

Fluid Injection Protection - 700 Bar Twin-line Hose

MMG Century

The Problem

The very first fluid injection death occurred in Glasgow, Scotland to a rescue worker using the Jaws of Life. The 700 bar (10,000psi) hose he had draped over him failed and injected a high-pressure stream of oil into his body.

Recognising the potential for fluid injection and other related injuries on mine sites, the New South Wales Department of Primary Industries – Mining developed the Mechanical Design Guidelines 41 (known as MDG41). This document is now the industry best-practice standard.

Mazzer Industries in Italy has developed the Textsleeve sleeve that goes over a hose. Under testing it has been found to prevent 950 bar (13,778 psi) of direct fluid injection oil spray. This product is certified to M.S.H.A. IC 213/0. Enerpac Australia is using this product on their commercially available 700 bar single hydraulic hoses. To date, no-one has been able to fit this sleeve to twin-line hoses used on the Jaws of Life and other workshop equipment. I have developed a process to fit this product to twin-line hoses, thereby increasing the safety of mine rescue and workshop employees by reducing the risk of fluid injection injuries.

The Solution

While the problem of fluid injection has been around since the 1960s, products and processes to minimise this risk are only just being developed. The TexSleeve was developed to protect the hose operator. However, as I have discovered in testing commercially available single hoses, one of its flaws is keeping the cover on the hose and preventing it from sliding down the hose.

As part of my work to develop the attachment process for the twin-line hose, I have also fixed the problem on the single hose and have modified all single hoses at Century to ensure that the sleeve does not slide off exposing the operator to potential harm.

The major problem to overcome with the twin-line hose is that it is split at the ends but remains a single hose in the middle. It must remain split so how do you take a single sleeve and split it on the ends? You can't cut and re-sew it as this destroys the integrity of the sleeve. The manufacturer cannot make it with a split and even if they could, what lengths would you make? Many of the twin-line hoses are different lengths.

A different approach was needed, one that allowed for the split in the hose and did not destroy the integrity of the sleeve while eliminating the risk of injury. Like most good inventions the solution was simple - provide an overlap in the material to ensure a direct fluid stream cannot reach an operator. Through experimentation I found a minimum of 100mm of overlap provided the coverage needed.

The manufacturer conducted the testing for the sleeve itself under controlled conditions (results are available by contacting the manufacturer). All other resources used to develop this lifesaving process were developed within the hose room at Century.

The current best practice process for attaching the sleeve is to use heat shrink. However through onsite testing of commercially available sleeves attached to single hoses, I have discovered that the sleeve can become detached from the hose end, exposing the operator to potential harm. Research and testing conducted in the Century hose room showed that if a crimp ring is used to secure the sleeve that this separation cannot occur and the ends continue to offer protection to the operator.

We are using this innovation on all single and twin-line hoses operating at 700 bar (10,000psi) as part of the MDG41 operational pilot program I am leading at Century. These hoses are used on all types of equipment by different manufacturers, such as Enerpac and Hytorc, and on all types of tools, pushers, torque wrenches and jacks.

While the best method in the *Hierarchy of Control* is Elimination, this is not an option. The next best method is Substitution, which again, is not an option as the hoses need to be used. As a result, I have used Engineering Controls - through a process to encase the hose - to reduce the risk to the operator.



The Innovation: Fluid Injection Protection Sleeve.

Benefits/Effects

By their very nature ultra high-pressure hoses are dangerous and each day operators are asked to work next to 700 bar hoses without protection from potentially life-threatening fluid injection injuries. Mine rescue workers are also asked every day to put their lives on the line to save the life of another. This safety innovation provides the operator and mine rescue worker with protection, thereby reducing the risk of a fluid injection injury.

Since we covered all 700 BAR (10,000psi) hoses on site, there have been no fluid injection injuries. We have also not lost the cover off any of the twin hoses fitted with the safety innovation.

At Century all 700 BAR (10,000psi) hoses are covered using TexSleeve. I put the first new sleeves on all in-use twin hoses – six in the Mill and four in the Mine Maintenance Workshop – in February 2011. We plan to fit the sleeve on all new hoses on site.

Transferability

The process for fitting the Texsleeve to any hose single or twin is quite simple.

The only products needed are:

- Texsleeve in 2 sizes 23mm and 31mm
- Glue lined heat shrink medium wall 25-8mm
- Glue lined heat shrink medium wall 35-12mm
- Crimping collar 22mm ID

Tools needed are a heat gun, sharp cutters/scissors and a crimping tool.

While a dedicated Hose Technician conducts this work at Century, a fitter or electrician could also safely fit the sleeve.

An important part of this process is regularly inspecting and re-certifying the integrity and function of the sleeve. I have developed a process to inspect and confirm the integrity and function of each hose every three months and pressure test the hose annually. This is critical because once the cover is on you can no longer see the condition of the hoses inside it. Re-testing could also be carried out offsite if necessary.

Innovation

This innovation follows the development in Australia of the MDG41 Guidelines, demonstrating that Australia is leading world in safety innovations to reduce the risk of fluid injection injuries.

In Australia only one manufacturer of 700 bar hoses commercially manufactures a hose meeting the guidelines of MDG41. The manufacturer has not been able to develop a twin-line hose cover and has only developed this process for single hoses, experiencing some teething problems with the cover sliding. It should be noted that this product only became available at the beginning of 2010.

With this in mind, it was necessary to develop another solution if the MDG41 Guidelines were to continue to be used to improve hose safety.

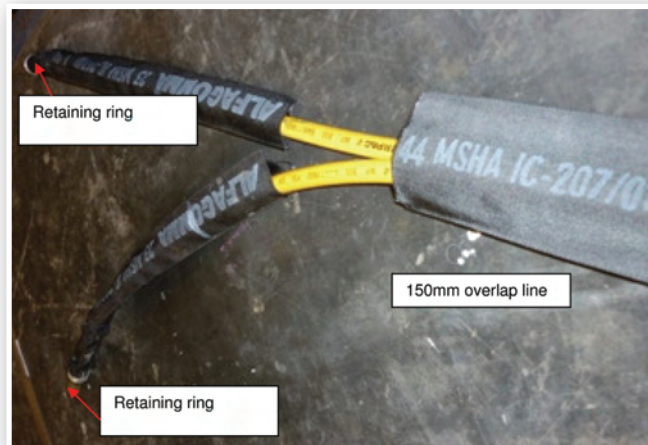
I first started to work at Century to develop an idea for the twin hose safety innovation when this single hose became available. I initially contacted the vendor about safety options, only to discover that they did not know how to develop a twin hose cover and were relying on external expertise to solve this problem. The OEM also did not have a solution.

I then set about developing my own process to cover a twin hose. I tried many configurations using two single hoses, but found I could not keep them paired.

For eight months I experimented with different ways to achieve a satisfactory result before identifying the solution – using one sleeve for each end with the overlap under a single cover. To do this, I built on the work I had undertaken to prevent other sleeves from sliding. The most difficult part of the problem was securing the overlap. I tried clamps and ties, but these kept getting caught on things or the sleeve slide out. I soon found that the solution was simple - use glued heat shrink.

Using 100mm I was able to glue the heat shrink to both covers. The glue is pushed into the cover, which holds it in place and allows the cover to slide on the hose, while not allow fluid injection to the operator. The heat shrink is also low profile and so does not catch.

I am pleased that through my extensive experimentation and field testing that I was able to develop a safety innovation with the potential to significantly reduce the risk of fluid injection injuries and allow workers from a wide range of industries to return home safely to their loved ones each night.



The Innovation: Fluid Injection Protection Sleeve.