

## ITS-90 Temperature Scale

In January 1995, the Sea-Bird Scientific 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), SBE software and 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.*

The 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, 16, 19, 21, 25, 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 software 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, 39plus-IM, 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 Scientific 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 temperature is output 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 the standard (T90 or T68) to be used to compute temperature.