

---

# Crucibles and Accelerators for Inorganic Carbon, Sulfur, and Moisture Determination

LECO® 744, 844, and RC612 Instrument Series

LECO Corporation; Saint Joseph, Michigan USA

---

## Index:

### Instruments:

[C744](#)  
[S744](#)  
[CS744](#)  
[C844](#)  
[S844](#)  
[CS844](#)  
[S844ES](#)  
[CS844ES](#)  
[RC612](#)

### Crucibles and Combustion Boats:

[528-018 – Ceramic Crucible](#)  
[528-018HP – High Purity Ceramic Crucible](#)  
[625-505-430 – Nickel Combustion Boat](#)  
[781-335 – Quartz Combustion Boat](#)  
[782-059 – Nickel Boat Liner](#)

### Accelerators/Additives:

[501-008, 502-297 – LECOCEL II \(Tungsten/Tin, Standard Grade\)](#)  
[501-077, 763-467 – Iron Chip Accelerator \(Standard Grade, -6 +20 Mesh\)](#)  
[501-078 – Iron Powder \(Low S\)](#)  
[501-263, 501-264, 501-640 – Copper Chip Accelerator \(-20 +30 Mesh\)](#)  
[501-636-HAZ – Vanadium Pentoxide](#)  
[502-156, 502-493 \(HP\) – Fluorhib](#)  
[502-173 – LECOCEL II HP \(Tungsten/Tin, High Purity\)](#)  
[502-231 – High Purity Iron Chip \(-6 +20 Mesh\)](#)  
[502-492 – High Purity Copper Accelerator](#)  
[502-857, 502-858, 763-263, 763-027 – LECOCEL III \(Tungsten, -12 +20 Mesh\)](#)  
[502-860, 502-861, 763-266, 763-026 – LECOCEL \(Tungsten, -20 +40 Mesh\)](#)

Note: Click on an instrument, crucible, combustion boat, accelerator, or additive to view specific information regarding that instrument, crucible, combustion boat, accelerator, or additive and its use\*.

\* When navigating this document using a hyperlink, you may return to your previous location by pressing: Alt+left arrow key

	<a href="#">C744</a>	<a href="#">S744</a>	<a href="#">CS744</a>	<a href="#">C844</a>	<a href="#">S844</a>	<a href="#">CS844</a>	<a href="#">S844ES</a>	<a href="#">CS844ES</a>	<a href="#">RC612</a>
<b>Crucibles/Combustion Boats</b>									
<a href="#">528-018 – Ceramic Crucible</a>	X	X	X	X	X	X	X	X	
<a href="#">528-018HP – High Purity Ceramic Crucible (Ultra Low Sulfur)</a>	X	X	X	X	X	X	X	X	
<a href="#">625-505-430 – Nickel Combustion Boat</a>									X
<a href="#">781-335 – Quartz Combustion Boat</a>									X
<a href="#">782-059 – Nickel Boat Liner</a>									X
<b>Accelerators/Additives</b>									
<a href="#">501-008/502-297 – LECOCEL II (tungsten/tin)</a>	X	X	X	X	X	X	X	X	
<a href="#">501-077/763-467 – Iron Chip, Standard Grade (-6 +20 mesh)</a>	X	X	X	X	X	X	X	X	
<a href="#">501-078 – Iron Powder (low Sulfur)</a>	X	X	X	X	X	X	X	X	
<a href="#">501-263, 501-264, 501-640 – Copper Chip Accel. (-20 +30 mesh)</a>	X	X	X	X	X	X	X	X	
<a href="#">501-636-HAZ - Vanadium Pentoxide</a>	X	X	X	X	X	X	X	X	
<a href="#">502-156(HP) – Fluorhib</a>									X
<a href="#">502-173 – LECOCEL II HP (tungsten/tin, high purity)</a>	X	X	X	X	X	X	X	X	
<a href="#">502-231 – High Purity Iron Chip (-6 +20 mesh)</a>	X	X	X	X	X	X	X	X	
<a href="#">502-492 – High Purity Copper Accelerator</a>	X	X	X	X	X	X	X	X	
<a href="#">502-857, 502-858, 763-263, 763-027 – LECOCEL III (tungsten, -12 +20 mesh)</a>	X	X	X	X	X	X	X	X	
<a href="#">502-860, 502-861, 763-266, 763-026 – LECOCEL (tungsten, -20 +40 mesh)</a>	X	X	X	X	X	X	X	X	

Note: Click on an instrument, crucible, combustion boat, accelerator, or additive to view specific information regarding that instrument, crucible, combustion boat, accelerator or additive and its use\*.

\* When navigating this document using a hyperlink, you may return to your previous location by pressing: Alt+left arrow key

# Instruments

## Combustion by Induction Instruments (744 and 844 Instrument Series)

Includes: C744, S744, CS744, C844, S844, S844ES, CS844, and CS844ES

### ► Carbon and Sulfur Determination

The use of an induction furnace is the preferred method of heating and combusting metals and other inorganic materials for carbon and sulfur determination. In an induction furnace, induced electrical currents heat the sample and accelerator; this transfer of power is commonly referred to as coupling with the electric field. Most metals couple well; however, most oxides do not. As combustion proceeds and the metals are transformed to oxides, the combustion temperature will drop significantly, resulting in poor recovery. Certain metals such as copper and iron, as well as their oxides, will couple in an HF furnace, thereby maintaining sufficient temperature to permit complete oxidation of the carbon and sulfur present in a sample. Therefore, iron and copper (along with other metals/oxides) are frequently used as accelerators to improve recovery.



CS744



CS844

### Applicable Crucibles:

- [528-018 – Ceramic Crucible](#)
- [528-018HP – High Purity Ceramic Crucible](#)

### Applicable Accelerators:

- [501-008 or 502-297 – LECOCEL II \(tungsten/tin, Standard Grade\)](#)
- [501-077 or 763-467 – Iron Chip Accelerator, Standard Grade \(-6 +20 Mesh\)](#)
- [501-078 – Iron Powder \(Low Sulfur\)](#)
- [501-263, 501-264, or 501-640 – Copper Chip Accelerator \(-20 +30 mesh\)](#)
- [501-636-HAZ – Vanadium Pentoxide](#)
- [502-173 – LECOCEL II HP \(tungsten/tin, high purity\)](#)
- [502-231 – High Purity Iron Chip \(-6 +20 mesh\)](#)
- [502-492 – High Purity Copper Accelerator](#)
- [502-857, 502-858, 763-263 or 763-027 – LECOCEL III \(tungsten, -12 +20 mesh\)](#)
- [502-860 or 502-861, 763-266 or 763-026 – LECOCEL \(tungsten, -20 +40 mesh\)](#)

Note: Click on a crucible or accelerator to view specific information regarding that crucible or accelerator and its use.

# Instruments

## Combustion by Induction Instruments (Continued...)

Includes: C744, S744, CS744, C844, S844, S844ES, CS844, and CS844ES

### Applicable Matrices and Elemental Determination\*:

- [Mold Powder \(Carbon\)](#)
- [Nitrides \(Carbon\)](#)
- [Refractory and Reactive Metals \(Carbon\)](#)
- [High Carbon Ferroalloys \(Carbon and Sulfur\)](#)
- [Low Carbon Ferroalloys \(Carbon and Sulfur\)](#)
- [Cast Iron \(Carbon and Sulfur\)](#)
- [Iron, Steel, Nickel-Based, and Cobalt-Based Alloys \(Carbon and Sulfur\)](#)
- [Lime \(Carbon and Sulfur\)](#)
- [Limestone/Dolomite \(Carbon & Sulfur\)](#)
- [Metal-Bearing Ores and Related Materials \(Carbon and Sulfur\)](#)
- [Soda-Lime Glass \(Carbon and Sulfur\)](#)
- [Battery Paste \(PbO/PbSO<sub>4</sub>\) \(Sulfur\)](#)
- [Copper-Based Materials \(Sulfur\)](#)
- [Ore Concentrate \(Sulfur\)](#)
- [Tungsten Carbide \(Carbon Only\)](#)
- [Tungsten Carbide \(Sulfur Only, or Simultaneous Carbon and Sulfur\)](#)
- [Fluorspar \(Carbon and Sulfur\)](#)
- [Steel, Nickel and Super Alloys \(Ultra-Low Sulfur\)](#)

Note: Click on a matrix above for additional details regarding the method and recommended crucibles and accelerators.

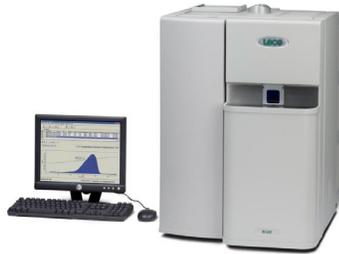
\*This list includes some of the typical matrices (and associated elemental determination) applicable to this group of instruments. It is not a comprehensive list of all possible applicable matrices.

## Instruments

### Multiphase Carbon and Moisture Determinator

Includes: RC612

#### ➤ Carbon and Moisture Determination



RC612

#### Applicable Combustion Boats:

- [625-505-430 – Nickel Combustion Boat](#)
- [781-335 – Quartz Combustion Boat](#)
- [782-059 – Nickel Boat Liner](#)

#### Applicable Additives:

- Analysis on the RC612 does not require the use of accelerators
- [502-493 or 502-156 – Fluorhib](#) (For moisture determination in fluoride containing materials)

*Note: Click on a crucible or additive to view specific information regarding that crucible or additive and its use.*

#### Applicable Matrices and Elemental Determination\*:

- [Welding Flux \(Moisture\)](#)
- [Aluminum Sheets/Rods/Wire \(Surface Carbon\)](#)
- [Steel Sheet and Rod Samples \(Surface Carbon\)](#)
- [TOC in Soil, Rock, and Shale \(Temperature-Dependent Determination of Carbon and TOC\)](#)

*Note: Click on a matrix above for additional details regarding the method and recommended combustion boats.*

*\*This list includes some of the typical matrices (and associated elemental determination) applicable to this instrument. It is not a comprehensive list of all possible applicable matrices.*

# Crucibles

Ceramic crucibles are used to contain the sample and accelerators during the combustion process. The ceramic crucibles used during the combustion of samples can add to analytical variability if they are not properly prepared. The standard 528-018 ceramic crucible weighs ~18 g on average. The samples analyzed typically weigh 1 g or less. This means only 1 ppm of carbon (or sulfur) in or on the crucible will result in 18 µg of carbon (or sulfur) being added to the analytical result. However, the contamination is not consistent. Some crucibles will have no carbon or sulfur in (or on) them, while others will have up to 25 micrograms. If the crucibles are handled with bare hands, contamination will be increased, resulting in even more erratic results. To account for this, ASTM and ISO procedures call for preheating or baking-off of the crucibles. This is typically done in a muffle or tube furnace at temperatures of at least 1000 °C for 2 hours or at more than 1250 °C for at least 15 minutes. Then they are removed from the heat, allowed to cool on a tray, and placed in a desiccator. The crucibles are then handled with clean tongs only and removed individually from the desiccator for use. They must not be allowed to remain in an open-air environment too long, as they can be contaminated with air-borne particulate. Although this procedure is typically reserved for low carbon (<0.1%) and sulfur (<0.01%) determination, the effects can be noticed on high carbon results when smaller sample masses are used. LECO supplies several types of ceramic crucibles, which are outlined on the following pages.

## Ceramic Crucible (528-018)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Considerations:

- Most commonly used crucible in LECO induction furnace units for carbon and sulfur determination
- Can be used with LECO autoloaders

### Applicable Sample Matrices and Elemental Determination\*:

- [Mold Powder \(Carbon\)](#)
- [Nitrides \(Carbon\)](#)
- [Refractory and Reactive Metals \(Carbon\)](#)
- [High Carbon Ferroalloys \(Carbon and Sulfur\)](#)
- [Low Carbon Ferroalloys \(Carbon and Sulfur\)](#)
- [Cast Iron \(Carbon and Sulfur\)](#)
- [Iron, Steel, Nickel-Base, and Cobalt-Base Alloys \(Carbon and Sulfur\)](#)
- [Lime \(Carbon and Sulfur\)](#)
- [Limestone/Dolomite \(Carbon and Sulfur\)](#)
- [Metal-Bearing Ores and Related Materials \(Carbon and Sulfur\)](#)
- [Soda-Lime Glass \(Carbon and Sulfur\)](#)
- [Ore Concentrate \(Sulfur\)](#)
- [Tungsten Carbide \(Carbon Only\)](#)
- [Tungsten Carbide \(Sulfur Only, or Simultaneous Carbon and Sulfur\)](#)
- [Fluorspar \(Carbon and Sulfur\)](#)

Note: Click on a matrix above for additional details regarding the method and recommended crucible and accelerators.

\*This list includes some of the typical matrices (and associated elemental determination) applicable to this crucible. It is not a comprehensive list of all possible applicable matrices.

[Return to Index](#)

## High Purity Ceramic Crucible (528-018HP)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Considerations:

- High-purity crucible with ultra-low sulfur content
- Recommended for ultra-low sulfur determination
- Can be used with LECO autoloaders

### Applicable Sample Matrices and Elemental Determination\*:

- **LECO Recommends 528-018HP Crucibles for low sulfur determination in the following matrices:**
  - [Copper-Based Materials \(Sulfur\)](#)
  - [Ultra-Low Sulfur Steel, Nickel, and Superalloys \(Sulfur\)](#)
- **LECO 528-018HP Crucibles may be used for the following matrices; however, the 528-018 Crucibles may be used as well:**
  - [Mold Powder \(Carbon\)](#)
  - [Nitrides \(Carbon\)](#)
  - [Refractory and Reactive Metals \(Carbon\)](#)
  - [High Carbon Ferroalloys \(Carbon and Sulfur\)](#)
  - [Low Carbon Ferroalloys \(Carbon and Sulfur\)](#)
  - [Cast Iron \(Carbon and Sulfur\)](#)
  - [Iron, Steel, Nickel-Base, and Cobalt-Base Alloys \(Carbon and Sulfur\)](#)
  - [Lime \(Carbon and Sulfur\)](#)
  - [Limestone/Dolomite \(Carbon and Sulfur\)](#)
  - [Metal-Bearing Ores and Related Materials \(Carbon and Sulfur\)](#)
  - [Soda-Lime Glass \(Carbon and Sulfur\)](#)
  - [Battery Paste \(PbO/PbSO<sub>4</sub>\) \(Sulfur\)](#)
  - [Ore Concentrate \(Sulfur\)](#)
  - [Tungsten Carbide \(Carbon Only\)](#)
  - [Tungsten Carbide \(Sulfur Only, or Simultaneous Carbon and Sulfur\)](#)
  - [Fluorspar \(Carbon and Sulfur\)](#)

*Note: Click on a matrix above for additional details regarding the method and recommended crucible and accelerators.*

*\*This list includes some of the typical matrices (and associated elemental determination) applicable to this crucible. It is not a comprehensive list of all possible applicable matrices.*

## Nickel Combustion Boat (625-505-430)

**Applicable Instrument(s):** RC612 (Multiphase Carbon and Moisture Determinator)



### Considerations:

- Combustion Boats must be baked-off at 1000 °C for a minimum of five minutes, prior to analysis. After cooling, the combustion boats should be stored in a desiccator until use (within 24 hours). If combustion boats are not used within 24 hours, they should be re-baked prior to use.

### Applicable Sample Matrices and Elemental Determination\*:

- [Welding Flux \(Moisture Determination\)](#)
- [Aluminum Wire \(Surface Carbon Determination\)](#)
- [Steel Wire/Rod \(Surface Carbon Determination\)](#)
- [Total Organic Carbon \(TOC\) in Soil, Rock, and Shale \(Temperature Dependent Determination of TOC\)](#)

*Note: Click on a matrix above for additional details regarding the method and recommended crucible and accelerators.*

*\*This list includes some of the typical matrices (and associated elemental determination) applicable to this crucible. It is not a comprehensive list of all possible applicable matrices.*

## Quartz Combustion Boat (781-335)

**Applicable Instrument(s):** RC612 (Multiphase Carbon and Moisture Determinator)



### Considerations:

- Combustion boats must be baked-off at 1000 °C for a minimum of five minutes, prior to analysis. After cooling, the combustion boats should be stored in a desiccator until use (within 24 hours). If combustion boats are not used within 24 hours, they should be re-baked prior to use.
- Should be used in combination with nickel boat liners when analyzing samples that contain fluorine to prevent damaging the quartz combustion boat.

### Applicable Sample Matrices and Elemental Determination\*:

- [Welding Flux \(Moisture Determination\)](#)
- [Aluminum Wire \(Surface Carbon Determination\)](#)
- [Steel Wire/Rod \(Surface Carbon Determination\)](#)
- [Total Organic Carbon \(TOC\) in Soil, Rock, and Shale \(Temperature Dependent Determination of TOC\)](#)

*Note: Click on a matrix above for additional details regarding the method and recommended crucible and accelerators.*

*\*This list includes some of the typical matrices (and associated elemental determination) applicable to this crucible. It is not a comprehensive list of all possible applicable matrices.*

## Nickel Boat Liner (782-059)

**Applicable Instrument(s):** RC612 (Multiphase Carbon and Moisture Determinator)



### Considerations:

- Used in conjunction with 781-335 Quartz Combustion Boats to prevent damage to the quartz boat when analyzing samples that contain fluorine.
- Nickel boat liners must be baked-off at 1000 °C for a minimum of five minutes, prior to analysis. After cooling, the boat liners should be stored in a desiccator until use (within 24 hours). If boat liners are not used within 24 hours, they should be re-baked prior to use.

### Applicable Sample Matrices and Elemental Determination\*:

- [Welding Flux \(Moisture Determination\)](#)

*Note: Click on a matrix above for additional details regarding the method and recommended crucible and accelerators.*

*\*This list includes some of the typical matrices (and associated elemental determination) applicable to this crucible. It is not a comprehensive list of all possible applicable matrices.*

## Accelerators/Additives

Often, combustion of inorganic materials can be hastened through the use of an accelerator. The purpose of the accelerator is to ignite or set fire to the sample. It can also double as a flux to dissolve any oxide skins making the melt thoroughly fluid. A completely fluid melt is essential in order to oxidize the carbon and sulfur in the sample in a relatively short time frame. Several metals have been used as accelerators over the years; however, only a few have been adopted for routine use. Certain advantages are found with each accelerator and in many cases, they are combined for optimum performance.

The purity and consistency of the accelerator is very important. An accelerator should be low in both carbon and sulfur content, as well as have any carbon and/or sulfur impurity evenly distributed. This will allow for proper blanking of the accelerator. Another area of concern is the handling and storage of accelerators. Accelerators can be packaged in a variety of containers in a variety of sizes. It is important to protect the accelerators from inadvertent contamination. A subtle but common source of contamination is leaving the lid of the accelerator container off for extended periods of time, allowing airborne particulate (dust) to contaminate the accelerator. This contamination is typically more evident for carbon than sulfur, but any variability contributed by the accelerator will be added to the variability inherent in the sample. The amount of accelerator used for each analysis should also be kept consistent within the method to reduce variability. LECO supplies several different types of accelerators, which are outlined on the following pages.

### LECOCEL II (Tungsten/Tin, Standard Grade) (501-008 or 502-297)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Considerations:

- Tungsten is a good accelerator for plain carbon steels, providing excellent combustion characteristics when combined with tin.
- Tin is typically used as an additive to tungsten, copper, and iron. It burns readily producing a lot of heat. It can lower the liquidus temperature of the melt.
- LECOCEL II is a good accelerator for general application in carbon and sulfur determination for steel alloys and nickel and cobalt base alloys. It can be used in conjunction with iron chip accelerator for nonferrous or hard to burn materials.
- Accelerators should be added by mass, not volume, to eliminate packing density variation which can occur when adding these materials by volume/scoop. Recommended masses are noted in the relevant application notes or the applicable matrices sections of this document.

### Applicable Sample Matrices and Elemental Determination\*:

- [Mold Powders \(Carbon\)](#)
- [Cast Iron \(Carbon and Sulfur\)](#)
- [Iron, Steel, Nickel-Base, and Cobalt-Base Alloys \(Carbon and Sulfur\)](#)
- [Metal-Bearing Ores and Related Materials \(Carbon and Sulfur\)](#)
- [Ore Concentrate \(Sulfur\)](#)
- [Soda-Lime Glass \(Carbon and Sulfur\)](#)

*Note: Click on a matrix above for additional details regarding the method and recommended crucibles and accelerators.*

*\*This list includes some of the typical matrices (and associated elemental determination) applicable to this accelerator. It is not a comprehensive list of all possible applicable matrices.*

## Iron Chip Accelerator, Standard Grade (-6 +20 Mesh) (501-077 or 763-467)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Considerations:

- Iron Chip is a good accelerator for general application, typically combined with tungsten, copper, or tungsten/tin accelerators.
- When analyzing nonconductive materials such as ceramics and many other nonferrous samples, the use of an accelerator with good inductive capabilities, such as iron, is essential.
- Used for both carbon and sulfur determination in some ferroalloys as well as nonferrous materials.
- Accelerators should be added by mass, not volume, to eliminate packing density variation which can occur when adding these materials by volume/scoop. Recommended masses are noted in the relevant application notes or the applicable matrices sections of this document.

### Applicable Sample Matrices and Elemental Determination\*:

- [Mold Powder \(Carbon\)](#)
- [Cast Iron \(Carbon and Sulfur\)](#)
- [Metal-Bearing Ores and Related Materials \(Carbon and Sulfur\)](#)
- [Ore Concentrate \(Sulfur\)](#)

*Note: Click on a matrix above for additional details regarding the method and recommended crucibles and accelerators.*

*\*This list includes some of the typical matrices (and associated elemental determination) applicable to this accelerator. It is not a comprehensive list of all possible applicable matrices.*

## Iron Powder (Low Sulfur) (501-078)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Considerations:

- When analyzing nonconductive materials such as ceramics and many other nonferrous samples, the use of an accelerator with good inductive capabilities, such as iron, is essential.
- Accelerators should be added by mass, not volume, to eliminate packing density variation which can occur when adding these materials by volume/scoop. Recommended masses are noted in the relevant application notes or the applicable matrices sections of this document.

### Applicable Sample Matrices and Elemental Determination\*:

- [High Carbon Ferroalloys \(Carbon and Sulfur\)](#)
- [Low Carbon Ferroalloys \(Carbon and Sulfur\)](#)
- [Limestone/Dolomite \(Carbon and Sulfur\)](#)
- [Tungsten Carbide \(Carbon and Sulfur\)](#)
- [Silicon Carbide \(Carbon and Sulfur\)](#)
- [Refractory/Reactive Metals \(Sulfur\)](#)

*Note: Click on a matrix above for additional details regarding the method and recommended crucibles and accelerators.*

*\*This list includes some of the typical matrices (and associated elemental determination) applicable to this accelerator. It is not a comprehensive list of all possible applicable matrices.*

## Copper Chip Accelerator (-20 +30 mesh) (501-263, 501-264, or 501-640)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Considerations:

- Copper is an excellent accelerator for carbon determination (particularly in ultra-low carbon determination) in steel, nonferrous metals, and alloys. It is usually combined with iron chip when nonferrous materials are being analyzed.
- Copper accelerator is normally not recommended for sulfur determination in ferrous materials, but it can be used for sulfur determination using a low temperature technique.
- Accelerators should be added by mass, not volume, to eliminate packing density variation which can occur when adding these materials by volume/scoop. Recommended masses are noted in the relevant application notes or the applicable matrices sections of this document.

### Applicable Sample Matrices and Elemental Determination\*:

- [Battery Paste \(PbO/PbSO<sub>4</sub>\) \(Sulfur\)](#)
- [Copper-Based Materials \(Sulfur\)](#)
- [Refractory/Reactive Metal \(Carbon\)](#)
- [Iron, Steel, Nickel Base, and Cobalt Base Alloys \(Carbon Only\)](#)
- [Tungsten Carbide \(Carbon Only\)](#)
- [Nitrides \(Carbon Only\)](#)

*Note: Click on a matrix above for additional details regarding the method and recommended crucibles and accelerators.*

*\*This list includes some of the typical matrices (and associated elemental determination) applicable to this accelerator. It is not a comprehensive list of all possible applicable matrices.*

## Vanadium Pentoxide ( $V_2O_5$ ) (501-636-HAZ)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Considerations:

- Vanadium Pentoxide ( $V_2O_5$ ) is an excellent accelerator for difficult to burn materials. It will produce very high combustion temperatures, while also contributing oxygen to the combustion process. It may be used in conjunction with tungsten metal and iron powder.
- Vanadium Pentoxide is considered a hazardous material; therefore, proper precautions should be taken, and appropriate PPE should be utilized.
- Accelerators should be added by mass, not volume, to eliminate packing density variation which can occur when adding these materials by volume/scoop. Recommended masses are noted in the relevant application notes or the applicable matrices sections of this document.

### Applicable Sample Matrices and Elemental Determination\*:

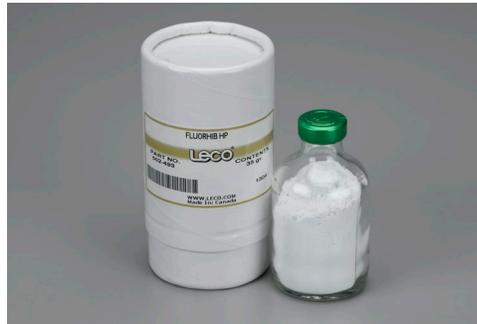
- [High Carbon Ferroalloys \(Carbon and Sulfur\)](#)
- [Low Carbon Ferroalloys \(Method 2\) \(Carbon and Sulfur\)](#)
- [Limestone/Dolomite \(Carbon and Sulfur\)](#)
- [Tungsten Carbide \(Sulfur-Only or Simultaneous Carbon and Sulfur\)](#)
- [Silicon Carbide \(Sulfur-Only or Simultaneous Carbon and Sulfur\)](#)

*Note: Click on a matrix above for additional details regarding the method and recommended crucibles and accelerators.*

*\*This list includes some of the typical matrices (and associated elemental determination) applicable to this accelerator. It is not a comprehensive list of all possible applicable matrices.*

## Fluorhib (502-156 or 502-493 HP)

**Applicable Instrument(s):** RC612 (Multiphase Carbon and Moisture Determinator)



### Considerations:

- Fluorhib is used when analyzing samples that contain fluorides to mitigate the formation of fluorine.
- Fluorhib ( $\text{SiO}_2$ ) reacts with fluorine ( $\text{F}_2$ ) to form Silicon Tetrafluoride ( $\text{SiF}_4$ ) which will not damage the internal components of the instrument, like fluorine would.
- Fluorhib must be baked-off at  $1000\text{ }^\circ\text{C}$  for 10 minutes prior to use. It can then be stored up to 24 hours in a desiccator prior to use without being re-baked.
- Additives should be added by mass, not volume, to eliminate packing density variation which can occur when adding these materials by volume/scoop. Recommended masses are noted in the relevant application notes or the applicable matrices sections of this document.

### Applicable Sample Matrices and Elemental Determination\*:

- [Welding Flux \(Moisture\)](#)
- [Mold Powders \(Moisture\)](#)

*Note: Click on a matrix above for additional details regarding the method and recommended crucibles and accelerators.*

*\*This list includes some of the typical matrices (and associated elemental determination) applicable to this accelerator. It is not a comprehensive list of all possible applicable matrices.*

## LECOCEL II HP (Tungsten/Tin, High Purity) (502-173)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Considerations:

- Tungsten is a good accelerator for plain carbon steels, providing excellent combustion characteristics when combined with tin.
- Tin is typically used as an additive to tungsten, copper, and iron. It burns readily producing a lot of heat. It can lower the liquidus temperature of the melt.
- LECOCEL II HP is a good accelerator for ultra-low carbon and sulfur determination; it results in lower and more consistent blanks than the LECOCEL II (501-008) accelerator. It can be used in conjunction with high purity iron chip for nonferrous or hard to burn materials.
- Accelerators should be added by mass, not volume, to eliminate packing density variation which can occur when adding these materials by volume/scoop. Recommended masses are noted in the relevant application notes or the applicable matrices sections of this document.

### Applicable Sample Matrices and Elemental Determination\*:

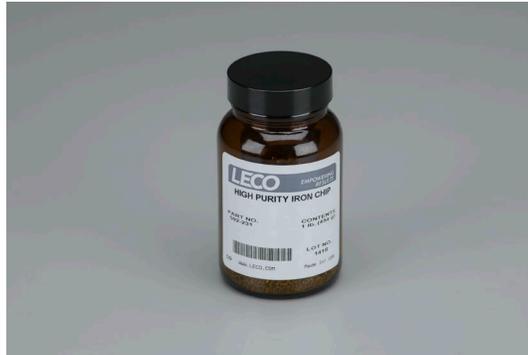
- [Mold Powder \(Carbon\)](#)
- [Low Carbon Ferrous Alloys \(Method 2\) \(Carbon and Sulfur\)](#)
- [Cast Iron \(Carbon and Sulfur\)](#)
- [Iron, Steel, Nickel-Base, and Cobalt-Base Alloys \(Carbon and Sulfur\)](#)
- [Metal-Bearing Ores and Related Materials \(Carbon and Sulfur\)](#)
- [Soda-Lime Glass \(Carbon and Sulfur\)](#)
- [Ore Concentrate \(Sulfur\)](#)
- [Ultra-Low Sulfur Steel, Nickel, and Superalloys \(Sulfur\)](#)

*Note: Click on a matrix above for additional details regarding the method and recommended crucibles and accelerators.*

*\*This list includes some of the typical matrices (and associated elemental determination) applicable to this accelerator. It is not a comprehensive list of all possible applicable matrices.*

## Iron Chip, High Purity (-6 +20 Mesh) (502-231)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Considerations:

- When analyzing nonconductive materials such as ceramics and many other nonferrous samples, the use of an accelerator with good inductive capabilities, such as iron, is essential.
- Used for both carbon and sulfur determination in some low carbon ferroalloys as well as nonferrous materials. It is usually combined with tungsten, copper, or tin accelerators.
- High Purity Iron Chip is a good accelerator for ultra-low carbon and sulfur determination; It results in lower and more consistent blanks than the 501-077 Iron Chip Accelerator.
- Accelerators should be added by mass, not volume, to eliminate packing density variation which can occur when adding these materials by volume/scoop. Recommended masses are noted in the relevant application notes or the applicable matrices sections of this document.

### Applicable Sample Matrices and Elemental Determination\*:

- [Mold Powder \(Carbon\)](#)
- [Cast Iron \(Carbon and Sulfur\)](#)
- [Lime \(Carbon and Sulfur\)](#)
- [Metal-Bearing Ores and Related Materials \(Carbon and Sulfur\)](#)
- [Ore Concentrate \(Sulfur\)](#)

*Note: Click on a matrix above for additional details regarding the method and recommended crucibles and accelerators.*

*\*This list includes some of the typical matrices (and associated elemental determination) applicable to this accelerator. It is not a comprehensive list of all possible applicable matrices.*

## High Purity Copper Accelerator (502-492)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Considerations:

- High purity copper is a good accelerator for low carbon determination.
- The use of copper accelerator for sulfur determination in battery paste and Copper-based Materials requires a reduced furnace power setting to prevent the deposition of Copper Oxide (CuO) in the dust filter. The CuO dust will act as an SO<sub>2</sub> scrubber and cause low sulfur recovery.
- Accelerators should be added by mass, not volume, to eliminate packing density variation which can occur when adding these materials by volume/scoop. Recommended masses are noted in the relevant application notes or the applicable matrices sections of this document.

### Applicable Sample Matrices and Elemental Determination\*:

- [Nitrides \(Carbon\)](#)
- [Refractory and Reactive Metals \(Carbon\)](#)
- [Battery Paste \(PbO/PbSO<sub>4</sub>\) \(Sulfur\)](#)
- [Copper-Based Materials \(Sulfur\)](#)
- [Tungsten Carbide \(Carbon\)](#)

*Note: Click on a matrix above for additional details regarding the method and recommended crucibles and accelerators.*

*\*This list includes some of the typical matrices (and associated elemental determination) applicable to this accelerator. It is not a comprehensive list of all possible applicable matrices.*

## LECOCEL III (Tungsten, -12 +20 Mesh) (502-857, 502-858, 763-263, or 763-027)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Considerations:

- Tungsten is a good accelerator for plain carbon steels, providing excellent combustion characteristics when combined with tin.
- LECOCEL III is a good accelerator for carbon and sulfur determination in plain carbon steels and copper base materials. It is the original LECOCEL used on older LECO induction furnace instruments. Its coarser mesh couples better on lower frequency RF furnaces (844).
- Accelerators should be added by mass, not volume, to eliminate packing density variation which can occur when adding these materials by volume/scoop. Recommended masses are noted in the relevant application notes or the applicable matrices sections of this document.

### Applicable Sample Matrices and Elemental Determination\*:

- [Lime \(Carbon and Sulfur\)](#)
- [Metal-Bearing Ores and Related Materials \(Carbon and Sulfur\)](#)

*Note: Click on a matrix above for additional details regarding the method and recommended crucibles and accelerators.*

*\*This list includes some of the typical matrices (and associated elemental determination) applicable to this accelerator. It is not a comprehensive list of all possible applicable matrices.*

## LECOCEL (Tungsten, -20 +40 Mesh) (502-860, 502-861, 763-266, or 763-026)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Considerations:

- Tungsten is a good accelerator for plain carbon steels, providing excellent combustion characteristics when combined with tin.
- Tungsten can be used in conjunction with iron or other accelerators when nonferrous and/or poor coupling materials are being analyzed.
- Accelerators should be added by mass, not volume, to eliminate packing density variation which can occur when adding these materials by volume/scoop. Recommended masses are noted in the relevant application notes or the applicable matrices sections of this document.

### Applicable Sample Matrices and Elemental Determination\*:

- [Tungsten Carbide \(Sulfur-Only or Simultaneous Carbon and Sulfur\)](#)
- [High Carbon Ferroalloys \(Carbon and Sulfur\)](#)
- [Low Carbon Ferroalloys \(Method 2\) \(Carbon and Sulfur\)](#)
- [Lime \(Carbon and Sulfur\)](#)
- [Limestone/Dolomite \(Carbon and Sulfur\)](#)
- [Metal-Bearing Ores and Related Materials \(Carbon and Sulfur\)](#)

*Note: Click on a matrix above for additional details regarding the method and recommended crucibles and accelerators.*

*\*This list includes some of the typical matrices (and associated elemental determination) applicable to this accelerator. It is not a comprehensive list of all possible applicable matrices.*

# Applicable Matrices and Elemental Determination

## Mold Powder (Carbon Determination)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Applicable Crucible(s) and Accelerator(s):

- [528-018](#) or [528-018HP](#) Ceramic Crucible
- [501-008](#) LECOCEL II or [502-173](#) LECOCEL II HP Accelerator
- [501-077](#) Iron Chip Accelerator or [502-231](#) High Purity Iron Chip Accelerator

### Considerations:

- Analyzing mold powder on the 744 and 844 instrument series requires the installation of a fluorine trap, using the [LECO 619-592-149 Fluorine Trap Kit](#).

*Note: For additional details regarding this application/method, refer to LECO Application Note "Carbon in Mold Powder," Form No. 203-821-474 (CS744).*

## Nitrides (Carbon Determination)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Applicable Crucible(s) and Accelerator(s):

- [528-018](#) or [528-018HP](#) Ceramic Crucible
- [501-263](#), [501-264](#), [501-640](#) Copper Accelerator or [502-492](#) High Purity Copper Accelerator
- [502-231](#) High Purity Iron Chip Accelerator

### Considerations:

- Surface contamination on the sample can cause significant errors in the analytical data; therefore, care must be taken to ensure a clean, representative sample is analyzed.
- Solid samples should be crushed to a uniform mesh size prior to analysis.

Note: For additional details regarding this application/method, refer to the following LECO Application Notes:

- "Determination of Carbon in Nitrides," Form No. 203-821-512 (C844)
- "Determination of Carbon in Nitrides," Form No. 203-821-513 (C744).

## Refractory and Reactive Metals (Carbon Determination)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Applicable Crucible(s) and Accelerator(s):

- [528-018](#) or [528-018HP](#) Ceramic Crucible
- [502-492](#) High Purity Copper Accelerator
- [502-231](#) High Purity Iron Chip Accelerator

### Considerations:

- This group of metals and alloys includes zirconium (Zr), titanium (Ti), hafnium (Hf), niobium (Nb), vanadium (V), chromium (Cr), molybdenum (Mo), tungsten (W), and tantalum (Ta) based materials.
- ASTM E 1941, "Carbon in Refractory and Reactive Metals and Their Alloys," covers this group of materials analyzed on LECO induction furnace-combustion instruments.
- ASTM E 1941 dictates using copper and iron chip as accelerators. This applies to carbon only analysis, since copper oxide dust will permeate the system and cause sulfur recovery losses in subsequent analyses.
- Surface contamination on the sample can cause significant errors in the analytical data; therefore, care must be taken to ensure a clean, representative sample is analyzed.

Note: For additional details regarding this application/method, refer to the following LECO Application Notes:

- "Carbon in Refractory and Reactive Metals," Form No. 203-821-471 (C744)
- "Carbon in Refractory and Reactive Metals," Form No. 203-821-472 (C844).

## High Carbon Ferroalloys (Carbon and Sulfur Determination)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Applicable Crucible(s) and Accelerator(s):

- [528-018](#) or [528-018HP](#) Ceramic Crucible
- [763-266 LECOCEL](#)
- [501-078 Iron Powder](#)
- [501-636-HAZ Vanadium Pentoxide Accelerator](#)

### Considerations:

- The carbon blank associated with the outlined accelerators is considered high, however, the blank is consistent enough to be properly removed from the analysis results.
- Vanadium Pentoxide is considered a hazardous material; therefore, proper precautions should be taken, and appropriate PPE should be utilized.
- Samples should be a uniform and representative powder or granular material.

*Note: For additional details regarding this application/method, refer to the following LECO Application Notes:*

- "Carbon and Sulfur Determination in High Carbon Ferroalloys," Form No. 203-821-577 (CS744)
- "Carbon and Sulfur Determination in High Carbon Ferroalloys," Form No. 203-821-602 (CS844).

## Low Carbon Ferroalloys (Carbon and Sulfur Determination)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Method 1: Applicable Crucible(s) and Accelerator(s):

- [528-018](#) or [528-018HP](#) Ceramic Crucible
- [502-231 High Purity Iron Chip Accelerator](#)
- [502-173 LECOCEL II HP](#)

### Method 2: Applicable Crucible(s) and Accelerator(s):

- [528-018](#) or [528-018HP](#) Ceramic Crucible
- [501-078 Iron Powder Accelerator](#)
- [501-636-HAZ Vanadium Pentoxide Accelerator](#)
- [763-266 LECOCEL](#)

### Considerations:

- Method 1 utilizes LECOCEL II and iron chip accelerators to facilitate combustion, without the use of hazardous materials.
- Method 2 utilizes iron powder, vanadium pentoxide, and LECOCEL as accelerators to facilitate combustion. This accelerator combination works well for ferroalloys and may improve sulfur recovery and precision.
- Vanadium pentoxide ( $V_2O_5$ ) is considered a hazardous material; therefore, proper precautions should be taken, and appropriate PPE should be utilized.
- Samples should be a uniform, representative, powder or granular material.

Note: For additional details regarding this application/method, refer to the following LECO Application Notes"

- "Carbon and Sulfur Determination in Low Carbon Ferroalloys," Form No. 203-821-565 (CS744)
- "Carbon and Sulfur Determination in Low Carbon Ferroalloys," Form No. 203-821-588 (CS844).

## Cast Iron (Carbon and Sulfur Determination)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Applicable Crucible(s) and Accelerator(s):

- [528-018](#) or [528-018HP](#) Ceramic Crucible
- [502-173](#) LECOCEL II HP or [501-008](#) LECOCEL II
- [502-231](#) High Purity Iron Chip Accelerator or [501-077](#) Iron Chip Accelerator

### Considerations:

- Cast iron is a common application for LECO induction furnace carbon and sulfur determinators.
- Since cast iron is higher in carbon than steel (typically containing > 2% carbon), LECO typically recommends that ~0.5 g of sample be analyzed with ~1.0 g of LECOCEL or LECOCEL II and ~0.8 g of iron chip.
- ASTM E1019 covers carbon and sulfur determination in cast iron using LECO induction furnace-combustion instruments.
- ASTM E1806 outlines proper sampling for cast iron.
- A solid slice or chunk of an as-cast sample must be used rather than a pulverized or crushed sample. A chilled sample (white iron) can be analyzed as a solid single piece or as drillings, chips, or powder.

*Note: For additional details regarding this application/method, refer to the following LECO Application Notes:*

- "Determination of Carbon and Sulfur in Cast Iron," Form No. 203-821-506 (CS744)
- "Determination of Carbon and Sulfur in Cast Iron," Form No. 203-821-537 (CS844).

## Iron, Steel\*, Nickel-Base, and Cobalt-Base Alloys (Carbon and Sulfur Determination)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Applicable Crucible(s) and Accelerator(s):

- [528-018](#) or [528-018HP](#) Ceramic Crucible
- [502-173](#) LECOCEL II HP or [501-008](#) LECOCEL II\*
- [502-231](#) High Purity Iron Chip Accelerator
- [501-263](#) Copper Accelerator or [502-492](#) High Purity Copper Accelerator (Carbon-Only determination)

\*LECOCEL and LECOCEL III can be used for certain steel alloys such as plain carbon steel. LECOCEL II is suitable for all steel alloys.

### Considerations:

- This is the most common application for the LECO induction furnace line of carbon and sulfur determinators.
- ASTM E 1019, "Determination of Carbon, Sulfur, Nitrogen and Oxygen in Steel, and in Iron, Nickel, and Cobalt Alloys," is applicable to carbon and sulfur determination in steel and iron, and nickel/cobalt base alloys on LECO induction furnace combustion instruments.
- Typically, 1.0 g samples of steel or iron are analyzed with approximately 1.0 g of LECOCEL II or LECOCEL accelerators for simultaneous carbon and sulfur determination.
- When carbon only is being determined, copper accelerator will suffice and is more cost effective.
- This group of materials includes high purity nickel and cobalt, as well as nickel base, iron nickel base and cobalt base superalloys (high temperature alloys). They are typically analyzed using the same procedure as steel. In some cases, they will not burn readily and may require the addition of extra accelerator. Combustion is more difficult when analyzing solid, single-piece samples. Samples of chunks, chips, drillings, shavings, and powders will combust more readily than solid single piece samples. Normally, 1.0 g samples are analyzed using ~1.0 g of LECOCEL II HP. If difficulty in combustion is encountered, then ~2.0 g of LECOCEL II HP can be used. If this still is not effective, ~1.0 g of LECOCEL II HP and ~1.0 g of HP iron chip may be a better alternative.
- Sulfur detection is of critical importance in many of these alloys. Detecting sulfur at levels less than 2 ppm may be required. At these low levels, the best method is to use only LECOCEL II HP instead of LECOCEL II HP and HP iron chip, due to the added sulfur content and variability of the iron chip.
- Surface contamination on the sample can cause significant errors in the analytical data; therefore, care must be taken to ensure a clean, representative sample is analyzed (refer to the application note indicated below for additional details regarding sample preparation).

*Note: For additional details regarding this application/method, refer to LECO Application Note "Carbon and Sulfur in Iron, Steel, Nickel-Base, and Cobalt-Base Alloys," Form No. 203-821-457 (CS744).*

## Lime (Carbon and Sulfur Determination)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Applicable Crucible(s) and Accelerator(s):

- [528-018](#) or [528-018HP](#) Ceramic Crucible
- [763-266 LECOCEL](#) or [763-263 LECOCEL III](#) Accelerator
- [501-077](#) Iron Chip Accelerator or [502-231](#) High Purity Iron Chip Accelerator

### Considerations:

- Sample should be a uniform powder, preferably to pass through a 100 mesh (150 micron) sieve.
- Hydrated lime, as well as other materials with elevated crystalline moisture content, cannot be analyzed on the 744/844 instrument series.

*Note: For additional details regarding this application/method, refer to LECO Application Note "Carbon and Sulfur in Lime," Form No. 203-821-476 (CS744).*

## Limestone/Dolomite (Carbon and Sulfur Determination)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Applicable Crucible(s) and Accelerator(s):

- [528-018](#) or [528-018HP](#) Ceramic Crucible
- [501-078](#) Iron Powder Accelerator
- [501-636-HAZ](#) Vanadium Pentoxide Accelerator
- [763-266](#) LECOCEL

### Considerations:

- Due to the low carbon recovery observed when using alternative accelerators, the use of iron powder, vanadium pentoxide, and tungsten accelerators are required to achieve accurate results.

*Note: For additional details regarding this application/method, refer to the following LECO Application Notes*

- "Carbon and Sulfur Determination in Limestone/Dolomite," Form No. 203-821-545 (CS744)
- "Carbon and Sulfur Determination in Limestone/Dolomite," Form No. 203-821-544 (CS844).

## Metal-Bearing Ores and Related Materials (Carbon and Sulfur Determination)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Applicable Crucible(s) and Accelerator(s):

- [528-018](#) or [528-018HP](#) Ceramic Crucible
- [501-077](#) Iron Chip Accelerator or [502-231](#) High Purity Iron Chip Accelerator
- [763-266](#) LECOCEL, or [763-263](#) LECOCEL III, or [501-008](#) LECOCEL II, or [502-173](#) LECOCEL II HP Accelerator

### Considerations:

- ASTM method E1915, "Analysis of Metal Bearing Ores and Related Materials by Combustion Infrared Absorption Spectrometry," was written specifically to cover carbon and sulfur determination of these material types and is applicable to the 744 and 844 instrument series.
- A nominal sample mass of 0.2 g to 0.25 g is combusted using ~1.0 g of tungsten or tungsten/tin (LECOCEL, LECOCEL II, or LECOCEL II HP) plus ~1.0 g of iron chip accelerator. Sample mass may be reduced when samples contain higher concentrations of sulfur.
- Samples should be a uniform powder, preferably to pass through a 100 mesh (150 micron) sieve.
- Samples and reference materials are typically dried at 105 °C for one hour, prior to analysis.

Note: For additional details regarding this application/method, refer to the following LECO Application Notes:

- "Carbon and Sulfur in Metal-Bearing Ores and Related Materials," Form No. 203-821-465 (CS744)
- "Determination of Carbon and Sulfur in Metal-Bearing Ores and Related Materials," Form No. 203-821-463 (CS844).

## Soda-Lime Glass (Carbon and Sulfur Determination)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Applicable Crucible(s) and Accelerator(s):

- [528-018](#) or [528-018HP](#) Ceramic Crucible
- [502-231](#) High Purity Iron Chip Accelerator
- [502-173](#) LECOCEL II HP Accelerator
- [501-636-HAZ](#) Vanadium Pentoxide

### Considerations:

- Some glass matrices may require high temperatures to completely liberate sulfur. For these glass materials, the use of iron powder, vanadium pentoxide, and tungsten accelerators may be required.
- Samples should be a uniform powder, preferably to pass through a 100 mesh (150 micron) sieve.

*Note: For additional details regarding this application/method, refer to LECO Application Note "Carbon and Sulfur Determination in Soda-Lime Glass," Form No. 203-821-549 (CS744).*

## Battery Paste (PbO/PbSO<sub>4</sub>) (Sulfur Determination)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Applicable Crucible(s) and Accelerator(s):

- [528-018HP](#) Ceramic Crucible
- [502-492](#) High Purity Copper Accelerator or [501-263](#) Copper Accelerator

### Considerations:

- Carbon analysis is relatively straightforward for this application, and typically 0.05 g to 0.10 g of sample is combusted with ~2 g of copper accelerator.
- For accurate sulfur determination, the use of a reduced furnace power method is required. The low temperature method prevents copper oxide (CuO) dust from depositing on the dust filter. The CuO dust will act as a scrubber for SO<sub>2</sub>, causing low analyte recovery.

*Note: For additional details regarding this application/method, refer to LECO Application Note "Sulfur Determination in Battery Paste (PbO/PbSO<sub>4</sub>)," Form No. 203-821-552 (CS744).*

## Copper Base Materials (Sulfur Determination)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Applicable Crucible(s) and Accelerator(s):

- [528-018](#) or [528-018HP](#) Ceramic Crucible
- [502-492](#) High Purity Copper Accelerator or [501-263](#) Copper Accelerator

### Considerations:

- The main difficulty with determination of sulfur in copper base materials relates to the dust build-up in the dust filter area. It is very important to keep the filter and surrounding area clean.
- For accurate sulfur determination, the use of a low temperature furnace method is required. The reduced furnace power method prevents copper oxide dust from depositing on the dust filter. Copper oxide dust will act as a scrubber for SO<sub>2</sub>, causing low analyte recovery.

*Note: For additional details regarding this application/method, refer to the following LECO Application Notes:*

- "Sulfur in Copper Base Materials," Form No. 203-821-439 (CS744)
- "Sulfur in Copper Base Materials," Form No. 203-821-438 (CS844).

## Ore Concentrate (Sulfur Determination)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Applicable Crucible(s) and Accelerator(s):

- [528-018](#) or [528-018HP](#) Ceramic Crucible
- [502-231](#) High Purity Iron Chip Accelerator or [501-077](#) Iron Chip Accelerator
- [502-173](#) LECOCEL II HP or [501-008](#) LECOCEL II

### Considerations:

- Sulfur determination in ore concentrate on the 744 can be challenging due to the high sulfur content of this material. Therefore, it is important that the sulfur mass of the sample being analyzed is kept within the mass range indicated in the 744 instrument's instruction manual.

*Note: For additional details regarding this application/method, refer to the following LECO Application Notes:*

- "Sulfur in Ore Concentrate," Form No. 203-821-493 (CS744)
- "Determination of Sulfur in Ore Concentrate," Form No. 203-821-507 (CS844).

## Tungsten Carbide (Carbon and Sulfur Determination)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Carbon-Only Determination:

Applicable Crucible(s) and Accelerator(s):

- [528-018](#) or [528-018HP](#) Ceramic Crucible
- [502-492](#) High Purity Copper Accelerator
- [502-231](#) High Purity Iron Chip Accelerator

### Sulfur-Only or Simultaneous Carbon and Sulfur Determination:

Applicable Crucible(s) and Accelerator(s):

- [528-018](#) or [528-018HP](#) Ceramic Crucible
- [502-078](#) Iron Powder Accelerator
- [501-636-HAZ](#) Vanadium Pentoxide Accelerator
- [763-266](#) or [502-860](#) LECOCEL

### Considerations:

- The use of copper accelerator will generate large amounts of copper oxide dust, which will act as an SO<sub>2</sub> scrubber, resulting in low analyte recovery. When switching from a carbon-only to a sulfur-only and/or simultaneous carbon and sulfur determination, changing the Anhydron and changing the dust filter will be required.

*Note: For additional details regarding this application/method, refer to LECO Application Note "Determination of Carbon and Sulfur in Tungsten Carbide," Form No. 203-821-508 (CS844).*

## Silicon Carbide (Carbon and Sulfur Determination)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Carbon-Only Determination:

Applicable Crucible(s) and Accelerator(s):

- [528-018](#) or [528-018HP](#) Ceramic Crucible
- [501-263](#) Copper Accelerator or [502-492](#) High Purity Copper Accelerator
- [501-077](#) Iron Chip Accelerator or [502-231](#) High Purity Iron Chip Accelerator

### Sulfur-Only or Simultaneous Carbon and Sulfur Determination:

Applicable Crucible(s) and Accelerator(s):

- [528-018](#) or [528-018HP](#) Ceramic Crucible
- [502-078](#) Iron Powder Accelerator
- [501-636-HAZ](#) Vanadium Pentoxide Accelerator
- [763-266](#) LECOCEL

### Considerations:

- The use of copper accelerator will generate large amounts of copper oxide dust, which will act as an SO<sub>2</sub> scrubber, resulting in low analyte recovery. When switching from a carbon-only to a sulfur-only and/or simultaneous carbon and sulfur determination, changing the Anhydron located downstream from the combustion furnace and changing the dust filter will be required.

*Note: For additional details regarding this application/method, refer to LECO Application Note "Determination of Carbon and Sulfur in Silicon Carbide," Form No. 203-821-635 (CS744).*

## Fluorspar (Carbon and Sulfur Determination)

**Applicable Instrument(s):** 744/844 Series (Induction Furnaces)



### Applicable Crucible(s) and Accelerator(s):

- [528-018](#) or [528-018HP](#) Ceramic Crucible
- [502-231](#) High Purity Iron Chip Accelerator
- [502-173](#) LECOCEL II HP

### Considerations:

- Surface contamination on the sample can cause significant errors in the analytical data; therefore, care must be taken to ensure a clean, representative sample is analyzed.
- Analysis of fluorspar will require the use of a Fluorine Trap ([619-592-149](#)).
- The oxides produced during the combustion of  $\text{CaF}_2$  may cause a flow restriction with the autocleaner, therefore it may be necessary to use the Manual Cleaner (619-593-161 (CS744) or 619-593-162 (CS844)) for analysis of  $\text{CaF}_2$ .

*Note: For additional details regarding this application/method, refer to LECO Application Note "Determination of Carbon and Sulfur in Fluorspar," Form No. 203-821-509 (CS844).*

## Ultra-Low Sulfur Steel, Nickel, and Superalloys (Sulfur Determination)

**Applicable Instrument(s):** 844/844ES (Induction Furnaces)



### Applicable Crucible(s) and Accelerator(s):

- [528-018HP](#) Ceramic Crucible
- [502-173](#) LECOCEL II HP Accelerator

### Considerations:

- Surface contamination on the sample can cause significant errors in the analytical data; therefore, care must be taken to ensure a clean, representative sample is analyzed.
- The use of the Enhanced Sensitivity (844ES) mode is applicable to sulfur determination only.
- To achieve accurate results, accelerators must be weighed accurately for each sample.

*Note: For additional details regarding this application/method, refer to LECO Application Note "Sulfur Determination in Ultra Low Sulfur Steel, Nickel and Superalloys," Form No. 203-821-540 (CS844/CS844ES).*

## Welding Flux (Moisture Determination)

**Applicable Instrument(s):** RC612 (Multiphase Carbon and Moisture Determinator)



### Applicable Crucible(s) and Additive(s):

- [781-335](#) Quartz Combustion Boat with [782-059](#) Nickel Boat Liner OR [625-505-430](#) Nickel Combustion Boat
- [502-156 or 502-493 \(HP\) – Fluorhib](#)

### Considerations:

- The 502-156 Fluorhib must be baked-off at 1000 °C for a minimum of 10 minutes prior to use. It can then be stored (for up to 24 hours) in a desiccator, prior to use.
- Per AWS A4.4, the use of a water slug is required for calibration verification. LECO recommends the use of capillary tubes that have been sealed at one end to perform this calibration verification. (Refer to Application Note for further details)
- The calcium oxalate reference material, typically recommended for water calibration, must be dried at 105 °C for one hour, prior to analysis.

*Note: For additional details regarding this application/method, refer to LECO Application Note "Determination of Moisture in Welding Flux," Form No. 203-821-567 (RC612).*

## Aluminum Sheets, Rods and Wire (Surface Carbon Determination)

**Applicable Instrument(s):** RC612 (Multiphase Carbon and Moisture Determinator)



### Applicable Crucible(s) and Accelerator(s):

- [781-335](#) Quartz Combustion Boat or [625-505-430](#) Nickel Combustion Boat\*

*\*Used for wire sample analysis. Sheet and rod samples are typically analyzed without a crucible.*

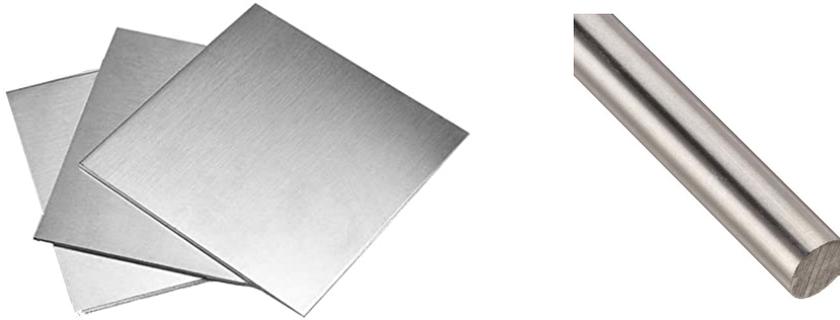
### Considerations:

- Sample size should not exceed 4 in (10 cm) in Length, and 1 in (2.5 cm) in Width. For Rod Samples, the diameter should not exceed 0.9 in (2.3 cm).

*Note: For additional details regarding this application/method, refer to LECO Application Note "Determination of Surface Carbon on Aluminum Sheets/Rods/Wire," Form No. 203-821-535 (RC612).*

## Steel Sheets and Rods (Surface Carbon Determination)

**Applicable Instrument(s):** RC612 (Multiphase Carbon and Moisture Determinator)



### Applicable Crucible(s) and Accelerator(s):

- [781-335](#) Quartz Combustion Boat or [625-505-430](#) Nickel Combustion Boat\*

*\*Used for small rod (or wire) sample analysis. Sheet and larger rod samples are typically analyzed without a crucible.*

### Considerations:

- Sample size should not exceed 4 in (10 cm) in Length, and 1 in (2.5 cm) in Width. For Rod Samples, the diameter should not exceed 0.9 in (2.3 cm).

*Note: For additional details regarding this application/method, refer to LECO Application Note "Surface Carbon on Steel Sheet and Rod Samples," Form No. 203-821-322 (RC612).*

## Total Organic Carbon (TOC) in Soil, Rock and Shale (Temperature-Dependent Determination of TOC)

**Applicable Instrument(s):** RC612 (Multiphase Carbon and Moisture Determinator)



### Applicable Crucible(s) and Accelerator(s):

- [781-335](#) Quartz Combustion Boat or [625-505-430](#) Nickel Combustion Boat

### Considerations:

- Temperature differentiation method that does not require the use of an acid-treatment step.
- Analysis is based upon the theory that organic carbon species combust to form CO<sub>2</sub> between 150 °C to 450 °C, and inorganic carbon species will thermally decompose and release CO<sub>2</sub> at temperatures above 450 °C.

*Note: For additional details regarding this application/method, refer to LECO Application Note "Temperature-Dependent Determination of Total Organic Carbon (TOC) in Soil, Rock, and Shale," Form No. 203-821-543 (RC612).*