FLUID POWER TECHNICAL NOTE

MXT™ MEGASys® Hydraulic Hose – Design Benefits

MXT braided hose is an innovative addition to Gates premium, MegaSys hydraulics portfolio. Advanced materials science and process technologies result in a patent-pending hose design that meets conventional 2-wire performance with 1-wire technology. MXT hose can provide many benefits to system design and savings compared to conventional braided hydraulic hoses. For example, the tables below compare a Gates 16G2 (SAE J517 100R2, ISO1436 2SN R2 and EN 853 2SN) hose to the 16MXT hose.

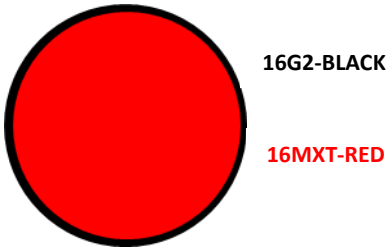
Outside Diameter (O.D.) – Cross Sectional Space

The smaller O.D. of MXT hoses provide a more compact design. The smaller hoses fit more easily on existing equipment. Engineers who are designing new hydraulic systems can use less space with MXT hoses which can reduce the overall machine size or free-up valuable real estate to help accommodate other components. The table below shows the 6.6% smaller O.D. and 12.9% smaller cross sectional area for the 16MXT hose compared to the 16G2 hose.

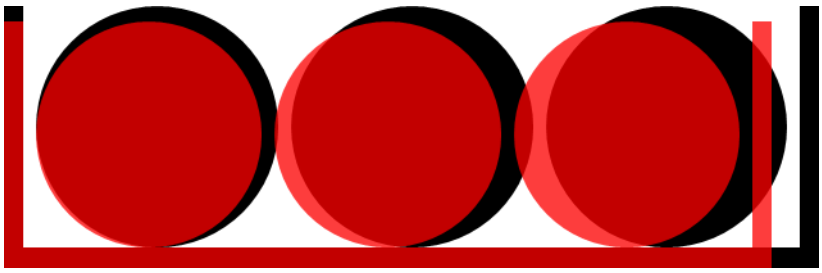
Hose/Cable tracks are often used on more complex machines to route and guide multiple longer hoses and electric lines. The smaller cross section of MXT hoses take up less space in the track which is beneficial for adding additional items without having to redesign existing tracks or possibly redesigning with a smaller track for additional machine space and weight savings. The table below compares the 11.7% track area savings for three -16 size hoses with 2 mm clearances between components. The picture demonstrates the smaller, red colored MXT track and hoses superimposed over the larger, black colored G2 hoses and track.

When substituting MXT hose for current hoses, there may be a concern about the smaller MXT hose fitting existing clamps for routing. However, comparing the hose circumferences, the difference can typically be accounted for in the clamp adjustment range. For example, the -16 hose comparison shows only a 6.6% difference in hose clamping circumference.

	16G2 Hose	MXT Hose	Difference	Savings
O.D. (mm)	37.6	35.1	-2.5	-6.6%
Cross Sectional Hose Area (mm^2)	1,110	968	-143	-12.9%
Track Area Required (mm^2)	5,148	4,545	-603	-11.7%
Circumference - Clamping (mm)	118.1	110.3	-7.9	-6.6%



Comparison of Hose O.D.'s & Area



Cross Sectional Comparison of 3 Hoses in a Guide Track

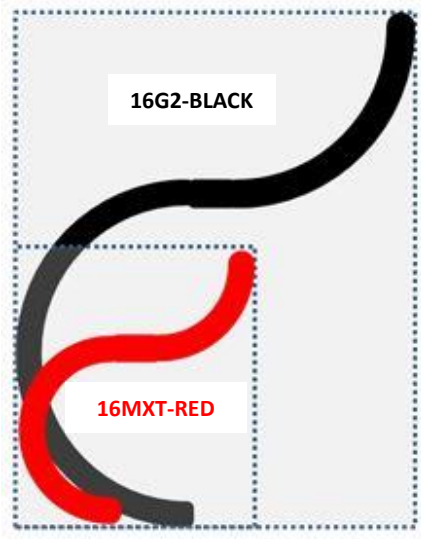
Minimum Bend Radius (MBR) – Hose Routing Area and Pressure Drop

The advanced materials design of MXT hoses provides much tighter minimum bend radii. For the example -16 size hoses shown below, the MXT MBR of 152 mm is half the MBR required by the G2 hose. The smaller MBR allows engineers to use tighter hose routings and greater design flexibility on placing other components such as pumps, valves and cylinders to achieve the most compact overall design possible.

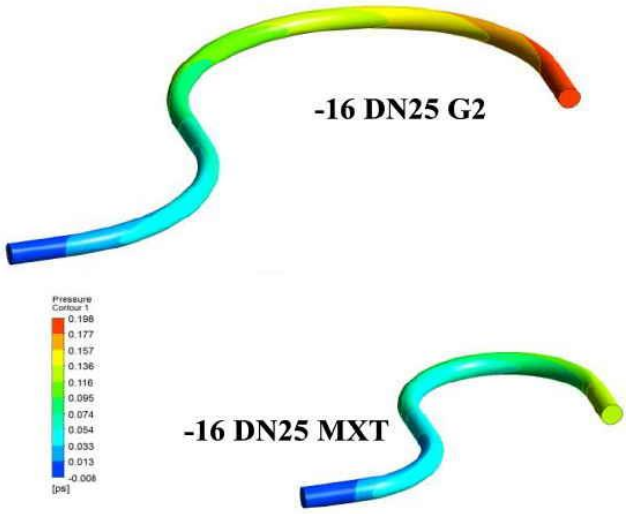
The hose routing length of 1550 mm for the larger MBR 16G2 hose can be reduced in length to just 425 mm with the smaller MBR 16MXT hose for a 72% hose length difference and hose price savings. Comparing the square routing area and cubic volume (using hose diameter) shows over a 70% savings in space required to fit the MXT hose compared to the G2 hose.

The shorter required length for the MXT hose also reduces pressure drop and increases fluid flow compared to the longer length required in the G2 hose. Computer modeling of the -16 hose routes shows over 50% less pressure drop for the 16MXT hose compared to the 16G2 hose. MXT hoses' improved flow rate creates less pressure drop and heat generation, resulting in improved system performance. This may allow the designer to re-engineer hydraulic pumps and other components for additional system savings from an MXT hose conversion.

	16G2	16MXT	Difference	Savings
Minimum Bend Radius (mm)	305	152	-153	-50.1%
Hose Cut Length (mm)	1550	425	-1125	-72.6%
Hose Routing Width (mm)	710	399	-311	-43.8%
Hose Routing Height (mm)	990	526	-463	-46.8%
Hose Routing Area (M^2)	0.70	0.21	-0.49	-70.1%
Hose Routing Volume (M^3)	0.026	0.007	-0.019	-72.1%
Hose Unit Price ($ U.S./mm)	$0.10	$0.10		
Hose Price ($U.S.)	$155.00	$42.46	-$112.54	-72.6%



Comparison of Hose Routing Area



Comparison of Computer Modeling - Fluid Pressure Flow

Force To Bend (FTB) – Installation, Ergonomics and Safety

The proprietary braiding process used to manufacture MXT hose results in an extremely flexible hose with minimal force required to bend. The 16MXT hose takes only 3.3 kg of force compared to the 10.3 kg of force required to bend the 16G2 hose to the same diameter. The improved flexibility makes hose installation much easier, especially in compact hose routing designs. This reduces the time and labor cost required to install hose on the production line or during field replacements. Timed installation trials resulted in the MXT hose taking 50% of the time or less to route. Better ergonomics also make it safer for all installers, reducing the risk for injuries.

	16G2	16MXT	Difference	Savings
Force-to-Bend (kg)	10.3	3.3	-7.0	-68.0%
Installation Time (minutes)	3.0	1.5	-1.5	-50.0%
Labor Rate ($U.S./hour)	$40.00	$40.00		
Installation Cost ($U.S.)	$2.00	$1.00	-$1.00	-50.0%

Weight of Hose and Fluid – Lighter Systems, Fuel Economy, Fluid Reservoir and Cooling

The advanced MXT hose is significantly lighter weight compared to conventional hose designs. This makes moving and installing hose assemblies much easier. OSHA recommends a single person lift a maximum of 23 kgs. The lighter MXT hose may negate the requirement for 2 people to lift longer and heavier assemblies. The 16MXT hose is 30.1% lighter weight than the 16G2 hose per unit of length.

MXT hose is lighter in unit weight, but, also offers further weight savings potential. As demonstrated above with the hose routing example, the tighter MBR for MXT hose can reduce the hose length required. This not only reduces the length and thus weight of the hose itself, but, also the fluid contained in the hose. The 1125 mm shorter hose length from the example above results in a 76.7% total weight savings from hose and fluid. When applied to multiple assemblies on one machine, the overall reduced hydraulic fluid volume may improve cooling or possibly allow a smaller fluid reservoir to be used saving additional weight and space. Lighter MXT hoses help design engineers meet overall machine weight goals for shipping requirements, improved fuel economy and other design goals.

	16G2	16MXT	Difference	Savings
Weight Per Unit Length (kg/100 meter)	143	100	-43	-30.1%
Cut Length - Hose Weight (kg)	2.22	0.42	-1.8	-80.8%
Hydraulic Fluid Weight (kg)	15.1	3.6	-11.5	-76.1%
TOTAL Weight (kg)	**17.3**	**4.0**	**-13.3**	**-76.7%**

Impulse Cycles – Durability and Replacements

The field performance of hydraulic hose assemblies can vary depending on actual fluids, pressures, temperatures, duty cycles, load spikes, abrasion, etc. Industry standards such as SAE J517 100R2, ISO1436 2SN R2 and EN 853 2SN define laboratory impulse tests to aid in comparing the relative performance and durability of braided hoses. These standards specify a minimum hose performance level of 200,000 impulse cycles. The premium performance provided by MXT hoses have been tested to a minimum of 600,000 impulse cycles. At 3x industry standards, the greater longevity of MXT hoses can reduce the number of hose replacements required which saves on assembly, installation and potential downtime costs.

	16G2	16MXT	Difference	Savings
Impulse Test (Cycles)	200,000	600,000	400,000	200.0%
# Hose Replacements for Each MXT Hose	3	1		
Assembly Price ($U.S.)	$175.00	$62.46	-$112.54	-64.3%
Installation Cost ($U.S.)	$2.00	$1.00	-$1.00	-50.0%
Downtime Cost ($U.S./hour)	$1,000	$1,000		
Replacement Cost($U.S.)	$3,531	$1,063	-$2,468	-69.9%

Multiple Assemblies - Overall Machine Savings

The examples above show the potential benefits and savings of designing with MXT hose for just a single hydraulic assembly. Large pieces of equipment may have 10, 20, even 30 or more hose assemblies per machine. The table below shows the overall savings potential for a machine with 15 hoses.

	16G2	16MXT	Difference	Savings
Number of Hose Assemblies per Machine	15			
Total Hose Cross Sectional Area (mm^2)	16,655	14,514	-2,141	-12.9%
Total Routing Area (M^2)	10.5	3.2	-7	-70.1%
Total Routing Volume (M^3)	0.4	0.1	-0.3	-72.1%
Total Weight of Hose/Fluid (kg)	259.3	60.3	-199.0	-76.7%
Total Hose Length (mm)	23,250	6,368	-16,882	-72.6%
Total Replacement Cost ($U.S.)	$52,965	$15,952	-$37,013	-69.9%

Combining the space, weight, flexibility and durability savings of MXT hoses can provide many potential design benefits to hydraulic engineers.

Should you have any questions or concerns regarding Gates hydraulic and industrial hose products, please contact **Product Application in Denver, Colorado at (303) 744-5070 or by e-mail at FPPASUPPORT@gates.com.**