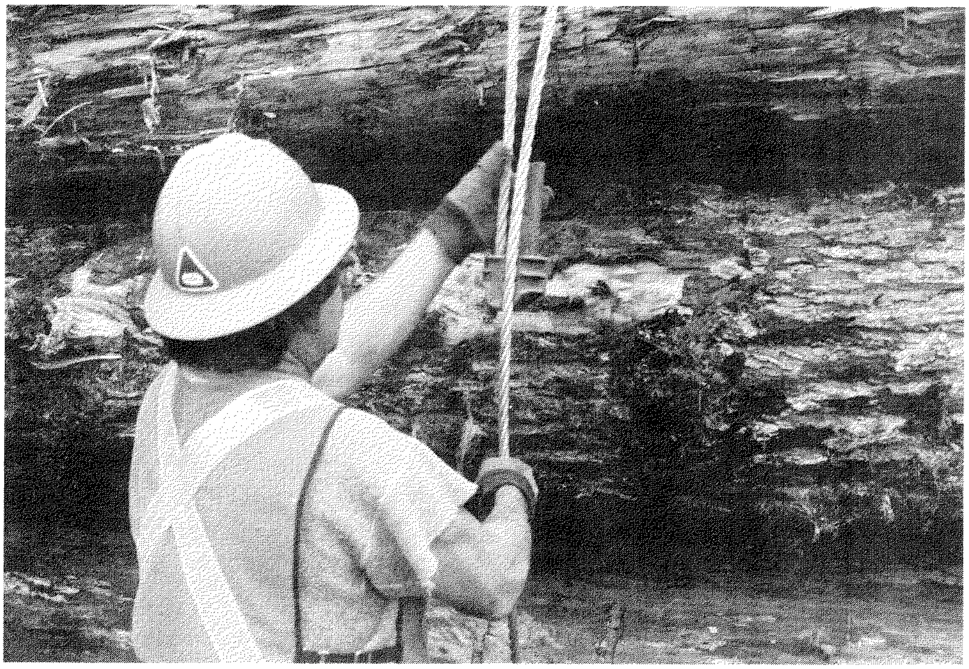

Figure C. Baker Side-Loading Bundle Hook.

The side-loading feature should allow bundle wires to have a longer life span because wires can be reused which have kinks and repair joints in any area of a bundle wire.

3. Background

Side-loading bundle hooks have been used for several years by B.C. Forest Products Ltd. on Williston Lake in the Northern Interior of B.C. However, a test of the hooks was required to determine their acceptability for Coastal bundling, dumping and towing conditions. Coastal conditions are considered more severe than those in the Interior.

Several different models of side-loading hooks were made as the final design evolved. During this period, they were bench tested by FERIC to determine their strength. The model that was field tested was considered the production model of the Baker side-loading bundle hook ("Baker Bundling Lock"). The Baker side-loading bundle hook is made by Baker Cable Ltd. of Prince George. Field tests were also carried out on the Scarr side-loading bundle hook (Figure D) but the number of these hooks tested was considerably fewer. The Scarr side-loading bundle hook is currently in the preproduction stage.

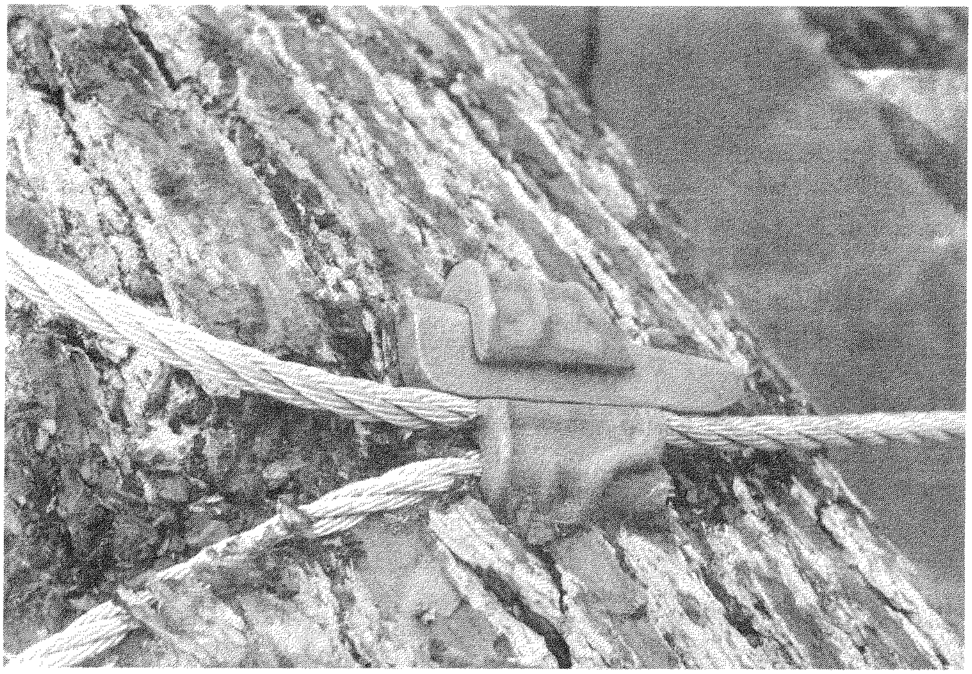

Figure D. Scarr Side-Loading Bundle Hook.

TEST DESCRIPTION

1. Test Conditions

A bundle wire in Coastal conditions must be capable of withstanding high forces (up to 80 000 N). These stresses are caused by a variety of factors. They include the type of dump ramp, the drop in elevation from land to the water at the dump ramp, the depth of water at the bottom of the dump ramp, the weather and tidal conditions in which the bundles are towed, and the condition of log storage areas. MacMillan Bloedel's Eve River dryland sortyard was used as a test site and the log booms were towed to Powell River on the mainland. This test location and towing route ensured that some severe stresses would be encountered and yet were typical of Coastal conditions (Figure E).

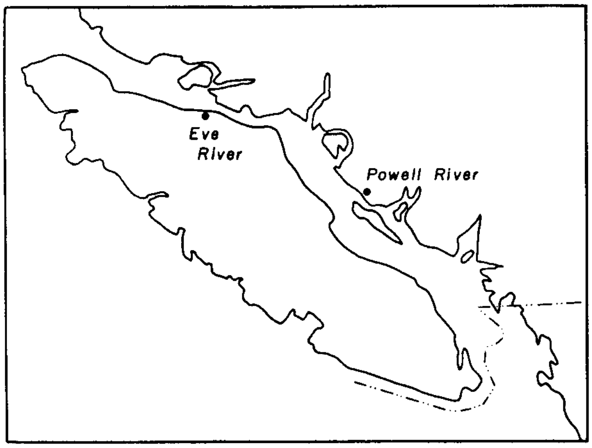

Figure E. Map of Coastal B.C.

The dump ramp at Eve River, a tripping stake hydraulic tilting type, allows the load to shift during dumping (Figure F). Logs from the top of the bundle will often fall to the back when the stakes are tripped. This shifting puts a sudden loading on the wire to the extent that a puff of smoke is sometimes observed as the hook and the bundle wire are embedded in the bark of the logs.

The dump ramp has a 34-degree slope and at low tide the bundles travel up to 18 meters (slope distance) down the ramp to the water. Also at low tide there is not enough water to prevent the bundles from hitting the ground at the foot of the ramp and thus higher stresses are placed on the wire.

Regardless of weather conditions, a tow from Northern Vancouver Island to the mainland results in heavy towing stresses because of the tidal conditions encountered. The tow from Eve River to Powell River is on this route.

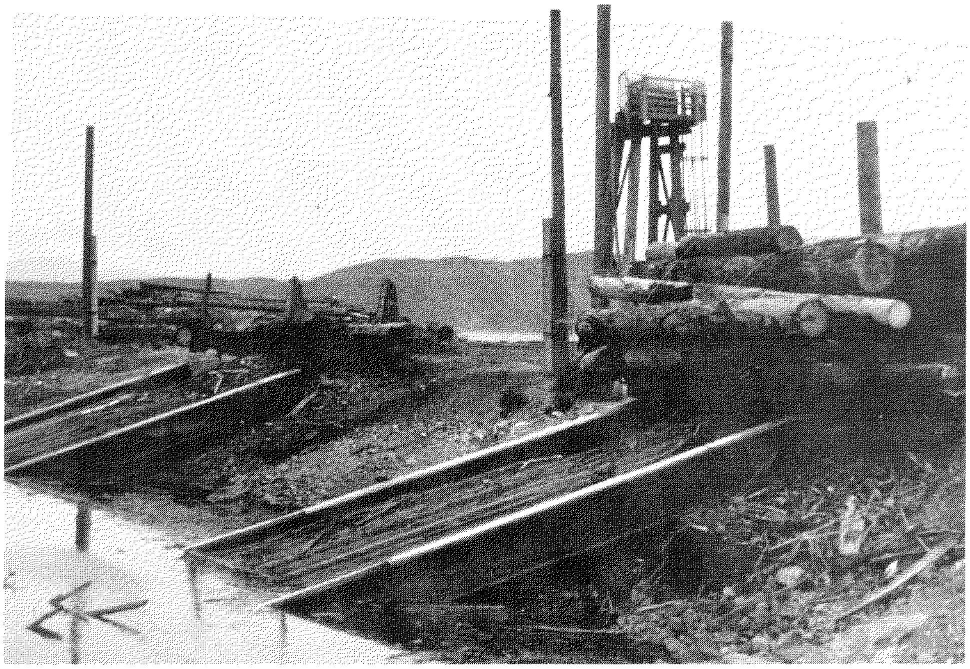

Figure F. Eve River Dump Ramp.

The log storage and booming ground areas at Eve River are limited and in shallow water. At low tides, some of the areas will have booms and bundles sitting on land rather than in the water. This introduces higher than normal stresses in the bundle wires and hooks.

Bundles were monitored during assembly, during dumping, after boom makeup, after towing, and during boom and bundle breakdown at the mill.

2. Description of Side-Loading Bundle Hooks

As mentioned earlier, two separate companies are involved in the manufacture of side-loading bundle hooks. Baker Cable Ltd. currently produces side-loading hooks while Scarr Industries Ltd. is preparing to begin production. The hooks are similar in appearance with gussetting on the back side of the body to support the cantilevered section created by opening up the opposite side (Figure G). The only operational differences appear to be in the wedge portion of the hook. The wedge on the Baker bundle hook will pivot backwards (Figure H) when it is in the fully withdrawn position to allow easy access of the wire through the slot in the body. The Scarr side-loading hook uses their conventional hook design with the wedge withdrawing (Figure I) far enough to provide full access to the side slot.

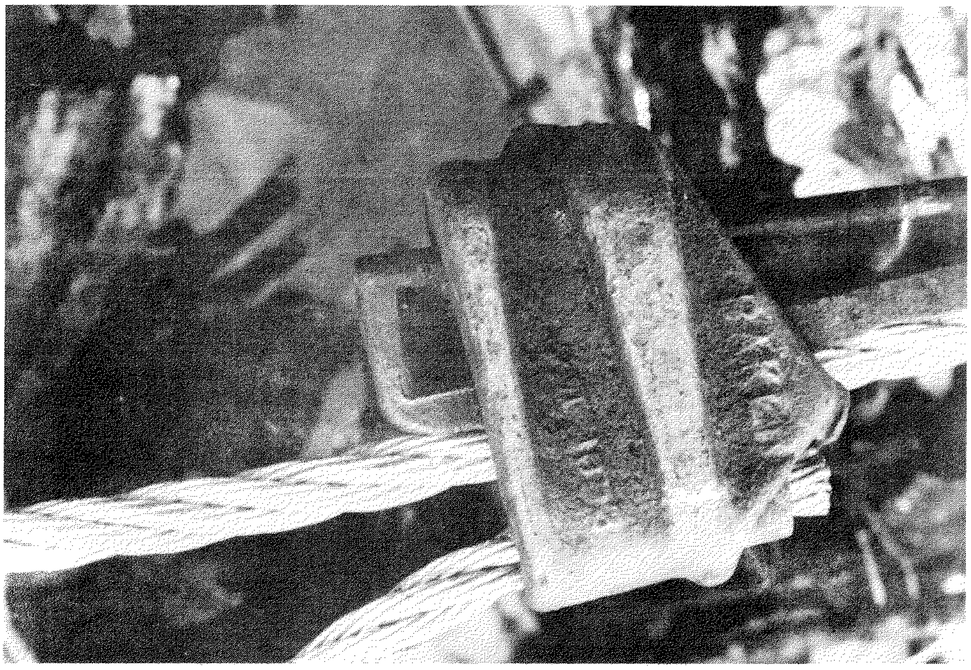

Figure G. Gussetting on Side-Loading Bundle Hook.

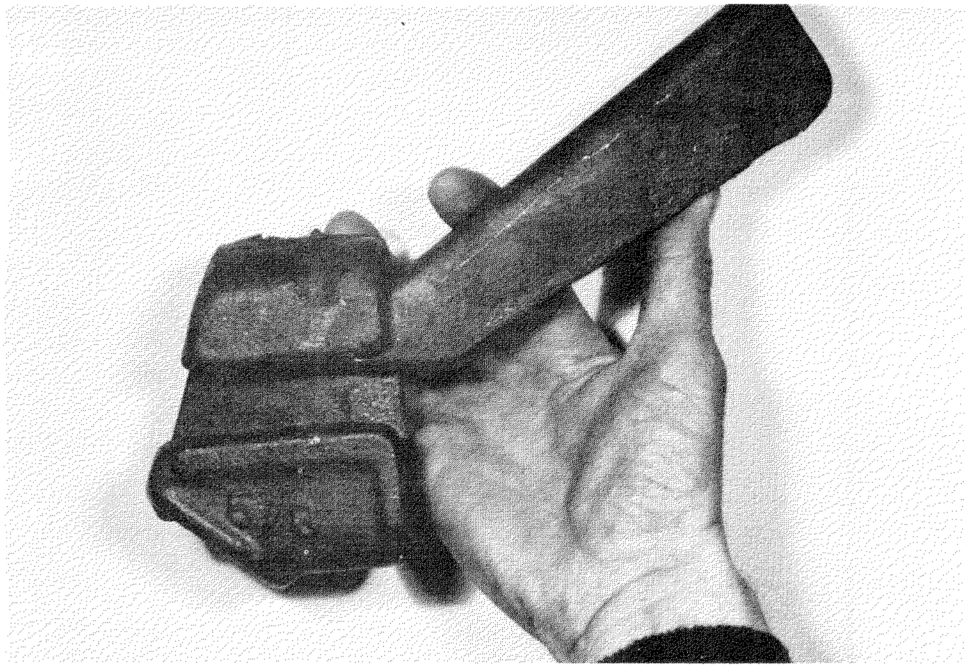

Figure H. Baker Wedge Portion.

Figure I. Scarr Wedge Portion.

TEST METHOD

A full scale field test was carried out with 180 Baker hooks. A small selection of these hooks was pull-tested to destruction (failure) on a Lloyds Certified Proof Tester to ensure adequate strength for field testing. This standard FERIC test consisted of pulling a bundle wire loop joined by the bundle hook until a failure occurred. The remaining hooks were used to make up four booms of bundles of both large and small diameter pulp log sorts. All wires and hooks used in the field test were new.

The large and small pulp log sorts were used because they are towed to the same mill, they are made up into large bundles with 15.2 m bundle wires, and the route to the mill provides severe towing stresses.

Each boom was made up of alternate bundles of the Baker test hooks and standard bundle hooks (Figure J) as a control. The time required to complete each of the bundling functions was recorded, as well as the length of drop to the water and the bundle survival rate. The booms were mapped before and after towing to determine any relationship between the bundle location within the boom and bundle-wire failure. The bundle breakup at the mill was monitored to determine any differences between the test and control groups.

Figure J. Test Bundle Boom.

RESULTS AND DISCUSSION

A summary of the bundling time appears in Table 1. The category "thread time" refers to the process of threading the loose bundle wire end through the hook (or dropping it through the side opening) and pulling the wire tight. The next category of "seal time" is the process of setting the wedge to pinch the wire between the wedge and the hook body. The "total bundling time" begins when the bunk is full and ready for the bundle wires to be joined, and ends when the bundle has been dumped and the bunk is reset and ready for reloading.

TABLE 1. Bundling Time Study Summary.

CATEGORY	NUMBER OF WIRES	THREAD TIME (min.)	SEAL TIME (min.)	TOTAL BUNDLING TIME (min.)
Small Pulp - Control	29	0.33	0.17	2.04
Small Pulp - Baker	21	0.34	0.20	1.86
Large Pulp - Control	22	0.33	0.17	1.84
Large Pulp - Baker	31	0.33	0.18	2.00

As can be seen in Table 1, there is essentially no time difference in threading the wire and driving the wedge to seal the bundle hook.

The bundle survival rate and statistics during dumping, boom makeup, storage and towing are summarized in Table 2. It should be noted that bundle security was maintained in all cases by at least one bundle wire.

TABLE 2. Bundle Survival.

CATEGORY	AVERAGE VOL./ BUNDLE (m^3)	NUMBER OF BUNDLES	AV.SLOPE DISTANCE TO WATER (m)	SURVIVAL AFTER DUMP (%)	SURVIVAL AFTER TOW (%)	TOTAL # OF FAILURES
Small Pulp - Control	30	32	11	100	100	0
Small Pulp - Baker	30	28	11	100	100	0
Large Pulp - Control	46	68	12	100	98	2
Large Pulp - Baker	46	41	11	99	98	2

The reason for the Baker bundle hook failure during dumping was not determined because the wire was lost. Similarly, one of the control wires that failed during towing could not be found to determine the reason for failure. The Baker bundle hook towing failure was caused by a casting flaw called a "cold shut". The control bundle hook failure during towing was a separation of the steel on the back of the hook and was caused by a heat-treatment problem.

Dumping of the large-pulp bundles at the sortyard pulled the Baker wedges deep into the body of the hook. Some wedges were pulled completely in with the wedge bottomed against its internal stop. The Baker side-loading hooks were considered to be more difficult to release when the bundles are opened at the mill than those in the control group. However, no test hooks had to be cut while one control was cut because the wedge would not release.

No problems were encountered with the Baker wedges during the test. However, a problem did occur during the second cycle of one bundle wire after these tests were completed. The tip of the wedge broke when it was struck during bundle breakdown and created a potential safety problem. As a result of this, all hooks at the mill (82) were given a Magnetic Particle Inspection (M.P.I.). The M.P.I. and visual inspection revealed two wedges with cracks, three wedges with casting porosity, and seven with "crater cracks" in the filler weld material. More detailed lab analysis identified the failure problem as beginning at the very hard and brittle interface in the wedge material adjacent to the filler weld. Baker Cable Ltd. has modified its welding process to solve this problem.

The side opening dimension of the Baker hook was measured after removal from the bundle at the mill to determine if any yielding of the cantilevered portion of the body had occurred. No significant increase in the opening was observed.

A very limited scale test of Scarr side-loading hooks was carried out under conditions similar to those of the Baker test. None of the 14 hooks failed during testing; however, these preproduction hooks had to be modified to provide more side opening clearance. As with the Baker hooks, some Scarr wedges were pulled down to the stop during dumping and one hook pinched some strands because of a limited pocket in the body.

CONCLUSIONS

The Baker bundle hook performed acceptably with the exception of the problems with the metallurgy of the wedge (which can be solved by better quality control) and with the wedge biting into the wire. This latter problem would be of significance in severe applications such as steep dumping.

The side-loading concept does not offer any significant time savings in bundling time when the wires are in new condition, but will when older wires with kinks in them are used.

Observations of bundling with used wires pointed out some cost savings. Repairs can be made in the first 4.6 m of the wire with the side-loading hooks. This will extend bundle wire life by allowing more repairs. However, an efficient repair station will reuse as much wire as possible. Side-loading hooks also have an advantage during bundle breakup if the tail end of the wire is pinched within the bundle. The side-loading hook can still be released, whereas a bundle wire with a center loading hook would have to be cut with an axe in order to be released. The crew is also less likely to discard a wire with a kink in the first 4.6 m when using side-loading bundle hooks.

These cost saving advantages must be weighed against the increased initial purchase price. Bundle wires traditionally undergo an average of six usage cycles before they are lost or discarded. The Baker side-loading bundle hooks cost $11.50 which is $3.50 more than the standard center loading hook. To offset this added cost, the life cycle will have to be increased by less than one additional trip or by eliminating the need for one repair (see Appendix). This should be achievable in practice.

APPENDIX

COST ANALYSIS

Cost per Trip Breakdown:

	Control (Center-Loading)	Baker (Side-Loading)
Hook	$ 8.00*	$11.50**
Assembly - Labour & Materials	6.00	6.00
Wire - 15.2 m (50 ft) @ $0.35/ft	17.50	17.50
Total	$31.50	$35.00
Cost/Cycle (based on 6 cycles)	$ 5.25	$ 5.83

Repair Cut Wire by Inserting One Aluminum Repair Sleeve:

Labour	$4.10
Parts	1.20
Total	$5.30*

*Reference - Scarr Industries Ltd.
**Reference - Baker Cable Ltd.