



## **Bilge Level Alarm Systems**

*An assessment of various bilge level alarm systems and technologies*

FIFG funded

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## **Introduction**

Despite advances in technology, many bilge alarm systems still fail to alert crews of rising water in the bilge, often resulting in the loss of the vessel and, in some cases, the loss of life. The most prominent occurrence in MAIB reports is flooding, often caused by failures in pipework or fittings. Two factors are common to most incidents; the bilge level alarm did not work and when flooding was discovered, the water was too deep to allow crew to reach the sea inlet valves to close them.

In the hope of reducing the number of these incidents, Seafish Marine Services decided to conduct an investigation into the efficiency of various bilge level alarm systems and technologies to determine which proved most reliable. In total, seven bilge alarm systems were carefully selected from the wide choice available, covering a range of popular methods for the detection of high water, including the use of resistive sensors, float switches, pressure sensors and optical sensors.

These bilge alarm systems were thoroughly tested both in-house and onboard fishing vessels, and it should be pointed out at this stage that the findings published in this report relate only to the use of these systems on board fishing vessels; individual items of equipment may actually function to a different degree of reliability if placed in another environment.

The intention of this report is to provide fishermen with the relevant information to allow them to make an informed decision as to which bilge alarm system or technology will best suit their vessels.

## **Selection**

Altogether, seven bilge alarm systems were purchased for testing, covering various methods of water level detection. Some of the systems were chosen because of their popularity, while others were selected because of specific design features or technology used. It should also be pointed out that the systems were not necessarily advertised as complete systems; in most cases, the sensors can be purchased separately from the control panels, allowing some variance in price and implementation. However, for the benefit of the project, the systems were all purchased on an even basis; that all should have four detection zones, allowing high and low level water detection in both the engine room of a vessel and in the fish hold.

The following seven systems were selected for testing:

### **Electronic Devices (ED830)**

- 1 No. ED830 Control Panel
- 4 No. ED735 Float Sensors
- 1 No. ED4 Sounder
- 1 No. Xenon Beacon (not included in cost comparison)

### **Index Marine (resistive)**

- 1 No. Index Marine 4 Station Bilge Alarm Control Box C-BE15
- 4 No. Index Marine Resistive Sensors C-BE55 with cables

### **Ormston Technology Hydralert**

- 1 No. Ormston Technology Hydralert Bilge Monitor
- 2 No. Ormston Technology Dual Stage Sensors c/w Test Boxes

### **Water Witch**

- 1 No. Water Witch Multi Bilge Alarm Unit ref WW600
- 4 No. Water Witch High Water Sensors ref WW23-24-1

### **Jabsco Hydro Air Switches**

- 1 No Custom-built Control Panel\*
- 4 No. Jabsco Hydro Air Switches

### **Cruz Pro BWA20**

- 4 No. Cruz Pro BWA20 Control Units c/w Sensors

### **Index Marine (optical)**

- 1 No. Index Marine 4 Station Bilge Alarm Control Box C-BE15
- 4 No. Index Marine Optical Sensors C-BE51 with cables

*\* Jabsco do not manufacture a control panel specifically for use with the Jabsco Hydro Air Switches but it was decided that these sensors should be tested because of their popularity. They were initially tested in-house using the Water Witch control panel, and then a control panel was custom-built for installation onboard the fishing vessel, Eagernoon.*

## **Testing**

The bilge alarm systems were tested in two stages, as follows:-

### **Stage 1 Testing (in-house)**

Each bilge alarm system was assembled on site and thoroughly tested to ensure it was in full working order and to determine the capabilities of the system. During this stage, the following tests were conducted using a container filled with approximately 80 litres of clean tap water and all results recorded.

#### **System Test**

If the control unit had a system test facility then this was activated to check that the control unit was working correctly with the sensors attached.

#### **High Level Water Test**

Each sensor was individually tested to check that the alarm activated when the sensor was held beneath water. This simply involved lowering the sensor beneath the water surface, to activation depth, and holding it there until the alarm activated. In each case, the delay between initial submersion and alarm activation was timed and recorded (many systems incorporate some form of delay to prevent activation during rolling/slopping conditions). The reaction of the control unit was also noted when the sensor was removed from water.

#### **Rolling/Slopping Test**

Each sensor was tested to determine the response of the system during rolling/slopping conditions. To do this, each sensor was intermittently dipped in and out of the water for an overall duration of thirty seconds, with the periods of submersion lasting no longer than five seconds at a time. It was accepted that different units would have different ways of determining rolling/slopping conditions and so notes were taken regarding the efficiency of each system.

#### **General**

Further tests were conducted to assess functionality. Checks were made to determine the reaction of the each system when the audible alarm was silenced while a sensor remained underwater (ie whether or not an indicator light remained on and/or the system re-armed itself). The reaction of the unit was also checked when a second sensor was submerged in water after one sensor had already triggered the alarm. And the reaction of any sounders, beacons and LED's was also noted wherever necessary. Any other notable points relating to individual manufacturers' instructions were also studied, including the complexity of each assembly.

### **Stage 2 Testing (onboard vessel)**

The bilge alarm systems were installed on fishing vessels which already possessed working bilge alarm systems. Each skipper was asked to regularly check the equipment, in accordance with an *Instruction to Crew* document, and each system was also tested at intervals by a Seafish representative. In each case, the system test facility was activated (if applicable) and high level water tests were performed by dipping each sensor in water (or using the test syringes in the case of the Ormston

Technology Hydralert system). Each system was tested for an initial duration of six months, except where failure prompted removal, and all results were recorded. *Note: while records were not maintained by the skippers of the vessels, individual comments were noted.*

## Installation

Six local fishing boats were selected, four based in Bridlington and two based in Scarborough, and the owners were approached for permission to include the boats in the project. At this point we had to also check that each vessel had a working bilge alarm system which would continue to be used as the primary source of alert. The vessels were also inspected for allocation of the equipment.

Unforeseen problems were encountered at an early stage which subsequently led to delays in the project. The electrical contractor who had originally been selected to perform the installation work had difficulties meeting the installation dates due to work commitments, which forced us to elect another contractor, and two of the vessels originally selected had to be replaced because of fishing schedules.

The installation stage progressed slowly, with arrangements between the electrical contractor and the fishermen being very dependent upon the weather. However, once installation was complete, the skippers were each given an *Instruction to Crew* document and a *Stage 2 Test Form*. Onboard testing then began, with a Seafish representative performing tests at selected intervals.

After five months testing of the Cruz Pro system, a decision was made to replace it with an optical system. Not only had the Cruz Pro system failed to prove itself worthy for use in the fishing sector but a revision of the Seafish Construction Standards completely ruled out the use of the system on any fishing vessel. Although there were doubts as to whether or not a fisherman would trust an optical sensor in a dirty bilge, it was decided that this technology should be tested.

The systems were installed onboard vessels as follow:

<b>Bilge Alarm System</b>	<b>Vessel</b>	<b>Port</b>
Electronic Devices (ED830)	Stormy C	Bridlington
Index Marine (resistive)	Hollie J	Bridlington
Ormston Technology Hydralert	Challenge	Bridlington
Water Witch	Pamela S	Bridlington
Jabsco Hydro Air Switches*	Eagernoon	Scarborough
Cruz Pro & Index Marine (optical)	Carousel	Scarborough

\* The Jabsco Hydro Air Switches were connected to a custom-built control unit.

## Conclusions

### Complying with the Seafish Construction Standards

When choosing a bilge alarm system, fishermen should first be aware of what is acceptable under the Seafish Construction Standards. Of the seven systems tested, only two comply with the Seafish Construction Standards for use on all fishing vessels up to 24 metres registered length, the Ormston Technology Hydralert system and the Electronic Devices (ED830) system. Barring the Cruz Pro system, the rest comply with the Standards for use on fishing vessels under 15 metres length overall (providing a suitable control box is provided in the case of the Jabsco sensors).

### Bilge Water

Compliance aside, there are many factors to consider when purchasing a bilge alarm system, the most influential of which is the environment in which the sensors will be situated. It would be a mistake to believe that the sensors will only encounter normal seawater when in fact they may frequently be submerged in oily liquid or sludge that will leave residue ‘clinging’ to the sensors. As an example of this, the photo below shows the Cruz Pro sensors at the time of their removal from the bilge of the fishing vessel *Carousel* after five months of use.



*Two Cruz Pro sensors after five months in the bilge of the fishing vessel, Carousel.*

During onboard testing, the Index Marine resistive sensors often continued to sound the alarm long after their removal from bilge water because of residue ‘clinging’ between the probes. In such cases, the sensors had to be physically wiped clean to silence the alarm. The Water Witch sensors, which rely on a similar technology, appeared to suffer from this problem on only one occasion, which indicates that this may be a design issue rather than a fault of the technology used.

The Index Marine optical sensors suffered from a similar problem, with residue sometimes clinging to the sensor eye. Again, wiping the sensors solved the problem but this isn’t really a viable option for a skipper at sea.

All of these sensors function perfectly well in clean water, as the in-house testing proved, but consideration has to be given to the environment in which they will serve and the bilge of a fishing vessel is very rarely filled with clean water.

### **Build Quality**

The build quality varied from system to system and again it would be unwise to ignore this as a consideration. The dedicated control units were all of adequate construction for installation aboard a fishing vessel barring the Cruz Pro unit which developed a faulty reset button at an early stage. The custom-built control unit for the Jabsco Hydro Air switches also developed a problem with the reset button and, although this should not reflect badly on the sensors themselves, it cannot be ignored as a problem to consider if opting for these sensors because Jabsco do not provide a dedicated control unit for them. Of all the control units tested, the Water Witch WW600 and the Electronic Devices ED830 control panels appeared to be the most robust.

Most of the sensors were of suitable construction for location in a bilge as far as durability is concerned. A weakness was discovered in the Jabsco sensors in the connection between the sensor cup and connecting tube. Unless the tube is firmly fastened in place, it can be easily pulled away from the cup with very little effort (whether by accident or on purpose to prevent the alarm from activating). However, this aside, none of the sensors developed any problems relating to durability.

### **Miscellaneous Issues**

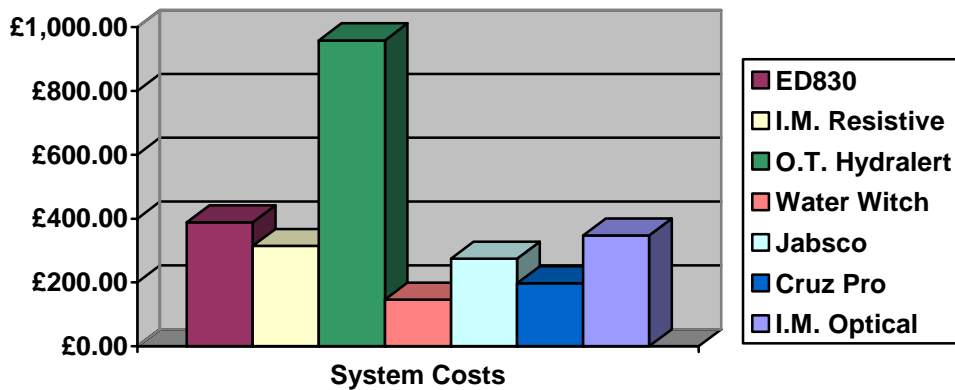
It should be pointed out that the Ormston Technology Hydralert system has the advantage that the alarm levels can be programmed into the unit. In other words, a sensor can be fitted low down in the bilge and then two higher levels programmed into the unit at which the alarm will activate if water reaches them. However, one problem with this is that, unless marked, the skipper may be unaware of these levels (especially if one skipper passes responsibility over to another). Another problem with this is that, if these levels are set much higher than the sensors, the skipper will have no choice but rely on the test syringes in the junction boxes to check that the sensors are working because it will be impossible to conveniently check them with a container of water. Although this is exactly what the syringes are provided for (and they are very easy to use), the skipper of *Challenge* was very reluctant to accept this as a method to rely upon rather than a simple cup of water.

### **Technology**

The ED735 float sensors are a compact version of the traditional float sensor which has been used in various forms throughout the years. Some manufacturers of solid-state sensor technologies may boast that their sensors are more reliable due to the lack of moving parts in them, but these tests have proven that this is not necessarily the case. The ED735 float sensors performed entirely without problem for the duration of the six month trial. This isn't to say that other technologies should be ignored. The Water Witch system uses solid-state sensors in a design that appears to work well. The Jabsco Hydro Air switch and the Ormston Technology Hydralert system both rely upon changes in pressure for the detection of water, and these also work fine. However, as already mentioned, problems can arise with certain sensors which rely on the passage of current between two probes, and also optical sensors, with oily/sludgy bilge water 'clinging' to the sensors, thereby triggering alarms for longer durations than necessary. And there are few fishermen who would tolerate the irritation of a constant alarm wailing beside them in the wheelhouse.

## Cost comparison

The chart below shows a cost comparison of the different systems tested. The cost shown for each system is based upon the actual price that Seafish paid for the equipment, which may differ from actual retail price, and does not include VAT or carriage.



In order to produce a fair comparison, the costs indicated cover the basic items that are needed for each system to detect high water in four zones. In the case of the Jabsco sensors, the cost of the custom-built control unit is included, and in the case of the ED830, the xenon beacon is not included.

Installation costs did not vary significantly from one system to the next, therefore these costs have not been taken into account in this comparison.

As can be seen, the Ormston Technology Hydralert system was by far the most expensive, while the Water Witch system was the cheapest (when purchased as a four zone alarm system).

# The Bilge Level Alarm Systems

## *Test Results*

## Electronic Devices (ED830)

### Components installed

1 No. ED830 Control Panel

4 No. ED735 Float Sensors

1 No. ED4 Sounder

1 No. Xenon Beacon (not included in price comparison)



### Description

The ED830 control panel is of a sturdy build with four independent circuits for the connection of up to four float sensors. Each of these circuits has a fault detection system which will raise an alert if the circuit becomes faulty. The control panel, which is the largest of the units tested, doesn't have a built-in audible alarm but external sounders and beacons can be connected to any or all of the four circuits if required (a sounder must be fitted to the unit for it to comply with the Seafish Construction Standards). Bilge pumps may also be connected to the circuits in a similar manner if desired. Each zone is marked on the front of the unit, with its own set of LED indicators and buttons (Alarm Accept, Reset and Test/Override). The ED735 float sensors themselves are fairly robust with an enclosed float mechanism. The separate ED4 sounder seems very much louder than any of the audible alarms built in to the other units tested, increasing the chance of crew hearing the alarm from elsewhere on the vessel, but obviously this item is an additional purchase to the control unit. Because this is quite a comprehensive unit that is already widely used, we also decided to add a xenon beacon, which worked quite effectively.

### In accordance with the Seafish Construction Standards

The ED830 control panel, with ED735 sensors and ED4 sounder, complies with the Seafish Construction Standards for use on any fishing vessel up to 24 metres registered length.

### Stage 1 Testing (in-house)

The system performed efficiently during in-house testing, reacting as it should without error. The control panel and sensors responded positively to the high water tests with the control panel resetting itself immediately when a sensor was removed from water. The time delay before activation, which can be adjusted, was exactly the same for each sensor in every test, and the rolling/slopping test proved successful with

no alarm sounding throughout. Importantly, the audible alarm (external sounder) can be muted while a sensor is under water but the visual alarm will remain active until the sensor is removed from the water. With regard to assembly, connecting the sensors, sounder and beacon to the control unit was a little more difficult than some of the other systems tested.

### **Stage 2 Testing (aboard vessel)**

This bilge alarm system performed efficiently throughout the six month trial period without failing a single test. The sensors were relatively easy to check by simply immersing each one in turn in a container of water. Each sensor circuit has its own test button and the only problem that occurred during this stage was that one sensor consistently took longer to report back than the other three when using the test button. The skipper reported that the system worked fine at sea, with the alarm activating whenever water in the bilge reached sensor level. He was quite satisfied with the system. The sounder, positioned in the wheelhouse, could be clearly heard from both the engine room and the hold while testing (which actually made testing quite easy).

### **Conclusion**

While a little more expensive than some of the other systems tested, the ED830 control panel, with ED735 sensors and ED4 sounder, is a very reliable system that can be adapted to suit individual needs. The float sensors work without fault, which is good evidence to support the use of float technology despite claims that solid-state technology should be more reliable due to the lack of moving parts, and while the control panel is fairly comprehensive it remains simple to use. When considering cost, this system provides best value for money for fishing vessels measuring 15-24m registered length, but that's not to say that it wouldn't be a suitable choice for vessels smaller than this. One final note to add would be that, due to the complexity of the connections involved (especially if multiple sounders and beacons are fitted) this system would be best installed by a competent electrician who has experience of this nature.

## **Index Marine (resistive)**

### **Components installed**

1 No. Index Marine 4 Station Bilge Alarm Control Box ref C-BE15

4 No. Index Marine Resistive Sensors ref C-BE55



### **Description**

The C-BE15 Control box is compact and fairly robust. It includes LED indicators for all four sensors and power-on, along with a power on/off switch, an 'Alarm Silence' switch and a built-in 90 dB audible alarm. There is no system check button, but the control unit performs a system check when first switched on. The C-BE55 sensors are relatively small, compared to the other sensors tested, and quite robust, with two small probes on the end which allow a small electrical current to pass between them (used to detect the presence of water). The sensors are supplied with a 10m cable already attached which is of sufficient length for most small vessels. There is additional scope to fit an external sounder or beacon.

### **In accordance with the Seafish Construction Standards**

The Index Marine (resistive) system can be used on any fishing vessel under 15 metres length overall. However, because the system does not have a fail-safe warning should the alarm circuitry become faulty, it may only be used on a larger fishing boat, measuring 15-24m, if the engine room is also provided with a secondary, independent alarm system.

### **Stage 1 Testing (in-house)**

The system performed exactly as the instructions suggested, without fault, responding positively to the high water tests. The sensors are checked every twenty seconds by the control box which, although this conserves power, it also means that activation during rolling conditions is rather hit and miss; if water slops across a sensor during a check then the alarm will sound, if it slops across during the twenty second period between checks then the alarm won't sound. During the rolling/slopping test, one of the sensors activated the alarm. Upon removal from water, the control panel can also take up to 20 seconds before deactivating the alarm. Notably, if the system is reset while a sensor remains underwater, the system re-arms itself and will re-activate the audible alarm if the sensor is still under water after a delay of approximately one minute. Performance aside, we actually found it quite difficult to connect the sensor

cables to the control box due to the lack of space by the side of the terminal blocks inside the box.

### **Stage 2 Testing (onboard vessel)**

The system successfully detected water during every test throughout the six month trial period but, quite frequently, the sensors had to be wiped after testing in order to de-activate the alarm. This problem appears to have been caused by bilge water 'clinging' between the probes (when tested in clean water during Stage 1, this problem didn't occur). However, there were no other problems reported by the skipper of the vessel.

### **Conclusion**

The system detects high water without fault, but there is a possibility that the alarm will continue to sound after water has been pumped from the bilge, depending how oily/sludgy the bilge water is, which may prove annoying to many fishermen. Compared to some of the other systems, there is a slightly higher chance of the alarm activating during rolling/slopping conditions, which may cause frustration. However, the system did prove to be reliable in the detection of water and the skipper of the vessel had no complaints.

## Ormston Technology Hydralert System

### Components installed

1 No. Ormston Technology Hydralert Bilge Monitor

2 No. Ormston Technology Dual Stage Sensors c/w Test Boxes



### Description

The Hydralert Bilge Monitor is a moderately sized control panel of suitable construction for fitting in the wheelhouse of a vessel. It has a simple front face layout with two sets of low and high level warning lights, two corresponding power lights and a reset button. There is no system test button, but the monitor unit performs a system test when first switched on. As a fail-safe measure, an alarm will sound in the event of an open or short circuit between the monitor unit and any auxiliary unit (sensor or repeater panel). The dual stage sensors are solid state pressure sensors of durable build quality. Unlike the other systems tested, two levels of alarm activation can be programmed into the Hydralert system - the test system was programmed by Ormston Technology so that water would trigger the low level alarm if it reached the top of the sensor cylinder and the high level alarm would be activated at a point 125mm above this. The system also includes one junction / test box for each sensor which is fitted between the sensor and the control panel. These boxes include a small plastic syringe which can be used to test that the sensor is working; connecting the syringe to the free end of the pressure equalization tube within the test box and pulling the plunger should trigger the alarm if it is working. The test boxes also include a small flip switch which can be used to test the open circuit alarm and short circuit alarm.

### In accordance with the Seafish Construction Standards

The Ormston Technology Hydralert system complies with the Seafish Construction Standards for use on any fishing vessel up to 24 metres registered length.

### Stage 1 Testing (in-house)

The system performed relatively well, with the alarm activating at the specific levels programmed into the unit. There was a delay of 4 seconds before the alarm was activated when Sensor 1 was submerged in water, to reduce the chance of activation during rolling/slopping conditions. However, there was no delay for Sensor 2 which meant that the alarm sounded the moment the sensor was submerged to activation depth. The unit is fully programmable, so these delays can be programmed to avoid

activation during rolling/slopping conditions but in the case of the test equipment, this delay did not exist for one sensor. We are in no doubt that Ormston Technology would have corrected the matter immediately, had we asked them to do so, but this was a test of the equipment we received, in the condition we received it, and so we had to proceed and include this point in our findings. As expected, when the reset button was pressed, the audible alarm was muted but the corresponding indicator light remained lit while the sensor remained underwater. Interestingly, the low level warning produces an intermittent bleep, approximately every ten seconds, while the high level warning produces a constant alarm – not only does this help immediately identify the level of urgency, but it also means that the low level warning is not as annoying (it's not uncommon for low level alarms to be triggered quite frequently). We also found that disconnecting a sensor triggered an alarm – part of the unit's fault detection facility.

### **Stage 2 Testing (onboard vessel)**

The system performed fairly well throughout the duration of the trial, with the alarm activating during each and every test. However, the skipper reported that the hold alarm was occasionally activating even though there wasn't enough water in the bilge to trigger it. This problem was later witnessed by the Seafish representative during a scheduled test of the system while the vessel was motionless in the harbour. All wiring outside of the monitor unit was checked for loose connections but none were found, so Ormston Technology were informed of the problem. Unfortunately, due to unforeseen circumstances, they were unable to attend the vessel to investigate (and it has to be said that they were under no obligation to do so, having not installed the system). As an additional note, the marine electricians who installed the system expressed concerns over its complexity and, indeed, the instructions supplied for the connection of the test boxes were not entirely adequate.

### **Conclusion**

The Ormston Technology Hydralert bilge alarm system is quite a sophisticated piece of technology when compared to the other systems described in this report, a point clearly reflected in the price, and additional items can be included (such as a phone dialler) if so required. There is no doubt that the system detects water levels without error, but we encountered problems with the alarm activation delay and also random activation while onboard the vessel (although the cause of this problem remains unknown). It is not as simple to install as some of the other systems tested and this is, perhaps, where its complexity becomes a disadvantage. The skipper of *Challenge* was also reluctant to rely upon the syringes to test the sensors but if the activation levels are programmed much higher than the sensors themselves then there really is no choice but to rely on them (and this is exactly what they are intended for). One drawback of being able to programme the levels of alarm activation is that these levels are not actually visible. Therefore, if using this system, it would be advisable to mark the activation levels by some permanent means so that the skipper and crew are fully aware of them.

## Water Witch

### Components installed

1 No. Water Witch Multi Bilge Alarm Unit ref WW600

4 No. Water Witch High Water Sensors ref WW23-24-1



### Description

The Water Witch control unit and sensors are of a heavy, robust build quality. The control unit is relatively small, taking up very little space on a wheelhouse console, and allows for the connection of up to six solid-state Water Witch sensors which are also fairly compact. With two circular probes on the front face, the sensors employ a similar technology to the Index Marine resistive sensors, using the passage of electrical current to detect the presence of water. Unlike the other systems tested, the control unit is constructed for console mounting, therefore, if mounting onto the face of a bulkhead, a back box is required. The face of the control unit has an indicator light for each sensor, a test button and a mute button. Upon initial activation, the alarm briefly pulses with all lights and buttons flashing, indicating that the unit is active and working. The system test button allows a quick check of the audible output and visual flash mode buttons. In addition, an external sounder or beacon may be connected to the control unit if desired.

### In accordance with the Seafish Construction Standards

The Water Witch system can be used on any fishing vessel under 15 metres length overall. However, because the system does not have a fail-safe warning should the alarm circuitry become faulty, it may only be used on a larger fishing boat, measuring 15-24m, if the engine room is also provided with a secondary, independent alarm system.

### Stage 1 Testing (in-house)

The Water Witch system performed efficiently during in-house testing, reacting as designed without error, responding positively to the high water tests. There was a five second time delay before alarm activation, to help prevent activation during rolling conditions, and at no point did the alarm sound during the rolling/slopping test. With a sensor underwater, the mute button silenced the audible alarm but left the indicator light flashing (the audible alarm reactivates after five minutes if left in this condition). Connecting the sensors to the control unit was a very simple process (much easier than any of the other multi-sensor systems in this report).

**Stage 2 Testing (onboard vessel)**

The Water Witch system performed very efficiently throughout the 6 month trial period and, unlike other electrical probe systems tested, bilge water residue only caused a problem in one recorded incident (the alarm continued to sound after a test until the sensor was wiped clean). The skipper of *Pamela S* reported that the system functioned well at sea, alerting him of high water when it should, and that he was entirely pleased with the system.

**Conclusion**

The Water Witch system provides a reliable and efficient means of detecting high level water in the bilge of a fishing boat. The control unit and sensors are well designed, durable, and simple to connect. Furthermore, the low cost of the system makes it an ideal purchase for fishing boats measuring under 15m length overall, to which it is best suited.

## Jabsco Hydro Air Switches

### Components installed

- 1 No. Custom-built Control Unit
- 4 No. Jabsco Hydro Air Switches



### Description

Each Jabsco Hydro Air switch package consists of a pressure switch unit, a small plastic cup, and a length of tube that connects the two together. The components are durable and relatively simple to install – the cup is mounted at the desired level in the bilge to detect water and the switch unit is mounted higher up above the bilge, where it won't come into contact with water. These units are primarily intended to activate bilge pumps and as such Jabsco do not produce a dedicated bilge alarm control panel which can be used in conjunction with them. Instead, a control panel must be purposely built or a suitable control panel located from another supplier. The decision to use a custom-built control panel for this project was influenced by the fact that the Jabsco sensors are already used by a number of local vessels, all of which use custom-built control panels. Please note that the control panel does not officially form part of this review, therefore a description is not warranted.

### In accordance with the Seafish Construction Standards

These sensors are primarily intended to operate bilge pumps, and so their use as part of a bilge alarm system is very much dependent upon the control box to which they are to be connected. They can only be used as part of a bilge alarm system onboard a fishing vessel if they are linked to a control box which has both audio and visual alerts. Furthermore, they may only be used in an engine room of a 15-24m vessel if the control unit has a failsafe warning of faulty circuitry or if a secondary independent bilge alarm system is also provided, otherwise they are restricted to under 15m vessels.

### Stage 1 Testing (in-house)

For the purpose of in-house testing, the Water Witch control panel was used to acknowledge the response of the Hydro Air switches. The sensors performed without fault during each test, activating the moment the sensor cups were immersed in water and de-activating the moment the cups were removed from the water. It was decided that a control panel would have to be custom-built to suit the switches and it would

have to incorporate anti-rolling/slopping measures because this function was not built-in to the sensors.

### **Stage 2 Testing (onboard vessel)**

Unfortunately, the control unit developed a couple of faults but the Hydro Air switches functioned efficiently throughout the duration of the six month trial. The skipper reported one occasion when the alarm had activated while the vessel was rolling (there was not enough water in the bilge to activate the alarm on a calm sea). It was also noted how easily the connecting tube could be pulled away from the sensor cup.

### **Conclusion**

As bilge water sensors, the Jabsco Hydro Air switches are very reliable, providing the connecting tubes are firmly fastened in place. A suitable control panel must be purchased separately if they are to be used as part of a bilge level alarm system, and it would be wise to place some consideration on the suitability and build-quality of such a unit. The technology used is very simple, with switches triggered by an increase in pressure caused by water rising above the sensor cup. They are very reasonably priced, with the overall cost very much dependent upon the control panel purchased, and very easy to test. It is just a shame that Jabsco don't produce a dedicated bilge alarm control panel to use with these sensors.

## Cruz Pro BWA20

### Components installed

4 No. Cruz Pro BWA20 Control Units c/w Sensors



### Description

The Cruz Pro BWA20 control unit measures just 100 x 60 x 30mm and is powered by a standard 9V DC battery which is housed inside the unit (accessed by removing the front panel). It has a built-in 85 dB audible alarm and a reset button, but no visual alarm, and comes supplied with a solid-state sensor already connected via a 5m length of cable. The control unit itself does not appear to be very robust and, indeed, during onboard testing, a fault occurred with the reset button on one unit. In contrast, the sensor seems to be quite robust and is of a solid-state variety which means there are no moving parts. Instead, it has two long probes which allow a small electrical current to pass between them for the detection of water. In order to compare it equally with the other systems, four of these units were purchased and installed onboard a vessel.

### In accordance with the Seafish Construction Standards

The Cruz Pro BWA20 control unit cannot be used as the primary form of alert on any fishing vessel covered by our standards because it has no visual warning at the control position. (Prior to the 2006 revision of the Standards, it could have been used in the hold of an under 10 metre vessel).

### Stage 1 Testing (in-house)

During in-house testing, each unit performed as it was designed to do so, reacting without error, and detecting high water in every test. The time delay before activation was exactly the same for each sensor in every test; the built-in audible alarm activated after 20 seconds of a sensor being submerged. The unit instantly re-arms itself when the sensor is removed from water but if the reset button is pressed to mute the alarm while the sensor remains underwater then the unit does not re-arm until the sensor is removed from the water (the alarm will not sound again during this time). There is no visual alarm and no system test facility.

### Stage 2 Testing (onboard vessel)

During the onboard testing stage, the units behaved quite erratically, annoying the skipper so much that he frequently removed the batteries. Another problem that arose was the fact that there were four units mounted side-by-side in the wheelhouse with

only audible alarms which made it very difficult to deduce which alarm was sounding. After three months, the reset button on one unit had stopped working and two units failed to detect water during tests. After five months, three units failed to detect water during tests and the fourth behaved erratically. The units were subsequently removed from the vessel.

### **Conclusion**

While the Cruz Pro BWA20 bilge water alarm may present a cheap solution for other vessels, such as leisure craft, it should not be used on any UK fishing vessel.

## **Index Marine (optical)**

### **Components installed**

1 No. Index Marine 4 Station Bilge Alarm Control Box ref C-BE15

4 No. Index Marine Optical Sensors ref C-BE51



### **Description**

The C-BE15 Control box is compact and fairly robust. It includes LED indicators for all four sensors and power-on, along with a power on/off switch, an 'Alarm Silence' switch and a built-in 90 dB audible alarm. The C-BE51 sensors are of similar size to the Index Marine resistive sensors and, again, quite solid and compact. However, these use optical technology as a form of detection; each sensor has an optical eye on the end face and uses light refraction to determine whether it has been submerged in water or not. The sensors are supplied with a 10m cable already attached which is of sufficient length for most small vessels.

### **In accordance with the Seafish Construction Standards**

The Index Marine (optical) system can be used on any fishing vessel under 15 metres length overall. However, because the system does not have a fail-safe warning should the alarm circuitry become faulty, it may only be used on a larger fishing boat, measuring 15-24m, if the engine room is also provided with a secondary, independent alarm system.

### **Stage 1 Testing (in-house)**

The system performed exactly as the instructions suggested, without fault, responding positively to the high water tests. The sensors are checked every twenty seconds by the control box which, although this conserves power, it also means that activation during rolling conditions is rather hit and miss; if water slops across a sensor during a check then the alarm will sound, if it slops across during the twenty second period between checks then the alarm won't sound. During the rolling/slopping test, three of the sensors activated the alarm. Upon removal from water, the control panel can also take up to 20 seconds before deactivating the alarm. Notably, if the system is reset while a sensor remains underwater, the system re-arms itself and will re-activate the audible alarm if the sensor is still under water after a delay of approximately one minute. Performance aside, we actually found it quite difficult to connect the sensor cables to the control box due to the lack of space by the side of the terminal blocks

inside the box, although this can be overcome by removing the circuit board from the box which is exactly what the electrician did when installing the system on the vessel.

### **Stage 2 Testing (onboard vessel)**

The system successfully detected water during every test throughout the six month trial period but, quite frequently, the sensors had to be wiped after testing in order to de-activate the alarm (much like the resistive sensors). This problem appears to have been caused by bilge water residue 'clinging' to the sensor eye (when tested in clean water during Stage 1, this problem didn't occur). In one instance, when switched on for testing, the control box indicated that three of the sensors were submerged in bilge water when in fact they weren't; when checked, the optical eyes were found to be covered in sludge, but not below water.

### **Conclusion**

The system detects high water without fault, but there is a possibility that the alarm will continue to sound after water has been pumped from the bilge, depending how oily/sludgy the bilge water is, which may prove annoying to many fishermen. Compared to some of the other systems, there is a slightly higher chance of the alarm activating during rolling/slopping conditions, which may cause frustration. There is no doubt that these sensors would work fine in a clean environment, but they could provide false readings in the oily/sludgy bilges of most fishing vessels.

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