

The times of various events, particularly astronomical and weather phenomena, are often given in "Universal Time" (abbreviated **UT**) which is sometimes referred to, now colloquially, as "Greenwich Mean Time" (abbreviated **GMT**). The two terms are often used loosely to refer to time kept on the Greenwich meridian (longitude zero), five hours ahead of Eastern Standard Time. Times given in UT are almost always given in terms of a 24-hour clock. Thus, 14:42 (often written simply 1442) is 2:42 p.m., and 21:17 (2117) is 9:17 p.m. Sometimes a Z is appended to a time to indicate UT, as in 0935Z.

When a precision of one second or better is needed, however, it is necessary to be more specific about the exact meaning of UT. For that purpose different designations of Universal Time have been adopted. In astronomical and navigational usage, UT often refers to a specific time called UT1, which is a measure of the rotation angle of the Earth as observed astronomically. It is affected by small variations in the rotation of the Earth. UT1 is a modern form of [mean solar time](#) on the Greenwich meridian. Times which may be labeled "Universal Time" or "UT" in data provided by the Astronomical Applications Department of the U.S. Naval Observatory (for example, in the annual almanacs) conform to this definition.

However, in the most common civil usage, UT refers to a time scale called "Coordinated Universal Time" (abbreviated **UTC**), which is the basis for the worldwide system of civil time. This time scale is kept by time laboratories around the world, including the U.S. Naval Observatory, and is determined using highly precise atomic clocks. The International Bureau of Weights and Measures makes use of data from the timing laboratories to provide the international standard UTC which is accurate to approximately a nanosecond (billionth of a second) per day. The length of a UTC second is defined in terms of an atomic transition of the element cesium under specific conditions, and is not directly related to any astronomical phenomena.

UTC is the time distributed by standard radio stations that broadcast time, such as WWV and WWVH. It can also be obtained readily from the Global Positioning System (GPS) satellites. The difference between UTC and UT1 is made available electronically and broadcast so that navigators can obtain UT1. UTC is the basis for civil standard time in the U.S. and its territories. Standard time within [U.S. time zones](#) is an integral number of hours offset from UTC.

UTC is equivalent to the civil time for Iceland, Liberia, Morocco, Senegal, Ghana, Mali, Mauritania, and several other countries. During the winter months, UTC is also the civil time scale for the United Kingdom and Ireland.

One can think of UT1 as being a time determined by the rotation of the Earth, over which we have no control, whereas UTC is a human invention. It is relatively easy to manufacture highly precise clocks that keep UTC, while the only "clock" keeping UT1 precisely is the Earth itself. Nevertheless, it is desirable that our civil time scale not be very different from the Earth's time, so, by international agreement, UTC is not permitted to differ from UT1 by more than 0.9 second. When it appears that the difference between the two kinds of time may approach this limit, a one-second change called a "[leap second](#)" is introduced into UTC. This occurs on average about once every year to a year and a half.

For more information on time, time scales, and accurate clocks, see the U.S. Naval Observatory [Time Service Department](#) web pages. Related information can be found on the pages of the [National Institute of Standards and Technology](#) (NIST).

## Historical Note

Greenwich Mean Time is a widely used historical term, but one that has been used in several ways. Because of the ambiguity, its use is no longer recommended in technical contexts.

Prior to 1925, in astronomical and nautical almanacs, a day of Greenwich Mean Time began at *noon*. This reckoning of Greenwich Mean Time is now called Greenwich Mean Astronomical Time, and is no longer used. Persons using old editions of the almanacs for historical research should be aware of the previous convention.

Original reference: <http://aa.usno.navy.mil/faq/docs/UT.php>