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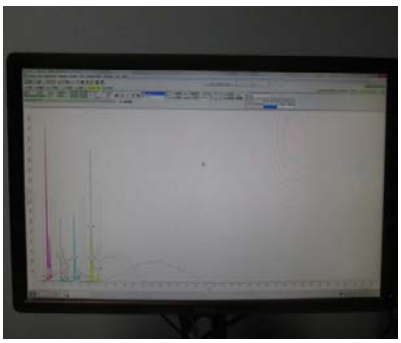
**Refractories, engineering and auxiliaries tailored to customers needs**

# Test and examinations in compliance with **ASTM - PRE** – and **EN Standard**s performable at LINCO BAXO Levate plant laboratory

**Key:** **S**= Shapes **M**= Unshaped **IFB**= Light Weight Bricks

| TEST | STANDARD | S | M | IFB | DESCRIPTION | EQUIPMENT |
|---|---|---|---|---|---|---|
| **Densità reale e apparente**<br><br>***True Density and bulk density*** | **ASTM C 134-95**<br><br>**UNI EN 1402-6** | ● | ● | ● | MISURA DELLA DENSITA' DI UN MATERIALE REFRATTARIO.<br><br>*STANDARD TEST METHODS FOR SIZE, DIMENSIONAL MEASUREMENTS, AND BULK DENSITY OF REFRACTORIES*<br><br>These test methods cover procedures for measuring size, dimensional measurement, bulk density, warpage, and squareness of rectangular dense refractory brick and rectangular insulating firebrick. | |
| **Contenuto d'acqua**<br><br>***Water content*** | **ASTM C 20-00** | ● | ● | ● | DETERMINAZIONE DEL CONTENUTO DI ACQUA DI MATERIALI REFRATTARI<br><br>*STANDARD TEST METHODS FOR SIEVE ANALYSIS AND WATER CONTENT OF REFRACTORY MATERIALS*<br><br>. These test methods cover a wet and a dry method for sieve analysis of refractory materials.<br><br>*Wet Sieve Analysis*—Water promotes the slaking of clays and helps to separate fine particles, washing them from the larger grains. This method is recommended for use with materials that require water addition, and that slake in normal industrial use.<br><br>*Dry Sieve Analysis*—The dry method is not as effective as the wet method in determining the amount of material present in the smaller particle sizes. It is recommended (1) for clays, when the slaking action of water is undesirable, (2) when the material is in the form of coarsely ground grog and calcine, and (3) when the clay is to be used in such a way that the ultimate particle size is of secondary importance.<br><br>These test methods also cover determination of the water content of refractory materials in the wet condition and of air-dried samples as received, so that the sieve analysis can be calculated on the dry basis. Included is a method for obtaining the water content of other refractory materials, such as plastic refractories and wet mixes. | |

| TEST | STANDARD | S | M | IFB | DESCRIPTION | EQUIPMENT |
|---|---|---|---|---|---|---|
| **Fluorescenza a Raggi X**<br><br>***X-Ray Fluorescence (XRF)*** | **UNI EN ISO 12677 2003** | ● | ● | ● | ANALISI DELLA COMPOSIZIONE CHIMICA DEL PRODOTTO FINITO.<br><br>*ANALYSIS OF THE CHEMICAL COMPOSITION OF FINAL PRODUCT.*<br><br>*XRF is an analytical method to determine the chemical composition of all kinds of materials. The method is fast, accurate and non destructive, and usually requires only a minimum of sample preparation.* | <br> <br>  |

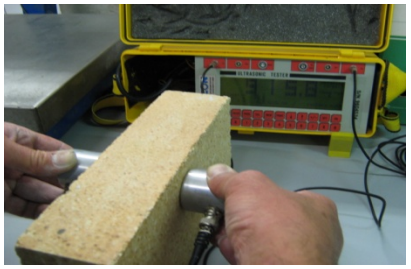
| TEST | STANDARD | S | M | IFB | DESCRIPTION | EQUIPMENT |
|---|---|---|---|---|---|---|
| **Analisi granulometrica**<br><br>***Sieve analysis*** | **ASTM C 92-95** | ● | ● | ● | DETERMINAZIONE DELLA DIMENSIONE DELLE PARTICELLE CHE COMPONGONO UN MATERIALE E CALCOLO DELLA LORO DISTRIBUZIONE.<br><br>*STANDARD TEST METHODS FOR SIEVE ANALYSIS AND WATER CONTENT OF REFRACTORY MATERIALS*<br><br>These test methods cover a wet and a dry method for sieve analysis of refractory materials.<br><br>*Wet Sieve Analysis*—Water promotes the slaking of clays and helps to separate fine particles, washing them from the larger grains. This method is recommended for use with materials that require water addition, and that slake in normal industrial use.<br><br>*Dry Sieve Analysis*—The dry method is not as effective as the wet method in determining the amount of material present in the smaller particle sizes. It is recommended (1) for clays, when the slaking action of water is undesirable, (2) when the material is in the form of coarsely ground grog and calcine, and (3) when the clay is to be used in such a way that the ultimate particle size is of secondary importance.<br>These test methods also cover determination of the water content of refractory materials in the wet condition and of air-dried samples as received, so that the sieve analysis can be calculated on the dry basis. Included is a method for obtaining the water content of other refractory materials, such as plastic refractories and wet mixes. | |

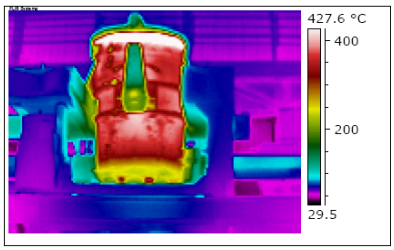
| TEST | STANDARD | S | M | IFB | DESCRIPTION | EQUIPMENT |
|---|---|---|---|---|---|---|
| **Resistenza alla compressione a freddo e modulo di rottura a freddo** | **ASTM C 133-97** | ● | ● | ● | DETERMINAZIONE, A TEMPERATURA AMBIENTE, DEL MASSIMO CARICO SPECIFICO CHE UN MATERIALE REFRATTARIO, ESSICATO E/O SOTTOPOSTO A COTTURA, RIESCE A SOPPORTARE.<br><br>*STANDARD TEST METHODS FOR COLD CRUSHING STRENGTH AND MODULUS OF RUPTURE OF REFRACTORIES*<br><br>These test methods cover the determination of the cold crushing strength and the modulus of rupture (MOR) of dried or fired refractory shapes of all types. | |
| ***Cold crushing strength (CCS) Cold Modulus of Rupture (CMOR)*** | **UNI EN 993-5** | ● | | | | |
| | **UNI EN 1094-5** | ● | | ● | | |
| | **UNI EN 1402-6** | | ● | | | |

| TEST | STANDARD | S | M | IFB | DESCRIPTION | EQUIPMENT |
|---|---|---|---|---|---|---|
| **Variazione lineare permanente**<br><br>***Permanent linear change*** | **ASTM C 113-02**<br><br>**ASTM C 210-95**<br><br>**UNI EN 1402-6** | ● | ●<br><br>●<br><br>● | <br><br>● | DETERMINAZIONE, A TEMPERATURA AMBIENTE, DELLA VARIAZIONE LINEARE PERMANENTE DOPO ESSICAZIONE E/O COTTURA.<br><br>*STANDARD TEST METHOD FOR REHEAT CHANGE OF REFRACTORIES*<br><br>This test method covers the determination of the permanent linear change of refractory bricks when heated under prescribed conditions | |
| **Test di porosità**<br><br>***Porosity test*** | **ASTM C 20-00**<br><br>**UNI EN 1094-4**<br><br>**UNI EN 993-1** | ●<br><br>●<br><br>● | ● | ●<br><br>● | QUESTO METODO PERMETTE DI DETERMINARE LA PERCENTUALE (IN VOLUME) DI POROSITA' APERTA, RISPETTO AL VOLUME DEL CAMPIONE IN ESAME.<br><br>*STANDARD TEST METHODS FOR APPARENT POROSITY, LIQUID ABSORPTION, APPARENT SPECIFIC GRAVITY, AND BULK DENSITY OF REFRACTORIES.*<br><br>These test methods cover the determination of the following properties of refractory shapes:<br><br>Apparent porosity,<br><br>Liquid absorption,<br><br>Apparent specific gravity, and<br><br>Bulk density.<br><br>These test methods are applicable to all refractory shapes except those that chemically react with both water and mineral spirits. When testing a material capable of hydration or other chemical reaction with water but which does not chemically react with mineral spirits, mineral spirits is substituted for water and appropriate corrections for the density differences are applied when making calculations. | |

| TEST | STANDARD | S | M | IFB | DESCRIPTION | EQUIPMENT |
|---|---|---|---|---|---|---|
| **Resistenza alla compressione a caldo (RUL)**<br><br>**Refractoriness Under Load (RUL)** | **UNI EN 1893** | ● | ● | | MISURA DEL COMPORTAMENTO DI DEFORMAZIONE DI PRODOTTI REFRATTARI CERAMICI SOTTOSPOSTI A PRESSIONE E AD UN AUMENTO DELLA TEMPERATURA COSTANTE. IL RISULTATO E' LA TEMPERATURA ALLA QUALE IL PROVINO SI E' DEFORMATO DI UNA PERCENTUALE FISSATA.<br><br>*STANDARD TEST METHOD OF MEASURING THERMAL EXPANSION AND CREEP OF REFRACTORIES UNDER LOAD*<br><br>This test method covers the procedure for measuring the linear change of refractory specimens that are subjected to compressive stress while being heated and while being held at elevated temperatures. | <br> |

| TEST | STANDARD | S | M | IFB | DESCRIPTION | EQUIPMENT |
|---|---|---|---|---|---|---|
| **Resistenza allo scorrimento a caldo**<br><br>**Creep** | **UNI EN 993-9** | ● | ● | | MISURAZIONE DELLA PERCENTUALE DI DEFORMAZIONE DI UN PROVINO POSTO SOTTO CARICO COSTANTE AD UNA TEMPERATURA FISSA PER UN LUNGO PERIODO DI TEMPO.<br><br>*STANDARD TEST METHOD OF MEASURING THERMAL EXPANSION AND CREEP OF REFRACTORIES UNDER LOAD*<br><br>This test method covers the procedure for measuring the linear change of refractory specimens that are subjected to compressive stress while being heated and while being held at elevated temperatures. | <br> |

| TEST | STANDARD | S | M | IFB | DESCRIPTION | EQUIPMENT |
|---|---|---|---|---|---|---|
| **Conducibilità termica**<br><br>**Thermal conductivity** | **ISO 8894-2 2007** | ● | ● | ● | MISURA DELLA PROPRIETA' DI UN PRODOTTO FINITO DI CONDURRE CALORE. IL RISULTATO E' ESPRESSO IN W/m*K. | |
| | **UNI EN 993-15** | ● | ● | ● | *STANDARD TEST METHOD FOR THERMAL CONDUCTIVITY OF REFRACTORIES*<br><br>This test method covers the determination of the comparative thermal conductivity of refractories under standardized conditions of testing. This test method is designed for refractories having a conductivity factor of not more than 200 Btu·in./h·ft$^2$·°F (2818 W/m·K), for a thickness of 1 in. (25 mm).<br><br>*STANDARD TEST METHOD FOR THERMAL CONDUCTIVITY OF UNFIRED MONOLITHIC REFRACTORIES*<br><br>This test method supplements Test Method C201, and shall be used in conjunction with that test method for determining the thermal conductivity of unfired monolithic Refractories | |
| **Resistenza all'abrasione**<br><br>**Abrasion resistance** | **ASTM C 704-15** | ● | ● | | MISURA, A TEMPERATURA AMBIENTE, DELLA RESISTENZA ALL'ABRASIONE DI UN PRODOTTO FINITO. | |
| | **UNI EN 993-20** | ● | ● | | *STANDARD TEST METHOD FOR ABRASION RESISTANCE OF REFRACTORY MATERIALS AT ROOM TEMPERATURE.*<br><br>This test method covers the determination of relative abrasion resistance of refractory bricks at room temperature. This test method can also be applied to castable refractories (see Metric Dimensions, Practice C861 and Practice C865) and plastic refractories (see Practice C1054). | |
| **Controllo ad ultrasuoni**<br><br>***Ultrasonic Test*** | | ● | ● | ● | DETERMINAZIONE DI EVENTUALI CREPE E/O VUOTI ALL'INTERNO DEL PREFABBRICATO<br><br>*EVALUATION OF POSSIBLE CRACKS AND/OR VOIDS IN THE PREFABRICATED PIECES.*<br><br>This test method use a series of ultrasonic pulsation passes through the material and a technical device calculates the crossing time. From this data as well its stability, you can detect any internal cracks or void. |  |

| TEST | DESCRIPTION | EQUIPMENT |
|---|---|---|
| ***Thermography*** | The thermograph images or infrared monitoring systems are made by use of infrared thermal cameras which is equipped with special lenses to allow the measurement and to represent graphically the infrared radiation released by an object. Since the radiation is a function of the objects surface temperature, the thermal camera is able to calculate and visualize the temperature. |   |

| Test and examinations in compliance with **ASTM - PRE** – and **EN Standard**s performable at sub-contracted laboratories | | | | | |
|---|---|---|---|---|---|
| **TEST** | **STANDARD** | **S** | **M** | **IFB** | **DESCRIPTION** |
| **Modulo di rottura a elevate temperature (HMOR)**<br><br>**Modulus of rupture at elevated temperature (HMOR)** | **ASTM C 583-15**<br><br>**UNI EN 993-7** | ●<br><br> | ●<br><br>● | | DETERMINAZIONE AD ALTA TEMPERATURA, DELLA RESISTENZA ALLA FLESSIONE DI UN MATERIALE REFRATTARIO DI DIMENSIONI SPECIFICHE.<br><br>*STANDARD TEST METHOD FOR MODULUS OF RUPTURE OF REFRACTORY MATERIALS AT ELEVATED TEMPERATURES*<br><br>This test method covers determination of the high temperature modulus of rupture of refractory brick or monolithic refractories in an oxidizing atmosphere and under action of a force or stress that is increased at a constant rate. |
| **Diffrazione dei raggi X (XRD)**<br><br>**X-ray Diffraction (XRD)** | | ● | ● | ● | MISURA DELLA COMPOSIZIONE MINERALOGICA DEL MATERIALE.<br><br>*MESUREMENTT OF THE MINERALOGICAL COMPOSITION OF THE MATERIAL..* |
| **Resistenza alla CO**<br><br>**CO Resistance** | **ASTM C 288-87**<br><br>**UNI EN ISO 12676** | ●<br><br>● | ●<br><br>● | ● | MISURA DEL COMPORTAMENTO DEI MATERIALI REFRATTARI SOTTOPOSTI ALL'AZIONE DISGREGANTE DEL MONOSSIDO DI CARBONIO (CO).<br><br>*STANDARD TEST METHOD FOR DISINTEGRATION OF REFRACTORIES IN AN ATMOSPHERE OF CARBON MONOXIDE*<br><br>This test method covers the comparative behavior of refractories under the disintegrating action of carbon monoxide( CO). The test method is an accelerated exposure to CO to determine potential material behavior in a relatively short time |