

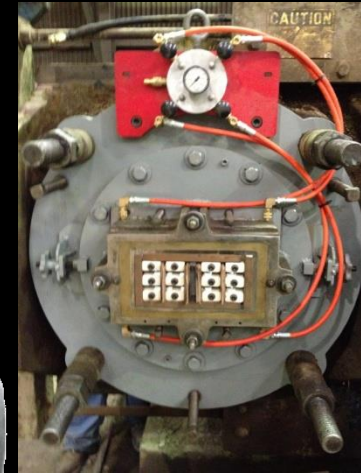
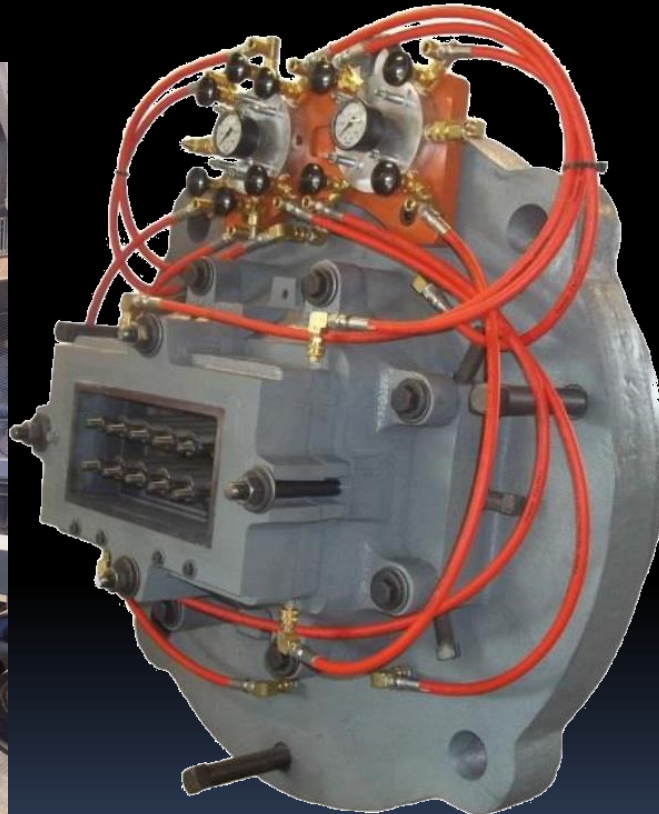
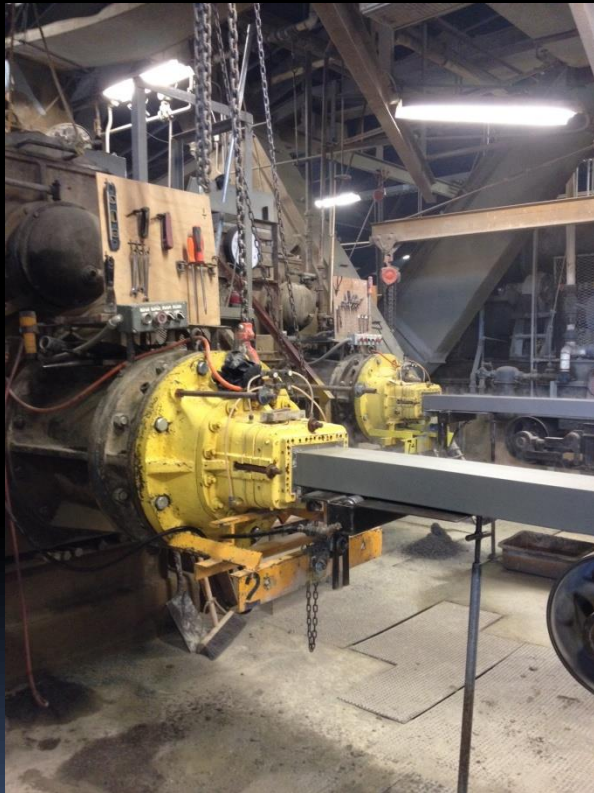
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Webinar 2014-May-28

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Balancing your Die for Optimum Extrusion



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Balancing your Die for Optimum Extrusion



Vince Lombardi

“Perfection is not attainable. But if we chase perfection, we can catch excellence”

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## Balancing your Die for Optimum Extrusion

### Key points about Extrusion Dies and Clay Products Manufacturing

- It is not possible to make a one die fits all clay extrusion operations.
- Most clay extrusion dies have some custom detail to help achieve the highest quality brick for your raw material, operation, product you are manufacturing, size, shape, ASTM specification, void, rate, and etc. .
- To achieve a quality manufactured clay product, attention to detail does matter.
- Extrusion dies wear, nothing last forever. We build a die that every component can be re-lined so you can maintain your extrusion quality.
- If you change your raw material even just change the percentage of the different materials, it can effect how the material extrudes.
- Worn extrusion augers and liners effect how raw material flows through a die, and also how much heat is generates.
- The point I am making is someone has to be looking and someone has to know what to look for.
- The day you think you know everything about brick manufacturing is the day you get a reality check.
- Put fail safes and documentation in place so issue do not repeat themselves.
- Try new things, you never know you may build in some wiggle room to help you through the ebb and flow of outside influences.
- Any problem that is solved in a brick plant is lived by the folks that work there and outside resources that are committed enough to live the problem with you. The outside resource should care enough to make your problem their problem.

**The Goal:** To make Extrusion Dies that compacts the raw material and clay as it flows through the die, creating the least amount of stress and heat as possible.



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# Method To Check Die Balance

## Bump Test

It is important that the bump test be done as quick as possible 1"-4" from the face of the cap is ideal. Before performing a bump test all normal extrusion parameters must be obtained: Temper, Tonnage, and lubrication pressure

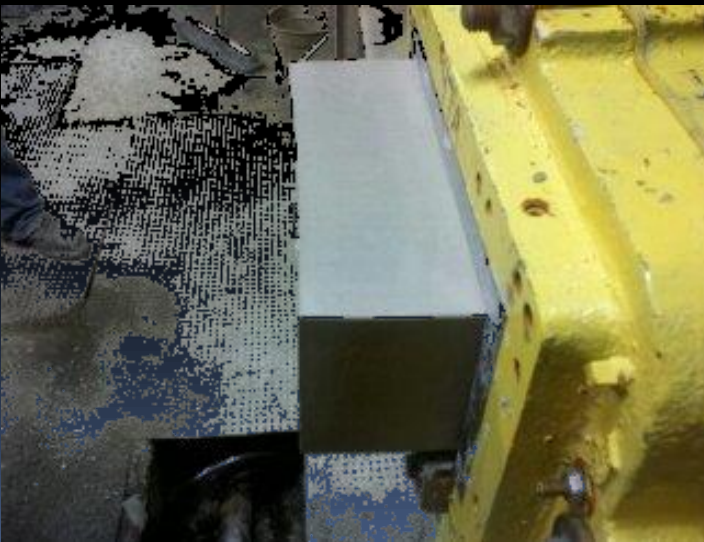


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# Bump Test Process





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# Bump Test Process

Once all parameters have been achieved stop extrusion and cut a section of material away. Cut the material as precisely as possible to the face of the cap as shown.



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# Bump Test Process

Material cut even with the cap



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# Bump Test Process

Bump / Jog the extruder

Jog the extruder on and off as fast as possible, just to bump out 1"-4" of column.



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# Bump Test Process

Results of a bump test



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# Bump Test Process

Use a tape measure to determine the results.



You should not have more than a  $\frac{1}{2}$ " deviation in measurements





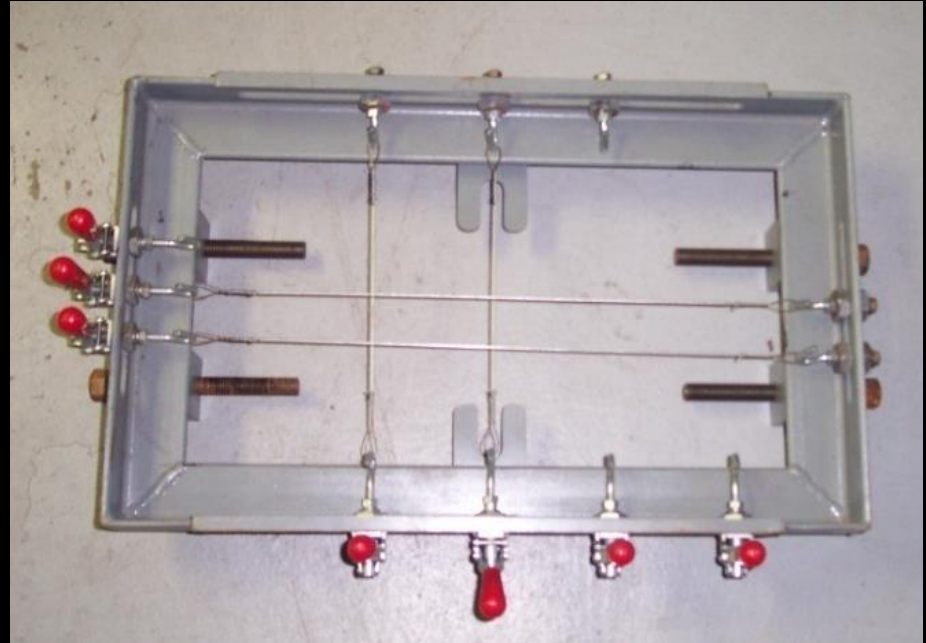
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# Bump Test Process

- A bump test is used to check for unusual flow through the die. If something unusual is noticed, a grid test should be performed at this point.
- A bump test should be performed at least three times consecutively to assume accuracy.
- A grid test, as rule of thumb, should show no more than one inch out of square within twelve feet of the extruded column.
- A grid test should be performed at least two times consecutively to assume accuracy.

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# Grid Test Process



- You should have as many vertical wires as you have rows of cores. If you are running a three hole you should have three vertical wires. five hole five vertical wires.
- Single bar bridge should have one horizontal wire.
- Double bar bridge should have two horizontal wire.



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## Grid Test Process

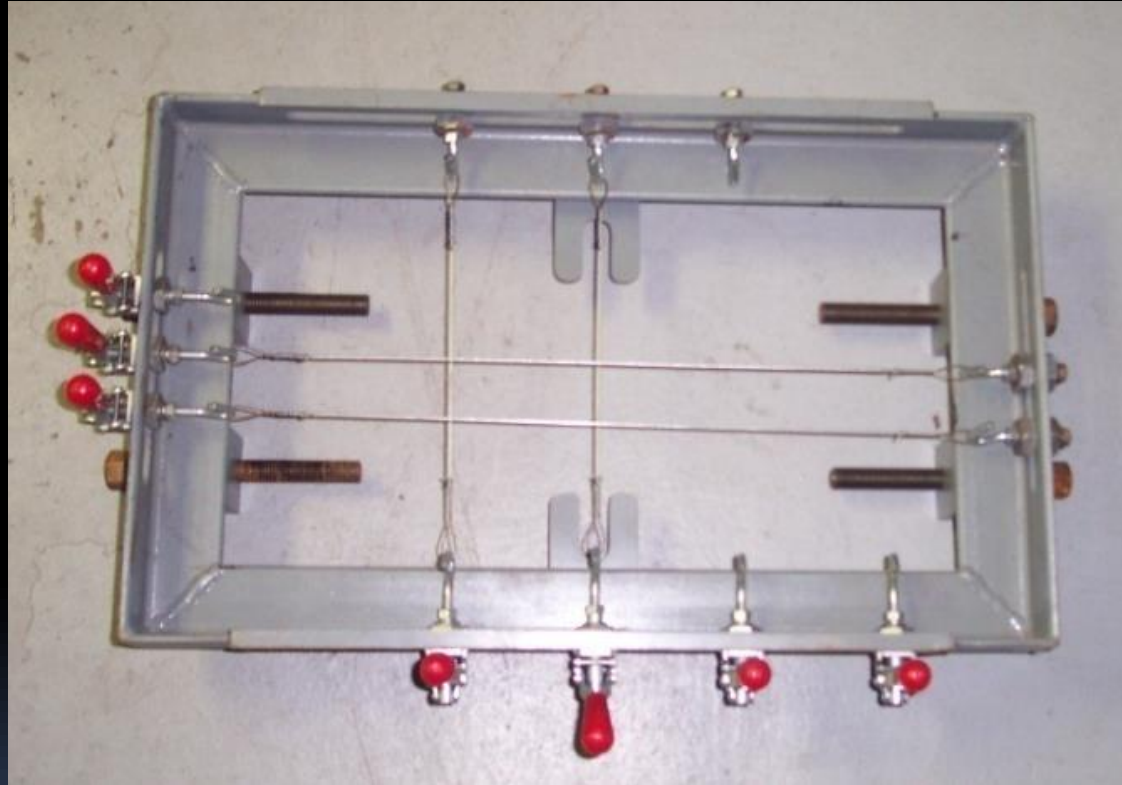
Once all parameters have been achieved stop extrusion and cut a section of material away. Cut the material as precisely as possible to the face of the cap as shown.



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# Grid Test Process

- Ensure sure extruder is full.
- Ensure column temper is normal.
- Ensure lubrication is normal.
- Mount the wire frame securely to the cap.
- Ensure sure you have enough horizontal and vertical wires.
- Line wires up with the center of each row of core vertically.
- Line wires up in the center of each row of cores horizontally.
- Ensure wires are very tight.

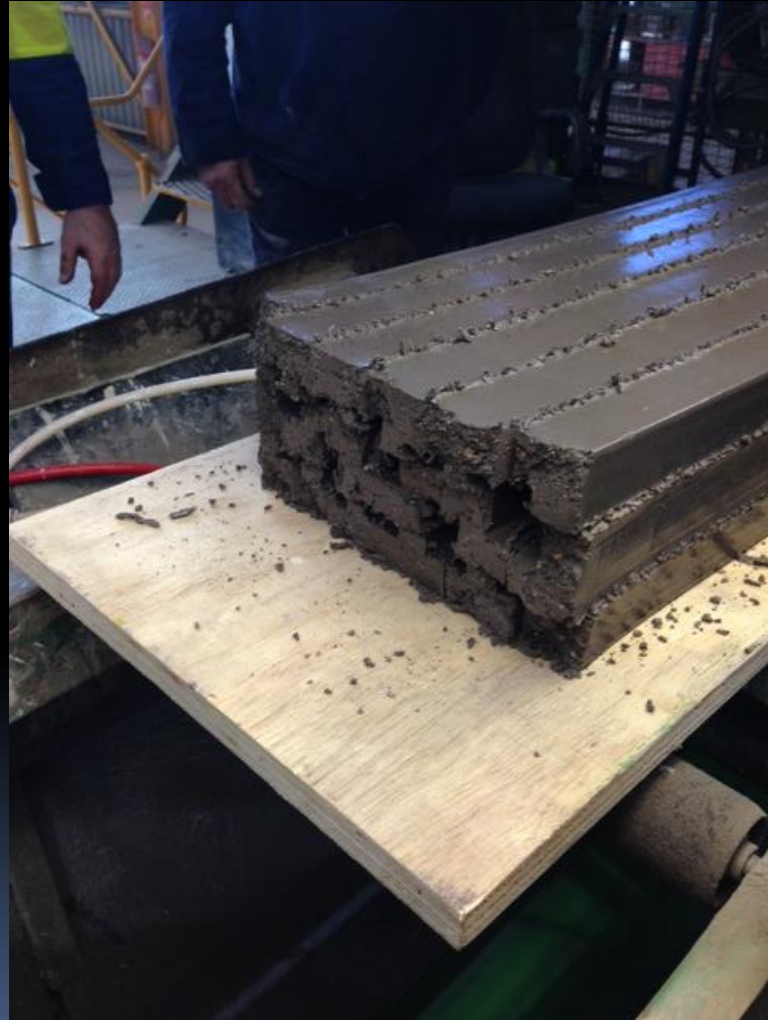




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# Grid Test Process

- Have enough people available to hold all clay streams together.
- Turn extruder and pug sealer on.
- Run out 10'-12' of material.
- You should have less than 1" of difference in the length of the individual clay streams.
- You should have at least two consecutive results before making any changes.



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## When should die balance be checked?

- A simple bump test should be done every time you do a change over.
- If you have not changed over in a week you should do a bump test.
- If parts are changed such as cores, bridges, or caps you should do a bump test.
- If you do a body change you should do a bump test.
- If you are more than a 1/2" out on a bump test do a grid test.







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## What influences Die Balance?

- Proper die set-up and installation
- Proper mounting of a die
- Column support after the die
- Velour frame alignment
- Off take belt, texturing beam, texturing equipment
- Bridge and Core Design
- Percentage of Void
- Field Corrections
- More Permanent Corrections
- Rear opening of the die compared to the auger size
- Die Lubrication
- Interruptions in clay flow " reverse lips" within the die
- Inconsistent material throughput
- Inconsistent material temper/moisture content/ vacuum





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## Proper Die Set-up and Installation

### Bridge Set-Up

- Bridge should be center right to left.
- Bridge should be centered up and down.



## Why?

What is **WRONG** with this picture?

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# Proper Die Set-up and Installation

## Bridge Set-Up

What will happen if a bridge is set up too high like this one?

**Answer:** Material flow is easier on the bottom, so the material will travel fast on the bottom and the column will extrude upward.



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## Proper Die Set-up and Installation Bridge Set-Up

What will happen if a bridge is set up too low like this one?

**Answer:** Material flow is easier on the top, so the material will travel fast on the top and the column will extrude downward.



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## Proper Die Set-up and Installation

### Bridge Set-Up

What will happen if a bridge is set up too far to the right like this one?

**Answer:** Material flow is easier on the left, so the material will travel fast on the left and the column will extrude to the right toward the thinner header shell.

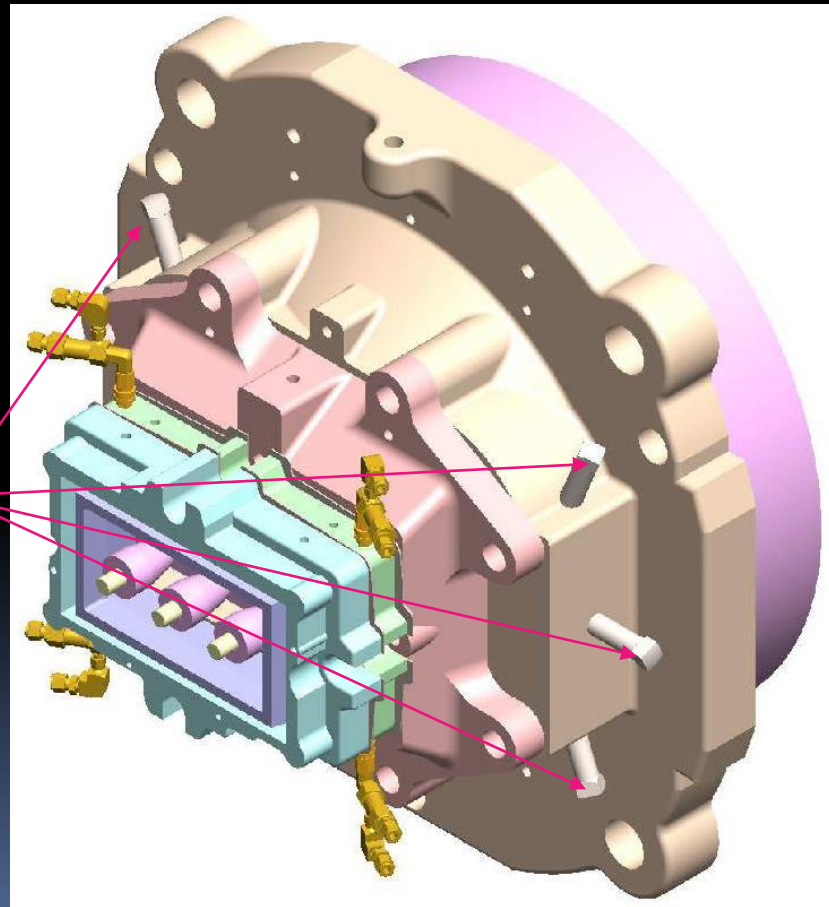


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# Proper Die Set-up and Installation

## Bridge Set-Up

- Reymond Die Adjustable Bridge Feature bridge set-up and maintainability of bridge easy.
- Bridge is externally adjustable from the outside of the unit.
- On each side of the unit you will find (3) bolts that are used to adjust the bridge: left, right, up, and down.
- Bridge is easiest adjusted during operation or clean.
- It is important not to over tighten the mounting bolts so that the bridge can be adjusted.

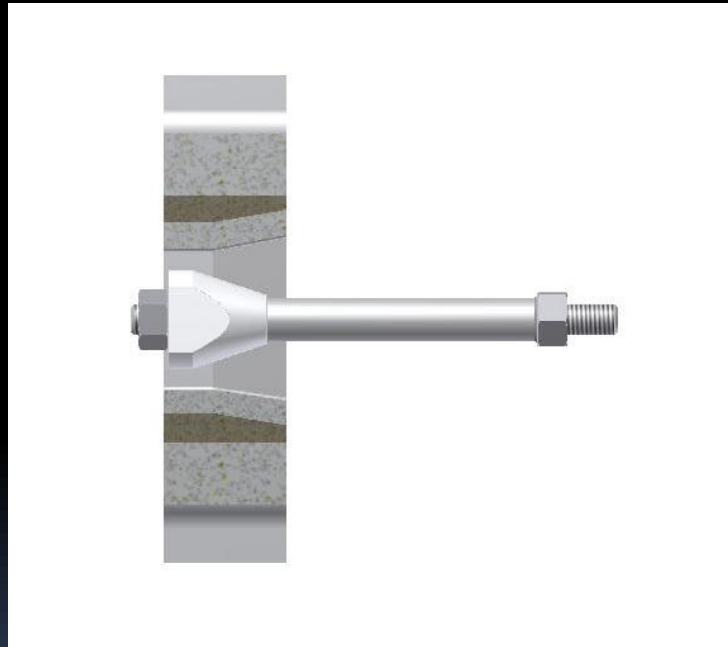




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## Proper Die Set-up and Installation Bridge Set-Up Proper Inset of Core within the Cap

- All Die combinations are figured so that the cores are recessed  $1/16''$  (1.58875mm) inside the face of the cap.
- This insure you get final compaction around the core at final cap size.
- Core outside the cap can result in header cracks.



This is not necessarily a balance issue but we see this detail missed so many times. This happens when people buy cores that are longer than the original supply.

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# Proper Die Set-up and Installation Bridge Set-Up Proper Inset of Core within the Cap

This becomes increasingly important on high void units like this 50% void product.







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# Proper Die Set-up and Installation Bridge Set-Up Proper Inset of Core within the Cap



Video





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# Proper Die Set-up and Installation

## Bridge Set-Up

### Proper Inset of Core within the Cap

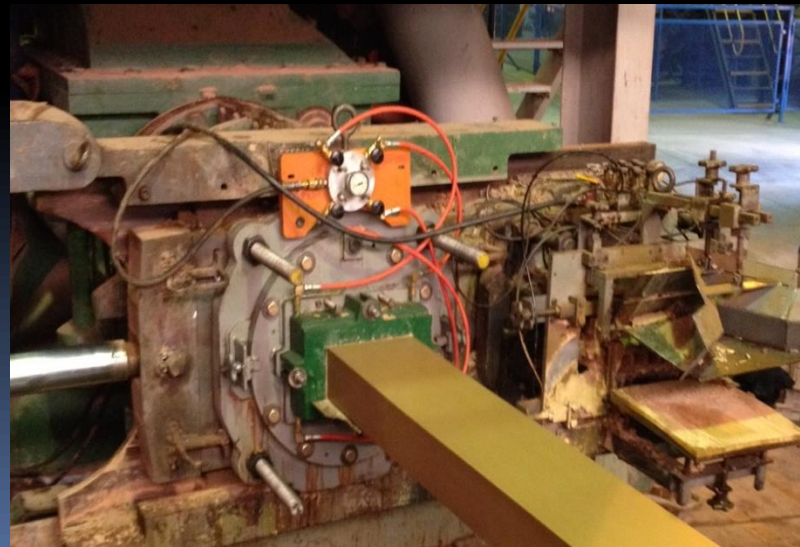


Video



## Proper Mounting of A Die

- Mount the unit firmly against the extruder, hinge door, or die changer.
- Align die center of the point auger, die should have a know center, extruder should have a center line.
- Evenly mounted top to bottom and right to left.
- We recommend starting right up as close as you can get to the point auger. It takes less energy to extrude that way.
- Some products like pavers may need extension rings.



## Column Support After Exiting the Die

- Proper column support should allow the column to exit the die level.
- The column should also be square with the column support.



GOOD



NOT SO GOOD



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## Column Support After Exiting the Die

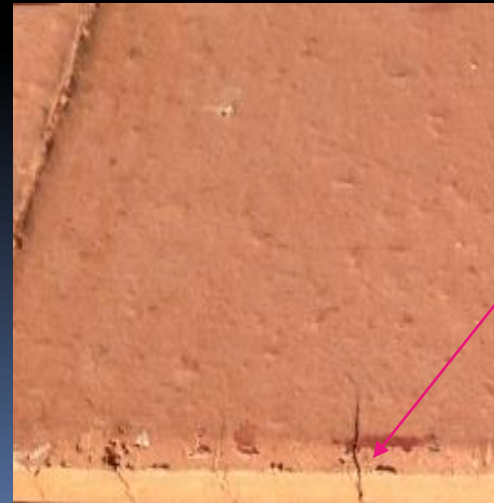
Attention to detail produces good results.



**GOOD**



**NOT SO GOOD**

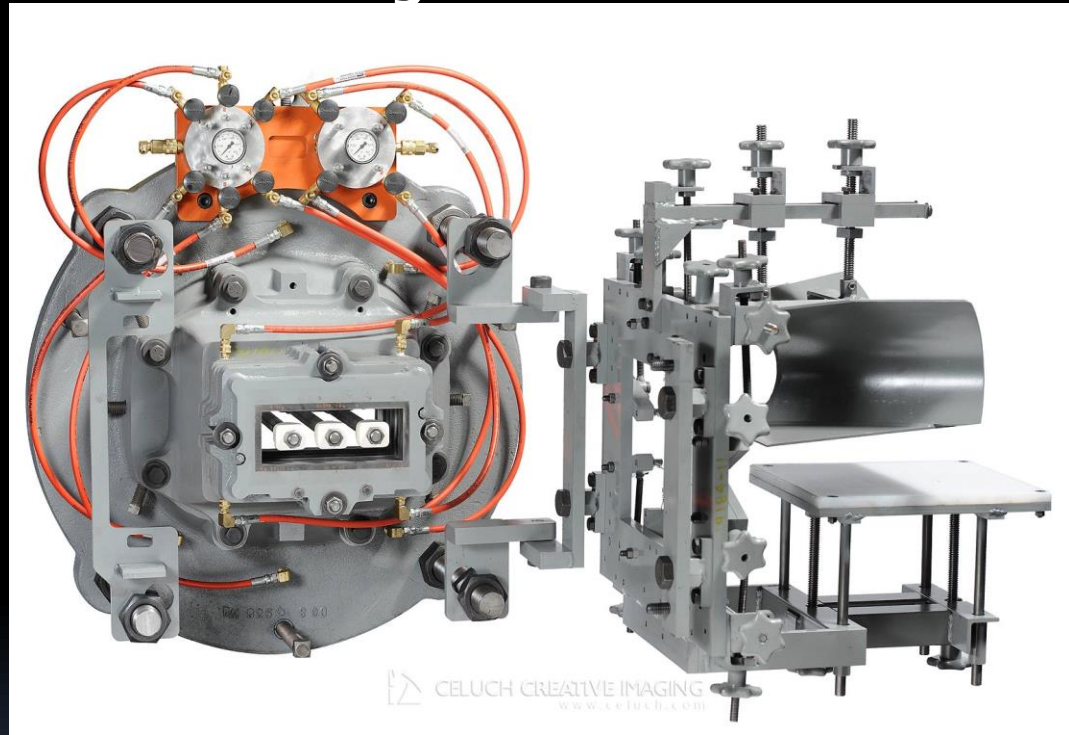


Lack of Attention to detail produces bad results.



## Velour Frame Alignment

- Mount frame secure.
- Mount same distance from the die right to left up and down.
- If you trim one side sooner than the other you can create a drag and pull toward the side trimmed first.
- Trimming more on one side than the other can create a drag on the heavy trimmed side.
- Trimming more on one side is not a fix for a bridge not being centered.



Trimming too much is not Good it:

- Cuts out compaction
- Slows extrusion
- Waste energy
- Returns too much de-aired material that will extrude different and cause balance issues.
- Also can cause lamination.



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## Texture Beam, Off Bearing, Texture



Video

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## Texture Beam, Off Bearing, Texture



Video





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## Texture Beam, Off Bearing, Texture



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## Texture Beam, Off Bearing, Texture

- What you do down stream of the die can effect the back pressure on the die.
- If you have a column pushing one way, and uneven depth of a texture roller may be pushing the column.
- A texture beam or off take belt that is not square with the die can push a column. Then most people push it back with a roller on the other side of the column and this stresses the brick.
- Deep textures can cause more column swell. Most people running deep textures are running very stiff columns.

The logo for Castings U.S.A. Inc. is contained within a blue speech bubble with a black outline. The text "Castings U.S.A. Inc." is written in a white, sans-serif font, centered within the bubble.

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# Bridge and Core Design Effect Clay Flow

Typical set-up for Modular Brick in the USA.

Three Hole Modular

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REVISIONS				
ECN	REV.	DESCRIPTION	BY	DATE
-	00	ORIGINAL RELEASE	JLB	09/03/2013

BASED ON SURFACE AREA  
ESTIMATED 22.50% VOID AFTER  
TRIMMED AND FIRED

MANUFACTURING BEGINS AFTER  
RECEIPT OF APPROVAL DRAWING

DATE: \_\_\_\_\_  
SIGNATURE: \_\_\_\_\_  
P.O. # \_\_\_\_\_

<p>REVISIONS</p> <p>PART USE</p> <p>DATE</p> <p>See Bill of Materials</p> <p>UNLESS OTHERWISE SPECIFIED:</p> <p>TOLERANCES</p> <p>ANGULAR DIMENSIONS ..... ± 5 deg.</p> <p>FRACTIONAL DIMENSIONS ..... ± 1/32 in.</p> <p>2 PLACE DECIMAL DIMENSIONS ..... ± 0.15 in.</p> <p>3 PLACE DECIMAL DIMENSIONS ..... ± 0.02 in.</p>	<p>Reymond Products International, Inc.</p> <p>P.O. Box 302</p> <p>Milwauke, WI 54903</p> <p>Web: www.reymondproducts.com</p> <p>Tel: 330.338.3053 Fax: 330.339.6909</p>
<p>WEIGHT 853.69 LBS.</p> <p>SCALE 1:2</p> <p>DATE 08/30/2013</p> <p>DESIGNER J. BAKER</p>	<p>3.750 (95.25mm) x 8.125 (206.38mm)</p> <p><b>MODULAR VELOUR</b></p> <p>QTY 1 OF 3</p>



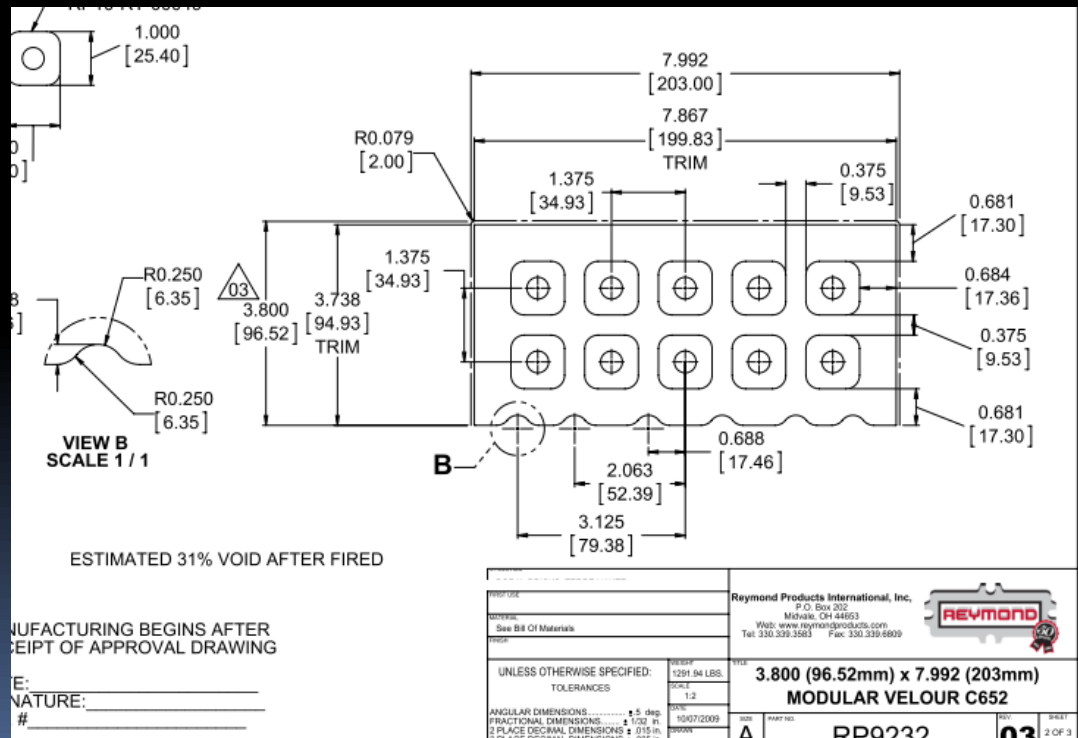


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# Bridge and Core Design Effect Clay Flow

Typical set-up for Modular Brick in the USA.

Ten Hole Modular





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## Bridge and Core Design Effect Clay Flow

Points to understand about a Ten Hole Set-up

- Double bar bridge
- Thinner Webs
- More Flow Restrictions in the center



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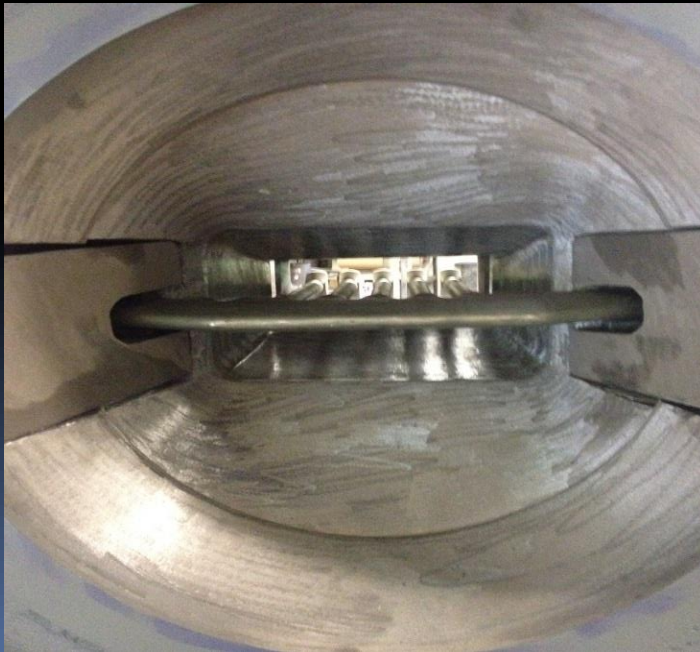


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## Bridge and Core Design Effect Clay Flow

Points to understand about a Three Hole Set-up

- Single bar bridge
- Thicker Webs
- Less Flow Restrictions in the center



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# Bridge and Core Design Effect Clay Flow

Results Of  
Less Flow Restrictions in the center  
Bump Test Result





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# Bridge and Core Design Effect Clay Flow

Results Of  
Less Flow Restrictions in the center



This is obvious.

Not so obvious







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## Bridge and Core Design Effect Clay Flow

Results Of  
Less Flow Restrictions in the center  
Fired Test Result Bowed Brick



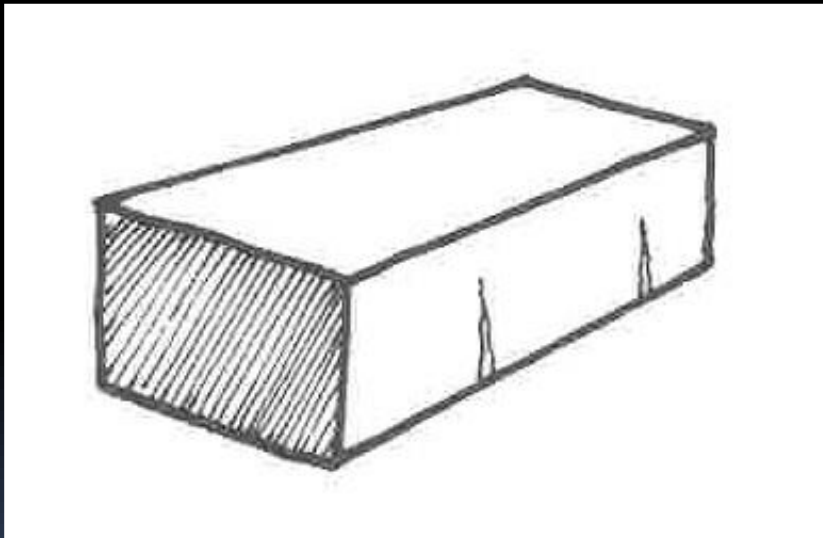


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# Bridge and Core Design Effect Clay Flow

Results Of  
Less Flow Restrictions in the center

Vertical Face Cracks



Generally corrected by slowing middle down or speeding up outside

Dog earing



Generally due to slow outside, corrected with lubrication





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# Bridge and Core Design Effect Clay Flow

## Bridge Design

- Custom built for your material needs.
- Sized for your needs.
- Pins centers are made to your needs.
- Spacing is for your material needs.
- Thickness is built for your material needs.
- Knitting grooves are machined into each bar to help promote knitting of material.



# Bridge and Core Design Effect Clay Flow

## Bridge Design



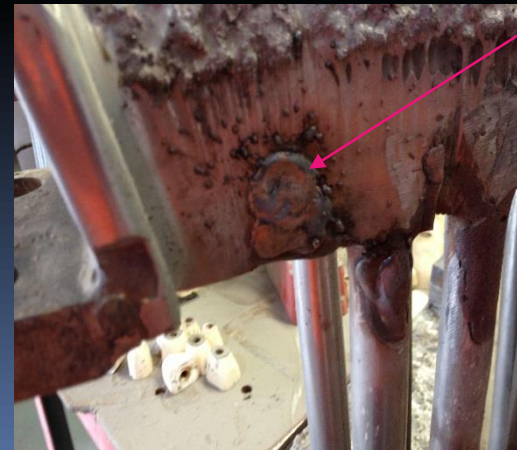
Practices like this will not save you money they will only cause quality issues.

I do not understand why my cores keep moving around.

What? I need that knitting groove?

### Do these look anything like original supply?

- Sharp bridges can cause header cracks
- Bridge built up larger than the design can cause
  - High amperage
  - Restricted flow
  - Balance change
  - Poor Quality





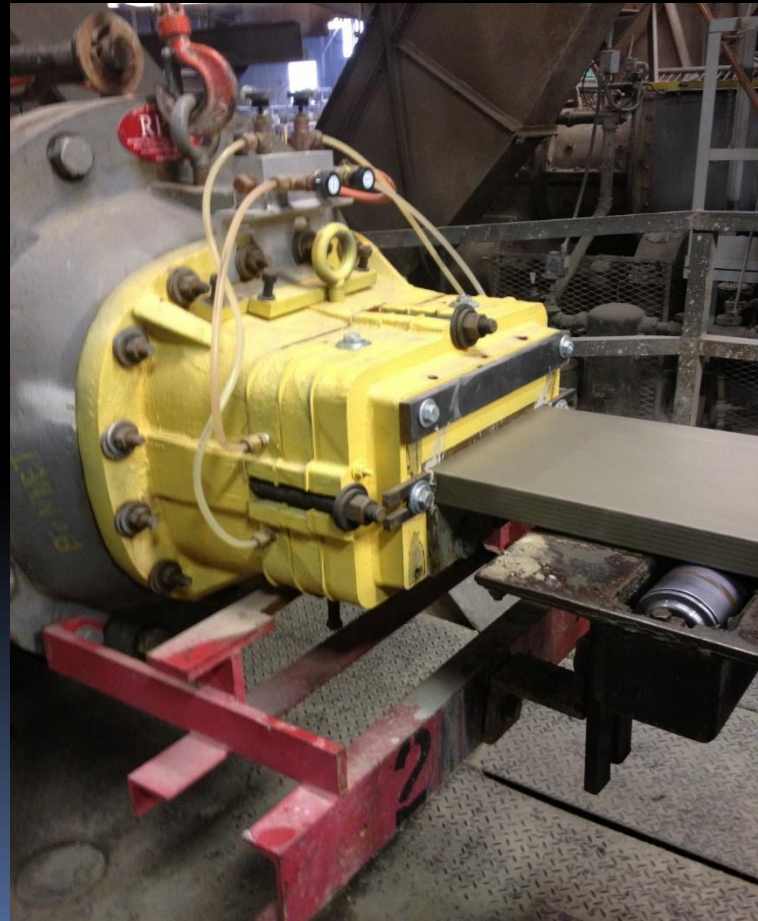
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## Bridge and Core Design Effect Clay Flow

None cored units are generally fast in the center

Corrections for flow on none cored units:

- Extension Ring
- Bulges
- Dummy Bridges
- Geometry



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## Percentage Of Void Effect Clay Flow



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## Percentage Of Void and Effect Clay Flow



Grid test at initial start-up





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## Field Corrections

### Bridge Clips



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## Field Corrections

### Bridge Clips



Grid test after adding bridge clips





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# Percentage Of Void Effect Clay Flow

Field Corrections

Bridge Clips



Video

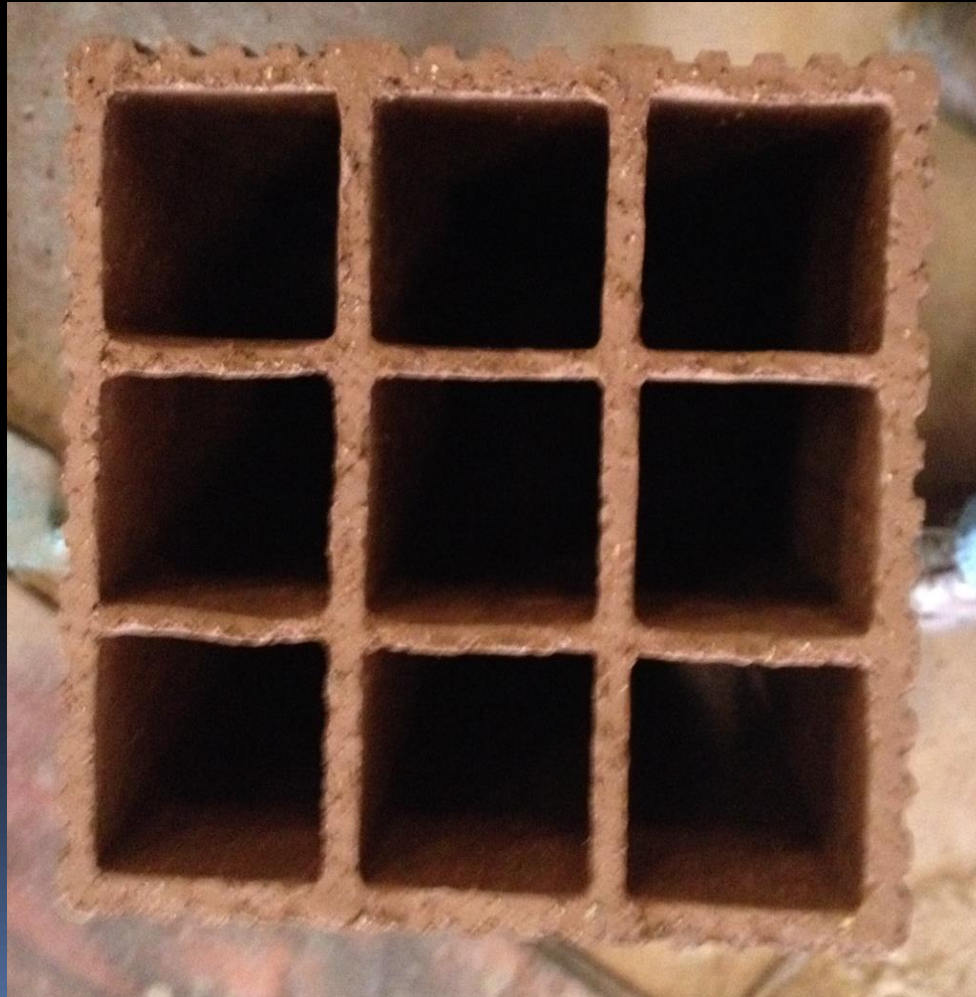




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# Percentage Of Void Effect Clay Flow

Field Corrections for a fast center  
Bridge Clips





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## Field Corrections

### Bridge Clips



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## Field Corrections

### Telescoping the Die

Center of column running too fast move the die away from the point auger



Center of column running too slow move the die toward the point auger



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## Field Corrections

### Sleeves





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## More Permanent Corrections

### Staggered Coring



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## Percentage Of Void Effect Clay Flow

More Permanent Corrections

- Length of Die
- Rear Die Opening
- Bridge Design
- Internal Geometry
  - Angels
  - Tapers
  - Bulges

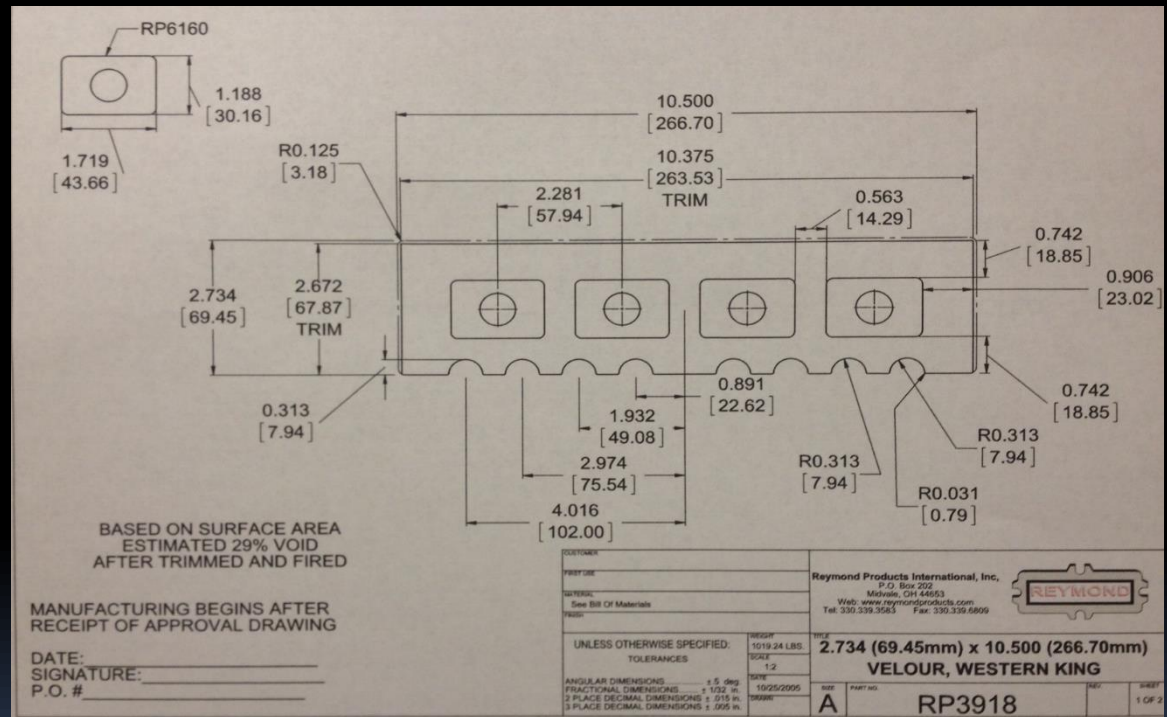


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## Scoring Effect Clay Flow

- Aggressive scoring can slow flow on the bottom of the brick.
- Changes to the bridge may be necessary.
- Changes to the liners in the die may be necessary.
- Bulges in the top of the die may be used.



## Die Lubrication Effect Clay Flow

- In soft extrusion lubrication is not as important because the material is more fluid.
- In stiff extrusion lubrication is a necessity in most cases.

### Why use Lubrication?

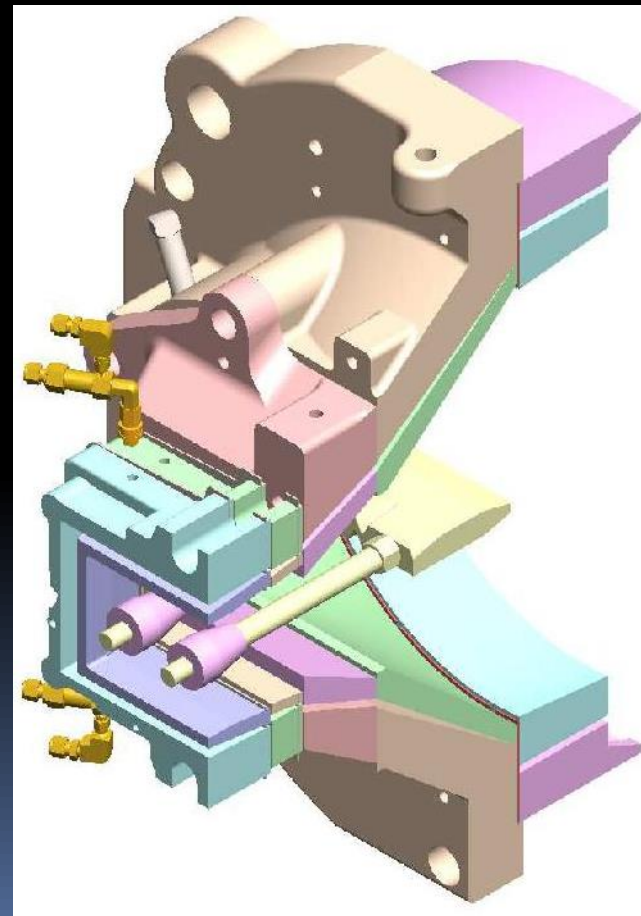
- Longevity of the interior of the die surfaces.
- Ease of material flow/die balance.
- Reduction of column temperature and internal stress.



## Die Lubrication Effect Clay Flow

### Lubrication Lips

- 1/8" Lips between each mating part act as lubrication reservoir.
- This requires less lubrication pressure from the lube pump.
- Without the lips you cause lubrication penetration because the lube has nowhere to go but in the column.
- Number of lubrication points is dictated by:
  - Size of product
  - Void
  - Shape
  - Length of die needed to extrude a quality product





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## Die Lubrication Effect Clay Flow

### Multiple Pump Lubrication

- Using two pumps eliminates the use of pressure regulators.
- Allows overall superior lubrication control.
- Pinpoint volume and pressure.
- Becomes a necessity in high production factories to be able to supply enough lubrication volumes in the correct location.



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## Die Lubrication Effect Clay Flow

Use a die lube that will stay on the outside of the clay column. Penetration cause lamination and header cracks.

- We recommend water soluble soap based lubricates like our RP<sub>3</sub>
- Or soybean oil like our Lubrick
- Diesel is not a good die lube it does not have a high enough viscosity



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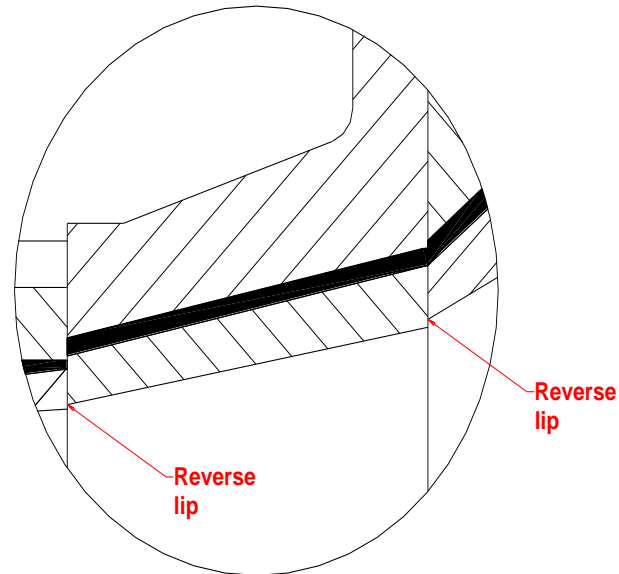
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## Interruptions in Clay Flow "Reverse Lips" within the Die

### Reverse Lips

- Cause lubrication penetration.
- Promote lamination from clay running over clay.
- Cause dry clay pieces to release, which causes torn webs and dry patches.
- Cause dog earing or corner tearing.
- Create drag which results in heat generation and internal stress.

### Cutaway of Unit showing Reversed Lips



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## Interruptions in Clay Flow "Reverse Lips" within the Die Blount Cores verses Tapered Cores

- Blount cores can create lamination.
- Blount cores can create interruption of clay flow.
- Blount cores create less compaction.
- Tapered core promote even flow.
- Tapered cores promote knitting.
- Tapered cores create better compaction.



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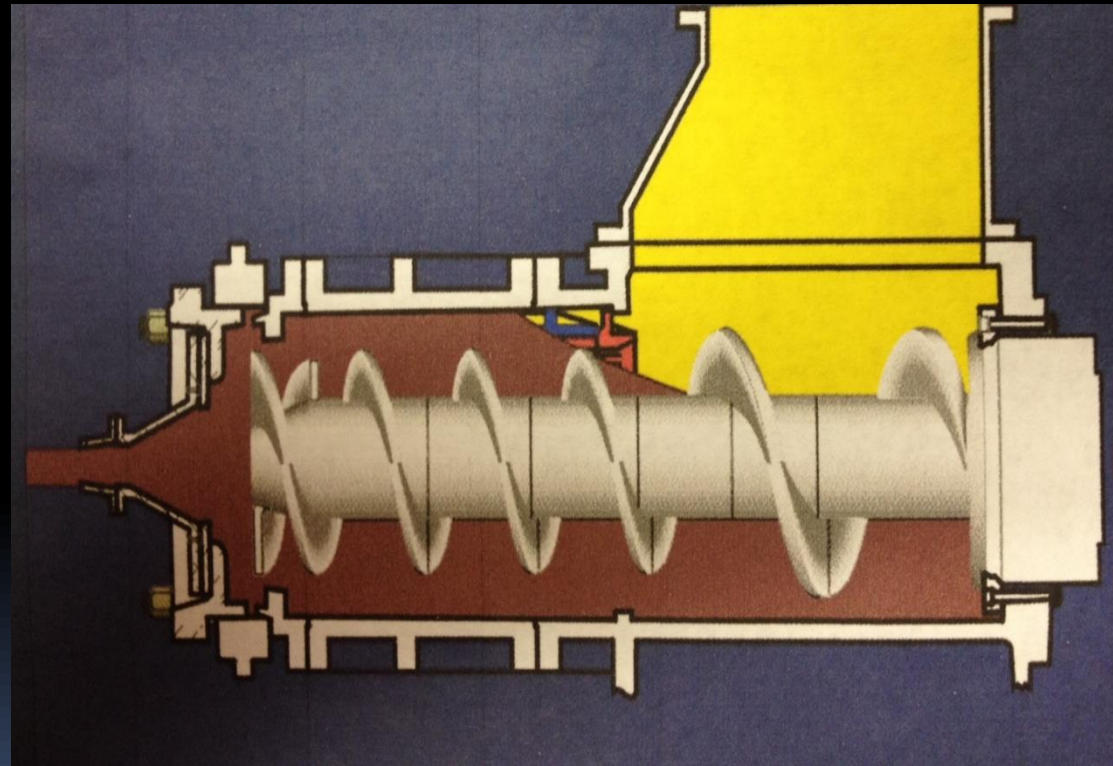
[www.reymondproducts.com](http://www.reymondproducts.com)

## Inconsistent Material Throughput Effects

### Negative Effects:

- Inconsistent column density.
- Inconsistent die balance due to change in column density.
- Inconsistent column speed
- More column shifting as auger turns.
- Lubrication penetration due to column slowing down.
- Lamination due to low column density.
- Lower productivity.
- Inconsistent product quality.

### Incorrect Auger Feed



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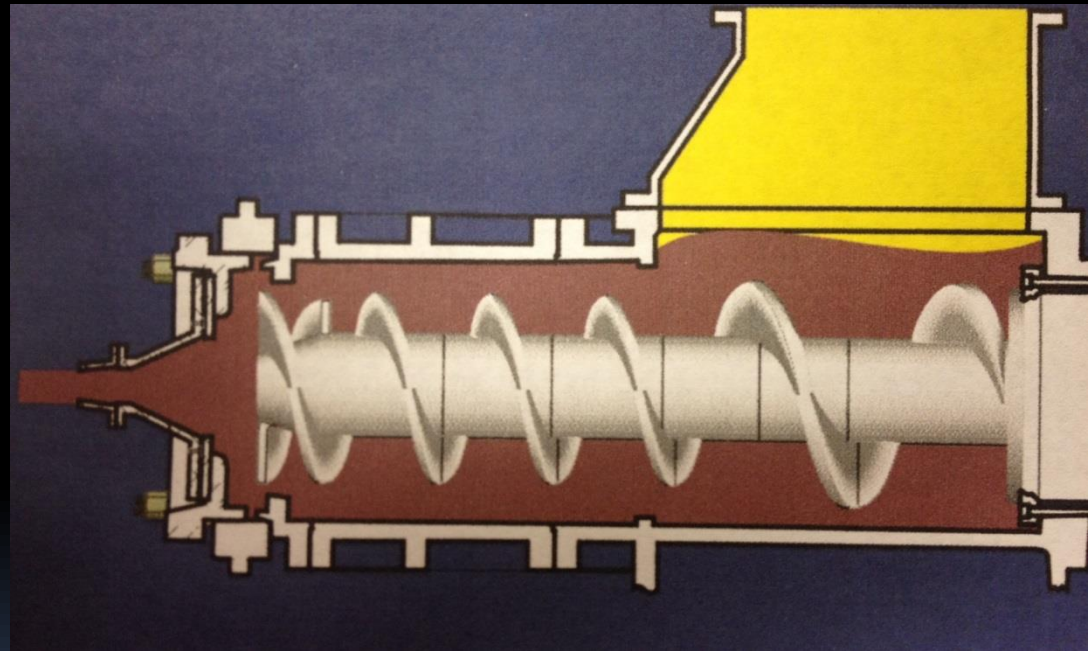
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## Inconsistent Material Throughput Effects

### Positive Effects:

- Consistent column density.
- Consistent die balance due to consistent column density.
- Consistent column speed.
- No column shifting as auger turns.
- No lubrication penetration.
- No lamination.
- Increase productivity.
- More consistent quality product.

### Correct Auger Feed



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## Inconsistent Material Temper , Moisture Content, and Vacuum Causes:

- Low column density
- Variation in size
- Variation in texture
- Distortion
- Low green strength
- Changes in column temperature
- Internal stress
- Down time due to handling equipment
- Lower product yield
- Downgraded product
- Overtime
- Little to no profit

