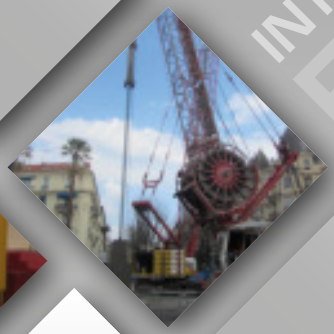
QUALITY

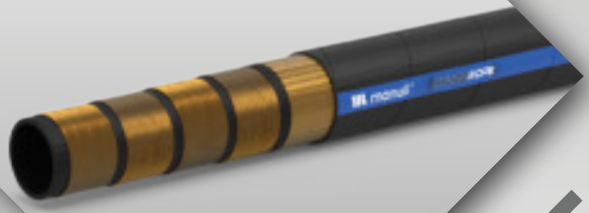
INTELLIGENT DESIGN

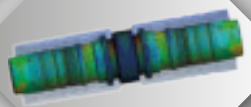
EXCELLENCE

PARTNERSHIP

INTEGRATED SOLUTIONS







HYDROROPE HIGH-TENSILE HOSE

manuli® HYDRAULICS

Working with industry leaders to develop outstanding products

Manuli Hydraulics are well established as global leaders in the supply of specialist hydraulic connectors to the foundation equipment sector, including hydraulic grabs, hydromills and pile driving equipment. Over the years we have worked in partnership with some of the most prominent global brands in the industry to develop products which meet their exacting requirements in some of the most demanding applications.

High-tensile hose for foundation applications

When selecting a hydraulic hose for most normal applications, the tensile strength of the hose is not usually a critical determining factor. However, in certain applications, particularly those mentioned above, tensile strength can make a huge difference to the operational life of the hose.

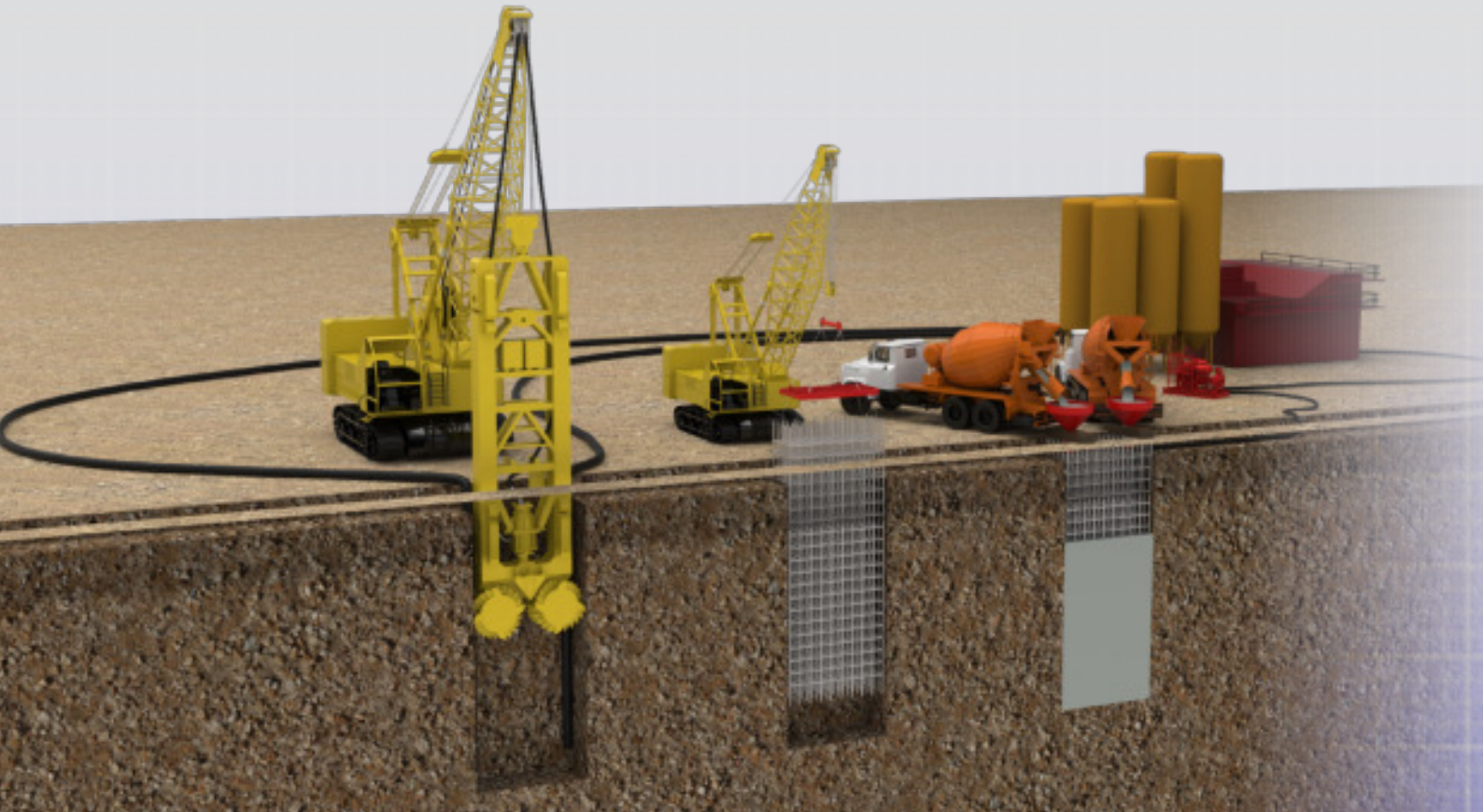
In applications where high tensile forces, either static or dynamic, are present, these forces can lead to the creation of minute cracks and/or tears in the rubber tube of the hose. This can in turn lead to premature failure of the assembly, because as the hose ages, the cracks become more pronounced due to the rubber becoming less flexible.

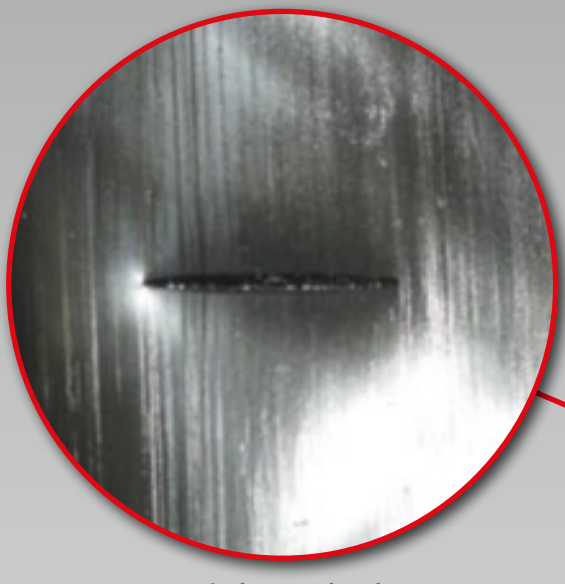
For this reason, Manuli Hydraulics has developed **HydroRope**, a 42 MPa premium hydraulic hose with specially enhanced tensile properties, making it ideal for use in foundation digging applications where high tensile loads are applied directly to the hose.

Based on a standard 4 and 6 wire spiral hose arrangement, this extra tensile strength is provided by our **unique (pat. pending) structural design** which includes an additional wire braid layer directly below the outer cover. This design allows the tensile forces to be redistributed throughout the hose structure and prevents them from damaging the tube or spiral reinforcement.

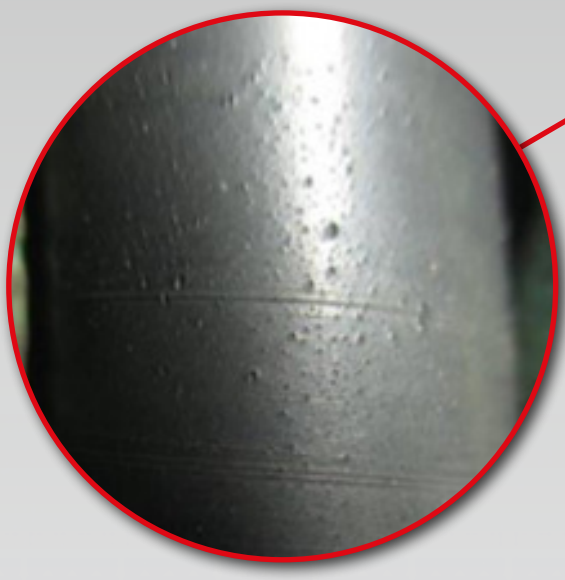
Features:

- Extreme tensile strength and minimal elongation under tensile loading
- 420 bar working pressure suitable for heavy duty power lines
- Available in sizes DN 25, DN 31 and DN38 (*DN 51, DN 63 and DN 76 coming soon*)
- Manuli “Strong - Type SC” cover for superior abrasion and cold temperature resistance
- Fully integrated Interlock Plus and Interlock Super fitting solutions





Tear in hose tube due to excessive tensile loading



Micro-cracks in hose tube due to excessive tensile loading

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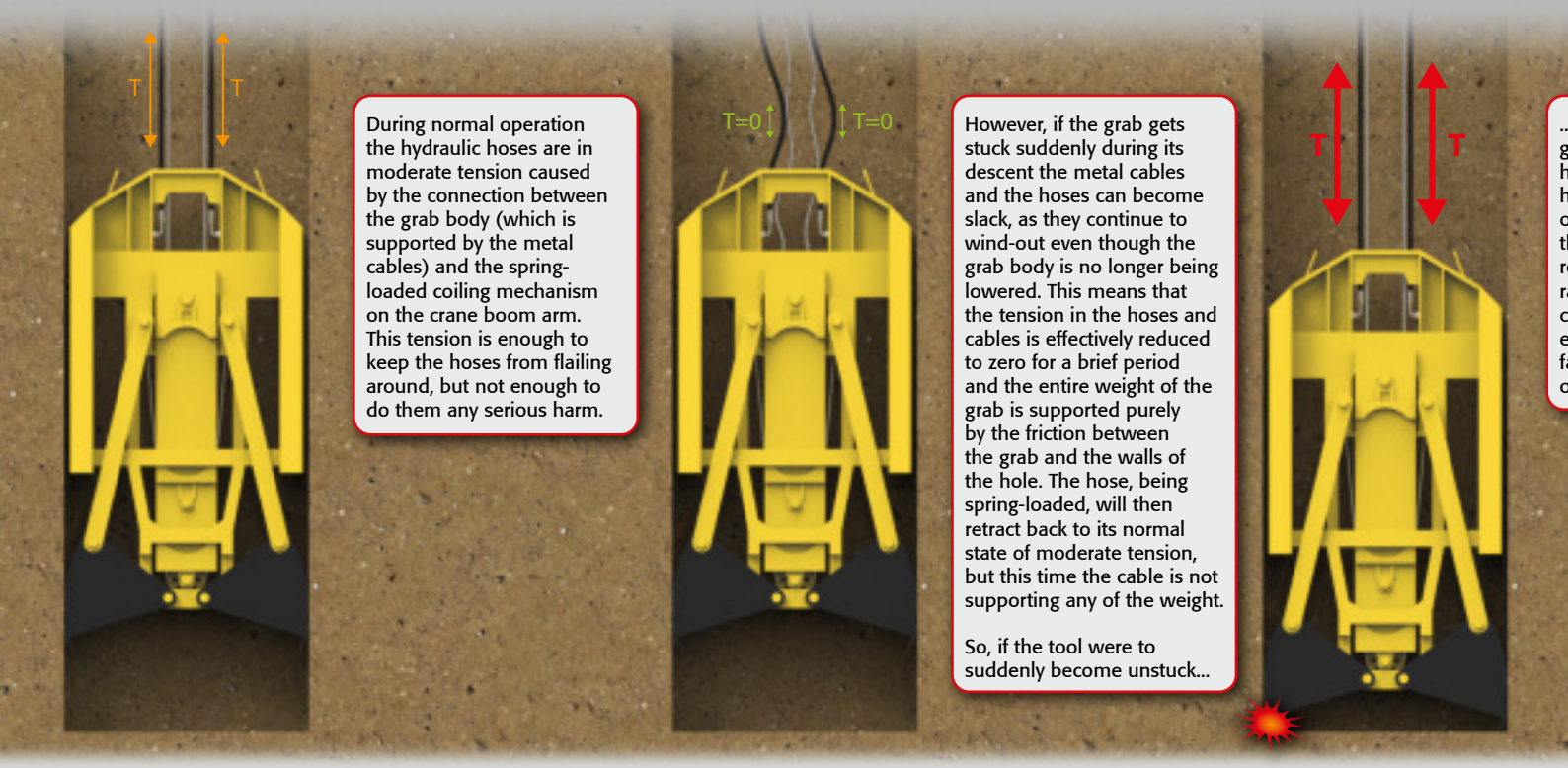
Some of the main causes of high-tension shock loading of hoses in foundation applicatio

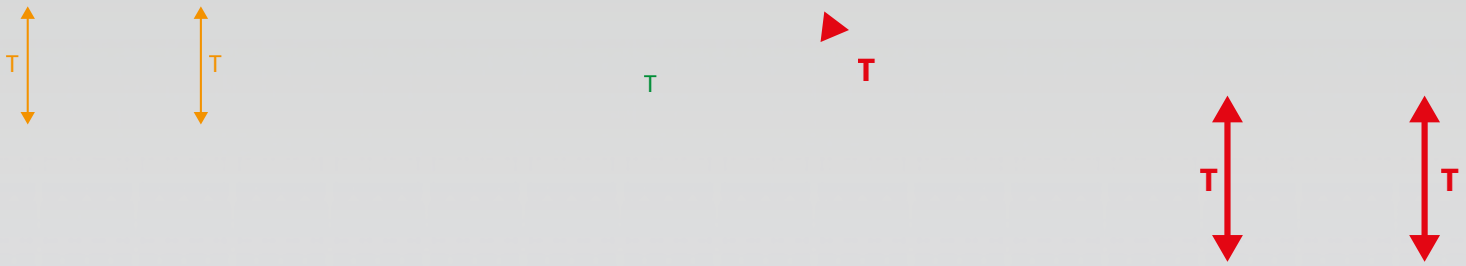
Foundation applications such as hydraulic grabs and hydromills are incredibly demanding even under o
things start to go wrong they can lead to huge increases in the hose tension as well a highly damaging
below examples give two typical "fault" situations where hydraulic grabs and hydromills can experience t



During normal operation the hydraulic hoses are in moderate tension caused by the connection between the grab body (which is supported by the metal cables) and the spring-loaded coiling mechanism on the crane boom arm. This tension is enough to keep the hoses from flailing around, but not enough to do them any serious harm.

However, if the grab gets stuck suddenly during its descent the metal cables and the hoses can become slack, as they continue to wind-out even though the grab body is no longer being lowered. This means that the tension in the hoses and cables is effectively reduced to zero for a brief period and the entire weight of the grab is supported purely by the friction between the grab and the walls of the hole. The hose, being spring-loaded, will then retract back to its normal state of moderate tension, but this time the cable is not supporting any of the weight.

So, if the tool were to suddenly become unstuck...



Similarly, during normal operation the hydraulic hoses are in moderate tension between the cable-supported hydromill body and the spring-loaded coiling mechanism.

If one of the hydromill rotors gets stuck part-way through the descent, the whole tool can become tilted. This can cause the hose on one side of the tool to experience a decrease in tension, whilst the other side experiences a significant increase in tension.

Coupled with the fact that the supporting cable may become slack due to the sudden stop, when the obstruction eventually clears...

ns

optimal working conditions. However, when and dangerous levels of shock loading. The these conditions.

. the entire weight of the grab would act upon the oses until the grab either it the bottom of the hole r reached the extent of he slack cable. This would esult in the hoses being apidly dragged off the oiling mechanisms and xperiencing tensions ar in excess of normal perating conditions.

To further complicate things, the rapid uncoiling of the hoses can also lead to the coiling mechanism going into a state of free-spinning due to the high rotational momentum of its flywheel-like design. This essentially means that when the weight of the grab is once again being supported by either the cable or the ground the hoses would continue to unwind for a short period - again effectively reducing the tension in them to zero before the spring recoil kicks in again.

This scenario is one of the major causes of hose shock-loading in grab applications

. the entire weight of the ydromill tool would act pon the hoses until the ool either hit the bottom f the hole or reached the xtent of the slack cable.

n the same way as with he grab tool, this would esult in the hoses being apidly dragged off the oiling mechanisms and xperiencing tensions ar in excess of normal perating conditions.

Once again, this sudden "stop-start-stop" situation can cause the hose to flap around as the momentum of the rapidly spinning hose reel begins a viscous cycle of uncoiling and recoiling hose. The tensile forces exerted on the hoses during these fault cycles can be extremely high and have been known to cause severe damage to the hydraulic hoses.

A typical situation where there is excessive slack in a long hose assembly, followed by rapid, high-impact retraction which can cause major damage to the hose

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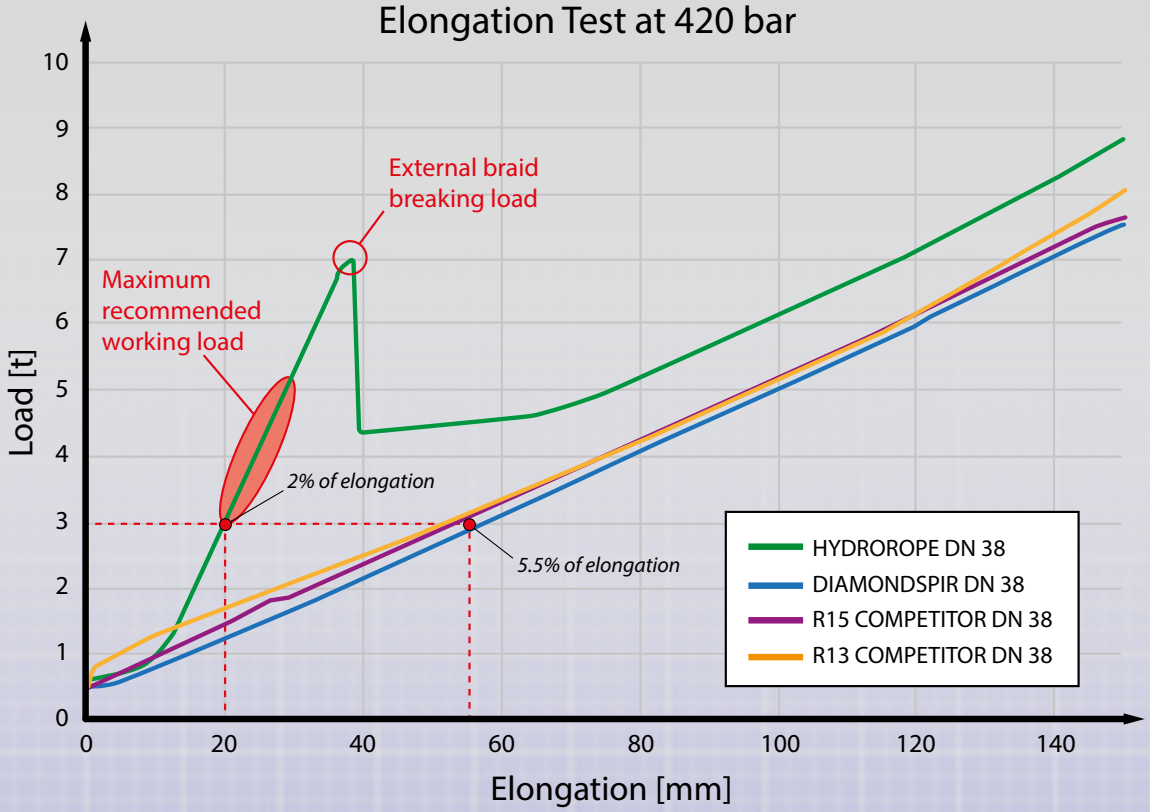
The innovative design of HydroRope has been developed in conjunction with major global OEMs and has endured exhaustive field testing in some of the harshest conditions imaginable. This is to ensure that its real-world performance far exceeds that of typical hydraulic hoses, allowing it to be safely used in situations where both static and dynamic loading is present. In fact HydroRope can comfortably support static loads of up to 3 to 5 tonnes* (safety factor of 2:1) without it having a detrimental effect on the hose performance or lifespan.

Tensile testing - the technical stuff

Tensile testing is a standard engineering test in which the two ends of a specimen are subjected to a steadily increasing load and the subsequent elongation of the specimen is measured. The results of several different specimens plotted together on a graph allow us to visualise the comparative tensile strengths of each specimen.

In the case of HydroRope, we tested it against a number of wire spiral hoses likely to be used in the same applications to see how the additional wire braid layer affected the performance. Each specimen was pressurised to 420 bar to ensure a real world operational comparison. As shown in the below graph, the elongation of the HydroRope specimen, when subjected to up to 7 tonnes of force, was up to 70% less than the elongation of all of the comparative specimens. This means that whilst in this range the inner tube of HydroRope is subjected to far less extension and is therefore far less liable to be damaged than the inner tube of the other sample hoses.

Even after the wire braid layer has finally broken (at approx. 7 tonnes), the wire spirals are completely unaffected and continue to provide a similar elongation profile to the other samples, although still performing at a noticeably higher level.



** HydroRope is **not** intended to be used instead of standard lifting cable (or similar) as the sole means of supporting loads. As such it does not have a Safe Working Load (SWL) value. The design of HydroRope is intended to provide additional protection and performance in tension applications, where the normal working load applied to the hose would cause cumulative internal damage to standard hoses. The application of high tensile loads, especially dynamic or shock loads, directly to the hose in normal operational conditions is not recommended or covered by the Manuli Hydraulics Warranty.*

Tensile testing of HydroRope at 420 bar

Interlock Plus and Interlock Super integrated fitting solutions

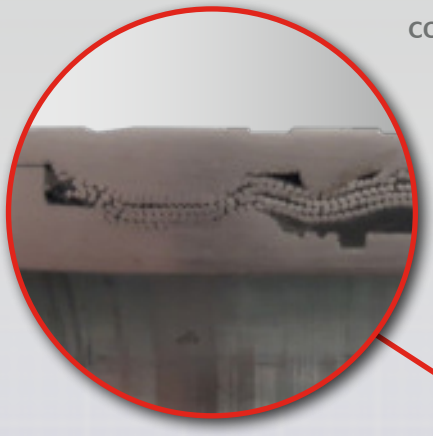
The Interlock Plus fitting solution has long been regarded as the gold standard for a high-pressure fitting solution. Tested to 1 million impulse cycles and with a double-skive, bite-the-wire design, Interlock Plus fittings guarantee the highest levels of fitting security, service life and leak protection, making them the go-to fitting for major OEMs.

Interlock Plus (left) and Interlock Super (right)

Along with the even more robust Interlock Super range, this extreme performance makes these the ideal fitting solutions for HydroRope.

In cases of high axial tension one of the most important factors of the Interlock Plus and Interlock Super design is the "locking" area, which provides constricted metal-to-metal contact between the hose reinforcement and the fitting to actively resist tensile forces. The internal "teeth" of the ferrule have also been proven to provide a firm grip on the hose reinforcement without the risk of accidentally cutting through the wire.

The Interlock Super range also provides additional length on the hose insert to further improve the security of the hose-fitting connection.



Locking area to actively resist axial loading

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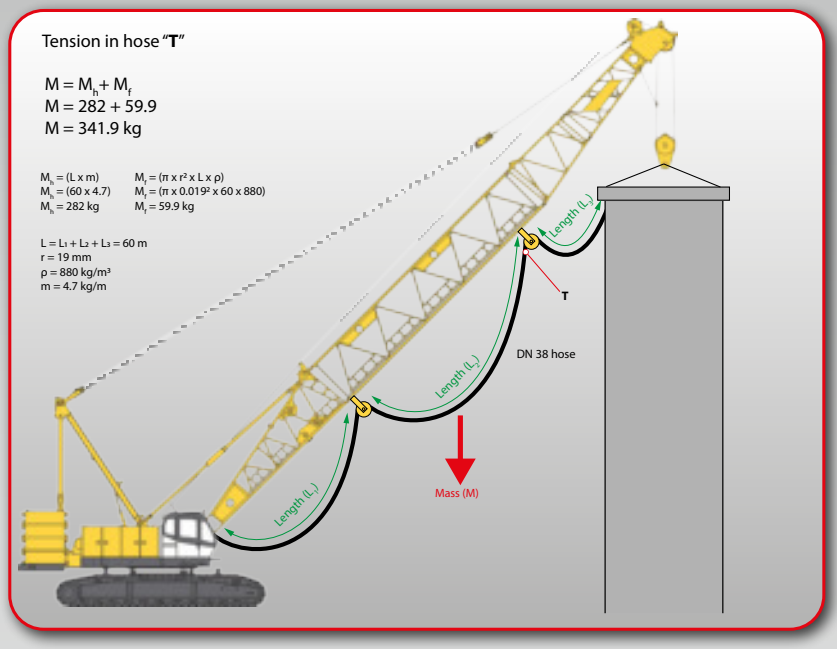
Long length applications

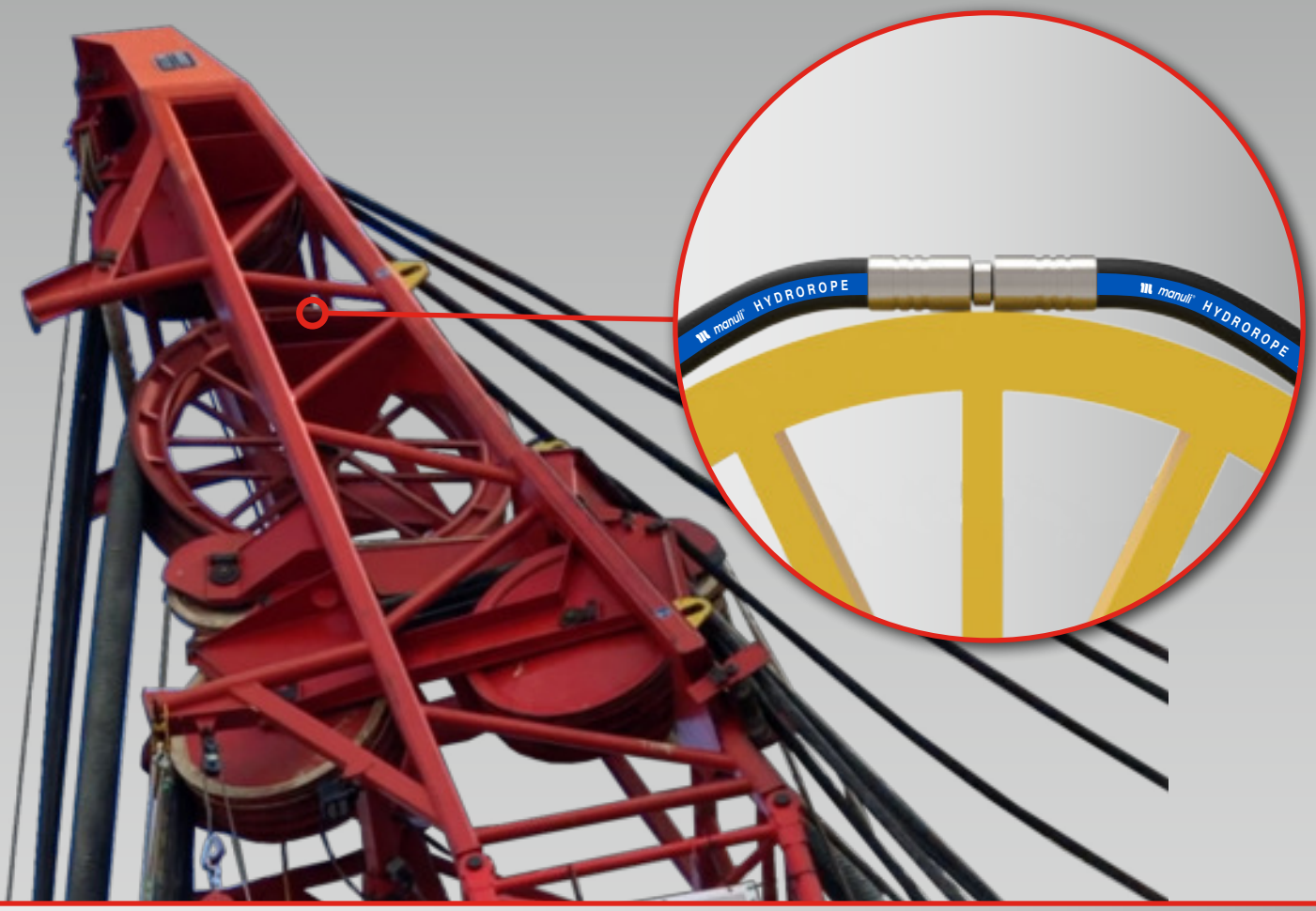
In addition to applications where the hydraulic hoses are being mechanically pulled, the high tensile strength of HydroRope also makes it ideal for many other applications where long lengths of suspended hose are required.

Offshore pile-driving, construction pile-driving and certain mining applications typically require extremely long lengths of hydraulic hose, many of which are only partially supported by pulleys, leaving large sections of the hose freely suspended. As these are usually large bore hoses, the suspended weight of the hose including the hydraulic fluid can be several hundred kilograms between supports.



In this example a DN 38 hose with a suspended length of just 60m would exert a tensile force of approximately 340kg on the hose. In large scale applications, such as offshore pile-driving, where the hose lengths can reach between 120m and 150m, simply supporting its own suspended weight would be taxing for most normal hoses.

HydroRope, on the other hand, can easily support its own weight, including hydraulic fluid, for lengths up to 500m.

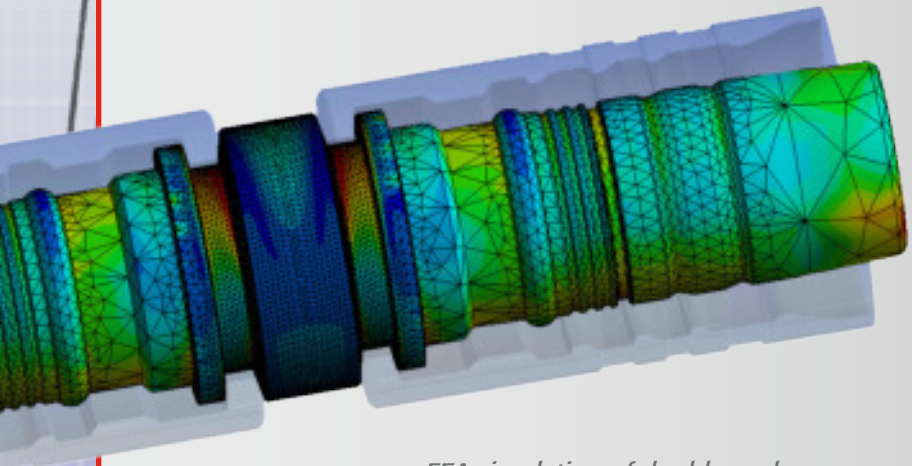


Similarly, hydromills and hydraulic grabs can require hose lengths of well over 100m meaning that the weight of the tool is not the only significant tensile force acting on the hose assemblies.

Robust hose-to-hose connection

This requirement for long lengths of hose means that they will inevitably require at least one hose-to-hose connection. If these connections result in weak-points in the complete hose assembly then any benefits of a high-tensile hose would be lost. That is why Manuli has developed a dedicated double-connector for use in these applications. This connector uses Manuli's Interlock Plus double-skive insert and ferrule to ensure a highly robust connection, while its compact dimensions allow it to pass over the smaller diameter boom-end pulleys without the risk of the hose becoming dislodged from the pulley groove.

The small diameter of the boom-end pulleys also puts significant stress on the connection by requiring the hose to bend far closer to the ferrule than would normally be recommended. The intelligent design of the connector, coupled with extensive field testing and FEA simulation, means that even under these harsh conditions Manuli guarantees that the connection is sturdy enough to endure repeated, long-term use without detrimentally affecting the life of the hose.



FEA simulation of double-end hose connector in use

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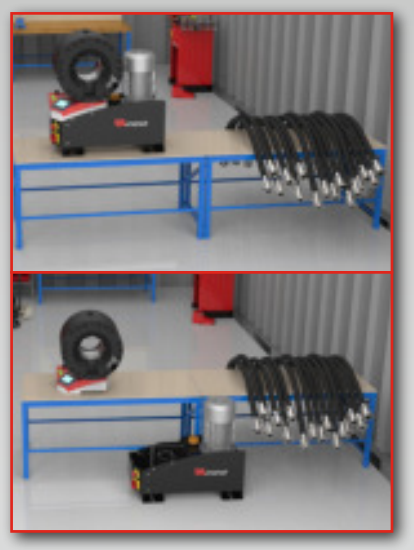
Fully integrated assembly solutions

As the world's leading manufacturer of integrated hydraulic connector solutions it goes without saying that Manuli offers a range of assembly equipment that has been proven to work seamlessly with both HydroRope and its relevant fitting solutions. Foremost amongst these solutions are the GoldenCrimp/420 and the MS 480 crimping machines.

Both machines are ideal for use with large bore, wire-spiral hoses and are rugged and reliable enough to withstand heavy usage, either in a field-repair workshop (GoldenCrimp/420) or on an OEM hose assembly line (MS 480).

MS 480 machines come with Manuli's proprietary SCS control system as standard, whereas the GoldenCrimp/420 is available with three different levels of automation, including the new bluetooth enabled controllers which link directly to your smart-phone or tablet. All three systems are designed to ensure that the possibility of human error creeping into your crimping operations is minimised as much as possible.

The GoldenCrimp/420 also offers a split-head design which allows the crimping head and controller to be located remotely from the power pack if required.



Each machine offers:

- High crimping force (420 or 480 tonnes)
- Wide opening with long master dies
- Full range of die sizes
- Integrated die storage*
- Footswitch operation*
- Robust and reliable operation

** optional on GoldenCrimp/420*

HYDROROPE

OUTSTANDING TENSILE STRENGTH

TECHNICAL DATA

PART REF.	HOSE SIZE			R.O.D		O.D		MAX. W.P		BURST		MIN. BEND		WEIGHT		FITTINGS	
	DN	dash	inch	mm	inch	mm	inch	bar	psi	bar	psi	mm	inch	g/m	lb/ft	Std 1	Std 2
H10136025*	25	-16	1	38.2	1.50	41.4	1.63	420	6,090	1,680	24,360	400	15.51	2,910	1.95	IP+M01850-16	
H10136031*	31	-20	1.1/4"	46.9	1.85	50.1	1.97	420	6,090	1,680	24,360	450	17.72	3,749	2.52	IP+M01600-20	
H10136A38*†	38	-24	1.1/2"	53.2	2.09	56.5	2.22	350	5,076	1,400	20,305	500	19.65	4,256	2.86	IP+M01600-24	
H10136038*	38	-24	1.1/2"	54.7	2.15	57.3	2.26	420	6,090	1,680	24,360	600	23.62	4,650	3.12	IS+M02700-24	
H10136051*	51	-32	2"	69.2	2.72	72.4	2.85	420	6,090	1,680	24,360	800	31.50	6,590	4.42	IS+M02700-32	
H10136063*	63	-40	2.1/2"	84.1	3.31	87.3	3.44	380	5,511	1,520	22,045	900	35.43	9,405	6.31	IP+M01900-40	
H10136076*	76	-48	3"	97.1	3.82	100.2	3.94	350	5,076	1,400	20,305	1000	39.37	11,106	7.46	IS+M02700-48	

† Compact hose

KEY FEATURES

- Designed to resist pulling force
- High pressure resistance
- Superior abrasion resistance
- High ozone and weather resistance
- Flame resistance to a wide range of specs
- Anti-static and anti-toxic cover

APPLICATIONS & FLUIDS

- Heavy duty power lines in severe environmental conditions
- Specific installations with tough abrasion conditions
- Off-shore applications, underground and open-pit mining, special machines where hose high pulling resistance is required (grabs, etc.)
- Mineral oils, vegetable oils and synthetic ester based oils (up to 100°C/212°F), glycols and polyglycols, mineral oils in aqueous emulsion, water

CONTINUOUS SERVICE TEMPERATURE RANGE

-46 °C, -50 °F

121 °C, 250 °F

TUBE

Oil resistant synthetic rubber

REINFORCEMENT

Four (DN 25, DN 38 Compact) and six (DN 38 - DN 76) high tensile steel spirals + One high

COVER

STRONG - TYPE “SC”
Synthetic rubber with high abrasion, ozone, weather and heat resistance and an extended operational temperature range

APPLICABLE SPECS

Manuli® Design

TYPE APPROVALS

MSHA; CU-TR;

manuli® HYDRAULICS

www.manuli-hydraulics.com

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GENERAL HYDRAULICS

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