

hydratight

MorSafe™ Online Bolt Renewal Service



Because ensuring a leak-free solution is critical. It has to be Hydratight.

For more than 100 years, Hydratight has provided world-class bolted joint solutions, assessing and managing joints to ensure leak-free start-ups. Today, we continue to set international standards in joint integrity—but we're so much more than just a bolting and on-site machining company.

Because even the tiniest leak can be costly and time consuming to repair, we manage every joint on a project for leak-free start-ups and production, which in turn removes the threat of environmental impact caused by unsafe joints. Safety continues to be the most important aspect of our business. We are a global organisation making a real difference to the industries and communities we work in, committed to improving safety, operational efficiency and uptime.

Because you require the support of an innovative partner committed to your success, we not only offer unrivalled service on a global scale, including customer training and software development; but also design and manufacture quality tools and equipment for bolted joint solutions to the highest standards. Our certified teams are dedicated to working closely with you, assessing and managing every joint on your project to prevent leaks from ever occurring, year in, year out.

Because you value safety and reliability, we work to ISO 9001, ISO 14001 and OHSAS 18001 standards in everything we produce, from manufacturing torque and tension bolting equipment to mechanical connectors, from on-site service to creating custom solutions in line with client specifications.

It means that whenever you need a complete joint integrity solution, whichever industry sector you're in, you can rely on us to get it 100% right first time, every time. **This is why it has to be Hydratight.**



Engineering Driven Safety Focused Solutions



LRQ 0912064



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LRQ 4003099



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KLN 4001579



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Safely extending the life of assets

Corrosion costs the oil and gas industry billions of dollars annually. Today, much of that infrastructure is reaching the end of its designed lifetime. Hydratight understands how serious this is to operations and continually works to develop solutions to help critical infrastructure run smoothly.

Preventing pipeline failure while minimising production loss

As per ASME PCC2, Hot Bolting is the sequential removal and replacement of bolts on flanged joints while under reduced operating pressure. It is carried out one bolt at a time in a predetermined cross pattern sequence. Each replaced bolt is tensioned before the next one is removed.

Hydratight offers safe hot bolting or online bolt renewal services on all commonly specified flanges, including ASME B16.5. These services are performed without any damage, leakages or interruptions in daily production using our patented MorSafe™ clamp.

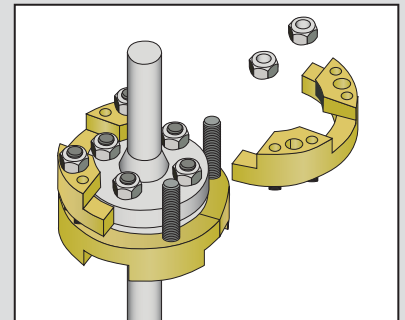
Hydratight's MorSafe™ clamp is a modular segmented clamp, which, when correctly assembled on a bolted flange while in service, permits safe removal of one or more of the parent flange bolts without risk to the integrity of the parent flange.

Principles of operation

The MorSafe™ clamp consists of a number of segments designed to fit around and encase the flange. The segments are bolted together, and each segment has a number of pre-installed 'backstops'.

Once fitted, the clamp bolts are torqued up (tensioned if the bolts are sufficiently large and space permits) to a nominal torque to ensure the segment ears have made light contact with the flange surface. The backstops are then screwed down until in contact with the facing segment. The MorSafe™ clamp bolts preload the clamp without any significant load passing through the parent flange and inter-alia the gasket. With the MorSafe™ clamp fitted, the parent flange bolts can be removed and replaced, one at a time.

The procedure and torque values used for bolt replacement are usually agreed to with the client, and online bolt renewal services from Hydratight are accompanied by a highly experienced team of Hydratight technicians. Each replaced bolt is torqued using a prescribed torque value followed by a final torque—up once all bolts have been replaced. Once the torque procedure is complete the clamp is removed.



A simple, safe, and secure solution

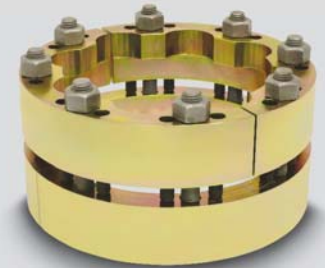
Our online bolt renewal solution is designed to be simple. The patented design of our MorSafe™ clamp provides a more robust solution and meets all safety standards.

The MorSafe™ Bolt Renewal clamp from Hydratight is intended solely as service product for use by our own competent technicians for removal and replacement of bolts one at a time. Once all bolts have been replaced the clamp will be removed.

The MorSafe™ Flange clamp is essentially the same product but intended to be permanently installed by Hydratight's competent technicians. Because of the intended permanency an additional design requirement is included to ensure the suitability of the material chosen to align with the parent flange.

Design basis of the Hydratight MorSafe™ clamp

- The design is simple and safe to install and capable of being 'abandoned' should an unforeseen event occur while being fitted.
- The clamp will have minimal effect on the installed parent gasket. No gross loading or crushing can be permitted. This is because it is impossible to predict exactly how the gasket will perform if the bolt load is significantly reduced or increased.
- The design recognises the bolt load in the parent flange is unknown; the bolt load will generally have decreased with time, but the possibility of local bending inducing higher loads cannot be ruled out.
- The clamp is preloaded to negate any change of load effects either due to use of mechanical tools to remove studs and/or sudden release of load by a failed bolt. It is impossible to accurately predict the force required to remove a rusty corroded bolt.
- The clamp is able to withstand pressure surges or vibration effects from the parent flange.
- The clamp is capable of being fitted and installed on the flange for long periods without risk to the integrity of flange or system.
- Both types of clamps are designed in accordance with ASME VIII Div 2 code requirements.
- Clamps are designed to suit any ASME, API, DIN or EN flange in any service, size, or pressure rating.
- Operational temperature range: -150°F (-101°C) through to 480°F (250°C).
- MorSafe™ clamps are designed for minimum space envelopes. The intent is to fit 90% of applications without modification to the standard design.
- Clamps are designed to permit safe access of a specified tool to remove the corroded bolt. Generally, due to bolt spacing it is only possible to include window access for flanges with 4 bolts. On flanges with 8 bolts or more, the use of nut-splitters is not possible for nut/bolt removal.



Safety, reliability, and performance

The patented design of Hydratight's MorSafe™ clamp provides the highest mitigation of risk of flange or gasket damage, or worse, a leak.



The philosophy behind the design is to minimise the possibility of disturbing the gasket. The solution does not require any pneumatics or hydraulics for clamp engagement, nor does it increase the load on the gasket. The lightweight and compact design fits almost all flange space restrictions; it is easy to handle and fit, therefore enabling speedy bolt replacement. Furthermore it is designed and tested in accordance with ASME VIII Division 2.

Any technical design is preceded by a safety review. At the least this will include:

- Tier 1 Assessment – Engineering survey & live plant risk assessment
- Tier 2 Assessment – Job specific risk assessment
- Consultation / interface with the client's master work scope risk assessment

Safe online bolt renewal on old flange connections, using the revolutionary clamp design, mitigates many unknowns such as the condition of the bolts and gaskets; how the gasket will act under increased or decreased load; the remaining bolt tension after a long time in service and how much force is needed to remove old rusted bolts.

Safe hot bolting also reduces many concerns including failure of bolts during hot bolting operation on adjacent bolt; changes in operating parameters like flow, temperature, or pressure and the occurrence of unpredictable situations which could cause personnel to leave the workplace.



Feature	Benefit
Safety: Pressure tested to 1.5X most stringent design pressure	Proven integrity before fitting
Conformance: Specify with low temperature materials	Withstand sudden de-pressurisation of system
Conformance: Designed in accordance with ASME; materials and coatings likewise	Can be safely left installed for extended periods of time
Robust: Compact design—radial and headroom	Will fit virtually all applications
Safety: Clamp bolt load resisted by backstops	Gasket undisturbed, mitigates risk of leakage—no significant change in gasket stress
Robust: Encasement of flange	Permits safe removal of rusty or corroded bolts from flange
Experience: Fitted by trained and competent Hydratight technicians	Certainty of correct installation, highest focus on safety

Assuring safety through testing and training

Hydratight has pioneered the online bolt renewal technique and has successfully completed the task on many offshore platforms worldwide. In addition, technician training programs and procedures have been developed to mitigate all risks and minimise leakage or harm to the technician.

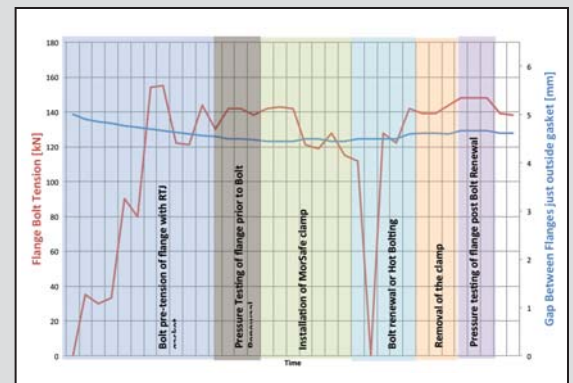
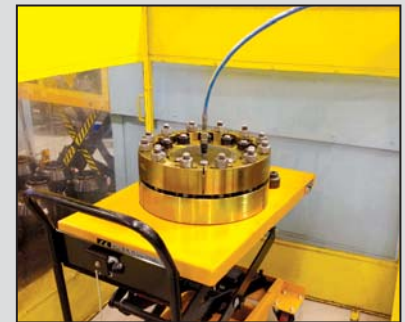
Testing, certification, and records

- Pressure testing: All clamps are tested using a pair of parent flanges normally fitted with a SWG gasket. Once assembled on the parent flange, the flange will be pressurised to 1.5 times the maximum allowable design pressure for the chosen design material. The test will be performed with both the parent flange bolting fitted and then all bolts removed.

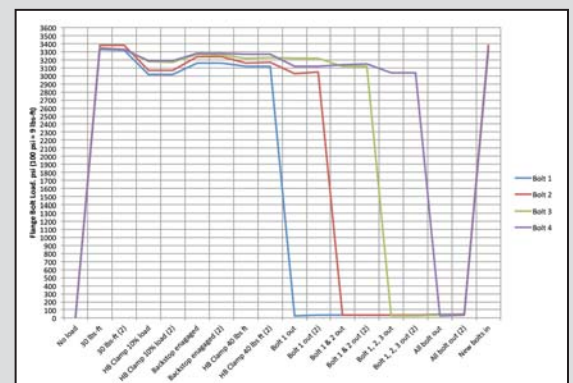
Each clamp is supplied with certificate of compliance and test certificate.

Flange Clamp Pressure Rating	Design Pressure (psi)	Test Pressure - 150% of Max Design (psi)
150#	300	450
300#	750	1125
600#	1500	2225
900#	2250	3350
1500#	3750	5575
2500#	6250	9275

- FEA: FE Analysis of the design produced satisfactory results. Conclusion of the independent third-party technical analysis: *“The performance of the hot bolting clamps can be considered as good. Whenever acceptance criteria for gasket stress were satisfied prior to hot bolting then they were also satisfied during and after hot bolting.”*
- Lab test: The gap between two flanges has been instrumented and recorded throughout a full pressure test, including removal of all the parent flange bolts. The results are depicted graphically to the right. The flange gap (blue line) hardly changes despite the considerable change in bolt load (red line).
- FADU (Flange Assembly Display Unit) Testing: Bolt load on each bolt on a 4 bolt flange is measured with strain gauges, and measurements are recorded during the entire operation of hot bolting using the MorSafe™ clamp. As illustrated, the bolt loads on each bolt remains almost constant, which proves the gasket stress is not affected.
- Special testing: Gas tests using nitrogen at 30 bar have been performed using 1.5" (38.1mm) class flanges for a client. The flanges were fitted with 1.5mm CAF gaskets to replicate the field situation. All tests were successful.
- DNV GL Certification: MorSafe™ clamp has a Type approval from DNV GL for offshore applications: for securing pressurised ASME B16.5 flange connections with degrading bolting, and for maintaining barrier for ASME B16.5 flange connections during live bolting.



Flange response curve



FADU test results

Examples of successful projects

Most major operators have shown strong interest in this service. Hydratight is committed to maintaining the highest standards of safety while providing solutions tailored according to customer needs.

MorSafe™ clamps have been successfully deployed on the following offshore/ onshore assets for hot bolting duties:

2012 North Sea – offshore platforms

- 120+ flanges, various 4 bolt sizes
- Fire water, foam, instrument air, flares lines
- Critical for platform stability

2014 West Africa – FPSO

- 6" and 10" CL 1500 (NORSOK flanges)
- Gas lift & production flow lines

2014 North Sea – offshore platform

- ¾"– 2" CL150 flanges, included SS clamps
- Cryogenic gas, process gas and glycol

2015 UK – offshore platform

- Multiple 4" CL150 flanges
- Flare lines

2015 UK – onshore refining facility

- 3" CL150 PSV isolation valve
- Flare line

2015 Brunei – offshore platform

- ¾"– 3" CL150 flanges, various sizes
- Water, instrument air

2015 UK – offshore platform

- Various 8 bolt flange sizes
- Mitigate the risk of cracked bolts due to chloride stress corrosion

If you are interested in online Bolt Renewal Services from Hydratight, or want more information on the MorSafe™ clamp, contact your local Hydratight representative or email us at solutions@hydratight.com.



hydratight®

Our global network means that you can rely on the right people, products, and services wherever you are in the world.

Email us at: solutions@hydratight.com
Or find your local representative at:
hydratight.com/contact

Hydratight provides support through service centers (●) and authorised representatives (◆)

