P14031 Test Plan Summary

Spec #	Metric/Specification	Units	Marginal	Target	Direction	Test Plan	Sonar Needed	Sailing Req'd	Actual	Concluded Condition
S1	Transfer time	sec	5	2	↓	TP1	X	X	3 sec	O
S2	User reach distance to jib lines	in	25	15	↓	TP2	X		19"	O
S3	Does design only contain mechanical parts?	yes/no	Yes	Yes	X	TP3			Yes	O
S4	Distance between existing bench and seat	mm	200	minimize	↓	TP4	X		6" (152.4 mm)	O
S5	Does design require boat modification?	yes/no	No	No	X	TP3			No	O
S6	Is fixture permanently fastened to boat?	yes/no	No	No	X	TP3			No	O
S7	Device Weight	lbs	100	50	↓	TP5			51 lbs	O
S8	Device displacement from secured position	in	2	0	↓	TP6	X		0.75"	O
S9	Number of potential pinch points	count	5	0	↓	TP7	X		0, but there is 1 trip hazard	O
S10	User's unobstructed field of view (compared to no device use)	%	75	100	↑	TP8	X	X	100%	O
S12	Does the user have the option to secure their limbs?	yes/no	Yes	Yes	X	TP3			Yes	O
S13	Time to get into seat	min	5	2	↓	TP9	X	X	dependent on disability	Δ
S14	Time to get out of seat	min	5	2	↓	TP9	X	X	dependent on disability	Δ
S15	Weight capacity	lbs	220	265	↑	TP10			215 lbs (ANSYS simulation shows failure at ~300 lbs, but team could not test to device failure)	Δ
S16	Are all components chosen for corrosion resistant properties?	yes/no	Yes	Yes	X	TP3			Yes	O
S17	Time to install device in Sonar	min	20	5	↓	TP11	X	X	4.5 minutes	O
S18	Number of installation steps	count	10	5	↓	TP11	X		6 steps	O
S19	Max horizontal distance from boat centerline	in	21	24	↑	TP12	X		23"	O
S20	Degrees of rotation	degrees	+/- 30	+/-45	↑	TP13	X		+/- 90	O
S21	Vertical distance between seat and boom	in	33	38	↑	TP14	X		34.5"	O
S22	Number of parts requiring specialized equipment to manufacture.	count	5	0	↓	TP15			1 part	O
S23	Number of custom parts used in design (custom parts cannot be purchased 'off-the-shelf' in a store or online)	count	5	0	↓	TP15			1 part	O
S24	Time to remove device from Sonar	min	20	5	↓	TP16	X	X	2.5 minutes	O
S25	Number of steps to uninstall device	count	10	5	↓	TP16	X		6 steps	O
S26	% of users who find seat "comfortable"	%	60	75	↑	TP17			Mfgr chooses seat that fits needs	Δ
S27	Depth of plywood groove after 13500 rotations (~5 years)	in	0.23	0.10	↓	TP18			depth = 0.025 in	O

KEY - TEST RESULTS	
X	Does not meet expectation
Δ	Caution-Undetermined if specification is met
O	Meets specification

Test Plan # 1 (TP1) - Transfer time between port and starboard

Back to P14031 Test Plan Summary

Test Team:

Test Location:

Test Date:

I. TESTING SPECIFICATION

Specification Number	Risk	Specification	Units	Marginal Value	Target Value	Comments/Status
S1	LOW	Transfer time	sec	5	2	Cannot test until device is fully built

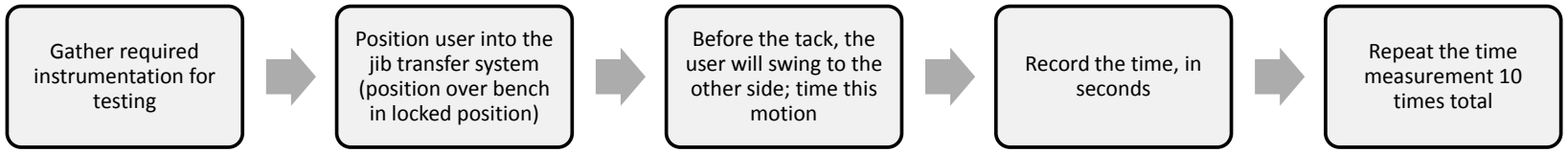
II. EQUIPMENT/CONDITIONS REQURIED

Specification Number	Equipment or Instrumentation required	Testing Conditions
S1	Completed Jib Transfer System Sonar Sailboat Stopwatch	Test under real sailing conditions - while on the water in order to obtain most accurate measurements. If these conditions are not available then it is possible to complete the test while stationary (test will show device does rotate; however, will provide unreliable results for transfer time conclusion)

III. DATA COLLECTION STRATEGY

Specification Number	Data Acquisition Strategy
S1	Conducting a time study will allow us to determine the time it takes to move the user between port and starboard. The transfer time is important because the user needs to be able to switch sides relatively quickly to maintain the appropriate weight distribution.

IV. TESTING FLOWCHART



V. RESULTS

The device was tested at a 15 degree heel angle and the results show approximately 3 second transfer time

VI. MITIGATION PLAN (IF NEEDED)

N/A

VII. CONCLUSION

The user will be able to transfer between port and starboard in an appropriate amount of time in order to maintain weight distribution

Test Plan # 2 (TP2) - Reach Distance to Jib Lines

Back to P14031 Test Plan Summary

Test Team: All

Test Location: Rochester Yacht Club (device installed in Sonar)

Test Date: 4/23/14

Concluded Condition

O

I. TESTING SPECIFICATION

Specification Number	Risk Level	Specification	Units	Marginal Value	Target Value	Comments/Status
S2	MED	User reach distance to jib lines	in	25	15	Cannot complete test until device is fully built

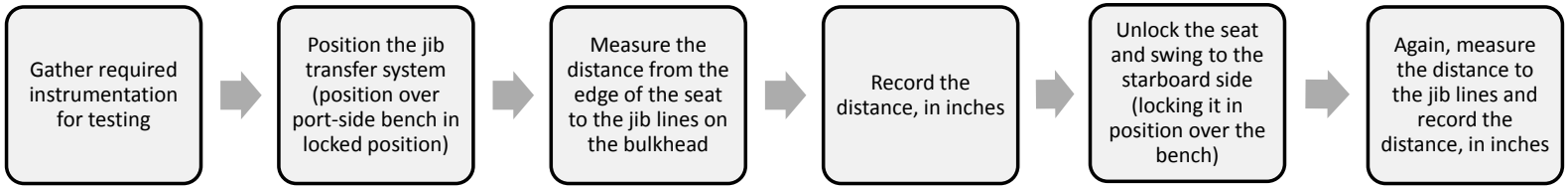
II. EQUIPMENT/CONDITIONS REQURIED

Specification Number	Equipment or Instrumentation required	Testing Conditions
S2	Completed Jib Transfer System Sonar Sailboat Tape Measure	None - Test can be completed while Sonar is out of water

III. DATA COLLECTION STRATEGY

Specification Number	Data Acquisition Strategy
S2	Measuring the maximum distance from the seat to the jib lines will allow the team to conclude that the jib system allows the user to reach the existing jib lines. We want the distance the user has to reach, in order to hold the jib lines, to be comfortable and not cause an excessive strain on their body.

IV. TESTING FLOWCHART



V. RAW DATA ACQUISITION

	Distance
Port-side locked position	19"
Starboard locked position	19"

VI. RESULTS

The distance for the user to access the jib lines is the same from both port and starboard locked positions, at 19"

VII. MITIGATION PLAN (IF NEEDED)

If the jib lines are not accessible by the user then the team can consider two options:

1) Moving the device more forward in the boat (if possible)

2) bringing the jib lines to the user by building another subsystem into the jib transfer system that feeds the existing jib lines within the user's reach

VIII. CONCLUSION

No mitigation action needed. The user is able to reach the jib lines from both port and starboard locked positions

Test Plan # 3 (TP3) - Yes/No Questions

Back to P14031 Test Plan Summary

Test Team: All

Test Location: Rochester Yacht Club (device installed in Sonar)

Test Date: 4/23/14

Concluded Condition

O

I. TESTING SPECIFICATION

Spec #	Risk Level	Specification	Units	Marginal Value	Target Value	Comments/Status
S3	LOW	Does design only contain mechanical parts?	yes/no	Yes	Yes	
S5	LOW	Does design require boat modification?	yes/no	No	No	Able to test concurrently with TP1, when the system is installed in the Sonar
S6	LOW	Is fixture permanently fastened to boat?	yes/no	No	No	Able to prove concurrently with TP16, when the system is uninstalled from the Sonar
S12	MED	Does the user have the option to secure their limbs?	yes/no	Yes	Yes	
S16	LOW	Are all components chosen for corrosion resistant properties?	yes/no	Yes	Yes	Corrosion testing on components not needed because using SS, aluminum, and plastic. These materials are known to be corrosion resistant

II. EQUIPMENT/CONDITIONS REQURIED

Spec #	Equipment/Instrumentation/Material required	Testing Conditions
S3	Completed BOM	N/A
S5	None	N/A
S6	None	N/A
S12	Completed Jib Transfer System 'Ace' Bandage	Device needs to be stable to that the user can sit in the seat for testing
S16	Completed BOM	N/A

III. DATA COLLECTION STRATEGY

Spec #	Data Acquisition Strategy
S3	The jib transfer system will comply with ISAF/IFDS Regulations if there are no electronic components. Complying with these regulations allows for the device to be used in competitive sailing. This test determines compliance with the ISAF/IFDS Regulations.
S5	The jib transfer system will comply with ISAF/IFDS Regulations if the device does not require modification of the Sonar (drilling into the boat, cutting into the boat, etc.) Complying with these regulations allows for the device to be used in competitive sailing. This test determines compliance with the ISAF/IFDS Regulations.
S6	The jib transfer system will comply with ISAF/IFDS Regulations if the device is not permanently installed in the boat. By proving that the jib transfer system is removable from the Sonar, the design will comply with this regulation. Complying with these regulations allows for the device to be used in competitive sailing. This test determines compliance with the ISAF/IFDS Regulations.
S12	The purpose of this test is to confirm the device allows the user to secure their lower limbs, which they may not have full control of. If the user has the option to secure their legs to the base, then the specification is met.
S16	Corrosion testing

IV. TESTING PROCEDURE

S3	When the device is complete, check the BOM for electronic components. If there are none, the specification has been met
S5	When the device is installed into the Sonar, verify the installation process does not require any modifications to the Sonar. If there a no modifications, the specification has been met
S6	At the completion of TP16, the jib transfer system will be removed from the Sonar. The specification has been met when the device is removed from the Sonar.
S12	After the device is installed in the Sonar, have a user sit in the seat and place their legs on the base (between the 2 PVC legs). Using an "Ace Bandage" see if the users legs are able to be secured between the PVC leg supports. Record the result
S16	When the components are purchased, ensure only the corrosion resitant material components are bought. If these materials are used, the specification has been met

V. RESULTS

S3	No electronic components on BOM
S5	Installed in Sonar on 4/23/14 - no modifcations to Sonar needed for proper device fit & function
S6	System was uninstalled from Sonar on 4/23/14 after testing - the device is not permanently fastened to the boat
S12	User's legs are able to fit between the PVC arm assembly - Piers Park can chose to add a strap depending on the user's needs
S16	All hardware components chosen with corrosion resistant properties

VI. MITIGATION PLAN (IF NEEDED)

S3	If there are electonic components in the BOM at completion, a note needs to be added to the instructional information that the device does not comply with sailing racing regulations. The jib transfer system will not be allowed for the user in a race.
S5	If there are Sonar modifications required during installation, a note needs to be added to the instructional information that the device does not comply with sailing racing regulations. The jib transfer system will not be allowed for the user in a race.
S6	If the device is permanently installed into the Sonar - and not able to be removed- a note needs to be added to the instructional information that the device does not comply with sailing racing regulations. The jib transfer system will not be allowed for the user in a race.
S12	N/A
S16	N/A

VII. CONCLUSION

No mitigation action needed. All specifications for TP 3 are satisfied

Test Plan # 4 (TP 4) - Distance between bench and device seat

Back to P14031 Test Plan Summary

Test Team: All

Test Location: Rochester Yacht Club (device installed in Sonar)

Test Date: 4/23/14

Concluded Condition

O

I. TESTING SPECIFICATION

Specification Number	Risk Level	Specification	Units	Marginal Value	Target Value	Comments/Status
S4	MED	Distance between existing bench and seat	mm	200	minimize	

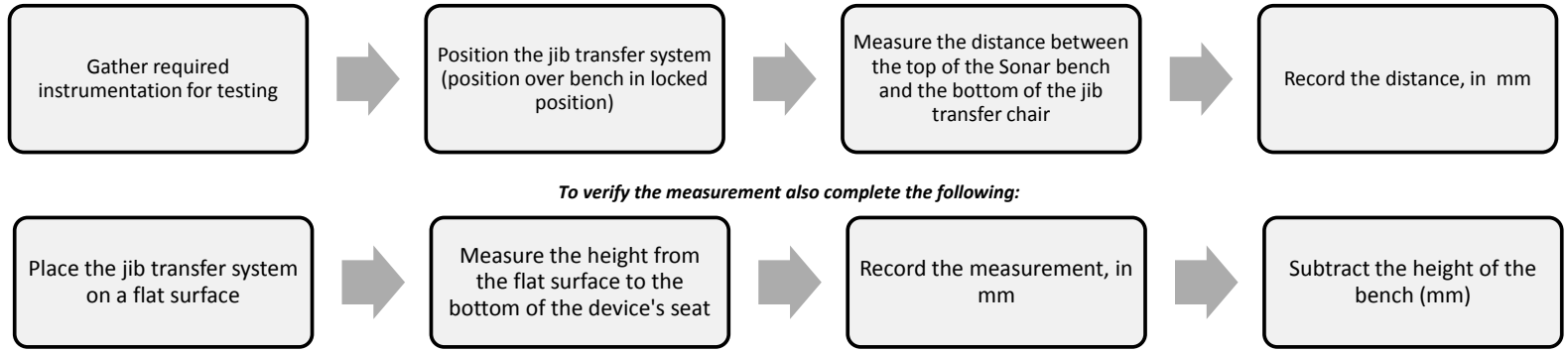
II. EQUIPMENT/CONDITIONS REQURIED

Specification Number	Equipment or Instrumentation required	Testing Conditions
S4	Completed base of system built Sonar Sailboat Tape Measure	PVC chair needs to be assembled, but NOT glued together

III. DATA COLLECTION STRATEGY

Specification Number	Data Acquisition Strategy
S4	The jib transfer system will comply with ISAF/IFDS Regulations if the vertical distance between the existign Sonar bench seat and the jib transfer system seat is less than 200mm. Complying with these regulations allows for the device to be used in competitive sailing. This test determines compliance with the ISAF/IFDS Regulations.

IV. TESTING FLOWCHART



V. RESULTS

Measurement from Sonar's existing bench seat to the top of the device's seat (where the user is seated) is ~6"

VI. MITIGATION PLAN (IF NEEDED)

If the height between the existing bench and the device seat is > 200mm then the team will not glue the PVC chair together. The team will re-evaluate the design to modify the height of the PVC chair. If this is not possible, the device will still function but will not comply with the ISAF/IFDS Racing Regulations. If the device does not comply with the racing regulations, a note needs to be added to the instructional information.

VII. CONCLUSION

The device complies with the ISAF/IFDS Regulations of being <200mm (~7.87 inches).
Complying with this regulation allows the assistive device to be used in competitive sailing

Test Plan # 5 (TP 5) - Weight of Jib Transfer System

Back to P14031 Test Plan Summary

Test Team: M. Brunelle, K. Wurman

Test Location: College of Engineering Machine Shop

Test Date: 4/28/14

Concluded Condition

O

I. TESTING SPECIFICATION

Specification Number	Risk Level	Specification	Units	Marginal Value	Target Value	Comments/Status
S7	MED	Device Weight	lbs	100	50	

II. EQUIPMENT/CONDITIONS REQURIED

Specification Number	Equipment or Instrumentation required	Testing Conditions
S7	Completed System Assembled Scale (lg enough to place system on)	N/A

III. DATA COLLECTION STRATEGY

Specification Number	Data Acquisition Strategy
S7	Weighing the device will ensure that the customer requirement of "lightweight" has been met. Since the volunteers at Piers Park are responsible for installing/un-installing the assitive devices, the weight is an important factor. If a device is too heavy then more volunteers are needed.

IV. TESTING PROCEDURE

When the device is completed, bring it to the KGCOE Machine Shop. Place the device on the scale and record weight, to the nearest pound. If the device is too large to place on the scale, the base and seat will be weighed separately. The indiidual components will then be summed to obtain the overall system weight.

VI. RESULTS

Whole device fits on scale for measurement - Total system weight is 51 lbs

VII. MITIGATION PLAN (IF NEEDED)

N/A

VIII. CONCLUSION

The device weight of 51 lbs is significanly less than the previous project iteration.
With a total system weight of 51 lbs, two volunteers are needed to safely install and uninstall the device from the Sonar

Test Plan # 6 (TP 6) - Secure Device Fit in Sonar

Back to P14031 Test Plan Summary

Test Team: All

Test Location: Rochester Yacht Club (device installed in Sonar)

Test Date: 4/23/14

Concluded Condition

O

I. TESTING SPECIFICATION

Specification Number	Risk Level	Specification	Units	Marginal Value	Target Value	Comments/Status
S8	MED	Device displacement from secured position	in	2	0	

II. EQUIPMENT/CONDITIONS REQURIED

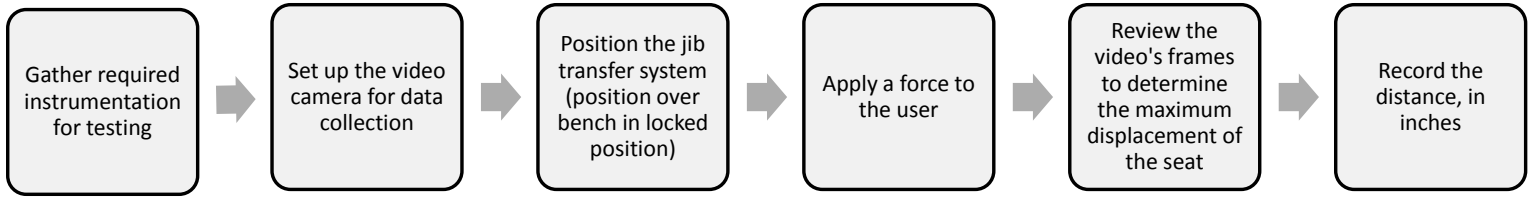
Specification Number	Equipment or Instrumentation required	Testing Conditions
S8	Completed System Assembled Sonar Sailboat Tape Measure Video Camera	Device needs to be secured in a Sonar. The user will have a force applied to them in order to measure the displacement of the system.

III. DATA COLLECTION STRATEGY

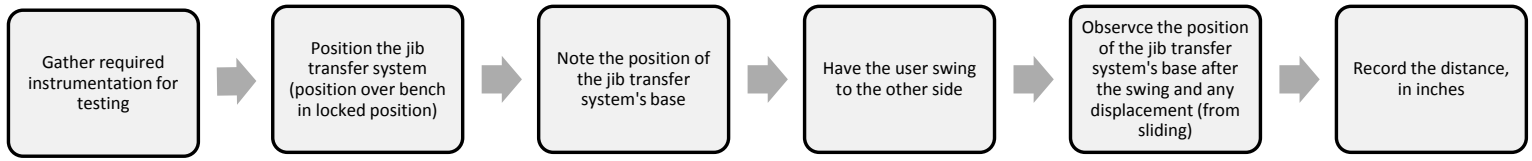
Specification Number	Data Acquisition Strategy
S8	The purpose of the test is determine how secure the jib transfer system fits in the Sonar. If the specification is met then the jib transfer systems was designed to the appropriate Sonar dimensions and fits securely in the sailboat.

IV. TESTING FLOWCHART

Testing procedure for displacement of user and seat:



Testing procedure for displacement of the device base:



V. RESULTS

The device displaces 0.50"-0.75" from it's initial secured position

VI. MITIGATION PLAN (IF NEEDED)

If the device moves > 2 inches then the team will re-evaluate the design of the securing mechanism, finding a way to secure the device to the Sonar more effectively

VII. CONCLUSION

The device is secure in the Sonar and is safe for use

Test Plan # 7 (TP 7) - Pinch Points

Back to P14031 Test Plan Summary

Test Team: All

Test Location: Rochester Yacht Club (device installed in Sonar)

Test Date: 4/23/14

Concluded Condition

O

I. TESTING SPECIFICATION

Specification Number	Risk Level	Specification	Units	Marginal Value	Target Value	Comments/Status
S9	MED	Number of potential pinch points	count	5	0	Cannot test until device is complete

II. EQUIPMENT/CONDITIONS REQURIED

Specification Number	Equipment or Instrumentation required	Testing Conditions
S9	Completed Jib Transfer System Sonar Sailboat	Device should be installed in the Sonar to accurately estimate pinch points in the real use environment

III. DATA COLLECTION STRATEGY

Specification Number	Data Acquisition Strategy
S9	This ergonomic analysis will determine the relative safety of the device for the user - and others in the boat - based on the number of pinch points.

IV. TESTING PROCEDURE

After the jib transfer system is installed in the Sonar, count the number of pinch points that pose a safety hazard to the user. Develop countermeasures to reduce the severity or likeliood of injury from these pinch points. Publish this information in the instruction manual.

V. RESULTS

Analysis shows no pinch points because the spring and all moving components are covered by the bases
The addition of handles to the bottom base did create one trip hazard (hazard for the user and the other people in the Sonar)

VI. MITIGATION PLAN (IF NEEDED)

N/A

VII. CONCLUSION

There is limited safety hazards for the user while using the device
The one trip hazard created by the handles on the bottom base will be outlined as a warning in the user manual

Test Plan # 8 (TP 8) - Unobstructed View

Back to P14031 Test Plan Summary

Test Team: All

Test Location: Rochester Yacht Club (device installed in Sonar)

Test Date: 4/23/14

Concluded Condition

O

I. TESTING SPECIFICATION

Specification Number	Risk Level	Specification	Units	Marginal Value	Target Value	Comments/Status
S10	LOW	User's unobstructed field of view (compared to no device use)	%	75	100	test after complete

II. EQUIPMENT/CONDITIONS REQURIED

Specification Number	Equipment or Instrumentation required	Testing Conditions
S10	Complete jib transfer system Sonar Sailboat	Ideally want to test under sailing conditions, but it is possible to test with device in a secure position

III. DATA COLLECTION STRATEGY

Specification Number	Data Acquisition Strategy
S10	By obtaining the user's estimated unobstructed field of view, the team will be able to determine if the device inhibts the user's ability to see their surroundings. The jib trimmer is often the "eyes of the boat" and needs to be able to see as much as possible of their field of view

IV. TESTING PROCEDURE

Gather required instrumentation and materials for testing → Have user sit on the existing bench of the Sonar and note what is in their field of view → Position the jib transfer system (position over bench in locked position) → Have the user sit in the device seat and note what is in their field of vision → Estimate the % of field of view that is unobstructed while in the jib transfer system seat*

*This is a subjective test and needs to be brainstormed further to see if another test is more suitable, or if the metric for the function needs to be changed

V. RESULTS

100% field of view is unobstructed (the user can see the same field of view they would have without the device)

VI. MITIGATION PLAN (IF NEEDED)

N/A

VII. CONCLUSION

The user has the same field of view they would have without the use of the device --> 100% of the user's field of view is unobstructed

** The user may actually have an advantage because they are positioned ~6" higher than if no device was used **

Test Plan # 9 (TP9) - Getting into/out of the device

Back to P14031 Test Plan Summary

Test Team: All

Test Location: Rochester Yacht Club (device installed in Sonar)

Test Date: 4/23/14

Concluded Condition

Δ

I. TESTING SPECIFICATION

Spec #	Risk Level	Specification	Units	Marginal Value	Target Value	Comments/Status
S13	LOW	Time to get into seat	min	5	2	
S14	LOW	Time to get out of seat	min	5	2	

II. EQUIPMENT/CONDITIONS REQURIED

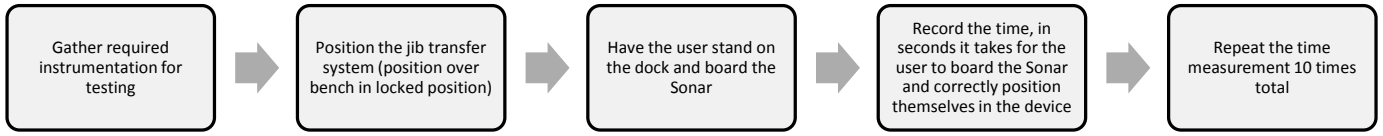
Spec #	Equipment/Instrumentation/Material required	Testing Conditions
S13	Completed Jib Transfer System Sonar Sailboat Stopwatch	Test under real sailing conditions - while on the water in order to obtain most accurate measurements. If these conditions are not available then it is possible to complete the test while stationary (test will not consider the reduce stability of the Sonar while it is in the water, or in a hoist)
S14	Completed Jib Transfer System Sonar Sailboat Stopwatch	

III. DATA COLLECTION STRATEGY

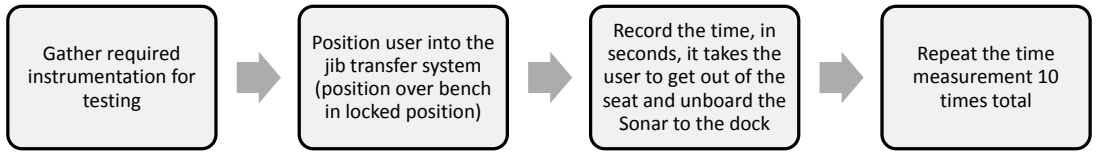
Spec #	Data Acquisition Strategy
S13	Conducting a time study will allow us to determine the time it takes to position a user into the seat. The entry time is important because the user wants to be able to easily begin using the device. A lengthy process to set the user up in the seat may be discourgaing and take away the freedom associated with sailing
S14	Conducting a time study will allow us to determine the time it takes to position a release themselves from the seat. The exit time is important because the user wants to be able to easily stop using the device. A lengthy process to get the user out of the seat may be discourgaing

IV. TESTING FLOWCHART

S13



S14



V. RESULTS

Cannot complete test

VI. MITIGATION PLAN (IF NEEDED)

N/A

VII. CONCLUSION

The time it takes for the user to get in and out of the seat is fully dependent on the user's disabilities

The test team is able to get in and out of the seat in <<1 minute, which meets the specification

No testing was complete with disabled users; however, the team is confident that the user will be able to position themselves in the seat in the 2-5min range

Test Plan # 10 (TP 10) - Weight Capacity

Back to P14031 Test Plan Summary

Test Team:

Test Location:

Test Date:

I. TESTING SPECIFICATION

Specification Number	Risk Level	Specification	Units	Marginal Value	Target Value	Comments/Status
S15	LOW	Weight capacity	lbs	220	265	cannot test until device is built

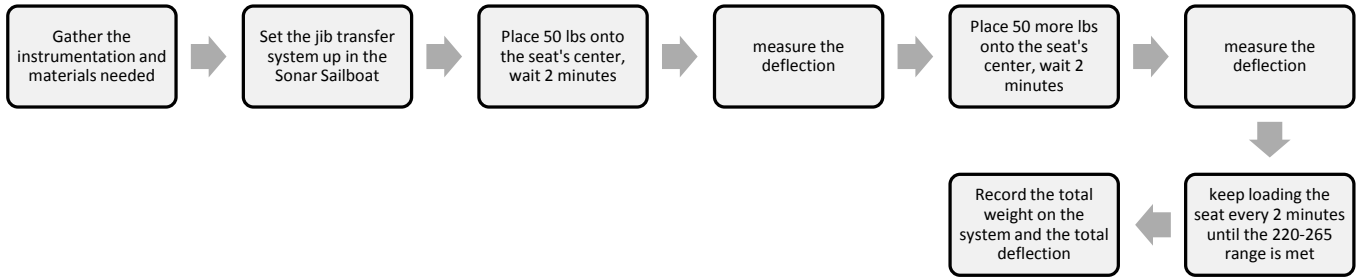
II. EQUIPMENT/CONDITIONS REQURIED

Specification Number	Equipment or Instrumentation required	Testing Conditions
S15	Sonar Sailboat Weights - up to a combined 265 lbs Tape Measure	Jib Transfer System needs to be installed into the Sonar. If a Sonar is not available for testing, then the device needs to be secured in position so that it is able to ungergo testing

III. DATA COLLECTION STRATEGY

Specification Number	Data Acquisition Strategy
S15	Determining the weight capacity of the system is a key piece of information that needs to be included in the instructional manual. If the specification is met, then the device is able to accommodate a wide range of users.

IV. TESTING FLOWCHART



V. RAW DATA ACQUISITION

ANSYS simulation shows device will fail at 260 lbs

The team cannot test the device to failure, but knows that it can hold at least 215 lbs

VI. RESULTS

VII. MITIGATION PLAN (IF NEEDED)

VIII. CONCLUSION

The device is able to accommodate a range of users, given that it can hold at least 215 lbs (most likely more given ANSYS analysis)

Test Plan # 11 (TP11) - Installation of Jib Transfer System

Back to P14031 Test Plan Summary

Test Team: All

Test Location: Rochester Yacht Club (device installed in Sonar)

Test Date: 4/23/14

Concluded Condition
O

I. TESTING SPECIFICATION

Spec #	Risk Level	Specification	Units	Marginal Value	Target Value	Comments/Status
S17	LOW	Time to install device in Sonar	min	20	5	
S18	LOW	Number of installation steps	count	10	5	The assumption is a device with a fewer number of steps will be easier for the user to install in the sailboat

II. EQUIPMENT/CONDITIONS REQURIED

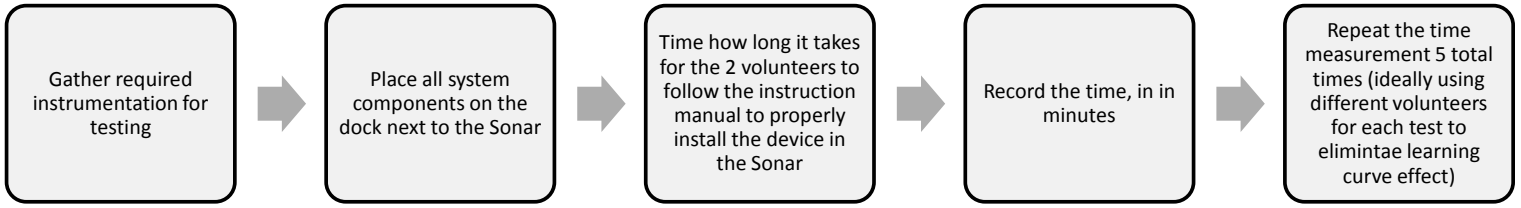
Spec #	Equipment/Instrumentation/Material required	Testing Conditions
S17	Completed Jib Transfer System Sonar Sailboat Volunteers	Testing should occur while the Sonar is docked on the water (or in a hoist) in order to represent real installation conditions. The volunteers used for testing will have limited to no knowledge of the device to represent the volunteers at Piers Park who may have no existing knowledge.
S18	None	None

III. DATA COLLECTION STRATEGY

Spec #	Data Acquisition Strategy
S17	Conducting a time study, with multiple users, to obtain the average time it takes for two individuals to properly install the device in the Sonar will allow the team to evaulate the ease of installation.
S18	Determining the number of steps in the installation manual will allow the team to evaluate the ease of installation.

IV. TESTING FLOWCHART

S17



S18	Count the number of steps in the completed installation manual and record the number

V. RESULTS

S17	4.5 minutes
S18	6 steps

VI. MITIGATION PLAN (IF NEEDED)

S17	N/A
S18	N/A

VII. CONCLUSION

The device is easy to install, requiring < 5 minutes for 2 people to complete the installation process.
It is not possible to install the device with less than 2 people due to the size
The instruction manual clearly states in 6 steps how to properly install the system into the Sonar

Test Plan # 12 (TP 12) - Max User Distance from Centerline

Back to P14031 Test Plan Summary

Test Team: All

Test Location: Rochester Yacht Club (device installed in Sonar)

Test Date: 4/23/14

Concluded Condition

O

I. TESTING SPECIFICATION

Specification Number	Risk Level	Specification	Units	Marginal Value	Target Value	Comments/Status
S19	LOW	Max horizontal distance from boat centerline	in	21	24	

II. EQUIPMENT/CONDITIONS REQURIED

Specification Number	Equipment or Instrumentation required	Testing Conditions
S19	Completed Jib Transfer System Sonar Sailboat Masking Tape Measuring Tape	The device needs to be properly installed in the Sonar, but the Sonar does not need to be on the water.

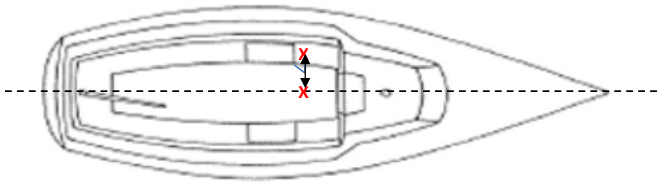
III. DATA COLLECTION STRATEGY

Specification Number	Data Acquisition Strategy
S19	The distance that the user is able to move to from the centerline is important because the user needs to be able to maintain the appropriate weight distribution. Jib Trimmers who do not need assistive devices are able to place themselves past the bench seats (seating themselves on the edge of the Sonar). If the specification is met, then the jim trimmer in the device will be able to provide sufficient weight distribution.

IV. TESTING FLOWCHART

Gather required instrumentation for testing → Place a piece of masking tape at the centerline of the sonar, as a reference → Position the jib transfer system (position over bench in locked position) → Place a piece of masking tape on the bench, at the back of the device seat → measure the horizontal distance between these two pieces of tape → subtract 1/2 the depth of the device seat (to obtain the distance in relation to the center of the seat) → Repeat with the device over the other Sonar bench

V. RAW DATA ACQUISITION



VI. RESULTS

23" distance between centerline and back of seat (when positioned over the bench)

VII. MITIGATION PLAN (IF NEEDED)

N/A

VIII. CONCLUSION

The jib trimmer can provide sufficient weight distribution while using the device

Test Plan # 13 (TP13) - Degrees of Rotation from Centerline

Back to P14031 Test Plan Summary

Test Team: All

Test Location: Rochester Yacht Club (device installed in Sonar)

Test Date: 4/23/14

Concluded Condition

O

I. TESTING SPECIFICATION

Specification Number	Risk Level	Specification	Units	Marginal Value	Target Value	Comments/Status
S20	LOW	Degrees of rotation	degrees	+/- 30	+/-45	cannot test until device is built

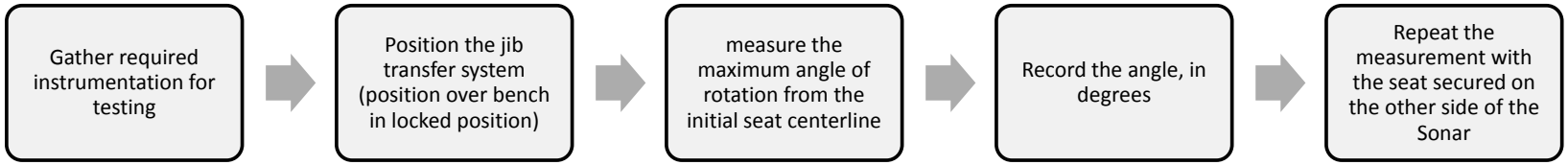
II. EQUIPMENT/CONDITIONS REQURIED

Specification Number	Equipment or Instrumentation required	Testing Conditions
S20	Completed Jib Transfer System Sonar Sailboat Tape Measure	Device needs to be installed in the Sonar; however, the Sonar does not need to be in the water. If a Sonar is not available for testing, then the test can be conducted knowing the internal dimensions of the Sonar

III. DATA COLLECTION STRATEGY

Specification Number	Data Acquisition Strategy
S20	Determining the degrees of rotation will allow the team to conclude that there is a large range of movement for the jib trimmer while using the assistive device.

IV. TESTING FLOWCHART



VI. RESULTS

Device can swing +/- 90 degrees from the centerline of the boat

VII. MITIGATION PLAN (IF NEEDED)

N/A

VIII. CONCLUSION

There is a large range of motion for the jib trimmer while using the assistive device

Test Plan # 14 (TP14) - Boom and Head Collision

Back to P14031 Test Plan Summary

Test Team: All

Test Location: Rochester Yacht Club (device installed in Sonar)

Test Date: 4/23/14

Concluded Condition

O

I. TESTING SPECIFICATION

Specification Number	Risk Level	Specification	Units	Marginal Value	Target Value	Comments/Status
S21	HIGH	Vertical distance between seat and boom	in	33	38	

II. EQUIPMENT/CONDITIONS REQURIED

Specification Number	Equipment or Instrumentation required	Testing Conditions
S21	Completed Jib Transfer System Sonar Sailboat Measuring Tape	Device needs to be installed in the Sonar and the boom needs to be positioned at its lowest point (directly down the centerline of the sailboat)

III. DATA COLLECTION STRATEGY

Specification Number	Data Acquisition Strategy
S21	Determining the vertical distance between the device seat and boom will determine the likelihood that the user's head will come in contact with the boom. If the specification is met, then the user should not have to worry about the boom hitting their head.

IV. TESTING PROCEDURE

Gather required instrumentation for testing → Position the jib transfer system at the centerline of the Sonar(this is not a locked position) → Position the boom to the minimum height at the centerline of the Sonar → Measure the distance from the top of the device seat to the bottom of the boom → Record this distance, in inches

V. RESULTS

Height between the seat top (where the user sits) and the boom is 34.5"

VI. MITIGATION PLAN (IF NEEDED)

If there is not enough distance between the boom and the device seat, there is a high probability that the boom will hit the user in the head. This is a big safety concern. In order to reduce the likelihood or severity of this hazard the team will need to incorporate warning labels on the device and in the instruction manual. In addition, the team will evaluate any minor design changes that could reduce this hazard.

VII. CONCLUSION

Most users should not have to worry about the hitting their head on the boom as they transfer
The user should still be aware of what is going on around them to ensure they are not injured while swinging between port and starboard

Test Plan # 15 (TP15) - Custom Parts Manufacturing

Back to P14031 Test Plan Summary

Test Team: All

Test Location: Rochester Yacht Club (device installed in Sonar)

Test Date: 4/23/14

Concluded Condition
O

I. TESTING SPECIFICATION

Spec #	Risk Level	Specification	Units	Marginal Value	Target Value	Comments/Status
S23	LOW	Number of parts requiring specialized equipment to manufacture.	count	5	0	Testing will occur periodically throughout the build phase. As parts are built, notes will be taken on the number of manufacturing processes and equipment used
S24	LOW	Number of custom parts used in design (custom parts cannot be purchased 'off-the-shelf' in a store or online)	count	5	0	

II. EQUIPMENT/CONDITIONS REQURIED

Spec #	Equipment/Instrumentation/Material required	Testing Conditions
S23	Completed Jib Transfer System	None
S24	None	None

III. DATA COLLECTION STRATEGY

Spec #	Data Acquisition Strategy
S23	The number of parts requiring specilized equipment to manufacture will relate to the ease of assembly, repdroduction, and cost. As the number increases these customer needs are less likely to be satisfied.
S24	Count number of parts that require more than 4 processes to manufacture.

IV. TESTING PROCEDURE

S23	Count the numer of parts that require specialized equipment to manufacture (specialized equipment is considered to be tools/machinery that the average person would not have in their posession).
S24	Count the number of parts that require more than 4 processes to manufacture.

V. RESULTS

S23	1 part
S24	1 part

VI. MITIGATION PLAN (IF NEEDED)

N/A

VII. CONCLUSION

The device only has one custom part that will need to be taken to a local machine shop for manufacturing
The specifications for TP15 are met

Test Plan # 16 (TP16) - Un-installation

Back to P14031 Test Plan Summary

Test Team: All

Test Location: Rochester Yacht Club (device installed in Sonar)

Test Date: 4/23/14

Concluded Condition

O

I. TESTING SPECIFICATION

Spec #	Risk Level	Specification	Units	Marginal Value	Target Value	Comments/Status
S24	LOW	Time to remove device from Sonar	min	20	5	Testing should occur after TP11 is complete
S25	LOW	Number of steps to uninstall device	count	10	5	

II. EQUIPMENT/CONDITIONS REQURIED

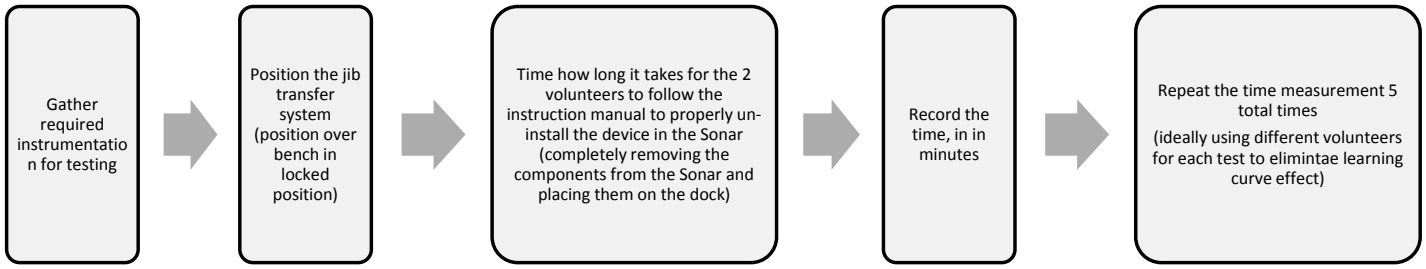
Spec #	Equipment/Instrumentation/Material required	Testing Conditions
S24	Completed Jib Transfer System Sonar Sailboat Volunteers	Testing should occur while the Sonar is docked on the water (or in a hoist) in order to represent real installation conditions. The volunteers used for testing will have limited to no knowledge of the device to represent the volunteers at Piers Park who may have no existing knowledge.
S25	None	None

III. DATA COLLECTION STRATEGY

Spec #	Data Acquisition Strategy
S24	Conducting a time study, with multiple users, to obtain the average time it takes for two individuals to properly uninstall the device in the Sonar will allow the team to evaulate the ease of un-installation.
S25	Determining the number of steps in the installation manual will allow the team to evaluate the ease of un-installation.

IV. TESTING FLOWCHART

S24



S25	Count the number of steps in the completed installation manual for the process of removing the device from the Sonar, and record the number

V. RESULTS

S24	2.5 minutes
S25	6 steps

VI. MITIGATION PLAN (IF NEEDED)

S24	N/A
S25	N/A

VII. CONCLUSION

The device is easy to un-install, requiring < 5 minutes for 2 people to complete the process.
It is not possible to un-install the device with less than 2 people due to the size
The instruction manual clearly states in 6 steps how to properly remove the system from the Sonar

Test Plan # 17 (TP17) - Comfort

Back to P14031 Test Plan Summary

Test Team:

Test Location:

Test Date:

Concluded Condition

Δ

I. TESTING SPECIFICATION

Specification Number	Risk Level	Specification	Units	Marginal Value	Target Value	Comments/Status
S26	LOW	% of users who find seat "comfortable"	%	60	75	

II. EQUIPMENT/CONDITIONS REQURIED

Specification Number	Equipment or Instrumentation required	Testing Conditions
S26	Completed Jib Transfer System	Ideally, would like the device installed in a Sonar. However, testing is possible as long as the device is properly secured to allow a user to place their weight on the seat

III. DATA COLLECTION STRATEGY

Specification Number	Data Acquisition Strategy
S26	This survey of "comfort" will evaluate whether the device can accommodate multiple users. If a wide audience is surveyed, and a large percentage find the seat "comfortable" then the specification has been met.

IV. TESTING FLOWCHART

Ask for volunteers to sit in the device and rate their relative comfort on a scale of 1-10. Record the results, and analyze the data.

V. RAW DATA ACQUISITION

VI. RESULTS

VII. MITIGATION PLAN (IF NEEDED)

If there are volunteers who do not find the device comfortable, the team will solicit their feedback on what would increase their comfort. These suggestions will be considered for potential (small scale) design changes

VIII. CONCLUSION

The seat is installed to the seat plate, so the person building the device can pick a seat that best suits their needs

Test Plan # 18 (TP18) - Plywood Base Lifetime

Back to P14031 Test Plan Summary

Test Team: Matt Brunelle, Mike Kennedy

Test Location: ME Machine Shop

Test Date: 2/11/14

Test Outcome

O

I. TESTING SPECIFICATION

Specification Number	Risk Level	Specification	Units	Marginal Value	Target Value	Comments/Status
S27	MED	Depth of plywood groove after 13500 rotations (~5 years)	in	0.23	0.10	Testing will be done by applying a constant load to the plywood test sample with the lathe running to estimate lifetime of the plywood under braking.

II. EQUIPMENT/CONDITIONS REQUIRED

Specification Number	Equipment or Instrumentation required	Testing Conditions
S27	Plywood test sample Lathe with with four-jaw chuck	Plywood sample must be secured in chuck so it will not move relative to the chuck during the test.

III. DATA COLLECTION STRATEGY

Specification Number	Data Acquisition Strategy
S27	Time and lathe speed will be measured to estimate usage lifetime

IV. TESTING FLOWCHART

Prepare lathe and chuck. → Secure test sample in chuck. → Start lathe. → Apply load to cross-slide handle to provide a constant pressure to the test sample and begin recording time. → Stop lathe and time measurment when a 1/4 inch 'groove' has been cut into the plywwod sample.

V. RAW DATA ACQUISITION

TEST #1

Test 1:	Depth at Position (in):				
Time (min)	1	2	3	AVG	Direction
0	0.000	0.000	0.000	0.000	-
10	0.025	0.005	-	0.015	CCW
15	0.033	0.007	-	0.020	CCW
20	0.036	0.007	-	0.022	CCW
25	0.038	0.008	0.068	0.038	CCW
30	0.058	0.070	0.081	0.063	CW
35	0.042	0.070	0.087	0.066	CCW
40	0.085	0.082	0.090	0.086	CW
45	0.098	0.086	0.093	0.092	CCW
50	0.100	0.086	0.105	0.097	CW
55	0.102	0.086	0.107	0.098	CCW
60	0.102	0.089	0.108	0.100	CW
65	0.107	0.091	0.108	0.102	CCW
70	0.110	0.105	0.111	0.109	CW
75	0.112	0.105	0.115	0.111	CCW
80	0.117	0.112	0.119	0.116	CW

-This test was run at a tangential velocity (of the "bolt head") of 2289.66 in/min
-The average tangential velocity of the brake during the worst case scenario is 2115 in/min
-The system is designed for 13500 cycles (5 seasons)
-The test was run at 179 RPM, so 13500 cycles is 76 minutes
-A failure is defined as a groove depth of 0.25in before 13500 cycles is reached

TEST #2

Test 2:	Depth at Position (in):				
Time (min)	1	2	3	AVG	Direction
0	0	0	0	0	
5	0.004	0.002	0.003	0.003	CCW
10	0.010	0.005	0.007	0.007	CW
15	0.015	0.005	0.007	0.009	CCW
20	0.016	0.009	0.007	0.011	CW
25	0.020	0.010	0.009	0.013	CCW
30	0.021	0.010	0.009	0.013	CW
35	0.021	0.012	0.009	0.014	CCW
40	0.022	0.017	0.009	0.016	CW
45	0.023	0.020	0.009	0.017	CCW
50	0.023	0.020	0.009	0.017	CW
55	0.024	0.025	0.009	0.019	CCW
60	0.027	0.032	0.015	0.025	CW
65	0.028	0.032	0.017	0.026	CCW
70	0.032	0.035	0.020	0.029	CW
75	0.032	0.035	0.025	0.031	CCW
80	0.032	0.037	0.025	0.031	CW

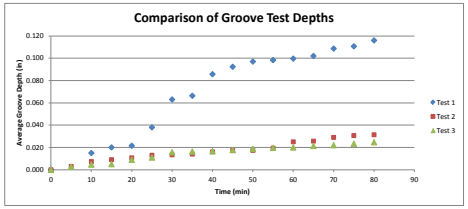
-This test was run at a tangential velocity (of the "bolt head") of 2115 in/min
-This test is a success! The average groove depth at 13500 cycles was 0.031 in.

Groove Test Data:

Test 3:	Depth at Position (in):				
Time (min)	1	2	3	AVG	Direction
0	0	0	0	0	
5	0.002	0.003	0.003	0.003	CCW
10	0.006	0.003	0.005	0.005	CW
15	0.006	0.004	0.005	0.005	CCW
20	0.014	0.005	0.008	0.009	CW
25	0.016	0.007	0.010	0.011	CCW
30	0.029	0.007	0.011	0.016	CW
35	0.031	0.007	0.011	0.016	CCW
40	0.032	0.007	0.011	0.017	CW
45	0.033	0.008	0.012	0.018	CCW
50	0.034	0.009	0.013	0.019	CW
55	0.035	0.011	0.013	0.020	CCW
60	0.036	0.011	0.013	0.020	CW
65	0.037	0.014	0.013	0.021	CCW
70	0.038	0.014	0.013	0.022	CW
75	0.039	0.018	0.013	0.023	CCW
80	0.039	0.021	0.014	0.025	CW

-This test was run at a tangential velocity (of the "bolt head") of 2115 in/min
-This test is a success! The average groove depth at 13500 cycles was 0.025 in.

VI. RESULTS



VII. MITIGATION PLAN (IF NEEDED)

N/A

VIII. CONCLUSION

The groove depth at 13,500 cycles (~5 sailing seasons) was 0.116in. This shows the plywood can withstand the braking mechanism for the duration of the device's use