The Expendable Bathythermograph (XBT) – Ship Reporting Obligations and How the Data is Used

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The Expendable Bathythermograph (XBT)

The Expendable Bathythermograph (XBT) is an oceanographic instrument used to measure ocean temperatures from the surface to a depth of ~1500m. XBT probes are dropped at the sea surface by moving or stationary ships and measure ocean temperature as they fall through the water column. Two small wires on the probe transmit the temperature data back to the ship, whilst depth is inferred as a function of launch time and known fall rate.

RAN vessels are fitted with the Devil XBT System, which includes the Devil unit, computer software, test canister, and a hand-held or fixed launcher. The type of XBT probe used varies with operational requirements and water depth. The three main probes are T10 (for use in shallow water, to 200m depth), T4 (to 460m depth) and Deep Blue (for use in deep water, to 760m depth). Ships should carry sufficient probes to meet the observation requirements for the duration of their deployment or patrol. The probes are available through Naval stores.

Figure 1: Devil hand-held launcher with XBT probe (Source: http://www.turo.com.au)

Reporting Obligations for Navy Vessels

RAN vessels are required to drop XBTs routinely at six hourly intervals, commensurate with the ship’s operational requirements. Units are to report these observations using the JJVV message format. Further information regarding the XBT reporting policy, including the guidelines for monthly submissions of archived XBT returns, can be found in AFTP 1(C) Chapter 204 – METOC Operations.
How the Oceanographic Data is Used

XBT probes are dropped by ships of opportunity, including Navy ships, throughout the world’s oceans. The data collected is used by oceanographers and the wider scientific community to assist in their analyses and understanding of the vertical temperature structure of the ocean and other related oceanic properties.

The XBT observations collected by Navy ships contribute a vital source of data to the global ocean observing network. Atmospheric and oceanographic forecasts need a large amount of information about the ocean to initialise their prediction systems. Although satellite information and Argo floats provide most of the data required, they are not able to provide sufficient information alone in areas of the ocean surrounding the North-west shelf and across the top end of Australia. Scientific peer-reviewed studies have found that in-situ observations, such as those from XBTs, are a crucial data source for short-range forecasts. The addition of XBT data into an ocean model can improve the accuracy of a forecast by up to 25%, and reduce the forecast errors by more than 2 degrees for sub-surface temperature, and 0.2 kt for ocean currents.

A more commonly known use for XBT data is for the calculation of sonar range predictions by RAN warships using the Tactical Environmental Support System 2 (TESS 2) software. The XBT data is also used by deployed Mobile METOC Teams (MMTs) and Navy forecasting centres to produce Tactical Oceanographic Summaries (TOS) in support of exercises and operations.

Figure 2: XBT data showing vertical temperature profile (left) and example sonar range prediction from TESS 2 SAGE (right).

In summary, the XBT data collected by Navy ships is essential for contributing to the accuracy of the Navy’s ocean and atmospheric forecasting systems, and thus the quality of the METOC forecasts and charts. Improved accuracy of the forecasting systems will benefit all varieties of warfare, including surveillance activities, amphibious operations, and anti-submarine warfare.
Figure 3: METOC Oceanographic Forecast Summary (MOFS) produced from the Navy’s ocean model

Further Information

To obtain further information regarding the XBT system, equipment issues, or reporting obligations, please contact the Operational METOC Centre on (02) 9359 3116 or e-mail dodc.dm@defence.gov.au.