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APPENDICES

EXECUTIVE SUMMARY

This document describes the standard operational protocols for conducting the Northeast Fisheries Science Center spring and autumn Multispecies Bottom Trawl Survey aboard the NOAA Ship *Henry B. Bigelow.* This manual documents current survey protocols and standard sampling gear implemented in spring 2009 after the 2008 survey calibration with the NOAA Ship *Albatross IV* and the NOAA Ship *Henry B. Bigelow.* It is intended to serve as a reference manual to ensure survey standardization and aid in the training of new personnel.

1.0 OVERVIEW

Since 1963, the Northeast Fisheries Science Center (NEFSC) has conducted standardized bottom trawl surveys (BTS) along the northeastern continental shelf of the United States. The Ecosystems Surveys Branch (ESB) is responsible for implementation of NEFSC BTS operations. Using the NOAA Ship *Albatross IV* as the primary research vessel and a standardized Yankee 36 survey bottom trawl as the primary sampling gear, these multispecies bottom trawl surveys targeted demersal fish and invertebrate species in the area comprising the Western Scotian Shelf of the Gulf of Maine, south to Cape Lookout, North Carolina (Yankee 36 sampling gear is described in Appendix A). With the decommissioning of the NOAA Ship *Albatross IV* in 2008, the NEFSC transitioned to the NOAA Ship *Henry B. Bigelow* as their primary research vessel, using a standardized 3-bridle, 4-seam survey bottom trawl rigged with a rockhopper sweep as the primary sampling gear (4-seam, 3-bridle sampling gear is described in Appendix B). An extensive calibration study was conducted in 2008 to evaluate relative catchabilities and estimate calibration coefficients between the 2 trawling systems to allow comparability of historical and future datasets (Miller et al. 2010). These protocols are intended for use as a reference manual to ensure survey standardization and aid in the training of new personnel.

1.1. Sampling Design

The NEFSC BTS employs a stratified random sampling design. The area of operation is divided into strata based primarily on depth and secondarily by latitude generally related to fish distribution (Grosslein 1969) (Appendix C). Locations of trawl stations are randomly selected within each stratum prior to each cruise. The number of stations within each stratum is generally proportional to the area of the stratum but also includes consideration of the overall variability in multispecies distribution among strata. Generally, a minimum of 3 stations are planned within each stratum, and a minimum of 2 stations must be successfully sampled in each stratum to obtain an estimate of variability. Random sampling within each stratum produces unbiased abundance indices with measurable statistical precision. Abundance estimates obtained from this survey are relative abundance indices rather than absolute abundance indices because catch efficiency of the sampling gear is less than 100%. Relative abundance indices are comparable through time because survey catchability is held constant through standardization of gear, vessel, and methodology.

1.2 Closed, Management and Conservation Areas

Vessel command must be cognizant of areas closed to fishing, fishery management areas, and conservation areas. However, NEFSC research vessels are permitted to survey in most areas closed to fishing activities for conservation and management purposes. Notable exceptions to

this are deepwater coral conservation areas in U.S. and Canadian waters. Survey stations are not plotted in coral conservation areas. Closed area boundaries do not constitute strata boundaries, unless otherwise noted. ESB will notify the vessel of any known modifications to closed, management, and conservation areas prior to the cruise as necessary. Specific geographic information and details regarding such areas can be found in 50 CFR Part 648[1].

2.0 PREDEPARTURE

Communications between ESB, vessel command, and the Chief Bosun are critical to maximize efficiency of the organization and planning of all NEFSC BTS cruises. The vessel must be available for loading survey equipment prior to the scheduled departure. Delivery of any gear requiring the vessel's heavy lifting equipment will be done in coordination between ESB and the Chief Bosun.

2.1 Cruise Scheduling

Cruise schedules are distributed through the NEFSC Vessel Coordinator and are organized by fiscal year and vessel. The schedules are set in advance through agreement by NOAA's Office of Marine and Aviation Operations (OMAO) and the NEFSC. Published cruise schedules will be made available prior to the start of the fiscal year.

2.2 Canadian License

A license to operate in Canadian waters must be obtained by the NEFSC Vessel Coordinator and transferred to the Commanding Officer (CO) of the vessel. Access to Canadian territorial waters is not permitted without this paperwork physically present aboard the vessel.

2.3 Cruise Instructions

Official cruise instructions will be submitted by the ESB to the NEFSC Vessel Coordinator 3 months prior to the ship's scheduled departure. The cruise instructions will contain the necessary authorities mandating the cruise and will outline cruise objectives, itinerary, methods, administrative requirements, and requested vessel support.

2.4 Cruise Staffing

ESB will coordinate scientific staffing for all NEFSC BTS cruises. A list of the scientific roster will be submitted to vessel command no later than 1 week prior to the departure of each cruise leg. Scientific staff must have medical clearance from the Health Services office of OMAO to be eligible to sail. ESB is responsible for obtaining security and foreign national clearances required for scientific participants. The vessel command is responsible for identifying any health or security related issues (e.g., missing paperwork or approvals) to the ESB cruise staffing coordinator a minimum of 48 hours prior to the scheduled cruise departure.

[1] http://www.greateratlantic.fisheries.noaa.gov/regs/fr.html

2.5 Scientific Equipment

2.5.1 Sampling Gear

The ESB will provide the necessary scientific sampling gear to the vessel along with detailed sampling gear plans (Appendix B). All sampling gear provided to the vessel must be in standard condition and configuration as certified by the detailed ESB survey gear inspection process. Specific BTS sampling gear includes trawl nets, sweeps, doors, rigging, cod-ends, cod-end liners and repair materials. Sampling gear will be maintained and repaired by the vessel, as practical, during the course of the survey.

2.5.2 FSCS Equipment and Scientific Supplies

Portions of the Fisheries Scientific Computer System (FSCS) equipment are owned and maintained by both the vessel and ESB. For the current equipment supply, the vessel owns and is responsible for maintenance of 2 large catch scales and 3 fish-meter scales. Additionally, the vessel is responsible for the wiring of all FSCS hardware, including fish-meters, scales, barcode readers, and printers, to the networked computers for FSCS 2.0 and the Scientific Computer System (SCS). ESB is responsible for the maintenance and setup of the monitors, fish-meters, 2 backup fish-meter scales, small scales, barcode readers, and printers. Additionally, ESB is responsible for the staging of all FSCS hardware and supplies for all cruises requiring the use of FSCS.

2.6 Trawl Winches and Towing Warps

The vessel's autotrawl system must be operated in tension-based mode during all NEFSC bottom trawl survey trawling operations. The NEFSC BTS requires redundant measurement of tension during all NEFSC survey bottom-trawling operations. The vessel is required to arrange for a winch technical representative to calibrate the autotrawl system prior to each bottom trawl survey cruise season. Both the winch-calculated tensions, based on system pressures, and turning block load cells should be calibrated simultaneously to ensure each measuring device is calibrated to an equal quantity. Proper calibration requires that full ship power be available during the procedure so that the system can be operated in "Autotrawl Mode." Additionally, the settings of all programmable winch parameters must be standardized and recorded during each calibration procedure. Per the current national protocol for trawl surveys, physical markings need not be inserted into the warps if an autotrawl system is employed (Stauffer 2004). However, the protocols do require redundant measurement of warp length. The vessel's trawl warp measuring systems are required to be operational during all NEFSC BTS operations.

2.7 Station Selection

No later than 2 weeks before a cruise, ESB will provide the vessel with a list of the randomly preselected station locations for the entire survey. ESB will submit electronic files containing the complete list of station positions and strata boundaries in a format that conforms to the vessel's current navigation software. The vessel must give advance notice regarding any changes in navigation software. In the event of a change, the vessel will determine the new system requirements and report these to ESB. In addition, stations at which plankton sampling is planned will be reported to the vessel. Vessel command and/or Navigation Officer must plot and examine the station locations and identify any stations that are problematic for the vessel in terms of depth, obstructions, or other issues. Any stations identified as problematic must be

brought to the attention of the Chief Scientist to discuss alternative locations or operational procedures prior to departure. Additional stations may need to be planned during the actual operation of the cruise to account for specific sampling problems and requirements (e.g., special deep-water, experimental, or targeted nonrandom stations).

2.7.1 Planned Cruise Track

On the day of sailing, the Chief Scientist will consult with vessel command and produce a partial cruise track list that determines the order in which preselected stations will be occupied. The planned cruise track will be updated by the Chief Scientist and provided to vessel command as necessary throughout the cruise. Unanticipated issues, such as weather, may force changes to the planned cruise track. The Chief Scientist will consult with vessel command to determine the most efficient and productive alternate plan.

3.0 SURVEY OPERATIONS

Each randomly preselected station location is defined by a single latitude and longitude point. A 1 nm radius around the point defines the area in which survey operations commence. Upon arrival on station, the officer on deck (OOD) must assess conditions at the station including depth contours, vessel traffic, navigational hazards, fixed fishing gear, and sea conditions and then determine the specific location at which the trawl will be towed. A standard survey station consists of a hydrographic profile by Conductivity, temperature, and depth (CTD) cast; a plankton sample by bongo net tow (at a subset of stations); and a bottom trawl haul. A standard bottom trawl haul is 20 min long (on-bottom) and is towed at 3.0 kts speed over ground (measured by Differential Global Positioning System). A standard trawl haul begins when the trawl first touches bottom, as determined by the winch operator via trawl mensuration equipment, and ends when the winches are reengaged at haul back.

3.1 Oceanographic Sampling

Conductivity, temperature and depth (CTD) sampling must occur at all station locations. The purpose of the CTD sampling on the survey is to collect hydrographic profile data that are representative of the haul location. To meet this purpose, the CTD should be deployed to within 5 m of the bottom and as close as operationally efficient to the actual haul location. A trawl-mounted temperature sensor collects temperature data along the trawl track.

Close to the actual haul is defined as:

Within **3 hours** of the start of a trawl haul (“Start Trawl”);
and
Within **3.0 nautical miles** of the mid-point of the on-bottom tow path;

If the CTD sample is not close to the haul or the CTD operator loses signal or is otherwise unable to collect CTD data, the cast will be repeated; only the Chief Scientist of the cruise can make an exception from this protocol. If the CTD is not functioning, the Watch Chief should be notified about the time needed for repairs. The Chief Scientist or Watch Chief will then determine if the repeat CTD cast will occur before or after the haul is conducted. Under no circumstances should the pressure rating of the CTD exceed 600 m.

3.1.1 Plankton Sampling

At a subset of the preselected stations, bongo tows will be conducted to survey plankton and larval fish resources. For stations at which plankton sampling is planned, a bongo net tow will occur in tandem with the CTD cast. The maximum depth rating for the bongo net is 200 m. If the bottom depth of the station is greater than 210 m, a dedicated CTD cast will be made to within 5 m of the bottom, but no deeper than 500 m.

3.2 Determination of Tow Path and Direction

Survey tow path should be along a consistent depth contour. For much of the survey region, mainly the southern portion, finding consistent depth contours is not problematic. If multiple tow directions achieve consistent depth, the default tow direction is toward the next planned station.

Consistent depth is defined for mean bottom depth over the tow duration as follows:

Mean bottom depths less than 50 m must be within ± 5 m of set depth.

Mean bottom depths 50 m and greater must be within ± 10% of set depth.

The OOD is encouraged to scout an optimal tow path. It is acceptable to make gentle course changes resulting in a nonlinear tow to achieve a viable tow path. All tows must be planned to be on-bottom for a 20 min duration.

3.2.1 Factors Affecting Tow Path and Direction

a. Hazards or obstructions. Before arrival, the vessel command will identify any obstructions or navigational hazards that may affect tow direction, location, or duration. Towing should be avoided in areas of known ship wrecks. If hazards or obstructions prevent the station from being occupied within the 1nm radius of the randomly selected location, the protocols detailed in section 3.3 must be followed, and the Chief Scientist or the Watch Chief must be informed.

b. Conditions at the station. Conditions at the station may affect tow direction. These include the presence of fixed fishing gear, vessel traffic, sonar targets indicating significant bottom obstructions, weather, and sea surface conditions. In some cases, i.e., the presence of fixed gear or significant sonar targets, the vessel may be required to scout a towable path.

c. Stratum boundaries. Stratum boundaries shall not be crossed during a tow unless all other options for tow direction are exhausted. Greater than 75% of the on-bottom tow distance must be within the initial stratum for the tow to be considered valid.

d. Presence of protected species. Refer to Appendix D regarding procedures for scouting the area prior to gear deployment and actions to be taken if protected species are detected in the sampling area.

e. Bottom currents. The design of the NEFSC BTS attempts to randomize tow direction relative to current direction. The trawl gear must be set initially according to the specified protocol for determination of tow direction without concern for bottom currents. The vessel's autotrawl system can partially compensate for bottom currents; however, this trawl gear does not perform well when towed in areas of strong currents. When towed into the current, gear takes a long time to settle and bottom contact is lost. When towed with the current, door spread varies. If the Chief Scientist determines these conditions are obtained during a tow and the tow will not be

considered valid, they will decide to abort the tow. Trawl performance on the repeat tow should be improved according to the following procedures:

i. The vessel's Acoustic Doppler Current Profiler (ADCP) may be used to aid the decision regarding the repeat tow direction.

ii. Towing in the opposite direction of the original planned tow path may be possible, but tow depth tolerance protocols must be maintained. If towing in the opposite direction is unlikely to improve trawl performance, the course of the repeat tow path should be altered by approximately 30° to offset the magnitude of the current flow relative to trawl direction. 30° is a suggested course change. The altered course tow path must still adhere to the tow depth tolerance protocols. The ADCP may be a useful tool to determine the actual course change in such situations.

iii. When settling times are long or bottom contact cannot be maintained because of strong currents, the repeat tow may be conducted along the original tow path with an increased wire length longer than designated on the Standard NEFSC Scope Table (Appendix E). Wire length must be increased quickly to avoid the trawl fishing near the bottom for an extended period of time, and the length increase must be completed before the beginning of the standard timed tow duration. The Chief Scientist and Winch Operator will determine the appropriate amount of wire increase. The increased wire length must not exceed **20%** more than the designated wire out listed on the Standard NEFSC Scope Table at **Depths Less Than 100 m,** or **50 m** more than the designated wire out listed on the Standard NEFSC Scope Table **at Depths 100 m and Greater**.

iv. These steps to improve trawl performance may not be possible because of high sea state, vessel traffic, or inconsistent bottom morphology. Under those conditions, the station location shall be moved according to the protocols outlined in section 3.3 Moving preselected station locations.

3.2.2 Deepwater Continental Shelf Edge Strata Sampling

Strata boundaries were determined in part by depth, but areas within a particular stratum that are shallower or deeper than the stratum depth range (because of holes or humps) are still considered representative of that stratum, regardless of depth. For the offshore strata on the continental shelf edge from eastern Georges Bank to Cape Hatteras, the stratum boundary lines are defined by the 110 m, 183 m, and 366 m depth contours. Since available bathymetry data were limited in these regions at the time that survey stratification was completed (1962 - 1963), the coordinates for stratum boundary lines may not actually represent the true depth contours associated with these strata. To ensure sampling occurs within the true depth boundaries of these strata, the sampling protocols must be altered at the continental shelf edge strata from Georges Bank south to Cape Hatteras. Gulf of Maine strata will follow the protocols outlined in section 3.2.

a. For offshore shelf edge strata defined by the 110 – 183 m contours:

   i. Begin operations within a 1 nm radius of the randomly preselected station location.

ii. Search within a 3 nm radius for a feasible tow path that achieves consistent depth within the depth zone of the stratum (110 - 183 m). Consistent depth is defined in section 3.2.
iii. If no feasible tow path is found within the depth range after 1 hour, the OOD will navigate from the original 1 nm radius perpendicular to the existing depth contours until reaching a towable area within the depth range of the stratum.
iv. During such occurrences, strata boundaries that were intended to delineate depth contours may be ignored; strata boundaries that were intended to create latitudinal/longitudinal separation between similar depth zones are to be observed.

b. For offshore shelf edge strata defined by the 184 - 366 m contours:
i. Begin operations within a 1 nm radius of the randomly preselected station location.
ii. Search within a 3 nm radius for a feasible tow path that achieves consistent depth within the depth zone of that stratum. Consistent depth is defined in section 3.2.
iii. If no feasible tow path is found after 1 hour, move the tow location according to the following methodology:
1) The Chief Scientist will subdivide the stratum into 4 distinct depth ranges: 184 - 229 m, 230 – 274 m, 275 - 320 m, and 321 - 366 m.
2) The Chief Scientist will randomly select 1 of the 4 subdivided depth zones. (NOTE: for subsequent tows in any stratum, the Chief Scientist will select 1 depth range from any of the 4 subdivided depth ranges to ensure random sampling with replacement.)
3) The OOD will navigate perpendicular to the existing depth contours from the 1 nm radius of the preselected station location until reaching a towable area within the targeted depth zone selected by the Chief Scientist.
iv. During such occurrences, strata boundaries that were intended to delineate depth contours may be ignored; strata boundaries that were intended to create latitudinal/longitudinal separation between similar depth zones are to be kept intact.
v. Subsequent tows within a stratum will follow the same methodology of initially searching for a feasible tow path within a 1 nm radius of the preselected station location. When necessary, as dictated by the protocols outlined above, the Chief Scientist will select 1 depth range from any of the 4 subdivided depth ranges to ensure random sampling with replacement.

3.3 Moving Preselected Station Locations

Tows should be made within a 1 nm radius of the preselected location, using criteria for tow path and direction described in section 3.2. A tow is considered to be within the 1 nm radius if ANY portion of the on-bottom tow distance occurs within a 1 nm radius of the preselected location.

a. If no feasible tow path is found after approximately 30 min of searching, the OOD will expand the radius to 3 nm and notify the Chief Scientist or Watch Chief. If any

portion of the on-bottom tow distance of a feasible tow occurs within the 3 nm radius, it is considered to be within the 3 nm radius.

b. If no feasible tow path is found after approximately 1 hour, the Chief Scientist or Watch Chief will identify an alternate random tow location.
c. Alternate random tow locations will be preselected for all strata by ESB personnel prior to the cruise. The number of alternate random tows per strata will be equal to the number of original random tows per strata.
d. The Chief Scientist or Watch Chief will select the alternate location that is closest to the location of the vessel.
e. Alternate locations must be within the same stratum as the original preselected tow location and adhere to the protocols outlined in section 3.2.

3.4 Standardized Trawling Procedures

A standard trawl haul is 20 min long at 3.0 kts (speed over ground, measured by Differential Global Positioning System [DGPS]). A standard trawl haul begins when the trawl first touches bottom, as determined by trawl mensuration equipment, and ends when the winches are reengaged at haul back. Fundamental activities associated with bottom trawling operations are time-stamped and recorded in the FSCS Operation Event Logger (FSCS OEL) by the OOD. Accurate recording of these event times is critical to the data quality of the survey. These time-stamps, commonly termed button presses, dictate streamed data capture periods and are used to calculate summary statistics on gear and vessel performance during a tow and are used to validate standard survey tows. Refer to section 4.0 Data Collection for more detail regarding event logging.

3.4.1 Setting the Trawl

a. The FSCS OEL must be opened and be ready to begin data collection before setting the trawl. The OOD will select the preplanned trawl site location in FSCS OEL and start the operation.
b. The vessel must set the course in accordance with the planned tow direction, leaving enough room for streaming the net so that the trawl does not over or undershoot the planned tow path.
c. The OOD will check for vessel traffic and fixed gear to ensure it is safe to deploy the trawl. Vessel maneuvers are done at the discretion of the OOD and Chief Bosun/Lead Fisherman to facilitate gear deployment.
d. The vessel will maintain a speed of approximately 3.0 kts to begin streaming the net. Once the vessel is at speed, the OOD will notify the winch operator to stream the net. The “Stream Net” FSCS OEL button must be pressed upon initialization of the deck crew streaming the net. Speed may be altered to facilitate streaming the net.
e. The winch operator and deck crew will monitor the gear during deployment to avoid snags and other potential damage to the gear. The winch operator and deck crew will ensure the gear is streamed in the proper configuration, all floats clear the webbing, and there are no twists in the rigging.
f. Once the net is fully streamed, the vessel speed will be increased to 5.5 kts for wire payout.
g. The “Setdepth” reading will be taken from the EK60 18 kHz transducer when the net is fully streamed, the vessel speed is 5.5 kts and the wire must be payed out in order

to sample the planned towpath. In the event the EK60 18kHz transducer is not functioning, the EK60 38 kHz transducer will be used.

h. The designated wireout length will be determined based upon the "Setdepth" reading and the Standard NEFSC Scope Table (Appendix E). If a planned tow path has been scouted, the designated wireout will be determined by the median depth over the planned on-bottom tow distance.
i. The winch operator will deploy the gear with the winches in "Auto Pay Out" mode. The "Auto Pay Out" mode on the auto-trawl winch system must be set at 50 – 100 m per minute.
j. Vessel speed must be decreased to the standard tow speed over ground of 3.0 kts by the time the last 50 m of cable is being deployed. The winch operator will inform the OOD at the point when the last 50 m is reached.
k. Upon completion of wire payout, the winch operator will engage the "Autotrawl Mode."

3.4.2 Standardized Towing

a. The winch operator will determine the start of the timed tow based on trawl sensor data, which must be monitored from a display at the winch console. The trawl sensors will be used to determine when the trawl sweep has settled on the bottom. Upon determination of bottom contact the winch operator will inform the OOD. The OOD will then immediately press the "Start Trawl" FSCS OEL button, thus beginning the standard timed tow duration.
b. The vessel speed must be maintained at 3.0 kts over ground for the duration of the tow.
c. The tow duration will be exactly 20 min from the time the "Start Trawl" button is pushed. Tows must always be planned for the full 20 min duration.
d. The winch operator is responsible for monitoring the gear and its performance (trawl mensuration data) throughout the tow.
e. At exactly 20 min, the OOD will inform the winch operator to haul back the net.

3.4.3 Haul Back

a. Haul back must commence with the winch operator stopping "AUTOTRAWL MODE" and engaging "HAUL MODE" on the auto-trawl system, at which time the OOD will press the "Haul Back" FSCS OEL button. The "HAUL MODE" on the auto-trawl winch system must be set at 50 -100 m per minute.
b. Vessel speed during haul back must be approximately 3.0 kts. The exact haul back speed may vary depending on catch size or sea conditions and may be increased to avoid vessel traffic or other navigational hazards. Caution must be used when increasing speed greater than 5.0 kts as this may cause damage to gear in tow behind the vessel.
c. Upon reaching the last 50 m of wireout length, the winch operator will inform the OOD.
d. Upon completion of wire retrieval, the doors must be secured and the net brought aboard the vessel. The OOD will press the "Net On Deck" FSCS OEL button when the cod-end is fully on deck.

3.4.4 Trawl On-Deck Post Tow

a. Catch will be emptied into the hopper by the vessel crew. When necessary, extremely large catches will be emptied on deck.
b. The vessel crew must shake and pick through the trawl to remove all organisms caught in the meshes of the body of the net and caught in the cod-end liner. These organisms must be given to the scientific party for sampling. This activity must be given a high priority by the deck crew. The goal is to avoid contaminating the next haul with organisms caught in the current haul, which may happen if organisms are retained in the trawl and then washed down into the next haul's catch. Vessel crew must inspect the survey gear for any damage and notify the Watch Chief or Chief Scientist of any damage and/or malfunction observed.
c. The Chief Bosun/Lead Fisherman will notify the Watch Chief or Chief Scientist of any repairs made to the survey gear. Notifications must be as descriptive as possible. The Watch Chief will record all survey gear damage/malfunction detail in the tow evaluation software.
d. The vessel crew will visually inspect the shine pattern of the trawl doors to ensure that the doors did not collapse during the tow.
e. The vessel crew will secure the survey gear and retie the cod-end and liner in preparation for the next station.
f. Once the survey gear and crane have been secured and the OOD is ready to move on to the next station location, the OOD will press the "Crane Secure" FSCS OEL button. The OOD will then press the "Stop the Operation" FSCS OEL button to exit the FSCS OEL program.

3.5 Survey Tow Evaluation and Validation

All standard survey tows are evaluated by tow evaluation software immediately post tow and are validated based on 4 categories, Type, Operation, Gear, and Acquisition (TOGA). TOGA is a detailed analysis of survey trawl and vessel performance during each tow, based on data from trawl mensuration systems and vessel sensors routinely logged by SCS. Tolerance limits and optimal values were calculated from data collected during the NEFSC calibration experiments. These tolerance limits are intended to promote consistency of trawl geometry and towing procedure to ensure comparability of the collected trawl survey data with results from the calibration experiments. Refer to Appendix F for additional details regarding tow validation and TOGA.

3.5.1 Repeating Tows

Any decision to repeat a tow must involve the Chief Scientist or Watch Chief and the OOD and should consider the following factors:

a. The probability of the same or greater damage to the gear. If probability is high, the station location should be moved.
b. Whether or not the catch is a representative sample or if the damage/malfunction significantly altered catch efficiency.
c. The time into the tow when the damage or malfunction occurred. If the damage/malfunction occurred after 16 min and did not significantly alter catch efficiency, the tow should be considered valid and the damage coded accordingly.

d. The current progress of the cruise as a whole (when time remaining in the cruise threatens the completion of the entire survey area).
e. If the OOD has any concerns regarding the Chief Scientist's decision, the CO should be consulted for discussion with the Chief Scientist.

When an invalid tow will be repeated, catch from the invalid tow will still be sampled by the scientific party at the discretion of the Watch Chief or Chief Scientist.

3.6 Intercepted Fixed Gear

Survey operations regularly occur in the vicinity of fixed fishing gear. Searching and scouting should be undertaken when planning a tow path to avoid interacting with fishing gear. When possible, any fixed gear entangled in the survey gear must be retained by the deck crew. Although fixed gear interceptions are often safety hazards, it is valuable to obtain as much information as possible on the extent of the intercepted gear, amount of damage, its status as actively fished or abandoned, its effect on trawl performance, and any indications of ownership such as registration numbers when it is safe to do so. The Chief Bosun/Lead Fisherman will report this information to the Watch Chief and to the OOD. The OOD will record all available information regarding the vessel's location and activities during the gear interaction in the FSCS OEL bridge comments. The Watch Chief will record all available information from any retained gear and detail all information regarding the gear interaction's effects on trawl performance in the Tow Evaluation software. The Chief Scientist is responsible for notifying shore-based personnel of fixed fishing gear interactions. ESB shore-based personnel are responsible for handling all tort claim activities.

3.7 Cessation of Operations Due to Weather or Sea Surface Conditions

Survey operations should cease any time the CO, OOD, or Chief Scientist believes the safety of personnel or the vessel is compromised. In certain instances, trawl performance is significantly affected before any safety concerns of the vessel are identified. Survey operations should be ceased any time the Chief Scientist, Watch Chief, or Winch Operator believes trawl performance is significantly altered by weather or sea conditions. During marginal weather conditions, bottom trawl performance should be closely monitored with net sensors and TOGA summaries.

4.0 DATA COLLECTION

Bottom trawl survey data are collected in a standard format using standard procedures to ensure accuracy and comparability of survey data throughout the time-series. The Chief Scientist and the FSCS Administrator have the primary responsibility for proper collection of data during the cruise. All station data are collected with sensor input from the SCS as well as metadata input by the OOD through the FSCS OEL. FSCS OEL incorporates SCS station data which are linked to all collected biological data. Oceanographic data are recorded in a separate database and are linked to the station and biological database. Data linkage is necessary for data integrity.

4.1 FSCS OEL Station Data Collection

The vessel's nonbiological sensor data are recorded continuously throughout the cruise by the vessel's Scientific Computer System (SCS) and loaded, in real-time, to an Oracle database through the FSCS OEL application. A subset of sensor data relevant to the standard survey tow are logged at specific time intervals, initiated by button presses that log events representing standardized towing operations (i.e., start of timed tow, haul back). These data are stored in an Oracle database and are referenced by the site and operation. The FSCS OEL data collection format is standardized and must not be altered in any way without agreement from ESB personnel.

4.1.1 Bridge Responsibilities

During standardized trawling operations, the OOD is responsible for executing the FSCS OEL Bottom Trawl Operations event. At each sampling site, the OOD launches the FSCS OEL program, enters all necessary data, and presses all required event buttons. FSCS OEL data are used to validate all standard survey tows for the timed tow duration, based on event button presses (Start Trawl to Haul Back). Accurate timing of event button presses is critical to the quality of collected SCS sensor data and proper evaluation of standard survey tows. Communication between the OOD, Chief Scientist and Watch Chief before conducting survey operations is encouraged to eliminate sources of error. The Watch Chief and/or Chief Scientist must be notified of all errors associated with FSCS OEL data collection. If errors occur with pressing of event buttons, (i.e., button pressed more than once or button press does not represent actual event occurrence), the time of the actual event occurrence should be documented, and the Watch Chief shall be notified of the error. Additionally, the OOD must detail all errors in the FSCS OEL "Comment," when applicable.

4.1.2 FSCS OEL Bottom Trawl Operations

The sequence of Bottom Trawl Operations event logging must be as follows:

a. Open FSCS OEL: The OOD will open the program and enter the necessary information, including vessel, cruise, operation type, project, and site.
b. Start Operation: Launch the program.
c. Bridge Officer: Select the current OOD by clicking "Bridge Officer=" on the right side of the screen.
d. Weather: The OOD will input the wave height, swell direction, and swell height by clicking each one on the right side of the screen.
e. Comment: Enter all comments relative to the current operation, when appropriate. Multiple comments may be entered.
f. Stream Net: The "Stream Net" button will be pressed at the time the gear is being set into the water. This begins the streamed data collection into the Oracle database.
g. Start Trawl: The "Start Trawl" button will be pressed when the trawl sweep has settled on the bottom, as determined by the Winch Operator's interpretation of trawl mensuration equipment. This begins the timed tow duration. This button may be pressed more than one time, when necessary, to capture the accurate start of the timed tow duration (e.g., if the button was initially pressed too early).
h. Hang: The "Hang" button will be pressed at the moment survey gear has hung on the bottom or encountered an obstruction, when applicable. This button may be pressed as many times during a tow as necessary.

i. Haul Back: The "Haul Back" button will be pressed when the winches are reengaged to retrieve the gear. This ends the timed tow duration. This button may be pressed more than one time, when necessary, to capture the accurate haul back time (e.g., the button was initially pressed too early). Start Trawl must be pressed prior to Haul Back.
j. Net On Deck: The "Net On Deck" button will be pressed when the gear has been retrieved and the cod-end is on deck. This ends the streamed data collection into the Oracle database.
k. Crane Secure: The "Crane Secure" button will be pressed when the back deck crane is secured.
l. Stop Operation: End data collection for the Bottom Trawl Operations event.
m. Exit OEL: Exit the program. Stop Operation must be pressed prior to Exit OEL.

4.2 Biological Data Collection

All biological data are collected with the Fisheries Scientific Computer System (FSCS).

4.2.1 Catch Processing

Catch processing will occur under the supervision and direction of the Watch Chief. The following basic operations shall occur:

a. Calibration of scales. At the start of each watch, the electronic scales must be calibrated. During a watch, additional calibrations may occur under the direction of the Watch Chief.
b. Sorting. Sorting will precede all biological sampling, except in special cases where subsampling methods are utilized. The majority of catch will be sorted to species and in some cases to sex within a species.
c. Weighing. All sorted samples will be weighed (in aggregate) with calibrated scales.
d. Measuring. All sorted samples will be measured; or partially measured, with subsampling methods.
e. Special sampling. Selected special sampling beyond weighing and measuring may take place through the authority of the Chief Scientist via approved requests from the ESB Chief. The primary vehicle for these requests will be, but is not limited to, the ESB Sampling Request Booklet and associated protocol sampling tables in FSCS.
f. Disposition of catch. The Watch Chief will supervise the disposition of the catch. Catch disposal will occur only after all pertinent data have been collected and/or verified. No catch will be disposed of while a net is in the water, to ensure that previously sampled organisms are not recaptured at subsequent stations. In certain cases, the disposal of the catch may be restricted, and in these instances the Chief Scientist will consult with the vessel command on how to adjust procedures.
g. Protected Species. Protected species will be handled according to NOAA and/or NEFSC protocols.

5.0 POST-CRUISE ACTIVITIES

5.1 Vessel Cleanup

At the end of each cruise leg, the scientific party will clean all scientific areas (lab space, ready room, lounge, hopper, offices, and berthing). The scientific party will clean all scientific equipment as well, including all FSCS hardware, measuring devices, and scales.

5.2 Sample Offload

The scientific party will organize and inventory scientific samples at the end of each cruise leg. Samples will be offloaded from the vessel at the discretion of ESB staff. Any offloading requiring the use of vessel equipment, such as cranes, must be coordinated between the Chief Scientist and the Chief Bosun.

5.3 Data Offload

The FSCS Administrator will create a copy of all data collected after each cruise leg and is responsible for transport of these data from the vessel to the lab.

5.4 Equipment Offload

Offload of survey trawl gear will be coordinated between the ESB warehouse staff and the vessel's Chief Bosun. Gear offload may occur between survey legs to maximize available storage space. Scientific equipment, such as FSCS hardware, will remain on the vessel until the end of the cruise season (unless damaged or otherwise necessary to remove).

5.5 Post-Cruise Meeting

Upon completion of each cruise leg, a post-cruise meeting will be held and attended by the vessel's officers, Chief Scientist, Chief Bosun, members of the scientific party, the NEFSC Vessel Coordinator, and the Port Captain to review the cruise. Concerns regarding safety, efficiency, and suggestions for improvements for future cruises should be discussed. Minutes of the post-cruise meeting will be distributed to all participants via email and to the CO.MOC.Atlantic@noaa.gov and ChiefOps.MOA@noaa.gov. The Port Captain, if attending, is responsible for recording and distributing the minutes. In his/her absence, the Operations Officer will be responsible for the minutes.

ACKNOWLEDGEMENTS

The authors would like to thank the Officers and Crew of the NOAA Ship *Henry B. Bigelow* for their assistance in developing and documenting these protocols. A special thanks to Commander Anne K. Lynch, Commander Kurt Zegowitz, and Chief Bosun Kenneth Rondeau for their knowledge and dedication to this process. Additionally, we acknowledge the contributions of the Oceanography Branch to these protocols. Finally, we thank the staff of the Ecosystems Surveys Branch for their invaluable efforts at sea both developing and implementing these protocols.

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Miller TJ, Das C, Politis PJ, Miller AS, Lucey SM, Legault CM, Brown RW, Rago, PJ. 2010. Estimation of Albatross IV to Henry B. Bigelow calibration factors. Northeast Fish Sci Cent Ref Doc. 10-05; 233 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

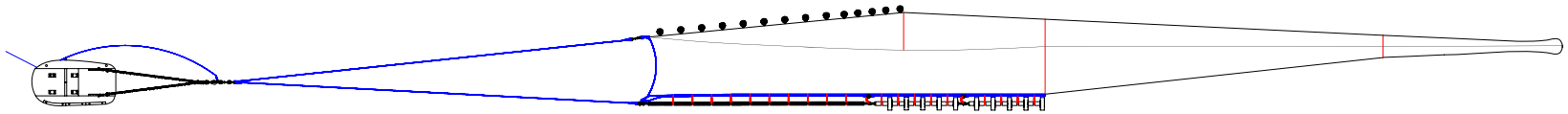
Grosslein MD. 1969. Groundfish survey methods. Bureau of Commercial Fisheries, Woods Hole, MA Lab Ref Doc. 69-02; 34p.

Stauffer G. 2004. NOAA Protocols for groundfish bottom trawl surveys of the nation's fishery resources. U.S. Dep. Commerce, NOAA Tech Memo. NMFS-F/SPO-65, 205 p.

Appendix A

Ecosystems Surveys Branch
National Marine Fisheries Service
Northeast Fisheries Science Center
166 Water Street
Woods Hole, Massachusetts 02543 USA

Survey Trawl Reference Manual



Yankee - 36

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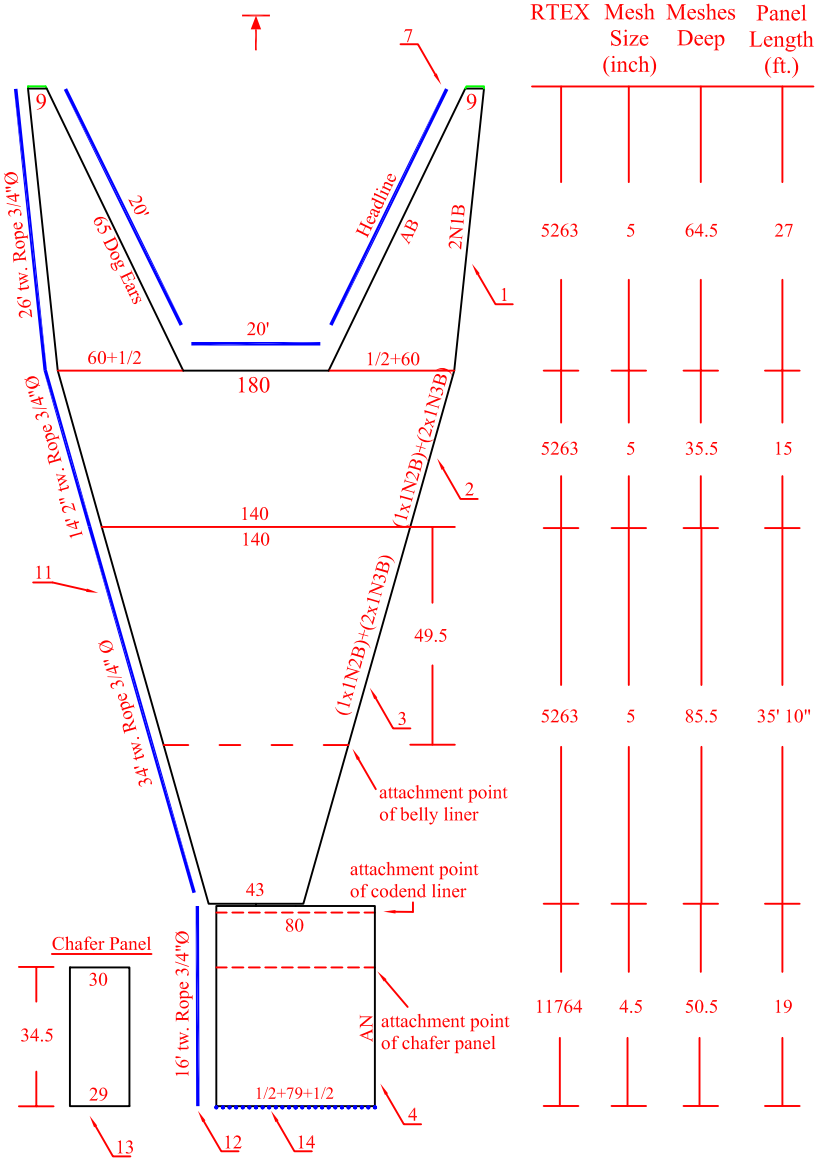
May 2006

SECTION 1 – NETTING

- ⇨ **YAN – 1** - TRAWL PLAN
- ⇨ **YAN – 2** - TOP WING DETAIL
- ⇨ **YAN – 3** - TOP WING HANGING DETAIL
- ⇨ **YAN – 4** - LOWER WING DETAIL
- ⇨ **YAN – 5** - LOWER WING HANGING DETAIL
- ⇨ **YAN – 6** - FOOTROPE TO SWEEP ATTACHMENT
- ⇨ **YAN – 7** - BELLY AND CODEND LINERS
- ⇨ **YAN – 8** - CHAFER ATTACHMENT TO CODEND

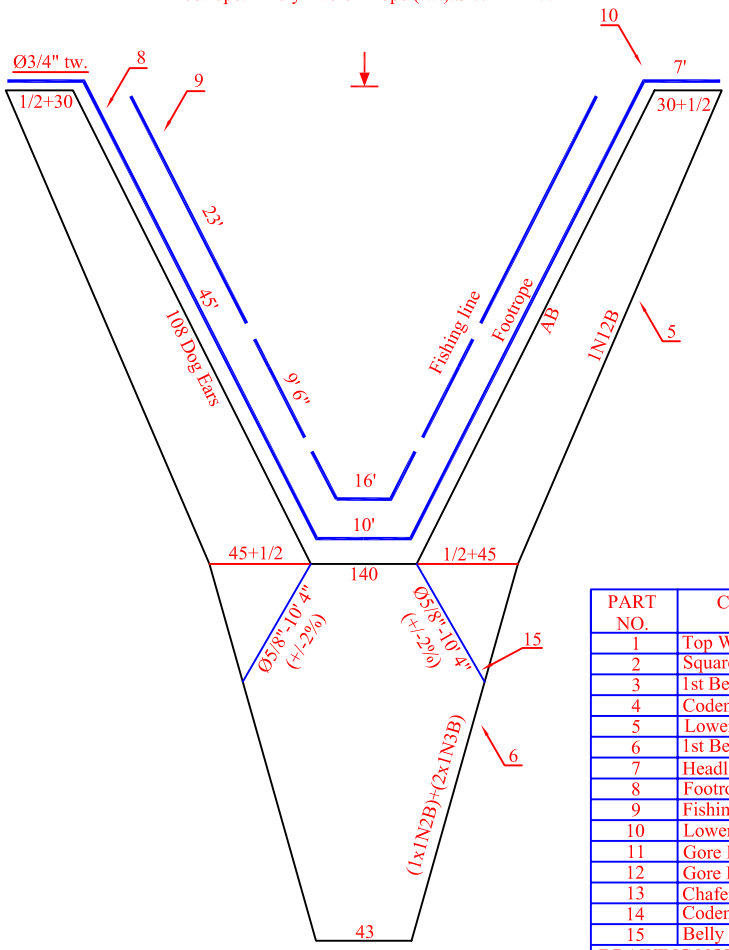
Headline: Combination Rope:Ø 7/8" - 60'



RTEX	Mesh Size (inch)	Meshes Deep	Panel Length (ft.)
5263	5	64.5	27
5263	5	35.5	15
5263	5	85.5	35' 10"
11764	4.5	50.5	19

Fishing line: Combination Rope:Ø 7/8" - 81'

Footrope: Poly Dacron Rope (tw.):Ø 3/4" - 100'



RTEX	Mesh Size (inch)	Meshes Deep	Panel Length (ft.)
5263	5	107.5	45

PART NO.	COMPONENT	MATERIALS	QTY	PAGE NO.
1	Top Wing	PA Netting	2	1 - 3
2	Square	PA Netting	1	1 - 3
3	1st Belly Top	PA Netting	1	1
4	Codend	PA Netting	1	1
5	Lower Wing	PA Netting	2	4 - 5
6	1st Belly Lower	PA Netting	1	4 - 5
7	Headline (3 pcs.)	Comb. Rope	1	1,3
8	Footrope	Poly Dacron Rope	1	1,5,6
9	Fishing Line (5 pcs.)	Comb. Rope	1	1,6
10	Lower Wingline	Poly Dacron Rope	2	1,5
11	Gore Line	Poly Dacron Rope	2	1
12	Gore Line	Poly Dacron Rope	2	1
13	Chafer	PA Netting	1	1,8
14	Codend Rings	Galvanized Steel	27	1,8,34
15	Belly Lines	Poly Dacron Rope	2	1

DRAWING NOTES:
- Panel depth (meshes deep) do not include joining rounds.
- Panel length includes joining rounds.
- Panel widths include selvedge meshes.
- Mesh sizes are knot center measurements.
- Six knots from each of the top and lower panels form the gore.
- Gore line measurements are taken from center of joining rounds
- Gore lines are seized to laceage at 18" intervals.
- Hammerlocks not included in headline or fishingline lengths.

NOAA Fisheries

TRAWL PLAN

NEFSC YANKEE - 36 SURVEY TRAWL

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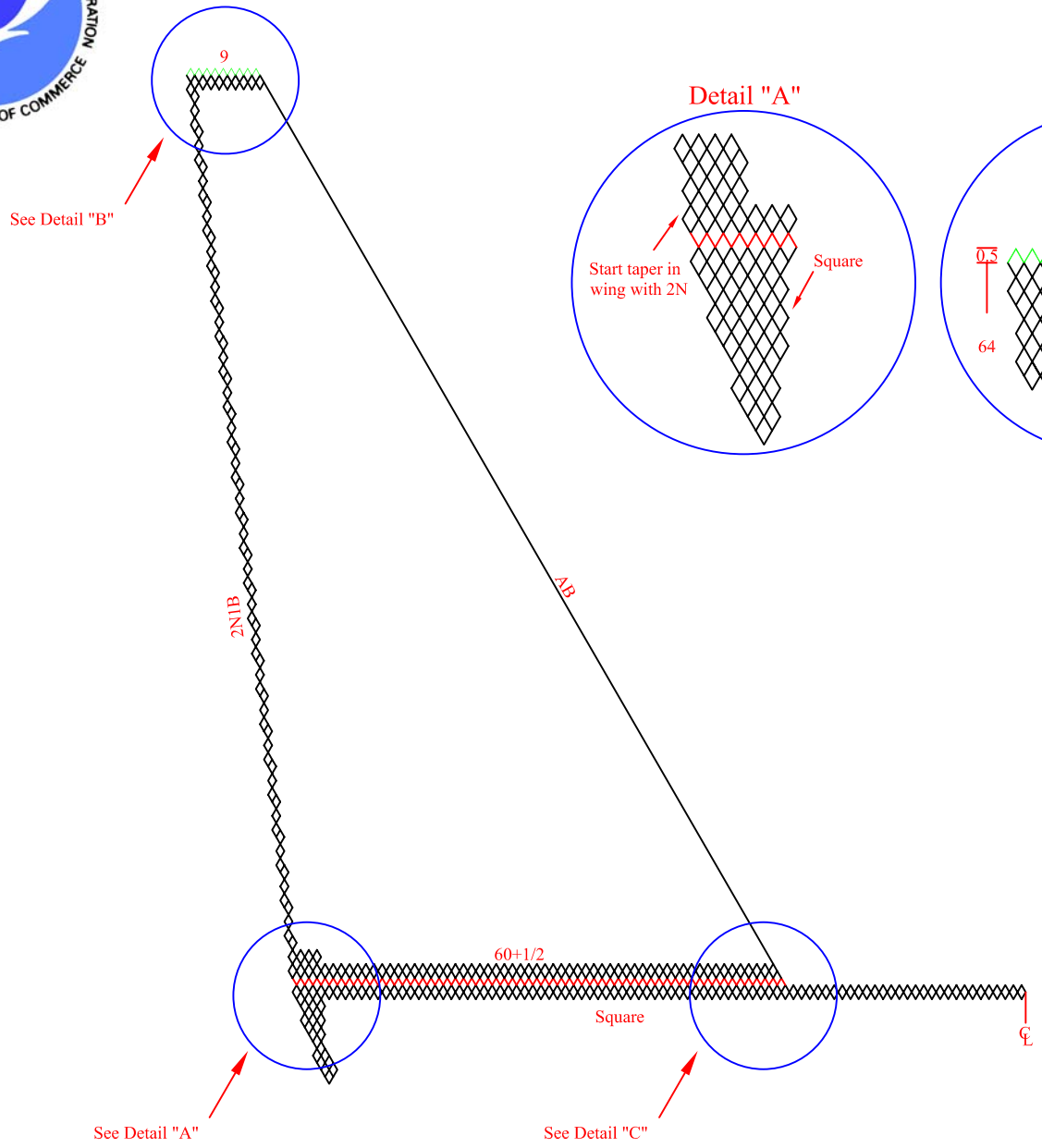
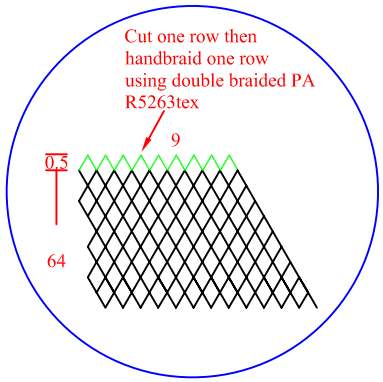


Detail "A"

Detail "B"



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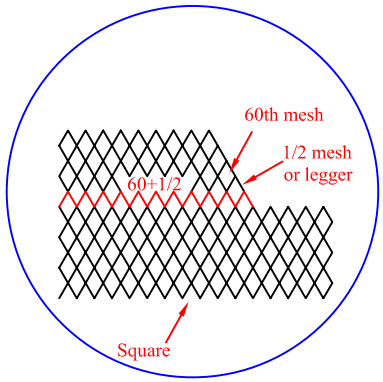

DRAWING NOTES:

A 1/2 mesh (1 row) of doubled orange twine is used to connect trawl sections together. This allows for easier section identification.

NOAA Fisheries

TOP WING DETAIL

NEFSC YANKEE - 36 SURVEY TRAWL

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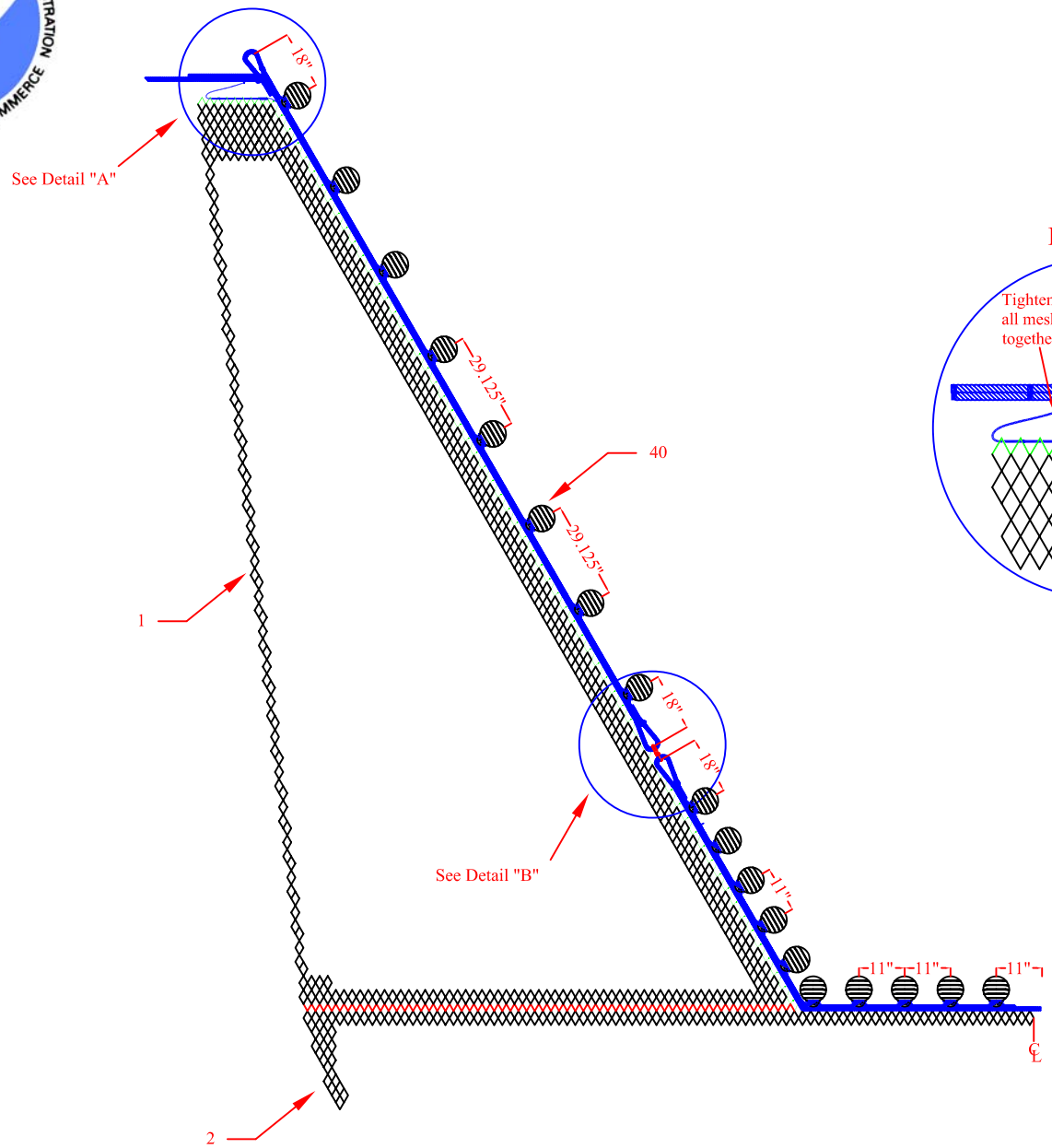
PART #	COMPONENT
1	Top Wing
2	Square
17	1/2" Hammerlock
40	8" Aluminum Becket Float



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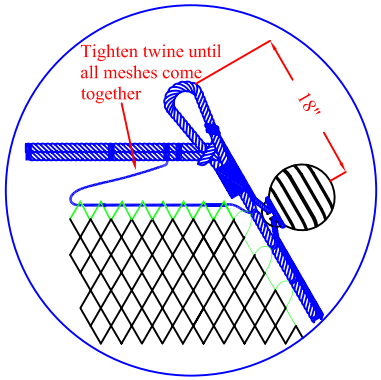

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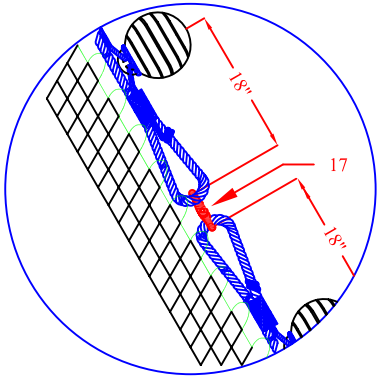

DRAWING NOTES:

A 1/2 mesh (1 row) of doubled orange twine is used to connect trawl sections together. This allows for easier section identification.

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TOP WING HANGING DETAIL

NEFSC YANKEE - 36 SURVEY TRAWL

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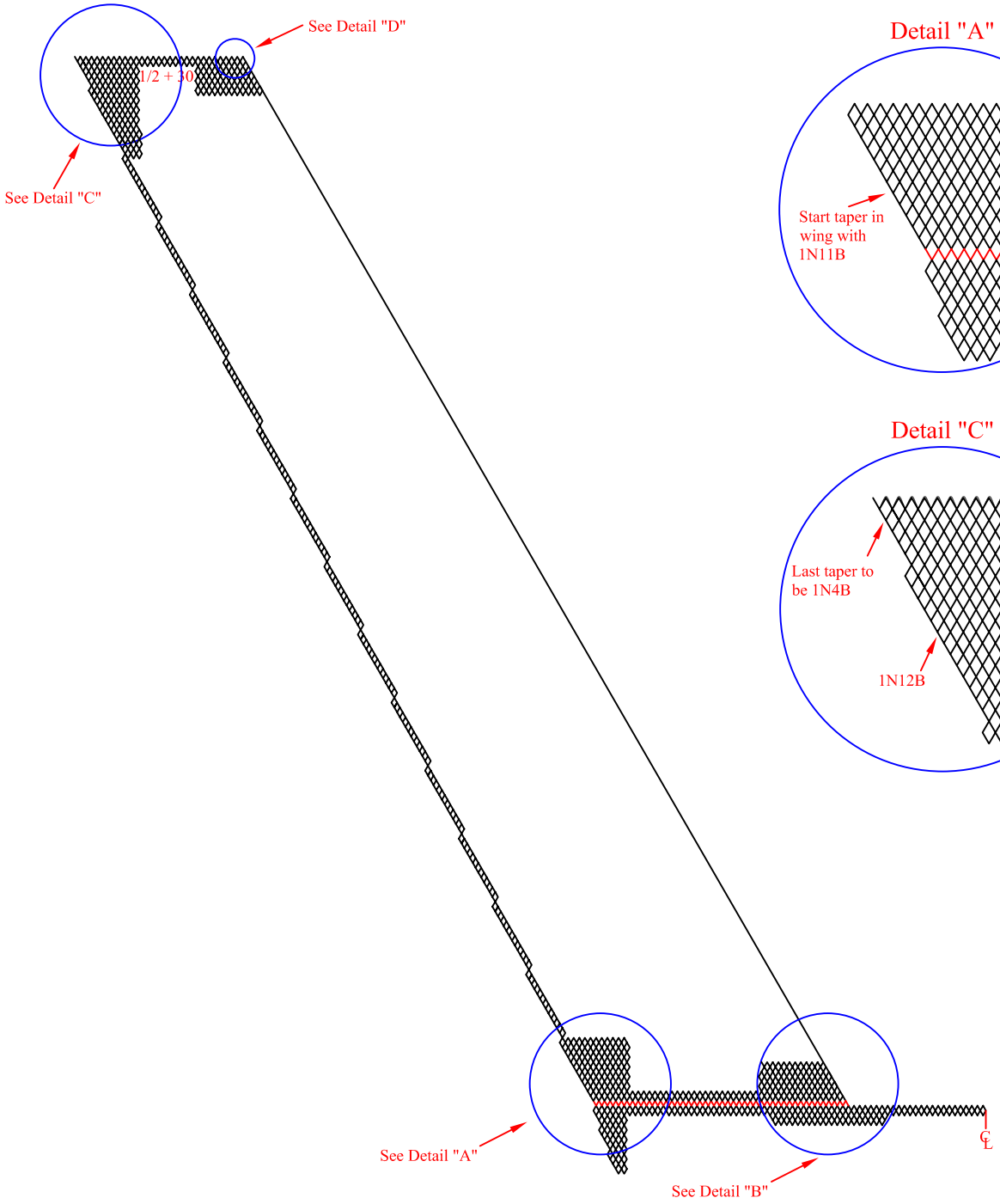
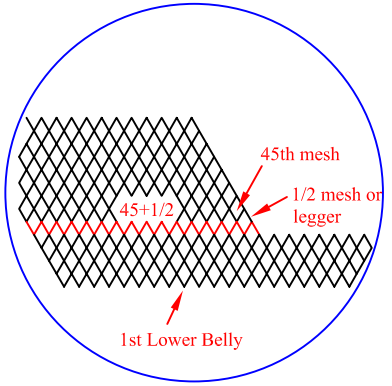


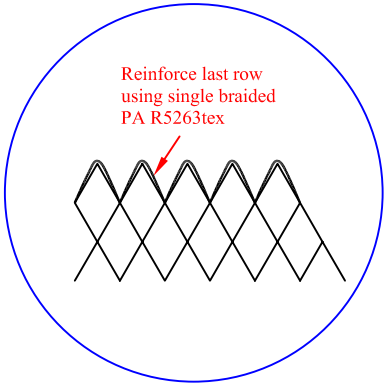
Detail "A"

Detail "B"



Detail "C"

Detail "D"



DRAWING NOTES:

A 1/2 mesh (1 row) of doubled orange twine is used to connect trawl sections together. This allows for easier section identification.

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LOWER WING DETAIL

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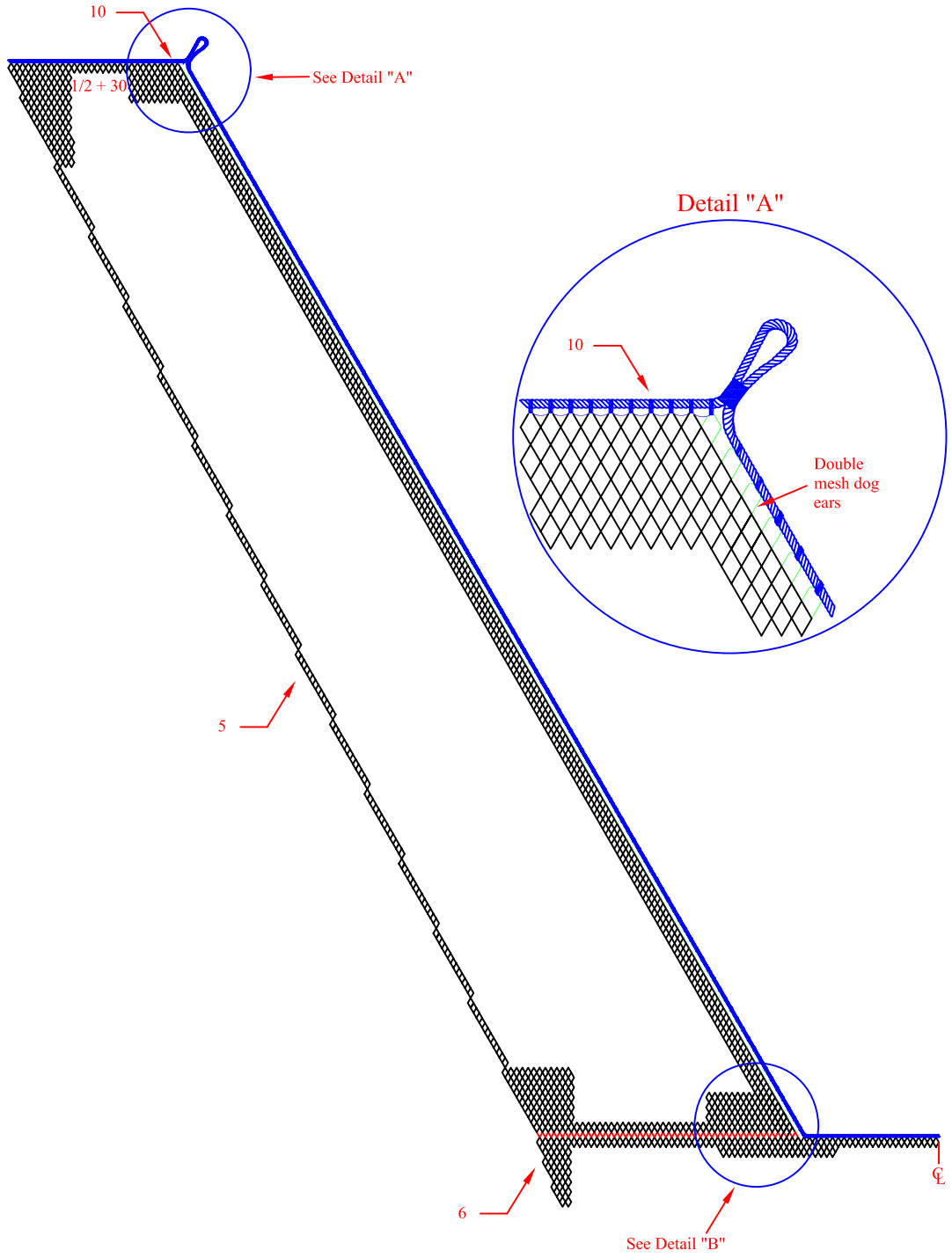
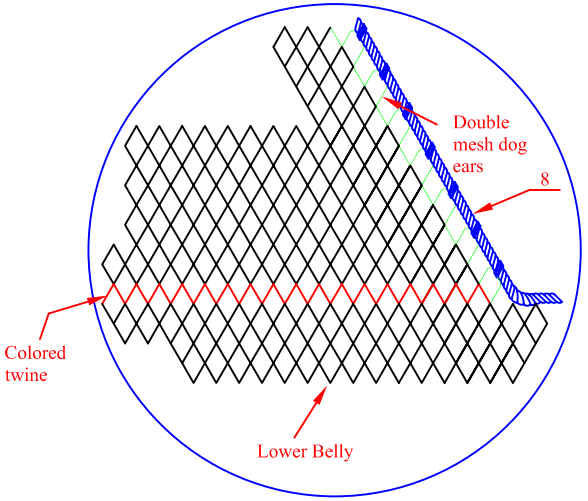


Drawing Notes:
See page 1 (Drawing # YAN-1) for more component information

PART #	COMPONENT
5	Lower Wing
6	Lower Belly
8	Footrope
10	Lower Wingline

Detail "A"

Detail "B"



DRAWING NOTES:

A 1/2 mesh (1 row) of doubled orange twine is used to connect trawl sections together. This allows for easier section identification.

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LOWER WING HANGING DETAIL

NEFSC YANKEE - 36 SURVEY TRAWL

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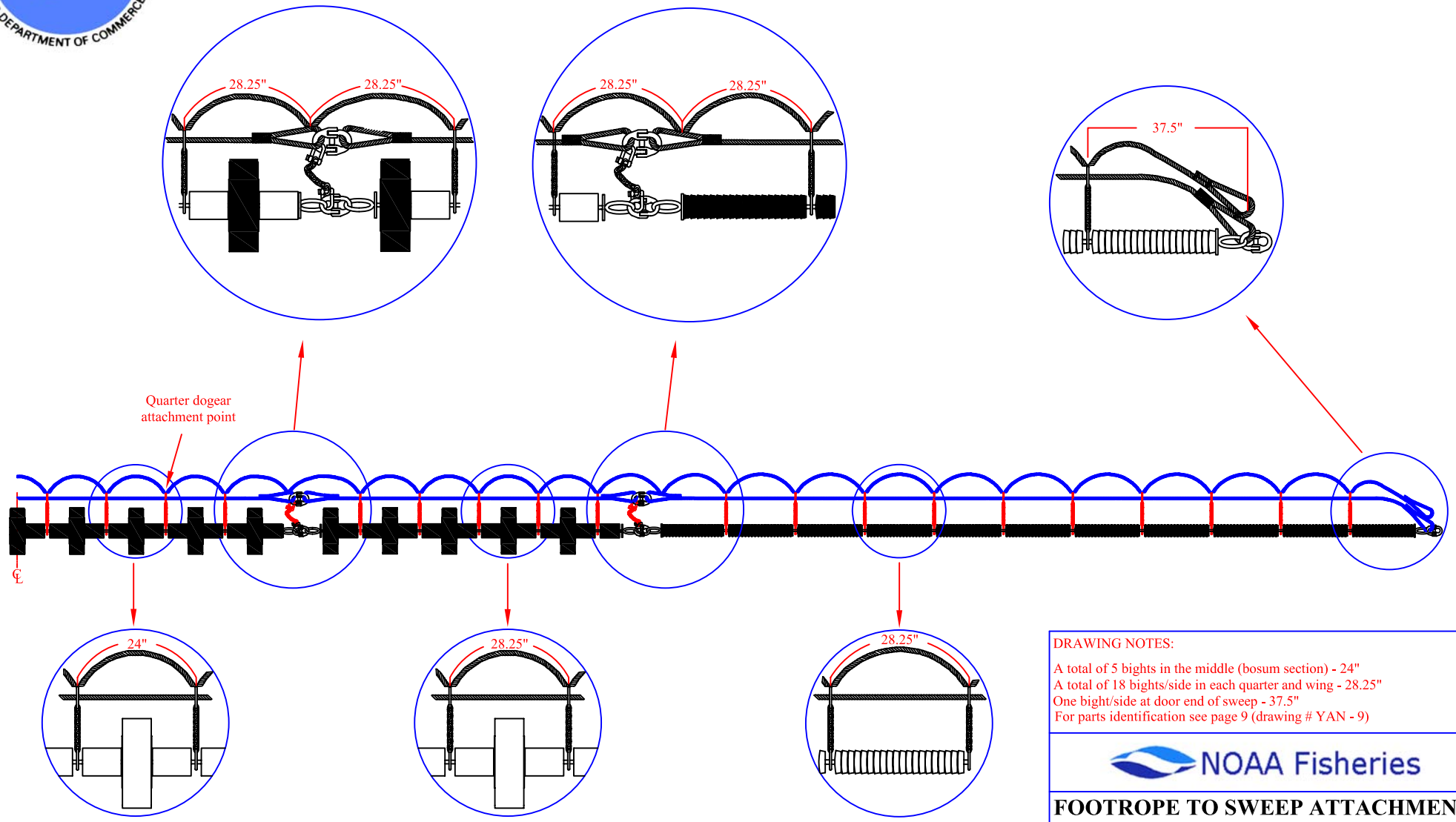

DRAWING NOTES:

A total of 5 bights in the middle (bosum section) - 24"
A total of 18 bights/side in each quarter and wing - 28.25"
One bight/side at door end of sweep - 37.5"
For parts identification see page 9 (drawing # YAN - 9)

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FOOTROPE TO SWEEP ATTACHMENT

NEFSC YANKEE - 36 SURVEY TRAWL

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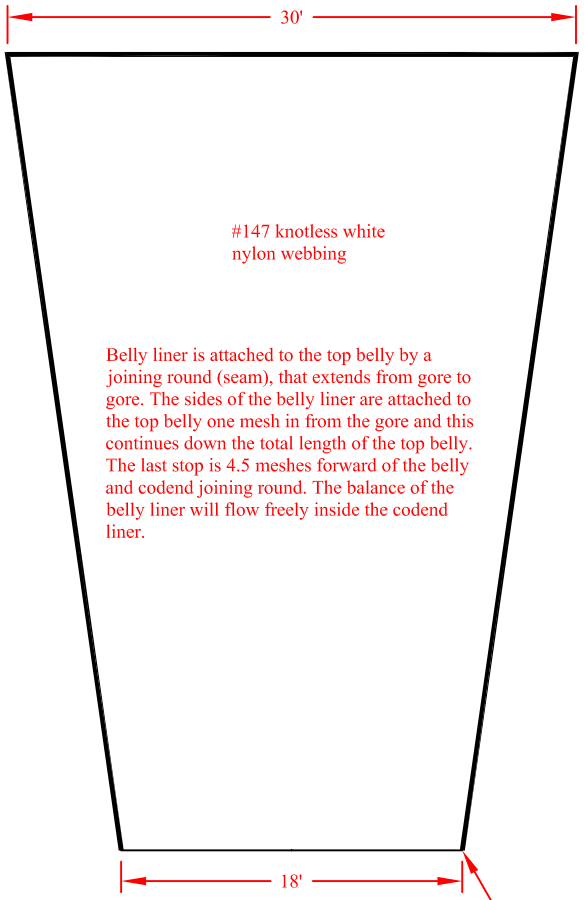
PART #	COMPONENT
59	Belly Liner (L1)
60	Codend Liner (L2)

BELLY LINER (L1)

Mesh Size (inch) | Panel Length (ft.)

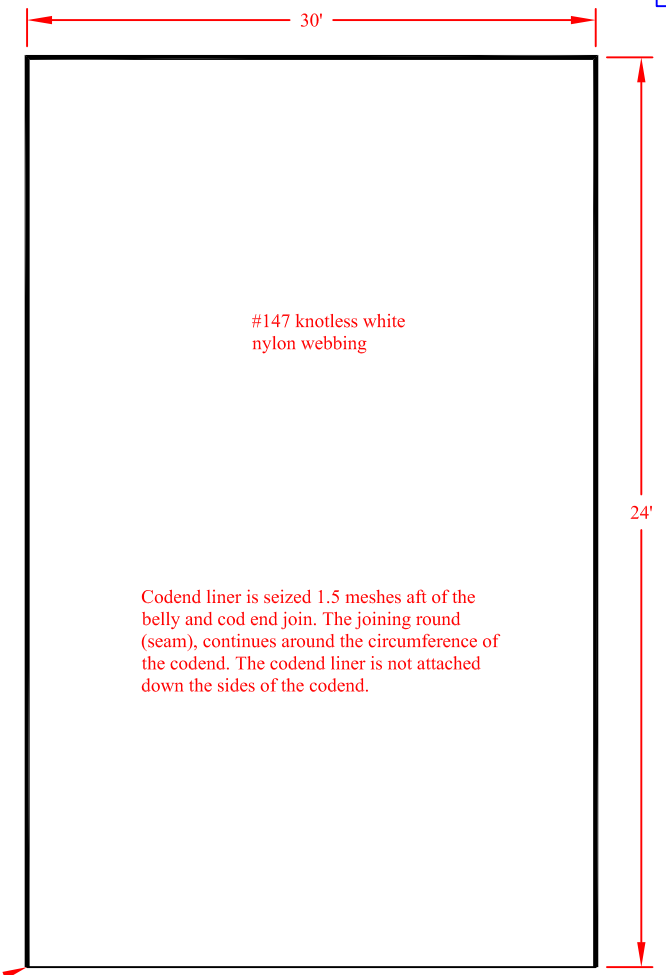
1/2" | 21'



#147 knotless white nylon webbing

Belly liner is attached to the top belly by a joining round (seam), that extends from gore to gore. The sides of the belly liner are attached to the top belly one mesh in from the gore and this continues down the total length of the top belly. The last stop is 4.5 meshes forward of the belly and codend joining round. The balance of the belly liner will flow freely inside the codend liner.

CODEND LINER (L2)



#147 knotless white nylon webbing

Codend liner is seized 1.5 meshes aft of the belly and cod end join. The joining round (seam), continues around the circumference of the codend. The codend liner is not attached down the sides of the codend.

Gather material to form a 1/2" diameter roll of liner material. The roll is formed around the perimeter of the liner except for the trailing edge. Overhand Knots are placed every 8" along the roll of netting.

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BELLY AND CODEND LINERS

NEFSC YANKEE - 36 SURVEY TRAWL

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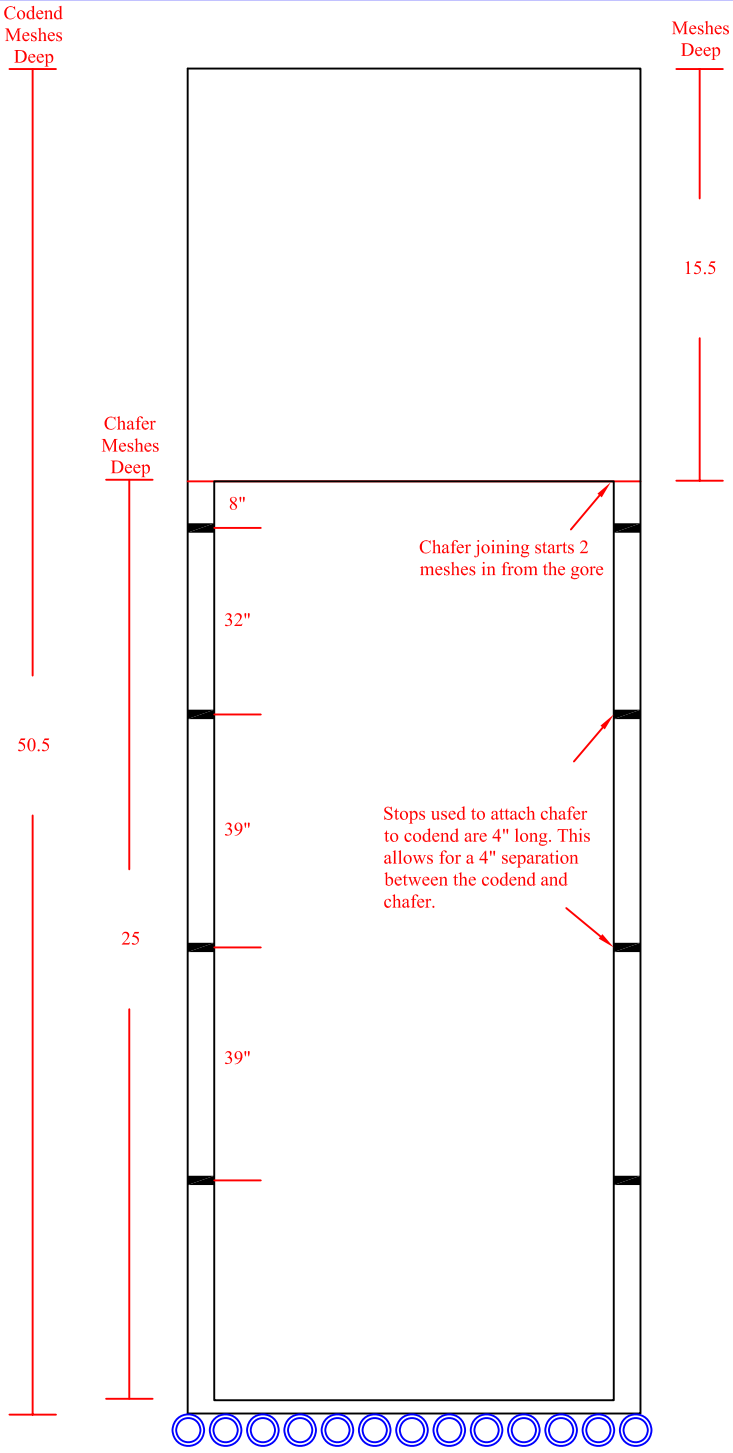

DRAWING NOTES:

Chafer must cover a minimum of 32 meshes from the bottom of the codend

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CHAFER ATTACHMENT TO CODEND

NEFSC YANKEE-36 SURVEY TRAWL

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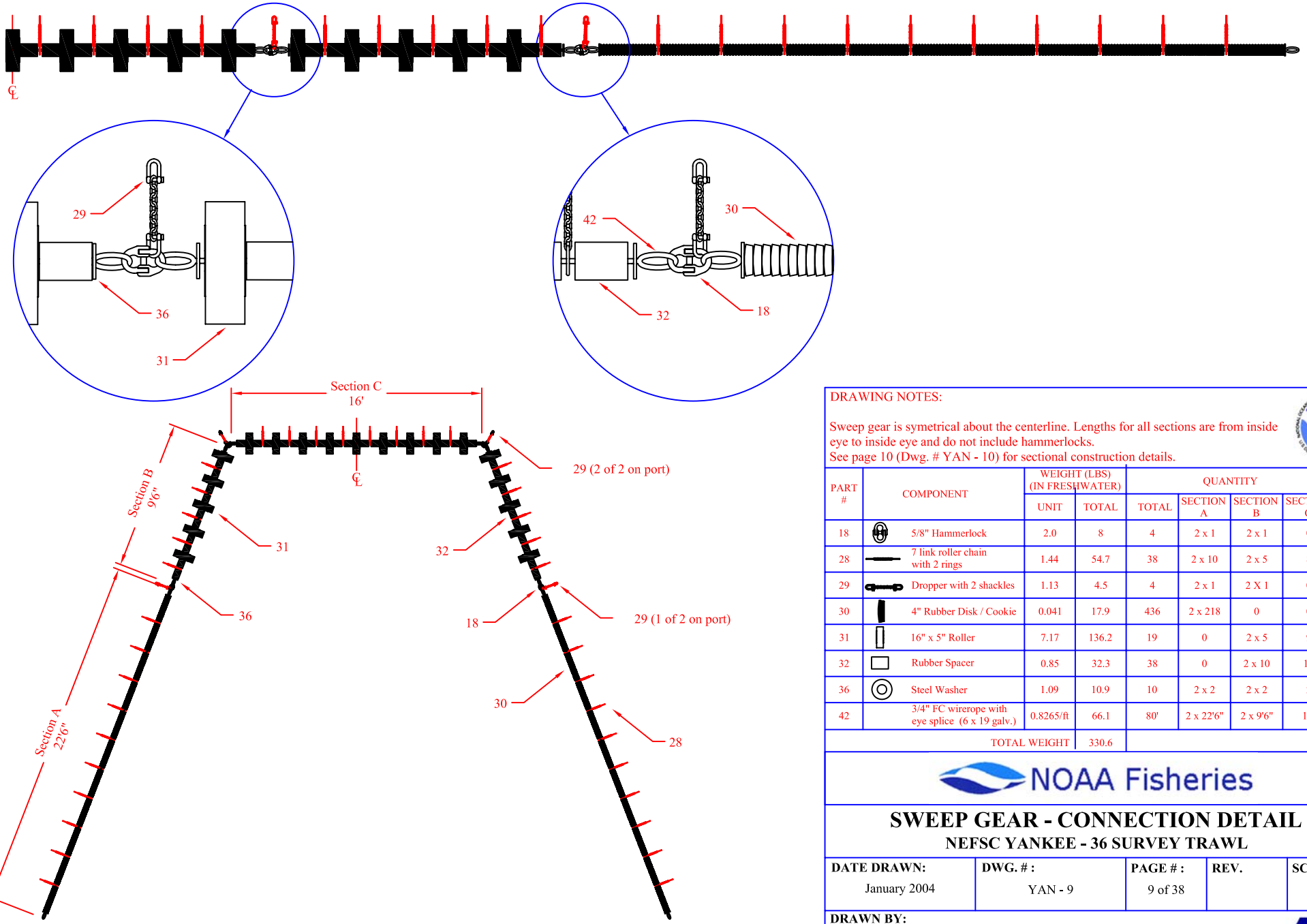
SECTION 2 – SWEEPS

- **YAN – 9** – SWEEP GEAR – CONNECTION DETAIL
- **YAN – 10** - SWEEP GEAR – SECTION DETAIL



DRAWING NOTES:

Sweep gear is symetrical about the centerline. Lengths for all sections are from inside eye to inside eye and do not include hammerlocks.
See page 10 (Dwg. # YAN - 10) for sectional construction details.

PART #	COMPONENT	WEIGHT (LBS) (IN FRESHWATER) UNIT	WEIGHT (LBS) (IN FRESHWATER) TOTAL	QUANTITY TOTAL	QUANTITY SECTION A	QUANTITY SECTION B	QUANTITY SECTION C	PAGE #
18	5/8" Hammerlock	2.0	8	4	2 x 1	2 x 1	0	16
28	7 link roller chain with 2 rings	1.44	54.7	38	2 x 10	2 x 5	8	26
29	Dropper with 2 shackles	1.13	4.5	4	2 x 1	2 X 1	0	27
30	4" Rubber Disk / Cookie	0.041	17.9	436	2 x 218	0	0	28
31	16" x 5" Roller	7.17	136.2	19	0	2 x 5	9	29
32	Rubber Spacer	0.85	32.3	38	0	2 x 10	18	30
36	Steel Washer	1.09	10.9	10	2 x 2	2 x 2	2	34
42	3/4" FC wirerope with eye splice (6 x 19 galv.)	0.8265/ft	66.1	80'	2 x 22'6"	2 x 9'6"	16'	NA
	TOTAL WEIGHT		330.6					

NOAA Fisheries

SWEEP GEAR - CONNECTION DETAIL

NEFSC YANKEE - 36 SURVEY TRAWL

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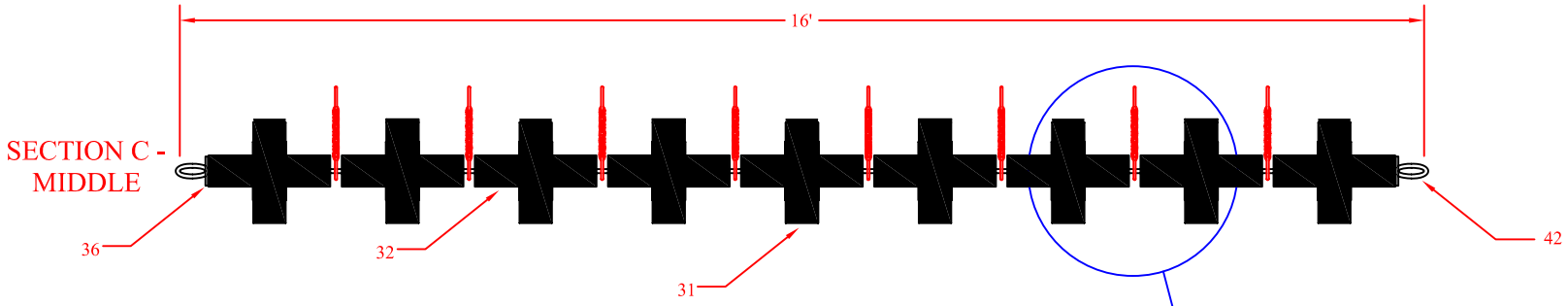

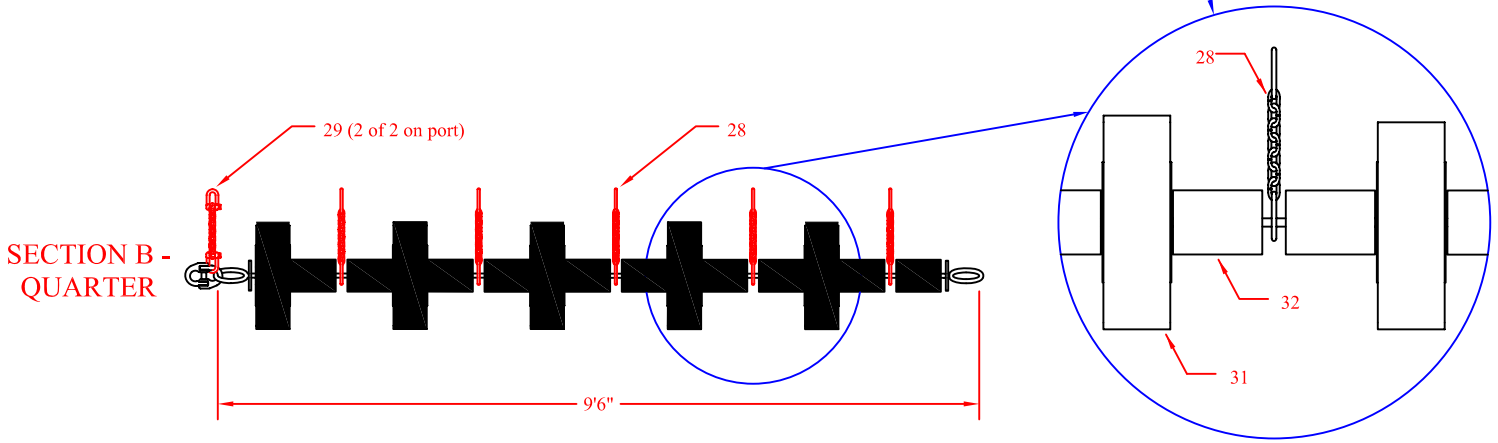

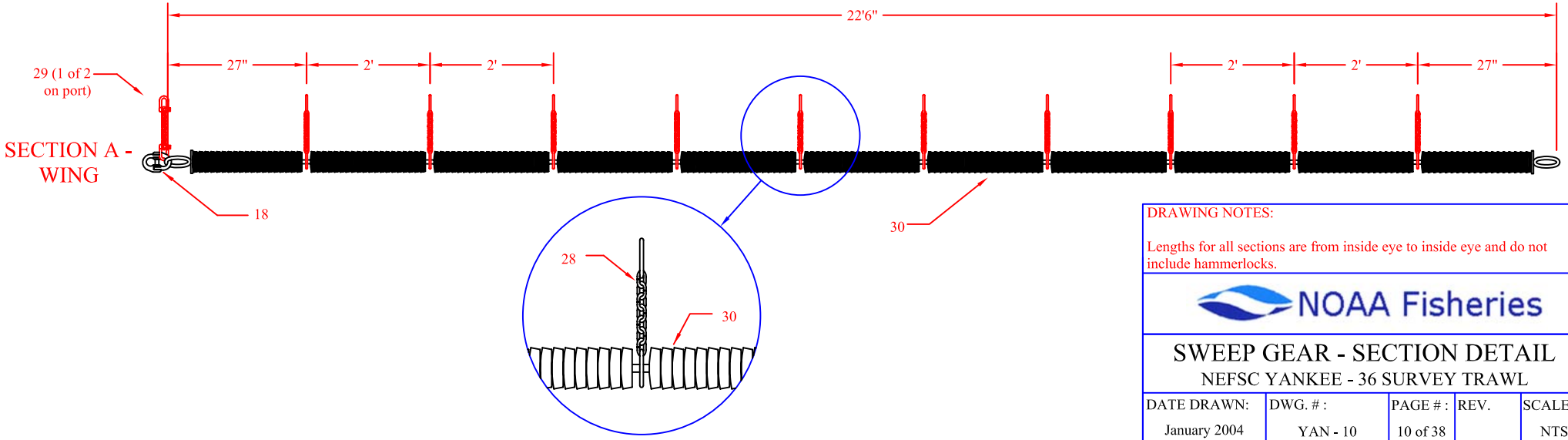

DRAWING NOTES:

See page 9 (Dwg. # YAN - 9) for more detailed component information.

PART #	COMPONENT
18	5/8" Hammerlock
28	7 link roller chain with 2 rings
29	Dropper with 2 shackles
30	4" Rubber Disk / Cookie
31	16" x 5"Roller
32	Rubber Spacer
36	Steel Washer
42	3/4" FC wirerope with eye splice (6 x 19 galv.)

DRAWING NOTES:

Lengths for all sections are from inside eye to inside eye and do not include hammerlocks.

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SWEEP GEAR - SECTION DETAIL

NEFSC YANKEE - 36 SURVEY TRAWL

DATE DRAWN:	DWG. # :	PAGE # :	REV.	SCALE:
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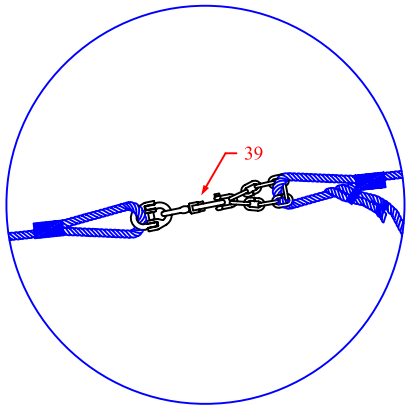
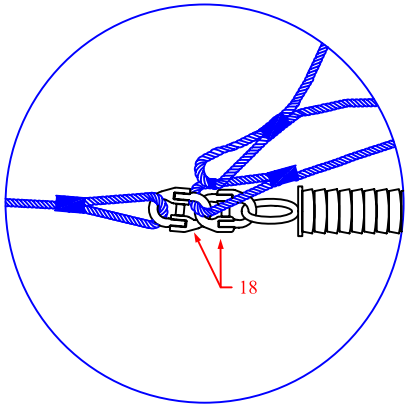
SECTION 3 – RIGGING

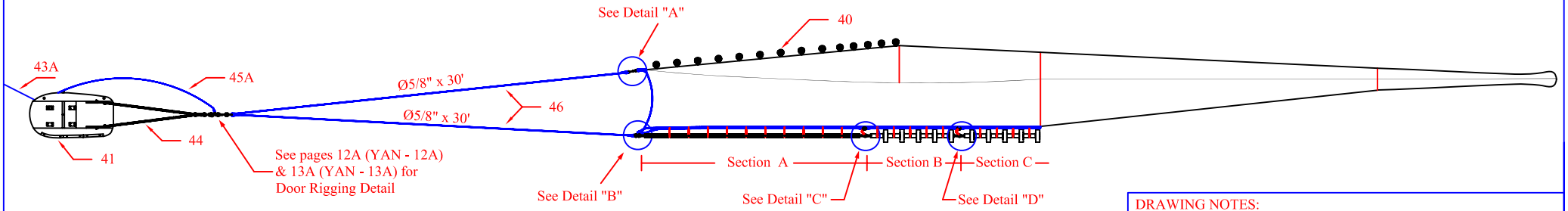
- **YAN – 11A** - RIGGING PROFILE – ALBATROSS IV
- **YAN – 11B** - RIGGING PROFILE – DELAWARE II
- **YAN – 12A** - DOOR RIGGING DETAIL – ALBATROSS IV
- **YAN – 12B** - DOOR RIGGING DETAIL – DELAWARE II
- **YAN – 13A** - DOOR RIGGING DETAIL – ALBATROSS IV
- **YAN – 13B** - DOOR RIGGING DETAIL – DELAWARE II

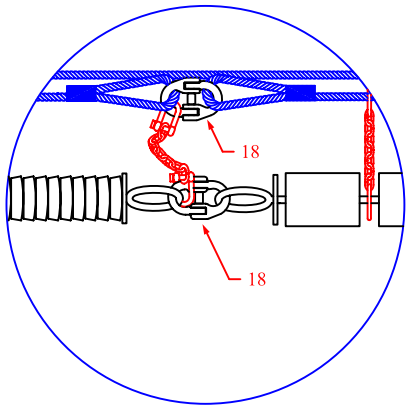


Detail "A" - Upper Leg Connection

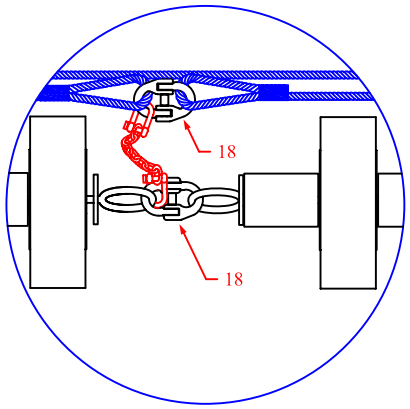


Detail "B" - Lower Leg Connection





Detail "C" - Wing to Quarter Connection



Detail "D" - Quarter to Middle Connection

DRAWING NOTES:

Sweep components are not included in the component list of this drawing, see page 9 (Dwg. # YAN - 9) for sweep component listing.

PART #	COMPONENT	MATERIALS	QTY	PAGE #
18	5/8" Hammerlock	Steel	12	16
39	Weak Link	Steel	2	36
40	8" Float with beckets	Aluminum	36	37
41	2.84 sqm. Trawl Door	990 lb Polyvalent	2	38
43A	Ø 7/8" Warp	6 x 26 Wire	2	NA
44	Chain backstrap	1/2" Chain	4	12A/13A
45A	Ø 9/16" x 17' Idler	6 x 37 Wire	2	12A/13A
46	Ø 5/8 x 30' Legs	6 x 19 Wire	4	NA
	Sweep Section A	Various	2	9 / 10
	Sweep Section B	Various	2	9 / 10
	Sweep Section C	Various	1	9 / 10

NOAA Fisheries

RIGGING PROFILE - ALBATROSS IV

NEFSC YANKEE - 36 SURVEY TRAWL

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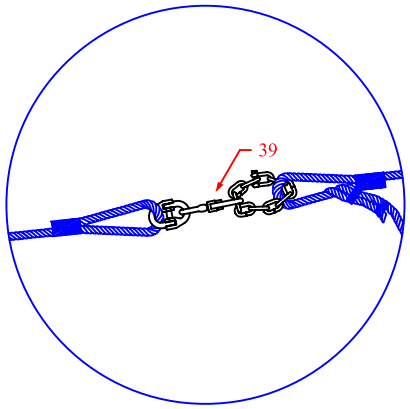
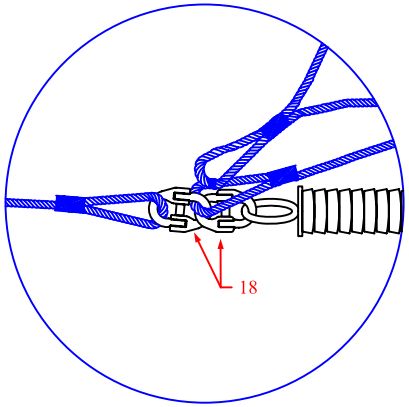
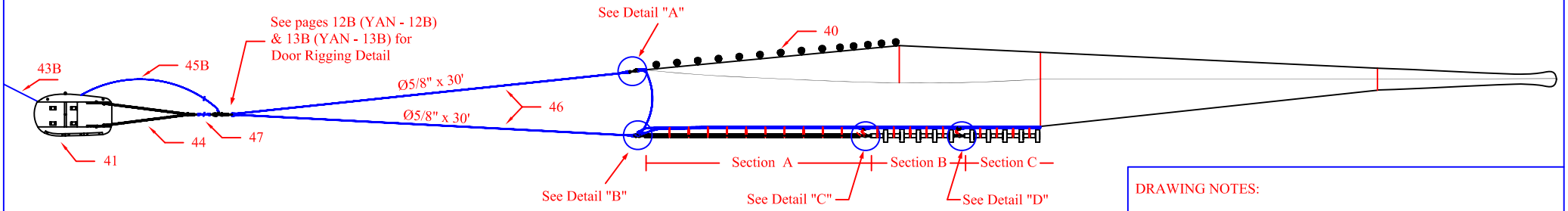
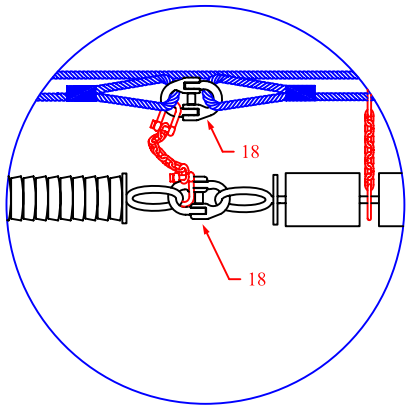


Detail "A" - Upper Leg Connection

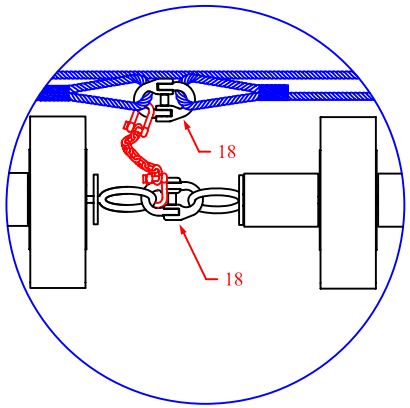


Detail "B" - Lower Leg Connection





Detail "C" - Wing to Quarter Connection



Detail "D" - Quarter to Middle Connection

DRAWING NOTES:

Sweep components are not included in the component list of this drawing, see page 9 (Dwg. # YAN - 9) for sweep component listing.

PART #	COMPONENT	MATERIALS	QTY	PAGE #
18	5/8" Hammerlock	Steel	12	16
39	Weak Link	Steel	2	36
40	8" Float with beckets	Aluminum	36	37
41	2.84 sqm. Trawl Door	990 lb Polyvalent	2	38
43B	Ø 1" Warp	6 x 25 Wire	2	NA
44	Chain backstrap	1/2" Chain	4	12B/13B
45B	Ø 9/16" x 33' Idler	6 x 19 Wire	2	12B/13B
46	Ø 5/8 x 30' Legs	6 x 19 Wire	4	NA
47	Ø 5/8" X 11' Extension	6 x 19 Wire	2	12B/13B
	Sweep Section A	Various	2	9 / 10
	Sweep Section B	Various	2	9 / 10
	Sweep Section C	Various	1	9 / 10

NOAA Fisheries

RIGGING PROFILE - DELAWARE II

NEFSC YANKEE - 36 SURVEY TRAWL

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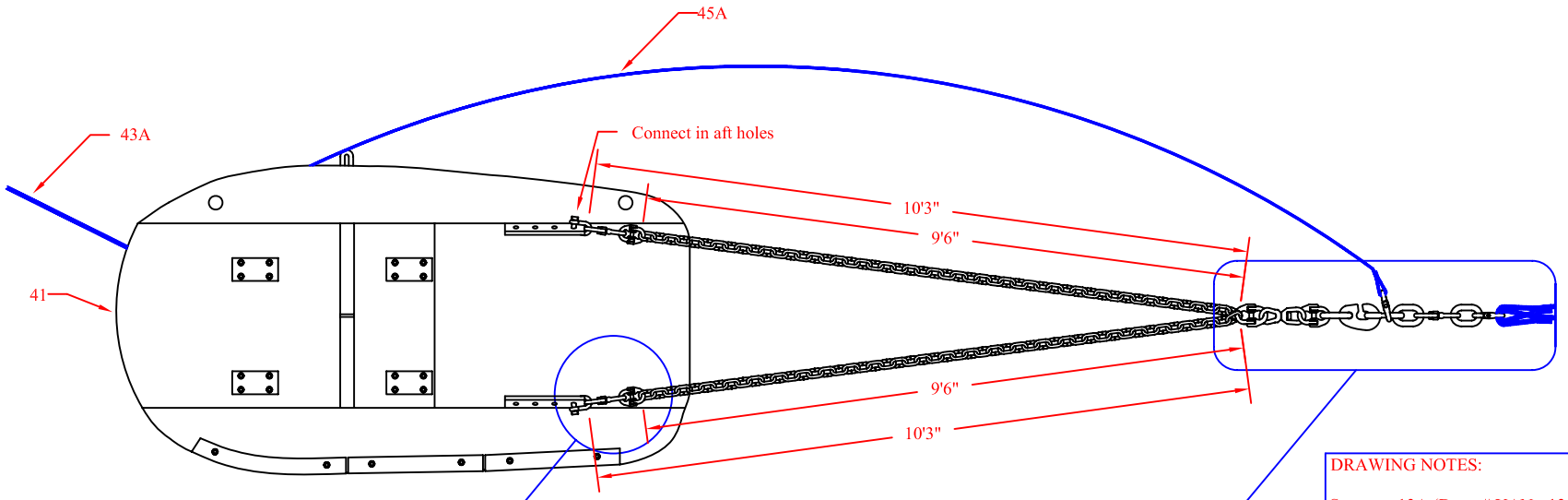
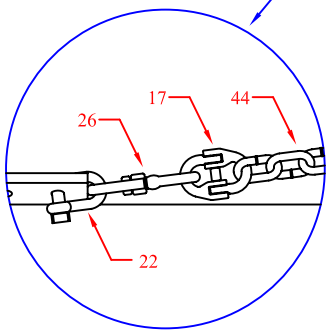
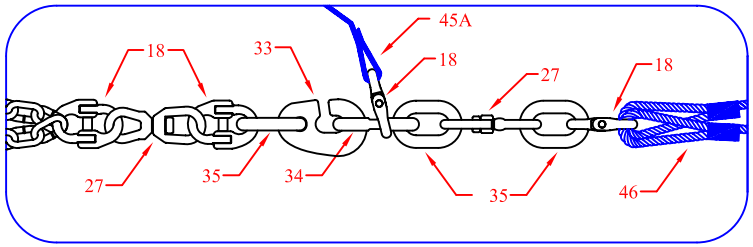


BACKSIDE VIEW OF DOOR





DRAWING NOTES:

See page 13A (Dwg. # YAN - 13A) for a detailed front view of the trawl door.

PART #	COMPONENT	MATERIALS	QTY	PAGE #
17	1/2" Hammerlock	Steel	2	15
18	5/8" Hammerlock	Steel	8	16
22	5/8" Trawl Shackle	Steel	4	20
26	5/8" Swivel	Steel	4	23
27	3/4" Swivel	Steel	4	24
33	G-hook	Steel	2	30
34	Flat link	Steel	2	31
35	Connecting Link	Steel	6	32
41	2.84 sqm. Trawl Door	990 lb Polyvalent	2	38
43A	Ø 7/8" Warp	6 x 26 Wire	2	NA
44	Chain backstrap	1/2" Chain	4	NA
45A	Ø 9/16" x 17' Idler	6 x 37 Wire	2	NA
46	Ø 5/8 x 30' Legs	6 x 19 Wire	4	NA

NOAA Fisheries

DOOR RIGGING DETAIL - ALBATROSS IV

NEFSC YANKEE - 36 SURVEY TRAWL

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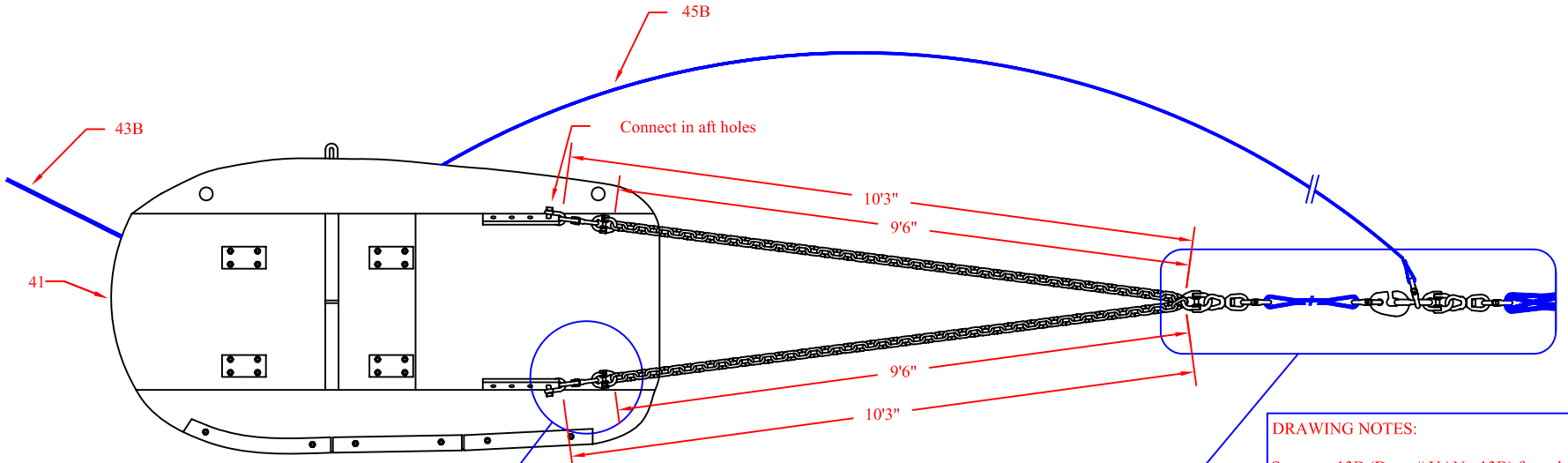
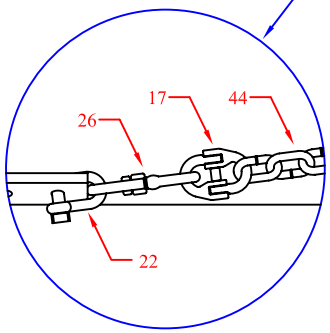
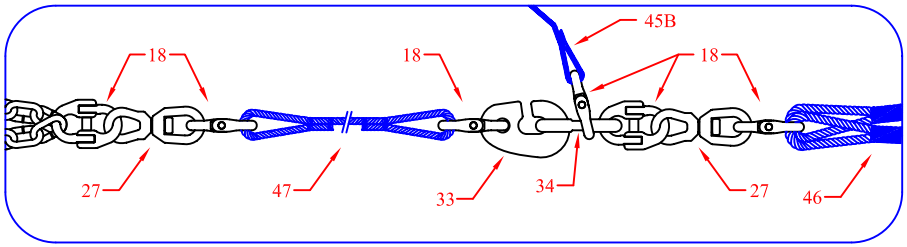


BACKSIDE VIEW OF DOOR





DRAWING NOTES:

See page 13B (Dwg. # YAN - 13B) for a detailed front view of the trawl door.

PART #	COMPONENT	MATERIALS	QTY	PAGE #
17	1/2" Hammerlock	Steel	2	15
18	5/8" Hammerlock	Steel	12	16
22	5/8" Trawl Shackle	Steel	4	20
26	5/8" Swivel	Steel	4	23
27	3/4" Swivel	Steel	4	24
33	G-hook	Steel	2	30
34	Flat link	Steel	2	31
41	2.84 sqm. Trawl Door	990 lb Polyvalent	2	38
43B	Ø 1" Warp	6 x 25 Wire	2	NA
44	Chain backstrap	1/2" Chain	4	NA
45B	Ø 9/16" x 33' Idler	6 x 19 Wire	2	NA
46	Ø 5/8" x 30' Legs	6 x 19 Wire	4	NA
47	Ø 5/8" x 11' Extension	6 x 19 Wire	2	NA

NOAA Fisheries

DOOR RIGGING DETAIL - DELAWARE II
NEFSC YANKEE - 36 SURVEY TRAWL

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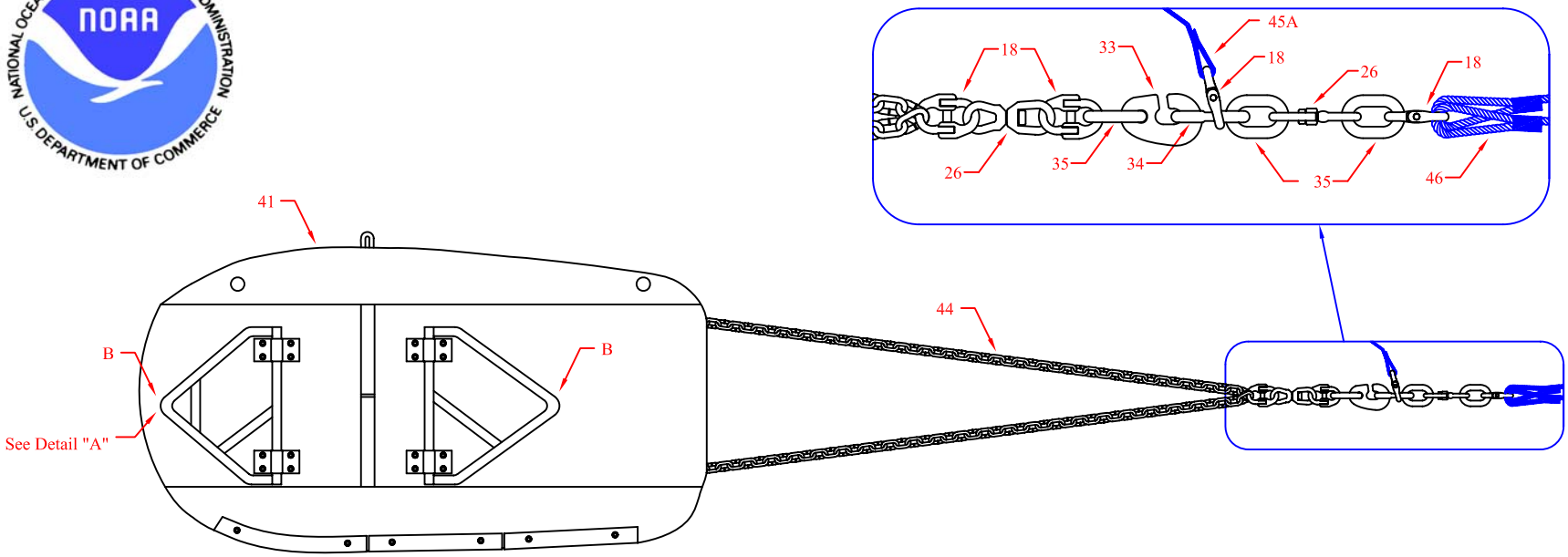
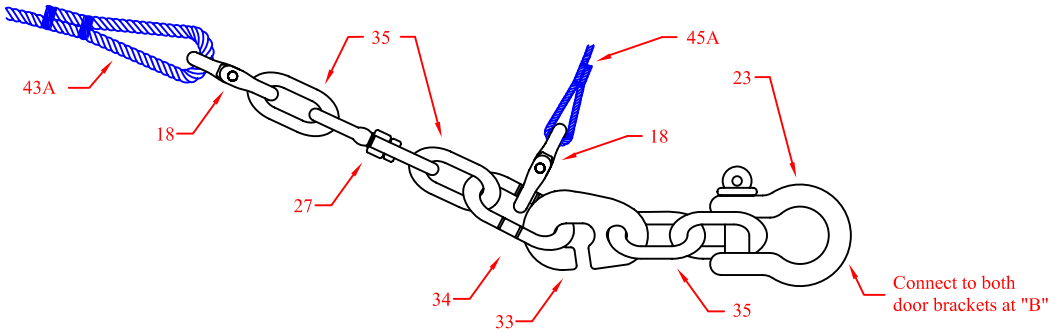


FRONTSIDE VIEW OF DOOR



Detail "A" - Warp/Idler
Connection Detail

DRAWING NOTES:

See page 12A (Dwg. # YAN - 12A) for a detailed rear view of the trawl door.

PART #	COMPONENT	MATERIALS	QTY	PAGE #
18	5/8" Hammerlock	Steel	12	16
23	Door Shackle	Steel	2	21
26	5/8" Swivel	Steel	4	23
27	3/4" Swivel	Steel	2	24
33	G-hook	Steel	4	30
34	Flat link	Steel	4	31
35	Link	Steel	14	32
41	2.84 sqm. Trawl Door	990 lb Polyvalent	2	38
43A	Ø 7/8" Warp	6 x 26 Wire	2	NA
44	Chain backstrap	1/2" Chain	4	NA
45A	Ø 9/16" x 17' Idler	6 x 37 Wire	2	NA
46	Ø 5/8 x 30' Legs	6 x 19 Wire	4	NA

NOAA Fisheries

DOOR RIGGING DETAIL - ALBATROSS IV
NEFSC YANKEE - 36 SURVEY TRAWL

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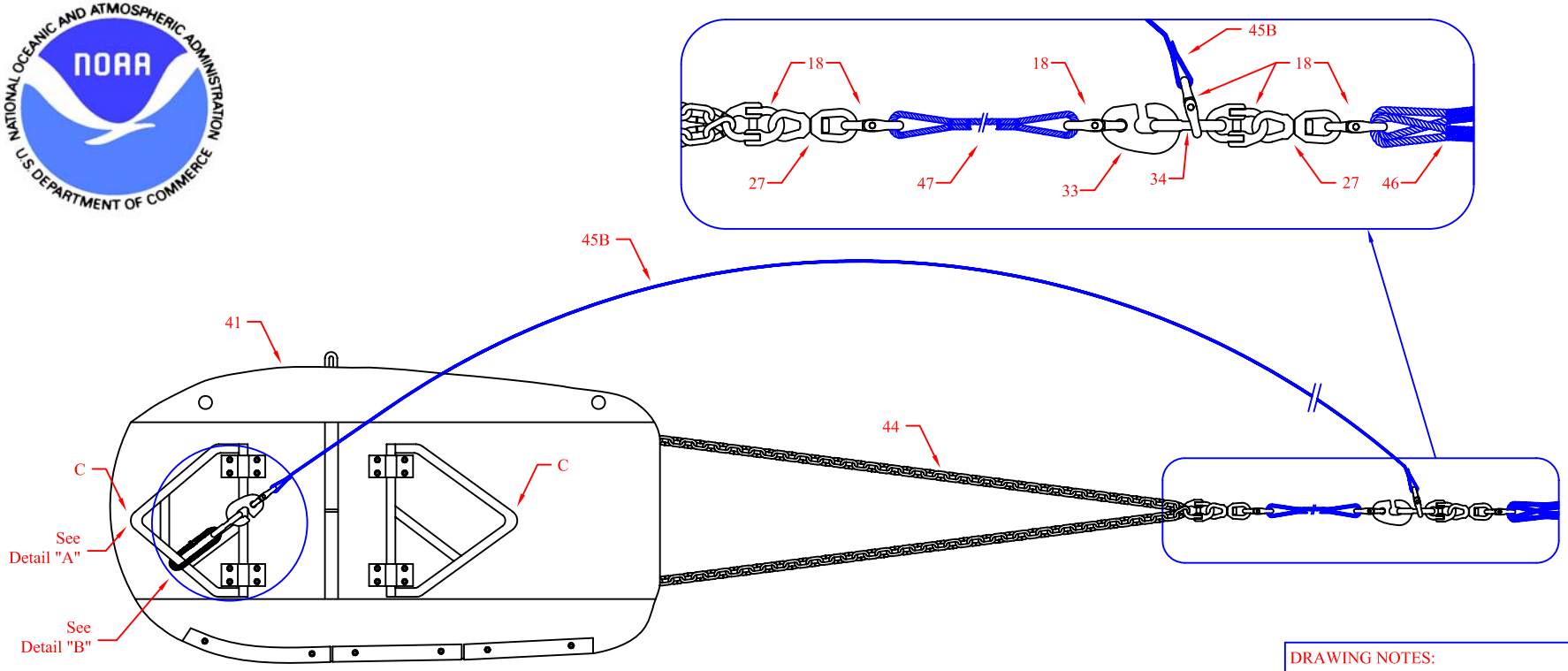
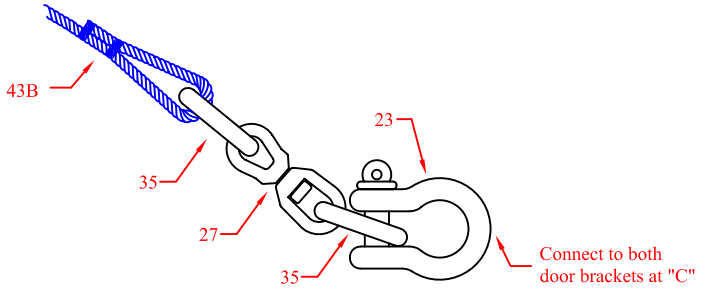
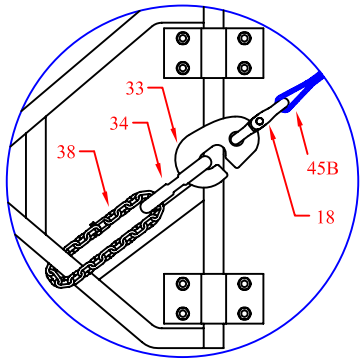


FRONTSIDE VIEW OF DOOR



Detail "A" - Warp
Connection Detail



Detail "B" - Idler
Connection Detail

DRAWING NOTES:

See page 12B (Dwg. # YAN - 12B) for a detailed rear view of the trawl door.

PART #	COMPONENT	MATERIALS	QTY	PAGE #
18	5/8" Hammerlock	Steel	14	16
23	Door Shackle	Steel	2	21
27	3/4" Swivel	Steel	6	24
33	G-hook	Steel	4	30
34	Flat link	Steel	4	31
35	Link	Steel	4	32
38	Idler Connection Chain	Steel	2	35
41	2.84 sqm. Trawl Door	990 lb Polyvalent	2	38
43B	Ø 1" Warp	6 x 25 Wire	2	NA
44	Chain backstrap	1/2" Chain	4	NA
45B	Ø 9/16" x 33' Idler	6 x 19 Wire	2	NA
46	Ø 5/8" x 30' Legs	6 x 19 Wire	4	NA
47	Ø 5/8" x 11' Extension	6 x 19 Wire	2	NA

NOAA Fisheries

DOOR RIGGING DETAIL - DELAWARE II
NEFSC YANKEE - 36 SURVEY TRAWL

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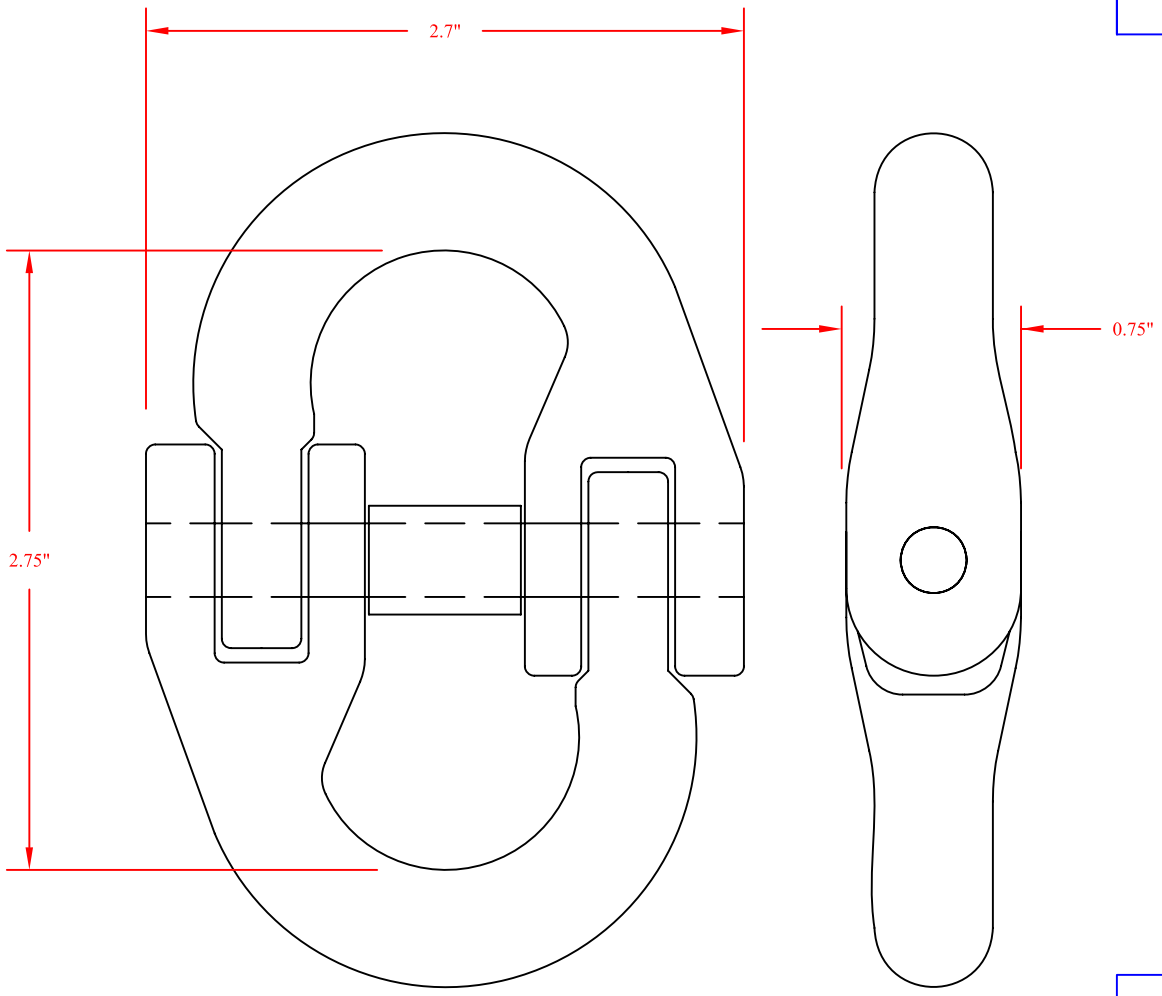
SECTION 4 – PARTS

- **YAN - 14 – 16** - 3/8” HAMMERLOCK
- **YAN - 15 - 17** - 1/2” HAMMERLOCK
- **YAN - 16 - 18** - 5/8” HAMMERLOCK
- **YAN - 17 - 19** - 5/16” TRAWL SHACKLE
- **YAN - 18 - 20** - 3/8” TRAWL SHACKLE
- **YAN - 19 - 21** - 1/2” TRAWL SHACKLE
- **YAN - 20 - 22** - 5/8” TRAWL SHACKLE
- **YAN - 21 - 23** - DOOR SHACKLE
- **YAN - 22 - 24** - 3/8” SWIVEL
- **YAN - 23 - 26** - 5/8” SWIVEL
- **YAN - 24 - 27** - 3/4” SWIVEL
- **YAN - 25 - 28** - 13.7” ROLLER CHAIN
- **YAN - 26 - 29** - DROPPER WITH 2 SHACKLES
- **YAN - 27 - 30** - 4” RUBBER DISK/COOKIE
- **YAN - 28 - 31** - 16” ROLLER
- **YAN - 29 - 32** - 4.8” x 6.7” RUBBER SPACER
- **YAN - 30 - 33** - G-HOOK
- **YAN - 31 - 34** - FLAT LINK
- **YAN - 32 - 35** - CONNECTING LINK
- **YAN - 33 - 36** - 4.5” STEEL WASHER
- **YAN - 34 - 14** - 2” CODEND RING
- **YAN - 35 - 38** - IDLER CONNECTION CHAIN
- **YAN - 36 - 39** - WEAK LINK
- **YAN - 37 - 40** - 8” ALUMINUM LUG FLOAT
- **YAN - 38 - 41** - TRAWL DOOR DETAILS

SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
16	0.77	0.69



NOAA Fisheries

3/8" HAMMERLOCK

NEFSC YANKEE - 36 SURVEY TRAWL

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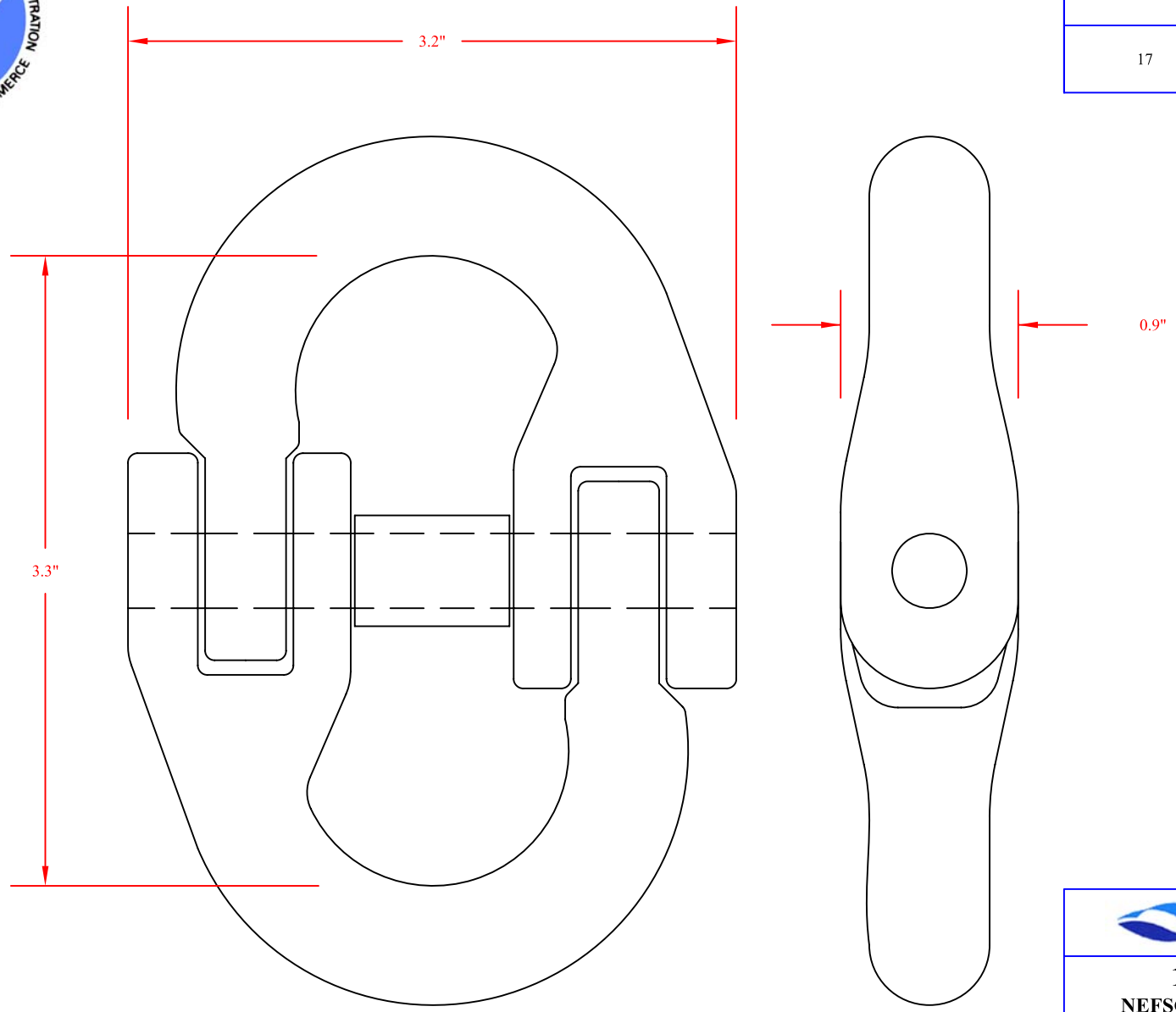

SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
17	1.35	1.17

NOAA Fisheries

1/2" HAMMERLOCK

NEFSC YANKEE - 36 SURVEY TRAWL

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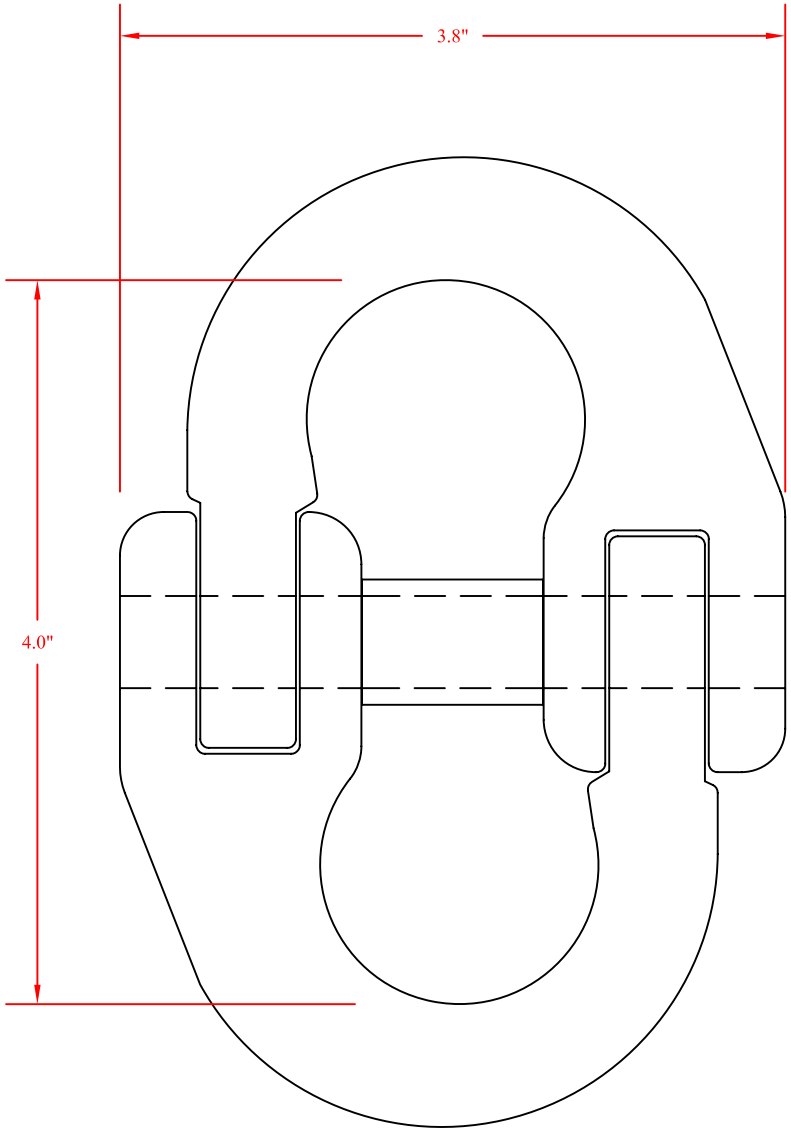
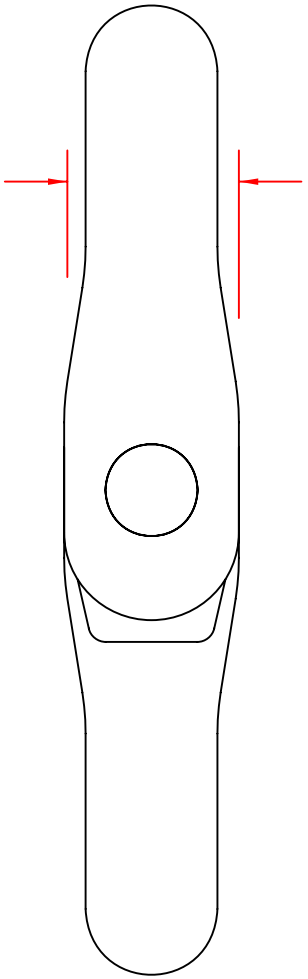
SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
18	2.30	2.00





NOAA Fisheries

5/8" HAMMERLOCK

NEFSC YANKEE - 36 SURVEY TRAWL

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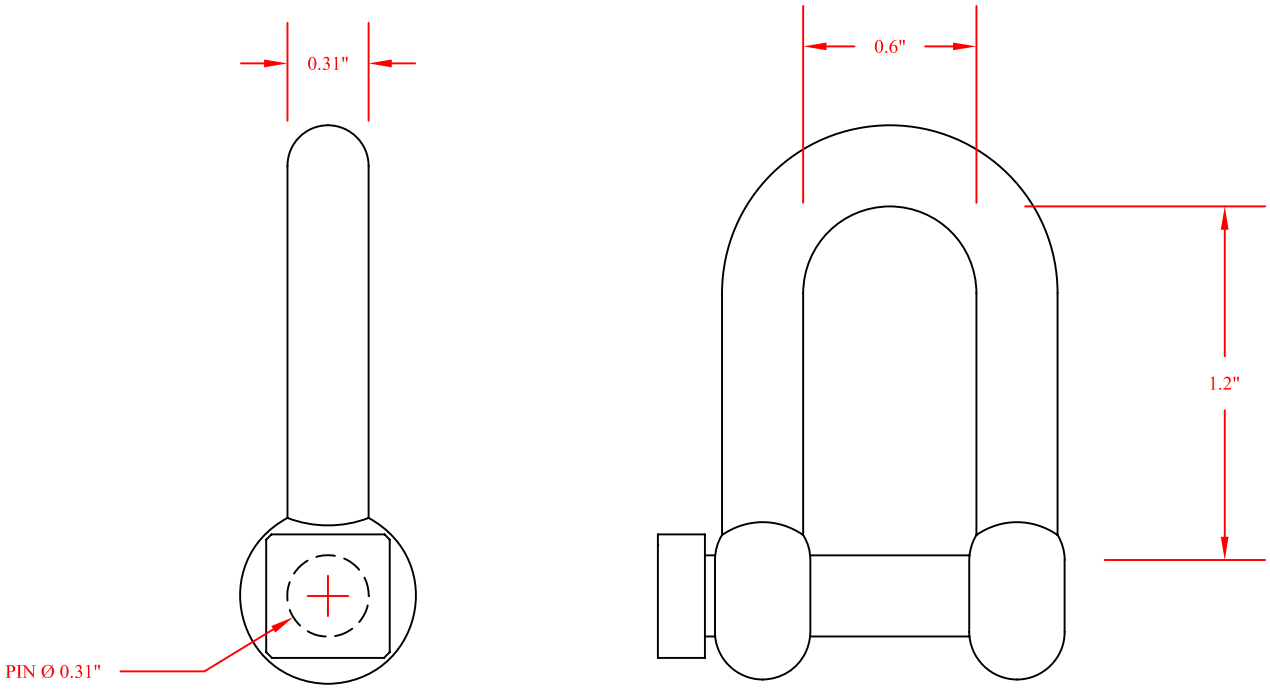
SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
19	0.13	0.12



NOAA Fisheries

5/16" TRAWL SHACKLE

NEFSC YANKEE - 36 SURVEY TRAWL

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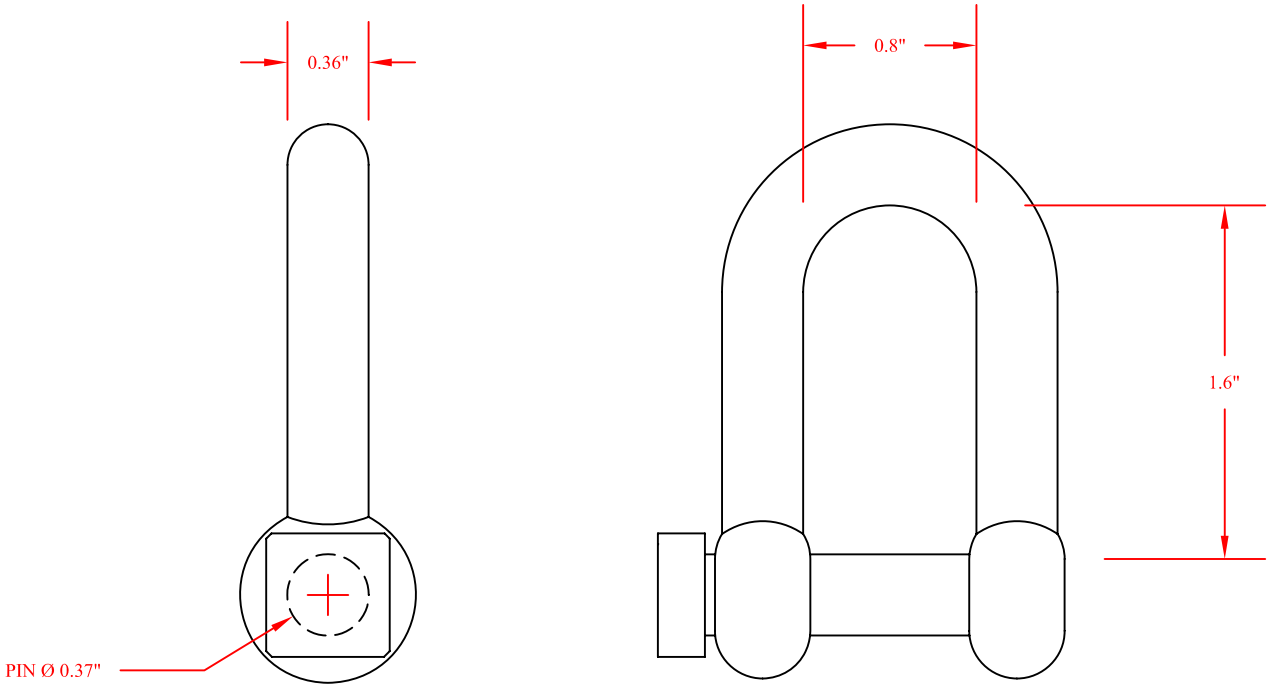
SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
20	0.22	0.19



NOAA Fisheries

3/8" TRAWL SHACKLE

NEFSC YANKEE - 36 SURVEY TRAWL

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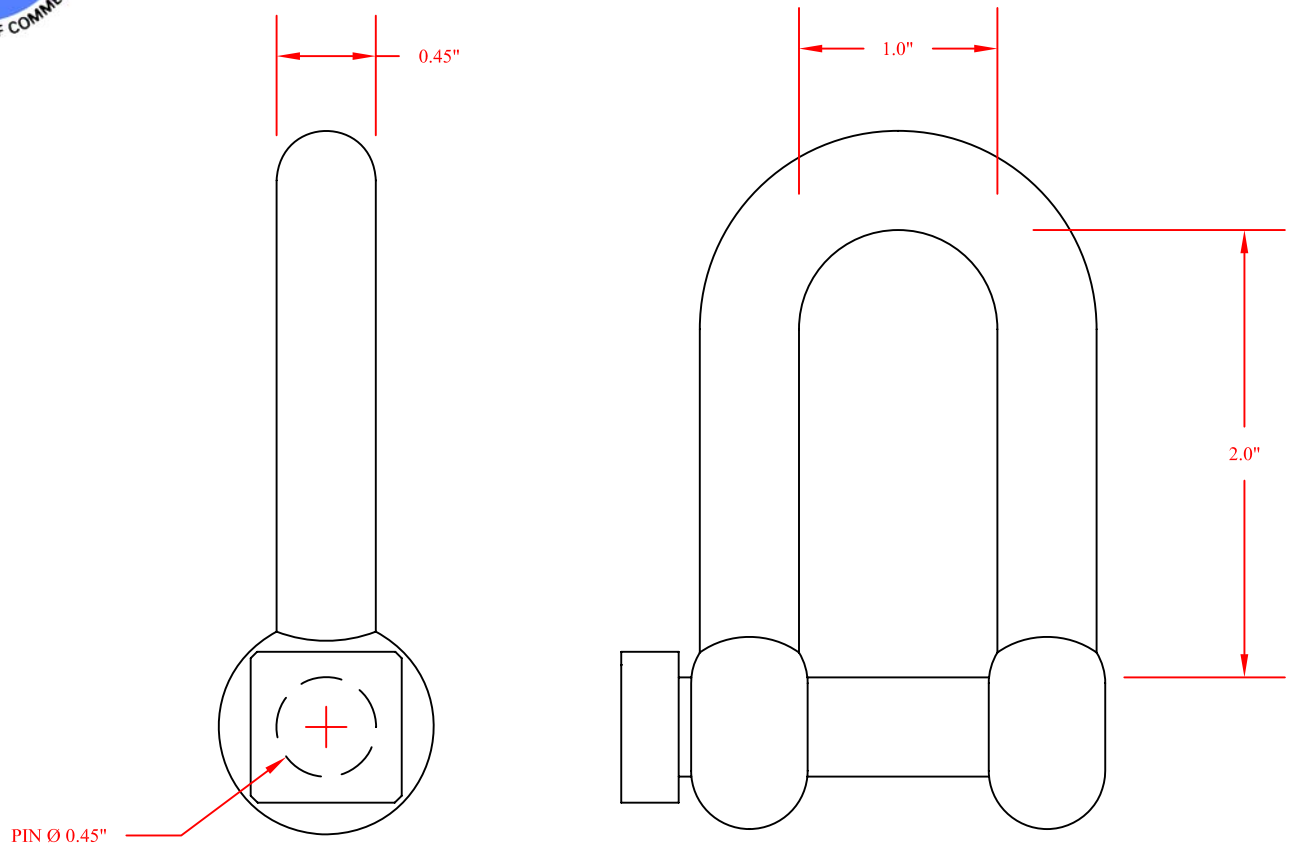
SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
21	0.42	0.37



NOAA Fisheries

1/2" TRAWL SHACKLE

NEFSC YANKEE - 36 SURVEY TRAWL

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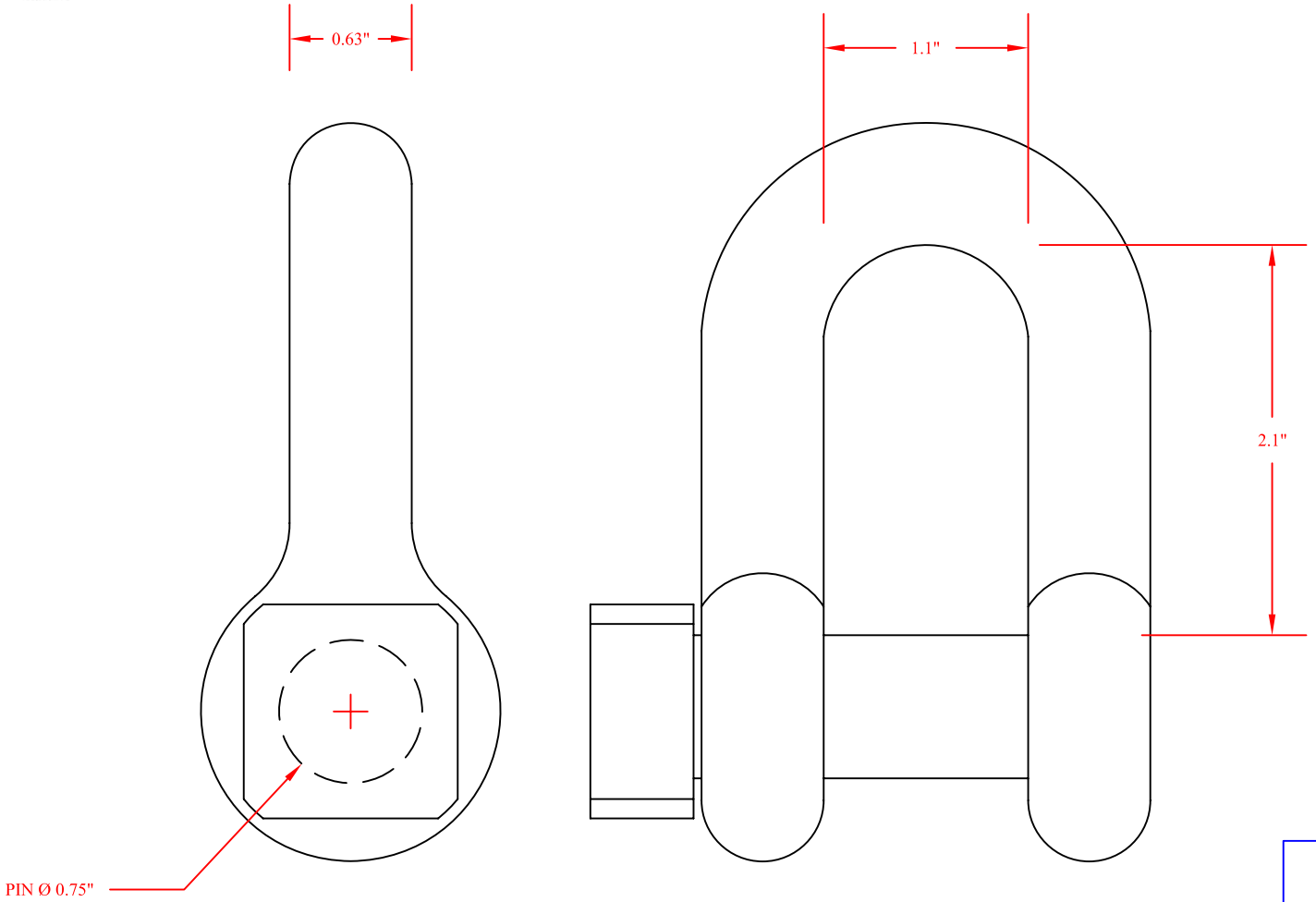
SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
22	1.31	1.17



NOAA Fisheries

5/8" TRAWL SHACKLE

NEFSC YANKEE - 36 SURVEY TRAWL

DATE DRAWN:	DWG. # :	PAGE # :	REV.	SCALE:
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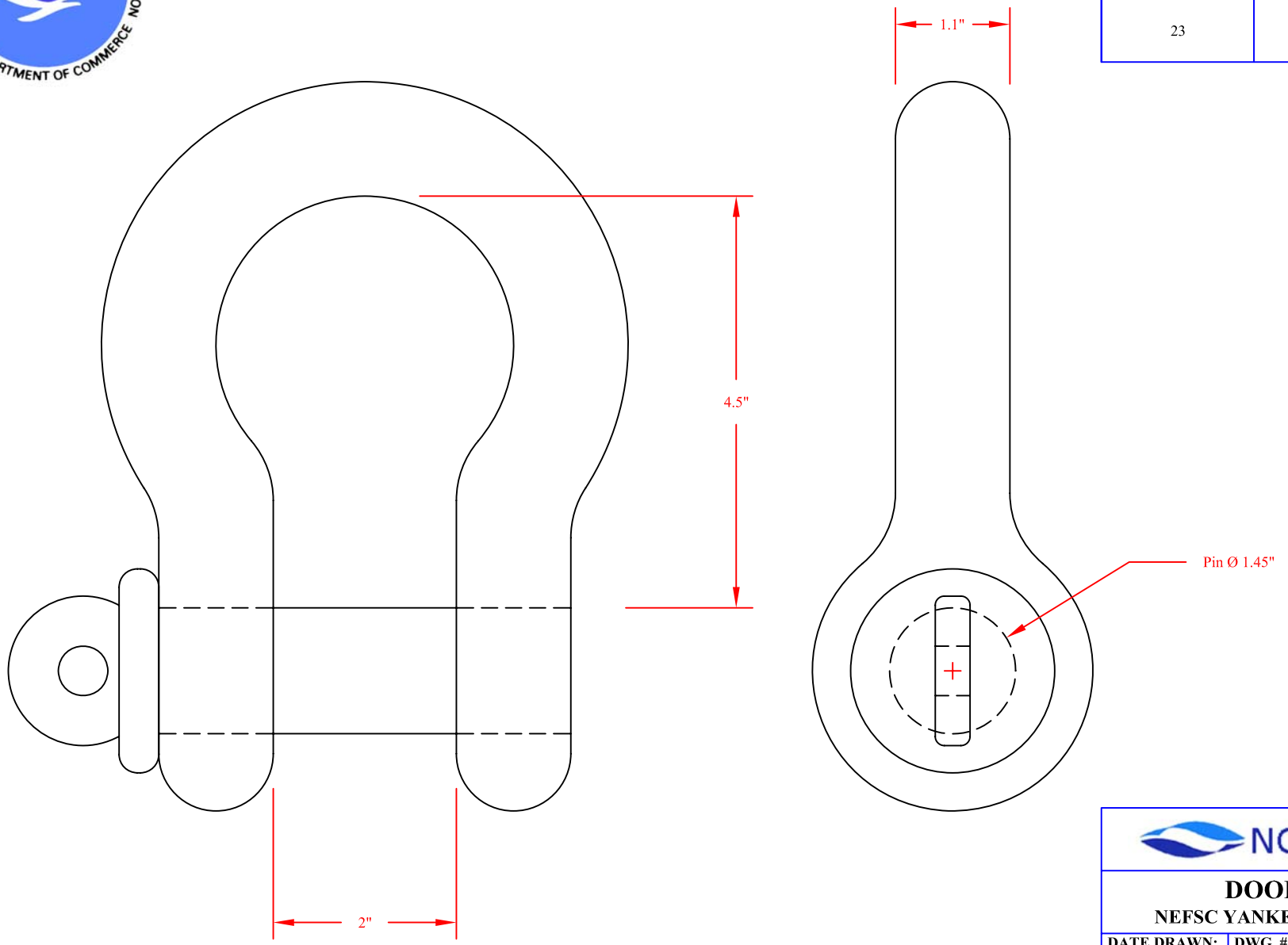
SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
23	14.3	12.7



NOAA Fisheries

DOOR SHACKLE

NEFSC YANKEE - 36 SURVEY TRAWL

DATE DRAWN:	DWG. # :	PAGE # :	REV.	SCALE:
March 2004	YAN - 21 - 23	21 of 38		NTS

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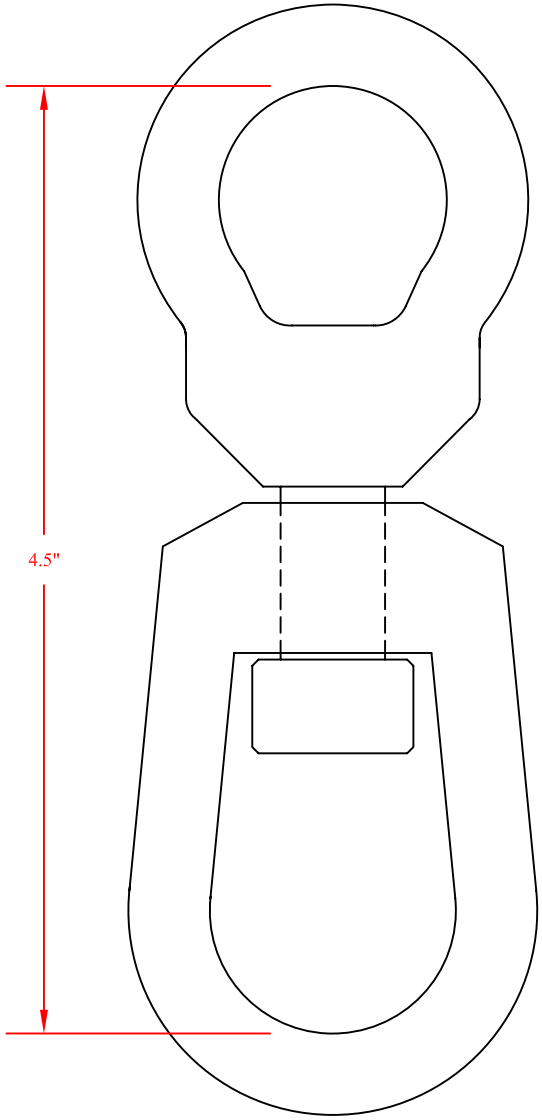

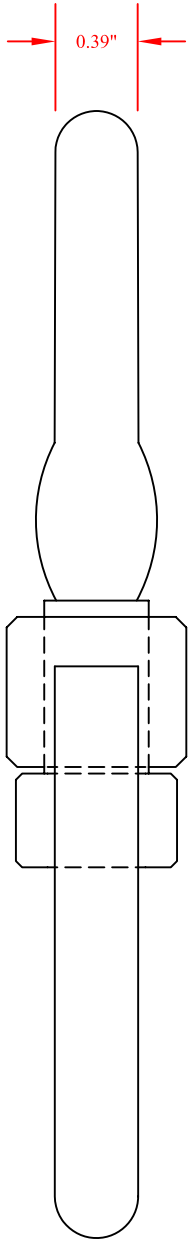

SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
24	0.64	0.57

NOAA Fisheries

3/8" SWIVEL

NEFSC YANKEE - 36 SURVEY TRAWL

DATE DRAWN:	DWG. # :	PAGE # :	REV.	SCALE:
March 2004	YAN - 22 - 24	22 of 38		NTS

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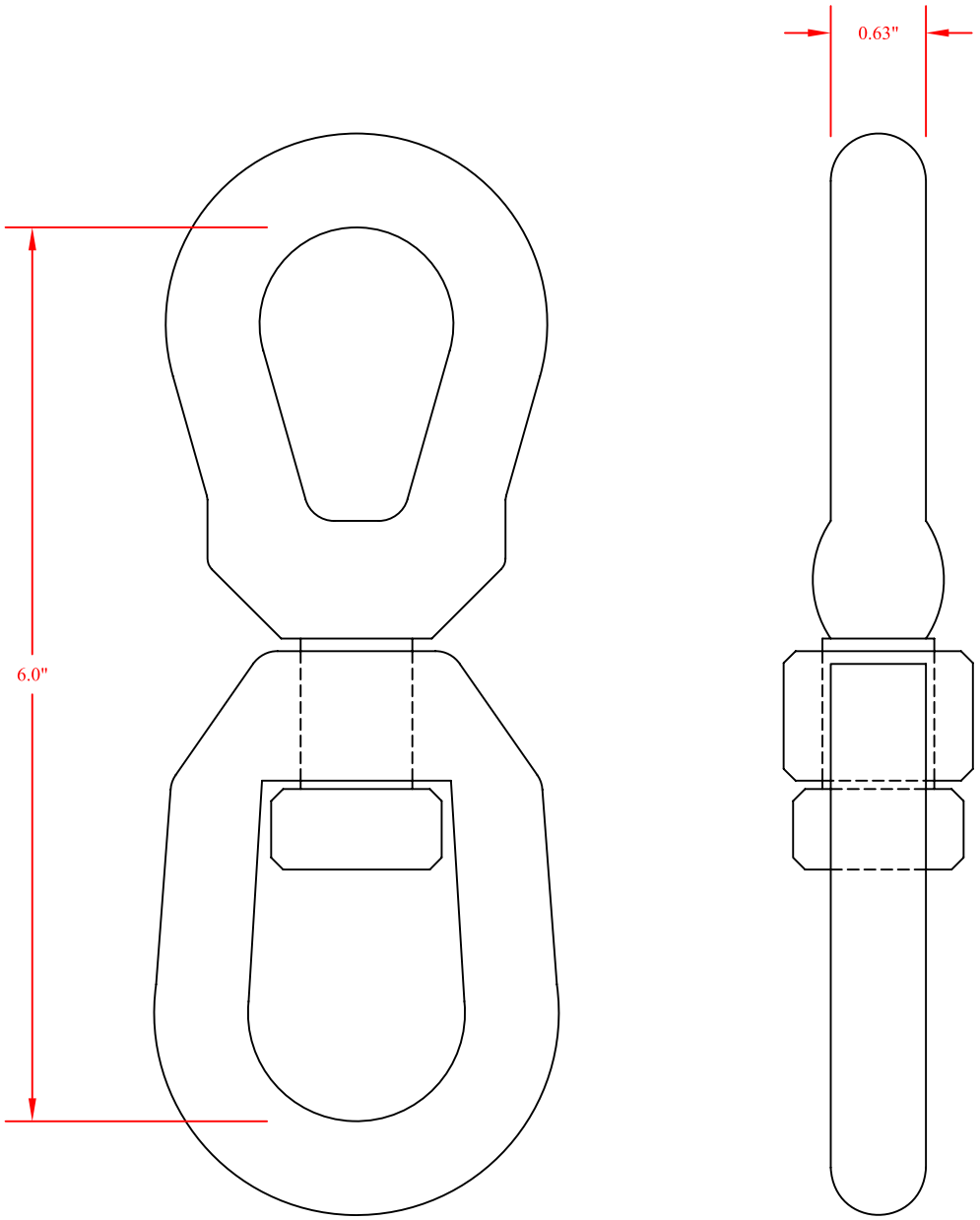

SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
26	1.90	1.65

NOAA Fisheries

5/8" SWIVEL

NEFSC YANKEE - 36 SURVEY TRAWL

DATE DRAWN:	DWG. # :	PAGE # :	REV.	SCALE:
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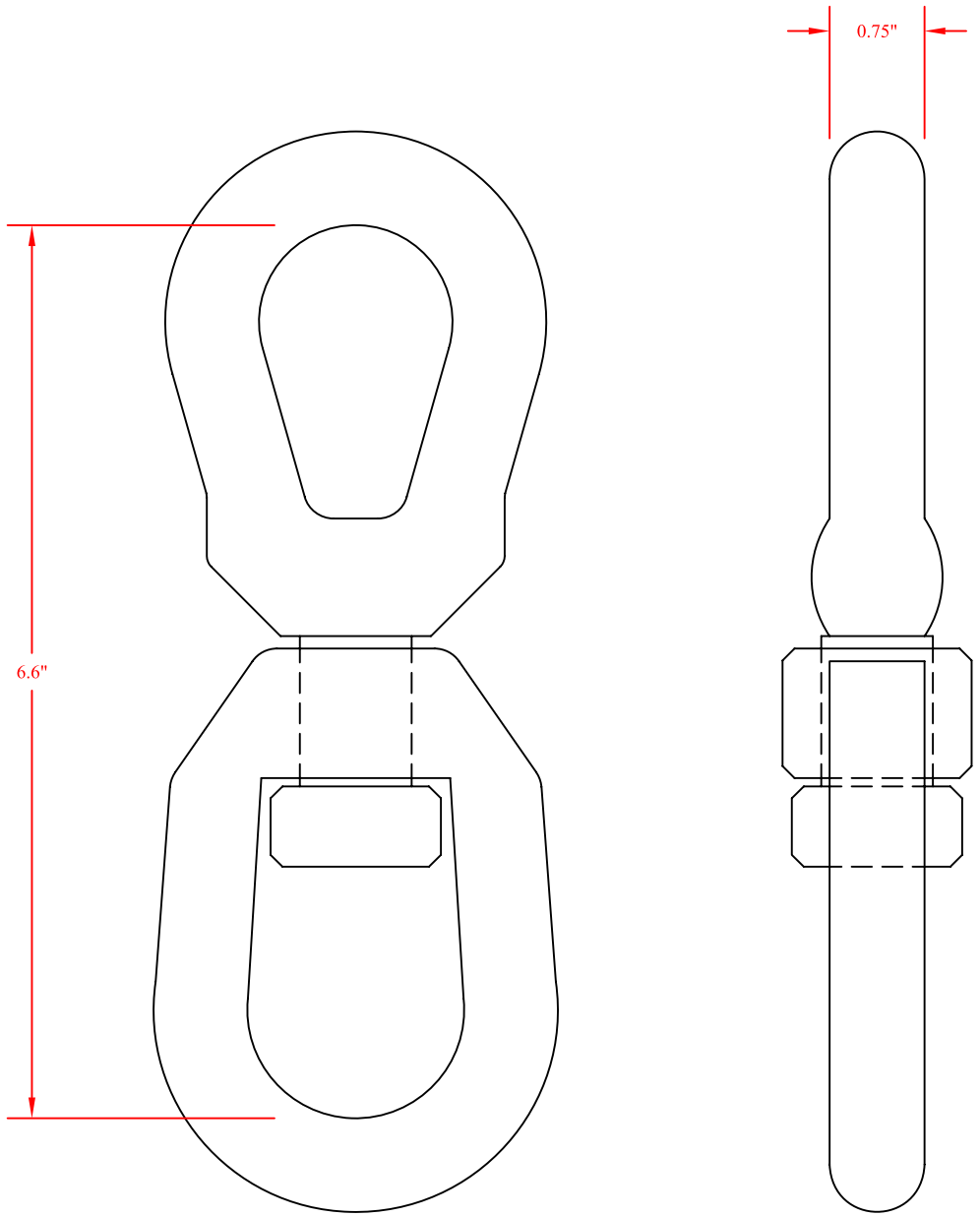

SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
27	3.1	2.7

NOAA Fisheries

3/4" SWIVEL

NEFSC YANKEE - 36 SURVEY TRAWL

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February 2004	YAN - 24 - 27	24 of 38		NTS

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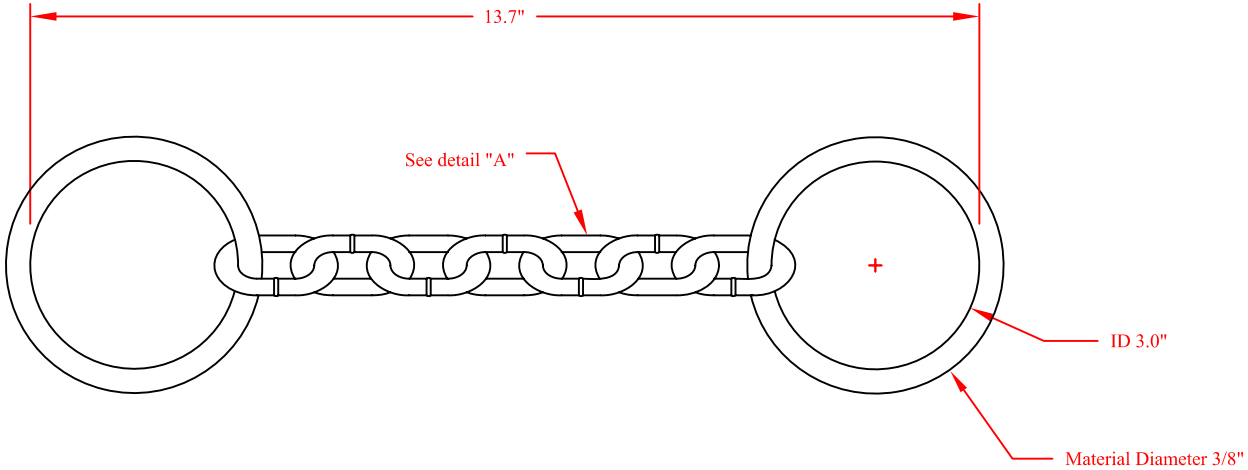
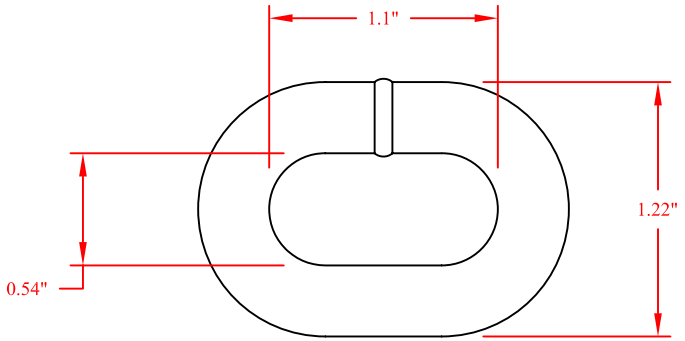
SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
28	1.66	1.44





CHAIN LINK DETAIL "A"

NOAA Fisheries

13.7" ROLLER CHAIN

NEFSC YANKEE - 36 SURVEY TRAWL

DATE DRAWN:	DWG. # :	PAGE # :	REV.	SCALE:
January 2004	YAN - 25 - 28	25 of 38		NTS

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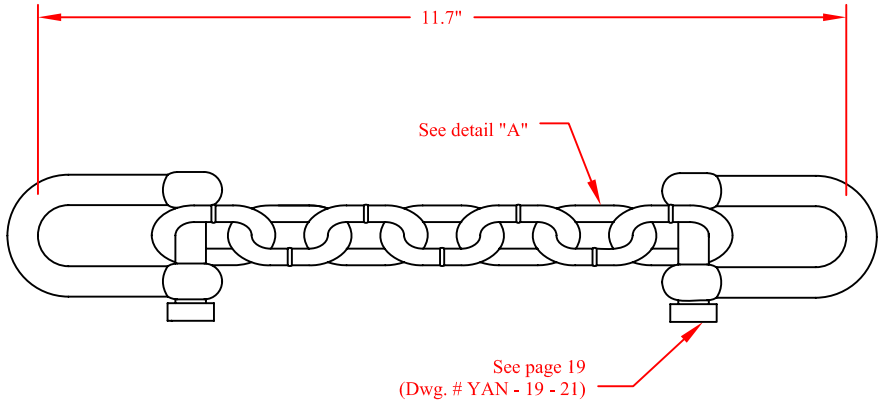
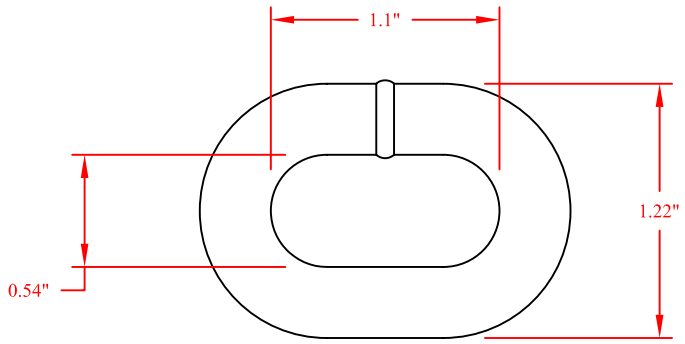
SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
29	1.30	1.13





CHAIN LINK DETAIL "A"

NOAA Fisheries

DROPPER WITH 2 SHACKLES

NEFSC YANKEE - 36 SURVEY TRAWL

DATE DRAWN:	DWG. # :	PAGE # :	REV.	SCALE:
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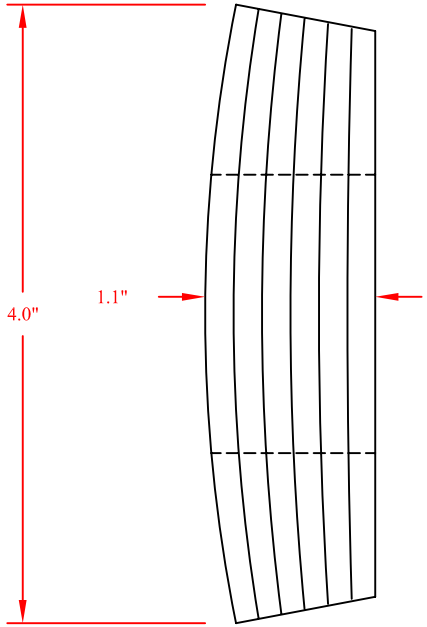
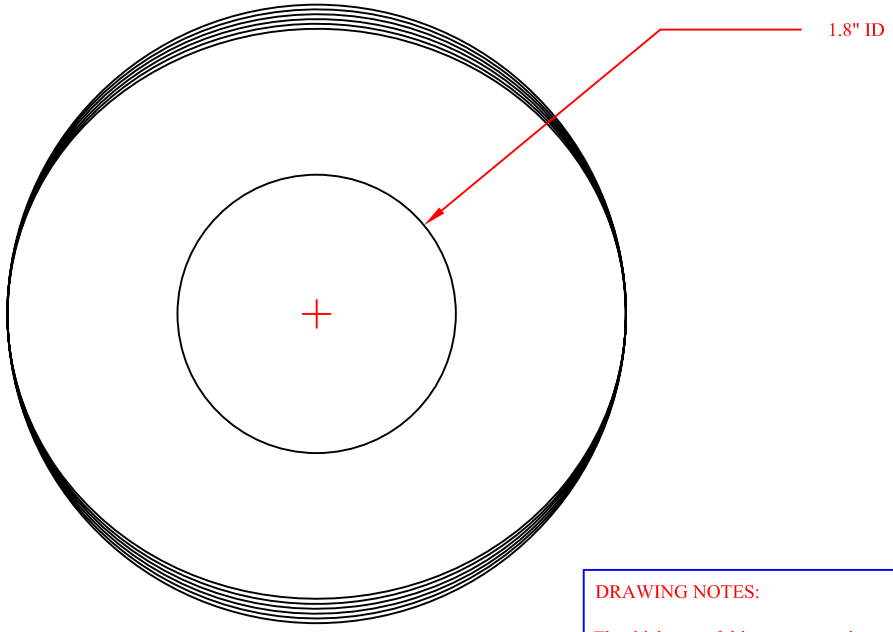
SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
30	0.41	.041





DRAWING NOTES:

The thickness of this component is extremely variable due to manufacturing processes. Tolerances for thickness are presented in the parts list.

NOAA Fisheries

4" RUBBER DISK / COOKIE

NEFSC YANKEE - 36 SURVEY TRAWL

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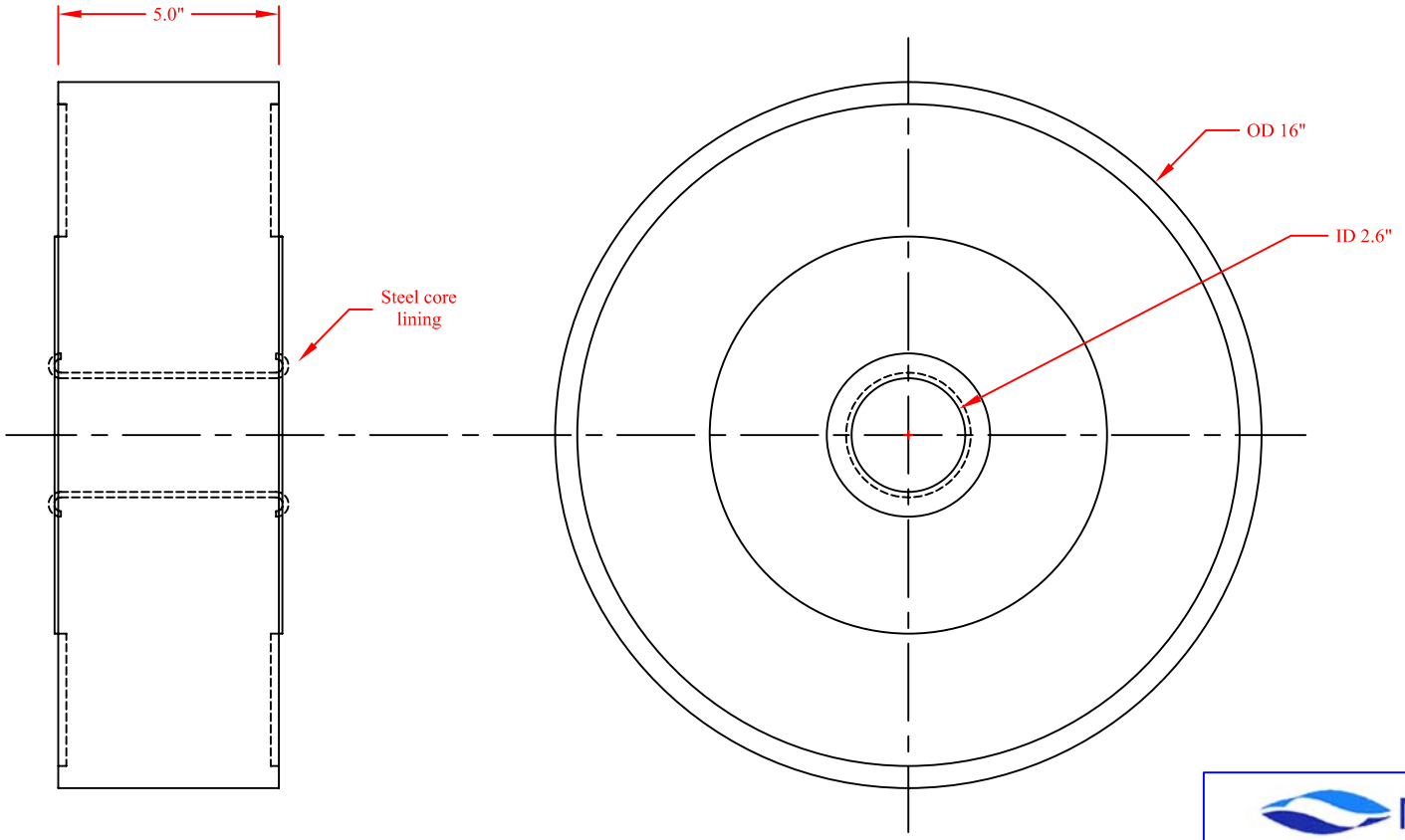
SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
31	41.28	7.17



NOAA Fisheries

16" ROLLER

NEFSC YANKEE - 36 SURVEY TRAWL

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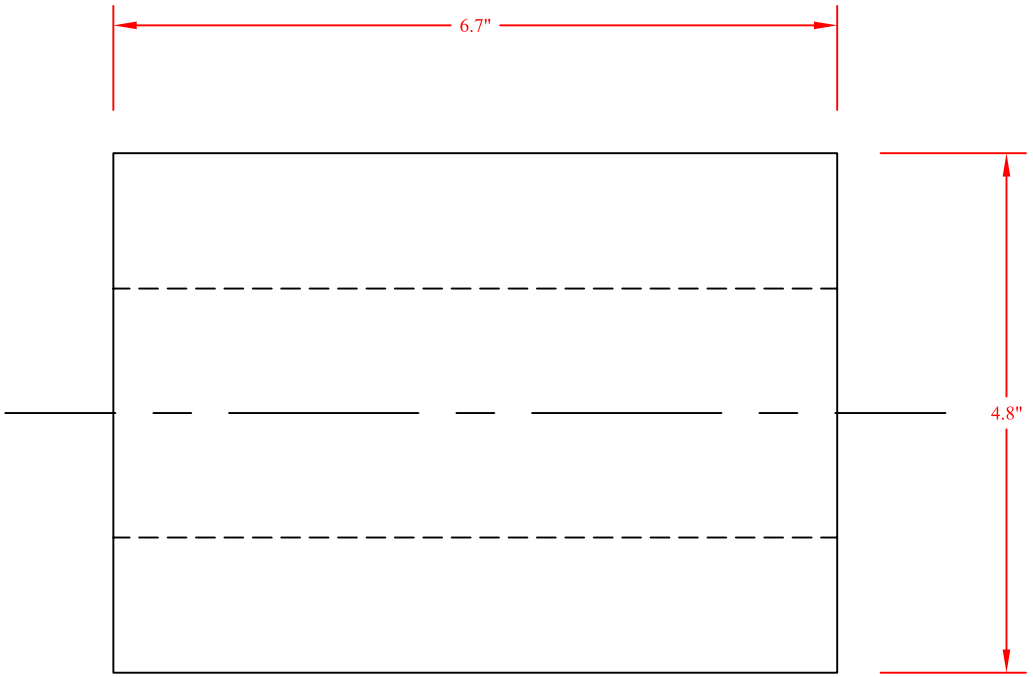
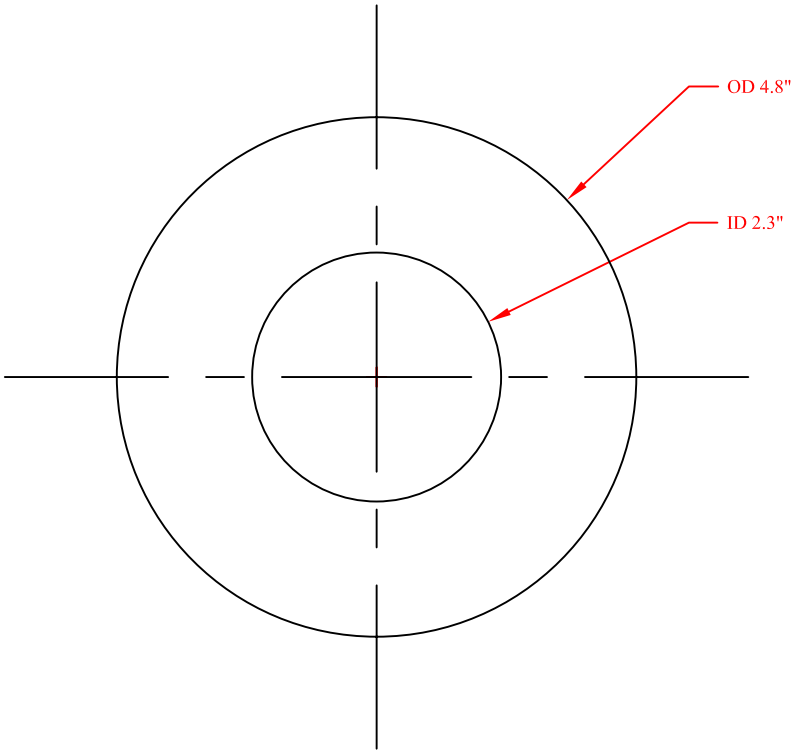
SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
32	4.03	0.85





NOAA Fisheries

4.8" x 6.7" RUBBER SPACER

NEFSC YANKEE - 36 SURVEY TRAWL

DATE DRAWN:	DWG. # :	PAGE # :	REV.	SCALE:
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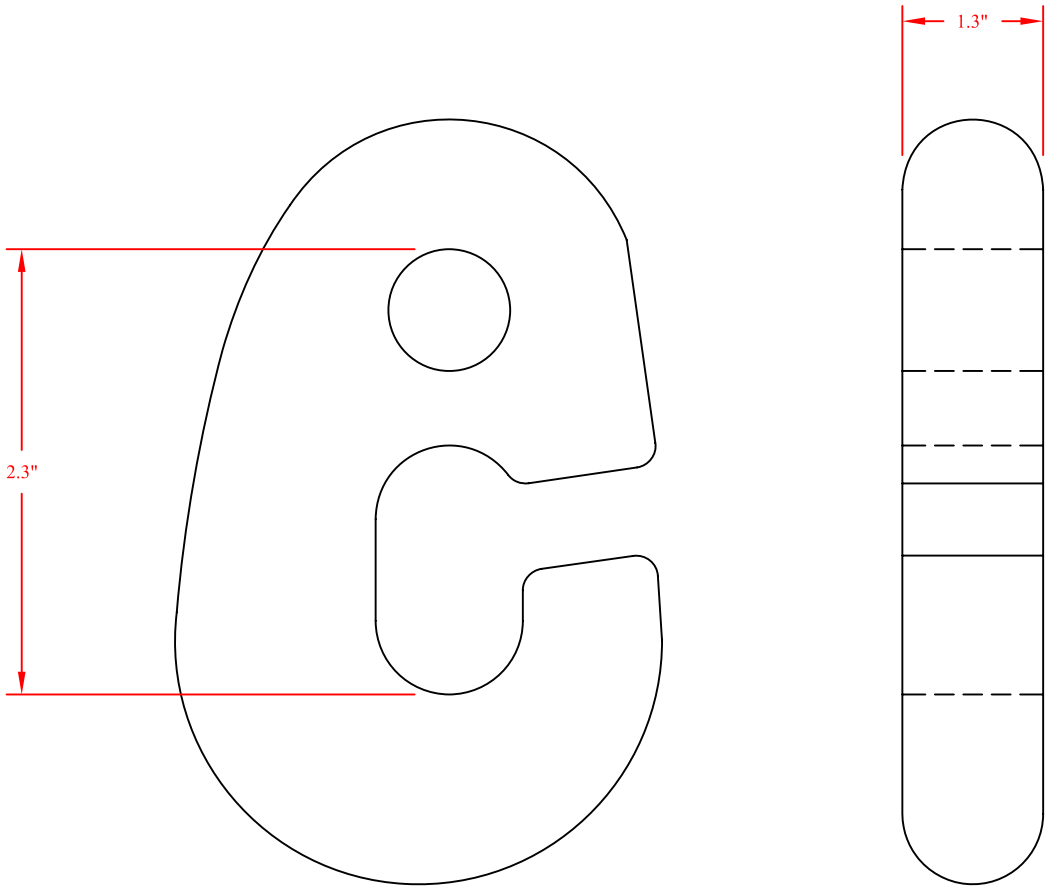
SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
33	5.06	4.43



NOAA Fisheries

G - HOOK

NEFSC YANKEE - 36 SURVEY TRAWL

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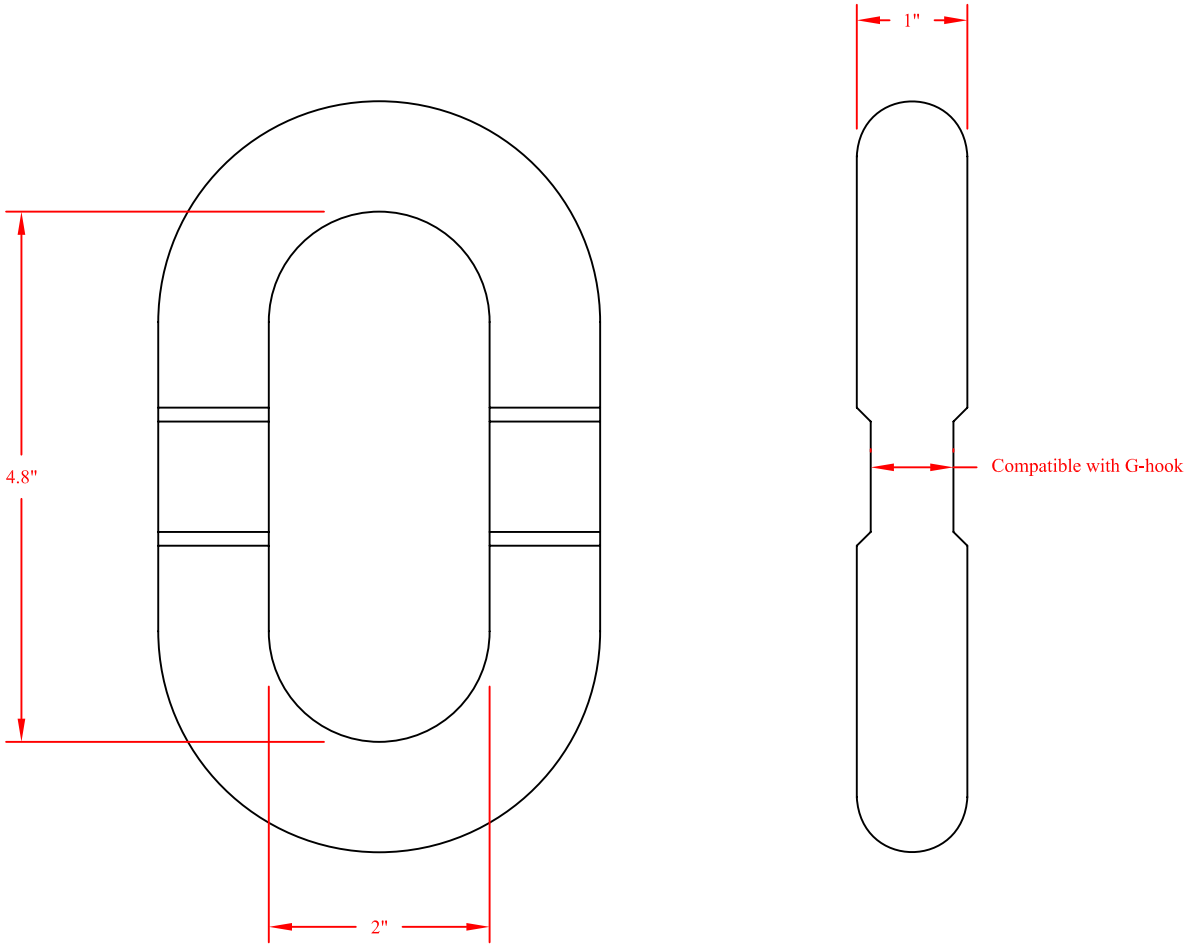
SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
34	3.5	3.1



NOAA Fisheries

FLAT LINK

NEFSC YANKEE - 36 SURVEY TRAWL

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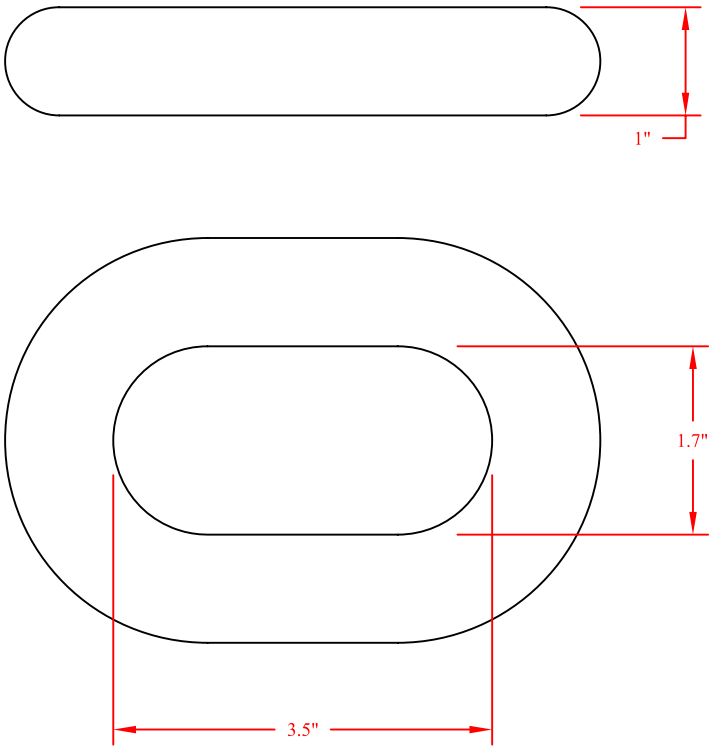
SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
35	3.36	3.00



NOAA Fisheries

CONNECTING LINK

NEFSC YANKEE - 36 SURVEY TRAWL

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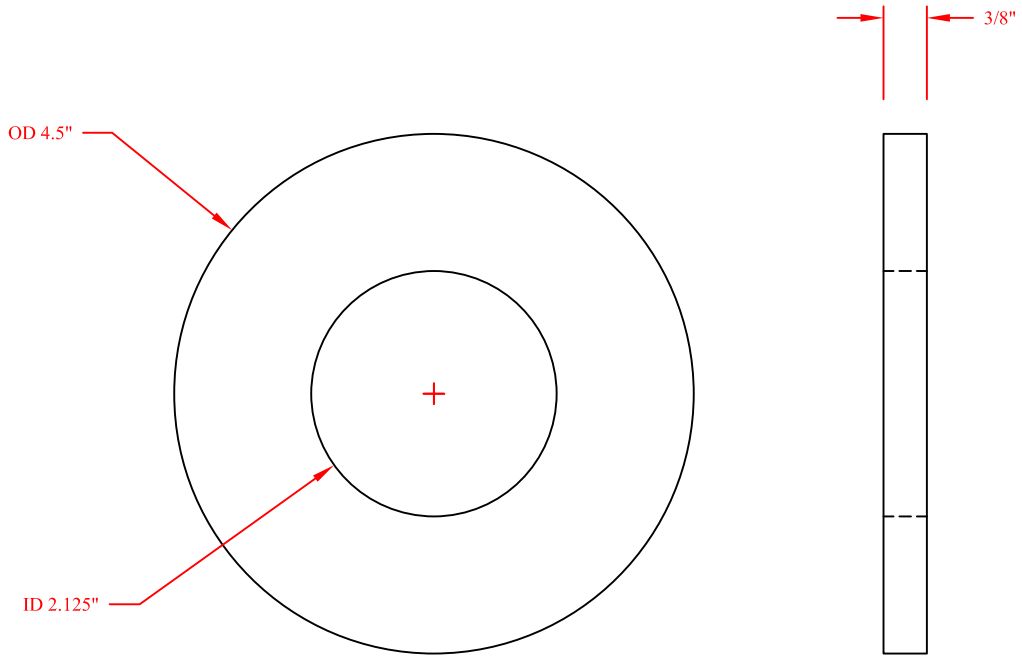
SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
36	1.23	1.10



NOAA Fisheries

4.5" STEEL WASHER

NEFSC YANKEE - 36 SURVEY TRAWL

DATE DRAWN:	DWG. # :	PAGE # :	REV.	SCALE:
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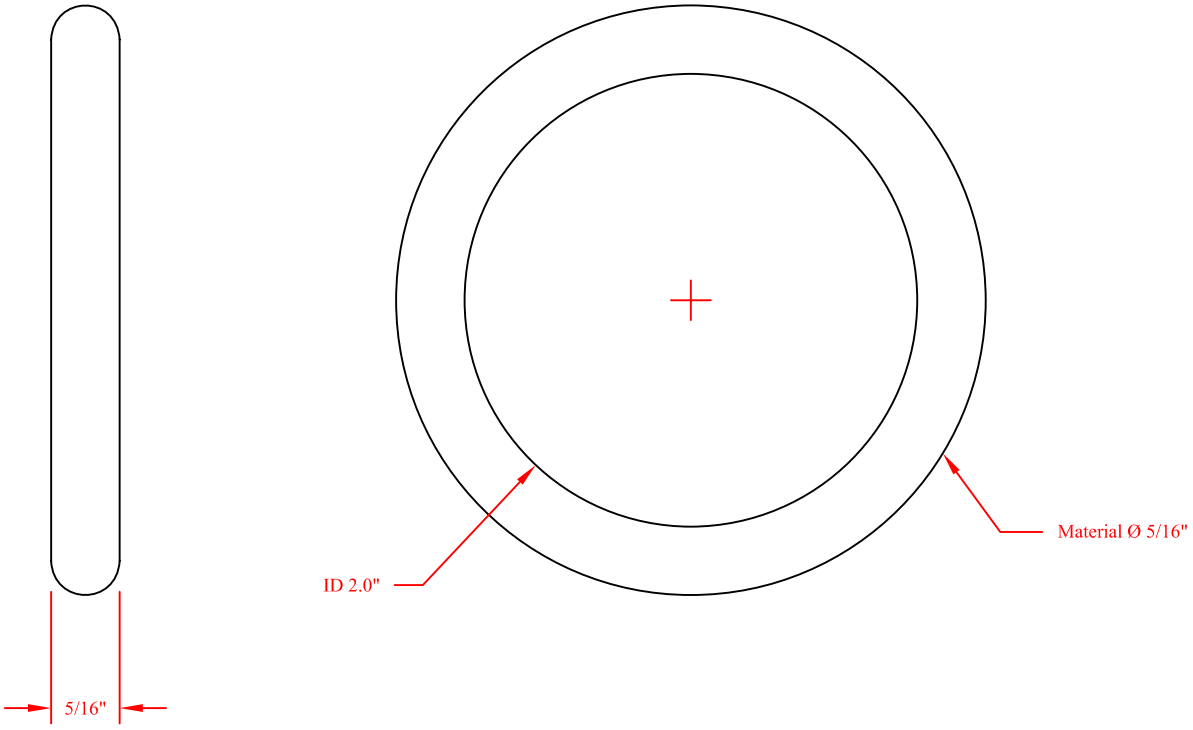
SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
14	0.16	0.14



NOAA Fisheries

2" CODEND RING

NEFSC YANKEE - 36 SURVEY TRAWL

DATE DRAWN:	DWG. # :	PAGE # :	REV.	SCALE:
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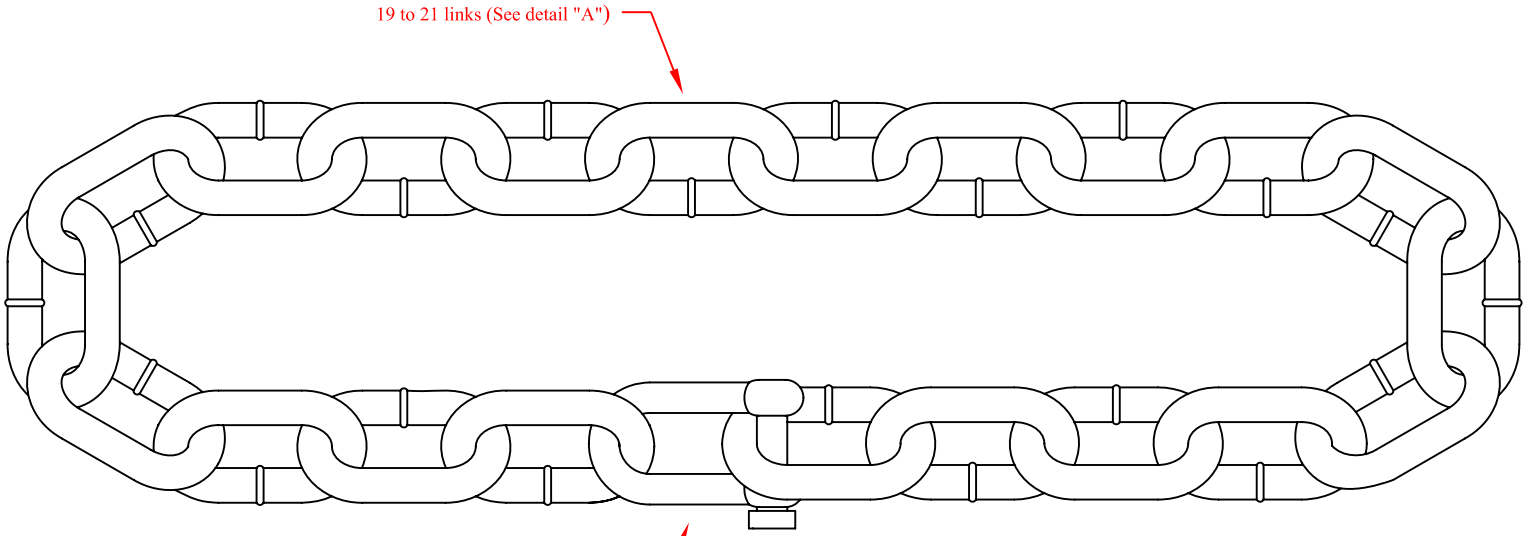
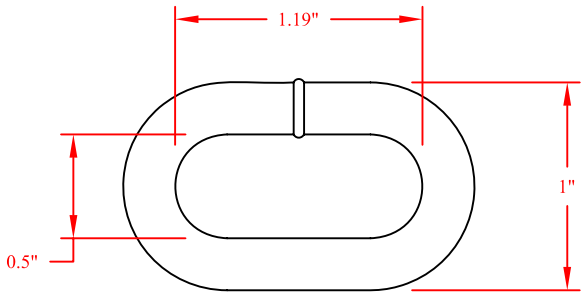
SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
38	1.4	1.2





CHAIN LINK DETAIL "A"

NOAA Fisheries

IDLER CONNECTION CHAIN

NEFSC YANKEE - 36 SURVEY TRAWL

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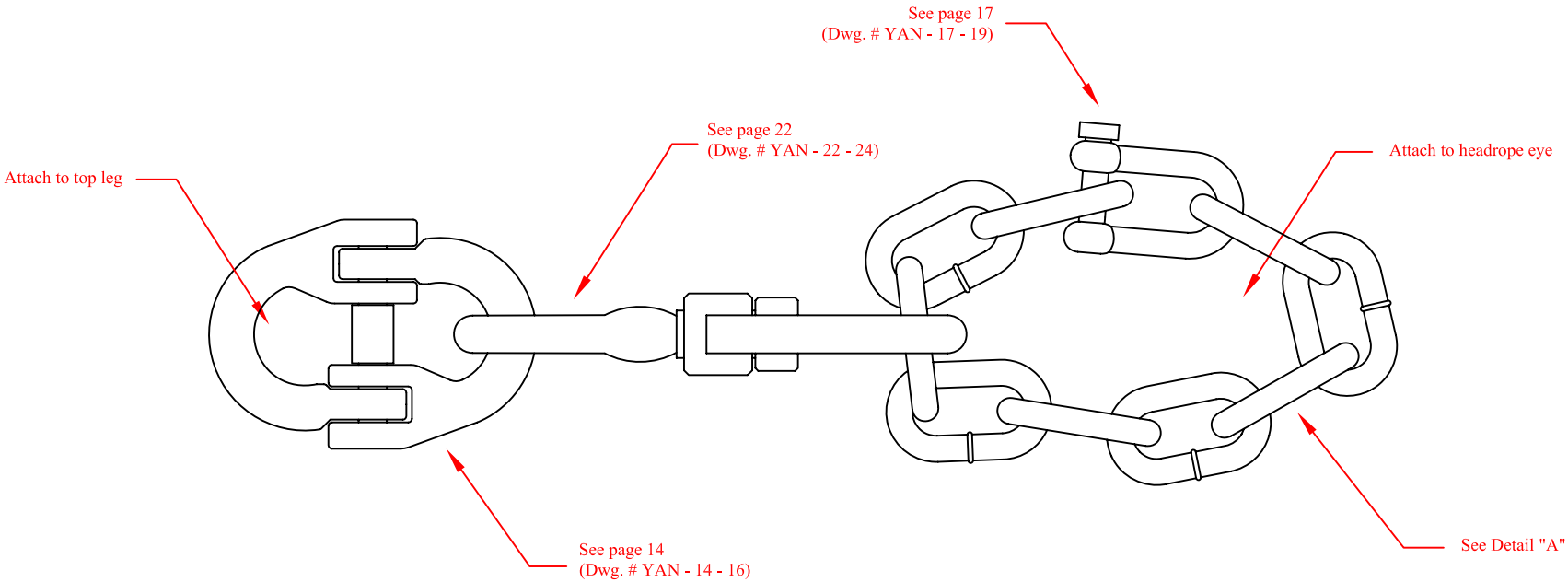
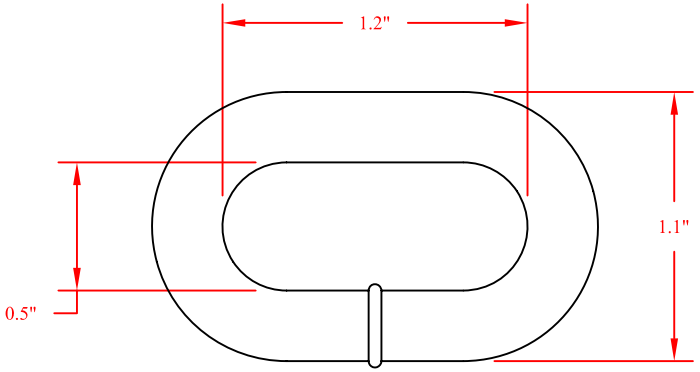
SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
39	2.2	1.94





CHAIN LINK DETAIL "A"

NOAA Fisheries

WEAK LINK

NEFSC YANKEE - 36 SURVEY TRAWL

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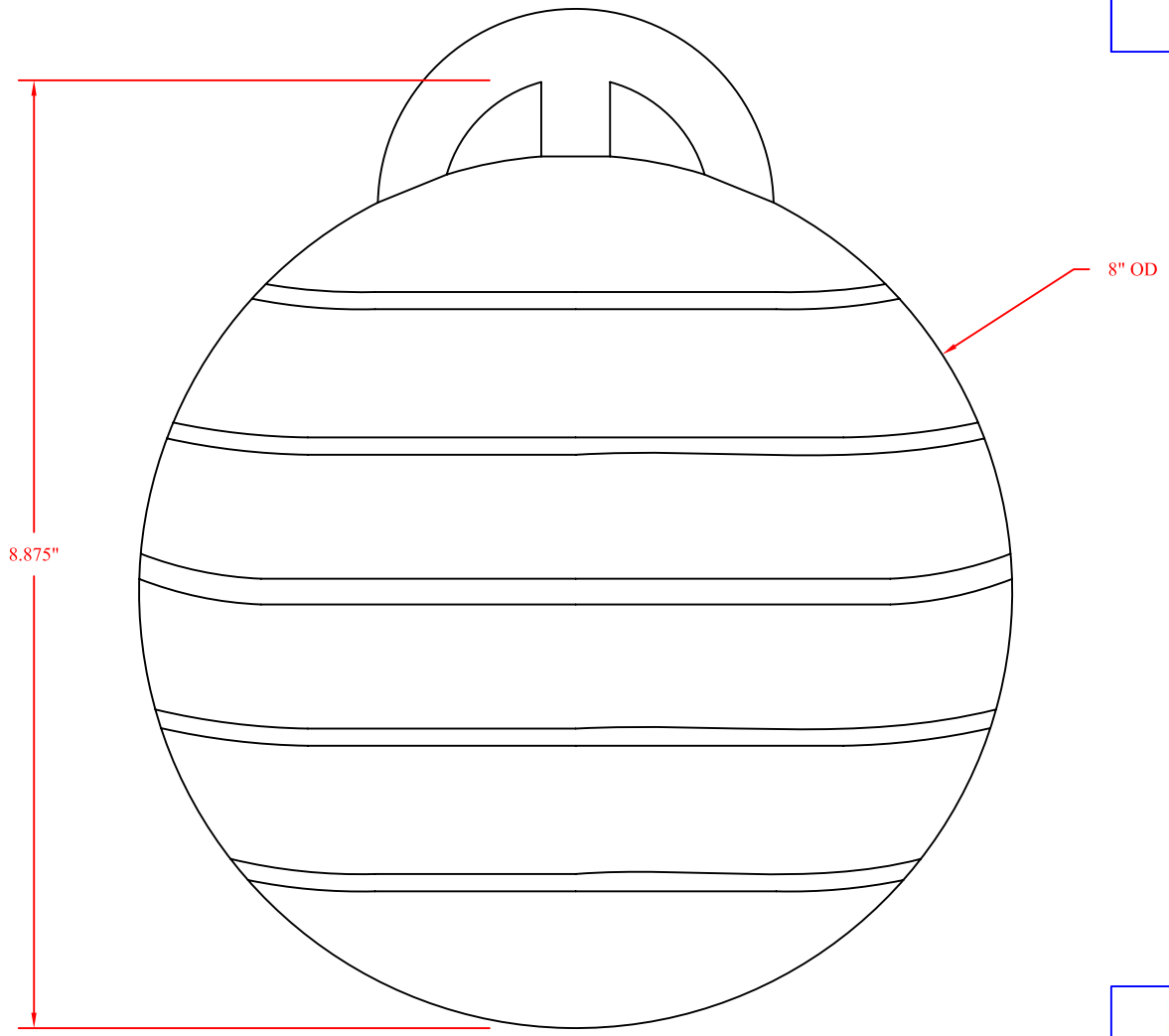
SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	BUOYANCY IN FRESH WATER (lbs):
40	3.80	4.76



NOAA Fisheries

8" ALUMINUM BECKET FLOAT

NEFSC YANKEE - 36 SURVEY TRAWL

DATE DRAWN:	DWG. # :	PAGE # :	REV.	SCALE:
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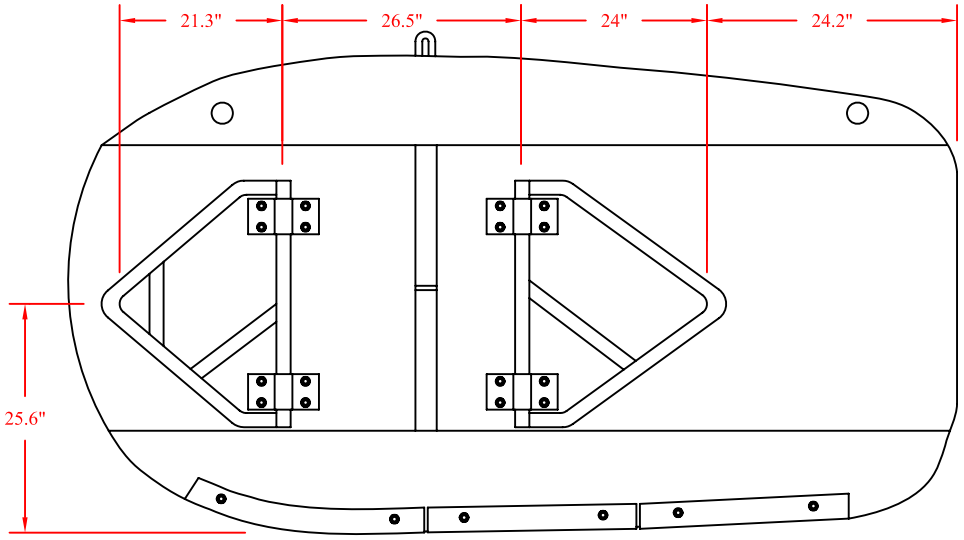
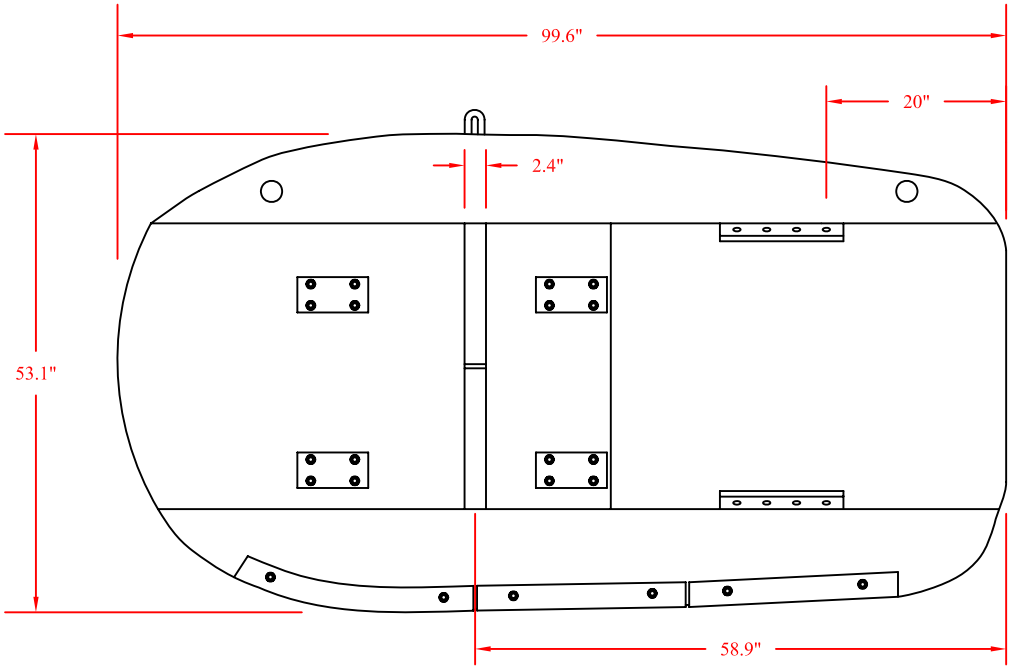


FRONTSIDE VIEW OF DOOR



BACKSIDE VIEW OF DOOR

SPECIFICATIONS

PART # :	WEIGHT IN AIR (lbs):	WEIGHT IN FRESHWATER (lbs):
41	990	N/A

NOAA Fisheries

TRAWL DOOR DETAILS

NEFSC YANKEE - 36 SURVEY TRAWL

DATE DRAWN:	DWG. # :	PAGE # :	REV.	SCALE:
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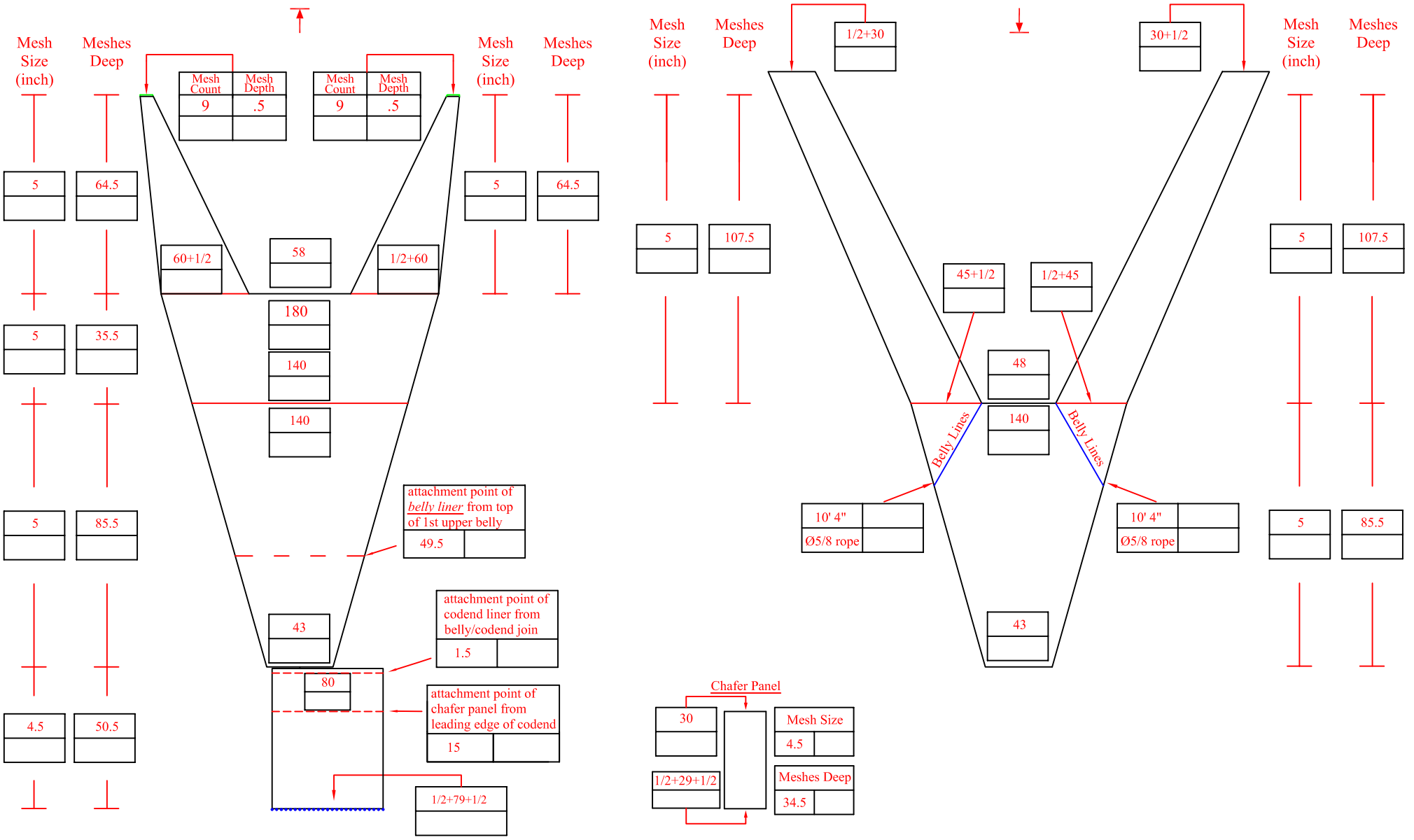
SECTION 5 – CHECKLISTS

- **PAGE 1 OF 4** - NET PLAN CHECKLIST
- **PAGE 2 OF 4** - FRAMEROPE CHECKLIST
- **PAGE 3 OF 4** - SWEEP GEAR CHECKLIST
- **PAGE 4A OF 4** - RIGGING CHECKLIST – ALBATROSS IV
- **PAGE 4B OF 4** - RIGGING CHECKLIST – DELAWARE II

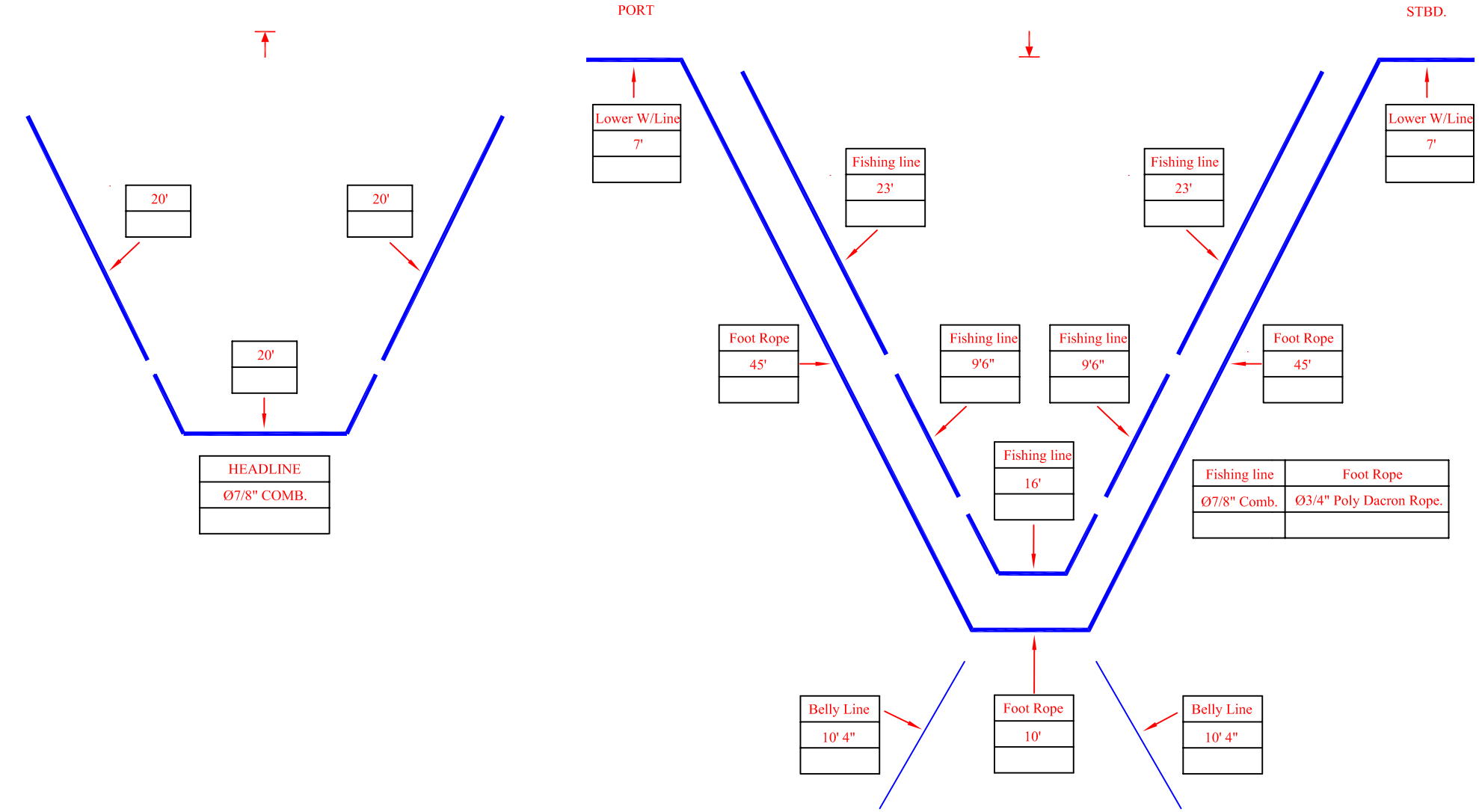


NOAA Fisheries

NET PLAN CHECKLIST
YANKEE - 36 SURVEY TRAWL

VESSEL: _____ PAGE: 1 OF 4
CRUISE: _____ DATE: _____

CHECKED BY: _____
APPROVED BY: _____



NOAA Fisheries

FRAMEROPE PLAN CHECKLIST
YANKEE - 36 SURVEY TRAWL

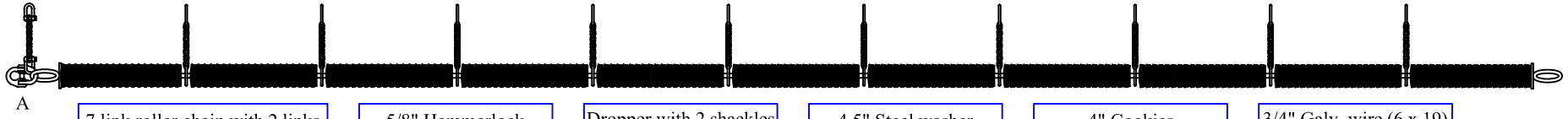
VESSEL: _____ PAGE: 2 OF 4

CRUISE: _____ DATE: _____

CHECKED BY: _____

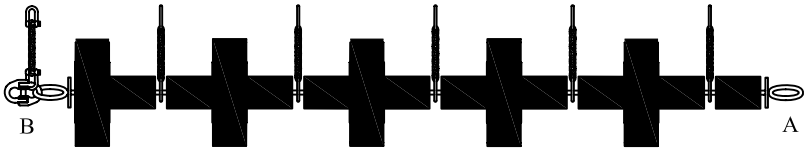
APPROVED BY: _____

SECTION A - PORT WING



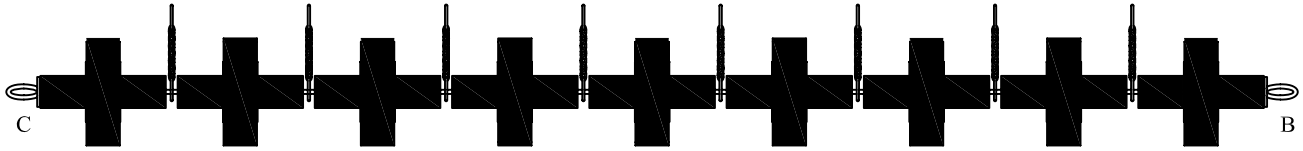
7 link roller chain with 2 links		5/8" Hammerlock		Dropper with 2 shackles		4.5" Steel washer		4" Cookies		3/4" Galv. wire (6 x 19)	
10		1		1		2		Throughout		22' 6"	

SECTION B - PORT QUARTER



7 link roller chain with 2 links		Dropper with 2 shackles		16" x 5" Roller		5/8" Hammerlock		Rubber spacer		4.5" Steel washer		3/4" Galv. wire (6 x 19)	
5		1		5		1		10		2		9'6"	

SECTION C - MIDDLE

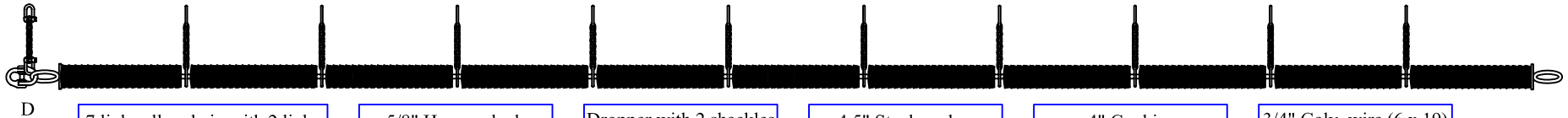


7 link roller chain with 2 links		Rubber spacer		16" x 5" Rubber wheel		4.5" Steel washer		3/4" Galv. wire (6 x 19)	
8		18		9		2		16'	

SECTION B - STBD. QUARTER

7 link roller chain with 2 links		Dropper with 2 shackles		16" x 5" Roller		5/8" Hammerlock		Rubber spacer		4.5" Steel washer		3/4" Galv. wire (6 x 19)	
5		1		5		1		10		2		9'6"	

SECTION A - STBD. WING



7 link roller chain with 2 links		5/8" Hammerlock		Dropper with 2 shackles		4.5" Steel washer		4" Cookies		3/4" Galv. wire (6 x 19)	
10		1		1		2		Throughout		22' 6"	

NOAA Fisheries

SWEEP GEAR CHECKLIST
YANKEE - 36 SURVEY TRAWL

VESSEL: _____ PAGE: 3 OF 4

CRUISE: _____ DATE: _____

CHECKED BY: _____

APPROVED BY: _____

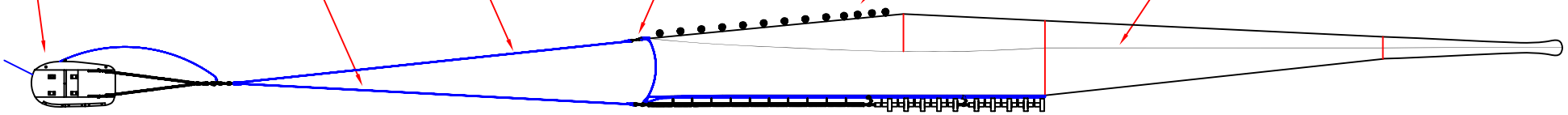
OTTERBOARD	
2.84 sq.m 450 kg	
PORT	STBD

BRIDLES (Ø 5/8" x 30')			
LOWER		UPPER	
PORT	STBD	PORT	STBD

WEAK LINK	
9 Links 1/4" Chain	
PORT	STBD

8" ALUM. FLOATS		
(2 x 8) + 20 = 36		
PORT	STBD	BOSUM

GORE LINES				
Ø 3/4" Poly Dacron 26' + 14.2' + 34' + 16'				
	TOP WING	SQUARE	BELLY	CODEND
PORT				
STBD				

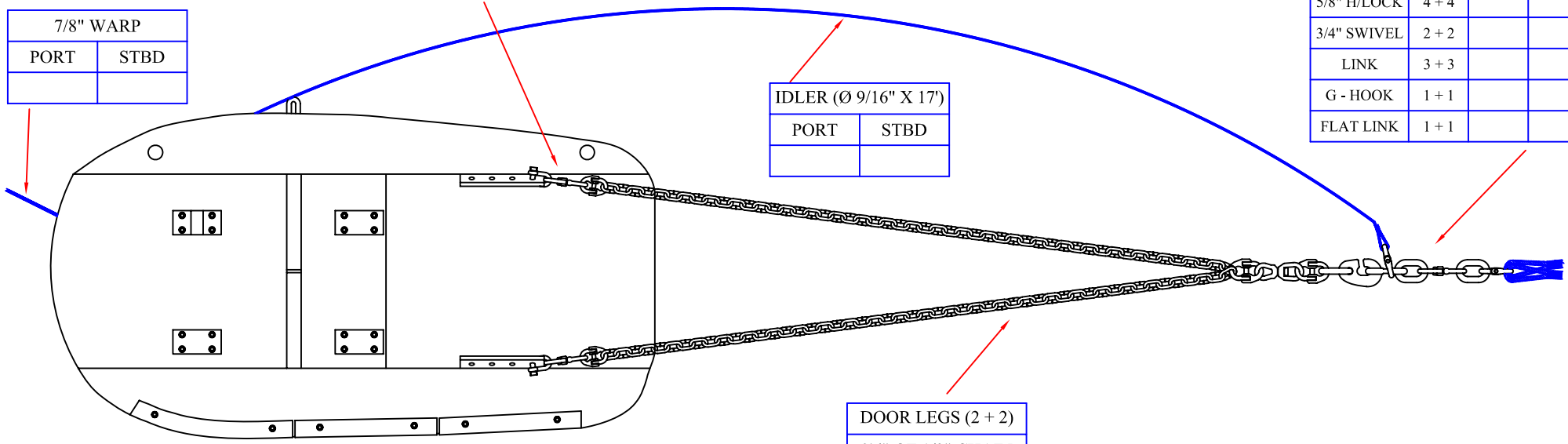


DOOR TO LEG RIGGING			
COMPONENT	QTY.	PORT	STBD
5/8" SHACKLE	1 + 1		
5/8" SWIVEL	1 + 1		
1/2" H/LOCK	1 + 1		

TRAWL TO DOOR RIGGING			
COMPONENT	QTY.	PORT	STBD
5/8" H/LOCK	4 + 4		
3/4" SWIVEL	2 + 2		
LINK	3 + 3		
G - HOOK	1 + 1		
FLAT LINK	1 + 1		

7/8" WARP	
PORT	STBD

IDLER (Ø 9/16" X 17')	
PORT	STBD



DOOR LEGS (2 + 2)	
9'6" OF 1/2" CHAIN	
PORT	STBD

NOAA Fisheries

RIGGING CHECKLIST
YANKEE - 36 SURVEY TRAWL

VESSEL: ALBATROSS IV PAGE: 4A OF 4
CRUISE: _____ DATE: _____

CHECKED BY: _____
APPROVED BY: _____

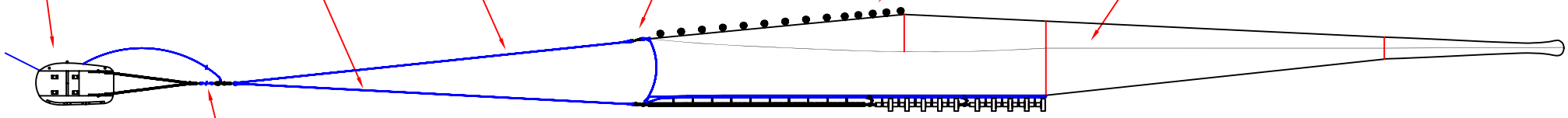
OTTERBOARD	
2.84 sq.m 450 kg	
PORT	STBD

BRIDLES (Ø 5/8" x 30')			
LOWER		UPPER	
PORT	STBD	PORT	STBD

WEAK LINK	
9 Links 1/4" Chain	
PORT	STBD

8" ALUM. FLOATS		
(2 x 8) + 20 = 36		
PORT	STBD	BOSUM

GORE LINES				
Ø 3/4" Poly Dacron 26' + 14.2' + 34' + 16'				
	TOP WING	SQUARE	BELLY	CODEND
PORT				
STBD				



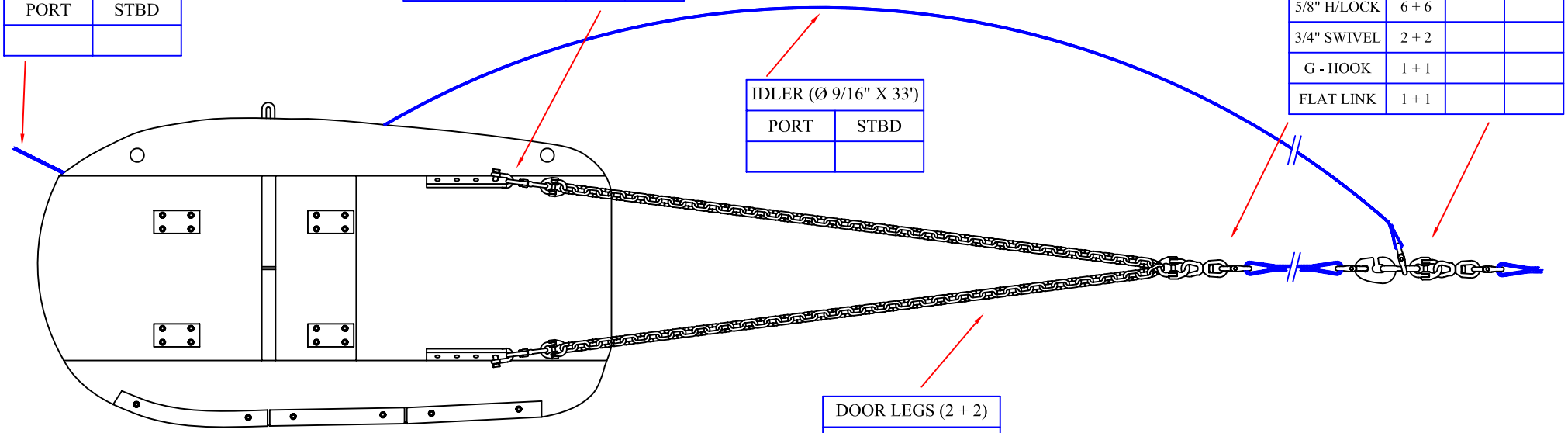
EXT. (5/8" x 11')	
PORT	STBD

DOOR TO LEG RIGGING			
COMPONENT	QTY.	PORT	STBD
5/8" SHACKLE	1 + 1		
5/8" SWIVEL	1 + 1		
1/2" H/LOCK	1 + 1		

1" WARP	
PORT	STBD

IDLER (Ø 9/16" X 33')	
PORT	STBD

TRAWL TO DOOR RIGGING			
COMPONENT	QTY.	PORT	STBD
5/8" H/LOCK	6 + 6		
3/4" SWIVEL	2 + 2		
G - HOOK	1 + 1		
FLAT LINK	1 + 1		



DOOR LEGS (2 + 2)	
9'6" OF 1/2" CHAIN	
PORT	STBD

NOAA Fisheries

RIGGING CHECKLIST
YANKEE - 36 SURVEY TRAWL

VESSEL: DELAWARE II PAGE: 4B OF 4
CRUISE: _____ DATE: _____

CHECKED BY: _____
APPROVED BY: _____

SECTION 6 – PARTS LIST

PARTS LIST

YANKEE - 36 SURVEY TRAWL

ITEM	PART	DESCRIPTION	QUANTITY	TOLERANCE	DRAWING	PAGE #	PART #
1	Top Wing	R5263tex Polyamide (nylon) netting 5" Mesh size (KC) #96/108 (3mm) 16-carrier virgin braided nylon Color white 9 X 60.5 X 64.5 Meshes deep	2	Rtex 5263 +/- 10% Mesh size (in.) 5 +/- 3%	YAN - 1 YAN - 2 YAN - 3	1,2,3	1
2	Square	R5263tex Polyamide (nylon) netting 5" Mesh size (KC) #96/108 (3mm) 16-carrier virgin braided nylon Color white 180 X 140 X 35.5 Meshes deep	1	Rtex 5263 +/- 10% Mesh size (in.) 5 +/- 3%	YAN - 1	1	2
3	First Belly Top	R5263tex Polyamide (nylon) netting 5" Mesh size (KC) #96/108 (3mm), 16-carrier virgin braided nylon Color white 140 X 43 X 85.5 Meshes deep	1	Rtex 5263 +/- 10% Mesh size (in.) 5 +/- 3%	YAN - 1	1	3
4	Codend	R11764tex Polyamide (nylon) netting 4.5" Mesh size (KC) #182, 16-carrier virgin braided nylon Color white 80 X (0.5+79+0.5) X 50.5 Meshes deep	1	Rtex 11764 +/- 10% Mesh size (in.) 4.5 +/- 3%	YAN - 1	1	4
5	Lower Wing	R5263tex Polyamide (nylon) netting 5" Mesh size (KC) #96/108 (3mm), 16-carrier virgin braided nylon Color white 30.5 X 45.5 X 107.5 Meshes deep	2	Rtex 5263 +/- 10% Mesh size (in.) 5 +/- 3%	YAN - 1 YAN - 4 YAN - 5	1,4,5	5
6	1st Belly Lower	R5263tex Polyamide (nylon) netting 5" Mesh size (KC) #96/108 (3mm), 16-carrier virgin braided nylon Color white 140 X 43 X 85.5 Meshes deep	1	Rtex 5263 +/- 10% Mesh size (in.) 5 +/- 3%	YAN - 1	1	6
7	Headline	Diameter 7/8" x 60' (3 x 20') Galvanized Comb. Rope (6 x 7 construction) Weight (air) = 0.568 lb/ft MBS = 12.4T (27337 lb)	1	Weight (lb/ft) 0.568 +/- 10% Dimensions (ft.) Length = 60 +/- 0.5%	YAN - 1 YAN - 3	1,3	7
8	Footrope	Diameter 3/4" x 100' Twisted Poly Dacron Rope Weight (air) = 11.4 lb (0.114 lb/ft)	1	Weight (lb/ft) 0.114 +/- 10% Dimensions (ft.) Length = 100 +/- 0.2%	YAN - 1	1	8
9	Fishingline	Diameter 7/8" x 81' (2 x 23') + (2 x 9'6") + (1 x 16') Galvanized Comb. Rope (6 x 7 construction) Weight (air) = 0.568 lb/ft MBS = 12.4T (27337 lb)	1	Weight (lb/ft) 0.568 +/- 10% Dimensions (ft.) Length = 81 +/- 0.3%	YAN - 1	1	9
10	Lower Wingline	Diameter 3/4" x 7' Twisted Poly Dacron Rope Weight (air) = 0.798 lb (0.114 lb/ft)	2	Weight (lb/ft) 0.114 +/- 10% Dimensions (ft.) Length = 7 +/- 3.5%	YAN - 1 YAN - 5	1,5	10
11	Gore Line	Diameter 3/4" x 74'2" Twisted Poly Dacron Rope Weight (air) = 8.455 lb (0.114 lb/ft)	2	Weight (lb/ft) 0.114 +/- 10% Dimensions Length = 74'2" +/- 1%	YAN - 1	1	11
12	Gore Line	Diameter 3/4" x 16' Twisted Poly Dacron Rope Weight (air) = 1.824 lb (0.114 lb/ft)	2	Weight (lb/ft) 0.114 +/- 10% Dimensions (ft.) Length = 16 +/- 2%	YAN - 1	1	12
13	Chafer	R5263tex Polyamide (nylon) netting 4.5" Mesh size (KC) #96/108 (3mm), 16-carrier virgin braided nylon Color white 30 X 29 X 34.5 Meshes deep	1	Rtex 5263 +/- 10% Mesh size (in.) 4.5 +/- 3%	YAN - 1 YAN - 8	1,8	13
14	Codend Ring	2" Codend Ring, Material Ø 5/16" Weight (air) = 0.16 lb Galvanized Steel Construction	27	Weight (lb) 0.16 +/- 10%	YAN - 34 - 14	34	14

PARTS LIST

YANKEE - 36 SURVEY TRAWL

ITEM	PART	DESCRIPTION	QUANTITY	TOLERANCE	DRAWING	PAGE #	PART #
15	Belly Line	Diameter 5/8" x 10'4" 3 Strand Twisted Poly Dacron Rope Weight (air) = 0.095 lb/ft MBS = 4.1T (9000 lb)	2	Weight (lb/ft) 0.095 +/- 10% Dimensions Length = 10'4" +/- 2%	YAN - 1	1	15
16	Hammerlock	3/8" Hammerlock, WLL = 7100 lb Effective length 2.75" Weight (air) = 0.77 lb Steel construction	2	Dimensions (in.) Length = 2.75 +/- 3%	YAN - 14 - 16 YAN - 36 - 39	14,36	16
17	Hammerlock	1/2" Hammerlock, WLL = 12000 lb Effective length 3.3" Weight (air) = 1.35 lb Steel construction	2	Dimensions (in.) Length = 3.3 +/- 3%	YAN - 15 -17	15	17
18	Hammerlock	**Albatross IV** 5/8" Hammerlock, WLL = 18100 lb Effective Length 4" Weight (air) = 2.30 lb Steel construction	36	Dimensions (in.) Length = 4.0 +/- 3%	YAN - 16 - 18	16	18
		Delaware II 5/8" Hammerlock, WLL = 18100 lb Effective Length 4" Weight (air) = 2.30 lb Steel Construction	42	Dimensions (in.) Length = 4.0 +/- 3%	YAN - 16 - 18	16	18
19	Shackle	5/16" Trawl Shackle WLL = 0.65 Ton Effective length 1.2" Steel construction	2	Dimensions (in.) Length = 1.2 +/- 3%	YAN - 17 - 19 YAN - 36 - 39	17,36	19
20	Shackle	3/8" Trawl Shackle WLL = 0.92 ton Effective length 1.6" Steel construction	2	Dimensions (in.) Length = 1.6 +/- 3%	YAN - 18 - 20 YAN - 35 - 38	18,35	20
21	Shackle	1/2" Trawl Shackle WLL = 1.45 ton Effective length 2.0" Steel construction	8	Dimensions (in.) Length = 2.0 +/- 3%	YAN - 19 - 21 YAN - 26 - 29	19,26	21
22	Shackle	5/8" Trawl Shackle WLL = 3.25 ton Effective length 2.1" Steel construction	4	Dimensions (in.) Length = 2.1 +/- 3%	YAN - 20 - 22	20	22
23	Shackle	Door Shackle, WLL = 13.5 ton Effective length = 4.5" Weight (air) = 11.65 lb Steel Construction	2	Dimensions (in.) Length = 4.5 +/- 3%	YAN - 21 - 23	21	23
24	Swivel	3/8" Swivel SWL = 1.1 ton BS = 11000 lb Effective length 4.5" Steel construction	2	Dimensions (in.) Length = 4.5 +/- 3%	YAN - 22 - 24 YAN - 36 - 39	22,36	24
25	Swivel	**Albatross IV** 5/8" Swivel SWL = 2.6 ton BS = 26000 lb Effective length 6" Steel construction	8	Dimensions (in.) Length = 6 +/- 3%	YAN - 23 - 26	23	26
		Delaware II 5/8" Swivel SWL = 2.6 ton BS = 26000 lb Effective length 6" Steel construction	4	Dimensions (in.) Length = 6 +/- 3%	YAN - 23 - 26	23	26
26	Swivel	3/4" Swivel SWL = 3.8 T (7600 lb) Effective length 6.6" Steel construction	6	Dimensions (in.) Length = 6.6 +/- 3%	YAN - 24 - 27	24	27

PARTS LIST

YANKEE - 36 SURVEY TRAWL

ITEM	PART	DESCRIPTION	QUANTITY	TOLERANCE	DRAWING	PAGE #	PART #
27	Roller Chain	Length 13.7" Weight (air) = 1.66 lb Steel Construction	38	Weight (lb) 1.66 +/- 10% Dimensions (in.) Length = 13.7 +/- 0.5%	YAN - 25 - 28	25	28
28	Dropper With 2 Shackles	Length 11.7" Weight (air) = 1.30 lb Steel construction	4	Weight (lb) 1.30 +/- 10% Dimensions (in.) Length = 11.7 +/- 0.5%	YAN - 26 - 29	26	29
29	Rubber Disk / Cookie	Diameter 4", thickness 1.1", Centerhole diameter 1.8", Weight (air) = 0.41 lb Rubber construction ** For thickness listed	**436	Weight (lb) 0.41 +/- 10% Dimensions (in.) Dia. = 4 +/- 10% Thickness = 1.1 +/- 50% Centerhole = 1.8 +/- 20%	YAN - 27 - 30	27	30
30	Rubber Roller	Diameter 16", thickness 5" Centerhole diameter 2.6" Weight (air) = 41.28 lb Rubber Construction with steel core	19	Weight (lb) 41.28 +/- 10% Dimensions (in.) Dia. = 16 +/- 2.5% Thickness = 5 +/- 2.5% Centerhole = 2.6 +/- 2.5%	YAN - 28 - 31	28	31
31	5" Rubber Spacer	Diameter 4.8", length 6.7" Centerhole diameter 2.3" Weight (air) = 4.03 lb Rubber construction	38	Weight (lb) 4.03 +/- 10% Dimensions (in.) Dia. = 4.8 +/- 5% Length = 6.7 +/- 5% Centerhole = 2.3 +/- 10%	YAN - 29 - 32	29	32
32	G-Hook	Leoperis 6 ton or equivalent Weight (air) = 5.061 lb L = 7", W = 4.1", thickness = 1.25" Gap = 0.8125" , Hole dia. = 1"	4	Weight (lb) 5.061 +/- 3% Dimensions (in.) Length = 7.0 +/- 3% Width = 4.1 +/- 3%	YAN - 30 - 33	30	33
33	Flat Link	4.8" x 2" Flat Link, Ø 1" Weight (air) = 3.5 lb Steel Construction	4	Weight (lb) 3.5 +/- 3% Dimensions (in.) Length = 4.8 +/- 3% Width = 2.0 +/- 3%	YAN - 31 - 34	31	34
34	Connecting Link	3.5" x 1.7" Connecting Link, Ø 1" Weight (air) = 3.003 lb Steel Construction	14	Weight (lb) 3.003 +/- 3% Dimensions (in.) Inside length = 3.5 +/- 3% Inside width = 1.7 +/- 3%	YAN - 32 - 35	32	35
35	Steel Washer	Diameter 4.5", 3/8" thick Centerhole diameter 2.125" Weight (air) = 1.23 lb Steel construction	10	Weight (lb) 1.23 +/- 10% Dimensions (in.) Dia. = 4.5 +/- 3% Thickness = 0.375 +/- 3% Centerhole = 2.125 +/- 3%	YAN - 33 - 36	33	36
36	Idler Connection Chain	Weight (air) = 1.4 lb Steel Construction	2	Weight (lb) 1.4 +/- 10%	YAN - 35 - 38	35	38
37	Weak Link	Weight (air) = 2.2 lb Steel Construction	2	Weight (lb) 2.2 +/- 10%	YAN - 36 - 39	36	39
38	Float with beckets	Diameter 8" float Working depth = 3937 ft Buoyancy (freshwater) = 4.76 lb Weight (air) = 3.8 lb Aluminum Construction	36	Buoyancy (lb) 4.76 +/- 3% Depth (ft) 3937	YAN - 37 - 40	37	40
39	Trawl Door	Portuguese polyvalent Otter boards, 2.84 sq.m, Weight (air) = 990 lb	2	Weight (lb) 990 +/- 5%	YAN - 38 - 41	38	41
40	Sweep Gear Wire Section A	Diameter 3/4" x 22' 6" Trawlmaster or equivalent Galvanized wire (6 x19 FC RRL construction) Spliced weight (air) = 25.01 lb Wire weight (air) = 0.95 lb/ft MBS = 21.4T (42800 lb)	2	Weight (lb/ft) 0.95 +/- 10% Dimensions (ft.) Length = 22.5 +/- 0.5%	YAN - 9 YAN - 10	9,10	42

PARTS LIST

YANKEE - 36 SURVEY TRAWL

ITEM	PART	DESCRIPTION	QUANTITY	TOLERANCE	DRAWING	PAGE #	PART #
40	Sweep Gear Wire Section B	Diameter 3/4" x 9' 6" Trawlmaster or equivalent Galvanized wire (6 x19 FC RRL construction) Spliced weight (air) = 12.58 lb Wire weight (air) = 0.95 lb/ft MBS = 21.4T (42800 lb)	2	Weight (lb/ft) 0.95 +/- 10% Dimensions (ft.) Length = 9.5 +/- 0.5%	YAN - 9 YAN - 10	9,10	42
40	Sweep Gear Wire Section C	Diameter 3/4" x 16' Trawlmaster or equivalent Galvanized wire (6 x19 FC RRL construction) Spliced weight (air) = 18.46 lb Wire weight (air) = 0.95 lb/ft MBS = 21.4T (42800 lb)	1	Weight (lb/ft) 0.95 +/- 10% Dimensions (ft.) Length = 16 +/- 0.5%	YAN - 9 YAN - 10	9,10	42
41	Warp	**Albatross IV** Diameter 7/8" wire Bridon (no substitutions) Galvanized wire (6 x 26 Dyform FC RRL IPS Dark petroleum heavy lubricated) Wire weight (air) = 1.53 lb/ft MBS = 43.8 T (87600 lb)	2	Weight (lb/ft) 1.53 +/- 10%	YAN - 11A	11A	43A
		Delaware II Diameter 1" wire Galvanized wire (6 x 25 Flattened strand FC RRL IPS Bright finish Wire weight (air) = 1.8 lb/ft MBS = 46 T (92000 lb)	2	Weight (lb/ft) 1.8 +/- 10%	YAN - 11B	11B	43B
42	Backstraps (Door Legs)	Diameter 1/2" Trawlex, Length 9'6", 52 links breaking load 29.2 ton Weight (air) = 2.36 lb/ft	4	Weight (lb/ft) 2.36 +/- 10% Dimensions (in.) Length = 114 +/- 0.5%	YAN - 12A YAN - 12B YAN - 13A YAN - 13B	12A,12B, 13A,13B	44
43	Idler / Pennant	**Albatross IV** Diameter 9/16" x 17' wire Trawlmaster or equivalent Galvanized wire (6 x 37 FC IPS RRL construction) Wire weight (air) = 0.53 lb/ft MBS = 12.2 T (24400 lb)	2	Weight (lb/ft) 0.53 +/- 10% Dimensions (ft.) Length = 17 +/- 0.5%	YAN - 12A YAN - 13A	12A,13A	45A
		Delaware II Diameter 9/16" x 33' wire Trawlmaster or equivalent Galvanized wire (6 x 37 FC IPS RRL construction) Wire weight (air) = 0.53 lb/ft MBS = 12.2 T (24400 lb)	2	Weight (lb/ft) 0.53 +/- 10% Dimensions (ft.) Length = 33 +/- 0.5%	YAN - 12B YAN - 13B	12B,13B	45B
44	Bridles / Legs	Diameter 5/8" x 30' wire Trawlmaster or equivalent Galvanized wire (6 x19 FC RRL construction) Wire weight (air) = 0.66 lb/ft MBS = 15 T (30000 lb)	4	Weight (lb/ft) 0.66 +/- 10% Dimensions (ft) Length = 30 +/- 0.5%	YAN - 11A YAN - 11B	11A,11B	46
45	Extension (Delaware Only)	Diameter 5/8" x 11' wire Trawlmaster or equivalent Galvanized wire (6 x19 FC RRL construction) Wire weight (air) = 0.66 lb/ft MBS = 15 T (30000 lb)	2	Weight (lb/ft) 0.66 +/- 10% Dimensions (ft.) Length = 11 +/- 0.5%	YAN -12B YAN - 13B	12B,13B	47
46	Belly Liner	#147 Knotless white nylon webbing 1/2" Mesh Size	1	Rtex 163 +/- 10% Mesh size (in.) 0.5 +/- 3%	YAN - 7	7	59
47	Codend Liner	#147 Knotless white nylon webbing 1/2" Mesh Size	1	Rtex 163 +/- 10% Mesh size (in.) 0.5 +/- 3%	YAN -7	7	60

4-Seam, 3-Bridle Survey Bottom Trawl Specifications

Northeast Fisheries Science Center

Standardized Reference Manual
August 2012

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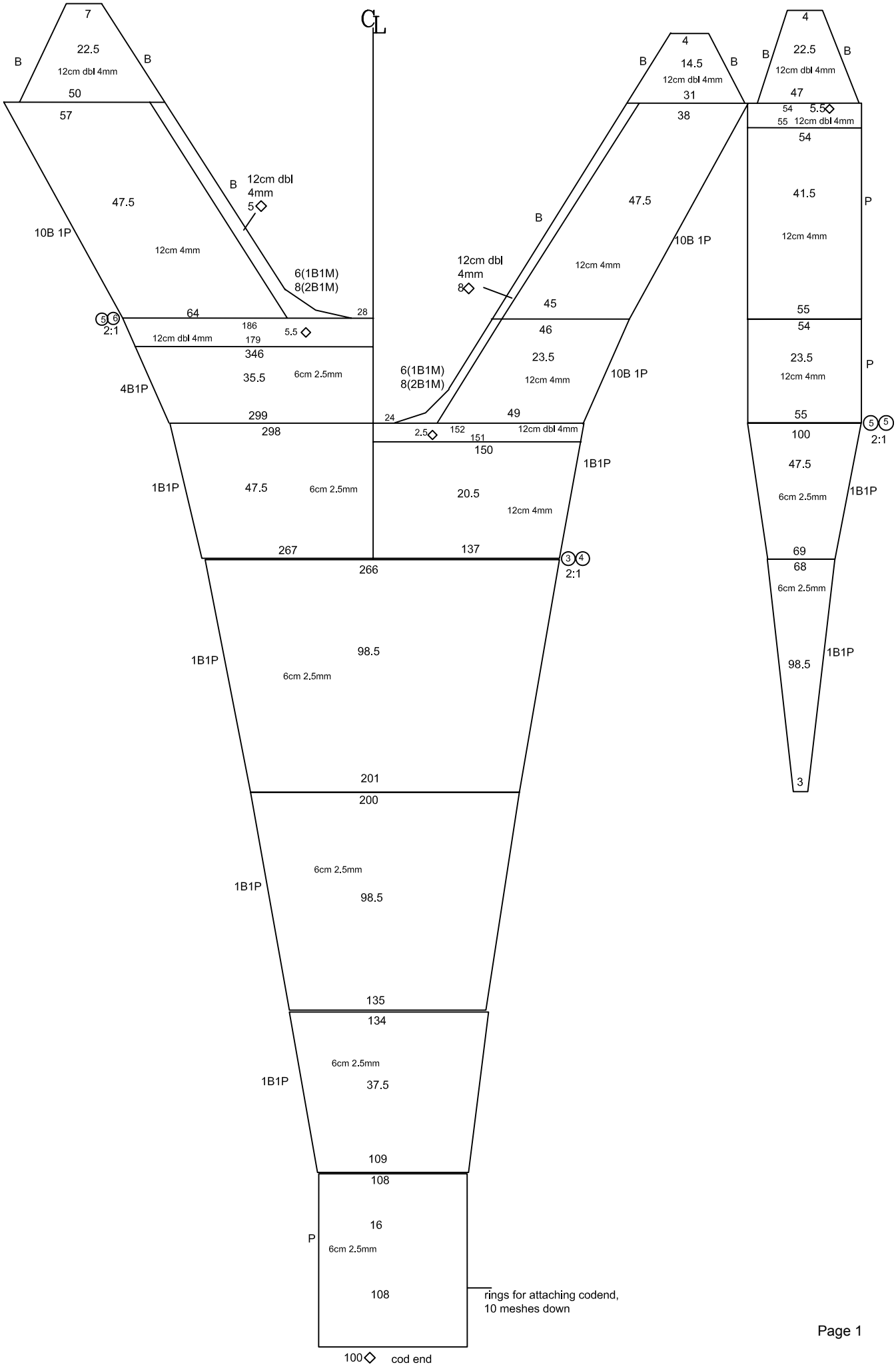
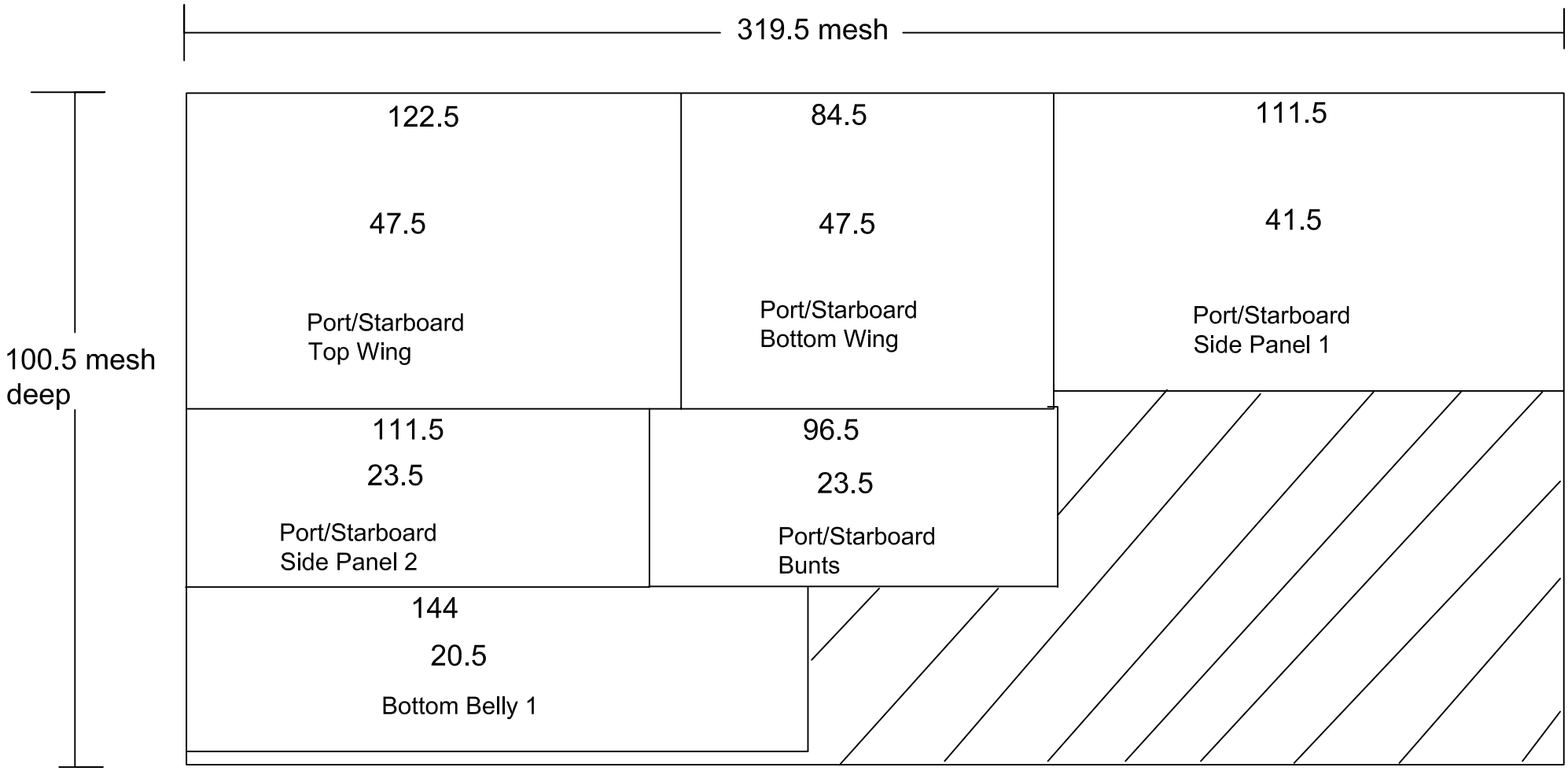
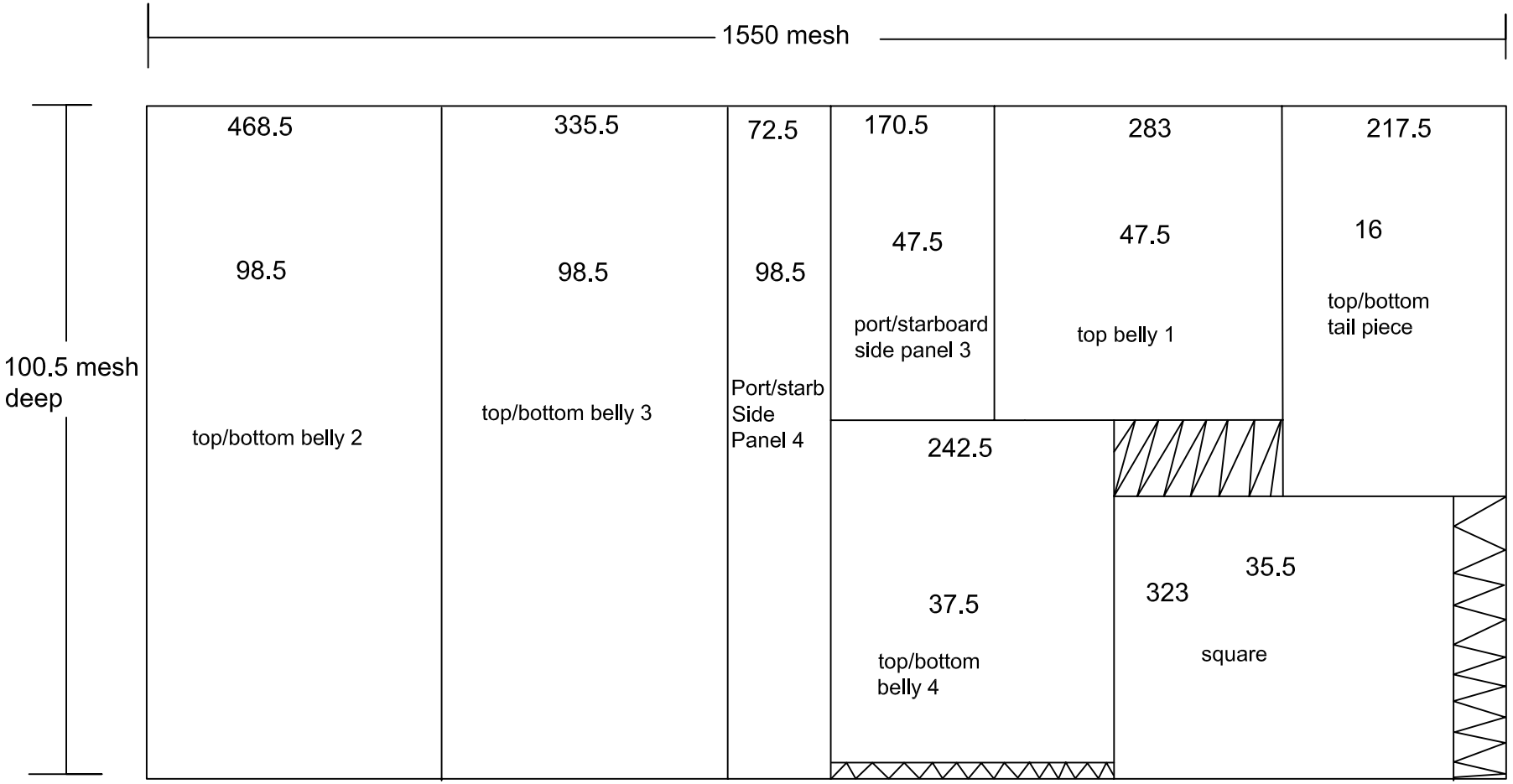

CL
7
22.5
12cm dbl 4mm
B
B
50
57
B
12cm dbl
4mm
5
47.5
10B 1P
12cm 4mm
6(1B1M)
8(2B1M)
64
28
5
6
2:1
186
179
5.5
12cm dbl 4mm
346
35.5
6cm 2.5mm
4B1P
299
298
1B1P
47.5
6cm 2.5mm
267
266
1B1P
98.5
6cm 2.5mm
201
200
1B1P
6cm 2.5mm
98.5
135
134
1B1P
6cm 2.5mm
37.5
109
108
P
16
6cm 2.5mm
108
rings for attaching codend,
10 meshes down
100
cod end
4
14.5
12cm dbl 4mm
B
B
31
38
B
47.5
10B 1P
12cm 4mm
12cm dbl
4mm
8
6(1B1M)
8(2B1M)
45
46
23.5
12cm 4mm
10B 1P
24
49
2.5
152
151
150
12cm dbl 4mm
1B1P
20.5
12cm 4mm
137
3
4
2:1
4
22.5
12cm dbl 4mm
B
B
47
54
5.5
55
12cm dbl 4mm
54
41.5
12cm 4mm
P
55
54
23.5
12cm 4mm
P
55
5
5
2:1
100
47.5
6cm 2.5mm
1B1P
69
68
6cm 2.5mm
98.5
1B1P
3

12 cm Webbing



6cm Webbing


1550 mesh
100.5 mesh deep
468.5
98.5
top/bottom belly 2
335.5
98.5
top/bottom belly 3
72.5
98.5
Port/starb Side Panel 4
170.5
47.5
port/starboard side panel 3
283
47.5
top belly 1
217.5
16
top/bottom tail piece
242.5
37.5
top/bottom belly 4
323
35.5
square

Components of the Trawl

Trawl

- 4 seam & 3 bridle
- 400 x 12cm 4800cm
- Footrope = 2700cm
- Headrope = 2424cm (including wing end extensions and shackles)

Twine Size and Thickness

- 12cm (kc), 4mm regular, dark green, braided polyethylene
  in top & bottom wings — in 1st bottom belly
  in bunts — in 1st & 2nd side panels

- 6cm (kc), 2.5mm regular, dark green, braided polyethylene
  in square — in 2nd belly aft to codend
  in 3rd & 4th side panels

Section Joining Twine

- 12cm mesh sections joined by double 2.5mm Orange P.E.
- 6cm mesh sections joined by single 2.5mm Orange P.E.
- 12cm mesh to 6cm mesh joined by single 2.5mm Orange P.E.
- Selvedge joined to wing sections by single 4mm dark green, braided, P.E.

Selvedge

- Selvedge cut from 12.0cm (kc), double 4mm dark green, braided polyethylene, Euroline with yellow tracer
- 8 meshes deep on the bottom wing bars
- 5 meshes deep on the top wing bars
- 5.5 meshes deep across forward square
- 5.5 meshes deep across forward 1st side panel
- 2.5 meshes deep across forward 1st bottom belly
- All jibs (top, bottom and side)

Gores

- 4 full meshes will be put into each gore
- Port Top= Orange 2.5mm P.E. & White #48 nylon
- Port Bottom= Double Orange 2.5mm P.E.
- Starboard Top= Green 2.5mm P.E. & White #48 nylon
- Starboard Bottom= Double Green 2.5mm P.E.

Hanging Lines
Hung using #96/108 white, braided, nylon twine

Headrope
- ¾" combination rope, IWRC, polypropylene clad with stainless steel core
- ¾" stainless steel heavy wire rope thimbles
- Top Wing End Extensions: ½" stainless steel wire & ½" stainless steel heavy wire rope thimbles
- Headrope is 2058cm eye to eye
- The headrope eye, the top jib end meshes and the upper wing end eye are all put in a ¾" Blue Line bow shackle with the 174cm headrope extension of ½" s.s. wire coming from it
- The headrope extension of ½" s.s. wire is 174cm
- The total headrope length from eye to eye is 2424cm, including port & starboard ¾" bow shackles (9") and 174cm, ½" s.s. wire, extensions
- A ½" hammerlock goes on the end of the 174cm extension
- 3 Nokalon #508, 8" center hole, orange trawl floats go on each 174cm extension separated by 4"x ½" rubber cookies

Wing End (Up & Down Lines)
- 5/8" combination wire rope, IWRC, polypropylene clad with stainless steel core
- 5/8" stainless steel HWR thimbles
- The upper wing end is 552cm eye to eye
- The lower wing end is 460.5cm eye to eye
- The top jib eye goes into the ¾" Blue Line bow shackle on the top
- The two side panel eyes and the middle jib end meshes are put into a ¾" Blue Line bow shackle with the middle extension coming from it
- The middle extension is made of 5/8" s.s. wire with 5/8" s.s. HWR thimbles. It is 133 cm - 9cm (3/4" bow shackle) = 124cm eye to eye
- The lower wing end eye and lower jib end meshes are put into a 3/4" Blue Line bow shackle
- A 5/8" hammerlock goes on the end of both the middle and lower 124cm extensions

Floats
- 60 Nokalon #508, 8" center hole, orange trawl floats
- The floats are mounted vertically in two 30-float strings, with the first float of each string starting 50cm from the center of the headrope
- Float line is made of ¾" polysteel blue, with orange tracer, float rope
- The first 24 floats are mounted at 25cm on center and the remaining 6 floats are mounted at 50cm on center
- 3 floats are put onto each port & starboard top wing end extensions

Bolschline (Rubberline): 3 Piece

- 2436cm total length outside eye to outside eye (including hammerlocks, 6cm each)
- 5/8" stainless steel wire.
- Center Section: 842cm outside eye to outside eye
- Wing Sections: 791cm outside eye to outside eye
- 2-3/8" spacer cookies cover wire. 4" cookies cover sockets
- 198 2-hole orange hangers total; center 76; wings 61
- 1 link of 5/8" trawlex chain used as hangers to pass traveler through, spaced 60cm
- 40 chain-link hangers total; center 14; wings 13
- 2, 5/8" Crosby hammerlocks connect 3 piece bolschline sections
- 5/8" Esco sockets swaged on each end of bolschline sections
- 10, 5/8" wire clamps total; center 6; wings 2

Tailpiece

- Tailpiece diameter is 216 meshes x 16 meshes deep, of 6.0cm, 2.5mm
- Placed 10 meshes down from top of tailpiece; for attachment to codend.
- 31 rings 3.5" plastic, 1 ring at top center 3/8" x 3" stainless steel, sewn on with #96 braided nylon twine.

Codend Liner

- #504 knotless nylon, 1" stretched diamond mesh.
- 432 meshes across by 384 meshes deep.
- The 432x384 section of knotless webbing is machine sewn, the full length of webbing, selvedge to selvedge, to form a tube open at both ends.
- The knotless nylon tube is joined to 6cm, 2.5mm green p.e. webbing 216 meshes around by 5.5 meshes deep (215.5 mesh wide sewn into cylinder 216 mesh circumference).
- A 700cm in length joining rope is spliced into a 648cm circle and marked at 3cm intervals (216 marks).
- 6cm, 2.5mm green p.e. webbing cylinder and #504 knotless nylon tube is gathered and sewn simultaneously to the joining rope at each mark using #182 braided nylon twine.
    - 6cm 1:1 ratio (216 meshes to 216 marks).
    - #504 2:1 ratio (423 meshes to 216 marks).
    - #504 sewn through 3rd mesh from top
    - Webbing sections sewn to rope with 1 locking hitch and 3 half hitches.
- 6cm p.e. webbing on forward portion of liner is sewn 1:1 to aft meshes of tailpiece.

Codend

- Same webbing as selvedge, 12.0cm (kc), double 4mm P.E. Euroline
- 100 meshes in diameter & 75 meshes deep, from 2 panels of 54 mesh x 75 mesh
- 4 meshes in each gore, 2 from each webbing panel port and starboard.
- The codend utilizes 1" diameter gore ropes.
    - Gore ropes are to have eyes spliced on forward and aft ends
    - Forward End- 14cm inside eye length. Aft End- 10cm inside eye length
    - At the aft end, the gore rope eye should be flush with the rings; at the forward trawl end, the gore rope should extend 70cm (includes 14cm eye)
- 32 total zipper rings at forward trawl end to attach codend to tailpiece. 31 3.5" plastic rings, 1 stainless steel ring at top center 3/8"x 3".
- 50 puckering rings total at terminus, attached 2:1. 5/16" x 2.5" stainless steel.
- Codend zipper line made from ½" polydacron rope, 650cm length.

Codend Ring Attachments

- Codend rings are attached on the forward and aft sections by #8 virgin polyester twine
- The forward trawl end ring attachment:
    - First row is 1:1 all the way around (108 meshes), 10cm bar length.
      Second row is sewn with the following pattern, 10cm bar length:
      Beginning at the TOP CENTER:
      Five times » 2:1, 2:1, 1:1/ One time » 2:1, 2:1/ Ten times » 2:1, 2:1, 1:1/ One time » 2:1, 2:1/ Five times » 2:1, 2:1, 1:1
      Third row is 1:1 all the way around (64 meshes), 15cm bar length to accommodate the rings. Rings attached 2 meshes per ring. 32 total rings.
- The aft ring end attachment:
    - Puckering Rings: 50, 5/16" x 2.5" stainless steel rings. Rings sewn on 2:1 with 8cm bar length

Codend Strengthening Straps, Splitting Strap & Bull Rope

- 5 straps around codend: 1 Lifting strap, 3 strengthening straps, 1 splitting strap.
- All straps attached by twine beckets.
    - Twine for beckets is 12mm virgin polyester.
    - Full circumference (other than top lifting strap stop 10 meshes from gore for reinforcement)
    - Spacing is 3 meshes x 1-1/2 meshes.
- Lifting strap is ¾" 12 strand, plasma rope, 650cm eye to eye. 20cm eyes connected by twine seizing.
    - Placed at 65 meshes from aft.
- Strengthening straps are 5/8" Samson Tenex-Tec, braided, 600cm eye to eye. 8cm eyes connected by twine seizing.
    - Placed at 25, 35, 45 meshes from aft.
- Splitting strap made from 1" Samson Tenex-Tec, braided, 600cm eye to eye. 8cm eyes connected by ¾" stainless steel, pear shaped, opening link.
    - Placed at 15 meshes from aft.

- Reinforcement is 12mm virgin polyester, 18cm mesh size.
  - 6-1/2 mesh deep, 20 meshes wide, All Bars taper.
  - Bottom edge knotted to codend webbing 12 meshes from top of codend, 10 mesh on each side of Port gore.
  - Spectacle consisting of two 2.5" and one 3" s.s. ring.
  - Top meshes of reinforcement sewn into 3" ring.
- Extension to 3rd belly is 925cm, 12 strand, plasma rope.
  - 8cm eye on aft end only.
  - Attached to lifting strap by 5/8" hammerlock.
- Bull rope is 1-1/8" 8 strand, braided, Samson "Ultra Blue", 4267cm. 8cm eye on aft end only. Attach to splitting strap into ¾" s.s. pear shaped link.

Chafing Mat

- 25L x 30W
- 6.0" kc, nylon
- Sewn at 33 mesh from aft, on underside of codend
- Seized on sides, each 7 meshes, using #8 polyester

Hanging Information

Twine Size- 12.0cm (knot center-knot center) 4mm Euroline, dark green, braided polyethylene.
Selvedge/Jibs are 12.0cm (kc-kc) double 4mm Euroline.
Bars hung at 105%

BOTTOM
24 ROUND MESHES @ 6cm = 138cm
in 23 spaces
6, 1B1M @ 10cm = 60cm
9, 2B1M @ 16cm = 144cm
12 BUNT BARS @ 105% = 151cm
48 WING BARS @ 105% = 605cm
14.5 JIB BARS + ½ @ 105% = 189cm
TOTAL WEBBING = 2436cm
EXTENSION = 133cm [124cm E.T.E (5/8" s.s. wire) + 9cm (3/4" Bow shackle)]

TOTAL FOOTROPE = 2702cm (see bolschline drawing for details)

TOP
28 ROUND MESHES @ 6cm = 162cm
in 27 spaces
6, 1B1M @ 10cm = 60cm
9, 2B1M @ 16cm = 144cm
36 WING BARS @ 105% = 454cm
22.5 JIB BARS + ½ @ 105% = 290cm
TOTAL WEBBING = 2058cm
EXTENSION = 183cm [174cm E.T.E (1/2" s.s. wire) + 9cm (3/4" Bow shackle)]

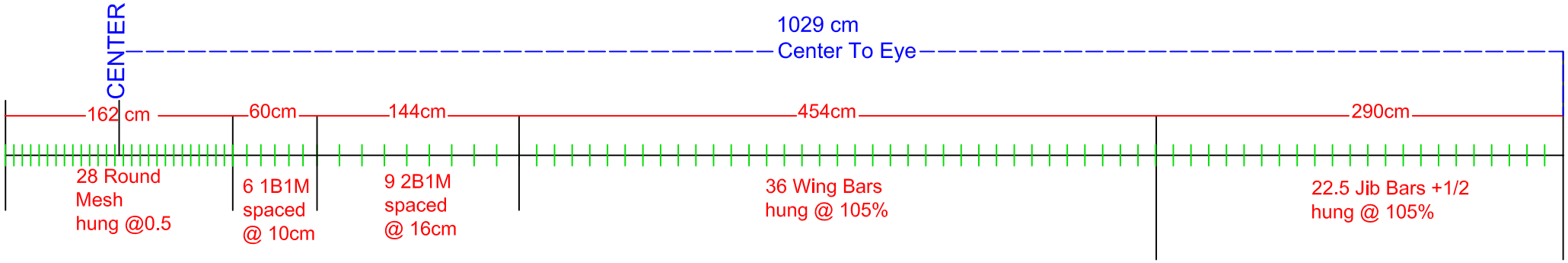
TOTAL HEADROPE = 2424cm

WIND ENDS
LOWER
BOTTOM - 14.5 JIB BARS + ½ @ 1.025 = 184.5cm
SIDE- 22.5 JIB BARS + ½ @ 1.0 = 276cm
TOTAL = 460.5cm

UPPER
TOP - 22.5 JIBBARS + ½ @ 1.0 = 276
SIDE - 22.5 JIBBARS + ½ @ 1.0 = 276
TOTAL = 552cm

HEADROPE HANGING RATIOS

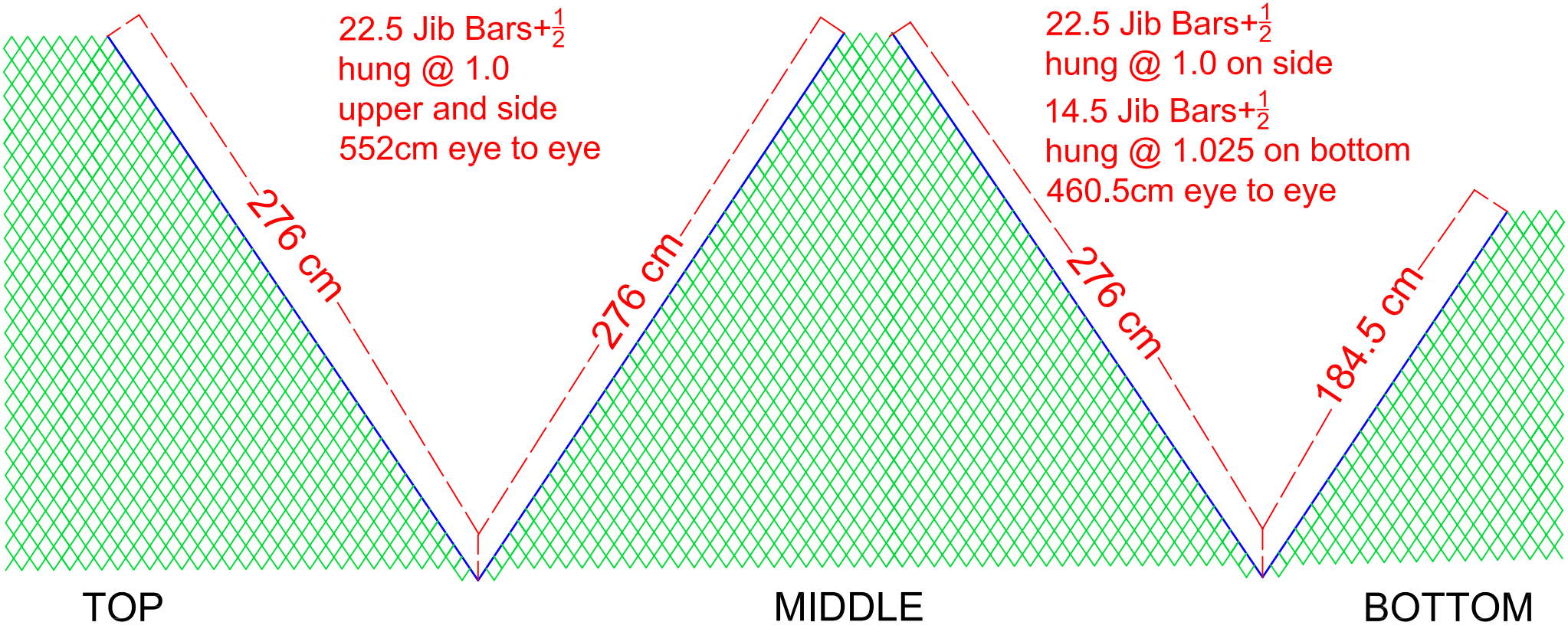
2058cm eye to eye
12.0 cm (kc-kc) meshes along headrope
Bars hung at 105%

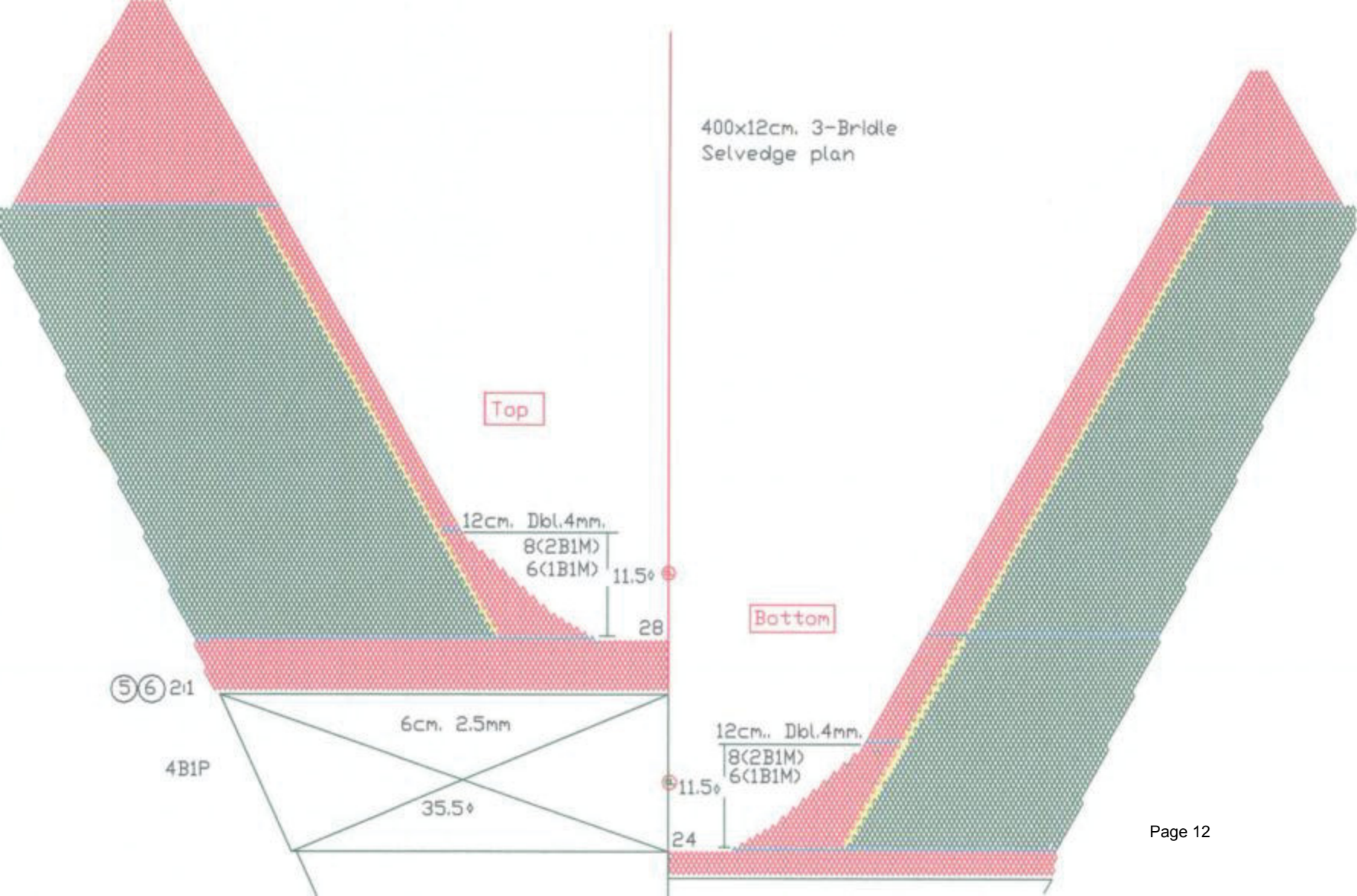


Wing End Up & Down Lines
Hanging Ratios

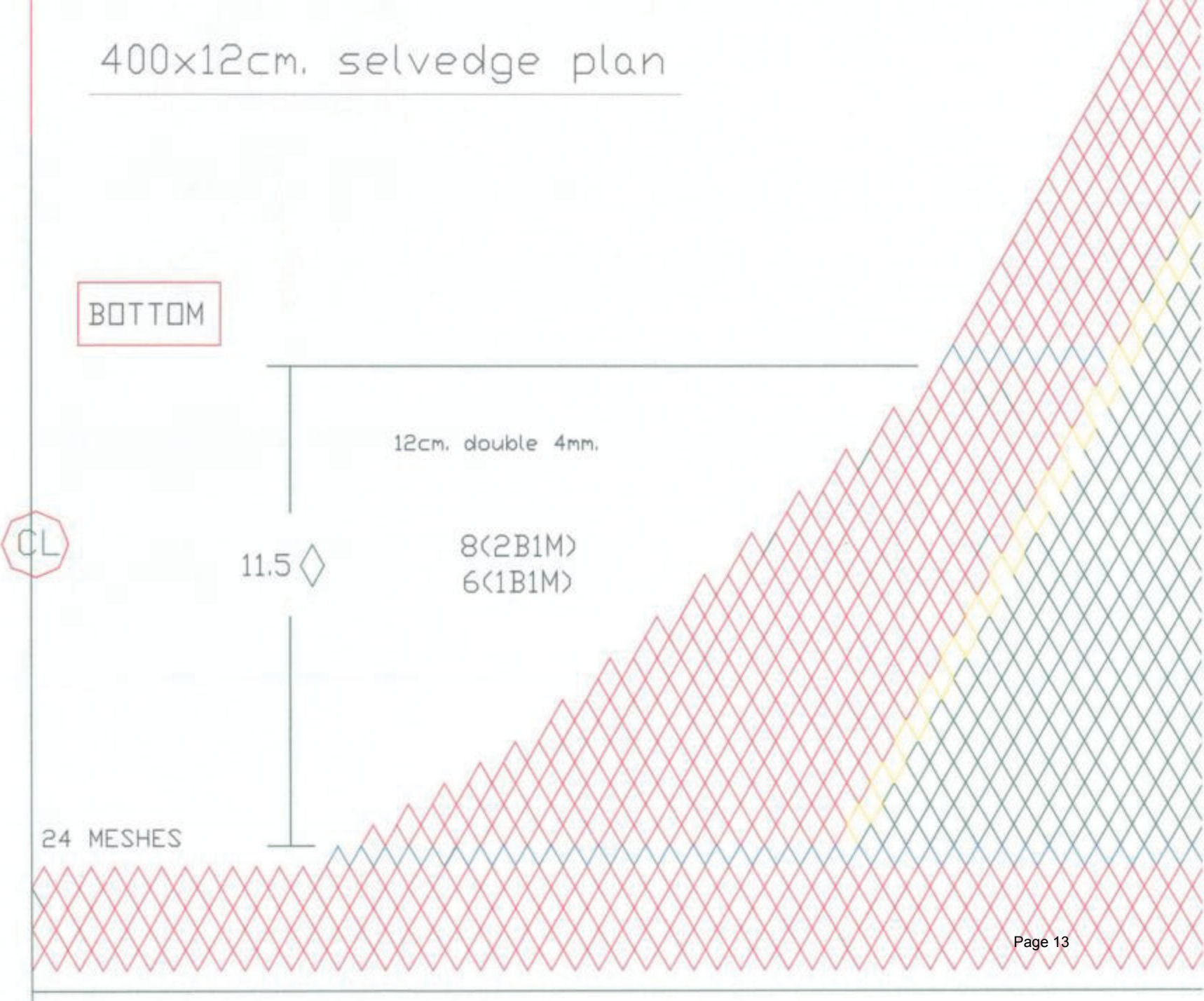
12.0cm (kc-kc) double 4mm, Euroline

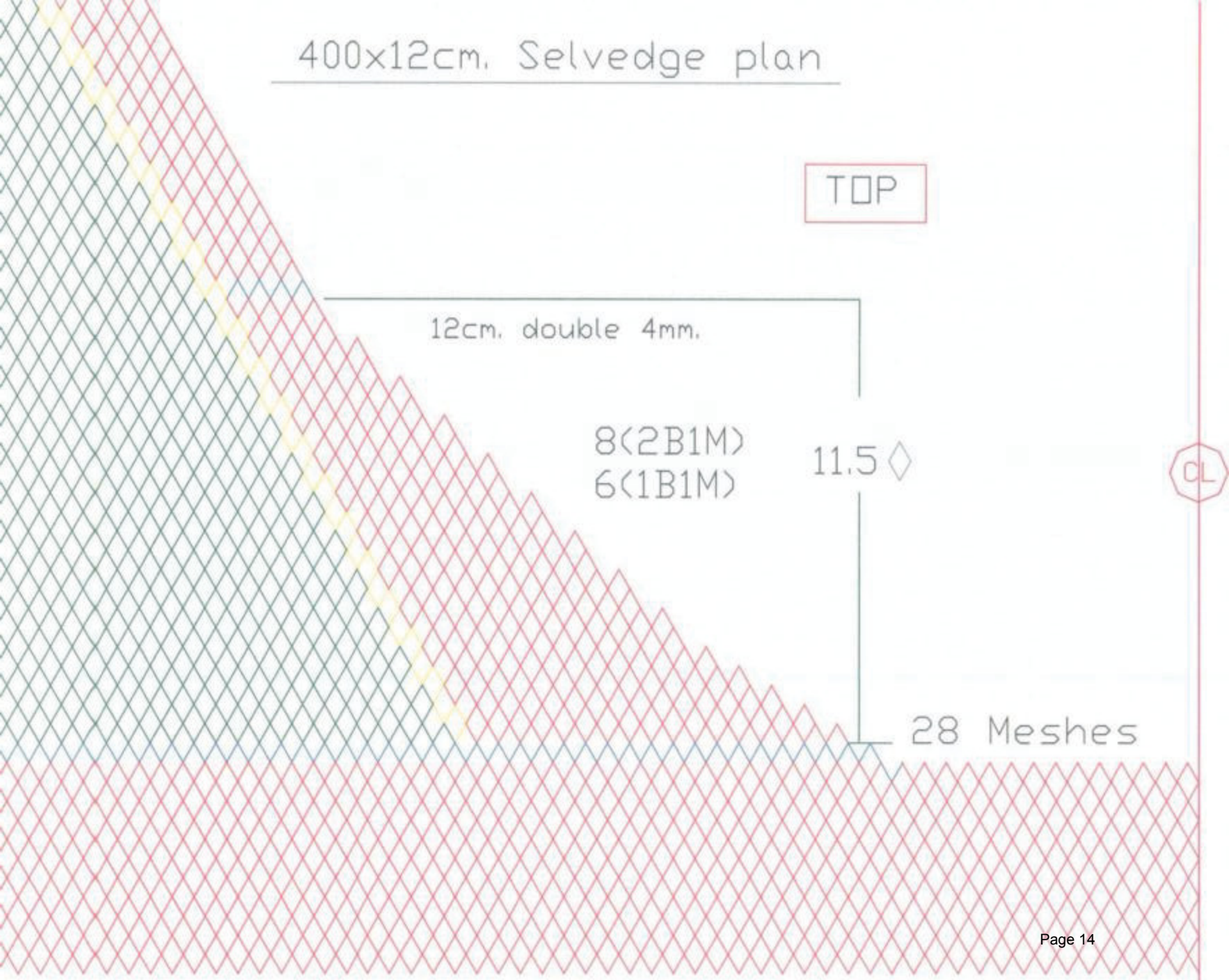
Upper = 552cm eye to eye
Lower = 460.5cm eye to eye



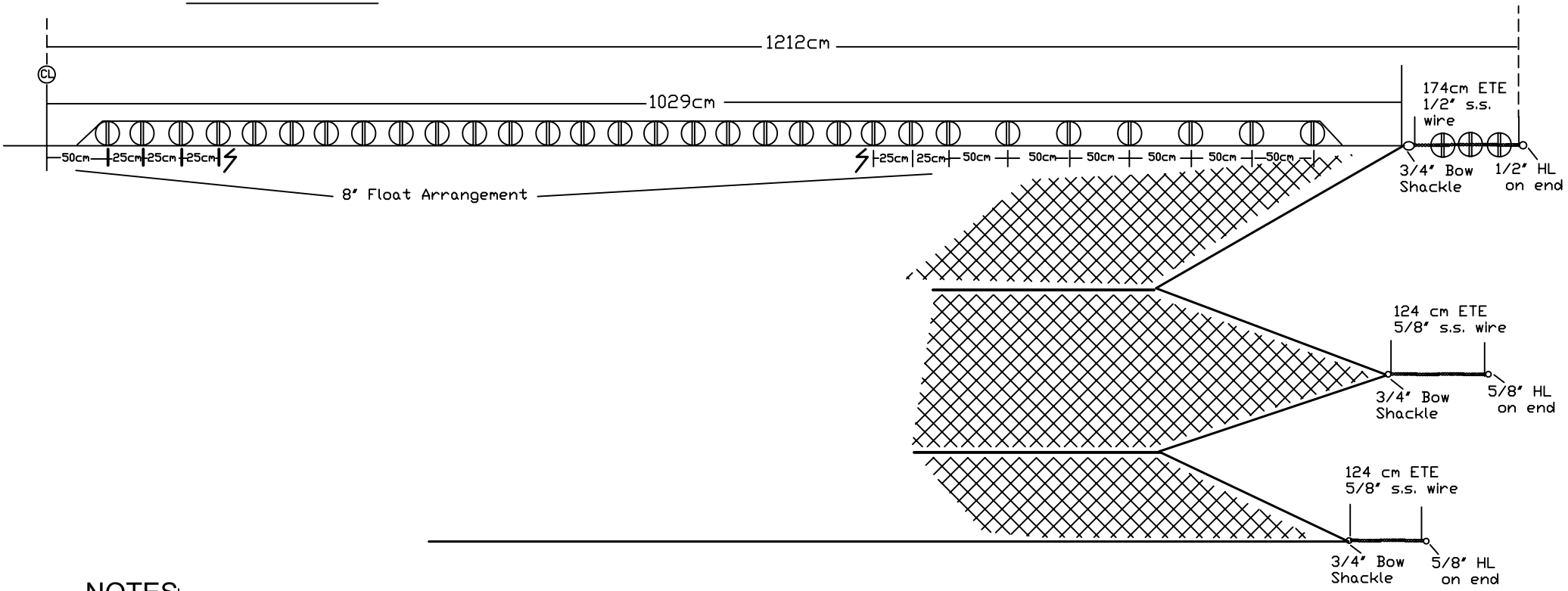

400x12cm. 3-Bridle
Selvedge plan
Top
12cm. Dbl.4mm.
8(2B1M)
6(1B1M)
11.5◊
28
Bottom
5 6 2:1
6cm. 2.5mm
4B1P
35.5◊
12cm.. Dbl.4mm.
8(2B1M)
6(1B1M)
11.5◊
24

400x12cm. selvedge plan




400x12cm. Selvedge plan
TOP
12cm. double 4mm.
8(2B1M)
6(1B1M)
11.5 ◊
CL
28 Meshes

Side View



NOTES:

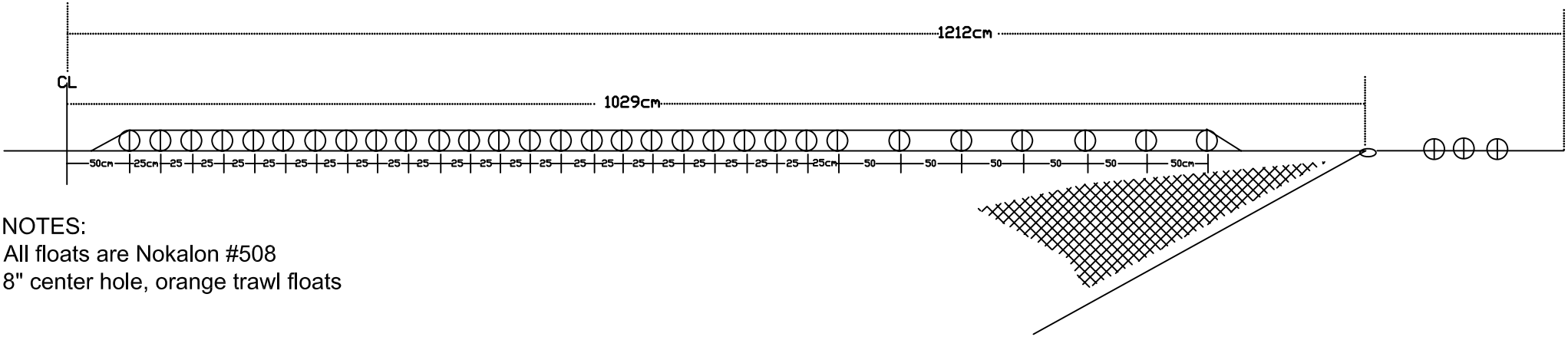
Total Headrope Length = 2424cm ETE including port and starboard 3/4" bow shackles and 174cm, 1/2" s.s. wire, extensions.

Upper wing end length is 685cm ETE including the middle 3/4" bow shackle and 124cm, 5/8" s.s. wire, extension.

Lower wing end length is 592cm ETE including the lower 3/4" bow shackle and 124cm, 5/8" s.s. wire, extension.

3 Nokalon #508, 8" center hole, orange trawl floats are put onto each top, 174cm extension.
The floats are separated by 4" x 1/2" rubber cookies.

FLOAT ARRANGEMENT



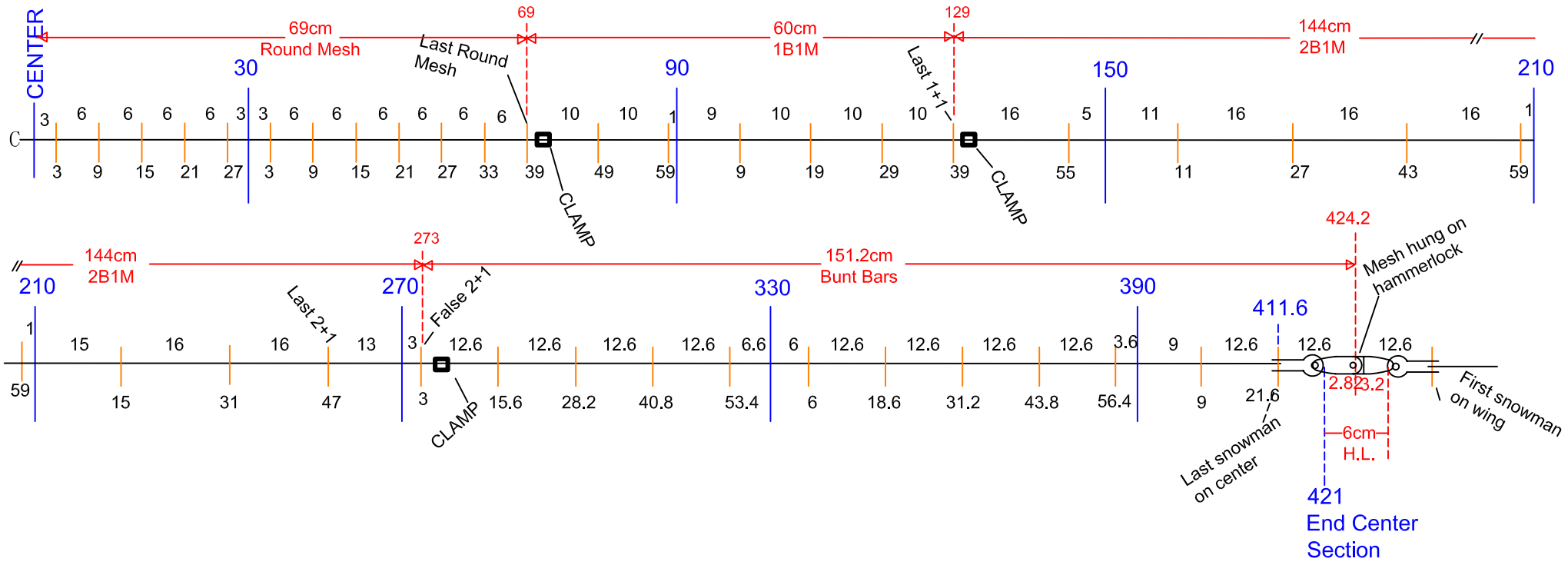
NOTES:
All floats are Nokalon #508
8" center hole, orange trawl floats

Bolschline Center Section Spacing

842cm Length, outside eye/outside eye

76 Snowmen
14 Hangers,
6 Clamps total

Cut wire 827.5 cm
String cookies from center
Then swage sockets

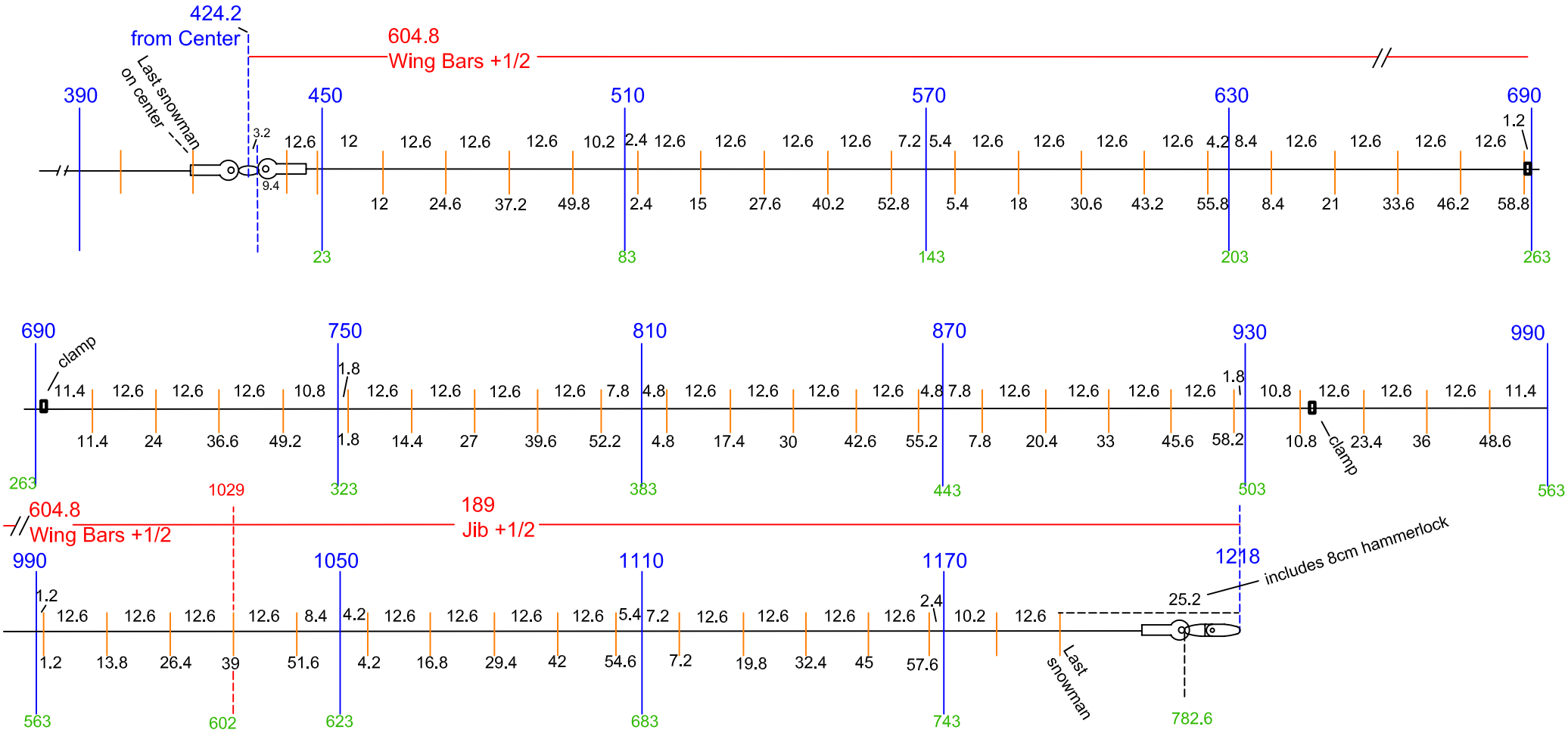


Bolschline Wing Spacing

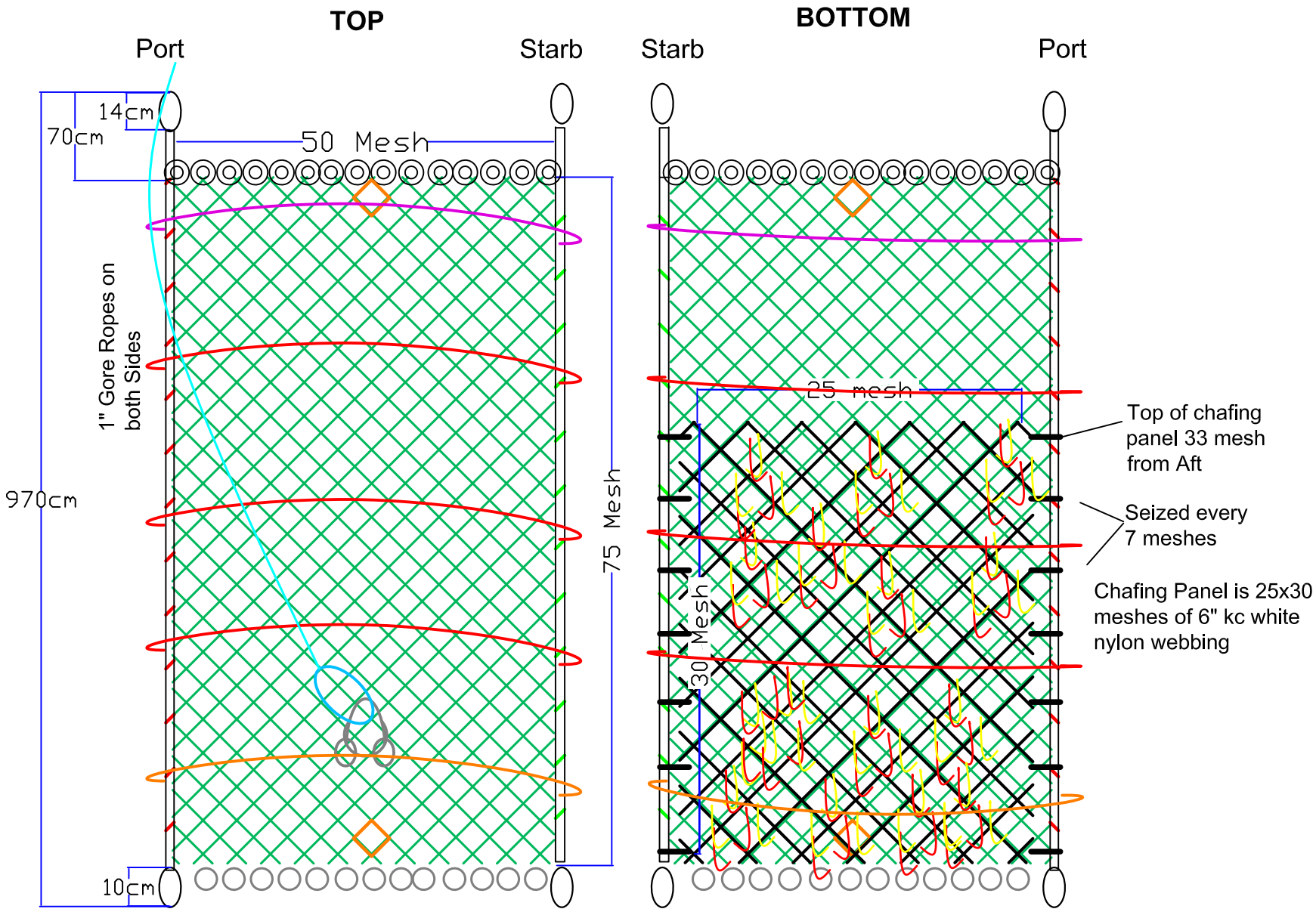
782.6 cm Length, outside eye/outside eye

Cut wire 766.2 cm

61 Snowmen 13 Hangers 2 Clamps



100x75 Mesh Codend



2 panels of 12cm (knot center), 4mm double Euroline Webbing. 54 x 75 meshes each, gored together with 1" gore ropes. 4 meshes in each gore (2 mesh from each panel).

Center Mesh forward, aft, top and bottom marked with orange poly twine.

Tailpiece Rings Detail

32 rings total (31 plastic 3.5”, 1 steel @ top center 3/8” x 3”)
Attached using #96 braided nylon twine. 10 meshes down from top of tailpiece.
Tied on every other mesh with 10cm bar length
Start on first mesh next to gore (either side). 3 10cm mesh to 1 ring. 16 rings top and bottom.

Forward Trawl End
Zipper Rings Detail

32 rings total (31 plastic 3.5”, 1 steel @ top center 3/8” x 3”)
Attached using #8 polyester twine

FIRST ROW: 1:1 all the way around (108 meshes), 10cm bar length

SECOND ROW: 10cm bar length, following pattern:
Begin @ Top Center

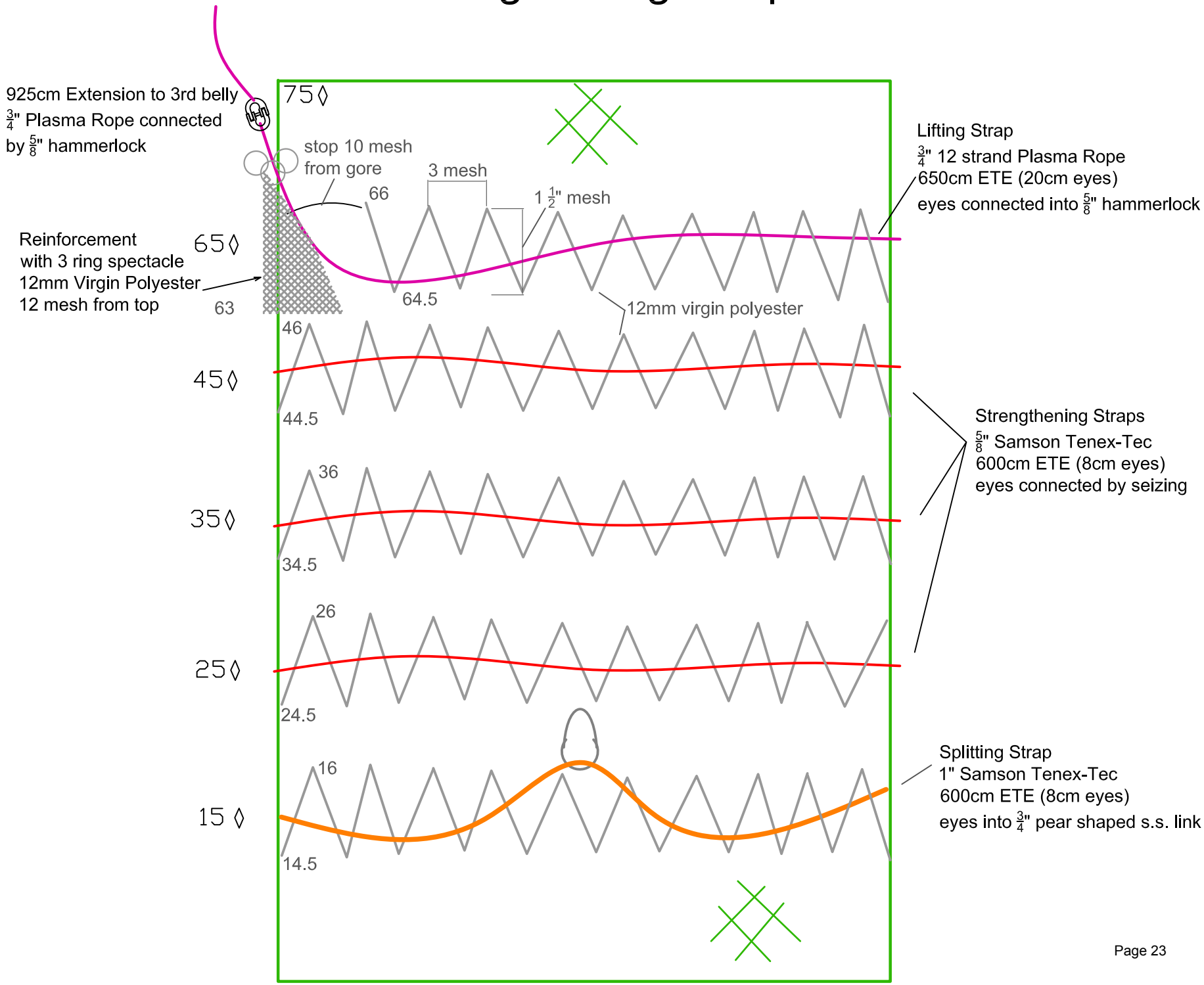
- 2:1, 2:1, 1:1 Five Times
- 2:1, 2:1 One Time
- 2:1, 2:1, 1:1 Ten Times
- 2:1, 2:1 One Time
- 2:1, 2:1, 1:1 Five Times

THIRD ROW: 15 cm bar length (to accommodate ring)
1:1 all the way around (64 meshes)
2 meshes per 1 ring

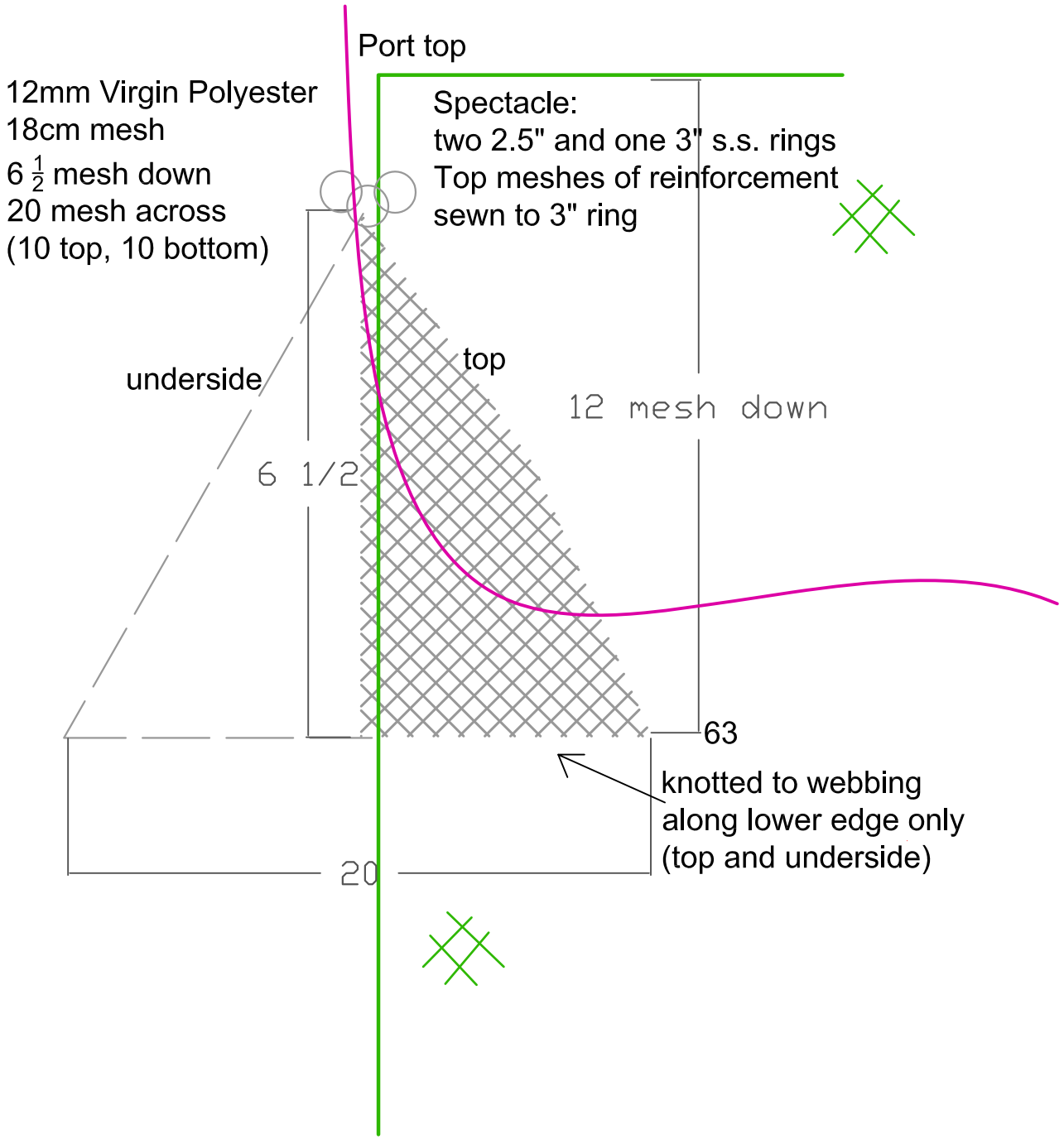
Aft Codend Puckering Rings

50 stainless steel rings. 5/16” x 2.5”
Rings sewn on 2:1, (25 rings per panel)
8cm bar length

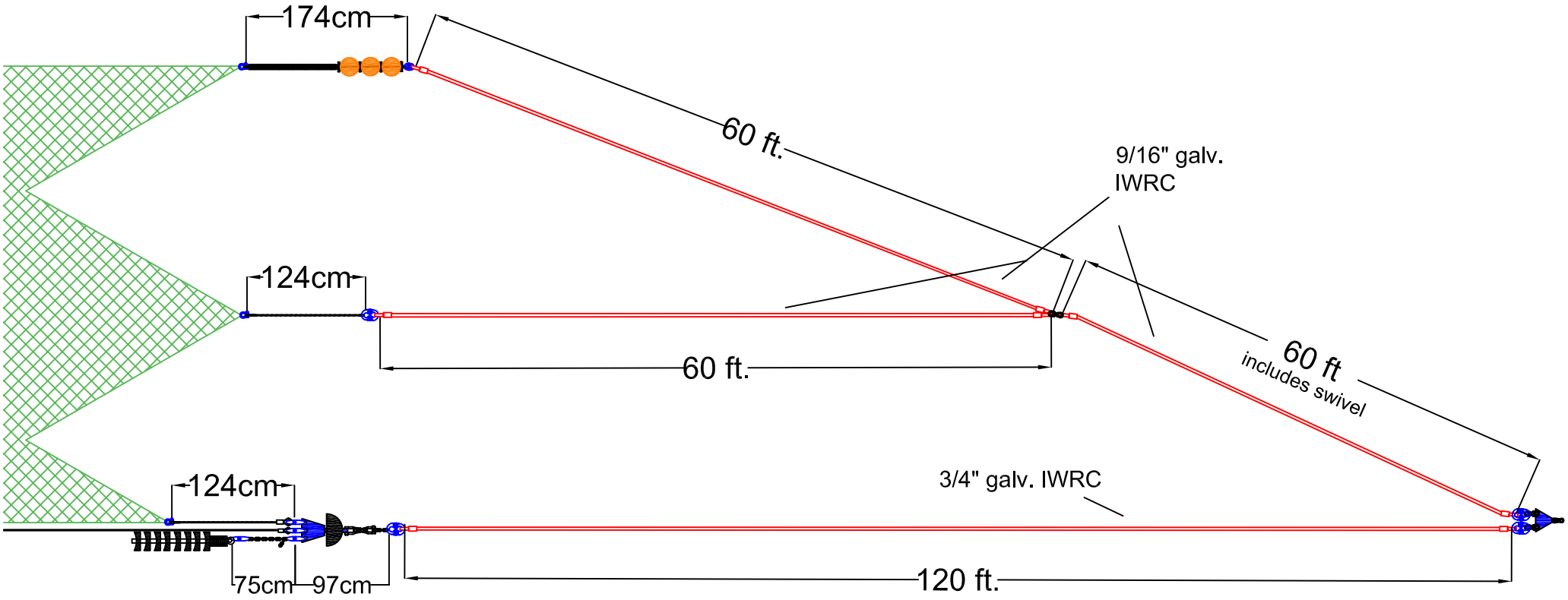
Codend Strengthening Strap Detail



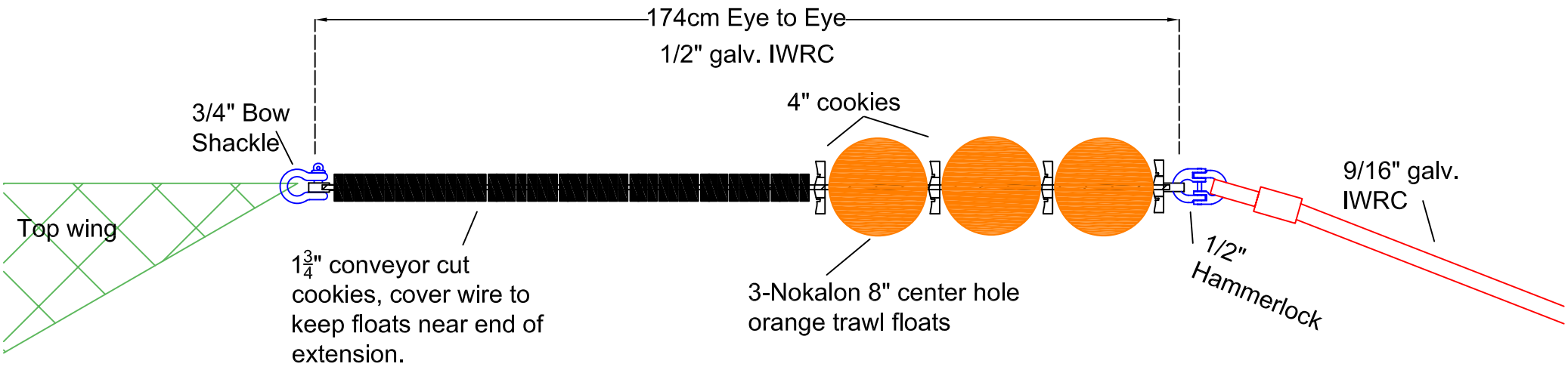
Reinforcement Detail



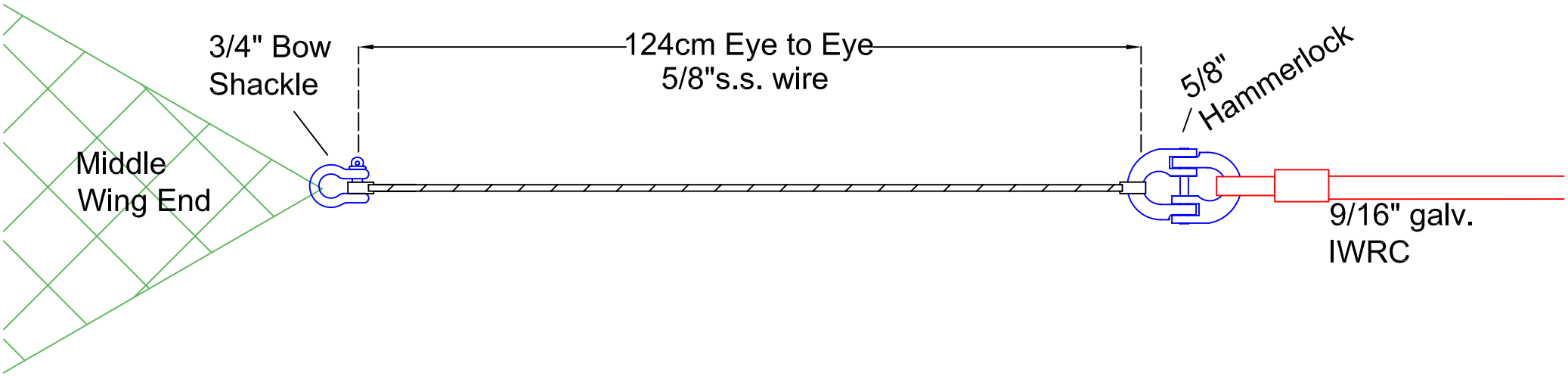
NEFSC 4 Seam, 3 Bridle Survey Trawl
Rigging Profile



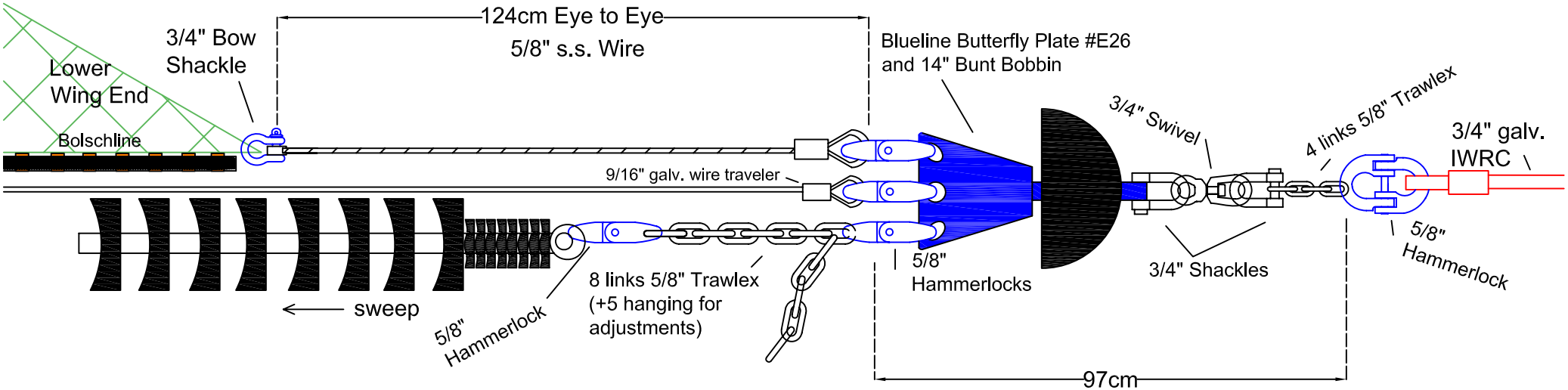
Top Wing End Extension Detail



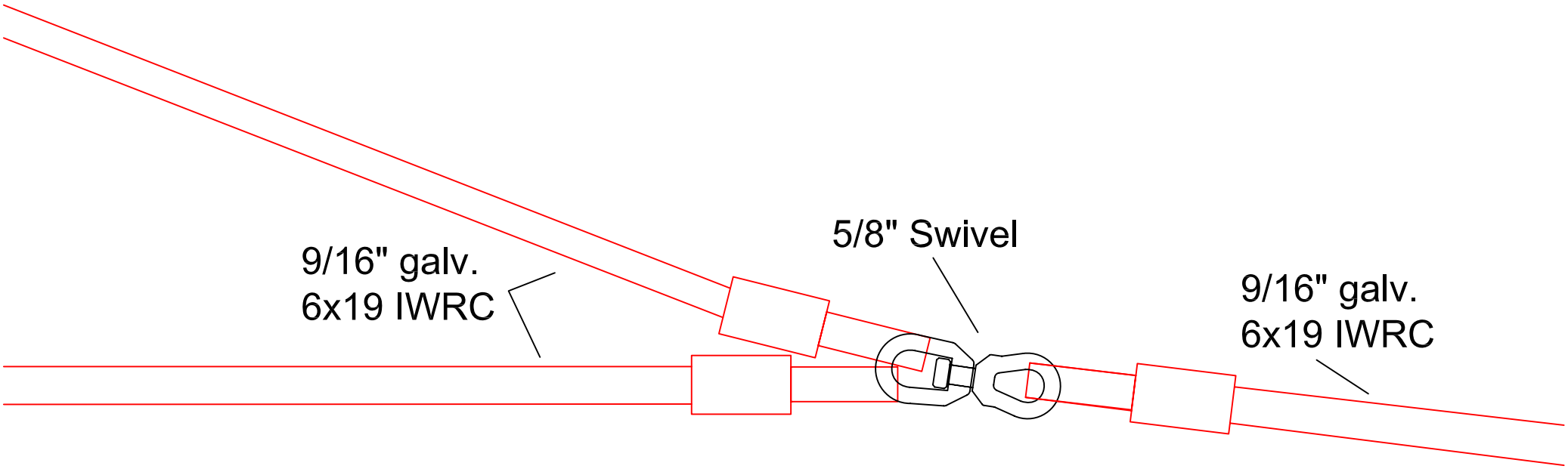
Middle Wing End
Extension Detail



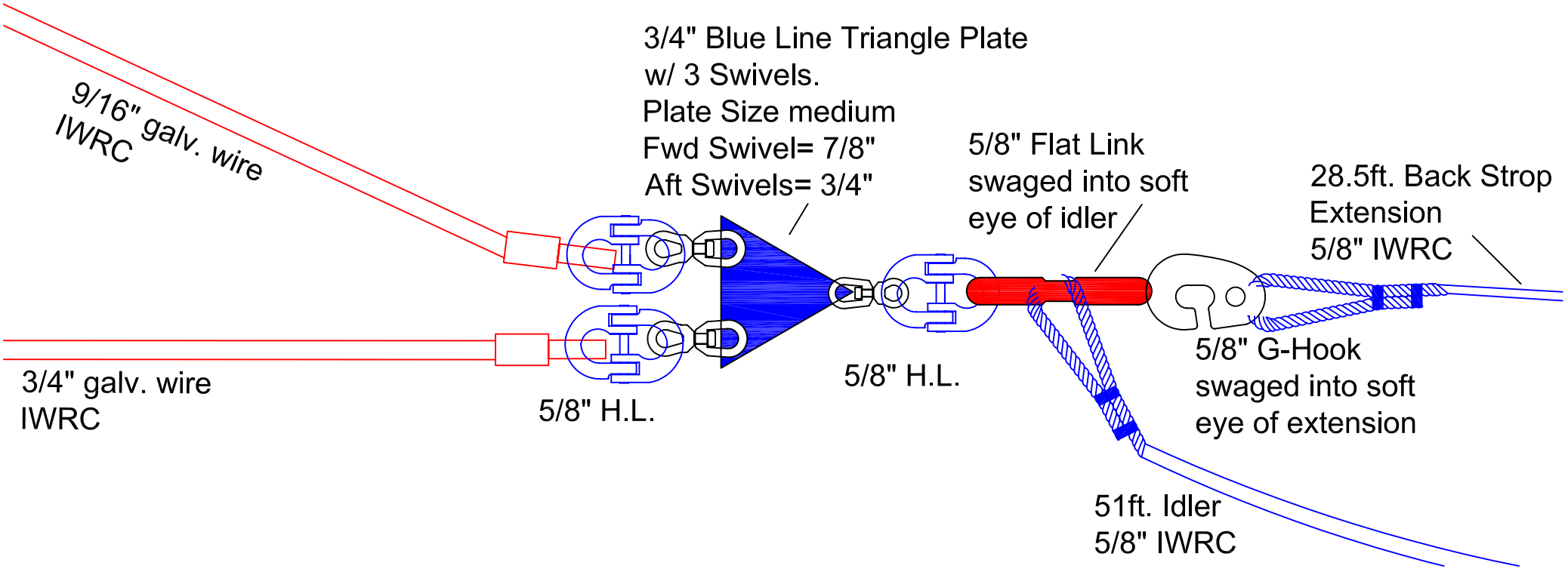
Lower Wing End Extension Detail



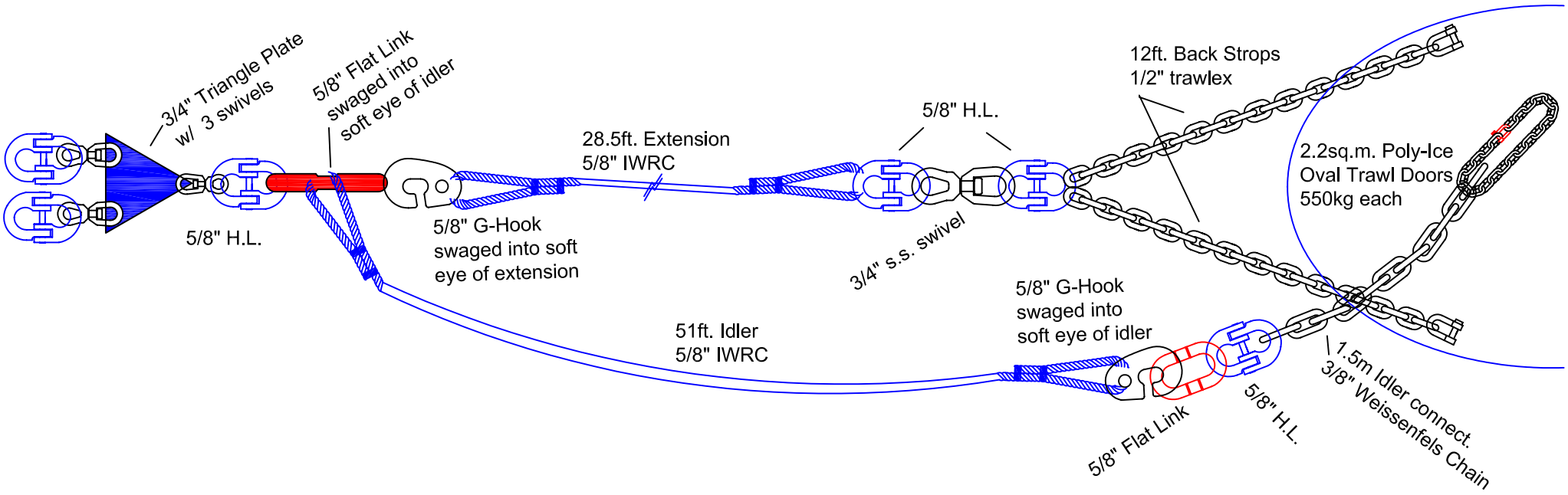
Upper Legs Connection Detail



Lower Leg Connection Detail



Door Rigging Detail



Rockhopper Sweep Details

Center Section

- 890cm Eye to Eye.
- 3/4" 6 x 25 IWRC stainless steel wire.
- 3/4" ESCO stainless steel sockets.

- Drop Chains:
  - 60cm drop chain spacing.
  - 1st and last drop chains are 25cm from inside of socket eye.
  - 15 drop chains total in center section.
  - Drop chains are comprised of 2-links of 5/8" long link trawlex, with 1 5/8" headless shackle.

- Total Center section has 14 sections, plus 2 end sections.

- 5/8" Wire clamps in every 3rd section, 4 clamps total.
  - 1st and last clamps spaced 175cm from inside the eyes.
  - Inner 2 clamps spaced 180cm from 1st and last and from each other.

- Discs
  - Rockhopper Discs
    - 30, 16" x 1", 2.5" thick (±0.5") Rockhopper discs, total in center section.
    - 2 rockhoppers per 60cm section.
    - 1 rockhopper on each end section.
    - Concave side of rockhoppers are to face towards the center.
  - Floppy Discs
    - 116, 16" x 1" Floppy discs, total in center section.
    - 8 floppy discs per 60cm section.
    - 2 floppy discs on each end section.
  - Filler Rubber
    - 5" x 1" filler rubber, tread cut. Fill in all gaps between floppy discs and rockhopper discs.
    - 6" x 2-3/8" filler rubber, tread cut. Used on end sections to cover the sockets.

- Lead Weight
  - 100 lbs total.
  - 80, 1-1/4 lbs lead weights are to be spaced evenly throughout the center section of the sweep.
  - Leads spaced evenly in between the first and last rockhoppers. No lead on end sections.

Wing Sections

- 820cm Eye to Eye.
- 3/4" 6 x 25 stainless steel IWRC wire.
- 3/4" ESCO stainless steel sockets.
- 1, 5" x 2-3/8" x 1/2" stainless steel washer, first item on 1st end section over the socket.
- 5/8" Hammerlocks connect wing sections to the center section.

- Drop Chains
  - 60cm drop chain spacing.
  - 1st drop chain is 25cm from inside of socket eye.
  - Last end drop chain is 135cm from inside of socket eye.
  - 12 drop chains total in wing sections.
  - Drop chains are comprised of 2-links of 5/8" long link Trawlex, with 1 5/8" headless shackle.

- Each wing section has 11, 60cm sections and 2 end sections.
  - 1st end section, towards the center, is 25cm from inside eye to the first drop chain and is comprised of 1 14" rockhopper, 1 14" floppy, and 6" filler rubber covers the socket.
  - Last end section, on the wing end, is 135cm from the last drop chain to inside the eye and is comprised of 4 14" rockhopper, 7 14" floppy discs, 1 5/8" wire clamp between the 20th and 27th rockhoppers, and 30cm of 6" filler rubber from the 27th rockhopper out to the end over the socket.

- Each wing section has 4 5/8" wire clamps total.
  - 1st clamp goes between the 4th and 5th drop chains.
  - 2nd clamp goes between the 7th and 8th drop chains.
  - 3rd clamp goes between the 10th and 11th drop chains.
  - 4th clamp goes on the last end section, between the 25th and 26th rockhoppers.

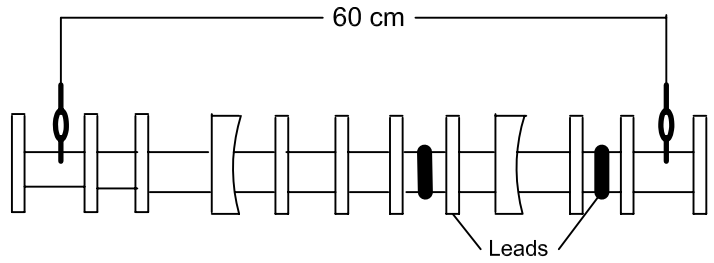
- Discs
  - Rockhopper Discs
    - 27, 14" x 1", 2.5" thick (±0.5") Rockhopper discs, total in each wing section.
    - 2 rockhoppers per 60cm section.
    - 1 rockhopper on 1st end section towards the center.
    - 4 rockhoppers on the last end section.
    - Concave side of rockhoppers are to face towards the center.
  - Floppy Discs
    - 52, 14" x 1" Floppy discs, total in each wing section.
    - 4 floppy discs per 60cm section.
    - 1 floppy disc on 1st end section
    - 7 floppy discs on last end section.
  - Filler Rubber
    - 5" x 1" filler rubber, tread cut. Fill in all gaps between floppy discs and rockhopper discs, between 1st and 27th rockhoppers.
    - 6" x 2-3/8" filler rubber, tread cut. Used on end sections to cover the sockets. 35cm on last end section from the 27th rockhopper out over the socket. On the 1st end section, cover the socket area after the 5" steel washer.

- Lead Weight
  - 30 lbs total on each wing section.
  - 24, 1-1/4 lbs lead weights are to be spaced evenly between the 20th and 27th rockhoppers.

ROCKHOPPER CENTER SECTION
Section = 890cm, 100lbs Lead

14 Sections (Excluding End Sects.)
60cm Spacing between chains
- Section Makeup -
2 - 16" x 1", 2.5" thick
Rockhopper Discs
8 - 16" x 1" Floppy Discs
5" x 1" Filler Rubber (tread cut)

80- Evenly Spaced,
1-1/4 lbs leads , (100lbs total)

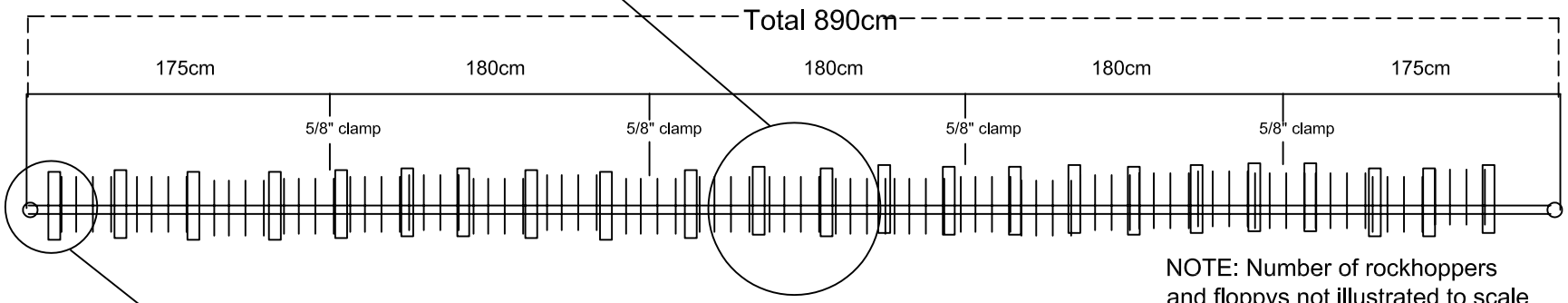


TOTAL CENTER SECTION

30- 16" x 1", 2.5" thick rockhoppers
(2 per section with 1 in end sections)

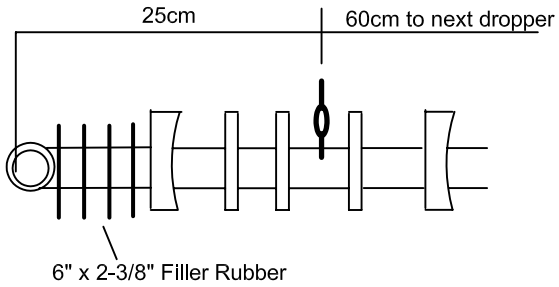
116- 16" x 1" floppy discs
(8 per section with 2 in the end sections)
(4 floppys between each rockhopper)

80 pieces of 1-1/4lbs lead (100lbs total), evenly spaced in between end rockhoppers.



NOTE: Number of rockhoppers and floppys not illustrated to scale

Begining and End Sections
25cm Inside the eye to chain
- End Section Makeup-
1- 16"x1", 2.5" thick
Rockhopper Disc
2- 16"x1"
Floppy Discs
3/4" ESCO s.s. Sockets
6" x 2-3/8" Filler Rubber
cover the 3/4" socket



Clamp in every 3rd section

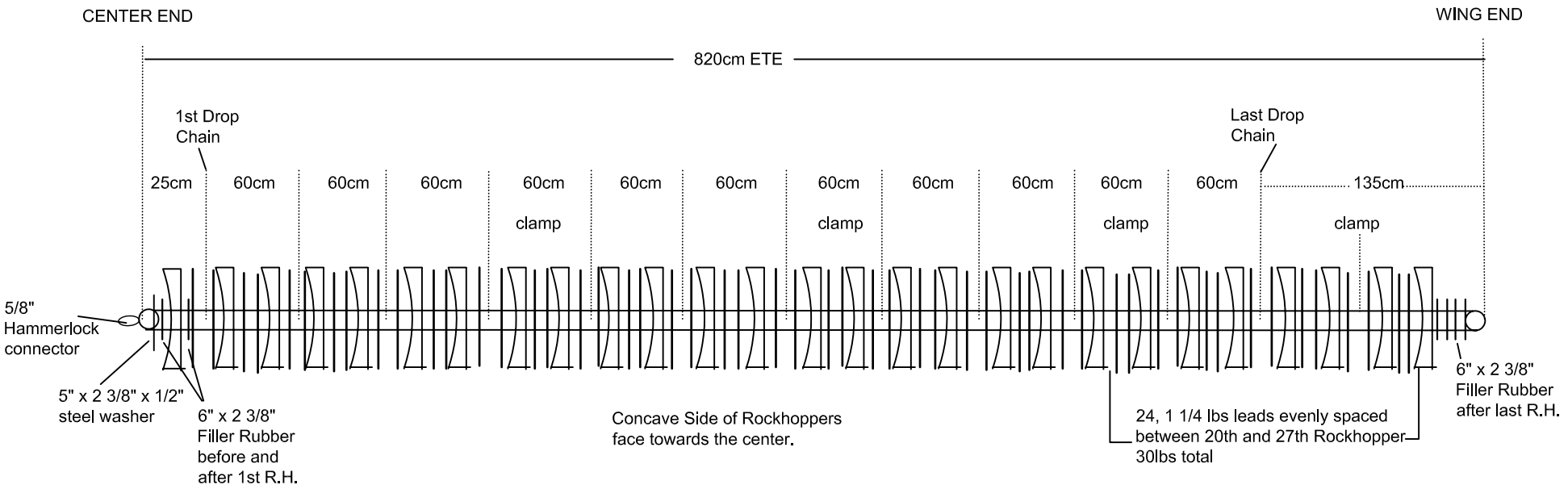
4, 5/8" Wire Clamps total in center section spaced as shown above

15 drop chains total, drop chains are
2 links of 5/8" long link trawlex and
1 5/8" headless shackle

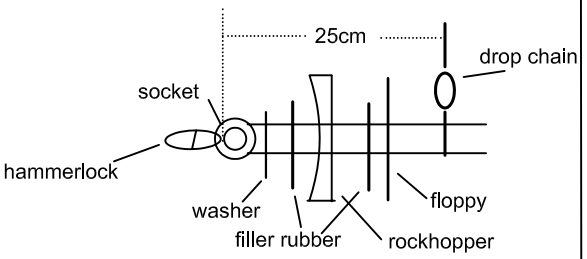
3/4" 6x25 IWRC STAINLESS STEEL WIRE	4, 5/8" WIRE CLAMPS	5" x 1" FILLER RUBBER tread cut	15 HANGING CHAINS EACH 2-LINKS OF 5/8" LONG LINK TRAWLEX + 1, 5/8" HEADLESS SHACKLE
3/4" ESCO STAINLESS STEEL SOCKETS	80, 1-1/4 lbs LEADS EVENLY SPACED, 100lbs total	6" x 2-3/8" FILLER RUBBER To Cover Sockets on End Sects.	

ROCKHOPPER SWEEP WING SECTIONS

820cm eye to eye, 30lbs lead



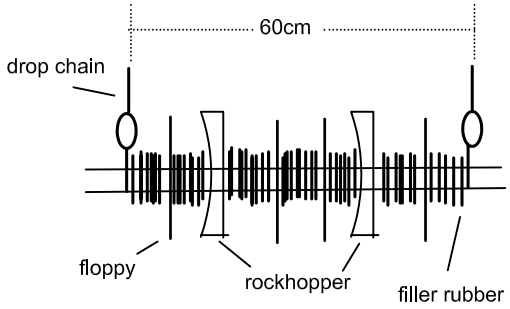
1st END SECTION



1st End Section Makeup:

-25cm from inside eye to 1st drop chain
-drop chain comprised of 2-links 5/8" Trawlex and 1 5/8"headless shackle.
-1, 5" x 2-3/8" x 1/2" s.s. washer.
-1, 14" x 1" x 2.5" thick Rockhopper.
-2, 14" floppy discs.
-1, 3/4" ESCO s.s. socket
-1, 5/8" hammerlock
-6" x 2-3/8" filler rubber, tread cut, before and after 1st rockhopper

60cm SECTIONS

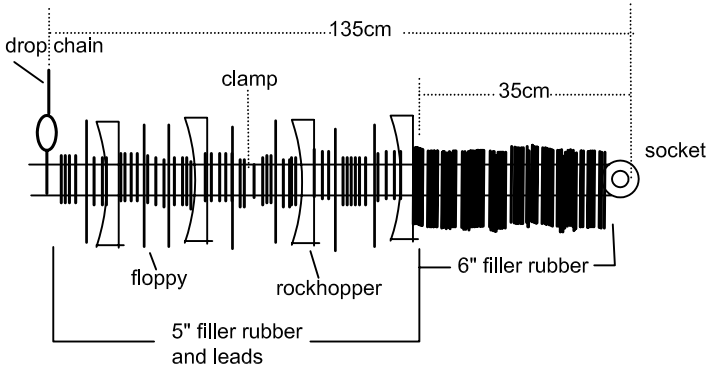


60cm Sections Makeup:

-60cm drop chain spacing.
-11 sections total.
-drop chains comprised of 2-links 5/8" Trawlex and 1 5/8"headless shackle.

-2, 14" x 1" x 2.5" thick Rockhopper.
-4, 14" floppy discs.

LAST END SECTION

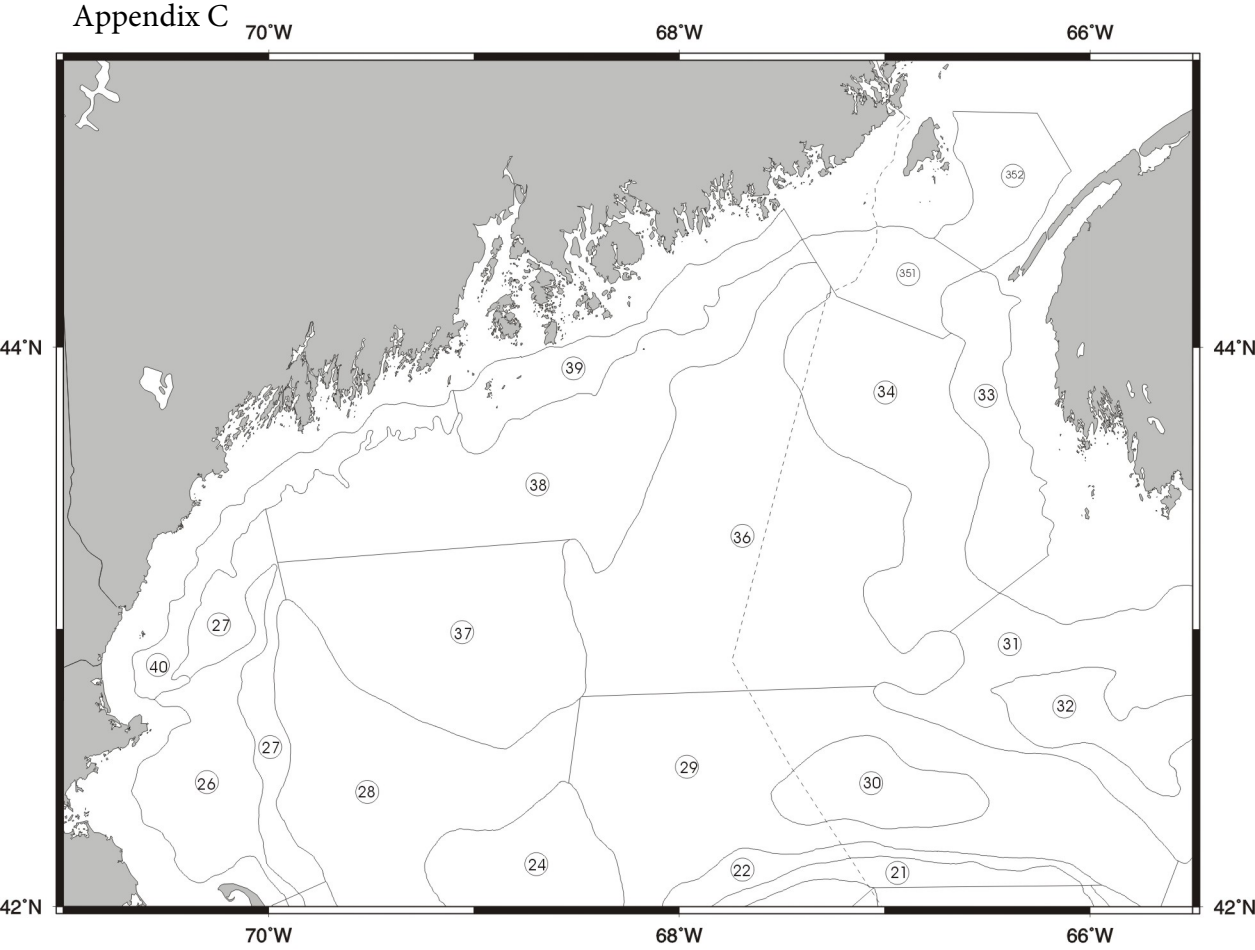


Last Section Makeup:

-135cm from last drop chain to inside eye.
-1, drop chain comprised of 2-links 5/8" Trawlex and 1 5/8"headless shackle.
-4, 14" x 1" x 2.5" thick Rockhopper.
-7, 14" floppy discs.
-1, 3/4" ESCO s.s. socket.
-5"x1" filler rubber, tread cut, from drop chain to 27th rockhopper.
-6" x 2-3/8" filler rubber, tread cut, over socket.

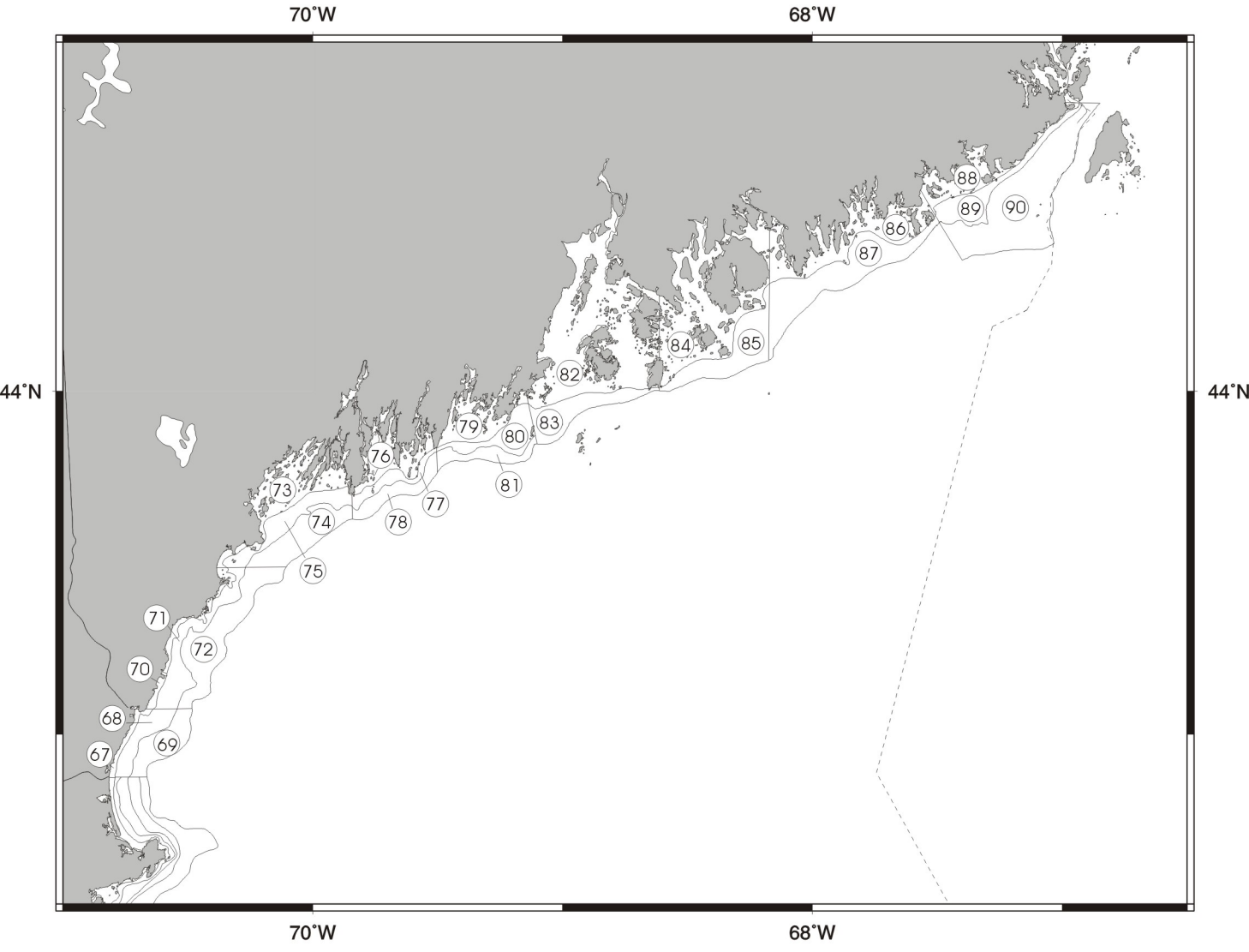
NEFSC Standard Bottom Trawl Survey Offshore Strata

Appendix C



Stratum	Sq. Nm.	Depth (m)	Stratum	Sq. Nm.	Depth (m)
21	424	55 - 110	33	861	55 - 110
22	454	110 - 183	34	1766	110 - 183
24	2569	110 - 183	351	533	110 - 183
26	1014	55 - 110	352	600	110 - 183
27	720	110 - 183	36	4069	> 183
28	2249	> 183	37	2108	110 -183
29	3245	> 183	38	2560	110 -183
30	619	> 183	39	730	55 - 110
31	1875	110 - 183	40	578	55 - 110
32	655	55 - 110			

NEFSC Finfish Strata (inshore)

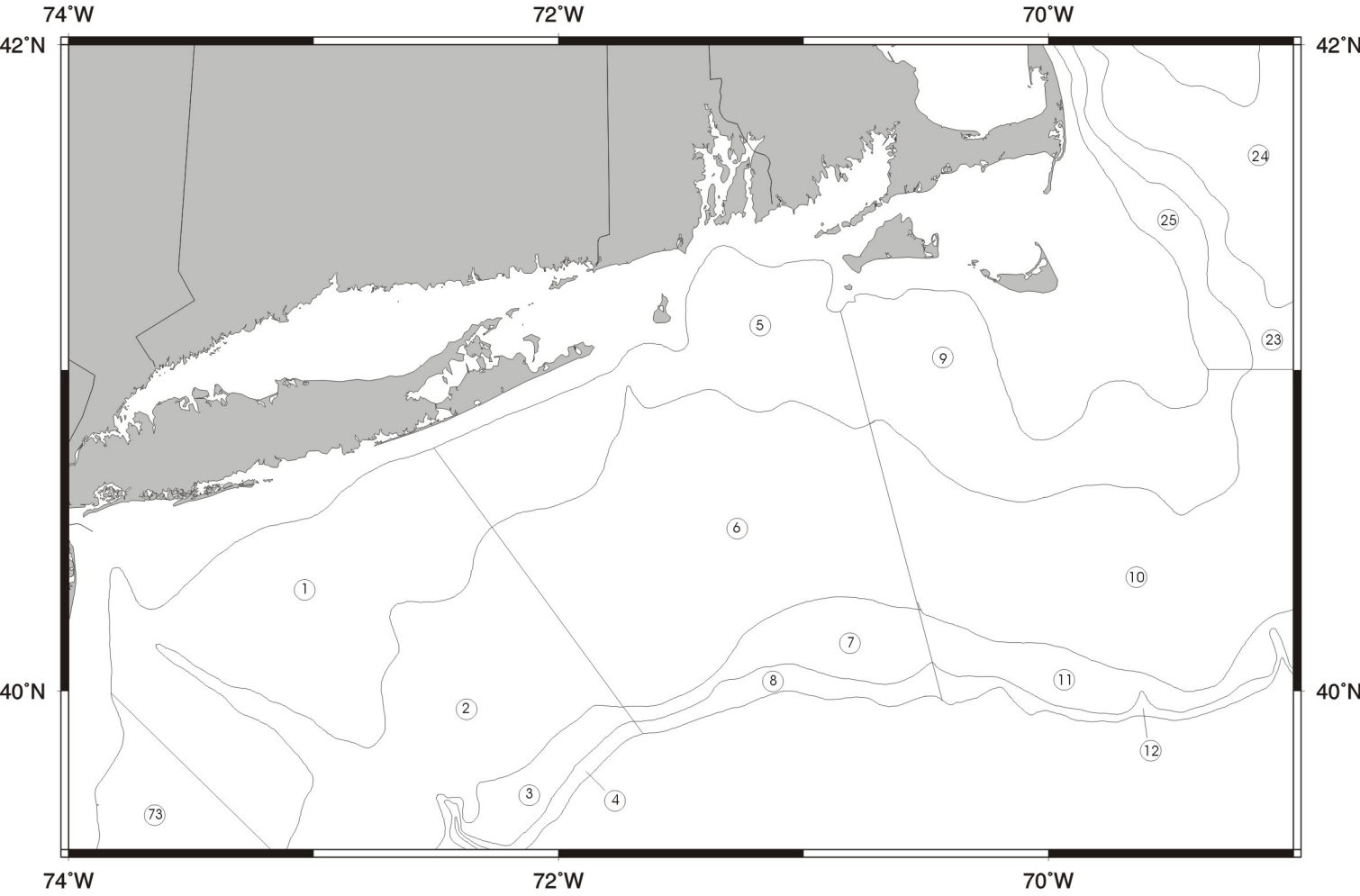


Stratum	Sq. Nm.	Depth (m)	Stratum	Sq. Nm.	Depth (m)
69	57	27 - 55	80	58	20 - 55
70	10	0 - 9	81	38	20 - 55
71	72	9 - 27	82	209	0 - 20
72	129	27 - 55	83	80	20 - 55
73	31	0 - 9	84	137	0 - 20
74	68	9 - 27	85	106	20 - 55
75	76	27 - 55	86	60	0 - 20
76	20	0 - 20	87	153	10 - 55
77	34	20 - 55	88	34	0 -20
78	44	20 - 55	89	59	20 -55
79	34	0 - 20	90	125	55 - 110

NEFSC Standard Bottom Trawl Survey Offshore Strata

Stratum	Sq. Nm.	Depth (m)	Stratum	Sq. Nm.	Depth (m)	Stratum	Sq. Nm.	Depth (m)
9	1522	27 - 55	17	360	110 - 183	25	390	27 - 55
10	2722	55 - 110	18	172	> 183	26	1014	55 - 110
11	622	110 - 183	19	2454	27 - 55	27	720	110 - 183
12	176	> 183	20	1221	27 - 55	28	2249	> 183
13	2374	55 - 110	21	424	55 - 110	29	3245	> 183
14	656	110 - 183	22	454	110 -183	30	619	> 183
15	230	> 183	23	1016	55 - 110	31	1875	110 - 183
16	2980	55 - 110	24	2569	110 - 183	32	655	55 - 110

NEFSC Standard Bottom Trawl Survey Offshore Strata

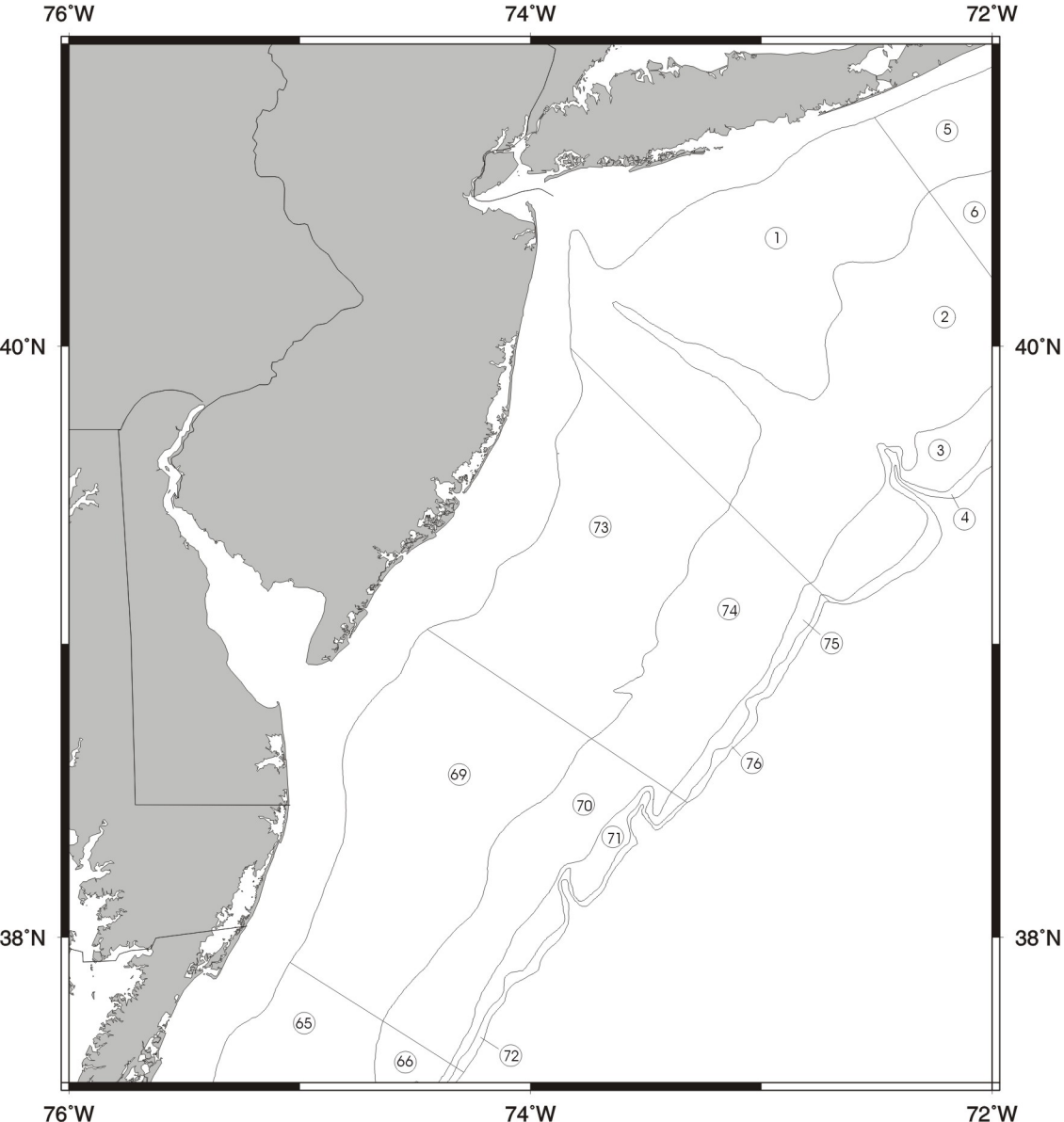


Stratum	Sq. Nm.	Depth (m)	Stratum	Sq. Nm.	Depth (m)
1	2516	27 - 55	9	1522	27 - 55
2	2078	55 - 110	10	2722	55 - 110
3	566	110 - 183	11	622	110 - 183
4	188	> 183	12	176	> 183
5	1520	27 - 55	23	1016	55 - 110
6	2775	55 - 110	24	2569	110 - 183
7	514	110 - 183	25	390	27 - 55
8	230	> 183			

NEFSC Standard Bottom Trawl Survey Inshore Strata

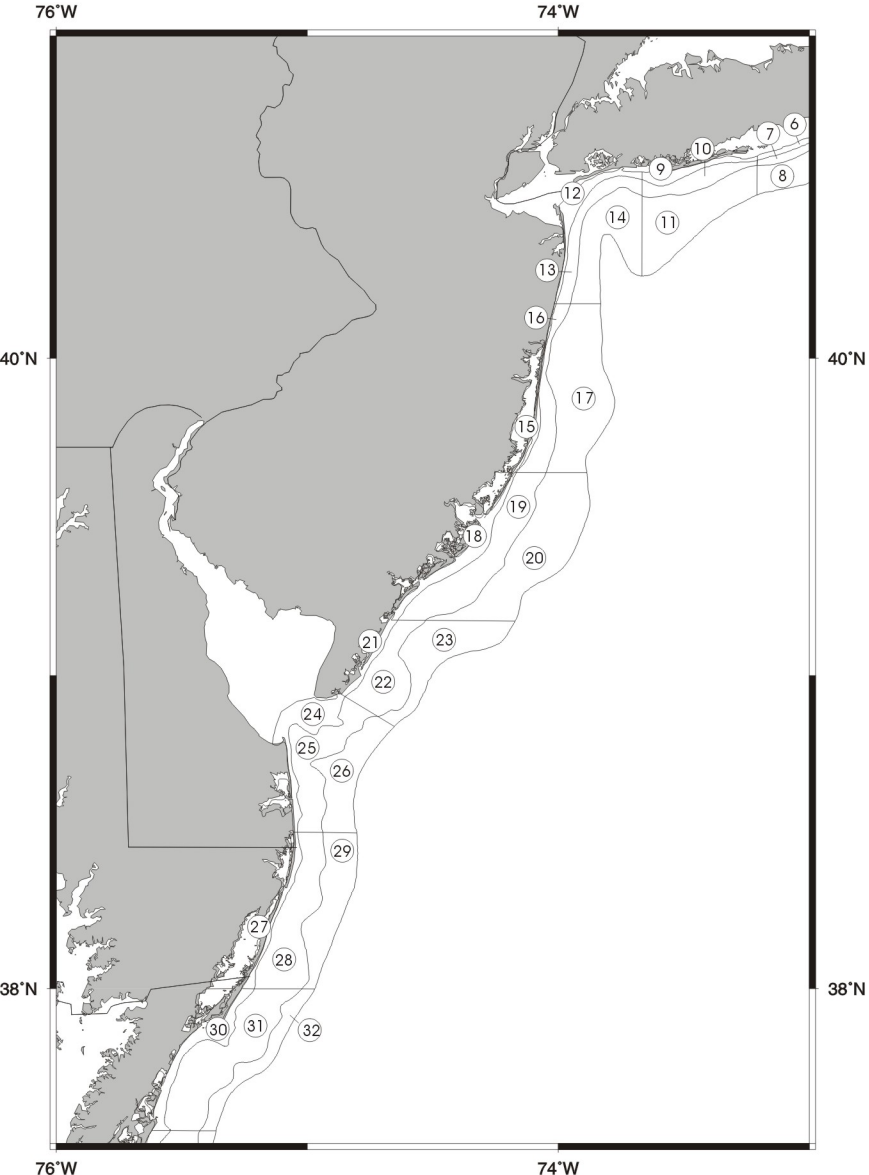
Stratum	Sq. Nm.	Depth (m)	Stratum	Sq. Nm.	Depth (m)
1	44	0 - 18	51	117	9 - 18
2	62	18 - 27	52	521	9 - 18
3	13	0 - 9	53	142	0 - 9
4	26	9 - 18	54	277	9 - 18
5	62	18 - 27	55	495	18 - 27
6	26	0 - 9	56	57	9 - 27
7	35	9 - 18	57	34	0 - 9
8	150	18 - 27	58	88	9 - 18
9	40	0 - 9	59	93	18 - 27
10	48	9 - 18	60	126	27 - 46
11	242	18 - 27	61	133	46 -55
45	170	18 - 27	62	62	0 - 9
46	273	18 - 27	63	78	9 - 18
47	45	0 - 18	64	90	18 - 27
48	113	0 - 9	65	75	27 - 46
49	299	0 - 9	66	151	46 - 55
50	15	0 - 9	91	941	0 - 9

NEFSC Standard Bottom Trawl Survey Offshore Strata



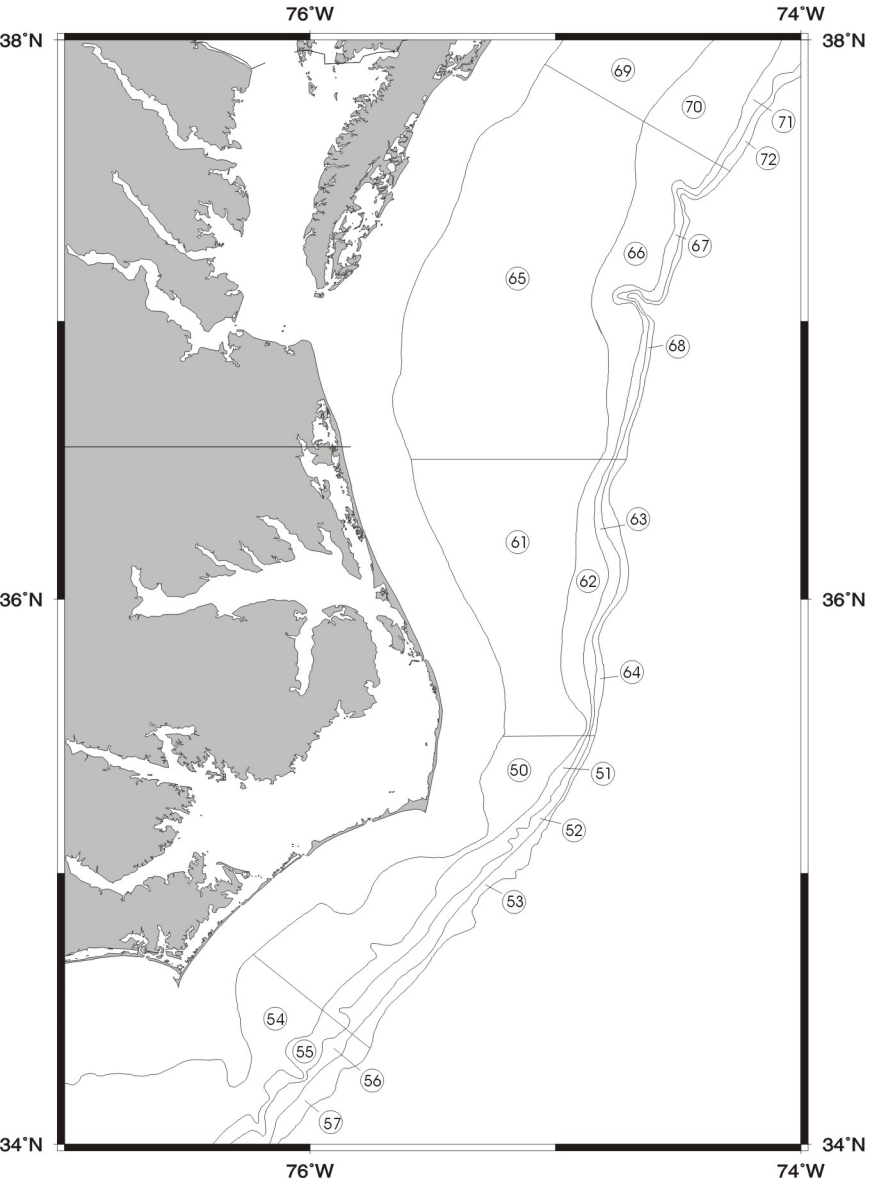
Stratum	Sq. Nm.	Depth (m)
1	2516	27 - 55
2	2078	55 - 110
3	566	110 - 183
4	188	> 183
5	1520	27 - 55
6	2775	55 - 110
69	2433	27 - 55
70	1024	55 - 110
71	281	110 - 183
72	105	> 183
73	2145	27 - 55
74	1273	55 - 110
75	139	110 - 183
76	60	> 183

NEFSC Standard Bottom Trawl Survey Inshore Strata



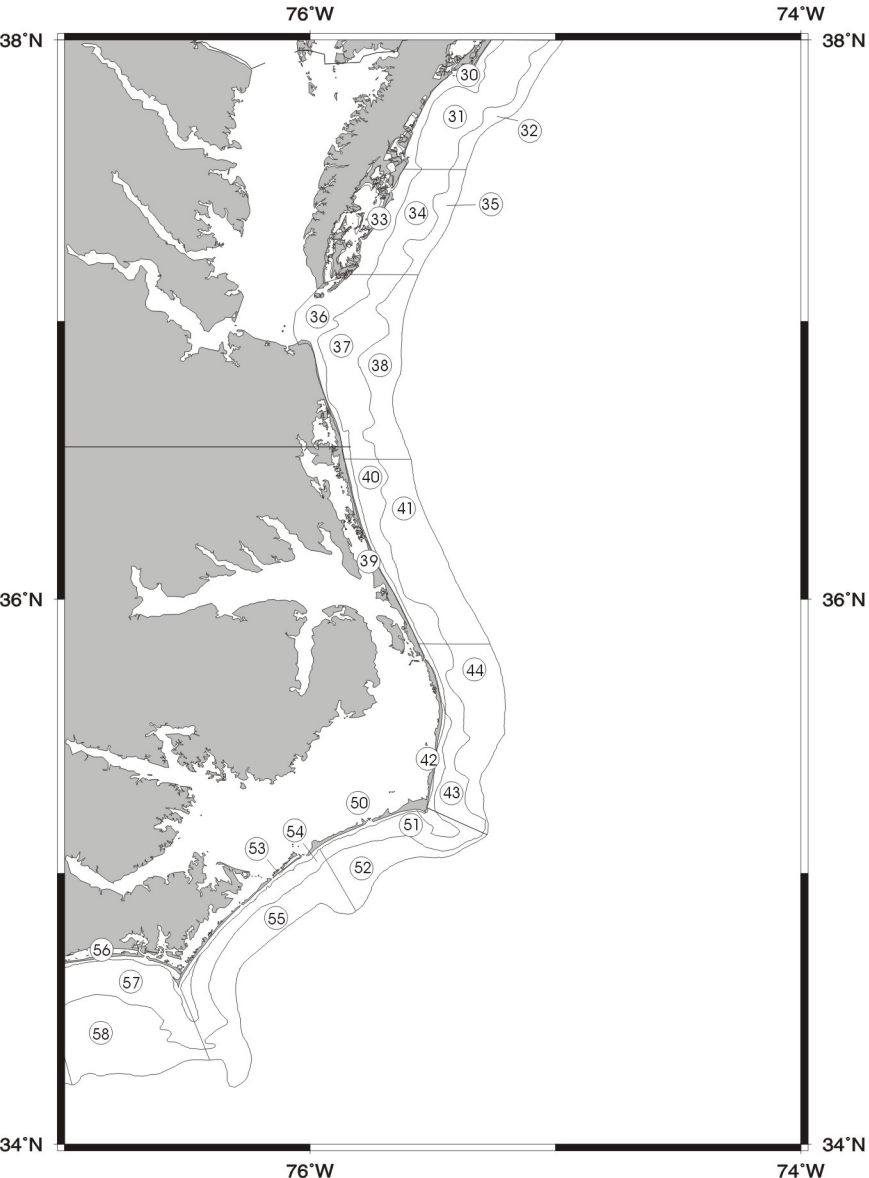
Stratum	Sq. Nm.	Depth (m)
6	26	0 - 9
7	35	9 - 18
8	150	18 - 27
9	40	0 - 9
10	48	9 - 18
11	242	18 - 27
12	44	0 - 9
13	88	9 - 18
14	110	18 - 27
15	22	0 - 9
16	62	9 - 18
17	238	18 - 27
18	97	0 - 9
19	216	9 - 18
20	356	18 - 27
21	22	0 - 9
22	154	9 - 18
23	167	18 - 27
24	53	0 - 9
25	172	9 - 18
26	154	18 - 27
27	35	0 - 9
28	220	9 - 18
29	185	18 - 27
30	75	0 - 9
31	299	9 - 18
32	106	18 - 27

NEFSC Standard Bottom Trawl Survey Offshore Strata



Stratum	Sq. Nm.	Depth (m)
50	796	27 - 55
51	268	55 - 110
52	216	110 - 183
53	150	> 183
54	1764	27 - 55
55	277	55 - 110
56	283	110 - 183
57	537	> 183
61	1318	27 - 55
62	243	55 - 110
63	86	110 - 183
64	60	> 183
65	2832	27 - 55
66	555	55 - 110
67	86	110 - 183
68	52	> 183
69	2433	27 - 55
70	1024	55 - 110
71	281	110 - 183
72	105	> 183

NEFSC Standard Bottom Trawl Survey Inshore Strata



Stratum	Sq. Nm.	Depth (m)
30	75	0 - 9
31	299	9 - 18
32	106	18 - 27
33	92	0 - 9
34	167	9 - 18
35	88	18 - 27
36	119	0 - 9
37	312	9 - 18
38	224	18 - 27
39	35	0 - 9
40	176	9 - 18
41	383	18 - 27
42	40	0 - 9
43	172	9 - 18
44	304	18 - 27
50	48	2 - 11
51	128	9 - 22
52	163	9 - 35
53	53	2 - 13
54	198	7 - 22
55	352	15 - 33
56	26	2 - 13
57	304	9 - 22
58	400	6 - 31

Protected Resources:

North Atlantic right whale protection: The vessel is requested to adhere to right whale protection regulations. Information on Seasonal Management Area (SMA) and Dynamic Management Area (DMA) regulations and information for protecting right whales from collisions with vessels are provided through the NOAA Protected Resources website (http://www.nmfs.noaa.gov/pr/shipstrike/), Right Whale Sighting Advisory System (SAS) website (http://www.nefsc.noaa.gov/psb/surveys/), the U.S. Coast Guard's "Notices To Mariners" and NOAA weather radio.

Mariners are urged to use caution and proceed at safe speeds in areas where right whales occur. U.S. Law (50 CFR 224.105) prohibits operating vessels 65 feet (19.8 meters) or greater in excess of 10 knots in Seasonal Management Areas (SMAs) along the U.S. east coast. Mariners are also requested to route around voluntary speed restriction zones, Dynamic Management Areas (DMAs) or transit through them at 10 knots or less. Approaching within 500 yards of right whales is prohibited, unless the Chief Scientist is in possession of an ESA/MMPA permit allowing such approaches.

Whale sightings: Sightings of right whales, or dead or entangled whales of any species, are extremely valuable and reports are urgently requested. Please report all right whale sightings north of the Virginia-North Carolina border to 978-585-8473; right whale sightings south of that border should be reported to 904-237-4220. Right whale sightings in any location may be reported to the U.S. Coast Guard via VHF channel 16. Protocols for reporting sightings are described in the Guide to Reporting Whale Sightings placard. The placard is available online (http://www.nefsc.noaa.gov/read/protspp/mainpage/surveys/documents/Guide_to_Reporting_Whale_Sightings.pdf) and laminated copies will be provided by the Protected Species Branch upon request. It is requested that this placard be kept on the bridge for quick reference and to facilitate rapid reporting (via satellite phone if necessary). Opportunistic sightings of other marine mammal species that are live and well may be reported using the Platforms of Opportunity (POP) forms and protocols.

Endangered Species Act and Marine Mammal Protection Act reporting requirements: This reporting is required and is in addition to the reports in the above two sections. If the ship has an interaction with a sturgeon, whale, dolphin, porpoise, marine turtle, or seal (e.g., collision with a whale or bycatch of a sea turtle), the NMFS Northeast Regional Office must be notified within 24 hours of the interaction. If an interaction with any of those species occurs or if the vessel's company notices an animal that is entangled, injured, in distress, or dead, they should contact the Northeast Regional Office's 24-hour hotline at 866-755-6622 to report the incident and receive further instructions.

Marine turtle bycatch: All marine turtles taken incidental to fishing activities must 1) be handled and resuscitated according to established procedures, 2) be clearly photographed (multiple views if possible, including at least one photograph of the head scutes), 3) be identified to the species level, 4) have width and length (carapace notch to notch, and notch to tip) measured in centimeters, 5) have supporting data recorded including GPS or Loran coordinates recorded describing the location of the interaction; time of interaction; date of interaction; condition of the animal upon retrieval (alive uninjured, alive injured, fresh dead, decomposed, comatose or unresponsive); the condition of the animal upon return to the water; GPS or Loran coordinates of the location at which it was released; and a description of the care or handling provided. Live animals shall then be returned to the sea. Dead animals shall, if feasible, be frozen and returned to the Woods Hole Laboratory.

Marine mammal bycatch: All marine mammals taken incidental to fishing activities must 1) be clearly photographed (multiple views if possible, including at least one photograph of the head, 2) be identified to the species level, 3) have body length (snout to tail (seals), beak to the notch in the fluke/tail (whales, dolphins and porpoises)), measured in centimeters, 4) have supporting data recorded including GPS or Loran coordinates recorded describing the location of the interaction; time of interaction; date of interaction; condition of the animal upon retrieval (alive uninjured, alive injured, fresh dead, decomposed, comatose or unresponsive). Live animals shall then be returned to the sea. Dead animals shall, if feasible, be frozen and returned to the Woods Hole Laboratory.

Stellwagen Bank: Any artifacts brought aboard the vessel due to fishing in the Stellwagen Bank National Marine Sanctuary must be immediately returned, as near as possible, to the location of interception. An artifact is defined as anything of man-made origin with the exception of modern fishing gear. Stations located within Stellwagen Bank will be identified prior to the cruise and reported to the chief scientist.

BIGELOW SCOPE TABLE
February 2010

DEPTH	RATIO	WIRE OUT	
15		60	4:1
16		64	
17		68	
18		72	
19		76	
20		80	
21		84	
22		88	
23		92	
24		96	
25		100	
26		104	
27		108	
28		112	
29		116	
30		120	
31		124	
32		128	
33		132	
34		136	
35		137	hold+1
36		138	hold+2
37		139	3.75:1
38		143	
39		146	
40		150	
41		154	
42		158	
43		161	
44		165	
45		165	hold
46		166	hold+1
47		167	hold+2
48		168	3.5:1
49		172	
50		175	
51		179	
52		182	
53		186	
54		189	
55		193	
56		196	
57		200	
58		203	
59		207	
60		210	
61		214	
62		217	

DEPTH	RATIO	WIRE OUT	
63		217	hold
64		218	hold+1
65		219	hold+2
66		220	hold+3
67		221	hold+4
68		221	3.25:1
69		221	hold
70		222	hold+1
71		222	hold+1
72		223	hold+2
73		223	hold+2
74		224	hold+3
75		225	3:1
76		225	hold
77		225	hold
78		226	hold+1
79		226	hold+1
80		227	hold+2
81		227	hold+2
82		228	hold+3
83		228	2.75:1
84		229	hold+1
85		229	hold+1
86		230	hold+2
87		230	hold+2
88		231	hold+3
89		231	hold+3
90		232	hold+4
91		232	hold+4
92		233	hold+5
93	2.5:1	233	2.5:1
94		235	
95		238	
96		240	
97		243	
98		245	
99		248	
100		250	
101		253	
102		255	
103		258	
104		260	
105		263	
106		265	
107		268	
108		270	
109		273	
110		275	

DEPTH	RATIO	WIRE OUT
111	2.5:1	278
112		280
113		283
114		285
115		288
116		290
117		293
118		295
119		298
120		300
121		303
122		305
123		308
124		310
125		313
126		315
127		318
128		320
129		323
130		325
131		328
132		330
133		333
134		335
135		338
136		340
137		343
138		345
139		348
140		350
141		353
142		355
143		358
144		360
145		363
146		365
147		368
148		370
149		373
150		375
151		378
152		380
153		383
154		385
155		388
156		390
157	HOLD	390
158	HOLD	391
159	HOLD	391
160	HOLD	392

DEPTH	RATIO	WIRE OUT
161	HOLD	392
162		393
163		393
164		394
165		394
166		395
167		395
168		396
169		396
170		397
171		397
172		398
173		398
174		399
175		399
176		400
177		400
178		402
179		404
180	2.25:1	405
181		407
182		410
183		412
184		414
185		416
186		419
187		421
188		423
189		425
190		428
191		430
192		432
193		434
194		437
195		439
196		441
197		443
198		446
199		448
200		450
201		452
202		455
203		457
204		459
205		461
206		464
207		466
208		468
209		470
210		473

DEPTH	RATIO	WIRE OUT
211	2.25:1	475
212		477
213		479
214		482
215		484
216		486
217		488
218		491
219		493
220		495
221		497
222		500
223		502
224		504
225		506
226		509
227		511
228		513
229		515
230		518
231		520
232		522
233		524
234		527
235		529
236		531
237		533
238		536
239		538
240		540
241		542
242		545
243		547
244		549
245		551
246		554
247		556
248		558
249		560
250		563
251		565
252		567
253		569
254		572
255		574
256		576
257		578
258		581
259		583
260		585

DEPTH	RATIO	WIRE OUT
261	2.25:1	587
262		590
263		592
264		594
265		596
266		599
267		601
268		603
269		605
270		608
271		610
272		612
273		614
274		617
275		619
276		621
277		623
278		626
279		628
280		630
281		632
282		635
283		637
284		639
285		641
286		644
287		646
288		648
289		650
290		653
291		655
292		657
293		659
294		662
295		664
296		666
297		668
298		671
299		673
300		675
301		677
302		680
303		682
304		684
305		686
306		689
307		691
308		693
309		695
310		698

DEPTH	RATIO	WIRE OUT
311	2.25:1	700
312		702
313		704
314		707
315		709
316		711
317		713
318		716
319		718
320		720
321		722
322		725
323		727
324		729
325		731
326		734
327		736
328		738
329		740
330		743
331		745
332		747
333		749
334		752
335		754
336		756
337		758
338		761
339		763
340		765
341		767
342		770
343		772
344		774
345		776
346		779
347		781
348		783
349		785
350		788
351		790
352		792
353		794
354		797
355		799
356		801
357		803
358		806
359		808
360		810

DEPTH	RATIO	WIRE OUT
361	2.25:1	812
362		815
363		817
364		819
365		821
366		824
367		826
368		828
369		830
370		833
371		835
372		837
373		839
374		842
375		844
376		846
377		848
378		851
379		853
380		855
381		857
382		860
383		862
384		864
385		866
386		869
387		871
388		873
389		875
390		878
391		880
392		882
393		884
394		887
395		889
396		891
397		893
398		896
399		898
400		900
401		902
402		905
403		907
404		909
405		911
406		914
407		916
408		918
409		920
410		923

DEPTH	RATIO	WIRE OUT
411	2.25:1	925
412		927
413		929
414		932
415		934
416		936
417		938
418		941
419		943
420		945
421		947
422		950
423		952
424		954
425		956
426		959
427		961
428		963
429		965
430		968
431		970
432		972
433		974
434		977
435		979
436		981
437		983
438		986
439		988
440		990
441		992
442		995
443		997
444		999
445		1001
446		1004
447		1006
448		1008
449		1010
450		1013
451		1015
452		1017
453		1019
454		1022
455		1024
456		1026
457		1028
458		1031
459		1033
460		1035

DEPTH	RATIO	WIRE OUT
461	2.25:1	1037
462		1040
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464		1044
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467		1051
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469		1055
470		1058
471		1060
472		1062
473		1064
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475		1069
476		1071
477		1073
478		1076
479		1078
480		1080
481		1082
482		1085
483		1087
484		1089
485		1091
486		1094
487		1096
488		1098
489		1100
490		1103
491		1105
492		1107
493		1109
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Appendix F

Northeast Fisheries Science Center
Bottom Trawl Survey Station Validation Computer Codes
T.O.G.A.
Guide for Stock Analysts

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Overview

It is important to understand that some aspects of station validation are subjective. These NEFSC Bottom Trawl Survey station validation codes serve as a guideline for qualifying a survey tow in a standardized manor and aid in the decision process for determining if a survey tow is valid. These codes are for use with the NEFSC Standard 4 Seam, 3 Bridle Survey Trawl and NOAA Ship *Henry B. Bigelow*.

Each standard survey tow is evaluated based on four categories, Type, Operational, Gear and Acquisition (T.O.G.A.). Type (T), Operational (O) and Gear (G) categories are used to validate each tow; the Acquisition (A) category is additional information not used for validation. T.O.G.A. is a detailed analysis of survey trawl and vessel performance during each tow, utilizing available data from trawl mensuration systems and vessel sensors not previously analyzed by the historical Station, Haul, and Gear (S.H.G.) coding system.

Tolerance limits and optimal values were calculated from data collected during the NEFSC calibration experiments. These tolerance limits are intended to promote consistency of trawl geometry and towing procedure to validate comparison of the collected trawl survey data with results from the calibration experiments.

Excluding Tows from Stock Analysis

TYPE (T): Tows included in NEFSC Bottom Trawl Survey abundance estimates should be conducted following the protocols of the random and stratified statistical design. Standard NEFSC BTS tows are coded with a T value = 1. Station Type is coded values between 1 and 8; see section: T-TYPE of Station for details.

OPERATIONAL (O): The operational category is coded values between 1 and 4. O Values= 1, 2 or 3 are considered Representative; O Value= 4 is considered non-representative and should not be used in NEFSC BTS calculated abundance estimates. See section: O-OPERATIONAL Code for details.

GEAR (G): The gear category is coded values 1, 2 or 4 (there is no G value=3). G Values= 1 or 2 are considered Representative; G Value=4 is considered Non-Representative and should not be used in NEFSC BTS calculated abundance estimates. See section: G-GEAR Code for details.

ACQUISITION (A): Acquisition category is coded values between 1 and 4. The A Value does not determine the validity of a tow. A Values= 1, 2, 3 and 4 are considered Representative. Tows coded with A Value=4 force an O Value=3 (O is coded with a value=4 if the operational parameters evaluate to that). See section: A-ACQUISITION Code for details.

T.O.G.A. CATEGORY DETAIL

T – TYPE of Station Details

This category defines the type of sampling conducted at each station. Tows included in NEFSC Bottom Trawl Survey abundance estimates should be conducted following the protocols of the random and stratified statistical design. Standard NEFSC BTS tows are coded with a T value = 1. The T value=1 is subdivided into 6 components to further detail the tow and the proximity to the preselected station location as follows:

- 1- RANDOM TOW, within 1nm Radius
  Location selected according to the random and stratified statistical design, and portion of tow occurs within a 1 nautical mile radius of the preselected station location.
- 1- RANDOM TOW, outside 1nm, within 3nm Radius
  Location selected according to the random and stratified statistical design. Tow occurs outside of 1nm radius, but within a 3nm radius of the preselected station location.
- 1- REPEAT TOW
  Repeat of a random tow.
- 1- RANDOM ALTERNATE
  Alternate station location within a stratum, randomly preselected. To be conducted if original randomly preselected location is un-towable.
- 1- RANDOM OFFSHORE CONTINENTAL SHELF
  Tow conducted in offshore continental shelf edge strata from eastern Georges Bank south to Cape Hatteras following secondary NEFSC BTS protocols for sampling these strata.
- 1- ALTERNATE OFFSHORE PROTOCOL
  Alternate tow location conducted in offshore continental shelf edge strata from eastern Georges Bank south to Cape Hatteras following secondary NEFSC BTS protocols for sampling these strata.

Tow types other than NEFSC BTS standard random tows are defined by the following code values:

- 2- NON-RANDOM TOW
  Tow is not conducted according a random and stratified statistical design. Tow must follow all other NEFSC BTS protocols.
- 3- SURVEY STANDARDIZATION
  Tow conducted to evaluate NEFSC BTS standardization (i.e. gear testing). Tow may or may not follow all other NEFSC BTS protocols, therefore values defining O, G and A categories may not determine tow validity.
- 4- COMPARISON TOW
  Tow conducted in comparison of other gears, surveys, vessels or operating procedures. Tow may or may not follow all other NEFSC BTS protocols, therefore values defining O, G and A categories may not determine tow validity.
- 5- ABORTED TOW
  Gear set but timed tow duration never started (aborted tow).
- 6- SITE SPECIFIC

Non-random tow conducted in a specific, targeted region. Tow must follow all other NEFSC BTS protocols

- 7- EXPERIMENTAL SURVEY DESIGN
  Survey design type other than random and stratified (i.e. transect, depletion study, grid, fixed etc.). Tow may or may not follow all other NEFSC BTS protocols, therefore values defining O, G and A categories may not determine tow validity.
- 8 – OTHER
  Tows that do not fall into the previous categories. Detailed description of the tow type shall be recorded. Tow may or may not follow all other NEFSC BTS protocols, therefore values defining O, G and A categories may not determine tow validity.

O – OPERATIONAL Code Details

O Value= 4 is considered non-representative and should not be included in NEFSC calculated abundance estimates.

This code defines the tow in terms of the operational characteristics. (i.e. tow duration, vessel speed, scope ratio, depth, trawl performance, winch performance, stratum boundaries). The Tow Evaluation software calculates and provides the value of the O code. For tows coded with an O value=4, the data is considered non-representative and should not be used for stock analysis. More than one operational characteristic will often define the value. The O value provided by the software may be amended by the Watch Chief or Chief Scientist if they choose, based on individual tow circumstances.

- 1- GOOD PERFORMANCE
  All operational parameters are within optimal tolerance range.
- 2- REPRESENTATIVE
  Tow duration 18.00min – 19.49min or 20.50min-21.00min.
  75-99% on-bottom tow distance within the correct stratum.
  Door Spread mean outside optimal but within the tolerance limit.
  Wing Spread mean outside optimal but within the tolerance limit.
  (Door and Wing spread are depth dependant calculations).
  Headrope Height mean outside optimal but within the tolerance limit.
  (Optimal Height is 3.2-4.1m)
- 3- REPRESENTATIVE
  Tow duration 16.00min – 17.99min.
  Acquisition Code Value = 4 (details given with A code).
  Door Spread Standard Deviation High (greater than 4.5m)
  Wing Spread Standard Deviation High (greater than 2.0m)
  Headrope Height Spread Standard Deviation High (Greater than 1.0m)
  Scope Ratio outside tolerance limit. (+/- 25%)
- 4- NON-REPRESENTATIVE
  Tow duration less than 16.00min or greater than 21.00min.
  Tow distance less than 0.8nm or greater than 1.20nm.
  Door Spread mean outside tolerance limit. (Depth dependant)
  Wing Spread mean outside tolerance limit. (Depth dependant)
  Headrope Height mean outside tolerance limit. (Less than 2.7m or greater than 4.7m)

Speed Over Ground mean outside tolerance limit. (Less than 2.6 or greater than 3.4kts)
Depth mean outside tolerance limit. (EK6018kHz, must be within +/- 10% of set depth, or +/-5m at depths less than 50m)
Mean Starboard and Mean Port Block Tension not equalized within ±0.5t.
Difference between mean Starboard and Port Winch calculated wire out lengths greater than 10m.
Difference between mean Starboard and Port Block wire out lengths greater than 10m.
Less than 75% of on-bottom tow distance within correct stratum.
Trawl Depth greater than 20% difference of vessel tow depth.
Chief Scientist or Watch Chief Failed tow- tow considered unsatisfactory based on vessel or gear performance. Detailed comments shall be recorded.

G – GEAR Code Details

This code defines gear condition, damage and/or malfunction. Gear is defined as trawl net, cod-end, liner, sweep, doors and rigging. The gear category is coded values 1, 2 or 4 (there is no G value=3). G Values= 1 or 2 are considered Representative; G Value=4 is considered Non-Representative and should not be used in NEFSC BTS calculated abundance estimates.

- 1- GOOD TOW
  No damage to webbing, frame ropes, sweep doors or rigging. Trawl properly rigged and considered to be in standard configuration.
- 2- REPRESENTATIVE
  Minor Small Holes or Tears in webbing (including cod-end and liner). Tears shall be easily and quickly repaired to be coded G-Value=2.
  Slightly larger holes or tears in Jibs, Wings, Bunts, Square or 1st and 2nd Top Bellies.
  Hole not thought to significantly alter fish capture.
  Obstruction IN/ON gear, not thought to significantly alter fish capture.
  Minor Hang. No significant gear damage.
  Hang, definitively occurring after 16.00min tow duration. Tow duration should be adjusted to time hang occurred.
  Insignificant sweep damage (i.e. slight damage to rockhoppers not thought to increase fish escapement).
  Loss or damage to less than 12 floats.
  Very large catch. Deck tow of dogfish or other species.
  Other gear damage/malfunction not thought to significantly alter fish capture. (Detailed comments shall be recorded).

- 4- NON-REPRESENTATIVE
  Significant holes or tears OR large holes occurring in bottom bellies, or any portion of webbing aft of 2nd belly.
  Major Gear Damage. (i.e. rim-rack, whole sections torn out, loss of trawl door(s) etc.).
  Open Cod-end.
  Improperly Attached Liner OR Open Liner OR Significant Catch Outside Liner.
  Twisted Wing(s).
  Significant Loss of bottom contacts (4min duration or longer).
  Improper Rigging.

Collapsed Doors.
Crossed Doors.
Major Sweep Damage. (Parted sweep and/or major damage(i.e. loss of more than one rockhopper, or damage to sweep components thought to significantly increase fish escapement).
Damaged Frame Rope(s). (headrope, up&down line, bolshline).
Open Gore.
Twisted or Crossed Bridle(s).
Parted Legs.
Loss or damage to 12 or more floats.
Significant damage to wing-end extension (i.e. loss, broken or altered length).
Significant Hang. Occurring at less than 16.00min tow duration (OR unknown tow duration).
Large Obstruction IN/ON gear thought to alter catch efficiency or trawl geometry (i.e. pot stuck in front opening of cod-end).
Catch not landed on deck.
Damage to main towing cable(s).
Other gear damage/malfunction thought to significantly alter catch efficiency by Watch Chief or Chief Sci.

A – ACQUISITION Code Details
This code defines the tow concerning data acquisition. (i.e. SCS data, trawl mensuration, SCS event button press). **The A code value does not determine the acceptance of a tow.** Tows coded with A Value=4 force an O Value=3 (or O Value=4 if the operational parameters evaluate to that).

- 1- No Data Acquisition Errors.
  All data acquisition 75% or greater valid.
- 2- REPRESENTATIVE
  Door Spread 50.00% - 74.99% data acquisition.
  Wing Spread 50.00% - 74.99% data acquisition.
  Height 50.00% - 74.99% data acquisition.
  Trawl Depth 50.00% - 74.99% data acquisition.
  Winch Tension 50.00% - 74.99% data acquisition.
  Winch Wire Out 50.00% - 74.99% data acquisition.
  Block Tension 50.00% - 74.99% data acquisition.
  Block Wire Out 50.00% - 74.99% data acquisition.
  Speed Over Ground 50.00% - 74.99% data acquisition.
  Vessel Depth 50.00% - 74.99% data acquisition.
  Event Button Pressed More Than Once. Actual event time recorded.
- 3- REPRESENTATIVE
  Door Spread 25.00% - 49.99% data acquisition.
  Wing Spread 25.00% - 49.99% data acquisition.
  Height 25.00% - 49.99% data acquisition.
  Trawl Depth 25.00% - 49.99% data acquisition.
  Winch Tension 25.00% - 49.99% data acquisition.

Winch Wire Out 25.00% - 49.99% data acquisition.
Block Tension 25.00% - 49.99% data acquisition.
Block Wire Out 25.00% - 49.99% data acquisition.
Speed Over Ground 25.00% - 49.99% data acquisition.
Vessel Depth 25.00% - 49.99% data acquisition.

- 4- NON-REPRESENTATIVE DATA
  Door Spread Less Than 25.00% data acquisition.
  Wing Spread Less Than 25.00% data acquisition.
  Height Less Than 25.00% data acquisition.
  Trawl Depth Less Than 25.00% data acquisition.
  Winch Tension Less Than 25.00% data acquisition.
  Winch Wire Out Less Than 25.00% data acquisition.
  Block Tension Less Than 25.00% data acquisition.
  Block Wire Out Less Than 25.00% data acquisition.
  Speed Over Ground Less Than 25.00% data acquisition.
  Vessel Depth Less Than 25.00% data acquisition.
  Error Recording Event Data. Trawl event data missing.
  Critical Button Press Error, Unknown Event Time(s).

CALCULATIONS AND TOLERANCE LIMITS

Operational and Acquisition code values are calculated by Tow Evaluation Software. The Tow Evaluation software is a tool used to quickly summarize data relevant to the evaluation of a standard tow. The Tow Evaluation software displays all the summary statistics along with graphs of each parameter to aid the Watch Chief in the decision making process to validate the tow. All statistics are calculated for the on-bottom tow duration, based on the trawl event button presses: START TOW to HAUL BACK. Each parameter is checked against the tolerance limits to determine the correct Operational code value and Acquisition code value. The Type code and Gear code values are determined by the Watch Chief and/or Chief Scientist. Sensor data used for tow validation are filtered prior to calculation of summary statistics (Table 1).

Table 1. Relevant data collected for tow validation indicating the sensor from which the data is obtained and the defined data filtering that occurs.

Trawl Mensuration Data	**Primary Sensor**	**Data Filtered**
Door Spread	Scanmar Distance	≤0 & >50m
Wing Spread	Scanmar Distance	≤0 & >30m
Headrope Height	Scanmar Trawl Sounder	≤0 & >10m
Trawl Depth	Scanmar Depth	≤0 & >1000m
Vessel Tow Data		
Speed Over Ground	MX420	<0 & >20kts
Tow Duration	derived	n/a
Depth	EK60-18kHz	≤0 & >1000m
Tow Location	POS MV	not null
Tow Distance	derived	n/a
Winch Data Port and Starboard		
Winch Wire Out	Rapp Hydema Autotrawl System	<0 & >2000m
Winch Tension	Rapp Hydema Autotrawl System	<0 & >50t
Block Wire Out	Block Counter	<0 & >2000m
Block Tension	Block Load Cell	<0 & >50t

Tow Evaluation Software evaluates each parameter against set tolerance limits after calculating summary statistics. Trawl geometry parameters (door spread, wing spread and head rope height) are evaluated against tolerance limits and optimal values as well. For trawl geometry parameters, standard deviations greater than the set tolerance limit are coded with and O Value=3. For all other parameters, standard deviation is not evaluated for the operational code, however, a standard deviation equal to 0 is reflected in the acquisition code as less than 25% data acquisition. The tolerance limits for each parameter used to define the operational code values are given in table 2. (See A-ACQUISITION CODE DETAILS for defined acquisition code values).

Table 2. Tolerance limits for each evaluated parameter and the associated operational code values. *See section: Depth Dependent Spread Calculations for details.

Parameter	Operational Code Value	Acceptance Range Mean	Standard Deviation
Door Spread	1	Depth Dependent* Within Optimal	≤ 4.5m
	2	Depth Dependent* Outside Optimal, Within tolerance	
	3	N/A	> 4.5m
	4	Depth Dependent* Outside Tolerance	
Wing Spread	1	Depth Dependent* Within Optimal	≤ 2.0m
	2	Depth Dependent* Outside Optimal, Within tolerance	
	3	N/A	> 2.0m
	4	Depth Dependent* Outside Tolerance	
Head Rope Height	1	3.2m to < 4.2m Within Optimal	≤ 1.0m
	2	2.7m to < 3.2m OR 4.2m to 4.7m Outside Optimal, Within tolerance	
	3	N/A	> 1.0m
	4	< 2.7m OR > 4.7m Outside Tolerance	
Speed Over Ground	1	2.6kts to 3.4kts	N/A
	4	< 2.6kts OR > 3.4kts	
Tow Duration	1	19.5 to 20.49min	N/A
	2	18.00 to 19.49min or 20.50 to 21.00min	
	3	16.00 to 17.99min	
	4	< 16min OR > 21min	
Depth	1	Mean tow depth within ±10% setdepth OR when set depth is <50m, mean tow depth within ±5m of setdepth	N/A
	4	Mean tow depth > ±10% setdepth OR when set depth is <50m, mean tow depth > ±5m of setdepth	
Tension (all calculations are Mean Strb minus Mean Port)			
Turning Block Load Cells			
Starb vs. Port Δ	1	-0.5t to +0.5t	N/A
	4	< -0.5t OR > +0.5t	
Wire Out (all calculations are Mean Strb minus Mean Port)			
Auto-trawl winch			
Starb vs. Port Δ	1	-10m to +10m	N/A
	4	< -10m OR > +10m	
Turning Block Wire Counter			
Starb vs. Port Δ	1	-10m to +10m	N/A
	4	< -10m OR > +10m	

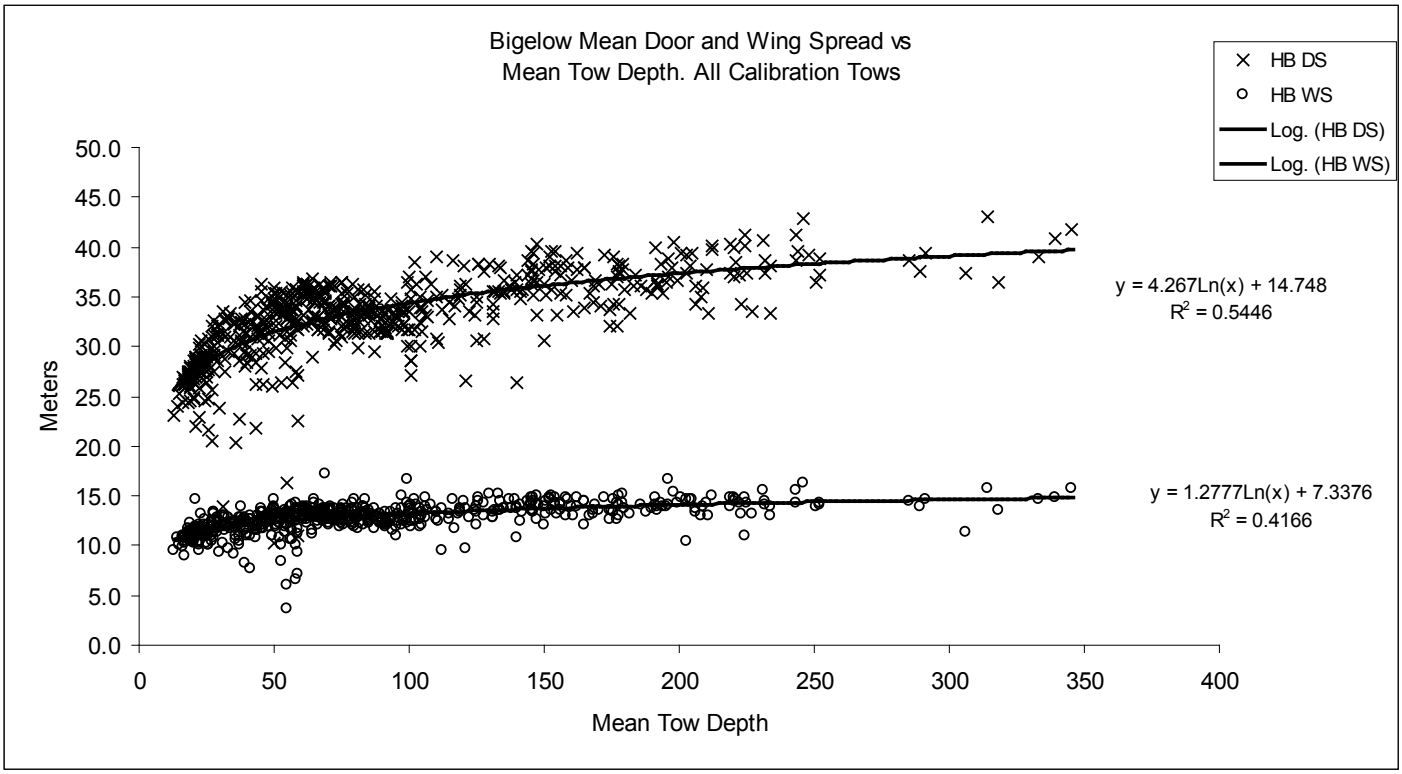
Depth Dependent Spread Calculations

It is expected that spread varies with depth. To avoid excluding only the shallowest and deepest tows, the tolerance limits and optimal values for mean door spread and mean wing spread are depth dependent. Based on the data collected during the NEFSC BTS calibration experiments, equations to calculate depth dependent predicted door spread and depth dependent predicted wing spread were derived. Mean door spread and mean wing spread from the full calibration data set were plotted as a function of mean tow depth (Figure 1). Each parameter was then normalized to mean tow depth using the following regression equations:

a) Door Spread: Predicted Door Spread= 4.267*Ln(Mean Tow Depth) + 14.748

b) Wing Spread: Predicted Wing Spread= 1.2777*Ln(Mean Tow Depth) + 7.3376

Figure 1.



Upper and lower tolerance limits were then set by calculating 95% confidence bands for the entire regression line (full depth range of the survey; 15m-500m) for both door and wing spread, based on the methods in [1]Netter et al., 1985, section 5.2.

[1]Netter, J., W. Wasserman, and M.H. Kutner. 1985. Applied Linear Statistical Models, 2nd ed. Homewood, Ill.: Richard D. Irwin Inc., pp. 154-155.

METHODS

Upper and Lower Boundary Levels of the Confidence Band:

$$\hat{Y}_h \pm W^* s(\hat{Y}_h)$$

Where:
$\hat{Y}_{h=}$ predicted spread
$s(\hat{Y}_h)$= estimated standard deviation of $\hat{Y}_h$
$W = \sqrt{(2*F(1-a; 2; n-2))}$

Calculate the variance of the predicted spread:

$$s^2(\hat{Y}_h) = MSE[1 + \frac{1}{n} + \frac{(X_h - \bar{X})^2}{\sum(X_i - \bar{X})^2}]$$

Where:
$\hat{Y}_{h=}$ predicted spread — $s^2(\hat{Y}_h)$= estimated variance of $\hat{Y}_h$
n= # of tows — X_h= mean tow depth at prediction
$\bar{X}$=mean depth of all tows — X_i= mean depth at tow *i*
MSE= mean square error

Door Spread Values from Calibration Data Set:

$$s^2(\hat{Y}_h) = 8.38\ [1+1/618+\frac{(\text{Mean Tow Depth} - 89.3)^2}{2522376.42}]$$

n=618; $\bar{X}$=89.3; $\Sigma(X_i - \bar{X})^2$= 2522376.42; MSE= 8.38
F(.95; 2; ∞) = 3.00; W= 2.45
$s = \sqrt{s^2(\hat{Y}_h)}$

Wing Spread Values from Calibration Data Set:

$$s^2(\hat{Y}_h) = 1.24\ [1+1/592+\frac{(\text{Mean Tow Depth} - 88.1)^2}{2371779.12}]$$

n=592; $\bar{X}$=88.1; $\Sigma(X_i - \bar{X})^2$= 2371779.12; MSE= 1.24
F(.95; 2; ∞) = 3.00; W= 2.45
$s = \sqrt{s^2(\hat{Y}_h)}$

*NOTE: Tows were not excluded from analyses based on spread values. However, only tows with 25% and greater valid spread data acquisition were used for analyses; thus, the estimated variance calculations for door and wing spread use different values of n, $\bar{X}$ and $\Sigma(X_i - \bar{X})^2$.

The upper and lower optimal boundary levels were calculated by removing the W statistic and simply multiplying the predicted spread by the estimated standard deviation:

$$\hat{Y}_h \pm s(\hat{Y}_h)$$

Figure 2. Mean door spread depth dependent tolerance limits and optimal limits, based on 95% confidence bands over the full depth range of the survey. Values 1, 2 and 4 indicate the operational code values.

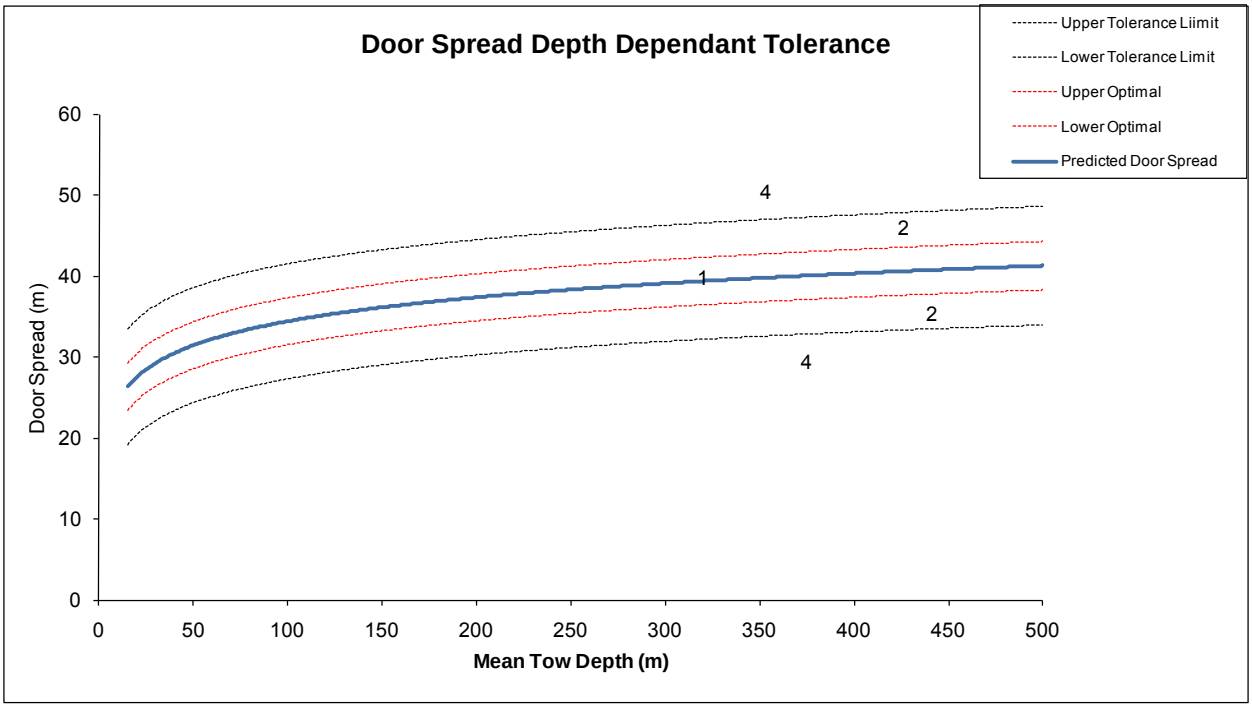
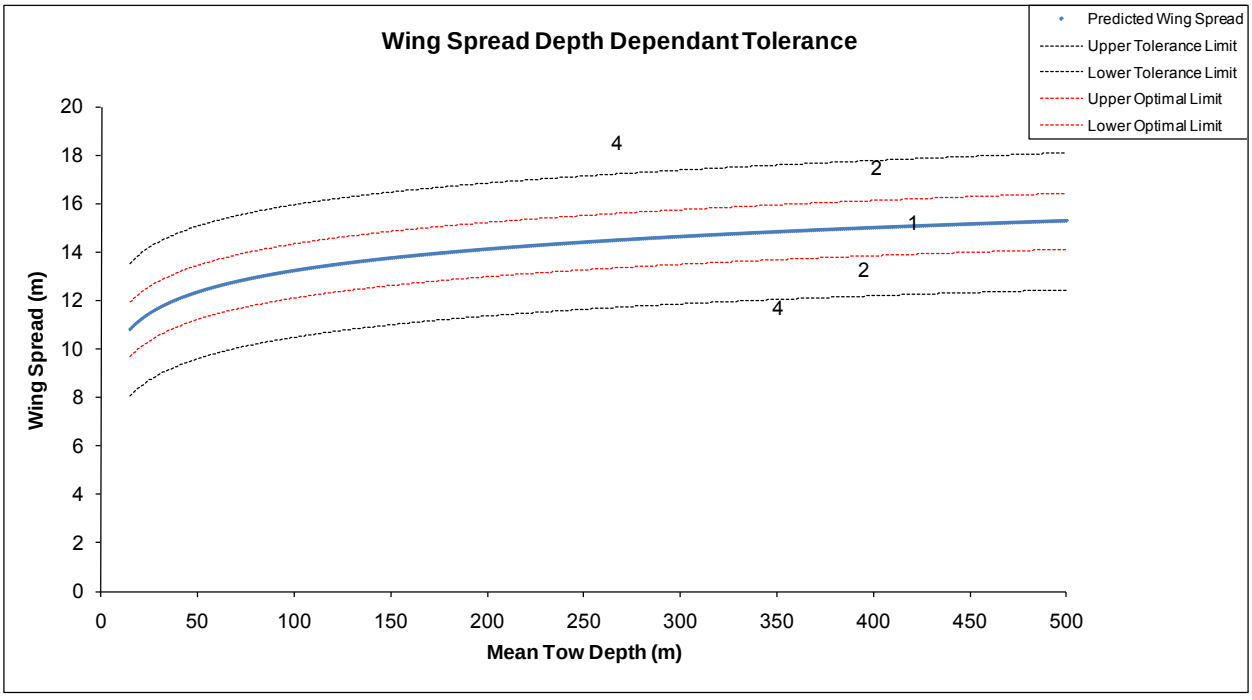


Figure 3. Mean wing spread depth dependent tolerance limits and optimal limits, based on 95% confidence bands over the full depth range of the survey. Values 1, 2 and 4 indicate the operational code values.



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