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SAFETY AT SEA HANDS-ON TRAINING

# Flooding, Leaks, and Pumps

(Or, “*How to keep water outside the boat*”)



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# Introduction



# Flooding and Dewatering

When it comes to water inside the boat, there are two aspects we need to consider:

- Flooding – unwanted water coming into the boat
  - Leaks vs. floods: leaks are a nuisance, floods sink boats
  - Turn a flood into a leak
- Dewatering – getting water out of the boat
  - Pumps, drainage, etc.



# Preparation versus Reaction

When it comes to flooding and dewatering, we can break this down further:

- Prevention and Preparation
  - Crew training
  - Boat preparation
  - Equipment
- Reaction – Keeping problems from escalating, and finding a solution
  - Problem-solving – turn big problems into small ones



## The Problem

A 1-inch hole below the waterline floods with approximately 25 gallons of water per minute...

But the pressure is only 2 psi – you can stop this with your hand

### Water Flow (gallons per minute)

	2 ft below waterline	4 ft below waterline	6 ft below waterline
1-inch hole	28	40	49
2-inch hole	111	157	192
3-inch hole	250	354	433



## Recent Examples, and Lessons Learned

- *Alliance* - 2024 NBR
- *Gunga Din* - 2024 NBR
- *Solution* - 2024 NBR  
return trip
- *Magic Bus* - 2025  
delivery south





## Bilge / High Water Alarms

- One lesson learned from many examples of boats flooding is the importance of bilge / high water alarms
- Alarms can buy time – it is almost impossible to find the source of a leak when the water has risen over it
- Alarms should be both audible and visual – and should be easy to notice by anyone on watch (not just at the nav station)



# When Problems Arise

For all problems, take a strategic, problem-solving approach:

- Slow the situation down – minimize risks, consider your options
  - Stabilize the problem to create time
- Leverage your preparation and training – identify a leader
- 3 phase approach: Stop / Think / Act
  - Identify and analyze your problem
  - Talk through possible solutions
  - Approach the problem, and re-evaluate as needed



# Mayday Calls

- If your problem is serious (and floods almost always are), early communication is important
- Mayday calls (or other emergency alerts) allow other boats to know that a serious situation is in process – they can be standing by, or providing assistance as needed
- You can always cancel a mayday or emergency call when your situation has stabilized and is under control



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# Leaks and Floods



# Flooding Happens for Many Reasons

- Hull breaches
  - Collision (rocks, other boats, containers, etc.)
  - Failure of hull integrity
- Through existing holes
  - Thru-hulls and hoses; seals and gaskets that have failed
  - Companionways, ports, chain lockers
  - Rudder posts, shaft logs, sprits
- Waves, capsize, etc.



# Find the Flood – Fast!

It's easier to find a flood when water isn't fully covering the area

- Alert the entire crew
  - On watch stabilizes the boat, makes appropriate communications (Mayday)
  - Damage control party finds the flood
- Assess the situation – salt or fresh water?
- Start the engine or generator and pumps
- Small or large flood – can determine what action to take
  - Small – pump first, then fix the problem
  - Large – find and solve the flood, then pump



# Preventing Floods

Boat prep – consider all of the possible points of water ingress

- Adding compartments or separating bilges (in front of rudder; forward chain locker)
- Easy access to whole hull – removable floorboards throughout
- Seals and gaskets around ports, sprits, etc.
- Stopcocks, hoses, etc. in good working order
- Wooden tapered plugs at every thru hull
- Clean, bright bilges; bilge alarms; bilge lights



# Equipment for Flooding Emergency Kits

Be creative! Most anything can help in an emergency

- Disc grinder, axe, handsaw, Sawzall – don't be afraid of doing damage to the boat in order to find the flood!
- Classic and modern plugs, push-through “mushrooms”
- Hose clamps, duct tape, wire ties
- Rubber sheets and foam; rubber floor mat; sheet lead or copper
- Underwater epoxy, Stay Afloat, plumbers' putty
- Screws, pieces of wood, screw gun
- Repurpose items: cushions, sails and sailbags, wood doors, etc.
- Collision mat



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# Pumps and Dewatering



# Factors That Affect Pump Performance

Pump performance can be affected by a number of factors:

- Pumping “uphill” – need to minimize head
- Electric pumps: voltage matters
  - Rule pump: 4000 GPH at 13.6v, 3300 GPH at 12v
- What powers the pump? What happens when you lose the engine or batteries?
- Manual pumps: How long can you continuously pump?
  - Might be better to have a smaller pump if it can be used longer
- Clean bilges – crucial to not clog pump intake



# Pump Hoses

Pump hoses can have a dramatic effect on pump performance.  
Consider hoses that...

- Are as short as possible (without sacrificing effectiveness)
- Are discharging as low as possible
- Are as smooth as possible
- Have as few kinks/bends as possible
- Have as large a diameter as possible

*Note:* Collapsible hoses are not effective for manual pumps – there isn't enough consistent pressure to keep their shape



## 2026 Newport Bermuda Race – Pump Requirements

**Emergency Dewatering Pump:** A boat shall have either fixed or portable electric pump(s) to remove ingress water from any compartment. This pump shall have a minimum rated capacity of 3,000 gal/hr, be operated by battery, main engine power or a separate engine. If portable electric-powered, power cables shall have connectors suitable for connection to the boat's electrical system and have sufficient hose to discharge directly overboard or into the cockpit. A combination of permanently installed and portable pumps may be combined to meet the above requirement.



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# Closing



## Final Reminders...

- **Slow everything down** – stabilize the problem to give you time to react, allows you to turn big problems into small ones
- **Know your boat** and prepare accordingly – may look different on different boats, with different equipment, and with different crews
- **Train your crew** with your equipment and in different scenarios – “hands in pockets”
- **Communicate early** – you can always cancel emergency calls after



## Lessons Learned?

- What are you taking away from today's class?
- What stood out to you? What made you think differently?
- Questions? We're happy to help!