Dear Mr. Huttman,

Thank you for your dedication to completing a report in response to Task Statement 13-06, “Recommendations for Maintenance, Repair and Utilization of Towing Equipment, Lines & Couplings.”

The recommendations contained in this TSAC report will be reviewed and considered in current regulatory and policy development. This report reaffirms TSAC’s partnership with the Coast Guard to improve the safety of all those working in the towing industry. The depth of consideration and quality of the recommendations within this report are a direct reflection of TSAC’s dedication and expertise.

Please accept my personal thanks, and convey my gratitude to the members of TSAC and the subcommittee, especially the subcommittee co-chairs, Mr. Steve Kress and Mr. Mark Grosshans, for the significant amount of time and effort devoted to this final report.

Sincerely,

[Signature]

PAUL F. THOMAS
Rear Admiral, U. S. Coast Guard

Mr. Steve Huttman
Chairman of TSAC
Vice President Operations
G&H Towing Company
P.O. Box 2270
Galveston, TX 77553
May 31, 2016

Rear Admiral Paul F. Thomas  
Assistant Commandant for Prevention Policy  
U. S. Coast Guard  
2703 Martin Luther King Jr Ave SE, Stop 7509  
Washington, DC 20593-7509

Subj: Towing Safety Advisory Committee Final Report – Task 13-06  
Recommendations for the Maintenance, Repair and Utilization of Towing Equipment, Lines and Couplings

Dear Admiral Thomas,

I am writing today to forward the final report and recommendations of the Towing Safety Advisory Committee for Task Statement 13-06.

The enclosed report was formally approved by the Towing Safety Advisory Committee at the spring meeting held in New Orleans, Louisiana on April 14, 2016. We believe that the final report and recommendations has addressed all of the tasks which were assigned to the committee in the task statement.

The Subcommittee Chair, Capt. Steve Kress and Co-Chair Capt. Mark Grosshans along with the 20 other subcommittee members worked very diligently to prepare a very detailed report that covers a wide array of towing gear used in the Towing Industry in the United States. We are hopeful that this reports aides the Coast Guard in understanding the use and maintenance of towing gear.

The members of the Towing Safety Advisory Committee greatly appreciate the support and cooperation of the U. S. Coast Guard participating and assisting the subcommittee with the Task. We are grateful for the chance to provide to the Coast Guard, the thoughtful advice and recommendations from the Towing Industry as the Coast Guard conducts its regulatory oversight. Should you have any questions regarding the final report or recommendations, please don’t hesitate to contact me or Capt. Kress.

Sincerely,

Steven J. Huttman  
Chairman, Towing Safety Advisory Committee

Encl: (1) Final Report – Towing Safety Advisory Committee Task 13-06 Towing Gear

cc: Capt. Steve Kress, TSAC Task 13-06 Chair  
CDR Jose Perez, Designated Federal Officer (DFO) – Towing Safety Advisory Committee  
LCDR William A. Nabach, Alternate DFO – Towing Safety Advisory Committee  
William Abernathy, Alternate DFO – Towing Safety Advisory Committee
TOWING SAFETY ADVISORY COMMITTEE

TASK 13-06

Recommendation for the Maintenance, Repair and Utilization of Towing Equipment, Lines and Couplings

(Short Title Towing Gear)

Final Report and Recommendations
March 31, 2016

To: Towing Safety Advisory Committee

From: Capt. Steven Kress, Chair
      Capt. Mark Grosshans Co-Chair

RE: TASK 13-06 “Recommendation for the Maintenance, Repair and Utilization of Towing Equipment, Lines and Couplings”

At the September 2013 Towing Safety Advisory Committee meeting a subcommittee was tasked with providing Recommendation for the Maintenance, Repair and Utilization of Towing Equipment, Lines and Couplings

The task number 13-06 was accepted on September 5th, 2013 at the full TSAC meeting in Chicago, Illinois.

Capt. Russell Luttman was nominated for Chairman and Capt. Steven Kress was nominated as Co-Chair of this Subcommittee. Both nominations were approved by the committee.

Chairman Luttman term as a member of TSAC terminated and Capt. Steven Kress assumed responsibilities as Chairman for TASK 13-06.

Subcommittee participants include TSAC members, industry, and affected Government Agencies. A complete list of participants is attached as Enclosure (2) to this report.

Respectfully Submitted,

Capt. Steven Kress
TASK 13-06 Subcommittee Chair

Enclosure:   (1) Task Statement 13-06
            (2) TSAC Representatives & Subcommittee Participants
            (3) References
            (4) Definitions
            (5) COMDTPUB 16700.4 NVIC 5-92 dated 27 JUL 1992
PLAN OF ACTION (POA)

1. Provide recommendations to the Coast Guard on specific criteria to be used in determining the proper utilization of towing equipment for specific towing evolutions to include:
   a. towing system capability
   b. towing systems compatibility with the tow in regards to:
      I. Operational environment; and
      II. Expected forces exerted on the towing equipment
      III. Sufficiency of fail-safes for redundancy and tow retrieval

2. Provide recommendations to the Coast Guard on specific criteria for the care and maintenance of towing equipment to include repairs, frequency of maintenance and criteria for removal from service.

3. Provide recommendations to the Coast Guard concerning the specific knowledge, skills and training of persons responsible for the maintenance, repair and determination of towing gear for establishing a tow.

4. Provide any other recommendations relevant to the intent of the Task Statement not specifically identified in this section.

5. Provide a Draft Report no later than August 2015

6. Submit Final Report not later than December 2015

ACTION

1. Subcommittee to compose list of factors for consideration on specific criteria to be used in determining the proper utilization of towing equipment for specific towing evolutions

2. List of factors for consideration for specific criteria for the care and maintenance of towing equipment to include repairs, frequency of maintenance and criteria for removal from service.

3. Collected and distributed to subcommittee members industry custom and practice procedures, U. S. Coast Guard requirements, and manufacturer’s recommendation reports for committee and public comments.

4. Draft Report submitted at March 26th, 2015 TSAC Meeting


6. Revised Draft Report

7. Revised Draft Report to be published on U. S. Coast Guard Homeport website for comments.
8. Final Report and Recommendations to be presented for consideration by Towing Safety Advisory Committee at its spring 2016 meeting.

RECOMMENDATIONS FOR TOWING GEAR NOT ASSOCIATED WITH CRITICAL TOWS

Task 1. Provide recommendations to the Coast Guard on specific criteria to be used in determining the proper utilization of towing equipment for specific towing evolutions to include:

a. standards for towing system capability

1. Tow Gear Selection and Accountability

It is strongly recommended that all tow gear: tow wires, sockets, towing shackles, delta plates, chain and high performance lines should be of the best quality available whenever critical tows, MODUs, MOUs, and ships are to be towed. These are engineered components and not commodities. All these components have serial numbers which are issued for traceability. In the event one component fails all the others from the same run or batch can be retired. These serial numbers are to be logged for tracking as per your Towing Safety Management System (TSMS).

2. Strength of Towline & Towline Connections (Outside of Ice Areas)

A. The Minimum Breaking Loads (MBL) of the main and spare towlines, and the Ultimate Load Capacity (ULC) of the towline connections to the tow including each bridle leg, shall be related to the continuous static bollard pull (BP) of the actual towing vessel to be used as follows (BP, MBL and ULC are in short tons):

<table>
<thead>
<tr>
<th>Continuous Bollard Pull (BP)</th>
<th>Benign Areas</th>
<th>Other Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>BP ≤ 44 short tons</td>
<td>2.0 x BP</td>
<td>3.0 x BP</td>
</tr>
<tr>
<td>44 &lt; BP ≤ 100 short tons</td>
<td>2.0 x BP</td>
<td>(3.8 – BP/50) x BP</td>
</tr>
<tr>
<td>BP &gt; 100 short tons</td>
<td>2.0 x BP</td>
<td>2.0 x BP</td>
</tr>
</tbody>
</table>

Towline Minimum Breaking Loads for Unrestricted Towages Table 2

<table>
<thead>
<tr>
<th>Bollard Pull (BP)</th>
<th>Minimum Breaking Load (MBL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 40 tonnes</td>
<td>3.0 x BP</td>
</tr>
<tr>
<td>40 to 90 tonnes</td>
<td>(3.8 - BP/50) x BP</td>
</tr>
<tr>
<td>Over 90 tonnes</td>
<td>2.0 x BP</td>
</tr>
</tbody>
</table>
Towline Minimum Breaking Loads for Restricted Towages Table 3

<table>
<thead>
<tr>
<th>Bollard Pull (BP)</th>
<th>Minimum Breaking Load (MBL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 40 tonnes</td>
<td>3.0 x BP</td>
</tr>
<tr>
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<td>(3.8 - BP/50) x BP</td>
</tr>
<tr>
<td>Over 90 tonnes</td>
<td>2.0 x BP</td>
</tr>
</tbody>
</table>

B. All tow gear (shackles, wire, chains) shall be appropriately sized relative to the bollard pull of the towing vessel with appropriate safety factors as per regulation.

C. For towing vessels with very large bollard pulls (typically over 100 short tons) it may be difficult to satisfy the requirements of Table 1 due to problems in safely handling the large towlines required. In these cases, the effective towing bollard pull for selecting the towline MBL may be reduced to not less than 300 tons provided that;

(1) The Towing Vessel is fitted with towline tension monitoring,
(2) Towing Vessel Master is in agreement,
(3) Reduction is documented in the towing procedures and Certificate of Approval,
(4) Towing Vessel Master must take extra care in bad weather to protect the towline and if practicable:
   (a) Winch should be adjusted to pay out at 80% of the towline MBL
   (b) Main engines should be mechanically or electronically limited to produce a maximum static bollard pull of not more than 50% of the towline MBL (i.e. the effective bollard pull).

D. For specific tows in benign weather areas and in deep water that allows long towlines to be deployed, the effective towing bollard pull may be further reduced to not less than 275 short tons after agreement with the relevant stake holders.

E. The Ultimate Load Capacity (ULC), in short tons, of towline connections to the tow, including each bridle leg, connectors (apart from shackles which are covered further on), chain pendants, and fairleads, where fitted, shall be not less than:

ULC = 1.25 x required towline MBL for the actual towing vessel (for MBL < 176 short tons) or ULC = required towline MBL for the actual towing vessel + 40 (for MBL > 176 short tons).

F. Where a reduced towline length demands a higher Minimum Breaking Load (MBL) in order to satisfy the towline length formula, then this increased MBL shall be the required MBL when determining the strength of the other components in the towing arrangement.

G. For specific tows in benign weather areas and in deep water that allows long towlines to be deployed, the effective towing bollard pull may be further reduced to not less than 275 short tons after agreement with the relevant stake holders.
H. A certificate to demonstrate the MBL of each towline shall be available. MBL may be obtained by testing, or by showing the aggregate breaking load of its component wires, with a spinning reduction factor. This certificate shall be issued or endorsed by a body approved by an IACS member or other recognized certification body.

I. Fairleads where fitted, shall be designed to take transverse loadings from any likely towing vessel pulling direction, and loadings along the line of the towline caused by a chain or shackle being caught in the fairlead.

J. For specific tows in benign weather areas and in deep water that allows long towlines to be deployed, the effective towing bollard pull may be further reduced to not less than 275 short tons after agreement with the relevant stake holders.

K. Where no fairleads are fitted, the towing connections shall be similarly designed.

L. If a fairlead or towing connection is to be used either with or without a bridle, it should be designed for both cases.

M. Where towing connections or fairleads may be subjected to a vertical load, the design shall take account of the connection or fairlead elevation, the proportion of bridle and towline weight taken at the connection or fairlead, and the towline pull, at the maximum pitch angle computed.

N. It should be noted that the above requirement represents the minimum values for towline connection strength. It may be prudent to design the main towline connections to allow for the use of tugs larger than the minimum required.

O. In particular circumstances, where the available towing vessel is oversized with regard to the Towline Pull Required, and the towline connections are already fitted to the tow, then the towline connections, fairleads and bridle (but not the towline itself, pendants, stretchers or shackles between the towline and bridle) may be related to the required BP rather than the actual BP but should allow for the effective length of the towline used. Such relaxation shall be with the express agreement of the Towing Vessel Master, and shall be noted in the towing procedures and Certificate of Approval. It shall not apply for towages in ice areas.

3. **Relationship between Towline length and Strength**

A. Except in benign areas and sheltered water tows, the minimum deployable length of each of the main and spare towlines (L) shall be determined from the “European formula” \[ L > (BP/MBL) \times 1800 \text{ meters (m)} \] except that in no case shall the deployable length be less than 650 meters, apart from coastal towages within a good weather forecast when this may be reduced to 500 meters.
B. For benign areas, the minimum deployable length shall be not less than: \( L > (BP/MBL) \times 1200 \) meters except that in no case shall the deployable length be less than 500 meters.

C. The deployable length shall not include the minimum remaining turns on the winch drum, and the distance from the drum to the stern rail or roller.

D. One full strength wire rope pendant which is permanently included in the towing configuration may be considered when determining the available length.

4. **Towline Connection Points - Towing pads, Smit brackets**

   A. Towline connections to the tow shall be of an approved type. Preferably they should be capable of quick release under adverse conditions, to allow a fouled bridle or towline to be cleared, but must also be secured against premature release.

   B. Towline connections and fairleads shall be designed to the requirements of a recognized classification society.

   C. Sufficient internal/underdeck strength must be provided for all towline connections and fairleads.

   D. Where fitted, fairleads should be of an approved type, located close to the deck edge. They should be fitted with capping bars and sited in line with the towline connections, to prevent side load on the towing connections.

   E. Where the bridle might bear on the deck edge, the deck edge should be suitably faired and reinforced to prevent chafe of the bridle.

   F. Where towing connections are of a quick-release type, then the fairlead design shall allow all the released parts to pass easily through the fairlead.

5. **Bridle Legs**

   A. As a practice for most ocean tows an appropriately sized chain towing bridle (with MBL of at least two (2) times \( \times \) the BP of the towing vessel) consisting of two bridle legs and a towing pigtail should be utilized.

   B. On tows such as ships a single tow chain may be utilized.

   C. Under special circumstances such as rescue tows or tows in protected waters appropriately sized synthetic and or wire bridles may be utilized. Wire and synthetic line should not be used around bitts of fairleads where there is a possibility of chafing but if circumstances require their use then the gear must be thoroughly protected from chafing.
D. Chain size may vary depending on the towing vessel and tow but are generally a grade 3 appropriately sized stud link chain. Each bridle leg should be of stud link chain or composite chain and wire rope. If composite, the chain should of sufficient length to extend beyond the deck edge and prevent chafing of the wire rope.

E. The angle at the apex of the bridle should normally be between 45 and 60 degrees but in any case it is not to exceed 90 degrees. Determining the bridle length can be accomplished by making sure that the length of each bridle leg is not less than .75 x the distance between the two towing pads/strong points or deck fairleads.

F. The end link shall be a pear and or kenter type connecting link, not a normal link with the stud removed. In the event of no large end link extra shackles will required.

G. All wire ropes shall have hard eyes or sockets.

H. Wire towing pendants shall:
   1. Be of the same lay as the towing wire, and
   2. Have a breaking load not less than the required breaking load of the main towing wire, and
   3. have a length appropriate to their intended service; typically, these will be in the range of 10 to 50 meters long but at least two should be suitable for making up a towing bridle, and
   4. Have hard eyes formed by a heavy-duty gusseted thimble or a spelter socket at each end.

I. If the vessel/object being towed does not have tow pads or Smit brackets for connecting the bridle legs then deck bitts may be used. In such cases the bridle leg chain may secured by taking one turn around the first bitt, then one turn around the second bitt. The chain can then be led to the next set of bitts and figure eighted around the bitts and end link of the chain secured back to itself in front of the forward bitt. Another option is to attach a wire to the end link and then secure the wire around the next set of bitts or another without slack.

6. Bridle Apex

The bridle apex connection should be a triangular plate, often referred to as a Delta Plate (Tow, Flounder, Fish or Monkey Plate) or when acceptable an enlarged bow towing shackle for tows of short duration.

7. Shackles

A. The documented breaking load of shackles forming part of the towline (including any shackle between the towline and the bridle apex) shall be at least 110% of the actual breaking load of the towline to be used.
B. The breaking load of shackles forming part of the bridle shall be not less than 110% of the required breaking load of the connected parts.

C. If the SWL or WLL of a shackle is documented but the minimum breaking load is not, the towing vessel owner should obtain a document (which could be a company brochure) from the shackle manufacturer stating the minimum Safety Factor - defined as minimum break load /SWL (or WLL as appropriate). Note: This is because there is a large range in shackle safety factors.

D. The shackles should be double or single nut towing shackles– not safety shackles.

8. Shackle Orientation

Shackles used in any towing system (especially those used in Delta plates) must be rigged with the shackle pin facing down with the nut(s) on the underside of the shackle and secured with properly secured with machine bolt with two jam nuts.

9. Intermediate Pendant or Surge Chains

A. An intermediate wire rope pendant may be fitted between the main towline and the bridle or chain pendant. Its main use is for ease of connection and reconnection. All wire rope pendants shall have hard eyes or sockets, and be of the same lay (i.e. left or right hand) as the tow wire.

B. A synthetic spring, if used, should not normally replace the intermediate wire rope pendant.

C. The length of the wire pendant for barge tows is normally 10-15 meters since this can be handled on the stern of most tugs without the connecting shackle reaching the winch. Longer pendants may be needed in particular cases.

D. The breaking strength of the wire rope pendant shall not be less than that of the main towline.

E. A surge chain may be used; especially in deep water where long towline catenary can be used to compensate for surge generated by interaction with large ocean swells. If a surge chain is supplied, then the MBL shall not be less than that of the main towing wire. The surge chain shall be a continuous length of welded stud link chain grade 2 or better (preferred) with a joining link each end (kenter/pear) and eliminate enlarged open link. A method of recovery of the chain shall be provided in case a tow wire breaks.

F. The use of a “fuse” or “weak link” pendant is not recommended.
10. Tow Wire Catenary

A. Tow wire catenary (sag) is caused by the relationship between vessel speed, length of the tow wire paid out and weight of the wire. It is the primary means of relieving peak dynamic tensions on the tow wire. When the tow wire is combined with surge gear the catenary will increase as will the surge protection, lengthening the tow wire will also increase both the catenary and improve surge protection.

B. Water depth governs the amount of catenary that can be safely maintained, therefore a compromise must be made between the water depth, tow wire length, vessel speed and surge gear used. With sufficient water depth good catenary can be maintained by lengthening the tow wire but while in shallow water the catenary and surge protection must be managed by the reduction of vessel speed and wire length in consideration of the governing water depth, and or the automatic towing winch (if fitted).

C. To avoid dragging or fouling the tow wire on the bottom while maintaining an adequate catenary to absorb the changes in tug/tow separation caused by the prevailing conditions, it is necessary to estimate the catenary or sag of the tow wire.

D. An initial estimate of the catenary depth of the towline may be determined using the following formula:

\[ C = \frac{T}{W} - \frac{T}{W} \sqrt{1 - \left(\frac{WS}{2T}\right)^2} \]

where:
- \( C \) = Catenary or sag (ft.)
- \( T \) = Steady tension (lbs. force)
- \( W \) = Weight in water per unit length (lbs. /ft.)
- \( S \) = Total scope (ft.) (total of all components)

Total weight in water per unit length \( (W) \) is computed as the sum of the weights of the individual towline components divided by the total towline scope.

Task 1. b. towing systems compatibility with the tow in regards to:

I. Operational Environment

1. Procedures

A. The tow should not proceed to sea until a satisfactory inspection of the tow has been carried out by the Towing Vessel Master and, if requested or for any reason considered necessary, by any other competent person.

B. The towing operation should not commence unless the environmental conditions prevailing, and forecast, will allow the tow to achieve safe sea room where the tow is not endangered by a lee shore or other navigational hazards.
C. Where operational limitations have been identified for the tow, procedures should be put in place to prevent the tow encountering conditions in excess of the limitations. Such procedures may include weather routing or safe shelter locations, or both.

D. The towed object, including cargo and securing arrangements, should be capable to withstand the loads caused by the most adverse environmental conditions expected for the season and areas in question.

E. The duration of a towing operation is measured from the time the operation is started until the tow is in a safe condition at its arrival location. If there are locations along the route where the towed object can safely be located, the duration of the towing operation can be measured between such locations.

F. For long duration towing operations passing through areas having different sea state characteristics, the worst sea state for the route should be considered when selecting the cargo securing arrangements and the equipment to ensure watertight integrity of the towed object.

G. The continuous bollard pull of the towing vessel(s) involved should be sufficient to maintain station keeping of the tow in the following environmental conditions, acting in the same direction:
   (1) Wind: 40 knots
   (2) Significant wave height: 16 ft.
   (3) Current: 1.0 knots

H. Other criteria may be acceptable if high confidence on the weather forecasts and experience data for the actual waters can be obtained.

2. Weather Forecast

A. Where possible a weather forecasting source should be available on a 24-hour basis for the whole towing operation.

B. Weather forecasts should, as a minimum, contain the following information:
   (1) Synopsis of the area
   (2) Wind speed and direction
   (3) Wave height and period
   (4) Swell height and period
   (5) Outlook for the next 48 hours.

C. In certain high risk situations, or when such forecast may be seasonally unpredictable consideration should be given to obtaining a second weather forecast.

D. Weather forecasts should be received on the towing vessel (and the tow if manned) at least every 24 hours during the towage.
Where there are specific weather limitations imposed, then more frequent forecasts may be appropriate and possible direct communication with the forecaster if significant changes are expected.

**Task 1. b. towing systems compatibility with the tow in regards to:**

**II. Expected forces exerted on the towing equipment:**

1. The tow shall be designed to withstand the loads caused by the most adverse environmental conditions expected for the area and season through which it will pass, taking account of any agreed mitigating measures. For each phase of a towing operation, the design criteria should be defined, consisting of the design wave, design wind and, if relevant, design current. It should be noted that the maximum wave and maximum wind may not occur in the same geographical area, in which case it may be necessary to check the extremes in each area, to establish governing load cases.

2. The tow should generally be designed to the 10-year monthly extremes for the area and season, on the basis of a 30-day exposure.

3. For detailed guidelines please refer to the information provided by: GL, DNV, CCS, etc.

**Task 1 b. towing systems compatibility with the tow in regards to:**

**III. Sufficiency of fail-safes for redundancy and tow retrieval**

1. **Emergency Towing Gear**

   A. Emergency towing gear shall be provided in case of towline failure, bridle failure or inability to recover the bridle. Preferably it should be fitted at the bow of the tow. It may consist of a separate bridle and pendant or a system as shown in Appendix C. Precautions should be taken to minimize chafe of all wire ropes.

   B. The emergency system will typically consist of the following:
      
      1. Towing connection on or near the centerline of the tow, over a bulkhead or other suitable strong point
      2. Closed fairlead
      3. Emergency pendant, minimum length 80 meters, with hard eyes or sockets, preferably in one length. This length may be reduced for small barges and in benign areas
      4. Extension wire, if required, long enough to prevent the float line chafing on the stern of the tow
      5. Float line, to extend 75-90 meters abaft the stern of the tow
      6. Conspicuous pick-up buoy, with reflective tape, on the end of the float line
C. The strength of items 1. and 2. above should be as for the main towline connections, as shown in Section 4. The breaking load of the handling system, items 4. and 5. above should be not less than 25 tons, and must be sufficient to break the securing devices.

D. If the emergency towline is attached forward, it must be led over the main tow bridle. It should be secured to the outer edge of the tow, outside all obstructions, with soft lashings, or metal clips opening outwards, approximately every three meters.

E. If the emergency towing gear is attached aft, the wire rope should be coiled or flaked near the stern, so that it can be pulled clear. The outboard eye should be led over the deck edge to prevent chafe of the float line.

F. For towage of very long vessels, alternative emergency arrangements may be approvable but an arrangement shall be agreed with the Towing Vessel Master to ensure that reconnection is possible in an emergency.

G. Whatever the arrangement agreed, care shall be taken that no chafe can occur to the floating line when deployed.

H. It is good practice to have swivels at the connection of the float line to the pendant line or extension wire, and at the connection of the float line to the buoy.

I. The following reconnection equipment should also be considered, and placed on board if the duration and area of the towage demand it:
   1. Heaving lines
   2. Line throwing equipment

**Task 2. Provide recommendations to the Coast Guard on specific criteria for the care and maintenance of towing equipment to include repairs, frequency of maintenance and criteria for removal from service.**

1. **Tow Wire Inspection Procedures**

   A. The purpose of this document is to provide instruction for the inspection of tow wires aboard towing vessels. Following the instructions below will ensure proper working life of the wire and promote the safety of the crew, vessels, and cargo.

   B. Tools needed:
      1. Caliper (digital preferred)
      2. A Tow Wire Inspection Report
      3. Writing utensil, clipboard, and rag (for cleaning micrometer or calipers between measurements)
C. **When conducting an inspection, the inspector must remain vigilant during the entire inspection and not become complacent only noting variations in diameter.** It is important to also note broken wires and deformed strands as the nature of any distortion or disturbance in the wire lay; breakage and uncharacteristic damage or the extent of abrasion or peening is also of great importance in telling the wire rope's operating history and condition.

*SAFETY NOTE: DO NOT CONDUCT AN INSPECTION WITH THE TOW WIRE UNDER LOAD. IT IS UNSAFE AND THE READINGS WILL PROVE FALSE.*

D. Inspections are best conducted in a shipyard or run out on a long pier. A tow wire can be paid out in deep water and inspected coming on or off the winch but due caution is needed.

2. **Inspection:**

A. A field inspection of a tow wire begins at the socket end of the hawser; the first thing the Deck Officer will check is the general condition of the towing socket. There should be no movement whatsoever of either the socket itself or the wires within the socket. Look for signs at the base of the socket indicating that the tow wire has either pulled-down or that the socket is canted. The socket is aligned with the tow wire's centerline prior to the pour. Even the slightest change in the socket's position requires immediate re-socketing. It is a requirement to re-socket a tow wire if one broken wire is within one rope lay length of the socket. It also requires the immediate re-socketing of a tow wire even if one broken wire is located at the base of the socket.

B. Once the socket and its end attachments have been inspected, the tow-wire itself must be examined. The single most important step beyond the discovery of kinks, doglegs, fractures, localized wear points, snags, gouges and "bad spots" is a measurement of the tow wire's diameter at designated points.

C. **Proper gauging, as seen below, is only accurate when made across the “crowns” of the rope strands.** The true diameter is the widest diameter at any point on the rope. To achieve the widest diameter reading, apply a caliper to the wire rope and with your thumb on the adjustment wheel, rotate the caliper around the wire noting the highest reading. Record this reading on the inspection report.
D. Do not take a measurement when the wire is bent around a tow pin or otherwise as the diameter is distorted and will not provide reliable data. Both excessive oversize and undersize readings are cause for concern.

Notify the Port Captain/responsible party if the diameter measurements you record fall below the nominal diameter of the tow-wire. Any readings below 2.000" on a nominal 2-inch wire, for example, would need to be reported from the field. These gauges need to be taken as close to the socket as possible and then at each ½ layer and drum cheek.

3. Recording:

Each tow wire inspection is to be recorded on a tow wire(s) inspection form. Fill in all appropriate boxes, the more information the better. For the wire length box just above the comments section, input the length of the wire after inspection. In the comments section, record the amount cut off for re-socketing. It is important to have a running record of the length at all times. If damage occurs to the wire at any time or is suspected of occurring after an event, use the tow wire inspection form to log the event, damage to the wire, and location of the damaged section. If a socket is poured in the field at a time when it is not possible to gauge, log it on the form along with the amount of wire cut off.

4. End for Ending:

The practice of cutting off the socket, removing the tow wire from the winch drum, re-spooling the wire, then returning the wire to the winch drum, and pouring a new socket on what had been the drum bitter end. This practice is acceptable should the entire wire meet inspection criteria. However, if the intention is to relocate the position of a damaged portion of the wire, the wire is still damaged and this process is strongly discouraged and the wire should be retired.
5. Tow Wire Retirement:

A. Six randomly broken wires in one rope lay length or three broken wires in one strand in a single rope lay constitute grounds for retiring the tow wire, depending on where the damage occurs. One rope lay is the length along the rope in which a single strand makes a complete spiral or 'turn' around the core. If, after a period of particularly hard going, the Deck Officer suspects the tow-wire has been overstressed, a measurement of the rope's lay length should be recorded.

This is especially true where the measured diameter has decreased below the nominal tolerance.

B. The design Lay Length of a 2-inch tow wire is 12.57". The tolerance for this tow-wire is plus 4% or 13.70".

This should be measured over three (3) successive rope lays in length so that an average lay length can be determined. Table 4 indicates the nominal tolerance (reduction of overall diameter) for tow wires. For example, a 2-inch tow wire should be withdrawn from service with a 10% reduction in overall diameter i.e. a gauging of 1.80 inch or less with a caliper.

**Table 4: Rope Diameters and Lay Length for Tow Wires**

<table>
<thead>
<tr>
<th>Nominal Rope Diameter (inches)</th>
<th>Minimum Tow Wire Diameter Tolerance - 10% below Nominal (inches)</th>
<th>Design Lay Length +5% (inches)</th>
<th>Discard Criteria Based on Maximum Lay Length + 4% (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.50</td>
<td>1.350</td>
<td>9.118</td>
<td>9.937</td>
</tr>
<tr>
<td>1.75</td>
<td>1.575</td>
<td>10.890</td>
<td>11.870</td>
</tr>
<tr>
<td>2.00</td>
<td>1.800</td>
<td>12.570</td>
<td>13.700</td>
</tr>
<tr>
<td>2.25</td>
<td>2.025</td>
<td>14.110</td>
<td>15.380</td>
</tr>
<tr>
<td>2.50</td>
<td>2.250</td>
<td>15.540</td>
<td>16.940</td>
</tr>
</tbody>
</table>

C. While overstressing the tow wire is a cause for retirement, so is wastage from improper or lack of lubrication. ***Proper lubrication will prevent corrosion and premature wire rope failure***
D. Listed in Table 5 below are the recommended Tow Wire Inspection Schedules and Service Life Limits for both Ocean and Coastwise Towing Vessels. Table 6 is the recommended Tow Wire Inspection Schedule for Harbor Tugs and other towing vessels utilizing Tow Wires for occasional inshore tows of short duration.

### Ocean & Coastwise Towing Vessels Table 5

<table>
<thead>
<tr>
<th>Nautical Mile Range</th>
<th>Inspection Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>12,000 - 15,000</td>
<td>7-9 Layer Inspection &amp; Re-socket</td>
</tr>
<tr>
<td>30,000 - 32,000</td>
<td>Full Inspection; Cut-off 20 ft. length for Destructive Pull-Test; End-For-End Tow Wire; Pressure Lubricate and Re-Socket</td>
</tr>
<tr>
<td>55,000</td>
<td>7-9 Layer Inspection &amp; Re-socket</td>
</tr>
<tr>
<td>75,000 - 85,000 (5 Year Maximum Term regardless of sea miles recorded)</td>
<td>Retire the Tow Wire</td>
</tr>
</tbody>
</table>

** Can vary with operator specific criteria for retirement of tow wire.

### Inshore & Harbor Towing Vessels Table 6

<table>
<thead>
<tr>
<th>Years</th>
<th>Inspection Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st, 2nd &amp; 3rd</td>
<td>7-9 Layer Inspection &amp; Re-socket at the End of the 2nd &amp; 3rd Years.</td>
</tr>
<tr>
<td>4th</td>
<td>Full Inspection; Cut-off 20 ft. length for Destructive Pull-Test; End-For-End Tow Wire; Pressure Lubricate and Re-Socket</td>
</tr>
<tr>
<td>5th, 6th &amp; 7th</td>
<td>7-9 Layer Inspection &amp; Re-socket in the 6th &amp; 7th Years</td>
</tr>
<tr>
<td>8th</td>
<td>Retire the Tow Wire</td>
</tr>
</tbody>
</table>

**Can vary with operator specific criteria for retirement of tow wire.

### 7. Towing Gear Inspection

A. There are ten towing gear items which are either directly employed in the tow-wire rigging scheme or stand at the ready in case of an emergency on any vessel hauling barges laden with environmentally sensitive cargoes, MOU’s, MODU’s, ships, etc. They are comprised of the following:

1. Towing Sockets
2. Towing Shackles
3. Towing Plates
4. Chain for briddles and surge gear
5. Towing Pad Eyes
6. Wire Rope Clips and Thimbles
7. Synthetic Resin Kit
8. Emergency Hawser
9. The Retrieval Hook
10. Wire pendants with closed spelter sockets/thimble, formed eyes

B. Towing Sockets

If towing sockets or thimbles are damaged, deformed, significantly corroded or show a loss of steel in the bearing surfaces/grip points or movement within the socket cone. The bore diameter of a towing socket is 2.125 inch or 2-1/8" inch (+1/32") for a 2 inch socket and 3.375 inch or 23 ¼ inch (+1/32") for a 2-¼ inch socket. Since the 2-inch and 2 ¼-inch sockets are otherwise dimensionally identical, the bale diameter, length over-all and width are 3 5/8 inch, 15 7/8 inch and 9 inch respectively. But to reiterate, the deck officer's chief concern is the condition of the resin as to coring, cracking, and movement.

C. Towing Shackles

1. In the field the diameter of the tow shackle pin, the diameter of the shackle bale and the condition of the pin as to straightness plus the fit and status of the threads and nuts are of particular importance. The threads, of course, should be routinely greased and not allowed to gall. But it is also of the greatest possible importance to examine whether or not the shackle has "sprung," a condition which results from upending the shackle and applying stress to one or both of the sides.

2. A visual inspection after each use checking for cracks or distortion to the body or pin. Also check bearing surfaces for any excessive wear on the body or pin.
During the inspection look for the following:

a. Marks, nicks, gouges or cracks
b. Wear, especially excessive wear at the bearing points/grip points
c. Twists or bends
d. Stretching
e. Distortion
f. Loose nut(s) indicating worn out threads
g. Log these inspections and findings in the tow gear log as part of your Safety Management System

Figure 2– Double nut – Chain Style Towing Shackle
D. Delta Plates

As a practical matter, the delta plate “fish plate” can be visually inspected for cracks or fissures. Dimensionally it is to be checked at the shackle pockets and for elongation of the bore diameter at the under-rider or haul-in hole per the manufacturers drawing.

![Figure 3 – Delta Plate](image-url)
E. Chain for bridle and surge gear

1. Before rigging up for tow each bridle leg and length of surge gear should be walked and visually inspected for deformation, broken studs, and overall condition. At shipyard docking, a length in each leg over five links should be measured three times in every 15 fathom length under tension with a proper chain gauge. The inside reach and link length and width should also be checked within the five link samples. The diameter of the chain at the grip or crown of the link, for our range of sizes, has a minus tolerance of just 1/8-inch.

2. Figure 3 and 4 are example of areas of attention while conducting inspection of chain.

Figure 4 – Delta Plate Dimensions
Figure 5 – Example of Worn Chain and broken stud

Figure 6 – Inspection points for chain

**F. Towing Pad Eyes**

The Tow-Pad or Pad-Eye should be checked at the bore for elongation. Visually any
evidence of body fissures or cracked welds in the mounting plate should be carefully assessed. Respective Port Captains or responsible parties should be notified if problems are suspected.

G. Wire Rope Clips and Thimbles

1. Wire rope clips should only be used in Ocean or Open Water towing where the tow is subjected to wave action in an emergency situation. As a method of making up tows on the Western Rivers, wire rope clips are recommended based upon the wires diameter according to the formula 3 x’s D+1. A properly applied wire rope clip develops fully 80% of the wire rope's rated efficiency. This means that clips rightly spaced and torqued create an assembly which bears 80% of the wire's rated breaking strength. The clips referred to are the U.S. made (Crosby) drop-forged wire rope clips and not to be malleable clips or clips of foreign manufacture.

2. In the interest of getting under-way after tow wire or pendant failure, use these few relatively inexpensive items in a specified manner. The enclosed table and the diagram below make clear there are four really important criteria in using 'clips' for an end termination in conjunction with a heavy-duty galvanized thimble. First and foremost, the clips should be applied according to the maxim: "Never saddle a dead horse."

2. Thus the live or long wire segment wears the saddle while the tail or segment bent back to form the eye in the termination is bound by the U-bolt that bolts to the saddle. The saddle or base of the clip also acts as a unit of measure and determines the spacing between clips. The clip size must be perfectly conforming to the wire-rope size.

4. So after forming the eye and making the tail extend according to the column, entitled “Amount of rope to turn back” in Table 6 on the next page, the 1st clip is secured one
base length from the seizing at the end of the tail. A second is to be applied one base length from the end of the tail always working toward the eye and applied and tightened. Take a good strain on the entire assembly and then tighten all the nuts according to the torque value in the table. The number of clips to be applied is, despite the seemingly high number cited, a minimum and must be observed if the assembly is not to dip further below the rated breaking strength. The 2-inch tow wire in our examples will lose nearly 34 tons or rate just 138 tons in the best of circumstances. But this minimum will certainly enable a prudent master to get under way until the wire can be inspected and properly re-socketed.

Figure 8 – Dimension of wire rope clip
H. Synthetic Resin Kit

1. These cold cure epoxies enable a boat crew to "pour a socket" without special equipment if required. A properly applied resin socket provides 100% of the wire rope's strength or efficiency; cures much more speedily and is far safer to apply than zinc spelter. In fact, it is easier in very many cases to re-socket a damaged hawser in the field than to apply wire rope clips to a larger wire.

2. At this time two manufacturers of proven reputation (The Crosby Group and ESCO; respectively the largest maker of rigging supplies and rope terminations in the country) have marketed fully sanctioned resin socketing kits under the trade names "™Wirelock" and "™Socketfast".

3. A booklet on resin socketing along with the appropriate product literature from the respective manufacturers is available from the manufacturers. In addition to the explicit instructions presented by the manufacturer the booklet offers a number of suggestions which, hopefully, will enable the deck officer to socket his assembly...
without difficulty.

4. Finally, deck officers should be mindful of the fact that all synthetic socketing resins have a *defined shelf-life* which is stamped on the can of resin and catalyst. Port Captains/responsible personnel should be notified in advance when resin kits will require renewal so that a fresh kit is placed aboard the vessel in a timely manner. The remaining items in the kit (including a spare towing socket, seizing wire, plastecene, and wire rope cleanser) should also be inventoried.

I. Emergency Hawser

1. In order to further enable emergency barge retrieval in the event of a main tow-wire failure, it is recommended that towing vessels carry synthetic hawers. Whether deployed as an emergency hawser directly; or in conjunction with a short reeved pendant and the Retrieval Hook (described below), the 10-inch x 600 ft. 12-strand Round Plait Nylon line must be maintained at the ready at all times. It is to be fully inspected prior to departure with a fuel or chemical barge on any coastwise or ocean sailing. Its containment in a self-draining deck box with unplugged scuppers or drain holes is to be carefully monitored. The box should have a protective cover which is to be inspected for tears and cracks. The grommets around the perimeter should be pressed and integral to the fabric and round stitched. Lashings should be made fast through the grommets and spliced.

2. A 12-strand round plait construction has been chosen for this emergency tow-line because unlike a 3-strand nylon hawser, the round plait better resists hockling. Nonetheless, the line needs to be 'exercised' periodically; repositioned in the box and kept supple to ensure its durability. It should be checked accordingly and hosed down with fresh water after a salt water drill. The line may be stored wet but should be kept out of direct sunlight. The synthetic hawser thimbles may be coated with light machine oil during storage but no oil should be permitted to contact the nylon line. The line should be checked for cuts, areas of abrasion, strand deformation, and discoloration and recorded on the proper form.

J. The Retrieval Hook

1. The final gear item to be discussed is the Orville Hook which represents still another method for retrieving a barge whose main tow-wire has failed. The approach in this regard is to provide the master with as many options for retrieving a barge that is adrift as possible. Thus the barge rigged emergency tow-wire can be utilized in its own right or linked to the secondary tow wire or to the synthetic pendant by means of a shackle dipped through the roven thimble on the shorter pendant. The five-foot eye on the synthetic eye can be, conditions permitting, directly rigged to bitts on the barge or used directly with the Retrieval Hook presently under discussion.

2. As the diagrams in NVIC 5-92 convey, the rigging scheme for the Retrieval Hook utilizes the 10-inch x 600 ft. nylon or an 8-inch x 600 ft. HMPE towing pendant made
up by means of a Nylite Spool, Shield and Shackle in opposite planes to the large slotted hook named after its developer, Captain Orville “Bud” Fuller, of Sause Brothers Ocean Towing.

3. The retrieval operation of "the hook" relies on its being towed off a small diameter wire rope bridle led by a buoy so that it is towed below the surface of the water yet in the same horizontal plane. Optimally, by making a pass before the barge the hook fetches the surge gear or "pigtail" of the bridle so that "strong center towage" results. Again, the Retrieval Hook is meant to complement the primary barge retrieval system which is the barge rigged Emergency Tow Wire. It provides for the multiplication of sensible options.

4. Vessels engaged in line hauling environmentally sensitive cargoes should be furnished with a DVD presentation of these matters for regular review by deck officers and crew.

5. An inspection of the Retrieval Hook includes the hook itself; the buoy (and the spare); the two bridle legs (and spares); the rigging shackles; the “Nylite Spool, Shield and Shackle”. The massive hook should be checked for accessibility in case of an emergency and its ancillary gear should also be readily deployable. The entire assembly should be inventoried and checked together with the synthetic tow line prior to any coastwise or ocean towage of fuels or environmentally hazardous cargoes. After ascertaining that all componentry is on hand, each piece should be individually checked. The wire bridles should not be corroded and their pressed eyes should 'bottom' at the terminus of the sleeve. The float line should maintain good color and not show fraying or hockles. The buoys should be pliant and their fill-hole plugs secured in place. All four shackles should turn freely and their threads should be oiled or greased and fully serviceable. The Nylite thimble requires its stainless pin in the sleeved bushing of the roller. It should turn freely and mate with the coupler. The coupler pin and nut must also be fully serviceable and re-rigged after inspection for ready deployment.
Task 3. **Provide recommendations to the Coast Guard concerning the specific knowledge, skills and training of persons responsible for the maintenance, repair and determination of towing gear for establishing a tow.**

These are the types of subject matter that one would expect to find in a well-conceived Safety Management System (SMS) and Towing Safety Management System (TSMS) or operators policies and procedures. They will be as detailed and extensive as the scope of the company’s operations.

1. **Tow Wire General Knowledge**

   A. The wire rope that is utilized in towing applications requires continuous care and Scrutiny. Beyond periodic formal inspections, best practices call for the visual observation of the tow wire whenever you shorten tow. The reasons for this practice include both the recognition of the tow wire's essential role in towing operations and the fact that wire rope is a consumable item. "It is", as one manufacturer's product literature puts it, "used up" as it is utilized and gradually loses strength during its operative life. "The purpose of an inspection, then, is simply to ascertain insofar as may be possible whether a wire rope retains sufficient capability to perform the work to be done before the next scheduled inspection."

   B. Any observation of the tow wire the crew makes bears on the wire rope assembly's "capability to perform the work to be done." Among other factors the overall strength of the wire rope relates to the steel content of the wire; how much is there as against how much has wasted away in a given area owing to abrasion or corrosion.

   C. The Tow-Wire Log/Record that is maintained aboard the towing vessel is meant to provide an up-to-date record of the tow wire's history and maintenance for the life of the tow wire or hawser. It details the date of its installation; it’s in the water record and the particulars of its condition. This log also allows the deck officer to enter his observations of the tow wire's performance characteristics and to note areas of concern. Areas of concern, therefore, should be marked, gauged, recorded and location mapped so that the responsible manager can be properly advised of the tow wire's status at the most opportune time. The condition of the towing socket at the termination is a vital element in this series of observations. Furthermore, the nature of any distortion or disturbance in the wire lay; breakage and uncharacteristic damage or the extent of abrasion or peening is also of great opportune time.

   D. Furthermore, the nature of any distortion or disturbance in the wire lay; breakage and uncharacteristic damage or the extent of abrasion or peening is also of great importance in telling the wire rope's operating history. Broken wires have tell-tale signatures and variously fracture, pull-apart, show chisel breaks, "neck" down and even break cleanly when fatigued. They, therefore, are directly attributable to methods of operation applied to the wire hawser. Because these histories have an origin the problems revealed are
traceable and can be corrected as well. Removal of the cause or causes will solve the
problem creating the impairment. The first step in the visual inspections required of the
deck officer, then, is maintenance of the log and a faithful recording of any deviation
from the high standard of the manufacturer's finished product. Besides reporting broken
wires, deformed strands, and variations in diameter (a point to be fully covered shortly)
input from the fleet can be evaluated on an on-going basis with a view to bettering
either the material or constructional standard for the tow wire. Communication with the
manufacturer's engineering department as well as an in-house review of the issues raised
by this process is meant to enhance the quality of rigging materials ultimately supplied
to the fleet.

2. Specific Knowledge

A tow wire should not be used if:

A. The reduction in the diameter of the tow wire, due to a loss in metallic content
   caused by wear, abrasion and corrosion exceeds 10% of the nominal value.

B. Six strand ropes are to be removed from service if there are either three broken wires
   in one strand of lay length, or six broken wires, however distributed, within one lay
   length. Lay length is defined as the distance measured parallel to the axis of the rope
   in which a strand makes one complete helical convolution around the core.

C. If a tow wire has severe kinking (a sharp bend permanently creasing the wires),
   crushing or other damage that distorts the tow wire’s structure, either the damaged
   segment should be removed or the entire tow wire removed from service.

D. If towing sockets or thimbles are damaged, deformed, significantly corroded or show
   a loss of steel in the bearing surfaces/grip points or movement within the socket cone.

E. Even a single broken wire next to a termination (socket) is a reason to remove a tow
   wire from service until the wire has been trimmed (at least six feet) and a new
   socket poured.
Figure 10 – Damaged Crown Wires

Figure 11 – Kinks in a Tow Wire
3. Skills and Training of personnel responsible for the Maintenance and Repair of Towing Gear

Training and skill development should be conducted by an experienced member of the marine operations department.

4. Determination of Towing Gear for Establishing a Tow

A. All tow gear (shackles, wire, chains) shall be appropriately sized relative to the bollard pull of the towing vessel with appropriate safety factors as per regulation.

B. The right gear selection is critical from the start. The gear selection itself must be carefully scrutinized for its suitability.

1. Are the correct towing shackles (not safety shackles) being employed in the first place?
2. Is the right towing socket (closed spelter not “pee-wee”) in place?
3. Is the chain grade 2 or better? Are the connections between rigging components made in the securest manner?
4. Does the nature of the tow require all new gear, extra heavy capacity chain & shackles?
5. The towing vessel should have an up to date certification packet on board that is complete and fully corresponds to the gear in use. The inspection and certification of inappropriate/in-adequate gear does little to insure the success of the tow.

C. Barge Tow Gear

1. Barges should have towing arrangements that are appropriate to their specific operation and service area.

2. The first rule of rigging a tow is: the heavier the bridle, surge gear and shackles, the better the protection from surge damage to the tow gear, this is particularly important when towing up short.

D. Bridles:

1. The breaking strength of each bridle leg and tow pendant should be no less than 1.5 times the minimum required breaking strength of the tow.
2. The angle formed by the two legs of the bridle should not exceed 120 degrees
3. Be made of grade 2 or higher welded stud- link chain or wire bridles of extra improved plow steel (EIPS) and extra extra improved plow steel (EEIPS) independent wire rope core (IWRC).
4. Where necessary fitted with chaffing gear and or butt chains.
E. *Surge gear should meet the following specifications:*

1. Surge chain should be grade 2 or higher welded stud-link chain.
2. The chain should be of the same grade and type and at least as large as that in the bridle.
3. A synthetic shock line may be used as surge gear if it is rated at 1.3 times the breaking strength specified for the main tow wire on coastal voyages 3 days or less.

F. *Other associated tow gear:*

All associated towing gear (shackles, fish plates/towing plates/delta plates, pendants, etc.) should be of sufficient size for the intended use and have a breaking strength of at least 1.5 times the breaking strength specified for the main tow wire.

3. **Review Coast Guard policy guidance documents, NVIC’s and the Marine Safety Manual.**

During the development of this report, the committee undertook a review of NVIC 5-92 Guidelines for Wire Rope Towing Hawsers which is attached as Enclosure (5) to this report. *It is our recommendation that NVIC 5-92 should be revised to include the recommendations provided in this report.* We believe that the information regarding the Hook Retrieval remains relevant to today.

**Task 4. Provide any other recommendations relevant to the intent of the Task Statement not specifically identified in this section.**

1. **Tow winches**

   A. It is recommended that tow winches:
   
   1. Are maintained good working order.
   2. Have brake systems that are in good condition (brake bands and brake pads with sufficient friction material) and mechanical application systems that are properly adjusted.
   3. Can release and free wheel the winch drum without power

   **4. DO NOT USE** dogs or locking devices other than the brake to prevent payout. Air, electric or hydraulically and manually actuated jaw clutches, are, however, acceptable as a means of engaging and disengaging the winch drum(s) from the gear train.
   
   5. Have controls above the weather deck.
6. Are fitted with a tow wire alarm system that is audible in the wheelhouse.
7. Are fitted with a spooling device (level wind).
8. Are fitted with emergency retrieval capability in the event the main means of powering the winch fails.

B. Tests of the towing winch brake(s) should take place annually, per the manufacturer’s recommendations and records of the tests maintained.

C. The crew should be trained in the operation and maintenance of the winch and checked for competency. Records supporting this should be maintained as per the Safety Management System or operating policies and procedures.

2. Towing best practices

A. When towing, keep a watchful eye on the motion of the tow in a seaway, the effect of the wind and seas on the tow and make appropriate course and speed changes to minimize them while maintaining way in the general direction of your destination.

B. Make sure that the initial length of tow wire deployed is adequate to provide the necessary catenary to protect the gear from shock loading during the tow consistent with the available depth of water.

C. When underway and caught in heavy weather, take appropriate measures such as lengthening tow wire, reducing speed and possibly changing course to avoid increased surging or shock loading of the tow gear.

D. This action will also help in preventing pounding and heavy weather damage to the tow. Make the speed and tow wire length adjustments such as to make sure that the towing vessel and tow are in “step” so that both have the same motion in the seaway (the towing vessel and barge either both on top of the swell or in the trough, not one going up on a swell and the other sliding off the back of a swell). This in itself will help prevent shock loading of the gear.

E. At all times when towing, make sure all possible action is taken to prevent damage to the tow wire by chafing. Tow wire chafing gear should be rigged and in place. Greasing the area of the tow pins rollers and level wind rollers will also help in limiting chafe and wear on the wire and chafing gear. Any location where the tow chain comes in contact with brackets, hawse pipes, fairleads, bitts, must be greased.

F. Frequent “freshening” of the tow wire 10-15 feet during each watch (if at all possible and done safely) but no less than in 24 hour intervals may also minimize any excessive crushing damage from shock loading as well as chafing at the winch and anywhere else.
This will also keep the heavy strain and stress from working on the same points on the wire for extended periods of time. “Freshening the nip” can be found under definitions of Enclosure 4.

G. When towing at slow speeds especially in heavy weather the tow wire will have a deeper catenary and will actually bend more at the stern of the towing vessel, therefore requiring freshening the tow wire at increased intervals to protect the wire from repeated stresses at this one position.

3. Towing Bridle Gear, for use on towing vessels engaged in coastwise and ocean towing.

A. The fundamental purpose of all of the towing components is to create a towing bridle that can safely tow a given barge, ship, derrick barge, MOU, MODU or comparable floating equipment safely from point to point in the ocean environment.

B. On occasion, when towing vessels with fine entries like certain Naval, Passenger and commercial vessels the rigging of a single pendant or single lead chain might be called for, in most instances, towing bridles best serve to check the yaw of the wide barges required of the loads generally towed. In any case, the composition of the gear and the rationale for its use is the same.

C. A generic tow bridle is shown in Figure 12 below to illustrate gear selection. rm is reset after each freshening to warn the watch in the event the tow winch starts to slip and pay out tow wire.

D. If tow winch alarm is not operational, unavailable or has failed it is acceptable on a temporary basis until alarm is repaired, to tie a light colored rag or paint a white mark on the tow wire between the winches and tow pins/stern. This will allow the crew to monitor the tow wire and determine if the winch brake is slipping.

E. The tow bridle is at root a very simple conception. The tow pads or Smit Brackets, as is more frequently the case, are almost universally set at opposing 60° angles and the bridle typically creates an equilateral triangle with the port and starboard leg lengths equal to the lateral or horizontal distance between the tow-pads.¹ Sighting along the spine of the tow pad down along the chain to the Delta Plate joining the legs at the base suggests conformance with the lines of force application.

F. Shortening the bridle legs arbitrarily can create side loads against the tow pads, especially in the critical region of the shackle bore where the tow pad typically protrudes or extends over the head-log. In the bridle drawing the distance between the tow-pads is 60 ft. and thus the bridle legs are also 60 ft. and the included angles created are all also 60°.
4. Bridle Chain

A. The three legs making which make up towing bridles and the surge gear carried on the tugs and coupled to the chain pendants or pendants\(^2\) at the apex of the Delta Plate in order to create towing catenaries are universally composed of Grade 3 Stud-Link Chain\(^3\). Grade 3 stud-link chain may be recognized by the deck officer because the stud is inserted and flash butt welded on one side at the bar stock but circumferentially bead welded on the opposite side. The photo in Figure 13 shows the ‘clean’ insertion of the stud on one side of the link and the full low hydrogen process weld opposite the flash butt weld. The size of the stud welds conforms to the cited standard in API Specification 2F. Grade 3 chain can be hardness tested and should conform to 207 on the Brinell scale whereas Grade 2 is 145.

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\(^1\) The tow pads themselves are beyond the scope of this document. It is safe to say, they are carefully engineered by the Naval Architect and follow the dictates of the relevant classification societies and meet the criteria imposed by towing resistance studies of the laden barges in all probable circumstances of transit with appreciable safety factors. Smit Brackets are invariably used with closed chocks, often Smit Chocks, and these too are beyond the immediate scope of this report.

\(^2\) Commonly called “pig-tails” and “stingers”.

\(^3\) Grade 3 is known or co-termed ‘U3’ in the ISO, DNV and ABS literature. (Grade 2 chain has gradually disappeared from the commercial market over the last 15 years except in smaller gauge anchor chains.)

B. Since all chain of the type and size range in use for towing applications was originally manufactured as anchor chain or mooring chain, it is conform to the applicable standards for the acceptance of these articles. All chain that is employed either for ground tackle but
most certainly for towing bridles should be ABS certified. In certain cases we will accept certification by other IACS member classification societies, notably Det Norske Veritas or DNV. The chain is therefore sourced from the ABS list of “APPROVED MANUFACTURERS OF SHIP ANCHOR AND OFFSHORE MOORING CHAIN” 06/Oct/2014. Certification implies not only testing to the prescribed proof and breaking test loads (the proof load is 70% of the breaking strength) but also to the prescribed process of manufacture as currently detailed in the “ABS RULES FOR TESTING AND CERTIFICATION OF MATERIALS”, PART 2, CHAPTER 2, SECTION 3 with special reference to the ABS “Guide for the Certification of Offshore Mooring Chain”. 4 The ABS standard referenced includes the chain’s required deoxidation process for “killed” steel in order to produce a “fine grain practice”;5 the specifics of the bar stock’s chemical composition and heat treatment as well as its mechanical and dimensional properties.

C. Good rigging practices do not permit studs to be cut out of the chain legs in the towing bridle for any reason. All bridle legs are rigged in place as fully integral assemblies.6

![Bridle Chain](image)

Figure 13- Bridle Chain

5. **SHACKLES**

A. The towing bridle requires seven (7) towing shackles to properly join the three legs at the Delta Plate. In order to comply with our policy of integral chain rigging we institute double shackles at the tow pads with the pin at the bore and the second shackle set bail to bail against the first so the chain legs ride the shackle pins in all cases. 4 shackles are therefore required at the tow pads with an additional 3 positioned at the Delta Plate. The tow plate has specially faired “pockets” in the 3 corners allowing the shackle body to pass and present the pin to the chain leg.7 The pendant (single chain) connects the towing bridle to the towing vessel at the tow shackle, made fast by the tugs crew. Refer to Figure 12, “Towing Bridle Configuration” on pg. 36.

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4 The applicable DNV standard is “Offshore Standard DNV-OS-E302, SECTION 2 MOORING CHAIN CABLES AND ACCESSORIES”.
5 ABS, p.77
Each shackle is secured with double safety or jam nuts slugged into final position over the threads of the shackle pin and align with specially drilled holes. The shackles have holes bored through the threaded (non-load bearing) portion of the pin over which the jam nuts are aligned and secured by 7/16” or 9/16” X 4” or 6” bolts depending on the shackle size with lock washers and double nuts securing each of these bolts. Finally a stainless steel cotter key is secured at the very end of the shackle pin where a final bore is seen.\(^8\) The tow shackle is thus secured 5 times in contrast to commercially available safety shackles which typically have but a large safety nut and a cotter key securing them. These shackles and other species of nominal “tow shackle” are best used in shipyard or construction crane lifts or in fixed guying applications.

C. Towing shackles are variously chain pattern or anchor pattern.\(^9\) As chain pattern tow shackles conform to the contour or basic shape of the chain link and prevent any possibility of the shackle’s up-ending, the Company mandates chain pattern shackles for our towing bridles. We reserve anchor pattern tow shackles for hawser thimble rigs on soft line pendants typically in harbor work or specialized emergency towing applications.

Tow shackles are made of forged billets of SAE 4340 alloy steel in both bails and pins. Alloved chemical elements include Manganese, Phosphorus, Sulfur, Silicon, Nickel, Chromium and Molybdenum in requisite proportions. Shackle pin hardness is generally 25.6 on the Rockwell ‘C’ scale and 255 Brinell. Towing shackles are rated by Working Load Limit or WLL. The WLL rating of these shackles are in a 6:1 ratio to their breaking strength or maximum load capacity as the following table demonstrates:

<table>
<thead>
<tr>
<th>Size (Inches)</th>
<th>Working Load Line (Short Tons)</th>
<th>Maximum Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>44</td>
<td>264</td>
</tr>
<tr>
<td>2-1/4</td>
<td>57</td>
<td>342</td>
</tr>
<tr>
<td>2-1/2</td>
<td>71</td>
<td>426</td>
</tr>
<tr>
<td>2-3/4</td>
<td>80</td>
<td>480</td>
</tr>
<tr>
<td>3</td>
<td>94</td>
<td>564</td>
</tr>
<tr>
<td>3 x 3-1/4(^{10})</td>
<td>123</td>
<td>738</td>
</tr>
<tr>
<td>3-1/2 x 3-3/4(^{11})</td>
<td>132</td>
<td>792</td>
</tr>
<tr>
<td>4 x 4-1/4(^{12})</td>
<td>185</td>
<td>1110</td>
</tr>
</tbody>
</table>

\(^7\) It is imperative that shackles at the Delta Plate be positioned “nuts down”; that is with the nuts securing the shackle pin oriented to face the sea bottom with the towing vessel and barge underway.

\(^8\) Deck officers are advised to gently peen the bolt ends as a final measure preventing even the safety bolt nuts from backing off.

\(^9\) Also called ‘bow’ pattern.

\(^{10}\) 3-inch DIAMETER BAIL WITH 3-1/4 inch PIN.

\(^{11}\) 3-1/2 inch DIAMETER BAIL WITH 3-3/4 inch PIN.

\(^{12}\) 4-inch DIAMETER BAIL WITH 4-1/4 inch PIN.

**WELDING PROCEDURE FOR WELDING A LOST STUD IN STUD LINK CHAIN**
Figure 14- Example of a Broken Stud weld

WELDING PROCEDURE FOR WELDING STUD IN STUD LINK CHAIN

1) GRIND CLEAN STUD AND AREAS OF CHAIN LINK TO BE WELDED.

2) WITH TORCH HEAT STUD AND AREAS TO BE WELDED TO 150-200 DEGREES F, TO GET ALL MOISTURE OUT OF STEEL.

3) WITH STUD AND LINK PREHEATED POSITION STUD AND BEGIN TO WELD, WELD STUD ALL AROUND TO DESIRED FILLET SIZE.

4) WHEN FINISHED LET WELDS COOL SLOWLY (DO NOT QUENCH).

5) WHEN WELDS ARE COOLED, CLEAN AREAS AND TREAT WITH RUST PREVENTIVE.

NOTE: USE 7018 LOW HYDROGEN ROD OR EQUIVALENT WIRE.

ENGINEERING DEPT,
WASHINGTON CHAIN & SUPPLY INC.

Figure 15- Welding Procedure to Welding Stud in Stud Link Chain
Figure 16 – Repaired Stud Link

Task 4. Provide any other recommendations relevant to the intent of the Task Statement not specifically identified in this section.

1. Towing Gear as it relates to the Marine Assistance Towing Vessels

   A. The marine assistance towing industry (commercial assistance) provides towing service to disabled vessels. To define assistance towing and disabled vessel, we refer to 46 C.F.R. §10.107 Definitions in subchapter B:

      1. Assistance towing means towing a disabled vessel for consideration.

      2. Disabled vessel means a vessel that needs assistance, whether docked, moored, anchored, aground, adrift, or underway. This does not mean a barge or any other vessel not regularly operated under its own power.

   B. The loads placed upon the towing gear used in the assistance towing industry are far different than that of traditional towing. There is far less risk of catastrophic damage to life, property and the environment should an assistance towing vessel and its tow part. Understanding there is some risk, all towing vessel operators must be mindful that injury may occur and proper selection, use, maintenance and discard policies and procedures for towline is an important part of operational procedures and/or Safety Management Systems (SMS).

   C. Tows in the assistance towing industry are of a much shorter duration, with a variety of size and vessel being towed, and various locations from protected inland lakes to near coastal and ocean situations. As such, it is recommended that all tow gear for assistance towing vessels be of the best quality available to meet the distinct needs and conditions of their area of operation. This equipment is a purchased commodity and reliance on the
manufacturer’s guidance and testing, along with the master’s knowledge and experience in the type of towing they will be performing, drives the decision.

D. The most common method of towing used by the assistance towing industry is astern towing. The towline is passed to the disabled boat, securing it either to the bow trailer eye or using a bridle and attaching it to bow cleats then attaching to the tow bitt on the towing vessel.

E. When towing from the boats trailer eye, it is recommended that the master use a carabineer (snap hook) to attach the line to the boat.

F. If necessary to attach the towline to the disabled boat’s cleats, it is recommended that the master use a bridle only after the master has determined that the cleats are strong enough to handle the strain of towing. The crew of the disabled vessel is asked to check for chafing of the bridle towline. It is recommended this be done and always prior to entering an inlet, creek, or river.

G. The length of towline used will be determined by the situation.

Example of a Synthetic towline on an outboard powered assistance towing vessel
H. Assistance Vessel Towline Maintenance:

1. Prior to getting underway, the master of the towing vessel shall conduct a visual inspection of the tow gear and towline.

2. It is recommended that towline be inspected for wear and damage weekly. This is a visual inspection by the master of the towing vessel according to the manufacturer’s guidelines.

Task 4. Provide any other recommendations relevant to the intent of the Task Statement not specifically identified in this section.

1. Inland & Western Rivers Towing

A. When discussing towing gear on the inland & western rivers there are several points that are different from towing practices in coastal and ocean towing operations.

B. First and foremost is that the majority of inland and river towing is done with the towing vessel made up fast to the stern of the tow and pushing the flotilla of barges in front rather than the tow being towed astern.

C. Tows found on the inland waterways system may consist of a single barge to over three dozen barges; these tows many times will contain both loaded barges and empty barges. Tows may also contain barges of varying shapes and sizes. (See Figures 1, 2 and 3 for examples of tow configurations)

D. In a tow it is not uncommon to find 200 ft. x 35 ft. covered hopper barges for grain or other dry goods, along with 297 ft. x 54 ft. tank barges for carrying a variety of liquid cargos. There may also be specialty barges such as equipment or deck barges of varied dimensions.

E. Another material difference is that the same type of towing gear is used for both long haul towing operations and fleeting and dock work on the inland and western rivers.

F. On the inland river system, tow rigging is viewed as a commodity and is readily interchangeable between all vessels, vessels to fleets, long haul towboats to short haul local tow boats, etc.
G. This towing gear is also used interchangeably between tows and fleeting operations where barges are stored at various localities while awaiting pick up, shifting in and out of docks to be loaded and unloaded, etc.

Figure 1 – 54 barge tow with open hopper, closed hopper and tank barges

Figure 2 – Tank (heater) barges and 6 barge tow

Figure 3 – Single tank barge tow
2. Wire rope on Inland Towboats

A. On the Inland towing vessel rigging failures are not typically due to wear and tear of the rigging but is normally due to the tow touching something, such as an allision, collision or grounding, etc.

B. There is typically redundancy built into the rigging make up with multiple wraps and multiple layers of wire, not necessarily out of need for multiple parts of wire but out of an abundance of caution in the case of failure of one part. In many cases a Towing Vessel Master may determine that even a double layer of wires is not sufficient and may opt to put a third or triple lay of wires. However it is advantageous for the towing gear to fail in certain situations. (For example in the case of a thirty barge tow allision with a bridge pier it is better for the force of one or two barge strings to absorb the shock and break away instead of having the force of the entire tow absorbed at the point of impact.)

C. A standard lay of wires on one coupling of a typical barge line tow will consist of multiple parts, generally involving two to four parts of wire, so that the total load at the coupling will be spread over those multiple parts. In certain situations doubling a rigging application at a coupling will add additional strength to the tow.

D. Excessive rigging applications may put undue stress on deck fittings causing them to fail. Therefore, double rigging should not be considered to be a required standard of rigging, but is intended to provide redundancy in the event of a rigging failure.

Figure 4 - Multiple wire layers to connect two barges
3. **Fiber and Synthetic Line on Inland Towboats**

Maximizing the safety and service life begins with selecting towing gear, managing its proper functionality through optimal handling practices and retiring it from service at the appropriate time—dictated by the characteristics of its application. Components of towing gear are serious working tools, and when used properly they will give consistent and reliable service. Components of rigging and towing gear should be used in accordance within the designed parameters.

4. **Proper Handling and Usage.**

The use of rope for any purpose subjects it to varying levels and modes of tension, bending, friction, and mechanical damage; as well as a wide range of environmental variables such as temperature, chemical exposure, etc. Regardless of application, as fiber rope is exposed to particular service conditions it will begin to suffer some level of degradation. Maximizing rope performance and safety involves selecting the correct rope, using optimal handling during its use, and retiring it from service before it creates a dangerous situation. Ropes are serious working tools, and when used properly, they will give consistent and reliable service. The cost of replacing a rope is extremely small when compared to the physical damage or injury to personnel a worn out rope can cause.

5. **Line Inspection and Retirement Checklist**

A. Any rope that has been in use for any period of time will show normal wear and tear. Some characteristics of a used rope will not reduce strength while others will. Below we have defined normal conditions that should be inspected on a regular basis.

B. If during an inspection any of these conditions are found, you must consider the following before deciding to repair or retire it:
   1. The length of the rope,
   2. The time it has been in service,
3. The type of work it does,
4. Where the damage is, and
5. The extent of the damage.

C. In general, it is recommended that you consider:
1. Repair the rope if the observed damage is in localized areas.
2. Retire the rope if the damage is over extended areas.

6. Western Rivers & Inland Tow Gear Inspection

A. When viewing towing gear on the inland waterways system as a commodity that readily travels throughout several geographic regions and may change hands dozens of times over the course of its lifetime, it quickly becomes apparent that attempting to catalogue, date and test each individual piece of rigging that goes into making up a towing or fleeting operation would be futile and overly time consuming.

B. A more prudent course of action for inland towing and fleeting operations is to develop, implement and document a consistent strategy for inspection and maintenance as rigging is brought into its system throughout the course of operations.

C. For operators engaged in the long haul towing trade this entails inspection and documentation when tow work is done at fleeting locations, and barges and rigging are added to the existing tow. Likewise, when barges or the entire tow is dropped and the rigging is paid back to the vessel (what is commonly referred to as a ‘rigging swap’ that the incoming rigging is checked and any damaged or defective rigging is refused.

D. This will be the same process for those in the short haul trade and for fleeting operators that working with neighboring fleeting companies. It is accepted practice for the mate or deckhand of a towing vessel to perform barge inspections on incoming barges to their tow or fleet which details condition, damage, leaks, etc. Documentation of the amount of rigging swapped and its condition may be noted on the barge and inspection report itself, or many operators make use of ‘rigging tickets’ which are signed off by both vessel and could readily be used to note the condition of rigging as well. (See Figures 6 & 7)

7. Recommendation for an Inspection Program that compiles with 33 C.F.R. 164.76

A. Every Company shall have an inspection program for all rigging components used in their operation.
   1. Established forms for rigging count and barge inspections
   2. Purchase criteria

B. Inspections have a tracking component.

C. All rigging shall be appropriate for intended use.
1. Barge line rigging
2. Face wires
3. Unit tow rigging
4. Rope

D. Condemnation/Retirement process

1. Whole strand broken
2. Narrowed diameter (width) (60%)
3. Deformed lay
4. Broken, deformed, damaged, crimp (swage / babbit)
5. Flexibility
<table>
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<th>Outbound Count</th>
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</table>

**Fleet Vessel:**

________________________________________

**Vessel Worked:**

________________________________________

**Fleet Mate (sign / print):**

________________________________________

**Vessel Mate (sign / print):**

________________________________________

**SAMPLE**

Figure 6 - Inland towing rigging receipt
BARGE AND RIGGING INSPECTION REPORT

BARGE * ___________ TYPE ___________ DATE ___________

LOCATION ___________ INSPECTED BY ___________

HEADLOGS ___________ RAKE DECKS ___________

CORNERS ___________

DECKS ___________ CLEAN OR DIRTY ___________

DECK FITTINGS ___________ MANHOLE COVERS ___________

SIDES ___________ WING TANKS DRY ___________

RAKE BOTTOM AND KNUCKELS ___________

HOPPER ___________ COAMINGS ___________

LOCKING DEVICES AND COVERS ___________

RIGGING CONDITION – ACCEPTABLE OR UNACCEPTABLE ___________

RIGGING REMOVED FROM SERVICE (TYPE AND AMOUNT) ___________

REMARKS ___________

________________________________________

SIGNATURE ___________

Figure 7 - Barge & Rigging Inspection Report
8. Components of towing gear for Inland and Western Rivers Towing

A. Face Wires

1. Face wires are used to connect the towing vessel to its tow of barges and depending on the size of the towing vessel and tow may consist of a single part face wire, multiple face wires with multiple parts connected to two or three winches on both the port and starboard sides. These may be referred to as primary face wires, secondary face wires, long wires, etc. (See Figure 8)

2. However many sets of face wires a vessel has, the inspection process is still the same. A visual inspection of the face wires (both steel and synthetic) should look for broken strands of the wire, kinks, twists, flat spots, or any other defect that could compromise the integrity of the face wire when put into service to secure the vessel to the tow.

3. In the case of synthetic face wires, appropriate chaffing gear (sleeves) must be used where the face wire comes into contact with barge and vessel fittings, or travels around sharps edges of the barge or vessel to prevent the likelihood of cuts or abrasion the face wires. (See Figures 8 and 9)
Figure 9 – Example of Face and wing wire chafing gear

4. The winches that are employed for the face wires should be inspected as well. Winch operation should be tested from all operating stations that are available, such as the deck level controls as well as the wheelhouse controls. The mounting frame/plates for the winch should be secured to the deck of the vessel and free from defects (all mounting hardware present and secure, no broken welds or pulled fittings, etc.) (See Figure 10)

5. Another tow rigging device worthy of note on some western rivers and inland towboats is the stern winch, which is used when a towing vessel will carry a barge 'on the hip', or alongside the vessel as part of its tow. This winch is located towards the center of the stern of the vessel so it may be employed when carrying a hip barge on either the port or starboard side. This winch is typically manually operated, however inspection of this winch is much the same as the facing wire winches. This stern winch may also be utilized as a stern line while the vessel is docked. (See Figure 11)

6. If the towing vessel is not fitted with a stern winch lines may be used for the same applications.
Figure 10 – Rigging and winches on the bow of a towboat

Figure 11 - Stern winch, being utilized as a stern line while vessel is docked
9. Portable Tow Rigging

A. A second essential part of Inland and Western Rivers tow gear is portable rigging, what is often referred to as ‘boat rigging’. A set of rigging may consist of up to five pieces of portable tow rigging: Listed below are the components:

1. Ratchet (See Figure 12)
2. Chain strap (See Figure 13)
3. 35’ wire, with an eye on each end (See Figure 14)
4. Chain links (See Figure 15)
5. Shackle w/Pin (See Figure 16)

Figure 12 - Ratchet

Figure 13 - Chain Strap– yellow circles highlight compression fittings used secure ends of wire to make a strap
Figure 14 – 35 ft. wires, in use on a tow – yellow circles highlight compression fittings used to secure eyes into ends of the wire

Figure 15 - Chain Links

Figure 16 - Shackle w/Pin
B. Shown in Figures 12 – 16 are the five components typically used in tow building operations on the Western Rivers and Inland waterways system. These same components are utilized in barge fleeting operations to secure the barges in fleeting areas. Ratchets (See Figure 12) should be inspected to ensure that the pelican hooks on each end are not bent or broken. The barrel of the ratchet, which is what each end screws into should not be bent or otherwise damaged. Likewise the handle and dog that operate the ratchet should be present and operable.

C. Chain straps (See Figure 13) are a section of wire joined by a compression fitting with a length of chain attached to it for the purpose of hooking a ratchet into, or attaching, a shackle and pin to connect additional pieces of rigging. In both the strap and wire illustration, the compression fittings have been highlighted as an inspection point to check that they are secure, have not slipped and are not cracked or broken.

D. In addition to checking these compression fittings on wires (See Figure 14), the length of wire itself should be inspected to ensure individual strands of the wire are not missing or broken.

E. Sections of chain (See Figure 15) should be inspected for cracks or breaks of any of the individual chain links, and shackles (See Figure 16) should be inspected for cracks, warpage or other distortion that may create a failure point.

F. In all cases, damaged or compromised rigging should be tagged, removed from service, and reported so it may be discarded and/or recycled.

10. Stationary Tow Rigging

A. As the name implies, stationary rigging (See Figure 17) is rigging that is permanently affixed to a barge. A majority of stationary rigging consists of a wire with a section of chain link attached to it. This wire is secured to a fitting on the barge by used of cable clamps, or a shackle and pin connected to a ‘D’ ring, or other similar fitting on the barge deck.

B. Another type of stationary rigging are barge winches (See Figure 18) that are usually attached to a frame welded to the barge deck, or with a shackle and pin connected to a welded fitting like a stationary wire.

C. Inspection of stationary rigging uses the same procedure as portable rigging. The main difference is that if the rigging is defective it cannot be removed from the barge. In these cases it can only be tagged as defective and reported to be repaired.
Figure 17 - Stationary wires and ratchets

Figure 18 - Stationary barge winch
11. Fleeting Operations

A. For operators that have a basis in fleeting work and maintaining those fleets the scope of inspection and maintenance is a bit different. Due to the nature of operating fleets (parking lots for barges) it is necessary that fleeting locations be checked frequently and consistently.

B. Fleets are also used as staging areas to build and or disseminate line haul tows. This means that rigging is being put on and taken off of barges on an almost continual basis depending on the needs of the operator’s customers and orders.

C. Documentation as part of a company’s towing safety management system, or operating policies/procedures, is key along with documentation by vessel crew at each interval that fleet checks are required (typically at least once per watch) on the condition of fleets, any rigging discrepancies, and actions taken to remedy the situation. (See Figure 19)

D. Another important aspect of fleeting operations in respect to rigging integrity is the observance of fleeting capacities. Published documentation of each fleet location, its rated capacity (number of barges, loaded or empty, etc.), minimum wiring requirements, and contingency plans for modifying capacities due to extenuating circumstances such as high or low water, drift, and ice conditions is critical to preventing rigging failures and subsequent breakaways.

E. Fleeting areas are used as staging areas for building and rearranging larger tows and facilitating barge movements such as spotting local docks for loading and unloading. With this in mind operators should plan fleeting and tow building evolutions so as not to compromise the integrity of the fleets that are being utilized and have adequate vessel resources available to perform said evolutions safely.
## FLEET CHECKLIST

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Name</th>
<th>Fleet Inspected</th>
<th>Location</th>
<th>Condition of anchors, shorewires, moorings</th>
</tr>
</thead>
<tbody>
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</table>

**Items requiring change or repair**


**Condition of fittings on spars**


**Items requiring change or repair**


**General condition of spars**


**Condition of rigging**


**Rigging removed from service (Type and Amount)**


**Details of Inspection**


**Corrective Action**


**Signature**

---

**Figure 19 – Fleet Checklist**
12. Rigging and Tow Performance

A. Regarding rigging condition as it relates to tows traveling extended distances, following previous suggestions, a documented inspection procedure at regular intervals while the tow is underway is advised. On towing vessels where a square watch is followed (6 hours on/6 hours off) at least one inspection of the tow and associated rigging should be performed each watch. When there is tow work of dropping or picking up barges during the watch the inspection may be performed during the course of that tow work.

B. Given the multitude of barge combinations that may be assembled to form a tow, it is neither within the scope nor the intent of this recommendation to advise how to wire a tow for transit. There are several guidelines which are followed when a tow is built, such using double rigging to provide extra strength in the tow such as high to low couplings (empty barge to a loaded barge), the outside edge and across the head of a tow, building a 'break coupling' when the tow will have to be broken in half to facilitate locking, and so forth.

C. Documenting these techniques through the operator's towing safety management system, or operating policies/procedures, and training vessel crews on proper procedure will result in safer tow building evolutions, a stronger finished tow, and less likelihood of broken/damaged rigging and tow malfunctions.

13. Retirement of synthetic towlines

A. Retirement of towline is determined by a number of factors to include amount of use, wear and tear to the line itself, exposure to shock and UV and others. Visual rope inspections should be completed following the rope manufacturers recommendations. An example of this of a rope inspection checklist and retirement criteria are shown in Figures 20 & 21 on the following pages.

B. Towing Vessel operators should engage the specific rope manufacturer to help develop inspection and retirement criteria based on the ropes application and usage.
Figure 20 – Example of a fiber rope inspection checklist
Figure 21 – Example of a fiber rope retirement criteria
Enclosure (1) to TSAC Task 13-06 Towing Gear

TOWING SAFETY ADVISORY COMMITTEE (TSAC)

TASK STATEMENT 13-06

I. TASK TITLE:

Recommendation for the Maintenance, Repair and Utilization of Towing Equipment, Lines and Couplings (Short Title Towing Gear)

II. BACKGROUND:

The ability of a towing vessel to control its tow is limited by those connection points between the towing vessel and tow by which the application of force results in a desired outcome. These connection points are often made of soft lines such as nylon or other synthetic fabric or hard lines such as wire cable. Industry is also readily integrating other systems to create a rigid interlock with a tow to establish and maintain control of a tow. Articulating tug and barges as well as Integrated Tug and barges are available to the towing industry as potential solutions to the unique challenges of their particular towing operations.

In all cases, the loss of control of a tow by a towing vessel due to a failure of its connection may result in catastrophic damage to life, property and the environment. As such, the reliability, integrity and appropriateness of the equipment utilized by a towing vessel should be a primary concern for a towing vessel Master when planning a towing evolution.

III. DISCUSSION:

Towing vessels have increased in both length and breadth substantially since their earliest inception. Modern towing vessels often have large horsepower and bollard pull capabilities that have permitted the sizes of tows to grow to in terms of both size and weight.

To accommodate the growth in both towing vessel capabilities and the size of tows, industry has embraced newer technology and systems. Synthetic lines, positive interlocks between towing vessels and barges, surge capacitive towing winches and other solutions are employed across the wide spectrum of the towing industry.

However, as the technology and systems have evolved there has been concern that a commensurate level of standardized care and guidance has not accompanied these new equipment capabilities. There have been a number of incidents of national concern regarding the failure of towing systems and the resultant loss of tows.

The Coast Guard views the failure of towing equipment to be a concern warranting potential action. TSAC offers the Coast Guard valuable expertise and insight regarding towing vessels and requests TSAC to consider factors relevant to the establishment of standards for the maintenance and repair and utilization of towing equipment.
Thus, the Coast Guard refers the following to the Towing Safety Advisory Committee for action.

IV. TASKS:

1. Provide recommendations to the Coast Guard on specific criteria to be used in determining the proper utilization of towing equipment for specific towing evolutions to include:
   a. towing system capability
   b. towing systems compatibility with the tow in regards to:
      I. operational environment; and
      II. expected forces exerted on the towing equipment
      III. Sufficiency of fail-safes for redundancy and tow retrieval

2. Provide recommendations to the Coast Guard on specific criteria for the care and maintenance of towing equipment to include repairs, frequency of maintenance and criteria for removal from service.

3. Provide recommendations to the Coast guard concerning the specific knowledge, skills and training of persons responsible for the maintenance, repair and determination of towing gear for establishing a tow.

4. Provide any other recommendations relevant to the intent of the Task Statement not specifically identified in this section.

V. DUE DATE:
Provide an Interim Report to the Coast Guard no later than August 2015. Provide all recommendations to the Coast Guard no later than December 2015.

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Enclosure (3) to TSAC Task 13-06 Final Report

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Enclosure (4) to TSAC Task 13-06 Final Report

Definitions

**Bollard Pull (BP).** Documented continuous bollard pull

**Breaking Load (BL).** Documented minimum breaking load

**Breaking strength.** The actual or ultimate rated load required to pull a wire, strand, or rope to destruction.

**Breaking of a tow.** The release of a towed vessel from the towing gear

**Bridles.** A length of chain or wire extending from the bow of a tow. Usually refers to the rigging of a tow with two legs from the tow’s bow to a flounder/delta plate

**Cable.** A heavy rope, chain, or wire of great strength. Applications include attachment to anchors and towing.

**Capstan.** A revolving device with a vertical axis used for the controlled deployment and retrieval of lines.

**Catenary.** The downward curve or sag of a rope, wire, or chain suspended between two points.

**Chafing gear.** Material used to prevent chafing and wear on both the hawser and the tug’s structure.

**Chafing pendant.** A length of chain used to reduce chafing or wearing.

**Chain bridle.** Two legs of chain joined by a flounder/delta plate extending from the bow of a vessel and connected to the tug’s towline

**Chain pendant.** A single length of chain extending from the bow of a vessel or from the apex of the flounder/delta plate used as a towing connection element.

**Chain pattern shackle.** A U-shaped fitting with a pin used for chain connections in a towing rig.

**Chock.** A heavy smooth-surfaced fitting, both “open and closed” usually located near the edge of the weather deck through which wire ropes, fiber hawsers or chain may be led.

**Cleat.** An anvil-shaped deck fitting for securing or belaying lines.

**Closed spelter socket.** A wire rope termination.
Enclosure (4) to TSAC Task 13-06 Final Report

**Constructional stretch.** The elongation of a wire rope caused by a virgin rope’s helical strands constricting the core during initial loading. This property is no longer exhibited after several loadings.

**Core.** The axial member of a wire rope, about which the strands are laid. It may consist of wire strand, wire rope, synthetic or natural fiber, or solid plastic.

**Cotter keys.** Also called cotter pins, are used to secure or block nuts, clevises, etc. Driven into holes in the shaft, the eye prevents complete passage, and the split ends, deformed after insertion, prevent withdrawal. Cotter keys are not used in towing.

**Detachable link.** A joining link that can be opened and is used to connect chain to mooring, towing, or beach gear equipment

**Delta plate.** A triangular steel plate to which the bridle legs are connected

**Die lock chain.** Chain formed by forging.

**Dipped shackle, padeye.** The placement of a shackle through a padeye or connection, as opposed to passing the pin of the shackle through opening in the padeye. The padeye is shaped to accept a shackle as described.

**Dog.** A pawl; a device applied to the winch drum to prevent rotation. See “On the dog.”

**Dye-penetrant test.** An inspection method used to detect weld surface discontinuances.

**Dynamic load.** Relating to energy or physical force in motion; as opposed to static load, a force producing motion or change.

**Dynamic tension.** Resistance of the ship to be towed, the tow hawser, and the vertical component of wire catenary. This resistance cannot be accurately predicted.

**Dynamic load.** Relating to energy or physical force in motion; as opposed to static load, a force producing motion or change.

**Eye splice.** A loop formed in the end of a line by tucking the strand ends over and under the strands of the standing part of the rope. A thimble is often used in the eye.

**Fairlead.** Metal fittings which lead lines in a desired direction.

**Fairlead (roller) chock.** A chock with a roller(s) installed to lead a line to a bitt or cleat.

**Fatigue.** The tendency for materials or tow gear to fail under repeated (cyclic) loading.
Enclosure (4) to TSAC Task 13-06 Final Report

**Fitting.** A specially designed piece on a vessel’s deck used to control or secure a line or rope (e.g., chock, bitts, padeye, etc.)

**Fish, Delta, Heart, Monkey face, plate.** See Delta plate.

**Fitting.** A specially designed piece on a vessel’s deck used to control or secure a line or rope (e.g., chock, bitts, padeye, etc.)

**Freshening the nip.** Paying out or hauling in the tow wire to move the contact point in order to distribute wear on the hawser, stern roller, towing bows, H-bitts, winch drum, etc.

**Frictional resistance.** The force created by an object as it moves through a fluid.

**Fuse pendant.** A pendant of wire rope or chain specifically designed to fail at a known tension. May be used to protect the rest of the rigging arrangement. Also called a “weak link.”

**Hawser.** A heavy line or wire rope of over five inches in diameter.

**Helix.** The twist or curvature of the individual strands of a wire rope.

**Hockle.** Kinking of one or more strands of twisted fiber line or wires on a wire rope.

**IPS.** Improved Plow Steel.

**IWRC.** Independent Wire Rope Core.

**Jaw width.** The dimension of the opening between the eyes of a shackle.

**Jewelry.** The gear used to assemble the towing bridle

**Lay.** The direction of the twist of strands of a rope.

**Lay length.** The distance measured parallel to the axis of the rope (or strand) in which a strand (or wire) makes one complete helical revolution about the core (or center).

**Layer.** In towing, the wraps of wire completely filling the tow winch barrel from one drum flange to the other are counted as layers.

**Lead pendant.** A length of chain or wire used between the tow and the towing wire/hawser to ensure a safe distance during hookup and disconnect and to add weight to increase catenary.

**Making tow.** The process of making up the connections to tow a vessel
Enclosure (4) to TSAC Task 13-06 Final Report

**Nip.** A sharp bend in a line or wire.

**OCIMF.** Oil Companies International Marine Forum.

**On the brake.** Towing with the tow wire restrained by the brake system of the towing machine or winch.

**On the dog.** Towing with the winch having a pawl engaged in the ratchet teeth of the towing machine’s drum.

**Open throat spelter socket.** A wire rope termination that is shaped similarly to a shackle; mates with a closed socket.

**Padeye.** A metal fitting welded to a deck or bulkhead designed to accept a chain or shackle.

**Pendant (pennant).** A single wire or chain that leads from the apex of a towing bridle to the towline; a single wire or chain that leads from the bow of the tow to connect to the tow hawser; a length of wire used as an under rider wire for multiple tows.

**Rigging.** Term used interchangeably with Towing Gear.

**Section modulus.** As used in reference to wire rope, the effective area of the steel in wire rope multiplied by the modulus of elasticity of the steel.

**Shackle.** U-shaped metal fitting, closed at the open end with a pin, used to connect wire, chain, and similar components.

**Smit towing bracket.** Two vertical plates similar to a pair of free standing padeyes with an elliptical pin fitted between them.

**Spring lay rope (Swede Wire).** A wire rope combining fiber and wire.

**Socket.** A wire rope termination attached by Zinc or resin.

**Steamboat Ratchet.** A sleeve, internally threaded at the ends and with attached eye-rods, equipped with a ratchet used to turn the sleeve, thereby pulling the rods toward each other. Used extensively on the Western Rivers when making up tow.

**Stud-link.** A chain link with a bar fitted across the middle to prevent the chain from kinking.

**Strap.** A short working wire with a spliced eye at each end.

**Stream.** To extend or increase the scope of the tow wire/hawser.
Enclosure (4) to TSAC Task 13-06 Final Report

SWL - Safe working load. The load for which a line, wire rope, a fitting, or working gear is designed. (Note: U.S. Engineering Standards, as well as European and ISO Standards no longer use the term *Safe Working Load* or *SWL*, officially). This term, at best, reflects the maximum load a product can carry or lift at optimum or brand new conditions. There is no way to predict the down rating or “derate” of load limits due to use of the equipment over time in various environmental conditions.

Swage. To connect, splice, or terminate wire rope by use of steel fittings installed under extremely high pressure.

Tow. The towing vessel, including towing vessel equipment and the towed object including its towing equipment, cargo and cargo securing

Towage. The complete towing operation

Towing equipment/gear. All towing equipment on the towing vessel and the tow used to effect the towage. (Inland Rivers see rigging).

Towline fatigue. The weakening of a towline due to cyclic application of load.

Towing hawser. Generally, the main towline that is carried by the tug or the principal segment of the towline.

Towline strength. The nominal breaking strength of the tow hawser.

Towline tension. The stress imparted to a towline during a towing operation.

Turnbuckles. A metal device consisting of a threaded link bolt and a pair of opposite threaded screws capable of being tightened or loosened and used for setting up standing rigging or stoppers.

ULC. Absolute maximum load that a structure can bear without failing.

Weather: 1 and 10-year return periods. The most unfavorable combination of extreme environmental conditions, comprising wind, wave and current, that can be expected statistically every 1 and 10 years respectively.

Wire rope. Rope constructed of wire strands twisted together, as distinct from the more common, and weaker, fiber rope.

Wire rope pendant. A length of wire with a termination fitting at each end

Working Load Limit (WLL). The maximum *working load* designed by the manufacturer. This *load* represents a force that is much less than that required to make the lifting equipment
fail or yield, also known as the Minimum Breaking Load (MBL). A simple Definition of Working Load Limit is the maximum load that includes mass or force, that should ever be applied to load carrying equipment in a specified configuration or application. Any rigging device or “configuration” is only as strong as its weakest, or lowest WLL rated, parts.

Yield strength. A measure of the maximum stress that can be applied to a material without permanent deformation. This is the value of the stress at the elastic limit for materials for which there is an elastic limit.