

**Manufacturing Insights**

Rapid Castings:

Rapid Prototypes for Metal Casting Processes

SCENE 1.

**RC62A**, CGS: Plaster Mold Casting

**MI BKGD**, MI background

**RC62B, RC11, 16:21:54:00-16:22:12:00**

pouring two plaster cast molds

SCENE 2.

continue previous shot

**RC63A, RC11, 16:13:26:00-16:13:36:00**

zoom out, plaster mold being sealed for pouring

**RC63B, RC11, 16:32:19:00-16:32:34:00**

plaster poured into pattern

**NARRATION (VO) :**

THE PLASTER MOLD CASTING PROCESS

COMBINES ELEMENTS OF INVESTMENT AND SAND

CASTING. INSTEAD OF A CERAMIC SHELL, IT

USES A MOLD MADE OF PLASTER. AND LIKE

SAND CASTING, THE MOLD COPE, DRAG AND

CORES ARE PRODUCED USING FOUNDRY

TOOLING, OR PATTERNS.

SCENE 3.

continue previous shot

**RC64A, RC12, 17:22:20:00-17:22:28:00**

zoom in, master model being sanded

**RC64B, RC10, 14:50:08:00-14:50:18:00**

zoom out, rtv core pattern

**RC64C, RC10, 14:10:22:00-14:10:36:00**

zoom out, rtv core pattern being filled with plaster

**NARRATION (VO) :**

THE PATTERNS ARE CONSTRUCTED FROM A

MASTER MODEL OF THE PART. RTV RUBBER—OR

IN SOME CASES, RIGID EPOXY—IS CAST ON

THE MODEL TO PRODUCE MASTER NEGATIVES

FOR THE COPE, DRAG AND CORES. THE NEXT

STEP IS TO POUR A PLASTER SLURRY OVER

THE PATTERNS TO MAKE THE METAL CASTING

MOLD.

SCENE 4.

**RC65A, RC12, 17:12:29:00-17:12:59:00**

rapid prototyping operation

**RC65B**, CGS: Mark R. Garofano

Vice President of Engineering  
& Q.A.

Armstrong Mold Corporation

**RC65C, RC08, 09:03:28:00-09:03:54:00**

**NARRATION (VO) :**

RAPID PROTOTYPING'S ROLE IS TO CONSTRUCT

THE MASTER MODEL THAT IN TURN IS USED TO

PRODUCE THE PATTERN. THE ADVANTAGES OF

mark garofano on camera

THIS ARE EXPLAINED BY MARK GAROFANO.

SCENE 5.

continue previous shot

**MARK GAROFANO (ON-CAM) :**

The plaster mold process, which has been in commercial use since back around the WWII era, is actually an ideal way of making thin-walled engineered geometry types of nonferrous castings...

SCENE 6.

**RC67A, RC08, 09:05:56:00-09:06:11:00**

mark garofano on camera

**RC67B, SME3024, 08:22:52:00-08:23:18:00**

die casting operation

**RC67C, RC08, 09:04:29:00-09:04:39:00**

mark garofano on camera

**RC67D, RC11, 16:28:25:00-16:28:42:00**

pouring of casting

**MARK GAROFANO (ON-CAM) :**

...typical applications would be quickly prototyping a thin walled nonferrous part that might later be made as a die cast part in production...

...the plaster mold process can be tooled up for about a tenth of the cost of die cast hard steel tool...

SCENE 7.

**RC68A, RC12, 17:11:53:00-17:12:15:00**

rapid prototyping process

**RC68B, RC08, 09:21:55:00-09:22:50:00**

mark garofano on camera

**NARRATION (VO) :**

SO, AS WITH INVESTMENT CASTING, RAPID PROTOTYPING MINIMIZES THE COST AND TIME FOR THE COMPLEX METAL PARTS THAT PLASTER MOLD CASTING IS CAPABLE OF MAKING. MARK GAROFANO OFFERS A BIT OF BACKGROUND ON THE IDEAL PROJECTS TO WHICH TO APPLY PLASTER MOLD CASTING.

SCENE 8.

continue previous shot

**MARK GAROFANO (ON-CAM) :**

...the advent of rapid prototyping modeling was a great advantage in getting into the more complex geometries fairly quickly, without the need for those large numbers of skilled craft trade hours that would have been, going back a number of years, from draftsmen doing drawings using manual machine tools and equipment. Of course it influenced it a great degree to be able to get into those shapes quickly with the advantage of reducing lead time and reducing costs along the way as well.

SCENE 9.

**RC70A, RC12, 17:15:25:00-17:15:41:00**

c.u. rapid prototyping operation

**NARRATION (VO) :**

AS EXPLAINED, RAPID PROTOTYPING IS USED TO MAKE RTV MASTER NEGATIVES. BUT THERE

ARE OTHER WAYS THAT IT IS APPLIED TO  
PLASTER MOLD CASTING.

SCENE 10.

**RC71A, RC08, 09:13:35:00-09:13:59:00**  
mark garofano on camera  
**RC71B, RC10, 14:03:06:00-14:03:25:00**  
zoom out, loose mold prototype model  
secured to board

SCENE 11.

continue previous shot  
**RC72A, CGS: Chip Britton**  
Foundry Operations Manager  
Armstrong Mold Corporation  
**RC72B, RC09, 12:04:35:00-12:05:32:00**  
chip britton on camera

SCENE 12.

continue previous shot  
**RC73A, RC10, 14:07:21:00-14:07:35:00**  
zoom out, mix being made  
**RC73B, RC10, 14:07:46:00-14:08:05:00**  
zoom out, plaster poured into loose mold  
flask  
**RC73C, RC10, 14:14:22:00-14:14:39:00**  
zoom in, pattern pulled from mold  
**RC73D, RC10, 14:21:18:00-14:21:38:00**  
mold, model being shellacked  
**RC73E, RC10, 14:28:00:00-14:28:22:00**  
adding parting agent, flask being  
reassembled  
**RC73F, RC10, 14:31:17:00-14:31:27:00**  
mix being mad  
**RC73G, RC10, 14:31:59:00-14:32:35:00**  
slurry poured over the second half on mold

SCENE 13.

**RC74A, RC11, 16:45:03:00-16:45:12:00**  
gating pulled from lost model mold

SCENE 14.

**RC75A, RC08, 09:55:15:00-09:55:58:00**  
mark garofano on camera  
lost model part placed in flask  
**RC75B, RC11, 16:38:54:00-16:39:12:00**  
plaster mold material poured into flask

**MARK GAROFANO (ON-CAM) :**

A very fast track way in which we might be approaching the plaster mold casting project, particularly with the advent of rapid prototyping technology, might be simply making a rapid prototype model that we can then loose mold off of in a parting board...

**NARRATION (VO) :**

THIS ALTERNATIVE ELIMINATES THE TIME AND LABOR TO MAKE NEGATIVES AND PATTERNS.  
CHIP BRITTON EXPLAINS.

**CHIP BRITTON (ON-CAM) :**

At that point the molder will make the mix, which is basically a water and dry powder gypsum, calcium sulfate, according to the mixing directions, then introduce the slurry onto the model. It takes about 10-15 minutes for it to harden up. At that point they will flip it over and extract the mold out of the pattern. With it will come the model. At that point what we'll do is end up shellacking or using something so the plaster we're about to pour into the mold we just made, so they don't adhere to one another. So we use some kind of parting agent there. We reassemble the flask with the slight rise to it, so we do have some mold medium above there. At that point we'll make another slurry with the plaster/water mixture, and repeat the previous, which is basically just mold over the model again.

**NARRATION (VO) :**

A SECOND ALTERNATIVE MIMICS INVESTMENT CASTING.

**MARK GAROFANO (ON-CAM) :**

The lost model, or tooling-less way in which to produce plaster mold parts is relatively straightforward, from the RP polystyrene selective laser sintered master model that's the intended as-cast

**RC75C, RC11, 16:43:55:00-16:44:06:00**  
flask removed from mold  
**RC75D, RC11, 16:46:11:00-16:46:40:00**  
mold placed in kiln, closed  
**RC75E, RC11, 16:48:42:00-16:48:50:00**  
zoom out, cast prototype  
**RC75F, still, rapid prototype master model**  
**RC75G, still, cast master model**

SCENE 15.

**RC76A, RC08, 09:45:30:00-09:45:45:00**  
mark garofano on camera

SCENE 16.

**RC77A, RC11, 16:07:01:00-16:07:11:00**  
zoom in, polystyrene part being gated up  
**RC77B, RC12, 17:06:36:00-17:06:53:00**  
zoom out, rapid prototyping operation  
**RC77C, RC12, 17:42:39:00-17:42:50:00**  
zoom in, dpt building

SCENE 17.

**RC78A, CGS: Mike Rufo**  
President  
Design Prototyping  
Technologies  
**RC78B, RC12, 17:29:40:00-17:30:05:00**  
mike rufo on camera  
**RC78C, RC12, 17:21:30:00-17:21:48:00**  
rapid prototype being sanded

SCENE 18.

**RC79A, RC11, 16:23:48:00-16:24:17:00**  
wide, foundry floor

SCENE 19.

**RC80A, RC12, 17:30:39:00-17:31:00:00**  
mike rufo on camera

geometry. That model, once procured and ready, is then literally invested in a flask or jacket, to be suspended in the mold material before it would be fired in a kiln to actually burn the master model from the interior mold of the cavity to produce the resulting casting...

**MARK GAROFANO (ON-CAM) :**

...The advantages are that you can get into a fairly intricate shape without the need to build any of the traditional pattern equipment that would be required for the process.

**NARRATION (VO) :**

WITH THE EXCEPTION OF THE TOOL-LESS PROCESS, WHICH USES POLYSTYRENE PATTERNS THAT ARE LASER SINTERED, ARMSTRONG FAVORS STEREOLITHOGRAPHY FOR ITS PATTERN-MAKING NEEDS. AND IT ELECTS TO TURN TO SKILLED SUPPLIERS FOR THOSE PATTERNS. ONE SUCH COMPANY IS DESIGN PROTOTYPING TECHNOLOGIES.

**MIKE RUFO (ON-CAM) :**

DPT offers a number of stereo lithography parts that foundries like. As long as the material is rigid enough for the preliminary processes of the foundries, it works very well. We typically use DSM 11-122, which is this material. The advantages of this material are it can be sanded very smooth, and it holds its dimensional integrity over a long period of time.

**NARRATION (VO) :**

DPT STARTS EACH PROJECT WITH A CONVERSATION WITH THE FOUNDRY.

**MIKE RUFO (ON-CAM) :**

That conversation involves what shrink parameters you want put on the part, it involves what surface finish they would

need, what the critical parameters are so we know what build orientation we want to put it in. Sometimes foundries even want parts split in two and delivered in two parts, so they can use them for coring.

SCENE 20.

**RC81A, RC12, 17:13:56:00-17:14:10:00**

zoom in, rapid prototyping operation

**RC81B, RC12, 17:02:37:00-17:02:50:00**

zoom out, rapid prototyped models draining

**RC81C, RC12, 17:03:39:00-17:03:54:00**

zoom out, finish curing operation

**RC81D, RC12, 17:20:48:00-17:21:00:00**

zoom out, sanding of model

**NARRATION (VO) :**

WITH THE DETAILS COVERED, THE PATTERNS ARE CONSTRUCTED IN A STEREOLITHOGRAPHY MACHINE AND THEN POST-PROCESSED. TYPICAL POST-PROCESSING INCLUDES DRAINING EXCESS RESIN FROM THE PATTERN..., FINISH CURING OF THE PATTERN IN A PCA OVEN..., AND THEN A FINISH SANDING PROCESS, WHICH MIKE RUFO DETAILS.

SCENE 21.

**RC82A, RC12, 17:31:45:00-17:32:11:00**

mike rufo on camera

**MIKE RUFO (ON-CAM) :**

...most foundries want what we call our pattern finish. It takes all the layer lines out, we ensure that critical dimensions are met, and then we ensure that any parts that need to fit together actually fit together before they go off to the foundry.

SCENE 22.

**RC83A, RC08, 09:28:40:00-09:29:14:00**

mark garofano on camera

**NARRATION (VO) :**

ASKED WHEN ARMSTRONG MOLD ELECTS TO USE RAPID PROTOTYPING, MARK GAROFANO RESPONDED:

SCENE 23.

continue previous shot

**RC84A, RC08, 09:29:39:00-09:29:59:00**

mark garofano on camera

**RC84B, RC10, 14:38:12:00-14:38:31:00**

zoom out, cope and drag pattern

**MARK GAROFANO (ON-CAM) :**

...General descriptors of when the technology makes sense to employ and when it doesn't would have been kind of around the part geometry in terms of the complexity, the timetable and compressed lead time objectives that might be required...

...So anything that might not be purely in the direction of straight cope and drag tool, as it's commonly referred to, starts to lend itself to the master

model being produced via rapid prototyping technologies...

SCENE 24.

**RC85A, RC11, 16:20:31:00-16:20:46:00**  
zoom out, poured plaster molds

**NARRATION (VO) :**

THE APPLICATIONS FOR PLASTER MOLD CASTING ARE NEARLY IDENTICAL TO THOSE OF RAPID PROTOTYPING FOR ANY METAL CASTING PROCESS. SO, IT IS NO WONDER THAT ARMSTRONG COMBINES THE TWO.

SCENE 25.

**RC86A, RC08, 09:35:37:00-09:35:52:00**  
mark garofano on camera  
**RC86B, RC08, 09:36:01:00-09:36:19:00**  
mark garofano on camera  
**RC86C, RC08, 09:36:35:00-09:37:03:00**  
mark garofano on camera  
**RC86D, RC11, 16:10:41:00-16:11:00:00**  
plaster molds pulled from oven  
**RC86E, RC11, 16:27:35:00-16:27:47:00**  
zoom out, pouring of plaster casting

**MARK GAROFANO (ON-CAM) :**

The first camp would be purely producing a thin walled engineered shape as a prototype opportunity for an OEM designer to verify his design before going into full scale production...  
...A second scenario would be to carry on with that process for the life of the program, that may be a capital intensive market that doesn't warrant the investment in production tooling...  
...the third scenario in which plaster mold would be utilized is going beyond prototypes and not being the production source for the part that needs to be tooled up, but the gap needs to be filled in between to keep that part (stammer) in supply to the customer assembly line...

SCENE 26.

**RC87A, RC08, 09:15:35:00-09:15:51:00**  
mark garofano on camera

**MARK GAROFANO (ON-CAM) :**

...a general feel for cycle time through the plaster mold process, particularly with the advent of the RP technology, could be anywhere from one to four weeks in a general sense.

--- TOUCH BLACK ---