Aspects of the Debate Surrounding Propeller Safety Issues

Propeller Guard Information Center

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This chart provides an overview of the issues surrounding propeller safety to aid those discussing the issue in staying more focused on one area at time, while still understanding the overall system and the inter-relationships of the various areas.
Do not use the complexity of the chart as a reason not to attack the problem. For a given boat type and application, the chart can often be greatly simplified.

You are welcome to print ONE copy of this 24 inch by 36 inch chart for your personal use or to have ONE copy printed at a copy shop at your own expense from this pdf file. You can tape the resulting chart to a piece of cardboard and display it for your viewing.

See our Propeller Guard Information Center for additional information about issues surrounding boat propeller accidents.
http://www.rbbi.com/pgic

If you have any comments or suggestions concerning this chart, please email them to us at: polsong@virtualpet.com

Contributors to Accidents

- Nature
  - Drought,Groundings, Shallow Water
  - Floating or Sunken Debris
  - Rough Water
  - Boat Wakes
  - Poor Visibility (Dark, Fog, Rain)
- Certain Water Activities
  - Swimming Beyond Ropes of Marked Swimming Areas
  - Diving / Scuba / Snorkeling
  - Swimming in Open Waters
  - Wake Surfing (No Rope)
  - Teak Surfing
  - Towed Sports Waterski, Wakeboard, Tubing, Inflatables
  - Human Smuggling
- Malicious Intent
- Boating Safety
  - Horseplay
  - Improper Lookout
  - Boating Safety Classes
  - Standing When Underway in Small Boats
  - Dangling Feet Off Bow of Pontoon Boats Underway
  - Riding in/on Bow When Underway
  - Operator Inexperience
  - Alcohol
  - Proper Supervision of Children
  - Excessive Speed for Conditions
  - Running High Speed Near Shore (swimmers)
  - Boater Fatigue
  - Is Increased by Use of Alcohol
  - Hit and Run Accidents
  - Crowded Waters (lots of boats)
  - Party Coves / Party Zones / Local Festivals
- Human
- Design
  - Not Designed for Environment/Setting Product is Used In
  - Poor Marking / Signage of Swimming Areas.
  - Inadequate Side Rail, Railing, Fences, Gates, etc.
  - Inadequate or Insufficient Interventions
  - Ladder Placement
  - Poor Visibility to Rear on Larger Vessels When Starting Engine
- Mechanical
  - Failure of Pedestal Seats
  - Engine Starts in Gear or Jumps Into Gear
  - Failed Steering Systems
  - Circle of Death (boat circles)
  - Failure of Side Rail, Railing, Fences, Gates , etc.

Statistics

- Number of Boats by Boat Type and Length
- Number of Hours Boats Are Used per Year by Boat Type and Length
- Cost per Fatality / Cost per Injury
- Exposure
- Definitions of Boat Types
- Damages to Non Human Life (Marine Life, Seagrass, etc)
- What Was Going On When the Accident Happened
- Average Number of People on Boats by Boat Type and Length
- Risk Levels
- Identify Higher Risk Boats and Situations
- Percentage of Accidents From Rental Boats
- Accidents Outside the U.S. Involving U.S. Built Boats and/or Drives
- Accident Data
- Severity of Accidents
- Determine if Was Struck by Boat, Motor, Skeg or Propeller
- Number of Accidents, Injuries, and Fatalities
- Event 1 BARD Stats Are Often Incorrectly Quoted by Media As Total Number of Prop Strikes Due to Confusion Surrounding Event 1,2,3 Data
- Accidents Out of the Water (on Trailers, etc)
- Relies on State Boating Accident Reports (No System Similar to CPSC's NEISS)
- Reporting of Accidents Within Three Mile Limit Offshore
- Accidents Not Reported to BARD
- Historical Data And Trends (Accuracy Issues)
- Errors in Compilations of BARD Data
- **U.S.C.G. BARD Data**
- Accidents MIsclassified in BARD
- California and Several Other States Accidents No Longer Individually Listed in BARD
- Reporting of Accidents in National Parks and National Forests
- Accidents Excluded From BARD by Definition

Proposed Interventions

- Turn Off Engine When Someone is Behind the Boat
- Decals / Placards
- In Manuals
- Rental Operator Training
- Warnings (Effectivity is Questioned)
- Education / Training (Effectivity is Questioned)
- Safety Propeller (Rounded Leading Edges)
- Water Jet Drives
- Pump Jet Drives
- Big Boats BEEP or Warn with Recorded Voice a Few Seconds Before Starting Sound Levels Could be Automatically Adjusted to be a Given Loudness Above Background Noise Levels
- Interlocks (Effectivity is Questioned)
- Swim Ladder Interlock
- Kort Nozzles
- Captain's Mate
- Virtual Propeller Guards (Sensors Detect People Near Prop)
- Others
- Conventional Guards (Effectivity is Questioned)
- Level of Protection to Rear is Questioned
- Ring Guards
- Use of Brunswick's 1970's "Trail Out" U.S. Patents to Reduce Blunt Force Trauma #3,999,502 and #4,050,359 AND recent 2010 Teleflex U.S. Patent #7,722,418
- Rear Screen Swings Up for Reduced Drag When Underway
- Ring Propellers
- Possible Additional Training Costs
- Aft Video Monitor on Larger Vessels
- Installation Costs
- Cost of Devices
- Time to Market (Accidents till Then)
- Operational Costs
- Traditional Lanyard
- Autotether
- Lanyard Kill Switch
- Virtual Lanyard
- CAST
- Virtual Lifeline
- Compare to Open Propeller
- U.S. Coast Guard Testing Protocol Being Developed
- The Mere Use of Guards or Other Devices Brings Greater Awareness to Propeller Location and Associated Dangers
- **Cage Guards**
- Mesh Size Tradeoffs (large open mesh lowers drag and increases propeller efficiencies, small tight mesh provides greater protection and reduces potential for entrapment)
- Shaped Rods / Wire (elliptical or flattened rods/wires reduce drag while maintaining stiffness and durability)
- Utilize Properties of Water, Shapes, Trip Wires, Roughness, and Drag Coefficient Curves to Minimize Drag at Higher Velocities
- Can Protect Propeller from Impact With Debris or Groundings

Implementation Costs

Testing of Interventions

- Testing of Interventions
- Effectiveness of Interventions (They Do Not Prevent All Injuries/Fatalities)
- Effectiveness of Proposed Interventions AND Their Availability Prior to the Accident
- Present Value of Past, Current, & Future Medical Costs
- Test With Novice or Professional Drivers
- Testing by Device Manufacturers
- Prop Size, Number of Blades, Pitch, etc Selected for Test
- Down Time to Repair Device
- Weight and Configuration of Boat During Tests
- May Disable Boat if Malfunction
- SUNY Buffalo / CRESE Circular Pool
- Live Human Surrogate Test Subjects - Ballistic Gelatin, Cadaver Parts, Dead Animals, Gourds, Others
- Live Human Test Subjects
- Product Reviews
- Testing Protocol and Course Selection
- Driver Feedback
- Industry Litigation Testing
- Lack of Existing Standards for Propeller Guards and Related Devices

Regulatory Issues

- NBSAC
- Office of Boating Safety
- NASBLA
- U.S. Coast Guard
- Original Efforts Tried to Address ALL boats With a Single Solutions
- Children and Youth are Disproportionately Injured
- Lack of Definitions (Boat Types, Propeller Guard, etc)
- Statistics
- Impact on Small Businesses
- Addressing New Boats vs. Retrofit Issues
- Current Economic Climate
- Previous Regulatory Efforts
- Previously Commissioned USCG Studies (Milligan & Tennant Reports, and the 1989 NBSAC Study)
- Value of a Life Value of an Injury
- Economic Justification
- Implementation Costs
- Accuracy of Measurements / Instrumentation (Top Speed, Acceleration, Trim, Roll, Porpoising, etc)
- Lack of Data
- FBSA 1971
- Congress
- Organizations Resisting Proposals
- NMMA MRAA HIA
- U.S. SBA Office of Advocacy

Emotions

- Horrificness of Some Accidents Brings Out Emotions
- Manufacturers of Devices Feel Neglected by the Industry
- Accidents Involving Children Bring Out Strong Emotions
- Victims and Their Families Want to Prevent Similar Future Accidents
- Industry Refuses to Give an Inch (Similar to NRA Position of Firearms)
- Long Term Propeller Safety Advocates Have Pent Up Emotions from Prior Encounters With What They Perceive As the Other Side
- Industry Blames Most Propeller Accidents on Alcohol and Unsafe Boating Practices
- Victims and Their Families Feel Betrayed by the Industry
- Boaters Do Not Want to be Forced to Use Safety Devices (Similar to Motorcyclists Resisting Helmet Laws)

Legal Issues

- Quality of Rental Orientation
- Safety Hierarchy
- 3 E's of Safety
- Did the person hit the drive/skeg or the propeller, or both?
- Proper Use of Warnings
- Manufacturer's Awareness of the Danger
- Manufacturers Are Asked to Explain How We Could Put Man on the Moon Over 35 Years Ago And Still Can't Design A Propeller Guard
- Crashworthiness Doctrine Were the victim's injuries enhanced AFTER the accident occurred by a defect in the product? Could a propeller guard have prevented or mitigated a person's injuries AFTER an impact knocked them overboard?
- Product Liability
- Boating Industry Claims the Qualifications and Skills to Design and Test a Guard Are Beyond the Capability of Those Currently Manufacturing Guards
- Emotions
- Extent of Loss of Earnings and Loss of Consortium (Family Relationships)
- How Much the Injured Party And/Or Others Contributed to the Accident
- Extent of Medical Injuries and Their Impact on Quality of Life
- Decreased Top Speed Decreased Accelleration
- Presence of a Safety Device May Increase Risk Taking Behaviors
- Personal Liability
- Plaintiffs Claim the Industry Rejected Guards to Retain Profits From Replacement Propellers
- Federal Pre-emption (Ruled Not to Exist)
- Guards Are Not Currently Issued as Standard OEM Equipment by Any Recreational Boat or Drive Manufacturer
- Boaters May Remove Device to Improve Performance, Leaving Boat Overpowered and Unsafe
- Accident Investigations
- Safety Performance of the Proposed Safer Alternative
- Which Parties Will Be Included in the Case
- Determine Any Speed, Acceleration, or Handling Performance Degradation of Proposed Safer Alternative
- Determine Acceptability of New Performance Levels
- Maritime Law Admiralty Law International Law
- Jurisdiction
- Qualifications of Expert Witnesses
- Use of Alcohol
- Previous Cases
- Legal Costs to Industry and to Those Injured
- Frequency of Similar Accidents
- Determine Person's Orientation to Propeller at Time of Strike
- Manufacturers Are Asked to Show the Extent of Their Efforts At Solving the Problem, Testing of Existing Devices, etc.

Possible Hazards and Problems Created by Some Devices in Some Situations

- Fouling (Clogged by Grass or Weeds)
- Catastrophic Failure of Guard at Higher Speeds May Eject Passengers
- Entrapment
- Increased Draft
- Cavitation of Propeller, Cage, Wires, or Ring
- Drag
- Additional Fuel Costs & Related Emissions
- Ring Guards Increase Rudder Area Behind Vertical Axis Pivot of Drives
- Level of Protection Provided May Depend on Orientation of Person's Body Near the Propeller/Guard AND Location on Person's Body of the Strike
- Boat Speeds
- Added Mass
- Increased Cross Sectional Area of Guard vs. Propeller
- Density of Water

Durability / Reliability

- Debris Impacts
- Fatigue Failure of Guard Wires, Rods, Welds, or Castings Due to Propeller Cyclic Loads
- Groundings May Drive Guard into Propeller Which May Also Damage the Gears
- Guards Requiring Holes to be Drilled in the Drive Create Stress Points
- Drive Anticavitation Plate Not Designed for Loads Transferred by Guards

Blunt Force Trauma

- Head vs. Other Body Parts
- Reduced Weight of People in Water

Boat Handling Issues

- Stability at Various Trim Positions
- Boats May Try to Plane on Ring Guard surfaces
- Boats May "Lay Over" on Ring Guards
- Intermittent Slipping in Turns
- Bow Steering
- Decreased Performance in Reverse
- Porpoising
- Power Steering May 0vercome Increased Steering Loads
- Increased Steering Loads