Depth Mode vs. Elevation Mode in HYPACK®

by Jerry Knisley

There has always been a bit of confusion about the **Depth Mode** versus **Elevation Mode** in HYPACK®. The reason for the confusion is because they look at the world from different perspectives. HYPACK® was designed to enable hydrographic surveys where typically the depth below a datum is plotted on a chart. Since depths are not plotted as a negative value on most charts, HYPACK® was built around **Depth Mode**. After several years and the adoption of HYPACK® for purposes other than charting, **Elevation Mode** was developed and added.

When working in HYPACK®, there is a formula to compute the vertical point of a sounding in relation to a datum. At the end of this article there is a section that explains what a datum is. Basically, the datum defines the zero point for the vertical component of the survey.

The formula that HYPACK® uses to calculate the corrected depths for single beam soundings is:

Corrected Depth = Depth Below Water + Draft + Tide – Heave

In this example the corrected depth is expected to be a positive number in relation to the datum reference of the tide value.

- Depth Below Water (DBW) is a positive number.
- Draft is the distance that the keel is below the water line.
- Tide is a negative number if the water is above the gauge because it needs to be removed from the water DBW to align the sounding to the datum.
- Heave is removed by subtracting the vertical motion of the vessel.

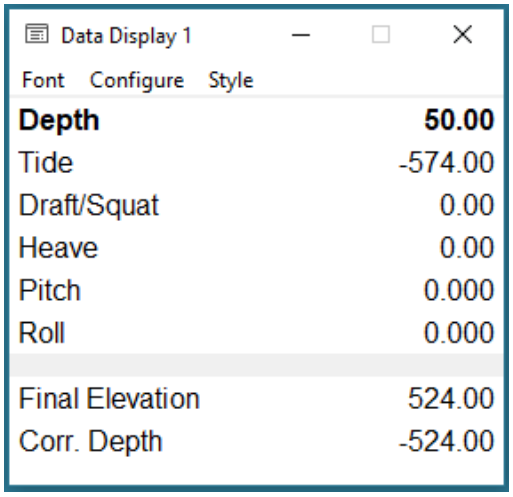
This is always the math that is applied to compute a corrected depth. Now there are other corrections that can come into play in post processing like sound velocity adjustment value or pitch and roll corrections. To keep this explanation simple, we are going to leave them out.

The conversion from **Depth Mode** to **Elevation Mode** is quite simple.

Final Elevation = Chart Datum Level – Corrected Depth

Chart datum level is the vertical reference value of the datum that the user can enter within HYPACK's Geodetic Parameters. In Michigan, a state that has produced a couple of long term HYPACK employees, the current standard is the **International Great Lakes Datum of 1985 (IGLD 85)**. If no chart datum level is entered, the value is the inverse of the corrected depth.

Let's put this into a practical example. There is a dredge operating inland. On this dredge, the tide computed by the RTK is -574 ft. The bucket is traveling to a depth below the water around 50 feet. Draft is set to 0 and there is no heave on the dredge. Chart datum level was left as 0 in this case.



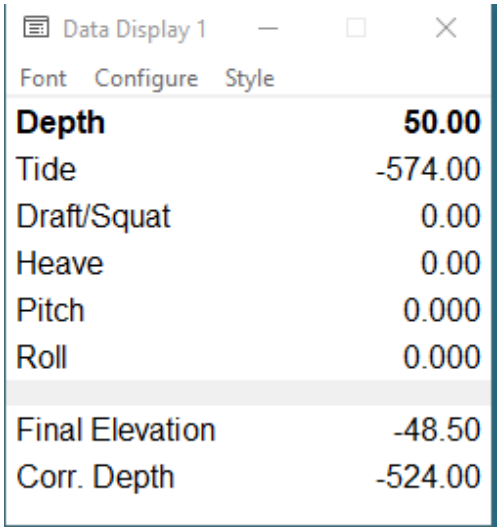
Corrected Depth = Depth Below Water + Draft + Tide – Heave
= 50 + 0 + (-574) - 0
= -524

Final Elevation = Chart Datum Level – Corrected Depth
= 0 – (-524)
= 524

The water surface value is a larger value than the depth below the water, so the depth mode makes for a corrected depth that is negative. When converted to elevation mode the value informs us that the elevation is 524 feet above the reference, which in this case is the mean sea level (MSL).

This is common in dredging operations inland where the project is dredging to a permitted elevation, but now let us assume that we are working in a channel and not on a permit. The charted depth on the Detroit River is most useful if the value lets the vessel operator know how much water to expect.

If we enter 572.5 as the chart datum level into the equation, the number makes more sense. The chart datum value is entered into Geodetic Parameters as a negative value to cancel out the elevation of the chart datum.



Corrected Depth = Depth Below Water + Draft + Tide – Heave
= 50 + 0 + (-574) - 0
= -524

Final Elevation = Chart Datum Level – Corrected Depth
= -572.5 – (-524)
= -48.5

The Final Elevation is a negative number because the result is below the Chart Datum Reference.

There are a few important takeaways from this lesson on depth and elevation modes.

1. The water level above a chart datum is **ALWAYS** entered as a negative number in HYPACK Survey.
2. Depth of a sensor below the water line is **ALWAYS** expected to be a positive number.

Datum Definition

A **datum** is a fixed reference surface used to measure locations, elevations, or depths consistently. In surveying and mapping, a vertical datum (like NAVD 88 or MLLW) provides a common "zero point" from which heights or water levels are measured, while a horizontal datum (like WGS 84 or NAD 83) defines a coordinate system for latitude and longitude. Without a datum, measurements would be relative only to local points and could not be compared or combined across regions. In short, a datum is the baseline that makes geographic and elevation data universally consistent.