



CATALINA 400

**OWNER'S
MANUAL**

FOREWARD

Congratulations on the acquisition of your new Catalina 400. All Catalina yachts are designed and built with care using quality materials to ensure that you have years of sailing enjoyment with a minimum of upkeep and maintenance.

Before attempting maintenance or operation of your Catalina 400, please read the catalina Yachts Limited Warranty booklet and fill out the enclosed warranty registration card.

The registration card enables Catalina to inform you of developments and modifications to enhance the performance or comfort of your yacht. It is also important to be able to contact owners to comply with Coast Guard notification requirements.

The launching and rigging of the Catalina 400 should be handled by experienced boat yard personnel under the direction of your authorized dealer. After the boat is launched, the dealer will complete the last stages of rigging and mast tuning.

The index page lists the contents of this manual. Warranties and information regarding installed optional equipment have been included when available and applicable.

Maintaining your yacht properly can become a satisfying part of your sailing activities. A regular inspection is the best preventive maintenance. It will help keep your boat safe and in good condition while in use, and ensure peace of mind when the boat is left unattended.

Take good care of your boat and take the time to learn and practice good seamanship.

PREFACE

This manual is intended and supplied to help owners of Catalina 400's understand their boats and answer common questions about maintenance and systems design specific to the Catalina 400.

This manual is not intended to provide sailing instructions. It is recommended that the operator consult books written for that purpose, or take sailing lessons or courses to gain the knowledge necessary for the safe operation of the vessel.

The systems descriptions and illustrations in this manual apply to boats built at the time of publication. Our policy of constant improvement necessitates that changes have been made to the Catalina 400 since its introduction. Therefore, these illustrations and descriptions may not apply to boats built before the time of publication.

Owners of earlier hulls, who have questions not answered herein should consult their local Catalina dealers, or write to Catalina Yachts. Please include your hull number in all correspondence.

The maintenance check lists contained within this manual are intended as guidelines for boats in private service under typical conditions.

Climate and use will vary and may require additional or special maintenance. Consult with your local boat yard or Catalina dealer for specific maintenance and precautions recommended for your purposes and climate.

Caution: The aluminum and other metal parts conduct electricity. Coming in contact with or near an electrical power line or lightning can cause severe injury or death. Stay away from overhead electrical power lines when sailing and/or launching the boat.

TABLE OF CONTENTS

1.0	<u>INTRODUCTION</u>		
1.1	Catalina 400 Specifications		5
1.2	Equipment Log		6
2.0	<u>COMMISSIONING CHECK LIST</u>		
2.1	Pre-Launch Procedure Check List		7
2.2	In the Water Check List		
	2.2.1	Electrical	7
	2.2.2	Plumbing	7
	2.2.3	Rigging and Hardware	8
	2.2.4	Engine	8
2.3	Operation Check List		8
	2.3.1	Final Check	8
3.0	<u>YACHT SYSTEMS, DESCRIPTIONS AND ILLUSTRATIONS</u>		
3.1	Rigging		
	3.1.1	Stepping the Mast	9
	3.1.2	Tuning the Mast	9
	3.1.3	Rigging Lengths	10
	3.1.4	Sail Plan	11
	3.1.5	Spreader Assembly	12
	3.1.6	Spreader Pin Install. Tech.	13
	3.1.7	Deck Tie-Down Installation	14
	3.1.8	Shroud Arrangement	15
	3.1.9	Main Sail Reefing	16
	3.1.10	Reefing Schematic	17
	3.1.11	Mainsheet/Traveler Assembly	18
	3.1.12	Halyard Arrangement	19
	3.1.13	Rigid Vang Schematic	20
	3.1.14	Genoa Sheet Leads	21
3.2	Electrical		
	3.2.1	Batteries	22
	3.2.2	Main Battery Switch	24
	3.2.3	Battery Schematic	25
	3.2.4	Battery Schematic w/Optional Starting Battery	26
	3.2.5	12 V.D.C. Panel Schematic	27
	3.2.6	12 V.D.C. Wiring Schematic	28
	3.2.7	12 V.D.C. Lighting Plan	29
	3.2.8	120 Volt System	30
	3.2.9	120 V.A.C. Panel Schematic	31
	3.2.10	120 V.A.C. Schematic without Inverter	32
	3.2.11	120 V.A.C. Schematic with Inverter	33
3.3	Plumbing		
	3.3.1	Pressure Water System Schematic	34
	3.3.2	Manual Bilge Pump	35
	3.3.3	Seacocks	36
	3.3.4	Through Hull Seacock Locations	36
	3.3.5	Marine Toilet Operation	37
	3.3.6	Macerator Pump and Trouble Shooting Guide	38
	3.3.7	Holding Tank and Macerator Schematic	39
3.4	Auxiliary Power		
	3.4.1	General Engine Information	40
	3.4.2	Packing Gland Assembly	41
	3.4.3	Shaft Packing Gland (Stuffing Box)	42
	3.4.4	Shaft Alignment	42
	3.4.5	Shaft Alignment Illustration	44
	3.4.6	Fueling	45
	3.4.7	Fuel Sanitation	46
	3.4.8	Fuel System Illustration	47
	3.4.9	Exhaust System Maintenance	48
	3.4.10	Engine Exhaust System Illustration	50
	3.4.11	Engine Panel and Harness Schematic	51

3.5	Steering	
3.5.1	Emergency Tiller	52
3.5.2	Steering System Diagram	53
3.6	<u>Accommodation</u>	
3.6.1	General Layout	54
3.6.2	Galley Stove	55
4.0	<u>MAINTENANCE GUIDE</u>	
4.1	Pre-Use Maintenance	57
4.2	Monthly Maintenance	57
4.3	Seasonal Maintenance	57
4.4	Fiberglass Maintenance and Repair	58
4.4.1	Fiberglass Touch up and Repair	59
4.5	Bottom Paint Preparation	61
4.6	Interior Teak Maintenance	61
4.7	Spar and Rigging Maintenance	62
4.8	Sail Maintenance	63
4.9.1	Interior Cushion, Fabric Cover	64
4.9.2	Pleated Shades	65
5.0	<u>DECOMMISSIONING</u>	
5.1	Lifting and Cradling	66
5.2	Winterizing Your Engine	67
6.0	<u>OWNER-USER RESPONSIBILITY</u>	
6.1	General Safety Tips	70
6.2	Required Safety Equipment	70
6.3	Suggested Safety Equipment	71
6.4	Safety Package Factory Option	71
6.5	Anchors, Anchoring and Mooring	72
6.6	Lightning Precautions	72
6.7	ABYC Lightning Protection Reprint	74
6.8	Labels	81
6.9	Sample Waste Management Plan which is required by the Marpol V Treaty	84
6.10	Pedestal Steering Maintenance	85
6.11	Night Vision, Lighting Reprint	86

CATALINA 400 SPECIFICATIONS

L.O.A. 40'6"
L.W.L. 36'6"
BEAM 13'6"

WING KEEL

Draft 5'6"
Ballast 8,000 Lbs.
Designed Weight 18,800 Lbs.
Disp./Length 200
Sail Area/Displacement 18.3

FIN KEEL

Draft 7'0"
Ballast 7,200 Lbs.
Designed Weight 18,000 Lbs.
Disp./Length 191
Sail Area/Displacement 18.8

SAIL AREA

Sail Area, Rated Total . . 808 Sq. Ft.
Mainsail, Rated 400 Sq. Ft.
100% Foretriangle, Rated . 408 Sq. Ft.

I 52'8"
J 15'6"
P 47'0"
E 17'0"

THEORETICAL HULL SPEED, KNOTS . . . 8.1

L.P.G.

(1) 10 Lbs. Aluminum Tank
With Solenoid

WATER TANK CAPACITY

(1) Aft @ 32
(1) Forward @ 55
(1) Water Heater @ 11
Total U.S. Gal. 98

PRIMARY WINCHES

Lewmar 58 . . . Chrome Brz, Self-Tailing

HALYARD WINCHES

Lewmar 40 . . . Chrome Brz, Self-Tailing

ICE BOX

Approx. (1) 6.0 Cu. Ft.
. (1) 3.5 Cu. Ft.

HOLDING TANK CAPACITY

(1) Forward @ 18 U.S. Gal.
(1) Aft @ 18 U.S. Gal.

FUEL TANK CAPACITY . . . 44 U.S. Gal.

ESTIMATED CONSUMPTION AT

2500 R.P.M. 1.8 G.P.H.

DISTANCE FROM WATERLINE

TO MASTHEAD 58'0"

HEADROOM

Main Cabin 6'11" Max.

STANDARD ENGINE

Westerbeke 42B
42 HP Diesel F.W. Cooled
4 Cylinder . . . Reduction Gear 2.63:1

PROPELLER

18x10 On 1.25" Dia. Shaft . 3 Blade RH

RIGGING

Double Spreaders In-Line
Intermediate
Shrouds 1/4" Dia. 1x19 Wire
Forestay & Upper
Shrouds 3/8" Dia. 1x19 Wire
Backstay, Fore & Aft
Lower Shrouds . . . 5/16" Dia. 1x19 Wire
Rope Halyards . . . Low Stretch, Led Aft
Boom Vang Spring Loaded Solid

rev. 6/6/96

EQUIPMENT LOG

1. Pedestal Steering
2. Headsail Roller Furling
3. Pressure Water Pump
4. Marine Toilet
5. Compass
6. Batteries
7. Winch Manuals
8. Engine Manual
9. Knot Meter and Log
10. Galley Stove and Oven
11. Fuel Filters
12. Bilge Pump
13. Galley Foot Pump
14. Running Lights
15. Anchor Windlass
16. Engine Tachometer Calibration Instructions
17. Anti-Fouling Bottom Paint
18. Gel Coat
19. Mainsail Flaking System
20. A.C./D.C. Power Inverter
21. Navigation and Communication Electronics
22. Stereo and Entertainment Electronics

NOTE: Some manufacturers enclosures may not be included with all manuals, depending upon optional equipment selection.

2.0 COMMISSIONING CHECK LIST

2.1 PRE-LAUNCH CHECK:

1. _____ Shaft turns freely by hand, zinc collar installed if required.
2. _____ Check intake hoses and clamps.
3. _____ Check all through-hull fittings.
4. _____ _____ engine, muffler and exhaust line OK.
5. _____ Bottom clean, paint OK.
6. _____ Hull sides clean, gel coat OK.
7. _____ Decks clean, gel coat OK.
8. _____ Teak cleaned and oiled.
9. _____ Interior finished, oiled, clean.
10. _____ Cushions, carpeting, curtains, clean and in place.
11. _____ Table converts to berth OK, dinette, traditional table stows OK.
12. _____ Hatch lids present and fit OK.
13. _____ Lifelines and pulpits rigged and OK.
14. _____ Spreaders taped and drilled at base end, upper shroud wired to tip end and taped or boots installed.
15. _____ Standing rigging pinned to mast.
16. _____ Rigging lengths verified with check list in kit.
17. _____ Mast and boom inspected; cotter pins, sheaves, tangs, spreaders OK.
18. _____ Mast lights checked before mast stepped.
19. _____ Check over head for electrical wires which may interfere with the space required to raise the mast to its full upright position. If there are wires of any kind, anywhere near the boat, DO NOT RAISE THE MAST. Move boat to another location away from any wires. Contact with wires can be fatal.
20. _____ Masthead sheaves lubricated and rotate freely.

2.2 IN WATER CHECK:

2.2.1 ELECTRICAL:

1. _____ Electrical equipment operational:
_____ Running _____ Cabin _____ Bow _____ Anchor
_____ Spreaders _____ Pressure Water
_____ Refrigeration
_____ Macerator Pump _____ Master
2. _____ Shore power outlet OK.
3. _____ Check battery switch #1 _____ #2 _____ OK.
4. _____ Check battery fluid level.
5. _____ Check battery terminals for tightness.
6. _____ Check battery tie-down straps.

2.2.2 PLUMBING:

1. _____ No leaks at through hull fittings with seacocks open.
2. _____ Fill all water tanks.
3. _____ Check all water tanks at fittings, and vent for leaks.
4. _____ Test all faucets and foot pumps for leaks.
5. _____ Check for leaks at sink drain fittings, sink drains OK.
6. _____ Put water in ice box and check for proper drainage.
7. _____ Check bilge pump operation, handle present.
8. _____ Check head by flushing and pumping.
9. _____ Check shower sump drain line.
10. _____ Check holding tank, pump vent and fitting.
11. _____ Check head and pump handle for leaks.
12. _____ Main hatch no leaks, slides freely, hatch boards fit OK.
13. _____ Cabin windows hose tested for leaks.
14. _____ Anchor locker drains OK, no leaks at bow lights.
15. _____ Stove operates OK: Check tank, fuel line, burner and oven.

2.0 COMMISSIONING CHECK LIST - (Continued)

2.2.3 RIGGING AND HARDWARE:

1. _____ Mast stepped.
2. _____ Pin, tape and tune standing rigging.
3. _____ Backstay adjuster, whisker pole, spinnaker gear, boom vang, OK.
4. _____ Blocks, cars, cleats rigged OK.
5. _____ Test all winches, winch handles present.

2.2.4 ENGINE:

1. _____ No leaks: shaft, rudder, stuffing box, or shaft log.
2. _____ Propeller shaft coupling bolts lockwired and coupling is secured.
3. _____ With fuel tanks full, no leaks at fill pipes, overflow vent, or any fuel line connections.
4. _____ With coupling disconnected, engine and shaft alignment OK -- Recheck alignment after rigging tuned.
5. _____ Transmission oil level OK.
6. _____ Crank case oil level OK.
7. _____ Fuel valves open, bleed and prime lines for diesel engine.
8. _____ Check that shaft is coupled and aligned to .003" maximum tolerance.
9. _____ Engine wiring OK, connections tight.
10. _____ Throttle control cable travel and brackets OK.
11. _____ Clutch control cable travel and brackets OK.
12. _____ Start engine.
13. _____ Exhaust water flow OK.
14. _____ No leaks in fuel lines at fittings, fuel filter, fuel pump or injectors.
15. _____ No engine or oil leaks.
16. _____ Idling speed set _____ R.P.M.'s.
17. _____ Shutoff cable for diesel engine OK.
18. _____ Check forward and reverse shifting lever friction OK.
19. _____ Check engine instruments for operation, tachometer for calibration.
20. _____ Run in gear for ten (10) minutes minimum.
21. _____ Recheck packing gland after engine stops for proper lubrication.
22. _____ Bilge blower and vent system OK.
23. _____ Exhaust system, check for leaks, insulation in place.

2.3 OPERATION CHECK LIST:

1. _____ Emergency tiller trial fitted and operational.
2. _____ Pedestal steering operation OK, Compass OK.
3. _____ Sails and halyards OK.
4. _____ Boat performance under power and sail OK.

2.3.1 FINAL CHECK:

1. _____ All accessory equipment operates OK.
2. _____ All boat, engine, and accessory literature, and/or manuals aboard.
3. _____ Warranty cards completed and mailed, owner registration card attached, owner informed of warranty responsibilities.
4. _____ Engine warranty card completed and mailed.

3.0 YACHT SYSTEMS

3.1 RIGGING:

3.1.1 STEPPING THE MAST:

1. Before stepping the mast check all standing rigging lengths against the checklist on Page 10.
2. Check all mast light wiring, be sure the masthead anchor light, steaming light and deck light function. The wires exiting at the base of the spar should be taped up to prevent damage when the spar is set on the step.
3. Prepare to step the mast in the following sequence:
 - a) Check all rigging lengths and inspect all end fittings.
 - b) Attach all shrouds, forestay and backstay. Tape clevis pins and spreader tips, check all halyards and secure to mast.
 - c) Check mast wiring and mast light wiring at mast step.
 - d) Before mast contacts maststep casting make electrical connections at base of mast for mast lights and check circuits.
 - e) Tune rigging at dock and when under sail.

3.1.2 TUNING THE MAST:

Your mast is held aloft by the standing rigging (forestay, backstay, upper, intermediate, fore and aft, lower shrouds). The term "tuning" refers to adjustment of the standing rigging so that the mast remains "in column" (not bent) when under load. This is accomplished by following the procedure outlined below.

AT THE DOCK:

The goals of tuning the mast are:

1. Mast is in the center of the boat and strait athwartships.
2. Leeward shrouds loosen slightly as the boat heels 15 deg+.
3. Balanced helm or slight weather helm.

Center the mast.

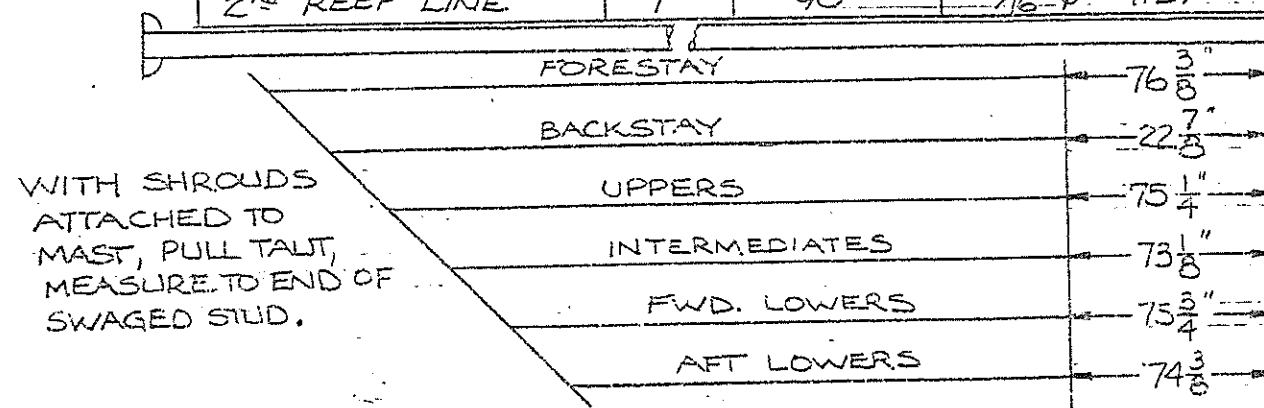
Until the mast is strait do not use wrenches on the turnbuckles, hand tightened is fine.

Check that the mast is in the center of the boat.

Pull a tape measure up to the masthead with the center forward halyard or a jib halyard. Measure the distance from the masthead to a reference point on the shear of the boat directly abeam of the mast. Check the other side and then adjust the upper shroud turnbuckles to get the measurements even, port and starboard, then remeasure.

— RUNNING RIGGING —				
ITEM	QTY.	LENGTH	MATERIAL	NOTES
SPINNAKER SHEETS	2	80'	1/2" ϕ Y.B.	LGE. SNAP SHACKLE W/SPINN. OPTION
BOOM VANG	1	45'	3/8" ϕ Y.B.	W/ FORESPAR VANG
MAINSHEET	1	100'	1/2" ϕ Y.B.	
GENOA SHEETS	2	50'	1/2" ϕ Y.B.	
MAIN HALYARD	1	125'	1/2" ϕ ULS Y.B.	BLUE TRACER; HEADBD. SHACKLE
GENOA HALYARD	2	125'	1/2" ϕ ULS Y.B.	1 W/ RED TRACER, 1 GRN. TRACER, LGE. SNAP SHACKLE
TRAVELER	2	33'	5/16" ϕ Y.B.	
BOOM TOP. LIFT	1	125'	3/8" ϕ Y.B.	
SPINNAKER HALYARD	1	130'	1/2" ϕ ULS Y.B.	BLUE TRACER; LGE. SNAP SHACK - OPTION
1 st REEF LINE	1	60'	7/16" ϕ Y.B.	W/ STD. MAST
2 nd REEF LINE	1	90'	7/16" ϕ Y.B.	OPTIONAL

NO.	REVISIONS	DATE
1	+1 1/2" F.L., A.L.	9-13-95
2	STAND. RIG. LENGTHS REVISED	12-11-95
3	REEF LINES ADDED	12-13-95
4	TURNBUCKLE ELIMINATED FROM STANDING RIGGING LENGTH	11-19-96

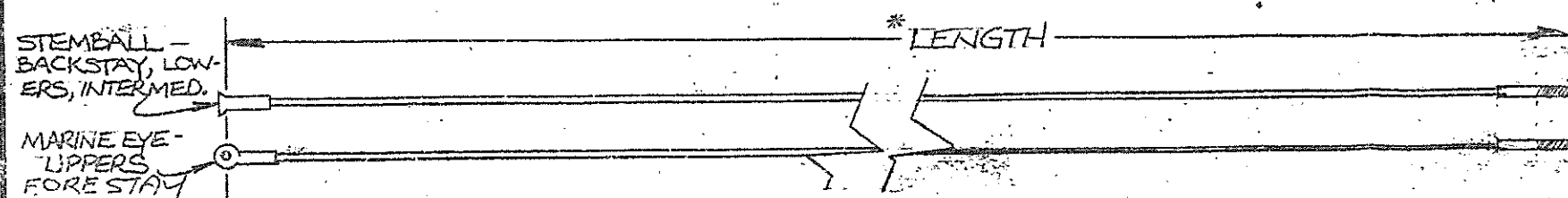


NOTES

- 1) FORESTAY IS FOR SCH. 3000 ROLLER FURLING EQUIPMENT.
- 2) STANDING RIGGING LENGTHS ARE FINISHED LENGTHS WITH SWAGED FITTINGS, AS ILLUSTRATED.
- 3) RIGGING FOR Z-SPAR 700/700E SECTION ONLY.
- 4) TOLERANCE $\pm 1/2"$

STANDING RIGGING

DESCRIPTION	QTY.	*LENGTHS	MATERIAL	TOP FITTING	BOTTOM FITTING
FORESTAY	1	52' 2 3/8"	3/8" - 1x19 S.S.	5/8" MAR. EYE	5/8" X 18" STUD
BACKSTAY	2	37' 1/2"	5/16" - 1x19 S.S.	STEMBALL w/cup	5/8" X 18" STUD
UPPERS	2	52' 11 1/2"	3/8" - 1x19 S.S.	MAR. EYE - 5/8" PIN	5/8" X 18" STUD
INTERMED.	2	37' 5 3/8"	1/4" - 1x19 S.S.	STEMBALL w/cup	1/2" X 20" STUD
FWD. LOWERS	2	20' 7 3/4"	5/16" - 1x19 S.S.	STEMBALL w/cup	5/8" X 18" STUD
AFT LOWERS	2	20' 9 1/8"	5/16" - 1x19 S.S.	STEMBALL w/cup	5/8" X 18" STUD



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7200 Bryan Dairy Road
Largo, Florida

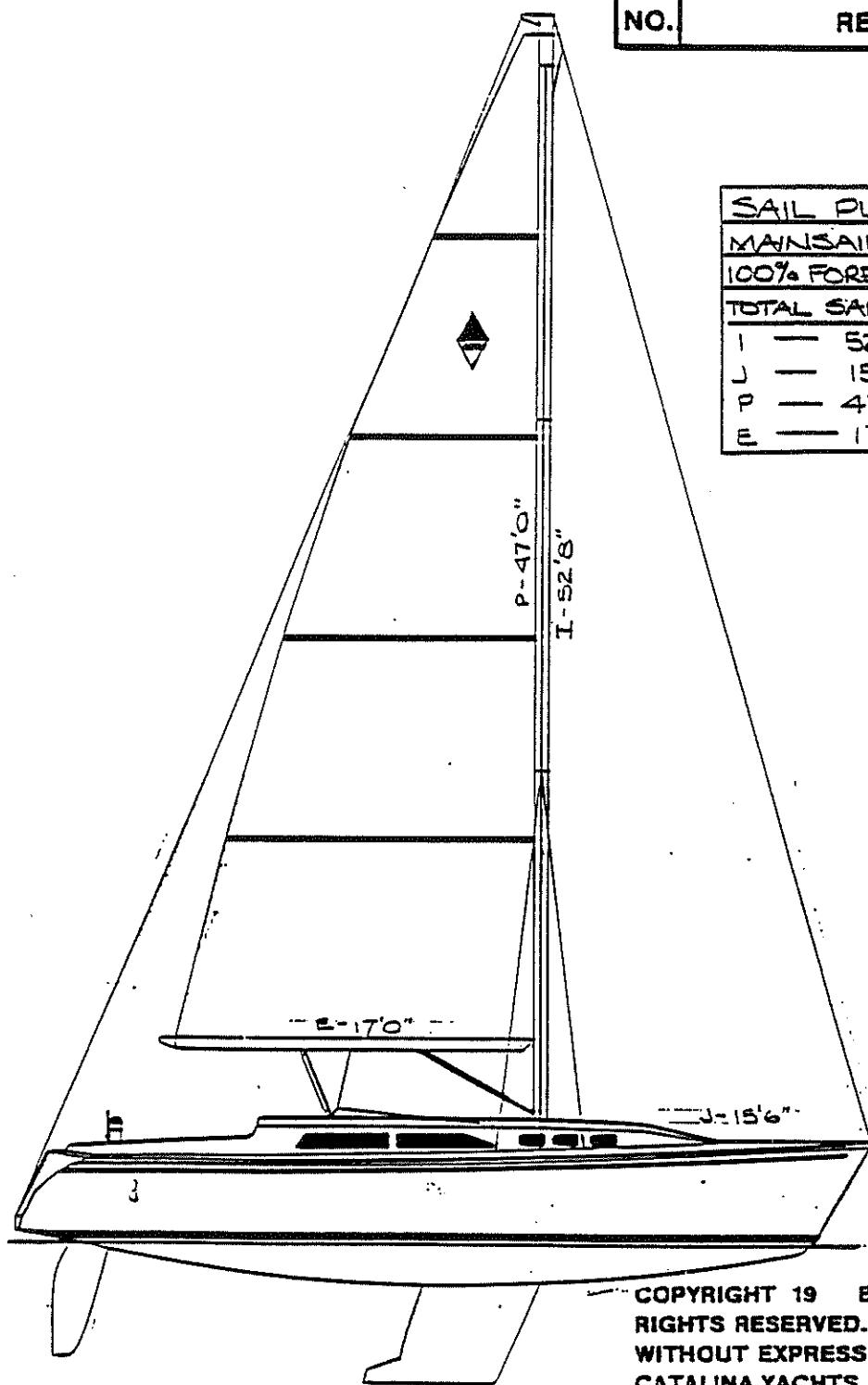
CATALINA 400
RIGGING LENGTHS

DESIGNED BY	DATE	DRAWING NO.
DRAWN BY ES	5-26-95	400-34004-2
CHECKED BY	SCALE	
APPROVED BY		

NO.

REVISION

DATE



SAIL PLAN DIMENSIONS

MAINSAIL 400 FT² 37.16 m²100% FORE Δ 408 FT² 37.90 m²TOTAL SAIL AREA 808 FT² 75.07 m²I — 52'8" — 16.05 m²J — 15'6" — 4.72 m²P — 47'0" — 14.33 m²E — 17'0" — 5.18 m²

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 **MURRAY
YACHT
SALES**

CATALINA YACHTS/MORGAN DIVISION

7200 Bryan Dairy Road
Largo, Florida

CATALINA 400

SAIL PLAN

DESIGNED BY

DATE

DRAWING NO.

DRAWN BY

8-8-94

CHECKED BY

SCALE

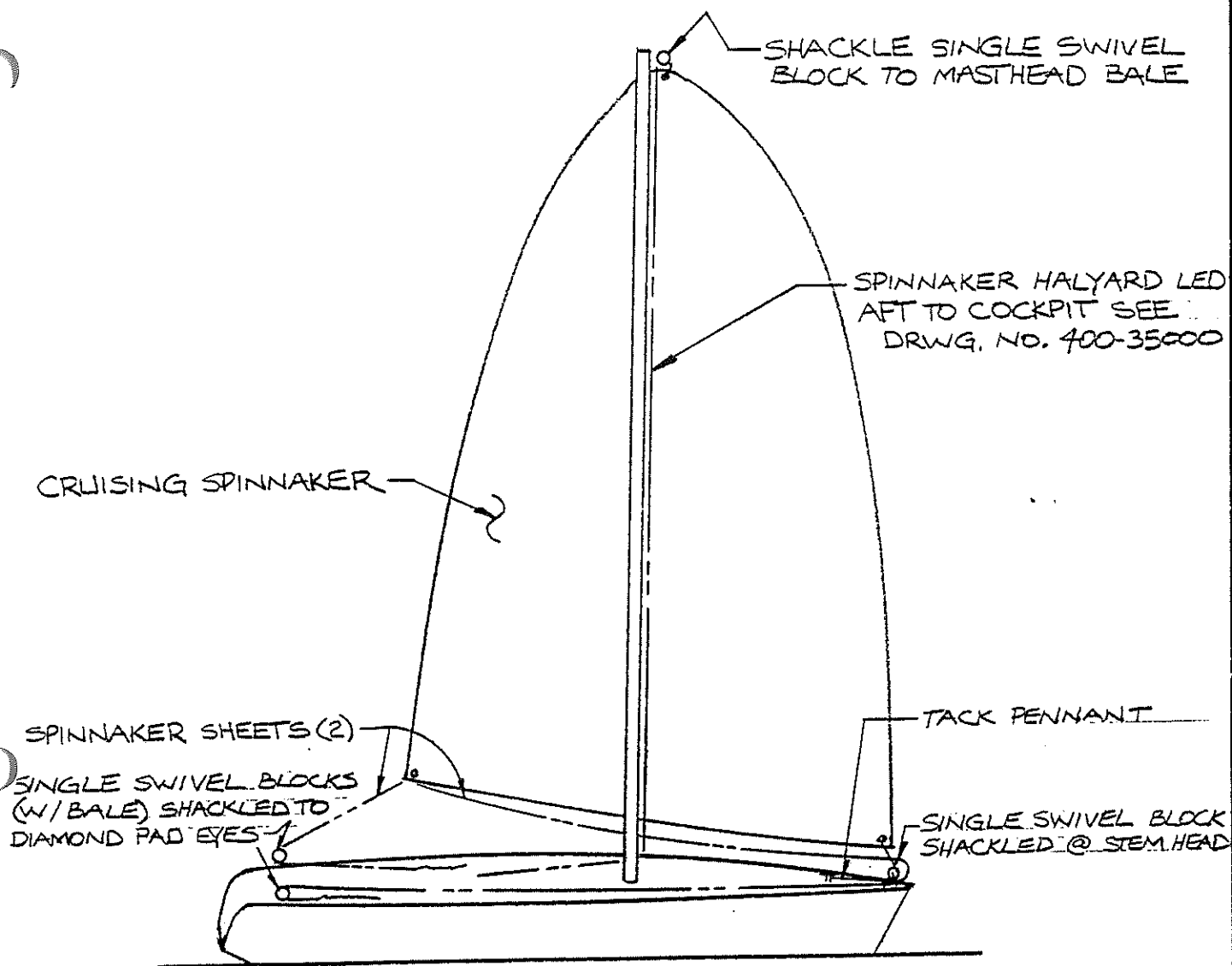
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1/8" = 1'0"

NO.

REVISION

DATE

NOTES

- 1) LEAD SPINNAKER TACK PENNANT THRU SINGLE SWIVEL BLOCK AND AFT TO MOORING CLEAT ON FORE DECK
- 2) SHOCK CORD AFT SWIVEL BLOCKS TO LIFE LINES.
- 3) BLOCKS ARE GARHAUER SERIES 60

DESCRIPTIONQTY / SIZE

SPINN. HALYARD $\frac{1}{2}$ " x 130' Y.B.
 TACK PENNANT $\frac{1}{2}$ " x 20' Y.B.
 SHOCK CORD $\frac{1}{4}$ " x 48"
 BLOCKS :

SINGLE SWIVEL W/BALE 2
 SINGLE SWIVEL 2
 SPINN. SHEETS 2- $\frac{1}{2}$ " x 80' Y.B.

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7200 Bryan Dairy Road
 Largo, Florida

CATALINA 400
SPINNAKER OPTION RIGGING

DESIGNED BY

DATE

DRAWING NO.

DRAWN BY ES

4-18-95

400-35007-0

CHECKED BY

SCALE

APPROVED BY

101820
BACKING SHELL

452229
STEMBALL

101703
WASHER

UPPERS
3/8"

101819
BACKING SHELL

452240
STEMBALL
NO WASHER
FORWARD
5/16"

BF3 TBAR
BF3 SPREADER

452232
STEMBALL

101701
WASHER

INTERM.
1/4"

BF4 TBAR

BF4 SPREADER

452240
STEMBALL

101703
WASHER

AFT LOWER
5/16"

NOTE

1) APPLIES TO ISOMAT SPARCRAFT
F580 SECTION

2) NUMBERS ARE ISOMAT PART NUMBERS

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CATALINA YACHTS/MORGAN DIVISION

7200 Bryan Dairy Road
Largo, Florida

CATALINA 400
SPREADER / SHROUD ASSEMBLY

DESIGNED BY

DRAWN BY

CHECKED BY

APPROVED BY

DATE

7-29-94

SCALE

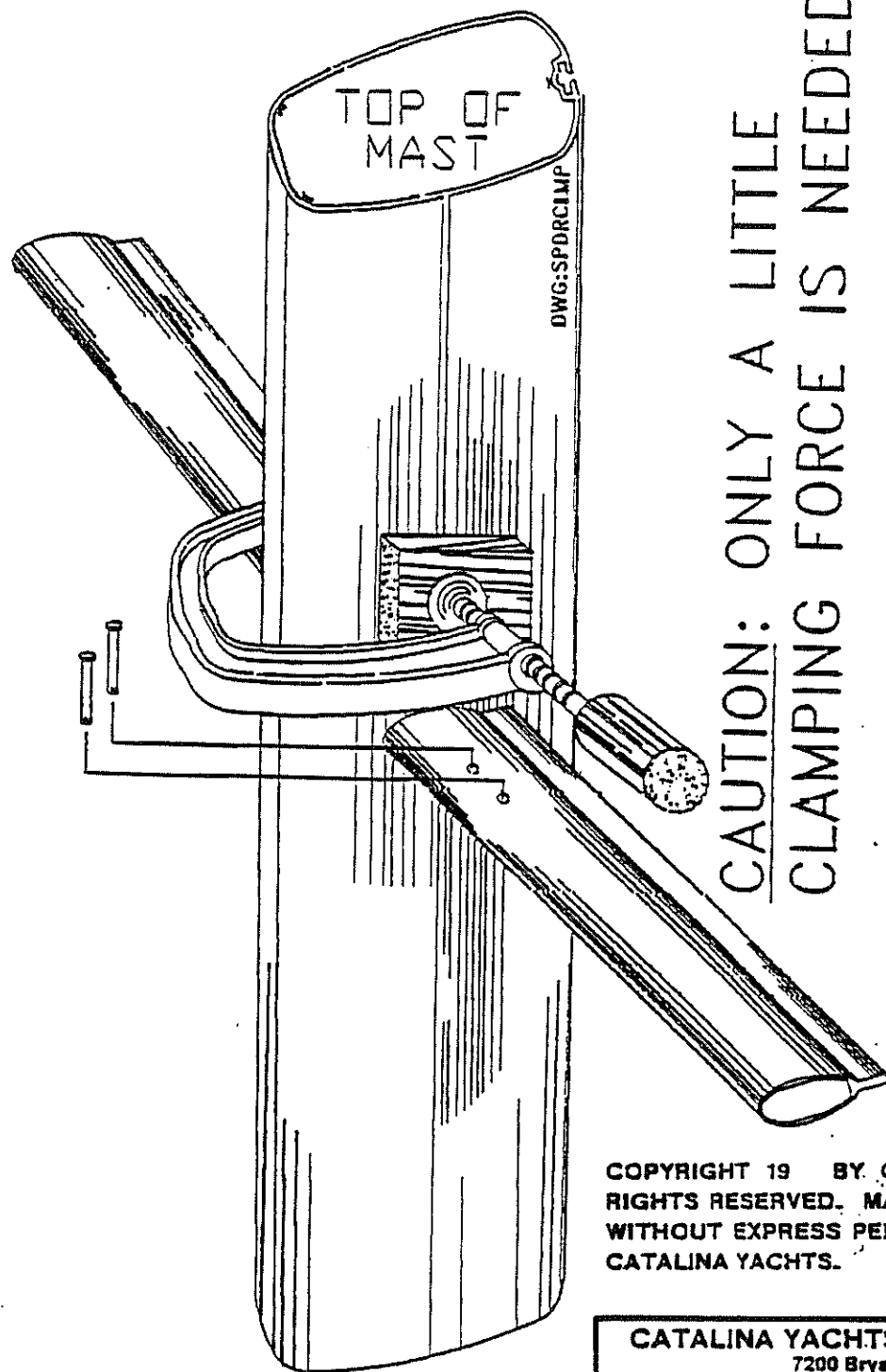
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400-32002-0

NO.

REVISION

DATE



**CAUTION: ONLY A LITTLE
CLAMPING FORCE IS NEEDED!!**

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CATALINA YACHTS/MORGAN DIVISION

7200 Bryan Dairy Road
Largo, Florida

CATALINA 400

SPREADER IN INSTALLATION TECHNIQUE

DESIGNED BY

DATE

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7-29-94

400-32003-0

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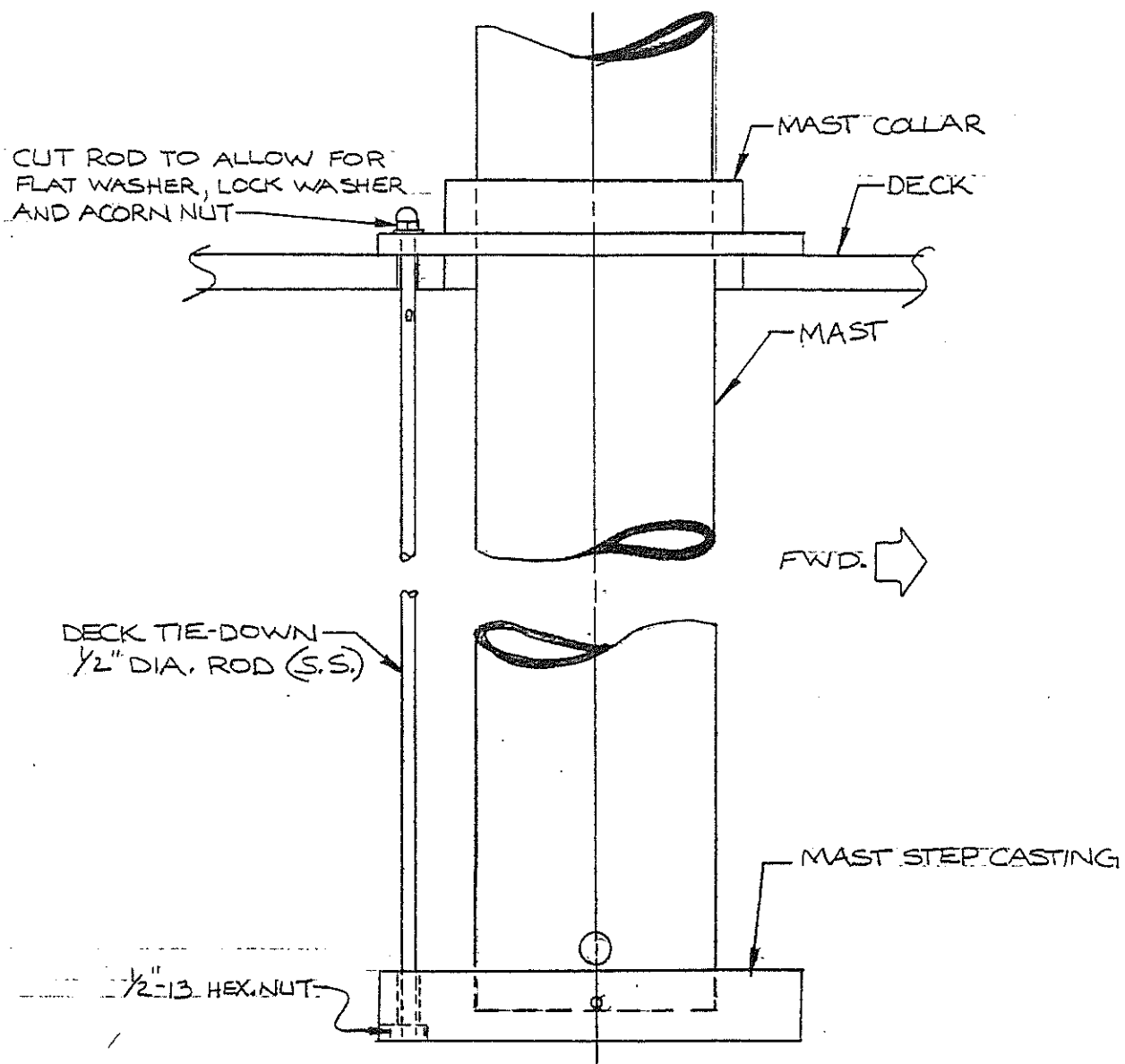
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CATALINA YACHTS/MORGAN DIVISION

7200 Bryan Dairy Road
Largo, Florida

CATALINA 400
DECK TIE-DOWN INSTALLATION

DESIGNED BY

DRAWN BY ES

CHECKED BY

APPROVED BY

DATE

5-22-95

SCALE

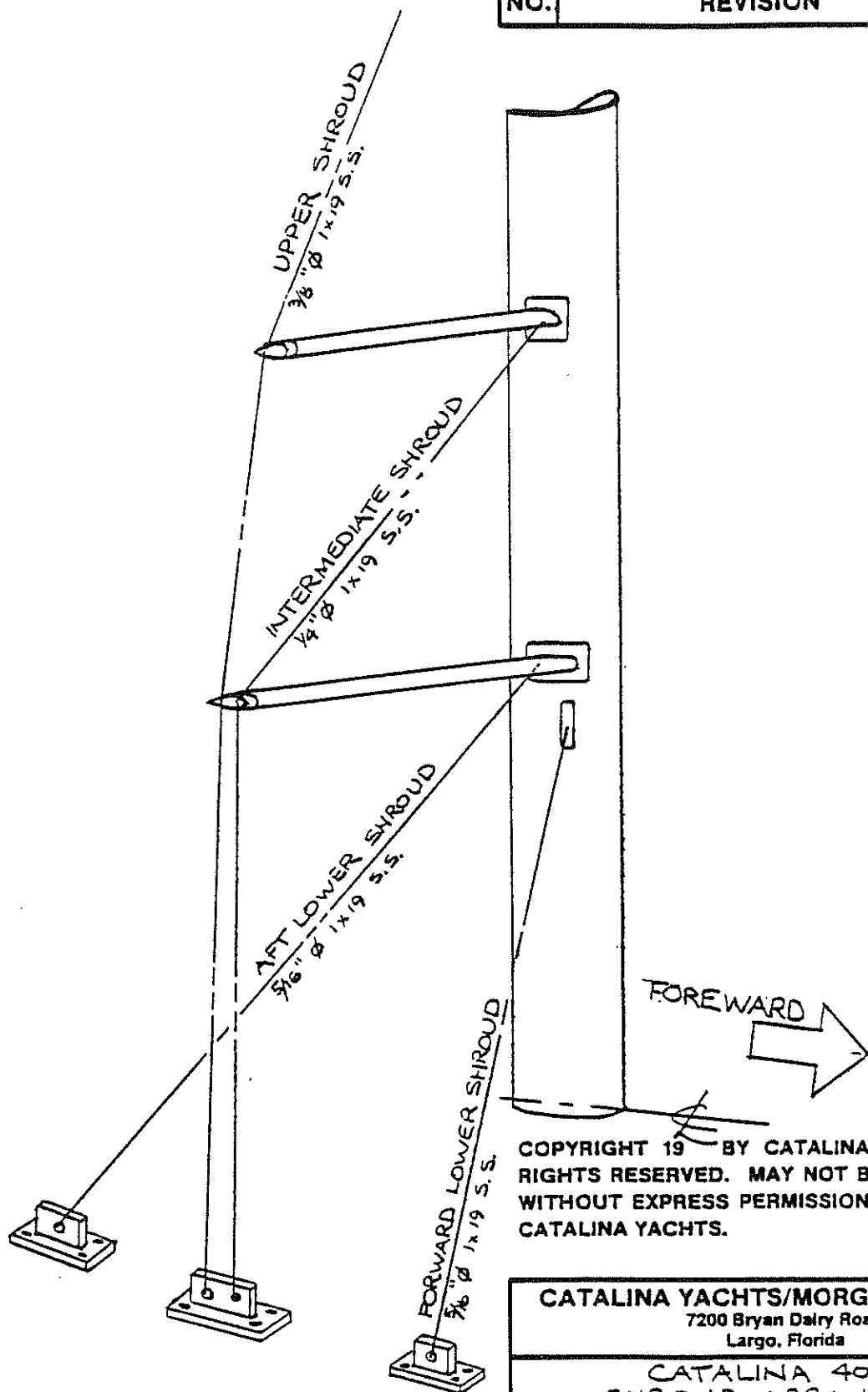
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REVISION

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CATALINA YACHTS/MORGAN DIVISION

7200 Bryan Dairy Road
Largo, Florida

CATALINA 400 SHROUD ARRANGEMENT

DESIGNED BY

DATE

DRAWING NO.

DRAWN BY

6-21-74

400-34000-0

CHECKED BY

SCALE

APPROVED BY

3.0 YACHT SYSTEMS - (Continued)

Starting with the lower shrouds and then any intermediates get the mast strait. At this point you will only need to get them hand tight.

Walk about three or four boat lengths away from the boat and sight down the center line of the boat, confirm that the rig is strait.

Using two adjustable wrenches tighten the lower shrouds. Match the number of turns from side to side. Keep checking the rig to make sure it stays strait. Get the lowers tight enough to keep the rig strait at the lower spreader when you deflect the shroud at about shoulder height. Sight up the luff groove while pulling on the shroud to check this.

Using the wrenches tighten the upper shrouds. These shrouds will end up about the same tension as the lower shrouds.

Tighten any intermediate shrouds using the same method as the lowers and the uppers. The intermediate shrouds should not be as tight as the lowers or uppers.

Go sailing in medium wind (8-12 knt) upwind and check the tune of the rig. This mast should remain strait regardless of how far over the boat heels. The leeward shrouds should begin to loosen at about 15 deg. of heel.

All rigging wire used on yachts has a tendency to stretch, especially on a new yacht, and after you have sailed in heavier wind than you are normally experienced for, therefore, you should periodically check the tension on the shrouds and stays, and tighten them, if it is required. Rigging, as well as tuning, becomes all too important when setting up the mast. A knowledgeable person should oversee the rigging and tuning so as to eliminate the possibility of an eccentric load, which might occur with an improperly loaded shroud. Special attention should be given to the initial stretch of the shrouds and a further gradual stretch of the wire over the first few hard outings.

3.1.9 MAIN SAIL REEFING

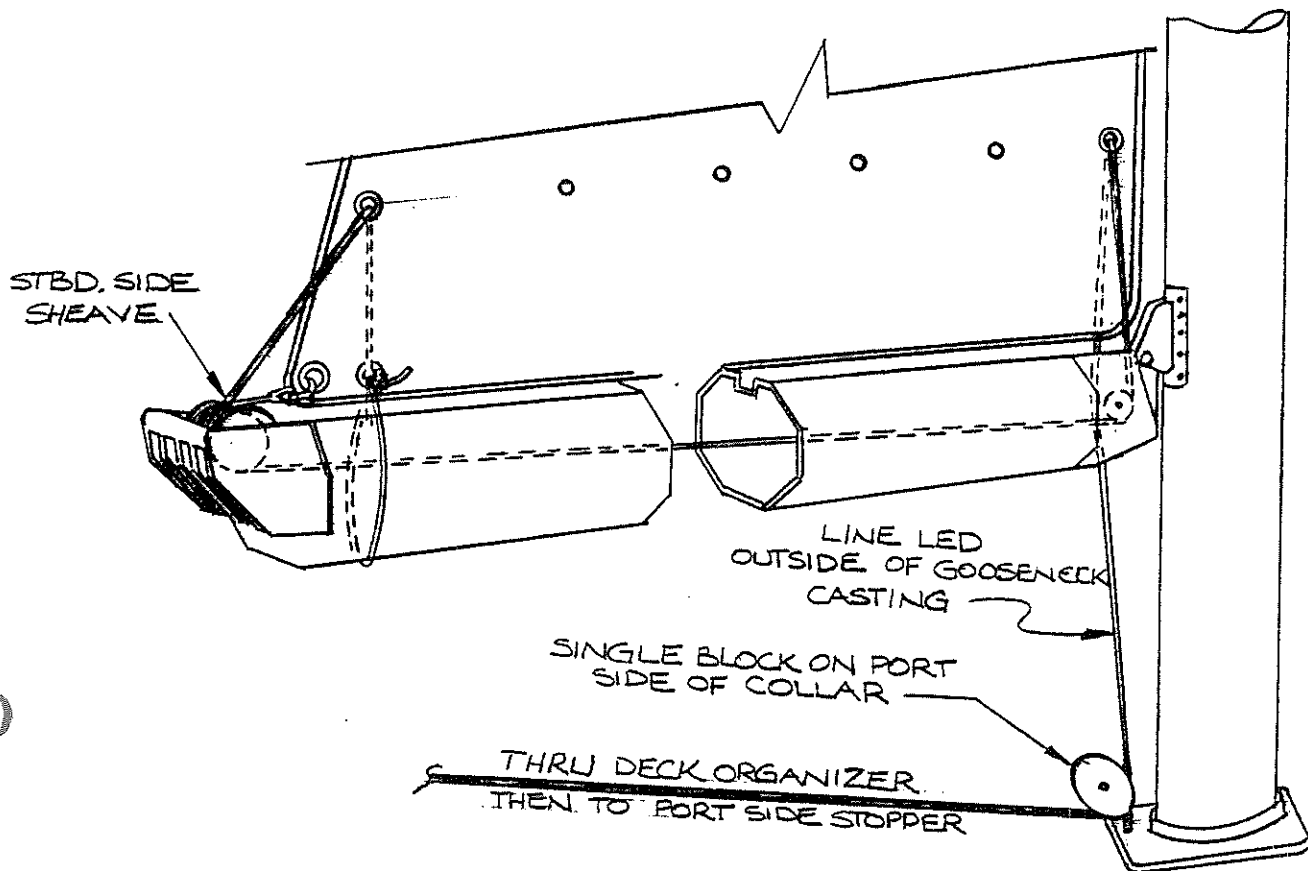
Reefing should always be done before it becomes necessary. Some sailors use the rule of thumb that if the thought of reefing occurs to you, it is time to reef. Sailing at extreme angles of heel, 20 degrees or more, is not efficient, fast or comfortable.

Your Catalina is equipped with single line reefing, for reefing the mainsail. The system consists of a line tied around the boom and reeved through the cringles, internal boom sheaves, and blocks as shown in the illustration. It is controlled through the port cabin top winch. A second reef line may be installed in a like manner, but to the opposite side of the boom, and led to the starboard side of the cockpit.

NO.

REVISION

DATE



NOTES

- 1) USE WITH Z-SPAR 701 MAST,
480 BOOM SECTION
- 2) USE STARBOARD SIDE BOOM SHEAVES
FOR FIRST REEF, PORT SIDE SHEAVES
FOR SECOND REEF
- 3) SECOND REEF LEADS TO SINGLE
BLOCK ON STBD. SIDE OF COLLAR.

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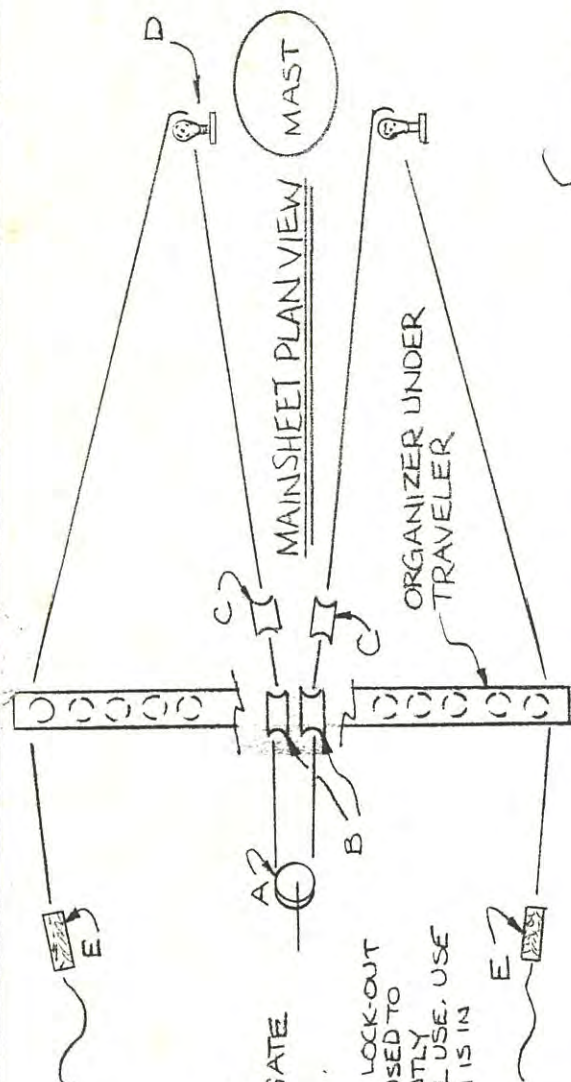
CATALINA YACHTS/MORGAN DIVISION

7200 Bryan Dairy Road
Largo, Florida

CATALINA 400 SINGLE LINE REEFING

DESIGNED BY	DATE	DRAWING NO.
DRAWN BY <i>ES</i>	12-19-95	400-35010-0
CHECKED BY	SCALE	
APPROVED BY		

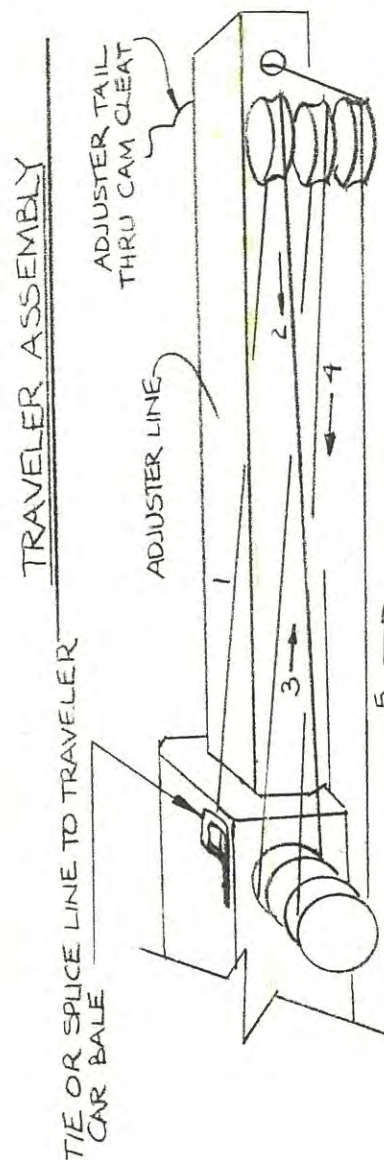
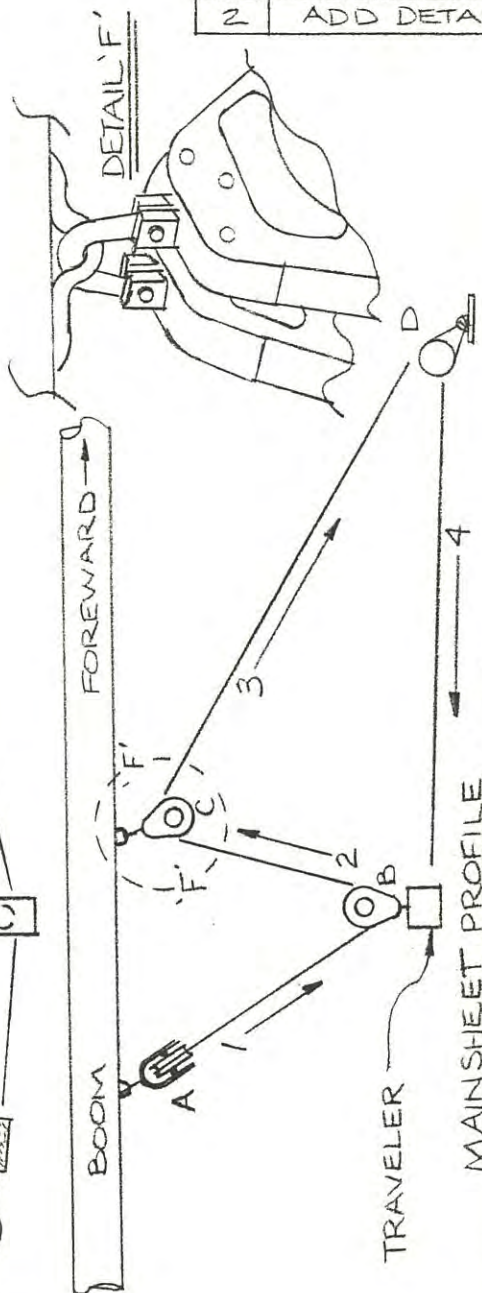
NO.	REVISION	DATE
1	STAND-UP SWIVEL WAS PIVOT LOW LEAD	10-7-94
2	ADD DETAIL 'F'	5-17-96



MAINSHEET PLAN

- A - SINGLE FIXED BLOCK
- B - DOUBLE FIXED BLOCK
- C - SINGLE SWIVEL BLOCK
- D - SINGLE STAND-UP BLOCK
- E - CLAM CLEAT W/ SPRING GATE.

NOTE:
DO NOT LEAD MAINSHEET THROUGH LOCK-OUT
BALE ON CLAM CLEAT. THIS BALE IS USED TO
PREVENT THE MAINSHEET FROM ACCIDENTLY
ENGAGING IN CLEAT DURING NORMAL USE. USE
CLEAT WHEN REEFING OR WHEN WINCH IS IN
USE.



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CATALINA YACHTS/MORGAN DIVISION

7200 Bryan Dairy Road
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CATALINA 400 MAINSHEET / TRAVELER ASSEMBLY

DESIGNED BY	DATE	DRAWING NO.
DRAWN BY	6-13-94	400-35001-2
CHECKED BY	SCALE	
APPROVED BY		

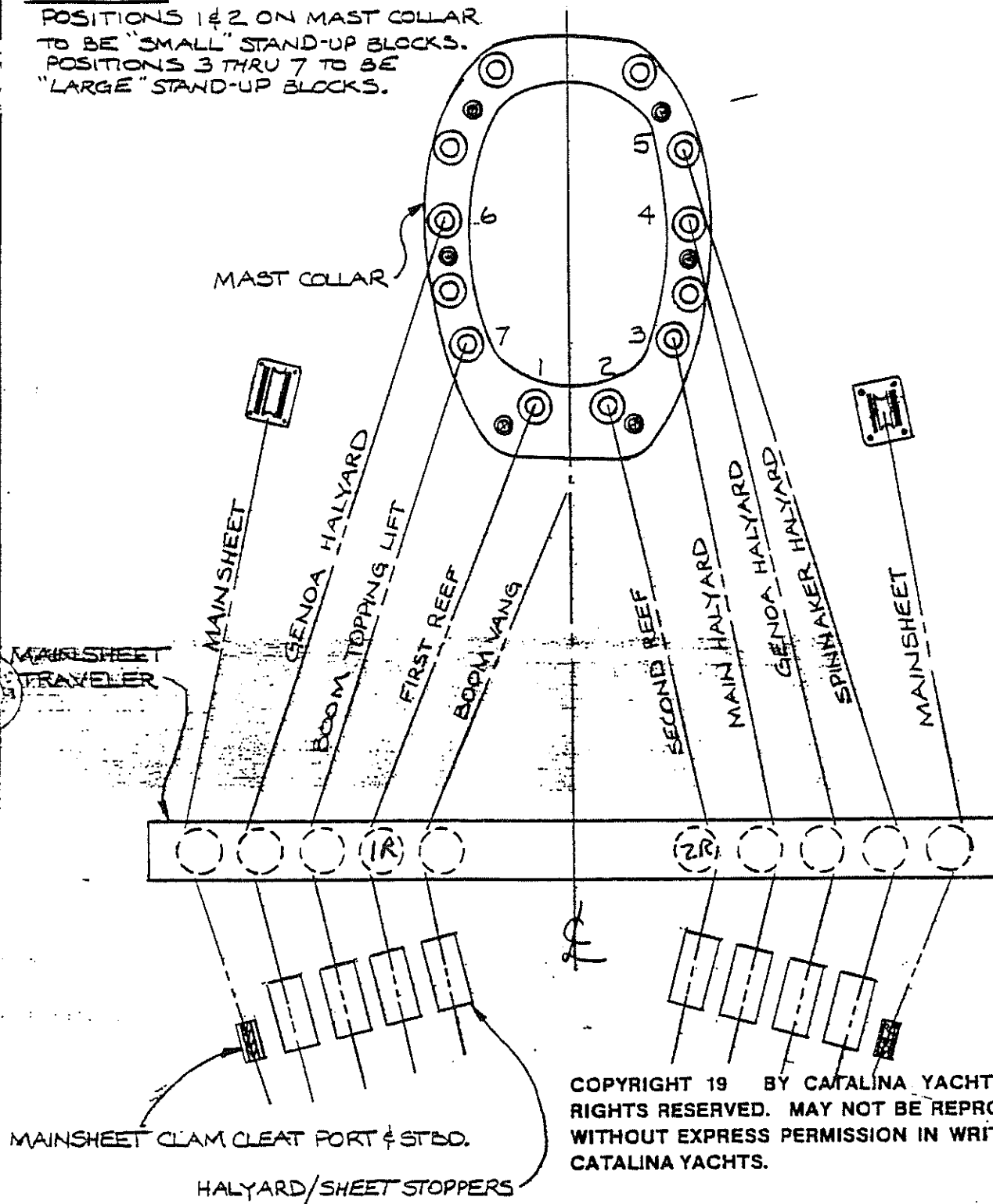
NOTE

POSITIONS 1 & 2 ON MAST COLLAR
TO BE "SMALL" STAND-UP BLOCKS.
POSITIONS 3 THRU 7 TO BE
"LARGE" STAND-UP BLOCKS.

NO.

REVISION

DATE



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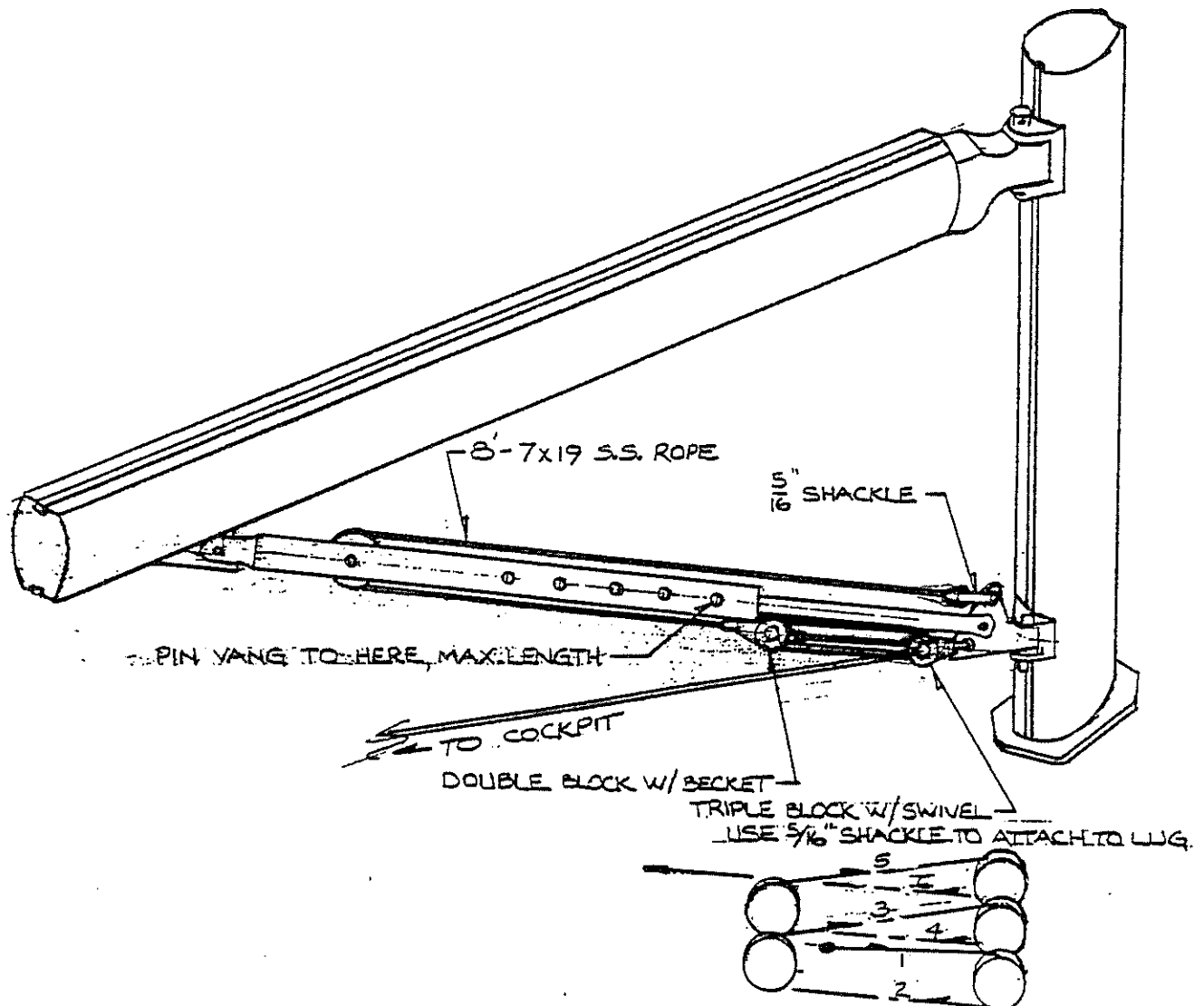
CATALINA YACHTS/MORGAN DIVISION

7200 Bryan Dairy Road
Largo, Florida

CATALINA 400 CABIN TOP HALYARD ARRANGEMENT

DESIGNED BY	DATE	DRAWING NO.
DRAWN BY	6-14-94	400-35000-1
CHECKED BY	SCALE	
APPROVED BY		

REV. 1 2-13-95 VANG U-BOLT NOT USED H.N. 271



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CATALINA YACHTS/MORGAN DIVISION
7200 Bryan Dairy Road
Largo, Florida

CATALINA 400 FORESPAR RIGID VANG INSTALLATION

DESIGNED BY

DRAWN BY *ES*

CHECKED BY

APPROVED BY

DATE

2-13-95

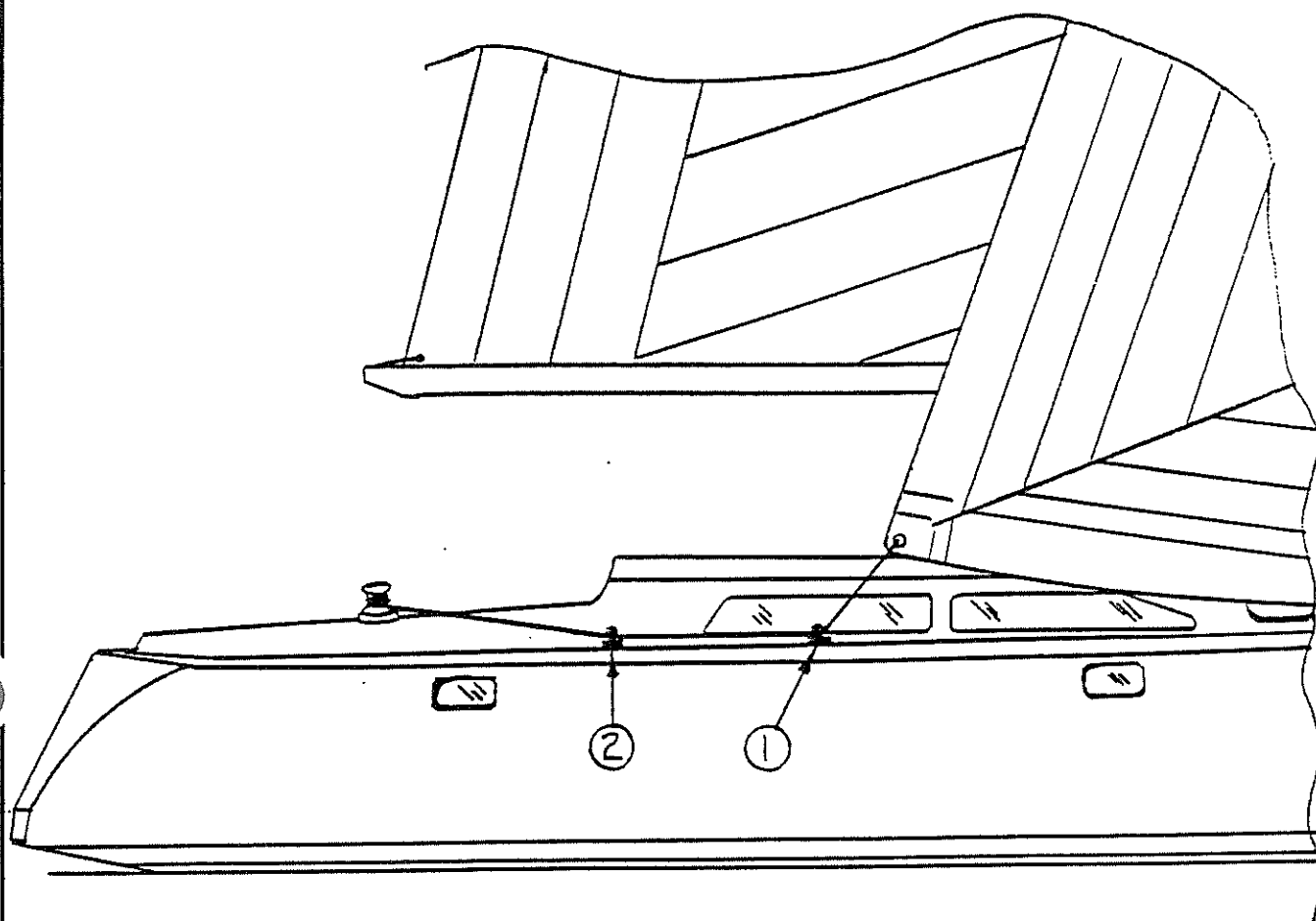
SCALE

DRAWING NO.

NO.

REVISION

DATE

NOTE

- 1) POSITION GENOA CAR NUMBER ONE FOR PROPER LEAD TO GENOA
- 2) POSITION GENOA CAR NUMBER TWO FOR PROPER LEAD TO WINCH

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CATALINA YACHTS/MORGAN DIVISION

7200 Bryan Dairy Road
Largo, Florida

CATALINA 400
GENOA SHEET LEADS

DESIGNED BY

DATE

DRAWING NO.

DRAWN BY

7-28-94

400-35004-C

CHECKED BY

SCALE

APPROVED BY

3.0 YACHT SYSTEMS - (Continued)

Tie a loop of line around the main boom with a bowline, through the cringles at the first reef and into the boom on the starboard sheave. The line exits the starboard forward sheave and through the cringle in the sail at the first reef. Lead the line to the turning block at the base of the mast, through the organizer on deck and through the sheet stopper to the winch on the port side.

REEFING PROCEDURE:

1. Ease the mainsheet.
2. Release the main halyard on the starboard side of the cockpit, to a predetermined point. (Marking the halyard with ink or a colored thread into the line is helpful.) Recleat the halyard after lowering.
3. Pull the luff and leech cringles down to the boom by pulling the reefing line through the blocks with the port cockpit winch and cleat off.
4. Trim in the mainsheet.
5. Tie off remaining reef points with lines around boom.
6. Snug up the main halyard as required to flatten out the mainsail.
7. Ease the topping lift.

3.2 ELECTRICAL:

3.2.1 BATTERIES:

Your electrical system is powered by 2 marine grade 12 volt, deep cycle 155 amp hour batteries for your service bank and a separate engine cockpit battery. Attention should be given to maintaining the proper level of distilled water. Do not overfill. The batteries are located under the sole beneath the companion way opening.

The batteries are provided with a tie down to prevent tipping over at extreme angles of heel. Be sure these tie downs are fastened securely.

With proper care, the battery installed in your Catalina 400 will provide long and satisfactory service. Proper care is not difficult if a few basic points are kept in mind, as follows.

Your battery should be checked periodically for any cracks or breaks in the case or cover, and any cracks in the sealing compound. If there is any damage, the battery should be repaired at once.

WARNING: The electrolyte in a battery is a solution of sulfuric acid. If any should enter the eyes, rinse immediately with large amounts of fresh water, and seek medical attention. Electrolyte spilled on skin should be rinsed well with fresh water also. Even a small amount of electrolyte spilled on clothing will destroy the clothing.

ELECTROLYTE LEVEL:

The electrolyte level in a battery should never be allowed to fall low enough to expose the plates. This not only results in a loss of battery capacity while the battery is low, but will cause hardening of the active material on the battery plates. This will result in a permanent loss of battery capacity.

CAUTION: Use only pure distilled water to replenish electrolyte levels. The water from many city water supply systems is unsatisfactory for battery use.

CHARGING THE BATTERY:

Before adding water, a hydrometer reading of the battery should be taken. If the reading shows the battery to be above 1.225 specific gravity, the battery has a sufficient charge. If the reading is below 1.225, the battery should be removed for bench charge.

IMPORTANT: Do not leave your batteries on charge for more than forty-eight (48) hours. If there is no rise in voltage or specific gravity in a period of two hours, further charging is useless and may damage the battery beyond repair.

Once charged, the battery should have a specific gravity of at least 1.260. If this cannot be reached, the battery should be inspected by a battery supplier.

The batteries should be checked often to ensure that they do not run down. Check that all battery cells keep an even fluid level and that the fluid is about 3/8" above the top of the separators.

If one or two cells have lower fluid levels, it is a good indicator that something is wrong with the battery, and it should be checked.

DISCHARGED STATE:

Leaving a battery in a discharged state for any length of time can also result in a permanent loss of capacity for the battery. Since it will freeze at relatively low temperatures, leaving it in the cold weather can destroy the battery.

CLEAN CONNECTIONS:

Keep battery connections clean and tight. A cupful of strong baking soda solution and a toothbrush will clean corrosion from the terminals and neutralize any spilled acid (do not allow any of the solution to enter the battery cells). A coating of petroleum jelly on the battery terminals will inhibit corrosion.

3.0 YACHT SYSTEMS - (Continued)

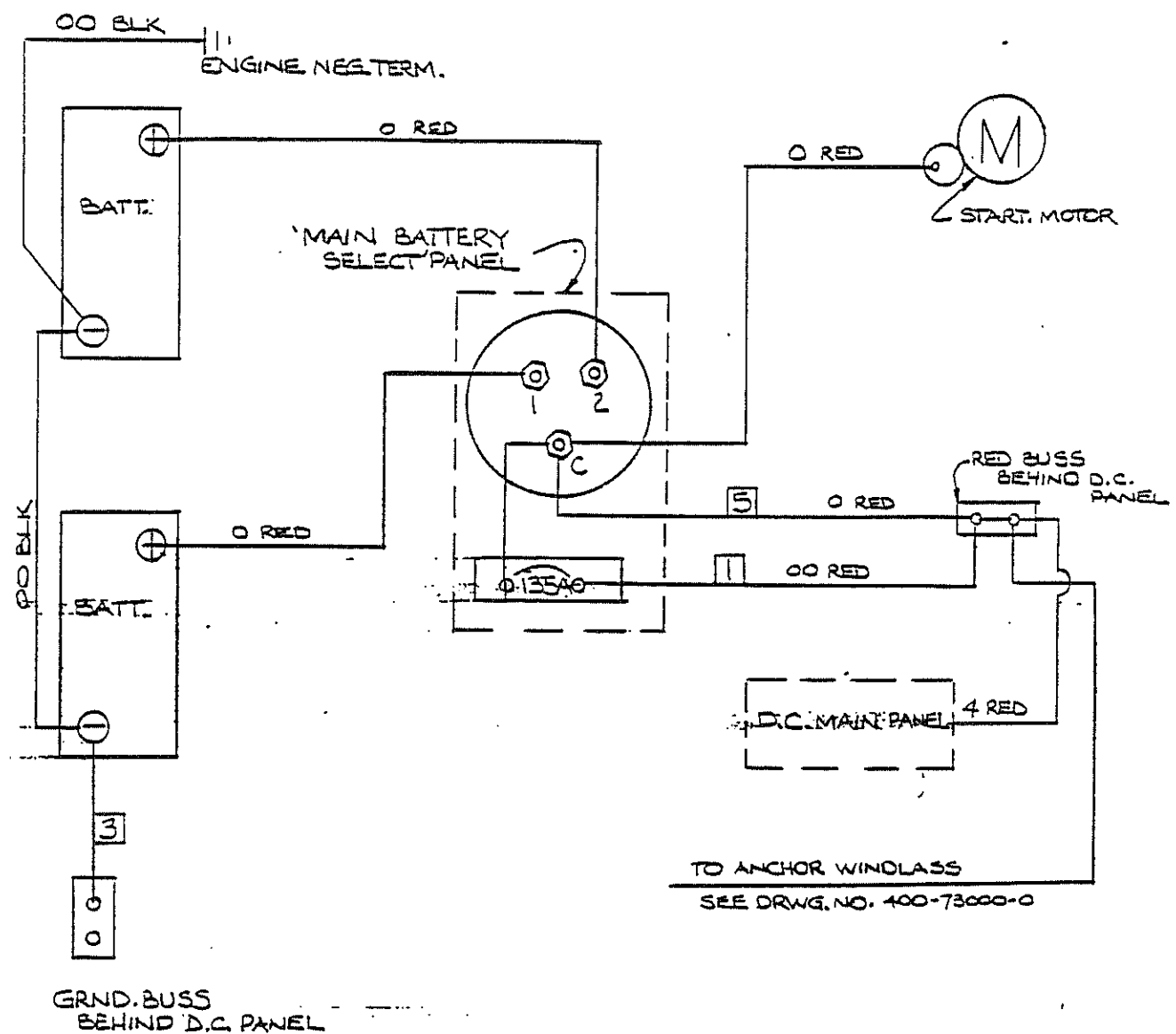
3.2.2 MAIN BATTERY SWITCH:

Electrical circuits are protected by breakers. The system is also controlled by a master switch. You should be sure that your boat is free of gasoline fumes before using the electrical system. Always run the blower for at least five minutes before starting the engine.

The circular battery switch has the markings 1, 2, and "ALL" as well as "OFF". You can selectively charge the batteries with the engine alternator. Many experienced sailors use battery #1 for electrical lighting needs and keep #2 in reserve for starting the engine.

When the engine is running, never pass through the "OFF" position to charge from one battery to the other or the alternator diodes will be burned out. Switching from one battery to another should only be done when the engine is stopped. If both batteries are of equal charge, keep the selector switch on "ALL" position, and use "ALL" to start the engine if both batteries are low.

NO.	REVISION	DATE
1	00 BLK WAS 0; NO. CABLES	10-7-94



**Bilge Pump
connected to
Battery # 2**

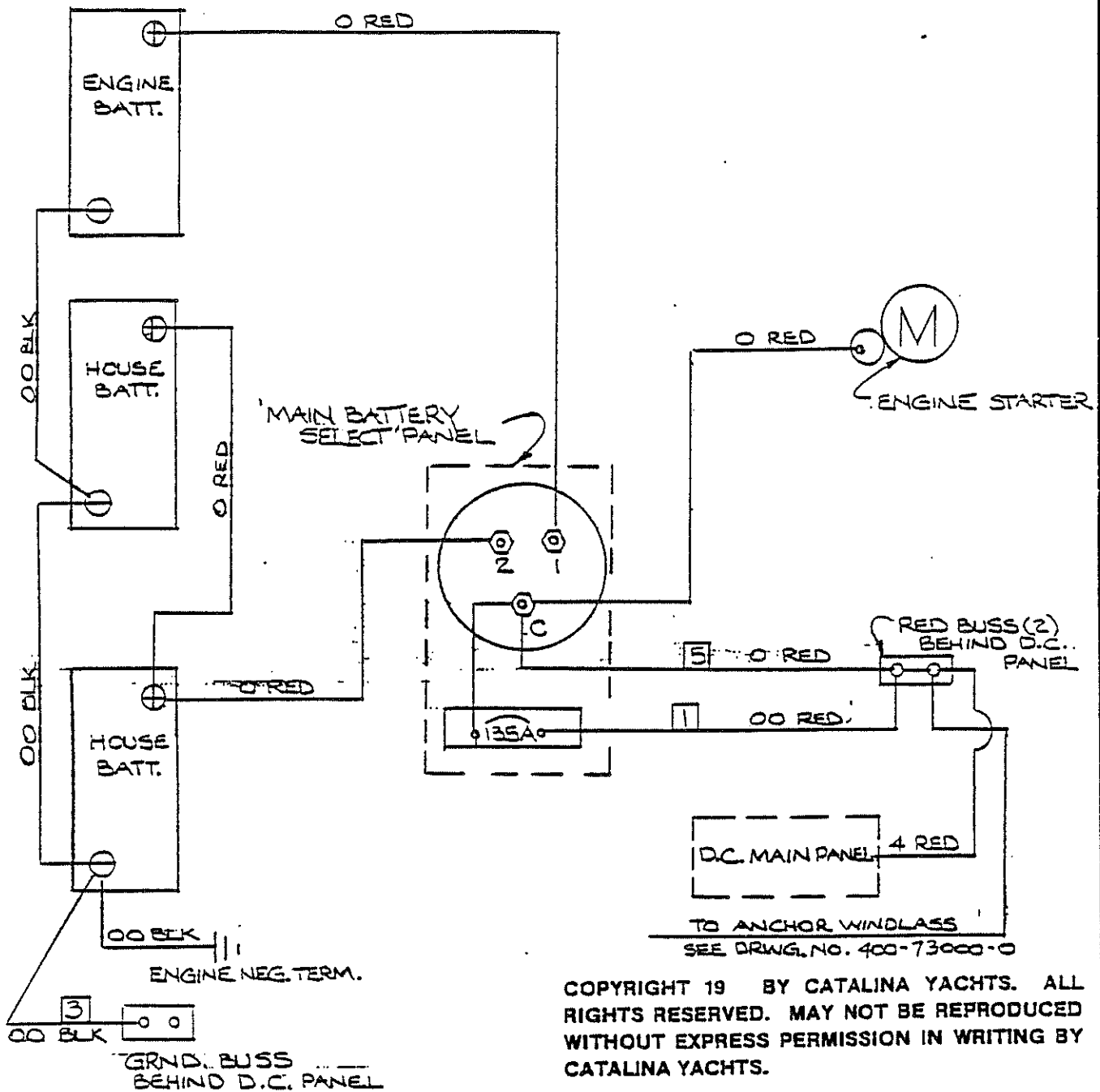
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CATALINA YACHTS/MORGAN DIVISION
7200 Bryan Dairy Road
Largo, Florida

CATALINA 400
BATTERY SCHEMATIC

DESIGNED BY	DATE	DRAWING NO.
DRAWN BY: ES	7-23-94	400-72002-1
CHECKED BY	SCALE	
APPROVED BY		

NO.	REVISION	DATE
1	00 BLK WAS 0; NO. CABLES	10-17-94

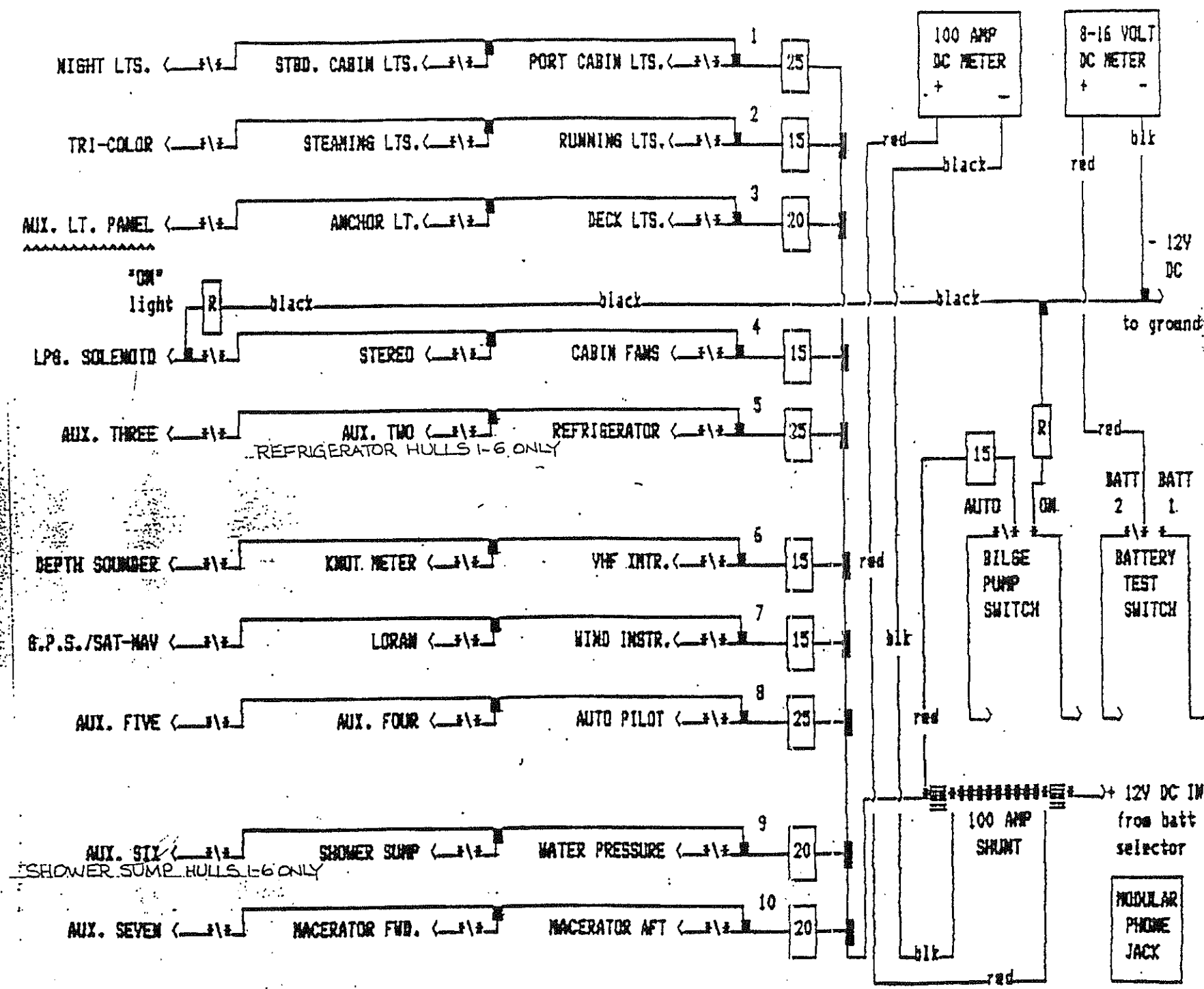


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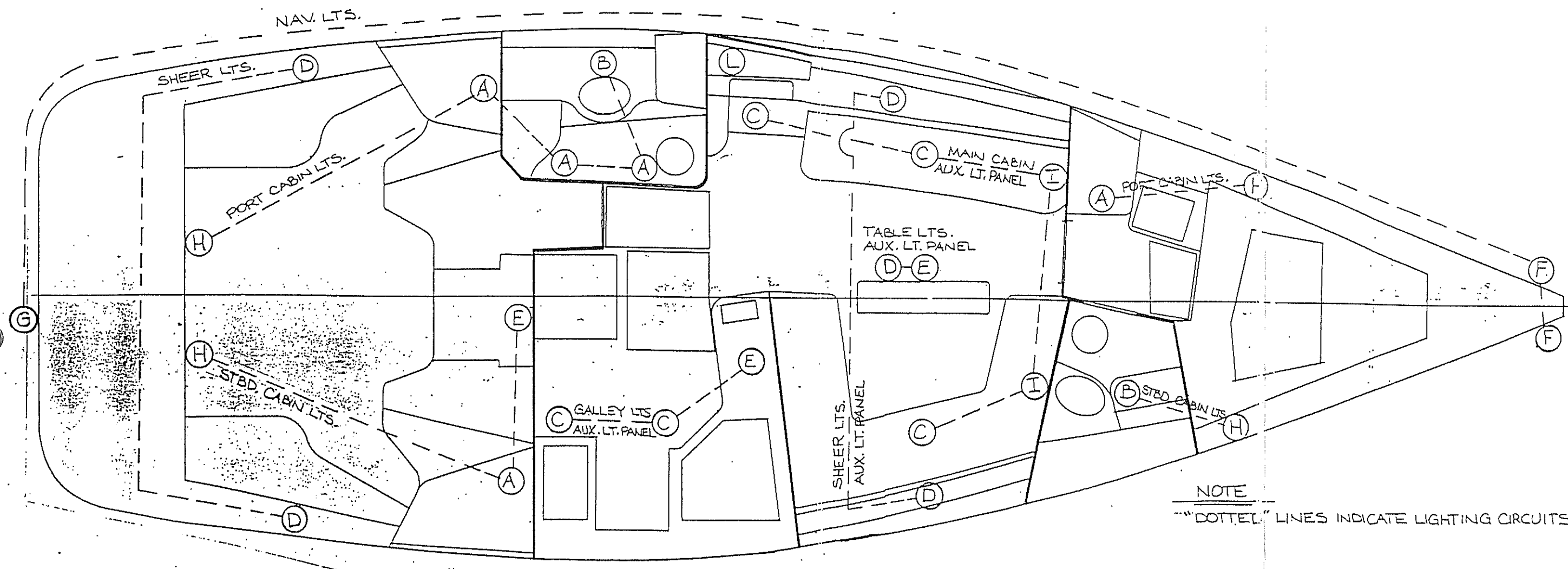
CATALINA 400
BATTERY SCHEMATIC W/OPTIONAL START. BATT.

DESIGNED BY	DATE	DRAWING NO.
DRAWN BY : ES	8-9-94	400-72003-1
CHECKED BY	SCALE	
APPROVED BY		



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CATALINA YACHTS/MORGAN DIVISION 7200 Bryan Dairy Road Largo, Florida		
CATALINA 400 12VDC PANEL SCHEMATIC		
DESIGNED BY	DATE	DRAWING NO.
DRAWN BY	7-25-94	100-72000-0
CHECKED BY	SCALE	
APPROVED BY		



NOTE
"DOTTEL" LINES INDICATE LIGHTING CIRCUITS

LIGHT FIXTURE SCHEDULE			
LTR	MAKE	LAMP	
A	RAMCO NO. 105460	NO. 906 / 12V	LTR MAKE LAMP
B	RAMCO NO. 105520	NO 211-2 12V	L HELLA NO. 87141 12V HELLA NO. 78166 5W
C	COMPONENT CONCEPT NO. 87072	NO. 44860 WFL 20W/12V	
D	RAMCO TAC LIGHTS		
E	RAMCO NO. 124011	NO. 1003 12V	
F	AQUA SIGNAL 41	AQ. SIG. NO. 90400 002 25W/12V	
G	AQUA SIGNAL 41	AQ. SIG. NO. 90400 005 10W/12V	
H	WHITE WATER NO. 2110B	WHITE WATER NO. 2112 15W/12V	
I	HELLA NO. 62717	LAMP NO. 64425 20W/12V	
J	PERKO 170 BMD (DECK/STEAM. LT.)	STEAM NO. 70-1 13W/12V; DECK NO. 64115 20W/12V	
K	PERKO 200 SWB (ANCHOR LT.)	1303 10W/12V	

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CATALINA YACHTS/MORGAN DIVISION
7200 Bryan Dairy Road
Largo, Florida

CATALINA 400
12V LIGHTING PLAN

DESIGNED BY	DATE	DRAWING NO.
DRAWN BY	7-28-94	400-74000-0
CHECKED BY	SCALE	
APPROVED BY		

3.0 YACHT SYSTEMS - (Continued)

3.2.8 120 VOLT SYSTEM:

The 120 volt AC system is connected to shore power by a grounded twist-lock connector mounted on the port side of the transom.

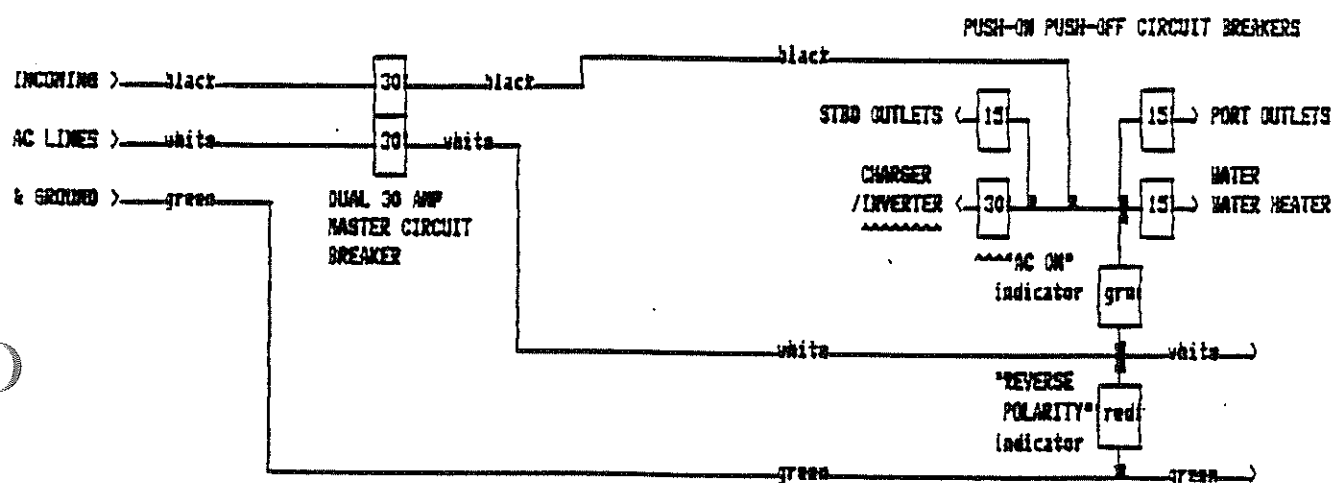
A thirty (30) amp two pole circuit breaker is located on the main panel, as well as under the port helm seat. Ten (10) duplex outlets for the 120 volt system are located in the cabin. Be certain that all 120 volt appliances, other than lamps, have an adequate grounding connector. Wet feet or moist atmosphere increases the potential shock hazard.

IMPORTANT: Do not open the electrical panel for any purpose with the 120 volt shore power connected to the dock. 120 volt wiring is exposed when the panel is open. Contact with 120 volt wiring can cause shock and death.

NO.

REVISION

DATE



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CATALINA YACHTS/MORGAN DIVISION

7200 Bryan Dairy Road
Largo, Florida

CATALINA 400 120 VAC PANEL SCHEMATIC

DESIGNED BY

DATE

DRAWING NO.

DRAWN BY

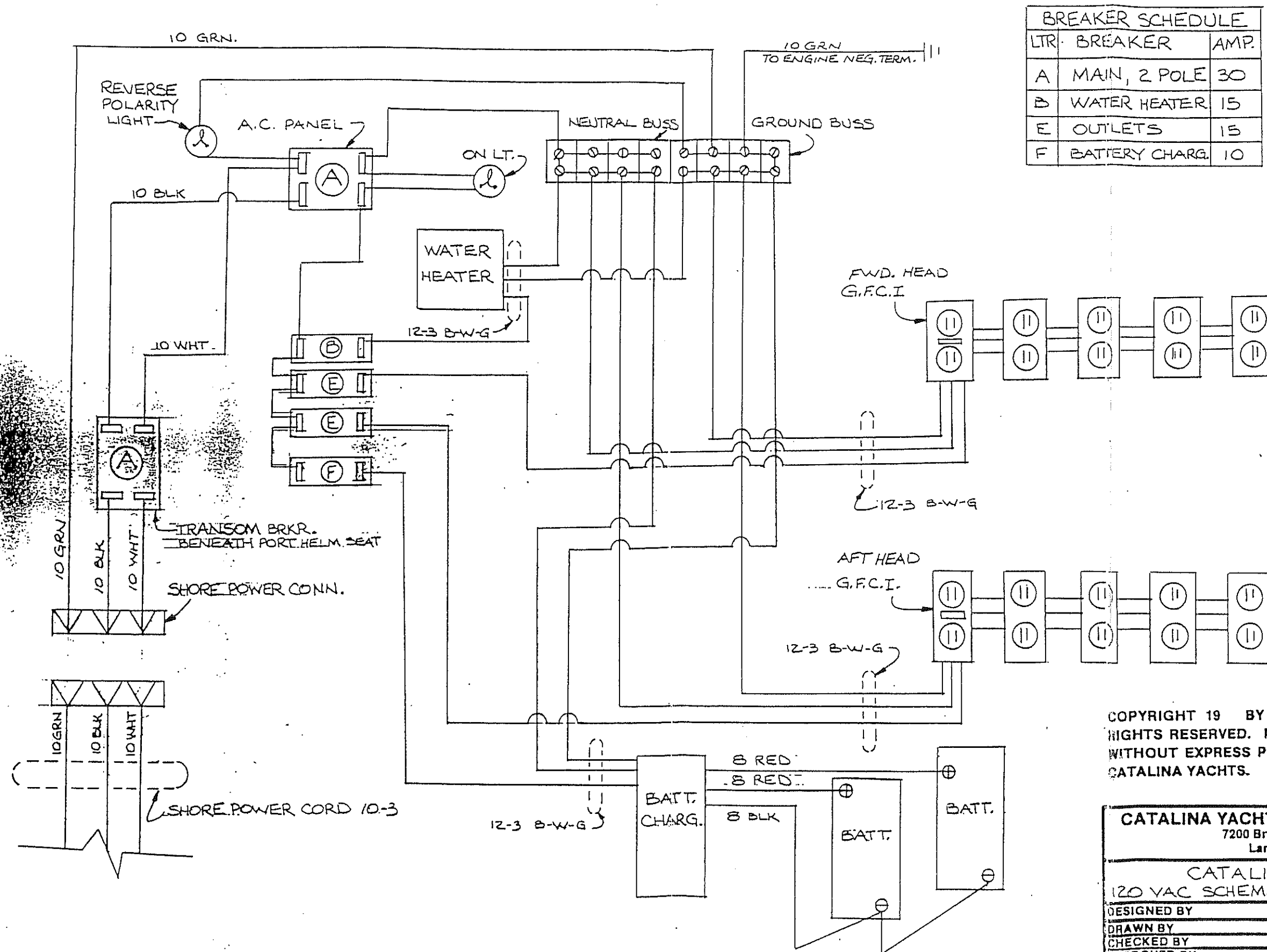
7-25-94

400-73000-0

CHECKED BY

SCALE

APPROVED BY



BREAKER SCHEDULE		
LTR.	BREAKER	AMP.
A	MAIN, 2 POLE	30
B	WATER HEATER	15
E	OUTLETS	15
F	BATTERY CHARG.	10

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CATALINA YACHTS/MORGAN DIVISION 7200 Bryant Dairy Road Largo, Florida		
CATALINA 400 120 VAC SCHEMATIC W/O INVERTER		
DESIGNED BY	DATE	DRAWING NO.
DRAWN BY	7-22-94	400-73001-0
CHECKED BY	SCALE	
APPROVED BY		

HEART INTERFACE INVERTER/CONVERTER

CATALINA 400

The Heart Interface (EMS) 2000 is a DC to AC power inverter and battery charger combination unit. It acts as power inverter, transforming DC power from the house batteries into AC power for household appliances, when you are off shore. When the boat is plugged into shore power the inverter is automatically switched off and the battery charger is activated. The unit will automatically switch itself between inverter and charger when the boat is plugged and unplugged from shore power.

The EMS-2000 is located beneath the chart table and is connected to the battery bank through the battery selector switch labeled Inverter/Battery Selector. There is also a 300-amp in-line fuse near the battery switch.

To operate the inverter or battery charger, the inverter battery selector switch must be on. It can be used to operate the inverter from bank 1, bank 2 or both banks combined.

The same batteries that provide AC power through the inverter are also the same batteries used for DC power e.g. lighting, engine starting, pumps, etc., through the main battery select switch. Since batteries are not an unlimited source of power, manage power consumption with care.

The AC output of the inverter is wired to the port and starboard outlets through the circuit breakers on the electrical panel.

The AC input to the battery charger is wired through the circuit breaker marked "Inverter/Charger" on the electrical panel. This circuit breaker must be on to operate the battery charger.

The EMS-2000 contains built-in relays which route the incoming shore power to the AC outlets when the boat is plugged in at the dock.

For more detailed information on the care and use of the Heart Interface 2000, please read the Heart Interface Owners manual that accompanies the Catalina-400 Owners manual.

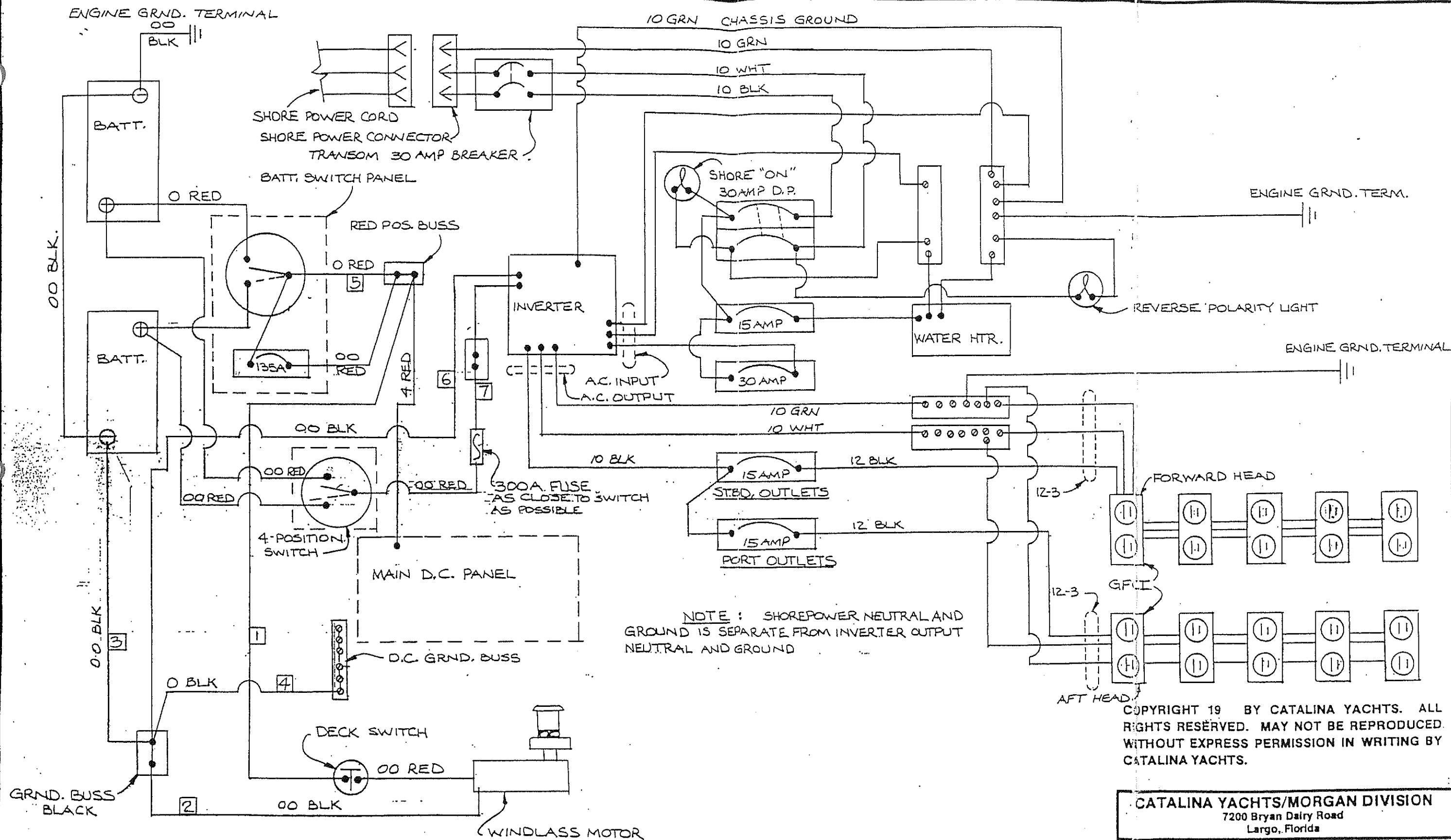
TROUBLESHOOTING THE HEART INTERFACE EMS:

No inverter output:

1. Check EMS-2000 power switch, it must be turned on.
2. Check Inverter Battery Selector switch, it must not be in the off position.
3. Check port and starboard circuit breakers on the electrical panel, they must be on.
4. Check battery voltage. The inverter will not work on less than 10.5 volts.
5. Check the LED indicators on the front of the EMS-2000 remote panel. The "Shutdown" LED may indicate the following.
 - (a) Solid green-low battery voltage
 - (b) Blinking green-overload, check for a short circuit due to bad wiring or appliance.
 - (c) Solid red-overtemperature, allow the unit to cool.
6. Write down the serial number, which is found on the front of the EMS-2000, and call the Heart Interface technical support line: 1-800-446-6180 or 206-872-7225.

No Battery Charging:

1. Perform steps 1 and 2 above.
2. Check "Inverter/Charger" circuit breaker on the electrical panel, it must be on.
3. Check shore power to make sure the boat is plugged in and power is available at the dock.
4. Check the "AC Input" LED. There is a 3-5 second delay from the time the AC is applied and the LED illuminates.
5. Check "Charge Rate" LED.
6. Write down the serial number, which is found on the front of the EMS-2000, and call the Heart Interface technical support line: 1-800-446-6180 or 1-206-872-7225.

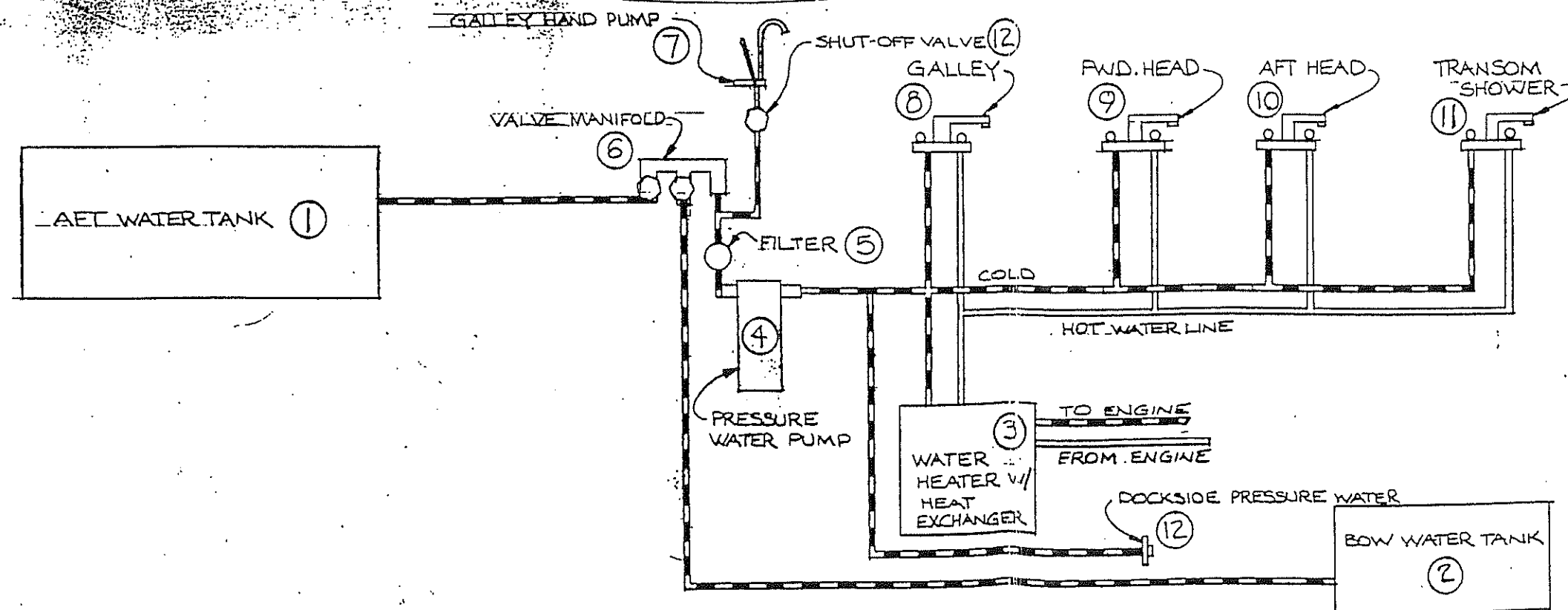
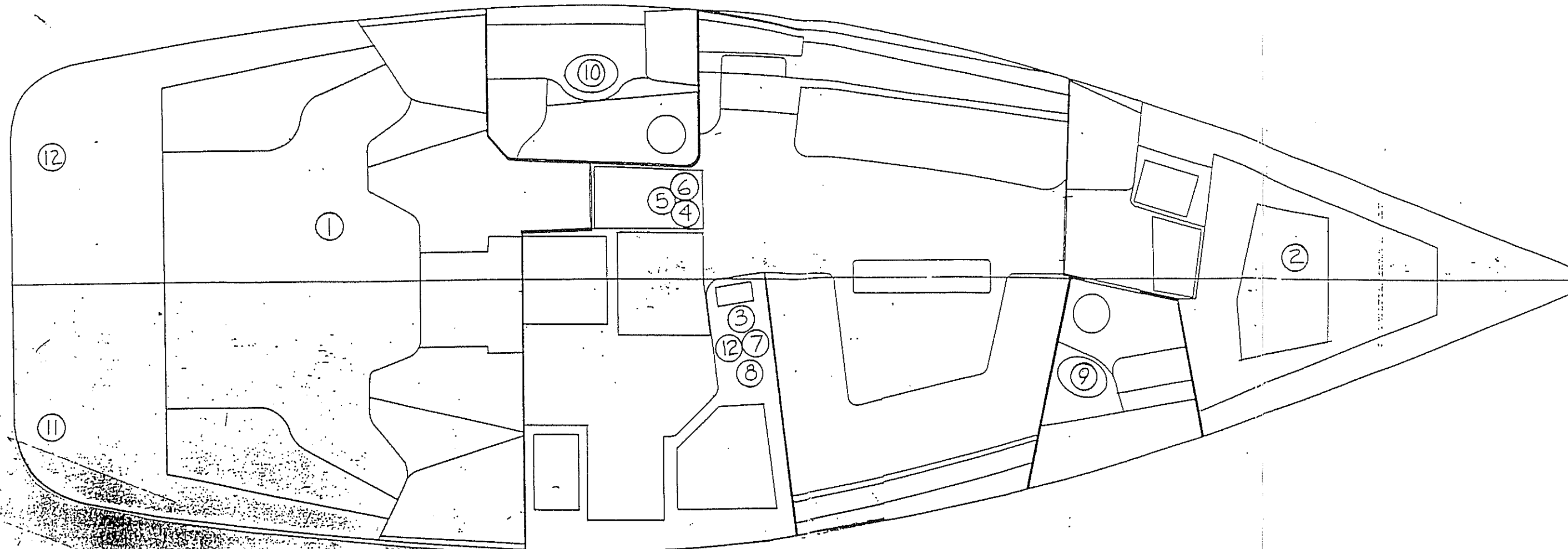


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CATALINA YACHTS/MORGAN DIVISION
7200 Bryan Dairy Road
Largo, Florida

CATALINA 400
120 V.A.C. SCHEMATIC W/INVERTER

1	ADD SEPARATE BATTERY SWITCH; INVERTER	10-10-94	DESIGNED BY	DATE	DRAWING NO.
			DRAWN BY ES	6-14-94	100-73000-1
			CHECKED BY	SCALE	
			APPROVED BY		



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CATALINA YACHTS/MORGAN DIVISION 7200 Bryan Dairy Road Largo, Florida		
CATALINA 400 PRESSURE WATER SYSTEM SCHEMATIC		
DESIGNED BY	DATE	DRAWING NO.
DRAWN BY	7-26-94	400-64000-0
CHECKED BY	SCALE	
APPROVED BY		

3.0 YACHT SYSTEMS - (Continued)

3.3.2 MANUAL BILGE PUMP:

The manual bilge pump is located outboard of the port side helm. Insert the handle through the water tight fitting in the cockpit to operate the pump.

The pump intake hose is in the keel stub under the main cabin sole.

3.3.3 SEACOCKS:

All underwater through hull fittings are equipped with Marelon® valves. It is good practice to close all valves when leaving the boat, especially for long periods of time.

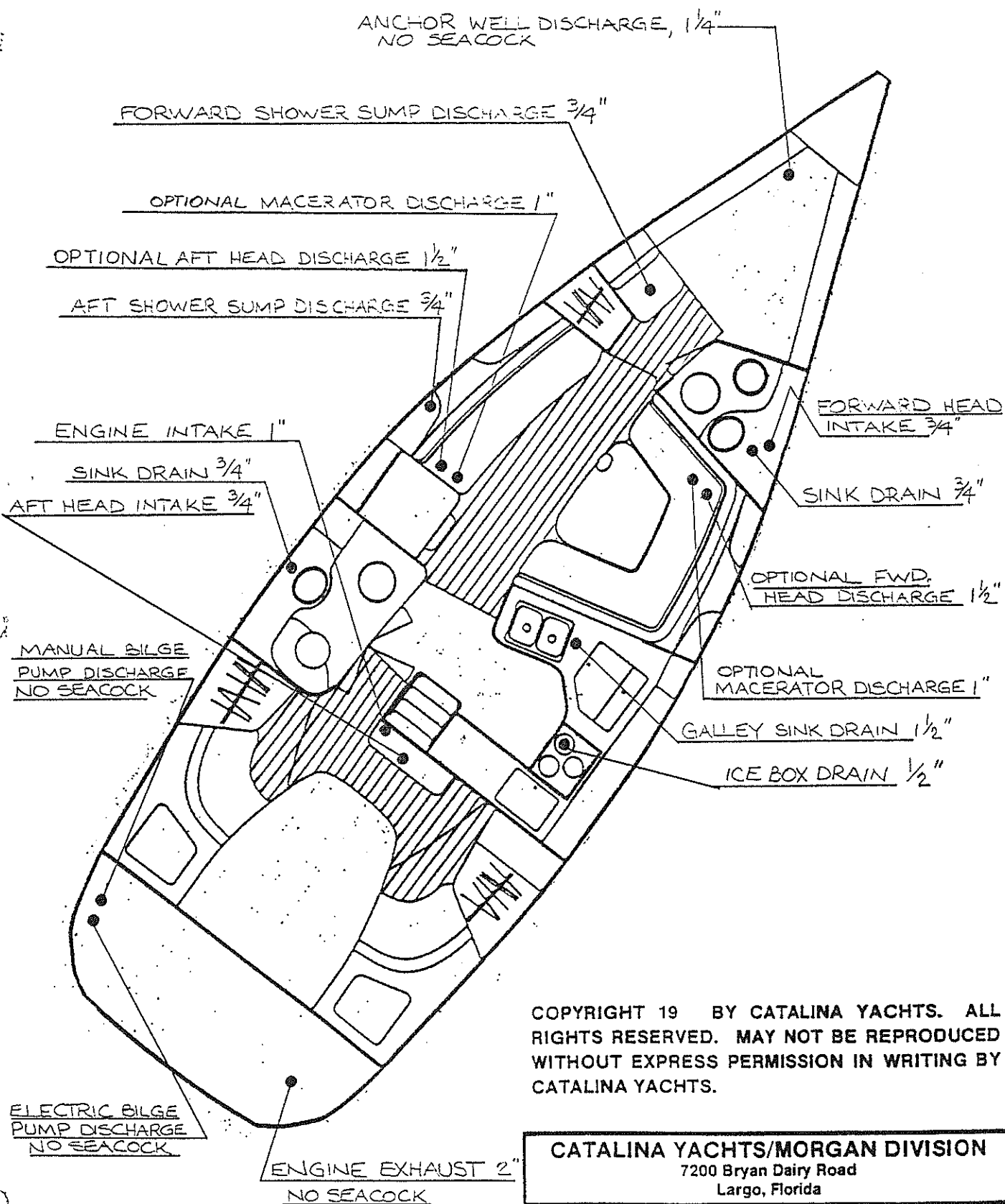
To close seacocks, turn clockwise: To open, turn counterclockwise.

It is good practice to operate the valves at least once a month to keep them in good working order.

NO.

REVISION

DATE



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CATALINA YACHTS/MORGAN DIVISION

7200 Bryan Dairy Road
Largo, Florida

CATALINA 400 THRU-HULL/ SEACOCK LOCATIONS

DESIGNED BY

DATE

DRAWING NO.

DRAWN BY

11-2-95

400-61000-1

CHECKED BY

SCALE

APPROVED BY

NOTE

-ALL THRU-HULLS HAVE SEACOCKS UNLESS NOTED

3.0 YACHT SYSTEMS - (Continued)

3.3.5 MARINE TOILET OPERATION:

USING THE HEAD:

1. Read the instructions for operation of the toilet supplied with the marine head by the manufacturer. These instructions are also printed on the toilet pump housing. Be sure everyone who will be using the head is familiar with these instructions.
2. Immediately before using the head, the inlet valve "A" must be opened. This provides flushing water to the toilet. The valve should be kept closed when the head is not in use. This will prevent water from flooding the boat if the valve in the toilet pump should fail.
3. Waste will be pumped directly into the holding tank when the bowl is emptied, unless the Y-valve is positioned to pump waste directly overboard. A minimum amount of water for every flush should be used in order to take best advantage of the tank's capacity between pump-outs.
4. The condition of the holding tank should be checked from time to time. Overfilling can cause the tank to burst.
5. To clean the head, use hot water and soap. High strength cleaners may cause damage to the valves and seals in your pump system. If there is any problem with the head, it should be corrected immediately.

EMPTYING THE TANK THROUGH THE DECK DISCHARGE PLATE:

1. The holding tank should be emptied via the deck discharge plate only at approved shore-based pump-out stations.
2. Remove the cap from the deck discharge plate. The threads on the plate cap should be periodically coated with silicone spray or petroleum jelly to ensure a good seal.
3. The pump-out station suction hose should form a seal at the deck plate.
4. Be sure inlet valves "A", "B", and "C" are closed when the tank is being emptied.
5. After the tank is empty, you may wish to open valve "A" and pump some water through the toilet and into the tank to dilute residual sludge and rinse the tank and lines.
6. Close all valves after the tank is emptied and recap the deck plate.

EMPTYING THE TANK USING THE MACERATOR PUMP:

1. Read the macerator pump operating instructions supplied by the pump manufacturer.
2. Close the inlet valves "A" and "C".
3. Open the through hull valve "B".

3.0 YACHT SYSTEMS - (Continued)

4. Turn on the pump with the switch on the 12 volt panel.
5. The pump will change tone after it becomes primed. It will resume the higher pitched tone after the tank is emptied.
6. You may wish to rinse the tank, hose lines, and macerator pump by pumping clear water through the head, then repeating the procedure for emptying the tank.
7. Close valve "B" immediately after emptying the holding tank.

3.3.6 MACERATOR PUMP AND TROUBLESHOOTING:

PROBLEM 1: The macerator pump motor starts then stops.

- A. Check the breaker: Identify problem and reset as required.
- B. Check the valves: "B" valve must be open.
- C. Check the vent line. If the boat has been sailed at extreme angles of heel, fluid may be clogging the vent line. Disconnect the vent at the tank and empty the hose into a disposable container. Holding tank vents through hull near sheer line.
- D. Sludge may have formed in the bottom of the tank. This should be emptied regularly to prevent sludge build up.

PROBLEM 2: The head toilet pump has excessive back pressure and will not evacuate the bowl.

- A. Refer to the toilet manufacturer's specifications and operating instructions.

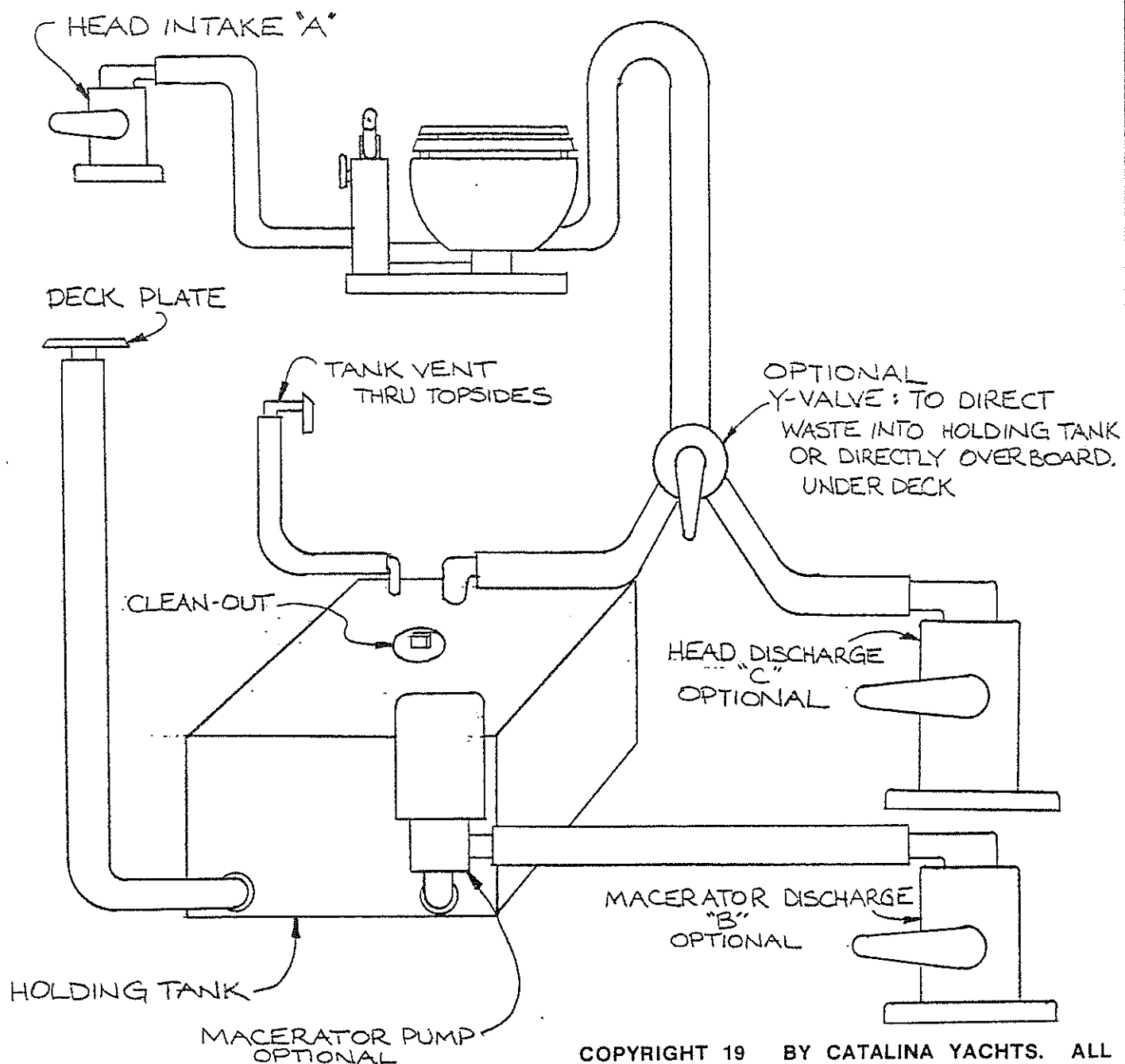
PROBLEM 3: The macerator pump, when on, makes a high pitched sound but does not empty the tank.

- A. Impeller in macerator pump is faulty and must be replaced.
- B. The vent is clogged and the pump cannot pull a prime against the vacuum in the tank.
- C. The hose into the pump may be clogged.
- D. The pump may be drawing air through the deck plate preventing a prime. Check seal at deck plate marked "WASTE", and lubricate threads.

NO.

REVISION

DATE



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 **MURRAY
YACHT
SALES**

CATALINA YACHTS/MORGAN DIVISION

7200 Bryan Dairy Road
Largo, Florida

CATALINA 400
HOLDING TANK AND MACERATOR SCHEMATIC

DESIGNED BY

DATE

DRAWING NO.

DRAWN BY

7-31-96

400-63000-0

CHECKED BY

SCALE

APPROVED BY

3.0 YACHT SYSTEMS - (Continued)

3.4 AUXILIARY POWER:

3.4.1 GENERAL ENGINE INFORMATION:

For a complete description of your engine, please consult the guide supplied by the engine manufacturer. This can be found in your owner's manual enclosure, or contact Westerbeke at (508) 588-7700.

Two points are worth special attention. Firstly, marine engines work under conditions tougher than those of automotive engines. Your marine engine faces constant torquing not encountered in other applications. For this reason, you must change your engine's crank oil as recommended in the engine manufacturer's guide. Secondly, before using your engine, the shaft coupling must be adjusted within a tolerance of .003" (thousandths of an inch) T.I.R. after launching. This is done during commissioning of the yacht. Be sure that your dealer has made this adjustment before using your engine.

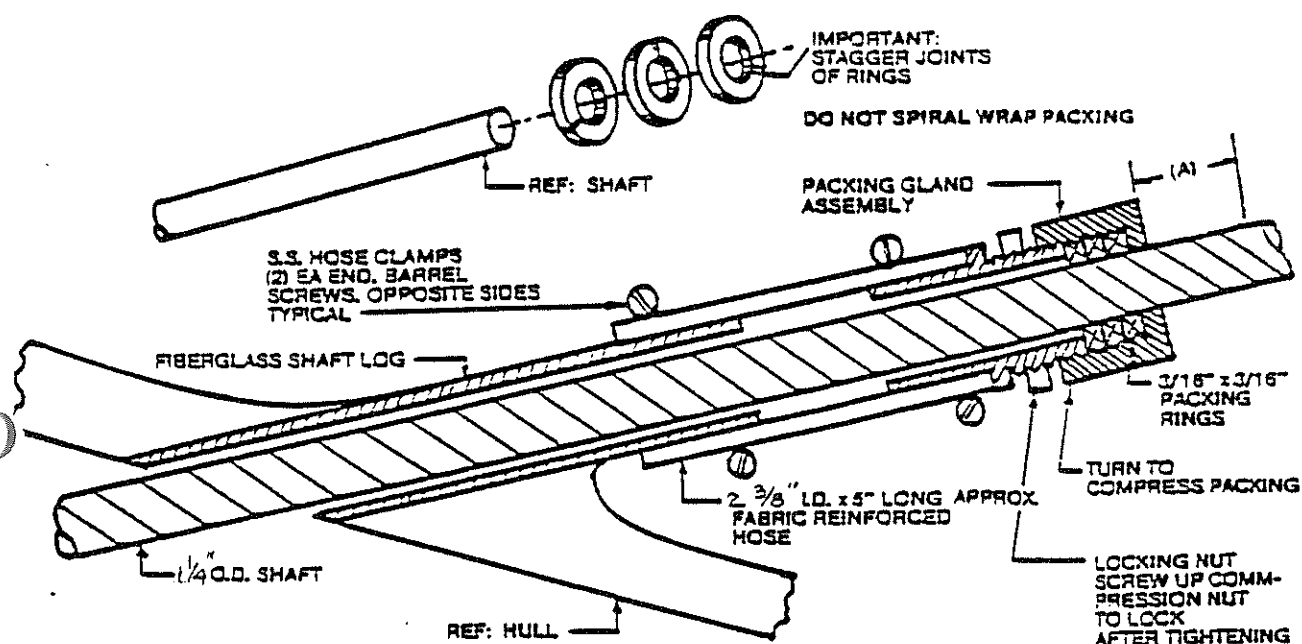
Change the oil regularly. Keep spare parts and alternator belts on hand and use only 3/4 throttle on long passages. Keep your fuel tank full whenever possible to prevent water condensation in your fuel tank.

To retard electrolysis, we recommend installing a zinc collar immediately on the propeller shaft when the boat is to be used in salt water.

NO.

REVISION

DATE



- (A) MAINTAIN CLEARANCE BETWEEN ENGINE COUPLING AND PACKING GLAND FOR REMOVAL AND REPACKING OF GLAND
- (B) SHAFT MUST NOT CONTACT GLAND OR LOG, SHAFT MUST BE IN CENTER OF LOG AND GLAND.
- (C) PACKING GLAND SHOULD NOT BE OVER TIGHTENED, ONE TO TWO DRIPS PER MINUTE IS NORMAL

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CATALINA YACHTS/MORGAN DIVISION

7200 Bryan Dairy Road
Largo, Florida

CATALINA 400 PACKING GLAND ASSEMBLY

DESIGNED BY	DATE	DRAWING NO.
DRAWN BY	3-7-84	400-58001-0
CHECKED BY	SCALE	
APPROVED BY		

3.0 YACHT SYSTEMS - (Continued)

3.4.3 SHAFT PACKING GLAND (STUFFING BOX):

The packing gland is located under the cabin sole at the base of the companion way ladder.

A properly adjusted shaft packing gland should drip slightly (from 1 to 2 drops per minute) with the engine off. Too loose an adjustment will allow too much water in the bilge and engine operation will spray water from the shaft. Too tight an adjustment will rob the engine of power, and the lack of water lubrication in the packing gland can generate enough heat to damage the gland and/or score the propeller shaft.

ADJUSTMENT:

1. Hold the packing nut with one wrench, use a second wrench to loosen the lock nut. Turn the lock nut far enough to keep it from interfering with the next adjustment (2 or 3 turns).
2. Tighten the packing nut to obtain 4 to 6 drops per minute under power. Hand tightening of the packing nut is often sufficient to obtain this adjustment. If this is not the case, an additional 1/4 to 1/2 turn with the wrench should produce the desired results.
3. Hold the packing nut in place with one wrench, and use the second wrench to bring the locking nut securely against the packing nut. Make certain that the locking nut is tight. Failure to do this could allow the packing nut to back off when the engine is operating.
4. Operate the engine at slow speeds in forward and reverse and use a light to check for excessive water at the packing nut. Shut off the engine and recheck packing for proper drip.

3.4.4 SHAFT ALIGNMENT:

For proper operation of the engine, the propeller shaft and engine must be aligned.

Alignment is gauged at the engine and shaft coupling. Alignment procedures must be done with the boat in the water after the mast is stepped and the rig is tuned.

1. The propeller shaft is dimpled (1/8" deep) for two (2) coupling set screws. The set screws must be safety wired, using the stainless steel wire provided, as illustrated. Check key in keyway, as it must be in place between shaft and coupling.
2. Remove coupling flange bolts and check propeller shaft for clearance. Adjust stuffing box so that excessive seepage is prevented, yet the shaft is allowed to spin freely.
3. Slide shaft away from engine and check coupling mating surfaces. These must be clean.

3.0 YACHT SYSTEMS - (Continued)

4. Slide shaft forward to connect coupling surfaces. Pilot on transmission flange must align with pilot on shaft coupling flange. This is an indication of correct axial alignment.
5. With coupling flanges in contact, measure gap around edge of coupling flanges with .003" feeler gauge. Maximum allowable gap at any point is three thousandths of an inch. Take this measurement several times ... rotating shaft 1/4 turn each time. Any gap in excess of .003" must be corrected by changing engine position, especially fore/aft tilt.

For example, excessive gap at the bottom of the coupling (see drawing) indicates engine is tilted too far aft (front too high). With a wrench, loosen lock nuts on forward motor mount(s). Lower front of engine by clockwise rotation of motor mount nuts. Remeasure gap at coupling. A gap at the top of the coupling would require the exact reverse procedure.

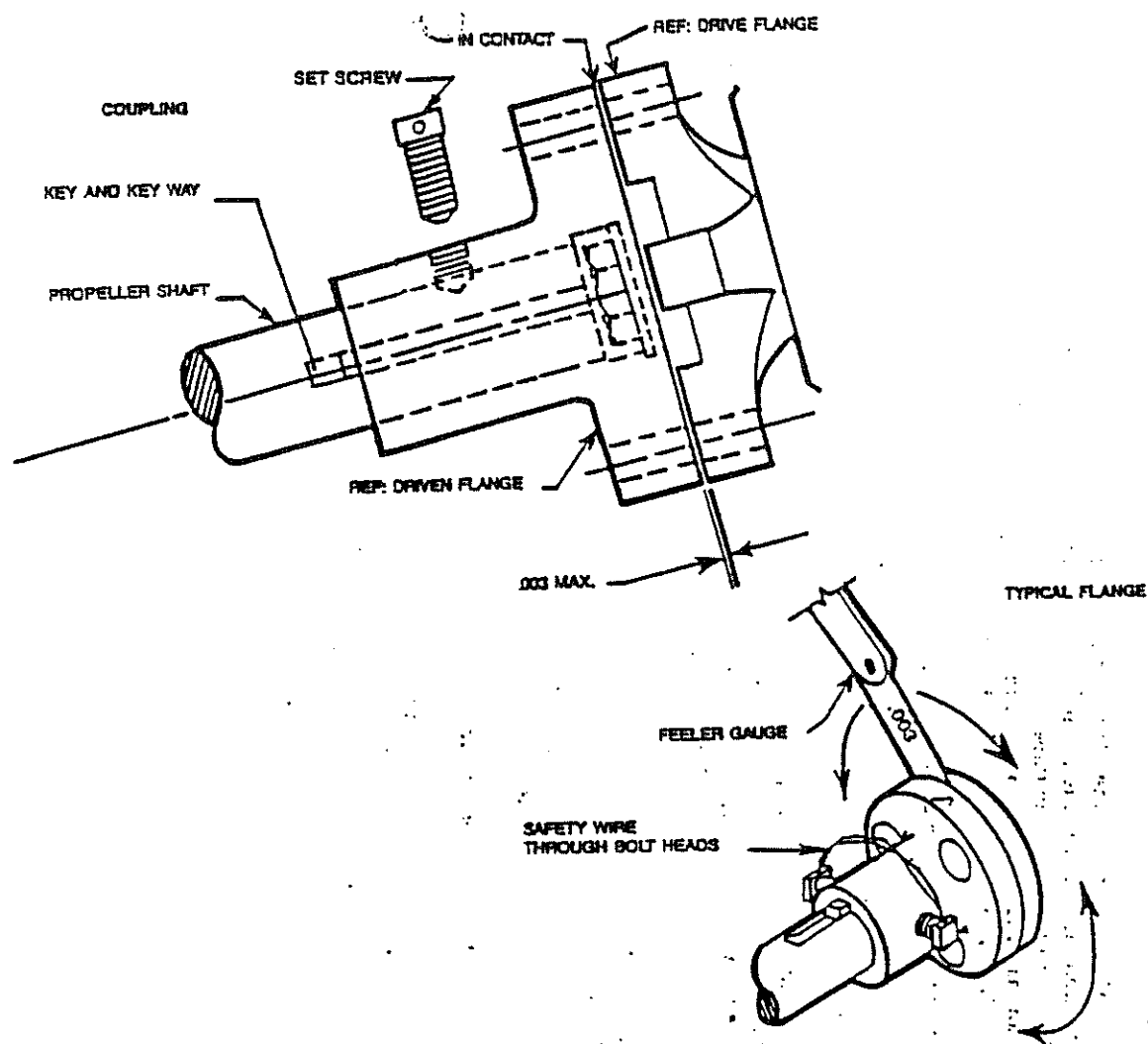
6. Pull shaft aft as in step 3. Again slide shaft forward, rechecking axial alignment as in step 4.
7. Repeat steps 5 and 6 until alignment within tolerance is achieved.
8. Tighten motor mount lock nuts and install coupling.

NOTE: Alignment should be checked yearly, or whenever any excess vibration is noticed. The alignment can also be affected by changes in rigging tension.

NO.

REVISION

DATE



MEASURE GAP BETWEEN MATING FACES OF COUPLING FLANGES. MAXIMUM ALLOWABLE GAP AT ANY POINT IS .003 WHEN ANY POINT OF COUPLING FACES ARE IN CONTACT. TAKE THIS MEASUREMENT SEVERAL TIMES, ROTATING SHAFT 1/4 TURN EACH TIME. THIS MEASUREMENT MUST BE MADE WITH COUPLING BOLTS REMOVED.

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CATALINA YACHTS/MORGAN DIVISION

7200 Bryan Dairy Road
Largo, Florida

CATALINA 400 SHAFT ALIGNMENT

DESIGNED BY

DATE

DRAWING NO.

DRAWN BY

8-9-94

400-58000-0

CHECKED BY

SCALE

APPROVED BY

3.0 YACHT SYSTEMS - (Continued)

3.4.6 FUELING:

The fuel system of the Catalina 400 is illustrated and consists of an 44 gallon aluminum fuel tank, fuel suction and return lines, a secondary fuel filter on the engine and primary remote filter and water separator, and an electric fuel pump controlled by the engine key switch, a deck fill plate, and an overboard vent through the starboard hullside.

Refer to the engine manual provided for recommended fuel type. A diesel engine does not require an ignition system and is superior to a gasoline engine in dependability. This depends on the clean fuel being supplied to the engine since the close tolerances required by the engine's fuel delivery system make it intolerant of dirt or water contamination. The engine is supplied with primary and secondary filters that prevent contaminants from reaching the engine where they could cause damage. However, a clogged filter, although providing this protection, can also stop an engine. Keeping the filters free of dirt and water is critical.

BEFORE FUELING:

1. Extinguish all smoking materials and check the fueling area for other sources of spark or flame. Remove if found.
2. Shut off the engine and any electrical accessories or devices.
3. De-energize all electrical equipment by turning the selector switch to the off position.
4. Close all hatches and ports.
5. Ensure that a fire extinguisher is readily available.
6. Ensure that the proper (diesel, not gasoline) hose is about to be used.

WARNING: Do not fuel during an electrical storm. Besides the obvious hazard of lightning, the possibility of static discharge is greatly increased at this time.

FUELING PROCEDURE:

1. Remove fill pipe cover using a proper tool.
2. Place nozzle of fuel hose in the fill pipe. Keep the nozzle in contact with the deck plate rim during fueling to avoid the possibility of a static spark.
3. Fill slowly, do not overfill. If it is not possible to see the meter on the fuel pump, the attendant or a crew member should call out the gallonage from the fuel dock. Filling the tank to only 95% of capacity will avoid overflow problems on a hot day.
4. Replace cover, clean up any spilled fuel. If any rags, etc., were used for this purpose, dispose of them ashore.

3.0 YACHT SYSTEMS - (Continued)

5. Check below decks for presence of fumes or fuel leakage. Check bilge, engine space, and main cabin. If fumes or evidence of leakage are found, determine the cause, correct it, and clean up any spillage before proceeding.
6. Open all hatches and ports to ventilate the boat.
7. Switch on battery.
8. The engine should be started only when it is certain that no potentially hazardous conditions exist.

3.4.7 FUEL SANITATION:

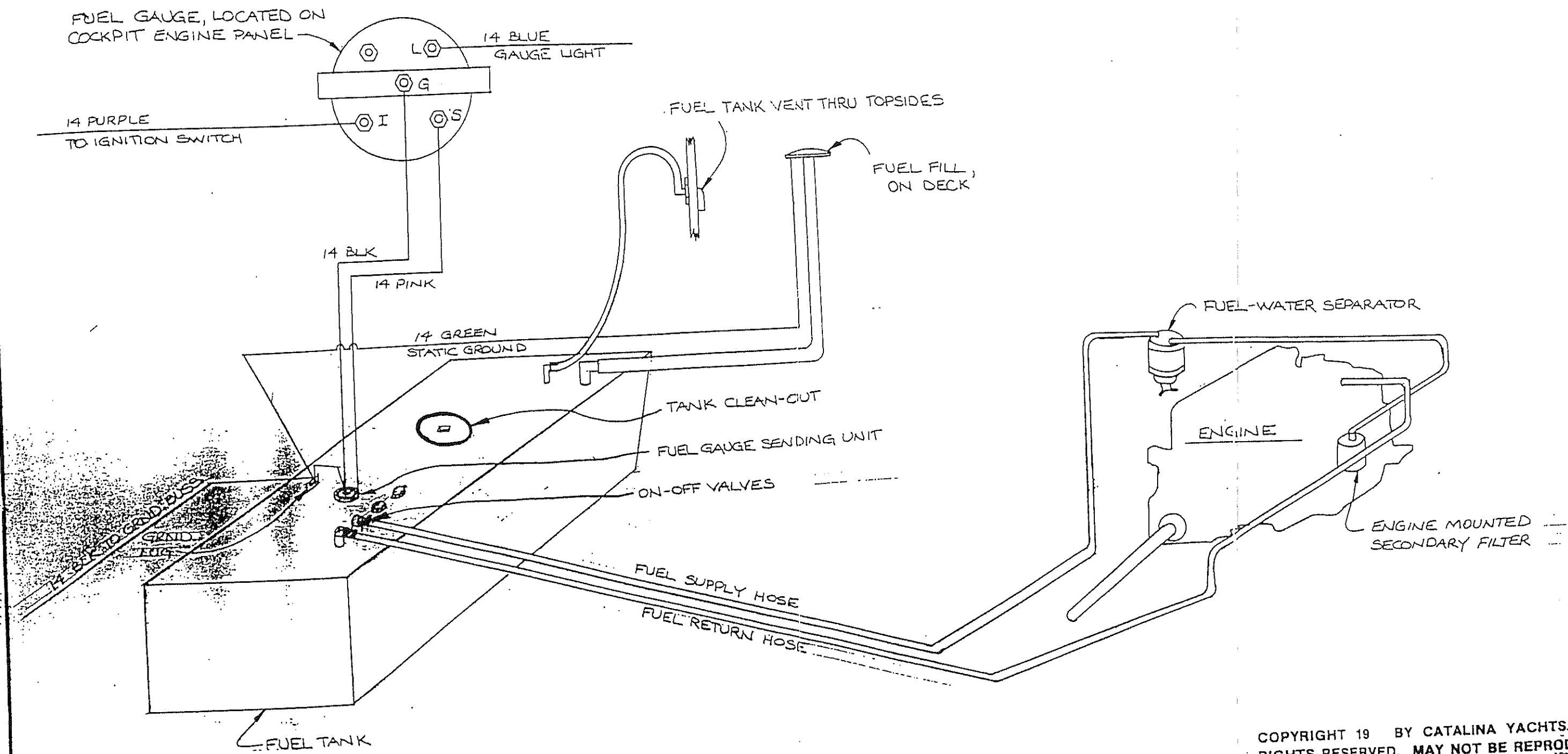
BACTERIAL CONTAMINATION:

Bacterial contamination of the diesel fuel can cause problems. The bacteria needs both water and fuel to exist, and thrive at the fuel/water interface in a fuel tank. As they multiply, they form more water and a filter choking brown slime. Their presence will not be known until rough weather churns up the fuel tank causing clogged filters at the worst possible time.

Keeping water out of the fuel will prevent the problem entirely. However, a certain amount of water due to normal condensation in the tank is to be expected.

FUEL ADDITIVES:

Fuel additives or fungicides provide another means of combating contamination. Additives break the water down to a molecular level, dispersing it throughout the fuel and allowing it to pass harmlessly through the fuel system. Several brands of this product are available at marine stores.



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CATALINA YACHTS/MORGAN DIVISION 7200 Bryan Dairy Road Largo, Florida		
CATALINA 400 FUEL SYSTEM SCHEMATIC		
DESIGNED BY	DATE	DRAWING NO.
DRAWN BY	7-21-94	400-53000-0
CHECKED BY	SCALE	
APPROVED BY	NONE	

3.0 YACHT SYSTEMS - (Continued)

3.4.9 EXHAUST SYSTEM MAINTENANCE:

In-board engine installations on sailboats differ from the engine installations on power boats. The primary difference is that the engine is usually installed below the waterline of the vessel.

The benefits of these locations are that the weight of the engine is where it will not adversely effect trim and that the shaft is at an efficient angle for powering and minimum drag when sailing.

Engine installations below the waterline require special attention to the design of the exhaust system. The discharged cooling water must be looped well above the waterline to avoid sea water from traveling up the exhaust line and entering the engine.

To exhaust the engine, the discharged cooling water and exhaust gas must be "lifted" to a level above the through hull fitting on the hull.

In the Catalina 400, the exhaust cooling water and exhaust gas are lifted above the waterline by an "Aqua-lift" type muffler. The Aqua-lift muffler performs three jobs:

1. It mixes engine gas and water to cool the gas and lower exhaust line temperature.
2. It baffles and deadens engine exhaust noise.
3. It creates pressure required to lift and expel cooling water.

The inlet tube into the "Aqua-lift" type muffler is short and the outlet tube is long, near the bottom of the tank.

As water accumulates in the bottom of the tank, exhaust gas pressure builds in the top of the tank. This forces the cooling water up the exit tube and through exhaust line overboard.

The system requires exhaust pressure in the tank to function. When the starter motor is turning over, before the engine fires, water is being pumped through the cooling system by the belt driven cooling water pump. It is very important not to operate the starter motor for more than 30 seconds if the engine does not fire. Should it be necessary to operate the starter motor more than 30 seconds, water must be drained from the Aqua-lift by opening the drain at the base of the Aqua-lift. The drain valve may be opened until the engine fires, if desired. All Catalina 400's are equipped with anti-siphon valves as an additional precaution to prevent cooling water from entering the engine.

The function of the anti-siphon valve is to prevent cooling water from being siphoned through the through hull valve, through the engine cooling system and into the Aqua-lift muffler when the engine is not operating.

If the muffler were to fill completely with water, water would travel up the inlet tube and enter the engine block.

3.0 YACHT SYSTEMS - (Continued)

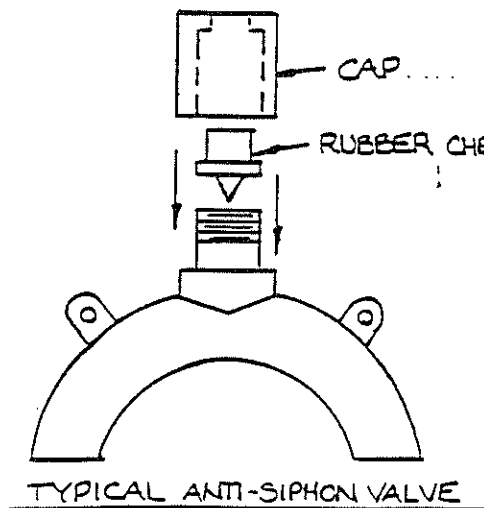
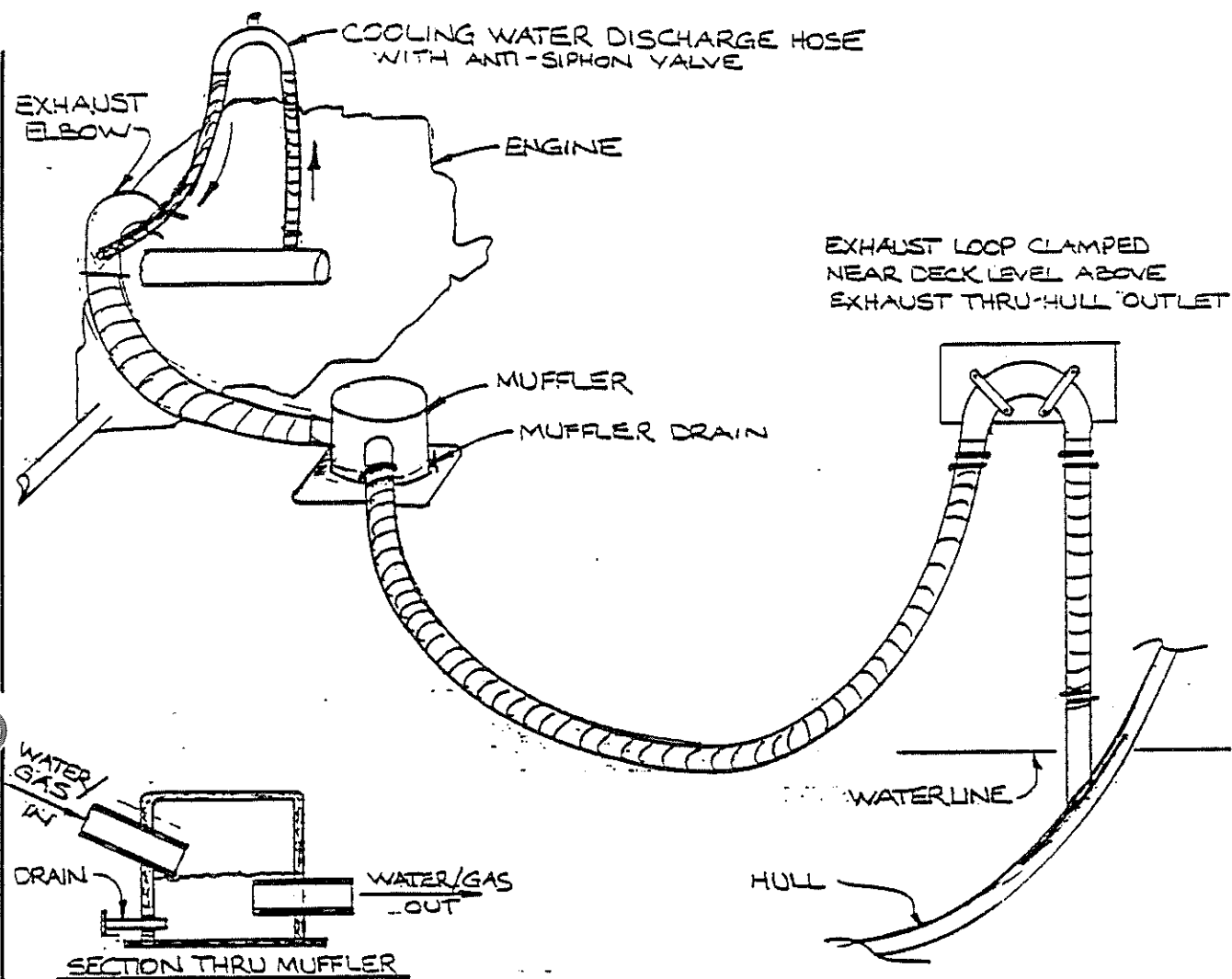
The Catalina 400 exhaust system is basically simple and will provide trouble free service if you perform regular maintenance and inspection. The important points to remember are:

1. Close the engine cooling water through hull valve when you are not operating the engine.
2. Do not operate the starter motor for more than 30 seconds without draining the Aqua-lift muffler.
3. Periodically disassemble the anti-siphon valve. Be sure the valve is not fouled with salt deposits and that it opens freely under the cap.
4. Check the operation by removing the valve:
 - A. Put a finger over one large hole and blow through the other. Air should not escape through the cap.
 - B. If you suck through one large hole with a finger over the other, air should enter the valve through the cap.

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DATE



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CATALINA YACHTS/MORGAN DIVISION

7200 Bryan Dairy Road
Largo, Florida

CATALINA 400 ENGINE EXHAUST SYSTEM

DESIGNED BY

DATE

DRAWING NO.

DRAWN BY

7-22-94

400-59000-C

CHECKED BY

SCALE

APPROVED BY

NO.

REVISION

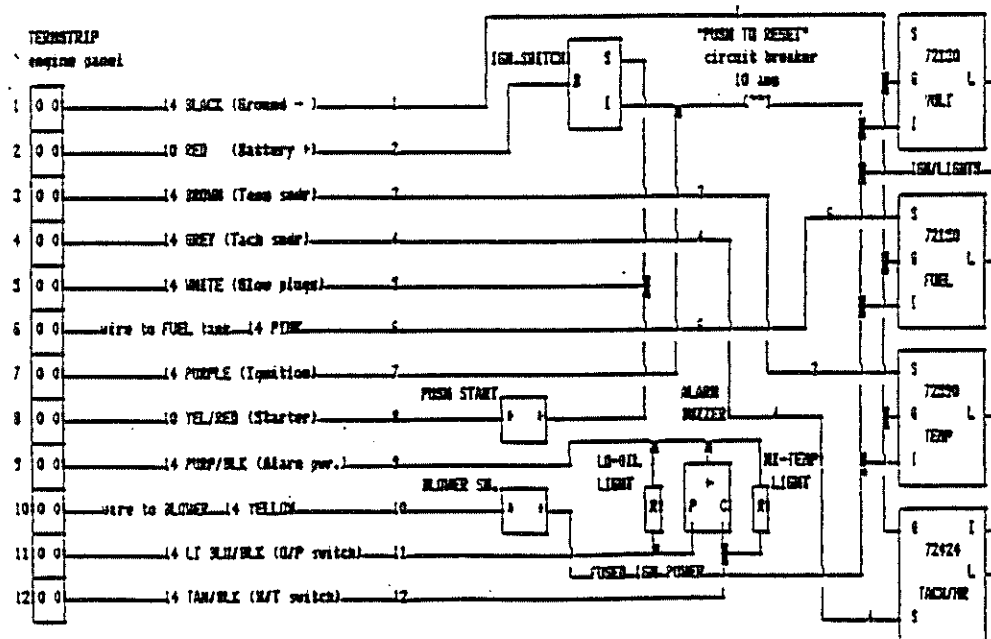
DATE

UNIVERSAL "TYPE A"
harness from engine

15 FOOT extension of harness from engine

TO TERMISTRIP
AT ENGINE PANEL

14 GREEN (Ground -)	1
3 RED (Battery +)	2
14 YELLOW (Tach snr)	3
14 BROWN (Tach snr)	4
14 VIOLET (Blow plugs)	5
	6
10 RED/WHITE	7
10 WHITE (Starter)	8
14 PINK	9
	10
14 LT.BLUE (O/P switch)	11
14 TAN (M/T switch)	12



NOTE

-DRAWING APPLIES TO WESTERBEKE
388 AND 428 ENGINES; TYPE 'A'

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CATALINA YACHTS/MORGAN DIVISION

7200 Bryan Dairy Road
Largo, FloridaCATALINA 400
ENGINE PANEL AND HARNESS SCHEM.

DESIGNED BY

DATE

DRAWING NO.

DRAWN BY

7-29-94

400-56000-C

CHECKED BY

SCALE

APPROVED BY

3.0 YACHT SYSTEMS - (Continued)

3.5 STEERING:

3.5.1 EMERGENCY TILLER

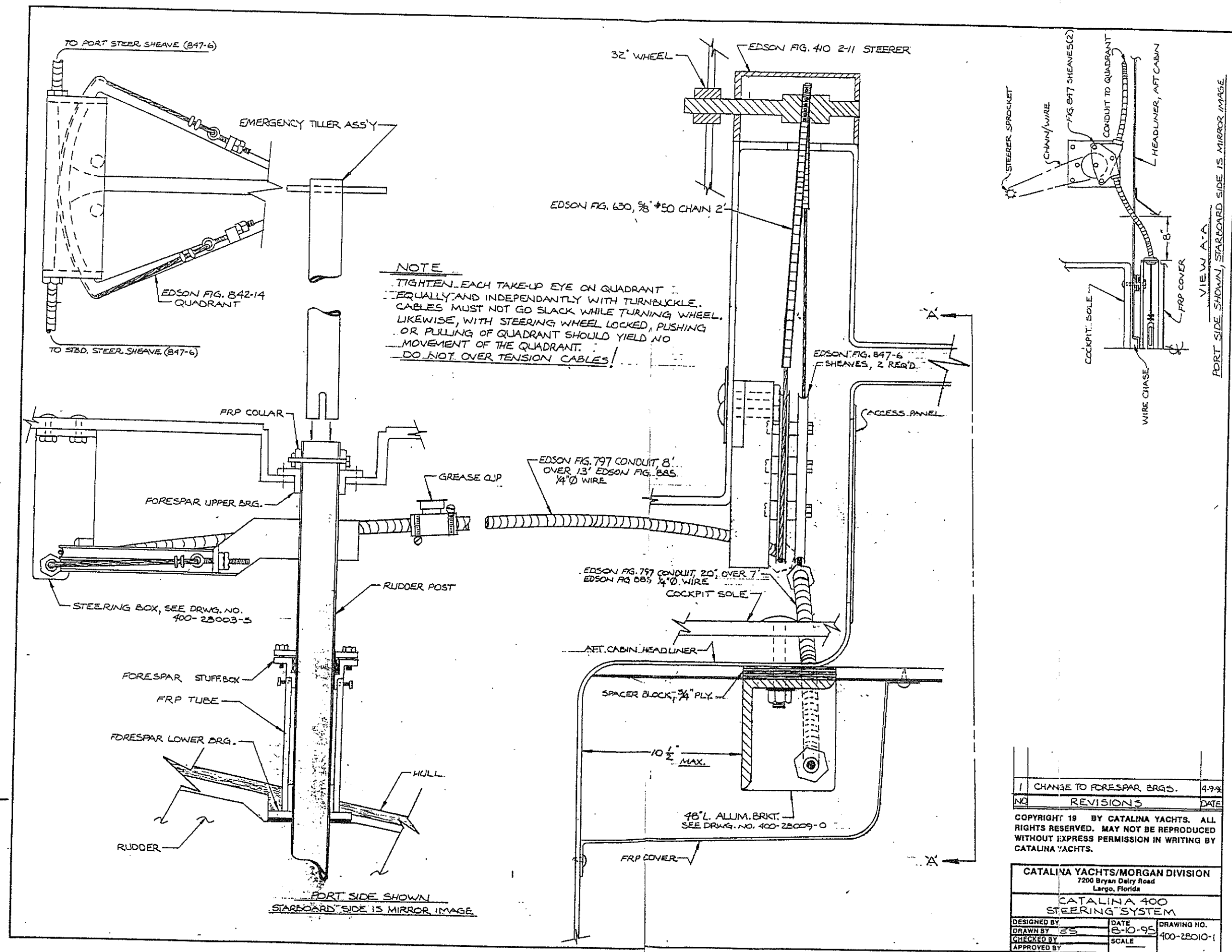
It is recommended that the skipper and crew become familiar with the emergency tiller and its use.

The emergency tiller is stored in a blue bag in the aft lazarette.

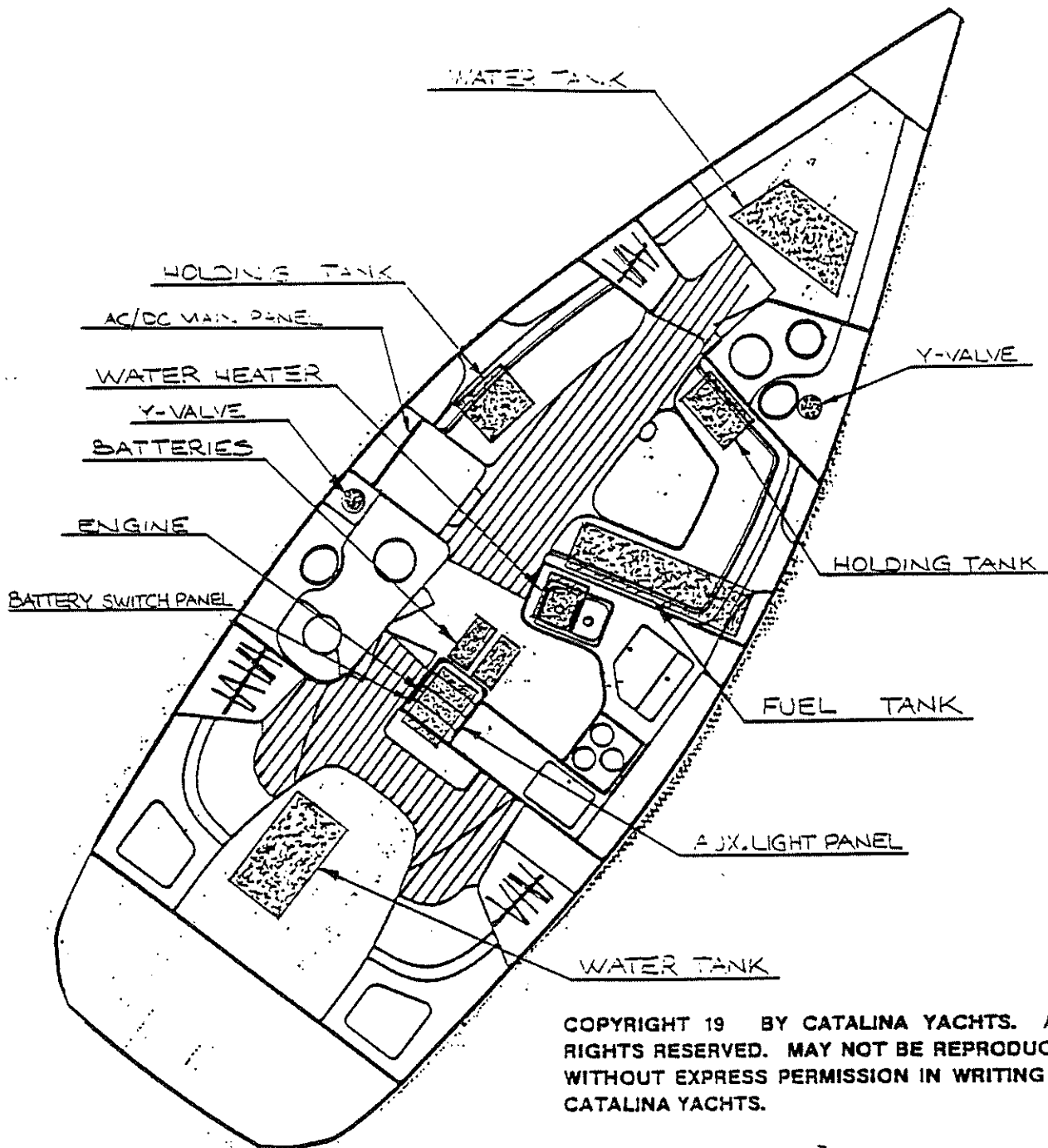
A dry run of the system will minimize confusion in an emergency:

1. Locate the emergency tiller.
2. Remove inspection port cover.
3. Insert the emergency steering tiller in the top of the rudder post.

NOTE: The emergency tiller moves the whole steering assembly, including cables quadrant. These components must be free to move in order to steer the boat.



NO.	REVISION	DATE
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 **MURRAY
YACHT
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CATALINA YACHTS/MORGAN DIVISION

7200 Bryan Dairy Road
Largo, Florida

CATALINA 400 GENERAL LAYOUT

DESIGNED BY	DATE	DRAWING NO.
DRAWN BY	6-23-94	400-40000
CHECKED BY	SCALE	
APPROVED BY		

LPG CONTROL PANEL AND SOLENOID VALVE.

GENERAL INFORMATION

1. Liquified petroleum gas (LPG) tanks should be installed in a sealed compartment and vented overboard.
2. The LPG solenoid should be mounted in the fuel tank compartment
3. All component parts of the LPG system should be carefully installed and tested for leaks.

WARNING: LPG IS HEAVIER THAN AIR AND WILL ACCUMULATE IN LOW AREAS SUCH AS ENGINE ROOMS AND BILGES POSING A FIRE HAZARD.

INSTALLATION GUIDELINES

1. Locate a flat surface that will accommodate the entire length of the solenoid bracket. The valve body becomes secure when the bracket is tightened into position. The valve may be mounted in any position.
2. Connect piping to valve according to marking on valve body. Apply pipe compound sparingly to pipe threads only; if applied to valve threads, it may enter valve and cause operational difficulty. Pipe strain should be avoided by proper alignment of the piping. DO NOT use valve as a lever when tightening. Both "in" and "out" parts of the valve require 1/4 NPT fittings.
3. Wire solenoid to control panel as shown on diagram using 14 ga. wire.
4. The LPG control panel should be located close to the stove where it is visible and easily accessible in the event of any emergency.
5. When the installation is complete, check the entire system for leaks.

OPERATION

When the control switch is turned on, the solenoid should make an audible click and the red indicator light will illuminate the switch signaling that gas is being supplied to the stove.

When use of the stove has been completed, turn off the solenoid control switch and wait for the flame to burn out, then close the burner valve. The LP tank has a manual valve which can be left open when the boat is occupied, however, the valve should be closed when the boat is left unattended.

3.0 YACHT SYSTEMS - (Continued)

3.6.2 GALLEY STOVE:

There is provision for a Gimballed stove with oven on the starboard side of the galley area. A three-burner LPG stove is the factory standard installation. It comes with an operation and maintenance booklet provided by the stove manufacturer. The standard LPG gas bottle is in the starboard side transom locker. The locker is fitted with a drain and vent fitting on the transom. Keep these clear at all times.

Follow the stove operation instructions located on the stove and on the tank compartment carefully.

A few additional points of operation for the standard LPG stove are:

It is recommended that every time the LPG tank valve is opened for use, the operator close the valve and watch that the gauge needle remains constant. The gauge should read approximately 110 PSI. If you can detect a falling in pressure over a 15-minute period of time, there is a leak. LEAKS CAN BE DANGEROUS.

- a. If a leak occurs, check all appliance burners to see if they are in the "OFF" position.
- b. Make sure the oven control is in the "OFF" position.
- c. Check all fittings with a soap and water solution. NEVER USE FLAME TO CHECK FOR LEAKS.

If you cannot find the leak, contact the stove manufacturer promptly.

To light the oven: Light the right front burner to bleed air from the system for at least one (1) minute. Turn the temperature control knob from the "OFF" position to the "PILOT ON" position. After this has been done, light the pilot in the oven (constant pilot).

After the oven pilot is lit, turn the oven temperature control knob to the desired temperature.

Notes on the Solenoid: The solenoid must be turned on to test gauge for leaks. Both the solenoid and the tank valve must be turned on to receive fuel. The solenoid is an electrical device for turning on or off the fuel from inside the cabin at the galley.

"It is important to check out your LPG appliance system each time you fill the tank, but certainly at least once per year. As a reminder please follow the enclosed operating and test procedures."

3.0 YACHT SYSTEMS - (Continued)

CAUTION

1. This system is designed for use with liquified petroleum gas (LPG) only. Do not connect compressed natural gas (CNG) to this system.
2. Keep cylinder valves closed when boat is unattended. Close them immediately in any emergency. When on board, cylinder valves or solenoid valves shall be closed when appliances are not in use.
3. Be sure all appliance valves are closed before opening cylinder valve.
4. Test for system leakage each time the cylinder supply valve is opened for appliance use. Close all appliance valves. Open, then close cylinder supply valve. Observe pressure gauge at the regulating device and see that it remains constant for not less than five minutes before any appliance is used. If any leakage is evidenced by a pressure drop check system with a soapy water or detergent solution and repair before operating system.
5. Test system for leakage at least every two weeks and after any emergency in accordance with paragraph (4) above. Repeat the test for a multi-cylinder system.

Never use flame to check for leaks.

4.0 MAINTENANCE GUIDE

4.1 PRE-USES MAINTENANCE:

RIGGING:

1. Inspect turnbuckles - tighten if necessary, inspect safety wires.
2. Inspect clevis pins and cotter pins.
3. Visually inspect spreader tips and other areas where sails may chafe during sailing, replace tape as necessary.
4. Halyards free and not tangled.
5. Inspect mast hardware attachment bolts, tighten as required.

HULL AND DECK INSPECTION:

1. Tiller moves freely, pedestal steering OK, rudder post packing gland.
2. Bilges and compartments are dry.
3. Through hull valves, hoses, and clamps, OK.
4. Check running lights.

ENGINE:

1. Check engine oil and fuel levels.
2. Packing gland OK, cooling water intake valve opens and closes OK.
3. Throttle shift OK.
4. Blower system OK.
5. Check bilge areas for fuel before starting engine.

4.2 MONTHLY MAINTENANCE:

RIGGING:

1. Inspect chain plates, fastenings, and bolts, tighten as necessary.
2. Inspect blocks, shackles, cotter pins.
3. Check rigging tune, rigging wire condition.
4. Check turnbuckles and locking pins.

HULL AND DECK:

1. Check cockpit drains, clear debris.
2. Inspect hull valves, open and close freely.
3. Winches turn freely, lubricate as per manufacturer's recommendations.
4. Clean and oil exterior teak as necessary.
5. Clean and wax gel coat surfaces as necessary.

ENGINE:

1. Check oil and fluid levels.
2. Battery: Check fluid levels and tie-downs.
3. Tighten all bolts and nuts to proper torque.
4. Check fuel tank fittings, and hose clamps.
5. Disassemble and inspect cooling system anti-siphon (located under galley counter near sink).
6. Check bolts.
7. Check filters.

4.3 SEASONAL MAINTENANCE:

RIGGING:

1. Mast head pins and sheaves turn freely.
2. Halyards and fittings are in good condition.
3. Spreader tips and bases, and mast fittings, OK.
4. All shroud terminations and swaged fittings, check for cracks or corrosion.
5. Gooseneck assembly and boom assembly.
6. Mast, boom, and spreaders cleaned and waxed.

4.0 MAINTENANCE GUIDE - (Continued)

7. Lifelines and stanchions all OK. All pins and fittings are secure, cotter rings taped. Turnbuckles, pelican hooks and connector loops OK. Screw fittings check for thread wear.

HULL, DECK AND CABIN:

1. All chainplates and through bolts tight.
2. Disassemble winches and lubricate bearings and pawls.
3. Inspect and coat electrical system connections, battery tie downs and terminal connectors to prevent corrosion.
4. Drain and flush fresh water system.
5. Check head and anti-siphon valve in toilet.
6. Hatch gaskets, and hold-down fasteners.
7. Bottom, keel, and rudder condition of anti-fouling paint.
8. Lifelines, stanchions, and pelican hooks.

ENGINE:

1. Check shaft alignment, repack stuffing box if necessary.
2. Clean motor thoroughly.
3. Inspect fuel system.
4. Tune engine as per manufacturers recommendations.
5. Exhaust system, check for leaks or deterioration, insulation in place.

4.4 FIBERGLASS MAINTENANCE AND REPAIR:

One of the major benefits of a fiberglass boat is the elimination of maintenance chores required by other materials. You have only three relatively easy maintenance rules to follow to keep your boat looking like new.

1. Each year clean, buff and wax the exterior of the boat.
2. Touch up and patch scratches, scars and small breaks.
3. Repair any major damage as soon as possible to avoid additional damage to the hull or deck.

Most fiberglass boats are manufactured of two types of material, permanently bonded together by a chemical reaction. The outside surface is formed by a colored gel coat. This is a special resin material containing concentrated color. It provides a smooth, finished surface.

The second type is made up of polyester and/or vinylester resin reinforced with laminations of fiberglass mat, cloth, or woven roving. Both the gel coat and polyester resin are cured by a chemical catalyst which causes them to form a hard, strong mass that is highly resistant to impact and damage.

After sailing, a good hosing down with fresh water and a mild detergent will keep your boat sparkling fresh and clean. The non-skid surfaces may need to be scrubbed with detergent. Smooth glass areas may be polished with liquid wax or any good fiberglass wax to add extra luster. In the case of older boats, where some fading or the gel coat has occurred, the surface should be buffed with polishing compound and then wax finished.

When buffing the boat to restore its finish, care should be taken not to cut through the gel coat surface. This is especially true on corners and edges of the hull. A power buffer may be used or the work may be done by hand, using a lightly abrasive rubbing compound such as Mirro Glaze No. 1 for power buffers, or Dupont No. 7 for hand buffing. Any high quality paste wax may be used after buffing.

RECEIVED JAN 17 1995

MATERIAL SAFETY DATA SHEET

Page 1

FOR GELCOATS, RESINS, AND RELATED MATERIALS

Prepared by- BK

Date of Preparation- 01-11-95

Manufacturer: NESTE POLYESTER

Address : 5106 Wheeler Ave.
Fort Smith, AR 72901

For: CATALINA YACHTS, INC.

7200 BRYAN DAIRY ROAD

LARGO

FL 34647

Telephone No.: (501) 646-7865

CHEMTREC (800) 424-9300

SECTION I PRODUCT IDENTIFICATION

Manufacturer's Code Identification: AG-21411

Revision 14

Product Class:

Trade Name: NEW GRAY GEL COAT

HMIS Information: Health- 2

Flammability- 3

Reactivity- 1

Personal Protective Equipment- I

Safety Glasses, Gloves, & Combination Dust and Vapor Respirator

SECTION II HAZARDOUS INGREDIENTS

MATERIAL %

14 METHYL METHACRYLATE

CAS# 80-62-6

% BY WT: 5-10

EXPOSURE LIMIT:

ACGIH TLV/TWA

100 PPM

TLV-STEL

NONE

25 STYRENE

CAS# 100-42-5

% BY WT: 34.30

EXPOSURE LIMIT:

ACGIH TLV/TWA

50 PPM

OSHA PEL

50 PPM

TLV-STEL

100 PPM

OTHER LIMITS:

IARC 2B

This product contains one or more reported carcinogens or suspected carcinogens which are noted NTP, IARC, or OSHA-Z in the other limits recommended column.

This product contains pigments which may become a dust nuisance when removed by abrasive blasting, sanding, or grinding.

SECTION III PHYSICAL DATA

Boiling Range: High- 295.0 F Low- 214.0 F
Vapor Pressure: 29.00 MMHG @68 F
Vapor Density: Heavier Than Air
Evaporation Rate: Slower than Ether
Weight per Gallon: 10.34
VOC: .021
Physical State: LIQUID
Appearance: GRAY
Odor: AROMATIC
Water Solubility: INSOLUBLE
UN Number: 1866 RESIN SOLUTION, FLAMMABLE

SECTION IV FIRE AND EXPLOSION HAZARD DATA

OSHA Flammability Classification: Class 1C DOT: Flammable Liquid
Actual Flashpoint TCC: 81.0 F
Explosion Level: Lower- 1.1 Upper- 12.5
A water stream can scatter flames. A spray of water may be used to cool fire-exposed containers.
EXTINGUISHING MEDIA
Use Foam, CO2, Dry Chemical, Water Fog
Fire fighters should use self-contained breathing apparatus with full
cepiece.

USUAL FIRE AND EXPLOSION HAZARD:
Keep containers tightly closed. Isolate from heat, electrical equipment, sparks, and open flame. Vapors may be heavier than air and may travel along the ground before ignition/flashing back to vapor source. Keep welding or cutting equipment away from product.

SECTION V HEALTH HAZARD DATA

EFFECTS OF EXCESSIVE OVEREXPOSURE

Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal. Do not breathe vapors or spray mist. Wear an appropriate, properly fitted respirator (NIOSH/MSHA approved) during and after application unless air monitoring demonstrates vapor/mist levels are below applicable limits. Follow respirator manufacturer's directions for respirator use.

Vapors of this product may cause irritation of the eyes, nose, throat, upper respiratory tract, mucous membranes, and skin.

FIRST AID

EYE CONTACT: Flush with luke warm water for 15 minutes. Seek physician immediately.

SKIN CONTACT: Flush wash with copious amounts of luke warm water. Remove contaminated clothing promptly. Wash thoroughly with soap and water.

HALATION: Remove exposed individual to fresh air. Restore breathing required. Contact a physician immediately.

NESTE POLYESTER

AG-21411 MATERIAL SAFETY DATA SHEET

Page 3

NEW GRAY GEL COAT

SECTION: Rinse mouth immediately. Give exposed individual 6 to 8 ounces of liquid. (Never give anything by mouth to an unconscious person.) Do NOT induce vomiting unless advised by a physician. Contact a physician immediately.

The International Agency for Research on Cancer (IARC) has classified styrene as a possible human carcinogen (class 2B). The IARC 2B classification is not based on significant new evidence that styrene might be a carcinogen, but on a revised IARC classification scheme and new data on styrene oxide.

SECTION VI REACTIVITY DATA

CONDITIONS TO AVOID

Avoid exposure to sparks, open flame, hot surfaces, and all sources of heat and ignition.

PRODUCT STABILITY: Stable; hazardous decomposition not expected; thermal decomposition may produce toxic oxides of carbon and/or nitrogen.

INCOMPATIBILITY (Materials to Avoid)

This product is incompatible with strong acids, peroxides, and other oxidizing agents, organic metal soaps.

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Stay upwind and away from spill unless wearing appropriate protective equipment. Stop and/or contain discharge if it may be done safely. Keep all sources of ignition away. Ventilate area of spill. Use non-sparking tools for cleanup. Cover with inert material to reduce fumes. Keep out of drains, sewers, or waterways. Contact fire authorities. Notify local health and pollution control agencies. Call spill response teams if large spill.

WASTE DISPOSAL METHOD

DO NOT FLUSH TO SEWER, WATERSHED, OR WATERWAY.

Dispose of in accordance with local, state and federal regulations. Do not incinerate closed containers.

SECTION VIII SAFE HANDLING AND USE INFORMATION

VENTILATION

Use ventilation as required to control vapor concentrations. Avoid prolonged or repeated breathing of vapors. If exposure exceeds TLV, use a NIOSH-approved respirator to prevent overexposure.

PROTECTIVE GLOVES

Required for prolonged or repeated contact. Wear resistant gloves such as natural rubber, neoprene, buna N or nitrile. An apron should be worn to avoid skin contact.

RESPIRATORY PROTECTION

In outdoor or open areas use (NIOSH/MSHA approved) mechanical filter respirator to remove solid airborne particles of overspray during spray application. In restricted ventilation areas use (NIOSH/MSHA approved) chemical-mechanical filters designed to remove a combination of particulate and gas and vapor. In confined areas use (NIOSH/MSHA approved) full line type respirators or hoods. Respiratory protection may also be

AG-21411

NESTE POLYESTER

MATERIAL SAFETY DATA SHEET

Page

4

NEW GRAY GEL COAT

Necessary in any later manufacturing operations in which the product may become airborne in the form of vapor or dust.

SECTION IX SPECIAL PRECAUTIONS

HANDLING AND STORAGE: Use in accordance with good industrial workplace practices; avoid unnecessary contact; wash thoroughly after handling; store in a dry area away from excessive heat.

OTHER PRECAUTIONS: For industrial use only.

Personnel should avoid inhalation of vapors. Personal contact with the product should be avoided. Should contact be made, remove saturated clothing and flush affected skin areas with water. Containers of this material may be hazardous when emptied. Since emptied containers retain product residues (vapor, liquid, and/or solid), all hazard precautions given in this sheet must be observed.

NOTICE - Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal.

SECTION IX (B) DOT INFORMATION

Flammable Liquid 3 Packing Group III

SECTION X Section 313 Toxic Chemicals

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act of 1986 and of 40 CFR 372:

Chemical	CAS Number	Weight %
METHYL METHACRYLATE	80-62-6	5-10
STYRENE	100-42-5	34.30

THE INFORMATION CONTAINED HEREIN IS INFORMATION RECEIVED FROM OUR RAW MATERIAL SUPPLIERS AND OTHER SOURCES AND IS BELIEVED TO BE RELIABLE. THIS DATA IS NOT TO BE TAKEN AS A WARRANTY OR REPRESENTATION FOR WHICH NESTE POLYESTER ASSUMES LEGAL RESPONSIBILITY

RECEIVED JAN 17 1995

MATERIAL SAFETY DATA SHEET

Page 1

FOR GELCOATS, RESINS, AND RELATED MATERIALS

Prepared by- BK

Date of Preparation- 01-11-95

For: CATALINA YACHTS, INC.

Manufacturer: NESTE POLYESTER

7200 BRYAN DAIRY ROAD

Address : 5106 Wheeler Ave.
Fort Smith, AR 72901

LARGO FL 34647

Telephone No.: (501) 646-7865

CHEMTREC (800) 424-9300

SECTION I PRODUCT IDENTIFICATION

Manufacturer's Code Identification: NG-20486

Revision 14

Product Class:

Trade Name: SEASHELL GEL COAT

HMIS Information: Health- 2

Flammability- 3

Reactivity- 1

Personal Protective Equipment- I

Safety Glasses, Gloves, & Combination Dust and Vapor Respirator

SECTION II HAZARDOUS INGREDIENTS

MATERIAL %

10 STYRENE

CAS# 100-42-5

% BY WT: 32.57

EXPOSURE LIMIT:

ACGIH TLV/TWA 50 PPM

OSHA PEL 50 PPM

TLV-STEL 100 PPM

OTHER LIMITS:

IARC 2B

16 METHYL METHACRYLATE

CAS# 80-62-6

% BY WT: < 5

EXPOSURE LIMIT:

ACGIH TLV/TWA 100 PPM

TLV-STEL NONE

This product contains one or more reported carcinogens or suspected carcinogens which are noted NTP, IARC, or OSHA-Z in the other limits recommended column.

This product contains pigments which may become a dust nuisance when removed by abrasive blasting, sanding, or grinding.

NG-20486 NESTE POLYESTER Page 2
SEASHELL GEL COAT MATERIAL SAFETY DATA SHEET

SECTION III PHYSICAL DATA

Boiling Range: High- 295.0 F Low- 214.0 F
Vapor Pressure: 29.00 MMHG @68 F
Vapor Density: Heavier Than Air
Evaporation Rate: Slower than Ether
Weight per Gallon: 11.15
VOC: .012
Physical State: LIQUID
Appearance: OFF-WHITE
Odor: AROMATIC
Water Solubility: INSOLUBLE
UN Number: 1866 RESIN SOLUTION, FLAMMABLE

SECTION IV FIRE AND EXPLOSION HAZARD DATA

OSHA Flammability Classification: Class 1C DOT: Flammable Liquid
Actual Flashpoint TCC: 83.0 F
Explosion Level: Lower- 1.1 Upper- 12.5
A water stream can scatter flames. A spray of water may be used to cool
fire-exposed containers.
EXTINGUISHING MEDIA
Use Foam, CO2, Dry Chemical, Water Fog
Fire fighters should use self-contained breathing apparatus with full
piece.

USUAL FIRE AND EXPLOSION HAZARD:
Keep containers tightly closed. Isolate from heat, electrical equipment,
sparks, and open flame. Vapors may be heavier than air and may travel
along the ground before ignition/flashing back to vapor source. Keep
welding or cutting equipment away from product.

SECTION V HEALTH HAZARD DATA

EFFECTS OF EXCESSIVE OVEREXPOSURE
Reports have associated repeated and prolonged occupational overexposure to
solvents with permanent brain and nervous system damage. Intentional
misuse by deliberately concentrating and inhaling the contents may be
harmful or fatal. Do not breathe vapors or spray mist. Wear an appro-
priate, properly fitted respirator (NIOSH/MSHA approved) during and after
application unless air monitoring demonstrates vapor/mist levels are below
applicable limits. Follow respirator manufacturer's directions for
respirator use.
Vapors of this product may cause irritation of the eyes, nose, throat,
upper respiratory tract, mucous membranes, and skin.

FIRST AID

EYE CONTACT: Flush with luke warm water for 15 minutes. Seek physician
immediately.
SKIN CONTACT: Flush wash with copious amounts of luke warm water. Remove
contaminated clothing promptly. Wash thoroughly with soap and water.
INHALATION: Remove exposed individual to fresh air. Restore breathing
required. Contact a physician immediately.

NG-20486

NESTE POLYESTER

MATERIAL SAFETY DATA SHEET

Page 3

SEASHELL GEL COAT

INGESTION: Rinse mouth immediately. Give exposed individual 6 to 8 ounces of liquid. (Never give anything by mouth to an unconscious person.) Do NOT induce vomiting unless advised by a physician. Contact a physician immediately.

The International Agency for Research on Cancer (IARC) has classified styrene as a possible human carcinogen (class 2B). The IARC 2B classification is not based on significant new evidence that styrene might be a carcinogen, but on a revised IARC classification scheme and new data on styrene oxide.

SECTION VI REACTIVITY DATA

CONDITIONS TO AVOID

Avoid exposure to sparks, open flame, hot surfaces, and all sources of heat and ignition.

PRODUCT STABILITY: Stable; hazardous decomposition not expected; thermal decomposition may produce toxic oxides of carbon and/or nitrogen.

INCOMPATIBILITY (Materials to Avoid)

This product is incompatible with strong acids, peroxides, and other oxidizing agents, organic metal soaps.

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Stay upwind and away from spill unless wearing appropriate protective equipment. Stop and/or contain discharge if it may be done safely. Keep all sources of ignition away. Ventilate area of spill. Use non-sparking tools for cleanup. Cover with inert material to reduce fumes. Keep out of drains, sewers, or waterways. Contact fire authorities. Notify local health and pollution control agencies. Call spill response teams if large spill.

WASTE DISPOSAL METHOD

DO NOT FLUSH TO SEWER, WATERSHED, OR WATERWAY.

Dispose of in accordance with local, state and federal regulations. Do not incinerate closed containers.

SECTION VIII SAFE HANDLING AND USE INFORMATION

VENTILATION

Use ventilation as required to control vapor concentrations. Avoid prolonged or repeated breathing of vapors. If exposure exceeds TLV, use a NIOSH-approved respirator to prevent overexposure.

PROTECTIVE GLOVES

Required for prolonged or repeated contact. Wear resistant gloves such as natural rubber, neoprene, buna N or nitrile. An apron should be worn to avoid skin contact.

RESPIRATORY PROTECTION

In outdoor or open areas use (NIOSH/MSHA approved) mechanical filter respirator to remove solid airborne particles of overspray during spray application. In restricted ventilation areas use (NIOSH/MSHA approved) chemical-mechanical filters designed to remove a combination of particulate and gas and vapor. In confined areas use (NIOSH/MSHA approved) r line type respirators or hoods. Respiratory protection may also be

NESTE POLYESTER

NG-20486

MATERIAL SAFETY DATA SHEET

Page

4

SEASHELL GEL COAT

cessary in any later manufacturing operations in which the product may become airborne in the form of vapor or dust.

SECTION IX SPECIAL PRECAUTIONS

HANDLING AND STORAGE: Use in accordance with good industrial workplace practices; avoid unnecessary contact; wash thoroughly after handling; store in a dry area away from excessive heat.

OTHER PRECAUTIONS: For industrial use only.

Personnel should avoid inhalation of vapors. Personal contact with the product should be avoided. Should contact be made, remove saturated clothing and flush affected skin areas with water. Containers of this material may be hazardous when emptied. Since emptied containers retain product residues (vapor, liquid, and/or solid), all hazard precautions given in this sheet must be observed.

NOTICE - Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal.

SECTION IX (B) DOT INFORMATION

Flammable Liquid 3 Packing Group III

SECTION X Section 313 Toxic Chemicals

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act of 1986 and of 40 CFR 372:

Chemical	CAS Number	Weight %
STYRENE	100-42-5	32.57
METHYL METHACRYLATE	80-62-6	< 5

THE INFORMATION CONTAINED HEREIN IS INFORMATION RECEIVED FROM OUR RAW MATERIAL SUPPLIERS AND OTHER SOURCES AND IS BELIEVED TO BE RELIABLE. THIS DATA IS NOT TO BE TAKEN AS A WARRANTY OR REPRESENTATION FOR WHICH NESTE POLYESTER ASSUMES LEGAL RESPONSIBILITY

FOR GELCOATS, RESINS, AND RELATED MATERIALS

Prepared by- BK

Date of Preparation- 05-10-94

Manufacturer: NESTE POLYESTER

Address : 5106 Wheeler Ave.
Fort Smith, AR 72901

For: CATALINA YACHTS, INC.

7200 BRYAN DAIRY ROAD

LARGO

FL 34647

Telephone No.: (501) 646-7865

CHEMTREC (800) 424-9300

SECTION I PRODUCT IDENTIFICATION

Manufacturer's Code Identification: LG-21400

Revision 14

Product Class:

Trade Name: MIDNIGHT BLUE GEL COAT

HMIS Information: Health- 2

Flammability- 3

Reactivity- 1

Personal Protective Equipment- I

Safety Glasses, Gloves, & Combination Dust and Vapor Respirator

SECTION II HAZARDOUS INGREDIENTS

MATERIAL %

14 METHYL METHACRYLATE

CAS# 80-62-6

% BY WT: 5-10

EXPOSURE LIMIT:

ACGIH TLV/TWA

100 PPM

TLV-STEL

75 PPM

26 STYRENE

CAS# 100-42-5

% BY WT: 32.03

EXPOSURE LIMIT:

ACGIH TLV/TWA

50 PPM

OSHA PEL

50 PPM

TLV-STEL

100 PPM

OTHER LIMITS:

IARC 2B

This product contains one or more reported carcinogens or suspected carcinogens which are noted NTP, IARC, or OSHA-Z in the other limits recommended column.

This product contains pigments which may become a dust nuisance when removed by abrasive blasting, sanding, or grinding.

LG-21400

NESTE POLYESTER
MATERIAL SAFETY DATA SHEET

Page 2

MIDNIGHT BLUE GEL COAT

SECTION III PHYSICAL DATA

Boiling Range: High- 295.0 F Low- 214.0 F
Vapor Pressure: 29.00 MMHG @68 F
Vapor Density: Heavier Than Air
Evaporation Rate: Slower than Ether
Weight per Gallon: 9.99
VOC: .020
Physical State: LIQUID
Appearance: BLUE
Odor: AROMATIC
Water Solubility: INSOLUBLE
UN Number: 1866 RESIN SOLUTION, FLAMMABLE

SECTION IV FIRE AND EXPLOSION HAZARD DATA

OSHA Flammability Classification: Class 1C DOT: Flammable Liquid
Actual Flashpoint TCC: 82.0 F
Explosion Level: Lower- 1.1 Upper- 12.5
A water stream can scatter flames. A spray of water may be used to cool fire-exposed containers.

EXTINGUISHING MEDIA

Use Foam, CO2, Dry Chemical, Water Fog
Fire fighters should use self-contained breathing apparatus with full facepiece.

UNUSUAL FIRE AND EXPLOSION HAZARD:

Keep containers tightly closed. Isolate from heat, electrical equipment, sparks, and open flame. Vapors may be heavier than air and may travel along the ground before ignition/flashback to vapor source. Keep welding or cutting equipment away from product.

SECTION V HEALTH HAZARD DATA

EFFECTS OF EXCESSIVE OVEREXPOSURE

Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal. Do not breathe vapors or spray mist. Wear an appropriate, properly fitted respirator (NIOSH/MSHA approved) during and after application unless air monitoring demonstrates vapor/mist levels are below applicable limits. Follow respirator manufacturer's directions for respirator use.

Vapors of this product may cause irritation of the eyes, nose, throat, upper respiratory tract, mucous membranes, and skin.

FIRST AID

EYE CONTACT: Flush with lukewarm water for 15 minutes. Seek physician immediately.

SKIN CONTACT: Flush wash with copious amounts of lukewarm water. Remove contaminated clothing promptly. Wash thoroughly with soap and water.

INHALATION: Remove exposed individual to fresh air. Restore breathing if required. Contact a physician immediately.

MIDNIGHT BLUE GEL COAT

INGESTION: Rinse mouth immediately. Give exposed individual 6 to 8 ounces of liquid. (Never give anything by mouth to an unconscious person.) Do NOT induce vomiting unless advised by a physician. Contact a physician immediately.

The International Agency for Research on Cancer (IARC) has classified styrene as a possible human carcinogen (class 2B). The IARC 2B classification is not based on significant new evidence that styrene might be a carcinogen, but on a revised IARC classification scheme and new data on styrene oxide.

SECTION VI REACTIVITY DATA

CONDITIONS TO AVOID

Avoid exposure to sparks, open flame, hot surfaces, and all sources of heat and ignition.

PRODUCT STABILITY: Stable; hazardous decomposition not expected; thermal decomposition may produce toxic oxides of carbon and/or nitrogen.

INCOMPATIBILITY (Materials to Avoid)

This product is incompatible with strong acids, peroxides, and other oxidizing agents, organic metal soaps.

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Stay upwind and away from spill unless wearing appropriate protective equipment. Stop and/or contain discharge if it may be done safely. Keep all sources of ignition away. Ventilate area of spill. Use non-sparking tools for cleanup. Cover with inert material to reduce fumes. Keep out of drains, sewers, or waterways. Contact fire authorities. Notify local health and pollution control agencies. Call spill response teams if large spill.

WASTE DISPOSAL METHOD

DO NOT FLUSH TO SEWER, WATERSHED, OR WATERWAY.

Dispose of in accordance with local, state and federal regulations. Do not incinerate closed containers.

SECTION VIII SAFE HANDLING AND USE INFORMATION

VENTILATION

Use ventilation as required to control vapor concentrations. Avoid prolonged or repeated breathing of vapors. If exposure exceeds TLV, use a NIOSH-approved respirator to prevent overexposure.

PROTECTIVE GLOVES

Required for prolonged or repeated contact. Wear resistant gloves such as natural rubber, neoprene, buna N or nitrile. An apron should be worn to avoid skin contact.

RESPIRATORY PROTECTION

In outdoor or open areas use (NIOSH/MSHA approved) mechanical filter respirator to remove solid airborne particles of overspray during spray application. In restricted ventilation areas use (NIOSH/MSHA approved) chemical-mechanical filters designed to remove a combination of particulate and gas and vapor. In confined areas use (NIOSH/MSHA approved) air line type respirators or hoods. Respiratory protection may also be

NESTE POLYESTER
LG-21400 MATERIAL SAFETY DATA SHEET
MIDNIGHT BLUE GEL COAT

Page 4

necessary in any later manufacturing operations in which the product may become airborne in the form of vapor or dust.

SECTION IX SPECIAL PRECAUTIONS

HANDLING AND STORAGE: Use in accordance with good industrial workplace practices; avoid unnecessary contact; wash thoroughly after handling; store in a dry area away from excessive heat.

OTHER PRECAUTIONS: For industrial use only.

Personnel should avoid inhalation of vapors. Personal contact with the product should be avoided. Should contact be made, remove saturated clothing and flush affected skin areas with water. Containers of this material may be hazardous when emptied. Since emptied containers retain product residues (vapor, liquid, and/or solid), all hazard precautions given in this sheet must be observed.

NOTICE - Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal.

SECTION IX (B) DOT INFORMATION

Flammable Liquid 3 Packing Group III

SECTION X Section 313 Toxic Chemicals

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act of 1986 and of 40 CFR 372:

Chemical	CAS Number	Weight %
METHYL METHACRYLATE	90-62-6	5-10
STYRENE	100-42-5	32.03

THE INFORMATION CONTAINED HEREIN IS INFORMATION RECEIVED FROM OUR RAW MATERIAL SUPPLIERS AND OTHER SOURCES AND IS BELIEVED TO BE RELIABLE. THIS DATA IS NOT TO BE TAKEN AS A WARRANTY OR REPRESENTATION FOR WHICH NESTE POLYESTER ASSUMES LEGAL RESPONSIBILITY

FOR GELCOATS, RESINS, AND RELATED MATERIALS

Prepared by- BK

Date of Preparation- 02-11-94

Manufacturer: NESTE POLYESTER

Address : 5106 Wheeler Ave.
Fort Smith, AR 72901

For: CATALINA YACHTS, INC.

7200 BRYAN DAIRY ROAD

LARGO FL 34647

Telephone No.: (501) 646-7865

CHEMTREC (800) 424-9300

SECTION I PRODUCT IDENTIFICATION

Manufacturer's Code Identification: WG-21455

Revision 14

Product Class:

Trade Name: CATALINA WHITE GEL COAT

HMIS Information: Health- 2

Flammability- 3

Reactivity- 1

Personal Protective Equipment- I

Safety Glasses, Gloves, & Combination Dust and Vapor Respirator

SECTION II HAZARDOUS INGREDIENTS

MATERIAL %

07 STYRENE

% BY WT: 32.66

CASH 100-42-5

EXPOSURE LIMIT:

ACGIH TLV/TWA

50 PPM

OSHA PEL

50 PPM

TLV-STEL

100 PPM

OTHER LIMITS:

IARC 2B

13 METHYL METHACRYLATE

% BY WT: < 5

CASH 80-62-6

EXPOSURE LIMIT:

ACGIH TLV/TWA

100 PPM

TLV-STEL

75 PPM

This product contains one or more reported carcinogens or suspected carcinogens which are noted NTP, IARC, or OSHA-Z in the other limits recommended column.

This product contains pigments which may become a dust nuisance when removed by abrasive blasting, sanding, or grinding.

SECTION III PHYSICAL DATA

Boiling Range: High- 295.0 F Low- 214.0 F
Vapor Pressure: 29.00 MMHG @68 F
Vapor Density: Heavier Than Air
Evaporation Rate: Slower than Ether
Weight per Gallon: 11.12
VOC: .012
Physical State: LIQUID
Appearance: WHITE
Odor: AROMATIC
Water Solubility: INSOLUBLE
UN Number: 1846 RESIN SOLUTION, FLAMMABLE

SECTION IV FIRE AND EXPLOSION HAZARD DATA

OSHA Flammability Classification: Class 1C DOT: Flammable Liquid
Actual Flashpoint TCC: 83.0 F
Explosion Level: Lower- 1.1 Upper- 12.5
A water stream can scatter flames. A spray of water may be used to cool fire-exposed containers.

EXTINGUISHING MEDIA

Use Foam, CO2, Dry Chemical, Water Fog
Fire fighters should use self-contained breathing apparatus with full facepiece.

UNUSUAL FIRE AND EXPLOSION HAZARD:

Keep containers tightly closed. Isolate from heat, electrical equipment, sparks, and open flame. Vapors may be heavier than air and may travel along the ground before ignition/flashback to vapor source. Keep welding or cutting equipment away from product.

SECTION V HEALTH HAZARD DATA

EFFECTS OF EXCESSIVE OVEREXPOSURE

Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal. Do not breathe vapors or spray mist. Wear an appropriate, properly fitted respirator (NIOSH/MSHA approved) during and after application unless air monitoring demonstrates vapor/mist levels are below applicable limits. Follow respirator manufacturer's directions for respirator use.

Vapors of this product may cause irritation of the eyes, nose, throat, upper respiratory tract, mucous membranes, and skin.

FIRST AID

EYE CONTACT: Flush with luke warm water for 15 minutes. Seek physician immediately.

SKIN CONTACT: Flush wash with copious amounts of luke warm water. Remove contaminated clothing promptly. Wash thoroughly with soap and water.

INHALATION: Remove exposed individual to fresh air. Restore breathing if required. Contact a physician immediately.

CATALINA WHITE GEL COAT

INGESTION: Rinse mouth immediately. Give exposed individual 6 to 8 ounces of liquid. (Never give anything by mouth to an unconscious person.) Do NOT induce vomiting unless advised by a physician. Contact a physician immediately.

The International Agency for Research on Cancer (IARC) has classified styrene as a possible human carcinogen (class 2B). The IARC 2B classification is not based on significant new evidence that styrene might be a carcinogen, but on a revised IARC classification scheme and new data on styrene oxide.

SECTION VI REACTIVITY DATA

CONDITIONS TO AVOID

Avoid exposure to sparks, open flame, hot surfaces, and all sources of heat and ignition.

PRODUCT STABILITY: Stable; hazardous decomposition not expected; thermal decomposition may produce toxic oxides of carbon and/or nitrogen.

INCOMPATIBILITY (Materials to Avoid)

This product is incompatible with strong acids, peroxides, and other oxidizing agents, organic metal soaps.

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Stay upwind and away from spill unless wearing appropriate protective equipment. Stop and/or contain discharge if it may be done safely. Keep all sources of ignition away. Ventilate area of spill. Use non-sparking tools for cleanup. Cover with inert material to reduce fumes. Keep out of drains, sewers, or waterways. Contact fire authorities. Notify local health and pollution control agencies. Call spill response teams if large spill.

WASTE DISPOSAL METHOD

DO NOT FLUSH TO SEWER, WATERSHED, OR WATERWAY.

Dispose of in accordance with local, state and federal regulations. Do not incinerate closed containers.

SECTION VIII SAFE HANDLING AND USE INFORMATION

VENTILATION

Use ventilation as required to control vapor concentrations. Avoid prolonged or repeated breathing of vapors. If exposure exceeds TLV, use a NIOSH-approved respirator to prevent overexposure.

PROTECTIVE GLOVES

Required for prolonged or repeated contact. Wear resistant gloves such as natural rubber, neoprene, buna N or nitrile. An apron should be worn to avoid skin contact.

RESPIRATORY PROTECTION

In outdoor or open areas use (NIOSH/MSHA approved) mechanical filter respirator to remove solid airborne particles of overspray during spray application. In restricted ventilation areas use (NIOSH/MSHA approved) chemical-mechanical filters designed to remove a combination of particulate and gas and vapor. In confined areas use (NIOSH/MSHA approved) air line type respirators or hoods. Respiratory protection may also be

CATALINA WHITE GEL COAT

necessary in any later manufacturing operations in which the product may become airborne in the form of vapor or dust.

SECTION IX SPECIAL PRECAUTIONS

HANDLING AND STORAGE: Use in accordance with good industrial workplace practices; avoid unnecessary contact; wash thoroughly after handling; store in a dry area away from excessive heat.

OTHER PRECAUTIONS: For industrial use only.

Personnel should avoid inhalation of vapors. Personal contact with the product should be avoided. Should contact be made, remove saturated clothing and flush affected skin areas with water. Containers of this material may be hazardous when emptied. Since emptied containers retain product residues (vapor, liquid, and/or solid), all hazard precautions given in this sheet must be observed.

NOTICE - Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal.

SECTION IX (B) DOT INFORMATION

Flammable Liquid 3 Packing Group III

SECTION X Section 313 Toxic Chemicals

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act of 1986 and of 40 CFR 372:

Chemical	CAS Number	Weight %
STYRENE	100-42-5	32.66
METHYL METHACRYLATE	80-62-6	< 5

THIS INFORMATION CONTAINED HEREIN IS INFORMATION RECEIVED FROM OUR RAW MATERIAL SUPPLIERS AND OTHER SOURCES AND IS BELIEVED TO BE RELIABLE. THIS DATA IS NOT TO BE TAKEN AS A WARRANTY OR REPRESENTATION FOR WHICH NESTE POLYESTER ASSUMES LEGAL RESPONSIBILITY

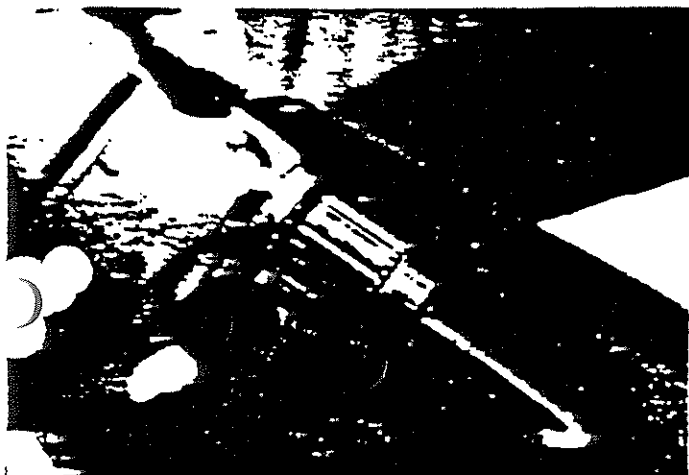
4.1 FIBERGLASS TOUCH UP AND REPAIR

Cracks, Shallow Nicks, Gouges, Small Holes
(that do not penetrate through the hull)

These repairs are easy because only the surface of the boat is damaged. They fall into two categories: (1) damage to the gel coat colored outer surface, and (2) holes or gouges that are deep enough to penetrate the fiber glass reinforced area of the boat. The repair operations are similar.

For damage to the gel coat surface, you will need a small can of gel coat, of the same color as your boat, and a small amount of catalyst. For deeper holes or gouges (1/8" or more) you will also need some short strands of fiber glass which can be trimmed from fiber glass mat or purchased in the form of "milled fibers." These materials can be purchased from your dealer.

- (1) Be sure the area around the damage is wiped clean and dry. Remove any wax or oil from the inside of the hole or scratch.
- (2) Using a power drill with a burr attachment, roughen the bottom and sides of the damaged area and feather the edge surrounding the scratch or gouge. Do not "undercut" this edge. (If the scratch or hole is shallow and penetrates only the color gel coat, skip to step No. 8.)
- (3) Into a jar lid or on a piece of cardboard, pour a small amount of gel coat . . . just enough to fill the area being worked on. Mix an equal amount of milled fibers with this gel coat, using a putty knife or small flat stick. Then add two drops of catalyst, using an eyedropper for accurate measurement. For a half-dollar-size pile of gel coat, this amount of catalyst will give you 15 to 20 minutes working time before it begins to "gel". Carefully cut the catalyst into the gel coat and mix thoroughly.

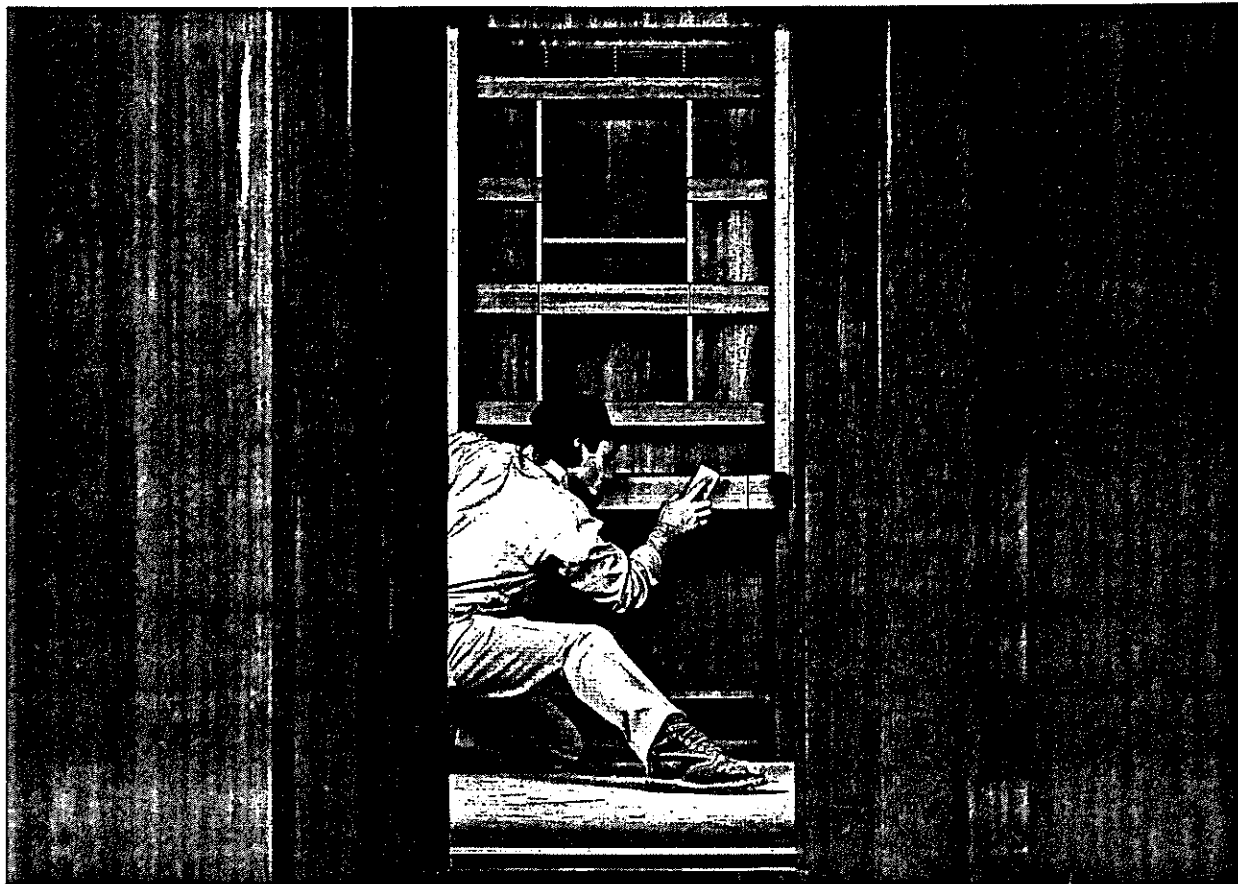


- (4) Work this mixture of gel coat, fibers and catalyst into the damaged area, using the sharp point of a putty knife or knife blade to press it into the bottom of the hole and to puncture any air bubble which may occur. Fill the scratch or hole above the surrounding undamaged area about 1/16".



- (5) Lay a piece of cellophane or waxed paper over the repair to cut off the air and start the "cure."

THE LOVE OF A CRAFT CARRIES THROUGH FROM SURFACE TO SURFACE



Billy Black Photography

The WB2000 System

Six interior and exterior water based wood coatings for marine applications.

Developed by Target Enterprises, a leader in the water-based coatings industry since 1989.

A Variety of Attractive Looks

Target's water-based coatings offer a wide range of finishes to match your design and construction needs. For that ultra-modern look, our super clear WB2000 System will give your exotic woods the rich, warm glow they truly deserve. And, for the traditionalist, our Oxford Series coatings provide the classic color tones of "Old World" varnish.

Time Savers That Perform

WB2000 System dries harder and resists scratches better than traditional varnishes and lacquers. Our exclusive waterborne urethane formulations are designed specifically to withstand extreme environmental changes that cause catalyzed furniture lacquers to check and crack and varnishes to turn yellow.

Environmentally Responsible

WB2000 is non-flammable, almost odorless and cleans up with regular tap water. You won't need extra thinning solvent. And, Target coatings have half the VOC content of oil-modified varnishes. Whether you're a small boat builder or a large manufacturer, lower emissions equal a cleaner, safer environment.

From New Construction to Restoration

WB2000 coatings have been used on hundreds of production boats and custom yachts around the world. However, new construction is not the only place you'll find Target. In their quest for dramatic results, hundreds of boatyards and restoration craftsmen are now using WB2000 to bring old classics back to life.

Our customers trust Target for quality coatings and friendly technical support. We have trained more OEM and restoration specialists in the use of water-based coatings than any other coatings manufacturer in the marine industry. After all, we understand the importance of helping you maximize your efficiency with our system.



 **TARGET™**

4.0 MAINTENANCE GUIDE - (Continued)

4.5 BOTTOM PAINT PREPARATION:

All Catalina 400's have a blister resistant gel coat. Special precaution must be used when preparing this bottom for painting. The underwater gel coated surfaces must be thoroughly dewaxed to remove all mold release wax from the gel coat. There are dewaxing cleaners sold by most bottom paint manufacturers. Follow the product instructions carefully, it is critical all wax be removed before applying any primer, sanding or painting the bottom. After dewaxing, the bottom can be prepared by lightly hand sanding with 120 grit paper. Be careful not to reduce the gel coat film thickness. An etching type "no sand" primer may also be used. Do not reduce the gel coat film thickness. Improper bottom preparation will void your Catalina Yachts Gel Coat Five Year Limited Warranty.

Anti-fouling paint should be applied to the bottom of your Catalina 400 if it is to be moored in either fresh or salt water for any length of time. There are many brands available. Anti-fouling paint prevents the growth of algae, barnacles, and other fouling organisms on underwater surfaces.

Boats which have factory applied bottom paint may be repainted following the paint manufacturers instructions which are within this manual. Should you be uncertain about the type of paint on your boat check with your dealer first to determine if your boat was painted at the factory or after delivery to the dealer and ask what type of paint was used. Not all paints are compatible and can have reactions which will result in a poor finished surface. If you cannot determine what paint is now on your boat, try a test patch of the paint you intend to use, let it dry and check for a reaction before proceeding. Your dealer or local paint supplier will often be able to make some specific recommendations for anti-fouling paint to be used over a paint of unknown composition.

The hull, bottom and rudder of your Catalina 400 are protected by Blisterguard gel coat, and the specific recommendations for the preparation of Blisterguard must be followed. The keel is a lead casting which has been faired with a minimum amount of polyester compound. The hull to keel joint is faired and fiberglassed over to create a smooth connection. The keel and joint are painted with an epoxy paint at the factory. Be sure to check for compatibility if you are painting your keel for the first time.

4.6 INTERIOR TEAK MAINTENANCE:

The interior joiner work of the Catalina 400 is coated with a clear, non-yellowing, aliphatic, water-based polyurethane to provide a durable finish. Normal household fine furniture cleaners can be used to help protect and keep the finish looking new. Do not use any harsh solvents such as lacquer thinner or acetone as these will destroy the fine finish. If in doubt about a particular cleaner try the cleaner on a small inconspicuous spot first before doing a large area.

IMPORTANT: Always be sure to have adequate ventilation when working with varnishes, cleaners, oils or paints.

4.0 MAINTENANCE GUIDE - (Continued)

4.7 SPAR AND RIGGING MAINTENANCE:

STANDING RIGGING:

Your boat is equipped with stainless steel standing rigging, and Dacron running rigging to give you years of trouble free service. However, due to normal wear and tear, it is recommended that a periodic inspection be made on all fittings and wire. Turnbuckles should never be neglected and should be unscrewed from time to time in order that they do not seize. Every three months should be about right for the average sailor. A slightly bent turnbuckle shaft or broken wire in your shrouds should be replaced immediately.

Under most conditions, 1 X 19 standing rigging has a safe "working" life span of approximately five years, seven years under ideal conditions. Factors which reduce the life of the wire are environmental factors such as high humidity (Florida, the Caribbean, and Gulf States), and high salinity (Great Salt Lake, Gulf States, or mooring near a sea wall with constant salt spray), extremes in temperature, and industrial pollution (pulp mills, generating plants, acid rain and smog). High loading of the rigging as required in most racing boats also induces stress in the rigging system.

Many of us have to deal with at least one of these conditions and should consider replacing standing rigging at the five year limit.

Unlike running rigging wire rope, which gives us clear signs that it is deteriorating by broken strands and "meat hooks", standing rigging may give no sign that failure is imminent. The usual point of failure of stay or shroud is approximately 1/4" inside the bottom swedged threaded stud fitting which threads into the turnbuckle barrel.

Although the stud is compressed around the wire during the swedging process, salt water and pollutants work down into the tiny cavities between the wire strands and the inevitable corrosive process starts in the crevice the first time the rigging becomes wet with salt water.

A common method of visually monitoring swedge fitting conditions, employed by distance racers and cruisers, is to dab a small ring of enamel paint around the joint between the wire and the swedge fitting. This will help provide a means to see if the wire is pulling out of the fitting.

Another technique used to check the condition of swedge fittings is a "dye penetrant" test. This simple test will detect any cracks which may develop in the fittings due to internal pressure from the corrosive process. Inexpensive dye test kits usually are available at most welding supply stores. Dye tests usually are not required by weekend sailors, but may be done before an extended cruise or ocean passage if any doubt about the integrity of the rigging exists.

All stainless steel wire rope rigging will develop some rust film when new. This is normal.

The rust is caused by two factors. When wire rope is manufactured, the wire strands are fed over steel rollers during the process of twisting or laying the wire. Trace amounts of the ferrous steel from the rollers and dies are transferred to the wire strands. As this small amount of steel rusts it causes a film on the new wire.

4.0

MAINTENANCE GUIDE - (Continued)

The second cause of the rust film on new wire rope is the microscopic veins of ferrous material which exist in stainless steel. After a period of time, as the surface material veins are depleted, and the stainless steel has been cleaned several times, new rust film development will slow to a minimum.

For the average sailor, the best insurance against a rigging failure is a periodic (every six months is recommended) inspection of all rigging parts, including turnbuckles, and replacement of standing rigging as required.

IMPORTANT: If any wear or sign of broken strands is found on the running or standing rigging, it is time to replace that part. Using your boat when the rigging is worn could cause the rigging to fail when you least expect it.

FITTINGS:

Marine fittings today usually need little maintenance. Deck hardware should be hosed down with fresh water after each sail in salt water. Stainless steel fittings such as pulpits and lifeline stanchions should be cleaned and waxed periodically to maintain their appearance. Winches require occasional cleaning and lubrication. Where possible, a maintenance brochure for your winches has been included in this manual. Masthead fittings, halyard sheaves, etc., should be inspected, cleaned, and lubricated periodically. Keep your equipment clean of dirt and salt.

SPARS:

Like all other fittings, mast and booms suffer from salt water, air and spray. These should be kept waxed where possible, and at least always hosed down with fresh water. Always see that the halyards are tied off away from the mast. This will eliminate slapping in the wind, and subsequent marking of the mast. Use a high pressure nozzle and shoot fresh water to the top of the mast and spreaders. This will help keep your sails clean too, as they rub on the mast and spreaders.

Inspect spreaders and spreader brackets for signs of fatigue. See that ends of spreaders are wired and well covered with tape to prevent wear on the sails.

Factory supplied masts are clear anodized, which should be touched up if damaged to prevent corrosion. Automotive touch-up paint of a like color can be utilized, if required.

4.8

SAIL MAINTENANCE:

Your sails should be protected from chafing. This can be done by either padding the areas that touch the sail or by having your sailmaker attach chafe patches to the sails themselves.

You should check your sails frequently for any signs of wear and have any tears or frayed stitches repaired immediately.

Sails should never be stored in the sun because they are susceptible to decay through exposure to too much ultraviolet light. Always keep your sails covered when they are not in use.

Sails should never be put away wet. If they are wet after sailing, leave them in loose bundles and dry them at your first opportunity.

4.0 MAINTENANCE GUIDE - (Continued)

For most problems such as common dirt, dried or caked salt, etc., try scrubbing the surface with a soft bristled brush and liquid detergent. Avoid harsh powder detergents and stiff brushes, as they may damage the finish or stitching. This approach should work nicely for most applications. More severe stains can be taken care of by the following:

IMPORTANT: FOR WHITE SAILS ONLY!

BLOOD: Soak the stained portion for 10-20 minutes in a solution of bleach (Clorox) and warm water. Generally 10 parts water to 1 part bleach. Scrub and repeat if necessary. Rinse thoroughly, particularly nylon, and dry completely.

OIL, GREASE, TAR AND WAX: Warm water, soap and elbow grease seem to be effective. On hard stains, propriety stain remover and dry cleaning fluids should do the trick. Be careful to remove all fluids, as they can soften the various resinated coatings on sailcloth.

RUST AND METALLIC STAINS: These types of stains are very often the most frustrating and difficult to remove. First scrub with soap and water and apply acetone, M.E.K., or alcohol. As a last resort, you might try a diluted mixture (5%) of oxalic soaked for 15-20 minutes. Hydrochloric acid, 2 parts to 100 in warm water will also work.

MILDEW: Hot soapy water with a little bleach will generally prevail. After scrubbing, leave the solution on the fabric for a few minutes and rinse thoroughly. When using a bleach, a residual chlorine smell may be present after rinsing. A 1% solution of Thiosulfate (photographers hypo) should remove all chlorine traces. Here again, rinse and dry well.

PAINT AND VARNISH: Acetone and M.E.K. should remove most common paint and stains. Varnish can be easily removed with alcohol.

Mylar sails are coated with a plastic film and are easily damaged. Avoid solvents, as they can destroy the film and fabric over a period of time. Soap and diluted bleaches should take care of most stains.

Generally speaking, use all solvents with care. Always rinse and dry thoroughly. It should be emphasized that nylon ripstop spinnaker fabrics are less durable and more sensitive than their polyester counterparts. Bleaches and solvents can ruin nylon if not used properly.

Follow the above guidelines, take your sails into your sailmaker for periodical inspection, and you will have many effective seasons of sailing and cruising pleasure.

4.9.1 INTERIOR CUSHION, FABRIC COVER:

CLEANING:

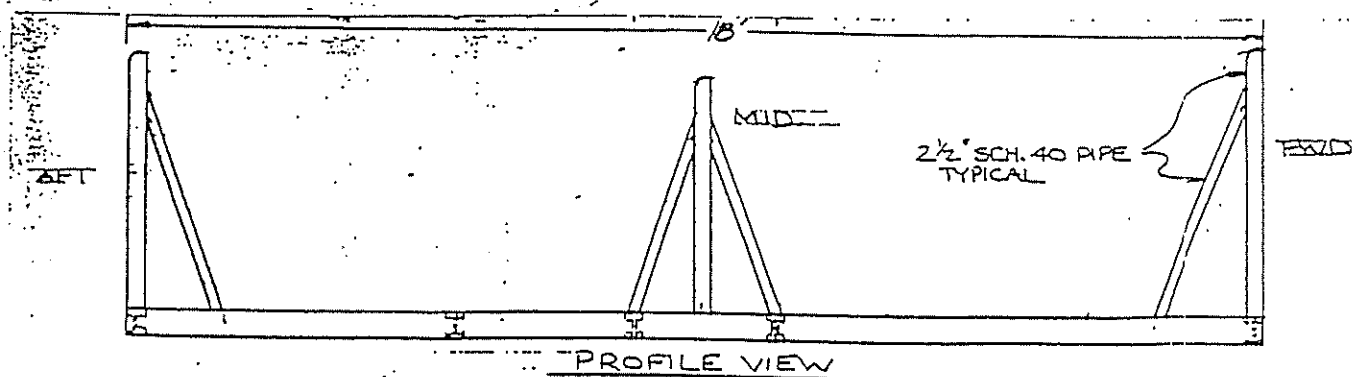
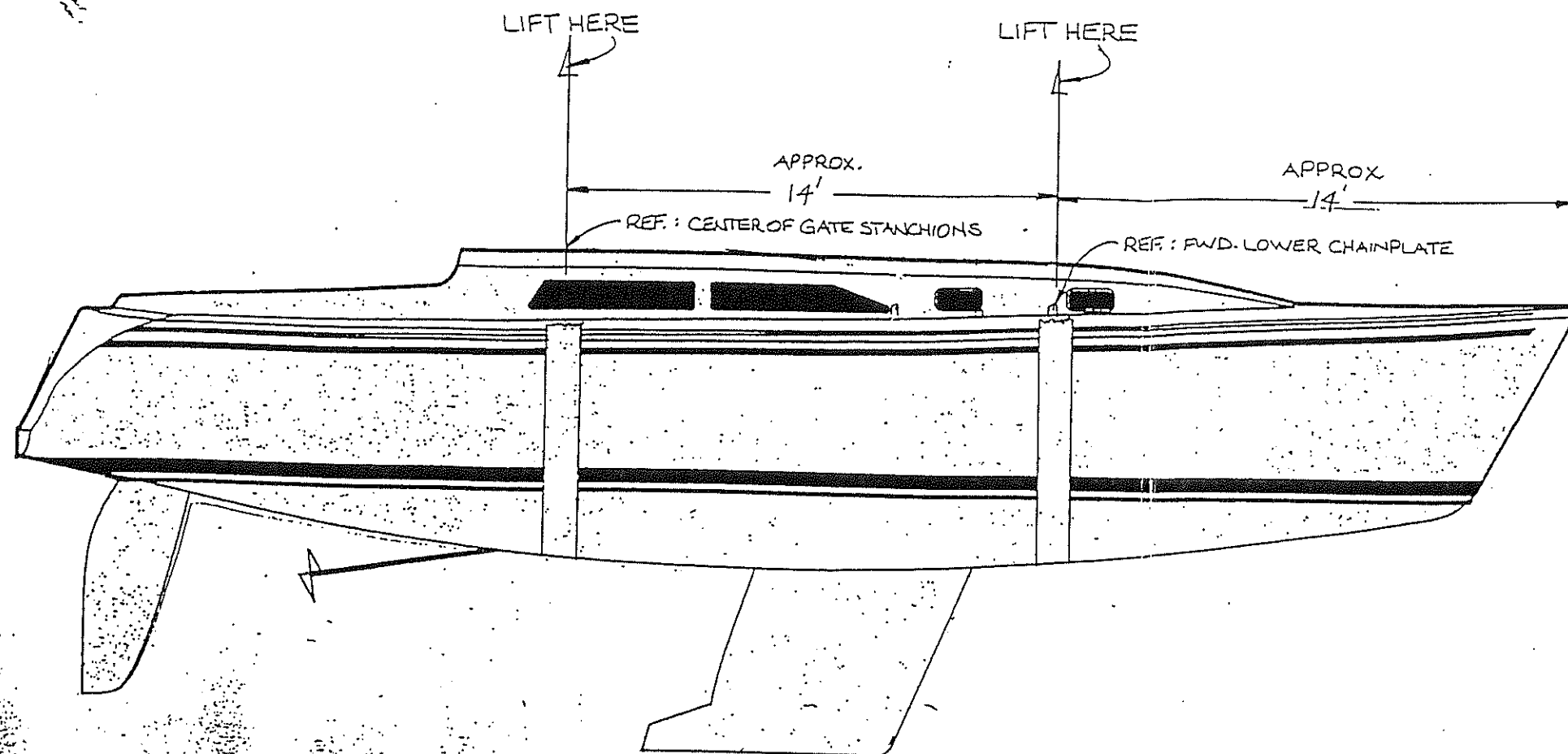
1. Regular vacuum cleaning or brushing in the direction of the pile with a soft brush.
2. Stains should, if possible, be removed at once with a damp cloth. Do not allow stains to harden and age.
3. Greasy stains can be removed with ordinary cleaning fluid.

4.0 MAINTENANCE GUIDE - (Continued)

4. For overall cleaning, use commercial types of upholstery shampoo using only the foam to protect the back padding from moisture. After a minute or so, remove foam, and when dry, vacuum or brush in the direction of the pile.
5. Do not use heat such as an iron or steam.
6. The use of some kind of fabric protector, such as "Scotch Guard" is strongly recommended when the cushions are new, and after each cleaning.

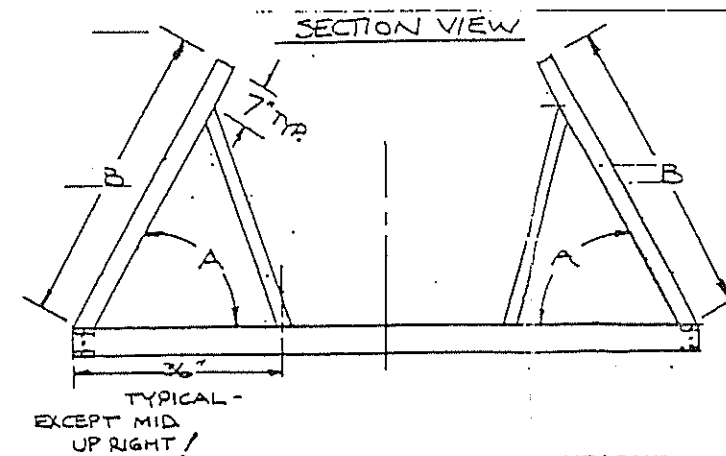
4.9.2. PLEATED SHADES

A regular vacuuming is all that's needed to keep the shades looking new. DO NOT hand, machine wash, or dry clean, for it will weaken the material. A good upholstery cleaner can be used to spot clean the shades as required.



	*LENGTH 'B', IN.	ANGLE 'A', DEG.
FWD. UPRIGHT	50"	60°
MID UPRIGHT	39"	70°
AFT UPRIGHT	42 1/2"	70°

*LENGTHS ARE 12" SHORT OF HULL TO ALLOW FOR SCREW JACKS, PADS, ETC.



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CATALINA YACHTS/MORGAN DIVISION
7200 Bryan Dairy Road
Largo, Florida

CATALINA 400 WING KEEL MODEL
LIFTING AND CRADLING

DESIGNED BY	DATE	DRAWING NO.
DRAWN BY	7-25-94	400-93000-0
CHECKED BY	SCALE	
APPROVED BY		

5.0 DECOMMISSIONING:

5.2 WINTERIZING YOUR ENGINE:

LAYING UP:

In cold climates where yachts are decommissioned during the winter, your Catalina 400 may be safely stored in the water provided adequate measures are taken to prevent ice damage to the hull. Check with your yard to determine the feasibility of storing in the water.

When the boat is to be stored on land, the mast may be left stepped on the deck. However, it is recommended that the mast be removed at the time of hauling for a thorough inspection and preparation for next season.

This allows plenty of time over the winter months to order and replace any shrouds or rigging parts avoiding any delays in the spring commissioning.

Following proper lay-up procedures will minimize the effort needed to recommission in the spring.

BEFORE HAULING:

1. Refer to engine manual instructions for winterizing the engine. Perform the appropriate in-water steps.
2. Consult the manufacturer's instructions for winterizing any optional or owner-installed equipment.
3. Inspect the cradle on which the boat will be stored. Check welds and padded poppits for condition and repair as required.
4. Lift the boat with straps at the locations illustrated.

AFTER HAULING:

1. Wash bottom, removing growth and loose paint.
2. Wash topsides, deck and all other exterior fiberglass surfaces. Wax all except the nonskid surfaces.
3. Remove all sails. Follow sailmaker's instructions, or instructions in section 4.8, with regard to cleaning. Schedule any repairs required and store in a dry place.
4. Remove all sheets and lines, clean and store in a dry place.
5. If the mast had been removed from the yacht, remove all stays and shrouds from the mast. Wash the entire stay or shroud assembly, using fresh water and a stiff brush. Dry thoroughly, and coil into large non-kinking coils. Store the coils in a dry place. Wash and wax all spars. Coil halyards into non-kinking coils and put in a dark-colored plastic bag to protect from sunlight if storing outdoors. Lash them to the mast. Store the mast either inside or outside with adequate support along its length.
6. If mast is to be left in place, remove the boom, clean and store as described before. Clean shroud/stay end fittings, toggles, etc. using fresh water and a stiff brush. Apply a light coat of silicone grease, paying particular attention to the end fittings where they connect to the stays and shrouds.

5.0 DECOMMISSIONING: - (Continued)

7. Clean and lubricate all deck hardware that contains moveable parts. Follow manufacturer's instructions on winches.
8. Remove all gear such as books, documents, bedding, PFD's, anything moveable that is subject to rust, corrosion or mildew.
9. Remove all food supplies from lockers and ice chest. Wash out ice chest's interior with a weak solution of Clorox. Leave ice chest lids open.
10. Stored batteries should be fully charged, and both positive and negative terminals should be disconnected. The batteries may be either left aboard or stored in a cool, dry place. Sub-zero temperatures will not harm a fully charged battery.
11. Close all manual shutoffs for the stove fuel system.
12. Winterize the head system in accordance with manufacturer's instructions.
13. Winterized the hot and cold water system, drain all tanks, hoses, pumps and valves.
14. Remove all electronic gear that may require servicing during the winter.
15. Remove fire extinguishers for weighing, checking, and any necessary recharging. If an automatic fire extinguisher system is installed, return the cylinders to the yacht and reinstall as soon as possible.
16. If cushions are left aboard, bring cockpit cushions below and place all cushions on edge to encourage ventilation.
17. Leave all interior lockers open to encourage ventilation.
18. Ensure that cockpit and deck scuppers are open and free.
19. If the boat is to be covered, ensure that the cover is installed in such a way as to provide adequate ventilation, and that the cover is not permitted to chafe against the hull or deck.
20. If the boat is not to be covered, ensure that mechanisms such as winches and steering pedestals are provided with adequate covers.
21. If the mast is to remain stepped, snug all shrouds and halyards to minimize noise and wear.

GENERAL NOTES:

We recommend the following procedures be followed when storing the yacht for prolonged winter months. Begin by consulting your authorized dealer about storing the boat in or out of water in freezing climates. If at all possible, the manufacturer recommends keeping the yacht in dry storage for severe winters.

All through hull fittings should be drained and closed off. Water in the sanitation system and other tanks should be pumped out. Fill the lines and fittings with antifreeze to prevent water from running in, freezing or expanding, and cracking the lines and fittings.

5.0 DECOMMISSIONING: - (Continued)

For diesel engines, consult the manufacturer's manual for special instructions.

Unless manufacturer's manual states otherwise, drain the raw cooling water from the block, disconnect the water intake hose from the through hull fittings, attach an additional length of hose and place the end of this hose in a bucket of antifreeze. Run the engine until straight antifreeze comes out the exhaust line. Stop the engine at this point, plug or cap the exhaust line, and remove the additional hose and bucket.

6.0

OWNER-USER RESPONSIBILITY:

6.1

GENERAL SAFETY TIPS:

1. Do not venture out when the weather conditions are unfavorable or are predicted to become so. Listen to weather forecasts, check with your Harbor Patrol Office, and look out for small craft storm warnings.
2. Be especially careful in areas where there may be commercial shipping traffic. Keep well away from shipping channels. Keep a sharp lookout when crossing the shipping channels.
3. Learn the rules of the road. All other sailors will expect that you know them and abide by them. The U.S. Coast Guard (BBE-2) 400 S. Eleventh Street, S.W. Washington, D.C. 20590, will supply free literature on this. Your local branch or Harbor Patrol Office may have it available.
4. If your boat has a Genoa sail that obscures the helmsman's vision, have a dependable person in the crew keep a sharp lookout under the Genoa sail for traffic.
5. When sailing at night, provide safety harnesses for yourself and your crew, and tie these lines to the boat. Use approved harnesses.
6. Purchase all Coast Guard required safety equipment and learn how to use it.
7. Enroll in a Coast Guard class or other certified boating and sailing class. You will learn a lot and enjoy sailing even more.
8. Do not take more than a safe number of persons aboard your boat when sailing.
9. Marine insurance is worth every penny you pay for it. Take out insurance from the start. See your dealer for a recommended marine agent if you do not have one.
10. Keep all seat hatches and main hatches closed during rough weather or gusty winds which could unexpectedly strike the boat and cause a knock down.
11. CAUTION: The aluminum mast, and the metal parts conduct electricity. Coming in contact with, or approaching an electrical power line can be fatal. Stay away from overhead power lines and wires of any kind, when launching, underway, or when stationary.

6.2

REQUIRED SAFETY EQUIPMENT:

FIRE EXTINGUISHER:

It is wise to locate a minimum of two, approved for marine use, fire extinguishers, one for forward of the galley and one for behind the galley, preferably below the cockpit hatch. Should stove or engine fire start, you can always reach a fire extinguisher.

For example, you do not want to locate both of your extinguishers in the head area because if you are located in the cockpit, you would have to get by the danger area to reach them if the fire is either in the galley or engine area.

6.0 OWNER-USER RESPONSIBILITY: - (Continued)

Dry chemical extinguishers should be inverted occasionally to prevent the contents from packing. Extinguishers should be recharged yearly or after each use, according to manufacturer's recommendations.

LIFE VESTS:

Keep a Coast Guard approved life vest on board for each crew member. Wear them during rough weather and night sailing. Children should wear vests at all times no matter how much they object.

HORN:

Your yacht should be equipped with a horn capable of producing a blast that can be heard for a distance of one mile.

FLARES:

The law requires that your yacht be equipped with a minimum of 3 day/night flares.

6.3 SUGGESTED SAFETY EQUIPMENT AND SAFETY PACKAGE:

MEDICAL KIT:

A basic medical kit is a wise investment for any boat owner. Suggested items include: Motion sickness pills, aspirin, bandages, etc. We recommend that you personalize your medical supplies for you and your crew's specific needs.

TOOL KIT:

A varied arrangement of tools is again, a wise investment to have on your boat. Tailor your tool box for the conditions that you sail. For local sailing, with professional help just a phone call away, you only need a small array of tools. However, for long range cruising, a more extensive supply of tools will be needed.

6.4 SAFETY PACKAGE, FACTORY OPTION: (Contents subject to change without notice)

<u>PACKAGE</u>	<u>DESCRIPTION</u>
<u>INCLUDES</u>	
1	West Marine TR-40 Anchor
35'	3/8" ACCO galvanized chain
2	7/18" anchor shackles
1	NE Ropes 5/8" x 250' anchor line with splico
4	Taylor "Big B" 10 x 26 fenders
40'	NE Ropes 3/8" white nylon fender line (4 x 10')
6	Kent adult (Type II) foam life jackets
1	White Type IV throwable cushion
1	Skyblazer 50-10001 flare kit
1	Skyblazer hand-held red flares(3)
1	Tempo "Ozone Safe" horn
1	8" Chrome Bell
3	Kidde 10BC fire extinguisher
1	Small boat first aid kit
1	Eveready halogen flashlight/batteries
4	NE Ropes 5/8" x 25' dock lines
1	Waste discharge plaque
1	Oil discharge plaque

6.0 OWNER-USER RESPONSIBILITY: - (Continued)

6.5 ANCHORS, ANCHORING AND MOORING

The manufacturer suggests an anchor in the 30-40 pound range to be used as a bow anchor in ordinary conditions. This anchor will only be effective with at least 15 feet of 5/16 inch or heavier gauge chain and at least 5/8 inch or heavier nylon line.

Under adverse weather conditions, a heavier bow anchor could prove necessary, and possibly a plough type anchor might be required.

Inquire in your local area about anchoring procedures relative to the place you plan to visit. Get the opinions of several experienced people. And, always play it on the safe side in "making up" your anchor and in using it. Do not forget to wire all shackle pins so they cannot come loose under water.

REMEMBER: Lighter anchors are made more effective by increasing the scope, i.e., the ratio of length of line and chain to depth of water. A 7:1 ratio is recommended. This means using 7 feet of anchor line for each foot in water depth.

6.6 LIGHTNING PRECAUTIONS:

Your yacht was not provided with a lightning protection system during construction. The reasons are as follows:

1. There is not a procedure for lightning protection which is proven reliable under all conditions. Yachts with elaborate lightning protection systems have sustained serious damage from a direct lightning strike.
2. If the builder were to assert that the yacht was lightning protected it could instill a false sense of confidence in the owner or operator, leading to less-than-prudent actions when lightning threatens.
3. Lightning systems are "out of sight, out of mind", except when lightning threatens. Generally, they are not checked and maintained on a regular basis. A defect in the system (i.e., a break in a ground line) could, in some cases, increase the risk of personal harm, as well as damage to the yacht, as compared to a yacht with no protection. The reason for this is that many lightning protection systems distribute the high voltage throughout the yacht before allowing it to exit through the ground.
4. It is impossible for Catalina Yachts to control changes which you, the owner, may make to the yacht, which could affect lightning protection system.

You, the owner, must decide whether or not you wish to equip your yacht with lightning protection and, if so, the method of doing it. For your guidance, a copy of ABYC recommendations is attached. The following suggestions and comments are also offered:

1. Keep the system as simple as possible. This will facilitate both installation and inspection/maintenance. Perhaps a single oversize ground (battery cable) from the mast base to the engine, coupled with external shroud grounds (see 2 below), will maximize reliability.

6.0

OWNER-USER RESPONSIBILITY: - (Continued)

2. ABYC recommends straight-line wire runs, which is virtually impossible within the yacht. For grounding the shrouds: A battery cable, which clips to each shroud and extends outside the yacht to the water, can minimize the number of bends required. This method has the added advantages of keeping the power surge outside the boat, and allowing easy, routine inspection. The obvious disadvantage is that the clip on cables are not a permanent installation and may not be in place when an unexpected lightning strike occurs.
3. Use only top quality materials and go oversize wherever possible.
4. Keep all permanent attachment points and connections where they are readily available for inspection, yet protected from damage or inadvertent disconnection.

Factory installed metal tanks, 110 volt systems and major components are grounded to the engine. The engine is grounded via the shaft and propeller to the water. The purpose of internal grounding is for static charge control and accidental shorts in the internal systems - not to provide lightning protection. However, you can incorporate the ground lines present in a lightning protection system you may wish to add.

By far, the most important consideration regarding lightning is observing common sense safety precautions when lightning threatens. The key considerations are listed in the American Boat and Yacht Council (ABYC) publication, which is reprinted herein for your reference.

RECOMMENDED PRACTICES AND STANDARDS COVERING LIGHTNING PROTECTION

PROJECT E-4

ABYC E-4-85

Based on ABYC's assessment of the state of existing technology and the problems associated with achieving the requirements of this standard, ABYC recommends compliance with this standard by August 1, 1985.

E-4.1 PURPOSE

These recommended practices and standards establish requirements for the design, construction and installation of lightning protection equipment on boats.

E-4.2 SCOPE

These recommended practices and standards apply to power and sailboats as indicated.

NOTE: *A lightning protection system offers no protection when the boat is out of water and is not intended to afford protection if any part of the boat comes in contact with power lines while afloat or ashore.*

E-4.3 DEFINITIONS

- a. **Air Terminal** - A metal rod that terminates in a sharp point.
- b. **Lightning Ground Plate** - A means to conduct the electrical current from a boat's conductive elements to the water in which the boat floats. A separate lightning ground plate may be used or it may also serve other purposes. (See ABYC E-4.6.g.)
- c. **Lightning Protective Mast** - A conductive structure or if non-conductive, equipped with a conductive means and an air terminal.
- d. **Zone of Protection** - An essentially cone shaped space below a grounded air terminal or mast or overhead ground wire which is substantially immune to direct strokes of lightning. (See Appendix)

E-4.4 REQUIREMENTS - IN GENERAL

Successful protection of persons and watercraft from lightning is dependent upon a combination of design and maintenance of equipment, and on personnel behavior. The basic guides contained in this standard shall be considered and used in designing and installing a lightning protection system. However, in view of the wide variation in structural design of boats, specific recommendations cannot be made to cover all cases.

- Design is covered in this and the following sections of this standard.
 - Maintenance of equipment is covered in the Appendix.
 - Personnel behavior is covered in the Appendix.
- a. To provide an adequately grounded conductor or lightning protective mast, the entire circuit from the top of the mast to the ground shall have a conductivity not less than that of an 8 AWG copper conductor and the path to ground followed by the conductor shall be essentially straight.
 - b. If there are large metal objects such as tanks, engines deck winches, stoves, etc. in proximity to the grounding conductor, there will be a strong tendency for sparks or sideflashes to jump from the grounding conductor to the metal object at the closest point. To prevent damage from such sideflashes, an interconnecting conductor at least equal to 8 AWG copper shall be provided at all places where they are likely to occur.
 - c. Large metallic objects which are not part of the electrical system of the boat and which are not already grounded due to their own functional or other requirements may be grounded directly to the ground plate, provided that it is not practical to interconnect with the lightning conductor or bonding systems. (See ABYC E-4.6.d.)

E-4.5. REQUIREMENTS - MATERIALS

- a. *Corrosion* - The material used in a lightning protective system shall be resistant to corrosion. If, as in certain installations, it is impractical to avoid a junction of dissimilar metals, the corrosion effects can be reduced by the use of suitable platings or special connectors which are available for such purposes.
- b. *Wire Conductors* -
 - (1) Wire conductors shall be stranded copper not less than 8 AWG.
 - (2) The size of any strand of a bare copper wire shall be not less than 17 AWG. Stranding of insulated copper wire shall be Type II stranding per ABYC E-8, "AC Electrical Systems" or ABYC E-9, "DC Electrical Systems Under 50 Volts".
- c. *Other Conductive Means* -
 - (1) Conductivity shall be equal to or greater than 8 AWG copper wire.
 - (2) The thickness of metal ribbon or strip shall be at least 1/32 inches.

E-4.6. REQUIREMENTS - INSTALLATIONS

- a. *Conductive Joints* - Conductive joints shall be made and supported in accordance with ABYC E-9, "DC Electrical Systems Under 50 Volts".
- b. *Lightning Protective Mast Height* - A lightning protective mast shall be of a height to provide the desired zone of protection in accordance with the following:
 - (1) For a mast height not exceeding 50 feet (15m) above the water, the base radius is approximately equal to the mast height. (See Figures 1 and 2)
 - (2) For mast heights in excess of 50 feet (15m) the zone of protection is based on the striking distance of the lightning stroke. Since the lightning stroke may strike any grounded object within the striking distance of the point from which final breakdown to ground occurs, the zone of protection is defined by a circular arc. (See Figure 3) The radius of the arc is the striking distance (100 feet (30m)). The arc passes through the tip of the mast and is tangent to the water. If more than one mast is used, the zone of protection is defined by arcs to all masts.
 - (3) The zone of protection afforded by any configuration of masts or other elevated, conductive, grounded objects can readily be determined graphically. Increasing the height of a mast above the striking distance will not increase the zone of protection.
- c. *Lightning Protective Mast Alternatives* -
 - (1) If the mast is of non-conducting material, the associated lightning or grounding conductor shall:
 - (a) be essentially straight,
 - (b) be securely fastened to the mast,
 - (c) extend at least 6 inches (150mm) above the mast,
 - (d) terminate in an air terminal, and
 - (e) be led as directly as practicable to the grounding connection. (See ABYC E-4.g.)

- (2) A radio antenna or outrigger may serve as a lightning protective mast provided it has conductivity equivalent to 8 AWG copper and is equipped with:
- (a) lightning arresters,
 - (b) lightning protective gaps, or
 - (c) means for grounding during electrical storms.

NOTE: Non-conducting antenna masts with spirally wrapped conductors are not considered suitable for lightning protection purposes.

- (3) The grounding of metal rod type radio antennas provides some protection for boats without masts and spars, provided:
- (a) Conductors in the grounding circuit of the antenna have a conductivity equivalent to 8 AWG copper in accordance with ABYC E-4.5.b.
 - (b) The top of the antenna is not more than 50 ft. (15m) above the water, and a line drawn from the top of the antenna downward toward the water at an angle of 45 degrees to the vertical does not intercept any part of the boat. (See ABYC E-4.6.b.)
 - (c) The antenna loading coil is provided with a suitable protective device for bypassing the lightning current.

NOTE: Because a loading coil presents a high impedance to the flow of lightning current, the portion of an antenna above the bottom of a loading coil is not effective as a lightning protective mast.

- d. **Interconnection of Metallic Masses** - Metallic masses aboard boats which are a permanent part of the boat or are permanently installed within or about the boat, and whose function would not be seriously affected by grounding, shall be made a part of the lightning-conductor system by interconnection with it. (See ABYC E-4.6.f.)

EXCEPTION: *Comparatively small size metallic masses.*

- NOTES:**
1. *The object of interconnecting the metal parts of a boat with the conductor is to prevent damage from sideflashes, especially in the case of rather extensive metal objects that are nearby. The main principle to be observed in the prevention of such damage is to identify on a boat the places where sideflashes are most likely to occur and to provide metallic paths for them.*
 2. *To minimize flow of lightning discharge current through engine bearings, it may be preferable to bond engine blocks directly to the ground plate rather than to an intermediate point on the lightning conductor.*

- e. **Exterior Bodies of Metal** - Metal situated wholly on the exterior of boats shall be electrically connected to the grounding conductor.

NOTE: *Exterior metal bodies on boats include any large masses such as horizontal guardrails, handrails on cabin tops, smokestacks from galley stoves, electric winches, davits, metal signal masts, and metallic hatches.*

- f. **Interior Bodies of Metal** - Metal situated wholly in the interior of boats and which at any point comes within 6 ft. (1.8m) of a lightning conductor shall be electrically interconnected with this lightning conductor.

NOTE: *Interior bodies of metal include engines, water and fuel tanks, and control rods for steering gear or reversing gear. It is not intended that small metal objects such as compasses, clocks, galley stoves, medicine chests, and other parts of the boat's hardware be grounded.*

- (1) Metal which projects through cabin tops, decks or sides of boats above the sheer shall be bonded to the nearest lightning conductor at the point where the metal emerges from the boat and shall be grounded at its lower or extreme end within the boat.
- (2) In order to protect the radio transmitter, antenna feedlines shall be:
 - (a) equipped with means for grounding during electrical storms, or
 - (b) protected by lightning arresters or lightning protective gaps.
- g. *Lightning Ground Connection* - A lightning ground connection for a boat may consist of any metal surface which is submerged in the water and which has an area of at least 1 sq. ft. (0.093m²).
 - (1) Metallic rudder surfaces, metal centerboards and keels, or the ground plate for radio transmitters may be used for this purpose.
 - (2) A metal hull itself constitutes an adequate lightning ground plate.

E-4.7. REQUIREMENTS - VESSELS WITH METAL HULLS

If there is electrical continuity between metal hulls and masts or other metallic superstructure of adequate height in accordance with ABYC E-4.6., then no further protection against lightning is necessary.

E-4.8. REQUIREMENTS - SAILBOATS WITH NON-METALLIC HULLS

- a. Sailboats with metallic standing rigging will be adequately protected provided that all rigging is grounded so that the mast and rigging meet the requirements of ABYC E-4.5. and E-4.6.
- b. Sailboats will be adequately protected if all shrouds, back stays, preventers and continuous metallic track on the mast and boom are grounded. These shall be electrically connected at the lower or forward end and grounded to a metal plate on the hull or to a metal rudder, centerboard or keel.
- c. All stays and sail tracks shall be grounded.
- d. Grounding of other objects on sailboats shall be in accordance with ABYC E-4.6.
- e. Multihull boats shall provide a lightning ground connection in accordance with ABYC E-4.6.g. for each hull that has items to be grounded, attached, or fitted to it.

E-4.9. REQUIREMENTS - POWER BOATS WITH NON-METALLIC HULLS

- a. Power boats may be adequately protected by a grounded radio antenna, outrigger, or other grounded lightning protective mast in compliance with ABYC E-4.6., provided the height of the mast conforms to that described for the zone of protection.
- b. Interconnection and grounding of metallic masses shall be in accordance with ABYC E-4.6.

E-4.10 REQUIREMENTS - SMALL BOATS

- a. Small boats may be protected by means of a temporary lightning protective mast which may be erected when lightning conditions are observed in the distance.
- b. Grounding provisions may be made by means of a flexible copper wire and a submerged ground plate of at least 1 square foot (0.093m²) in area.

FIGURE 1 — BOAT WITH MAST NOT EXCEEDING 50 ft. (15m) ABOVE THE WATER

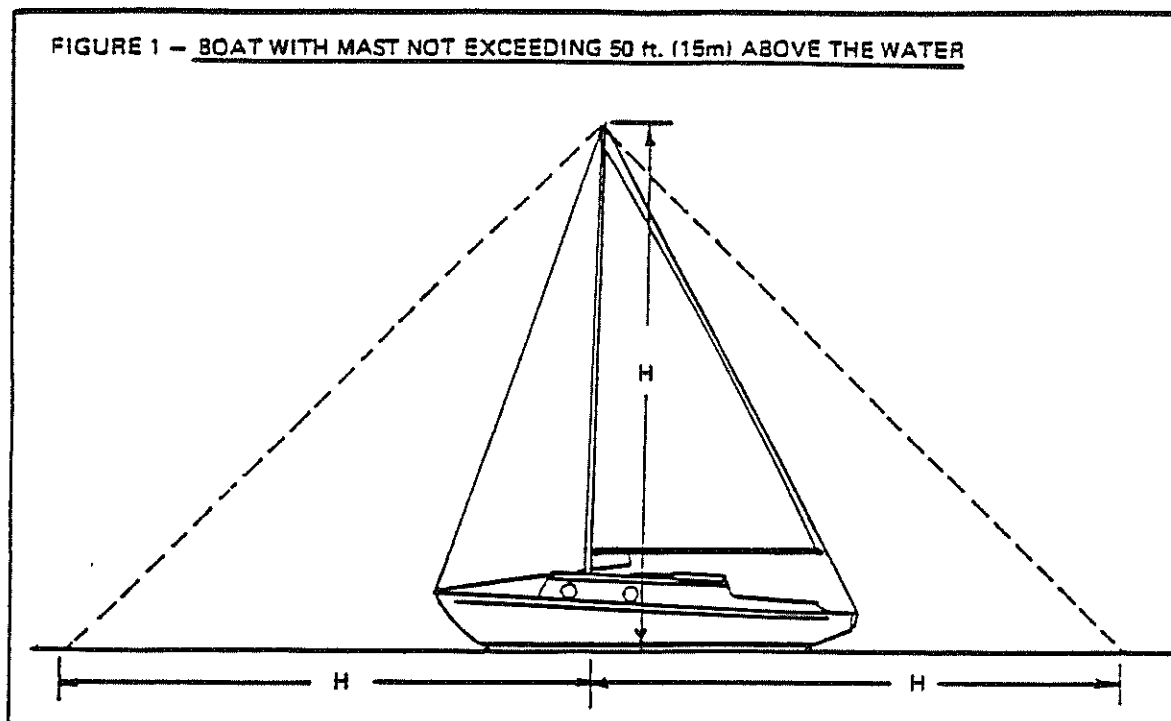


FIGURE 2 — BOAT WITH MAST NOT EXCEEDING 50 ft. (15m) ABOVE THE WATER

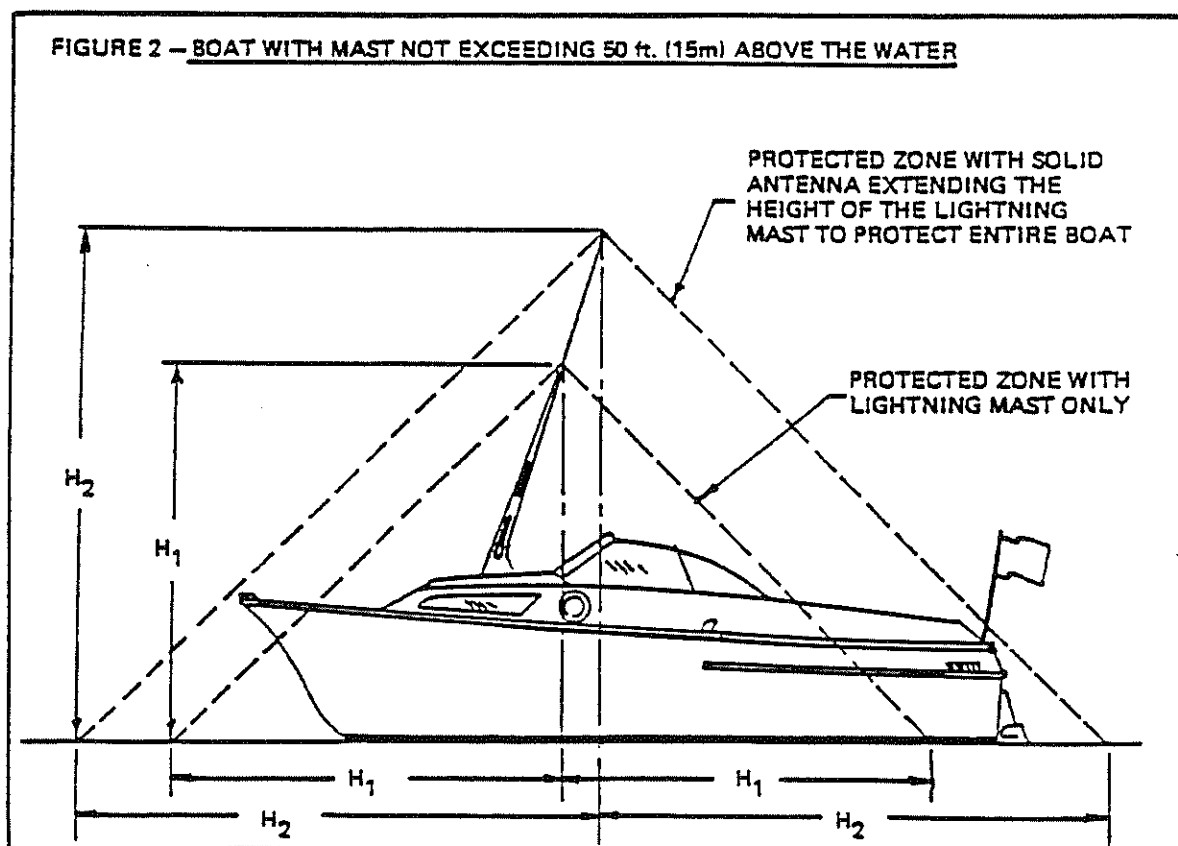
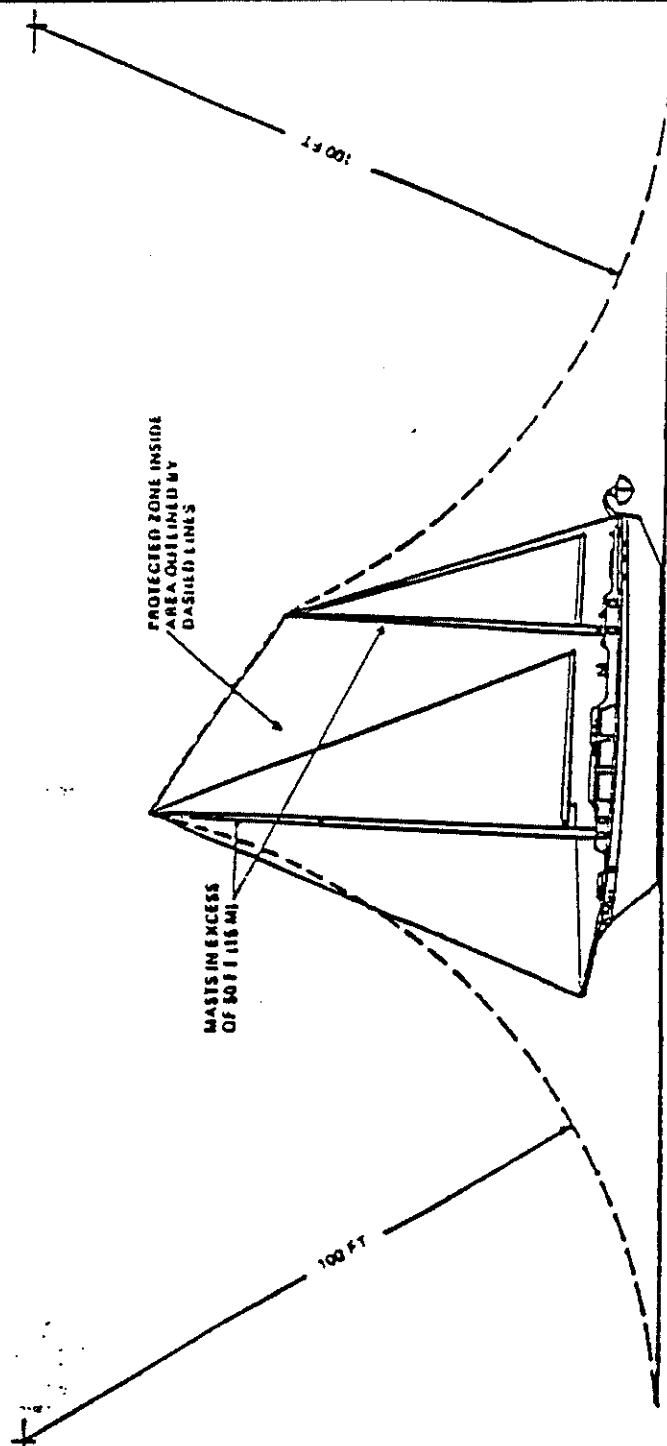


FIGURE 3 -- BOAT WITH MASTS IN EXCESS OF 50 ft. (15m) ABOVE THE WATER -- PROTECTION IS BASED ON LIGHTNING
STRIKING DISTANCE OF 100 ft (30m)



APPENDIX - LIGHTNING PROTECTION

This appendix contains additional information of a descriptive nature and recommendations pertaining to maintenance and behavior of personnel.

E-4.Ap.1. *Zone of Protection* - A grounded conductor, or lightning protective mast, will generally divert to itself direct hits which might otherwise fall within a cone-shaped space, the apex of which is the top of the conductor of lightning protective mast and the base a circle at the surface of the water having a radius which is related to the height of the top of the conductor or lightning protective mast.

- a. To protect a boat of the size that renders the use of a single mast impracticable, additional lightning protective means shall be erected to form overlapping zones of protection.
- b. Boats with ungrounded or non-conductive objects projecting above the metal masts or superstructure may have these objects protected by a lightning ground conductor terminating in an air terminal above the object.
- c. Whip-type radio antennas shall not be tied down during a lightning storm if they have been designed as a part of the lightning protection system.

E-4.Ap.2. *Maintenance* - Lightning protection provisions are quite likely to receive scant attention after installation, and therefore their composition and assembly shall be strong and materials used shall be highly resistant to corrosion.

- a. Grounding of metallic objects for lightning protection may increase the possibility of harmful galvanic corrosion: (See ABYC E-2, "Cathodic Protection")
- b. If a boat has been struck by lightning, compasses, electrical and electronic gear shall be checked to determine whether damage or changes in calibration has taken place.
- c. If a boat has been struck by lightning the lightning protection system shall be inspected for physical damage, system integrity and continuity to ground.

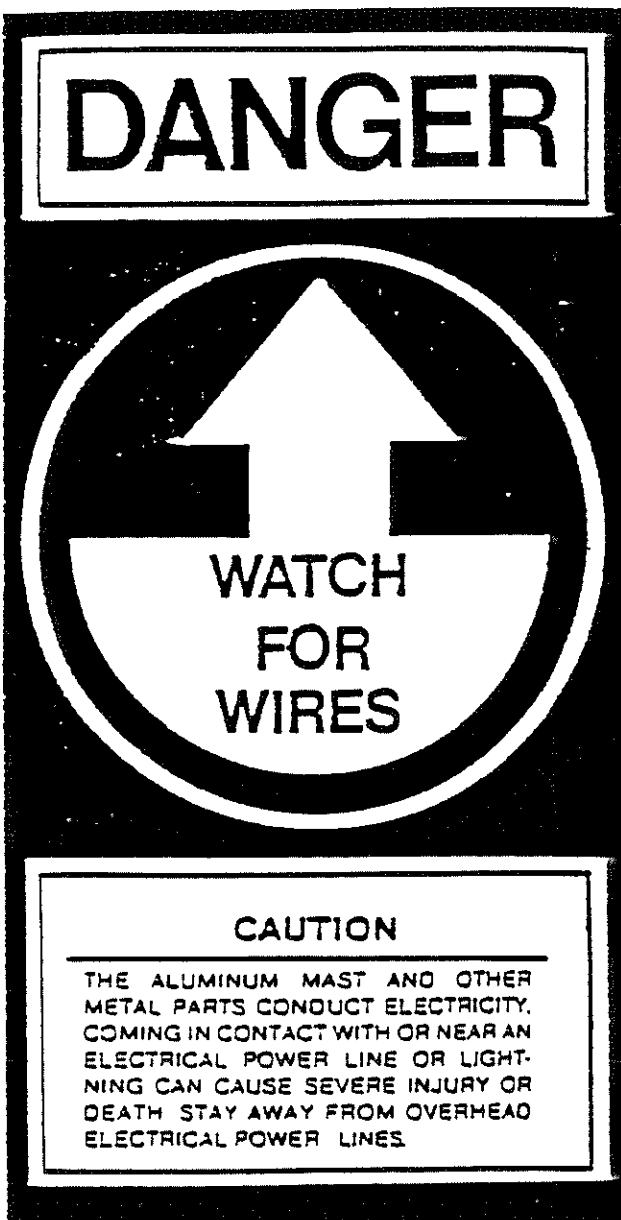
E-4.Ap.3. *Precautions for Personnel* - The basic purpose of protection against lightning is to ensure the safety of personnel. It is therefore appropriate that the following precautions be taken:

- a. personnel shall remain inside a closed boat, as far as practical, during a lightning storm,
- b. arms and legs shall NOT be dangled in the water,
- c. consistent with safe handling and navigation of the boat during a lightning storm, personnel shall avoid making contact with any items connected to a lightning protection system and especially in such a way as to bridge between these items; for example it is undesirable that an operator be in contact with reversing gear levers and a spotlight control handle at the same time,
- d. personnel shall NOT be in the water during a lightning storm, and
- e. personnel shall avoid contact with metal parts of a sailboat's rigging, spars, fittings and railings.

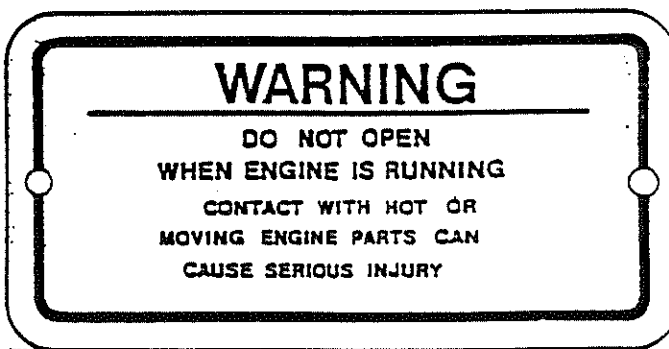
* * * * *

WARNING LABELS

THESE WARNING LABELS WERE APPLIED TO YOUR C-30 AT THE FACTORY, AND CONTAIN INFORMATION IMPORTANT FOR THE SAFE OPERATION OF YOUR BOAT. IF ANY OF THESE LABELS ARE MISSING, OR YOU REQUIRE REPLACEMENTS OR ADDITIONAL LABELS, PLEASE CONTACT THE CATALINA YACHTS PARTS DEPARTMENT, 1916 954-7700.



PART # WS1
ON FORWARD SIDE OF MAST



PART # WS3
ON ALL-ENGINE ACCESS
DOORS AND PANELS

IMPORTANT! IF ENGINE FAILS TO START AFTER 30 SECONDS
OF STARTER MOTOR OPERATION, WATER MUST BE DRAINED FROM AQUA-LIFT
MUFFLER TO PREVENT SERIOUS DAMAGE TO ENGINE FROM COOLING WATER BACK-UP.

PART # WS4
BELOW ENGINE
INSTRUMENT PANEL

IMPORTANT

READ THE OWNERS MANUAL BEFORE
USING THIS VESSEL, ADDITIONAL
COPIES OF THE OWNERS MANUAL ARE
AVAILABLE FROM:

Catalina//Yachts

21200 VICTORY BLVD., WOODLAND HILLS, CA 91367

PART # WS5
IN THE COCKPIT ON DECK

IMPORTANT! IMPORTANT!
Close through hull valves
each time the head is used.

PART # WS6
IN HEAD NEAR ACCESS DOOR
TO VALVES

CAUTION

KEEP CURTAINS
AWAY FROM STOVE

PART # WS7
ON OVERHEAD ABOVE STOVE

DISCHARGE OF OIL PROHIBITED

THE FEDERAL WATER POLLUTION CONTROL ACT PROHIBITS
THE DISCHARGE OF OIL OR OILY WASTE INTO OR UPON THE
NAVIGABLE WATERS AND CONTIGUOUS ZONE OF THE UNITED STATES,
IF SUCH DISCHARGE CAUSES A FILM OR SHEEN UPON, OR
DISCOLORATION OF, THE SURFACE OF THE WATER, OR CAUSES
A SLUDGE OR EMULSION BENEATH THE SURFACE OF THE WATER.
VIOLATORS ARE SUBJECT TO A PENALTY OF \$5,000.

PART # WS8 N AFT COCKPIT SEAT

It is illegal for any vessel to dump plastic trash anywhere in the ocean or navigable waters of the United States. Annex V of the MARPOL TREATY is an International Law for a cleaner, safer marine environment. Violation of these requirements may result in civil penalty up to \$25,000, fine and imprisonment.

U.S. Lakes, Rivers, Bays, Sounds and 3 miles from shore	3 to 12 miles	12 to 25 miles	Outside 25 miles
ILLEGAL TO DUMP	ILLEGAL TO DUMP	ILLEGAL TO DUMP	ILLEGAL TO DUMP
Plastic & Garbage	Plastic	Plastic	Plastic
Paper Metal	Dunnage, lining & packing materials that float, also	Dunnage, lining & packing materials that float.	
Rags Crockery	if not ground to less than one inch:		
Glass Dunnage	Paper Crockery		
Food	Rags Metal		
	Glass Food		

State and local regulations may further restrict the disposal of garbage.

PART # WS9 ON GALLEY FRONT FACE

10/25/91

IMPORTANT NOTICE
WASTE STORAGE AND DISPOSAL

In order to preserve our Marine Environment and to comply with the MARPOL V Treaty tenants, which are enforced by the U.S.C.G. as well as other marine regulatory and policing agencies, Catalina Yachts reminds you that your boat must have the following on board. All boats 26 feet and larger must:

1. Display in a prominent place the MARPOL Treaty placard.
All Catalina's, Capri's and Morgan's built after 5/1/91 have placards which meet MARPOL standards installed at the factory. Should you need a replacement or have a boat built before 5/1/91, placards are available through Catalina Parts Department. You are required to read, understand and educate your crew and passengers of these regulations.
2. All boats 42 feet and larger must display the MARPOL placard described above and have a written waste management plan aboard. A typical waste management plan follows. This is a waste plan model only. You may fill it out and use it if it suits your conditions or amend or modify as required. You may be asked to produce your waste management plan if boarded by the U.S.C.G. so please take the time to complete, modify or draft a plan as required and keep it aboard your boat.

WASTE MANAGEMENT PLAN

Vessel Name: _____

Person in Charge: _____

Solid waste management procedures:

If the vessel is outside of 12 miles from shore:

All the garbage with the exception of food materials and paper is put in a garbage bag to be hauled to the dockside trash receptacle at trip's end. Food materials and paper generated in the galley are collected in a bucket (or in a paper bag or cardboard box) and the bucket emptied over the side (or the food filled bag or box is thrown overboard) by a crew member.

If the vessel is within 12 miles of shore or returning to shore:

All refuse materials are put in a garbage bag and at the end of the trip are hauled up to the dockside trash receptacle by the deck hand.

Crew education: At the beginning of each season all crew members are reminded of the refuse discharge laws and shown the MARPOL V placard posted in the galley. Crew is told that it is vessel policy to stow all garbage materials on board except for food and paper when the vessel is outside of 12 miles. The captain orients all new crew and passengers to the rules governing the vessel including refuse laws and refuse handling.

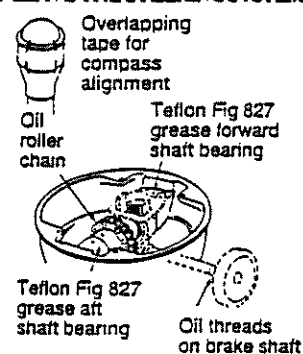
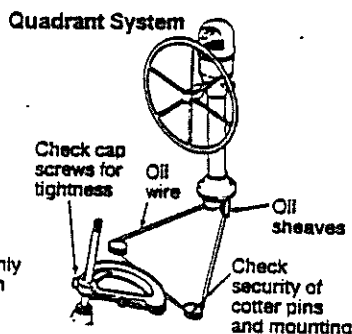
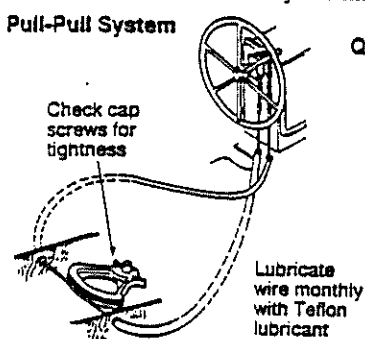
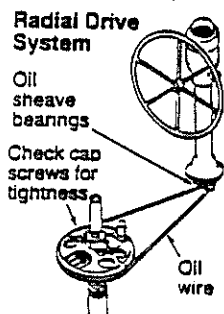
PEDESTAL STEERING MAINTENANCE

To properly maintain the moving parts in the top of the pedestal, it is necessary to remove the compass and its cylinder. For proper alignment when re-installing the compass, we recommend placing three or four lengths of tape on the pedestal and compass as shown below. Slit the tape when removing compass, align the strips of tape when re-installing the compass for visual realignment. Your compass **MUST** then be checked out for accuracy. Lubrication of needle bearings should be done by squeezing Edson Fig 827 Teflon Lubricant into the holes located on top of the bearing housings inside the pedestal bowl. Spin the wheel when squeezing the lubricant in to make sure the entire bearing is serviced. Winch grease or water pump grease can be used as an alternative, but don't let the bearings run dry. Do not over grease as it will run onto the brake pads. Oil the chain with #30 weight motor oil. Do NOT grease chain as it does not penetrate the links.

Inspect the condition of the wire, tension of the wire and lightly oil. Edson recommends placing about five layers of "Kleenex" on the palm of your hand, squirt oil on the tissues and lightly oil the wire. This will lubricate the strands but will also "flag" a broken or hooked strand by tearing off a small section of tissue. If you do have a wire break, replace the wire immediately. See Edson Fig 775 Wire and Chain Replacement Kits. (Caution: Wire splinters can cause painful cuts.) Replace the wire after 5 years. If still good, keep the old wire on board as a spare.

STEERING WIRE TENSION

A top quality roller chain to wire steering system can be kept in "as new" sensitivity by keeping the wire at a correct tension. To check for proper wire tension, lock the wheel in position by using the pedestal brake, or by tying off the wheel. Cable tension is best when you cannot



move the quadrant or drive wheel by hand with the wheel locked in place. Over tightening will greatly reduce the sensitivity of the system.

It must be emphasized that all on board must be familiar with the care and operation of the Steering System and engine controls. One person must be assigned the job of maintenance and must be thoroughly familiar with the operation and intent of all the equipment. If at any time your Steering System makes strange noises or reacts differently than it has previously, you must find the causes immediately and correct the problem.

Screws, nuts, bolts, as well as clevis and cotter pins that are part of the steering system, engine controls or pedestal accessories, must be checked regularly for tightness and wear. Failure to inspect all steering parts, engine controls and pedestal accessories may cause loss of control or failure of the engine or steering system. *All boats must have an emergency tiller or its equivalent and all on board must be familiar with its location and operation. An emergency tiller drill is just as important as a man-overboard drill and must be regularly conducted.*

On a new boat and at least once a year, inspect the system when under a strong load. On a calm day and under power, go away from the other boats and with the person who is assigned the maintenance watching from below, put the wheel hard over at full throttle. The maintenance man should watch carefully for all parts of the system bending, distorting, creaking, or giving any indication of failing if placed under a heavy load for a period of time. If, for any reason something did fail or needs adjusting, the day is early and you will have plenty of time.

When leaving your boat at her mooring or slip, make sure that your wheel is properly tied off. **DO NOT LEAVE THE STEERING SYSTEM TO FREE WHEEL.**

CLEANING STAINLESS STEEL

Pedestal guards, steering wheels and shafts are all made from top quality stainless steel. The implication of its name "stainless steel" does not mean it is totally rustproof. All stainless steel will rust to a certain degree due to chemical reaction to air and saltwater. This is mainly cosmetic and will require an occasional polishing with an abrasive type cleaner such as "Brasso" or equivalent.

CLEANING PEDESTAL AND ACCESSORIES

Clean them with soap and water; don't use chemicals such as MEK or acetone as they break down the super finish on your Edson pedestal

system, compasses and instruments. Most manufacturers of compasses and electronic instruments suggest that they all be removed during winter storage and kept in a warm dry area. Compasses are normally held in place by two or three slotted-head screws, placed near the top of the compass. A Fig 672 Rubber Connector will assist in removing the compass. Instruments can be removed by the screws in the Edson faceplate. Just unplug the instrument and you are all set.

CAUTION: When the equipment is in the tropics or in charter service, the maintenance schedule must be speeded up. Or, to put it in a few words: clean it up, oil it, inspect it, cover it. The effects of sun, saltwater and inexperienced operators can be severe.

LUBRICATION RECORD

component	lubricant	schedule	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year
			19____	19____	19____	19____	19____	19____	19____
sheave bearings	#30 oil*	check and oil monthly							
pull-pull cables	Teflon Fig 827	check and grease monthly							
wire rope	#30 oil*	check and oil annually							
roller chain	#30 oil*	check and oil annually							
pedestal shaft bearings	Teflon Fig 827	check and grease annually							

*Any light oil is suitable. We recommend #30 weight motor oil since most boat owners have it aboard.

CAUTION: 1.) On extended voyages your steering system should be inspected each day and lubricated weekly. Carefully inspect your steering system at least one week before a vacation cruise to avoid last minute maintenance.

2.) When the boat is unattended secure the wheel with the brake or a line. In rough weather the rudder can swing violently from stop to stop causing damage.

Edson
INTERNATIONAL

Night vision, running, strobe, & cabin lights.



Background information for your safety at night/restricted visibility.

VISIBLE RADIATION (Light)

The Incandescent - filament lamp common in home, car and boat, is a 'Thermal radiator' emitting electromagnetic-energy. Only a small part of this energy is 'seen' by the eye as light.

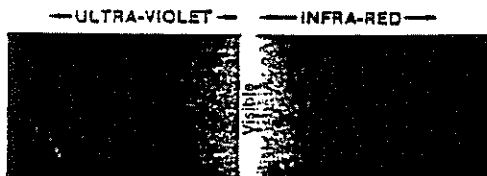


fig 1. The 'Optical' Spectrum

So called as the energy of the wave lengths obey the optical laws of reflection and refraction.

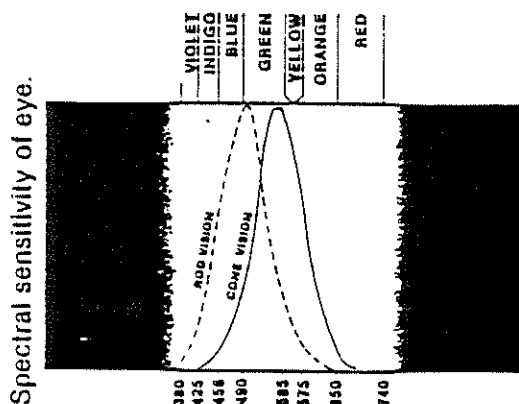


fig 2. The part of the 'Optical Spectrum' that can be 'seen' by the human eye.

EFFICIENCY OF LIGHT SOURCE

It is by heating a tungsten filament in a vacuum in excess of 1000° Kelvin ($^{\circ}\text{K} = ^{\circ}\text{C} + 273$) that it becomes 'incandescent' i.e. it emits visible radiation. As the filament temperature is increased not only does the visible light become brighter but the color shifts to shorter wave lengths as the filament progresses from 'red' hot to 'white' hot.

The ratio of power radiated as a visible or luminous source as against the total power used in heating the filament is expressed as 'mean spherical candlepower per watt' (CPW) of electricity used. To convert CPW to lumens per watt multiply by 4π (12.57).

It is possible to increase the lumens per watt by replacing the vacuum with an inert gas like halogen which allows the filament to be heated to a higher

temperature and thereby emit more lumens per watt of electricity. This has to be traded against the higher cost of a halogen lamp coupled with its shorter life. The same and sometimes greater efficiency can be obtained by the use of 'optical' enhancement without the cost trade off disadvantages of Halogen and this is covered in the section on running lights.

DAY AND NIGHT VISION

The retina at the back of the eye is composed of 'cones' and 'rods'. The cones distinguish color and are mainly concentrated in the center, the reason your eyes are 'scanning' these lines in order to read. Rods are distributed across the retina; they cannot distinguish color.

An iris at the front of the eye acts as a variable diaphragm, small for bright light, wide open in low light. The cones are used and can respond within minutes to changes in light intensity down to the equivalent of moonlight. With the iris fully open and illumination below that of a full moon, the rods are used. Their response is slow, their initial sensitivity improves 1,000 times after ten minutes and one million times for full dark adaption/night vision after thirty or forty minutes. This dark adaption can be maintained by illuminating control panels and cabin interiors by low level 'red' light, as the cones are less sensitive to red light and have a quick recovery time and the rods are not sensitive to red and thereby keep their dark adaption. Fig 2. See also section on cabin lighting.

PREVENTION OF COLLISIONS

Vessels 'underway' (i.e. not anchored, aground or moored to shore).

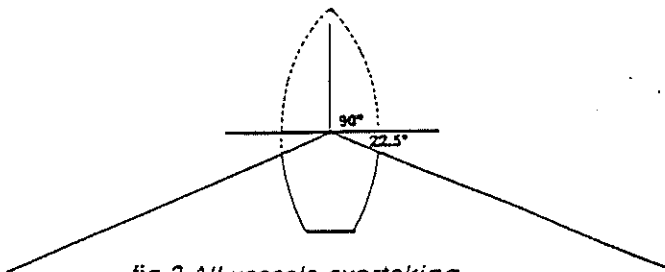


fig 3 All vessels overtaking

. any vessel overtaking any other shall keep out of the way of the vessel being overtaken. Rule 13(a)

A vessel shall be deemed to be overtaking when coming up with another vessel from a direction more than 22.5° abaft her beam.

vessel she is overtaking, that at night she would be able to see only the sternlight of that vessel but neither of her sidelights. Rule 13(b) see also (c) & (d).

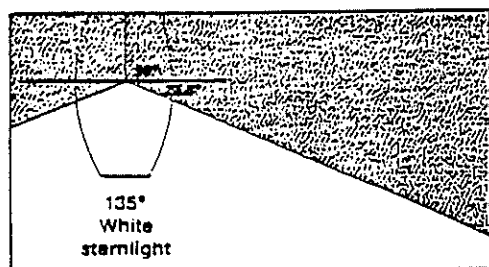


fig 4. Sternlight

With some exceptions for vessels under 23ft see Rule 25(d) (i) (ii), vessels under oars, under sail or being towed exhibit sidelights. The cut-off between the red and green sidelights and the sternlight gives the essential information for obeying Rule 13 'Overtaking'.

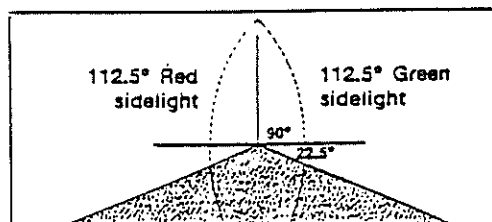


fig 5. Sidelights

As any vessel overtaking is required to keep clear there is no need for the sternlight to show whether the vessel being overtaken is under sail or power. If it is being towed, there is the necessity to continue to keep clear and this is given by towing vessel ahead exhibiting not just a white sternlight but in addition a yellow 'towing' light (also of 135°) above the sternlight. See Rule 24 (a) (iv) & Rule 24 (j) exception.

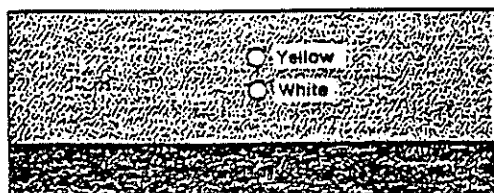


fig 6. Sternlights of tug towing astern.

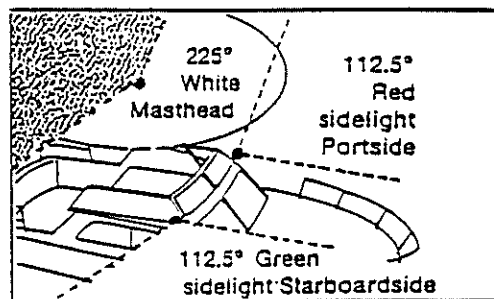


fig 7. a powerdriven vessel, see exceptions Rule 23(c) is required to exhibit a white 225° masthead light - what used to be called a 'bow' or 'steaming' light. It is carried above the 112.5° red & green sidelights and

confuse the new term masthead light with a mast-top light like an anchor light or a sailboats TRI-COLOR sailing light.

When two power-driven vessels are meeting on reciprocal or nearly reciprocal courses so as to involve risk of collision, each shall alter course to starboard so that each shall pass on the port side of the other. Rule 14(a)

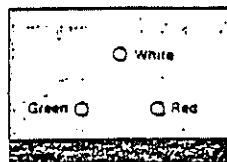


fig 8a. From ahead

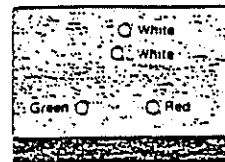


fig 8b. From ahead

Such a situation shall be deemed to exist when a vessel sees the other ahead or nearly ahead and by night she could see the masthead lights* of the other in line or nearly in a line and/or both sidelights Rule 14(b).

*refers to a 2nd masthead light exhibited as a range light



fig 9. A Range light is optional for vessels under 164.1ft but is a requirement for vessels over that length. There is a required vertical separation in order that the range light should appear above the forward masthead light at 1000 meters from the stem. Rule 23(a)(ii) see also Annex I.

From dead ahead do not confuse such a range light with the masthead lights of a tug towing astern which will exhibit a 2nd masthead vertically above the masthead light displayed as a vessel under power. If the tow exceeds 200 meters a 3rd masthead light will be displayed vertically above. Spacing is required to be equal. Note: there may also be a range light displayed.

Other vessel identification in order that Rule 18 'Responsibilities between vessels underway' is made possible at night by the addition and/or substitution of 360° All-round lights to show 'privilege'. For example: three all-round lights in a vertical row, red over white over red is shown in addition to running lights when 'unable to deviate from course'. While vessels 'engaged' in fishing douse their forward 225° white masthead and exhibit in its place an all-round white with an all-round red over it (or a green if bottom trawling). Note: when going to the fishing grounds or sport fishing (trolling), they exhibit normal running lights as they are not 'hampered' in maneuverability and therefore are not 'privileged'. See Rule 26: Fishing; 24: Towing/ pushing; 27: N.U.C.; 28: Draft; 29: Pilot; 30: Anchored; also 23 (b), 31 and 34.

COMPASS BEARINGS

While it is obvious if a bearing does not change you are on a collision course or if you see both red and green sidelights, you are 'head-on', you may not know that a compass bearing taken when only one sidelight can be seen will give you quickly and easily an indication of that vessels heading. For example: Take a bearing over a compass card of the sidelight visible, take the reciprocal and deduct 10 points or 112.5° (22.5° + 90°).

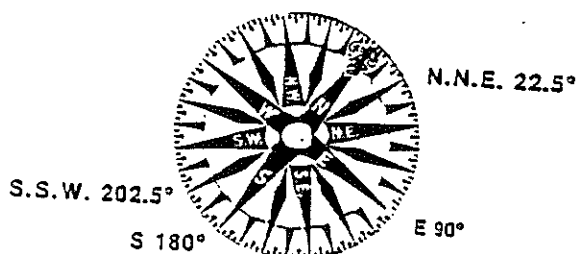


fig. 10: Green sidelight bearing NNE or 22.5°, reciprocal is SSW or 202.5°. deduct 10 points or 112.5°. The other vessels course lays between due East (90°) and SSW (202.5°). This coupled with knowledge of our own course can be useful, particularly when the other vessel may have 'privilege' as a 'stand-on' vessel. See Rules 9, 10 & 18.

MINIMUM VISIBILITY IN NAUTICAL MILES

Vessel length	less than 39.4' (12m)	39.4' - 65.7' -	65.7' - 164.1' -	over 164.1' (50m)
Masthead	2 n.m.	3 n.m.	5 n.m.	6 n.m.
Sidelight	1 n.m.	2 n.m.	2 n.m.	3 n.m.
Sternlight	2 n.m.	2 n.m.	2 n.m.	3 n.m.
360° light	2 n.m.	2 n.m.	2 n.m.	3 n.m.

Note: Rule 22 only specifies minimum visibility for each size vessel, an owner may well opt to exhibit the minimum for the next vessel size up.

HORIZONTAL SECTOR CUT-OFF

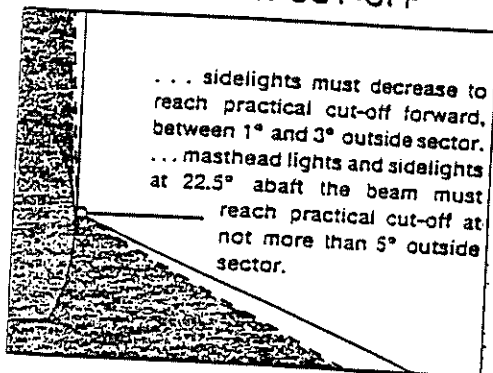


fig 11: Sidelights

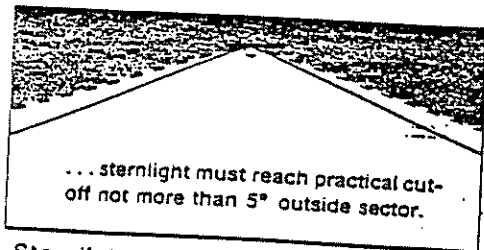


fig 12: Sternlight

VERTICAL SECTORS

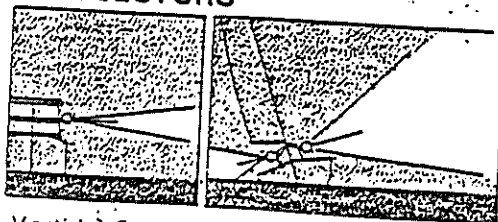


fig 13: Vertical Sectors

Arc discharge i.e. fluorescent or H.I.D. is not practical in Nav. Lights and oil lamps cannot meet the visibility requirements. The only light source is the tungsten-filament bulb. The cheapest bulbs are those made by the millions for the automobile industry. Unfortunately as the lamp manufacturers themselves stress, the placing of the filament with respect to the socket cannot be controlled in economical large-scale production. And without the filament being positioned in the center of the bulb, it will not be in the focal point of the running light to meet the cut-off requirements or to take advantage of optical magnification. The five auto-type bulbs below (taken from eleven bought over the counter) show how varied the filament position can be.

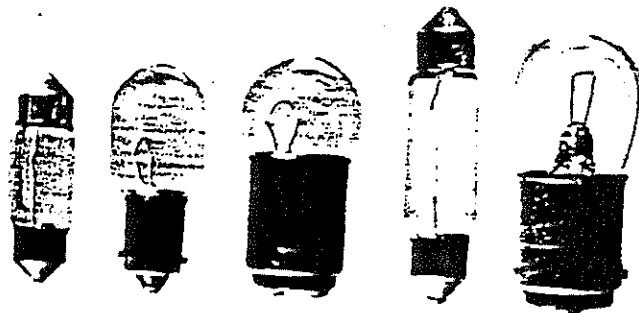


fig: 14 Five auto-type bulbs.

Additional problems come with bulbs with filament supports that 'block' light and bulb brightness dependent on automobile type operation.

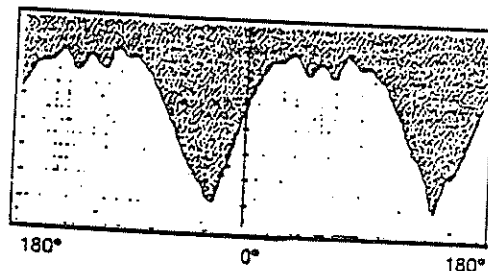


fig 15: Blockage of light by filament arms of a #1004 bulb (extreme right fig 14).

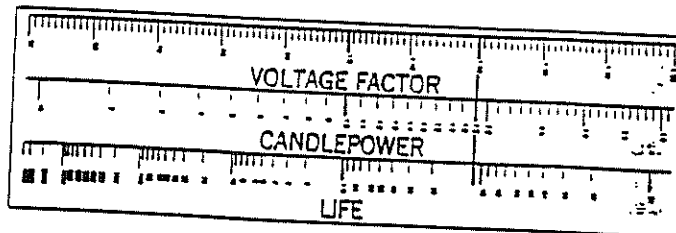


fig 16: Voltage/Candlepower/life

More than you may expect a decrease below the design voltage decreases light output (and extends life) just as an increase shortens life but increases light, i.e. a #90 lamp, third from left fig: 14 is rated 6 cd at 13 volts, at 12 v, a drop of only 7.7% will lose 25% of its intensity. In auto use this is not important but at sea it can be critical for safety of vessel and crew.

BROWNING MARINE INC.