

Technical Information

INSTALLATION PROCEDURES RESCO PLASTICS

The following procedure is recommended for Resco Products' Plastic product lines.

Tools:

- Pneumatic Rammer with a 2 ½"-3" convex head
- Trowel
- Trimmer, flat blade spade or other similar
- Venting Rod, 1/8" to 3/16" rod (a welding rod is suitable)
- Rawhide or rubber mallet
- 3 lb machine hammer

A satisfactory ramming pattern for installing plastic in straight walls with an air hammer consists of striking a series of blows along the top face of the plastic adjacent to the backing wall for a convenient distance. This single row of hammer blows temporarily secures the slices of plastic in position. The pattern of blows then starts at the backing wall and works toward the inside edge of the plastic wall.

A flat level surface of the plastic is maintained by "lifting" the hammer slightly as it approaches the edge of the plastic wall, as this decreases the impact of the hammer blows. The hammer should be held at an angle tilted away from the backing wall at all times so that the plastic will be driven toward the backing wall. This will prevent fracturing of the plastic and pulling away from the backing wall.

As successive layers of plastics are put in place for ramming, stagger the placement of the slabs on each layer much the same way a brick construction would proceed.

When installing refractory sidewall anchors, the plastic should be rammed up to slightly above the bottom of the intended anchor location. The anchor is put in place and then tapped with the mallet to set it in position. The anchor is then removed and reset in place with the proper clips. The anchor then should be tapped lightly with a wooden block or hammer handle to set it properly. As the plastic is built up around the anchor, it is advisable to use a hand hammer to pound the plastic into the corrugations on the side of the anchor tile.

If the wall thickness is greater than 6" and/or greater than 4' in height, consider the use of Plate Supports

To prevent plastic from filling in the recess of anchor and wedging around the clips, which would prevent free movement, a strip of cardboard should be placed on top of the anchor over the recess. The first layer of plastic rammed over the top of the anchor should be hand rammed carefully to prevent cracking of anchors or knocking out of alignment.

In building a plastic suspended arch, the plastic slab should be set edgewise on the form boards. The air hammer should be held at an angle so that the plastic is driven down toward the form and back against the previously installed plastic. The blow should start at the form and work up toward the top of the arch.

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Treat any roof, bull nose or arch forms with oil or other release agent.

The metal clip that holds the ceramic anchor in place on roofs should be exposed to air to allow heat to dissipate.

The use of a wooden pattern or dummy to make a recess in the plastic for the refractory anchor is advantageous. If a wooden pattern or dummy is not available, an extra refractory anchor may be used and it is extremely important that this anchor is plainly marked and the same one used for subsequent anchor settings. This anchor must not be used in the arch as it may be weakened or cracked and it should be discarded at the end of the job.

Trimming

There are several good reasons for trimming plastic walls. First, unless the wall is trimmed, more material is used than is necessary or has been estimated for the job. Also, a trimmed wall with a rough surface dries more uniformly and is not so likely to sheet or peel off. During trimming do not smooth the plastic surface.

There is no one tool, which will answer all the requirements for the trimming of different installations, although a trimming spade is the most usable all around tool. An adz or a trimming spade is a good tool, particularly for the first rough or heavy trimming. A flat blade scraper, such as a sidewalk scraper or garden hoe with the gooseneck straightened out can then be used to trim to the final thickness. A heavy mason's trowel with the point cut off is a handy tool for scraping the wall to remove all slick surfaces so that the moisture can escape. It also can be used for final trimming around doorjambes, rounding the edges of the door arches, etc.

After trimming, "ring" all anchors by face ramming the plastic around each anchor. Direct the rammer perpendicular to the plastic surface and do not angle the rammer head.

Trim frequently as you work up the wall. This will help maintain the wall thickness and will provide a better overall construction. Place clean plastic or burlap on the floor under the area to be trimmed so that the droppings will remain clean and can be reused.

Do not trim roofs or other surfaces that use forms.

Curing of Plastics

Prolonged air drying of any plastic lining has a tendency to produce more cracks than if the material was properly burned in immediately after installation. Contraction cuts, which will be covered later, will greatly reduce irregular drying cracks if the setting is to be subjected to a long period of air drying before being burned in. In this case, additional precautions should be taken to prevent excessive drying cracks.

When possible, the installation of the plastic should be delayed until the furnace can be fired immediately upon completion of the work. Where it is impossible to do this, excessive air-drying can be prevented by keeping all doors closed and covering the walls with damp burlap sacks, damp canvas or plastic sheeting held in place by nails driven into the plastic. Even with the furnace doors shut, the damp fabric will dry out, so the moisture in the fabric should be renewed from time to time as required.

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Air-drying does not usually affect the ultimate service obtained from a plastic lining. Possibly, the greatest danger in long air-drying is that the operator may consider the plastic thoroughly dried and fire up too rapidly.

Expansion Joints

The allowance for expansion with plastic will vary from job to job, and for this reason no set rule can govern. Installation drawings, where available, should be followed for placement of expansion joints. Where possible, expansion joints should be placed in the corner of the settings where the expansion joint material is not subjected to direct radiation or furnace gases. There will be cases, though, where expansion joints will have to be placed at various locations in the length of the wall, and in these cases, installation drawings should be followed.

Contraction Cuts

Contraction cuts or cut joints are made in the wall to control the location of cracking when shrinkage takes place.

With these cuts properly located, the plastic wall will have a tendency to crack at these cuts during the drying stage, avoiding the irregular cracking that would otherwise occur.

The cuts create lines in the plastic along which it will crack as it dries and are to be made approximately 1" to 2" deep in vertical and sometimes horizontal lines after the wall has been trimmed. The cuts are to be located on approximately 3' to 6' centers and can be made with a cutting tool or cut-off trowel driven into the plastic.

The contraction cuts should preferably be made midway between the refractory anchors and not extend directly into such anchors.

These contraction cuts will then close when expansion takes place. When the unit is off the line, it will be noted that the contraction joints will again open up, but are clean; indicating that they were closed while the unit was in operation.

Venting

Venting allows the moisture to escape rapidly and reduce the chances of bloating or the material sheeting. Greater than 3" linings should be vented by poking $\frac{1}{8}$ " to $\frac{3}{16}$ " diameter holes into the lining with a welding rod or other suitable tool. Vent holes should be on 8" to 12" centers, $\frac{2}{3}$ of the lining thickness deep.

General Information

Next to controlling the temperature, the most important thing to watch in the burning-in procedure is flame impingement on the refractory material. Excessive temperatures at any point tend to seal the wall and to stop free movement of the moisture contained within the material.

It is definitely important that the temperature is held steady or slowly increased and not allowed to drop before the entire burning cycle is completed. If allowed to cool, wet pockets will form in the plastic material and cause cracking on reheating of the unit or sheeting off of the hot face.

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If the unit is to be cooled after the burning-in cycle is completed, it is essential that the unit be kept at operating temperatures for at least 24 hours before cooling. This particular schedule assures that all moisture is removed from the refractory material and it develops additional ceramic bond.

CAUTIONS:

- As successive layers of plastics are put in place for ramming, stagger the placement of the slabs on each layer much the same way a brick construction would proceed.
- Attention should be paid to ensure that the plastic surrounds the anchors completely and fills in the anchor corrugations. As the plastic is built up around the anchor it is advisable to use a hand hammer to pound the plastic into the corrugations. The first layer of plastic rammed over the top of the anchor should be hand rammed carefully to prevent cracking of the anchors or knocking them out of alignment.
- Consider the use of Plate Supports if the wall thickness is greater than 6" and/or greater than 4' in height. The supports should be spaced on 12" centers horizontally and no more than 48" centers vertically. If more than one row of supports is being used alternate rows should be staggered.
- To prevent plastic from filling in the recess between the anchor and the clips, which would prevent free movement, a strip of cardboard should be placed on top of the anchor over the recess.
- Ensure that proper knitting occurs in the plastic as new material is added. Pay particular attention to the joints where improper knitting occurs most.
- Do not face ram the plastic construction. This tends to open up joints and create voids behind the face. Control the construction thickness with proper ramming technique and trimming.
- Treat any roof, bull nose or arch forms with oil or other release agent.
- The metal clip that holds the ceramic anchor in place on roofs should be exposed to air to allow heat to dissipate. This holds true even when the plastic is backed up with a light weight insulating material.
- If an extra refractory anchor is used as a template, it is extremely important that this anchor is plainly marked and the same one used for subsequent anchor settings. This anchor must not be used in the construction as it may be weakened or cracked and it should be discarded at the end of the job.
- During trimming do not smooth the plastic surface.
- Place clean plastic or burlap on the floor under the area to be trimmed so that the droppings will remain clean and can be reused.

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- Do not trim roofs or other surfaces that use forms.
- Contraction cuts or cut joints are made in the wall to control the location of cracking when shrinkage takes place. The cuts create lines in the plastic along which it will crack as it dries and are to be made approximately 1" to 2" deep in vertical and sometimes horizontal lines after the wall has been trimmed. The cuts are to be located on approximately 3' to 6' centers and can be made with a cutting tool or cut-off trowel driven into the plastic. The contraction cuts should preferably be made midway between the refractory anchors and not extend directly into such anchors.
- Greater than 3" linings should be vented by poking $\frac{1}{8}$ " to $\frac{3}{16}$ " diameter holes into the lining with a welding rod or other suitable tool. Vent holes should be on 8" to 12" centers, $\frac{2}{3}$ of the lining thickness deep.
- If steaming occurs during the initial ramp of the heat-up, discontinue the heat-up until the steaming stops. Adjust the heat-up rate as necessary to prevent further steaming.
- Next to controlling the temperature, the most important thing to watch in the burning-in procedure is flame impingement on the refractory material. Excessive temperatures at any point tend to seal the wall and to stop free movement of the moisture contained within the material.
- It is definitely important that the temperature is held steady or slowly increased and not allowed to drop before the entire burning cycle is completed. If allowed to cool, wet pockets will form in the plastic material and cause cracking on reheating of the unit or sheeting off of the hot face.
- If the unit is to be cooled after the burning-in cycle is completed, it is essential that the unit be kept at operating temperatures for at least 24 hours before cooling. This particular schedule assures that all moisture is removed from the refractory material and it develops additional ceramic bond.

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Installation of Ram and Plastic Mixes in Cupola Troughs and Runners

General

Resco Products, Inc produces a number of cupola refractory plastics and ramming mixes for use in both the slagging trough and runners. These come in various high alumina formulations with silicon carbide and graphite additions. They are furnished in two types: plastics and ramming mixes. Each type of mix has its own special installation techniques. The plastic can be installed like a ram mix, however the ram mix cannot be installed like a plastic. The use of a form is mandatory with a ramming mix, while plastics can be rammed with or without the use of a form.

Ramming mixes are never used without forms except on flat areas, such as floors and bottoms. Ramming mixes lack the additional moisture and plasticity of the plastic mixes and bonding between layers will not be accomplished unless it is confined through the use of forms.

This set of instructions deals with the installation of both types of product. These instructions will provide the maximum physical properties of either of these material systems.

Preparation

Preparation is extremely important to ensure that a clean, dry, hard surface is made available for the installation of either plastics or ramming mixes. When installing a new lining, all loose material should be cleaned and removed. The back up lining is prepared by leveling and/or repairing as required to provide a good working surface. If the installation is a repair between furnace taps, the lining should be free of slag and foreign material before installing new material on the old lining. Sometimes it is advisable to wet the old surface in order to reduce the heat content of that lining. A hot surface could cause the new material to dry out rapidly and prevent bonding between the two materials. This could result in the repair material pulling away prematurely.

In the installation of a new trough, care should be used to ensure that all dimensions are followed. This will ensure that the proper slope and size of the trough or runner are maintained. The sidewall contours can be properly maintained by laying them out and measuring from time to time with a template. A simple wooden template could be used to maintain the proper form throughout the entire installation. This will allow proper flow of the slag and iron. If the volume is too restricted, then the flow of iron and slag is faster than desired, and a more rapid wear rate of the refractory lining will occur.

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Equipment Required

Good installation practice requires proper equipment. To accomplish the installation of both plastics and ram mixes; air rammers such as floor rammers and bench rammers are required. The heads for these rammers should be of a nature so as to disrupt the tamped surface as the work progresses. This provides a keying affect so that the material is knitted together rather than laying one layer on top of the next. Layering can produce laminations, which can cause zones of weakness. Thermal cycling or molten metal will attack the refractory in these laminations (joints) and cause the material to spall or wash out rapidly.

Various efficient ramming heads can be used, such as worn out Star Drills. Rammer heads can be fabricated by laying a metal bead across the face of the hammer in an X with a welding rod and torch. Other designs are square in nature with either points welded on the end or serrated ends. These should be three to four inches in diameter. Additional tools required will be normal bricklaying tools such as spades for trimming the plastic; welding rod for testing density and air venting; trowels; etc.

Ramming of Plastics

Plastic material comes in cartons ready to use. It is precut into slices for easy handling. Starting at the end near the skimmer, slabs of the material should be laid down for three or four feet (91.4 cm to 121.9 cm). A second layer of slabs is then laid on top of the first, overlapping so as to bond or break the joints. After the two layers are laid out they are rammed to knit them together until the entire surface is extremely dense and one's thumb cannot penetrate it. Enough vertical pressure should be applied during ramming to cause the material to flow together. Bench type rammers with a 2 to 2½- inch (51 mm to 64 mm) diameter malleable iron button are recommended. No joints should be visible, and the surface should appear completely monolithic. An additional layer, one slice thick, is laid on top of the compacted layer and, again, rammed in place until all material is well knitted.

After the floor has been completed, the sidewalls are installed. The thickness of the wall is established and the material rammed one slice at a time. The first two layers should be well knitted into the material already installed in the floor. After the first layers are thoroughly knitted, additional layers are installed and rammed into place following the same procedures already discussed. The sidewalls are continued upward in this manner until the desired elevation and shape is obtained.

Trimming with a spade can be started when the sidewall is approximately half way up, or when completed. This will depend on the height of the wall and the dryness of the material as the work progresses.

A short handled spade can be used to trim the wall to the proper thickness. A template can be used to maintain the proper slope and dimensions while trimming.

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Trimming produces a smooth surface and seals the plastic. An impermeable surface is not desirable. Therefore, roughing this surface after trimming is required to facilitate removal of the moisture during the drying cycle. The surface should be scratched with a currycomb or other multi pointed instrument.

The entire trough or runner is installed using this method. The principal objective is to produce a monolithic joint-less lining. The working face can be rammed perpendicularly in order to seal off small surface laminations that may occur. Ramming behind a form will give improved properties, but as stated above, is not necessary.

After the work has been completed, a thin coating of a mortar should be applied over the entire trough. This coating keeps the graphite from oxidizing during the initial heat-up. Since the graphite gives the material non-wetting properties, it is important that this layer of mortar be placed over the lining before the drying cycle to guard against the oxidation. After the coating has been applied, provision for moisture escape is recommended. Use a 1/8" diameter rod with a pointed end. Insert the rod approximately two-thirds of the thickness of the material on 8" to 12" (20.32 cm to 30.48 cm) centers. This is to vent the material so that steam can easily escape during the dry-in.

Ram Mix Installation

Ramming mixes must be installed with a form. The form is made to the contour of the working floor and sidewall dimensions. The form must be strong enough and internally braced so that no movement occurs during the ramming process. One must remember that the density of these high alumina ramming mixes is approximately one hundred eighty to one hundred ninety pounds per cubic foot, which will exert extreme pressure on the form. The form must be well oiled with brick oil or heavy weight oil so that easy removal of the form after installation can be accomplished.

The work is started on the floor by adding approximately 4 to 6 inches (10.16 cm to 15.24 cm) of loose material evenly over the working area. The material is rammed until it is compacted to about twenty-five percent of the original thickness. After this layer has been installed, it should be raked or scratched to a depth of about 1/16" (1.6 mm) to ensure that the next layer will bond readily.

Another four inches is then distributed and rammed until it is densified. Density is reached when a welding rod inserted into the ram mix will not penetrate more than one-half to one inch. If this is not the case, ramming without addition of material should continue until that density is achieved.

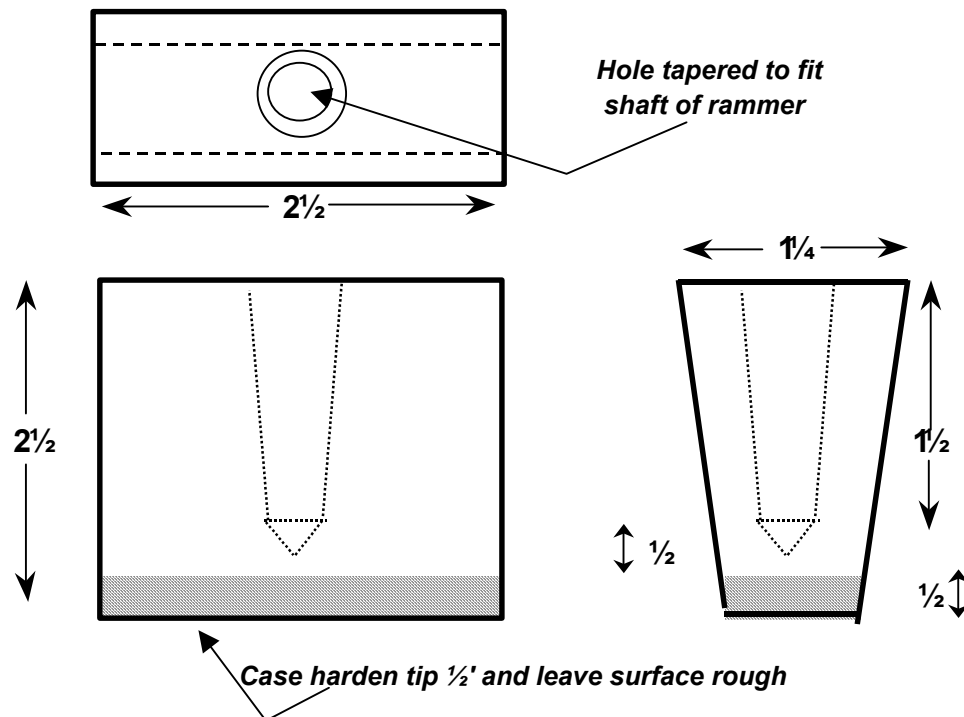
After the bottom has been installed, the area where the sidewalls will rest should be scratched and roughened. The form is then set, braced into position, and immobilized. It is absolutely crucial that the form does not move during the installation.

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Ramming should commence on both sides of the form simultaneously so that the work can proceed upward and maintain the form in the center. Four to six inches (10.16 cm to 15.24 cm) of loose material is laid down over the work area, smoothed out, and then rammed. The material should be continually tested with a welding rod to ensure that good density is being obtained. In between each layer, the material is roughened or scratched as discussed for bottom installations above, in order to make a better bond between each succeeding material addition. The lining is brought up to the top of the form, or the required elevation.

Since most trough sidewalls are sloped, it is extremely important that the material be compacted along the form. If this is not done, a surface is produced which will be shelly, soft, and easily worn during operation.

It is suggested that a square head rammer be used along the form so that it can be guided parallel to the form to obtain the best compaction in this area. Such a ramming head is illustrated below.



Drying

The drying and burn-in of trough and runners is necessary to remove the moisture and set the bonds. Also, check the schedule recommended on the Technical Data Sheet for additional tips and information.



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The hold temperature for plastics and ramming mixes that contain carbon, silicon carbide and/or carbon bonds should not exceed 800°F (427°C). Higher temperature holds will promote oxidation. After the 800°F (427°C) hold, these products should be brought to operating temperature as quickly as possible, but not to exceed 200°F/hr (112°C). If steam is observed, immediately stop increasing the temperature and hold until steaming abates.

The drying process is accomplished by the use of heat and a large volume of air. As moisture migrates to the surface, the circulating air removes it. Any method that improves air volume and circulation is desirable.