

**Risk Proofing My Boat Against Propeller Injuries  
by the Propeller Guard Information Center  
[PropellerSafety.com](http://PropellerSafety.com)**

**ROUGH DRAFT**

16 December 2011

**This document is NOT to be used to make decisions at this time. It is only for stimulating discussions, generating ideas, and feedback.**

This document is far from completed. It is being posted to help stimulate discussions and suggestions around the U.S. Coast Guard's ongoing efforts to create a "Matrix" to help consumers sort through the various propeller guard alternatives.

We recognize the approach described in this document is far too complex for use as a Point of Sale guide. But we point to the relatively complex guides available to select the optimal propeller for your needs as an example that boaters can navigate and apply such guides.

Some consumers (boaters) will be happy with the basic "matrix" comparison guide for propeller guards suggested in USCG's December 12, 2011 USCG Propeller Strike Mitigation Project webinar.

Just as with propeller selection, some boaters will say, just give me one that works. Others will try to maximize the performance of their boat by selecting the propeller that gets the most out of their boat in the exact situations they use it in. "Risk Proofing My Boat Against Propeller Injuries" will be read and studied by those that similarly seek additional information and want to accomplish specific objectives with propeller protection, such as maximum protection, minimum problems, maximum protection without using a guard, etc. for their specific situation and needs.

We also note that little has been said about many boats needing to be re-propped after adding a propeller guard in order to keep their wide open throttle (WOT) RPM in the desired range (often go down a step in pitch) and to achieve optimum performance. This creates an opportunity for propeller sizing and guard selection as a combined experience. Some propeller manufacturers may welcome that opportunity (sell more props, plus sell guards).

## **Risk Proofing My Boat Against Propeller Injuries by the Propeller Guard Information Center**

**Disclaimer - these tools are provided for information only. It is NOT professional advice. As a boat owner or operator you remain responsible for your own safety and for the safety of those on and near your boat. The Propeller Guard Information Center, Polson Enterprises, and/or Gary Polson assume no responsibility for actions taken or not taken based on this information.**

This document is directed to typical recreational boats owners and operators. The following boat owners and operators face an entirely different set of circumstances: fleet owners, commercial craft, boat rental / livery operations, swift water rescue, search and rescue operations, law enforcement, military, water taxi, excursion boats, party barges, ferries, fast ferries, fractional owners, dive boats, whale watch boats, dolphin watch boats, parasail boats, wildlife dept. boats, fireworks barges, charter fishing boats, and other special situations. Owners and operators of those types of boats may find these comments useful, but they also face additional issues and responsibilities.

Recreational boat owners operating in nontypical situations (such as competition skiing, competition wakeboarding, competition fishing, poker runs, pulling a parasail, operating around children, etc.) may also face additional considerations beyond those covered by this discussion.

### **Feedback**

This document is a working paper. It needs your input. Please email any suggestions or comments you may have to [polsong@virtualpet.com](mailto:polsong@virtualpet.com). Please put the word "Propeller" as the first word in the subject line of your message. Or you can post messages directly on our [Consumer Guide to Propeller Guards and Other Propeller Safety Modifications for Their Specific Boat and Operating Conditions](#) post.

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## Introduction

Propeller injuries continue to occur at an alarming pace. In absence of action by the boating industry, we prepared this document to help you reduce the risk of propeller injuries to yourself, those on your boat, and those near your boat.

Our [Consumer Guide to Propeller Guards and Other Propeller Safety Modifications for Their Specific Boat and Operating Conditions](#) provides **four tools** for reducing propeller injuries:

1. **This educational document.**
2. **The Propeller Accident Risk Worksheet.** This downloadable checklist collects information on your boat, its use, your boating experience, and your boating environment. That information is then used to identify and roughly rank the risk of propeller injuries to those on or near your boat from various events.
3. **A radar plot** showing the relative effectiveness of various propeller injury avoidance devices in specific types of situations (like I just fell overboard, water skiing, etc). These charts can be used to select devices that reduce risk in your areas of greatest exposure.
4. **You become the fourth tool.** Use the first three tools to better education yourself to the risks involved and identify your primary risks. Select the Propeller Injury Risk Reduction Activities that are the most appropriate for your particular situation (like taking a boating safety class, banning alcohol from your boat, etc.). Sort though the available propeller injury avoidance devices with the aid of the Radar Plot to select the ones most appropriate for your specific situation. Think of those in and near your boat as having a certain level of risk of being injured by your propeller(s) or by the propeller(s) of a nearby boat. We call this risk, **Propeller Accident Risk (PAR)**. Your boat's PAR score is based on your boat, your current operating conditions, and your past and current actions and choices. You can lower your boat's PAR by study, practice, training, by altering your boat, and by altering its operating environment as necessary. This document will help you through the process.

You are the captain of your vessel. Take responsibility for actions and behaviors on your boat. As per the recent U.S. Coast Guard Office of Boating Safety program, "You're in Command, Boat Responsibly".



## Propeller Accident Risk (PAR) Worksheet

The first major step in evaluating the risk of propeller injuries to those on or near your boat is to identify and quantify them. This is done using our **Propeller Accident Risk (PAR) Worksheet**.

The Propeller Accident Worksheet also collects information that can be useful later in selecting propeller guards or other propeller injury avoidance devices. The worksheet is in pdf format and approximately 15 pages in length.

Print it off, staple it together, and mark it with a red pen or other brightly colored marker so your answers are easy to score later on.

The worksheet has five main sections:

- 1. Boat Specifications** - collects boat specifications useful in determining if swim ladder interlocks, swim gate interlocks or propeller guards might be applicable to the boat. Identifies challenges that might limit the use of some specific propeller guard designs (high speed operation, etc).
- 2. Operator Experience and Environment** - provides an indication of the risk level due to the operator(s) and environment on and near the boat. This section primarily indicates the operator(s) need for education and behavioral changes as well as environmental risk from rowdy or novice boaters in the area.
- 3. Water Conditions** - Water conditions (salt water, rocks, weeds, rough water, debris, potential for groundings, etc) are an indicator of which propeller injury avoidance devices might be best for your situation, as well an indicator of the probability of the operator or passengers being ejected from rough water, groundings, collisions or debris impact, especially when used in conjunction with some of the other sections. For example, small boats and rough water in combination with novice operators is a formula for MOB (man over board) situations.
- 4. Activities On and Near My Boat** - examines risk to people who exited your boat for activities on the water (swimming, skiing, PWC, float, tubing, wake boarding, etc) AND people performing similar activities that did not originate from your boat. It also inventories your exposure to ropes, lines, and nets that might foul a propeller or certain propeller guards.
- 5. Exposure Time & Boater Fatigue** - estimates the added risks from the boat operator and passengers being exposed to water, boat motions, hull vibrations, sun, wind, heat and other variables for extended periods of time. NOTE- Boater Fatigue is said to multiply the risks associated with the use of alcohol.

The Propeller Accident Risk (PAR) Worksheet does not currently provide an exact "Propeller Accident Risk" (PAR) score. However, it does provide a "feel" for your relative risk in certain areas, plus it can identify certain hazards or practices you may have overlooked. The worksheet also provides high quality information that you and/or trained professionals can use to help minimize your PAR.

The more answers you have in the far left columns, the higher your risk level, similarly, the further your answers are to the right, the lower your risk level. NOTE- not all the questions are of equal weight. For example, excessive use of alcohol in a wild party atmosphere onboard far outweigh having a swim platform (an indication people will be swimming around your boat) or boating in an area that seasonally floods (potential for debris in the water).

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## **Propeller Risk Reduction Activities**

Before we review and discuss the results of your answers to the worksheet, we will briefly inventory and discuss some actions that might reduce your PAR.

Propeller Risk Reduction Activities tend to fall into one of five categories:

### **1. Propeller Injury Avoidance Devices**

- A. Propeller Guards
- B. Swim ladder and swim gate interlocks
- C. Other devices - lanyard kill switches, virtual lanyards, neutral detent on shift-throttle controls (typically already present), neutral start interlocks on outboards (typically already present)

### **2. Educational & Training Opportunities**

### **3. Behavioral Modifications**

### **4. Alternative Propulsion Systems**

### **5. Warnings**

Each of the five categories is briefly discussed on the following pages.

## Propeller Injury Avoidance Devices

Several devices can reduce the number propeller injuries or their severity. Some are listed below.

1. Lanyard kill switch - short coiled cord that look like the coiled electrical cord between a landline telephone and the receiver. It clips to the operator (to a belt, belt loop, PFD, etc) and has special "key" on the other end. The key inserts attaches to a receiver similar to an ignition switch. If the operator moves more than the extended length of the cord from the operators station (such as when they are thrown overboard), the "key" pulls out and the engine stops. This prevents the boat from circling endlessly, possibly striking the operator or others with its propeller.

Many boats built in the last several years have a lanyard kill switch. Systems are available for installation if your boat does not have one. Get one and use it. PLUS, be sure to have a spare "key" onboard so if the operator falls overboard, you can restart the boat, pick them up, and return to shore. One downside on this device, is you can still be struck by the propeller as the boat goes over you when you fall in. (It takes a while for propeller rotation to stop and for the boat to stop).

Some boating safety advocates advise unhooking the lanyard during emergency situations and during docking to prevent loss of power at these critical times.

2. Virtual Lanyard / CAST - Maritech has a "Virtual Lifeline -XL" system of wearable pendants that emit a radio signal when they get wet (when you fall in the water). That signal immediately kills the engine. The system can then be over ridden by the boat operator to begin a rescue. Their CAST version is specifically designed for use in competition bass fishing. Similar to "real" lanyards, they cannot protect you from being struck by the propeller as the boat moves over you when you first fall in. However, they can be very useful on swimmers and perhaps even more effective than a swim ladder interlock (if everybody is wearing one and keeps it on).

3. Autotether - Autotether has a virtual lanyard pendant somewhat similar to MariTech's product above, but it physically removes the lanyard "key" to stop the boat. It is not designed for use by swimmers and still places you at risk from being struck when you initially fall overboard.

4. Swim Ladder Interlocks and Swim Gate Interlocks - MariTech's Prop Stopper can be integrated into swim ladders and swim gates (often used on larger boats to provide access to the swim platform or to the water). Prop Stopper will not allow the engine to be started if the ladder is down (or gate is open). It will also shut the engine off if the ladder is lowered or gate is opened while the engine is running. Prop Stopper will not allow the engine to start until someone swings up the ladder (or shuts the gate) signaling no swimmers are in the water. Another nice features is that going back to swing up the ladder or close the gate places someone in a good lookout position for other swimmers or other hazards. Downsides with these devices are they do not protect

swimmers that dive from your boat without putting the ladder down, or swimmers that come to the stern of your boat but did not originate from your boat. However, in both cases, if you walk back to check the ladder before you start the boat, you should be able to see them.

5. Deeper swim ladders / boarding ladders can help prevent contacting the ladder during boarding, especially when the boat is rocking in rougher water.

6. Secure handholds and appropriate step areas for use in boarding from the swim ladder / boarding ladder can also help prevent contact with the propeller.

7. Neutral start interlocks on side mount shift-throttle controls and outboard neutral start interlocks have been with us a long time, but they too are propeller safety devices.

The propeller injury avoidance devices above help protect people on and with your boat from your boat's propeller. They do not protect others in the water that are not from your boat. General safe operation, vigilant lookouts and propeller guards are often the only things between them and your propeller.

A few devices provide some level of protection to people on your boat, as well as to others.

1. Remote Video Systems - Several companies manufacture video systems for remotely monitoring / viewing the swim deck area and swimming areas behind larger vessels (like house boats and cabin boats) from the operator's station. They primarily serve as a remote "lookout" and take no automatic actions in man overboard situations. But unlike pendant/tag devices, they can make operator at the helm aware of people in high risk areas that did not come from their boat.

2. Mirrors - some house boaters use large, truck style mirrors to view behind the boat from the operators station. If you elect this option be sure you can view all areas necessary AND the mirrors will not vibrate too much to be of use when the engine is running. Similar to Remote Video Systems, they serve as a remote "lookout" and have no impact on man overboard situations, but can also sometimes see people that did not come from your boat. In general, mirrors seem to be used more for monitoring behind houseboats when underway (identify boats coming up behind them) than at startup. However they can be used to spot people in the water to the sides and rear of a houseboat.

3. RingProp launched a "ringed" propeller a few years ago and claimed it reduced the severity of injuries from propeller strikes. They have since gone out of business, and we are not aware of comparison testing between them and other alternatives. If this product works as advertised, it would provide some level of protection to those in the water that did not come from your boat. A few of these propellers may still be on the market.



4. Mercury Marine recently announced a Moving Propeller (MP) spinning LED light display available on some boats to indicate to those in the water that the propeller is spinning.

5. Propelled guards are not applicable to all boats, but can provide some protection to those on your boat and to others as well in some situations. We discuss them beginning on the next page.

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## Propeller Guards

If you are considering installing a propeller guard on your outboard or stern drive powered boat, we suggest you begin by identifying which guards might fit your drive, then find out how much they cost, and how easy they are to install. Some easy to install "bolt on" units are available for stern drives and outboards depending on their propeller diameter and boat operating speeds. Some will require drilling some holes in your drive, typically in the anticavitation plate (see warranty comments below).

Inboard (mid-hull shaft drive) propeller guards are generally more difficult to find off the shelf. Mid-hull shaft drives or through hull drives are generally seen as being safer in terms of propeller danger than outboards or stern drives because their propeller is not exposed at the stern.

Just like the other intervention devices (swim ladder interlocks, virtual lanyards, virtual propeller guards), propeller guards tend to come in a few basic configurations. Each configuration has certain advantages and disadvantages that lend them to certain situations. The most frequently encountered types of guards for outboards and stern drives are listed below. Web sites for the manufacturers listed can be found on our [Propeller Guard Manufacturers](#) page.

Propeller Guard Configurations:

1. Cage type guards - Adventure Marine, Barro Boote (Germany), Clack-a-Craft Prop Guard (cage plus foil), MariTech, SeaSpeed Propeller Guard (available in Israel)
2. Vane type guards (similar to cages but wires/rods are flat vanes, some have rings too) - Jiaxing Dajiang Mould Co. Ltd. (China), MidCoast Marine (cage plus ring), PESA
3. Duct type / Ring Type Guards - 3PO, 3PO w/shield, Barro Boote (Germany), Bite-Me-Too Enterprises, ClackaCraft (ring plus foil), Mac's Troll Prop Saver, Pooderbuilt, Prop Guard from Safe Marine (ring plus two bars)
4. Concentric Ring Guards - PropGuard Marine, Thrustor (Marine Propulsion Technologies)

Each propeller guard configuration is briefly discussed below.

Cage type guards tend to have more drag than ring type guards, but easily allow a screen to be placed at the rear to provide greater protection for those who may be backed into, or sucked into the prop from the rear. On the downside, their drag may impact handling and steering issues in higher speed applications.

Vane type guards are similar to cage type guards, present less frontal area to oncoming water to reduce drag, can be sturdier than some wire mesh cage type guards, but the

broad vanes may affect boat handling above certain speeds or in certain situations. They also tend to have larger openings than cage type guards.

Duct type guards tend to have lower drag and be useable at higher speeds than cage guards. Some duct type guards may have steering/handling issues at higher speeds, in turns, or when trimmed under. Duct type guards without screens to the rear do not provide the protection to the rear afforded by some cage type guards. A few duct type guards do have screens, bars, or rings to the rear. Some have recently added screens / shields that automatically flip up when underway (3PO).

Concentric ring guards can actually improve thrust in certain situations. The large flat surfaces of the concentric rings may impact handling at higher speeds, in turns, or when trimmed under on some vessels.

Screens come in different "mesh" sizes, wire diameters and materials. Engineers try to provide the smallest mesh and largest wire diameter they can in order to provide the protection needed, but also try to "open up the mesh" and reduce the wire size to minimize the screen's impact on drag and handling of the boat. In the end, like most engineering designs, it ends up being a trade off. Stainless steel is the preferred material due to corrosion issues. Some boats may suffer problems in reverse (top speed, handling, steering) with some propeller guards.

Each guard has certain disadvantages. Several objections raised against propeller guards in general are listed on our [Objections List](#). With some thought, you can begin to envision which objections might be applicable to your situation and the guards that seem most logical for your boat. Many of the objections are somewhat speed dependent. The slower you are going, the less likely propeller guards are to cause drag or handling issues. As a result, some propeller guard manufacturers target the houseboat and pontoon boat markets.

Warranty issues- marine drive manufactures do not like propeller guards for a host of reasons. They do not like them being installed on their drives, and they do not like having holes drilled in their drives to install them. During installation of the guard you need to be positive you do not disturb flow around or into the water inlet in the drive. Partially blocking the inlet can overheat your engine and cause it to fail. Corrosion issues may arise between the guard and the drive, or between the guard and the propeller. If you do hit something (like a rock) with the guard, the drive manufacturer may say you only hit it due to the increased diameter of the guard and any damage to the drive is your fault. Similarly, if you knock the "cage" into the prop you are probably not going to get any assistance from anybody. For example, one of Mercury's warranties reads as it does not cover "use of an accessory or part not manufactured or sold by us". The "bottom line" is warranty issues need to be considered in selecting and installing a propeller guard.

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## Education

Propeller safety education, combined with boater safety education is a great way to begin reducing risk of propeller injuries to those on or near your boat. Some steps are listed below:

1. Learn and obey the boating laws and regulations of your state and of specific bodies of water where you boat.
2. Learn the boating safety education requirements of your state and make sure you meet them. Boat US provides a site for determining [your state's requirements](#).
3. Regardless of your level of boating experience, if you have not taken a Boating Safety Class, or if you have not taken one recently, sign up and take one. The U.S. Coast Guard has a tool that helps identify [Boating Safety Courses](#) in your area. Some online sites provide the official state courses for free and you only have to pay to take the exam for certification. This is an excellent way for experienced boaters to refresh themselves for free. Personally, we recommend the United States Power Squadron classes as they allow direct interaction with other boaters and skilled instructors and they can be tailored to the specific waters where you operate.
4. The U.S. Coast Guard has a propeller safety flyer titled, [Beware Boat Propellers .. a Hidden Danger](#). Read it, print it off and review it from time to time.
5. To gain an understanding of severity and frequency of serious propeller accidents, read news coverage of a few accidents from our annual coverage of propeller accident reports in the media (available from the "Accidents" tab at the top of our site). Reading about a few accidents can inspire you to action in making your boat safer for everybody.
6. Be trained in First Aid and CPR and stay current (see your local Red Cross office).
7. Be sure you are aware of any permanent underwater obstructions in your boating area (rocks, trees, other debris that may strike your boat when the water levels are low or at low tide).
8. Learn and apply basic boating safety tips like these:
  - A. Never backup your boat to pickup a skier, tuber, wake boarder, or anybody being towed.
  - B. Always turn you engine off when people are entering or exiting the boat.
  - C. Always closely inspect the swim platform and stern for swimmers before starting your boat.
  - D. Do not let people ride in the bow of a bow rider when underway.
  - E. Keep people in their seats and do not allow horseplay when underway.
  - F. Do not carry more passengers than your boat can safely handle.
  - G. If the water is too rough, too stormy, too crowded, or the crowd is too rowdy, park your boat and take a break.

- H. Make sure you run the proper lights at night.
  - I. Never try to re-board an unmanned boat that is circling under power.
  - J. The "Safety Tips" listed on the U.S. Coast Guard Propeller Safety Brochure, [Beware Boat Propellers... A Hidden Danger](#).
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## Behavior Modifications

Behavioral changes can significantly reduce your "Propeller Risk". Among them are:

1. Alcohol - Many boating accidents, including some propeller accidents are attributed to the use of alcohol. The more you reduce the use of alcohol by anyone on board, the safer your passengers and others become. Many operators are not aware alcohol use by passengers can contribute to injuries or death. Passengers under the influence are more likely to fall overboard or make poor judgement decisions that can lead to propeller accidents. Plus the motion of the boat, hot weather, noise, exposure to the sun, and other boater fatigue variables multiply the effects of alcohol. Any steps you take to reduce or eliminate the use of alcohol by those on your boat will make it safer.
  2. Drugs - ban the use of illegal drugs on and off your boat.
  3. Ban teak surfing (hanging onto the swim platform while underway) from your boat.
  4. Ban wake surfing from your boat (riding a board very close to your boat without using a rope) IF you have an outboard, stern drive or inboard-outboard.
  5. Have a brief safety discussion with everyone on your boat before pulling out. Make sure they understand proper safety procedures, the location and risk of the propeller(s), your expectations of their behavior, and assign one person to be responsible for each child on board.
  6. Always hookup a lanyard kill switch when operating the boat (or use one of the electronic virtual lanyards).
  7. Life Jackets / Personal Floatation Devices (PFDs) - The more people wearing a jacket, the safer your vessel is. PFDs greatly reduce the risk of drowning in man overboard situations. Have everyone wear a PFD (Personal Floatation Device) at all times. Additionally, we have seen several propeller accidents in which a conventional (non inflatable) PFD absorbed a considerable portion of the impact of the propeller and reduced the severity of the injuries to the person wearing it.
  8. Incorporate the behaviors listed in the "Safety Tips" listed on the U.S. Coast Guard Propeller Safety Brochure, [Beware Boat Propellers ... A Hidden Danger](#).
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## **Alternative Propulsion Systems and Propellers**

If you are considering purchasing a different boat, re-powering or need to replace your propeller, you might consider some of the alternatives listed below.

1. Water Jets - traditional water jets are available in several configurations in a wide range of sizes. Water jets have pluses and minuses (engineering trade offs) that need to be seriously considered before making a change. Those considerations are beyond the scope of this document. However, one specific type of water jet, the Pump Jet, avoids many of the negative issues and is directly applicable to most smaller (<50HP) outboard powered vessels. Pump Jets are further described below.

2. Pump Jet - this water jet looks like a traditional outboard, except instead of a propeller, it has a housing containing an impeller. These units are widely sold by ACT Pump Jet, Premier Marine Durajet outboard pump jets, Small Outboards.com / AFA Marine, and others.

3. Ring Propeller - Propellers built with a "ring" around their perimeter are said to offer additional protection to swimmers and others in the water. It sounds reasonable, but detailed scientific comparison testing has yet to be presented to the public. RingProp from the U.K. made ringed propellers and introduced them to the U.S. The company encountered financial difficulties and no longer exists. A few of their propellers may still be around.

4. Tunnel Drive - some tunnel drives raise the propeller considerably and thereby decrease its exposure to those passing under the vessel.

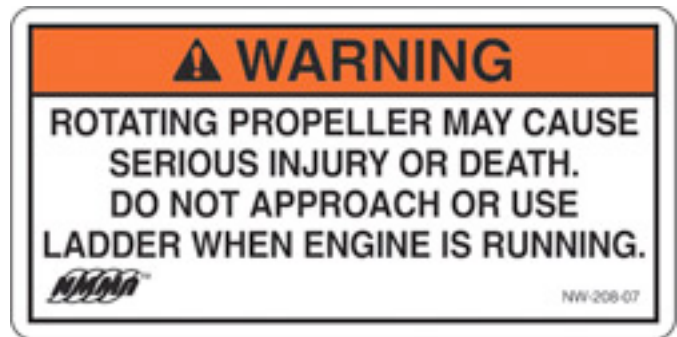
5. If you are considering tractor drives (forward facing propellers such as those on Volvo Penta's Inboard Performance System - IPS) be sure you are willing to accept the risk of propeller injuries associated with them and the particular vessel and circumstances you will be using them in. In general, they tend to be used on larger vessels in open water with less chance of propeller interaction with people in the water, plus the drive is up under the boat.

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## Warnings

Warnings are often among the least effective means of injury prevention. But with hazards as serious as propeller injuries, every bit of protection is needed.

Be sure to read all propeller safety warnings in your operators manuals. Also identify any propeller safety decals on your boat and point them out to your passengers. If your boat does not have a propeller danger decal, get one, install it on your boat, and make sure your passengers read it.



## **Reviewing Results of Your Propeller Accident Risk (PAR) Worksheet**

NOTE- not all the questions should be considered with an equal weight. Some obviously have greater influence on your boat's safety than others. For example, frequent use of alcohol by the boat operator, doing drugs on the boat, and not wearing a lanyard kill switch will probably increase the risk of propeller injury to those on or near your boat much more than responsibly using a PWC near your boat.

Now its time to identify your risks from the survey. As mentioned before, it identifies risks in five major areas:

1. Boat Specifications
2. Operator Experience and Environment
3. Water Conditions
4. Activities on and Near My Boat
5. Exposure Time & Boater Fatigue

The answers were positioned such that, the further to the left the answer you selected is, the higher your risk. Answers in the two furthest left columns should especially be examined. As you review them by area, you will probably find some areas will look well under control, while others will need attention. When areas needing attention are identified, proper solutions can then be identified from the propeller injury avoidance devices, propeller guards, educational and training opportunities, alternative propulsion methods, behavioral modifications and warnings discussed earlier.

Identify which areas you seem to have more significant problems in. Each major survey area will now be briefly discussed.

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## Boat Specifications

A common problem with some types of boats (like houseboats) is lack of a clear view of the stern, the swim platform and/or those who may be in the water near the stern from the helm. If you cannot see the stern clearly from the helm, station a lookout at the rear of larger boats prior to starting the engine. For small boats, walk to the rear, look around, then return and start the boat. These practices can be supplemented with closed circuit television cameras, mirrors and other devices on larger vessels.

Most houseboats and pontoon boats are excellent candidates for cage type propeller guards or the 3PO guard with the flip up rear shield. Several guards have minimal impact on handling and fuel consumption at slower operating speeds. Plus these large boats often have a lot of people in the water around them and are also particularly exposed to propeller injuries at the rear due to operator visibility issues and the use of water slides.

Swim ladder / swim gate interlocks are nice accessories for many boats with a ladder or gate. They prevent starting the boat with the ladder down or gate open. Walking back to raise the ladder or close the gate puts the operator in a good lookout position on most boats.

Swim ladder interlocks can be a good addition to any boat equipped with a ladder that you anticipate people may be swimming from. The interlock provide quick feedback of the ladder being down and the possibility of swimmers being in the water.

If the boat is overpowered per its capacity plate, you should take steps to reduce its maximum power.

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## Operator Experience and Environment Risks

If you have operator and behavioral risks (such as inexperienced operators, operators who have not recently been through a boating safety class, use of alcohol, a very rowdy atmosphere, or other related issues), immediately stop the use of alcohol on your boat, take an online boating safety class, a local boating safety class, or a Power Squadron class. Find an experienced boater in your area and ask them to mentor you a bit. You will learn more about boating safety as well as make a friend. Plus you might learn about some good fishing holes or a sunken tree near the surface of the lake that could rip a hole in the bottom of your boat when the water level is low.

All small boat operators need to be using kill switch lanyards (or their virtual equivalents).

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## Water Conditions Risks

When the water is too choppy, full of swells and wakes, or floating debris, just park your boat and enjoy other outdoor activities near the water. On large lakes, learn your way around and make sure you have a map of underwater hazards and know where they are.

Lookout for large waves and boat wakes.

If water conditions are rough enough that one or more persons is falling out of the boat every few years, immediately change any contributing behaviors as well as take any training that may be of assistance. Use man overboard indicators (Autotether, CAST, Mobi-lert, Virtual Lifeline), and consider installing a propeller guard.

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## Activities On and Near My Boat Risks

The more likely people are to be in the water around your boat, the more likely they are to be struck by your propeller or by another propeller. Certain activities such as tubing and scuba diving place people at even higher risks (those on tubes can be hit while waiting to be picked up, backed up on, and hit while swinging at the end of the tow rope by you or others, divers sometimes surface and are struck). When near people on skis, tubes, or PWCs always have someone watching each one of them.

The presence of tow ropes, fishing lines, lobster pot lines, commercial fishing nets and other lines will need to be taken into consideration when choosing physical guards for your propeller (to avoid fouling the propeller with the lines).

Your length of time on the water and the frequency at which you are normally on the water, along with alcohol consumption determine your level of boating fatigue which can impair your ability to make good decisions. Take your boat to land now and then and let everybody at least partially reset their internal boater fatigue exposure clock. Ban the use of alcohol on longer boating sessions in small boats.

As mentioned briefly earlier, swim gate interlocks, swim ladder interlocks, lanyards, and virtual lanyards can help protect the people on or from your boat. But the only thing between your propeller and those on other boats is careful boating, vigilant spotters, and a propeller guard. Except for propeller guards, the safety devices mentioned have minimal or no effect on those in the water that did not come from your boat (swimmers, floaters), those on Personal Water Craft (PWCs), or people on or with other boats.

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## Exposure Time and Boater Fatigue Risks

Every half hour or so, take a special look around your boat to see how everybody is doing, as well as yourself. If people are becoming fatigued, take your boat to shore for a while.

Ban the use of alcohol onboard small boats if staying on the water more than 90 minutes.

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## You Are In Command

The interventions you select will help you reduce your Propeller Risk. You decide how many and which ones to apply based on your risk level, your willingness to accept those risks, and any applicable regulations.

Some risks can be addressed by several interventions, each one adding an additional layer of protection. For example:

1. If you think people may be ejected due to rough water you (A) avoid the rough water when the hazard reaches a certain level, (B) make sure everyone is wearing a life jacket, (C) make sure the operator has recently taken a boating safety class, (D) have one person assigned to each child on board to keep an eye on them, (E) make sure the boat operator wears a lanyard or a virtual lanyard, (F) consider having all individuals onboard wear a "virtual lifeline" type device, (G) make sure passengers are "hanging on", (H) make sure passengers remain seated, (I) consider use of a propeller guard, etc.
  2. If you are towing tubers, wake boarders, or skiers or boating in an area with several people participating in those activities you can (A) avoid the area if it gets too crowded, (B) have one person always watching each person on a towed rope including after they fall, (C) be extremely careful when pulling more than one person (often one tuber falls and the second person remains on, the second person is then hit when the boat goes around to get the first person), (D) be extremely careful when swinging around to pick someone up (several people have fallen from the boat during this maneuver and been struck by the propeller), (E) always stop the engine before picking up a skier or tuber, (F) never back up to pickup a skier or tuber, (6) be very aware of others being towed in your area, (G) when being towed, be very aware of your surrounding and always wear a life jacket, (H) when being towed wear highly visible clothing, (I) do not tow in low light conditions (dusk or very early in the morning), (J) ban the use of alcohol by the operator and/or all on board on the boat, (K) consider use of a "Prop Stopper" on the swim ladder to prevent starting the engine when the ladder is down, (L) consider use of a propeller guard, etc.
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## Statement on Tubing

Tubing is great fun, but it is fast becoming a leading activity of those injured by propellers. Please use extreme caution while tubing. Plus, we are noticing a common thread of many tubing accidents involving more than one person on a tube or inflatable OR two or more inflatables being towed at once. Again great fun, but even higher risk. Many tubing accidents involve the person that did not fall off. They are struck by the tow boat, by another boat, or injure themselves getting in while the fallen person is retrieved. Plus their weight on the tow rope can make it difficult to recognize the first person fell off (exposing them to risk longer in the water). Use a proper lookout and be very careful with tubes AND around them.

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## Closing Thoughts on Risk Management

One method of managing risk is risk avoidance. In this case it can reasonably be accomplished by staying on shore and forgetting boating (I say reasonably because some people have actually been killed by propellers on shore when they were ran over by out of control boats.). We are not suggesting frequent use of this approach, however if the water is rough, its stormy, the lake is full of drunk spring breakers and you plan on going tubing, it might be a wise decision. It may be best to just park the boat on rare occasions to avoid propeller strikes and other on water dangers.

Per Wikipedia, once a risk has been identified and assessed techniques to manage those risks fall into one or more of four categories called the "4 T's".

1. Tolerate - live with it (the risks you are willing to accept)
2. Treat - reduce it (identify risk using our process and reduce them)
3. Terminate - eliminate it (parking your boat at dangerous times - lake full of drunk boaters and tubers)
4. Transfer - insure against potential losses (insure against personal injuries in boating accidents)

We mention this process here as you may wish to transfer some of your risks by making sure your personal medical, personal life, and boating insurance policies will cover the major expenses that can result from propeller injuries or death to both those on OR near your boat, including those in your party that might be struck by the propeller of another boat.

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## One Step at a Time

Together we can all improve propeller safety one step at a time. By working through the steps we outlined you have raised your level of awareness and educated yourself. By making small steps we can all participate in the change. We just need to start now!

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## Summary of Tools Now and in the Future

**This document** guides you through the process of making your boat safer. It identifies behavioral, educational, and other opportunities that can improve your safety on the water, as well as propeller safety devices.

Our **worksheet** identifies your risks into five major categories:

1. Boat Specifications
2. Operator Experience and Environment
3. Water Conditions
4. Activities on and Near My Boat
5. Exposure Time & Boater Fatigue

Your answers to questions in the worksheet are used to identify risks and guide you to the proper solutions.

Our **Propeller Injury Avoidance Device Radar Plot document** further simplifies the selection of propeller safety devices by identifying ways people end up in the water near your boat:

1. Man overboard
2. People being towed by you
3. People being towed by others
4. People swimming immediately behind your boat, etc

Then it ranks various Propeller Injury Avoidance Devices against each potential accident scenario. For example, lanyard kill switches score very high against the operator falling overboard and being struck by a circling boat.

We graphed the results as a Radar Plot (looks somewhat like weather radar on TV). We feel that properly constructed, the Radar Plot could be a very useful tool in helping boaters select the best intervention devices for a particular scenario.

Boaters review their worksheet and identify which scenarios seem most likely with their boat, then select the device(s) that best meet their needs if they feel their boat still needs some more protection after they have addressed the other needs (behavioral, etc.)

## The Next Step in Development of This Process

The Radar Plot method forces you to evaluate your worksheet answers against the scenario types to determine which ones are of highest risk to you. This requires identifying which questions are relevant to which scenarios and sometimes more than one answer must be considered at a time.

We are considering creating an online form that will ask almost exactly the same questions as our Propeller Accident Risk worksheet. Each scenario (such as man overboard) will then evaluate and weigh your answers to the specific questions that impact it to determine your risk. A report will be printed listing each scenario along with your answers that "raised a red flag" for that particular potential propeller injury scenario. You can then evaluate your specific answers against that risk and decide if an intervention is needed.

Once we get that system running smoothly, we will use the information gathered to generate an actual relative risk number for each potential type of propeller injury (scenario) , provide you with a risk level score for each scenario, along with automatically recommending potential solutions based on your inputs to the worksheet.

It is easy to anticipate this process being carried forward with the data the U.S. Coast Guard is starting to collect on "in water" performance of specific guards to allow selection of the best intervention for your specific situation.

We know the current Risk Proofing document, its Five Category Checklist, and its accompanying Radar Plot are challenging to use in their current form. We chose to go ahead and publish them as we feel they can stimulate conversation, and the feedback will be invaluable in moving forward to the next generation tools we described. They may also assist USCG with their efforts to create a "consumer matrix", somewhat of a Point of Sale Card, to assist boaters in selecting the best device for their needs.

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## Feedback

We welcome any comments anyone may have about this document, the Five Category Checklist, the Radar Plot, or any other thoughts you may have about these methods.

We know this discussion was a bit complex, but hope you found it useful. Please email any comments you may have to [polsong@virtualpet.com](mailto:polsong@virtualpet.com) AND make sure the first word in message subject line is Propeller. We would especially like to hear from people who are reading it for ideas about how they might make their own boat safer. Or you can directly post your comment on our [Consumer Guide to Propeller Guards and Other Propeller Safety Modifications for Their Specific Boat and Operating Conditions](#) post.