

IRTEENZ

Technology 2000

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ADVANCES IN BRAKE LINING TECHNOLOGY

KEYLOK™ ... the key to better braking

INNOVATION.

Companies that fail to innovate will fail to succeed in the 21st Century.

Innovation is becoming the No 1 strategic issue for companies around the world as the link between innovation, organizational growth and value creation is recognised.

The most valuable organisations of tomorrow will be the idea rich. The culture of these companies will encompass innovation as a core capability and value. These companies will embrace new and unusual ways of fostering innovation.

These are some of the key findings revealed by a recent cross-industry survey of more than 800 companies in seven countries. The findings are published in a report by Price Waterhouse Coopers titled "Innovation and Growth – A Global Perspective"

BACKGROUND

Hi-Bond Technology Pty Ltd was formed in 1986 when the potential was recognised for bonded commercial vehicle brakes to provide a lower overall cost base and better performance than riveted linings.

Hi-Bond Technology, which is located in the Melbourne suburb of Dandenong, supplies tens of thousands of CV brake shoes and lining sets per year in Australia for both OEM and after-market applications.

We service the Australian market via a network of over one hundred parts and service dealers located in every State.

QUALITY AND INNOVATION.

In 1996 we achieved Quality accreditation to ISO 9002

We were a finalist in the Quality Awards section of the 1996 Telecom and Victorian Government Small business Awards.

In 1998, the development of our Keylok innovation provided us with the opportunity to extend our Quality Accreditation to AS/NZS ISO 9001:1994.

R & D...a vital ingredient

Hi-Bond Technology's success is largely attributable to a significant annual investment in research and development. As a pioneer of the replacement lining market, we have always had the need to develop our own equipment and processes as none was available commercially.

In the early 1990's we developed and installed a high-speed integrated continuous bondline which took our production capacity of 4515 type lined shoes from eight to one hundred per hour.

Innovation has been a vital ingredient in our development since 1986.

RIVETED LININGS...the starting point

- rivet holes reduce brake lining surface area by up to 7%
- reduced surface area causes linings to run hotter and wear more quickly
- effective lining volume is reduced – this limits lining life.
- rivet holes trap abrasive road dirt and grit causing premature wear.
- aluminium rivets have low shear strength – particularly at elevated temperatures.
- steel rivets require correct equipment and techniques.
- poor assembly causes loose, noisy and failed linings.

BONDED LININGS...an improvement.

- up to 7% more surface area
- more useable lining volume
- lower operating temperatures
- no rivet holes to trap abrasive dirt and grit
- reduced lining wear
- better drum wear and elimination of drum ridging
- extended service intervals

These incremental benefits add up to lower overall brake maintenance costs.

FAILURE... the spur

In 1992, the failure of our bonded shoes on two log trucks working in the National forest in the Snowy Mountains were thought to have caused a brake jam-up which resulted in the two trucks catching fire.

Subsequent tests could not prove if the lining failure was the cause of, or the result of, the problem. The operator later acknowledged they were having some intermittent problems with sticking brake booster push-rods. This may have led to the brakes being held on causing severe overheating and subsequent lining separation.

The failure highlighted the need for us to look for a solution that when used in conjunction with bonding, would prevent a lining segment from jamming even if the bond did fail. A late night brainstorming session resulted in some roughly sketched ideas being held over for consideration in the cold and clear light of day.

One idea looked really promising. It involved the use of dovetail keyways in the underside of the linings to provide a secondary attachment in support of the primary bonding attachment. It looked simple and appeared to be feasible but it needed to be proved. We recognised that when dealing with primary safety items on trucks and buses, no chances could be taken.

KEYLOK™

Is an innovative and simple method of fastening commercial vehicle brake linings that combines the benefits of a bonded lining yet can be easily, quickly and safely fitted in the field by relatively unskilled labour using minimal equipment.

KEYLOK™...initial design brief.

At the commencement of the project we drew up a detailed design brief (QD 4.06) covering what we believed were the key characteristics of the ideal product.

The process should be:

- stronger than riveted or bonded linings.
- unaffected by temperature changes (heat cycling).
- suitable for severe service applications.
- simple, fast and easily fitted and removed.
- designed for consistent high quality installation by non-specialists.
- suitable for all makes of commercial vehicles including European makes.
- suitable for both O.E.M. and Aftermarket applications.
- eliminate necessity for core exchange/return.
- fit existing brake shoes without requiring any modifications.
- meet or exceed known International standards of lining attachment.
- competitively priced against riveted or bonded linings.

To satisfy end user requirements the product should be;

- field attachable and removable.
- require minimal skills or special tools.
- easy and fast to remove and attach.
- secure and safe attachment

AN ACADEMIC SLANT

An early approach was made to Associate Professor Bruce Kuhnell of the Mechanical Engineering Department at Melbourne's Monash University. We identified the need to do some mathematical modeling to prove the design concept before embarking on an expensive exercise of development and testing.

From 1992 onwards, we explored many different versions of the initial Keylok concept. What appeared simple in the first place actually proved difficult in practice.

As work progressed, it became clear that Keylok would actually be strong enough in its own right to replace both bonding and riveting.

ALLIANCES...a key strategy.

We needed to develop some strategic alliances to bring more expertise to the project.

In 1998, we secured a commitment from Ajax Fasteners, Australia's largest manufacturer of industrial and automotive fasteners, to assist in the development of a special fastener for the application. Ajax saw the potential for the project and commissioned their research department, Ajax Technology Centre, to use their considerable engineering expertise and talents.

At this time, the combined research team had grown and real progress was being forged.

By now, the project was divided into two distinct and separate research areas being the special fastener on which Ajax was working and the production capability to economically machine the brake linings.

MACHINING... a critical element

The placement of the dovetailed grooves on the underside of the lining blanks was crucial to the application of the design.

A critical element of the Keylok concept was the ability of the finished process to be able to be fitted to standard brake shoes by way of the existing rivet holes.

During the initial research stage, we built a simple manually operated, high-speed, single spindle, machine to grooving the linings. The prototype machine was not capable of any reasonable volume but it did enable the concept to be fully tested and proven.

Several of Australia's leading specialised machine builders were approached to assist in the design and construction of the production prototype machining centre. Melbourne's John Hart Pty Ltd, a major supplier of automated machine solutions to the automotive industry including such companies as GMH and Ford, was selected.

The addition of the John Hart team increased the combined development team to around twelve. It was a period of intense research and development with many different avenues and solutions being explored.

A COMPLEX MATRIX.

The very large number of different brake lining configurations suiting a multitude of different vehicles including American, European and Japanese trucks, buses and trailers, provides considerable complexity. This involved a complex matrix of different

- brake drum diameters.
- lining widths and inside radii.
- lining arc lengths
- a multitude of rivet hole combinations
- grades and compositions of friction material

The challenge was to develop a simple, or at least a relatively simple solution.

THE CUTTING EDGE

Friction material by its very nature, is extremely abrasive. Different friction material compositions that include exotics such as Kevlar and carbon fibre, place a very high demand on cutting tools. An economical solution was demanded.

As more experts were called into the project, it quickly became clear that no one in the world had any experience with machining friction materials in the required manner. Yet another research project within the overall project was commissioned. The research team grew yet again.

DECEPTIVE SIMPLICITY.

The Ajax Fastener team developed a deceptively simple fastener that was substantially stronger than conventional rivets. It was also considerably faster and easier to apply than rivets. Detailed laboratory and field tests were being conducted on various severe braking applications with all results being closely analysed.

With the aid of 3D-computer modeling, the John Hart team developed some innovative solutions to the complex machining and fixturing problems.

Progress with tool design was also making good headway.

INNOVATION & THE LAW

Our patent attorneys provided a detailed study into known "prior art" and advised us that Keylok could achieve full International Patent status. Provisional Patents were lodged and another expensive phase of the project commenced.

We have now registered Patents and Trademark in all of the Worlds major markets.

COMMERCIALIZATION

During the research and development period, with the aid of consultants, we had unsuccessfully approached the Australian Federal Government for a Research and Development Grant. These grants are competitive and very scarce. It is difficult for small to medium enterprises to secure these Grants without having a previous track record.

However, by the end of 1998, we were successful in obtaining a Concessional Loan from the Australian Federal Government Ausindustry to commercialise Keylok.

John Hart was commissioned to manufacture the first pre-production prototype machining centre. A commissioning date of end March 1999 was targeted.

Ajax Fasteners began preparing production tooling for the fasteners.

Cutting tools were ordered.

TORQUING SENSE

We identified the need for a special tool that could be used by mechanics to quickly, consistently and reliably, torque the Keylok fasteners.

Norbar Torque Tools Australia, part of the worldwide Norbar group, was commissioned to develop a suitable torque-limiting device that could be used with electric or pneumatic driving systems. The end result is a simple unit which upon reaching the correct pre-set torque of 15Nm, simply over-cams.

From the initial concept to the final application of Keylok we have tried to develop simple, effective, reliable and consistent solutions.

KEYLOK... a clever brake.

It is not until you actually use Keylok that you realise just how clever this stunningly simple system really is.

- Strength. Only six fasteners per lining block are required compared with up to 16 steel rivets.
- Speed. Keylok linings can be easily removed and refitted in only 27% of the time required for riveted linings.
- Safety. Unlike riveted and bonded joints, which become weaker at elevated temperatures, Keylok provides increased lining retention as temperature increases.
- Suitable for severe service applications.
- Not affected by elongated or deformed rivet holes in the brake shoes.
- Meets or exceeds the mechanical requirements of ECE13 Reg.90 & AS4649.
- Designed for consistent high quality installation by non specialists.
- Longer lining life compared with riveted linings.
- Eliminates brake drum ridging and extends drum life.
- Cost effective and economical.

With Keylok, fewer, faster, easier and more economical relines are now a reality.

INNOVATION...developing solutions.

Sometimes customers are not even aware of a problem or don't understand its importance. Innovation involves identifying a problem and then developing a solution.

Keylok is an innovation that should benefit end users well into the 21st Century.

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