

Foundry Procedures

Furnace Set Up

1. Check weather report and only proceed if there is no chance of rain
2. lay out tarp on patio
3. place 3 fire bricks to support furnace
4. put down bottom of furnace to check alignment of bricks
5. put down two firebrick to support crucible
6. put down two firebrick to support lid
7. pour dry sand to depth of 2"
8. insure that sand is right up against the bricks including where the three meet under the furnace
9. put down body of furnace
10. place top firebricks
11. bring over small shelf unit to hold crucible lift hook, pouring arm, and dross stirring wire
12. reserve room for flasks
13. run 220V extension cord from outlet to control unit
14. plug in 220V extension into control unit and be sure switch is in off position
15. plug furnace into control unit
16. turn on 220V power next to breaker box
17. place muffin tin and all ingot molds on sand (used for emergency dump of charge)
18. verify that pour procedure does not require any walking backwards; turning side to side without walking is OK
19. inspect crucible for
 - 19.1. thinning of walls or bottom
 - 19.2. cracks in walls or bottom
 - 19.3. loose studs
 - 19.4. trial fit lifting hook
 - 19.5. trial fit pouring handle
 - 19.6. **do not proceed unless all equipment is OK**
20. fill crucible with aluminum being sure none can melt and fall outside the crucible
 - 20.1. if using pattern made of MDF, weigh pattern, sprue, riser, and gate; then multiply by 3.6 to get estimate of needed aluminum
 - 20.2. if pigging scrap, fill as much as possible

21. carefully lower crucible into furnace with hook
22. either plug the furnace's top hole with steel plate or with one of the tapered plug with copper tube down center which provides for thermocouple access to crucible
23. install cover on top of furnace body
24. feed thermocouple probed down copper tube or flanking steel plate so it rests on aluminum in crucible
25. connect thermocouple to meter
26. ready to start heat up schedule

Heat-Up Schedule for First Melt of the Day

1. inspect furnace for
 - 1.1. lost refractory
 - 1.2. loose element
 - 1.3. debris on bottom of furnace chamber
 - 1.4. bent power prongs
2. do not proceed unless all equipment is OK
3. $t = 0$
 - 3.1. set 0 on count up timer and start
 - 3.2. set 15 minutes on count down timer and start
 - 3.3. record temperature
 - 3.4. set power level to 20%
 - 3.5. turn on power switch
 - 3.6. listen for soft thumping sound to prove element is getting power
4. $t = 15$ minutes
 - 4.1. verify temperature is rising which verifies thermocouple and meter ok; chill is off of element now
 - 4.2. set power level to 75%
 - 4.3. restart count down timer
5. every 15 minutes
 - 5.1. gently push down thermocouple into crucible and feel if it is mush or liquid (expect start of phase change at above 500C read with the thermocouple down in mushy aluminum)
 - 5.2. check temperature until it reaches 662C for thick wall or 746C for thin wall; consult graphs to get estimate for the amount of aluminum being melted
6. if more metal is to be added
 - 6.1. heat metal with propane torch to insure it is dry
 - 6.2. turn off power

- 6.3. remove lid and place metal into crucible being careful not to add so much that the melt freezes or splashes (do not drop metal through hole in lid)
- 6.4. turn on power
- 6.5. go back to step 5
7. when at **662C** for thick wall or **746C** for thin wall
 - 7.1. **turn off power**
 - 7.2. ready for pour

Heat-Up Schedule for Second and Subsequent Melts of the Day

1. **verify power is off**
2. fill crucible with aluminum being sure none can melt and fall outside the crucible
 - 2.1. if using pattern made of MDF, weigh pattern, sprue, riser, and gate; then multiply by 3.6 to get estimate of needed aluminum
 - 2.2. if pigging scrap, fill as much as possible
3. set power level to 75%
4. turn on power
5. start 15 minute count down timer
6. every 15 minutes
7. 6.1 gently push down thermocouple into crucible and feel if it is mush or liquid (expect start of phase change at above 500C)
8. 6.2 check temperature until it reaches **662C** for thick wall or **746C** for thin wall; consult graphs to get estimate for the amount of aluminum being melted
9. if more metal is to be added
 - 9.1. preheat metal with propane torch to insure it is dry
 - 9.2. **turn off power**
 - 9.3. remove lid and place metal into crucible being careful not to add so much that the melt freezes or splashes (do not drop metal through hole in lid)
 - 9.4. turn on power
 - 9.5. go back to step 5
10. when at reaches **662C** for thick wall or **746C** for thin wall,
 - 10.1. **turn off power**
 - 10.2. ready for pour

Molding Procedure

1. put 40 pounds of compressed air in tank and place it next to sand box

2. put down molding board
3. lightly dust surface
4. invert the drag and place down on molding board
5. verify that holes are present in drag part of pattern to lift it out
6. place pattern on molding board being mindful of cope part of pattern and leaving room for sprue and riser
7. lightly dust pattern on top and on sides
8. put down 1" or to top of pattern (which ever is less) of sifted sand to hold pattern in place
9. ram sand in tight pushing at an angle into the corners of the flask and against the pattern edges but do not move pattern around
10. put down 1" layers and ram until slightly above top of drag using sifted sand against the pattern
11. when cope full, strike off sand
12. sift sand over the surface
13. rub in the bottom board in a circular motion until it rests firmly on the frame of the drag
14. roll over the drag
15. remove the molding board
16. if needed, put in one or more ribs and if needed, gagers into the cope
17. put down the cope and verify it is seated on the drag all the way around
18. verify that holes are present in cope part of pattern to lift it out
19. put down cope part of pattern and verify loose fit to drag part of pattern
20. lightly dust the top surface of the drag and pattern including the sides of the pattern
21. press in the sprue pin about 1/2" into drag if gate and runner not part of pattern
22. press in one or more risers if needed
23. use sifter for first inch of sand
24. ram sand as hard as on the cope; pushing at an angle into the corners of the flask and against the pattern edges
25. put down 1" layers and ram until slightly above top of cope
26. if necessary, stand on step stool, and open the mold by lifting the cope straight up
27. gently rap or vibrate the sprue pin to loosen it and pull it straight out the top of the cope
28. cut lower funnel shape with sprue cutter and use paint knife to cut funnel on top end of sprue being careful to not let crumbs fall on drag
29. round bottom of sprue opening so small pieces will not fall

30. screw in lift hooks
31. rap or vibrate hooks too loosen pattern parts from sand
32. lift pattern straight up
33. cut gates if they were not part of sprue pin
34. carefully inspect cavity for damage and repair as necessary
35. gently blow out cavity with compressed air
36. if flask light enough to move as a single unit
 - 36.1. close mold
 - 36.2. move to pouring area on bottom board
37. if too heavy
 - 37.1. move drag and bottom board to pouring area
 - 37.2. put empty large square container next to drag
 - 37.3. carry cope on edge to pouring area
 - 37.4. rotate cope over square container in case of drops out
 - 37.5. lower onto cope
38. level mold in sand
39. place a sheet metal heat shield over side of flask that will be exposed to the crucible
40. if necessary, place weights on corners of cope

Pouring Procedure

1. review these safety rules every time

- 1.1. wear heavy boots with spats on top
- 1.2. wear double leathers
- 1.3. wear safety glasses with side shields
- 1.4. wear face shield
- 1.5. wear heavy welder's gloves
- 1.6. work behind sheet metal fence as much as possible
- 1.7. never walk backwards
- 1.8. verify there is nothing to trip on as I move from furnace to the flasks
- 1.9. use the propane torch to heat up each metal mold to be sure it is dry
- 1.10. use the propane torch to heat up stirring/dross removal rod

2. verify power is off

3. pull thermocouple from lid
 - 3.1. place such that it does not pose a tripping hazard
 - 3.2. be sure it is not coated with so much aluminum that it won't fit down access pipe on the next pour

4. read the rest of this procedure now, before executing it

- 4.1. remove furnace lid and place on fire bricks

- 4.2. skim off dross and stir once to verify aluminum is fluid; no aluminum should stick to red hot steel rod
- 4.3. slowly lower lift hook into furnace and engage crucible studs; verify both studs are engage
- 4.4. slowly lift crucible out of furnace being careful not to hit walls
- 4.5. place on the 2 firebricks and verify it will not spill; position crucible studs to make it easy to attach pour handle
- 4.6. slowly attach pour handle verifying that both studs are engaged before rotating handle to the down position
- 4.7. turn handle until cross bar is under front chock of crucible
- 4.8. grab handle about 6" from crucible with other hand on the end of the handle
- 4.9. carry to first pour site and position spout within 2 inches above sprue
- 4.10. when done pouring, empty crucible of all aluminum into ingot molds or muffin tin
- 4.11. if pigging was done, turn crucible upside down onto sand to dump any non-aluminum that sat on the bottom
- 4.12. put crucible back into furnace
- 4.13. add next charge of metal if going for another melt cycle
- 4.14. close lid
5. if done for the day, let furnace cool until morning

Shaking Out the Casting

1. for 4 pounds of aluminum, wait at least 30 minutes before disturbing flask; for 9 pounds of aluminum, wait at least 60 minutes before disturbing
2. move all sand in sandbox to one end so the space that will support the flasks has no sand under it
3. move flask with molding board to sand box
4. place on wood bars off to left side of sandbox
5. lift off cope and place on wood bars on right side of the sandbox
6. use long pliers to pull out casting
7. shake loose burnt sand off of casting and place casting on fire bricks to finish cooling
8. collect burnt sand and run through sifter

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