TES Thomson Environmental Systems

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TELEDYNE
ANALYTICAL INSTRUMENTS
A Teledyne Technologies Company

Series 4060 Gas Chromatographs

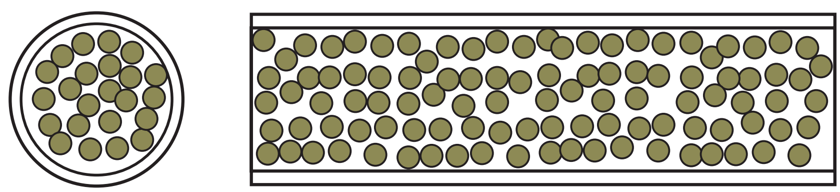
Series 4060 Overview

The Teledyne Analytical Instruments (TAI) Series 4060 speciates gases of interest by combining well-accepted gas chromatography techniques with TAI's field-proven detector technologies. This combination, along with effective electrometer-based signal amplification and temperature control, enables the Series 4060 to detect either single or multiple compounds in a background gas possessing potentially interfering compounds.

Gas Chromatography Column

Gas Chromatography

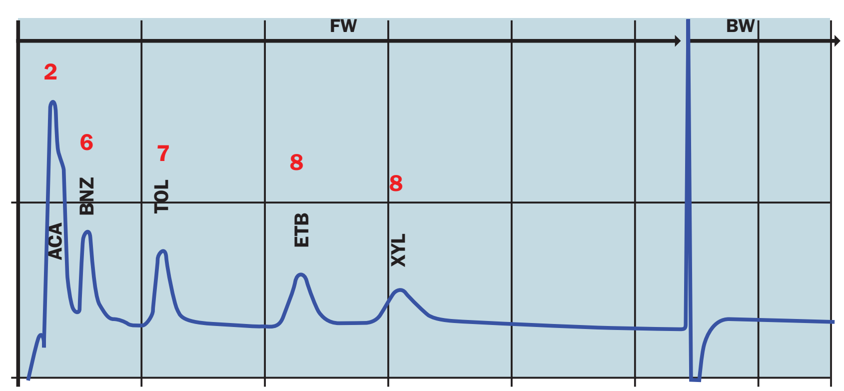
Component separation is achieved using an appropriate packed column. The column consists of a suitable length of inert stainless steel tubing packed with particles of porous polymer or bonded phase materials of varying length and diameter (per application). The coating interacts less with smaller and more volatile compounds, causing them to pass more quickly through the column than larger and less volatile compounds. In some cases, multiple columns may be employed to achieve a quick and thorough speciation of the parameters of interest.



Cross-Section of a Column

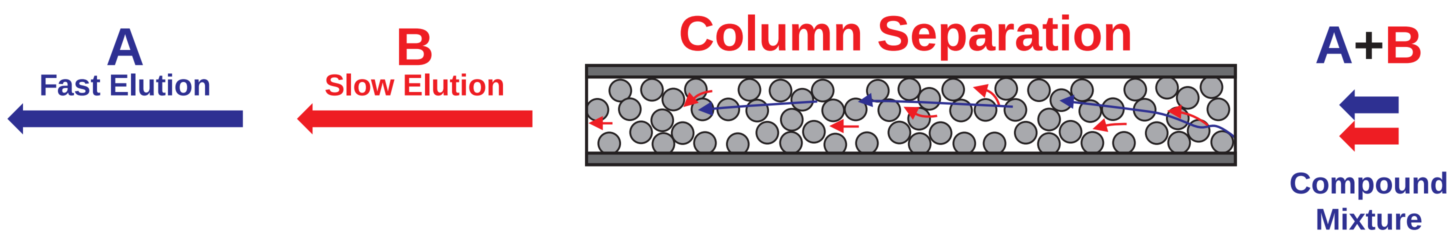
An inert carrier gas is used to push the sample through the column at a constant flow rate. With proper temperature and pressure control, the time it takes each gas to exit the column is repeatable.

Chromatogram



Retention Time

The sample exiting from the column then passes through the detector. The sensor response during the time a gas of interest is detected is integrated into a volumetric concentration.

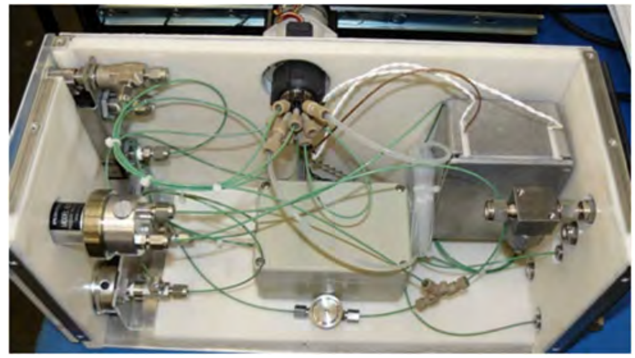


Sample Handling System

Optimal control of temperature and flow rates for the column, detector and sample handling components is critical for stable, repeatable readings. The Model 4060 sample system is sealed and insulated, utilizing PID controllers to ensure the ultimate temperature stability of the switching valve and column/detector compartment. Tubing, fittings and components within the sample system are 300-series stainless steel and Teflon.

The carrier gas and other applicable utility gases are regulated using miniature stainless steel regulators with gauges for precise pressure control. Proper flow rates to the detector are ensured with fixed orifices. All adjustable pressure and flow devices are easily accessible from the front panel. Both rack-mount and wall-mount configurations provide easy access to sample system components for maintenance.

The 4060 utilizes a switching valve with two states. The first is a sampling state, which collects a precise volume of the sample while bypassing the carrier gas to the vent. The valve is then actuated to an analysis state where the speciated gas of interest is then pushed through the sample loop by the carrier gas and on to the detector for analysis. The signal peaks are then collected and the gas concentration(s) measured and displayed.



4060A TCD Rack-Mount Analysis Compartment

PID Controllers

4060B FID Wall-Mount Analysis Compartment

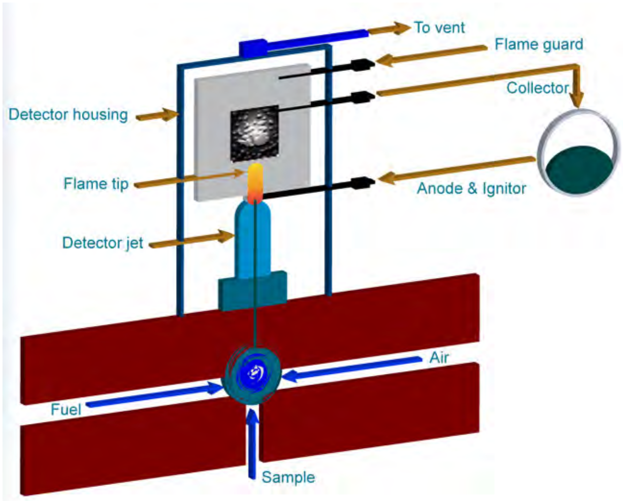
Detector Technologies

Flame-Ionization Detector (FID)

Because of its high sensitivity to most organic compounds, the flame ionization detector is a powerful tool for measuring hydrocarbon impurities in gases. It also provides a linear response over a wide range of analysis.

Figure A shows the general construction of an FID. Organic compounds from the sample stream or separation column are injected into the detector housing where they are mixed with Hydrogen and air before entering the detector jet where the mixture is burned.

During this process, organic compounds are broken down into carbon fragments and acquire a positive charge (i.e., become ionized) at the surface of the anode. Carbon fragments are detected by the collector. The signal is then amplified and sent to the data processing system



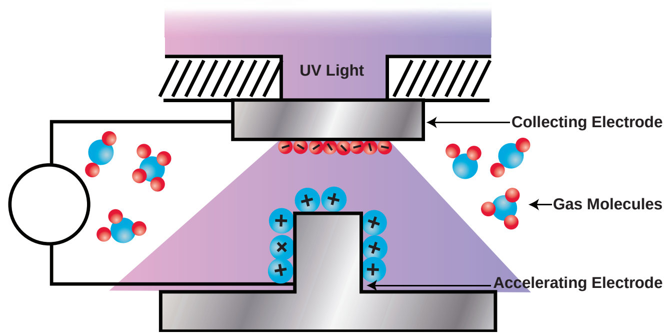
Flame Ionization Detector (FID)
Figure A

Photoionization Detector (PID)

For ultra-low detection of volatile organic carbons (VOCs) and other compounds with low ionization potential, the PID detector offers high sensitivity for part per billion (ppb) or part per million (ppm) detection.

Figure B below illustrates the principle. After column separation, the flowing gas sample passes through a sealed chamber where the gas is radiated by a quartz ultraviolet lamp through a window. Any gas compounds present with ionization potential below 10.6 eV will lose electrons, thereby ionizing and acquiring a positive charge.

The molecule ionization attracts the charged ions to the accelerating electrode, which carries a voltage potential, while the electrons pass to the collecting electrode. The generated electrical current from this reaction is proportional to the ionizing gas(es) present. This signal is then amplified and sent to the data processing system.

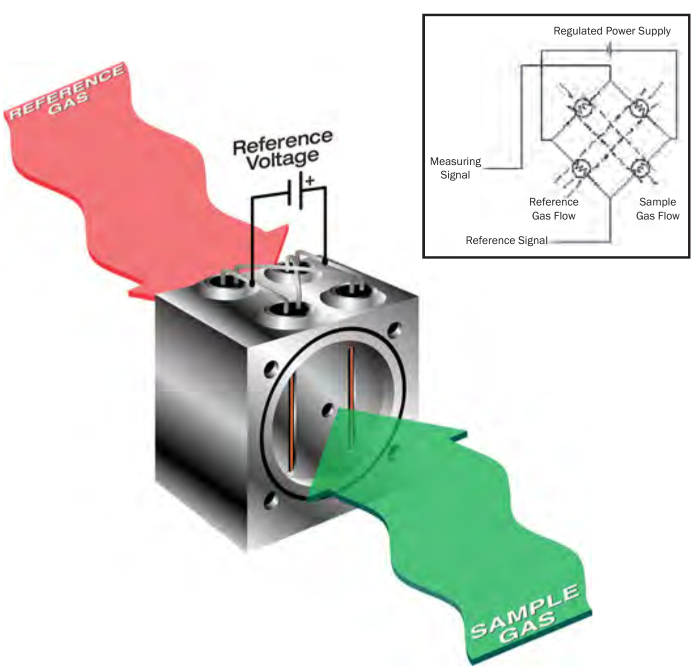


Photoionization Detector (PID)
Figure B

Thermal Conductivity Detector (TCD)

A thermal conductivity detector measures levels of a gas by its ability to conduct heat. The cell block is heated to a fixed temperature; it consists of four filaments arranged in a Wheatstone bridge configuration. Two filaments are exposed to a reference gas (sealed or flowing) of a known thermal conductivity, while the other two see the sample gas being measured. A reference voltage is applied across the bridge.

If the measuring filaments are exposed to a gas of the same thermal conductivity as the reference filaments, the bridge will be balanced (the differential voltage will be zero). However, if the thermal conductivity of the measuring gas changes, the filaments' temperature will increase or decrease respectively. This change will affect the electrical resistance across the filaments, which creates a measurable voltage differential proportional to the volumetric concentration of the gas of interest.



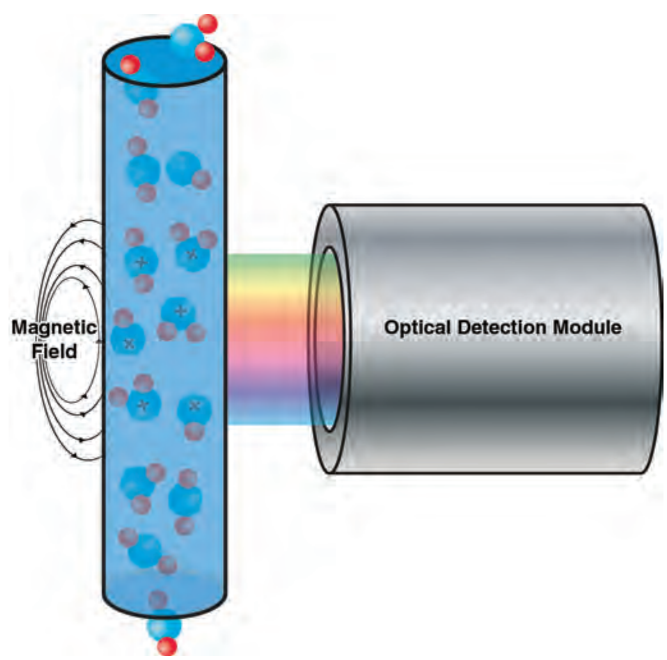
Thermal Conductivity Detector (TCD)
Figure A

Plasma Emission Detector (PED)

The PED detector uses electroluminescence technology to offer low ppm detection of stable compounds such as hydrogen, nitrogen, methane, carbon monoxide and carbon dioxide.

A carrier gas of argon or helium is used to push the sample gas through the column, then through a quartz tube. It is here that the sample is exposed to an intense, high frequency magnetic field causing the stable compounds to lose electrons and ionize. The carrier gas will emit a spectral profile, which will have varying wavelength properties based on the ionized impurities of interest present.

The spectral emission is received by an optical detector and wavelengths of interest analyzed to determine volumetric concentrations of the components of interest by the data processing system.



PLasma Emission Detector (PED)

Electronic Interface

Features

- *Field-proven microprocessor-based electronics provide menu-driven functionality*
- *Easy-to-view 5-digit LED display for readings*
- *2x20 vacuum fluorescent display for menu options, settings, and status*
- *Built-in diagnostic capability*
- *EEPROM to store factory defaults in the event of loss of power*
- *Ready for auto-calibration and remote-calibration with external solenoid valves (integral cal valves available as option)*
- *Automatic flame ignition / re-ignition and flame-out guard circuitry (for FID detector)*
- *Methanizer available with FID version for detection of carbon monoxide and carbon dioxide*

I/O

- *0-1 VDC and 4-20 mADC (isolated) analog outputs*
- *0-1 VDC and 4-20 mADC gas identification outputs*
- *RS-232 duplex digital output*
- *Two (2) fully-configurable concentration outputs with Form-C relay contacts*
- *System alarm with Form-C relay contact*
- *Next Generations will have up to four (8) gas identification outputs, Form-A type*

Model 4060

Series 4080 MTBE in H_2O System

Common Detectable Gases (Contact TAI for feasibility on other applications)

4060/FID	4060/PID	4060/TCD	4060/PED
Acetaldehyde	Ammonia	Argon impurity	Carbon Dioxide
Benzene	Benzene	Argon purity	Carbon Monoxide
Butane	Ethyl benzene	Carbon dioxide	Hydrogen
Ethane	Toluene	Carbon monoxide	Methane
Ethyl benzene	VOCs	Helium	Nitrogen
Ethylene	Xylenes	Hydrogen	Oxygen
Hexane		Hydrogen sulfide	
Methane		Krypton	
Methanol		Nitrogen impurity	
MTBE		Nitrogen purity	
Propane		Xenonl	
Propylene			
Toluene			
VOCs			
Xylene			

Teledyne Tracs™ Diagnostic Software

Tracs™ software developed by TAI is a unique program to unveil chromatogram and compound retention sequences on which concentrations of compounds of interest are calculated. It provides valuable access for an ordinary user to look into inside the complicated GC world with a computerized tool. It suits the needs for high accuracy in GC technique and for ease of communication in digital format.

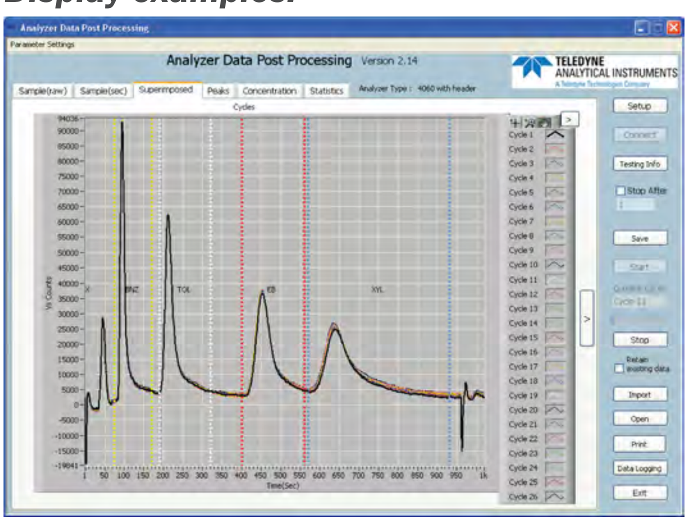
Features:

- Bi-directional communication of analyzer's range, alarm and timing settings which can be remotely uploaded and downloaded
- Acquires real-time raw data for continuous display of chromatograms
- Chromatograms can be superimposed upon one another to verify repeatability
- Elution peaks can be displayed within their own respective timing frames or individually manipulated for optimal peak scrutinization
- Statistical summary including analytical calculation of measurements, distribution of values and deviations
- Data-logging
- Saving and retrieving of digitized data files

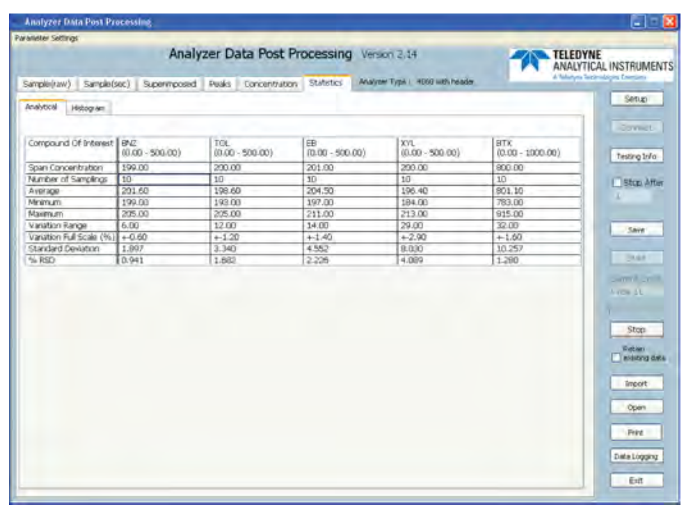
Advantages:

- Ease of troubleshooting and root-cause diagnosis
- Faster and more comprehensive factory technical support
- Better analyzer performance monitoring and measurement evaluation

Display examples:



Superimposed Chromatograms



Statistical Summary

Technical Specifications

	4060/FID	4060/PID	4060/TCD	4060/PED
SENSING TECHNOLOGY	Flame-Ionization Detector (FID)	Photoionization Detector (PID)	Thermal Conductivity Detector (TCD)	Plasma Emission Detector (PED)
GAS AND RANGES	Hydrocarbon compounds Trace or percent level detection (Contact factory to verify application)	Some Hydrocarbon Compounds, Trace level detection, (Contact factory to verify application)	Most gases Trace or percent level detection (Contact factory to verify application)	Specific Compounds, Trace level detection, (Contact factory to verify application)
SENSITIVITY	1% of full-scale	1% of full-scale	1% of full-scale	1% of full-scale
ACCURACY	± 2% of full-scale (at constant temperature)	± 2% of full-scale (at constant temperature)	± 2% of full-scale (at constant temperature)	± 2% of full-scale (at constant temperature)
REPEATABILITY	1% of full-scale through all ranges	1% of full-scale through all ranges	1% of full-scale through all ranges	1% of full-scale through all ranges
RESPONSE TIME	Application Dependent	Application Dependent	Application Dependent	Application Dependent
OPERATING TEMPERATURE	40-110°F (4-43°C)	40-110°F (4-43°C)	40-110°F (4-43°C)	40-110°F (4-43°C)
ZERO AND SPAN NOISE	Less than 0.5% of full-scale	Less than 0.5% of full-scale	Less than 0.5% of full-scale	Less than 0.5% of full-scale
ZERO AND SPAN DRIFT	2% of full-scale per week	2% of full-scale per week	2% of full-scale per week	2% of full-scale per week
ANALOG OUTPUTS	0-1 VDC and 4-20 mADC isolated (one output with Gas ID for 3+ gases)	0-1 VDC and 4-20 mADC isolated (one output with Gas ID for 3+ gases)	0-1 VDC and 4-20 mADC isolated (one output with Gas ID for 3+ gases)	0-1 VDC and 4-20 mADC isolated (one output with Gas ID for 3+ gases)
ALARMS	One system alarm and two concentration alarms. Form-C relays rated @ 3A 250VAC resistive	One system alarm and two concentration alarms. Form-C relays rated @ 3A 250VAC resistive	One system alarm and two concentration alarms. Form-C relays rated @ 3A 250VAC resistive	One system alarm and two concentration alarms. Form-C relays rated @ 3A 250VAC resistive
SUPPLY VOLTAGE	110 or 220 VAC 50/60 Hz	110 or 220 VAC 50/60 Hz	110 or 220 VAC 50/60 Hz	110 or 220 VAC 50/60 Hz
MAXIMUM POWER CONSUMPTION	600 VA	600 VA	600 VA	600 VA
MAXIMUM LOAD IMPEDANCE OF 4-20 MA OUTPUT	500 ohms	500 ohms	500 ohms	500 ohms
SAMPLE FLOW RATE	1 SCFH (0.5 LPM) standard	1 SCFH (0.5 LPM) standard	1 SCFH (0.5 LPM) standard	1 SCFH (0.5 LPM) standard
DIMENSIONS (RACK MOUNT)	19" W x 8.72" H x 24.54" D (483 x 221 x 623 mm)	19" W x 8.72" H x 24.54" D (483 x 221 x 623 mm)	19" W x 8.72" H x 18.58" D (483 x 221 x 472 mm)	19" W x 8.72" H x 24.54" D (483 x 221 x 623 mm)
DIMENSIONS (WALL MOUNT)	30" W x 30" H x 12.9" D (762 x 762 x 328 mm)	30" W x 30" H x 12.9" D (762 x 762 x 328 mm)	30" W x 30" H x 12.9" D (762 x 762 x 328 mm)	30" W x 30" H x 12.9" D (762 x 762 x 328 mm)

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Warranty
Instrument is warranted for one year against defects in material or workmanship

NOTE: Specifications and features will vary with application. The above are established and validated during design, but are not to be construed as test criteria for every product. All specifications and features are subject to change without notice.

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