

Authored by:

Andreas Weil

Chief Engineer, New Product
Development and Innovation

Greg Reardon

Business Development Manager
Parker Hannifin, Hose Products Div.
Wickliffe, Ohio

Edited by **Kenneth J. Korane**
ken.korane@penton.com

Key points:

- Compact hose built to ISO specs has the same pressure and flow rating as similar SAE hose.
- Compact spiral hose has longer life, weighs less, and is more flexible than traditional spiral-wire reinforced hose.

Resources:

Parker Hannifin Corp., Hose Products Div., www.parkerhose.com

RS# 622

To learn more about Parker Compact Spiral hose, visit www.compactspiral.com

Compact hose does more with less

For engineers specifying hydraulic hose, SAE J517 traditionally provided the benchmark for pressure ratings and performance. The standard's 100R Series specifications have been driven by hose manufacturers and were traditionally based on hose design and construction — such as one or two-wire braided reinforcement and four or

six-wire spiral; on pressure capacity that varies by size (R9, R10, R11, R12); and on constant pressure ratings regardless of size (R13, R15, R17, R19).

In recent years, however, the trend has been away from SAE in favor of ISO specifications — in particular the constant-pressure classifications of ISO Standard 18752.



Compact Spiral hose was subjected to flex-impulse testing to mimic real-world conditions.

Compact spiral hose built to ISO specs weighs less than comparable SAE hose. Better flexibility permits tighter routing with shorter hose lengths. It reduces the weight of mobile machinery that uses a lot of hose, such as construction equipment and on-road vehicles such as garbage trucks.

A new hydraulic hose handles the same flow and pressure of traditional hose, yet is smaller, more flexible, and lasts longer.

ISO 18752

Why ISO 18752? Many major mobile and industrial OEMs have already switched to ISO standards in their design and manufacturing processes to streamline global sales and service of their machinery. Released in 2006, ISO Standard 18752 for hydraulic hose is relatively new to North American manufacturers.

Performance testing

ISO Standard 18752's toughest requirements are for grade D, type DC hose. It specifies that hose **must last** a minimum of 1 million impulse cycles with fluid at 120°C and impulse pressure at 133% of maximum working pressure.

This accelerated test — where a "U" shape hose mounts on the test stand — puts impulse stress on the spiral wires and fittings/coupling attachments for the **minimum** number of required cycles.

Parker's 787TC and 797TC Series hoses have been tested under those requirements for 2 million cycles, and at bend radii even tighter than the standard requires. It indicates that the hose could provide double the life required in the ISO standard.

Though not specified by SAE or international standards, Parker also subjected its hoses to flex tests. Here, the hose flexes while impulse pressure is applied to gauge performance and longevity. Results show superior life compared with standard spiral hose.

ISO Standard 18752 takes a different approach from SAE J517. It reflects the design practices of users who construct hydraulic systems based on performance and pressure requirements. In the ISO standard, hydraulic hoses are classified into four grades, A, B, C and D, according to their resistance to impulse pressure at a specified temperature. Each grade is then refined by the OD of the hose into standard (AS, BS, CS) or compact types (AC, BC, CC, DC).

As shown in the table, "ISO 18752 ratings," each grade requires that a hose meet a minimum number of impulse cycles at specific temperatures and impulse pressures. For instance, grade D, type DC Series hoses must last at least 1 million impulse cycles.

While it is difficult to predict hose life in specific applications, experience shows that the service life of these hoses will significantly exceed that of traditional hoses built to meet less-stringent specs.

This is particularly true in applications with many cycles repeated in a short time frame — such as on injection-molding machines. Replacing hose that meets the SAE requirement of 500,000 cycles at 120% of working pressure with ISO hose rated for 1 million cycles at 133% of working pressure can significantly extend hose life.

Overall, if routed and installed correctly and protected from external damage, hose with higher impulse life-cycle rating will last longer in nearly all real-world applications.

Compact spiral

A good example of hoses built to ISO specs is the new Compact Spiral line from Parker Hannifin, Wickliffe, Ohio. It provides OEMs with the performance of traditional spiral hose, but with characteristics of braided hose — lighter weight, more flexibility, and a tighter bend radius.

Specifically, the new lines are designated 787TC (rated for 35.0 MPa; 5,000-psi maximum working pressure across all sizes) and 797TC (42.0 MPa; 6,000 psi for all sizes).

Key to the new design is a proprietary nitrile-based inner tube that is stronger than comparable tubes in stan-

ISO 18752 ratings

Grades	Types	Resistance to impulse		
		Temperature, °C	Impulse pressure (% of maximum working pressure)	Minimum number of cycles
A	AS	100	133%	200,000
	AC			
B	BS	100	133%	500,000
	BC			
C	CS	120	133 or 120%	500,000
	CC			
D	DC	120	133%	1,000,000

Specs for ISO 18752 show the highest-rated hose must resist a minimum 1 million impulse cycles at 133% of maximum rated working pressure.

standard spiral hose. Higher strength means the new inner tube can be thinner without sacrificing pressure and sealing capabilities.

Reducing the tube wall thickness, in turn, opened an opportunity to redesign the wire reinforcement, even though the number of spiral-reinforcement layers remains the same as on standard hose.

A thinner tube means each reinforcement layer subsequently has a smaller OD. Also, using higher-tensile-strength steel wires let engineers reduce the wire diameter without sacrificing reinforcement capacity — and this further decreases the diameter of each wire layer.

In addition, the wrap angle of each wire layer is set to maximize both flexibility and pressure capacity. And, finally, all components are assembled to tighter-than-ever tolerances. Added up, the new hose has a smaller OD than standard spiral products — but with the same pressure rating.

Hose benefits

Here's a look at some of the advantages compact hose offers:

Smaller OD with same ID. The ID of 787TC and 797TC hose is the same as common SAE spiral hoses, ensuring consistent performance and flow characteristics without the need to modify a hydraulic system. What has dramatically changed, however, is the external size of the hose, with space savings as high as 29%.

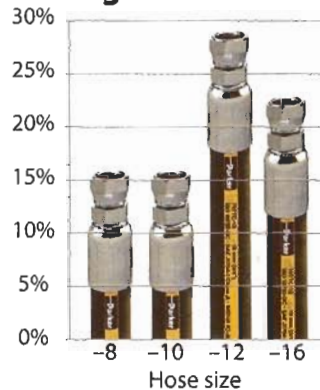
This offers a couple of advantages for OEMs. One, with a smaller OD, designers will have more room to fit hoses

into limited spaces, and with it the possibility of tighter routing in new system designs.

Or equipment builders can specify hose that's one size larger without requiring more space — such as going from a traditional size -8 to size -10, or -10 to -12. This can improve a circuit's flow characteristics without a redesign.

Flexibility. The new construction and smaller exterior dimensions gives compact spiral hose a tighter minimum bend radius compared with standard SAE hose. This means less hose is needed to make port-to-port connections. For new machines, a smaller bend radius also lets designers place key components — such as pumps and valves — closer together, so systems can be more compact. This gives engineers more freedom in configuring

Weight reduction



Compact spiral hose weighs up to 26% less than standard SAE 100R13 and R15 spiral hose.

equipment.

Lighter weight. Due to smaller size, compact spiral hose weighs as much as 26% less than standard versions. This weight reduction can cut fuel consumption on mobile and on-road equipment with many hydraulic hoses, such as refuse trucks. It also translates into packaging,

Calculate your savings on-line

Parker Hannifin has a calculator program that helps evaluate the value Compact Spiral hose can bring to a machine. Get more info at www.compactspiral.com.

Comparing bend radius

797TC-12,
minimum
bend
radius =
5.25 in.

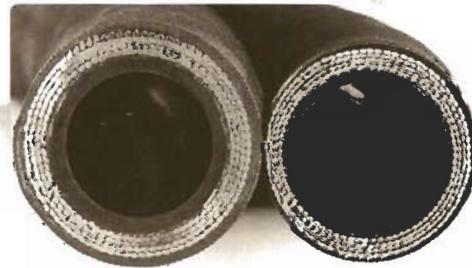


SAE
100R15-12,
minimum
bend radius
= 10.5 in.

10.5 in.

21.0 in.

Bend radii for 787TC and 797TC hoses are much tighter than for comparable standard SAE hose at the same constant pressure.



Parker's 797TC hose has a smaller OD than comparable SAE hose, permitting tighter routing and potential space savings.

space, and shipping savings.

Installation. Hose that is smaller, lighter, and more flexible simplifies installation. Traditional spiral hydraulic hoses are stiff and heavy. That makes installation hard work. Pulling hose through equipment, moving it into place, and connecting fittings is, at best, quite burdensome, and may require two or three people. Compact spiral hose, on the other hand, reduces installation time and manpower requirements. As an added benefit, this may reduce employee fatigue and the risk of injuries.

Long life. As mentioned above, spiral hose built to ISO's highest specs will last longer, and that saves on replacement parts and labor. Also, the inner-tube compound used in 787TC and 797TC hose improves heat-aging and fluid-compatibility characteristics. Although actual hose life depends on the hydraulic fluid, temperature, and operating conditions, tests indicate that compact hose life is significantly longer than that of standard spiral hose.

Potential savings

Changing from standard SAE spiral hose to ISO compact spiral offers potential savings for equipment builders. For instance, on mobile equipment, savings might include:

- Smaller bend radius reduces overall hose length, saving on costs.
- Lighter weight hose lessens vehicle weight, saving on fuel. Or it lets users install additional equipment with no increase in vehicle weight.
- Field life will exceed that of standard spiral hose. Less frequent replacement leads to obvious savings.

In particular, on mobile equipment that uses movable cable track

to protect hoses and cables as they run the length of a boom arm, potential savings include:

- Smaller OD hose may permit a smaller, less-expensive cable track.
- Better flexibility lets the track move smoother and more easily, possibly with less hose abrasion and wear and tear on other components. And the machine might consume less energy when moving the boom.
- Smaller and lighter cable track is easier to handle, requiring fewer man-hours for installation and repair.

It's not unusual for total saving to add up to more than \$1,000 per machine. Obviously, actual savings will vary by application. **MD**

New fittings an industry first

New fittings — the 77 Series for 787TC and 797TC hose — feature a nipple profile that bites into the wire reinforcement without removing (skiving) the inner tube, reportedly an industry first. Other fittings on the market require complex, slow, and error-prone internal skiving to let the nipple grip the wire. The 77 Series fitting also cuts through the outer cover to grip the wire OD, again without skiving.

The fitting clamps the hose-reinforcing wire from inside and out to give excellent holding power despite high pressures — and with shorter fittings than those used with comparable spiral hose.

The fitting also requires less "push-in" force to insert it on the hose before crimping, compared with the company's previous designs. Finally, to protect the hose/fitting interface against contaminants such as dirt and rain, a weather seal has been incorporated at the end of the 77 Series fittings. This prevents moisture from penetrating the fitting and corroding the spiral wire.