

## General

This procedure covers the recommended procedures for the storage, mixing and installation of Vesuvius conventional castables, CERCAST / PLICAST, products and is a guide to good practice.

CERCAST / PLICAST castable refractories are dry, granular mixes consisting of selected raw materials, precisely proportioned and blended. They are hydraulically bonded and develop strength by the hydration of the cement when mixed with water.

If in doubt about any aspect of installation please contact the Vesuvius Australia Technical & Engineering Department.

## Storage

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.

Keep all castable refractory packages dry since moisture can reduce the castable's ultimate strength and even cause hardening.

It is recommended that the castable be stored in dry warehouse conditions.

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.

Due to pressure and settlement in storage it is possible for the materials to become compacted. These lumps can readily be broken down by hand. However, hard lumps indicate some setting has occurred. Do not use partially reacted castable.

Average storage life varies from 6 to 12 months, depending upon the individual grade of castable, and is shown on individual Product Information Sheets.

When CERCAST / PLICAST materials approach or exceed their storage life, test samples should be made prior to installation and checked to see if the physical properties are normal.

## Conventional Castable Refractories – CERCAST / PLICAST

Notes:

1. General purpose castables – designed for strength, abrasion and erosion resistance.
2. Each castable type offers distinct properties. Before beginning an installation, determine which type of CERCAST / PLICAST castable is being used.
3. The castable selected directly affects the castable mixing time, water content and heat-up schedule required.

## Equipment Required

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

- Welding equipment for anchor installation.
- Forms, Plywood, wood, polystyrene, or steel..... together with timber for bracing.
- Normal carpentry tools.
- Waterproofing compounds.
- Mixing equipment: Paddle type mixers are recommended for most installations. A mortar box can be used for small installations. On large volume pours, a large capacity, high shear paddle mixer is recommended. Please consult with the Vesuvius Technical Department on the feasibility of mixing specific castables in large volume pours. Special instructions may apply.
- Convey equipment: buckets, wheelbarrows, belt conveyor, kibble, chutes, etc. suitable for job-site conditions are used to convey the castable. All such equipment needs to be thoroughly clean.
- An immersion vibrator. A pencil-type unit with a 20mm to 50mm diameter operating at 14,000 to 16,000 cycles per minute is recommended for very dense Castables.

**Note:** CERCAST / PLICAST conventional castables are NOT suitable for placement by pumping. If this method of placement is required then Vesuvius Australia does make a range of refractory castables suitable for placement by pumping. Please consult the Vesuvius Technical & Engineering Department for alternatives.

## Site Preparation

Before beginning the installation of CERCAST / PLICAST castable refractories, certain job site precautions should be taken.

1. The site where the castable materials are to be installed must be clean so nothing can contaminate the castable.
2. Mixers, tools, vibrators, and conveying equipment must also be thoroughly 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 castable will be poured must be smooth and free from wide gaps or cracks. This surface, if not waterproofed, must be coated with curing compounds, or a water proof membrane.  
**CAUTION:** Plastic film can be used but it must be securely attached or it may float, fold or tear away during pouring.
4. Ambient temperature extremes, cold or hot, require special precautions see sections on Special Weather Conditions.

## Anchoring Provisions

Depending on the dimensions and position of the castable refractory lining, anchorage will be required. Anchors, typically made from stainless steel, 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. At times 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 locations, temperatures and process conditions.

The distance between the anchors, the pitch and the pattern depend on the lining thickness, location, 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 25mm back from the hot face or two thirds of the hot face lining thickness.

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 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 and hook or claw.

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

## **Special Weather Installation**

### **Cold Weather Installation**

When CERCAST / PLICAST castables are to be installed in cold environments, the following precautions are recommended.

- The dry castable materials 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 least 10°C.
- The castable temperature during curing must be maintained at about 15°C by the use of portable heaters.
- When CERCAST / PLICAST castables are applied against a steel shell, the steel temperature is often lower than inside the furnace or vessel. Thus, the steel may have to be externally insulated during the curing process so that the castable's heat of hydration is not lost by conduction through a very cold shell or structure.
- In general, CERCAST / PLICAST conventional castables which have cured for 24 hours at 15°C have developed sufficient strength to resist subsequent freezing conditions.

### **Hot Weather Installation**

When CERCAST / PLICAST castables are to be installed in hot weather environments, the following precautions are recommended.

- 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 cold water.

## Preparing for the Pour

### Provisions for Forms

The lateral thrust of wet, freshly mixed castables upon the formwork can be considerable, especially with Vesuvius CERCAST / PLICAST range of castables.

Therefore forms should be constructed with tight joints and must be well braced in order to prevent movement, bending or flexing until initial set begins at which point these forces cease.

The form surface next to the castable must be made non-absorbent by covering it with plastic film or coating it with oil, or waterproofing compound.

Special mould release agents should be tested to ensure they do not react with the castable surface.

### Provisions for Movement

A CERCAST / PLICAST lining undergoes thermal movement when heated, therefore during the forming and pouring, provisions must be made for these movements. Allowances can be formed by inserting wood, cardboard, expanded plastic or ceramic fibre at prescribed locations.

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

### Evaporation Holes

During heating up, the water needed for hydraulic setting of the castable mix is evaporated. In the case of two or three layer linings, it is recommended to provide venting holes through the top (hot face) layer. This can be done by placing cotton lines through the lining at regular intervals.

In some cases (like non-pressurised vessels) it is possible to provide weep-holes in the furnace shell to allow steam to escape to atmosphere during the heating-up process.

## Installation Process

Proper mixing of CERCAST / PLICAST castable refractories is essential to a sound installation. The use of a paddle mixer is strongly recommended.

Best results are obtained when the mixer capacity is large enough to complete a casting in a single pour. If multiple pours are required they must be successive and completed before the material begins to set.

### Water Addition Considerations

Water for mixing must be clean and free from foreign matter. Use only clean, fresh potable water with a pH between 6 and 8. The mixing water acceptable temperature range is from 10 to 30°C. The typically expected amount of mixing water required to achieve good casting consistency can be obtained from

the Product Information Sheet provided with the material or upon request. However, the actual quantity to be used may vary with the water temperature and ambient temperature. It is recommended that with dense castables the smallest amounts of water that will consolidate the castable yet allow it to flow during the pour be used.

Using too little water for casting can reduce workability and result in voids and laminations whilst using too much water will adversely affect the material physical properties.

## The Mixing Process

Start the mixer and empty the entire contents of one or more bags of castable into the clean mixer, and allow dry mixing for 5 turns of the mixer. Initially add 80% of the specified water, add the balance progressively until desired consistency is obtained. Do not use more as the batch could become unusable. Keep mixing time to a minimum to achieve proper consistency. This is normally accomplished within 2 to 5 minutes depending on the type of material. Note; conventional castables take less time than the low cement materials. Extended mixing times speed up setting and reduce ultimate strength.

Using the “Ball in Hand” consistency test:

At this stage, it is recommended that after 2 minutes of mixing that the “Ball in Hand” consistency test be performed to check whether the castable consistency is suitable for placement.

- (a) Form a compact ball of mix.
- (b) Toss the ball up about 30cm and catch it in one hand.
- (c) If it maintains its shape, but just barely begins to go through the fingers, it contains the correct amount of water. If the mix crumbles, it contains too little water. Additional water may then be added if necessary to obtain the desired consistency. If the mix oozes through the fingers, it contains too much water. The entire batch must be discarded.

## Material Placement

Material placement should begin as soon as mixing is complete. The total time interval from addition of water until the material is placed should not exceed 20 minutes. Pour the dense CERCAST / PLICAST castable into place; be careful to completely fill any undercuts or profiles. Vibrate the material by inserting the poker to a depth of 300-400mm vertically and moving it slowly across the castable mass to remove trapped air. At intervals the poker is withdrawn slowly to avoid leaving cavities and inserted again. The process is repeated as necessary to vibrate all areas of the cavity. For deep cavities that

require successive layers of castable mix, the poker should pass through the fresh addition into the previously cast material to ensure homogeneous lining free of laminations.

When using a vibrator, do not vibrate for more than 2 minutes or segregation may result, and never vibrate material which has been in place for 20 minutes. At no time should a castable be trowelled to a smooth or slick surface. If excess material must be removed, use a wood screed.

Protect exposed castable surfaces from drying out before curing is complete by applying an impermeable membrane coating or plastic sheeting to all exposed surfaces immediately after placement is complete.

## **Curing**

CERCAST / PLICAST castable refractories begin the initial set in 25 to 40 minutes. The poured 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) Form work is kept in place and exposed areas can be water sprayed.
- (2) Exposed area is covered with wet sacks which must be kept wet.
- or
- (3) Covered with plastic sheeting or sprayed with an approved curing membrane.

The first two methods employing water have the advantage of assisting to keep the installation cool. This can be very important with large 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**

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 Vesuvius upon request. Once begun, the heating schedule must not be stopped or interrupted. In emergency, such as a burner failure, the lining must be kept warm. When cooling down cannot be avoided, it must be done carefully, ideally with the unit sealed. Subsequent re-heating must then follow the original heating schedule.

Note: Multiple layer linings may require special consideration for the initial heat-up schedule. Please consult the Vesuvius Australia Technical & Engineering Department.

## **Health and Safety**

Health and safety regulations apply to all Vesuvius refractories. These are outlined on the appropriate Safety Data Sheet which is available upon request.

## **Disclaimer**

Any non-field technical advice furnished by Seller with reference to the use of its Products is given gratis, and Seller assumes no obligation or liability for the advice given or the results obtained. All such advice is given and accepted at Buyer's sole risk.