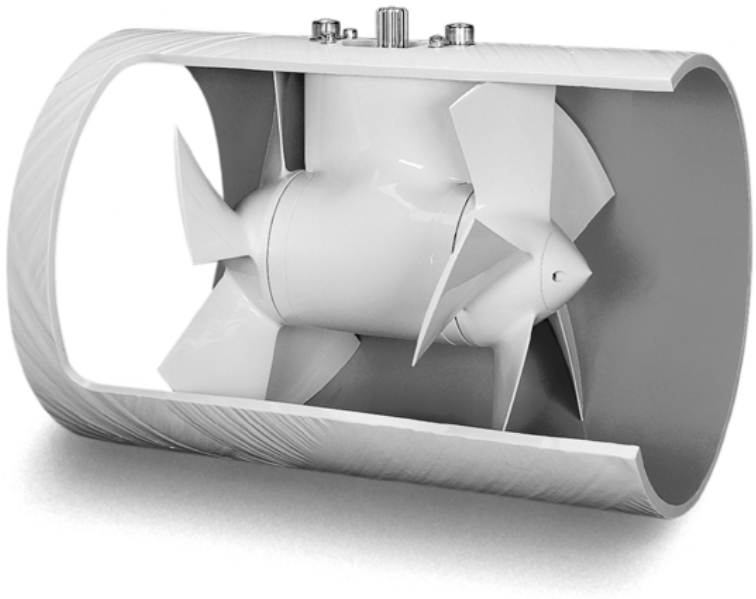
ARCTURUSMARINE

AMERICAN BOW THRUSTER



TRAC Series

DC Thruster Installation and Operation Manual

American Bow Thruster
Standard Installation and Operating Instructions
Version 9.05a
DC TRAC Table of Contents

Arcturus Marine
American Bow Thruster
517-A Martin Avenue
Rohnert Park, CA 94928
U.S.A
Phone (707) 586-3155
FAX (707) 586-3159

Section 1 - Before Starting Installation:

Please read this manual in its entirety before starting installation! It will save you money!

Technical Assistance:

If you have any questions, please call us at (800) 752-0661 or (800) 535-5377 or (707) 586-3155. We want to help!

Section 2 - Basic Component Installation

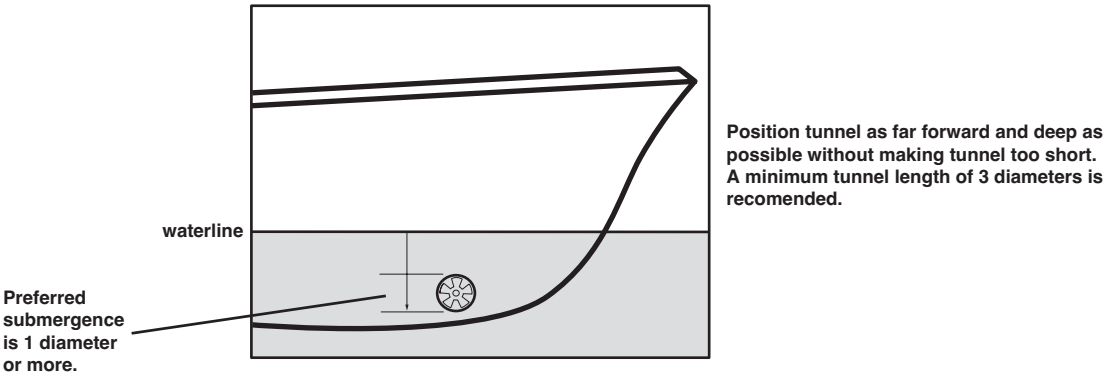
Tunnel Installation:

Warning: Thruster tunnel becomes an integral part of the hull. Installation of thruster tunnel should be undertaken only by professionals with certified competency in the fabrication and repair of the hull material in question. Proper mechanical bonding of the tunnel to the hull and support of the tunnel must be confirmed and certified with your naval architect.

Tunnel Positioning:

Priority 1 - Locate top of tunnel at least 1/2 diameter below the waterline. It is strongly recomended that this distance be at least 1 diameter whenever possible. Deeper is better.

Priority 2 - Locate the tunnel as far forward as possible while maintaining adequate tunnel length. At a minimum, the tunnel must be long enough so that no part of the thruster protrudes. Ideally the tunnel length would be at least 3 diameters.

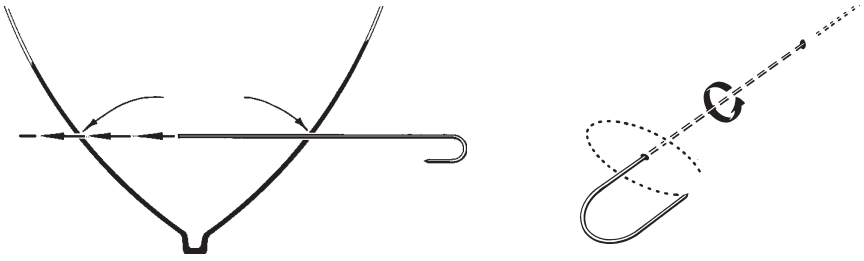


Marking the Tunnel Cut-out:

1 - Measure and re-measure to exactly pinpoint the center of the tunnel on the inside of the hull on both sides. Be sure that the location is square in all directions.

2 - Drill a horizontal 3/16" diameter hole through the hull at each center point.

3 - Fabricate a scribing tool from 1/8" steel rod as shown. Bend the end of the rod into a hook shape having a diameter equal to the tunnels O.D. radius. Pass the scribing tool through the holes in the hull as shown and scribe the tunnel openings on both sides of the hull.

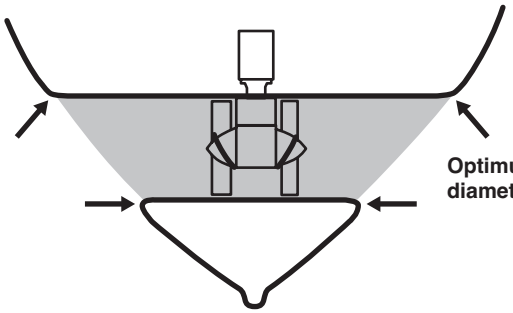


4 - Cut holes in both sides of hull at scribe mark. Try to hold cutting device paralell to the ground.

Tunnel/Hull Joint Radius:

To minimize inlet turbulence, which can reduce thrust, it is best if the tunnel/hull joint radius be not more or less than 1/10 the tunnel diameter. It is recognized that fabrication of such a radius can be quite time consuming and expensive. It should be noted that this reccomendation is made in the pursuit of an ideal situation and that in practice is not often achieved.

On steel and aluminum tunnels, where such a radius is most difficult, but where performance is critical, a 45 degree chamfer, also 1/10 the tunnel diameter in dimension, can be fabricated at the tunnel/hull joint.

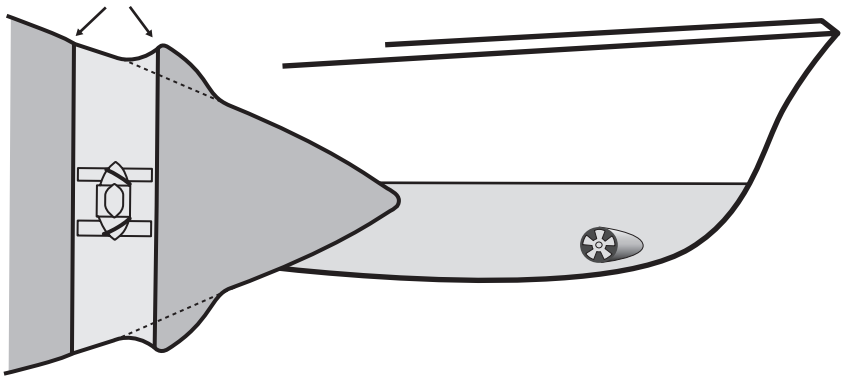


Optimum radius or chamfer = 1/10 tunnel diameter.

Other Tunnel/Hull Joint Treatments:

The "eyebrow":

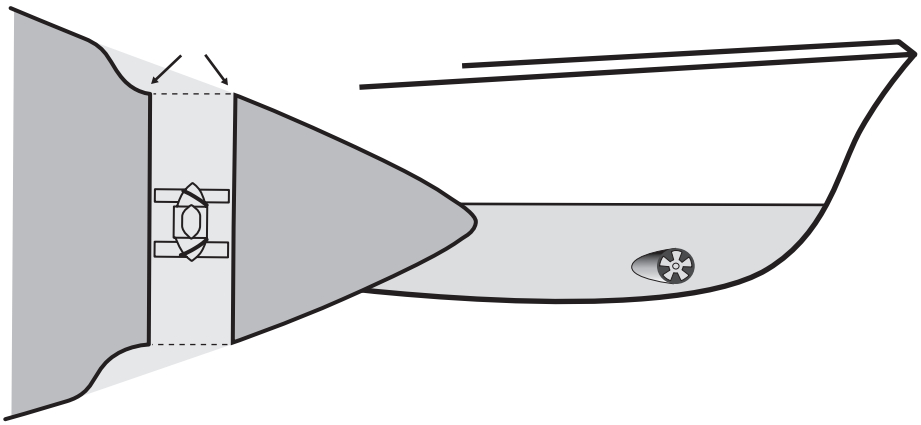
This treatment was very common 5-10 years ago. An "eyebrow" would be built up at the leading edge of the tunnel. The theory was that the eyebrow would deflect water from "tripping" on the trailing edge of the tunnel and thus reducing turbulence drag. It is our opinion that this theory is not technically supportable. However, it is acknowledged that an eyebrow may have some benefit in deflecting larger debris from hitting the trailing edge of the tunnel although damage to a vessel from this type of impact has never been reported. Eyebrows have also been used sucessfully in the reduction of propeller freewheeling while underway.(See page 2-3)



The "scallop":

Some builders have taken the approach of scalloping out the hull at the trailing edge of the tunnel in order to soften or eliminate the tunnel edge. It is reasoned that, left untreated, the trailing edge of the tunnel would cause turbulence and hull drag. This approach is expensive because of the extensive hull work required.

When builders have done tank tests to determine which type of tunnel treatment is best, the results have shown drag to be negligible (even unmeasurable) with or without tunnel treatments.



Propeller Free-Wheeling:

For some hull shapes water flow through the tunnel while the vessel is underway can cause the thruster propeller and motor to spin at high rpm under some sea conditions. For DC motor driven thrusters, this can be an unacceptable problem mainly due to the resultant high level of noise.

There have been two approaches to addressing the free-wheeling problem. One has been to install a tunnel eyebrow as described above. The other has been to install tunnel gratings as described below. The effectiveness of either approach is probably due to a lessening of flow into the tunnel when water is encouraged to flow over the surface of the tunnel opening.

All thruster propellers free-wheel to some extent while underway. Only those that turn fast enough to generate significant noise would require special measures. We would recommend, particularly on high speed vessels (speeds exceeding 10 to 12 kts), that gratings be considered as a preventive measure.

Few vessels experience a free-wheeling problem, but those that do tend to have similar characteristics:

1) the tunnels are extremely short
2) the hulls have very fine entry at the bow

Tunnel gratings:

Tunnel gratings are installed to keep people and large debris out of thruster tunnels. We recomend the use of tunnel gratings for these reasons and also to minimize the probability of free-wheeling problems.

Bars made of 1/4" stainless steel flat stock, 1" to 2" wide, are fixed at 3" to 3.5" intervals across the tunnel opening. Material size can vary with tunnel diameter. The bars are oriented perpendicular to the normal flow of water across the tunnel opening (i.e. bars will be approximately vertical, not horizontal).

Methods of fixing bars can include perimeter rings, or screw tabs integrated into the tunnel wall.

Thruster Mounting:

The thruster is secured into the tunnel with six socket head cap screws. Screw diameter and material varies with thruster size and material. Use only the screws supplied by American Bow Thruster. A gasket is usually installed between the top of the thruster strut and the inside surface of the tunnel. Because of tunnel diameter variances, it is acceptable to: (1) use one of the gaskets provided, (2) use two gaskets, or (3) use no gaskets at all. In the latter case, Sikaflex® sealant should be used between the thruster strut and the tunnel wall.

Checking propeller tip clearance:

Test mount the thruster in the tunnel using a single gasket. Pull the thruster up tight with the screws provided. Slide both propellers onto their respective shafts and check for acceptable tip clearance. A minimum tip gap of .050" is recommended. Ideal tip clearance would be 0.10". In exceptional circumstances tip clearance may be greater depending on tunnel material and tunnel condition. Aluminum tunnels may deform during installation and present more variablility for tip clearance.

Because the thruster strut is machined with the same radius as the inside of the tunnel, the strut is inclined to align itself axially in the tunnel. This tends to result in propeller shafts being well centered. However, by loosening the mounting screws the thruster's axial alignment can be adjusted to improve propeller tip clearance.

Also, the addition or removal of the normal mounting gasket may help to acheive optimal tip clearances.

When it has been established that the propeller tip clearance is acceptable, remove the propellers and dismount the thruster.

Final Thruster Mounting:

- Carefully clean the mounting surfaces on the thruster strut and the inside of the tunnel.
- Apply RTV silicone to both sides of the gasket (If a gasket is not being used, coat the thruster mounting surface with an underwater gasket material such as Sikaflex®).
- With the gasket in place, fasten the thruster into the tunnel with the screws provided. Screw threads should be coated with anti-seizing compound.
- Before tightening mounting screws, slide props in place to be sure that thruster is centered properly.
- Torque mounting screws to the values shown on the appropriate Thruster Assembly drawing.
- Install safety wire through the thruster mounting screws to secure them against vibration (see pg.2-5).

Propeller Mounting:

1) Clean the propeller shaft and the inside of the propeller hub. Test fit the propeller onto the shaft with the shaft key installed in the keyway. The propeller should make up cleanly on the shaft. If the propeller does not fit snugly, then remove the propeller and correct the problem.

2) For final mounting fit key into shaft keyway then install the prop onto the clean and dry shaft. Slide the propeller onto shaft, making sure the key does not “cock up”.

3) Slide the prop nut washer onto shaft end (when provided).

4) Coat the prop shaft threads with high strength locking compound.

5) Tighten prop nut to the torque listed on the Thruster Assembly Drawing.

Prop nut materials:
Bronze thrusters must use Monel nuts. These nuts are usually marked “NICU”.
Aluminum thrusters must use 316 stainless nuts (usually marked "316")

6) Check that the installed propeller rotates freely and does not bind against the face of the thruster gearbox.

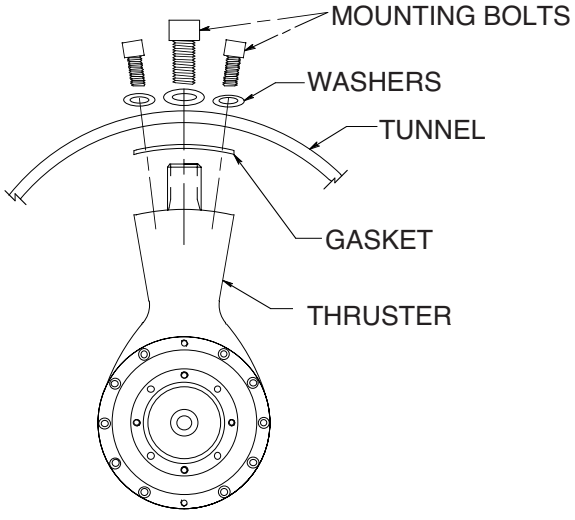
7) Insert and secure the prop nut cotter pin through its hole at the end of the shaft.

8) Install nose cone (except on 8" size) to the face of propeller with the screws provided. Coat screws with mediumstrength locking compound and tighten to 8 ft-lb.

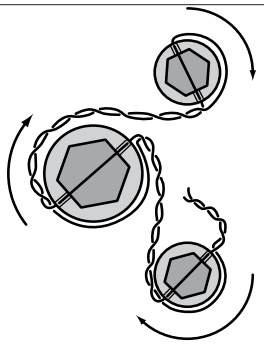
Nose cone screw materials:
Bronze thrusters must use Monel screws. These screws are usually marked “NICU".
Aluminum thrusters must use 316 stainless screws. These screws are usually marked "316".

Safety Wiring the Thruster Mounting Bolts:

After Installing the thruster in the tunnel (refer to the Thruster Assembly Drawing) the six thruster mounting bolts must be secured against loosening with safety wire. Mounting bolts supplied by American Bow Thruster are pre-drilled to accept this wire. Stainless safety wire is included in the thruster mounting kit, and must be used. Refer to the illustration here for proper wiring technique.



Route safety wire around bolt heads in a direction that pulls bolts tight and opposes loosening rotation



Header Tank Mounting/Lubrication Requirements:

Warning! on some systems,the header tank fitting and plumbing must be connected before the driveline or motor are installed, or they cannot be reached.

The header tank maintains positive fluid pressure inside the thruster gearbox to prevent water intrusion in the unlikely event of a leak. Although rare, the most probable source of a leak in the thruster is through the shaft seals.

In the event of a leak, case fluid will slowly seep out of the thruster gearbox, rather than water seeping in. The fluid level in the header tank should be monitored on a regular basis, and must be kept 1/2 full.

1- Using the brackets provided, mount the header tank in any convenient location near the thruster. The header tank must be mounted at least 30" above the waterline.

2- Connect the header tank hose to the supplied fitting on the thruster with the 3/8" diameter, oil resistant, low pressure hose. The fittings on the header tank and the thruster are -6 male JIC.

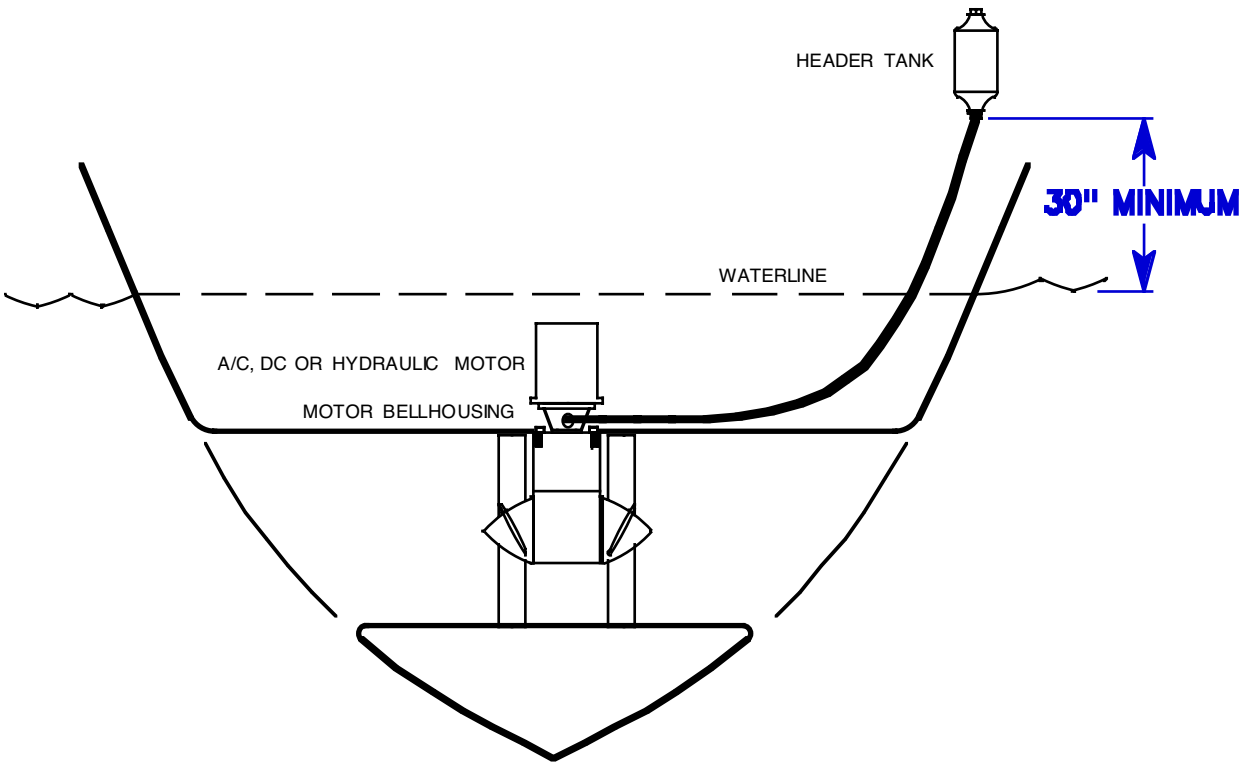
3- Fasten the hose along its route to the hull or bulkhead with nylon straps or clamps at one foot intervals.

NOTE: Be sure that the hose cannot be pinched or become crimped at a later date by stowed gear or equipment.

4- Remove the breather cap on the header tank and begin filling with the gear oil supplied.

NOTE: Use ONLY Chevron Delo Gear Lubricant SAE 80-90.
Thruster is shipped pre-filled with gear oil.

5- fill the header tank approximately 1/2 full. Store remaining fluid for future use.



Thruster Control Station (TCS) Installation:

Thruster Control Stations should be located at steering stations near main engine throttle and shift controls. A console cut-out template and gasket is provided with each unit. Make the console cut-out as shown and drill the four mounting holes. The control station mounts to the console with four pre-installed stainless 10-32 studs. Extra long coupling nuts are provided for tightening from the rear.

The portion of the control station that extends below the console is NOT weather resistant. In situations where the area below the mounting surface is open to the environment, a protective cover for the bottom of the control station must be fabricated.

Central Control Box Installation:

The central control box is typically mounted in a dry location for convenient wire runs to location of the thruster motor and to the locations of thruster control stations. Consult the System Electrical Wiring Diagram to review wire runs. A location should be selected where ambient temperature will not exceed 120 degrees F. Access to the central box should be made convenient for trouble-shooting.

In most systems, all control wires connect to the Central Control Box. Consult the System Electrical Wiring Diagram for number and size of control wires.

Installing the Motor Bell Housing:

The bell housing is designed to slide onto a boss on the pinion shaft seal housing in order to properly align the bell housing with the thruster pinion shaft. The bell housing fasteners pass through the seal housing and screw into the top of the thruster strut. It is important that the bell housing remain square with the top of the thruster in order to insure the required alignment of the motor shaft and the thruster pinion shaft.

1) Clean the mating surfaces on the bottom of the bell housing. Apply a light coat of medium to heavy weight grease. Also clean the pinion shaft seal housing on the top of the thruster. On some systems with fiberglass tunnels, it may be necessary to use a grinder to smooth any rough spots on the outside of the tunnel that interfere with bellhousing mounting. The bell housing must not contact the tunnel surface.

2) Remove the set screw plug from the thruster seal housing's gear oil port, and install the provided o-ring.

3) Position the bell housing onto the top of the pinion shaft seal housing. Be sure that the bell housing seats squarely on the seal housing and that the o-ring stays properly positioned.

4) Coat threads of seven fasteners with high strength locking compound and tighten to the torques shown on the Thruster Assembly Drawing.

5) Install the case oil fitting to side of motor bell housing, then cap the fitting until the oil hose is attatched.

Installing the Electric Motor:

1. Make a preliminary check of shaft to shaft clearance by setting the DC motor onto the bell housing. There should be 0.1" to 0.35" clearance between shaft ends. After this check, set the motor aside.

2a. (for 8" TRAC with keyed thruster pinion shaft) Grease the thruster's pinion shaft then install the lower "jawed coupling piece, pushing it onto the shaft (and key) until the bottom of the coupling contacts the aluminum bell housing. Now, back off for 1/8” clearance. Make sure the shaft key is properly positioned then fully tighten the coupling set screw using high strength thread locking compound on its threads.

2b. (for 10" & 12" TRAC with splined thruster pinion shaft) Grease the thruster's pinion shaft then install the lower jawed coupling piece, pushing it onto the shaft until the bottom of the split coupling contacts the aluminum bell housing. Now, back off for 1/8” clearance. Apply high strength thread locking compound to the coupling's socket head cap screw then fully tighten the coupling onto the pinion shaft.

3. Loosely install the keyed jawed coupling piece onto the end of the motor shaft. Tighten the set screw just slightly in order that this coupler will be able to move with pressure but not slide freely.

4. Nest the coupling plastic insert into the lower jawed coupler on the thruster pinion shaft, then position the motor onto the bell housing and mate the motor side coupler jaws seat into the insert.

5. Check that the motor flange is seated fully onto the bell housing, then view through the bell housing side slots, and, if necessary, adjust the motor jawed coupling downward into the plastic insert.

6. Lift the motor off the bell housing without disturbing the position of the motor shaft coupling piece.

7. Mark the motor shaft to indicate the fully seated coupler position, then re-locate the coupling by 0.050” toward the motor body. This creates a required gap in the three piece coupling unit.

8. With the motor shaft coupling in this new location, make sure the shaft key is in place, then fully tighten the coupling using high strength locking compound on the set screw threads.

9. Reinstall the motor and tighten motor flange bolts to torques shown on the Thruster Assembly Drawing.

Section 4 - Wiring

System Power and Control Wiring:

System wiring should be installed according to details shown on the System Electrical Wiring Diagram, and on the diagram entitled "Reversing Contactor Assembly: Wire Connections".

Warning! Wire sizes must be equal or greater than those shown on the above diagrams. When point to point wire distances exceed 40 ft (i.e. reversing contactor assembly to thruster batteries; Central Control Box to Thruster Control Station), wire sizes may need to be increased from those shown on diagrams. Contact American Bow Thruster.

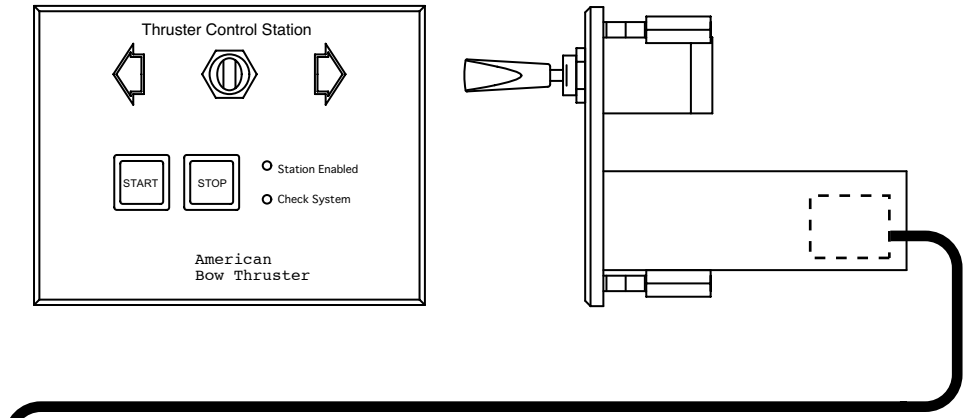
Thruster Control Station Wiring:

Thruster Control Stations for DC Systems are always single speed controls. Different styles of stations are available including the High Profile Jog Lever station (not shown), the Toggle Switch station (shown here) and additional custom configurations which use a Stop/Start station together with custom direction switchs.

Installation mounting dimensions and cut-out templates for the different stations are provided with the equipment. When these are needed in advance, contact American Bow Thruster.

The Jog Lever and Toggle Switch style stations are supplied with the color coded wire pigtail illustrated below.

Multiple stations may be installed and are wired in parallel. Parallel connection points can be made at the field terminal strip of the Central Control Box, or alternatively at installer provided junction boxes in other locations.



Control Station Wire Color & Function

- Red - Station power (+V)
- Black - Station power (neg)
- Orange - START signal (switch closure sends neg to Central Control)
- Yellow - STOP signal (switch closure sends neg to Central Control)
- Green - "A" direction signal (switch closure sends +v to A coil)
- Brown - "B" direction signal (switch closure sends +V to B coil)
- Blue - Alarm signal from motor thermal alarm relay

Section 5 - Miscellaneous pre-start-up notes

Corrosion Control:

All seagoing vessels must be protected from corrosion from galvanic and electrolytic potential. American Bow Thruster encourages all boat owners to enlist the services of a corrosion control expert to evaluate your vessel's corrosion control system and how your thruster should be made a part of that system.

Our thrusters are particularly resistant to all types of corrosion, especially bronze models. However, serious corrosion problems can take their toll on all types of equipment, especially on aluminum boats. Whatever system you use, you must definitely take the thruster system into consideration and include it into your corrosion control system.

Paint and Coatings:

On Hydraulic Systems:

Reservoirs, heat-exchangers and bellhousings are painted with Dupont 25P epoxy Primer and IMRON 333 white polyurethane.These are the only components painted on a regular basis. When it is requested that other components in the system be painted, the same coatings will be used.

Thrusters, Propellers, and Tunnels:

Thrusters, propellers, and tunnels are normally not painted. The installer must coat the thruster, propellers, and tunnel with the same system as is found on the rest of the hull including anti-fouling paint.

Prior to Launching of Vessel:

If the thruster system is not complete, but the gearbox is filled with oil and the header tank is plumbed and filled, no special steps need to be taken.

Section 6 - Final Check

Successful Installation Checklist:

Did You?.....

- call American Bow Thruster whenever necessary for answers to your questions? It's important to avoid problems that could require expensive adjustments.

- install the tunnel at least 1/2 diameter (and preferably deeper) from the waterline to the top of the tunnel?

- have a professional, certified craftsman install the tunnel to the architects standards?

- ensure that thruster does not protrude from tunnel?

- use the thruster mounting screws supplied by American Bow Thruster?
  - monel (NICU) for bronze thrusters
  - stainless steel (316 only) for aluminum thrusters

- properly torque the thruster mounting screws?

- use safety wire the thruster mounting screws?

- properly install the oil port o-ring prior to installing the motor bell housing?

- insure that thruster propellers turn freely and do not scrape the tunnel or thruster seal housing?

- connect the bell housing to the vessel's corrosion protection system?

- use recommended sizes for motor power and system control wire?

- insure that thruster batteries are recommended size?

- fill the gear oil header tank half full with Chevron Delo SAE 80-90 gear oil?

Section 7 - Operation

Preliminary check:

- Insure that all mechanical components are properly mounted.
- Check that electrical connections are properly routed and properly tightened.
- Carefully check that there are no persons near the thruster motor, and no swimmers near the tunnel.
- Turn ON the battery power switch for the thruster system.

Initial Operation:

1) Enable the thruster by pushing "START" at any thruster control station switch. The "STATION ENABLED" lamp will illuminate to indicate that the system is ready for operation.

2) Test for correct thrust direction at the main helm station by briefly throwing the jog switch or jog lever in alternated directions. If thrust direction is not correct, then swap the "A Coil" and "B Coil" conductors at the Central Control Box.

- If this test is made prior to launch, then jog switch to port should give air flow out of tunnel to stbd side.
- Do not run the thruster for more than 2 to 3 seconds when props are not in water. Motor damage will result.

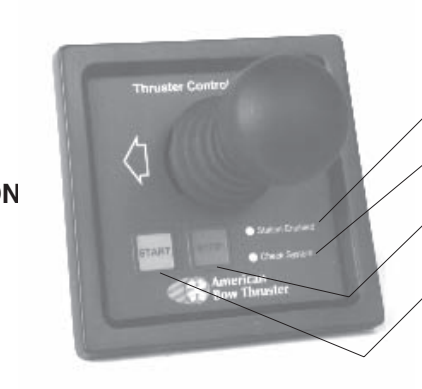
3) Test for correct thrust direction at other installed control stations. Incorrect thrust direction at any accessory station must be corrected at that station by swapping "green" and "brown" wires at the thruster station's wire harness.

4) Press "STOP" at any thruster control station to disable jog levers at all stations.

Normal Operation:

1) Maintain thruster battery charge level.
2) Turn on battery power switch to the thruster system.
3) Press "START" at any thruster control station to enable jog lever action.
4) Deflect jog lever off center as required for thrusting action. Before reversing direction, wait for thruster sound to stop.
5) When thruster use is completed, press "STOP" to disable jog levers at all station.

JOG LEVER STYLE
THRUSTER CONTROL STATION



Thrust Duration:

The continuous run period for a TRAC DC Thruster is very long in relation to typical usage periods for normal docking maneuvers (7.5 hp @ 3.5 minutes; 10 hp @ 3 minutes; 12 hp @ 2.5 minutes). In circumstances where prolonged thrusting is required, a warning alarm will occur at all thruster control stations at an elapsed time that is approximately equivalent to those listed above. If thrusting is completed within 1 minute after the alarm period begins, there should be no damage to motor insulation. Thruster motor cooldown to starting conditions will take around 1.5 hours.

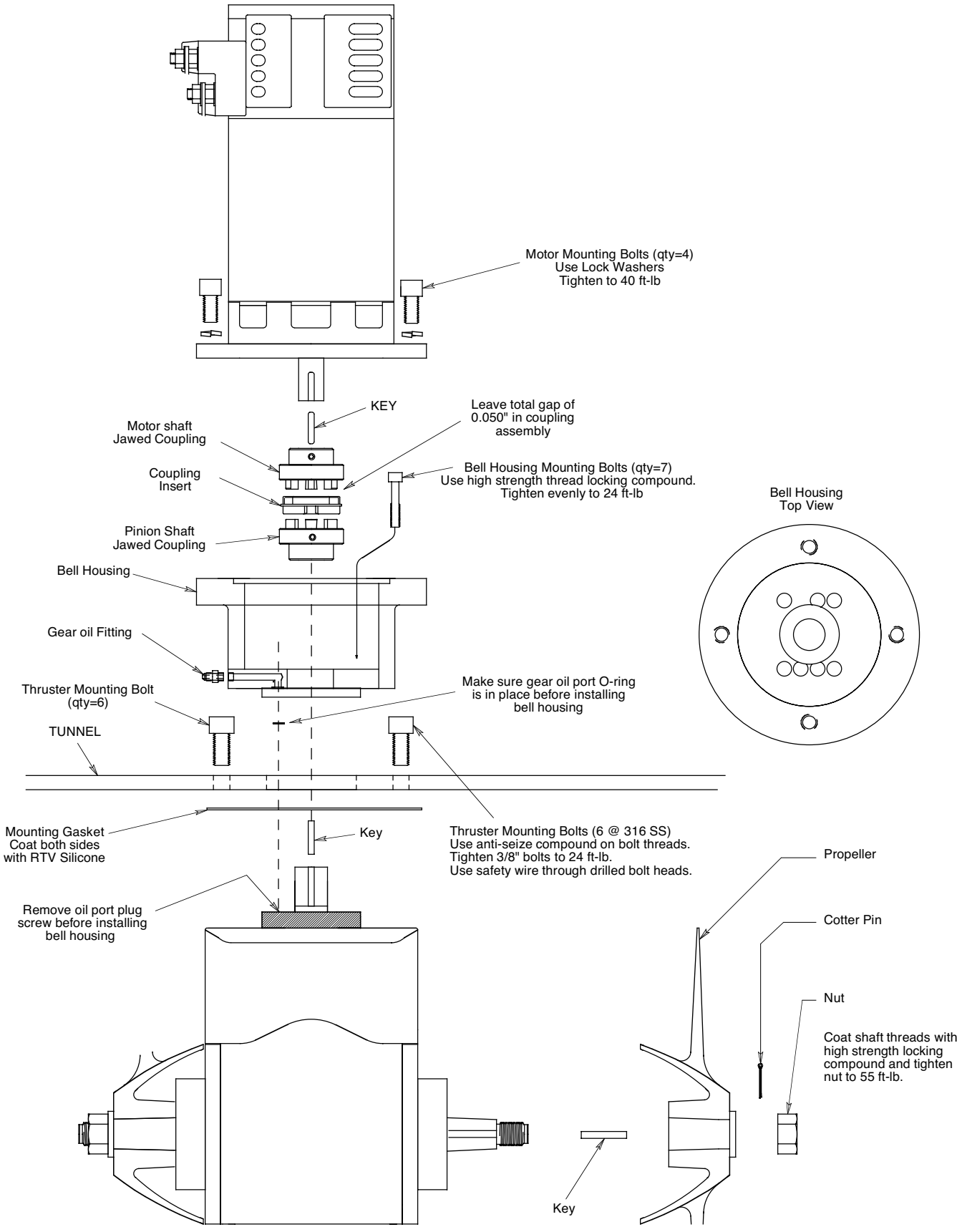
Section 8 - System Drawings

System drawings included in this section are provided for convenient reference. Before using any of these drawings for any installation purpose, the installer must confirm appropriate matching of drawings to the equipment actually provided.

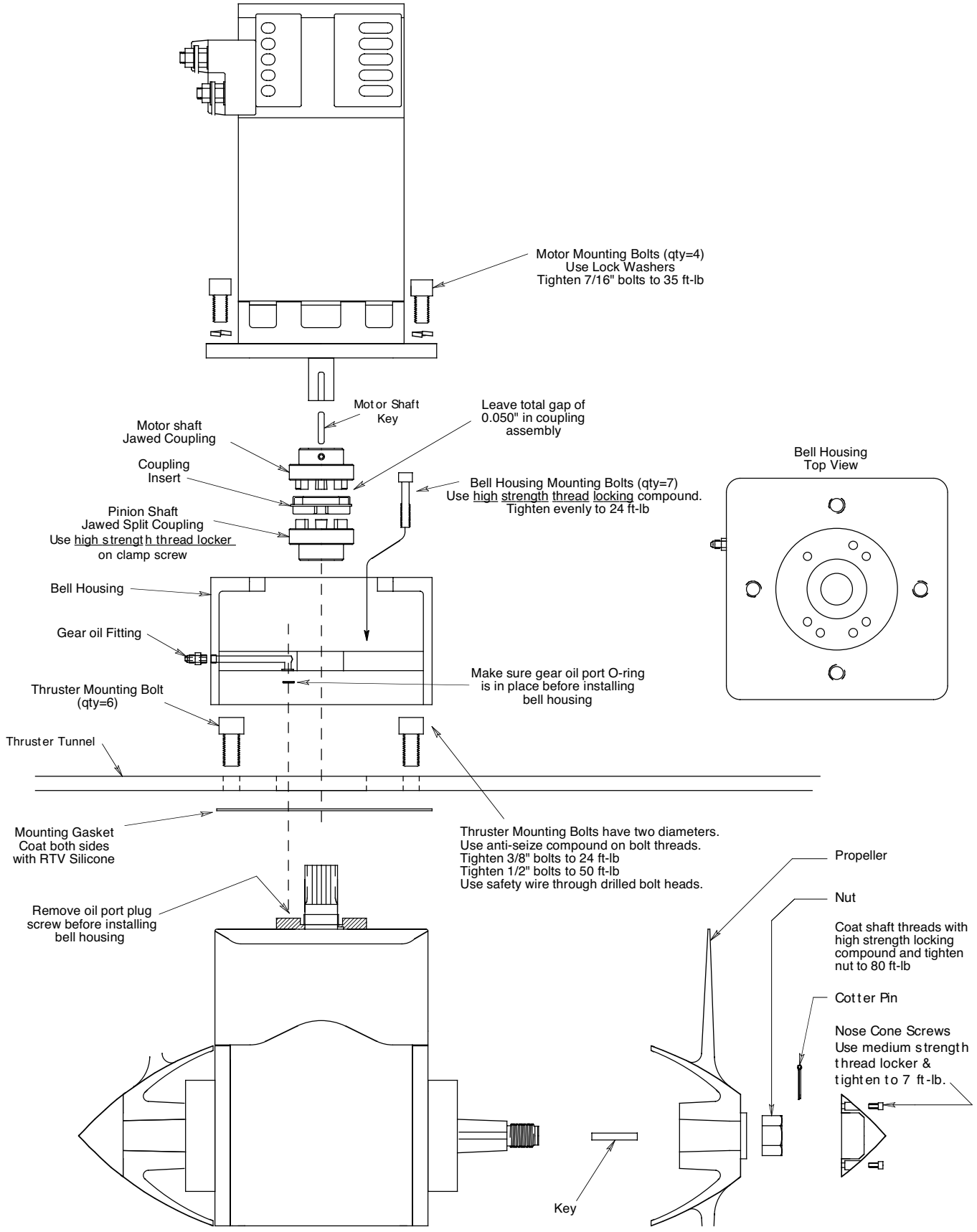
Thruster Assembly Drawings provide important details not found elsewhere in this manual, particularly concerning fastener preparation and fastener seating torque. It is essential that appropriate diagrams be consulted.

Wiring diagram details vary with thruster power, particularly as they pertain to power wire size and to specifications for installer provided accessories.

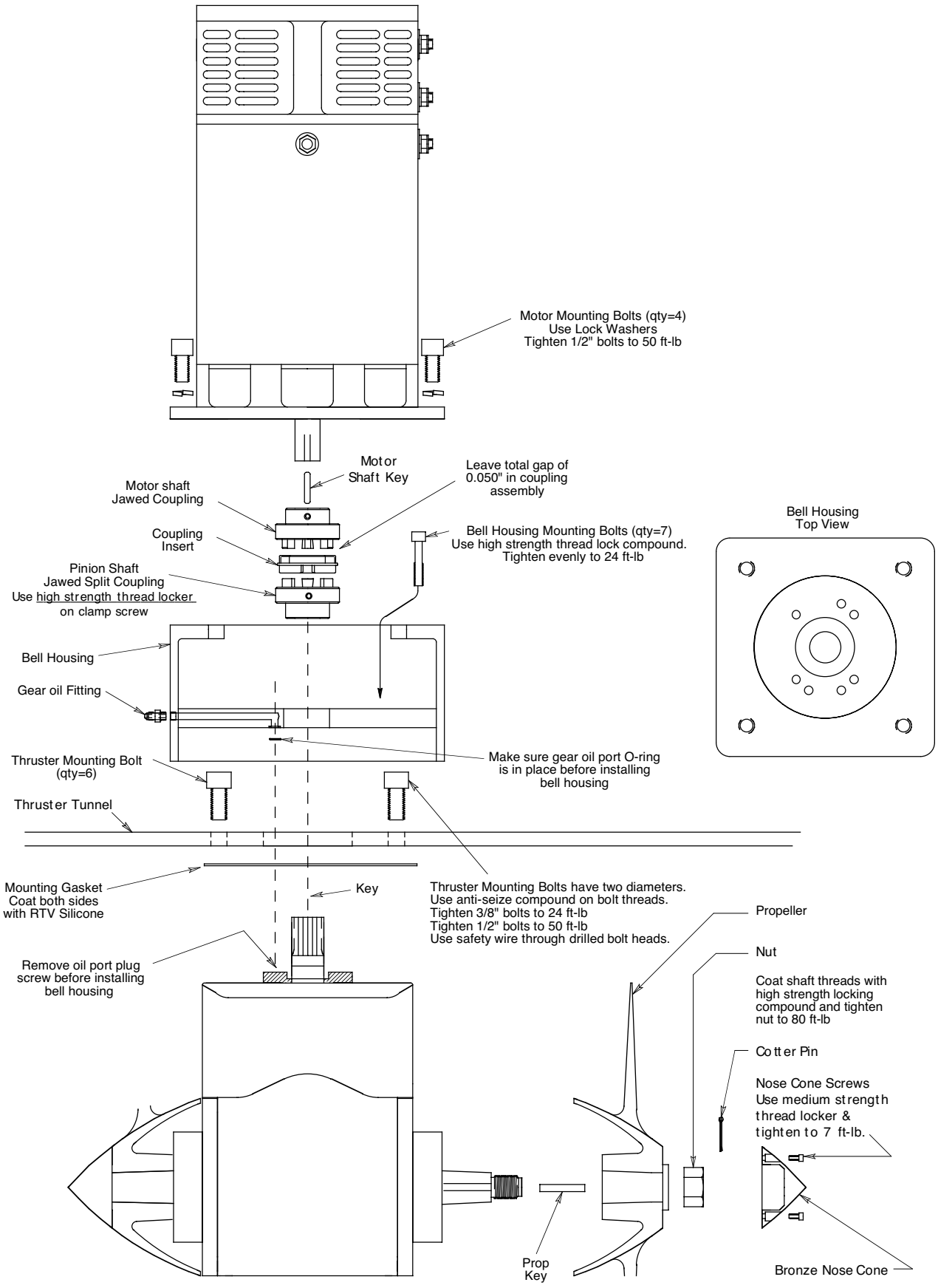
The installer must reference appropriate drawings. Contact American Bow Thruster to resolve any uncertainty.



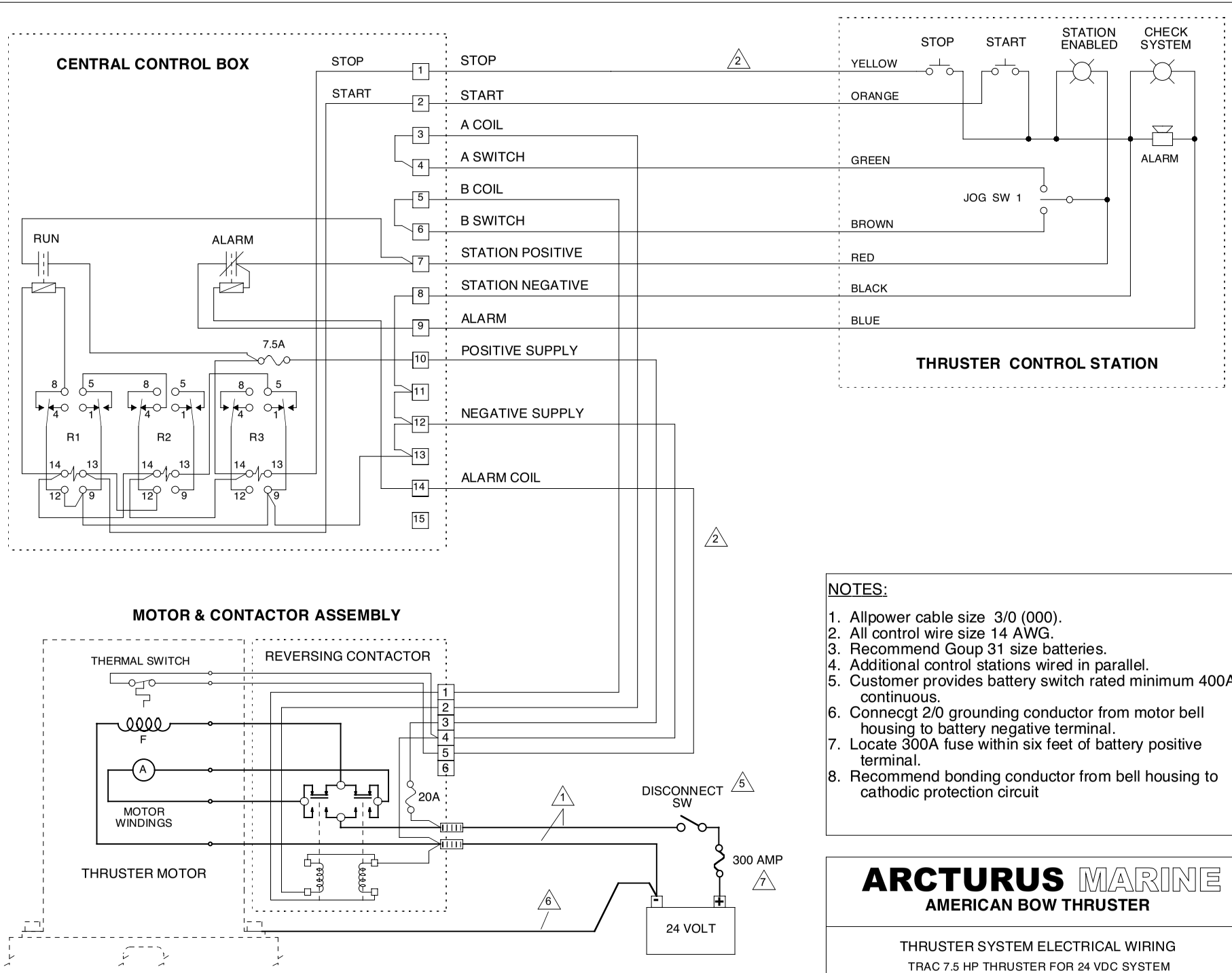
8" TRAC DC
Thruster Assembly Drawing



10" TRAC DC
Thruster Assembly Drawing



12" TRAC DC
Thruster Assembly Drawing



NOTES:

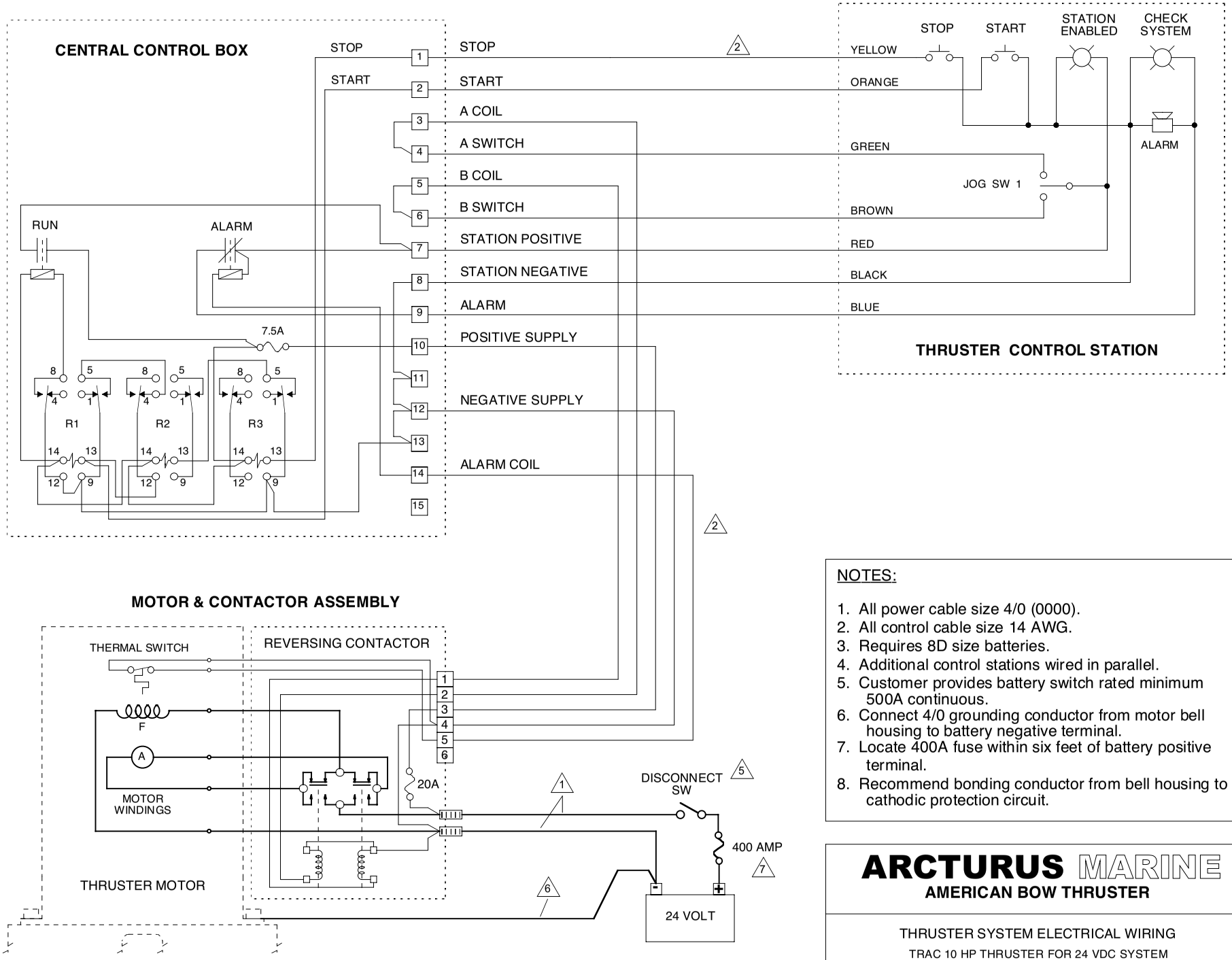
1. Allpower cable size 3/0 (000).
2. All control wire size 14 AWG.
3. Recommend Goup 31 size batteries.
4. Additional control stations wired in parallel.
5. Customer provides battery switch rated minimum 400A continuous.
6. Connecgt 2/0 grounding conductor from motor bell housing to battery negative terminal.
7. Locate 300A fuse within six feet of battery positive terminal.
8. Recommend bonding conductor from bell housing to cathodic protection circuit

ARCTURUS MARINE

AMERICAN BOW THRUSTER

THRUSTER SYSTEM ELECTRICAL WIRING

TRAC 7.5 HP THRUSTER FOR 24 VDC SYSTEM



NOTES:

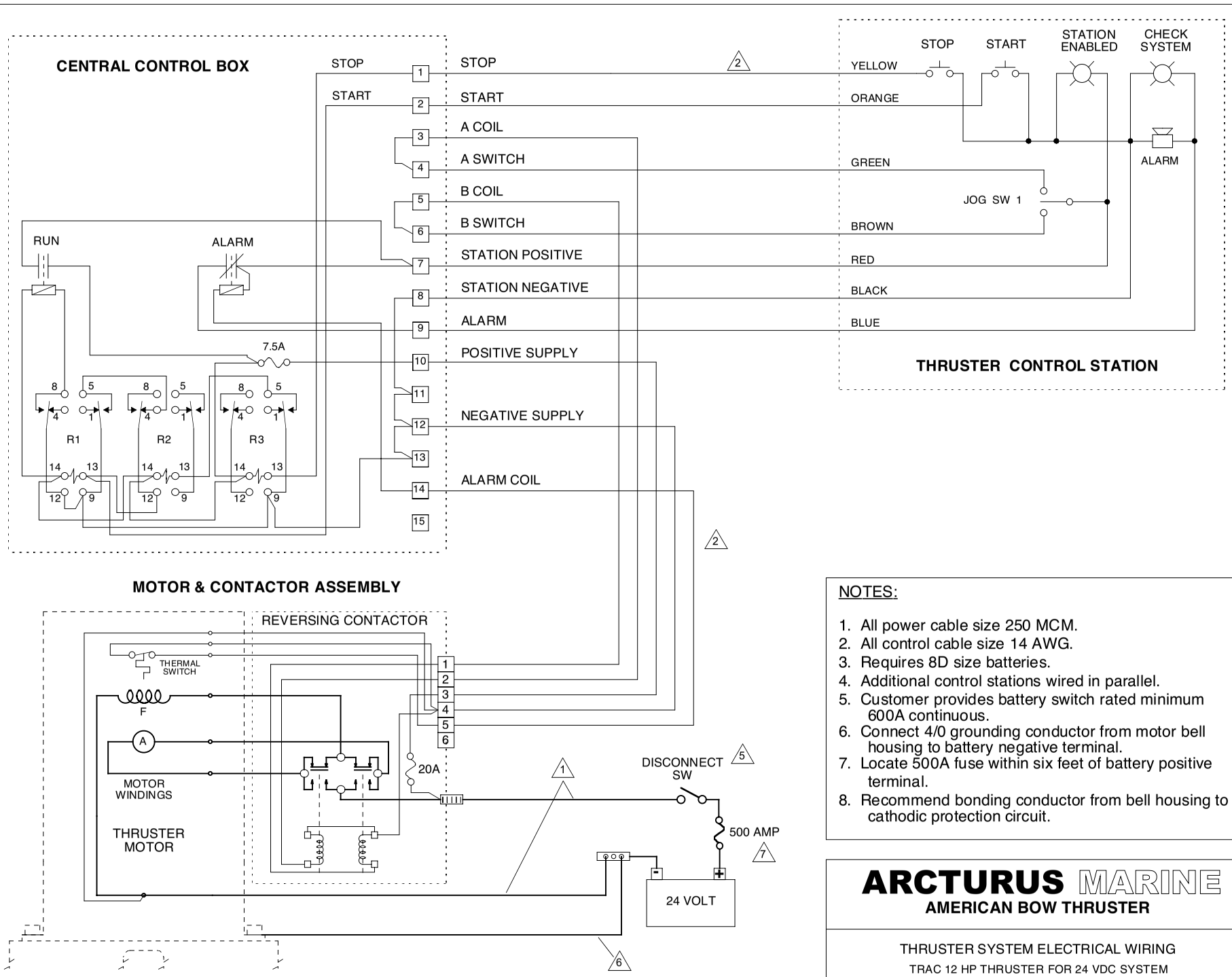
1. All power cable size 4/0 (0000).
2. All control cable size 14 AWG.
3. Requires 8D size batteries.
4. Additional control stations wired in parallel.
5. Customer provides battery switch rated minimum 500A continuous.
6. Connect 4/0 grounding conductor from motor bell housing to battery negative terminal.
7. Locate 400A fuse within six feet of battery positive terminal.
8. Recommend bonding conductor from bell housing to cathodic protection circuit.

ARCTURUS MARINE

AMERICAN BOW THRUSTER

THRUSTER SYSTEM ELECTRICAL WIRING

TRAC 10 HP THRUSTER FOR 24 VDC SYSTEM



NOTES:

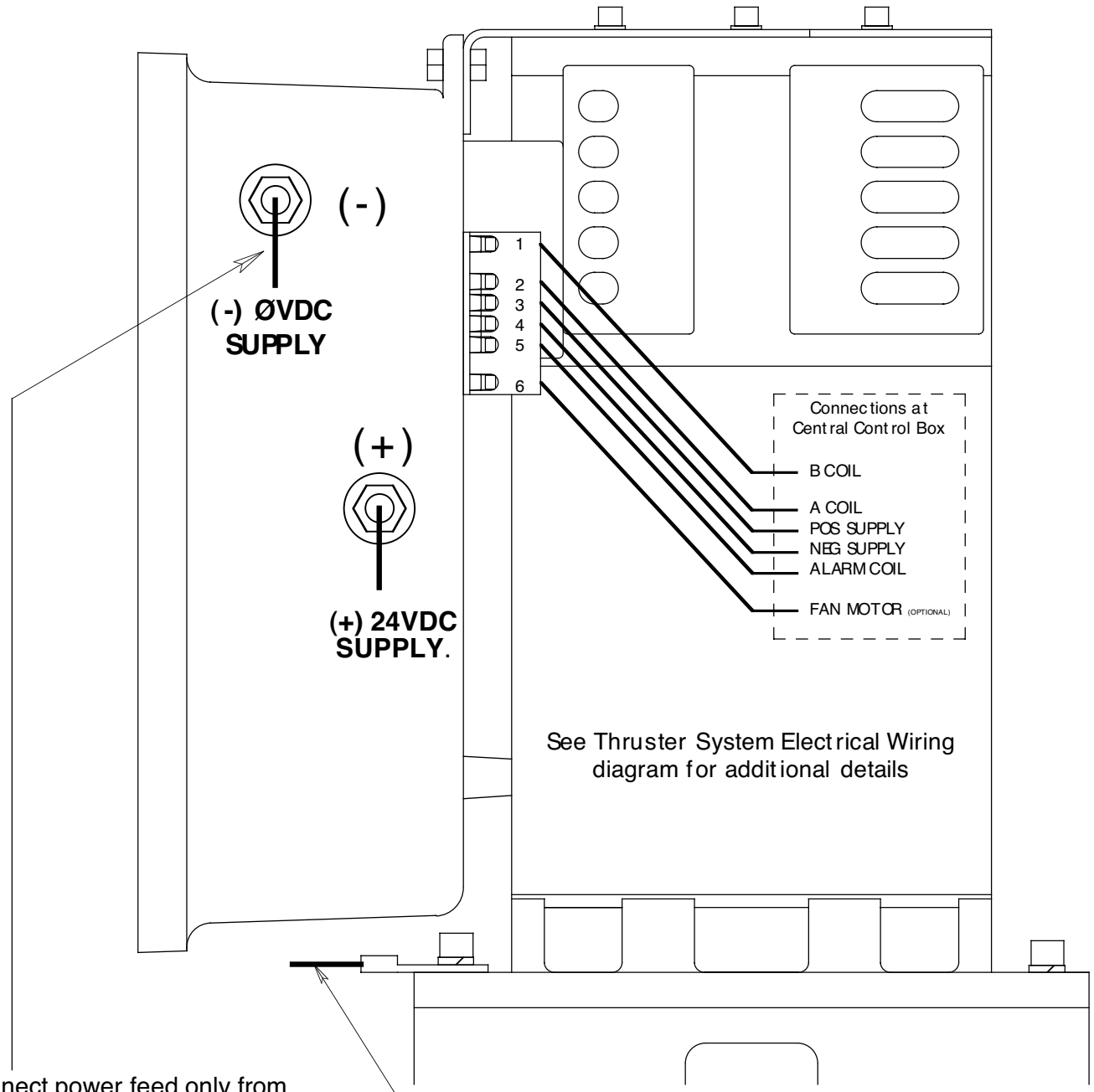
1. All power cable size 250 MCM.
2. All control cable size 14 AWG.
3. Requires 8D size batteries.
4. Additional control stations wired in parallel.
5. Customer provides battery switch rated minimum 600A continuous.
6. Connect 4/0 grounding conductor from motor bell housing to battery negative terminal.
7. Locate 500A fuse within six feet of battery positive terminal.
8. Recommend bonding conductor from bell housing to cathodic protection circuit.

ARCTURUS MARINE

AMERICAN BOW THRUSTER

THRUSTER SYSTEM ELECTRICAL WIRING

TRAC 12 HP THRUSTER FOR 24 VDC SYSTEM



Connect power feed only from 300A fuse located within 6 ft of battery +24v terminal.

Power feed to this terminal must be fitted with a disconnect switch as specified on the system wiring diagram.

Connect motor flange directly to thruster battery negative terminal (0vdc) with minimum size 2/0 (000) cable.

All Power Cable - 3/0 (000) AWG
All Control Wire - Minimum 14 AWG

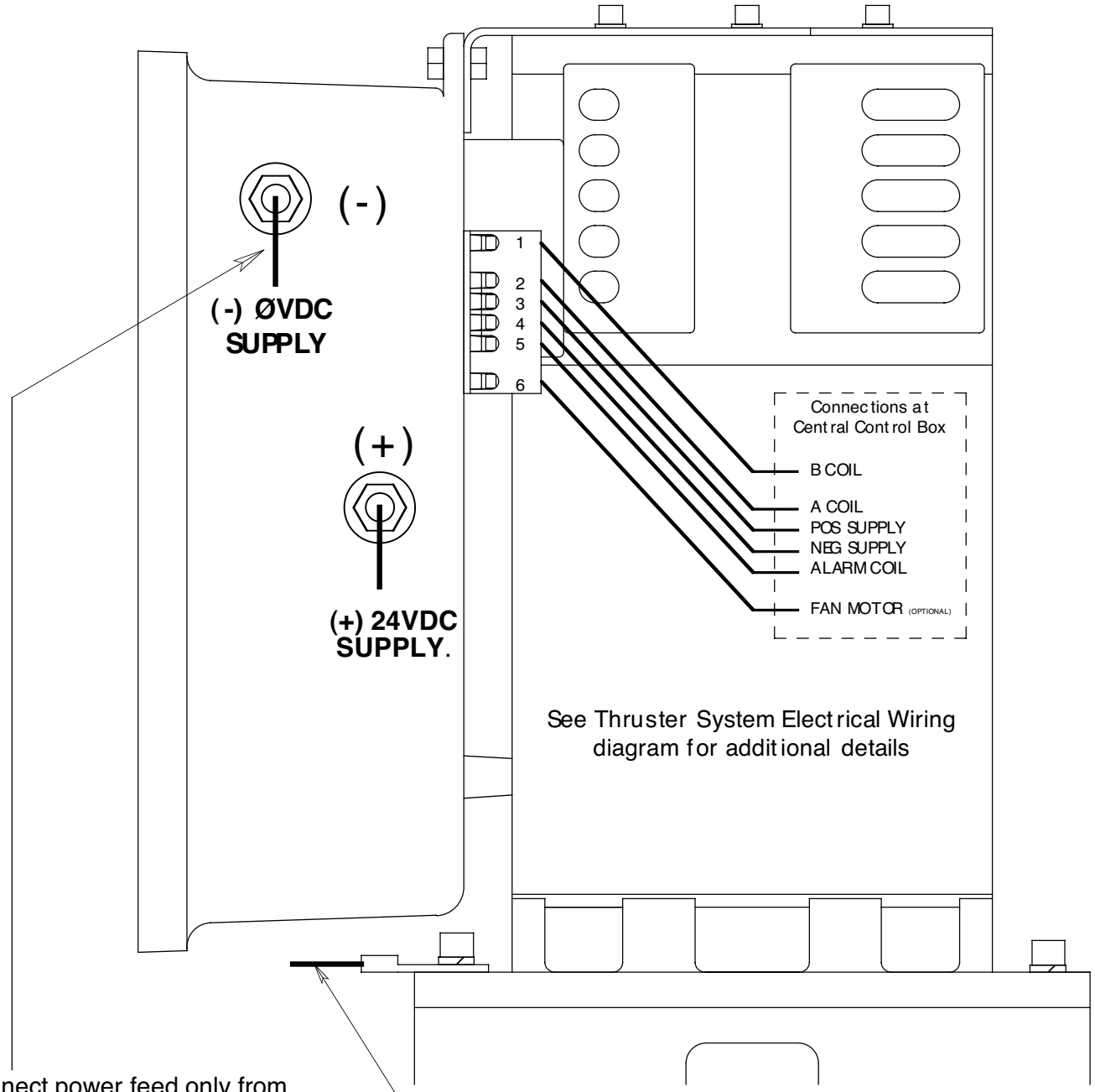
Include thruster in corrosion control system. Connect bonding wire at motor flange when appropriate.

AMERICAN BOW THRUSTER

5.6 kW - 7.5 HP DC TRAC

Reversing Contactor Assembly
Wire Connections

RJP 04/02



Connect power feed only from 400A fuse located within 6 ft of battery +24v terminal.

Power feed to this terminal must be fitted with a disconnect switch as specified on the system wiring diagram.

Connect motor flange directly to thruster battery negative terminal (0vdc) with minimum size 3/0 (000) cable.

All Power Cable - 4/0 (0000) AWG
All Control Wire - Minimum 14 AWG

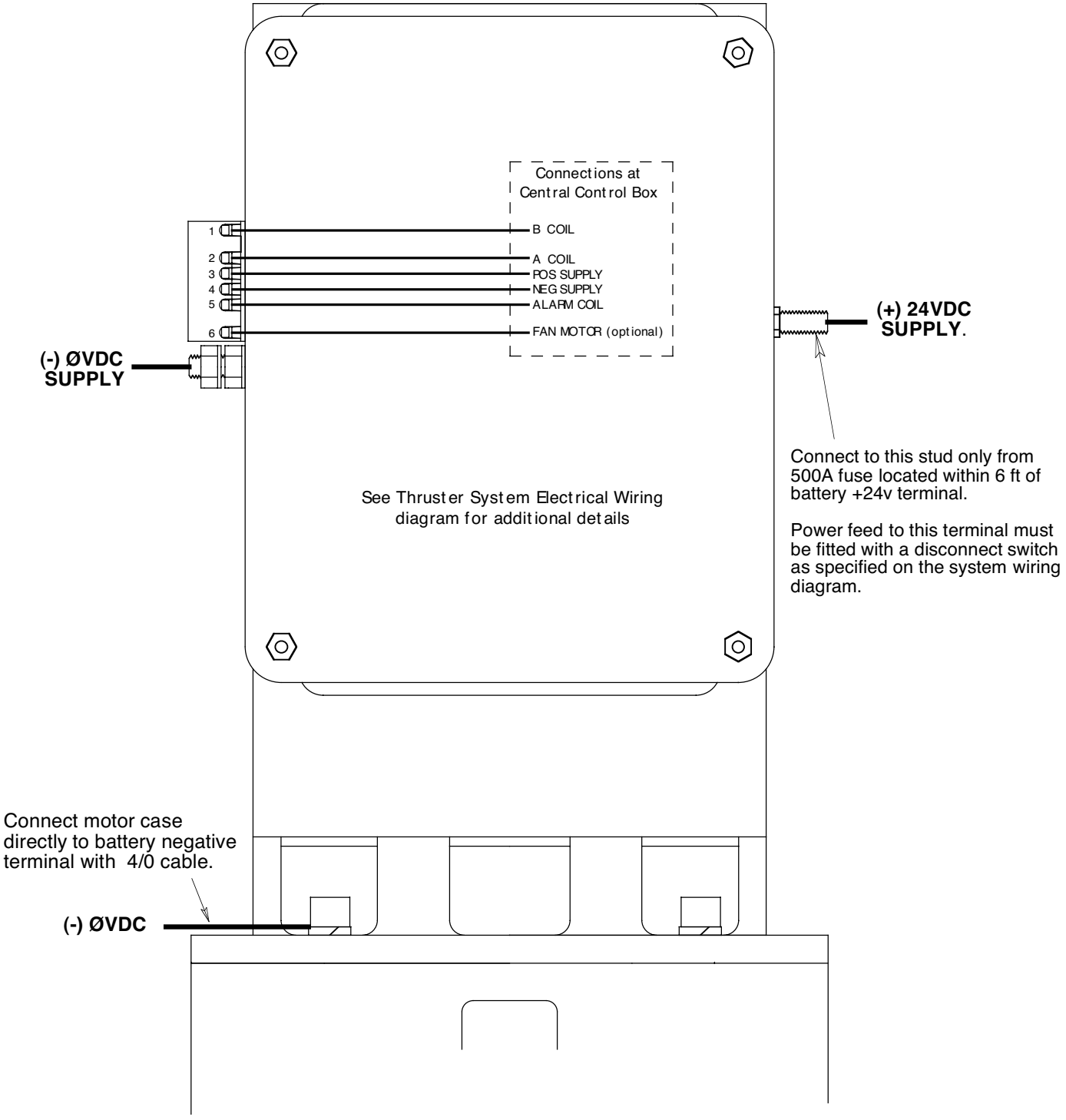
Include thruster in corrosion control system. Connect bonding wire at motor flange when appropriate.

AMERICAN BOW THRUSTER

7.5 kW - 10 HP DC TRAC

Reversing Contactor Assembly
Wire Connections

RJP 04/02



All Power Cable - 250 MCM
All Control Wire - Minimum 14 AWG

Include thruster in corrosion control system.
Connect bonding wire at motor flange when appropriate.

AMERICAN BOW THRUSTER

9.0 kW - 12 HP DC TRAC

Reversing Contactor Assembly
Wire Connections

RJP 04/02