928 Series

Carbon/Nitrogen/Sulfur Determinator

Specification Sheet

Instrument Range*	**Helium Carrier Gas**		**Argon Carrier Gas**	
	10 cm³ Aliquot Loop	**3 cm³ Aliquot Loop**	**10 cm³ Aliquot Loop**	**3 cm³ Aliquot Loop**
Nitrogen, FP928	0.02 mg to 300 mg	0.04 mg to 300 mg	0.06 mg to 300 mg	0.12 mg to 300 mg
Carbon, CN928	0.02 mg to 200 mg	0.04 mg to 200 mg	0.02 mg to 200 mg	0.04 mg to 200 mg
Sulfur, CNS928	0.02 mg to 50 mg	0.04 mg to 50 mg	0.02 mg to 50 mg	0.04 mg to 50 mg
Precision Range† *(mg vs. RSD, whichever is greater)*				
Nitrogen, FP928	0.01 mg or 0.3 % RSD	0.02 mg or 0.6 % RSD	0.03 mg or 0.6 % RSD	0.06 mg or 1.2 % RSD
Carbon, CN928	0.01 mg or 0.4 % RSD	0.02 mg or 0.8 % RSD	0.01 mg or 0.4 % RSD	0.02 mg or 0.8 % RSD
Sulfur, CNS928	0.01 mg or 0.4 % RSD	0.02 mg or 0.8 % RSD	0.01 mg or 0.4 % RSD	0.02 mg or 0.8 % RSD

Sample Mass		
Nitrogen (FP)	up to 3.0 g, 1.0 g nominal	
Carbon/Nitrogen	up to 1.0 g, 0.5 g nominal	
Carbon/Nitrogen/Sulfur	up to 0.3 g, 0.2 g nominal	
Cycle Time/Throughput†† *(Analyzing EDTA at Nominal Mass)*	5 min (12 samples/h)	
Autoloader	100-position	
Detection Method		
Nitrogen	Thermal Conductivity (TC Cell) Detector	
Carbon/Sulfur	Non-Dispersive Infrared (NDIR) Absorption	
Gases Required		
Helium Carrier Gas	Helium (99.99 % pure) @ 25 psi (1.7 bar) ±10 %	
Argon Carrier Gas	Argon (99.99 % pure) @ 25 psi (1.7 bar) ±10 %	
Combustion	Oxygen (99.99 % pure) @ 25 psi (1.7 bar) ±10 %	
Pneumatic Gas	Compressed Air (oil and water free) @ 40 psi (2.8 bar) ±10 %	
Resistance Furnace	500 °C** to 1,450 °C, ±10 °C of setpoint (1,250 °C nominal operation)	
Operating Conditions	**Temp:** 15 °C to 35 °C (59 °F to 95 °F)	**Rel. Humidity:** 20% to 80%, non-condensing
Sound Pressure Level	55 dBa (max reading at operator's level per IEC/EN 61010-1)	
Electrical Power	230 V~ (+10 %/-15 %; at max load), 50/60 Hz, single phase, 12 A max, 5 A idle	
Thermal Dissipation	**Analyzing:** 4,100 Btu/h§	
Dimensions‡		
Instrument with Autoloader	44 in H × 59 in W × 30 in D (112 cm H × 150 cm W × 76 cm D)	
Weight (approximate)	**Analyzer, Loader, Monitor:** 415 lb (188 kg)	**Analyzer, Loader:** 393 lb (178 kg)

Part Numbers

FP928-MLC	FP928 with loader, software, PC, and touch-screen display
CN928-MLC	CN928 with loader, software, PC, monitor, and touch-screen display
CNS928-MLC	CNS928 with loader, software, PC, monitor, and touch-screen display
NS928-MLC	NS928 with loader, software, PC, monitor, and touch-screen display

** Lower range is calculated as 2 instrument blank deviation. Method range may differ due to factors such as sample type and method parameters.*
*** Furnace operation below 800 °C requires optional software registration. Contact LECO Service for more information.*
† Calculated as 1 instrument blank deviation. Method precision may differ due to sample inhomogeneity or other external factors.
†† Cycle Time and Throughput represent the time between two sequential samples results being reported with portions of the Analysis time for the samples being interleaved.
‡ Allow for a 6 in (15 cm) minimum access area around the sides of the instrument; space not needed behind the instrument.
§ Average output based on nominal operating parameters. This instrument supports either Helium or Argon carrier gas. The type of carrier gas used may affect some instrument specifications.

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Theory of Operation

The 928 series determines nitrogen/protein, carbon/nitrogen, or carbon/nitrogen/sulfur in a multitude of organic matrices from foods and feeds, to soils and fertilizers. The system utilizes a high temperature horizontal ceramic combustion furnace designed to handle macro sample mass with a rapid analysis time delivering unsurpassed application capabilities and throughput.

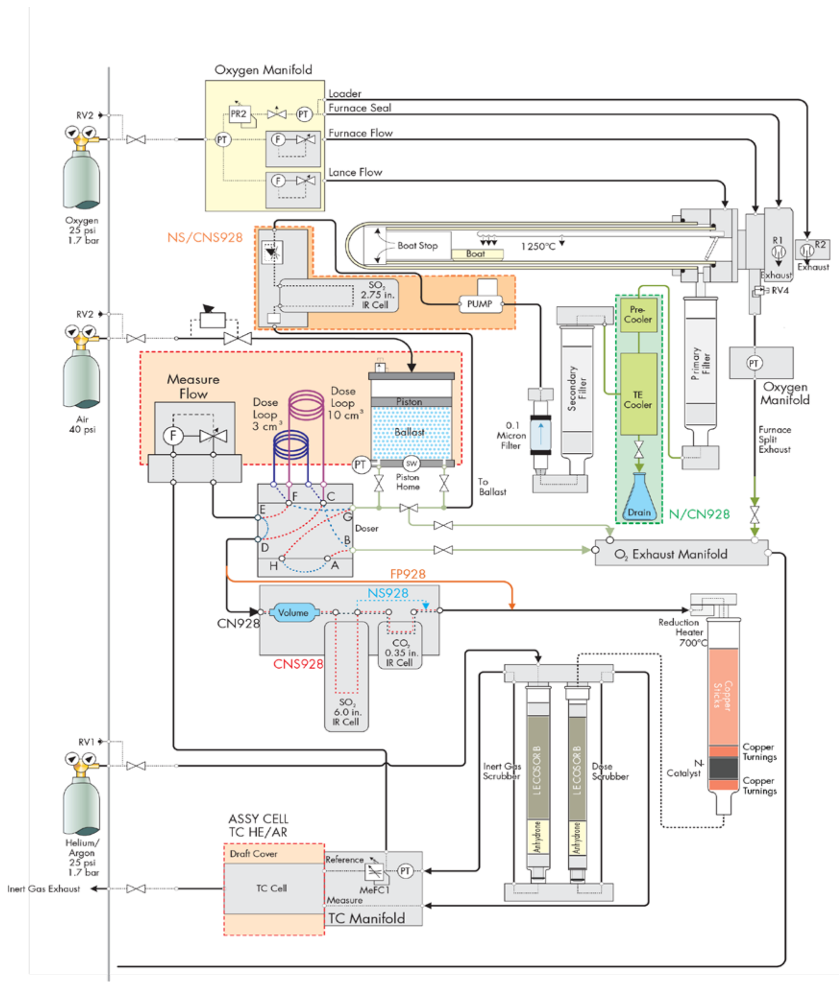
To start an analysis, a macro-sized sample is weighed into a ceramic boat and placed in the 100-position loader. A fully automated analysis sequence transfers the sample to a sealed purge chamber, where entrained atmospheric gas is removed. The purged sample is transferred automatically to the furnace, which can be operated at temperatures from 1,100 °C to 1,450 °C. To ensure complete and rapid combustion (oxidation) of the sample, the furnace environment is composed of pure oxygen with a secondary oxygen flow directed to the sample via a ceramic lance. The combustion gases are swept from the furnace through a thermoelectric cooler (nitrogen/protein and carbon/nitrogen models) or an anhydrone reagent (carbon/nitrogen/sulfur model) to remove moisture. The gases are then collected in a thermostatically controlled ballast volume The gases equilibrate and mix in the ballast before a representative aliquot of the gas is extracted and introduced into a flowing stream of inert gas for analysis. Depending upon the analyzer model, the aliquot gas is carried to a non-dispersive infrared (NDIR) cell for the detection of carbon (as carbon dioxide) and sulfur (as sulfur dioxide), and a thermal conductivity cell (TC) to detect nitrogen (N_2). Unlike NDIR cells, TC cells are chemically non-specific, so a series of reagents and scrubbers are used to ensure quantitative detection of N without chemical interference. A heated reduction tube, filled with copper, is used to convert nitrogen oxide species (NO_x) to N_2 and to x remove excess oxygen. Carbon dioxide (CO_2) is removed by LECOSORB and water (H_2O) is removed by Anhydrone.

Careful sequencing of the analysis by the Cornerstone® brand software provides maximum sample throughput by interleaving the sample loading sequence with quantitation of the aliquot gases from the previous sample. As soon as the combustion gas is collected in the ballast, the analysis sequence is initiated for the next sample.

The determined composition of the sample is displayed by Cornerstone in weight percent or parts-per-million but can be displayed in other custom units, if preferred.

Many diagnostic sensing capabilities are included in the 928 Series analyzer. Multiple Pressure Transducers (PT) are used to ensure the presence of sufficient oxygen and helium. The PTs also provide the ability to leak check individual segments of the flow path. Digital Mass Flow Controllers (MFC's) are used to control and measure critical flows of oxygen and helium. Thermal sensors and heaters are used to thermostatically control the temperature of critical components, such as the furnace, the ballast, the dose loop, the helium MFC, the NDIR cell, and the TC cell.

Flow Diagram



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