## From geometry file times to Aarhus Workbench times – gate times

The geometry file lists the center, open and close GateTimes. These times are adjusted with the calibration factor GateTimeShift and a delay called the MeaTimeDelay to get the times used in Aarhus Workbench.

The MeaTimeDelay is an instrument related factor. In the instrument, the gates start quite narrow and the get wider and wider for later times. If the same setup was used for both low and high moment, one would get unnecessarily broad gates for the high moment, so SkyTEM Surveys started to shift all the gates when measuring high moment. This shift was initially included in the calibration factor, but this was rather confusing, so it was separated out into its own value when this geometry format was created. It is of course always 0 for the low moment and 0 for both moments when using separate gate table for each moment.

Workbench GateTimes = Geometry File GateTime + GateTimeShift + MeaTimeDelay

## From geometry file times to Aarhus Workbench times – front gate times

Similarly, there is a FrontGateTime listed in the geometry file, this one should be adjusted with the GateTimeShift and FrontGateDelay to get the times used in Aarhus Workbench.

The FrontGateDelay is another instrument related factor. There is, and have always been, a delay from where the FrontGateTime is set, and to where it actually is. This delay was in the past always include in the FrontGateTime, but to make things less confusing this again was separated out into its own value. It always has the same value though.

Workbench FrontGateTime = Geometry File FrontGateTime + GateTimeShift + FrontGateDelay

The front gate is only used for the high moment. The negative values given to the FrontGateTime for the low moment indicated that it has no effect on anything.

## First usable gates

Based on the above timings it is possible to calculate a lower bound for the first usable gates of each moment. It is usually not necessary to make this calculation as SkyTEM Surveys conveniently writes the first usable gate values into the geometry file using the RemoveInitialGates lines, but it can be relevant to know how this lower bound can be found.

Below is an example of this calculation. First the relevant parts of the geometry file are listed.

FrontGateDelay=2.5E-06

/-------- Waveform definition ------------------------------------
/WaveformPoint  Time (s)  Normalized amplitude [0;1]
…
WaveformLMPoint36=6.6839E-06  0.0000E+00
…
WaveformHMPoint29=4.48234E-05  0.00000E+00

/------- Gate Time table ----------
/GateTimeNumber  Center (s)  Open (s)  Close (s)
GateTime01=7.150E-07 4.300E-07 1.000E-06
GateTime02=2.215E-06 1.430E-06 3.000E-06
GateTime03=4.215E-06 3.430E-06 5.000E-06
GateTime04=6.215E-06 5.430E-06 7.000E-06
GateTime05=8.215E-06 7.430E-06 9.000E-06
GateTime06=1.022E-05 9.430E-06 1.100E-05
GateTime07=1.221E-05 1.143E-05 1.300E-05
GateTime08=1.472E-05 1.343E-05 1.600E-05

[Channel1]
GateTimeShift=-1.5e-6
MeaTimeDelay=0.000E+00
FrontGateTime=-1.000E-06

[Channel2]
GateTimeShift=-1.6e-6
MeaTimeDelay=6.000E-05
FrontGateTime=7.000E-05

The relevant gate open times are calculated using:

Workbench GateTimes = Geometry File GateTime + GateTimeShift + MeaTimeDelay

First the low moment:

Low moment gate 5 opens in 7.430E-06 -1.5E-06 + 0 = 5.93E-6

Low moment gate 6 opens in 9.430E-06 -1.5E-06 + 0 = 7.93E-6

Then it is compared with the end of the waveform. For low moment it ends in 6.6839E-06. So, the first potentially usable low moment gate is gate 6.

Then the high moment:

High moment gate 7 opens in 11.43E-06 -1.6E-06 + 60E-06 = 69.83E-06

High moment gate 8 opens in 13.43E-06 -1.6E-06 + 60E-06 = 71.83E-06

Then it is compared with the end of the waveform. For high moment it ends in 44.8234E-06. So that is well out of the way, but for high moment it is also necessary to compare with the time for the front gate that is calculated using:

Workbench FrontGateTime = Geometry File FrontGateTime + GateTimeShift + FrontGateDelay

The high moment front gate is located at 70.000E-06 -1.6E-06 + 2.5E-06 = 70.9E-06

So, the first potentially usable high moment gate is gate 8.

### Auto disabling gates close to the end of the waveform

In practice it is not quite enough to have the first gate open after the end of the waveform. There should in fact be a little time interval between the end of the waveform and the begin of the first gate. If they are too close together, it can cause numerical instability when inverting.

To prevent this from becoming an issue, the inversion setup will auto disable gates that begin before 1,05 times the end of the waveform. This simple solution of course only works because the zero time has been defined to be at the begin of the ramp down.

The value can be adjusted through the TEMFileSettings.ini file located in the InversionSettings folder of the Workbench installation, but this should only be done by expert users.