MATHERS CONTROLS INC.

Technical Manual

Mathers ClearCommand MS546-11729
System Serial Number
3074

Mathers Controls Inc.

Technical Manual

August 1999

Vessel Specifications

Power:	**Twin Screw Cummins**
Water Jet:	**Hamilton 291 Jet Pump**
Stations:	**One Station**

ClearCommand Specifications:

Control Processor	**MS546-11729**
System Serial Number:	**3074**
Sales Order Number	**63316**
Drawing Number	**11228, 4 pages**

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Drawing. No. 11228, 4 pages

1. THEORY OF OPERATION

1.1 THIS MANUAL

The purpose of the ClearCommand System manual is:

- Operation (Section 2)
- Installation (Section 5)
- Adjustments (Section 6)
- Trouble Shooting Reference (Appendix B)

Keep this Manual on the vessel for future reference.

Throughout the manual special attention should be paid to the following boxes:

NOTE: **Contains Helpful Information**

CAUTION: **Disregarding these messages may cause damage to the equipment.**

WARNING: **Disregarding these messages may result in personal injury.**

1.2 MS546-11729 CLEARCOMMAND SYSTEM

The Control Processor (hereafter referred to as Processor) is designed specifically for:

- Mechanical command of Hamilton Water Jet
- Mechanical command of throttle

This system includes the following features:

- Station-in-Command Indication (Section 2.1)
- Start Interlock (option) (Section 2.2)
- ClearCommand System Fault Indication (Section 2.3)
- Hydraulic Servo Pressure Switch (Section 3.8)
- ClearCommand Failure Alarm Contact (optional) (Section 8.1)

System Requirements (Refer to Section 3):

- One Processor per engine
- One Dual lever Control Head with detents for Water Jet command.
- One Dual lever Control Head with no detents for Engine Governor command.

- One Engine Stop Switch per remote station
- Two Eight-conductor electric cables for each Control Head
- One 33C push-pull cable for each Water Jet connection.
- One 33C push-pull cable for each Engine Governor connection.
- One Two-conductor electric cable for power connection of the Processor
- One Two-conductor electric cable for Start Interlock connection
- One Hydraulic Servo Pressure Switch per Processor
- One Two-conductor electric cable per Hydraulic Servo Pressure Switch for connection to Processor

During Installation and Testing, take special care to verify all wiring is to specifications, terminations are correct, and that all Notes in Appendix C Drawing Notes are followed.

2. OPERATOR INSTRUCTIONS

2.1 DC POWER ON

When control system DC power is turned ON:

- Intermittent tone will sound at all remote stations indicating that no station has command. (refer to Section 2.3)

To take command at a remote station:

- Water Jet Control Head lever may be in any position.
- Throttle Control Head lever must be in the Idle position.
- Operator must depress either the Water Jet or Throttle Control Head station transfer button for at least 1/2 second.

The tone will stop at all remote stations and the red indicator light on the Control Heads will be lit indicating station has taken command.

2.2 ENGINE START

There are three features related to main engine start:

Start Interlock to block the engine start signal if the DC power has not been turned ON.

Start Interlock to block the engine start signal if no station has command.

Start Interlock to block the engine start signal if Throttle Control Head lever is more than 10% of travel.

The engine Start signal will be connected through the Processor to the starter solenoid or relay. Refer to Section 5.2.3 for Start Interlock connection.

2.3 CONTROL HEAD TONES

- Low Repetition Rate Tone is normal when DC power is first applied to ClearCommand. This tone indicates the Processor is ready and the operator can take command at a remote station.
  If this tone occurs during operation, refer to Appendix B Trouble Shooting Section.

- Steady Tone signals a voltage problem or a component has failed. Confirm the voltage is steady between 12 and 24 volts DC, and that there is not a momentary voltage drop.

- Steady Tone may also occur if the cross-bar in the Processor is unable to attain the Idle position.

  If tone continues, refer to the Appendix B Trouble Shooting.

- Steady Tone is used to show a Throttle position feedback error.
  If tone continues, refer to the Appendix B Trouble Shooting.

- High Repetition Rate Tone is used to signal a jam condition of the push-pull cable. The Processor has stopped when this tone is heard. Moving the Control Head lever away from the position that the tone was encountered will usually stop this tone. The cause of the excessive push-pull cable load MUST be found.
  If tone continues, refer to the Appendix B Trouble Shooting.

2.4 WATER JET COMMAND

The Processor, on command from the Water Jet Control Head lever, provides infinite position output to the Hamilton Water Jet lever via push-pull cable connections.

On the Water Jet Control Head there is a detent at the vertical position that corresponds to ZERO thrust. (Refer to System Drawing in Appendix C) Thrust will correspond to Control Head lever position command, regardless of how fast thrust is called for.

A Normally Open (N.O.) pressure switch with a working pressure rating greater than the relief valve settings on the Water Jet System interlocks thrust command.

2.5 THROTTLE COMMAND

The Processor, on command from the Throttle Control Head lever, provides control of speed that corresponds to Control Head lever position via push-pull cable connections.

The Throttle Control Head's Idle position is with the lever aft. (Refer to System Drawing in Appendix C)

Forward movement of the Control Head Lever to the vertical position corresponds to 50% throttle, with continued movement forward to achieve 100% throttle.

3. REQUIRED PARTS AND TOOLS

3.1 PROCESSOR

- One Processor required per engine (refer to Figure 1)
- Mounting Hardware is installer supplied.
- Included with the Processor:
  - ✓ Wago Tool
  - ✓ Anti-Static Wrist Strap
  - ✓ Spare Fuse

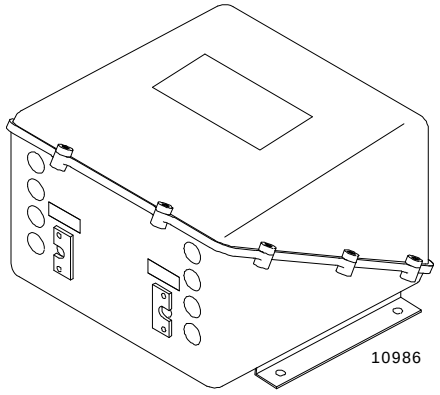

Figure 1 - Processor

3.2 CONTROL HEAD

Refer to Appendix C System Drawing for dimensional information.

- Included with the Control Head:
  - ✓ Gasket
  - ✓ Terminals
  - ✓ Mounting screws
  - ✓ Watertight cable grip for the cable entrance on the Processors
  - ✓ Control Head Dimensions Variations & Installation Sheets

NOTE: **Retrofit applications may require planning for an adapter pad to cover the old Control Head cutout. A variety of adapter and cover pads are available from Mathers Controls Inc.**

3.3 ELECTRIC CABLE

Eight-Conductor Cable (Control Head to Control Processor)
Shielded 20 AWG, 300V, PVC Insulated: -20 degrees C to +80 degrees C.
UL VW-1 PVC Jacket. Color Coded.

Two Conductor Power Cable (Processor to DC Power Supply)
14 AWG, 300V, PVC Insulated: -20 degrees C to +105 degrees C
UL VW-1 PVC Jacket. Red with purple stripe and black.

Two Conductor Start Interlock Cable (Starter Switch to Processor to Starter Solenoid)
16 AWG, 300 V, PVC Insulated: -20 degrees C to +105 degrees C
UL VW-1 PVC Jacket. Yellow with red stripe.

3.4 TOOLS REQUIRED FOR INSTALLATION

- Wago Tool (provided)
- Anti-static Wrist Strap (provided)
- Wire cutter (Recommend Thomas & Betts WT-2000)
- Wire stripper (Recommend Thomas & Betts WT-2000)
- Wire crimper (Recommend Thomas & Betts WT-2000)
- Screwdriver – med. Phillips #2
- Screwdriver – med. straight slot
- Screwdriver -- small straight slot
- Hole saw -- 1 inch (25,4mm)
- Drills -- 9/32 inch (7,2mm) and 7/32 inch (5,6mm)
- Saw (appropriate type of saw for cutting material Control Head will be mounted on)

3.5 ENGINE STOP SWITCH

It is mandatory for an Engine Stop Switch to be located at each remote station.

WARNING: **An Engine Stop Switch at each station is an <u>absolute requirement,</u> and will cancel warranty if not installed.**

3.6 CONTROL SYSTEM POWER

The Processor requires (Refer to Figure 2):

- A battery source of 12 or 24 volts DC
- A 10 ampere circuit breaker with manual reset

The power for the Control System should come from the same power distribution panel as the other required engine functions. (Refer to Appendix C Drawing Notes)

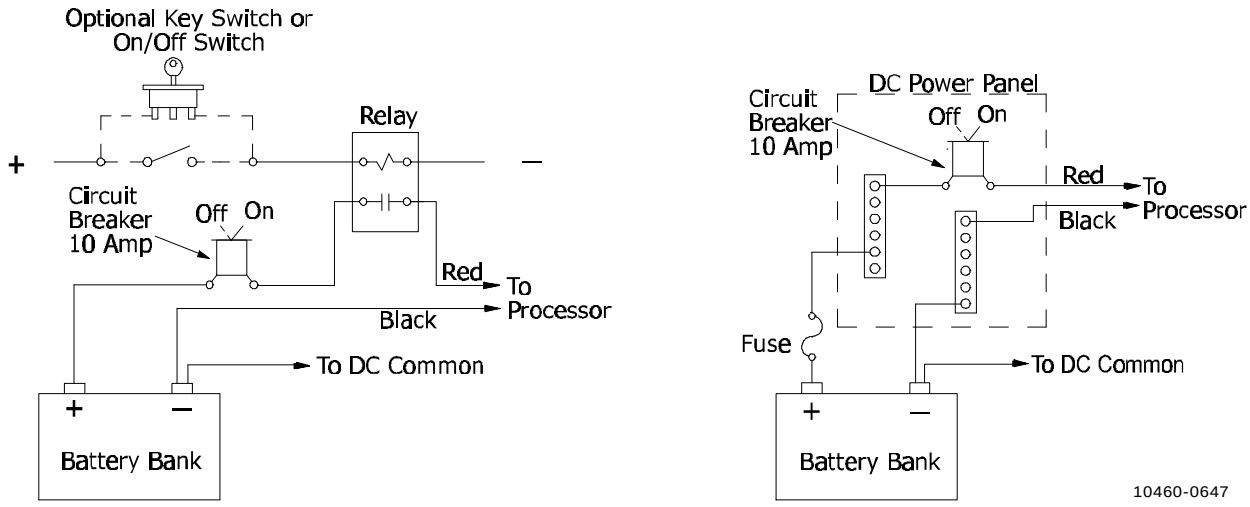

Figure 2 - <u>Power Source</u>

3.7 PUSH-PULL CABLE

Use Type 33C push-pull cable from the Processor to the Hamilton Water Jet Gate levers. Hamilton recommends the Morse 33C Supreme (low friction) cable. (Refer to the Hamilton Jet Installation and Service Manual).

Use Type 33C push-pull cable from the Processor to the engines.

When measuring cable length, measure cable from end of thread to end of thread.

Many engines are delivered with factory push-pull cable mounting kits. If mounting kit is not included, contact the engine dealer for a Factory Cable Connection Kit or refer to the Universal Mounting Figure in the Engine Push-Pull Cable Installation Section of this manual.

3.8 HYDRAULIC SERVO PRESSURE SWITCH

The purpose of the Hydraulic Servo Pressure Switch is to inform the Control Processor when hydraulic oil pressure is present. The Processor will only control thrust when hydraulic pressure is available. This switch must be used.

Refer to Appendix B - Manufacturer Data Sheets for information on the switch.

4. PLAN THE INSTALLATION

4.1 CONTROL PROCESSOR LOCATION

Considerations:

- Refer to Figure 3 for dimensions.
- The Processor is spray proof but cannot be immersed.
- Bulkhead mount preferred for ease of access for wiring and adjustments. Mount the Processor in any attitude easily accessible for electric connections. (See System Drawing for mounting dimensions.)
- Do not mount to the engine, or transmission, or any location that will allow excessive vibration.

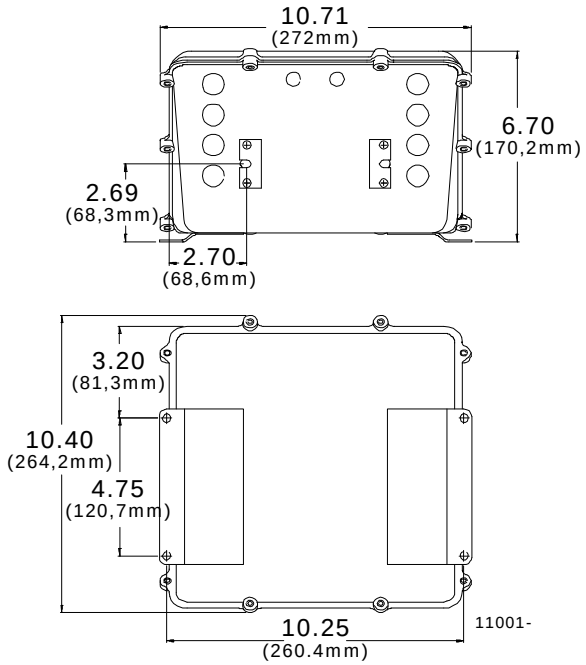

Figure 3 - Processor Dimensions

- ClearCommand uses electronic circuits that can be influenced by strong magnetic fields, and static charges. Allow 4 feet (1,2m) of clearance between the Processor and alternators or electric motors.
- Locate away from heat sources, such as engine exhaust manifolds.
- Mounting Hardware is installer supplied.
- Locate the Processor such that the push-pull cable to the Engine and the push-pull cable to the Hamilton Jet Bucket lever has large radius bends, with the least total degrees of bend and moderate length.

NOTE: EXAMPLE: **Minimum bend radius 10-inches (254mm) for total degrees of bends of less than 270 degrees. Push-pull cable lengths should not exceed 20 feet (6m).**

CAUTION: It is mandatory the Processor power source is bonded (connected) to the hull. See Section on Bonding.

4.2 REMOTE CONTROL HEAD LOCATION

Refer to Appendix C Control Head sheet for specific information on a Control Heads.

When properly mounted on a console, the Control Head is watertight from the top. An adhesive gasket must be used to seal the Control Head to the mounting surface. However, below the mounting surface the Control Head needs protection from water or spray.

NOTE: **If a Control Head is mounted weather exposed from the underside, consider using a Watertight Enclosure. Reference Appendix A Watertight Enclosure for specific information.**

See Appendix C Control Head sheets for mounting dimensions.

4.3 DC POWER SOURCE (REFER TO FIGURE 2)

It is important to keep the length of power cable short to reduce voltage drop. The power cable should not exceed 20 feet (6m).

If individual wires are used for supply (+) and return (-) then the total wire length should not exceed 40 feet (12m).

CAUTION: **It is <u>important</u> that the wire size from the battery to the circuit breaker panel is large enough to keep voltage drop due to current flow, to less than 3 percent. The DC return to the battery must be large enough to supply <u>all</u> current requirements with a voltage drop of less than 3 percent.**

4.4 HYDRAULIC SERVO PRESSURE SWITCH

Refer to Appendix B - Manufacturers Data Sheets for specific information relating to the pressure switch dimensions and location requirements.

5. INSTALLATION

NOTE: **Before starting the actual installation of ClearCommand, make sure you have the correct parts and tools on hand. See Section 3. Read <u>ALL</u> the instructions pertinent to each part before beginning the installation of that part.**

CAUTION: **Static electricity can destroy electronic components. Anytime the Processor cover is off, use the anti-static wrist strap provided and connect it to the Processor frame. This will drain any static charge you may have on your person.**

5.1 EIGHT-CONDUCTOR CABLE

A) Install the eight-conductor electric cable between each Control Head and the appropriate Processor.

B) Label each eight-conductor cable at both ends with the station it connects, and Port or Starboard for Twin Screw applications.

When installing the eight-conductor cable, support the cables using clamps or straps not more than 18 inches (0,5m) apart, unless contained in a conduit.

Install each cable so it is protected from physical damage.

5.2 PROCESSOR

A) Secure the Processor using 1/4 inch or M6 fasteners.

B) Remove the Processor cover.

C) Connect the wrist strap to your person, and the ground connector to the Processor frame.

CAUTION: **When not working on the Processor, keep the cover in place to prevent damage to circuits.**

D) Install the watertight cable grips needed for cable entrance. Refer to Figure 4.

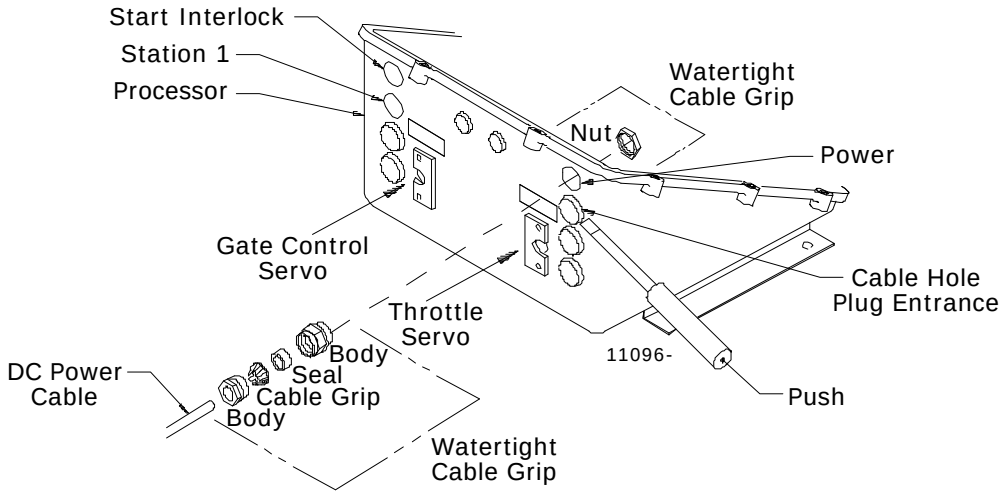

Figure 4 - Plug Removal and Cable Grip Installation

5.2.1 Station Connection

A) Insert cable through the appropriate watertight cable grip.

B) Strip the PVC jacket and shielding back approximately 3 inches (75mm).

C) Stagger wire lead length to match the correct Station terminal strip.

CAUTION: **Wire leads must not touch frame.**

D) Strip the wire insulation 3/8-inch (9,5mm) on each wire.

E) Locate the WAGO Tool that is taped to the relay on the circuit board in each Processor. Use this tool to depress the spring lock for the individual wire connections to the terminal strip. (See Figure 5)

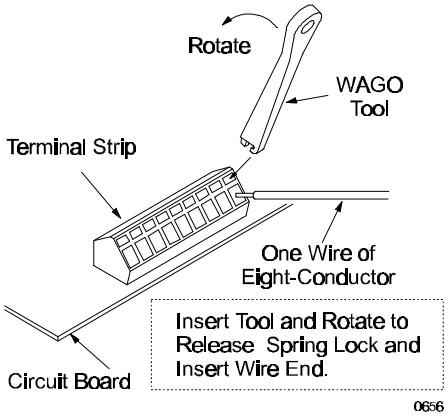

Figure 5 - Terminal Connection

F) Connect colors to the station terminal strips as shown on System Drawing in Appendix C.

G) Connect the shielding drain wire (bare wire) to Terminal 8 on the station terminal strip.

CAUTION: **The shielding drain wire MUST NOT touch any other components.**

H) Feed through a little slack cable, and tighten the cable grip on the eight-conductor cable.

NOTE: **Bring the other station's eight-conductor cables in the same way, and connect to the appropriate station terminal strips. (Refer to Drawing in Appendix C)**

I) Tie wrap the station cable to the Processor frame.

CAUTION: **A jumper is required between terminals 5 and 6 on all unused station terminals on the circuit board. Refer to Drawing Notes in Appendix C.**

5.2.2 Power Cable

WARNING: **When connecting the DC power cable to the Processor be sure the power is OFF.**

A) Run the length of two-conductor power cable between the DC Power Supply and the Processor.

B) Install the power cable grip in the Processor enclosure. (refer to Figure 4)

C) Connect the two-conductor cable to the Processor. Refer to the Drawing in Appendix C for power connection points.

D) Feed through a little slack cable and tighten the cable grip.

E) Tie wrap the power cable to the Processor frame.

NOTE: **Repeat for all Processors. Ensure all connections are as indicated on the Drawing in Appendix C.**

5.2.3 Start Interlock

CAUTION: **The Processor is designed for a <u>maximum</u> of 30 amperes, <u>maximum</u> 50 volt, start signal current. Greater current will damage the interlock circuit.**

Run the length of two-conductor start interlock cable between the Starter Solenoid and the Processor. (Refer to Figure 6)

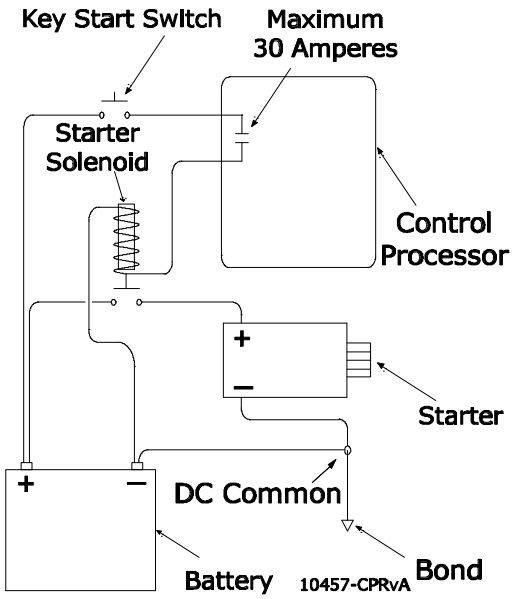

Figure 6 - Start Interlock Connections

Connections at Starter Solenoid:

A) Remove the remote start switch lead from the Starter Solenoid.

B) Strip and connect one start interlock cable wire to this lead.

C) Strip and connect the second start interlock cable wire to the Starter Solenoid

Connections at Processor:

A) Install the start interlock grip in the Processor enclosure. (refer to Figure 4)

B) Run the two-conductor start interlock cable through the watertight cable grip.

C) Strip insulation off of each wire 3/8-inch (9,5mm), then install crimp terminals.

D) Connect the two-conductor cable as indicated on the Drawing in Appendix C.

E) Feed through a little slack cable and tighten the cable grip.

F) Tie wrap the start interlock cable to the Processor frame.

CAUTION: **The most common source of trouble is loose wiring connections. Verify wiring connectors are properly crimped and cannot be pulled out. Crimps and connections must be made to the wire, not to the wire insulation. Verify all screwed wire connections are secure.**

5.3 CONTROL HEADS

See Appendix C Control Head sheet for location of cutout and mounting holes for the Control Heads.

5.3.1 Install

A) Drill the screw holes and the corner cutout holes.

B) Saw between the corner cutout holes.

C) Check that the four mounting screws will start into the Control Head.

D) Remove the Control Head.

E) Strip the adhesive cover from the gasket and apply the adhesive side to the console.

5.3.2 Cable Connection

A) At the Control Head, strip back the PVC jacket on the eight-conductor cable approximately 2-1/2 inches (63,5mm).

B) Strip and cut off the shielding and drain wire flush with the end of the PVC jacket.

CAUTION: **Do not connect the drain wire at the Control Head to ground.**

C) Strip 3/8-inch (9,5mm) insulation off each wire, then install crimp terminals.

CAUTION: **Connections 5 and 7 at the terminal block are direction sensitive. The connections must be as follows:**

Bucket Port Lever:	Throttle Starboard Lever:
Terminal 5 Blue	Terminal 5 Yellow
Terminal 7 Yellow	Terminal 7 Blue

D) Connect the Throttle Control Head and the Water Jet Control Head as shown on the Appendix C – System Drawing, Control Head Sheet.

5.4 ENGINE STOP SWITCH

The Installer supplies the Stop Switches. Refer to the information supplied with the Stop Switches for installation specifications.

WARNING: **Each remote station must have some method to stop the engine. Warranty canceled if requirement not followed.**

5.5 HYDRAULIC SERVO PRESSURE SWITCH

Locate the Hydraulic Servo Pressure Switch at a higher elevation and within 5 feet of the Hamilton Jet Pump.

Refer to Appendix B - Manufacturers Data Sheets for specific information relating to the pressure switch.

Refer to System Drawing for details on connection of the pressure switch to the Processor.

5.6 PUSH-PULL CABLE

The Processor interconnects by push-pull cable with the engine governor and the Jet Pump. The nominal load rating is 30 pounds force and 3 inches (76,2mm) maximum movement of the push-pull cable.

WARNING: **Take care to verify that push-pull cable installation is correct, as misadjusted cables may cause damage to the engine governor and the Jet Pump.**

A) <u>Verify</u> installation of push-pull cable brackets on the engine governor and Jet Pump. If the brackets are not installed, fabricate brackets as shown in Figure 7

B) Remove the jam nut and the two rubber seals from the push-pull

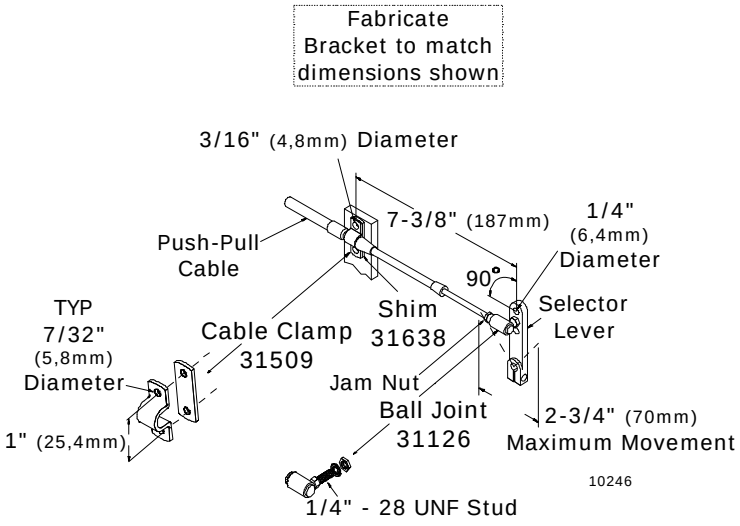

Figure 7 - <u>Universal Mounting</u>

cable end that is to connect to the Processor. Discard the seals.

C) On the Processor housing, remove one screw from the cable retainer clip for the cable.

D) Loosen the remaining screw and swing the cable retainer clip away from the entry hole.

E) Insert the push-pull cables through the entry hole.

CAUTION: **Ensure that the push-pull cable for the engine enters the Processor through the Throttle Servo opening. Ensure the Water Jet push-pull cable enters the Gate Control Servo opening. Refer to Figure 4.**

F) When the push-pull cable end is visible within the Processor interior, reinstall the jam nut.

G) Connect the push-pull cable to the hex nut (See Figure 8, Detail I). Use a 7/16-inch socket to turn the hex nut onto the cable rod end until there is approximately 5/16 inch (7,9mm) of thread showing beyond the jam nut.

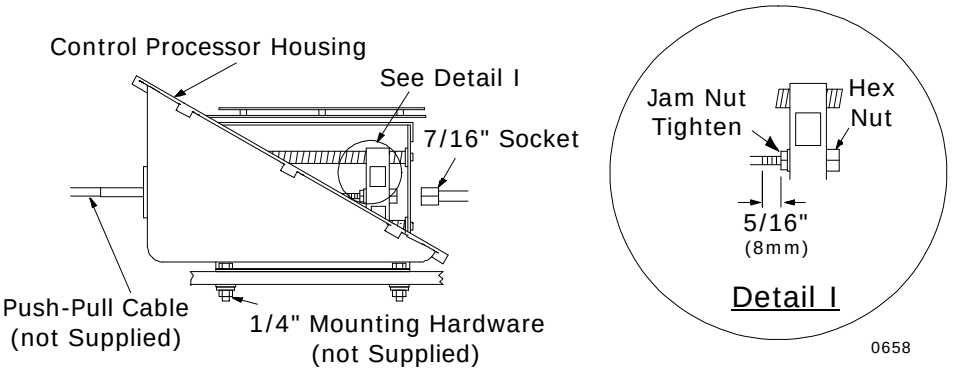

Figure 8 - Push-Pull Cable Connection

H) Tighten the jam nut to the hex nut.

I) Reinstall the cable retainer clip to secure the push-pull cable to the Processor housing.

J) Do not connect the push-pull cable at the engine or the Water Jet at this time.

6. ADJUSTMENTS AND TESTS (SECURED TO DOCK)

6.1 CONTROL HEAD (ENGINES STOPPED)

A) Turn the power ON to the control system.

> ***WARNING:*** **Keep hands and tools clear of the Processor when power is ON. Turn OFF the control system power before disconnecting from the batteries. Do not disconnect battery terminals when engine is operating.**

B) The Control Head at each station will produce an intermittent tone.

C) Take command at a remote station.

D) Move each Throttle Control Head lever from Idle to Full Speed. Ensure the Port Processor reacts to Port lever movement and the Starboard Processor reacts to the Starboard lever.

> ***NOTE:*** **This will check that the Control Head lever is operating the correct Processor. Push-pull cable direction will be tested later.**

6.2 WATER JET CABLE ADJUSTMENT (ENGINES STOPPED)

> ***NOTE:*** **Hydraulic pressure MUST be available to move propeller.**

A) Manually move the Jet Pump lever from the required Ahead thrust to the required Astern thrust. Choose a radius on the Jet Pump lever that will result in a push-pull cable movement of greater than 2 inches (51mm) and less than 2.90 inches (74mm).

B) Take command at the remote station.

C) Leave the Water Jet Control Head lever in the Zero Thrust position.

D) Manually move the Jet Pump lever to the Zero Thrust position.

E) Adjust the push-pull cable ball joint to match the Jet Pump lever in the Zero Thrust position. Do not connect push-pull cable to the Jet Pump lever at this time.

> ***NOTE:*** **The push-pull cable should form a right angle (90 degrees) with the Jet Pump lever in the Zero Thrust position.**

F) Manually move the Jet Pump lever to the Full-Ahead position.

G) Move the Water Jet Control Head Lever to Full-Ahead Thrust.

H) Verify the push-pull cable moves the correct direction to move the Jet Pump lever to the Full-Ahead Thrust position.

- If correct, continue with the adjustments.
- If incorrect, change Jumper 4 on the Processor circuit board to the correct direction setting. Refer to Appendix C – System Drawing Notes.

I) Adjust trim pot R7 to match the push-pull cable to the Jet Pump Full-Ahead Thrust position. Refer to Appendix C – System Drawing for trim pot location.

NOTE: **Before the Processors are shipped, the trim pots are set for minimum cable movement.**

J) When you have achieved the required movement for Full-Ahead thrust, then verify Full-Astern thrust.

- If Full-Astern is incorrect, a combination of Dip Switch settings can be set to increase the portion of the cable movement from Zero Thrust to Full-Ahead and decrease movement Astern. Refer to Appendix C – System Drawing Notes for Offset settings.
- If Full-Astern is correct, continue with the adjustments.

K) Verify all three positions; Full-Ahead Thrust; Zero Thrust; and Full-Astern Thrust.

- If cable movement is correct at all three positions, continue with the Adjustments and Tests.
- If cable travel is incorrect, review steps A) through K), making the necessary adjustments.

L) Connect the thrust push-pull cable to the Jet Pump lever.

M) Confirm the Processor does not jam the Jet Pump lever against its stops, and that Zero thrust is correct.

- If cable movement is correct at all three positions, continue with the Adjustments and Tests.

- If cable travel is incorrect, the Processor jams the Jet Pump lever against its stops, or Zero Thrust is incorrect, review steps A) through M), making the necessary adjustments.

6.3 WATER JET RATE ADJUSTMENT (ENGINES STOPPED)

NOTE: **Hydraulic pressure MUST be available to command thrust.**

A) Time how long it takes the Jet Pump lever to move it's full range by manually moving the Jet Pump lever.

B) A combination of Dip Switch settings adjust the thrust push-pull cable maximum travel time. Refer to the System Drawing Notes for specific switch setting.

NOTE: **Configure the Dip Switches to meet the closest time. If time cannot be matched exactly, choose the setting the for the slightly slower time.**

6.4 THROTTLE PUSH-PULL CABLE ADJUSTMENT (ENGINES STOPPED)

A) Locate trim pot R8 on the Processor Circuit Board.

B) Verify potentiometer R8 is fully in the counterclockwise position, as shipped from the factory.

CAUTION: **Turning too hard against the stop can damage Potentiometers.**

B) Leave the throttle push-pull cable disconnected at this time.

C) Measure the throttle movement of the engine governor selector lever from Idle to full-speed. It must be within the Processor range of 2-inch (51mm) to 3-inches (76mm).

- If the throttle movement is less than 2-inch (51mm) or greater than 3-inches (76mm), the lever radius must be changed to be within range.

- If possible, throttle movement should be 2-1/2-inches (64mm) from Idle to full-speed.

D) Ensure engines are stopped.

E) Take command at the remote station.

F) Manually move the throttle selector lever on the governor to the Idle position.

G) Move the Throttle Control Head lever from Idle to full-speed. Verify the throttle push-pull cable moves the correct direction to move the engine governor selector lever to the full speed position.

- If correct, continue with the adjustments.
- If incorrect, change Jumper 3 on the Processor circuit board to the correct setting. Refer to Appendix C – System Drawing Notes.

H) Place the Throttle Control Head lever to the Idle position.

I) Manually move the engine throttle lever to the Idle-speed stop.

J) Adjust the throttle cable ball joint at the engine to match the throttle selector lever at the Idle position.

K) Leave the cable disconnected at this time.

L) Place the Throttle Control Head lever to the full-speed position.

M) Manually move the engine throttle lever to the full-speed position.

N) Gradually turn potentiometer R8 on the circuit board clockwise ↻ until the push-pull cable ball joint, when connected, will exert a slight amount of pressure against the full-speed throttle stop.

O) Recheck from Idle to full-speed.

- If incorrect, repeat step F) through N) until correct.
- If correct, connect the push-pull cable ball joint to the throttle selector lever.

6.5 START INTERLOCK TEST AND ADJUSTMENTS (ENGINES STOPPED)

NOTE: **If any of the following tests fail, verify Start Interlock Installation and Start Interlock connections as shown on the Drawing in Appendix C and in** Figure 6**.**

A) Turn the ClearCommand DC power OFF.

B) Verify that the engine(s) will not start.

C) Turn the ClearCommand DC power ON.

D) Accept command at the remote station.

E) Place the Throttle Control Head Lever to 50% speed.

F) Verify engine(s) will not start.

G) Place Throttle Control Head Lever in the Idle position.

H) Verify engine(s) will start in this position.

6.6 ENGINE STOP SWITCHES TEST (ENGINES RUNNING)

A) Start engine(s).

B) Verify that all Engine Stop Switches function correctly at all stations.

Refer to information supplied by engine manufacturer or switch supplier for set-up and adjustments.

CAUTION: **An Engine Stop Switch at each station is an absolute requirement, and will cancel warranty if not installed.**

WARNING: **Do not attempt to continue tests until Engine Stop Switches function correctly.**

7. ADJUSTMENTS UNDERWAY

WARNING: **DO NOT attempt to operate ClearCommand away from the dock with any system abnormality. Verify that all the above tests are completed and are correct.**

CAUTION: **Start slowly and learn to appreciate that the ClearCommand System provides a light touch that is fast and accurate.**

7.1 FULL-SPEED SETTING - ENGINE RPM

In open water gradually move the Throttle Control Head Lever to full-speed. Engine(s) should be running at full rated RPM. Consult the engine operator's manual for additional RPM adjustments.

8. CONTROL OPTIONS

8.1 ALARM CAPABILITY

ClearCommand offers a single alarm connection that OPENS with a system power failure or circuit malfunction.

The Processor's alarm connection point is a single connection block on each Processor Circuit Board. The alarm circuit in the Processor operates an alarm system supplied by others.

The control failure alarm is rated for a maximum of 200 mA. Do not exceed this rating. Normal operation is 21 ohms to DC return, high impedance indicates Alarm Condition.

It is the Shipyard's responsibility to utilize the alarm connection in an appropriate alarm circuit that has the same common mode voltage.

9. MAINTENANCE

9.1 CONTROL PROCESSOR

The ClearCommand Processor requires the following annual checks:

- Check all terminal connections for signs of corrosion or loose connections.
- Check mechanical connections within the Processor, and at the engine and Water Jet System.
- Check mechanical movement of the selector levers. Ensure that the push-pull cable does not jam.
- Cycle the Processor and if lead screws are noisy, apply a light coating of silicone grease to the stainless steel lead screw.

9.2 CONTROL HEAD

Verify once a year that Control Head terminals are secure and free of corrosion. Apply a light coating of Teflon grease, or corrosion block, to the contacts.

Appendix A

Table of Contents

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BONDING A.B.Y.C. 46 CFR 111.05 5
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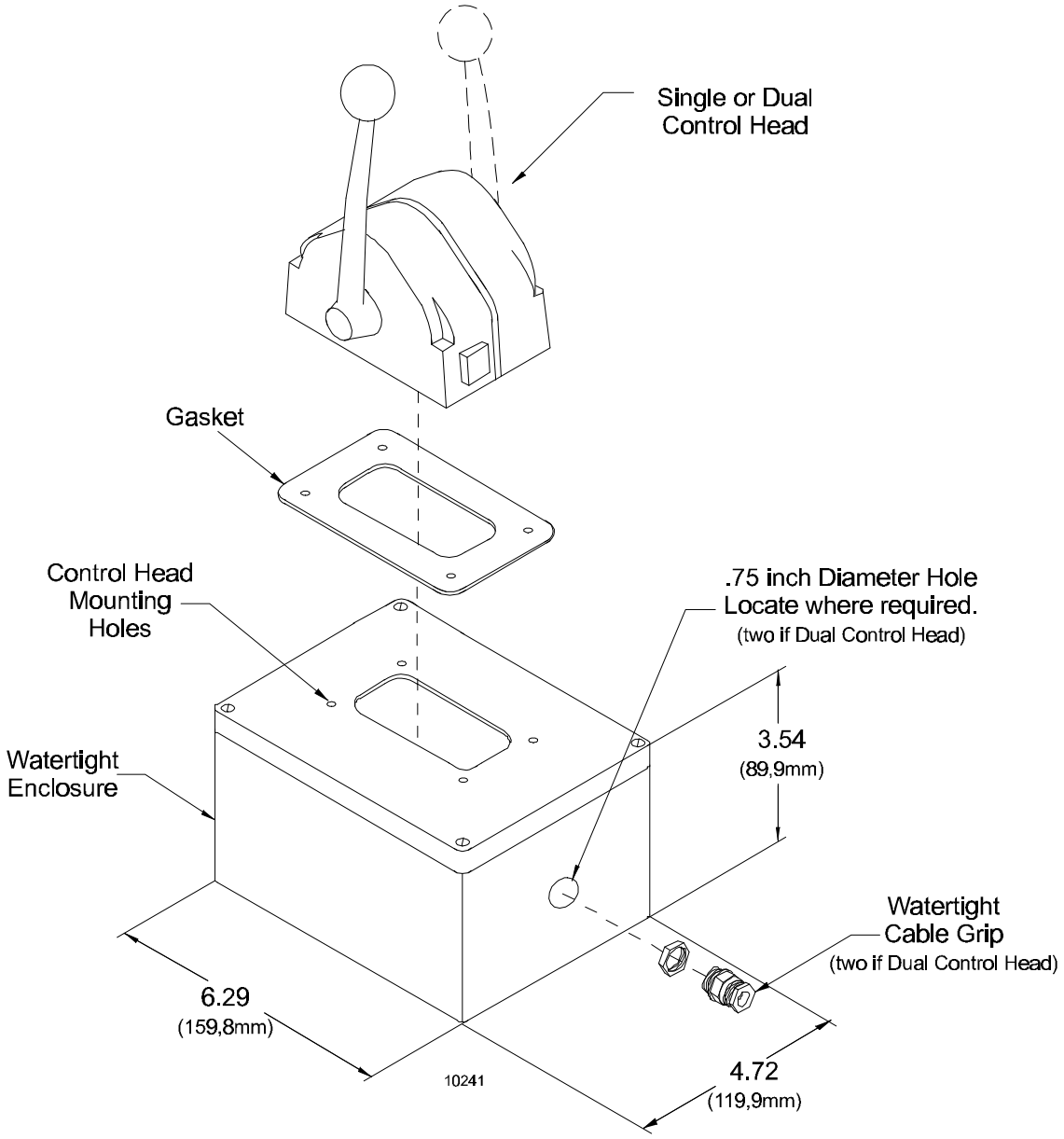
PARTS SOURCE 8
CHECKOUT & SEA TRIAL REPORT 9



WATERTIGHT ENCLOSURE

- Deck Mount or Exposed Mount
- Ideal for outside Weather Mount
- To prevent internal condensation and moisture build up the mount is drilled to allow air circulation.
- Part No. 12110

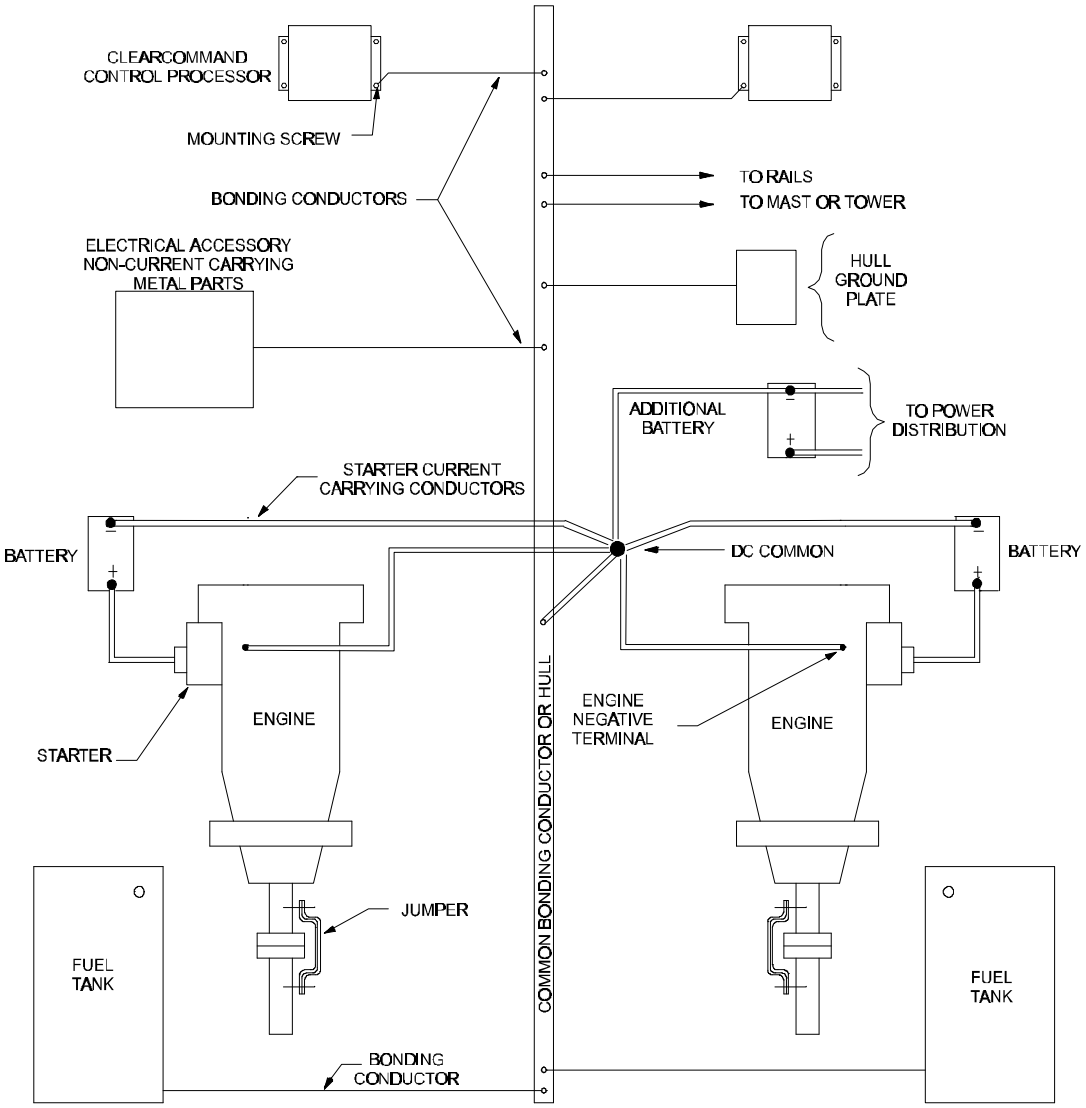
MMC-279
1/97

BONDING A.B.Y.C. 46 CFR 111.05

All boats equipped with a permanently installed electrical system shall also be equipped with a bonding system. The negative terminal of all batteries should be connected at only one point, the DC common, and from DC common to bond system or hull.

Metal - Hull Vessels

The hull of a metal - hull vessel may serve as the common bonding conductor. Any item to be bonded not in contact with the hull requires a bonding conductor to the hull.



REFERENCES

AMERICAN BOAT & YACHT COUNCIL

(ABYC)
Box 806
Amityville, NY 11701

E-1 Bonding of Direct Current Systems
E-3 Wiring Identification on Boats
E-9 DC Electrical Systems on Boats
H-2.4e or 32.4g Ambient Temp. 50 degrees C

CODE OF FEDERAL REGULATIONS

33 CFR 183 Subpart I - Electrical Systems
33 CFR 183, 410 Ignition protection
33 CFR 183, 415 Grounding
33 CFR 183, 425 Conductors: General
33 CFR 183, 430 Conductors in circuit of less than 50 Volts
33 CFR 183, 445 Conductors: Protection
33 CFR 183, 455 Over-current and Protection: General
46 CFR 111.01 - 15(b) Ambient Temp.
Machinery Spaces 50 degrees C
46 CFR 111.05- System Grounds

SOCIETY OF AUTOMOTIVE ENGINEERS

400 Commonwealth Drive
Warrendale, PA 15096

J1171 External Ignition Protection
J1428 Marine Circuit Breakers
J378 Marine Engine Wiring

NATIONAL MARINE MANUFACTURERS ASSOCIATION

401 North Michigan Avenue
Chicago, IL 60611

UNDERWRITERS LABORATORIES

PARTS SOURCE

Anti-Static Wrist Strap	Part No. 517	[Thomas & Betts (Part No. AWCC)]
Fuse	Part No. 1030	[Bussman (Part No. GDC-1A)]
WAGO Tool	Part No. 397	[WAGO (Part No. 236-332)]

MicroCommander/ClearCommand Checkout &Trial Report

Mathers Controls, Inc.
675 Pease Road
Burlington WA 98233-3103
U.S.A.
Tel: 360-757-6265
Fax: 360-757-2500
e-mail: mathers@matherscontrols.com

Vessel Name: _____ **Trial Date:** _____ **ClearCommand SSN:** _____

Owners Name: _____

Address: _____

Tel/Fax/e-mail: _____

Contact Name: _____

APPLICATION:

A: Boat Builder _____ **Model** _____ **Size** _____ **Year** _____

Original Equipment ☐ Retrofit ☐ Type of Controls Replaced _____

B: Single or Twin Screw _____

Engine Make _____ Model _____

Horsepower _____ RPM _____ Engine Hours _____

Reduction Gear/Drive _____ Model/Ratio _____ Trolling? Yes ☐ No ☐

Type of Service (Pleasure, Fishing, Rental, Etc) _____

C: Number of Control of Stations _____

Port Actuator/Control Processor: **Model** _____ **S/N** _____ Starboard Actuator/ Control Processor: **Model** _____ **S/N** _____

Trolling Actuator: **Model** _____ **S/N** _____

Synchronizer: Yes ☐ No ☐ **Type of Input Signal** (tach gen, mag pick-up, etc.) _____

Control Station Location(s) and Model(s) _____

Before Running Engine:

	Port	Stbd
1. Voltage at the Battery Terminals.	VDC	VDC
2. Voltage at the Actuator/Control Processor.	VDC	VDC
3. Warm-up Indicator Light blinks in 'Ahead'. All Stations.	Yes☐ No☐	Yes☐ No☐
4. Electric Cables are supported every 18 inches.	Yes☐ No☐	Yes☐ No☐
5. Cable connections are tight at the Actuator/Control Processor and Control Heads.	Yes☐ No☐	Yes☐ No☐
6. Engine Shutdown Switches at EACH Remote Station are operational.	Yes☐ No☐	Yes☐ No☐
7. Check push-pull cable match. Disconnect push-pull cables at the clutch and throttle. Check that cables travel in the correct direction. Check the cable movement, insure that it matches clutch and throttle.	Yes☐ No☐	Yes☐ No☐

Dock Side Tests (Running):

	Port	Stbd
1. Voltage at the Battery Terminals.	VDC	VDC
2. Does Engine 'Start' when Controls are 'OFF'?	Yes☐ No☐	Yes☐ No☐
3. Low Idle RPM.	RPM	RPM
4. High Idle RPM (optional).	RPM	RPM
5. Check Warm-Up Mode.	Yes☐ No☐	Yes☐ No☐
6. Check shift in both directions.	Yes☐ No☐	Yes☐ No☐

Sea Trials:

	Port	Stbd
1. Check that Twin Screw Levers match position and RPM throughout speed range.	Yes☐ No☐	Yes☐ No☐
2. Set maximum engine RPM as required.	RPM	RPM
3. Adjust Full Speed Reversal Delay.	SEC.	SEC.
4. Is Synchronizer operational?	Yes☐ No☐	Yes☐ No☐
5. Is Trolling Valve operational?	Yes☐ No☐	Yes☐ No☐

SW 1 Switch Settings:

PORT

	1	2	3	4	5	6	7
ON	☐	☐	☐	☐	☐	☐	☐
OFF	☐	☐	☐	☐	☐	☐	☐

PORT JMPR 3 ☐ ☐ PUSH ← → PULL

JMPR 4 ☐ ☐ PUSH ← → PULL

STBD

	1	2	3	4	5	6	7
ON	☐	☐	☐	☐	☐	☐	☐
OFF	☐	☐	☐	☐	☐	☐	☐

STBD JMPR 3 ☐ ☐ PUSH ← → PULL

JMPR 4 ☐ ☐ PUSH ← → PULL

Comments (Please use additional paper as necessary):

General Installation Condition:

Any Irregularities:

ARE THE MANUALS ON BOARD? Yes☐ No☐

IS THE OPERATOR CARD ON BOARD? Yes☐ No☐

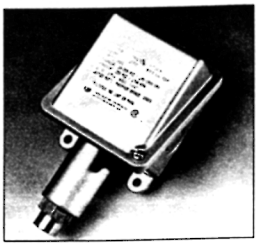
INSPECTOR _____ DATE _____

MAIL COMPLETED COPY TO:

Mathers Controls Inc.
675 Pease Road
Burlington, WA 98233

OR FAX TO: 360-757-2500

Appendix B



100 Series Pressure Switch

Type H100

UNITED ELECTRIC CONTROLS

Installation and Maintenance Instructions

Please read all instructional literature carefully and thoroughly before starting. Refer to the final page for the listing of Recommended Practices, Liabilities and Warranties.

GENERAL

The H100 pressure switch is activated when a bellows, diaphragm or piston sensor responds to a pressure change. This response, at a predetermined set point, actuates a single snap-acting switch, converting the pressure signal into an electrical signal. Control set point may be varied by turning the internal adjustment hex according to procedures outlined below (See Adjustments -PART II).

Part I - Installation

Tools Needed

Adjustable wrench
Screwdriver
Hammer (for alternate wire knockouts)

MOUNTING

INSTALL UNIT WHERE SHOCK, VIBRATION AND TEMPERATURE FLUCTUATIONS ARE MINIMAL. ORIENT UNIT SO THAT MOISTURE IS PREVENTED FROM ENTERING THE ENCLOSURE. IF UNIT IS BEING INSTALLED WHERE HEAVY CONDENSATION IS EXPECTED, VERTICAL MOUNTING (PRESSURE CONNECTION DOWN) IS REQUIRED. DO NOT MOUNT IN AMBIENT TEMPERATURES EXCEEDING PUBLISHED LIMITS.

Controls may be mounted and operated in any position. They may be surface mounted via the two mounting ears on either side of the enclosure, or directly to a rigid pipe by using the pressure connection. Low pressure units, models 520 - 535, are also available with an optional surface mounting bracket. Should the control be installed where condensation is expected, vertical mounting is recommended as a means of keeping water as far away as possible from switch terminals.

Never use the enclosure for leverage to hand tighten the pressure connection. Always use a wrench to tighten the pressure connection to the pipe. To prevent damaging the pressure sensor, use a back-up wrench to hold the hex nut in place when surface mounting.

On models supplied with an external manual reset button, be sure to leave sufficient finger space over the reset button for the operator to reset the control. See Mounting Diagrams.

WIRING

DISCONNECT ALL SUPPLY CIRCUITS BEFORE WIRING.

ELECTRICAL RATINGS STATED IN LITERATURE AND ON NAMEPLATE SHOULD NEVER BE EXCEEDED. OVER-LOAD ON A SWITCH CAN CAUSE FAILURE ON THE FIRST CYCLE.

WIRE UNITS ACCORDING TO LOCAL AND NATIONAL ELECTRICAL CODES. MAXIMUM RECOMMENDED WIRE SIZE IS 14 AWG.

Remove the two screws retaining the cover and cover gasket. Two cast-in knockouts for 1/2" conduit are located on the side and back of enclosure. These can easily be knocked out by placing the blade of a screwdriver in the groove and rapping sharply with a hammer. A 1/2" NPT conduit connection is also provided on the left hand side of the enclosure. The three switch terminals are clearly labeled "common", "normally open" and "normally closed". For switches supplied with lead wires, the following color coding applies:

	Man. Res.	DPDT (Option 1010)	
	SPDT	SWT1	SWT2
Common	Violet	Violet	Yellow
Normally Open	Black	Black	Red
Normally Closed	Blue	Blue	Orange

Grounding screw and clamp (cast in symbol) is provided. Keep the wire as short as possible to prevent interference with the plunger and the adjustable differential switch wheel if applicable.

Part II - Adjustments

Tools Needed

5/8" open end wrench

SOME MODELS HAVE A TWO-PIECE, ADJUSTABLE PLUNGER. THIS FEATURE IS CHARACTERIZED BY A 3/16" HEX HEAD SCREW INSTALLED IN THE 1/4" HEX PLUNGER. THE LENGTH OF THIS ASSEMBLY IS ADJUSTED AT OUR FACTORY AND IS CRITICAL TO THE FUNCTION OF THE CONTROL.

DURING NORMAL CALIBRATION, THIS ADJUSTMENT SHOULD NOT BE DISTURBED. HOWEVER, WHEN REPLACING THE ELECTRICAL SWITCH, IT MAY BE NECESSARY TO ADJUST THE PLUNGER LENGTH IN ORDER TO "RE-GAP" THE SWITCH. REFER TO INSTRUCTION IN "PART III-REPLACEMENTS" TO DETERMINE IF REGAPPING IS NECESSARY.

For set point adjustments and recalibration, connect control to a calibrated pressure source.

Standard Types

Remove pressure switch cover. Adjust set point by turning 5/8" hex adjustment screw clockwise (in) to raise set point, or counter clockwise (out) to lower set point. Tension on adjustment screw can be increased by tightening adjustment lock into it. (See diagrams.) Controls include uncalibrated reference scales for high, low or mid range settings.

Note: Models 190 - 193 (welded stainless steel diaphragms with NACE Option, M411). These models are application sensitive. For rising pressure applications, set point should be adjusted from low pressure up to set point. For falling pressure applications set point should be adjusted from high pressure down to set point. Wide pressure cycling above and below set point can cause control band shift.

Adjustable Differential Models

Control types with option code 1519 incorporate a snap switch with internal adjustment wheel. Turning this wheel raises or lowers the pressure rise set point. The fall set point remains constant. Consult factory for additional information.

Manual Reset Models

Control types with option code 1530 incorporate a snap switch which when actuated, remains actuated until the pressure drops sufficiently to allow the reset button (located on top of the control) to be manually depressed to reset the switch.

Part III - Replacements

Tools Needed

Adjustable wrench
Screwdriver

USE ONLY FACTORY AUTHORIZED REPLACEMENT PARTS AND PROCEDURES. COMPONENTS AVAILABLE FOR REPLACEMENT ARE THE SWITCHES. OTHER COMPONENTS FACTORY REPLACEABLE ONLY. DISCONNECT LIVE CIRCUITS BEFORE REPLACING THE SWITCH.

Switch replacement (all models)

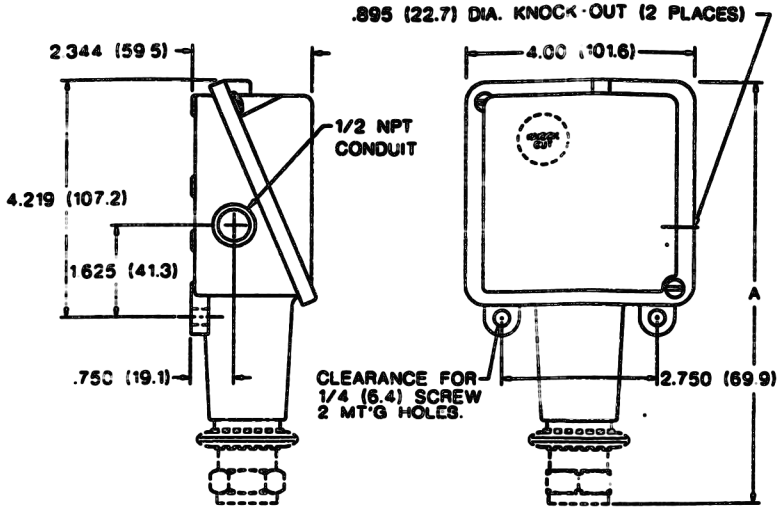
1. Disconnect lead wires from the terminals.
2. Remove switch mounting screws (2) and take out the switch and insulator.
3. Insert insulator and replacement switch. Orient switch plunger over the adj. screw; tighten switch mounting screws securely.

Gapping

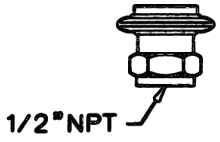
Turn 5/8" hex adjustment screw in approximately mid range. This puts a load on the sensor. Using a 1/4" wrench on the plunger and a 3/16" wrench on the plunger hex screw, turn hex screw out from plunger until switch actuates. (If switch is already actuated proceed to next step.) Turn plunger hex screw in, until switch just transfers. Turn hex screw in a additional 2 - 2 1/2 flats from this point (approximately 1/3 turn). This will provide a 9 - 11 Mil gap. Follow set point adjustment procedure. Exceptions to the 2 - 2 1/2 flat gap: Model 194: gapped only 1 (one) flat; models 610 - 616: gapped 4 flats.

4. Check set point according to PART II.
5. Connect wires and replace cover securely.

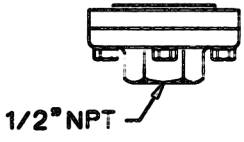
Dimensions



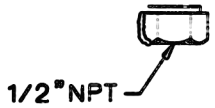
Models	Dimension A Inches	mm	NPT
Pressure			
171-174	7.50	190,57	1/2
183-186	7.56	192,07	1/2
188, 189	6.62	168,27	1/2
190-194	6.63	168,27	1/2
218-274	6.56	166,67	1/4
358-376	7.03	176,99	1/4
471-474	7.50	190,57	1/2
483-486	7.56	192,07	1/2
488, 489	6.62	168,27	1/2
490-494	6.63	168,27	1/2
520-525	8.44	214,30	1/2
530-535	8.00	203,20	1/2
610-616	7.00	177,80	1/4
680	6.97	177,04	1/4
701-713	6.56	166,67	1/4



Models 171-174, 471-474

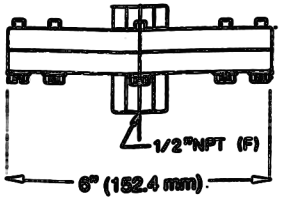


Models 183-189, 483-489

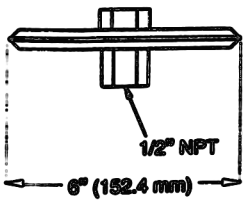


Models 190-194, 490-494

Models 218-376, 610-713



Models 520-525



Models 530-535

RECOMMENDED PRACTICES

United Electric Controls Company recommends careful consideration of the following factors when specifying and installing UE pressure and temperature units. Before installing a unit, the Installation and Maintenance instructions provided with unit must be read and understood.

- To avoid damaging unit, proof pressure and max temperature limits stated in literature and on name plates must never be exceeded, even by surges in the system. Operation of the unit up to proof pressure or max temperature is acceptable on a limited basis (i.e.start-up, testing) but continuous operation must be restricted to the designated adjustable range. Excessive cycling at proof pressure or maximum temperature limits could reduce sensor life.
- A back-up unit is necessary for applications where damage to a primary unit could endanger life, limb or property. A high or low limit switch is necessary for applications where dangerous runaway condition could result.
- The adjustable range must be selected so that incorrect, inadvertent or malicious setting at any range point cannot result in an unsafe system condition.
- Install unit where shock, vibration and ambient temperature fluctuations will not damage unit or affect operation. Orient unit so that moisture does not enter the enclosure via the electrical connection.
- Unit must not be altered or modified after shipment. Consult UE if modification is necessary.
- Monitor operation to observe warning signs of possible damage to unit, such as drift in set point. Check unit immediately.
- Preventative maintenance/periodic testing is necessary for critical applications where damage could endanger property/ personnel.
- For all applications, a factory set unit should be tested before use.

Electrical ratings stated in literature and on nameplate must not be exceeded. Overload on a switch can cause damage, possible on the first cycle. Wire unit according to local and national electrical codes, using wire size recommended in installation sheet.

- Use only factory authorized replacement parts and procedures.
- Do not mount unit in ambient temp. exceeding published limits.
- For remote mounted temperature units, capillary lengths beyond 10 feet can increase chance of error, and may require re-calibration of set point and indication.

LIMIT WARRANTY

UE warrants that the product thereby purchased is, upon delivery, free from defects in material and workmanship and that any such product which is found to be defective in such workmanship or material will be repaired or replaced by UE (F.O.B. UE); provided, however, that this warranty applies only to equipment found to be so defective within a period of 12 months after installation by buyer but not to exceed 18 months after delivery by the seller. Except for the limited warranty of repair and replacement stated above, UE disclaims all warranties whatsoever with respect to the product, including all implied warranties of merchantability or fitness for any particular purpose.

LIABILITY LIMITATION

The sole and exclusive remedy of buyer for any liability or seller for any claim, including incurred in connection with (I) breach of any warranty whatsoever expressed or implied, (II) a breach of contract, (III) a negligent act or acts (or negligent failure to act) committed by seller, or (IV) an act for which strict liability will be imputed to seller, is limited to the limited warranty or repair and replacement stated herein. **In no event shall the seller be liable for any special, indirect, consequential or other damages or like general nature, including, without limitation, loss of profits or production, or loss or expenses of any nature, incurred by the buyer or any third party.**

UE

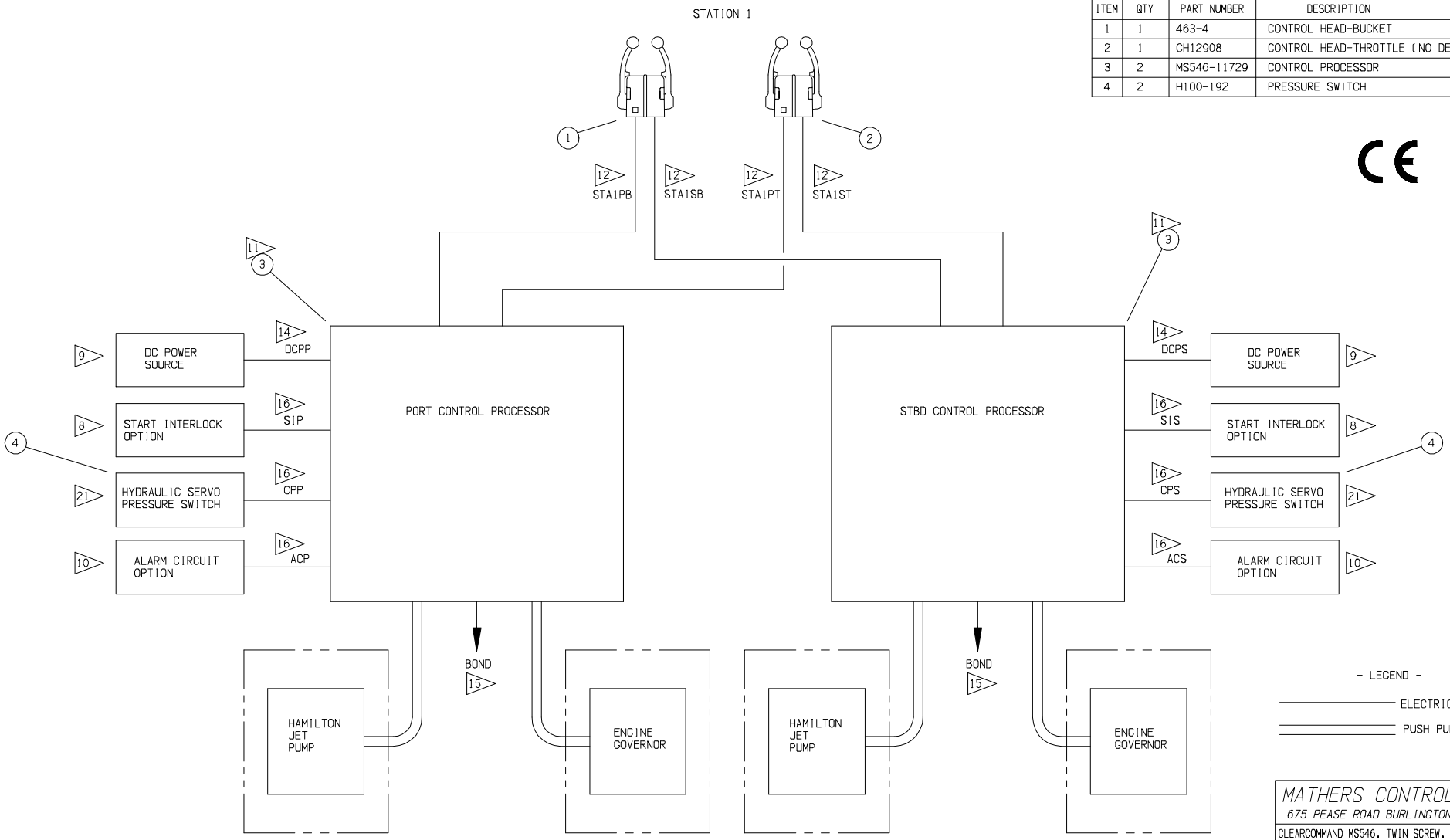
UNITED ELECTRIC CONTROLS

P.O. Box 9143, Watertown, MA 02272-9143 USA

617 926-1000 Fax 617 926-2568

Appendix C

MATERIAL LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	463-4	CONTROL HEAD-BUCKET
2	1	CH12908	CONTROL HEAD-THROTTLE (NO DETENTS)
3	2	MS546-11729	CONTROL PROCESSOR
4	2	H100-192	PRESSURE SWITCH



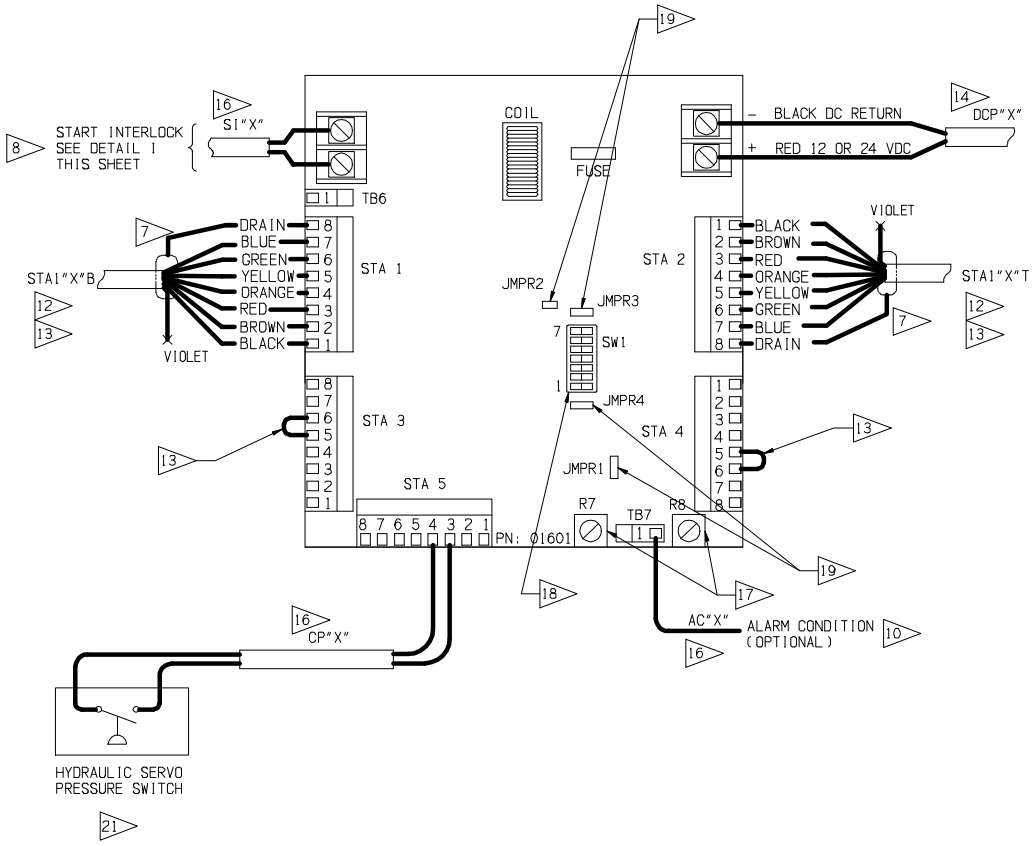
SEE SHEET 4 FOR NOTES

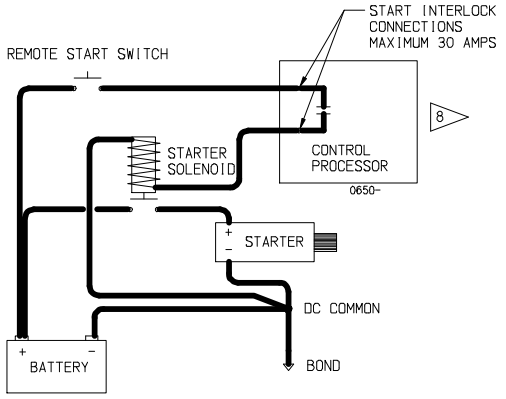
MATHERS CONTROLS INC.
675 PEASE ROAD BURLINGTON WA. 98233

CLEARCOMMAND MS546, TWIN SCREW, ONE STATION, SEPERATE LEVER THROTTLE/JET PUMP CONTROL

	ENG. J.H.C.	DWN. M.WILSON
	CKD.	DATE 8-26-99
	SCALE: NONE	SHT. 1 OF 4
		SIZE B
		DWG.NO. 11228

PART NUMBER MS546-11729 CONNECTIONS





DETAIL 1

START INTERLOCK SCHEMATIC

SEE SHEET 4 FOR NOTES

CE

MATHERS CONTROLS INC.
675 PEASE ROAD BURLINGTON WA. 98233

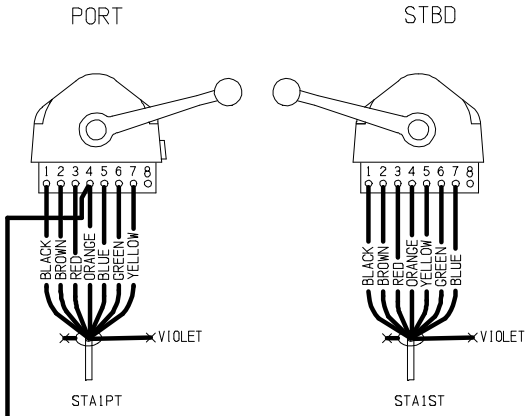
CLEARCOMMAND MS546, TWIN SCREW, ONE STATION,
SEPERATE LEVER THROTTLE/JET PUMP CONTROL

	ENG. J.H.C.	DWN. M.WILSON
	CKD.	DATE 8-27-99
	SCALE: NONE	SHT. 2 OF 4
		SIZE B
		DWG.NO. 11228

CONTROL HEAD
REFERENCE INFORMATION

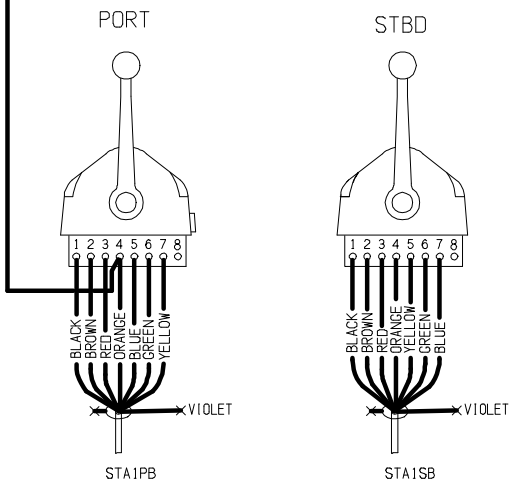
THROTTLE

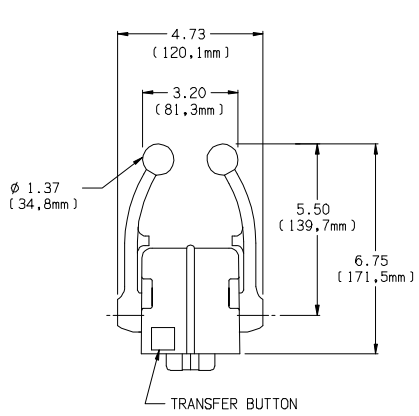
CONTROL HEAD PART NUMBER CH12908
(SHOWN IN IDLE POSITION)

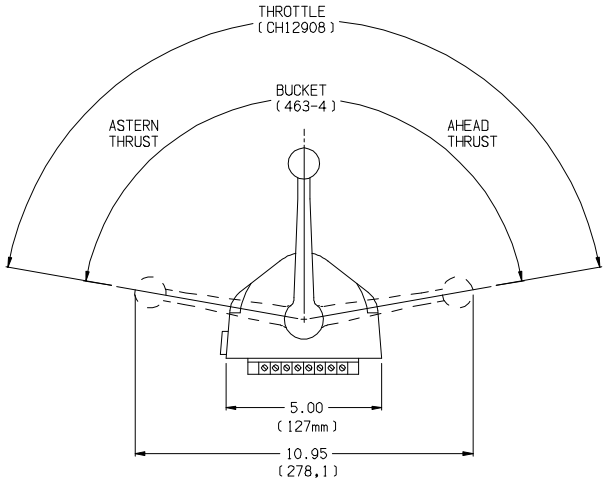


BUCKET

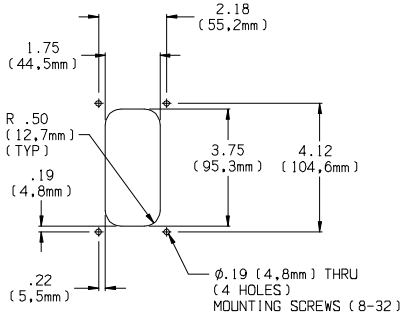
CONTROL HEAD PART NUMBER 463-4
(SHOWN IN ZERO THRUST POSITION)







OUTLINE DIMENSIONS



PANEL CUT-OUT DIMENSIONS

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SEE SHEET 4 FOR NOTES

MATHERS CONTROLS INC.	
675 PEASE ROAD BURLINGTON WA. 98233	
CLEARCOMMAND MS546, TWIN SCREW, ONE STATION, SEPERATE LEVER THROTTLE/JET PUMP CONTROL	
ENG. J.H.C.	DWN. M.WILSON
CKD.	DATE 8-28-99
SCALE: NONE	SHT. 3 OF 4
	SIZE B
	DWG.NO. 11228

- NOTES -

1. DO NOT MOUNT CONTROL SYSTEM COMPONENTS ON ENGINE OR REDUCTION GEAR.

2. DO NOT MOUNT CONTROL COMPONENTS NEAR SOURCES OF HIGH HEAT. (EXHAUST DUCTS, ETC.)

3. DO NOT MOUNT CONTROL COMPONENTS NEAR SOURCES OF STRONG ELECTROMAGNETIC FIELDS. (STARTERS GENERATORS,ETC.)

4. MOUNT CONTROL COMPONENTS IN A LOCATION ACCESSIBLE FOR CHECKOUT, MONITORING AND MAINTENANCE.

5. THE "X" SHOWN IN THE CABLE DESIGNATORS CAN BE EITHER P OR S, CORRESPONDING TO PORT OR STARBOARD AS APPROPRIATE.

6. ALL ELECTRICAL CABLES ARE TO BE SUITABLE FOR MARINE APPLICATION AND MEET ALL APPLICABLE REGULATORY REQUIREMENTS.

7. INSURE THAT DRAIN WIRE ON ALL SHIELDED CABLE IS CONNECTED ONLY AT ONE END AS SHOWN ON SCHEMATIC AND THAT THE DRAIN WIRE DOES NOT TOUCH THE CHASSIS OR ANY OTHER CONDUCTIVE SURFACE.

8. START INTERLOCK RELAY WITH NORMALLY OPEN CONTACTS. CONTACTS ARE CLOSED WHEN SYSTEM IS OPERATING AND COMMANDING IDLE MAXIMUM OF 30 AMP, MAXIMUM OF 50V.

9. THE CONTROL PROCESSOR WILL BE PROVIDED SHIPS SUPPLY OF 12 OR 24 VDC, PROTECTED BY A 10 AMP RATED CIRCUIT BREAKER PROVIDED BY THE SHIPYARD.

10. CONTROL FAILURE ALARM RATED FOR A MAXIMUM OF 200mA. DO NOT EXCEED THIS RATING. NORMAL OPERATION IS 21 OHMS TO DC RETURN. HIGH IMPEDENCE INDICATES ALARM CONDITION. IT IS THE SHIPYARDS RESPONSIBILITY TO UTILIZE THE ALARM CONNECTION IN AN APPROPRIATE ALARM CIRCUIT THAT HAS THE SAME COMMON MODE VOLTAGE.

11. CAUTION:
THIS PART CONTAINS ELECTRONIC COMPONENTS WHICH CAN BE DESTROYED BY STATIC ELECTRICITY. PERSONNEL SHOULD GROUND THEMSELVES TO DISSIPATE ANY STATIC ELECTRICITY PRIOR TO WORKING INSIDE THE PART.

12. 8 CONDUCTOR 20 AWG SHIELDED CABLE (P/N 00350) WITH COLOR CODE AS SHOWN.

13. REMOVE THE JUMPER IF CONNECTING A CONTROL HEAD TO THIS TERMINAL BLOCK. PLACE A JUMPER BETWEEN PINS 5 AND 6 ON THE TERMINAL BLOCK IF REMOVING A CONTROL HEAD FROM THIS STATION.

14. ELECTRICAL CABLING MUST BE 14 AWG OR LARGER.

15. THE CONTROL PROCESSOR'S MOUNTING FEET MUST BE CONNECTED TO VESSELS BONDING SYSTEM.

16. ELECTRICAL CABLING MUST BE 14-20 AWG.

17. R7 (BUCKET RANGE) AND R8 (THROTTLE RANGE) TRIMPOT SETTINGS: BOTH FULLY COUNTER CLOCKWISE.

- NOTES - (CONTINUED)

18. DIP SWITCH SETTINGS. (PRESET FROM PRODUCTION)

1 ON - } BUCKET RATE (SEE TABLE BELOW)
2 OFF - }
3 OFF - NOT USED
4 OFF - NOT USED
5 OFF - OFF-BUCKET OFFSET ASTERN, ON-BUCKET OFFSET AHEAD
6 OFF - 5% BUCKET OFFSET
7 OFF - 10% BUCKET OFFSET

1	2	BUCKET RATE APPROXIMATELY AT MAXIMUM TRAVEL
ON	ON	8 SECONDS
OFF	ON	10.6 SECONDS
ON	OFF	12.3 SECONDS
OFF	OFF	15 SECONDS

19. JUMPER SETTINGS. (PRESET FROM PRODUCTION)

JUMPER 1 — 3 2 1 — MUST BE IN THIS POSITION TO USE R8

JUMPER 2 — 2 1 — MUST BE IN THIS POSITION FOR BUCKET TO FUNCTION

JUMPER 3 (SPEED) — 3 2 1 — THROTTLE DIRECTION (PULL FOR THROTTLE INCREASE)

JUMPER 4 (BUCKET) — 3 2 1 — BUCKET DIRECTION (PUSH FOR AHEAD)

20. A JUMPER CAN BE PLACED BETWEEN THE CONTROL HEADS (PIN 4) SO THAT EITHER TRANSFER BUTTON CAN BE PRESSSED.

21. PRESSURE SWITCH MUST BE SET TO CLOSE WHEN THERE IS ADEQUATE HYDRAULIC PRESSURE TO OPERATE THE JET PUMP BUCKET UNDER ALL CONDITIONS.

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