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**Product Interface Division Report
Aquatic Invasive Species Project
Technical Committee**

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ABYC T-32

DESIGN AND CONSTRUCTION IN CONSIDERATION OF AQUATIC INVASIVE SPECIES

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This information report was developed under procedures accredited as meeting the criteria for American National Standards. The Project Technical Committee (PTC) that approved the Standard was balanced to ensure that individuals from competent and concerned interests have had an opportunity to participate.

This information report, which is the result of extended and careful consideration of available knowledge and experience on the subject, is intended to provide minimum performance requirements.

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REQUEST FOR INTERPRETATIONS

Upon written request the PTC will render an interpretation of any requirement of the Standard. The request for interpretation should be clear and unambiguous. Requests should be presented to the PTC in a manner in which they may be answered in a yes or no fashion.

The committee reserves the right to reconsider any interpretation when or if additional information that might affect it, becomes available to the PTC. Persons aggrieved by an interpretation may appeal to the Committee for reinterpretation.

**T-32 DESIGN AND CONSTRUCTION IN CONSIDERATION OF AQUATIC
INVASIVE SPECIES**

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BACKGROUND

This technical information report is intended to provide information regarding Aquatic Invasive Species (AIS) with consideration to the design and construction of boats, trailers, engines, components and accessories in order to minimize the spread of AIS.

The prevention and control of AIS are impacted by a multitude of design and construction features on many types of boats. In order to ensure a healthy aquatic ecosystem and viability of our boating waters and the boating industry, consideration should be given to the design and construction of boats, trailers, engines, components, and accessories relative to improving cleaning, drainage, drying, and access for AIS inspection and decontamination.

This technical information report will discuss current AIS inspection and decontamination processes, provide general design and construction considerations, and provide best practices and recommendations for manufacturers to reference while designing boats and associated components.

INTENT

This technical information report contains information to increase understanding of the impact of AIS on design and construction to improve cleaning, draining, drying, inspection, and decontamination processes for watercraft and accessory manufacturers. These procedures are intended to cover most AIS threats and represent the worst case scenarios that a boat may be exposed to in the field.

REFERENCES

The following references form a part of this technical information report. Unless otherwise noted the latest version of the referenced standards shall apply.

ABYC - American Boat & Yacht Council, 613 Third Street, Suite 10, Annapolis, MD 21403. Phone: (410) 990-4460. Fax: (410) 990-4466. Website: www.abycinc.org

Colorado Parks & Wildlife, 1313 Sherman Street, 6th Floor, Denver, CO 80203. Phone: (303)-297-1192. Website: www.cpw.state.co.us Also available on www.westernais.org

[Student Training Curriculum for Watercraft Inspectors and Decontaminators to Prevent and Contain the Spread of Aquatic Invasive Species in the USA](#)

Pacific States Marine Fisheries Commission, 205 SE Spokane Street, Suite 100, Portland, OR 97202. Phone: (503) 595-3100. Fax: (503) 595-3232. Websites: www.psmfc.org and www.westernais.org

[Uniform Minimum Protocols and Standards for Inspection and Decontamination Programs for Dreissenid Mussels in the Western United States \(UMPS III\)](#)

DEFINITIONS

For the purposes of this technical information report, the following definitions apply.

Aquatic Invasive Species (AIS) - any plant, animal, or microbe that is not native to the ecosystem under consideration whereby introduction does or is likely to cause economic or environmental harm or threaten human health. AIS is often used interchangeably with Aquatic Nuisance Species (ANS).

Clean Drain Dry[®] - a primary education message for boaters, intended to prevent the spread of AIS. "Clean, Drain, Dry in between each and every use! No Mud. No Plants. No Water. No Animals/Mussels."

Clean - watercraft, trailer, or equipment that does not show visible AIS or attached vegetation, dirt, debris, or surface deposits. This includes mussel shells or residue on the watercraft, trailer, outdrive, or equipment that could mask the presence of attached mussels or other AIS.

Drain - to the extent practical, all water removed from any live-well, bait-well, storage compartment, cooler, bilge area, engine compartment, deck, ballast tank, raw water storage and their delivery systems on the watercraft, trailer, engine, or equipment.

Dry - no visible sign of standing water, or in the case of equipment, wetness on or in the watercraft, trailer, engine, or equipment.

Decontamination - hot water treatments intended to kill, destroy, and remove AIS to the extent technically and measurably possible.

Dreissenid Mussel - the common term associated with the family Dreissenidae, which are small freshwater mussels who attach themselves to hard surfaces using byssal threads (e.g., quagga and zebra mussels).

Inspection - a process to determine whether a watercraft or equipment presents an AIS risk by physically examining watercraft/equipment/conveyance.

Unverifiable Water - water that is found within boat compartments that cannot be visually or physically inspected, such as in ballast tanks or engines.

Verifiable Water - water that is found within boat compartments that can be felt or visually inspected, such as in wells or bilges.

Veliger - the free-floating microscopic larval form of some AIS.

Watercraft Inspection and Decontamination Program (WID) - any program that seeks to prevent the spread of AIS on watercraft and/or equipment by requiring or requesting the watercraft and/or equipment be cleaned and, to the extent practical, drained and dried prior to launching or upon exiting.

GENERAL INFORMATION

AIS and their spread seriously and detrimentally impact the boating experience and the future of the boating lifestyle.

AIS include plant life such as Eurasian watermilfoil and water hyacinth, and animals such as spiny water flea, quagga, and zebra mussels. AIS may vary in size from microscopic to easily visible to the naked eye and can live in residual water and/or mud. These species damage ecosystems and negatively impact fishing by depleting natural food resources, altering the water environment, and changing the structure of the ecosystem.

The impact of AIS has already resulted in the limiting of boat access to many aquatic resources throughout North America, the closure of public boat ramps, and the reduction of availability for fishing and boating across the United States. A large number of federal, state, and local agencies have enacted laws and regulations for inspections, permits, launch availability, and water access for vessels entering public waterways.

AIS infestation can often result in serious damage to boats and their components. Invasive plant life can foul propellers, jam impellers, and cause bilge pump failure. Mussels can attach to boats and negatively affect performance, attach to engines causing component failure, and obstruct water lines causing system failure.

Boats and Spread of AIS

Boats and associated equipment are considered to be major contributors to the spread of AIS. Boats that have come into contact with AIS waters can become a means of transportation of AIS through:

- Standing water, which may contain AIS within the hull or water systems
- AIS on the trailer or trapped between the boat and the trailer bunks
- Attachment of AIS to the hull or components of the boat
- Entrapment of AIS within the mechanical systems

The potential for transportation of AIS has led to significant efforts to inspect boats moving between water bodies or across state and federal boundaries, and could lead to delay or denied access if AIS are suspected.

Impacts on Boats and Boaters

AIS are an expanding threat that negatively impact the boating experience in several ways including:

- Inspection and decontamination causes delays and may prevent access to water
- Damage to boats and components
- Decontamination procedures may damage boats and components
- Reduced desirability of boating and related activities due to ecosystem degradation

Future for Manufacturers

Manufacturers should consider the design of their engines, boats, trailers, systems, or selections of associated components to mitigate the spread of AIS through:

- Making boats and associated equipment easier to inspect and decontaminate
- Designs that prevent water entrapment and promote drainage
- Exploring technologies that deter the attachment of AIS
- Selecting (or specifying) materials and components that can withstand decontamination
- Avoiding sea trials on contaminated water bodies or implementing decontamination procedures after sea trials

WATERCRAFT INSPECTION AND DECONTAMINATION

The primary goal of all watercraft inspection and decontamination (WID) programs is to prevent the transfer of AIS to safeguard natural resources, water supplies, recreation opportunities, and other important water-dependent values.

Watercraft inspection includes the visual and physical evaluation of a watercraft for attached AIS or residual water. Either presence may trigger the boat decontamination process.

While there is no national or international standard defining decontamination procedures, the *Uniform Minimum Protocols and Standard for Inspection and Decontamination Programs for Dreissenid Mussels in the Western United States* (UMPS III) serves as the scientific basis for most decontamination protocols in North America. [TABLE 1](#) provides a matrix of decontamination criteria based on UMPS III.

TABLE 1 - Decontamination Criteria Based on UMPS III Table 3

Table 1. A summary of scientific research indicating the lethal water temperature at point of contact and duration for decontamination. Information is grouped by the location of the boat that is targeted and the life form of Dreissenid mussel targeted (e.g., adult mussel or veliger). Please refer to the *Student Training Curriculum for Watercraft Inspectors and Decontaminators to Prevent and Contain the Spread of Aquatic Invasive Species in the USA* for complete step by step procedures.

	BOAT PART/ LOCATION	WATER TEMPERATURE	DURATION* (seconds)	TYPE OF APPLICATION	TARGET LIFE STAGE
EXTERIOR	Hull	140°F	10	High pressure spray ¹	Adult
	Trailer	140°F	70	Low pressure spray ²	Adult
	PFDs, anchor, paddle	140°F	10	Low pressure spray	Adult or Veliger
PROPULSION SYSTEM	Gimbal	140°F	132	Low pressure spray	Adult
	Engine	140°F ^{4,5}	See note	Flush ⁵	Veliger
INTERIOR	Ballast tanks	120°F ⁴	130	Low risk – Flush ³	Veliger
				High risk– Fill and flush	
	Live well/bait well	120°F	130	Low pressure spray or flush	Veliger
	Bilge	120°F	130	Flush or low pressure spray	Veliger

*the times listed are the minimum times necessary to achieve mortality

¹High pressure = 3000 psi.

²Low pressure = using the pressure from the decontamination unit with no nozzle, not to exceed 60 psi (essentially a garden hose flow).

³ Flush = adding water to a compartment of a boat to treat or force the water out.

⁴These temperatures denote the exit temperature (i.e., temperature of water exiting the boat not exiting the wand or flush attachment).

⁵ When flushing engines with a dedicated connection (not muffs) the pressure should be limited to less than 60 psi to prevent internal engine damage. The maximum input temperature during flushing should not exceed 140°F.

NOTE: Engine flushing relies on the exit temperature as a guideline for decontamination duration.

Prior to decontamination, UMPS III suggests WID programs consider requesting a liability waiver signature from the watercraft operator as a condition of the decontamination. The alternative is typically quarantine.

Decontamination consists of a hot water rinse or flush at low pressure or spray at high pressure. The general recommendation is 140°F water at high pressure (3000 psi) for hull decontamination and 140°F water at a lower pressure for engine/motor decontamination.

Interior compartments are decontaminated with 120°F at a low pressure to avoid damaging pumps and other interior components.

Decontamination stations range from fixed systems to portable stations (see [FIGURE 1](#) and [FIGURE 2](#)). UMPS III recommends a power-washing unit that can spray five gallons/minute at a nozzle pressure of 3000 psi.

FIGURE 1- Example of a Permanent Decontamination Station



FIGURE 2- Example of a Portable Decontamination Station



HULL CONSIDERATIONS

Design and Construction Consideration

Manufacturers should make reasonable efforts to support inspection and decontamination processes by constructing boats designed with *Clean Drain Dry*[®] requirements in mind. Design consideration should be given to improving access to areas subject to holding unverifiable water (e.g., ballast tanks, bilge areas, other raw water storage areas, etc) and the tendency of these areas to help or hinder inspection and decontamination requirements. For example, drain plugs and direct water flow should be at the lowest point of the boat. Manufacturers should also ensure hose routings are designed to minimize residual water, while making live-wells and other tanks accessible and easy to clean. Engine flushing could be made more convenient by developing standardized hose connections outside the boat versus inside. If boat builders implement standardized external flushing ports for inboard and sterndrive engines, decontamination could be easier and more efficient. Manufacturers should indicate plugs not designed for removal on a regular basis (for example pontoons).

Inspection

During an UMPS III-based comprehensive WID inspection and decontamination, all hull and hull-related structures at or below the waterline are inspected.

Examples of exterior surfaces and structures (at and below waterline):

- Hull
- Transducers
- Speed indicator
- Through-hull fittings
- Trim tabs
- Water intakes
- Galvanic anodes
- Centerboard or keel box
- Keel
- Pontoons
- Foot wells (personal watercraft)
- Strakes

Decontamination

Hull decontamination procedures are outlined in the Watercraft Inspection and Decontamination section.

The following summarizes UMPS III-recommended steps and tools for decontamination:

1. Remove any visible plants, animals, and mud using tools such as plastic scrapers, brushes, and gloves.
2. Rinse or flush with a power washer areas of the boat hull with hot water (140°F exterior or 120°F interior at the point of contact, see [TABLE 1](#)) to kill and remove any possible AIS.
 - a. Allow 10 sec to elapse from the leading edge of the spray to the trailing edge when moving the wand across the surface to maintain “lethal” contact time.
 - b. Use a power wash unit with 40° spray nozzle attachment (typically colored white) at a distance of 12 in to remove attached, visible, AIS from all exposed hull surfaces. A 40° spray nozzle minimizes damage risk.
 - c. Use flushing attachments to rinse areas such as trailer bunks or rollers that are hard to reach and where water pressure may cause damage.
 - i. A brush may also be used in conjunction with flushing to remove more AIS from hard to access areas. A minimum flushing time of 130 sec is utilized in these indirectly reached areas.

Best Practices for Boat Design and Construction

- Improve visual and physical access to areas subject to inspection and decontamination
- Design wells and other areas for complete drainage
- Implement external flushing ports
- Seal strakes, keels, ribs, and other structural components
- Design bilges to prevent water-trapping features
- Select materials to allow complete drainage
- Design features that facilitate inspection without the use of tools
- Provide methods of identifying the location and function of through-hull fittings

SYSTEM/COMPONENT CONSIDERATIONS

Design and Construction Consideration

This section is intended to provide information pertaining to systems that may utilize, come into contact with, or hold water such as bilge pumps, raw water wash downs, air conditioning systems, and boarding ladders. Design consideration should be made by component manufacturers and system designers to facilitate the ease of inspection and decontamination.

Inspection

During an UMPS III-based comprehensive WID inspection and decontamination, the following interior areas and equipment are inspected:

Examples of interior areas:

- Bait- and live-wells
- Storage areas
- Splash wells
- Cockpit soles and decking
- Bilge areas
- Raw water plumbing
- Ballast tanks
- Drain plugs
- Sea strainers

Examples of equipment:

- Anchors
- Anchoring and mooring rodes
- Personal flotation devices
- Swim platform and ladders
- Wetsuits and dive gear
- Inflatables
- Downriggers
- Water skis and toys
- Wake boards and ropes
- Ice chests
- Fishing gear
- Bait buckets and stringers
- Fenders and docking lines

Decontamination

UMPS III recommends draining the live-well, bait-well, wet storage compartments, and bilge prior to flushing with 120°F water while maintaining 130 sec of contact time.

NOTE: Alternatively, it suggests live/bait-well and bilge areas may be filled with 120°F water and held for 130 sec prior to draining with care taken in the bilge area to not flood the engine or reach the float valve, which would expel water from the discharge port.

During the ballast tank flush, it is critical that water temperature be reduced to avoid damaging the pumps and other internal components. To achieve 100% mortality, it is important to pump water into the area until the exiting water reaches a temperature of 120°F and for a minimum of 130 sec. The water temperatures both entering and exiting the vessel need continual monitoring and should not exceed 120°F.

Best Practices for System/Component Design and Construction

- Design systems and components for complete drainage
- Utilize universal flush inlet fittings
- Provide methods to identify the location and function of through-hull fittings
- Consider filtration devices for raw water systems
- Select materials and coatings with consideration to the maximum temperatures that may result during decontamination (see [TABLE 1](#)).

PROPULSION SYSTEMS CONSIDERATIONS

Design and Construction Consideration

Engine flushing practices should be efficient, effective, and convenient while maintaining the integrity of the system. To this end, boat builders and engine manufacturers could investigate designing standardized external flushing ports for inboard and sterndrives. Incorporate integrated strainer/flushing capabilities to help protect inboard engines from AIS and debris while standardizing to common garden hose adapters for flushing could also improve efficiency.

Inspection

During an UMPS III-based comprehensive WID inspection and decontamination, the following propulsion systems are inspected.

Examples of areas inspected:

- Lower units
- Cavitation plates
- Cooling system intakes
- Trolling motors
- Prop and prop shafts
- Fasteners
- Gimbal and transom mounts
- Engine housings
- Jet and engine intakes
- Paddles and oars

Decontamination

Hard to reach areas and sensitive areas (such as rubber boots in the gimbal area) may be exposed to water temperatures of 140°F for 132 seconds (see [TABLE 1](#)).

Best Practices for Propulsion System Design and Construction

- Include AIS supplements in owner's manuals
- Standardize flush connections (e.g., common garden hose)
- Utilize external flush adapters or integrated flushing technologies
- Utilize closed cooling systems (sterndrive/inboard)
- Design easily drained raw water systems
- Test engines to current decontamination procedures for adverse effects

TRAILER CONSIDERATIONS

Design and Construction Consideration

Trailers, while not generally submerged for long periods of time, may transport AIS.

Challenges exist with drainage of standing water and from flushing and carpeted bunks that can easily trap plant material and hold water. AIS can also become trapped between the boat and trailer, axles, light fixtures, or license plate supports.

Trailers with low clearance can make decontaminating spaces between wheel fenders and the hull difficult.

Trailer frames with a tube design can hold water and create difficulty in determining if the trailer is fully drained and dry. This design also makes access to problem areas difficult when flushing with hot water.

Inspection

During an UMPS III-based comprehensive WID inspection and decontamination, the trailer is inspected.

Examples of trailer areas inspected:

- Rollers and bunks
- Light brackets
- Wheels and tires
- Cross-members
- Hollow frames and beams
- Axles
- License plate bracket
- Springs and fenders

Decontamination

UMPS III recommends all accessible surfaces of a trailer should be sprayed with 140°F water. Hollow frame members should be drained and flushed. Carpeted bunks should be soaked with 140°F water for at least 70 sec, allowing capillary action to pull adequate hot water through the carpet to kill AIS. Trailer components with brake and lighting wires should also be treated with a low pressure flush to avoid damage.

Best Practices for Trailer Design and Construction

- Incorporate labeled AIS flush ports or openings
- Add standardized hose fitting at flush opening (i.e., garden hose)
- Where possible, avoid square edges; rounded designs prevent corners that may trap organic material
- Utilize open frame construction or self-draining tubular design
- Components that are immersed in water during the normal launch and retrieval process, such as trailer lighting systems, should be self-draining or submersible
- Components that are not normally immersed but which may come into contact with the high water temperatures and pressures of the decontamination process should be watertight and capable of withstanding exposure to 140°F
- Incorporate a message to “Clean, drain, and dry the boat, trailer and equipment, removing any attached plant material or debris”

OWNER’S MANUAL AND COLLATERAL LITERATURE

Clean Drain Dry

Clean Drain Dry[®] is a nationwide call to action intended to instruct boaters how to stop the spread and prevent new invasions of AIS. Owners’ manuals should include a section on Aquatic Invasive Species that includes some background information on the issue, why preventing the spread is important, examples of AIS of concern, and an explanation of *Clean Drain Dry*[®] and a reference to the *Stop Aquatic Hitchhikers*[®] website. Owner’s manuals should also have specific information and diagrams on places within the watercraft, trailer, engine, or systems that boaters should inspect, clean, or drain (e.g., ballast tanks). See the [APPENDIX](#) for examples of owners’ manual AIS text available for use and customization.

APPENDIX - Example of AIS Owner's Manual Information

Aquatic Invasive Species (AIS)

Aquatic Invasive Species (AIS) are plants and animals that occur in waters in which they are not native and whose introduction causes or is likely to cause economic or environmental damage or harm to human health. AIS have a negative impact on the waterway, its native species, and recreational and commercial uses of the waterway.

As responsible boaters and citizens, each boat owner should do their part to prevent the spread of these aquatic hitchhikers. In many cases, it is also required by law. Check local regulations for any waterway where you will boat.

After each boating trip, follow these three simple steps before you leave the water access to stop the spread of AIS: Clean, Drain, and Dry. This is the boater's way to help protect the environment from the damage that AIS can cause.



**STOP AQUATIC
HITCHHIKERS!™**

Be A Good Steward. Clean. Drain. Dry.
StopAquaticHitchhikers.org

Clean

Inspect and remove all aquatic plants, animals, mud, and debris from the boat, engine, trailer, anchor, and any watersports equipment.

Rinse, scrub or wash, as appropriate, away from storm drains, ditches, or waterways.

Rinse watercraft, trailer, and equipment with hot water, when possible.

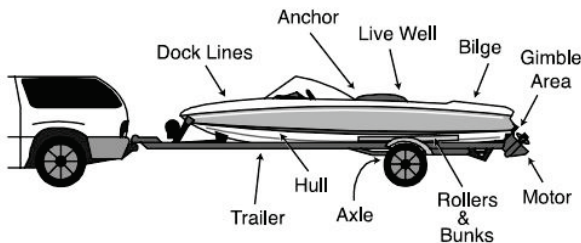
Flush motor according to owner's manual.

Drain

Completely drain all water from the boat and its compartments, including but not limited to the bilge, wells, lockers, ballast tanks or bags, bait containers, engines, and outdrives.

Dry

Allow the boat to completely dry before visiting any other bodies of water.



NOTE: Some localities may require inspection or decontamination before and/or after launching. Check state and local laws and regulations for requirements prior to traveling to go boating.

Additional Boat Specific Recommendations

NON-MOTORIZED WATERCRAFT

Canoes, rafts, kayaks, rowboats, paddleboats, inflatables, sculls, and other non-motorized recreational watercraft also require proper treatment.

- **Clean** straps, gear, paddles, floats, ropes, anchors, dip nets, and trailer before leaving the water body.
- **Dry** everything completely between each use and before storing.
- **Wear** quick-dry footwear or bring a second pair of footwear with you when portaging between waterbodies.

SAILBOATS

- **Clean** centerboard, bilge board, wells, rudderpost, trailer, and other equipment before leaving the water body.
- **Drain** water from boat, motor, bilge, ballast, wells, and portable bait containers before leaving the water body.

MOTORIZED WATERCRAFT

- **Inspect** and **clean** motor or engine, including the gimbal area; trailer, including axles, bunkers, and rollers; anchors; dock lines; and equipment before leaving the water body.
- **Drain** live-wells, bait containers, ballast and bilge tanks, and engine cooling systems.

JET BOATS AND PERSONAL WATERCRAFT (PWCs)

- **Inspect** and **clean** hull, trailer, intake grate, and steering nozzle, etc.
- **Clean** hull, trailer, intake grate, and steering nozzle, etc before leaving the water access.
- **Run** engine 5 -10 sec to blow out excess water and vegetation from internal drive before leaving the water body.

* * * * *

Origin and Development of ABYC T-32, Design and Construction of Boats in Consideration of Aquatic Invasive Species

This is the first publication of ABYC T-32, *Design and Construction in Consideration of Aquatic Invasive Species*. It is the work of the Aquatic Invasive Species Project Technical Committee.

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