Frequently Asked Questions

Question: My WL3100 has a stated accuracy of 0.02% but it is not measuring accurately as the water level changes ?

Answer:

First, some theory:

A bubbler (or submersible) water level transducer measures the water pressure (relative to atmospheric pressure) and calculates the water depth. In the transducer, a simple formula is used:

Water Level =   Measured Pressure   x   User Factor   (+   User Offset)
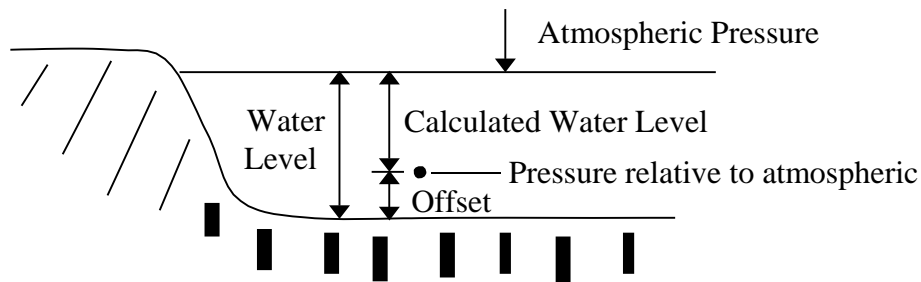
We are taught that :   "Force = mass x acceleration"   the amount of force that a body of water exerts is dependant upon the acceleration due to gravity.

The mass of an object is :   "mass = volume x   density"

so now we have :   Force =   mass   x   acceleration due to gravity
= (volume x   density)   x   gravity
= (area x depth x density)   x gravity

Relating back to pressure :
"Pressure   =   Force /   Area"   (substitute the Force from above)
= (area x depth x density) x gravity   /   area
Pressure   =   depth x density x   gravity

Solve for depth :
Depth   =   Pressure   /   (density x gravity)

Water Depth =   Pressure   x   (1 / (density x   gravity))

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Therefore :

$$\text{User Factor} \quad = \quad 1 \; / \; (\text{density} \; \text{x} \; \text{gravity})$$

NOTE : **We have now shown that the User Factor is a function of water density and gravity !!!**

You may think that water density and gravity are constant !   ***** WRONG *****

We learn at school that gravity creates an acceleration of $9.8m/s^2$. Note however, this is just an approximation !! The exact measurement of gravity is different at every location on earth, and depends upon your distance from the centre of the earth. The earth is not exactly spherical, so gravity is dependant upon your latitude and your height above sea level.

Water density also changes slightly with the water temperature and purity.

The above laws of physics apply to any pressure transducer that you buy !!

(There are other minor factors which also affect the Water Level !)

The user factor programmed in to all Hydrological transducers is **" 0.101972 m / kPa "**

However, when we ship a transducer to a customer, the exact relationship will change because the customer is at a different location on earth, at a different altitude, with a different climate.

So if a customer requires an **"exact"** result, they may have to **trim** the user factor. Once you determine the correct User Factor, all transducers from Hyquest Solutions can be changed to have the same factor.

How do I trim the User Factor ?   You could do this in one of 2 ways –

1. By trial and error.

When installing a transducer, you would normally set the Water Level to match a Gauge Plate at the site. This will automatically introduce a "User Offset" (as shown in the first equation). As the water level changes you may notice an error compared to the Gauge Plate.

If the "change" in the measured water level is less than the "change" shown on the Gauge Plate, then increase the User Factor slightly.

If the "change" in the measured water level is more than the "change" shown on the Gauge Plate, then decrease the User Factor slightly.

2. By calculation !!!

Gauge Plate

This is best explained with an example.
(exaggerated)

When the WL3100 is first installed, the water
Level is set to the reading on the Gauge Plate
(say 1.000m) As the water level varies you
notice that when the water level is at the 3.500m
point on the Gauge Plate, the WL3100 reads
3.350m, so the WL3100 is "**under**" reading by :
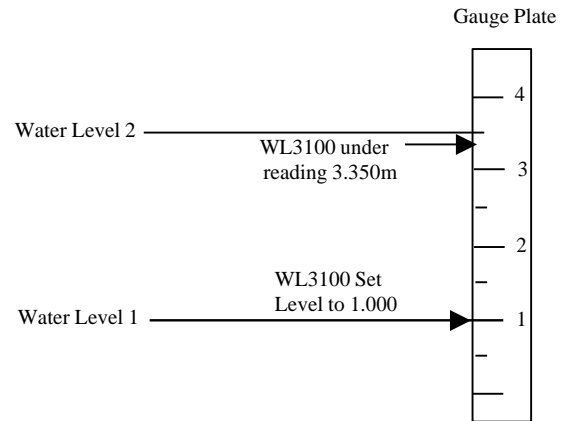
$$\frac{\text{error}}{\text{change}} = \frac{(3.500 - 3.350)}{(3.350 - 1.000)} = \frac{0.150}{2.350} = 0.06383$$

You should **"increase"** the User Factor by this ratio :

New User Factor = 0.101972 x (1 + 0.06383) = 0.108480 m / kPa

(If you have selected "feet" and "psi" in your WL3100, the default User Factor is 2.306668 ft / psi)
(So **your** new User Factor = 2.306668 x (1 + 0.06383) = 2.453903 ft / psi)

Set the WL3100 Level to match that on the Gauge Plate, and the WL3100 should now track the water
level accurately !