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SURVEY TRAWL REFERENCE MANUAL

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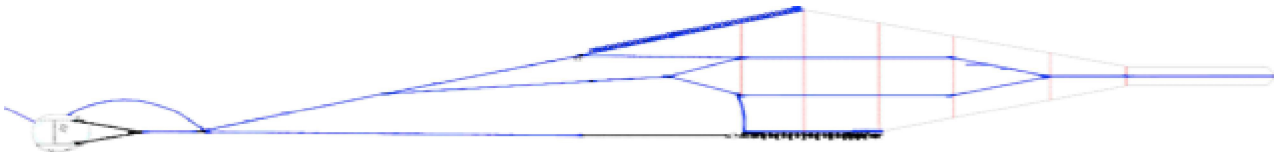

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CHAPTER 1

INTRODUCTION

1.0 History

Trawls have been used as a means for obtaining a relative measure of abundance of fish for more than 100 years. Annual bottom trawl surveys for determination of fish stock size have been conducted off the east coast of Newfoundland since 1971 following the guidelines of Doubleday [1][6]. In the early 1990s under the auspices of the Northern Cod Science Program, DFO's Northwest Atlantic Fisheries Centre (NAFC) began to develop a 'survey trawl standardization' program to ensure all aspects of the procurement, design, construction and repairs of survey trawls, and trawl survey procedures were consistent from year to year (for details see [2]). The first set of trawl plans were created in 1993 for the old survey trawl, Engel 145 High Lift otter trawl, and in 1994 for the new survey trawl, Campelen 1800 shrimp trawl. After extensive NAFC investigations from November 2005 to Sept 2007, a new version of the survey trawl reference plans and checklist was created by MUN Fisheries and Marine Institute (MI) under contract from DFO in October 2007 [3][7].

The principal objective of NAFC multi-species/ecosystem trawl surveys is to derive independent indices of stock abundance for use in stock assessment and ecosystem monitoring models based on standardized haul by haul. The importance of standardization can be best summarized by the following quote[8]:

"The very long, coherent time series from the research vessel surveys is of incalculable value and a fundamental change of design and/or survey operations risks undermining this valuable data set."

Standardization of the design, use and repair of the survey trawl is unquestionably the most critical element for survey standardization because the Campelen trawl is not simply a device to capture fish but is a scientific instrument used to sample various components of the ecosystem. Consistency in the survey time series is important for multispecies assessment and ecosystem monitoring and is important for increasing public confidence in the reliability of scientific advice on management issues. Bias in the form of a systematic error can occur in abundance estimates as a result of many factors, chief of which are adherence to trawl construction specifications during fabrication and repairs and adherence to fishing protocols during the survey. Both occurrences will affect the performance and

[6] [No.] refers to a reference in the Bibliography Chapter 9.

[7] The manual incorporates the October 2007 MI Trawl Drawings in Chapter 3.

[8] Robin Cook, Director, FRS Marine Lab Aberdeen.

efficiency of the gear and contribute to both bias and noise in the survey estimates. Rigid standardization of all technical aspects of surveying should minimize variability in trawl performance during annual surveys, and thus result in constant trawl performance, i.e. at the same depth, bottom type and hydrographic conditions the survey trawl should operate physically in the same way. However this rigid standardization of survey trawls and fishing procedures should not prevent the introduction of new instrumentation and procedures, and the fixing of trawl construction errors once discovered.

2.1 Philosophy of Survey Operations

The philosophy of ownership and responsibility regarding survey operations is broken down as follows:

2.2 maintenance and calibration of ship board hardware/software used in fishing operations are owned by Canadian Coast Guard (CCG);

2.3 survey planning and its execution are owned by DFO Science; and,

2.4 quality controls and assurances on purchasing, construction and repairs of trawls and issues related to procedures during trawling operations are jointly owned and shared by Science and CCG.

Specific details and the procedural routines to obtain standardization of trawls and trawl surveys have not been well defined in previous NAFC survey manuals. The compilation and development of survey protocols in this report[9] are therefore focused on these issues. The intent of these written protocols is to specify those issues that may affect survey consistency and provide a mechanism for communication between scientific staff and the officers and crew of the research vessel which maintains continuity in procedures as staff and vessels change over time.

Written unambiguous protocols and procedures in this survey trawl operations manual are meant to meet the intended specifications for the survey when it was initially drawn up. Failure to strive for optimal operation of a given survey trawl and protocol on the grounds that previous operations were defective would be indefensible [4]. Standardization should not be an obstacle for giving survey protocols a normal scientific evaluation associated with advances in scientific knowledge and technology. Therefore the NAFC Survey Trawl Operations Manual's Protocols should be considered a 'living document' that requires periodic revisions and update.

[9] The protocols developed in this manual relied heavily on the reports of the ICES Study Group on Survey Trawl Standardization 2005-2008[4] and communications with researchers in USA, Scotland, England, Ireland, and Norway.

CHAPTER 2

TRAWL SURVEY PROTOCOLS

2.1 INTRODUCTION

Standardization of trawl deployment, operation, and retrieval procedures are critical for maintaining consistency to ensure these components do not bias survey catchability over time. Some factors that can be standardized to minimize their effect on trawl performance and catchability of finfish, shellfish and benthos include: determination of scope ratio; determination of bottom contact on deployment; towing, and retrieval of gear; estimation and standardization of tow distance; tow direction; tow speed; and maximum sea state. Written unambiguous protocols specifying these and other issues that may affect survey consistency provide a mechanism for communication between scientific staff and the officers and crew of the research vessel which maintains continuity in procedures as staff and vessels change over time.

By increasing the level of detail, and formalizing the communication of procedures, the intent of these protocols is to make operations consistent among members of scientific staff and vessel crew and consistent over time.

Although Section I is directed towards the annual Multi-species Ecosystem surveys, the procedures in Sections II and III can be applied to other species specific surveys using the Campelen trawl.

SECTION I: START-UP PROCEDURES FOR THE ANNUAL SURVEY

2.2 SURVEY PLANNING MEETING

2.2.1 At least 1 month prior to the start up of the main spring and fall surveys, the Aquatic Resources Division (ARD) Survey Program Leader calls a meeting of senior survey technical and scientific staff[10], Ecosystem Research (ERI) staff, oceanography and acoustic staff, regional vessel coordinator, scientific staffing coordinator, Science gear technologist, CCG Supply Chain Coordinator, seabed mapping specialist, and any other science staff with special requests for additional work during the surveys.

[10] Throughout the rest of this document SIC will stand for both scientist- and technician-in-charge of the survey

2.2.2 This meeting should also include discussions on priorities and logistics, turnaround schedules, staffing, set selection and chart plotting, etc.

2.2.3 The regional vessel coordinator ensures all appropriate paperwork is filed with CCG NL and/or Maritimes Region, including trip programs, security clearances for science staff and requests for permission to enter foreign waters (i.e. French Zone on St. Pierre Bank), and completion of relevant forms for non-DFO staff participating in the surveys , and ensures all deadlines are met.

2.2.4 The SIC coordinates logistics for each survey leg including drafting a Trip Program, survey supplies, SCANMAR instrumentation and data logging computer, FFS computers, electronic weigh balances, acoustics instrumentation and oceanography instrumentation. Pre-assignment of cabins and bunks should follow agreed protocols.

2.2.5 Gear technologist coordinates with CCG annual spring and fall calibration of vessel warp counters, sheaves and trawl warp markings, and carries out annual spring and fall shakedown cruise and calibration trials, quality assurance checks of fishing gear with ARD Survey Program Leader, SICs, CCG Supply Warehouse Coordinator and vessel fishing officers.

2.3 SURVEY SUPPLIES ACTIVITIES

2.3.1 At least one week before the scheduled departure of the first leg of the survey, technical staff assigned to provisioning the vessel with scientific supplies will procure supplies according to the NAFC vessel supply inventory list and ensure a complete inventory is available.

2.3.2 Technical staff will deliver supplies to the vessel at least one full working day before the scheduled departure.

2.3.3 At sea, technical staff will monitor the use of supplies and record any deficiencies for the SIC who will inform the next SIC of any supplies needed for the next survey leg via email two days before returning to port.

2.4 ACOUSTICS & SCANMAR ACTIVITIES

2.4.1 Setup and maintenance of SCANMAR instruments and data logging software is the responsibility of the Science gear technologist or his designate.

2.4.2 Details concerning setup of hardware and software and any sensor calibration can be found in the NAFC SCANMAR Reference Guide, maintained as a separate document.

2.4.3 SCANMAR computer setup should occur one full working day before the scheduled departure.

2.4.4 Responsibility for setup and maintenance of acoustics and related peripheral equipment is an Acoustics Section function.

2.4.5 Responsibility for setup and maintenance of seabed mapping systems and related peripheral equipment is a Shellfish Section function.

2.5 FFS COMPUTERS WEIGHT BALANCES & CTD ACTIVITIES

2.5.1 Responsibility for setup and maintenance of FFS computers and related peripheral equipment is an IT Section function in coordination with the ARD staff.

2.5.2 Details concerning FFS software setup are found in a FFS Reference Guide, with some 'HELP" documentation within FFS software, in the drylab.

2.5.3 Responsibility for setup and maintenance of oceanographic computers, CTD sensor and board and related peripheral equipment is an Oceanography Section function.

2.5.4 Responsibility for setup and maintenance of electronic balances is an Acoustic Section function.

2.6 FISHING GEAR QUALITY ASSURANCE ACTIVITIES

2.6.1 At least two weeks before the startup of a NAFC survey using the Campelen trawl the Science fishing gear technologist will lead a NAFC Inspection Team through the Quality Assurance program to certify that the required trawls are "ready for survey use" using the MASTER CHECKLIST (see Chapter 8).

2.6.2 Two full working days prior to departure on the first and fourth leg of the annual spring and fall surveys, the Science gear technologist, CCG Supply Chain Coordinator and SIC or his/her designate meets with fishing mate/boson and deck crew to carry out a final inspection of the hookup of the survey trawl (see Chapter 8).

2.6.3 On the day the vessel arrives back in port for the 2nd , 3rd, and 5th and 6th (if there is a 7th leg) legs of annual spring and fall surveys the Science gear technologist, CCG Supply Chain Coordinator and SIC for next leg or his/her designate meets with fishing mate/bosom and deck crew to carry out a partial inspection using the QUICK CHECKLIST FORM of the survey trawl spread out on the dock, carry out a final inspection of the hookup of the survey trawl (see Chapter 8).

2.7 BIOLOGICAL SAMPLING COORDINATION ACTIVITIES

2.7.1 After each leg of the survey, new SIC discusses status/completion of sampling requests with previous SIC/Watch Leaders.

2.7.2 One work day prior to sailing departure SIC meets with Watch Leaders to review all sampling requests including the standard ones.

2.8 ONBOARD VESSEL MEETING

2.8.1 One work day before or on the day of sailing, depending on timing, the SIC should meet with vessel commander, first officer, fishing mate and bosom to discuss cruise track, first station set location, setting time for sailing departure, delays, safety drills, fishing gear issues, shakedown and calibration trials.

SECTION II: AT SEA PROCEDURES

2.9 DEFINING RESPONSIBILITY REGARDING SURVEY OPERATIONS

APPENDIX 1 contains a flow chart for preparations of survey gear during annual surveys and deployment at sea. APPENDIX 2 contains a summary hand sheet of survey activities for SIC.

2.9.1 It is the SIC responsibility to oversee all aspects of survey and fishing protocols with final decisions regarding set locations and cruise track being his/her responsibility. SIC should confer with Watch Leader on what survey plans to carry out while the SIC is off watch.

2.9.2 Vessel operation, trawl gear deployment and retrieval, and all matters related to vessel safety will be the responsibility of the Vessel Commanding Officer or his designate.

2.9.3 It is the SIC responsibility to oversee the collection of the station and tow information, SCANMAR net mensuration data, other related data

2.9.4 On the **second tow** of the 1st and 4th legs of the annual spring and fall multi-species surveys both the SIC and Fishing Officer measure the bridles and door leg extensions as the trawl is being deployed and recording data on Master Checklist Form (see Chapter 8).

2.9.5 Both the SIC/Watch Leader and the Fishing officer must oversee all repairs and complete the Trawl Repair Form noting tag number of trawl, new panel or component tag number and extent of repairs.

2.9.6 During the survey, should the primary trawl (net and/or footgear) be deemed unsuitable for use, the secondary trawl will replace it. After hookup SIC and Fishing Officer carry out a limited version of the Quick Checklist to certify the trawl is "ready for survey use" (see Chapter 8).

2.9.7 ***Both the Watch Leader and the boson must ensure that all fish catch and debris is removed/cleaned from the trawl after every tow***.

2.9.8 Before the codend is closed, the Watch Leader and boson should inspect and ensure that the codend liner is properly tied off to prevent escapement of any portion of the next catch, and ensure that the liner extends 1.87 m (6 ft) outside the tied off codend.

2.9.9 Before the trawl is shot away, the Watch Leader should inspect to see all SCANMAR sensors and the CTD board are in place with safety lines attached and that the CTD is initialized.

2.9.10 Both the SIC and Vessel Commanding Officer or their designates should keep each other abreast of activities and changes in survey-fishing operations to ensure success in the survey. Daily discussions regarding cruise track, set selection, weather, safety and logistics should be routine.

2.9.11 Any procedural modifications affecting fishing operations during the survey must be justified and mutually agreed upon by the SIC and Vessel Commanding Officer or his designate and documented in the Station and Tow Information Form (APPENDIX 3).

2.10 SCIENTIFIC WATCH LEADERS

In addition to the above related duties in Section 2.8 the following should be noted:

2.10.1 Brief other Watch Leader and SIC on status of station selection, cruise track and biological sampling issues prior to the start of new watch.

2.10.2 Brief other Watch Leader and SIC on status of fishing gear, SCANMAR and oceanographic instrumentation issues prior to the start of new watch.

2.10.3 Two days before end of survey compile a list of supplies needed for next leg of survey and pass it to SIC to email to the next SIC in charge of upcoming survey leg.

2.11 SCOPE RATIO

The following scope (warp-to-depth) table developed in 1995 will be used to determine the amount of warp to be set given the depth of the survey tow. ***No deviation permitted.*** Bridge officer records the amount of warp out for every tow on the Set Detail, and Station and Tow Information Forms

	WARP OUT(METERS)									
Depth (m)	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
10	34	37	40	44	47	50	54	57	60	64
20	67	70	73	77	80	84	87	90	93	97
30	100	103	106	110	113	116	119	122	126	129
40	132	135	139	142	145	148	151	155	158	161
50	164	167	171	174	177	180	183	186	190	194
60	196	199	202	205	208	211	215	218	220	224
70	227	230	233	236	239	242	245	249	251	254
80	258	261	264	266	270	273	276	279	282	285
90	288	291	293	297	300	303	306	308	312	315
100	318	321	323	327	330	333	336	338	341	344
110	348	351	353	356	359	362	365	367	371	374
120	377	380	382	385	388	391	394	396	399	402
130	406	409	411	414	417	420	423	425	428	431
140	434	437	440	442	445	448	451	454	456	459
150	462	465	468	470	473	476	479	482	483	487
160	490	493	496	497	500	503	506	509	511	514
170	517	520	523	526	527	530	533	536	539	541
180	544	547	550	553	554	557	560	563	566	567
190	570	573	576	579	582	583	586	589	592	595
200	596	599	602	605	608	611	612	615	618	621
210	624	625	628	630	633	636	637	640	643	646
220	649	652	653	656	659	662	664	665	668	671
230	674	677	680	680	683	686	689	692	695	695
240	698	701	704	707	708	711	713	716	719	722
250	723	725	728	731	734	734	737	740	743	746
260	749	749	752	755	758	761	763	764	766	769
270	772	775	778	778	781	784	787	789	790	792
280	795	798	801	804	804	807	809	812	815	818
290	818	821	823	826	829	832	832	835	837	840
300	843	846	846	848	851	854	857	860	859	862
310	865	868	870	873	873	876	878	881	884	887
320	886	889	892	895	897	900	900	903	905	908
330	911	914	913	916	919	921	924	927	926	929
340	932	934	937	940	939	942	945	947	950	953
350	956	955	957	960	963	966	968	967	970	973
360	976	978	981	980	983	986	988	991	994	996
370	995	998	1001	1003	1006	1009	1008	1010	1013	1016
380	1018	1021	1020	1023	1025	1028	1031	1033	1036	1035
390	1037	1040	1043	1045	1048	1051	1049	1052	1055	1057
400	1060	1063	1061	1064	1067	1069	1072	1074	1077	1076
410	1078	1081	1084	1086	1089	1087	1090	1093	1095	1098
420	1100	1103	1101	1104	1107	1109	1112	1114	1117	1115
430	1118	1121	1123	1126	1128	1131	1129	1132	1134	1137
440	1140	1142	1145	1143	1146	1148	1151	1153	1156	1158
450	1157	1159	1162	1164	1167	1169	1172	1170	1172	1175
460	1178	1180	1183	1185	1183	1186	1188	1191	1193	1196
470	1199	1196	1199	1201	1204	1207	1209	1212	1209	1212
480	1214	1217	1219	1222	1225	1222	1225	1227	1230	1232
490	1235	1237	1240	1237	1240	1242	1245	1247	1250	1252
500	1250	1253	1255	1258	1260	1263	1265	1268	1265	1267
Depth (m)	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**
600	1428	1446	1463	1474	1491	1508	1525	1541	1557	1573
700	1589	1605	1620	1635	1650	1665	1680	1694	1716	1730
800	1744	1758	1771	1785	1806	1819	1832	1853	1866	1878
900	1890	1911	1923	1944	1965	1976	1987	1998	2019	2030
1000	2050	2060	2081	2091	2111	2132	2141	2161	2171	2191
1100	2211	2220	2240	2260	2280	2289	2308	2328	2348	2368
1200	2376	2396	2416	2435	2455	2475	2495	2515	2534	2554
1300	2574	2594	2614	2633	2653	2673	2693	2713	2746	2766
1400	2786	2806	2826	2860	2880	2900	2920	2955	2975	2995
1500	3030	3050	3086	3106	3126	3162	3182	3219	3239	3275

2.12 WINCH OPERATIONS DURING NET DEPLOYMENT & RETRIEVAL

At present the vessels CCGS *W. Templeman* and *A. Needler* use a brake locking (block) winch system while the CCGS *Teleost* uses an auto-trawl winch system. Trawl deployment and retrieval procedures will differ somewhat between the two winch types and are noted separately below:

Chapter 5 has a section on Trawl Warp Standardization, Calibrations and Marking using winch counters and physical markings on the warps.

TRAWL DEPLOYMENT

The actions of deployment of the trawl will vary depending on depth range and weather conditions which will impact the general guidelines below:

2.12.1 During trawl deployment, vessel speed should be maintained at least 3 knots faster than the net pay out rate (up to brake-set) between 6-7 knots.

2.12.2 Some vessels[11] use forward pitch (speed) to regulate settling rate of the trawl. Speeds between 1 and 2 knots can be used to increase sink rate and speeds up to 4.5 knots can be used to decrease the sink rate.

2.12.3 After paying out all but the last 50 meters of warp begin reducing the vessel speed to 3 knots.

2.12.4 Vessel speed should be maintained close to 3 knots as possible when the net is on the bottom.

2.13 LOCKED WINCHES

2.13.1 Deploy the wire to the prescribed length (scope ratio) using the block counters on bridge winch panel. Crosscheck the accuracy of the block counters with the physical warp marks, e.g., check that the 50, 250 m, etc., marks passes through the block sheave when the counter says 50, 250 m, etc. (See procedures in Chapter 5 on Trawl Warps Standardization Protocols).

2.13.2 Set the winch brakes at the determined warp length and adjust the vessel speed back down to 3.0 knots as soon as possible.

2.13.3 Both the port and starboard marks should line up when the correct warp-to depth length has been shot according to scope table. If they do not then investigate the problem following procedures in Chapter 5 on Trawl

[11] The *Teleost* can regulate the sink rates and does so generally in deep water. The *Templeman* does not adjust the sink rates.

Warps Standardization Protocols.

2.13.4 **Never change warp length after trawl hits bottom or during a tow.**

2.13.5 If depth changes *while shooting* is greater than 10 m then a revised warp length should be used from the scope table. **Never change warp length after trawl hits bottom or during a tow. Should bottom depth keep changing then abandon tow following guidelines in Section 2.23.4 below.**

2.14 AUTO-TRAWL WINCHES

2.14.1 The length of warp to be deployed is programmed into the winch controller at the start of each tow based on the warp scope ratio table. The first fifty meters of warp is deployed manually after which the auto-trawl system automatically takes control and shoots the remainder.

2.14.2 Once the prescribed length of warp is deployed, the auto-trawl system switches into the towing mode, actively varying warp lengths in response to varying tensions, for the duration of the tow. After the trawl is on bottom accurate measurement of relative warp length differences is relatively unimportant unlike locked winch systems.

2.15 TEAWL RETRIEVAL

2.15.1 **Locked Winches**: start haul back of the trawl at the 14 minute mark, depending on depth, by clutching in winches. The vessel may go astern until the trawl leaves bottom whereby it will start to pickup forward speed. Decrease the forward pitch by 20-25% during retrieval of last 50 meters to prepare for bringing doors up to the gallows.

2.15.2 **Auto-trawl Winches**: increasing the forward pitch by 20-25% at the same time as starting the winch and start haul back of the trawl at the 13-14 minute mark, depending on depth, by pressing the hoist button. This will automatically take in the warp to the last fifty meters before it switches into manual mode again. The last 50 meters is taken in manually to prepare for bringing doors up to the gallows.

Note: the lift off at the 14 min mark for both winch types generally results in an increase in SCANMAR "clearance" value and a decrease in SCANMAR depth readings once the trawl leaves bottom. Lift-off will vary according to depth (e.g., 1 minute at 500 m and 3 minutes at 1000 m).

2.16 DETERMINING BOTTOM CONTACT, START AND END OF TOW

2.16.1 Bridge officers initialized SCANMAR data logging software to "START SET" when trawl doors enter the water.

2.16.2 Use SCANMAR trawl (height) sounder to monitor trawl position in the water column relative to the bottom, and the depth sensor should the height sensor fail. The height senor will pick up the bottom 30-90 m above it. The first SCANMAR 'clearance' signal of **0.0** and a '**touchdown**' from the trawl sounder should not be taken as the trawl is on bottom but as a first indication of decrease in headline height.

2.16.3 Bottom contact is usually detected by watching the headline height measurements decrease rapidly from over 10 m to around 6 m as the net approaches bottom. Upon touchdown the headline height will be around 5.9-6.2 m falling off to 3.2 to 3.9 m as the wings spread and fishing begins. A blue streak is seen in the mouth of the trawl on the SCANMAR monitor from the noise of the touch down. ***Note***: depending on tide and tow direction the range of opening could vary from as low as 2 m to a high of 5 m.

2.16.4 Bridge officers initialized SCANMAR data logging software to "START TOW' when bottom contact is made.

2.16.5 Bridge officer record times for start of tow, sink times, end of tow, etc., in the SCANMAR section of the Station and Tow Information Form (APPENDIX 3).

2.16.6 At the 14 minute mark, fishing mate/bosom begins haul back of trawl and Bridge Officers initialize SCANMAR data logging software to "END TOW' at the **15 minute mark.**

2.16.7 Bridge officer initialize SCANMAR data logging software to "END SET" when trawl doors are back in the gallows.

2.17 DURATION OF TOW

2.17.1 15 minutes after touch-down has been determined - this equates to approximately 0.75 nautical miles.

2.17.2 Tows may be shortened due to upcoming obstructions, inability to follow a depth contour, hookup of the trawl on bottom, or extremely large catches which affect the efficiency of the trawl (see Sections 2.20 to 2.23 for guidelines).

2.17.3 Tows less than 10 minutes are invalid and should be repeated or alternate station picked at the discretion of the SIC.

2.17.4 Bridge officer records reason for shorter tow in the Speed Log section of the Station and Tow Information Form and the Set Detail sheet.

2.18 SPEED OF TOW

2.18.1 A target towing speed of **3 knots,** measured as vessel speed over ground, using the differential global positioning system (DGPS) unit, from the time of bottom contact to lift off should be adhered to as closely as possible (see restrictions in Section 2.23.2).

2.18.2 Bridge officer records actual towing speed every 3 minutes on the Speed Log section of the Station and Tow Information Form.

2.19 DIRECTION OF TOW

2.19.1 Towards the next station when possible or along the contour of the slope when at the edge of the continental shelf. **Tows must be contained within stratum boundaries.**

2.19.2 Start shooting before the station to ensure the net is generally on bottom at the station (distance depends on depth fished and sink rate of gear).

2.19.3 In high winds a tow is generally made with or against the wind, whichever allows better control of vessel direction and towing speed.

2.19.4 In high cross currents, alter direction to tow into the current to prevent trawl distortion.

2.19.5 Tow direction can differ from above if the Bridge Officer/Fishing Mate determines that safety is a concern such as avoiding cables and other hazards, or to avoid crossing into another stratum, or if the net geometry is severely distorted (e.g., doors falling over due to tow in direction of a strong current or net will not touch bottom).

2.20 STATION LOCATION-UNTRAWLABLE BOTTOM

2.20.1 Set locations near fixed gear should be relocated up to 1 nautical mile in consultation between Bridge officer and SIC.

2.20.2 Set locations in difficult bottom topography should be searched for good bottom prior to beginning trawling operations. If unavailable, use the alternate tows designate in the station allocation instructions.

2.20.3 A station set is designated as untrawlable if the Fishing Mate and SIC determine that the bottom topography precludes a successful tow due to potential major trawl damage, insufficient tow distance, widely changing depth range, and obstruction in the tow path.

2.20.4 If untrawlable areas are known prior to survey, exclude them from the set selection. The survey work chart used on the bridge will have positions of previous major trawl damage set locations.

2.20.5 If depth changes during a tow in difficult areas cannot be avoided then it is better to tow from deep to shallow because too much scope (warp out) is better than too little. **Never adjust the scope (warp out) during a tow to correct changing depth.**

2.21 CRITERIA FOR SUCESSFUL & UNSUCCESSFUL TOWS

2.22 INTRODUCTION

The acceptance or rejection of a tow has often been a subjective decision made by the SIC in consultation with fishing mate/boson. The criteria for repeating a tow are typically related to events such as gear damage from hook-ups and encounters with obstructions such as large rocks, abandoned or active fishing gears; towing protocol violations such as exceeding allowable depth range, tow duration, towing speed and use of improper scope ratios; oversized catches (e.g. jelly fish, mud, corals, etc.) that impair normal trawl performance; and occasionally tow abandonment due to unusually large fish sign as observed on the echosounder or mechanical problems with the vessel. In those cases of severe gear malfunction such as crossed doors, busted footgear or severe damage to net (i.e. rim-racked trawl) the judgment call of an unsuccessful tow is clear. However, when the damage is to the trawl net body then the call is more subjective. The procedures outlined below provides standards to guide the SIC in determining whether or not a tow is successful.

Alterations to trawl geometry and performance due to a trawl damage, obstruction or improper rigging can seriously affect the catchability of the trawl (See APPENDIX 4). When significant gear damage or malfunction occurs, the SIC/Watch Leader should be informed, and the decision to re-tow must be made based on the severity of the situation. The SIC must consider the effect of the damage on catch ***rate*** of fish and shellfish, particularly shrimp and crab, and whether or not the catch is a ***representative*** sample. In rough bottom areas where the likelihood of sustaining similar or greater gear damage is high, the decision to repeat the tow may also be influenced by whether the risk is greater than the reward.

Although an unsuccessful tow is not a standard haul it may be sampled for biological data which is independent of abundance and biomass estimation.

2.23 SUCCESSFUL TOWS

A flowchart is given in APPENDIX 5 to complement this Section and APPENDIX 6.

2.23.1 A successful tow is defined as a tow in which the trawl was maintained on the bottom in the standard fishing configuration determined by SCANMAR along with correct scope ratio and a targeted towing speed of 3 knots for 10-15 minutes. It also includes no major hook-ups, minor gear damage, and no gear or vessel malfunction or gear conflicts. Attention to the SCANMAR mensuration monitor and logging of towing speeds is critical.

2.23.2 A tow can be successful when there is damage to the trawl netting however the length of torn meshes in any one panel torn must be less than that permitted in Point # 2.23.7 below.

2.23.3 A tow can be successful when a hook-up caused by the trawl being stuck in mud or on a sand wave causes a stoppage of the vessel (haul back should commence immediately), trawl damage is minimal, and the tow was at least 10 minutes in duration. An exception may be when a catch of mud would prove difficult to separate from the catch.

2.23.4 Standard fishing configuration for CCGS *Teleost* is an average door spread within the range of 44-66 m, average wing spread within the range of 16-20 m and an average opening within the range of 3.7-4.6 m; for CCGS *W. Templeman*[12] *the standard is* an average door spread of within the range 40-53 m, an average wing spread within the range of 15-18 m and an average opening within the range of 4.4-5.2 m [7]. The ranges for these standard configurations reflect the varying depth ranges which these vessels fish. The trawl spread is affected by depth, amount of warp, stability of the vessel, currents and bottom type.

Note: After every tow the Boson and Watch Leader will inspect the trawl for damage and inspect the 'shine' pattern on the trawl doors to confirm proper performance of the trawl.

[12] Insufficient analysis exists for CCGS *A. Needler* surveys, but in 2008 the *Needler* warps were changed from 1 1/8 to 1 inch diameter which is same used by sister ship CCGS *W. Templeman* so we may expect similar ranges.

2.24 UNSUCCESSFUL TOWS

2.24.1 Tows of less than 10 minute duration;

2.24.2 Tows with average towing speeds greater than 3.2 knots or less than 2.8 knots [8];

2.24.3 Tows using wrong scope ratio (warp out to depth fished) for depth fished;

2.24.4 Tows that stray into the depth range of an adjacent stratum, i.e. the depth is rapidly changing outside the range, the haul is abandoned and tow is declared unsuccessful if is less than 10 minutes – may occur along shelf edge[13];

2.24.5 Tows where the trawl net becomes twisted in cables or hung up on the trawl doors;

2.24.6 Tows where most of the netting is destroyed, i.e. rim-racked, and where there is either complete loss of all the gear, or loss of footgear, or loss of one or both trawl doors;

2.24.7 Tows where severe damage to any panel in the trawl in which 1 or more tears in the panel results in: tears in top and bottom wings exceeding 1.2 m (4 ft); or tears exceeding 0.9 m (3ft) in the square and bellies; or tears exceeding 0.6 m (2 ft) in the extension and cod-end. Tows where the tear in the codend liner exceeds 0.3 m (1ft) in any direction (see APPENDIX 6);

2.24.8 Tows where there is a collection of fish between the codend and liner even though both appear to be tied securely.

2.24.9 Tows where either the codend or codend liner was left untied;

2.24.10 Tows where 6 or more floats are missing and/or broken;

2.24.11 Tows where there is a break in the main warps, or bridles, or head ropes, or riblines, or wing/breast lines, or fishing line;

[13] If the changing depth is not rapid but near the upper or lower end of the depth range according the towplot/echosounder then a tow may still be successful because the trawl which is very far behind the vessel may not have strayed into the next depth range or if it did may not have spent less time there. After the tow examine the CTD trace of depth mode and mean values and add it to the headrope height. If these measurements are outside the depth range then the set is unsuccessful. If there is no CTD data then one should classify the tow as unsuccessful.

2.24.12 Tows where there is a heavy trawl door "shine" pattern on the side of one or both door shoes and towing brackets, which indicates the doors have fallen over, intermittent SCANMAR door readings should have indicated a problem;

2.24.13 Tows where the trawl was improperly rigged, e.g. footgear travel wire was not connected or was missing; wrong towing points were used on trawl doors; middle bridle extension wire was not attached; floats for SCANMAR wing canisters were not attached; improper delta plate rigging was used for footgear rigging; and any other major item that would impair travel performance and catching efficiency;

2.24.14 Tows where all SCANMAR sensors are not working at start of tow-usually indicates foul gear. *Note:* in very deepwater tows the signal may be lost for a minute or 2, and or then comes in sporadically. These tows **would not** be declared unsuccessful;

2.24.15 Tows where SCANMAR data indicates the trawl geometry is not within those dimensions (in real time) expected for the towing depth, i.e. outside the standard geometry configuration. For the *Teleost* expect an average door spread within the range of 44-66 m, an average wing spread within the range of 16-20 m and an average opening within the range of 3.7-4.6 m; for the *W. Templeman* expect an average door spread within the range of 40-53 m, an average wing spread within the range of 15-18 m and an average opening within the range of 4.4-5.2 m.

2.24.16 Tows where SCANMAR sensors show the trawl is off bottom for 2 minutes or comes off bottom more than twice in a 15 minute tow; occasionally occurs in areas with heavy currents, rough seas or when improper warp scope ratio being used;

2.24.17 Tows where anything that could impair the efficiency (changes geometry and/or performance) of the trawl, e.g. significant obstructions in the trawl such as large rocks equivalent to half the size of a crab pot; other large objects, such as crab pots, large truck tires, anchors, timbers/tree roots; oversized catches of mud, or jellyfish or kelp or corals or sponges;

2.24.18 Tows that were abandoned due to unusually large fish sign as observed on the echosounder;

2.24.19 Tows that were abandoned due to weather or sea conditions, even if tow duration was 10 minutes or higher;

2.24.20 Tows where the haul back of trawl was delayed due to mechanical problems[14].

[14] Here fish can swim out of the trawl.

***Note 1*:** NAFC gear codes matching the descriptions of the ABOVE types of gear damage or malfunction are described in APPENDIX 7.

2.25 REPEAT TRAWL PROTOCOLS

Sets classified as unsuccessful should be re-towed unless circumstances make it impossible to complete the set within the stratum (e.g., extreme currents, bad bottom, tight depth contours). The SIC will make the final decision as to whether the set was successful or not, and whether it will be re-towed and where.

The following factors may be considered when making the decision to repeat a set:

2.25.1 The probability of the same or greater damage to the trawl occurring, considered using the alternate station;

2.25.2 The number of successful sets completed in the stratum in question (higher priority should be placed on a set that represents the second set in a difficult stratum with low allocation, lower priority should be placed on a set in strata with high allocation);

2.25.3 The extended effort on one station could threaten the completion of other important sets/strata in the survey;

2.25.4 The relative importance of the stratum in question (is it a critical stratum for certain assessment species?); and

2.25.5 The geographic coverage within stratum that the tow represents.

2.26 CESSATION OF FISHING

2.26.1 When there is difficulty maintaining average towing speeds of the trawl, i.e. average speed is greater than 3.2 knots or less than 2.8 knots because of sea or wind conditions.

2.26.2 When sustained wind speeds reach 35 knots/hour; exception may be in the shelter of bays.

2.26.3 When wave height and swells pose a safety concern for crew on deck.

2.26.4 When other types of weather conditions, e.g. snow and ice, pose a safety concern to deck hands and scientific staff.

2.26.5 The decision to suspend fishing operations is made by the Vessel Commanding Officer and this decision is relayed to the SIC and/or Watch Leader.

2.27 LOSS OF TRAWL AND/OR FOOTGEAR

When trawl or footgear is lost then drag for it using 'creepers'- use last position coordinates from SEATRAWL- repeat set using the alternate station. Often the SCANMAR signals from the trawl will help locate its position.

SECTION III: POST SURVEY ACTIVITIES

2.28 GEAR CONDITION REPORT, SUPPLIES & REPAIRS

2.28.1 Fishing mate must contact CCG Supply Chain Coordinator one to two days before end of current leg of survey to inform shore staff of gear requirements for next leg. This communication should be by email with a copy sent to the Science gear technologist.

2.28.2 Fishing mate/boson will ensure all gear going ashore is tagged and a record of its condition and Trawl Repair Forms are supplied to warehouse staff. Offloading of fishing gear schedule is after every species specific survey, and after each third leg and end of each ecosystem survey (see guidelines in Chapter 7 on Trawl Repairs).

2.29 DATA TRANSFER

2.29.1 SIC ensures that any reports on the operations of the vessel and equipment during the survey is copied and given to Science Survey Leader and Regional Vessel Coordinator.

2.29.2 SIC ensures that SCANMAR data is downloaded onto a CD and given along with Station and Tow Information Forms and other gear related forms to Science gear technologist.

2.29.3 SIC ensures that FFS data is downloaded onto CD and all paper records for the survey are given to senior technician responsible for post survey checking.

2.29.4 SIC ensure oceanographic staff download the trawl mounted CTD data for use in adjustments of tow durations based on analysis of CTD data.

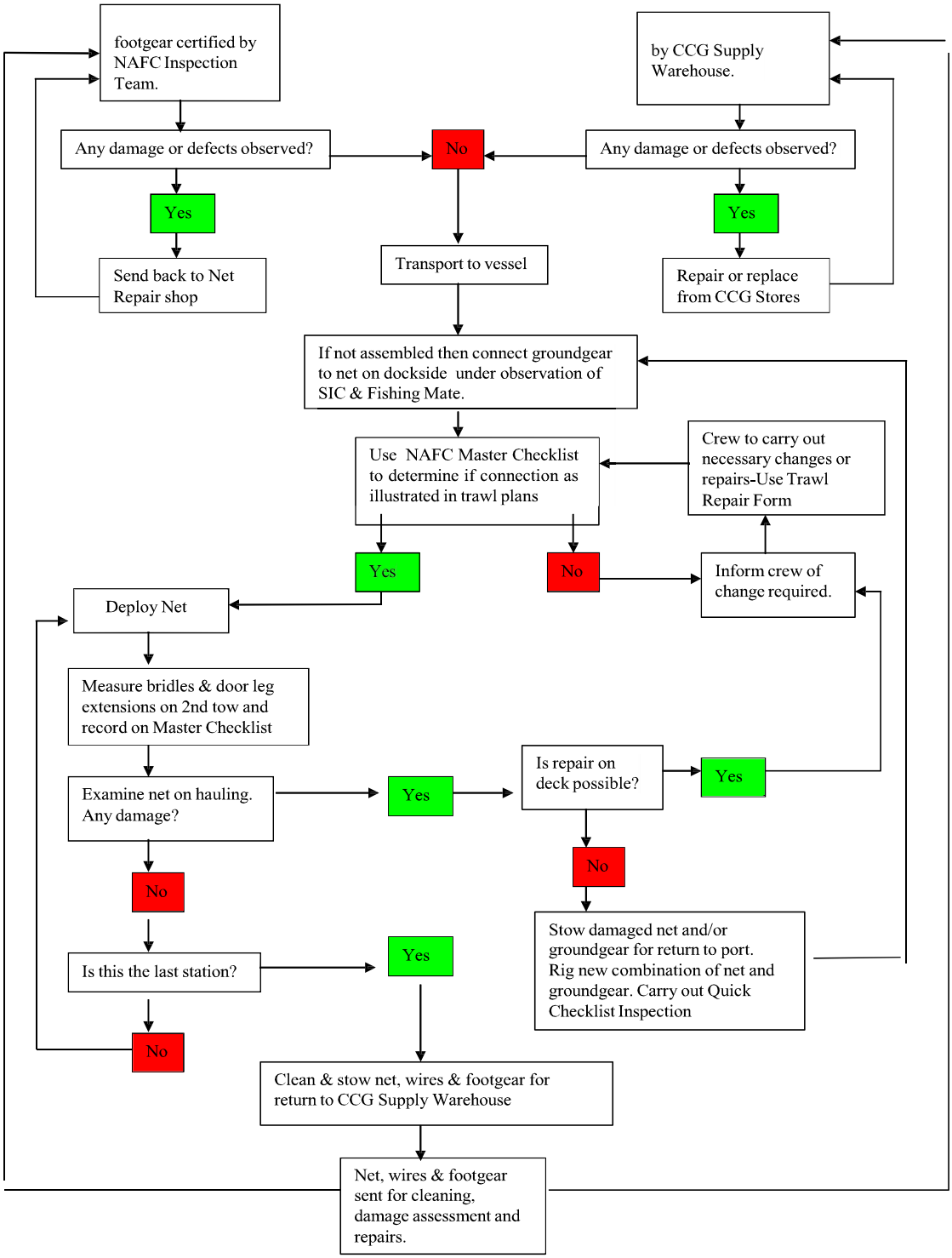
2.30 POST TRIP & SURVEY MEETINGS

2.30.1 The day of or day after completion of each survey leg, the outgoing SIC should meet with incoming SIC to brief him/her on cruise track, number of stations left to complete, fulfillment of sampling requirements and status of special requests and fishing gear related issues. This meeting should include ARD Survey Program leader if the planned survey coverage was compromised due to mechanical or weather problems with the vessel.

2.30.2 At the end of all legs of the spring and fall surveys the ARD Survey Program Leader calls a meeting of all senior survey technical and scientific staff, Ecosystem Research (ERI) staff oceanography and acoustic staff, regional vessel coordinator, scientific staffing coordinator, Science gear technologist, CCG Supply Chain Coordinator, and seabed bottom mapping specialist involved in the survey, for a discussion on the survey in general. At this meeting problems encountered during the survey should be discussed and when necessary, referred to the appropriate Science of CCG staff for resolution.

APPENDIX 1

ANNUAL NAFC CAMPELEN SURVEY TRAWL PREPARATIONS & DEPLOYMENT



APPENDIX 2

SURVEY TOW PROTOCOL HAND SHEET FOR SIC/TIC

1) SIC, Gear Technologist and Fishing Officer observe and check the assemblage of the NAFC Inspection Team certified trawls on the dockside and vessel using the QA Master Checklist.

2) SCANMAR technician monitors the installation/hook-up of sensors and initiates SCANMAR data logging program. CTD board is attached by crew to trawl.

3) Watch Leader & deck crew observes the deployment of gear, ensuring that gear is free from any defects or obstructions. If any problems are noticed then he/she alerts the Fishing Officer to terminate deployment.

4) If this is the **second tow** of the 1st & 4th survey leg then SIC measures bridles and door leg extensions using Master Checklist.

5) Bridge Officer start SCANMAR monitoring program on PC by pressing "Start of Set" key when trawl doors enter the water.

6) Once gear has touched down on seabed, press "Start of Tow" on PC monitor system and ensure Bridge Officer records time and checks towing speeds every 3 minutes through the tow on the Station and Tow Information Form

7) Monitor Scanmar display throughout tow. After 14 minutes towing start lift off and after 15 minutes, press "End of Tow" on PC monitor system and ensure Bridge Officer record time.

8) End Scanmar monitoring program on PC by pressing "End of Set" key when trawl doors come up to the gallows.

9) SIC/Watch Leader and deck crew observes the net and groundgear as it arrives back onboard to ensure that gear is still clear from obstruction. Once trawl is on deck examine the shine on the trawl doors to ensure the trawl was towing properly and not damaged during the tow.

10) SIC/Watch Leader examines the catch in cod-end ensuring that no damage had occurred to small mesh liner, and that the cod-end was sealed properly

11) SIC/Watch Leader and deck crew check SCANMAR sensor mesh pockets, door pockets and canisters for damage. Download CTD data.

12) Crew transfers the catch into the fish chute for below deck sampling by scientific staff. SIC/Watch Leader ensures crew cleans all fish debris out of trawl, ties up codend liner, and codend.

13) Crew checks the entire trawl for damage especially frameropes, lacings on fame lines, guard meshes, and gussets. Major repairs are logged in the Trawl Repair Form.

APPENDIX 3

STATION AND TOW INFORMATION FORM
(Bridge Log)
(revised April 2009)

Vessel	Trip	Set Number	Depth Sounder (meters)

1. Amount of Warp Out (meters):

WARP	Length (meters)	Tension Meter (tons)
Port		
Starboard		

2. SCANMAR Sink Rate and Bottom Contact: record time (NST)

1) Time Winch Block or Auto-trawl Shooting Finished	
2) Time of Trawl Touchdown - Start of tow	
3) Time Haul Back Started	
4) Time Trawl Off Bottom	
5) Sink Rate in Minutes (Time # 2minus Time # 1)	

3. Seabed Classification System in Use: **YES** ( ) **NO** ( )

4. Tow Speed Measurements: Actual values.

Time Point (minutes)	SPEED (KTS)	SPEED INSTRUMENT
3		
6		
9		Comments:
12		
14 (Haul Back)		
AVERAGE		

REMARKS:

Bridge Officer: _____

Date: _____

APPENDIX 4

ALTERATIONS TO TRAWL GEOMETRY DURING A TOW & ITS EFFECT ON TRAWL PERFORMANCE

The Campelen is a 3 bridle trawl where the main towing strain is taken on the centre bridle. There is none to very little slack in the netting panels which ensures a more even shape particularly in the lower wing and belly areas. The top and centre bridle merge into a single cable leaving only two main towing bridles connected to each door leg extension. By making the centre bridle slightly shorter than the top and bottom bridles much of the strain is taken in the centre of the net allowing the top panel to rise up under the action of the floats and the lower panel to 'dig' in due to the footgear weight. ***Any adjustment of the length of the bridle and/or footrope will result in the net fishing hard down on the bottom or fish lighter and upward***.

1. **Reduce Towing Speed:** Drag force (resistance to motion) is reduced and the headline height of the trawl increases and wing spread decreases or stays constant depending upon size of the trawl doors. Door spread will remain the same or will be reduced and at low speeds the doors will collapse.

2. **Increase Towing Speed:** Drag force increases and headline height is reduced. Wing spread may increase or stay constant. At high speeds doors will lift off bottom.

3. **Increase Warp (Scope Ratio) Length:** Door spread may increase, headline height decrease and wing spread should increase depending upon the amount of warp out. The doors may become unstable with too much warp and possibly fall over.

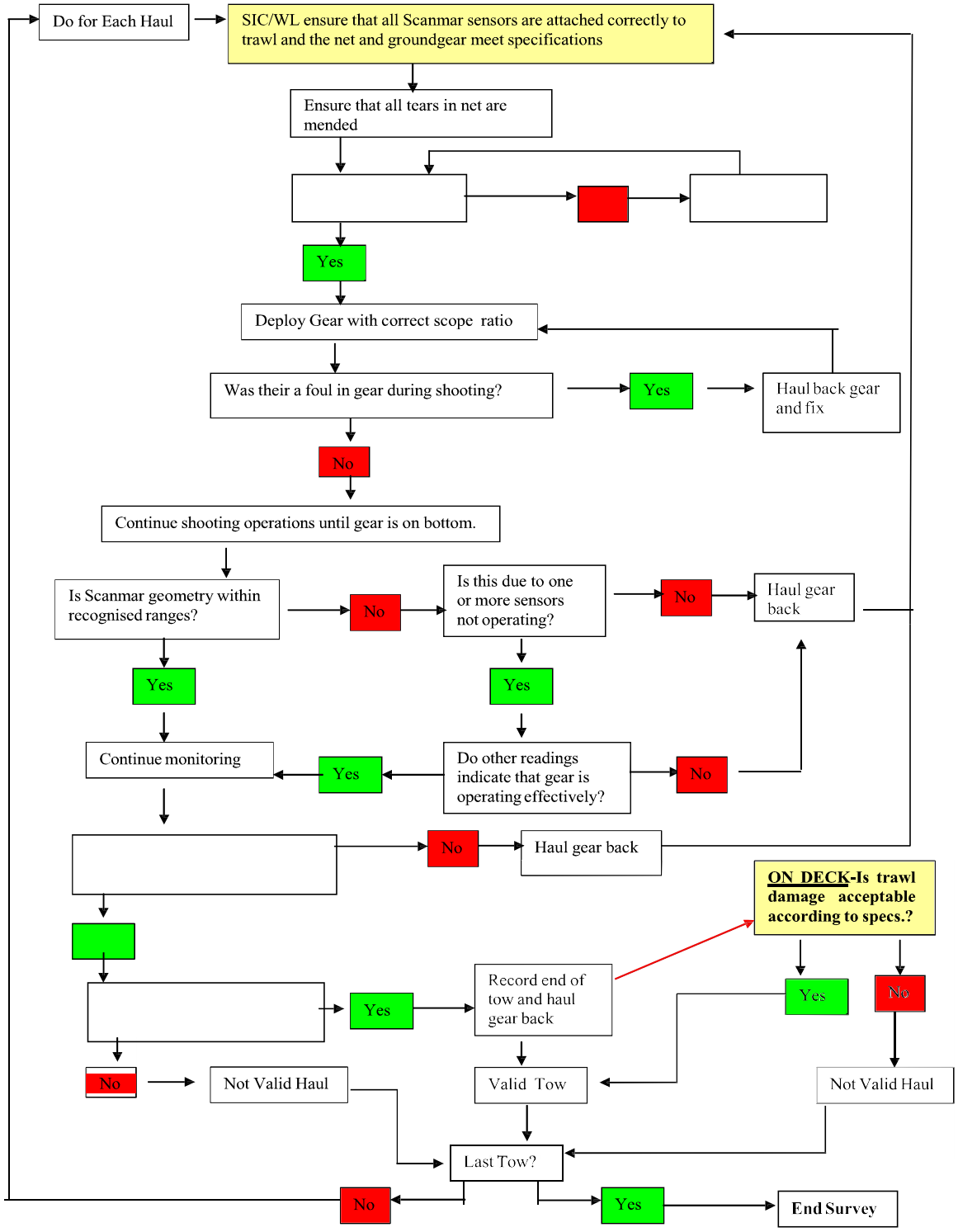
4. **Reduce Warp (Scope Ratio) Length:** Door spread may decrease, headline height increase and wing spread should decrease or remain constant depending upon the amount of warp out. The doors may become unstable. Critical when depth changes rapidly.

5. **Decrease Floatation:** Less buoyancy will decrease headline height and cause the footgear and lower panels to dig more into bottom.

6. **Increase Footgear Length:** The adding of set back to the footgear will increase its length and cause increase tension in the headline. It will pull the headline down and reduce trawl opening and make the footgear dig harder into the bottom. This could also occur after a major hookup of the footgear on bottom.

APPENDIX 5

NAFC SUCCESSFUL TOW CRITERIA
(Must be used in conjunction with Sections 2.20- 2.23)



APPENDIX 6

DERIVATION OF DAMAGE CRITERIA FOR NAFC CAMPELEN SURVEY TRAWL NET BODY

The original NAFC Protocol [8] for classifying damage to the net body of the trawl and determining whether a tow was unsuccessful appeared in later versions (~1998) of the 1994 "DFO, Newfoundland Canada Survey Trawl Reference Manual Campelen 1800 (McCallum &Walsh) ". It described two damage conditions to the trawl net body: 1) severe damage to large sections of lower wings, or bellies or codend; and 2) two or more tears in the net which comprise 20% or more of meshes in that panel.

In March 2009[15], it was agreed that the old 20% damage protocol, developed for groundfish surveys, did not cover the usage of the Campelen trawl for sampling shellfish and benthos in multi-species ecosystem surveys where large holes in certain panels/positions of the trawl would result in a large amount of catch escapement or drop out. It was agreed that a more conservative approach was necessary.

The table below shows the agreed damage lengths for each panel.

Panels	Stretch lengths (m)	Mesh Size (MS) (mm)	Meshes Deep (MD)	Damage Length (m)	Damage Length (ft)
Top Wings	11.76	80	147.0	1.2	4.0
Bottom Wings*	7.15	70	105.0	1.2	4.0
Square	3.33	60	55.5	0.9	3.0
1st belly	3.87	60	64.5	0.9	3.0
2nd belly	11.24	44	255.5	0.9	3.0
3rd belly	4.38	44	99.5	0.9	3.0
Extension	8.78	44	199.5	0.6	2.0
Codend	8.78	44	199.5	0.6	2.0
Codend Liner	10.20	12.7	803.2	0.3	1.0

* Average of 80 mm and 60 mm mesh sizes for lower wings
9-Mar-09

***Note**: Side panels are excluded because when they tear it is generally along with other panels to which they are attached.*

If the trawl is rigged properly then most tears will occur to the lower sections of the trawl. Tears in panels generally occur in the direction of the tow, i.e., on the long axis. Tears in the top panels are often associated with hookups or obstructions.

Any hole in the liner ***exceeding 0.3 m (1 ft)*** in any direction would render the haul invalid because of loss of catch, especially shrimp and juvenile and small forms of many finfish and shellfish. Tears in the liner generally results from/with tears in the codend or unrepaired damage.

[15] S. Walsh, D. Stansbury, D, Power & D. Orr.

APPENDIX 7

OPERATION GEAR CODES FOR CAMPELEN SURVEY TRAWL

These title (in bold) of these gear codes are the same ones that have been used by NAFC since the 1970s. Their descriptions have undergone an upgrade here.

1. **Normal tow**, no damage to trawl and tow time is a minimum of 10 minutes;

2. **Normal, some damage to net**, i.e. the length of torn meshes in any one panel torn are less than the maximum number permitted (see Code 3 below); in the case of a hook-up caused by the trawl being stuck in mud or on a sand wave which causes a shudder or stoppage of the vessel, haul back should commence immediately and if trawl damage is minimal (see Code 3) then the tow may be considered successful provided it was fishing at least 10 minutes. Catch is not affected.

3. **Unsuccessful**, damage to the trawl as follows: total tear up of trawl net, i.e. rim-racked, or loss of all gear, or loss of footgear, or loss of one or both trawl doors; severe damage to any panel in the trawl where 1 or more tears in the panel results in: tears in top and bottom wings exceeding 1.2 m; tears exceeding 0.9 m in the square and bellies; tears exceeding 0.6 m in the extension and cod-end. Tows where the tear in the codend liner exceeds 0.3 m in any direction. Broken main warps, bridles, head ropes, riblines, wing/breast lines, and fishing line; Catch is affected

4. **Unsuccessful, depth range covered was too large**. Wrong depth range for that stratum, i.e., tows that stray into the depth range of an adjacent stratum and the depth is rapidly changing outside the range, the haul is abandoned and tow is declared unsuccessful if is less than 10 minutes – may occur along shelf edge.

5. **Unsuccessful, net not damaged** but there may have been a malfunction in operations of the trawl. For example:
    a) Average towing speeds greater than 3.2 knots or less than 2.8 knots as calculated from Tow Form deck sheets**;**
    b) Wrong scope ratio (warp out to depth fished) used;
    c) Trawl net twisted in cables or hung up on the trawl doors;
    d) Codend or codend liner untied.
    e) Tows where there is a collection of fish between the codend and liner even though both appear to be tied securely.
    f) Eight or more floats missing or broken;
    g) Trawl door shine pattern on either one or both door shoes and tow brackets which indicates the doors have fallen over;
    h) All SCANMAR sensors not working at start of tow-usually indicates foul gear, all SCANMAR sensors not working throughout the tow or SCANMAR data indicates the trawl geometry are not within those dimensions expected for the towing depth.

i) SCANMAR sensors show the trawl is off bottom for most of the tow, i.e. greater than 2 minutes and/or more than twice in a 15 minute tow
j) Tows where anything that could impair the efficiency (changes geometry, and/or performance) of the trawl, e.g. large rocks equivalent to the size of a crab pot; other large objects, such as crab pots, truck tires, anchors, timbers/tree roots; oversized catches of mud, jellyfish or kelp or corals or sponges;
k) Any tow abandonment due to unusually large fish sign as observed on the echosounder.
l) Any tow abandonment due to weather or sea conditions even if tow duration was 10 minutes or higher.
m) Haul back of trawl delayed due to mechanical problems.
n) Any other malfunction that results in the tow duration being less than 10 minutes.

CHAPTER 3

TRAWL SPECIFICATION PROTOCOLS

3.1 INTRODUCTION

The Campelen 1800 shrimp trawl has been used as the annual multi-species bottom survey trawl at NAFC since the fall of 1995. The trawl, 'Campelen 1800 Super bottom trawl', as it is correctly known, was designed by Cosmos Trawl, Hirtshals/Skagen, Denmark who provided a copy of the design to NAFC in 1992. It is a 3-bridle, 4 panel, high opening polyethylene trawl with small rockhopper footgear and a small mesh liner in the codend. The trawl has a fishing circle of 1800 meshes of 60 mm twine with large side panels extending from ahead of the footgear back to the end of the 2nd belly. In this design the fore section of the lower trawl wing has been cut away, i.e., 'flying wing', leaving a bunt wing section that is in line with the top wing bunt.

The top and centre bridle merge into a single cable leaving only two main towing bridles connected to each door leg extension. By making the centre bridle shorter than the top and bottom bridles much of the strain is taken in the centre of the net allowing the top panel to rise up under the action of the floats and the lower panel to 'dig' in due to the footgear weight.

The footrope is of rockhopper construction consisting of 102 × 35.6 cm diameter tightly packed rubber disks, rubber and iron spacers and washers. The trawl is spread by 4.3 m^2 Morgère polyvalent trawl doors weighing 1400 kg.

This Chapter serves as an introduction to the Campelen Trawl Drawings and Parts List, and is integral to the protocols in the chapters on Procurement (4), Construction (6), Repair (7) and Quality Assurance (8).

3.2 TRAWL DRAWINGS

The trawl plan is the primary form of engineering and construction drawings used to visually convey the form and specification of the Campelen trawl. Technical specifications of the trawl drawings are not drawn to scale but are sufficient to give the impression of proportions and accuracy for assemblage. The Trawl Drawings are presented in a series of 28 pages (APPENDIX 1) with each drawing carrying an unique number and each component is cross-referenced with a Trawl Parts List number (AAPENDIX 2). Twelve drawings describe the rigging of the Campelen trawl and an additional 16 drawings describe in detail various hardware (Parts List) used in the trawl.

Specification of wire, chain and rope include construction, Minimum Breaking Strength (MBS), and grade.

3.3 RUNNING LINES

3.3.1 BRIDLES (Drawing Number CAM*1.0)

The bridles are made up of upper (20 m), upper/middle bridle extension (20 m) and middle (20 m) bridles consisting of 16 mm diameter 6x19-9/9/1 fiber core, galvanized wire rope (MBS=12 mt) swaged at both ends with the lower (40 m) bridle having a larger 22 mm diameter (MBS=22 mt). The middle bridle has a 3.97 m extension made of 20 mm diameter combination rope (MBS=8.87 mt) swaged at both ends.

The sections are joined with 5/8" hammerlocks. The 39.4 cm eye splices are included in the overall length measurements. Length measurements do not include the hammerlocks.

3.3.2 DOOR LEGS AND EXTENSIONS (Drawing Number CAM*1.1)

The 3.05 m upper and lower door legs are made up of 16 mm mid-link chain (Grade 80 alloy steel; MBS=20 mt) and are hammerlocked into the forward hole of the door using a combination of 5/8 inch and ¾ inch hammerlocks. The aft end of the door legs are attached to the door leg extension with a ¾ inch hammerlock.

The 6.1 m door leg extensions for the CCGS *W. Templeman* and the 7.62 m door leg extensions of the CCGS *Teleost* are made up of 22 mm diameter 6x19-9/9/1 fiber core, galvanized wire rope (MBS=22 mt) swaged at both ends. The fore extension is connected to the bridles with a 1 1/4 inch G-hook-recess link combination which is hammerlocked (5/8 inch) into the upper-middle bridle extension, lower bridle and pennant wire. The 39.4 cm eye splices are included in the overall length measurements.

Hammerlocks are not included in any of the length measurements.

3.3.3 DOOR PENNANTS (Drawing Number CAM*1.2)

The 12.82 m pennant wires for the CCGS *W. Templeman* and the 13.80 m wires for the CCGS *Teleost* are made up of 19 mm diameter 6x19-9/9/1 fiber core, galvanized wire rope (MBS=16 mt) spliced at both ends. The forward end of the pennant wire is attached to the door frame using a combination of hammerlocks, G-hook-recess links and chain.

Hammerlocks are not included in any of the length measurements.

3.4 NETTING (Drawing Numbers CAM*2.0 to 2.5)

The webbing for all panel sections is single braided polyethylene knotted netting (with the exception of the codend cover which is double knotted polyethylene netting), pre-stretched, heat treated and dyed green. Mesh sizes are stretch measures using knot center- to - knot center. Trawl construction is of 4.0, 3.0 and 2.0 mm diameter polyethylene twine varying in mesh size from: 80 mm in top wings and corresponding 1st and 2nd side panels; 80 and 60 mm in lower wings; 60 mm in the square and 1st belly and 3rd and 4th side panels; and, 44 mm in 2nd and 3rd bellies, 5th side panel, codend extension and codend. There is little-to-no-slack in the netting panels with the exception of lower bunt wings (60mm), where the slack is mainly located, and this bunt section is 7 meshes longer than the corresponding side panel. Stretch lengths of panels do not include joining rounds. Panel widths include selvedge meshes.

The main netting has a single selvedge with the top and bottom sections of the net joined together at their sides by gathering three meshes (four knots) for each stop. (See Chapter 6:Trawl Construction Protocols). Specification of netting selvedges for gussets and guard meshes and the codend assembly is as follows:

3.3.1 **GUSSET and GUARD MESHES***:* The 80 mm mesh size gussets/guard meshes in the top wings and 140 mm mesh size guard meshes in the lower wings are double braided polyethylene knotted netting. Two knots from guard netting and lower wing form the selvedge.

3.3.2 **CODEND:** The codend is a two panel construction with single braided polyethylene 44 mm stretched mesh knotted netting. The selvedge is created in the same manner as in the main netting. The codend is closed at terminal end using a series of knitted loops (~2 inches) constructed of braided nylon twine. Loops are hung to the codend using a general ratio of 1 loop to 2-3 meshes of codend and cover. A 3/4" Sampson braided nylon rope is passed through the nylon loops and the bag is then closed using a chain knot.

3.3.3 **CODEND LINER**: the 2 panel liner is 12.7 mm stretched meshed knotless white nylon netting. It is hung on the inside of the codend 2 meshes deep fore of the join of the codend and the extension section. It is attached to every mesh in the top of the codend. The selvedge of the liner is created by gathering the two panels and lacing an approximately 1/2" roll of the material. The liner is closed off with 3 mm poly twine near the section where it extends outside the codend.

3.3.4 **CODEND COVER**: The codend cover is a 140 mm stretched meshed two panel construction, 2 mm double braided polyethylene knotted netting covering the extension and codend. It is attached to the extension piece 20.5 meshes deep from where the extension joins the third belly. The selvedge (3 meshes) is laced to the ribline.

3.4 FRAME LINES

3.4.1 HEADLINE (Drawing Number CAM*2.0)

The 29.5 m headline is made up of 3 sections[1] of 22 mm diameter combination rope (MBS=14 mt). The 2x13.5 m quarter and 1x 2.44 m bosom sections are swaged at both ends and hammer locked together. The length of the headline includes the length of the joining hammerlocks and all 39.4 cm eye splices.

3.4.2 BOLSHLINES (Drawing Number CAM*2.0)

The upper 29.95 m bolshline is made up of 3 sections of 16 mm diameter pre-stretched Kraft rope (MBS=5.8 mt). The 2x13.5 m quarter and 1x2.89 m bosom sections are seized together with nylon twine at the eye splices.

The lower 20.00 m bolshline is made up of 3 sections of 16 mm diameter Kraft rope. The 8.75 m quarter and 1x2.70 m bosom sections are seized together with nylon twine at the eye splices

The lower wingend bolshlines are 2.34 m length of 16 mm diameter Kraft rope.

All lines include the standard eye tucks of 12.7 cm at each end. The lengths of the upper and lower bolshline includes the length of the joins and all eye splices.

3.4.3 BREASTLINES/WINGLINES (Drawing Number CAM*2.0)

The 8.02 m upper wingline, and the 3.60 m upper and lower breastlines use 20 mm diameter combination rope (MBS=8.87 mt).

The 2.34 m lower winglines are made up of 22 mm diameter combination rope (MBS=14 mt).

---

[1] (6×12) polypropylene jacket over a steel core

The sections are swaged at both ends. The lengths includes the length of the 39.4 cm eye splices but no hammerlocks.

3.4.4 RIBLINES (Drawing Number CAM*2.0)

The riblines are made up of 4 sections of 20 mm diameter pre-stretched Kraft rope (MBS=10 mt). The 1x 16.0 m codend-extension section, 1x 4.0 3rd belly section, 2x10.22 m 2nd belly sections and 2x 10.59 m 1st belly and square sections are seized (butted) together with nylon twine at the eye splices. The latter two sections form the upper and lower riblines. The lengths of the riblines include the eye splices but not the joins. All riblines include the standard eye tucks of 12.7 cm at each end.

3.4.5 FISHINGLINE (Drawing Number CAM*2.0 & 3.2)

The 19.5 m headline is made up of 3 sections of 22 mm diameter combination rope (MBS=14 mt). The 2x8.43 quarter and 1x2.44 m bosom sections are swaged at both ends and hammer locked together.

The length of the fishing line includes the length of the hammerlocks and all 39.4 cm eye splices

3.5 FOOTGEAR (Drawing Numbers CAM*3.0 to 3.2 & Appendix B)

The footgear is symmetrical about the centre line 35.60 m (length includes hammerlocks) of 16 mm (5/8 inch) long mid-link galvanized Grade 80 alloy chain comprising 5 sections of the footgear. Onto the bosum (5.9 m) and quarter sections (6.85 m/each) are strung, under tension, 34x14 inch (356 mm) rubber rockhopper disks in sets separated by 34x7inch rubber and 39x8 inch iron spacers and 6x6 inch steel washers. The length of each footrope chain section is measured from centre hammerlock to centre hammerlock with the exception of the aft end of each flying wing chain eye splice where the hammerlock length is not included.

Each quarter section is hammerlocked into the lower swivel/hole at one end of a 3 holed-triangular shaped delta plate. At the opposite lower end hole of the plate is attached an 8 m flying wing made up of 16 mm (5/8 inch) long mid-link galvanized Grade 80 alloy chain to which, at the aft end, is attached a 6 inch washer-14 inch rubber bunt bobbin-7 inch spacer arrangement. Upon assembly the fore end of the flying wing hammerlocks into the lower bridle.

Once the footgear is assembled a 19.5 m x 9.5 mm (3/8 inch) long mid-link galvanized Grade 80 alloy (travel) chain is strung through the top of each disk and

hammerlocked into the top swivel/hole of each delta plate above the footrope attachment. The 35 bobbin chains, each 393 mm (15.5 inches) long are wrapped once around the travel chain over the centre of each iron spacer, except where two sections of the footgear meet they are located over a rubber spacer. The total weight (in seawater) of the footgear is 503.41 kg.

The fishing line passes through both end rings of the bobbin chains. Into the top hole of the delta plate are hammerlocked the lower wingline, lower wingend bolshline, lower bolshline, and fishing line.

3.6 ATTACHMENTS

3.6.1 DOORS (Drawing Number CAM*1.1 & 1.2; CAM*4.0 to 4.2)

The trawl doors are 4.3m^2 Morgère[2] single slot, cambered, oval polyvalent doors painted black. Weight in air is 1400 kg. The doors have three (aft, middle and forward) removable shoes. A 38 mm (1 ½") oval action swivel (Safe Working Load (SWL)=18 mt) connects the trawl warp to a 38 mm (1 ½") bow shackle (SWL=17 mt) bolted into the centre brace of the door.

Each door will have a engraved number code and a Scanmar door sensor pocket installed.

3.6.2 FLOTATION (Drawing Number CAM*2.3)

Eighty-eight 8" (200 mm) deep-water (rated ~ 1400 m) yellow trawl floats (2.61 kg of buoyancy each) hung evenly to headline (10 in bosum and 39 along the quarters of the wings. Six extra floats (13.05 kg buoyancy) of the same dimensions are seized to backside of the headline on each wing end to counter the negative buoyancy of the Scanmar wing canisters. Total number of floats used on the headline is 100 (261 kg of buoyancy).

3.6.3 TRAWL WARPS (Drawing Number CAM*1.0)

The type of warp construction is a galvanized steel strand wire with a steel core (IWRC) and is composed of 6 steel strands containing 19 wires. The individual wires are twisted into a strand and the strand is then twisted around a steel core. Each warp diameter is 25.4 mm and its MBL is 49.5 mt. Weight is specified as 2.92 kg/m (± 3% tolerance).

---

[2] In the spring of 1996 the CCGS *Wilfred Templeman* purchased a new set of trawl doors meeting the same specifications, but not made by Morgère. After some days of fishing it was recognized that these doors were very unstable and were falling over. These doors were replaced with the spare set from the CCGS *Teleost* and after a few test trials they were found to work perfectly. It is for this reason that the Morgère brand is specified for the trawl doors.

The wire is generally purchased in 4000 m lengths on reels[3] to satisfy the requirements of both vessels and is pre-lubricated with light petroleum or solvent-based penetrating lubricant before it leaves the factory. The warps are specified as one being left lay and the other right lay.

3.6.4 SCANMAR WING CANNISTERS AND CTD BOARD & CANNISTER (CAM* 4.3 & 4.4)

Although not a part of the Campelen trawl itself, special wing canisters each ~ 12 kg weight in water) were developed to house the SCANMAR wingend sensors. An additional 12 floats are used on the headline at each end to make them near neutral buoyant.

The Oceanographic conductivity-temperature-depth (CTD) probe is attached to the centre of the headline and sits in over the square. The 4.9 kg (weight in water) probe sits inside a shock absorbing canister (7.2 kg weight in water) connected to a UHMV polyethylene mounting board (1.4 kg weight in water). No extra floats are used since the upward lifting force of the board negates the weight of the unit. ***Note: the bosom floats on the headline remain in front of the CTD board; do not string them down the side of the board.***

[3] At present CCGS *Teleost* can carry 4000 m and CCGS *W. Templeman* and her sister ship CCGS *A. Needler* can only accommodate 3500 m.

APPENDIX 1

FISHERIES AND OCEANS-MARINE INSTITUTE 2015 TRAWL DRAWINGS

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CAMPELEN 1800

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Section 4 – Parts

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SECTION 1 - RIGGING

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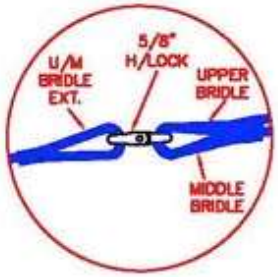
NOTE:
- HAMMERLOCKS ARE NOT INCLUDED IN LENGTH MEASUREMENTS

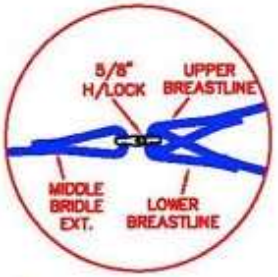
DETAIL 'A'



DETAIL 'B'

DETAIL 'C'

DETAIL 'D'



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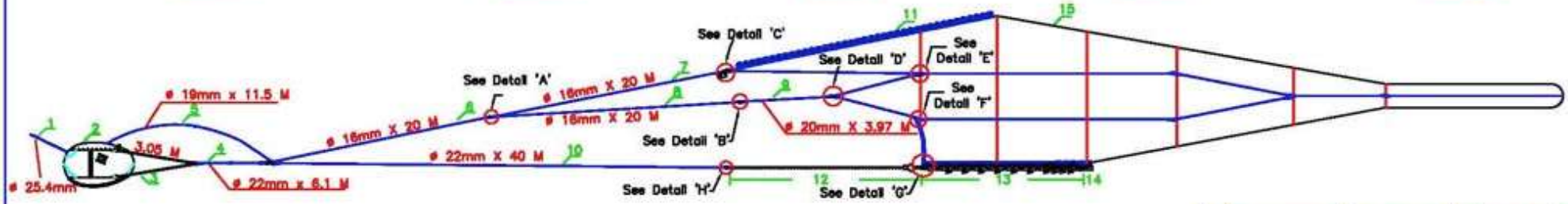

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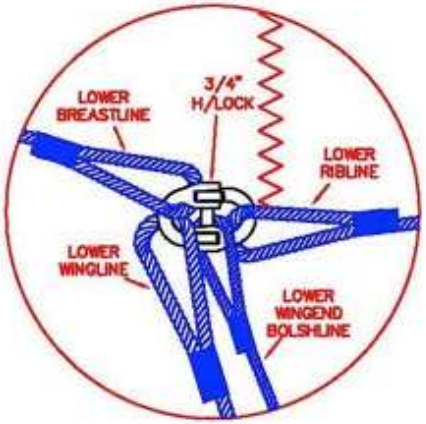

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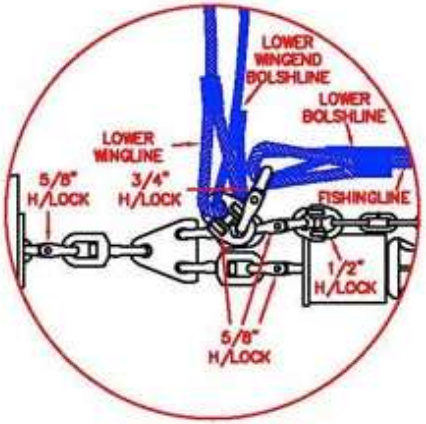

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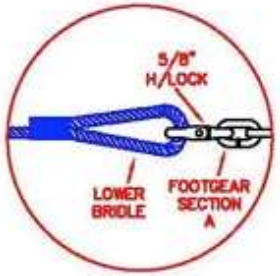

SEE APPENDIX B

#	COMPONENT	MATERIALS	QTY	PAGE NO.	PART NO.
1	Warp	Wire 6 x 19	2	1-3	CT01
2	4.58 sqm Door	1400 kg Oval	2	1-3,13-14	CT02
3	Door Legs	16mm Chain	4	1-3	CT03
4	Door Leg Extn	Wire 6 x 19	2	1-3	CT04
5	Pennant Wire	Wire 6 x 19	1	1-3	CT05
6	U/M Bridle Ext.	Wire 6 x 19	2	1	CT06
7	Upper Bridle	Wire 6 x 19	2	1	CT07
8	Middle Bridle	Wire 6 x 19	2	1	CT08
9	Middle Bridle Ext.	Comb. Rope	2	1	CT09
10	Lower Bridle	Wire 6 x 19	2	1	CT10
11	Floats (203mm)	Plastic	100	1,7	CT11
12	F/Gear Sect. A	Chain 16mm ø	2	1,10-12	CT12
13	F/Gear Sect. B	Chain 16mm ø	2	1,10-12	CT13
14	F/Gear Sect. C	Chain 16mm ø	1	1,10-12	CT14
15	Trawl Body	PE Netting	1	1,4	CT15

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CAMPELEN 1800 SURVEY TRAWL
RIGGING PROFILE

DATE DRAWN:	DWG NO.:		REV.	SCALE:
12/01/15	CAM*1.0	PG 1 OF 28 PG	4	NTS

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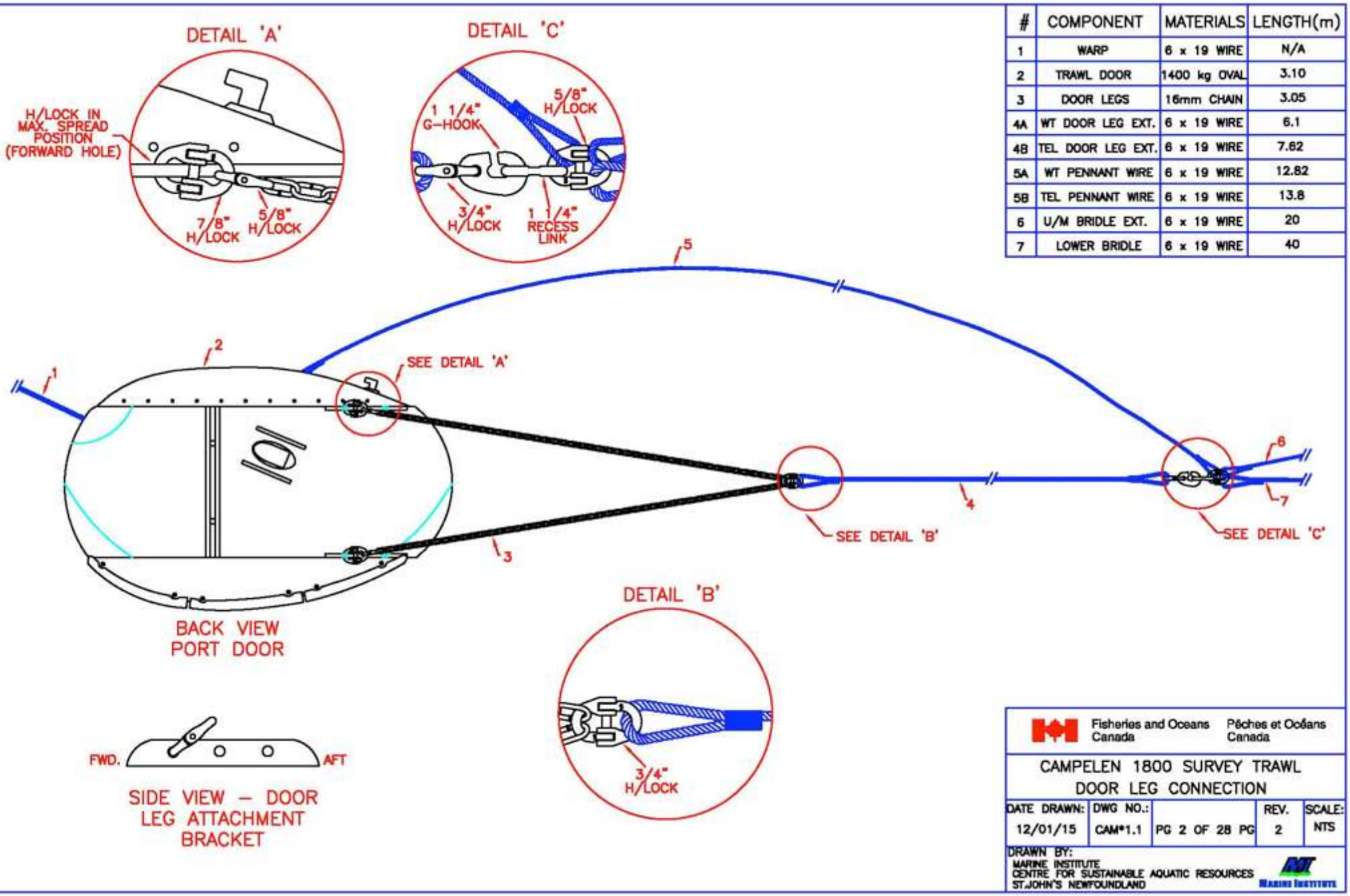

#	COMPONENT	MATERIALS	LENGTH(m)
1	WARP	6 x 19 WIRE	N/A
2	TRAWL DOOR	1400 kg OVAL	3.10
3	DOOR LEGS	16mm CHAIN	3.05
4A	WT DOOR LEG EXT.	6 x 19 WIRE	6.1
4B	TEL DOOR LEG EXT.	6 x 19 WIRE	7.62
5A	WT PENNANT WIRE	6 x 19 WIRE	12.82
5B	TEL PENNANT WIRE	6 x 19 WIRE	13.8
6	U/M BRIDLE EXT.	6 x 19 WIRE	20
7	LOWER BRIDLE	6 x 19 WIRE	40

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CAMPELEN 1800 SURVEY TRAWL
DOOR LEG CONNECTION

DATE DRAWN:	DWG NO.:		REV.	SCALE:
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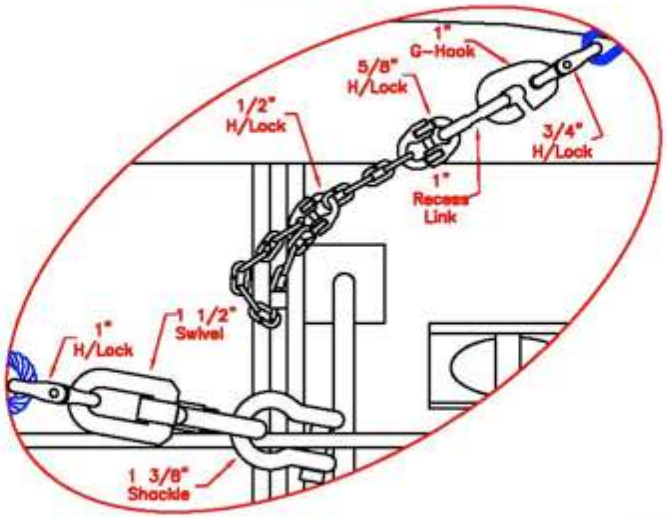
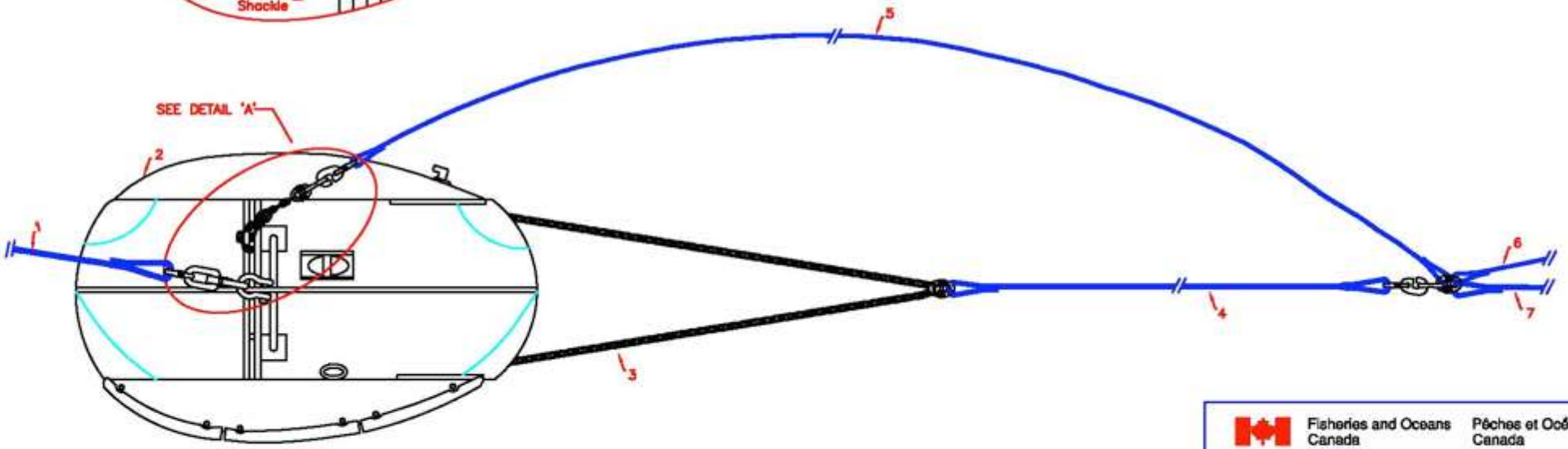
DETAIL 'A'





FRONT VIEW
STBD DOOR

#	COMPONENT	MATERIALS	LENGTH(m)
1	WARP	6 x 19 WIRE	N/A
2	TRAWL DOOR	1400 kg OVAL	3.10
3	DOOR LEGS	16mm CHAIN	3.05
4A	WT DOOR LEG EXT.	6 x 19 WIRE	6.1
4B	TEL DOOR LEG EXT.	6 x 19 WIRE	7.62
5A	WT PENNANT WIRE	6 x 19 WIRE	12.82
5B	TEL PENNANT WIRE	6 x 19 WIRE	13.8
6	U/M BRIDLE EXT.	6 x 19 WIRE	20
7	LOWER BRIDLE	6 x 19 WIRE	40

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CAMPELEN 1800 SURVEY TRAWL
PENNANT CHAIN CONNECTION

DATE DRAWN:	DWG NO.:		REV.	SCALE:
12/01/15	CAM*1.2	PG 3 OF 28 PG	2	NTS

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SECTION 2 - NETTING

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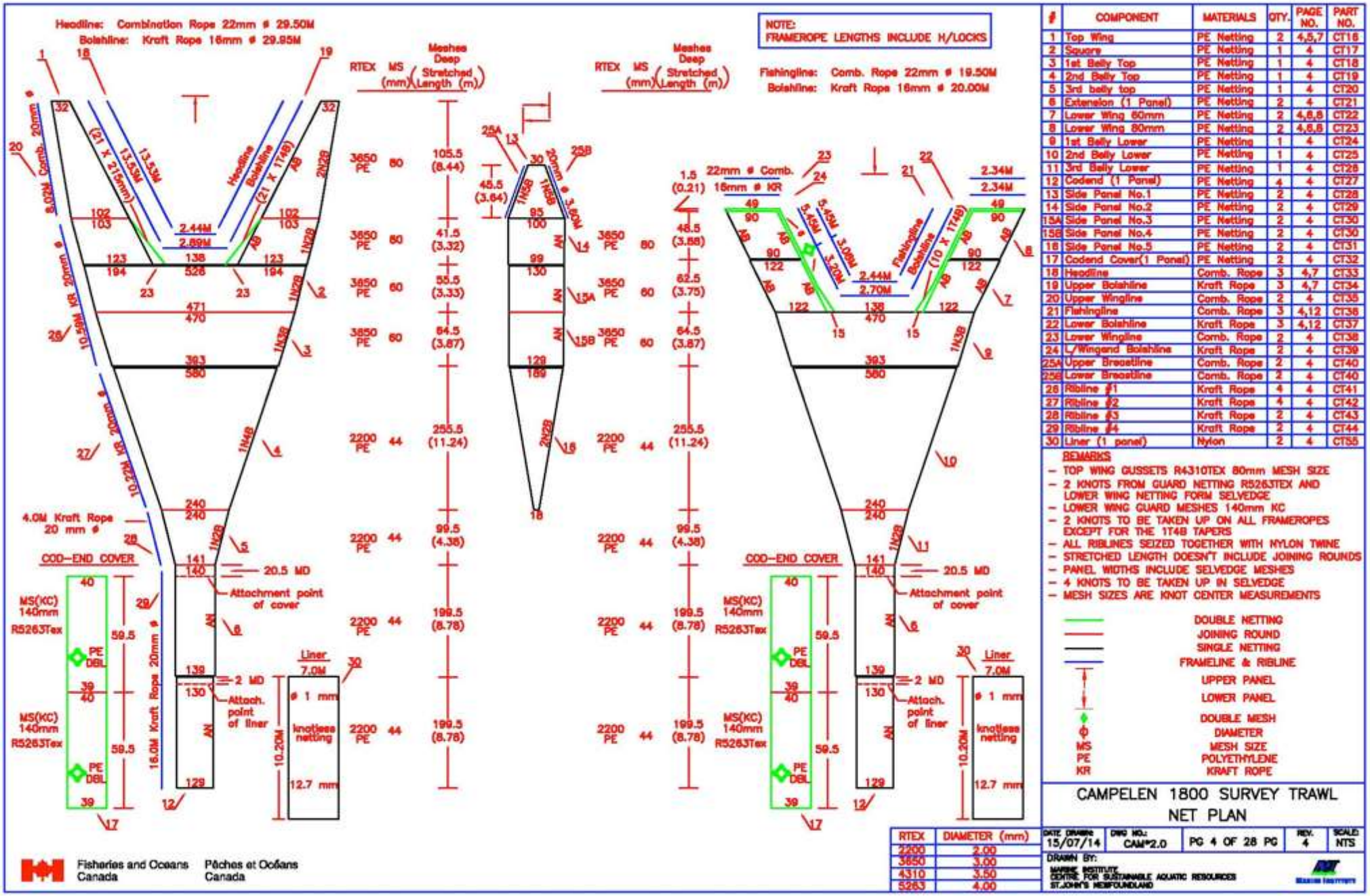

#	COMPONENT	MATERIALS	QTY.	PAGE NO.	PART NO.
1	Top Wing	PE Netting	2	4,5,7	CT16
2	Square	PE Netting	1	4	CT17
3	1st Belly Top	PE Netting	1	4	CT18
4	2nd Belly Top	PE Netting	1	4	CT19
5	3rd belly top	PE Netting	1	4	CT20
6	Extension (1 Panel)	PE Netting	2	4	CT21
7	Lower Wing 60mm	PE Netting	2	4,6,8	CT22
8	Lower Wing 80mm	PE Netting	2	4,6,8	CT23
9	1st Belly Lower	PE Netting	1	4	CT24
10	2nd Belly Lower	PE Netting	1	4	CT25
11	3rd Belly Lower	PE Netting	1	4	CT26
12	Codend (1 Panel)	PE Netting	4	4	CT27
13	Side Panel No.1	PE Netting	2	4	CT28
14	Side Panel No.2	PE Netting	2	4	CT29
15A	Side Panel No.3	PE Netting	2	4	CT30
15B	Side Panel No.4	PE Netting	2	4	CT30
16	Side Panel No.5	PE Netting	2	4	CT31
17	Codend Cover(1 Panel)	PE Netting	2	4	CT32
18	Headline	Comb. Rope	3	4,7	CT33
19	Upper Bolshline	Kraft Rope	3	4,7	CT34
20	Upper Wingline	Comb. Rope	2	4	CT35
21	Fishingline	Comb. Rope	3	4,12	CT36
22	Lower Bolshline	Kraft Rope	3	4,12	CT37
23	Lower Wingline	Comb. Rope	2	4	CT38
24	L/Wingend Bolshline	Kraft Rope	2	4	CT39
25A	Upper Breastline	Comb. Rope	2	4	CT40
25B	Lower Breastline	Comb. Rope	2	4	CT40
26	Ribline #1	Kraft Rope	4	4	CT41
27	Ribline #2	Kraft Rope	4	4	CT42
28	Ribline #3	Kraft Rope	2	4	CT43
29	Ribline #4	Kraft Rope	2	4	CT44
30	Liner (1 panel)	Nylon	2	4	CT55

REMARKS
- TOP WING GUSSETS R4310TEX 80mm MESH SIZE
- 2 KNOTS FROM GUARD NETTING R5263TEX AND LOWER WING NETTING FORM SELVEDGE
- LOWER WING GUARD MESHES 140mm KC
- 2 KNOTS TO BE TAKEN UP ON ALL FRAMEROPES EXCEPT FOR THE 1T48 TAPERS
- ALL RIBLINES SEIZED TOGETHER WITH NYLON TWINE
- STRETCHED LENGTH DOESN'T INCLUDE JOINING ROUNDS
- PANEL WIDTHS INCLUDE SELVEDGE MESHES
- 4 KNOTS TO BE TAKEN UP ON SELVEDGE
- MESH SIZES ARE KNOT CENTER MEASUREMENTS

DOUBLE NETTING
JOINING ROUND
SINGLE NETTING
FRAMELINE & RIBLINE
UPPER PANEL
LOWER PANEL
DOUBLE MESH
Φ DIAMETER
MS MESH SIZE
PE POLYETHYLENE
KR KRAFT ROPE

RTEX	DIAMETER (mm)
2200	2.00
3650	3.00
4310	3.50
5263	4.00

CAMPELEN 1800 SURVEY TRAWL NET PLAN

DATE DRAWN	DWG NO.:		REV.	SCALE
15/07/14	CAM*2.0	PG 4 OF 28 PG	4	NTS

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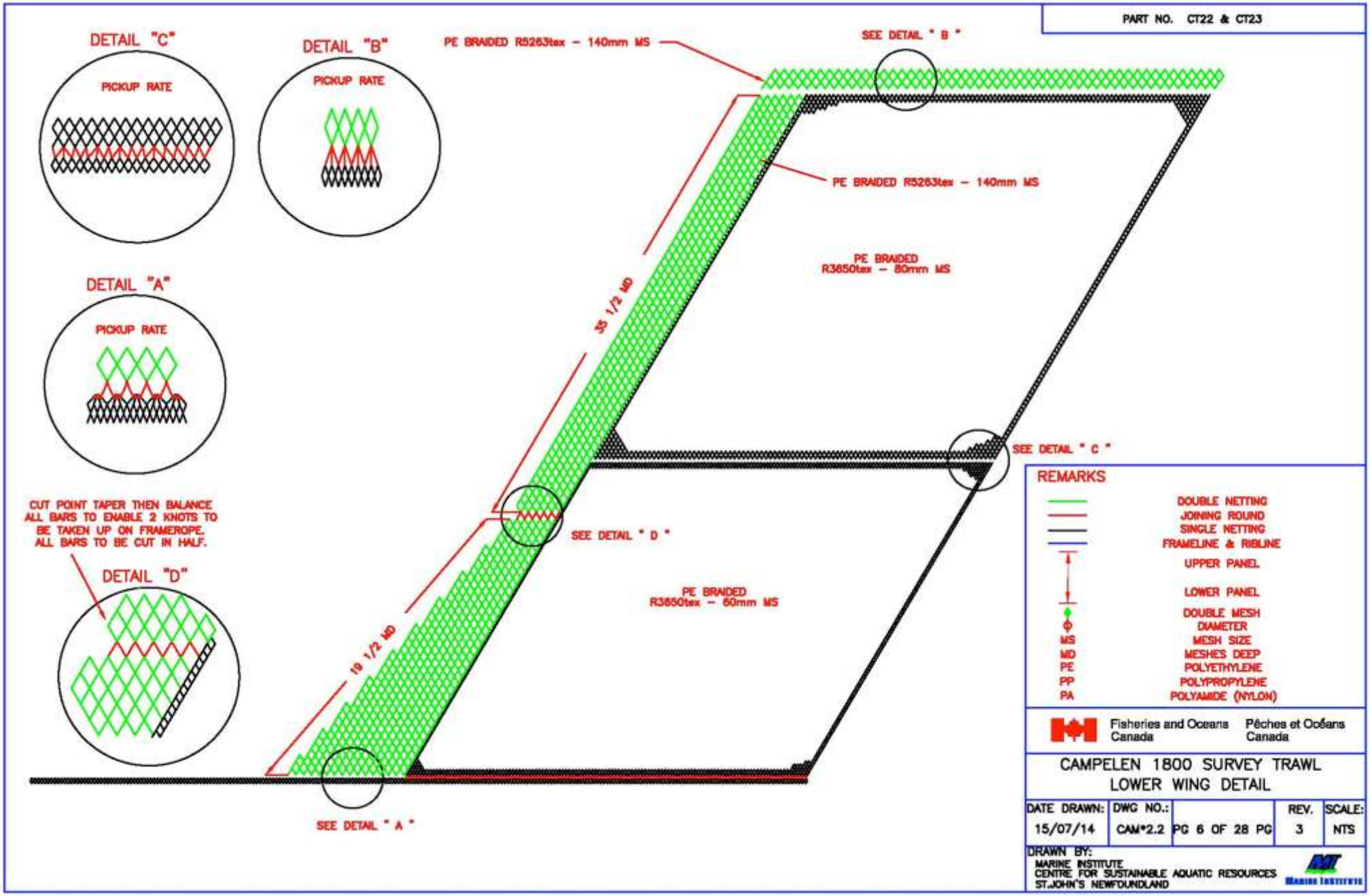
PART NO. CT22 & CT23
DETAIL "C"
PICKUP RATE
DETAIL "B"
PICKUP RATE
DETAIL "A"
PICKUP RATE
DETAIL "D"
CUT POINT TAPER THEN BALANCE ALL BARS TO ENABLE 2 KNOTS TO BE TAKEN UP ON FRAMEROPE. ALL BARS TO BE CUT IN HALF.
PE BRAIDED R5263tex – 140mm MS
SEE DETAIL " B "
PE BRAIDED R5263tex – 140mm MS
PE BRAIDED R3650tex – 80mm MS
35 1/2 MD
SEE DETAIL " C "
SEE DETAIL " D "
PE BRAIDED R3650tex – 60mm MS
19 1/2 MD
SEE DETAIL " A "
REMARKS
DOUBLE NETTING
JOINING ROUND
SINGLE NETTING
FRAMELINE & RISLINE
UPPER PANEL
LOWER PANEL
DOUBLE MESH
Φ DIAMETER
MS MESH SIZE
MD MESHES DEEP
PE POLYETHYLENE
PP POLYPROPYLENE
PA POLYAMIDE (NYLON)
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CAMPELEN 1800 SURVEY TRAWL
LOWER WING DETAIL
DATE DRAWN: 15/07/14
DWG NO.: CAM*2.2
PG 6 OF 28 PG
REV. 3
SCALE: NTS
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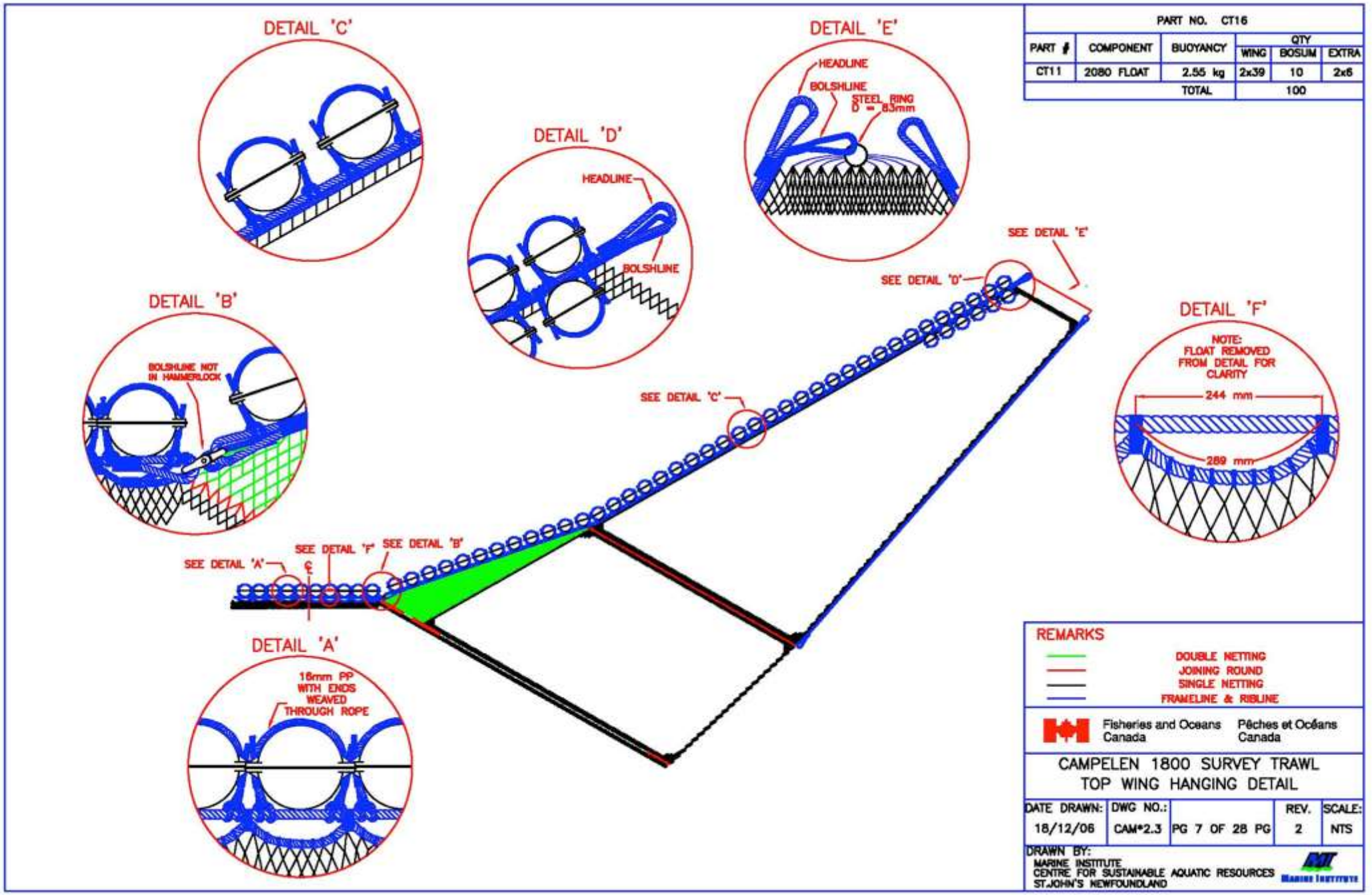

PART NO. CT16					
PART #	COMPONENT	BUOYANCY	QTY		
			WING	BOSUM	EXTRA
CT11	2080 FLOAT	2.55 kg	2x39	10	2x6
		TOTAL		100	

REMARKS

DOUBLE NETTING
JOINING ROUND
SINGLE NETTING
FRAMELINE & RIBLINE

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CAMPELEN 1800 SURVEY TRAWL
TOP WING HANGING DETAIL

DATE DRAWN:	DWG NO.:		REV.	SCALE:
18/12/06	CAM*2.3	PG 7 OF 28 PG	2	NTS

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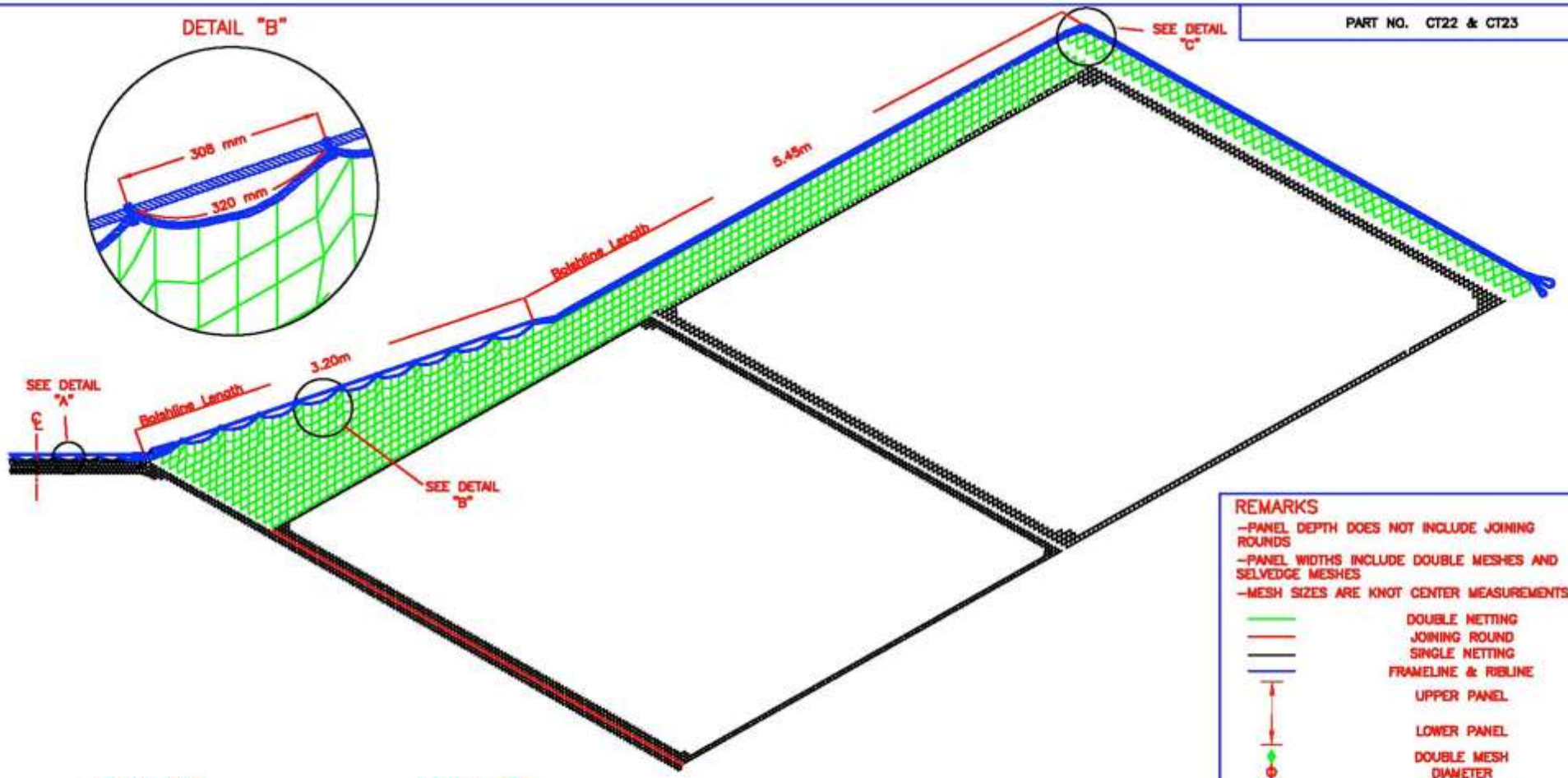

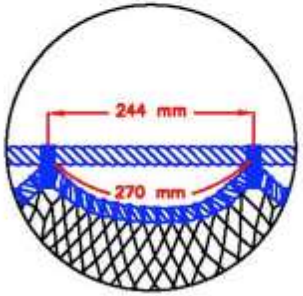

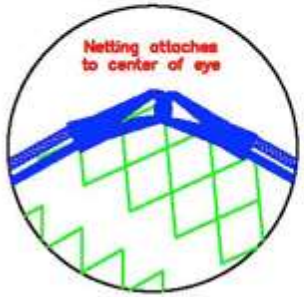

PART NO. CT22 & CT23

REMARKS

- PANEL DEPTH DOES NOT INCLUDE JOINING ROUNDS
- PANEL WIDTHS INCLUDE DOUBLE MESHES AND SELVEDGE MESHES
- MESH SIZES ARE KNOT CENTER MEASUREMENTS

	DOUBLE NETTING
	JOINING ROUND
	SINGLE NETTING
	FRAMELINE & RIBLINE
	UPPER PANEL
	LOWER PANEL
	DOUBLE MESH
Φ	DIAMETER
MS	MESH SIZE
MD	MESHES DEEP
PE	POLYETHYLENE
PP	POLYPROPYLENE
PA	POLYAMIDE (NYLON)

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CAMPELEN 1800 SURVEY TRAWL LOWER WING HANGING DETAIL

DATE DRAWN:	DWG NO.:		REV.	SCALE:
12/11/14	CAM*2.4	PG 8 OF 28 PG	4	NTS

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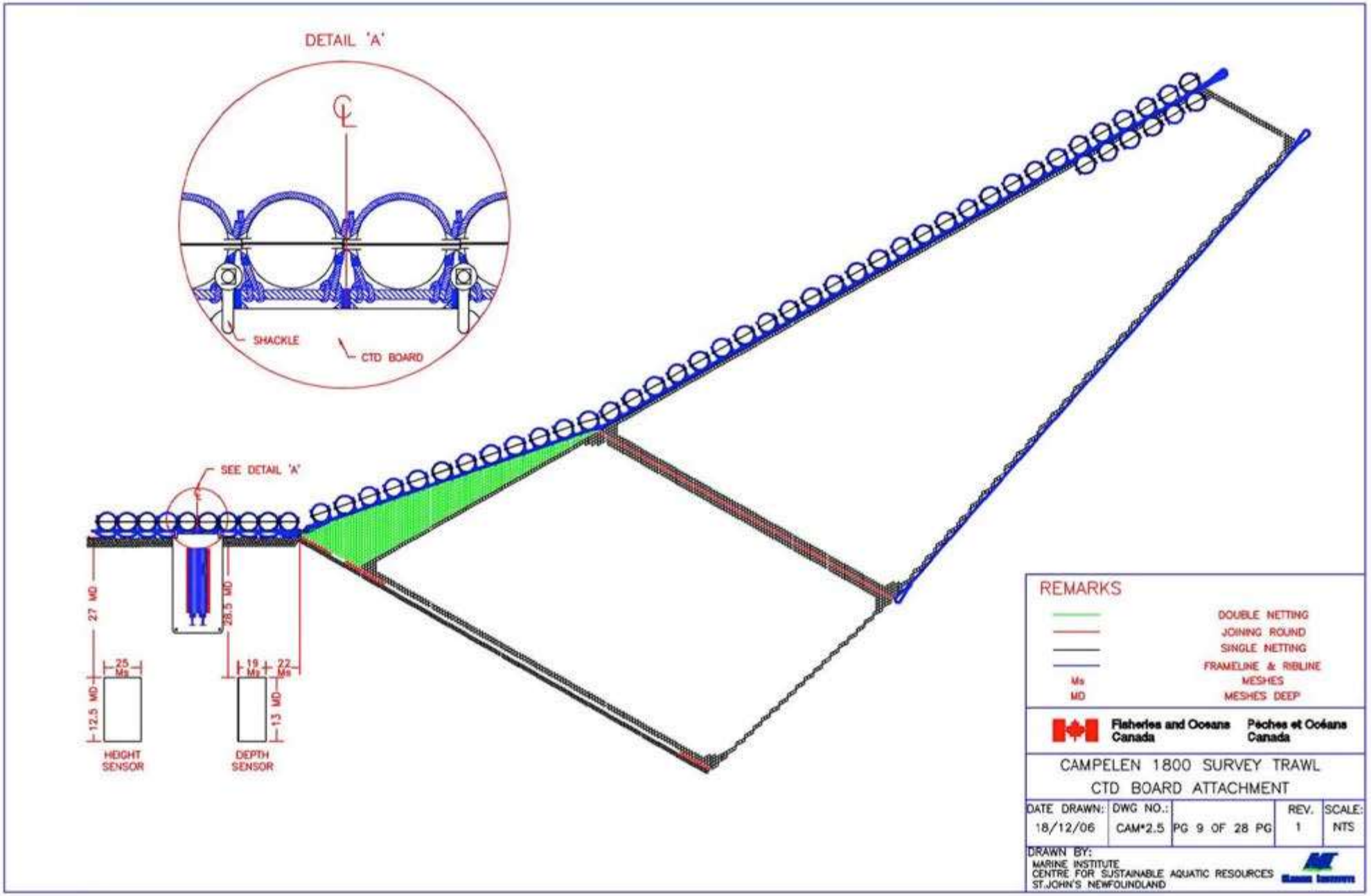
DETAIL 'A'
SHACKLE
CTD BOARD
SEE DETAIL 'A'
27 MD
28.5 MD
25 Ms
19 Ms
22 Ms
12.5 MD
13 MD
HEIGHT SENSOR
DEPTH SENSOR
REMARKS
DOUBLE NETTING
JOINING ROUND
SINGLE NETTING
FRAMELINE & RIBLINE
Ms MESHES
MD MESHES DEEP
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Pêches et Océans Canada
CAMPELEN 1800 SURVEY TRAWL
CTD BOARD ATTACHMENT
DATE DRAWN: 18/12/06
DWG NO.: CAM*2.5
PG 9 OF 28 PG
REV. 1
SCALE: NTS
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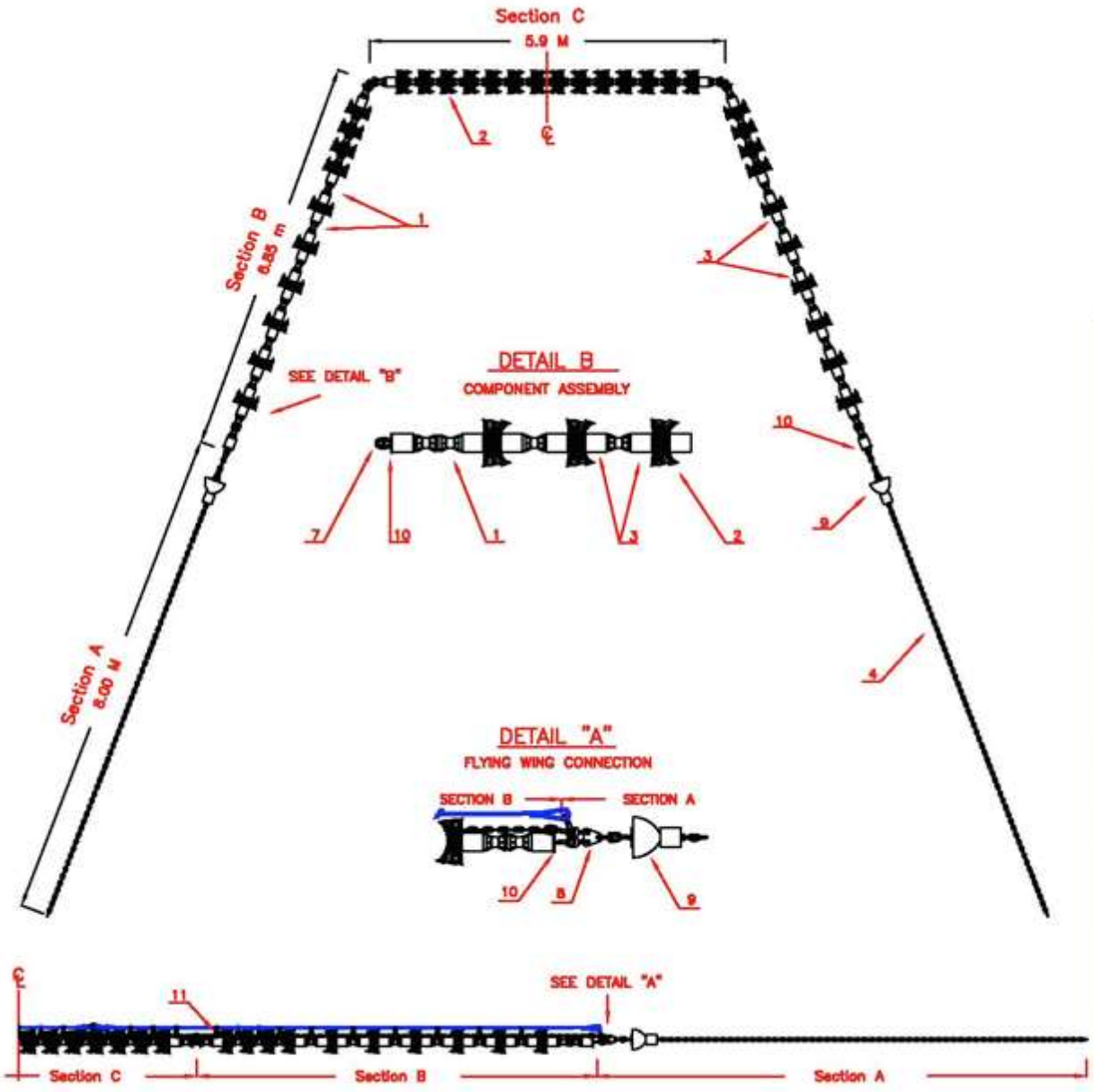
SECTION 3 – FOOTGEAR



DRAWING NOTES:

- GROUND GEAR IS SYMMETRICAL ABOUT CENTERLINE.
- LENGTHS FOR SECTION B & C ARE MEASURED FROM CENTRE HAMMERLOCK TO CENTRE HAMMERLOCK.
- LENGTH OF SECTION A IS MEASURED FROM CENTRE HAMMERLOCK TO END OF CHAIN (SEE DETAIL A).

#	COMPONENT	WEIGHT (KGS) (IN SEAWATER)		NUMBERS				Page NO.	PART NO.
		UNIT	TOTAL	TOTAL	SECT. A	SECT. B	SECT. C		
1	8" (200mm) Iron Spacer	5.29	206.31	39	0	2x12	1x15	21	CT44
2	14"(356mm) Rockhopper Sets of 3 Disk	0.43	43.9	34X3	0	2x10	1x14	22	CT45
3	7" (178mm) Rubber Spacer	0.37	12.58	34	2X1	2x15	1x2	23	CT46
4	5/8" (16mm) Mid Link Chain	4.96/M	74.30	14.98	2x7.46m			11	CT12
5	5/8" (16mm) Mid Link Chain	4.96/M	66.96	13.5m		2x6.75m		11	CT13
6	5/8" (16mm) Mid Link Chain	4.96/M	28.76	5.80m			1X5.80m	11	CT14
7	5/8" (16mm) Hammerlock	1.0	12.0	10	2x4	2x2	0	18	CT48
8	Delta Plate (441mm)	5.37	10.74	2	2	0	0	24	CT49
9	14"(356mm) Rubber Bunt Bobbin	4.80	9.6	2	2	0	0	25	CT50
10	6" (152mm) Washer	0.42	3.36	8	2x1	2x2	1x2	26	CT51
11	13.5" (393mm) Bobbin Chain	0.58	20.3	35	0	2x10	1x15	27	CT52
	TOTAL WEIGHT		468.81						

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CAMPELEN 1800 SURVEY TRAWL

FOOTGEAR

DATE DRAWN:	DWG NO.:		REV.	SCALE:
06/11/14	CAM*3.0	PG 10 OF 28 PG	3	NTS

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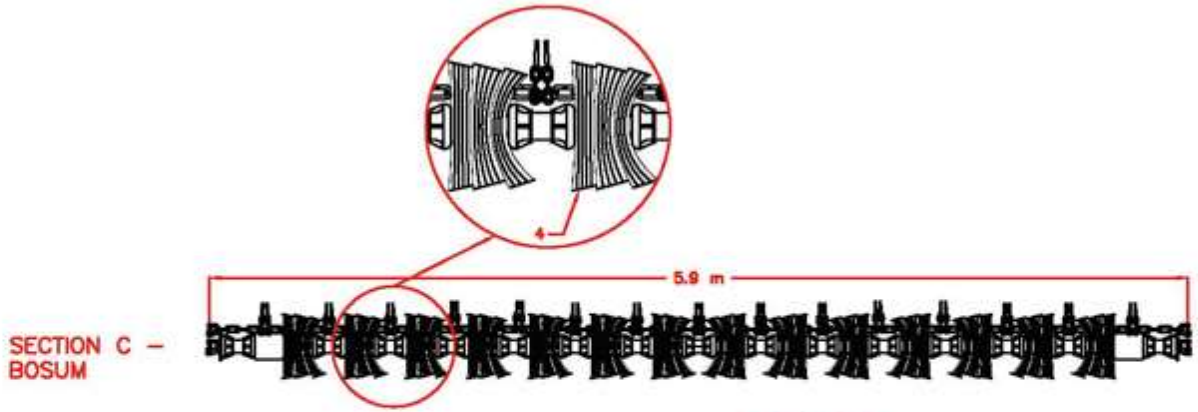

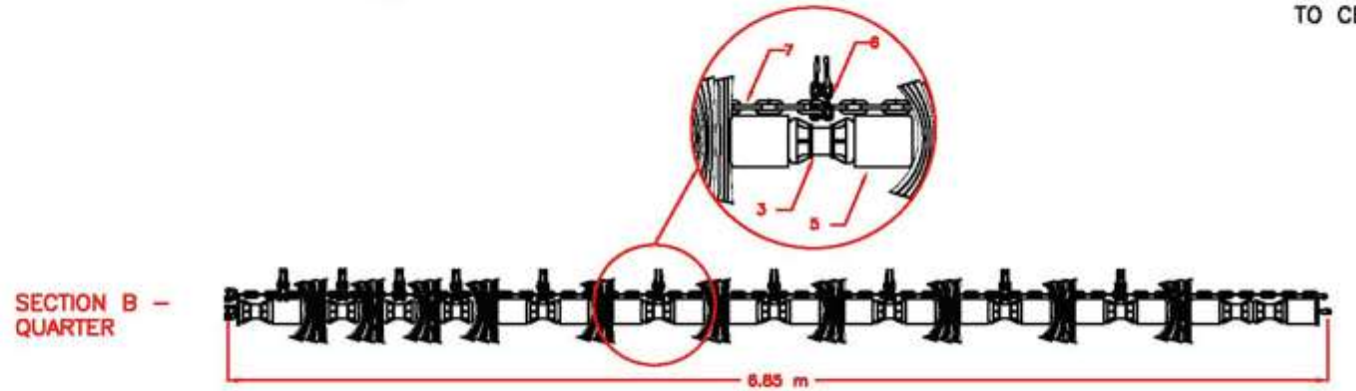

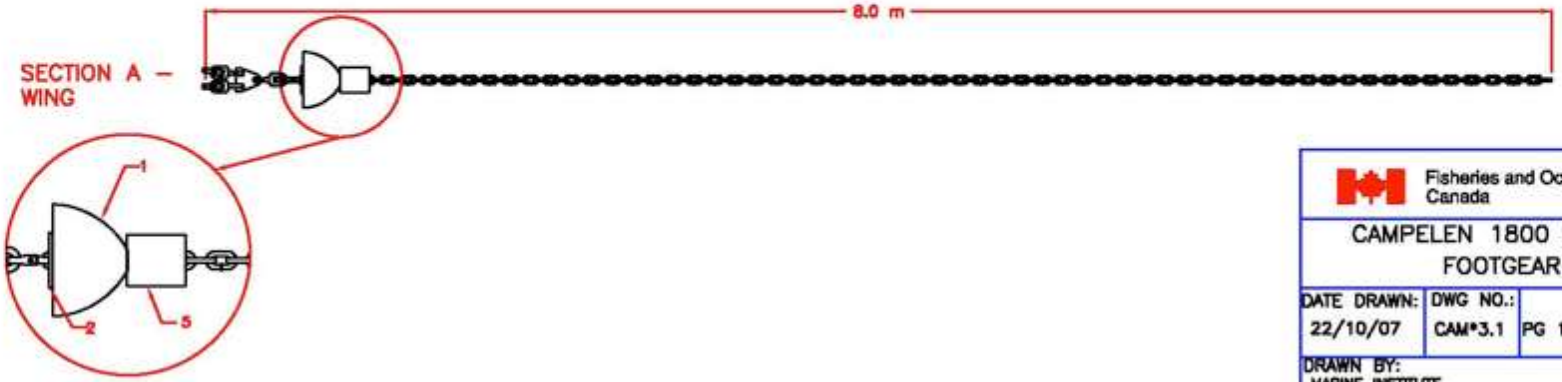

#	COMPONENT	LENGTH (m)
1	14" RUBBER BUNT BOBBIN	0.226
2	6" WASHER	0.008
3	8" IRON SPACER	0.200
4	14" ROCKHOPPER DISK	0.054
5	7" RUBBER SPACER	0.178
6	BOBBIN CHAIN	0.395
7	TRAVEL CHAIN	19.5

NOTE:

MEASUREMENTS ARE CENTRE H/LOCK TO CENTRE H/LOCK

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CAMPELEN 1800 SURVEY TRAWL
FOOTGEAR DETAIL

DATE DRAWN:	DWG NO.:		REV.	SCALE:
22/10/07	CAM*3.1	PG 11 OF 28 PG	2	NTS

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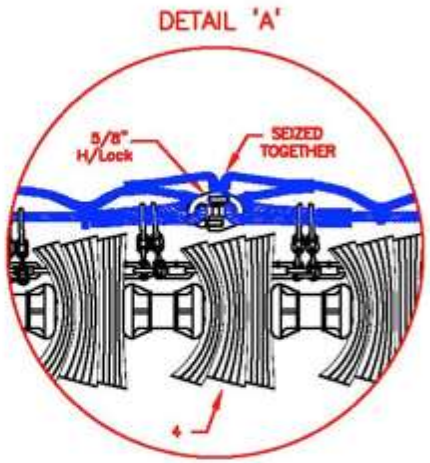
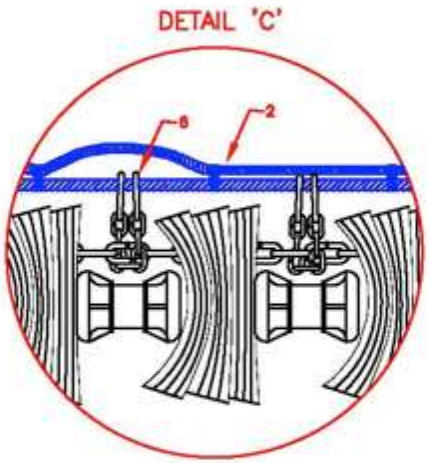
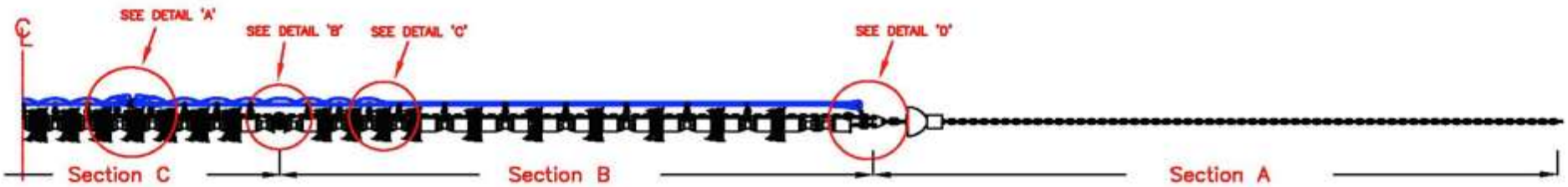
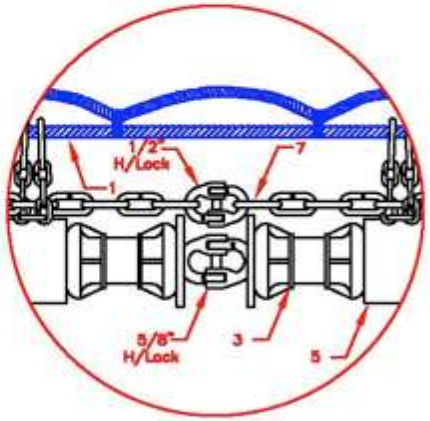
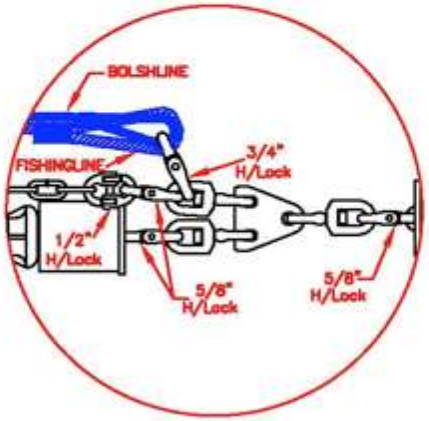




#	COMPONENT	LENGTH (m)
1	FISHINGLINE (INCL. H/LOCK)	19.5
2	L/BOLSHLINE (INCL. H/LOCK)	20.0
3	8" IRON SPACER	0.200
4	14" ROCKHOPPER DISK	0.054
5	7" RUBBER SPACER	0.178
6	BOBBIN CHAIN	0.395
7	TRAVEL CHAIN	19.5







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CAMPELEN 1800 SURVEY TRAWL
FOOTGEAR ATTACHMENT METHOD

DATE DRAWN:	DWG NO.:		REV.	SCALE:
22/10/07	CAM*3.2	PG 12 OF 28 PG	2	NTS

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APPENDIX A

Symbols & Abbreviations

Symbols


Upper Panel


Lower Panel


Side Panel


Diameter


Center line

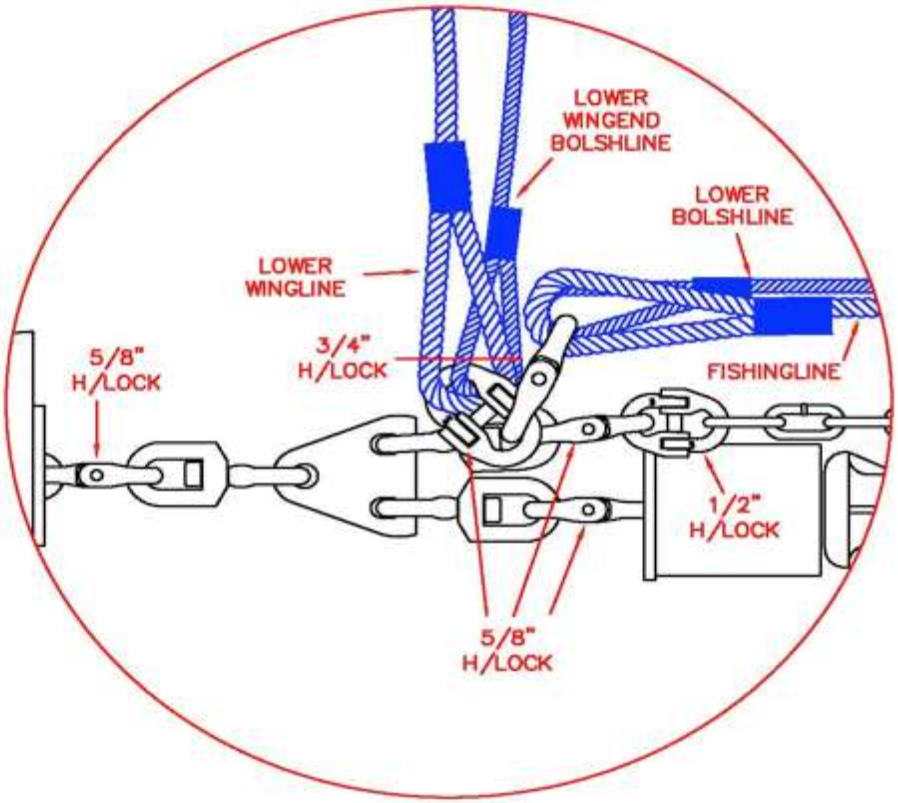

Double Mesh

Abbreviations

Btm.	Bottom	**MS**	Mesh size
Comb.	Combination	**MD**	Meshes deep
CTD	Conductivity-Temperature-depth	**PE**	Polyethylene
D	Diametre	**Pl.**	Plastic
Dia.	Diametre	**PP**	Polypropylene
Ext.	Extension	**R**	Radius
F/Gear	Footgear	**Stbd.**	Starboard
H/Lock	Hammerlock	**Sqm.**	Square metre
in	Inches	**S.W.L.**	Safe working load
KC	Knot center	**TEL**	Teleost
Kg	Kilograms	**U/M**	Upper middle
KR	Kraft Rope	**WT**	Wilfred Templeman
m	Metres		
MBS	Minimum breaking strength		
mm	Millimetres		

APPENDIX B

DELTA PLATE ASSEMBLY

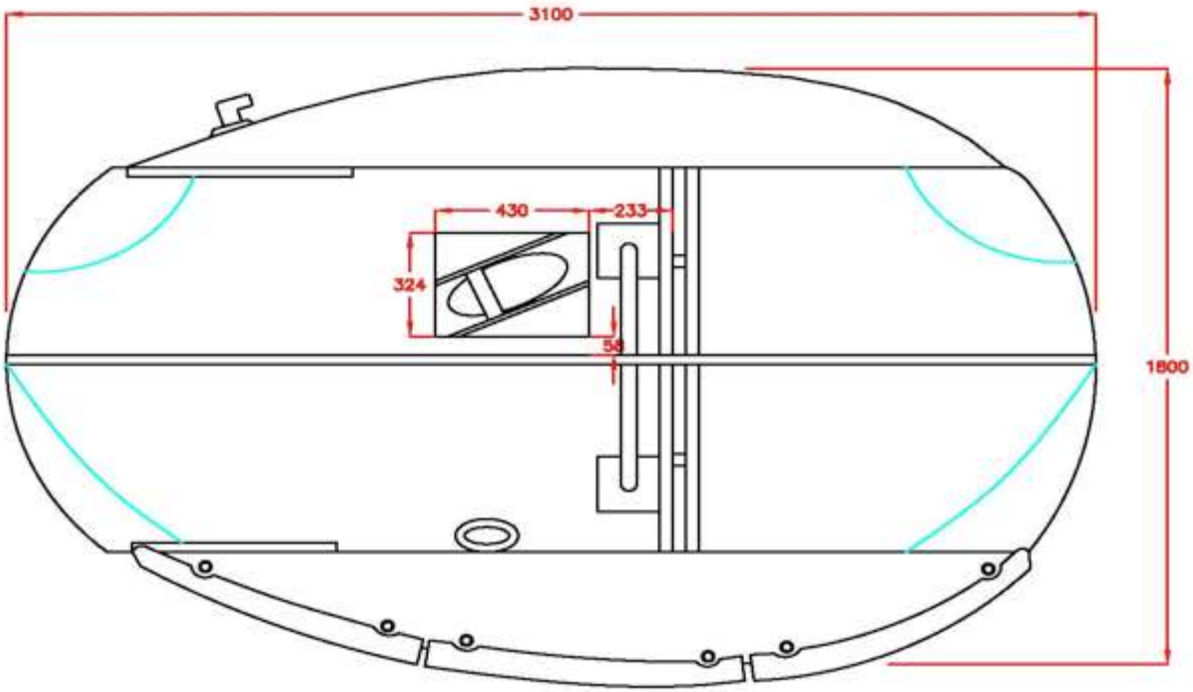


The delta plate has 3 hammerlocks, one for each swivel.

- The forward 5/8" hammerlock belonging to the delta plate is attached to the flying wing. The two aft 5/8" hammerlocks are attached to two different components of the footgear system.
- The lower 5/8 " hammerlock attaches the footgear centre chain to the lower delta plate swivel;
- The upper 5/8" hammerlock attaches the upper delta plate swivel to the 1/2" travel chain hammerlock.
- A 3/4" hammerlock is used to connect the lower bolshline and fishing lines to the upper delta plate swivel.
- The lower wingline and lower wingend bolshline are attached to the 3/4" hammerlock (not attached directly to the delta plate) by the means of a 5/8" hammerlock. Both eyes of the lower wingline and lower wingend bolshline are connected to one end of the 5/8" hammerlock while the other end is connected to the forward section of the 3/4" hammerlock.

SECTION 4 – PARTS

SPECIFICATIONS	
PART #	WEIGHT IN AIR (kg)
CT02	1400



FRONT VIEW

NOTE : ALL DIMENSIONS ARE IN MILLIMETRES

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PORT TRAWL DOOR

DATE DRAWN:	DWG NO.:		REV.	SCALE:
12/01/15	CAM*4.0	PG 13 OF 28 PG	1	NTS

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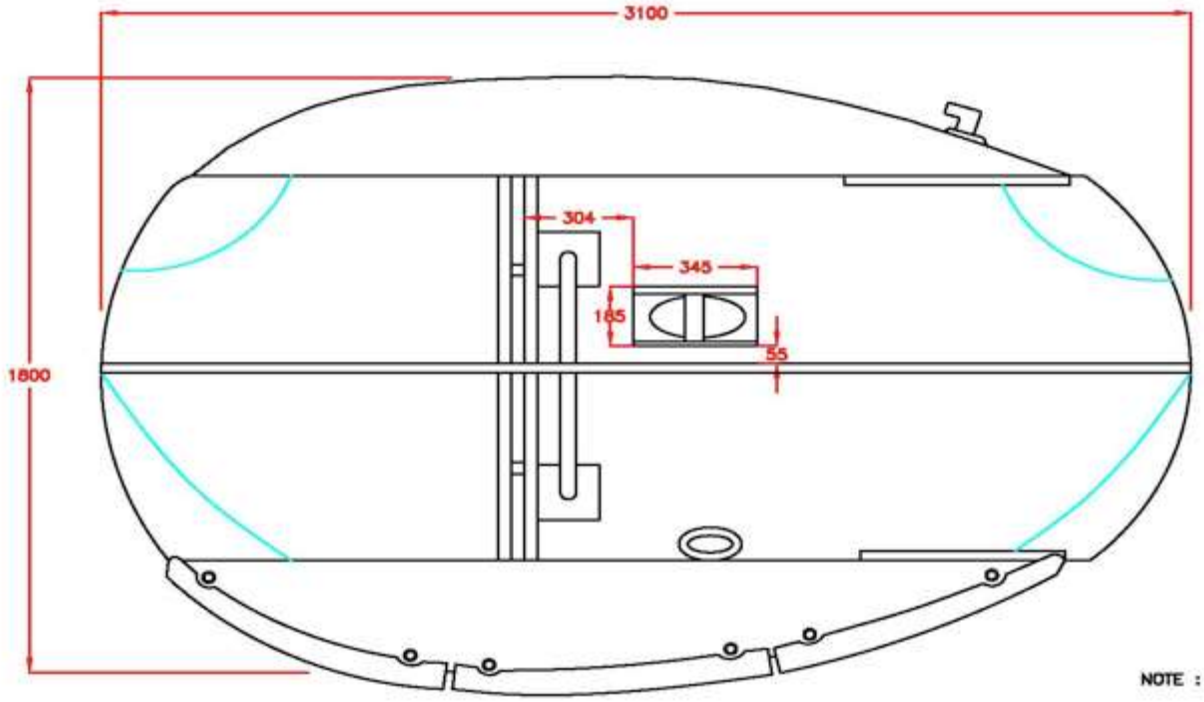
SPECIFICATIONS	
PART #	WEIGHT IN AIR (kg)
CT02	1400



FRONT VIEW

NOTE : ALL DIMENSIONS ARE IN MILLIMETRES

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STARBOARD TRAWL DOOR

DATE DRAWN:	DWG NO.:		REV.	SCALE:
12/01/15	CAM*4.1	PG 14 OF 28 PG	1	NTS

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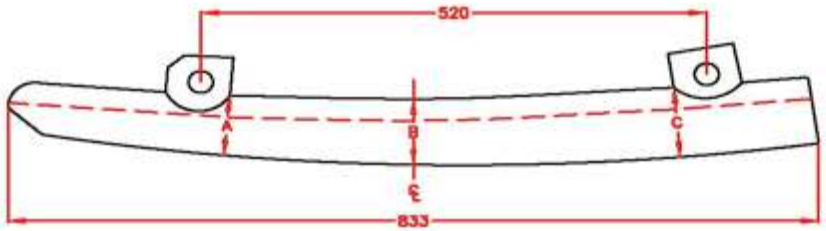
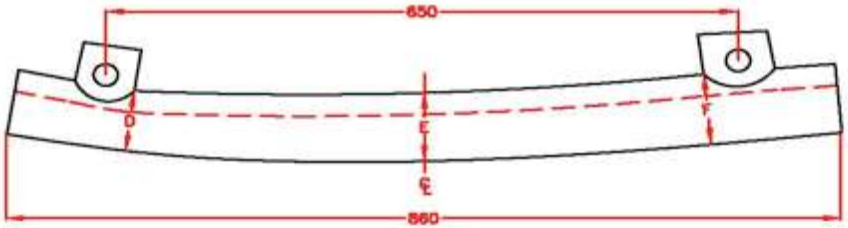
DEPTH
A = 0.070 m
B = 0.078 m
C = 0.082 m



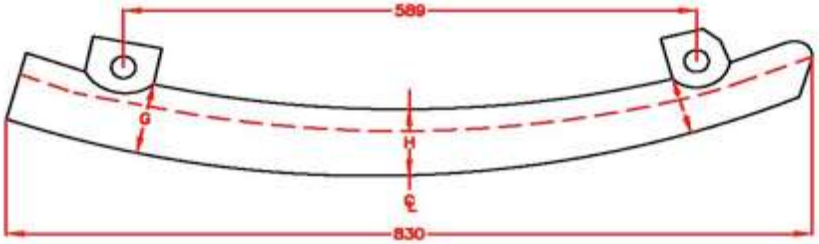
#1

DEPTH
D = 0.078 m
E = 0.076 m
F = 0.079 m



#2

DEPTH
G = 0.078 m
H = 0.077 m
I = 0.066 m



3

SPECIFICATIONS

PART #	COMPONENT	WEIGHT IN AIR (kg)
28611	SHOE #1 (AFT)	54.6
28610	SHOE #2 (MIDDLE)	59.28
28609	SHOE #3 (FWD)	51.06

NOTES: – ALL SHOES ARE 138mm WIDE.
– ALL DIMENSIONS ARE IN MILLIMETRES

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DOOR SHOES

DATE DRAWN:	DWG NO.:		REV.	SCALE:
18/12/06	CAM*4.2	PG 15 OF 28 PG	1	NTS

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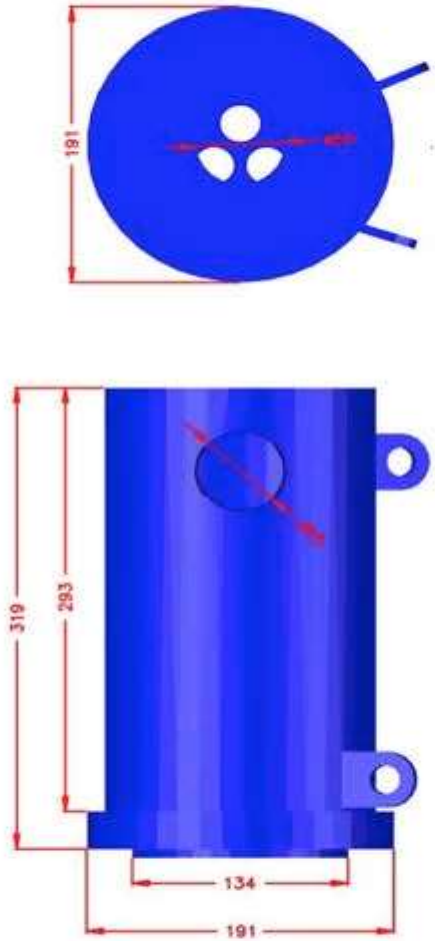
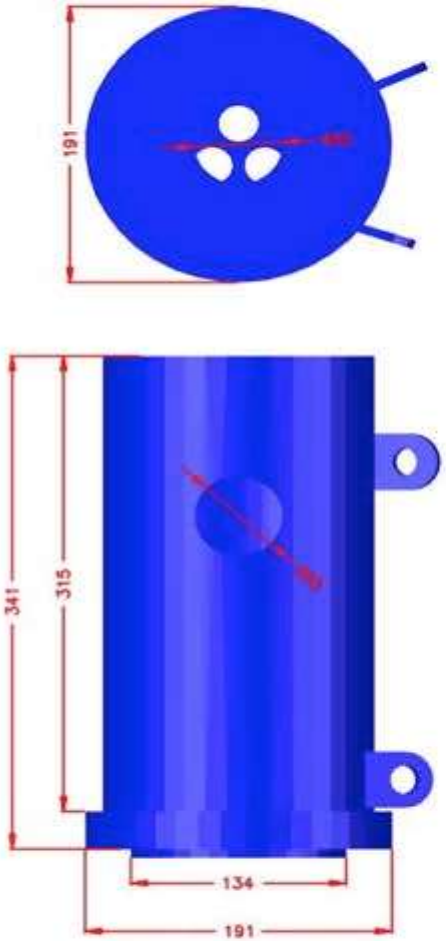
SPECIFICATIONS			
MASTER		SLAVE	
WEIGHT IN AIR (kg)	WEIGHT IN WATER (kg)	WEIGHT IN AIR (kg)	WEIGHT IN WATER (kg)
13.664	11.907	13.408	11.684



WING CANNISTER – SLAVE



WING CANNISTER – MASTER

NOTE : ALL DIMENSIONS ARE IN MILLIMETRES

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WING CANNISTERS

DATE DRAWN:	DWG NO.:		REV.	SCALE:
24/03/06	CAM*4.3	PG 16 OF 28 PG		NTS

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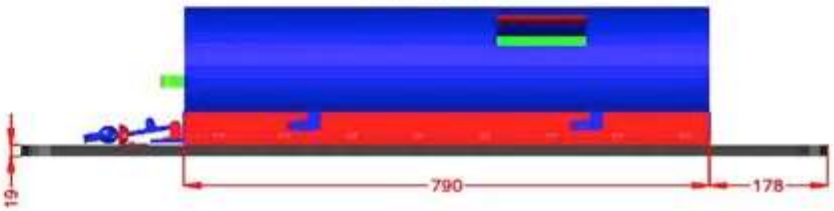
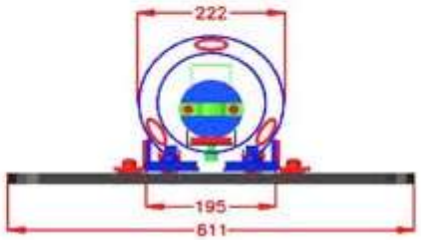
SPECIFICATIONS			
PART #	COMPONENT	WEIGHT IN AIR (kg)	WEIGHT IN WATER (kg)
	BOARD W/RAILS	16.390	1.429
	PIPE SECTION	12.967	7.207
	CTD	10.265	4.848

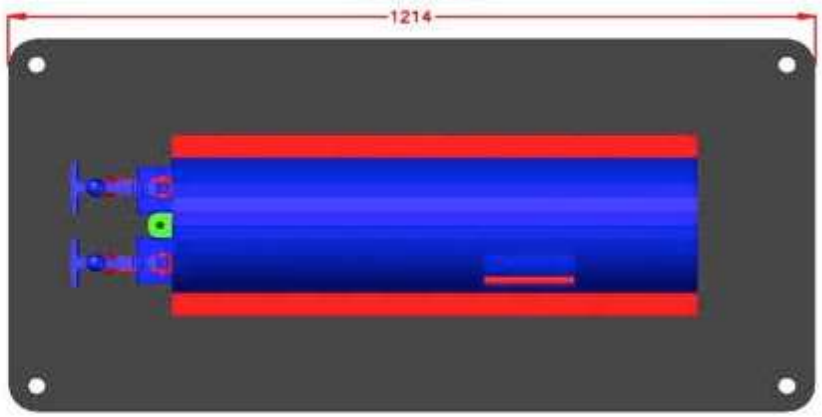
SIDE VIEW



BACK VIEW



TOP VIEW



NOTE : ALL DIMENSIONS ARE IN MILLIMETRES

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CTD BOARD

DATE DRAWN:	DWG NO.:		REV.	SCALE:
24/03/06	CAM*4.4	PG 17 OF 28 PG		NTS

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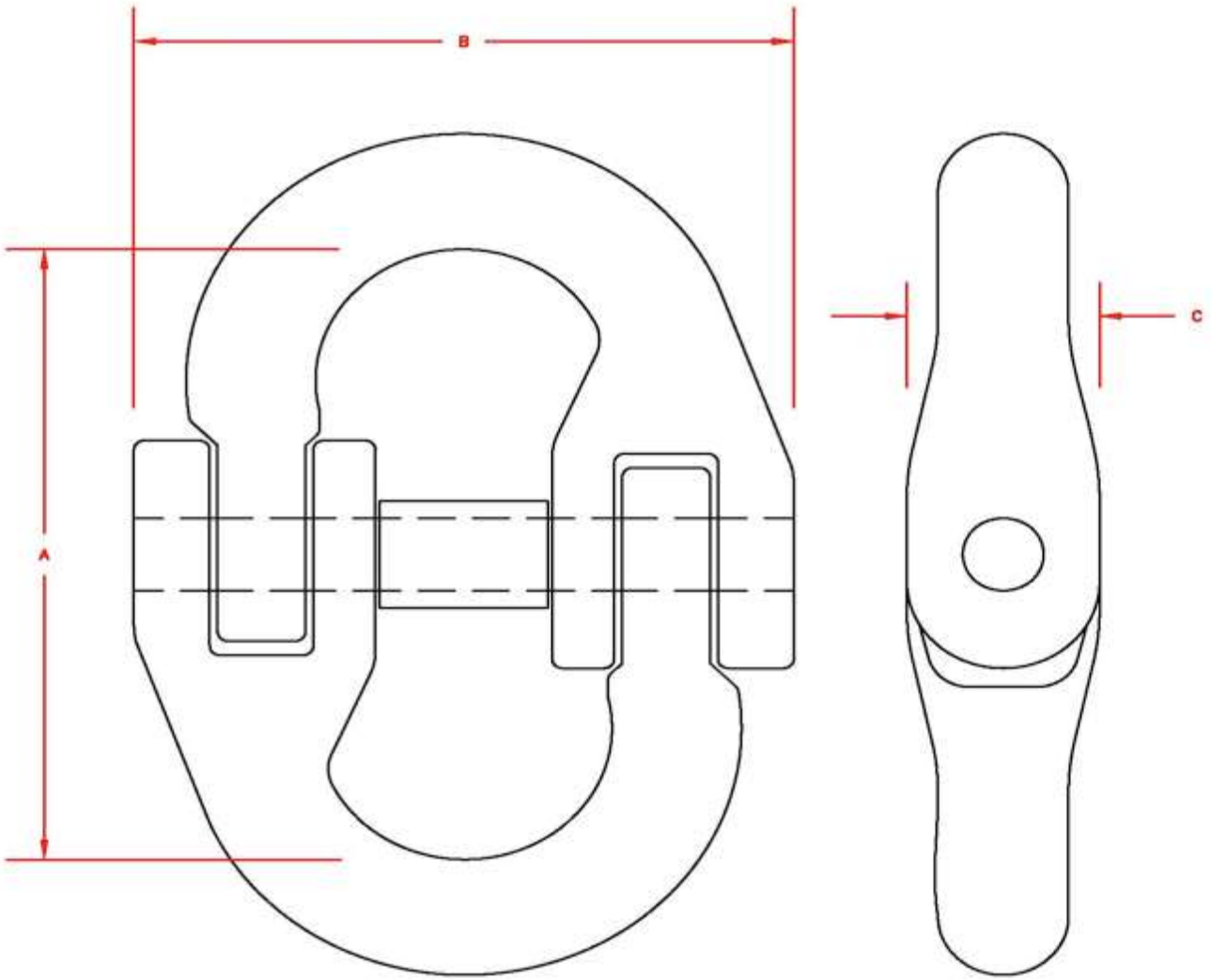

SPECIFICATIONS

NOMINAL SIZE (in.)	DIMENSIONS (mm)			WEIGHT IN AIR (kg)
	A	B	C	
1/2	86	78	23	0.61
5/8	102	95	26	1.08
3/4	122	108	30	1.74
7/8	139	132	34	2.76
1	145	158	40	4.15

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HAMMERLOCK

DATE DRAWN:	DWG NO.:		REV.	SCALE:
24/03/06	CAM*4.5	PG 18 OF 28 PG		NTS

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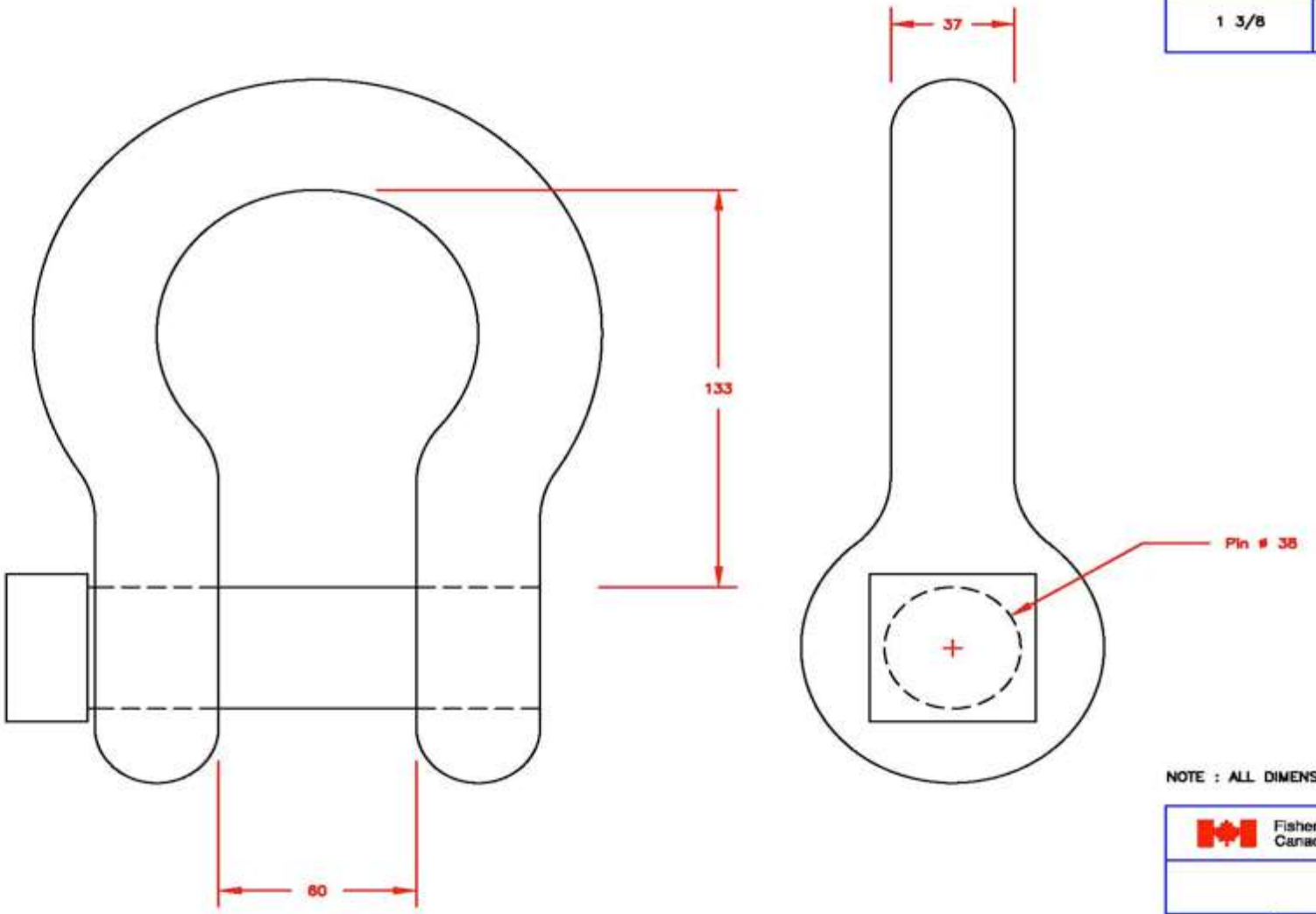

SPECIFICATIONS		
NOMINAL SIZE (in.)	WEIGHT IN AIR (kg)	WEIGHT IN WATER (kg):
1 3/8	6.24	5.45

NOTE : ALL DIMENSIONS ARE IN MILLIMETRES

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SHACKLE

DATE DRAWN:	DWG NO.:		REV.	SCALE:
24/03/06	CAM*4.6	PG 19 OF 28 PG		NTS

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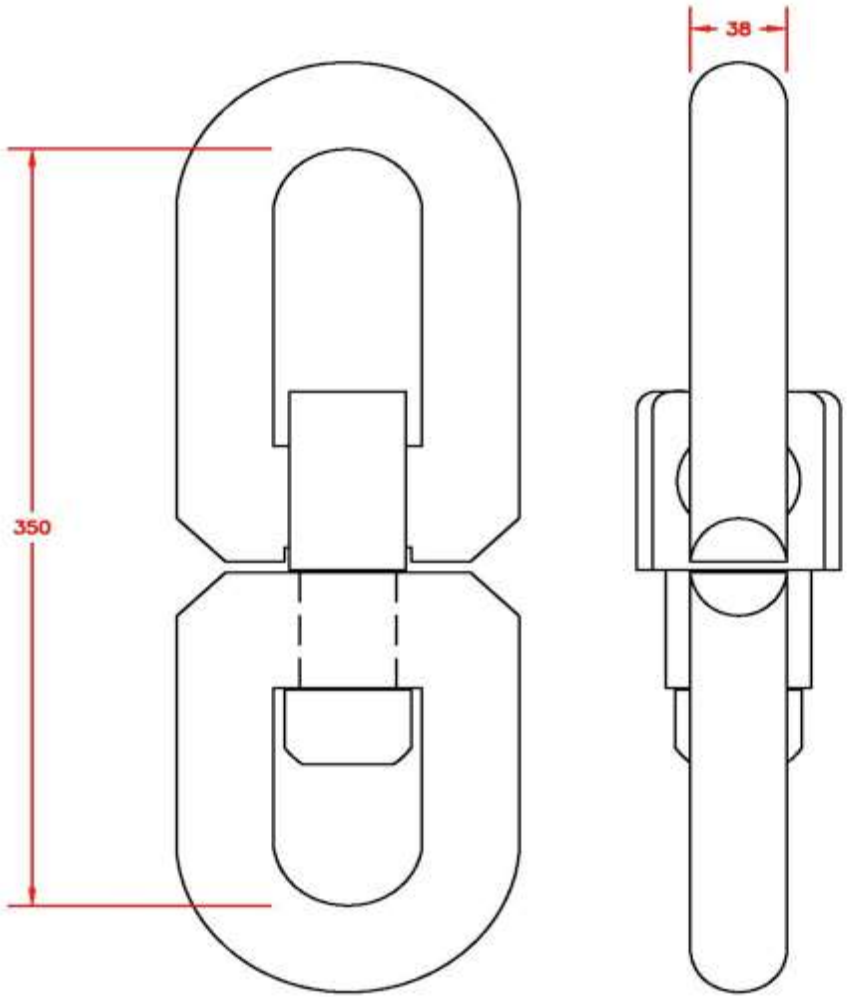

SPECIFICATIONS		
NOMINAL SIZE (in.)	WEIGHT IN AIR (kg)	WEIGHT IN WATER (kg):
1 1/2	11.18	9.77

NOTE : ALL DIMENSIONS ARE IN MILLIMETRES

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OVAL ACTION SWIVEL

DATE DRAWN:	DWG NO.:		REV.	SCALE:
24/03/06	CAM*4.7	PG 20 OF 28 PG		NTS

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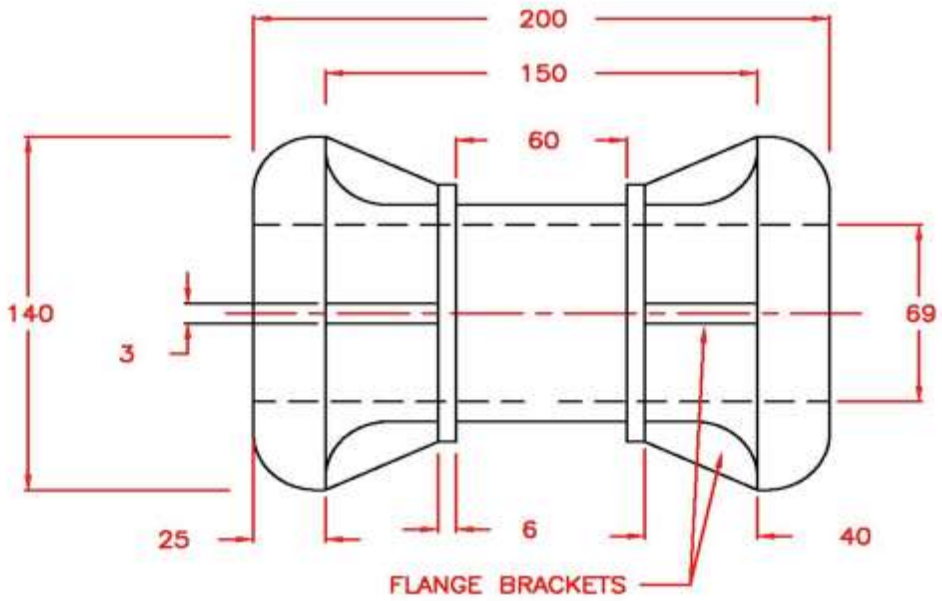
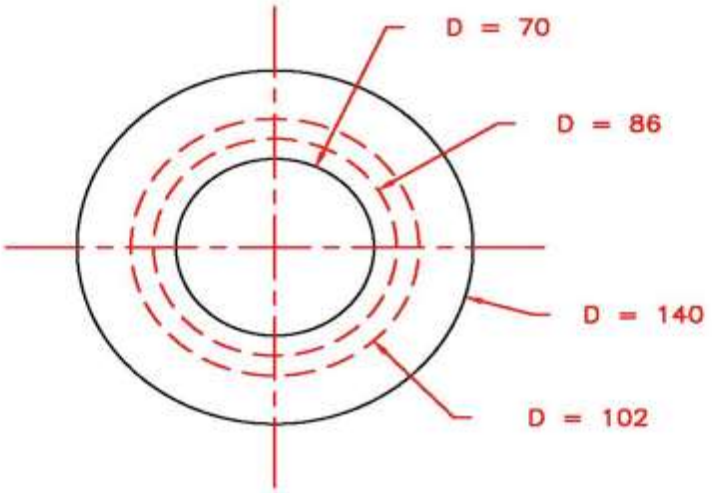
SPECIFICATIONS		
PART NO.	WEIGHT IN AIR (KG)	WEIGHT IN WATER (KG)
CT44	6.57	5.29





NOTE : ALL DIMENSIONS ARE IN MILLIMETRES

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8" (200mm) IRON SPACER

DATE DRAWN:	DWG NO.:		REV.	SCALE:
24/03/06	CAM*4.8	PG 21 OF 28 PG	1	NTS

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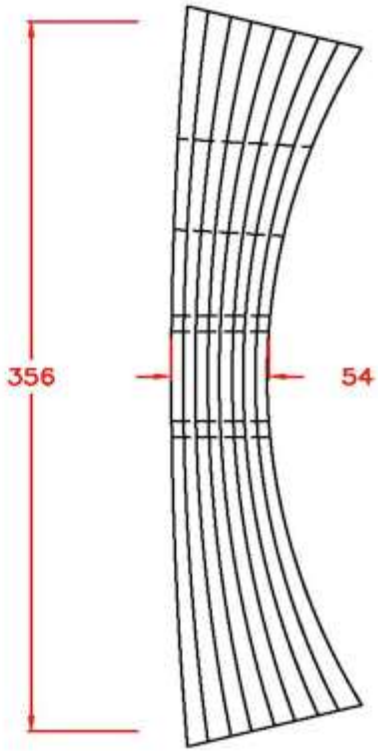
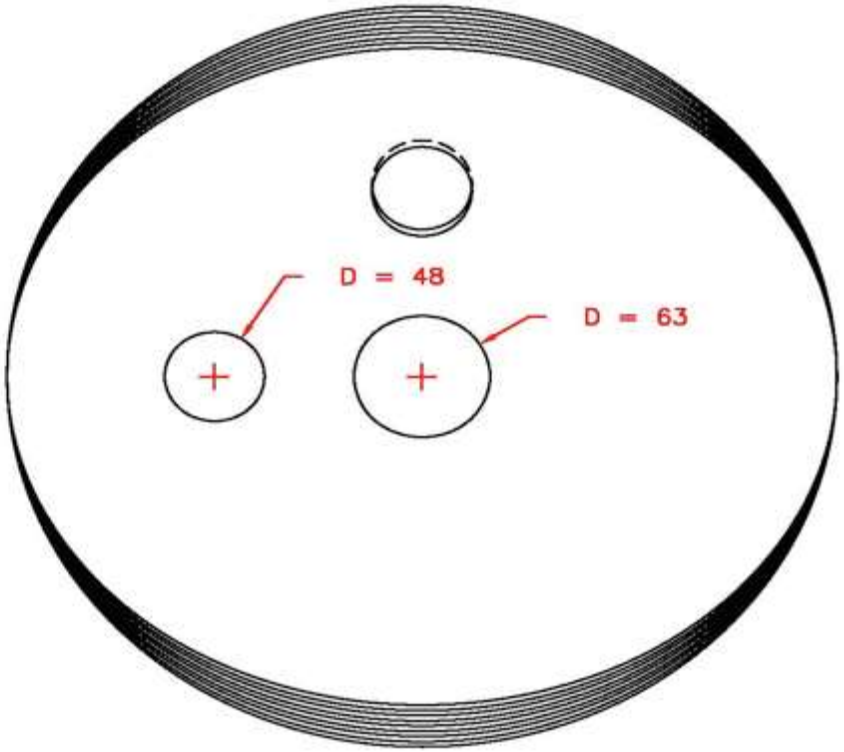
SPECIFICATIONS		
PART NO.	WEIGHT IN AIR (KG)	WEIGHT IN WATER (KG)
CT45	6.11	0.43





NOTE : ALL DIMENSIONS ARE IN MILLIMETRES

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14" (356mm) ROCKHOPPER DISK

DATE DRAWN:	DWG NO.:		REV.	SCALE:
06/11/14	CAM*4.9	PG 22 OF 28 PG	2	NTS

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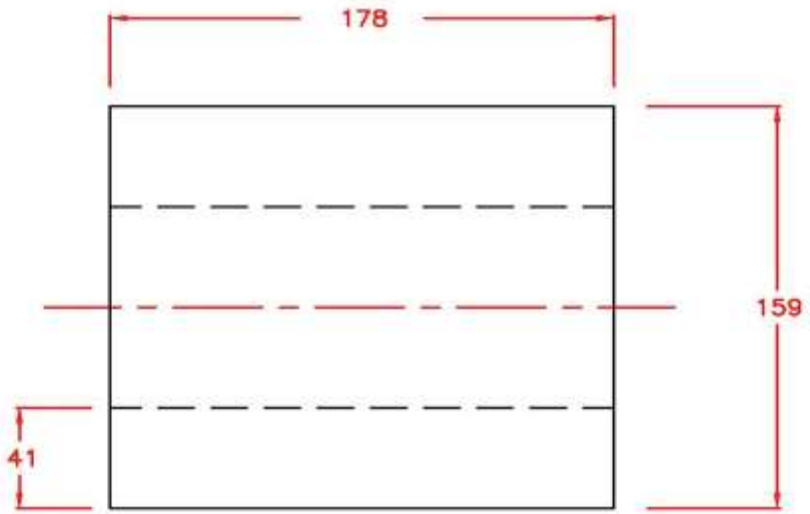
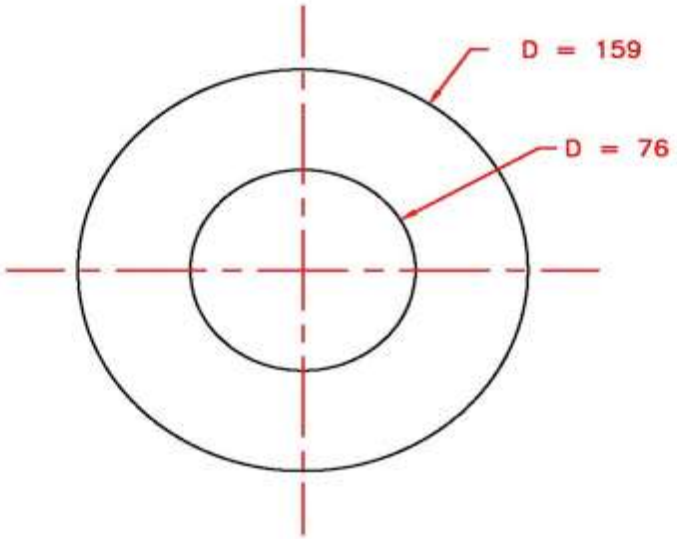
SPECIFICATIONS		
PART NO.	WEIGHT IN AIR (KG)	WEIGHT IN WATER (KG)
CT45	3.08	0.37





NOTE : ALL DIMENSIONS ARE IN MILLIMETRES

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7" (178mm) RUBBER SPACER

DATE DRAWN:	DWG NO.:		REV.	SCALE:
06/11/14	CAM*4.10	PG 23 OF 28 PG	2	NTS

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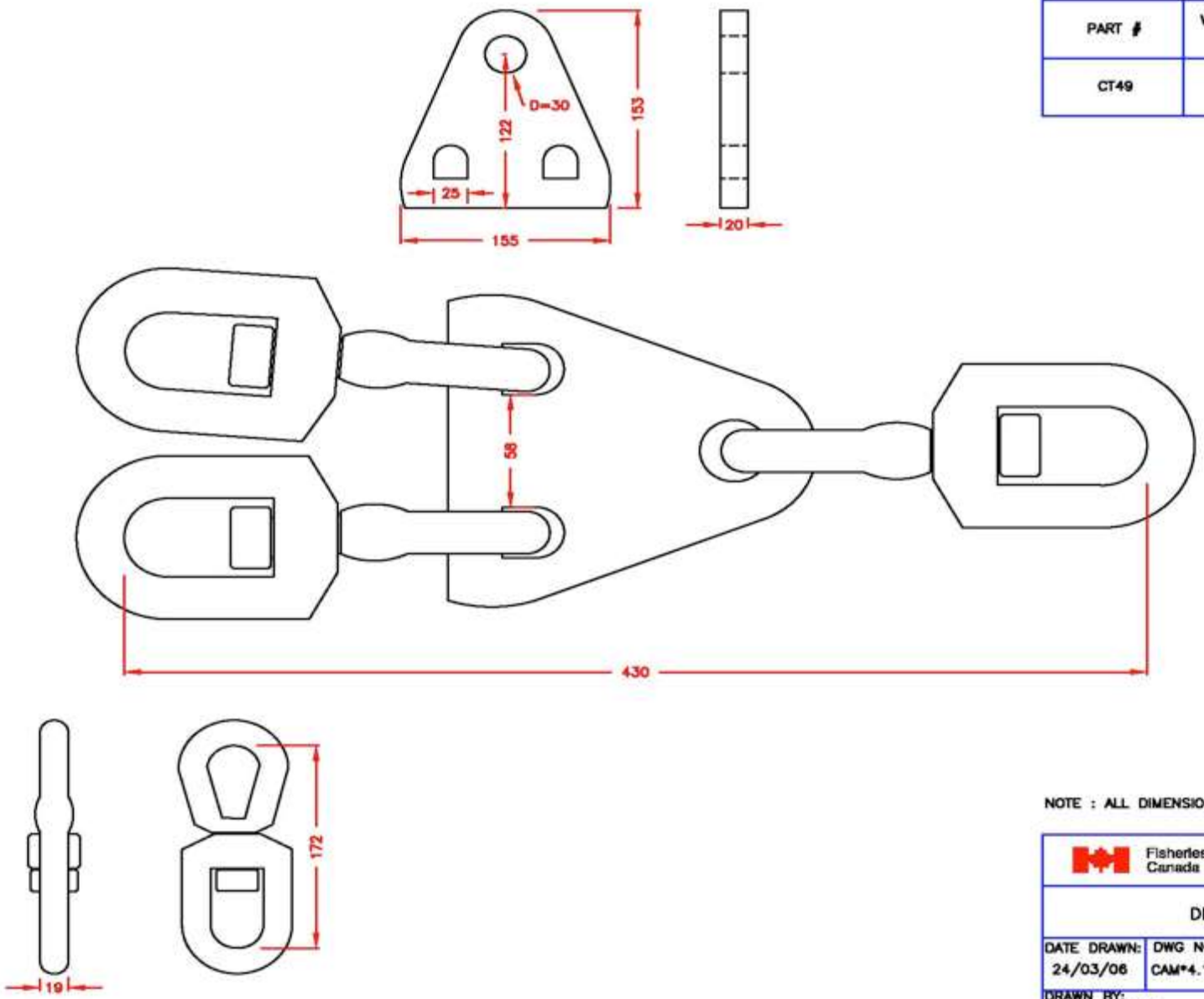

SPECIFICATIONS		
PART #	WEIGHT IN AIR (kg)	WEIGHT IN WATER (kg):
CT49	6.17	5.39

NOTE : ALL DIMENSIONS ARE IN MILLIMETRES

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DELTA PLATE

DATE DRAWN:	DWG NO.:		REV.	SCALE:
24/03/06	CAM*4.11	PG 24 OF 28 PG	1	NTS

DRAWN BY:
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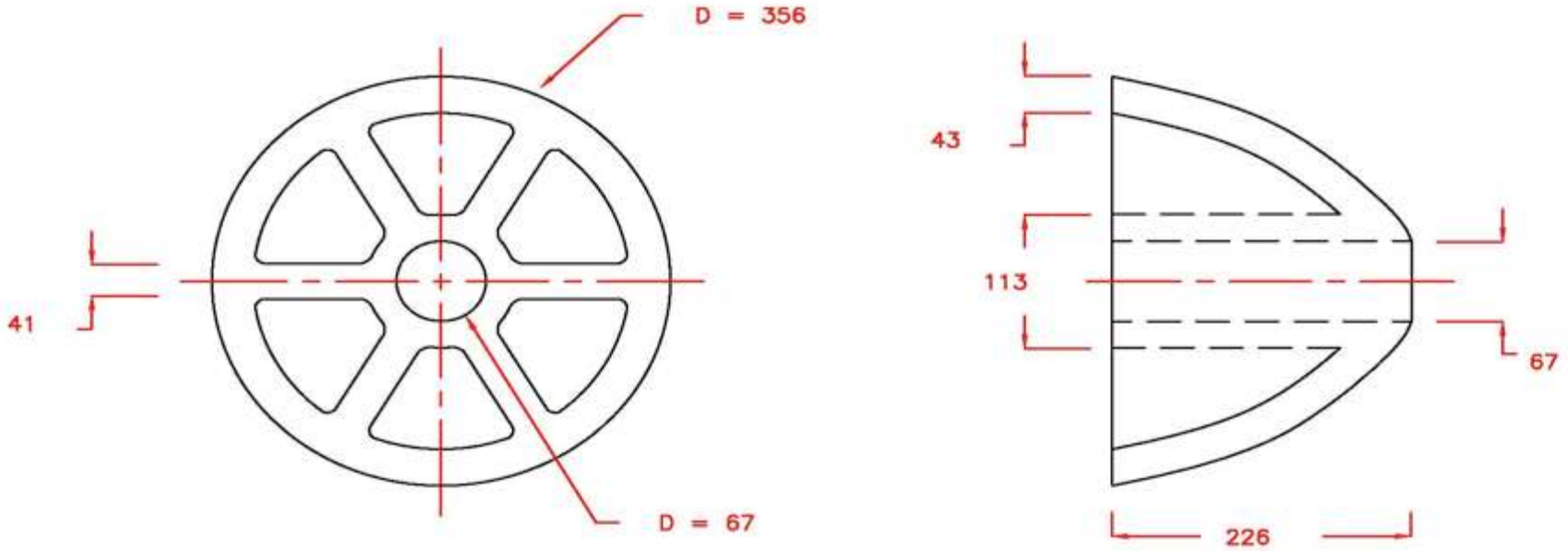
SPECIFICATIONS		
PART NO.	WEIGHT IN AIR (KG)	WEIGHT IN WATER (KG)
CT50	17.35	4.80



NOTE : ALL DIMENSIONS ARE IN MILLIMETRES

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14" (356mm) RUBBER BUNT BOBBIN

DATE DRAWN:	DWG NO.:		REV.	SCALE:
06/11/14	CAM*4.12	PG 25 OF 28 PG	2	NTS

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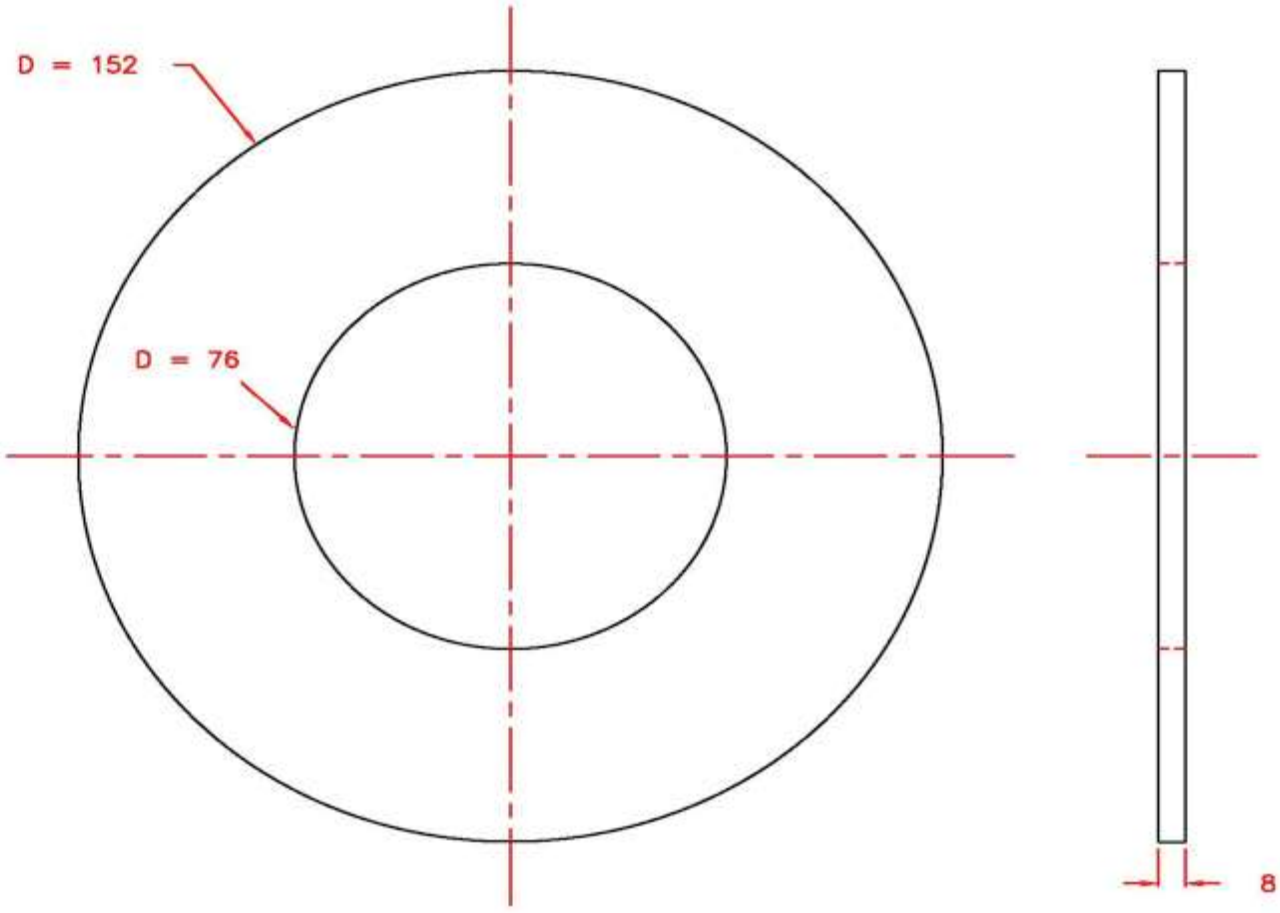
SPECIFICATIONS		
PART NO.	WEIGHT IN AIR (KG)	WEIGHT IN WATER (KG)
CT51	0.57	0.42



NOTE : ALL DIMENSIONS ARE IN MILLIMETRES

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6" (152mm) WASHER

DATE DRAWN:	DWG NO.:		REV.	SCALE:
24/03/06	CAM*4.13	PG 26 OF 28 PG	1	NTS

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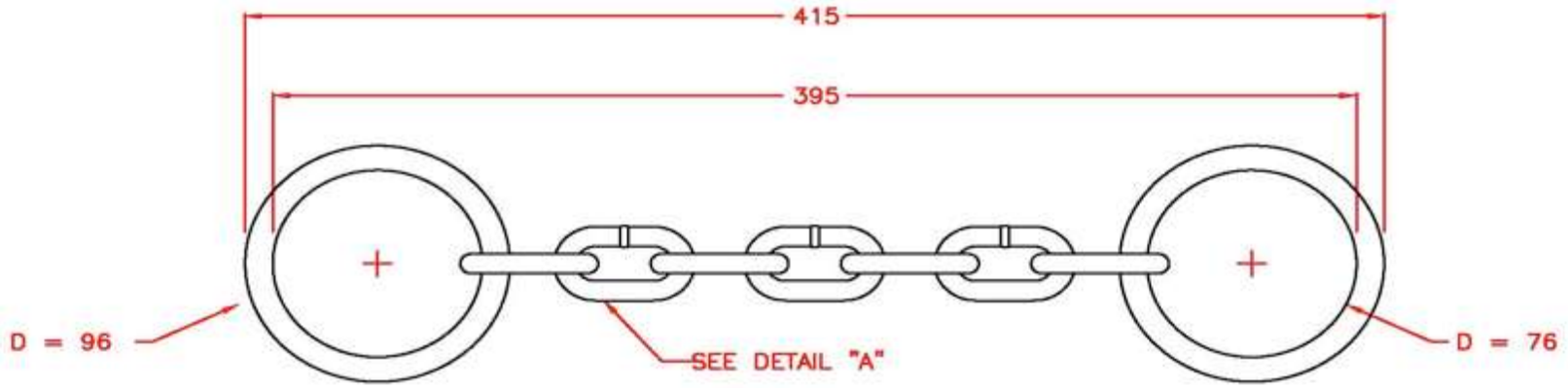
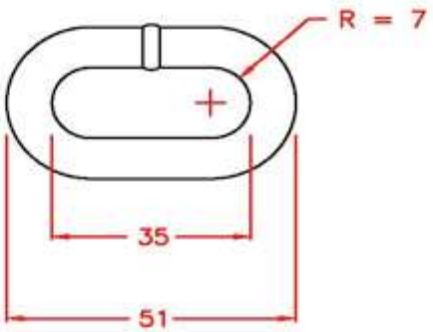
SPECIFICATIONS		
PART NO.	WEIGHT IN AIR (KG)	WEIGHT IN WATER (KG)
CT52	0.64	0.56





DETAIL A

NOTE : ALL DIMENSIONS ARE IN MILLIMETRES

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BOBBIN CHAIN

DATE DRAWN:	DWG NO.:		REV.	SCALE:
24/03/06	CAM*4.14	PG 27 OF 28 PG	1	NTS

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ORIGINAL DRAWING #	REVISION #	ORIGINALLY DRAWN	NEW DRAWING #	DATE REVISED	AUTHORIZED BY	REVISION DESCRIPTION
CAM*1.0	1	02/08/93	CAM*1.0	24/03/06	S.J. Walsh	Slight formatting changes, additional connection details added, scanner sensors added.
CAM*1.0	2	24/03/06	CAM*1.0	18/12/06	S.J. Walsh	Lower breastline eye splice moved to other half of hammerlock.
CAM*1.0	3	18/12/06	CAM*1.0	22/10/07	S.J. Walsh	Additional text added to Detail "G". Joining round added to separate side panel #3 and #4, note addded.
CAM*1.0	4	22/10/07	CAM*1.0	12/01/15	S.J. Walsh	Text edit
CAM*1.1	1	24/03/06	CAM*1.1	22/10/07	S.J. Walsh	Door leg ext. listed as #4A and 4B, h/lock at bridle end of door leg ext. changed from a 3/4" to a 5/8", Side view of attachment bracket added.
CAM*1.1	2	22/10/07	CAM*1.1	12/01/15	S.J. Walsh	Text edit
CAM*1.2	1	24/03/06	CAM*1.1	22/10/07	S.J. Walsh	Door leg ext. listed as #4A and 4B, Door shackle shown as pin through door
CAM*1.2	2	22/10/07	CAM*1.2	12/01/15	S.J. Walsh	Text edit
CAM*2.0	1	02/08/93	CAM*2.0	24/03/06	S.J. Walsh	Slight formatting changes, additional remark added, headline shown in 3 pieces.
CAM*2.0	2	24/03/06	CAM*2.0	18/12/06	S.J. Walsh	Stretched length measurements added, side panel (part #15) divided into two pieces now part 15a and 15b.
CAM*2.0	3	18/12/06	CAM*2.0	22/10/07	S.J. Walsh	PP ropes changed to KR, length of ribline #3 & 4 modified, item #25 is now 25a and 25b, attachment point of cover and liner indicated, extra remarks and notes.
CAM*2.0	4	22/10/07	CAM*2.0	15/07/14	S.J. Walsh	CT23 depth (N-Direction) changed from 42.5 to 48.5 meshes deep.
CAM*2.1	1	02/08/93	CAM*2.1	24/03/06	S.J. Walsh	Slight formatting changes.
CAM*2.2	1	02/08/93	CAM*2.2	24/03/06	S.J. Walsh	Slight formatting changes.
CAM*2.2	2	24/03/06	CAM*2.2	18/12/06	S.J. Walsh	Extra text added for tapering to detail "D".
CAM*2.2	3	18/12/06	CAM*2.2	15/07/14	S.J. Walsh	CT23 (80mm) --changed from 42.5 to 48.5 meshes deep. Dimension lines drawn in to illustrates depth of guard netting for both the 1T4B and AB tapers
CAM*2.3	1	02/08/93	CAM*2.3	24/03/06	S.J. Walsh	Slight formatting changes, float attachment detailed, h/line connection details added.
CAM*2.3	2	24/03/06	CAM*2.3	18/12/06	S.J. Walsh	Floats now attached to headline only, float attachment rope changed from twisted nylon to polypropylene.
CAM*2.4	1	02/08/93	CAM*2.4	24/03/06	S.J. Walsh	Slight formatting changes.
CAM*2.4	2	24/03/06	CAM*2.4	22/10/07	S.J. Walsh	Stop attachment more detailed.
CAM*2.4	3	22/10/07	CAM*2.4	15/07/14	S.J. Walsh	Added dimensionlines with values to clearly illustrate bolshline lengths for both tapers on the guard netting. Guard netting is now attached to the center of the eye. Added new detail drawing to represent this modification
CAM*2.4	4	15/07/14	CAM*2.4	12/11/14	S.J. Walsh	Corrected Bolshline length in "Detail B".
CAM*2.5	1	24/03/06	CAM*2.5	18/12/06	S.J. Walsh	Floats now attached to headline only.
CAM*3.0	1	02/08/93	CAM*3.0	24/03/06	S.J. Walsh	Slight formatting changes, delta plate specification adjusted due to supplier modifications, travel wire redrawn to indicate chain, fishingline connection added to "Detail A".
CAM*3.0	2	24/03/06	CAM*3.0	18/12/06	S.J. Walsh	Two Toggles added in boxum.
CAM*3.0	3	18/12/06	CAM*3.0	06/11/14	S.J. Walsh	Correction to the specified weight and total weight of footgear components
CAM*3.1	1	02/08/93	CAM*4.8	24/03/06	S.J. Walsh	Slight formatting changes.
CAM*3.1	2	24/03/06	CAM*3.1	18/12/06	S.J. Walsh	Two Toggles added in boxum.
CAM*3.1	2	18/12/06	CAM*3.1	22/10/07	S.J. Walsh	Note added.
CAM*3.2	1	02/08/93	CAM*4.9	24/03/06	S.J. Walsh	Slight formatting changes.
CAM*3.2	1	24/03/06	CAM*3.2	18/12/06	S.J. Walsh	Toggle added in boxum.
CAM*3.2	2	24/03/06	CAM*3.2	22/10/07	S.J. Walsh	Slight formatting changes.
CAM*3.3	1	02/08/93	CAM*4.10	24/03/06	S.J. Walsh	Slight formatting changes, including page renumbering
CAM*3.4	1	02/08/93	CAM*4.11	24/03/06	S.J. Walsh	Slight formatting changes, part modified by manufacturer, specifications updated.
CAM*3.5	1	02/08/93	CAM*4.12	24/03/06	S.J. Walsh	Slight formatting changes.
CAM*3.6	1	02/08/93	CAM*4.13	24/03/06	S.J. Walsh	Slight formatting changes.
CAM*3.7	1	02/08/93	CAM*4.14	24/03/06	S.J. Walsh	Slight formatting changes.
CAM*4.0	1	24/03/06	CAM*4.0	12/01/15	S.J. Walsh	Dimensions edited.
CAM*4.1	1	24/03/06	CAM*4.1	12/01/15	S.J. Walsh	Dimensions edited.

ORIGINAL DRAWING #	REVISION #	ORIGINALLY DRAWN	NEW DRAWING #	DATE REVISED	AUTHORIZED BY	REVISION DESCRIPTION
CAM*4.2	1	24/03/06	CAM*4.2	18/12/06	S.J. Walsh	Depth measurements added.
CAM*4.9	2	24/03/06	CAM*4.9	06/11/14	S.J. Walsh	Correction to the specified seawater weight.
CAM*4.10	2	24/03/06	CAM*4.10	06/11/14	S.J. Walsh	Correction to the specified seawater weight.
CAM*4.12	2	24/03/06	CAM*4.12	06/11/14	S.J. Walsh	Correction to the specified seawater weight.

ADDITIONAL NOTES:

THE ORIGINAL DRAWING SET WAS UPGRADED IN MARCH 2006. THE ORIGINAL SET CONTAINED 14 DRAWINGS, THE MARCH 2006 UPGRADE CONSISTED OF THE ADDITION OF 13 DETAILED DRAWINGS AND A REVISIONS TABLE, GIVING A TOTAL OF 28 PAGES. THESE ADDITIONAL DRAWINGS AND THE MODIFICATIONS TO THE ORIGINAL DRAWINGS WERE APPROVED BY STEVE WALSH AND WILLIAM HICKEY, DFO.

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LIST OF REVISIONS

DATE DRAWN:	DWG NO.:		REV.	SCALE:
12/01/15	CAM*5.0	PG 28 OF 28 PG	5	NTS

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APPENDIX 2

CAMPELEN PARTS LIST

The Parts List provides detailed specification and allowable tolerances for each trawl component. The list provides a technical description or specification of the component and the quantity required to make one trawl.Tolerances assigned to key specifications of component forms the basis for acceptance or rejection criteria used during quality control inspections. Each trawl component is assigned a part's number, and this number is cross-referenced with the trawl drawings. Parameters such as length, diameter, weight, buoyancy, colour, twine diameter and mesh size are assigned allowable tolerances expressed as a specified range of values for that particular parameter. The parameters to be controlled were selected with consideration to their influence on catchability and performance, i.e. mesh size and bobbin weight. Each component is subjected to a quality control inspection prior to acceptance; components unable to meet the allowable tolerances are rejected (see Chapter 6: Trawl Procurement Protocols). Tolerance levels were derived statistically by sampling large quantities of each component from each of six different gear manufactures/suppliers, providing information on manufacturing variances (process) and the variability between manufacturers (supply) [9].

Similar quality control inspection is carried out using the tolerances to ensure the survey trawl meets all construction and repairs protocols (see Chapter 8: Survey Trawl Quality Controls Protocols, Section 8.1 on the Master Checklist). Components that do not meet the allowable tolerances whether during construction or repairs are rejected. The Parts List provides the most common reference used between the ships crews, warehousing staff, purchasing staff, fishing gear suppliers, and net makers.

CAMPELEN 1800 SURVEY TRAWL

Original: March 22, 1994
Last revised: January 12, 2015

	PART	DESCRIPTION	QTY	TOLERANCE	DRAWING	PART #
1	WARP	DIA. 25.4mm WIRE, 6 x 19 CONSTRUCTION SPLICED AT ONE END FIBRE CORE, MBS = 48 T	2	WEIGHT (kg/m) 2.81 -2.87	CAM*1.0-1.2	CT 01
2	TRAWL DOORS	MORGÈRE CAMBERED OVAL SINGLE SLOT POLYVALENT TYPE AA09, 3.10 m x 1.80 m , 4.58 SQUARE METER WEIGHT (AIR) = 1400 kg	2	WEIGHT (kg) 1330 - 1470	CAM*1.0-1.2 CAM*4.0-4.2	CT 02
3	DOOR LEGS	DIA. 16mm X 3.05m (MID-LINK) CHAIN GRADE 80 ALLOY STEEL, MBS = 30MT	4	WEIGHT (kg/m) 4.86 - 5.06 LENGTH (m) 3.03 - 3.07	CAM*1.0-1.2	CT 03
4a	DOOR LEG EXTENSION (Templeman)	DIA. 22mm x 6.1m WIRE 6 x 19-9/9/1 CONST. SWAGED AT BOTH ENDS FIBRE CORE, MBS = 22 MT	2	WEIGHT (kg/m) 1.72 - 1.79 LENGTH (m) 6.07 - 6.13	CAM*1.0-1.2	CT 04
4b	DOOR LEG EXTENSION (Teleost)	DIA. 22mm x 7.62m WIRE 6 x 19-9/9/1 CONST. SWAGED AT BOTH ENDS FIBRE CORE, MBS = 22 MT	2	WEIGHT (kg/m) 1.72 - 1.79 LENGTH (m) 7.58 - 7.66	CAM*1.0-1.2	CT 04
5a	PENNANT WIRE (Templeman)	DIA. 19mm x 12.82m WIRE, 6 x 19-9/9/1 CONST. SPLICED AT BOTH ENDS FIBRE CORE, MBS = 16 MT	2	WEIGHT (kg/m) 1.29 - 1.35	CAM*1.0-1.2	CT 05
5b	PENNANT WIRE (Teleost)	DIA. 19mm x 13.8m WIRE, 6 x 19-9/9/1 CONST. SPLICED AT BOTH ENDS FIBRE CORE, MBS = 16 MT	2	WEIGHT (kg/m) 1.29 - 1.35	CAM*1.0-1.2	CT 05
6	UPPER MIDDLE BRIDLE EXT.	DIA. 16mm x 20m WIRE, 6 x 19-9/9/1 CONST. SWAGED AT BOTH ENDS FIBRE CORE, MBS = 12 MT	2	WEIGHT (kg/m) 0.90 - 0.94 LENGTH (m) 19.9 - 20.1	CAM*1.0	CT 06
7	UPPER BRIDLE	DIA. 16mm x 20m WIRE, 6 x 19-9/9/1 CONST. SWAGED AT BOTH ENDS FIBRE CORE, MBS = 12 MT	2	WEIGHT (kg/m) 0.90 - 0.94 LENGTH (m) 19.9 - 20.1	CAM*1.0	CT 07
8	MIDDLE BRIDLE	DIA. 16mm x 20m WIRE, 6 x 19-9/9/1 CONST. SWAGED AT BOTH ENDS FIBRE CORE, MBS = 12 MT	2	WEIGHT (kg/m) 0.90 - 0.94 LENGTH (m) 19.9 - 20.1	CAM*1.0	CT 08
9	MIDDLE BRIDLE EXTENSION	DIA. 20mm x 4.0m COMBINATION WIRE, 6 x 12 POLY JACKET SWAGED AT BOTH ENDS STEEL CORE, MBS = 8.87 MT	2	WEIGHT (kg/m) 0.54 - 0.56 LENGTH (m) 3.98 - 4.02	CAM*1.0	CT 09
10	LOWER BRIDLE	DIA. 22mm x 40m WIRE, 6 x 19-9/9/1 CONST. SWAGED AT BOTH ENDS FIBRE CORE, MBS = 22 MT	2	WEIGHT (kg/m) 1.72 - 1.79 LENGTH (m) 39.8 - 40.2	CAM*1.0	CT 10
11	FLOATS	DIA. 8" (200mm) FLOATS WORKING DEPTH = 1400m COLOR YELLOW BUOYANCY (SEAWATER) = 2.61 kg WINGS (2 x 39), BOSUM (10) EXTRA WINGEND FLOATS (2 x 6)	100	BUOYANCY (kg) 2.56 - 2.66 DEPTH (m) 1260 - 1540	CAM*1.0 CAM*2.3	CT 11
12	F.R. CHAIN SECTION A FLYING WING	DIA. 16mm X 7.41m (MID-LINK) CHAIN GRADE 80 ALLOY STEEL, MBS = 30MT	2	WEIGHT (kg/m) 4.86 - 5.06 LENGTH (m) 7.37 - 7.45	CAM*1.0 CAM*3.0-3.2	CT 12
13	F.R. CHAIN SECTION B QUARTERS	DIA. 16mm X 6.75m (MID-LINK) CHAIN GRADE 80 ALLOY STEEL, MBS = 30MT	2	WEIGHT (kg/m) 4.86 - 5.06 LENGTH (m) 6.72 - 6.78	CAM*1.0 CAM*3.0-3.2	CT 13
14	F.R. CHAIN SECTION C BOSUM	DIA. 16mm X 5.80m (MID-LINK) CHAIN GRADE 80 ALLOY STEEL, MBS = 30MT	1	WEIGHT (kg/m) 4.86 - 5.06 LENGTH (m) 5.77 - 5.83	CAM*1.0 CAM*3.0-3.2	CT 14

CAMPELEN 1800 SURVEY TRAWL

Original: March 22, 1994
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	PART	DESCRIPTION	QTY	TOLERANCE	DRAWING	PART #
15	8" (200mm) IRON SPACER	DIA. 140mm, LENGTH 200mm STEEL CONSTRUCTION, WEIGHT (SEAWATER) = 5.29 kg	39	WEIGHT (kg) 5.26 - 5.32 DIMENSIONS (mm) DIA. = 137.2 - 142.8 LENGTH = 196 - 204	CAM*3.0-3.2 CAM*4.8	CT 44
16	14" (356mm) ROCK HOPPER	DIA. 356mm, THICKNESS 54mm RUBBER TIRE CONSTRUCTION, WEIGHT (SEAWATER) = 0.43 kg	102	WEIGHT (kg) 0.41 - 0.45	CAM*3.0-3.2 CAM*4.9	CT 45
17	7" (178mm) RUBBER SPACER	DIA. 159mm, LENGTH 178mm, RUBBER CONSTRUCTION, WEIGHT (SEAWATER) = 0..37 kg	34	WEIGHT (kg) 0.35 - 0.39 DIMENSIONS (mm) DIA. = 156 - 162 LENGTH = 174 - 182	CAM*3.0-3.2 CAM*4.10	CT 46
18	HAMMER-LOCK	5/8" (16mm) HAMMERLOCK S.W.L. = 6.0 MT	10		CAM*3.0-3.2 CAM*4.5	CT 48
19	DELTA PLATE	LENGTH 430mm WEIGHT (SEAWATER) = 5.37 STEEL CONSTRUCTION,	2	WEIGHT (kg) 5.10 - 5.64	CAM*3.0-3.2 CAM*4.11	CT 49
20	14" (356mm) BUNT BOBBIN	DIA. 356mm, LENGTH 226mm, RUBBER CONSTRUCTION, WEIGHT (SEAWATER) = 4.80 kg	2	WEIGHT (kg) 4.56 - 5.04 DIMENSIONS (mm) DIA. = 349 - 363 LENGTH = 221 - 231	CAM*3.0-3.2 CAM*4.12	CT 50
21	6" (152mm) WASHER	DIA. 152mm, THICKNESS 8.0 mm, STEEL CONST. WEIGHT (SEAWATER) = 0.42 kg	8	WEIGHT (kg) 0.40 - 0.44 DIMENSIONS (mm) DIA. = 149 - 155 THICKNESS = 7.84 - 8.16	CAM*3.0-3.2 CAM*4.13	CT 51
22	BOBBIN CHAIN	LENGTH = 415mm WEIGHT (SEAWATER) = 0.58 kg STEEL CONSTRUCTION	35	WEIGHT (kg/m) 0.55 - 0.61 LENGTH (mm) 413 - 417	CAM*3.0-3.2 CAM*4.14	CT 52
23	G-HOOK	1 1/4" G-HOOK AND RECESS LINK (FOR DOOR LEG EXTENSION) S.W.L. = 15.0 MT	2		CAM*1.1	CT 53
24	G-HOOK	1" G-HOOK AND RECESSED LINK (FOR PENNANTS) S.W.L. = 5.0 MT	2		CAM*1.2	CT 54
25	TOP WING	R3650tex BRAIDED POLYETHYLENE NETTING CENTRE CORE, ROUND CONSTRUCTION, AND HEAT STRETCHED 80mm MESH SIZE (KC), COLOUR GREEN 102 x 32 x 105.5 MESHES DEEP STRETCHED LENGTH = 8.44 m	2	Rtex 3285 - 4015 MESH SIZE (mm) 80 - 82.40 LENGTH (m) 8.36 - 8.52	CAM*2.0-2.1 CAM*2.3	
		R3650tex BRAIDED POLYETHYLENE NETTING CENTRE CORE, ROUND CONSTRUCTION, AND HEAT STRETCHED 80mm MESH SIZE (KC), COLOUR GREEN 123 x 103 x 41.5 MESHES DEEP (INCLUDES GUSSET) STRETCHED LENGTH = 3.32 m	2	Rtex 3285 - 4015 MESH SIZE (mm) 80 - 82.40 LENGTH (m) 3.24 - 3.40	CAM*2.0-2.1 CAM*2.3	
26	SQUARE	R3650tex BRAIDED POLYETHYLENE NETTING CENTRE CORE, ROUND CONSTRUCTION, AND HEAT STRETCHED 60mm MESH SIZE (KC), COLOUR GREEN 526 x 471 x 55.5 MESHES DEEP STRETCHED LENGTH = 3.33 m	1	Rtex 3285 - 4015 MESH SIZE (mm) 60 - 61.80 LENGTH (m) 3.27 - 3.39	CAM*2.0	CT 17

CAMPELEN 1800 SURVEY TRAWL

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	PART	DESCRIPTION	QTY	TOLERANCE	DRAWING	PART #
27	1ST TOP BELLY	R3650tex BRAIDED POLYETHYLENE NETTING CENTRE CORE, ROUND CONSTRUCTION, AND HEAT STRETCHED 60mm MESH SIZE (KC), COLOUR GREEN 470 x 393 x 64.5 MESHES DEEP STRETCHED LENGTH = 3.87 m	1	Rtex 3285 - 4015 MESH SIZE (mm) 60 - 61.80 LENGTH (m) 3.81 - 3.93	CAM*2.0	CT 18
28	2ND TOP BELLY	R2200tex BRAIDED POLYETHYLENE NETTING CENTRE CORE, ROUND CONSTRUCTION, AND HEAT STRETCHED 44mm MESH SIZE (KC), COLOUR GREEN 580 x 240 x 255.5 MESHES DEEP STRETCHED LENGTH = 11.24 m	1	Rtex 1980 - 2420 MESH SIZE (mm) 44 - 45.32 LENGTH (m) 11.20 - 11.28	CAM*2.0	CT 19
29	3RD TOP BELLY	R2200tex BRAIDED POLYETHYLENE NETTING CENTRE CORE, ROUND CONSTRUCTION, AND HEAT STRETCHED 44mm MESH SIZE (KC), COLOUR GREEN 240 x 141 x 99.5 MESHES DEEP STRETCHED LENGTH = 4.38 m	1	Rtex 1980 - 2420 MESH SIZE (mm) 44 - 45.32 LENGTH (m) 4.34 - 4.42	CAM*2.0	CT 20
30	EXTENSION (1 PANEL)	R2200tex BRAIDED POLYETHYLENE NETTING CENTRE CORE, ROUND CONSTRUCTION, AND HEAT STRETCHED 44mm MESH SIZE (KC), COLOUR GREEN 140 x 139 x 199.5 MESHES DEEP STRETCHED LENGTH = 8.78 m	2	Rtex 1980 - 2420 MESH SIZE (mm) 44 - 45.32 LENGTH (m) 8.74 - 8.82	CAM*2.0	CT 21
31	LOWER WINGS (60mm)	R3650tex BRAIDED POLYETHYLENE NETTING CENTRE CORE, ROUND CONSTRUCTION, AND HEAT STRETCHED 60mm MESH SIZE (KC), COLOUR GREEN 122 x 122 x 62.5 MESHES DEEP (TO INCLUDE GUARD MESHES & GUSSET) STRETCHED LENGTH = 3.75 m	2	Rtex 3285 - 4015 MESH SIZE (mm) 60 - 61.80 LENGTH (m) 3.69 - 3.81	CAM*2.0 CAM*2.2 CAM*2.4	CT 22
32	LOWER WINGS (80mm)	R3650tex BRAIDED POLYETHYLENE NETTING CENTRE CORE, ROUND CONSTRUCTION, AND HEAT STRETCHED 80mm MESH SIZE (KC), COLOUR GREEN 90 x 90 x 48.5 MESHES DEEP (TO INCLUDE GUARD MESHES) STRETCHED LENGTH = 3.88 m	2	Rtex 3285 - 4015 MESH SIZE (mm) 80 - 82.40 LENGTH (m) 3.80 - 3.96	CAM*2.0 CAM*2.2 CAM*2.4	CT 23
33	1ST LOWER BELLY	R3650tex BRAIDED POLYETHYLENE NETTING CENTRE CORE, ROUND CONSTRUCTION, AND HEAT STRETCHED 60mm MESH SIZE (KC), COLOUR GREEN 470 x 393 x 64.5 MESHES DEEP STRETCHED LENGTH = 3.87 m	1	Rtex 3285 - 4015 MESH SIZE (mm) 60 - 61.80 LENGTH (m) 3.81 - 3.93	CAM*2.0	CT 24
34	2ND LOWER BELLY	R2200tex BRAIDED POLYETHYLENE NETTING CENTRE CORE, ROUND CONSTRUCTION, AND HEAT STRETCHED 44mm MESH SIZE (KC), COLOUR GREEN 580 x 240 x 255.5 MESHES DEEP STRETCHED LENGTH = 11.24 m	1	Rtex 1980 - 2420 MESH SIZE (mm) 44 - 45.32 LENGTH (m) 11.20 - 11.28	CAM*2.0	CT 25

CAMPELEN 1800 SURVEY TRAWL

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	PART	DESCRIPTION	QTY	TOLERANCE	DRAWING	PART #
35	3RD LOWER BELLY	R2200tex BRAIDED POLYETHYLENE NETTING CENTRE CORE, ROUND CONSTRUCTION, AND HEAT STRETCHED 44mm MESH SIZE (KC), COLOUR GREEN 240 x 141 x 99.5 MESHES DEEP STRETCHED LENGTH = 4.38 m	1	Rtex 1980 - 2420 MESH SIZE (mm) 44 - 45.32 LENGTH (m) 4.34 - 4.42	CAM*2.0	CT 26
36	CODEND (1 PANEL)	R2200tex BRAIDED POLYETHYLENE NETTING CENTRE CORE, ROUND CONSTRUCTION, AND HEAT STRETCHED 44mm MESH SIZE (KC), COLOUR GREEN 130 x 129 x 199.5 MESHES DEEP STRETCHED LENGTH = 8.78 m	2	Rtex 1980 - 2420 MESH SIZE (mm) 44 - 45.32	CAM*2.0	CT 27
37	SIDE PANEL NO. 1	R3650tex BRAIDED POLYETHYLENE NETTING CENTRE CORE, ROUND CONSTRUCTION, AND HEAT STRETCHED 80mm MESH SIZE (KC), COLOUR GREEN 95 x 30 x 45.5 MESHES DEEP STRETCHED LENGTH = 3.64 m	2	Rtex 3285 - 4015 MESH SIZE (mm) 80 - 82.40 LENGTH (m) 3.56 - 3.72	CAM*2.0	CT 28
38	SIDE PANEL NO. 2	R3650tex BRAIDED POLYETHYLENE NETTING CENTRE CORE, ROUND CONSTRUCTION, AND HEAT STRETCHED 80mm MESH SIZE (KC), COLOUR GREEN 100 x 99 x 41.5 MESHES DEEP STRETCHED LENGTH = 3.32 m	2	Rtex 3285 - 4015 MESH SIZE (mm) 80 - 82.40 LENGTH (m) 3.24 - 3.40	CAM*2.0	CT 29
39	SIDE PANEL NO. 3	R3650tex BRAIDED POLYETHYLENE NETTING CENTRE CORE, ROUND CONSTRUCTION, AND HEAT STRETCHED 60mm MESH SIZE (KC), COLOUR GREEN 130 x 129 x 55.5 MESHES DEEP STRETCHED LENGTH = 3.33 m	2	Rtex 3285 - 4015 MESH SIZE (mm) 60 - 61.80 LENGTH (m) 3.27 - 3.39	CAM*2.0	CT 30
40	SIDE PANEL NO. 4	R3650tex BRAIDED POLYETHYLENE NETTING CENTRE CORE, ROUND CONSTRUCTION, AND HEAT STRETCHED 60mm MESH SIZE (KC), COLOUR GREEN 130 x 129 x 64.5 MESHES DEEP STRETCHED LENGTH = 3.87 m	2	Rtex 3285 - 4015 MESH SIZE (mm) 60 - 61.80 LENGTH (m) 3.81 - 3.93	CAM*2.0	CT 30
41	SIDE PANEL NO. 5	R3650tex BRAIDED POLYETHYLENE NETTING CENTRE CORE, ROUND CONSTRUCTION, AND HEAT STRETCHED 44mm MESH SIZE (KC), COLOUR GREEN 189 x 18 x 255.5 MESHES DEEP STRETCHED LENGTH = 11.24 m	2	Rtex 1980 - 2420 MESH SIZE (mm) 44 - 45.32 LENGTH (m) 11.20 - 11.28	CAM*2.0	CT 31
42	CODEND COVER (1 PANEL)	R5263tex BRAIDED POLYETHYLENE NETTING DOUBLE NETTING CENTRE CORE, ROUND CONSTRUCTION, AND HEAT STRETCHED 140mm MESH SIZE (KC), COLOUR GREEN 40 x 39 x 59.5 MESHES DEEP	4	Rtex 4737 - 5789 MESH SIZE (mm) 140 -144.20	CAM*2.0	CT 32

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	PART	DESCRIPTION	QTY	TOLERANCE	DRAWING	PART #
43	HEADLINE (3 PIECES)	DIA. 22mm COMBINATION WIRE, 6 x 12 POLY JACKET, STEEL CORE, MBS = 14 MT SWAGED AT BOTH ENDS LENGTH = (1 x 2.44m, 2 x 13.43m)	1	WEIGHT (kg/m) 0.72 - 0.74 LENGTH (m) 1 @ 2.43 - 2.45 2 @ 13.36 - 13.50	CAM*1.0 CAM*2.0 CAM*2.3	CT 33
44	UPPER BOLSHLINE (3 PIECES)	DIA. 20/16mm TWISTED PRE-STRETCHED KRAFT ROPE MBS = 5.8 MT LENGTH = (1 x 2.89m, 2 x 13.50m)	1	WEIGHT (kg/m) 0.127 - 0.133 LENGTH (m) 1 @ 2.88 - 2.90 2 @ 13.43 - 13.57	CAM*2.0 CAM*2.3	CT 34
45	UPPER WINGLINE	DIA. 20mm x 8.02m COMBINATION WIRE, 6 x 12 POLY JACKET, STEEL CORE, MBS = 8.87 MT SWAGED AT BOTH ENDS LENGTH = 8.02m	2	WEIGHT (kg/m) 0.55 +/- 2% LENGTH (m) 7.98 - 8.06	CAM*1.0 CAM*2.0	CT 35
46	FISHING LINE (3 PIECES)	DIA. 22mm x 19.50m COMBINATION WIRE, 6 x 12 POLY JACKET, STEEL CORE, MBS = 14.0 MT SWAGED AT BOTH ENDS LENGTH = (1 x 2.44m, 2 x 8.43m)	1	WEIGHT (kg/m) 0.72 - 0.74 LENGTH (m) 1 @ 2.43 - 2.45 2 @ 8.39 - 8.47	CAM*1.0 CAM*2.0 CAM*3.2	CT 36
47	LOWER BOLSHLINE	DIA. 20/16mm x 20m TWISTED PRE-STRETCHED KRAFT ROPE MBS = 5.8 MT LENGTH = (1 x 2.70m, 2 x 8.62m)	1	WEIGHT (kg/m) 0.127 - 0.133 LENGTH (m) 1 @ 2.69 - 2.71 2 @ 8.58 - 8.66	CAM*1.0 CAM*2.0 CAM*3.2	CT 37
48	LOWER WINGLINE	DIA. 22mm x 2.34m COMBINATION WIRE, 6 x 12 SWAGED AT BOTH ENDS POLY JACKET, STEEL CORE, MBS = 14.0 MT LENGTH = 2.34m	2	WEIGHT (kg/m) 0.72 - 0.74 LENGTH (m) 2.33 - 2.35	CAM*1.0 CAM*2.0	CT 38
49	L/WINGEND BOLSHLINE	DIA. 20/16mm x 2.34m TWISTED PRE-STRETCHED KRAFT ROPE MBS = 5.8 MT LENGTH = 2.34m	2	WEIGHT (kg/m) 0.127 - 0.133 LENGTH (m) 2.33 - 2.35	CAM*1.0 CAM*2.0	CT 39
50	UPPER BREASTLINE	DIA. 20mm x 3.60m COMBINATION WIRE, 6 x 12 POLY JACKET, STEEL CORE, MBS = 8.87 MT SWAGED AT BOTH ENDS LENGTH = 3.60m	2	WEIGHT (kg/m) 0.54 - 0.56 LENGTH (m) 3.58 - 3.62	CAM*1.0 CAM*2.0	CT 40
51	LOWER BREASTLINE	DIA. 20mm x 3.60m COMBINATION WIRE, 6 x 12 POLY JACKET, STEEL CORE, MBS = 8.87 MT SWAGED AT BOTH ENDS LENGTH = 3.60m	2	WEIGHT (kg/m) 0.54 - 0.56 LENGTH (m) 3.58 - 3.62	CAM*1.0 CAM*2.0	CT 40
52	RIBLINE #1	DIA. 24/20mm x 10.59m TWISTED PRE-STRETCHED KRAFT ROPE MBS = 10.0 MT LENGTH = 10.59m	4	WEIGHT (kg/m) 0.225 - 0.235 LENGTH (m) 10.54 - 10.64	CAM*2.0	CT 41
53	RIBLINE #2	DIA. 24/20mm x 10.22m TWISTED PRE-STRETCHED KRAFT ROPE MBS = 10.0 MT LENGTH = 10.22m	4	WEIGHT (kg/m) 0.225 - 0.235 LENGTH (m) 10.17 - 10.27	CAM*2.0	CT 42
54	RIBLINE #3	DIA. 24/20mm x 4.0m TWISTED PRE-STRETCHED KRAFT ROPE MBS = 10.0 MT LENGTH = 4m	2	WEIGHT (kg/m) 0.225 - 0.235 LENGTH (m) 3.98 -4.02	CAM*2.0	CT 43
55	RIBLINE #4	DIA. 24/20mm x 16 m TWISTEDPRE-STRETCHED KRAFT ROPE MBS = 10.0 MT LENGTH = 16m	2	WEIGHT (kg/m) 0.225 - 0.235 LENGTH (m) 15.92 - 16.08	CAM*2.0	CT 44
56	LINER	DIA. 1mm KNOTLESS NETTING 12.7mm STRETCHED MESH, COLOUR WHITE 7.0m x 7.0m x 10.20m	2	MESH SIZE (mm) 12.3 - 13.1	CAM*2.0	CT 55
57	TRAVEL CHAIN	3/8" CHAIN LENGTH = 19.50m	1	WEIGHT (kg/m) 1.81 - 1.89 LENGTH (m) 19.40 - 19.60	CAM*3.0-3.2	CT 56

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	PART	DESCRIPTION	QTY	TOLERANCE	DRAWING	PART #
58	AFT TRAWL DOOR SHOE	DISTANCE BETWEEN MOUNTING HOLES = 520mm OUTSIDE WIDTH = 138mm WEIGHT = 54.6kg MANGANESE STEEL CONSTRUCTION	2	WEIGHT (kg/m) 51.9 - 57.3 DIMENSIONS (mm) HOLE TO HOLE 519 - 521 WIDTH 137 - 139	CAM*4.2	
59	MIDDLE TRAWL DOOR SHOE	DISTANCE BETWEEN MOUNTING HOLES = 650mm OUTSIDE WIDTH = 138mm WEIGHT = 59.3kg MANGANESE STEEL CONSTRUCTION	2	WEIGHT (kg/m) 56.3 - 62.3 DIMENSIONS (mm) HOLE TO HOLE 649 - 651 WIDTH 137 - 139	CAM*4.2	
60	FWD. TRAWL DOOR SHOE	DISTANCE BETWEEN MOUNTING HOLES = 589mm OUTSIDE WIDTH = 138mm WEIGHT = 51.1kg MANGANESE STEEL CONSTRUCTION	2	WEIGHT (kg/m) 48.5 - 53.7 DIMENSIONS (mm) HOLE TO HOLE 588 - 590 WIDTH 137 - 139	CAM*4.2	
61	WING CANNISTER (SLAVE)	DIA. 191mm x 319mm WEIGHT (SEAWATER) = 11.64 kg STAINLESS STEEL CONSTRUCTION	1	WEIGHT (kg) 11.06 - 12.22 DIMENSIONS (mm) DIA. = 187 - 195 LENGTH = 313 - 325	CAM*4.3	
62	WING CANNISTER (MASTER)	DIA. 191mm x 341mm WEIGHT (SEAWATER) = 11.86 kg STAINLESS STEEL CONSTRUCTION	1	WEIGHT (kg) 11.27 - 12.45 DIMENSIONS (mm) DIA. = 187 - 195 LENGTH = 334 - 348	CAN*4.3	
63	CTD MOUNTING BOARD WITH RAILS	1214mm x 611mm x 19mm (LENGTH x WIDTH x THICKNESS) COLOUR WHITE, HIGH DENSITY POLYETHYLENE / ALUMINUM CONSTRUCTION WEIGHT (SEAWATER) = 1.06 kg	1	WEIGHT (kg) 1.01 - 1.11 DIMENSIONS (mm) LENGTH = 187 - 195 WIDTH = 334 - 348 THICKNESS = 18.6 - 19.4	CAM*4.4	
64	CTD PROTECTIVE PIPE SHELLS	DIA. 222mm x 790mm WEIGHT (SEAWATER) = 7.063 kg ALUMINUM / RUBBER CONSTRUCTION	1	WEIGHT (kg) 6.710 - 7.416 DIMENSIONS (mm) DIA. = 218 - 226 LENGTH = 774 - 806	CAM*4.4	
65	CTD	SEABIRD CTD WEIGHT (SEAWATER) = 4.713 kg	1	WEIGHT (kg) 4.477 - 4.949	CAM*4.4	
66	TRAWL DOOR SHACKLE	1 1/2" (38mm) BOW SHACKLE S.W.L. = 17 MT			CAM*4.6	
67	OVAL ACTION SWIVEL	1 1/2" OVAL ACTION SWIVEL, LENGTH = 350mm WEIGHT (SEAWATER) = ?? kg S.W.L. = 18 MT STAINLESS STEEL CONSTRUCTION	2		CAM*4.7	
68	MENDING TWINE	DIA. 2.5 mm, R>2400tex BRAIDED POLYETHYLENE CENTRE CORE, ROUND CONSTRUCTION MBS ≥ 86 Kgf. COLOUR GREEN AND ORANGE	N/A	Rtex 2469 - 3448 MBS (Kgf.) 86 - 174		
69	MENDING TWINE	DIA. 3.0 mm, R>3000tex BRAIDED POLYETHYLENE CENTRE CORE, ROUND CONSTRUCTION MBS ≥ 120 Kgf. COLOUR GREEN	N/A	Rtex 3559 - 4348 MBS (Kgf.) 120 - 192		
70	LACING TWINE	DIA. 2.0 mm, R>2700tex BRAIDED NYLON CENTRE CORE, ROUND CONSTRUCTION MBS ≥ 133 Kgf. COLOUR WHITE	N/A	Rtex 2778-3125 MBS (Kgf.) 133 - 370		

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	PART	DESCRIPTION	QTY	TOLERANCE	DRAWING	PART #
71	LACING TWINE	DIA. 2.5 mm, R>2400tex BRAIDED POLYETHYLENE CENTRE CORE, ROUND CONSTRUCTION MBS ≥ 86 Kgf. COLOUR GREEN	N/A	Rtex 2469 - 3448 MBS (Kgf.) 86 - 174		

NOTES TO CAMPELEN
1800 PARTS LIST

- All mesh sizes are to be taken as knot centre stretched mesh.
- All wire and rope weights are specified as in air.
- All footrope components are specified as in seawater.
- MBS = Minimum breaking strength
- S.W.L. = Minimum safe working load (factor of safety 1:5)
- Wire, chain and rope lengths do not include hammerlocks and their lengths have been adjusted downward.

CHAPTER 4

TRAWL PROCUREMENT PROTOCOLS

4.1 INTRODUCTION

In an effort to increase the level of standardization and conformity of the survey trawls, the Department of Fisheries and Oceans' Northwest Atlantic Fisheries Centre instituted a quality assurance program in 1994 for the verification of survey trawl related components. These specifications were updated in August 25, 2008 along with the Campelen Parts list. Additional revisions are made below.

An independent commercial net maker is responsible for constructing the trawl from components supplied by CCG Supply Chain Coordinator. The CCG warehouse staff stock various trawl components in their inventory and order via the tender process additional components in bulk when the inventory is low. When a tender to supply is sent out to the gear suppliers the trawl specifications (detailed trawl plans), parts list with its tolerances (Chapter 3) and these quality assurance instructions are attached.

4.2 QUALITY ASSURANCE PROCEDURES

Quality assurance (QA) refers to a planned and systematic set of activities intended to ensure that trawl components satisfy NAFC survey trawl construction and repair requirements in a systematic, reliable fashion. This QA process ensures the product is suitable for the intended purpose and sub-standard materials and mistakes in construction are eliminated. The survey trawl QA includes regulation of the **quality** of raw materials, and assemblage of products and components through a detailed inspection process.

Given that the survey trawl is a scientific instrument, rigorous adherence to specifications is more of a concern than would normally be the case with a commercial fishing trawl. Detailed Campelen Trawl Plans, found in Chapter 3 Trawl Specifications, along with the updated Parts List and Tolerances will guide suppliers and manufactures in DFO Science requirements.

4.3 TOLERANCES ON COMPONENT SPECIFICATIONS

Component specifications are given in detail in the parts list and engineering trawl drawings of Chapter 3. While all components and assemblies are expected to meet specification the following specific tolerances ***must*** apply:

4.3.1 NETTING BALES AND PANELS

4.3.1.1 ***Twine diameters***: The runnage specified in Rtex may be no greater than +/- 10% of the specified Rtex value.

4.3.1.2 ***Twine knots****:* To reduce weakness of the twine at the knots, the knot's loop must be made using alternate direction between immediately adjacent pairs of knots, i.e. the rows of knots are alternately S-type and Z-type.

4.3.1.3 ***Mesh size****:* It may be no greater than +1.5% from specification and include uniformity of twines (i.e. all twines having identical physical characteristics) uniformity of mesh size and uniformity of bar length.

4.3.1.4 ***Colour****:* No substitution permitted.

4.3.1.5 ***Material*****:** No substitution permitted; individual rows of mesh must be the same length and the netting must be pre-stretch in 'N' direction and steam heated after it comes off the loom.

4.3.1.6 ***Mesh counts and tapers***: No substitution permitted[1].

4.3.1.7 ***Panel stretch length***: Cut within a ½ mesh of length specified for the panel (only mesh counts in 'N' direction may vary slightly).

4.3.1.8 ***Certificates****:* Required (see below).

4.3.2 WIRE

4.3.2.1 ***Material****:* No substitution.

4.3.2.2 ***Weight****:* May be no greater than +/-2% from specification with the exception of part no. CT 01 (trawl warps) which is +/- 1%.

4.3.2.3 ***Length:*** May be no greater than +/- 0.5% of the specified length.

[1] When cutting panels adherence to stretch length rule may result in a difference in specified meshes deep in the 'N' direction. This is acceptable.

4.3.2.4 ***Lubrication:*** No grease or lubrication accepted.

4.3.2.5 ***Certificates:*** Required (see below)

4.3.3 WARPS

4.3.3.1 ***Material:*** No substitution.

4.3.3.2 ***Weight*****:** 2.922 kg/m ± 3% (without lubrication)
2.980 kg/m (with lubrication, i.e. add 2%).

4.3.3.3 ***Length*****:** No substitution.

4.2.3.4 ***MBL*****:** 49.5 t

4.3.3.4 ***Certificates:*** Required (see below).

4.3.4 DOORS

4.3.4.1 ***Manufacturer*****:** Morgère S.A.S: No substitution.

4.3.4.2 ***Weight:*** In air may not be greater than +/-5% from specification.

4.3.4.3 ***Size*****:** No substitution.

4.3.4.4 ***Certificates*****:** Required (see below)

4.3.5 FOOTROPE COMPONENTS

4.3.5.1 ***Length:*** May be no greater than +/-2% from specification.

4.3.5.2 ***Diameter*****:** May be no greater than +/-2% from specification.

4.3.5.3 ***Weight :*** In seawater may be no greater than +/-5% from specification.

4.3.5.4 ***Material*****:** No substitution

4.3.6 FLOATS

4.3.6.1 ***Buoyancy***: May be no greater than +/-2% from specification

4.3.6.2 ***Colour:*** No substitution.

4.3.6.3 ***Depth rating*****:** May be no greater than +/-10% from specification.

4.3.6.4 ***Certificates:*** Required (see below)

4.3.7 CODEND LINER

4.3.7.1 ***Twine diameters*****:** No substitution.

4.3.7.2 ***Material*****:** No substitution.

4.3.7.3 ***Colour:*** No substitution.

4.3.7.4 ***Mesh size*****:** May be no greater than +1.5% from specification and include uniformity of twines (i.e. all twines having identical physical characteristics) uniformity of mesh size and uniformity of bar length.

4.2.8.5 ***Certificates*****:** Required (see below)

4.4 TENDERING GUIDELINES

All of the tendered items will be inspected by DFO personnel or designates using the detailed methods of Inspection and Verification below. The inspection may take place at the manufactures/suppliers warehouse, and it will be the manufactures/suppliers' responsibility to notify DFO that the material is available for inspection prior to delivery. **DFO reserves the right to reject material which does not meet specifications.** If suppliers have questions as to the acceptability of their material they are invited to submit a sample to DFO for advice. This will not preclude the final inspection.

4.3 METHODS OF INSPECTION AND VERIFICATION

4.3.1 BALES OF NETTING

The successful bidder on the tender is asked to bring in bales (of up to 3 different mesh sizes to match our requirements for the trawl) of netting twine, whose characteristics must meet the specifications in the Parts List and Trawl Drawings in Chapter 3 on Trawl Specifications and Section 4.2.1 above. The bidder must supply a certificate of compliance from the netting manufacturer identifying size of the bales (length, weight, mesh counts and tapers), twine diameter, number of strands in core, shape of twine, Rtex of twine, mesh size, uniformity of bar length, uniformity of

length of individual rows of mesh, machine method of knot making and type, pre-stretch and heating method used and percentage of elongation at knot break. Each bale should have a unique tracking number. Inspection takes place at the supplier's warehouse.

4.3.1.1 *Method of Inspection of Mesh Size*

4.3.1.1.1 DFO staff unrolls each bale, checks the characteristics of the netting which includes uniformity of physical characteristics, uniformity of mesh size and uniformity of bar length, uniformity of length for individual rows and colour.

4.3.1.1.2 The number of meshes deep of the panel is checked by marking with a non-green colour twine every 50 meshes to arrive at the total depth of the bale.

4.3.1.1.3 The stretch length of the bale is measured at three locations, the two sides and the centre of the bale, and must be done while the twine is on the floor- never lift the twine off the floor when determining the length. At each side of the bale, move in 5 meshes and then hook the next 5 meshes together and tie that end onto a stationary hook/ or pole with a piece of non-stretching rope.

4.3.1.1.4 At the opposite end gather the 5 meshes in the same manner as above and hook a calibrate weight scale to it. Attach the top end of the scale to a pull-along which is attached to another stationary hook or pole with a non-stretching rope. Exert 10 kg of tension to pull the meshes closed.

4.3.1.1.5 A cloth tape is then used to measure the stretch length of the bale. The measurements are checked against the specified number of meshes deep and length for the bale in the tender. When checking the stretch length of the bale at the centre, take up the corresponding 5 meshes at each end.

4.3.1.1.6 Next the mesh size of the bale is determined by dividing the stretch length by the number of meshes deep to arrive at average mesh size.

4.3.1.1.7 Should the mesh size not be within tolerance a quick check of the mesh size near the top centre and bottom along side the stretch length section should disclose the trouble area. Never measure mesh sizes at locations laterally to each other. At these 3 locations take 10 randomly selected meshes (dry) running in the 'N' direction and mark both ends with a non-green colour twine, and stretched closed between two staff[2] members. A cloth tape is used to measure total length which is divided by 10 to get an average mesh size. This method of determination of mesh size is carried out according to procedures outlined in Canadian General Standards Board (CGSB), Standard CAN2-55.1-M85. A calibrated digital calliper can be used to check mesh size using knot-centre-to knot centre (kc) at the 10 locations to verify the discrepancy.

4.3.1.1.8 ***The results of these secondary checks cannot over-rule the mesh size determined by the stretch length method as these are only the mesh sizes for particular areas of the bale.***

4.3.1.2 ***Method of Inspection of Twine diameter***

4.3.1.2.1 The supplier is asked to deliver a 110 meter sample of netting from each bale to determine twine diameter. Twine diameter, or Rtex (resultant linear density, g/1000m) value is determined using the multi-strand method as outlined in CGSB Standard CAN2-55.1-M85.

4.3.1.2.2 A mounting hanging stand is used to have the meshes inspected at working level. An exact precision 1 meter cutting device is used to cut the 10 m sample into 1 m sections. Each of these sections is placed in a small plastic bag labelled

[2] If there is only a single staff member available a hanging stand is used to attached one end of the 10 mesh section to it while the staff member pulls the other end. A 10 kg weight is attached at the last mesh at the hanging stand to mimic the strain that two people would use to pull the meshes together by hand.

with date, mesh size and supplier and weighed using lab scales.

4.3.1.2.3 Rtex values for each sample is determined and written on the plastic bag label and stored for future reference. An average Rtex value is derived for the bale. Average Rtex values must not exceed +/- 10% of the specified Rtex value.

4.3.1.3 ***Verification***

All measurements of mesh sizes twine diameters and stretch lengths of the bales along with any other discrepancies are presented to the DFO Science gear technologist for final acceptance or rejection of the bales.

4.3.1.3.1 If the inspections of the bales show that they do not meet specifications then the tender is rejected and the whole tendering process is repeated.

4.3.1.3.2 The bales that are accepted are marked property of DFO_NL Region and generally stored at supplier's warehouse. Panels are cut upon request according to details below.

4.3.2 NET PANELS

Panels are cut according to stretch length specifications for each panel from the bales of netting that have passed quality control inspection and stored at the supplier's warehouse. Guard meshes and gussets are to be included where specified in the trawl plans.

4.3.2.1 ***Method of Inspection of Net Panels***

Upon delivery to the CCG Supply Chain warehouse, a physical inspection of the panels is carried out which includes measuring the stretch lengths, counting the meshes across, and the taper, and in the case of the wings checking for guard meshes.

4.3.2.1.1 ***In order to meet panel specifications the stretch length of the panel, not the number of meshes deep, will be the only acceptable criteria for determining the overall length of the panel prior to cutting***.

4.3.2.1.2 There is a ½ mesh tolerance on the stretch length of each panel (see Appendix 1 for instructions on measuring panels).

4.3.2.2 ***Verification***

All measurements and discrepancies are completed by DFO Science gear technologist and CCG warehouse staff and are assessed for final acceptance or rejection of the panels. All information and lengths are recorded using the net plan section of the NAFC Survey Trawl Checklist (see Chapter 8).

4.3.2.2.1 Those panels that do not meet specifications are returned to supplier for replacement. In the case where the panel length exceeds specifications the supplier will be instructed to cut the excess length off to meet **exact** specification for stretch panel length.

4.3.2.2.2 Panels that meet specifications are tagged with a cloth tag by CCG warehouse staff using a unique waterproof written code[3] and stored until requested by vessel. After installation of a panel into the trawl onboard the vessel or at the net maker the tags are recorded in the repair manual and returned to the warehouse staff.

4.3.3 CODEND LINER

The successful bidder on the tender is asked to bring in bales whose dimensions are 2.4 m x 91.4 m (width x depth) whose characteristics must meet the specifications in the Parts List and Trawl Plans (Chapter 3) and Section 4.2.1 above). The bidder must supply a certificate of compliance from the netting manufacturer identifying size of the bales (length, weight), twine diameter, number of strands in core, shape of twine, mesh size, uniformity of bar length, uniformity of length of individual rows of mesh, and pre-stretch method used.

4.3.3.1 ***Inspection and Verification***

Upon delivery to the warehouse CCG staff unrolls each bale, checks the characteristics of the netting which includes uniformity of physical characteristics, uniformity of mesh size and uniformity of bar length, uniformity of length for individual rows and colour.

[3] On the tag should be written: Part No.; part name; mesh size; meshes deep; stretch length; and date inspected. Indication of guard meshes should be included where necessary.

4.3.3.1.1 A calibrated digital calliper is used to check mesh size using the diagonal of the twine of 20 meshes selected at 10 different locations in the bale, but never in the same row.

4.3.3.1.2 All measurements of mesh sizes, and twine diameters of the bales along with any discrepancies are presented to the DFO Science gear technologist for final acceptance or rejection of the bales.

4.3.3.1.3 Bales that meet inspection are stored at the DFO warehouse and sent to the survey vessels upon request. The vessel crews are responsible for cutting out the codend liner and sewing the panels together.

4.3.3.1.4 If the inspections of the bales show that they do not meet specifications then the tender is rejected and the whole process is repeated.

4.3.4 WIRE AND COMBINATION ROPE

The successful bidder on the tender is asked to deliver to CCG a sample (approximately 3 ft) of each wire type whose characteristics must meet the specifications in the Parts List and Trawl Plans in Chapter 3 and Section 4.2.2 above. CCG warehouse staff checks to see if it meets specifications by weighting it in air and measuring (callipers) the diameter. These values will be used to compute weight per unit length and expressed in kg/m. If the sample meets specifications then the tender is accepted, and the entire order is tagged property of DFO-NL region and generally stored at supplier's warehouse and cut upon request, e.g., bridles and frame (wire) ropes, according to specifications and cutting details below.

If the sample does meet not specifications then the bidder is asked to re-supply or if he cannot then the tender is rejected then the whole process is repeated.

4.3.4.1 *Method of Construction*

Where pre-fabricated lengths with spliced or swaged eyes are specified the length shall be taken as the inside eye to inside eye distance with the rope or wire fully extended (not loaded). The eyes are to be machine compressed. Procedures for mechanical

swaging, hand splicing and rope cutting are according to the following standardized practices:

4.3.4.1.1 Mechanical Swaging

Measure 1 meter from end of wire mark, take top two layers and unwind 7 tucks, roll into a Flemish eye and then measure the distance from mark to end of eye. This will result in a standard eye measure of approximately 39.4 cm (15.5 inches) of 5/8 inch wire for required bridle length.

Note: as the diameter of each wire increases then the size of the eye will be slightly larger because of the increase size of wire. In that case again use the same principle of 7 tucks and roll into a Flemish eye and measure distance from mark to end of eye. Swage size must match wire rope size i.e., a 16 mm wire should have a 16mm swage. Each swage should be made of carbon steel and stamped with the diameter in the sleeve.

4.3.4.1.2 Hand splicing

Measure off 1 meter from end of wire and use for the 1st lay 3 tucks, 2nd lay 4 tucks, 3rd lay 5 tucks. Cut off all spurs and wrap splice with brim or ballistic protective guard.

4.3.4.2 Inspection and Verification of Pre-cut Wire and Combination Rope

Before delivery, all wires and wire ropes are tagged by the supplier with part name, number and length listed.

4.3.4.2.1 Upon delivery to the warehouse all wires are measured and checked against specifications using the following method: each finished bridle is uncoiled stretched, measured, and weighted, with construction, lay of wire and swaging being recorded. All information and lengths are recorded using the frame rope section of the NAFC Survey Trawl Checklist (Chapter 8).

4.3.4.2.2 Those bridle wires and combination frame ropes not meeting specifications are returned to the supplier for replacement.

4.3.4.2.3 Those found acceptable are tagged with a cloth tag that is given a unique waterproof written code[4] and stored until requested by vessel.

4.3.4.2.4 After attaching the wire ropes to the trawl onboard the vessel or at the net maker the tags are recorded in the repair manual and returned to the warehouse staff.

4.3.5 ROPE

Before delivery, all ropes are tagged by the supplier with part name, number and length listed.

4.3.5.1 *Method of Construction*

Measure all bolshlines and riblines and cut them to specified length. The total length specified must include the standard eye tucks of 12.7 cm (5 inch). Wrap the ends of eye tucks/splice with an electric tape.

4.3.5.2 *Inspection and Verification of Pre-cut Wire and Combination Rope*

4.3.5.2.1 Upon delivery to the warehouse all ropes with their splices are measured and checked against specifications using the following method: each finished rope is uncoiled stretched, measured, and recorded.

4.3.5.2.2 Those frame ropes not meeting specifications are returned to the supplier for replacement.

4.3.5.2.3 Those found acceptable are tagged with a cloth tag that is given a unique waterproof written code[5] and stored until requested by vessel.

4.3.5.2.4 After attaching the rope to the trawl onboard the vessel or at the net maker the tags are recorded in the repair manual and returned to the warehouse staff.

4.3.6 WARPS

There is a bidders conference prior to closure of tender where product information is analyzed. There are 8 critical areas of specifications that

[4] On the tag should be written: Part No.; part name; length; weight (kg/m); swage indication and date inspected.
[5] On the tag should be written: Part No.; part name; length; and date inspected.

are mandatory. The 8 areas are: 1) the warp dimensions; 2) the MBL minimum must be set at 49.5 T; 3) weight per unit length should either be 2.92 kg/m ±3% tolerance (without lubrication) or 2.98 kg/m +/-3% tolerance (with light lubrication), 4) the wire lubrication is specified as internal grease and external grease using light lubrication only, heavy grease or tar will not be accepted; 5) warps are to be supplied on clearly identified steel reels with a center hole of no less than 7.6 cm, and 6) the reel size should be no larger than 2 m dia. x 1.5 m wide), 7) the wire must be one continuous length per reel; and 8) the test certificate must be provided to CCG prior to shipment.

4.3.6.1 ***Method of Inspection and Verification of Warps***

Upon delivery of main trawl warps, CCG warehouse staff verify warp specifications (diameter, construction, lay, core and certificates). Supplier terms and conditions of installing wire and marks and corresponding warranty agreements are also checked.

4.3.7 DOORS

Trawl doors are exactly specified in the tender as being 4.3 square meter Morgère single slot, cambered, oval polyvalent doors. No substitution is permitted. The doors are to be rigged with door leg chains and SCANMAR sensor pockets as described in Trawl Plans in Chapter 3 and painted black. Compliance certificates must include the following information: door type, engraved number code, material, size, surface area, weight in air and stability (lift and drag coefficients at various attack angles).

Extra shoes may be ordered separately along with bolts and other hardware for repairs to doors according to specifications of the door manufacturer.

4.3.7.1 *Method of Inspection and Verification of Doors*

Upon delivery, trawl doors are weighted and physically checked. Each door has a unique number engraved into the metal so later a history of repair and vessel ownership can be tracked.

4.3.7.11 If trawl door shoes are ordered separately then these are measured, weighed and checked against specifications in the Parts List and Trawl Plans in Chapter 3. These shoe components should have a unique number engraved into the side of the shoe.

4.3.8 FOOTGEAR COMPONENTS

The successful bidder on the tender or supplier is asked to deliver a manufacturer's certificate with each specified component ordered.

4.3.8.1 *Method of Inspection of Footrope Components*

Upon delivery CCG warehouse staff checks components against specifications in the Parts List and Trawl Plans in Chapter 3 with regard to dimensions and certifications.

Those components that do not meet specifications are returned to supplier for replacement.

4.3.8.2 *Verification*.

The length of each component is taken as the maximum linear measurement along an axis running through the centre of and parallel to the centre hole; the diameter of each component is taken as the maximum linear measurement along an axis running through the geometrical centre of the component and at right angle to the length axis; the weight of the component is taken as weight in seawater.

4.3.8.2.1 Periodically, the weight in seawater of a component is checked against specifications at Memorial University's Marine Institute flume tank by suspending the component in freshwater from a calibrated balance, with the component fully submerged. The measurement is corrected to an equivalent value in seawater by multiplying by 1.025.

4.3.9 FOOTGEAR CONSTRUCTION

The successful bidder on the tender is asked to construct/assemble the footgear under tension in sections according to specifications in Trawl Plans and Parts List in Chapter 3. For each section the first rockhopper disk will have a unique number code (supplied by CCG) burned into the side of the disk.

Note: DFO warehouse staff supply all components of the footrope and all components have undergone a quality assurance inspection (weight,

diameter, description, length, and other physical dimension checked) according to Section 4.3.8 above.

4.3.9.1 *Method of Inspection of Footrope Construction*

Warehouse staff inspects the gear against the specifications and tolerances before it leaves supplier. Rejection of the footgear section can occur if any of the main measurements fall outside the tolerance levels. All information and lengths are recorded using the ground gear rigging section of the NAFC Survey Trawl Checklist (Chapter 8).

4.3.9.1.1 Upon delivery of the assembled footgear CCG warehouse checks the overall length and weight of each footgear sections and records engraved code on first disk.

4.3.9.1.2 A count of the number of components and their location must meet the specifications in the Trawl Plans in Chapter 3.

4.3.9.1.3 A visual inspection is carried out to verify that the footgear has been strung tightly under tension.

4.3.9.1.4 Those sections that do not meet specifications are returned to supplier for replacement.

4.3.10 FLOATS

The successful bidder on the tender is asked to deliver a manufacturer's certificate and a sample of the floats to the DFO.

4.3.10.1 *Method of Inspection of Floats*

Upon delivery CCG warehouse staff checks floats against specifications with regard to size, colour and buoyancy. Floats that do not meet specifications are returned to supplier for replacement.

4.3.10.2 *Verification*

Periodically or when in doubt, the specifications of the suppliers trawl floats are checked at Memorial University's Marine Institute flume tank in regards to depth rating. Buoyancy in seawater is determined by suspending a float in freshwater from a calibrated balance, a counter weight of known mass in water is attached to

the float so that it fully submerges. The mass of the counter weight in water less the weight of the float and counter weight will be taken as the buoyancy of the float. The measurement is corrected to a equivalent value in seawater by dividing by 1.025 and checked against specifications in Chapter 3.

4.3.11 HARDWARE AND MENDING/LACING TWINES

The successful bidder on the tender or supplier is asked to deliver a manufacturer's certificate for all hardware, mending and lacing twines.

4.3.11.1 *Method of Inspection*

Always the same brand-name of hardware components such as hammerlocks, shackles, toggle chains, delta plates, etc. are sourced from a supplier. Upon arrival at the warehouse these components dimensions are checked against the specifications in Parts List and Trawl Plans in Chapter 3, and compared with the manufacturers' specifications certificate.

Similar procedures are in effect for mending and lacing twines.

Those components and twines that do not meet specifications are returned to supplier for replacement

4. 3.12 MISCELLANEOUS COMPONENTS

Many items are bought directly from suppliers such as 1) bushings, pins, and punches for hammerlocks; 2) various needles such as flat, Norwegian, and sail, used for mending and lacing the trawl; and 3) chain.

APPENDIX I

PROCEDURES FOR STRETCHED LENGTH MEASUREMENTS OF NET PANELS

Background: For the time period 1994-2007 the acceptance of netting panels meeting quality assurance standards for construction was based on two criteria: 1) the mesh size should be within + 3 % of that specified and 2) the number of meshes deep (MD) in a panel should be exact. In recent years it has been discovered that mesh sizes in some netting bales were not consistent resulting in the overall length of a panel being significantly different even though the number of meshes deep was constant. This created problems during construction and repairs. The 2008 acceptance criteria for panels is based on 1) the mesh size should be within + 1.5% of that specified, and 2) stretch length of the panel must be ± ½ mesh of that specified. It is critical that the overall (stretch) panel length is identical to panel specifications to minimize its effects on performance and catchability of the trawl. ***Note***: ***All measurements are done with the panel stretched along the floor; do not lift the panel up***.

1. Top and bottom bellies, square and side panels can all be marked and measured in the same fashion. Start at the center mesh in the panels and follow that mesh in the N direction until the last mesh in the last section is reached. Place a mark approximately every 50 meshes with white or some other colour twine in contrast to that of the original netting. If panel mesh number is not equally devisable by 50 adjust number of meshes in each section.

2. Top and bottom wings will have to be marked differently because of their cutaway nature. Start at the narrow wing end of the ***top wing***. Proceed by counting in the T direction 10 meshes in from the edge and placing the first mark. Count down 50 meshes, place a mark and then follow this mesh towards the headline until you are again 10 meshes from the headline, place another mark. Follow this mesh for 50 meshes and put another mark. Continue this method until the wing has been completely marked. The ***bottom wing*** should be marked in the same way except the fore section of 42.5 meshes can be measured without marking; the second section of 62.5 meshes can be marked at 30 mesh location.

3. Leave marks intact in case there is a need to re – measure.

4. If the meshes in any one measurement won't close completely continue halving the number of meshes in the measurement until mesh closure is achieved.

5. Mistakenly choosing the wrong mark when measuring the wings is a possibility because of the offset in the mesh sequences. Therefore extra care should be taken when measuring the wings (consider a marking system to identify each sequence i.e. different number of marks or different colors of twine for marks).

6. Make sure that in cases where the beginning or end mark is on a half mesh that when measurement is carried out that the tape is extended one half mesh beyond the mark.

7. After the panel is marked for measurement take up 5 meshes at the edge and hook them together and tie that end onto a stationary hook/ or pole at floor level with a piece of non-stretching rope. At the opposite end gather the 5 meshes in the same manner as above and hook a calibrate weight scale to it. Attach the top end of the scale to a pull-along which is attached to another stationary hook or pole with a non-stretching rope. Exert 10 kg[6] of tension to pull the meshes closed.

8. A cloth tape is then used to measure the stretch length of the panel. The measurements are checked against the specified stretch length for the panel in the tender.

9. Joining rounds are not to be included in the measurements.

[6] Smaller panels may need less force to close meshes.

CHAPTER 5

TRAWL WARP PROTOCOLS

SECTION I: PROTOCOLS FOR TRAWL WARP STANDARDIZATION

5.1 INTRODUCTION

The length of the warp deployed relative to the bottom depth of the water being fished (i.e., warp-to-depth or scope ratio) influences door contact, stability and spread, and hence trawl performance and geometry. Generally, small variations in scope ratio will have little effect on trawl performance and geometry. However differences in warp lengths between port and starboard sides may be very influential to the symmetry of the trawl that may not be detected by acoustic door, wing and headline height sensors but can be detected by bottom contact and symmetry sensors [8]. As the warp length differences become larger the trawl begins to contort to the point where the footgear is lightly tending the bottom and may lift off bottom. Depending on the degree of skewness, the catching efficiency of the trawl will be affected due to poor bottom contact of footgear (fish and shellfish escape underneath the trawl [8]), reduced headline height (loss of fish over the trawl) and reduced herding by bridles and doors (loss of fish from the trawl mouth area). When the degree of skewness is beyond the accepted limit the result is a reduction in capture ability and trawl efficiency, which will contribute to both bias and noise in the survey estimates.

Annual NAFC bottom trawl surveys are carried out by two classes of vessels with different trawl winch systems to deploy the Campelen survey trawl. CCGS *W. Templeman* and *A. Needler* use a fixed length of warp throughout the tow with the brakes remaining locked on the winches. The CCGS *Teleost* uses an auto-trawl style winch system in which the warp length is dynamically increased or decreased by the trawl winches throughout the tow in response to difference in tensions on each warp, i.e., to correct trawl symmetry. Accurate measurement of warp length during the tow is relatively unimportant in auto-trawl systems but it is important during deployment of the trawl.

5.2 DIFFERENTIAL WARP LENGTHS DURING THE SURVEY

Accuracy in the measurement of warp length deployed at each fishing station is extremely important for maintaining consistency in trawl performance and geometry. Protocols are necessary to ensure that warp length differences are maintained within a specified tolerance. In 2009 NAFC set the tolerance limit for

those vessels fishing the Campelen trawl based on the 2002 NOAA/NMFS "Report of the Workshop on Trawl Warp Effects on Fishing Gear Performance" [9].

Protocol 1: *The recommended maximum warp offset is 5.4 meters*[7] *during survey operations, i.e. if during a survey tow the difference between the two warps lengths on deployment exceeds 5.4 meters, then the cause of the discrepancy must be determined and remedied before the next survey tow.*

This procedure involves comparison of redundant measuring systems (warp counters and/or warp marks) to detect differences in warp length beyond the specified tolerance limit. It is the difference between port and starboard length values when comparing the two methods that is important i.e., the warp offset from one another.

Example

At the start of the survey both block counters and physical marks give the same readings with the counters measuring 150 m at the 150 m tape mark (over centre of sheave). Then a serious hang on a bottom obstruction occurs or the block counters are spinning in rough weather. If the port block counter reads 152 m at the 150 m physical mark and the starboard block counter reads 146 m at the 150 m mark then the difference between the two would be 6 m (152-146= 6), i.e. beyond acceptable tolerance limit. However, if both block counters were reading 154 m at the 150 m physical marking then the offset between the wires would be zero (154-154 = 0), i.e. within the acceptable tolerance level.

Sometimes a possible cause for the offset differences is that the counters were not zeroed before the warp was deployed.

5.3 WARP LENGTH STANDARDIZATION PROCEDURES FOR LOCK WINCH SYSTEMS

Currently, warp length payed out by the vessel is determined by two methods: 1) the winch system's automated block wire counters; and 2) the physical marks on the warps at increments of 50 m. Both methods are used for real-time measurements and both methods have errors. For example, the measured values may be incorrect due to 1) un-calibrated block wire counters; 2) slippage of the block wire counters; 3) stretching of the warps; 4) physically shortening a damaged warp resulting in incorrect mark locations; 5) inherent error in the block wire counters; and (6) error in the placement of the 50 m marks.

[7] Offset is based on NOAA protocols [10] developed after the 2002 trawl warp incident onboard one of NEFSC Woods Hole survey vessel which led to a court challenge by the fishing industry. The maximum allowable offset between trawl warps is 4% of the distance from door to door as measured around the bridles and footgear. For the Campelen this critical value is determined as follows: Door legs = 3.05 m/side, door leg extension = 6.1 m /side, bridles = 40 m /side, footgear and flying wing = 35.6 m. Critical length is (6.1 + 12.2 + 80+ 35.6)*0.04 = 5.4 m.

Block wire counters[8] measure the length of wire passing over a trawl block of known circumference. These metering blocks are equipped with an incremental shaft (optical) encoder mounted to the block sleeve which gives a fixed number of pulses per revolution of the sheave or a fraction thereof. The length of the warp is determined by counting the number of pulses. Warp tension is measured by a strain gauge load measuring pin mounted in proximity to the block. The block is equipped with an electronic monitoring unit.[9]

Protocol 2: *The accuracy in warp length determination is affected by wear and tear of the block counters and these counters and associated instrumentation should be inspected and calibrated before each multi-species ecosystem survey*.

5.2.1 WARP MARKINGS FOR LOCK WINCH SYSTEMS

Since the fall of 2007, NAFC surveys by the CCGS *W. Templeman* and since the fall of 2008 by CCGS *A. Needler* are carried out with the entire length of the trawl warps marked with a ballistic tape (60.96 cm x 2.54 cm) interwoven into the strands of wire every 50 meters in a 1, 2 designation, i.e., 1 mark at 50 m, 2 marks at 100 m. These warps are marked when they are first installed (see Section III and Appendix 1 for details).

The physical warp marks are employed as an independent means of validating the accuracy of the block counters e.g., check that the 250 m mark passes through the sheave when the counter says 250 m. These warp marks are also used when checking the periodic calibrations of the block counter (see Section II, Item 5.9.1). It is critical that the marks on both warps line up evenly with each other during deployment to ensure standardization of warp length for each tow. Both warp marks and the block counters should be cross-checked whenever one of them indicates that warp measurements fall outside the maximum allowable offset threshold (length differences in Protocol # 1).

Protocol 3: *During trawl deployment it is critical that the marks on both warps line up evenly with each other at the blocks during deployment to ensure that the block counters are properly calibrated.*

The assumption is the physical marks are more reliable than the block counters which often tend to loose accuracy after calibration. Appendix 2 describes a method to adjust the block counters to agree with the physical

[8] Based on the CCGS *W. Templeman* system and should be applicable to CCGS *A. Needler*.

[9] At times during fishing, the heaving motion of the vessel can cause the encoders to increase or decrease the warp-out readings displayed on the Bridge Trawl Warp Monitoring Panel even though the sheaves are not moving forward or backward when the vessel is heaving. It has been suggested that the installation of a pressure switch on the brake pressure line would result in the programmable controller ignoring any increment/decrement caused by this rocking motion. Avalon Controls St. John's, 2007.

marks anytime a discrepancy is observed that can not be attributed to physically shortening a damaged warp and/or stretching of a the warps and/or error in the placement of the 50 m marks.
NAFC and CCG do not have an independent calibrated measuring method which will measure the warp in real time while at sea. Investigations of new methodology and instruments to calibrate length of warp independent of trawl marks and block counters during survey operations are needed.

5.4 WARP LENGTH STANDARDIZATION PROCEDURES FOR AUTO-TRAWL WARP SYSTEMS

The auto-trawl winch system is dynamic in that it uses a tensioning method to increase and decrease one or both warp lengths during a tow in response to changes in bottom type, currents, and hook-ups/obstructions on the bottom. The hydraulic winches are synchronized to keep equal warp tension and maintain trawl symmetry. On the CCGS *Teleost* the auto-trawl system is set up in the following manner. The amount of warp to be used is programmed into the winch controller at the start of each fishing set based on bottom depth. The first fifty meters of warp is deployed manually, after which the auto-trawl system automatically takes control and shoots the remainder.

Once the prescribed length of warp is deployed, the auto-trawl system switches into the towing mode and actively varies warp lengths during the tow in response to sensed tension changes. Unlike the locked winch systems, after the trawl is on bottom measurement of warp length differences is relatively unimportant. Auto-trawl winches often result in a 1-2% offset in warp length in order to match warp tension.

Auto-trawl wire counters are the component of the auto-trawl system that is used to measure the length of the warp. They use the number of wraps, diameter and width of the drum, diameter of the warp and other parameters to estimate the length of warp deployed. The counters may need to be calibrated when the warp diameter decreases, due to stretching of the warps. Counter accuracy is also affected when the warps do not wrap evenly onto the drums. If this occurs frequently the guide-on problem should be addressed.

Protocol 4: T*he accuracy in warp length determination is affected by wear and tear of the Auto-trawl wire counters and guide-ons, and these counters and guide-ons along with their associated instrumentation should be inspected, tested and calibrated before and after each survey*.

NAFC and CCG do not have an independent calibrated measuring method which will measure the warp in real time while at sea. Investigations of new

methodology and instruments to calibrate length of warp independent of Auto-trawl wire counters during survey operations are needed.

SECTION II: WARP CONSTRUCTION, SPECIFICATION, MAINTANENCE AND CALIBRATION

5.5 INTRODUCTION: WARP CONSTRUCTION AND SPECIFICATIONS

The responsibility for procurement maintenance and installation of trawl warps resides with Canadian Coast Guard (CCG). Marking of the trawl warps is a shared operation between CCG and DFO Science Branch.

The type of warp construction used by east coast DFO/CCG fishery research vessels is a steel strand wire with a steel core (IWRC) composed of 6 steel strands containing 19 wires. The individual wires are twisted into a strand and the strand is then twisted around a steel core. Each warp diameter is 25.4 mm and its Minimum Breaking Load (MBL) is 49.5 mt. The wire is generally purchased in 4000 m lengths on reels[10] to satisfy the requirements of both vessels. Weight per unit length is specified as 2.92 kg/m ± 3%.

The warps are pre-lubricated generally with a light, petroleum or solvent based penetrating lubricant before it leaves the factory. This initial lubricant will protect the warp during storage, shipping and initial use. Warps must be lubricated regularly to prolong the life expectancy, i.e. to protect steel wire from rust, and to reduce friction between wires and strands.

The warps are specified as one being left lay and the other right lay. The lay of the wire describes how the strands are laid in a helix (or spiral). To determine the lay of a warp, look at it as it points away from you. Strands turning clockwise are right hand lay and those turning counter-clockwise are left hand lay. When warps are installed, the left hand lay warp goes on the port winch drum and the right hand lay warp goes on the starboard winch drum. The use of right and left hand lay warps helps achieve a torque balancing of the whole trawl system and reduces differential stretch between the starboard and port warps.

5.6 INSPECTION OF TRAWL WARPS

The following topics should serve as general guidelines to cover specific points and are not meant to be a complete manual nor do they supersede CCG Ship Safety Branch TP 9912 Document" 'Standard for Inspection of Tackle for Large

[10] At present CCGS *Teleost* can carry 4000 m and CCGS *W. Templeman* and her sister ship CCGS *A. Needler* generally carry 3500 m.

Fishing Vessels', TP 9396E Document: 'Wear Standards for Cargo Gear' or any other applicable Transport Canada regulations.

Warps should be inspected for damage annually or at any time an irregular activity in the warp or its associated equipment and instrumentation is observed. Damage is not always clearly visible; whereas a detailed inspection can detect corrosion, breaks, reduction in strength, and defective equipment. A well monitored program can increase warp longevity, reduce costs and enhance safety.

5.7 WARP ENLONGATION

There are two different types of cable stretch, i.e. permanent elongation and elastic elongation. Permanent elongation, also known as constructional or plastic stretch, is the amount of stretch or increase in length in a cable which occurs over time and use until a cable is "seasoned". A seasoned cable is one in which irreversible elongation or stretch does not appreciably occur with use. Permanent stretch can also occur any time a cable is subjected to tension greater than the tension at which the cable is seasoned. Elastic elongation or elastic stretch is commonly defined as a coefficient in the form of feet of stretch per 1000 feet of cable per 1000 pounds of tension (Ft./1000 ft./1000 lb). For practical purposes, a normal stretch coefficient is very close to 0.1 inch/100 Ft./100 lb. meaning that for every change in tension of 100 pounds, 100 feet of cable will lengthen (or shorten) 0.1 inch.

If the warps suddenly become longer, then rapid deterioration from wear and fatigue has occurred or the warps have been subjected to an excessive load. These warps should be replaced immediately.

The trawl warps are sometimes used in a non-standard manner which requires attention to elongation: single warp towing of 1) single warp sampling gears and 2) other vessels during SAR.

Protocol 5**:** *The practice of using one warp to tow single warp sampling gears such as scallop dredges will hasten the demise of that warp if one side is constantly used. To spread the wear and tear during the survey rotate the gear from one warp to the other after 50 % of the tows has been completed.*

Protocol 6**:** *The practice of towing another vessel with one warp could increase stretching and hasten the demise of that warp. When this occurs the warp diameters from port and starboard should be compared to see if the diameter is below the acceptable tolerance level.*[11]

[11] Warps should be replaced when they are worn down to 10% of the original dimension: Brunton-Shaw UK/Extreme East Rigging Services Ltd., St. John's 2008.

After a towing operation the warps should be inspected for damage and the warp diameter should be measured using calipers at the widest point ('across the crowns') in at least three different places, e.g. 50 meters from terminal end, and at the 100 m and 200 m marks. If the diameter is below tolerance level then the warps will have to be replaced. If stretching has occurred but not beyond the tolerance level then re-calibration of warp marks must occur soon after the towing incident and before the next survey tow.

5.6.1 END OVER END SWAPPING OF WARPS

To increase longevity, at two year intervals a warp is often reversed so that the inboard end becomes the outboard end. This procedure must include a check of the warp marks. Although this procedure is a cost savings measure it may cost operational problems particularly for auto-trawl system winches. The end-over-end swapping procedure results in the winch being wound with a wire of inconsistent diameter. This may cause uneven spooling on the drum and result in problems with guide-ons, and estimation of warp lengths. Calibration parameters for the auto-trawl system computer may also be affected because the number of windings per wrap as well as the number of wraps may change due to changes in the diameter of the warp. ***Note: The winch manufacturer should be consulted to see what effect the end-over-end swapping of warps would have on the accuracy of measurements of warp lengths during fishing.***

5.8 WARP REPLACEMENT

5.8.1 *FULL WEAR AND TEAR*

Both warps must be replaced at the same time (see Installation and Marking of New Warps in Section III). Never mix old warps with new warps.

Protocol 7: *Warps should be replaced when they are worn down to 10% of the original dimension. If the core is sticking out between the strands the warps should be replaced immediately.*

5.8.2 *PARTIAL WEAR AND TEAR, AND SHORTENING OF TRAWL WARPS*

Often the forward section of the warps may show heavier wear and tear, and fatigue. At times it may be possible to cut off a damaged section. When shortening a warp the following guidelines should be followed:

5.8.2.1 The matching amount of warp length must be cut off from both warps.

5.8.2.2 Cut both warps at the same position close to the nearest warp mark, allowing for the length needed to make the new eye splice on the terminal end.

5.8.2.3 Re-attach the dummy marks that warn the operator when the trawl doors are near the surface.

5.8.2.4 Record the following information in the Wire Log Book kept on the bridge: date, time and the amount of warp cut off and whether the reprogramming of the auto-trawl winch computer was needed.

5.8.2.5 Kinks cause permanent damage to the warps and that section must be replaced immediately.

5.8.2.6 Replace immediately any section where the core is sticking out between the strands.

5.9 MAINTENANCE OF WARP GUIDANCE EQUIPMENT

Proper maintenance of all equipment that comes in contact with the warps will prolong the life of the warps. A good risk averse strategy would be to keep an extra set of sheaves and shaft encoders as backup in the CCG warehouse inventory. The following topics serve as general guidelines and are not meant to be a complete manual nor do they supersede standard vessel maintenance practice.

Guide-ons (cable spoolers), and sheave grooves must be inspected before each survey:

5.9.1 Worn, jammed or crooked sheaves or guide-ons must be replaced or repaired immediately. Damaged sheaves must be replaced with new sheaves specifically suited to the size and type of warp installed.

5.9.2 If sheaves are repaired by welding, use a welding material with a hardness of close to 250-300 Brinel.[12] Care should be taken to match sheave size specifications and not increase warp wear with too much buildup of welding material.

5.9.3 Warp fittings and splices must be inspected before each survey. Check for wear or broken wires, loose or split strands in the wires and wear and cracks in the fittings. Replace immediately sections and fittings damaged

[12] Bruton_Shaw UK 2007

or cracked, especially sections where the core is sticking out between the strands.

5.9.4 After installation of new trawl warps check to see if both sheaves are properly aligned and running true.

Note: Sprockets on winch drum guide-ons on the CCGS *W. Templeman* were set for the initial 28.6 mm warps and not changed to handle 25.4 mm warps. This affects the proper spooling of the warps onto the drum and could contribute to earlier fatigue in the warps due to an increase in the amount of compression of strands and/or core. The CCGS *A. Needler* guide-ons were changed in 2008 to handle the smaller warp diameter.

5.10 CALIBRATION PROCEDURES FOR WINCH MEASURING SYSTEMS

Calibrations should be carried out at least 30 days prior to each multi-species ecosystem survey or whenever irreconcilable discrepancies between warp marks and the shipboard measurement system persist.

5.10.1 CALIBRATIONS FOR LOCK WINCH BLOCK COUNTERS

5.10.1.1 The block wire counters must be calibrated by a certified technician representing the winch manufacturer and should include both shaft encoders, load pins and the mechanical functioning of the block sheaves including sheave diameters.

5.10.1.2 After calibrations, sea trials should be carried out to verify winch functioning and correct readings from automated block wire counters with the service technician participating. During these trials automated block wire counters and warp marks should be crossed check for agreement.

5.10.2 CALIBRATIONS FOR AUTO-TRAWL WIRE COUNTERS

Auto-trawl wire counters use the number of winch rotations (wraps), diameter and width of the drum, diameter of the warp and other parameters to estimate the amount of warp out. Warp length throughout the tow is balanced by the warp tension sensors in the auto-trawl system. Problems with the auto-trawl wire counters can result in incorrect warp lengths being paid out on each side.

5.10.2.1 Testing and certification of the warp tension meters must be carried out by a certified technician representing the winch manufacturer and should include, but not be restricted to, winch motors and drums, equalizing values, diameter of warps, auto-trawl wire counters and controller system.

5.10.2.2 Ensure all operational parameters such as wire diameter, drum dimensions are correctly specified in the controller system.

5.10.2.3 After calibration, sea trials should be carried out to verify winch functioning and tension meter dynamics with the service technician participating. During these calibrations counters and warp marks should crossed check for agreement.

SECTION III: TRAWL WARP INSTALLATION

5.11 INTRODUCTION

This section offers a set of guidelines for the installation of trawl warps. Only warps for lock winch systems will have their warps marked at 50 m intervals. This section also offers guidelines to the warp supplier on how to add physical marks into the trawl warps for use on lock winch vessels. The marking of the trawl warps is to be carried out at the supplier's premises before warps are sent to the vessel. ***Note****:* there is no requirement to have the warps of auto-trawl winch vessels marked.

The following procedures have been developed by CCG to serve as general guidelines for installation of new trawl warps on DFO survey vessels.

5.12 WARP PRE-INSTALLATION CHECKLIST

Responsibility: This should be carried out by CCG staff.

5.12.1 Verify warp specifications: diameter, construction, lay, and length, as per manufacturer's certificate.

5.12.2 Check Supplier terms and conditions for installing wire and marks vs. warranty agreements.

5.12.3 Check the warp reel for any damage.

5.12.4 Check availability of reeling support equipment and verify that it is in safe working order.

5.13 EQUIPMENT SAFETY CHECKLIST AND PLAN

Responsibility: This should be coordinated by CCG staff

5.13.1 Schedule a meeting with the Vessel Commanding Officer and all parties involved to discuss operations and the Safety plan.

5.13.2 Ensure Personal Protective Equipment is available for all parties and include: hardhat, safety vest, work-boots, safety glass, safety gloves and hearing protection.

5.13.3 Ensure people working around the marking station or anywhere near dock edge wear life vests.

5.13.4 Ensure safety around heavy equipment and crane operation by marking off the area of the worksite with pylons, tape and amber lighting. Be aware of other activities around vessel such as pedestrians, traffic, and blind spots during all operations.

5.13.5 Communications are vital around the workstation area, drum area, deck and bridge of vessel. Use VHF radios with same frequency to minimize delay in communication, and if possible rebroadcast communications over a PA system from a vehicle which will allow communication to be heard over hearing protection devices and other workplace noises. If broadcasting over radio and an emergency occurs, a blast of the air horn or siren will signal to the bridge or warp drum operators to stop operation immediately. This precaution should ensure that the warp doesn't break and also prevents any serious injury occurring to staff in the work area.

5.13.6 Ensure moving warps do not ride up against vessel tie up lines. Adapt warp installation to current weather conditions.

5.13.7 Establish a reasonable work time frame with the Vessel Commanding Officer and all parties involved to accommodate possible delays, mechanical problems and fatigue.

5.14 VESSEL INSTALLATION EQUIPMENT CHECKLIST

Responsibility: This should be coordinated with the CCG Vessel Chief Engineer and the Shore Engineer prior to warp installation.

5.14.1 *Drum*: Inspect for wear, damage, grooves and impressions, balance, bearings etc. and repair any damage.

5.14.2 *Guide-ons*: Verify that they are working in proper order and repair if necessary.

5.14.3 *Sheaves*: Use a sheave grooved gauge, supplied with sheaves, to check width and depth of groove and compare with manufacturers specifications; check the roundness and contours of the groove, which is necessary for proper support of the warp, check for excessive wear; and check for holes, cracks, uneven surface that may be detrimental to installation of new warps and cause further damage to the warps during regular trawling operations.

5.14.4 *Blocks*: Ensure each block turns freely, with proper alignment, no broken or cracked flanges, and the bearings are working properly.

Repairs: Damaged or misaligned components related to items 5.13.1-5.13.4 must be replaced or repaired before installation of the new warps.

5.15 PROCEDURES FOR INSTALLATION OF NEW TRAWL WARPS.

Responsibility: This should be coordinated by CCG with the involvement of the contractor and Vessel staff. The installation and marking of trawl warps are completed at dockside.

5.15.1 Ensure safeguards are in place to prevent toppling over of the wire reels, since a collapse or damaged reel could prevent the unloading of the wire from reel.

5.15.2 To move wire reels always lift from flanges and drum, and never put lifting straps around the reels since this could crush the reels.

5.15.3 Drum reels should be positioned as far away from the vessel as possible to avoid a turn in the wire and minimize the load on the hydraulics over the total duration period of the installation. The use of this long distance should help control the movement of the warp as it is being spooled off the drum and onto the vessel winch drum[13]. Align drum, if at all possible, in a straight line to the block at the stern of the vessel then anchor or secure the drum.

5.15.4 Wash all work surfaces of the dock and sections of the vessel that the warps will contact ensuring they are free from rocks, dust and sand particles which could mix into the lay of the wire lubrication and cause premature wear.

[13] A space of at least 50 meters is required to load warps. A block attached to boom/crane truck is used to assist in keeping the movement of the warps in a straight line between the spool and the vessel.

5.15.5 Lubricate the winch drum surface to help prevent overlapping of warps and to allow the wire to lay in a wrapping sequence with little resistance. Use Dylube grease, unless otherwise specified by supplier or manufacturer, and smeared lightly all around drum shaft.

5.16 ATTACHING END OF WARP TO WINCH DRUM

When the vessel is being loaded with the warps, the left hand lay is installed on the port winch and the right hand lay is installed on the starboard winch drum.

5.16.1 Spool the warp on either over the top or under the bottom of the drum ensuring the same approach is used on both sides.

5.16.2 Attach the end of the warp to the drum and secure warp with wire rope clips that can accommodate the size of the warp.

5.16.3 Before spooling onto the drum, verify that the starting position of the first warp is aligned properly on the drum and it will spool correctly. Raise your arm up to face the drum and use the following hand positions to determine spooling direction: for right hand lay (rhl), and left hand lay (lhl) use your fist to represent the drum, your index finger, the wire rope on the drum, and your thumb the direction and starting point or side where the warp is to be attached. Over winding (for rhl and lhl), your palm is down, under winding, your palm is up. Coordinate the correct alignment with crews on dock, bridge and winch deck before spooling begins and periodically during the whole spooling process.

5.17 FIRST WRAP OF WARP ONTO WINCH DRUM

5.17.1 It is very critical that the wrapping sequence works in conjunction with the drum guide-on. If the wrap is too tight it will cause binding, overlapping and pinching and if too loose it will cause gaps, uneven distribution, and flattening. etc.

5.17.2 *Note 1:* On the CCGS *W. Templeman* the original guide sprockets were set for 28.6 mm wire and not replaced when the 25.4 mm warps was adopted. This will affect the ease to which the warp is wrapped around the drum.

5.17.3 *Note 2*: The guide-ons for the CCGS *A. Needler* were replaced when the vessel converted from using 28.6 mm warps to 25.4 mm warps in 2008.

5.17.4 A block hanging off a crane is occasionally used between the spooling reel and the stern of the vessel in order to control the warps moving in a straight line to compensate for movement up or down of the vessel and, as well, to ensure the warp is centered with the sheave.

5.17.5 Lock Winch Systems: Use the warp markings to cross-check the accuracy of the block counters. A table of values should be created so that each warp mark on each warp has a corresponding warp length derived by the block counters. Note: The readings for the 100 m marks should be the centre of the two marks.

5.18 LAST WRAP OF WARP ONTO THE WINCH DRUM

5.18.1 When the end of the wire on the reel is approaching, slow down the spooling of the warp on the winch drum and prepare to let the wire clips and rope release to the vessel.

5.18.2 Install dummy marks (rope splice into warp by crew near the warp end) to indicate when the trawl doors are near surface during retrieval of trawl and also consider the length taken up by the installation of the eye splice at the end of the warp and how it affects the length of the last 50 m interval. This may require some cutting of the warp ends.

SECTION IV: PROCEDURES FOR MARKING AND CALIBRATING TRAWL WARP MARKS[14]

5.19 MARKING NEW WARPS FOR LOCK WINCH VESSELS.

Physical warp marks inserted into the strands of the warp are employed as an independent measurement of the length of warp deployed, and as a calibration tool. During trawl deployment warp markings are used to verify the accuracy of the winch counters. It is critical that the marks on both warps line up evenly with each other during deployment to ensure standardization of warp length for each tow and to maintain trawl symmetry. To achieve this requires 1) strict adherence to marking procedures to minimize error in marking the warps and 2) regular calibration of warp markings after initial installation.

[14] Much of the procedures in warp mark calibration is based on protocols developed by Philip Politis of Ecosystems Survey Branch NEFSC, Woods Hole.

The error in marking each warp must be kept to a minimum and should be the same for both port and starboard warps, i.e. the offset difference between the port and starboard warp markings should be close to zero.

Protocol # 8: *Both warps must be marked **simultaneously** to minimize error from one side to the other*.

The NAFC gear technologist will oversee the marking operation since it is essential that an estimate of error for each 50 m increment warp marking be determined and minimized.

Protocol # 9: *The warps are to be marked by the warp rigging supplier[15] at his premises to minimize error in measurement of each mark*.

If the marking cannot be done at the supplier's premises then the rigging contractor must complete it during the installation of the new warps onto the vessel (see both options' setup in Appendix 2: Figure 1).

5.18.1 VESSEL RESPONSIBILITIES

The marking of new trawl warps should be coordinated by CCG staff with the involvement of the rigging supply contractor and NAFC gear technologist. The warps are marked at 50 m intervals in a 1, 2 designation with ballistic tape.

5.18.1.1 Prior to the scheduled date, the Commanding Officer of the vessel should make the necessary arrangements to contract the markings of the new warps to the rigging supply company, and ensure the Marking Inspection Team comprised of a NAFC gear technologist, Fishing Mate and CCG shore based representative are notified and available.

5.18.1.2 If the warps are marked at the rigging company's facility then The Fishing Mate informs the company that it is responsible to tag both ends of each wire "port" and "starboard" for identification after marking process is finished.

5.18.1.3 For both marking options, if warps need to be shortened then the Fishing Mate is responsible for making all parties involved aware of the amount of warp that needs to be cut, prior to the marking or installation.

[15] Previously this was done at dockside as the warps were being loaded. Because both warps were not or could not be marked simultaneously at dockside differential measurement errors between port and starboard warps are likely and would affect later calibrations.

5.18.1.4 The Fishing Mate supplies the Standard 50 meter measuring wire (see Appendix 2: Figure 4).

5.18.2 SCIENCE RESPONSIBILITIES

The NAFC gear technologist or his representative will provide:

5.18.2.1 Clipboard.

5.18.2.2 Metric Tape Measure.

5.18.2.3 Writing tools.

5.18.2.4 Standard Warp Marking Form (SWMF) (Appendix 3)

5.18.2.5 Copy of this document.

5.18.3 RIGGING SUPPLY COMPANY RESPONSIBILITIES

The rigging supply will provide:

5.18.3.1 Adequate personnel for the marking process.

5.13.3.2 Mobile winches capable of spooling both 3500 meters of 254 mm (1") Ø cable, simultaneously.

5.18.3.3 All necessary materials for the remarking process, including highly visible paint, 5.1 cm (2") paint brushes, marlin spikes and ballistic tape for marks.

The Marking Inspection Team, consisting of 1) NAFC Science gear technologist or his designate, 2) Fishing Mate or designated and 3) CCG shore base representative, are responsible for insuring the rigging company installs the trawl warps in compliance with these protocols. Additional Science and CCG staff may be needed to assist in the inspection.

The following are guidelines for the marking of trawl warps:

5.19 MARKING STATION

A minimum of 55 to 60 meters of flat straight surface on the floor or dock apron is crucial to minimizing some of the error in marking the warps.

5.19.1 Set up a table or portable bench mounted 40 inches high which will allow installation of marks to be done in an ergonomical environment on both warps simultaneously. All installation equipment is located at this workstation including a large bench vice, marlin spikes, orange ballistic tape markings precut at 60.96 cm x 2.54 cm lengths, quick

drying, highly visible marking paint with several 5.1 cm (2 inch) oil paint brushes, cleaning materials and various hammers.

5.19.2 At this workstation area, observation of condition of wire (kinks, frayed wire, crushing, pitting and tension. Also from this area frequently scan the warp for possible slack and development of kinks.

5.19.3 Calibration Equipment: first verify certification and working order of the independent wire counter [16]. This instrument is set up on a flat surface whether on a floor or dock apron.

5.20 MARKING PROCEDURE

5.20.1 Attach a Chinese finger or braided rope sock onto the end of each warp and secure it with tape.

5.20.2 Attach each Chinese finger or braided sock to a pull scale-strain gauge which is attached at the other end to a machine capable of exerting tension, e.g. a forklift or truck. Apply a force to both warps to achieve a straight line while **keeping warp flat** on the floor. Ensure there are no twists or bends in the wire affecting the 50 meter mark measurement.

5.20.3 Pass each warp through a CCG supplied short legged wire counter (± 0.05% accuracy) set up to the left of the marking station and mark the 50 m interval with a 5.1 cm **(2 inch)** paint strip so that the centre of the paint mark is exactly 50 m. Lay both warps on the flat surface and double check the accuracy of the mark with a metric tape. The accuracy of this check is critical before the ballistic tape is inserted and should be ± 3 cm, i.e. close to the wire counter measurement.

5.20.4 Lay the Standard 50 meter measuring wire along side each individual warp aligning the middle of the centre stop (where both sleeves join) with the end of the warp and the centre of the paint mark. ***For single marks***: one paint mark at the 50 m interval is all that is required. ***For double marks****:* apply 2 additional paint marks (both 5.1 cm (2 inch) wide) equally spaced (15 cm) from the edge of the centre stop to correspond with the marks on the Standard 50 m measuring wire (see Appendix 2: Figure2).

[16] Before each use the independent wire counter is sent out to calibration service company to be cleaned, repaired and re-calibrated. Calibration is verified by testing against a known length of wire. Science and CCG should use wire counters whose accuracy can be guaranteed at ± 0.05%. For example, Length Rite 600 counters, Taymer International Inc. Ontario list this requirement for their product.

5.20.5 The rigging supply company installs orange ballistic tape[17] tucked into at least two wires of the warp (see Appendix 4). ***For single marks***: the ballistic tape mark is inserted into the warp beginning forward of the paint mark so that the paint mark is at the **center** of the ballistic tape mark. ***For double marks***: the tape marks are inserted into the warp at the first and third paint marks beginning at the edge closest to the center paint mark and thread the tape outwards from center. This insures that at all times, the distance between the inside edge of each tape is always 15 cm from center stop, even if the paint is not visible.

5.21 WARP CALIBRATION PROCEDURES FOR MARKED WARPS

Because all warps stretch after major hook ups, and with excessive usage and fatigue (see Section II for details), trawl marks must be recalibrated before the annual NAFC spring and fall multi-species ecosystem surveys, and checked whenever irreconcilable discrepancies between warp marks and the block counters persist. These calibrations must be overseen by the NAFC gear technologist.

The calibration and/or re-marking of trawl warps can be done by two methods: 1) spool off the warps onto a rigging supply company's mobile spools and have the company carry out the calibration at their facility; and 2) spool both warps off simultaneously at the dockside onto mobile spooling drums and have the rigging supply company carry out the calibration at the dock. A CCG-NAFC Inspection Team must oversee all calibrations regardless of location. Procedures for calibration at the rigging's facility will be the same as that use at the dockside. NAFC gear technologist and the Fishing Mate are responsible for insuring the rigging company calibrates the trawl warps in compliance with the protocols described in this manual. Again the emphasis in the calibration is on accuracy while minimizing error in measurements and markings.

5.21.1 VESSEL RESPONSIBILITIES

5.21.1.1 Prior to the scheduled date, the Commanding Officer of the vessel should make the necessary arrangements to contract the calibrations of the new warps to the rigging supply company, and ensure the Calibration Inspection Team comprised of a NAFC gear technologist, Fishing Mate and CCG shore based representative are notified and available.

[17] The dimensions of the ballistic tape and method of weaving should be reviewed by NAFC gear technologist in consultation with rigging supply company who conducts the marking. A smaller size and precise attachment method should lessen the measurement error while still providing good visual reference.

5.21.1.2 If the warps are to be spooled off the vessel winches and taken to the rigging company's facility then it is the Fishing Mate's responsibility to tag both ends of each wire "port" and "starboard" for identification.

5.21.1.3 For both methods it is important that if warps need to be shortened then the Fishing Mate is responsible for making all parties involved aware of any known regions of the trawl warps that need to be cut, prior to the calibration.

5.21.1.4 The Fishing Mate is responsible for informing the rigging company and the NAFC gear technologist of the amount of wire to be calibrated.

5.21.1.5 The Fishing Mate supplies the Standard 50 meter measuring wire (Appendix 2: Figure 4).

5.21.2 **SCIENCE RESPONSIBILITIES**

The NAFC gear technologist or his representative will provide:

5.21.2.1 Clipboard.

5.21.2.2 Metric Tape Measure.

5.21.2.3 Writing tools.

5.21.2.4 Standard Warp Calibration Form (SWCF) (Appendix 5).

5.21.2.5 Copy of this document.

5.21.3 **RIGGING SUPPLY COMPANY RESPONSIBILITIES**

The rigging supply will provide:

5.21.3.1 Adequate personnel for the remarking process.

5.21.3.2 Transportable winches capable of spooling both 2000 meters of 254 mm (1") Ø cable, simultaneously.

5.21.3.3 All necessary materials for the remarking process, including highly visible paint, 5.1 cm (2") paint brushes, marlin spikes and ballistic tape for new marks.

5.22 OPERATIONAL PROCEDURES

Port and starboard trawl warps are to be calibrated **simultaneously**. Both port and starboard warps will be spooled off the vessel winches onto the transportable winches (truck winches) out to the predetermined length. The predetermined warp length to be calibrated is 1700 m which covers the NAFC fishing depths (~ 750 m) required by CCGS *Wilfred Templeman* and CCGS *Alfred Needler*. If after lining up the marks at the starting length, the next two marks are offset from either each other or the centre stop of the Standard 50 m measuring wire, more cable must be calibrated. Cable will be spooled out until the first three marks line up even. If this does not occur at any point on the warps, then the entire 1700 m length of both trawl warps must be calibrated.

5.22.1 The NAFC gear technologist will record the mark type at each 50 m increment on the Standard Warp Calibration Form (SWCF) as the warps are spooled **off** the vessel winches (Appendix 2: Figure 1), so that he/she keeps track of how much wire has been spooled off the vessel.

5.22.2 Both warps are laid out side by side on a flat surface with sufficient tension to keep them straight. Line up the marks at the predetermined length evenly; **this length** is the starting point for the calibration process.

5.22.3 The Standard 50 m measuring wire is laid out next to the two warps with sufficient tension exerted by two people to keep it straight and the stops at are aligned with the marks at the starting point.

5.22.4 The marks at both the first 50 m increment and 100 m increment will be checked by the Inspection Team and any offset from the true 50 m measuring wire will be measured and recorded on the SWCF, proper positive and negative offsets must be noted on the form (see Appendix 2: Figure 3 and Appendix 6).

5.22.5 M**easurements are taken in whole centimeters from:**

i. The middle of the center paint mark, for *double marks*, to the middle of the centre stop of the Standard 50 m measuring wire. If the center paint mark is not visible at the double marks, the center point between the two marks is determined and the measurement is taken from there to the middle of the center stop on the Standard 50 m measuring wire.

ii. The center of the ballistic tape mark, for *single marks*, to the middle of the center stop of the Standard 50 m measuring wire.

5.22.6 For an offset measured, if the MARK ON THE WARP IS MORE TOWARD THE VESSEL THAN THE 50 M STOP, the offset is

5.22.7 For an offset measured, if the MARK ON THE WARP IS MORE TOWARD THE TRUCK THAN THE 50 M STOP, the offset is POSITIVE (i.e., the trawl warp mark is longer than a true 50 m or 100 m measurement) (Appendix 2: Figure 3).

5.22.8 After both the port and starboard marks are checked, the next 50 m of warp will be spooled off the truck. The marks at the 50 m increment previously calibrated will be lined up and the Standard 50 m measuring wire laid out straight next to the warps and aligned with the calibrated marks at the previous 50 m increment.

5.22.9 The marks at the next 50 m and 100 m increments will then be checked identically to the previous marks. This process will continue in the identical manner for the entire length of the warps out to the eye splices. ***Note:*** Measurements are a cumulative sum along the length of the warps.

5.22.10 The 50 m increment at which the cumulative measured offset difference in length between the port and starboard warps equals 28 cm or greater, the physical marks in the warps must be removed. New paint mark(s) are added and the new tape marks are re-inserted into the wire at the correct alignment with the Standard 50 m measuring wire[18]. *Note*: The tolerance remains the same for calibration operations conducted dockside and at the rigging company's facility.

5.22.11 After the initial re-mark, the next 50 m of wire will spooled off the truck. The newly inserted marks will then be aligned with the Standard 50 m measuring wire.

5.22.12 The marks at the next 50 m increments will then be checked and recorded identically to the previous marks. It is highly likely that after the initial re-mark, all subsequent marks will need to be corrected. Offsets from the Standard 50 m measuring wire are still measured and recorded in the SWCF and are still a cumulative sum along the length of the warps. Therefore, the maximum allowable offset, along the entire length of the warps, is 28 cm.

5.22.13 As the procedure continues, subsequent marks need only be re-marked if the cumulative measured difference in length between the port and starboard warps equal 28 cm or greater (both at the rigging company's location and dockside, subsequent offsets are held to the 28 cm

[18] This offset tolerance is 5 % of 5.6 m offset warp tolerance in Section x above.

tolerance**).** ***Note: Keep in mind that the offsets are cumulative, so if this occurs multiple times, the mark would be changed at the point when the offset reaches 28 cm.***

5.22.14 When the tape mark is left in place because the offset is only by a small distance, the next measurement takes place from the **correct** mark location. Mark the correct location with paint and that mark will now be the location where the next increment is aligned with the Standard 50 m measuring wire, thus keeping the offset in the accumulation. ***Note: The most that the total length of cable can be offset is 28 cm.***

5.22.15 It is the judgment of the Fishing Mate whether or not to re-mark at any time if the offsets are less than 20 cm between port and starboard. However, if the marks are not removed then follow guidelines in Section 5.20.14.

5.22.16 The procedure of measurement and re-marking (as necessary) continues out to the eye splices. Eye splice offset measurements are taken from the outside of the eye (Appendix 2: Figure 2).

5.22.17 If there have been marks corrected during the procedure, one of the wires will be noticeably longer than the other at the eye splices. To correct the length difference, wire must be cut from both warps at the previous correct and/or re-marked single tape mark increment and new eyes spliced into each wire (see Section 5.22). The Fishing Mate may decide to have more than 50 m of wire cut. All cuts must be made in 50 m increments to maintain the length of the last 50 m of warp indicated by the single tape marking.

5.22.18 Install dummy marks (rope splice into warp by crew near the warp end) to indicate when the trawl doors are near surface during retrieval of trawl.

5.23 INSERTING NEW MARKS

See Section 5.20.5
Note: All old marks must be removed and replaced with new marks.

5.24 NEW EYE SPLICES

5.24.1 If wire is cut, new eye splices must be made in both the port and starboard warps.

5.24.2 The marks previous to the new eye splices must be a single mark. The center of the single mark out to the eye must be 50 m.

5.24.3 To make the eye splice, align the Standard 50 m measuring wire at the center stop with the single mark. Make the three paint marks aligned with the Standard 50 m measuring wire where the eye splice should be. Cut the wire forward of the last paint mark.

5.24.4 ***The center paint mark now becomes the center of the eye***.

5.24.5 A standard splice of no less than 6 tucks per strand must be used.

5.24.6 The oval action swivel which connects the warp to trawl door must be spliced into the eye.

APPENDIX 1

A Method To Deal With Unreliable Calibrated Block Counters Used In Lock Winch Systems.

In the case where calibrations of the block counters become unreliable after initial use, a look-up table should be developed at the start of each survey to cross reference block counter values to physical marks by recording counter values at each warp mark when it is at the centre of the block sheave. Here the assumption is the physical marks are more reliable than the block counters. Look-up values should be recorded during two separate deployments to ensure repeatability and must cover all or most of the survey depth stations. Since warps are paid out to the nearest meter, fit a regression function through the cross referenced values (marks and counters for each warp) then use the function to calculate the appropriate amount of wire for entering in the look up table. When using the look up table and comparing values, it is the (offset) difference between port side and starboard side values when comparing the two methods that is important, because we are looking for warp offset from one another.

For each tow monitor the block counters and should they vary from the winch look-up table beyond the 5.4 m tolerance value then the tow is abandoned and the solution to the discrepancy resolved before continuing with the survey.

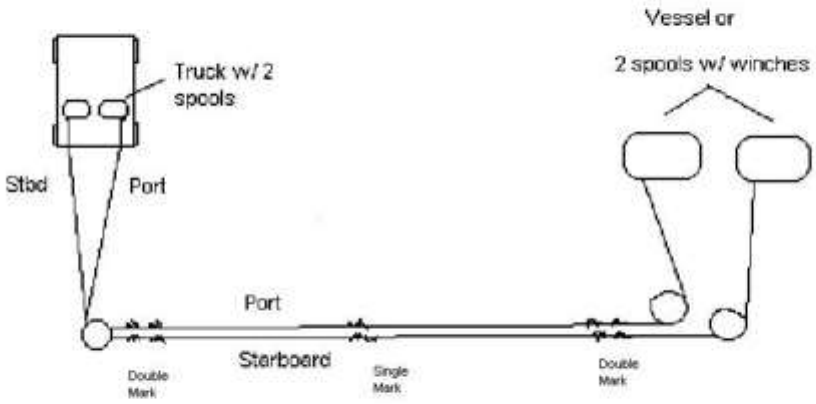
Example

At the start of the survey both block counters and physical marks give the different readings with the counters measuring 156 m at the 150 m tape mark (over centre of sheave). The lookup table says that at 150 m tape mark the counters should read 150 m. Then a serious hang on a bottom obstruction occurs or the block counters are spinning. If the port block counter lookup table reads 154 m at the 150 m physical mark and the starboard block counter lookup tables reads 146 m at the 150 m mark then the difference between the two would be 8 m (154-146= 8), i.e. beyond acceptable tolerance limit. However, if both lookup table readings for the block counters were 154 m at the 150 m physical marking then the offset between the wires would be zero (154-154 = 0) and acceptable.

APPENDIX 2

TRAWL WARP CALIBRATION SETUP

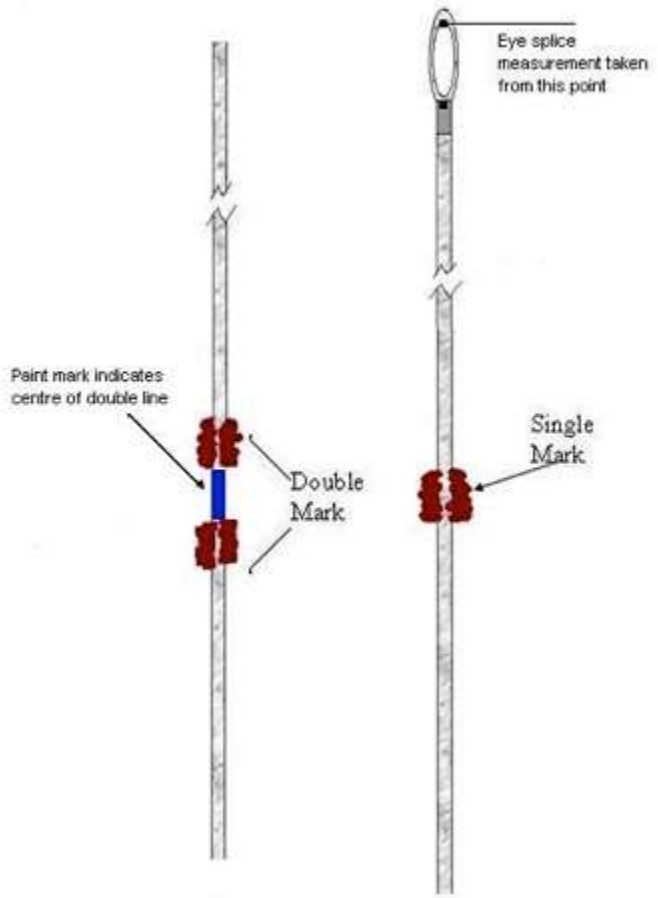
FIGURE 1



APPENDIX 2 (cont'd)

DIAGRAM OF TRAWL WARP MARK TYPES

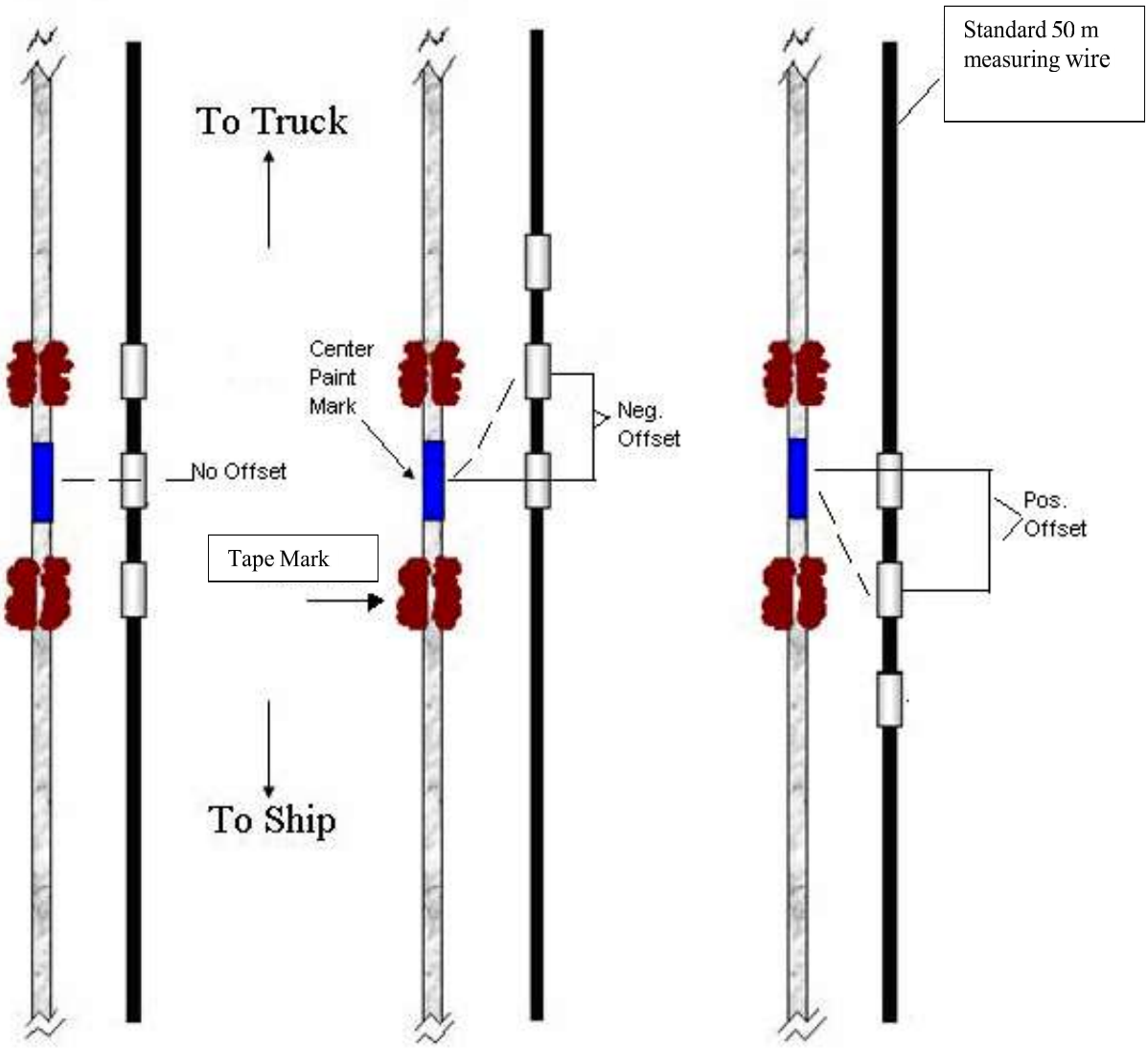
FIGURE 2



APPENDIX 2 (cont'd)

DIAGRAM OF OFFSET MEASUREMENT SCENARIOS

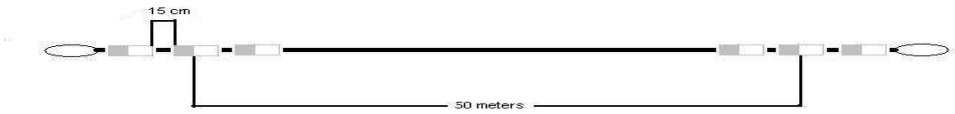
FIGURE 3



APPENDIX 2 (cont'd)

STANDARD 50 METER MEASURING WIRE

FIGURE 4.



The Fishing Officer must supply a slightly longer than 50 m of 7.4 mm (3/16 inch) metal measuring wire marked with three equidistant stops using 2x2.54 cm aluminum duplex sleeves (0.44 inch diameter) crimped and butted together to form a 5.08 cm (2 inches) long stop at each end locations: 0 and 50 meters. The middle of the centre stop join should be exactly 50 meter to the middle of the centre stop at the other end. The inside edges of the two adjacent stops must be spaced 15 cm on either side of the center stop for each 0 and 50 m increment. The inspection team should use a measuring tape to confirm the marks on the standard 50 m measuring wire prior to beginning any work.

APPENDIX 3

STANDARD WARP MARKING FORM

1 Fill in top of the Standard Warp Calibration Form (SWCF).

2 Record the color of the paint marks at the top of the SWMF

3 Begin entering the measurements at the "Meters Out" row for which the markings begin, i.e., 4000 m and work upwards on the SWMF to "0 Meters Out", this must be the eye splices.

4 As wire is spooled off the truck onto the secondary truck winches at the rigging supply company or onto the vessel winches, record in columns 2 & 3 and columns 8 & 9 the offset distance recorded at middle of the centre paint mark with the metric tape.

5 Enter incremental offset distance measurements (Port minus Starboard) in columns 4 & 10.

6 Record the mark types used in columns 5 & 11: "E"=Eye Splice, "D"=Double, "S"=Single.

7 After the marking is complete, the SWMF must be given to the NAFC/Science staff member in charge of the trawl warp marking. Notify this person of any known problems that arose during the marking.

8 Note in the "comments" section the amount (if any) of wire cut. Also note any other issues observed during the marking.

APPENDIX 3 (cont'd)

STANDARD WARP MARKING FORM

VESSEL:						DATE:				Mark	Paint Color:
Science Inspector:						Mark Type:					
CCG Inspector:						S="Single"				Single:	
Fishing Officer:						D="Double"				Double:	
Rigging Company:						E="Eye"					

Meters Out	Port	Stdb	Offset Differnce (cm)	Mark Type		Meters Out	Port	Stdb	Offset Differnce (cm)	Mark Type	
0						2050					
50						2100					
100						2150					
150						2200					
200						2250					
250						2300					
300						2350					
350						2400					
400						2450					
450						2500					
500						2550					
550						2600					
600						2650					
650						2700					
700						2750					
750						2800					
800						2850					
850						2900					
900						2950					
950						3000					
1000						3050					
1050						3100					
1100						3150					
1150						3200					
1200						3250					
1250						3300					
1300						3350					
1350						3400					
1400						3450					
1450						3500					
1500						3550					
1550						3600					
1600						3650					
1650						3700					
1700						3750					
1750						3800					
1800						3850					
1850						3900					
1900						3950					
1950						4000					
2000											

COMMENTS:

APPENDIX 4

BALLISTIC TAPE MARKS

FIGURE 1. Ballistic Tape Mark Insertion Into The Trawl Warps.
A 1 " x 24" length of ballistic tape is doubled over to have loops in each end and inserted between strands using a marlen spike

.

APPENDIX 5

STANDARD WARP CALIBRATION FORM

1 Fill in top of the Standard Warp Calibration Form (SWCF).

2 As wire is spooled off the vessel onto the truck winches, record in column 4 the mark types. "E"=Eye Splice, "D"=Double, "S"=Single.

3 Record the color of the old paint marks and color of the new paint marks at the top of the SCF.

4 Begin entering the measurements at the "Meters Out" row for which the 1700 m calibration begins and work upwards on the SWCF to "0 Meters Out", this must be the eye splices.

5 Enter measurements of Port 50 m incremental offset distance in column 2.

6 Enter measurements of Starboard 50 m incremental offset distance in column 5.

7 Enter measurements of Port 100 m incremental offset distance in column 3.

8 Enter measurements of Starboard 100 m incremental offset distance in column 6.

9 Enter incremental offset distance measurements (Port minus Starboard) in column 7.

10 When a new mark is inserted into the wires, record the mark type in column 8.

11 See sample demonstration Standard Warp Calibration Form in Appendix 6.

12 After the calibration is complete, the SWCF must be given to the NAFC/Science staff member in charge of the trawl warp calibration. Notify this person of any known problems that arose during the calibration.

13 Note in the "comments" section the amount (if any) of wire cut. Also note any other issues observed during the calibration.

APPENDIX 5 (cont'd)

STANDARD WARP CALIBRATION FORM

VESSEL:						DATE:		Paint Color:	Old	New
Science Inspector:						Mark Type:				
CCG Inspector:						S="Single"		Single:		
Fishing Officer:						D="Double"		Double:		
Rigging Company:						E="Eye"				
PORT				STARBOARD						
Meters Out	50 m	100 m	Mark Type	50 m	100 m	Offset (cm)	New Mark			
0										
50										
100										
150										
200										
250										
300										
350										
400										
450										
500										
550										
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1900										
1950										
2000										
COMMENTS:										

APPENDIX 6

STANDARD WARP CALIBRATION FORM - DEMONSTRATION

VESSEL: W. Templeman						**DATE:**		**Paint Color:**	**Old**	**New**
Science Inspector: Steve Walsh						**Mark Type:**				
CCG Inspector: Jeff Porter						**S="Single"**		**Single:**	white	red
Fishing Officer:	Kevin Hillier					**D="Double"**		**Double:**	green	red
Rigging Company:	Extreme East, Mt. Pearl					**E="Eye"**				

PORT				**STARBOARD**						
Meters Out	**50 m**	**100 m**	**Mark Type**	**50 m**	**100 m**	**Offset (cm)**	**New Mark**			
0	-16		E	20		36				
50	12		S	48		36	S			
100		7	D		49	42	D			
150	1		S	33		32	S			
200		4	D		40	36	D			
250	-2		S	38		36	S			
300		-6	D		45	51	D			
350	-10		S	36		46	S			
400		-11	D		44	55	D			
450	-13		S	29		42	S			
500		-15	D		20	35	D			
550	-11		S	20		31	S			
600		14	D		19	33	D			
650	-9		S	28		37	S			
700		-15	D		18	33	D			
750	-9		S	11		20				
800		-9	D		9	18				
850	-9		S	12		21				
900		-7	D		9	16				
950	0		S	0		0				
1000		0	D		0	0				
1050	0		S	0		0				
1100		2	D		2	0				
1150	-2		S	-2		0				
1200		-1	D		0	1				
1250	3		S	2		1				
1300		2	D		2	0				
1350	-2		S	-2		0				
1400		-1	D		0	1				
1450	0		S	0		0				
1500		0	D		0	0				
1550	0		S	0		0				
1600		0	D		0	0				
1650	0		S	0		0				
1700	-	-	D	-	-	-				
1750										
1800										
1850										
1900										
1950										
2000										

COMMENTS:

Last 50 m of cable cut, new eyes spliced into warps

CHAPTER 6

TRAWL CONSTRUCTION PROTOCOLS

6. 0 INTRODUCTION

Trawl construction, which includes the building of a complete trawl, or the replacing of damage sections of the net ideally should be done ashore, however, there will be times when minor construction will take place at sea by the vessel's crew (See Chapter 7 on Trawl Repair Protocols). The construction of new trawls is to be carried out by an independent commercial net maker.

It is critical that net makers/deck crews understand their role is not to enhance the net to improve its fishing capability, nor should they take shortcuts to save time and expense, rather they are to restore the net back to its original form exactly as depicted in the trawl plans.

Prior to construction all sections are laid out for inspection, tags are checked and panel stretched lengths are measured. Prepare for trawl construction by laying out all components in the area where construction is to take place. These include net sections, hanging twines, frame ropes, floats, and footropes. Ensure that no other trawl components are in the immediate area. When all components are laid out assign personnel to specific tasks. For example have people assigned to attach netting to bolsh lines, bolsh lines to fishing lines and headline, sewing selvedges together, sewing net panels together, attaching riblines, and attaching floats. Only commercial net makers or experienced deck crews who have the necessary training and skills should be assigned to sewing net panels together or sewing net panels to frame ropes. ***When construction/repairs are carried out at sea the bosun or the fishing mate must be in attendance to participate and supervise deck crews in proper construction protocols at all times.***

It is understood that on some vessels, net sections are sewn to bolshlines and kept in storage for later use. All frameropes, including rib lines, are cut to specifications when ordered from the supplier and these are the only ones to be used by ship crews in construction. Guidelines for swing net panels to bolshlines are provided below.

Once a new trawl is constructed a metal banded tag is wrapped around the headline by the CCG Supply Chain Coordinator (see Chapter 7 Repair Protocols, Section 7.2 for information on tagging procedures).

The construction of trawls will follow specifications and Trawl Drawings found in Chapter 3: Trawl Specifications. The following construction guidelines apply:

6.1 SEWING NET PANELS TOGETHER

Note on Pickups rates: Leave a minimum of 4 free meshes on selvedge side before commencing pick-ups. Never put pick-ups in selvedge.

6.1.1 TOP PANELS

6.1.1.1 Always start on the first mesh in the forward section, e.g. when sewing top wing to square start on 1st mesh on wide end of top wing. Care is to be taken as to which mesh is picked up first (***it makes a difference)*** so as to maintain the proper taper.

6.1.1.2 When sewing panels together always run a string through a row of meshes 4 or 5 rows in front of the joining round. This keeps the tension on the center of the meshes and results in the formation of even half meshes when completing the joining round. Not all of the joining rounds have even numbers. Extra meshes should be distributed throughout the width of the panel rather than all being taken up in the selvedges.

6.1.1.3 Bar length of joining round should match as close as possible that of the original mesh.

Note: Before joining panels together, e.g. belly to square, and belly to side panel proper alignment of slack and proper alignment of sections (i.e. not front to back, etc.) should also be ensured (see details regarding slack in panels in Section 6.3.4 below).

6.1.1.4 <u>Top wings to square</u>
Use the pickup rate 4 free[19]/side and then 3\4. Use 2.5 mm[20] red/orange single PE twine for sewing.

6.1.1.5 <u>Top Wing Front Section Top Wing Aft Section</u>
Use pickup rate 1\1. Use 2.5 mm (red/orange) single PE twine for sewing.

6.1.1.6 <u>Top Wing Gusset to Square</u>
Use pickup rate 3\4. Use 2.5 mm red/orange single PE twine for sewing.

6.1.1.7 <u>Square to 1st Top Belly</u>
Use pickup rate 1\1. Use 2.5 mm red/orange single PE twine for sewing.

[19] Also referred to as single in net making terminology

[20] In 2008 NAFC moved away from using flat (no centre) twines for mending and lacing. New twines such as Euronete's twines have the same strength as used before but with smaller diameters, i.e. 3cm flat twine = 2.5 mm round core twines.

6.1.1.8 1st Top Belly to 2nd Top Belly (applies to top and bottom bellies)
Use pickup rate 10 free/side and then 2\3. Use 2.5 mm double red/orange PE twine for sewing.

6.1.1.9 2nd Top Belly to 3rd Top Belly
Use pickup rate 1\1. Use 2.5 mm double red/orange PE twine for sewing.

6.1.2 LOWER PANELS

Pickups rates

6.1.2.1 Lower Wing to 1st Bottom Belly (60mm mesh)
Use Pickup rate 1\1. Use 2.5 mm double red/orange PE twine for sewing.

6.1.2.2 Lower Wing Gussets to 1st Bottom Belly
Use pickup rate 1\3. Use 2.5 mm double red/orange PE twine for sewing.

6.1.2.3 Lower Wing 80mm Section to Bunt Wing 60mm Section
Use pickup rate 9 free selvedge/ side then 5\7. Use 2.5 mm double red/orange PE twine for sewing.

6.1.2.4 Mesh and One Half of 140mm Mesh at Wing End
Use pickup rate 1\3. Use 3 mm green single PE twine for sewing.

6.1.3 SIDE PANELS

Pickups rates

6.1.3.1 Side Panel No.1 to side panel No.2
Use pickup rate 14 free/side and then 22\23 (a pick-up every 22 meshes). Use 3 mm green single PE twine for sewing.

6.1.3.2 Side panel No.2 to side panel No.3
Use pickup rate 6 free/side and then 3\4. Use 2.5 mm red/orange single PE twine for sewing.

6.1.3.3 Side panel No.3 to side panel No.4
Use pickup rate 1\1. Use 2.5 mm red/orange single PE twine for sewing.

6.1.3.4 Side panel No.4 to side panel No.5

Use pickup rate 6 free/side and then 2\3. Use 2.5 mm red/orange single PE twine for sewing.

6.1.4 CODEND PANELS

Pickups rates

6.1.4.1 Codend and Codend Extension
Use pickup rate 1\1. Use 2.5 mm red/orange single PE twine for sewing.

6.1.4.2 Cover Construction
Use pickup rate 1\1. Use 2.5 mm double red/orange PE twine for sewing.

6.1.4.3 Codend Liner
The liner consists of 2 panels and joined by gathering the two panels and lacing an approximately 1/2" roll of the material into a selvedge before sewing.

6.2 ATTACHING NET PANELS TO BOLSH LINES

In the Campelen design the netting is always shorter than the corresponding length of framerope. Therefore, before applying tension to the netting/framerope it is critical that the 1T4B taper and the all bar taper are properly secured to their respective lengths.

6.2.1. Attaching these tapers can be achieved by securing approximately 5 knots (stops on both sides) in length of bar tapers starting on it's respective mark on the framerope and heading in the direction of the wing-end. The 5 knots in question are immediately after the last drop mesh. This will minimize the 1T4B taper from creeping into the all bar section when tension is being applied.

6.2.2. After securing the respective tapers to the frameropes, apply tension to both the netting panel (stretch the netting either by hand if possible or use two come-alongs/and or stationary object) and framerope simultaneously. Before commencing with attaching the netting to the framerope ensure the restricting stops have not slipped.

6.2.3 After securing the respective tapers to the frameropes, attach one end of the framerope to a stationary object and apply tension to both the netting panel (stretch the netting either by hand for all bar cut panels or use a come-along for panels with drop mesh and bars) and framerope simultaneously.

6.2.4 Both port and starboard sides of panels should be completed together if enough crew is available. Have 2 or 3 twine hands work the same side (port or starboard) but ensure they are all going in the same direction. For instance when one side (port) is complete other twine hands can help out the other team (starboard), but work/move in the same direction.

Lace the netting to the bolshline using the following guidelines:

6.2.5 Two knots of the netting to be taken up on all frame ropes except the 1T4B tapers.

6.2.6 Netting is sewn tight all along the bolsh line. Stops shall be comprised of at least four rotating hitches.

6.2.7 When sewing a bar cut to the bolsh line pass the needle through each succeeding bar between stops. Take up 2 knots for each stop except for bosom and 1T4B tapers.

6.2.8 When attaching 1T4B tapers, the first bar taper immediately after the drop mesh (T-Cut) is not attached to the framerope (let it drop). The second bar taper is attached to the framerope by putting stops on either side of the knot, the third bar taper is secured by a single stop and the fourth bar taper has a stop applied on both sides of the knot.

6.2.9 The centre of the drop mesh is then attached to the mark (stop distance) that has been placed on the framerope. Repeat this sequence until all of the 1T4B tapers have been attached to the framerope.

6.2.10 Use 1.5 mm single white nylon twine and 4 rotating hitches when sewing guard meshes or gusset to bolshline.

6.2.11 **TOP PANEL**

6.2.11.1 *Top Wing (8.44 m section)*

6.2.11.1.1 Begin attaching the netting 1 mesh length behind the last tuck on the eye-splice.

6.2.11.1.2 Use 1.5-2 mm double white nylon for lacing panels onto bolshline.

6.2.11.1.3 Stops will be placed at every 2nd knot on the all bar taper.

6.2.11.1.4 Hang 8.48 meters (includes joining round of 4 cm) of netting to 9.02 meters of bolsh line. To accomplish this hang netting and bolshline together on a set of stationary

hooks and stretch netting until it reaches the length of the bolshline.

6.2.11.2 *Top Wing (3.32 m section) and Gusset*

6.2.11.2.1 For the gusset put stops at the mesh of the 1T4B then drop first bar and put stops on all remaining knots. See above description in Point # 6.2.8.

6.2.11.2.2 Netting should extend ½ mesh length beyond the eye-splice of the bolshline. The joining round between the square and top wing should be positioned directly below hammerlock that joins bosom of headline to wing section of headline.

6.2.11.3 *Bosum (2.89 m section)*

6.2.11.3.1 Meshes are sewn right to the center of each eye-splice.

6.2111.3.2 Hang individual meshes a distance of 211 mm apart.

6.2.12 BOTTOM PANEL

6.2.12.1 Bottom Wing (3.40 m section)

6.2.12.1.1 Begin attaching the netting 1 mesh length behind the last tuck on the eye-splice.

6.2.12.1.2 Use 1.5 mm double white nylon for lacing panels to bolshline.

6.2.12.1.3 Stops will be placed at every knot (½ mesh) on the all bar taper.

6.2.12.1.4 Hang 4.71 meters (includes joining round of 4 cm and 4 rows of 140 mm mesh size plus 16.5 meshes of 60 mm netting from bunt wing) of netting to 5.45 meters of bolsh line. To accomplish this hang netting and bolsh line together on a set of stationary hooks and stretch netting until it reaches the length of the bolshline.

6.2.12.2 *Bottom Wing (3.75 m section) and Gusset*

6.2.12.1 For the gusset, put stops at the mesh of the 1T4B then drop first bar and put stops on all remaining knots. See above description in Point # 6.2.8.

6.2.12.2 Hang 2.80 meters of netting to 3.20 meters of bolsh line.

6.2.12.3 Netting should extend ½ mesh length beyond the eye-splice of the bolshline. The joining round between the square and top wing should be positioned directly below lacing that joins bosom to the bolshline to wing section of bolshline.

6.2.13.3 *Bosum (2.70 m section)*

6.2.13.1 Meshes are sewn up to the center of each eye-spice.

6.2.13.2 Hang individual meshes a distance of 197 mm apart.

6.2.13.4 *Guard Meshes*

6.2.13.4.1 When attaching guard twine to net sections ensure both guard meshes and wing are stretched enough to prevent slack in either one.

6.2.13.4.2 When attaching guard twine to bolshline mark proper stop length on bolshline.

6.3 LACING SELVEDGES TOGETHER

To prepare for lacing a selvedge, hang 4 meshes from each end of panel on opposing wall hooks (***failure to hang these meshes will result in uneven mesh pickup while sewing***). Use 2.5 mm green sewing twine. Two people can work on the same selvedge by starting at each end and meeting in the center using the following guidelines:

6.3.1 Count in three meshes and four knots from the end of each section to make the first stop. The two ends should be stretched just enough so that all the slack is taken out of the length of netting but not enough to make the needle difficult to get through the meshes. ***Note:*** this only applies if the two panels are of the same stretched length.

6.3.2 In the case of even panel lengths start making the selvedge by making 4 rotating hitches around the three meshes at the point where the four knots

meet. Upon completion of the stop and while proceeding to the position of the next stop run the needle through each mesh making sure it is in line with the taper.

6.3.3 Make the next stop 1 mesh length from the first one and continue this until the end of the panels. Both selvedges can be completed in this way preferably at the same time. When both selvedges are complete stretch them side by side to check for accuracy.

6.3.4 The process of attaching adjacent panels together to form a selvedge can sometimes be challenging. The following is a list of scenarios that can occur when preparing to form a selvedge and the various approaches that should be taken:

6.3.4.1 *How to deal with slack in panels of the same mesh size*?

If corresponding panels have same number of meshes but there is slack lace mesh for mesh, i.e. line the knots up first and then the slack will take care of itself.

6.3.4.2 *How to deal with slack in panels of different mesh sizes*?

If the panel lengths are uneven then mark the shorter panel so that it is divided into 8 parts, and do the same with the longer panel. Attach the marks on the longer panel to those on the shorter one. The panels can then be sewed together making sure that slack is divided evenly while sewing.

6.3.4.3 *How to deal with slack in panels of different mesh sizes and different number of meshes?*

Same as Point # 6.3.4.2 above. If there is no slack in panel then create selvedge as the panels lie (do not force alignment of meshes).

6.3.4.4 *How to selvedge new panel to old panel in a used trawl.*

When inserting new panel in a older trawl use QA certified panel (don't adjust either new or old panel for stretch length to match the stretch in the other panel). Stretch both panels together and lace it together mesh for mesh same as in new trawl (see Point# 6.3.4.1). If mesh sizes and/or panel depth are different follow (see Point # 6.3.4.2 or 6.3.4.3).
Note: Two knots from guard netting and two knots from the top or lower wing form the selvedge, i.e. 2 knots are used when forming selvedge in top and bottom wings only.

6.3.5 LACING DETAILS

6.3.5.1 Top Wings to 2nd Section of Side Panels
The two sections are the same stretched length so they are hung under the same tension.

6.3.5.2 Square to 3rd Section of Side Panel
The two sections are the same stretched length so they are hung under the same tension.

6.3.5.3 1st Top Belly to 4th Section Side Panel
The two sections are the same stretched length so they are hung under the same tension.

6.3.5.4 2nd Top Belly to 5th Section of Side Panel
The two sections are the same stretched length so they are hung under the same tension.

6.3.5.5 3rd Top Belly to 3rd Lower Belly
The two sections are the same stretched length so they are hung under the same tension.

6.3.5.6 1st Section of Bottom Wing to 2nd Section Side Panel
There is slack in the bottom wing section. Divide up the side panel so that there are 8 marks and attach to those 8 marks for the bottom wing (as described in Point # 6.3.4 above). Same comments as above (see sewing selvedges Point # 6.3.4.3)

6.3.5.6 2nd Section of Bottom Wing to 3rd Section of Side Panel
There is slack in the lower wing section. Divide it into 8 sections and place marks. Attach those to corresponding marks on the side panel (as described in Point # 6.3.4 above). Same comments as above (see sewing selvedges Point # 6.3.4.3)

6.3.5.7 1st Lower Belly to 4th Section of Side Panel
The two sections are the same stretched length so they are hung under the same tension.

6.3.5.8 2nd Lower Belly to 5th Side Panel
The two sections are the same stretched length so they are hung under the same tension.

6.4 ATTACHING UPPER WINGLINE & RIBLINES TO SELVEDGES

The riblines are made up of 4 sections of 16 mm diameter pre-stretched Kraft rope seized (butted) together with nylon twine at the eye splices. Attach netting section to corresponding length of ribline. Evenly distribute the slack netting to the ribline and mark it where it is to be stopped to the selvedge. To prevent slippage run the lacing twine through the ribline rope. Use 2mm white nylon when attaching riblines to selvedge. Mark the selvedge to correspond to each mark on the ribline as follows:

6.4.1 For the 8.02 m combination rope - upper wing line in the forward section of the top wing place marks every 401mm apart. The corresponding selvedge shall have marks every 424 mm apart (approximately 20 stops).

6.4.2 For 10.59 m Kraft rope - Upper and Lower Rib Line # 1- used for the aft section of the top wing, the square and the 1st belly place marks 424 mm apart. The corresponding marks on the selvedge will be 425 mm (approximately 25 stops).

6.4.3 For the 10.22 m Kraft rope - Upper and Lower Rib Line # 2 used for the 2nd belly place marks 409 mm apart. The corresponding marks on the selvedge shall be 450 mm apart (approximately 25 stops).

6.4.4 For the 4.0 m Kraft rope - Rib Line # 3- used for the 3rd belly place marks 400 mm apart. The corresponding marks on the selvedge shall be 440 mm apart (approximately 10 stops).

6.4.5 For the 16 m Kraft rope - Rib Line # 4- used for the extension and codend place marks 533 mm apart. The corresponding marks on the selvedge shall be 585 mm apart (approximately 30 stops).

6.5 ATTACHING BOLSHLINE TO HEAD LINE

The upper 29.95 m bolshline is made up of 3 sections of 16 mm diameter pre-stretched Kraft rope seized (butted) together with nylon twine at the eye splices. When attaching bolshline to combination frame rope proceed as follows: hang both eyes of combination rope to stationary hooks. Attach bolshline to frame rope at the specified beginning of each section (i.e. 1T4B or all bars) by applying several temporary stops and then proceed to apply tension until frame rope is taut. Begin attaching bolshline to frame rope. Temporary stops can be removed if desired.

6.5.1 ***Mark the Centres****:* Find the centre of the square at mesh 263 (count from edge) and mark by weaving a non-green colored twine into 1 mesh; if the centre is between 2 meshes then mark the knot perpendicular to the

headline. Mark centre of both the bolshline and headline with a different color twine woven 3 times around the line and tied off. This is the centre stop or staple. Ensure that the centre of the square is attached to the centre of the bolsh line which is attached to the centre of the head line and then begin hookup by working out towards to the quarters. ***This is extremely important to keep the trawl symmetrical.***

6.5.2 TOP PANEL

In the top wing the bolsh line and frame rope is of equal length. Ensure entire length of bolsh line is attached evenly to headline (no bights except in bosum area -see Detail F of Top Wing Hanging Detail of net plans (Drawing Number CAM*2.3). Place the eye-splices of the headline and the bolshline together and begin placing stops at the distances given below. Use 1.5-2.0 mm double white nylon twine when lacing bolshline to headline and fishing line.

6.5.2.1 Wing End to Gusset (9.02 m headline/bolshline)
30 Stops each 300 mm apart, i.e., weave needle through each bar.

6.5.2.2 Gusset (4.51 m headline/bolshline)
15 Stops each 300 mm apart

6.5.2.3 Top Bosum (2.44 m headline/2.89 m bolshline)
Headline - 10 stops each 244 mm apart. Bolsh line 10 stops each 289 mm apart.

6.5.3 ATTACHING FLOATS TO HEADLINE

All floats are laced individually using 16 mm PP rope around the headline and bolshline with the ends woven through rope. See Detail 'A' of Top Wing Hanging Detail in Net Plans (Drawing Number CAM*2.1 in Chapter 3).

6.7 SEWING BOLSHLINE TO FISHING LINE

The lower 20 m bolshline is made up of 3 sections of 16 mm diameter Kraft rope. The 19.5 m fishing line is made up of 3 sections of 22 mm diameter combination rope hammer locked together.

6.7.1 ***Mark the Centres*** Find the centre of the 1st lower belly at mesh 235 (count from edge) and mark by weaving a non-green colored twine into 1 mesh; if the centre is between 2 meshes then mark the knot perpendicular to the bolshline. Mark centre of both the bolshline and the fishing line with a

different color twine woven 3 times around the line and tied off. This is the centre stop or staple. Ensure that the centre of the belly is attached to the centre of the bolsh line which is attached to the centre of the fishing line and then begin hookup by working out towards to the quarters. ***This is extremely important to keep the trawl symmetrical.***

6.7.2 LOWER PANEL

Bights are shown in Detail 'A & B' of Lower Wing Hanging Detail in Net Plans (Drawing Number CAM*2.3 in Chapter 3) to illustrate the bolsh line is longer than the fishing line. This extra length is accommodated for in the bosom area and the 1T4B taper. The balance of the bolsh line and fishing line should be taken up evenly.

6.7.2.1 Wing End to Gusset (5.45 m fishing line/bolsh line)
18 Stops each 300 mm apart, i.e. weave needle through each bar.

6.7.2.2 Gussets (3.20m bolsh line/3.08mfishing line)
Fishing line stops each 308 mm apart …Bolshline stops each 320 mm apart .

6.7.2.3 Lower Bosum (2.44 m fishing line /2.70 m bolsh line)
Fishing line - 10 stops each 244 mm apart. Bolsh line 10 stops each 270 mm apart.

6.8 ASSEMBLING THE CODEND, LINER AND COVER

6.8.1 **CODEND:** The codend is a two panel construction with single braided polyethylene 44 mm stretched mesh knotted netting. The codend is closed at terminal end using a series of knitted loops (~2 inches) constructed of braided nylon twine. Loops are hung to the codend using a general ratio of 1 loop to 2-3 meshes of codend and cover. A 3/4" Sampson braided nylon rope is passed through the nylon loops and the bag is then closed using a chain knot.

6.8.2 **CODEND LINER**: The 2 panel liner is 12.7 mm stretched meshed knotless white nylon netting. It is hung on the inside of the codend 2 meshes deep fore of the join of the codend and the extension section. It is attached to every mesh in the top of the codend. The liner is closed off with 3 mm poly twine near the section where it extends outside

6.8.3 **CODEND COVER**: The codend cover is a 140 mm stretched meshed two panel construction, double braided polyethylene knotted netting covering the extension and codend. It is attached to the extension piece 20.5 meshes deep from where the extension joins the third belly. The selvedge (3 meshes) is laced to the ribline.

6.9 ASSESSMBLY OF FOOTGEAR

Once the 3 sections of the footgear have been shackled together a 19.5 m x 9.5 mm (3/8 inch) long mid-link galvanized Grade 80 alloy (travel) chain is strung through the top of each disk. The 35 bobbin chains, each 393 mm (15.5 inches) long are wrapped once around the travel chain over the centre of each iron spacer, except where two sections of the footgear meet they are located over a rubber spacer. The fishing line passes through both end rings of the bobbin chains.

When footrope is ready to be attached to the trawl, the fishing line and the assembled footrope is stretched out on a flat surface, the eye splices of the bolsh lines and the fishing lines are hammer-locked together. The bolshline must have standard eye splice size of 15 cm-4 tucks and before using, the bolsh line must be dry and not under load for 24 hrs. Assemble according to the following guidelines and according to the Footgear Drawings in Chapter 3:

6.9.1 A crane or forklift is required to apply tension and take the slack out of the footgear and fishingline. It is crucial that the tension be maintained on the trawl until all attachments (stops) have been made to the footgear/fishingline. If this is not done the stops will never be positioned in the right place and the footrope will be distorted during fishing operations.

6.92 The centre of the bolshline, fishing line and footgear must be aligned with each other before attaching trawl to footgear. Begin lining up the centre stop for the bolsh line and the fishing line and then continue out to the quarters.

6.9.3 The fishing line and bolshline are stopped together with the stops placed at the center of each 14” rockhopper disc approximately 200 mm apart in the bosom and gusset and approximately 610 mm apart on the rest of the lower wing . See Point # 6.10.2 below.

6.9.4 Ensure the stops are tight and do not interfere with the movement of the bobbin chains – See Detail 'A - C' of Footgear Attachment Method in Net Plans: Drawing Number CAM*3.2 in Chapter 3).

6.9.5 The bobbin chains, which have been placed on the fishing line before hand, are now positioned so that they sit exactly halfway between the stops and the 14" rubber discs. The only exception to this occurs in the quarter where the stops are placed over the 2 - 8" iron spacers adjacent to the hammerlocks. There is no bobbin chain between those 2 stops.

6.9.6 There is no stop in the bosom section where the bolshline eye-splices are lashed together and the fishing line eye-splices are hammer locked together. This serves as a stop.

6.9.7 Upon assembly of complete trawl the delta plate assembly hook up should be checked thoroughly since this a re-occurring problem area (See Appendix B Delta Plate Assembly in Net Plans in Chapter 3). The travel chain is hammerlocked into the top swivel/hole of a 3 holed-triangular shaped delta plate. Each footgear quarter section is hammerlocked into the lower swivel/hole. At the opposite lower end hole of the plate is attached an 8 m flying wing made up of 16 mm (5/8 inch) long mid-link galvanized Grade 80 alloy chain to which, at the aft end, is attached a 6 inch washer-14 inch rubber bunt bobbin-7 inch spacer arrangement. The forward section of the flying wing hammerlocks into the lower bridle upon assembly. Into the top hole of the delta plate are hammerlocked the lower wingline, lower wingend bolshline, lower bolshline, and fishing line.

6.10 ADDITIONAL NOTES

6.10.1 During trawl construction the distinction between port and starboard and top and bottom can be visible by marking each with different color twines: port wing, starboard wing.

6.10.2 When the footgear snags on an obstruction at sea it is very difficult to line up the toggle chains and stops on fishing line. This can be resolved by permanently marking the position for each stop, and the centre of the whole fishing line, when it is constructed at the suppliers. This should be investigated by the Science gear technologist.

6.11 STORAGE OF TRAWLS

Storage of all used, new, unused or repaired trawls including footgear and wires is to be in wire bins kept indoors in a rodent proof dry area

6.12 CONSTRUCTION CERTIFICATION PROTOCOL

The certification process is a two stage process carried out by 1) the net maker and 2) the NAFC Inspection Team. The certification process checks and verifies adherence to survey trawl construction standards, both for new construction and for repairs[21], and entails using the Survey Trawl Master Checklist and Parts List. See Chapter 8 Survey Trawl Quality Control Protocols for guidelines.

[21] When repairs are conducted the Trawl Repair Form is used (see Chapter 7)

CHAPTER 7

TRAWL REPAIR PROTOCOLS

SECTION I: STANDARDIZED PROCEDURES FOR TRAWL REPAIRS AND PREPARATIONS OF TRAWLS FOR THE SURVEY

7.1 INTRODUCTION

Annually there are several survey demands for use of the Campelen survey trawl in the Newfoundland and Quebec regions. NL-NAFC carries out annual multispecies ecosystem spring surveys of St. Pierre and Grand Banks generally with one vessel, and annual fall surveys of the Grand Bank and Newfoundland and Labrador Northeast Shelves generally with two vessels. Throughout the year there are other species specific surveys in the NL region where the Campelen trawl is used. Quebec/IML carries out an annual fall multispecies ecosystem of the northern Gulf of St. Lawrence. Here all survey types will be considered the same and all of the procedures outlined here will have the same application. The annual NAFC spring and fall surveys are divided into short trips called 'legs' and specific procedures will address this operation design. Although the IML survey is broken into two legs it will be considered as one survey and is addressed below in Section 7.3. This heavy use of the Campelen trawl will result in much wear and tear and damage. Strict procedures for repairs are necessary to ensure the trawl stays within survey tolerances thus maintaining the integrity of the sampling tool as a scientific instrument.

Prior to the survey each vessel is issued two trawls[22],[23]; it is the responsibility of the vessel crew to make at sea repairs on damaged nets but if the primary net is completely destroyed, or lost, the secondary net is then put into service. The CCG Supply Chain Coordinator should have in reserve at least two complete spare nets with floats, one complete set of footgear, and one set of trawl doors for each vessel. All post survey repairs, and the construction of new trawls are to be carried out by a commercial net maker under contract. Where indicated in Section 7.3, the trawls are removed from the vessel at certain scheduled intervals and replaced with fully repaired and certified trawls.

[22] Teleost IML survey will require three trawls.

[23] With the introduction of these new protocols, all trawls and footgear aboard each vessel will be removed and sent to an independent net repair contractor for complete overhaul at scheduled intervals. When returned, each trawl will be certified for use by a NAFC Inspection Team using Survey Trawl Checklist (Chapter 8) certification procedures before being sent to the vessels.

7.2 CERTIFICATION PROTOCOL

The certification process is a two stage process carried out by 1) the net maker and 2) the NAFC Inspection Team. The certification process checks and verifies adherence to survey trawl construction standards, both for new construction and for repairs, and entails using the Trawl Drawings, Master Checklist and Parts List. The Trawl Repair Form is used by the net maker to document the repairs needed (see Appendix 1). The Master Checklist Form (Chapter 8) is used by the net maker to certify that the actual assemblage of the trawl is according to specifications listed in the manual. See Chapter 8 Survey Trawl Quality Control Protocols for guidelines

7.3 TAGGING PROCEDURES

Tracking the history of newly constructed or repaired trawls and their movement requires the use of a tagging system. Each trawl in the CCG Supply Chain Warehouse will have two types of tags: 1) a metal banded tag wrapped around the headline and an engraved tag for the footgear to track history of trawl usage; and 2) a durable cloth tag attached to the headline to designate its state of repair. On the metal tag will be engraved: 1) a unique alpha-numerical identifier (NXXX for net, and 2) the date (dd/mm/yy) constructed[24]. On the corresponding footgear, the first disk in each of the 3 sections will have a code burned into the rubber using: 1) a unique alpha-numerical identifier (FXXX for footgear), and 2) the date (dd/mm/yy) when constructed. The cloth tag will be used to identify trawls that are 1) 'ready for survey use', i.e. repaired and certified by the NAFC Inspection Team and carry a *green* tag, and 2) 'in need of repairs' and carry a *red* tag.

A trawl that is delivered to the vessel but is not used during the survey maintains the green tag and can be used on subsequent surveys without re-inspection/certification. Spare footgear will also be tagged in a similar fashion. After the survey or designated survey leg, the used trawl (s) gets a red tag and is sent ashore with a detailed description of the damage and a list of repairs made (copies of Trawl Repair Forms). The trawls are sent to the commercial net maker for inspection and repairs.

7.4 REPAIR AND REPLACEMENT SCHEDULE

At the beginning of the survey

7.4.1 Each vessel is issued two tagged trawls, one complete with footgear and the other with footgear separated, if necessary for ease of storage. Any final certification of hook up of the trawl aboard the vessel will follow guidelines in Chapter 8 and be carried out by the SIC and Fishing Officer.

[24] In the beginning of the tagging program this date information may reflect the date the trawl was first repaired by net maker. A log file will be kept by the CCG Supply Chain coordinator which will record the history of each trawl including vessel name, dates and extent of all repairs, the number of days the trawl was fished, where and when repaired and who QA certified it before survey use. This log system should be coordinated with vessel fishing officers and NAFC fishing gear technologist.

7.4.2 Additional net panels, hardware and other trawl components will also be loaded onboard as required.

During the survey

7.4.3 The vessel crew makes at-sea repairs on damaged nets according to guidelines in Section II below.

7.4.4 If the primary net is completely trashed, destroyed, lost or deemed to no longer meet survey standards (see Section II), the secondary net is then put into service. The primary trawl is replaced with a certified trawl upon arrival at port which then becomes the secondary trawl onboard.

At the end of the survey

7.4.5 **Single species surveys**: all used trawls are given a red tag, and along with their footgear, and bridles are put ashore, sent to the net maker and later certified for survey use by the NAFC Inspection Team.

7.4.6 **Multi-species surveys divided into several survey legs**: after every third leg of the survey or when a major tear-up occurs the used trawls, footgear and bridles are given a red tag, removed and replaced with NAFC certified gear.

7.4.7 **Multi-species surveys - last survey leg:** all used trawls, footgear, bridles and doors are put ashore. This gear will be given a red tag and sent to the net repair contractor and later certified for survey use by the NAFC Inspection Team. A complete inventory[25] of all Campelen trawl panels, twine, components and hardware is then carried out by the CCG Supply Chain Coordinator and the vessel Fishing Officers.

7.4.8 **Storage of all used, new, unused or repaired trawls including footgear and wires is to be in wire bins kept indoors in a rodent proof dry area.**

SECTION II: AT SEA REPAIRS AND MAINTENANCE

7.5 INTRODUCTION

Repairs made at sea are restricted to minor repairs in order to ensure the trawl stays within survey tolerances thus maintaining the integrity of the sampling tool. If the deck crew are unable to return a net to survey standards as determined by the fishing mate/bosun and SIC/Watch Leader then the damaged net is retired and the secondary net is deployed.

[25] An inventory tracking system is needed to log the quantities of all trawl components aboard the ship and used by both vessel and CCG warehouse

7.5.1 GENERAL GUIDELINES

It is the responsibility of the fishing mate and bosun to oversee and carry out all major repairs on deck and the SIC or Watch leader to verify that repairs are within survey standards. This includes but is not restricted to the following:

7.5.1.1 When a net is damaged, repaired, or retired, a Trawl Repair Form[26] should be completed by the fishing mate or bosun, noting the net ID number and all damage and repairs made.

7.5.1.2 Nets, doors, bridles, ropes and hookups, should be examined as a routine procedure after every tow, checking for any damage which must be acted on before the next tow.

7.5.1.3 Damage which places a trawl component outside of specifications tolerances must be immediately fixed or in such cases where much time would be lost in carrying out extensive repairs, a new component should be installed in its place, e.g. replace footgear with spare set.

7.5.1.4 ***Prior to sending a trawl ashore the net is picked clean of fish and debris and towed behind the vessel to dislodge any remaining garbage.***

7.6 PROCEDURES FOR HOOK-UP OF GEAR ON AN OBSTRUCTION

If a hook-up on a bottom obstruction is experienced at sea the trawl shall be examined visually and components assessed for damage. Even though damage is not visible, changes may have occurred to the trawl as a result of excessive stretching. Only those repairs necessary to ensure the survey trawl stays within specified tolerances are to be carried out based on application of the following procedures:

7.6.1 ***Major Hookup*****:** In the case of a major hook-up which causes a stoppage of the vessel, the primary net, footgear and bridles must be replaced by the secondary trawl, footgear and bridles even though there is minimal or no trawl damage visible. Such a hookup could have caused major stretching in the footgear, frame ropes and wires, and panels, most of which will affect trawl geometry, performance and catchability.

7.6.2 ***Minor Hookup*****:** In the case of a minor hook-up which causes the vessel and warps to shudder, the net, footgear and bridles must be inspected for visible trawl damage and repairs made accordingly. Even though damage is not

[26] Formerly the CHECKLIST FORM was used to capture this information.

visible, changes may have occurred in trawl components as a result of stretching. The following inspections are to be carried out:

7.6.2.1 *Frameropes*: Length measurements are to be conducted on bridles, headline, and fishing line, including the flying wing extension. Any changes outside the stated tolerances will result in replacing the component or in the case of minor damage a repair is to be made.

7.5.2.1 *Footgear*: Check all of the stops as the movement of stops joining fishing line and bolshline[27] can interfere with the footrope performance. All broken or loose stops or those out of position must be fixed according to specifications in Construction Protocols in Chapter 6 and Trawl Specifications in Chapter 3.

7.6.3 **M*ajor Damage:*** If major visible damage involving many components is experienced after hookup then the trawl, footgear and bridles should be removed and replaced with the secondary trawl.

Note: When a trawl has been rim-wrecked, lost or deemed to no longer to meet survey standards then CCG Supply Chain Coordinator should be contacted before the vessel reaches port to arrange immediate replacement with a certified trawl.

7.7 PROCEDURES FOR ENCOUNTER WITH AN OBSTRUCTION

Encounters with significant obstructions that becomes part of the trawl catch such as, large rocks, crab pots, large truck tires, anchors, timbers/tree roots; and oversized catches (e.g. jelly fish, mud, corals etc.) can impair normal trawl performance and affect catchability.

Only those repairs necessary to ensure the survey trawl stays within specified tolerances are to be carried out based on the following:

7.7.1 When large and/or several medium sized rocks or other types of obstructions are taken back in the codend the lower net panels from the 1st belly to the codend shall be checked for damage. Panels and frame ropes in the likely path of the rock should be checked and measured for stretching and damage.

7.7.2 If major damage involving many components is experienced then the trawl, footgear and bridles should be removed and replaced with the secondary trawl.

[27] During construction it is recommended that permanent physical marks be placed on the fishing line and lower bolshline so that any movement or replacement of the stops can be precisely fixed. This is most apparent for at-sea repairs.

7.8 GENERAL PROCEDURES FOR TRAWL REPAIRS

After every tow the fishing mate/bosun and deck crew along with SIC or Watch Leader must carry out a visual inspection to reveal torn and worn netting especially in the wings, guard meshes and lower belly areas, breaks in frame ropes, slippage of settings (stops) on bolshlines, fishing line and headline, toggle chain damage, bridle and door assembly damage, delta plate assembly damage, and loss of floats. Whenever the trawl requires repairs during survey operations, such repairs will be done following the standards set forth in the following section and documented on the Trawl Repair Form. Trawl components potentially affected by at-sea repairs will be re-measured to confirm that the trawl is meeting specifications in accordance with Trawl Construction Protocols in Chapter 6.

It is the responsibility of the fishing mate or bosun to monitor all assessment and repairs of damage to the trawl using the following guidelines:

7.8.1 *NETTING*

7.8.1.1 Worn netting and mended netting should be replaced on a regular basis.

7.8.1.2 Torn or abraded areas on the net should be repaired by experienced crews familiar with twine mending by sewing in patches of twine which follows the general shape of the hole.

7.8.1.3 If crews are inexperienced then sew in square section of netting patches, and rather than hand sewing new meshes into a panel replace with new panels.

7.8.1.4 Should a new net panel be too short then do not use it - **DO NOT** try to stretch it to the correct length

7.8.1.5 Straight tears of 2 meters or less like those often seen in bottom bellies can be sewn provided that closing the hole does not result in making any more than one half mesh in the T or N direction.

7.8.1.6 ***The practice of lacing (scunning) holes and tears is not permitted***.

7.8.1.7 Guard twine damage should be repaired by inserting sections rather than sewing meshes.

7.8.2 *CODEND, LINER AND COVER*

When large or several rocks, other obstructions and oversized catches of mud, sponges and corals are dumped from the net, codend liners should be checked for damage as follows:

7.8.2.1 Check the liner for holes and repair small holes with a patch (cut both in square shape) and sew in place. Large holes or rips require replacement of that panel. ***The practice of lacing (scunning) holes and tears is not permitted.***

7.8.2.2 Ensure the liner is proper length and that it extends 1.87 m (6 feet) outside when the bag is untied.

7.8.2.3 For damage to codend and codend cover, follow guidelines for general netting repairs in Section 7.71 above.

7.8.2.4 Ensure the nylon codend loops are not damaged or torn loose; repair or replace when necessary.

7.7.3 FRAMEROPES AND WIRES (INCLUDING BRIDLES)

In any repair the use of hardware components, such as shackles, hammerlocks, delta plates, etc., which differ in length than that recommended specification in the manual, are used in such a way that the specified overall lengths of the wires and ropes are not affected as follows:

7.7.3.1 ***If the use of any hardware increases or decreases the specified length of a component, for example the headline or flying wing, then the length of that component must be adjusted to account for the difference in length of the hardware.*** In this situation a quick measurement will confirm the overall length. This adjustment should be noted has occurred on the Trawl Repair Form. When the component becomes available from the CCG Supply Warehouse it should be replaced immediately and the lengths re-adjusted back to specifications in the manual.

7.7.3.2 After each tow, check the stops used to attach bolshline to headline and re-attach or replace all that have become untied or broken.

7.7.3.3 Breaks in combination rope used for fishing lines or headline require that the section be replaced.

7.7.3.4 If frameropes and wires (including bridles or pennants) [28] are frayed (broken strands), brittle, stretched or worn then they are to be replaced with new material. Even if only the eye splices have flattened strands and visible core or broken wires then replace that wire.

7.7.3.5 Wire ropes that show 10% of broken strands in a length of 8 diameters shall be replaced.

7.7.3.6 Wire ropes (combinations and bridles) that show a 10% decrease in diameter with the lay uniform and 7% reduction in diameter when elongation has occurred shall be replaced.

7.7.3.7 Ribline lengths are extremely important and need to be checked often. They prevent the stretching of selvedges and when this happens the lower belly can begin to take the strain resulting in changes in performance and catchability.

7.7.4 *FLOATS*

7.7.4.1 Floats are counted, and checked for damage and proper (equal) spacing.

7.7.4.2 Ensure each float is snug to the headrope and repair those that have excessive play.

7.7.4.3 The floats have a 16 mm polypropylene line threaded through their double eyelets. This poly line is then seized to the headline. The first float begins at the eye splice at the wing end.

7.7.4.4 Ensure the extra 6 extra floats on each wing are in proper position.

7.7.5 *FOOTGEAR*

7.7.5.1 After each tow check the stops used to attach bolshline to fishing line are in the proper position and re-attach or replace all that have become untied or broken so as not to restrict the movement of toggle chains.

7.7.5.2 After every repair to lower framelines, inspect the delta plate hookup to ensure the correct lines are in the appropriate holes. ***Check thoroughly since this is a re-occurring problem area*** (see Hook-Up Drawing in Appendix B of Chapter 3 Trawl Specifications.

7.7.5.3 When the secondary footgear is used; first shackle the three sections

[28] Items 4-6 follow Transport Canada Guidelines- CCG Wear Standards For Cargo Gear Transport Publication TP9396E

together, secondly, stretch the entire footgear, including fishing line, under tension and thirdly attach net to the footgear ensuring stops are in proper place. See Section 3.5 and Trawl Drawing No. CAM*3.2 in Chapter 3 Trawl Specifications and Page 10 of NAFC Master Checklist in Chapter 8 for details.

7.7.6 *WARPS*

Trawl warp protocols for installation, inspection and maintenance are given in Chapter 5. Trawl warps should be visually inspected by the bosun or fishing mate during and at the end of each survey. Check for signs of damage and wear. One particular area of concern is having significant wear in one warp but not in the other. This may occur during the survey and the following guidelines should be followed to remedy the situation.

7.7.6.1 If there is over 2 meters of wear on one warp but not the other then the cause for this discrepancy shall be sought and the problem addressed immediately before the next tow.

7.7.6.2 The areas checked shall be door legs, swivels, door shoes, shackles and hammerlocks and bridles. If these are all found to be within tolerance then the main warp lengths should be checked. For Locked Winch systems warp lengths should be crossed-checked with the physical trawl marks to determine if the warp counters are responsible for unequal lengths of warps being deployed as the cause of the problem.

7.7.6.3 Also a quick check of sheaves and guide-ons may reveal another source for the problem.

7.7.6.4 Excessively worn or damaged warps should be cut off or replaced according to protocols in Chapter 5: Section 5.7.

7.7.7 *DOORS*

Any damage done to the trawl doors is best repaired on land and should only be attempted at sea in an emergency. The backup set of doors should be used. ***Note: never mix or match trawl doors since they are made as pairs and must only be used as pairs. Scanmar door sensor pockets can be replaced at sea.*** In addition, the following protocols apply:

7.7.7.1 Door leg chains should be change when there is a 10% reduction in weight.

7.7.7.2 During the annual spring and fall surveys, switch door shoes from one side to the other mid-way through each survey and record change on the Trawl Repair Form.

7.7.7.3 To prevent the doors from being flooded frequently check to ensure that the vent holes are not blocked. When they become blocked fix them immediately.

7.7.7.4 Inspect the 1 3/8 inch bow shackle which bolts the warp to the door at the beginning and end of each survey to ensure it is not wearing the hole in the door bracket. If this becomes enlarged at sea either change doors, if at the beginning of survey leg, or have the hole welded as soon as vessel docks in port.

7.7.7.5 Inspect the 1 ½ inch oval action swivel that is attached to the terminal end of the main warps and which bolts into the bow shackle for damage. If crushed then it needs immediate replacement.

7.7.7.6 Inspect the door pennant wire hookup for any damage or interference with warp hookup.

7.7.8 *HARDWARE*

The hardware used to connect various parts of the net, footgear and doors take a lot of abuse and must be check regularly especially for safety concerns

7.7.8.1 Severely worn hardware such as rings, shackles, G-hooks, and links are replaced as needed.

7.7.8.2 Replace[29] any shackle or hook that has a significant nick.

SECTION III: ONSHORE REPAIRS AND MAINTENANCE

7.8 INTRODUCTION

Trawl repairs carried out in port can be conducted in a more precise manner because of an absence of time constraints and space limitations which are experienced at sea. When repairs are conducted in port the construction procedures in Chapter 6 Trawl Construction Protocols should be followed.

When the trawl is send to the net maker the Trawl Repair Forms used aboard the vessel must accompany the trawl. The net maker will conduct thorough inspection and carry out all necessary repairs using a new copy of the Trawl Repair Form. When all repairs are finished an entire inspection of the trawl and footgear using

[29] Transport Canada Guidelines- CCG Wear Standards For Cargo Gear Transport Publication TP9396E

the Checklist Form is carried out to ensure that the net meets the construction standards of the survey trawl. Before the annual spring and fall multi-species ecosystem surveys the main trawl doors are sent ashore to the net maker to be inspected for wear and damage and repaired as needed.

It is critical that net makers clearly understand their role is not to enhance the net to improve its fishing capability, nor should they take shortcuts to save time and expense, rather they are contracted to restore the net back to its original form exactly as depicted in the trawl plans.

Net makers will be supplied detailed trawl drawings, parts list, checklist and certification protocols along with Chapter 6 on Trawl Construction protocols and Chapter 7 on Trawl Repair Protocols. Such extensive detail should result in a finished product closer to the standard trawl, while too little information will allow net makers to improvise. When replacing any component of the trawl, net makers must use only the approved components supplied by the CCG Supply Warehouse.

7.9 GENERAL PROCEDURES FOR TRAWL REPAIRS

Net repair[30] begins with the removal of the footgear to facilitate its inspection, as well as, inspection of the net and all of its components. All lengths of wires, ropes, bridles, footgear and panels must be inspected and measured to meet specifications in the trawl drawings in Chapter 4. All repairs are documented using the Trawl Repair Form.

7.9.1 NETTING

The top, bottom, and side panels of the net are inspected from wing tip through to the codend for holes, rips, or abrasions and repairs in the webbing.

7.9.1.1 Repairs made to panels while at sea which look out of shape or have many bars undone are replaced with new patches of netting or if the repairs are extensive replace with new panels. When repairing small holes or worn twine, use of a new netting patch is preferred rather than hand sewing of meshes. This applies to the guard meshes as well.

7.9.1.2 ***The practice of lacing (scunning) holes and tears is not permitted***.

7.9.1.3 Straight tears of 2 meters or less like those often seen in bottom bellies can be sewn provided that closing the hole does not result in making any more than one half mesh in the T or N direction.

[30] There is some duplication here with procedures in Section II and this is deliberate.

7.9.1.4 Inspection of the codend includes chafing gear, riblines, webbing, liners, and codend rings. Repair and replacement of worn or missing codend panels, including the cover are carried out as needed. Upper or lower panels of liners are replaced if one is torn.

7.9.1.5 Guidelines for sewing panels together, and to frame ropes are found in Chapter 6 on Trawl Construction Protocols.

7.9.2 FLOATS

7.9.2.1 Floats are counted, and checked for damage and proper (equal) spacing.

7.9.2.2 The number of floats, with specified buoyancy and position must meet specifications.

7.9.2.3 Check to ensure each float is snug to the headrope and they do not have excessive play.

7.9.2.4 The floats have a 16 mm polypropylene line threaded through their double eyelets. This poly line is then seized to the headline. The first float begins at the eye splice at the wing end.

7.9.2.5 Ensure the extra 6 floats on each wing are in proper position.

7.9.3 FRAMEROPES AND WIRES

Framing wires and ropes (including bridles or pennants) are inspected for wear and measured for proper length and checked against specifications.

7.9.3.1 If frame ropes and wires are frayed, brittle, stretched or worn then they are replaced with new material. If wire eye splices have flattened strands and visible core or broken wires then replace those wires.

7.9.3.2 Wire ropes[31] that show 10% of broken strands in a length of 8 diameters shall be replaced.

7.9.3.3 Wire ropes (combinations and bridles) that show a 10% decrease in diameter with the lay uniform and 7% reduction in diameter when elongation has occurred shall be replaced.

7.9.3.4 The attachment of the bolshline to the frame ropes should be examined and stops which have come undone should be replaced paying particular attention to those stops on the fishing line.

7.9.3.5 Bridles are measured to ensure they meet survey specifications and, if

[31] Items 2-3 follow Transport Canada Guidelines- CCG Wear Standards For Cargo Gear Transport Publication TP9396E

not, are discarded and replaced with new ones.

7.9.3.6 Ribline ropes are measured and if longer or shorter than specifications are replaced.

7.9.3.7 Guidelines for sewing panels to frame ropes and frameropes together are found in Chapter 6 on Construction Protocols.

7.9.4 HARDWARE

The hardware used to connect various parts of the trawl to footgear and doors take a lot of abuse and must be check regularly especially for safety concerns.

7.9.4.1 Severely worn hardware such as rings, shackles, G-hooks, and links are replaced as needed.

7.9.4.2 Replace any shackle or hooks that have a significant nick.

7.9.5 FOOTGEAR

The footrope is examined for excess wear and damaged or missing components. Replacement parts are installed and each section of the reconditioned footrope is strung under tension and then measured and weighed to make sure it meets the survey standard. If the footrope chain is overly worn, or stretched then it is replaced with a newly constructed one.

7.9.5.1. The rockhopper footgear must meet overall length specifications.

7.9.5.2. Measurement of footrope and related components can only be carried out with the footrope fully extended and under tension.

7.9.5.3. Check and measure the flying wing under tension. Stretching of footgear chain outside tolerance specifications requires replacement.

7.9.5.4. If repairs of a footgear component or hardware are longer or shorter than specifications, request the correct component or hardware from the CCG Supply Chain Coordinator. If a correct replacement is not available the length differences will require an adjustment in overall length of the flying wing to ensure its length stays within specification.

7.9.5.5. Check that the toggle chain movement is not restricted by stapling (stops) of fishing line to bolshline, if it is then reattach the stops.

7.9.5.6. Check the diameter of the rockhopper discs. If minimum diameter of the rockhopper discs (normal is 14 inches or 35.56 cm) has decreased below 30.48 cm (12 inches) then they must be replaced.

7.9.5.7. Chains associated with the footgear should be changed when there is a 10% reduction in weight.

7.9.5.8. At the beginning and end of the survey year, the total weight of footgear in water should checked. If it is less than 450 kg., i.e. not less than 10% weight reduction from nominal footgear weight then inspect the footgear to establish the problem.

7.9.5 DOORS

Each door has a unique number engraved so a history of repair and vessel ownership can be tracked. Doors are ordered in pairs and must never be used separately with another door, i.e. never mix and match. Upon arrival of new doors, the CCG Supply Chain Coordinator checks the weight against manufacture's certificate and again after Scanmar sensor pockets are installed (see Chapter 4: Trawl Procurement Protocols). Both weights are recorded with the engraved number and stored on file. Before the beginning of the spring and fall multi-species ecosystem surveys the following inspection and repair protocols should be carried out on the main trawl doors:

7.9.5.1. Main trawl doors are removed from vessel and inspected for wear and damage and repaired as needed.

7.9.5.2 Weigh each door and check against nominal weights provided by manufacturer and the weight of the doors recorded after installation of Scanmar sensor pockets. If one door is lighter then the other then determine if shoes are worn, or 'skin' of door is damaged. An ultrasound test may be necessary to determine thickness of skin in comparison to manufacturer's specifications.

7.9.5.3 Ensure the door shoes have an edge and are not rounded. Shoes should be replaced when 1/3 of the depth is worn (see specifications in Trawl Drawing CAM*4.2 in Chapter 3 Trawl Specifications).

7.9.5.4 Check front edge of door for wear and build up with welding if necessary. If welding is required check with callipers to see if they meet specifications noted on manufacturer's certificate.

7.9.5.5 Check Scanmar sensor pockets for damage and wear and repaired when required.

7.9.5.6 Doors are sand blasted to check for cracks which are fixed by welding and then doors are painted black.

7.9.5.7 After a change-over of door shoes, or welding of holes in the doors they must be weighed again to see if they meet specifications.

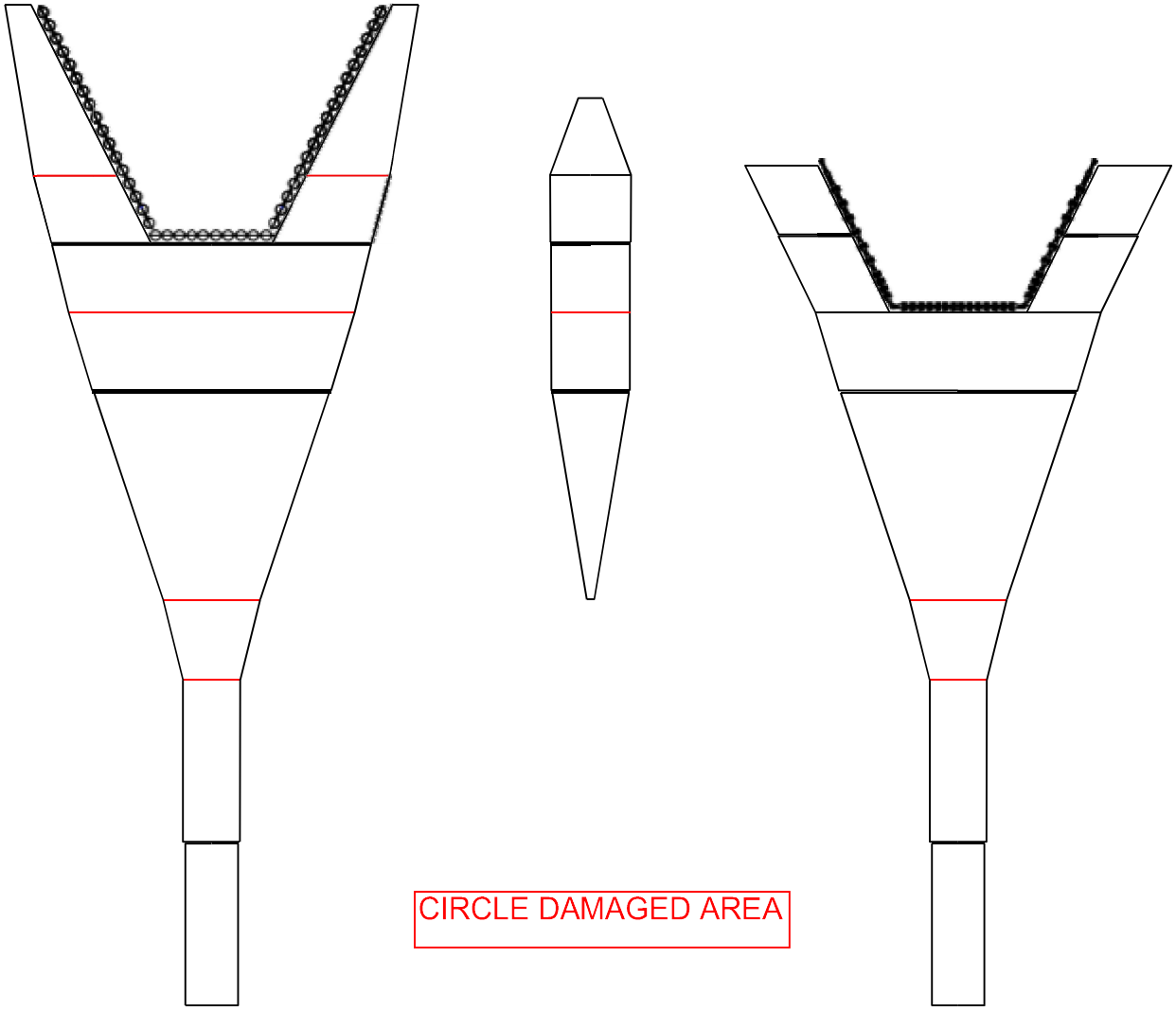
7.9.5.8 Ensure that the vent holes in the doors are not blocked. This prevents the doors from being flooded at sea.

7.9.5.9 Inspect the 1 3/8 inch bow shackle for attachment of warp to door and ensure the hole in the door is not significantly worn in size. If worn then weld it to decrease overall size.

7.10 ASSEMBLYING THE TRAWL AND FOOTGEAR

See Trawl Specification Protocols in Chapter 3 and Trawl Construction Protocols in Chapter 6

TRAWL REPAIR FORM
CAMPELEN 1800 SHRIMP TRAWL



CIRCLE DAMAGED AREA

Vessel _____ Trip No. _____

Net No. _____ Footgear No. _____

Date _____

Net was ☐ Repaired (Describe repair on this form)

☐ Replaced with Net No. _____

Footgear was ☐ Repaired (Describe repair on this form)

☐ Replaced with Footgear No. _____

Comments: _____

Checked By: _____

Fishing Mate/Bosun

Fisheries and Oceans Canada / Pêches et Océans Canada

DRAWN BY:
MARINE INSTITUTE
CENTRE FOR SUSTAINABLE AQUATIC RESOURCES
ST.JOHN'S NEWFOUNDLAND

CHAPTER 8

SURVEY TRAWL QUALITY CONTROL PROTOCOLS

8.1 INTRODUCTION

Standardization of trawl construction and repair is unquestionably the most critical element for survey standardization. Trawls operate in a harsh environment and are constantly undergoing change through abrasion, damage, stretch, etc. which can affect performance and catchability. Because NAFC survey trawls are used as scientific instruments to sample and measure various components of the ecosystem the level of tolerance in their construction and repair is higher than that seen in commercial fishing gears. Hence there is a need for a Quality Control (QC) protocols or set of procedures intended to ensure that a manufactured performed service adheres to a defined set of quality criteria and meets the requirements of the DFO Science.

In order to implement an effective QC program, DFO Science first decided which specific standards the service must meet for procurement, construction and repairs.The first Survey Trawl Quality Control Program was centred on a Checklist Form developed in 1992, revised in 2007 and updated here. The Program certifies that procurement, construction and repair specifications are consistently maintained year after year, survey after survey. The are now two versions of quality control checklist used: 1) the traditional **Master Checklist (Appendix 3)** is used to certify that procured trawl components meet specifications, and to certify the newly constructed or repaired trawl is "ready for use"; and 2) the "new" **Quick Checklist (Appendix 5)** is used to check the trawl between designated survey legs, and when the secondary net and/or footgear is used at sea.

The Master Checklist Form has been ergonomically designed for ease of use under difficult conditions and is composed of 10 drawings: rigging profile (2), net plan (3) frameropes (1) and footgear rigging (4). Each component is shown as a drawing along with an entry block naming the component and listing its tolerance specification (minimum and maximum range of acceptable values) with a space to record the measured value. **Any measurement on a component that falls outside the tolerance range is deemed unacceptable**. The Checklist Form fills two valuable functions: it provides the user with a systematic guide ensuring that nothing is overlooked and that a record of each trawl mensuration is kept. The Form is used together with the Trawl Drawings and Parts List in Chapter 3: Trawl Specification Protocols.

The Master and Quick Checklists have two primary uses: 1) as a log form to certify that trawl components meet specifications (Master only); and 2) as a log

form to certify that repairs and/or construction meet specifications. Chapter 4: Trawl Procurement Protocols covers detail (item # 1) of its use for newly purchased trawl components. This Chapter will focus on using the Checklist for certifying trawls that are "ready to use for survey".

The intent of these Survey Trawl Quality Protocols is to ensure that, through the process of QA certification, the Campelen trawl is constructed and repaired within specified tolerances for the requirement of an identical trawl being used at every sampling station on every survey, year after year. A flow chart is presented in Appendix 1 which illustrates the QA Certification Process.

8.2 ONSHORE CONSTRUCTION & REPAIR CERTIFICATION PROCEDURES – MASTER CHECKLIST

At the end of every survey or *designated* survey leg (see schedule in Appendix 2), the used trawl(s) (net, footgear, wires and occasionally doors[1]) is sent ashore, checked, repaired and made ready for the next survey. After the completion of shore repairs[2] or after the construction of a new trawl, a QA certification using the Master Checklist is conducted by the net maker at his/her facility followed by a second independent QA conducted by the NAFC Inspection Team at the CCG warehouse. The latter QA certifies that proper standards in trawl construction and repairs have been maintained. The QA certification process involves a complete inspection of the trawl before it is sent back to CCG warehouse by the net maker, and before it is sent from CCG warehouse to the ship.

The certification process using the Master Checklist Form takes approximately 4-5 hours for 3-4 people on one net and uses supplementary information from the Parts List and Trawl Drawings in Chapter 3: Trawl Specification Protocols.

See Appendix 1 flowchart for cycle of events in QA Certification process. General guidelines are as follow:

8.2.1 ***Net Maker***: The Master Checklist Form is used by the net maker to certify his trawl construction/repairs is according to specifications listed in the manual following guidelines in Chapter 6 (Trawl Construction Protocols) and Chapter 7 (Trawl Repair Protocols). The net maker returns the Checklist and Trawl Repair Forms (and any other documentation) to CCG Warehouse with trawl upon completion of contract.

8.2.2 ***NAFC Inspection Team***: Upon the trawl's arrival back from the net maker, the NAFC Inspection Team will examine the Trawl Repair and

[1] The main doors, and secondary doors if used, are sent ashore for inspection after the annual spring and fall NAFC multi-species surveys.
[2] When repairs are conducted the Trawl Repair Form is used with the Checklist Form (see Chapter 7)

Master Checklist Forms from the net maker. The team will conduct their own independent inspection using the Master Checklist Form and measure the entire trawl, cross-checking their values with those on the net maker‘s Checklist. This second quality assurance step is needed to certify that construction by the net maker fully meets all standards set out in this manual. **No variations are accepted**. The team will summarize any improper repairs, construction, any improper components used that do not meet tolerance, and any missing parts using the **NAFC Inspection Team Summary Sheet** (Appendix 4).

8.2.3 If variations are found in repairs or construction the trawl and the Inspection Summary Sheet is returned to the net repair contractor who documents the new changes on the Trawl Repair and Checklist Forms. Upon return of the trawl the NAFC Inspection Team will once again certify only those changes/repairs on their Master Checklist Form. Then and only then can the trawl be certified ‘ready for survey use”.

8.2.4 After the trawl has been certified then the trawl receives a “ready for survey use” green tag from the Inspection Team and is sent to the vessel or stored “**indoors**” at the CCG warehouse.

8.2.5 The NAFC inspection should be completed long before the trawl is loaded onto the survey vessel so that any errors can be addressed by the net maker.

8.3 GUIDELINES FOR USING THE MASTER CHECKLIST

These general guidelines can be used by the net maker and the NAFC Inspection Team in carrying out the QA Certification Program.

The primary trawl with the footgear attached is inspected at the net maker’s facility and at the CCG warehouse after it is returned by the net maker. ***Time must be allowed for any further repairs or changes documented during the QA inspection to be carried out by the net maker and NAFC verification of those repairs.*** The NAFC Inspection Team will use the Master Checklist to measure all trawl components and fill out all blocks on the Checklist Form, with the exception of bridles, door leg extensions which are measured under tension during the second tow of the first survey leg. The trawl door hookup certification is carried out at the dockside and/or on the vessel.

8.3.1 ***Filling Out the Master Checklist Form***: Each component is shown in a drawing along with its tolerance specification (minimum and maximum range of acceptable values) and an entry block for entering the measured value. **Any measurement on a component that falls outside the tolerance range is deemed unacceptable**. The actual size value for the

component is listed in the Parts List and Trawl Drawings. The Team summarizes any improper repairs, construction, any improper components used that do not meet tolerances, and any missing parts on the NAFC Inspection Team Summary Sheet. The Inspection Summary Sheet accompanies the trawl back to net maker who must address the problem areas. Upon return the Summary Sheet is used with Master Checklist to certify whether the problem area was fixed and meets standards.

In addition to measuring trawl components, the following inspection guidelines should serve as an introductory routine to check the overall construction and repairs of the trawl:

8.3.2 **RIGGING CHECKLIST (Pages 1 & 2)**

Note: Bridles and door leg extensions' measurements are taken during the ***second tow*** *as the trawl is being deployed and are recorded on the Master Checklist Form that accompanied the trawl onboard. Door hookup, Scanmar door pockets and all attachments should be checked before sailing.*

8.3.2.1 *FLOATS*: ensure each float is attached tight to the headline. Count floats in each section and ensure they are evenly along the headline. Ensure that the extra 6 floats on each side of the top wings are present to neutralize the weight of the wing-end canisters for Scanmar sensors.

8.3.2.2 *BRIDLES:* Check for worn or broken strands of wire and ensure the wires of eye splices are not flattened with broken wires. Replace those sections that are damaged (broken strands of wires) or heavily worn. *Measure the bridles at sea after the* ***second tow,*** *and after every change over of an old bridle following the second tow rule (Page 1).* Check and verify bridle lengths.

8.3.2.3 *RIBLINES*: Check for worn or broken strands of rope and check the twine lacing that is used to seize the ropes together is not broken or frayed. Replace those sections that are damaged or heavily worn. Check and verify ribline lengths.

8.3.2.4 *DOORLEG EXTENSIONS:* Check for worn or broken strands of wire and ensure the wires of eye splices are not flattened with broken wires. Replace those sections that are damaged (broken strands of wires) or heavily worn. *Measure the extensions at sea after the second tow and after every change over following the second tow rule (Page 1).* Check and verify door leg extension lengths.

8.3.2.5 *DOORS:* These inspections are done on the vessel. Inside section of doors: ensure the shoes have an edge and are not rounded. Ensure the upper and lower door legs are shackled into the **forward hole bracket** and that the door leg chains are not worn to the breaking point. Outside section of doors: check door slot hole. If the 1 3/8 inch bow shackle has worn the hole larger then the hole needs to be reduced in size by welding. Check lengths of pennant wires to see if they conform to specifications for each vessel.

8.3.3 **NET PLAN CHECKLIST (Pages 3-5)**

8.3.3.1 *HOLES/TEARS*: Check overall netting condition for holes and tears in meshes, including the guard meshes and gussets, codend, codend cover and liner.

8.3.3.2 *MESHES*: Check for deformity, slipped knots and meshes made oversize or undersize by repairs or hookups during fishing. Have repaired or replaced all broken, torn netting or poorly repaired sections.

8.3.3.3 *LACING*: Check seizing (lacings) of netting to bolshlines and riblines to ensure these are not torn, and repair or replace when necessary.

8.3.3.4 *SELVEDGES*: Inspect the selvedges for wear and ensure there are no excess pockets of twine bunched up into the selvedge. If pockets are found have them redone by net maker following guidelines in Chapter 6: Trawl Construction Protocols, Section 6.3.

8.3.3.5 *CODEND ASSEMBLY*: Check length of codend and cover. Ensure the attachment point of cover is 20.5 meshes aft of the beginning of the extension section. Attachment point for the liner is 2 meshes aft of the beginning of the codend. Check for poor repairs to liner. If liner has any holes or oversize patches then have that panel repaired or replaced.

8.24 FRAMEROPE CHECKLIST (Page 6)

*Note: do not include the hammerlocks in the length measurements of the framerope*s.

8.2.4.1 *HEADLINE*: Ensure centre of bolshline is attached to centre of headline. Check for worn or broken strands of wire and ensure the wires of eye splices are not flattened with broken wires. Replace

8.2.4.2 *BOLSHLINE:* Ensure centre of square is attached to centre of bolshline. Check for worn or broken strands of rope and check the lacing that is used to seize the ropes together are not broken or frayed. Replace those sections of the headline that are damaged or heavily worn. Verify upper upper and lower bolshline lengths, including the lower wingline/bolshlines and record them.

8.2.4.3 *FISHING LINE*: Ensure centre of fishing line is attached to centre of bolshline. Check for worn or broken strands of wire and ensure the wires of eye splices are not flattened with broken wires. Replace those sections of the fishing line that are damaged or heavily worn. Verify fishing line length of each of the three sections and record it. ***Note***: a shortened fishing line will cause footgear to dig in and a longer line will cause the footgear to be light on bottom.

8.2.4.4 *WINGLINES & BREASTLINES*: Check for worn or broken strands of wire and ensure the wires of eye splices are not flattened with broken wires. Replace those sections that are damaged or heavily worn. Verify the lengths of each line and record it.

8.25 FOOTGEAR CHECKLIST (Pages 7-10)

The footgear can only be measured under tension. Tie one end to a stationary object and use a forklift or crane at the other end to stretch. Use the ends of the flying wings as attachment points. Undersized hammerlocks, shackles or swivels are not permitted to replace specified hardware because of safety concerns.

8.2.5.1 *FISHING LINE*: Ensure the centre of fishing line is attached to centre of footrope.

8.2.5.2 *DISKS*: Check the rubber rockhopper disks to see if any are loose indicating the chain has probably stretched and the footgear section needs to be re-strung. Ensure the diameter of the disks are not below 30.48 cm (12 inches).

8.2.5.3 *FOOTROPE:* Measure the total stretch length of each section of the footrope including hammerlocks where indicated (Page 7).

8.2.5.4 *TRAVEL CHAIN*: Measure the total stretch length of the travel chain (Page 7).

8.2.5.5 *SPACERS*: Ensure the correct number and position of iron and rubber spacers matches the footgear plan (Page 7).

8.2.5.6 *BOBBIN CHAINS*: Ensure the correct number and position of bobbin chains matches the footgear plan (page 7). Ensure only the fishing line, not bolshline, runs through the end rings of the toggle chains. Replace any chains that are stretched, distorted and have broken or split rings.

8.2.5.7 *DELTA PLATE*: Check delta plate assembly for improper alignment and attachment of shackles and hammerlocks connecting frameropes and footgear (see page 9). The wrong length of shackles or swivels would change the overall length of the fishing line.

8.2.5.8 *FLYING WING CHAIN*: Verify the total length of the flying chain. Use notes on Page 8 for guidance. Check the bunt bobbin for wear and replace when worn or damaged. Verify the assembly is as follows: delta plate-washer-bunt bobbin-spacer. Check the overall condition of the chain.

8.2.5.9 *LACING STOPS*: Ensure all stops (lacing) on the footgear are evenly spaced and tight (see page 10). Replace those that are loose, broken or out of alignment. All stops connecting the bolshline and the fishing line should be located over the centre of each rockhopper disc except where two footgear sections join and they are centered over the iron spacer at the end of each section.

8.3 SECTION II: QUICK CHECKLIST

The Quick Checklist (Appendix 5) has two uses: 1) to check the condition of the trawl between scheduled survey legs (Appendix 2) and 2) to check the condition of the rigging of the secondary trawl when change over occurs at sea. This checklist is a short version of the NAFC Campelen Master Checklist, but without the drawings, and relies mostly on a QUICK visual inspection to determine if the trawl is symmetrical and close to the standard, and that any damage is identified and repaired before leaving port.

8.3.1 BETWEEN SURVEY LEGS

The Quick Checklist should be carried out shortly after arrival of the vessel into port. Sufficient time should be allocated for repairs identified. The primary trawl with footgear must be placed on the dock. Footgear can only be measured under tension so tie one end to a stationary object and use a forklift or crane at the other end to

stretch. Use the ends of the flying wings as attachment points. If the vessel is docked away from home port and a crane or a forklift is not available[3] a truck (if available) may be used.

The inspection of the survey trawl using the Quick Checklist is carried out by the Gear Technologist, SIC and the fishing mate with assistance of other science and vessel staff. All repairs are made before sailing

8.3.2 AT SEA CHANGE OVER TO SECONDARY TRAWL

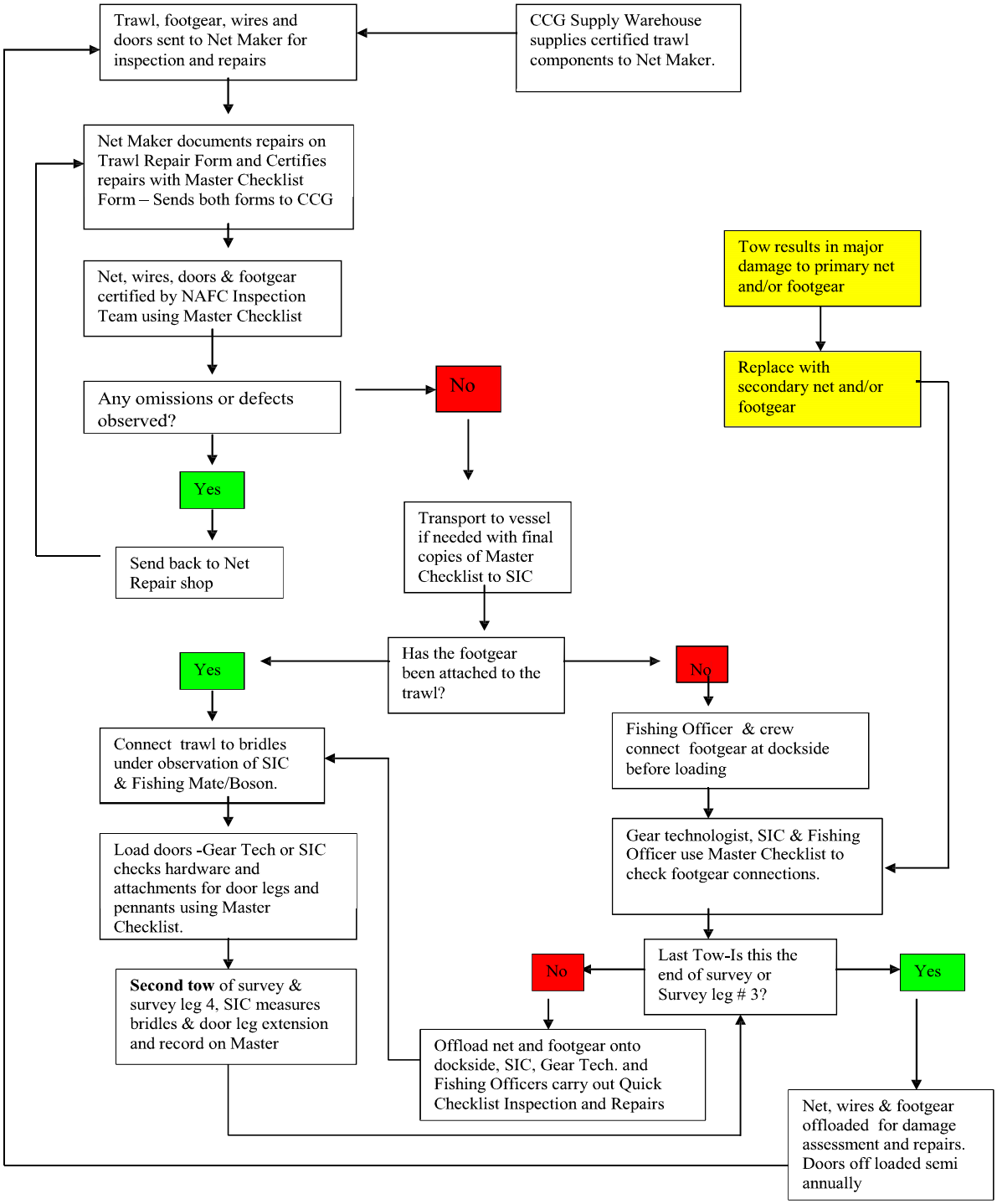
There may be an occasion when the primary survey trawl (net and/or footgear) is deemed not suitable for survey use because of major damage or loss and the secondary trawl is made ready for replacement (see guidelines on replacement in Section 7.5 of Chapter 7: Trawl Repair Protocols). Normally the secondary trawl is stored on the net drum with the footgear stored elsewhere on the vessel. After the net is hooked up to the footgear the SIC and Fishing Officer use the Quick Checklist to check all connections.

Limit the rest of the Quick Checklist inspection to: float numbers and position, condition and length bridles and door leg extensions, and footgear condition and rigging.

[3] The hiring of a crane or forklift should be arranged before vessel arrives in port

APPENDIX 1

Flow Chart of Survey Trawl Quality Assurance Certification Process



APPENDIX 2

SCHEDULE USE OF MASTER AND QUICK CHECKLISTS

SURVEY LEG	CHECKLIST
Before Survey or Survey Leg # 1	MASTER
Before Survey Leg # 2	QUICK
Before Survey Leg # 3	QUICK
Before Survey Leg # 4	MASTER
Before Survey Leg # 5	QUICK
Before Survey Leg # 6	QUICK
Before Survey Leg # 7 (if designated)	QUICK

Note: That the QUICK CHECKLIST is used if the secondary trawl (net and/or footgear) is used during the survey.

APPENDIX 3

CAMPELEN MASTER CHECKLIST

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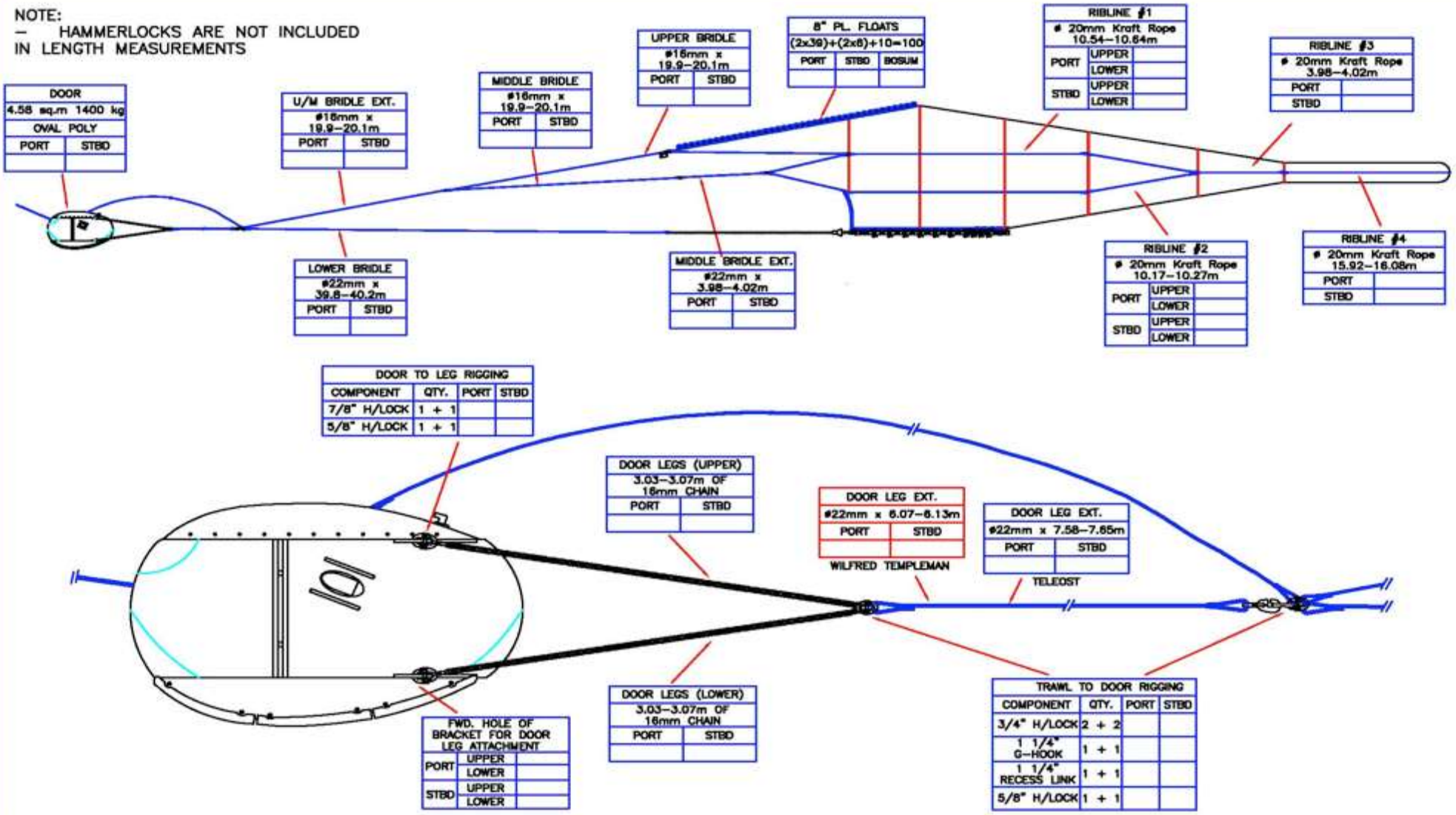
NOTE:
– HAMMERLOCKS ARE NOT INCLUDED IN LENGTH MEASUREMENTS



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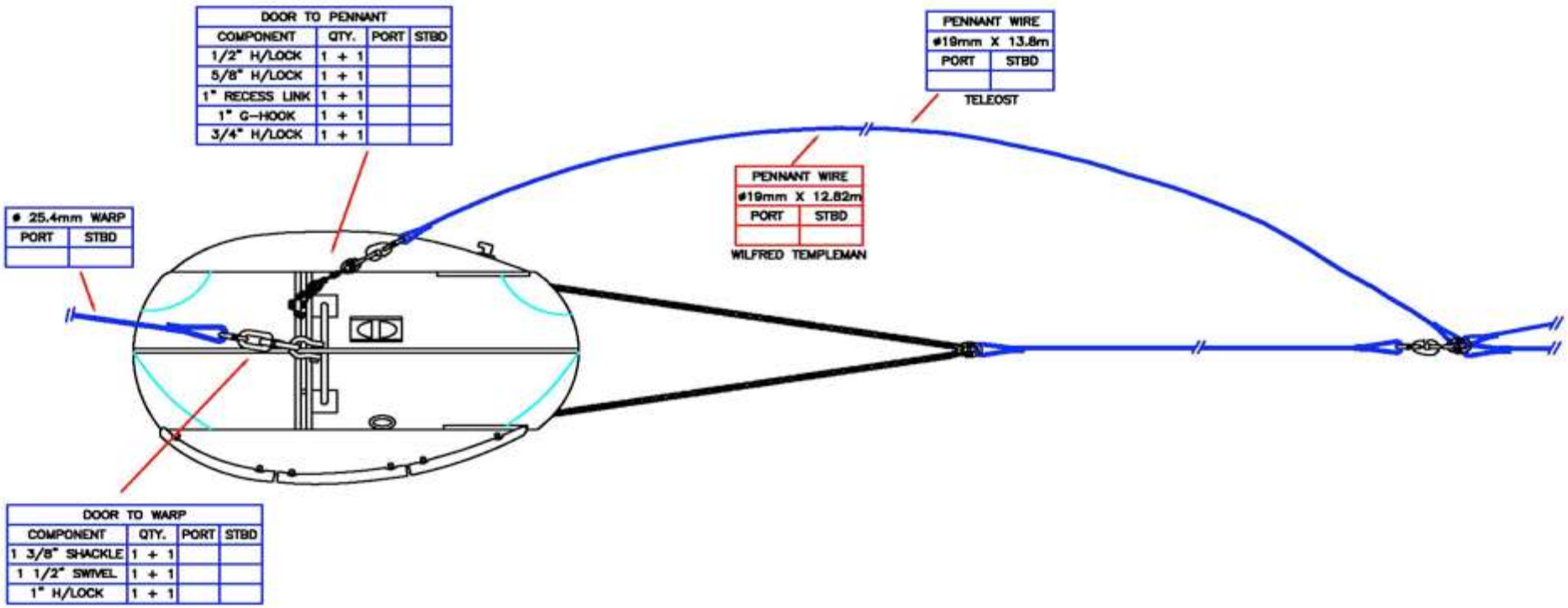
RIGGING CHECKLIST
CAMPELEN 1800 SURVEY TRAWL

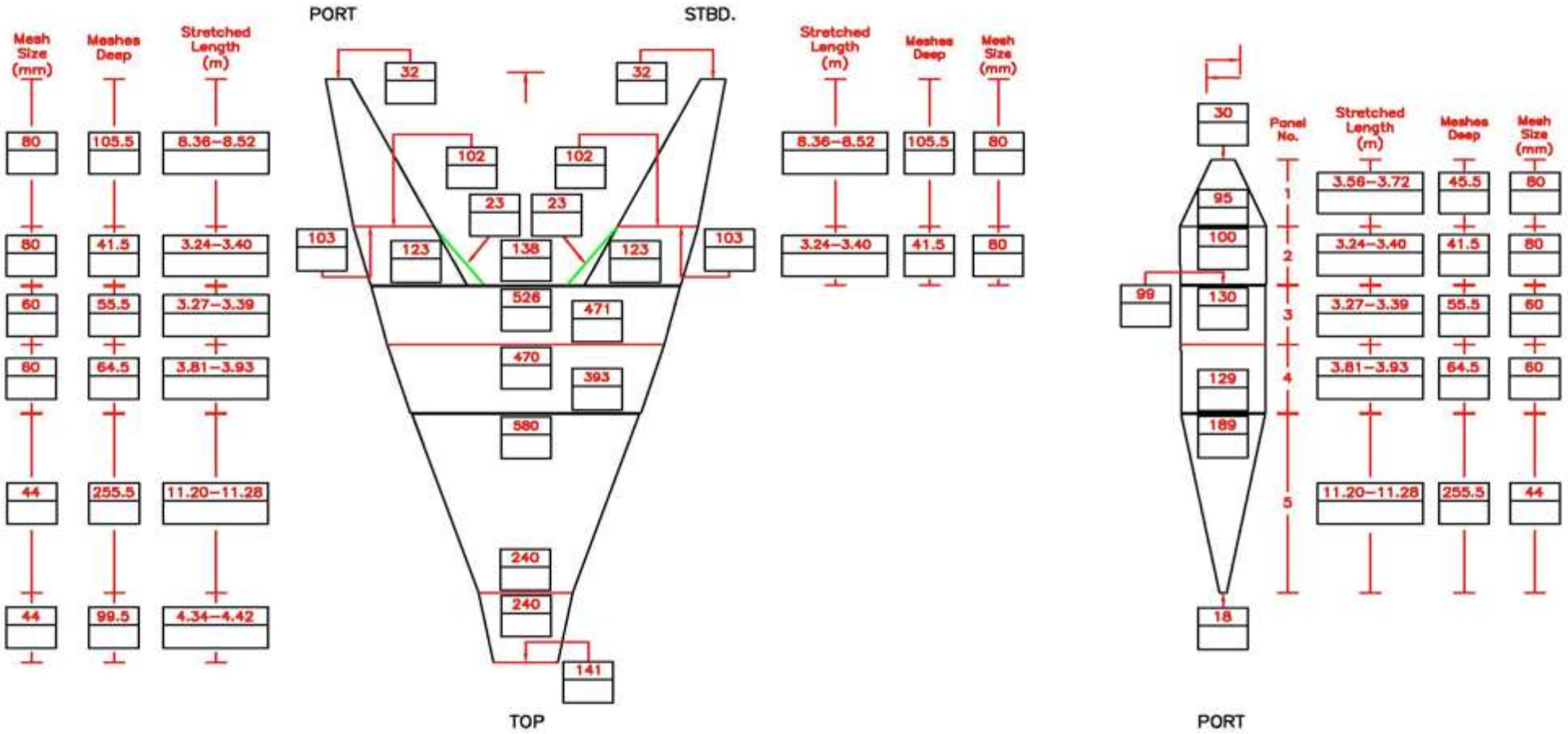
VESSEL: _____ TRAWL NO.: _____
CRUISE: _____ DATE: _____

PAGE: 1 OF 10
CHECKED BY: _____

NOTE:
– HAMMERLOCKS ARE NOT INCLUDED IN LENGTH MEASUREMENTS



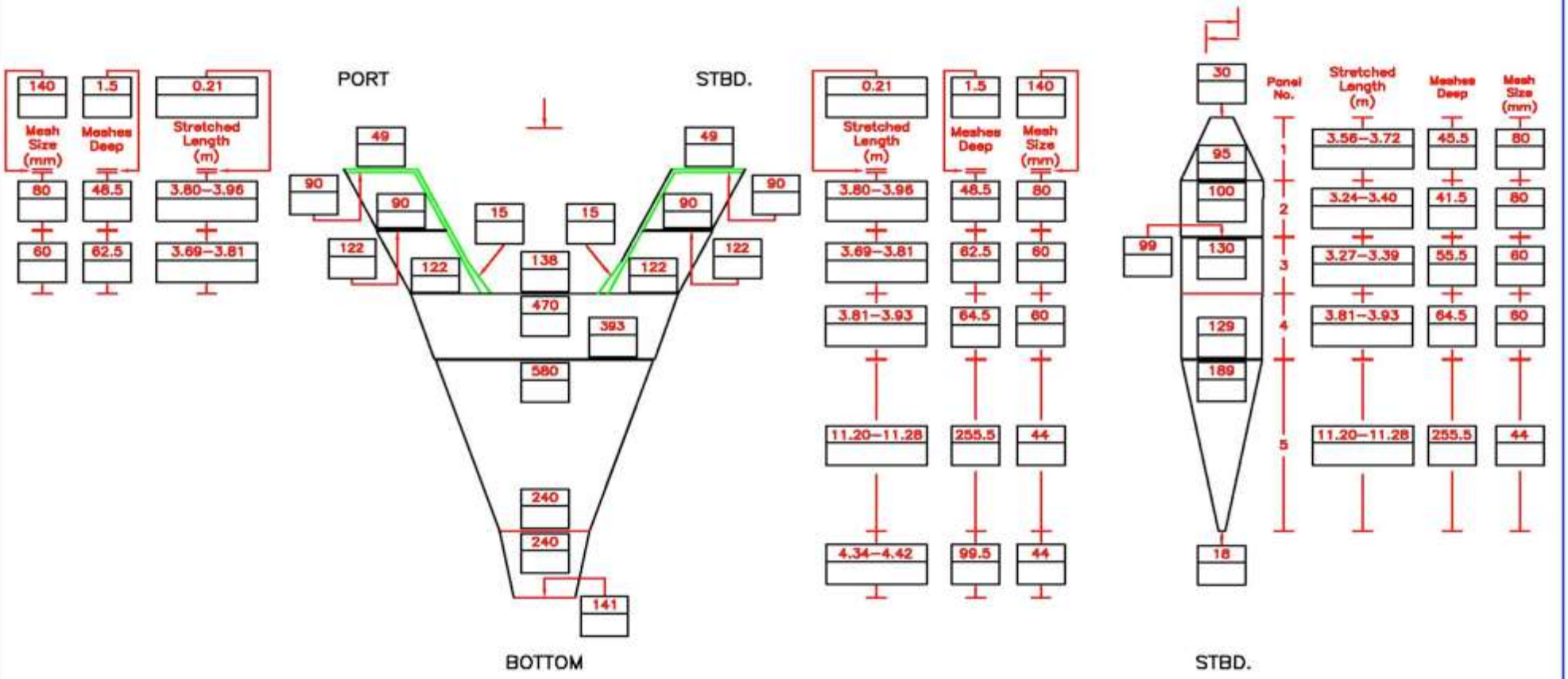
Fisheries and Oceans Canada / Pêches et Océans Canada	RIGGING CHECKLIST CAMPELEN 1800 SURVEY TRAWL	VESSEL: _____ TRAWL NO.: _____ CRUISE: _____ DATE: _____	PAGE: 2 OF 10 CHECKED BY: _____



NOTE:

– STRETCHED LENGTH MEASUREMENTS DO NOT INCLUDE JOINING ROUNDS

Fisheries and Oceans Canada / Pêches et Océans Canada	NET PLAN CHECKLIST CAMPELEN 1800 SURVEY TRAWL	VESSEL: _____ TRAWL NO.: _____ CRUISE: _____ DATE: _____
		PAGE: 3 OF 10 CHECKED BY: _____



NOTE:

– STRETCHED LENGTH MEASUREMENTS DO NOT INCLUDE JOINING ROUNDS

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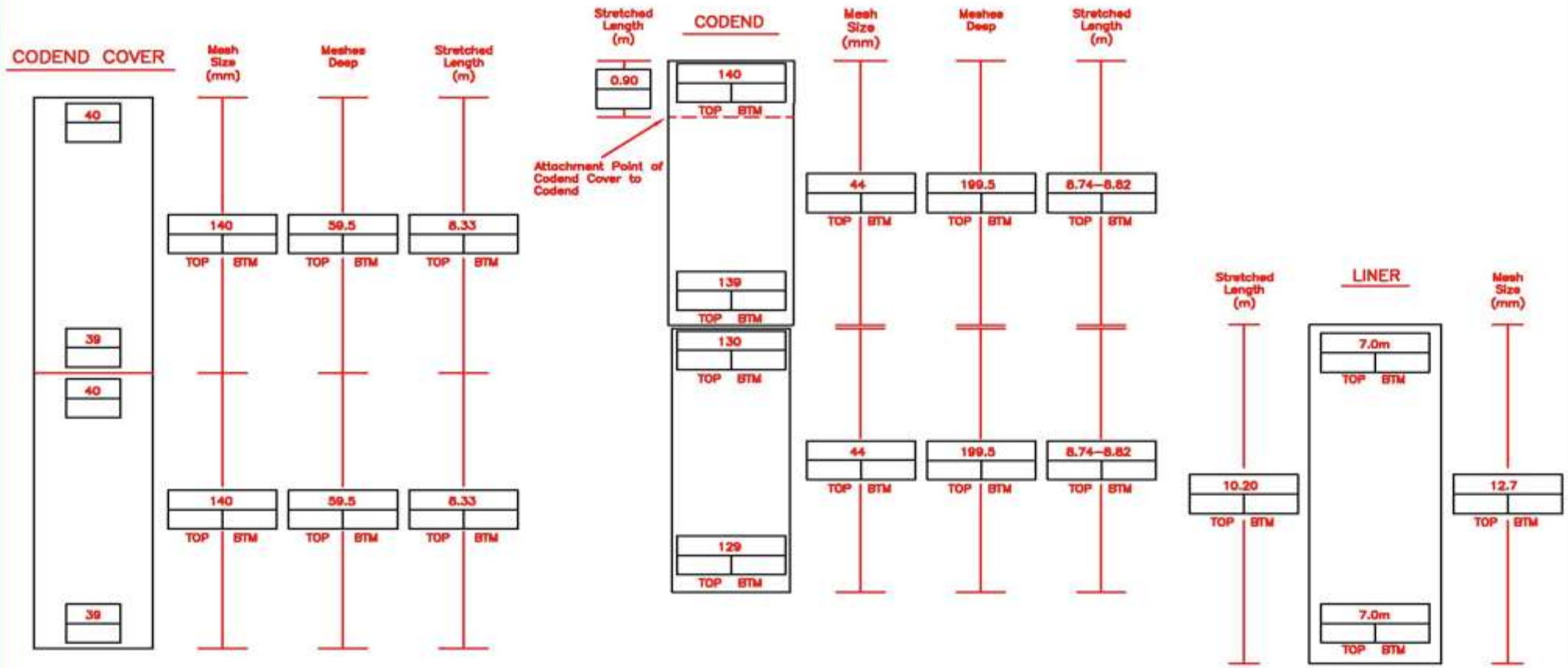
NET PLAN CHECKLIST
CAMPELEN 1800 SURVEY TRAWL

VESSEL: _____ TRAWL NO.: _____
CRUISE: _____ DATE: _____

PAGE: 4 OF 10
CHECKED BY: _____

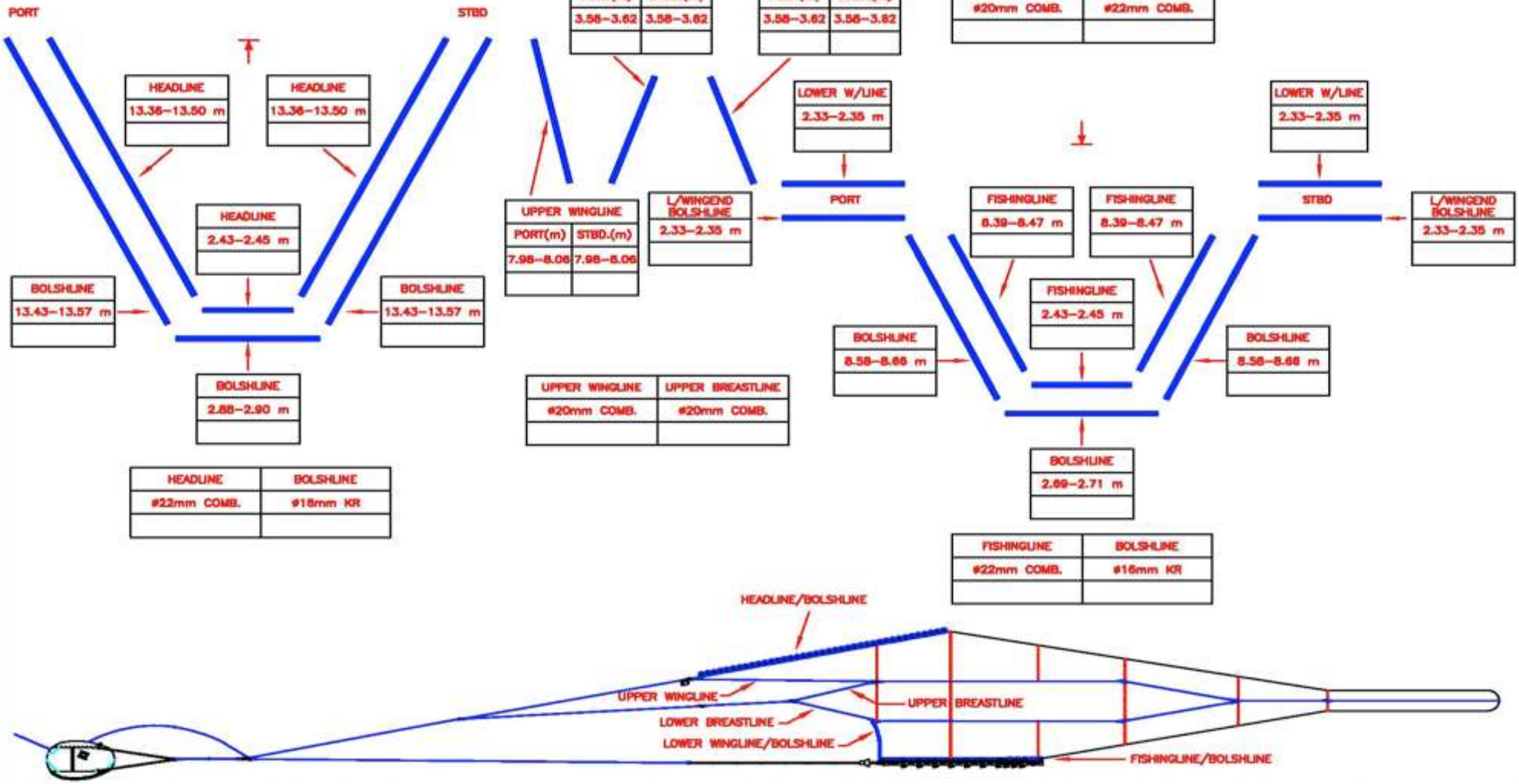
NOTE:

- TOP = TOP PANEL
- BTM = BOTTOM PANEL
- STRETCHED LENGTH DOES NOT INCLUDE JOINING ROUNDS



Fisheries and Oceans Canada / Pêches et Océans Canada	CODEND, CODEND COVER, CODEND LINER CHECKLIST CAMPELEN 1800 SURVEY TRAWL	VESSEL: _____ TRAWL NO.: _____ CRUISE: _____ DATE: _____	PAGE: 5 OF 10 CHECKED BY: _____

NOTE:
– HAMMERLOCKS ARE NOT INCLUDED IN LENGTH MEASUREMENTS



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FRAMEROPE CHECKLIST
CAMPELEN 1800 SURVEY TRAWL

VESSEL: _____ TRAWL NO.: _____
CRUISE: _____ DATE: _____

PAGE: 6 OF 10
CHECKED BY: _____

SECTION B – PORT QUARTER

TOTAL LENGTH (CHAIN + 1 H/LOCK)	
6.78–6.92m	

BOBBIN CHAIN	
10	

8" (200mm) IRON SPACER	
12	

7" (178mm) RUBBER SPACER	
15	

6" (152mm) WASHER	
2	

5/8" (16mm) HAMMERLOCK	
1	

5/8" (16mm) CHAIN	
6.68–6.81m	

1/2" (13mm) HAMMERLOCK	
2	

3/8" TRAVEL CHAIN	
6.75–6.90m	

14" (356mm) ROCKHOPPER DISK	
10	

SECTION C – BOSUM

5/8" (16mm) CHAIN TOTAL LENGTH (CHAIN ONLY, NO H/LOCKS)	
5.73–5.87m	

BOBBIN CHAIN	
15	

8" (200mm) IRON SPACER	
15	

7" (178mm) RUBBER SPACER	
2	

6" (152mm) WASHER	
2	

14" (356mm) ROCKHOPPER DISK	
14	

3/8" TRAVEL CHAIN	
5.80–5.95m	

SECTION B – STBD QUARTER

TOTAL LENGTH (CHAIN + 1 H/LOCK)	
6.78–6.92m	

BOBBIN CHAIN	
10	

8" (200mm) IRON SPACER	
12	

7" (178mm) RUBBER SPACER	
15	

6" (152mm) WASHER	
2	

5/8" (16mm) HAMMERLOCK	
1	

5/8" (16mm) CHAIN	
6.68–6.81m	

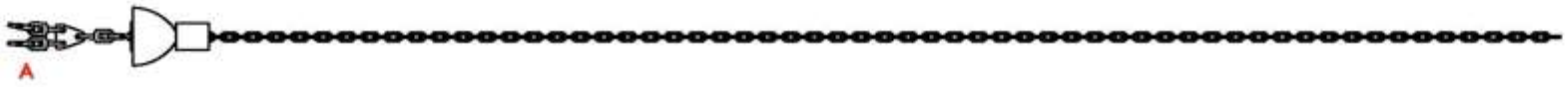
1/2" (13mm) HAMMERLOCK	
2	

3/8" TRAVEL CHAIN	
6.75–6.90m	

14" (356mm) ROCKHOPPER DISK	
10	

Fisheries and Oceans Canada / Pêches et Océans Canada	FOOTGEAR CHECKLIST CAMPELEN 1800 SURVEY TRAWL	VESSEL: _____ TRAWL NO.: _____ CRUISE: _____ DATE: _____	PAGE: 7 OF 10 CHECKED BY: _____

SECTION A –
PORT FLYING WING



TOTAL LENGTH (CHAIN + DELTA PLATE ASSEMBLY + 2 H/LOCK)	
7.97–8.11m	

DELTA PLATE ASSEMBLY	
0.43m	

5/8" (16mm) HAMMERLOCK	
3	

14" (356mm) RUBBER BUNT BOBBIN	
1	

7" (178mm) RUBBER SPACER	
1	

6" (152mm) WASHER	
1	

5/8" (16mm) CHAIN	
7.34–7.48m	

Note:

1) Total length measurements are from aft hammerlock (full) on delta plate to the end of the chain.

2) Should the total length be longer than the tolerance values then shorten the chain.

3) Should the total length be shorter than the tolerance values then replace the chain.

SECTION A –
STBD FLYING WING

TOTAL LENGTH (CHAIN + DELTA PLATE ASSEMBLY + 2 H/LOCK)	
7.97–8.11m	

DELTA PLATE ASSEMBLY	
0.43m	

5/8" (16mm) HAMMERLOCK	
3	

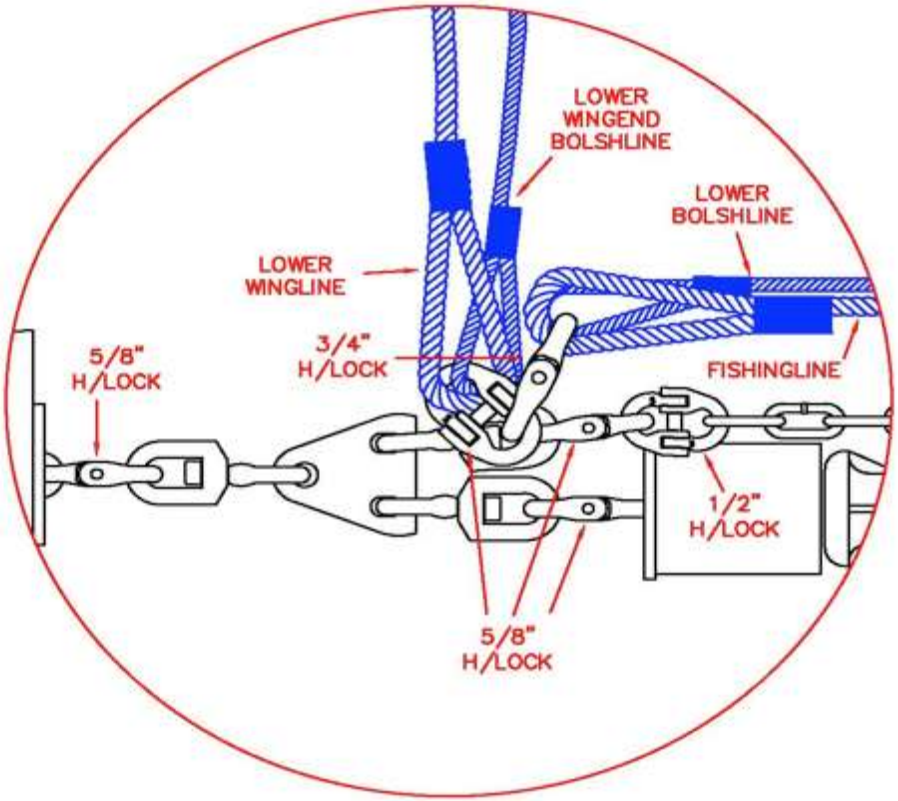
14" (356mm) RUBBER BUNT BOBBIN	
1	

7" (178mm) RUBBER SPACER	
1	

6" (152mm) WASHER	
1	

5/8" (16mm) CHAIN	
7.34–7.48m	

DELTA PLATE ASSEMBLY



IS THE DELTA PLATE HOOKUP CORRECT?
YES_____ NO_____

IF NO FIX IT.

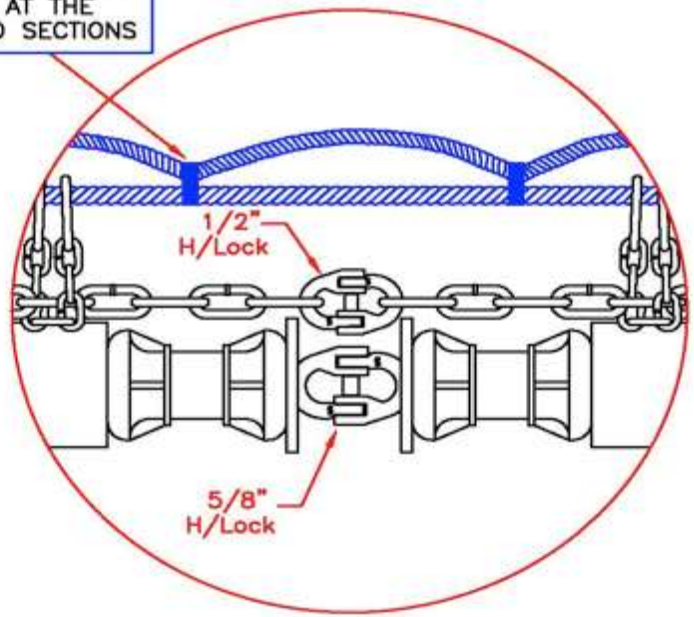
The delta plate has 3 hammerlocks, one for each swivel.

- The forward 5/8" hammerlock belonging to the delta plate is attached to the flying wing. The two aft 5/8" hammerlocks are attached to two different components of the footgear system.
- The lower 5/8 " hammerlock attaches the footgear centre chain to the lower delta plate swivel;
- The upper 5/8" hammerlock attaches the upper delta plate swivel to the 1/2" travel chain hammerlock.
- A 3/4" hammerlock is used to connect the lower bolshline and fishing lines to the upper delta plate swivel.
- The lower wingline and lower wingend bolshline are attached to the 3/4" hammerlock (not attached directly to the delta plate) by the means of a 5/8" hammerlock. Both eyes of the lower wingline and lower wingend bolshline are connected to one end of the 5/8" hammerlock while the other end is connected to the forward section of the 3/4" hammerlock.

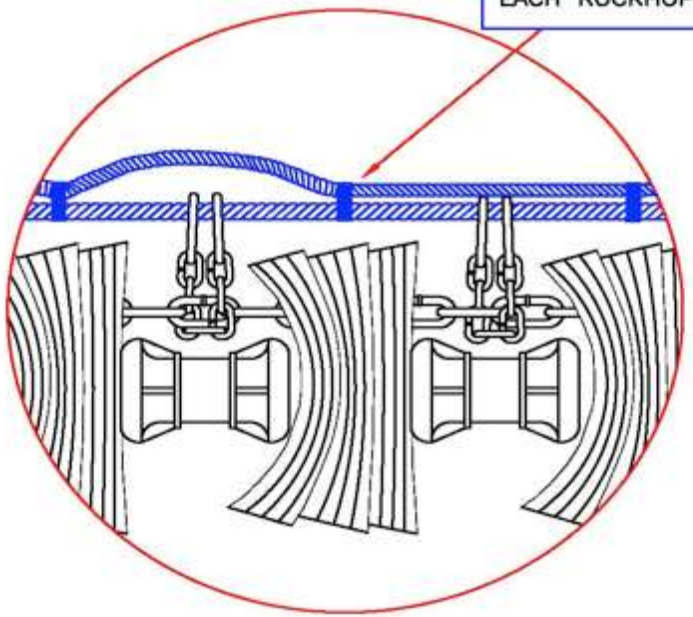
Fisheries and Oceans Canada / Pêches et Océans Canada	DELTA PLATE ASSEMBLY CHECKLIST CAMPELEN 1800 SURVEY TRAWL	VESSEL: _____ TRAWL NO.: _____ CRUISE: _____ DATE: _____	PAGE: 9 OF 10 CHECKED BY: _____

BOLSHLINE STOPS ON FISHING LINE
(FOOTROPE MUST BE UNDER TENSION)

STOPS MUST APPEAR OVER CENTRE OF EACH IRON SPACER AT THE JOINS OF TWO SECTIONS



STOPS MUST APPEAR OVER CENTRE OF EACH ROCKHOPPER



WERE ALL STOPS FOUND IN THE CORRECT POSITION? YES _____ NO _____

IF NO, HAVE THEM ATTACHED CORRECTLY WHEN THE FOOTROPE IS STRETCHED UNDER TENSION

Fisheries and Oceans Canada / Pêches et Océans Canada	BOLSHLINE STOPS ON FISHING LINE CAMPELEN 1800 SURVEY TRAWL	VESSEL: _____ TRAWL NO.: _____ CRUISE: _____ DATE: _____	PAGE: 10 OF 10 CHECKED BY: _____

APPENDIX 4

NAFC INSPECTION TEAM SUMMARY SHEET FOR MASTER CHECKLIST

Vessel:	**Trip No.**	**Date:**	**Net Number:**
Rigging Checklist	**Problems/Comments**		**FIXED**
Net Plan Checklist	**Problems/Comments**		**FIXED**

INSPECTION TEAM SUMMARY SHEET **Page 2/4**

Net Plan Checklist	**Problems/Comments**	**FIXED**
Framerope Checklist	**Problems/Comments**	**FIXED**

INSPECTION TEAM SUMMARY SHEET **Page 3/4**

Framerope Checklist	**Problems/Comments**	**FIXED**
Footgear Checklist	**Problems/Comments**	**FIXED**

INSPECTION TEAM SUMMARY SHEET **Page 4/4**

Footgear Checklist	**Problems/Comments**	**FIXED**

OTHER REMARKS

NAFC INSPECTORS
CHECKED BY: _____ DATE: _____

NET MAKER INSPECTORS
CHECKED BY: _____ DATE: _____

NAFC INSPECTORS
RE-CHECKED BY: _____ DATE: _____

APPENDIX 5

QUICK CHECKLIST - FOR BETWEEN SURVEY LEGS

Vessel:	**Trip No.**	**Date:**	**Net #:** **Footgear #:**

Rigging Checklist	**OK**	**Problems/Comments**	**FIXED**
Floats: Ensure each float is attached tight to the headline. Count floats (88) and make sure they are evenly spaced along the headline. Ensure the 6 floats are on wing ends for Scanmar wing canisters.			
Bridles: ***On deck-*** Check for worn or broken strands of wire and ensure the wires of eye splices are not flattened with broken wires. Replace those sections that are damaged.			
Riblines: Check for worn or broken strands of rope and check the lacing that is used to seize the ropes together, and to selvedge are not broken or frayed. Replace those sections that are damaged or heavily worn.			
Net Plan Checklist	**OK**	**Problems/Comments**	**FIXED**
Netting: Check condition for holes and tears in meshes, especially guard meshes and gussets, codend, codend cover and liner. Look for deformity, slipped knots and meshes made oversize or undersize by repairs or hookups during fishing. Repair or replace all torn or poorly repaired netting.			

Net Plan Checklist	**OK**	**Problems/Comments**	**FIXED**
Inspect the selvedges for wear and ensure there are no excess pockets of twine bunch up into the selvedge. Repair any damage.			
Framerope Checklist	**OK**	**Problems/Comments**	**FIXED**
Headline: Ensure centre of bolshline is attached to centre of headline. Check for worn or broken strands of wire and ensure the wires of eye splices are not flattened with broken wires. Replace those sections of the headline that are damaged or heavily worn.			
Bolshline*:* Ensure centre of square is attached to centre of bolshline. Check for worn or broken strands of rope and check the lacing that is used to seize the ropes together are not broken or frayed. Check upper and lower bolshline lengths, including the lower wingline/bolshlines. Replace those sections of the bolshline that are damaged or heavily worn			
Fishing line: Ensure centre of bolshline is attached to centre of fishing line. Check for worn or broken strands of wire and ensure the wires of eye splices are not flattened with broken wires. Replace those sections of the fishing line that are damaged or heavily worn.			

Framerope Checklist	**OK**	**Problems/Comments**	**FIXED**
Winglines & Breastlines: Check for worn or broken strands of wire and ensure the wires of eye splices are not flattened with broken wires. Replace those sections that are damaged or heavily worn.			
Footgear Checklist	**OK**	**Problems/Comments**	**FIXED**
Ensure the centre of fishing line is attached to centre of footgear travel chain and verify that only the fishing line, not to bolshline, runs through the rings of the bobbin chains.			
Check the disks to see if any are loose indicating the chain has probably stretched and the footgear section needs to be re-strung.			
Ensure the correct number and position of iron and rubber spacers matches the footgear plan (see page 7 Master Checklist (MC)).			
Ensure the correct number and position of bobbin chains matches the footgear plan (page 7, MC). Replace any chains that are stretched, distorted and have broken or split rings			
Check delta plate assembly for improper alignment and attachment of shackles and hammerlocks (see page 9, MC). The wrong length of shackles or swivels would change the overall length of the fishing line.			

Footgear Checklist	**OK**	**Problems/Comments**	**FIXED**
Ensure the stops (lacing) on the footgear are evenly spaced and tight. All stops connecting the bolshline and the fishing line should be located over the centre of each rockhopper disc except where two footgear sections join and they are centered over the iron spacer at the end of each section (see page 10). Replace those that are loose, broken or out of alignment.			
OTHER REMARKS			

NAFC INSPECTORS
CHECKED BY: _____ DATE: _____

CCG INSPECTORS
CHECKED BY: _____ DATE _____

CHAPTER 9

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