Mooring Bollard & Tugboat Testing

CrosbyTech Series

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Testing of mooring bollards & Tugboat pull testing

White Paper
Crosby Straightpoint - November 2023

Abstract
This paper looks at two similar principles:

- Load testing bollards, the importance of determining the maximum load a bollard can withstand before failure. And the importance to know how much force is being exerted by moored vessels using the berth, and the solution to avoid a bollard failure.

- Bollard pull testing tugboats to determine the maximum pulling power for a tugboat to safely rescue stranded vessels and how catastrophic it could be if it's not correctly load tested.

CONTENTS

The consequences of mooring bollard failures

Mooring bollard failure refers to a situation where a bollard located along a shoreline fails to properly perform its intended function.

Failure could be caused by poor installation, **overload** and/or lack of maintenance

Lack of Maintenance: Regular maintenance is crucial to ensure that bollards remain in good condition. If maintenance tasks like repainting, lubrication, or inspection are neglected, the bollards could deteriorate faster and fail.

Overloading: In the case of bollards used for mooring ships, if they are subjected to excessive loads beyond their design capacity, they could fail under the pressure.

When a mooring bollard fails, it can lead to traffic accidents, security breaches, or problems with mooring operations. To prevent such failures, it's important to choose bollards made from durable materials, install them correctly, perform regular maintenance, and assess their condition periodically to identify and address any signs of deterioration.

After a recent catastrophic incident the USCG issued an alert informing that there have been a number of shore side marine bollard failures whereby moored vessels were cast adrift. In some cases, this resulted in damage to the involved vessel, as well as other nearby vessels and shore side structures.

USCG found:
– the rotting of organic bollards made of marine pilings
– the undetected fracture of bollard castings due to manufacturer defects
– damage from previous **overloads**
– the degradation of bollard foundations and fasteners.

Damage to a ship after a bollard overload failure

The Coast Guard strongly recommends that facility owners and operators take steps to develop a routine inspection program for bollards and other mooring equipment. Furthermore, vessel personnel should report discoveries of apparently deficient shore side mooring equipment to facility managers.

Why test mooring bollards

Testing mooring bollards for **overload** is crucial to ensure the safety and integrity of both the bollards themselves and the vessels or vehicles they are intended to secure. Here are some reasons highlighting the importance of testing shore bollards for overload:

Safety: Overloaded bollards are at a higher risk of failure. When a bollard fails under load, it can result in accidents, injuries, or damage to property. Proper load testing helps identify weak or compromised bollards, preventing potentially dangerous situations.

Preventing Catastrophic Failures: Ships and vessels can exert tremendous forces on bollards when they are moored. Overloading can cause bollards to snap, detach, or be pulled out of the ground. By testing bollards for overload, you can detect vulnerabilities and address them before a catastrophic failure occurs.

Preserving Infrastructure: Bollards are often installed as part of a larger infrastructure, such as docks or piers. A failure in a bollard due to overload could lead to damage to the surrounding structures, requiring costly repairs.

Regulatory Compliance: Many maritime regulations and industry standards require proper testing and load rating for bollards. Ensuring compliance with these standards is not only a legal requirement but also a responsible practice to maintain safety.

Insurance and Liability: In case of accidents resulting from bollard failure, liability issues can arise. Properly tested and maintained bollards demonstrate due diligence in preventing accidents, which can be important for insurance claims and legal considerations.

Predictive Maintenance: Overload testing can help identify signs of wear and tear or corrosion that might not be readily apparent. This proactive approach to maintenance can extend the lifespan of bollards and reduce the likelihood of unexpected failures.

Operational Continuity: A bollard failure can disrupt operations in ports, harbors, and other maritime facilities. Regular overload testing helps ensure that bollards are in good working condition, minimizing disruptions and maintaining operational continuity.

Long-Term Cost Savings: Detecting issues early through testing can prevent the need for costly emergency repairs or replacements. Investing in regular testing is a cost-effective strategy in the long run.

Environmental Protection: In maritime environments, bollard failures can lead to oil spills, debris release, or other forms of pollution. By preventing bollard failures through testing, you contribute to environmental protection.

In conclusion, testing shore bollards for **overload** is essential for safety, regulatory compliance, liability mitigation, and the overall integrity of maritime infrastructure. It's a proactive measure that safeguards lives, property, and the environment.

Mooring bollard load testing

Load testing mooring bollards involves applying controlled loads to the bollards to assess their strength and capacity. By using load cells you can determine this in a controlled environment.

Determine Load Conditions:
- Identify the maximum expected loads that the bollard will experience during its intended use (e.g., mooring a ship).
- Determine the type of load to apply (vertical or horizontal) and the direction in which the load will be applied.

Prepare the Bollard:
- Ensure that the bollard is clean and free from debris that could affect the test results.
- Attach load-measuring devices to the bollard if necessary, such as load cells.

Apply Load:
- Apply the calculated load gradually and uniformly.
- Monitor the load application process carefully to avoid sudden jerks or shocks to the bollard.

Measure and Record:
- Measure the load exerted on the bollard using calibrated load-measuring devices.
- Record the load values at specific intervals to create a load vs. deformation curve.

Regulations and Standards for testing mooring bollards in ports:
It is recommended that load testing should be conducted by experienced professionals who are knowledgeable about bollard design, load application, and safety protocols. Additionally, load testing procedures may vary depending on the specific type of bollard and its intended use, so consulting relevant standards and guidelines is recommended.

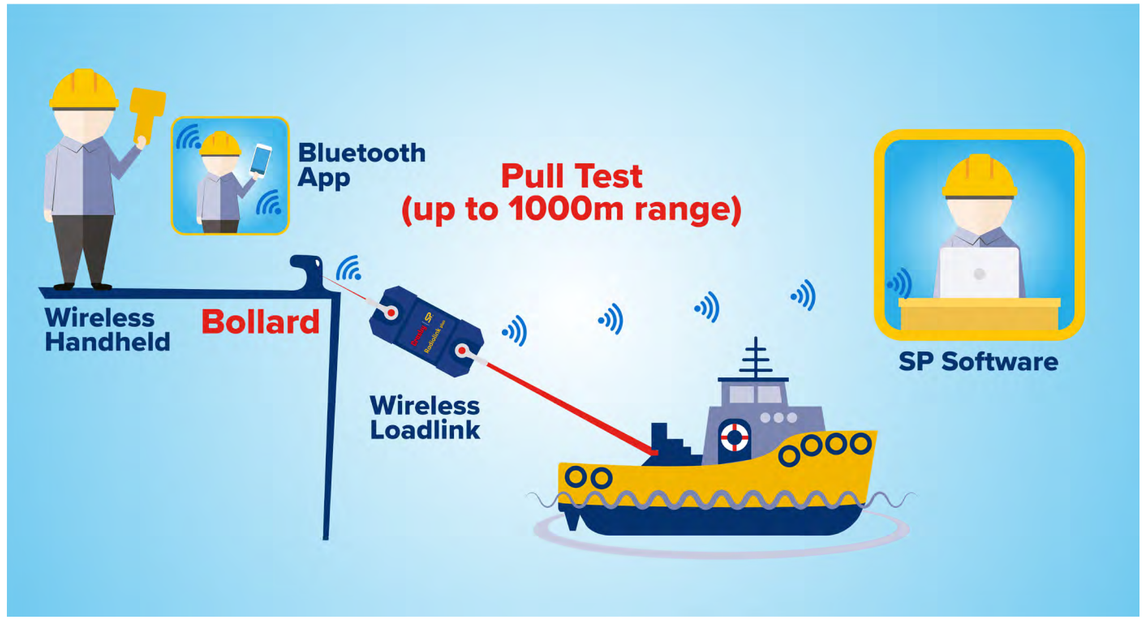
UK
- Provision and Use of Work Equipment Regulations 1998 (PUWER).

USA
- Unified Facilities Criteria (UFC) 4-150- 08 – Inspection of Mooring Hardware.

Mooring bollard load testing solution

Crosby Straightpoint provide DNV-GL type approved load cells and software to determine the load applied, with options of a Bluetooth app, Handheld or INSIGHT software for reporting for later analysis.

TYPE APPROVAL
DNV·GL
DNVGL-ST-0378



Bollard load testing and bollard pull testing for tugboats

Preventing overloads on tugboats

Bollard pull tests are carried out in order to certify a tugboat as fit for service. “Overload” in the context of a tugboat refers to a situation where the tugboat is subjected to a load or towing task that exceeds its designed or safe capacity. Tugboats are designed with specific bollard pull ratings and other performance characteristics that determine their maximum safe towing capacity. Operating a tugboat beyond its designed limits can lead to various safety risks, decreased maneuverability, and potential damage to the vessel or the objects being towed.

Potential issues and considerations related to tugboat overload:

Safety Concerns: Overloading a tugboat can compromise its stability, making it more susceptible to capsizing or sinking, especially in rough seas or adverse weather conditions.

Decreased Performance: Tugboats are designed to provide optimal performance within a certain range of loads. Overloading can result in decreased speed, reduced maneuverability, and difficulty in controlling the vessel.

Structural damage: Exceeding the vessel’s designed load capacity can lead to structural stress, potentially causing damage to the hull, propulsion systems, and other critical components.

Towing Equipment Strain: Overloading the towing equipment, such as the winches, ropes, and connections, can lead to their failure, posing a risk to both the tugboat crew and the crew of the vessel being towed.

Fuel Efficiency: Operating a tugboat beyond its optimal capacity can lead to increased fuel consumption due to higher engine loads, resulting in higher operational costs.

Legal and Regulatory Compliance: Maritime regulations and safety standards require vessels to operate within their designed limits to ensure the safety of crew members, other vessels, and the environment. Overloading a tugboat can lead to legal and regulatory consequences.

Risk to Cargo: If the tugboat is towing a vessel or a cargo barge, overloading can lead to damage or loss of the cargo being transported, resulting in financial losses and potential legal liabilities.

To avoid tugboat overload and its associated risks, it’s crucial for operators and shipowners to adhere to the vessel’s design specifications and recommended operating limits. Tugboat operators should consider factors such as the vessel’s bollard pull capacity, stability, weather conditions, and the weight and size of the object being towed. Adhering to safe operating practices and conducting regular maintenance checks on the vessel and its equipment will help ensure the safety of the crew, the tugboat, and the tasks it performs.

Determine a tugboat maximum towing power

Assessing the tugboats towing power enables the safety and ability to provide assistance in towing ships, barges, or other vessels. Here’s how the bollard pull test for a tugboat typically works:

The tugboat is typically positioned in open water or a controlled environment near a solid and immovable object like a bollard, which is a strong post or pillar used for mooring ships.
A certified load cell is attached to the tugboat’s towline, and the other end is secured to the bollard. The load cell measures the force applied by the tugboat in pulling against the bollard. This force is typically measured in metric tons or kilonewtons.

During the test, various parameters are monitored and recorded, including the force exerted by the tugboat, the engine RPM (Revolutions Per Minute), the fuel consumption rate, and any other relevant data. The test continues until the tugboat reaches its maximum pulling capacity or until the engines are operating at their maximum safe RPM. The maximum force exerted by the tugboat during the test is its bollard pull rating.
The data collected during the test is analyzed to determine the tugboat’s performance characteristics. This information is crucial for vessel operators, port authorities, and shipowners to assess the tugboat’s capabilities for various towing and maneuvering tasks.

It’s important to note that bollard pull tests are conducted under controlled conditions to ensure the safety of the vessel and personnel involved in the test. Additionally, environmental factors such as wind and current should be taken into consideration during the test.

The results of a bollard pull test provide valuable information about the tugboat’s capabilities, which is essential for making informed decisions regarding its operational use and effectiveness in various maritime tasks.

Crosby Straighpoint Radiolink plus with INSIGHT software and a handheld.
Note: Software distance is up to 700m, close proximity only for photographic purposes.

International Standards

“A critical consideration from a safety and contractual perspective.
Bollard pull (BP) measurement is a simple but vital assessment for anchor handling vessels. There are two aspects that particularly call for precise BP measurements. The first is safety, as an overestimated BP value can give rise to serious accidents when the vessel is in operation. The second is contractual, as a vessel’s BP value is a key consideration for FOWF developers when chartering vessels to work on their project.”

- Bollard pull and escort trial document

- International Standard

In 2019 the International Standard for Bollard Pull Trials was launched. Over the past 2 years a great number of bollard pull trials have been executed according to this new standard. This paper was presented by Thijs Hasselaar during TUGTECHNOLOGY 2021 and describes the technical and operational experiences of applying the new standard to bollard pull testing. Guidance is provided to reduce the uncertainty caused by load cells and power measurement to get the most reliable and repeatable bollard pull test results.

This technical paper gives an overview and user experience of methodology to define, test and document the bollard pull performance of tugs launched in 2019.
It explains the difference with existing bollard pull trial methods and gives solutions to reduce uncertainty from load cells.

- Paper Tugnology 2019 International Standard

“The growth of floating offshore wind is cause for optimism for anchor handling vessel owners. This could mean more contract opportunities for them as the oil and gas industry moves into a new phase. However, in order to make the leap into serving the renewable energy industry, owners may have to retrofit and upgrade their vessels to meet sustainability standards.”

Marin (Maritime Research Institution Netherlands).

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