RC Model Submarines & Accessories

The SAS Sub-driver

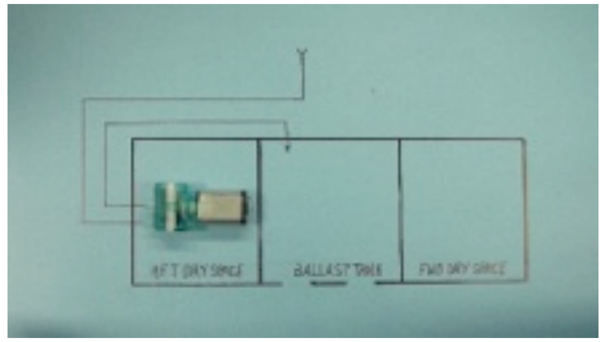
SAS is a ballast water management system that works in the semi-aspirated mode. The air used to displace/eject water from the flooded ballast tank comes from one of two sources: air from the outside gathered through a snorkel head-valve located in the submarines sail, or air scavenged from the dry spaces within the Sub-driver itself. It's the ability of the SAS to draw air from within the Sub-driver's interior that permits displacement change without need of an induction line to the surface.

The SAS System is perfect for model submarines representing modern Russian and British submarine designs, or just about any pre-nuclear age submersible (boats of high freeboard that spent most of their time atop the waves). Ballast systems such as RCABS suffer from low flood-able volume to system component volume ratio They can't achieve both a scale surfaced trim freeboard waterline and have the flood-able volume to get enough water weight aboard to get the model to submerged trim.

The Low Pressure Blower (LPB) or Snort Pump

For many years, Sub-driver’s employed a gas type ballast system to blow out ballast water. A charge of propellant, liquefied gas, held within an on-board bottle was used to expel ballast tank water to float to surface trim. Later, we introduced the LPB/Snort ballast system, pumping air into the ballast tank from the surface via a snorkel tube.

The LPB system worked in parallel with the gas, becoming the primary means of emptying the ballast tank, with the gas in stand-by to blow the tank should the model not be able to make the surface. For the LPB/Snort ballast system to be able to blow out ballast water, its induction line inlet must be in air, necessitating the retention of the gas ballast system hardware as a failsafe.



The LPB system is incredibly simple.
Requires an air pump that can also pump water.
Dispenses with water detectors, floats or solenoid valve actuated snorkel head-valves.
It takes up little space; the plumbing is simple and short of runs.
Requires the minimum of set-up and maintenance.

LPB/Snort Operation

In operation the LPB ballast system is very simple: An open hose in the submarine's sail/ conning tower, connects to the LPB/Snort pump inlet.
The discharge outlet of the LPB/Snort pump connects to the ballast tank, pushing air in to force water out.

Should the sail be underwater and the LPB/Snort pump running (through operational ‘incident’ or driver error) water is pumped through the entire system and into the ballast tank. No ill effect, but then again, no water is blown out of the tank -- net change to submarine displacement is zero. No harm, no foul.
The pump gleefully pumps the water into the ballast tank. However, the moment the sail once again broaches the surface, air replaces the water in the lines and the ballast tank starts emptying. The beauty of these robust air-pumps is that they can tolerate water ingestion so there is no need for a protecting valve in the induction line to block the entrance of water, with all the attendant complexity such Rube Goldberg components would entail.

An operational consideration, for both the LPB and SAS system, when actuated from your transmitter: You are likely to leave a transmitter toggle-switch, controlling the LPB/Snort pump, in the wrong position while operating the model submarine submerged. You forgot to turn the damn pump off after the last surfacing. That won't happen if you control of the LPB with a spring loaded toggle or, better yet, the spring loaded left-right stick of ch-4. Do that and you have to make a conscious effort to keep the LPB motor running by holding down a toggle or pushing a stick against spring pressure. So, control operation of the LPB or SAS system with a spring-loaded transmitter toggle or stick.

The LPB ballast water management system is simple, cheap, reliable, and robust. However, it will not save a sunken model submarine.
If your model submarine is to sail around in any open body of water, we strongly recommend that the LPB system be backed up with a gas type ballast system; a system that has the ability to empty the ballast tank (or a significant fraction of it) regardless of depth.
So configured, both the LPB and gas systems work off the same channel -- gas actuation occurring only when the fail-safe (or full throw of both the stick and its trim knob) to command a 115% throw to the vent/blow servo (this established through gas system linkage adjustment and fail-safe set-up). When employing the normal command range of the r/c system -- operation of the system to normal servo throws -- no gas will be discharged at the 'blow' command from the transmitter.

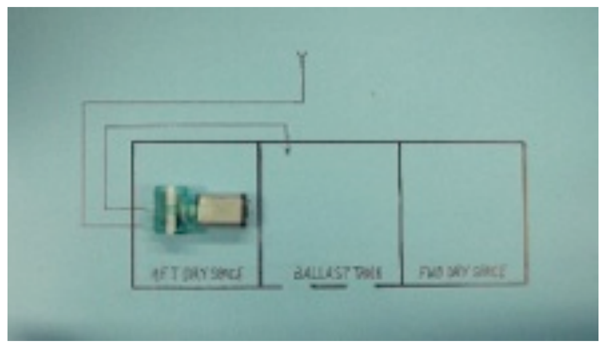
The SAS

As with the LPB type ballast systems, the SAS equipped Sub-driver is intended to be used to either completely flood, or completely blow dry the ballast tank. The SAS is not to be used to ‘hover’ the model submarine. The use of Sub-driver interior air, scavenged by the LPB pump, is only employed to broach the model submarine sail should it become difficult to otherwise get the sail into the air by planing up to the surface dynamically. With SAS, normal ballast tank blowing is accomplished using snorkel air, not Sub-driver air. In fact the only time the SAS should operate with the model completely submerged is in the event you lose sight of it for an extended period, or the signal between your transmitter and the model is interrupted and the system is activated via the fail-safe circuit.

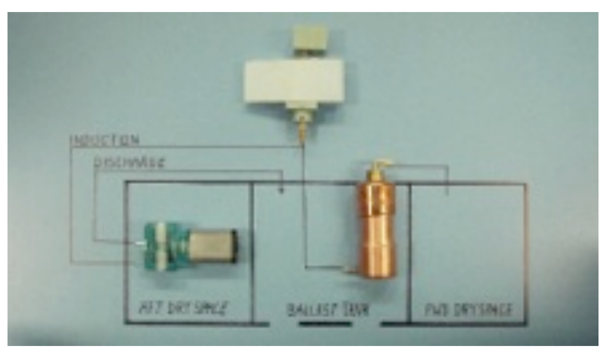
The volume of air within the Sub-driver is limited. That fact, coupled with the LPB's ability to pull only seventeen-inches of Mercury (about eight PSID if the boats near the surface, less if deep), means only a sizable fraction, not all, of ballast water can be discharged from the ballast tank using Sub-driver air alone.

The SAS system only uses Sub-driver air to get the model submarines sail above water, not to play games fine-tuning displacement while cruising along submerged!

Once Sub-driver air is used, the sail must broach and draw outside air through the snorkel head-valve as soon as possible. The air in that side of the induction line passes through the safety float-valve and into the Sub-driver, breaking the partial vacuum that was created when the LPB pumped Sub-driver air into the ballast tank to broach the sail. Once the Sub-driver is replenished with air (an operation that takes only seconds and is accompanied by a 'whooshing' sound you can hear from feet away!), the cycle is completed, and the model submarine can then be safely submerged again.



The upper photo shows the standard LPB ballast system.
The photo below shows how -- through the addition of two more system components, the basic -- LPB ballast system can be upgraded to a SAS ballast system.



In this arrangement the Sub-driver’s interior is an alternative source of air used by the LPB pump to empty the ballast tank.

As the Sub-driver's interior now communicates with the induction line, a positive means of keeping water out of the induction line has to be provided for.

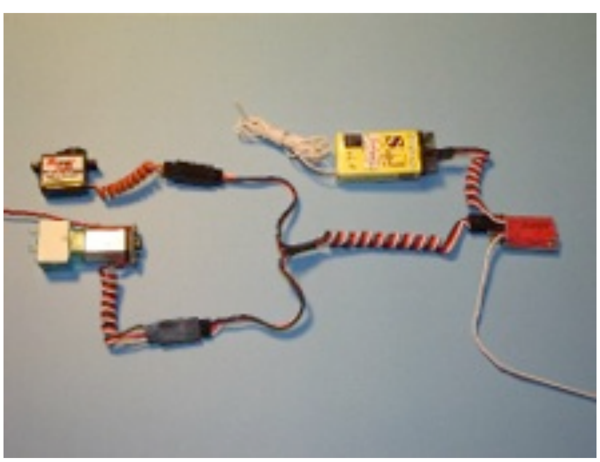
The primary valve that isolates the induction line from water is the ***snorkel head-valve***. It's the item at the extreme top of the above photo. However, single valve protection is not enough on a submarine. To insure that a flooded induction line will not dump water into the Sub-driver's interior, a back-up valve is required. In this case, a ***safety float-valve***.

The safety float-valve, when the induction line is dry, permits air in and out of the Sub-driver through the induction line. However, when (for whatever reason) the induction line is flooded, the safety float-valve closes, isolating the interior of the Sub-driver from the induction line. Two-valve protection, boy's and girl's ... don't leave home without it!

The above configuration is how the SAS plumbing aboard our 2” and 2.5” Sub-driver’s is arranged. The 3.5” Sub-driver’s differ only in that the safety float-valve is located in the after dry space, not within the ballast tank. The bigger Sub-driver's have the available real-estate to accommodate it.

That covers the plumbing, now, let's talk about how the devices of the system plug together:

The lead from the ballast system servo (its function is to open or close the ballast tank vent valve) plugs into a Y-lead (which connects two devices leads to a single receiver/other devices port) leg, and the lead from the LPB's MPC connects to the other leg of the Y-lead. The female plug of the Y-lead makes up to the fail-safe output port of the ADF. The servo and MPC get



the same command, at the same time. Study the picture below.

As we want to incorporate a fail-safe device in the circuit, the Y-lead makes up to the output pins of the fail-safe side of the ADF (pitch controller) device. In the picture we see that the fail-safe in turn hooks up directly to the receivers ch-4 port. However, if the Sub-driver is using a Lithium-polymer battery, insert the Lipo-Guard circuit between the receiver and the fail-safe input; the Lipo-Guard monitors battery voltage and will cut out the ch-4 pulse train to the fail-safe circuit, representing a 'lost signal' condition, which then causes the fail-safe to command a blow signal to both the MPC and ballast system servo: vent valve shut, LPB pump running.

This device hook-up arrangement is the same for either the classic LPB or the SAS.

SAS Operation

Keep in mind that both the LPB and SAS systems require the use of a dedicated vent valve servo to open and close a vent valve atop the ballast tank. Opening the valve releases the air trapped within the ballast tank, permitting flooding water to enter from open holes drilled into the bottom of the ballast tank.

Submerging The transmitters left stick, left-right axis, is ch-4, the channel we're using to control the ballast system. When the transmitters left stick is pushed all the way to the left, that commands a vent of the ballast tank -- the servo pushes the ballast tank vent valve open and the MPC remains dormant, i.e. the LPB is not running. The ballast tank fills with water, and the model submarine transitions from surfaced trim to submerged trim. The spring-loaded stick is release to the neutral position (center) and the vent valve closes and the LPB remains dormant.

As the sail submerged the snorkel head-valve float rose, causing the head-valve to isolate the otherwise open induction line. The induction line remains dry, but shut-off from outside air. However, the induction line does communicate with the air inside the Sub-driver through the safety float-valve.

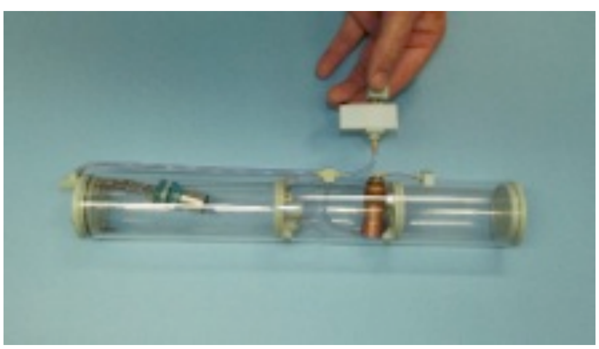
The model is operated in submerged trim.

Surfacing When you decide to surface, you command full rise on the stern planes and full rise on the bow/fairwater plane and wait for the sail to broach the surface. The moment it does you shove the left stick all the way to the right and hold it. The vent valve remains closed, the MPC runs the LPB motor and air is drawn in through the open snorkel head-valve, compressed by the LPB pump and discharged into the ballast tank, blowing out the water.

However, should the sail not broach high enough to open the snorkel head-valve, the open induction line to the SA's interior will draw air from the forward and after dry spaces to feed the LPB, that air pumped into the ballast tank, blowing enough water out to get the snorkel head-valve high enough into the air to open that valve, which immediately permits air to rush into the partially evacuated Sub-driver and then onto the LPB where surface air is used to finish blowing out the ballast water.

A Detailed Look at the SAS Components and Devices I'll refer you to the photos below. First, note the unaltered arrangement of the internals in the Sub-driver's after dry space that make up to the LPB pump configured for SAS use -- just like that of the basic LPB system. The physical difference between the two modes of operation is the inclusion of a snorkel head-valve, housed within the model submarine sail; a ballast tank housed safety float-valve; and two specialized manifolds glued atop the Sub-driver cylinder.

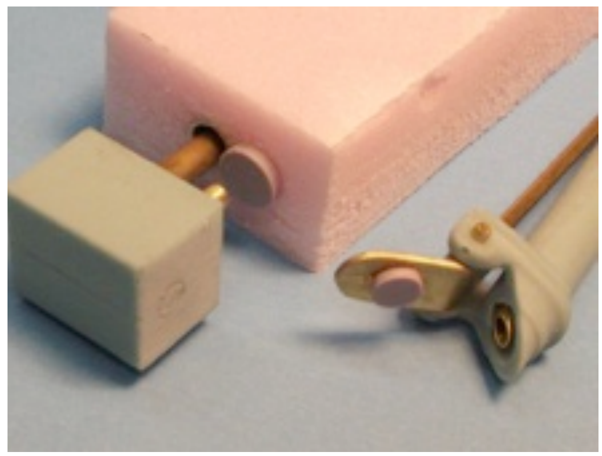
The snorkel head-valve works to keep water out of the induction line. The safety float-valve is there to keep any water that does get by the snorkel from getting into the Sub-driver dry spaces. And the specialized manifolds serve to keep the flexible hose plumbing to a minimum.



The snorkel head-valve HAS to be as high up within the sail structure as possible -- the higher up the snorkel head-valve, the less water has to be blown out of the ballast tank using Sub-driver air alone. As different model submarines present different shaped conning tower/fairwater/fin/sails, a one-size-fits-all snorkel head-valve could not be employed.

No! That would have made life way too simple!

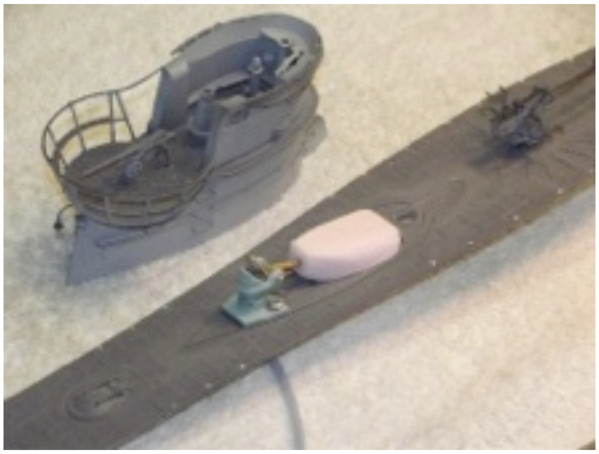
Snorkel Head-Valve I've been compelled to develop two broad categories of snorkel head-valve. One type for broad, squat structures, like those on WW-2 era and older design. And another type for tall thin sails as seen on post-war designs. I differentiate between the two by describing the snorkel head-valves used in post-war model submarines as the vertical type. And snorkel head-valves used in the older style submarine models as the horizontal type. Below is a shot of the two type snorkel head-valves. To the left is the vertical type. To the right is the horizontal type.



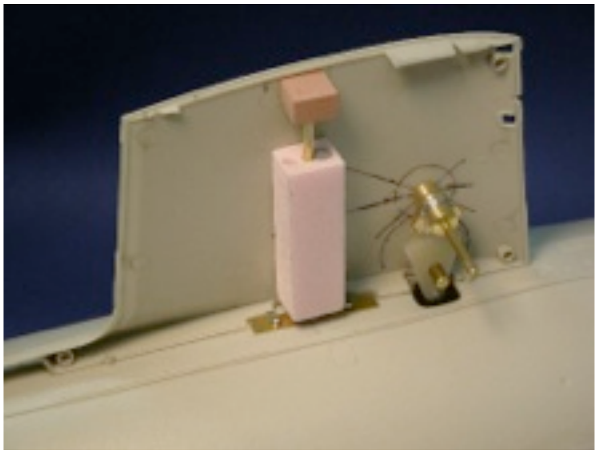
The vertical type -- used most often on models representing 'modern' submarine -- employs a ported block. This is the head-valve proper. In this design the centrally running 1/8" brass tubes serves double-duty as support for the head-valve, and guide, around which, the float (with attached rubber element) slides up or down. When the float is immersed in water it is buoyed up until the rubber element glued to its top makes contact with and blocks the intake nipple on the block, isolating the entire induction line from sea.

The head-valve to the right is of the horizontal type and is employed aboard model submarines with plenty of deck area under the sail structure, but little height -- a characteristic shared by most pre-atomic era submarines. A horizontally oriented float, connected to a 1/16" brass rod, works to swing the brass stopper of the head-valve so that its rubber elements blocks the intake side of the induction line when the float is buoyed up by rising water. The design of this type snorkel head-valve was heavily influenced by the good works of Manfred Reusing.

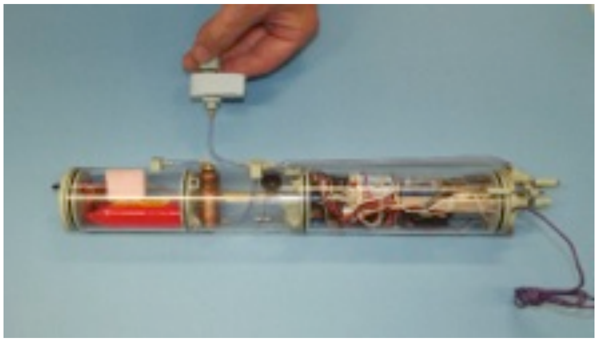
And here's the horizontal type snorkel head-valve installed aboard the beautiful Revell 1/72 GATO kit. The fairwater is secured atop the hull with magnets, permitting quick and easy access to the float and its flexible hose. Such access is needed to make/break the hose connection between the snorkel head-valve and the Sub-driver's five-point manifold under the float, glued atop the Sub-driver.



The same type horizontal snorkel head-valve is employed aboard the Revell 1/72 Type-7 kit with suitably sized float -- all fitting nicely under the magnetically attached fairwater. Note the flexible hose under the deck. The end of this piece of induction hose makes up to the Sub-driver mounted five-point manifold prior to securing the deck atop the models hull.



Above is a variation of the vertical type snorkel head-valve. This one being test-fitted aboard the soon-to-be-released Moebius Models 1/72 SKIPJACK kit. Note that the unit secures to the deck of the hull and takes full advantage of the thin, tall sail which is common to boats built during the cold-war era.

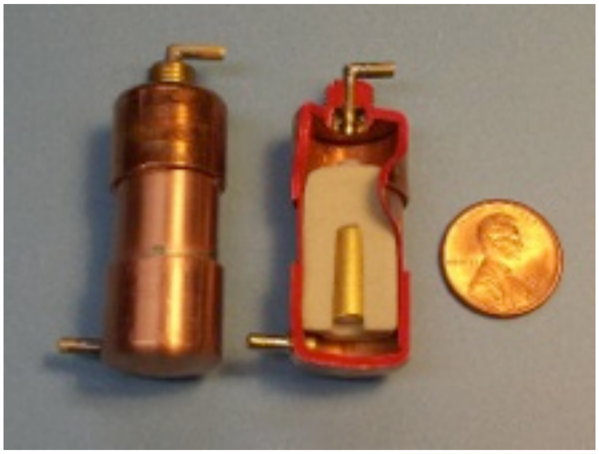


A short but long-of-cord float works to block off the head-valve when water reaches the sail of the Trumpeter 1/144 SEAWOLF this SAS equipped Sub-driver is designed for.

Safety Float-Valve The snorkel head-valve HAS to go into the sail/fairwater structure. On the other hand, the safety float-valve can be put anywhere: You can stick it in the Sub-driver dry space, in the Sub-driver's ballast tank, or even external of the Sub-driver, mounted somewhere within the free-flooding model submarine hull. But, as a practical matter, you want to keep line resistance low -- that means as short a hose run as possible between system components.

For the smaller Sub-driver's I've found that the best place for the safety float-valve is in the ballast tank -- occupying the same space formerly taken up by the gas systems on-board bottle. On the larger 3.5" Sub-driver's its a simple mater to put the safety float-valve within the after dry space itself, reducing the outside plumbing as compared with the Sub-driver's that employ a ballast tank housed safety float-valve.

Within the body of the safety float valve is a float. If water gets into the induction line and into the safety float-valve, the rising float pushes its attached rubber element up tight against the inlet/ outlet nipple atop the body, blocking water, keeping it out of the Sub-driver.



Compatibility of SAS with other Ballast systems

Inclusion of the SAS hardware does not interfere with the (if installed) existing gas ballast system; the two system work in concert with one another. A re-setting of the blow valve actuating stem position in relation to the linkage arm so that the blow valve will only open with 110% of servo travel to the ‘blow’ position -- a situation only achieved through a fail-safe generated command -- is all that is required to get the gas system out of the way (physically and functionally) of the SAS.

See the web page to order