

## **INSTALLATION INSTRUCTIONS for CALDERYS AUSTRALIA P/L**

### **Installation method - GUNNING.**

- **Pre-Installation Considerations**

Castable refractories are dry, granular mixes consisting of selected raw materials, precisely proportioned and blended. For protection, these materials are packed in moisture resistant bags, and complete pallet loads are covered with polyethylene, which should remain in place until the material is ready to use.

- **Storage**

- Keep castable refractories packages dry since moisture can reduce the castables ultimate strength and even cause hardening.
- It is recommended that all monolithic refractories be stored in a dry warehouse.
- If the material must be stored outdoors it should be raised off the ground and covered by tarpaulins.
- Do not store in direct sunlight, especially in hot climates. Pallets should not be stacked more than three high.

Average storage life varies from 6 to 12 months, depending upon the individual grade of castable and is shown in individual Technical Data Sheets. When castable refractories approach or exceed their storage life, test samples should be made and checked to see if the physical properties are normal, prior to installation.

- **Gunnable Castables**

Calderys Australia have developed a wide range of gunnable castables, which have been designed to be installed by means of pneumatic application. Specially designed equipment, referred to as cement gun, is used to pneumatically convey refractory materials through suitable flexible hoses to the installation position. The material is then projected through a hand held nozzle at the target area. The water is added into the dry material stream at the nozzle by the nozzleman. This application method is not suitable for all situations and its success depends on the skill of the operators and the correct use of equipment and material.

- **Equipment Required**

Materials and equipment will vary with the nature and scope of the refractory installation. Generally, provision should be made for the following:

- Welding equipment for anchor installation
- Forms, plywood, wood or steel.... together with timber for bracing.
- Normal carpentry tools.
- Waterproofing compounds.
- Gun.
- Sufficient reinforced hoses.
- Compressor able to meet air requirements. See table 1.

- **Site Preparation**

Before beginning the installation of gunnable refractories, certain job-site precautions should be taken.

1. The site where the gunnable materials will be installed must be clean so nothing can contaminate the castable.
2. Tools, nozzle, gun, hoses, and conveying equipment must also be clean.  
**NOTE:** Contamination, particularly by Portland Cement, can cause flash setting, which reduces working time.
3. The back-up wall or lining material against which the gunnable material will be gunned must be smooth and free from wide gaps or cracks.

This surface, if not waterproofed, must be coated with curing compounds, oil or a bituminous compound.

4. Ambient temperature extremes, cold or hot, require special precautions.  
See section on 'Special Weather Conditions'.

- **Anchoring Provisions**

Depending on the dimensions and position of the gunnable refractory lining, anchorage will be required. These hold and secure the lining to the outer structure and make it possible to remove a section of the lining for repairs or modifications later, without affecting the stability of the remaining lining. With gunned linings the anchoring is of assistance to hold the fresh-gunned material in place, and helps to reduce the rebound. The anchorage may be designed to help the installation. There is a wide range of flexible and fixed refractory anchors and supports, suitable for all kinds of positions, temperatures and process conditions.

The distance between the anchors, the pitch and the pattern depends on the lining thickness, position, service conditions and method of installation. In general, the length of the metal anchor is such that the top of the anchor is at least 25 mm back from the hot face or two thirds of the hot face.

In order to avoid the risk of cracking the lining at the position of the metal anchors, it is recommended to wrap the anchor with the tape or to coat them with an ash-free bituminous or plastic product to provide allowance for movement in the refractory lining under operating conditions.

Flexible or ceramic anchors must be fixed in a stretch position before the installation of the lining commences. This can be achieved by the use of wedges between the anchor element, hook or claw.

Calderys will be pleased to give further advice regarding anchoring in specific instances.

## **Special Weather Conditions**

### **• Cold Weather Installation**

When gunnable materials are to be installed in cold environments, the following precautions must be observed.

- The dry gunnable material should be stored in a warm warehouse. Both the material and the water to be added should be warmed so that during installation the mix temperature is at 10°C. The castable temperature during curing must be maintained at about 15°C by the use of portable heaters.
- In general, gunnable refractories, which have cured for 24 hours at 15°C, have developed sufficient strength to resist subsequent freezing conditions.

### **• Hot Weather Installation**

When gunnable refractories are to be installed in hot weather environments, the following precautions must be observed.

- Cool mixing water may be necessary to maintain the mix temperature below 30°C.
- Protect exposed castable surfaces from drying out before curing is completed by applying impermeable membrane coating or plastic sheeting.
- The temperature of the steel against which the castable is being installed may be abnormally high and require cooling. This can be done by using sunshade or by spraying the exterior with water.

### **• Preparing for gunning**

### **• Provisions for Movement**

Refractory linings undergo thermal expansion when heated, therefore during gunning, provisions must be made for these. Allowances can be formed by inserting wood, cardboard, expanded plastic, or ceramic fibre at prescribed locations.

Due to the enormous range of castable products, and their vastly different linear change characteristics, it is wise to consult Calderys for recommendations concerning joints for specific applications.

- **Installation Process**

When gunnable materials are applied on to a vertical surface, the most widely accepted technique of application is to hold the nozzle at a distance of 0.6 – 1 metre from the surface, at right angle to the gunning face in the horizontal plane and at a slightly downward angle in the vertical plane.

This technique, with the use of a small circular motion, will provide minimum rebound, equal material structure and minimum risk of laminations. It is important that the material is gradually built up to the lining thickness over a small area at a time.

It is recommended to gun in defined panels or areas and upon completion of a panel the edges be cut at right angles to the shell, removing all waste and rebound before proceeding to gun the next adjacent panel.

If for any reason, an interruption delays application in excess of 10 minutes, any area which has not been built up to full thickness should be removed and replaced after cutting back edges at right angles to the work face.

- **Curing**

Gunnable refractories begin their initial set in 25 to 40 minutes. The gunned lining must be cured for at least 24 hours after the installation is complete to achieve maximum strength.

There are several acceptable methods, these are:

(1) Exposed area is covered with wet sacks which must be kept wet

Or

(2) Covered with a plastic sheeting or sprayed with an approved curing membrane.

Employing water has the advantage of assisting to keep the installation cool. This can be very important with massive sections or in very hot weather, since it is not unknown for the heat of hydration to cause thermal explosive spalling and cracking.

- **Initial Heating Instructions**

The initial drying and firing of the castable is very important. Temperature increases must follow a prescribed heating schedule to properly control removal of the remaining free and combined water without damage to the structure. A copy of this schedule can be obtained from Calderys upon request. Once begun, the heating schedule must not be stopped or interrupted. In emergency, such as burner failure, the lining must be kept warm. When cooling down can not be avoided, it must be done carefully. Subsequent reheating must then follow the original heating schedule.

- **Health and Safety**

Health and safety regulations apply to all Calderys materials. These are outlined in the appropriate Material Safety Data Sheet, which is available on request.

- **Curing and Commissioning**

Please refer to Standard Heat Up Schedules for Curing and Commissioning of castable refractories.

**Table 1. SUGGESTED GUN PRESSURES FOR CALDERYS PRODUCT RANGES**

<b>CLASSIFICATION</b>	<b>TYPICAL PRODUCTS</b>	<b>DENSITY RANGE</b>	<b>GUN PRESSURE</b>
Extra Lightweight Insulating	CASTFLO AI 1000	400 – 750 kg / m <sup>3</sup>	100 – 140 kPa
Lightweight Insulating	CASTFLO AI 1100	900 – 1250 kg / m <sup>3</sup>	120 – 160 kPa
Medium Weight Insulating	CASTFLO AI 1200	1200 – 1500 kg / m <sup>3</sup>	160 – 210 kPa
Conventional Dense	CASTFLO AG 1600	1800 – 2400 kg / m <sup>3</sup>	220 – 280 kPa
Abrasion Resistant Dense	CASTFLO AG1650ARG	2000 – 2400 kg / m <sup>3</sup>	220 – 280 kPa
Enhanced Binder Gunnables	AH 405 SR	2000 – 2800 kg / m <sup>3</sup>	220 – 280 kPa

**NOTE !**

These figures are based on utilising two lengths of hose at ground level and must be considered indicative only as different makes of machine vary as do machines, condition of nozzles, rates of pressure drop etc.

Correct pressures can only be ultimately set by experienced nozzle men and operators on the job and taking into consideration equipment, elevation, orientation, complexity of contour, ultimate property requirements of the lining and “gunnability” of the material being applied.