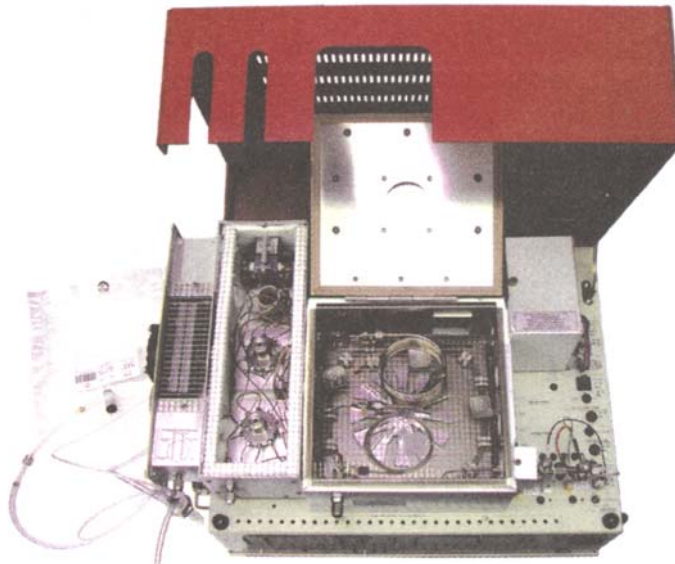


Transformer Oil Gas Analyzer (TOGA) GC System

- **HID, FID and/or TCD Detectors**
- **Built-in PeakSimple Data System**
- **Built-in Standards Preparation Module—
Make Your Own Standards**
- **Dual 10-port Gas Sampling Valves**
- **Gas Extraction Loop**
- **...on the compact 8610C chassis**

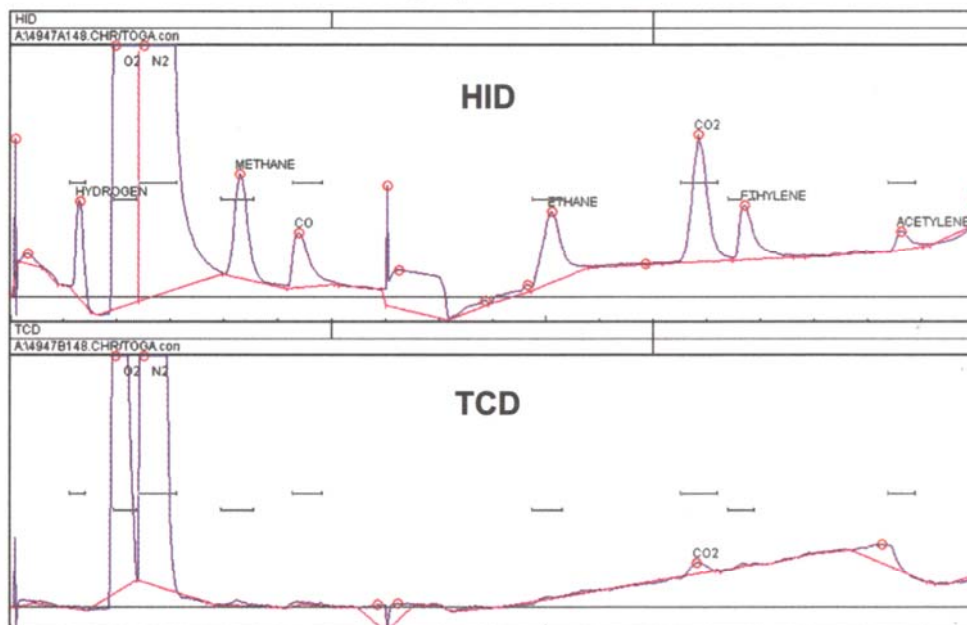
By analyzing the gases dissolved in transformer oil, potential transformer faults can be avoided. ASTM D3612 provides for identification and quantification of dissolved gases in transformer oil by GC. The SRI TOGA GC uses the version referred to as D3612B, the direct injection technique where the dissolved gas extraction takes place inside the GC. Other than collecting the transformer oil in an airtight glass syringe, no sample preparation is necessary prior to injection into the TOGA GC. This helps to avoid contamination made possible by transferring the sample between various containers.



The presence and quantities of certain gases in the oil indicate four broad types of possible general fault conditions:

- ① **Transformer Oil Overheating:** methane, ethane, ethylene, and small quantities of acetylene
- ② **Partial Discharge:** hydrogen, methane, and small quantities of acetylene and ethane
- ③ **Sustained Arcing:** hydrogen, acetylene and ethylene
- ④ **Insulating Paper Overheating:** carbon monoxide and carbon dioxide

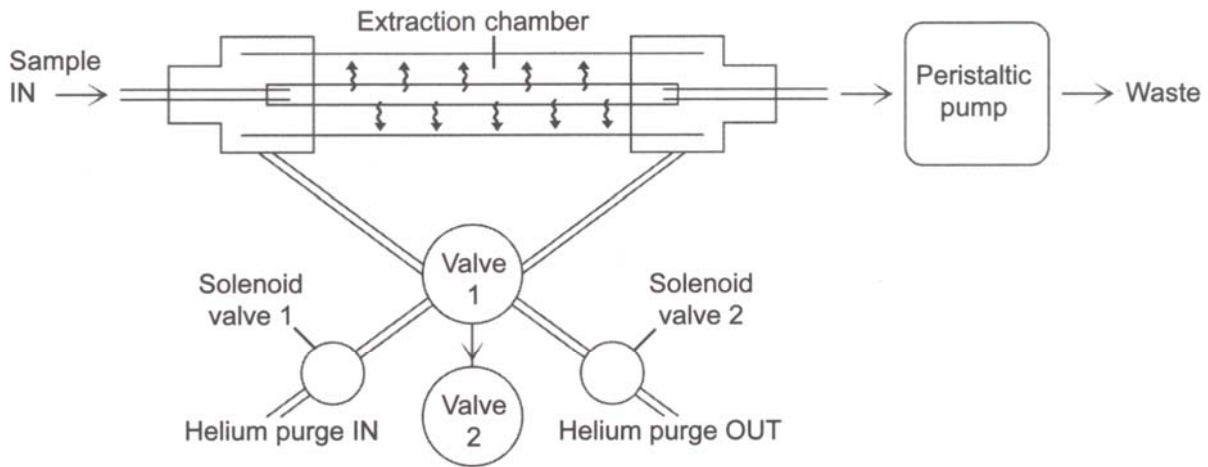
To achieve these chromatograms, a transformer oil standard was pumped through the gas extraction loop of a TOGA GC equipped with HID and TCD detectors. The TCD was used to quantify the oxygen and nitrogen because the HID is too sensitive for the large quantities found dissolved in transformer oil.



Concentration by Weight:
Hydrogen 10.7ppb
Oxygen 25.74ppm
Nitrogen 76.65ppm
Methane 70.6ppb
Carbon monoxide 207.4ppb
Carbon dioxide 518ppb
Ethylene 120.9ppb
Ethane 120.7ppb
Acetylene 86.7ppb

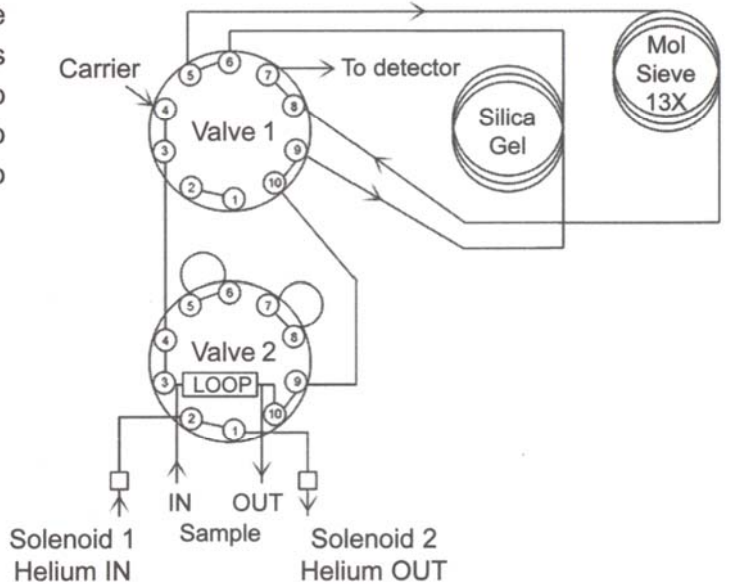
Transformer Oil Gas Analyzer (TOGA) GC System

In the TOGA GC, the sample is injected by peristaltic pump through a unique gas extraction loop. The gas extraction loop consists of permeation membrane tubing encapsulated in a trap-heated glass tube. The permeation tubing is plumbed to the sample inlet, the dual 10-port valves and the waste/sample outlet. Solenoid valves are included for purging the gas extraction chamber with helium between runs.



While the transformer oil is being pumped through the gas extraction loop, the 10-port electrically actuated valves are in the LOAD position. During this time, the dissolved gases in the transformer oil permeate through the membrane, into the extraction chamber. When the valves are switched to the INJECT position, the contents of the loop are swept into the Silica Gel and Molecular Sieve 13X columns.

TOGA valves in the INJECT position



TOGA GC in standards preparation mode

By reconnecting a few tubing lines, the TOGA GC can be configured to prepare dissolved gas standards. A Tedlar bag, or other container, filled with gas standard is connected to the standard pump. The standards preparation vessel is filled with sample liquid, such as water or transformer oil. The standard pump bubbles gas standard into the standards preparation vessel, equilibrating the liquid over time to a known concentration.

- 8610-0031 TOGA GC System with HID Detector & 1 channel data system
- 8610-0032 TOGA GC System with TCD & HID Detectors, & 4 channel data system



OPTIONS & UPGRADES: additional detectors, 6 channel USB PeakSimple data system.
(VOLTAGE: for 110VAC, use 8610-5405-1; for 220VAC, use 8610-5405-2)