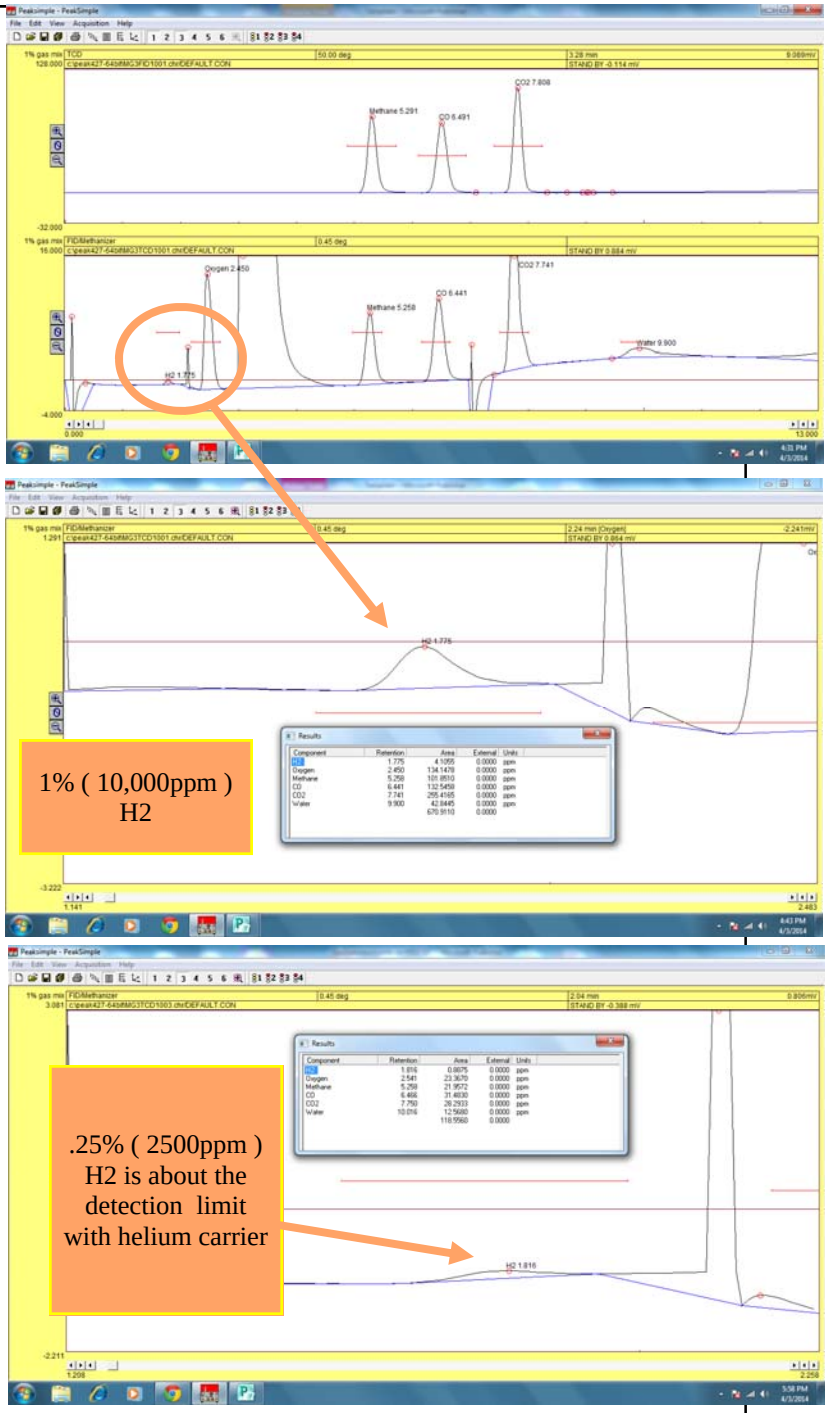
Detection Limit for Hydrogen On SRI Multiple Gas #3 GC

The Multiple Gas#3 GC configuration is described in another document.

A typical MG3 chromatogram of a 1% gas mix is shown at right.
The top trace shows the FID/methanizer signal on Medium gain. The bottom trace shows the TCD on high current. Helium carrier gas was used for this series of chromatograms.

The 1% hydrogen peak is much smaller than the other peaks. This is because the thermal conductivity of hydrogen is very similar to the thermal conductivity of the helium carrier. The TCD sensitivity depends on the difference in thermal conductivities.
Hydogen's TC is 419
Helium's TC is 343
Nitrogen's TC is 58
Methane's TC is 73
CO's TC is 53
CO2'sTC is 34
Argons's TC is 39



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The series of chromatograms shown at right illustrates another peculiar thing about hydrogen in a helium carrier gas.

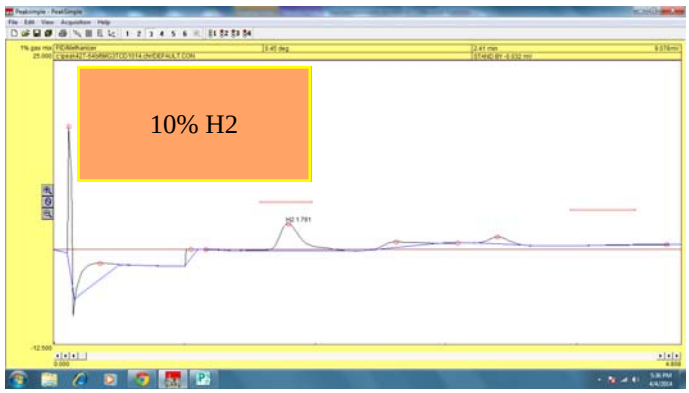
As the concentration of hydrogen mixed in with helium exceeds 8%, the thermal conductivity of the mixture decreases rather than increases as would be expected. This only happens with mixtures of helium and hydrogen. No other molecules behave this way.

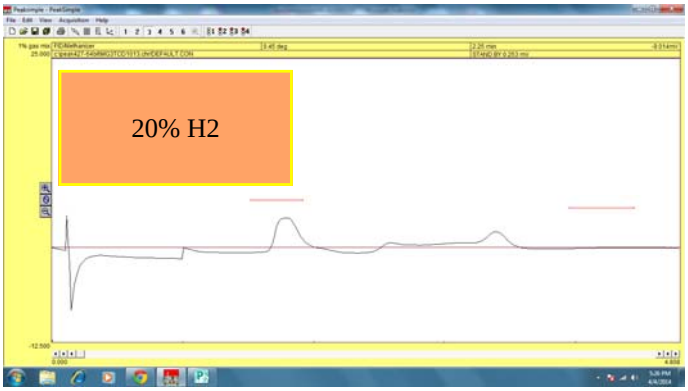
As shown at right, the 10% H2 peak goes positive, like the other peaks in the mix.

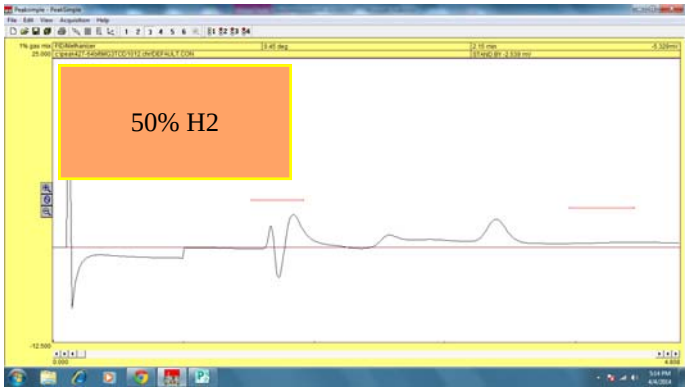
The 20% H2 peak has a strange shape with a flattened top because at the tippy top the peak is just starting to go negative.

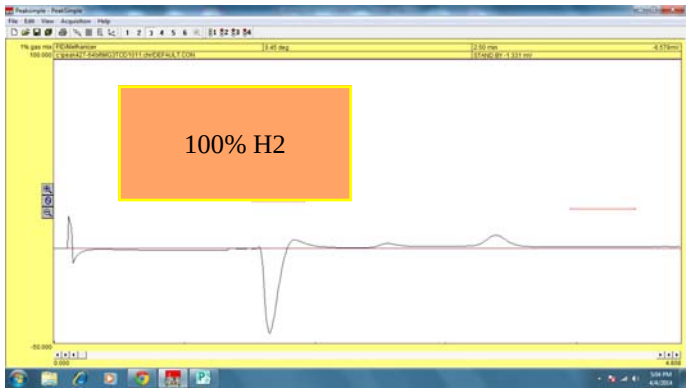
The 50% H2 peak shows the conductivity reversal very clearly. You can see the peak starting to increase in the positive direction then reversing negative and then going positive again. A " W" shaped peak.

At 100%, the H2 peak is completely negative.









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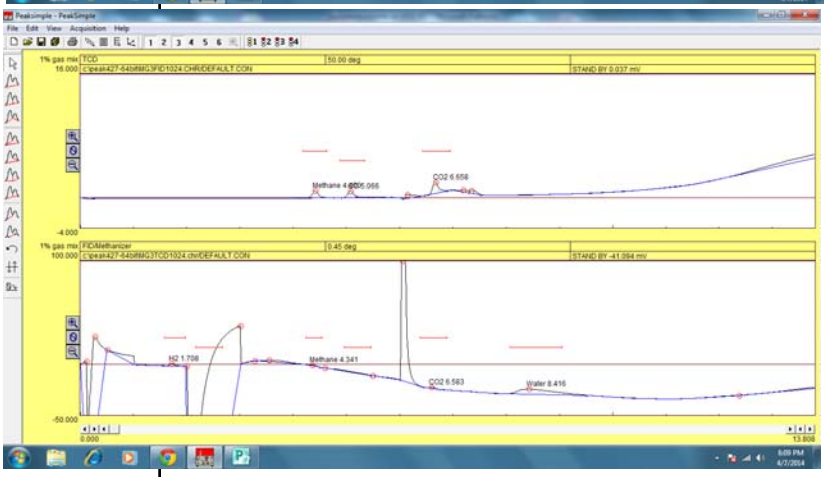
The following chromatograms were run using Nitrogen carrier gas instead of helium.

The 1% mix is shown at right. Note the very large Hydrogen peak. Note also that no CO peak is detected on the TCD detector, although methane and CO2 are detected. CO is still well detected by the FID/ methanizer.

At .1% (1000ppm) the H2, methane and CO2 are all detected.

At .01% (100ppm) the peaks are still detectable.



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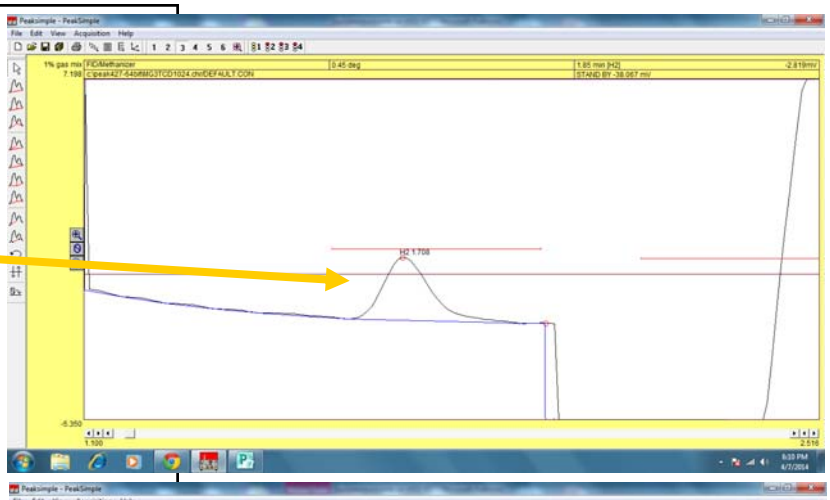
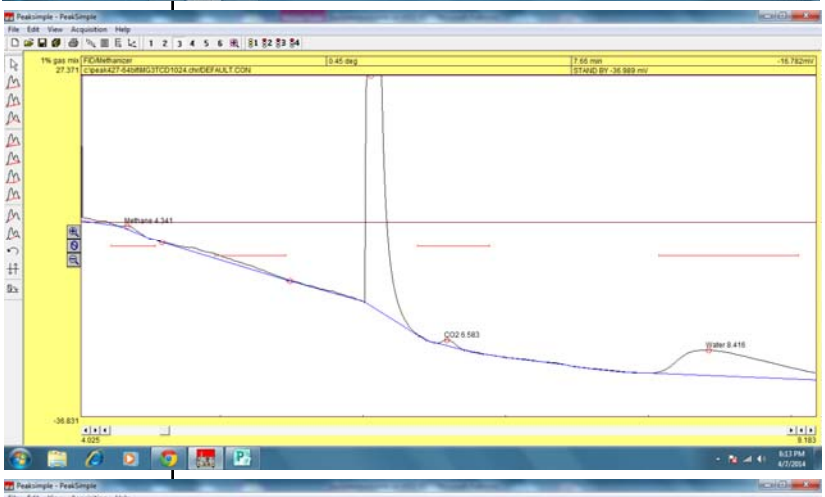
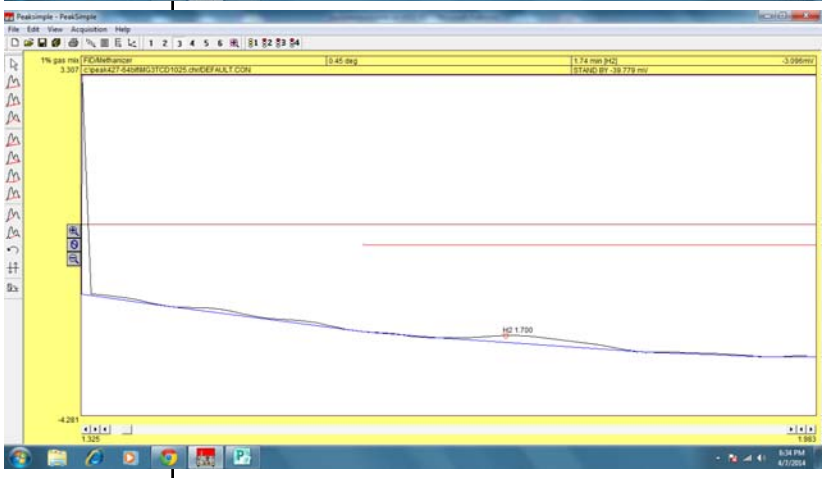
This is what 100ppm H2 looks like with Nitrogen carrier on high TCD current.



Methane and CO2 are still just detectable at 100ppm.



At 10ppm only the H2 is still detectable.



Detection Limit for Hydrogen On SRI Multiple Gas #3 GC

The following series of chromatograms were run using argon carrier and low TCD current. With argon carrier it is best to only use low current, as filament damage may occur when using the high current setting.

At .1% (1000ppm) all the peaks are detectable on the TCD.

At 100ppm the H2 is still easily detectable, the methane is just detectable, but the CO and CO2 are not detected.