



Metal pipe penetration seals – a comparison analysis

Roxtec SPM™ seal, bulkhead unions and sealing plugs

Analysis of three sealing methods

It is important to protect metal pipes with an effective and reliable seal when penetrating decks or bulkheads. Some use Roxtec SPM™ seals while others use bulkhead unions or sealing plugs. All three options are valid, certified and approved but there are significant differences between them which should be understood and taken into consideration before deciding which solution to use. One important

aspect to consider is the time needed to complete each installation whereas other relevant factors are the number of component parts to each solution, the total additional weight as well as the space taken. This document is a summary of an installation comparison exercise conducted between three different solutions, all designed to protect and seal a 16mm metal pipe.

Results in numbers

Roxtec SPM™ seal	Bulkhead unions	Sealing plugs
		
Number of component parts		
1	5	3
Length of completed installation (millimeters)		
44	107	134
Weight (grams)		
138	588	782
Number of welded joints		
0	2	2
Number of installation steps		
4	16	16
Effective installation time (minutes)		
2:13	7:15	10.22

Number of component parts required

Roxtec SPM™ seal	Bulkhead unions	Sealing plugs
		
1	5	3

Assuming a requirement for a single watertight, gastight and fire rated solution, only one article is required when using the Roxtec SPM™ seal.

A bulkhead union requires five separate pieces, which are typically ordered and purchased separately using three different article codes. There is normally one article code for the welded bulkhead connector, another for the two union nuts and a third for the cutting rings.

The sealing plug requires a sleeve plus two sets of plugs, one for each side of the deck or bulkhead. Each set of plugs includes the two half seals required to complete one side of the penetration. Therefore, in order to complete a watertight and fire rated installation, two sets of plugs will typically need to be quoted, and eventually purchased.

Length of a 16mm pipe installation

Roxtec SPM™ seal	Bulkhead unions	Sealing plugs
 A close-up photograph of a metal pipe passing through a dark metal plate. A blue and silver Roxtec SPM seal is installed around the pipe, creating a tight seal.	 A close-up photograph of a metal pipe passing through a dark metal plate. A bulkhead union is installed, consisting of a nut and washer on the outside of the plate and a corresponding nut and washer on the inside of the plate.	 A close-up photograph of a metal pipe passing through a dark metal plate. A sealing plug is installed, which is a cylindrical component that fits into the hole in the plate and is secured with a nut and washer on the outside.
44 millimeters	107 millimeters	134 millimeters

The length of each installation could also be described as the depth of each penetration. The longer the installation, the further away from the deck or bulkhead the installer is able to add a joint or coupling, or more importantly, route the pipe system in a different direction.

Space, or the lack of it, is a critical factor when managing pipe penetrations. The shorter the installation piece, the more flexibility the installers have to route pipe or to fit other systems into a confined space.

The Roxtec SPM™ seal is more than 50% shorter than the other solutions.

Weight of a 16mm pipe installation

Roxtec SPM™ seal	Bulkhead unions	Sealing plugs
		
138 grams	588 grams	782 grams

Weight savings onboard marine vessels in order to support greater speeds and improved fuel efficiency are particularly important for many owners and shipyards.

Due to the fact the Roxtec SPM™ seal does not require a sleeve or any steel parts welded directly to either the deck or the bulkhead, the total weight of any installation is significantly lower than any alternative solution. The Roxtec SPM™ seal weighs 138g, the bulkhead union 588g, which is more than three times heavier than the Roxtec SPM™ seal, and sealing plugs with the sleeve, 782g or more than four and a half times heavier. Bulkhead unions are considered a small, lightweight component whereas in reality, due to the heavy steel body which is required to weld directly to the ship's structure, it is significantly heavier than the equivalent Roxtec SPM™ seal.

The weight differential between one solution and another might not appear to be that significant however, when you extrapolate over multiple penetrations, the total savings start to become very significant indeed.

The weight savings become even more substantial when looking at larger diameter pipe. The above data is reflective of comparative solutions for 16mm pipes however, if you were to compare the Roxtec SPM™ seal with sealing plugs (plus sleeves) for a pipe diameter of 54mm (2"), the weight differential is much more significant. For example, the Roxtec SPM™ 92 solution that protects a 54mm diameter pipe, weighs only 500g whereas the weight of just the sleeve for an equivalent sealing plug solution is five times (2.5kg) the weight of the Roxtec SPM™ seal.

Number of welded joints

Roxtec SPM™ seal	Bulkhead unions	Sealing plugs
0	2	2

The costs associated with welding, whether it be on a new build or a retrofit/repair project, are always very high and the industry is becoming more and more interested in learning new ways to reduce welding time and its associated cost. The number of welded joints for each penetration can therefore, be a direct method of calculating potential time and cost savings over the scope of a complete project.

Bulkhead unions and the sleeves required for sealing plug solutions can in some cases be installed by single sided welding. However, most shipyard standards require them to be welded on both sides in order to minimize opportunities for moisture to build behind steel plates and cause potential corrosion issues.

With the Roxtec SPM™ seal requiring zero welded joints, the difference in installation time and the subsequent total cost savings between the Roxtec non-weld product and alternative solutions, very soon become a significant financial benefit.

This benefit becomes even more significant when you extrapolate the savings per penetration over a full ship set of metal pipe penetrations.

For the comparison exercise to be fair, open and transparent, Roxtec chose to conduct the installations on a small diameter pipe (16mm) to limit the impact of the welding time on the final results. Obviously, the larger the diameter of the pipe being sealed, the larger the diameter of the sleeve needs to be which has a direct impact on the time spent completing the welding process.

Cutting the pipe?

Roxtec SPM™ seal

No

Bulkhead unions

Yes

Sealing plugs

No



Cutting the pipe is an additional step that has to be completed when installing bulkhead unions. It takes extra time plus the need for extra tools. In addition to the simple cutting process, new preparation work is required to make the newly cut end of pipe clean and free from rough edges.

However, the main issue with cutting the pipe during the process of sealing a pipe penetration is compromising the integrity, quality and performance of the pipe system. At every bulkhead union penetration, the chosen, technically superior thin walled metal pipe of choice is being replaced by a simple, low quality steel pipe.

The cutting of the pipe in order to transition to a bulkhead union means there are two more connections included within the pipe system. The more connections, the higher the risk of leaks forming and ultimately, exposing the pipe system to the subsequent corrosion risks that follow.

Number of steps per installation

Roxtec SPM™ seal	Bulkhead unions	Sealing plugs
		
4	16	16

In general, an installation process that requires more steps to finalize will take more time to complete than a process with fewer steps. Also, a process that takes more time to finalize will generally cost more for each penetration when it comes to pure labor costs.

Another factor to consider with a multiple step installation process is there are more opportunities for an incorrect installation to potentially occur. With both the system of plugs and bulkhead unions, multiple steps exist that are critical for the complete performance of the system. If a mistake is made at any of these stages, the performance in respect of fire or water tightness could be significantly compromised.

Total installation time

Roxtec SPM™ seal	Bulkhead unions	Sealing plugs
		
2:13 minutes	7:15 minutes	10:22 minutes

Where labor rates are a significant factor in the total cost of building marine vessels and offshore platforms, any opportunity to reduce installation time is a key advantage towards cost savings for the installer or the shipyard. By using the Roxtec SPM™ seal, it is possible to save nearly 70% of the installation time when compared to bulkhead unions and almost 80% when compared to sealing plugs.

In addition to cost savings, one of the benefits resulting from a reduced installation time is the fact it contributes towards delivering projects on time. Delivery timetables are very strict with high penalties for delays. Any aspect that can help a shipyard become more efficient and assist the delivery of projects on time will be very much appreciated by shipyards, owners and installers.

The timings in this test installation do not include movement of installers and welding equipment from one side of the structure to the other which would be required for both bulkhead unions and sealing plugs. Therefore, these comparison timings are very conservative and in reality, substantially more time savings would be generated by using the Roxtec SPM™ seal.

Summary

As we can see, the use of a Roxtec SPM™ seal can generate significant time savings, weight reductions and space savings allowing greater flexibility. However, this installation comparison was conducted with only a single, small diameter metal pipe whereas in reality, most projects require multiple pipe penetrations.

Therefore, when these weight and time savings are extrapolated over a more realistic situation requiring multiple penetrations, we really start to see the significant savings and benefits associated with replacing bulkhead unions and sealing plugs with the Roxtec SPM™ seal.

Summary chart - installation 16mm pipe

No. of penetrations	Weight				Extra weight vs Roxtec SPM™
	1	10	100	500	
Roxtec SPM™	0.14kg	1.4kg	14kg	70kg	-
Bulkhead unions	0.59kg	5.9kg	59kg	295kg	+ 326%
Sealing plugs	0.78kg	7.8kg	78kg	390kg	+ 467%

No. of penetrations	Number of welded joints / welding processes			
	1	10	100	500
Roxtec SPM™	0	0	0	0
Bulkhead union	2	20	200	1000
Sealing plugs	2	20	200	1000

No. of penetrations	Time				Extra time vs Roxtec SPM™
	1	10	100	500	
Roxtec SPM™	2:13 mins/sec	0:22 hrs/mins	3:42 hrs/mins	18:28 hrs/mins	-
Bulkhead union	7:15 mins/sec	1:12 hrs/mins	12:05 hrs/mins	60:25 hrs/mins	+ 69%
Sealing plugs	10:22 mins/sec	1:44 hrs/mins	17:17 hrs/mins	86:23 hrs/mins	+ 79%

Protecting life and assets

Roxtec is the world leader within flexible cable and pipe transits. Since the start in Sweden in 1990 we have grown successfully to cover all continents. Our passion is innovative sealing solutions, and our goal is to make our world a safer place.

- Extensive R&D resources and advanced test facilities
- Inventor of Multidiameter™
- Customers in more than 80 markets

Would you like to learn more about pipe sealing?

Contact your Roxtec representative for more information or if you have questions regarding the analysis.

You can also explore the Roxtec SPM™ seal on roxtec.com/spm