Damage Control and Basic Repairs

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Constructive feedback and suggestions for improvements to the SAR Training Matrix is appreciated. Please email feedback / suggestions to sartrainingfeedback@coastguard.co.nz providing as much detail as possible. Thank you

The CRV skipper is responsible for the safety of the CRV crew and the safe navigation of the CRV. The need for damage control measures to be implemented on CRV systems is less likely to arise if the CRV is navigated safely and well maintained.
Overview

The CRV skipper is responsible for the safety of the CRV crew and the safe navigation of the CRV. The need for damage control measures to be implemented on CRV systems is less likely to arise if the CRV is navigated safely and well maintained. The overarching purpose of any damage control measures or repairs should be to preserve life, minimize further damage to the CRV and get to a safe haven.

The CRV SSM system, crew training plan and crew culture provide the first line of defence against these factors through their preventative nature.

1. Preventative Actions

Fire, collision, grounding, heavy weather, corrosion, UV damage to pontoons or sponsons and general wear and tear are all factors that can contribute to a sudden reduction in the seaworthiness of a vessel. However, the unit can mitigate many of these risks before the vessel is even launched. Some of the key preventative actions a Coastguard Unit can take include:

- effective crew training
- regular MOSS (SSM) drills
- navigation using CRM best practice
- documented risk management tools to assess mission safety
- utilization of pre-launch and post-retrieval checklists
- adhering to a vessel maintenance schedule
- a robust documented system for recording and remediying faults
- regular fire and safety equipment checks
- a clean, tidy working environment on the CRV
- a culture of respect for unit property

Once underway the CRV crew should be aware of and report any unusual noises, vibrations, smells, flickering or dimming lights, loss of propulsion, power, or steering. Anything out of the ordinary should be investigated, as this could be an indicator of a potential fault. Possible faults should be recorded in the vessel’s log or dedicated maintenance log and reported to the relevant Unit Officer.

1.1 The CRV

In the event of damage occurring, the CRV should carry some equipment that is intended to be used to control damage. The equipment carried may be required by MOSS (SSM) or is sensible to carry for the purpose of preserving life at sea. The CRV crew...
should be trained where to find this equipment on board, how to safely operate the equipment in working together to respond to a variety of damage control situations.

As well as equipment to deal with fire and hull damage, the CRV will carry some tools and equipment to effect minor repairs. Each CRV will have a limit to the repairs that can feasibly be carried out at sea. Many propulsions systems are subject to agreements effected at the time of sale which limit who may carry out repairs. The available space on the CRV to stow spare parts and tools will constrain the extent of repairs that can be done. The size and handling characteristics of the CRV in any given conditions will also influence its suitability as platform on which to safely and effectively carry out repairs whilst underway.

The CRV skipper is responsible for the safety of the CRV crew and the safe navigation of the CRV. The over-arching purpose of any damage control measures or repairs should be to preserve life, minimize further damage to the CRV and get to a safe haven.

1.2. Other vessels
A decision to attempt repairs on another vessel should be very carefully considered bearing in mind that the primary objective of search and rescue is to preserve life, not property.

From time to time repairs to property may be among the actions carried out to preserve life in an emergency situation. Effecting minor emergency repairs at sea may allow a vessel in distress to resume a passage under its own power rather than being towed by the CRV.

However, often attempting the repair of another vessel is not practical or desirable. If the crew of the vessel in distress are not able to utilize their own tools and spares to carry out repairs, and unless the repair is very obvious and simple, it would normally be best left for a professional. Any spares and tools that are required to be carried on the CRV under MOSS (SSM) are not primarily intended to be removed to another vessel. In many cases

“In order to accomplish the goal of assisting people in distress the team and the vessel must be fit and prepared. If something goes wrong the team must be ready to respond with or without direction. This is why we practice. A rescue vessel can never be too prepared. Caring for a vessel is usually twice as much commitment as originally expected, and the care of a rescue vessel is double that.”

Canadian Coast Guard Auxiliary Search & Rescue Crew Manual P. 51
attempting a repair may invalidate the owner’s warranty. It is not in the interests of the CRV crew or Coastguard for the organization to be in a situation where they could be held liable for damage to a vessel.

The skipper of the vessel in distress is responsible for the safety of their crew vessel. If a repair is to be attempted the skipper of the CRV must gain the express permission of the vessel’s skipper.

2. Damage Control

Damage control as the name would suggest is essentially about ensuring that any damage or failure is contained, and at the very least not allowed to get any worse. Damage control is normally an operation to combat fire, water ingress and / or structural failure.

2.1 Fire Fighting

Fire is one of the most potentially dangerous emergencies to be encountered at sea. It is also an emergency that requires quick action to contain or eliminate the emergency. Crew training should include fire drills aboard the vessel as described in the unit MOSS (SSM) Manual, so that the actions required for preventing, containing, and extinguishing a fire have been thoroughly rehearsed.

Fire needs three components:

- Fuel to vaporise and burn.
- Oxygen to combine with the fuel.
- Heat to raise the temperature of the fuel vapour to ignition point.

If any one of these components is missing, then a fire will not start. Remove any one of these components and the fire is extinguished.

Removing the Fuel

- Turn off the supply – gas, petrol, or diesel.
- Physically remove nearby materials that may combust.
Removing the Oxygen
- Fire blanket.
- Smothering agents – i.e. foam and CO2.
- Close down hatches and vents.

Removing the Heat
- Cool - i.e. use water.
- Turn off electrical supply.

2.2 Basic Generic Safety Rules
- Upon discovery of a fire, call out and sound the alarm to summon help.
- Never pass the fire to get an extinguisher.
- If you enter a compartment to fight a fire, keep an escape path open.
- Never let the fire get between you and the escape path.
- Always keep as low down as possible to prevent inhaling fumes.
- If you fail to extinguish a fire with a portable fire extinguisher in a compartment get out immediately and close the door or hatch to confine the fire.

Procedure for fighting fire can be remembered as FIRE.

Find (location and size of fire)
Inform (raise alarm to skipper, make distress call)
Restrict (remove air supply, shut off fuel supply, manoeuvre vessel to minimise wind effect)
Extinguish (use appropriate fire extinguisher, set up watch in case fire starts again, if unable to control abandon vessel).

2.3 Standard Fire Fighting Procedures
The procedure for fire fighting on the CRV is detailed in the Unit MOSS (SSM) Manual. This procedure should have been developed with the crew and reflects ‘best’ practice for the unit CRV. It may detail specific roles and responsibilities of crew following the initial fire alarm. Below are some key points to consider in the development of the unit CRV response to fire as outlined in the MOSS (SSM) manual.
Alarm
- The crew member that discovers the fire, or an indication of fire, must raise the alarm and give the location.

Reaction
- With a fire forward turn stern to wind if possible.
- With a fire aft turn head to wind if possible.
- If practical - anchoring or using a sea anchor may be a viable option.
- Make a distress call

Assessment
- What is burning & where?
- How advanced is the fire?
- Can its spread be prevented?
- What type of extinguishing agent is suitable for the type of fire?
- Are vulnerable areas of the boat able to be secured or isolated? For example electrical circuits, engine and fuel supply, air intakes doors or hatches.

Combating the Fire
Having expediently assessed the fire, an attack should be started immediately to gain control and to prevent or minimise the fire spreading. The attack will be either direct or indirect depending on the fire’s situation.

- Direct: If the fire is small and has not gained headway crew can use an appropriate extinguisher(s) directly onto the fire.
- Indirect: The success of an indirect attack depends on complete containment of the fire. All possible avenues allowing the fire to spread must be cut off by closing doors, hatches, and securing all ventilation systems.

Overhauling the Fire
Once the obvious signs of fire are extinguished, a careful examination of the vessel must take place to ensure that the fire is completely extinguished. One crew member should be assigned to do nothing but check for re-ignition.
Final Assessment

- Crew should now conduct a check of the vessel, and ‘tidy up’ as much as possible.
- Any necessary de-watering operations should be started.
- Re-stow all fire-fighting equipment.
- Portable fire extinguishers, whether partially or fully discharged, should be put aside and replaced as soon as possible upon arrival back at Unit.
- Complete all necessary Unit and Maritime NZ paperwork.

The lack of ‘containment areas’ on most CRV’s and the speed at which fire can spread, mean that if a direct attack with available extinguishers is not successful the crew will have to abandon ship.

Every crew member of a CRV should be fully aware of the contents of the MOSS (SSM) Manual as a reference and training aid regarding the operation of the CRV.

For an example of specifications see http://tinyurl.com/d8u73qw

2.4 Fire Extinguishers
Extinguishers generally affect one or two sides of the fire triangle. They smother the fire to exclude or reduce oxygen, and some also have a cooling effect.

Class D fires involve combustible metals and require special purpose extinguishers. Extinguishers also have pictograms showing which class of fire they are suitable for, and which type of fire they should not be used on.

Know the operating limits of your fire extinguisher – check with the manufacturer to determine how long it will take to discharge a ‘full’ extinguisher. A 4.5kg ABE dry powder will discharge in 20 seconds. A 9 litre foam extinguisher will discharge in 48 seconds.

The three most common types of extinguisher carried on small vessels are:
- Foam
- Dry powder
- CO₂
Dry Powder
Aimed at the base of the fire, and applied with a sweeping motion. The powder is dangerous if inhaled therefore due care should be taken operating the extinguisher particularly in a confined space.

Foam
Foam is used in the same way as dry powder for Class A fires, but needs a different method of application for Class B fires. Applied directly onto a burning liquid the force of the extinguisher may spread the liquid and hence the fire. The foam needs to be allowed to spread over the surface of the burning liquid. This can be done either by aiming the foam at an adjacent vertical surface and allowing it to drop down the surface and spread out. Alternatively the foam is aimed in an arc to fall vertically down onto the burning liquid.

<table>
<thead>
<tr>
<th>Extinguisher Type</th>
<th>A Wood Paper &amp; Plastics</th>
<th>B Flammable Liquids</th>
<th>C Flammable Gases</th>
<th>E Energised Electrical Equipment</th>
<th>F Cooking Oils &amp; Fats</th>
<th>LIMITED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Powder ABE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Carbon Dioxide (CO₂)</td>
<td>LIMITED</td>
<td>LIMITED</td>
<td>N</td>
<td>Y</td>
<td>LIMITED</td>
<td></td>
</tr>
<tr>
<td>Water</td>
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<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
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<tr>
<td>Foam</td>
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<td>Y</td>
<td>N</td>
<td>N</td>
<td></td>
<td>LIMITED</td>
</tr>
<tr>
<td>Wet Chemical</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Fire Blanket</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td></td>
<td>LIMITED</td>
</tr>
<tr>
<td>Fire Hose Reel</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td></td>
</tr>
</tbody>
</table>
Carbon dioxide (CO₂)

CO₂ is applied to the base of fire with a sweeping motion for a spill fire, or applied downwards at the centre of a confined fire. The effective range for a portable CO₂ extinguisher is about 1.5m. Care should be exercised when using CO₂ extinguishers, the cylinder can get extremely cold – enough to induce cold burns. The extinguisher should only be held by the trigger handle and at the end of the hose, not the cone. The cones usually found on the end of a CO₂ extinguisher’s hose have occasionally been found to blow off when the extinguisher is activated.

Water

Water is not usually carried on board a CRV in an extinguisher – but is more likely to be used in conjunction with a salvage / fire pump or bucket. Sea-water is the most readily available and most effective extinguishing agents for Class A fires.

Large amounts of water can seriously affect the stability of a vessel – 1000 litres being roughly equivalent to 1 Tonne. There have been numerous cases of vessels that have capsized and sunk because excessive amounts of water were used in fire fighting.

Water is primarily a cooling agent; it absorbs heat and cools the burning material. The effectiveness of water as a cooling agent can be greatly increased if it is delivered in a spray. The increase in surface area when the water is in droplets greatly increases its ability to absorb heat, and as a ‘water wall’ affords protection to the fire fighters from flames, heat, and smoke. Alternatively when delivered as a jet, the fire can be fought from a greater distance than any hand held extinguisher.

3. Water Ingress

Vessels taking on water usually have one of three problems:

- The hull itself or fittings such as rudder stock or propeller shaft have been damaged in a collision / grounding, or the vessel has suffered a structural failure such as a plank working loose on a wooden vessel allowing water ingress.
- A seal preventing water ingress (such as a stern gland) or a pipe attached to a skin fitting or sea cock has given way or become detached.
- The plumbing system on the vessel itself has managed to create a siphon, sucking sea water into the vessel (marine toilets are a common cause of this particular problem).
Should a CRV be called to assist a vessel taking on water, having arrived on scene, the first priority is to take action to preserve life and if necessary transfer the crew of the distressed vessel to the CRV.

After all crew are accounted for and safe, it may be appropriate to establish where the water is entering the vessel from and take steps to stem the flow, isolate the flooded compartment and/or use the salvage pump to remove water. A crew member should standby any lines made fast to a vessel that may subsequently sink due to water ingress and be prepared to cut the CRV free.

3.1. Salvage / Fire Pumps

Operation

- Secure the pump on the CRV.
- Prime the pump.
- Transfer the suction hose into the water-filled compartment
- Start the pump, ensuring that the outlet clearly discharges overboard.
- Take care to keep the suction from getting blocked by loose plastic bags or rags.
- Monitor fuel level.

If the source of the water ingress is accessible from inside the vessel, then stuff rags, clothing or other suitable material into the hole to reduce the flow, or turn off the relevant sea cock in order to reduce the flow to the point where the pumps can cope. Pumps can

Waiheke Rescue was out on the water at 6.45am on Saturday morning helping four fishermen in the water off Calypso Bay less than 24 hours after helping in the search for a 13-year-old boy after the boat he was in capsized in rough water near Ponui Island.

Salvage pumps were used to empty the vessel.

See http://tinyurl.com/muks8qq
and do fail or get blocked, so if every pump employed is only just containing the water ingress, you should be looking for ways to reduce the ingress still further if possible.

3.2 Fothering (collision mat)
The source of the water ingress may not be easily accessible from the interior of the vessel, in which case fothering may be an option. Fothering is when a sail, tarpaulin or similar is positioned over the hole and held in place on the outside of the hull. The water pressure will push the material used into the hole and reduce the flow.

Positioning the fothering / collision mat can be tricky, and any lines attached to the mat usually need to be weighted so they will drop under the vessel’s hull. A triangular shaped mat is usually relatively easy to position and secure. Any movement through the water will probably displace the fothering / collision mat, however it may buy valuable time in which to come up with a more permanent fix.

3.3 Heel & Trim
Deliberately heeling or trimming the distressed vessel is also a tactic that can be employed. This may raise the hole out of the water, or at least get it closer to the surface to reduce water pressure, and hence the flow.

3.4 Tingles (patches)
A small hole in a wooden or fibreglass hull can be repaired with what is traditionally called a tingle. A tingle consists of a patch of soft metal or wood, tacked or screwed onto the hull from the outside often with a cloth gasket of the same size between it and the hull. In an emergency a patch of any suitable material may be fashioned and secured (inside or outside the hull) from what is available – for example a plastic sheet / bag held in place with duct tape.

4. Beaching
Beaching is a deliberate attempt to put a vessel ashore. Such a manoeuvre may be necessary if a boat has suffered serious damage, or is taking in water and is in danger of sinking. The nature of the situation may not allow a particularly wide choice of suitable sites, or much opportunity to spend time in selection. The ideal beach for the purpose should be of sand, mud or light shingle. It should have a gentle slope and be free of off-lying rocks, boulders, surf, and cross-currents. A windward shore is almost always preferable to a lee shore.

“To raise the alarm, the skipper alerted Police by dialling 111 and then put out a mayday call. The vessel had struck rocks and was taking on water, and the skipper made the decision to run the vessel onto Ruapuke Island (which is near Stewart Island). “

Twenty six rescued after Torea grounding.

Safe Clean Seas Issue 42, December 2012
4.1 Bow or Stern First
The advantages and disadvantages of a bow or stern first entry onto a beach should be considered before any attempt is made to beach a vessel. Beaching the boat bow first will reduce the chance of damage to the propeller / drive system and rudder(s). Beaching stern-first leaves the bow seawards. This part of the boat is better shaped to ride any waves and surf as the manoeuvre is carried out. For outboard-powered craft, raising the engine(s) will reduce the chance of damage.

4.2 Control Speed and Broach
When the wind and waves are blowing onto the beach, the vessel will try to broach in the surf or as it runs aground. The approach to the beach must be made at a speed slightly slower than the incoming waves. If this is not possible by reducing the vessel’s motive power, a drogue can be used to reduce speed. An anchor will prevent the vessel broaching once it runs aground.

- The anchor is deployed from either the bow or stern depending on how the approach is made.
- Adjusting the tension on the anchor rode and allowing it to drag if necessary will control the boat’s speed, prevent it from surfing uncontrollably and, by keeping it end-on to the waves, will help prevent broaching as it approaches the beach.
- At a suitable distance from the beach the anchor is allowed to dig in and the anchor rode surged to control the vessel’s speed and direction.

It is primarily the responsibility of the Skipper of the distressed vessel to contact MNZ or the Harbour Authority.
If conditions on the chosen beach are such that there is a significant risk of injury to persons on board when beaching, it would be better to let the vessel beach unmanned.

4.3 Securing on Landing

The moment of greatest danger to the beaching vessel is when the vessel first touches the beach, especially when there is an undertow running, as it could easily swing around to lie broadside to the waves and subsequently be rolled up the beach. To minimise this risk;

- On touching the bottom all aboard should jump over the side, and the boat should be manhandled quickly as far up the beach as possible (if the size of the boat permits).
- A larger boat should be quickly secured in position. If possible, lines should be run from the bow and quarter up the beach and secured ashore to brace the boat.
- Secure them to any suitable object; rocks, piles, trees, or posts driven into the sand.
- The anchor if used should be left to seaward; this will help hold the boat in position and may be useful later when trying to refloat.

Any vessel that has been beached comes under the authority of MNZ or the Local / Regional Harbour Master depending on the location. The relevant authority must be informed as they have responsibility for any subsequent pollution control.
5. Troubleshooting and Basic Repairs

5.1 Propulsion Systems

It is not expected that crew be able to identify or fix an engine fault, however they should be able to recognize when something is potentially wrong.

There can be many causes for engine failure, and many of the causes will not be something that can be rectified at sea. Sometimes however fixing the problem can be a very simple and quick ‘repair’.

The following is a list of the possible simple causes for a particular engine problem, and the sort of repairs that coastguard crew might be able to carry out on their own CRV, or assist another vessel with.

The failure of an outboard motor could be caused by a faulty starter motor, fuel pump, or faulty ignition switch / coil. These are not things to fix at sea. There could equally be some very simple reasons for the problem such as;

Outboard Motor – will not start
- Fuel tank empty.
- Fuel tank vent closed or restricted.
- Engine stop engaged or faulty.
- Fuel supply hose incorrectly fitted.
- Fuel supply hose crushed or kinked.
- Fuel supply hose has small hole / puncture.
- Fuel filter clogged.
- Spark plugs fouled.
- Spark plug leads interchanged.
- Battery undercharged (electric start).

Outboard Motor – starts, runs for a while then stops
- Fuel tank empty.
- Fuel tank vent closed or restricted.
- Engine stop engaged
- Fuel supply hose incorrectly fitted.
- Fuel supply hose crushed or kinked.
- Choke still on

Inboard Motor – will not start
- Flat battery or poor connections between battery and engine (engine won’t turn).
- Fuel tank empty.
- Fuel tank valve closed.
- Engine stop engaged.
- Air filter clogged (filter will need to be changed).
- Fuel filter clogged (filter will need to be changed).

Activity:
Troubleshooting

Rather than list all the possible faults for the engines – divide the crew into four groups.

Have them list as many reasons for the following problems. Use their answers as the basis for running through the faults.

If time discuss what remedies can be used.

- Group 1 – Outboard motor not starting.
- Group 2 – Outboard motor runs then stops
- Group 3 - inboard motor will not start
- Group 4 – inboard motor overheats

What are the key safety points to consider when working around engines?
• Air in the system (evidence of any leaks in the fuel system would indicate this possibility).

Both of the last two problems will entail bleeding the system to remove any air. As with any other repair, this is a procedure that should only be followed if the Coastguard crew involved are suitably qualified and have the relevant experience and skills to do so.

**Inboard Motor – overheat**

• Air filter clogged (filter will need to be changed).
• Raw water filter clogged.
• Raw water sea cock shut or partially closed.
• Raw water pump impellor damaged.
• Raw water pump belt drive broken or loose.
• Engine oil / gearbox oil levels low.
• Coolant level low.

If working on a fuel system keep a fire extinguisher handy. Do not start a motor if petrol fumes are present – ventilate the area thoroughly. Be extremely careful when checking fuel lines on a hot engine, especially around the carburettor – allow the engine to cool before working on the fuel system.

5.2 Steering Systems

If a vessel’s steering system is inoperable there may be alternative methods of steering that can be employed. CRV crew should all be trained and up to date with the MOSS (SSM) drill for steering failure on the CRV as per the procedure in the Unit MOSS (SSM) Manual.

In a twin engine vessel varying the RPM of the individual engines can be an effective method of steering the vessel.

On small vessels an oar / paddle lashed to the stern of the vessel can make an effective makeshift rudder. It will need to be well secured as the forward motion of the vessel will naturally try to lift...
the ‘rudder’ upwards, but while secured allow enough lateral movement to be effective for steering.

A small jet vessel can be steered by attaching a manual tiller and/or manually adjusting the bucket.

For a vessel with working outboard motor(s) but broken steering system, lashing an oar or paddle, boat hook or similar to the outboard motor, can give enough leverage to become tiller and hence an alternative steering method.

With larger vessels where an oar or similar will not be sufficient, rigging an effective alternative steering method can be a difficult, complex, and time consuming problem. Essentially what is required is sufficient drag to be employed on either side of the vessel to steer in a particular direction. Often the only sensible solution is to arrange for a tow unless the vessel has available a powerful winch or winches to help with the steering (as in the case with many sailing yachts).

5.3 Mechanical Systems
Many steering systems use mechanical linkages of wire, cable, chain or steel rod to transfer the motion of the vessel’s wheel to its rudder or drive unit. An actual breakage in any of these component parts is not something which a Coastguard crew are likely to be able to repair even temporarily.

What can sometimes happen is a simple disconnection of part of the steering system such as a nut & bolt that has worked loose. Many systems employing wire as a component part have rigging screws to tighten the wire. These can work loose allowing the wire to drop out of any pulley they are normally held in. These sorts of problems can often be repaired quickly and easily. Checking over the system for any obvious problems can be worthwhile if the alternative is a lengthy tow.

5.4 Hydraulic Systems
A complete failure of a hydraulic steering system such as a ruptured pipe or fractured fitting is unlikely to be repairable unless adequate spares and sufficient replacement fluid are available.

Often hydraulic systems can suffer small leaks from corroded or even loose fittings (such as bleed screws) and these problems can be repaired - especially if it is as simple as tightening a loose fitting.

Duct tape or similar may reduce a hydraulic leak temporarily, but is unlikely to completely stop the loss of fluid. Any fluid however will suffice as a replacement in an emergency (oil or water). Fresh water preferably as salt water is corrosive, however once safely home, a full system flush, and replacement hydraulic fluid will be required.
Most small boat hydraulic steering systems have a hydraulic reservoir, filler cap, and vent at or near the steering wheel which can be filled with a replacement fluid if necessary. Care must be taken to remove all traces of hydraulic fluid from the surrounding area if any is spilled as it can be a slip hazard on the deck.

If steering is ‘crunchy’ or jerky as a result of fluctuating friction in the system then this is indicative of a leak and a low hydraulic fluid level. If it is a little ‘spongy’ this is an indication of air in the system. Bleeding a hydraulic system to fully expel any air in the system may not be something that will be fully successful on another vessel while at sea, but for any Coastguard CRV that has hydraulic steering the crew should able to bleed their own system if necessary.

**Hydraulic System Bleeding Procedure**

- Fill the hydraulic reservoir.
- Fit two lengths of clear plastic tubing to the bleed nipples on the piston cylinder, and place the free ends into containers with a little oil in them. Keep the ends of the tubes immersed in the oil to prevent air being sucked back into the cylinder.
- Turn the wheel slowly one way – oil (and hopefully air) will be vented from the bleed nipple at one end of the cylinder (keep topping up the reservoir). When no more air is vented, tighten the bleed screw, and repeat the process turning the wheel the other way while venting the other end of the cylinder.
- If the steering is still spongy repeat the process.

5.5 Electrical Systems

Care is required when working around high-voltage areas such as the battery. Batteries when being charged produce Hydrogen gas which is highly explosive, and bridging the battery terminals will produce a spark.

If necessary isolate the battery – do not attempt to disconnect the battery, you are just as likely to create a spark removing terminals. If the system has no isolator, cover the terminals with a non-conductive material to prevent arcing which will result if terminals are bridged by conductive materials (metal watch straps and tools can all ‘arc’ on battery terminals).
Start Packs
Jumper leads / start packs must be used with caution if the battery is located near fuel areas. Whether using heavy jumper leads or a Start Pack, the same procedure applies;

- Check for vapours, and ventilate area if possible.
- Check whether it is a 12 or 24 volt system.
- Connect leads to starter motor if possible – positive first.
- Or onto the battery terminals – positive first.
- Disconnect in the reverse order – negative first.

Activity:
Repair tools

- Have the crew record as many tools as possible that are carried on board the CRV
- Rank the top 5 tools / items carried in order of importance.
- Do all the crew agree?
- What are the criteria for most important?
- Are there any tools that are not on the CRV but could be carried? State these.
- Remember the tools should be carried for basic repair to unit CRV.
- What is the main priority and focus of Coastguard missions?

6. Basic Repair Tools

The best way to approach the subject of what to carry is to concentrate on the repair equipment and tools that are required for the CRV, the repair equipment and tools that are desirable for the CRV first, and then consider what additional gear might be of use to assist other vessels, given the remaining space available.

The following items could be found on board a CRV.

- A portable pump with suction and delivery hoses, for de-watering or fire fighting.
- Jumper leads or quick start pack.
- Spare filters belts and impellors for CRV engine(s) if applicable.
- A general tool kit containing such basics as;
  - Assorted screwdrivers.
  - Spanners.
  - Pliers.
  - Allen Keys.
  - Adjustable spanners.
  - Socket set(s) (principally of a size suitable for the CRV).
  - Vice Grips.
  - Assorted tapes – electrical, plumbers, duct and cable (pull) ties.
  - Hacksaw & blades.
• Repair kit / plugs for CRV sponsons and or hull.
• Spare hydraulic fluid
• WD40 or other suitable marine lubricant

Tools should be stowed so that they are accessible and as far as possible protected from corrosion. Because the CRV is in a corrosive environment, tools should be checked and moving parts lubricated regularly.