# 928 Series Determinator

## Specification Sheet


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| **Instrument Range*** | | |
| Nitrogen, Helium Carrier Gas | 0.02** mg to 300 mg | |
| Nitrogen, Argon Carrier Gas | 0.06** mg to 300 mg | |
| Carbon | 0.02** mg to 200 mg | |
| **Precision Range[†]** | | |
| Nitrogen, Helium Carrier Gas | 0.01 mg or 0.3% RSD (whichever is greater) | |
| Nitrogen, Argon Carrier Gas | 0.03 mg or 0.6% RSD (whichever is greater) | |
| Carbon | 0.01 mg or 0.4% RSD (whichever is greater) | |
| **Sample Mass** | | |
| Nitrogen (FP) | up to 3.0 g, 1.0 g nominal | |
| Carbon/Nitrogen | up to 1.0 g, 0.5 g nominal | |
| **Cycle Time/Throughput[††] (Analyzing EDTA at Nominal Mass)** | | |
| | **Helium Carrier Gas** | **Argon Carrier Gas** |
| Nitrogen (FP) | 5.3 mins / 11 samples/hr | 5.8 mins / 10 samples/hr |
| Carbon/Nitrogen | 5.8 mins / 10 samples/hr | 6.3 mins / 9 samples/hr |
| **Autoloader** | 100-position | |
| **Detection Method** | | |
| Nitrogen | Thermal Conductivity (TC Cell) Detector | |
| Carbon | 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** | 800 °C to 1450 °C, ±10 °C of setpoint (1250 °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, 12A max, 5A idle | |
| **Thermal Dissipation** | **Analyzing:** 4,100 Btu/hr[§] | |
| **Dimensions[‡]** | | |
| Instrument with Autoloader | 44.0 in H x 59.0 in W x 33 in D (112 cm H x 150 cm W x 84 cm D) | |
| **Weight (approx.)** | **Analyzer, Loader, Monitor:** 415 lb (188 kg) **Analyzer, Loader:** 393 lb (178 kg) | |

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| **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 |

**Use the following formula to calculate element concentration:*
*% element concentration = ((absolute element mass in mg)/(sample mass in mg))*100*
***Lower range is calculated as 2 sigma instrument blank deviation. Method range may differ due to factors such as sample type and method parameters.*
*[†]Calculated as 1 sigma 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-inch (15 cm) minimum access area around the side of the instrument; space not required 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 or carbon/nitrogen 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.

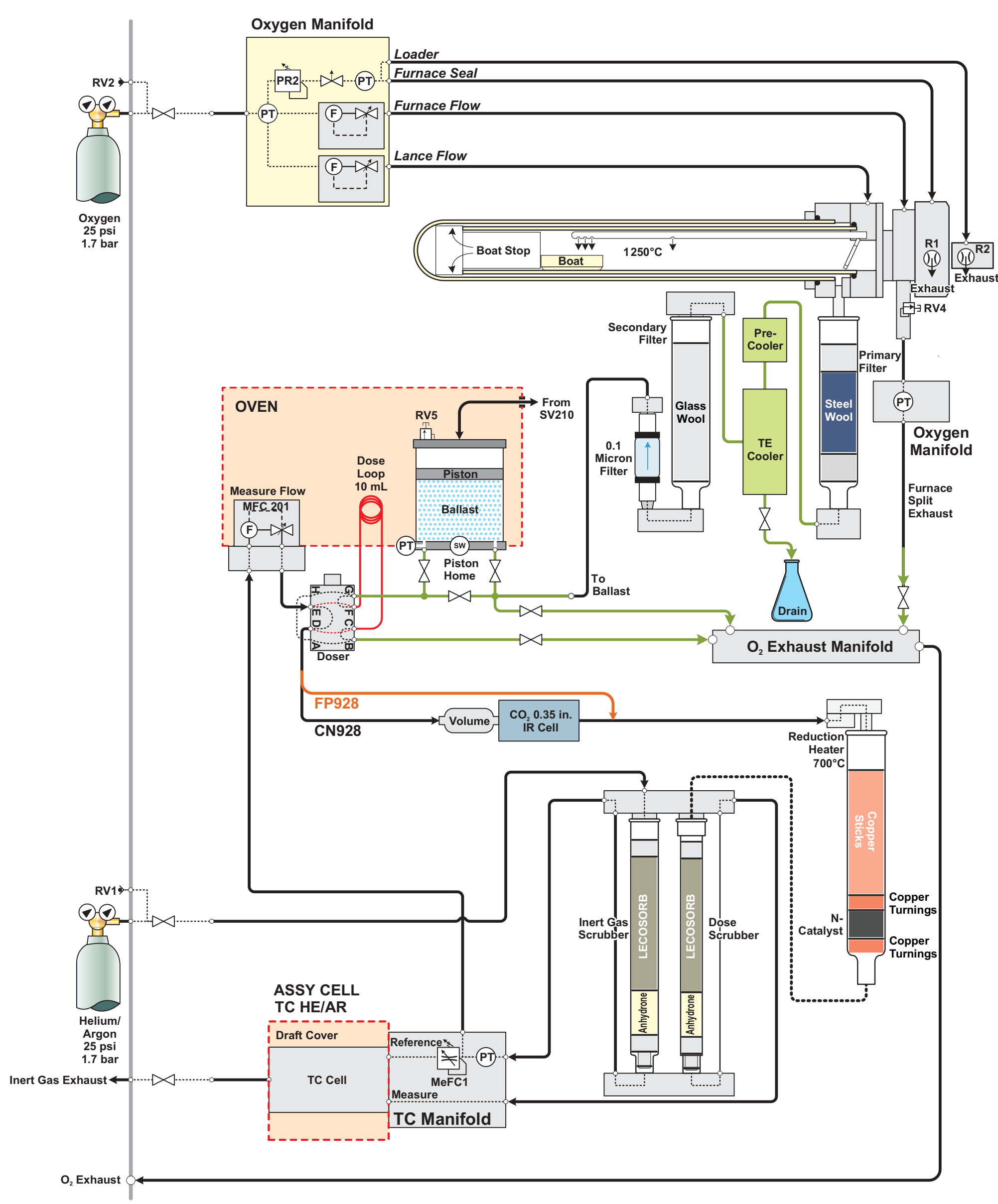
To start an analysis, a macro-sized sample is weighed into a ceramic boat and placed in the 100-position loader. A fully automated analysis sequence transfers the sample to a sealed purge chamber, where entrained atmospheric gas is removed. The purged sample is transferred automatically to the furnace, which can be operated at temperatures from 1100 °C to 1450 °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, to remove moisture, and 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 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 $N_2$ without chemical interference. A heated reduction tube, filled with copper, is used to convert nitrogen oxide species ($NO_x$) to $N_2$ and to 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 if it has been weighed, loaded, and logged-in by operator. It is important to remove the ceramic boat and sample ash from the furnace at the end of every analysis to ensure the furnace remains free of ash build-up.

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) have been included to ensure the presence of sufficient oxygen and helium, and to provide the ability to leak check individual segments of the flow path by controlled pressure decay measurements. Digital Mass Flow Controllers (MFC's) are used to control and measure critical flows of oxygen and helium. The integrity of the furnace seal is monitored electronically during an analysis. 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.

## FP928 & CN928 Analytical Flow Diagram




*Specifications and part numbers may change.*
*Consult LECO for latest information.*
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