

# Detection Limit for Hydrogen On SRI Multiple Gas #3 GC - TCD

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.

**Hydrogen's TC is 419**

Helium's TC is 343

Nitrogen's TC is 58

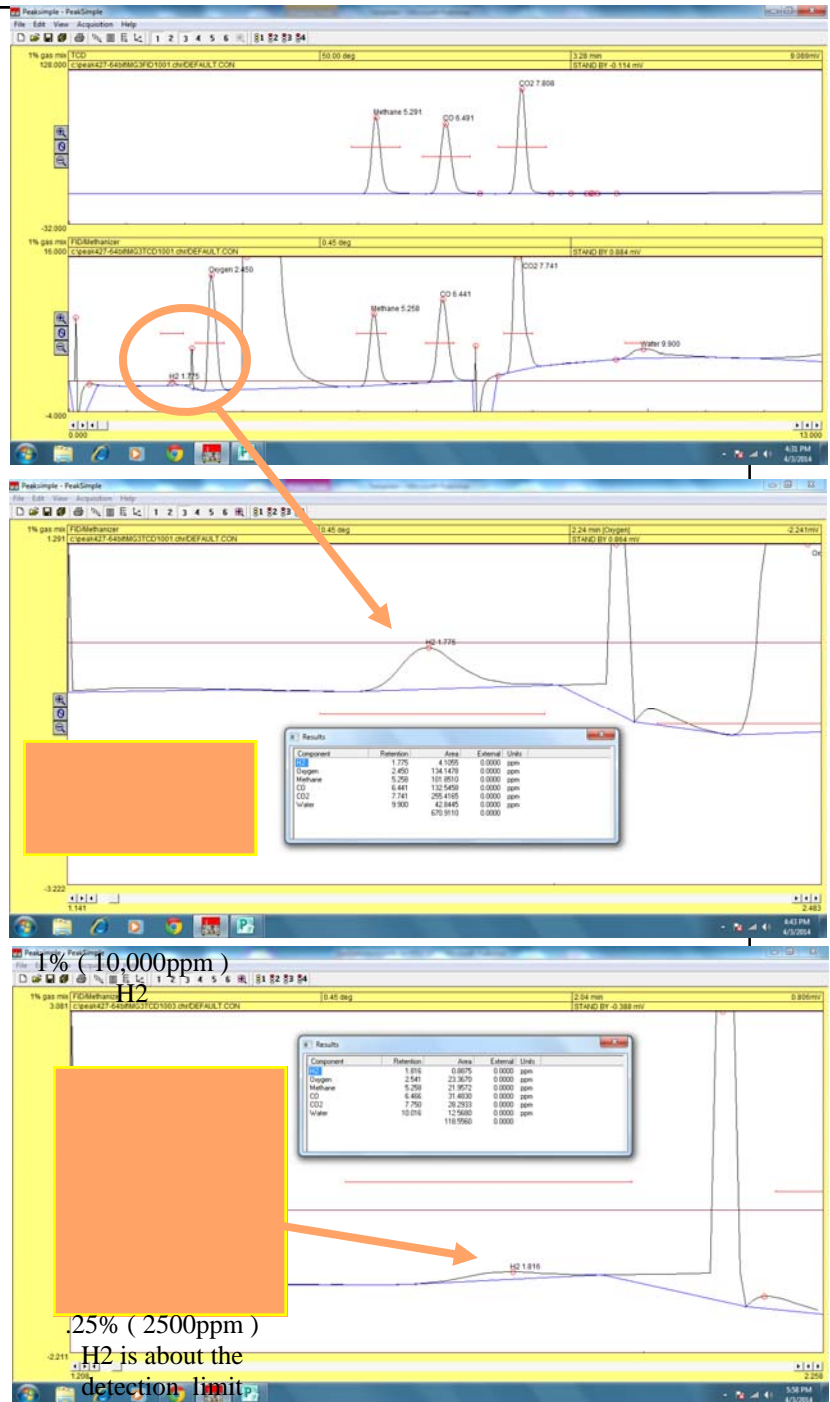
Methane's TC is 73

CO's TC is 53

CO2's TC is 34

**Argon's TC is 39** > as Carrier; H2 sensitivity is excellent ~1ppM for lower use SRI RGD Detector

**BUT All others/VOCs are useless >5000-10000ppM using Argon**



1% (10,000ppm)  
H2

0.25% (2500ppm)  
H2 is about the  
detection limit  
with helium carrier



# Detection Limit for Hydrogen On SRI Multiple Gas #3 GC - TCD / He Carrier Gas

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% H<sub>2</sub> peak goes positive, like the other peaks in the mix.

The 20% H<sub>2</sub> peak has a strange shape with a flattened top because at the tippy top the peak is just starting to go negative.

The 50% H<sub>2</sub> 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 H<sub>2</sub> peak is completely negative.

TCD of He/H<sub>2</sub> mixes is thermodynamically anomalous at 1-10% > bad non-linearity response



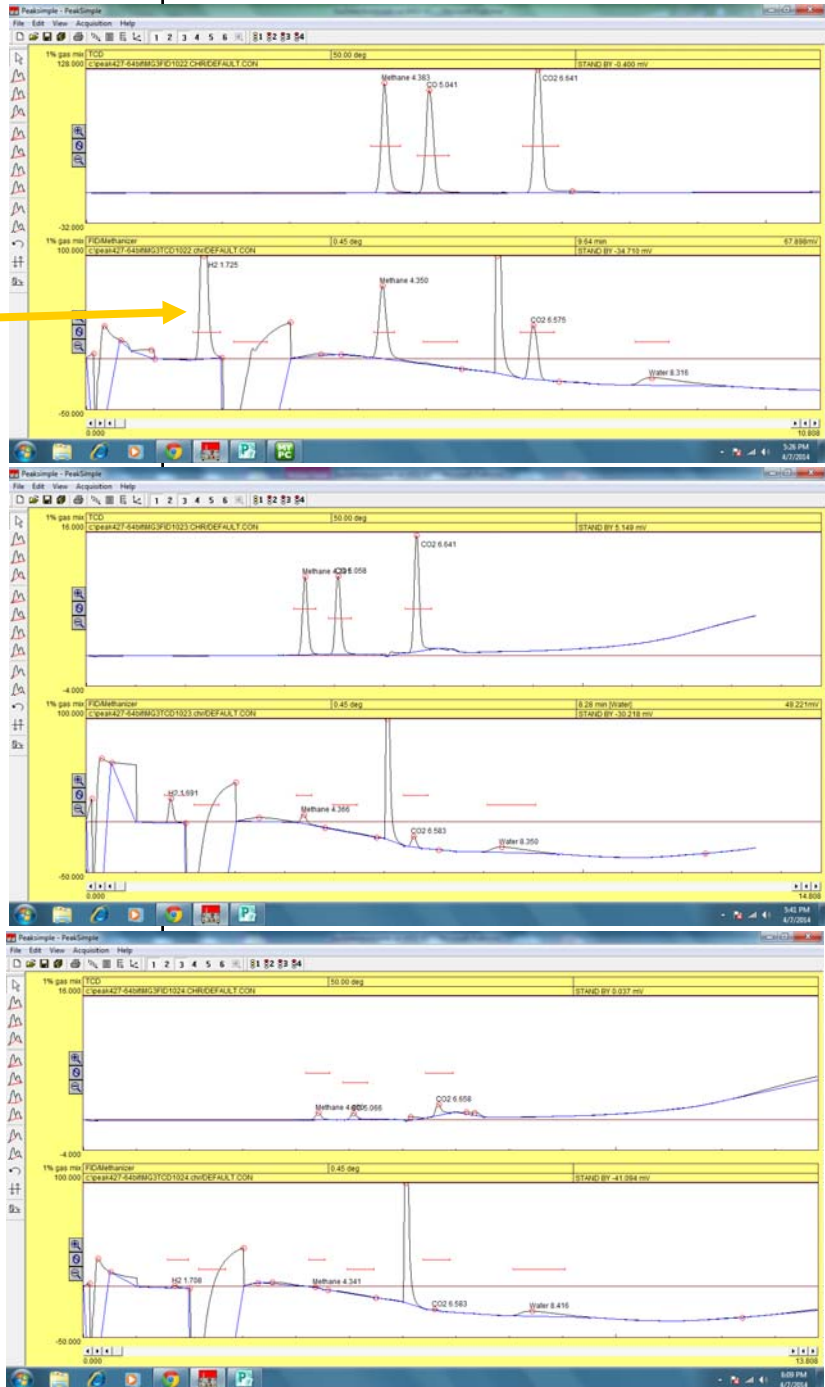
# Detection Limit for Hydrogen On SRI Multiple Gas #3 GC - TCD / He CarrierGas

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 CO<sub>2</sub> are detected. CO is still well detected by the FID/methanizer.

At .1% ( 1000ppm ) the H<sub>2</sub>, methane and CO<sub>2</sub> are all detected.

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

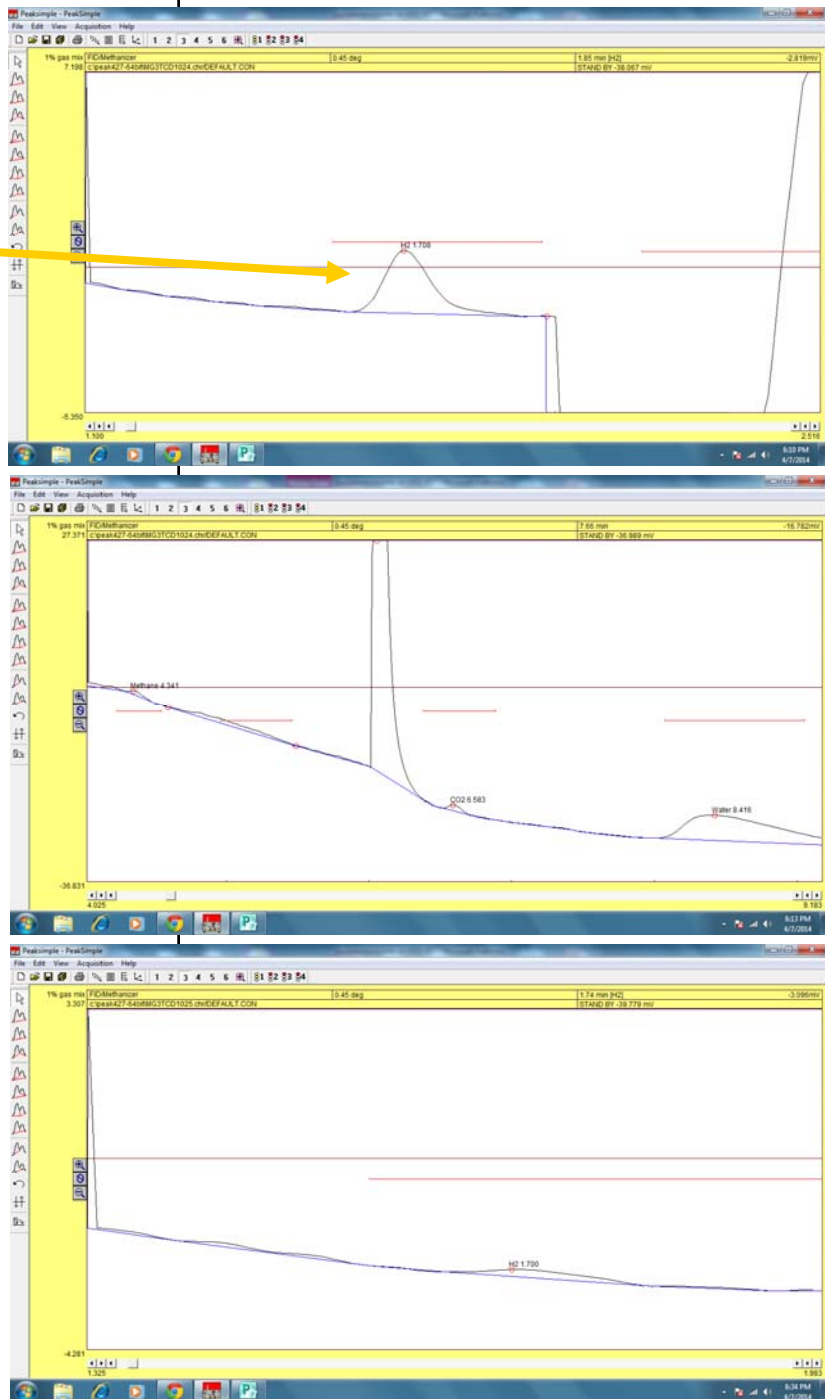


# Detection Limit for Hydrogen On SRI Multiple Gas #3 GC - TCD / N<sub>2</sub> Carrier Gas

This is what 100ppm H<sub>2</sub> looks like with Nitrogen carrier on high TCD current.

Methane and CO<sub>2</sub> are still just detectable at 100ppm.

At 10ppm only the H<sub>2</sub> is still detectable.



# Detection Limit for Hydrogen On SRI Multiple Gas #3 GC - TCD/Argon Carrier Gas

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.

