



Up Top in Operations

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Differential GPS (DGPS)

Differential GPS refers to any system used to augment (improve) normal GPS (Global Positioning System) operation. There are actually many such systems in use today (private, public, and subscription-fee based), but the Coast Guard's Maritime Differential GPS Service is of interest to us.

The Maritime Differential GPS Service consists of two control centers and over 50 remote broadcast sites. The Service broadcasts correction signals on marine radio beacon frequencies to improve the accuracy of and integrity to GPS-derived positions. Suitably equipped receivers provide typically 10 meter accuracy, especially benefiting harbor entrance and approach navigation. The system provides service for coastal coverage of the continental U.S., the Great Lakes, Puerto Rico, portions of Alaska and Hawaii, and portions of the Mississippi River Basin. (The U.S. Army Corp of Engineers operates a number of transmitter sites as part of this system.)

It is a common misconception and a disservice to Differential GPS to say that this system was intended to "undo" the effects of Selective Availability, the intentional degrading of the accuracy civilian GPS positions. The Coast Guard's analysis of the needs of Harbor and Harbor Approach navigation considered the accuracy and reliability needed for an electronic navigation system. Based on the environmental results of what a navigation accident could bring with commercial shipping (and considering harbor approach channel widths, ship sizes, maneuverability, and other issues), this analysis indicated that 10 meter or better absolute positional accuracy was required. In addition, a reliability function was needed to insure that faulty signals are detected and an alarm generated within 10 seconds of occurrence.

GPS by itself does not meet either of these basic requirements (accuracy and integrity). Civilian GPS accuracy is specified at best (without Selective Availability) at 30 meters accuracy. Selective Availability is only one error source in GPS-derived positions: the effects of the atmosphere and regional weather add a significant error by changing very slightly the speed of radio signal propagation. From an integrity viewpoint, the GPS satellite architecture allows faulty signals to be transmitted up to six hours before receivers are notified about the health change in the satellites.

Differential GPS provides a solution to these issues. Each differential station uses its own carefully surveyed position to determine errors in position from each GPS satellite in view. At the same time, satellites sending signals that are clearly wrong are detected in real time. The results are then transmitted to users over Medium Frequency (MF) radio beacon transmitters. Monitoring of the differential stations is done to insure that failures of the differential stations themselves are detected immediately.

Because the atmosphere is in constant change, these corrections are only valid for a short time period. The closer the user is to the differential station, the more likely the user has the same atmospheric effects corrected by the differential station.

Vehicle location systems and precision agriculture are two areas where there is a requirement for significantly more accuracy than GPS can provide (even with Selective Availability off), and represent a need for DGPS across the entire U.S., not just coastal regions. Because of the exploding demand for electronic precision location, the Department of Transportation's Nationwide Differential GPS (NDGPS) expansion is underway. The NDGPS plan calls for the conversion of a number of U.S. Air Force Ground Wave Emergency Network (GWEN) sites in their current location and relocation of the remaining sites into desired regions. Each of these sites has a useful range of 250 miles, generally much larger than the marine radio beacon transmitters. Budget decisions of Congress have limited the funding for this project in the current budget, in spite of DOD, DOT, and administration support.

Ned Kroeker, BC-OEN

The Backfire Flame Arrestor

The Winter doldrums offer an opportunity to do many of those maintenance tasks that often fall victim to procrastination during the Spring, Summer, and Fall boating season. One of those tasks is inspecting and cleaning the backfire flame arrestors on those boats equipped with installed gasoline engines. The Federal Requirements state, Gasoline engines installed in a vessel after 25 April 1940, except outboard motors, must be equipped with an acceptable means of backfire flame control. The device must be suitably attached to the air intake with a flame tight connection and is required to be Coast Guard approved or comply with SAE J-1928 or UL 1111 standards and marked accordingly. The purpose of installing a flame arrestor is to prevent an engine backfire from setting fire to combustible materials or explosive fumes near a gasoline engine.

After some hours of engine operation there may be an accumulation of oil or grease on the inner and outer surfaces of the flame arrestor. In a worse case scenario an ordinary backfire could ignite this oil or grease and start a fire in the boat's engine compartment. Such a fire if undetected and extinguished immediately could result in severe damage or even loss of the boat. It is a good practice to inspect the flame arrestor on a regular basis and to make sure it is free of any accumulation of oil or grease. How often oil or grease will build up on a flame arrestor, if at all, will depend on the type of engine and how it is used and maintained. As the old saying goes, An ounce of prevention is worth a pound of cure.

Art Murray, BC-ONB

A Word from the Editor

Thanks to all of you who commented on our first newsletter of the year. I will forward comments to the appropriate Division Chief for his/her information and consideration. We are happy to see so many of you are reading it.

Those of you wish to may use the articles for your own letters. We like to see the information disbursed to as many people as we can reach. You can help us do that by passing along the information.

Janet Gaynor, BC-OSE