AFT OVERBOARD HANDLING SYSTEM

R/V SIKULIAQ

Top Level Maximum Capability Document

Manufactured By: XXX

Reference Drawing Number: XXX-XXX

Prepared By: [Company Name]

[Engineer's Name/Stamp]

[Date]

1. Abbreviations

MCD	**M**aximum **C**apability **D**ocument
MPT	**M**aximum **P**ermissible **T**ension
NBL	**N**ominal **B**reaking **L**oad
NSF	**N**ational **S**cience **F**oundation
UNOLS	**U**niversity-**N**ational **O**ceanographic **L**aboratory **S**ystem

2. Purpose

The Aft Overboard Handling System (AOHS) consists of a suite of deck machinery and gear that can be arranged in various configurations as required to meet the needs of a variety of science missions. As each component in that suite has a different load capacity, which also may vary depending on how that component is used, the overall system capacity for a given configuration thus also varies.

If the configuration meets certain requirements then this document provides the end user with a systematic approach to determine the load capacity of the handling system configuration. The capacity is stated in terms of the Maximum Permissible Tension.

If it is determined that the chosen system configuration does not meet the requirements then the approach outlined in this document cannot be used and the system arrangement must be reviewed by a competent engineer who will make the load capacity determination.

The tension member employed in the AOHS is considered a component of the entire handling system and shall be used in accordance with Appendix A (See Reference 3.3.2) The NBL of the tension member shall be less than the MPT for the given operation.

2.1. Deployment Types

This AOHS will potentially be used for the following types of deployments:

Operation	Y/N	Notes
Towing - Surface	Y	
Towing – Mid Water	Y	
Towing – Deep Water	Y	
Station Keeping – Surface	Y	
Station Keeping - Mid Water	Y	
Station Keeping - Deep Water	Y	

See Reference 3.3.3, Section B.3.5 for descriptions of operations

3. General

3.1. Description

Figure 1 depicts the suite of components that can be used together to make up a configuration of the AOHS to perform a given task. These components are divided into two main categories, permanently mounted ship supplied equipment (items #1-7) and charter or project furnished equipment (item #8). Charter equipment consists of project winches blocks, fairleads and rigging. Descriptions of the permanent ship supplied equipment can be found in the component level MCDs included in this MCD booklet.

3.2. Approach

A flowchart (Figure 2.) is used to guide the end-user through the decision making process described above. To use the flowchart the end user must have the following information available:

1. Rigging plan depicting all components to be used in the load path. The plan must identify which A-frame padeyes are to be used and what positions the A-frame is to be operated in. If the plan includes charter winches the deck location of the winch must be identified.
2. Cognizance as to whether the maximum load occurs during A-frame luffing or only when the A-frame is at a stop position.
3. MCDs for any charter gear to be used with the AOHS.used in the configuration.

3.3. Reference Documents

3.3.1. 46 CFR 189.35 "Wet Weight Handling Gear."

3.3.2. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix A: "Rope and Cable Safe Working Load Standards," March 2009.

3.3.3. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix B: "Overboard Handling Systems Design Standards Criteria for the Design and Operations of Overboard Handling Systems," March 2009.

3.3.4. *Overside Equipment Handling Arrangement,* Marinette Marine Corp., Drawing No. 0650-714-01, Rev. B.

4. Maximum Capabilities

The system maximum capabilities meet the following requirements:

Arrangement No.	Components[1]	A-Frame Padeye Position	A-Frame Stop Position	Type of Deployment	MPT
1	5,6,7,8,9	Center	2	Station Keeping	TBD
2	5,6,7,8,9	Center	2	Towing	TBD
3	5,6,7,8,9	Center	3	Station Keeping	TBD
4	5,6,7,8,9	Center	3	Towing	TBD
5	5,6,7,8,9	Wing	2	Station Keeping	TBD
6	5,6,7,8,9	Wing	2	Towing	TBD
7	5,6,7,8,9	Wing	3	Station Keeping	TBD
8	5,6,7,8,9	Wing	3	Towing	TBD

Note 1: Components between the storage reels and the traction winch are not shown as the tension will be constant regardless of the wire/storage drum used.

Item No.	Component Description		Item No.	Component Description
1	Storage reel No. 1, .680” EM cable		7	Science block
2	Storage reel No. 2, .9/16” 3 x 19 trawl wire		8	Shackle
3	Traction winch		9	Pad Eye
4	Slack compensator		10	Charter gear
5	Traction winch fairlead		11	Deck Sockets
6	Stern A-frame			

Note: Items #1 and #2, the traction winch storage reels are not weight handling and thus not subject to Ref 3.3.1 requirements.

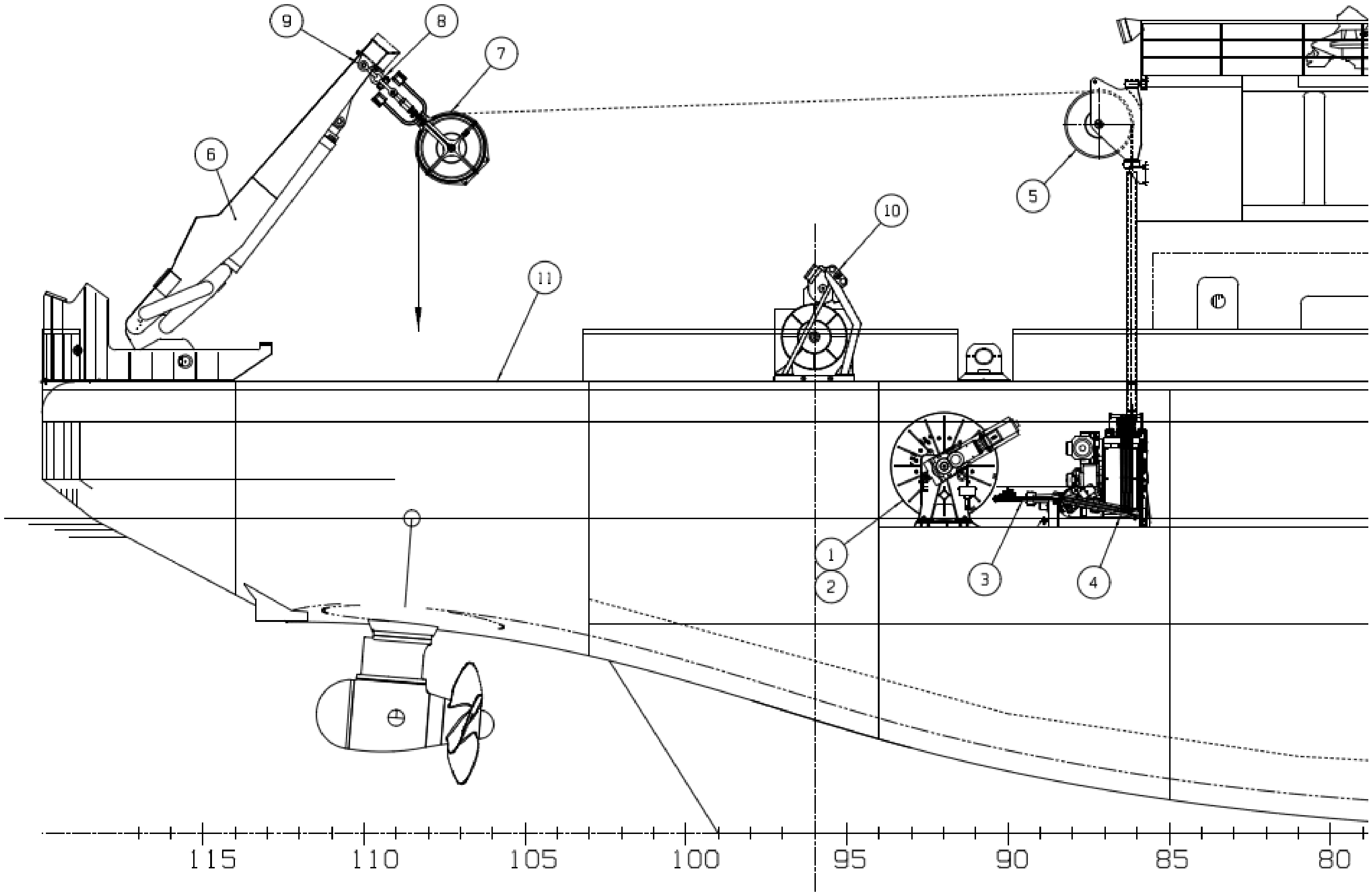


Figure 1 Aft Overside System Key Plan

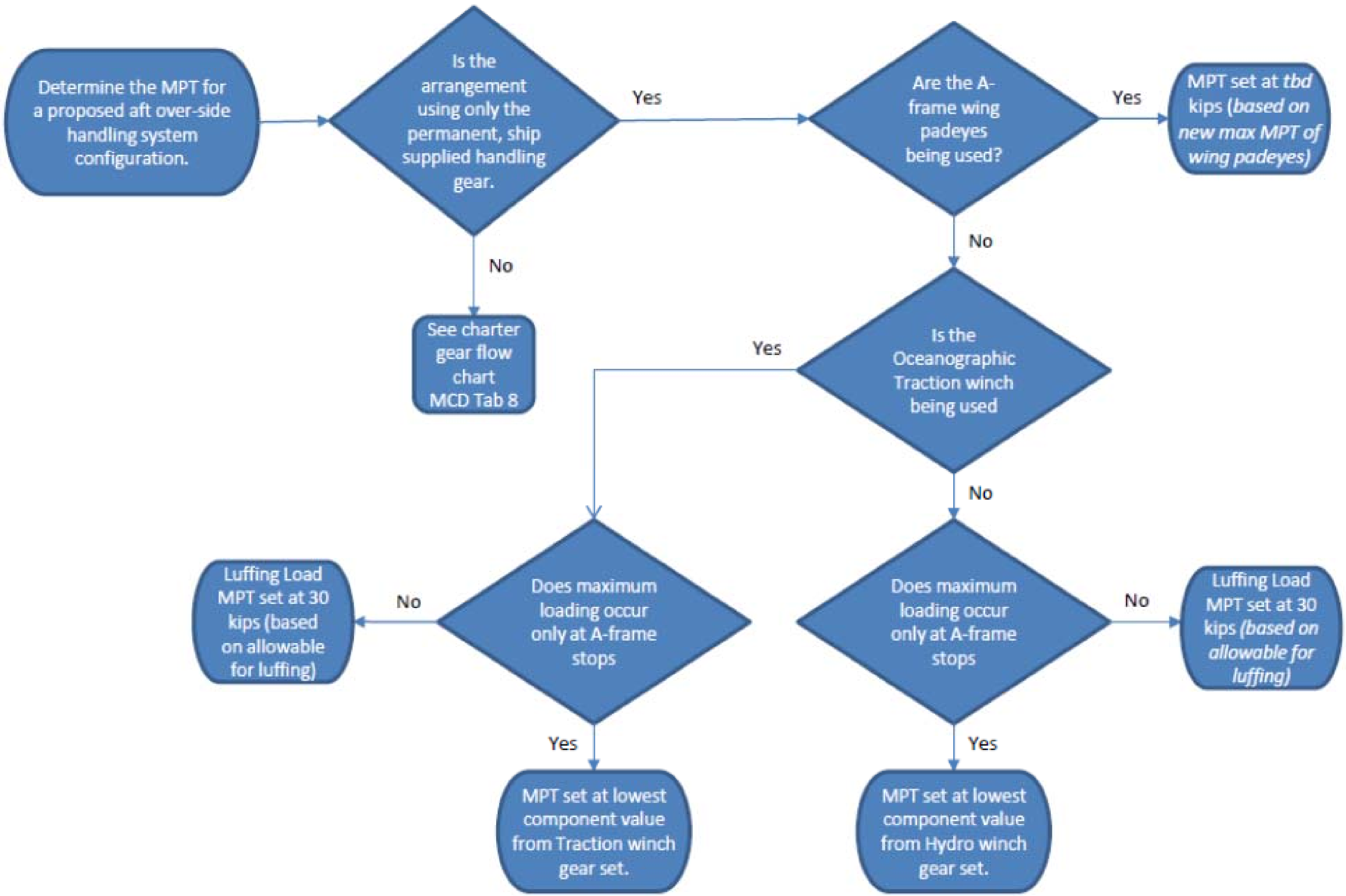


Figure 2 Top Level MCD Flowchart

Attachment A1

TABLE B.3 — Overboard Handling Data Document

REQUIRED DATA	**Operator/Designer Response**
Deployment Type	*Towing – all depths* *Station Keeping – all depths*
Provide a brief narrative of scientific purpose and the equipment to be deployed. A drawing or drawings of the proposed "system" or "component" architecture is to be appended showing, for example, wire angles and potential loadings (Principle , Secondary & Worst Case) relative to the Varies system elements. Provide information on the vessel or vessels (size(s), type(s), UNOLS or not, etc) intended for the system deployment, its/their area(s) of operation and the likely weather conditions to be encountered	*The Aft Overside Handling System is comprised of the Stern A-frame, the 48" Hanging Block and companion rigging and either one of the ship's permanent winch systems or a portable charter gear deck winch.*
Provide Primary Deployment Information;	
Package Type	*Varies*
Maximum Package Weight	*Varies*
Base Package Mass	*Varies*
Added Mass to Include Captured and Entrained Added Mass (E.G., Water/Mud)	*Varies*
Maximum Hydrodynamic Resistance	*Varies*
Dynamic Factors	*Varies*
Rope or Cable Type and Breaking Load	*Maximum 120,000 lbf for arrangements using permanent winch systems and center A-frame padeye locations.*
Maximum Wire Weight (In Water)	*Varies*
Maximum Wire Mass	*Varies*
Selected Rope or Cable Factor of Safety Per Appendix A	*Varies*
Maximum Anticipated Depth of Deployment	*Varies*
Maximum Allowable Depths of Water	*Varies*
Deployment/Water Depth Ratio	*Varies*
Principle Loading	*Varies*

Secondary Loading	*Varies*
Worst Case Loading	*Varies*
Ultimate Design Load	*Varies*
Load Limiting Equipment	*None*
Maximum Anticipated Operating Tension	*Varies*
Design Line Tension	*120,000 lbf for maximum loading conditions*
Other Emergency Means of Package or Wire Detachment	*Varies*
Other Means Proposed for Package Control	*Varies*
Description of Fail Safes in the Event of Power Loss or Mechanical/Electrical Failure of System Components	*Hydraulic locking valves on A-frame cylinders and spring applied fail safe brakes on ship's winch systems.*

Aft Overboarding System: Storage Reels

R/V SIKULIAQ

Maximum Capability Document

Manufactured By: Rapp Hydema

Model: RW-2326BS

Reference Drawing Number: RH314163

Prepared By: The Glosten Associates

[Engineer's Name/Stamp]

30 January 2012

1. Abbreviations

MCD	**M**aximum **C**apability **D**ocument
MPT	**M**aximum **P**ermissible **T**ension
NBL	**N**ominal **B**reaking **L**oad
NSF	**N**ational **S**cience **F**oundation
UNOLS	**U**niversity-**N**ational **O**ceanographic **L**aboratory **S**ystem

2. Purpose

This document describes the general arrangement of the traction winch storage reels installed onboard the vessel *R/V Sikuliaq*. It establishes their load capacities as components of the Aft Overboarding System.

This document sets the Maximum Permissible Tension (MPT) as required by the UNOLS RVSS, Appendix B when the storage reels are used to support over-the-side operations for science.

The tension member employed in the system is considered a component of the entire handling system and shall be used in accordance with Appendix A. The NBL of the tension member shall be less than the MPT.

2.1. Deployment Types

This Storage Reel will potentially be used for the following types of deployments:

Operation	Y/N	Notes
Towing - Surface	Y	On Low Tension Side
Towing – Mid Water	Y	On Low Tension Side
Towing – Deep Water	Y	On Low Tension Side
Station Keeping – Surface	Y	On Low Tension Side
Station Keeping - Mid Water	Y	On Low Tension Side
Station Keeping - Deep Water	Y	On Low Tension Side

See Reference 3.2.3, Section B.3.5 for descriptions of operations

3. General

3.1. Description

Two storage reels in the Aft Winch Room provide tailing tension for a single traction winch serving the aft overboarding system. One reel has Lebus grooves for 9/16 inch trawl wire. The other has Lebus grooves for 0.681 fiber optic signal wire. The reels are considered to have identical performance and are combined in this single maximum capability document.

3.2. Reference Documents

3.2.1. 46 CFR 189.35 “Wet Weight Handling Gear”.

3.2.2. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix A: “Rope and Cable Safe Working Load Standards,” March 2009.

3.2.3. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix B: “Overboard Handling Systems Design Standards Criteria for the Design and Operations of Overboard Handling Systems,” March 2009.

3.2.4. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix B: “Overboard Handling Systems Design Standards Criteria for the Design and Operations of Overboard Handling Systems,” March 2009.

3.2.5. *Oceanographic Storage Reel RW-2326BS Dimensional Sketch*, Rapp Hydema, Drawing No. RH314163, Rev. A1, 5 October 2010.

3.2.6. *Traction Winch System TRW-4000B + 2x RWS-2326/ Spooling Device Principal Arrangement*,” Rapp Hydema, Drawing No. RH310356, 08 February 2008, Rev. B.

3.2.7. *Overside Equipment Handling Arrangement,* Marinette Marine Corp., Drawing No. 0650-714-01, Rev. B.

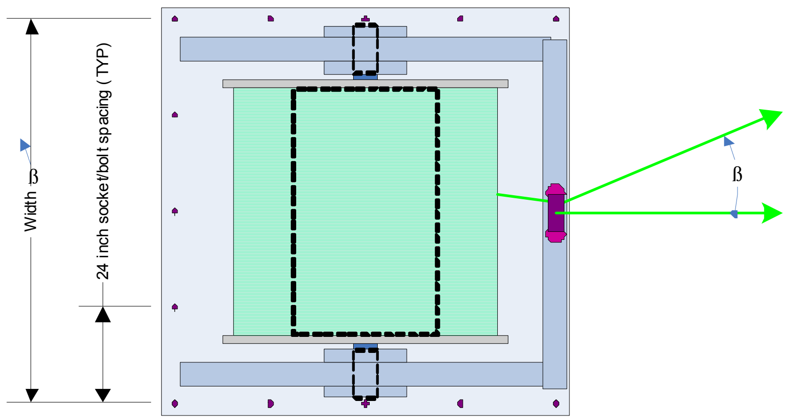
4. Maximum Capabilities

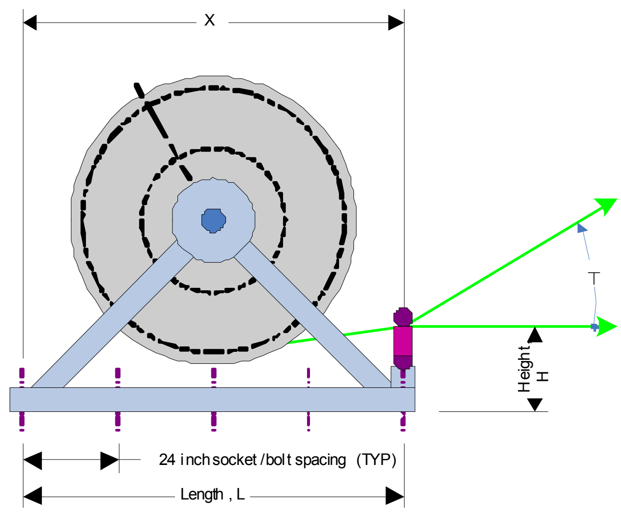
Maximum capabilities of the storage reels meet the following requirements:

Item	Maximum Capability Value	Criteria Source
Maximum Permissible Tension (MPT)	*{Vendor Supplied}*	Reference 3.2.X
Design Line Tension (DLT)	40,000 lbf	0.680" NBS
Wire Groove Size	9/16" or 0.68"	Reference 3.2.X
Lead Angles		
θ	*{Vendor Supplied}*	Reference 3.2.X
β	*{Vendor Supplied}*	Reference 3.2.X
Other		
Speed range	*{Vendor Supplied}*	Spec min is 60 m/min
Bolts		
Maximum Uplift (T_{bolt})	N/A	Per Bolt
Maximum Shear (V_{bolt})	N/A	Per Bolt

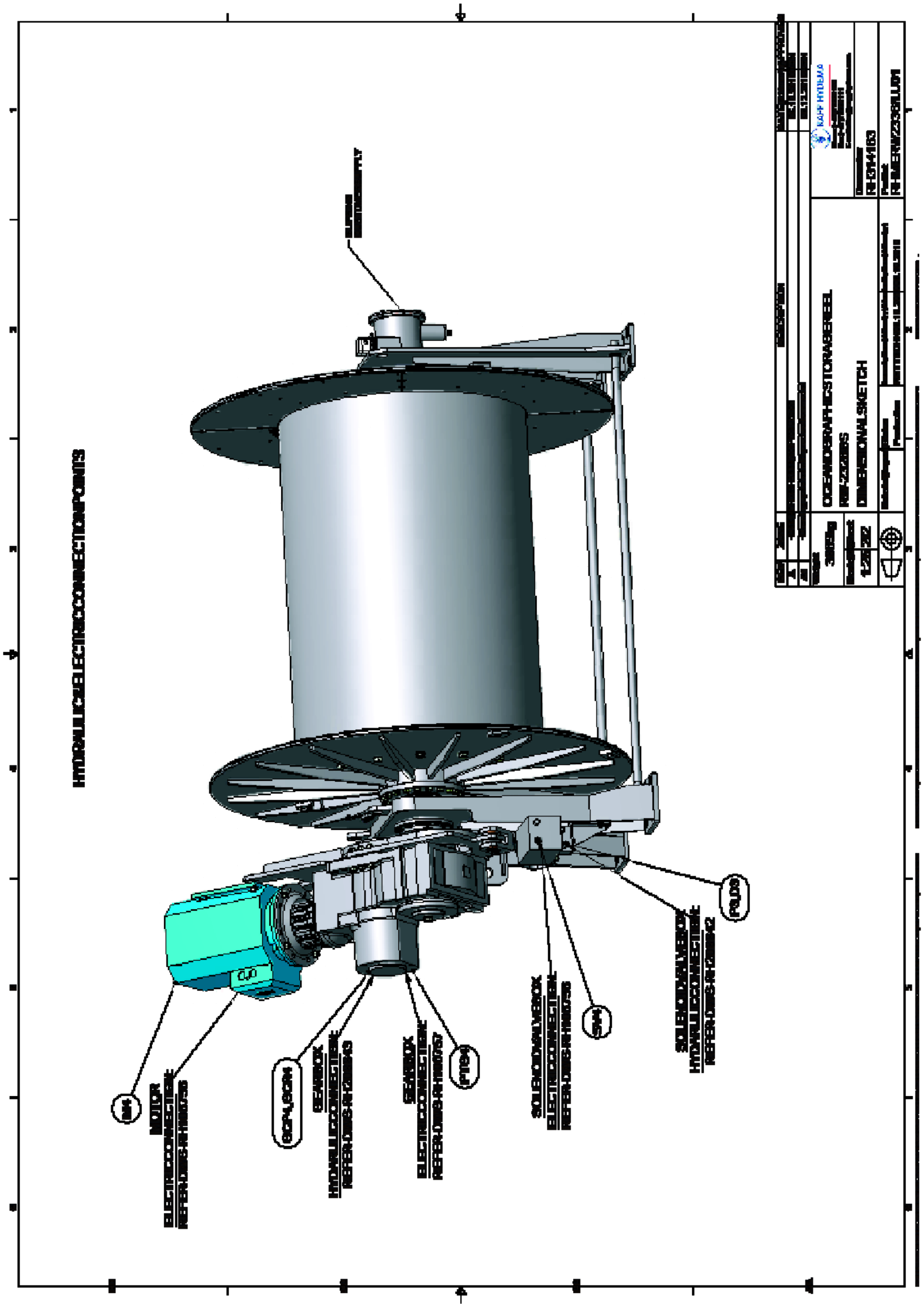
5. Operational Figures

5.1. Load Geometry





5.2. Vendor Drawing



Attachment A1

TABLE B.3 — Overboard Handling Data Document

REQUIRED DATA	**Operator/Designer Response**
Deployment Type	*Towing – all depths* *Station Keeping – all depths*
Provide a brief narrative of scientific purpose and the equipment to be deployed. A drawing or drawings of the proposed "system" or "component" architecture is to be appended showing, for example, wire angles and potential loadings (Principle , Secondary & Worst Case) relative to the Varies system elements. Provide information on the vessel or vessels (size(s), type(s), UNOLS or not, etc) intended for the system deployment, its/their area(s) of operation and the likely weather conditions to be encountered	*Spool drum on low tension side of traction winch. Used to tail and store 9/16" or 0.680" cables*
Provide Primary Deployment Information;	
Package Type	*Varies*
Maximum Package Weight	*Varies*
Base Package Mass	*Varies*
Added Mass to Include Captured and Entrained Added Mass (E.G., Water/Mud)	*Varies*
Maximum Hydrodynamic Resistance	*Varies*
Dynamic Factors	*Varies*
Rope or Cable Type and Breaking Load	*Maximum 40,000 lbf - 0.680" EM Cable* *Maximum 33,600 lbf – 9/16" Trawl Wire*
Maximum Wire Weight (In Water)	*Varies*
Maximum Wire Mass	*Varies*
Selected Rope or Cable Factor of Safety Per Appendix A	
Maximum Anticipated Depth of Deployment	*Varies*
Maximum Allowable Depths of Water	*Varies*
Deployment/Water Depth Ratio	*Varies*
Principle Loading	*Line lead off bottom of drum to level wind*
Secondary Loading	

Worst Case Loading	*Line Break if traction winch fails*
Ultimate Design Load	*{Vendor Supplied}*
Load Limiting Equipment	*Traction Winch*
Maximum Anticipated Operating Tension	*{Vendor Supplied}*
Design Line Tension	*40,000 lbf*
Other Emergency Means of Package or Wire Detachment	*None*
Other Means Proposed for Package Control	*Varies*
Description of Fail Safes in the Event of Power Loss or Mechanical/Electrical Failure of System Components	*N/A*

AFT OVERBOARD HANDLING SYSTEM: LEVEL WINDS

R/V SIKULIAQ

Maximum Capability Document

Manufactured By: Rapp Hydema

Model: Level Wind (left hand side motor)

Reference Drawing Number: RH314164

Prepared By: The Glosten Associates

[Engineer's Name/Stamp]

30 January 2012

1. Abbreviations

MCD	**M**aximum **C**apability **D**ocument
MPT	**M**aximum **P**ermissible **T**ension
NBL	**N**ominal **B**reaking **L**oad
NSF	**N**ational **S**cience **F**oundation
UNOLS	**U**niversity-**N**ational **O**ceanographic **L**aboratory **S**ystem

2. Purpose

This document describes the general arrangement of the level winds serving traction winch storage reels installed onboard the vessel *R/V Sikuliaq* and establishes their load capacities as components of the Aft Overboarding System.

This document sets the Maximum Permissible Tension (MPT) as required by the UNOLS RVSS, Appendix B when the level winds are used to support over-the-side operations for science.

The tension member employed in the system is considered a component of the entire handling system and shall be used in accordance with Appendix A. The NBL of the tension member shall be less than the MPT.

2.1. Deployment Types

This Level Wind will potentially be used for the following types of deployments:

Operation	Y/N	Notes
Towing - Surface	Y	On Low Tension Side
Towing – Mid Water	Y	On Low Tension Side
Towing – Deep Water	Y	On Low Tension Side
Station Keeping – Surface	Y	On Low Tension Side
Station Keeping - Mid Water	Y	On Low Tension Side
Station Keeping - Deep Water	Y	On Low Tension Side

See Reference 3.2.3, Section B.3.5 for descriptions of operations

3. General

3.1. Description

Two level winds serve storage reels in the Aft Winch Room as components of the aft overboarding system. The level winds are considered to have identical performance and are combined in this single maximum capability document.

3.2. Reference Documents

3.2.1. 46 CFR 189.35 “Wet Weight Handling Gear”.

3.2.2. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix A: “Rope and Cable Safe Working Load Standards,” March 2009.

3.2.3. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix B: “Overboard Handling Systems Design Standards Criteria for the Design and Operations of Overboard Handling Systems,” March 2009.

3.2.4. *Level Wind (left Hand Side Motor) Traction Winch System Dimensional Sketch*, Rapp Hydema, Drawing No. RH314164, Rev. A, 05/10/2010.

3.2.5. T*raction Winch System TRW-4000B + 2x RWS-2326/ Spooling Device Principal Arrangement*, Rapp Hydema, Drawing No. RH310356, Rev. B, 08/02/2008

3.2.6. MMC Drawing No. 0650-714-01, “Overside Equipment Handling Arrangement” Rev B.

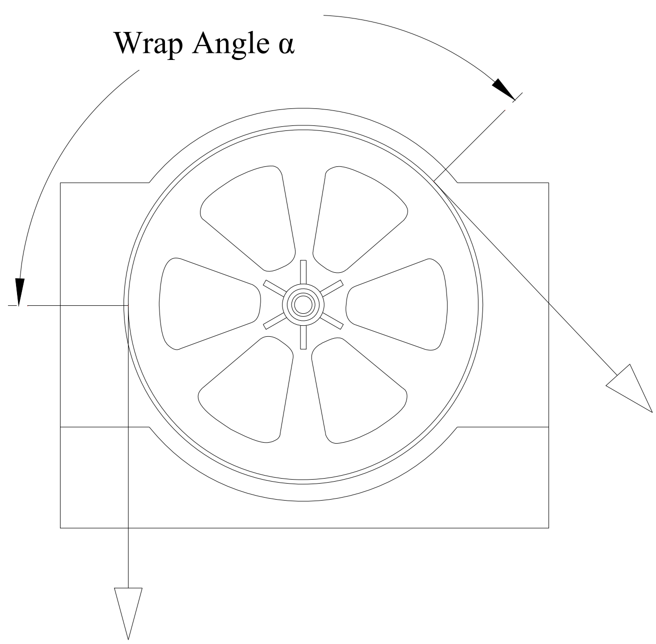
4. Maximum Capabilities

Maximum capabilities meet the following requirements:

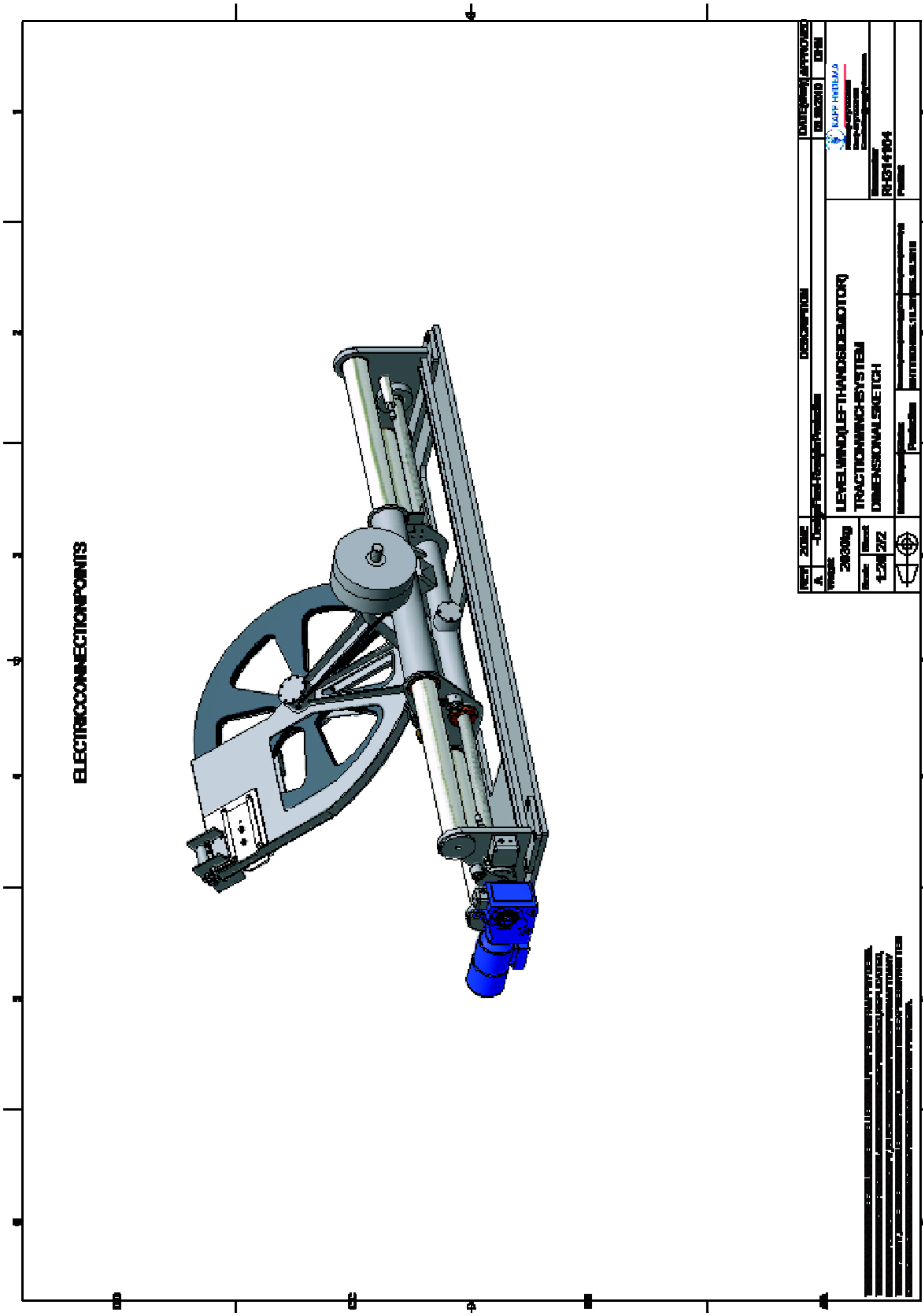
Item	Maximum Capability Value	Criteria Source
Maximum Permissible Tension (MPT)	*{Vendor Supplied}*	Reference 3.2.X
Design Line Tension	46,000 lbf	.680" NBS
Factor of Safety (FS)	*{Vendor Supplied}*	SF to Yield
Wire Groove Size	0.680" Or 9/16"	Reference 3.2.X
Wrap Angles (α)		
Minimum	*{Vendor Supplied}*	Reference 3.2.X
Maximum	*{Vendor Supplied}*	Reference 3.2.X
Other		
Sheave speed range	*{Vendor Supplied}*	Spec min is 60 m/min

5. Operational Figures

5.1. Load Geometry



5.2. Vendor Drawing



Attachment A1

TABLE B.3 — Overboard Handling Data Document

REQUIRED DATA	**Operator/Designer Response**
Deployment Type	*Towing – all depths* *Station Keeping – all depths*
Provide a brief narrative of scientific purpose and the equipment to be deployed. A drawing or drawings of the proposed "system" or "component" architecture is to be appended showing, for example, wire angles and potential loadings (Principle , Secondary & Worst Case) relative to the Varies system elements. Provide information on the vessel or vessels (size(s), type(s), UNOLS or not, etc) intended for the system deployment, its/their area(s) of operation and the likely weather conditions to be encountered	*Level Winds serving traction winch storage reels*
Provide Primary Deployment Information;	
Package Type	*Varies*
Maximum Package Weight	*Varies*
Base Package Mass	*Varies*
Added Mass to Include Captured and Entrained Added Mass (E.G., Water/Mud)	*Varies*
Maximum Hydrodynamic Resistance	*Varies*
Dynamic Factors	*Varies*
Rope or Cable Type and Breaking Load	*Maximum 46,000 lbf - 0.680" EM Cable* *Maximum 33,600 lbf – 9/16" Trawl Cable*
Maximum Wire Weight (In Water)	*Varies*
Maximum Wire Mass	*Varies*
Selected Rope or Cable Factor of Safety Per Appendix A	
Maximum Anticipated Depth of Deployment	*Varies*
Maximum Allowable Depths of Water	*Varies*
Deployment/Water Depth Ratio	*Varies*
Principle Loading	*90° wrap, MAOT*
Secondary Loading	

Worst Case Loading	*Line Break, 90° wrap*
Ultimate Design Load	*{Determined byVendor}*
Load Limiting Equipment	*Traction Winch*
Maximum Anticipated Operating Tension	*Varies*
Design Line Tension	*46,000 lbf – 0.680" EM Cable* *33,600 lbf – 9/16" Trawl Cable*
Other Emergency Means of Package or Wire Detachment	*None*
Other Means Proposed for Package Control	*Varies*
Description of Fail Safes in the Event of Power Loss or Mechanical/Electrical Failure of System Components	*N/A*

AFT OVERBOARD HANDLING SYSTEM: TURNING SHEAVE

R/V SIKULIAQ

Maximum Capability Document

Manufactured By: Rapp Hydema

Model: DS-D1220

Reference Drawing Number: RH313983

Prepared By: The Glosten Associates

[Engineer's Name/Stamp]

30 January 2012

1. Abbreviations

MCD	**M**aximum **C**apability **D**ocument
MPT	**M**aximum **P**ermissible **T**ension
NBL	**N**ominal **B**reaking **L**oad
NSF	**N**ational **S**cience **F**oundation
UNOLS	**U**niversity-**N**ational **O**ceanographic **L**aboratory **S**ystem

2. Purpose

This document describes the general arrangement of the turning sheave that serves the storage reel level winds onboard the vessel *R/V Sikuliaq*. It establishes the load capacity of the sheave as a component of the Aft Overboarding System.

This document sets the Maximum Permissible Tension (MPT) as required by the UNOLS RVSS, Appendix B when the sheave is used to support over-the-side operations for science.

The tension member employed in the system is considered a component of the entire handling system and shall be used in accordance with Appendix A. The NBL of the tension member shall be less than the MPT.

2.1. Deployment Types

This block will potentially be used for the following types of deployments:

Operation	Y/N	Notes
Towing - Surface	Y	
Towing – Mid Water	Y	
Towing – Deep Water	Y	
Station Keeping – Surface	Y	
Station Keeping - Mid Water	Y	
Station Keeping - Deep Water	Y	

See Reference 3.2.3, Section B.3.5 for descriptions of operations

3. General

3.1. Description

A turning sheave in the Aft Winch Room routes wire between the level winds and motion compensator components of the aft overboarding system.

3.2. Reference Documents

3.2.1. 46 CFR 189.35 “Wet Weight Handling Gear.”

3.2.2. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS)*, Appendix A: “Rope and Cable Safe Working Load Standards,” March 2009.

3.2.3. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix B: “Overboard Handling Systems Design Standards Criteria for the Design and Operations of Overboard Handling Systems,” March 2009.

3.2.4. *Deck Sheave DS-D1220 Dimensional Sketch*, Rapp Hydema, Drawing No. RH313983, Rev. A, 20 August 2010

3.2.5. *Traction Winch System TRW-4000B + 2x RWS-2326/Spooling Device Principal Arrangement*, Rapp Hydema, Drawing No. RH310356, Rev. B, 08 February 2008.

3.2.6. *Overside Equipment Handling Arrangement,* Marinette Marine Corp., Drawing No. 0650-714-01, Rev. B.

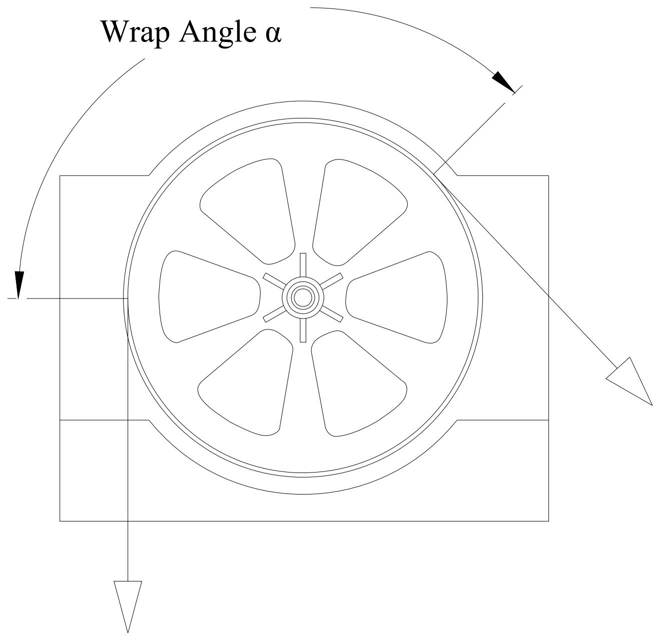
4. Operational Requirements

Maximum capabilities meet the following requirements:

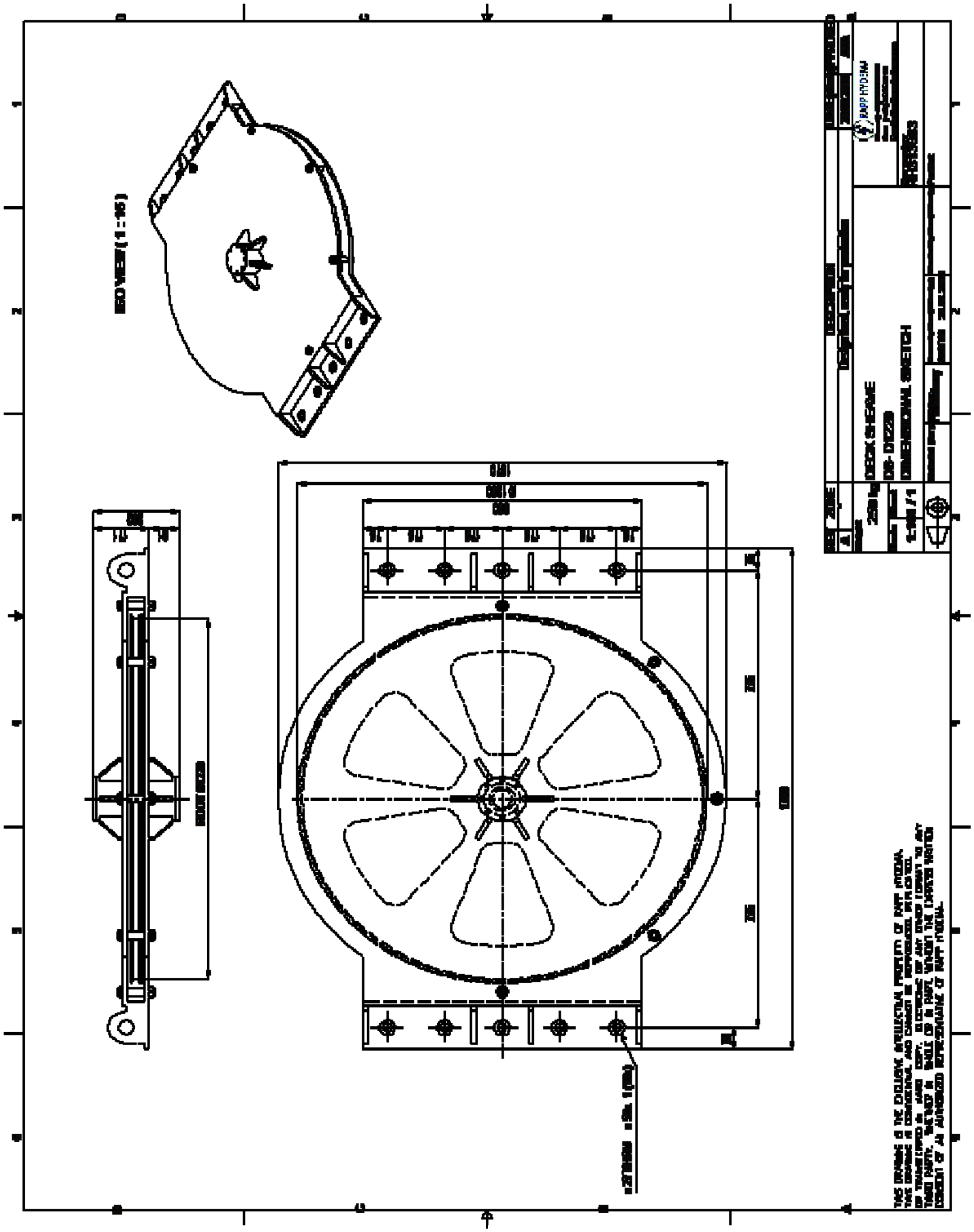
Item	Maximum Capability Value	Criteria Source
Maximum Permissible Tension (MPT)	*{Vendor Supplied}*	Reference 3.2.X
Ultimate Design Load	69,000 lbf	1.5x0.680” NBS
Factor of Safety (FS)	*{Vendor Supplied}*	SF to Yield
Wire Groove Size	0.680” Or 9/16”	Reference 3.2.X
Wrap Angles (α)		
Minimum	*{Vendor Supplied}*	Reference 3.2.X
Maximum	*{Vendor Supplied}*	Reference 3.2.X
Other		
Sheave speed range	*{Vendor Supplied}*	Spec min is 60 m/min

5. Operational Figures

5.1. Load Geometry



5.2. Vendor Drawing



Attachment A1

TABLE B.3 — Overboard Handling Data Document

REQUIRED DATA	**Operator/Designer Response**
Deployment Type	*Towing – all depths* *Station Keeping – all depths*
Provide a brief narrative of scientific purpose and the equipment to be deployed. A drawing or drawings of the proposed "system" or "component" architecture is to be appended showing, for example, wire angles and potential loadings (Principle , Secondary & Worst Case) relative to the Varies system elements. Provide information on the vessel or vessels (size(s), type(s), UNOLS or not, etc) intended for the system deployment, its/their area(s) of operation and the likely weather conditions to be encountered	*Turning Sheave serving the storage reel level winds* *Sheave will be used with on-board fixed winches as well as portable winches.*
Provide Primary Deployment Information;	
Package Type	*Varies*
Maximum Package Weight	*Varies*
Base Package Mass	*Varies*
Added Mass to Include Captured and Entrained Added Mass (E.G., Water/Mud)	*Varies*
Maximum Hydrodynamic Resistance	*Varies*
Dynamic Factors	*Varies*
Rope or Cable Type and Breaking Load	*Maximum 46,000 lbf - 0.680" EM Cable*
Maximum Wire Weight (In Water)	*Varies*
Maximum Wire Mass	*Varies*
Selected Rope or Cable Factor of Safety Per Appendix A	
Maximum Anticipated Depth of Deployment	*Varies*
Maximum Allowable Depths of Water	*Varies*
Deployment/Water Depth Ratio	*Varies*
Principle Loading	
Secondary Loading	
Worst Case Loading	*Line Break, 180° wrap*

Ultimate Design Load	*{Determined byVendor}*
Load Limiting Equipment	*None*
Maximum Anticipated Operating Tension	*Varies*
Design Line Tension	*46,000 lbf*
Other Emergency Means of Package or Wire Detachment	*None*
Other Means Proposed for Package Control	*Varies*
Description of Fail Safes in the Event of Power Loss or Mechanical/Electrical Failure of System Components	*N/A*

AFT OVERBOARD HANDLING SYSTEM: TRACTION WINCH

R/V SIKULIAQ

Maximum Capability Document

Manufactured By: Rapp Hydema

Model: RHMETRW0402B/2UL

Reference Drawing Number: RH310323

Prepared By: The Glosten Associates

[Engineer's Name/Stamp]

30 January 2012

1. Abbreviations

MCD	**M**aximum **C**apability **D**ocument
MPT	**M**aximum **P**ermissible **T**ension
NBL	**N**ominal **B**reaking **L**oad
NSF	**N**ational **S**cience **F**oundation
UNOLS	**U**niversity-**N**ational **O**ceanographic **L**aboratory **S**ystem

2. Purpose

This document describes the general arrangement of the traction winch onboard the vessel *R/V Sikuliaq*. It establishes the traction winch load capacity as a component of the Aft Overboarding System.

This document sets the Maximum Permissible Tension (MPT) as required by the UNOLS RVSS, Appendix B when the sheave is used to support over-the-side operations for science.

The tension member employed in the system is considered a component of the entire handling system and shall be used in accordance with Appendix A. The NBL of the tension member shall be less than the MPT.

2.1. Deployment Types

This Traction Winch will potentially be used for the following types of deployments:

Operation	Y/N	Notes
Towing - Surface	Y	
Towing – Mid Water	Y	
Towing – Deep Water	Y	
Station Keeping – Surface	Y	
Station Keeping - Mid Water	Y	
Station Keeping - Deep Water	Y	

See Reference 3.2.3, Section B.3.5 for descriptions of operations

3. General

3.1. Description

A traction winch in the Aft Winch Room serves the aft overboarding system.

3.2. Reference Documents

3.2.1. 46 CFR 189.35 “Wet Weight Handling Gear.”

3.2.2. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS)*, Appendix A: “Rope and Cable Safe Working Load Standards,” March 2009.

3.2.3. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix B: “Overboard Handling Systems Design Standards Criteria for the Design and Operations of Overboard Handling Systems,” March 2009.

3.2.4. *Traction Winch Type RHMETRW0402B/2UL Dimensional Sketch,* Rapp Hydema, Drawing No. RH310323, Rev. A712, 7 July 2010.

3.2.5. *Traction Winch System TRW-4000B + 2x RWS-2326/ Spooling Device Principal Arrangement*, Rapp Hydema, Drawing No. RH310356, Rev. B, 2 August 2008.

3.2.6. *Overside Equipment Handling Arrangement,* Marinette Marine Corp., Drawing No. 0650-714-01, Rev. B.

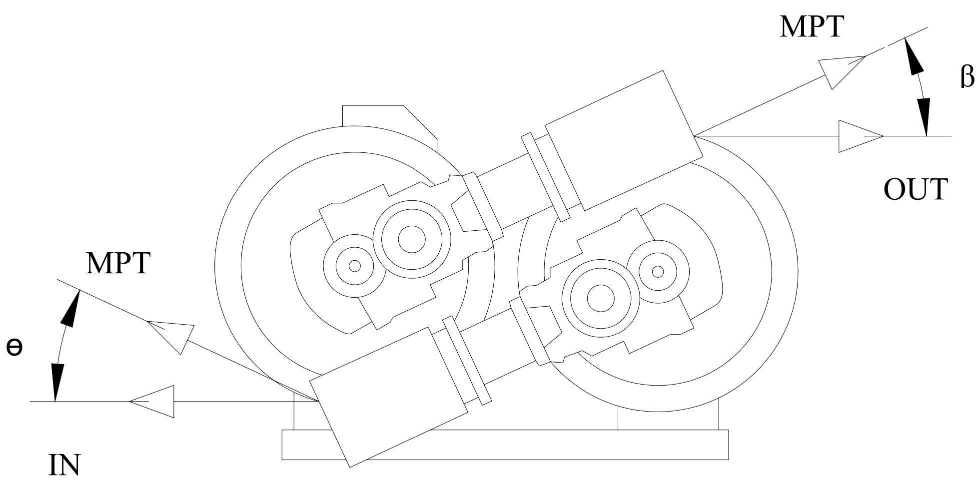
4. Maximum Capabilities

Maximum capabilities meet the following requirements:

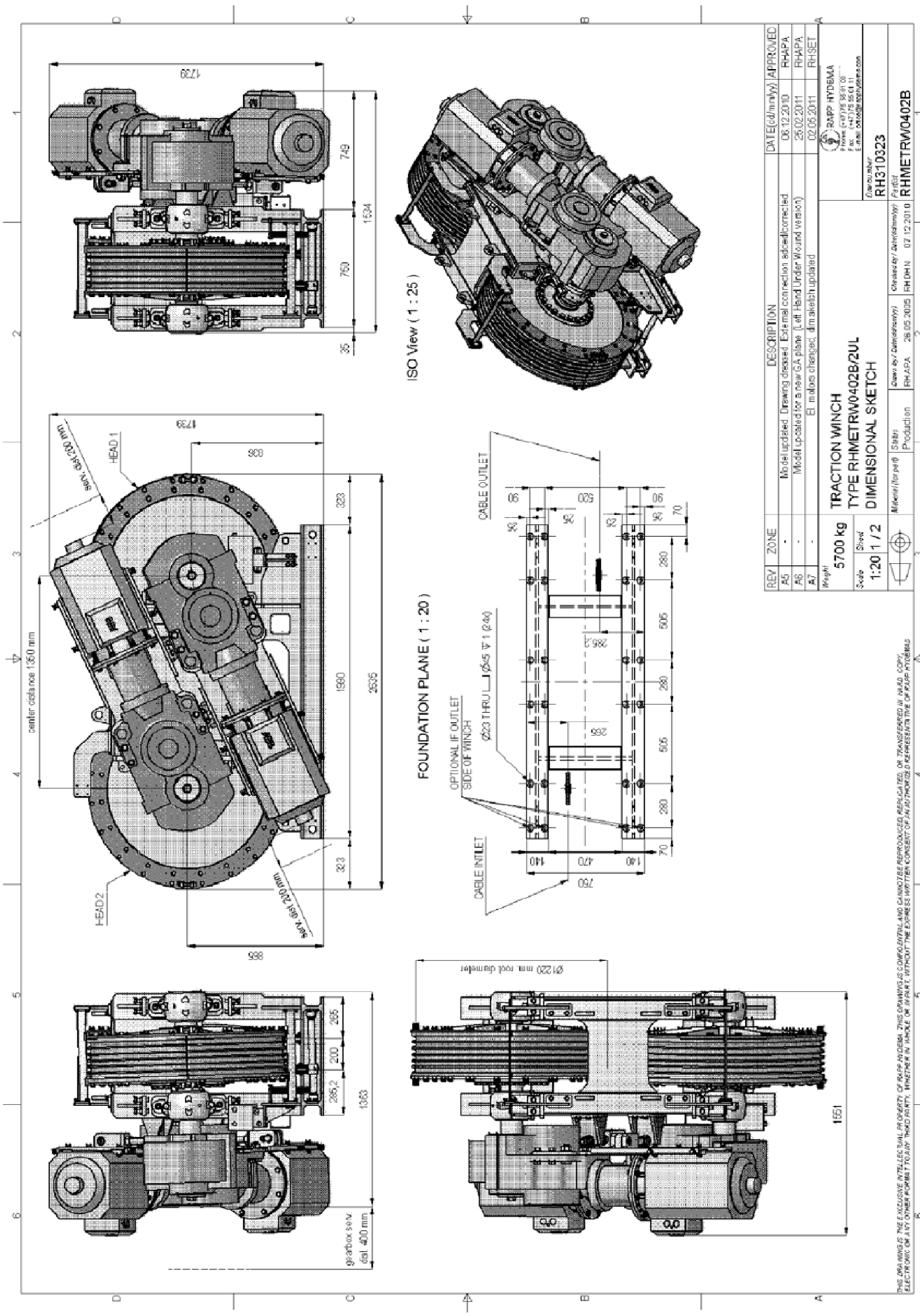
Item	Maximum Capability Value	Criteria Source
Maximum Permissible Tension (MPT)	*{Vendor Supplied}*	Reference 3.2.X
Design Line Tension (DLT)	46,000 lbf	0.680” NBS
Factor of Safety (FS)	*{Vendor Supplied}*	SF to Yield
Wire Groove Size	0.680”	Reference 3.2.X
Lead Angles		
In (ϴ)	*{Vendor Supplied}*	Reference 3.2.X
Out (β)	*{Vendor Supplied}*	Reference 3.2.X
Other		
Sheave speed range	*{Vendor Supplied}*	Reference 3.2.X

5. Operational Figures

5.1. Load Diagram



5.2. Vendor Drawing



Attachment A1

TABLE B.3 — Overboard Handling Data Document

REQUIRED DATA	Operator/Designer Response
Deployment Type	*Towing – all depths* *Station Keeping – all depths*
Provide a brief narrative of scientific purpose and the equipment to be deployed. A drawing or drawings of the proposed "system" or "component" architecture is to be appended showing, for example, wire angles and potential loadings (Principle , Secondary & Worst Case) relative to the Varies system elements. Provide information on the vessel or vessels (size(s), type(s), UNOLS or not, etc) intended for the system deployment, its/their area(s) of operation and the likely weather conditions to be encountered	*Traction Winch*
Provide Primary Deployment Information;	
Package Type	*Varies*
Maximum Package Weight	*Varies*
Base Package Mass	*Varies*
Added Mass to Include Captured and Entrained Added Mass (E.G., Water/Mud)	*Varies*
Maximum Hydrodynamic Resistance	*Varies*
Dynamic Factors	*Varies*
Rope or Cable Type and Breaking Load	*Maximum 46,000 lbf - 0.680" EM Cable*
Maximum Wire Weight (In Water)	*Varies*
Maximum Wire Mass	*Varies*
Selected Rope or Cable Factor of Safety Per Appendix A	
Maximum Anticipated Depth of Deployment	*Varies*
Maximum Allowable Depths of Water	*Varies*
Deployment/Water Depth Ratio	*Varies*
Principle Loading	*MAOT, Direct Load into Winch*
Secondary Loading	
Worst Case Loading	*Line Break, Direct Lead into Winch*

Ultimate Design Load	*{Vendor Supplied}*
Load Limiting Equipment	*None*
Maximum Anticipated Operating Tension	*Varies*
Design Line Tension	*46,000 lbf*
Other Emergency Means of Package or Wire Detachment	*None*
Other Means Proposed for Package Control	*Varies*
Description of Fail Safes in the Event of Power Loss or Mechanical/Electrical Failure of System Components	*N/A*

AFT OVERBOARD HANDLING SYSTEM: SLACK WIRE COMPENSATOR

R/V SIKULIAQ

Maximum Capability Document

Manufactured By: Rapp Hydema

Model: SWC-D1220

Reference Drawing Number: RH313902

Prepared By: The Glosten Associates

[Engineer's Name/Stamp]

30 January 2012

1. Abbreviations

MCD	**M**aximum **C**apability **D**ocument
MPT	**M**aximum **P**ermissible **T**ension
NBL	**N**ominal **B**reaking **L**oad
NSF	**N**ational **S**cience **F**oundation
UNOLS	**U**niversity-**N**ational **O**ceanographic **L**aboratory **S**ystem

2. Purpose

This document describes the general arrangement of the slack wire compensator that serves the traction winch onboard the vessel *R/V Sikuliaq.* It establishes the compensator load capacity as a component of the Aft Overboarding System.

This document sets the Maximum Permissible Tension (MPT) as required by the UNOLS RVSS, Appendix B when the sheave is used to support over-the-side operations for science.

The tension member employed in the system is considered a component of the entire handling system and shall be used in accordance with Appendix A. The NBL of the tension member shall be less than the MPT.

2.1. Deployment Types

This Slack Line Tensioner will potentially be used for the following types of deployments:

Operation	Y/N	Notes
Towing - Surface	Y	On Low Tension Side
Towing – Mid Water	Y	On Low Tension Side
Towing – Deep Water	Y	On Low Tension Side
Station Keeping – Surface	Y	On Low Tension Side
Station Keeping - Mid Water	Y	On Low Tension Side
Station Keeping - Deep Water	Y	On Low Tension Side

See Reference 3.2.3, Section B.3.5 for descriptions of operations

3. General

3.1. Description

A slack wire compensator in the Aft Winch Room serves the traction winch system components of the aft overboarding system. The compensator minimizes line tension spikes due to slack wire snapping from vessel motion or package dynamics.

3.2. Reference Documents

3.2.1. 46 CFR 189.35 "Wet Weight Handling Gear."

3.2.2. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix A: “Rope and Cable Safe Working Load Standards,” March 2009.

3.2.3. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix B: “Overboard Handling Systems Design Standards Criteria for the Design and Operations of Overboard Handling Systems,” March 2009.

3.2.4. *Deck Sheave DS-D1220 Dimensional Sketch*, Rapp Hydema, Drawing No. RH313983, Rev. A, 20 August 2010.

3.2.5. *Slack Wire Compensator SWC-D1220 Dimensional Sketch*, Rapp Hydema, Drawing No. RH313902, Rev. A3, 23 December 2010.

3.2.6. *Overside Equipment Handling Arrangement,* Marinette Marine Corp., Drawing No. 0650-714-01, Rev. B.

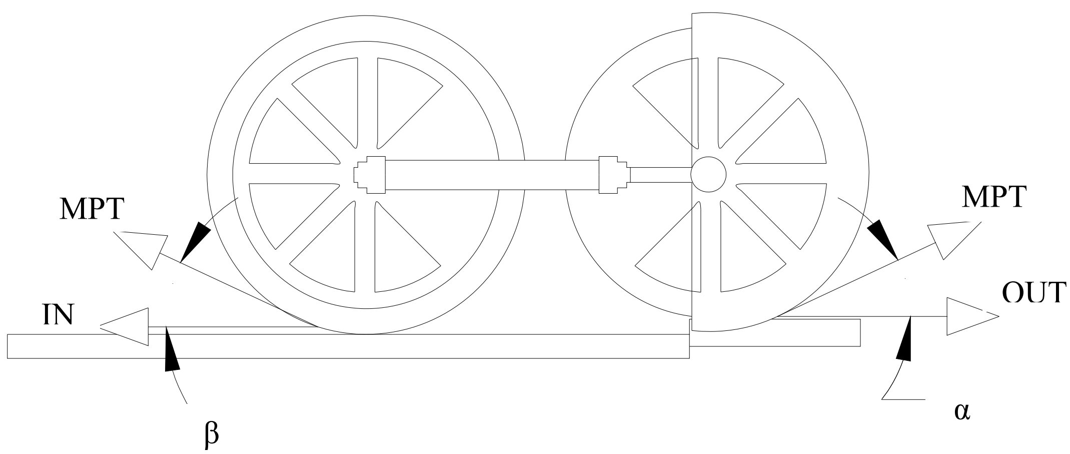
4. Maximum Capabilities

Maximum capabilities meet the following requirements:

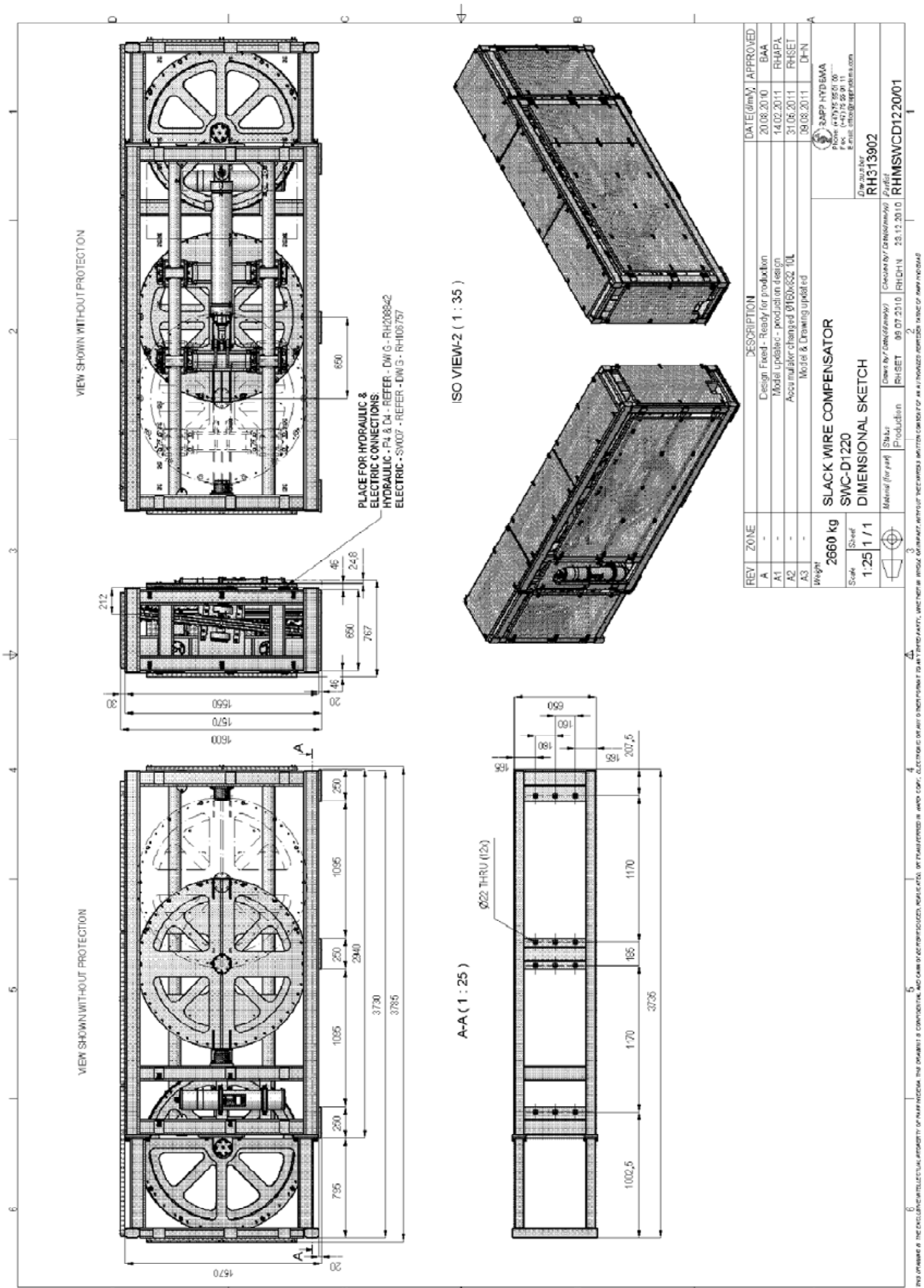
Design Requirement	Maximum Capability Value	Criteria Source
Maximum Permissible Tension	*{Vendor Supplied}*	Reference 3.2.X
Design Line Tension (DLT)	46,000 lbf	0.680" NBS
Factor of Safety (FS)	*{Vendor Supplied}*	SF to Yield
Wire Groove Size	0.680"	Reference 3.2.X
Lead Angles		
θ	*{Vendor Supplied}*	Reference 3.2.X
β	*{Vendor Supplied}*	Reference 3.2.X
Other		
Sheave speed range	*{Vendor Supplied}*	Spec min is 60 m/min

5. Operational Figures

5.1. Load Diagram



5.2. Vendor Drawing



Attachment A1

TABLE B.3 — Overboard Handling Data Document

REQUIRED DATA	**Operator/Designer Response**
Deployment Type	*Towing – all depths* *Station Keeping – all depths*
Provide a brief narrative of scientific purpose and the equipment to be deployed. A drawing or drawings of the proposed "system" or "component" architecture is to be appended showing, for example, wire angles and potential loadings (Principle , Secondary & Worst Case) relative to the Varies system elements. Provide information on the vessel or vessels (size(s), type(s), UNOLS or not, etc) intended for the system deployment, its/their area(s) of operation and the likely weather conditions to be encountered	*Slack-wire compensator that serves the traction winch*
Provide Primary Deployment Information;	
Package Type	*Varies*
Maximum Package Weight	*Varies*
Base Package Mass	*Varies*
Added Mass to Include Captured and Entrained Added Mass (E.G., Water/Mud)	*Varies*
Maximum Hydrodynamic Resistance	*Varies*
Dynamic Factors	*Varies*
Rope or Cable Type and Breaking Load	*Maximum 46,000 lbf - 0.680" EM Cable*
Maximum Wire Weight (In Water)	*Varies*
Maximum Wire Mass	*Varies*
Selected Rope or Cable Factor of Safety Per Appendix A	
Maximum Anticipated Depth of Deployment	*Varies*
Maximum Allowable Depths of Water	*Varies*
Deployment/Water Depth Ratio	*Varies*
Principle Loading	*Direct Lead, 180°, MAOT*
Secondary Loading	
Worst Case Loading	*Direct Load, Line Break, 180° wrap*

Ultimate Design Load	*{Determined byVendor}*
Load Limiting Equipment	*Traction Winch*
Maximum Anticipated Operating Tension	*Varies*
Design Line Tension	*46,000 lbf*
Other Emergency Means of Package or Wire Detachment	*None*
Other Means Proposed for Package Control	*Varies*
Description of Fail Safes in the Event of Power Loss or Mechanical/Electrical Failure of System Components	*N/A*

AFT OVERBOARD HANDLING SYSTEM: FLAGGING EXIT SHEAVE

R/V SIKULIAQ

Maximum Capability Document

Manufactured By: Rapp Hydema

Model: XXXX

Reference Drawing Number: XXXX

Prepared By: The Glosten Associates

[Engineer's Name/Stamp]

30 January 2012

1. Abbreviations

MCD	**M**aximum **C**apability **D**ocument
MPT	**M**aximum **P**ermissible **T**ension
NBL	**N**ominal **B**reaking **L**oad
NSF	**N**ational **S**cience **F**oundation
UNOLS	**U**niversity-**N**ational **O**ceanographic **L**aboratory **S**ystem

2. Purpose

This document describes the general arrangement of the Aft Winch Room exit sheave onboard the vessel *R/V Sikuliaq*. It establishes the sheave load capacity as a component of the Aft Overboarding System.

This document sets the Maximum Permissible Tension (MPT) as required by the UNOLS RVSS, Appendix B when the sheave is used to support over-the-side operations for science.

The tension member employed in the system is considered a component of the entire handling system and shall be used in accordance with Appendix A. The NBL of the tension member shall be less than the MPT.

2.1. Deployment Types

This Exit Sheave will potentially be used for the following types of deployments:

Operation	Y/N	Notes
Towing - Surface	Y	
Towing – Mid Water	Y	
Towing – Deep Water	Y	
Station Keeping – Surface	Y	
Station Keeping - Mid Water	Y	
Station Keeping - Deep Water	Y	

See Reference 3.2.3, Section B.3.5 for descriptions of operations

3. General

3.1. Description

A 48" flag block is attached to the 02 Level above the aft working deck (Figure 1). The block routes wire from the aft winch room to the stern A-frame and is a primary component of the aft overboarding system. The sheave is groved for 0.680” and 9/16” trawl wire.

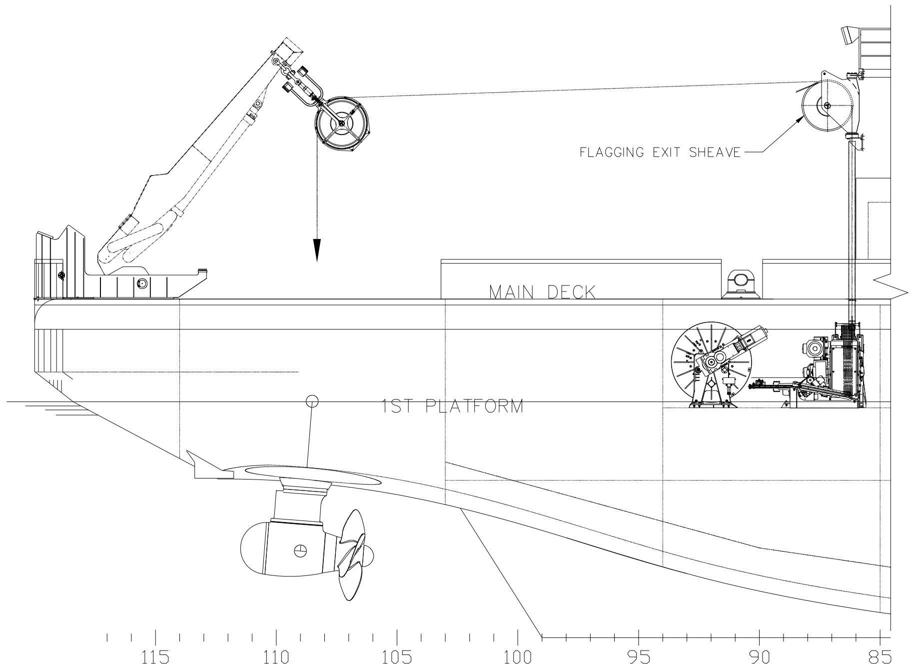


Figure 1 Location of the Flagging Exit Sheave

3.2. Reference Documents

3.2.1. 46 CFR 189.35 “Wet Weight Handling Gear.”

3.2.2. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix A: “Rope and Cable Safe Working Load Standards,” March 2009.

3.2.3. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix B: “Overboard Handling Systems Design Standards Criteria for the Design and Operations of Overboard Handling Systems,” March 2009.

3.2.4. *Deck Sheave DS-D1220 Dimensional Sketch*, Rapp Hydema, Drawing No. RH313983, Rev. A, 20 August 2010.

3.2.5. *Overside Equipment Handling Arrangement,* Marinette Marine Corp., Drawing No. 0650-714-01, Rev. B.

3.2.6. Aft Overboarding MCD.

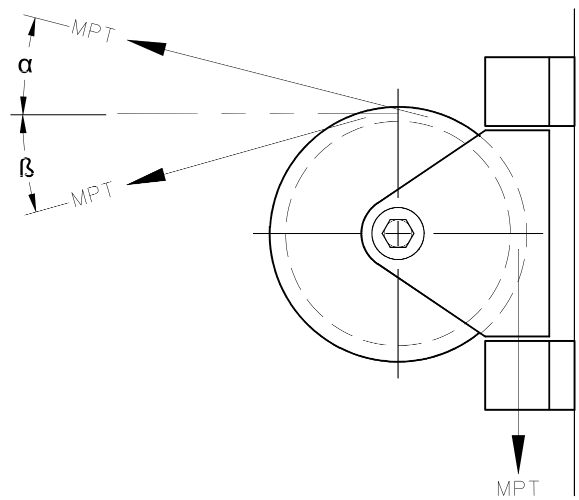
4. Maximum Capabilities

Maximum capabilities meet the following requirements:

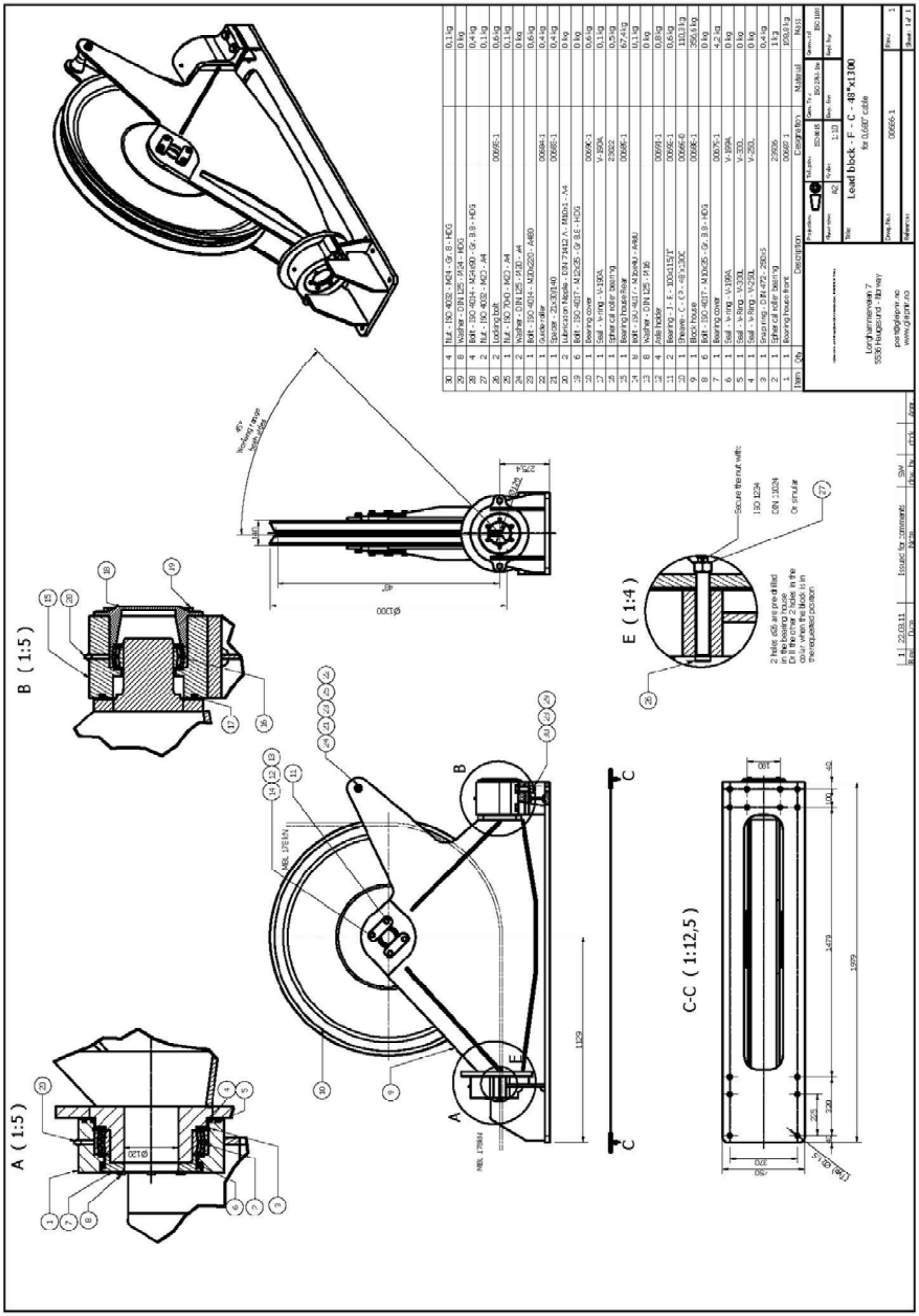
Item	Maximum Capability Value	Criteria Source
Maximum Permissible Tension	{Vendor Supplied}	Reference 3.2.X
Design Line Tension (DLT)	46,000 lbf	0.680” NBS
Factor of Safety (FS)	{Vendor Supplied}	SF to Yield
Wire Groove Size	0.680”	Reference 3.2.X
Lead Angles		
α	{Vendor Supplied}	Reference 3.2.X
β	{Vendor Supplied}	Reference 3.2.X
Other		
Sheave speed range	{Vendor Supplied}	Reference 3.2.X

5. Operational Figures

5.1. Load Diagram



5.2. Vendor Drawing



Attachment A1

TABLE B.3 — Overboard Handling Data Document

REQUIRED DATA	**Operator/Designer Response**
Deployment Type	*Towing – all depths* *Station Keeping – all depths*
Provide a brief narrative of scientific purpose and the equipment to be deployed. A drawing or drawings of the proposed “system” or “component” architecture is to be appended showing, for example, wire angles and potential loadings (Principle , Secondary & Worst Case) relative to the Varies system elements. Provide information on the vessel or vessels (size(s), type(s), UNOLS or not, etc) intended for the system deployment, its/their area(s) of operation and the likely weather conditions to be encountered	*Flagging exit sheave.*
Provide Primary Deployment Information;	
Package Type	*Varies*
Maximum Package Weight	*Varies*
Base Package Mass	*Varies*
Added Mass to Include Captured and Entrained Added Mass (E.G., Water/Mud)	*Varies*
Maximum Hydrodynamic Resistance	*Varies*
Dynamic Factors	*Varies*
Rope or Cable Type and Breaking Load	*Maximum 46,000 lbf - 0.680” EM Cable*
Maximum Wire Weight (In Water)	*Varies*
Maximum Wire Mass	*Varies*
Selected Rope or Cable Factor of Safety Per Appendix A	
Maximum Anticipated Depth of Deployment	*Varies*
Maximum Allowable Depths of Water	*Varies*
Deployment/Water Depth Ratio	*Varies*
Principle Loading	*MAOT, 90° wrap*
Secondary Loading	
Worst Case Loading	*Line Break, 110 deg wrap*
Ultimate Design Load	*{Vendor Supplied}*

Load Limiting Equipment	*None*
Maximum Anticipated Operating Tension	*Varies*
Design Line Tension	*46,000 lbf*
Other Emergency Means of Package or Wire Detachment	*None*
Other Means Proposed for Package Control	*Varies*
Description of Fail Safes in the Event of Power Loss or Mechanical/Electrical Failure of System Components	*N/A*

AFT OVERBOARD HANDLING SYSTEM: 28 INCH HANGING BLOCK

R/V SIKULIAQ

Maximum Capability Document

Manufactured By: Gleipnir

Model: Snatch Block –C-CP-28"-31,5"

Reference Drawing Number: T248-1000

Prepared By: The Glosten Associates

[Engineer's Name/Stamp]

30 January 2012

1. Abbreviations

MCD	**M**aximum **C**apability **D**ocument
MPT	**M**aximum **P**ermissible **T**ension
NBL	**N**ominal **B**reaking **L**oad
NSF	**N**ational **S**cience **F**oundation
UNOLS	**U**niversity-**N**ational **O**ceanographic **L**aboratory **S**ystem

2. Purpose

This document describes the general arrangement of the stern A-frame hanging block onboard the vessel *R/V Sikuliaq*. It establishes the load capacity of the block as a component of the Aft Overboarding System.

This document sets the Maximum Permissible Tension (MPT) as required by the UNOLS RVSS, Appendix B when the block is used to support over-the-side operations for science.

The tension member employed in the system is considered a component of the entire handling system and shall be used in accordance with Appendix A. The NBL of the tension member shall be less than the MPT.

2.1. Deployment Types

This Hanging Block will potentially be used for the following types of deployments:

Operation	Y/N	Notes
Towing - Surface	Y	
Towing – Mid Water	Y	
Towing – Deep Water	Y	
Station Keeping – Surface	Y	
Station Keeping - Mid Water	Y	
Station Keeping - Deep Water	Y	

See Reference 3.2.3, Section B.3.5 for descriptions of operations

3. General

3.1. Description

A 28 inch snatch block hangs by a shackle from the stern A-frame and is a primary component of the aft overboarding system.

3.2. Reference Documents

3.2.1. 46 CFR 189.35 "Wet Weight Handling Gear."

3.2.2. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS)*, Appendix A: "Rope and Cable Safe Working Load Standards," March 2009.

3.2.3. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix B: "Overboard Handling Systems Design Standards Criteria for the Design and Operations of Overboard Handling Systems," March 2009.

3.2.4. *Snatch block–C-CP-28"-31,5"*, Gleipnir, Drawing No. T248-1000, Rev. 1, 2011.

3.2.5. *Overside Equipment Handling Arrangement,* Marinette Marine Corp., Drawing No. 0650-714-01, Rev. B.

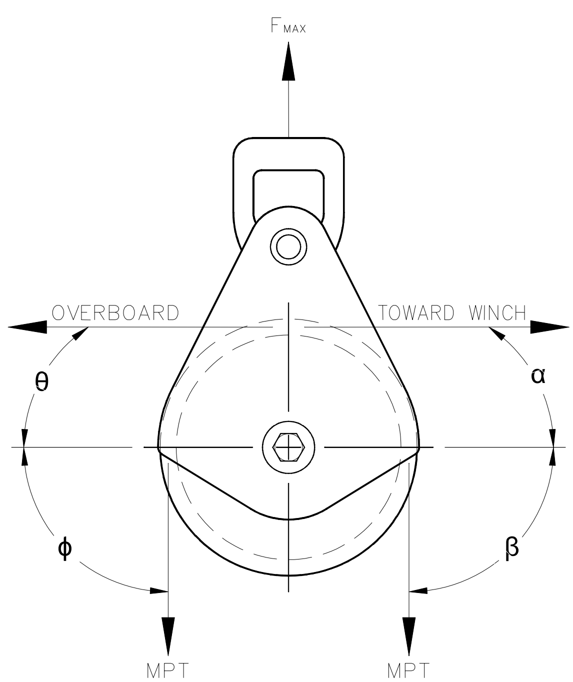
4. Operational Requirements

Maximum capabilities must meet the following requirements:

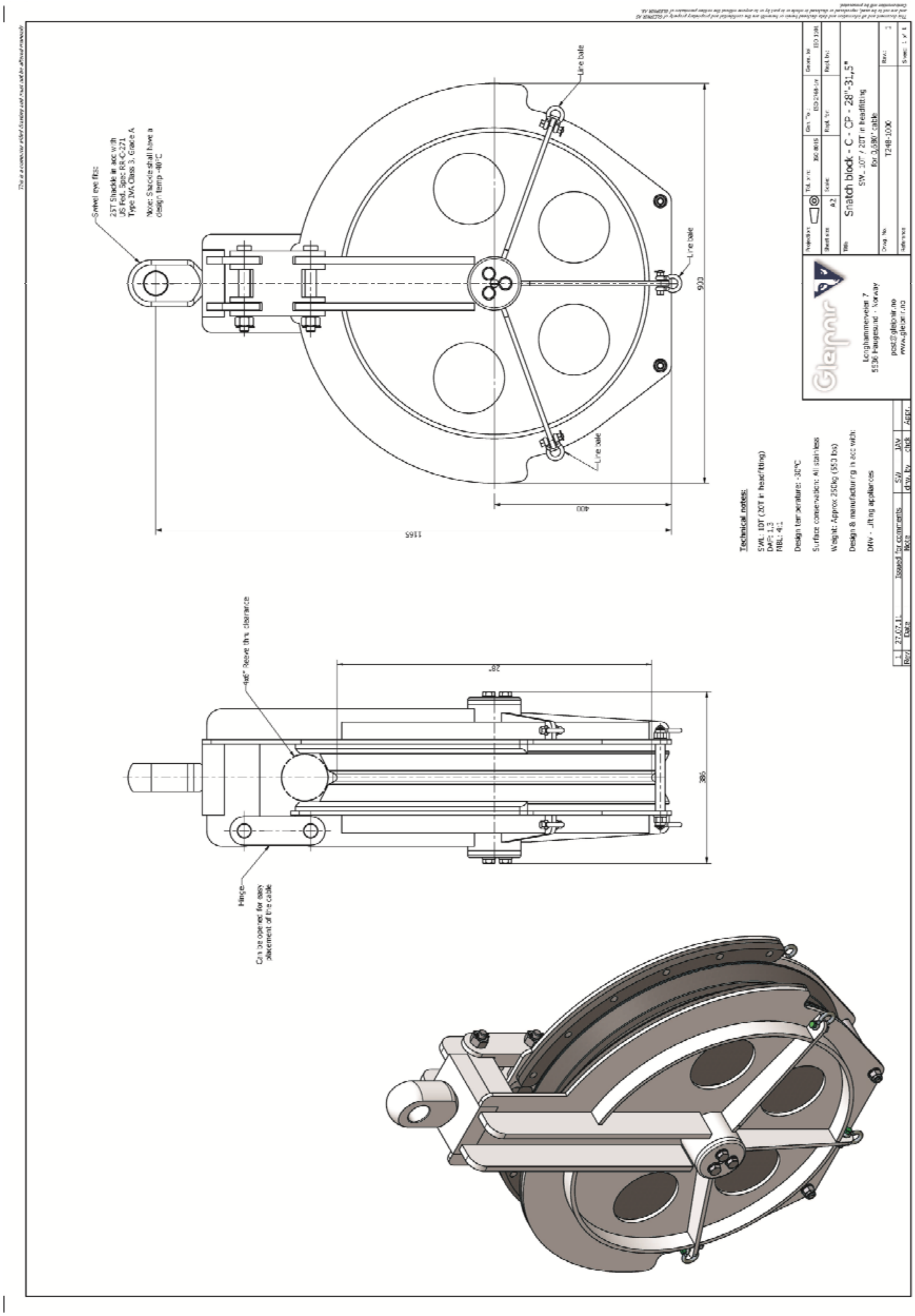
Item	Maximum Capability Value	Criteria Source
Maximum Permissible Tension (MPT)	22,040 lbf	Reference 3.2.4
Design Line Tension (DLT)	46,000 lbf	0.680” NBS
Factor of Safety (FS)	*{Vendor Supplied}*	SF to Yield
Wire Groove Size	0.680”	Reference 3.2.4
Wrap Angles (α)		
Minimum	10°	Reference 3.2.4
Maximum	180°	Reference 3.2.4
Other		
Sheave Speed Range	*{Vendor Supplied}*	Spec min is 60 m/min

5. Operational Figures

5.1. Load Diagram



5.2. Vendor Diagram



Attachment A1

TABLE B.3 — Overboard Handling Data Document

REQUIRED DATA	**Operator/Designer Response**
Deployment Type	*Towing – all depths* *Station Keeping – all depths*
Provide a brief narrative of scientific purpose and the equipment to be deployed. A drawing or drawings of the proposed "system" or "component" architecture is to be appended showing, for example, wire angles and potential loadings (Principle , Secondary & Worst Case) relative to the Varies system elements. Provide information on the vessel or vessels (size(s), type(s), UNOLS or not, etc) intended for the system deployment, its/their area(s) of operation and the likely weather conditions to be encountered	*28" hanging block serving the A-frame.*
Provide Primary Deployment Information;	
Package Type	*Varies*
Maximum Package Weight	*Varies*
Base Package Mass	*Varies*
Added Mass to Include Captured and Entrained Added Mass (E.G., Water/Mud)	*Varies*
Maximum Hydrodynamic Resistance	*Varies*
Dynamic Factors	*Varies*
Rope or Cable Type and Breaking Load	*Maximum 46,000 lbf - 0.680" EM Cable*
Maximum Wire Weight (In Water)	*Varies*
Maximum Wire Mass	*Varies*
Selected Rope or Cable Factor of Safety Per Appendix A	
Maximum Anticipated Depth of Deployment	*Varies*
Maximum Allowable Depths of Water	*Varies*
Deployment/Water Depth Ratio	*Varies*
Principle Loading	*MAOT, Approximated 90° wrap*
Secondary Loading	
Worst Case Loading	*Line Break, 180° wrap*

Ultimate Design Load	*{Vendor Supplied}*
Load Limiting Equipment	*None*
Maximum Anticipated Operating Tension	*Varies*
Design Line Tension	*46,000 lbf*
Other Emergency Means of Package or Wire Detachment	*None*
Other Means Proposed for Package Control	*Varies*
Description of Fail Safes in the Event of Power Loss or Mechanical/Electrical Failure of System Components	*N/A*

AFT OVERBOARD HANDLING SYSTEM: 48 INCH HANGING BLOCK

R/V SIKULIAQ

Maximum Capability Document

Manufactured By: Gleipnir

Model: Snatch Block–C-CP-48"/1300/140

Reference Drawing Number: 00696

Prepared By: The Glosten Associates

[Engineer's Name/Stamp]

26 January 2012

1. Abbreviations

DLT	**D**esign **L**ine **T**ension
MCD	**M**aximum **C**apability **D**ocument
MPT	**M**aximum **P**ermissible **T**ension
NBL	**N**ominal **B**reaking **L**oad
NSF	**N**ational **S**cience **F**oundation
UNOLS	**U**niversity-**N**ational **O**ceanographic **L**aboratory **S**ystem

2. Purpose

This document describes the general arrangement of the stern A-frame hanging block onboard the vessel *R/V Sikuliaq*. It establishes the load capacity of the block as a component of the Aft Overboarding System.

This document sets the Maximum Permissible Tension (MPT) as required by the UNOLS RVSS, Appendix B, when the block is used to support over-the-side operations for science.

The tension member employed in the system is considered a component of the entire handling system and shall be used in accordance with Appendix A. The NBL of the tension member shall be less than the MPT.

Associated MCDs for this component are:

a. Stern A-Frame
b. A-Frame Padeyes
c. Hanging Block Shackle

2.1. Deployment Types

This block will potentially be used for the following types of deployments:

Operation	**Y/N**	**Notes**
Towing - Surface	Y	
Towing – Mid Water	Y	
Towing – Deep Water	Y	
Station Keeping – Surface	Y	
Station Keeping - Mid Water	Y	
Station Keeping - Deep Water	Y	

See Reference 3.2.3, Section B.3.5 for descriptions of operations

3. General

3.1. Description

A 48 inch block hangs by a shackle from the stern A-frame and is a primary component of the aft overboarding system. It is grooved for 0.680” diameter cable.

3.2. Reference Documents

3.2.1. 46 CFR 189.35 "Wet Weight Handling Gear."

3.2.2. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix A: "Rope and Cable Safe Working Load Standards," March 2009.

3.2.3. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix B: "Overboard Handling Systems Design Standards Criteria for the Design and Operations of Overboard Handling Systems," March 2009.

3.2.4. *Snatch Block–C-CP-48"/1300/140*, Gleipnir, Drawing No. 00696.

3.2.5. *Overside Equipment Handling Arrangement,* Marinette Marine Corp., Drawing No. 0650-714-01, Rev. B.

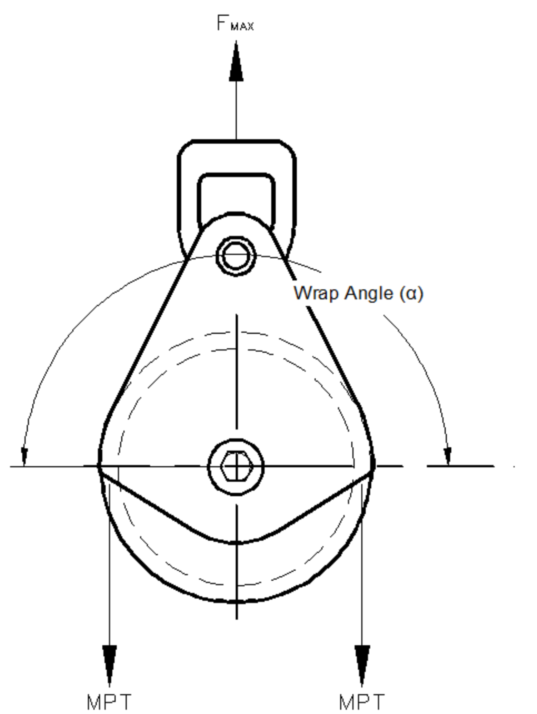
4. Maximum Capabilities

Maximum capabilities meet the following requirements:

Item	Maximum Capability Value	Criteria Source
Maximum Permissible Tension (MPT)	22,050 lbf	Reference 3.2.4
Design Line Tension (DLT)	46,000 lbf	0.680" NBS
Factor of Safety (FS)	*{Vendor Supplied}*	SF to Yield
Wire Groove Size	0.680"	Reference 3.2.4
Wrap Angles (α)		
Minimum	10˚	
Maximum	180˚	Reference 3.2.4
Other		
Fmax	55,115 lbf	Reference 3.2.4
Sheave speed range	*{Vendor Supplied}*	Spec min is 60 m/min

5. Operational Figures

5.1. Load Geometry



5.2. Vendor Drawing

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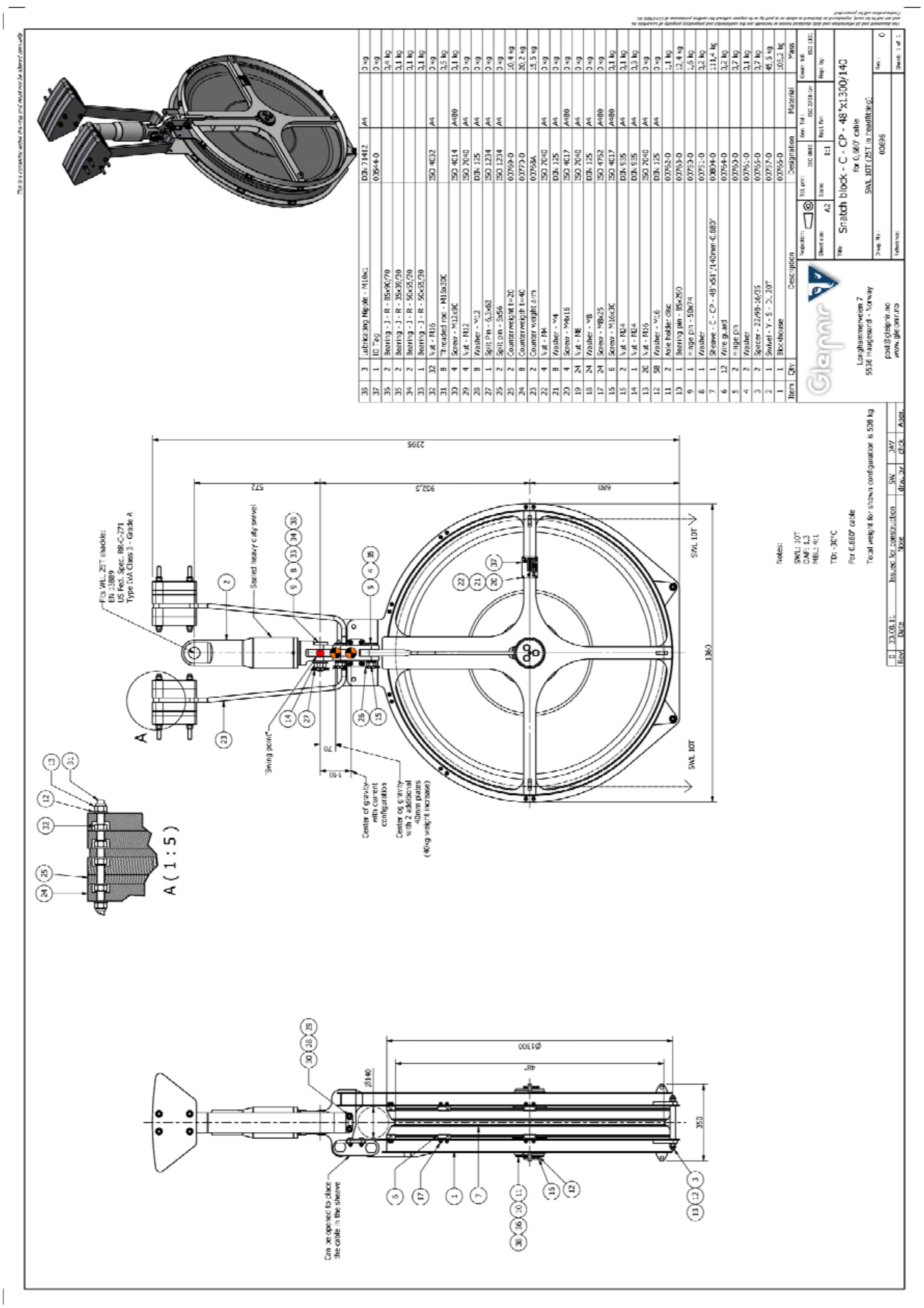


Attachment A1

TABLE B.3 — Overboard Handling Data Document

REQUIRED DATA	**Operator/Designer Response**
Deployment Type	*Towing – all depths* *Station Keeping – all depths*
Provide a brief narrative of scientific purpose and the equipment to be deployed. A drawing or drawings of the proposed "system" or "component" architecture is to be appended showing, for example, wire angles and potential loadings (Principle , Secondary & Worst Case) relative to the Varies system elements. Provide information on the vessel or vessels (size(s), type(s), UNOLS or not, etc) intended for the system deployment, its/their area(s) of operation and the likely weather conditions to be encountered	*48" Dia. Overboarding sheave intended for general purpose use. Sheave will be positioned in the center portion of the A-frame.* *Sheave will be used with on-board fixed winches as well as portable winches.*
Provide Primary Deployment Information;	
Package Type	*Varies*
Maximum Package Weight	*Varies*
Base Package Mass	*Varies*
Added Mass to Include Captured and Entrained Added Mass (E.G., Water/Mud)	*Varies*
Maximum Hydrodynamic Resistance	*Varies*
Dynamic Factors	*Varies*
Rope or Cable Type and Breaking Load	*Maximum 46,000 lbf - 0.680" EM Cable*
Maximum Wire Weight (In Water)	*Varies*
Maximum Wire Mass	*Varies*
Selected Rope or Cable Factor of Safety Per Appendix A	
Maximum Anticipated Depth of Deployment	*Varies*
Maximum Allowable Depths of Water	*Varies*
Deployment/Water Depth Ratio	*Varies*
Principle Loading	
Secondary Loading	
Worst Case Loading	*Line Break, 180° wrap*

Ultimate Design Load	*{Determined byVendor}*
Load Limiting Equipment	*None*
Maximum Anticipated Operating Tension	*Varies*
Design Line Tension	*46,000 lbf*
Other Emergency Means of Package or Wire Detachment	*None*
Other Means Proposed for Package Control	*Varies*
Description of Fail Safes in the Event of Power Loss or Mechanical/Electrical Failure of System Components	*N/A*

AFT OVERBOARD HANDLING SYSTEM: HANGING BLOCK SHACKLE

R/V SIKULIAQ

Maximum Capability Document

Manufactured By: Crosby

Model: G-2130CT, 1-3/4"

Reference Drawing: Attached

Prepared By: The Glosten Associates

[Engineer's Name/Stamp]

30 January 2012

1. Abbreviations

MCD	**M**aximum **C**apability **D**ocument
MPT	**M**aximum **P**ermissible **T**ension
NBL	**N**ominal **B**reaking **L**oad
NSF	**N**ational **S**cience **F**oundation
UNOLS	**U**niversity-**N**ational **O**ceanographic **L**aboratory **S**ystem

2. Purpose

This document describes the shackle used to hang blocks from the stern A-frame onboard the vessel *R/V Sikuliaq* and it establishes the load capacity of the shackle as a component of the Aft Overboarding System.

This document sets the Maximum Permissible Tension (MPT) as required by the UNOLS RVSS, Appendix B when the block is used to support over-the-side operations for science.

The tension member employed in the system is considered a component of the entire handling system and shall be used in accordance with Appendix A. The NBL of the tension member shall be less than the MPT.

2.1.Deployment Types

This Shackle will potentially be used for the following types of deployments:

Operation	Y/N	Notes
Towing - Surface	Y	
Towing – Mid Water	Y	
Towing – Deep Water	Y	
Station Keeping – Surface	Y	
Station Keeping - Mid Water	Y	
Station Keeping - Deep Water	Y	

See Reference 3.2.3, Section B.3.5 for descriptions of operations

3. General

3.1. Description

A 1-3/4", 25 t working load limit, cold rated shackle is used to support the hanging blocks on the stern A-frame.

3.2. Reference Documents

3.2.1. 46 CFR 189.35 “Wet Weight Handling Gear”.

3.2.2. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix A: “Rope and Cable Safe Working Load Standards,” March 2009.

3.2.3. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix B: “Overboard Handling Systems Design Standards Criteria for the Design and Operations of Overboard Handling Systems,” March 2009.

3.2.4. Cutsheet, Cold Tuff® Shackles, Model No. G-2130 CT, The Crosby Group, 2011.

3.2.5. *Overside Equipment Handling Arrangement,* Marinette Marine Corp., Drawing No. 0650-714-01, Rev. B.

3.2.6. *Aft Overboarding System: 28 inch Hanging Block, R/V SIKULIAQ,* Maximum Capability Document. The Glosten Associates, Inc. 07096, 30 Jan 2012.

3.2.7. *Aft Overboarding System: 48 inch Hanging Block, R/V SIKULIAQ,* Maximum Capability Document. The Glosten Associates, Inc. 07096, 30 Jan 2012.

4. Operational Requirements

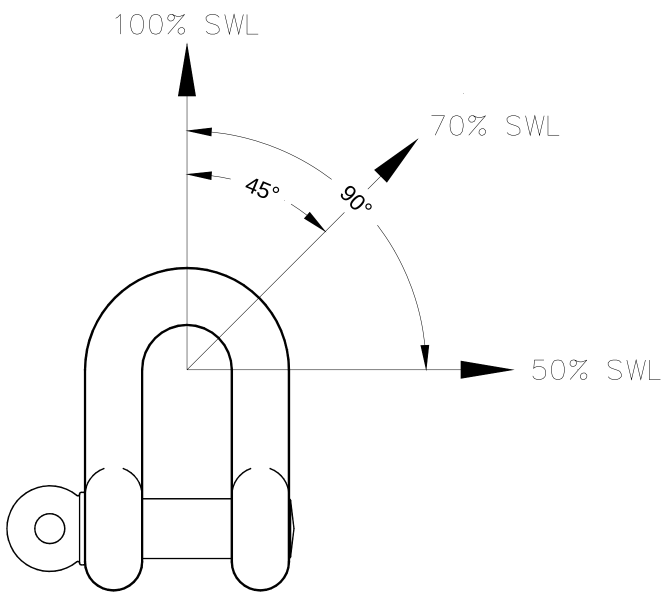
Maximum capabilities meet the following requirements:

Item	Maximum Capability Value*	Criteria Source
Maximum Permissible Tension (MPT)		
0° (In Line)	50,000 lbf	Reference 3.2.4 – WLL
45°	35,000 lbf	Reference 3.2.4, 70% of WLL
90° (Side Load)	25,000 lbf	Reference 3.2.4, 50% of WLL

**Note 1: Maximum Capability value for the shackle is compared to the resultant load (Fmax) of the hanging block MCD (see Ref. 3.2.6 and 3.2.7)*

5. Operational Figures

5.1. Load Diagram

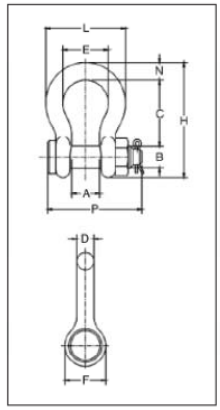


5.2. Vendor Diagram

Crosby® COLD TUFF® Shackles

G-2130CT
and
G-2140CT

- Forged - Quenched and Tempered, with alloy bolt.
  - G-2130CT - Carbon Steel
  - G-2140CT - Alloy Steel
- Working Load Limit permanently shown on every shackle.
- Individually Serialized with Certification.
- Fatigue Rated (G-2130CT only).
- Shackles 25t and larger are **RFID EQUIPPED.**
- All sizes are individually proof tested to 2.0 times the Working Load Limit.
- Finish is Inorganic Zinc Primer or Hot Dipped Galvanized.
- Bow and Bolt are Certified to meet charpy impact testing of 42 joules (31 ft-lbs.) min. ave. at -20 degree C (-4 degree F).
- Individually Mag Inspected with certification.
- Type Approval and certification in accordance with DNV 2.7-1 Offshore Containers, and Rules for Certification of Lifting Appliances, and are produced in accordance with DNV MSA requirements, including required documents.
- COLD TUFF® shackles are suitable for use to -50° F.
- Refer to page 147 for COLD TUFF® Master Links and Master Link assemblies.



G-2130CT

- Bolt Type Anchor shackle with thin head bolt - nut with cotter pin. Meets the performance requirements of Federal Specification RR-C-271F Type IVA, Grade A, Class 3, except for those provisions required of the contractor. For additional information, see page 450.

Nominal Shackle Size (in.)	Working Load Limit (t)*	G-2130CT Stock No.	Weight Each (kg)	Dimensions (mm)										Tolerance +/-	
				A	B	C	D	E	F	H	L	N	P	A	C
3/4	4-3/4	1260568	1.23	31.8	22.4	71.5	19.1	51.0	46.0	126	89.0	20.6	108	1.50	6.35
7/8	6-1/2	1260577	1.76	36.6	25.4	84.0	22.4	58.0	53.0	148	102	24.6	120	1.50	6.35
1	8-1/2	1260586	2.57	42.9	28.7	95.5	26.2	68.5	60.5	167	119	26.9	137	1.50	6.35
1-1/8	9-1/2	1260595	3.75	46.0	31.8	108	28.7	74.0	68.5	190	131	31.8	150	1.50	6.35
1-1/4	12	1260604	5.31	51.5	35.1	119	32.8	82.5	76.0	210	146	35.1	168	1.50	6.35
1-3/8	13-1/2	1260613	6.85	57.0	38.1	133	35.1	92.0	84.0	233	162	38.1	183	3.30	6.35
1-1/2	17	1260622	9.43	60.5	41.4	146	39.1	98.5	92.0	254	175	41.1	195	3.30	6.35
1-3/4	25	1260633	15.4	73.0	51.0	178	46.7	127	106	313	225	57.0	233	3.30	6.35

* **NOTE:** Maximum Proof Load is 2.0 times the Working Load Limit.
4-3/4t - 25t, Minimum Ultimate Load is 5.4 times the Working Load Limit.
For Working Load Limit reduction due to side loading applications, see page 80.

Attachment A1

TABLE B.3 — Overboard Handling Data Document

REQUIRED DATA	**Operator/Designer Response**
Deployment Type	*Towing – all depths* *Station Keeping – all depths*
Provide a brief narrative of scientific purpose and the equipment to be deployed. A drawing or drawings of the proposed "system" or "component" architecture is to be appended showing, for example, wire angles and potential loadings (Principle , Secondary & Worst Case) relative to the Varies system elements. Provide information on the vessel or vessels (size(s), type(s), UNOLS or not, etc) intended for the system deployment, its/their area(s) of operation and the likely weather conditions to be encountered	*Shackles used to for hanging blocks on stern a-frame.*
Provide Primary Deployment Information;	
Package Type	*Varies*
Maximum Package Weight	*Varies*
Base Package Mass	*Varies*
Added Mass to Include Captured and Entrained Added Mass (E.G., Water/Mud)	*Varies*
Maximum Hydrodynamic Resistance	*Varies*
Dynamic Factors	*Varies*
Rope or Cable Type and Breaking Load	*Maximum 46,000 lbf - 0.680" EM Cable*
Maximum Wire Weight (In Water)	*Varies*
Maximum Wire Mass	*Varies*
Selected Rope or Cable Factor of Safety Per Appendix A	
Maximum Anticipated Depth of Deployment	*Varies*
Maximum Allowable Depths of Water	*Varies*
Deployment/Water Depth Ratio	*Varies*
Principle Loading	
Secondary Loading	
Worst Case Loading	*Line Break, 180° wrap*

Ultimate Design Load	*80,000 lbf*
Load Limiting Equipment	*None*
Maximum Anticipated Operating Tension	*Varies*
Design Line Tension	*46,000 lbf*
Other Emergency Means of Package or Wire Detachment	*None*
Other Means Proposed for Package Control	*Varies*
Description of Fail Safes in the Event of Power Loss or Mechanical/Electrical Failure of System Components	*N/A*

AFT OVERBOARD HANDLING SYSTEM: A-FRAME PADEYES

R/V SIKULIAQ

Maximum Capability Document

Manufactured By: CS Controls

Model: Reference Drawing:

Prepared By: The Glosten Associates

[Engineer's Name/Stamp]

30 January 2012

1. Abbreviations

MCD	**M**aximum **C**apability **D**ocument
MPT	**M**aximum **P**ermissible **T**ension
NBL	**N**ominal **B**reaking **L**oad
NSF	**N**ational **S**cience **F**oundation
UNOLS	**U**niversity-**N**ational **O**ceanographic **L**aboratory **S**ystem

2. Purpose

This document describes the movable padeyes on the stern A-frame onboard the vessel *R/V Sikuliaq* and it establishes the load capacity of the padeyes as components of the Aft Overboarding System.

This document sets the Maximum Permissible Tension (MPT) as required by the UNOLS RVSS, Appendix B when the padeyes are used to support over-the-stern operations for science.

The tension member employed in the system is considered a component of the entire handling system and shall be used in accordance with Appendix A. The NBL of the tension member shall be less than the MPT.

2.1. Deployment Types

This ~~block~~ padeye will potentially be used for the following types of deployments:

Operation	Y/N	Notes
Towing - Surface	Y	
Towing – Mid Water	Y	
Towing – Deep Water	Y	
Station Keeping – Surface	Y	
Station Keeping - Mid Water	Y	
Station Keeping - Deep Water	Y	

See Reference 3.2.3, Section B.3.5 for descriptions of operations

3. General

3.1. Description

The padeye will be bolted to the A-frame and will support hanging loads on the stern A-frame . A maximum padeye size of ~~1-3/4~~X", ~~25~~ WW t working load limit, cold rated shackle is to be used with the padeye. ~~used to support the primary Hanging Block on the stern A-frame. [describe the padeye, e.g.,what is max shackle size?]~~

3.2. Reference Documents

3.2.1. 46 CFR 189.35 "Wet Weight Handling Gear."

3.2.2. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix A: "Rope and Cable Safe Working Load Standards," March 2009.

3.2.3. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix B: "Overboard Handling Systems Design Standards Criteria for the Design and Operations of Overboard Handling Systems," March 2009.

3.2.4. A-Frame and Padeyes, CS Controls, Drawing No. XXXX.

3.2.5. *Overside Equipment Handling Arrangement,* Marinette Marine Corp., Drawing No. 0650-714-01, Rev. B.

~~3.2.5.~~3.2.6. Aft Overboarding System: 28 inch Hanging Block, R/V SIKULIAQ, Maximum Capability Document.

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Aft

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3.2.7. Overboarding System: 48 inch Hanging Block, R/V SIKULIAQ, Maximum Capability Document.

3.2.8. Aft Overboarding System: Hanging Block Shackel, R/V SIKULIAQ, Maximum Capability Document.

3.2.9. American Institute of Steel Construction, Specification for Structural Steel Buildings.

4. Operational Requirements

Maximum capabilities meet the following requirements:

Item	**Maximum Capability Value**	**Criteria Source**
Maximum Permissible Tension (MPT)		
Resultant Load Angle (β=0°)		
α=0°	MPT = 46,000 lbf F_{max}[1] = 80,000 lbf	Assumes 180° wrap on the hanging block
α=45°	MPT = *{Vendor Supplied}* F_{max} = *{Vendor Supplied}*	Assumes 180° wrap
α=90°	MPT = *{Vendor Supplied}* F_{max} = *{Vendor Supplied}*	Assumes 180° wrap
Resultant Load Angle (β=30°)~~Load Angle (β=30°)~~		
α=0°	MPT = *{Vendor Supplied}* F_{max} = *{Vendor Supplied}*	Assumes 180° wrap on the hanging block
α=45°	MPT = *{Vendor Supplied}* F_{max} = *{Vendor Supplied}*	Assumes 180° wrap
α=90°	MPT = *{Vendor Supplied}* F_{max} = *{Vendor Supplied}*	Assumes 180° wrap
Design Line Tension (DLT)	46,000 lbf	0.680" Wire N.B.S.
Design Force		
Factor of Safety (FS)	*{Vendor Supplied}*	SF to Yield
Other		
Bolts		X" Dia, Grade X
Allowable Tension	XX,XXX lbf	Reference 3.2.9
Allowable Shear	X,XXX lbf	Reference 3.2.9
Maximum Tension (T_{bolt})	*{Vendor Supplied}*	Per bolt
Maximum Shear (V_{bolt})	*{Vendor Supplied}*	Per bolt

Note 1) F_{max} = Resultant Load (= 2 x MPT for a 180° wrap on the hanging block).

~~Maximum Permissible Tension (MPT)~~

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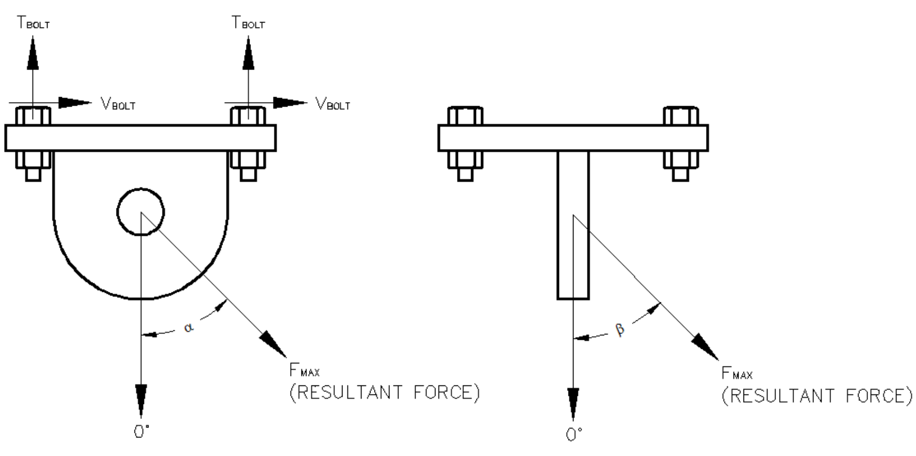
~~4.~~

~~Maximum capabilities meet the following requirements:~~

~~Design Requirement~~	~~Maximum Capability Value~~	~~Criteria Source~~
~~Operating line load for NBL of 1" wire.~~	~~XXX kn~~	~~46 CFR 189: Material stresses at line break are less than 66% of yield.~~
~~Maximum Permissible Tension~~	~~XXX kn~~ ~~Note: See working load of padeye~~	~~=design line load? Add'l S.F?~~

5. Operational Figures

5.1. Load Geometry



~~Drawing of moveable padeye~~

Attachment A1

TABLE B.3 — Overboard Handling Data Document

REQUIRED DATA	**Operator/Designer Response**
Deployment Type	*Towing – all depths* *Station Keeping – all depths*
Provide a brief narrative of scientific purpose and the equipment to be deployed. A drawing or drawings of the proposed "system" or "component" architecture is to be appended showing, for example, wire angles and potential loadings (Principle , Secondary & Worst Case) relative to the Varies system elements. Provide information on the vessel or vessels (size(s), type(s), UNOLS or not, etc) intended for the system deployment, its/their area(s) of operation and the likely weather conditions to be encountered	*Movable padeyes serving the stern A-frame.*
Provide Primary Deployment Information;	
Package Type	*Varies*
Maximum Package Weight	*Varies*
Base Package Mass	*Varies*
Added Mass to Include Captured and Entrained Added Mass (E.G., Water/Mud)	*Varies*
Maximum Hydrodynamic Resistance	*Varies*
Dynamic Factors	*Varies*
Rope or Cable Type and Breaking Load	*Maximum 46,000 lbf - 0.680" EM Cable*
Maximum Wire Weight (In Water)	*Varies*
Maximum Wire Mass	*Varies*
Selected Rope or Cable Factor of Safety Per Appendix A	
Maximum Anticipated Depth of Deployment	*Varies*
Maximum Allowable Depths of Water	*Varies*
Deployment/Water Depth Ratio	*Varies*
Principle Loading	
Secondary Loading	
Worst Case Loading	*Line Break, 180 deg wrap*

Ultimate Design Load	~~*{Determined byVendor}*~~*80,000 lbf*
Load Limiting Equipment	*None*
Maximum Anticipated Operating Tension	*Varies*
Design Line Tension	*46,000 lbf*
Other Emergency Means of Package or Wire Detachment	*None*
Other Means Proposed for Package Control	*Varies*
Description of Fail Safes in the Event of Power Loss or Mechanical/Electrical Failure of System Components	*N/A*

AFT OVERBOARD HANDLING SYSTEM: STERN A-FRAME

R/V SIKULIAQ

Maximum Capability Document

Manufactured By: CS Controls, Inc.

Reference Drawing Number: XXX-XXX

Prepared By: [Company Name]

[Engineer's Name/Stamp]

30 January 2012

1. Abbreviations

MCD	**M**aximum **C**apability **D**ocument
MPT	**M**aximum **P**ermissible **T**ension
NBL	**N**ominal **B**reaking **L**oad
NSF	**N**ational **S**cience **F**oundation
UNOLS	**U**niversity-**N**ational **O**ceanographic **L**aboratory **S**ystem

2. Purpose

This document describes the general arrangement of the Stern A-frame installed onboard the vessel *R/V Sikuliaq* and sets the Maximum Permissible Tensions (MPT) under the various operational loading conditions as required by the UNOLS RVSS, Appendix B. Operational conditions will include various A-frame positions, and load geometries.

This A-frame is intended for "Lifting and Towing, Deep Water" per Section B.3.5 of Appendix B.

The tension member employed over the frame is considered a component of the entire handling system and shall be used in accordance with Appendix A. The NBL of the tension member shall be less than the MPT for the given operation, or the maximum tension otherwise limited, as described below.

Likewise, all shackles, blocks, and science package capture devices attached to the A-frame are considered components and must have their MCD documents provided for full system evaluation.

2.1. Deployment Types

This system will potentially be used for the following types of deployments:

Operation	Y/N	Notes
Towing - Surface	Y	
Towing – Mid Water	Y	
Towing – Deep Water	Y	
Station Keeping – Surface	Y	
Station Keeping - Mid Water	Y	
Station Keeping - Deep Water	Y	

See Reference 3.2.2, Section B.3.5 for descriptions of operations

3. General

3.1. Description

The stern A-frame is a steel constructed articulated framework used to launch, recover, and/or tow a wide variety of science packages from the ship's main deck, over the transom and into the water. Hydraulically powered cylinders provide the actuation for the system. The A-frame is designed to be used with the ship installed winch systems and portable deck winches installed such that the load path of the tension member falls within the angular zones shown on Figures 2 through 12.

The clearances, range of motion, and structural stop positions of the A-frame is shown below in Figure 1. The normal range of motion extends from the inboard stop position #1 to either of the two outboard stop positions, #2 or #3. The A-frame is used for load handling only within the working range. The maintenance position is provided only to allow main deck access to the bolting flange and padeyes.

At the two outboard positions the A-frame can withstand up to 120,000 LBS (60 S.Tons) as illustrated in the diagrams below. The A-frame has a capacity of 30,000 LBS (15 S.Tons) throughout its luffing range. For loads higher than 30,000 LBS the Operator shall position the A-frame at one of the two outboard (position #2 and #3) stop positions for all over the side operations. These stops enable the A-frame structure to take up the load as opposed to the actuating cylinders.

3.2. Reference Documents

3.2.1. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix A: "Rope and Cable Safe Working Load Standards," March 2009.

3.2.2. University National Oceanographic Laboratory System (UNOLS), *UNOLS Research Vessel Safety Standards (RVSS),* Appendix B: "Overboard Handling Systems Design Standards Criteria for the Design and Operations of Overboard Handling Systems," March 2009.

3.2.3. *A-frame General Arrangement*, CS Controls, drawing number xxx.

3.2.4. *Overside Equipment Handling Arrangement,* Marinette Marine Corp., Drawing No. 0650-714-01, Rev. B.

3.2.5. *A-frame Companion Sheave and Shackle Installation Drawing*, ACME Manufacturing, Drawing number xxx.

4. A-Frame Operational Requirements

4.1. For all heavy operations such as towing or coring where the cable tension will approach the MPT of the A-frame, the A-frame must be positioned at one of the two outboard stop positions, bearing against the structural stops.

4.2. When the A-frame is positioned on the stops, the Maximum Permissible Tension is 120,000 LBS 60 S. Tons) as shown in Figures 4 and 5.

4.3. When the A-frame is not positioned in the stops, the Maximum Permissible Line Tension at any time is 30,000 LBS (15 S. Tons).

4.4. If the A-frame is to be used with more than one tension member at one time, the user must consider the resultant loads of the combined NBLs of the wires and ensure that the sum of the NBLs is within the Maximum Allowable Tension of the A-frame in the position of interest.

5. A-Frame Operational Figures

5.1. Note that the MPTs for infeed and outfeed shown in Figures 2 through 5 apply to any position between the frame legs.

5.2. Note that the MPTs for infeed and outfeed shown in Figures 6 through 12 apply to the port and starboard padeyes.

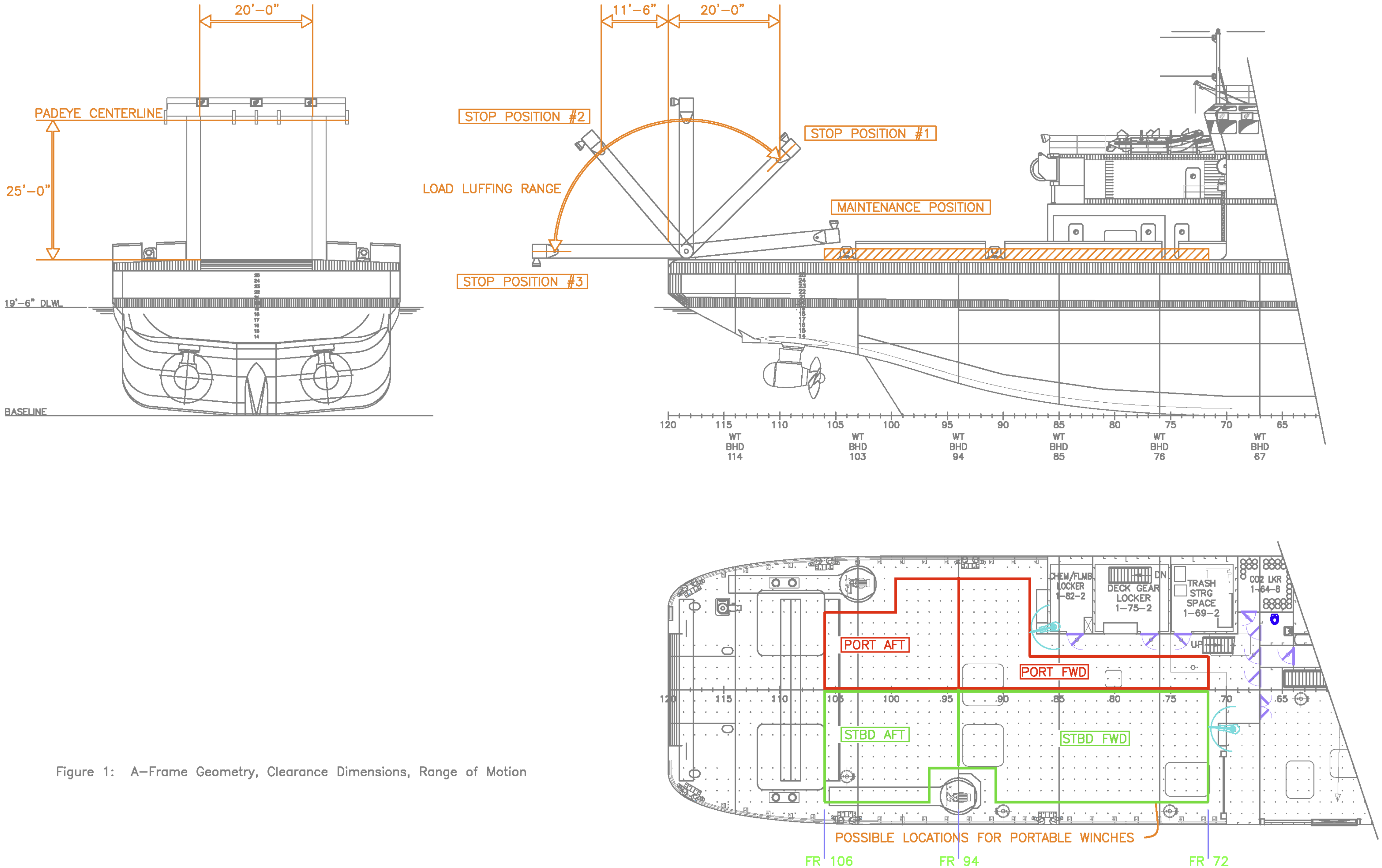
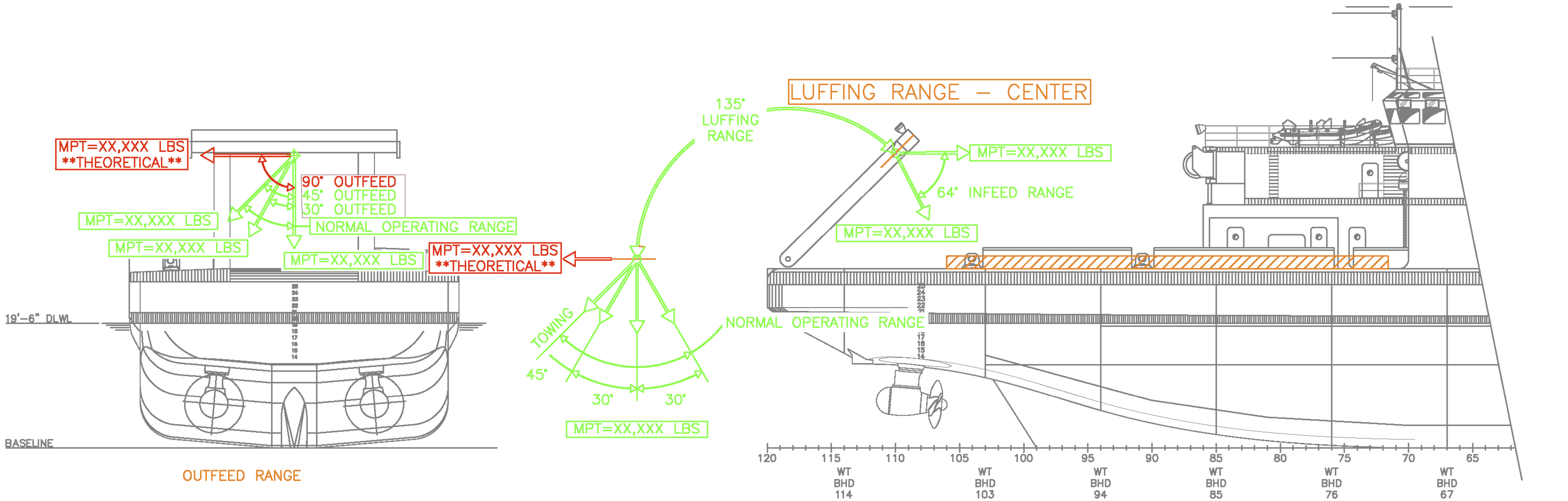


Figure 1: A–Frame Geometry, Clearance Dimensions, Range of Motion



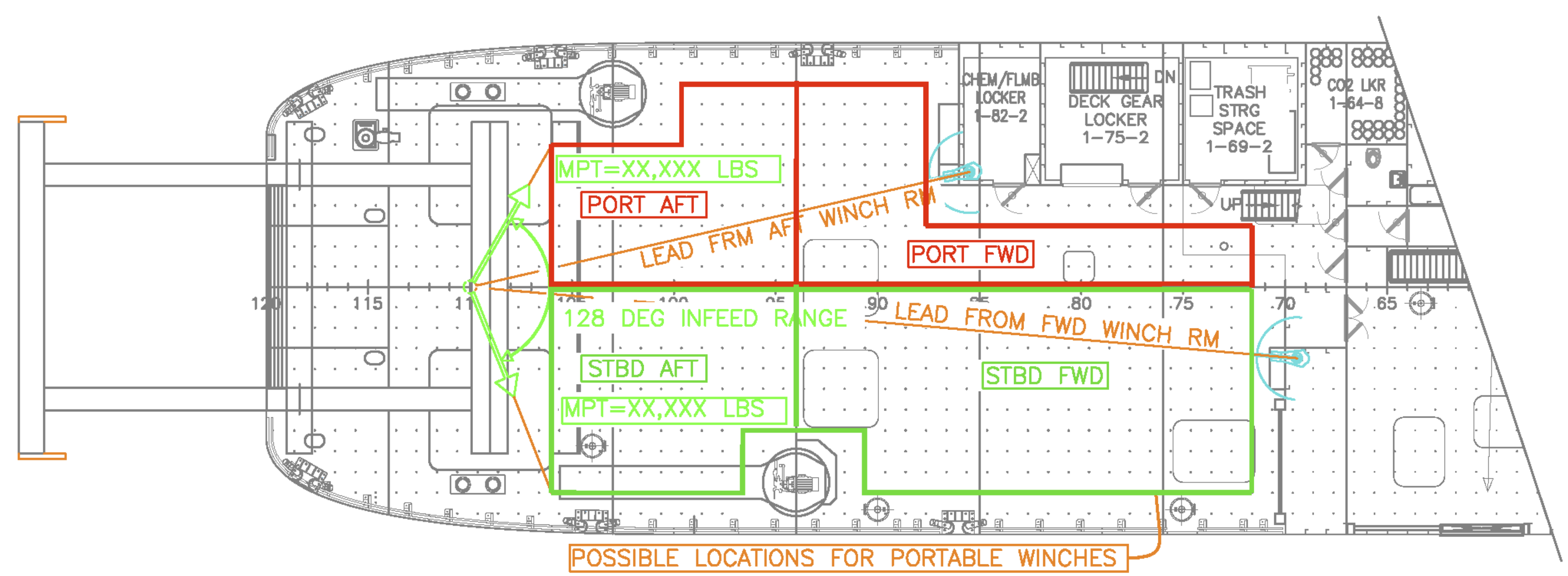
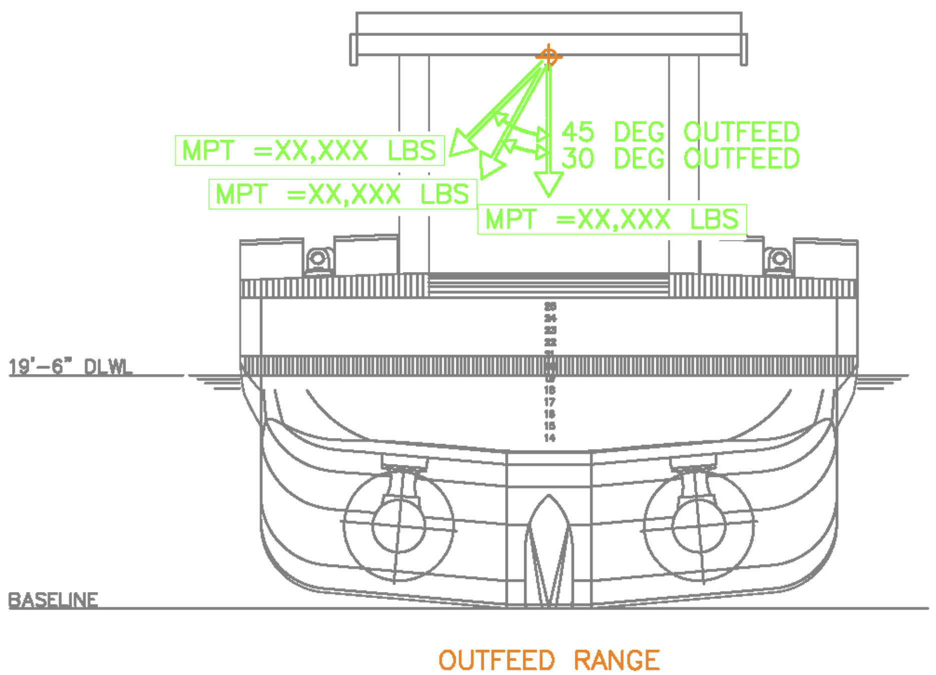


Figure 2: Frame In Luffing Position, Center



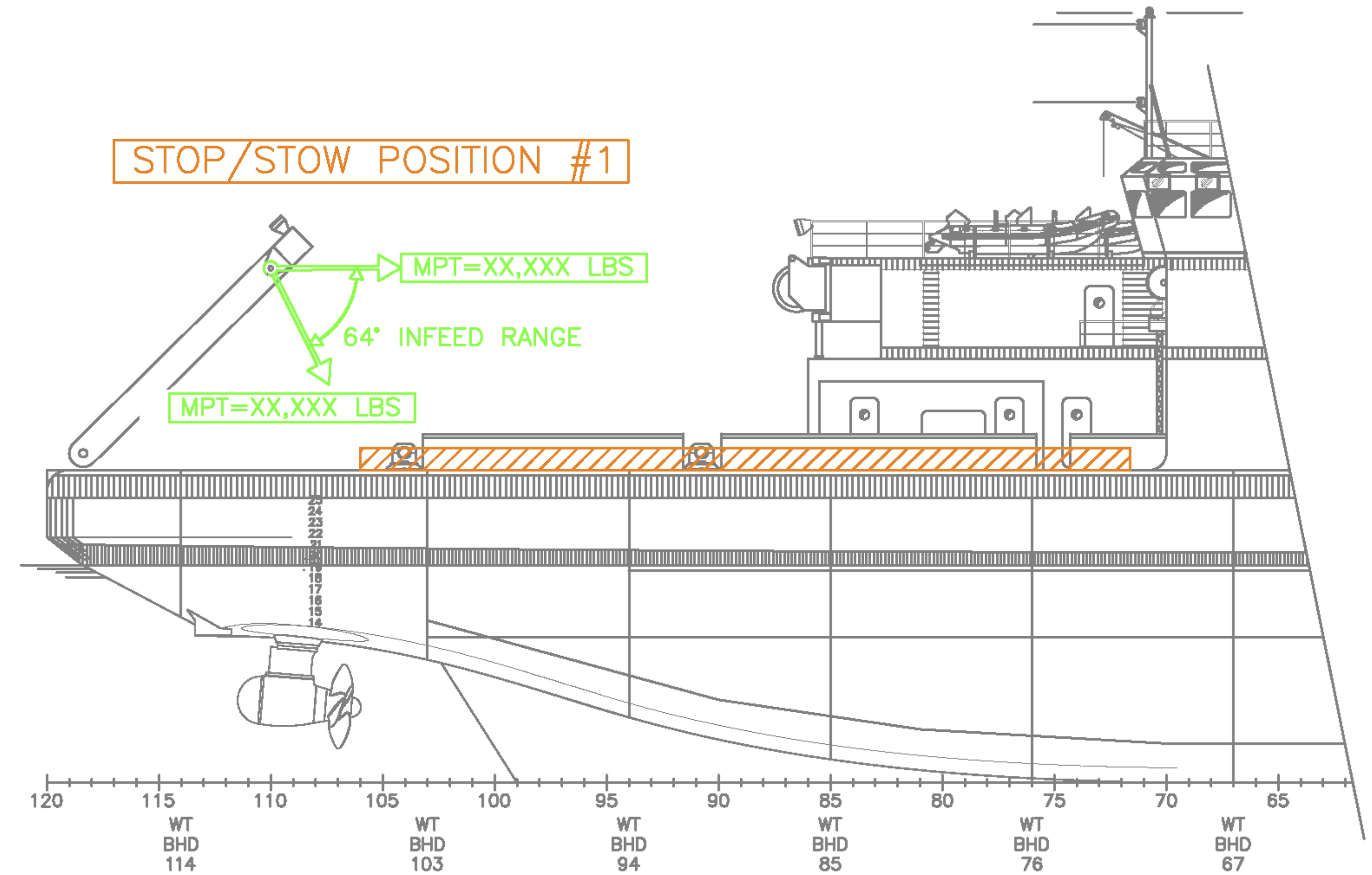
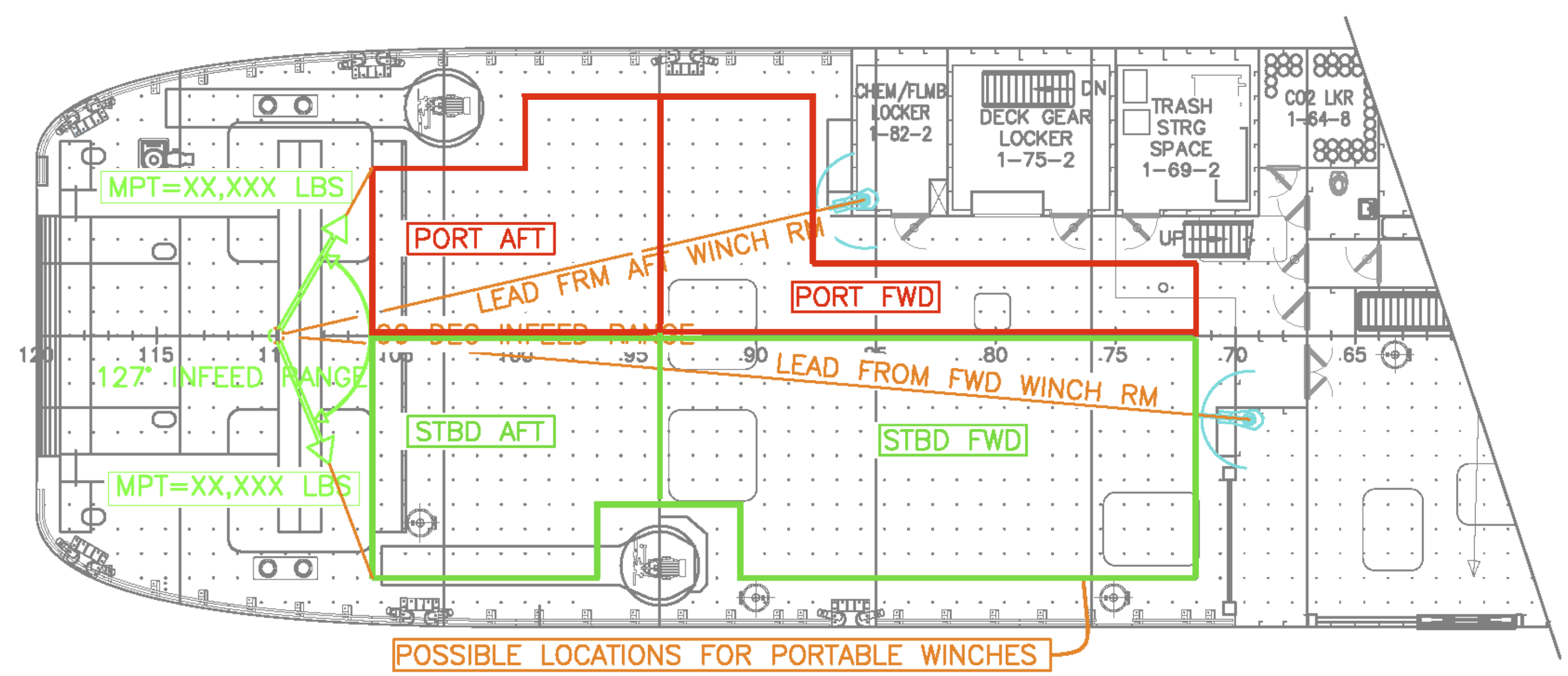


Figure 3: Frame in Inboard Stop Position #1, Center



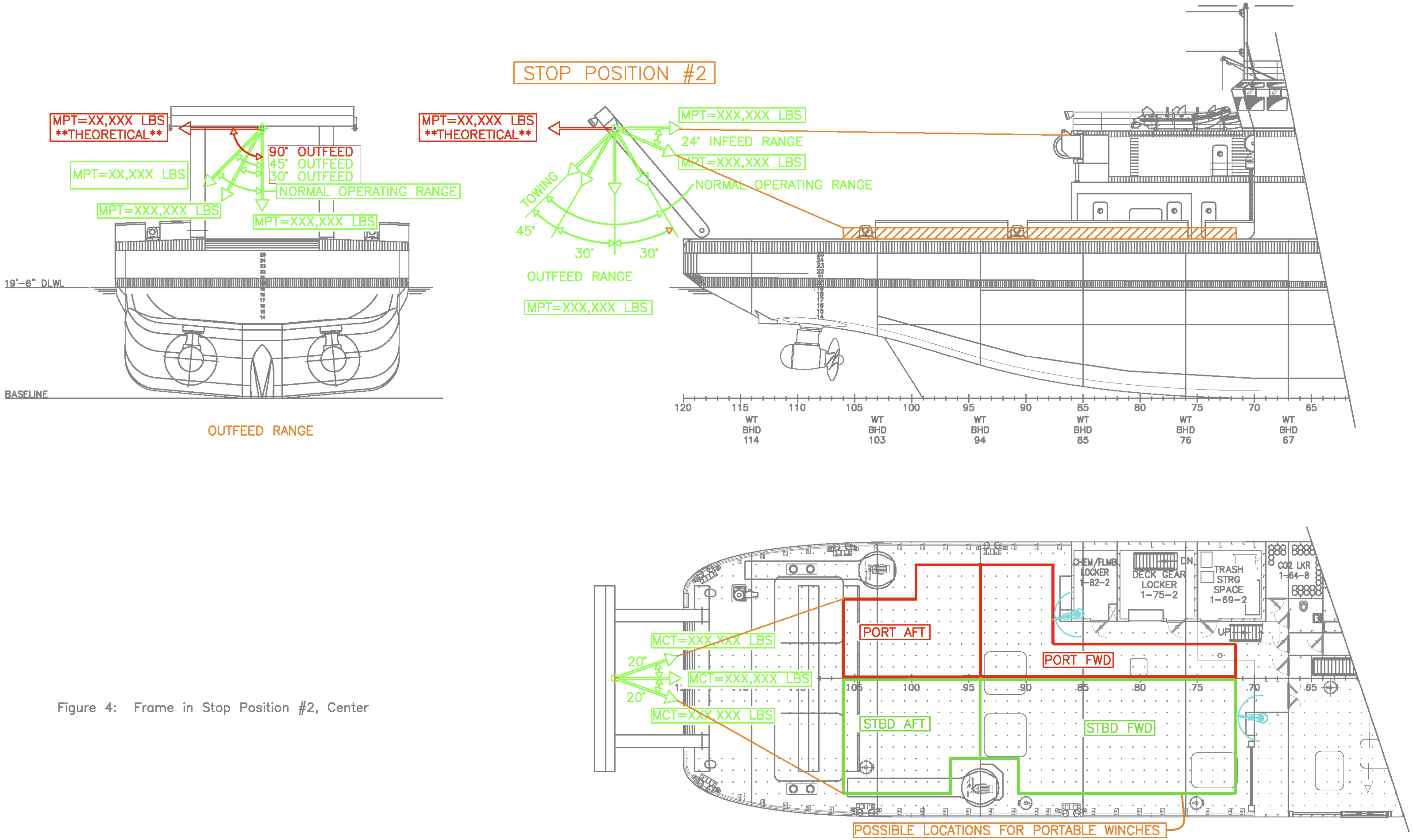


Figure 4: Frame in Stop Position #2, Center

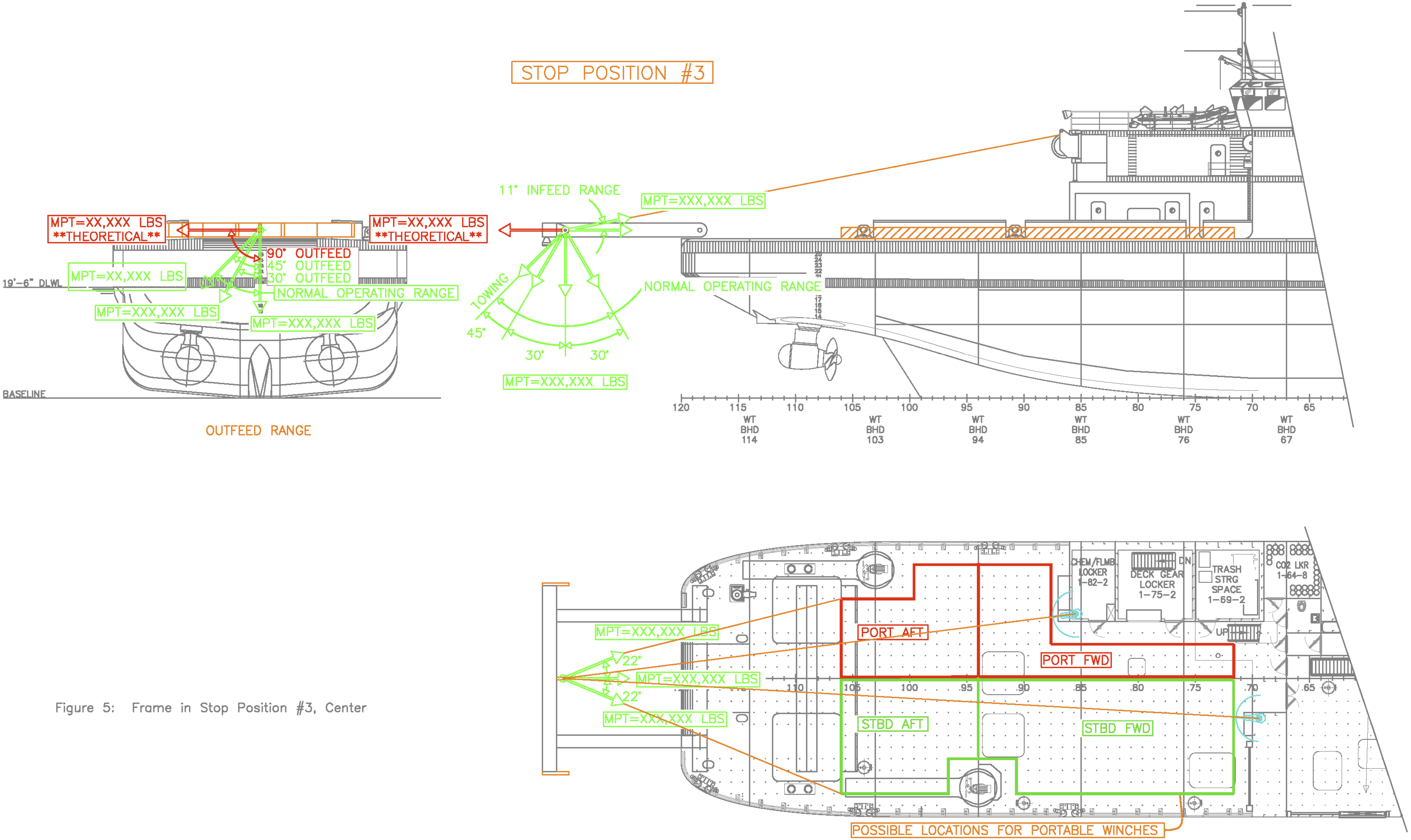


Figure 5: Frame in Stop Position #3, Center

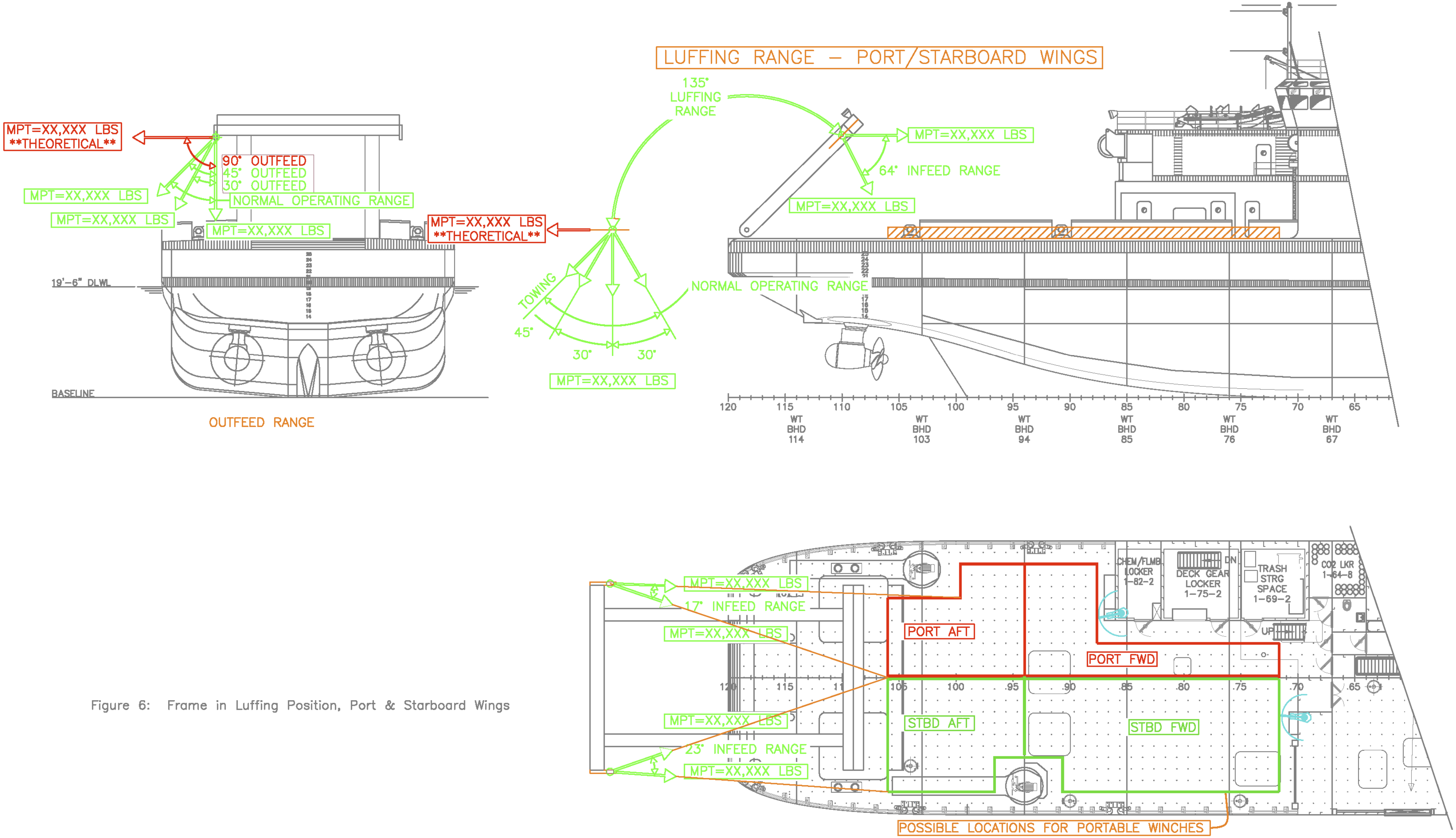
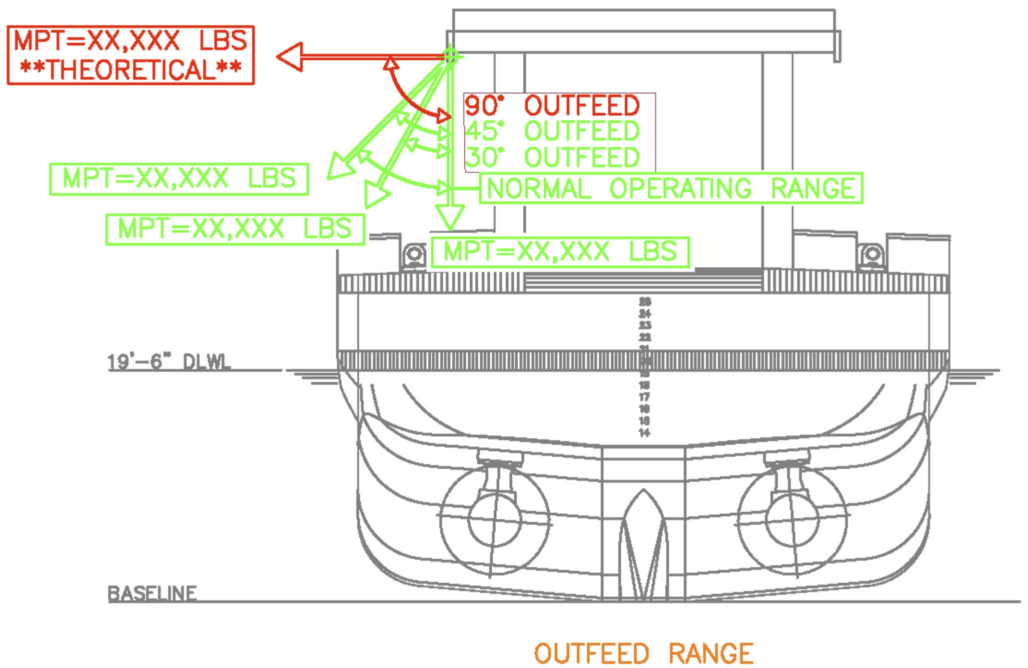
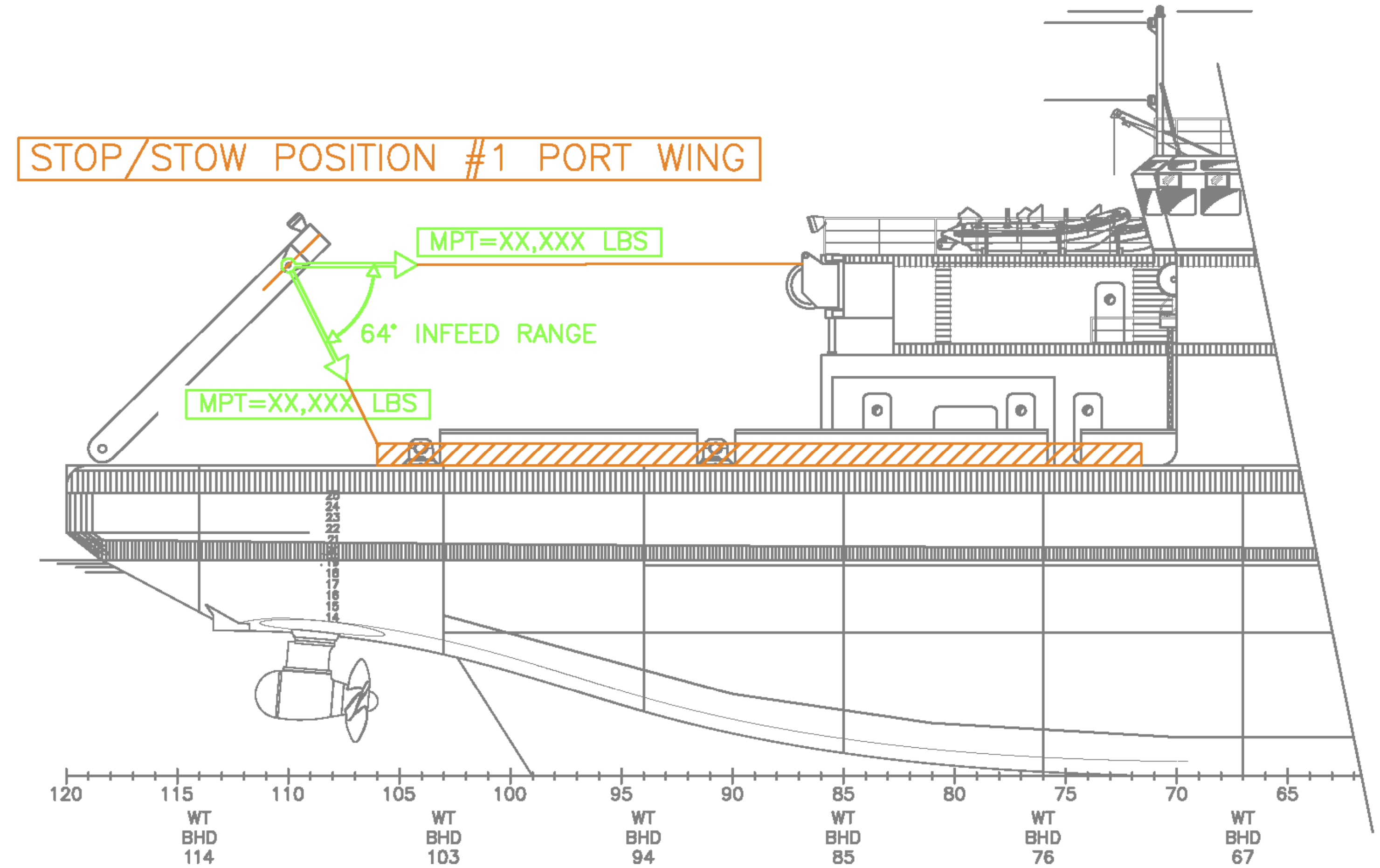


Figure 6: Frame in Luffing Position, Port & Starboard Wings





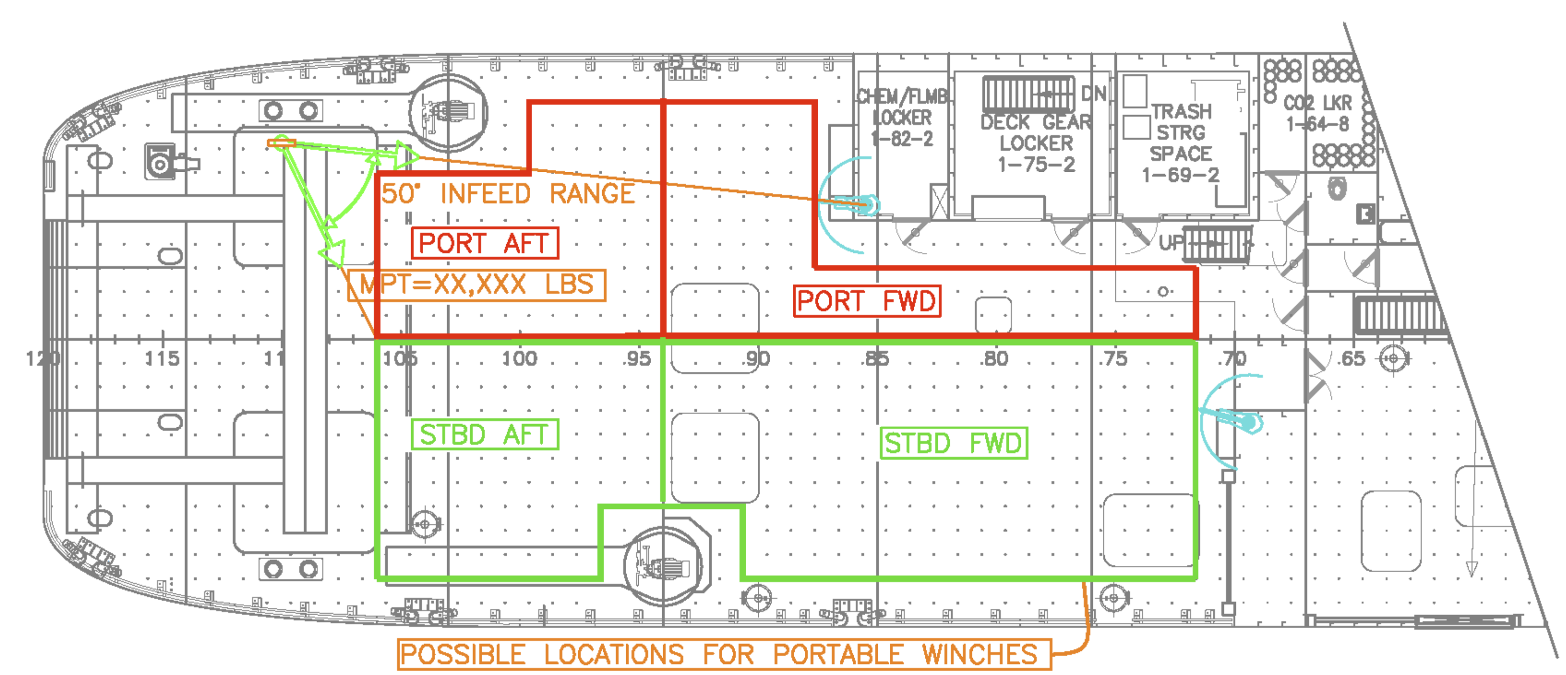
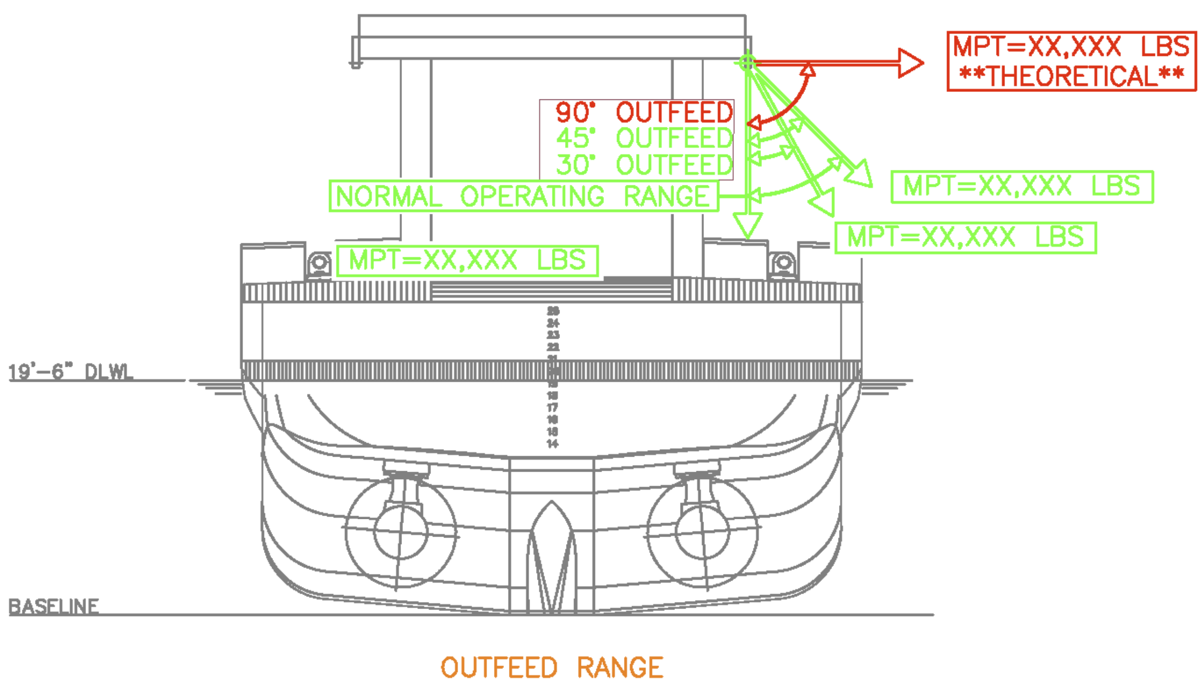
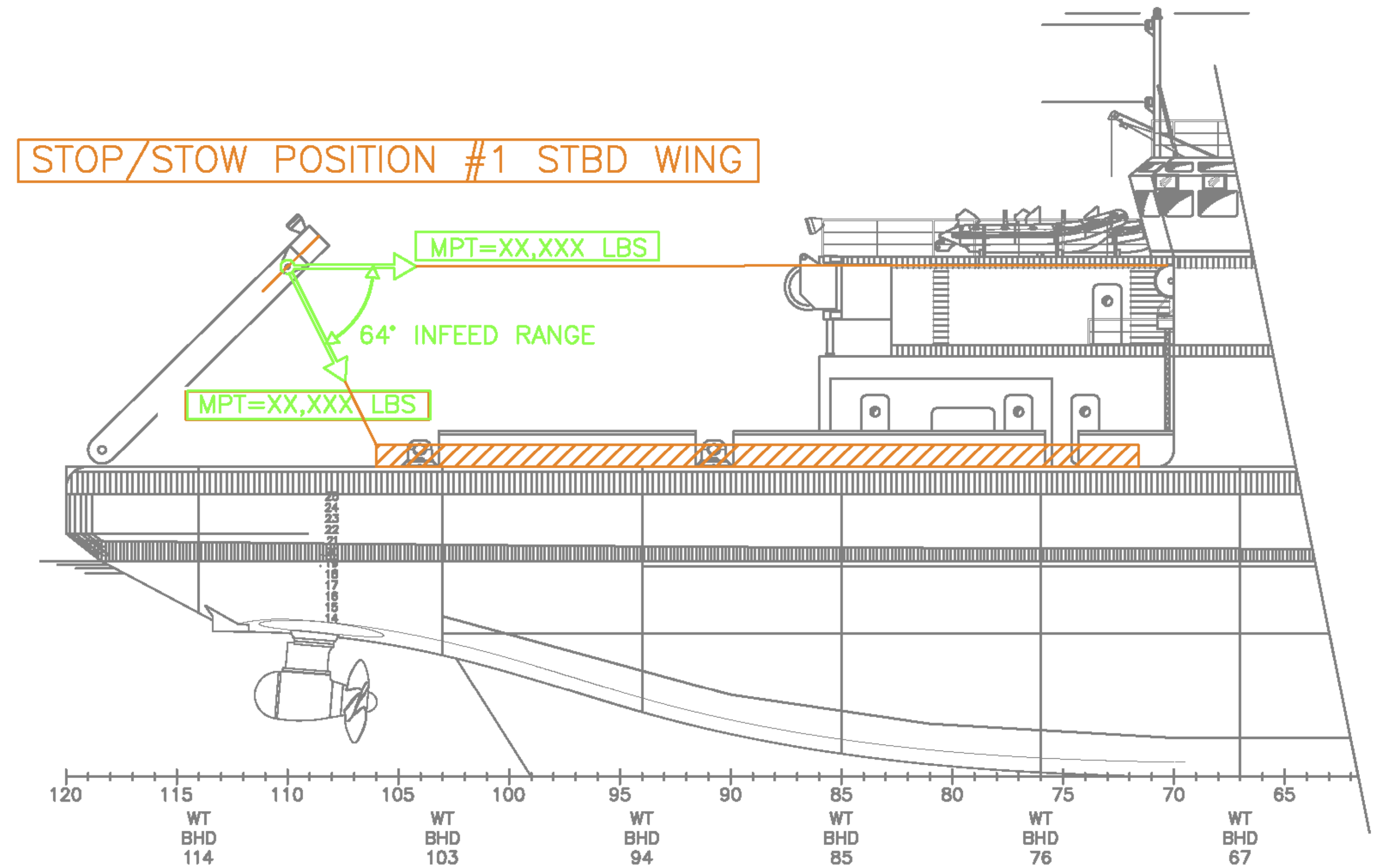


Figure 7: Frame in Inboard Stop Position #1, Port Wing





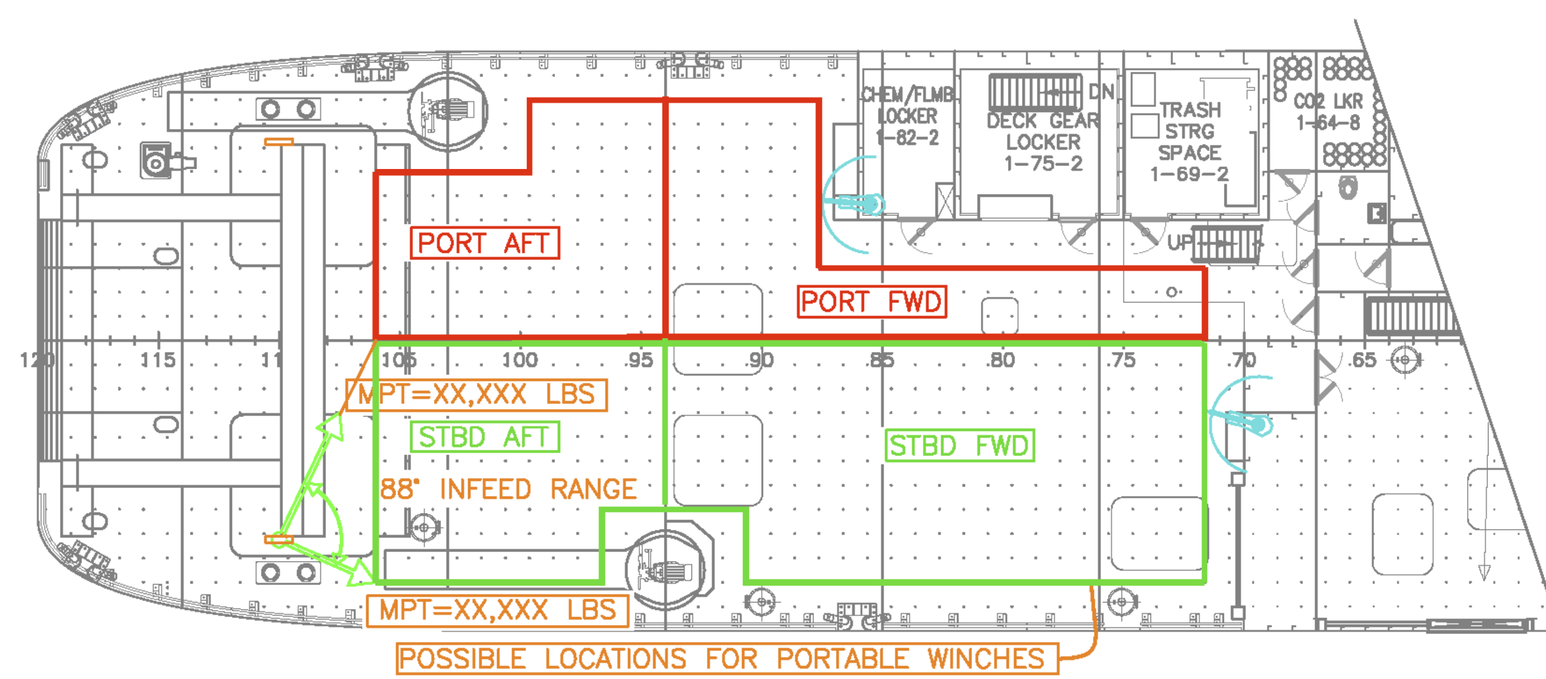


Figure 8: Frame in Inboard Stop Position #1, Stbd Wing

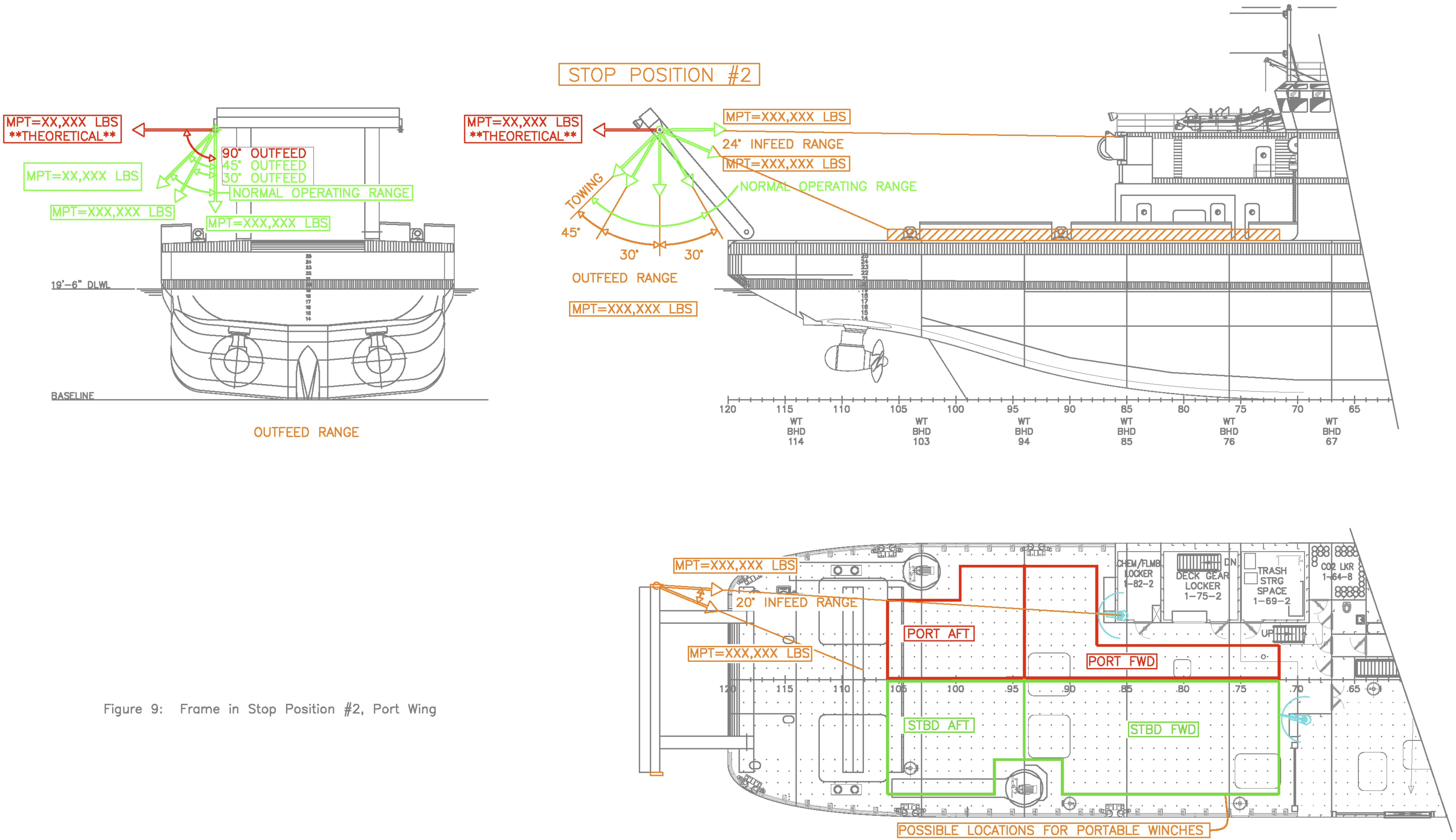
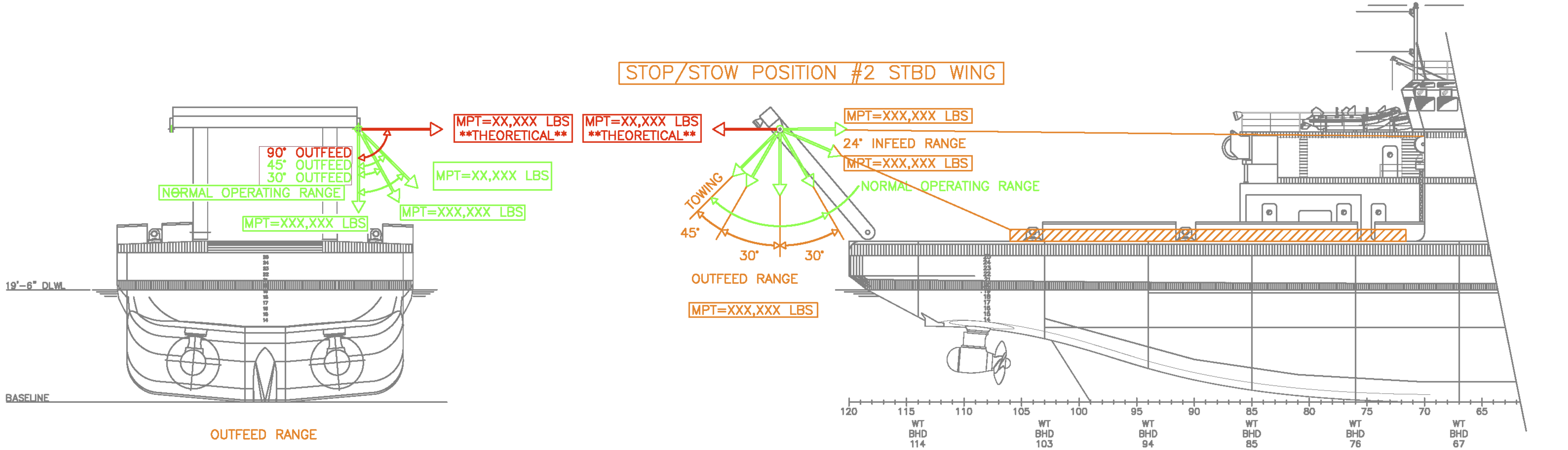


Figure 9: Frame in Stop Position #2, Port Wing



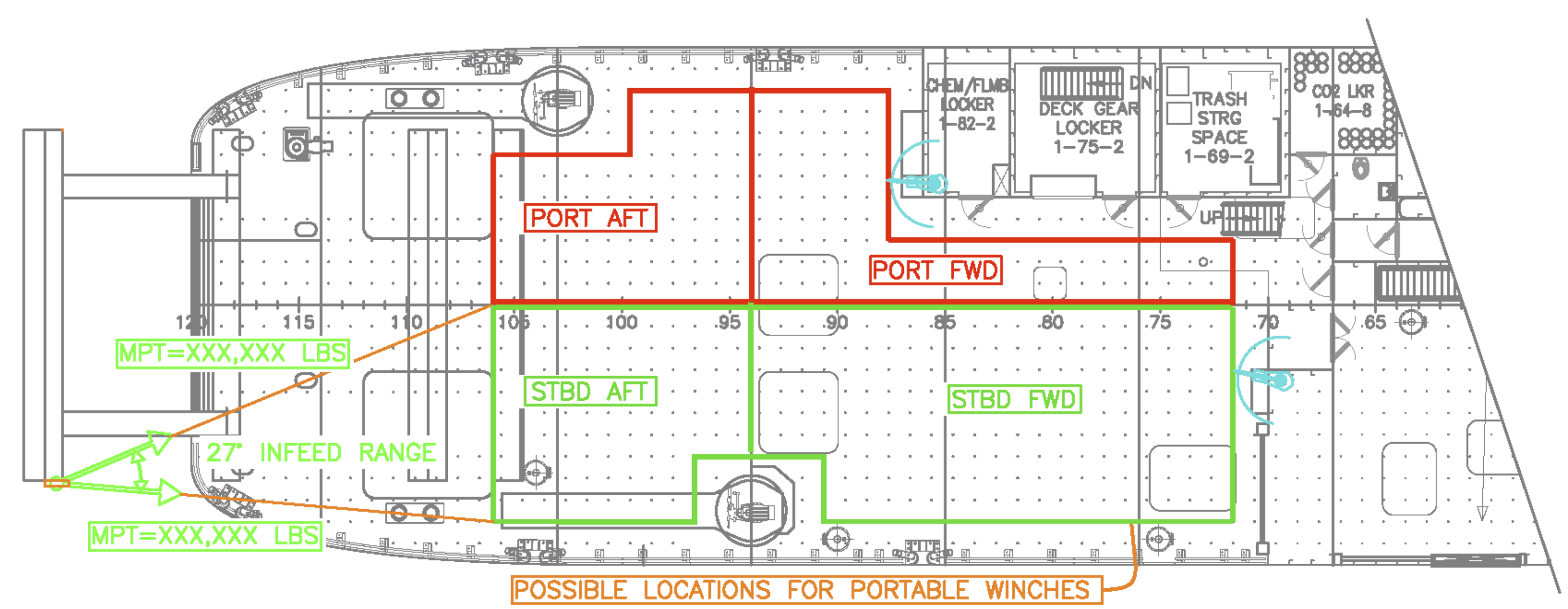


Figure 10: Frame in Stop Position #2, Stbd Wing

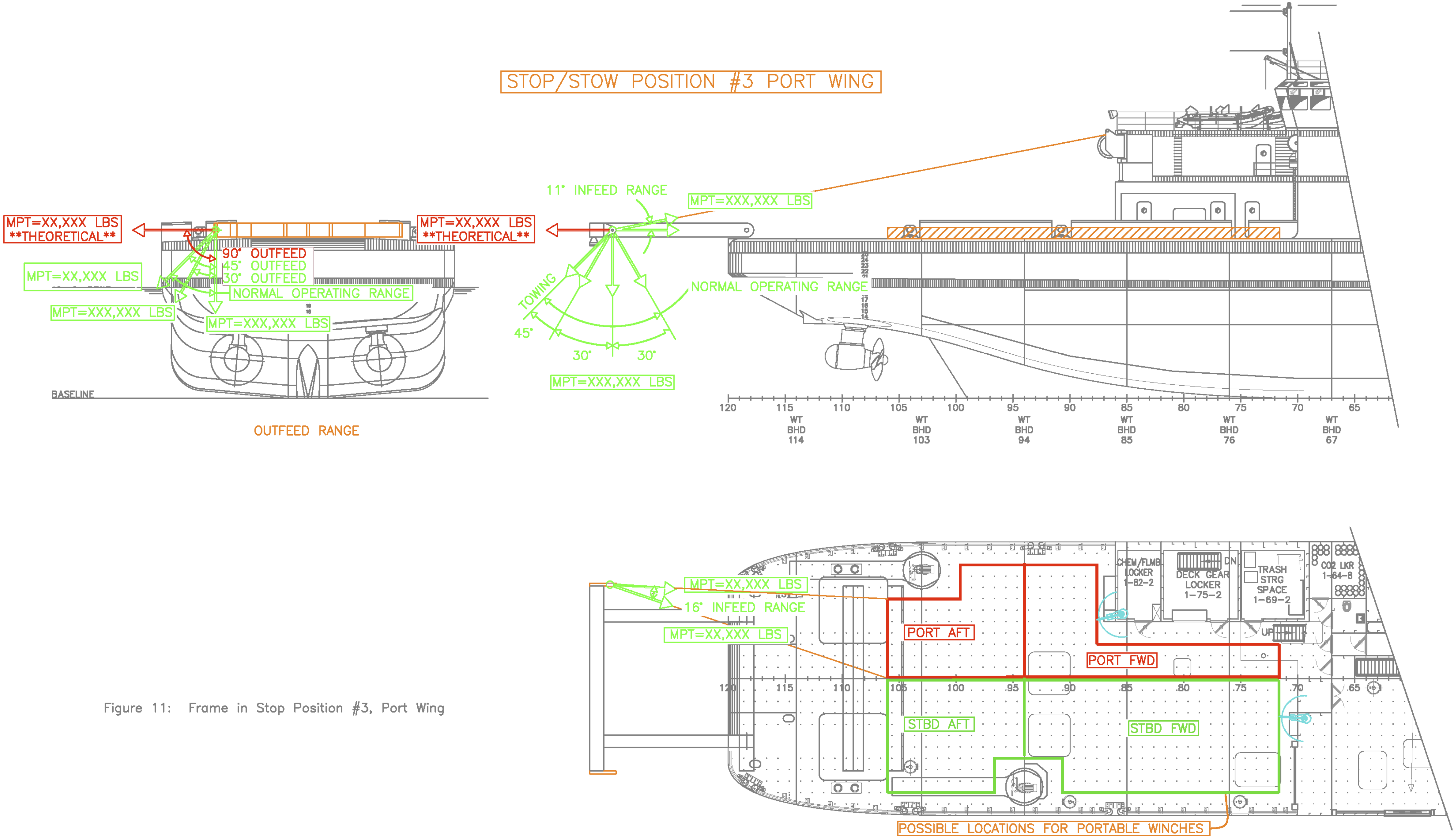
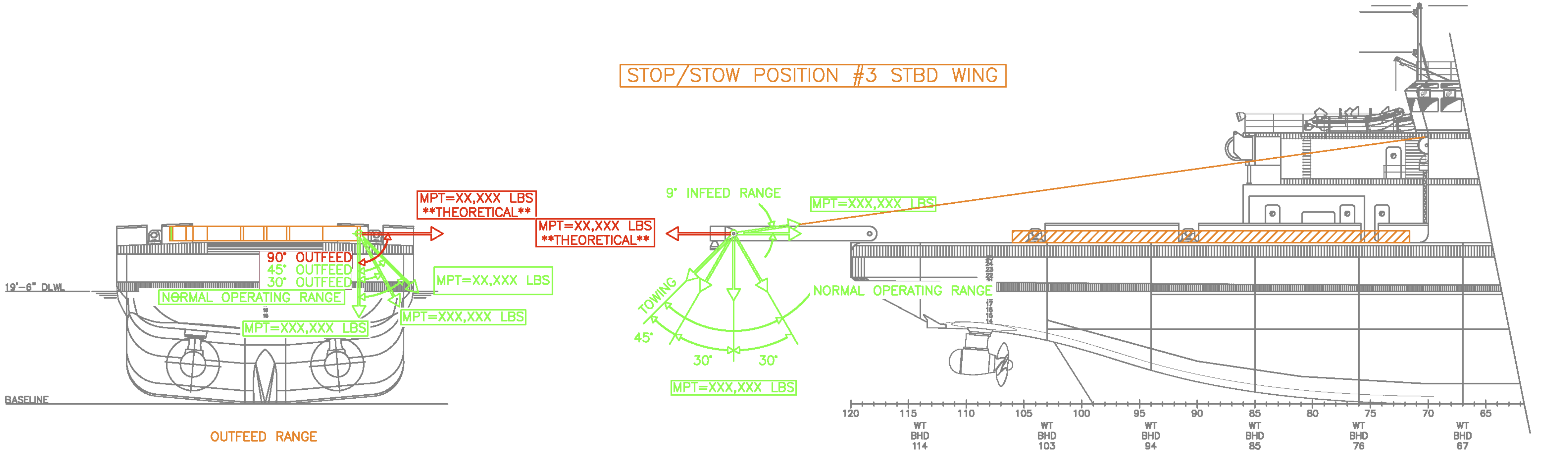


Figure 11: Frame in Stop Position #3, Port Wing



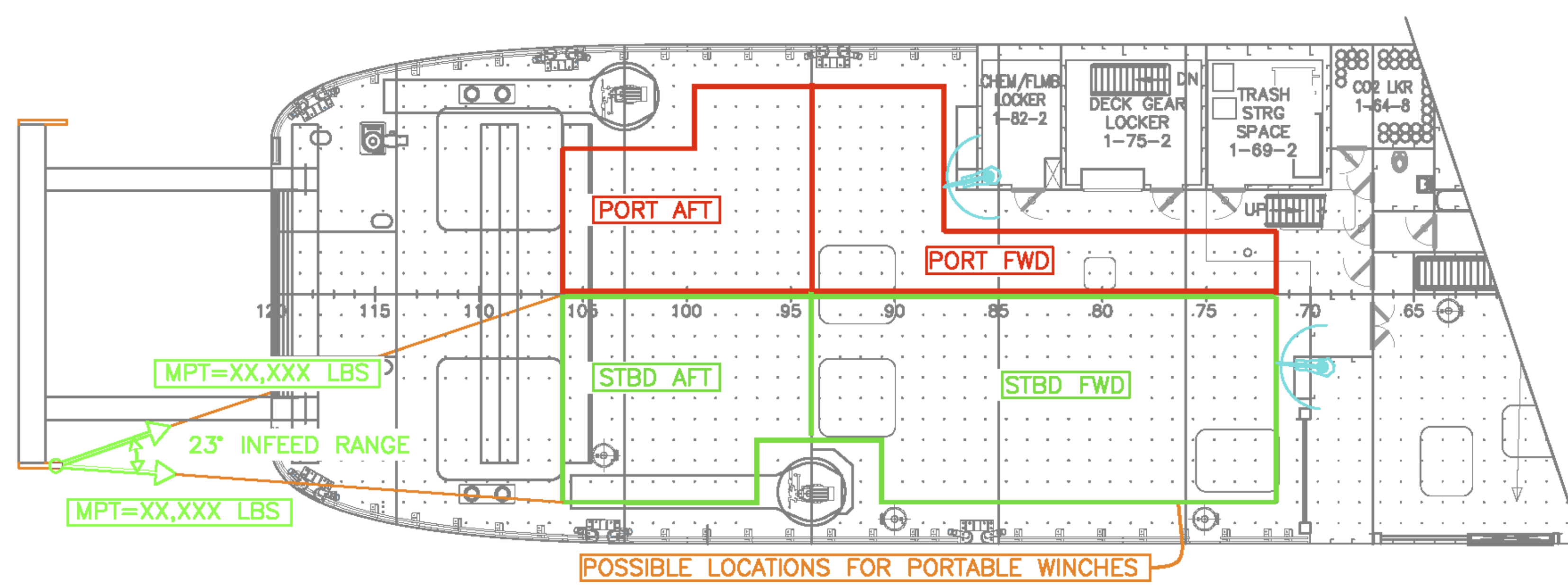


Figure 12: Frame in Stop Position #3, Stbd Wing

TABLE B.3 — Overboard Handling Data Document

REQUIRED DATA	**Operator/Designer Response**
Deployment Type	*Towing – all depths* *Station Keeping – all depths*
Provide a brief narrative of scientific purpose and the equipment to be deployed. A drawing or drawings of the proposed "system" or "component" architecture is to be appended showing, for example, wire angles and potential loadings (Principle , Secondary & Worst Case) relative to the Varies system elements. Provide information on the vessel or vessels (size(s), type(s), UNOLS or not, etc) intended for the system deployment, its/their area(s) of operation and the likely weather conditions to be encountered	*Stern A-frame for handling and deployment of various mission packages and scientific equipment.*
Provide Primary Deployment Information;	
Package Type	*Varies*
Maximum Package Weight	*Varies*
Base Package Mass	*Varies*
Added Mass to Include Captured and Entrained Added Mass (E.G., Water/Mud)	*Varies*
Maximum Hydrodynamic Resistance	*Varies*
Dynamic Factors	*Varies*
Rope or Cable Type and Breaking Load	*Maximum 40,000 lbf - 0.680" EM Cable*
Maximum Wire Weight (In Water)	*Varies*
Maximum Wire Mass	*Varies*
Selected Rope or Cable Factor of Safety Per Appendix A	
Maximum Anticipated Depth of Deployment	*Varies*
Maximum Allowable Depths of Water	*Varies*
Deployment/Water Depth Ratio	*Varies*
Principle Loading	
Secondary Loading	
Worst Case Loading	*Line Break, 180° wrap*
Ultimate Design Load	*{Determined byVendor}*
Load Limiting Equipment	*None*

Maximum Anticipated Operating Tension	*Varies*
Design Line Tension	*40,000 lbf*
Other Emergency Means of Package or Wire Detachment	*None*
Other Means Proposed for Package Control	*Varies*
Description of Fail Safes in the Event of Power Loss or Mechanical/Electrical Failure of System Components	*N/A*

AFT OVERBOARD HANDLING SYSTEM: DECK TIE-DOWNS

R/V SIKULIAQ

Maximum Capability Document

Manufactured By:

Reference Drawing Number: XXX-XXX

Prepared By: [Company Name]

[Engineer's Name/Stamp]

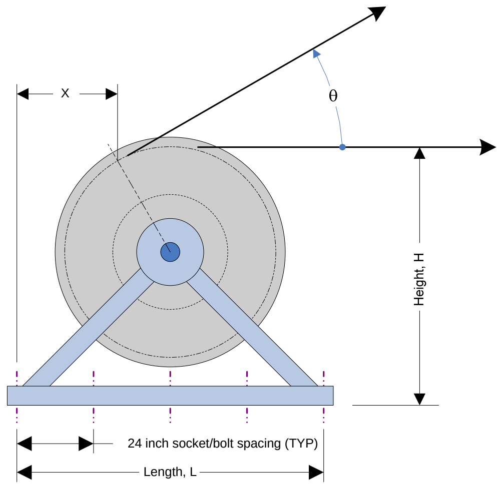
Draft Rev. 2, 3 December 2011

Determination of Minimum Bolts for Winch Foundations on *R/V Sikuliaq*

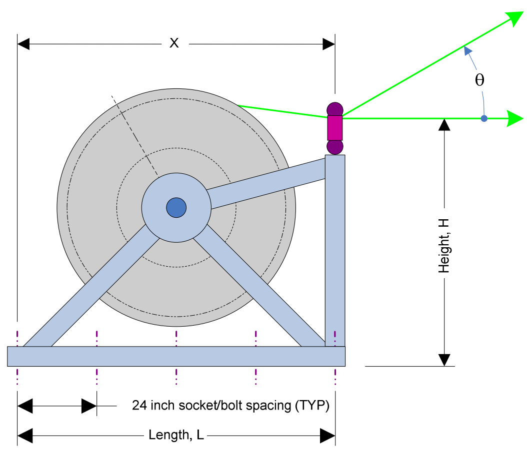
ASSUMPTIONS

1) Exterior bolt-down fittings (*aka* ‘deck sockets’) are located on a 24 inch orthogonal grid.
2) The deck sockets provide a threaded dead-end hole suitable for a 1-inch NC threaded bolt, with at least 2 inches of threaded depth.
3) One percent of the total number of exterior bolt-down fittings (selected at random) have been subjected to proof tests of 7,000 pounds applied vertically and also applied at 45 degrees from the vertical.
4) Tensile capacity of the design bolts is presumed to be at least 7,000 pounds. However those using the following calculation sheets may specify bolt tensile capacities equal to or less than 7,000 pounds.
5) It is presumed that winch foundations offer bolting opportunities that match the 24 inch orthogonal grid of exterior bolt-down fittings. To the extent that the bolt pattern of the winch does not match the 24 inch orthogonal grid of deck sockets it is presumed that a sub-base will be designed, manufactured and installed which does match the 24-inch orthogonal grid of deck sockets.
6) Pursuant to assumption #6 (above), key winch foundation dimensions, in particular length, L, and width, are presumed to be integer multiples of 24 inches.
7) Winch foundation bolts are designed to be capable of withstanding the loads resulting from the design wire breaking.
8) The design minimum average deck load capacity of the exterior main deck is 1200 lbs/ft^2 psf (8.33 psi).

Basic Winch without Fairlead: Section 1



Winch with Fairlead: Section 2



Example Winch with Fairlead: Section 3

Table of Sines and Cosines: Section 4

Basic Winch without Fairlead: Section 1

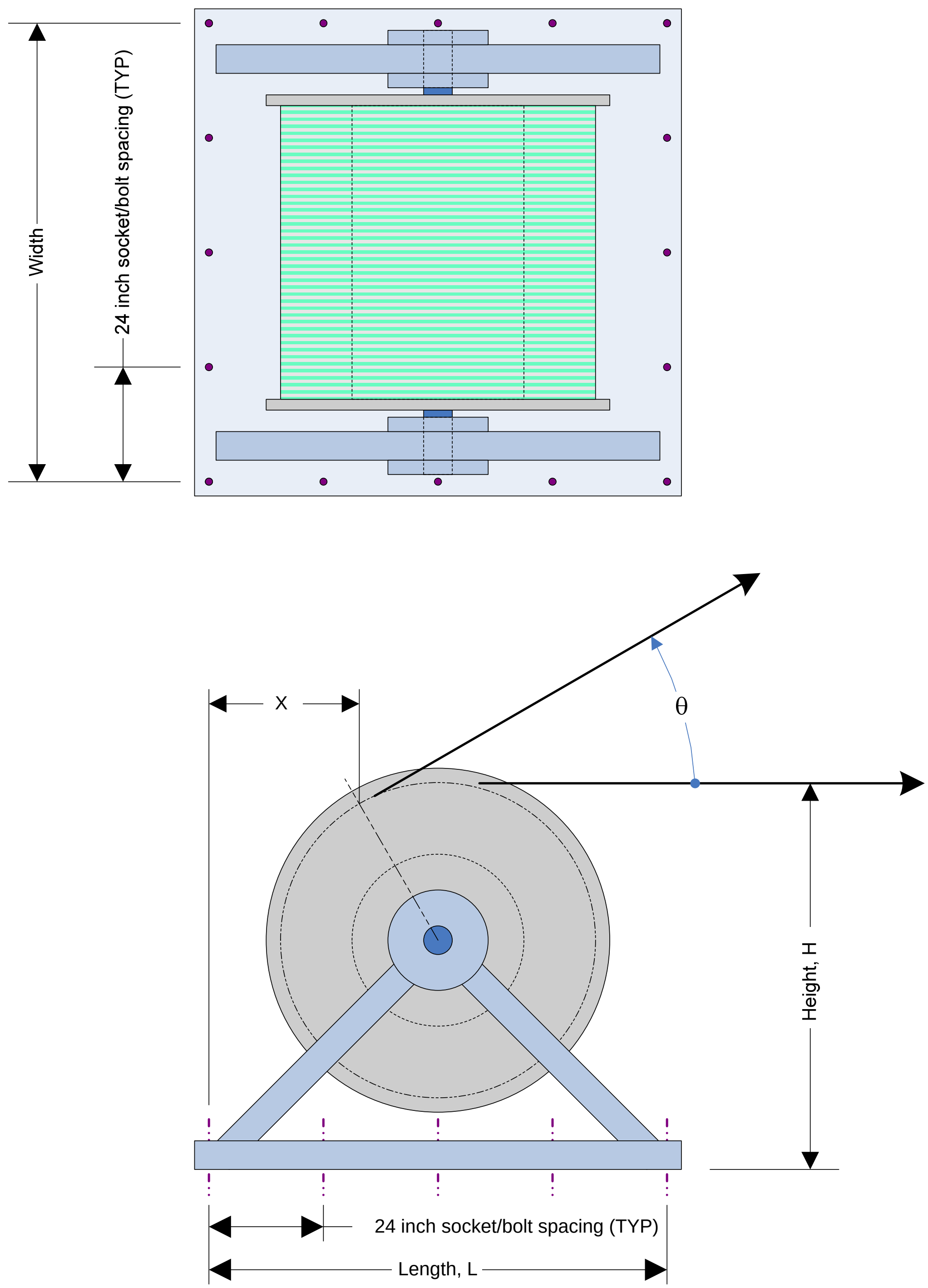


Figure 1 Basic winch without fairlead

INPUT DATA (refer to Figure 1)

ENTER LENGTH OF THE WINCH FOUNDATION, L	___________	inches	(1)
ENTER LONGITUDINAL POINT OF ACTION, X	___________	inches	(2)
ENTER HEIGHT OF POINT OF ACTION, H	___________	inches	(3)
ENTER MAXIMUM INCLINATION OF WIRE ROPE, θ	___________	degrees	(4)
ENTER WEIGHT OF WINCH without wire, W	___________	lb	(5)

ENTER WIRE ROPE SPECIFICATION: ____

ENTER MINIMUM BREAKING STRENGTH OF WIRE ROPE	___________	lb	(6)
ENTER WIRE LOAD 1.5 × Minimum Breaking Strength from Line (6), P .... [Reference: 46 CFR, Subchapter U, §189.35-9(c)(1)]	___________	lb	(7)

<u>BOLTS IN TENSION</u>

ENTER THE DESIGN TENSILE CAPACITY OF WINCH FOUNDATION BOLTS, $C\sigma$ (must be 7,000 pounds or less)...	___________	lb	(8)
ENTER THE YIELD TENSILE CAPACITY OF WINCH FOUNDATION BOLTS, $Y\sigma$ (must be 1.67 × $C\sigma$ or less)...	___________	lb	(9)

<u>BOLTS IN SHEAR</u>

ENTER THE DESIGN SHEAR CAPACITY OF WINCH FOUNDATION BOLTS, $C\tau$ (should be 5880 lbs for 1” 316 SST)	___________	lb	(10)
ENTER THE YIELD SHEAR CAPACITY OF WINCH FOUNDATION BOLTS, $Y\tau$ (should be 9700 lbs for 1” 316 SST)	___________	lb	(11)

ENTER THE UNIT WEIGHT (in air) OF THE WIRE ROPE	___________	lb/ft	(12)
ENTER THE LENGTH OF WIRE SPOOLED ON WINCH DRUM ...	___________	feet	(13)
ENTER THE WIDTH OF THE WINCH FOUNDATION..................	___________	inches	(14)

CALCULATE MINIMUM NUMBER OF BOLTS

Part 1: Calculation of Minimum Number of Tensile Bolts for Horizontal Pull

$N\sigma_1 = 1 + INT\left\{\frac{1}{Y\sigma}\left[\frac{PH}{L} - \frac{W}{2}\right]\right\}$ Where $N\sigma_1$ is the minimum number of Tensile Bolts for Horizontal Pull

Multiply Wire Load by Height of Point of Action, PH = Line (7) × Line (3)	____________	lb-in	(15)
Divide Line (15) by Length of Base, PH/L = Line (15) / Line (1)	____________	lb	(16)
Enter one-half of the Weight of the Winch, $W/2$ = 0.5 × Line (5)	____________	lb	(17)
Subtract Line (17) from Line (16); If negative, enter zero, PH/L - $W/2$ = Line (16) - Line (17)	____________	lb	(18)
Divide Line (18) by Line (9) and enter the whole number (integer) part. If Line (18) is zero, enter zero	____________		(19)
Add one (1) to value in Line (19), $N\sigma_1$	____________		(20)

Part 2: Calculation of Minimum Number of Tensile Bolts for Upwards Pull

$$N\sigma_2 = 1 + INT\left\{\frac{1}{Y\sigma}\left[P\cos(\theta)\frac{H}{L} + P\sin(\theta)\frac{(L-X)}{L} - \frac{W}{2}\right]\right\}$$

Where $N\sigma_2$ is the minimum number of Tensile Bolts for Upwards Pull

If θ = 0 deg, enter the value from Line (20) on Line (31) and proceed to Part 3.

Enter the Cosine of angle θ (refer to Section 4), cos(θ).................	____________		(21)
Enter the Sine of angle θ (refer to Section 4), sin(θ)......................	____________		(22)
Multiply Line (16) by cos(θ), $P\cos(\theta)\,H/L$ = Line (16) × Line (21)	____________	lb	(23)
Multiply Wire Load by sin(θ), $P\sin(\theta)$ = Line (7) × Line (22)	____________	lb	(24)
Subtract the longitudinal location of the point of action from the length of base, $L - X$ = Line (1) - Line (2)	____________	in	(25)

Multiply Line (24) by Line (25),
$P\sin(\theta)(L-X)$ = Line (24) × Line (25) .... ____________ lb-in (26)

Divide Line (26) by length of base,
$P\sin(\theta)(L-X)/L$ = Line (26) / Line (1)....................................... ____________ lb (27)

Add Line (23) and Line (27), Line(23) + Line(27)............................ ____________ lb (28)

Subtract Line (17) from Line (28); If negative, enter zero,
Line (28) - Line (17) .... ____________ lb (29)

Divide Line (29) by Line (8) and enter the whole number
(integer) part. If Line (29) is zero, enter zero .... ____________ (30)

Add one (1) to value in Line (30), $N\sigma_2$ .... ____________ (31)

Part 3: Minimum Number of Bolts for Tension

$$N\sigma = Maximum(N\sigma_1, N\sigma_2)$$

Enter the larger of the values from Lines (20) and (31), $N\sigma$ .... ____________ (32)

If Line (32) is greater than six (6), contact naval architect for engineering review.

Part 4: Minimum Number of Bolts for Shear

$$N\tau = 1 + INT\left\{\frac{P}{Y\tau}\right\}$$

Divide the Wire Load by Yield Shear Capacity and enter the whole
number (integer) part,
$INT(P/Y\tau)$ = INT(Line (7) / Line (11))... ____________ (33)

Add one (1) to value in Line (33), $N\tau$ .... ____________ (34)

Part 5: Total Number of Bolts

$$N = Maximum(N\sigma + 2, N\tau)$$

Add two (2) to the value entered on Line (32), $N\sigma + 2$ .... ____________ (35)

Enter the value from Line (34), $N\tau$ .... ____________ (36)

Enter the larger of the values from Lines (35) and (36) .... ____________ (37)

If Line (37) is greater than twelve (12), contact naval architect for engineering review.

Part 6: Gross Deck Load Check

Weight of wire rope,
Line (12) × Line (13).. ____________ lb (38)

Gross weight of winch,
Line (5) + Line (38).. ____________ lb (39)

Nominal effective area of winch base,
Line (1) × Line (14).. ____________ in^2 (40)

Gross downward unit deck load,
Line (39) / Line (40).. ____________ psi (41)

If Line (41) is greater than 8.33 psi, contact naval architect for engineering review.

Enter value from Line (24) .... ____________ lb (42)

Enter value from Line (5) .... ____________ lb (43)

Subtract Line (43) from Line (42),
Line (42) - Line (43) .... ____________ lb (44)

Gross upward unit deck load,
Line (44) / Line (40).. ____________ psi (45)

If Line (45) is greater than 8.33 psi, contact naval architect for engineering review.

Winch with Fairlead: Section 2

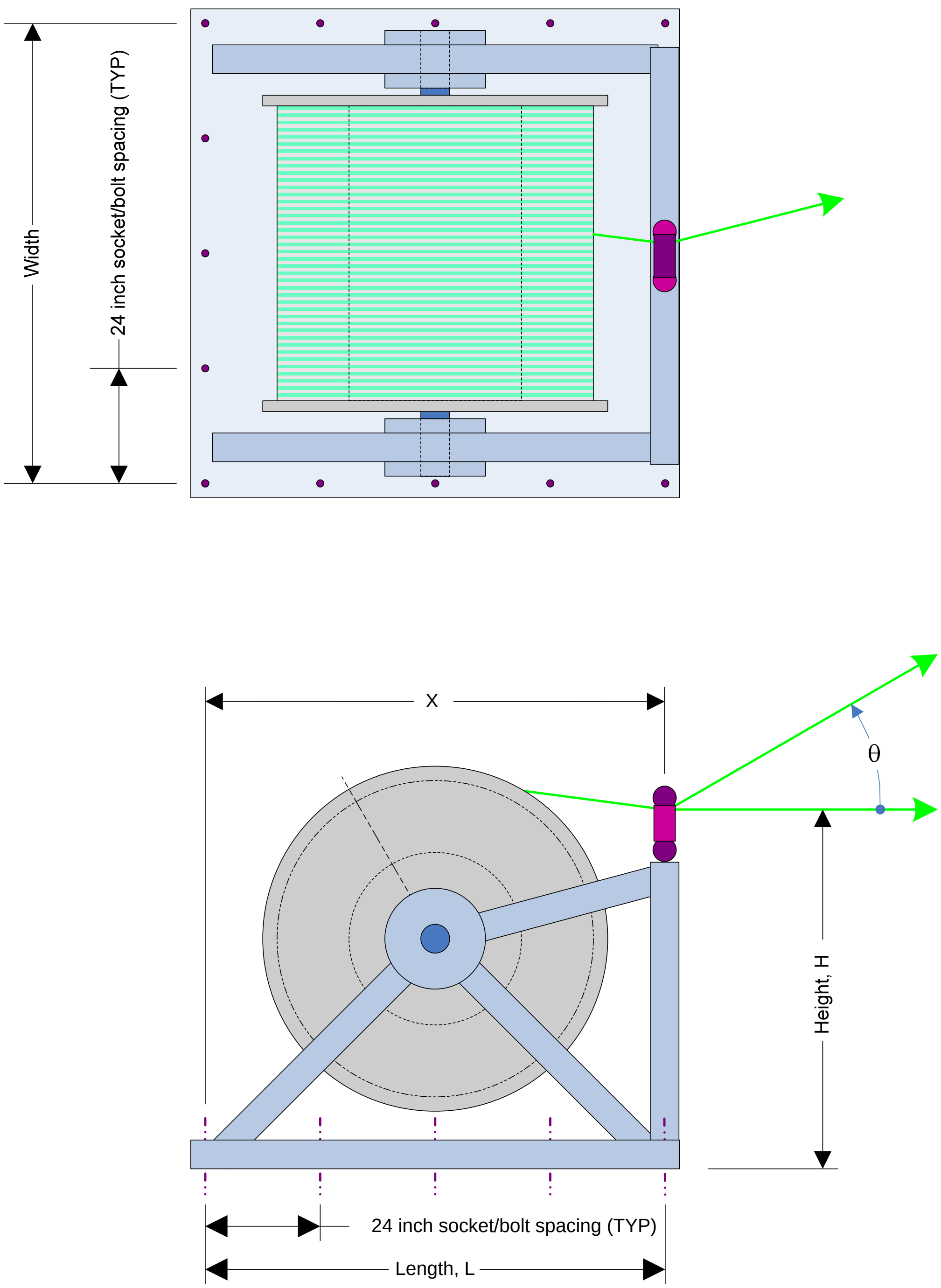


Figure 2 Winch with fairlead

INPUT DATA (refer to Figure 2)

ENTER LENGTH OF THE WINCH FOUNDATION, L.................... ____________ inches (1)

ENTER LONGITUDINAL POINT OF ACTION, X........................... ____________ inches (2)

ENTER HEIGHT OF POINT OF ACTION, H................................. ____________ inches (3)

ENTER MAXIMUM INCLINATION OF WIRE ROPE, θ.................. ____________ degrees (4)

ENTER WEIGHT OF WINCH without wire, W................................ ____________ lb (5)

ENTER WIRE ROPE SPECIFICATION: ____

ENTER MINIMUM BREAKING STRENGTH OF WIRE ROPE........ ____________ lb (6)

ENTER WIRE LOAD
1.5 × Minimum Breaking Strength from Line (6), P.......................... ____________ lb (7)
[Reference: 46 CFR, Subchapter U, §189.35-9(c)(1)]

<u>BOLTS IN TENSION</u>

ENTER THE DESIGN TENSILE CAPACITY OF WINCH FOUNDATION BOLTS, $C\sigma$
(must be 7,000 pounds or less).. ____________ lb (8)

ENTER THE YIELD TENSILE CAPACITY OF WINCH FOUNDATION BOLTS, $Y\sigma$
(must be 1.67 × $C\sigma$ or less).. ____________ lb (9)

<u>BOLTS IN SHEAR</u>

ENTER THE DESIGN SHEAR CAPACITY OF WINCH FOUNDATION BOLTS, $C\tau$
(should be 5880 lbs for 1” 316 SST) .... ____________ lb (10)

ENTER THE YIELD SHEAR CAPACITY OF WINCH FOUNDATION BOLTS, $Y\tau$
(should be 9700 lbs for 1” 316 SST) .... ____________ lb (11)

ENTER THE UNIT WEIGHT (in air) OF THE WIRE ROPE............. ____________ lb/ft (12)

ENTER THE LENGTH OF WIRE SPOOLED ON WINCH DRUM... ____________ feet (13)

ENTER THE WIDTH OF THE WINCH FOUNDATION................... ____________ inches (14)

CALCULATE MINIMUM NUMBER OF BOLTS

Part 1: Calculation of Minimum Number of Tensile Bolts for Horizontal Pull

$$N\sigma_1 = 1 + INT\left\{\frac{1}{Y\sigma}\left[\frac{PH}{L} - \frac{W}{2}\right]\right\}$$ Where $N\sigma_1$ is the minimum number of Tensile Bolts for Horizontal Pull

Multiply Wire Load by Height of Point of Action,
PH = Line (7) × Line (3) .... ____________ lb-in (15)

Divide Line (15) by Length of Base,
PH/L = Line (15) / Line (1) .... ____________ lb (16)

Enter one-half of the Weight of the Winch,
$W/2$ = 0.5 × Line (5) .... ____________ lb (17)

Subtract Line (17) from Line (16); If negative, enter zero,
PH/L - $W/2$ = Line (16) - Line (17) .... ____________ lb (18)

Divide Line (18) by Line (9) and enter the whole number
(integer) part. If Line (18) is zero, enter zero .... ____________ (19)

Add one (1) to value in Line (19), $N\sigma_1$ .... ____________ (20)

Part 2: Calculation of Minimum Number of Tensile Bolts for Upwards Pull

$$N\sigma_{2B} = 1 + INT\left\{\frac{1}{Y\sigma}\left[P\cos(\theta)\frac{H}{L} + P\sin(\theta)\frac{(L-X)}{L} - \frac{W}{2}\right]\right\}$$

Where $N\sigma_{2B}$ is the minimum number of Tensile Bolts for Upwards Pull at back of winch

If θ = 0 deg, enter the value from Line (20) on Line (31) and proceed to Part 3.

Enter the Cosine of angle θ (refer to Section 4), cos(θ)................. ____________ (21)

Enter the Sine of angle θ (refer to Section 4), sin(θ)...................... ____________ (22)

Multiply Line (16) by cos(θ),
$P\cos(\theta)\, H/L$ = Line (16) × Line (21) .... ____________ lb (23)

Multiply Wire Load by sin(θ),
$P\sin(\theta)$ = Line (7) × Line (22) .... ____________ lb (24)

Subtract the longitudinal location of the point of action from the
length of base,
$L - X$ = Line (1) - Line (2) .... ____________ in (25)

Multiply Line (24) by Line (25),
$P\sin(\theta)(L-X)$ = Line (24) × Line (25) .... ____________ lb-in (26)

Divide Line (26) by length of base,
$P\sin(\theta)(L-X)/L$ = Line (26) / Line (1)....................................... ____________ lb (27)

Add Line (23) and Line (27), Line (23) + Line (27).......................... ____________ lb (28)

Subtract Line (17) from Line (28); If negative, enter zero,
Line (28) - Line (17) .... ____________ lb (29)

Divide Line (29) by Line (9) and enter the whole number
(integer) part. If Line (29) is zero, enter zero .... ____________ (30)

Add one (1) to value in Line (30), $N\sigma_{2B}$ .... ____________ (31)

$$N\sigma_{2F} = 1 + INT\left\{\frac{1}{Y\sigma}\left[-P\cos(\theta)\frac{H}{L} + P\sin(\theta)\frac{X}{L} - \frac{W}{2}\right]\right\}$$

Where $N\sigma_{2F}$ is the minimum number of Tensile Bolts for Upwards Pull at front of winch

Multiply Line (24) by the longitudinal location of the point of action,
$P\sin(\theta)X$ = Line (24) × Line (2)... ____________ lb-in (32)

Divide Line (30) by length of base,
$P\sin(\theta)X/L$ = Line (32) / Line (1) .... ____________ lb (33)

Enter the value from Line (23) .... ____________ lb (34)

Subtract Line (34) from Line (33); If negative, enter zero,
Line (33) - Line (34) .... ____________ lb (35)

Enter the value from Line (17) .... ____________ lb (36)

Subtract Line (36) from Line (35); If negative enter zero,
Line (35) - Line (36) .... ____________ lb (37)

Divide Line (37) by Line (9) and enter the whole number
(integer) part. If Line (37) is zero, enter zero .... ____________ (38)

Add one (1) to value in Line (38), $N\sigma_{2F}$ .... ____________ (39)

Enter the larger of the values from Line (31) and (39), $N\sigma_2$ .... ____________ (40)

Part 3: Minimum Number of Tensile Bolts

$$N\sigma = Maximum(N\sigma_1, N\sigma_2)$$

Enter the larger of the values from Lines (20) and (40), $N\sigma$ .... ____________ (41)

If Line (41) is greater than six (6) then contact naval architect for engineering review.

Part 4: Minimum Number of Bolts for Shear

$$N\tau = 1 + INT\left\{\frac{P}{Y\tau}\right\}$$

Divide the Wire Load by Yield Shear Capacity and enter the whole number (integer) part,
$INT(P / Y\tau)$ = INT(Line (7) / Line (11)) .... ____________ (42)

Add one (1) to value in Line (42), $N\tau$ .... ____________ (43)

Part 5: Total Number of Bolts

$$N = Maximum(N\sigma + 2, N\tau)$$

Add two (2) to the value entered on Line (41), $N\sigma + 2$ .... ____________ (44)

Enter the value from Line (43), $N\tau$ .... ____________ (45)

Enter the larger of the values from Lines (44) and (45) .... ____________ (46)

If Line (46) is greater than twelve (12), contact naval architect for engineering review.

Part 6: Gross Deck Load Check

Weight of wire rope,
Line (12) × Line (13)... ____________ lb (47)

Gross weight of winch,
Line (5) + Line (47)... ____________ lb (48)

Nominal effective area of winch base,
Line (1) × Line (14)... ____________ in^2 (49)

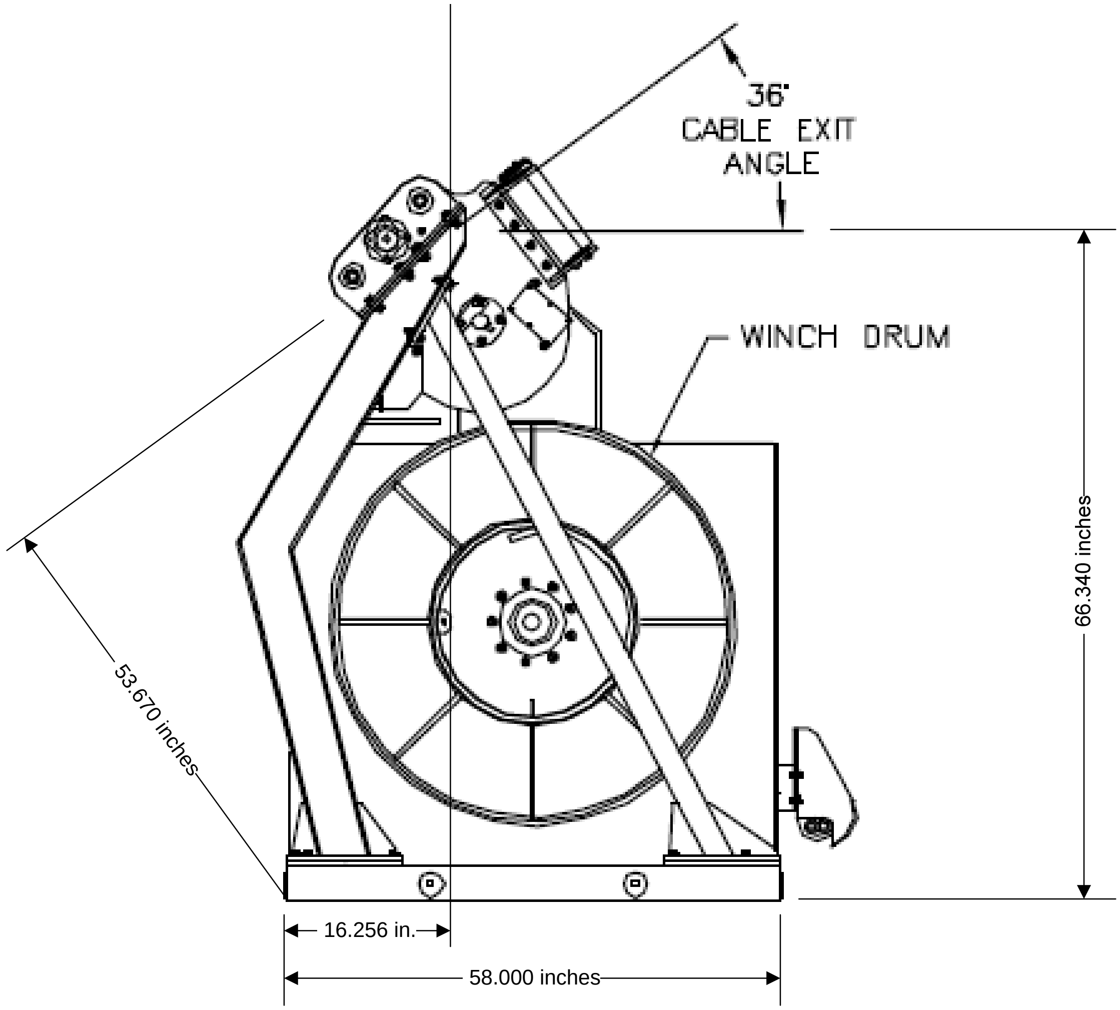
Gross downward unit deck load,
Line (48) / Line (49).. ____________ psi (50)

If Line (50) is greater than 8.33 psi, contact naval architect for engineering review.

Enter value from Line (24)	___________	lb	(51)
Enter value from Line (5)	___________	lb	(52)
Subtract Line (52) from Line (51), Line (51) - Line (52)	___________	lb	(53)
Gross upward unit deck load, Line (53) / Line (49)..	___________	psi	(54)

If Line (54) is greater than 8.33 psi, contact naval architect for engineering review.

Example Winch with Fairlead: Section 3



Note:

1) The length, L, shown in the plans provided by the winch manufacturer is 58 inches, which, however, is not an integer multiple of the 24 inch deck socket spacing. In accordance with assumption #6, it is presumed that a sub-base will be designed, manufactured, and installed which provides bolt holes aligning with the 24 inch deck socket spacing. It is presumed for this example that the sub-base will extend beyond the foundation of the winch to the next multiple of 24 inches; which, in this case, is 72 inches as entered on line (1) of this example.

2) The width of the winch foundation shown in the plans provided by the winch manufacturer is 58 inches, which, however, is not an integer multiple of the 24 inch deck socket spacing. In accordance with assumption #6, it is presumed that a sub-base will be designed, manufactured, and installed which provides bolt holes aligning with the 24 inch deck socket spacing. It is presumed for this example that the sub-base will extend beyond the foundation of the winch to the next multiple of 24 inches; which, in this case, is 72 inches as entered on line (14) of this example.

INPUT DATA (refer to Figure 2)

ENTER LENGTH OF THE WINCH FOUNDATION, L	72.000	inches	(1)
ENTER LONGITUDINAL POINT OF ACTION, X	16.256	inches	(2)
ENTER HEIGHT OF POINT OF ACTION, H	66.340	inches	(3)
ENTER MAXIMUM INCLINATION OF WIRE ROPE, θ	36	degrees	(4)
ENTER WEIGHT OF WINCH without wire, W	5600	lb	(5)

ENTER WIRE ROPE SPECIFICATION: 9.98 mm OD Triaxus Type A305382 Cable

ENTER MINIMUM BREAKING STRENGTH OF WIRE ROPE	15961	lb	(6)
ENTER WIRE LOAD 1.5 × Minimum Breaking Strength from Line (6), P .... [Reference: 46 CFR, Subchapter U, §189.35-9(c)(1)]	23942	lb	(7)

BOLTS IN TENSION

ENTER THE DESIGN TENSILE CAPACITY OF WINCH FOUNDATION BOLTS, $C\sigma$ (must be 7,000 pounds or less)..	7000	lb	(8)
ENTER THE YIELD TENSILE CAPACITY OF WINCH FOUNDATION BOLTS, $Y\sigma$ (must be 1.67 × $C\sigma$ or less)...	11690	lb	(9)

BOLTS IN SHEAR

ENTER THE DESIGN SHEAR CAPACITY OF WINCH FOUNDATION BOLTS, $C\tau$ (should be 5880 lbs for 1" 316 SST)	5880	lb	(10)
ENTER THE YIELD SHEAR CAPACITY OF WINCH FOUNDATION BOLTS, $Y\tau$ (should be 9700 lbs for 1" 316 SST)	9700	lb	(11)
ENTER THE UNIT WEIGHT (in air) OF THE WIRE ROPE	0.2614	lb/ft	(12)
ENTER THE LENGTH OF WIRE SPOOLED ON WINCH DRUM ...	17582	feet	(13)
ENTER THE WIDTH OF THE WINCH FOUNDATION..................	72.000	inches	(14)

CALCULATE MINIMUM NUMBER OF BOLTS

Part 1: Calculation of Minimum Number of Tensile Bolts for Horizontal Pull

$$N\sigma_1 = 1 + INT\left\{\frac{1}{Y\sigma}\left[\frac{PH}{L} - \frac{W}{2}\right]\right\}$$ Where $N\sigma_1$ is the minimum number of Tensile Bolts for Horizontal Pull

Multiply Wire Load by Height of Point of Action, PH = Line (7) × Line (3)	1588279	lb-in	(15)
Divide Line (15) by Length of Base, PH/L = Line (15) / Line (1)	22059	lb	(16)
Enter one-half of the Weight of the Winch, $W/2$ = 0.5 × Line (5)	2800	lb	(17)
Subtract Line (17) from Line (16); If negative, enter zero, PH/L - $W/2$ = Line (16) - Line (17)	19259	lb	(18)
Divide Line (18) by Line (9) and enter the whole number (integer) part. If Line (18) is zero, enter zero	1		(19)
Add one (1) to value in Line (19), $N\sigma_1$	2		(20)

Part 2: Calculation of Minimum Number of Tensile Bolts for Upwards Pull

$$N\sigma_{2B} = 1 + INT\left\{\frac{1}{Y\sigma}\left[P\cos(\theta)\frac{H}{L} + P\sin(\theta)\frac{(L-X)}{L} - \frac{W}{2}\right]\right\}$$

Where $N\sigma_{2B}$ is the minimum number of Tensile Bolts for Upwards Pull at back of winch

If θ = 0 deg, enter the value from Line (20) on Line (31) and proceed to Part 3.

Enter the Cosine of angle θ (refer to Section 4), cos(θ)	0.8090		(21)
Enter the Sine of angle θ (refer to Section 4), sin(θ)	0.5878		(22)
Multiply Line (16) by cos(θ), $P\cos(\theta)\,H/L$ = Line (16) × Line (21)	17846	lb	(23)
Multiply Wire Load by sin(θ), $P\sin(\theta)$ = Line (7) × Line (22)	14072	lb	(24)
Subtract the longitudinal location of the point of action from the length of base, $L - X$ = Line (1) - Line (2)	55.744	in	(25)

Multiply Line (24) by Line (25),
$P\sin(\theta)(L-X)$ = Line (24) × Line (25) .... 784455 lb-in (26)

Divide Line (26) by length of base,
$P\sin(\theta)(L-X)/L$ = Line (26) / Line (1) .... 10895 lb (27)

Add Line (23) and Line (27), Line (23) + Line (27) .... 28742 lb (28)

Subtract Line (17) from Line (28); If negative, enter zero,
Line (28) - Line (17) .... 25942 lb (29)

Divide Line (29) by Line (9) and enter the whole number
(integer) part. If Line (29) is zero, enter zero 2 (30)

Add one (1) to value in Line (30), $N\sigma_{2B}$ 3 (31)

$$N\sigma_{2F} = 1 + INT\left\{\frac{1}{Y\sigma}\left[-P\cos(\theta)\frac{H}{L} + P\sin(\theta)\frac{X}{L} - \frac{W}{2}\right]\right\}$$

Where $N\sigma_{2F}$ is the minimum number of Tensile Bolts for Upwards Pull at front of winch

Multiply Line (24) by the longitudinal location of the point of action,
$P\sin(\theta)X$ = Line (24) × Line (2) .... 228762 lb-in (32)

Divide Line (30) by length of base,
$P\sin(\theta)X/L$ = Line (32) / Line (1) .... 3177 lb (33)

Enter the value from Line (23) .... 17846 lb (34)

Subtract Line (34) from Line (33); If negative, enter zero,
Line (33) - Line (34) .... 0 lb (35)

Enter the value from Line (17) .... 2800 lb (36)

Subtract Line (36) from Line (35); If negative enter zero,
Line (35) - Line (36) .... 0 lb (37)

Divide Line (37) by Line (9) and enter the whole number
(integer) part. If Line (37) is zero, enter zero 0 (38)

Add one (1) to value in Line (38), $N\sigma_{2F}$ 1 (39)

Enter the larger of the values from Line (31) and (39), $N\sigma_2$ 3 (40)

Part 3: Minimum Number of Tensile Bolts

$$N\sigma = Maximum(N\sigma_1, N\sigma_2)$$

Enter the larger of the values from Lines (20) and (40), $N\sigma$ 3 (41)

If Line (41) is greater than six (6) then contact naval architect for engineering review.

Part 4: Minimum Number of Bolts for Shear

$$N\tau = 1 + INT\left\{\frac{P}{Y\tau}\right\}$$

Divide the Wire Load by Yield Shear Capacity and enter the whole number (integer) part,
$INT(P / Y\tau)$ = INT(Line (7) / Line (11)) 2 (42)

Add one (1) to value in Line (42), $N\tau$ 3 (43)

Part 5: Total Number of Bolts

$$N = Maximum(N\sigma + 2, N\tau)$$

Add two (2) to the value entered on Line (41), $N\sigma + 2$ 5 (44)

Enter the value from Line (43), $N\tau$ 3 (45)

Enter the larger of the values from Lines (44) and (45) 5 (46)

If Line (46) is greater than twelve (12), contact naval architect for engineering review.

Part 6: Gross Deck Load Check

Weight of wire rope,
Line (12) × Line (13).. 4596 lb (47)

Gross weight of winch,
Line (5) + Line (47).. 10196 lb (48)

Nominal effective area of winch base,
Line (1) × Line (14).. 5184 in^2 (49)

Gross downward unit deck load,
Line (48) / Line (49)... 1.967 psi (50)

If Line (50) is greater than 8.33 psi, contact naval architect for engineering review.

Enter value from Line (24)	14072	lb	(51)
Enter value from Line (5)	5600	lb	(52)
Subtract Line (52) from Line (51), Line (51) - Line (52)	8472	lb	(53)
Gross upward unit deck load, Line (53) / Line (49)..	1.634	psi	(54)

If Line (54) is greater than 8.33 psi, contact naval architect for engineering review.

The example calculation determines the need for a minimum of three (3) tensile bolts and a total of five (5) bolts overall. An acceptable arrangement of these required bolts is illustrated below:

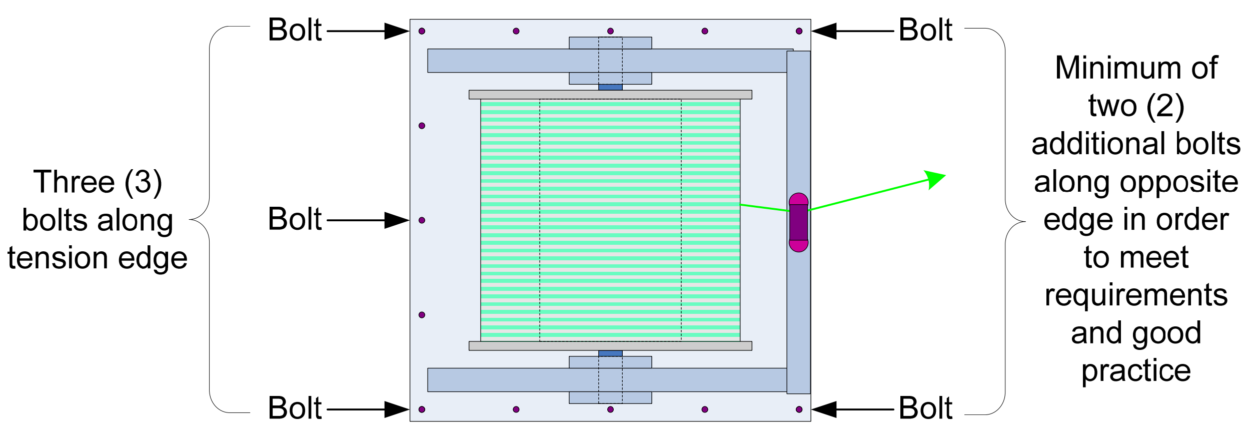


Table of Sines and Cosines: Section 4

θ [degrees]	Sine	Cosine		θ [degrees]	Sine	Cosine
0	0.0000	1.0000		45	0.7071	0.7071
1	0.0175	0.9998		46	0.7193	0.6947
2	0.0349	0.9994		47	0.7314	0.6820
3	0.0523	0.9986		48	0.7431	0.6691
4	0.0698	0.9976		49	0.7547	0.6561
5	0.0872	0.9962		50	0.7660	0.6428
6	0.1045	0.9945		51	0.7771	0.6293
7	0.1219	0.9925		52	0.7880	0.6157
8	0.1392	0.9903		53	0.7986	0.6018
9	0.1564	0.9877		54	0.8090	0.5878
10	0.1736	0.9848		55	0.8192	0.5736
11	0.1908	0.9816		56	0.8290	0.5592
12	0.2079	0.9781		57	0.8387	0.5446
13	0.2250	0.9744		58	0.8480	0.5299
14	0.2419	0.9703		59	0.8572	0.5150
15	0.2588	0.9659		60	0.8660	0.5000
16	0.2756	0.9613		61	0.8746	0.4848
17	0.2924	0.9563		62	0.8829	0.4695
18	0.3090	0.9511		63	0.8910	0.4540
19	0.3256	0.9455		64	0.8988	0.4384
20	0.3420	0.9397		65	0.9063	0.4226
21	0.3584	0.9336		66	0.9135	0.4067
22	0.3746	0.9272		67	0.9205	0.3907
23	0.3907	0.9205		68	0.9272	0.3746
24	0.4067	0.9135		69	0.9336	0.3584
25	0.4226	0.9063		70	0.9397	0.3420
26	0.4384	0.8988		71	0.9455	0.3256
27	0.4540	0.8910		72	0.9511	0.3090
28	0.4695	0.8829		73	0.9563	0.2924
29	0.4848	0.8746		74	0.9613	0.2756
30	0.5000	0.8660		75	0.9659	0.2588
31	0.5150	0.8572		76	0.9703	0.2419
32	0.5299	0.8480		77	0.9744	0.2250
33	0.5446	0.8387		78	0.9781	0.2079
34	0.5592	0.8290		79	0.9816	0.1908
35	0.5736	0.8192		80	0.9848	0.1736
36	0.5878	0.8090		81	0.9877	0.1564
37	0.6018	0.7986		82	0.9903	0.1392
38	0.6157	0.7880		83	0.9925	0.1219
39	0.6293	0.7771		84	0.9945	0.1045
40	0.6428	0.7660		85	0.9962	0.0872
41	0.6561	0.7547		86	0.9976	0.0698
42	0.6691	0.7431		87	0.9986	0.0523
43	0.6820	0.7314		88	0.9994	0.0349
44	0.6947	0.7193		89	0.9998	0.0175
45	0.7071	0.7071		90	1.0000	0.0000