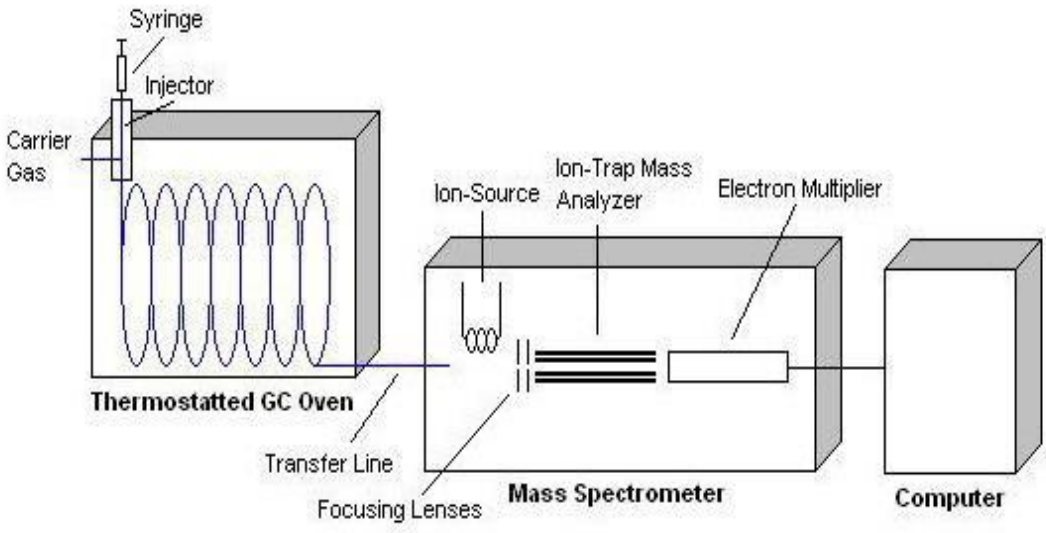
Gossman Forensics
A Division of ChemRight Laboratories, Inc.
103 South Main Street
Maquoketa, IA 52060
Phone: 563.652.2822
Email: dgossman@gossmanforensics.com

How Does Gas Chromatography and Mass Spectroscopy (GC/MS) Work?

Gas chromatography (GC) and mass spectroscopy (MS) are an effective combination for chemical analysis. Gas chromatography analysis separates compounds in complex mixtures, and mass spectroscopy analysis determines the molecular weight and ionic fragments of individual components, aiding in the identification of those compounds. GC/MS is an excellent way for experts to identify substances in a sample because it is a *specific* test. A specific test positively identifies the actual presence of a particular substance in a given sample.

The analytical process of GC provides a representative chromatographic output. The analyst injects the sample into the injection port of the GC instrument. The GC vaporizes the injected sample and separates the various components. Each of the components in the sample generates a specific peak which is recorded electronically. GC measures the retention time, which is the elapsed and recorded time between the injection of the sample and the process of elution (separating one material from another). The retention time helps the scientist to differentiate between some compounds. The peaks that are recorded are generally proportional to the quantity of the corresponding substances in the sample analyzed.



Example of a Gas Chromatography Mass Spectrometer

Mass spectroscopy analysis is commonly used in petroleum product analysis, arson investigations, engine exhaust analysis and for blood testing. MS identifies substances by electrically charging the sample's molecules, breaking the molecules into charged fragments, accelerating them through a magnetic field, and detecting the different fragments. The results of this process provide the analyst with a plot which displays the mass and relative amount of each fragment from the compound. The analyst can utilize the compound's mass spectrum for qualitative identification. By determining the molecular mass and the mass of the fragments, the analyst is able to utilize and compare reference data to determine the identity of the specimen sample. The National Institute of Standards and Technology (NIST) Mass Spectral Library and Standard Reference Database is available for determinations. Numerous American Society for Testing and Materials (ASTM) standards that cover GC/MS are also utilized for routine determinations. The mass spectrum is relatively unique for each substance, particularly compounds with different molecular weights and/or elemental constituents. When the analyst uses the GC instrument to separate compounds before analysis with an MS instrument, a complementary

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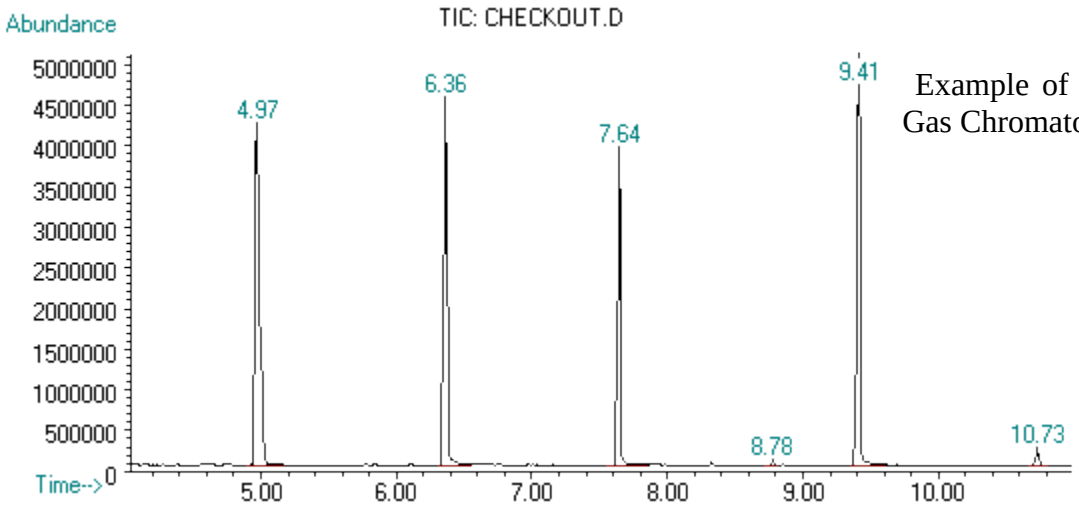
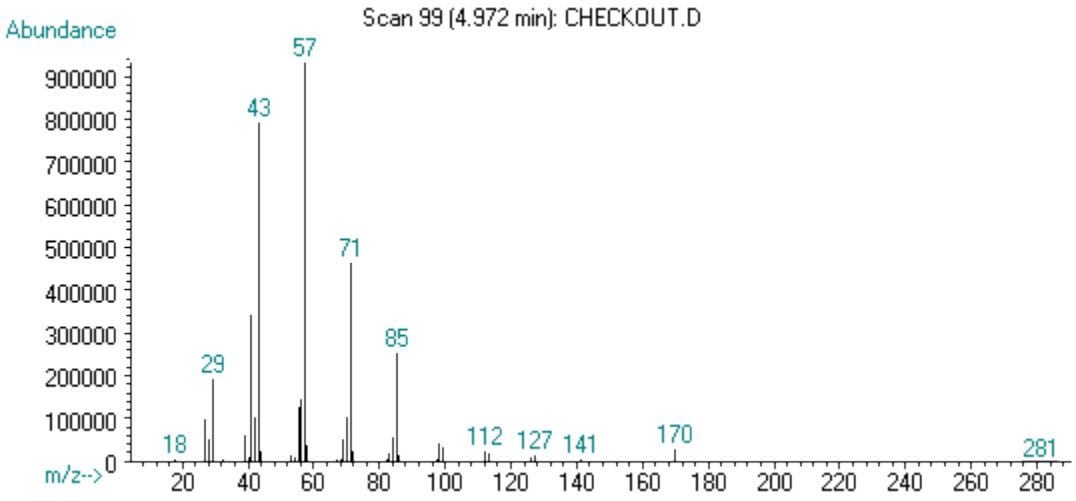
relationship exists. This combination gives the analyst information on both the retention times and mass spectral data. Scientists consider GC/MS analysis as a tool for conclusive proof of identity and it is therefore widely used.



Example of a Chromatogram from a Gas Chromatograph



Example of a Mass Spectrum from a Mass Spectrometer