

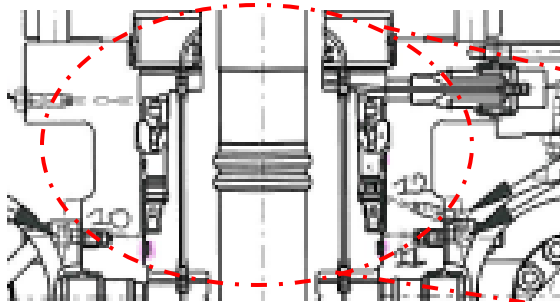


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**North Sea Platform
Wellhead Isolation
Tubing Hanger Body Seals Locking Device
20-3/4" x 13-3/8" Mandrel Neck Seal
Project and Product Review Mac-Seal
18-06-2009 AB544RM**

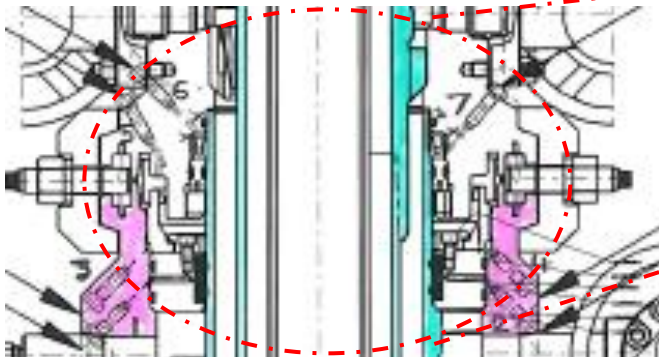
History / Introduction:

Failed test issues as reported in 2001(SBMS-II, 'S' Seal)
Reference Kittiwake Wellhead Integrity Testing report August 2003 (2001)
KCI evaluation and sealant deployment method.

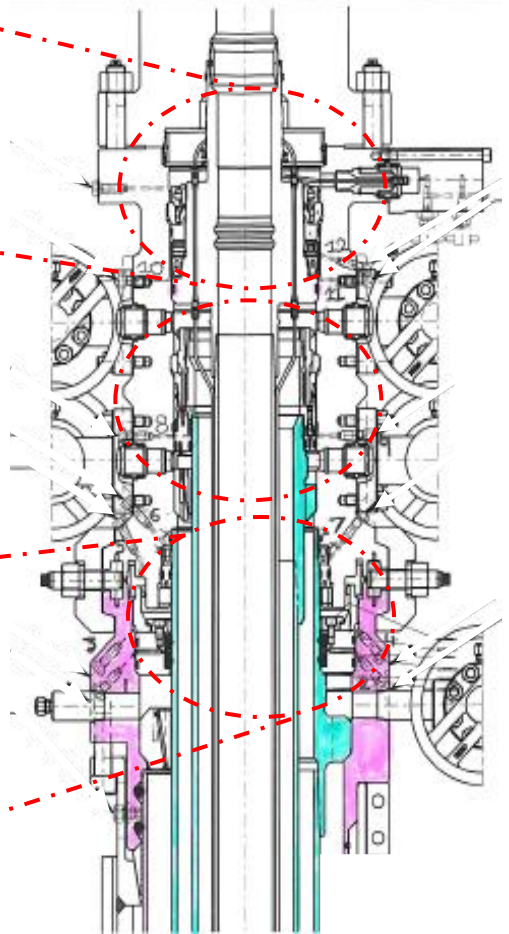


9-5/8" x 5-1/2" Tubing Hanger

26" x 18-5/8" x 13-3/8" Casing



20 - 3/4" 3,000psi x 13-5/8" 5000psi



Typical Kittiwake Wellhead



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Tubing Hanger Review:

Tubing hanger neck seal, metal to metal, low pressure / monitoring test port 16.

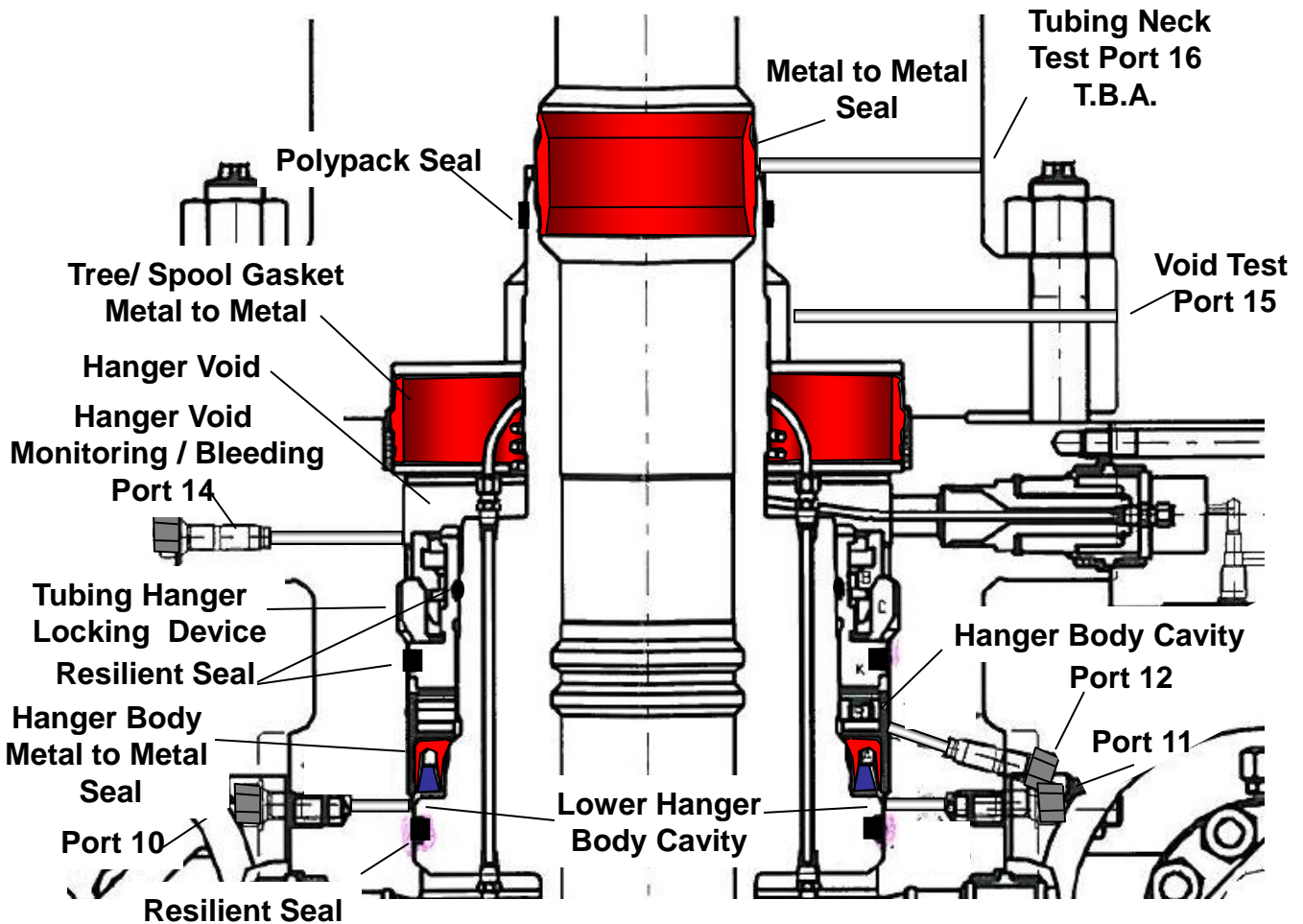
Tree spool gasket, metal to metal,

Hanger void, monitoring / bleed port, test port 14 & 15.

Tubing hanger locking device, resilient seals in OD & ID

Hanger body cavity, test / monitoring port No.12 (between resilient seal & metal seal)

Lower hanger body cavity, test port Nos.10 & 11 (between metal seal & resilient seal)





Tubing Hanger Evaluation: Hanger Body Cavity Test Fluid: Light Oil or Water Based Fluid

Review: KCI Evaluation

Fill void with test fluid i.e. inject test fluid through test port 14 and displace through port 15, close port 14 Vent / bleed hanger void, and ports 15,12, 11 & 10.

Inject test fluid in through port 10 and displace through port 11. Close port 11 and lock in 2,000psi

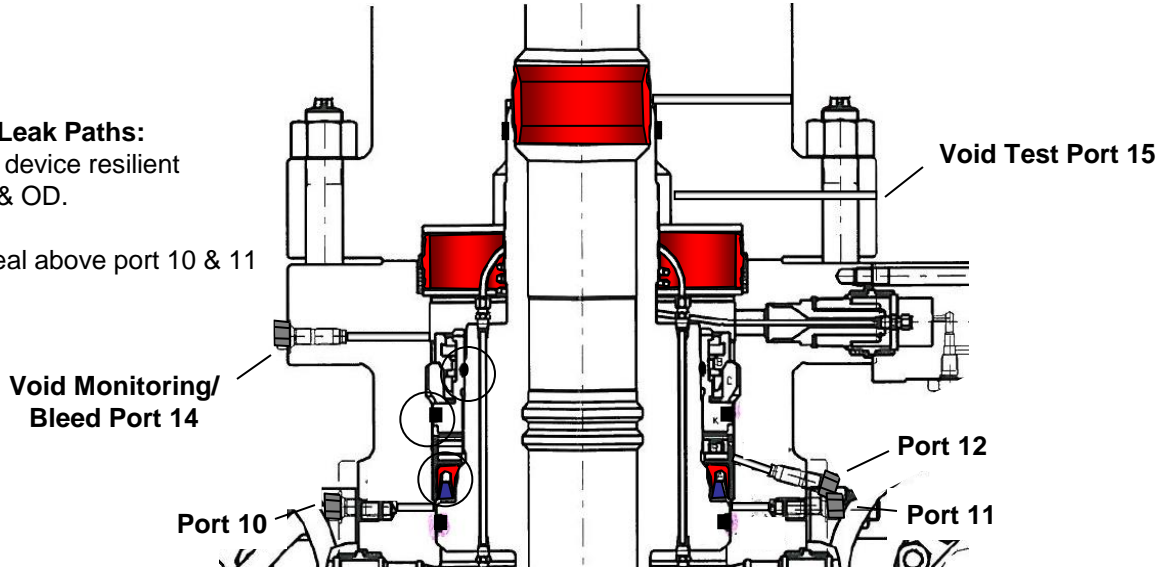
Inject a set volume of (1 Litre) test fluid through port 12 (500psi) and monitor leak rate and fluid displacement at port 15.

Bleed / vent port 12, apply 2000psi within void through port 15 and monitor leak rate through port 12 (confirmation).

Potential Leak Paths:

1/ Locking device resilient seal ID & OD.

2/ Metal seal above port 10 & 11



Inject a set volume of Mac-Seal 06 (1.5 Litres)

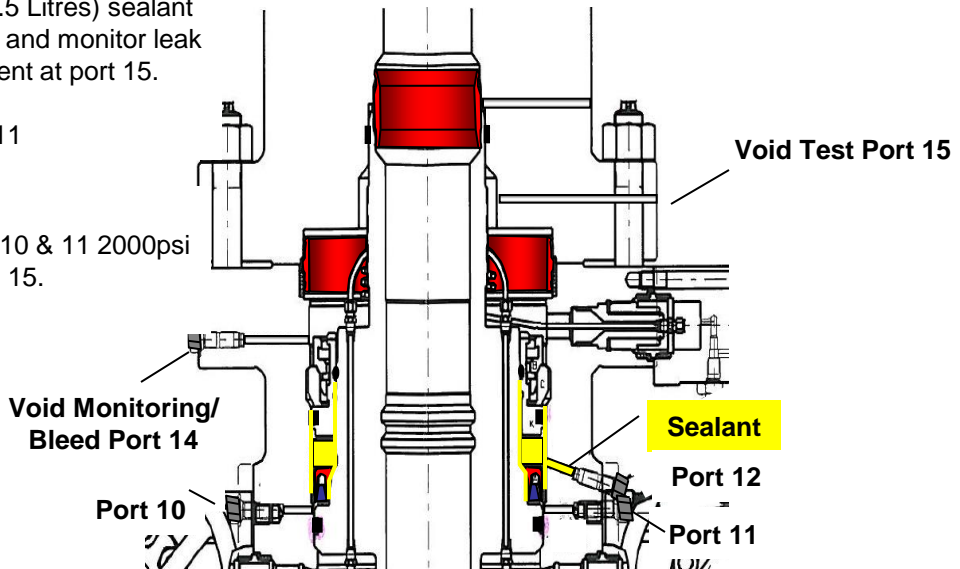
Inject a set volume of (1.5 Litres) sealant through port 12 (500psi) and monitor leak rate and fluid displacement at port 15.

Allow 3 hours to cure.

Vent / bleed ports 10 & 11

Testing: inflow only:

Pressure between ports 10 & 11 2000psi and sting / vent void port 15.



Mac-Seal 06 Application



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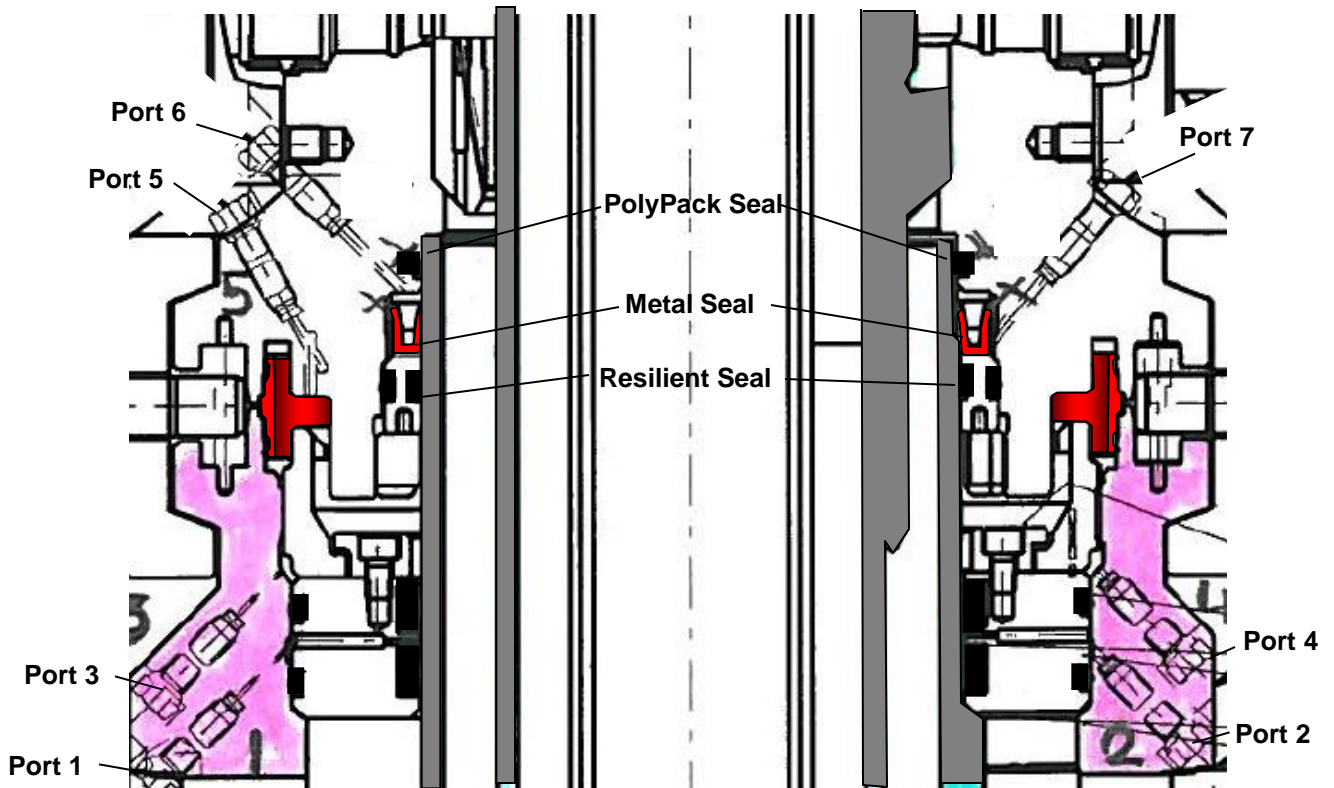
13-3/8" Hanger, Neck Seal and Pack-off Review:

Test Port 6: Supported by upper polypack seal and lower metal seal

Test / monitor port 7: Supported by upper metal seal and S-Seal resilient seal (ID & OD Seals)

Test port 5: Void communicating with test ports 3 & 4 (drain ports)

Test port 1 & 2 Pack-Off





13-3/8" Hanger, Neck Seal and Pack-off Review: Neck Seal Port 6 Test Fluid: Light Oil or Water Based Fluid

Review:

Vent/bleed both annuli above and below

Fill void with test fluid i.e. vent port 5 and close port 3. Inject test fluid through port 4 and displace through port 5

Close port 4

Sting and vent ports 6, 7, 5

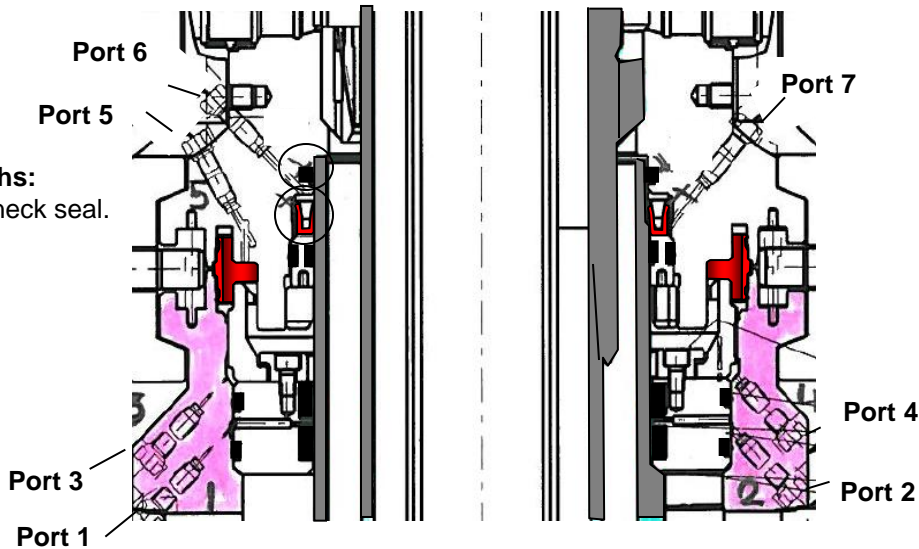
Inject test fluid and maintain pressure (1000psi) through port 6 and vent / monitor port 7 for any fluid displacement.

Maintain test pressure within port 6 and apply fluid test pressure through port 7 (500psi T.B.A) monitor leak rate through port 5.

Potential Leak Paths:

1/ Resilient casing neck seal.

2/ Metal seal



Inject a set volume of Mac-Seal 02 (750mls)

Maintain test pressure within port 6 and apply 750mls of Mac-Seal 06 through port 7 (500psi T.B.A).

Allow 3 hours to cure

Bleed / Vent port 6

Test / Monitor:

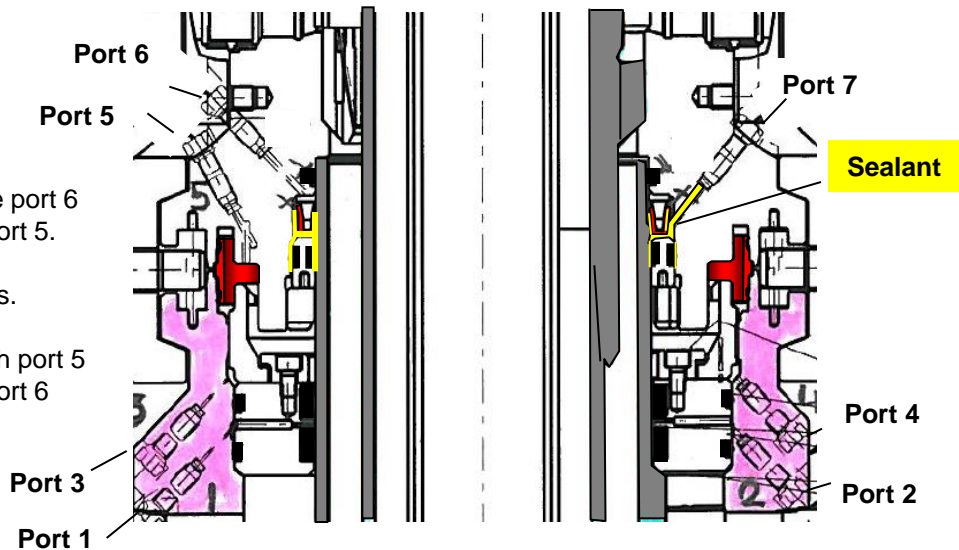
Inflow test, pressure port 6
Sting and monitor port 5.

Reverse the process.

Close ports 3 & 4

Pressure test though port 5

Sting and monitor port 6





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Mac-Seal Products: Viscosities, 01, 02, 04, 06

Mac-Seal is a two-part sealant i.e. compound and hardener. The sealant is deployed as a fluid and converts to a solid but flexible self-energising seal structure within the void / cavity of the wellhead. The Mac-Seal sealant is designed as an emergency seal and is deployed as a temporary or permanent isolation across a number of applications.

The Mac-Seal product is provided as a kit i.e. compound and hardener, with a set volume of hardener for a pre-determined curing time and to support on-the-job review and deployment procedures.

Mixing Instructions:

The product is provided in two parts:

- 1/ Compound,
- 2/ Hardener,

Both products combined provides a package to meet a specified setting time.

Note: The hardener measure is subject to curing time requirements and can be adjusted – please contact KCI for advice on this if required.

Standard setting times 2 to 12 hours -Surface

Standard setting times 12 to 45hours -Subsea

Review information label attached to both compound and hardener.

Mixing:

Use in well ventilated area.

Do not mix in other containers as this may interfere with quality of product.

KCI provides a large container (compound) to allow for mixing.

Empty hardener fluid into compound and stir gently but thoroughly with a clean spatula or other device until mixed.

Deployment: Subject to Viscosity

1/ Hand-held hydraulic injection gun.

2/ Pneumatic or hydraulic injection gun (large volumes).

3/ Cylinders

4/ Spatula

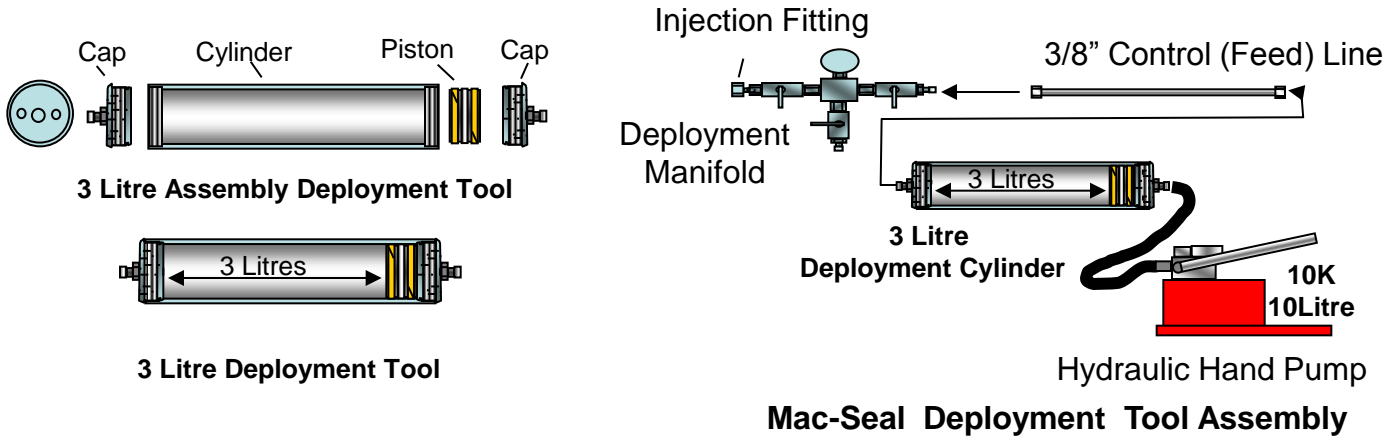
Follow procedure (work scope) in accordance with the application and its environment.

Note: This product is required to be deployed by KCI trained and registered personnel or trained and registered sub-contractors.



Deployment Tools

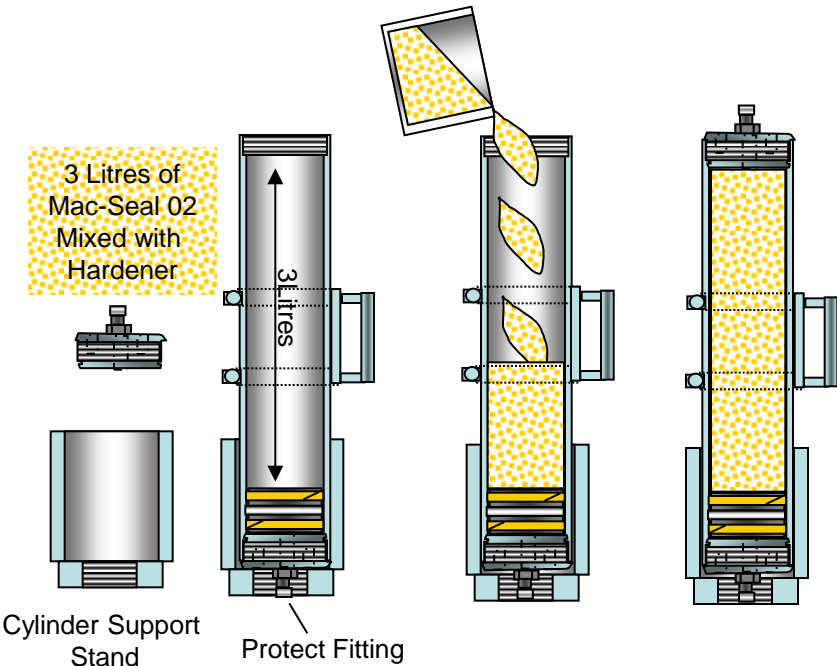
Cylinders are provided as the method of deploying the sealant. These are designed as a simple process for preparation / handling, deployment (diver assist) and refurbishment. The cylinders have been designed to operate with seawater



Mac-Seal Deployment Tool Assembly

Mixing Instructions

The Mac-seal is a two-part product i.e. compound and hardener. The product has been provided with set volumes of up to 3 litres of compound (white) and a set volume of hardener. Pour the set volume of hardener into the 3 litre tub (example) of compound and mix until the sealant becomes. Pour the mixed compound into the cylinder and attach to the deployment package.



Note: Prepare all cylinders to receive the sealant prior to mixing

Sealant curing time:
3 hours subject to temperature

Sealant deployment time:
1 hour after mixing.

