Antisiphon Valves – Editorial: “Workplace Distraction Revisited”

From the Masthead

Workplace Distraction Revisited: The Tale of Submarine S-48

Submarine technology was still in its infancy when the 240-foot S-48 was launched from the Lake Torpedo Boat Company, in Bridgeport CT in 1921. On a cold December day of that year, if it were not for the valiant efforts of her crew, the S-48 would have written a tragic rather than triumphant note in submarine history.

The S-48 (at this time submarines were not deemed worthy of names like their sister surface ships) was still undergoing trials by the builder and the US Navy, and she had yet to practice a dive. On December 7, she slips her lines and heads east through Long Island Sound, toward Block Island where she will practice, among other things, “deep” diving to 200 feet. Shortly after passing Penfield Reef, however, Captain Joseph Elliot Austin decides to carry out a preliminary dive in the Sound’s shallow, 60-foot waters. The dive klaxon sounds, the conning tower is cleared and all hatches secured, ballast tanks are blown and the submarine descends on a level dive beneath the Sound’s icy black waters. Suddenly, however, the pressure inside the boat (submarines are affectionately referred to as “boats” and not ships) increases and the crew instinctively raise their hands to their ears; and a moment later the sub’s stern begins to sink sickeningly as she descends toward the bottom. With her bow pointed upward, her stern digs into the Sound’s mud and shudders to a halt, and all the crew freeze in anticipation of what’s to come.

The S48's saga is a cautionary tale, one that applies to mariners as much as it did hundred years ago, as it does today.

During the next twelve and a half hours the crew is subject to flooding, power failures, suffocating chlorine gas, a raging blizzard, and the prospect of a watery death. All remain calm, however, and thanks to the tireless efforts of several crewmen, including two electricians who hacksaw through the cables leading to the submerged aft batteries, and Captain Austin's leadership, they are eventually rescued with no loss of life.

The S-48 is raised and refit and goes on to serve the US Navy through the end of WWII. The inquiry later determines the cause of the flooding, this from the yard's founder Simon Lake in his autobiography, it's refreshingly frank, "The noon whistle blew one day and the workman who had been screwing on a manhole cover in a dark compartment back of the Diesel engines dropped his tools and hustled for his dinner bucket, leaving his job uncompleted. After lunch he was given another job and … forgot all about the half-open manhole."

Distraction in the workplace is a subject I've covered in the past, and the results can be disastrous and even deadly. In

this case they were, thankfully, only the former and not the latter. If you work in the industry as a technician or boat builder, or you are a do-it-yourself boat owner, be mindful of this potentially catastrophic scenario, something as seemingly insignificant as a loose hose clamp or ring terminal screw, can have dire consequences. Today, it may not be the noon whistle, the number one distraction is in your pocket all the time.

This months Marine Systems Excellence eMagazine covers (fittingly as it relates to flooding) the subject of antisiphon valves, I hope you find it both useful and interesting.

Antisiphon Valves

As a small boy, I clearly recall the first time I witnessed a siphon in action. A neighbor needed to pump out a boat that was stored on land. He placed a garden hose inside the boat, filled the hose with water, then held his thumb over the discharge end and brought it up over the side of the boat and down to the ground. When he removed his thumb, the water in the hose drained, beginning the siphon, which continued until the boat was empty.
How siphons can “pull” water upward remains a mystery to many boat owners and marine industry professionals alike. To explain them to apprentice technicians, one analogy I’ve used is to think of a chain being “pulled” up and out of a chain locker by a free-falling anchor. The weight of the chain going overboard exerts the force required to lift the chain from the locker.

It’s important to understand the difference between siphoning and water that is forced back aboard. A deflector can often prevent the latter while an antisiphon valve is required to resolve the former.

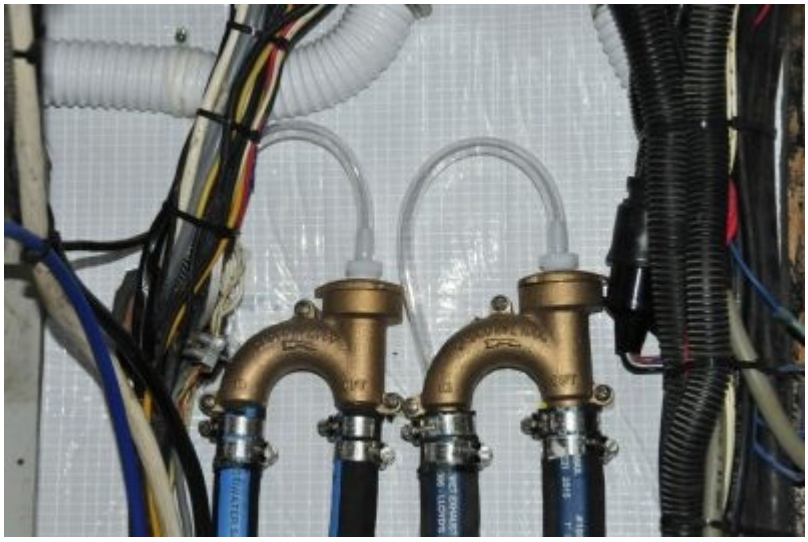
Siphon versus Flooding

This lack of understanding was illustrated several years ago when I was managing a boatyard that offered warranty service for a new boat dealership. I was called to repair a generator flooded with seawater. The manufacturer, one of the largest production builders in the country, told me that other owners of the same model had also reported the problem. As a result, the manufacturer had issued a service bulletin, directing dealers to replace the antisiphon valve with an “improved” model. The diagnosis was that water was being forced into the generator through the raw-water intake. This made little sense to me. When water is under pressure of any sort, flooding may occur; however, these are decidedly not the conditions under which siphons occur.

Skeptical of the prognosis, I directed the mechanic installing the replacement generator to take two additional steps: leave the exhaust hose separated from the exhaust elbow (so I could see water entering the exhaust without it filling the engine’s cylinders); and separate the raw-water-inlet hose from the raw-water pump (so I could see water being forced through this

location).

During a sea trial no water gushed from the raw-water intake as the manufacturer suggested. It did, however, enter the exhaust system from the exhaust outlet on the side of the hull. At just the right speed, the bow wave moved aft and entered this exhaust flange, forcing water into, upward, and ultimately filling the exhaust and then the generator. This problem was solved by adding a simple deflector forward of the exhaust outlet. That was the easy part. It took me weeks to convince the manufacturer that the culprit was not the antisiphon valve; it was, instead, the design of the vessel and the location of the exhaust outlet.



A leaking antisiphon valve needs to be serviced or replaced. Though it's common practice to add remote vents to antisiphon valves, small diameter hose like this is prone to clogging and kinking, or its outlet may become submerged if it's near the bilge. The author has encountered two cases in which a generator and propulsion engine flooded because of this arrangement.

Siphon Causes

Siphons can lead to serious problems, including down-flooding and even sinking. Raw-water siphons are most common in engines and generators, heads, and bilge pumps. For engines and

generators, siphons are a danger when they are installed below the waterline and can occur when water drawn into the engine for cooling continues to flow after the engine is shut down (like filling the aforementioned garden hose and then lowering it to the ground). If this happens, seawater will first flow into the exhaust the same way it does while the boat's running; however, and depending on the exhaust system design, without exhaust gases to expel the water, it will eventually fill the muffler, the hoses, and then the engine itself via open exhaust valves. Under the right circumstances, water may then leak out of the engine's air intake and into the boat, causing it to flood and possibly sink. I've seen this transpire over the course of just a day or two.

Once past the valves it enters the cylinders, and then slowly leaks past the rings and into the crankcase. A high dip stick oil level is often the first indication of such a scenario. If water fills cylinders, and the engine is cranked, significant damage may occur, so don't ignore that high oil level, investigate it before attempting to start the engine.

Heads and bilge pumps can suffer the same fate. If the overboard discharge is lower than the inlet, and most are, then seawater may continue to flow after a head has been flushed. The insidious aspect of this problem is that it may not happen for years. A siphon is often not possible if the rubber flapper valves in the head are in good condition—also true for an engine's impeller or (diaphragm) bilge pump—or simply if the right, or wrong, conditions of wind, waves, angle of heel, etc. don't manifest themselves.

Bilge pump risers will prevent downflooding; however, they will do nothing to prevent a siphon and thus should be equipped with antisiphon valves.

For bilge pumps, the problem is exceedingly simple. Siphons begin when the overboard discharge is submerged, in spite of the fact that the hose rises at some point above the heeled waterline. (If it doesn't rise above the waterline, then it's simple down-flooding rather than siphoning, and an antisiphon valve would not prevent it.) The water running back into the bilge initiates the self-sustaining siphon. As an aside, ABYC Standards define the "waterline" as all portions of the hull that are submerged when heeling to the toe rail for sailing vessels, and all portions of the hull that are submerged when heeling 7 degrees for power vessels. If a bilge pump discharge can be submerged, its plumbing must be equipped with a riser and an anti-siphon valve. Also, consideration should be given to the possibility of extreme healing in the event of a grounding.

Antisiphon Valves

In simple terms, antisiphon valves allow air to enter while preventing water under pressure from exiting the plumbing run, thereby "breaking" the siphon. Every engine, generator, head, and bilge pump needs a properly installed antisiphon valve (also called a siphon break) if they are ever below the

waterline under any vessel attitude. Also note that they are not interchangeable with raw-water check valves, which are prone to failure and should be avoided in most cases (those will be covered in a future edition of Marine Systems Excellence).

Antisiphon valves are typically installed: between the heat exchanger and the injection point on the exhaust elbow; between the raw-water flush pump and the toilet bowl (they are commonly and incorrectly installed on the pump inlet, where they will suck air); and anywhere along the discharge line for the bilge pump.

Antisiphon valves come in a variety of types. All rely on an in-situ check valve of sorts, which should be inspected and cleaned at least annually.

Most important is that the antisiphon valve be installed well above the waterline under all operating conditions. Some antisiphon valve manufacturers require the valve to be installed a minimum of 2’ (61cm) above the waterline to ensure proper operation, so make certain you read the installation instructions regardless of how many times you’ve installed these valves. Antisiphon valves should be inspected regularly, and serviced, disassembled, and cleaned annually to prevent clogging. If you are uncertain that an antisiphon valve is necessary, then install one. There’s little harm in having one

where it’s not needed; however, untold difficulty and damage may occur when one is needed but was never installed.