

Boats

Feedback

Valves in closed position
with autopilot

40-49

OWNERS MANUAL



1579 Barber Rd
34240

SARASOTA, FL.

813-379-0500

(11/12/92 from
NAVICO)

941

MANUAL HYDRAULIC STEERING INSTALLATION AND SERVICE MANUAL

Steering Pump
replaced May 2003

THIS MANUAL SHOULD BE KEPT ON BOARD YOUR VESSEL.

***** WARRANTY *****

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HOW AND WHY IT WORKS

THERE ARE FOUR BASIC ELEMENTS TO YOUR HYDRAULIC STEERING SYSTEM: THE HELM, THE RESERVOIR, THE RELIEF VALVE, AND THE CYLINDER.

THE STEERING STATION ASSEMBLY INCLUDES A HYDRAULIC PUMP AND PILOT CHECK VALVE ASSEMBLY. ROTATING THE SHIP'S WHEEL MOVES SEVEN SMALL PISTONS IN A CONTROLLED PATTERN. THESE PISTONS, IN TURN, PUMP HYDRAULIC FLUID TO THE STEERING CYLINDER. INTERNALLY LOCATED IN THE STEERING SENDER ARE TWO PILOT CHECK VALVE ASSEMBLIES. THESE ISOLATE EACH STEERING STATION FROM ALL OTHERS. THEY ALSO LOCK THE RUDDER AND ELIMINATE "KICKBACK" FROM THE RUDDER TO THE STEERING WHEEL.

EXTRA HYDRAULIC FLUID AND A PRESSURE HEAD FOR THE SYSTEM IS MAINTAINED BY THE RESERVOIR. THE RESERVOIR STORES APPROXIMATELY TWO QUARTS OF HYDRAULIC FLUID UNDER A PRESSURE OF 20 PSI. THIS PREVENTS AIR FROM ENTERING THE SYSTEM. LOCATED ON THE RESERVOIR IS AN AIR VALVE AND A PRESSURE GAUGE, WHICH SHOWS THAT THE RESERVOIR IS CHARGED TO THE PROPER PRESSURE. THE HYDRAULIC FLUID IN THE RESERVOIR PASSES THROUGH A SINTERED BRONZE FILTER UPON ITS EXIT FROM THE RESERVOIR, THEREBY PREVENTING DIRT FROM ENTERING THE SYSTEM. HYDRAULIC FLUID FROM THE RESERVOIR PASSES INTO THE SYSTEM THROUGH CHECK VALVES, LOCATED IN THE STEERING SENDER.

PROTECTION OF BOTH THE MECHANICAL PORTION OF THE RUDDER (SHOULD THE RUDDER STRIKE A SOLID OBJECT) AND HYDRAULIC SYSTEM IS HANDLED BY A RELIEF VALVE ASSEMBLY, FACTORY SET AT 500 OR 950 PSI. THE RELIEF VALVE IS CONNECTED BETWEEN THE STEERING CYLINDER AND THE RESERVOIR. LOCATED IN THE RELIEF VALVE ARE TWO SMALL SINTERED BRONZE FILTERS AND AS THE UNIT RELIEVES HYDRAULIC FLUID TO THE RESERVOIR, THEY FILTER OUT ANY FOREIGN MATERIAL THAT MAY HAVE BEEN ENTRAPPED IN THE LINES OR THE FLUID. THIS RELIEVING FEATURE ALLOWS AIR TO BE EASILY REMOVED FROM THE SYSTEM BY A CONSTANT ROTATION OF THE STEERING WHEEL IN THE SAME DIRECTION AFTER IT HAS REACHED HARDOVER. THIS ACTION PROGRESSIVELY FORCES ALL THE AIR OUT OF THE SYSTEM THROUGH THE RELIEF VALVE AND INTO THE RESERVOIR.

THE RELIEF VALVE-RESERVOIR RELATIONSHIP IN THE SYSTEM PREVENTS THERMAL EXPANSION OR CONTRACTION DUE TO TEMPERATURE CHANGES FROM RUPTURING OR CAUSING "AIR POCKETS" IN THE SYSTEM.

STEERING CYLINDER ASSEMBLIES ARE DOUBLE-ACTING, DOUBLE ROD END TYPES, EITHER RIGIDLY MOUNTED OR TRUNION MOUNTED WITH RODS OF SEALOY (SPECIAL NON-MAGNETIC STAINLESS STEEL). WHEN THE CYLINDER IS RIGIDLY MOUNTED, THE MECHANICAL LINKAGE BETWEEN THE PISTON ROD END AND THE RUDDER ARM SHOULD BE AT LEAST 12 INCHES LONG.

VARIOUS CYLINDER SIZES ARE OFFERED. 1 1/2" ID CYLINDERS CAN EXERT APPROXIMATELY 1250 LBS. OF FORCE ON THE RUDDER ARM, WITH A 950 PSI RELIEF VALVE. WITH A 2" CYLINDER, APPROXIMATELY 2400 LBS. OF FORCE IS AVAILABLE. SEE THE HELM AND CYLINDER PERFORMANCE CHART IN THE APPENDIX FOR TORQUE AND WHEEL TURNS REQUIRED.

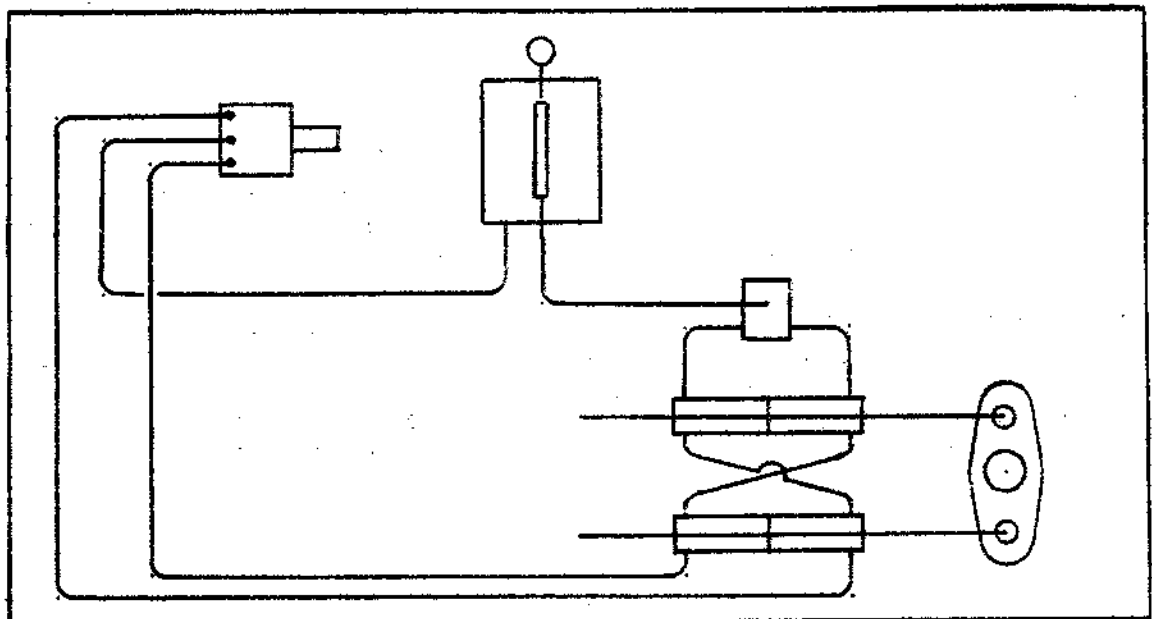
APPLICATION EXAMPLE:

CYLINDER: 1 1/2 X 10
HELM DISPLACEMENT: 2.75 CU.IN./REV.
WHEEL TURNS (HARDOVER TO HARDOVER): 5
RUDDER ARM LENGTH: 8 INCHES.
TURNING TORQUE ON RUDDER: 7,900 IN-LBS.
RUDDER ARC: 77

MANUAL HYDRAULIC STEERING CAN BE USED ON ANY BOAT WHICH CAN BE STEERED MANUALLY. SHOULD A GREATER TORQUE BE REQUIRED ON THE RUDDER THAN SHOWN IN THE SYSTEM PERFORMANCE DATA, THE RUDDER ARM LENGTH MAY BE INCREASED. THIS WOULD INCREASE THE TORQUE ON THE RUDDER BUT DECREASE THE TOTAL RUDDER ARC. ANOTHER METHOD WOULD BE TO ADD A SECOND STEERING CYLINDER (IN PARALLEL WITH THE FIRST STEERING CYLINDER) TO THE SYSTEM. THIS WOULD DOUBLE THE TURNING TORQUE ON THE RUDDER, BUT IT WOULD ALSO DOUBLE THE NUMBER OF TURNS FROM HARDOVER TO HARDOVER. SEE THE EXAMPLE BELOW.

APPLICATION EXAMPLE:

CYLINDER: 1 1/2 X 10 INCHES
HELM DISPLACEMENT: 2.75 CU.IN./REV.
WHEEL TURNS (HARDOVER TO HARDOVER): 10
RUDDER ARM LENGTH: 8 INCHES
TURNING TORQUE ON RUDDER: 15,800 IN-LBS.
RUDDER TRAVEL: 77



PREPARATION FOR INSTALLATION

- 1) READ YOUR INSTRUCTION MANUAL FIRST BEFORE YOU START ANY WORK. THIS WILL SAVE YOU TIME AND ELIMINATE MOST OF YOUR INSTALLATION PROBLEMS.
- 2) BEFORE INSTALLATION IS STARTED VERIFY THAT A COMPLETE SYSTEM HAS BEEN RECEIVED.
- 3) IT IS RECOMMENDED THAT ALL SYSTEM COMPONENTS BE INSTALLED PRIOR TO RUNNING THE SYSTEM TUBING. THIS ALLOWS THE TUBING TO BE RUN BETWEEN TWO DEFINITE POINTS WITH LESS CHANCE OF A HOOKUP ERROR.
- 4) IF IT IS NECESSARY FOR THE TUBING TO BE STRUNG FIRST, A SYSTEM OF MARKING THE DIFFERENT TUBING RUNS SHOULD BE USED.
- 5) DO NOT USE ANY THREAD LUBRICANT OR SEALER ON THE FLARED TUBE FITTINGS. WHEN USING THREAD LUBRICANT ON THE PIPE FITTINGS, TAKE CARE NOT TO INDUCE THE SUBSTANCE INTO THE SYSTEM.
- 6) DRY SEAL THREADS AND HIGH QUALITY FITTINGS ARE USED THROUGHOUT YOUR HYNAUTIC SYSTEM. DO NOT USE PERMATEX OR FORMATEX, OR SIMILAR TYPE THREAD SEALANTS, ON THE PIPE JOINTS WHEN INSTALLING THE FITTINGS. SHOULD THIS SEALANT BE INTRODUCED INTO YOUR SYSTEM, A MALFUNCTION COULD RESULT. THE ONLY SEALANT HYNAUTIC RECOMMENDS FOR PIPE THREADS IS LOCTITE HYDRAULIC SEALANT #69-31, AND LOCQUIC PRIMER GRADE T #47-56. AGAIN, THIS SEALANT SHOULD BE USED WITH CAUTION AND VERY SPARINGLY.
- 7) CLEANLINESS IS EXTREMELY IMPORTANT. CARE SHOULD BE TAKEN TO PREVENT CHIPS OR ANY FOREIGN MATTER FROM GETTING INTO THE COMPONENTS OR TUBING BEFORE OR DURING INSTALLATION.
- 8) THE FOLLOWING SET OF INSTALLATION INSTRUCTIONS HAS BEEN MADE AS COMPLETE BUT AS BRIEF AS PRACTICAL. IF YOU HAVE ANY QUESTIONS, CONTACT YOUR DISTRIBUTOR OR HYNAUTIC, INC.

INSTALLATION INSTRUCTIONS: RIGIDLY MOUNTED CYLINDERS

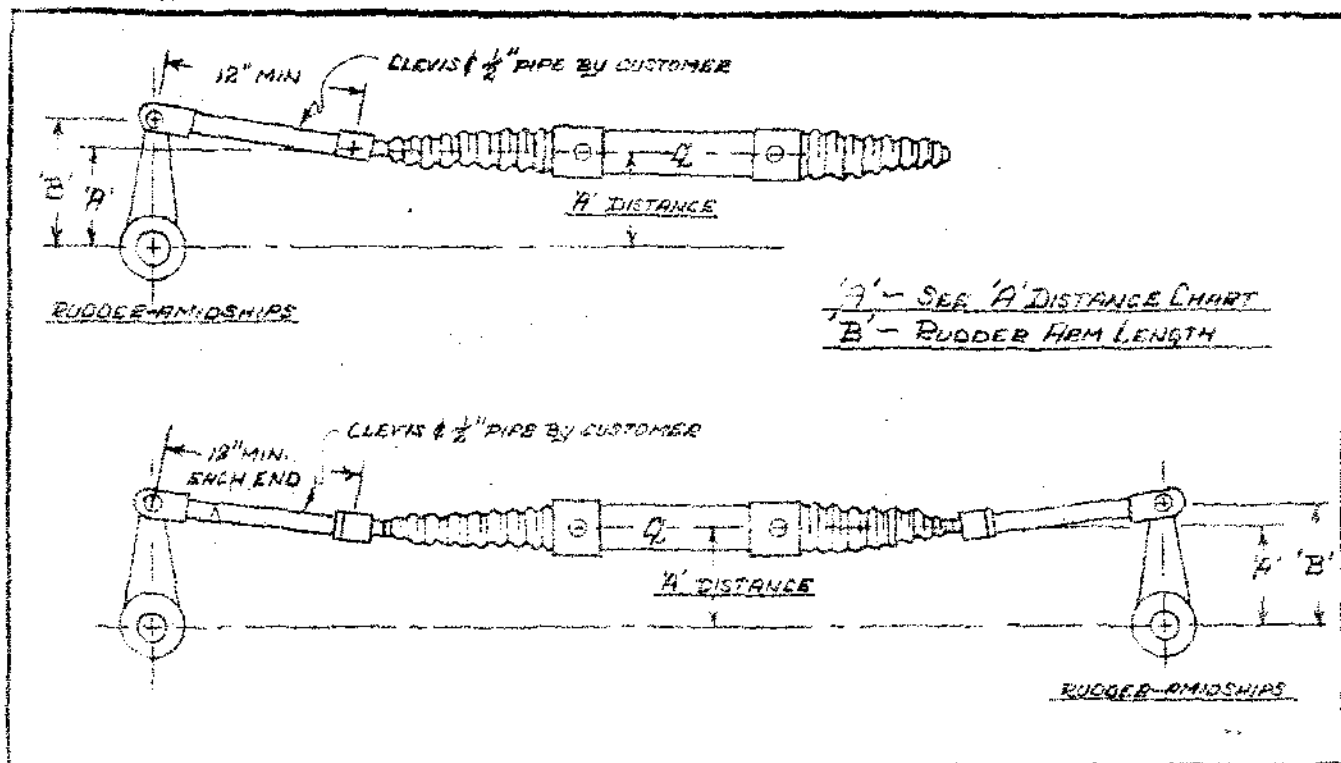
K22, 24, 27, 28, 29

MOUNT THE CYLINDER ASSEMBLY

CYLINDER LAYOUT AND DIMENSIONS ARE GIVEN IN THE APPENDIX FOR THE 5, 10, AND 12 INCH CYLINDERS.

THE CYLINDER MAY BE MOUNTED EITHER CROSSWISE OR LENGTHWISE TO THE VESSEL'S KEEL. IT IS IMPORTANT TO MAINTAIN A 12" MINIMUM LENGTH BETWEEN THE CENTER OF THE BALL JOINT AND THE RUDDER ARM. (SEE THE FIGURE BELOW)

POSITION THE RUDDER ARM IN THE MIDSHIPS POSITION AND THE CYLINDER IN ITS CENTER POSITION. THE CLEVIS SHOULD BE CONNECTED TO THE RUDDER ARM. NOW POSITION THE CYLINDER'S CENTERLINE ALONG A LINE THAT IS AN 'A' DISTANCE FROM THE RUDDER POST RUNNING AT RIGHT ANGLES TO THE RUDDER ARM. THE 'A' DISTANCE CHART INDICATES THE 'A' DISTANCE FOR DIFFERENT RUDDER ARM LENGTHS.



'A' DISTANCE CHART

5" STROKE CYLINDER		
<u>RUDDER ARC DEGREES</u>	<u>RUDDER ARM LENGTH INCHES</u>	<u>'A' DISTANCE INCHES</u>
60	5	4-3/4
67	4-1/2	4-1/8
78	4	3-5/8
92	3-1/2	3
10" STROKE CYLINDER		
<u>RUDDER ARC DEGREES</u>	<u>RUDDER ARM LENGTH INCHES</u>	<u>'A' DISTANCE INCHES</u>
60	10	9-3/8
67	9	8-3/8
78	8	7-1/8
92	7	6
12" STROKE CYLINDER		
<u>RUDDER ARC DEGREES</u>	<u>RUDDER ARM LENGTH INCHES</u>	<u>'A' DISTANCE INCHES</u>
60	12	11-1/4
70	10-1/2	9-5/8
80	9-1/2	8-1/2
90	8-1/2	7-1/4

THE MOUNTING SURFACE TO WHICH THE CYLINDER IS MOUNTED SHOULD BE FREE OF OBSTRUCTIONS AND FLAT. SHOULD THIS SURFACE BE WARPED, IT WILL CAUSE THE CYLINDER TO BECOME TWISTED WHEN IT IS BOLTED DOWN, THEREBY CAUSING EXCESSIVE INTERNAL BINDING.

THE RUDDER ARM, OR ARMS, MUST HAVE AN UNOBSTRUCTED ARC OF TRAVEL, WITH THE RUDDER POST PACKING ALLOWING A FREE MOVEMENT OF THE RUDDER ARM AND RUDDER. IT IS MOST DESIRABLE TO HAVE A CLOSE FITTING, BUT FREE, REAMED CLEVIS PIN HOLE. THIS WILL ASSURE A LONG CLEVIS PIN LIFE.

INSTALLATION INSTRUCTIONS: TRUNION MOUNTED CYLINDER

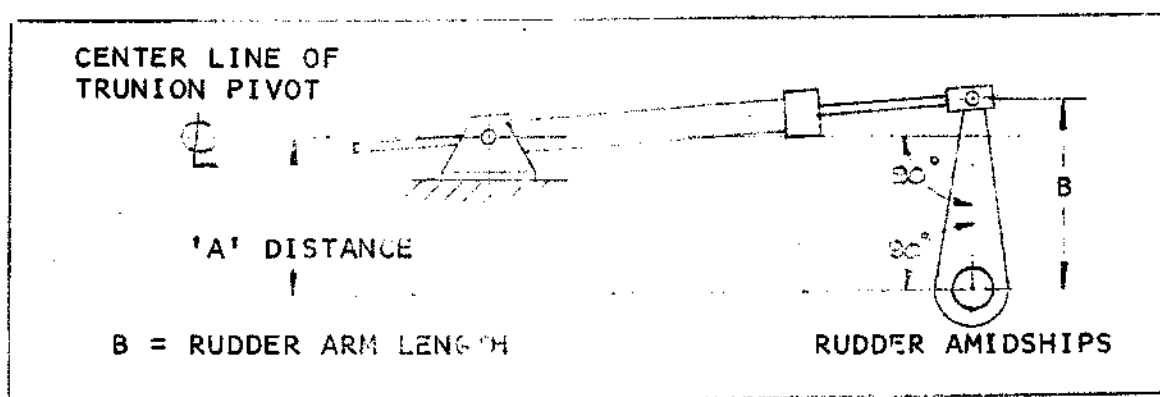
K 5, K26

MOUNT THE CYLINDER

CYLINDER LAYOUT AND DIMENSIONS ARE GIVEN IN THE APPENDIX FOR THE 10 AND 12 INCH STROKE CYLINDERS.

MOUNT THE CYLINDER IN EITHER A CROSS WISE (ABEAM) DIRECTION OR A LENGTHWISE (FORE AND AFT) DIRECTION TO THE BOAT. THE RUDDER ARM IS CONNECTED DIRECTLY TO THE CLEVIS ON THE END OF THE CYLINDER ROD.

POSITION THE RUDDER ARM IN THE MIDSHIPS POSITION AND THE CYLINDER IN ITS CENTER POSITION. THE CLEVIS SHOULD BE CONNECTED TO THE RUDDER ARM. NOW POSITION THE CYLINDER'S CENTERLINE ALONG A LINE THAT IS AN 'A' DISTANCE FROM THE RUDDER POST AND AT RIGHT ANGLES TO THE RUDDER ARM. THE 'A' DISTANCE CHART INDICATES THE 'A' DISTANCE FOR DIFFERENT RUDDER ARM LENGTHS.



A DISTANCE CHART

10" STROKE CYLINDER

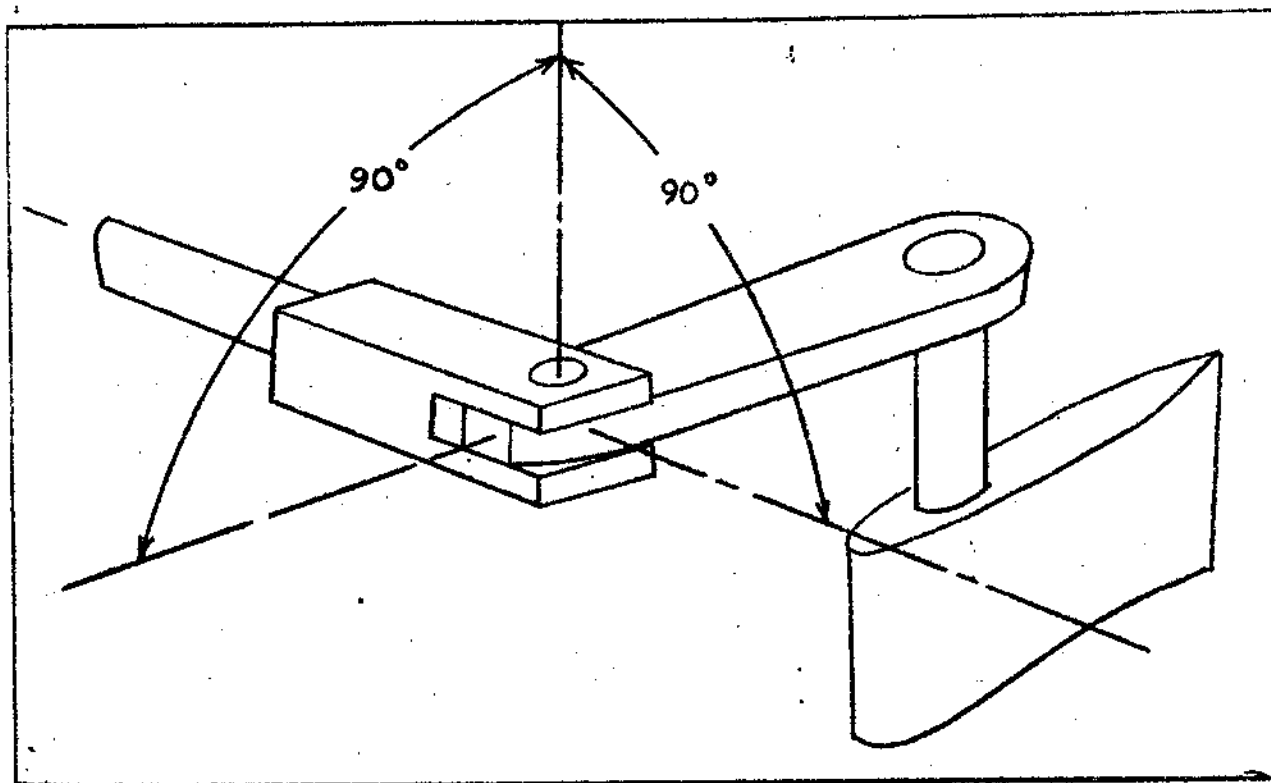
<u>RUDDER ARC DEGREES</u>	<u>RUDDER ARM LENGTH INCHES</u>	<u>'A' DISTANCE INCHES</u>
60	10	9-3/8
67	9	8-3/8
78	8	7-1/8
92	7	6

12" STROKE CYLINDER

60	12	11-1/4
70	10-1/2	9-5/8
80	9-1/2	8-1/2
90	8-1/2	7-1/4

CRITICAL FACTORS IN MOUNTING THE TRUNION MOUNTED CYLINDER

- 1) CARE SHOULD BE TAKEN NOT TO KNICK OR SCRATCH THE CYLINDER ROD OR LEAKAGE WILL RESULT.
- 2) THE CYLINDER AND TILLER ARM MUST SWING TOGETHER IN THE SAME PLANE. THERE SHOULD BE NO BINDING AND THE CLEVIS PIN MUST BE EASILY REMOVED AT ANY POINT THROUGHOUT THE RUDDER ARM'S TRAVEL IF THE CYLINDER IS INSTALLED CORRECTLY.
- 3) THE TRUNION AND CLEVIS DO NOT ALLOW FOR INSTALLATION MIS-ALIGNMENT OR ADJUSTMENT.
- 4) THE CYLINDER SHOULD BE LOCATED IN A POSITION TO INSURE AN UNOBSTRUCTED PATHWAY FOR THE FLEXIBLE HOSE TO GO FROM THE RELIEF VALVE TO THE CYLINDER PORTS.
- 5) THE TRUNION BRACKET SHOULD BE THROUGH-BOLTED TO A SUBSTANTIAL MEMBER, SINCE IT WILL HAVE TO WITHSTAND FORCES UP TO 1250 LBS.
- 6) THE RUDDER ARM, OR ARMS, MUST HAVE AN UNOBSTRUCTED ARC OF TRAVEL, WITH THE RUDDER POST PACKING ALLOWING A FREE MOVEMENT OF THE RUDDER ARM AND RUDDER. IT IS MOST DESIRABLE TO HAVE A CLOSE FITTING, BUT FREE, REAMED CLEVIS PIN HOLE. THIS WILL ASSURE A LONG CLEVIS PIN LIFE.



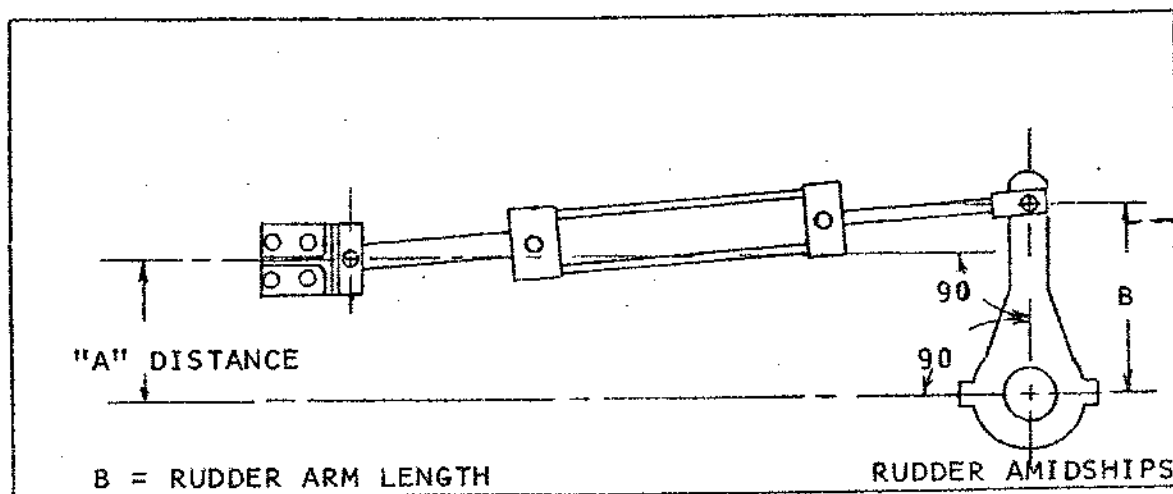
INSTALLATION INSTRUCTIONS: PIVOT MOUNTED CYLINDER

MOUNT THE CYLINDER:

CYLINDER LAYOUT AND DIMENSIONS ARE GIVEN IN THE APPENDIX FOR THE 8 AND 10 INCH STROKE CYLINDERS.

MOUNT THE CYLINDER IN EITHER A CROSSWISE (ABEAM) DIRECTION OR A LENGTHWISE (FORE AND AFT) DIRECTION TO THE BOAT. THE RUDDER ARM IS CONNECTED DIRECTLY TO THE CLEVIS ON THE END OF THE CYLINDER ROD.

POSITION THE RUDDER ARM IN THE MIDSHIPS POSITION AND THE CYLINDER IN ITS CENTER POSITION. THE CLEVIS SHOULD BE CONNECTED TO THE RUDDER ARM. NOW POSITION THE CYLINDER'S CENTERLINE ALONG A LINE THAT IS AN "A" DISTANCE FROM THE RUDDER POST AND AT RIGHT ANGLES TO THE RUDDER ARM. THE "A" DISTANCE CHART INDICATES THE "A" DISTANCE FOR DIFFERENT RUDDER ARM LENGTHS.

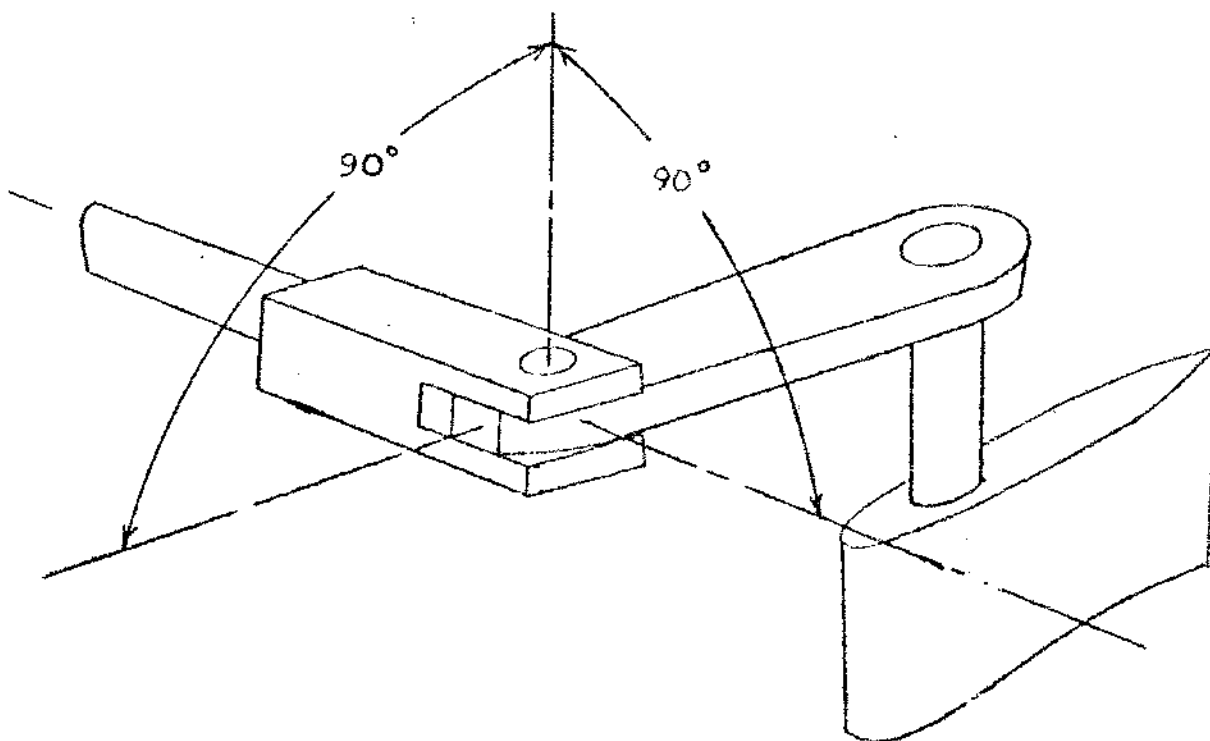


"A" DISTANCE CHART

<u>8" STROKE CYLINDER</u>	<u>RUDDER ARM</u>	<u>"A" DISTANCE</u>
60	8	7 1/2
67	7 1/4	6 3/4
78	6 1/4	5 7/8
92	5 1/2	5 1/8
<u>10" STROKE CYLINDER</u>		
60	10	9 3/8
67	9	8 3/8
78	8	7 1/8
92	7	6

CRITICAL FACTORS IN MOUNTING THE PIVOT MOUNTED CYLINDER

- 1) CARE SHOULD BE TAKEN NOT TO KNICK OR SCRATCH THE CYLINDER ROD OR LEAKAGE WILL RESULT.
- 2) THE CYLINDER AND TILLER ARM MUST SWING TOGETHER IN THE SAME PLANE. THERE SHOULD BE NO BINDING AND THE CLEVIS PIN MUST BE EASILY REMOVED AT ANY POINT THROUGHOUT THE RUDDER ARM'S TRAVEL IF THE CYLINDER IS INSTALLED CORRECTLY.
- 3) THE PIVOT MOUNTING DOES NOT ALLOW FOR INSTALLATION MIS-ALIGNMENT OR ADJUSTMENT.
- 4) THE CYLINDER SHOULD BE LOCATED IN A POSITION TO INSURE AN UNOBSTRUCTED PATHWAY FOR THE FLEXIBLE HOSE TO GO FROM THE RELIEF VALVE TO THE CYLINDER PORTS.
- 5) THE BRACKET SHOULD BE THROUGH-BOLTED TO A SUBSTANTIAL MEMBER, SINCE IT WILL HAVE TO WITHSTAND FORCES UP TO 2400 LBS.
- 6) THE RUDDER ARM, OR ARMS, MUST HAVE AN UNOBSTRUCTED ARC OF TRAVEL, WITH THE RUDDER POST PACKING ALLOWING A FREE MOVEMENT OF THE RUDDER ARM AND RUDDER. IT IS MOST DESIRABLE TO HAVE A CLOSE FITTING, BUT FREE, REAMED CLEVIS PIN HOLE. THIS WILL ASSURE A LONG CLEVIS PIN LIFE.



INSTALLATION INSTRUCTIONS: MOUNT THE RELIEF VALVE

RELIEF VALVE DIMENSIONS ARE GIVEN IN THE APPENDIX.

THE RELIEF VALVE SHOULD BE MOUNTED ABOVE THE CYLINDER, IN ORDER TO HELP THE PURGING PROCESS. REMEMBER, YOU MUST HAVE ACCESS TO THIS VALVE FOR PURGING. MOUNT IT WHERE YOU CAN GET AT THE BRASS SCREWS.

TWO HELPFUL HINTS CONCERNING THE INSTALLATION AND USE OF THIS UNIT:

- 1) IT IS BETTER TO MOUNT THIS VALVE WITH THE BRASS PLUGS UP.
- 2) AFTER PURGING, SCREW DOWN THE VALVE SCREWS OR THE CYLINDER WILL BE BYPASSED.....RESULT: NO STEERING!

INSTALLATION INSTRUCTIONS: MOUNTING THE RESERVOIR

RESERVOIR DIMENSIONS AND LAYOUT ARE GIVEN IN THE APPENDIX. SEE FIGURE 13.

MOUNT THE RESERVOIR IN AN UPRIGHT POSITION AND WHERE IT WILL BE EASY TO FILL, PRESSURIZE, READ THE PRESSURE GAUGE, AND VIEW THE SIGHT TUBE. WHILE THE RESERVOIR CAN BE LOCATED ANY PLACE IN THE BOAT, SYSTEM PURGING WILL BE EASIER IF IT IS NEAR THE HELM UNITS. THIS IS PARTICULARLY IMPORTANT WHERE LONG RUNS OF TUBING ARE INVOLVED, AS IN VERY LARGE BOATS, HOUSEBOATS, AND SPORT-FISHERMEN WITH TUNA TOWERS. IN THESE INSTANCES, IT IS RECOMMENDED THAT THE RESERVOIR BE MOUNTED FORWARD, HIGH IN THE BOAT, AND CLOSE TO THE HELMS.

IT SHOULD BE NOTED THAT THE PORT ON THE BOTTOM OF THE RESERVOIR IS THE SUPPLY PORT. THE LINE FROM THIS PORT GOES TO THE HELM UNITS.

THE PORT ON THE BOTTOM OF THE SIGHT TUBE IS THE RETURN PORT. THE LINE FROM THIS PORT GOES TO THE RELIEF VALVE.

WHEN TIGHTENING FITTINGS AT THE RESERVOIR, USE A BACKUP WRENCH. THIS WILL PREVENT DISTORTION OF THE FITTING ASSEMBLIES ON THE RESERVOIR.

A COMPLETE SET OF PURGING INSTRUCTIONS IS AFFIXED TO THE SIDE OF THE RESERVOIR. SHOULD AN ADDITIONAL OR REPLACEMENT COPY BE REQUIRED, CONTACT HYNAUTIC, INC.

INSTALLATION INSTRUCTIONS: MOUNTING THE HELM UNIT

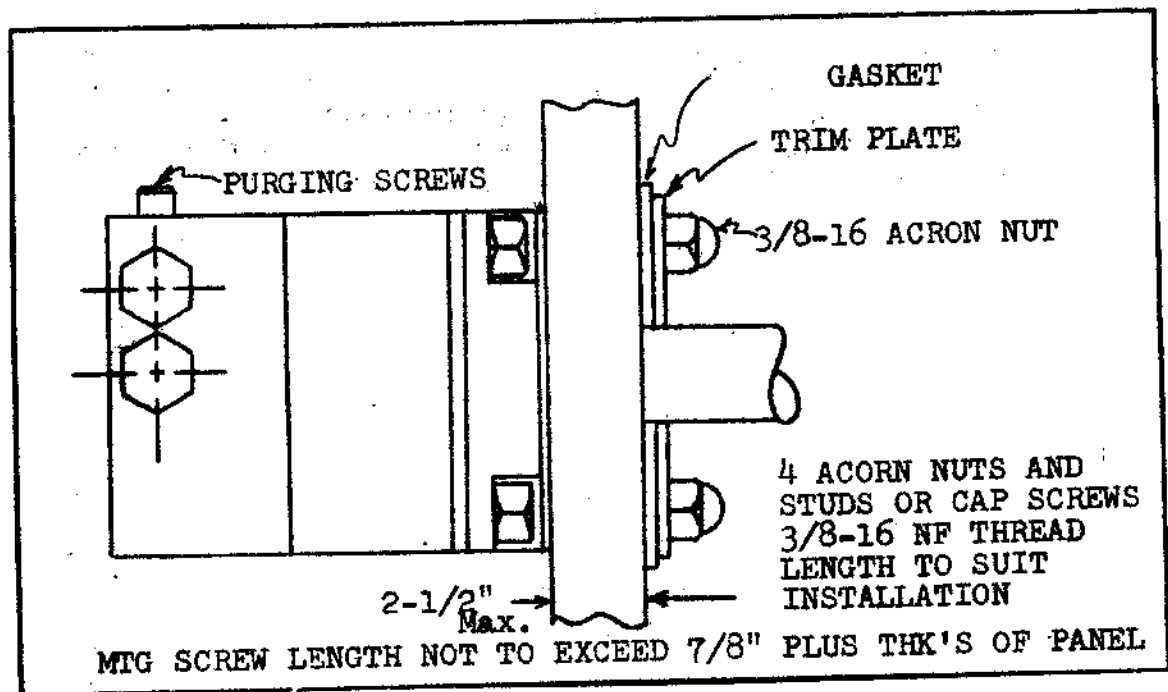
HELM UNIT DIMENSIONS AND LAYOUTS ARE GIVEN IN THE APPENDIX, FIGURE 14, AND IN THE SYSTEM PERFORMANCE SECTION OF THE APPENDIX.

THE HELM UNITS MAY BE MOUNTED WITH THE TUBING PORTS UP, DOWN, OR IN ANY POSITION. THE SHAFT MAY BE AT AN ANGLE IF SO DESIRED. VERIFY AFTER MOUNTING THAT THE HELM UNIT'S SHAFT DOES NOT BIND ON THE PANEL.

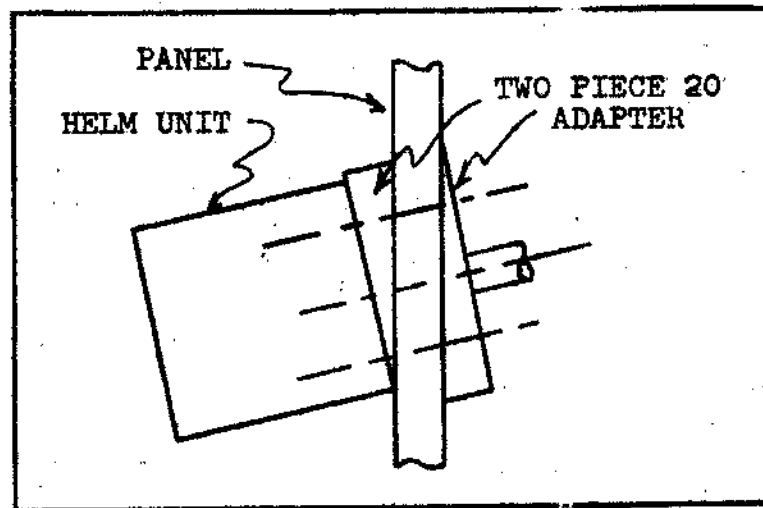
A TEMPLATE IS PROVIDED IN THE APPENDIX. THIS MAY BE USED FOR LOCATING THE SHAFT AND MOUNTING HOLES. IF THIS TEMPLATE IS USED, THE DIRECTION OF THE TUBING PORTS WILL CORRESPOND TO THE HORIZONTAL AND VERTICAL LINES DRAWN ON THE TEMPLATE.

FOR THE HELM UNIT'S SHAFT A 1-1/4" DIAMETER HOLE PROVIDES THE PROPER CLEARANCE.

EXTREME CARE MUST BE TAKEN TO USE THE CORRECT LENGTH 3/8-16 NF STUDS. THESE ARE PROVIDED BY THE BOAT BUILDER, OR OWNER, AND SHOULD NOT EXCEED THE THICKNESS OF THE CONSOLE BY MORE THAN 7/8 INCH.

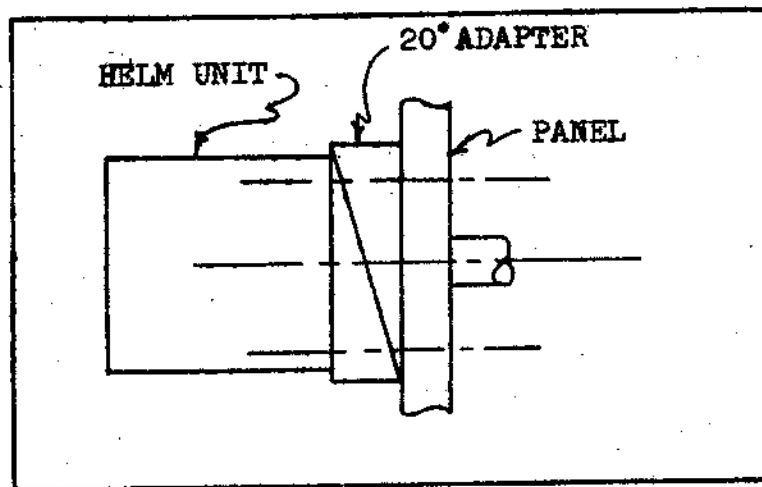


IF A 20 DEGREE ADAPTER HAS BEEN PROVIDED, IT SHOULD BE INSTALLED AS SHOWN BELOW.



THE 20 DEGREE ANGLE SHOULD BE TAKEN INTO ACCOUNT WHEN DRILLING THE HOLES THROUGH THE PANEL. THE HELM'S SHAFT SHOULD NOT BIND ON THE PANEL WHEN THE STUDS ARE TIGHTENED DOWN.

THE TWO PIECE ADAPTER MAY BE PUT TOGETHER AND PLACED ~~BETWEEN~~ THE HELM AND THE BACK OF THE PANEL SO THAT LESS OF THE HELM'S SHAFT IS SHOWING.



THE 3/8 TUBE PORTS ARE MARKED S AND P. ROTATING THE STEERING WHEEL IN A CLOCKWISE DIRECTION WILL PRESSURIZE S. ROTATING IT IN THE COUNTERCLOCKWISE DIRECTION, P WILL BE PRESSURIZED.

INSTALLATION INSTRUCTIONS: RUNNING TUBING

WHEN USING COPPER TUBING

TUBING SHOULD BE RUN PER THE TUBING DIAGRAMS IN THE APPENDIX.

YOU MUST CONNECT THE 'S' LINES TO THE END OF THE CYLINDER WHICH MOVES THE RUDDER TO PROVIDE STARBOARD STEERING. CONNECT LINES AS SHOWN IN THE SELECTED DIAGRAM. PRESSURE IN THE RIGHT END OF THE CYLINDER MOVES THE LINKAGE ARM LEFT.

SOFT REFRIGERATION TYPE COPPER TUBING WILL BE EASILY FLARED AND CONTOURED FOR THE INSTALLATION. DO NOT OVERTIGHTEN JOINTS. THERE IS SEEPAGE, THEY CAN EASILY BE RETIGHTENED.

IF YOU REAM BEFORE FLARING, KEEP CHIPS OUT OF THE TUBING.

SYSTEMS WITH 2.0 OR 2.75 CU.IN. HELMS SHOULD BE PIPED WITH 3/8" OD SOFT REFRIGERATION TYPE COPPER TUBING 'P' AND 'S' LINES. THE 'R' LINES FROM RELIEF VALVE TO RESERVOIR AND RESERVOIR TO HELM(S) SHOULD BE 1/4".

SYSTEMS WITH 4.0 AND 5.5 CU.IN. HELMS SHOULD BE PIPED WITH 1/2" OD SOFT REFRIGERATION TYPE COPPER TUBING 'P' AND 'S' LINES WITH 3/8" 'R' LINES.

***** C A U T I O N *****

* TRUNION AND PIVOT MOUNT CYLINDERS MUST BE FITTED *
* WITH SHORT LENGTHS OF 1500 PSI WORKING PRESSURE *
* HOSE (AEROQUIP 2651 OR EQUIVALENT, IN THE SAME *
* NOMINAL SIZE AS THE COPPER USED IN 'P' AND 'S' *
* LINES) TO PERMIT CYLINDER MOVEMENT. IF COPPER *
* IS USED HERE, IT WILL WORK-HARDEN AND FAIL. *
* *

IT IS POSSIBLE TO PIPE THE ENTIRE SYSTEM IN SUITABLE HOSE, BUT THIS MAY CAUSE SOME "SPONGINESS" IN THE SYSTEM. CONSIDERATION SHOULD BE GIVEN TO THE USE OF HOSE AT POINTS SUBJECT TO FREQUENT FLEXING OR EXCESSIVE VIBRATION.

THE RESERVOIR AND RELIEF VALVE ARE FITTED WITH 10 MICRON FILTERS TO PREVENT DIRT FROM DAMAGING THE SYSTEM. HOWEVER, THEY WILL NOT PREVENT COPPER CHIPS OR DIRT PICKED UP DURING THE TUBING INSTALLATION FROM ENTERING THE CYLINDER OR OTHER COMPONENTS WHEN THE SYSTEM IS BEING PURGED. CLEANLINESS IS EXTREMELY IMPORTANT!

INSTALLATION INSTRUCTIONS: PURGING THE SYSTEM

SYSTEM FLUID MAY BE EITHER AUTOMATIC TRANSMISSION TYPE 'A' DEXRON APPROVED OR MIL H-5606 AIRCRAFT HYDRAULIC FLUID. MIL H-5606 IS BETTER SUITED OVER A WIDER AMBIENT TEMPERATURE RANGE AND IS HIGHLY RECOMMENDED.

LOOSEN THE TWO VALVE SCREWS ON THE RELIEF VALVE (SEE THE RELIEF VALVE LAYOUT DIAGRAM) WITH A 1/2" WRENCH UNTIL ALL THE PRESSURE IS REMOVED FROM THE INTERNAL SPRING. NOTE: THESE SCREWS CANNOT BE REMOVED FROM THE RELIEF VALVE EXCEPT BY TOTAL DISASSEMBLY OF THE RELIEF VALVE.

REMOVE THE FILLER PLUG FROM THE TOP OF THE RESERVOIR AND FILL WITH OIL TO WITHIN 2" OF THE TOP. REPLACE THE FILLER PLUG AND SLOWLY PRESSURIZE WITH AIR TO 20-30 PSI. THE RESERVOIR IS EQUIPPED WITH AN AIR VALVE LIKE THOSE USED IN AUTOMOBILE TIRES, SO A BICYCLE PUMP OR OTHER SOURCE OF COMPRESSED AIR IS USED. OIL WILL START FLOWING INTO THE LINES AND THE OIL LEVEL WILL START TO DROP. SHOULD THE OIL LEVEL DROP TO APPROXIMATELY 2" FROM THE BOTTOM OF THE RESERVOIR AT ANY TIME, STOP AND OPEN THE SYSTEM, THEN REFILL WITH OIL TO WITHIN 2" OF THE TOP AND REPRESSURIZE. IF AFTER A FEW MINUTES THE PRESSURE AND OIL LEVELS ARE NOT HOLDING FAIRLY CONSTANT, CHECK ALL FITTINGS AND CONNECTIONS FOR LEAKS. NOTE: THE RESERVOIR PRESSURE MAY BE INCREASED TO 50 PSI IF LONG TUBING RUNS ARE ENCOUNTERED (HOUSEBOATS, TUNA TOWERS, ETC.). HOWEVER, A FINAL PURGE APPROXIMATELY 8 HOURS AFTER MUST BE PERFORMED. TO COMPLETE THE PURGING PROCESS, PERFORM THE FOLLOWING STEPS:

- 1) WHEN POSSIBLE, DISCONNECT THE CYLINDER FROM THE RUDDER SYSTEM. MAKE CERTAIN IT IS FREE TO STROKE FULL STROKE WITHOUT INTERFERENCE.
- 2) WHILE AT THE CYLINDER, BLEED BOTH ENDS BY CRACKING THE BLEEDER SCREWS (OR FITTINGS) AT EACH END OF THE CYLINDER. AIR WILL ESCAPE; RETIGHTEN THE BLEEDER SCREW (OR FITTING) WHEN SOLID OIL APPEARS. WHEN BLEEDING A SINGLE ROD END CYLINDER, BEGIN BLEEDING THE CYLINDER AT THE ROD END FIRST.
- 3) GO TO THE HIGHEST HELM AND TURN SLOWLY (2 TO 3 SEC./REV.) 25-35 TURNS IN ONE DIRECTION.
- 4) REPEAT 25-35 SLOW TURNS IN THE SAME DIRECTION AT THE NEXT LOWEST HELM.

INSTALLATION INSTRUCTIONS: PURGING THE SYSTEM
(CONTINUED)

- 5) REPEAT 25-35 SLOW TURNS IN THE SAME DIRECTION AT THE NEXT LOWEST HELM FOR THE REMAINDER OF THE HELMS.
- 6) ONCE MORE CRACK THE FITTINGS AT THE CYLINDER AS IN STEP 2, CLOSING WHEN SOLID OIL APPEARS.
- 7) CHECK RESERVOIR PRESSURE AND OIL LEVEL AND RE-ESTABLISH THE OIL LEVEL IF REQUIRED, AND THE PRESSURE TO 20-30 PSI.
- 8) GO TO TOP STATION AND TURN SLOWLY 25-35 TURNS IN THE OPPOSITE DIRECTION. REPEAT AT SUCCESSIVELY LOWER STATIONS.
- 9) ONCE MORE, CRACK THE FITTINGS AT THE CYLINDER AS IN STEP 2, CLOSING WHEN SOLID OIL APPEARS.
- 10) IF BOAT IS EQUIPPED WITH AN AUTO-PILOT, REFER TO THE SECTION ON "PURGING THE AUTO-PILOT" IN THE MANUAL.
- 11) PURGING SHOULD BE COMPLETE AT THIS POINT.

* * * * * NOTE * * * * *

*
* CRACKING THE FITTINGS AT THE CYLINDER IS NOT *
* ABSOLUTELY NECESSARY, BUT IT WILL GREATLY REDUCE *
* YOUR PURGING TIME. *
* *
* * * * *

AS A PROGRESS CHECK, CLOSE THE VALVE SCREWS ON THE RELIEF VALVE AND SEE HOW MANY TURNS ARE REQUIRED AT THE HELM FROM HARDOVER TO HARDOVER. REFER TO THE "HELM AND CYLINDER PERFORMANCE CHART" FOR THE NUMBER OF TURNS YOU SHOULD HAVE WITH YOUR COMBINATION OF HELM AND CYLINDER(S).

YOU SHOULD BE WITHIN 1/2 TURN OR LESS OF THE DESIGNED NUMBER OF TURNS. IF YOU EXCEED THE LIMITS BY MORE THAN 1/2 TURN, THE SYSTEM IS NOT COMPLETELY PURGED AND YOU MUST REPEAT THE PURGING PROCESS. AGAIN, CHECK THE OIL LEVEL AND GAUGE PRESSURE OF THE RESERVOIR IF IT HAS DROPPED; RE-CHECK FOR LEAKS AT ALL JOINTS AND FITTINGS.

IF A LINE MUST BE DISCONNECTED FOR ANY REASON, LET THE AIR OUT OF THE RESERVOIR AND REMOVE THE FILLER CAP AND THEN LOOSEN THE SCREWS ON THE RELIEF VALVE TO RELIEVE ALL PRESSURE IN THE CYLINDER LINES. DO NOT FORGET TO RE-TIGHTEN AFTER MAKING YOUR ADJUSTMENT.

INSTALLATION INSTRUCTIONS: PURGING THE SYSTEM
(CONTINUED)

IF IT IS NOW DETERMINED THAT THE PROPER NUMBER OF TURNS LOCK TO LOCK HAVE BEEN OBTAINED, WE SHOULD RE-CHECK THE OIL LEVEL (2/3 TO 1/2 FULL) AND LEAVE 20-30 PSI OF PRESSURE ON THE SYSTEM.

IF IT IS POSSIBLE, IT IS RECOMMENDED TO GIVE THE SYSTEM A SHORT FINAL PURGE AFTER A PERIOD OF TIME (APPROXIMATELY 8 HOURS). THIS TIME PERIOD ALLOWS ANY SMALL POCKETS OF AIR THAT EXIST TO FORM LARGER BUBBLES AND BE EASILY REMOVED WITH THIS FINAL PURGE. A FEW TURNS AFTER REACHING HARDOVER ON EACH OF THE HELM UNITS WILL BE SUFFICIENT.

VERIFY THAT THE VALVE SCREWS ON THE RELIEF VALVE HAVE BEEN CLOSED. IF THEY ARE NOT CLOSED, THE CYLINDER WILL BE BYPASSED AND THIS WILL RESULT IN NO STEERING.

INSTALLATION INSTRUCTIONS: AUTO PILOTS

The leading manufacturers of marine auto-pilots offer systems that are compatible with Hynautic steering. Before selecting your auto-pilot consult the auto-pilot manufacturer if there is any question regarding the proper model for use with Hynautic Steering.

Automatic pilots may be integrated easily into the Hynautic System through the use of an auto-pilot helm unit connected into the steering system as though it was another station. With the auto-pilot connected in such a manner, the Captain may manually override the auto-pilot without turning the auto-pilot off. When the ship's wheel is released, the auto-pilot returns the boat again to its previously set course.

It should be noted that all auto-pilots have a feedback system that makes the rudder correction proportional to the error in heading. In the Hynautic steering system it is necessary to connect this feedback to the rudder or rudder cylinder. The steering wheel DOES NOT indicate the rudder position due to the differential effect of the several steering stations.

PURGING THE AUTO PILOT

Verify that the manual system has been completely purged and has the proper number of turns hardover to hardover. Turn one of the helms hardover in one direction either port or starboard. Stop steering and leave the rudder in the hardover position. Again remove all pressure from the screws on the relief valve, noted in "Purging the System". At dockside, set a course on the auto-pilot to make a large correction in the same direction as the rudders were placed by the manual helm. Start the auto-pilot and run one or two minutes and you will purge the auto-pilot for that direction; stop the auto-pilot. Repeat this process by turning the helm to hardover in the opposite direction and reset the auto-pilot in the opposite direction and run it for one or two minutes. After purging, close the relief valve screws and recheck the manual system.

TROUBLE SHOOTING

<u>PROBLEM</u>	<u>CAUSE</u>	<u>SOLUTION</u>
TURN WHEEL ON ONE HELM UNIT AND WHEEL ON OTHER STATION ALSO TURNS.	DIRT IN PILOT CHECK VALVE ASSEMBLY OF FREE-WHEELING HELM.	SEND UNIT BACK TO HYNAUTIC FOR REPAIR.
RUDDER DRIFTS EXCESSIVELY.	LEAKAGE IN RELIEF VALVE ASSEMBLY OR VALVE SCREWS ARE NOT COMPLETELY DOWN.	TIGHTEN VALVE SCREWS DOWN OR RETURN DEFECTIVE UNIT, IF APPLICABLE, TO HYNAUTIC FOR REPAIR.
SYSTEM SEEMS NOT TO BE PURGED WHEN IT HAD JUST BEEN PURGED THE DAY BEFORE.	AIR SATURATION INTO OIL CAUSED BY HIGH PURGING PRESSURE.	RE-PURGE SYSTEM USING JUST 20-30 PSI.
OIL IS DRAWN OUT OF SIGHT GLASS WHEN SYSTEM IS BEING PURGED (RESERVOIRS WITH EXTERNAL SIGHT TUBE).	OIL LINES (INPUT AND OUTPUT) FROM RESERVOIR ARE REVERSED.	REVERSE LINES MAKING SURE LINE FROM BOTTOM OF TANK GOES TO HELM UNITS AND LINE FROM BOTTOM OF SIGHT GLASS GOES TO RELIEF VALVE.
EXCESSIVE STEERING TORQUE AT ALL STATIONS WHILE VESSEL IS AT DOCK.	RUDDER PACKINGS TIGHT AND BINDING OR CYLINDER IS MOUNTED ON A WARPED SURFACE CAUSING INTERNAL BINDING.	DISCONNECT CYLINDER FROM RUDDER, THEN ROTATE WHEEL. IF STEERING IS FREE, CHECK PACKINGS. IF SYSTEM IS STILL STIFF, LOOSEN CYLINDER MOUNTING BOLTS AND CHECK TURNING TORQUE ON WHEEL.
STEERING EFFORT INCREASES AS OUTSIDE TEMPERATURE DROPS.	TYPE 'A' TRANSMISSION FLUID BECOMES MORE VISCOUS WITH LOWER TEMPERATURES.	CHANGE FLUID TO MIL H-5605 AIRCRAFT HYDRAULIC FLUID. THIS FLUID HAS A MUCH LOWER CHANGE IN VISCOSITY WITH TEMPERATURE CHANGE.

TROUBLE SHOOTING

<u>PROBLEM</u>	<u>CAUSE</u>	<u>SOLUTION</u>
ONE HELM UNIT TURNS RUDDER IN ONE DIRECTION WHILE OTHER STATION(S) TURN IT IN OTHER DIRECTION.	HYDRAULIC LINES P AND S HOOKED UP BACKWARDS AT HELM STATION.	REVERSE LINES GOING TO P AND S ON THE STATION IN ERROR.
HELM UNIT PUMPS IN ONE DIRECTION BUT NOT IN THE OTHER.	DIRT IN MAKEUP CHECK VALVE ASSEMBLY (VALVES LOCATED IN HELM UNIT) OR THE RELIEF VALVE IS NOT FUNCTIONING.	VERIFY THAT THE VALVE SCREWS ARE RUN DOWN. RETURN THE UNIT IN ERROR TO HYNAUTIC.
HELM UNIT SHOWS NO DEFINITE STOP IN EITHER DIRECTION.	VALVE SCREWS LEFT OPEN ON THE RELIEF VALVE, OR EXCESSIVE AIR IN THE SYSTEM.	CLOSE THE VALVE SCREWS. IF AIR IS IN THE SYSTEM RE-PURGE THE ENTIRE SYSTEM.
HELM UNIT TAKES EXCESSIVE TURNS GOING HARDOVER TO HARDOVER.	AIR IN SYSTEM. ALSO VERIFY CORRECT HELM DISPLACEMENT.	IF AIR, RE-PURGE THE SYSTEM.
LOSS OF FLUID AND PRESSURE IN THE RESERVOIR.	LEAK IN THE SYSTEM.	CHECK ALL CONNECTIONS IN THE SYSTEM AND REPAIR AS REQUIRED.
LOSS OF PRESSURE BUT NO LOSS OF FLUID IN THE RESERVOIR.	AIR LEAK IN UPPER AREA OF THE RESERVOIR.	IF LOSS IS OVER A LONG PERIOD, JUST RE-PRESSURIZE THE RESERVOIR TO 20-30 PSI. IF LOSS IS OVER A SHORT TIME PERIOD, CHECK FOR AIR LEAKAGE USING A SOAPY SOLUTION AND REPAIR AS REQUIRED. RE-PRESSURIZE TO 20-30 PSI.

PREPARING YOUR SYSTEM FOR EMERGENCY TILLER OPERATION

IN THE EVENT THAT YOU HAVE A SYSTEM FAILURE AND (OR) REQUIRE THE USE OF AN EMERGENCY TILLER, ONE OF THE FOLLOWING METHODS MAY BE USED TO DEACTIVATE YOUR HYDRAULIC STEERING SYSTEM.

1. BY DISCONNECTING THE CYLINDER FROM THE TILLER ARM OR RUDDER SYSTEM AT ITS POINT OF ATTACHMENT.
2. BY OPENING THE PURGING SCREWS ON THE SYSTEM'S RELIEF VALVE.
3. IF APPLICABLE, BY OPENING PRE-INSTALLED CYLINDER BYPASS VALVES, OR VALVE. THIS IS A CUSTOMER INSTALLED FEATURE.
4. IF APPLICABLE, BY OPENING THE PORT AND STARBOARD VALVES ON THE FF-01 FEEDBACK KIT.

A DETAILED EXPLANATION OF EACH METHOD IS LISTED BELOW:

DISCONNECTING AT THE RUDDER ARM

THIS IS PERHAPS THE EASIEST, AND MOST STRAIGHTFORWARD, METHOD OF DEACTIVATING A SYSTEM WHEN TILLER STEERING IS REQUIRED. CYLINDER ATTACHMENT TO THE RUDDER SYSTEM IS USUALLY ACCOMPLISHED THROUGH THE USE OF A CLEVIS OR BALL JOINT, AND IN THE CASE OF A TILT OR GUIDE TUBE MOUNTED CYLINDER, AN 'S' LINK. THE DETACHING PROCEDURE FOR EACH OF THESE CASES FOLLOWS:

1. CLEVIS PINS ARE NORMALLY USED WHEN ATTACHING RIGIDLY MOUNTED OR TRUNION MOUNTED CYLINDERS TO A RUDDER ARM. THESE CYLINDERS ARE EASILY DETACHED FROM THE RUDDER ARM BY REMOVING ONE OF THE COTTER PINS FROM THE CLEVIS PIN, THEN REMOVE THE CLEVIS PIN FROM THE CLEVIS AND ARM, PLACING THE COTTER AND CLEVIS PINS IN A CONTAINER FOR RE-INSTALLATION AT A LATER TIME.
2. CYLINDERS ATTACHED TO THE RUDDER ARM BY A BALL JOINT CAN BE DISCONNECTED BY REMOVING THE 1/2-20 LOCK NUT AND WASHERS, PLACING THIS HARDWARE IN A CONTAINER FOR LATER USAGE.
3. CYLINDERS THAT ARE MOUNTED DIRECTLY TO A GUIDE TUBE OR TILT TUBE ARE CONNECTED TO THE STEERING ARM OF THE OUTBOARD OR OUTDRIVE BY AN 'S' LINK. THE DRIVE IS PREPARED FOR EMERGENCY STEERING BY DISCONNECTING THE 'S' LINKAGE AT EITHER THE TILLER ARM OR ADAPTER ROD, PLACING THE MOUNTING HARDWARE IN AN APPROPRIATE CONTAINER.

IN ALL CASES THE CYLINDER, OR LINKAGES, SHOULD BE SWUNG OUT OF THE PATH OF THE RUDDER ARM, SO THAT IT WILL NOT INTERFERE WITH THE ARM'S TRAVEL WHILE THE TILLER IS BEING USED.

BYPASSING THE SYSTEM'S RELIEF VALVE

A SECOND MEANS OF PREPARING YOUR SYSTEM FOR EMERGENCY TILLER OPERATION WOULD BE TO BACKOFF BOTH PURGING SCREWS ON THE RELIEF VALVE, THEREBY ALLOWING THE OIL TO BE BYPASSED BACK TO THE RESERVOIR WHEN THE TILLER IS IN OPERATION.

THIS METHOD OF DEACTIVATING YOUR SYSTEM WILL EVENTUALLY CAUSE A VACUUM TO BE DRAWN AT THE CYLINDER RESULTING IN THE REQUIREMENT OF A COMPLETE SYSTEM REPURGING AT THE TIME OF SYSTEM REACTIVATION.

THIS METHOD OF SYSTEM DEACTIVATION CAN BE PERFORMED IN ALL CYLINDER CASES.

BYPASSING USING CUSTOMER INSTALLED CYLINDER BYPASS VALVES

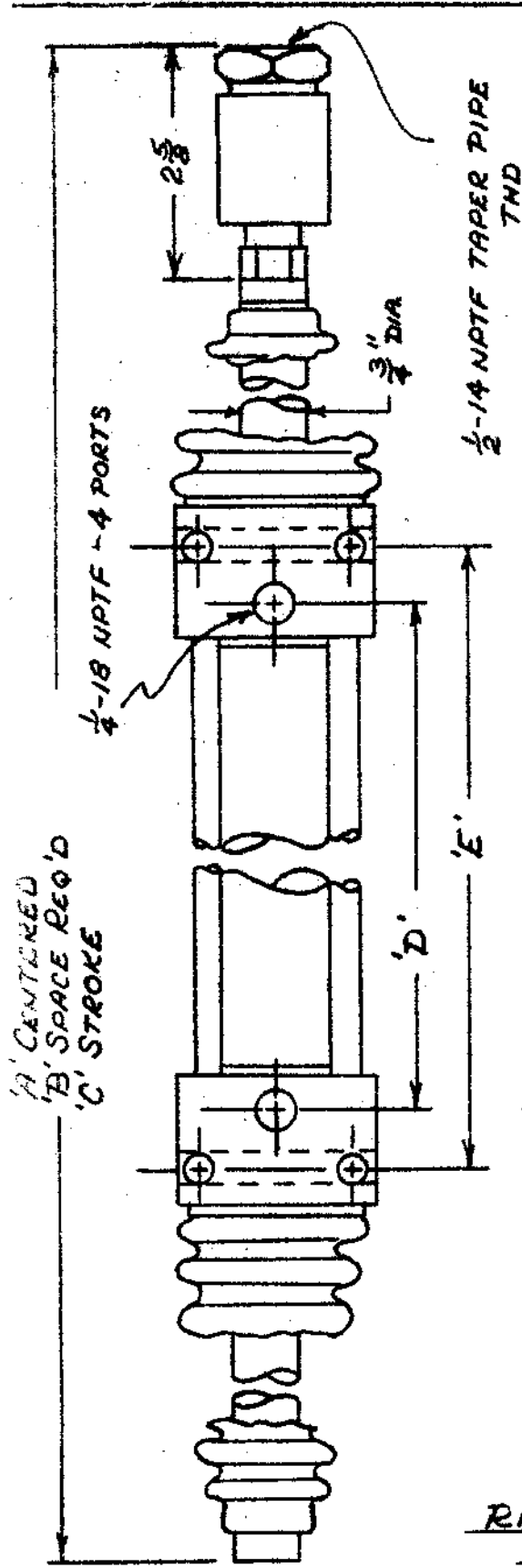
IN SOME CASES, OWNERS HAVE EQUIPPED THEIR SYSTEM WITH AN EMERGENCY BYPASS VALVE LOCATED AT THE CYLINDER. IF THIS HAS BEEN DONE, THEN THE VALVE NEED MERELY TO BE OPENED FOR EMERGENCY TILLER OPERATION, SINCE THIS VALVE ALLOWS OIL TO BE BYPASSED DIRECTLY FROM ONE SIDE OF THE CYLINDER TO THE OTHER WITH NO INTERFERENCE.

BOATS EQUIPPED WITH THE RUDDER FEEDBACK OPTION

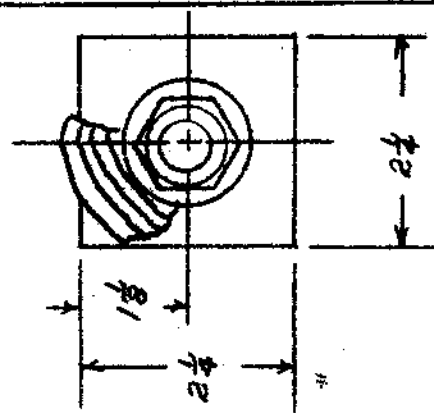
IF YOUR VESSEL HAS BEEN EQUIPPED WITH THE HYNAUTIC FF-01 RUDDER FEEDBACK KIT, YOU MUST MERELY OPEN BOTH THE PORT AND STARBOARD VALVES, AS YOU WOULD TO OBTAIN FEEDBACK, INSTALL THE TILLER, AND RESUME STEERING THE BOAT.

APPENDIX

LAYOUT FIGURES
TEMPLATE
PIPING DIAGRAMS
SYSTEM SPECIFICATIONS
SYSTEM PERFORMANCE CHARTS



1/2-14 NPTF TAPER PIPE TND



CYLINDER No	'A'	'B'	'C'	'D'	'E'
K-24	24 3/8	34 3/8	5	6 1/8	8 1/4
K-22	34 3/8	44 3/8	10	11 1/8	13 1/4
K-27 *	36 3/4	46 3/4	10	11 1/8	13 1/4

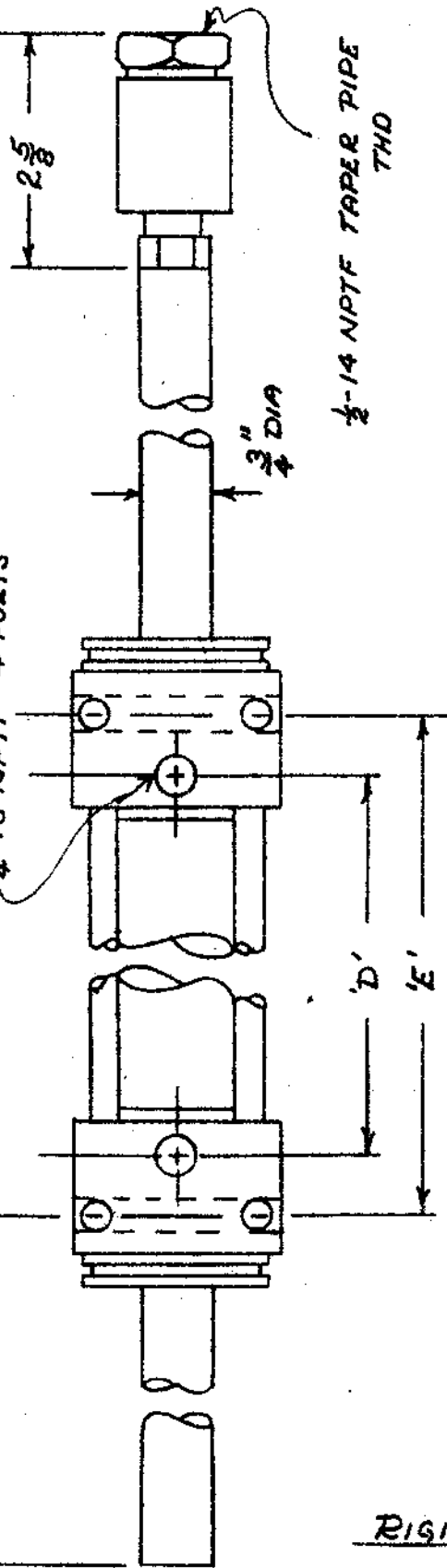
ALL CYLINDERS HAVE 1 1/2" ID

RIGIDLY MOUNTED CYLINDER

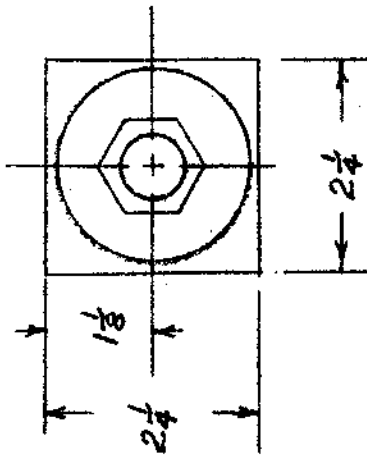
* UTILIZES 2 BALL JOINTS

'A' CENTERED
'B' SPACE REQ'D
'C' STROKE

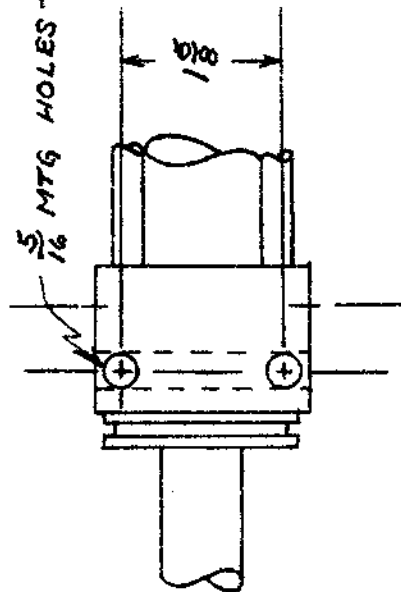
1/4-18 NPTF - 4 PORTS



1/2-14 NPTF TAPER PIPE
THD



5/16 MTG HOLES - 4 REQ'D

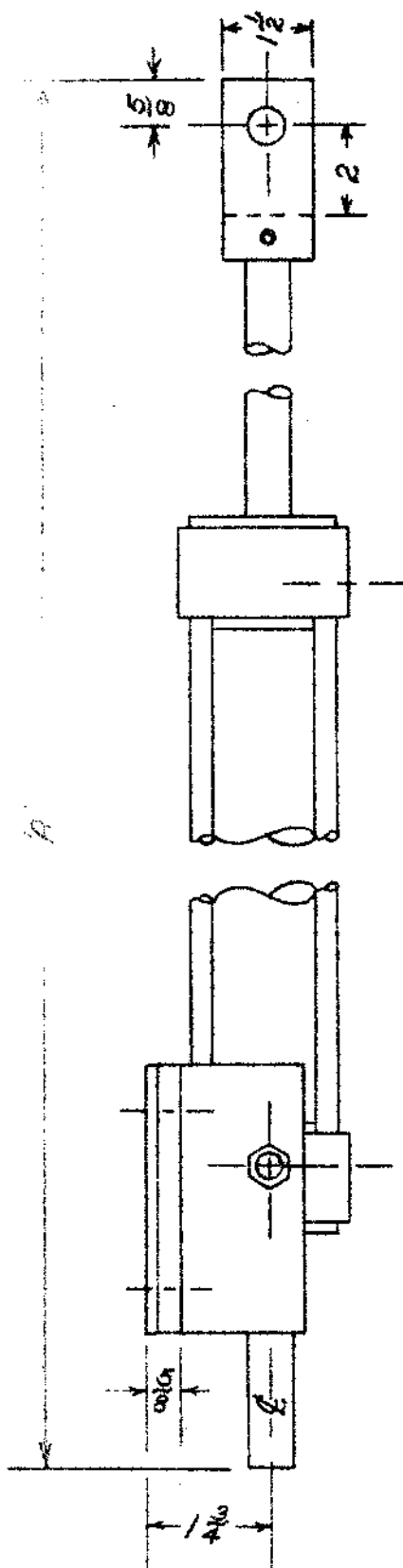


RIGIDLY MOUNTED (12 IN.)
CYLINDER

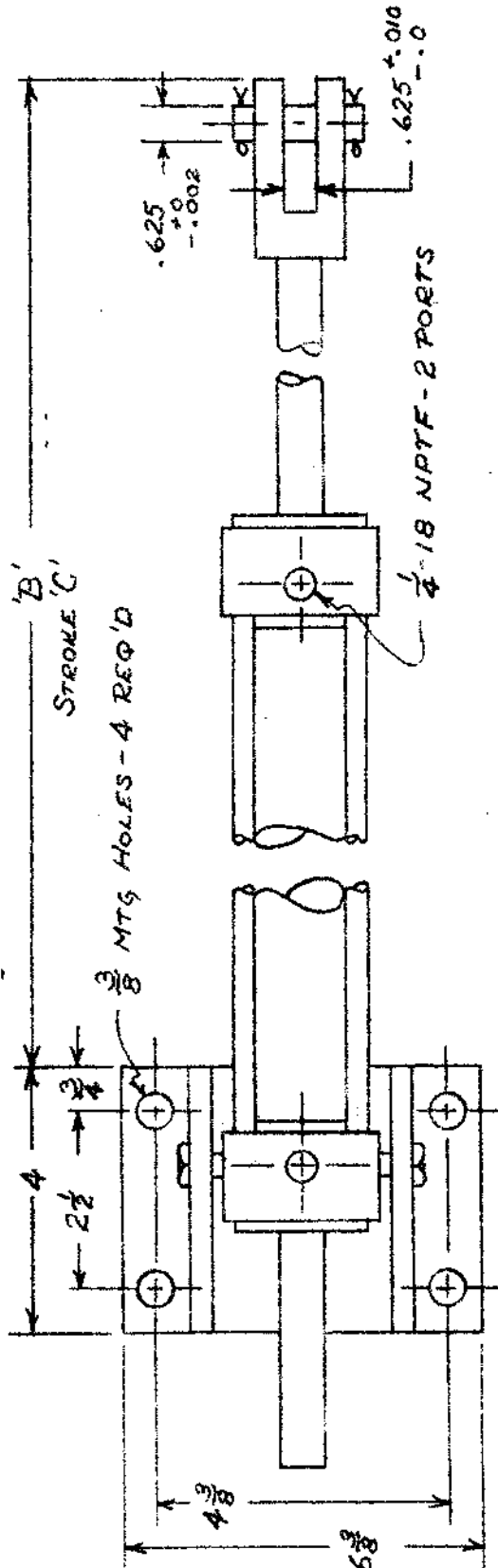
CYLINDER NO	'A'	'B'	'C'	'D'	'E'
K-28 *	36 3/4	46 3/4	12	13 15/16	15 1/4
K-29	34 1/8	44 1/8	12	13 15/16	15 1/4

ALL CYLINDERS HAVE 1 1/2" ID

* UTILIZES 2 BALL JOINTS



'B' DIM'N WHEN CYL. IS CENTERED



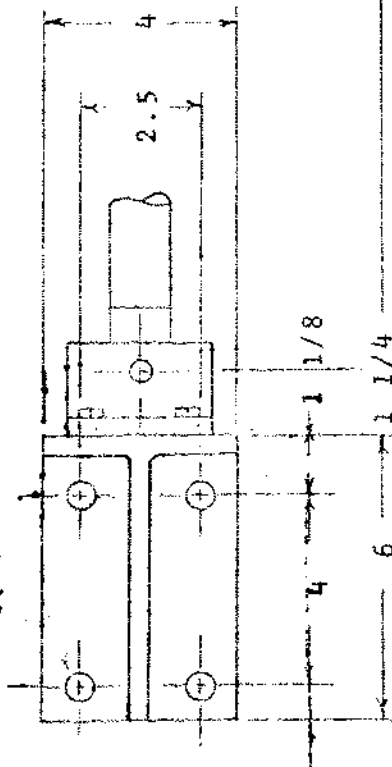
TRUNION MOUNTED
CYLINDER

CYLINDER	'A'	'B'	'C'
K-25	28 ³ / ₈	20 ³ / ₈	10
K-26	32 ³ / ₈	23 ³ / ₈	12

CYLINDERS SHOWN HAVE: 1 1/2" I.D. WITH
3/4" DIA. ROD

CYL NO.	A DMN	STROKE IN.	VOLUME CU. IN.
K-31	38 3/8	10	25.5
K-32	33 3/8	8	20.0
K-33	* 34 1/4	9	22.75

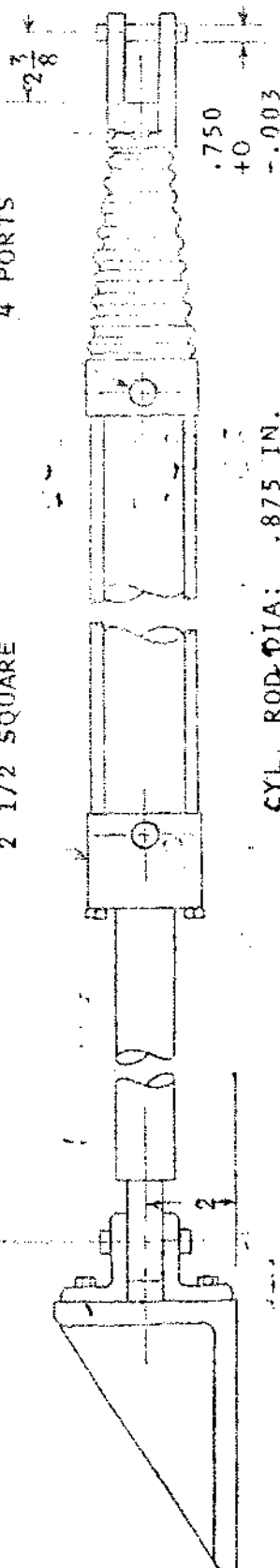
1 7/32 DIA 4 HOLES



'A' CENTERED

1/4 - 18 NPTF
4 PORTS

2 1/2 SQUARE



CYL. ROD DIA: .875 IN.
CYL. BORE: 2.0 IN.

* K33 HAS
1-11 1/2 NPT

END. NO CLEVIS

TRUNION MOUNTED CYLINDERS K31, 32, 33

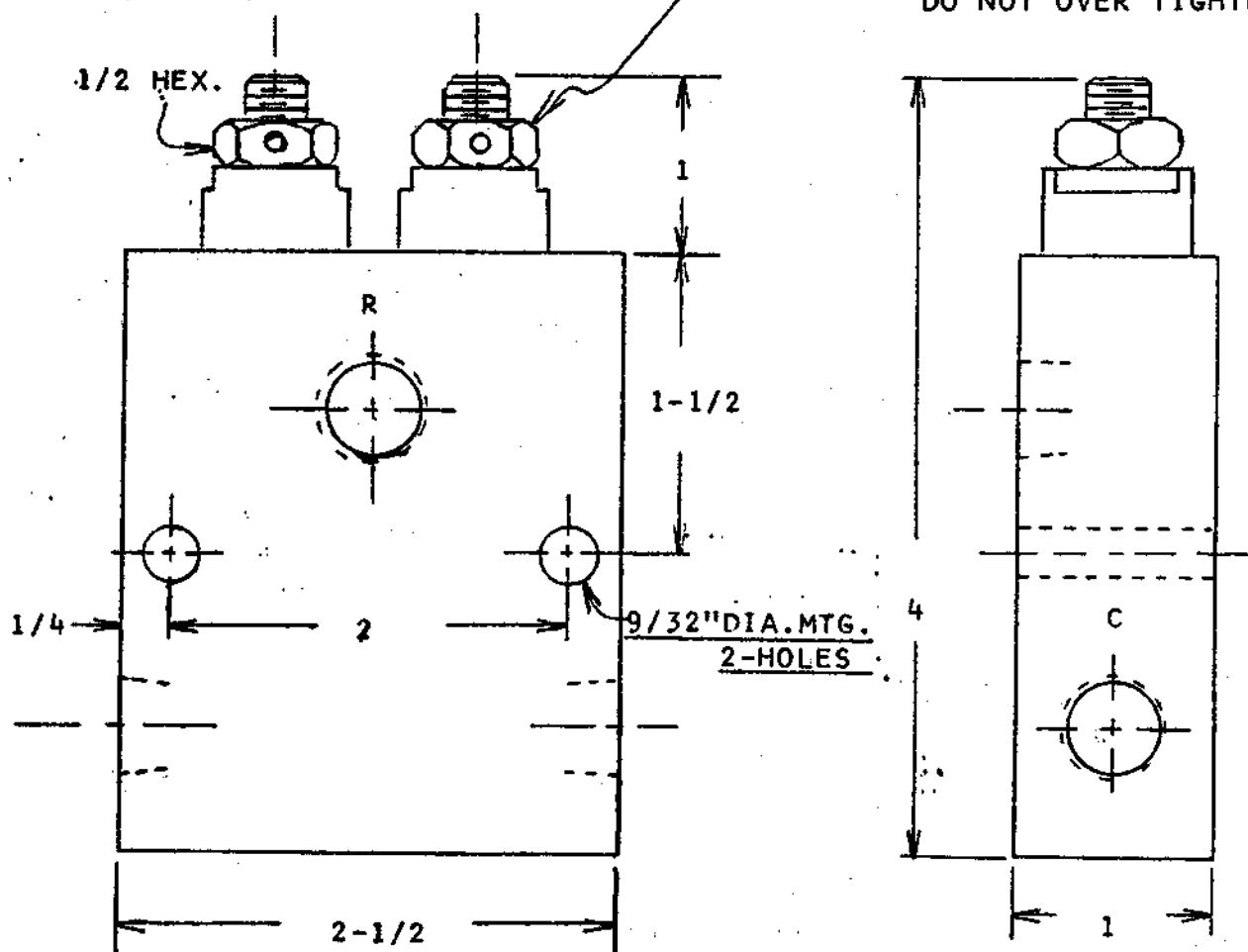
REL. VAL.#	PRESS. SET'G
MSV-19	500 PSI.
MSV-21	950 PSI.

PORTS:

'R' PORT - TO RESERVOIR
'C' PORT - TO CYLINDER
ALL PORTS ARE 1/4-18 NPTF

PURGING SCREWS:

LOOSEN TO PURGE
CANNOT BE REMOVED
DO NOT OVER TIGHTEN

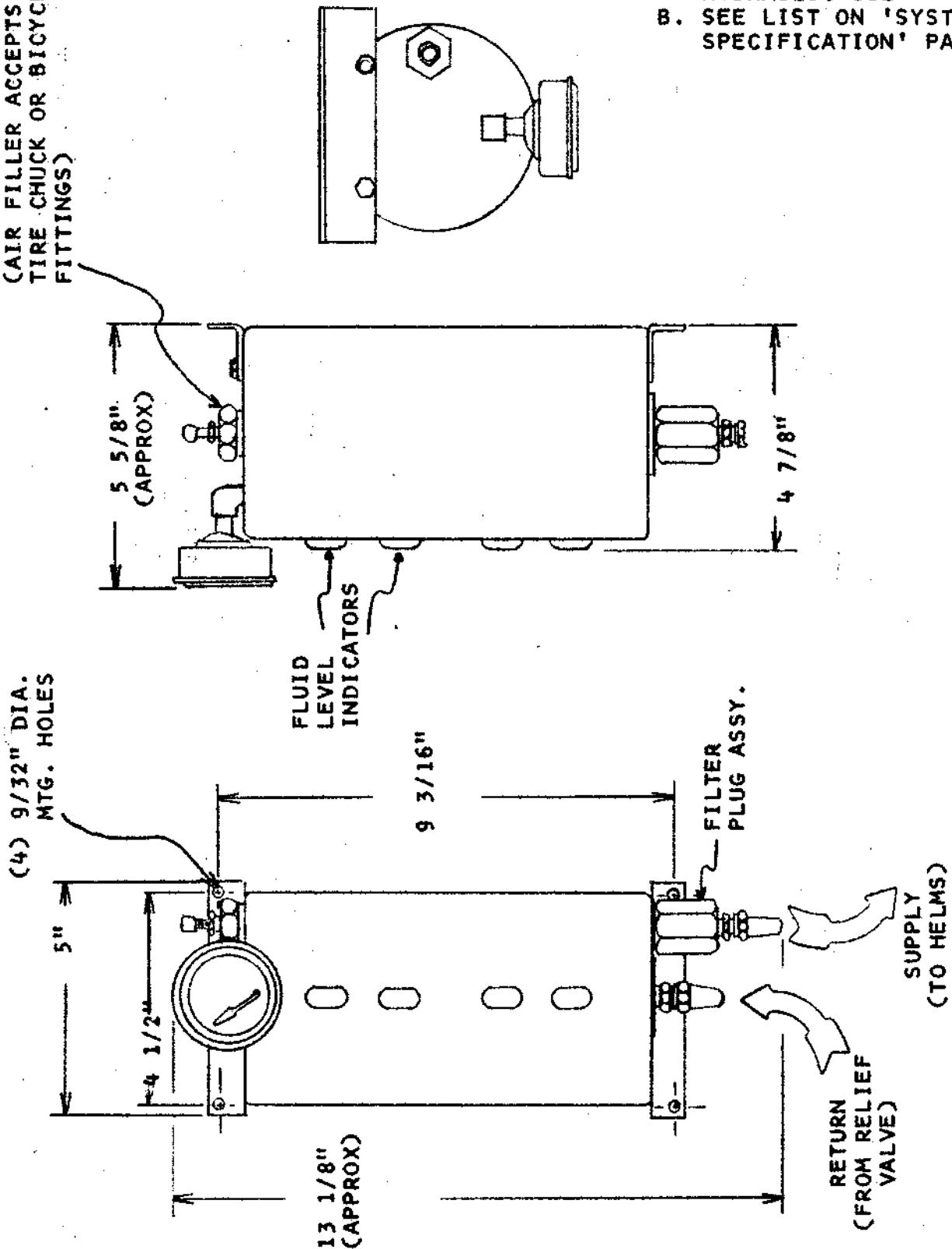


NOT TO SCALE

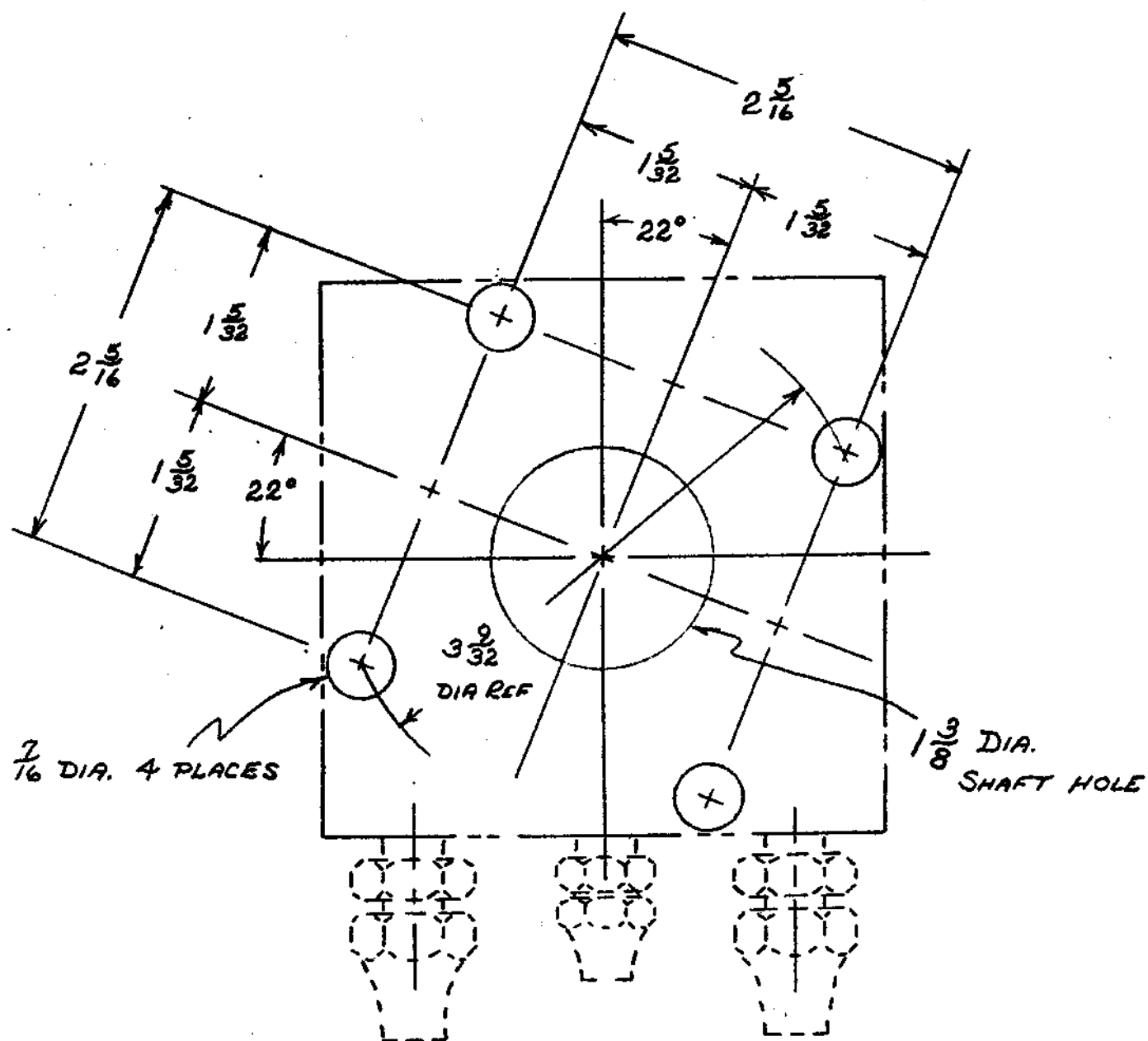
RESERVOIR
(R-05 SHOWN)

1. CAPACITY - 2 QTS.
2. NORMAL OPERATING PRESSURE
25-30 PSI
MAX. PRESS. 55PSI
3. OIL:
 - A. MIL H-5606A AVIATION
HYDRAULIC OIL
 - B. SEE LIST ON 'SYSTEM
SPECIFICATION' PAGE

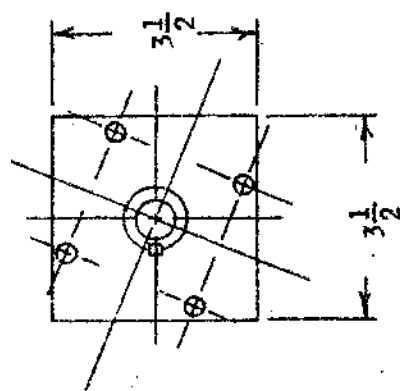
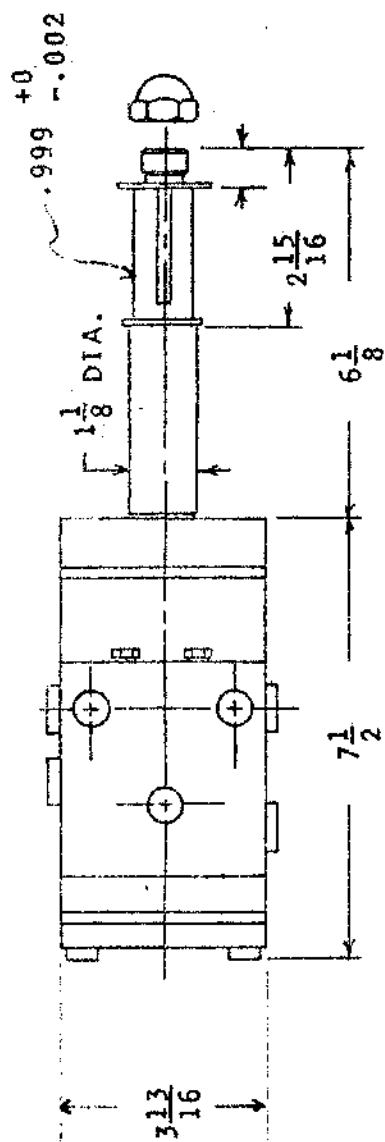
OIL & AIR FILLER PLUG
(AIR FILLER ACCEPTS STANDARD
TIRE CHUCK OR BICYCLE PUMP
FITTINGS)



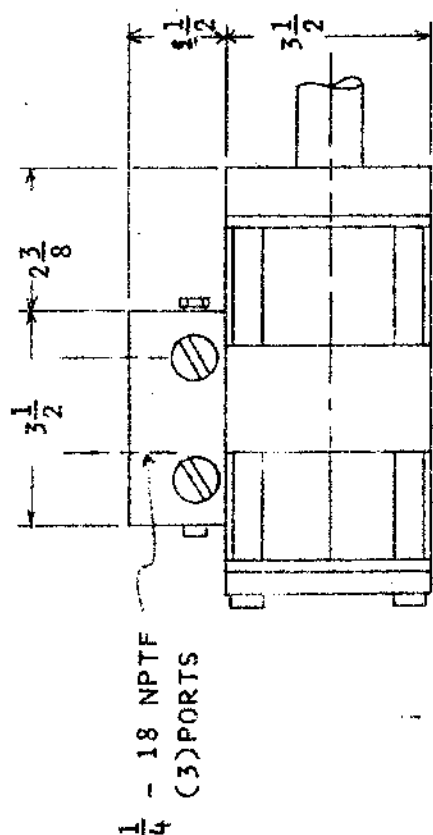




HELM MOUNTING TEMPLATE



SEE HELM TEMPLATE

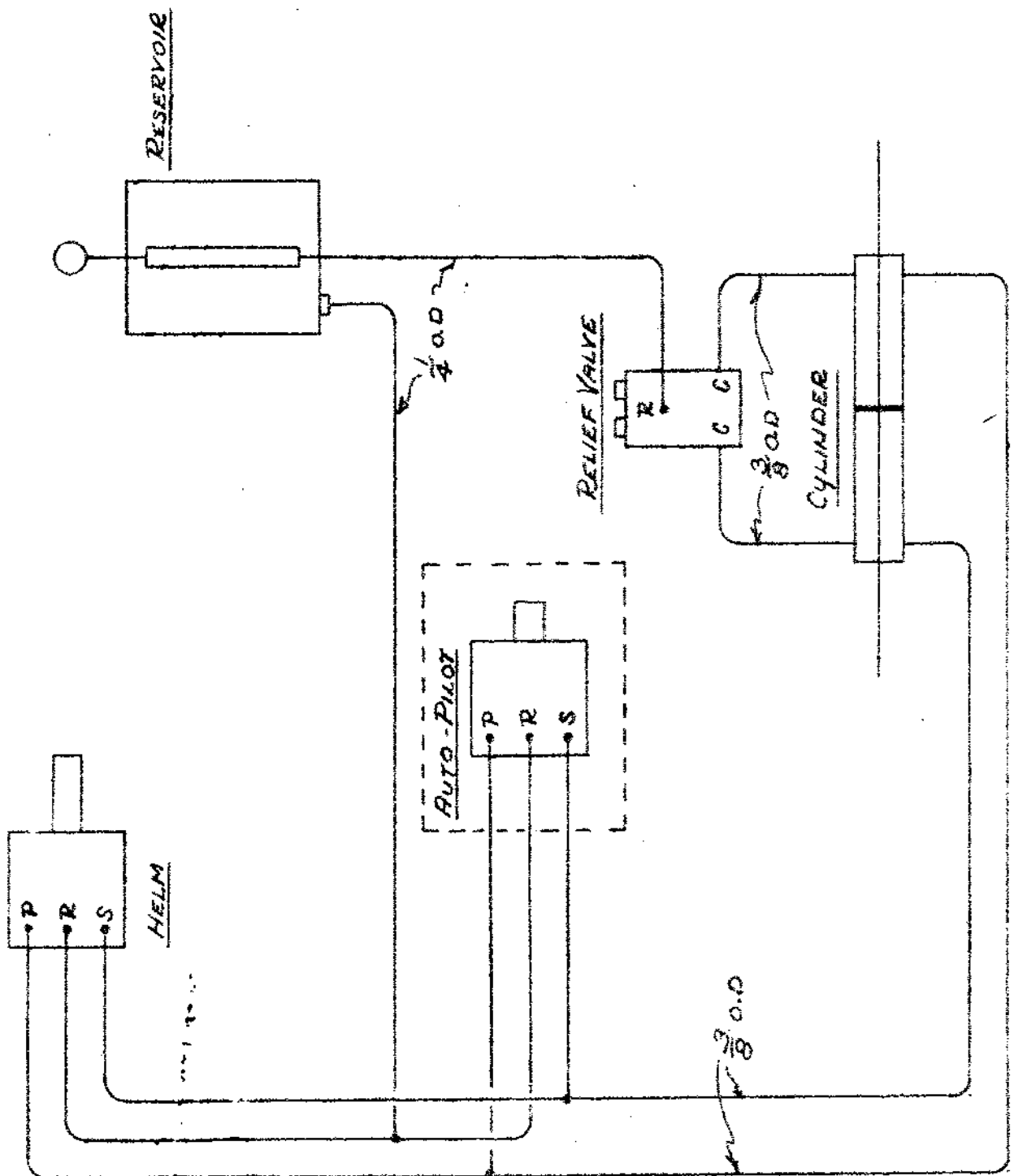


"S" PORT CLOCKWISE ROTATION DISCHARGE
 "P" PORT COUNTER CLOCKWISE DISCHARGE
 "R" PORT RESERVOIR
 SERVICE PRESSURE 1000 PSI
 MAX. SPEED 75 PRM
 FLUID-CLEAN PETROLEUM OIL, 50-200 SUS @100 F

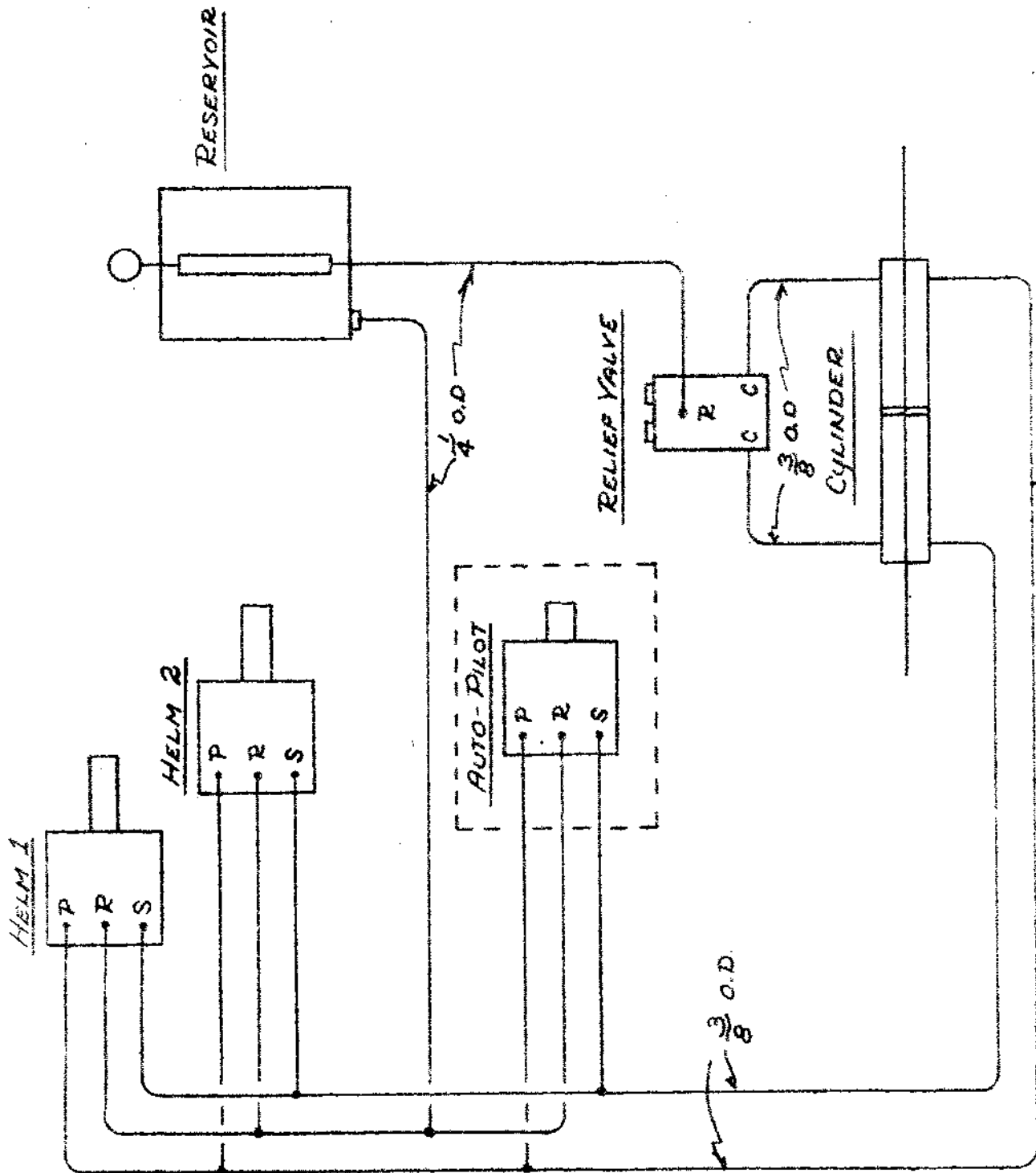
HELM UNIT	PART #	H-41	H-41-01	H-41-02	H-42	H-42-01	H-42-02	H-42-04	H-45
SHAFT TYPE									
1" STRAIGHT	X				X			X	X
MORSE TAPER			X			X			
TELEFLEX TAPER				X			X		
HELM DISPL.									
4 CU.IN./REV.						X	X	X	
5.5 CU.IN./REV.	X	X	X	X	X				X

HELM DIMENSIONS - 4.0 & 5.5 CU.IN.

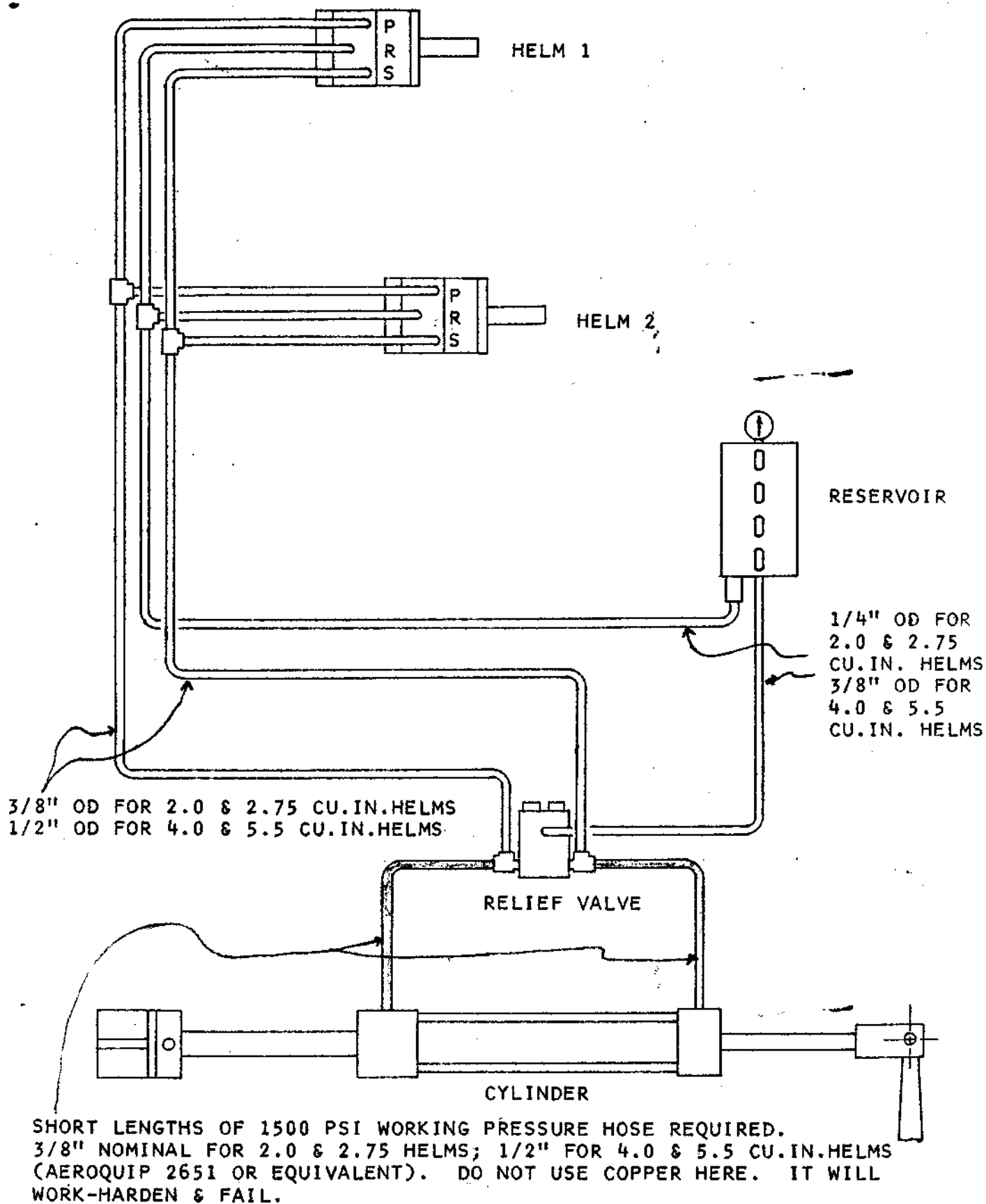
PIPING DIAGRAM - RIGIDLY MOUNTED CYLINDERS
SINGLE STATION (WITH AUTO-PILOT)



PIPING DIAGRAM - RIGIDLY MOUNTED CYLINDERS
DUAL STATION (WITH AUTO-PILOT)



PIPING DIAGRAM - PIVOT & TRUNION MOUNT CYLINDERS



SYSTEM SPECIFICATIONS

HELM UNIT

SEE SEPARATE SHEET ON HELM PERFORMANCE AND SPECIFICATIONS.

RESERVOIR

CAPACITY: 2 QUARTS
NORMAL OPERATING PRESSURE: 20-30 PSI
MAX. PURGING PRESSURE: 55 PSI

RELIEF VALVE

SETTING:
MSV-19 : 500 PSI
MSV-21 : 950 PSI

OIL

MIL H-5606 AIRCRAFT HYDRAULIC FLUID (HYNAUTIC PART #MCO-02) IS PREFERRED, OR

SAE 5 OR 10W MOTOR OIL

MOBIL DTE 11 OR 13

GULF HARMONY AW41 OR 43

AMERICAN OIL CO. RYKON 11 OR 15

SHELL TELLUS OIL 11, 15, 21 OR 23

CASTROL HYPIN (UNITED KINGDOM)

AWS 10, 15, OR 22

TYPE 'A' TRANSMISSION FLUID (UNDESIRABLE IN COLDER CLIMATES)

HELM & CYLINDER PERFORMANCE CHART

MAXIMUM TORQUE
(IN-LBS)

HELM TURNS HARDOVER TO HARDOVER

HELM DISPLACEMENT (CU-IN/REV.)

CYLINDER
NO.BORE
&
STROKE
(IN.)DISPL'T
(CU-IN)RUDDER
ARC@ 500
PSI@ 950
PSI

2.0

2.75

4.0

5.5

K-24	1-1/2 X 5	6.6	60	3325	6250	3.3	2.5			
K-18	1-1/4 X 7	7.0	60	3500	6650	3.5	2.6			
K-12	1-1/4 X 7	8.6	60	3500	6650	4.3	3.1			
K-14*	1-1/4 X 7	8.6	60	3500	6650	4.3	3.1			
K-19	1-1/4 X 9	9.0	60	4500	8550	4.5	3.6			
K-11*	1-1/4 X 9	11.0	60	4500	8550	5.5	4.0			
K-16*	1-1/4 X 9	11.0	60	4500	8550	5.5	4.0			
K-22	1-1/2 X 10	13.3	60		12500	6.7	5.0	3.3	2.5	2.5
K-25	1-1/2 X 10	13.3	60		12500	6.7	5.0	3.3	2.5	2.5
K-27	1-1/2 X 10	13.3	60		12500	6.7	5.0	3.3	2.5	2.5
K-26	1-1/2 X 12	16.0	60		15500	8.0	6.0	4.0	3.0	3.0
K-28	1-1/2 X 12	16.0	60		15500	8.0	6.0	4.0	3.0	3.0
K-29	1-1/2 X 12	16.0	60		15500	8.0	6.0	4.0	3.0	3.0
K-32	2 X 8	20.0	60		19250		7.3	5.0	3.7	4.6
K-31	2 X 10	25.5	60		24000		9.2	6.4		
DUAL CYLINDER INSTALLATIONS ARE CHARTED BELOW										
(2)K-18	1-1/4 X 7	14.0	60		13300	7.0	5.1	3.5	2.5	2.5
(2)K-12	1-1/4 X 7	15.5	60		14750	7.8	5.7	3.9	2.8	2.8
(2)K-14	1-1/4 X 7	15.5	60		14750	7.8	5.7	3.9	2.8	2.8
(2)K-19	1-1/4 X 9	18.0	60		17100	9.0	6.5	4.5	3.3	3.3
(2)K-11	1-1/4 X 9	20.0	60		18900	10.0	7.3	5.0	3.6	3.6
(2)K-16	1-1/4 X 9	20.0	60		18900	10.0	7.3	5.0	3.6	3.6
(2)K-22	1-1/2 X 10	26.6	60		25000		9.7	6.7	4.8	4.8
(2)K-25	1-1/2 X 10	26.6	60		25000		9.7	6.7	4.8	4.8
(2)K-27	1-1/2 X 10	26.6	60		25000		9.7	6.7	4.8	4.8
(2)K-28	1-1/2 X 12	32.0	60		30000			8.0	5.8	5.8
(2)K-32	2 X 8	40.0	60		38500			10.0	7.3	7.3
(2)K-31	2 X 10	51.0	60		48000			12.8	9.3	9.3

* DISPLACEMENT AND NUMBER OF TURNS SHOWN WHEN PRESSURIZING THE HEAD END OF CYLINDER, MAX. TORQUE SHOWN WHEN PRESSURIZING THE ROD END OF CYLINDER.



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INSTALLATION INSTRUCTIONS FOR
CAPILANO SLAVE CYLINDER UNITS
(ALL MODELS)

Proper cylinder installation is key to the successful operation of your hydraulic steering system. Please read the following instructions carefully before proceeding with your installation.

1. Select the diagram and dimensional data that describes your particular cylinder(s).
2. Ensure that the rod end clevis of the cylinder matches your tiller arm.
3. Mount the tiller arm on the rudder post ensuring there is no slack when secured.
4. With the rudder in the fore and aft position, attach the rod end clevis of the cylinder to the tiller arm.
5. Extend cylinder rod to arrive at the 'A' dimension.
6. Swing the cylinder mounting clevis to it's correct position and anchor the cylinder.

A special mounting bracket may be required if transom or side wall mount is not possible.

NOTE. All Clevis pins must be parallel to the rudder post, and ports for hose connections must be in uppermost position.

7. Swing rudder to ensure free movement of all components before proceeding further.
8. The above instructions also apply to stern drive installations.

NOTE

Please refer to the instructions packaged with each helm unit to complete the Helm installation.

SINGLE BALANCED CYLINDER INSTALLATIONS OPTIONS

ALL BALANCED CYLINDERS "A" DIMENSIONS 29-1/2"

FIGURE 1 - Single Hole Tiller Arm

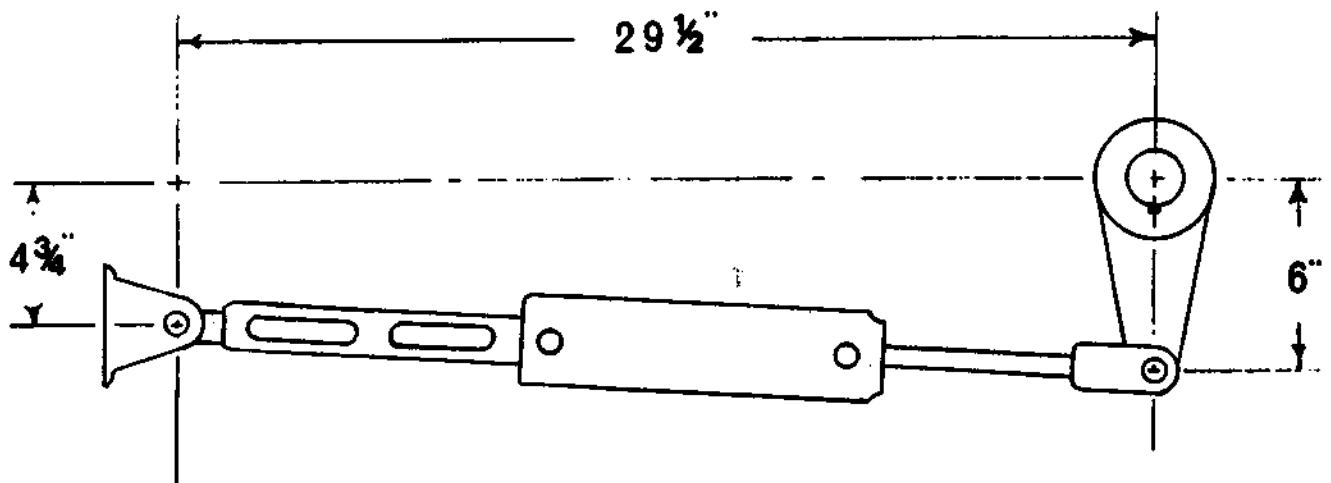


FIGURE 2 - Dual Hole Tiller Arm

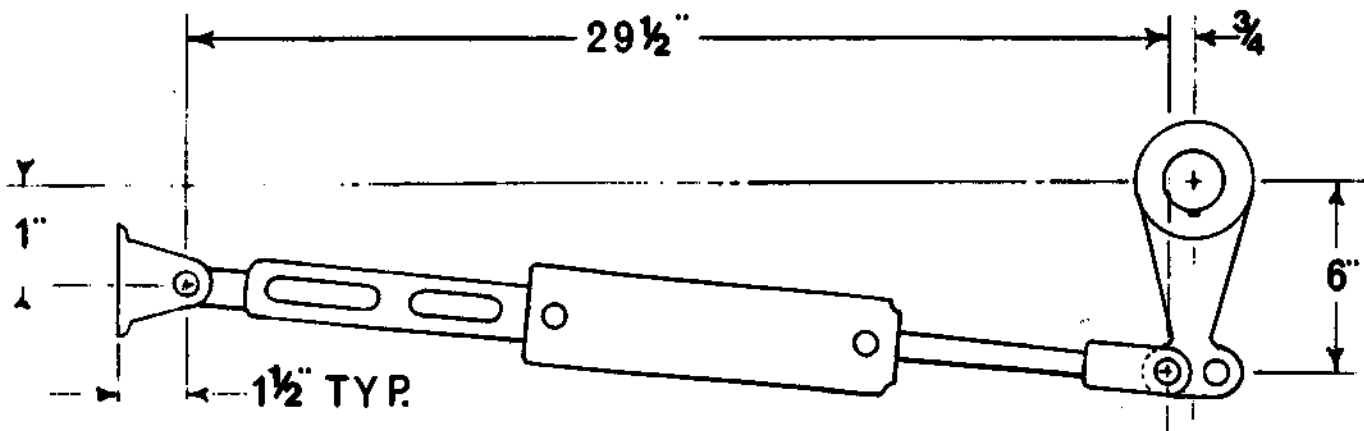
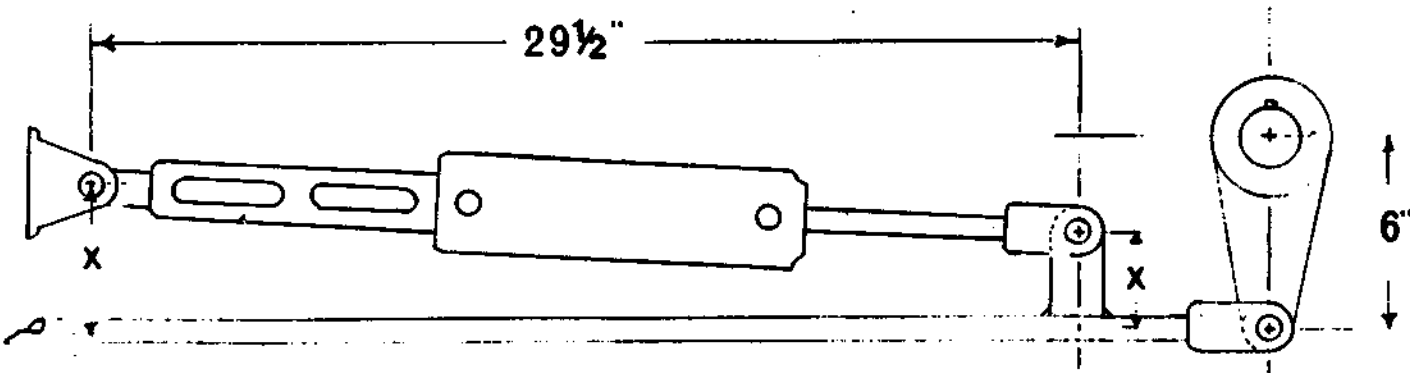


FIGURE 3 - Tie Bar Mount

NOTE. X - DIMENSIONS: These should be determined by the installer. The rule being the cylinder should be mounted on the rudder post side of the Tie Bar. With the rudder in the hard-over position it should be as close as possible to and parallel to the Tie Bar.



NOTE: All Ports are 3/8" N.P.T. All clevis pins 5/8" O.D.