

The aluminium dross

HANDBOOK

How to cast aluminium dross

INTRO
what is dross?

STEP 1
components

STEP 2
the furnace

STEP 3
texture catalogue

STEP 4
potential of dross

WHAT IS DROSS?

It is the by-product of the aluminium smelting process. When aluminium is molten it will create a protective layer of aluminium oxide, mixed with some other residue on top. This is called dross. This material can result in very inconsistent outcomes, but this manual is made to explain why the different variables of dross occur and how to manipulate them.

INTRO

This is a designer's guide to experimenting and designing with aluminium dross. Over a period of five months, I've worked with dross and mapped out my findings and turned them into this handbook for designers wanting to experiment with dross. The instructions aim for designers who have never worked with dross, but want to design and explore its possibilities. Do take in consideration that the instructions will only focus on the aspect of dross and as this material is an by-product of aluminium basic experience with smelting and casting aluminium is expected.

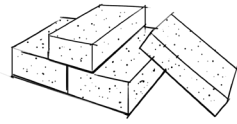
The manual will go through the following steps:

- 1) an inventory list of tools needed to cast dross and recreate the various examples.
- 2) a guide on how to build a propane furnace.
- 3) eight different textures and how to recreate them.
- 4) a suggestion on the potential use of dross and how to design with it.

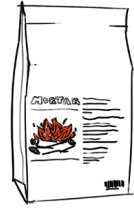
INDEX

components.....	6
the furnace	8
texture catalogue	11
toplayer.....	12
top layer*	14
bottom layer	16
fine grind	18
stamped.....	20
preassurized	22
low aluminium	24
medium aluminium	26
high aluminium	28
potential use of dross	31

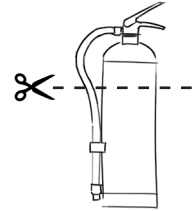
FURNACE COMPONENTS



42x FIREBRICKS
50mm thick brick used to build the furnace



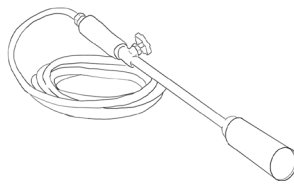
FIRE RESISTANT MORTAR
used to bind the firebricks as well as being fire proof



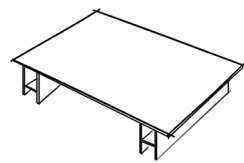
FIRE EXTINGUISHER
cut the extinguisher 3/4 from top and use as crucible



PROPANE TANK
heats the furnace, the easiest method in my opinion



WEED BURNER
used to direct the heat through holes in furnace



STEEL BASE
self made steel base, used to shield ground from heat

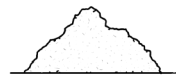
MOLDING COMPONENTS



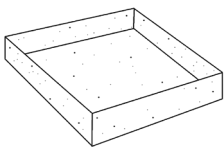
CASTING SAND
oil based sand that is moldable and doesn't stick



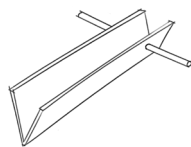
SUSPENDASLURRY (SUS)
a paint like consistency, dip model to create a shell mold



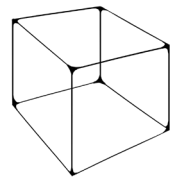
RANGO-SILA (RSA)
after dipping model in SUS use RSA to stop dripping



STEEL MOLD
a negative steel structure of model, smelt dross in mold

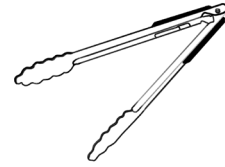


STEEL POUR GUIDE
used to avoid the force of pured aluminium in mold

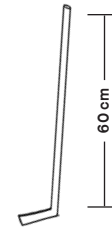


3D print
alternative if model is too detailed to make steel mold

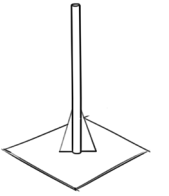
CASTING COMPONENTS



STEEL TONGS
used to handle crucible, dross lumps, other heated objects



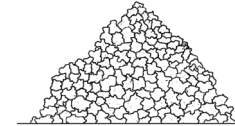
STEEL STIRER
used to stir and mix dross and aluminium to create texture



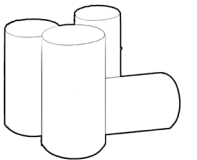
STEEL STAMP
used to fuse dross and aluminium and for flat textures



DROSS (x1)
aluminium scrap burned once will create dross lumps



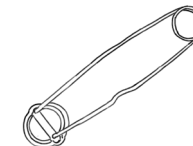
DROSS (multiple)
burn dross lumps and grind it to mold it with higher detail



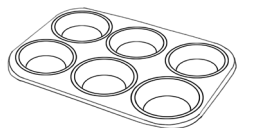
ALUMINIUM
Regular aluminium or pure aluminium scrap for casting



ALUMINIUM CANS
when burning make sure they are completely disintegrated



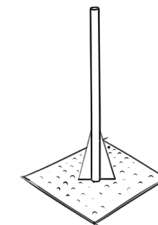
IGNITER
creates a spark that ignites the propane weed burner



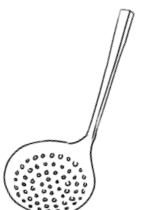
STEEL MUFFIN PAN
used to save excess aluminium from casting



PESTLE AND MORTAR
used to grind dross lumps

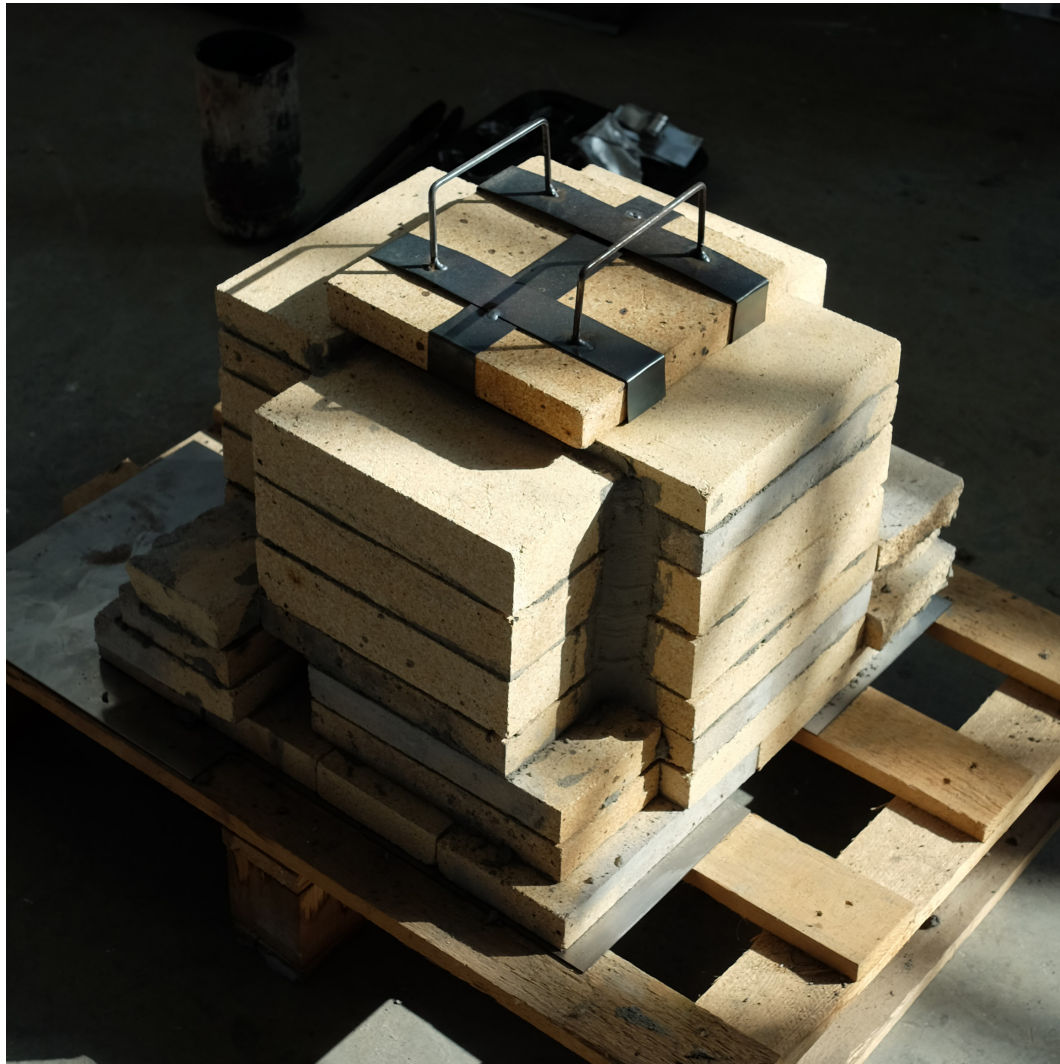


STEEL DRAIN STAMP
preassurize dross/aluminium creating a top coating



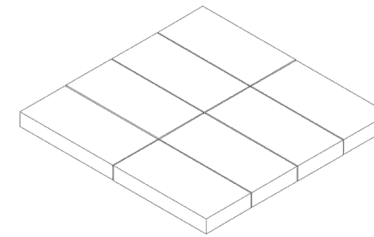
STEEL DRAINER
used to submerge floating dross in aluminium

THE FURNACE



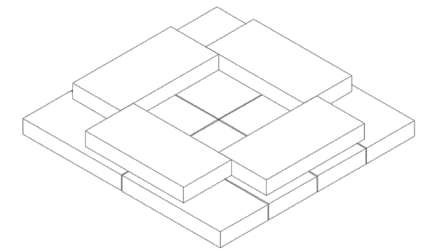
The key for reaching the aluminium melting point of 660.3 °C is heat isolation. The most efficient way of doing this is to apply a little too much mortar to the firebricks then pressing down hard and remove the excess mortar around the edges. The best heating method is propane as it is easy to operate and doesn't leave a mess. An important reminder for when you are building your own furnace is to let the mortar dry for three to four days. If the furnace is heated before the mortar is completely dry it will crack, letting out heat, making it more time and resource demanding to reach the required temperature. Remember to measure the head of the weed burner to make sure it fits through the hole. The weed burner needs oxygen to burn so make sure you don't put it too far inside the furnace as it will go out due to lack of air. The bricks will get extremely hot so make sure to build the furnace on a fireproof base.

1.



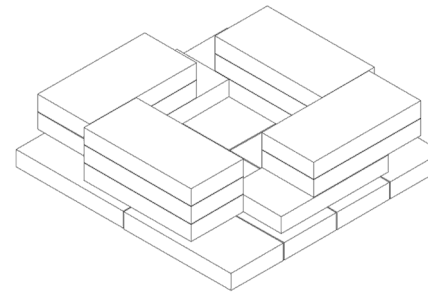
the foundation - 8 bricks

2.



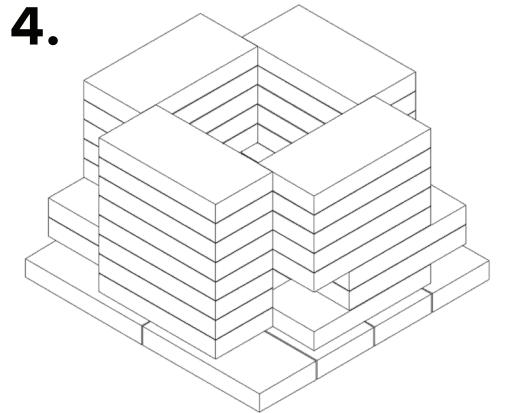
the base - 4 bricks

3.



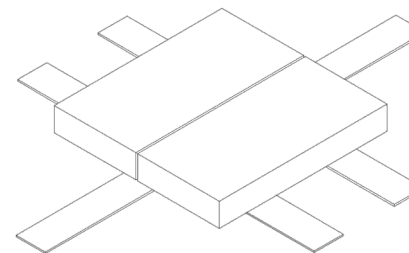
offsetting to make hole - 8 bricks

4.



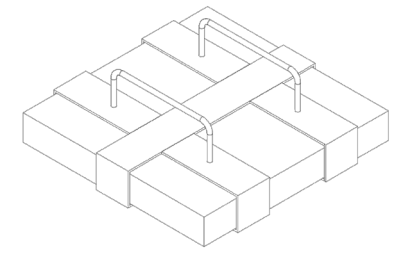
same position as base - 20 bricks

5.



lid: 3 steel strips - 2 bricks

6.



Wrap steel around - add two handles

TEXTURE CATALOGUE

STEP 3

9 aluminium dross textures and how to recreate them.

TOP LAYER	NO.1
TOP LAYER*	NO.2
BOTTOM LAYER	NO.3
FINE GRIND	NO.4
STAMPED	NO.5
PRESSURIZED	NO.6
LOW ALUMINIUM	NO.7
MED ALUMINIUM	NO.8
HIGH ALUMINIUM	NO.9

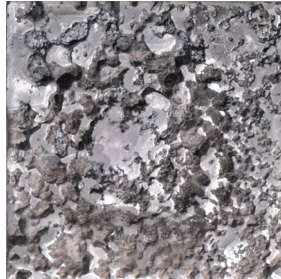
NO.1



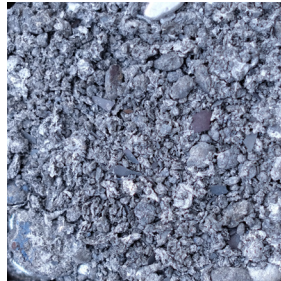
NO.2



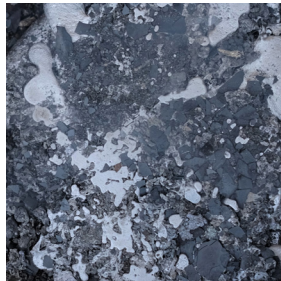
NO.3



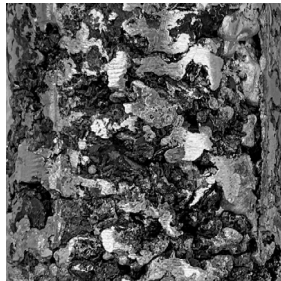
NO.4



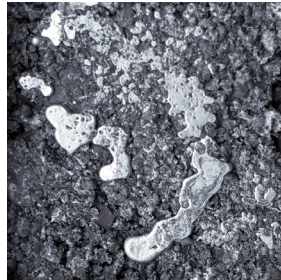
NO.5



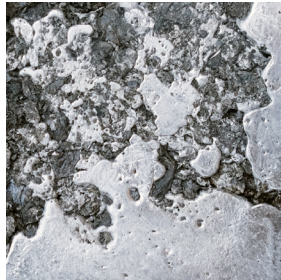
NO.6



NO.7



NO.8



NO.8



amt. DROSS	amt. ALUMINIUM	MOLD	TOOLS	DURABILITY
the amount of dross in the texture	the amount of aluminium in the texture	specifies the molding method/ components	casting tools required to create the texture	specifies the strength/weight of the texture

TOP LAYER

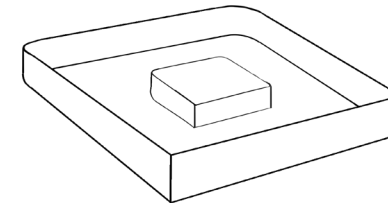
NO. 1



To attain this texture the dross and aluminium will be heated to melting point within the mold, hence important that the mold has a higher melting temperature than 700 degrees. The top layer will be affected by the stirring and mixing of dross and aluminium hence the flow in the texture. Keep in mind that in most cases the top layer in the mold will be the bottom layer of your model.

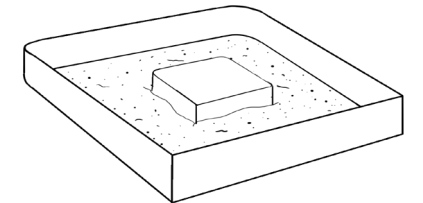
amt. DROSS	amt. ALUMINIUM	MOLD	TOOLS	DURABILITY
low	medium	steel mold casting sand pour guide	steel stirrer aluminium multi burned dross	high

1.



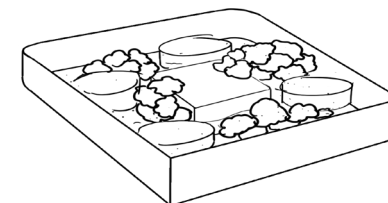
create a steel mold of model

2.



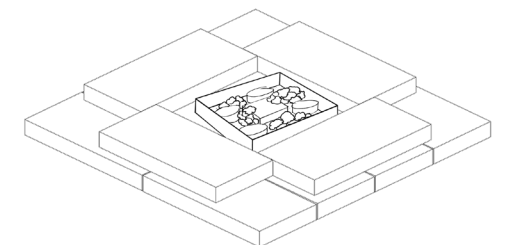
cover bottom of mold with casting sand

3.



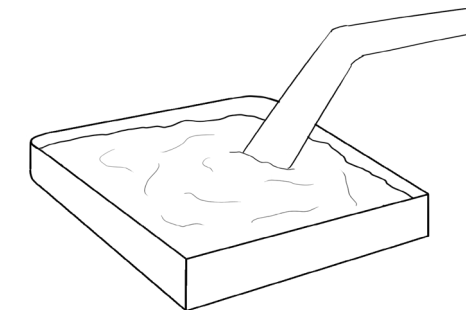
mix dross and aluminium and fill mold

4.



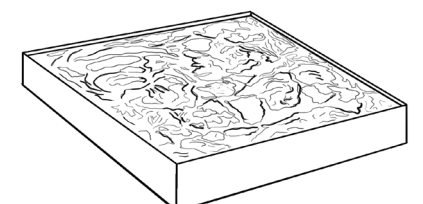
place mold in furnace (heat until molten)

5.



with the stir tool stir in a shape of an 8

6.



air cool until hardened

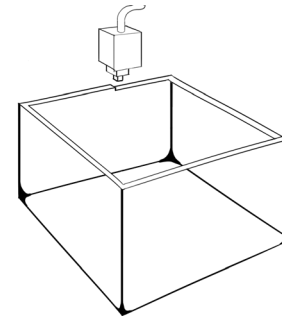
TOP LAYER* NO. 2



Compared to texture no. 1 this top layer has more depth. This is achieved by pushing the dross down with a steel drainer (they float back up) to create an aluminium coating. 3D printing is the preferable molding method because of the height required when submerging. It can be difficult to remove the model from a steel mold because of the large contact surface.

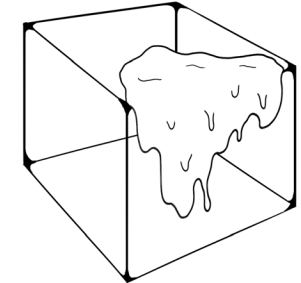
amt. DROSS	amt. ALUMINIUM	MOLD	TOOLS	DURABILITY
medium	medium	3D print Paint dip Salt dip	steel drainer aluminium multi burned dross	high

1.



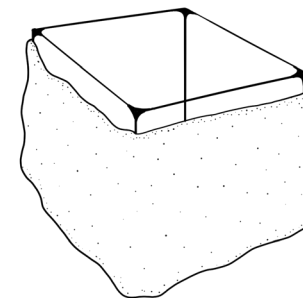
3D print model

2.



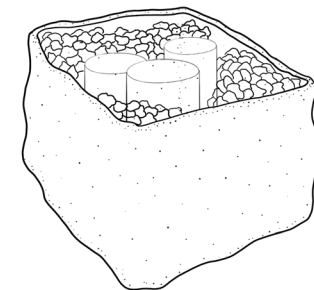
dip print in SUS and RSA (x4)

3.



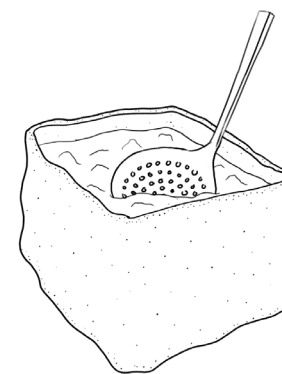
burn out the print from the shell

4.



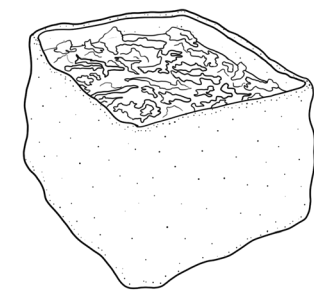
fill shell with dross and aluminium

5.



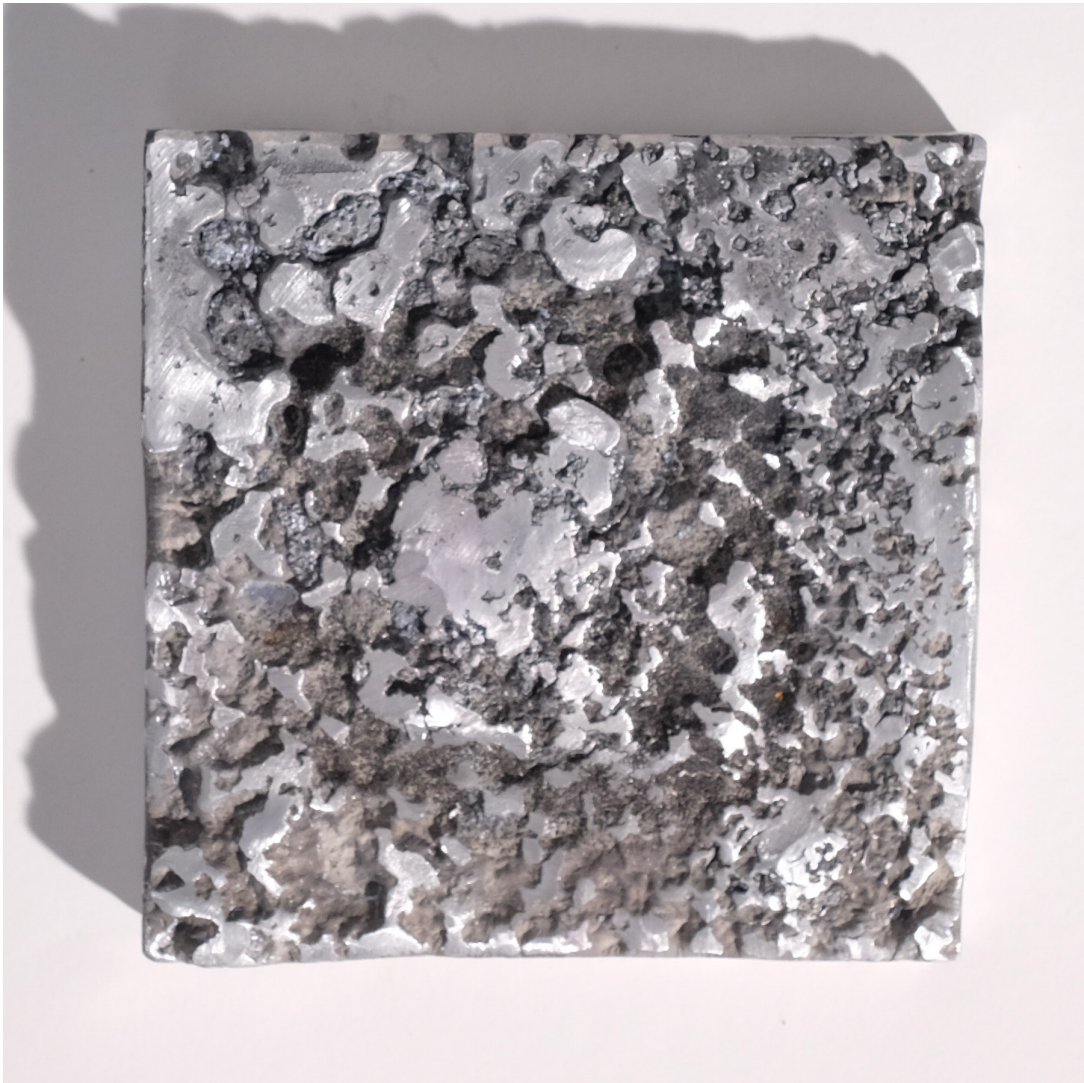
use a the drainer to submerge the dross

6.



air cool untill hardened

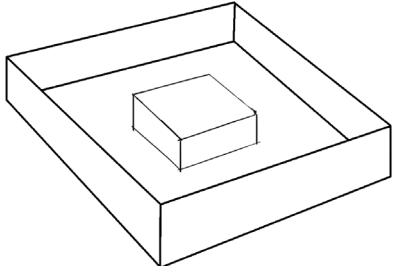
BOTTOM LAYER NO. 3



This texture requires you to have smelted aluminium once before as you will need to collect dross and grind it to sprinkle it in the mold. This texture occurs at the bottom of the mold, which will in most cases be the top layer of the model, casting it bottom up gives a better finish. Be careful when pouring the aluminium as this can move the dross around.

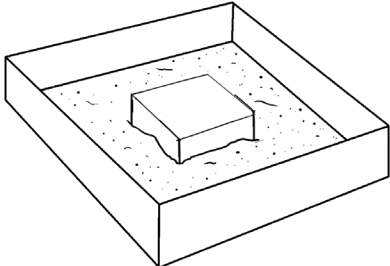
amt. DROSS	amt. ALUMINIUM	MOLD	TOOLS	DURABILITY
low	medium	3D print Paint dip Salt dip	steel drainer aluminium multi burned dross	high

1.



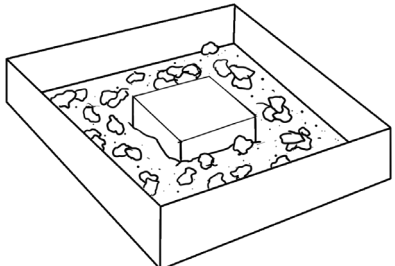
create a steel mould of model

2.



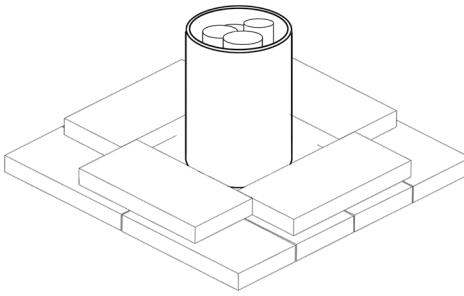
cover bottom of mold with casting sand

3.



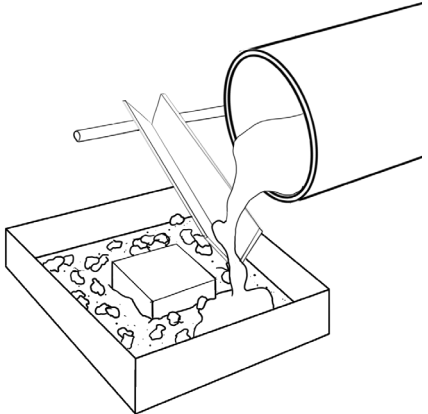
sprinkle grinded dross in mold

4.



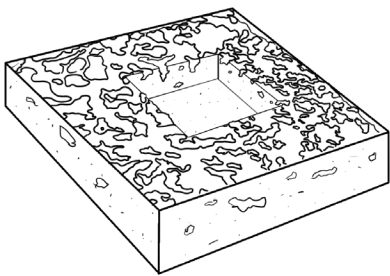
heat aluminium in crucible until molten

5.



use pour guide to pour aluminium in mold

6.



air cool untill hardened then flip around

GRINDED

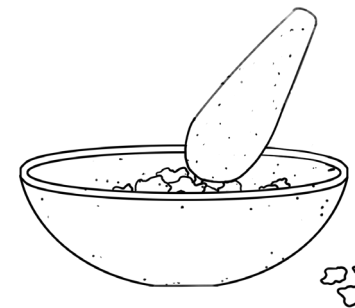
NO. 4



Dross separated from molten aluminium and finely grinded to then be mixed in with molten aluminium will look like this. You obtain this texture by melting the aluminium then sprinkle dross on top and carefully push it down until mold is full. When pushing the last layer down do it slowly so the molten aluminium can flow through and bind the dross.

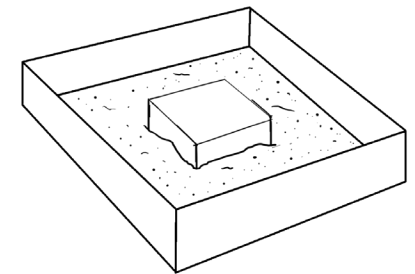
amt. DROSS	amt. ALUMINIUM	MOLD	TOOLS	DURABILITY
medium	medium	steel mold casting sand	stamp drainer aluminium multi burned dross tongs	medium

1.



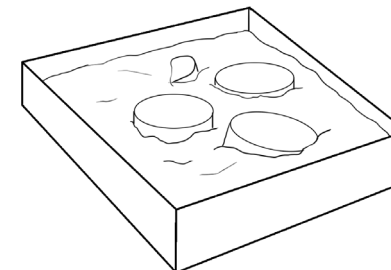
use mortar to grind multi burned dross

2.



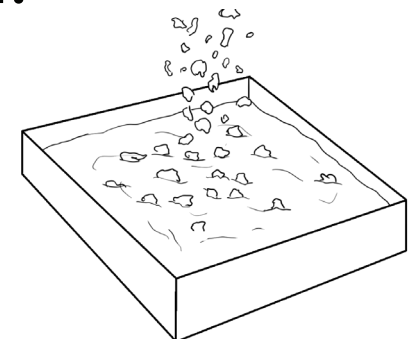
fill bottom of steel mold with casting sand

3.



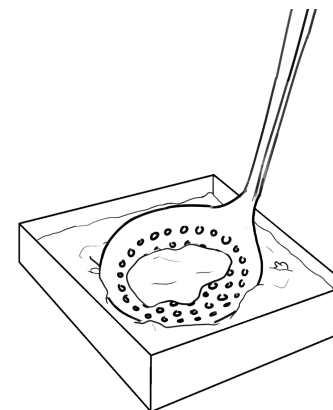
heat mold with aluminium until molten

4.



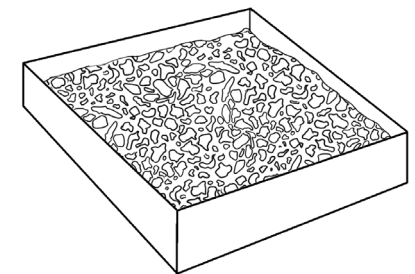
sprinkle dross over molten aluminium

5.



push dross down with stamp drainer

6.



repeat 4. and 5. until desired dross amount

STAMPED

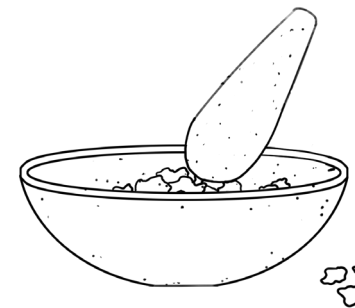
NO. 5



The texture of stamped dross is easy to recreate as a surface but is quite challenging to mold. The trick with this texture is to fill the mold with dross lumps from the crucible and not pressurize until the mold is full. The challenge is that the longer the dross is left out of the heat the less it will bind, making this a rapid procedure.

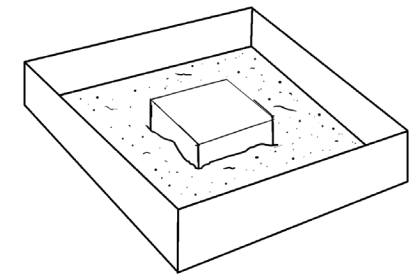
amt. DROSS	amt. ALUMINIUM	MOLD	TOOLS	DURABILITY
medium	medium	3D print Paint dip Salt dip	steel drainer aluminium multi burned dross	medium

1.



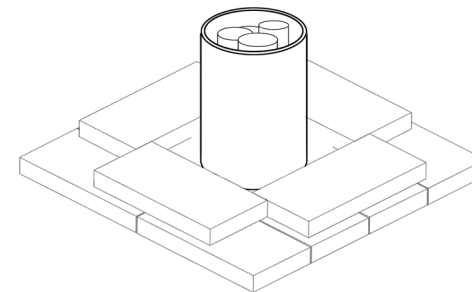
grind dross in mortar

2.



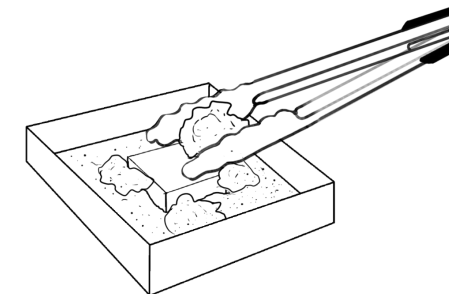
fill mold with casting sand

3.



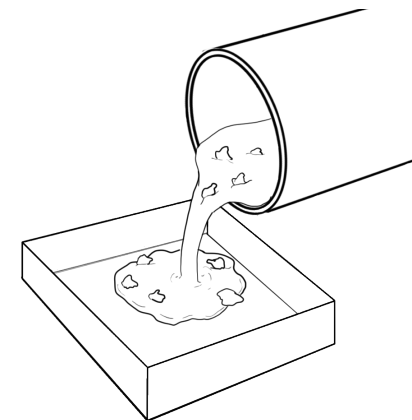
in the crucible mix dross and aluminium

4.



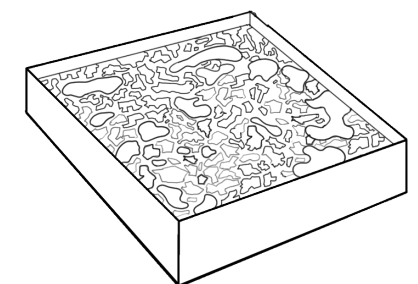
move molten dross lumps to mold

5.



pour mix in the steel mold and stamp it once

6.



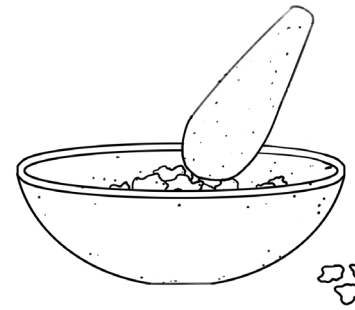
air cool untill hardened

PRESSURIZED NO. 6



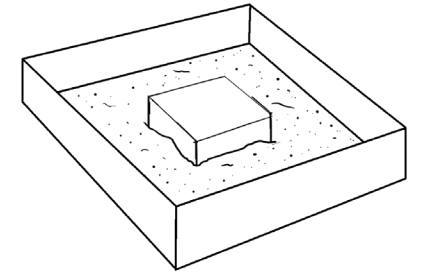
This texture occurs from preassurizing the dross slowly. It's a method that will bind a dross heavy mixture, but won't fuse well to aluminium. Grind down the top layer 1mm ish and the texture is very aesthetically beautiful. As the dross is burned it turns dark but is still mostly aluminium on the inside, thats the reason for the high contrast after grinding it down.

1.



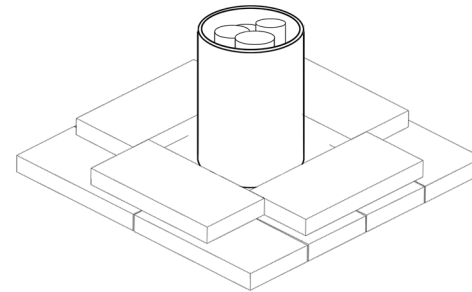
grind dross in mortar

2.



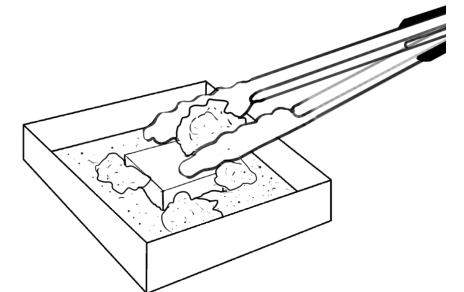
fill mold with casting sand

3.



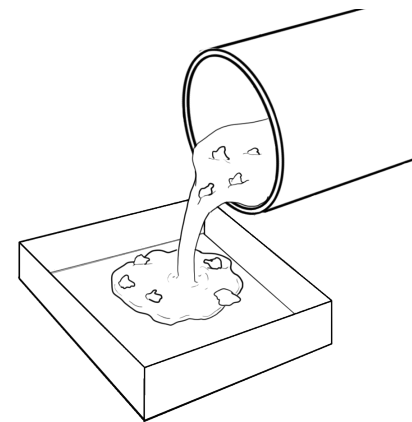
in the crucible mix dross and aluminium

4.



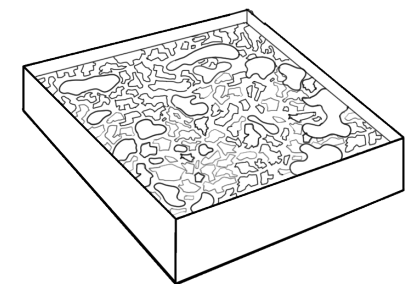
move molten dross lumps to mold

5.



pour mix in the steel mold and preassurize

6.



air cool untill hardened

amt. DROSS	amt. ALUMINIUM	MOLD	TOOLS	DURABILITY
high	low	steel mold	steel pressurizer dross lumps aluminium scrap	medium

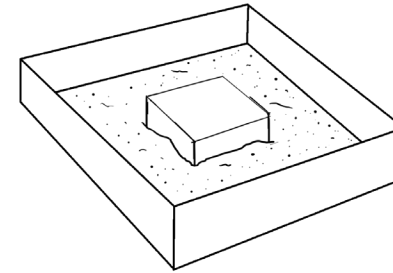
LOW AL

NO. 7



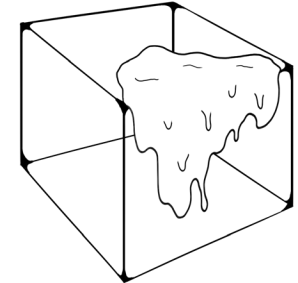
Casting dross with a small amount of aluminium will give you a rough texture but it will be less coherent as aluminium works better as a binding material than dross. A difficult aspect of this process is to get the dross/aluminium ratio right. Too much dross and the texture won't bind properly, too little and the aluminium will flood the dross and the texture will be submerged.

1.



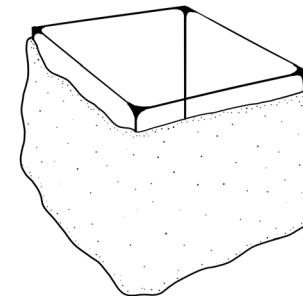
create a steel mold, add casting sand

2.



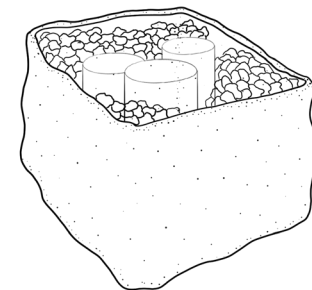
heat up previously casted dross tests

3.



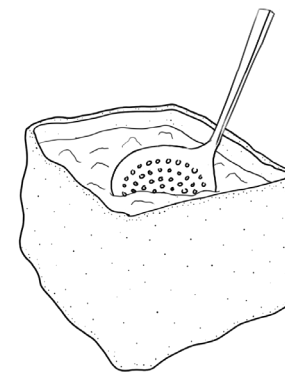
add multi burned dross to mold

4.



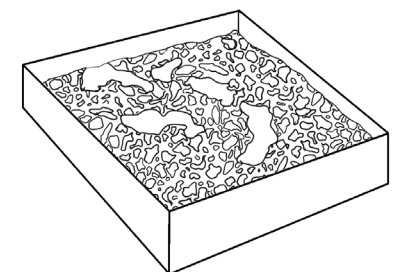
scrape off top layer of molten aluminium

5.



mix in mold then preassurize

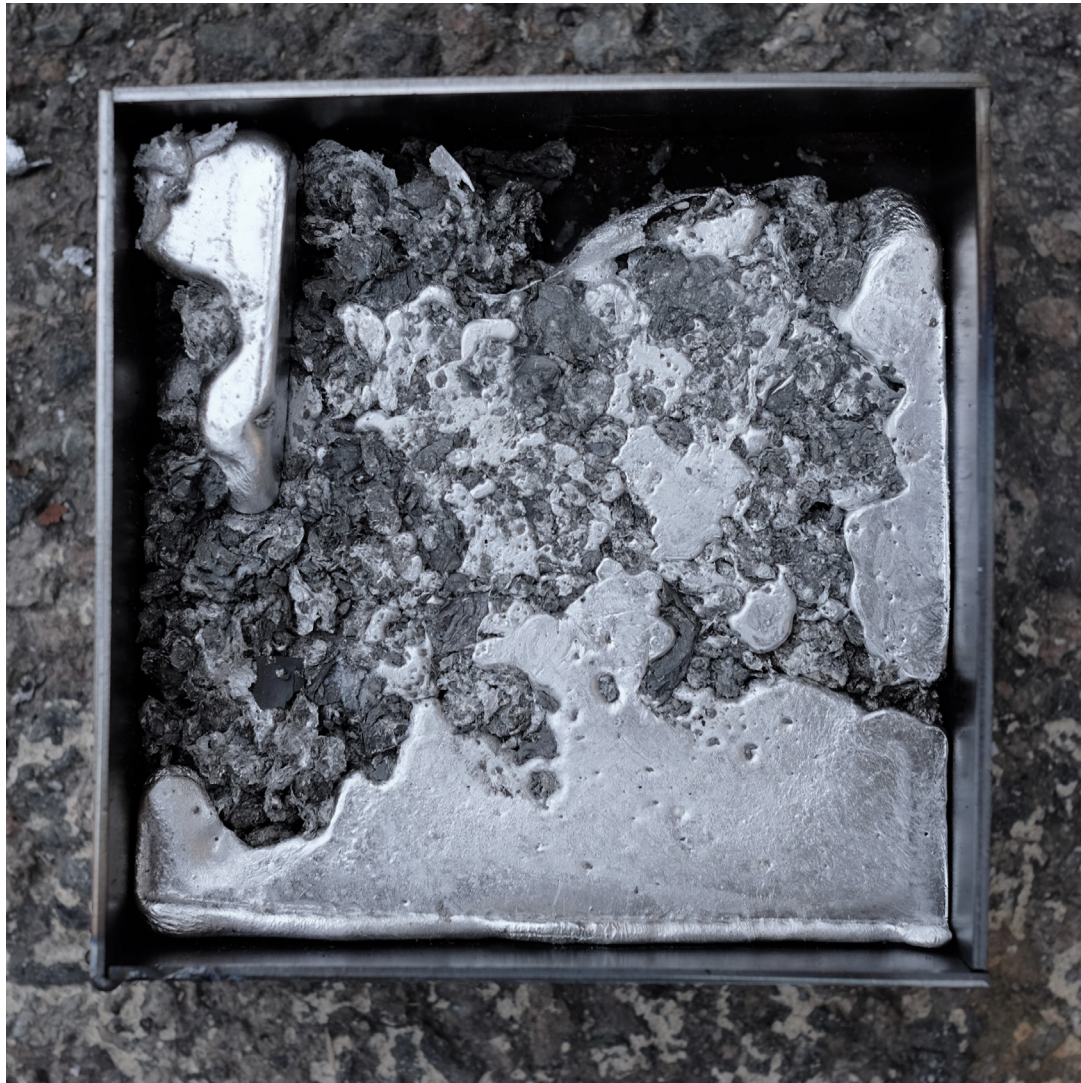
6.



air cool untill hardened

amt. DROSS	amt. ALUMINIUM	MOLD	TOOLS	DURABILITY
high	low	3D print Paint dip Salt dip	steel drainer aluminium multi burned dross	medium

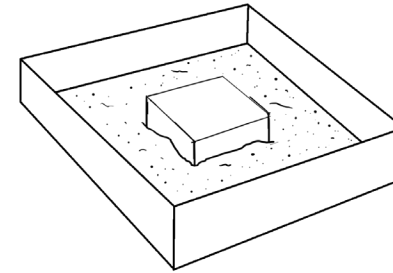
MEDIUM AL NO. 8



Texture No. 7 this will use the same molding technique as the previous texture, but with a different ratio of dross/aluminium. A very practical texture as it will be visible unique with the advantage of being durable as the aluminium works as a coating and binder. The texture is roughly 1 part aluminium to 1 part dross in volume.

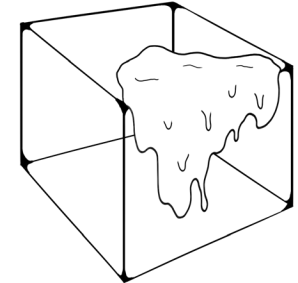
amt. DROSS	amt. ALUMINIUM	MOLD	TOOLS	DURABILITY
medium	medium	3D print Paint dip Salt dip	steel drainer aluminium multi burned dross	high

1.



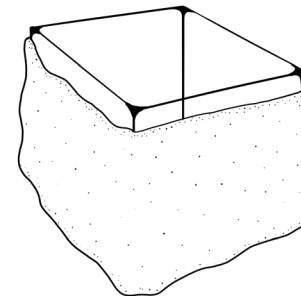
create a steel mold, add casting sand

2.



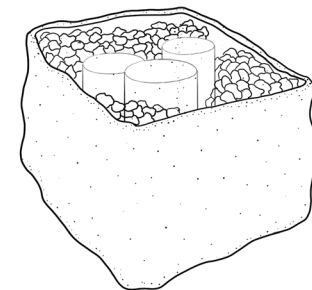
heat up previously casted dross tests

3.



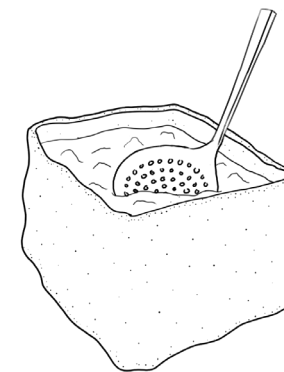
add multi burned dross

4.



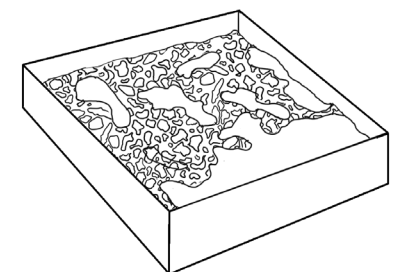
fill shell with dross and aluminium

5.



use a the drainer to submerge the dross

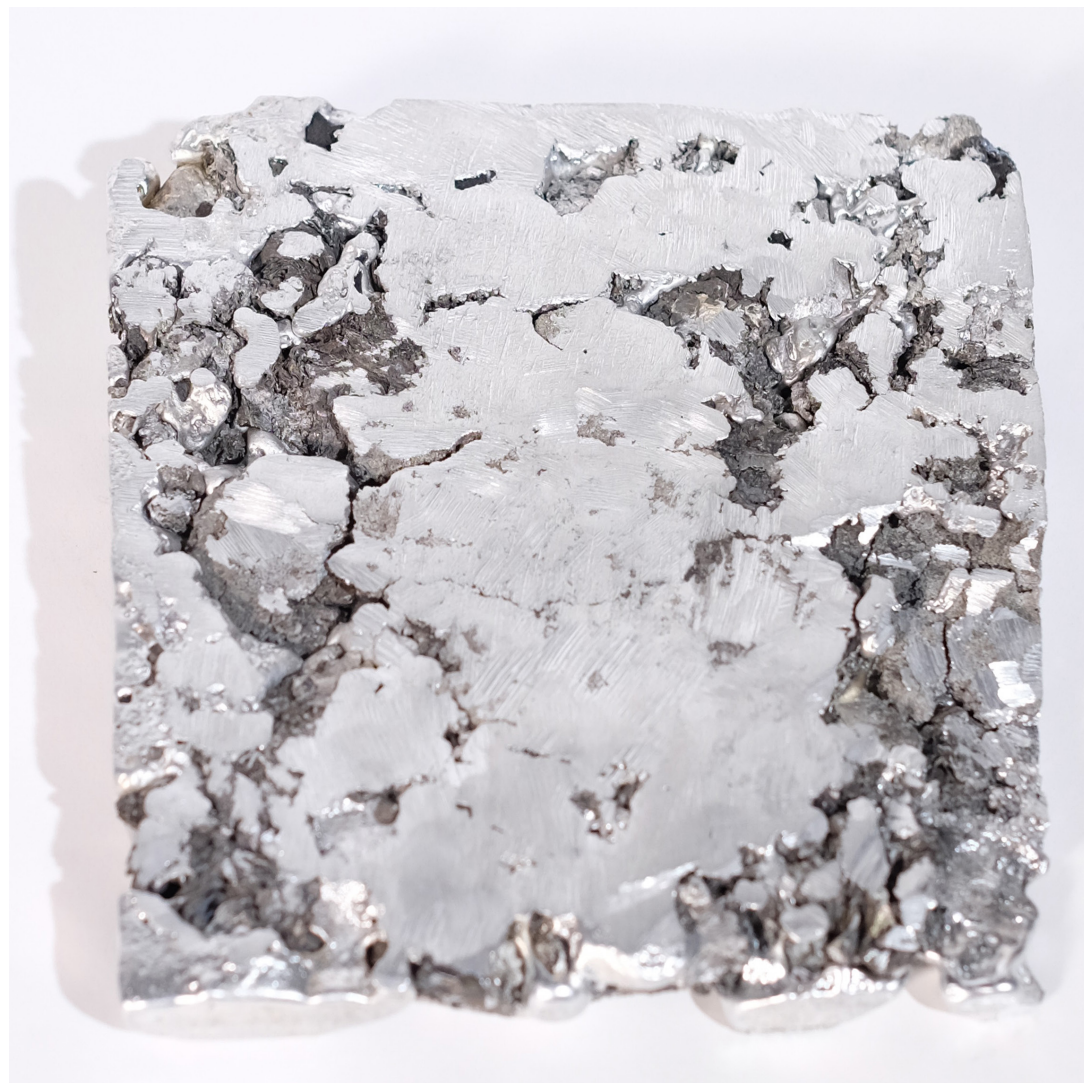
6.



air cool untill hardened

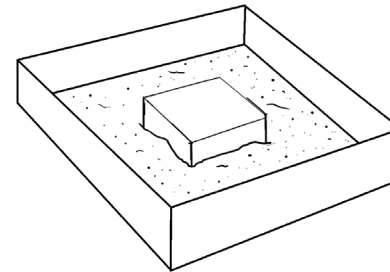
HIGH AL

NO. 9



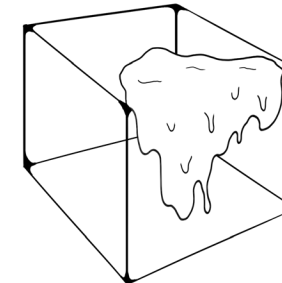
Use this if you're looking to have just a patch or a part of the model with dross texture. This will be the heaviest, but also the most durable as it will have a substantial ratio of aluminium making it very dense. I should mention that it is difficult to place the dross exactly where you want it in the mold as dross float in and on molten aluminium. A tip, use lumps instead of grinded dross.

1.



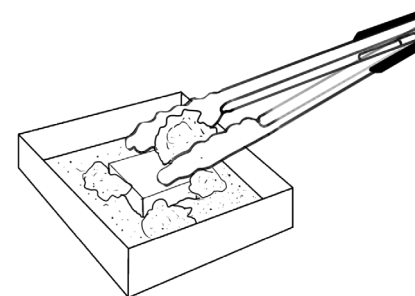
create a steel mold, add casting sand

2.



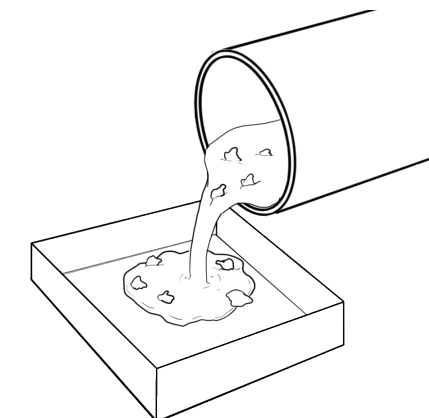
heat up previously casted dross tests

3.



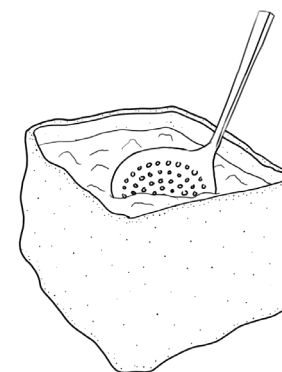
place dross lumps in mold

4.



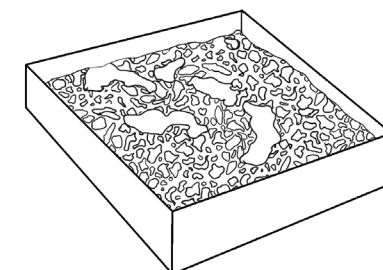
pour aluminium over

5.



air cool until hardened

6.



submerge in water to recude shrinking

amt. DROSS	amt. ALUMINIUM	MOLD	TOOLS	DURABILITY
low	high	3D print Paint dip Salt dip	steel drainer aluminium multi burned dross	high

POTENTIAL USE OF DROSS

STEP 4

Though difficult to handle at times the aluminium by-product material does have its useful attributes. Pragmatically, it is lighter than aluminium as it's less dense, but the most apparent attribute is the randomized texture that can be showcased in multiple different styles.

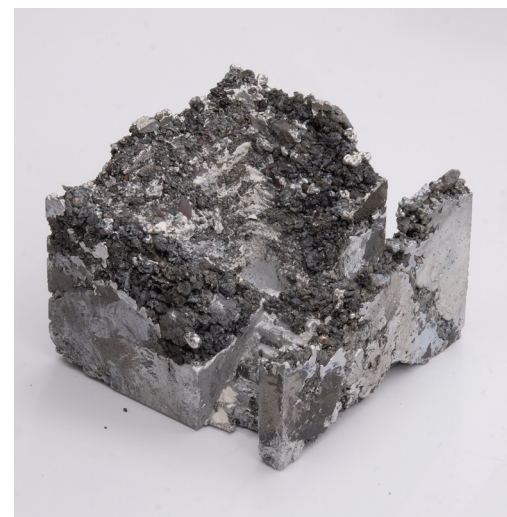
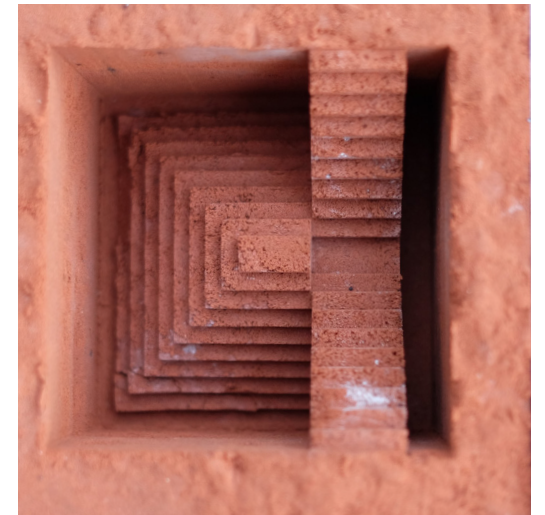
POTENTIAL



Brutalism is a design style that suits this material perfectly. The geometrical characteristics of brutalism are generally large and voluminous and perceived as rough. This correlates well with the attributes of dross and are one of the reasons I chose to showcase a product in that design style. The voluminous shapes give room for the dross and aluminium to be mixed evenly, removing some of the weak and difficult aspects of casting dross.

Aluminium lamp with dross lampshade. The dross lampshade is an example of texture no. 7 (aluminium content: medium). The lampshade, compared to the base, creates a rough vs sharp contrast that brings out the qualities of dross. The lampshade's inside dross texture reflects light down to create a unique shadow as well as diffusing the sharp light.

DETAILING



The above detail tests exemplify the level of detail possible to obtain with different ratio of dross vs aluminium levels. The test to the left is molded with SUS and RSA and the test to the right is molded with steel and casting sand. The left model has the same ratio of dross as texture no. 6 (20/80 ish). The test on the right is done with a similar dross/aluminium ratio as texture no. 7 (40/60). Smaller details requires a casting ratio that is majority aluminium as molten aluminium is more fluid than dross. As seen on these examples the aluminium have on neither been able to pierce the bottom layer of dross, but it is showcased how thoroughly it has pierced through on each of the models. The left one is made with a dross heavy mixture causing it to not bind properly and break apart. The other consists of an aluminium heavy mixture making the bottom layer the only dross apparent area.

A reminder that safety gear is very important as molten aluminium is extremely dangerous. For your own safety it is recommended to always use it. Molten aluminium will boil and potentially explode in contact with water, so make sure that the aluminium has hardened before submerging it in water and avoid casting in the rain. Good luck!