BHP Mitsubishi Alliance

Hay Point Coal Terminal Mooring Guidelines
March 2024 – Version 3.0

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1. Introduction

The upper met ocean conditions experienced at the port of Hay Point present a challenge for ships during mooring operations.

To ensure safe loading operations and mitigate potential risks, every vessel nominated to visit Hay Point must complete the Hay Point Terminal Vetting Questionnaire (TVQ). Approval of the TVQ is mandatory prior to Notice of Readiness being accepted and authorization to berth .

Since the introduction of the TVQ, the Terminal has experienced a significant decrease in mooring incidents, notably the parting of mooring lines during loading operations.

These guidelines provide further detail behind the rationale for the TVQ requirements.

2. BMA Hay Point Terminal Location and Met Ocean Conditions

The Hay Point Terminal is located 40km south of Mackay, Queensland Australia. It is located within the Great Barrier Reef Marine Park. The Terminal operates 3 offshore berths that can accommodate a range of bulk carriers from Handymax to Cape size vessels.

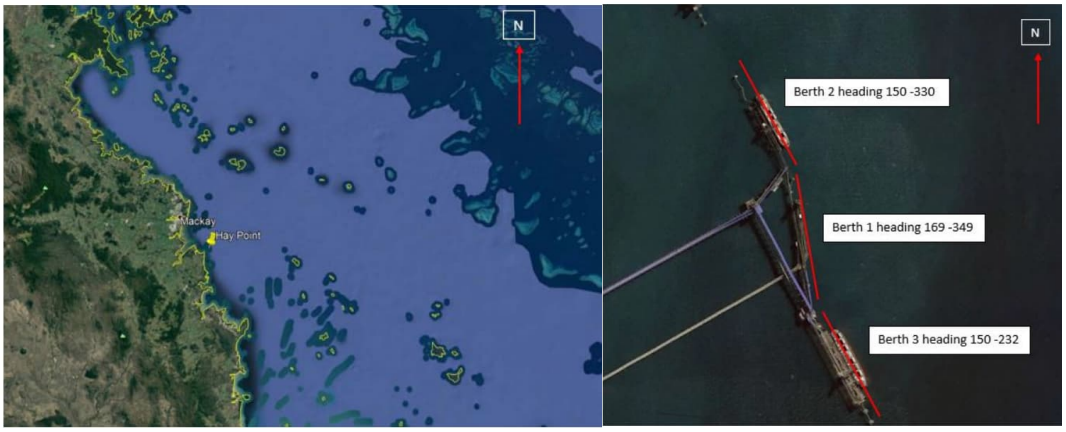


Fig 1: Hay Point Berth Locations

The berths at the Terminal, located up to 3 kilometres offshore, are fully exposed to the prevailing southeast trade winds which persist for most of the year. These winds generate short, sharp waves reaching heights of around 2 meters at the berths. Additionally, longer period waves, roughly 1 meter in height, result from the Terminal's position relative to the Capricorn Channel.

The Port of Hay Point experiences significant tidal ranges, with king tides surpassing 7 meters above LAT. These wide ranges lead to currents of greater than 1 knot during movements and while vessels are alongside.

The ebb tide sets to the NNW and the flood tide to the SSE at approximately 150 degrees. Met ocean conditions at the Terminal pose challenging mooring conditions with the analysis of mooring hook load cell data during adverse conditions revealing loads on ship's mooring system can exceed 40 tonnes for panamax vessels and 60 tonnes for cape size vessels. Under normal weather conditions, loads range between 5 and 30 tonnes.

In severe conditions, ship movements induced by met ocean conditions heighten the risk of mooring lines parting, uncontrolled ship movements, hull damage and damage to the wharf infrastructure. Vigilance during mooring operations is imperative for ship's Masters, crew and Terminal staff.

3. Guidelines for Mooring Equipment Design

Noted below are key factors considered when assessing a ship's mooring system:

- The type of mooring lines

- The management of mooring lines whilst in service

- The size and type of mooring equipment

- Relationship of the ship's mooring lines and mooring equipment to the ship's design MBL

Further to the above, the mooring line design breaking force (LDBF), the maximum brake holding capacity (BHC) of the mooring winches, the pulling force of the mooring winches, the safe working loads (SWL) of all mooring equipment and the relationship of all these to the ship design MBL are critical components of a ship's mooring system.

Hay Point expects all ships calling the Terminal have a clear understanding of the mooring equipment and mooring lines on board and the relationship these have to the ship design MBL.

3.1. Defining Ship Design Minimum Breaking Load

The ship design MBL should be calculated based on either Class society rules, which is linked to the ship Equipment Number (EN), or via the guidelines outlined in the Oil Companies International Marine Forum (OCIMF) Mooring Equipment Guidelines (MEG) 4.

The ship design MBL OCIMF MEG 4 guidelines are generally larger due to metocean requirements. Therefore, for bulk carriers the correct ship design MBL should be derived from the Class approved EN calculation.

For older ships, cases where the ship design MBL is unknown or when the EN calculation is missing or unknown, the ship design MBL can be estimated and used for mooring system management as follows:

1. The ship design MBL can be assumed to be the same as the size of the original mooring lines which were placed on board as part of the ship's compliance to Class and Flag State requirements.
2. The ship design MBL can be calculated and assumed to be 125% of the maximum BHC of the mooring winches which can be found on the mooring winch certificate.
3. The ship design MBL can assumed to be the same as the SWLs of the mooring furniture which is used for mooring operations.

In cases were the original mooring lines and/or 125% of the maximum BHC are greater than the SWL of the mooring furniture, the ship design MBL should be taken as the SWL of the mooring furniture.

As a guide, the ship design MBL for panamax vessels range between 55-63 tonnes while for cape sized vessels the ship design MBL range is 72-80 tonnes.

3.2. Optimum Mooring Configuration

It is appreciated that most ships do have standard mooring configurations which are focussed on evenly distributing mooring loads to each mooring line.

However, for each of the 3 berths at Hay Point, the Terminal have recommended mooring configurations which consider the following:

- Vessel size
- Ship's mooring winch arrangement
- Direction the vessel will berth, e.g. port side to or starboard side to

The recommended mooring configurations will be considered during the vetting process and confirmed with the ship's Captain by the Pilot before mooring operations commence. Specific mooring configurations for specific ship types are available if requested.

Typically for handy sized vessels a minimum of 8 powered mooring winches are required.

For panamax vessels a minimum of 10 powered mooring winches are required although 10 lines on drums acquire berthing restrictions as these ships present an additional mooring risk with not all spring lines run from winch drums. This being the case 12 lines on mooring drums are preferred by the Terminal.

For mini cape and cape sized vessels a minimum of 16 powered mooring winches are required.

The Terminal also expects ships can deploy additional lines that are secured to bitts should environmental conditions require it.

The guidelines for mooring arrangements on ships visiting the Terminal are summarised below:

1. As far as possible, all lines should be run from mooring winches.
2. Lines must lead from winch drums to shore via fairleads with minimum deflection / turns between the mooring winch and the shore hooks.
3. Only one mooring fairlead or mooring fitting must be used per mooring line. Multiple lines must not be passed over a single fitting.
4. Ships with split drum mooring winches must only have a single layer of mooring line on the working part of the drum.
5. There must be sufficient deck crew to monitor the forward and aft mooring lines simultaneously. The mooring lines must be monitored at all times.
6. Vessels MUST have chafe protection installed.

3.3. Design and Safety Factors of Fixed Mooring Equipment

The guidelines for the design and construction of a ship's mooring system ensure the mooring equipment can secure the vessel and heave against the forces generated by the ship's interaction with environmental conditions without overstressing each component of the mooring system (e.g. mooring winches, mooring lines, etc).

The guidelines for mooring equipment design and operations for ships visiting the Terminal can be summarised as follows:

1. Where possible, all mooring winches as a minimum should comply with ISO 3730.
2. The minimum ship design MBL should be equal to or greater than 1.25 times the maximum BHC of the mooring winch.
3. The mooring winch brakes should be set to render between 60%-80% of the ship design MBL or max BHC, whichever is lesser. On ship's with conventional mooring drums a minimum of 30 tonnes is required at the third layer of rope on the drum. On ships with split drums a minimum of 30 tonnes is required at the first layer of rope on the drum. Brake render tests should be performed annually. It is critical the max BHC of the winch is not exceeded at any layer.
4. The SWL of all fairleads and mooring rollers must be equal to or greater than the ship design MBL.
5. All mooring fairleads need to be smooth. All mooring rollers should be rust free and move without resistance.

3.4. Initial and in Service Mooring Lines

When ships are delivered they are typically provided with mooring lines with line design breaking forces (LDBF) approximately equal to the ship design MBL. However, data indicates that both panamax and cape sized vessels appear to have mooring line LDBF on average 130% above the ship design MBL.

The reason for this is likely to be that ship operators believe that a higher LDBF mooring line is more superior and improves the mooring system overall. This is not necessarily the case especially where ships experience elevated met ocean conditions.

The guidelines for mooring lines visiting the Terminal can be summarised as follows:

1. Mooring lines as a minimum should comply with ISO 3730. If possible, the mooring line LDBF should be between 100-105% of the ship design MBL.
2. In cases where greater strength lines (i.e. larger LDBF) are used than what was originally installed, the correct setting of the mooring winch brake rendering point is critical to ensure the safety of the mooring system.
3. The diameter of mooring lines should not be greater than 110mm.
4. Mooring lines must not be constructed of wire.
5. Mooring lines constructed of high modulus material (e.g. HMPE lines) MUST be fitted with synthetic mooring tails.
6. Mooring tails should be attached via cow hitching as shown below.

7. Mooring lines in the same lead (e.g. head lines, fwd spring lines, etc) must be of similar material type, diameter (within 5mm) and MBL (within 5t).
8. All mooring lines that run through fairleads or mooring rollers MUST be fitted with fit for purpose chafe protection.
9. Mooring lines should be kept under tension and monitored by ship's crew at all times.

4. Mooring Equipment, Mooring Line Management and Life Cycle Management

4.1 Mooring Equipment Plan

All ships must have detailed mooring line management documentation (e.g. vessel evaluation, mooring line certificates, etc) and a detailed mooring arrangement. This information will be reviewed as part of the TVQ process.

Some of the information requested as part of the TVQ includes:

1. A summary of permanent fittings and machinery installations, usually found on the mooring arrangement.
2. A general arrangement indicating the locations of mooring machinery.
3. Details of machinery specifications or operating manuals of the mooring machinery.
4. Details of deck strengthening in the areas of mooring equipment and furniture.
5. Details of mooring equipment and furniture SWLs.
6. Photos of mooring fittings to show the condition and ratings.

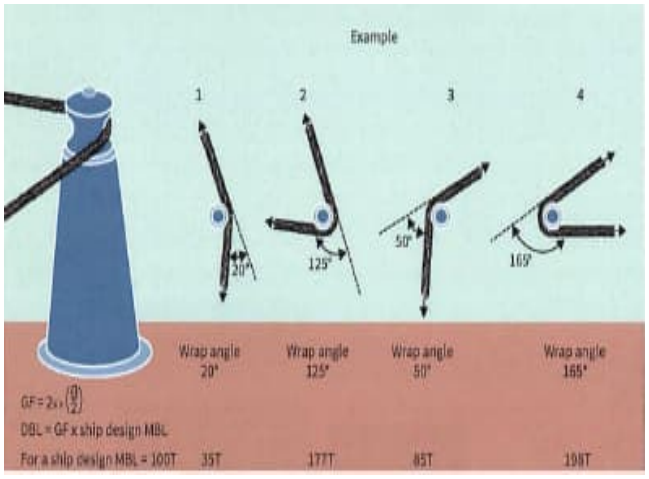
4.2 Factors Affecting Mooring Loads Mooring Line and Equipment Strength Criteria

The mooring equipment Design Basis Load (DBL) is to be taken into consideration when planning mooring operations.

The strength criteria can be defined as follows:

DBL: The design load on a fitting calculated by applying a geometric factor. It should be noted that DBL will change when load is applied from mooring lines at different angles. This may exceed the SWL of a fitting particularly in cases where angles of more than 90 degrees occur. Applied loads

rapidly increase as the angle of the load applied by the mooring line increases reaching a maximum of 180 degrees.



Angle of deflection of Mooring line over the fitting	Load on the line	Actual load on the fitting at various angle of deflection
0	100ts	0ts
10	100ts	17ts
30	100ts	50ts
50	100ts	84ts
70	100ts	**114ts**
100	100ts	**152ts**
150	100ts	**182ts**
180	100ts	**200ts**

Fig 2: Mooring line load increases with angle

The maximum angle over which a line can be turned over a fitting is given in the ships mooring arrangement plan. This value should be known by all ships staff involved in mooring operations.

The angle must not be exceeded. Mooring lines must pass from winch drum to the shore via fairleads in as straight line as possible without undue deflections around fittings.

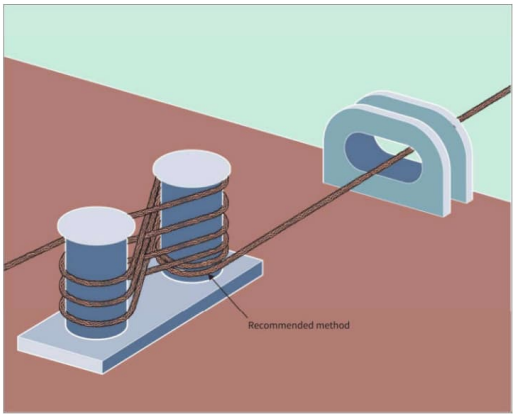
4.3 The Use of Loose Mooring Lines

The use of loose mooring lines should be avoided. Where possible lines should be deployed using powered drums. In cases where loose mooring lines are required, the Pilot and Terminal should be consulted.

In the case where loose lines are required for service, they should be secured by the ship's mooring bitts. Methods for securing, creating, maintaining and relaxing tension need to be agreed with the Terminal.

Mooring lines should be secured to the ships mooring bitts using a figure of 8. Mooring lines should not be secured using cruciform bollards or gypsy drums.

The diameter of mooring bitts should be 15 times greater than the mooring line diameter to maximise mooring strength and working life.



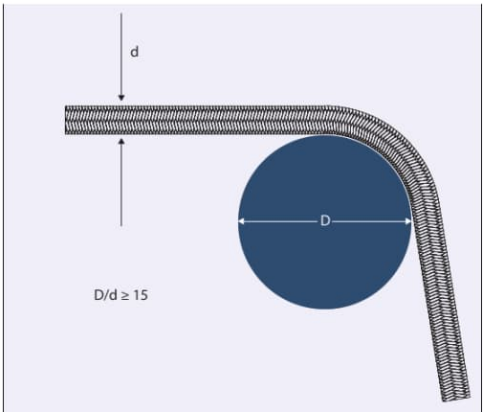


Fig 3: Loose Line Mooring Operations.

4.4 Mooring Line Stiffness

The stiffness of a mooring line is its ability to stretch under load. Mooring lines with low stiffness absorb higher dynamic loads. Wire and HMPE lines have high stiffness and synthetic lines have low stiffness.

Mooring lines made of extremely low stiffness materials such as nylon will potentially result in the ship moving while alongside. This can create a safety risk, particularly when ship's are moored in upper metocean conditions.

In cases were mooring lines of different stiffness are used in the same lead, the lines with higher stiffness will take greater load.

If possible, nylon mooring lines should not be used as mooring lines except when used as mooring tails due to the increased risk of ship's surging at berth.

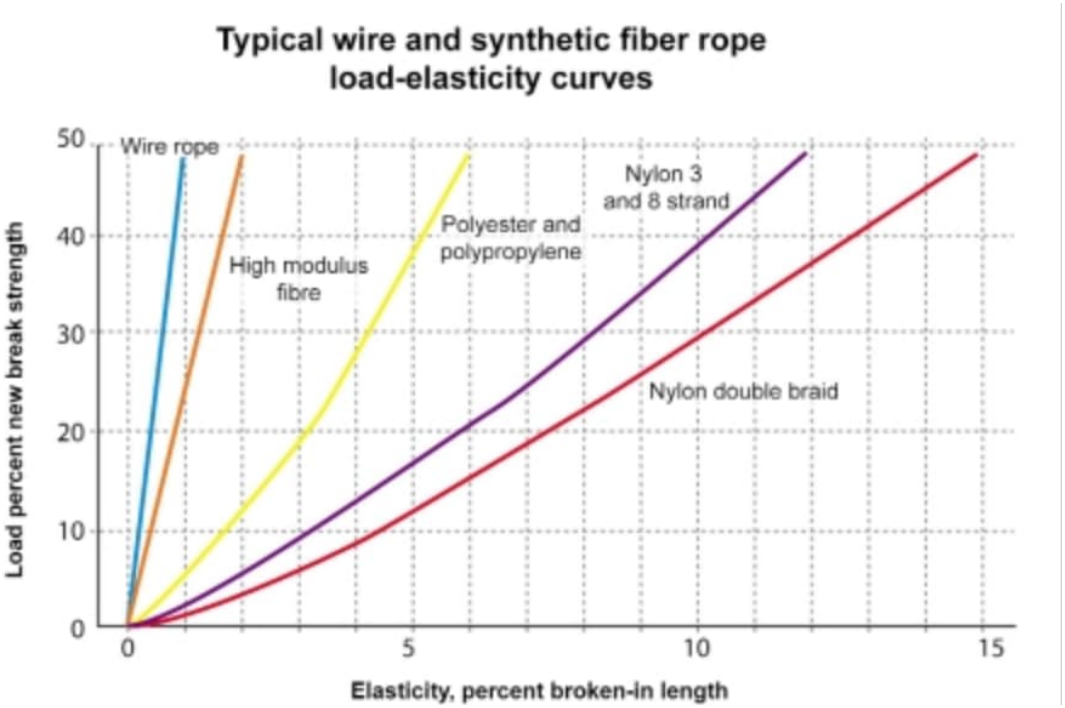
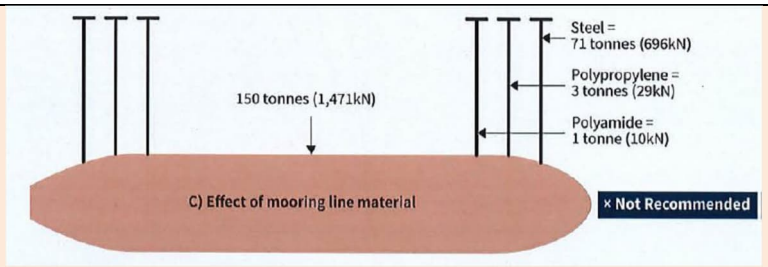


Fig 4: Typical wire and synthetic fibre rope load-elasticity curves.

4.5 Mixed Mooring Line Usage

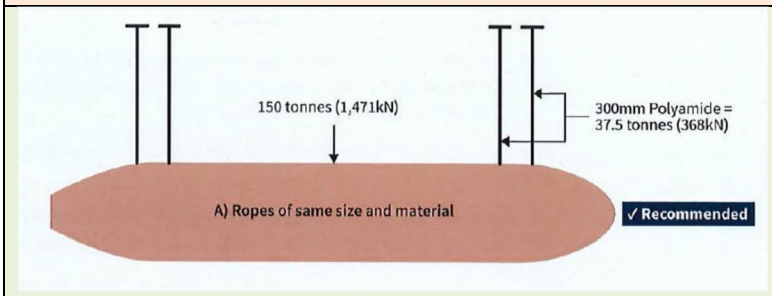
Mooring lines of similar material, diameter (within 5mm) and strength (within 5t MBL) should always be used for all leads used in the same service e.g. fwd breast lines, fwd spring lines, headlines, stern lines, etc.

When mooring tails are used, they must be of same material type in each lead, length (minimum 11m), diameter and MBL.



Different material used in same service / lead

Not Permitted



Mooring lines with same material type and in same service / lead.

Permitted

Fig 5: Loose Line Mooring Operations (source Anglo Eastern)

4.6 Mooring Tail Service Requirements

The Terminal requires that ship's using HMPE lines have mooring line tails attached to the lines.

The mooring tails must be a synthetic material that is less stiff than the mooring line.

Using mooring lines with different stiffness affects how mooring loads are distributed. There is evidence indicating that the use of mooring line tails dampens and reduces load on the mooring system.

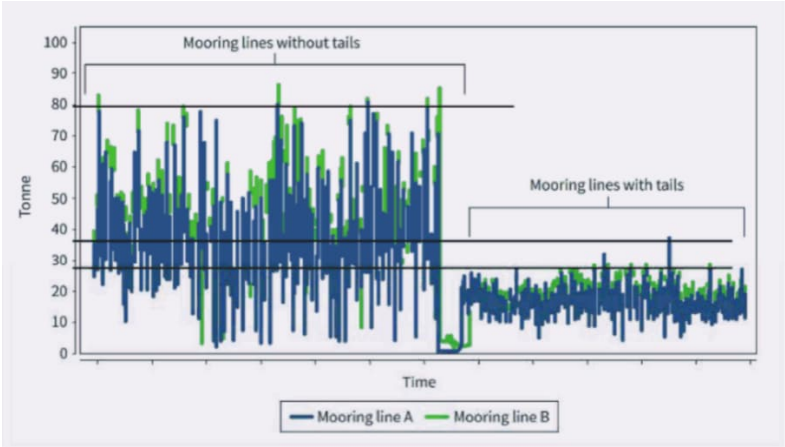


Fig 6: Mooring Tail dampening (MEG 4)

The requirements of mooring tail usage at the Terminal can be summarised as follows.

1. The mooring tails must be constructed of a synthetic material which is less stiff than the mooring line in use. They must not be constructed of HMPE.
2. The mooring tails must be between 11 meters and 22 meters in length.
3. The LDBF of the mooring tails must be 125%-130% higher than the LDBF of the mooring line it is attached to.
4. Mooring tails must be attached to mooring lines via cow hitch.

4.7 Mooring Line and Tail Service Life

Hay Point expects every ship have a mooring line management plan that defines the procedure for retiring mooring lines and tails.

Hay Point requires mooring lines and tails are retired when they reach a defined service life or when their physical condition does not allow further service.

Retirement procedures may take the form of:

1. For mooring lines, an inspection of the mooring lines based on the Cordage Institute 2001E inspection for synthetic lines. When any retirement criteria are met, it is assumed that the strength of the line is less than 75% of SDMBL and line is to be retired from service. Mooring tails do not form part of inspections and residual strength assessments.

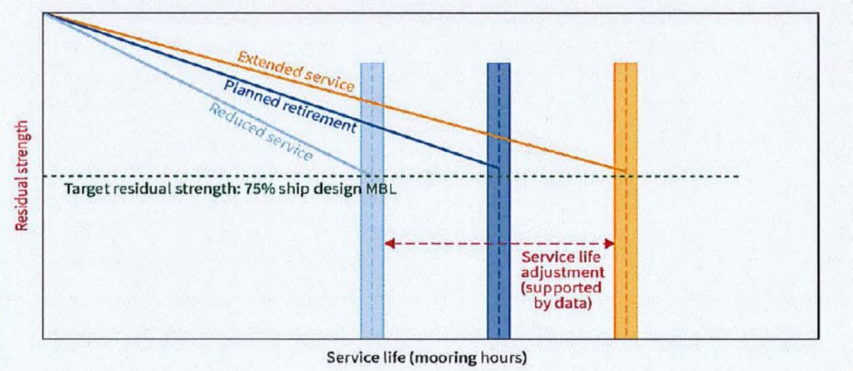


Fig 7: Mooring line residual strength (source MEG 4)

2. In service condition-based monitoring. If the inspection indicates the condition of the mooring lines or tails have been damaged or there has been evidence of mooring lines or tails being overloaded, they should be retired.

3. The mooring lines or tails have a defined time or have reached the manufactures lifecycle limits as per the below table.

Type	Retirement	Condition for Extension in Service
Mooring lines	5 years from date of certificate	Extension on case-by-case basis after thorough evaluation of condition and consultation or inspection by line manufacturer or third party. A mooring line test must be undertaken and a certificate supplied as part of an extension to the mooring lines service life.
Mooring wires	Not permitted at Terminal	n/a
Mooring tails	18 months from date of certificate	Extension on case-by-case basis after thorough evaluation of condition and consultation or inspection by line manufacturer or third party. A mooring tail test must be undertaken and a certificate supplied as part of an extension to the mooring lines service life.

Table 1: Mooring Line and Tail Service Lives

5. Terminal Mooring and Mooring Line Inspection Guidelines

The Terminal expects all ships maintain the following documentation. The documentation will be reviewed as part of the TVQ process and may also be audited while the vessel is alongside.

5.1 Mooring Line / Tail Certificate File

Every mooring line and tail is issued with a manufacturer's certificate which should specify the following:

- Certificate number
- Construction and material type of the mooring line / tail
- Length of the mooring line / tail
- Diameter of the mooring line / tail
- MBL of the mooring line / tail
- Number of coils supplied
- Certificate date

Certificates must be delivered to the ship along with the line / tail. Lines / tails that do not have a certificate on board must not be used at Hay Point.

Once the line / tail is on board, the certificate must be placed into a file for easy access. The file should also record when the line / tail was put into use and its position in the mooring arrangement.

5.2 Mooring Line Age and End for End Dates

The Terminal requires mooring lines are end to ended after being installed for 2.5 years and then replaced after 5 years from date of certificate.

5.3 Minimum Mooring Line Length

The Terminal require mooring lines are at least 200m in length at all times.

It is recommended that when sourcing new mooring lines 220m length lines are sourced. This allows for 20m of line to be tested as required.

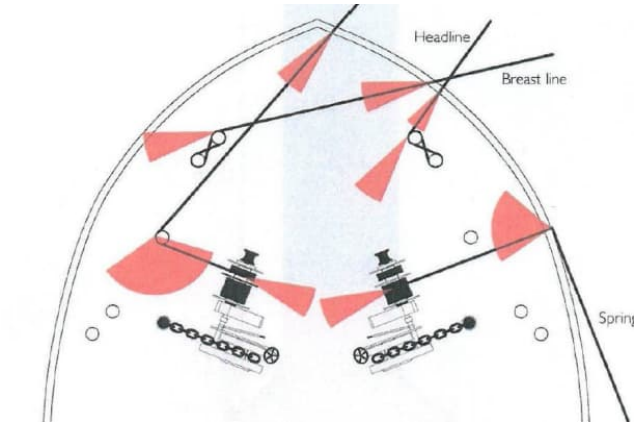
5.4 Management of Snap Back Zones

Vessel movement caused by upper metocean conditions at the Terminal creates additional energy in the mooring system. If the energy is released via a sudden failure of a mooring line, the release of energy will cause the mooring line to snap back unpredictably.

The amount of energy produced from a snap back event is proportional to the sea state, the length of mooring line deployed and the stiffness of the line.

There is an increased risk of mooring lines parting at the Terminal due to metocean conditions therefore all ship's are expected to have a comprehensive snap back zone management plan.

Ships should not mark individual snap zones around winches. The whole mooring area at the bow and stern along with areas surrounding spring and breast winches should be marked as a snap back zone.



Do not mark zones of danger on deck. The entire mooring area is a hazardous area

Fig 8: Snap Back Zone Markings

5.5 Mooring Line Spares

The Terminal requires every ship have at least 2 spares on board that meets the same requirements as lines in use. The same applies for mooring line tails.

The 2 spares are in addition to all lines that can be deployed. For example, if a ship has 12 winches but can also deploy 2 fwd breast lines and 2 aft breast lines, the Terminal expects the vessel to have a total of 18 mooring lines on board that meet the requirements (16 lines potentially deployed plus 2 spares).

5.6 Inspection Intervals of Mooring Lines and Tails

The Terminal requires mooring lines and tails be inspected at regular intervals. The inspection intervals of mooring lines and tails depend on the service interval.

As a guide, the Terminal requires the following:

1. The inspection of mooring lines and tails must be undertaken by the ship's Senior Officers. The inspection process and guidelines should be clearly outline in the ship's line management plan.

2. All mooring lines and tails must have a routine inspection at a minimum of 12 month intervals.

3. An inspection of the mooring line high wear or contact areas must be performed before undertaking cargo operations.

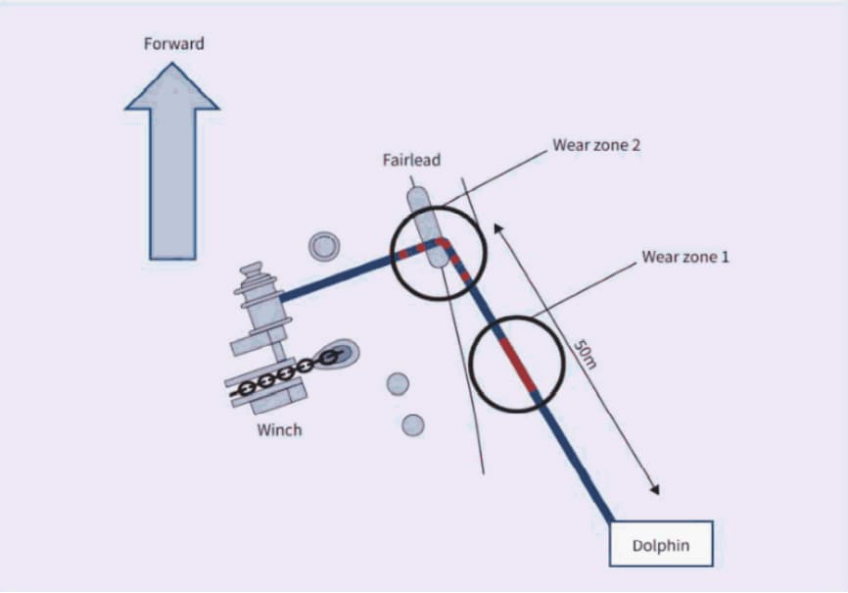


Fig 9: Mooring Line and tail High Wear Zones (MEG 4)

A mooring line and mooring tail inspection record should be maintained. The document should contain details of the mooring line, mooring tail and inspection information.

6. Guidelines on Mooring Operations

Terminal staff are available to provide guidance and assistance during a ship's call to the Terminal however it is the responsibility of the Master and the ship's crew to ensure the ship remains alongside.

The ship's mooring and line management documentation should guide the Master and crew on safe mooring practices and tending of mooring lines.

The Terminal expect the ship's mooring policies and procedures incorporate the following:

6.1 The Management of Shipboard Activities during Cargo Operations

It is critical the ship's crew are focused on mooring operations while alongside. The Terminal does not provide for any bunkering activities.

It is advised all activities that deflect the crew's attention away from cargo and mooring operations be undertaken before, after or during stops in cargo operations.

6.2 Mooring Equipment and Mooring Line Verifications

Lines must be correctly tensioned to ensure the ship remains securely alongside. Lines that are under tensioned will cause additional load to be transferred to the adjacent mooring lines. Mooring lines that are over tensioned can potentially pass their working load limit (WLL) and become overloaded, causing the mooring winch to render or in extreme cases cause the mooring line to part.

The Terminal supplies a tablet that records the tension in the mooring lines however the tablet should be used as guide and is not a substitute for continual monitoring of mooring lines by the ship's crew. The vessel must tend the mooring lines every 30mins due to the environmental conditions experienced at the Terminal.

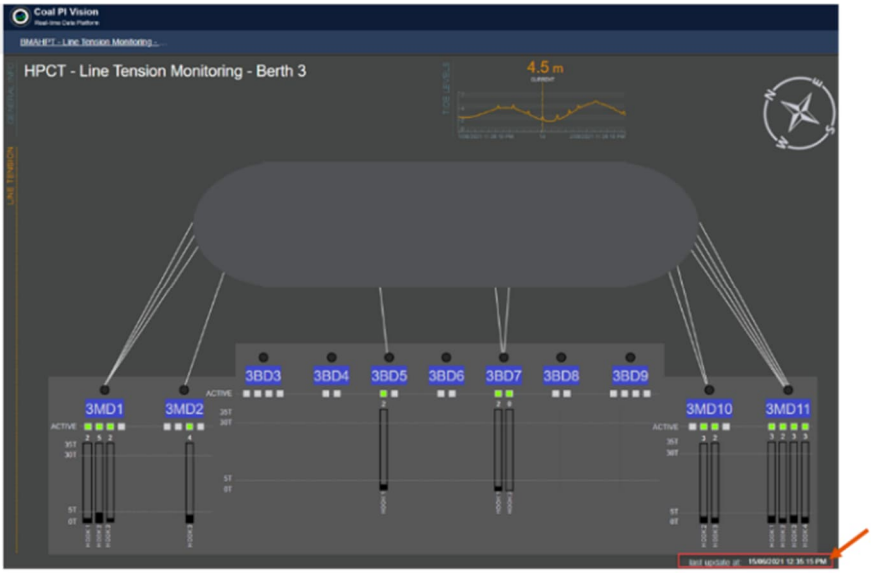


Fig 10: Vessel Tablet Mooring Line Tension

To ensure mooring lines are continually monitored, the Terminal requires all ships have sufficient deck crew to tend the fwd and aft mooring lines simultaneously.

A formal system for continually monitoring the tension of the lines, the brake render set point indicator and chafe protection is required and may be audited while the ship is alongside.

6.3 Mooring Winch Verifications

The Terminal requires mooring winch brake render tests be performed annually.

The mooring winch brakes should be set to render between 60-80% of the ship design MBL or maximum brake holding capacity (BHC), whichever is the lesser. The Terminal also require the brake render set point is at least 30t to account for metocean conditions.

For conventional drums, the render point must be set at the 3rd or 4th layer of rope on the drum. For split drums, the render point must be set at the 1st layer of rope on the drum. For both conventional and split drum mooring winches, the render point must not exceed the maximum BHC at the first rope layer.

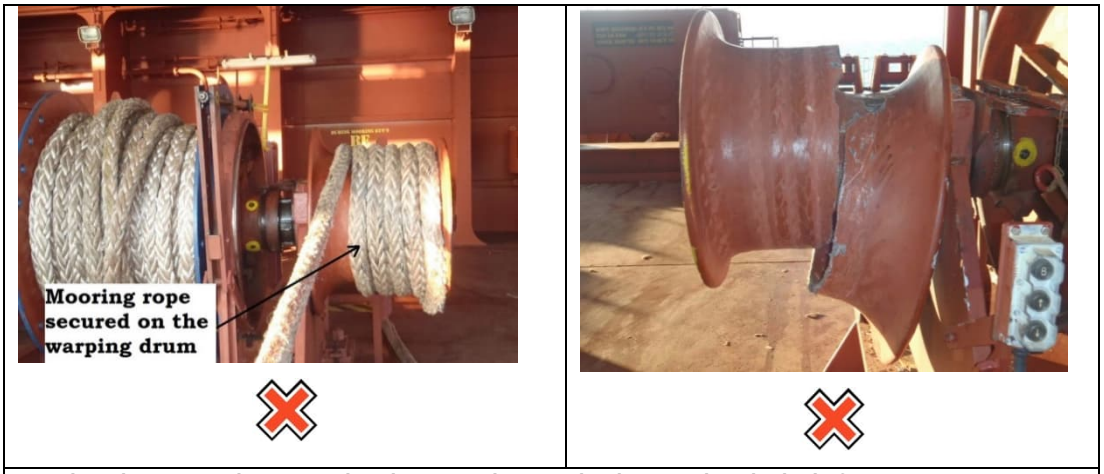
A more detailed explanation of the Terminal's requirements on mooring winch brake rending tests can be found in 'HPCT Brake Render Testing Guidelines'.

The mooring winch render set points should be clearly marked on the brake spindle with the mooring winch brake applied as per the marks when the vessel is alongside.

Fig 11: Mooring Winch Brake Correct Setting/Alignment.

6.4 Use of Mooring Lines on the Drum End

The Terminal does not allow loose mooring lines to be made fast on the winch warping drums. The warping drums are not designed for making fast a mooring line.



Mooring Line Secured to a Warping drum can damage the drum or the winch shaft

Fig 12: Mooring Winch Line secured to warping drum.

6.5 The Use of Fairleads

The Terminal requires that only 1 mooring line pass through each fairlead and only 1 line passes each mooring bitt. Ships must not deploy multiple lines from a single fairlead or mooring bitt as it will lead to over stressing of deck furniture and create friction points on the mooring line.

Fig 13: Overloading Fairleads and mooring bitts

6.6 Split Drum Mooring Winches

The Terminal requires only 1 layer of rope be maintained on the working part of a split drum mooring winch. Additional layers of rope on the working part of the drum will impact the brake render set point potentially resulting in lines rendering at different loads. Unequal load sharing between lines in the same lead can result in lines parting.

Fig 14: Multiple layers on a split mooring drum

6.7 Embedded Mooring Lines

Unequal load sharing between lines in the same lead can cause brakes to render at different loads resulting in the sudden transfer or energy to other lines. Such events can cause unexpected line failure if the other drums fail to render.

This situation may also present when lines embed within the layers of rope on the drum. Ship’s crew should pay close attention to this risk and where necessary use anti-embedding devices.

An example of this is shown below:

Fig 15: Anti mooring Line embedding

6.8 Wear Zone Management

Due to the open water nature of the Terminal and the associated metocean conditions, there is an increased risk for mooring line wear.

The Terminal requires all ships manage wear zones to protect the mooring line from damage. Pedestal rollers, roller fairleads and universal roller fairleads must be maintained and be free to rotate to allow the mooring line to move over them.

Fixed deck fittings, mooring bitts and closed fairleads must be maintained free of any sharp edges and burrs. Any such edges and burrs must be evened out. Abrasion resistant chafe protection must be used with all mooring lines deployed to prevent damage.

Where possible, stainless steel or synthetic inserts must be used with all mooring lines.

Fig 16: Mooring Line chafe protection.