

# APPLICATION NOTES

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## **APPLICATION NOTE NO. 42**

**Revised February 2014**

### **ITS-90 TEMPERATURE SCALE**

In January 1995, Sea-Bird's temperature metrology laboratory (based upon water triple-point and gallium melt cell, SPRT, and ASL F18 Temperature Bridge) converted to ITS-90 (T90). These T90 standards are employed in calibrating *all* Sea-Bird temperature sensors, and as the reference temperature used in conductivity calibrations.

The international oceanographic research community continues to use IPTS-68 (T68) for computation of salinity and other seawater properties. Therefore, following the recommendations of Saunders (1990) and as supported by the Joint Panel on Oceanographic Tables and Standards (1991), our software and our instrument firmware (for instruments that can calculate and output salinity and other seawater properties directly) converts between T68 and T90 according to the linear relationship:

$$T_{68} = 1.00024 * T_{90}$$

*The use of T68 for salinity and other seawater calculations is automatic in our software and in those instruments that directly output salinity and other seawater parameters.*

**Note:** In our Seasoft V2 suite of software programs, edit the CTD configuration (.con or .xmlcon) file to enter calibration coefficients using the Configure Inputs menu in Seasave V7 (real-time data acquisition software) or the Configure menu in SBE Data Processing (data processing software).

#### **SBE 9plus (using SBE 3plus temperature sensor), 16, 19, 21, 25 (using SBE 3F temperature sensor), and 25plus (using SBE 3F temperature sensor)**

In January 1995, Sea-Bird temperature calibration certificates began listing a set of coefficients labeled *g*, *h*, *i*, *j*, and *F0*, corresponding to ITS-90 (T90) temperatures. For user convenience and for historical comparison with older calibrations, the certificates also continue to list *a*, *b*, *c*, *d*, and *F0* coefficients corresponding to IPTS-68 (T68) temperatures. The T90 coefficients result directly from T90 standards; the T68 coefficients are computed using the Saunders linear approximation.

Seasoft supports entry of either the T90 or the T68 coefficients for these instruments. When selecting temperature as a display/output variable, you must select which standard (T90 or T68) is to be used to compute temperature. Seasoft recognizes whether you have entered T90 or T68 coefficients in the configuration (.con or .xmlcon) file, and performs the calculations accordingly, depending on which coefficients were used and which display variable type is selected.

- If *g*, *h*, *i*, *j*, *F0* coefficients (T90) are entered in the configuration file and you select temperature display/output variable type as T68, Seasoft computes T90 temperature directly and multiplies it by 1.00024 to display or output T68.
- If *a*, *b*, *c*, *d*, and *F0* coefficients (T68) are entered in the configuration file and you select temperature display/output variable type as T90, Seasoft computes T68 directly and divides by 1.00024 to display or output T90.

#### **SBE 16plus, 16plus-IM, 16plus V2, 16plus-IM V2, 19plus, 19plus V2, 26plus, 35, 35RT, 37 (all), 38, 39, 39-IM, 39plus, 45, 49, 51, 52-MP, 53, and all higher numbered instruments**

For these instruments, all first manufactured after the switch of our metrology lab to ITS-90, Sea-Bird provides only one set of temperature calibration coefficients, based on the T90 standards. These instruments all have user-programmable internal calibration coefficients, and can output data in engineering units (°C, S/m, dbar, etc. as applicable to the instrument). When outputting temperature in engineering units, these instruments always output T90 temperatures.

- Instruments that can internally compute and then output salinity and other seawater parameters (for example, SBE 37-SI) - Use of T68 for salinity and other seawater calculations is automatic; the instrument internally performs the conversion between T90 and T68 according to the Saunders equation.
- Instruments supported in Seasave and SBE Data Processing (for example, SBE 19plus V2) - Use of T68 for salinity and other seawater calculations is automatic; the software performs the conversion between T90 and T68 according to the Saunders equation. When selecting temperature as a display/output variable, you must select which standard (T90 or T68) is to be used to compute temperature.

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## Application Note Revision History

Date	Description
Nov1996	Initial release.
Sep01	Previously referred to SEACON in discussions of .con files. Added references to modifying .con file using Configure menu in Seasave or SBE Data Processing in Windows software.
May07	<ul style="list-style-type: none"> <li>• Incorporate Seasave V7.</li> <li>• Add information on instruments that output temperature in engineering units.</li> </ul>
Mar08	Add applicability to V2 SeaCATs (16plus V2, 16plus-IM V2, 19plus V2)
Feb10	<ul style="list-style-type: none"> <li>• Change Seasoft-Win32 to Seasoft V2.</li> <li>• Add info on .xmlcon.</li> <li>• Update address.</li> </ul>
Jan14	Add applicability to SBE 25 <i>plus</i> and 39 <i>plus</i> .



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## APPLICATION NOTE NO. 71

**Revised January 2014**

### **Desiccant Use and Regeneration (drying)**

This application note applies to all Sea-Bird instruments intended for underwater use. The application note covers:

- When to replace desiccant
- Storage and handling of desiccant
- Replacement of desiccant
- Regeneration (drying) of desiccant bags
- Material Safety Data Sheet (MSDS) for desiccant bags – see Süd-Chemie website ([www.sud-chemie.com](http://www.sud-chemie.com)) for updates

### **When to Replace Desiccant**

Before delivery of the instrument, a desiccant package is placed in the housing, and the electronics chamber is filled with dry Argon. These measures help prevent condensation. To ensure proper functioning:

1. Install new desiccant each time you open the housing and expose the electronics.
2. If possible, dry gas backfill each time you open the housing and expose the electronics. If you cannot, wait at least 24 hours before redeploying, to allow the desiccant to remove any moisture from the chamber.

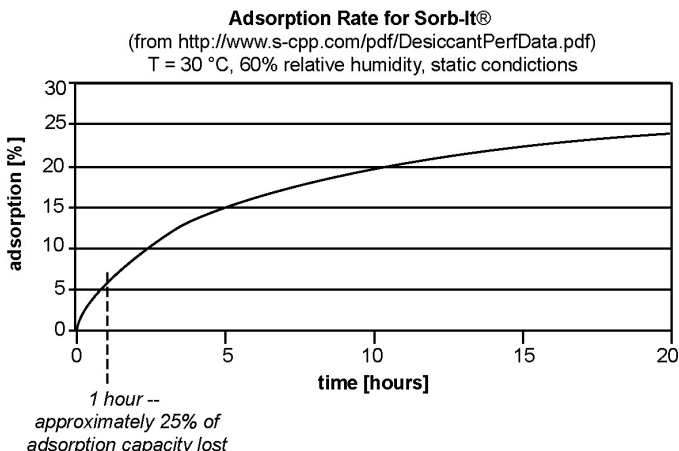
What do we mean by *expose the electronics*?

- For most battery-powered Sea-Bird instruments (such as SBE 16, 16*plus*, 16*plus* V2, 16*plus*-IM, 16*plus*-IM V2, 17*plus*, 19, 19*plus*, 19*plus* V2, 25, 25*plus*, 26, 26*plus*, 37[SM, SMP, SMP-IDO, SMP-ODO, IM, IMP, IMP-IDO, IMP-ODO], 44, 53, 54, 55, Auto Fire Module [AFM]), there is a bulkhead between the battery and electronics compartments. Battery replacement does not affect desiccation of the electronics, as the batteries are removed without removing the electronics and no significant gas exchange is possible through the bulkhead. Therefore, opening the battery compartment to replace the batteries does not expose the electronics; you do not need to install new desiccant in the electronics compartment each time you open the battery compartment. For these instruments, install new desiccant if you open the electronics compartment to access the printed circuit boards.
- For the SBE 39, 39-IM, and 48, the electronics must be removed or exposed to access the battery. Install new desiccant each time you open the housing.
- For the SBE 39*plus* and 56, the electronics must be removed or exposed to access the battery and/or the internal USB connector. Therefore, install new desiccant each time you open the housing.

### **Storage and Handling**

Testing by Süd-Chemie (desiccant bag manufacturer) at 60% relative humidity and 30 °C shows that approximately 25% of the desiccant's adsorbing capacity is used up after only 1 hour of exposure to a constantly replenished supply of moisture in the air. In other words, if you take desiccant out of a container and leave it out on a workbench for 1 hour, one-fourth of its capacity is gone before you ever install it in the instrument. Therefore:

- Keep desiccant in a tightly sealed, impermeable container until you are ready to use it. Open the container, remove the desiccant, and quickly close the container again.
- Once you remove the desiccant from the sealed container, rapidly install the desiccant in the instrument housing and close the housing. **Do not use the desiccant if exposed to air for more than a total of 30 minutes.**



## Replacement of Desiccant

Replacements are available from Sea-Bird (except as noted, all desiccant is manufactured by Süd-Chemie, a division of Clariant):

- PN 60039 is a metal can containing 25 1-gram desiccant bags and 1 humidity indicator card. The 1-gram bags (PN 30558) are used in smaller diameter housings, such as SBE 3 (*plus*, F, and S), 4 (M and C), 5T and 5P, 37 (SI, SIP, SIP-IDO, SIP-ODO, SM, SMP, SMP-IDO, SMP-ODO, IM, IMP, IMP-IDO, IMP-ODO), 38, 39, 39-IM, 39*plus* (version with no external connector), 43, 44, 45, 48, 49, 50, and 63.
- PN 31180 is a 1/3-ounce desiccant bag, used in SBE 16*plus*, 16*plus* V2, 16*plus*-IM, 16*plus*-IM V2, 19*plus*, 19*plus* V2, 21, and 52-MP.
- PN 30051 is a 1-ounce desiccant bag used in larger diameter housings, such as SBE 9*plus*, 16, 17*plus*, 19, 25, 25*plus*, 26, 26*plus*, 32, 53 BPR, 54, 55, AFM, and PDIM.
- PN 60058 is a glass bottle containing 5 desiccant capsules (PN 31044) for use in SBE 39*plus* (version with external connector) and 56. These DriCap capsules are manufactured by Multisorb Technologies.

## Regeneration (drying) of Desiccant Bags

If you run out of **bags**, you can regenerate your existing bags using the following procedure provided by the bag manufacturer (Süd-Chemie, a division of Clariant).

**NOTE:** This regeneration procedure is **not applicable** to the **desiccant capsules** used in the **SBE 39*plus* (version with external connector)** or **SBE 56**.

### ***MIL-D-3464 Desiccant Regeneration Procedure***

Regeneration of the United Desiccants' Tyvek Desi Pak® or Sorb-It® bags or United Desiccants' X-Crepe Desi Pak® or Sorb-It® bags can be accomplished by the following method:

1. Arrange the bags on a wire tray in a single layer to allow for adequate air flow around the bags during the drying process. The oven's inside temperature should be room or ambient temperature (25 – 29.4 °C [77 – 85 °F]). **A convection, circulating, forced-air type oven is recommended for this regeneration process. Seal failures may occur if any other type of heating unit or appliance is used.**
2. When placed in forced air, circulating air, or convection oven, allow a minimum of 3.8 to 5.1 cm (1.5 to 2.0 inches) of air space between the top of the bags and the next metal tray above the bags. If placed in a radiating exposed infrared-element type oven, shield the bags from direct exposure to the heating element, giving the closest bags a minimum of 40.6 cm (16 inches) clearance from the heat shield. Excessive surface film temperature due to infrared radiation will cause the Tyvek material to melt and/or the seals to fail. Seal failure may also occur if the temperature is allowed to increase rapidly. This is due to the fact that the water vapor is not given sufficient time to diffuse through the Tyvek material, thus creating internal pressure within the bag, resulting in a seal rupture. Temperature should not increase faster than 0.14 to 0.28 °C (0.25 to 0.50 °F) per minute.
3. Set the temperature of the oven to 118.3 °C (245 °F), and allow the bags of desiccant to reach equilibrium temperature. **WARNING:** Tyvek has a melt temperature of 121.1 – 126.7 °C (250 – 260 °F) (Non MIL-D-3464E activation or reactivation of both silica gel and Bentonite clay can be achieved at temperatures of 104.4 °C [220 °F]).
4. Desiccant bags should be allowed to remain in the oven at the assigned temperature for 24 hours. At the end of the time period, the bags should be immediately removed and placed in a desiccator jar or dry (0% relative humidity) airtight container for cooling. If this procedure is not followed precisely, any water vapor driven off during reactivation may be re-adsorbed during cooling and/or handling.
5. After the bags of desiccant have been allowed to cool in an airtight desiccator, they may be removed and placed in either an appropriate type polyliner tightly sealed to prevent moisture adsorption, or a container that prevents moisture from coming into contact with the regenerated desiccant.

**NOTE:** Use only a metal or glass container with a tight fitting metal or glass lid to store the regenerated desiccant. Keep the container lid **closed tightly** to preserve adsorption properties of the desiccant.

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**Application Note Revision History**

<b>Date</b>	<b>Description</b>
November 2002	Initial release.
September 2003	Add reference to newer instruments – SBE 16 <i>plus</i> -IM, 37-SMP, 37-IMP.
July 2005	<ul style="list-style-type: none"> <li>• Add information on SBE 37-SIP, 39-IM, 52-MP, and 53 BPR.</li> <li>• Remove '90208' from AFM name (90208 is AFM with standard connectors).</li> </ul>
Mar 2008	<ul style="list-style-type: none"> <li>• Add information on V2 SeaCATs (16<i>plus</i> V2, 16<i>plus</i>-IM V2, 19<i>plus</i> V2).</li> <li>• Add information on SBE 5P, 54, and 55.</li> </ul>
October 2012	<ul style="list-style-type: none"> <li>• Add information on SBE 25<i>plus</i>, SBE 37 IDO and ODO MicroCATs, and SBE 63.</li> <li>• Update MSDS from Süd-Chemie.</li> <li>• Change ownership information for Süd-Chemie.</li> </ul>
January 2014	<ul style="list-style-type: none"> <li>• Add information on SBE 25<i>plus</i>, 39<i>plus</i>, and 56.</li> </ul>