



Linear Dynamic Range for Toluene

Linear dynamic range can be defined as a detector's response increasing proportionally with increased quantity of detected material. Linear dynamic range is important in any detection system for gas chromatography to minimize sample handling (i.e. dilutions and concentrations) and number of analyses. Linearity varies from 10^3 for flame photometric and electron capture detectors, to 10^7 for flame ionization detectors. Mass spectrometers typically fall somewhere in the middle of that range. Recently an evaluation was performed to test the linearity of a LECO Pegasus Gas Chromatograph—Time-of-Flight Mass Spectrometer for a toluene standard in hexane.

Standards

Toluene in hexane, 0.004 to 100 ppm

Methods and Materials

Gas Chromatography

Column: 10 m x 0.18 mm x 0.40 μ m Rtx-5 (Restek Corporation)
Carrier: Helium at 0.5 ml/min, constant flow
Injection: 1 μ l split 50:1 at 150°C
Oven Program: 90°C (3 min)

Mass Spectrometry

Ionization: Electron ionization at 70eV
Source Temperature: 180°C
Stored Mass Range: 45 to 150 u
Acquisition Rate: 10 spectra/sec.
Total Run Time: 3 min

Results

Figure 1 is the calibration curve plotted from analysis of 0.004, 0.007, 0.04, 0.07, 0.4, 0.7, 1, 2, 4, 7, 10, 20, 40, 70, and 100 ppm solutions of toluene in hexane. Linearity is excellent. Closer inspection of the lower end of the curve is illustrated by Figure 2.

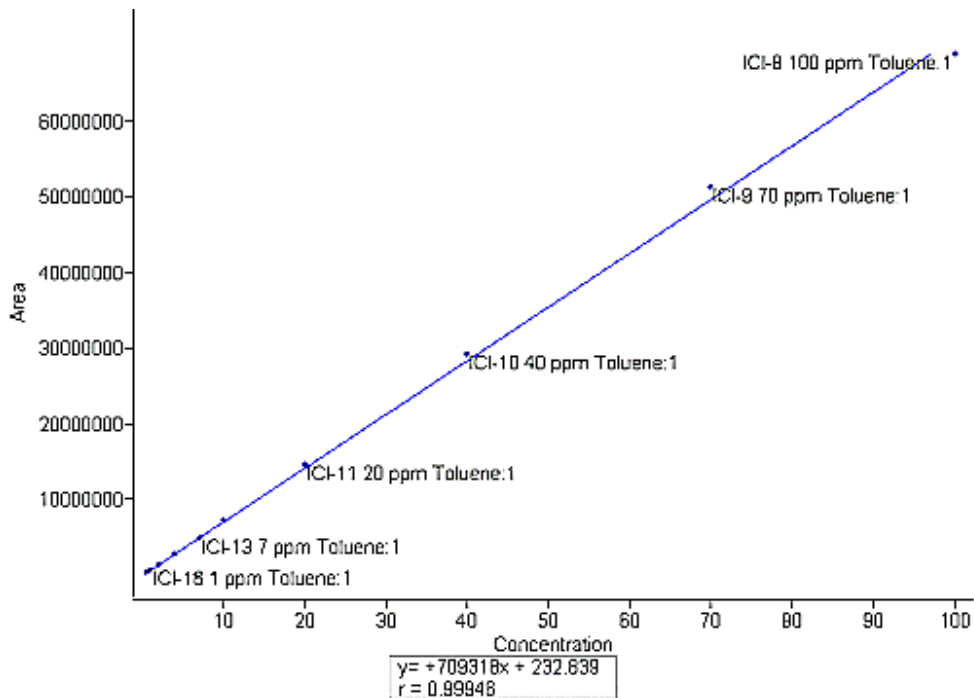


Figure 1. TOFMS linear calibration curve for toluene from 0.004 to 100 ppm.

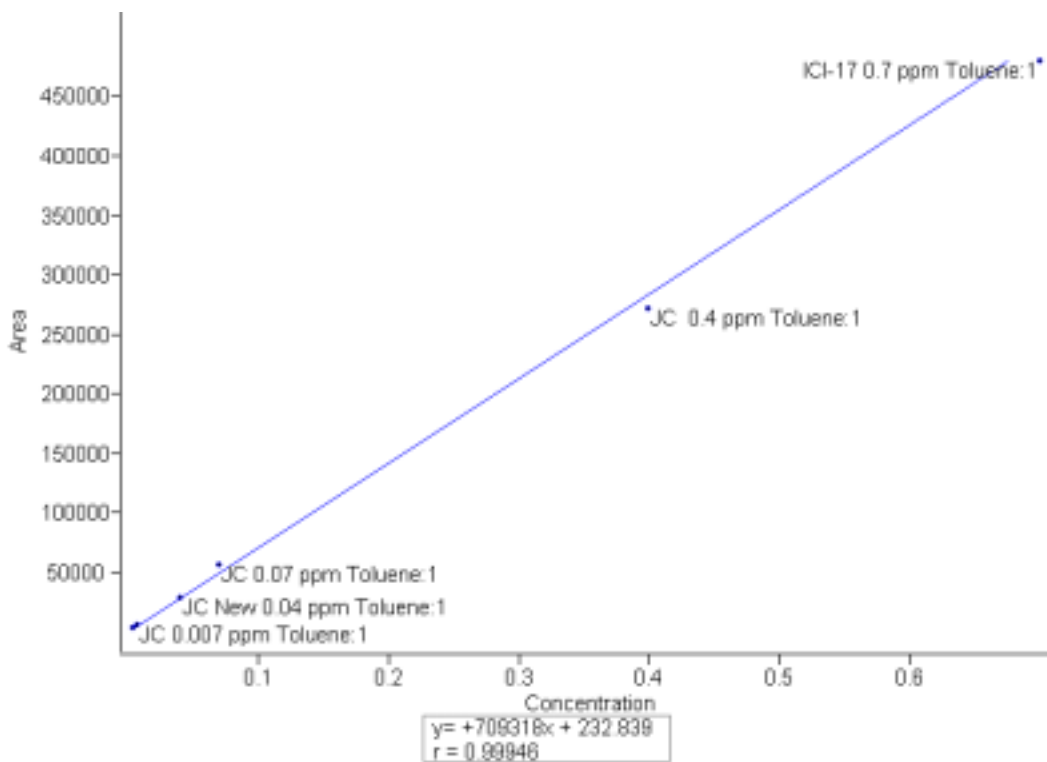


Figure 2. Lower end of TOFMS calibration curve for toluene. The lowest point is 0.004 ppm. All points are extremely close to the calculated line demonstrating the integrity of the calibration even at the lower end.

Figures 3 and 4 demonstrate the TOF mass spectral integrity for toluene at extreme concentration ranges, 0.007 and 70 ppm. NIST library matches for both concentrations were very good.

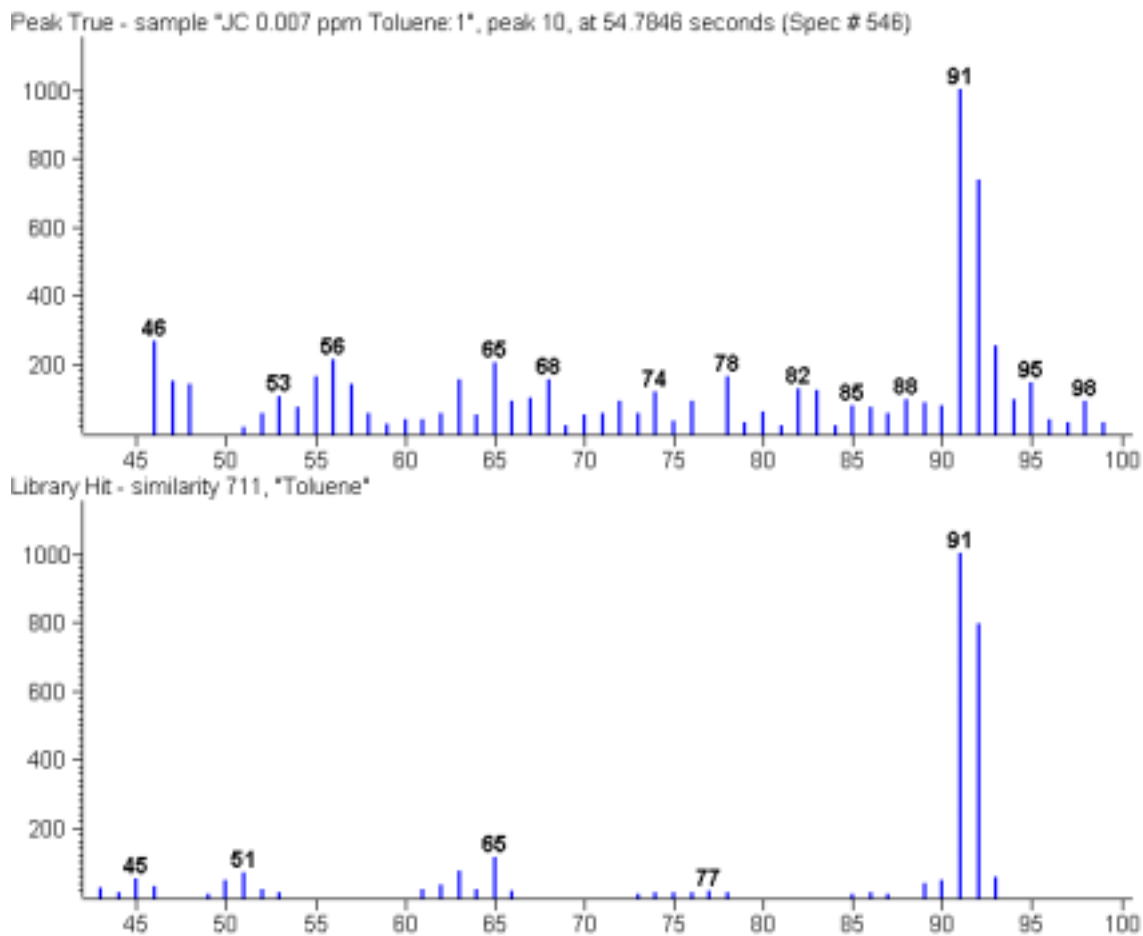


Figure 3. TOFMS spectrum for toluene at 0.007 ppm (top) and NIST library mass spectrum (bottom). The library match is 711.

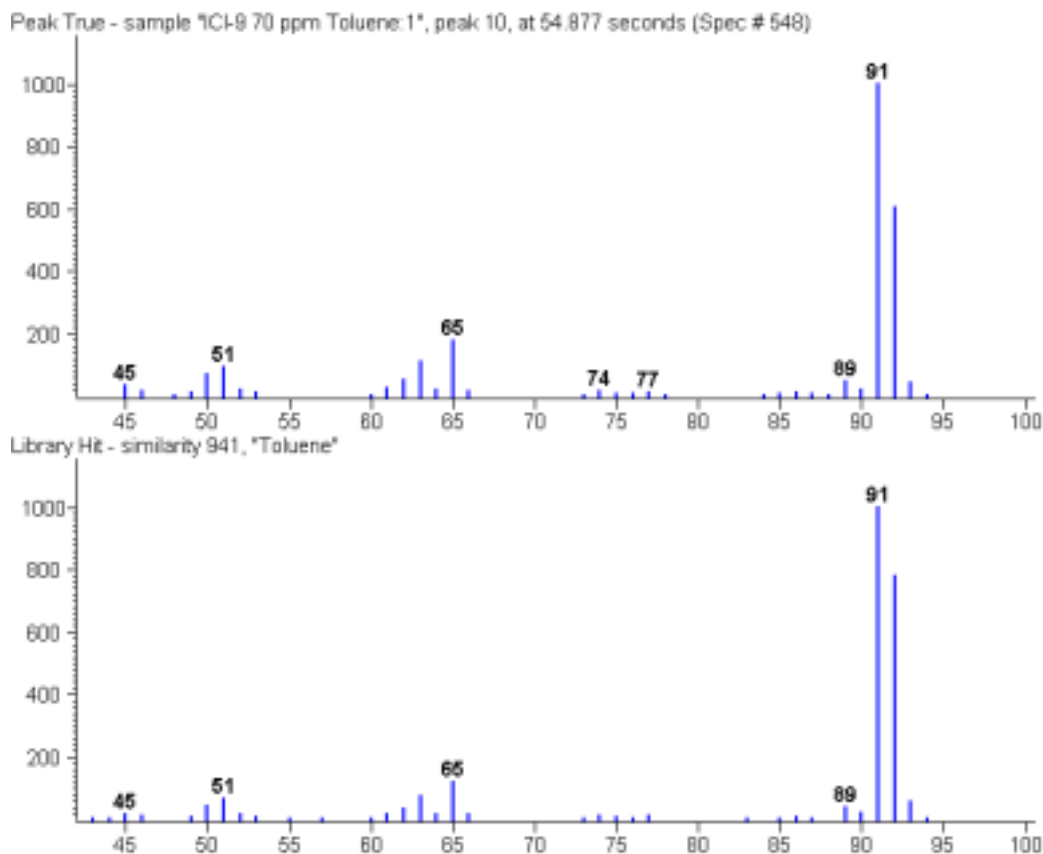
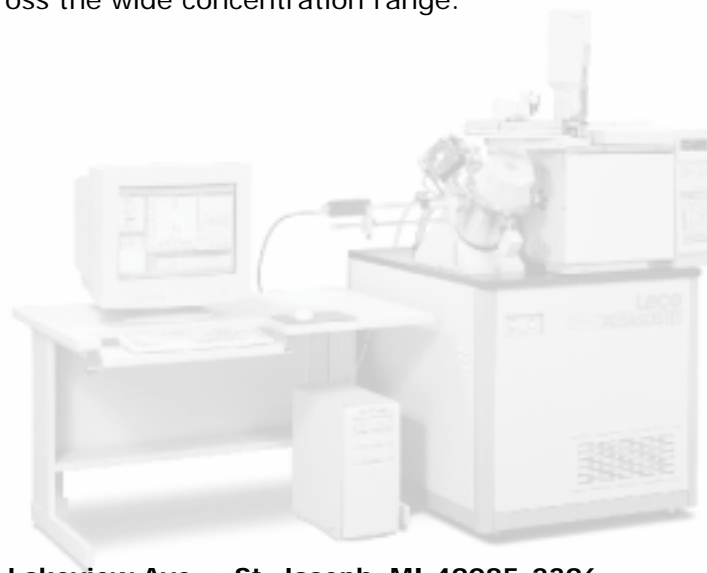


Figure 4. TOFMS spectrum for toluene at 70 ppm (top) and NIST library mass spectrum (bottom). The library match is 941.

Conclusion

The linear dynamic range for the Pegasus GC-TOFMS has been determined to be at least 10^5 for toluene in hexane. Spectral integrity is good across the wide concentration range.



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