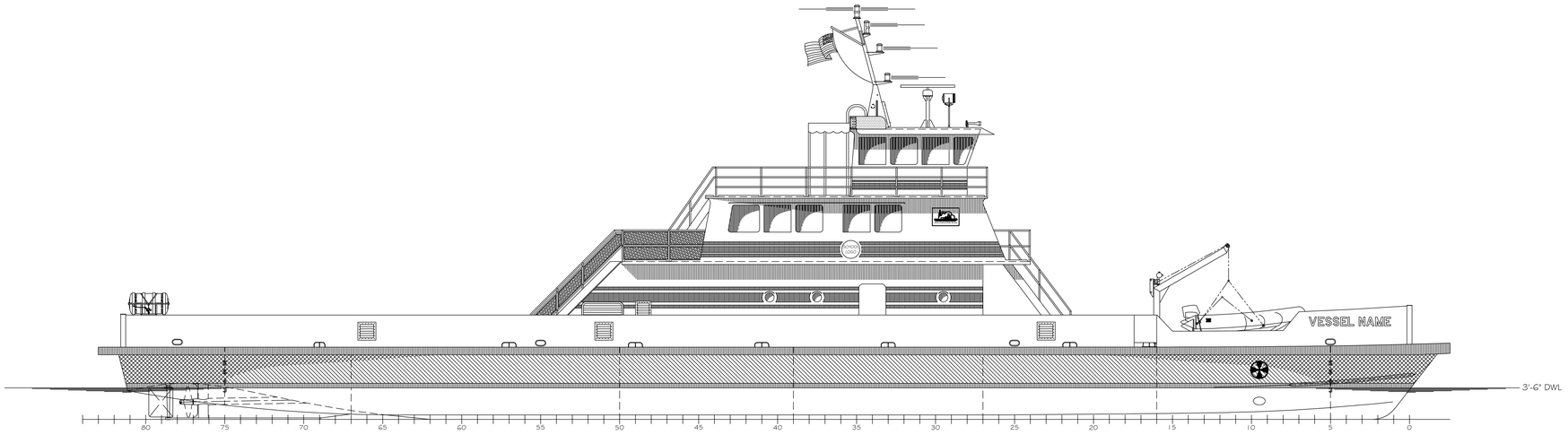
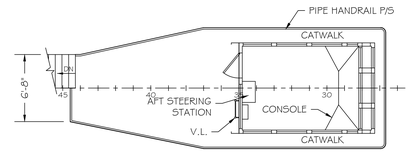


OUTBOARD PROFILE

3/16" = 1'-0"

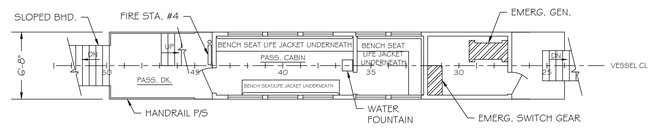
PARTICULARS

L.O.A.	149'-09"
L.B.P.	140'-00"
BREADTH AMIDSHIP ACROSS DECK	42'-00"
DEPTH AMIDSHIP ON CL	8'-06"
FRAME SPACING	1'-09"



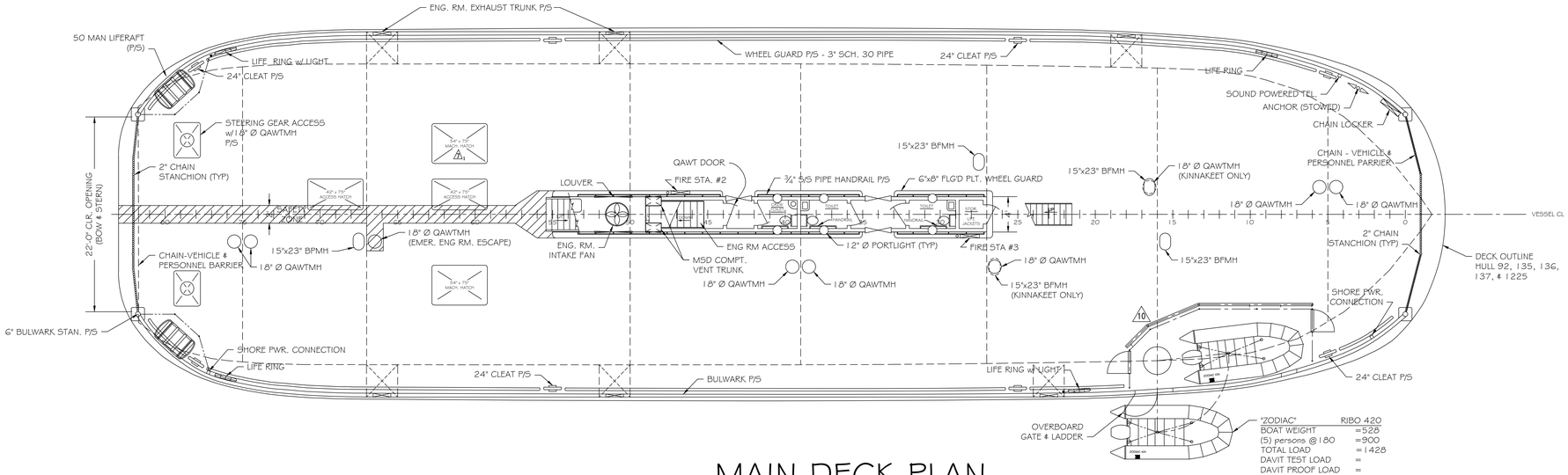
P.H. DECK PLAN

3/16" = 1'-0"



PASSENGER DECK PLAN

3/16" = 1'-0"



"ZODIAC"	RIBO 420
BOAT WEIGHT	=528
(5) persons @ 180	=900
TOTAL LOAD	=1428
DAVIT TEST LOAD	=
DAVIT PROOF LOAD	=

MAIN DECK PLAN

3/16" = 1'-0"

APPLICABLE TO:	OF NO.
KINNAKEET	944638
FRISCO	946908
CHICAMACOMICO	949252
CAPE POINT	949251
OCRACOKE	964046
ROANOKE	996146
THOMAS A BAUM	1025834

No.	DESCRIPTION	By	Date	App'd.
11	1. RELOCATED IBA LOCATIONS TO AS-BUILT 2. ADDED ACCESS HATCHES AS PER AS-BUILT	STJ	30-OCT 2023	
10	CHANGED SECURITY FENCE AND DAVIT	STJ	3-14 11	
9		STJ	3-04 09	
8	1. REPRODUCED IN ITS ENTIRETY USING AUTOCAD 2. COMPUTER PAIRED BY COAST DESIGN	EBJ	5-19 93	
7	1. ADDED MACHINERY HATCHES P & S MAIN DK. OVER MN. ENGS. SAME MEMO & REF. 1 2. ADDED THREE(3) FREEING PORTS AFT BULWARK P & S (SAME MEMO AGAIN) 3. ADDED STATE DECALS TO SUPERSTRUCTURE. REVISED VESSEL PARTICULARS. REMOVED B.P. ACCESS HATCHES OVER RUDDERS	EBJ	8-13 92	
6	1. REVISED SAFETY ZONE TO SHOW " AS BUILT" 2. REVISED S. PWR. TEL. LOC. TO "AS BUILT"	EBJ	10-5 88	
5	AS BUILT	VF	12-7 87	
4	REV. MAST, RADAR & LIGHTS ON PILOT HOUSE TOP. REV. H.R. TO 3 COURSE ON UPPER DK. FWD. & P.H. DK. REV. M.P. & ADDED 2 MORE ENG. RM. EX. TRUNK.	VF	12-19 86	
3	REVISED MANHOLES & REMOVED CL STANCHION BOW & STERN @ CHAIN BARRIER	VF	10-5 86	
2	ADDED "SPLASHRAIL" - P & S BOW	EBJ	7-18 86	
1	UPPER HOUSE TO 6'-8" / ADD ENG. RM AIR INTAKE	RK	5-16 86	

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

OUTBOARD PROFILE & GEN. ARRG'TS.— MN. DK.; UPPER DK.; P.H. DK.

SEAL

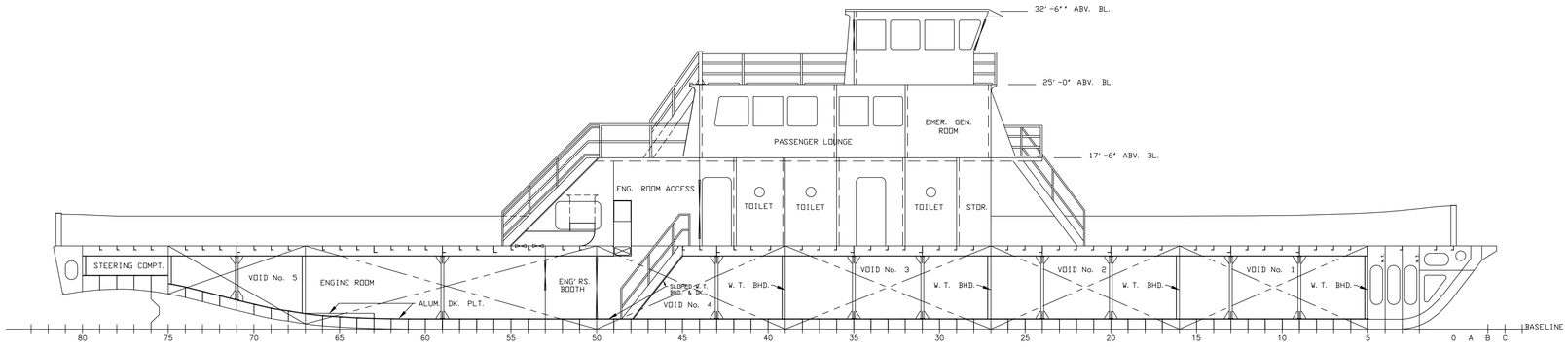
DRWN. A. OVERSTREET

CHKD.

SCALE 3/16" = 1'

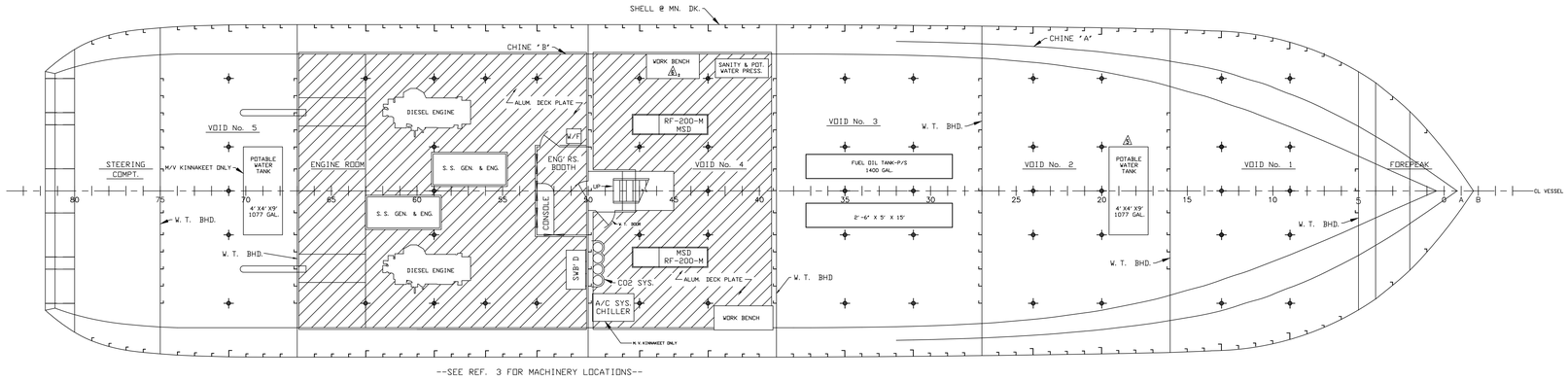
APPROVALS
USCG-SER-H2-80356-APRIL 14, 1988

NC-220-0005 REV. 11



INBOARD PROFILE

3/16" = 1'



--SEE REF. 3 FOR MACHINERY LOCATIONS--

PLAN-HOLD

3/16" = 1'

REFERENCES

1. CONTRACT SPECIFICATIONS
2. DWG. N. C. 220-0005-----OUTB. PROFILE & DK. ARRG'MTS.
3. DWG. N. C. 220-0052-----MACHINERY ARRANGEMENTS

No.	DESCRIPTION	By	Date	App'd.
7	REPRODUCED IN ITS ENTIRETY USING AUTOCAD RELEASE 12 REVISED DRAWING TO SHOW CORRECT STANCHION LOCATION IN ENGINE ROOM	EBJ	5/28 '93	
6	ADDED WORKBENCH IN MSD COMPT.	EBJ	8/14 '92	
5	RELOCATED POTABLE WATER TANK TO REFLECT CHN'G FOR 5TH VESSEL CONTRACT	EBJ	6/23 '89	
4	AS BUILT		4/19 '89	
3	REV. H.R. @ P.H. DK. TO 3 COURSE RAILS REMOVE CL STANCHION @ FR.60. RELOCATED PRESS SETS @ WATER HEATER. CHANGED DOOR TO E/S TO PORT BHD.	VF	12/15 '88	
2	RELOCATED SHIPSERVICE GENERATORS F.O. TANKS & F.W. TANK	EBJ	7/12 '88	
1	REV. UPPER HOUSE/ADD ENG. RM. AIR INTAKE	RK	5/18 '88	

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

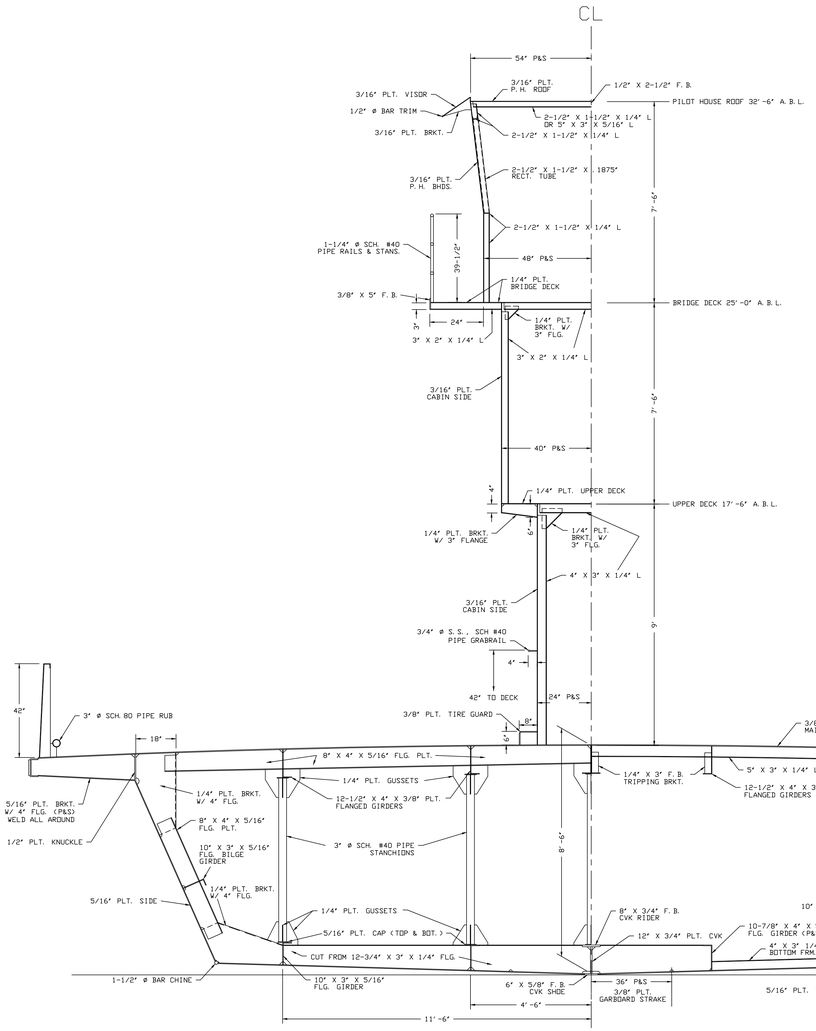
INBOARD PROFILE & GEN. ARRG'TS.— BELOW MAIN DK.

SEAL

APPROVALS
USCG-SER-H2-80356-APRIL 14, 1988

DRWN. A. OVERSTREET
CHKD.
SCALE 3/16" = 1'

NC-220-0006 REV. 7

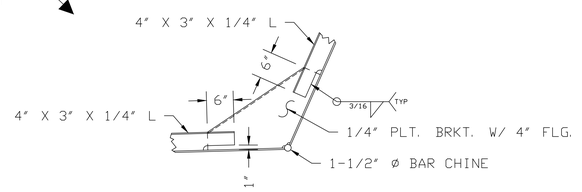


TYPICAL WEB FRAME

TYPICAL FRAME

MIDSHIP SECTION

SCALE: 1/2" = 1'



DETAIL "A" TYPICAL LAP

SCALE: 1" = 1'

GENERAL NOTES

1. DECK BEAMS ARE 5" X 3" X 1/4" L's AND SIDE FRAMES ARE 4" X 3" X 1/4" L's.
2. WEB FRAMES ARE 1/4" PLT. & 5/16" PLT. W/ FLANGES LOCATED AT FR. # 9, 13, 20, 24, 31, 35, 43, 47, 53, 56, 59, 63, 71
3. W.T. BHDS. ARE 1/4" PLT. WITH 4" X 3" X 1/4" L STIFF. AS SHOWN ON PLAN, REF. No. 3
4. DECK OVERHANG IS SUPPORTED BY 5/16" PLT. BRACKETS WITH 4" FLANGE, AT EACH FRAME.
5. DECK EDGE IS MADE UP FROM 8" X 22.8# CHANNEL WITH A 3/4" X 7" RUB STRAKE ALL AROUND.
6. LONGITUDINAL DECK GIRDERS ARE 12-1/2" X 4" X 3/8" FLANGED PLATES W/ 1/4" X 3" F.B. TRIPPING BRACKETS AT EACH DECK BEAM.
7. LONGITUDINAL BOTTOM GIRDERS ARE 10" X 3" X 5/16" FLANGED PLATES W/ TRIPPING BRACKETS AT EACH FRAME.
8. LONGITUDINAL BILGE GIRDERS ARE 10" X 3" X 5/16" FLANGED PLATES.
9. MAIN DECK PLATE IS 3/8" PATTERN PLATE.
10. TUNNEL PLT. IS 5/8". SIDE AND BOTTOM PLATE IS 5/16", EXCEPT GARBOARD STRAKE WHICH IS 3/8" PLT. FROM 6" FWD. FR. 10 TO FR. 80. BOW PLATE IS 3/8" FROM STEM TO 6' FWD. FR. 10 (KEEL-CHINE A)
11. VERTICAL KEEL IS 3/4" PLT. WITH 8" X 3/4" RIDER.
12. BULWARK IS 1/4" PLT. WITH 3/8" PLT. BRKTS EVERY TWO(2) FRS. FROM FR. 16 TO 74, EA. FR. 16 FWD. & 74 AFT.
13. DECK HOUSE IS OF 3/16" PLT. WITH 4" X 3" X 1/4" L STIFF. BETWEEN MAIN DK. & UPPER DK. UPPER DK. BEAMS TO BE 4" X 3" X 1/4" L's. DECK HOUSE STIFF. 3" X 2" X 1/4" L BETWEEN UPPER DECK & BRIDGE DK. BRIDGE DECK BEAMS TO BE 3" X 2" X 1/4" L.
14. PILOT HOUSE IS OF 3/16" PLT. SIDES WITH 2-1/2" X 1-1/2" X 1/4" L STIFF., TOP IS 3/16" PLT. WITH 2-1/2" X 1-1/2" X 1/4" L.
15. WELDING DETAILS TO BE SUBMITTED BY CONTRACTOR FOR OWNERS'S & U.S.C.G. APPROVAL.
16. WELDING & WORKMANSHIP TO BE IN ACCORDANCE WITH THE REQUIREMENTS OF AMERICAN BUREAU OF SHIPPING & U.S. COAST GUARD.

REFERENCES

1. CONTRACT SPECIFICATIONS
2. DWG. NC-220-0008, HULL STRUCTURE
3. DWG. NC-220-1010, W.T. BULKHEADS
4. DWG. NC-220-0032, LOWER HOUSE STRUCTURE
5. DWG. NC-220-0033, UPPER HOUSE STRUCTURE
6. DWG. NC-220-0036, BULWARK & DETAILS

No.	DESCRIPTION	By	Date	App'd.
7	REPRODUCED IN ITS ENTIRETY USING AUTOCAD RELEASE 12	EBJ	5/26 '93	
6	REVIEWED STRUCT. CALL-OUTS VS. SPECS. & HULL STRUCT. DWG.-REVISED TO SUIT; ADDED REF. 4,5 & 6	EBJ	8/14 '92	
5	REV. AS PER COMMENTS OF NCDOT LTR. 12-16-88; ADD 6" DIM. ON UPPER DECK D.H. BRKT., ADD BRKT. @ P.H. ROOF	RF	12/22 '88	
4	CHANGE LONGL. GIRDERS IN HULL REVISE FLANGES OF STRUCTURES REVISE DWNG. NUMBER SEQUENCE ORIGINAL PATTI SUBMITTAL/REDRAW	RF	12/8 '88	

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

MIDSHIP SECTION

SEAL

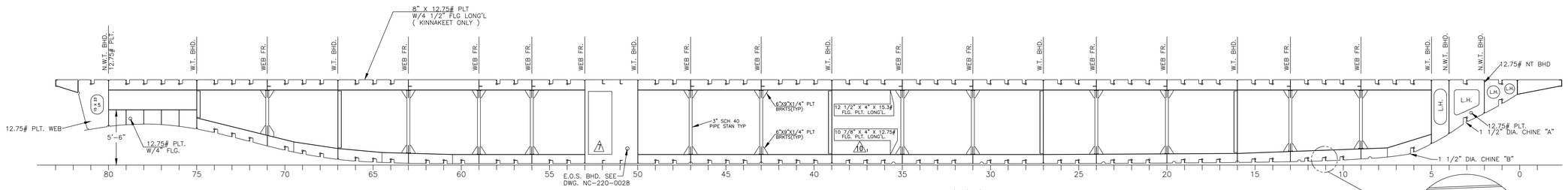
APPROVALS
U.S.C.G. MOBILE MSO 16711 APPROVED DEC. 22, 1989

DRWN. A. OVERSTREET

CHKD.

SCALE 1/2" = 1'

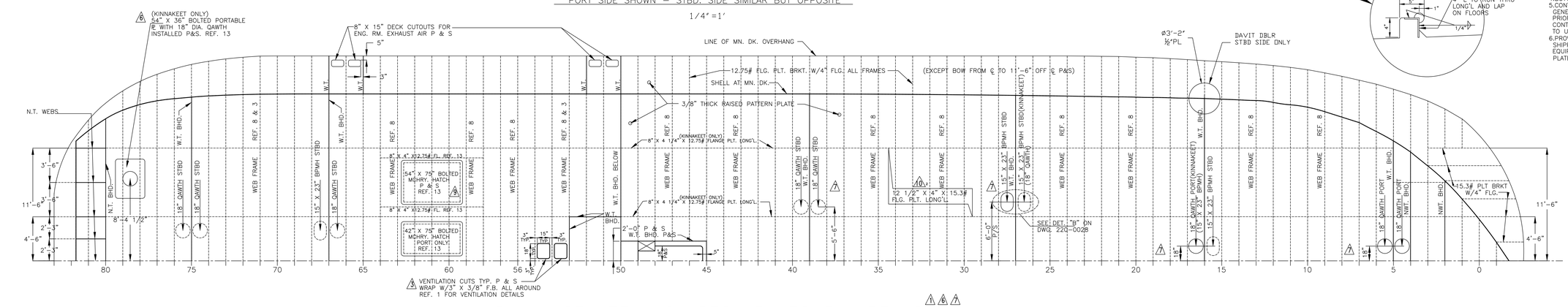
NC-220-1007 — REV. 7



SECTION 4'-6" OFF C -PORT SIDE SHOWN ⚠4⚠

PORT SIDE SHOWN – STBD. SIDE SIMILAR BUT OPPOSITE

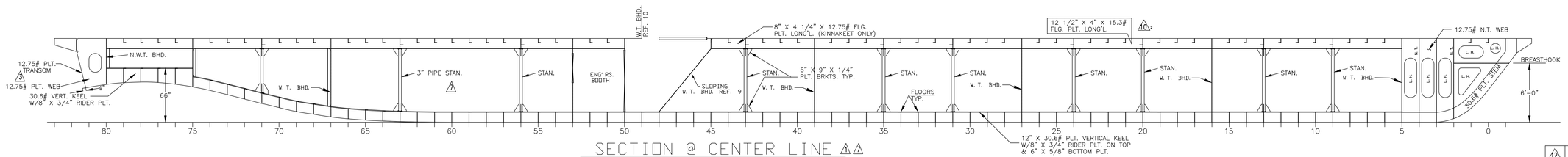
1/4" = 1'



PLAN VIEW OF MAIN DECK PLATING & BEAMS ⚠6⚠

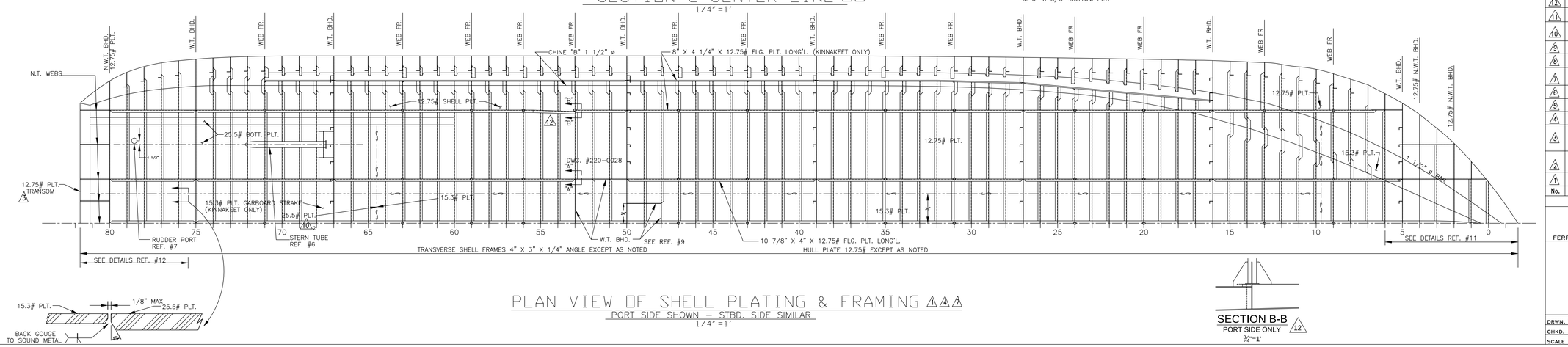
PORT SIDE SHOWN – STBD. SIDE SIMILAR EXCEPT AS NOTED

1/4" = 1'



SECTION @ CENTER LINE ⚠4⚠

1/4" = 1'



PLAN VIEW OF SHELL PLATING & FRAMING ⚠4⚠7

PORT SIDE SHOWN – STBD. SIDE SIMILAR

1/4" = 1'

GENERAL NOTES

1. ALL WELDING TO BE IN ACCORDANCE WITH ABS STANDARDS AND PERFORMED BY USCG CERTIFIED WELDERS. WELD SCHEDULE AND DETS SHALL BE PREPARED BY CONTRACTOR AND SUBMITTED BY CONTRACTOR FOR U.S. COAST GUARD APPROVAL.
2. ~~~~~~~~
3. MN DK BEAMS TO BE INTERCOSTAL TO CENTERLINE DK STRINGER ONLY. LONG'L 4'-6" & 11'-6" OFF CENTER LINE P&S TO BE CONTINOUS AND NOTCHED FOR DK BEAMS.
4. BUTTS AND SEAMS TO BE MADE TO SUIT AVAILABLE PLATE.
5. CONTRACTOR SHALL PROVIDE FDNS TO SUIT MN ENGINES GENERATORS, SWITCHBOARDS AND ALL OTHER EQUIPMENT. PRIOR TO INSTALLATION OF MN ENGINE FDNS, CONTRACTOR SHALL SUBMIT PLANS (ARRGT & DETS) TO U.S. COAST GUARD FOR APPROVAL.
6. PROVIDE OPENING THROUGH MAIN DECK FOR SHIPPING MAIN ENGINES, GENERATORS AND OTHER EQUIPMENT AND SHALL BE IN LIEU OF ANY PORTABLE PLATES AND SHALL BE CLOSED AS SOON AS POSSIBLE.

REFERENCES

1.	ENG RM & MSD VENTILATION	220-0059
2.	LINES AND OFFSETS	220-0001
3.	MIDSHIP SECTION	220-1007
4.	W.T. BULKHEADS	220-1010
5.	~~STRUCT ABOVE MN DK~~	~~220-0009~~
6.	SHAFTING & BEARINGS	220-0011
7.	RUDDER & RUDDER PORTS	220-0012
8.	FRAMES	220-0025
9.	MISC HULL FRAMING	220-0028
⚠3 10.	LOWER HOUSE STRUCTURE	220-0032
11.	FWD END FRAMING	220-0026
12.	AFT END FRAMING	220-0027
13.	MISC SECTIONS	220-0038

No.	DESCRIPTION	By	Date	App'd.
⚠12	AS-BUILT SECTION B-B, FRAME 53, PORT SIDE ONLY. LONG'L BETWEEN FRS 53 & 56 ADJUSTED TO SUIT SEACHEST STRAINER, NOT SHOWN.	BTJ	5/14 '18	
⚠11	REPRODUCED IN ITS ENTIRETY USING ACAD REL 12	AO	9/29 '33	
⚠10	1.MODIFIED DECK OVERHANG @ BOW PER MEMO BY R.F. GOINS dtd. 8/11/92 REQUIRING DECK EXTENSION 2.MODIFIED STRUCT. CALL-OUTS-4'-6" & 11'-6" DK. LONG'L 11'-6" RUN LONG'L CHINE A	EBJ	8/14 '92	
⚠9	ADDED NEW MACHINERY HATCHES	KEG	2/11 '91	
⚠8	AS BUILT	VF	4/3 '89	
⚠7	REMOVED SIDE STRINGER BETWEEN FRS. 5 & 16 REVISED W. H. NOTED – ADDED DOOR TO E. O. S. REMOVED CENTER LINE STANCHION @ FR. 60	VF	12/16 '88	
⚠6	REVISED MANHOLES AND RUDDER HATCH	VF	10/5 '88	
⚠5	REV. BOW SECTION @ CENTER; INDICATED E. O. S. N.T. BHD. REV. MAN HOLE LOCATIONS; ADDED REF. 11, 12 & 13	RK	8/24 '88	
⚠4	ADDED E. O. S. BHD. IN ENGINE ROOM @ ELEVATION 4'-4" OFF CENTER LINE	VF	8/9 '88	
⚠3	RELOCATED CENTER STANCHIONS IN ENG. RM. TO FRS. 56, 60 & 63			
⚠2	ADDED VENT CUTS FOR ENGINE ROOM ADDED PLATE SIZE TO TRANSOM PLATE REVISED DECK CUT ON CENTER @ FR. 49 ADDED REF. 10	VF	6/1 '88	
⚠1	ADDED SECTION @ BOTTOM SEAM ADDED DETAIL FOR BRKTS. AT TRANSOM REVISED DET. FOR PK LONG'L CUT OUT ALL PER OWNERS REQUEST	VF	5/17 '88	
	ADDED SECT. CUTS FOR STAT. & DET. NOTE FOR MANHOLES. ADDED DET. OF CUT FOR FRS. @ LONG'L ADDED W.T. BHD. & DK. CUT FOR ENG. RM. ACC.	VF	4/25 '88	

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

HULL STRUCTURE

SEAL

APPROVALS
USCG-SER-H2-80430-APRIL 28, 1988

DRWN. A. OVERSTREET
CHKD.
SCALE 1/4" = 1'

NC-220-0008 REV. 12

BILL OF MATERIALS

PIECE NUMBER	QTY	DESCRIPTION	MATERIAL	MAT'L SPEC.	MANUFACTURER	WT.	REMARKS
1	2	TAILSHAFT, 4"Ø x 21'-0" LONG	STN STL	AQUAMET 22	ARMCO STEEL	42 72 LB/FT	
2	2	LINE SHAFT, 4"Ø x 6'-2 5/8" LG	STEEL	SAE No. 1040			
3	2	SHAFT SLEEVE 22" LG X 4-3/4" O.D.	BRONZE	ABS GR. 1			ALT. MATERIAL S.A.E. 660
4	2	SHAFT SLEEVE (TO BE LG X 4-3/4" O.D.	BRONZE				
5	2	STRUT BEARING	VARIOUS		Bearing, Cutless, Flanged Brass Shell 4-3/4" x 6-1/4" x 19" - Bolt pattern to be drilled to match existing		
6	2	STUFFING BOX			FIG-1789 ---(Formally TM-PSE-04-1) Serial) ---		WATER SERVICE; CODE No. 0434; TYPE "S"
7	2	STUFFING BOX BEARING			Bearing, Cutless, Flanged Brass Shell 4-3/4" x 6-1/4" x 19" - Bolt pattern to be drilled to match existing		
8	2	FLANGED COUPLING		XB 6162	TWIN DISC DR EQ.		
9	2	PILLOW BLOCK BEARING		DIBCP400EX	COPPER		EXPANSION TYPE, SELF ALIGNING
10	60"	KEY STOCK 1" X 5/8"	ST. ST.	A. B.S. GR. 2			
11	16	BOLT 3/4" UNC X 2-3/4" LG, W/NUT, HEAVY HEX	STEEL	ASTM A-325			FOR FLANGE COUPLING--TWIN DISC--XB50540
12	4	PROPELLER 40"Ø, 2 R.H.; 2 L.H.	BRONZE		MICHIGAN WHEEL		4 BLADE, 36" PITCH
13	2	STERN TUBE	ST. STEEL	ASTM A-36			7-3/4"O.D. X 1/4" WALL THICKNESS MECH. TUBING
14	4	FLANGED COUPLING	ST. ST.		TIDEWATER CASTINGS		2401 WESLEY ST. PORTSMOUTH, VA 23707
15	2	FLANGED COUPLING	STEEL	PN PX-11256	TWIN DISC		MATING HALF TO MOX 5145 GEAR SPLICE

REVISION 12

DETAIL "B-B" BEARING STEPS
SCALE: 3" = 1'

DETAIL "A-A" TYPICAL KEY
FULL SIZE

BOLT FLANGE
SCALE: 3" = 1'
9-3/8"Ø, 8, X 6-3/4" I.D. (NOM.)
1-1/4" THICK STEEL
I. D. LIGHT PRESS FIT

ADAPTER PLATE
SCALE: 3" = 1'
19" O.D. X 8 3/4" I.D.
1-1/4" THICK STEEL
FOR JOHN CRANE SEAL
ON STEINER HULL 331

SECTION "A-A"
FULL SIZE

SHAFTING DETAILS
SCALE: 3" = 1'

FLANGED COUPLING
NOT TO SCALE
HULLS 135, 136, 137 & 1225 ONLY

COMPANION FLANGE NUT
SCALE: 3" = 1'
2 REQ'D

RUDDER/STRUT FOUNDATION PLAN
SCALE: 3/4" = 1'

SKEG BASE-SECTION "D-D"
SCALE: 3/4" = 1'

ELEVATION-SHAFTING
SCALE: 3/4" = 1'
8'-0" OFF CENTERLINE

SECTION @ FR. 76-LKG. AFT
SCALE: 3/4" = 1'

STERN TUBE HULL PENETRATION DET
SCALE: 1-1/2" = 1'

STERN TUBE HULL PENETRATION AT SKEG
SCALE: 1-1/2" = 1'

GENERAL NOTES:

1. TEMPLATE ALL WORK FROM VESSEL.
2. HARDWARE; "BODY BOUND" BOLTS, NUTS, STUDS AND WASHERS SHALL BE STAINLESS STEEL, ASTM 276 TYPE 316 EXCEPT AS NOTED.
3. ALL KEYWAYS TO BE FULL "SPOONED" WITH FILLET RADII AT BOTTOM - NOT TO BE LESS THAN 1/8" IN ACCORDANCE WITH A.B.S. REQUIREMENTS.
4. ALL OUTFITTING & CONSTRUCTION IS TO BE ACCEPTABLE TO COGNIZANT U.S.C.G. INSPECTOR & OWNER'S INSPECTOR.
5. STUFFING BOX BEARING TO BE MACHINED TO 5.75"Ø MIN., 6.156250"Ø MAX. STERN TUBE BEARING TO BE MACHINED IN THREE STEPS AS SHOWN ON DWG.
6. COUPLING HALVES SHALL BE FITTED TO BOTH TAILSHAFTS (i.e. TWO TAILSHAFTS FITTED FOR STBD. SIDE RUNNING, TWO FOR PORT)
7. PROVIDE SUITABLE LOCKING DEVICES FOR ALL COUPLING/SHAFT NUTS. LOCKING DEVICES SHALL BE DESIGNED FOR EASY REMOVAL & BE REUSABLE.

REFERENCES

1. CONTRACT SPECIFICATIONS
2. DWG. NC-220-0012 -- RUDDER & RUDDER PORTS
3. DWG. NC-220-1010 -- W.T. BULKHEADS

APPLICABLE TO FOLLOWING VESSELS

1. CAPE POINT	O.N. 949251, PATTI SHIPYARD		HULL 137
2. FRISCO	O.N. 946908, PATTI SHIPYARD		HULL 135
3. CHICOPACOMICO	O.N. 949252, PATTI SHIPYARD		HULL 136
4. KINNAKEET	O.N. 944638, HOUMA FABRICATORS		HULL 92
5. OCRACOKE	O.N. 964046, TRINITY MARINE		HULL 1215
6. ROANOKE	O.N. 996146, STEINER SHIPYARD		HULL 331

Rev.	DESCRIPTION	By	Date
12b	CHANGED GEAR MATING COUPLING AND DIMENSIONS TO SUIT	JDWaldrep	7-22-2013
12a	INSERTED C18 CAT. ENGINE PACKAGE AND CHANGED DIMENSIONS		
11b	INSERTED RUDDER DETAIL FROM RUDDER DRAWING (REF. 2).	JDWaldrep	1-4-2013
11a	CHANGED ME FROM CAT. 3408 TO CAT C18 TIER III/IMO II (FHWA PROJECT FY 2002 HATTERAS CLASS REMOVED)		
10	REPRODUCED IN ITS ENTIRETY USING AUTOCAD; FOR THIS PROJECT ITEM 6 IN B.O.M. IS A JOHN CRANE SEAL # K70034000010760	EBJ	5/26 '93
9	REVISED PC. #14 TO READ FLANGED COUPL. WAS COMPANION COUPLING; CHK'GD REF. TO "FITTED BOLTS" TO "BODY BOUND"	EBJ	8/17 '90
8	ADDED COMP. FL & NUT DET.	WP	11/1 '89
7	REVISED BILL OF MATERIALS TO REFLECT INSTALLED EQUIPMENT	EBJ	6/14 '89
6	AS BUILT	VF	3/31 '89
5	REMOVED DBLR. FROM "I" STRUT @ HULL & REMOVED DETAIL "C-C" - ADDED DBL. PLT. @ SKEG STRUT @ "SECT. @ FR. 76"	VF	12/15 '88
4	REV. STERN TUBE PENE. DBLR; ADDED STERN TUBE PENE. DETAIL	JK	10/3 '88
3	ADDED WELD SYM-DETAILS; REV. DBLR. PLT. SIZE	RK	9/8 '88
2	MOVED RUDDER AFT 1-1/2" REMOVED RUDDER STRUT IN HULL	RK	7/29 '88
1	MISC. REV.	RK	6/22 '88

REVISIONS

NC DEPARTMENT OF TRANSPORTATION
FERRY DIVISION

8550 SHIPYARD RD — MANNS HARBOR, NC 27953

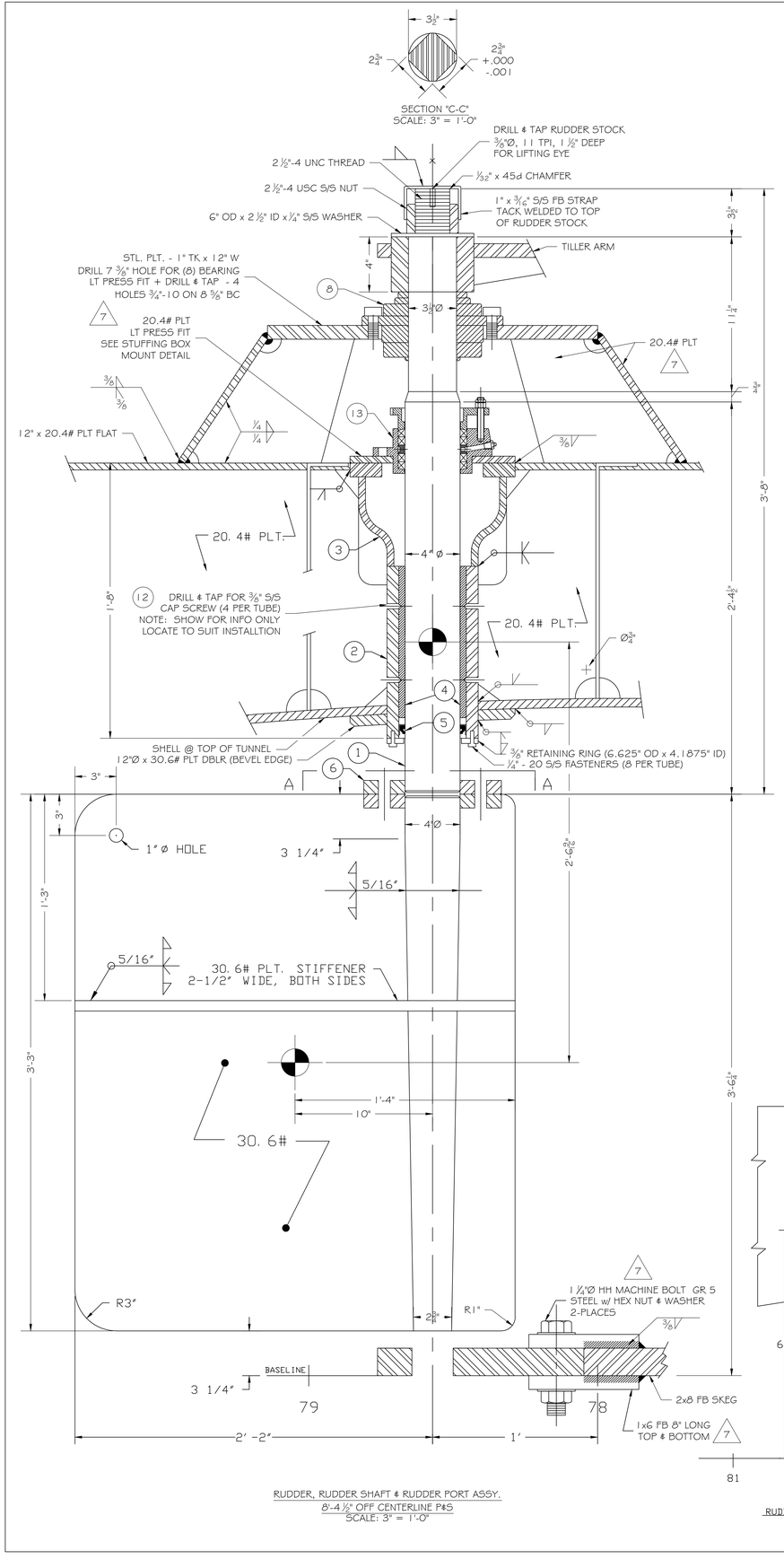
150'-0" HATTERAS CLASS FERRIES

SHAFTING, BEARINGS & STERN TUBES

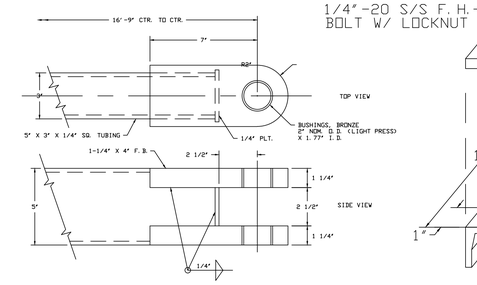
APPROVALS: USCG-SER-HE-80356-APRIL 14, 1980

DRAWN: A. OVERSTREET
CHK'D:
SCALE: AS NOTED

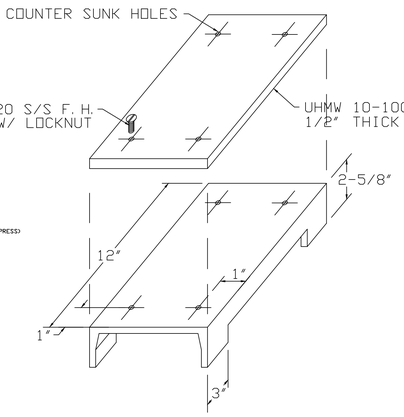
DWG. NO. NC-220-0011 — REV. 12



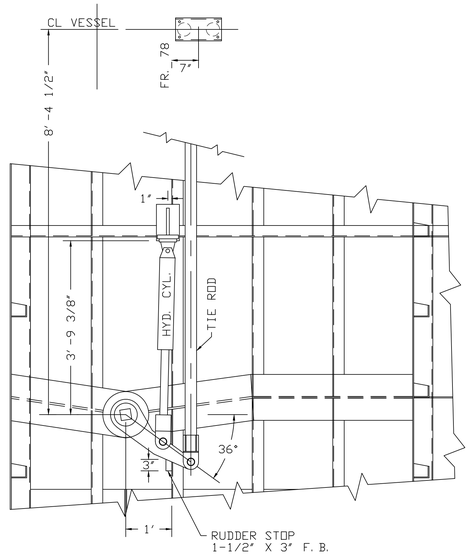
RUDDER, RUDDER SHAFT & RUDDER PORT ASSY.
8'-4 1/2" OFF CENTERLINE P&S
SCALE: 3" = 1'-0"



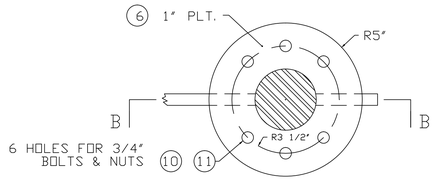
TIE ROD DETAILS
SCALE: 3" = 1'



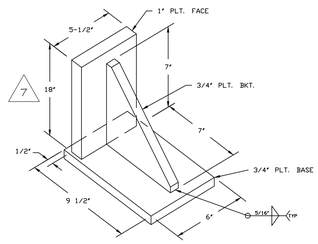
TIE ROD SUPPORT
N. T. S.



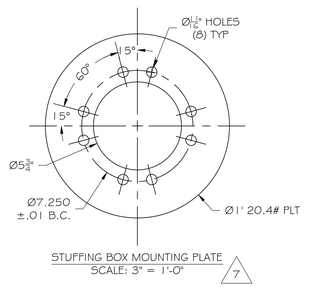
STEERING GEAR PLAN-(STBD. SHOWN, PORT OPP.)
SCALE: 3/4" = 1'



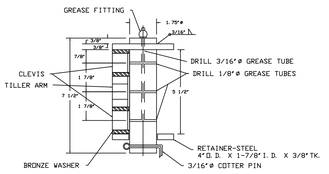
SECTION "A-A"
SCALE: 3" = 1'



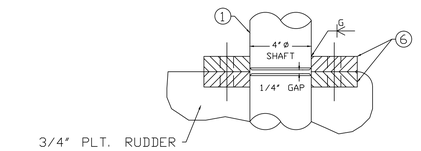
CYLINDER BRACKET
N. T. S.



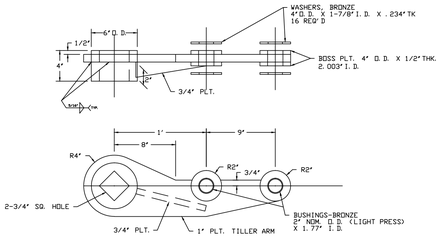
STUFFING BOX MOUNTING PLATE
SCALE: 3" = 1'-0" 7



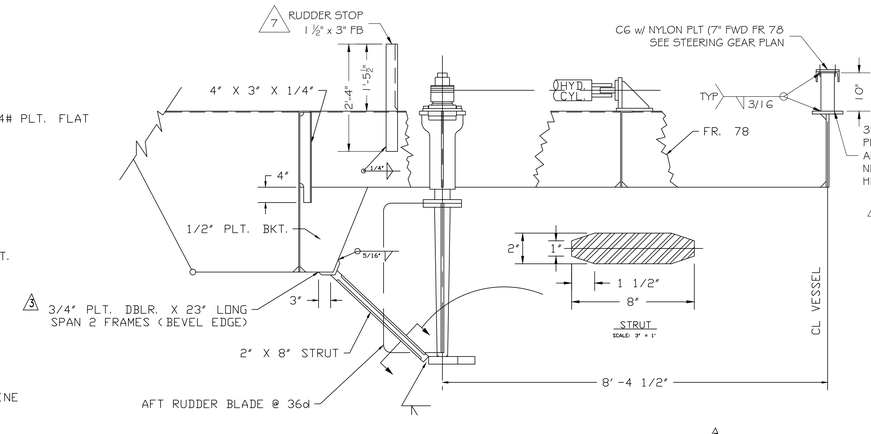
STEERING PIN-4 REQ'D
SCALE: 3" = 1'



SECTION "B-B"
SCALE: 3" = 1'



TILLER HUB & ARM-(STBD. SHOWN PORT OPP.)
SCALE: 1-1/2" = 1'



SECTION 12" AFT OF FR. 78 3
SCALE: 3/4" = 1'

BILL OF MATERIALS

MK.	QTY	DESCRIPTION	MATERIAL	REMARKS
1	2 EA.	UPPER & LOWER RUDDER STOCKS	ST. ST.	4"ø AQUAMET 22-MACH"B. TO SUIT
2	2 ø 12.5"/6	RUDDER TUBE - XX STRONG	STEEL	6. 625"O. D. X 4. 897" I. D. SEAMLESS MECH. TUBING
3	2	CONCENTRIC REDUCER - X STRONG	STL-ASTM 234	6" X 10"
4	2 ø 11"/16 (A	BUSHING 4. 897"O. D. X 4. 010" I. D.	SXL	THORDON - LIGHT PRESS FIT O. D.
5	4	RUDDER STOCK SEALS	--------	GARLOCK KLOSURE-MODEL 23
6	4	RUDDER PALM - 10" W/6-3/4" BOLTS	1" STL. PLT.	A. B. S. GRADE "AH" OR "B"
7	2	SKEG BEARING	BRONZE	2.010" I. D. X 3"O. D. W/ 1/2" FLG.
8	2	FLANGE BEARING (NON-EXPANSION)	CAST STEEL	DODGE-PART# 059138
9	2	1/4"-18 NPT GREASE FITTING		
10	12	BOLTS - HEX HEAD 3/4" X 3"	STEEL	GRADE 5
11	12	NUTS - HEX 3/4"	STEEL	
12	8	CAP SCREW 3/8-LB.	ST. ST.	CUPPED END (LENGTH TO SUIT)
13	2	STUFFING BOX - 4"		DURAMAX MARINE - 1791-0400
14				
15				

GENERAL NOTES:

1. TEMPLATE ALL WORK FROM VESSEL.
2. ALL WELDING SHALL BE ACCOMPLISHED IN ACCORDANCE WITH A. B. S. RULES FOR BUILDING AND CLASSING STEEL VESSELS, SECTION 30
3. ALL WELDING SHALL BE ACCOMPLISHED BY WELDERS HOLDING CURRENT A. B. S. OR U. S. C. G. CERTIFICATES
4. ~~PROVISIE AND INSTALL 1/4" COPPER TUBING GREASE LINES & FITTINGS FROM RUDDER PORTS TO CENTRAL LUBRICATION POINT AT MAIN DECK HATCH.~~
5. ~~MACHINE SPIRAL GROOVE IN EACH RUDDER STOCK BUSHING TO FACILITATE GREASE DISTRIBUTION.~~
6. MACHINE LONGITUDINAL GROOVES IN EACH RUDDER STOCK BUSHING TO FACILITATE WATER LUBRICATION PER TECHNICAL MANUAL, SECTION 4.

REFERENCES

1. CONTRACT SPECIFICATIONS
2. DWG. NC-220-0008 -- HULL STRUCTURE
3. DWG. NC-220-1010 -- W. T. BULKHEADS

No.	DESCRIPTION	By	Date	App'd.
7	A: ADDED STUFFING BOX TO UPPER RUDDER STOCK. (RAISED STEARING LINKAGE) B: REMOVED SKEG RUDDER BEARING C: CHANGED UPPER BEARING MATERIAL. (B.O.M. #4)	BTJ	FEB 26 2013	
6	REPRODUCED IN ITS ENTIRETY USING AUTOCAD RELEASE 12	EBJ	5/26 '93	
5	REMOVED DBLR. FROM "I" STRUT ø HULL & ADDED TIE ROD SUPPORT DET.	VF	12/7 '88	
4	AS BUILT	VF	4/5 '88	
3	CHG TOLERANCE OF BRG & BUSHING TO 0.010" REV DBLR PLT. ø STRUT & RUDDER PORT, ADD WELD DETS.	VF	9/6 '88	
2	MOVED RUDDER AFT 1-1/2", MOD TO SQUARE OF RUDDER BRG. .02 TO .001 CLEARANCE, ADD LIFT EYE.	RK	7/29 '88	
1	COMPLETED DRAWING	RK	7/6 '88	

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

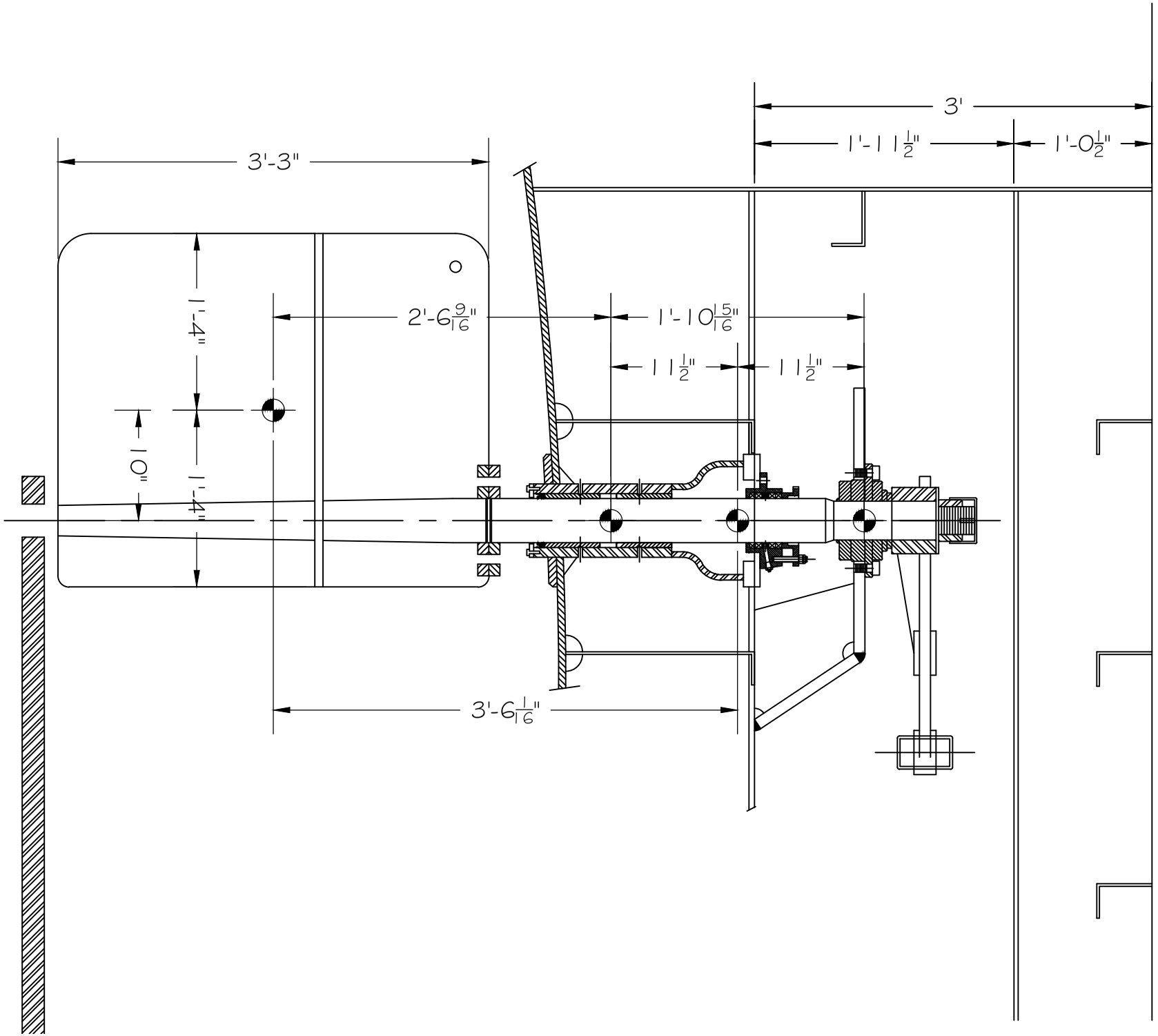
RUDDERS & RUDDER PORTS

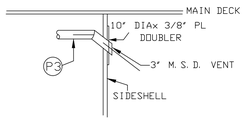
SEAL

APPROVALS
USCG-SER-42-80356-APRIL 14, 1988

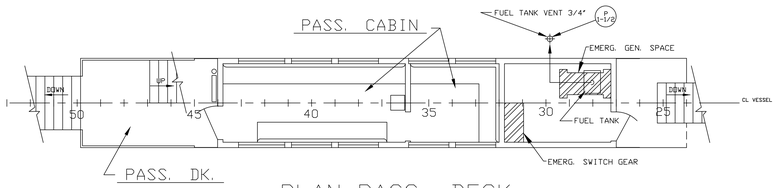
DRWN. A. OVERSTREET
CHKD.
SCALE 3/4" = 1'

NC-220-0012 — REV. 7

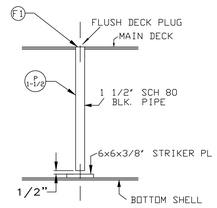

3'
1'-11 1/2"
1'-0 1/2"
3'-3"
1'-4"
2'-6 9/16"
1'-10 5/16"
11 1/2"
11 1/2"
10"
1'-4"
3'-6 1/16"



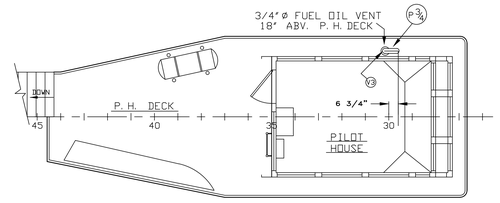
M. S. D. VENT DETAIL



PLAN-PASS. DECK



SOUNDING TUBE DETAIL



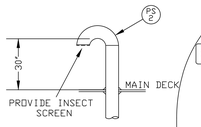
PLAN-P. H. DECK

SCHEDULE OF MATERIALS

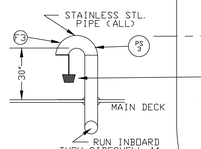
SYSTEM	SIZE	PIPE	FITTINGS	TAKE DOWN JOINTS	VALVES	REMARKS
VENTS	2 1/2" AND ABOVE	SCH 80 GALV STL. ASTM A-53 GRD.A OR B TYPE E	SCH 80 , B.W. GALV, F.S. ASTM A-234 GR WPA OR WPB SCH.40 S.S. ASTM A-376	150# S.O. FLG GALV FS ASTM A-105 GR. 10R2 SCH.40 S.S. ASTM A-376	INVERTED TANK VENT CHECK VALVE MEMARKO MODEL # VC 200 GALV.CAST STEEL W/DOUBLE SCREEN, COPPER BALL FLOAT, FLGD CONNECTION	1.) NUTS AND BOLTS TO BE ASTM A-307 GALV GRD. B 2.) GASKET MAT'L TO BE RED RUBBER CLOTH INSERTED 3.) ALL MFG'S AND MODEL #'S ARE "OR EQUAL"
	2" AND BELOW	SCH.40 STAINLESS STL. ASTM A-376	3000# F.S. S.W. GALV ASTM A 105 GR. 10R2 ON MAIN DECK USE SCH.40 S.S. ASTM A-182	3000# GALV FS., SW., G.J. UNION ASTM A 105 GR 10R2 ON MAIN DECK USE SCH.40 STAINLESS STL. ASTM A-182	INVERTED TANK VENT CHECK VALVE SAME AS ABOVE EXCEPT SCREWED CONNECTION	
SOUNDS AND FILLS	2" AND BELOW	SCH 80 GALV STL. ASTM A-53 GRD.A OR B TYPE E ON MAIN DECK USE SCH.40 S.S. ASTM A-376	3000# F.S. S.W. GALV ASTM A-105 GR. 10R2 ON MAIN DECK USE SCH.40 S.S. ASTM A-182	3000# GALV FS., SW., G.J. UNION ASTM A 105 GR 10R2	GATE VALVE QUICK OPENING, SELF CLOSING 125-175 LB BR2 SCRD "GRINNELL"	

PARTS LIST

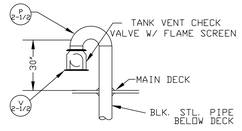
SYMBOL	QTY. (EST.)	DESCRIPTION
F3	12	3" SCH 40 STAINLESS STL 180° RETURN BEND
F1	9	"MEMARKO" DP-1B DECK PLUG- 1 1/2" SIZE
V1	3	1/4" PETCOCK VALVE (SEE NOTE 2)
V1 1/2	1	1 1/2" "POWELL" FIG. 502 H GATE VALVE
V2	1	2" GATE VALVE "POWELL" FIG. #502 H
V2 1/2	2	2 1/2" "MEMARKO" INVERTED VENT CHECK VA.
P 3/4	AS REQ	3/4" SCH 80 PIPE
P1 1/2		1 1/2" SCH 80 PIPE
P2		2" SCH 80 PIPE
PS2		2" SCH 40 STAINLESS PIPE (316)
P2 1/2		2 1/2" SCH 80 PIPE
PS1 1/2		1 1/2" SCH 40 STAINLESS PIPE (316)
P3		3" SCH 80 PIPE
PS3		3" SCH 40 STAINLESS PIPE (316)
V3	1	1 1/2" "MEMARKO" INVERTED VENT CHECK VA



FRESH WATER VENT

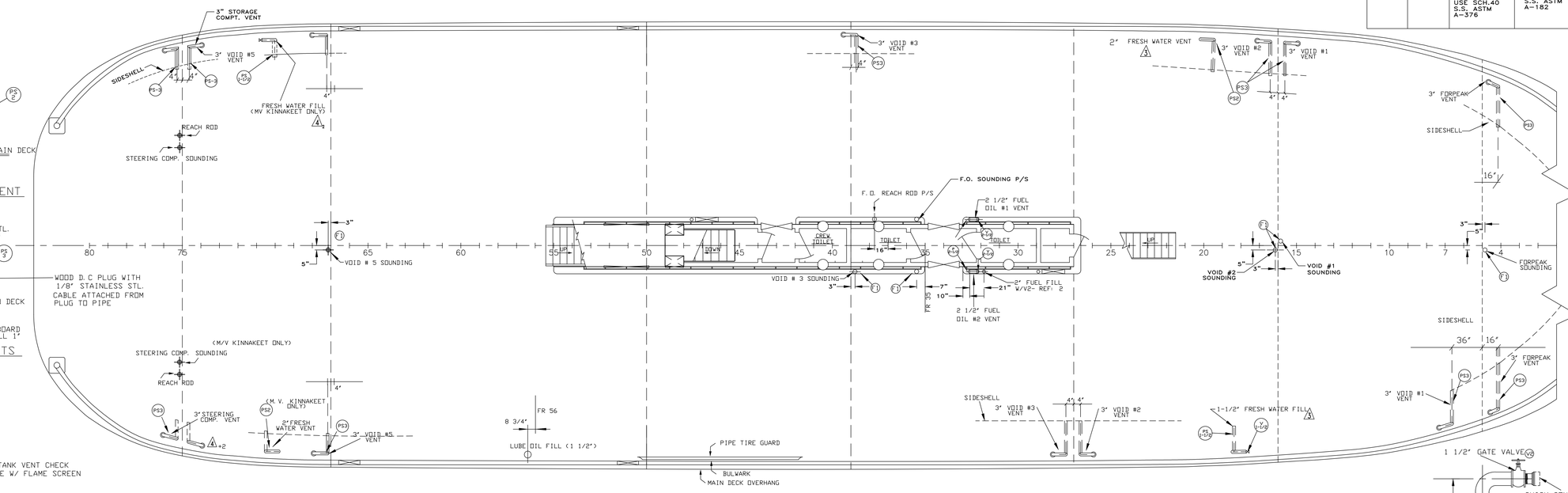


VOID TANK VENTS

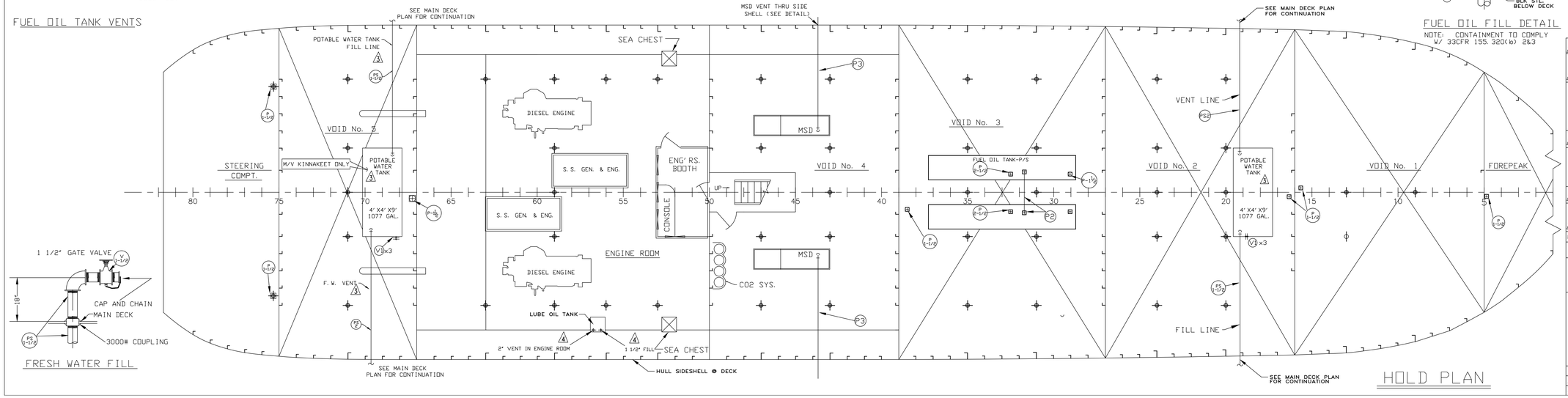


FUEL OIL TANK VENTS

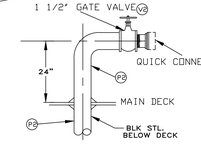
FRESH WATER FILL



MAIN DECK PLAN



HOLD PLAN



FUEL OIL FILL DETAIL

NOTE: CONTAINMENT TO COMPLY W/ 33CFR 155.320(e) 2&3

SYMBOL LIST

SYMBOL	DESCRIPTION
	GATE VALVE
	PIPE TURNED UP
	PIPE TURNED DOWN
	UNION
	FLANGED TAKE DOWN JOINT
	HOSE

NO.	DESCRIPTION	BY	DATE	APP'D
5	REPRODUCED IN ITS ENTIRETY USING AUTOCAD RELEASE 12	EAO	9/13 '93	
4	2. ADDED VOID VENT BTWN. FRS. 67&68 PORT & BETWEEN FRS. 74 & 75 STBD. 1. CHANGED LUBE OIL TANK TO 1 1/2" & L.O. TANK VENT TO 2"	EBJ	8/17 '92	
	GENERAL NOTES 1. ALL WORKMANSHIP, MATERIALS, & COMPONENTS TO BE U.S.C.G. APPROVED 2. PROVIDE (3) THREE PETCOCKS IN FRESH WATER TANK, ONE LOW - ONE HIGH - AND ONE IN THE MIDDLE			
3	RELOCATED POT. WATER TANK; FILL LINE; VENT LINE TO SUIT 3 BOAT CONTRACT	EBJ	6/14 '89	
	REF: 1. CONTRACT SPECIFICATIONS 2. FUEL PIPING SYSTEM - NC-220-0016			
2	AS BUILT	VF	4/7 '89	
1	RELOCATED POT. WATER TANK & ADDED F.W. VENT & FILL @ BULWARKS ADDED F.O. CROSS OVER LINE & F.O. SOUNDING TUBES AT P&S	EBJ	7/19 '88	

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

VENTS, FILLS, AND SOUNDS

SEAL

APPROVALS

USCG-SER. M-80067-2/12/1988

DRWN. R.L. FYFFE

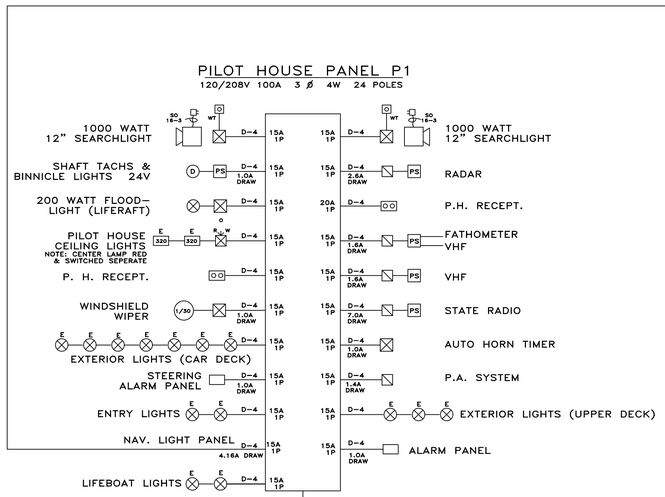
CHKD.

SCALE 1/4" = 1'

NC-220-0017 REV. 5

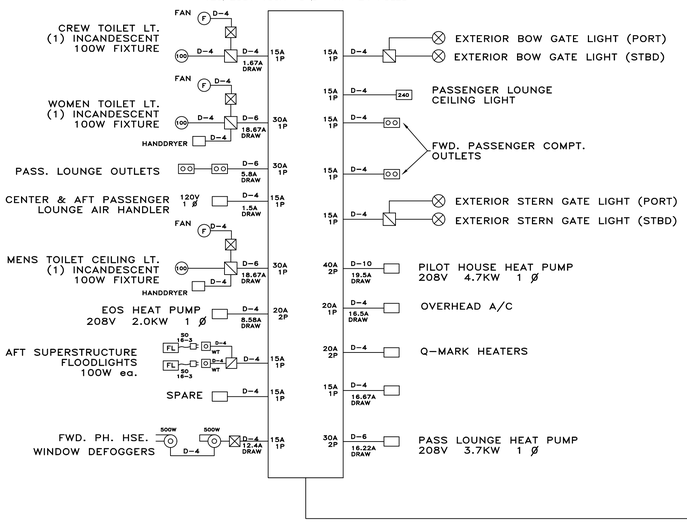
PILOT HOUSE PANEL P1

120/208V 100A 3 ø 4W 24 POLES



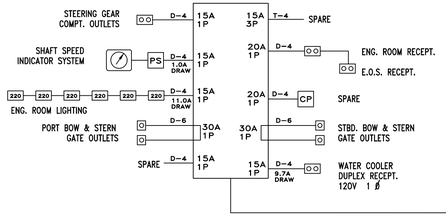
PILOT HOUSE PANEL P2

120/208V 100A 3 ø 4W 24 POLES

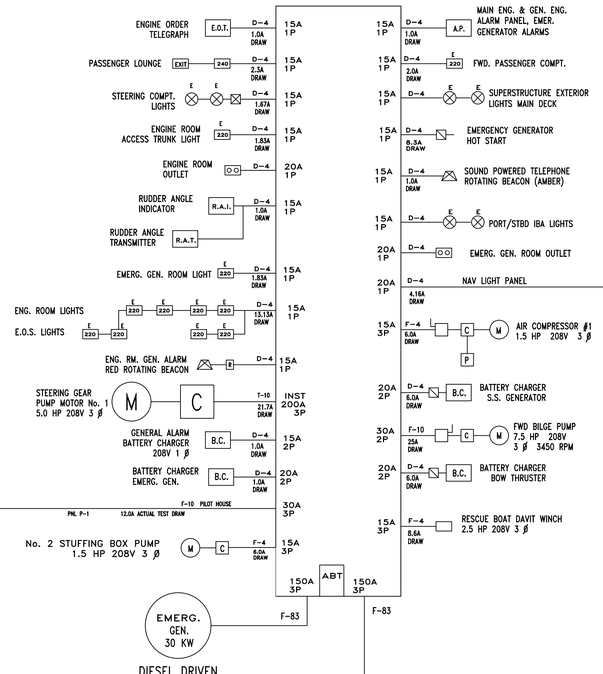


E.O.S. PANEL P3

120/208V 100A 3 ø 4W 24 POLES



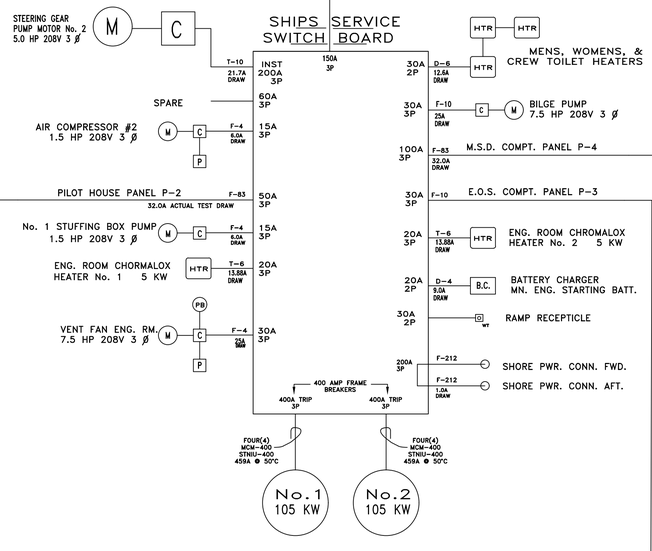
EMERGENCY SWITCHBOARD



EMERG. GEN. 30 KW

DIESEL DRIVEN 208V 3 ø 69A MAX

SHIPS SERVICE SWITCH BOARD



FOUR(4) MCM-400 STNIU-400 459A @ 50°C — No.1 105 KW

FOUR(4) MCM-400 STNIU-400 459A @ 50°C — No.2 105 KW

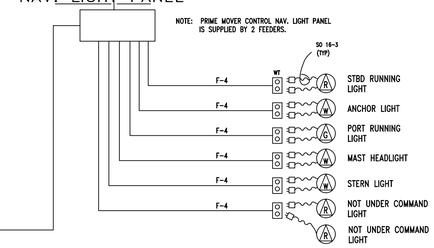
SHIPS SERVICE GENERATORS

DIESEL DRIVEN 208V 3 ø

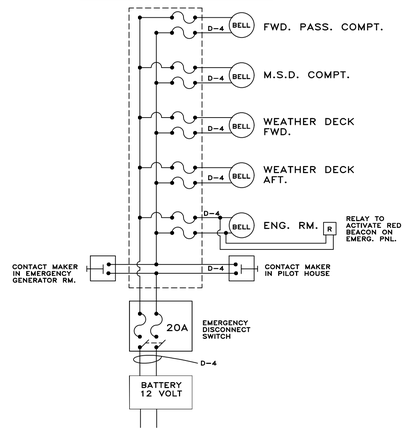
310A MAX

NAV. LIGHT PANEL

NOTE: PRIME MOVER CONTROL NAV. LIGHT PANEL IS SUPPLIED BY 2 FEEDERS.

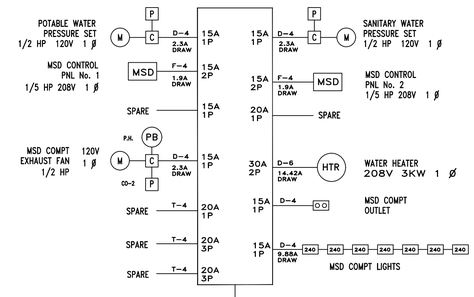


GENERAL ALARM PANEL

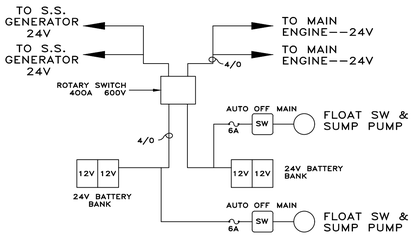


M.S.D. COMPT. PANEL P4

120/208V 225A 3 ø 4W 30 POLES



BATTERY SWITCHING



GENERAL NOTES

1. CABLE TO BE OF THE "TNI" TYPE THERMOPLASTIC NYLON INSULATED, MANUFACTURED BY MARINE CABLE CORP. (L. F. GAUBERT)
2. ALL ELECTRICL EQUIPMENT LOCATED IN THE ENG. ROOM TO BE RATED FOR AN AMBIENT TEMP. OF 50 deg. C. EQUIPMENT LOCATED OUTSIDE ENG. ROOM TO BE RATED FOR 40 deg. AMBIENT TEMP.
3. PROVIDE AUDIBLE & VISUAL ALARMS FOR STEERING GEAR IN PILOT HOUSE & E.O.S. CONSOLE IN ACCORDANCE WITH 46 CFR 111.93-13.
4. ALL WIRING SHALL BE IN ACCORDANCE WITH 46 CFR 110-113 INCLUSIVE, U.S.C.G. ELECTRICAL ENGINEERING REGULATION WITH REVISIONS.
5. ALL CABLES SHALL BE IN ACCORDANCE WITH I.E.E.E. BULLETIN NUMBER 45, LATEST EDITION.
6. AUTOMATIC BUS TRANSFER PANEL SHALL BE LOCATED AFTER THE EMERG. GEN. CIRCUIT BKR.
7. PROVIDE OVERCURRENT PROTECTION DEVICES IN LIGHT PANELS IN ACCORDANCE WITH REQUIREMENTS OF CFR 111.75.
8. VENT FANS IN MACHY. SPACES & EMERG. GEN. TO BE INTERCONNECTED VIA PRESS. SWITCH TO CO-2 SHUTDOWNS. MAIN ENGINE & S.S. GENERATOR TO HAVE INDIV. MANUAL SHUTDOWNS LOC. FR. 42-44 MN. DK.
9. PACKAGE AIR CONDITIONERS/HEAT PUMPS SHALL BE THERMOSTAT CONTROLLED FOR PASSENGER LOUNGES AND PILOT HOUSE.
10. SHIPS SERVICE GENERATORS SHALL NOT BE PARALLELED. PROVIDE SWITCH'BD. MECHANICAL LOCK-OUT TO PREVENT PARALLEL OPERATION.
11. LIGHTING & POWER PANELS TO THREE PHASE 4-WIRE TYPE.
12. BALANCE THREE PHASE LOAD FOR FULL OPERATING CONDITIONS TO ELIMINATE NEUTRAL CURRENT.
13. MOTOR CONTROLLERS LOCATED OUT OF SIGHT OF, OR MORE THAN 50' FROM THE MOTOR SHALL BE FITTED WITH A LOCKING DISCONNECT SWITCH.
14. IF A STARTER MUST BE INSTALLED OUT OF SIGHT OF THE MOTOR SERVICED, SEPARATELY MOUNTED START/STOP PUSHBUTTONS IN WTR PROOF CORROSION RESISTANT ENCLOSURE, SHALL BE INSTALLED NEAR THE MOTOR, IN ADDITION TO THOSE AT THE STARTER.
15. PROVIDE LOW VOLTAGE PROTECTION IN ACCORDANCE WITH 46 CFR 111.70-(f),(g).
16. ALL INCANDESCENT LIGHT FIXTURES ARE 100 WATT.

REFERENCES

1. CONSTRUCTION SPECIFICATIONS
2. DWG. NC 220-0050(REV. 4)---LIGHTING PLAN-OUT'BD. PROFILE & HOLD
3. DWG. NC 220-0051(REV. 5)---LIGHTING PLAN-MN. DECK & ABOVE

No.	DESCRIPTION	By	Date	App'd.
12	REMOVED CHILL WATER SYSTEM, ADD MINI SPLIT HVAC REARRANGED DWG TO MATCH PANEL AS BUILD LOCATIONS	BTJ	NOV 15 '22	
11	MOVED No. 2 STUFFING BOX PUMP TO EMERGENCY SWITCHBOARD.	BTJ	APR 13 '12	
10	ADDED EMERGENCY IBA LIGHTS PORT/STBD & CHANGED SHIPS SERVICE GEN CONNECTIONS AND TRIP	BTJ	JAN 3 '12	
9	CHANGED EMERGENCY GENERATOR FM 20kw to 30kw & CHANGED BREAKER FM 80 AMP to 125 AMP	BTJ	10/26 '10	
8	ADDED WT RECEPT. TO EMERGENCY SWITCHBOARD FOR DAVIT WINCH	BTJ	11/23 '09	
A	GENERAL REVISION TO SATISFY ELECTRICAL REQUIREMENTS FOR PROJECT No. 8.1230801	EJ	8/27 '92	
C	2. ADDED P.H. WIN. DEFOGGERS-P.H. PANEL P2 1. ADDED 200A-3P SHORE POWER CIRCUIT BREAKER (AFT) MN S/S SWITCH'BD.	EJ	8/17 '92	
B	ADDED REF. 2 & 3, ADDED TWO (2) FLOODLIGHTS TO PANEL P-2; ADDED FLOODLIGHT TO LEGEND	EJ	4/30 '90	
A	GENERAL REVISION	WP	11/5 '90	
7	"AS-BUILT" CORRECTIONS COMPLETE	WP	11/3 '90	
6	ADDED A/C CIRCUITS; MOVED LIGHT E.R. STAIRS TO M.S.D.	WP	6/19 '90	
5	CHANGED G.A. RED LT. FROM C.B. TO EMER. LT. CIRCUIT MOVED G.A. BELL TO M.S.D. COMPT.	WP	5/11 '89	
4	CHG. MAIN SWBD. BKR. TO 400A; CHG. E.R. VENT FAN BKR. TO 100A	WP	4/17 '89	
3	REDRAWN, ADDED MSD PANEL P-4	WP	4/10 '89	
2	REV. PER H. C. LTR. 22 NOV. 88	JK	12/5 '88	
1	REVISED GENERAL ALARM DIAGRAM; REV. WIRE SIZES, REV. BREAKER SIZES, REV. GEN. NOTES, REV. "DETAIL A"	JK	9/5 '88	

REVISIONS

THIS PLAN APPLICABLE TO:

	OFF.NO.
KINNAKEET	944638
FRISCO	946908
CHICAMOCOMICO	949252
CAPE POINT	949251
OCRACOKE	964046
ROANOKE	996146

LEGEND

P	PRESSURE SWITCH	duplex	RECEPT., WATERTIGHT DUPLEX
J	DISCONNECT SWITCH	WT	RECEPT., WATERTIGHT SINGLE
⊗	EXTERIOR LIGHT	○	RECEPT., INTERIOR SINGLE
PB	PUSH BUTTON	○○	RECEPT., INTERIOR SINGLE
M	MOTOR	PS	POWER SUPPLY 110VAC TO 12VDC
D	DIMMER SWITCH		CONNECTION BOX
240	FLUORESCENT LT. (32w)		SWITCH
FL	FLOODLIGHT	R	RELAY
C	CONTROLER		WINDOW DEFOGGER

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

ELEMENTARY WIRING DIAGRAM AND GENERAL ALARM SYSTEM

SEAL

APPROVALS
U.S.C.G. (MSC) SER. E-00041 dtd. 24 JAN. '90 REV. A

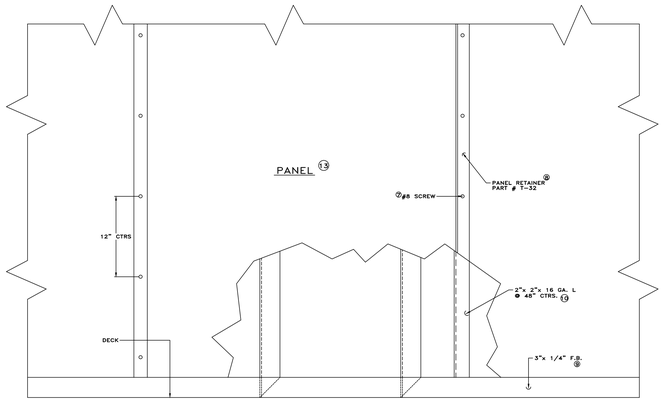
DRWN. e.b.j.-rev. D

CHKD.

SCALE

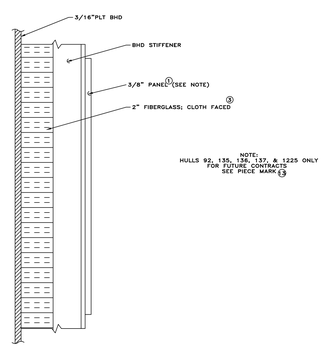
NC-220-0020

REV. 12



STD. PANEL INSTALLATION

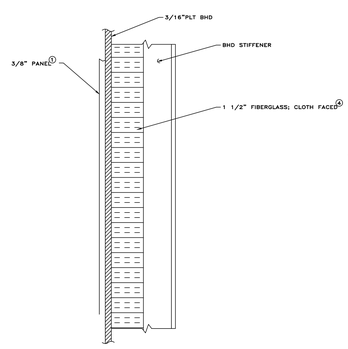
1 1/2" = 1'



NOTE:
HULLS 92, 135, 136, 137, & 1225 ONLY
FOR FUTURE CONTRACTS
SEE PIECE MARK (13)

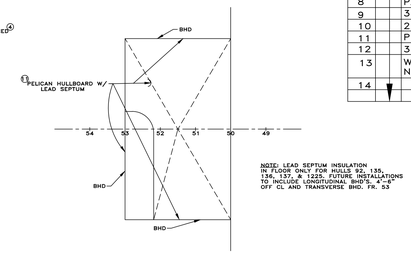
DETAIL 1

(A-0)



DETAIL 2

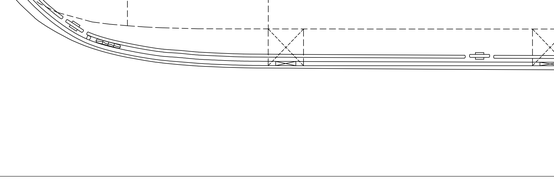
(A-15)



NOTE: LEAD SEPTUM INSULATION
IN FLOOR ONLY FOR HULLS 135,
136, 137, & 1225 FOR FUTURE INSTALLATIONS
TO INCLUDE LONGITUDINAL BHD'S, 4'-6"
OFF CL AND TRANSVERSE BHD. FR. 53

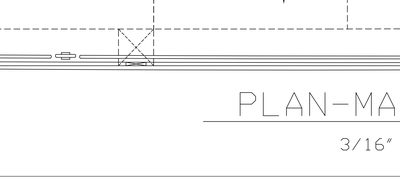
EOS FLOOR

3/8" = 1'



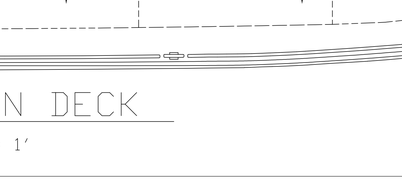
DETAIL 3

(A-0)



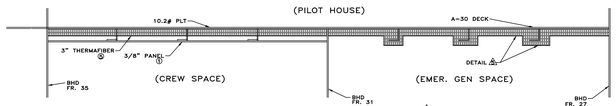
DEATIL 4

(A-0)



DETAIL 5

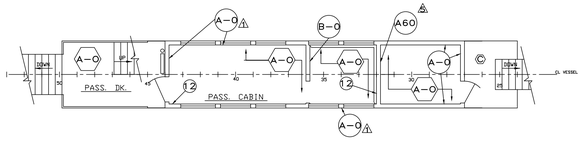
(A-60)



DETAIL 6

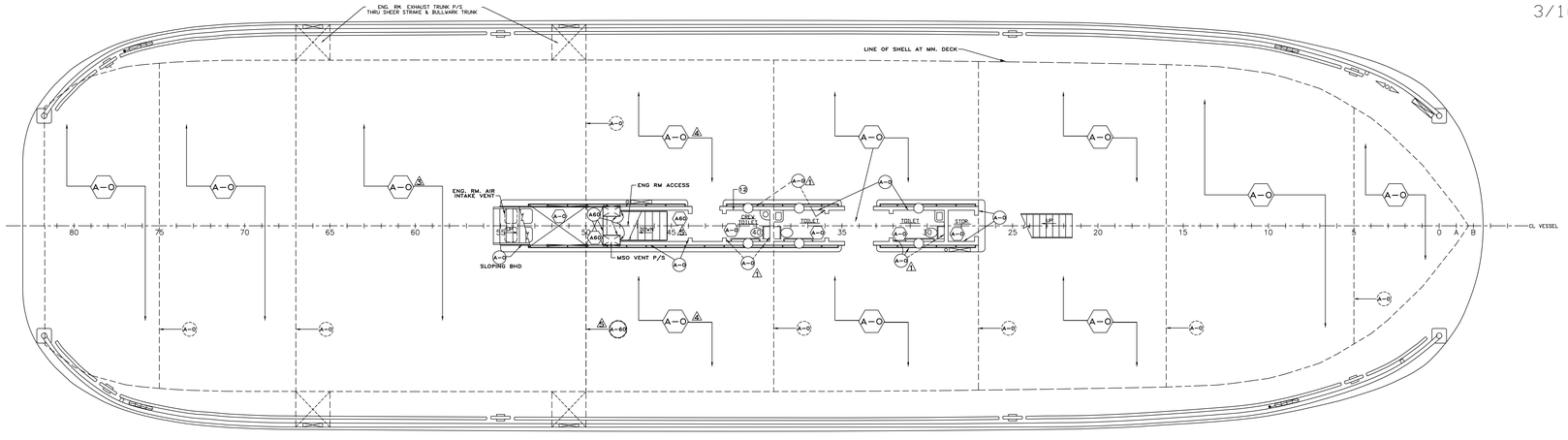
PILOT HOUSE DECK

3/16" = 1'



UPPER DECK

3/16" = 1'



PLAN-MAIN DECK

3/16" = 1'

GENERAL NOTES

1. STEEL PINS (WELDED ON) AND CLIPS SHALL BE USED TO ATTACH INSULATION TO STEEL BHD'S & UNDERSIDE OF DECKS. PINS SHALL BE 1/8" DIA., SPACED ON 12" CENTERS, WITH 1 1/4" DIA. SPEED CLIPS
2. ALL BUTTS & SEAMS IN CLOTH FACED INSULATION TO BE TAPED WITH FIBERGLASS LAGING TAPE
3. ALL EXPOSED CLOTH FACED INSULATION TO BE COATED WITH VAPOR BARRIER SOLUTATION-MIL-P17970 FORMULA 124, WHITE.
4. ALL WINDOWS, FIXED & DROP SASH, SET IN SELF LOCKING RUBBER CHANNEL OR FRAMES OTHER THAN STEEL SHALL BE INSTALLED WITH STEEL RETAINING CLIPS IN ACCORDANCE WITH NVIC 6-80; SECT. 210
5. DOOR CONSTRUCTION TO BE DETERMINED BY CLASSIFICATION OF BHD. TO WHICH IT IS ATTACHED. SEE 46 CFR 72.05 AND NVIC 6-80
6. ALL CREW & PASSENGER SPACES ARE CONSIDERED AS HAVING INCOMBUSTIBLE FURNISHINGS, TRIM, BHD. LINERS, ETC.
7. PROVIDE STRUCTURAL FIRE INSULATION (A-60) ON FWD. SIDE OF BHD. 50, STBD. SIDE, FROM 24" OFF CL TO SIDESHELL IN WAY OF FIXED CO_2 SYSTEM

REFRENCES

1. CONTACT SPECIFICATIONS
2. DWG. N.C. 220-0005.....OUTBD. PROFILE AND DK ARRG'MTS
3. DWG. N.C. 220-0006.....INBD. PROFILE AND GEN. ARRG'MTS BELOW MN. DECK

LEGEND

- A-0 — INDICATES BULKHEAD DESIGNATION
- A-0 — INDICATES BULKHEAD DESIGNATION (BELOW MN. DK.)
- A-0 — INDICATES DECK DESIGNATION

LIST OF MATERIALS

Pc.	QTY	DESCRIPTION	U.S.C.G. APPV'L. No's
1	AS REQ'D	3/8" PANEL; MASONITE (FIRETEST 36) GOLDEN ASHE/ANTIQUE WHITE	164.008/112/0
2		1" FIBERGLASS; CLOTH FACED; OWENS CORNING OR EQ.	164.009/120/1
3		2" FIBERGLASS; CLOTH FACED; OWENS CORNING OR EQ.	164.009/120/1
4		1 1/2" "THERMAFIBER"; CLOTH FACED; OR EQ 7 LBS/CUFT	164.007/40/0 164.012/81/0
5		3" "THERMAFIBER"; CLOTHFACED; OR EQ 7 LBS/CUFT	164.007/40/0 164.012/81/0
6		2" "THERMAFIBER"; CLOTH FACED; OR EQ 7 LBS/CUFT	164.007/40/0 164.012/81/0
7		S/S SCREW; #8 x 1"LG; W/ S/S CUP WASHER	
8		PANEL RETAINER; MASONITE PART No. T-32	
9		3"x 1/4" F.B.; ASTM A-36	
10		2"x 2"x 16GA. ANGLE; GALVANIZED STEEL	
11		PELICAN HULLBOARD W/ LEAD SEPTUM	164.009/120/1 164.012/50/0
12		3 1/2" FIBERGLASS, UNBACKED "CERTAINTEED" 82005975	UL C-25 SMOKE-50 UL C-1335, FH C-25/50
13		WISON-ART #960 METALCOR NEPAL TEAK/ANTIQUE WHITE	164.012/92/0 (LAMINATE)
14			

No.	DESCRIPTION	By	Date	App'd.
6	REPRODUCED IN ITS ENTIRETY USING AUTOCAD RELEASE 12	EAO	12/9 '93	
5	3. ADDED Pc No 13 AS A REPLACEMENT FOR Pc No 1 (WHICH IS NO LONGER AVAILABLE) 2. ADDED NOTE 7 1. CHANGED BHD DESIGNATION FR. 50, STBD. FROM A-0 TO A-60 IN-WAY-OF FIXED CO^2 SYSTEM	EBJ	8/18 '92	
4	ADDED Pc. 12 ON BILL OF MATERIALS	WP	11/12 '38	
3	AS BUILT	VF	4/7 '89	
2	ADDED A-60 TO BHD @ FR. 32 UPPERDK. REVISED CREW SPACE TO PASS LOUNGE. RELOCATED MSD VENTS TO FR. 49 REVISED DESIGNATION OF DECK IN HOUSE AFT FR. 49.	VF	3/14 '38	
1	Pc No 1-6 IN MATERIAL REVISED IN ACCORDANCE WITH USCG LTR. 14APR'88	N.C.	MAY 1988	

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

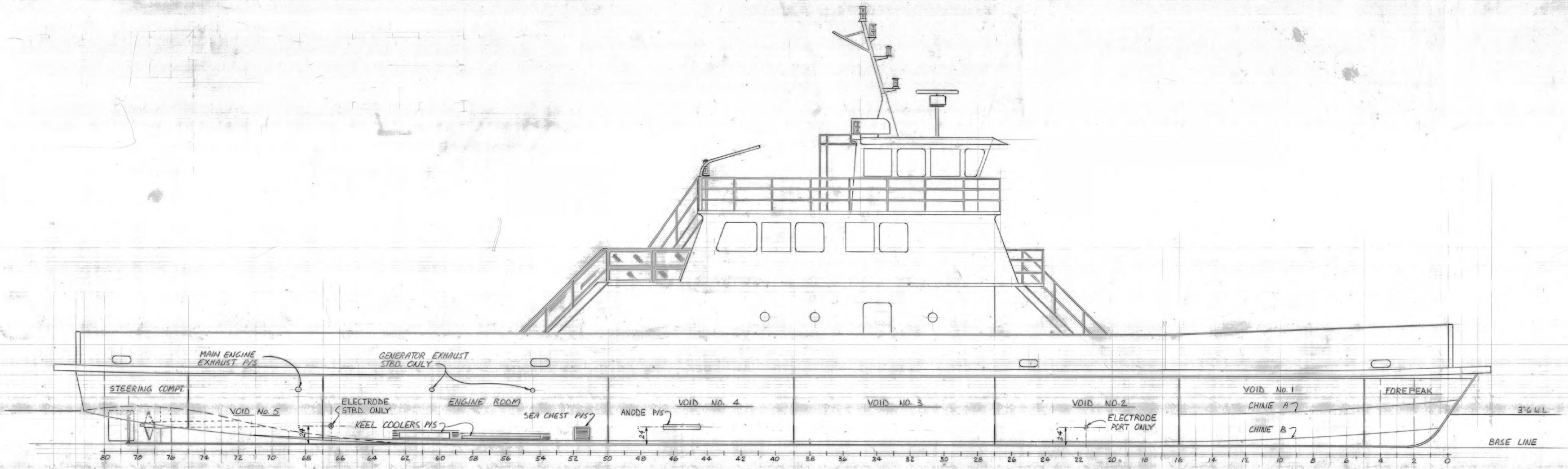
INSULATION AND FIRE BOUNDARY DIAGRAM

SEAL

APPROVALS
USCG-SER-H2-90422-APRIL 20, 1989

DRWN. D. OVERSTREET
CHKD.
SCALE AS SHOWN

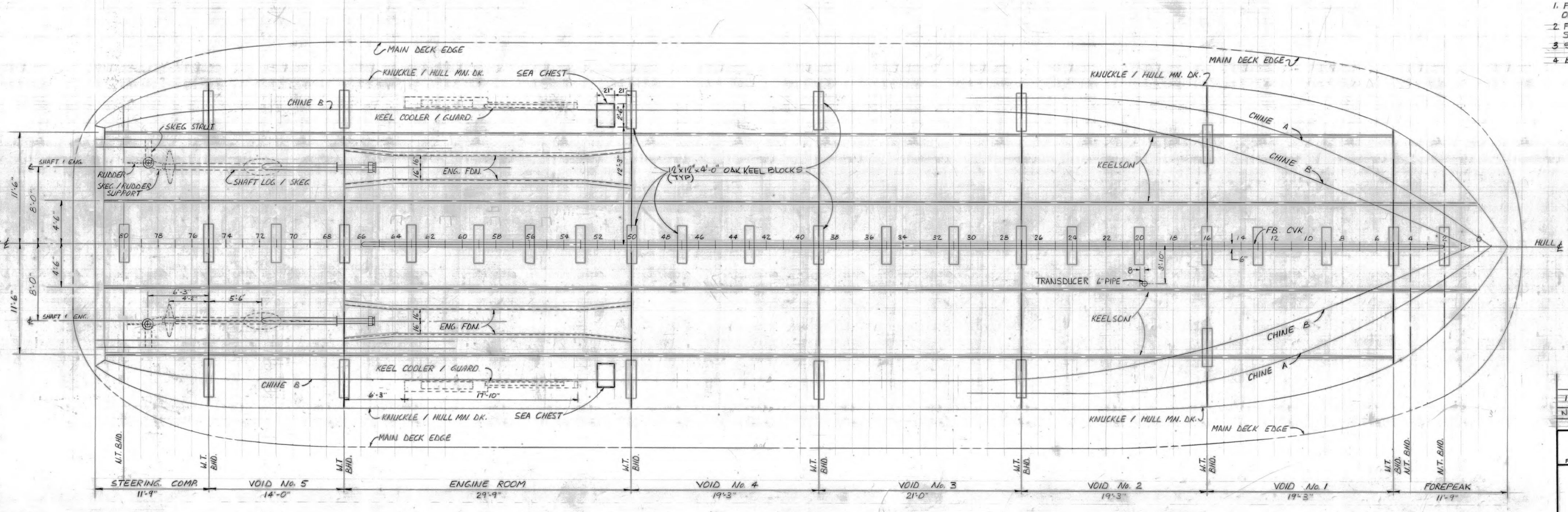
NC-220-0021 REV. 6



PROFILE OF HULL
1/4" = 1'-0"

NOTES

1. FOR OFFSETS SEE LINES DRAWING #NC. 220-0001 AND OFFSET BOOKLET.
2. FOR INFORMATION NOT SHOWN ON SECTIONS SEE FRAME DWG. #NC-220-0025.
3. SEE SHT. 2 OF 2 FOR OFFSET @ BHDS.
4. ALL FRAME SPACING 1'-9" EACH.



PLAN OF BOTTOM
1/4" = 1'-0"

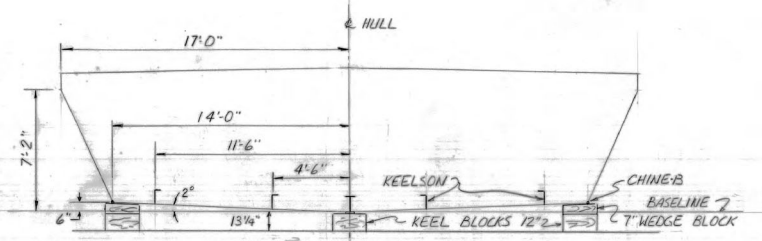
No.	DESCRIPTION	BY	DATE	APPV.
1	AS BUILT	VF	5-1-89	

REVISIONS

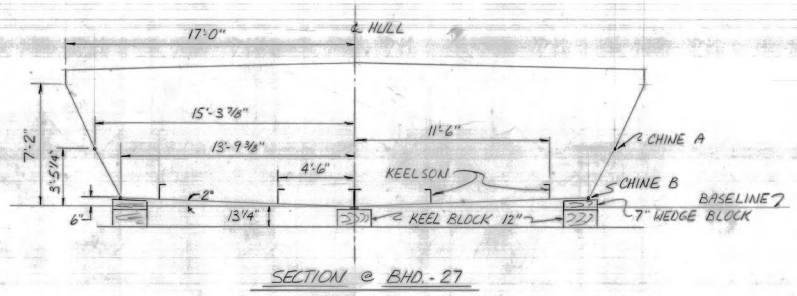
STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
FERRY DIVISION — MARINE ENGINEERING

DOCKING PLAN

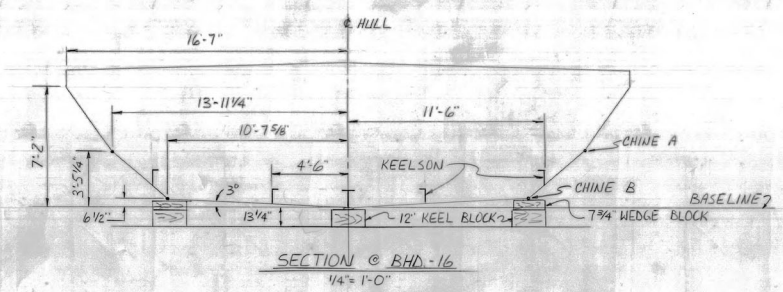
SEAL
APPROVALS
DRWN. C.H.K.
CHKD.
SCALE NOTED
NC-220-0022 SHT. 1 OF 2 REV. 1



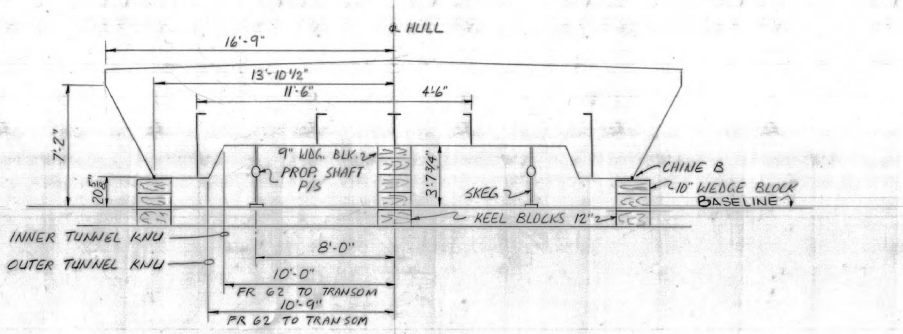
SECTION @ BHD-39, BHD-50 TYP.
1/4"=1'-0"



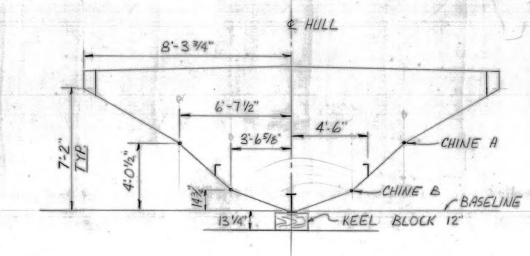
SECTION @ BHD.-27
1/4"=1'-0"



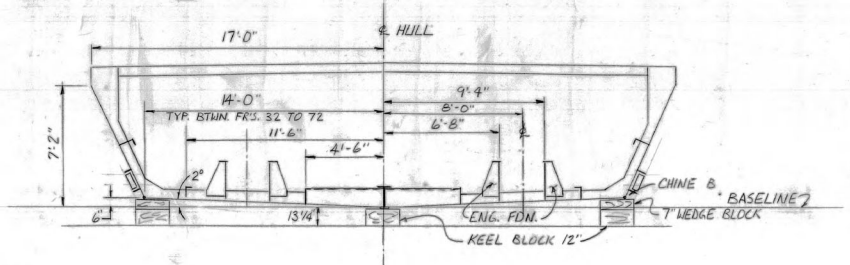
SECTION @ BHD.-16
1/4"=1'-0"



SECTION @ BHD.-75
1/4"=1'-0"



SECTION @ BHD.-5
1/4"=1'-0"



SECTION @ FR.-60
1/4"=1'-0"

NOTES

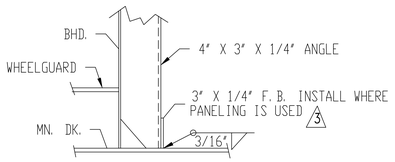
1. KEEL BLOCKS SHOWN ARE 12"H x 24"L. HEIGHT TYPICAL EXCEPT WHERE NOTED.

NO.	REVISIONS	BY	DATE	APPV.
1	AS BUILT	VF	3-1-89	

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
FERRY DIVISION — MARINE ENGINEERING

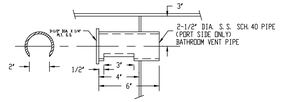
DOCKING PLAN

SEAL
APPROVALS
DRWN. C.W.K.
CHKD.
SCALE NOTED
NC-220-0022 SHT. 2 OF 2
REV. 1



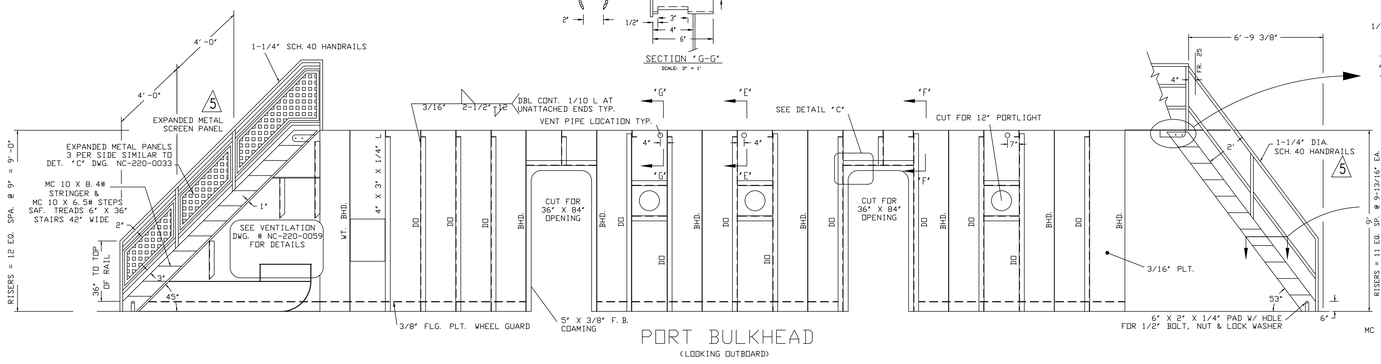
TYP. STIFF DECK CONN.

SCALE: 1-1/2" = 1'



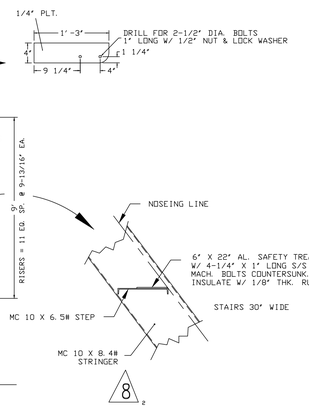
SECTION "G-G"

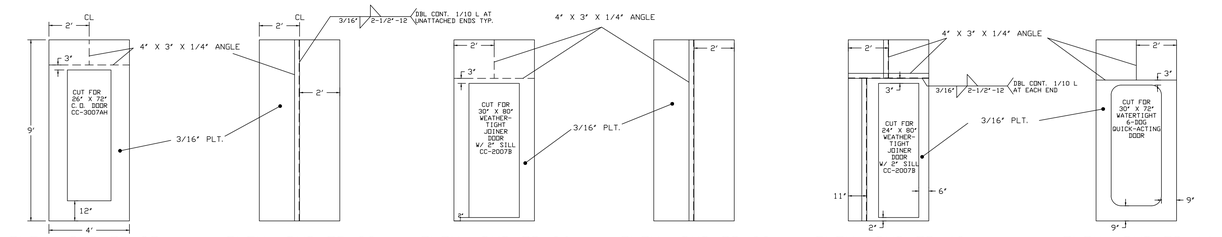
SCALE: 3" = 1'

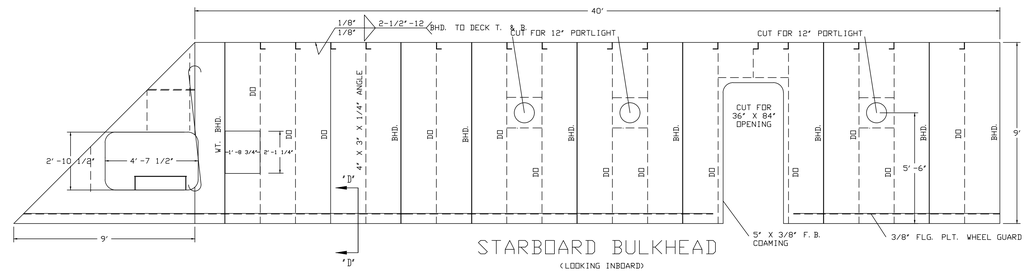


PORT BULKHEAD

(LOOKING OUTBOARD)

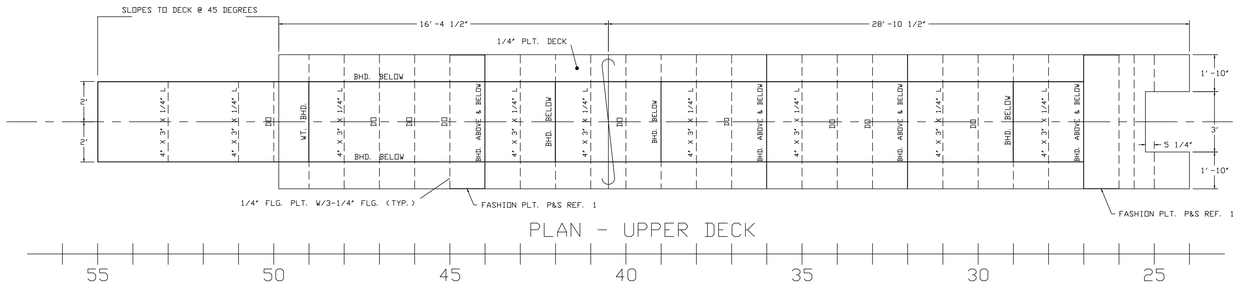




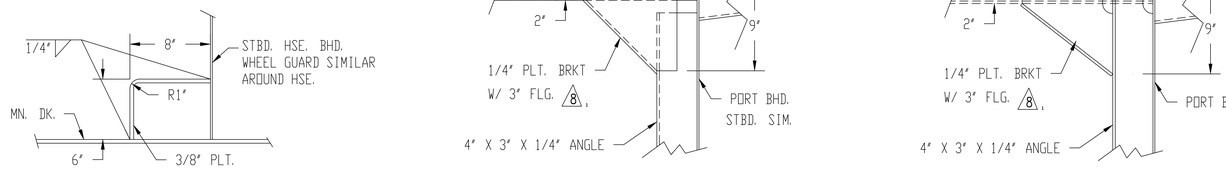


STARBOARD BULKHEAD

(LOOKING INBOARD)

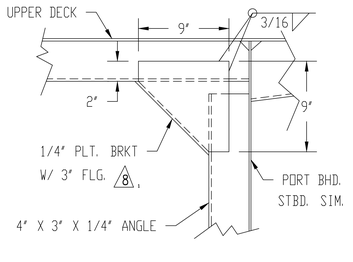


PLAN - UPPER DECK



SECTION "D-D"

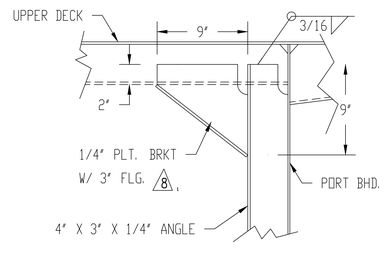
SCALE: 1-1/2" = 1'



SECTION "E-E"

TYP. BKT. DETAIL

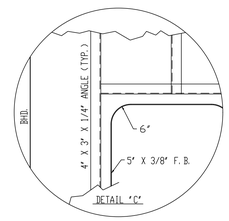
SCALE: 1-1/2" = 1'



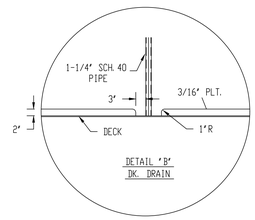
SECTION "F-F"

TYP. LAPED ANGLE

SCALE: 1-1/2" = 1'



DETAIL 'C'



DETAIL 'B' DK. DRAIN

REFERENCES

1. UPPER HOUSE STRUCTURE NC-220-0033

GENERAL NOTES:

1. ALL WELDING SHALL BE ACCOMPLISHED IN ACCORDANCE WITH A.B.S. STANDARDS AND PERFORMED BY USCG CERTIFIED WELDERS
2. BUTTS IN PLATING SHALL BE LOCATED TO SUIT AVAILABLE PLT. SIZE
3. ALL STIFFENERS WHICH LAND ON BOTTOM OR DK. PLT. SHALL BE SNIPED AT 45 DEG.

No.	DESCRIPTION	By	Date	App'd.
10	REPRODUCED IN ITS ENTIRETY USING AUTOCAD RELEASE 12	EBJ	5/27 '93	
9	MOVED SAFETY TREAD FWD. TO EDGE OF STEP.	EBJ	4/2 '93	
8	2. CHNG'D. STAIR STRINGER FROM 8.5# TO 8.4#–FWD. & AFT MN. DK. STAIRS 1. CHNG'D. FLG. FROM 3-1/4" TO 3" ON BKTS. "SECT.E-E" & "SECT.F-F"	EBJ	8/18 '92	
7	AS-BUILT	VF	4/5 '89	
6	REV. PORT SIDE BHD. ELEV. AFT FR. 50. REMOVED ELEV. BHD. FR. 52 & "SECT. G-G", "LOUVER DET.","W.T. COVER DET." & "SECT.H-H"	VF	3/6 '89	
5	ADDED HANDRAILS ON STAIRS. ADDED 2 EXTRA HOLD DOWN BARS ON WATERTIGHT COVER DET.	VF	10/6 '88	
4	REVISED BOLTS-NUTS & WASHERS FOR LOUVERS & COVER TO BE 5/5 – COMPLETE. SECT. H-H AS PER OWNERS LETTER DATED 8-18-88	VF	9/2 '88	
3	ADDED BKT. TO SECT."F-F" – MOVED ANGLE TO N.S. @"LOUVER DET." TO SHOW INSECT SCREEN ATTACHMENT. ADDED F.B. TO "TYP. STIFF. DK. CONN.	VF	7/29 '88	
2	REV. NOTE ON BHD. 29 TO READ "BHD FR 49 SIM"	VF	6/8 '88	
1	REVISED SECT."S-ELEV. & WELDS PER OWNER. ADDED STAIRS & STAIRS DETS., ENG. RM. FAN VENTILATION ENCLOSURE, LOUVER, & W.T. COVER DETS. & FAN.	VF	5/19 '88	

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

LOWER HOUSE STRUCTURE

SEAL

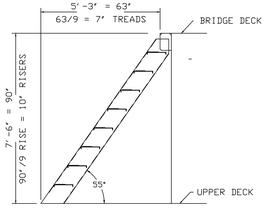
APPROVALS
U.S.C.G. (MSC) SER. E-00041 dtd. 24 JAN. '90 REV. A

DRWN. A. OVERSTREET

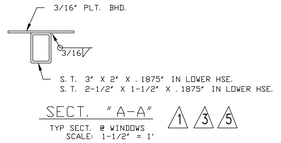
CHKD.

SCALE 3/8" = 1'

NC-220-0032 REV. 10

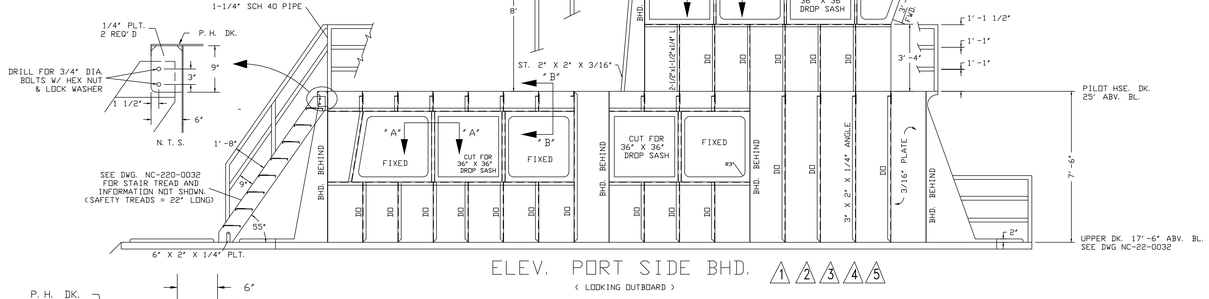


STAIR TO P.H. LAYOUT



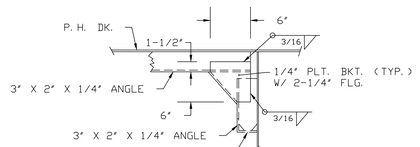
SECT. "A-A" 1 3 5

TYP SECT. @ WINDOWS
SCALE: 1-1/2" = 1'



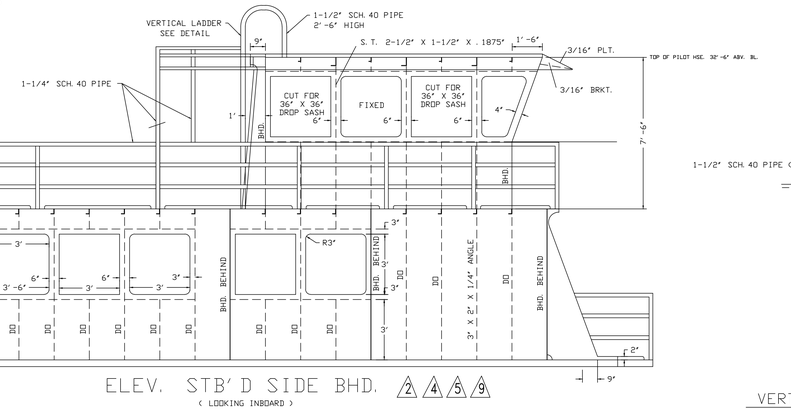
ELEV. PORT SIDE BHD. 1 2 3 4 5

(LOOKING OUTBOARD)



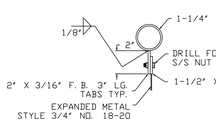
SECT. "B-B" 1 5

SCALE 1" = 1'



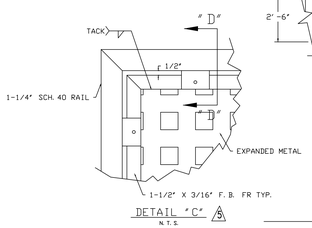
ELEV. STB'D SIDE BHD. 2 4 5 9

(LOOKING INBOARD)



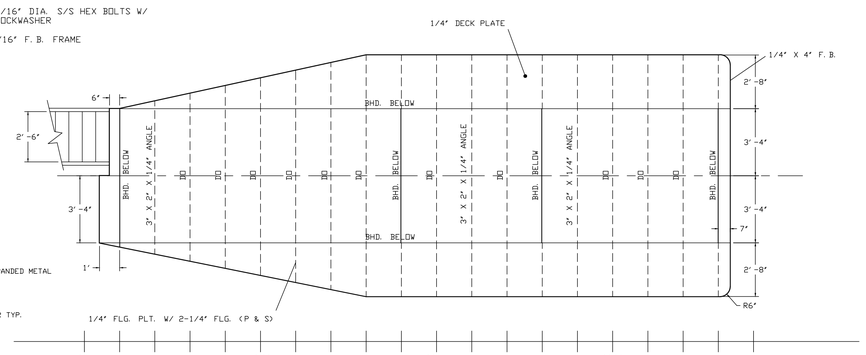
SECT. "D-D" 4 6 8

N.T.S.



DETAIL "C" 9

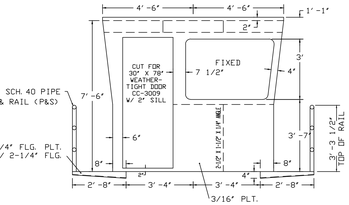
N.T.S.



1/4" FLG. PLT. W/ 2-1/4" FLG. (P & S)

PLAN - PILOT HOUSE DECK

45 40 35 30



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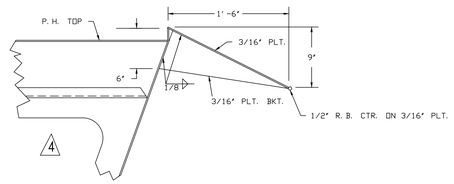
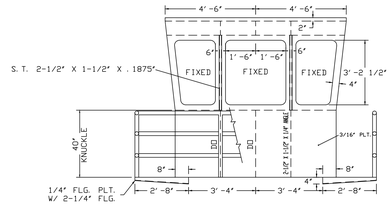
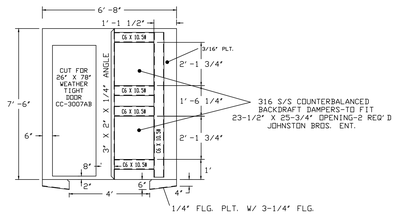


4

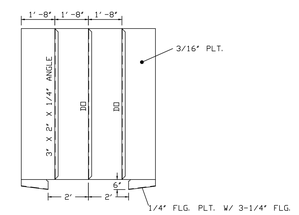
ELEV. PILOT HOUSE
BHD. FR. 35
LOOKING FWD



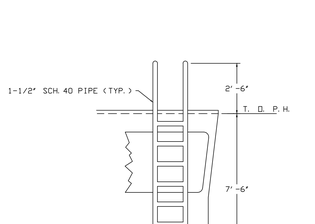
ELEV. PILOT HOUSE
BHD. FR. 28
LOOKING AFT



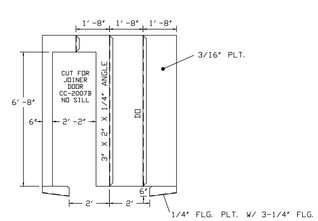
ELEV. PASS. & CREW DK.
BHD. FR. 27
LOOKING AFT 1 5
6 9



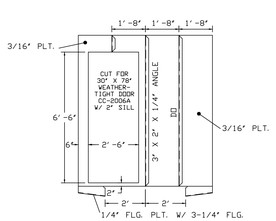
ELEV. PASS. & CREW DK.
BHD. FR. 32
LOOKING AFT



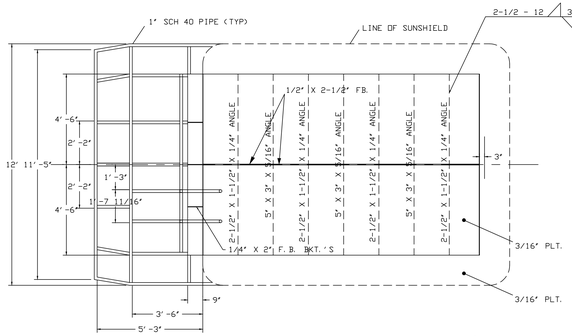
VERTICAL LADDER DET.



ELEV. PASS. & CREW DK.
BHD. FR. 36
LOOKING AFT

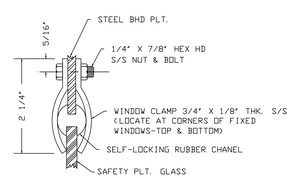


ELEV. PASS. & CREW DK.
BHD. FR. 44
LOOKING AFT



PLAN - TOP OF PILOT HOUSE 2 6

35 30



TYP FIXED WINDOW CLAMP

N. T. S.

GENERAL NOTES

1. ALL WELDING SHALL BE ACCOMPLISHED IN ACCORDANCE WITH A. B. S. STANDARDS AND PERFORMED BY USCG CERTIFIED WELDERS.
2. BUTTS IN PLATING SHALL BE LOCATED TO SUIT AVAILABLE PLATE SIZE.
3. ALL STIFFENERS WHICH LAND ON BOTTOM OR DECK PLATE SHALL BE SNIPED AT 45 DEGREES.

No.	DESCRIPTION	By	Date	App'd.
12	REPRODUCED IN ITS ENTIRETY USING AUTOCAD RELEASE 12	EBJ	5/28 '14	
11	P.H. AFT BHD. CHG. TO SINGLE GLASS	VF	11/1 '89	
10	AS BUILT	VF	4/3 '89	
9	REVISED BHD. 27 UP. DK. REMOVED LOUVER FROM STBD. SIDE BHD. & DETS. ADDED FRAME FOR CANOPY ❸ ADDED DET FOR VERT. LADDER	VF	2/28 '89	
8	REV. EXP. METAL CONN. ❸ SECT."D-D" ADDED LOWER DET. & COVER PLT. DET.	VF	12/13 '88	
7	ADDED BKT. DET. FOR STAIR	VF	10/6 '88	
6	REMOVED SOFT PATCH FROM BHD. 27 ALL FASTENERS CHANGE TO S/S P.H. TOP ANGLES CHANGE FROM 4" TO 5" AS PER OWNER'S LTR DTD. 8/18/88	VF	9/7 '88	
5	REVISED COVERSIE BHD. ❸ FR.27 REPLACED 2-1/2" ANGLE W/ 4" X 3" X 5/16" ANGLE 3 PLACES ADDED 1/2" F.B. ON CL P.H. TOP REMOVED NOTE FROM WELD ❸ PORT ELEV. REVISED SIZE OF TUBING ❸ SECT."A-A" CHANGE SIZE OF ANGLE'S ❸ SECT. OF P.H. TOP. ADDED DRAWS P/S ❸ P.H. AFT BHD. REVISED ANGLE CONN. ❸ SIDE BHD. CORRECTED FIG. TOE OF BKT. SECT."B-B" REMOVED SECT'S & DETAILS OF REMOVABLE PANELS & REDESIGNED PANELS FOR H.R. W/ ONE MIDDLE RAIL SEE DET."C" & DET."D". ADDED SOFT PATCH & DET. TO BHD. ❸ FR.27	VF	8/2 '88	
4	ADDED VISOR DET. TO P.H.			
3	REVISED SIZE OF REMOVABLE PANELS UPPER DK. ENDS. 3" FWD FR. 50 REVISED THK. OF HANGER CLIPS ON PORTABLE SCREENS-DET."C" & DET."D". REVISED STIFF. IN P.H. TO 2-1/2" X 1-1/2" X 1/4" ANGLE & WINDOW STIFF. TO 5-1/2-1/2" X 3-1/2" X 3/16"	VF	6/9 '88	
2	CORRECTED PLT. SIZE ON P.H. TOP, & REVISED WELDING PER OWNER REQUEST. ADDED DETS. FOR PORTABLE SCREEN PANELS ❸ HANDRAILS	VF	5/20 '86	
1	ADDED SECT.A-A, BB, & DETS ❸ PILOT HOUSE. REVISED DOOR ❸ BHD. 27 & ADDED GENERAL NOTES	VF	4/26 '88	

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

UPPER HOUSE STRUCTURE

SEAL

APPROVALS
U.S.C.G. (MSC) SER. E-00041 dtd. 24 JAN. '90 REV. A

DRWN. A. OVERSTREET

CHKD.

SCALE 3/8" = 1'

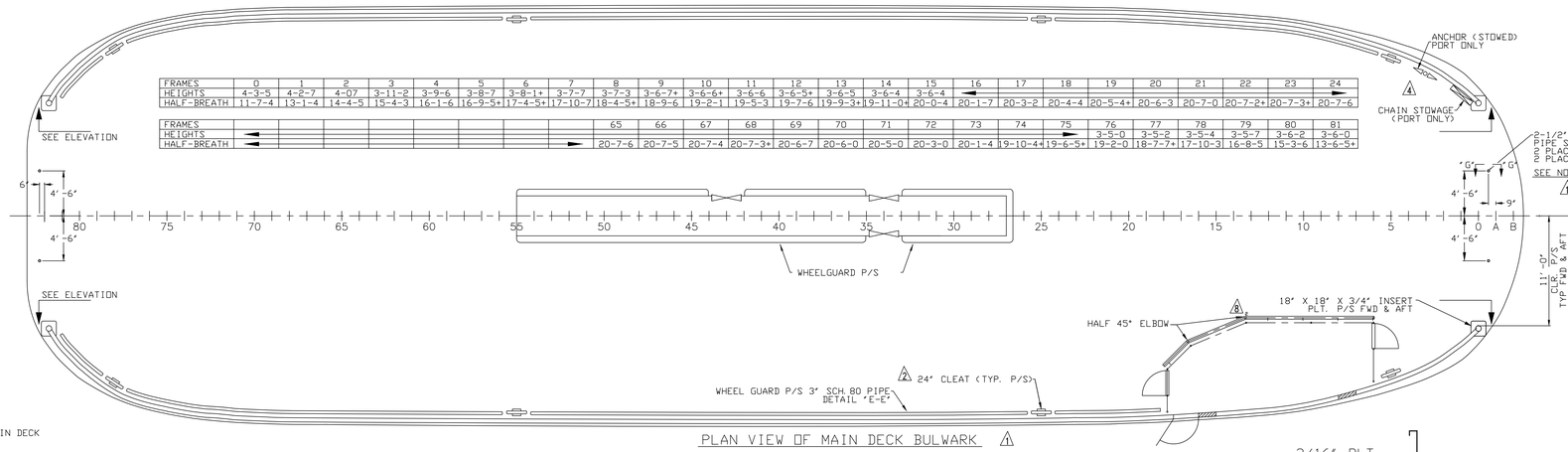
NC-220-0033 — REV. 12

REFERENCES

1. LOWER HOUSE STRUCTURE NC-220-0032

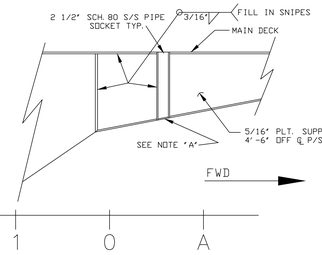
FRAMES	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
HEIGHTS	4-3-5	4-2-7	4-07	3-11-2	3-9-6	3-8-7	3-8-1+	3-7-7	3-7-3	3-6-7+	3-6-6+	3-6-6	3-6-5+	3-6-5	3-6-4	3-6-4	◄								
HALF-BREATH	11-7-4	13-1-4	14-4-5	15-4-3	16-1-6	16-9-5+	17-4-5+	17-10-7	18-4-5+	18-9-6	19-2-1	19-5-3	19-7-6	19-9-3+	19-11-0+	20-0-4	20-1-7	20-3-2	20-4-4	20-5-4+	20-6-3	20-7-0	20-7-2+	20-7-3+	20-7-6

FRAMES									65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
HEIGHTS	◄																		►	3-5-0	3-5-2	3-5-4	3-5-7	3-6-2	3-6-0
HALF-BREATH	◄							►	20-7-6	20-7-5	20-7-4	20-7-3+	20-6-7	20-6-0	20-5-0	20-3-0	20-1-4	19-10-4+	19-6-5+	19-2-0	18-7-7+	17-10-3	16-8-5	15-3-6	13-6-5+

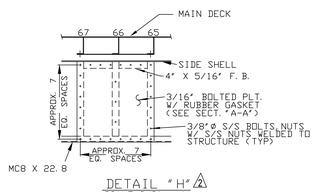


PLAN VIEW OF MAIN DECK BULWARK 1
3/16" = 1'

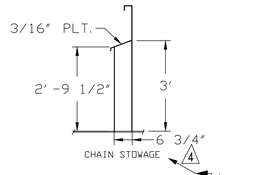
1 NOTE "A" : S/S WATER TIGHT CLOSURE PLT. IS TO BE FITTED @ THE BOTTOM
2 OF ALL SOCKETS W/1/2" DRAIN HOLE.

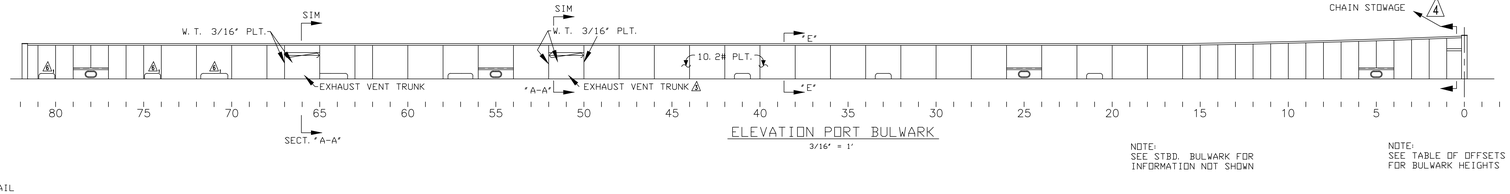


SECTION "G-G" 2
2 REQ'D AS SHOWN
NOT TO SCALE



DETAIL "H" 2
SCALE 3/8" = 1'

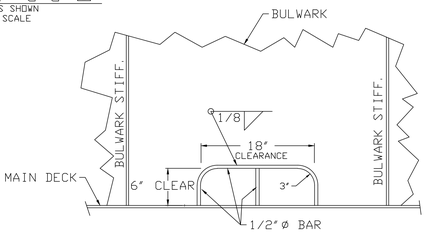




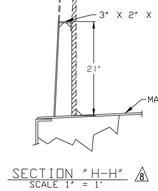
ELEVATION PORT BULWARK
3/16" = 1'

NOTE:
SEE STBD. BULWARK FOR INFORMATION NOT SHOWN

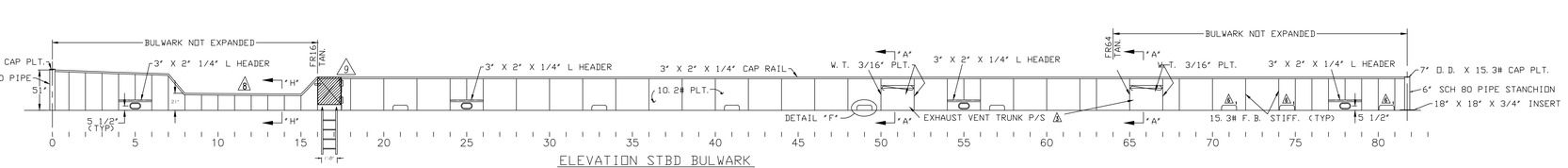
NOTE:
SEE TABLE OF OFFSETS FOR BULWARK HEIGHTS



DETAIL "F" 4
SCALE 1-1/2" = 1'



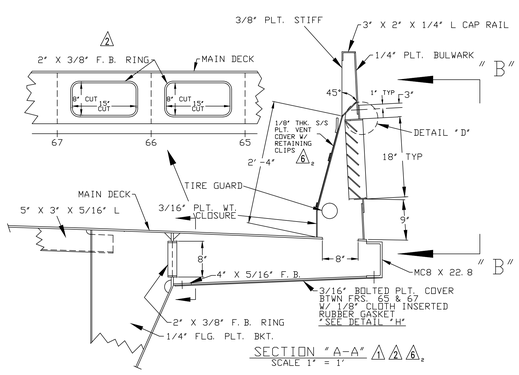
SECTION "H-H" 6
SCALE 1" = 1'



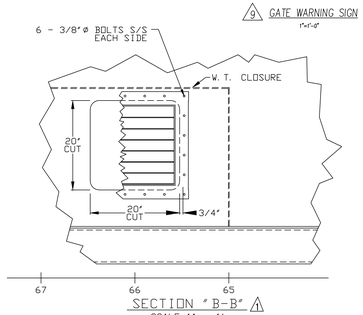
ELEVATION STBD BULWARK
3/16" = 1'

GENERAL NOTES

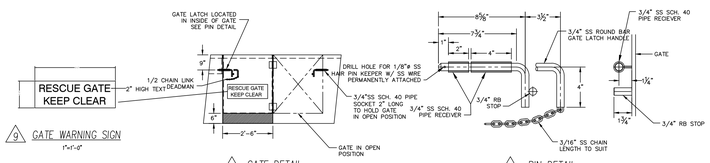
1. ALL WELDING SHALL BE ACCOMPLISHED IN ACCORDANCE WITH A.B.S. STANDARDS AND PERFORMED BY USCG CERTIFIED WELDERS.
2. ALL MEMBERS TO BE SEAL WELDED.
3. BUTTS IN PLATING SHALL BE LOCATED TO SUIT AVAILABLE PLATE SIZES.
4. BARRIER SOCKETS TO BE 2-1/2" SCH 80 S/S PIPE WITH I.D. = 2.323", STANCHION TO BE 2" SCH. 80 PIPE WITH O.D. = 2.375". YARD TO INSURE FIT OF STANCHION INTO SOCKET.
5. PROVIDE S.S. LANYARD OF SUITABLE LENGTH, TO SECURE PORTABLE BULWARK VENT CONER TO BULWARK.



SECTION "A-A" 1 2 6 2
SCALE 1" = 1'



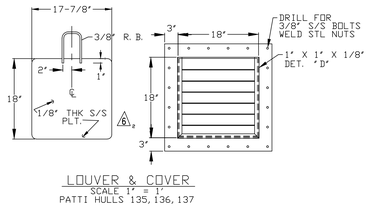
SECTION "B-B" 1
SCALE 1" = 1'



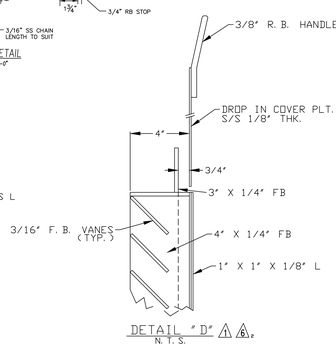
9 GATE WARNING SIGN
1"=1'-0"

9 GATE DETAIL
1/2"=1'-0"

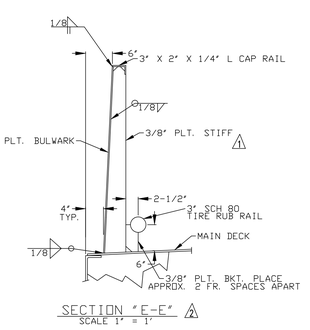
9 PIN DETAIL
3"=1'-0"



LOUVER & COVER
SCALE 1" = 1'
PATTI HULLS 135, 136, 137



DETAIL "D" 1 6 2
N. T. S.



SECTION "E-E" 2
SCALE 1" = 1'

No.	DESCRIPTION	By	Date	App'd.
9	ADDED GATE & LADDER @ FW 16 STBD	BTJ	6/10/09	
8	2. REVISED TIRE RUB RAIL STBD FROM FR 18 FWD 1. NOTCHED STBD BULWARKS TO ACCOMMODATE RESCUE BOAT INSTALLATION	BTJ	2/25/09	JDW
7	REPRODUCED IN ITS ENTIRETY USING AUTOCAD RELEASE 12	EBJ	5/20/93	
6	3. ADDED NOTE No. 5 2. REVISED SECT."A-A" & DET."D" TO SHOW 1/8" THK. S.S. VENT COVER (PORTABLE) 1. ADD SCUPPERS P&S - FR 80,74 & 70	EBJ	8/19/92	
5	AS BUILT	VF	4/4/89	
4	REVISED LOCATION OF ANCHOR & CHAIN STORAGE, ADDED DET. ON CHAIN STOWAGE; CORRECTED HEIGHT ON BULWARK FWD. & AFT.	VF	3/20/89	
3	ADDED DIM FOR SOCKETS AFT END.; REVISED HINGE SECT."C-C" ADDED ENGINE ROOM EXHAUST VENT TRUNK BTWN. FR.50 & 53 P/S.	VF	12/13/88	
2	INCREASED F.B. SIZE @ SECT."A-A" ADDED DET."H" ADDED TIRE RAIL BRKT @ SECT."E-E", ADDED MISC. & MOD. TO CLEATS & CHOCKS - REMOVED CL SOCKETS FWD & AFT MAIN DECK; REVISED NOTE"A" & REPLACED F.B. W/ PLATE @ SECT."G-G".	VF	10/10/88	
1	ADDED GEN. NOTE 4 & REFERENCES; CHANGED PIPE SOCKETS TO 2-1/2" SCH. 80 S/S PIPE. ADDED DETAIL "D"; REVISED HINGE AND PAD SECT."C-C" REVISED BULWARK STIFF TO 3/8" PLT.; ADDED WELDING @ DET."E"; ADDED ANCHOR, CHAIN LOR. & WHEEL GUARD TO PLAN VIEW - PER OWNER LETTER DTD. 8-18-88	VF	9/13/88	

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

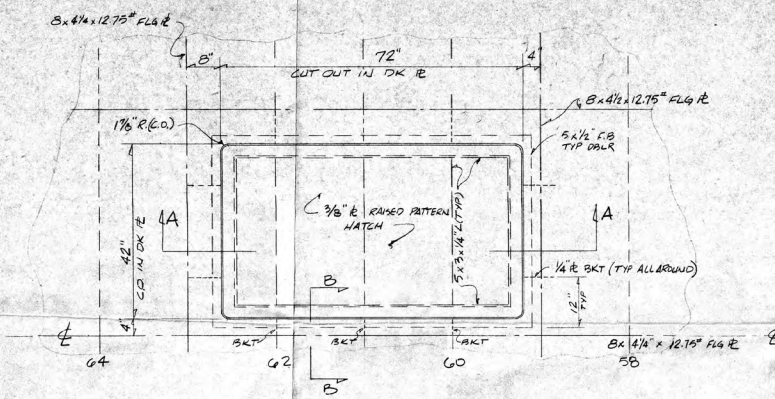
BULWARK & DETAILS

SEAL

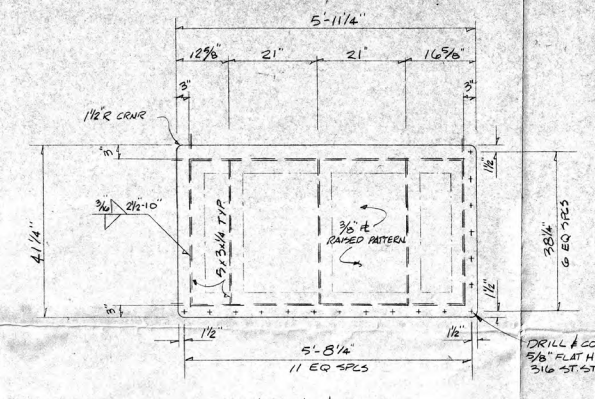
APPROVALS
USCG-SER-H2-90268-MARCH 13, 1989

DRWN. A. OVERSTREET
CHKD.
SCALE 3/16" = 1'

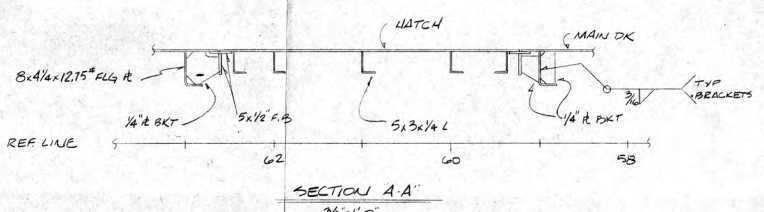
NC-220-0036 REV. 9



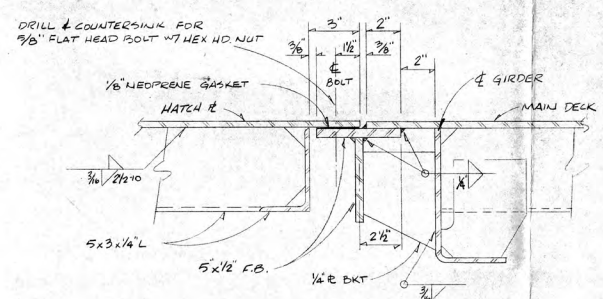
PLAN VIEW
3/4"=1'-0"



HATCH R DETAIL
3/4"=1'-0"

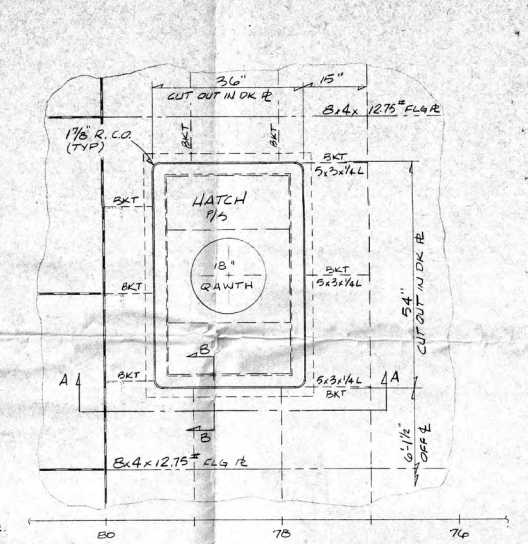


SECTION A-A
3/4"=1'-0"

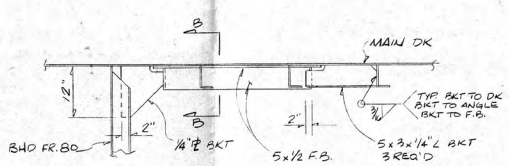


SECTION "B-B"
3"=1'-0"

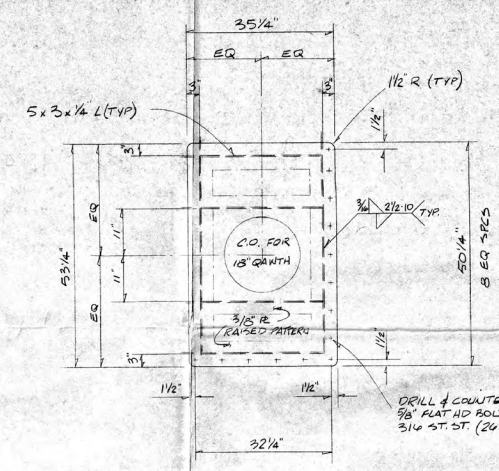
MACHINERY HATCH DETAILS
AS NOTED



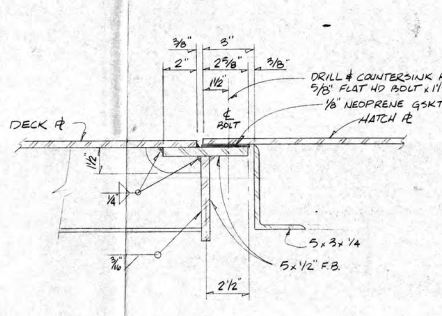
PLAN VIEW
(PORT SIDE SHOWN - STBD SIM.)
3/4"=1'-0"



SECTION "A-A"
3/4"=1'-0"

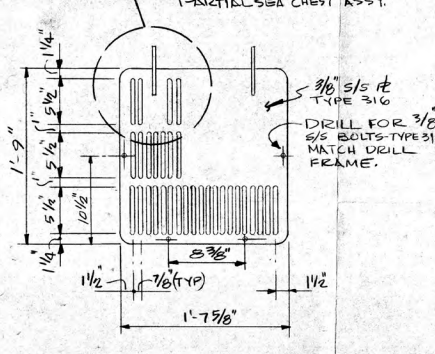


HATCH R DETAIL
3/4"=1'-0"

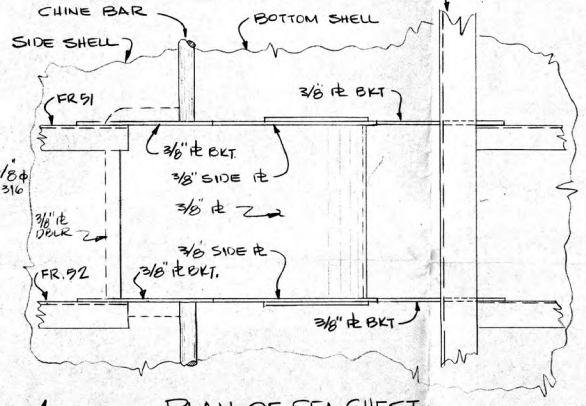


SECTION "B-B"
3"=1'-0"

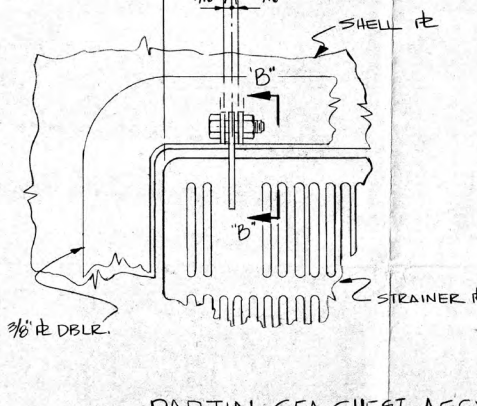
RUDDER HATCH DETAILS
AS NOTED



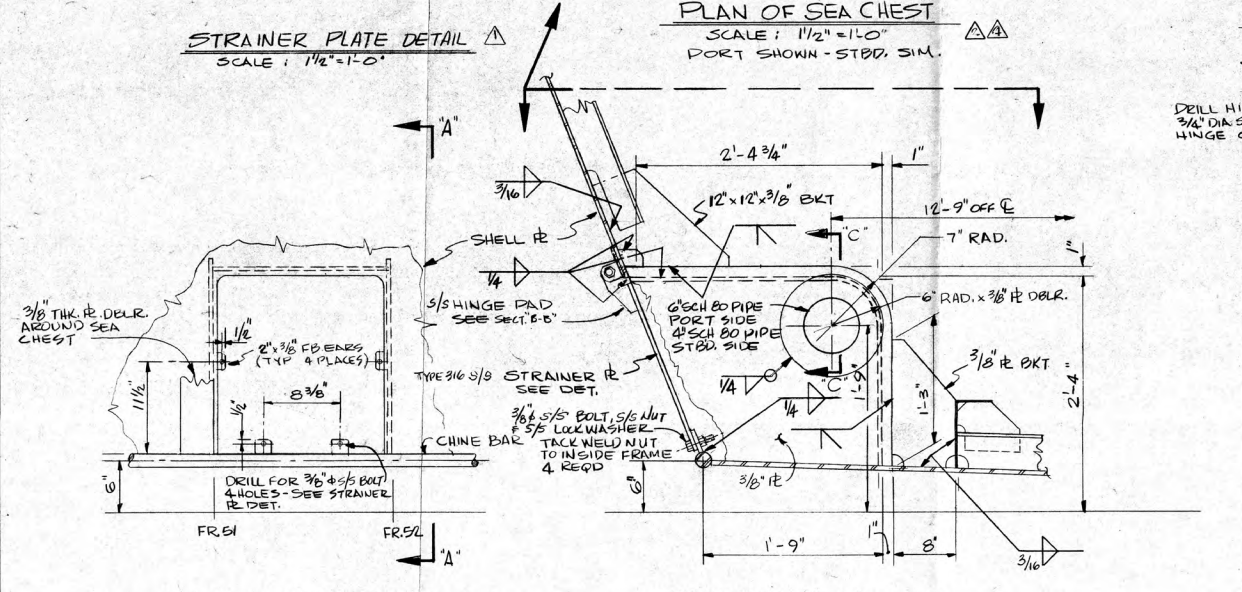
STRAINER PLATE DETAIL ⚠
SCALE : 1½"=1'-0"



PLAN OF SEA CHEST ⚠⚠
SCALE : 1½"=1'-0"
PORT SHOWN - STBD. SIM.

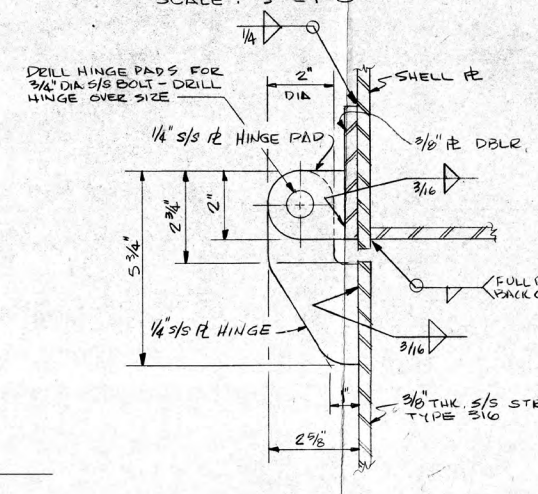


PARTIAL SEA CHEST ASSY. ⚠
SCALE : 3" = 1'-0"

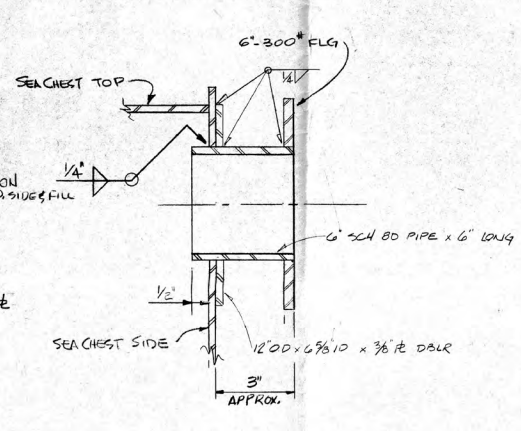


SEA CHEST FRAME ⚠⚠
SCALE : 1½" = 1'-0"

SECTION "A-A" ⚠⚠⚠
SCALE: 1½"=1'-0"



SECTION "B-B" ⚠⚠
SCALE : HALF



SECTION "C-C" ⚠
SCALE : 3"=1'-0"

REV.	DESCRIPTION	BY	DATE
5	AS BUILT		3/31/89
⚠	ADDED ⅜" DBLR R TO SEA CHEST SECT. A-A & PLAN.	V.F.	12/31 88
⚠	ADDED RUDDER HATCH R DETAILS ADDED DBLR TO SECTION C-C OF SEA CHEST DETAILS		10/4/88
⚠	REMOVED INSIDE FRAME FROM SEACHEST & ADDED OUTSIDE FBLR R PER OCMI ADDED MACH HATCH DET.	VF	9/6/88
⚠	NOTED S/S BOLTS, NUTS, WASHERS, HINGES, HINGE PADS & STRAINER R. ADDED SECT C-C. - AS PER OWNER REQUEST.	VF	8-26-88

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
FERRY DIVISION — MARINE ENGINEERING

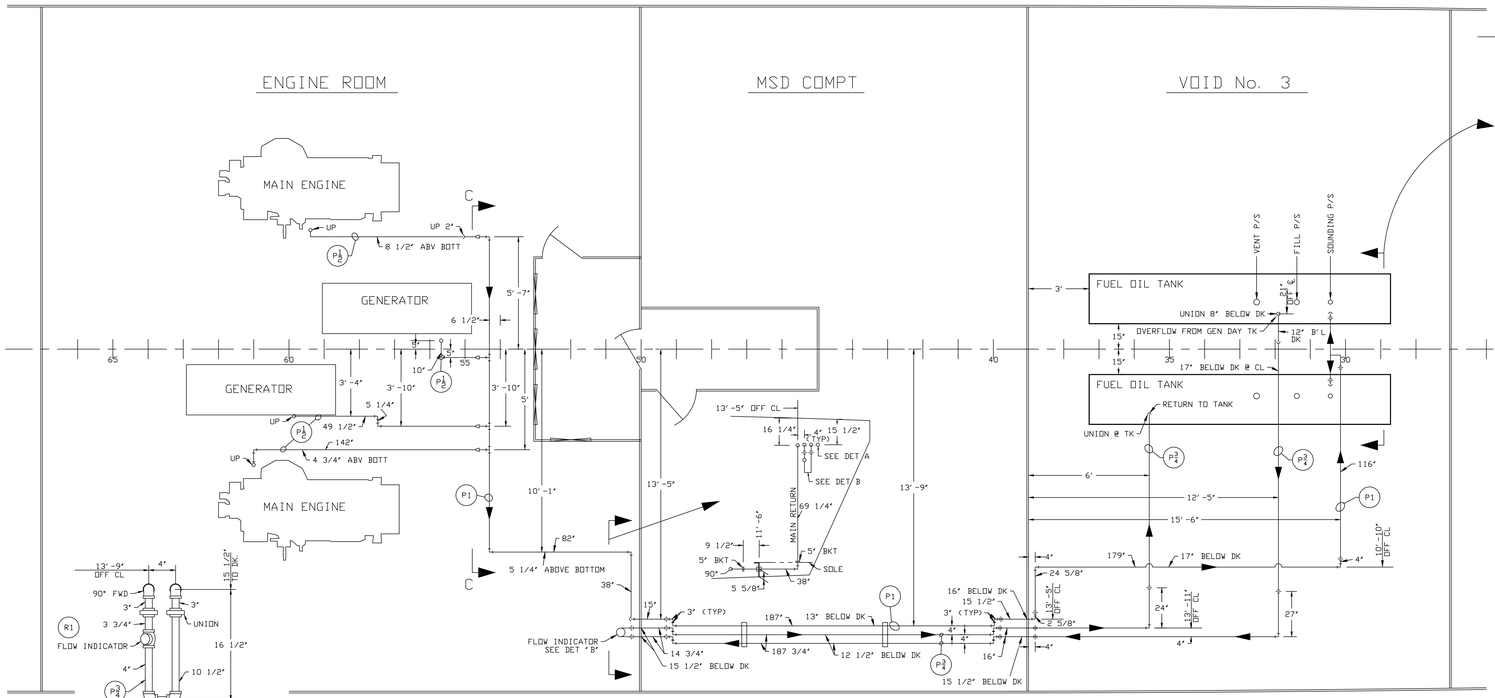
APPROVED Subject to comments in USCG Ltr dtd. Ltr of MAY 24 1989
SEAL

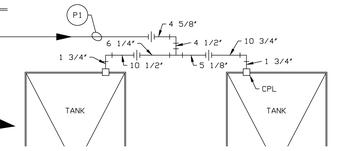
MISCELLANEOUS SECTIONS AND DETAILS

APPROVALS
USCG - SER. NO. 81050 - SEPT. 30, 1988

DRWN.	V. FORD
CHKD.	
SCALE	NOTED

NC-220 -0038 — REV. 5



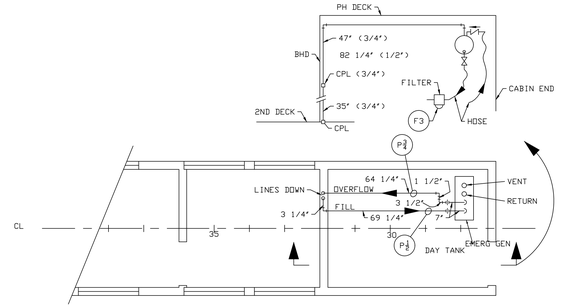


FUEL RETURN

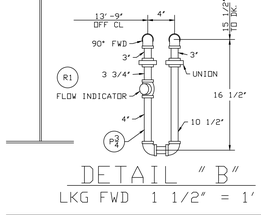
SEE NOTE - F.O. FILTER DETAIL B

BILL OF MATERIAL

PIECE No.	QTY.	DESCRIPTION	MATERIAL	ASTM	MFG.
P-1/2	A/R	PIPE, 1/2" SCH 80 BLACK	STL	A-53 GR. B	
P-3/4	A/R	PIPE, 3/4" SCH 80 BLACK	STL	A-53	
P-1	A/R	PIPE, 1" SCH 80 BLACK	STL	A-53	
P-1 1/4	A/R	PIPE, 1 1/4" SCH 80 BLACK	STL	A-53	
V-1	2	GATE VALVE 2"	IRON	A395	
V-2	0	GLOBE VALVE 3/4" SCR'D W/ PLUG	BRZ	B62	
V-3	5	BALL VALVE 1/2" SCR'D	BRZ	B62	
V-4	5	GATE VALVE 1/2" SCR'D	BRZ	B62	
V-5	5	SWING CHECK VALVE 1/2"	BRZ	B62	
V-6	1	GATE VALVE 1 1/4"	BRZ	B62	
F1	A/R	FLEXIBLE HOSE 3/8"			AEROQUIP AQ FC300-DC
F2	4	FILTER/SEPARATOR, DUPLEX			RACOR 75/900 MA
R1	1	ROTARY LIQUID FLOW INDICATOR	BRZ		EEP
B1	2	DECK ACCESS BOX, REMOTE	STL, BRZ		KPM 18389-612
H1	1	HAND PUMP, ROTARY 1 1/4"			BLACKMER PA414
F3	1	FILTER/SEPARATOR, SIMPLEX			RACOR 900 MA
F-2A	4	FILTER/SEPARATOR DUPLEX W/ ISOLATION VALVE			RACOR 75/900 MAV
	ALL	UNIONS, 3000# SOCKET WELD	FG STL	A105	
	ALL	FITTINGS, 3000# SOCKET WELD	FG STL	A105	
	4	FLANGES, 2" SLIP-ON 150#	FG STL	A105	

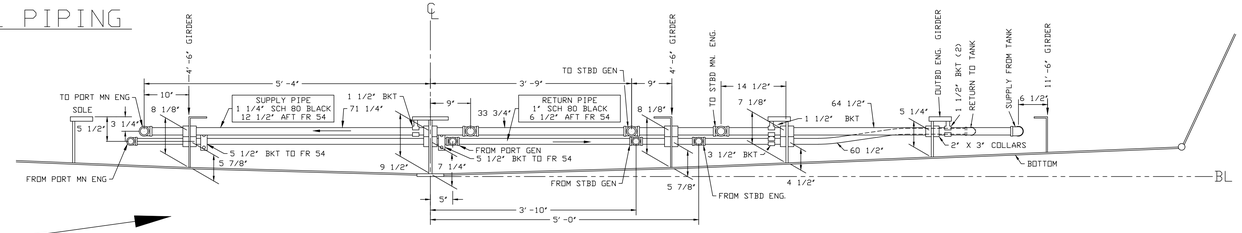


UPPER DECK
3/8" = 1'



DETAIL "B"
LKG FWD 1 1/2" = 1'

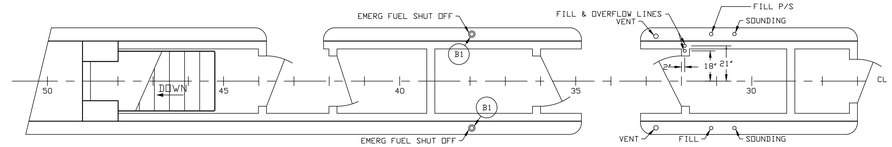
RETURN FUEL PIPING



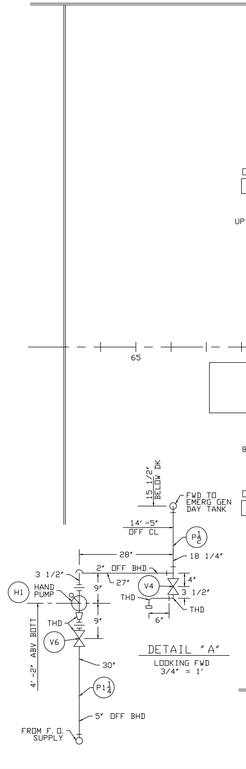
SECTION C-C
LOOKING FORWARD
1" = 1'

GENERAL NOTES

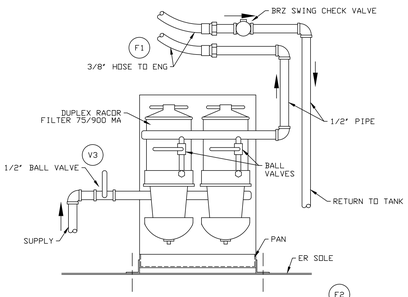
1. ALL WORKMANSHIP, MATERIALS AND COMPONENTS TO BE U.S.C.G. APPROVED.
2. TAKE DOWN JOINTS TO BE PROVIDED ON BOTH SIDES OF ALL BHD. & DECK PENETRATIONS AND AT ALL PUMPS
3. OIL DRIP PANS TO BE INSTALLED UNDER ALL PUMPS AND FILTERS
4. SEE DWG 220-1034 FOR F.O. TANK CONSTRUCTION



MAIN DECK PLAN
3/8" = 1'



SUPPLY FUEL PIPING



F.O. FILTER DET.
TYP. MN ENG & GEN

NOTE: B2
F.O. FILTER DETAIL APPLICABLE TO HULLS 92,135,136,137 & 1285. FOR EQUIP. CHANGE REV. B SEE PIECE No. F-2A IN BILL OF MATERIALS.

No.	DESCRIPTION	By	Date	App'd.
C	REPRODUCED IN ITS ENTIRETY USING AUTOCAD RELEASE 12	EBJ	7/14 '93	
B	2. ADDED NOTE TO FUEL OIL FILTER DET. & ADDED PC. No.F-2A TO B.O.M. FOR FILTER WITH ISOLATION VALVE 1. ADDED REVISION COLUMN	EBJ	8/17 '92	

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

FUEL OIL PIPING

SEAL

APPROVALS

DRWN. A. OVERSTREET

CHKD.

SCALE 3/8" = 1'

NC-220-1042 REV. C

DETAIL "C"
NTS

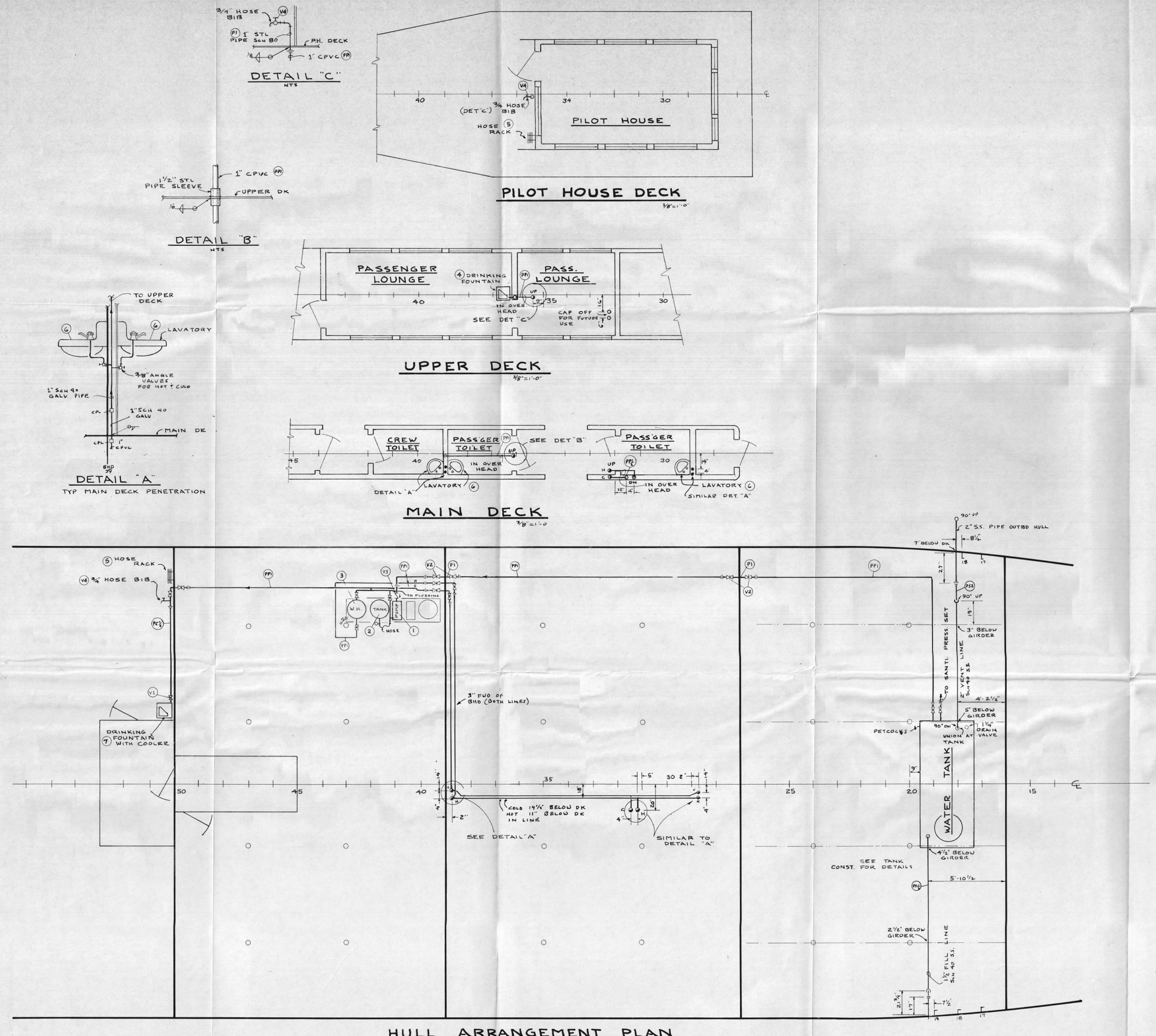
PILOT HOUSE DECK
3/8"=1'-0"

DETAIL "B"
NTS

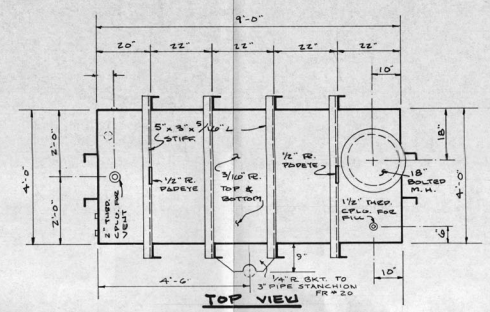
DETAIL "A"
TYP MAIN DECK PENETRATION

UPPER DECK
3/8"=1'-0"

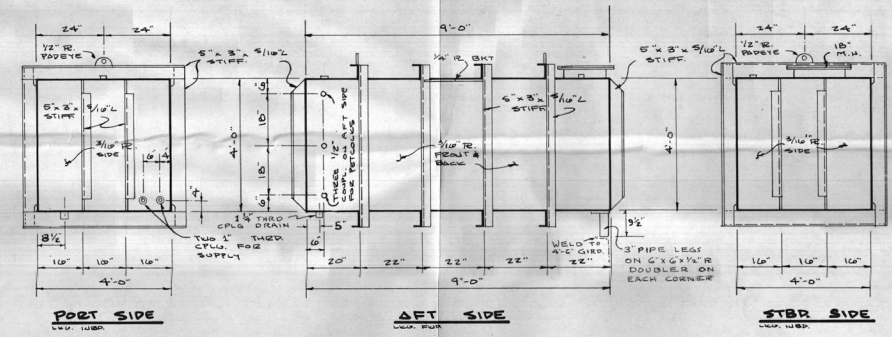
MAIN DECK
3/8"=1'-0"



HULL ARRANGEMENT PLAN
3/8"=1'-0"



TOP VIEW



POTABLE WATER TANK CONSTRUCTION
SC: 1/2"=1'-0"

BILL OF MATERIALS

No	QTY	DESCRIPTION	MATERIAL	ASTM	MFG
1	1	PUMP, 120 VAC 300 GPH	CI BODY BRZ IMP.		MCDONALD 8151
2	1	PRESSURE TANK 30 GAL	GLASS LINED		CLAYTON MARK EM 60E
3	1	WATER HEATER 30 GAL		208 1 PHW	RHEEM 81V30D
4	1	WATER COOLER 14 GPH		MODEL DP3RH	OASIS
5	3	3/4" HOSE, RACK NOZZLE			
6	3	LAVATORY, VITREOUS CHINA			AMER. STD 451.021
7	1	WATER COOLER W/ COOLER		MODEL SCWT-14A	HALSEY TAYLOR
V-1	1	1/2" GLOBE VALVE, SCR'D	BRZ	B-61	
V 2	16	1" GATE VALVE, SCR'D	BRZ	B-62	
V 3	1	1" SWING CHECK VALVE, SCR	BRZ	B-62	
V 4	2	3/4" HOSE BIB	BRZ	B-62	
PP-1	A/R	1" CPVC SCH 80 PIPE	PLASTIC	D 1785	
P-1	A/R	1" SCH 80 STEEL PIPE	STEEL	A-53	
PP 1/2	A/R	1/2" CPVC-SCH 80 PIPE	PLASTIC	D 1785	
PC 1/2	A/R	1/2" COPPER TUBING	COPPER		
PS 1 1/2	A/R	1 1/2" SCH 40 STAINLESS STL PIPE	STAINLESS STL	A 376	
PS 2	A/R	2" SCH 40 STAINLESS STL PIPE	STAIN. STL	A 376	

NO	DESCRIPTION	BY	DATE

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
FERRY DIVISION — MARINE ENGINEERING

POTABLE WATER PIPING

PATTI SHIPYARD, INC.
"PATTI BUILT"

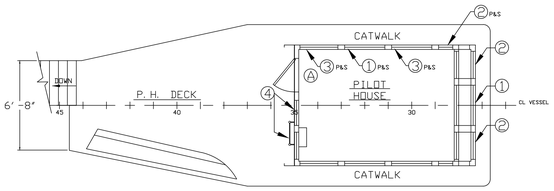
DRAWN BY: WGP
DATE: 5-4-89
YARD NUMBER:

SEAL

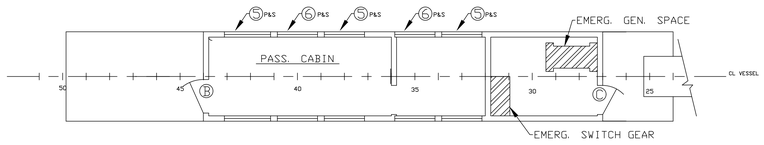
APPROVALS:
DRWN.
CHK'D.
SCALE 3/8"=1'-0"

NC-220-1049

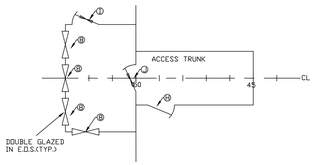
REV.



PLAN OF P. H. DECK

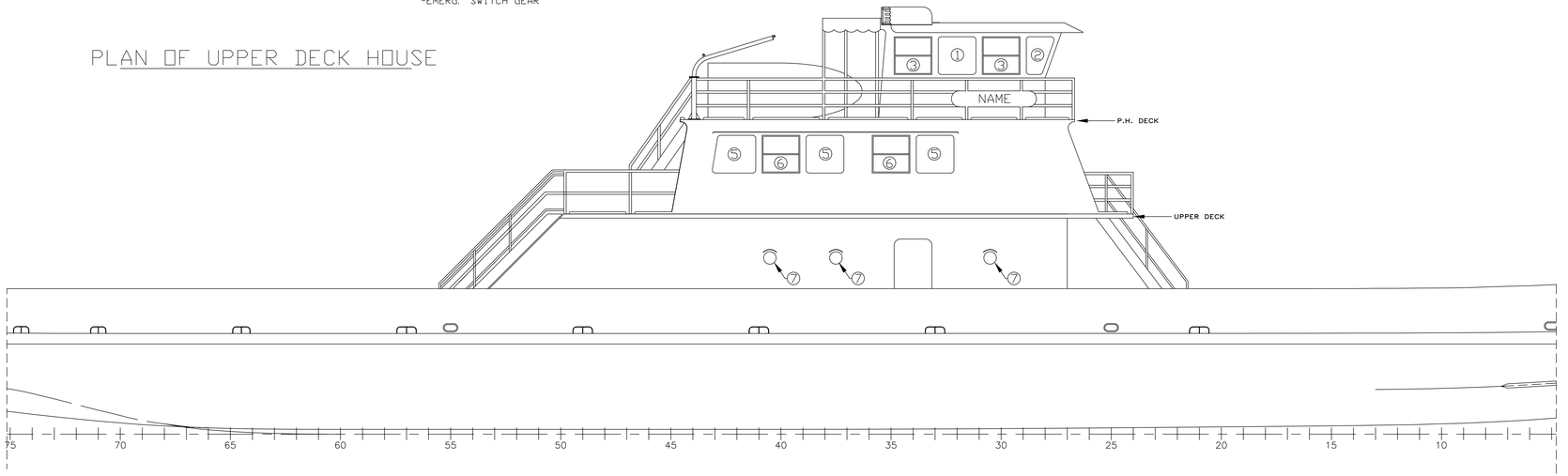


PLAN OF UPPER DECK HOUSE

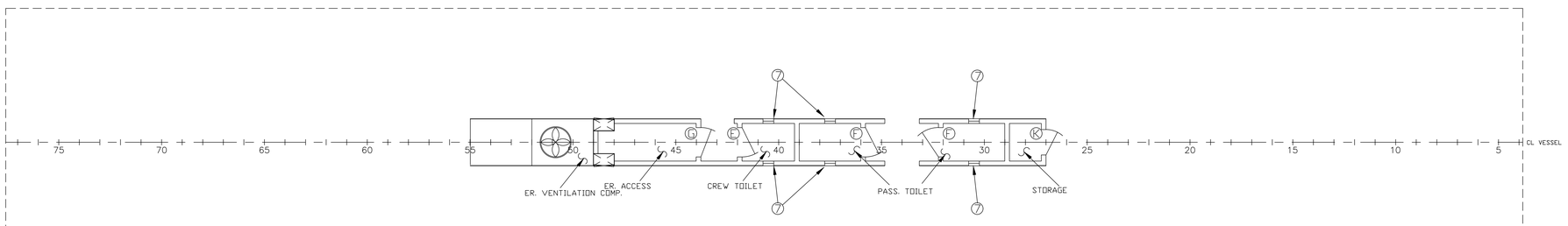


PLAN OF ENGINEER'S OPERATING STAT.

(BELOW MN. DK.)



OUTBOARD PROFILE



PLAN-MAIN DECK

1/4" = 1'

DOOR SCHEDULE

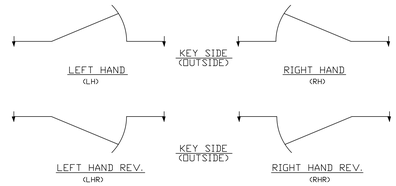
PC NO	QTY	SIZE	DESCRIPTION	PART NO.	MGF	MATERIAL	REMARKS-L/H,R/H	SILL HGT.
A	1	30x78	WEATHER TIGHT DOOR, W/ S/S FRAME, SILL, HINGES, & LOCKSET	CC-3009	CORNELL CARR	S/S	W/1/4" PL GLASS PANEL-L.H.	2"
B	1	30x78	JOINER DOOR W/ S/S FRAME, SILL, HINGE, AND LOCKSET	CC-2005-A	CORNELL CARR	S/S	W/1/4" PL GLASS PANEL-R.H.R.	2"
C	1	26x78	WEATHER TIGHT DOOR W/ FRAME, SILL, HINGE, TYPE 'A' LEVER & QUADRANT LOCKSET S/S	CC-3007-AH	"	"	FLUSH DOOR L.H.R.	2"
D			NOT USED					
E	1	24x80	JOINER DOOR WITH S/S FRAME, SILL, HINGE, TYPE "A" LEVER & QUADRANT LOCKSET	CC2007-B	"	"	L/H	2"
F	2	30x80	JOINER DOOR WITH S/S FRAME, SILL, HINGE, TYPE "A" LEVER & QUADRANT LOCKSET	CC2007-B	"	"	R.H.R.	2"
G	1	30x72	WATER TIGHT-QA TYPE, 6DOG CLASS		CENTEX	STL	L.H.R.	9"
H	1	24x66	WATER TIGHT-QA TYPE, 6DOG CLASS		CENTEX	STL	RH	6"
I	1	24x75	JOINER DOOR- FIT W/ DBL-1/4" THK SAFETY PL GLASS-INSULATION-FUME-TIGHT		AMATEX	STL	W/ HEAVY DUTY S/S HINGES AND LOCKSET-L.H.R.	FLUSH
J	1	24x75	SAME AS ABOVE		AMATEX	STL	RH	FLUSH
K	1	26x72	WEATHER TIGHT DOOR W/ FR. SILL, HINGES, AND LOCKSET. S/S TYPE A LEVER QAD	CC-3007	CORNELL CARR	S/S	L.H.R.	12"

WINDOW SCHEDULE

PC NO	QTY	DESCRIPTION	PART NO.	MGF	MATERIAL	
1	3	36x36x1/4" SAFETY PL GLASS			1/4" THK	SET IN SELF LOCKING RUBBER CHANNEL, CLEAR GLASS
2	4	36" HIGH SAFETY PL GLASS (SEE DWG. FOR SIZE)			1/4" THK	SEE ABOVE
3	4	36"x36" DROP SASH WINDOW	CC-1001	CORNELL CARR	S/S FRAME &HARDWARE	BOLT ON FRAME CLEAR GLASS
4	2	36"x21" SAFETY PL GLASS			1/4" THK	SET IN SELF LOCKING RUBBER CHANNEL CLEAR GLASS
5	6	36"x36" SAFETY PL GLASS			1/4" THK	SET IN SELF LOCKING DARK TINT GLASS
6	4	36"x36" DROP SASH WINDOW	CC-1001	CORNELL CARR	S/S FRAME& HARDWARE	BOLT ON FRAME DARKTINT GLASS
7	6	12" DIA HINGED PORTLIGHT(NO COVER)	SIM TO KS-17535	CEN-TEX DWG#800	BRONZE FRAME	FROSTED GLASS
8	8	24"x36" SAFETY PL GLASS- DBL GLASS			1/4" THK	SET IN SELF LOCKING RUBBER CHANNEL CLEAR GLASS* * SEE DWG. 0028

GENERAL NOTES

1. WATER TIGHT DOORS ARE TO BE USCG APPROVED 6 DOG TYPE
2. ALL HOLLOW TYPE DOORS SHALL BE COATED THOROUGHLY WITH CORROSION PREVENTATIVE COMPOUND ON INTERIOR SURFACES BEFORE ASSEMBLY.
3. ALL DOORS TO BE FITTED WITH HEX HEAD S/S MACHINE SCREWS WITH S/S NUTS AND LOCKWASHERS.
4. WINDOWS IN PILOT HOUSE TO BE 1/4" THK(MIN.) SAFETY PLATE GLASS, CLEAR IN ACCORDANCE WITH ANSI Z26.1
5. DROP SASH WINDOWS SHALL HAVE S/S FRAMES AND BE MOUNTED WITH S/S HEX BOLTS WITH S/S NUTS AND LOCK WASHERS.



DOOR SWING KEY PLAN

No.	DESCRIPTION	BY	DATE	APP'D
2.	REPRODUCED IN ITS ENTIRETY USING AUTOCAD RELEASE 12	EAD	9/7/93	
1.	AS BUILT	VF	4/13/89	

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

DOOR, WINDOW, HARDWARE SCHEDULE

SEAL

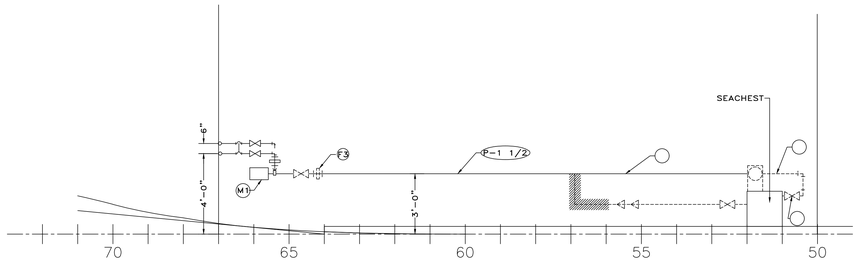
APPROVALS

DRWN. V. FORD

CHKD.

SCALE 1/4"=1'-0"

NC-220-0056 REV. 2



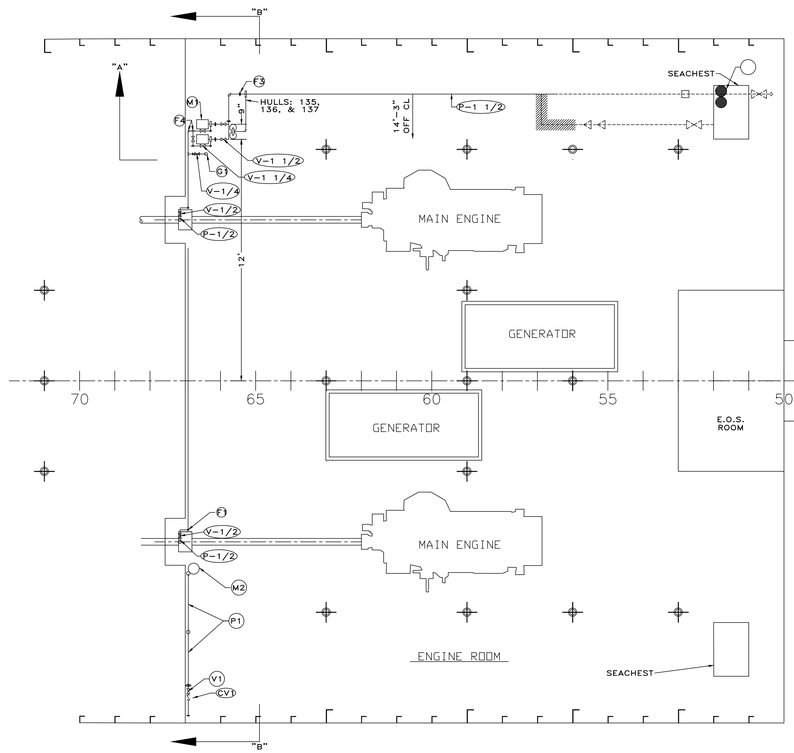
SECTION "A-A"
3/8"= 1'-0"

BILL OF MATERIALS

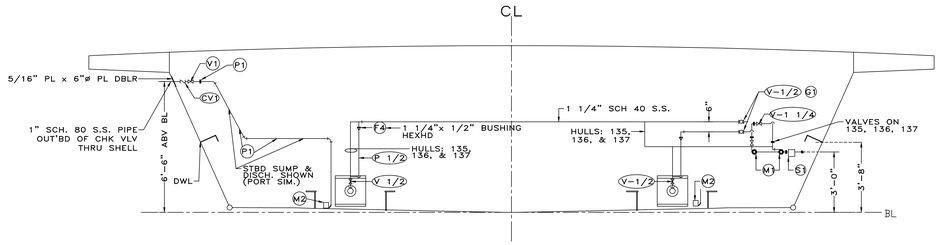
Pc No	QTY	DESCRIPTION	MATERIAL	ASTM	REMARKS
V-1/2	2	1/2" GATE VALVE 150# SCRD	BRZ	B-62	WALWORTH # 11
V-1 1/4	3	1 1/4" GATE VALVE " "	BRZ	B-62	GRINELL
V-1 1/2	3	1 1/2" GATE VALVE " "	BRZ	B-62	GRINELL
V-1	2	1" GATE VALVE " "	BRZ	B-62	WALWORTH # 11
V-1/4	2	1/4" GLOBE VALVE			WALWORTH
CV-1	2	1" SWINHG CHECK VALVE	BRZ	B-62	POWELL
P-1/2	A/R	1/2" ø S.S.PIPE SCH 80 THR'D	S.S.	A312	
P-1 1/4	" "	1 1/4" ø " "			
P-1 1/2	" "	1 1/2" ø " "			CPVC PATTI
P-1	A/R	1" ø CPVC PIPE SCH 80 SW	CPVC		CONTRACT
G-1	2	GAGE 0-60 P.S.I.	S.S.		DASCO
S-1	1	1 1/2" DUPLEX STRAINER, SCRD	BRZ	B-62	HAYWARD MOD # 51
M-1	2	1 1/2"S x 1 1/4"D PUMP	BRZ		FLOMAX # 25990
M-2	2	SUMP PUMP, SUBMERSIBLE 24V			RULE # 2000 W/ FLOAT SWITCH
F-1	2	1/2" UNION 150# THRD	FG S.S.	A182	
F-2	3	1 1/4" UNION " "	" "	" "	
F-3	5	1 1/2" UNION " "	" "	" "	
F-4	A/R	FITTINGS " "	" "	" "	TEE'S AND ELBOW'S
F-5	2	1" UNION SCH 80 CPVC SW/THRD	CPVC	F439	
F-6	A/R	1" FITTINGS SCH 80 CPVC SW	" "	" "	45°'S AND 90°'S

GENERAL NOTES

1. ALL WORKMANSHIP, MATERIALS, AND COMPONENTS TO BE U.S.C.G. APPROVED.
2. TAKE DOWN JOINTS TO BE PROVIDED AT PUMPS, SUCTIONS, AND DISCHARGES.
3. PROVIDED PRESSURE GAGE AND ROOT VALVE AT PUMP DISCHARGE.
4. ALL PLASTIC FITTINGS TO BE CPVC SCH 80 ASTM-F-439 SOCKET TYPE.



HOLD PLAN
3/8"= 1'-0"



SECTION "B-B"
3/8"= 1'-0"

No.	DESCRIPTION	By	Date	App'd.
5	REPRODUCED IN ITS ENTIRETY USING AUTOCAD RELEASE 12	EAO	12/23/93	
4	SHOW PROPOSED STERNTUBE CIRCULATING PIPING RELOCATION IN ACCORDANCE WITH SKETCH NC 92-4	EBJ	3/-/92	
3	AS BUILT HULL 135	WP	11/2/89	
2	REVISED 9/M AND PP TO INCLUDE NEW GLOBE VALVES	KEG	6/10/89	
1	AS BUILT		4/30/89	

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

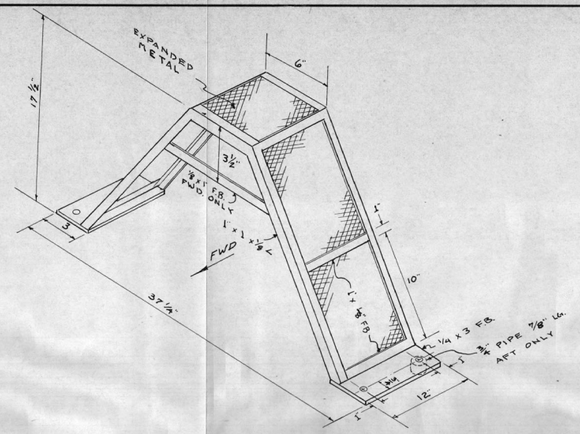
STERNTUBE CIRCULATING DIAGRAM

SEAL

APPROVALS
USCG-FEB 12, 1988- SER-M-80067

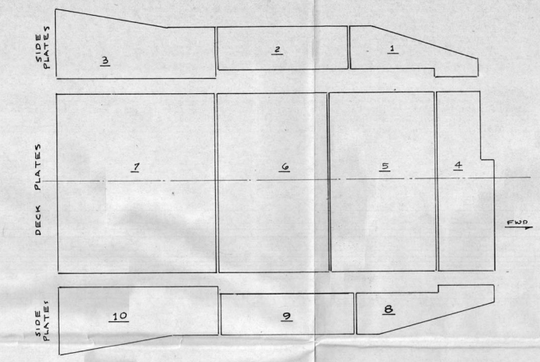
DRWN. D. OVERSTREET
CHKD.
SCALE 3/8" = 1'

NC-220-0062 REV. 5



COVER FOR FIRE PUMP COUPLING

N.T.S.

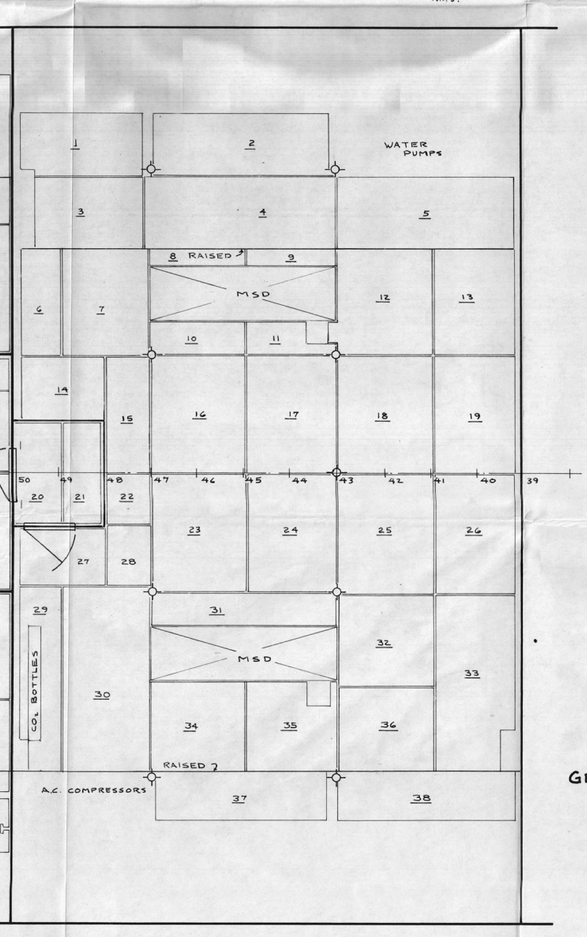


PLATES OVER SHAFT

1"=1'-0"

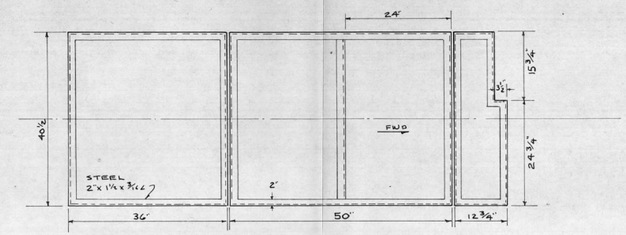
ENGINE ROOM

1/2"=1'-0"

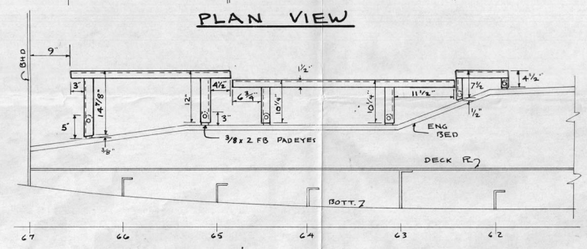


M.S.D. ROOM

1/2"=1'-0"



PLAN VIEW



PROFILE

FRAMING OVER SHAFT

1"=1'-0"

GEN. NOTES:

1. ALL DECK PLATES ARE ¼" DIAMOND PATTERN
2. FASTENERS ARE SS 3/8" x 3/4" FLAT HEAD FOR ALLEN WRENCH APPOX. 1200 REQ

No.	DESCRIPTION	BY	DATE	APP.
1	ADDED FIRE PUMP CPL COVER	UP	1/26/11	

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
FERRY DIVISION — MARINE ENGINEERING

PATTI SHIPYARD, INC.
"PATTI BUILT"

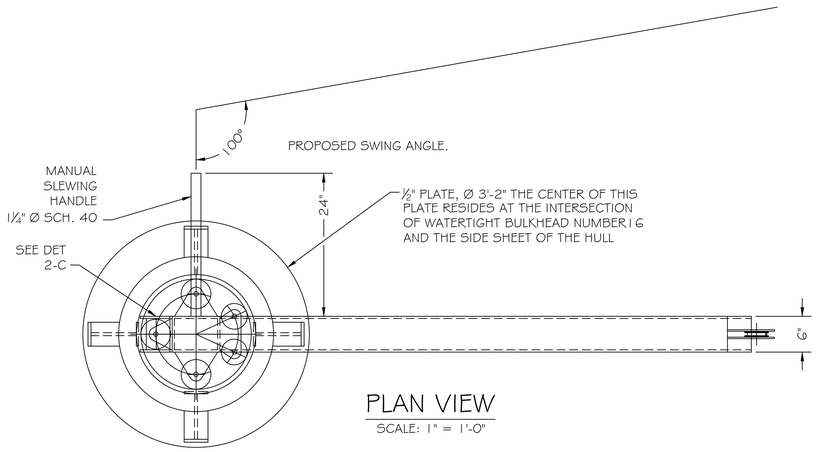
SEAL

DRAWN BY:
DATE:
YARD NUMBER:
APPROVALS:
DRWN:
CHKD:
SCALE: ½ = 1'-0"

ENGINE ROOM & MSD DECK PLATES

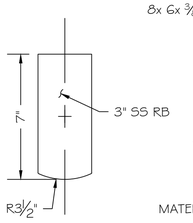
NC-220-1066

REV. 1



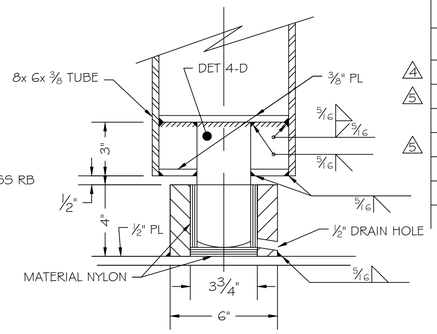
PLAN VIEW

SCALE: 1" = 1'-0"



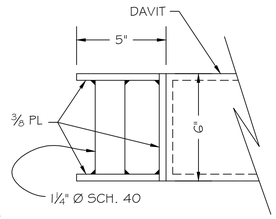
DETAIL 4-D

SCALE: 3" = 1'-0"



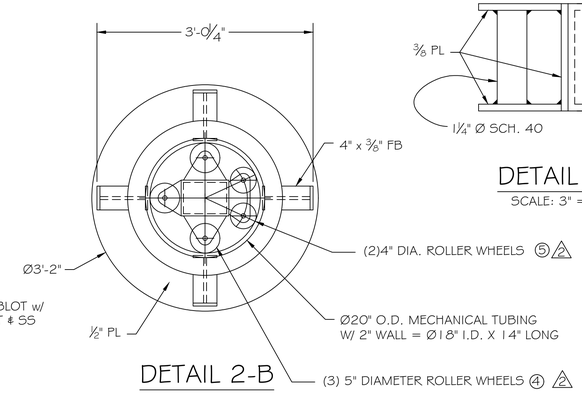
DETAIL 3-D

SCALE: 3" = 1'-0"

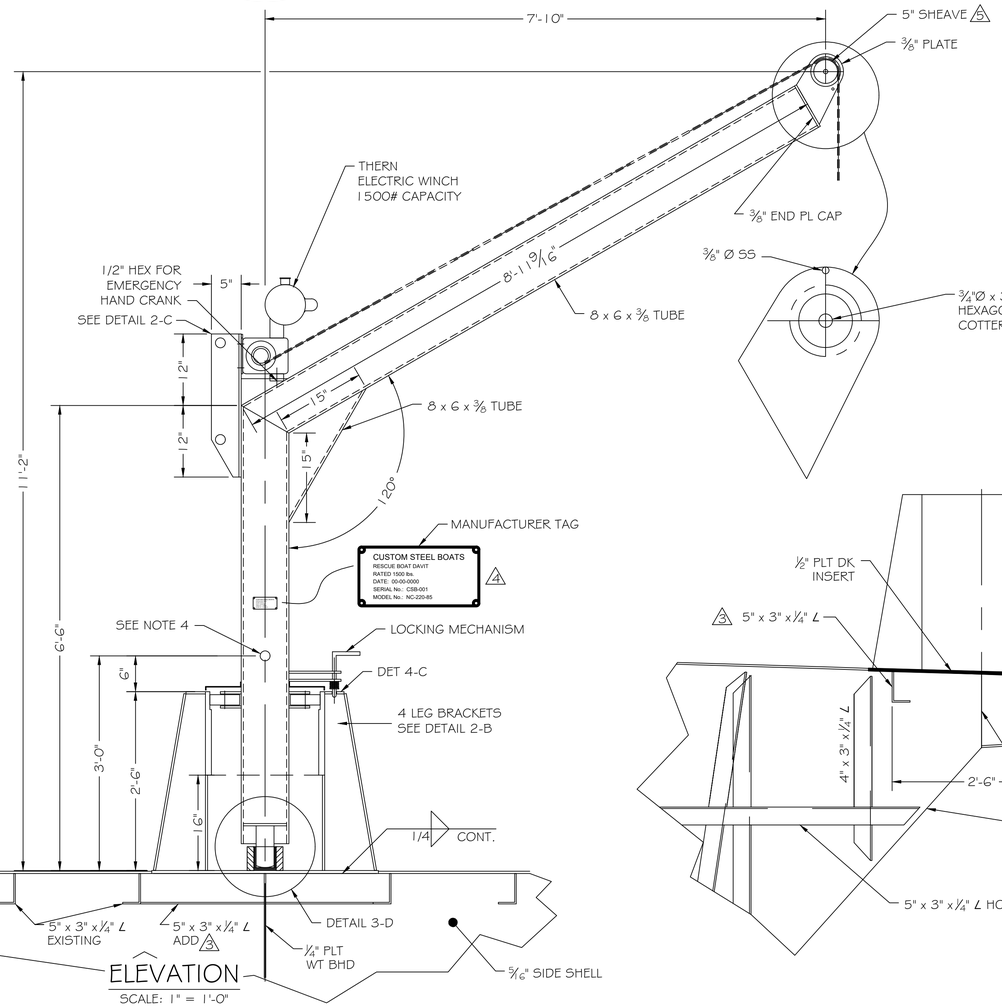


DETAIL 2-C

SCALE: 3" = 1'-0"

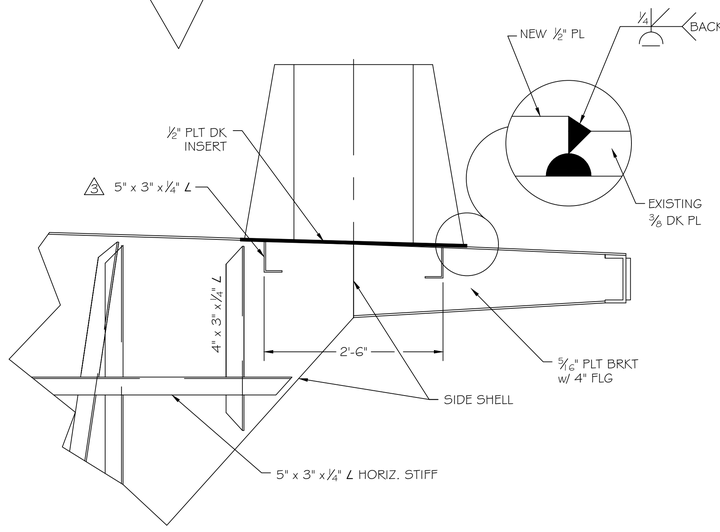


DETAIL 2-B



ELEVATION

SCALE: 1" = 1'-0"



BILL OF MATERIALS

ITEM	DESCRIPTION	MFG. BY	PART NO.	QTY.
1	WINCH -	THERN	4WP2D8-1500-40-F	1
2	CABLE, 5/16" x 45', 19x7 GALV.			1
3	SWIVEL HOOK - S-322CN	CROSBY	1048609	1
4	SHEAVE, 5" DIA.	McKISSICK	51071	1
5	ROLLER WHEELS - 5" DIAMETER	McMASTER-CARR	2307T72	3
6	ROLLER WHEELS - 4" DIAMETER	McMASTER-CARR	2307T71	2

GENERAL NOTES

1. DAVIT MUST BE SHOP TESTED.
2. ALL WELDS MUST BE FULL PENETRATION AND INSPECTED BY USCG.
3. DAVIT MUST HAVE TURNING ARM TO ALLOW FOR EASY MANEUVERING.
4. ALL BOLTS AND PINS TO BE 316 SS.
5. SHEAVES TO BE 4" DIA. COMPOSITE.
6. WINCH CABLE TO BE LOAD CERTIFIED.
7. UPPER CARRIER BEARINGS TO BE PERMANENT SEALED TYPE.
8. PROVIDE POSITION SECURING PIN PER PROPOSED SWING ANGLE.
9. WINCH, CABLE, & ALL ACCOMPANYING HARDWARE TO BE FURNISHED BY NORTH CAROLINA SHIPYARD.
10. NC SHIPYARD WILL BLAST & PAINT DAVIT.
11. SHOP WILL LOAD TEST DAVIT @ 2.5 x WORKING LOAD. [(2.5 x 675 = 1680) USCG WITNESS]

REFERENCES

1. OUTBOARD PROFILE & GEN. ARRGTS. NC-220-0005
2. BULWARK & DETAILS NC-220-0036

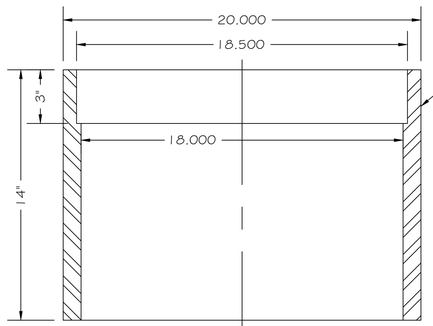
REV.	DESCRIPTION	DATE	REVISED BY
5	INCREASED WIRE ROPE & SHEAVE SIZE.	17 FEB., 2014	BRENT JONES
4	CHANGED WINCH MODEL TO MEET USCG REQUIREMENTS. ADDED STAINLESS STEEL MANUFACTURER INFORMATION TAG TO DAVIT.	07 DEC., 2010	BRENT JONES
3	ADDED ANGLE STIFFENER UNDER DAVIT BASE.	12 MAR., 2010	BRENT JONES
2	REDESIGNED ROLLER WHEELS TO CORRECT SLEWING PROBLEM, ADDED BILL OF MATERIAL LISTING AND REFERENCES.	29 OCT., 2009	JOE D. WALDREP
1	ADDED ROLLER GUARD	12 OCT., 2009	BRENT JONES

NORTH CAROLINA FERRY SYSTEM
8550 SHIPYARD RD. MANNS HARBOR, NC. 27953

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
FERRY DIVISION

HATTERAS CLASS FERRY
STD. 1500# CAP. DAVIT

DWG. BY:	APPROVED BY:	SIZE	PROJECT NO.	DWG NO.	REV
B.T. JONES	J.D. WALDREP	D	000	NC-220-0085	5
DATE: 06-30-09	DATE APPROVED:	SCALE 1"=1'-0"			SHEET 1 OF 2



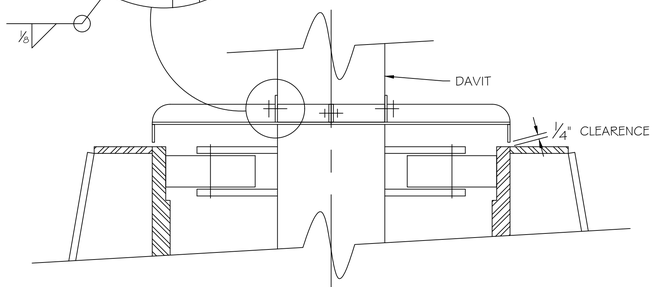
Ø20" O.D. MECHANICAL TUBING
W/ 1" WALL = Ø18" I.D.
@14" LONG

5/16" SS Ø STUD
(4) PLACES

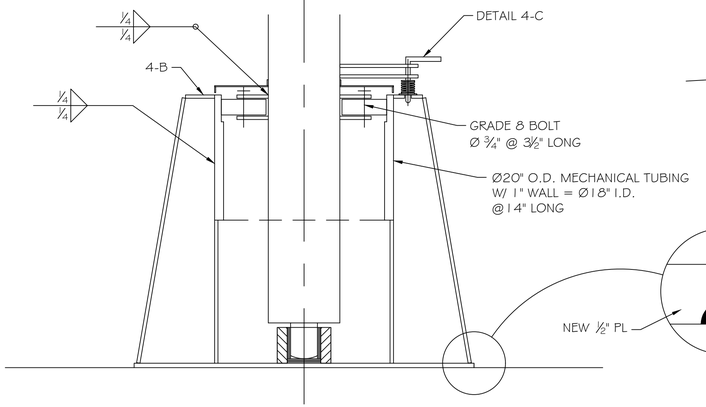
1-1/2"

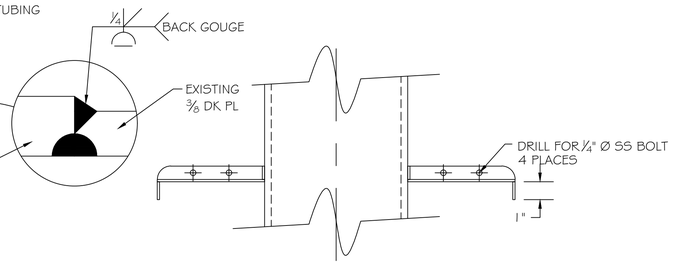
1/8

MECHANICAL TUBING DETAIL
SCALE: 3" = 1'-0"

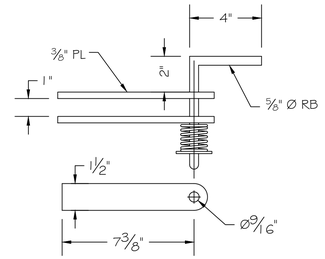


SECTION A-A

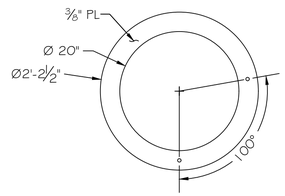




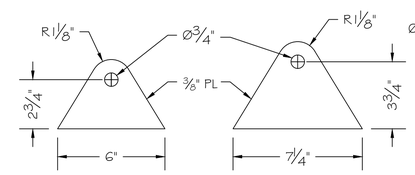
ELEVATION



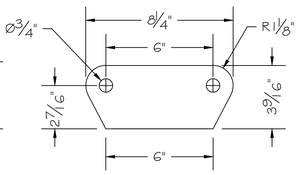
DETAIL 4-C
SCALE: 3" = 1'-0"



DETAIL 4-B

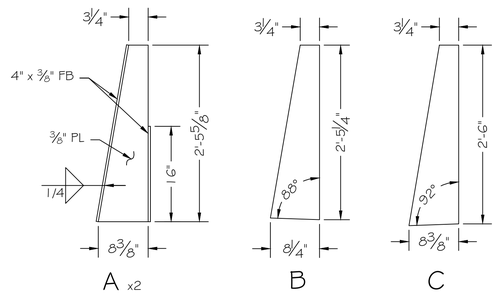


D x2 E x4



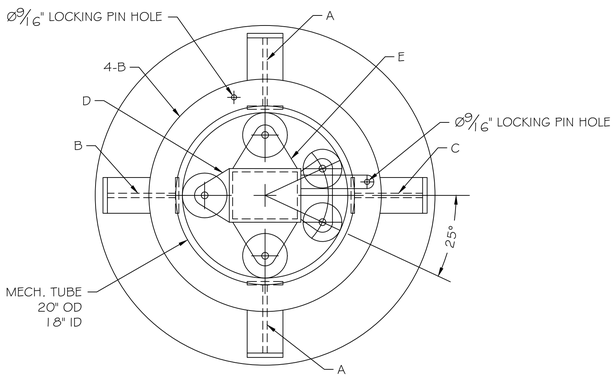
F x2

CASTER BRACKET DETAIL
SCALE: 3" = 1'-0"

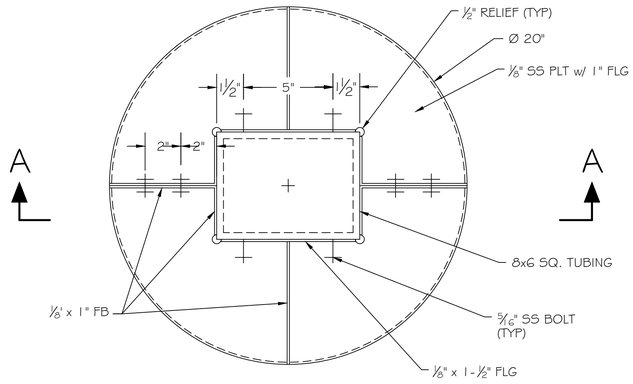


A x2 B C

DETAIL 2-B

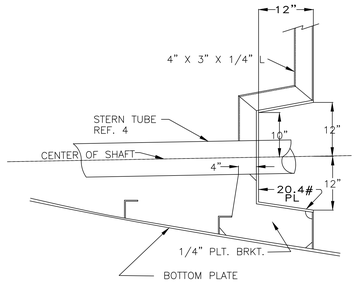


DAVIT BASE SECTION
SCALE: 1 1/2" = 1'-0"



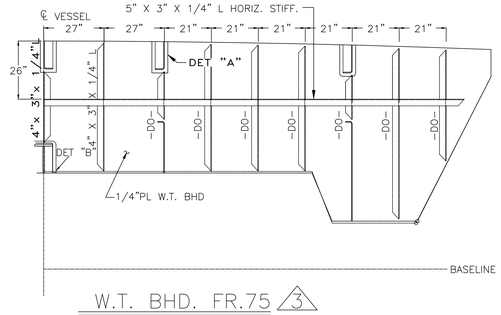
ROLLER GUARD
PLAN VIEW
SCALE: 3" = 1'-0"

SIZE	PROJECT NO.	DWG NO.	REV
D	000	NC-220-0085	5
SCALE 1"=1'-0"			SHEET 2 OF 2



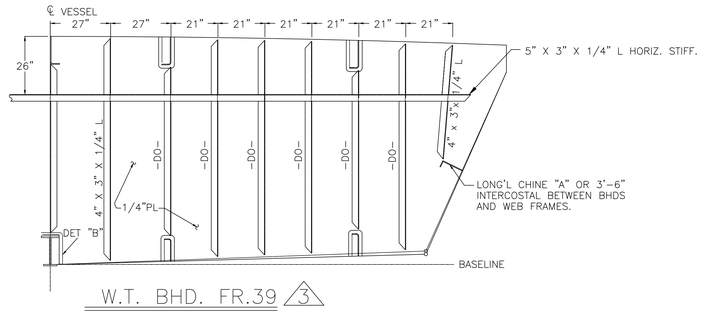
SECTION "C-C"

NOT TO SCALE



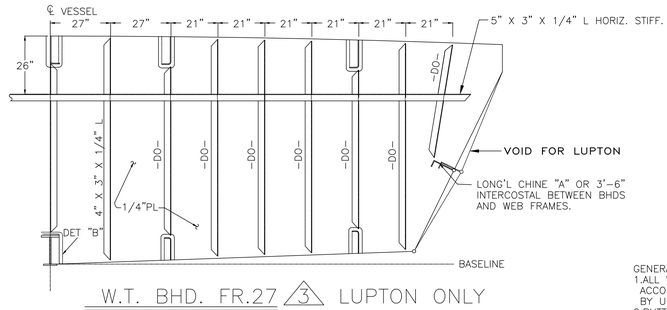
W.T. BHD. FR.75 (3)

STBD. LKING. FWD. PORT SIM.
SCALE 1/2"=1'



W.T. BHD. FR.39 (3)

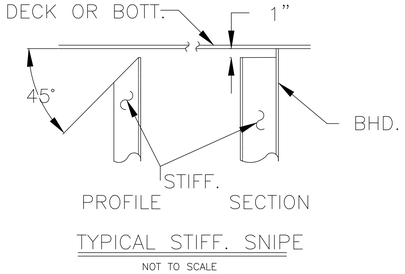
STBD. LKING. FWD. PORT SIM.
SCALE 1/2"=1'



W.T. BHD. FR.27 (3) LUPTON ONLY

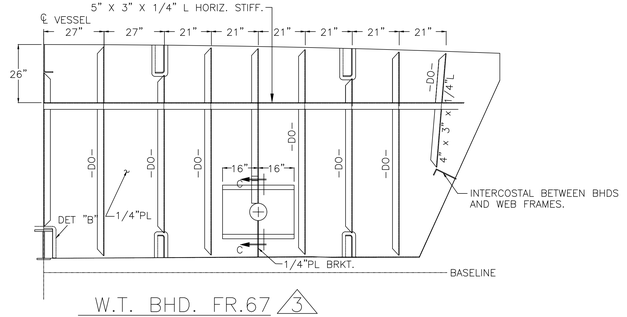
STBD. LKING. FWD. PORT SIM.
SCALE 1/2"=1'

GENERAL NOTES
1. ALL WELDING SHALL BE ACCOMPLISHED IN ACCORDANCE WITH A.B.S. STANDARDS AND BY U.S.C.G. CERTIFIED WELDERS.
2. BUTTS IN PLATING SHALL BE LOCATED TO SUIT AVAILABLE PLATE SIZES.
3. ALL STIFFNERS WHICH LAND ON BOTTOM OR DECK PLATE SHALL BE SNIPED AT 45 DEGREES.
4. CABLES, PIPING OR TUBING PASSING THROUGH WATERTIGHT BULKHEADS SHALL BE FITTED WITH SUITABLE SLEEVES AND/OR STUFFING TUBES.
5. LONGITUDINAL STRINGERS & MEMBERS SHALL RUN CONTINOUS THRU BHDS. AND SHALL BE FITTED WITH COLLARS AT THE PENETRATIONS AS DETAILED. EXECPT FOR M/V FLOYD J. LUPTON



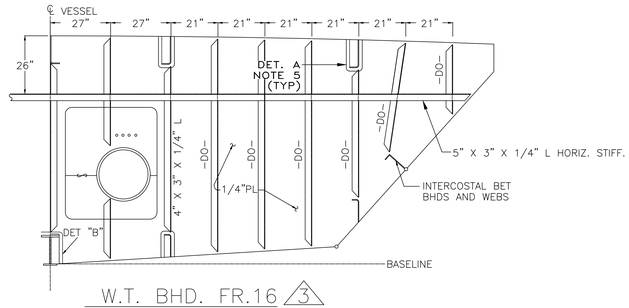
TYPICAL STIFF. SNIPE

NOT TO SCALE



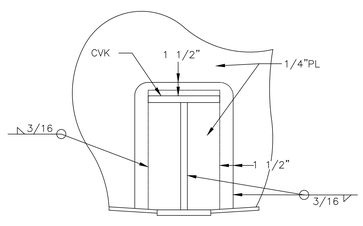
W.T. BHD. FR.67 (3)

STBD. LKING. FWD. PORT SIM.
SCALE 1/2"=1'



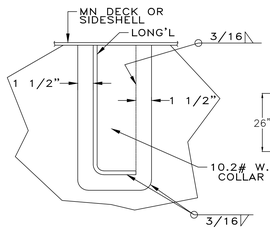
W.T. BHD. FR.16 (3)

STBD. LKING. FWD. PORT SIM.
SCALE 1/2"=1'



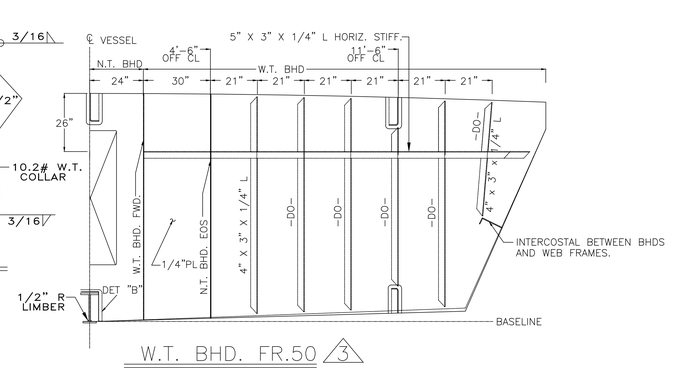
DETAIL "B"

NOT TO SCALE



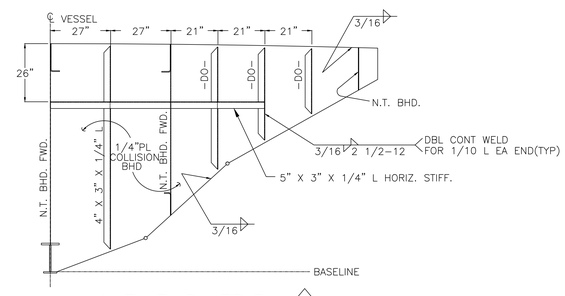
DETAIL "A"

NOT TO SCALE
VOID THIS PROJECT



W.T. BHD. FR.50 (3)

STBD. LKING. FWD. PORT SIM.
SCALE 1/2"=1'



W.T. BHD. FR.5 (3)

STBD. LKING. FWD. PORT SIM.
SCALE 1/2"=1'

REFEERENCES

1. CONTRACT SPECIFICATIONS
2. DWG. NC 220-0001 LINES & OFFSETS
3. DWG. NC 220-0008 HULL STRUCTURE
4. DWG. NC 220-0011 SHAFTING, BEARINGS & STERN TUBES
5. DWG. NC 220-0028 MISC. HULL FRAMING

NO.	DESCRIPTION	BY	DATE	APPD.
6	1.) DWG REPRODUCED IN ITS ENTIRETY USING ACAD REL 12 2.) REVISED TO "AS-BUILT" FOR STEINER HULL 331	AO	9-22 93	
5	REVISED W.T. BHD. #67 AT STUFFING BOX POCKET	RF	2-20 89	
4	REVISE DRAWING SEQUENCE TO REFLECT PATTI DRWG. NUMBER CHANGE LONG'L DECK & BOTT GIRDERS, ADD HORIZ. STIFF.	RF	12-6 88	
3	CHANGED TOE OF CENTER LONG'L TO STBD. SIDE	VF	6-20 88	
2	MOVED SLOPING BHD DETAIL TO DWG. REF 5	VF	5-13 88	
1	ADDED REF #5 ADDED REF TO BHD 50 MOVED LONG'L BHD TO DWG NC-220-0028	VF	4-25 88	

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

W.T. BULKHEADS

SEAL

DRWN. 6/87

CHKD.

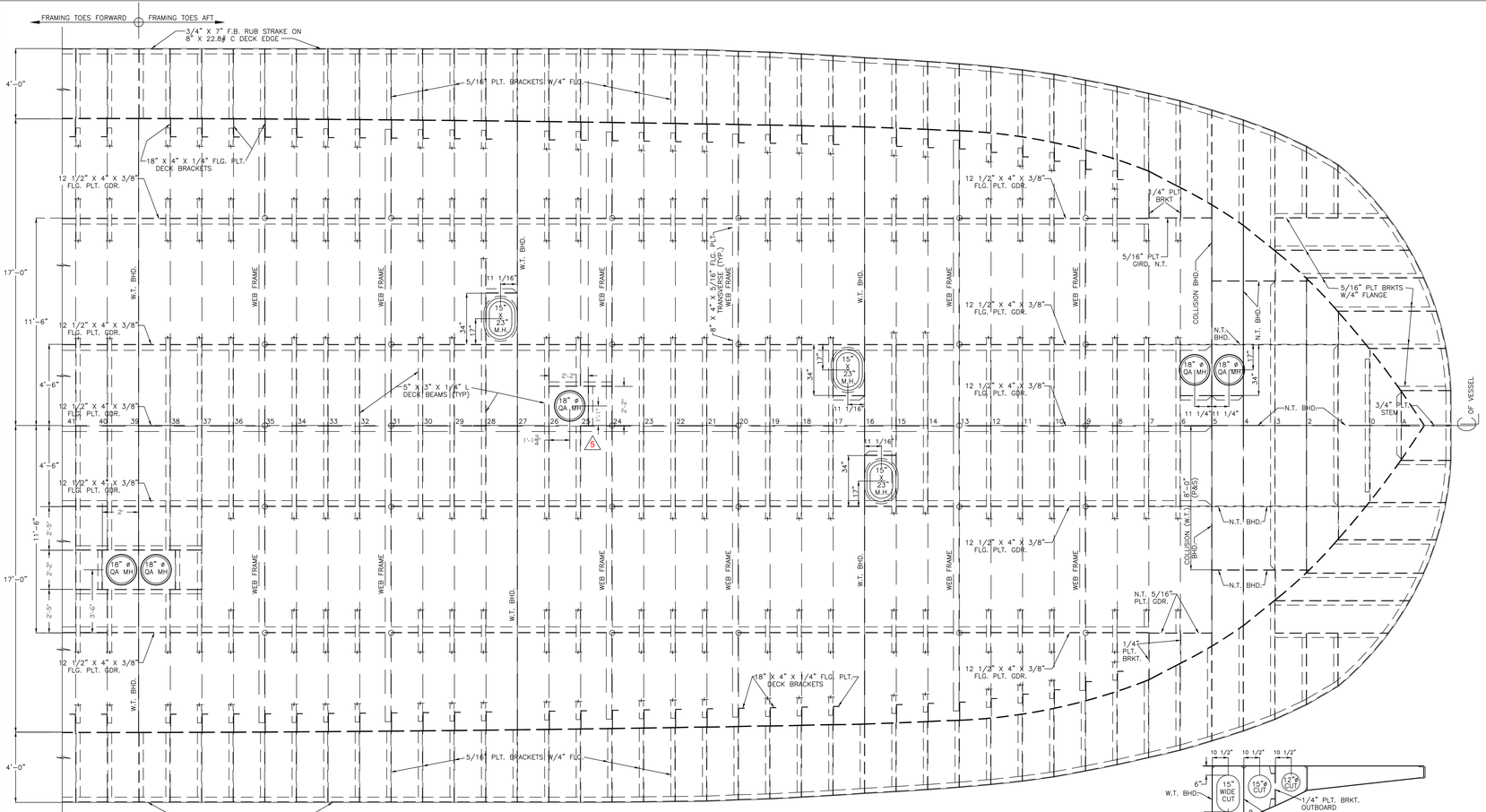
SCALE AS SHOWN

APPROVALS

USCG (MSO) SER 16711 DTD 22 DEC. 88

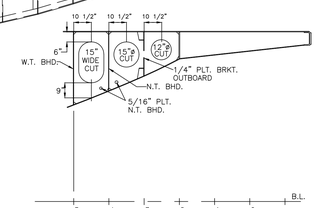
NC-220-1010

REV. 6



BOW DECK SCANTLING PLAN

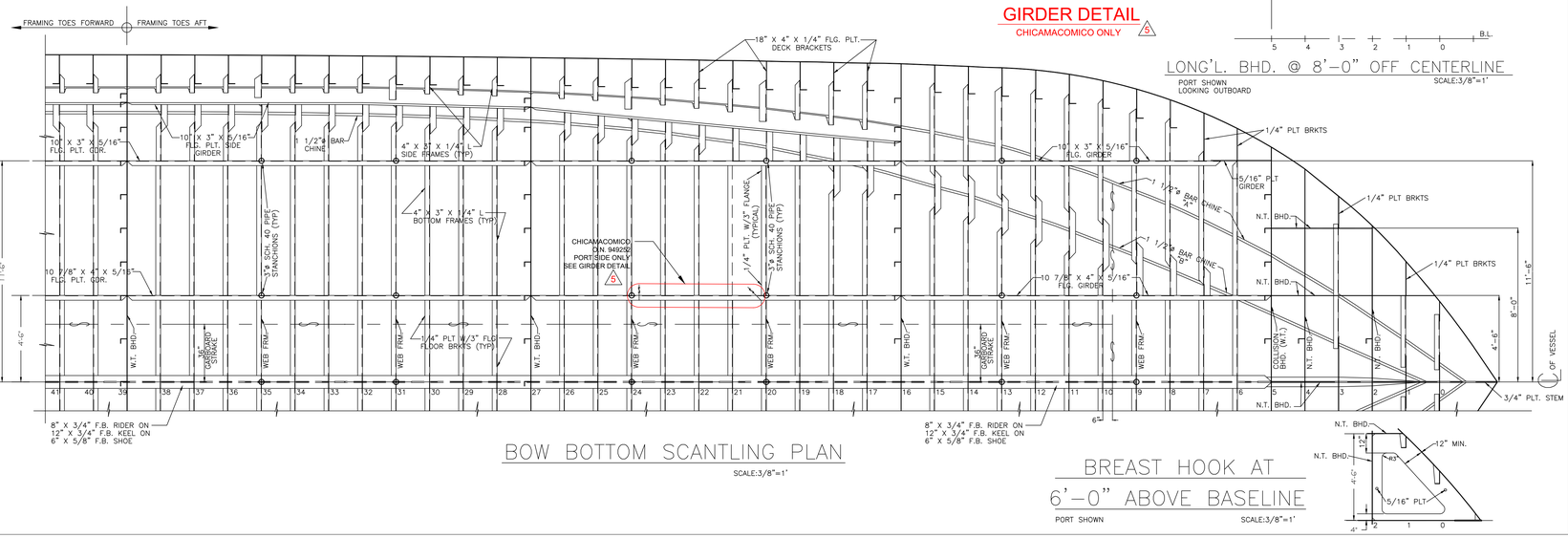
SCALE:3/8"=1'



LONG'L. BHD. @ 8'-0" OFF CENTERLINE

PORT SHOWN
LOOKING OUTBOARD

SCALE:3/8"=1'



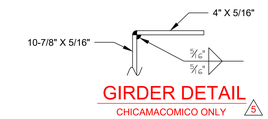
BOW BOTTOM SCANTLING PLAN

SCALE:3/8"=1'

BREAST HOOK AT 6'-0" ABOVE BASELINE

PORT SHOWN

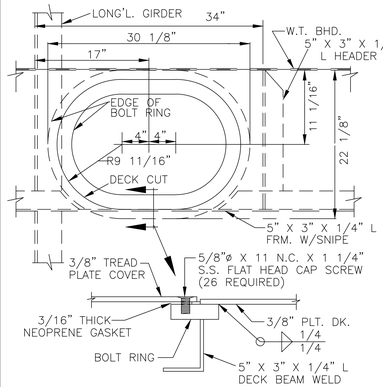
SCALE:3/8"=1'



GIRDER DETAIL

CHICAMACOMICO ONLY

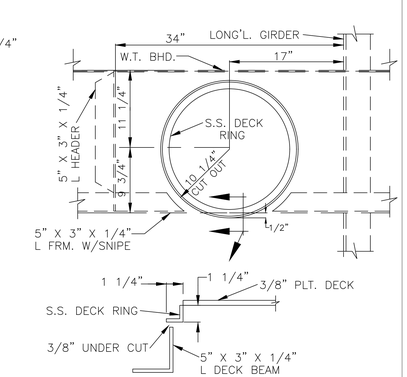
5



NOTE: INSTALLATION FOR MARHIL DWG. #58-2 W.T. MANHOLE (15" X 23")

15" X 23" MANHOLE DETAIL

SCALE:1 1/2" & 3"=1'



NOTE: INSTALLATION FOR FREEMAN MARINE #18DI Q.A. W.T. MANHOLE (18"ø)

18" DIA. Q.A. MANHOLE DETAIL

SCALE:1 1/2" & 3"=1'

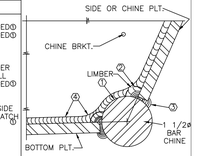
PLATE SCHEDULE

AREA	PLATE
MAIN DECK PLATING	3/8" PATTERN PLT.
SHEER STRAKE	1/2"
SHEER STRAKE TO CHINE "A"	5/16"
CHINE "A" TO CHINE "B" 6" FWD. OF FR.# 10 TO BOW	3/8"
CHINE "A" TO CHINE "B" 6" FWD. OF FR.# 10, AFT	5/16"
SHEER STRAKE TO CHINE "B" AFT OF CHINE "A"	5/16"
BOTTOM PLATE 6" FWD. OF FR.# 10 TO BOW	3/8"
BOTTOM PLATE 6" FWD. OF FR.# 10, AFT	5/16"
GARBOARD STRAKE 36" P&S, 6" FWD. FR.# 10, AFT	3/8"

WELDING SCHEDULE

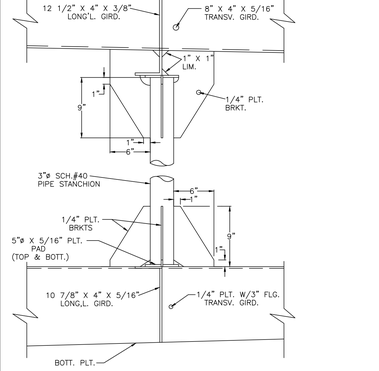
NO.	MEMBER WELDED	TO MEMBER	WELD SIZE	WELD LENGTH	WELD SPACING	NOTES
1)	FLOORS	TO CVK	3/16"	CONT.	BOTH SIDES	
2)	FLOORS	TO SHELL PLT.	3/16"	2 1/2"	@12"	STAGGERED①
3)	FRAMES	TO SHELL PLT.	3/16"	2 1/2"	@12"	STAGGERED①
4)	FRAMES	TO FRM. BRKTS.	3/16"	CONT.	BOTH SIDES	
5)	FRM BRKTS	TO DECK	3/16"	CONT.	BOTH SIDES	
6)	FRM BRKTS	TO SIDE & BOTT PLT.	3/16"	CONT.	BOTH SIDES	
7)	FRM INTERSCTN	AT LONGL. GIRDS	3/16"	CONT.	BOTH SIDES	ON GIRDER
			3/16"	2 1/2"	MATCHED SET②	ON SHELL
8)	WEB FRAMES	TO SHELL	3/16"	2 1/2"	@8"	STAGGERED①
9)	WEB FRAMES	TO WEB BRACKETS	3/16"	CONT.	BOTH SIDES	
10)	WEB FRAMES	TO LONGL. GIRDS.	3/16"	CONT.	ONE SIDE	
			3/16"	2 1/2"	@12"	OTHER SIDE
11)	LONGL GIRDS	TO SHELL	1/4"	3"	@10"	CHAIN MATCH
12)	TRIP. BRKTS	TO LONGL GIRDS & FRS	3/16"	CONT.	BOTH SIDES	
13)	STAN. BRKTS	TO STANS & GIRDS	3/16"	CONT.	BOTH SIDES	
14)	CVK RIDER BAR	TO CVK	7/16"	CONT.	BOTH SIDES	
15)	CVK SHOE	TO CVK	3/8"	CONT.	BOTH SIDES	
16)	DK. O.H. BRKTS	TO DECK & KNUCKLE	3/16"	CONT.	BOTH SIDES	
17)	PERIPH. OF N.T. BHD	TO SHELL	3/16"	2 1/2"	@9"	CHAIN MATCH
18)	STIFFNERS	TO N.T. BHD.	3/16"	2 1/2"	@12"	STAGGERED①
19)	PERIPH. OF W.T. BHD.	TO SHELL	3/16"	CONT.	BOTH SIDES	
20)	STIFFNERS	TO W.T. BHD.	3/16"	2 1/2"	@12"	STAGGERED②
21)	ENGINE BEDS	TO ENGINE GIRDERS	5/16"	CONT.	BOTH SIDES	
22)	ENGINE GIRDERS	TO BOTTOM PLATE	1/4"	CONT.	BOTH SIDES	
23)	GIRD BRKTS	TO ENG. GIRDS & FRMS	3/16"	CONT.	BOTH SIDES	

①MATCHED SET AT ENDS
②MATCHED SET FOR 10% OF STIFFNER LENGTH



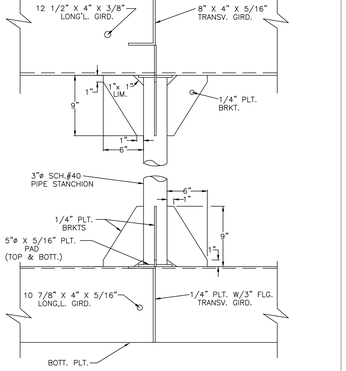
CHINE INSTALLATION DETAIL

① CHINE WILL BE INSTALLED ON VESSEL AND FIT INTO CHINE BRACKET.
② LIMBER HOLES WILL BE TORCHED INTO CHINE BRACKET FOR CHINE TO SHELL WELDS
③ CHINE WILL BE WELDED TO SHELL.
④ CHINE BRKT. WILL BE WELDED TO SHELL AND CHINE BAR. LIMBER HOLES WILL BE FILLED IN AND PASSED OVER.



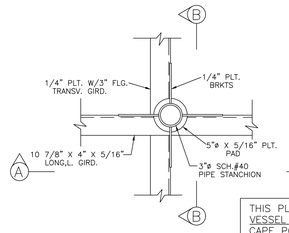
SECTION-B, TRANSVERSE

SCALE 1 1/2"=1'



SECTION-A, LONGITUDINAL

SCALE 1 1/2"=1'



STANCHION PLAN

SCALE 1 1/2"=1'

5	REMOVED BOW THRUSTER SEACHEST, RETURNED BOTTOM STRUCTURE TO ORIGINAL MOVED 18" MANHOLE, AT BH 27 TO PORT OF CENTER FRAME 26	BTJ	11-1 '17
4	MOVED 18" MANHOLES, AT BH 39	BTJ	5/28 '14
3	REVISED MANHOLE DETAILS W/ACTUAL DIMENSIONS DRAWING REPRODUCED IN ITS ENTIRETY USING AUTOCAD REL. 12	EAO	10/21 '93
2	"AS BUILT" CORRECTED W/V FRISCO	WP	10/18 '89
1	INCORPORATED COMMENTS OF NCDOT LETTER OF 1-20-89 AND RED-LINE DRWGS.	RF	2/4 '89

REVISIONS

THIS PLAN APPLICABLE TO:

VESSEL NAME	OFF.NO.
CAPE POINT	949251
CHICAMACOMICO	949252
FRISCO	946908
KINNAKEET	944638
OCRACOKE	964046
ROANOKE	996146
THOMAS A BAUM	1025834

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

FWD. END BOTTOM AND DECK SCANTLING PLAN

SEAL

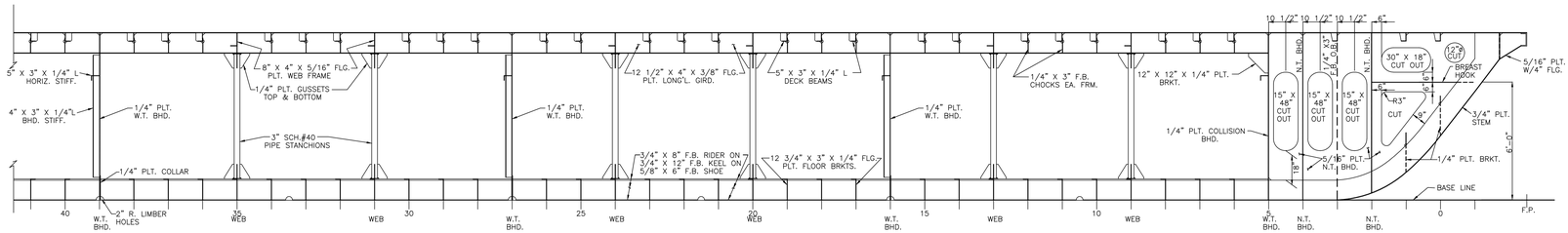
APPROVALS
USCG, MOBILE, MSO 3/23/89
16711 APPROVED

DRWN.

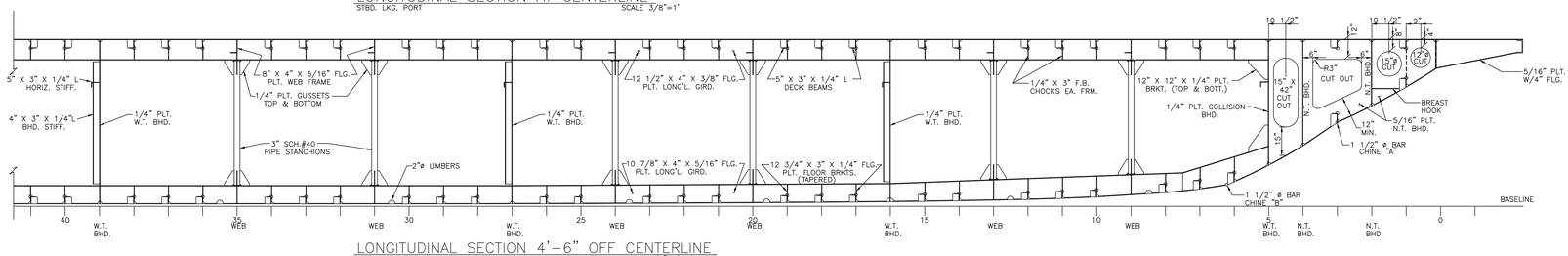
CHKD.

SCALE 3/8"=1' & AS NOTED

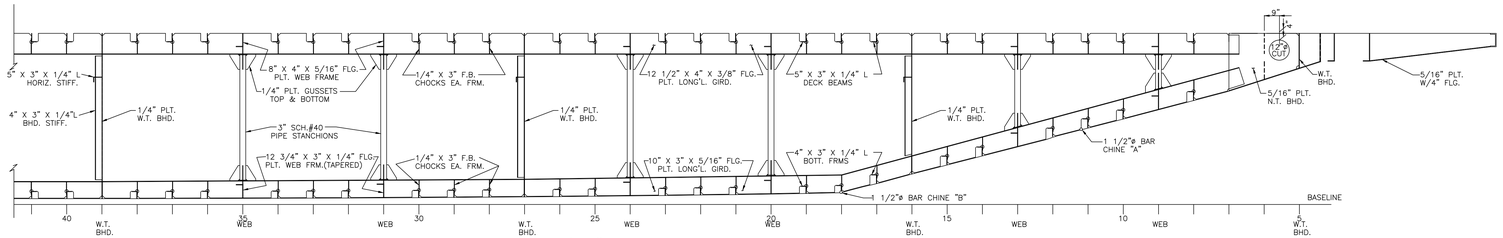
NC-220-1024 REV. 5



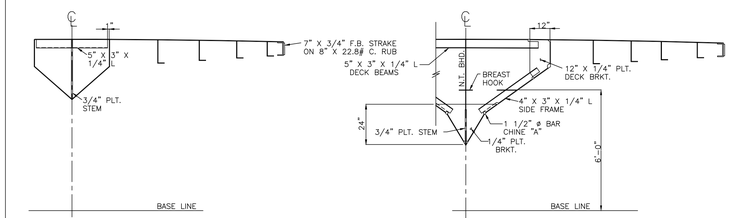
LONGITUDINAL SECTION AT CENTERLINE
STBD. LKG. PORT SCALE 3/8"=1'



LONGITUDINAL SECTION 4'-6" OFF CENTERLINE
PORT SHOWN, LKG. PORT SCALE 3/8"=1'

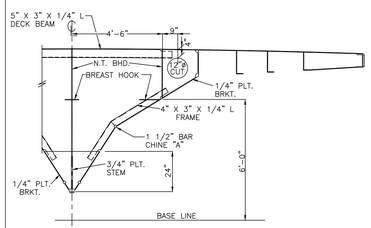


LONGITUDINAL SECTION 11'-6" OFF CENTERLINE
PORT SHOWN, LKG. PORT SCALE 3/8"=1'

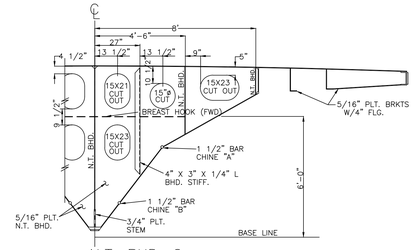


FRAME A

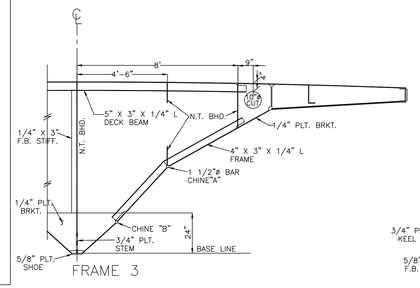
FRAME 0



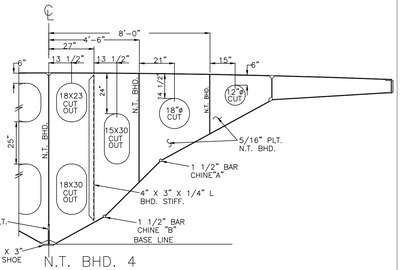
FRAME 1



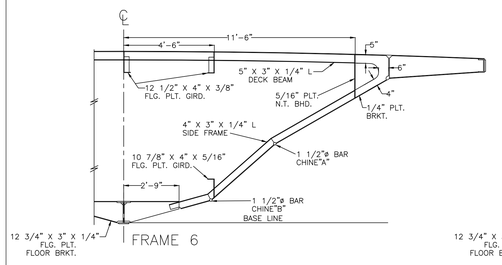
N.T. BHD. 2



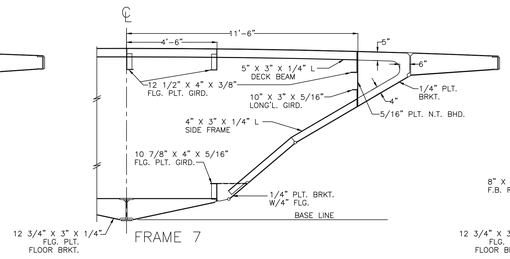
FRAME 3



N.T. BHD. 4



FRAME 6



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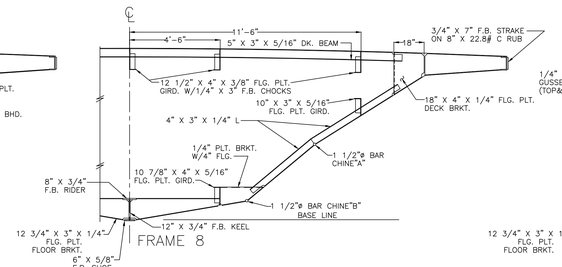
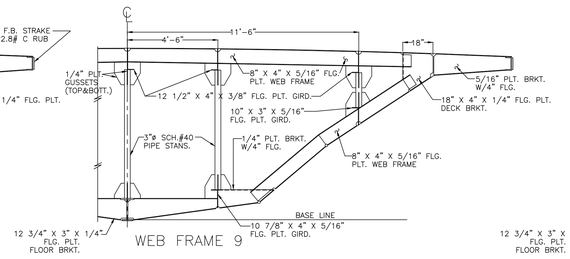
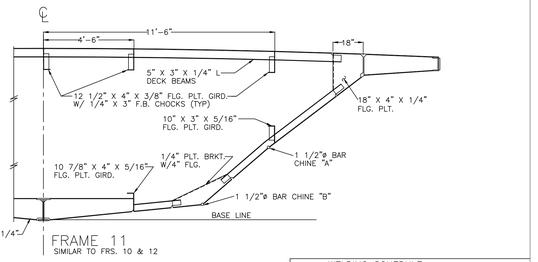


FRAME 8

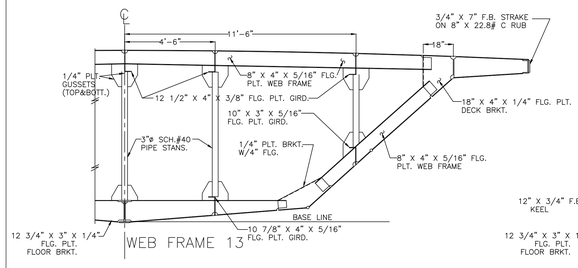


WEB FRAME 9

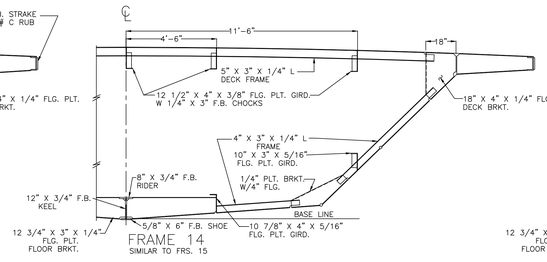


FRAME 11
SIMILAR TO FRS. 10 & 12

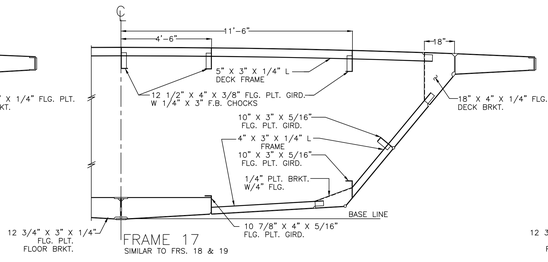
NOTES:
1.) ORENTATION OF ALL FRAMES IS AFT LOOKING FORWARD.
2.) STBD. SIDE OF ALL FRAMES SHOWN. PORT SIDE SIMILAR.



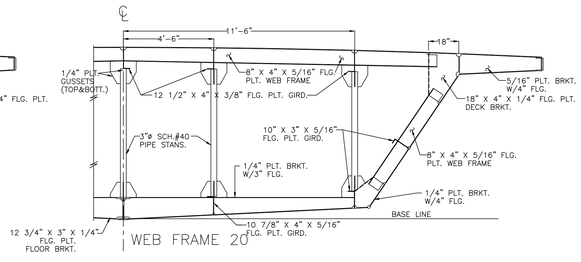
WEB FRAME 13



FRAME 14
SIMILAR TO FRS. 15



FRAME 17
SIMILAR TO FRS. 18 & 19



WEB FRAME 20

WELDING SCHEDULE

NO.	MEMBER WELDED	TO MEMBER	WELD SIZE	WELD LENGTH	WELD TYPE	NOTES
1)	FLOORS	TO CVK	3/16"	CONT.	BOTH SIDES	
2)	FLOORS	TO SHELL PLT.	3/16"	2 1/2"	@12"	STAGGERED@
3)	FLOORS	TO SHELL BRKTS.	3/16"	2 1/2"	@12"	STAGGERED@
4)	FRAMES	TO FRM. BRKTS.	3/16"	CONT.	BOTH SIDES	
5)	FRM BRKTS	TO DECK	3/16"	CONT.	BOTH SIDES	
6)	FRM BRKTS	TO SHELL & BOTT PLT.	3/16"	CONT.	BOTH SIDES	
7)	FRM INTERCSTN	AT LONGL GIRDS	3/16"	CONT.	BOTH SIDES	ON GIRDER
8)	WEB FRAMES	TO SHELL	3/16"	2 1/2"	MATCHED SET@N SHELL	
9)	WEB FRAMES	TO WEB BRACKETS	3/16"	2 1/2"	@8"	STAGGERED@
10)	WEB FRAMES	TO LONGL GIRDS.	3/16"	CONT.	BOTH SIDES	
			3/16"	2 1/2"	@12"	
11)	LONGL GIRDS	TO SHELL	3/16"	2 1/2"	@12"	OTHER SIDE CHAIN MATC@
12)	LONGL GIRDS	TO STANG & GIRDS	3/16"	CONT.	BOTH SIDES	
13)	STAN. BRKTS	TO STANG & GIRDS	3/16"	CONT.	BOTH SIDES	
14)	CVK RIDER BAR	TO CVK	3/16"	CONT.	BOTH SIDES	
15)	CVK FLG. PLT.	TO CVK	3/16"	CONT.	BOTH SIDES	
16)	DK. EJK. BRKTS	TO DECK & KNUCKLE	3/16"	CONT.	BOTH SIDES	
17)	PERIPH. OF N.T. BHD	TO SHELL	3/16"	2 1/2"	@8"	CHAIN MATCH
18)	STIFFNERS	TO N.T. BHD.	3/16"	2 1/2"	@12"	STAGGERED@
19)	PERIPH. OF W.T. BHD	TO SHELL	3/16"	CONT.	BOTH SIDES	
20)	STIFFNERS	TO W.T. BHD.	3/16"	2 1/2"	@12"	STAGGERED@
21)	ENGINE BEDS	TO ENGINE GIRDERS	1/4"	CONT.	BOTH SIDES	
22)	ENGINE GIRDERS	TO BOTTOM PLATE	1/4"	CONT.	BOTH SIDES	
23)	GIRD BRKTS	TO ENG. GIRDS & FRMS	5/16"	CONT.	BOTH SIDES	

@MATCHED SET AT ENDS OF OVERLAP OR START OF STIFFNER LENGTH.

No.	DESCRIPTION	By	Date	App'd.
3	DRAWING REPRODUCED IN ITS ENTIRETY USING AUTOCAD REL. 12 "AS BUILT" CORRECTED W/V FLOYD & LIPTON	AO	10/27 '93	
2	"AS BUILT" CORRECTED W/V FRISCO	WP	10/18 '89	
1	INCORPORATED COMMENTS OF N.C.D.O.T. LETTER OF 1-20-89 AND RED-LINED DRAWINGS.	RF	3/4 '89	

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

FWD. END LONGITUDINAL AND TRANSVERSE SECTIONS

SEAL

APPROVALS

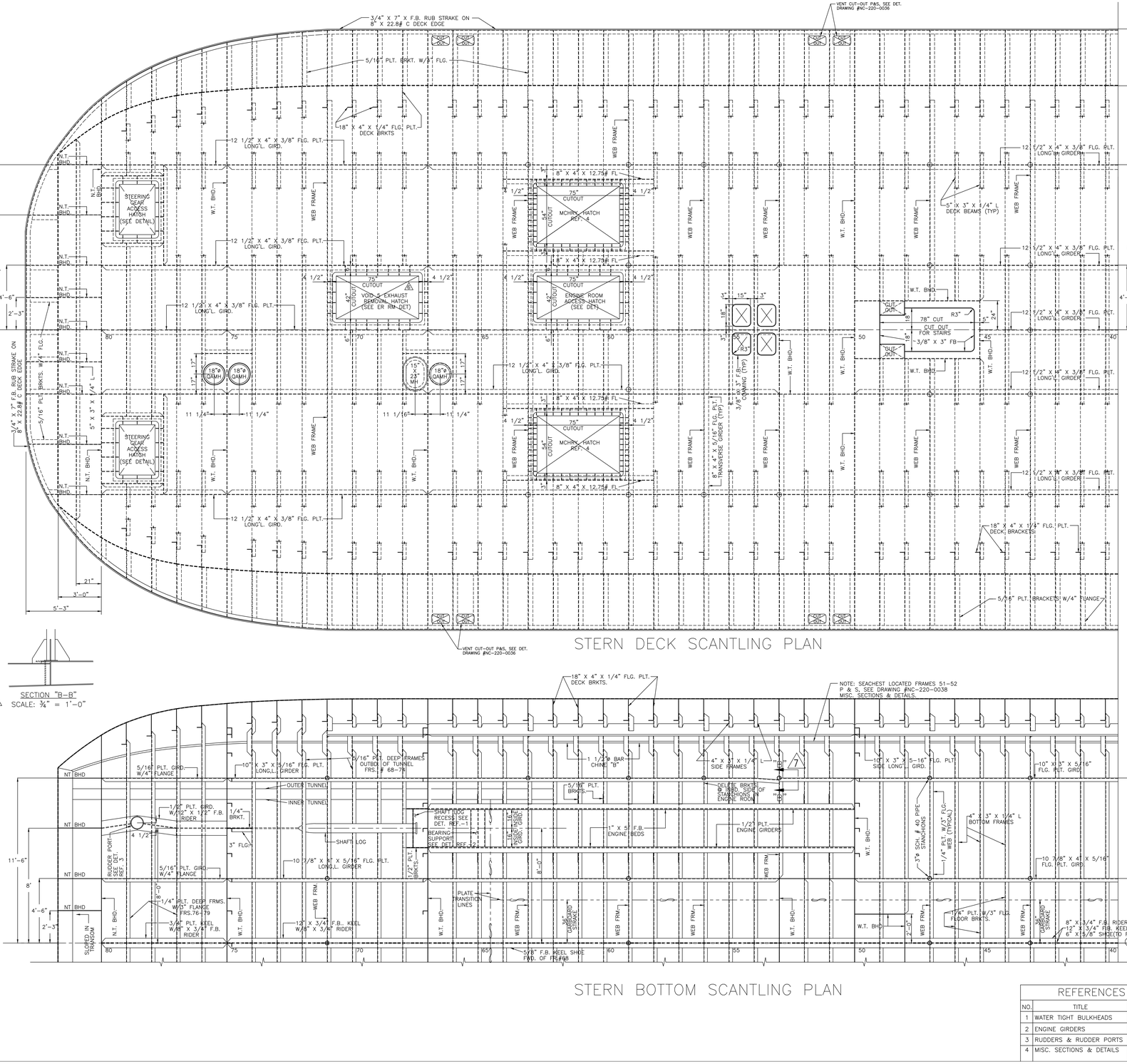
DRWN.

CHKD.

SCALE 3/8" =1'

NC-220-1025

REV. 3



STERN DECK SCANTLING PLAN

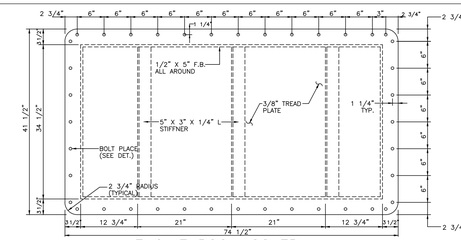
STERN BOTTOM SCANTLING PLAN

REFERENCES		
NO.	TITLE	DRWG. NO.
1	WATER TIGHT BULKHEADS	NC-220-1010
2	ENGINE GIRDERS	NC-220-1029
3	RUDDERS & RUDDER PORTS	NC-220-1012
4	MISC. SECTIONS & DETAILS	NC-220-0038

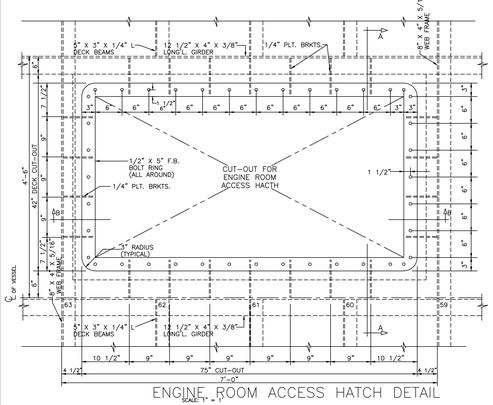
PLATE SCHEDULE	
AREA	PLATE
MAIN DECK PLATING	3/8" PATTERN PLT.
SHEER STRAKE	1/2"
SHEER STRAKE TO CHINE "B"	5/16"
BOTTOM PLATE FRAME 64.5 FWD.	5/16"
GARBOARD STRAKE 36" P&S, FRAME 64.5 FWD.	3/8"
BOTTOM PLATE CHINE "B" TO OUTER TUNNEL	5/16"
TUNNEL SIDE OUTER TUNNEL TO INNER TUNNEL	5/16"
TUNNEL SIDE: FRAME 64.5 AFT OUTER TUNNEL TO INNER TUNNEL	5/8"
TUNNEL PLATE INNER TUNNEL TO KEEL, FR. 64.5 AFT	5/8"

WELDING SCHEDULE				
NO.	MEMBER WELDED	TO MEMBER	WELD SIZE	WELD LENGTH/SPACING
1)	FLOORS	TO CVK.	3/16"	CONT. BOTH SIDES
2)	FRAMES	TO SHELL PLT.	3/16"	CONT. @12"
3)	FRAMES	TO SHELL PLT.	3/16"	2 1/2" @12"
4)	FRAMES	TO FRM. BRKTS.	3/16"	CONT. BOTH SIDES
5)	FRM BRKTS	TO DECK	3/16"	CONT. BOTH SIDES
6)	FRM BRKTS	TO SIDE & BOTT PLT.	3/16"	CONT. BOTH SIDES
7)	FRM INTERCTN	AT LONGL. GIRDS	3/16"	CONT. BOTH SIDES ON GIRDER
			1/4"	2 1/2" MATCHED SETTON SHELL
8)	WEB FRAMES	TO SHELL	3/16"	2 1/2" @6"
9)	WEB FRAMES	TO WEB BRACKETS	3/16"	CONT. BOTH SIDES
10)	WEB FRAMES	TO LONGL. GIRDS.	3/16"	CONT. @12" OUT SIDE
			1/4"	2 1/2" @12" OTHER SIDE
11)	LONGL. GIRD	TO SHELL	3/16"	CONT. BOTH SIDES CHAIN MATE②
12)	TRSN. BRKTS	TO LONGL GIRDS & FRS	3/16"	CONT. BOTH SIDES
13)	TRSN. BRKTS	TO LONGL GIRDS & GIRD	3/16"	CONT. BOTH SIDES
14)	CVK RISER BAR	TO CVK	3/16"	CONT. BOTH SIDES
15)	CVK SHOE	TO CVK	3/8"	CONT. BOTH SIDES
16)	DK., CVK. BRKTS	TO DECK & KNUCKLE	3/16"	CONT. BOTH SIDES
17)	PERIPH. OF N.T. BHD	TO SHELL	3/16" 2 1/2" @6"	CHAIN MATCH①
18)	PERIPH. OF W.T. BHD.	TO SHELL	3/16" 2 1/2" @12"	STAGGERED②
19)	PERIPH. OF W.T. BHD.	TO W.T. BHD.	3/16" 2 1/2" @12"	STAGGERED②
20)	STIFFNERS	TO W.T. BHD.	3/16" 2 1/2" @12"	STAGGERED②
21)	ENGINE SEDS	TO ENGINE GIRDERS	3/16"	CONT. BOTH SIDES
22)	ENGINE GIRDERS	TO BOTTOM PLATE	1/4"	CONT. BOTH SIDES
23)	GIRD. GIRDS & FRMS	TO SHELL	3/16"	CONT. BOTH SIDES

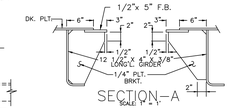
①MATCHED SET AT EACH
②MATCHED SET FOR 10ft OF STIFFNER LENGTH



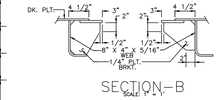
ENGINE ROOM COVER



ENGINE ROOM ACCESS HATCH DETAIL



SECTION-A



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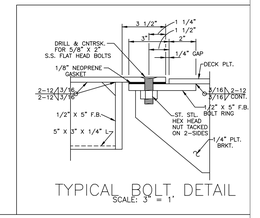
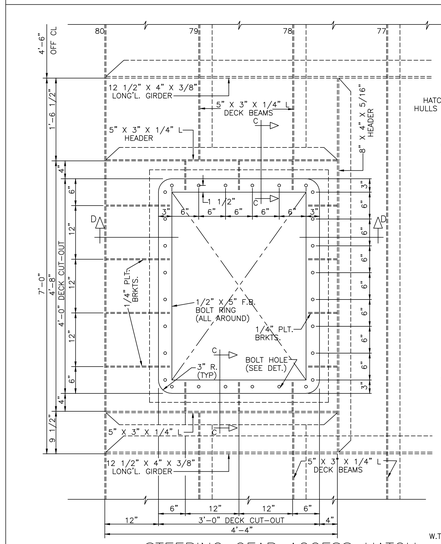
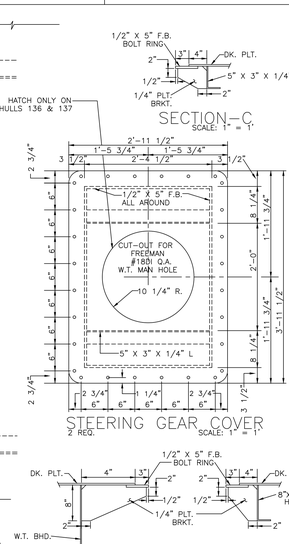


TYPICAL BOLT DETAIL



STEERING GEAR ACCESS HATCH
STBD. SHOWN



STEERING GEAR COVER
2 REQ.

SECTION-D

REVISIONS		
NO.	DESCRIPTION	BY DATE
7	ASBUILT CONDITION FOUND, SECTION "B-B", PORT SIDE ONLY. ADJUSTED TO SUIT SEACHEST STRAINER, NOT SHOWN.	BTJ 5-23-18
6	MADE STEERING HATCH TO APPLICABLE ALL HULLS ADDED EN RM ACCESS HATCH TO VOID 5 FOR EXHAUST EQUIPMENT - AS NEEDED	BTJ 1-17-14
5	DRAWING REPRODUCED IN ITS ENTIRETY USING ACAD REL 12 AS BUILT CORRECTED mv FLOYD J. LUPTON	AO 11-08-93
4	ADDED MOORY HATCHES	KEG 02-12-91
3	AS BUILT CORRECTED mv FRISCO	MP 10-18-89
2	REVISED STRUCTURE IN WAY OF ENGINE GIRDERS	RF 02-22-89
1	INCORPORATED COMMENTS OF NCDOT LETTER OF 1-20-89 AND RED-LINED DRWGS.	RF 02-04-89

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
FERRY DIVISION — MARINE ENGINEERING

AFT END BOTTOM AND DECK SCANTLING PLAN

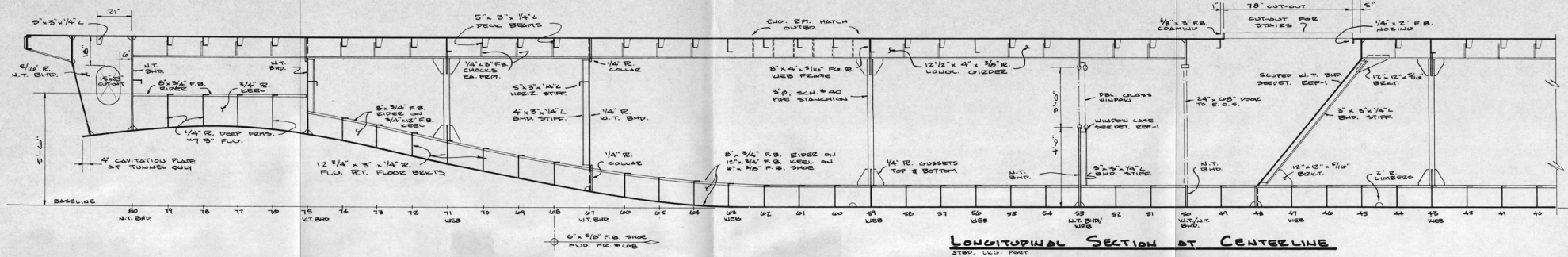
THIS PLAN APPLICABLE TO:	
VESSEL NAME	OFF NO.
KINNAKEET	944638
FRISCO	946908
CAPE POINT	949251
CHICAMACOMICO	949252
OCRACOKE	964046
RONAOKE	996146
THOMAS A BAUM	1025834

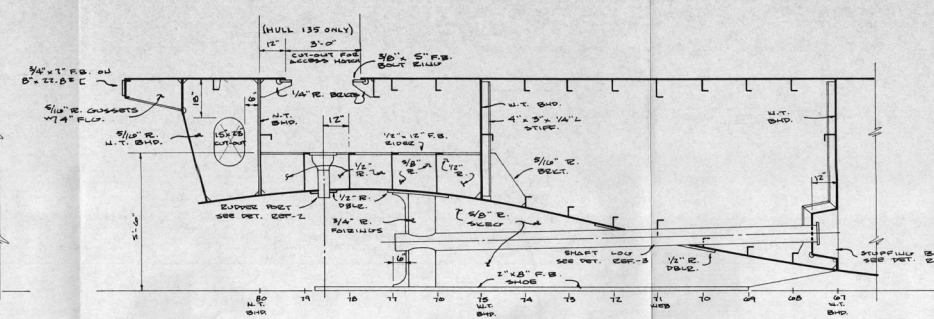
SEAL

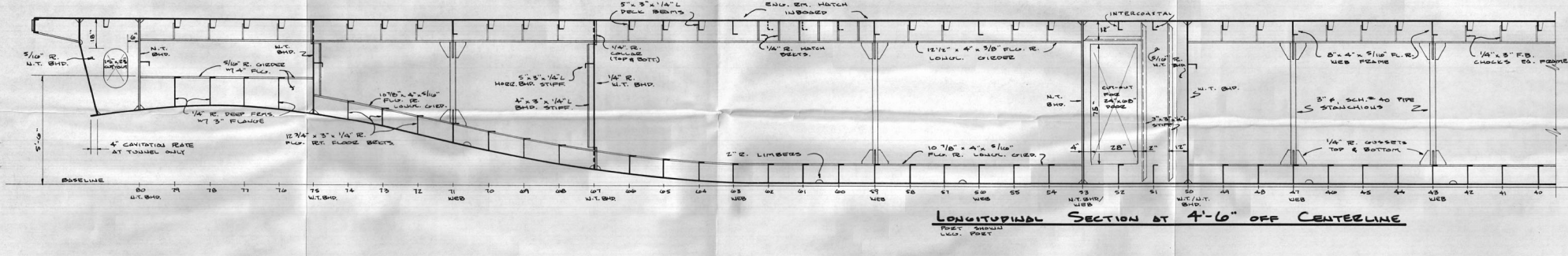
APPROVALS
USCG, MOBILE, MSO 3/23/89
16711 APPROVED

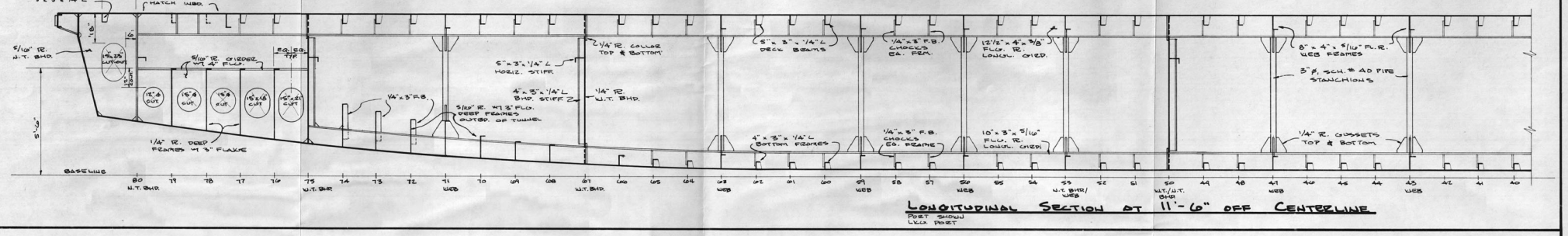
DRWN.
CHKD.
SCALE AS NOTED 1/8"=1' &

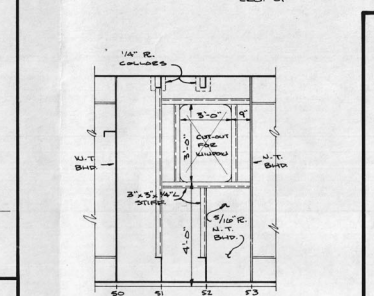
NC-220-1026 REV. 7

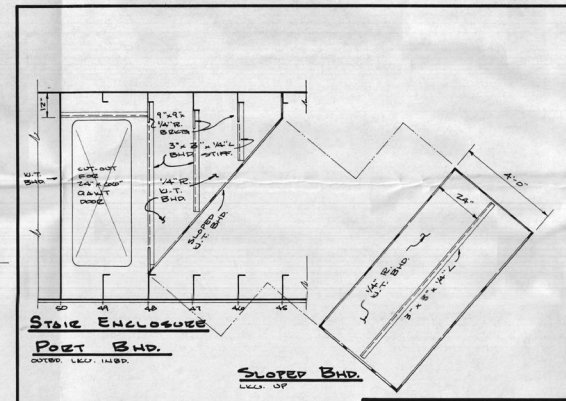


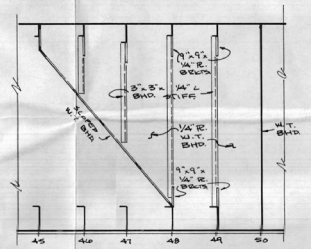


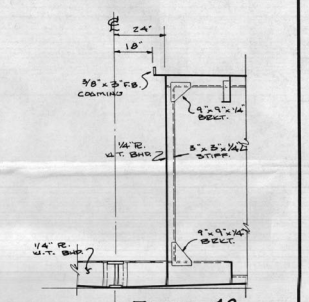


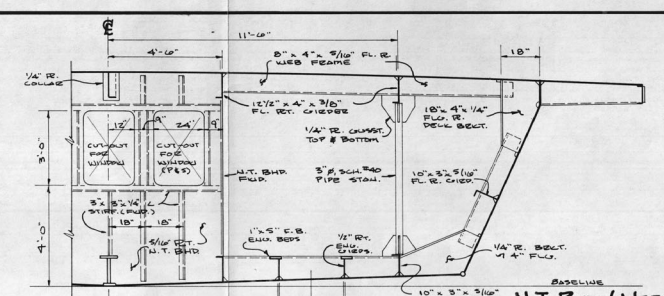


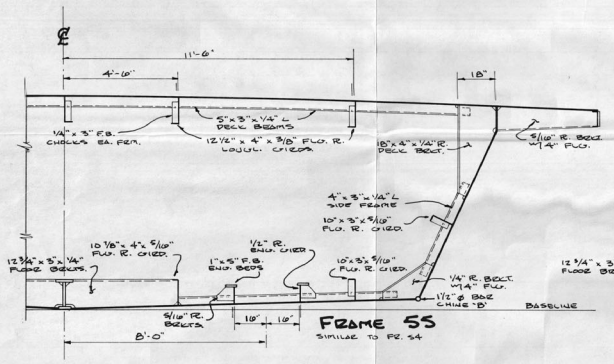


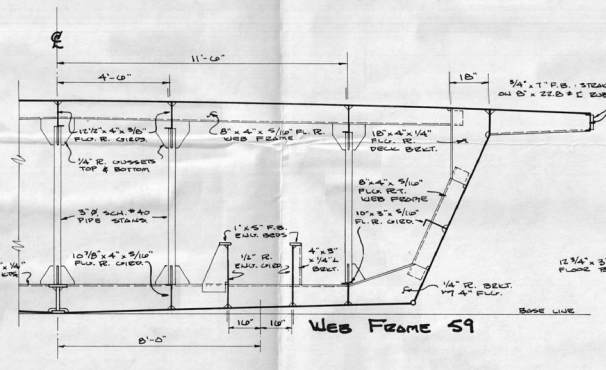


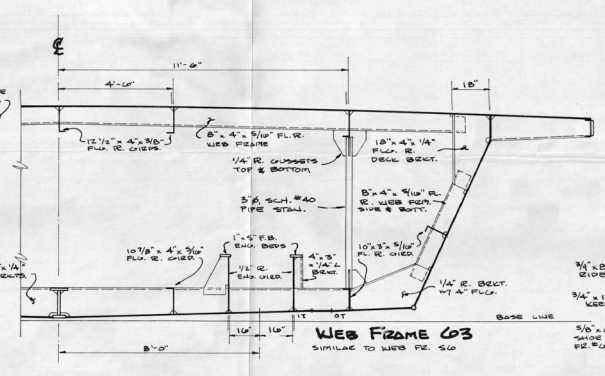


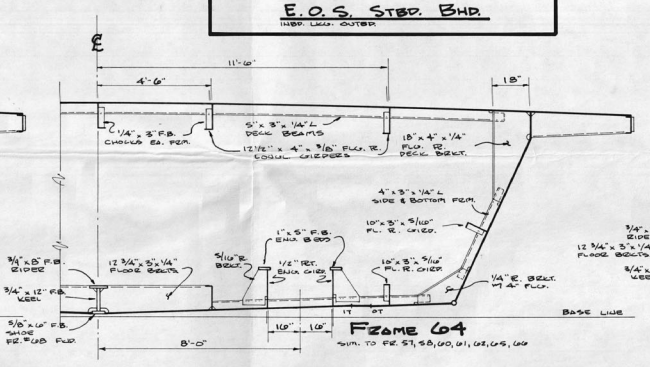


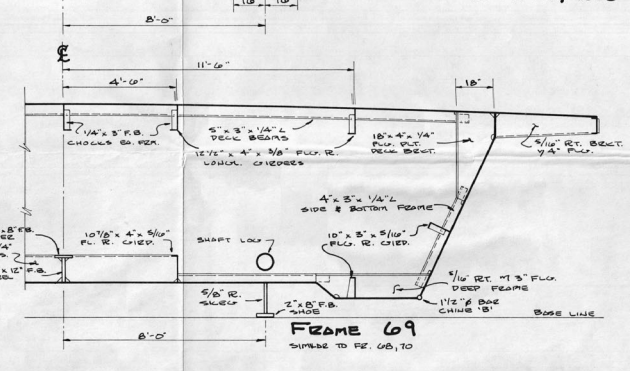


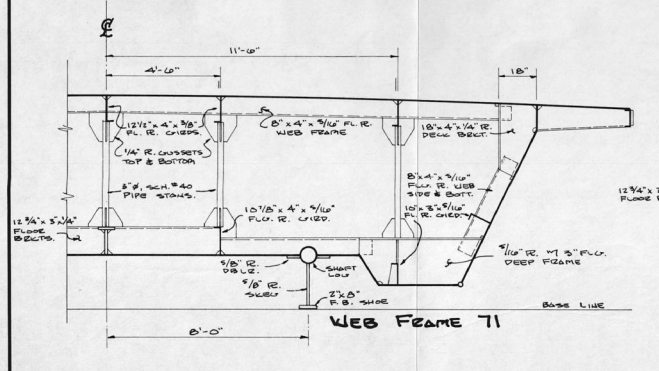


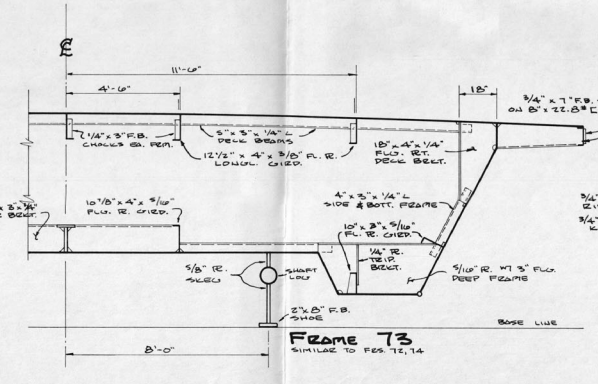


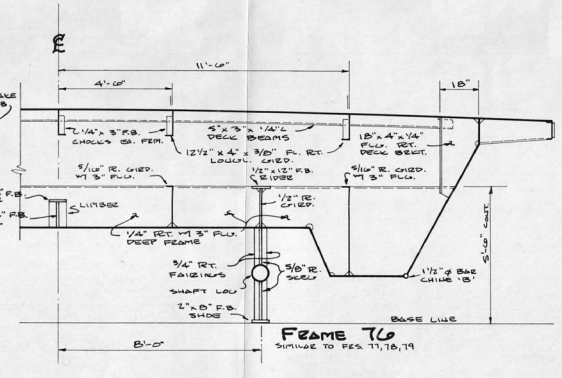


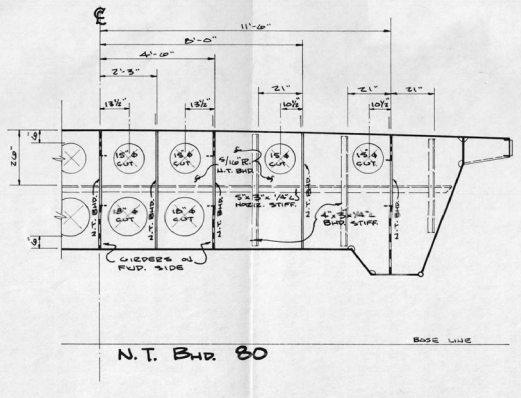












Notes:

1) The orientation of all frames is aft looking forward.

2) Stbd. side shown of all frames. Port side similar.

No.	Description	By	Date
3	"As Built" corrected P/C Frisco	WP	10-18-89
2	Revise structure in way of Engr. Chocks	R.F.	5-22-89
1	Incorporated comments of NCDOT letter of 1-20-89 and Rev. Lines Drawings	R.F.	5-4-89

Revisions

No.	Title	Drwg. No.
4	Water Tight Bulkhds	NC-220-1010
3	Shaftline, Bearings and Stern Tubes	NC-220-1011
2	Rudders & Rudder Posts	NC-220-1012
1	Fwd. End Bottom and Deck Sheathing Plans	NC-220-1024

References

PATTI SHIPYARD, INC. "PATTI BUILT"

Drawn by: [illegible] Date: 1-11-89

Yard Number: S-4

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
FERRY DIVISION — MARINE ENGINEERING

Aft End Longitudinal and Transverse Sections

Seal

Approved: USCG Mobile, MSO 3/23/89 16711 Approved

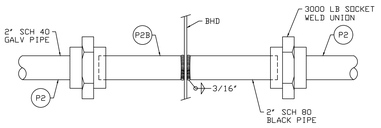
Drwn. R. Fritz

Chkd:

Scale: 3/8"=1'-0"

NC-220-1027

Rev. 3

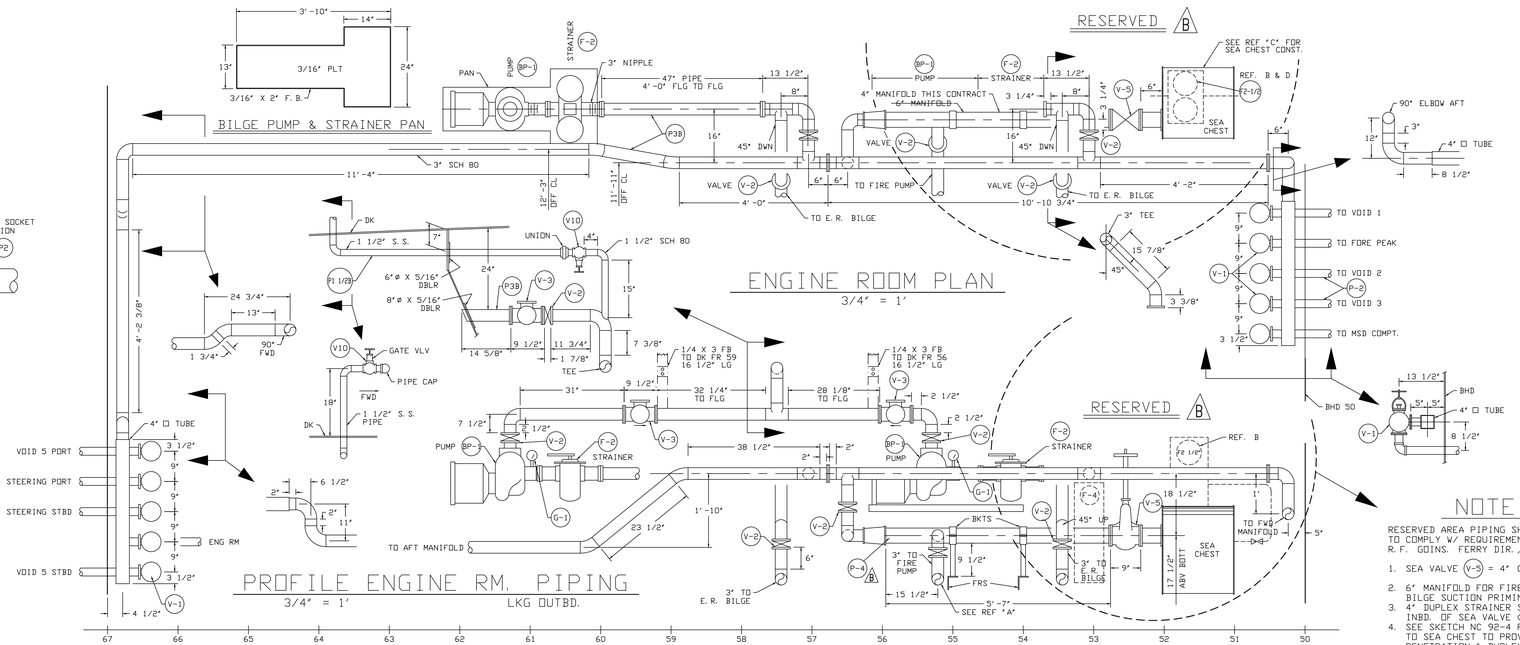


BHD PENETRATION

SEE BHD DWGS FOR DETAILS

N. T. S.

BILGE PUMP & STRAINER PAN



BILL OF MATERIAL

PIECE No.	QTY.	DESCRIPTION	MATERIAL	ASTM	REMARKS
P1 1/2	A/R	PIPE 1 1/2" SCH 40 GALV	STEEL	A-53	
P1 1/2 B	A/R	PIPE 1 1/2" SCH 80 BLACK			
P2	A/R	PIPE 2" SCH 40 GALV			
P2-B	A/R	PIPE 2" SCH 80 BLACK			
P3	A/R	PIPE 3" SCH 40 GALV			
P3-B	A/R	PIPE 3" SCH 80 BLACK			
P6	A/R	PIPE 6" SCH 80 BLACK			
P1 1/2 S	A/R	PIPE 1 1/2" SCH 40	S/S	A-376	
P-1	20'	PIPE 1" SCH 80 CPVC	PLASTIC	F 441	
P-1 S	2'	PIPE 1" SCH 80 ST STL	S/S	316	
G-1	2	VACUUM GUAGE 0 - 30"	BRZ		ERNST GAUGE
F-1	3	FLUSH DECK BOX & REACH ROD	BRZ BODY S/S SLEEVE		KINGS POINT 18389-612
F-2	2	3" STRAINER, DUPLEX	BRZ	B-62	HAYWARD 50
F-3	2	1/2" PRESSURE GAUGE 0 - 200	BRZ	B-62	
S P 1	2	STUFFING BOX SUMP PUMP 24V DC	PLASTIC		RULE 2000/SW
B P 1	2	BILGE PUMP 3" X 3" 7.5 HP 208V	BRZ		MP FLOMAX 15
V1	10	2" ANGLE STOP CHECK VALVE 150 LB, FLANGED	STL BODY BRZ SEAT	A-126	WALWORTH 5313F
V2	7	3" BUTTERFLY VALVE LUG TYPE	S/S	316	MUELLER 53-HHH-3-1
V3	5	3" SWING CHECK VALVE 150 LB, FLANGED	BRZ	B-62	PIMA B1620A
V4	2	2" GATE VALVE 150 LB, THRD	BRZ	B-62	KITZ AK150L
V5	1	6" GATE VALVE 150 LB, FLG	CAST STL	A-216	FAIRBANKS #4
V6	15	2" FOOT VALVE STRAINER	BRZ	B-62	MP 21522
V7	2	1/2" GLOBE VALVE 150 LB THRD	BRZ	B-62	
V8	2	1" GATE VALVE 150 LB THRD	BRZ	B-62	
V9	2	1" SWING CHECK VALVE THRD	BRZ	B-62	
V10	2	1 1/2" GATE VALVE THRD	BRZ	B-62	
V4A	1	2" GATE VALVE, 150 LB, THRD	F. STL	A-105	VOGT

B PARTIAL BILL OF MATERIALS EQUIP. CHANGE THIS CONTRACT

P-4	A/R	PIPE 4" SCH 80 BLACK	STL	A-53	
V-5	1	4" GATE VALVE, 150 LB, FLG	D. IRON	A-395	PIMA FIG. D-102A
V-2 1/2	1	2 1/2" GATE VALVE, 150 LB, FLG	BRZ	B-61	PIMA FIG. B-102A
F-2 1/2	1	2 1/2" DUPLEX STRAINER	BRZ	B-62	HAYWARD 50
F-4	1	4" DUPLEX STRAINER	BRZ	B-62	HAYWARD 50

NOTE A

RESERVED AREA PIPING SHALL BE MODIFIED TO COMPLY W/ REQUIREMENTS OF MEMO BY R. F. GOINS, FERRY DIR., dtd 8/11/92.

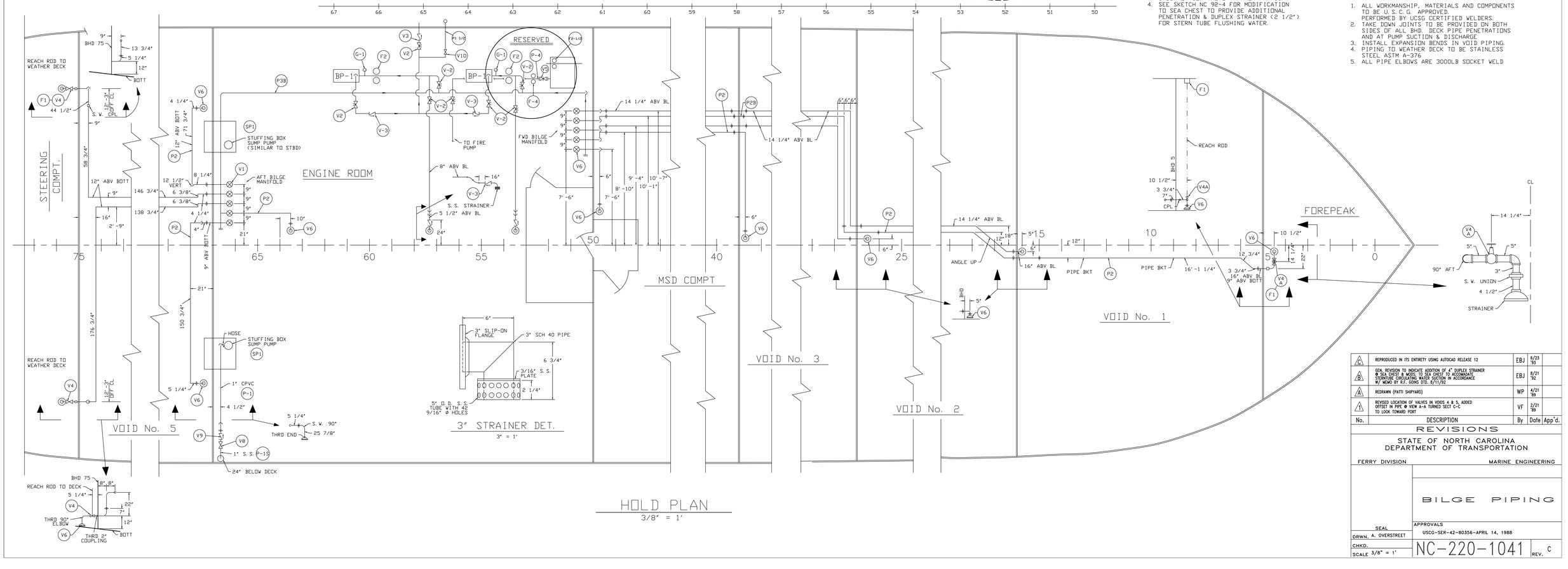
1. SEA VALVE (V-5) = 4" GATE
2. 6" MANIFOLD FOR FIRE PUMP SUCTION & BILGE SUCTION PRIMING SHALL BE 4" SCH 80
3. 4" DUPLEX STRAINER SHALL BE INSTALLED INBD. OF SEA VALVE (APPROX FR. 53)
4. SEE SKETCH NC 92-4 FOR MODIFICATION TO SEA CHEST TO PROVIDE ADDITIONAL PENETRATION & DUPLEX STRAINER (2 1/2") FOR STERN TUBE FLUSHING WATER.

REFERENCES

A D. SKETCH NC 92-4 2 SHEETS SEACHEST MODS. -STERNTUBE CIRCULATING WATER
C. MISC SECTIONS & DETAILS NC 220-0038
B. STERNTUBE CIRCULATING DIA. NC 220-0038
A. FIRE MAIN PIPING NC 220-1047

GENERAL NOTES

1. ALL WORKMANSHIP, MATERIALS AND COMPONENTS TO BE U.S.C.G. APPROVED. PERFORMED BY USCG CERTIFIED WELDERS.
2. TAKE DOWN JOINTS TO BE PROVIDED ON BOTH SIDES OF ALL BHD. DECK PIPE PENETRATIONS AND AT PUMP SUCTION & DISCHARGE
3. INSTALL EXPANSION BENDS IN VOID PIPING.
4. PIPING TO WEATHER DECK TO BE STAINLESS STEEL ASTM A-376
5. ALL PIPE ELBOWS ARE 3000LB SOCKET WELD



No.	DESCRIPTION	By	Date	App'd.
6	REPRODUCED IN ITS ENTIRETY USING AUTOCAD RELEASE 12	EBJ	6/23 '93	
5	GEN. REVISION TO INDICATE ADDITION OF 4" DUPLEX STRAINER @ SEA CHEST & MODS. TO SEA CHEST TO ACCOMADATE STERNTUBE CIRCULATING WATER SUCTION IN ACCORDANCE W/ MEMO BY R.F. GOINS DTD. 8/11/92	EBJ	8/21 '92	
4	REDRAWN (PATTI SHIPYARD)	WP	4/23 '89	
3	REVISED LOCATION OF VALVES IN VOIDS 4 & 5, ADDED OFFSET IN PIPE @ VIEW A-A TURNED SECT C-C TO LOOK TOWARD PORT	VF	2/21 '89	

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

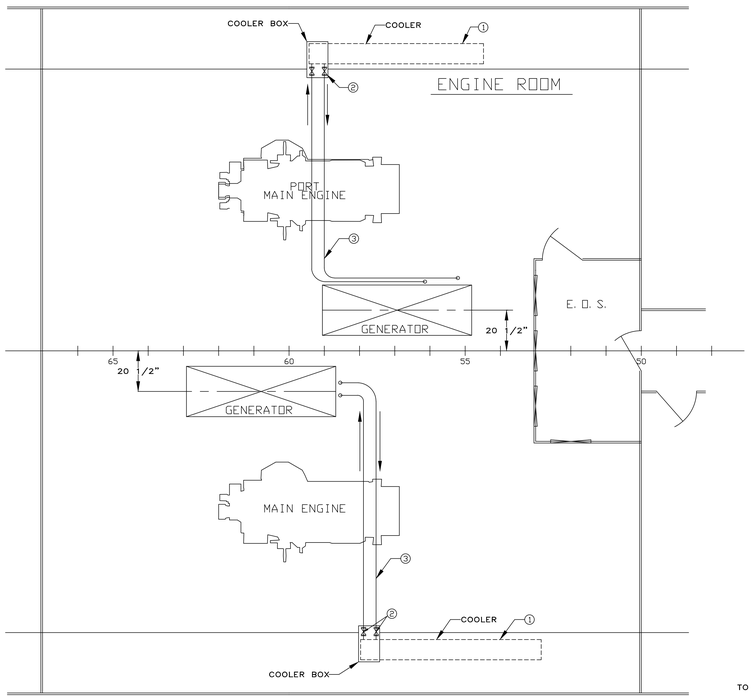
BILGE PIPING

SEAL

APPROVALS
USCG-SER-42-80356-APRIL 14, 1988

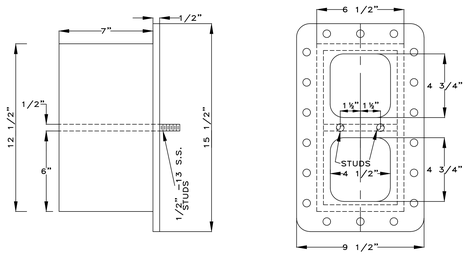
DRWN. A. OVERSTREET
CHKD.
SCALE 3/8" = 1'

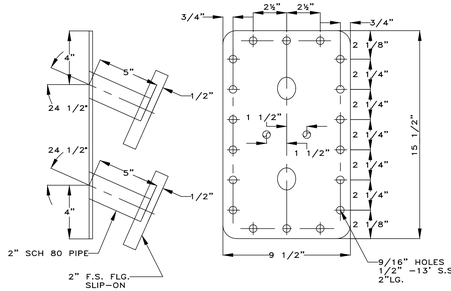
NC-220-1041 REV. C



PIPING DIAGRAM

3/8" = 1'





GENERATOR COFFERDAM

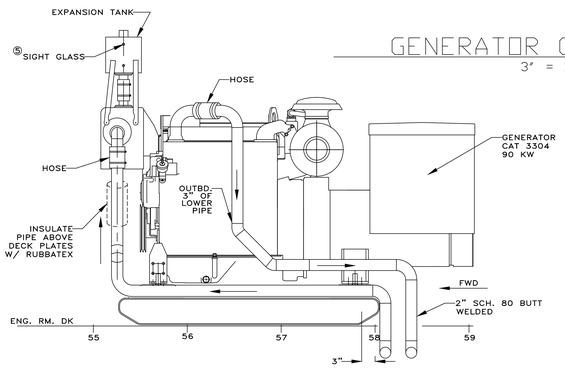
3" = 1'

BILL OF MATERIAL

No.	QTY.	DESCRIPTION	MATERIAL	ASTM	REMARKS
1	2	KEEL COOLER FERNSTRUM D 890U FOR GENERATOR	CU-NI		REMOVE ANODE
2	4	2" BUTTERFLY VALVE	S. S.		MUELLER 53-HHH-3-1
3	A/R	2" SCH 80 PIPE, BLACK	STL.	A-53	
4	8	2" 150 LB. F. S. FLANGE SLIP-ON	F. S.	A 105	
5	2	SIGHT GLASS, EARNST GAGE E-28, 4-3/4" CENTERS, 1/2" NPT	BRZ		POLYCARBONATE TUBE

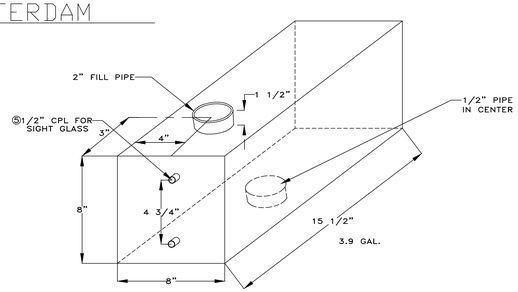
GENERAL NOTES

1. PIPE DIMENSIONS ARE ACTUAL LENGTHS
2. TOTAL LIQUID IN ENGINE, PIPING AND COOLER IS 18 GALLONS.



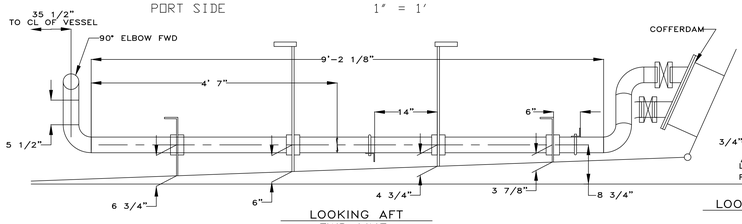
PORT GENERATOR

PORT SIDE 1" = 1'

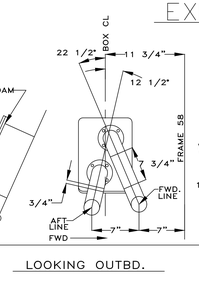


EXPANSION TANK

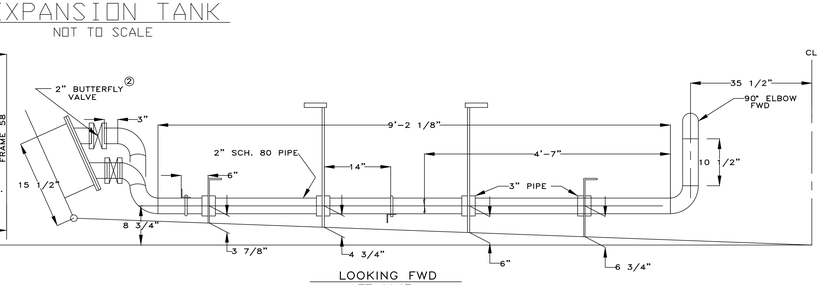
NOT TO SCALE



LOOKING AFT
FWD LINE



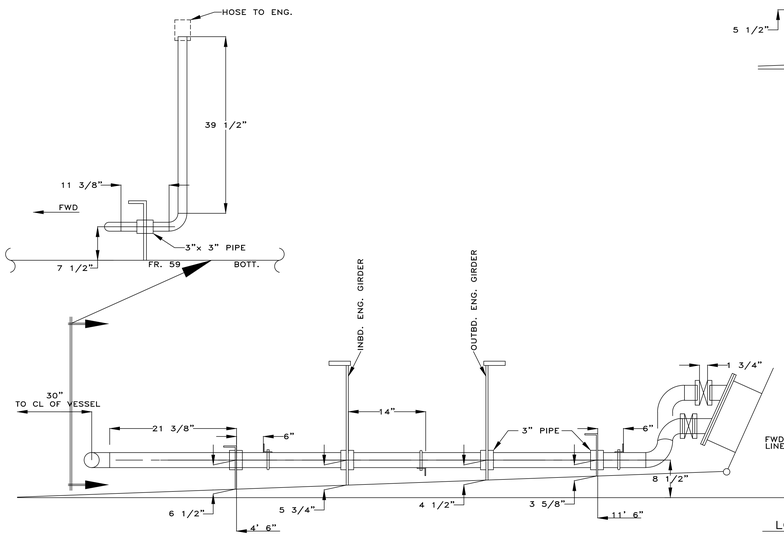
LOOKING OUTBD.



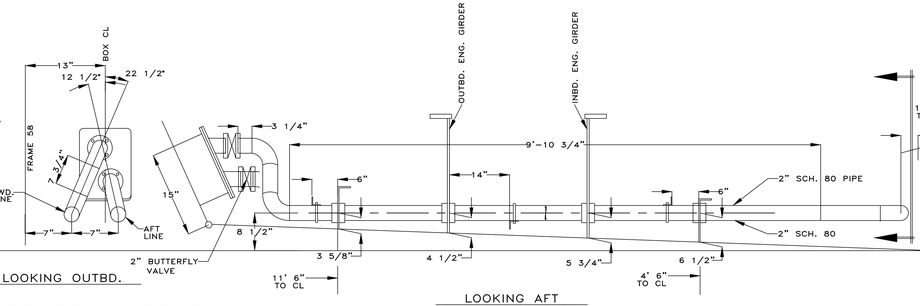
LOOKING FWD
AFT LINE

PORT GENERATOR COOLING

1" = 1'



LOOKING FWD
AFT LINE (RETURN)

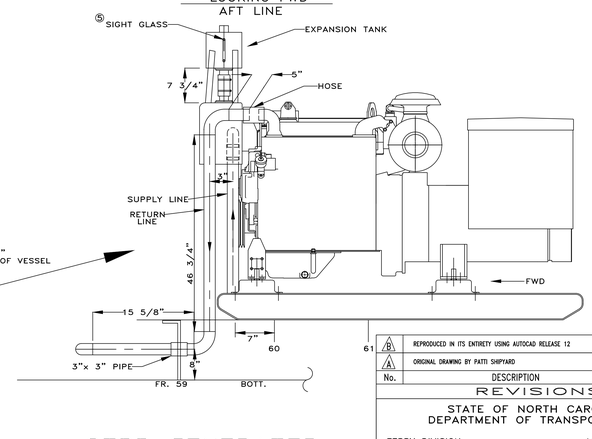


LOOKING OUTBD.

LOOKING AFT
FWD LINE (RETURN)

STBD GENERATOR COOLING

1" = 1'



STBD GENERATOR

PORT SIDE 1" = 1'

No.	DESCRIPTION	By	Date	App'd.
B	REPRODUCED IN ITS ENTIRETY USING AUTOCAD RELEASE 12	EAO	10/28 '93	
A	ORIGINAL DRAWING BY PATTI SHIPYARD	WGP		

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

GENERATOR COOLING PIPING

SEAL

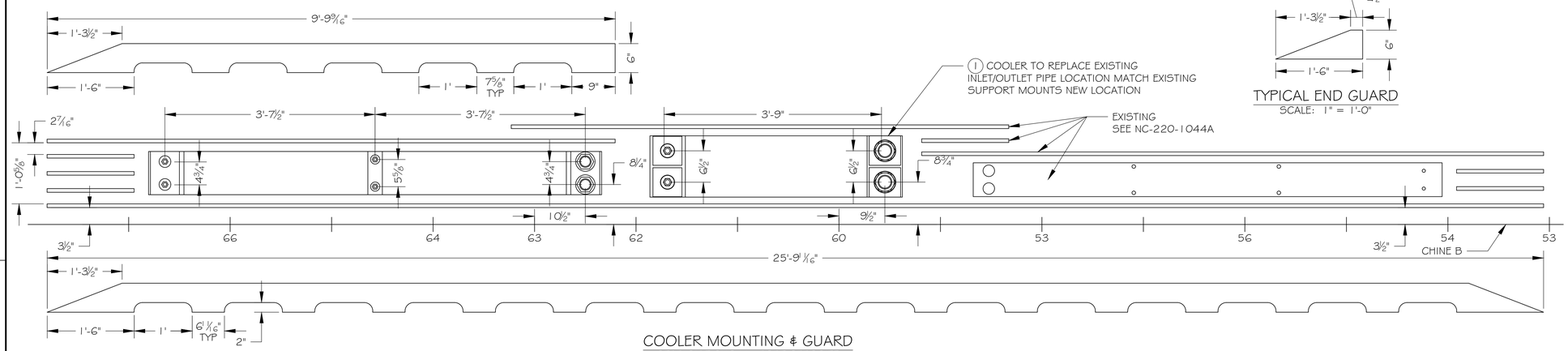
APPROVALS

DRWN. D. OVERSTREET

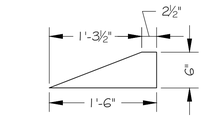
CHKD.

SCALE AS SHOWN

NC-220-1044B REV. B



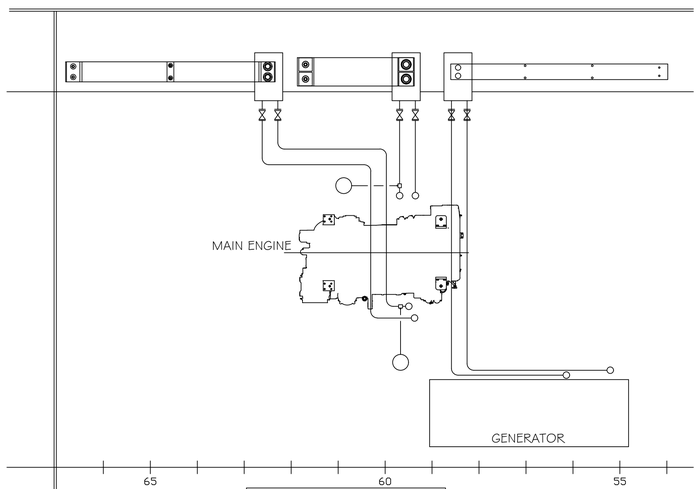
COOLER MOUNTING & GUARD
STBD SIDE SHOWN, PORT OPPOSITE
SCALE: 1" = 1'-0"

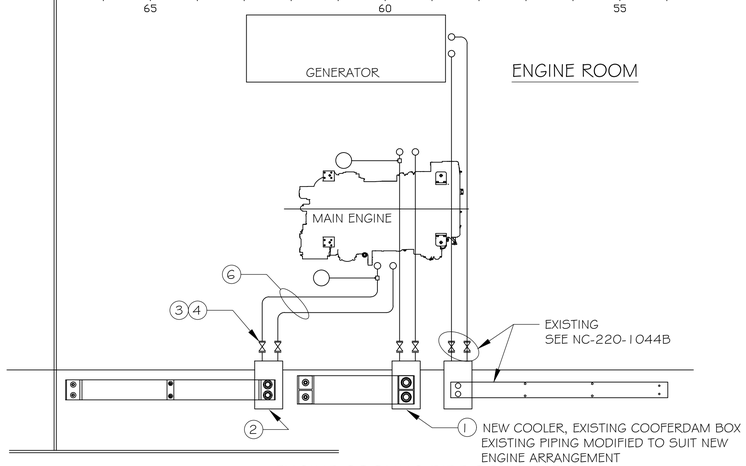


TYPICAL END GUARD
SCALE: 1" = 1'-0"

BILL OF MATERIAL

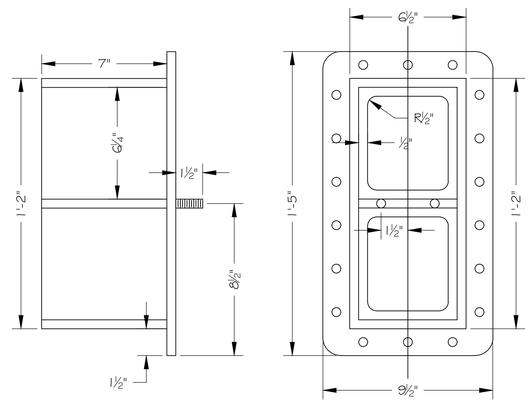
No	QTY	DESCRIPTION	MATERIAL	ASTM
1	2	FERNSTRUM COOLER - MODEL D1445U, AFTERCOOLER CIRCUIT	CU NI	-
2	2	FERNSTRUM COOLER - MODEL D1087U, JACKET WATER CIRCUIT	CU NI	-
3	8	2 ½" - BUTTERFLY VALVE, "NIBCO" LD2000 LUG TYPE MSS SP-67 CATEGORY-A, 200 PSI	DUCTILE IRON	A-536
4	8	2 ½" - FLANGE 150 LB. SLIP-ON	STEEL	A-105
5	32	2 ½" - 90° EL "VIEGA" #556570	CU NI	
6	160'	2 ½" - PIPE "VIEGA"	CU NI	
7	8'-0"	PIPE, 20" SCH 10, SEAMLESS	STEEL	A-53
8	4	PIPE, 1 1/2" X 8" THD NIPPLE, SCH 40	STEEL	A-53
9	4	ELBOW 180°, ½", SCREWED, 150 LB	MI	A-197
10	12	COUPLING, HALF, ½" THREADED 3000LB	STEEL	A-105
11	12	COUPLING, HALF, 1 1/2" THD.. 3000LB	STEEL	A-105
12	8	COUPLING, HALF, 2" THREADED 3000LB	STEEL	A-105
13	8	2 ½" - FLANGE "VIEGA" #592059	CU NI	
14	8	2 ½" - CPLG. "VIEGA" #556495	CU NI	
15	4	SIGHT LEVEL GAUGE, ½" NPT w/ BALL CHECK VALVES	BRONZE	
16			-	
17	4	PLUG, ½", THREADED	BRONZE	
18	4	PLUG, 2", THREADED	BRONZE	
19	AR	PLATE, MILD STEEL, ¼"	STEEL	A-36



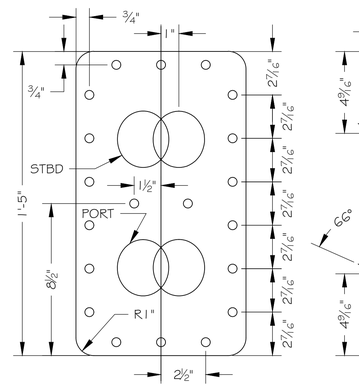


ENGINE ROOM

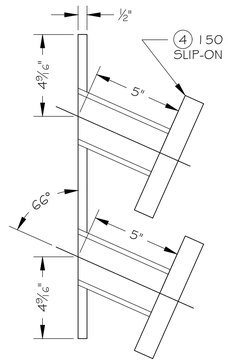
ENGINE COOLING PIPE SCHEMATIC
SCALE: 3/8" = 1'-0"



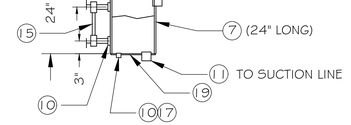
COFFERDAM BOX
SCALE: 3" = 1'-0"



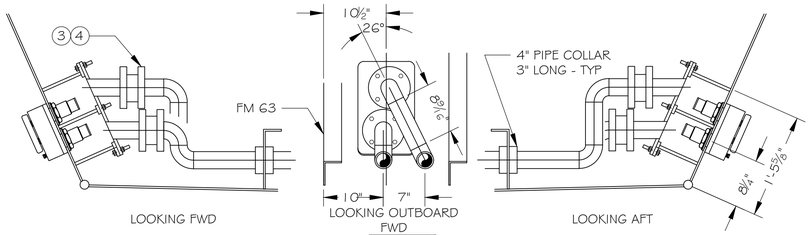
COFFERDAM COVER
SCALE: 3" = 1'-0"



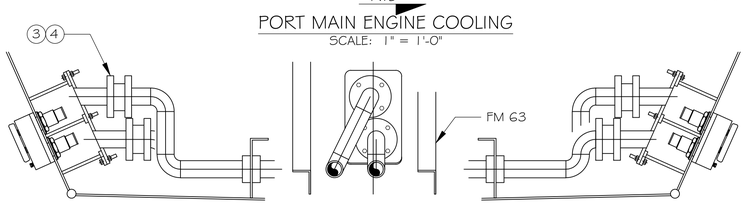
REFERENCES
1. NC-220-1044



EXPANSION TANK
SCALE: NONE
FOUR (4) TANKS REQUIRED



PORT MAIN ENGINE COOLING
SCALE: 1" = 1'-0"



STBD MAIN ENGINE COOLING
SCALE: 1" = 1'-0"

THIS PLAN APPLICABLE TO:

VESSEL NAME	OFF.No.
CAPE POINT	949251
CHICAMACOMICO	949252
FRISCO	946908
KINNAKEET	944638
OCRACOKE	964046
RONAOKE	996146

No	DESCRIPTION	DATE
1	CHANGED PIPE MATERIAL TO "VIEGA" CU NI 90/10. THIS INCLUDES PIPE, FITTINGS AND FLANGES.	DEC. 12, 14

REVISIONS

NORTH CAROLINA FERRY SYSTEM
8550 SHIPYARD RD MANNS HARBOR, NC 27953

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
FERRY DIVISION

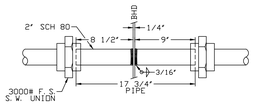
MAIN ENGINE COOLING PIPING

REPOWER: CAT 3408 TO C18

DWG BY:	APPROVED BY:
BTJ	JDW
DATE:	DATE APPROVED:
8/5/2013	X

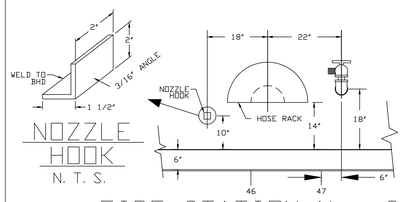
SIZE	PROJECT NO.	DWG NO.	REV
D	F5505	NC-220-1044C	1

SCALE: AS NOTED SHEET 1 OF 1



PENETRATION BHD 50 & 39

1 1/2" = 1'

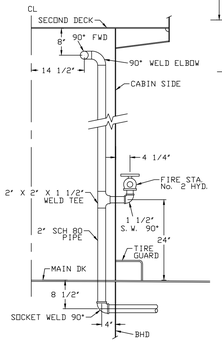


NOZZLE HOOK

N. T. S.

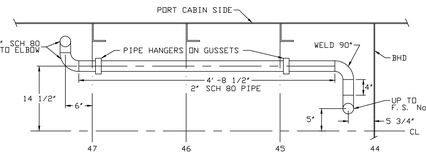
FIRE STATION No. 2

3/4" = 1'



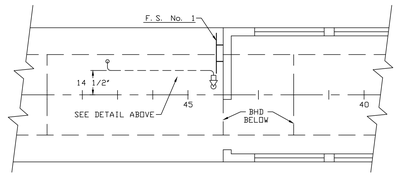
CABIN SECTION

3/4" = 1' LKG AFT



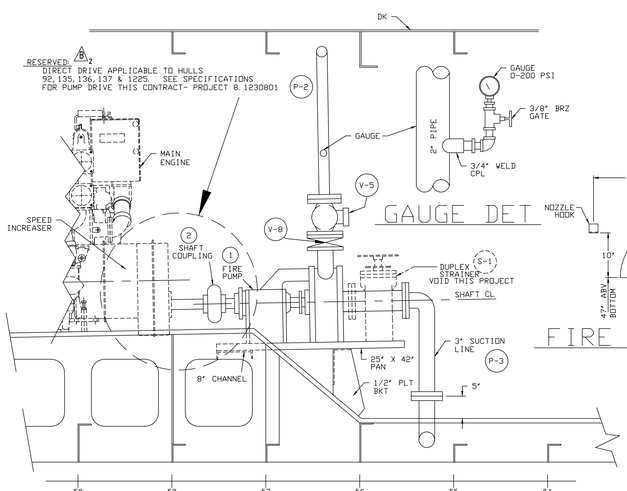
MAIN DK CABIN OVERHEAD

1" = 1' LKG DWN



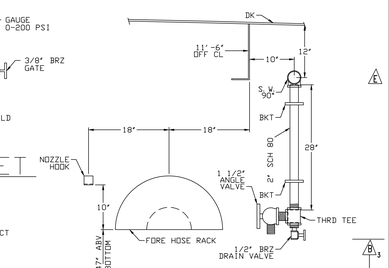
UPPER DECK PLAN

3/8" = 1'



FIRE PUMP INSTALLATION

1" = 1'



FIRE STATION No. 5

1" = 1'

PIECE No.	QTY.	DESCRIPTION	MATERIAL	ASTM	REMARKS
V-1	2	1/4" GLOBE VALVE	BRZ	B-61	
V-2	5	1-1/2" ANGLE GLOBE VALVE	BRZ	B-61	
V-3	1	3/4" GATE VALVE, 150# SCR	BRZ	B-62	
V-4	2	2" GATE VALVE 150# SCR	BRZ	B-62	KITZ 27AKH
V-5	2	2" SWING CHECK VALVE FLG	BRZ	B-62	KITZ 04AKR
V-6	2	3" BUTTERFLY VALVE	S/S	316	MUELLER 53-HHH-3-1
V-7	1	4" GATE VALVE	S/S	316	
V-8	2	2" BUTTERFLY VALVE	S/S	316	
V-9	1	2" PRESSURE RELIEF VALVE			SET TO 125 PSI
P-1/2	A/R	PIPE 1/2", SCH 80 GALV.	STL	A-53	
P-3/4	A/R	PIPE 3/4", SCH 80 GALV.	STL	A-53	
P-1-1/2	A/R	PIPE 1-1/2" SCH 80 GALV. 4	STL	A-53	
P-2	A/R	PIPE 2" SCH 80 GALV.	STL	A-53	
P-3	A/R	PIPE 3" SCH 80 BLACK	STL	A-53	
FS-1	5	FIRE HOSE, 50' 1-1/2", BRZ CPLS	RUBBER LINED		U. L. 19 APPROVED
FS-2	5	FIRE NOZZLE, 1-1/2" AKRON 2032	BRZ		
FS-3	5	SPANNER WRENCH			
S-1	1	STRAINER 3" DUPLEX, FLG'D BASKET TYPE	BRZ, S/S BASKET		HAYWARD No. 50
S-2	1	STRAINER 1-1/4" DUPLEX, SCR BASKET TYPE	BRZ, S/S BASKET		HAYWARD No. 50
1	2	PUMP, CENTRIFUGAL, 13" IMPELLER	AL/BRZ		MCM 178-2" X 3"
2	2	COUPLING DODGE PARAFLEX FXSQ 2-1/2" X 1 7/8" 010605			
P-4	A/R	4" SCH 80 PIPE; BLACK	STL	A-53	
S-3	1	STRAINER; DUPLEX; FLANGED	BRONZE W/ S/S BASKET	B-62	HAYWAD No. 50

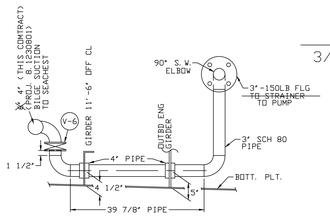
GENERAL NOTES

1. ALL WORKMANSHIP, MATERIALS AND COMPONENTS TO BE U.S.C.G. APPROVED. PERFORMED BY U.S.C.G. CERTIFIED WELDERS.
2. TAKE DOWN JOINTS TO BE PROVIDED ON BOTH SIDES OF ALL BHD., DECK PIPE PENETRATIONS AND AT PUMP SUCTION & DISCHARGE
3. EACH FIRE STATION TO INCLUDE: 50 FT. OF 1-1/2"ø LINED FIREHOSE, 1-1/2" BRONZE NOZZLE W/ 5/8" STREAM & WATER SPRAY, HOSE RACK & SPANNER WRENCH, BRZ CPLGS W/ NATIONAL STD. HOSE THD.
4. FOUR FIRE AXES TO BE PROVIDED SEE REF. 'A' FOR LOCATION
5. ATTACH SPANNER WRENCH TO FIRE HYDRANT WITH BRASS CHAIN

△6. POP-OFF VALVE AT FIREMAIN PUMP TO BE SET AT 125 P. S. I. WITH A RETURN TO THE INTAKE

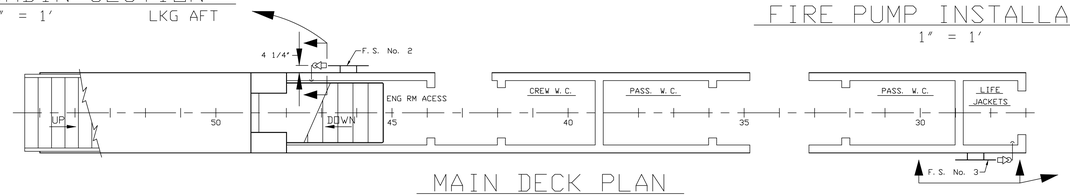
REFERENCES

△1 C. SKETCH NC 92-4 - PROPOSED PIPING MODS. (NEW HATT. CLASS) 2-SHTS.
B. MISC SECTIONS & DETAILS NC 220-0038
A. SAFETY PLAN NC 220-0054



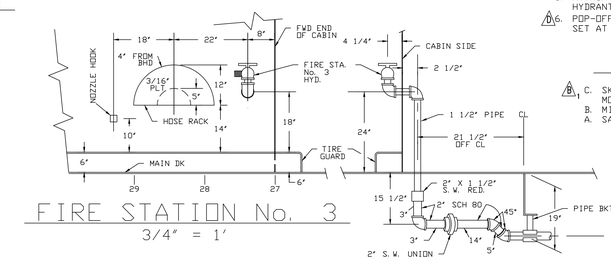
PORT PUMP SECTION

3/4" = 1'



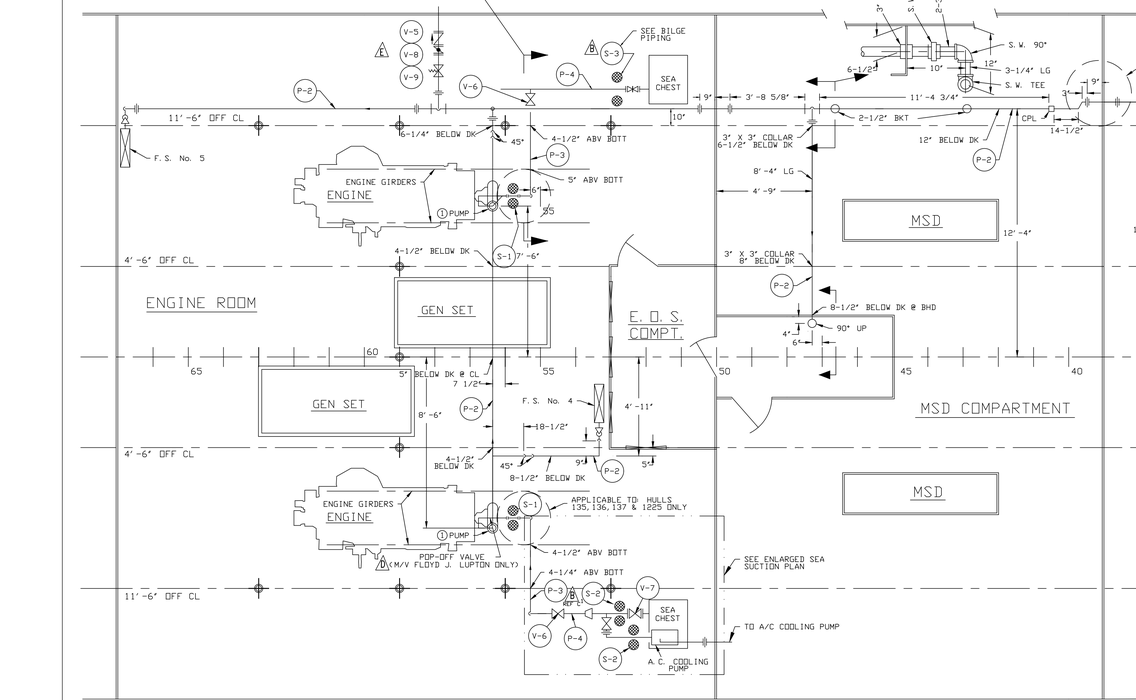
MAIN DECK PLAN

3/8" = 1'



FIRE STATION No. 3

3/4" = 1'



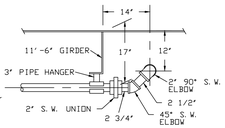
HULL PLAN

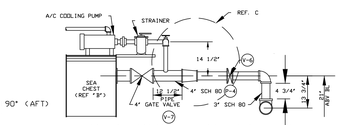
3/8" = 1'

ENGINE SPEED NOT TO EXCEED 1100 RPM DURING OPERATION OF FIRE PUMP.

TO BE POSTED AT EACH MAIN ENGINE

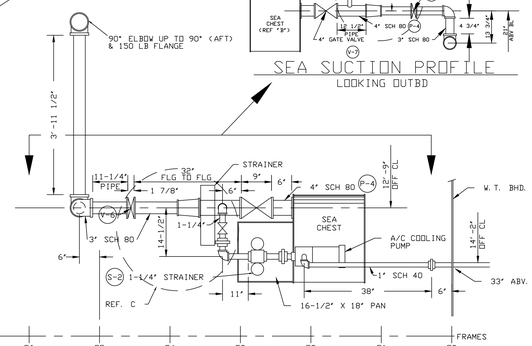
△E APPLICABLE TO VESSELS: FRISCO 946908, CAPE POINT 949251, CHICAMACOMICO 949252, OCRACOKE 964046, ROANOKE 996146





SEA SUCTION PROFILE

LOOKING OUTBD



STBD SEA SUCTION PLAN

3/4" = 1'

NOTE: △B1 APPLICABLE TO HULLS 135, 136, 137 & 1225. SEE REF. C FOR MODIFICATIONS THIS CONTRACT. PROJ. No. 8.1230801

No.	DESCRIPTION	By	Date	App'd.
△E	REVISED LOCATION OF POP-OFF VALVE TO OVERBOARD DISCHARGE. REVISED BILL OF MATERIAL	BTJ	12/7 '17	
△D	REVISED TO "AS-BUILT" SPEC'S WITH ADDITION OF THE 125 P.S.I. POP-OFF VALVE AT THE FIREMAIN PUMP	EAO	4/8 '94	
△C	REPRODUCED IN ITS ENTIRETY USING AUTOCAD RELEASE 12	EBJ	5/20 '93	
△B	3. GEN. REVISIONS & MODS. TO B.O.M. REQ'D BY ADDITION OF DUPLEX STRAINER AS PER MEMO BY R.F. GOINS, DR. dtd. 8/11/92 2. RESERVED FIRE PUMP DRIVE METHOD PROJ. 8.123081 (SPEED INCREASER OR BELT) 1. ADDED NOTE & REF. C. STBD. SEA SUCTION PLAN FOR PIPING MODS. PROJ. 6.171532	EBJ	8/24 '92	
△A	REDRAWN (PATTI SHIPYARD)	WP	7/22 '59	

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

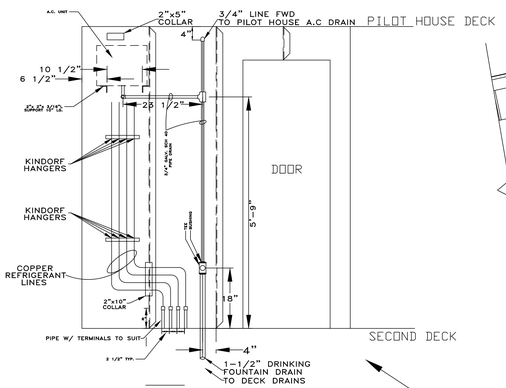
FIREMAIN PIPING

SEAL

APPROVALS

DRWN. A. OVERSTREET
CHKD.
SCALE AS NOTED

NC-220-1047 REV. E

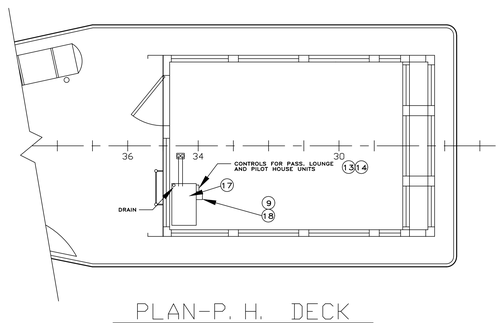


ELEV. PASS. & CREW DK.

BHD. FR. 36

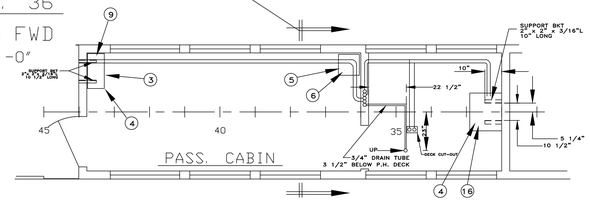
LOOKING FWD

3/4" =1' -0"



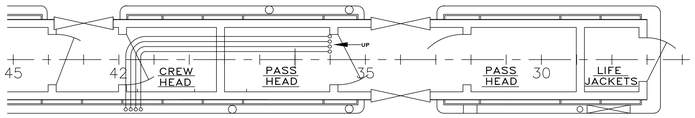
PLAN-P. H. DECK

3/8" = 1'



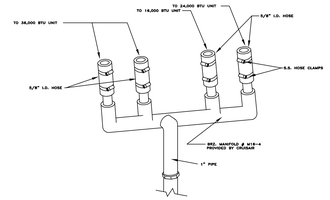
UPPER DECK

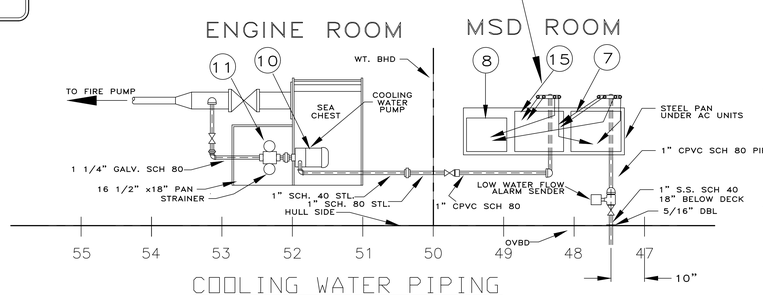
3/8" = 1'



MAIN DECK

3/8" = 1'



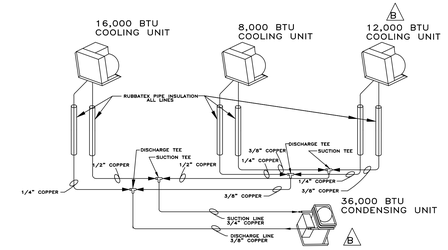


COOLING WATER PIPING

3/4" = 1'

BILL OF MATERIAL

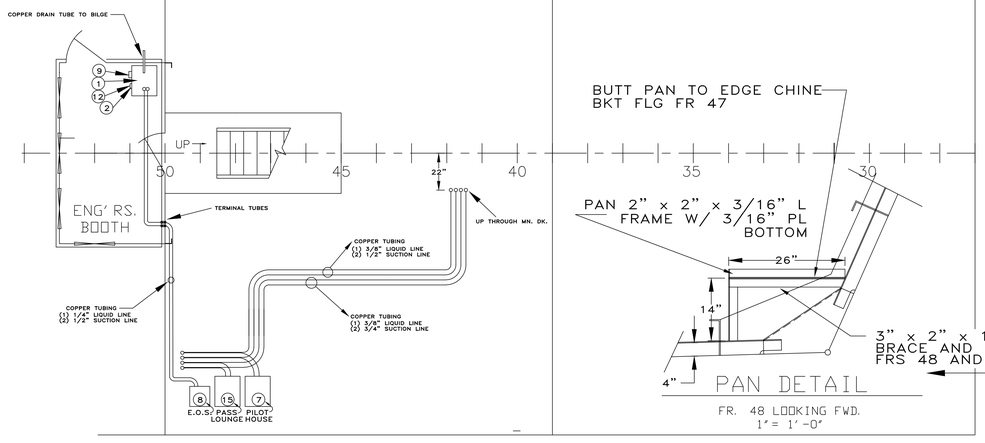
PART	QTY	ITEM	MFG	MODEL
1.	1	16,000 BTU/HR COOLING UNIT, 115v 1 PH	CRUISAIR	EB5165
2.	1	2 KW DUCT HEATER	CRUISAIR	HMD2-7
3.	1	16,000 BTU/HR COOLING UNIT, 115v 1 PH	CRUISAIR	EFL16(M-255)
4.	2	2 KW HEAT MODULE 115v 1 PH	CRUISAIR	HMH-2
5.	1	1KW HEAT MODULE 115v 1 PH	CRUISAIR	HMH-1
6.	1	8,000 BTU/HR COOLING UNIT, 115v 1 PH	CRUISAIR	EFB-8(M-254)
7.	1	24,000 BTU/HR CONDENSING UNIT, 208 v 3PH	CRUISAIR	WFAH24-D (PH)
8.	1	16,000 BTU/HR CONDENSING UNIT UNIT, 115v 1PH	CRUISAIR	WFAH 16 (E.O.S.)
9.	2	THERMOSTAT	HONEYWELL	T6051 W/Q651A SUB-BASE
10.	1	COOLING WATER PUMP 208v 3PH 1 1/4" x1" 50' C RATING TEFC 1H.P. C.I. BODY, BRZ 4.5" IMPELLER	MP PUMPS	SERIES 60 #27675
11.	1	SEA WATER STRAINER 1 1/4" BRZ 5/64" PERFERATED S.S BASKET	HAYWARD DUPLEX	MODEL 50
12.	1	SWITCH ASSEMBLIES E.O.S. 3 KNOBS	CRUISAIR	SA3H-ZNIO
13.	1	SWITCH ASSEMBLIES, PASS 2 KNOBS	CRUISAIR	TSRH-TZN
14.	2	SWITCH ASS'B, PASS. AND P.H. 1 KNOB	CRUISAIR	5A4-ZN
15.	1	36,000 BTU/HR CONDENSING UNIT, 208v 3 ø	CRUISAIR	WFAH-36D (PASS.)
16.	1	12,000 BTU/HR COOLING UNIT, 115v 1 ø	CRUISAIR	EFLS12 (M-255)
17.	1	24,000 BTU/HR COOLING UNIT, 115v 1 ø	CRUISAIR	EBOH24
18.	1	SWITCH ASS'B P.H. 2 KNOBS	CRUISAIR	SA43-BN
19.	1	POWER RELAY, E.O.S.	CRUISAIR	PWX
20.	1	RELAY TRIGGER FOR POWER RELAY-E.O.S.	CRUISAIR	TR115
21.	1	RELAY, PASS. LOUNGE, 115v, 20A	CRUISAIR	41312-20



PIPING SCHEMATIC

FOR REFRIGERANT LINES

NOT TO SCALE



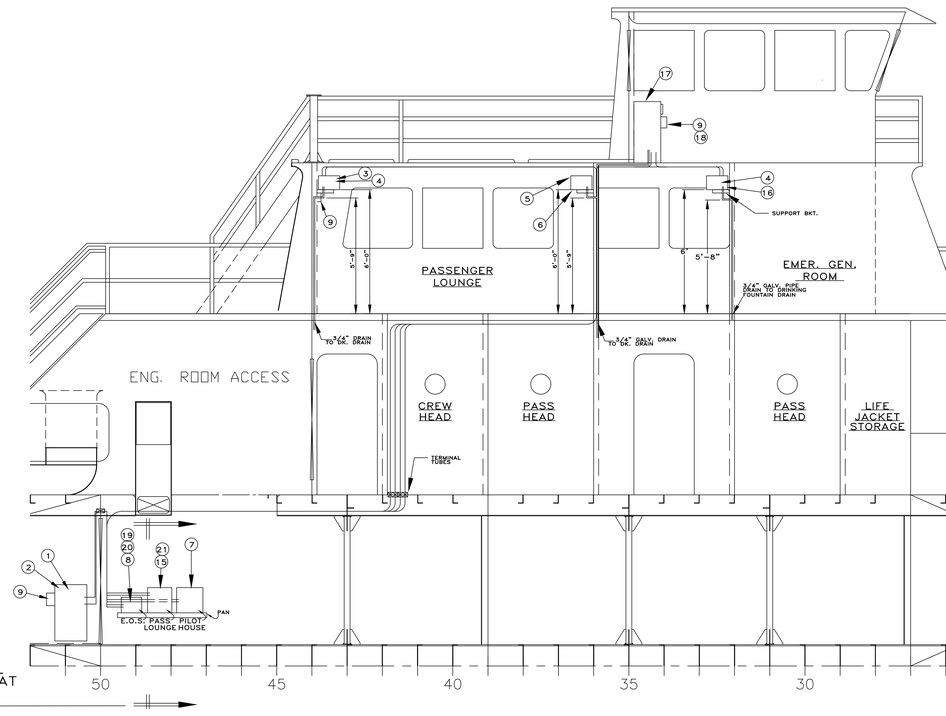
HULL ARRANGEMENT PLAN

3/8" = 1'

PAN DETAIL

FR. 48 LOOKING FWD.

1" = 1' -0"



INBOARD PROFILE

3/8" = 1'

NO.	DESCRIPTION	BY	DATE	APP'D
C	REPRODUCED IN ITS ENTIRETY USING AUTOCAD RELEASE 12	EAO	9/17 '93	
B	REVISED DWG. TO REFLECT CHANGES MADE NECESSARY BY REQ'MT TO PROVIDE ADDITIONAL COOLING IN P.H.- SEE MEMO BY R.F GOINS dtd 8/11/92	EBJ	8/24 '92	
A	AS BUILT			

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

HEATING AND AIR CONDITIONING

SEAL

APPROVALS

DRWN.

CHKD.

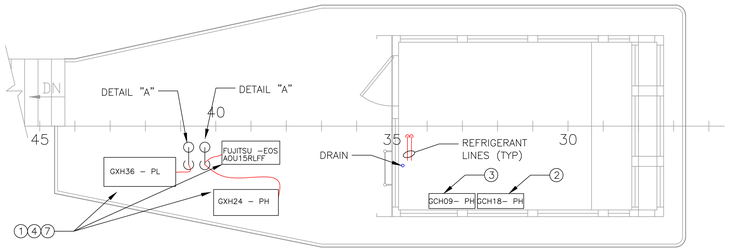
SCALE

NC-220-1048 — REV. C

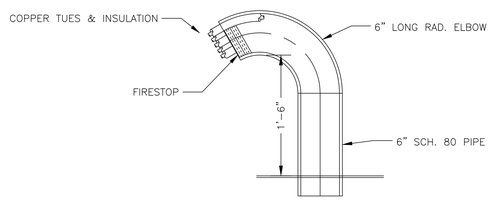
BILL OF MATERIAL				
ITEM	DESCRIPTION	MAKE	MODEL	ZONE
1	CONDENSER, HEAT PUMP	AIRTEMP	GXH24(7.0) FMK4DH-1	PILOT HOUSE
2	EVAPORATOR, INDOOR UNIT	AIRTEMP	GCH18(5.3) FMK4DH	PILOT HOUSE
3	EVAPORATOR, INDOOR UNIT	AIRTEMP	GCH09(2.6) FMK4DH	PILOT HOUSE
4	CONDENSER, HEAT PUMP	AIRTEMP	GXH36(10.6) FMK4DH	PASSENGER LOUNGE
5	EVAPORATOR, INDOOR UNIT	AIRTEMP	GHH18 LUK4DH	PASSENGER LOUNGE
6	EVAPORATOR, INDOOR UNIT	AIRTEMP	GHH24 LUK4DH	PASSENGER LOUNGE
7	CONDENSER, HEAT PUMP	FUJITSU	AOU15RLFF	EOS
8	EVAPORATOR, INDOOR UNIT	FUJITSU	AGU15RLF	EOS
9				

THIS PLAN APPLICABLE TO:

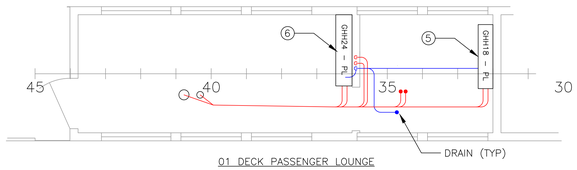
	OFF.NO.
KINNAKEET	944638
FRISCO	946908
CHICAMOCOMICO	949252
CAPE POINT	949251
OCRACOKE	964046
ROANOKE	996146



PILOTHOUSE DECK

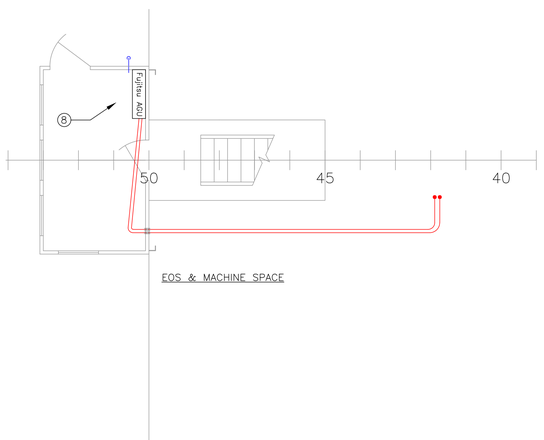


DETAIL "A"
NEW DECK PENETRATION
SCALE: 1½" = 1'-0"

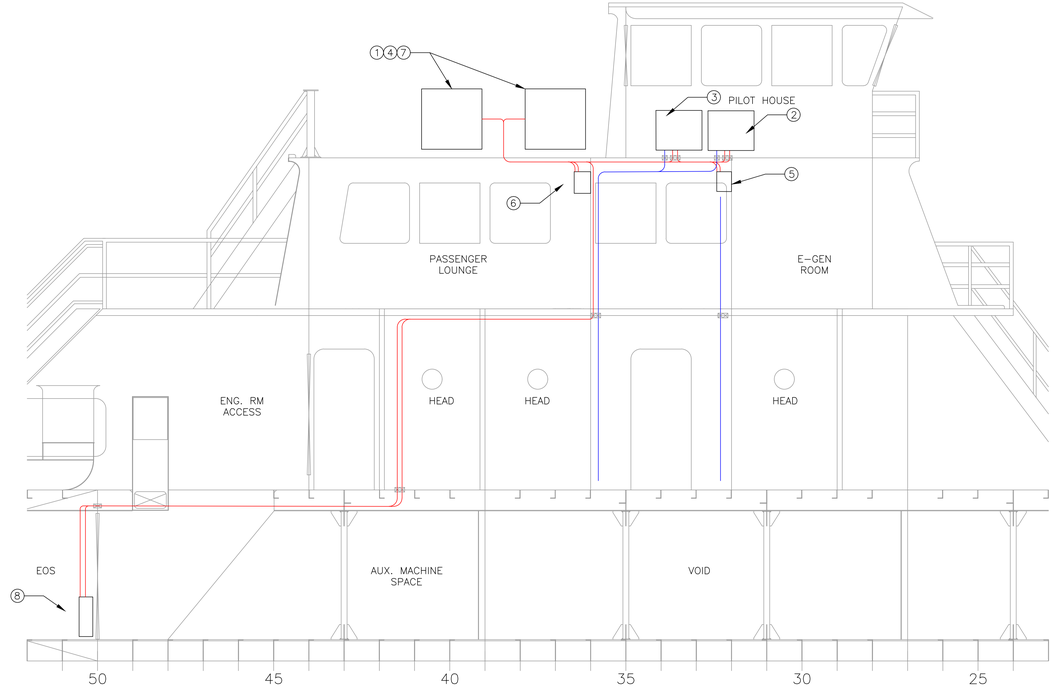


01 DECK PASSENGER LOUNGE

MAIN DECK



EOS & MACHINE SPACE



INBOARD PROFILE

NO.	DESCRIPTION	BY	DATE	APP'D
E	1. Changed model of PH unit	JJR	10/18 '23	
D	1. REMOVED ALL CHILL WATER COOLING EQUIPMENT AND ACCOMMODATION SPACE HEATERS. 2. ADDED HEAT-PUMP STYLE MINI-SPLIT SYSTEM PER BILL OF MATERIAL. 3. EXISTING DECK AND BULKHEAD PENETRATIONS REUSED WHERE POSSIBLE. ALL PENETRATIONS ARE EXISTING UNLESS SPECIFIED AS NEW.	BTJ	9/19 '22	
C	REPRODUCED IN ITS ENTIRETY USING AUTOCAD RELEASE 12	EAO	9/17 '93	
B	REVISED DWG. TO REFLECT CHANGES MADE NECESSARY BY REQ'MT TO PROVIDE ADDITIONAL COOLING IN P.H.- SEE MEMO BY R.F GOINS dtd 8/11/92	EBJ	8/24 '92	
A	AS BUILT			

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

HEATING AND AIR CONDITIONING

SEAL

APPROVALS

DRWN: BTJ

CHKD: JJR

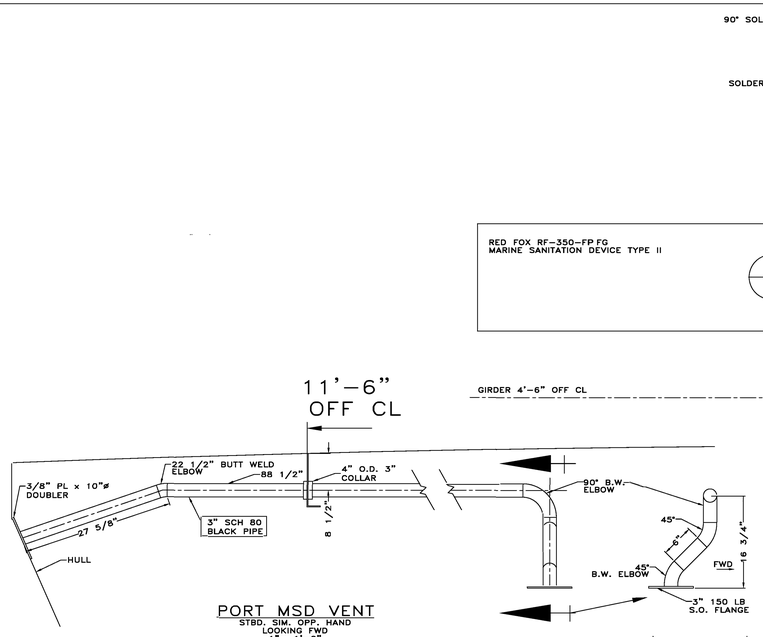
SCALE: ¾" = 1'-0"

NC-220-1048

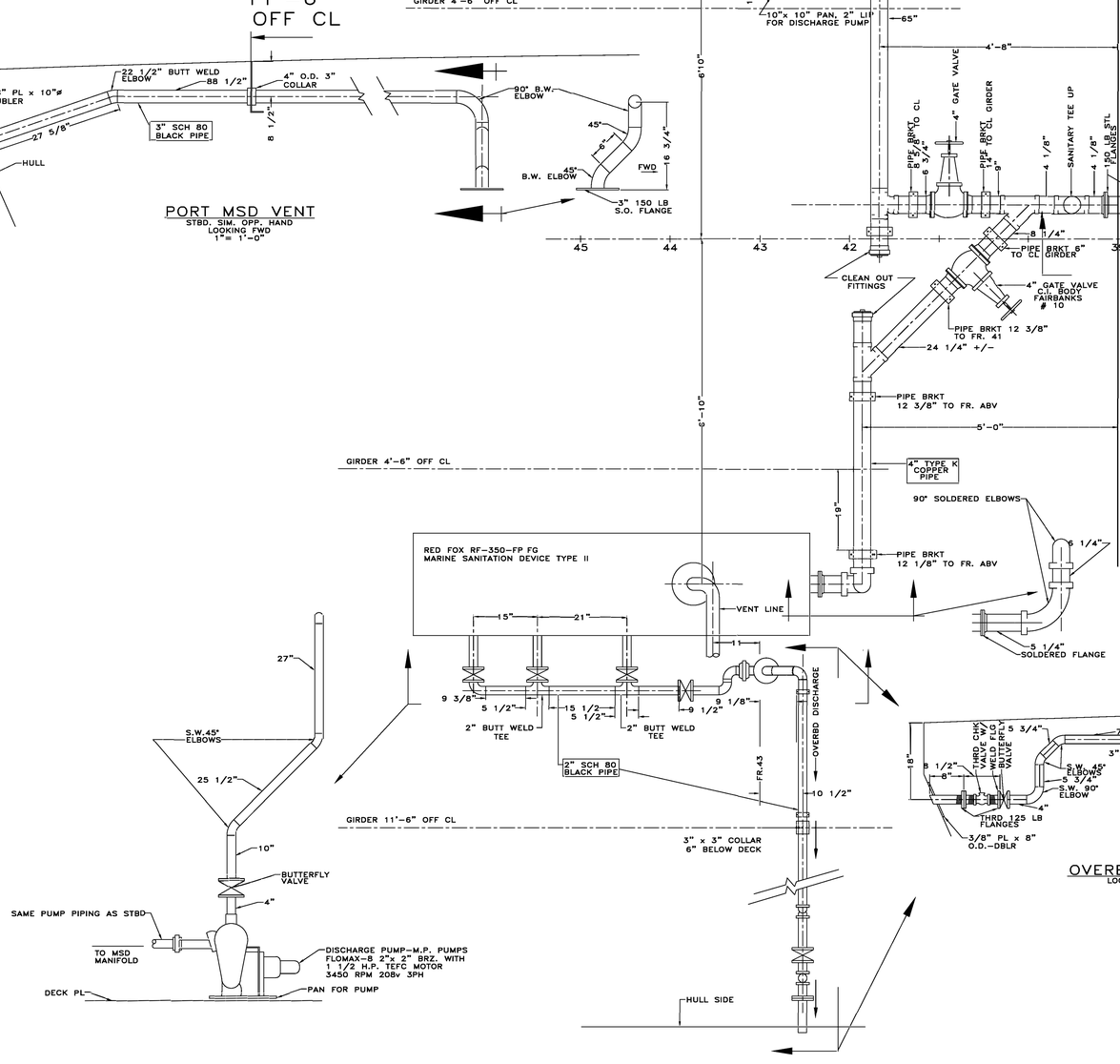
REV. E

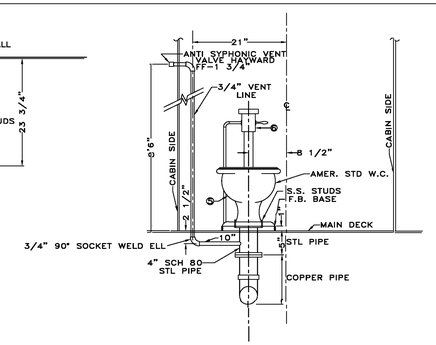
BILL OF MATERIALS

No.	QTY	DESCRIPTION	MATERIAL	ASTM	MFG
1	2	SEWAGE DISHARGE PUMP 2"x2" 1 1/2hp 208V 3PH	BRZ		M.P. FLOMAX 8
2	2	MARINE SANITATION DEVICE RF-200-M			RED FOX
3	2	4" GATE VALVE	C. IRON	A-126	FAIRBANKS # 10
4	12	2" BUTTERFLY VALVE 4 LUG	S. STL		MUELLER 53-WHM-3-1
5	3	WATER CLOSET, MEDERA WATER SAVER	VIT CHINA		AMERICAN STD 2221.018
6	3	FLUSH VALVE			SLOAN 110
7	2	2" CHECK VALVE, SWING, THRD	BRZ	B-62	KITZ 04AKR
8	13	COPPER FLANGES, SOLDERED	BRZ		
9	4	4" SANITARY TEE, SOLDERED	COPPER		
10	2	4" WYE, SOLDERED	COPPER		
11	3	4" CLEAN-OUT, SOLDERED	COPPER		
12	4	4" 90° ELBOW, SOLDERED	COPPER		
13	38'	4" COPPER PIPE, TYPE K	COPPER	B-306	
14	40'	2" SCH. 80 PIPE	STL	A-53	
15	18	2" SOCKET WELD FLANGE, 150 LB	STL F.S.		
16	4	2" THREADED FLANGES	STL		
17	22'	3" SCH 80 PIPE	STL		
18	2	3" SCH 80 90° ELBOW B.W.	STL		
19	5	3" SCH 80 45° ELBOW B.W.	STL		
20	2	3" FLANGE 150LB.	F.S.	A-105	
21	2	2" UNION, THRD	STL		



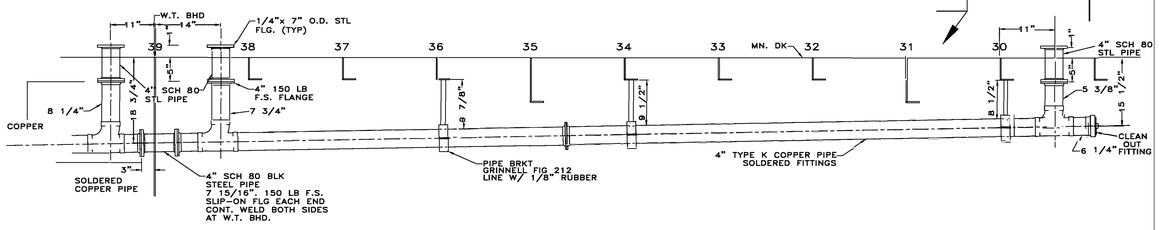
PORT MSD VENT
STBD, SIM, OPP, HAND
LOOKING FWD
1"= 1'-0"





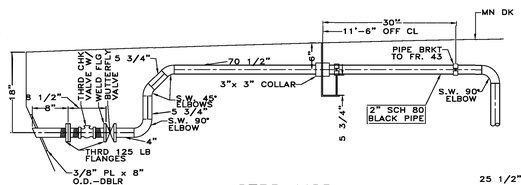
PLAN
1"= 1'-0"

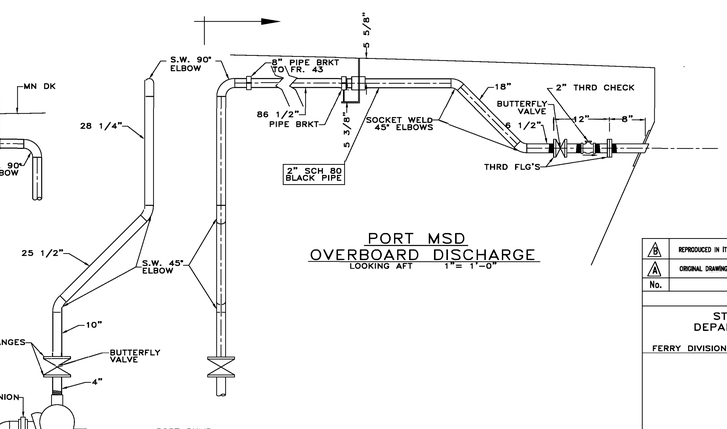
TOILET DETAIL
1"= 1'-0"



PROFILE
1"= 1'-0"

STBD MSD
OVERBOARD DISCHARGE
LOOKING AFT 1"= 1'-0"





PORT MSD
OVERBOARD DISCHARGE
LOOKING AFT 1"= 1'-0"

No.	DESCRIPTION	By	Date	App'd.
2	REPRODUCED IN ITS ENTIRETY USING AUTOCAD RELEASE 12	EAO	12/20/95	
1	ORIGINAL DRAWING BY PATH SHIPYARD INC.			

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

SEWAGE AND M.S.D. PIPING

SEAL

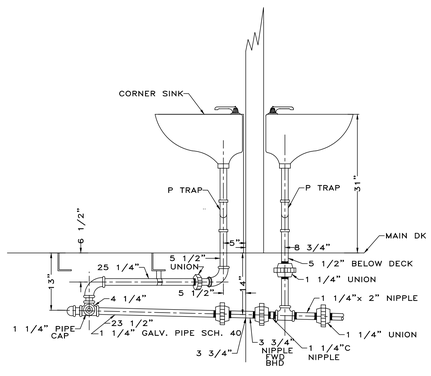
APPROVALS

DRWN. D. OVERSTREET

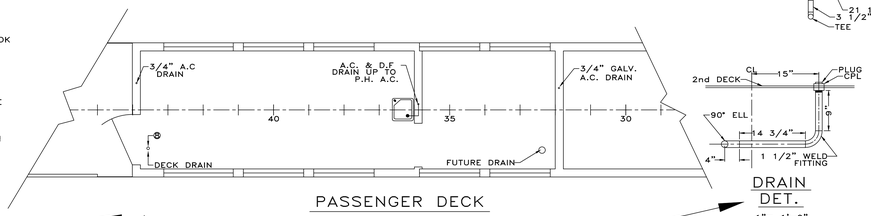
CHKD.

SCALE 3/8" = 1'

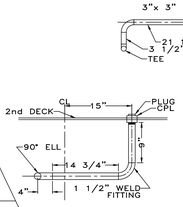
NC-220-1057 REV. B



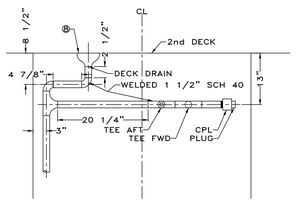
LAVATORY DRAIN DETAIL
SECTION "A–A"
1"= 1'–0"



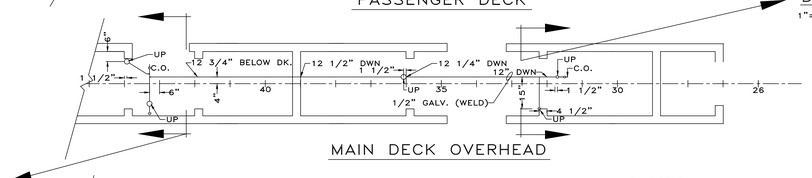
PASSENGER DECK



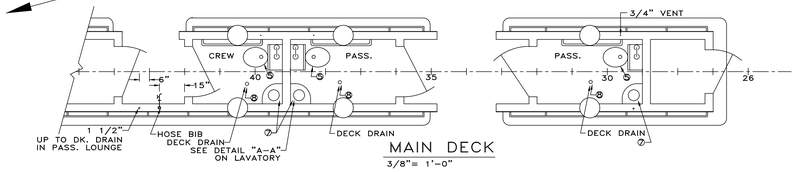
DRAIN DET.
1"= 1'–0"



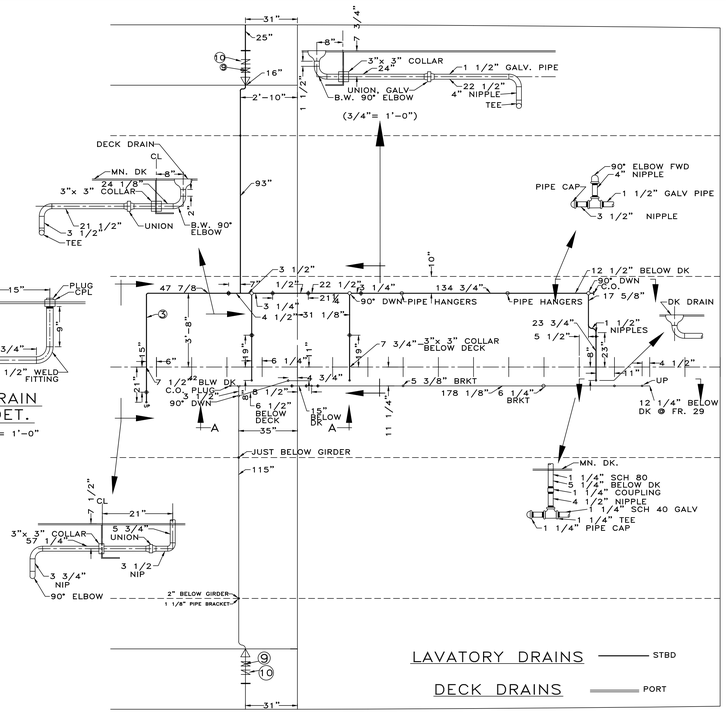
DRAIN PIPING
LKG AFT
1"= 1'– 0"



MAIN DECK OVERHEAD

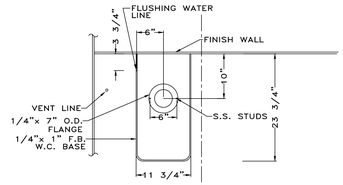


MAIN DECK
3/8"= 1'–0"

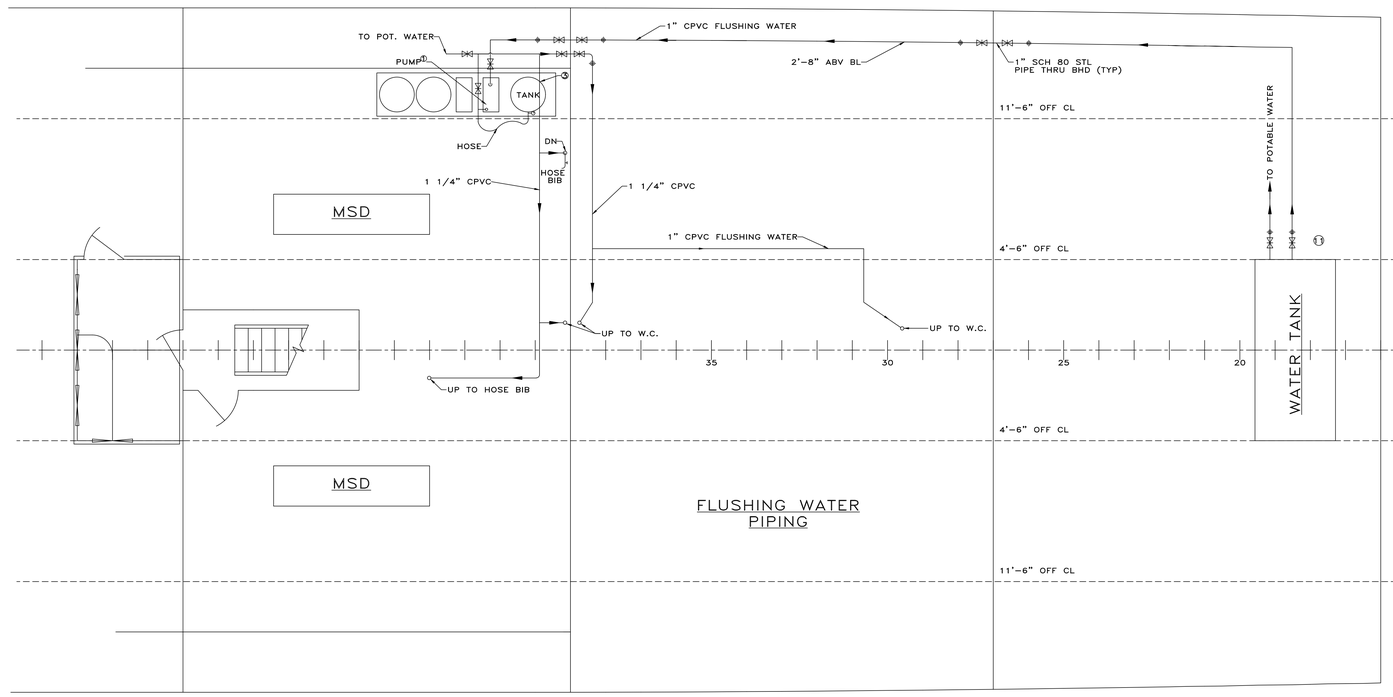


HULL ARRANGMENT
3/8"= 1'–0"

No.	QTY	DESCRIPTION	MATERIAL	ASTM	MFG
1	1	PUMP PRESSURE SET 1/2 H.P. 115v 300 GPH 1 1/4 S x 3/4" D	C.I. BODY BRASS IMP.		McDONALD 8151
2	2	PUMP SEWAGE DISCHARGE 2"x 2" 1/2 H.P. 208v 3	BRZ		FLOMAX #8
3	1	PRESSURE TANK 30 GAL			CLAYTON MARK
4	2	MARINE SANITATION DEVICE			RED FOX RF–200M
5	3	WATER CLOSET, MADERA WATER SAVER	VIT CHINA		AMERICAN STD 2221.018
6	3	FLUSH VALVE			SLOAN 110
7	3	LAVATORY SINK, CORNER	VIT CHINA		AMERICAN STD 0451.021
8	4	DECK DRAIN, BUTT WELD	BRZ/STL		KINGS POINT 1017V 1–1/2"x 4"
9	2	2" BUTTERFLY VALVE 4 LUG	ST. STL		MUELLER 53–HHH–3–1
10	2	2" CHECK VALVE, SWING, THRD 150 LB	BRZ	B–62	KITZ 04AKR
11	2	1" GATE VALVE, THRD	BRZ	B–62	KITZ 27AKH
12	2	2" 150 LB F–S. FLG. SLIP–ON	STL		
13	2	2" 150 LB THRD FLG	STL		
14	A/R	3"SCH. 80 PIPE, BLACK	STL	A–53	
15	A/R	2" SCH 80 PIPE, BLACK	STL	A–53	
16	A/R	4" COPPER PIPE TYPE K	COPPER	B–306	
17	A/R	4" SCH 80 PIPE, BLACK	STL	A–53	
18	A/R	1 1/2" SCH 80 PIPE, BLACK			
19	A/R	1 1/2" SCH 40 PIPE, GALV		A–53	
20	A/R	1 1/4" SCH 40 PIPE, GALV.			
21	A/R	1" SCH 80 PIPE, BLACK			
22		1" SCH 40 PIPE, GALV			

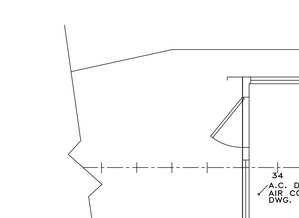


PLAN

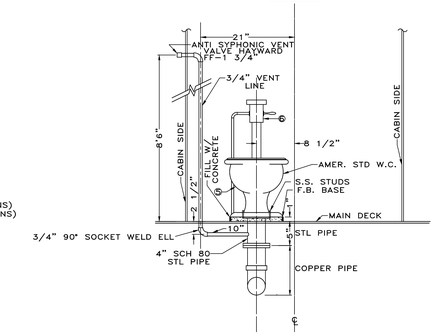


FLUSHING WATER PIPING

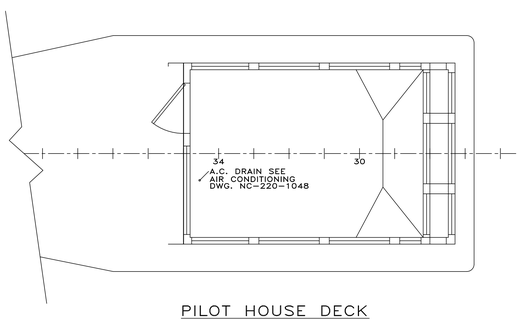
HULL ARRANGEMENT PLAN
3/8"= 1'–0"



OVERB'D DISCHARGE DETAIL
1"= 1'–0"



TOILET DETAIL
1"= 1'–0"



PILOT HOUSE DECK
3/8"= 1'–0"

No.	DESCRIPTION	By	Date	App'd.
B	REPRODUCED IN ITS ENTIRETY USING AUTOCAD RELEASE 12	EAQ	12/13 93	
A	ORIGINAL DRAWING BY PATTI SHIPYARD INC.			

REVISIONS

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FERRY DIVISION — MARINE ENGINEERING

FLUSHING WATER PIPING, LAVATORY & DECK DRAINS

SEAL

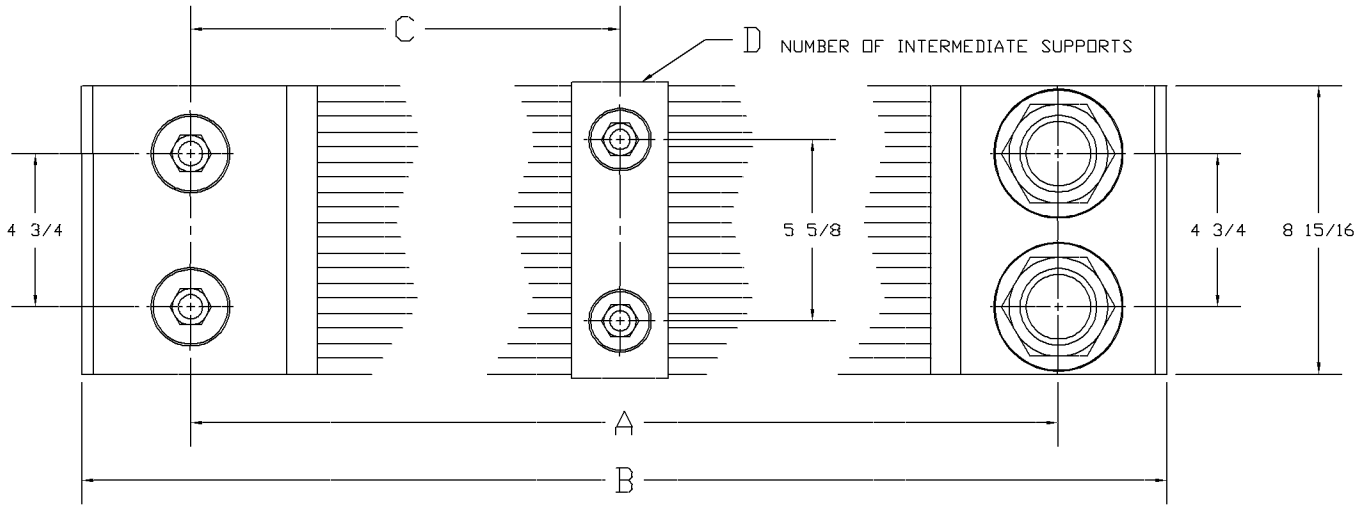
APPROVALS

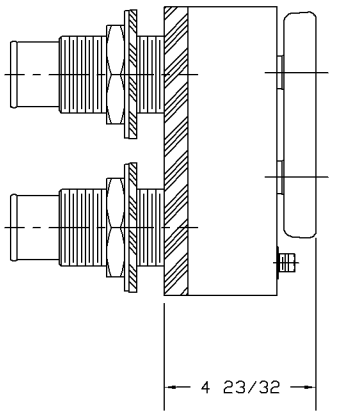
DRWN. D. OVERSTREET

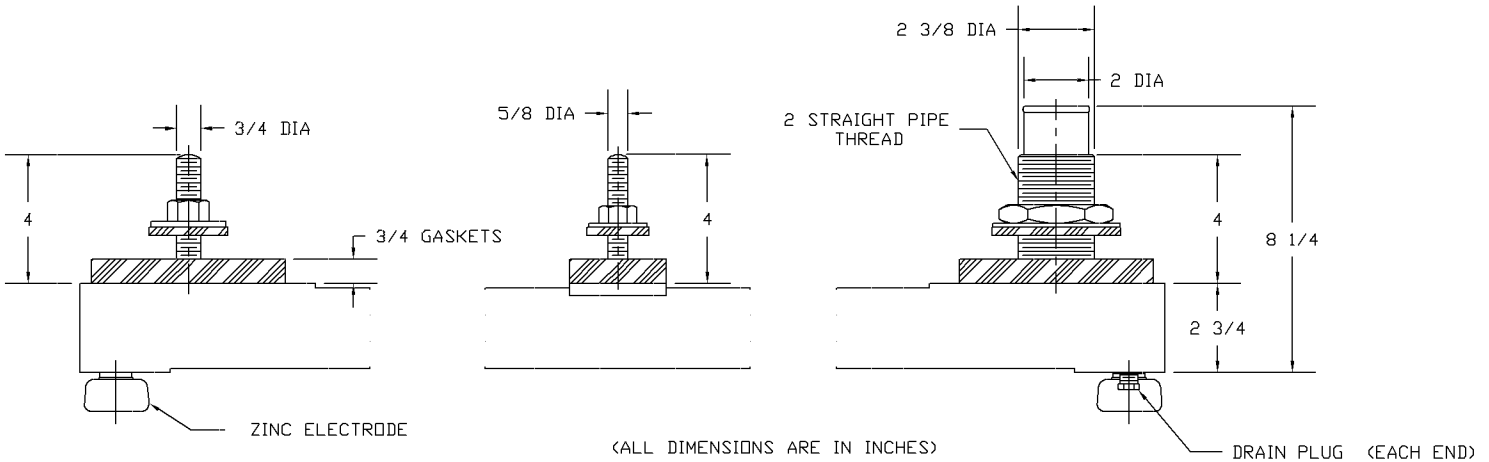
CHKD.

SCALE 3/8" = 1'

NC–220–1058 REV. B







(ALL DIMENSIONS ARE IN INCHES)

MODEL	D1027U	D1033U	D1039U	D1045U	D1051U	D1057U	D1063U	D1069U	D1075U	D1081U	D1087U
A	27	33	39	45	51	57	63	69	75	81	87
B	33 3/4	39 3/4	45 3/4	51 3/4	57 3/4	63 3/4	69 3/4	75 3/4	81 3/4	87 3/4	93 3/4
C								34 1/2	37 1/2	40 1/2	43 1/2
D	NONE		BLANK			BLANK		1	1	1	1

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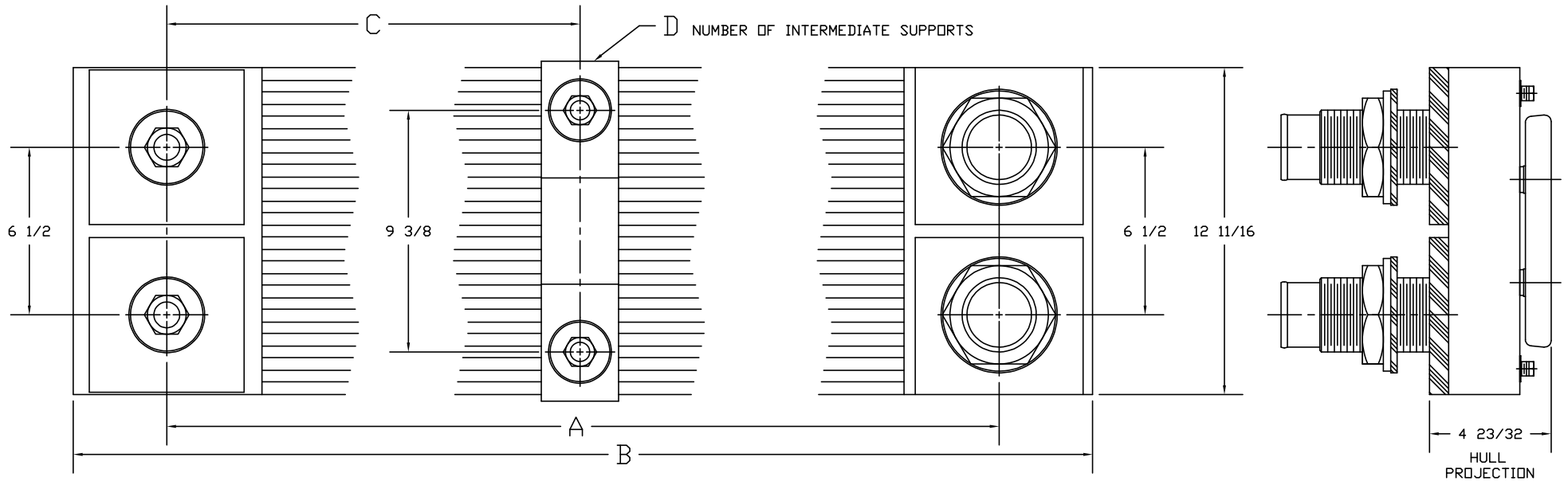
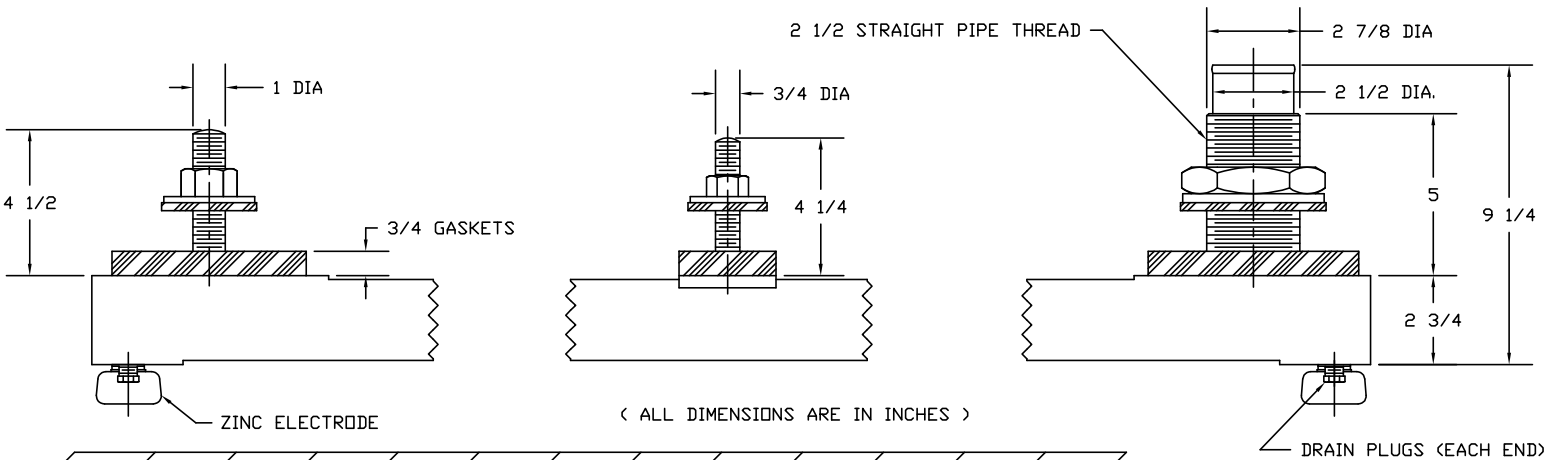
TOLERANCES (EXCEPT AS NOTED)	REVISIONS			R.W. FERNSTRUM & COMPANY MENOMINEE, MICHIGAN		
DECIMAL ±	NO.	DATE	BY	GRIDCOOLER INSTALL DIMENSIONS		
FRACTIONAL ±	1			DRAWN BY S.LUCAS	SCALE 1/4	MATERIAL
ANGULAR ±	2			CHK'D	DATE 10-5-98	DRAWING NO. D1000U-5
	3			TRACED	APP'D	
	4					
	5					

Jacketwater circuit.





(ALL DIMENSIONS ARE IN INCHES)

MODEL	D1427U	D1433U	D1439U	D1445U	D1451U	D1457U	D1463U	D1469U	D1475U	D1481U	D1487U	D1493U
A	27	33	39	45	51	57	63	69	75	81	87	93
B	34 1/4	40 1/4	46 1/4	52 1/4	58 1/4	64 1/4	70 1/4	76 1/4	82 1/4	88 1/4	94 1/4	100 1/4
C								34 1/2	37 1/2	40 1/2	43 1/2	46 1/2
D	NONE			BLANK		BLANK		1	1	1	1	1

Aftercooler and gear circuit.

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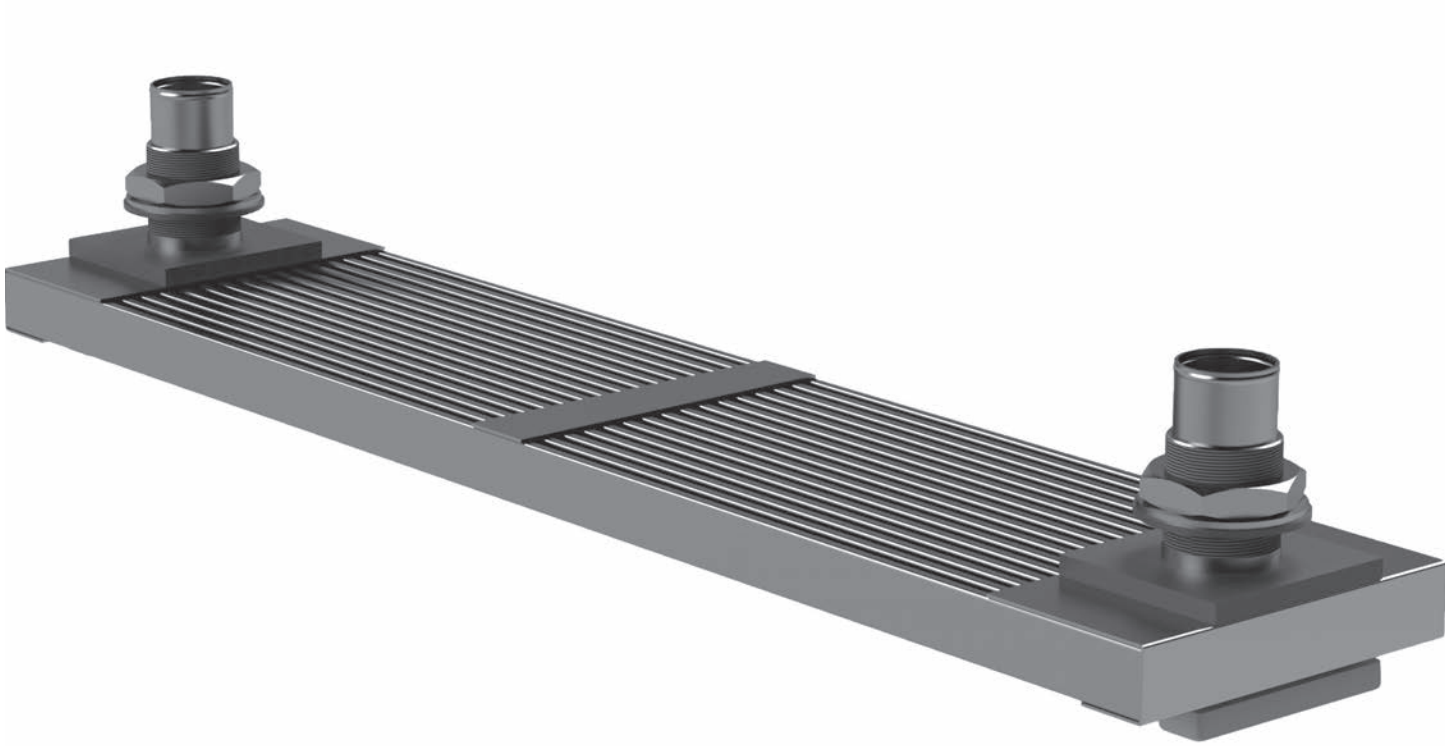
TOLERANCES (EXCEPT AS NOTED)	REVISIONS			R.W. FERNSTRUM & COMPANY MENOMINEE, MICHIGAN		
DECIMAL ±	NO.	DATE	BY	GRIDCOOLER INSTALL. DIMENSION		
FRACTIONAL ±	1					
ANGULAR ±	2					
	3			DRAWN BY S.LUCAS	SCALE 1/4	MATERIAL
	4			CHK'D	DATE 10-13-98	DRAWING NO. D1400U-5
	5			TRACED	APP'D	



GRIDCOOLER®

KEEL COOLER

Installation and
Maintenance Manual

Form 185

R.W. Fernstrum & Company

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1.0 PLANNING & LOCATION

To function properly, the FERNSTRUM® GRIDCOOLER® Keel Cooler must be properly located on your vessel's hull. Please consider the following before installing your keel cooler on most types of vessels. For additional details on displacement or planing hulls, refer to the appropriate sections.

1.1 DETERMINING PROPER LOCATION – TYPICAL

1.1.1 Sea water must flow over the entire length of the unit.

1.1.2 Always install the unit parallel, not transverse, to the skeg or keel. See Figures 1 & 2.

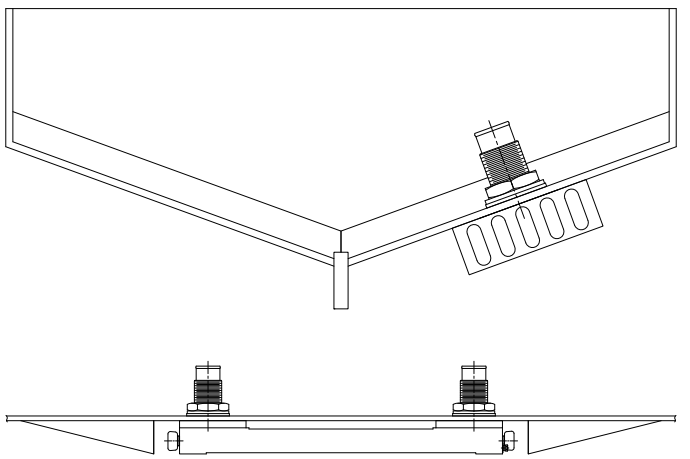

FIG.1 External type installation with E1 OPTION end-mounted anodes using fairing blocks for protection and streamlining.

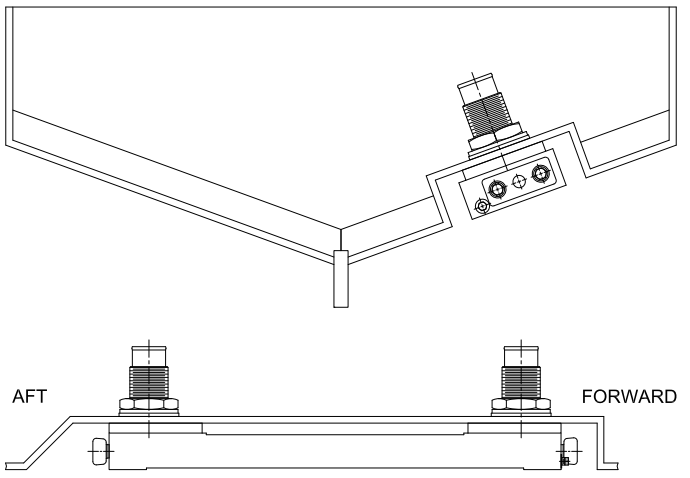

FIG.2 Recess type installation with E1 OPTION end-mounted anodes.

1.1.3 When using a two-circuit cooling system, consisting of a high temperature jacketwater circuit and a low temperature aftercooler circuit, make certain the aftercooler circuit cooler is placed forward of the jacketwater circuit cooler. When room allows, they can be installed side by side with the aftercooler circuit lower on the hull (i.e. closer to the skeg or keel) and a divider plate between the high and low temperature units.

1.1.4 When the GRIDCOOLER unit is used on a generator set or if your application requires sizing for a hull speed of 0 knots, make sure that sea water can freely circulate past the cooler tubes. Do not recess a generator set unit on the bottom of a flat bottom boat unless the hull section where the unit will be mounted inclines a minimum of 20 degrees (from forward to aft) to avoid entrapment of heated water around the tubes. See Figure 3.

1.2 DETERMINING PROPER LOCATION – DISPLACEMENT VESSELS

1.2.1 On vessels performing pushing, towing, dragging or pulling operations, the unit may be installed near the propeller, but not directly above it. See Figure 3. Install the unit to avoid the full impact of the propeller wash as this could cause damage to the unit.

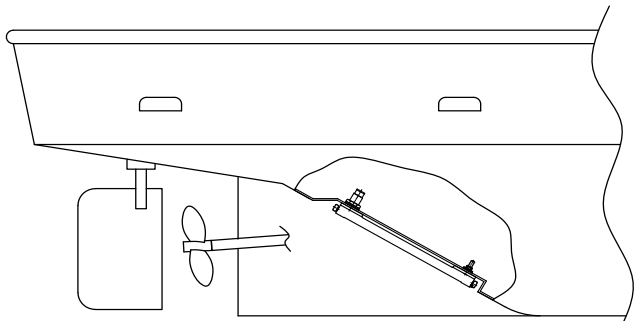

FIG.3 Recessed installation is made by welding in a box-shaped recess in the hull. Note aft end of recess is tapered to prevent hot water entrapment.

1.2.2 When installing a unit on the side of a hull, position it well below the water line to avoid aerated surface water. Take the bow wave into consideration. Aeration reduces heat transfer and can cause overheating.

1.3 DETERMINING PROPER LOCATION – PLANING VESSELS

1.3.1 For planing hull vessels, locate the unit as far aft as possible to avoid aeration and impact shock in heavy seas.

1.4 IMPROPER (NOT RECOMMENDED) LOCATIONS

1.4.1 The area of the hull where the GRIDCOOLER® Keel Cooler is installed must not vibrate or flex severely.

1.4.2 To eliminate unnecessary stress and vibration on the cooler, do not locate the unit directly below engine mounts or above the propeller(s).

1.4.3 Make sure that hot water is not discharged on or near the unit.

1.4.4 Do not locate the unit on the front 1/3 of the hull for displacement hulls. Bowthruster coolers could be an exception, depending on the vessel.

1.4.5 The GRIDCOOLER Keel Cooler is designed to be mounted directly to the hull. Do not mount the unit to any external structure without first consulting the factory.

1.5 MOUNTING CONSIDERATIONS – TYPICAL

1.5.1 Some classed vessels (ABS or Coast Guard, for example) may require cofferdams, check with your local officials for more information. For this type of installation, see Cofferdam Installation in Section 3.1.

1.5.2 The GRIDCOOLER unit can be canted from the hull (sideways) to vertically align the nozzles. This can reduce interference problems with stringers on cofferdam installations. See Figure 4. (referred to section 3.1 for cofferdam installation)

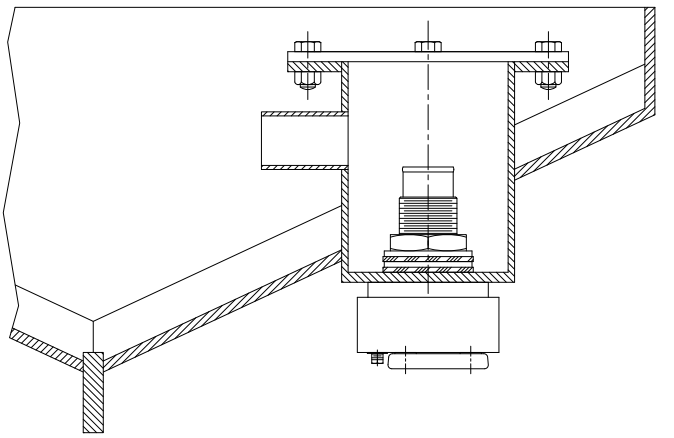

FIG.4 Canted Installation with Cofferdam.

1.5.3 If the unit is recessed into the hull, make sure that there is 1-1/2 in. (38 mm) minimum clearance on all sides (this does not include between the hull and the top of the cooler). The recess should be no deeper than 1/2 in. (13 mm) plus the hull projection (listed on installation drawing) of the cooler.

1.5.4 In extreme cases, where logs, debris, or dragging bottom may endanger the unit, a protective guard may be mounted over the unit. Make certain the guard does not cover more than 25% of the face opening. For examples of protective guards and different installations that have been used, see Figures 5 and 6.

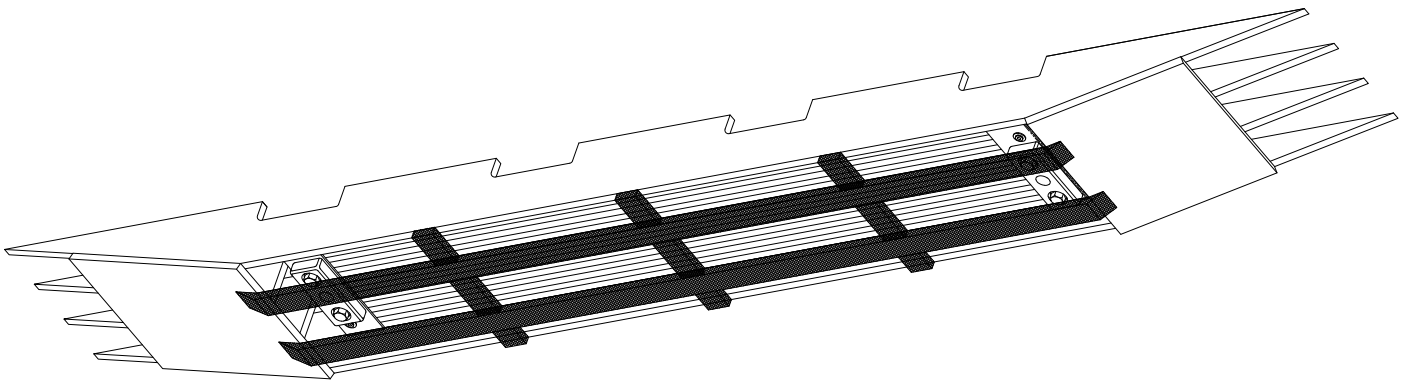

FIG.5 Example of external guarding

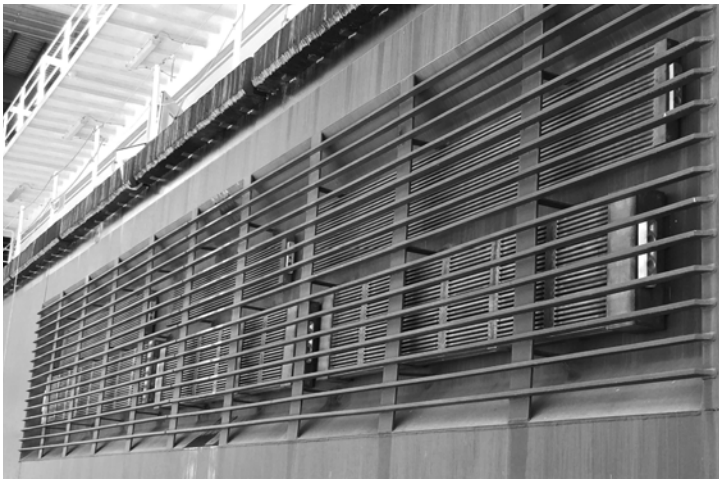

FIG.6 Side mounted coolers

1.5.5 Copper-nickel units can be bent to conform to the hull. The bending can be done at the yard or by R. W. Fernstrum & Company. Contact us if you are considering bending a unit. See Section 4.1 – Bending A GRIDCOOLER® Keel Cooler. The bending of aluminum keel coolers is not recommended.

1.6 MOUNTING CONSIDERATIONS – DISPLACEMENT VESSELS

1.6.1 Owners of vessels with displacement hulls moving at less than 10 knots may find an external mounting with fairing blocks to their advantage; provided there isn't much chance of the unit being damaged in their operating environment

1.6.2 When recessing the unit into the side of the hull for generator sets and/or equipment operating at dockside, angle the top of the recess box to improve convection current over the cooler. See Figure 7.

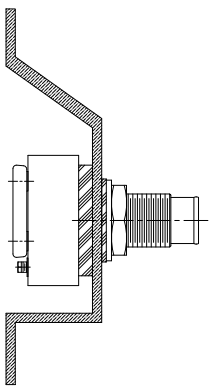

FIG.7 Side Mounted Recess.

NOTE: Recess box with angled top suggested for generator set and equipment operating at dock side only. NOT required for propulsion engines.

1.6.3 When installing a multiple-pass unit on an incline, make sure that the nozzles are at the high end to avoid air entrapment. See Figure 8.

1.6.4 If coolers must be installed with the nozzles at the low end, special units can be ordered with additional vents in the stud end of the cooler.

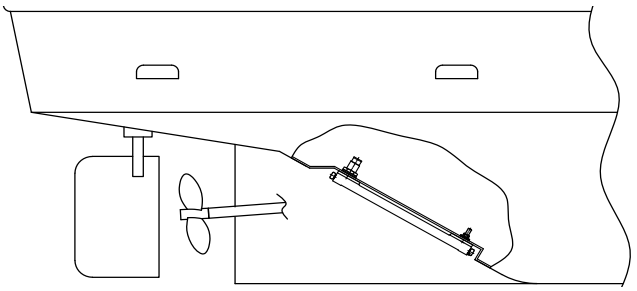

FIG.8 U-Flow unit with E1 OPTION end mounted anodes mounted on rake of vessel with nozzles positioned to avoid air entrapment.

1.6.5 If side plates and fairing blocks are used, make sure that the side plates are scalloped (notched) out so they will not entrap water. Fairing blocks are most effective when installed with a 4 to 1 slope. See Figures 1 & 5.

1.7 MOUNTING CONSIDERATIONS – PLANING VESSELS

1.7.1 We recommend using a recess on planing hulls and vessels moving at 10 or more knots.

1.7.2 High speed applications (10+ knots) can reduce the 1-1/2 in. clearance recommendation in section 1.5.3 to 1/2 in. minimum due to increased raw water flow over the cooler at high speed.

1.7.3 High speed applications and others that use E1 OPTION™ coolers should take into consideration the removal and replacement of anodes and drain plugs when sizing the length of a recess. See Figure 2.

1.8 BONDING OR ISOLATION TO MINIMIZE CORROSION

1.8.1 It is recommended that the installer consult with a corrosion engineer to review the corrosion protection system of the vessel to determine the best mode of installation for their particular situation.

1.8.2 Typically, it is common practice to isolate the keel cooler from the hull. This ensures that the antifouling property of the copper-nickel is at full potential. However, there are other variables that may affect the decision whether to isolate or bond the unit.

2.0 INSTALLATION

Once you have decided on the correct location, use the following steps as a guideline for installing your GRIDCOOLER® Keel Cooler.

2.1 MAKING HOLES

2.1.1 Measure the distance between the inlet & outlet nozzles from center to center (also measure to the centers of the support studs when applicable) before cutting holes for them in the ship's hull.

2.1.2 Make the holes through the hull 1/4 in. (6.4 mm) diameter oversized.

2.1.3 Make sure that the hull surfaces where the unit will be mounted are smooth and properly aligned (on steel hulls, if you burn the holes, grind the edges smooth afterwards). This will allow the gaskets to seal properly and ensure that no undue stress will be placed on the cooler.

2.2 FITTING UP

2.2.1 Under normal conditions, the compression of the mounting gaskets puts sufficient tension on the nozzle nuts (and support bolt nuts when applicable) to prevent them from working loose. To seal out water, apply a bead of sealant to the exterior of the gaskets, and around the points where the nozzles and support bolts penetrate the hull before assembly.

2.2.2 Remember to tighten the nuts again, after the caulking has set.

2.3 COPPER-NICKEL INSTALLATION

2.3.1 Mounting gaskets supplied with the GRIDCOOLER Keel Cooler must be used to provide proper spacing between the unit and the ship's hull. See Figure 9. For exterior gasket thickness see the chart below, all exterior gaskets are available in ¼" on request

EXTERIOR GASKET THICKNESS				
B	BN	C	CN	D
¼" 6.4mm	½" 12.7mm	¼" 6.4mm	½" 12.7mm	¾" 19mm

NOTE: INSULATORS: Insulators for galvanic isolation of through-hull installation studs and nozzles are available upon request at time of purchase. When requesting the insulators, provide hull thickness so the insulators can be supplied at the proper length.

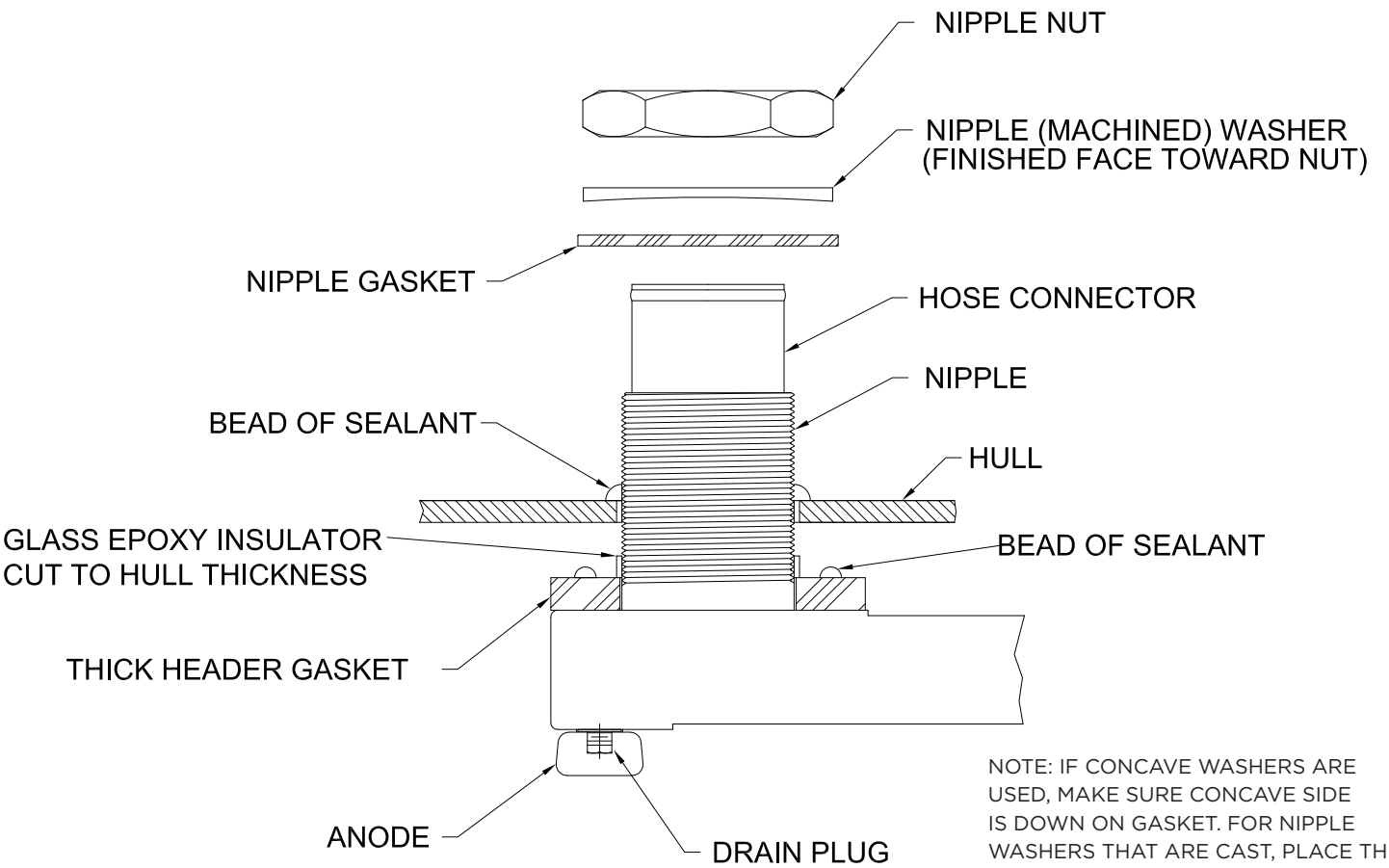

FIG.9 Mounting Parts Placement

2.3.2 To avoid over-tightening any of the supporting nuts, we recommend the following torques for all standard installations:

COPPER-NICKEL UNIT NUT TORQUES FT.-LBS. (KG-M)			
NOZZLE THREAD SIZE			
¾" 19mm	1 - 1 ½" 25 - 38mm	2" 51 mm	2 ½ - 3 ½" 63 - 89mm
50 - 60 (7 - 8)	75 - 100 (10 - 14)	125 - 150 (17 - 21)	200 - 250 (28 - 35)
HEADER STUD		SUPPORT BOLT	
⅝ - ¾" 16 - 19mm	1" 25 mm	½ - ¾" 13 - 19mm	
35 - 40 (5 - 5 ½)	50 - 60 (7 - 8)	20 - 25 (3 - 3 ½)	

2.3.3 Anodes are standard equipment with copper-nickel units. They minimize the effects of galvanic corrosion and should be replaced when deteriorated. The life of these plates varies with localities.

2.3.4 Attach the anodes using the special bolts and washers supplied with the unit. They can be found in a cardboard box inside the unit shipping box. See Figure 10.

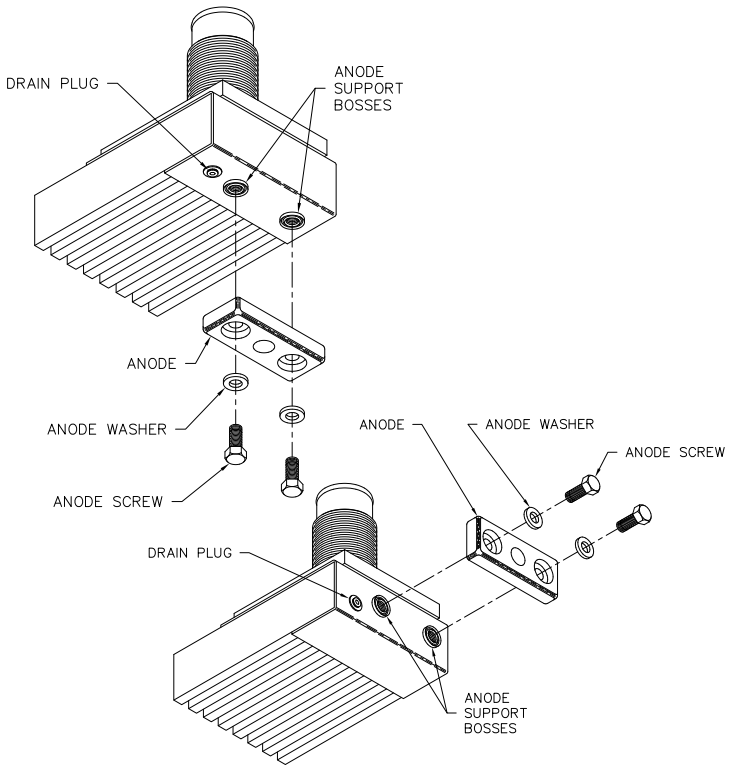

FIG.10 Anode Attachment Detail

NOTE: Anode replacement kits, including anodes, screws, and washers, can be ordered from the factory. They are available with zinc anodes or aluminum anodes upon request. Please provide the model number of your GRIDCOOLER® Keel Cooler to ensure the proper replacement anodes are sent.

2.4 ALUMINUM INSTALLATIONS

2.4.1 Aluminum GRIDCOOLER Keel Coolers should be installed on unpainted aluminum hulls only.

2.4.2 The 1/4-inch mounting gaskets supplied with the unit must be used to provide proper spacing between the cooler and the ship's hull.

2.4.3 To avoid over-tightening any of the supporting nuts, we recommend the following torques for all normal installations:

ALUMINUM UNIT NUT TORQUES FT-LBS (KG-M)		
NOZZLE THREAD		SUPPORT BOLT
1" 25 mm	1 ½ - 3" 38 - 76mm	⅝" 16mm
75 - 100 (10 - 14)	125 - 150 (17 - 21)	20 - 25 (3 - 3 ½)

2.4.4 Most aluminum units have tapered threads on the nipples and no hose connectors (see installation drawing). These units can be piped directly to the engine, provided flexible couplings are used to remove engine vibration between the engine and the cooler.

2.4.5 If a wire reinforced rubber hose is used to connect the unit to the engine, put a screw-on coupling over the cooler nozzle threads.

2.4.6 Aluminum GRIDCOOLER Keel Coolers do not use anodes.

2.5 PLUMBING

NOTE: Prior to installing cooler, flush entire piping system to remove any debris.

2.5.1 Remove the orange nozzle plugs from the GRIDCOOLER unit before hooking up the plumbing to the cooler.

2.5.2 Engines equipped with inboard raw water heat exchangers may not be able to be converted to keel cooling, please consult your engine dealer and Fernstrum representative for guidance.

2.5.3 As a rule-of-thumb, the expansion tank for your cooling system should be able to hold approximately

10% of the total cooling system coolant. Contact your engine dealer for the exact size.

2.5.4 When piping, do not use tubing or fittings smaller than the engine or keel cooler connections. If those on the engine are larger than those on the keel cooler, reduce the piping at the keel cooler, not the engine. Use a minimum of elbows and check all connections for leaks. All high areas in piping must be vented.

2.5.5 To avoid transmitting engine vibrations to the GRIDCOOLER unit, use wire reinforced rubber hoses and clamps at the engine and keel cooler connections.

2.5.6 When installing a multiple-pass unit in a side mounted position, the inlet line should be connected to the lower nozzle to force air up and out of the cooling system. Special units can be ordered with additional air bleeding vents in the stud end of the cooler.

2.5.7 To avoid air pockets that would restrict coolant flow through the system and cause overheating, install the piping between the engine and the cooler so that it is self- venting.

NOTE: Depending on installation, special air bleeding vents are available as an option.

2.5.8 For piping diagrams for multiple cooler installations, see Figures 11 through 14.

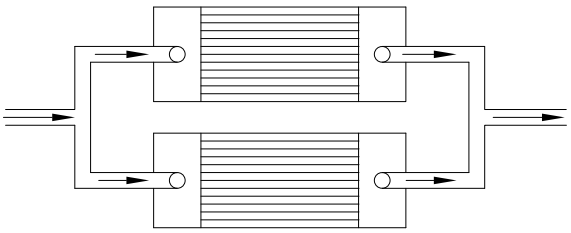

FIG.11 Coolers connected in parallel

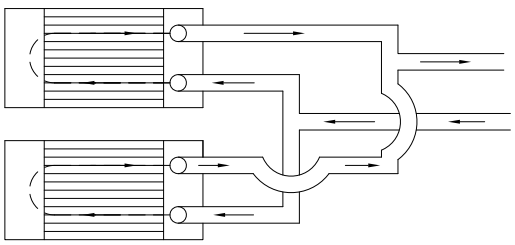

FIG.12 Multiple-pass coolers connected in parallel

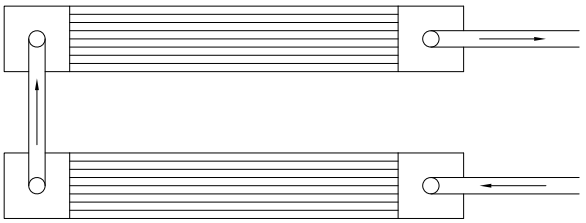

FIG.13 Coolers connected in series

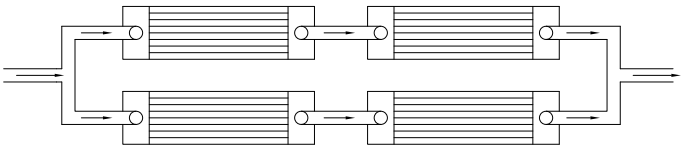

FIG.14 Coolers connected in series parallel

2.6 FILLING & TESTING

NOTE: Do not exceed 35 PSI (2.41 Bar) when pressure testing a GRIDCOOLER® Keel Cooler.

2.6.1 Always premix ethylene glycol (antifreeze) with water before adding it to the cooling system. Contact your engine dealer for the proper antifreeze type and percentage for your engine. We do not recommend the use of propylene glycol in your cooling system.

2.6.2 Never mix ethylene and proplyene glycol-based antifreezes in your cooling system.

2.6.3 When installing a GRIDCOOLER Keel Cooler in a side mounted position, it is important that the unit is completely filled with coolant before launching the vessel. This can be accomplished by using the following procedure:

2.6.4 At the outlet end of the unit, remove the upper drain plug and fill the unit with coolant

2.6.5 When coolant runs out of the upper drain, replace the plug.

2.6.6 The unit is now filled with coolant. If the system is ever drained, you must repeat this procedure.

3.0 SPECIAL INSTALLATIONS

3.1 COFFERDAM INSTALLATION WITH COMPRESSION SEALING KIT

3.1.1 Place a continuous bead of sealant around the header gasket that separates the GRIDCOOLER® unit from the outer hull. Customers have reported good success with polysulfide rubber sealants.

3.1.2 Place a second continuous bead of sealant on the inner hull around the nipple. This bead must be in contact with the hull and the nipple.

3.1.3 Hoist the unit up into the mounting position. The exterior header gasket must be in full contact with the hull.

3.1.4 Place the nipple gasket (harder of the two interior gaskets) down over the nozzle as far as possible.

3.1.5 Place the unfinished cast washer down over the nipple as far as possible. The side of the washer marked “up” must face away from the hull.

3.1.6 Place the compression gasket (softer of the two interior gaskets) down over the nipple as far as possible.

3.1.7 Place the semi-finished washer down over the nipple, finished side away from the hull.

3.1.8 Run the nut down over the nipple and torque to spec. (See chart in Section 2.3.2)

3.1.9 Torque the nut to spec a second time after the sealant has set.

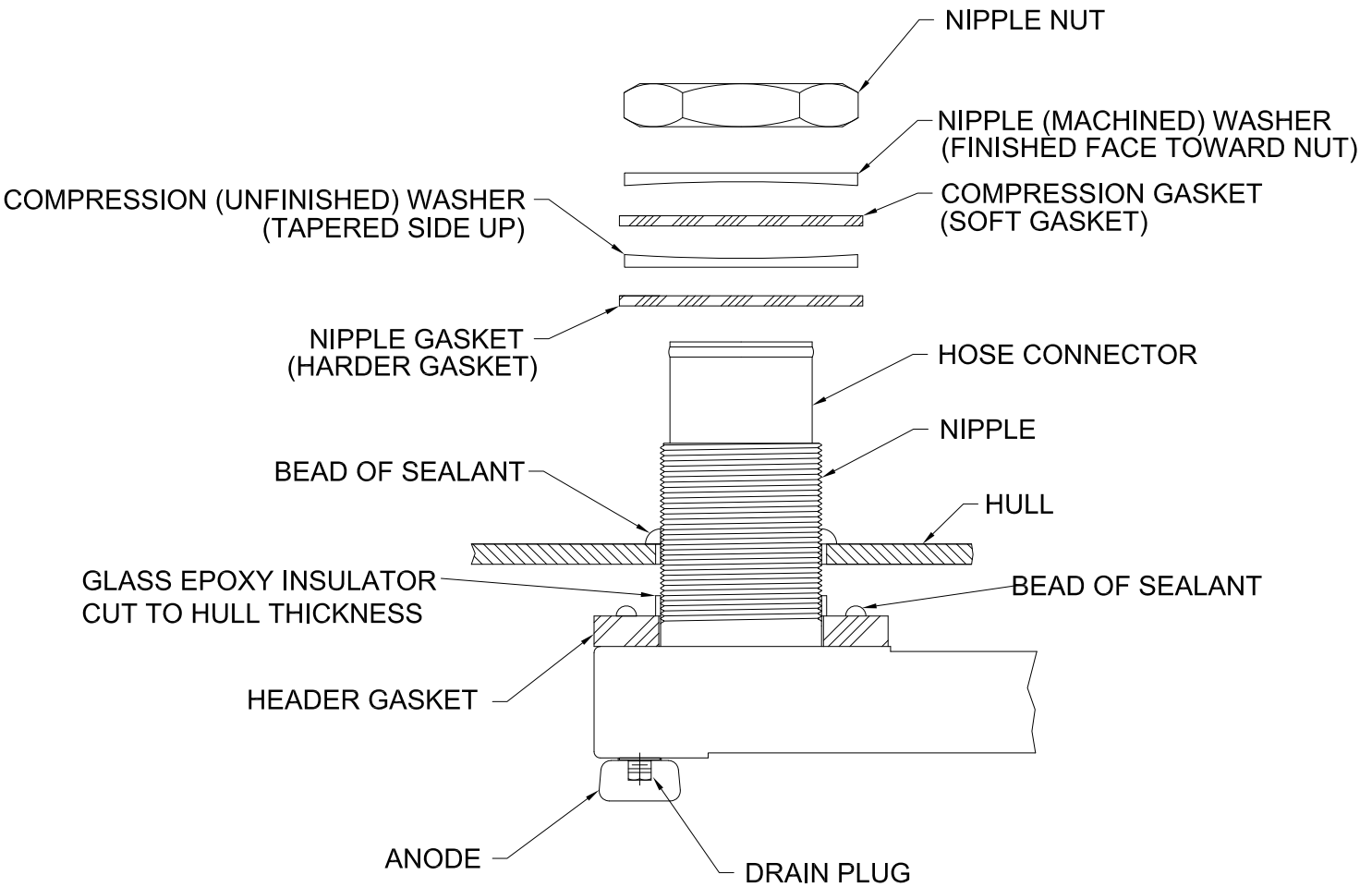

FIG.15 Compression Sealing Parts Replacement

OPTION: For ease of installation and maintenance, pipe to the side of the cofferdams. (see Figure 16)

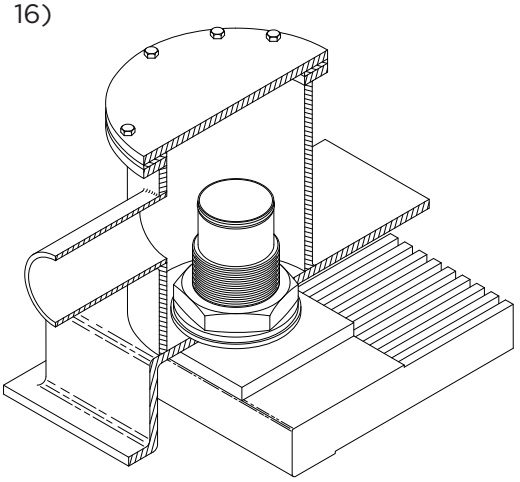

FIG.16 Pipe to side of cofferdam

3.2 Z OPTION™ INSTALLATIONS

3.2.1 The Z OPTION GRIDCOOLER Keel Cooler replaces the standard through-hull nozzle mounting/ connecting means with a copper-nickel flange, fused to the header. This flange utilizes a plurality of stainless-steel mounting studs locked in place by set screws to allow replacement in the event of damage.

3.2.2 The unit is also supplied with mating ASTM steel flanges and flange mounting hardware. The supplied hardware illustrated in Figure 17 includes nylon shoulder washers combined with neoprene gaskets to allow isolation from the vessel's hull. Special extra heavy lock nuts and washers are provided for a secure installation.

3.2.3 Flange mounting hardware can be found in a cardboard box inside the unit shipping box.

3.2.4 The mating steel flange is welded to a pipe stub extending from the hull of the vessel. This pipe stub must be long enough to allow access to the flange lock nuts for tightening. Alignment of the flanges on the hull is critical. We suggest that a template be made of the cooler to aid with the proper alignment of the flanges.

NOTE: Temporarily remove nylon shoulder washers while welding. Re-insert prior to mounting cooler

The torque specification for the flange nuts is as follows:

FLANGE NUT TORQUE SPECIFICATIONS	
⅝" diameter or larger stud	**½" diameter stud**
35 - 40 FT. LBS.	**20 - 25 FT. LBS.**

NOTE: Z OPTION units utilize our L OPTION™ support plates for intermediate mounting of the cooler. See the next section for L OPTION mounting instructions.

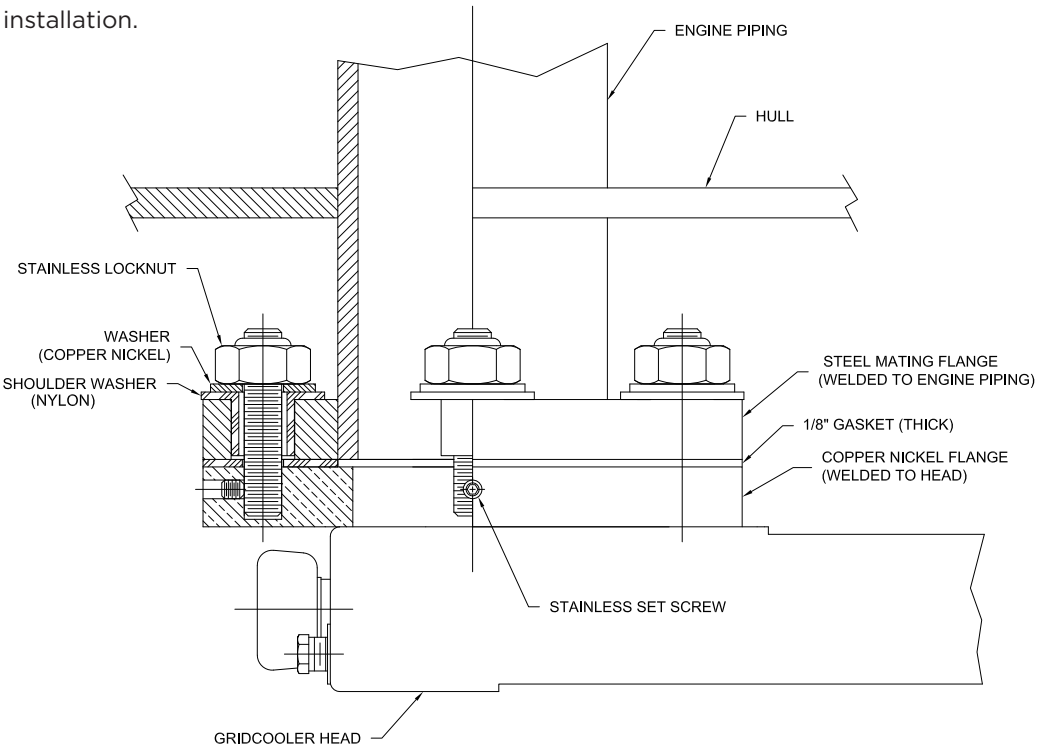

FIG.17 Z OPTION mounting detail

3.3 L OPTION™ SUPPORT PLATE INSTALLATION

The L OPTION support plates do not require a through-hull penetration. These support plates extend beyond the sides of the keel cooler allowing the customer the option to weld a mounting stud directly to the hull or to weld a short piece of angle to the hull as a securing means. The customer can then install the appropriate fasteners for the support plates. Figures 18 and 19 show examples of this style of mounting. The combination of the neoprene gasket and the nylon shoulder washer provide isolation of the cooler from the hull.

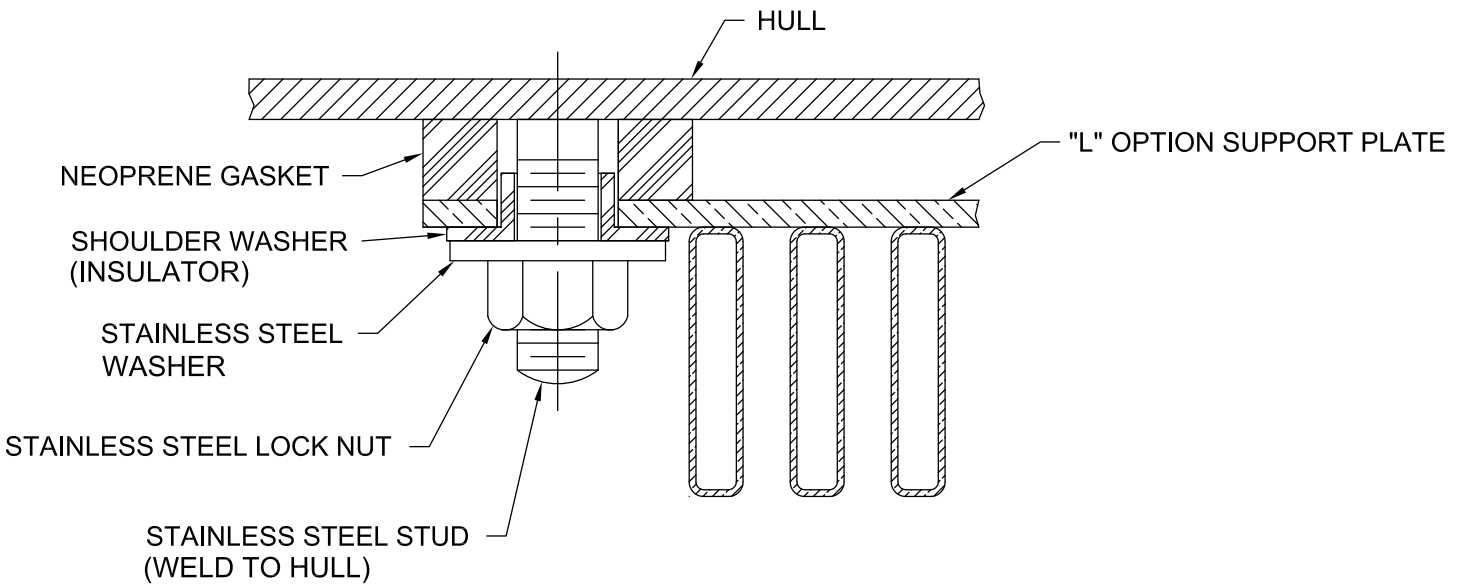

FIG.18 L OPTION support plate with stud welded to hull

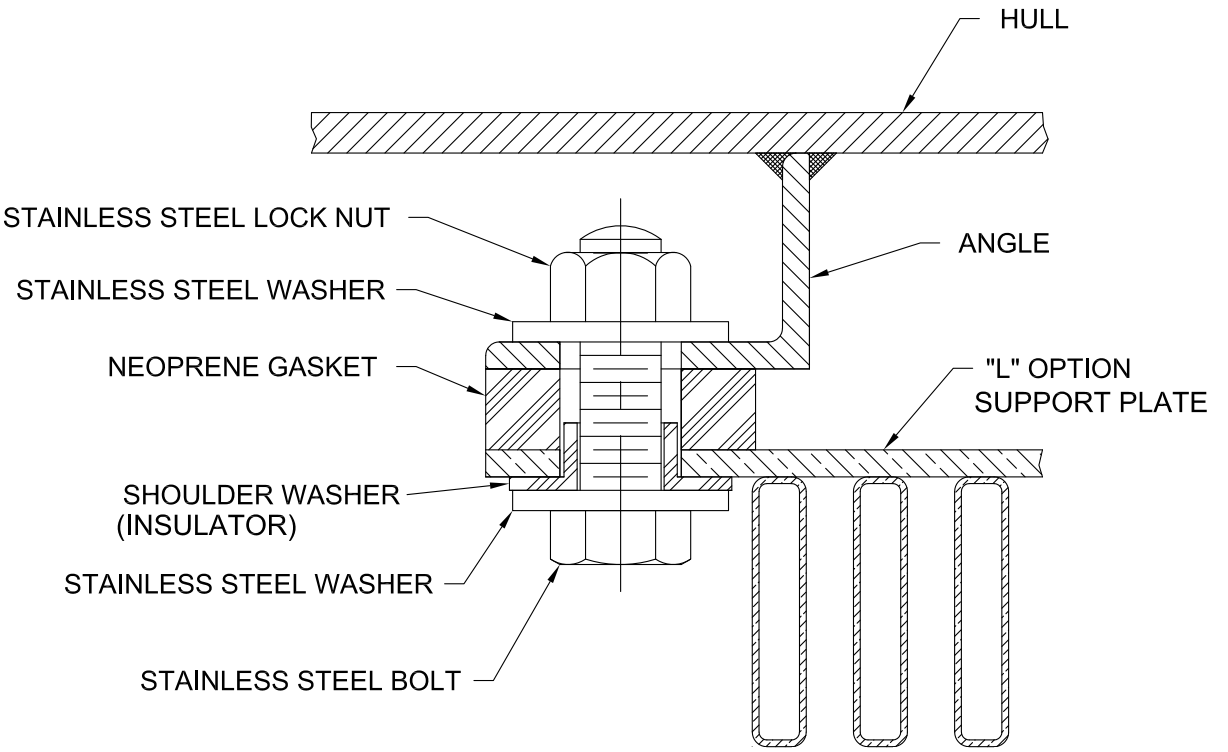

FIG.19 L OPTION support plate with angle welded to hull

3.4 MOUNTING COPPER-NICKEL COOLERS ON ALUMINUM HULLS

3.4.1 An electrical barrier must be placed between the GRIDCOOLER® unit and the hull. R. W. Fernstrum & Company does not formally approve any method of installing a copper-nickel GRIDCOOLER Keel Cooler on unpainted aluminum hulled vessels. However, the following technique has been used on hundreds of boats.

3.4.2 Sandblast the area of the hull where the unit will be installed.

3.4.3 Coat the sandblasted area with a two-part fiberglass epoxy resin.

3.4.4 Spray the resin on in four separate coats. Do not use any matting. Spray each coat just heavy enough so that it does not start to run off.

3.4.5 After spraying on the fourth coat, and while the resin is still tacky, prime the entire area with the hull priming paint used on the rest of the vessel's hull.

3.4.6 Apply the final bottom paint, and then install the cooler.

4.0 FORMING THE GRIDCOOLER® KEEL COOLER

BENDING A GRIDCOOLER KEEL COOLER

When bending a cooler in a press, support the cooler from underneath with wood blocking across the entire width of the unit. Blocking is also placed on top of the cooler, centrally located between the wood blocking underneath the cooler. The location of the wood blocking on the top of the cooler will determine the location of the bend. Since this method of bending exerts pressure on only a small area, the cooler will need to be repositioned multiple times to produce an even bend over the length of the cooler. Care must be taken to ensure that the unit is not bent too far at any one point. A tape measure or other measuring instrument, along with a template of the hull profile can be used to measure your progress. See Figures 20 and 21.

TWISTING A GRIDCOOLER KEEL COOLER

To produce a twist, first fabricate a hook onto the end of a short length of pipe using barstock. Hook this bar across the header as close to the nipple or stud as possible. The cooler may be secured in a press or placed on sawhorses with a person at each end. By placing your weight on the end of the pipe, you can produce a twist in the cooler. See Figures 22 and 23.

NOTE: Do Not Bend greater than 1" (25 mm) over 12" (305 mm) of cooler length. Do Not Twist beyond 1° over 12" (305 mm) of cooler length. Do Not Tension Bend the keel cooler.

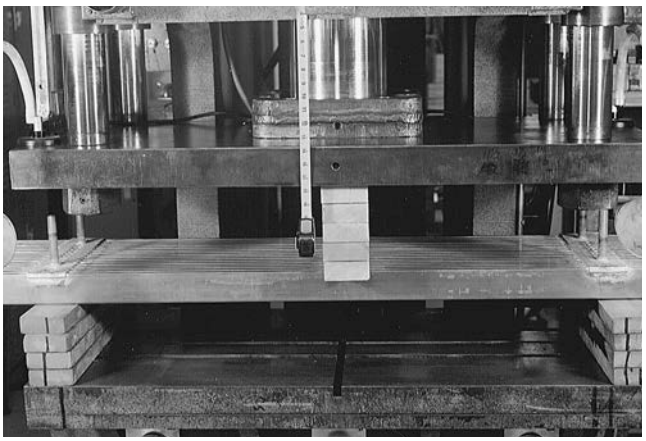

FIG.20 Creating a bend in a cooler using a hydraulic press

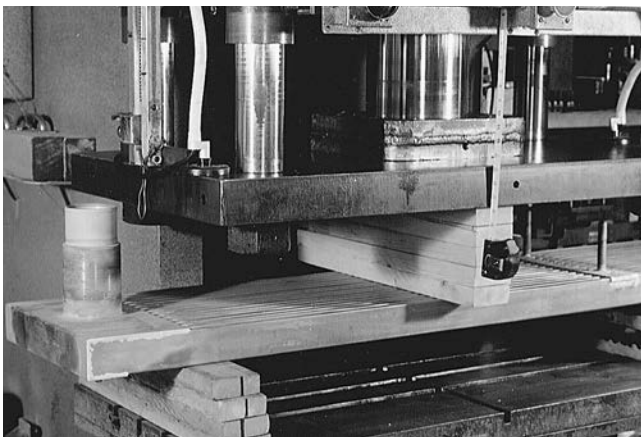

FIG.21 Creating a bend in a cooler using a hydraulic press

FIG.22 Locate twisting hook as close as possible to the nozzle or stud

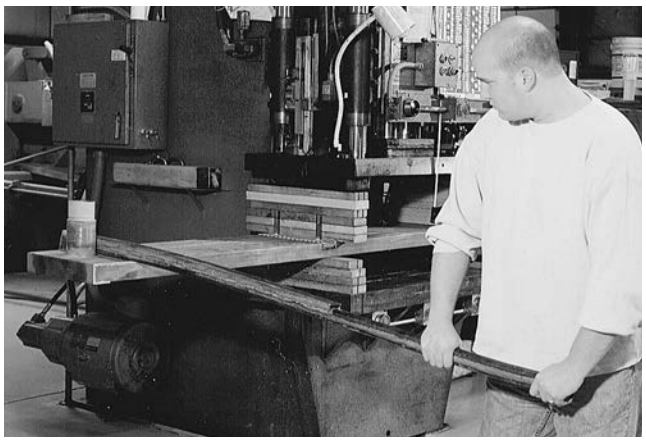

FIG.23 Carefully apply downward force to impart a twist in the cooler

5.0 PERFORMANCE ISSUES

Determining the cause of overheating can be difficult. Here are some things to look for:

WIRE REINFORCED RUBBER HOSE:

Could the rubber hose connecting the engine piping and the cooler be collapsed? This could cut the cooling water supply to the unit and reduce its efficiency. Be sure you are using wire reinforced rubber hose.

PIPING:

Is the piping between the engine and the cooler as large or larger than the engine and cooler connections? (See section 2.5.4 under plumbing.) The piping should also be self-venting and arranged so that a minimum number of elbows are used.

JACKETWATER:

Is the coolant circulating through the cooler? It may be taking a path of least resistance through the bypass (if one exists).

THERMOSTAT:

Could the thermostat be stuck, or could the wrong thermostat be in use? If so, it could give you a faulty temperature.

CIRCULATING PUMP:

Is the circulating pump working properly? If not, it could reduce the cooling systems efficiency.

AIR IN THE SYSTEM:

Was the unit installed in a way to allow all the air in the system to escape? When a multiple-pass unit is mounted on the rake of the vessel, make sure that the nozzles are mounted in the up or high position. See sections 1.6.3, 2.5.6, 2.5.7, & 2.6.3 under Installation. See Figure 8

FOREIGN MATTER:

Could anything have gotten into the cooler nozzles? Make sure that the orange plastic cap plugs covering the ends of the hose connectors were removed and that no foreign matter, such as a rag, was dropped into the cooler nozzles.

EXPANSION TANK:

Could the water level be too low in the expansion tank? This can reduce the cooling system's efficiency.

EXTERNAL COATING:

Is the cooler painted or covered with any other coating? This will have an insulating effect and will greatly reduce the heat transfer rate of the unit. The standard recommendation is to not coat the keel cooler.

WATER AERATION:

Could the water around the cooler be aerated in any way? Aeration will reduce the heat transfer rate of the keel cooler.

MOORED AT DOCK:

Is the engine temperature rising while the vessel is moored in dock? If the unit is installed near the propeller, engage the propeller to circulate water past the unit, after taking the proper safety precautions.

PLACEMENT:

Is an aftercooler circuit overheating? Make sure that the low temperature cooling circuit is mounted forward of or closer to the skeg or keel than the jacketwater coolers.

MOUNTING GASKETS:

Were the mounting gaskets put in place when the unit was installed? The mounting gaskets supplied with the cooler must be used to provide adequate spacing between the unit and the ship's hull. This will allow water to flow freely over the cooler tubes.

GLYCOL:

How much glycol (antifreeze) is in the system? Perhaps the cooler was not sized for the use of glycol in the system.

NOTE: Always premix glycol with water before adding it to the cooling system.

NOTE: Never mix ethylene and propolyene glycol.

CRUSHED TUBES:

Have the rectangular tubes on the cooler been crushed or pinched? This could restrict the internal water flow.

BLOWN TUBES:

Could the rectangular tubes on the unit have been blown or bulged by unusually high pressures? If so, the exterior water flow past the unit tubes could be impaired, retarding heat transfer.

MARINE GROWTH:

Has your vessel been in dock for several months? You may find marine growth on the unit which will hinder the unit's heat transfer rate. See Maintenance Section.

OIL DEPOSITS:

Have you had engine problems? Oil may have gotten into the cooling water system and collected in the cooler, coating it with an oil film. See Maintenance Section.

MINERAL DEPOSITS:

Could you be using hard water in the system? Mineral Deposits can collect on the tube in the cooler, lining the inside with lime, calcium, etc. See Maintenance Section.

6.0 MAINTENANCE

A GRIDCOOLER® Keel Cooler that is clean inside and out will dissipate heat most efficiently. To keep your unit clean, a periodic check of the cooling system is recommended. What follows are some ways to clean your GRIDCOOLER unit.

EXTERIOR

If the GRIDCOOLER Keel Cooler is used regularly, the 90/10 copper-nickel alloy in conjunction with the unit's operating temperature will tend to keep the exterior of the unit relatively free of marine growth. However, if the unit is not in operation for extended periods of time, marine growth may result. Below are some ways of removing marine growth, paint, etc. from the exterior of the GRIDCOOLER unit:

SCRAPE:

Scraping is an effective way of removing larger matter from a cooler. The use of a rectangular instrument works best.

PRESSURE WASHING:

Pressure washing is effective in cleaning many things off of a cooler. Do not exceed 3000 psi (206.84 bar).

SANDBLAST:

Sandblasting is also very effective, but very fine sand such as 40 to 60 grit blasting media should be used.

For suction blast do not exceed 90 psi (6.21 bar).

For pressure pot blasting do not exceed 35 psi (2.41 bar).

NOTE: Never sandblast an ALUMINUM GRIDCOOLER unit.

PAINTING:

Coolers do not require painting. Doing so will decrease the unit's efficiency.

ANODES:

Anodes are standard equipment with most copper-nickel units. They minimize the effects of galvanic corrosion and should be replaced when deteriorated. The life of these anodes varies with localities.

Anode replacement kits, including anodes, screws, and washers, can be ordered from the factory. When contacting our sales representatives, provide the model number of your GRIDCOOLER Keel Cooler. Anodes are available in aluminum or zinc material.

NOTE: Anodes installed on coolers provide immediate protection to the cooler only. When using an active protective system, the cooler should be taken into consideration during the hull survey.

INTERIOR

The interior of your GRIDCOOLER unit may need periodic cleaning to remove oil, old glycol, mineral deposits, etc. The easiest and most convenient way of doing this is the use of a radiator flush. Contact your engine dealer for the proper radiator flush type for your engine.

PRESSURE TESTING

Do not exceed 35 psi (2.41 bar) when pressure testing a GRIDCOOLER® Keel Cooler.

7.0 REPAIR

For a unit in warranty, attempt no repairs without first contacting the manufacturer, otherwise your warranty will be void.

For a unit out of warranty, if the unit is accidentally damaged while in use, you can make minor shipyard repairs as follows:

STRAIGHTENING

If the tubes are accidentally bent, they can be straightened with a hard wood block and a mallet. See Figure 24.

FIG.24 Straightening tubes with a wooden block & mallet

COPPER-NICKEL GRIDCOOLER® KEEL COOLER REPAIRS

BRAZING:

Drain the cooler before brazing. Clean the area or joint to be brazed thoroughly with a good degreasing solvent followed by wire brushing. The braze wire should be 56% silver, AWS A5.8 BAg-7. See Figure 25.

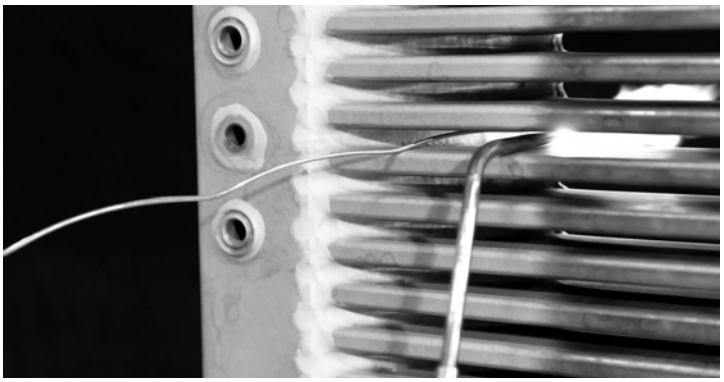

FIG.25 Brazing repair

TIG WELDING:

C70600 copper-nickel or monel 67 wire may be used.

TEMPORARY REPAIR

For temporary repairs, liberally apply an epoxy compound.

Before applying the epoxy compound, clean the surface of the GRIDCOOLER unit and relieve any internal pressure.

For major repairs not covered by our Limited Warranty, contact us. Give us a complete description of the damage, and we will tell you if and how your unit can be repaired.

TUBE COUPLING REPAIRS

A damaged section of D or C tube can be replaced with two couplings and a replacement length of tube brazed in place.

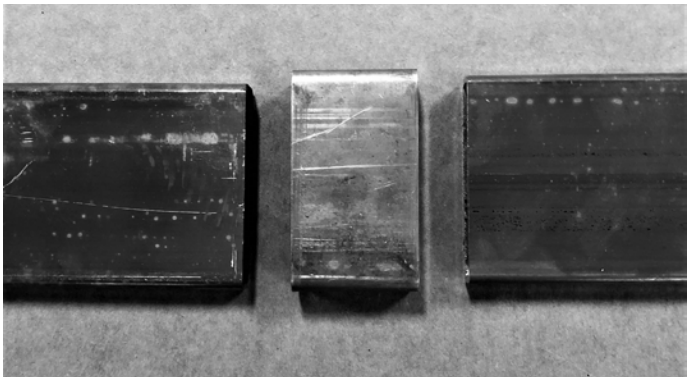

FIG.26 Replacing a section of tube

A single coupling can be cut or split, slid over the tube, and brazed into place to patch a hole in a tube.

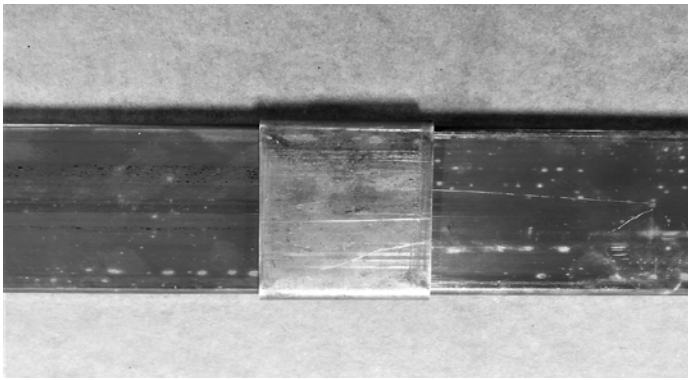

FIG.27 Patching a hole in a tube

ALUMINUM GRIDCOOLER KEEL COOLER REPAIRS

TIG WELDING:

Drain the cooler before welding. Clean the area or joint to be welded thoroughly with a good degreasing solvent followed by stainless steel wire brushing. The aluminum filler rod used in the GRIDCOOLER Keel Cooler is R 5554 aluminum wire.

8.0 STRAY-CURRENT CORROSION

Since Fernstrum's involvement in the design of any particular marine vessel is limited to the heat transfer requirements of the vessel, grounding or bonding of the keel cooler is best left to the person responsible for the design of the corrosion protection system. If the customer needs guidance on this issue it is suggested to isolate the cooler from the hull and monitor closely the condition of the cooler, anodes and surrounding hull area for the first few months. This is for the simple fact that it is easier to ground a cooler after installation than it is to isolate it.

When welding is taking place on the hull while in the water, steps should be taken to monitor the keel cooler for any possible stray current corrosion. For guidance on proper welding equipment connections for waterborne vessels, we suggest consulting either *NAVSEA S9086-CH-STM-010/CH-074R4 Welding and Allied Processes, Naval Ships' Technical Manual Chapter 74 - Volume 1*, or *ANSI/AWS D3.5:1993(R2000) Guide for Steel Hull Welding, Section 6 Stray Current Protection*. Note that the Section 6 of the ANSI/AWS D3.5:1993 standard comes directly from the document provided by NAVSEA.

If an impressed current system is used, it is best to consult the manufacturer of the system for their recommendations as to grounding or bonding of equipment mounted to the hull.

The product warranty is not affected by how the keel cooler is configured into the corrosion protection system, as it covers defects in material and workmanship, not failure due to galvanic or stray current corrosion.

The best plan of action is to have a corrosion engineer evaluate the corrosion protection scheme of the vessel and verify its proper function.

9.0 REPLACEMENT PARTS

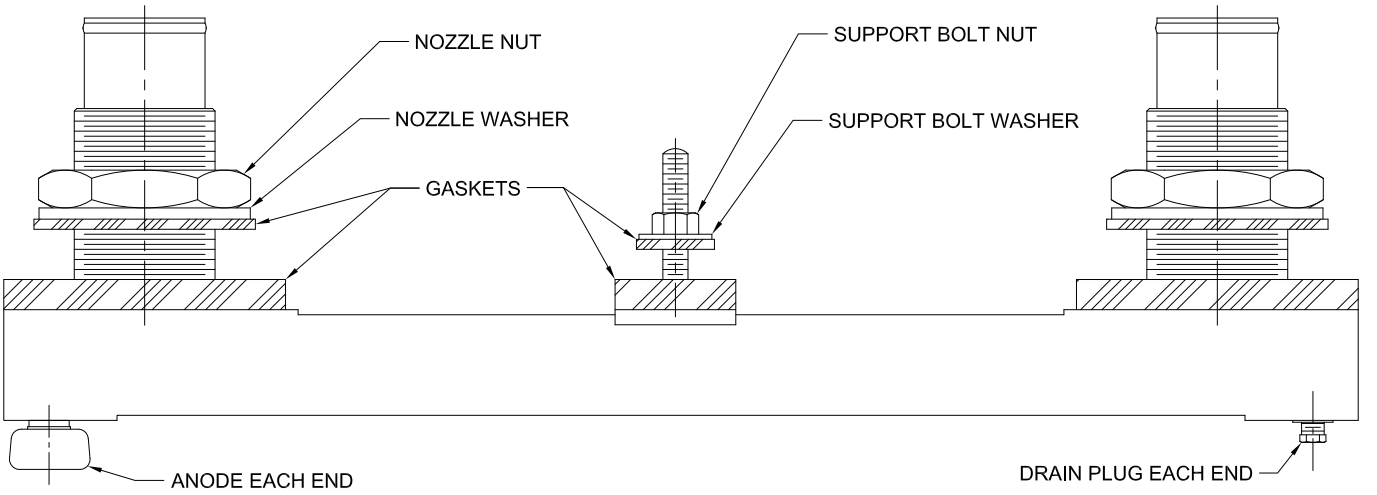

FIG.28 Single Pass Gridcooler Keel Cooler

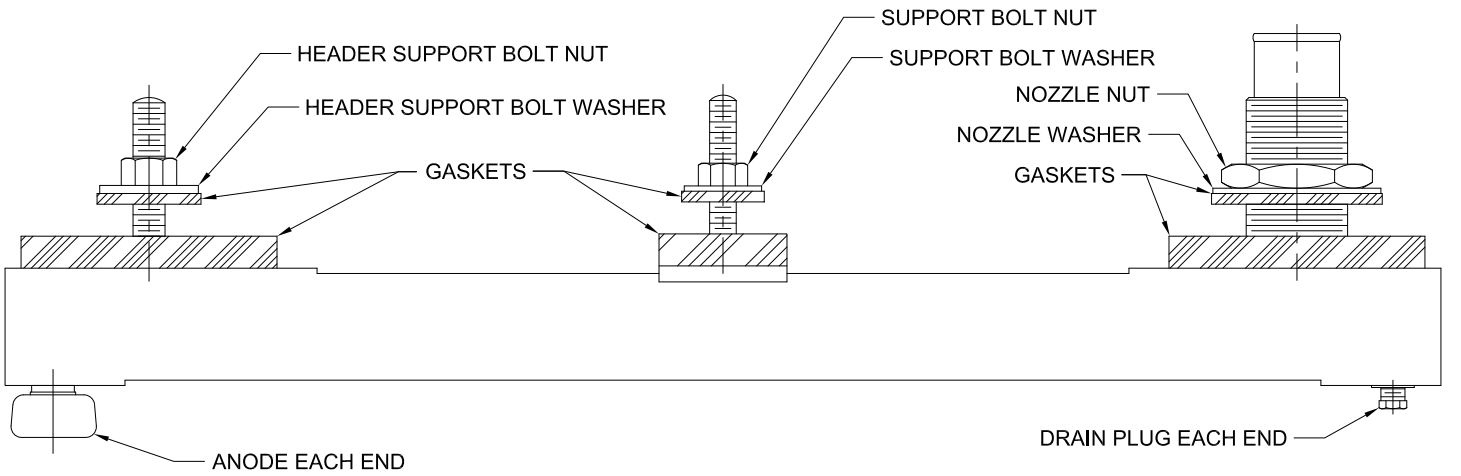

FIG.29 Multi Pass Gridcooler Keel Cooler

9.0 REPLACEMENT PARTS

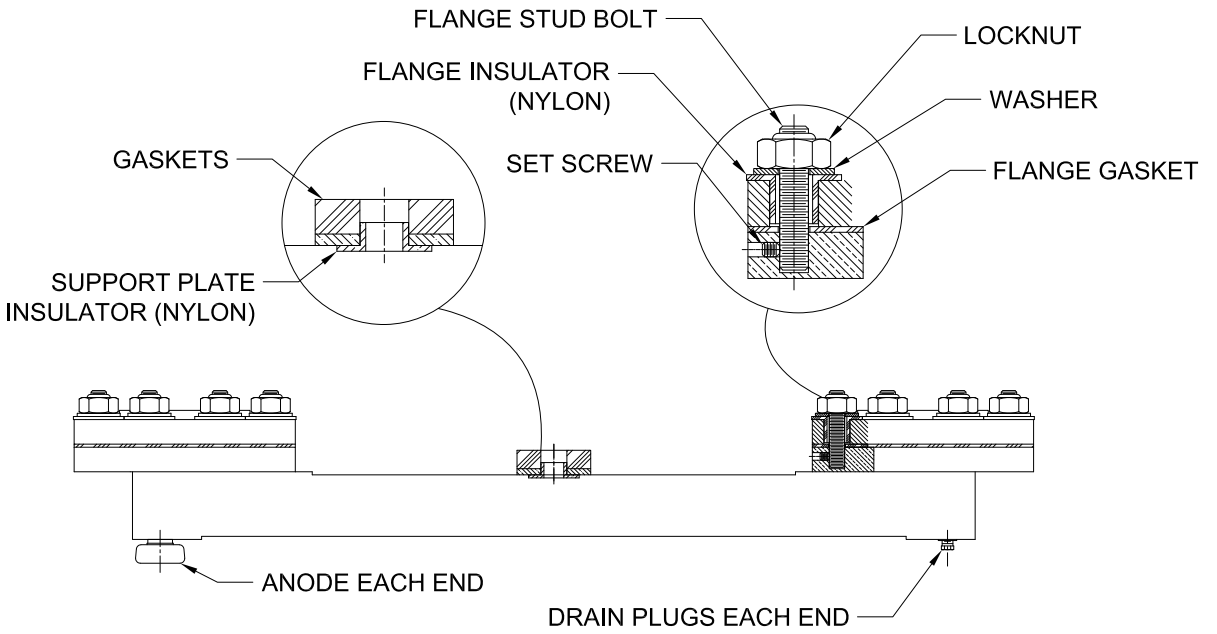

FIG.30 Z-Option Single Pass Gridcooler Keel Cooler

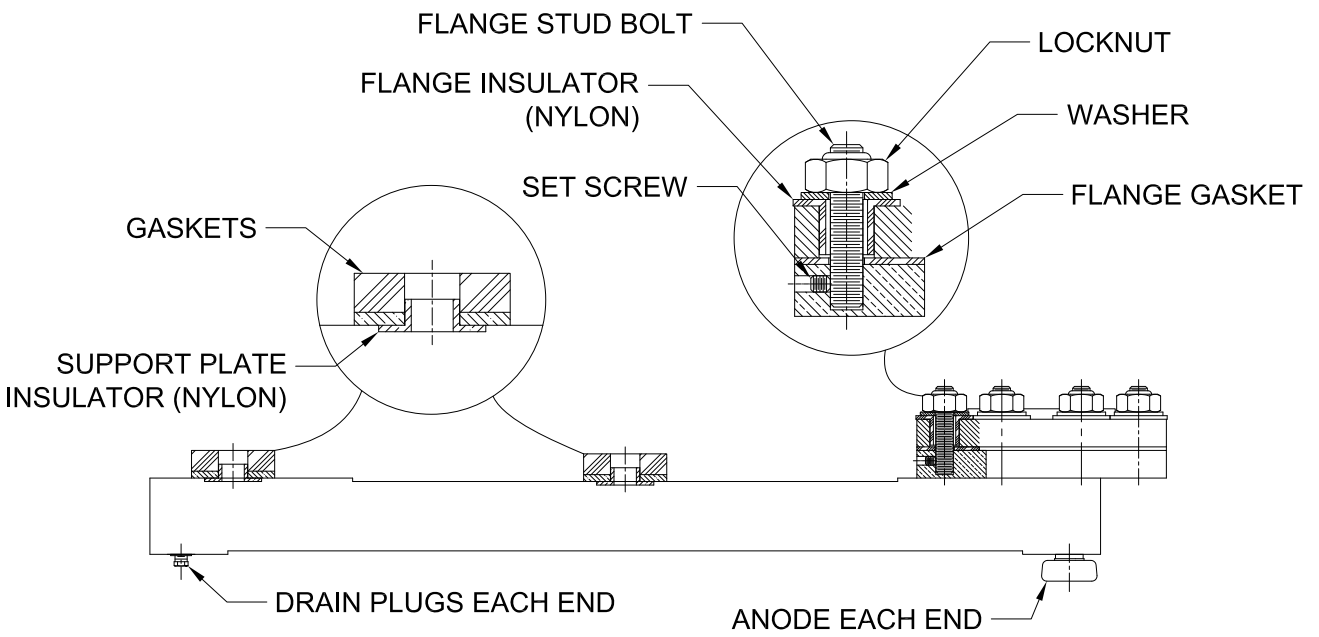

FIG.31 Z-Option Multi Pass Gridcooler Keel Cooler

NOTE: All gaskets are sold in complete sets. Gasket sets include all internal gaskets, exterior gaskets and isolators.

NOTE: Anodes are sold in kits consisting of anodes and mounting hardware. Most Keel Coolers require one (1) anode kit. Larger Keel Coolers may require two (2) anode kits. Keel Cooler model number is needed to identify correct kit. Anodes are standardly sold in zinc, but can be aluminum upon request.

10.0 LIMITED WARRANTY

THIS LIMITED WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS AND YOU MAY ALSO HAVE OTHER RIGHTS, WHICH VARY FROM STATE TO STATE.

THE LIMITED WARRANTY CAN ALSO BE FOUND

ONLINE AT http://www.fernstrum.com/support/grid- cooler-keel-cooler/ AND IN THE DOCUMENTATION WE PROVIDE WITH THE PRODUCT.

WE WARRANT THAT DURING THE WARRANTY PERIOD, THE PRODUCT WILL BE FREE FROM DEFECTS IN MATERIALS AND WORKMANSHIP.

TO THE EXTENT NOT PROHIBITED BY LAW, THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, ORAL, WRITTEN, STATUTORY, EXPRESS OR IMPLIED. EXCEPT FOR THE EXPRESS WARRANTIES CONTAINED IN THIS LIMITED WARRANTY STATEMENT AND TO THE EXTENT NOT PROHIBITED BY LAW, WE DISCLAIM ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABI- LITY AND FITNESS FOR A PARTICULAR PURPOSE. SOME STATES DO NOT ALLOW DISCLAIMERS OF IMPLIED WARRANTIES, SO THIS DISCLAIMER MAY NOT APPLY TO YOU. TO THE EXTENT SUCH WARRANTIES CANNOT BE DISCLAIMED UNDER THE LAWS OF YOUR JURISDICTION, WE LIMIT THE DURATION AND REMEDIES OF SUCH WARRANTIES TO THE DURATION OF THIS EXPRESS LIMITED WARRANTY. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATION MAY NOT APPLY TO YOU.

OUR RESPONSIBILITY FOR DEFECTIVE GOODS IS LIMITED TO REPAIR OR REPLACEMENT AS DESCRIBED BELOW IN THIS WARRANTY STATEMENT.

10.1 WHO MAY USE THIS WARRANTY?

R.W. Fernstrum & Company, located at 1716 11th Ave. Menominee, Michigan 49858 USA ("we") extend this limited warranty only to the original purchaser of the product ("you"). This limited warranty does not extend to any subsequent owner or other transferee of the product.

10.2 WHAT DOES THIS WARRANTY COVER?

This limited warranty covers defects in materials and workmanship of the GRIDCOOLER® Keel Cooler (the "product") for the Warranty Period as defined below.

10.3 WHAT DOES THIS WARRANTY NOT COVER?

This limited warranty does not cover any damage due to: (a) transportation; (b) storage; (c) misuse, improper use or improper installation; (d) failure to follow the product instructions or to perform any preventive maintenance (e) modifications (f) unauthorized repair;

(g) normal wear and tear; or (h) external causes such as accidents, abuse, chemical, biological or electrical corrosion or other actions or events beyond our reasonable control.

10.4 WHAT IS THE PERIOD OF COVERAGE?

This limited warranty starts on the date of delivery and lasts for 90 days for the aluminum GRIDCOOLER® Keel Cooler, and lasts for 2 years for the copper-nickel GRIDCOOLER® Keel Cooler (the "Warranty Period"). The Warranty Period is not extended if we repair or replace the product. We may change the availability of this limited warranty at our discretion, but any changes will not be retroactive.

10.5 WHAT ARE YOUR REMEDIES UNDER THIS WARRANTY?

With respect to any defective product during the Warranty Period, we will, in our sole discretion repair or replace such product (or the defective part) free of charge. The cost of repair or replacement does not include labor, transportation, freight, haul-out, launch, towing, dry docking, storage charges, mechanic travel time, inconvenience, loss of time or income, removal and replacement and/or modifications of any boat parts to facilitate repair or replacement.

HOW DO YOU OBTAIN WARRANTY SERVICE?

To obtain warranty service, you must call (906) 863-5553 during the Warranty Period to obtain a Return Merchandise Authorization ("RMA") number. No warranty service will be provided without an RMA number. The product or part must be returned with the RMA number noted. You are responsible for the cost of shipping the returned product or part. Upon calling the above number, customer service will walk you through the steps to request warranty service.

LIMITATION OF LIABILITY

THE REMEDIES DESCRIBED ABOVE ARE YOUR SOLE AND EXCLUSIVE REMEDIES AND OUR ENTIRE LIABILITY FOR ANY BREACH OF THIS LIMITED WARRANTY. OUR LIABILITY SHALL UNDER NO CIRCUMSTANCES EXCEED THE ACTUAL AMOUNT PAID BY YOU FOR THE DEFECTIVE PRODUCT, NOR SHALL WE UNDER ANY CIRCUMSTANCES BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, SPECIAL OR PUNITIVE DAMAGES OR LOSSES, WHETHER DIRECT OR INDIRECT.

SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU.

WHAT CAN YOU DO IN CASE OF A DISPUTE WITH US?

The following informal dispute resolution procedure is available to you if you believe that we have not performed our obligations under this limited warranty: should a dispute arise, you should contact customer service at (906) 863-5553. You must use this informal procedure before pursuing any legal remedy in the courts. All such disputes shall be governed by the laws of the State of Michigan to the extent that the same do not conflict with the laws of the United States.

PLEASE KEEP THIS FORM ON THE VESSEL FITTED WITH THE GRIDCOOLER UNITS.
THE INFORMATION BELOW WILL BE OF USE FOR FUTURE REFERENCE.

ENGINE INFORMATION			GRIDCOOLER INFORMATION	
MAKE OF ENGINE	MODEL OF ENGINE	HP/RPM (KW/RPM)	MODEL OF GRIDCOOLER	QUANTITY

R.W. Fernstrum & Company • P.O. Box 97 • Menominee, Michigan 49858
Phone: 906.863.5553 • Fax: 906.863.5203 • Email: sales@fernstrum.com

11.0 RECOMMENDATION FORM

*Required Information

COMPANY NAME* _____

CONTACT NAME* _____

ADDRESS _____

CITY, STATE, ZIP CODE _____

COUNTRY _____

PHONE* _____ FAX _____

EMAIL* _____

VESSEL NAME / PROJECT NAME _____

PRODUCT DESIRED* GRIDCOOLER® Keel Cooler ☐ BOXCOOLER ☐

ENGINE TYPE* Propulsion ☐ Bow Thruster ☐ Generator ☐ Other _____

Emissions Data Tier 1 ☐ Tier 2 ☐ Tier 3 ☐ IMO ☐

Manufacturer* _____

Model* _____

Rating (BHP / RPM, BKW / RPM, EKW / RPM)* _____

Minimum Hull Speed at Full Rated Power (under full load)* _____

Maximum Sea Water Temp* _____ Engine Age _____ **% Antifreeze Used*** _____

Make & Model of Gear _____

Type of Boat (ferry, trawler, pleasure boat, etc.)* _____

Hull Construction* Steel ☐ Fiberglass ☐ Wood ☐ Aluminum Painted ☐

Cofferdam Installation ☐ Aluminum Unpainted ☐

Heat Rejection _____

Fresh Water Flow Rate _____

Fresh Water Temp into Cooler _____

Fresh Water Temp Out or Drop Across Cooler _____ ☐ Drop ☐ Out

Comments

_____

_____

_____

_____

_____

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_____

_____

_____

_____

FERNSTRUM®

R.W. Fernstrum & Company

fernstrum.com

Phone: 906.863.5553 • Fax: 906.863.5203 • Email: sales@fernstrum.com

P.O. Box 97 • 1716 11th Avenue • Menominee, Michigan 49858 • USA

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THERN

ATLAS CONSTRUCTION WINCH

Read this Owner's Manual thoroughly before operating the equipment. Keep it with the equipment at all times. Replacements are available from Thern, Inc., PO Box 347, Winona, MN 55987, 507-454-2996. www.thern.com

IMPORTANT: Please record product information on page 2. This information is required when calling the factory for service.

Owner's Manual

For
4WP2D Series
Worm Gear Power Winches

A8328A-0806

Two-Year Limited Warranty

Please record the following:

Date Purchased:

Model No.:

Serial No.:

This information is required when calling the factory for service.

Thern, Inc. warrants its products against defects in material or workmanship for two years from the date of purchase by the original using buyer, or if this date cannot be established, the date the product was sold by Thern, Inc. to the dealer. To make a claim under this warranty, contact the factory for an RGA number. The product must be returned, prepaid, directly to Thern, Inc., 5712 Industrial Park Road, Winona, Minnesota 55987. The following information must accompany the product: the RGA number, the date of purchase, the description of the claimed defect, and a complete explanation of the circumstances involved. If the product is found to be defective, it will be repaired or replaced free of charge, and Thern, Inc. will reimburse the shipping cost within the contiguous USA.

This warranty does not cover any damage due to accident, misuse, abuse, or negligence. Any alteration, repair or modification of the product outside the Thern, Inc. factory shall void this warranty. This warranty does not cover any costs for removal of our product, downtime, or any other incidental or consequential costs or damages resulting from the claimed defects. This warranty does not cover brake discs, as these are wear components and their life is subject to use conditions which vary between applications.

FACTORY AUTHORIZED REPAIR OR REPLACEMENT AS PROVIDED UNDER THIS WARRANTY IS THE EXCLUSIVE REMEDY TO THE CONSUMER. THERN, INC. SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR BREACH OF ANY EXPRESS OR IMPLIED WARRANTY ON THIS PRODUCT. EXCEPT TO THE EXTENT PROHIBITED BY APPLICABLE LAW, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ON THIS PRODUCT IS LIMITED IN DURATION TO THE DURATION OF THIS WARRANTY.

Some states do not allow the exclusion or limitation of incidental or consequential damages, or allow limitations on how long an implied warranty lasts, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Note: Thern, Inc. reserves the right to change the design or discontinue the production of any product without prior notice.

About This Manual

The Occupational Safety and Health Act of 1970 states that it is the employer's responsibility to provide a workplace free of hazard. To this end, all equipment should be installed, operated, and maintained in compliance with applicable trade, industrial, federal, state, and local regulations. It is the equipment owner's responsibility to obtain copies of these regulations and to determine the suitability of the equipment to its intended use.

This Owner's Manual, and warning labels attached to the equipment, are to serve as guidelines for hazard-free installation, operation, and maintenance. They should not be understood to prepare you for every possible situation.

The information contained in this manual is applicable only to the Thern 4WP2D Series Worm Gear Power Winches. Do not use this manual as a source of information for any other equipment.

The following symbols are used for emphasis throughout this manual:

⚠WARNING

Failure to follow 'WARNING!' instructions may result in equipment damage, property damage, and/or serious personal injury.

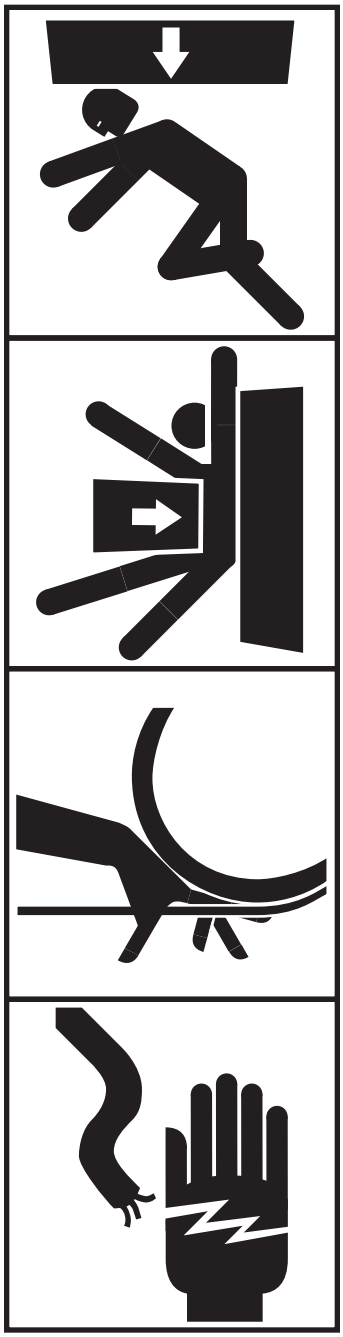
⚠CAUTION

Failure to follow 'CAUTION!' instructions may result in equipment damage, property damage, and/or minor personal injury.

Important!

Failure to follow 'important!' instructions may result in poor performance of the equipment.

Suggestions for Safe Operation



⚠WARNING

DO the following:

Read and comply with the guidelines set forth in this Owner's Manual. Keep this manual, and all labels attached to the winch, readable and with the equipment at all times. Contact Thern, Inc. for replacements.

Check lubrication before use.

Install the wire rope securely to the winch drum.

Keep at least 4 wraps of wire rope wound on the drum at all times, to serve as anchor wraps. With less than 4 wraps on the drum the wire rope could come loose, causing the load to escape.

Keep hands away from the drum, wire rope, and other moving parts of the equipment.

Keep all unnecessary personnel away from winch while in operation. Keep out of the path of the load and out of the path of a broken wire rope that might snap back and cause injury.

Disconnect power before servicing the equipment.

DO NOT do the following:

Do not lift people, or things over people. Do not walk or work under a load or in the line of force of any load.

Do not use clutch equipped models to lift loads, or drag loads on an incline. Accidental release of the clutch could result in loss of the load.

Do not exceed the load rating of the winch or any other component in the system. To do so could result in failure of the equipment.

Do not use more than one winch to move a load unless each winch was designed for use in a multiple winch system.

Do not use damaged or malfunctioning equipment. To do so could result in failure of the equipment.

Do not modify the equipment in any way. To do so could cause equipment failure.

Do not wrap the wire rope around the load. This damages the wire rope and could cause the load to escape. Use approved rigging connectors to secure the wire rope to the load.

Do not lift loads or pull loads on an incline unless the winch is equipped with a load brake.

Do not divert your attention from the operation. Stay alert to the possibility of accidents, and try to prevent them from happening.

Do not jerk or swing the load. Avoid shock loads by starting and stopping the load smoothly. Shock loads overload the equipment and may cause damage.

Do not leave a suspended load unattended unless specific precautions have been taken to secure the load and keep people away from the winch and out from under the load.

Do not adjust the brake with the load suspended.

Do not exceed the 5 minute duty cycle rating of the winch. To do so could result in equipment damage or failure.

1.1 Installing the Winch

Important!

- Inspect the winch immediately following installation according to the Instructions for Periodic Inspection. This will give you a record of the condition of the winch with which to compare future inspections.
- A qualified professional should inspect or design the foundation to insure that it will provide adequate support.
- Locate the winch so it will be visible during the entire operation.
- Do not weld the winch frame to the foundation or support structure. Welding the frame may void warranty, contact Thern, Inc. Use fasteners as instructed.

⚠WARNING

Do not install the winch in an area defined as hazardous by the National Electric Code, unless installation in such an area has been thoroughly approved.

Do not install the winch near corrosive chemicals, flammable materials, explosives, or other elements that may damage the winch or injure the operator. Adequately protect the winch and the operator from such elements.

Position the winch so the operator can stand clear of the load, and out of the path of a broken wire rope that could snap back and cause injury.

Attach the winch to a rigid and level foundation that will support the winch and its load under all load conditions, including shock loading.

1.1.1 CONSULT APPLICABLE CODES AND REGULATIONS for specific rules on installing the equipment.

1.1.2 LOCATE THE WINCH in an area clear of traffic and obstacles. Make sure the winch is accessible for maintenance and operation.

1.1.3 LOCATE THE WINCH in an area with adequate temperatures. The winch is rated for operation in ambient temperatures ranging from 0° to 100° F.

1.1.4 MAINTAIN A FLEET ANGLE between 1/2 and 1-1/2 degrees. The proper fleet angle minimizes wire rope damage by helping the wire rope wind uniformly onto the drum. See figure 2.

1.1.5 POSITION THE WINCH to allow access for proper lubrication.

1.1.6 FASTEN THE WINCH securely to the foundation.

a FOR STANDARD PRODUCTS referred to in this manual, use 3/8 - inch coarse thread fasteners, grade 5 or better, torque dry to 30 ft lb without lubrication. Make sure the winch is secured to a solid foundation able to support the winch and the load under all conditions with design factors based on accepted engineering practices.

b NON-STANDARD PRODUCTS that vary from the original design may have different fastening requirements. Contact a structural engineer or Thern, Inc. for this information.

TO COMPLY WITH LOCAL CODES, CONTACT A QUALIFIED PROFESSIONAL TO OBTAIN PROPER STRUCTURE OR FOUNDATION SPECIFICATIONS FOR THE MOUNTING OF THERN PRODUCTS.

1.2 Installing the Breather Plug

Important!

- Save the oil plug for use when the winch is removed for storage or transport.

⚠CAUTION

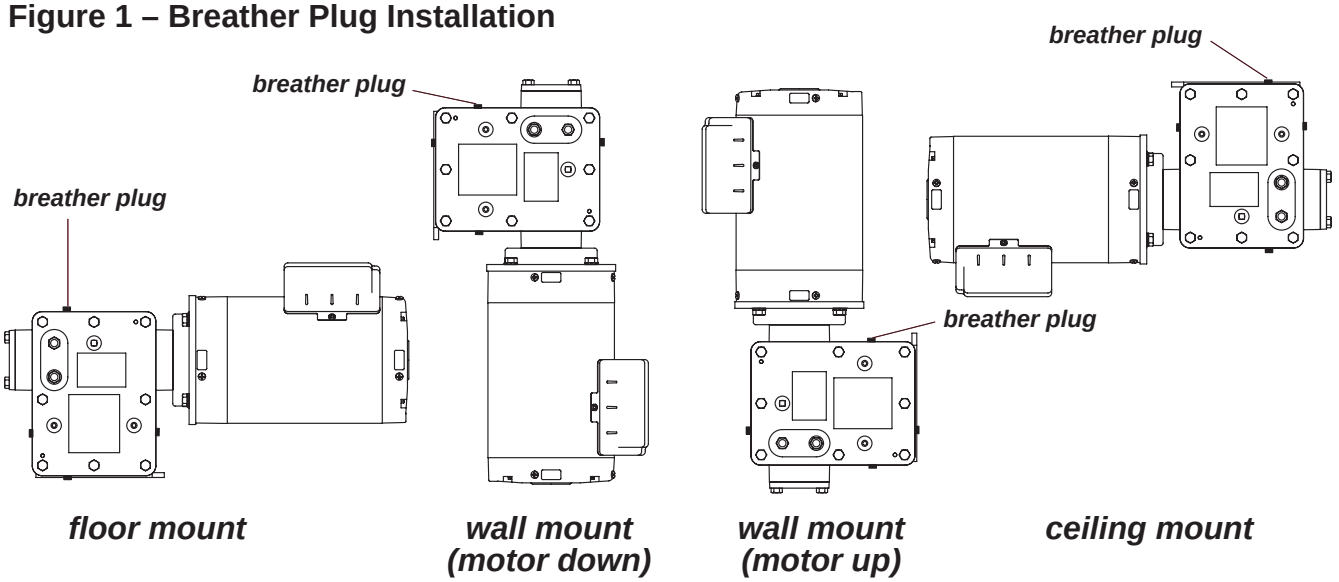
Install the breather plug to vent heat and pressure from the gearbox. Failure to do so could result in pressure buildup which can cause the gearbox to leak or damage the equipment.

For shipment, the gearbox is sealed with an oil plug, and the breather plug is attached to the gearbox or shipped in a separate envelope.

1.2.1 REMOVE THE OIL PLUG and install the breather plug in the proper location. Make sure the breather plug is above the level of the oil. See figure 1.

1.2.2 CHECK THE OIL LEVEL in the gearbox to make sure no oil was lost during shipment. See Section 3.3 Lubricating the Winch.

Figure 1 – Breather Plug Installation

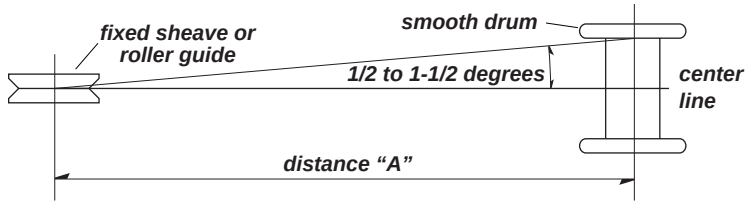


Important!

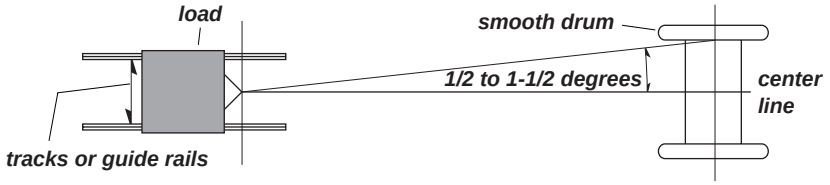
- Use a sheave or roller guide to direct the wire rope to the drum whenever possible.
- Install sheaves, tracks and other equipment so they will remain fixed under all load conditions. Follow the recommendations of the equipment manufacturer.
- Use sheaves of proper diameter to minimize wear on the wire rope. Follow the recommendations of the sheave manufacturer.

Figure 2 – Maintaining the Fleet Angle

When wire rope travels over a sheave or through a roller guide – maintain fleet angle by locating the sheave or guide an appropriate distance from the drum, shown as distance "A".



When wire rope travels directly to the load – maintain fleet angle by controlling side-to-side movement of the load with tracks or guide rails. Allowing the load to move too far to one side causes stress on the drum flange which may cause damage.



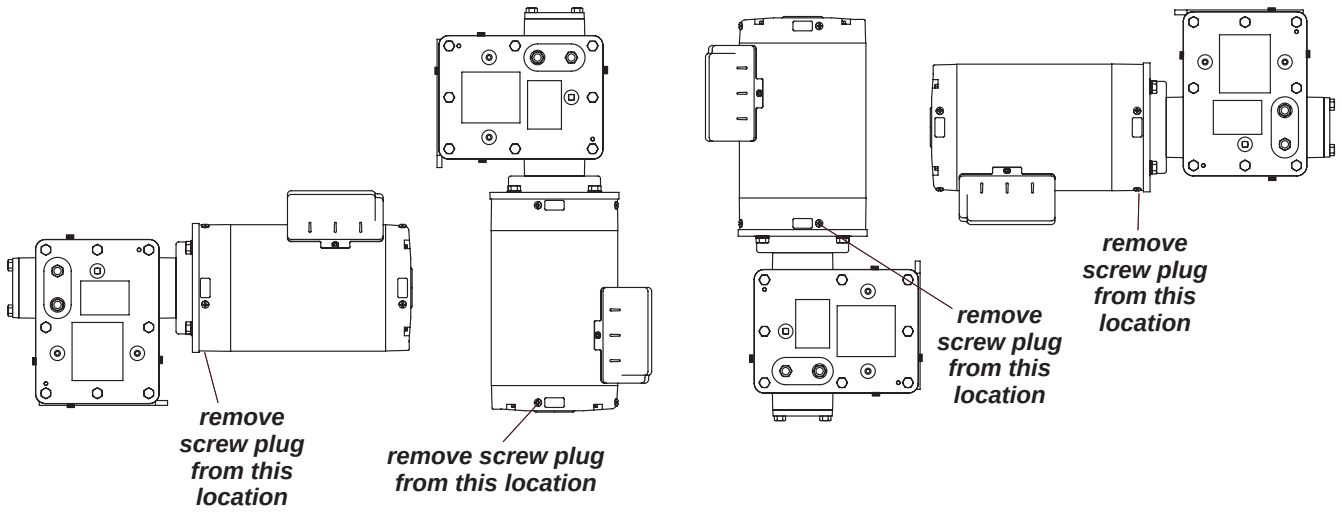
1.3 Removing Motor Drain Plugs

Some electric motors are equipped with screw plugs which are designed to be removed to provide drain holes.

1.3.1 LOCATE THE LOWEST POINT ON THE ELECTRIC MOTOR.

1.3.2 REMOVE THE SCREW PLUG located at this lowest point. See figure 3.

Figure 3 – Motor Drain Plug Removal



1.4 Connecting Power

Important!

- Use components rated for the power supply you will be using.
- Always disconnect power when the winch is not in use.

⚠WARNING

Install proper branch circuits, disconnect devices, protection, and grounding as required by article 430 of the National Electric Code.

All electrical work must be performed by a licensed electrician. Failure to do so could result in electric shock or poor winch operation.

All control devices must be momentary contact type. Install all control devices so the winch motor will stop when the operator releases the device.

Locate control devices so the operator will be able to view the load through the entire operation.

Locate control devices so the operator will be clear of the load, the wire rope, and the path of a broken wire rope that could snap back and cause injury.

It is the responsibility of the owner to provide equipment for controlling the winch. Controls are available from Thern. The following guidelines are supplied as a reference for the installer.

1.4.1 CONSULT APPLICABLE CODES AND REGULATIONS for specific instructions regarding power supply installation and hookup.

1.4.2 FOR ELECTRIC WINCHES: install a fuse or circuit breaker, and a disconnect device in the power supply circuit, as required by the National Electric Code. The disconnect device should be a switch you can lock in the OFF position to prevent unauthorized use of the winch.

1.4.3 CONNECT THE POWER CORD to a grounded outlet.

1.4.4 FOR PNEUMATIC WINCHES: install a regulator, filter, lubricator and drier in the air supply line. Failure to operate with clean, dry, lubricated air will void warranty.

1.4.5 FOR HYDRAULIC WINCHES: install a filter in the hydraulic supply line. **Use Mobil DTE hydraulic fluid, or equal, with a viscosity range of 100 – 200 SUS.**

1.4.6 INSTALL A CONTROL DEVICE in the power supply line and connect power to the motor. Make sure the control device is a momentary contact type so the motor will stop when the operator releases the control.

1.4.7 CONNECT OTHER EQUIPMENT to the power supply as necessary.

1.4.8 CHECK POWER SUPPLY at the motor and make sure it agrees with the motor rating. Do not operate the winch until proper power is supplied to the motor.

1.4.9 TEST CONNECTIONS by operating the winch. The rotation of the drum must agree with the labels on the control device, and the motor must stop when the control is released.

CONTACT THE FACTORY OR A QUALIFIED PROFESSIONAL FOR HELP.

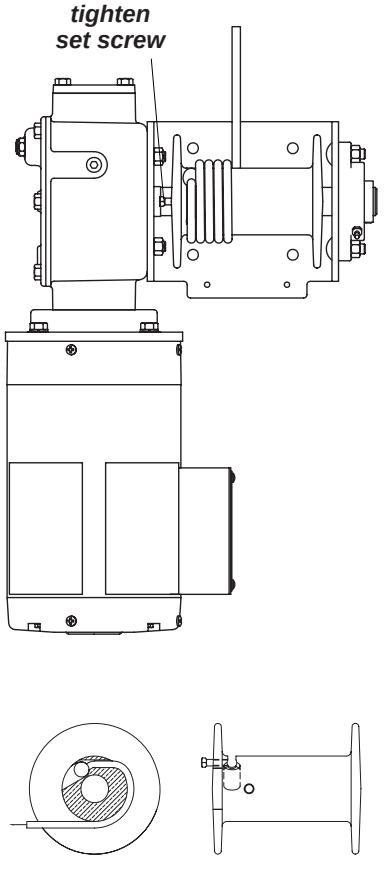
1.5 Installing the Wire Rope

Important!

- Use wire rope and other rigging equipment rated for the size of the largest load you will be moving.
- Do not drag the wire rope through dirt or debris that could cause damage, or poor operation.
- Always wear protective clothing when handling wire rope.

Figure 4 – Installing the Wire Rope

install the wire rope so it is underwound on the drum as shown



typical installation shown left lay – underwound

Wire rope assemblies with anchor fittings can be purchased from Thern, Inc.

⚠WARNING

Install the wire rope securely to the winch drum. A poorly secured wire rope could come loose from its anchor and allow the load to escape.

Do not use 3/16 inch or smaller wire rope on standard drums. To do so could cause damage to the wire rope and allow the load to escape.

Install the wire rope so it is wound correctly as shown or the winch and brake will not work properly, and could allow the load to escape, see figure 4.

1.5.1 PURCHASE THE PROPER WIRE ROPE for your application. Keep the following in mind when selecting a wire rope. Contact a reputable wire rope supplier for help.

a BREAKING STRENGTH of new wire rope should be at least 3 times greater than the largest load placed on the winch. If loads are lifted or pulled on an incline, the breaking strength must be at least 5 times greater than the largest load. These are minimum values and will vary with the type of load and how you are moving it.

b WIRE ROPE LAY must agree with the winding direction of the drum to help insure proper winding.

c WE RECOMMEND 7x19 galvanized aircraft cable for diameters up to 5/16 inch. Do not use 3/16 inch or smaller wire rope on standard drums.

1.5.2 ANCHOR THE WIRE ROPE to the drum using either the set screw or quick disconnect anchor.

a SET SCREW ANCHOR. See figure 4.

- PASS THE WIRE ROPE under the drum from the front and position it in the slot in the drum. Make sure at least 1/2 inch of wire rope extends past the set screw, and the end of the wire rope does not protrude out where it will interfere with wire rope winding onto the drum.
- TIGHTEN THE SET SCREW to hold the wire rope in place. Hold the wire rope down while tightening so the wire rope does not push up out of the slot.

b QUICK DISCONNECT ANCHOR. See figure 4.

- PASS THE WIRE ROPE under the drum from the front and position the anchor fitting in the groove in the drum.
- PULL THE WIRE ROPE to firmly lodge the anchor fitting in place.

1.5.3 WIND FOUR FULL WRAPS of wire rope onto the drum by operating the winch while holding the wire rope taught. **These wraps serve as anchor wraps and must remain on the drum at all times.** See figure 4.

CONTACT A REPUTABLE WIRE ROPE SUPPLIER FOR HELP.

2.1 General Theory of Operation

Important!

- Limit nonuniform winding by keeping tension on the wire rope and by maintaining the proper fleet angle.
- To help insure rated performance, make sure power supply at the motor is equal to the motor's power rating.
- It is your responsibility to detect and account for different factors affecting the condition and performance of the equipment.

2.1.1 THE PULL REQUIRED to move the load must not exceed the load rating of the winch. Consider the total force required to move the load, not the weight of the load.

2.1.2 THE AMOUNT OF TIME required to move the load must not exceed the 5 minute duty cycle rating of the winch.

2.1.3 THIS EQUIPMENT CAN develop forces that will exceed the load rating. It is the responsibility of the equipment user to limit the size of the load. Inspect the equipment regularly for damage according to the instructions contained in this manual and in component manufacturer's information.

2.1.4 USE A LOAD BRAKE on all winches used to lift loads or pull loads on an incline. Although a new winch may appear to hold the load in place, this characteristic will diminish with use. **Do not depend on gearing to hold the load in place.**

2.1.5 PERFORMANCE RATINGS of the equipment are affected by the amount of wire rope wound on the drum, the way in which it is wound, and the way the winch is used.

a DRUM CAPACITY depends on how tightly and evenly the wire rope is wound on the drum. "Actual drum capacities are usually 25-30% less than values shown in performance tables, due to loose winding and over lapping."

b LINE SPEED increases with each additional layer of wire rope wound onto the drum. Line speed will also vary with load weight and power supply for pneumatic and hydraulic models. Load weight does not affect line speed for electric models.

c LOAD RATING represents the maximum pull that can be placed on new equipment. Load ratings are assigned values for specific amounts of load travel or wire rope accumulation. The load rating decreases as layers of wire rope accumulate on the drum.

2.1.6 DUTY RATINGS refer to the type of use the equipment is subject to. Consider the following when determining duty rating. The winch has a 5 minute duty cycle rating.

a ENVIRONMENT: harsh environments include hot, cold, dirty, wet, corrosive, or explosive surroundings. **Protect the equipment from harsh environments when possible.**

b MAINTENANCE: poor maintenance, meaning poor cleaning, lubrication, or inspection, leads to poor operation and possible damage of the equipment. **Minimize poor maintenance by carefully following the instructions contained in this manual.**

c LOADING: severe loading includes shock loading and moving loads that exceed the load rating of the equipment. **Avoid shock loads, and do not exceed the load rating of the equipment.**

d FREQUENCY OF OPERATION: frequent or lengthy operations increase wear and shorten the life span of gears, bearings, and other components. **Increase maintenance of the equipment if used in frequent operations. Length of operation should not exceed the 5 minute duty cycle rating.**

CONTACT THE FACTORY FOR MORE INFORMATION.

2.2 Breaking-In the Winch

2.2.1 BREAK-IN OCCURS during the first 30 to 60 minutes of operation. During break-in, mating surfaces become polished, and clearances increase. This is desired for efficient operation of bearings and gears.

2.2.2 INSPECT THE WINCH following break-in according to the Instructions for Periodic Inspection. See Section 3.4 Inspecting the Equipment.

2.3 Preparing for Operation

Important!

- When determining whether the load will exceed the load rating, consider the total force required to move the load.

2.3.1 CONSIDER THE OPERATION. Do not begin until you are sure you can perform the entire operation without hazard.

2.3.2 INSPECT ALL COMPONENTS of the system.

a INSPECT THE WINCH and other equipment according to the Instructions for Frequent Inspection.

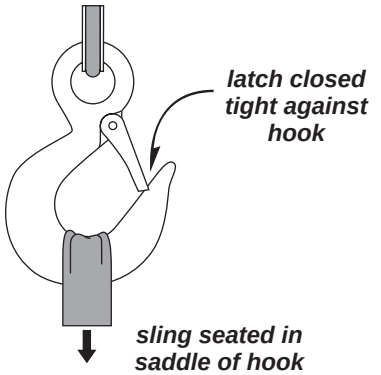
b OPERATORS must be in good health, alert, thoroughly trained in operating the equipment, and properly clothed (hard hat, safety shoes and safety glasses, no loose clothing).

c THE LOAD must be clear of other objects and free to move. Make sure the load will not tip, spin, roll away, or in any way move uncontrollably.

2.3.3 KNOW YOUR LOAD and make sure you do not exceed the load rating of the winch or any other equipment in the system.

2.4 Attaching the Load

Figure 5 – Attaching Load



⚠WARNING

Do not wrap the wire rope around the load. This damages the wire rope and could cause the load to escape. Use a sling or other approved rigging device.

2.4.1 CLEAR OBJECTS from the path of the load so you can move it freely and observe it at all times during the operation.

2.4.2 ATTACH THE LOAD using a nylon sling, or other approved rigging device. Follow the recommendations of the sling manufacturer.

a SEAT THE SLING in the saddle of the hook with the hook latch completely closed. See figure 5.

b CENTER THE LOAD on the hook so it will remain balanced and not tip or rotate to one side.

2.5 Moving the Load

Important!

- Obey a stop signal from anyone.
- Maintain tension on the wire rope to keep it tightly and evenly wound on the drum.
- If the winch and load are not visible during the entire operation, get help from another person.
- Appoint a supervisor if more than one person is involved in the operation. This will reduce confusion and increase safety.
- When lifting a load, use a tag line to keep the load from swinging or twisting, while keeping yourself away from the load.

2.5.1 MOVE THE LOAD slowly and smoothly, only a small distance at first. Make sure the load is balanced and securely attached before continuing.

2.5.2 USE THE CONTROL DEVICE to operate the winch. The control device should be momentary contact type, so the winch will stop when the operator releases the control.

2.5.3 DO NOT EXCEED DUTY CYCLE RATING of the winch. This equipment is rated for a 5 minute duty cycle.

2.5.4 OBSERVE THE WIRE ROPE as it winds onto the drum. If it becomes loose, uneven, or overlapped, stop the operation and rewind the wire rope before continuing. **Continued operation with overlapped or uneven wire rope can damage the wire rope and shorten its life.**

2.5.5 ALLOW THE WINCH TO COOL DOWN to ambient temperature in rest periods between operations.

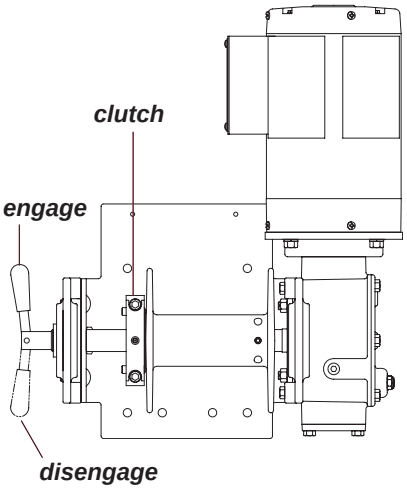
2.5.6 OBSERVE THE GEARBOX AND BRAKE during operation for signs of overheating. **Frequent overheating may be a sign of damage, or may indicate the need for a larger winch.**

a WATCH FOR SMOKE, the smell of burnt oil, and other signs of overheating. Use a thermocouple or other device to monitor gearbox temperature. The temperature of the oil should not exceed 150° F.

b STOP THE OPERATION if the gearbox or brake overheats, and allow the winch to cool until it reaches ambient temperature. **Continued operation may cause damage.**

2.6 Operating the Clutch

Figure 6 – Operating the Clutch



⚠WARNING

Do not engage or release the clutch while the winch drum is turning.

Engage the clutch completely before operating the winch. Operating the winch with a released or partially engaged clutch may cause damage, or allow the load to escape.

2.6.1 RELEASE THE CLUTCH with the clutch handle, and unwind the wire rope for hookup to the load. See figure 6.

2.6.2 ENGAGE THE CLUTCH with the clutch handle. You may need to rotate the drum by hand to align the clutch jaws. **Visually inspect the clutch for complete engagement.**

2.7 Emergency Operation
(for models equipped with this feature)

⚠WARNING

Do not adjust the brake with the load suspended. Accidental release of the brake could allow the load to escape.

Do not leave a suspended load unattended unless specific precautions have been taken to secure the load and keep unnecessary personnel away from the winch and from under the load.

2.7.1 IN CASE OF POWER FAILURE, turn the control device to OFF and DISCONNECT electric power. Leave electric power DISCONNECTED.

2.7.2 MAKE SURE SAFETY PRECAUTIONS have been taken to secure the load and keep unnecessary personnel away from the winch and from under the load while operating the emergency hand crank.

2.7.3 IF EQUIPPED WITH A BRAKE MOTOR you must disengage the brake on the motor before using the emergency hand crank. Operating the emergency hand crank with the brake on the motor engaged could result in equipment damage or failure.

a It is recommended for two people to operate the winch using the emergency hand crank.

b If the winch is equipped with a brake motor, assign one person to operate the hand crank while the other is assigned to operate the brake. Have control of the hand crank before disengaging the brake on the motor. Accidental release of the brake could allow the load to escape.

c If the winch is not equipped with a brake motor, assign one person to operate the hand crank while the other is assigned to observe and control the load.

d Always follow the brake manufacturers operating instructions for engaging or disengaging the brake.

2.7.4 DO NOT USE AN IMPACT WRENCH to operate the emergency hand crank option of the winch. To do so could result in equipment damage or failure. Use a drill-motor.

2.7.5 DO NOT EXCEED THE 5 MINUTE DUTY CYCLE rating of the winch if operating with a drill-motor and do not operate the winch with a drill-motor that exceeds 400 rpm. To do so could result in equipment damage or failure.

2.7.6 ENGAGE THE BRAKE and remove the handle or drill-motor before operating the winch using electric power.

ANY QUESTIONS ON OPERATING THE EMERGENCY HAND CRANK OPTION OR WINCH APPLICATION CONTACT THERN, INC.

3.1 Cleaning the Winch

Important!

Increase the frequency of maintenance procedures if the winch is:

- Operated for long periods.
- Used to pull heavy loads.
- Operated in wet, dirty, hot, or cold surroundings.

Clean the winch to remove dirt and help prevent rust and corrosion.

3.1.1 CLEAN THE WINCH every 6 months or whenever it is dirty.

a WIPE ALL EQUIPMENT to remove dirt and grease.

b LEAVE A LIGHT FILM of oil on all surfaces to protect them against rust and corrosion.

c WIPE OFF excessive amounts of oil to avoid the accumulation of dirt.

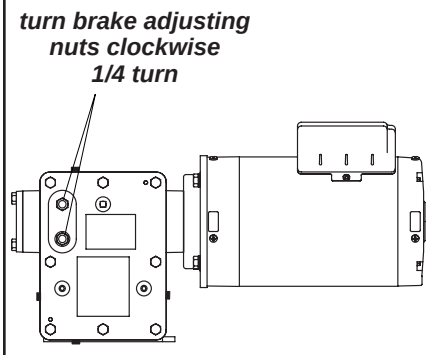
3.1.2 REMOVE ALL UNNECESSARY OBJECTS from the area surrounding the winch.

3.2 Adjusting the Brake

Important!

- Do not overtighten the brake, since this will cause parts to wear and become damaged.

Figure 7 – Adjusting the Brake



⚠WARNING

Do not adjust the brake with the load suspended. Accidental release of the brake could allow the load to escape.

3.2.1 ADJUST THE BRAKE whenever it appears to need adjustment, or at least every 3 months.

3.2.2 CHECK THE BRAKE by operating the winch with a test load equal to the winch load rating.

a RAISE THE LOAD, then lower it and stop it about one foot off the ground.

b OBSERVE THE LOAD when stopped. If it continues to coast or creep, the brake should be tightened.

3.2.3 TIGHTEN THE BRAKE by turning the adjusting nuts clockwise about 1/4 turn. Continue to test and tighten the brake by alternating tightening of each brake nut until it stops and holds the load securely. See figure 7.

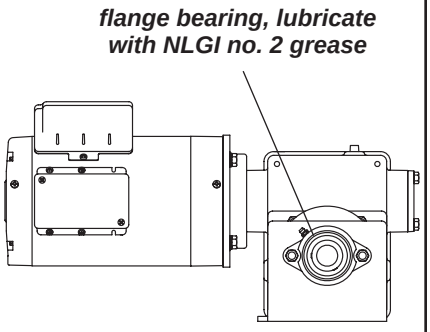
a A DECELERATION DISTANCE while stopping is typically 6 inches.

3.3 Lubricating the Winch

Important!

- Do not leave plug holes in the reducer open. Open plug holes will allow dirt and moisture to contaminate the lubrication.
- Make sure lubricant has a temperature rating appropriate for the ambient temperatures of the operation.

Figure 8 – Lubricating the Flange Bearing



⚠CAUTION

Make sure the breather is clean and open to vent heat and pressure. Poor ventilation may cause overheating and result in equipment damage.

Check the gearbox for proper level before operating. Too much or too little oil will cause overheating and result in equipment damage.

Lubricate the winch properly to help protect it from wear and rust. Read the following instructions carefully.

3.3.1 FOR 4WP2D SERIES, the winch is shipped from the factory with the proper amount (44 ounces) of Mobilgear 630 lubricant in the gearbox. Lubricate the winch as follows. See figure 9.

3.3.2 MOTOR BEARINGS are typically lubricated for life by the manufacturer.

a REPLACE MOTOR BEARINGS if the motor is disassembled for any reason.

b REFER TO MOTOR MANUFACTURER'S INFORMATION for specific instructions regarding motor lubrication.

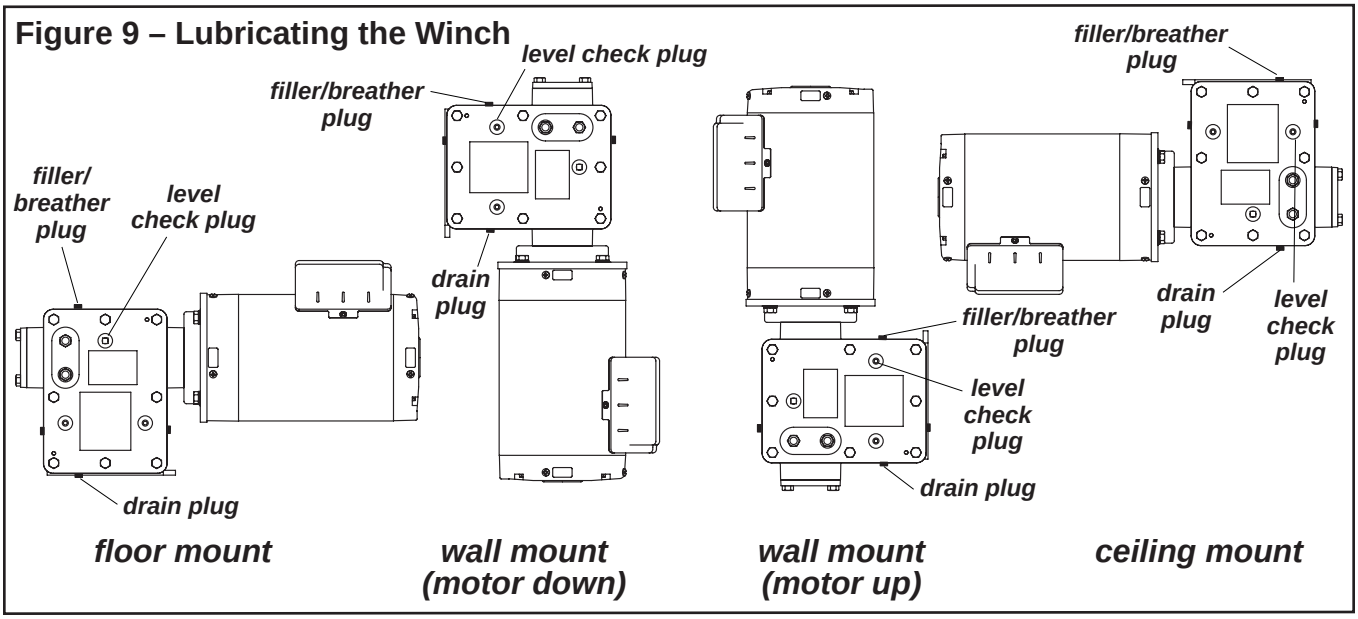
3.3.3 CHECK OIL LEVEL before every operation and every 10 hours during operation. Remove the level check plug and make sure oil is even with the plug hole. Add oil to the gearbox if necessary. **Do not use synthetic lubricants and do not mix different lubricants.** See figure 9.

3.3.4 CHANGE GEARBOX OIL at least every 6 months, or whenever it is dirty or contaminated. Remove the drain plug to drain oil from the gearbox. See figure 9.

3.3.5 LUBRICATE THE FLANGE BEARING at least once every month or more, depending on usage. Use a grease gun to insert NLGI no. 2 grease until clean grease appears at the seals. The bearing will squeak if it is dry. See figure 8.

3.3.6 LUBRICATE THE WIRE ROPE and other equipment by following the manufacturers recommendations.

Figure 9 – Lubricating the Winch



3.4 Inspecting the Equipment

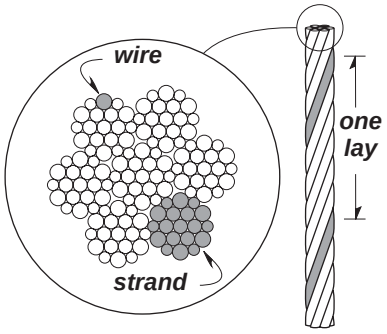
Important!

- Start an inspection program as soon as you put the winch into use.
- Appoint a qualified person to be responsible for regularly inspecting the equipment.
- Keep written records of inspection. This allows comparison with comments from previous inspections so you can see changes in condition or performance.

Perform frequent inspections:

- Before each operation.
- Every 3 hours during operation.
- Whenever you notice signs of damage or poor operation.

Figure 10 – Broken Wires



Wire rope assembly must be replaced if more than 6 wires are broken in one lay, or if more than 3 wires are broken in one strand in one lay.

⚠WARNING

Do not use damaged or malfunctioning equipment. Place an "OUT OF ORDER" sign on the winch. Do not use the winch until the sign is removed by a qualified maintenance person who has completely corrected the problem.

Inspect the winch to detect signs of damage or poor operation before they become hazardous.

3.4.1 CONSULT APPLICABLE CODES AND REGULATIONS for specific rules on inspecting the winch and other equipment.

3.4.2 CONSULT MANUFACTURER'S RECOMMENDATIONS for information on inspecting the wire rope and other equipment.

3.4.3 Instructions for Frequent Inspection

a VISUALLY INSPECT the entire winch and all other equipment involved in the operation.

- Check all equipment for cracks, dents, bending, rust, wear, corrosion and other damage.
- Make sure the wire rope is installed correctly and anchored securely to the drum.
- Make sure the winch is properly lubricated.
- Check the gearbox for signs of leakage, and make sure it is filled with the proper lubricant. Contact the factory if there are any signs of lubricant leaking from the gearbox.
- Make sure the breather plug is clean, open, and installed correctly.
- Make sure mounting fasteners are tightened securely.
- Make sure the foundation is in good condition, and capable of supporting the winch and its load under all load conditions.
- Check electrical wiring and connections for wear, corrosion, cuts, and other damage.
- Check clutch operation, if applicable, to make sure it moves freely and engages completely.

b TEST WINCH PERFORMANCE by moving a test load equal to 10% of the rated capacity.

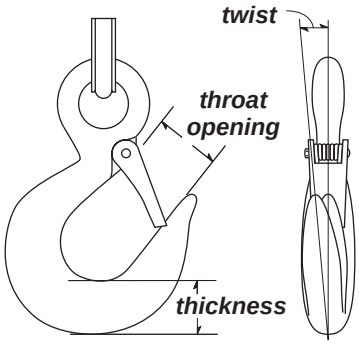
- Listen for unusual noises, and look for signs of damage as you operate the winch.
- Make sure the wire rope winds evenly and tightly onto the drum. If it is loose or uneven, rewind it before continuing.
- Make sure the load moves smoothly, without hesitation or strain.
- Make sure the winch responds to the control device. It must rotate as shown on the control labels, and it must turn off when you release the control.
- Check the brake. Raise the load, then lower it and stop it a few feet off the ground. If the load continues to coast or creep, the brake needs adjustment. See Section 3.2 Adjusting the Brake.

Completely correct all problems before continuing. Use the Troubleshooting Chart to help determine the cause of certain problems. See table 2.

Perform periodic inspections:

- Every 6 months.
- Whenever you return the winch to service from storage.
- Whenever you notice damage or poor operation in a frequent inspection.
- Whenever you have, or think you may have, overloaded or shock loaded the winch.

Figure 11 – Load Hook Inspection



The wire rope assembly must be replaced if the throat opening is 15% wider than nominal, if the thickness is 10% less than nominal, or if the hook is twisted 10° or more.

3.4.4 Instructions for Periodic Inspection, see table 1.

a VISUALLY INSPECT the winch and all other equipment.

- Disassembly may be required in order to properly inspect individual components. Contact factory for assembly/disassembly instructions. Disassembly of the gearbox before contacting Thern, Inc voids all warranties.
- Check the finish for wear, flaking, or other damage.
- Check all equipment for cracks, dents, bending, rust, wear, corrosion and other damage. If the equipment was overloaded, or if you notice cracks and other signs of overloading and damage, promptly remove equipment from use and have it repaired or replaced. DO NOT CONTINUE TO USE DAMAGED OR OVERLOADED EQUIPMENT.
- Check all fasteners for stripped threads, wear, bending, and other damage.
- Check the gearbox for signs of leakage. Contact factory if there are any signs of lubricant leaking from the gearbox.
- Make sure the breather plug is clean, open and installed correctly.
- Make sure the winch outboard bearing is properly lubricated.
- Check clutch operation, if applicable, to make sure it moves freely and engages completely.
- Make sure all labels and plates are readable, firmly attached, free of damage and clean. Replacements are available from the factory.

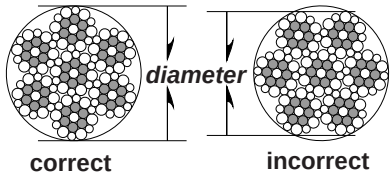
b DRAIN A SMALL AMOUNT OF OIL from the gearbox into a clean container.

- Check the oil for dirt, metal particles, water, and other signs of contamination. Completely drain the gearbox if oil is contaminated.
- Make sure the gearbox is properly lubricated. See Section 3.3 Lubricating the Winch.

c INSPECT THE WIRE ROPE according to the wire rope manufacture's recommendations, or follow accepted industry standards for wire rope inspection.

- Always wear protective clothing when handling wire rope.
- Check the entire length of wire rope for bent wires, crushed areas, broken or cut wires, corrosion, and other damage. Carefully inspect areas that pass over sheaves or through roller guides.
- Note the location and concentration of broken wires. Replace wire rope if more than 6 wires are broken in one lay, or more than 3 wires are broken in one strand in one lay. See figure 10.
- Make sure hooks and other fittings are securely attached to the wire rope, and the wire rope where they are attached is not frayed, corroded, broken, or otherwise damaged.
- Measure the throat opening, thickness, and twist of the hook. Replace the hook if it shows signs of damage. See figure 11.
- Make sure any hook latches open without binding and close when released.
- Check the anchor holes in the drum and the surrounding area for signs of wear or distortion.

Figure 12 – Rope Diameter



The wire rope assembly must be replaced if the diameter measures less than the minimum diameter at any point.

wire rope diameter	minimum diameter
1/4 in	15/64 in (.2344 in)
5/16 in	19/64 in (.2969 in)

d MOVE THE DRUM with your hands. Check for excessive movement indicating worn or loose gears, bearings, or shafts. Slight endplay in the driveshaft is normal. Excessive movement is caused by overloading or overheating, and is a sign that your application may require a larger winch.

e PLACE 100 POUNDS of tension on the wire rope.

- Measure the diameter of the wire rope, especially in areas where wear is noticeable. Replace the wire rope if the diameter measures below the minimum diameter at any point. See figure 12.

f INSPECT THE FOUNDATION AND RIGGING

- Check mounting fasteners for stripped threads, wear, and other damage.
- Check the foundation for cracks, corrosion, and other damage.

g TEST WINCH PERFORMANCE by operating the winch with a test load equal to the load rating.

- Listen for unusual noises, and look for signs of damage as you operate the winch.
- Make sure the wire rope winds evenly and tightly onto the drum. If it is loose or uneven, rewind it before continuing.
- Observe the rotating drum, look for signs of loose or misaligned bearings.
- Make sure the load moves smoothly, without hesitation or strain.
- Make sure the winch responds to the control device. It must rotate as shown on the control labels, and it must turn off when you release the control.
- Check the brake. Raise the load, then lower it and stop it a few feet off the ground. If the load continues to coast or creep, the brake needs adjustment. See Section 3.2 Adjusting the Brake.

h DISCONNECT POWER and inspect power supply equipment.

- Check supply lines for wear, cuts, corroded connections, and other damage.
- Check control devices and other power supply components for signs of moisture, corrosion, burn marks, cracks, and other damage.

i CONNECT POWER.

- Check power supply at the motor and make sure it agrees with the motor rating. Do not operate the winch until proper power is supplied to the motor.

Completely correct all problems before continuing. Use the troubleshooting chart to help determine the cause of certain problems. See table 2.

Table 1 – Inspection Checklist

checked boxes indicate damage or problem in need of repair

	damages	problems
general	☐ finish weathered, flaking, otherwise damaged	☐ winch jerks or hesitates during operation
	☐ parts cracked, bent, rusted, worn, otherwise damaged	☐ unusual noises, other signs of malfunction
fasteners	☐ stripped threads, bent, worn, otherwise damaged	☐ loose, not tightened to proper torque
reducer	☐ gears, bearings, or shafts loose, worn, otherwise damaged	☐ not properly lubricated
	☐ lubricant leakage	☐ lubricant contaminated
wire rope	☐ bent, crushed, otherwise damaged	☐ wire rope loosely or unevenly wound
	☐ broken wires, see figure 10	
	replace if more than 6 wires in one lay,	number per strand =
	or 3 wires in one strand in one lay, are broken	number per lay =
	☐ diameter reduced, see figure 12	
	replace if diameter is excessively worn	diameter =
end connections	☐ corroded, rusted, worn, otherwise damaged	☐ not securely attached
hook or other device	☐ twisted, bent, worn, otherwise damaged, see figure 11	☐ hook latch fails to close when released
	replace if twist is 10 degrees or more,	twist =
	replace if throat width is 15% larger than nominal	throat width =
	replace if thickness is 10% less than nominal	thickness =
drum	☐ anchor worn, distorted, otherwise damaged	☐ excessive movement or backlash
motor	☐ motor corroded, burnt out, otherwise damaged	☐ motor is sluggish or operates poorly
brake	☐ brake worn, corroded, otherwise damaged	☐ brake does not operate properly
power supply	☐ components corroded, burnt, otherwise damaged	☐ control device fails to control winch properly
	☐ supply lines worn, cut, corroded, otherwise damaged	☐ supply lines unprotected, obstructing traffic
	☐ connections loose, corroded, otherwise damaged	power supply at motor =
clutch	☐ worn, bent corroded, otherwise damaged	☐ does not move freely or engage completely
labels and plates	☐ dirty, illegible, otherwise damaged	☐ loosely attached or missing

comments _____

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authorized signature _____ **date** _____

Table 2 – Troubleshooting Chart

Contact the factory for detailed instructions on re-sealing the gearbox if you are required to disassemble the gearbox for any reason. Disassembly of the gearbox before contacting Thern, Inc. voids all warranties.

problem	cause	correction
motor won't run	• circuit breaker tripped or fuse blown	reset circuit breaker or replace fuse
	• poor power supply	inspect and repair as necessary
	• power supply lines loose or damaged	inspect, repair and tighten as necessary
	• power supply failure	check power supply source
	• motor burnt out or damaged	repair or replace as necessary
motor runs, drum doesn't turn	• loose or broken spring pins or keys	inspect and replace as necessary
	• clutch disengaged	stop motor and engage clutch
	• loose, stripped or broken gears	inspect and replace as necessary
motor tries to turn but can't	• unit overheated	allow to cool
	• load too heavy	lighten load
	• poor power supply	inspect supply circuit and repair as needed
	• band brake too tight	loosen brake and readjust
	• brake broken or locked	inspect and replace as necessary
	• gears or bearings broken or locked	inspect and replace as necessary
brake does not operate properly	• wire rope installed improperly	reinstall wire rope correctly
	• brake adjusted incorrectly	adjust brake
	• brake worn or damaged	inspect and replace as necessary
	• brake components seized up or damaged	inspect and repair as necessary
lubricant leakage	• worn bearings	inspect and replace as necessary
	• oil seals leaking or damaged	inspect and replace as necessary
	• gaskets leaking or damaged	tighten fasteners or replace gasket
	• cracked or damaged reducer	inspect and repair as necessary
	• hydraulic equipment leaking or damaged	inspect and replace as necessary
excessive end play on drive shaft	• loose or damaged keys or keyways	inspect and replace as necessary
	• excessively worn gears	inspect and repair as necessary
excessive worn gears or bearings	• load too heavy	lighten load
	• poor lubrication of gears or bearings	inspect and lubricate as necessary
overheating	• operated too long without rest	allow to cool
	• load too heavy	lighten load
	• poor lubrication	inspect and lubricate as necessary
	• breather plug clogged or damaged	clean or replace breather plug
	• bearing seized up	inspect and replace as necessary
unusual noises		
high pitched squeak	• poor lubrication	inspect and lubricate as necessary
grinding noise	• contaminated lubrication	drain, clean and lubricate the winch
	• broken gears or bearings	inspect and replace as necessary
whining motor	• load too heavy	lighten load
	• motor overheated	allow to cool
	• motor bearings burnt out	replace motor or bearings
whistling noise	• air leak in pneumatic equipment	inspect and repair as necessary
rattling noise	• loose fasteners or setscrews	tighten all fasteners and screws
heavy thump during operation	• contaminants in lubricant	drain, clean and lubricate the winch
	• loose setscrews or keys in gears or shafts	inspect and repair as necessary

3.5 Repairing the Winch

Important!

- It is your responsibility to determine when to replace parts. When considering whether to continue using a part or to replace it, remember that replacing it is the best way to avoid further equipment damage.
- Replace spring pins, retaining rings, and oil seals whenever the winch is disassembled for inspection or repair.
- During reassembly, use loctite 598 Ultra Black to create a seal between the two halves of the gearbox and the input shaft. Contact factory for detailed instructions. Disassembly of the gearbox before contacting Thern, Inc voids all warranties
- Appoint a qualified person to be responsible for all repairs to the equipment.

3.5.1 GET FACTORY AUTHORIZATION for all repairs. Unauthorized repairs will void the warranty, and may lead to damage or failure of the winch.

3.5.2 REPLACE DAMAGED OR POORLY OPERATING PARTS with Thern repair parts.

3.5.3 REFINISH AREAS where the paint is worn or flaking. A good finish helps to protect against corrosion and weather damage.

a REMOVE THE FINISH from damaged areas, down to the bare metal.

b CLEAN THE AREA thoroughly.

c REPAINT with a high quality primer and finishing coat.

3.5.4 TO ORDER REPAIR PARTS, contact your local dealer. Include the following information when ordering:

- model number
- **serial number** (or code number)
- part number
- date purchased, and from whom
- description of what happened, or what is wrong
- your name and return address

4.1 Transporting the Winch

Important!

- Keep a record of what you ship, and when you send it.

4.1.1 REMOVE THE BREATHER PLUG and install a sealed oil plug to prevent the loss of lubrication during shipment.

4.1.2 PACK THE WINCH in an upright position for transport, using the original packaging materials, if possible.

a FASTEN THE WINCH to a wooden base using lag bolts, to keep it from moving during transport.

b SEAL THE WINCH in plastic with a desiccant to help protect it from rust, corrosion, and other damage.

c CONSTRUCT WOODEN SIDES and top to enclose the winch in a solid protective crate.

d PACK LOOSE PARTS in small boxes or ship separately.

4.1.3 INSPECT THE WINCH according to the Instructions for Periodic Inspection before installing it in a new location.

4.2 Storing the Winch

4.2.1 LUBRICATE THE WINCH as necessary, and make sure the breather plug is clean and properly installed. Add a rust preventative for long term storage.

4.2.2 SEAL THE WINCH in plastic with a desiccant to help protect it from rust, corrosion, and other damage.

4.2.3 STORE THE WINCH upright, in a cool clean place away from corrosive chemicals and moisture.

4.2.4 ROTATE THE DRUM PERIODICALLY to keep bearing and gears surfaces from becoming lacquered.

4.2.5 INSPECT THE WINCH according to the Instructions for Periodic Inspection before installing it for operation.

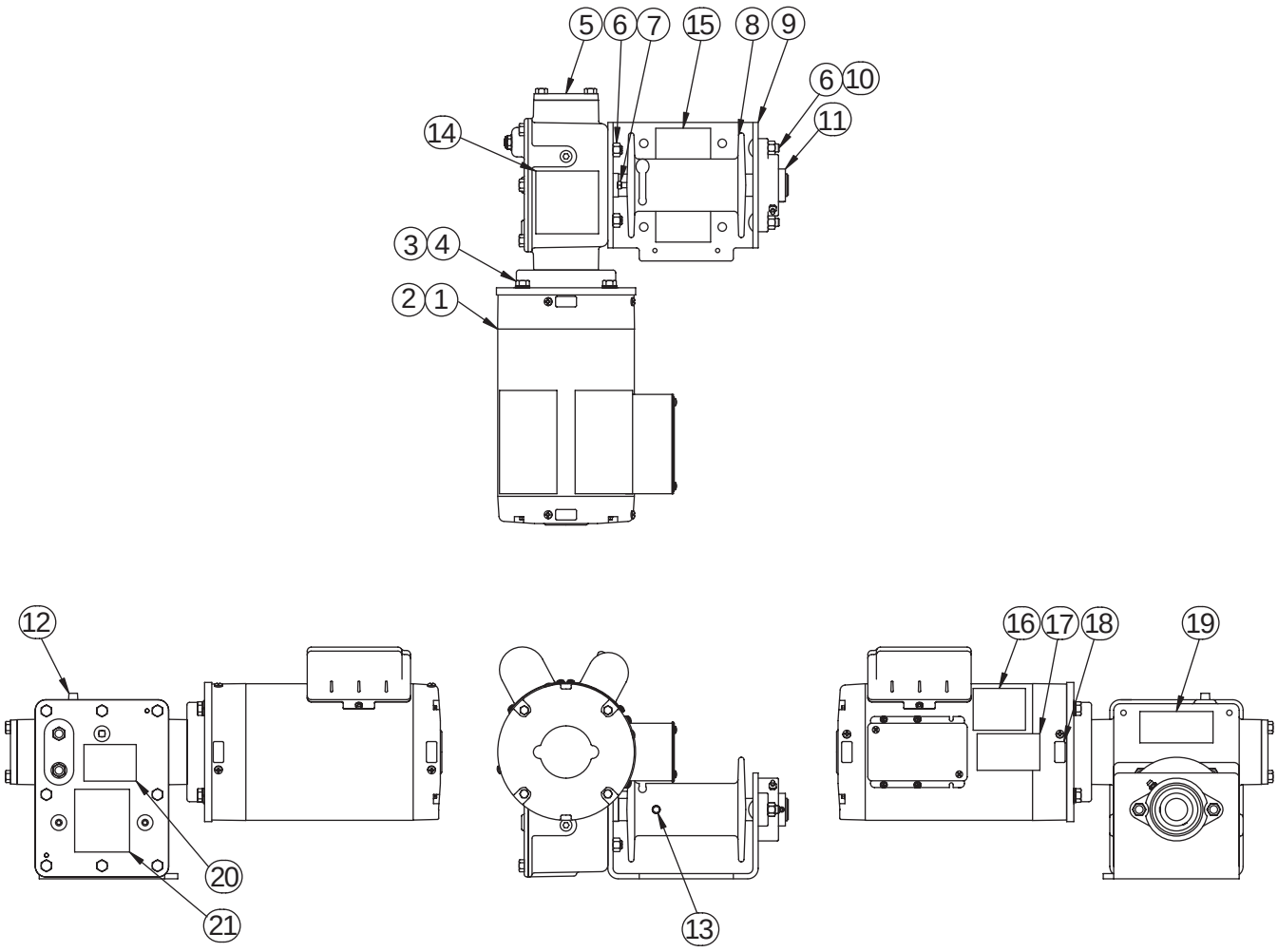
4.2.6 TEST INSULATION RESISTANCE in the motor to detect moisture damage. Refer to the motor manufacturer’s instructions.

4.2.7 LUBRICATE THE WINCH PROPERLY prior to operation. See Section 3.3 Lubricating the Winch.

4WP2D Series Assembly

item	description	part number	qty.
1[1]	MOTOR	MTR4WP2D	1
2	KEY .188 X .188 X 1.375	A5178	1
3	CAPSCREW HEXHD .375-16NC X 1.000	A2922	4
4	HELSPRLK WASHER .375 X .683 X .094	A2926	4
5	REDUCER ASSEMBLY	D2595	1
6	HEX NUT .375-16NC	A3017	6
7	SETSCREW SQHD .312-18NC X .875	A7703	1
8	DRUM	C3381	1
9	FRAME	D1913	1
10	CARRIAGE BOLT .375-16NC X 1.250	A7283	2
11	FLANGE BEARING	A7285	1
12	BREATHER PLUG .375-18NPT X .48	A3408	1
13	GROOVE PIN TYPE A .312 X 2.500	A7284	1
14	LABEL WARNING POINTS	A2655	1
15	LABEL WARNING KEEP HANDS AWAY FROM DRUM	A2659	2
16	LABEL WARNING DISCONNECT ELECTRIC POWER	A2256	1
17[2]	LABEL REMOVE DRAIN PLUGS	A8338	1
18[2]	LABEL DRAIN PLUG WITH ARROW	A8339	8
19	LABEL WARNING	A7406	1
20	LABEL WARNING DO NOT ADJUST BRAKE WHEN	A2658	1
21	LABEL NAMEPLATE	A5957	1

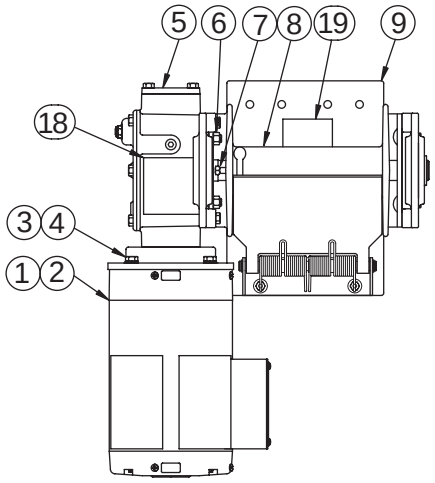
[1] Motor varies.
[2] Some electric motors are equipped with screw plugs which are designed to be removed to provide drain holes.

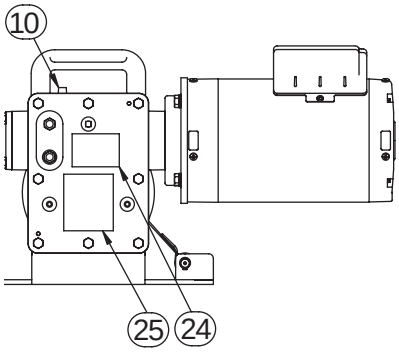


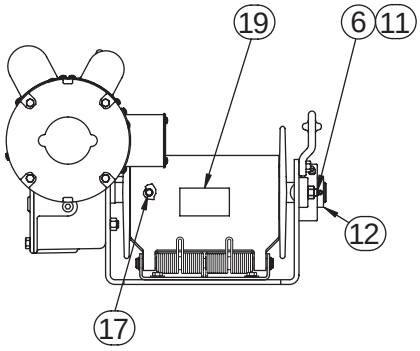
4WP2D8 Series Assembly

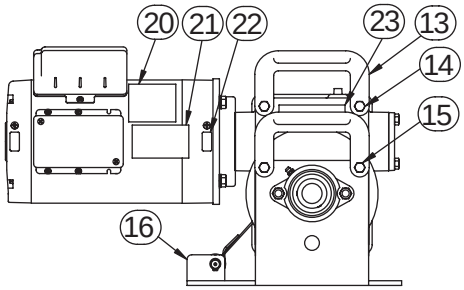
item	description	part number	qty.
1[1]	MOTOR	MTR4WP2D	1
2	KEY .188 X .188 X 1.375 4140	A5178	1
3	CAPSCREW HEXHD .375-16NC X 1.000	A2922	4
4	HELSPRLK WASHER .375 X .683 X .094	A2926	4
5	REDUCER ASSEMBLY	D2600	1
6	HEX NUT .375-16NC	A3017	6
7	SETSCREW SQHD .312-18NC X .875	A7703	1
8	DRUM	D2281	1
9	FRAME	D2248	1
10	BREATHER PLUG .375-18NPT X .48	A3408	1
11	CARRIAGE BOLT .375-16NC X 1.250	A7283	2
12	FLANGE BEARING 1.062	A7285	1
13	HANDLE	B3620	2
14	CAPSCREW HEXHD .312-18NC X 1.000	A3028	4
15	CAPSCREW HEXHD .312-18NC X .625	A3529	2
16	PRESSURE PLATE	B3861	1
17	GROOVE PIN TYPE A .312 X 2.500	A7284	1
18	LABEL WARNING POINTS	A2655	1
19	LABEL WARNING KEEP HANDS AWAY FROM DRUM	A2659	2
20	LABEL WARNING DISCONNECT ELECTRIC POWER	A2256	1
21[2]	LABEL REMOVE DRAIN PLUGS	A8338	1
22[2]	LABEL DRAIN PLUG WITH ARROW	A8339	8
23	LABEL WARNING	A7406	1
24	LABEL WARNING DO NOT ADJUST BRAKE WHEN	A2658	1
25	LABEL NAMEPLATE	A5957	1

[1] Motor varies.
[2] Some electric motors are equipped with screw plugs which are designed to be removed to provide drain holes.





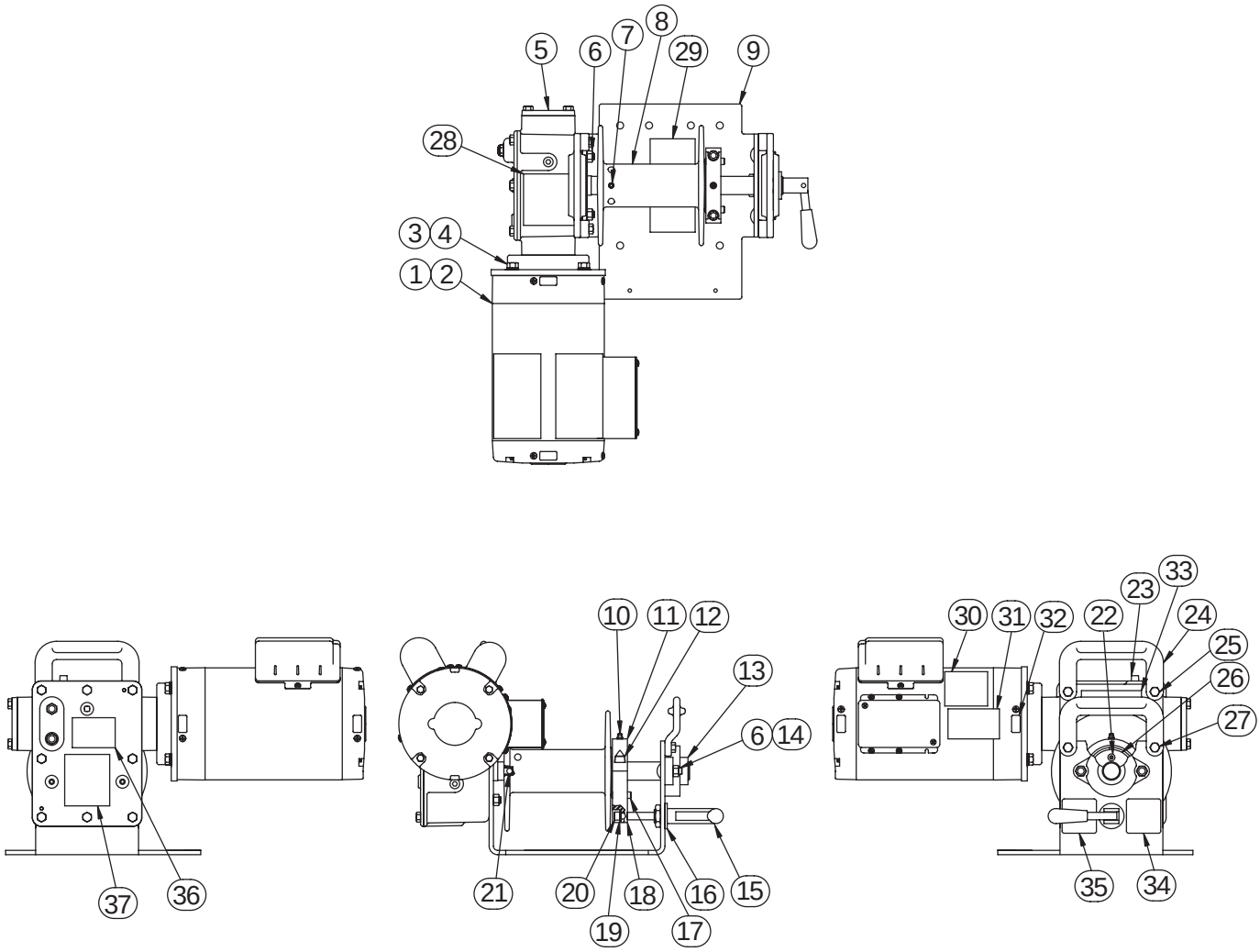




4WP2DC Series Assembly

item	description	part number	qty.
1[1]	MOTOR	MTR4WP2D	1
2	KEY .188 X .188 X 1.375	A5178	1
3	CAPSCREW HEXHD .375-16NC X 1.000	A2922	4
4	HELSPRLK WASHER .375 X .683 X .094	A2926	4
5	REDUCER ASSEMBLY	D2601	1
6	HEX NUT .375-16NC	A3017	6
7	SETSCREW SOKHD .312-18NC X .375	A3745	1
8	DRUM	D2337	1
9	FRAME	D2248	1
10	ZERK DRIVE .250	A3988	1
11	TOP CLUTCH	C3695	1
12	CAPSCREW SOKHD .375-16NC X 1.000	A3445	2
13	BEARING FLANGE 1.062	A7285	1
14	CARRIAGE BOLT .375-16NC X 1.250	A7283	2
15	PUSH PULL CLAMP	A7785	1
16	FLAT WASHER SAE .750 X 1.469 X .134	A6500	1
17	SPRING PLUNGER NYLK .375-16NC X 1.125	A7792	2
18	BOTTOM CLUTCH	C3697	1
19	HELSPRLK WASHER .312 X .586 X .078	A2925	1
20	CAPSCREW SOKHD .312-18NC X 1.250	A3548	1
21	GROOVE PIN TYPE A .312 X 2.500	A7284	1
22	CAPSCREW SOKFLTHD 10-24NC X 1.250	A7794	4
23	BREATHER PLUG .375-18NPT X .48	A3408	1
24	HANDLE	B3620	2
25	CAPSCREW HEXHD .312-18NC X 1.000	A3028	2
26	CLUTCH HUB	B3927	1
27	CAPSCREW HEXHD .312-18NC X .625	A3529	2
28	LABEL WARNING POINTS	A2655	1
29	LABEL WARNING KEEP HANDS AWAY FROM DRUM	A2659	2
30	LABEL WARNING DISCONNECT ELECTRIC POWER	A2256	1
31[2]	LABEL REMOVE DRAIN PLUGS	A8338	1
32[2]	LABEL DRAIN PLUG WITH ARROW	A8339	8
33	LABEL WARNING	A7406	1
34	LABEL CLUTCH DISENGAGED	A7842	1
35	LABEL CLUTCH ENGAGE	A7843	1
36	LABEL WARNING DO NOT ADJUST BRAKE WHEN	A2658	1
37	LABEL NAMEPLATE	A5957	1

[1] Motor varies.
[2] Some electric motors are equipped with screw plugs which are designed to be removed to provide drain holes.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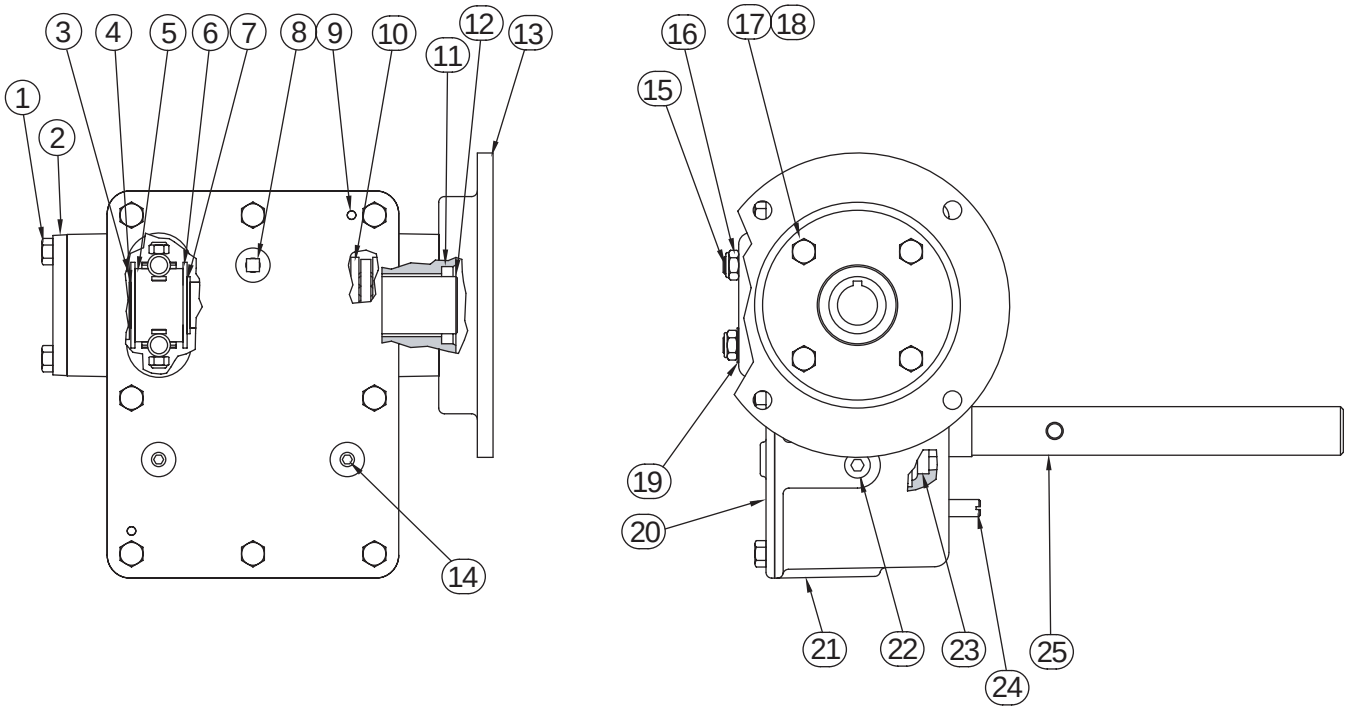
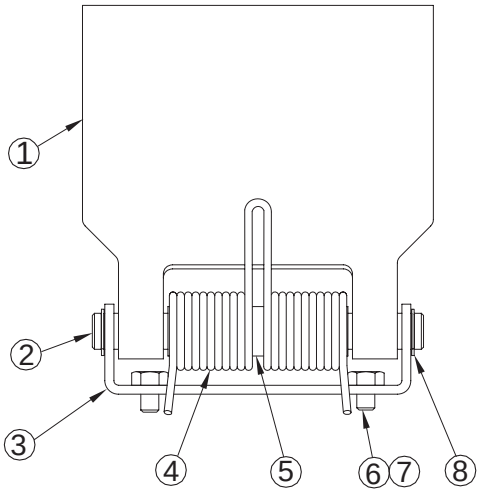
Reducer Assembly		D2595		D2600		D2601	
item	description	part number	qty.	part number	qty.	part number	qty.
1	CAPSCREW HEXHD .312-18NC X .750	A3032	12	A3032	12	A3032	12
2	BEARING HOUSING ASSEMBLY	B4265	1	B4265	1	B4265	1
3	THRUST BEARING .753ID X 1.250OD X .125	A8181	1	A8181	1	A8181	1
4	SHIM .751/.755 X 1.12 X .032	A8182	1	A8182	1	A8182	1
5	BRAKE DRUM ASSEMBLY	B4266	1	B4266	1	B4266	1
6	FLAT WASHER .781ID X 1.875OD X .090	A8184	2	A8184	2	A8184	2
7	FLAT WASHER .765ID X 1.254OD X .060	A8185	1	A8185	1	A8185	1
8	PIPE PLUG SQHD .125-27NPT X .35	A3407	1	A3407	1	A3407	1
9	DOWEL PIN .188 X .500	A7308	2	A7308	2	A7308	2
10	BALL THRUST BEARING	A8186	1	A8186	1	A8186	1
11	OIL SEAL 1.250ID X 1.687OD X .250	A8187	1	A8187	1	A8187	1
12	INPUT SHAFT	C3749	1	C3749	1	C3749	1
13	MOTOR MOUNT	D2594	1	D2594	1	D2594	1
14	PIPE PLUG HEXSOC .125-27NPT X .31	A3405	2	A3405	2	A3405	2
15	BRAKE BAND CONNECTOR	B2917	1	B2917	1	B2917	1
16	HEX JAM NUT NYLK .375-16NC	A3180	2	A3180	2	A3180	2
17	CAPSCREW HEXHD .312-18NC X 1.000	A3028	4	A3028	4	A3028	4
18	HELSPRLK WASHER .312 X .586 X .078	A2925	4	A2925	4	A2925	4
19	SPRING WASHER .380 X .750 X .034	A3296	1	A3296	1	A3296	1
20	COVER	D2052RED	1	D2052RED	1	D2052RED	1
21	GEARCASE	D2449RED	1	D2449RED	1	D2449RED	1
22	PIPE PLUG HEXSOC .375-18NPT X .425	A3290	4	A3290	4	A3290	4
23	OIL SEAL 1.125ID X 1.874OD X .250	A8188	1	A8188	1	A8188	1
24	STUD .375-16NC X 1.312	A7279	4	A7279	4	A7279	4
25	DRUM SHAFT ASSEMBLY	C3414	1	C3623	1	C3694	1



Pressure Plate Assembly		B3688[1]		B3861[2]	
item	description	part number	qty.	part number	qty.
1	PRESSURE PLATE	B3643	1	B3858	1
2	PIN	A3269	1	B3859	1
3	PRESSURE PLATE BASE	A3268	1	B3860	1
4	TORSION SPRING	A3277	1	A3277	2
5	SPACER TUBE	A3273	1	A3273	2
6	CAPSCREW HEXHD .250-20NC X .375	A7434	2	A7434	2
7	FLAT WASHER	–	–	A3052	2
8	RETAINING RING .500	A3278	2	A3278	2

[1] B3688 option for 4WP2D series winches – sold separately.

[2] B3861 supplied with 4WP2D8 series winches.



4WP2D Series – Performance Characteristics [1]

			load rating (lb)			wire	line speed (fpm)		drum capacity (ft)[2]			approx.
model	motor codes	motor hp	1st layer	mid drum	full drum	rope dia. (in)	1st layer	full drum	1st layer	mid drum	full drum	ship wt. (lb)
4WP2D-800-26	A,B,D,E	1	800	590	460	1/4	26	45	11	35	77	75
4WP2D-800-40	D,E	1.5	800	590	460	1/4	40	68	11	35	77	75
4WP2D-1500-26	D,E	2	1500	1100	900	1/4	26	45	11	35	77	75
4WP2D-1500-40	B,D,E	3	1500	1100	900	1/4	40	68	11	35	77	75
4WP2D8-800-26	A,B,D,E	1	800	460	330	1/4	26	65	19	130	280	100
4WP2D8-800-40	D,E	1.5	800	460	330	1/4	40	97	19	130	280	100
4WP2D8-1500-26	D,E	2	1500	900	600	1/4	26	65	19	130	280	100
4WP2D8-1500-40	B,D,E	3	1500	900	600	1/4	40	97	19	130	280	100
4WP2DC-800-26	A,B,D,E	1	800	460	330	1/4	26	65	12	87	190	100
4WP2DC-800-40	D,E	1.5	800	460	330	1/4	40	97	12	87	190	100
4WP2DC-1500-26	D,E	2	1500	900	600	1/4	26	65	12	87	190	100
4WP2DC-1500-40	B,D,E	3	1500	900	600	1/4	40	97	12	87	190	100

Motor Codes

A	115 volt	1 phase
B	230 volt	1 phase
D	230 volt	3 phase
E	460 volt	3 phase

[1] Performance Characteristics are for standard products referred to in this manual. Non-standard products may vary from the original design. Contact Thern, Inc. for this information.

[2] Actual drum capacities may be 25-30% less, due to nonuniform winding. Tension in wire rope will also affect drum capacity.

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EMAIL: info@thern.com
www.thern.com

Series 4WP2D High Speed Worm Gear Power Winches

Up to 1500 lb capacity

- **Direct Drive Design** delivers high speed operation in both directions, even under full load.
- **Machine Cut Bronze Worm Gears** provide accurate operation and long lasting service.
- **Enclosed Oil Bath** provides continuous lubrication of gears to minimize wear. Oil seals keep oil in and dirt out.
- **Internal Mechanical Brake** provides positive load control for lifting and lowering operations.
- **Ball Bearings** and self-aligning bronze bearings provide smooth and efficient operation.
- **Pressure Plate** applies pressure to drum and wire rope to help maintain uniform winding. Not available on clutch models.
- **Dual Function Cable Anchor** for quick disconnect of wire rope with swaged ball fitting, or recessed cable anchor with set screw for wire rope with unfinished end.
- **Mounting Options** include floor, wall, or ceiling.
- **Two-year Limited Warranty**
- **Cast Aluminum** construction, for lightweight strength.
- **Corrosion Resistant** durable paint finish protects against corrosion in harsh environments.

Model 4WP2D8-1500-40 shown with wire rope

Wire rope assemblies and controls sold separately

- **Large Diameter Drums** minimize wear to the wire rope and help extend its life.
- **Clutch Model** allows operator to manually disengage the drum to rapidly unwind wire rope. **Clutch models do not include pressure plates.**

Series 4WP2D – Performance Characteristics – Section 2

When ordering, please indicate Model Number and Extensions
Examples: 4WP2D8-800-26-A (without clutch); 4WP2DC-800-40-A (with clutch)

	model number extensions				load rating (lb)			wire	line speed (fpm)		drum capacity(ft)[2]			approx.[3]
model number	load rating	line speed	motor codes	motor hp	1st layer	mid drum	full drum	rope dia.(in)[1]	1st layer	full drum	1st layer	mid drum	full drum	ship wt.(lb)
High Speed Atlas winches for lifting or pulling														
4WP2D8	800	26	A,B,D,E	1	800	460	330	1/4	26	65	19	130	280	100
4WP2D8	800	40	D,E	1.5	800	460	330	1/4	40	97	19	130	280	100
4WP2D8	1500	26	D,E	2	1500	900	600	1/4	26	65	19	130	280	100
4WP2D8	1500	40	B,D,E	3	1500	900	600	1/4	40	97	19	130	280	100
High Speed Clutch Models for HORIZONTAL PULLING ONLY														
4WP2DC	800	26	A,B,D,E	1	800	460	330	1/4	26	65	12	87	190	100
4WP2DC	800	40	D,E	1.5	800	460	330	1/4	40	97	12	87	190	100
4WP2DC	1500	26	D,E	2	1500	900	600	1/4	26	65	12	87	190	100
4WP2DC	1500	40	B,D,E	3	1500	900	600	1/4	40	97	12	87	190	100

Motor Codes

A	115 volt	1 phase
B	230 volt	1 phase
D	230 volt	3 phase
E	460 volt	3 phase
F	All other voltages – please contact factory	
PN	please contact factory	

■ For more information and other control options, please see pages 46-47.

■ Custom controls are available including wireless remote control, variable speed control, electronic overload, and enclosures for special environments.

Please contact factory or nearest Thern Distributor for firm fixed price and delivery.

[1] Minimum wire rope diameter is 1/4 inch.

[2] Actual drum capacities 25-30% less, due to nonuniform winding. Wire rope tension will also affect drum capacity.

[3] Weight may vary with motor.

Control Options and Accessories – Section 2

model	description	115/1/60[4]	230/1/60	230/3/60	460/3/60
EL1CS	NEMA 1	to 1.5 hp	to 2 hp	to 3 hp	to 3 hp
EL2CS	NEMA 1	to 1.5 hp	to 3 hp	to 5 hp	to 7.5 hp
EL1CSW	NEMA 4 – watertight	to 1.5 hp	to 2 hp	to 3 hp	to 3 hp
EL2CSW	NEMA 4 – watertight	to 1.5 hp	to 3 hp	to 5 hp	to 7.5 hp
EL1PD	6 ft pendant control	to 1 hp	—	—	—
TPL-4WP2T8	Two Part Line Kit				

Please contact factory or nearest Thern Distributor for firm fixed price and delivery.

[4] Controls for 115V single phase motors up to 1 hp, include an 8 ft power cord with grounded plug.

See Dimensions on Next Page

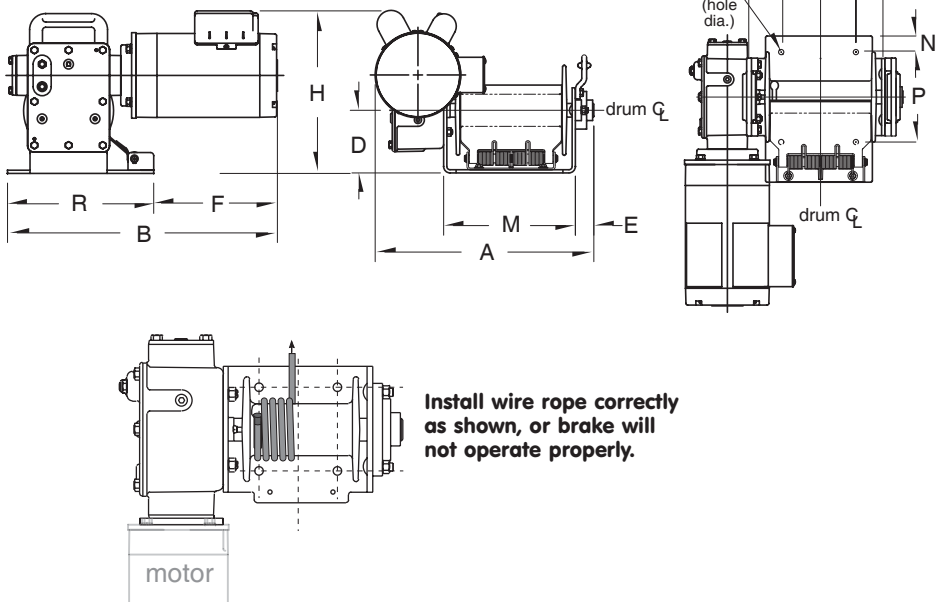
Thern products are not for lifting people or things over people.

Options and Accessories

- **Emergency Hand Crank** for manual operation in case of power failure. Does not include handle.
- **Two Part Line Kit** to convert to double line rigging.
- **Rotary Limit Switches** for secondary shut-off to limit load travel in one or two directions. **Not available on clutch models.**
- **Special Motors and Controls** including severe duty and explosion proof.
- **Special Finishes** for hazardous environments.
- **Torque Limiters** as part of the motor controls on electric models.

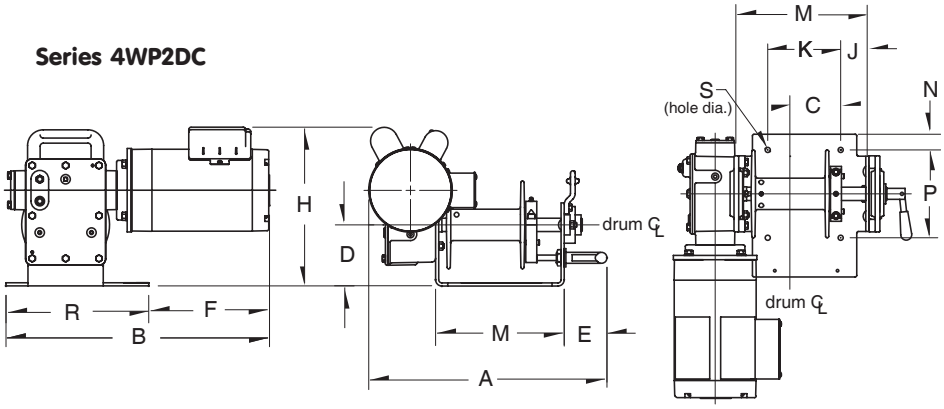
Side View **Rear View** **Top View**

Series 4WP2D8



Install wire rope correctly as shown, or brake will not operate properly.

Series 4WP2DC



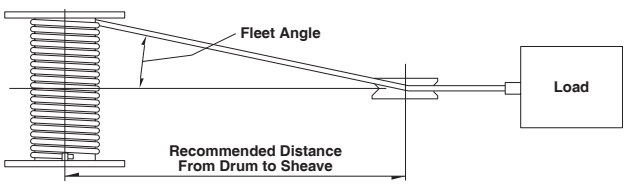
Important:
It is the owner's or operator's responsibility to determine the suitability of the equipment to its intended use. Study all applicable codes, manuals, and regulations. Be sure to read the Owner's Manual supplied with the equipment before operating it.

Series 4WP2D – Dimensions (in)

series	A[1]	B[1]	C	D	E	F	H[1]	J	K	M	N	P	R	S (hole dia.)
4WP2D8	17.50	21.00	2.75	5.00	1.50	9.50	12.75	2.25	5.81	10.25	1.25	7.00	11.50	.41
4WP2DC	19.00	21.00	4.00	5.00	3.50	9.50	12.75	2.25	5.81	10.25	1.25	7.00	11.50	.41

Dimensions are for reference only and subject to change without notice.

[1] Dimensions A, B and H may vary with motor selection.



Series 4WP2D – Drum Dimensions

model extension	drum diameter	flange diameter	drum width	fleet angle distance[2]
4WPD8	2.50 in	7.00 in	8.00 in	13 ft
4WPDC	2.50 in	7.00 in	5.50 in	9 ft

Dimensions are for reference only and subject to change without notice.

[2] Recommended minimum distance between drum and lead sheave for smooth drum.