National® Brand

COMPUTATION NOTEBOOK

Department MILLIKEN

Subject RESEARCH

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43-648

75 Sheets, 4 x 4 Quad., 11 3/4" x 9 1/4"

2012-10

scan 12x9

73333 43648 8

Rediform Inc. • Coppell, TX 75019

Made in Mexico

Master List of Projects

#1 Vulcan

#2 Shumle Works

#3 Splish Splash

#4

#5

#6

#7

#8

#9 General

#1 Vulcan - Phone Discussion 10/25/12

Questions for Intertek: (210) 635 8100
- slip drills UPS 222-612 - OK
- accelerated curing check - will ask Victor

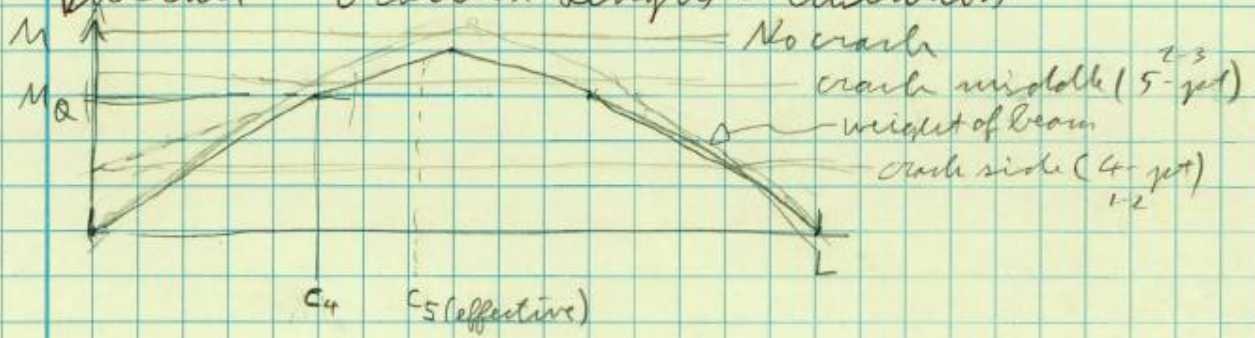
- extrapolate from 1" to 1.5" board if 1" board lasts 2H 45 MIN?
→ "we don't extrapolate" ~~at~~ interpolate with factor of safety, linear with safety factor, about 20%, based on opinion
could recommend but can't give rating
→ use 9 data points to do a best fit plane, determine uncertainty factor... judgement based on familiarity
Morgan is good.. ½" may break off
could use 4×4 slot test "use what you most commonly use"
- listing progress?
Greg Luier: "I don't know of any. Typically large scale structures type tests are not done according to a formal standard."
get real numbers on bread & butter]
could test 1" → 3H, say ¾" should get 2H based on small scale
apply factor of safety to less common items
will have it this month
test report would include what we did
but not the listing
could use in promotional material

#1 Vulcan - Carriage Redesign 11/1/12

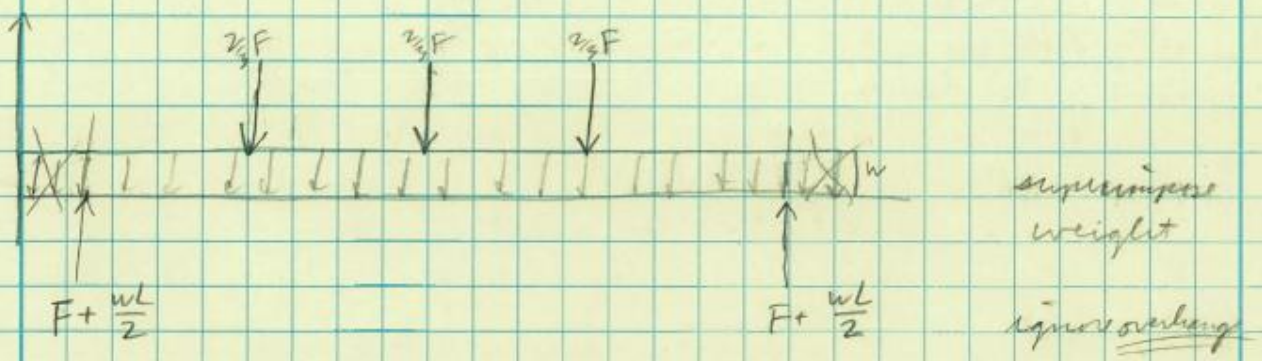
Redesigned carriage for track system
- uses roller bearings
- operate from light side
- tighter fitting in width
- intuitive up/down switch

Ø Track System Assy Disk 1552
→ See Vulcan\CAD\Vulcan Parts.xls

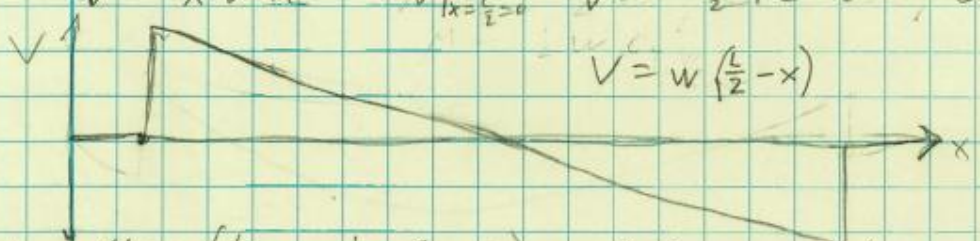
Vulcan - Cranked Length Calculation 11/23/12



$M_Q = F_{total} \cdot c_4 - M_{wgt,Q}$ ← distributed load



$V = -x\,w + C \qquad V|_{x=\frac{L}{2}=0} \qquad V = -\frac{Lw}{2} + C = 0 \qquad C = \frac{Lw}{2}$



$V = w\left(\frac{L}{2} - x\right)$

$M = w\left(\frac{L}{2}x - \frac{1}{2}x^2 + C\right) \qquad M(0) = 0 = w(0 + 0 + C) \qquad C = 0$

$M = \frac{wx}{2}(L - x)$ interpolate segment 2: $\frac{M_C - M_Q}{M_N - M_Q} \cdot \left(\frac{L}{2} - c_4\right) + c_4$

#1 Vulcan - Cracked Length Calculation, ctd.

11/23

$$w_s = \frac{12}{\alpha \cdot b} \cdot \frac{8 \cdot \phi \cdot M_n}{L^2} - w_d/1000$$

$\alpha \cdot b$: in → ft; L^2: ft²; M_n: k-ft; w_d: lbs/ft → k/ft

Moment due to distributed load:

$$M_u = \frac{wx}{2}(L - x)$$

$$M_u\Big|_{x=\frac{L}{2}} = \frac{wL}{4}\left(L - \frac{L}{2}\right) = \frac{wL^2}{8} \qquad \frac{wbL^2}{8}$$

(w: k/ft; wbL²: k/ft²)

$$\frac{bwL^2}{8} = \frac{1}{\alpha} \cdot \phi M_n \qquad \boxed{M_u = \frac{\phi}{\alpha} \cdot M_n}$$

(note: no φ!)

M_u = F37 18204 · B191

$$w = \frac{8M}{L^2} \quad \text{or} \quad \frac{8M}{bL^2} = w_s/b \qquad M = \frac{bwL^2}{8}$$

$$[\text{in-lbf}] = [\text{in}] \cdot [\text{lbf}/\text{ft}^2][\text{ft}^2]$$

#1 Vulcan - Thermal Modeling 12/13

Thermal modeling of 7x7 slab, apply to beam & 13x18

Results on 7'x7 test vs model - tweak properties
Try to match TC #12 1" Morgan, no edge effect

	1h	2h	3h	4h	
#1 2	112°	179	234	284	
original:	137.5°	219.8	287.2	348.8	(concrete 1) 1" wide
	(3600s)	(7200s)	(10800s)	(14400s)	
original:	137.5°	219.8	287.2	348.8	(concrete 1, 1/8" wide) FASTER
original:	118.4	187.3	251.0	310.0	(concrete 2 - 4% water)

Actual 7x7 slab had 55.3% RH

~~$m_a = A \times m_{eq}$~~ $m_a = V \cdot m_{eq} \cdot A$ ← drying factor

concrete RH → m_a; V = volume fraction; m_{eq} = cement RH

$m_{eq} = 0.185$ @ 55 0.175 @ 50 ∴ 55.3 ⇒ 0.185 close enough

$V = 0.24$ typical ... makes $m_s = 4.4\%$ on 7x7 slab/beams: $m_c = 0.24$ $m_s = 5.76\%$

from p. 139 on 7/11/2012, $H_{water} = 2.23 \times 10^6$ J/kg

1114 + 2.23E6 × m_s / 10°C = 10034 @ 4%

↑ baseline ↑ ≠ width of peak ↑ BY WEIGHT!

4.4% → 1.73% water by weight → 4,972 peak

75% RH 5.76% → 2.24% " " " → 6120 peak

Actual concrete mix:

3564	423 lb cement	2.15 ft³
	1780 lb limestone	11.05 ft³
	1361 lb sand	8.35 ft³
	245 lb water	(3.92 ft³)
	6% air	(1.63 ft³)

423 is 11.9% of solid content by weight

21.55 ft³ - about 10.0% cement by volume (no water)
- 28.2% including water

27.1 ft³ - everything - 6.07/27.1 = 22.4% cement paste

THUS 7x7 slab had 1.61% water and beams to have 2.10%

→ seems reasonable based on chart concrete.net.au/publications/pdf/Kirkpatrick

7x7 → concrete 3, peak @ 4715 TBCOPY ALL 2,3

original:	127.4	205.0	271.2	331.8	(1.6% water)

~~15"~~ → thickness was 6" → 4.625"

127.4	205.2	272.7	335.3	almost no difference!

Estimate blanket compressed to 0.15", 1.15" insulation

108.1	164.8	221.4	275.2	pretty close!

BUT - need to use actual Morgan properties

Board: Superwool 607 HT - same for blanket

create materials 220 = Morgan board, 230 = blanket

script 111	88.2	122.0	161.2	202.3	Try basket capacity
	93.2	125.3	163.9	205.0	60% = 503

#1 Vulcan - Thermal Modeling, ctd. 12/14

How to get better agreement?
- change heat capacity back, ~~reduce~~ increase conductivity by 10%

	3600	7200	10800	14400 s	
~~☆ GOAL:~~	~~137.5~~	~~219.8~~	~~287.2~~	~~348.8~~	
1st try =	88.2	122.6	161.2	202.3	(100%)
2nd try :	94.8	131.6	175.5	221.3	(110%)
3rd try :	132.1	221.7	305.4	386.1	(200%)

clearly off in lower temp range.
Should be a little better than Unifrax - see what Unifrax (200) is...

Unifrax :	103.3	152.6	204.6	254.6	
4th try :	108.3	154.8	200.6	243.9	(adjust curve)
5th try :	123.2	191.5	253.3	309.5	
6th :	126.0	191.5	249.6	302.3	
7th :	144.3	221.9	286.8	344.1	

Pretty close! Just a little front-heavy

8th :	142.6	221.9	289.5	350.0	drop 1st by 50%
9th :	136.9	214.6	282.6	344.1	go half way back to 5
10th :	138.6	216.3	283.1	342.6	go half again
11th :	140.6	218.6	285.7	345.7	close enough!

~~Change to 1.5" board~~
~~109.0 160.2 208.4 253.2~~

PAGNABIT! Real goal is

	112	179	234	284	
~~12th~~ :	109.0	160-2	208.4	253.2	(150%)

SOMETHING WRONG

↳ 26 low vs 71, 37% down to 200 → 168% should center

13th :	117.6	190.9	262.9	332.2	(168%)

Hmm, too much. 19/30 × 18% = 11% → 161%

14th :	113.9	183.2	252.4	319.0	(161%)
Rerun 12th :	109.8	172.0	236.4	298.8	(150%)

Now shift forward a bit 60/140

15th :	109.4	169.8	231.2	290.8	(160/140)
16th :	109.8	168.0	226.6	283.2	(170/130)
17th :	111.8	172.0	231.5	288.5	(180/130)
	Perfect	7 low	2 low	4 hi	good enough!

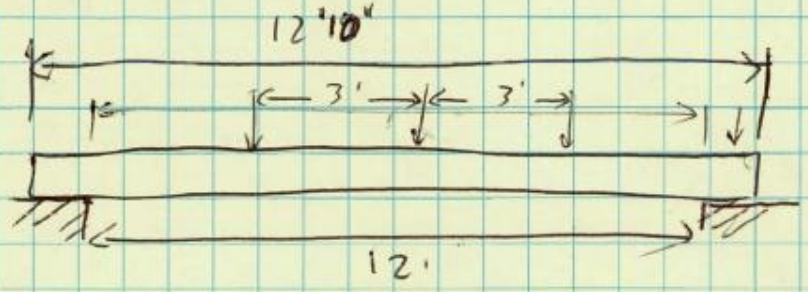
Now check 1.5" insulation
91.0 126.9 167.0 207.3

#1 Vulcan - Intertek Big Burn

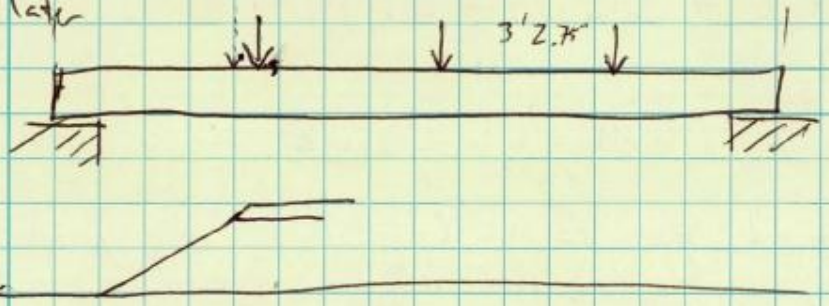
1/8/13

Slab - Thermocouples

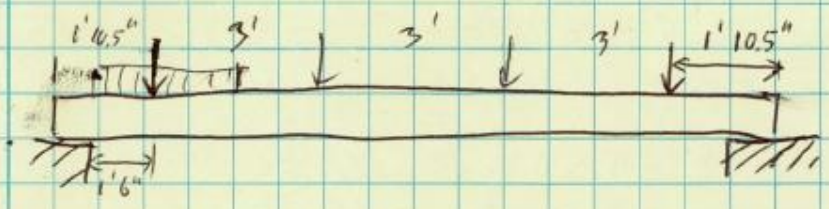
dk ~~X~~ 21 - 29 are unexposed T/C's (on top surface)
slab is supported on ends but restrained on 4 sides
Repair job on ~~slab~~ rod 3 panel, 18" from T/C 3 (33?)
plan to hookup rod T/C's on 31 - 42

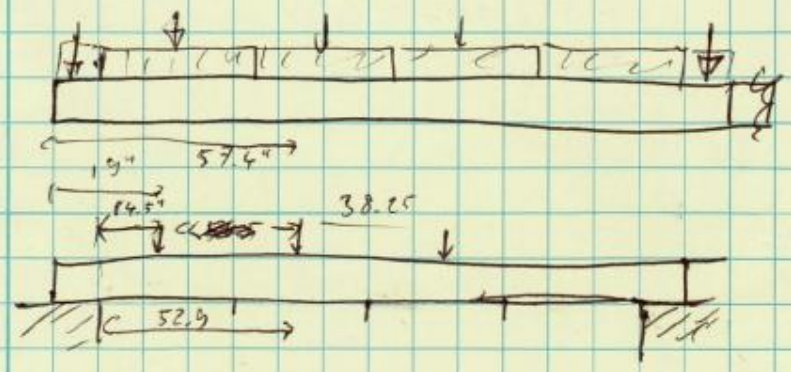


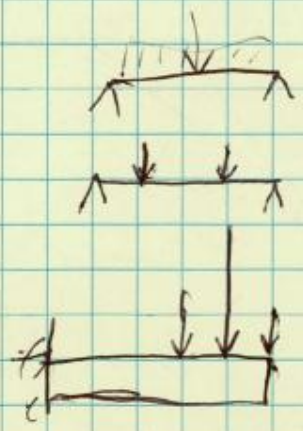
X 30 - 41 are rods T/C 1 - 12
X 42 - 49 are steel T/C 1 - 8
changed later



There are 4 actuators!
(4 × 4 = 16)



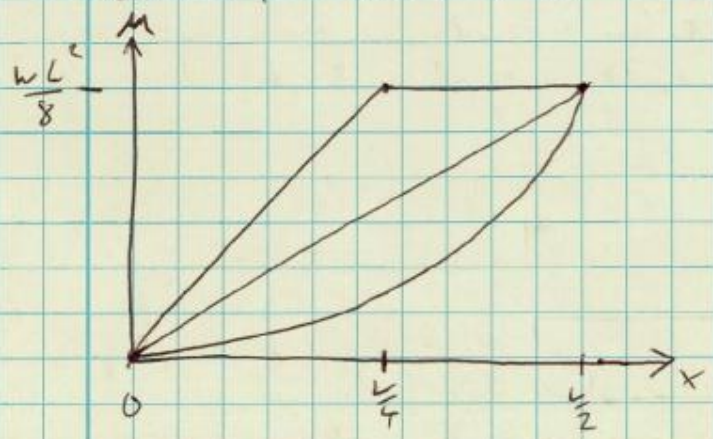




14.5 vs 18 — 80%
52.9 vs 54 — 98%
67.4 vs 72 — 1.08

#1 Vulcan - Intertek Big Beam, ctd.

21-29 Unexposed
30-37 cedar 1-8 changed from previous notes
38-49 rods 1-12



distributed:
$M_{center} = \frac{1}{2} w x^2 = \frac{1}{8} w L^2$

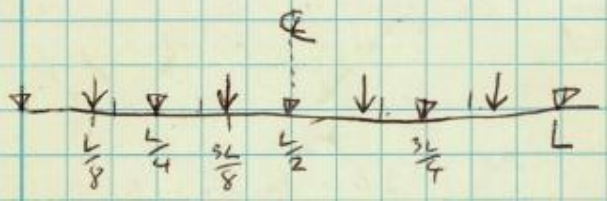
3-point: $w \cdot \frac{L}{2} \cdot \frac{L}{2} = \frac{1}{4} w L^2$
→ 2× the moment

4-point: $w \cdot \frac{L}{2}$ @ $\pm \frac{L}{4}$
$M = w \frac{L}{2} \cdot \frac{L}{4} = \frac{1}{8} w L^2$
→ same moment

5-point: $w \cdot \frac{L}{3}$ @ $\frac{L}{6}$ & $\frac{L}{3}$

$$M_5 = \frac{wL}{3} \cdot \frac{L}{6} + \frac{wL}{3} \cdot \frac{L}{3} = wL^2\left(\frac{1}{18} + \frac{1}{9}\right) = \frac{1}{6} w L^2$$

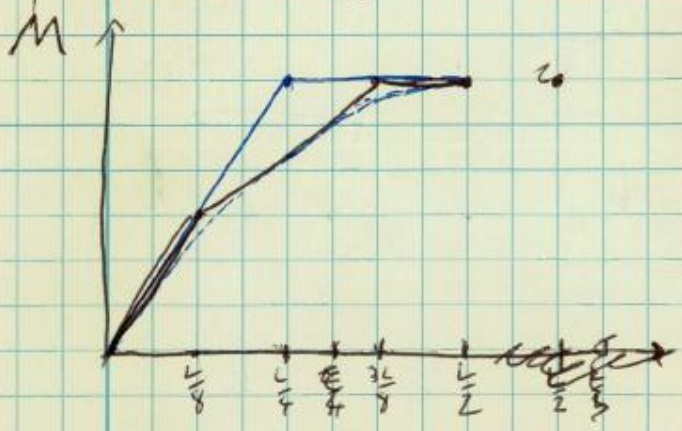
6-point: $w \frac{L}{4}$ @ $\frac{L}{8}$ & $\frac{3L}{8}$



$$M_6 = \frac{wL}{4} \cdot \frac{L}{8} + \frac{wL}{4} \cdot \frac{3L}{8}$$
$$= wL^2\left(\frac{1}{32} + \frac{3}{32}\right)$$
$$= wL^2\left(\frac{4}{32}\right) = \frac{1}{8} w L^2 \;!$$

~~$M_{6@\frac{L}{4}} = wL^2\left(\frac{1}{32} + \frac{3}{8} \cdot \frac{1}{4}\right) =$~~

$$M @ \frac{L}{8} = \frac{wL}{4} \cdot \frac{L}{8} + \frac{wL}{4} \cdot \frac{3L}{8} \cdot \frac{1}{3} = wL^2\left(\frac{1}{32} + \frac{1}{32}\right) = wL^2/16$$

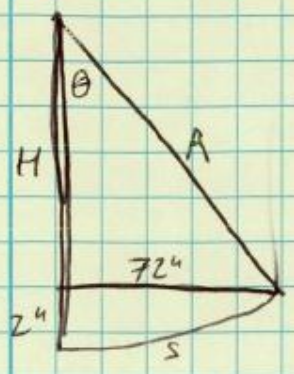


Slab average = 56°F

4:03pm – actual start (Casio)
5:0

Rod avg: 384°F
rod max: 411°F
steel max: 1100°F
surf max:

#1 Vulcan - Intertek Big Beam, ctd.



$$72^2 + H^2 = R^2 = (H+2)^2 = H^2 + 2H + 4$$

$$2H = 72^2 - 4$$

$$H = 2590 \qquad R = 2592$$

$$\tan\theta = \frac{72}{2590} = 0.0278$$

$$\theta = 1.59^\circ = 0.0278 \text{ rad}$$

$$S = R\theta = 72.037'' \qquad \Delta S = 0.037'' \text{ per side}$$

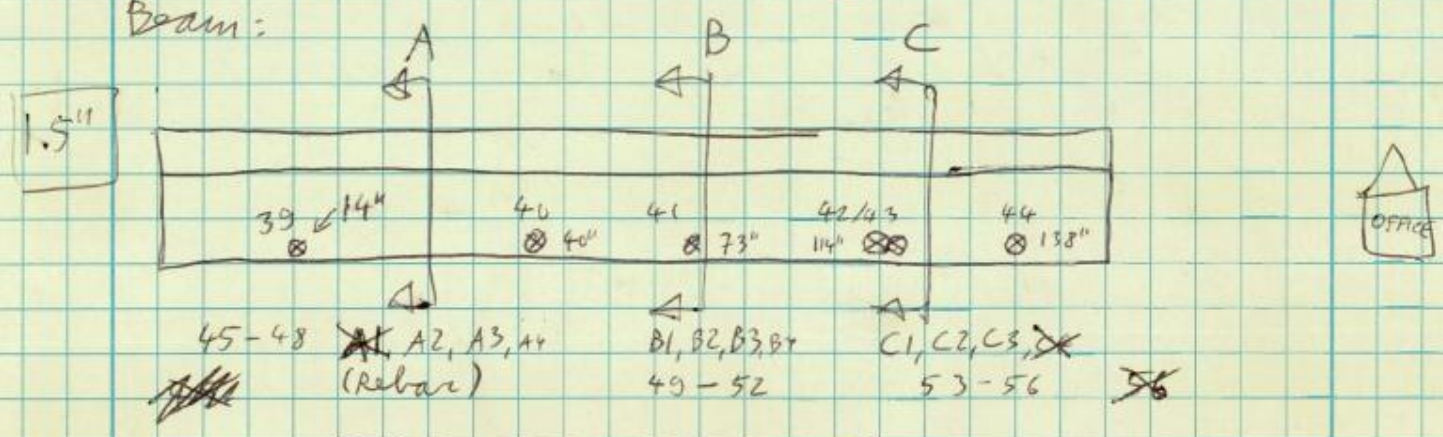
10'9" rods = 129" = 2 × 64"

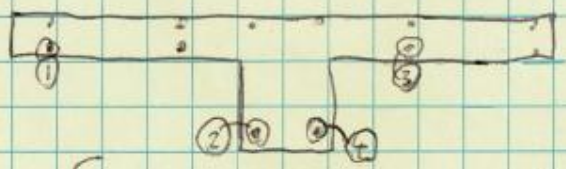
$$\frac{0.037}{64} = 0.00057 = 0.57\,\mu\text{strain}\ !\ ? \quad (0.057\%)$$

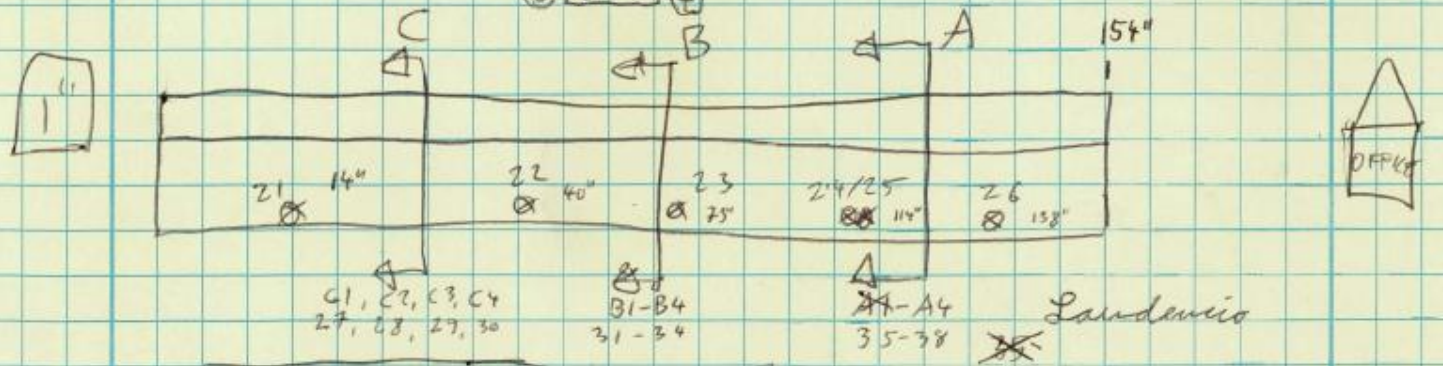
~~WALL~~

1/10

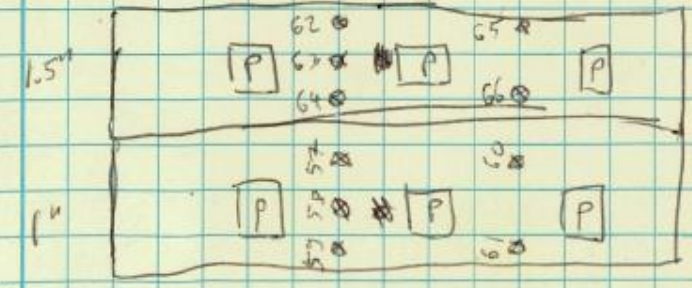
Beam:







Landencio



P @ 7" Ø bores
38.5" spacing

85.5 min w/o correction on 9" → 42.1F

T/C

#1 Vulcan - Interlock and Dumbell Tests

1/11

Post mortem

- Phillips screws very effective in preventing a gap
- Beam 1 rebar is toast
- Beam 2 (1.5") looks much better
- Ceramic caulk worked well
- Still, gaps opening - intumescent would help

Cut ~~rebar~~ FRP on beam 1 in 6 places to eliminate it from the equation, break alongside beam 2

1/21

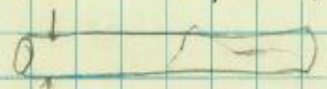
Prepare rods for dumbell tests

- 16" long, 48" & 49" rods → 3 pieces

- One set: sand coat without lugs
  ↳ need to fit die for 0.255" rods or make new die

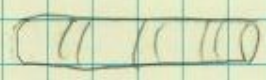
0.100 & 0.094" for	0.088" rods	OD, guide D	+6, +12
0.107 & 0.104" for	0.092 rods		+12, +15
0.135 & 0.129" for	0.125 rods		+4, +11
? for	0.255 ?		

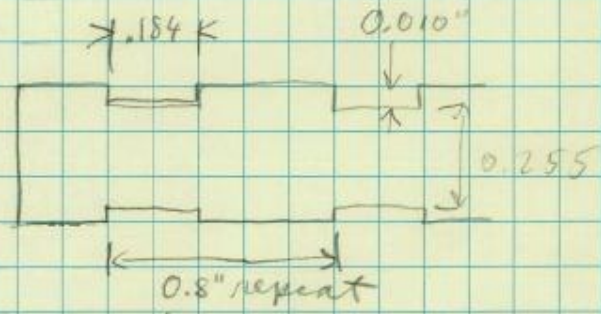
drill sizes are .257, .261, .266, .272, .277
probably guide ⇒ ⇐ OD Actual holes appear to be 265, 269



~~0.255 ± 0.002~~

Spiral:





- Matches old groove with smaller diameter

Dish #1552 DWG# 88173 (both)

1/25

Sand coated 3 small rods

- OD 0.255 ± 3
- 1.6 : 1 Lindoxy
- cured 10:50 am - : pm @
- control batch of resin in pan

#1 Vulcan - Grout Curing Test

Objective: observe shrinkage or expansion of our Target 1121 Grout

Procedure: suck grout into 60 ml syringe and observe

1/29 Syringe dry weight: 36.2 g ~4PM
Filled with ~~55~~ 55cc : 137.4 g +101.2g, 1.84 g/cc
Taped end shut : 138.8 g (1.4 g duct tape)
observed void bubble in syringe, but quickly covered it in black residue when handling within ½ hour of fill

1/29 138.8 g Syringe ~~lying~~ lying on side, scale bar up. 8am
still at 55cc. Top quarter has some bubbles/foam & black residue. Bottom looks chalky dry. Sides look wet. Bottom looks striated, bringing out the extrusion marks in the PP syringe (very slight)
10 am - sides definitely dries than before - only speckles now

4:30 pm: 138.8 g - no change. Sides look dry now!

1/30 138.81 g definitely dry now - spots a little lighter
1/31 138.84 g seems to be visually stable now
2/1 138.83 g (8am) no change
2/11 138.8 g - still no change
remove duct tape → 137.4 g
remove plunger → 119.5 g

2/12	119.478 g				
2/13	119.436 g	actually losing weight now!			
2/14	119.408 g	3/22	119.006 g	4/29	100.398 3:30pm
2/15	119.382 g	3/25	118.996 g	4/30	100.304 3:00pm
2/18	119.326 g	3/27	118.978 g	5/1	100.238 9am
2/22	119.260 g	3/28	118.972 g	5/2	100.188 3:15am
2/25	119.234 g	4/1	118.956 g	5/3	100.152 11:10am
2/27	119.208 g	4/3	118.940 g	5/7	100.018 8:45am
2/28	119.198 g	4/5	118.932 g	5/8	99.986 9:12am
3/4	119.150 g	4/8	118.924 g	5/9	99.942 2:20pm
3/5	119.136 g	4/12	118.918 g	5/13	99.752 8:30am
3/6	119.128 g	4/17	118.896 g	5/21	99.546 2:45pm
3/11	119.086 g	4/22	118.874 g	5/28	99.320 8:45am
3/14	119.065 g	4/29	118.856 g	6/17	99.074 2pm
3/18	119.040 g	↳ 100.448 removed shell		7/15	98.956
3/20	119.020 g	void & bubbles on top 10:15am			

#9 General - Innovation Fair 1/31

For Bailey: focus on Horizon 2 (take 10→100 million)
and accelerate horizon 3 (validate hypothesis ASAP)

Speaker: Joseph Pistrui
Apple vs Microsoft vs Facebook
Need both operational excellence & willingness to take leaps
Generative learning: horizons 2 & 3, not incremental
If you ask customers what they want, they would have said a faster horse
question assumptions, experience shapes perception
works in business school, coaching startups
Nextsensing or Foresensing
observe, organize, originate, foresense ← format to brainstorm
Sony invented Walkman to entertain CEOs on long flights
Innovating is like skateboarding - you will fall, etc.

Whirlpool: Jeavita not Jim Barkley
Strategic Global Alliances
The art and science of open innovation
← Jeavita's change
#1 major appliance company - started as a laundry!
brand: Maytag, Jenn-Air, Amana
used to launch a product every 10 years - now 6-8 months
Requirements:
- meet customer need (do good)
- sustainable competitive advantage
2003 → focused on innovation, ~~turned down~~
new bad is open innovation - ~~exploit others~~ win-win
★ take ideas outside - track system!
Whirlpool has group of people, like a marketing department for research "we don't do chemistry, we bend metal)
oxi clean needs to be dispensed at the right time in dishwasher

Gary Smith - Herman Miller MSU Michigan
L Director, design facilitation & exploration
very industrial design focused
"I was very impressed with the purposeful plan"
"A designer of life" problems that make someone's life better
what am I advancing the art of?

Steve Lucas - solved seam jumping with better seams
★ advertise human side - benefit of Firestrong
maybe, or maybe homeless - 15% - 55%
F: W 35% L 35%
E: W 30% L = 40%

		30% 3-3	40% 4-2
50%	E	W/W 15%	W/L 20%
50%	W	L/W 15%	L/L 20%

F/E

#9 General - Innovation Fair, ctd.

Stan Jewellis - VF Corporation
↳ lots of apparel companies - Nautica, Wrangler, Lee, North Face, Timberland.... some better than others
Transformed company, more external & cross functional
Innovation: Product / Cost / Experiential / Business

Sustaining	[good]	[OK]
Stretch		
Revolution	[Terrible]	

Found similar needs across all businesses
Durability, protection, functionality, comfort, appearance, care & maintenance
Looking for overlaps & synergies
Ram Henderson - CEO New Edge UT, CMU, WSU
wear chicken hats during presentations at New Edge
Market insight + design firm DS, UI, MD + opportunity thinking
Challenge: designers needed spatial way to see attributes of their materials
pass around samples led to plastic guitar
Only thing learned: "go talk to people" DIVERGENCE
standard textile: towel soft on one side, harder on the other
Created pop-up house from brochure - cool!
Millikin - AFM wound care visuals are powerful
↳ changed name to Tristar (pull preserve protect)
Education: like airplane slides
Flip book to explain moisture management
Designers and scientists should interact early on
"Look at tertiary attributes" - allows expanding to new markets
Owen Foster - design the next experiences SCAD
3 phase: artifact - service - feedback (interaction)
need 300 sketches to shut off critical, analytical brain
Apple: Ipods have social aspect - white earphones

#1 Vulcan - World of Concrete

Norton: don't make overhead cutting
bolt a wall saw to the ceiling
↳ check with Diamond or Husqvarna

Hughes Brothers: #2-#4 bars ribbon equal to #2, #3 -
rule of thumb 50 ø development for steel
so #4 → 25"
but 4 × stronger → 100"
only develop 70% of tensile strength
carbon used in rehab → epoxy holes at grout
would be impractical to embed in concrete
Have a nice sand coating

Braxton-Bragg: distributor of Diamond saws
no one asks for multi-blade cutting - I would be only
one out of 50,000 people who ask

#1 Vulcan - Hardness Tester

Try out new accessories: fresh diamond tips and ⅛" ball indenter. Also V-groove holder.

Old "N" Braille indenter, 150 kg (~~R~~HRC) on control disk: 31.5 HRC vs 32.2 ± 0.8
new indenter: 31.3 HRC both seem OK!
V-groove holder: doesn't fit, too tight. ☹
Now try Hal's stuff "1.0 PSF = P4600"
⅛" ball, 60 Kg (HRH) 55.0 ~~78.5~~ 60.5
read all balls on red scale 48.5 52.0 65.5
1.0 PSF = P 4600

Try same w/ 100 Kg (HRE) 83.5 98.0 (−2.0?)
cratered in quite far! (−16.5?)

Non-treated sample 1.28 mm HRH 54.0, 37.5, 55.5, 52.0

Treated 1.05 mm back side HRH 42.0, 30.5, 45.5

Tegris silver plain HRH 78.5, 80.0, 78.5

Tegris grey twill HRH 68.5, 67.2, 69.5
considerable "settling" →

Production: felt backed! And curled lots of settling
7.5 HRH

Tegris silver plain: HRD 69.5 67.0
should be ~ HRF 68 actual: 37.5, 33.5

#1 Vulcan - Corrosion Resistant Rebar

Stainless cost as of 10/11/2012: (Salit)
$2.87/lb + $2400 freight on 48,000 lb truck
#3 = 0.376 lbs/ft → $1.10/ft net, 4.5x normal rebar

MMFX2 chrome steel rebar

Buy 6 sticks for $740, 6' ~~long~~ long
$123.33 per stick, $20.50 per foot
not very smart about sampling, perhaps they

Kevin Bates - send e-mail
5x last longer with standard cover
STADIUM modeling software - Chloride penetration
Dr. ~~[illegible]~~ - VP of technology
Salem FAZA

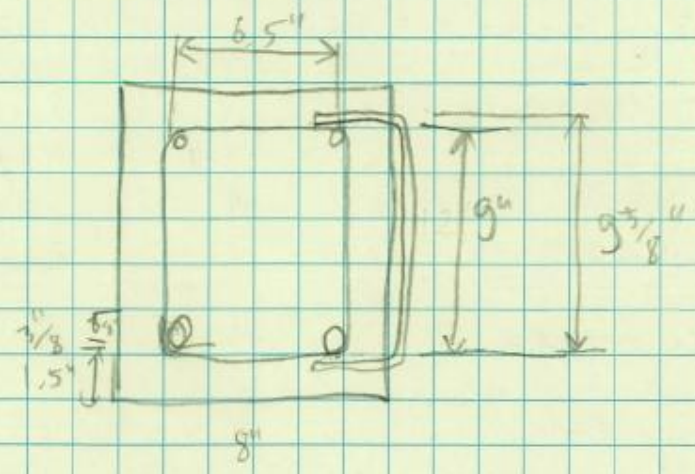
2/21 Call Back
Not recommended for direct exposure to environment
corrosion rate is 1/3rd of black steel
Chloride environment
Website - products - study under life cycle cost of corrosion
4x lower chloride threshold (threshold)
cover determines corrosion ~~rate, then~~ onset, then rate
set by material
Happy to supply bars, could sign NDA
Grade 100 and 120, most 100 label are really 120
linear to 80, 0.2% offset is yield, mostly 120 & 130
Cost:
Truckload, 20 tons 80-90¢/lb
depends on scrap metal price
China has come down
No heating required after bending
Bend diameters are the same
Started selling ~~in~~ 2002 epoxy coat doesn't work
Make plate right now
Don't own the mill, working under license
Haven't done fire testing, critical temperature

#1 Vulcan - Rebar Staples & Thermal Modeling II 2/21

Rebar staples:

CAD drawing

5' long.



Thermal Modeling, Take II 2/28

- Numbers predicted for partial insulation are much better than observed - full coverage runs quicker, but may be too idealistic. New plan:

1) - Calibrate model to match 6" overlap on 7×7 slab (T/C #1-6)
2) - Check against #21 or #12
3) - Adjusting to zero water, check against beams
4) - See how much water would explain slab result

1)

	3600	7200	10800	
#58 (1-6)	121	197	263°C	Partial Ins Script 12

→ Make 18" wide ±9 panel, measure at 3" (6" from edge), conv = ?
9" gap... ±4.5"... need conv = 13.5"×2=27" insulation = 18"
conv mat = 3 (1.61% water) insulation - start w/ 220
Partial Insulation Model 4. xLSx
Try #1 89°C 138°C 195°C N.B. center location is really no different - 89/134/181
Now try 221 material just for kicks
Try #2 120°C 195°C 268°C great fit!
↳ Interior 119°C 190°C 254°C is still better than #36/#21

2) Run with full coverage (infinite board) script 13

	104°C	171°C	230°C	vs
#21	106°C	166°C	213°C	... not bad!
#12	112°C	179°C	234°C	... not bad either!!

3) Go to Interior beam 7. start w/ 1" beam → 1.375"

center, rod	116°C	169°C	219°C	324°C	ANSYS
avg	143°	208°	280°	n.b. large variation! min is 127/183/248

Run with 1.25" effective thickness → 127°/180°/235°

#1 Vulcan - Thermal Modeling II

2/28 Continue 3) for 1.5" beam

	60 min	90 min	120 min
with ⅛" for blanket:	89°	120°	157°
with ¼" blanket:	89°	128°	167°
Actual (Average):	68°	131°	182°
Actual min:	60°	123°	179°
Actual max:	83°	149°	202°

4) Look at slab see p. 5

concrete #4 with slab RH (2.24% water), etc.

0%:	106°	149°	191°	275°
2.24%:	96°	127°	164°	245°
4%:	94°	117°	149°	224°
6%:	93°	110°	136°	204°

2.23E6 × 0.0610 + 1114 = 14,494

1 hour not getting any closer, but others may

1.5H: 117 → 110 → 106 (Δ = 7, Δ 4)

$6 + \frac{4}{7} \cdot 2 = 7.14\%$

2H: 149 → 136 → 127 (Δ = 13, Δ = 9)

$\frac{13}{9} \cdot 2 + 6 = 7.38\%$

3H: 224 → 204 → 198 (Δ = 20, Δ = 6)

$6 + \frac{6}{20} \cdot 2 = 6.60\%$

Try average → 7.04% make it 7%

does not converge → go to 12" beam → 2.23E6 + 0.07112 + 1114 = ~~15305~~

7%:	92°	107°	131°	194°
vs	80°	106°	127°	198°

pretty good fit... but what would explain the early drop? moisture in the insulation??

Dale: factor in initial temperature... good point

~~Script #4~~ - Material 4, TUN 1°, 13 ← initial temp 56°F

cooling goes to ambient - also 55.5°F

→ Partial insulation script 13 big slab

3/4 Other studies to do:

A) Vary water fraction in part of slab (bottom)

B) Vary h (convection coefficient) on slab/beams

C) Predictions for columns

D) Predict next round of beams

#1 Vulcan - Thermal Modeling II, ctd.

Notes on the previous points:

B) Typical convection coefficients free: 5-37
forced: 10 to 100 to 200
↑ low speed ↑ moderate speed ↑ over cylinders
gas flow over tubes: 10 - 350 W/m²-K
... considerable variation quite common!

c) Area to heated perimeter ratio

$$\frac{A}{P} = \frac{tL}{L} = t$$

$$\frac{A}{P} = \frac{\pi R^2}{2\pi R} = \frac{R}{2}$$

... so a 12" column "equates" to a 3" slab. 16" → 4"
which may explain why Bénichou (NRC paper)
had a 16" column with 87% RH and 53 mm spray-on insulation
reach ~400°C in 3 hours

A) Intertek slab 14 split, t×t
→ add w const with wetter concrete
A5 - normal concrete A8 - wet concrete A6 - blanket A7 - board
↑ 4 (2.24%) ↑ 5 (7%) ↑ 231 ↑ 221
Results: see Partial insulation model 6. xls x
2 hours: 1" wet only 1°C hotter than all 6" wet. ½" +7°
3 hours: 2" is 1° hotter, 1" 22° hotter

B) Start with Intertek beam 7 - dry beams, t×t
↳ Intertek beam 8 - vary h, t×t
Beam surface was 65°F furnace was 68°F room was 62°F
18°C 20°C 17°C
Since ambient only got warmer, make top 20°C, initial
beam temp 17°C
∴ Initially some effect, but soon levels off and more
convection makes little difference. Also, vast majority
of energy is transfered by radiation.
If we look at Nusselt number $Nu = \frac{hL}{K}$
~~we look~~ we have K concrete = 1.35 up to 293 then tapers
down to 0.23 at 1200°C board: 0.078 - 0.375 call it 0.1-0.2
With h=25, $L^* = \frac{1.35}{25} = 5.4$ cm up to $\frac{0.23}{25} = 0.9$ cm!
And board is even smaller. $L^* = 0.4$ cm → 0.2 cm

#1 Vulcan - Additive Fibers

3/6

Acryloc: use 0.66 lbs/yd³ or 0.39 kg/m³
I have 20 2×2×2 cubes
- 5 control, 5 Acryloc, 5 Aramid, 5 PVA

Target 1121 23.5% water
Millikrogrout #2 12.5% (Sika 212)
1 bucket = 2.173 l
5237 g of Sika 212
↳ 65.5 g ~~fiber~~ water
~ ¼ L of grout 0.39 g/L 0.1 g fibers
actual 0.15 g
barely made 2 cubes!!!
672 g Sika 212
⇒ 84 g + 0.12 g fibers

3/7 So 524 g is not enough for two cubes, and 672 g had a little left over
- Let's say 570 g needed, 300 g per cube (used) 285 g - actual
Fibers: ~~300 g / 2 in³~~ $\frac{285\,g}{(2\,in)^3}$ = 2174 kg/m³ grout only

$\frac{0.39}{2174}$ = $\boxed{0.018\%}$ fibers by weight Acryloc

285 g → about 0.051 g fibers in a cube
Nylon:
PVA-RSC15 8 mm fibers melt ~225°C 38 μm Ø
1 lb/yd³, max 4-9 lbs $\boxed{1 \rightarrow 0.027\%}$ $\boxed{9 \rightarrow 0.25\%}$
AR-DM Fiberglass, ½" fibers 1100°C max
1 lb/yd³ 1 → 0.027 0.27 mg/g

16 more → 4/4/4/4
1200 g grout, actual 1365 g → 171 g water, 0.25 g fibers min
use 1.25 g fibers
383 g left over
PVA: 1233 g grout 154 g water 0.33 g min → 1.66 g
214 g left over
1193 g 149 g AR ※AK-28 was also 200°C
1228 g → 154 g

		melt	Test:
control			A = 25°C
AR-DM	5 lb/yd³	1100°C	B* = ~~200°C~~ 25°C
Acryloc	3 5.3 lbs/yd³	330°C	C = ~~250°C~~ 200°C
Nylon PVA-RSC15	5 lb/yd³	225°C	D* = ~~300°C~~ 200°C

*expect ~~PVA~~ @ ~~150°C~~

#1 Vulcan - Thermal Modeling II, ctd (from p. 19)

Vary insulation: 0.5", 1", 1.5", 2"
Vary diameter: 4", 8", 12", 16"

Use column script 1, 2, 3 in Vulcan\ANSYS\Column

Data saved to column ANSYS 1.xls

Written up in ANSYS Column Study.pptx

→ into Patent Safe as ~~MLKN-00116146~~
MLKN 0100062766

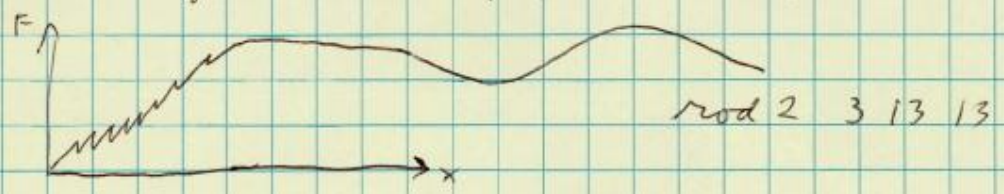
		File	Break	Peak	
	AK - 1A	001	12057	20792	
	AK - 1B	2		20283	
	AK - 2A	3	28830	28830	big drop
	CTL - A	4	21151	23646	
	AK - 3A	5	22990	22994	
	AR - A	6	21498		a bit uneven load
	PVA - A	7	24362		"
4/15	AK - 3B	8	28230		
	CTL - B	9	~~21700~~	21700	
	PVA - B	10	28470		very tilted
	AR - B	11	26510		
	The rest are hot, 200°C from 8:45 - 13:45				
	AK - 2B	12	37130		* explode @ 2nd peak! & more unfixed
	CTL - C	13	23000 → 24140 → 27160 → 29640		
	AK - 3C	14	27520 → 29810 → 29890 → 31100		
	AR - C	15	21780 → 25090 → 28250 → ... 32250		not as pulverized
	PVA - C	16	24600 → 30110 → 32890		
on upper shelf	CTL - D	17	9300 → 17490 → 18630 → 19720 →		
	AK - 3D	18	28__ → 30690 → 33930 → ... 34020		POP
	AR - D	19	21__ tiny crack → 30210 → ... 3		
	PVA - D	20	30- ... 34390 → ... 35400		

↑ pushed in further

* plastic base flowed into pores, very level

#1 Vulcan – NCSU Round 3 Install 3/13

12:18 pull ups at CFL
12:36 new grips in tensile tester strain gauge is broken
steel fiber 263 lbs per cubic yard
1:02 track system is up, marking rebar, big dent on slab
↑ Bernie: "in 15 minutes"
tensile clamp: 2000 PSI 0.05 in/min
1:19 start pulling 1:29 20.5 kips 20.7?
other grout: big jumps, grout slip, pops
still hung in to 20.4 kips, now dropping



2:22 start 3rd one 2500 light click 4k, 5k still linear
8200 big jump 9700 → 8000 second big jump 12.8 → 10.5
Pk 15960 → hung slip
2:55 rods cut, ready to hang 9' 0"
groove is only 7/16" wide, really tight
supply omissions:
- scissors
- countersink drill bit
- saw sparks

3:12 applying primer
3:43 film on, back check
4:12 water in 2 channels
4:17 water in 3 channels
leak at mold seam on 2 rods
big leak at end ...

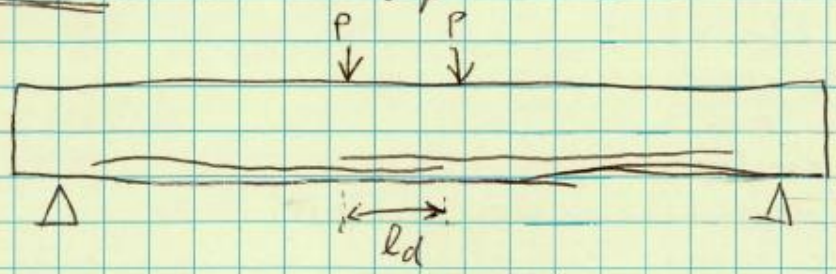
4:42 ~~dis~~ water out of 2 grooves. 4:40:46 start mixing
4:47 water out of 3rd channel, filtering grout
5:42 packing up

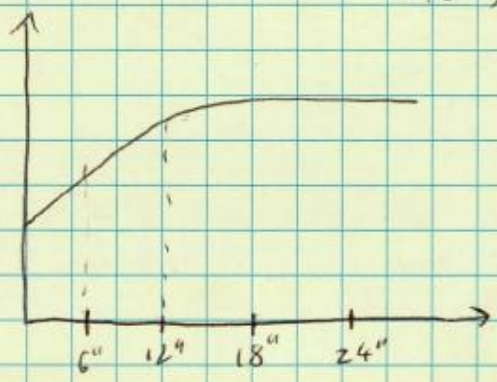
several leaks ~~worst in~~ 3x in middle groove 1&3 OK

#1 Vulcan - Sami conference call

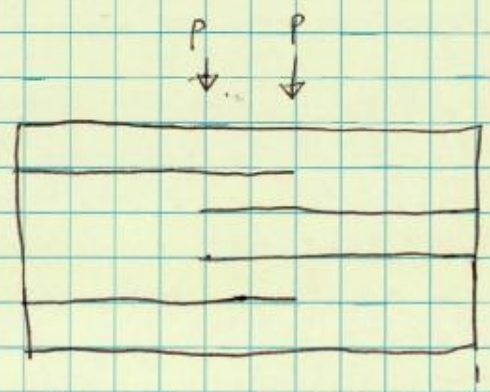
Have to measure development length test in half-beam test

Splice test? 12" overlap...





make 1 ft wide, 8' long



could go to 18' long, have more steel to support weight of 12' slab
add expansive material to grout would helps

Need to repeat test at least 5x ... NCSU tested 100 sandwich panels
Average - $3\sigma_{mean}$ ... value was negative!
focus on round columns
↳ square will introduce complicated relations
Need 2-3 parameters, 2-3 samples @ each
columns: lower strength 3K - 6K 1 wrap, 2 wrap
6", greater cannot break it tied rebar not
10" dia max 8KSI → 900 kips 8" max (Sami)
columns - do 2 columns? 12" column is min
demonstrate thermal in small oven, test 16" at NRC
↳ persuade Intertek
test it hot? control & control strengthened
↑ cooled down "could sell like hot cakes"
4' tall, 8" → heat at Intertek, break at NCSU
Shear: definitely T-beams 24" depth 16" depth
T to avoid crushing shear - change spacing
good shear needs anchorage or not effective

#1 Kulcan - Sami Conference Call, ctd

Conference call
shear... 1 or 2 layers of sheet
OR matrix 2 layers @ 0.4%
Interstitial - 1 beam
Again, key to shear is anchoring

2-Way slabs
- 2 way VS 11 "should work"
- air pressure
- have drawings 8'x8' simply supported 4" thick
  1 control

Round 2 - every 12" or 8" spacing
Blaszak: test 2-way or 1-way slab? Sami - NO!
must have controls
1 big slab @ Interstitial, cover entire slab
Blaszak: Intermediate structure to make a square 2-way?
Sami - doesn't have to be symmetric
Sami: paper needs to highlight improvement of frp
system, not just insulation

Load Frame (Bernie)
DAQ from MTS
"totally different type of system"
much nicer - which is good
Sami: make columns taller - 4-5'+ → go to 15'
don't like bolted connection at base
oven good to 500°F

Gregg is expert in stiffener design AISC
don't weld top & bottom

#1 Vulcan - Intertek beam fire displacement 3/15

Files are spread out...

→	Temp in fire
Slab	6100 910577 SAT-001 Milliken 12x18 slab PP mod v1.xls
Beam	Intertek Beam Temps - JRS.xls
? →	Deflection before, during, after fire
Slab	Intertek Slab Deflection in Fire+cool.xls
→	Deflection during fire
Beam	Intertek beam deflection in fire.xls
→	Deflection during break next day
	Intertek T-beam break next day.xls

Bumps in curve: calibrate to load removal @ 7:59
considerable correlation between beams 1 & 2
- may be fluctuations in pump pressure or just tiny jumps/vibrations of the cross piece to which LVDT's were mounted.

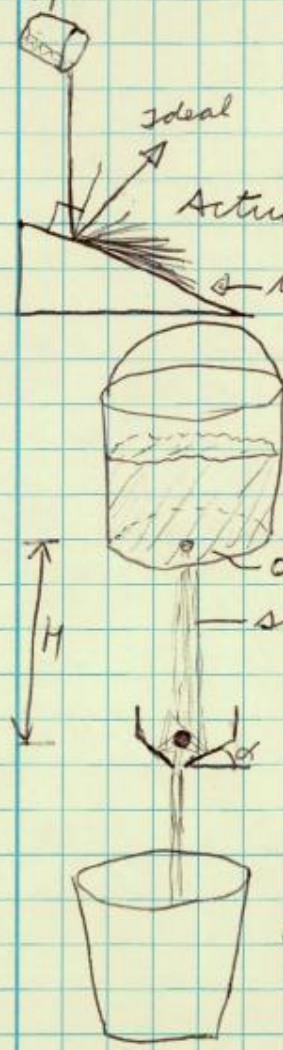
		PSI before	
7:59:00	remove load	240	
58:39		230	
57:54	bump up	220	
56:56	"	210	
55:52	"	200	
54:45		190	
53:52	◁ 53:50 read 180	180	
52:52		170	
51:44		160	
50:28		150	
48:02		140	7:48:30
45:14	(rough)	130	
41:35		120	clear
38:09	?	110	
36:34			
34:41		103	

#2 Sand Coating* - Skunk trial 3/28

*AKA Sangenbrezel

Objective: - test an elastic opening orifice for uniform resin coating
- see how sand bounces

sand collisions are extremely inelastic on Aluminum plate



H: the higher, the further the sand goes, but angle doesn't really change. If too low, sand accumulates. 6" seems to work OK!

$\alpha \approx$ 15° - OK 7° - No 10° - some accum. on hi side 13° - right on limit 20° - plenty safe
static repose ~25°

hose - lots of friction, not so good

Silicone - 10 mil wire deforms it too easily

funnel down a PVC tube - 20" drop - pretty good "sandstorm" on 15°, 20° surface

#2 Sand Coating - Applicator Design

Cast from Silicone rubber - max temp 205°C is OK near oven - should be durable.
Available: 10, 20, 25, 30, 40, 60 A
~~60A is too hard~~ 60 - upper limit if thin
30 - quite soft, no less

Mold Max 30 - 25,000 cps 110 PSI modulus @ 100%
(pink) 300% elong. 577 PS tensile .002 shrink
Mold Max 40 - 45,000 cps 190 PSI
250% elong 550 PSI 0.004 shrink

try both - 40 has 2x the shrinkage and higher viscosity, less elongation $25 for 2 lbs
30 is probably better

Urethane rubber: 40A 1,500 cps 73 PSI mod
1000% el. 490 PSI tensile
50A 2,000 cps 152 PSI
435% el. 580 PSI shrink <0.001
Part A is TDI $26 for 2 lbs

Thick-walled cylinder p. 51-5
Thin wall: $\Delta C = C\,\epsilon_h = \pi d_0 \left(\frac{\sigma_h - \nu\sigma_\ell}{E}\right)$

$$\Delta \varnothing = d_0 \left(\frac{\sigma_h - \nu\sigma_\ell}{E}\right) \qquad \sigma_h = \frac{pr}{t} \qquad \sigma_\ell = \frac{pr}{2t}$$

$$= d_0 \left(\frac{pr}{Et}\right)\left(1 - \frac{\nu}{2}\right) \quad \text{[isostatic pressure)}$$

$$\varepsilon = \frac{\sigma_c - \nu\sigma_r}{E}$$ ~~let's say $\sigma_c \approx 0$ with the epoxy lubricant.~~ $\sigma_r = p$

$$\frac{\delta}{D_0} = \frac{\sigma_c}{E} = \frac{pr}{Et} \qquad \sigma_c = \frac{pr}{t}$$

$$\varepsilon = \frac{\frac{pr}{t} - \nu \cdot p}{E} = \frac{p}{E}\left(\frac{r}{t} - \nu\right) \qquad p = E\varepsilon\left(\frac{1}{\frac{r}{t} - \nu}\right)$$

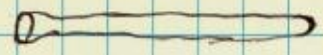
Hertzian contact - cylinder on plane:

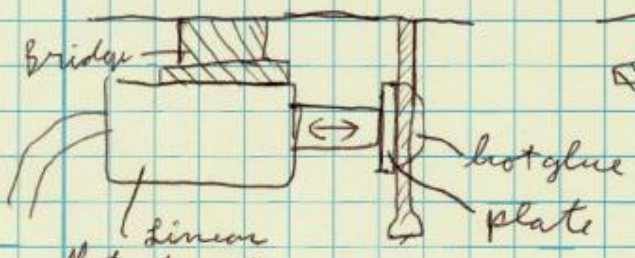
$$a = \sqrt{Rd} \qquad d = \frac{4F}{\pi E^* L} \qquad F_n = \frac{p \cdot \pi \cdot D \cdot \ell}{N}$$

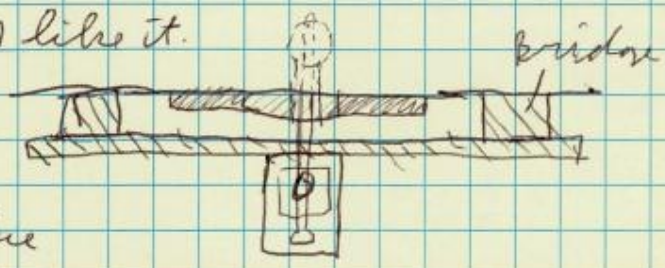
$$p_0 = \left(\frac{E^* F}{\pi L R}\right)^{\frac{1}{2}} = \sqrt{\frac{E^* F}{\pi L R}} \qquad \frac{1}{E^*} = \frac{1-\nu_1^2}{E_1} + \cancel{\frac{1-\nu_2^2}{E_2}} \rightarrow 0 \text{ for stiff rod}$$

$$\text{so } E^* \approx \frac{E}{1-\nu^2}$$

#1 Vulcan - NCSU Round 3 4/10

Arrive 8:00 am columns not sand blasted!
Attach both nails to slab 9:02 am
"N" end used 1/16" drill and .074" nail
↳ nail a bit bent, but it holds
other end 5/64" = 0.078" and glue w/ Loctite 426 w/
Loctite 7452 accelerator
filed tip, slides right in 
seems better!
Mounted to bridge - I like it.



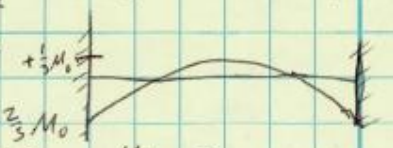


Bridge on "N" side is grey (metal)
vs black on other side

~ 2 V/in
9:45 almost reading, checking calibrations
0.1"/min 10:05 sand blasters are here
10:17 start loading
small gap to close. Load is negative

#1 Vulcan - 2-Way Slab Notes

Design of Reinforced Concrete, 8th Edition (ACI 318)
pp. 484+
Bars, drop panels, and spearheads and caps increase the shear capacity from $4\sqrt{f'_c}\, b_o d$
Min thickness given by $l_n / 33$ l_n = long span direction
BUT slabs with drop panels no less than 4"
→ reasonable basis for testing a 4" slab
p. 495 Slabs with interior beams
- equations use $\beta = l_{long} / l_{short}$ $h = \frac{m}{36+9\beta} = \frac{m}{4+\beta}$
min: $4+\beta = 5$ max: $4+\beta = 6$ (2:1 is largest)
so 20% difference
p. 497 edge or corner panel will usually determine h
For direct design, live load ≤ 2× deadload ($DL \geq \frac{1}{2} LL$)
Total static moment $M_o = \frac{q_u l_2 l_n^2}{8}$



If long continuous span →
p. 503 - method first h then M then steel
get ρ steel from table A.12 p. 658 $\rho = f\left(\frac{M_u}{\phi b d^2}\right)$
- or similar based on f'_c, f_y
M_u uses safety factor of 0.75 × 0.65
and there is a ρ_{min} which is pretty high

Simply supported beam: $s = -\frac{Wl}{8z}$ $W = p \cdot l \cdot w$ $z = \frac{I}{c}$

$z = \frac{I}{c} = \frac{w h^3 \cdot 2}{12 \cdot h} = \frac{w h^2}{6}$ where $l = b$ (span short dimension)

$s = \frac{p \cdot l \cdot w \cdot l \cdot 6}{8 \cdot w \cdot h^2} \Rightarrow \frac{s}{p} = \frac{3l^2}{4h^2} = \frac{3b^2}{4t^2}$

Totally fixed beam: $s = \frac{Wl}{12z}$ at ends, $s = \frac{-Wl}{24z}$ at center

so $\frac{s}{p} = \frac{1}{3} \left.\frac{s}{p}\right|_{s.s.} = \frac{b^2}{4t^2}$

#9 General - Jean-Luc Doumont Persuasion Class 5/6

Name, why, fave food
Persuasion = maximize probability of "yes"
pick battles but don't chicken out
Non-verbal → it's ok to speak
AUTHORITY, TACTICS, INFLUENCES
↳ $, information, people > Organizational power
Charisma → body language > Personal power
look confident & get rid of noise
1) become aware, feel like you belong
where you sit is important - common sense
speak standing up vs sitting @ in circle
sincerity is everything. Once you can fake that, you've got it made!
Body language - instinctual
Talk... look for changes. Sit back in chair - same position = good
you have to mean it - 3 year old bedtime
visualize - horse example

TACTICS HEAD/HAND/HALO/HEART
Say what you want!
Oratory precaution
Replace with expert opinion
Give & take - very American
Hand = exchange
Halo = moral argument... need credibility "right thing to do"
Heart = we're friends!
↳ be nice to secretaries
ask for advice, then make them do it
choose based on person, use several at once

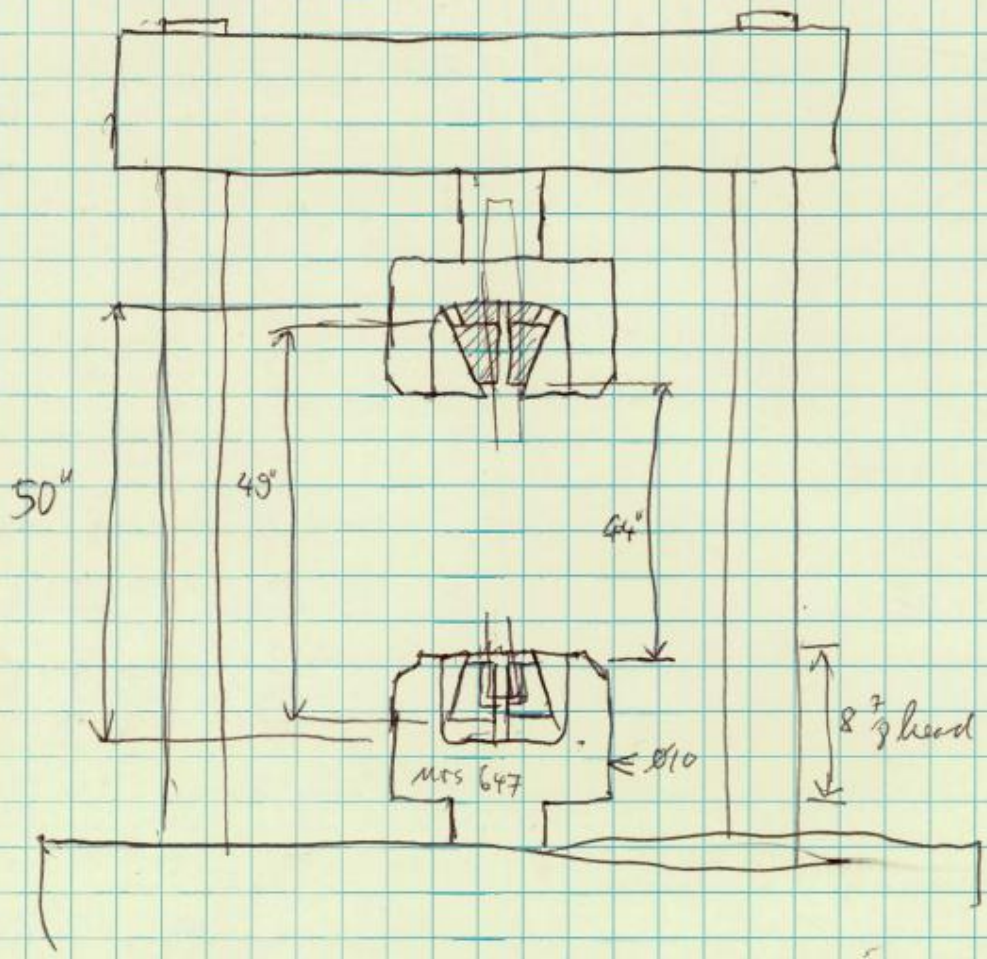
INFLUENCES - *use with prudence
Reciprocation free sample
Ask for more, then concede
Don't assume what ppl like
!Consistency - you said this was important
↳ make the other person say it
Liking - appearance, don't be obvious
common cause or common enemy use "we" be nice
Validation: others do it too
eat shit - 6 billion flies can't be wrong
experts say celebrity endorsements

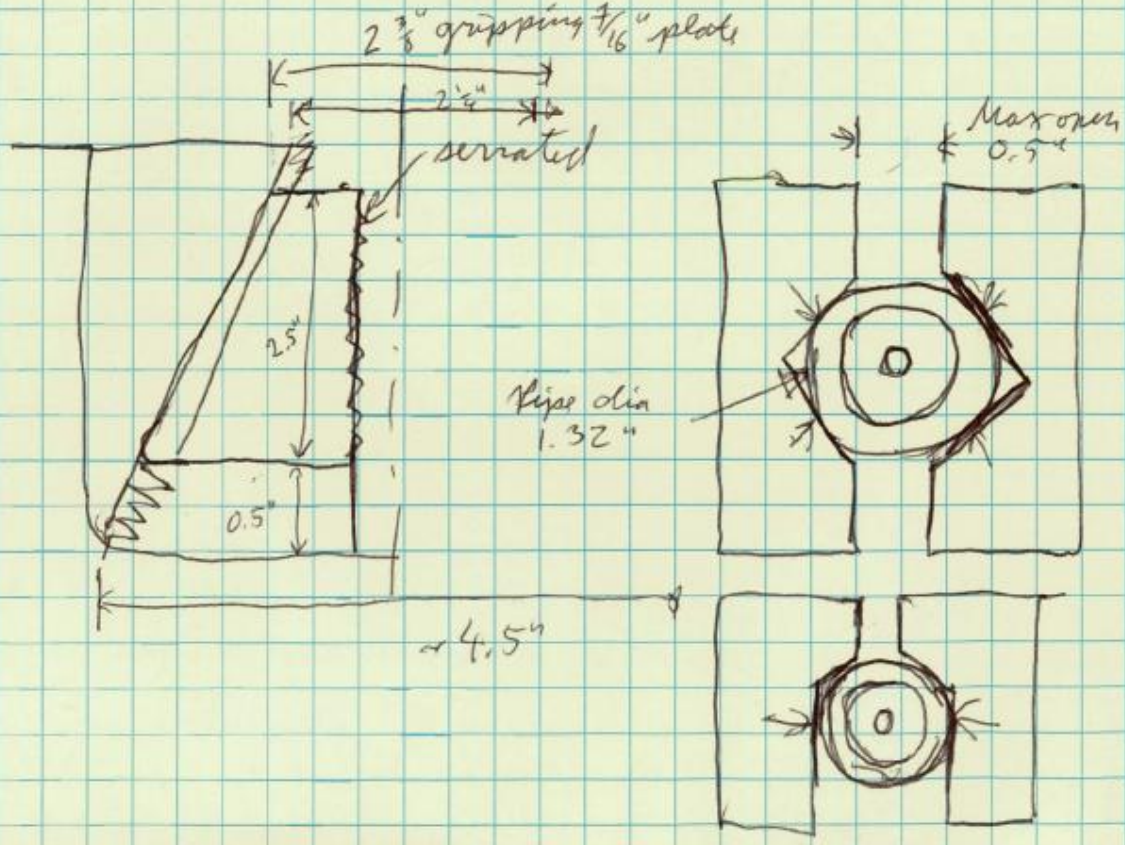
9 General - Jean Luc, ctd.

... should teach people ~~not~~ to resist reliance on role model
scarcity - while supplies last
Tell about the family
Validation: make group say it
Jealousy - plays well in USA
— BREAK, then role play
Sanjiv - timid, too quiet "$6 MM" but inconsistent
- kept asking on one plane
- natural distance sit vs standing
Jeff - "anything else I can do?"
sitting down felt very different
make emotions facts - "it surprised me that this was bad"
"who does the talking"
- power belongs to him who makes the other person speak
Mark P./Deidre
mistake: small talk but not sincerely interested in the work
"I could say X and it would be flattering, so I will ask it"
Bernie vs Ryan
heavy samples - scheme and plan
emotional attack
didn't use halo - save Millikes $ x $
ASK QUESTIONS
Break the setting; make the other person talk; WE; awareness of nonverbals; make them say it; be prepared; wait for answer; ask for what you want; expect a "yes"; ask for more; use scarcity; use org. power last; role play; make 'em feel important; flattery

#1 Vulcan – MTS Machine

Max opening: (no more stroke:)





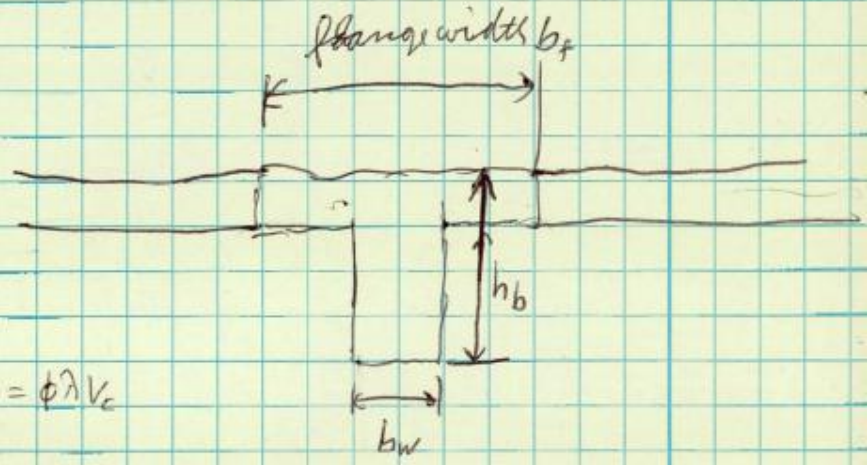
#1 Vulcan - Jim Price meeting 5/29

Most rehab work has been for Milliken
- repair concrete tank at Milliken, injection
Mostly new construction
Direct Design method → most common
CRSI concrete reinforcing steel institute
equivalent frame is impractical
TEDDS - software, 2-way based on direct design
could do FEA in STED (sp?)
not familiar w/ yield line analysis
Tedds - RC TWO-WAY SLAB DESIGN (ACI 318-11
l x w x h flange beam details

factored ultimate load
is input!
↳ 200/1.6 = 400 PSF

Reinforcement
→ negative moment
can't be zero
+ and -, x and y

shear capacity = 5.4 kips = $\phi \lambda V_c$



#1 Vulcan - Inside sample prep 6/3/13

5 sets with 1% CaOH, 5 sets with 2% CaOH

used 5 g Target 1121 ~5500
g water (20%) ~1100
g CaOH (1%) ~55g
6655

Rods: DSC 5/16" rods with Diversified resin,
22 peel turns per foot (~0.5")
One grommet on each end

Using brand new alignment jig
Pour in with blue funnel
- tried narrowing hose, but funnel as-is worked best
- stir occasionally

Had just enough for 10 sets. Second batch added
g CaOH to ~29g
3 g grout paste ~3500
g cement powder ~2890

6/5 Try this again with CaO PolyCal OS 325
Bought 12-10-10 owned by Y. Novosz code 002782
Do this again with ~6000g of grout
3949g Target 1121 white bucket = 303 g
+2026g 1121 blue bucket 796 g
5975 g grout → 60g CaO, 1195g H_2O (20%)
1195 g water start 4:38:30
60 g CaO add 40:30
end 41:30

4051 g left done 5:10 pm
hose down immediately

6/6 Looks good... some standing water.
some grout very wet, easy to remove.
cup sample is solid when smashed to pound.

6/11 Cast 3 different rods (15, 24, and 36 psi) w/ 1121 as addition,
14" pipes 3931 + 1102g = 5033g 1121 Target
1007g water finish 2:31 pm

#1 Vulcan - Tensile Setup MTS 6/18/13

4" Epsilon extensometer not working - Ryan working on it
crosshead has to be locked for test on C45
turn off handset control
clamp - try 4500 PSI
Blue box needs to heat up (on ~ 9:30am)
shunt on → 1456000 microstrain @ 125 gain, 80 mV
↑ EpsilonExt1
want 115590 microstrain 12.596 X off
0.0793887
25% full scale on 1" → 6.25% on 4" 62500 με
1.456 V shunted but want 1.1684 mV/V
125 X gain → 11.684 mV output
0.01164 % right on!
set gain 0.79 37 full scale -1,000,000 to +1,000,000
on Test Works
→ Ch. 2 Method: Vulcan D7205
sample #1 - 1% CaOH - max 19,185 lbs
#6 - 2% CaOH - max 21,493 lbs Dale Wells
↳ tube slips

#2	1% CaOH -	19,037
#3	"	20,564
#4	"	20,386
#5	"	20,621
#7	2% CaOH	21,275
#8	2% - grommet loose	20,705
#9	2%	20,357
#10	2%	20,713
#1	1% CaO	21,110
#2	1% - slip??	19,731 → 17100 on restart

#3	1% CaO	21036
#4	1% CaO	19741
#5	1% CaO	19608
#6	2% CaO	12353 *
#7	"	17536
#8	"	19836
#9	"	18169 ~~[illegible]~~
#10	"	19933

*: first break @ 9500, sequential break

			24/ft	36/ft
#1	15/ft	15024 slip	2592 crushed	17,894 rupture
#2	"	15224 slip	20238 slip	18547 rupture
#3	"	14356 slip	20025 "	20,520 "

#2 Sand Coating

6/24

Lindau: Lindoxy 19 1: 1.6 LSV ratio
Sand dispenser hole: 5/32"

98.2g Lindoxy → 157.1g LS-252V
actual 153g
357.45g - rod wt before - 368? initial...
→ 361.1 after resin + some sand
361.4
361.1 w/fan off
wiped clean, sideways → 360.667g

didn't reach 392°F - oven shut off!

6/25 leftover resin: 228g w/ cup & tongue depressor
9.847g cup & tongue depressor
219g left

made 251g → "used" 32g, most probably wasted

Oven fired back up to 392° - stayed there "a few minutes"
oven shut off - dropped to 384° 8:30 am → back up in seconds
peaked to 403°F
8:36 - rods out. No drips! Uniformity decent, a little lighter on the bottom. Degree of sanding a bit light, but heavy where rod was stopped. Some 12"/min (we were much faster) would be pretty solid coverage.

Pushing force was still a bit high
correction: resin only part did move to bottom, but no big drip, barely a bulge

Mold for 5/16" rod:
refer to Documents\Vulcan\CAD\Rubber casting\Rubber calculations.xls
0.370" - actual rod OD with sand - 0.42 to 0.43"
funnel ID ~ 0.354" ~ .358
new DSC rods (smooth, Lindau): 0.311, .310,
old DSC rods (DSC resin): 0.309, .308, .310, .3095
Mold ID: .358 (non-protuberance)
→ .012 interference + nubs (±4) = 0.020 interference a little tight
.310 × 0.020 / .375 = 0.0165 ~~0.2935 gives same~~ .2935
~~.294 would be same~~ .3015 Do → use .302, "N" drill
seal is .312 - may need smaller one also

#1 Vulcan - Intertek 4" 7×7 burn 6/27

one way slab w/ experimental gypsum panels
2:03 (my watch) go watch is 4 min ahead of PC
3:37:09 - lower MgO fell down
transfer notes from cell phone texts here...
6/28 Inspection check if 25/27 switched
Lots of spalling on floor - positively from cooling
Inventory:
Trash panels, rods
keep: 7½ ceramic paste tubes
½ box of blanket
Morgan boards
Grout - most of bucket
skip: saw
red box w/ paint, ½ paste tube

confirmed that 25 is @ board/blanket interface
which was thought to be 27
27 is on concrete surface 2" out so 25/27 swapped
24 is right 23 on surface ✓ 19 surface ✓
↳ 3" away 20 is 3" in ✓ 21 is 2.5" toward 25 ✓
16 is ✓, 3½" in 17 is ✓, 3" to center

Notes:
~~105 min - ~~both~~ MgO boards fell down in middle~~
~~111 min - hybrid 53+, MgO 3.1, USG 321~~
~~35 min - lower MgO board on hybrid is sagging~~
~~60 - USG in hybrid fell off → actually USG/USG~~
~~95 min - lower MgO fell down?! probably means second USG board fell down in USG/USG~~
~~106 min - MgO on hybrid fell down → would have been~~

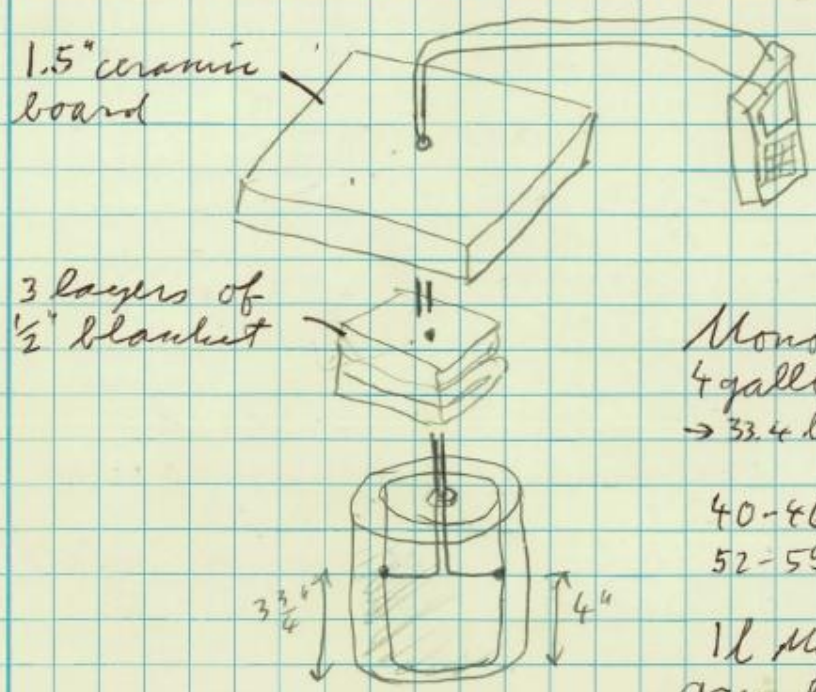
2:04 on watch = 2:00 on PC clock = 3:05 on camera clock
2:03 " 1:59 start test 3:04 "

#1 Vulcan - Column Insulation 7/9

Procedure: drill center hole 5/16" over half way down a 4" x 8" cylinder
drill side hole thru 3/16"
Use type K 30 gauge wire (Omega GG-K-30-SLE (ROHS))
yellow/red
length = 36" to 48"
thread up using copper wire, string as needed
one T/C on each side
weld tip at low power (< 120)
other end: double expand connect w/ red on right
- check, but remove for later

353g T1121
20% = 70.6g
+ 10g
80.6

Fill hole & anchor T/C's with grout
let dry overnight
insulate, let dry a few days
run wires thru insulation



Monolock 146
4 gallons H_2O per 49 lb bag
→ 33.4 lbs 68.2% water by wt

40-46 lbs/ft³ sprayed
52-59 pcf mixed

1l Monolock = 689g
grey bucket = 158.3g
2 quarts dry ≈ 1076g
↳ 733.8g water
1810g total 2.5 quarts
0.0836 ft³

~48 PCF! vigorous mix
is closer to spray density

All cylinders from 3/26
grout filled 7/9
#1 - in pipe, 5 1/16" ID w/ lines
→ ~ 3/8" insulation
1387g → 946g water
7/11 #2 free form, 7" ID (7.1"?)
1427g → 973g water just enough
actual density (wet) 57 pcf

#1 Vulcan - Column Insulation, ctd 7/11

Pyrocrete 241: mix 4½ gallons water with 50 lbs
↳ 37.6 lbs 75.2% water

wet density should be 74-80 pcf (77)
↳ expect to need 1176 g dry powder
Bag: 31.3 g

I have 1247.6 g - 31.3 g = 1216.3 g
75% water - add 912 g

→ makes 2129 g or 106 in³ column needs 103 in³

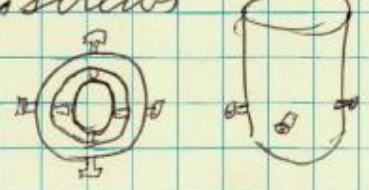
1215.3 g left now → 911.5 g water

Pyrocrete is MUCH thicker, even with more water. I have about 1.5" of un-covered material at the top

7/12 Remove cover from #2
~~the~~ Pyrocrete seems to stick pretty well - it may be tough to remove the PVC pipe ... but at least cylinder is well centered.

Top off with Monobrite: 223.6 g
68.2% water → 152.5 g
actual 166 g

7/15 Remove #3 from PVC pipe - slit down one side and pound out. ~~too~~ Concrete column is not very well centered - should add screws
(Pyrocrete is much higher viscosity and it difficult to pack in. I did fairly well, but I pushed the column around.
Good thing we have two thermocouples!



7/25 Weigh Monobrite sample from cylinder: 257.73 g
Cylinder, Ø = 4", H = 2¼-2⅜, ave above 2⅜ on average → 2.15"
volume = 27.0 in³ → density is 0.582 or 36.4 PCF on light side! (vs 40-46) 40 → H = 1.95" definitely statistically significant

#1 Vulcan - Intertek Beam Layout

7/26

Attempting to illustrate the Intertek T-beam with possible side shear strengthening

rods = 10' 9" grooves: 11' 3" insulation 11' 9"
→ 141", average 35.25" Two @ 36" Two @ 34.5"
Beams = 12' 10" insulation goes 6.5" from end
OR 3 @ 36" 1 @ 33"

Sides would go 1.5" + 6" = 7.5" up
Make 36" long - shear section is 34.5"
↳ Full ht = 1.5+8 = 9.5"

Actually, add 3/8" for blanket! width = 8 3/4"
Side height = 7 7/8" and 9 7/8"

#1 Vulcan - NCSU R6 test 7/29

Overhead hoist fuse broke, so problems with slab
Start w/ development test
control (continuous): office side hole @ 25.5"
seems to be exactly at end of rod! Drill another hole
at 29.25". Small hole punched thru - air on top side
of rod likely. Rod end mark is at 22" → did
rod slide over ?? Would be a 113" = 9' 5" rod
far side hole* is at 26.5" from end, rod end mark
is at 21" total length 13' = 156"
156 - 22 - 21 = 113" ✓ *: rod unexpectedly shallow, drilling bit
Carlos - student helping out Junior
Glue in nails w/ black Loctite 426
Bigger nails - 0.073" and 0.079" bit
1:40 pm - installing pi gauges and Jerry working on PC
control station
2:20 - named "Splice Control"
2:28 - almost ready, load @ 0.25"/min - running
2:46 - hit 6k, stall
2:47:20 - little crack 2:47:51 - pop
3:13 sliding in ~~36~~ overlap (?) 36"!
3:34 nails are in (2" from end, so 16" from centers)
3:58 talk to Sami - her is gone (test) 10-12, arrive 8:30
have controlled contact - OK (bar @ 7' × 7' □)
shear... cracks start vertical, deboned @ top
issue is developing strength in short rod
4:36 slip transducers glued on 36" beam, positioning
actuator
4:44 starting test
4:48 "slip" is 0.006 & 0.008
5:04 done, slip @ 6.8 kips 5:08 unloading specimen
5:19 shutting down
7/30 9:00 last beam (18" overlap) last bridge hot - glued on
9:06 start test
10:11 start excavating - control
AHA! first hole was at the edge of a spring!
BUT - big air pocket beneath rod
end is right @ mark ↳ from end of groove to 34.5' pos
(12.5" undermined). Opp. end is good beyond
end of rod, 2" over, then porous appearance.
Rod cover looks good everywhere, ~3/8"

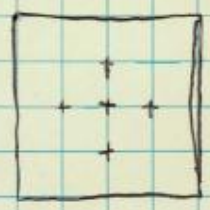
-ctd-

#1 Vulcan – NCSU R6 Test, Ctd 7/30

Start 36" Spline beam (slab)
Right end – solidly embedded but some bubbles starting @ last spring – even @ rod surface!
Rod did not move, almost ½" of cover
Other rod didn't move either BUT again see small bubbles (spongy?) surface on rod
7/16" cover on short end rod
short end of other rod – solid, a few small bubbles. epoxy swirled off edge of groove
↳ most visibly on long side – odd
Bernie's springs do seem to help anchor, but they also induce more bubbles
Far ("left") end: solid, oddly see epoxy slivings plenty of bubbles @ bottom of groove, ~ ⅜" cover

18" beam: "Left" end – Solidly embedded, ⅜" cover, end @ mark, Some bubbles @ bottom of groove but rod is totally encapsulated.
Some yellow edge on long edge due to epoxy strain.
Middle – also solid. Rod pulled back ~ 3/16" and clear strain on epoxy edge. Nail is 2⅛" from end
Other middle – very similar, about 2⅛" to nail, a few bubbles at bottom of groove away from rod
Far end – rock solid, but bubble @ BOG @ ½" past end of rod. ⅜" cover.

Air bladder is close – 11:43am, loaded w/ control slab 8×8
12:00 wiring in sensors. center, front, back, left, right
± 21" each way



max is 2160 PSF

1:26pm – start inflation

1:18PM very close
26.8 = 1 PSF
1:38 now at 268 PSF 1:47 530 PSF – heard cracks
Photo @ 715 PSF 104-0682
850 PSF – see cracks visually 2:01 @ 1200 PSF
CH14 (Back) is wrong sign (+ vs –)
2155 – pic – some slope change but still steady,
☆ 2540 – maxed out x-disc 2:27 bleeding down
3:10 hopping to order PX02C1-100GV transducer

#1 Vulcan - NCSU R6 Test, ctd. 7/30

Ordered Fedex overnite 307925615 - order # 27606

Bag is rated to 20 PSI
Transducer can be overloaded 150%
safety factor on airbag is 2.5 → 45 PSI
Lucies - could do point load in a day
would not recommend breaking slab in a different configuration once cracking pattern has formed
... much discussion ... plan as of 4:24
→ switch to 0-60 PSI transducer, push airbag to the limit
Slab hit is 8¾" vs 9" constrain on airbag
↳ on 2" pallet ← uninflated
~~924 mV/V~~ ... transducer is linear
~~92~~ 924 PSI/V vs 864 - close enough
~~4:39~~ start air → 932
4:42
1 PSI = 26 in (13×2) vs 26.8
2 = 25⅝ vs 26.8
4:49 @ 1000 PSF 4:50 ~ 2000 PSF
4:52 - 2340
3000 - head pop 4:57 done!
peak load was 4727 PSF = 32.8 PSI
could switch to water (Sami) - safer

7/31

8:05 - slab is getting disassembled
9 - Jerry & Greg diverted for concrete removal
9:25 - back working on NSU slab
9:33 now working on sandwich beam
9:40 NSU slab is rising 9:52 lifting hooks cut off
10:04 gluing neoprene pads on rough parts where hooks were
10:16 slab is roughly positioned
10:19 slab now on 4×4's - higher than last time
reuse the wood contact frame, which looks OK
10:23 walked down to 2×4 height with pallet jack
lowering steel frame 10:34 steel frame is level
10:53 mounting string pots. Lucies wants air - let's hope it doesn't leak
11:08 cross drains mounted 11:20 ready to turn lever 11:23 filling
~ 0.25" to engage slab 11:23 1300 PSF
1680 - see cracks 1930 - crack in middle
11:38 - 3270 PSF, pretty fully cracked $\boxed{7200 = 50\ \text{PSI limit}}$
4270 - loud pop peak was 5120 PSF

#1 Vulcan - NCSU R6 Test, ctd 7/31

Now test the wet layup slab
1:52 pm - slab is in position, steel frame level
2:26 pm - chains on, pots getting calibrated
2:31 pm - air is filling
2:37 - <1000 PSF - corners of FRP debonded
2000 PSF - no visible damage except ↑
3500 PSF - no change!
4000 - now popping ...
5000 - sth moved visibly in center
6400 - moved back pot
Peak is 6789 PSF → rupture everything at once
3 pm - wrapping up

#1 Vulcan - Column insulation test

log 04 stopped
Initial temp 22.2°C
Start 8:57am = 9:04 on DAQPRO-5300
Unplug @ 8:58 40°C oven major sparks/short
→ heats to ~50°C
log 05 ended

8/19 New kiln bought, David Bishop working on the setup (wiring, floor, mobile platform)

Silca 212:	Plastic	6pt	6.26 lbs	12.5%
	Flowable	6.5pt	6.78 lbs	13.5%
	Fluid	8.5pt	8.87 lbs	18%

per 50-lb bag

#1 kiln
#2 short wire
#3 long wire

9/3 first test completed Friday. cover is ~1.5" on both sides - maybe 1 5/8"

Now test 3/4" cover Monolots
#1: furnace
#2: blue tape
#3: other one initial temps = 73-75°C ??
↳ internal compensation: 24°C
log ~~0~~ should be the file
→ log1 13:37:10 start power (1 min in)
1:26:00 on my watch temp = 24.4°C (1:31)
1:36 - #1 @ 29.9°C #2 @ 30.9 #3 @ 32.3°C

9/4 Entire cylinder slips off
one cover: 3/4" opposite: 13/16" (3/4 + 1/16")
↑ #2 ↑ #3

9:25:00 start ~~kiln~~ logger (9:36:20 logger time)
9:26:02 start kiln log in 1 sec interval - oops

#1 Vulcan - Stainless Staple Installation 8/20

Drilling - worked well, will do "plot diary" entry
Filling - Millikan grout #2 (Sika 212) w/ 12% water
was too solid to displace.
1142.6 g Sika 212 (#2)
137.1 g water (12%)
would 12.5% make a big difference?
see p. 45 - 13.5% should be better.
769.8 g Sika 212 (#2)
→ 103.9 g water
873.7 g

870.2 g after mix (2:20 pm)
635.6 g left → 234.6 g used (207 g grout)
2:31 pm done & bucket clean
2:37 pm everything put away

Equipment:
- hammer drill & chuck key
- ½" × 18" masonry bit
- ½" × 2" masonry bit
- rebar cutter/bender
- tape measure
- 90° indicator... bend rig?

=

- small bucket for grout
- container for water
- pipette
- scale
- (hammer drill)
- mixing paddle

=

- screwdriver (flat) for un-wedging
- hammer & crowbar (just in case)
- ★ poking rod to poke grout into hole
- sealing tape if drippy
- water nozzle to wash out/saturate hole

=

- rubber gloves
- 210 g + of grout per staple (Sika 212)
- water (13% should be good)

#1 Vulcan - NCSU R7 8/22

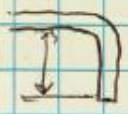
~~8~~ 10am - slab ready except for slip displacement gauges
shear beam also close to ready
lots of specimens outside:
- 6 2-way slabs (look good)
- 7 splice slabs (a bit rough, some shrinkage cracks worse than others)
- 13 shear beams (one cracked pretty bad, 4 medium bad, 5 good, 2 hidden

2-way slab B: nail in shallow direction (FRONT) is good
nail in deep (LEFT) questionable
now on rollers
- centers to centers: 87.5" 4" wide strips
83.5", 83.~~4~~5" inside-to-inside
Hatem Seliem - post doc
10:13 gauges glued down
slab has lots of holes @ crossover points
Hatem: span:depth of 14 gives arch action '07 PhD
limit is ~20 in bridges, use short spans
gauges are ~~@~~ calibrated → Egypt
10:32 take up slack in the airbag
no claims
10:40 load @ 100 PSF
500 PSF - some pops - settling?
800 PSF - definite crack pop
1500 - still no visible cracks detected
2350 - big crack!
11:23 taking frame apart. Max load was ~4800 PSF
minimal edge crushing - rollers did their job
rods popped out in middle, slipped @ end
Bottoms of slabs: definitely not concrete crushing
in the middle... round shear ring of failure

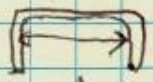
Excavation: cracks at tops of rods
both slip nails were placed well!
Including the deep one.
2:14 working on shear beam instrumentation, sending for Amir 2:30 - ready to bond studs for 2nd pi gauge
2:51 Carlos still struggling w/ pi gauge, mediocre placement
top offset: 5/32" Bottom: ½" offset 3:18 start load

#1 Vulcan - Stainless Staple Repeat 8/29

Bending: 7" from 0 to end - bends to $6\frac{1}{8}$"



17" from end to second bend
(Bend @ tail keeps bends co-planar!
→ 16.25" inside spread



start with small pilot hole ($\frac{3}{16}$") to hit the marked position

Clean with air, then water temp is 91°F
516.94 g Silica 212
66.4 g 13% water
4.1 g more water → 13.6%

↳ barely fluid enough... thicker than 8/20
but OK - tap in with hammer

#1 Vulcan - NCSU R8 Install

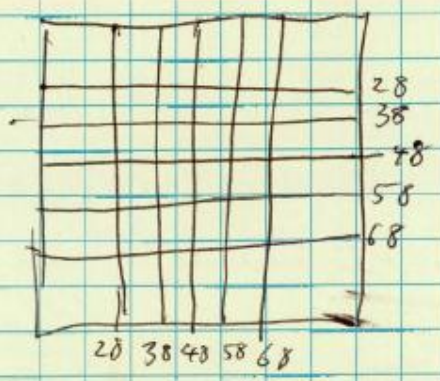
9/9

3:30 PM - cut one development length beam, started on second

problems:
- lifting pressure lifts slab, bad regulator
- everything heavy
- lose length @ crank
- pinch points

3:33 drop save, start move to third (8.5' rods)
6.5' rod cut first, on CFL side

8 x 8 marks:

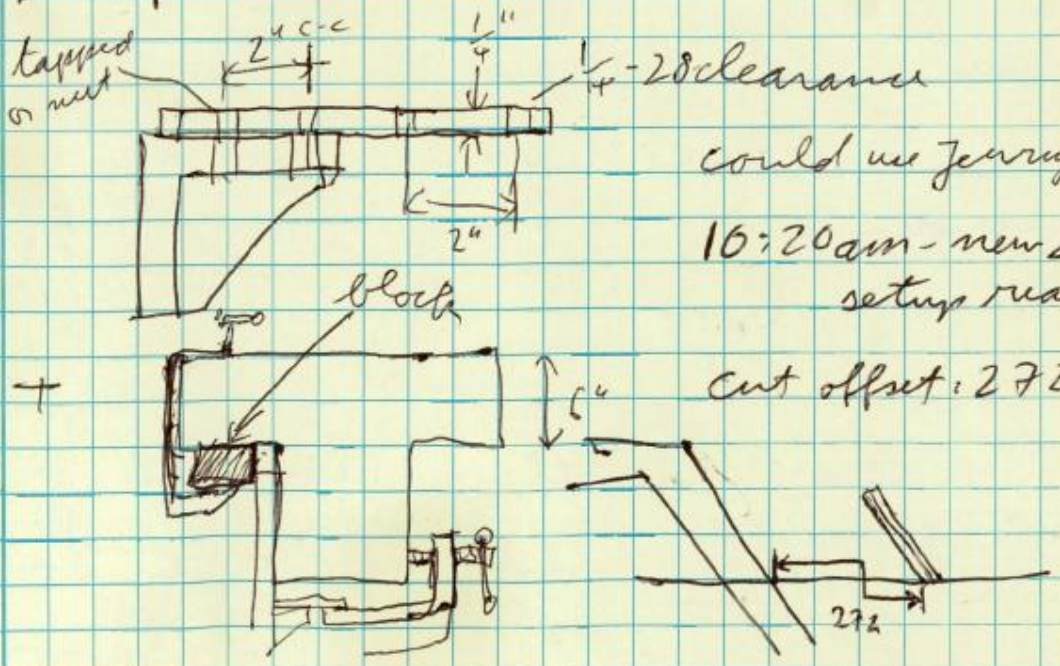


shear beam: red clamp is too small

development rods:

8-12-13	#18	6.5'
8-13-13	#43	7.5'
8-13-13	#83	8.5'

Plan for shear:



could use Jerry's bar

10:20 am - new shear setup ready

cut offset: 272 mm

#1 Vulcan - NCSU R8 Install, ctd. 9/11

Plan: grout in #3 bars next to cut stirrups on shear beam...

Stl was contacted in 17 places on one side of the Beam when cutting the NSM shear strengthening grooves & contacted in 2 places on the other side of the beam.

Lowe's (Cary) has #3 rebar
Home Depot (") has 24" bits in STS

2-way slab rods out:

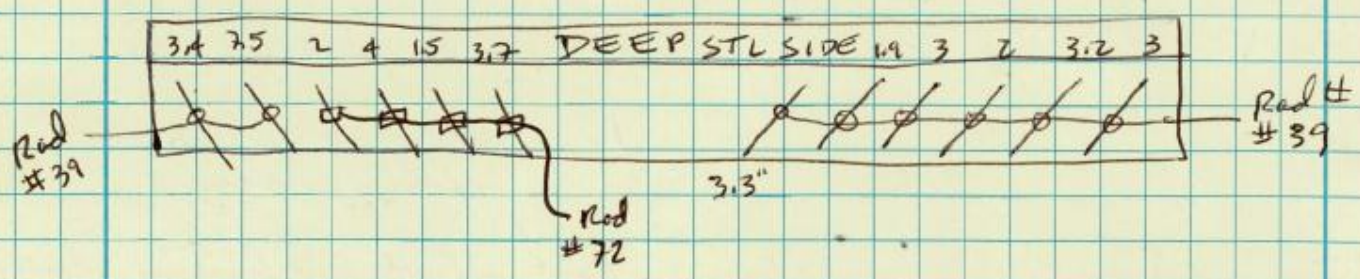
8/13/13 #79
8/13/13 #75
8/13/13 #68
8/13/13 #56 — Must be #72
? ? 2
8/13/13 #31
8/12/13 #4
8/12/13 #42
8/13/13 #73
8/12/13 #14

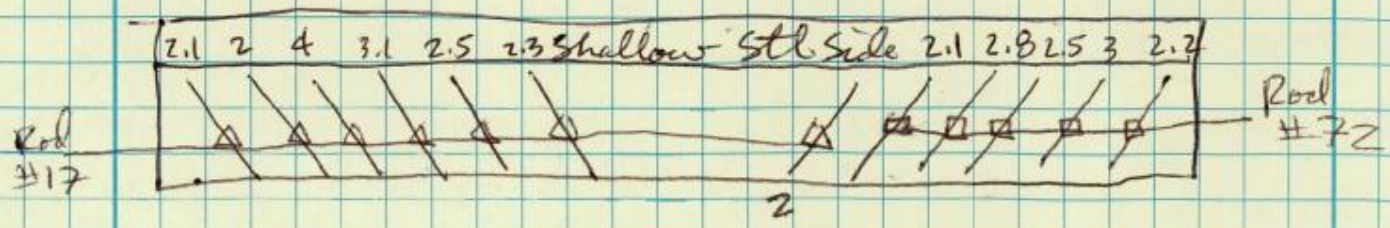
deep:
79 - 14 - 4 - 31 - 56

shallow: drain port
72 - 68 - 73 - 42 - 75
rough ends

4:15 - soak 2-way u/mats
4:24 - soak 3 development slabs

Rods used in Shear Beam





#1 Vulcan - NCSU R8 Install, etc

6:48 start mixing grout
7:30 leave, 8.5 & 7.5 beams are pumped

8:50 am - pull in, bought ST drill & relas. 9/12
9:01 start filling 2-way slab
9:04 full!
10:00 finished drilling (x4) and drain slab/d.l.
11:20 soaked the shear beam
11:43 soak relas holes 11:50 drain shear
12:03 mixed 4 bags of grout (start)
12:07 - start pump big slab
1:02 - start pump d #3 & drain relas
1:21 - start pump shear
2:44 - firing blown ports on shear beam
~8 of 24
3:13 start mixing grout
3:52 done pumping, tidying up

#2 Shaunk Works - Magnolia visit 9/27

Heather Sensiba - MPS director

Project #1 - Color control center design
Signal valve - not working - someone coming next week Ricardo - detail bad shape
#2 - Orion - one of 3 cts color ranges - med weight
↳ no quick change
design a wet out system Nicole Seay
Andy Oberg - gone ... new plant manager
#3 - Nice to have ... safer way to dispense chemicals
~~#5~~ "less sexy"
#5 - Use liquid dyes - price going up - powder dyes
- Wolf Redding in 2 years, could be issue

#4 Cedar Hill - near Union
PVA & Size ~~on~~ slashed on yarns killing wastewater
need a pump-back system "ME's dream"
more Chem E?

Bill Baird Signal here Oct 7.
Cassy Horn ("Catherine") Shade PI in dye house
make more like quick change dip pad
just has 1 trough - lots of waste
300 yard "patch" (sample)
pre-dryer ~~won~~ won't turn on for 30 sec 120 PM mins 80
last period - ~240 patches, ⅓=80 ~100 patches
are 3x as long almost all 2"ds $9/yd
~ $200,000 in one period
Nicole Seay owns range
Nathan Morrison - lab manager
steamer seal is too large

Bill - valves - dispense dyes - pneumatic valves
sticks and leaks ½ of bad shade
5 of 10 leaked on arrival
Ricardo Diaz - worked with SMC - never worked
input pressure (pneumatic) is low
↳ installing new compressor spec = 95 PSI
72 x 3 valves some from 2001
had lubrication problem - no oil in air lines
valves have "toggle" function to jiggle loose
can also manually pop up valves

#2 Skunk Works - Magnolia Visit, ctd 9/22

solenoid controls air
Jeremy Widener - demos valve
80 PSI - high flow
35 PSI - low flow - middle stream only
~45 PSI - transition to low flow when dropping
tighten down with channel locks
PVC washer
no torque spec
$1200 per valve - assembled
need to toggle to pop up to high flow
Valves were custom made for Millibar
~~Famosi~~ Famosi make cylinders for Signal
↳ Ray Sanders knows history
spring pushes shaft down
↳ air assisted?
both springs push down

need a spray bar to wet out during starting
vertical pre-dries units

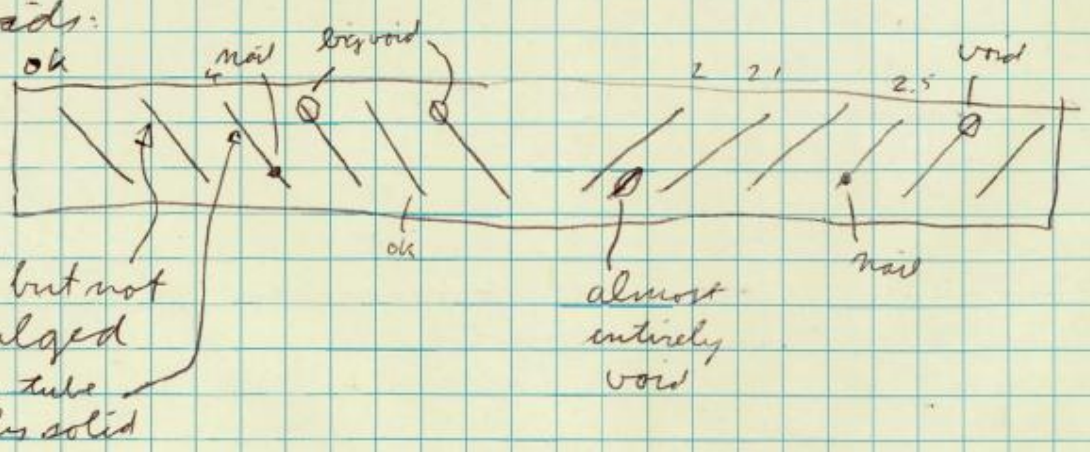
Tyler Tisdale - works with the valve testers

#1 Vulcan - NCSU R8 Tests 9/30

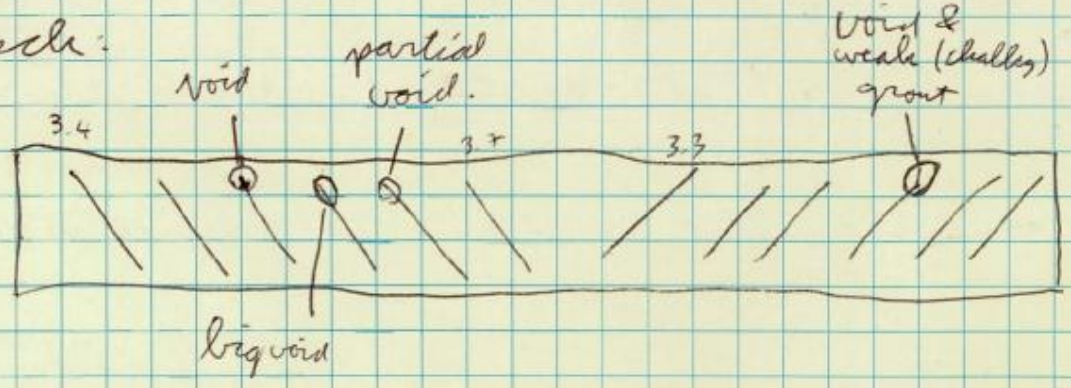
9:25am - development length has 2 nails, almost ready

Shear - 2 nails 1.5" rep 31.5" not glued in yet on third rod from end. One has 4" embedded, the other 2.5"

voids:



Back:



8.5' beam - test @ 0.25"/min 9:37 start test

~4300 yield, 6620 rupture - 2000 sec, 5"

10:16 - loud pop, but cannot confirm rupture

↳ appears that right side ~~concrete~~ grout debonded, pulling nail into hole

delam is on "second pump" side

grout looks solid, no voids and tiny bubbles

resin scraped on edges of lugs

at big middle crack - resin on left AND right

10:36 new beam (7.5') placed

11:10 second nail installed

T-beams: cover varies from $\frac{5}{8}$" to $1\frac{1}{8}$" but hard to measure. No $\frac{3}{8}$ or $\frac{1}{8}$ found on accessible beams

11:41 - start 7.5' test

peak = 6903

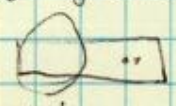
#1 Vulcan - NCSU R8 Tests, ctd. 9/30

2:05pm - nails glued to 6.5' beam
span on all tests has been 2' not 3' !!!
so 6.5' has $\frac{4.5'}{2} = 2.25'$ (27") to "develop"

Nails are 2" from rod end
2:38 pm - 6.5' beam very close, Tayla Wise setting up the shear beam strain
3:25 - 6.5' beam failed by gradual slippage
→ 6000 lbs peak then drop ~ 5500 & draw out

R7 8/22 control was 120,139 lbs max @ failure by shear splitting displace ~0.46"
Now test NSM shear beam #1
4:05 - checked all transducers
4:15 - start test
- failure @ 183.6 kips ultimate

tension rebar has ~2" cover
failure thru the cut rebar
cover delam below or above critical crack
~~To~~ Higher tension rebar 5 1/16" from bottom of slab to top of bar
nothing on opposite side



OK!

10/1 Examine development slabs
8.5' - one end sucked nail in, other end did not bridge. Nail set ~ 7/16" into grout below but there really was zero movement
grout porous but OK
7.5' - Nail on one end missed completely
rod actually pulled out ~ 1/2"
far end: first hole missed, second was tangent, third is OK but rod did not slip there
8.5' has some void above rod but rod covered on all sides & seems OK - no slip there
no voids on any ends
No voids on 7.5'
* in center closer to 1st pump end

9:53 holes drilled, working on slimming
2pm - still setting up
control: 4727 PSF EB: 6789 PSF Move SP right to 4th slip gauge
NSM#1: 5121 PSF Today's NSM: 4993 PSF
NSM#2: 4836 grooves split at <3 KSF

#1 Vulcan - Stainless 11/21

Mix new bag of Libra 212

5.6 lbs grout = 2520 g
↳ 13% = 327.6 g (327.9 cancel)
add 1%
then 2% more - almost too fluid (16%)
did 7-11 stopks

11/22 7.0 lbs = 3150 g
↳ 15% = 473.5 g too running!
continue with 12, 1-6

472.5 is 13.5% → grout is 3500
-3150
350

actually add 347 → good consistency

4.8 lbs = 2160 g
13.5% = 291.6 g a bit running!
finished 1 & 24

10:45 new batch
8.0 lbs = 3600 g
13% = 468 g
did # 15, 16, 17, 18, 19, 21, 22, 23

23 pushed #2 out a bit...
6.0 lbs = 2700 g finished 13, 14, 24
13% = 351 g
#1 was pushed out, but top stuck
↳ cut off & remake (10 5/8" backbone)

6 lbs → 2700 g 20 & 11 redo left
351 g

3:25 pm - done!

#2 Skunk Works - Magnolia visit #2 12/5

also see p. 52

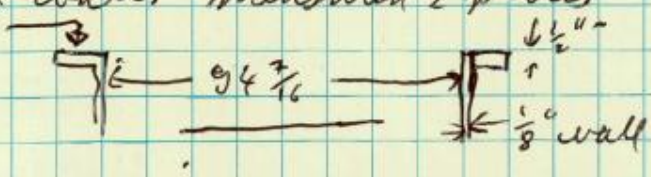
Magnolia wash lab - Mary White 839-0245
↳ call or e-mail

3 machines, 1 auto pump, 2 hand dose
3 or 4 chemicals come together - 6 should be safe

lint cleaned out with air hose, gets caught
clean lint tray with broom once per day
6 people on rotate - washing & cutting
↳ 1 person
40-45 washes, same for dry

Sample 893 on 76 cycles, start 11/25
↳ down 4 days over Thanksgiving
6 days -
30-50 samples per week, usually do 25, 50, 100 or sometimes just 10...
if really bad ball after wash, straighten out by hand
serge - sew the edges - helps greatly with balling
remark after 25-50 washes
staples are fine comm, would probably tear out
RFID device - sew on a pocket?
burn test is not as critical for balling - shrinkage is
hurricane strip fabric or lavender cloth survived 100 washes @ 150°F
160°F does wrinkle much more than 150°F
3 shifts - special handling - start Monday
4th machine could do special project wash

Wet-out Madison Orion (middle range)
spray bar install would be fairly simple
Dean Myers - new operator - certified last week
talk of a 7 oz fabric
width is 63", varies by ~5"
94 9/16" between metal walls measured 2 places
ledge is 2 5/16" wide



fabric ~~5 1/2"~~ 5 1/2" below edge

Ricardo Diaz - valve problems went from 16 → 5 last period, attributed to the use of Loctite. Will try torque 10, 15, 20 in-lbs

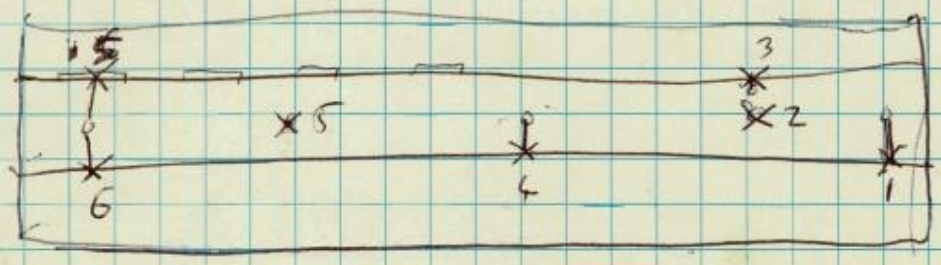
#1 Vulcan – Intertek big retest install 12/16

1PM – Beams #1 & #2 positioned.
#1 → Wet layup, 2 × 6" layers
#2 → NSM 2 rods

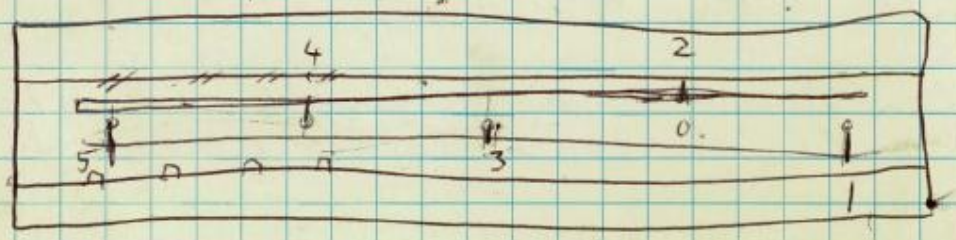
12/17

All Major holes drilled Bottom view

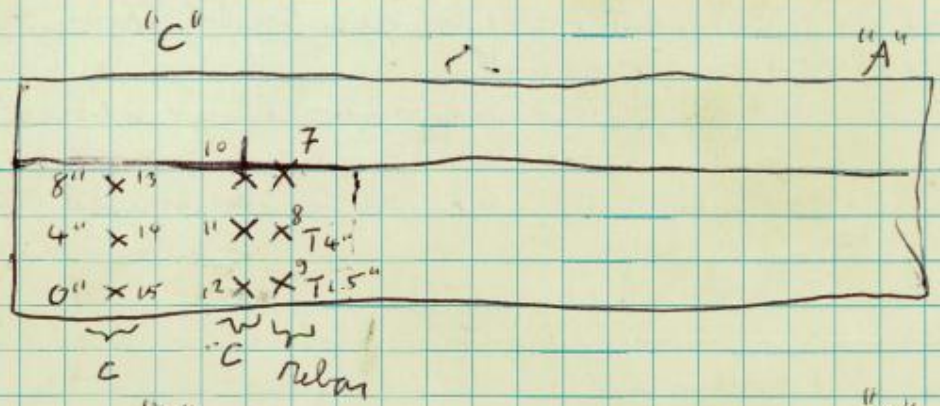
Wet layup #1



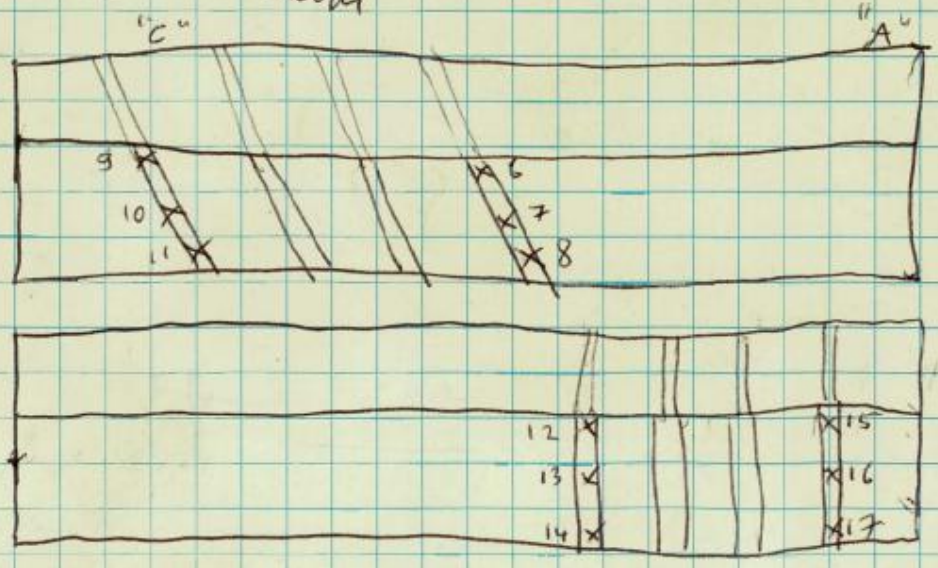
NSM #2



WL side



NSM SIDE



NSM SIDE

#1 Vulcan - Intertek Big retest install, ctd 12/17 2013

Carbon bars: 8/12/13 - 5 (5), 7, (9), (53), 62
#62
8/12/13 - #53 11' 1" in flex 9,
8/12/13 - 7
8/12/13 - 9

Thermocouples

Wet layup A1, A2, A3, A4
B1 - 4
C1 - - 4

6 surface flex 1-6
6 surface shear ~~7-9~~ 10-15
3 stirrup shear 7-9
15

NSM A1, A2, A3, A4
B1 - 4
C1 - 4

5 on flex rods 1-5
6 angled shear 6-11
6 vert shear 12-17
17

32 new 10:35 all T/C's threaded

1:35 back from lunch - ready to pump

Water: ~~2.271~~ kg
2.257 kg → 22.5%
+3.015 kg grout
+2.965 kg 4028
+3.136 884
+0.888 kg

3:25 done pumping, all T/E wires grouted
4:29 wet layup is up

Panel sizes: Mag Ox
8' x 8.75" (4 pcs) 45" x 8.75" (4 pcs)
8' x 7.6" (8 pcs) 45" x 9.6" (8 pcs)

done cutting - all style C 12/18
need 8' x 8.75 and ~~two~~ 8' x 7.6"

#2[3] Splish Splash - Sample sizes

Petr: 1 yard 60" to 70" or 75" (woven is wider)

5-7 oz/yd²

Vertical burn: ~~Bi~~ ~~Ex~~ 5 vertical, 5 horizontal
piece is 8" x 2 or 3", Magnolia is bigger ~~2.5" x 3"x10"~~
2.5" x 10" 2.5!

in-house pieces are 16" x 39" (pin frame)
16" x 39" = 0.48 yd² (0.5) → 2.5 to 3 oz
↓ ↓
128 91

20 lbs = 320 oz
1 yd x 70" → 2 yd²
32 23 pieces

1/16 2014 Call Angela Sim - Intertek Arlington Heights (CHI)
& Robbie - discuss best practice for washing

usually 60 cm x 60 cm max 24" x 24" up to 25"
ballast up to 4 lbs never had issues
- smaller sample is better, more accurate
- serge edges no need to fold
- avoid abrasion.. smaller sees more abrasion

Industrial wash @ Courtland facility (Newark)

#2 Skunk Works - Magnolia Wet-out 1/15

Meeting at 2 pm today, this is prep work.

Look at spraynozzle math.xlsx in Magnolia folder
Early guess: 80-120 YPM, 6.5-9 oz/yd² (OSY), 50%-70% wet pickup → 0.2 to 0.6 gal/min @4" spacing
... could do 6" spacing for 0.3 gpm

McMaster spray tips
3404K78 $10.17 SS 0.3 @20PSI, 0.7 @100PSI
... goes up to 1000 PSI - what is water pressure?
others are 0.5-1.2, 0.7-1.5, 1.4-3.1 ... most ⅛" NPT
wide angle 0.1-0.1, 0.1-0.2, 0.7-1.2
food grade (plastic) 0.1-0.3, 0.3-0.7, 0.6-1.5
quick change 0.1-0.2 $33, tips $5.57
0.5 @ 500 PSI

Savings - is it really $300K per period? !! year?
1-800-95 SPRAY
Spraying Systems Co: 0.025-2500 gpm catalog.PDF

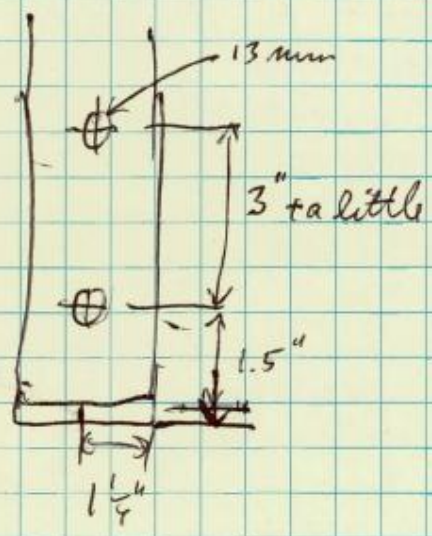
$$\frac{Q_1}{Q_2} = \left(\frac{P_1}{P_2}\right)^n \quad n=0.5 \text{ so range is } \left(\frac{100}{20}\right)^{\frac{1}{2}} = 2.24\times$$

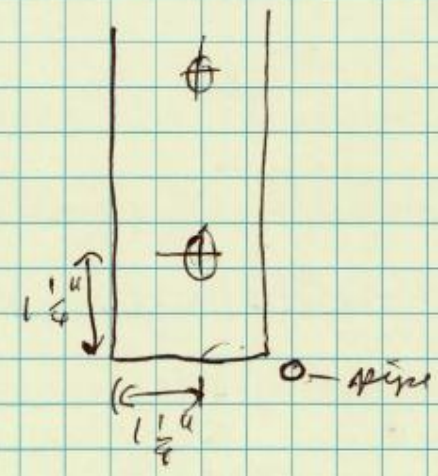
... with standard water pressure
5 to 100 PSI → 4.5×
Drop size: 10-100 μm = fog Fine spray = 375 (orange)
Flat fan = 260-4300 should be OK...
Stainless wear is 4-6× better than brass PP = 1-2× brass
flow resistance - p.A12 to size the pipe
need 4-12 gal/min 10 gal/min, schedule 40
1" pipe → 0.3 PSI per 10 ft 1¼" pipe → 0.08 per 10 ft
¾" pipe → 1.0 PSI per 10 ft still not bad

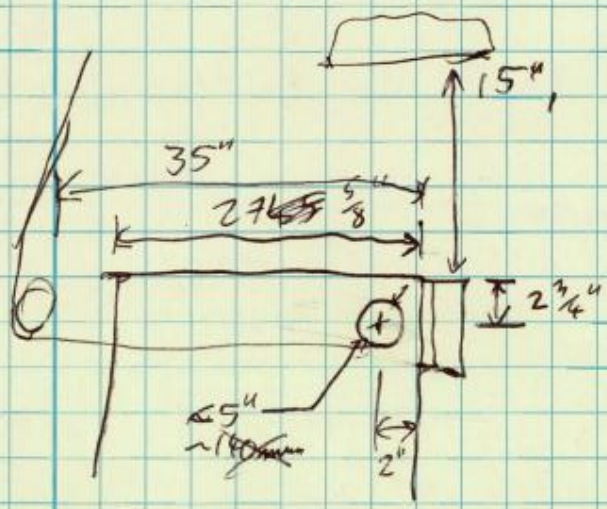
p.C6 - some at 0.05 gpm, more at 0.1 gpm ← 40PSI
as low as 5 PSI, 0.035 gpm ← absolute minimum

Are drips OK? Cattle pan?
May also do pulse width modulation! up to 33Hz 167Hz!
↳ probably advisable if flow < 0.1 gpm ... 5PSI
Meeting with Nicole Leary, Keith Hill (plant engineer), Juan Duque - operator
Wonderware 55% - 60% moisture, 8.5 oz/yd² leader
lin speed: 70-130 ypm. Drips are killer
pressure only 60 PSI Cam-Lock fitting

#2 Shrunk Works - Magnolia Wet-out, ctd. 1/15







15", 35" with RH sensors gone

Inlet hose is 3/4" ID

#2 Skunk Works - Testrake Revival

1/17

Try out the old yarn splices again...
cart from end of Delta Form line
resin box from middle of aisle
cardboard box from green table

Full pressure, manual valve, thick yarn (1440 dtex)
1 yarn in 4th slot (1-3 are bad)
↳ decent splice, but breaks by hand
Nesdan - tears also by hand, but stronger
8 yarns, every other slot
↳ 2 completely unattached (2nd & 3rd ones)
#1 - OK
#4, #5 OK
#6 - yikes! Can't tear it #7 also
#8 - OK
25% great, 50% so-so, 25% awful

Fill all but the first 4 open holes w/ plumber's putty. About ½ the chamber volume
→ held up with valve half open, but then blowout!

Turn on intentionally slow
↳ 8/8 yarns pushed out before able to splice!

#2 Skunk Works - Magnolia Net-Out

Eastern - water pressure regulator $73.52 1"
25-75 PSIg

McMaster is cheaper, 15-75 PSIg

1/8-27 NPT tap drill: 21/64 to 11/32 mid: Q

1/4-18 NPT tap drill: 27/64 to 29/64 mid: 7/16"

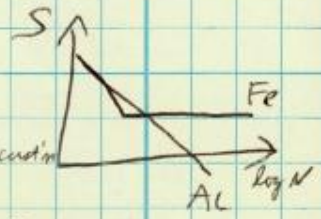
Works...

The straight nozzles seem to be more stable (spray angle vs pressure) and have a lower minimum pressure. Plastic nozzle seems very uniform but does collapse sooner.
08-120 and 05-120 are good down to 15PSI, maybe 10-

#9 General - Innovation Fair 2014 1/23

Dawn Weiry: Innovation & Insights
understand needs → emotions → feelings
not superficial market reports, the best insights are hard to get to.
Amplitude, Select Silver
Floor Covering: wants nurse not hero
- hold hand throughout the process
Observation: Moxcell, ReacTint
Pizza boxes in trash - add restaurant & hotel
Experiencing: go thru customer's path
Connecting: need + inefficient ads + market work = e-Bay

Lou Rassey - MIT Master's - McKinsey - Innovation in manufacturing
US constant @ 20% while market grows, China & India grabbing all growth
7 million assembly jobs - 17 million total w/service
6 disruptive trends
1) demand - 2 Billion new people by 2025
7000 new large companies, 70% in emerging markets
China doubled GDP per capita in 12 years (1300 to 2600) vs 50 in US
2) Inputs - scarcity of water, energy, food
shortage of high skill workers
shale gas boom
3) Policy - deficits, income inequality
4) Shift in industry - low cost producers have the volume but not the revenue
5) Stability - uncertainty / volatility jumps <2000 vs >2005 - large broadening of cost distribution
(6) Technology & Innovation - 5 areas



- Production processes
3D printing, additive mfg niche → mass cust'n
Baxter, friendly robot
Chris Musso - Materials: B/W, Aerospace carbon but using Aluminum in trucks is 5x bigger (F150)
- crowd sourcing, open innovation, integration
people like "awesome" but value is key
↳ design to value, price it appropriately
↳ invest more in margin improvement
- Digital Mfg - Factory in a box?
- Business Models - Twitter to check on plants
Instant information FB, G, APPLE: 130K emp, $790B

#9 General - Innovation Fair 2014, ctd 1/23

... take advantage of easy information exchange
Rich Gibson hurt foot playing soccer
Biggest takeaway - design to value, more research on production things
get to Charlotte in 15 minutes - can't just drive faster
Chris: assume Carbon was $5/lb - where would we use it?

Jason Bradley - John Deere 67,000 employees
Insight Drives Innovation
Advanced Marketing
Enabled green revolution
7B → 9B people by 2050
Double agricultural productivity in 40 years
Spent 1 day on the definition of innovation
↳ from the Midwest
Accelerate innovation program
1) Bring focus to emerging innovation
2) Start earlier - creates uncertainty
Idea creation - autonomous mower
Opportunity evaluation - hybrid electric loaders
Project Management - RFID stuff
Business Development - Data analytics
research centers in Kaiserslautern, ~~Asia~~, China, India
very open, only 1 secret project
key is business buy-in early on
Key technology enabled trend - look for mismatches
Paths out to 2026 (12 years)
Running a railroad vs lay new tracks

Track "real option value" as project progresses,
Invest in a narrow technology field
Backlog of "next best" project
Ahead of schedule → customer interaction clinic

1/24 De Souza - culture of Innovation
R&D100 - Conceal, Neolon award, Innovision
China: Hyperform in PPR - PP random copolymer - $15MM
Geospray: 1MM → 2.4MM → 6MM in 2014?
Giant squid: structural connect cloth for culverts
Liquitint unit dose
Assist Silver - combined adhesion & moisture management
FR growing from 5 → 30 MM in 2017
China - ahead of the curve - 3MM in 2014

#9 General - Innovation Fair 2014, ctd

SuperOx is magic chemical, kills Formaldehyde, all kinds of side benefits
FR started for military because workwear was not investable, Keller pushed for it, workwear now a huge success
ResQ Recist: FR + Moisture management in cold weather
Caterpillar - ultra thin Nylon 6, 6
- 5% less rolling resistance
- 40% less cap ply weight
i2m - idea to market - web tool for NPD
R&D 100 - Firestone, FR knit, ASSIST Silver
Innovation: 2.8% of sales in 2008 to 3.3% in 2013
% gross margin from research: 31.7% in 2008 → 40% in 2013
(5 year window). BUT less growth

Brad Koerner - Philips lighting Blog:
very fragmented markets
lights constrained by fixtures
How to create surfaces of light?
IP connectivity for each light source
Pay per lux models
Full ~~lifetime~~ life cycle engineering
Issues: sapphire used in iPhones, disrupts pricing
similar issues with Phosphorus from China - 2x $

Joe Arcadi - Owens Corning open innovation
founded in 1938 - fiberglass by accident
debt rating BBB- $5B in sales
open innovation started in 2010
academic sources not great, not on same page

#3 Splish Splash

1/27

Questions for Eric Wamsley (Steve Lucas)

1) What rolls are available? Steve looking at it
   Different colors have different curing temps
   Colors may not bracket - 1000's = blues from light to dark
2) Char length direction? (Warp or Fill)
   doesn't know

3) Finish code? 0736, 0816, 0821
   07xx: non-water repel 0736 is most common

4) Char length @ 150 vs 160? 160° is longer
   spec @ 160 is 6" vs 4"

5) Sample size standard? 16"x39" = 0.5 yd²
   ↳ 25"x25" or 30"x30" (rough, hand cut)

6) Detergent: First fill: 17 g Metasilicate powder
   11 g Tripolyphosphate powder
   22 g Tergitol liquid

   Last cycle: 6 g Sour powder

   Which can we combine? We have 2 powder trays.
   liquid form of sour is available...
   powders may react, no pre-mix

7) pH range: 6-13
8) Detergent - get from Magnolia? Can ask James Chiu
   Special handling - Steve Lucas
9) Less noisy? ICP, XRF - Phosphorus correlated to ICP
   XRF @ 10 washes, should have 100 soon
   100 wash on every 100th 1-2 or rest week or two
   Retains kept at all wash steps

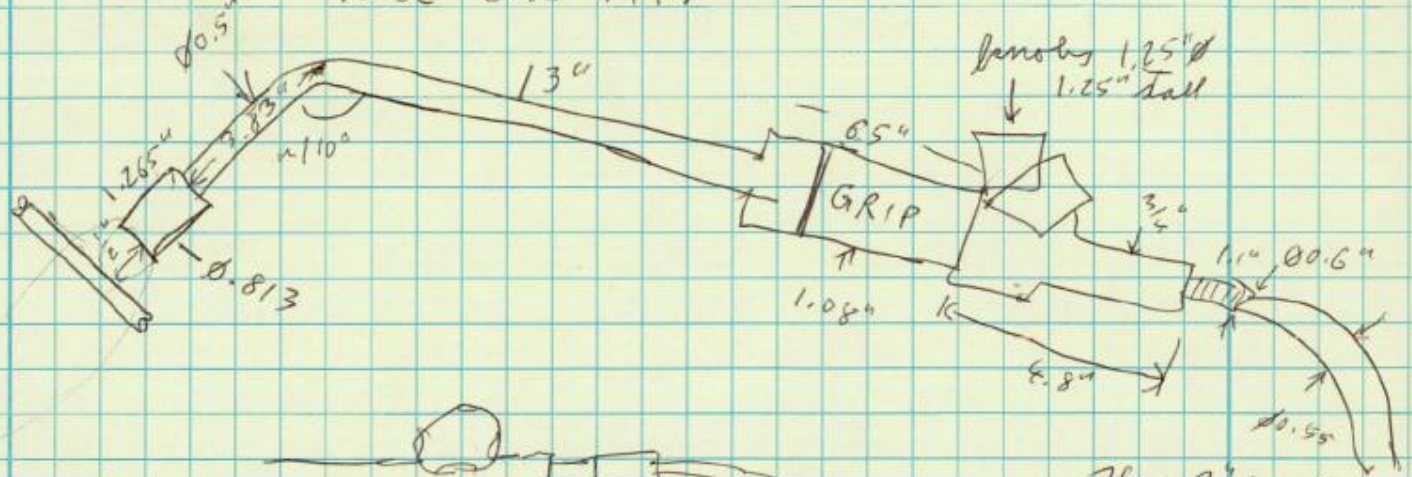
use 5562 - 5500 Charcoal

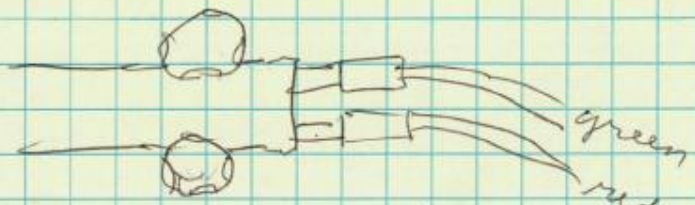
1717 = Navy
1750 = Royal blue
1117 = Almost black navy
✓4507 = light khaki
✓0001 = white (no dye)
✓5500 = charcoal

#2 Skunk Works - Shulong's Metal Splash Test 1/28

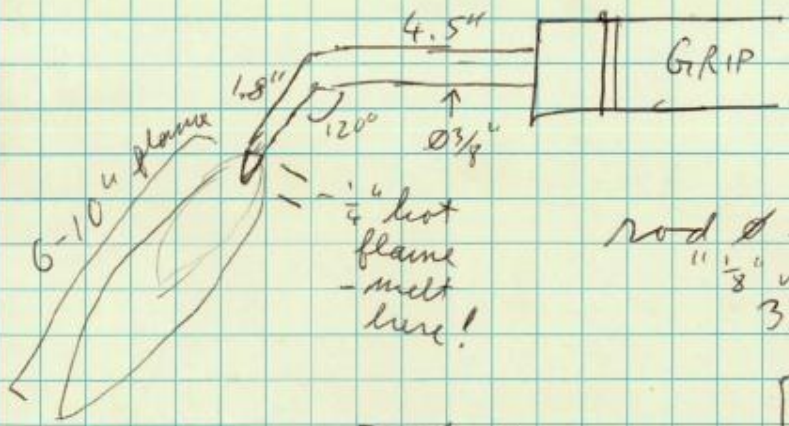
Acetylene torch dimensions:

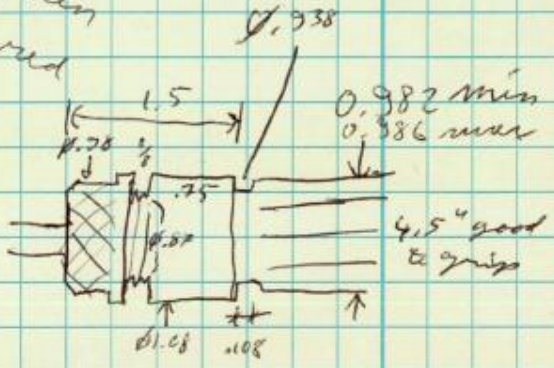
ROSE BUD TIP!



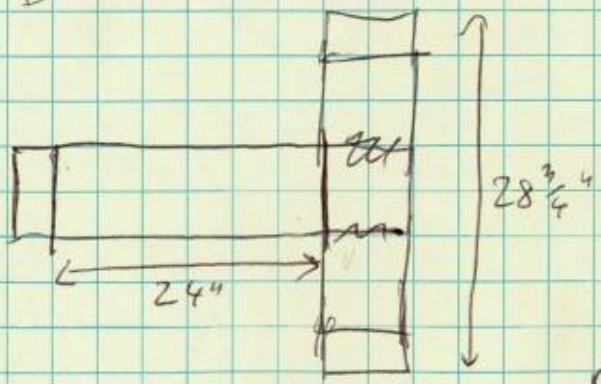


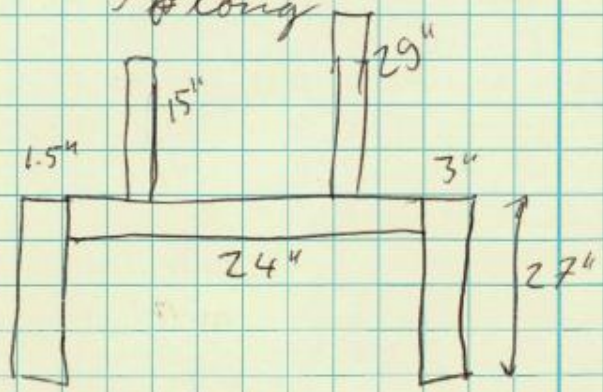
Actually, use a different tip.

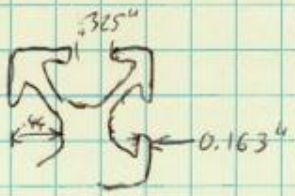




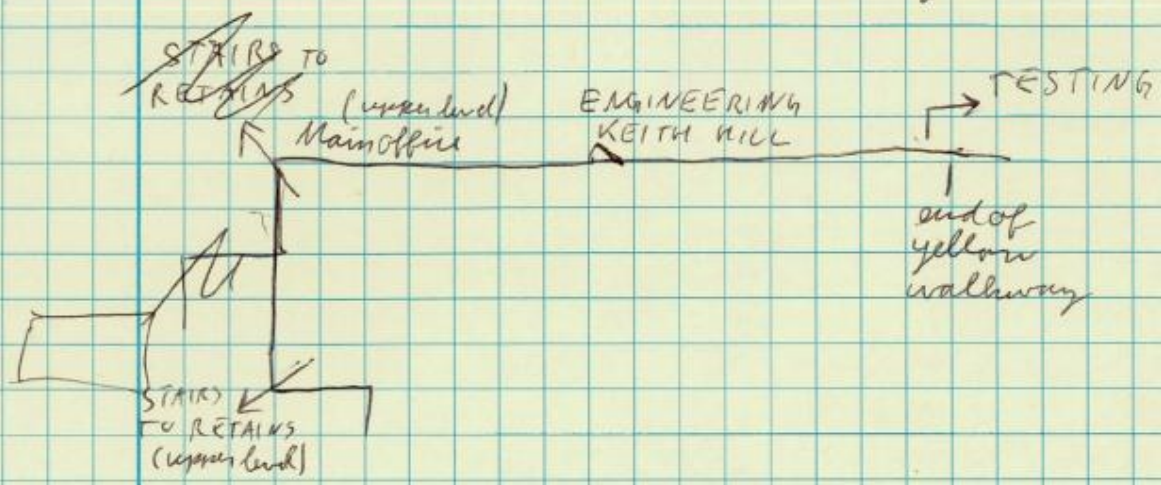
rod Ø: 0.153"
"1/8" welding rod mild steel
3' long







#3 Splish Splash - Retain Testing 1/31



Hunt for retains (2) 5562 - 5500 (grey)
(5) 5590 - 1717 (navy) or 1750
(6) 5570 - 4507 (lehabi) or
(2) 1750 (royal)
(16) 5565 - 0001 (white) or
(2) 1116 (blue)
to end of 4th shelf (2 more to wall)

Found:

Box date	Test	test date
5562 - 5500 (grey)		
July/Aug	876	7/14
July 2013	857	6/10
5565 - 0001 (white)		
11-13-13	801	10/30/13
10-31-13	858	10/16
10-31	813	10/4
9-4	836	8/24
10-14	850	9/28
5565 - 1116 (blue almost black)		
July/Aug	?	6/13/13
July/Aug	825	6/26
5565 -0001 cont.		
Aug 2013	886	7/18
3-29-13	866	4/4
3-29-13	861	4/3
3-29-13	919	4/16
July 2013	827	6/26
July 2013	826	6/26

Box date	Test	test date
5570 - 4507 (lehabi)		
10-4-13	873	9/16
10-31	875	10/21
10-31	817	10/11
10-31	822	10/11
Aug 2013	816	7/31
5-22-13	910	4/15
5570 - 1750 (royal)		
11-13-13	893	10/28
10-4-13	848	9/11
5590 - 1717 (navy)		
10-31-13	823	10/14
10-14	856	10/1
10-14	854	9/24
5/22-13	856	5/6
5-22-13	855	5/6
001 5-22-13	869	5/6
July 2013	831	6/27
July 2013	834	6/27
001 5/13	883	4/6
5/13	884	4/8

#3 Splish Splash - Retain Testing, ctd. 2/5/13

Richard Graves and Brian Faulkner punched out weights and sorted samples for me. I have split up the ICP workload as follows:

URGENT 60 (due Fri 2/7)

5562 - 5500	857 (no AR), 876 (no 100W)		grey
5565 - 0001	801, 858		white
5565 - 1116	825, 894	(all)	black (navy)
5570 - 4507	873, 875		khaki
5570 - 1750	848 (no25), 893	(all)	royal
5590 - 1717	823, 856-100W		navy

GEORGE #1 48486

white 813, 836, 861 (no 50)

navy* 854, 855 (no 100), 856 (no 50) *5590

GEORGE #2 48488

khaki 816, 817, 826

white 822, 831, 850

~~GEORGE #3~~

GEORGE #3 48490

khaki 910 (no AR) white 866, 883, 919, 869 (no 100W)

NO TEST

834 - no AR, 886 - no 50W, 827 - no 100W

Weight on 861-100W (white) corrected: 2.35 g not 3.35 g
- weighed out in analytical, 2.0461 g + 0.3087 g ICP sample

#2 Skunk Works - Magnolia Wet-out 2/6

At meeting on 2/4, James Banks and Keith Hill are on board, excited to try.

Minimum add-on would be
4.3 oz/yd @ 110 YPM

Max
8.7 oz/yd @ 110 YPM

Water pressure is 60 PSI, but can only count on 50

Demand @
6" spacing - 3.46" distance - 0.325 to 0.717
8" spacing - 4.62" - 0.433 to 0.956

Theoretical: 120° .3 20 PSI - 0.33 40 - 0.46 60 - 0.56
120° .5 20 PSI - 0.54 40 - 0.77 60 - 0.94

Try to verify!
Bucket = 160.52 g

Pressure	12" bit	16"	Flow inner		0.8 Nozzle 12"	16"	Flow sec	
10 PSI	6"	6.5-7	805.7g	60	4.2		1333.9	60
15 PSI	~4.6"	6.0"	980.5g	60	4.1		1741.9	
20 PSI	~~4.6~~ 3.9"	5.3"	1166.3	60	3.8		2020.4	
25			1310.7	"			2232.7	
30			1464.6	"	3.5		2468.1	
35			1575.6				2214.6	50
40			1671.6		3.4		2371.5	50
45			1763.5				2038.0	40
50			1886.3		3.4		2105.6	40
55			1976.5				2214.1	40
60	3.5"	4.4"	2070.0		3.2		2316.5	40

Nozzle spacing: Theoretically, could stagger both bars ±2" to spread out flow on thin spots, but rarely use both. Better to keep both parts the same.

! Actually, can stagger on the machine! Best of both worlds
- just make pipes 4" longer and center
- 3" stagger is enough... 68" fabric!
- cut pipe short later if problematic?

#3 Splish Splash – RMC Preparation 2/13

Rajib: Him & Lets check @ 10 washes for the initial stage – large quantities. "Reliable data @ 100 washes would definitely be useful but is not critical"
15 pieces from plant trial
Develop for 1.5–2.0% when need 1.5%
↳ sometimes get 1.7%
→ Idea – test fabric with no treatment
100% cotton doesn't lose any phosphorous
"5 or 10 wash increments would be better"
cure at different temperature
Rajib can look
– do a familiar treatment, 3 temperature
Follow what Sintas is doing

— — —

2/24

I have 30 pieces 16"×39" (cut oversize to 17"×40") ready for padding. Try to do 300°F and 330°F setting today with 12 pieces each. Finish the rest tomorrow.

Treatment chemistry:
(courtesy of Rajib)
caustic = 12% NaOH
check pH ~ 5.5–5.6
Actual 5.7 pass

40psi nip pressure

1–12 cured 4 min @ 250
3 min @ 330°F

13–24 cured @ 250, 300°

40% P_{20} 10M

	%	g	
Urea	7	140	✓
Water	45.2	904	✓
DSH	40	800	✓
NCM	.2	4	✓
1928M	.2	4	✓
HDC35	5	100	✓
12% CaNSbic	2.4	48	
Total	100	2000	

found 3
✓
✓
2nd to last ✓
✓
✓
✓
last ✓

Then "oxidize" wash in large washer, extra large (lot) one rinse / hand wash 6.
– fill then add 250 ml NaOH to fill
– then turn to Delicate rinse
– repeat: fill, add "liberal amount" of H_2O_2
Delicate rinse
– 3 NaOH – H_2O_2 cycles then dry

2/26

Finish last batch (360°F) 31–42
First NaOH – fabric not frayed! First H_2O_2 – still not frayed
2nd NaOH but – still OK Pick 2nd did a full wash cycle!
3rd NaOH ✓ H_2O_2 ✓ dry – a little more frayed, not as wrinkled

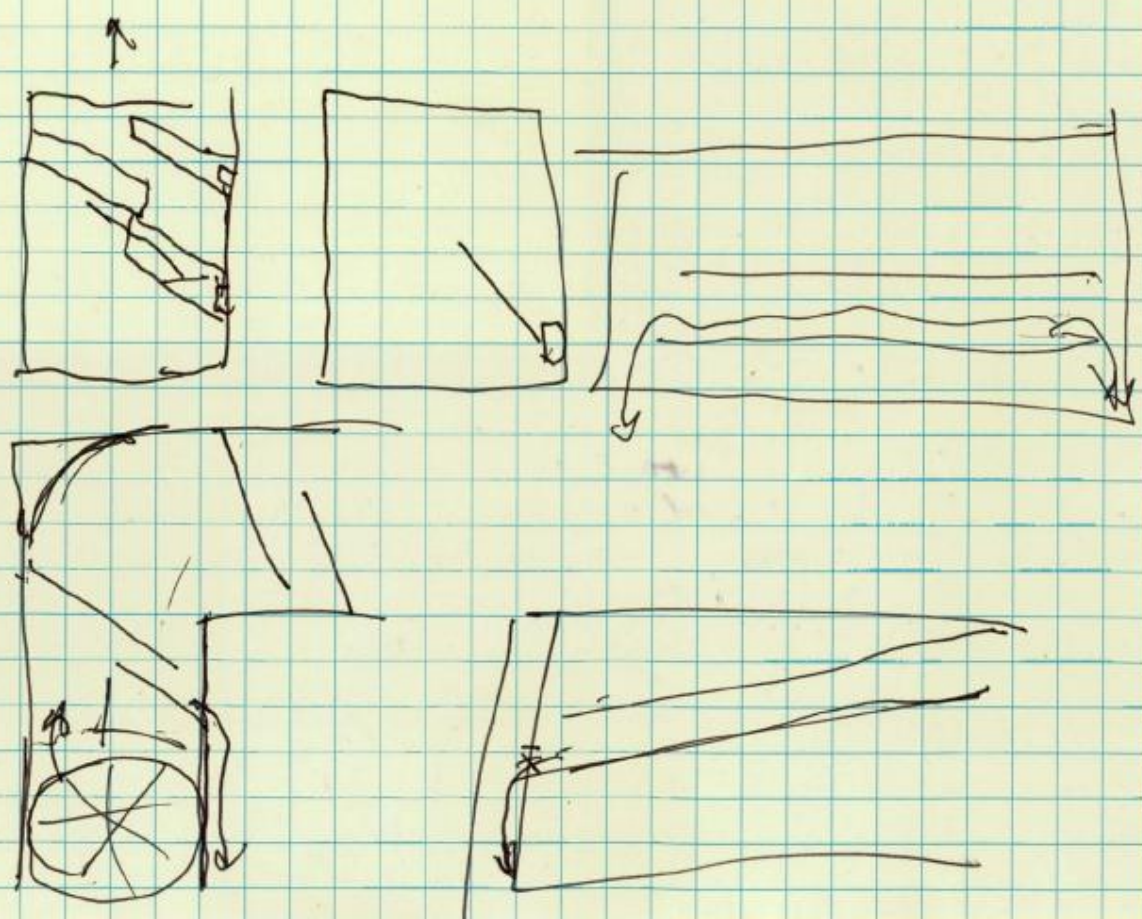
#2 Plumb Works - T2 Cleaning 2/16

Arrive 7am - Bernie forgot, but no clean until 8:30 anyway.
Derrick gave me tour - drips coming out of plenums
- middle ones over rolls are ~~blocked~~ capped off because they can't be cleaned
- back door won't open because of junk on floor

Daniel : Move the E-house would be better than trying to seal it
- concern is drains clogging and a flood/spill
- old, irreplaceable hardware in the E-house

James Banks - PI leader, going to safety meeting

Daniel - could also not recirculate air



#3 Split Splash - Magnolia Info 2125

Magnolia Milnor program:

		type	mins	%	temp	hot	cold	level	steam	drain	valve	flush sec										
#15		T	M	M	Q	F	F	F	MC	L	S	C	W	S	S	*	SpD	D	R	E
wash	01	2	1	0	0	1	5	0	13	1	4	4	0	0	5	0			v	
rinse	02	2	0	5	0	1	5	0	13	1	4	0	8	8	8	-				
rinse	03	2	0	2	0	1	3	5	13	5	4	0	8	8	8	-				
rinse	04	2	0	2	0	1	1	8	21	5	4	0	8	8	8	-				
rinse	05	2	0	2	0	1	0	0	21	5	4	0	8	8	8	-				
sour rinse	06	2	0	5	0	1	0	0	21	1	4	5	0	0	3	0				
extract	07	5	0	5	0	-	—													
	08	0																		

Milnor people: CLT (
ATL (
Whirlpool 704 466 - 9708
spin 500 RPM G-force ~180 FACT
regular ~60 RPM 50-60
wash: ↻ 20 sec ↺ 20 sec (with foam)

anti-crease 20sec / 20 sec action

Anthony - hemming machine operator
#15 translation:

01 2-way wash 10 min @ 150°F hot on, cold to modulate temp
low water level, steam - ~~not active~~ irrelevant? ? Add chemical #4
at start (no prefilling) for 5 sec ~~A~~ dumps it all in
one place, then dilute?
02 2-way wash 5 min @ 150°F H/C low level no chem
03 2-way wash 2 min @ 135°F level = 5?? " " 5 = 10"?
04 " " 2 min @ 118°F C/H level 5 " "
05 " " 2 min @ 100°F C/H lv 5 " "
06 " " 5 min @ 100°F C/H low level chem #5 added
right away for 3 sec Debbie Blanton
07 extract for 5 min
08 end

Hydrofluorosilicic acid $\rho = 1.23$ (Dan Tilite (513) 870-4830
Sour - Pinnacle Liquid Sour - MSDS in environmental
- use 0.6 oz (3 sec of pumping) - ~~30 g~~ 18 g
↳ minimum you can pump
Bonder = Sour-cide U.N.X. Incorporated 252-756-8616
Peristaltic pump = Nova Controls Model LM-250-Eclipse
~30 ft of hose

#3 Splish Splash - Magnolia Info, cta, Big Trial

Sour-Cide 30-40% trade secret
MSDS 12303 60-70% Sodium Silicofluoride
0-5% Sodium Bifluoride
no specific gravity

LM-200 puts out 12 oz / min or 0.2 oz / sec
~~1 fluid ounce = 28.4 ml~~ imperial
US fluid ounce = 29.57 ml
so we are probably using
0.6 oz → 17.74 ml
× 1.23 = 21.8 g

alleged requirement is 6 g powder - "use the same amount of liquid" - 6 g liquid (3.6 × two mils)

pumps needed ~ 46 sec to pump 8 oz (49 to 43)
(0.174 oz per second ~~0.214 fluid oz/sec~~
0.14 fluid oz / sec
3 sec → 0.522 oz weight 15.7 g

Sergitol 15.S.9 density = 1.006 100% active
- surfactant
- use 25 ml (5 sec, 47 sec is 8 oz)
0.170 per second × 5 = 0.851 oz = 25.5 g
22 g <=> 4.3 sec (can't do fractional seconds)

3/3 At Splish Splash 12:40 arrive 1:40 call Electrolux
2:50 pm - finally got driver installed
Model = WDX655 ??
Calvin - have old software, install 6.3
3:18 - music, not working 3:27 need to convert to Wascomat format

01 = 65 C = hot
02 = 58° C = ~~hot~~ medium 136° F
03 = 40° C = low
04 = 0

4:58 start - added chemicals right away
5:08 - start drain nothing sticking to walls
5:10 - rinsing (missed exact start)
5:15 - start hi rinse, drain took 30 sec
5:19 - rinsing (hi water)

#3 Splish Splash - Big Trial Notes

5:22 start drain ~35 sec, start rinse
5:25 still rinsing, 1½ minutes
5:26 start drain 5:27 final rinse - something didn't move
5:33 start drain 5:34 extract ~40 sec in 9 sec
Ernesto (516) 330-1798 ↳ 270 RPM?
5:39 done extracting, one more drain
→ nothing stuck to wall
5:40 drying levels never budged

use time rather than level no refill
#3 - bleach
#4 - flower
just use 1 & 2 only 6:35 time to wrap up

3/4 OK, let's try it! Jergito - 22 ml Tour - 14 ml

9:50 - start drat. detergent just rinsite the back
rotation should be 637 RPM ~ Hz
total time 64 min
10:31 start drain (last)
10:32 dry, 21 min left altho set to 25 min!
10:48 dry, "13 min left"
10:53 dry, 8 min
10:59 spinning slowly
11:00 off samples still slightly damp
upload Millibar 3 and test 2
start test 2 - 11:13 am
→ instantly flushes 1 & 2
flush again
11:17 start drain

3 min wash 1 & 2, drain ✓
2 min rinse none, drain ✓
3 min rinse, 3 & 4!, drain ✓
2 min Extract @ max, 40 sec to ✓
dry 5 min

11:18 rinse - no fle[illegible]
11:20 start rinse - [illegible]ing chambers! Now
siphoning o[illegible] fills again, siphons again
11:24 start drain
11:29 drain, coast down, nothing stuck 11:30 start dry
"7 min left" although 5 min dry
chemicals do not get added on second fill!
rags don't fall in dry tumble - slow down on WD5240
→ reverse would help

#3 Splish Splash - Big Trial Notes, ctd

11:42 detergents & samples loaded!
display says "Milliken"
11:49 upload Milliken3
11:50 START! 1 & 2 are flushing "68 min left"
12:18 40 left, start a rinse (lin water)
12:20 start rinse, flushed 3 & 4 only one flush?
1:30 extra 10 min dry because still damp
2:39 still damp, 10 more minutes
3:11 added 10 more, 10 more
UGH medium heat is 58°, but we want 68°!
→ set to high heat, 65°
3:15 pretty good, do 1 more dry
Factory settings are supposed to be 70, 60, 50
but we are at 65, 58, 40! 70°C is max
Each "10 min" is 7 min at med temp
56 min left - starts lin water rinse
52 min - start another rinse
44 min left - start final rinse, siphon works
"31 min left" @ 4:26 even tho 40 min dry 44 from 40
5:37 - changed temps to 65/58/50
but 65 is max - won't go hotter!
5:52 start cycle #4, "24 min left"
MAIN WASH - (17) DRAIN (17) RINSE (CD) 5 6:05 PM stuck on "17"
6:08 drain (17) RINSE (17) DRAIN (17) RINSE #2 (17) DRAIN (17) RINSE
@ 6:16 6:20 start last RINSE - DRAIN start @ 12 (11) EXTRACT
(5) DRAIN 6:34 start dry - 4 min left
7:27 done 7:30 start new cycle
lint trap has some balls @ bottom, not much though

3/5 7:23 am - start an 8-min dry cycle (fabric is damp)
7:34 am - start wash, "34 min remaining"
8:06 am - time left now 64 min
8:16 start drying - paused (54 left)
↳ fabric is damp but not [illegible] Probably damper than at end of cycle, but n[illegible] not.
8:3[illegible] pause (33 left) - still pretty damp
pause @ (23) - better, definitely warm/hot on parts of drum
9:12 done 9:15 restart reasonably dry...
9:43 back flush. Now (69) - 28 minutes in
10:49 start again clean air intake ducts!
12:51 started #9 1:46: "43 min remain"

#3 Splish Splash - Big Trial Notes, ctd.

3/5 continued...

1:52 38 minutes remain - fabric still a little clammy (paused)

2:06 23 remain - fabric is quite hot - a few pieces still slightly damp. When will it shut off?

2:11 19 left - start cool-down?
- slow tumble, much less air flow

2:12 - predict 18 left

2:15 - pause, 16 left - fabric is hot & dry

2:19 - 11 left - stop already!
→ cut dry time to 35 minutes

2:35 63 min left, started last cycle

2:57 63 min left, rinsing high

3:02 - final rinse - flooding chambers
left still faster to fill and to drain
(repeats once more)

Frank

Phone support: (516) 371-4400
x 114 Calvin Yan - programming
x 182 Gary - president, knowledgable

3:09 start extract, "time left 234"!
WTH??

(229) start drain / slow tumble

3:16 DRYING - 40 min left air is kinda cool

3:24 - air definitely warmer, hot but not as hot as at end

3:42 - 14 min left - seems warm enough

3:51 - one thread from a red sample got caught in the vent, twisted up the piece

3:55 done!

4:18 - Maricoma struggling with directions, put sons in bin 2, running a wash to flush out

4:29 M. aborted program with a full drum

4:45 started #3 for real

5:00 I can finally leave

#3 Splish Splash – Magnolia Drying

3/6 • Submitted ICP samples – as received (A1 – O1)
• Submitted clear & weight samples – A2 – K2
– need to move L1 – O1 to clear / weight
– need to move A1 – O1 to weight for more fabric

• Submitted Magnolia sets to Debbie Blanton

All dryers set to medium heat
– fabrics aren't nearly as wrinkled
– Debbie says a cycle takes 22 minutes
Including cool-down... maybe 15 min of actual drying
Drying temp is 158° F (70°C)
1:25 arrive
1:50 ~~→~~ washers, dryers are idle
Dryers: Huebsch HT050NQTB1G2W01 130,000 BTU/hr
1:59 – start end dryer 20 min heat medium
5 min cool down
wash – added 17 g Nelso Tents
11 g FSPP

End ~~washer~~ dryer – "fabric always feels damp" 130,000 BTU
Middle – OK Huebsch Originator 50 120,000 BTU
Front – "lint builds up quickly" 120,000 BTU
Calibration w/ no load: dryers swing from 174 to 122 F
really fast. – 158 was the midpoint

2:19 – fabrics feel pleasant, a touch moist, but certainly not hot (end unit)
Dryer #2 still going, started a minute later
2:29 – dryer 2 stopped, now in cool-down
Fabrics also feel nice, a little bit damp
2:59 – got T/C reader from Benjamin
72 F in testing area
Red & Yellow = K type Red & White = J type
we have red & yellow
3:13 – 118°F 3:14 start 96° F Dryer #2:
3:15 – 96-98, start timer (reset 25 → 20 min)

+1	100	+5	104.9	+9	107.5	+13	109.1	+17	119.5
+2	101.7	+6	105.9 → 104.9 (drop)	+10	108.0	+14	109.4	+18	121.7
+3	102.9	+7	106.4	+11	108.3	+15	110.1	+19	124.8
+4	104.5	+8	106.9	+12	109.0	+16	115.1	+20	126.1

#3 Splish Splash - Magnolia Drying, ctd.

3/6 Continued

+21 - 127.0 shut off burners! drop fast...
+22 - 115.5 ↓
+23 - 104.0
+24 - 95.5
+25 - 90.1
+26 - 85.4 26:45 done
+27 - 85.7
+28 - 90.7

Probe depth
~ middle of duct

After 16 minutes, change to a steeper exponential

#3 Splish Splash - Sour

NFPA 2112 requires 6g of sour (sodium silicofluoride) and appendix A.8.1.3 specifically recommends sourcide from UNX Chemical Co.
Sodium Silicofluoride = Sodium Fluorosilicate (Wikipedia)
Na_2SiF_6 density = 2.7 g/cm³
solubility = 0.64 g/100 ml @ 20°C
Hexafluorosilic acid $(H_3O)_2SiF_6$
↳ density is 1.22 g/cc (25% solution)

% solids in liquid sour = 6.87%
↳ should be roughly 0.1854 g + 0.9313 = 1.117

Hydrofluorosilicic acid = Hexafluorosilicic acid
= Fluorosilicic acid
↳ pH = 1.2 @ 1% solution

Magnolia Liquid sour
pH = 1.2 straight up
pH = 1.7 10:1 diluted

Magnolia Sour-cide
pH = 3.8 (7% solids) *
pH = 3.5 (0.7% solids)
* not very soluble

Rajil helping
↳ determine normality NaOH titration, pink indicator
5 ml sour
vial = 66.12 g w/cap add 5 ml sour
+ 5.71 g ~~[illegible]~~ density = 1.142
add 95 ml water (20:1 dilution)
→ 100.30 g total
Flask = 88.72 g → tare
+5 ml = + 5.03 g
+2 drops indicator 3.5 ml - still clear 5.6
+7.0 ml NaOH (0.3M) = neutral

$$N = \frac{7}{5} \times 20 \times \frac{1.25}{1.2} = 29.2\,M \times 0.3 = 8.75\,N$$

correction factor

→ 12.20 g (7.17 g added)
0.5110 g Sour-cide + water → 100 ml
100.11 g new added material
heat a little to dissolve 99.80 g left - volume expanded
5 ml → weighs 5.06 g (with 3 drops indicator
1 ml - clear ~~[illegible]~~ too much... ~~[illegible]~~ ml neutralizes
5.03 g added 1.15 ml
5.07 g w/indicator

#3 Splish Splash - Sour, ctd

$$\frac{1.15}{5} \times \frac{100}{0.511} \times \frac{1.25}{1.2} \times 0.3 = 14.06\ N$$

→ Powder is 1.607x as concentrated
6 g powder ~~<=> 3 g liquid~~
<=> 9.64 g liquid

Analytical: 6.87
Straight up: 7% solids → 14.56 dilution
$\log_{10} = 1.163$

pH of powder 1.16 less? 3.8 - 1.2 = 2.6
dilute 10:1 pH should change by 1! ??
3.5 vs 1.7 3.5 - 1.7 = 1.8

#3 Splish Splash – Dryer

(at Durham laundromat)

3/6 11:45 – 65 minutes left. 77 when I came – must have started the wash when I said I was just about to arrive (12 minutes away; main wash still running when I got there)

66°F exterior temperature

12:02 extracting, 49 min left Running Milliken 6

12:07 drain (42)

12:09 86° dryer exhaust temperatures

12:10 90.4° (start) watch times)

+1 95.2°

+2 102.2° start rain? ü

+3 110.6°

+4 111 – probe still heating up

+5 117.2°

+6 120 " " a bit

+7 126.2°

+8 126.4°

+9 129.0°

+10 132.4°

+11 138.2° getting uncomfortable, set up with

+12 crescent wrench to hold

+13 144.0°

+14 146.4° .. falling! 143 @ 14.5

+15 139.0

+16 133°

+17 135.0° (22 left) pause – fabric is still a little damp

+20 137.0

+21 141

+22 144.0

+23 147.4 (peak @ 147.8°)

12:33 fabric very dry

3/12 1:08 uploaded Milliken 8

1:14 start (84)

1:43 min in – filled

2:28 start main wash but no detergent!

1:28 stop after drain, first fill level changed 8→4

1:31 start again

53s done fill sour is #3!!! Damn Ernesto

1:40 – connect cable – error code 13

1:42 drain

1:45 start again Jergitol is too thick to siphon

– seems to react with the sour & gel!

#3 Splish Splash - Dryer, ctd. 3/12

Manually flush tergitol - oops
2:07 started another rinse, no sour (hi water)
2:10 start drain
2:11 rinse / fill high again (60)
2:14 drain
2:15 rinse still high water!
2:19 drain
2:19 rinse, no sour
2:20 sour flush! Yay - one thing works right
2:27 extract start 2:34 start drying
Monitor drying temps on medium heat

2:31	-3	66.6°F			
2:34	0	71° (rises fast)	+16	136.2	(136.8 max)
	+1	84.6°	+17	127.4	
	+2	92.2°	+18	121.6	(121.4 min)
	+3	98.6°	+19	123.8	
	+4	103.8	+20	127	brief pause still damp
	+5	109.4	+21	127	8 min left?
	+6	113.0	+22	130.4	
	+7	117.2	+23	134.2	
	+8	121.2	+24	130.4	
	+9	125.0	+25	125.4	
	+10	128.6	+26	120.0	(cool-down)
	+11	136.0	+27	115.2	
	+12	134.0 (falling)	+28	110.8	28:30 down - no air
	+13	123	+29	106.6	air off
	+14	124.4	+30	94.2	
	+15	131.2			

→ Fabric almost dry, still a few damp spots in creases
3:11 start #23 3:12 main wash flush
(will dry laundry)

Magnolia dryer 4/9: turn back on 10 min
temp = 144° quickly rise to 160° w/ Bernie's multimeter
152, 150 dropping 143, 137, 129 → 145, 153, ...
rise to 161, creep to 162, drop → 151, creep to ~~14~~ 128
quick rise to 149, 153, ... about 1-2 min left ... 128, 126, 122 (cooling)
Fabric feels very dry but not overdry

#2 Shrimp Works - Magnolia Wet-out Flows

0.5 gal nozzles

3/14 Flow test - 50 PSI 1 min 20 sec

Nozzle	ṁ	25 PSI	20 PSI	35 PSI
1	2550 g	1856	2454	3262, 3281
2	2665 g	1860	2499	~~3132~~, 3390
3	2678 g	1839	2452	3303, 3312
4	2554 g	1783	2386	3213, 3249
5	2602 g		2461	3274, 3315
6	2700 g		2566	3449, 3502
7	2641 g		2505	3401, 3428
8	2519 g		2362	3232, 3221
9	3102 g	2872	2878	3896, 3899
10	3101 g, 3081 g	2889	2924	3941, 3954
	80 sec	80 sec	120 sec	120 sec
11				3180, 3192

3/18 Flow test - 0.8 gallon nozzles

max flow is 35 PSI

	20 PSI	
#1	2569 g	2629, 2726
2	2640	2760, 2744
3	2518	2566, 2655
4	2578	2664, 2630
5	2581	2654, 2713
6	2689	2771, 2757
7	2579	2675, 2716
8	2659	2742, 2715
9	2545	2606, 2654
10	2631	2725, 2695
11		
	(80 sec)	(60 sec)

Note: all odds done together, all evens

see Spray nozzle math 3.xls

#3 Split Splash - Component Analysis 3/24

Detergent components - analysis
- solubility? density? compatibility?

graduated cylinder: 50.15 g

Metasilicate - has trouble flowing thru funnel!
8.9 ml = 58.71 g (+ 8.56 g) 0.962 g/cc
17 g → ~~[illegible]~~ cc 17.67

Triphosphate TSPP - flows much better
9.2 ml = 56.33 g (+ 6.18 g) 0.6717 g/cc
11 g → ~~[illegible]~~ cc 16.38

Sour-cide powder - flows well
9.3 ml = 12.97 g 1.395 g/cc
6 g → 4.301 cc
= 1" × 1.693 cm² = πD²/4
D = 1.468 cm = 0.578"

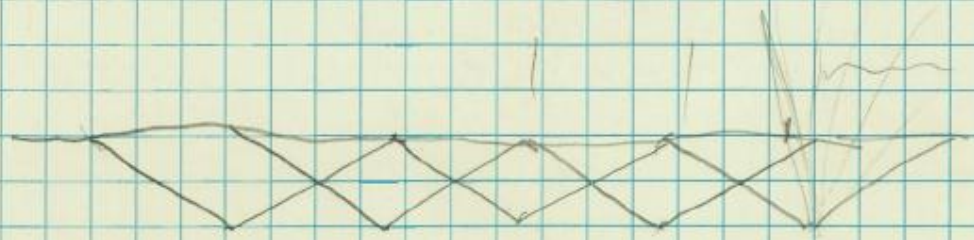
Beaker: 9.82 g

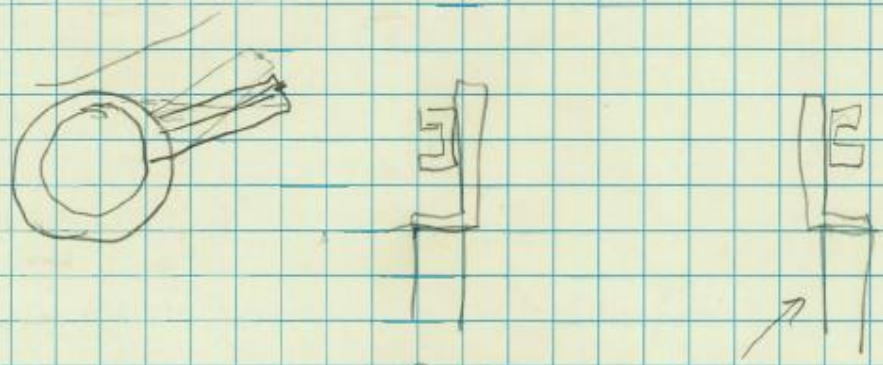
Metasilicate: 5.47 g
133.6 g total - not soluble
48.08 g total - ~~not soluble~~ dissolves with repeated agitation (1:29 pm - some material floating but seems stable - 1:33 good enough)

TSPP: 5.02 g
197.3 g total - settles out, keep stirring 1:38
some solids on bottom but OK - doable
1.43 - significant solids
51.28 g total - much clearer with almost no stirring, but residue in middle won't go away. More falls out slowly 1:48
amount left ~ 0.18 g incl. water
~ 0.07 g fairly dry - but may have poured some out.

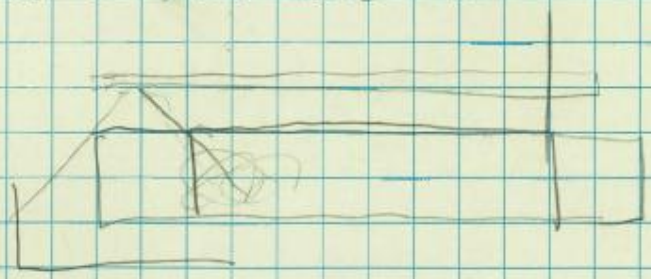
Zergitol: 12.2 g + 0.21 g sour - a little lumpier but no gel + 1.38 g (total) - no gel
+ 0.11 g TSPP - no gel
+ 0.28 g Metasilicate - no gel
+ bleach - no gel

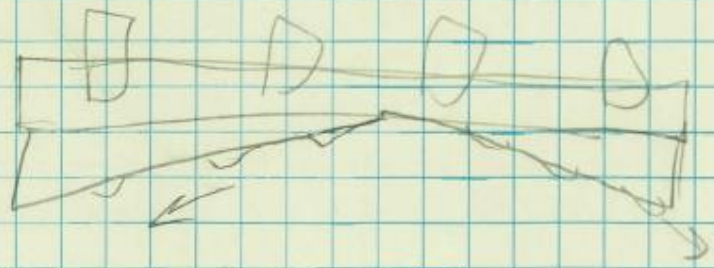
#2 ~~Splish Splash~~ Skunk Works - Spray bar notes





1) swap ends so legs are inside
2) angle up so no drips
3) get bar level
4) water restriction





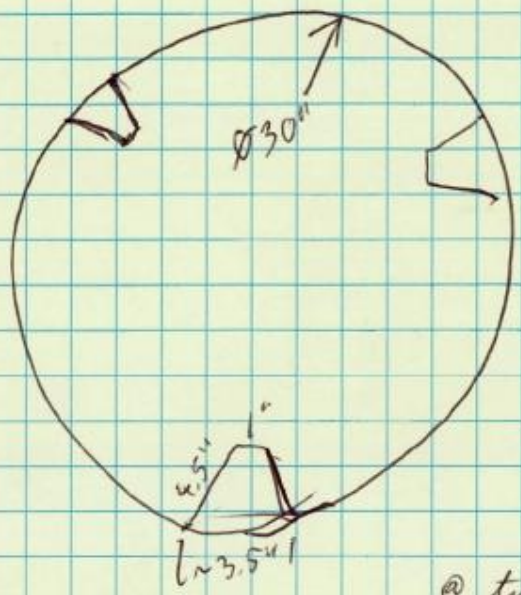
#3 Splish Splash - Magnolia metrics

5/19

1 dryer running on arrival & 1 washer

Washers have 3 paddles @120°

video of Milnor C



32" to center of drum
~16" to bottom of
gray thing
→ 17" is bottom
drum level

drain is 13.5"
(12" to 15" - 3" pipe)
- water is definitely
below drum level but
is drum empty?

@ time = 32 min, foam
in washer
dispense liquid soap??

Dryer #1 @ 125°F
→ 120°F
burners on to 126°F
" to 131° max
> 139° (missed it)

Dryer #2 log w/ Bernie's multimeter
11:20 Start 78°F 20 min dry setting
"medium"

← continue

min	Temp	
1	111°F	burners on
2	121.4	
3	128°	⇓
4	133.4	⇓
5	134.8	↓
6	132	off? start #1 on but temp dropping!!! Not enough gas?
7	126	on!
8	125.2°F	on!
9	123.6°F	on!
10	123.4°	
11	~~132~~	
12		
13		
14		
15	128.8°F	on
16	132.6	
17	138	
18	142	

120,000 BTU
1000 BTU/CFT
lin = 1/4 + 1/16 = 13/16 in

3" vs 7" water level
→ set to 5"

13/16 = 0.81"
nom. 1/2"
sch. 40 → 0.6221 ID

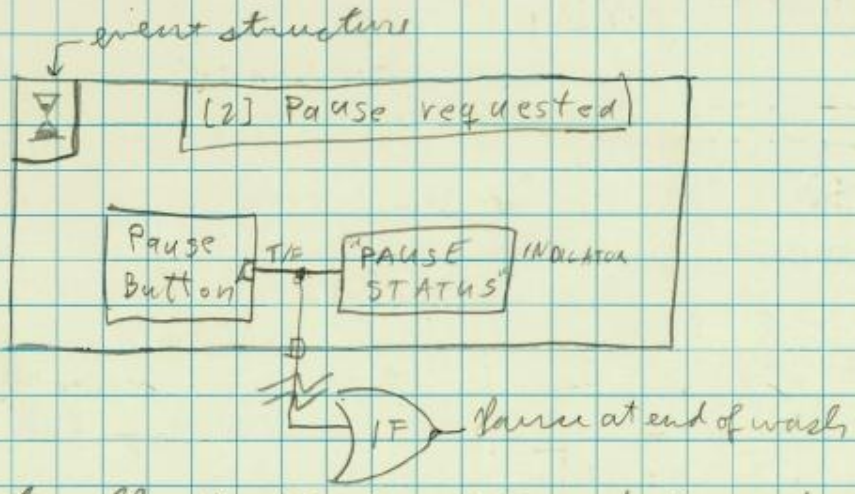
19	147.6	151 peak → off
20	143.2	cooling...
21	126.4	...

#1 end of heat cycle
116.8° ← still going!
+1 118.8° off
+2.5 101.4°

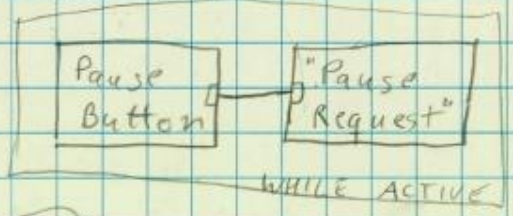
#2 feels dry
#1 feels very damp

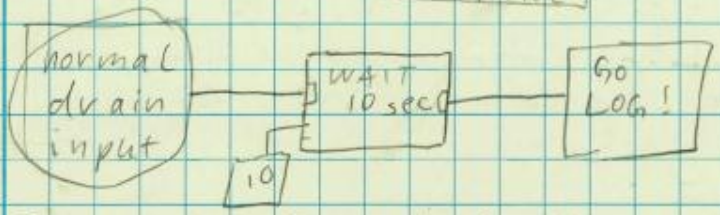
#3 Splish Splash - LabView notes 6/10

Here are some attempts to code snippets of the "Splish splash program flow chart" documented in MLKN01000 75017.



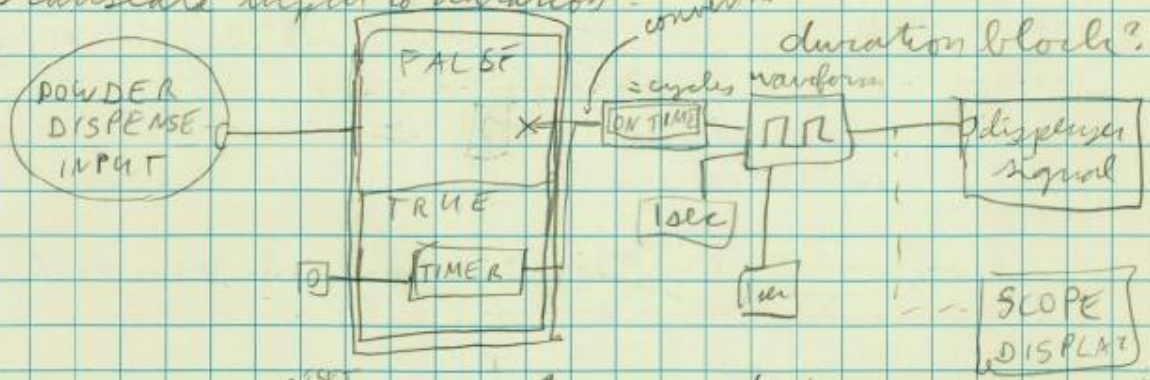
Actually, LabView is all event-based anyway! All we need is

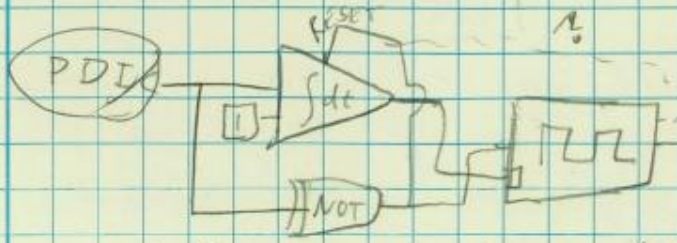




put in a debounce circuit? (wait 0.1 sec)

Translate input to duration:

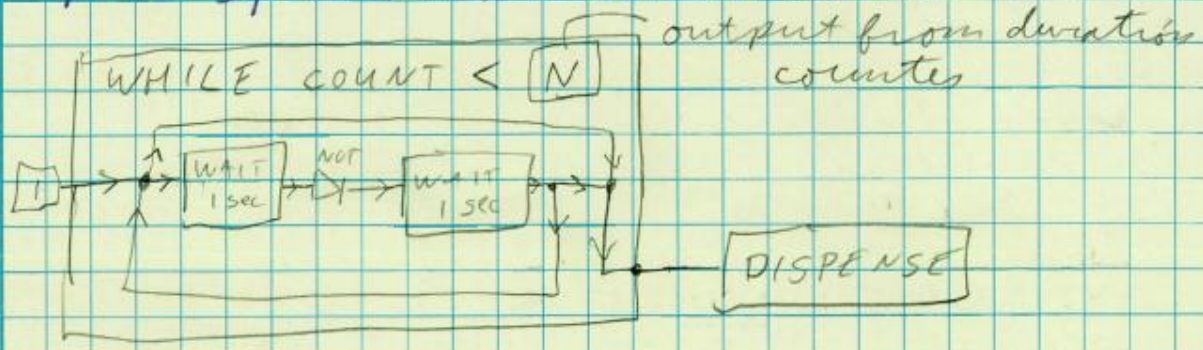




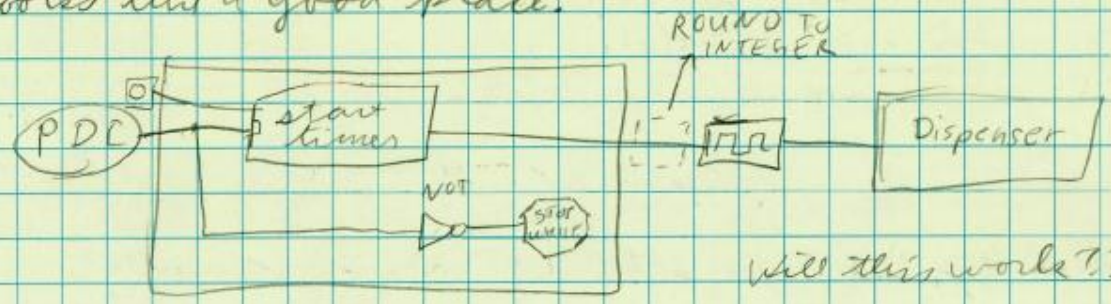
- start integrating on rise
- start wave on drop count
- reset integrator when done

start dispensing immediately ??

#3 Splish Splash - LabView notes ctd. 6/11



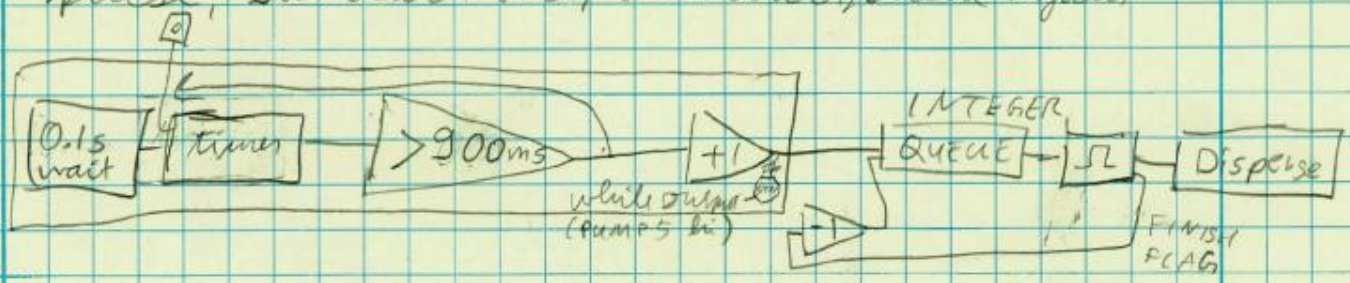
gotta dig through options... "Timed structure" looks like a good place.

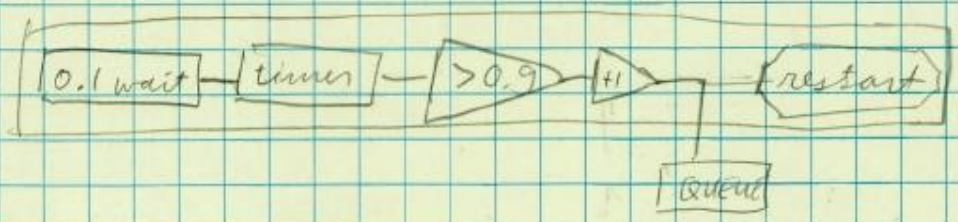


will this work??

(when does waveform start executing? wait on loop to finish? Right away? Build in a buffer?

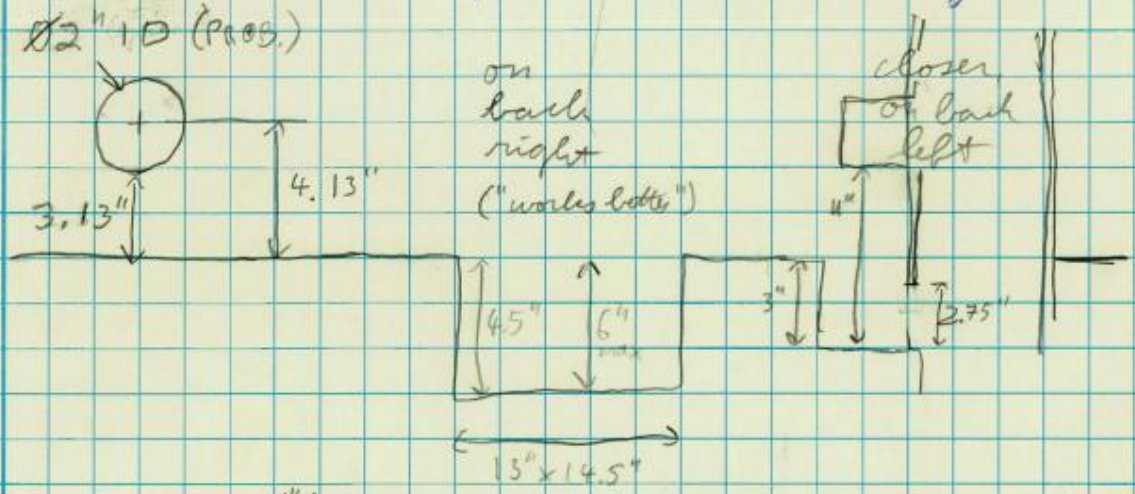
if timer > 0.9 add 1 to dispense queue, wait 0.1 seconds, reset timer. If queue > 0, do one pulse, subtract one, and wait/check again

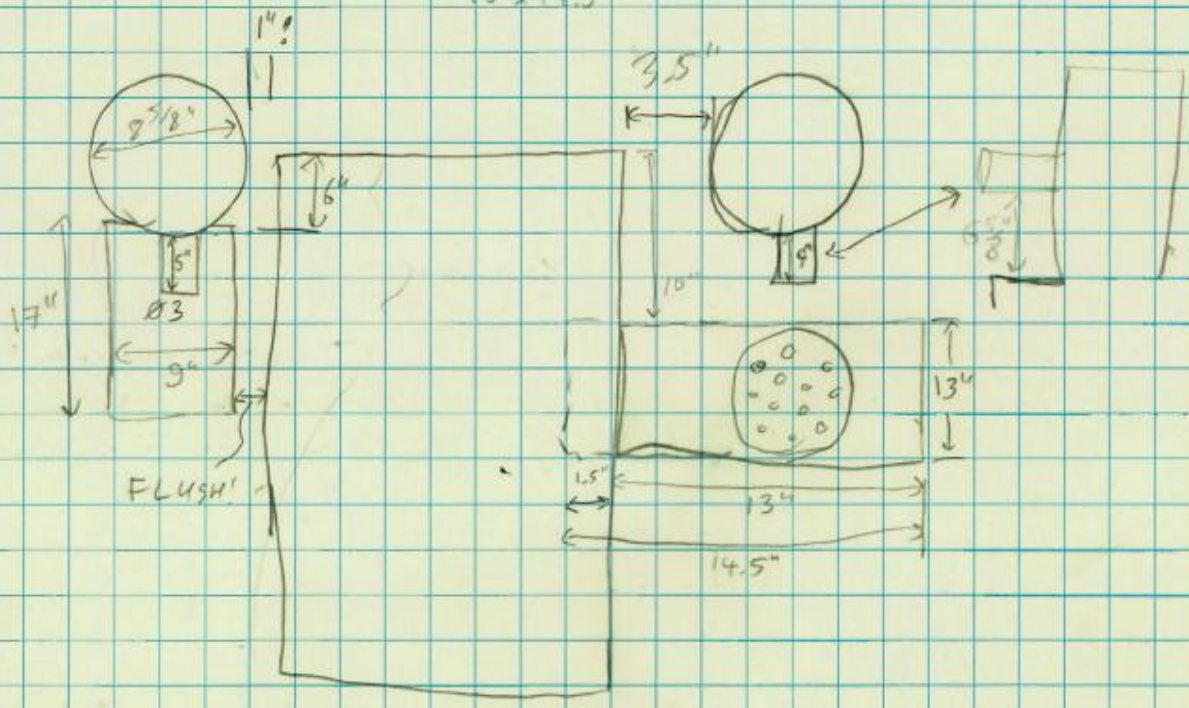




#3 Splish Splash - pH meter mounting

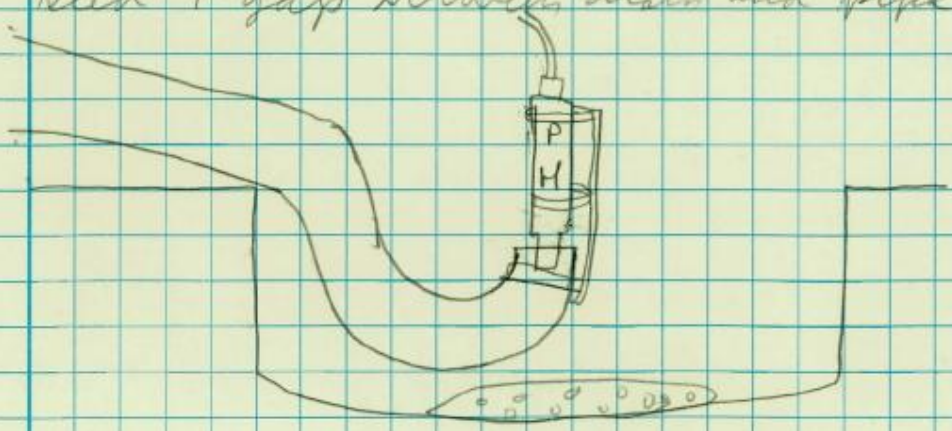
6/20





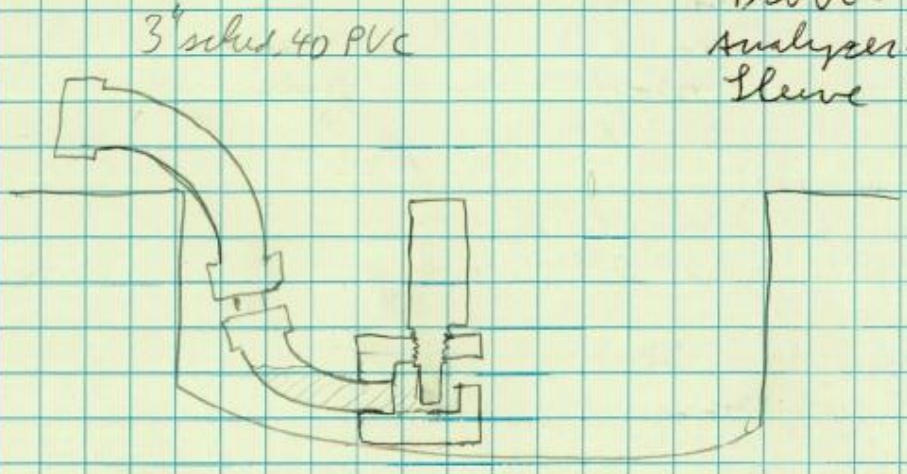
NOTE: could enlarge opening or cut off protruding pipe at the drain

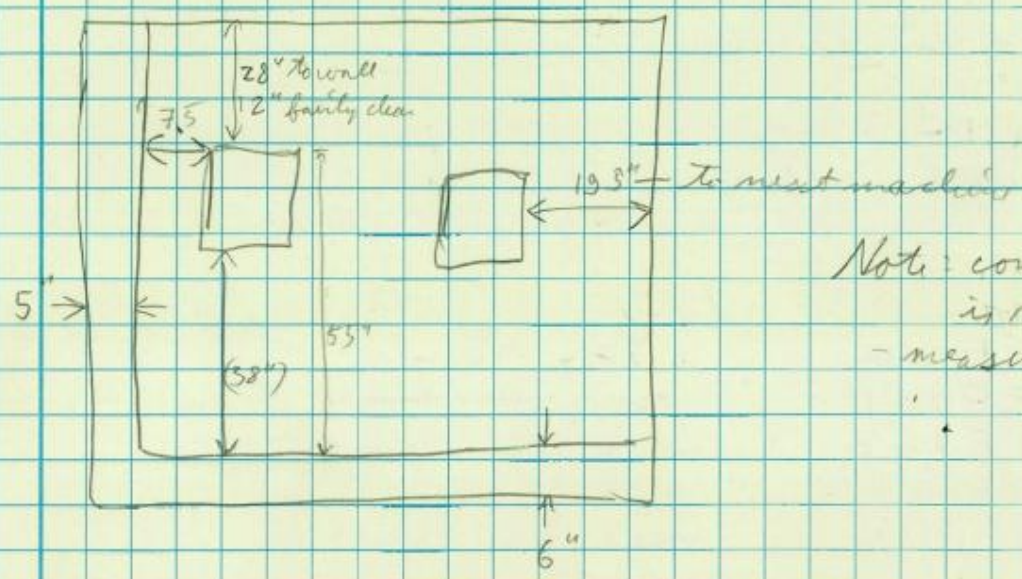
Need 1" gap between drain and pipe



#3 Splish Splash - pH meter mounting, ctd 6/20

Probe: 871PH-1G1A
Analyzer: 875PH-A2F-A
Sleeve = 005189





Note: concrete work is irregular - measure to minimum

Peristaltic pump tubing: OD ½" ID ¼" ~0.12" wall

Compresses to 0.23" to 0.21", with more force 0.165"

#3 Splish Splash - RFID trial

created 2 programs:
1 ~~socks~~ Tumble 1 min
⇒ 1 sample read 1700x in 1 min

Quick RFID wash:
3 min wash comp 1 - 30 sec flush
8" water, 130°F 0.51 G
+0.5 min drain
"drain A" active
1 min rinse - 5" cold water ~~rsm~~
0.51 G
+0.5 min drain
"drain B" active
2 min extract
890 RPM ~ 350 g
"drain C" active

~2 minutes to sew on an ID

11:06:30 am - start

samples
white : 3FF092
red : 3FF041
khaki : 3FF104
navy/purple : 3FF10E
grey/purple : 3FF114

Quick RFID wash 20dB
1654 wet → 1675 in 1 min
34 seconds to pick up
5th one in full water
8 readings worst one @ end of main wash.
900 in 18 seconds dripping wet

tumble, dry 1 min @ 20dBm
↳ 3747 reads
max: 894 min: 625 avg: 749
tumble, dry 1 min @ 27.4dB
↳ 3934 khaki red
max: 1026 min: 492
repeat:
3523 white: 525
max: 907 (khaki) min: 523 red
tumble, dry 1 min @ 17 dBm
↳ 3339
max: 1043 (khaki) min: 393 (white)
Throw khaki in back, red in front
(khaki) 743 690 (red)
(khaki moved back to front somehow)
tumble, moist 1 min @ 20 dBm
↳ 3067
max: 733 (white) min: ~~493~~ 432 (khaki)

~30 sec to detect in 8" water with detergent

#3 Splish Splash - Programming Details

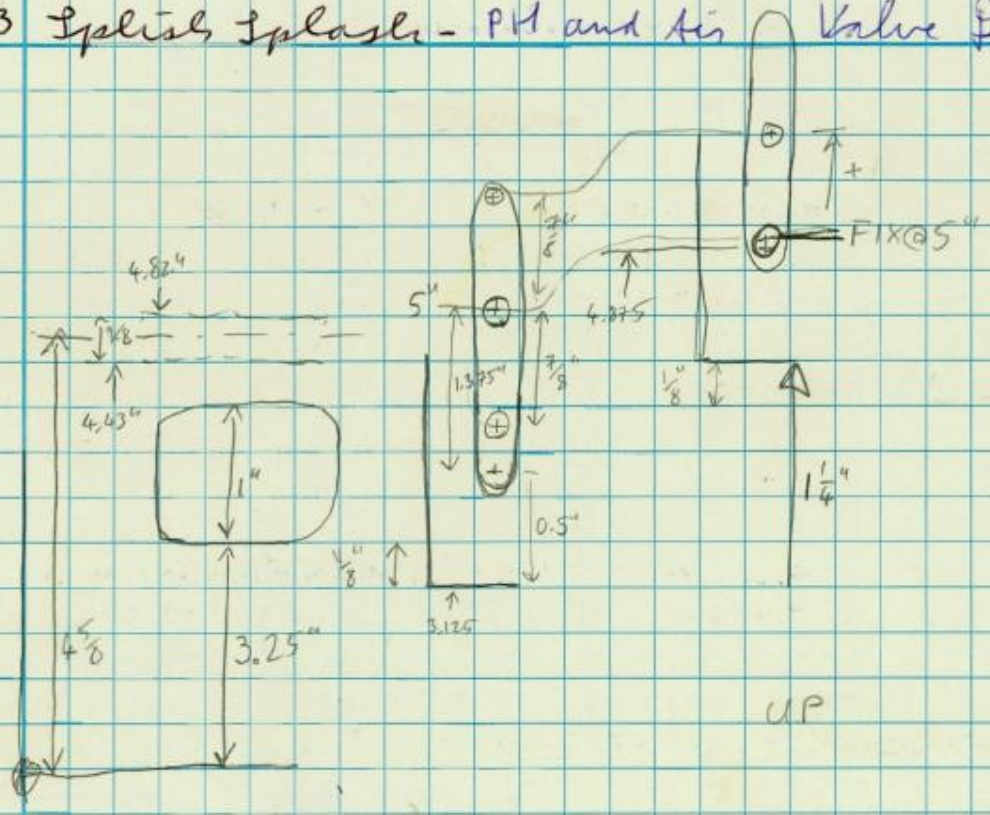
Start button/selector encoding: we have four signals, S1-S4.

Voltage	S1	S2	S3	S4	
Initial	0	5	5	5	
+1 CW	0	5	5	5	??
+2	0	0	5	5	
+3	0	0	0	5	(actual output)
+4	0	0	5	5	
+5	0	0	0	5	(MCU)
+6	0	0	0	5	??
+7	0	0	0	5	??? (INTERNAL)
+8	0	0	0	5	????
+9	0	5	5	5	
+10	0	5	5	5	(WEIGHT)
+11	0	0	5	5	
+12	0	0	0	5	
+13	0	0	5	5	
+14	0	0	0	5	(MCU)
+13 ←	0	0	5	5	
+12	0	5	5	5	
+11	0	5	5	5	
+10	0	5	5	5	(WEIGHT)

Press: S4 goes to 0V
release: S4 back to 5V

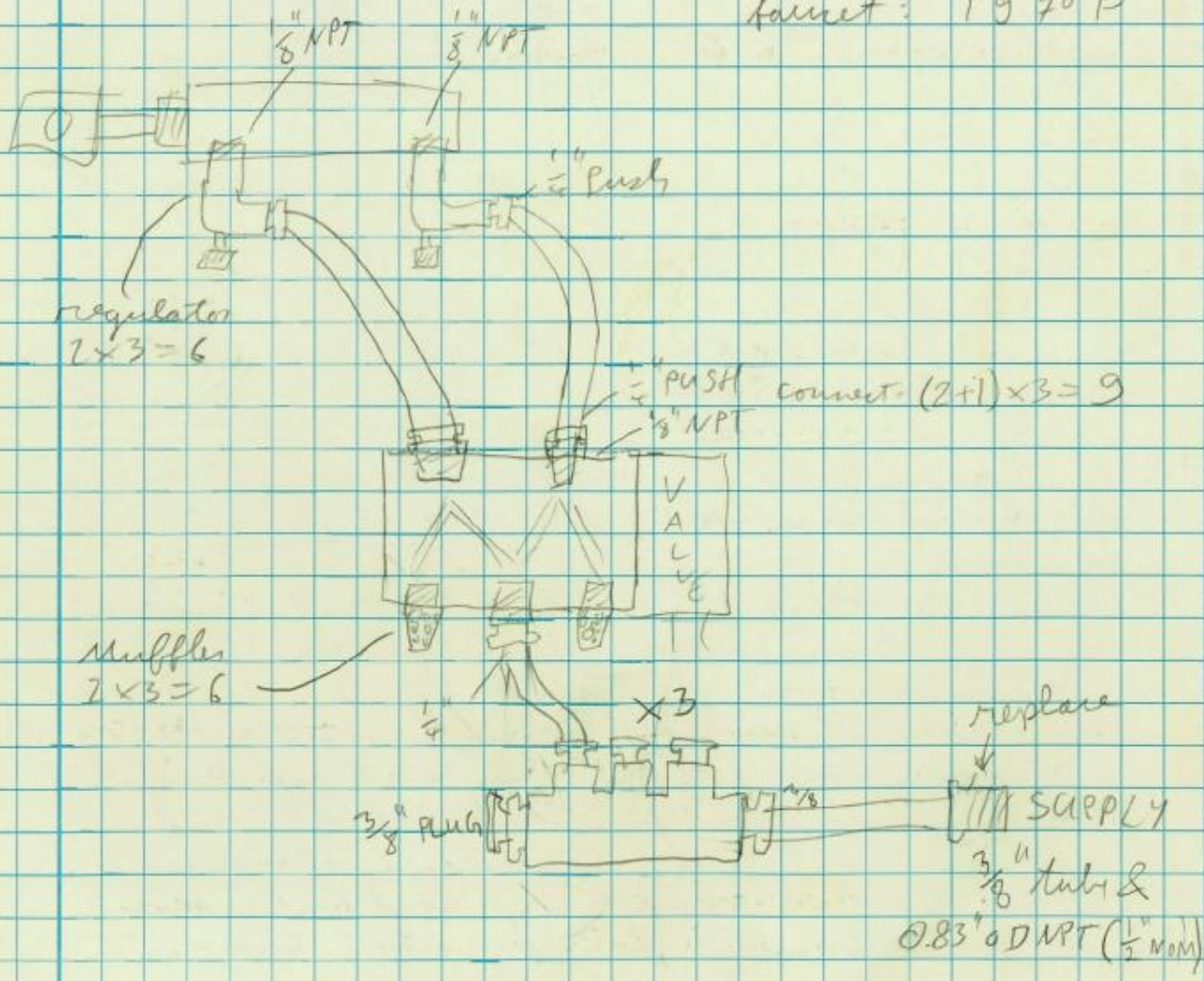
Status Menu - ON! (~~steps~~ must've been off before)
call N4 to get in Config 2 - set drain time
↳ default is 2.5 minutes?
↳ 5-digit code is generated, N4 will decrypt and respond corresponding password, good for a single use!
↳ Some confusion over "drain time" set in the program - Ernesto making stuff up. Washer should wait until water is low, THEN wait an additional x seconds as specified. Or is that incorrect too? Wait minimum of two? Timeout based on ??? Do some tests to figure it out.

#3 Splish Splash - PH and Air Valve Design



at drain!

Hot water: 192°F
faucet: 197°F



#3 Splish Splash - Wash timing

7/8

Run 3 min wash:

				repeat
start	0:00	Main wash		0:00 ☆
	2:07	Drain	86° F.	1:58 - 2:03 sec water
	2:21	Extract		2:20
	4:14	Done		4:06 Spin down
	4:39	unlock		4:33

* Water set to 80°F
1 min wash → 58 sec extra to fill to 4"
0:01 drain → 22 sec = 21 + 1 ?? need different program
1 min extract → 1:46 46 sec to accelerate to 100 G's
27 sec to coast down

☆ Note: 5 sec delay from drain → sec water
exit the pipe at 4" level

New program: DRAIN_TIMING
8" water @ 150°F for 2 minutes
↳ flush comp. 1 for 30 sec
Drain 1 min
Distribution 1 sec
Start: 0:00 - count wt ä 1:36 actual start
2:01 Begin flush
2:32 End flush temp = 89°F ?
4:09 Start drain 2:08 to fill
~ 4:28 Water level low ~~2:08~~ 3:08
~ 5:00 No more water ~ gal in 3 minutes
5:30 end drain/d
5:35 done
Redo, no count weight

0:00	start		0:00
1:05	flush (@ ")	30 sec advertised	0:59
1:35	end flush 114°F		1:29 123°F
3:08	start drain		3:01
3:39	water level low	+30	3:36 (34 min?)
3:59	no more water	+50 1:34	3:58
4:42	done	1 min!	4:37

started wrong program - can't get into status menu!
is it because common service tool's running?

7/9 #3 Splish Splash - Competitors, Sweden, & water temp

Competitors: 240 l = 63 gallons = 8.5 ft³ (WD5240)

Whirlpool - 4 Combination washer/dryers
2.5 ft³ gas or electric 1.5 ft³ gas or electric
(compact for home use. $1500 dial controls

GE - largest is 5 ft³ No combination

LG Electronics: 4 models 2.3 ft³ x 2,
4.3 ft³ ($1900), 24" wide compact

Samsung - No combination, 49 models of washer or dryer

Professional

ITW - Refridgeration, cooking, wet (components)

Manitowoc - Cranes, Ice Machines, ovens, beverage, refrigeration,

Alliance - Stove, Freezer, Washer (dish?), Dryer
(413) 443-1230 - parts & repair only?
↳ busy signal alliancecappliance479@yahoo.com ???
↳ seems pretty shady! Small...

Miele
- 3 washing machines, 3 dryers, home use

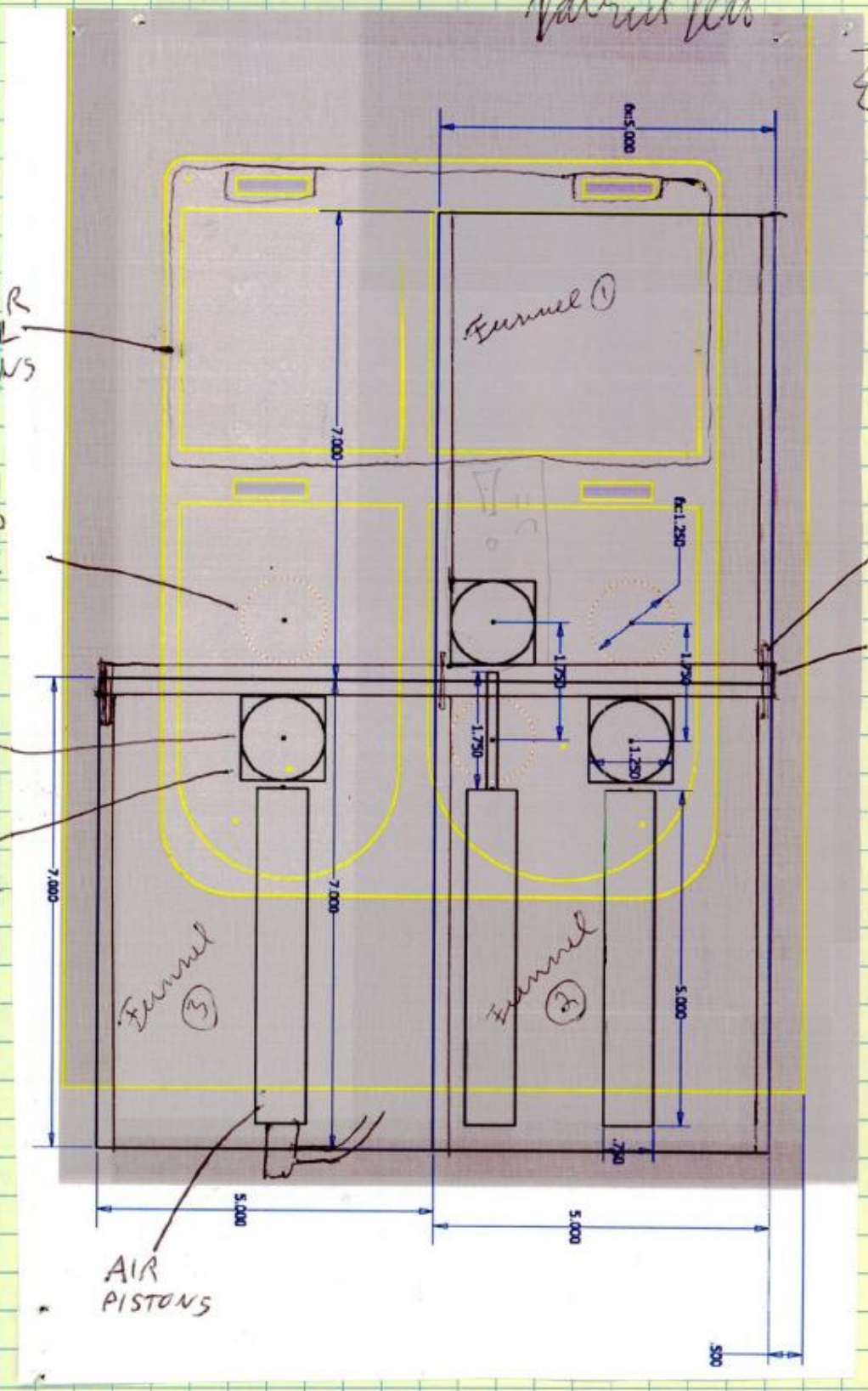
Bosch - "compact washers & dryers" $1400 max
24" compact

Indesit - (Italian) 65 products
capacity 5 kg to 9 kg (20 lbs)

#3 Splish Splash - Dispenser Design, ctd.

7/21

Patrick Pitts



Funnel:
460 in³
4.64 = 2 gallons

Air pistons normally in FILL position (0.25" extended)
Pumps @ 1.75" motion - 2" stroke pistons

#3 Splice Splash - Dispenser Design

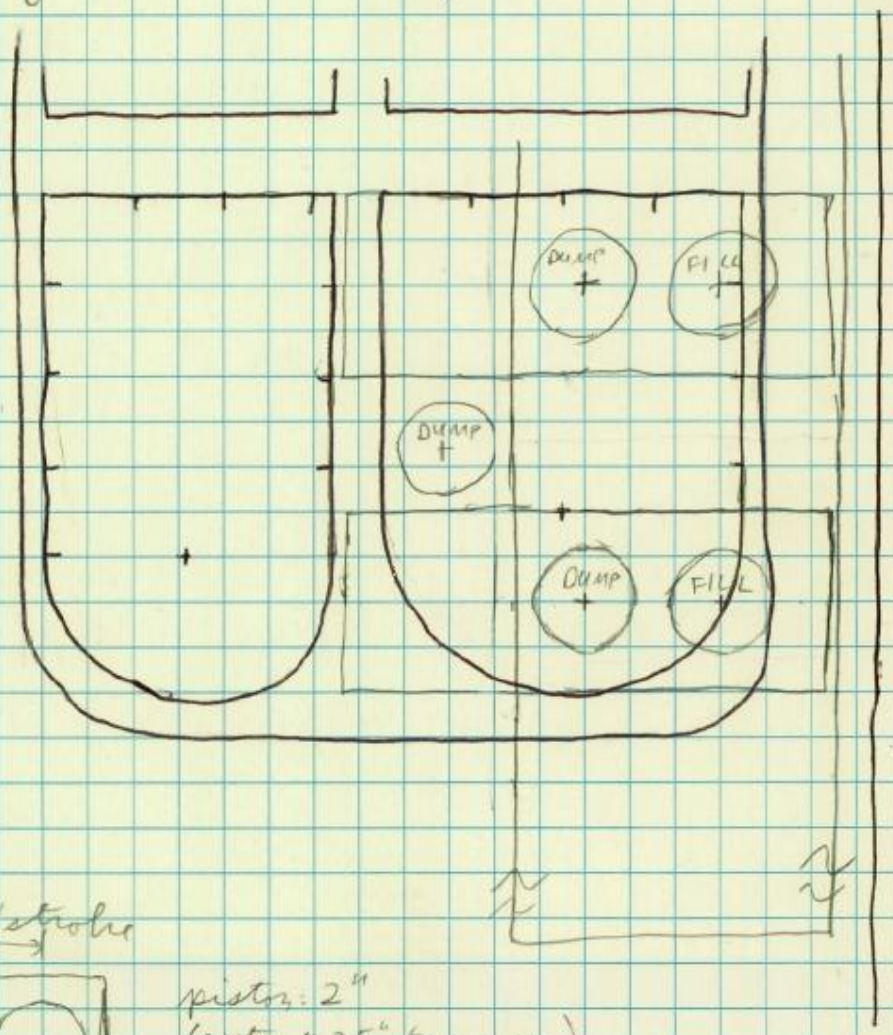
7/18

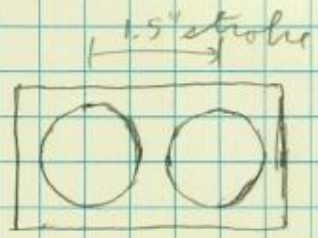
2.31" hinge to back of machine + 0.25 bar to lid inside
= 2.56" offset.

cutout: 26.55 in, 0.25 deep, 1" wide

One attempt - see next page! For layout

7/21

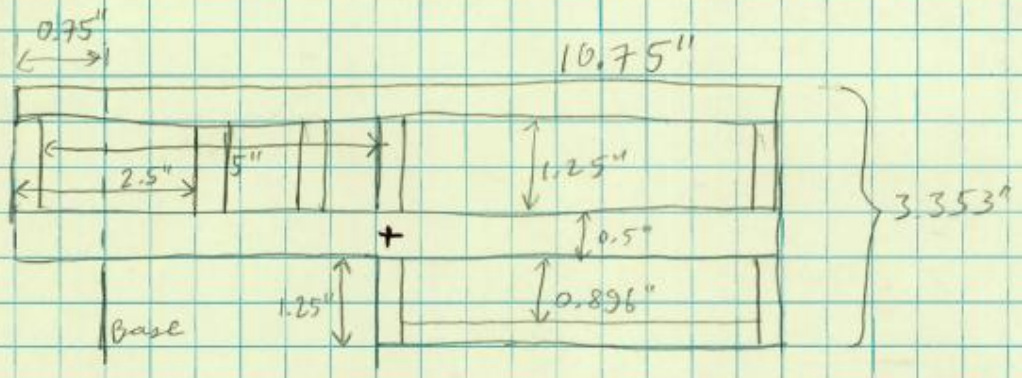




piston: 2"
(extra 0.25" to engage)

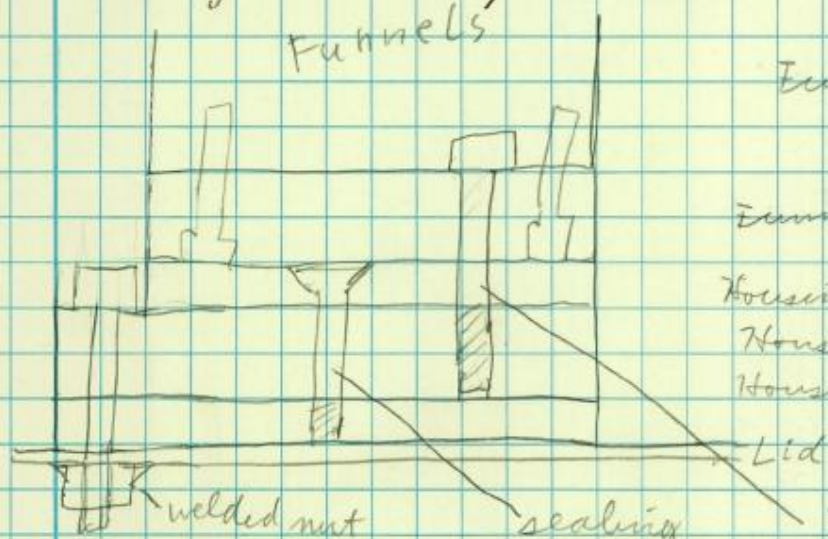
0.25" position + 1.5" = 1.75"

#3 Splish Splash - Dispenser Design, ctd. 7/25



Merge Housing Fill Face and Funnel Mtg Block?
Make 1" thick, eliminate 1 interface.
Bolt Funnel all the way down? Glue FMB to funnel to seal - No, need access to screens.

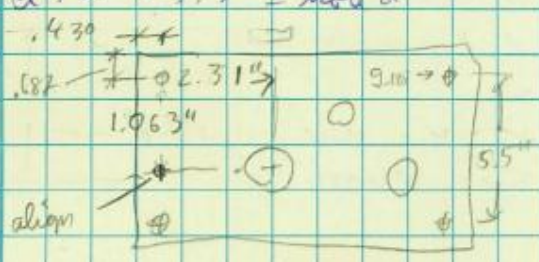
Bolting & Housing Fill Face 7/28



4 bolts tie all to lid
- removable as one unit
DO NOT connect FMB

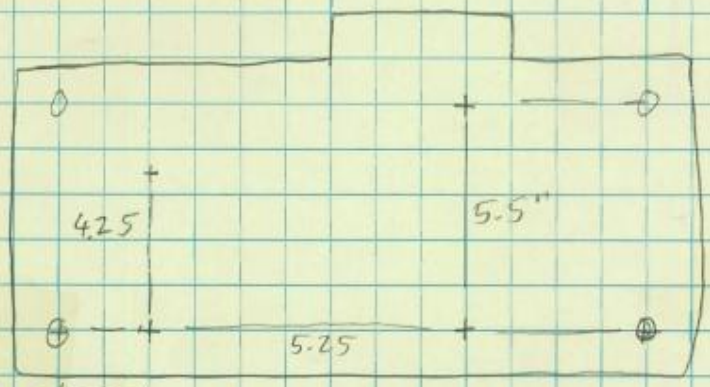
Dessicant: 10-20 mesh
Stock room has 4 mesh Dry-Rite

d159 = 9.125" below
d160 = 5.5" = hold d



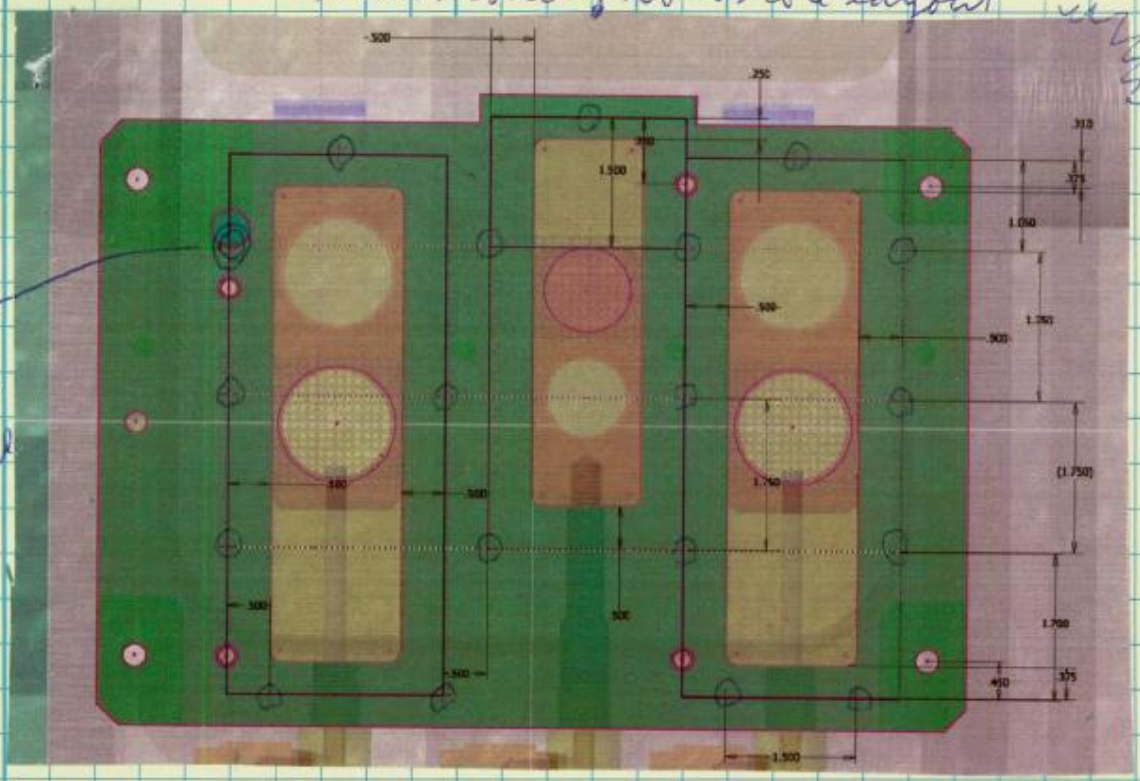
Alignment: $\frac{1}{8} + 0.97\,\frac{1}{4} + (<1)^{0.45}$
≈ 2.025"
use $\frac{1}{4} \times 2$" pin

#3 Splish Splash - Dispenser Design, ctd. 7/28



+ = 4 bolts to tie funnel to housing

Main sealing bolt hole layout



No! conflicts with funnel

Shift 0.01" to right to get 2.5" not 2.49" on wrong hole locations! 1.24" → 1.25" slider offset

Funnel 1.48" → 1.50" from left

→ Main holes align Lid: 0.43" → 0.42" from left edge

Funnel, etc. now 0.49" from edge

DAMNIT! Funnels were moved the wrong way.

Gaps now 0.205 & 0.245

↳ mount @ 0.51" from edge → binge!

LID offset 0.42" → 0.44" (not R side is 0.435")

↳ this moves alignment dowel

Lid nut may hit seal! 0.59" space - nut is .438" wide

↳ spacing now 0.25" w/ inside nuts moving in

Hole is now 0.31" from edge

→ PRINTS IN 7/30.

#3 Splish Splash - Design Notes

8/1

Ladder: remove McM 7928T72
8106T83 platform

PH threaded rod: total length
16.125 - 14.5 = 1.625" tubing w/ 2 x 7" rods
→ need 12.375" length
(min 11.875" max 13.5")
1" is just too short...

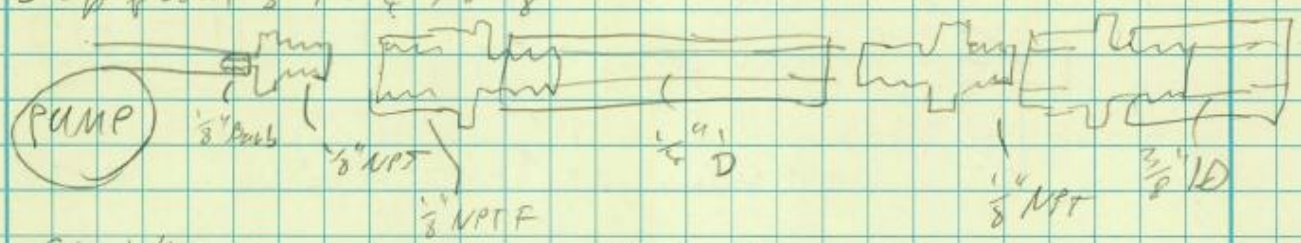
Tubing: McM has ¼" x ½" ⅛" x ¼"
3mm x 8mm (0.118" x 0.315") about ⅛" x 5/16"
And many others...

fittings? Eric uses "Nylon braided hose" but this may be Tygon or PVC
→ believed to be PVC
⅜" ID ⅝" OD → most likely 6534T22

Machine: ~ ⅜" OD protrusion

Pumps: ½" OD T-50-E Genuine Knight tubing
connects via ⅜" barb to ½" x ¼"
⅝" OD ⅜" ID nylon braid hose
KPC Made in the USA 7716
6th pump is "Horizon" KPC #5201 ¾" OD ~½" ID

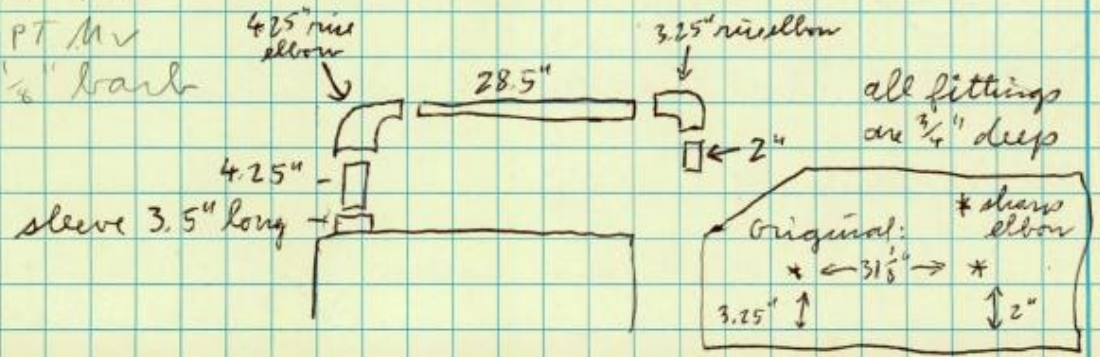
Step from ⅛" to ¼" to ⅜"



Go ¼" to machine or ½"? by both

⅜ NPTF ✓
¼ NPT M ✓
¼ NPT F ✓
⅛ NPT M ✓
⅛ to ¼" barb

Drain: ½" SS rod: 4.5" on R (inside) 9.25" on R (outside) to hold pH block



#3 Splish Splash - Design Notes, ctd. 8/11

Gas spring / Lid installation:

Close Blocks ×2 ¼-20 × 7/16 (2)

- one in existing hole (¼-20, any length/head)
  - ↳ Lid closes with ¼-20 (~½", maybe less) (2)
- second: drill 18" over, 0.261", same depth

Spring Mount Block (short one)

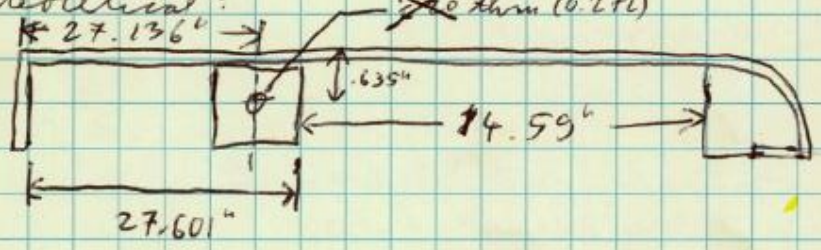
- nestle into corner on cross brace
- drill through .332" for 5/16" screw
- screw: ★ 5/16 × 1.75" with nut & lock, washer
- also drill hole for #10 on side
- transfer punch thru <.156"
- short #10 flat head ★ #10 × ½ ✓

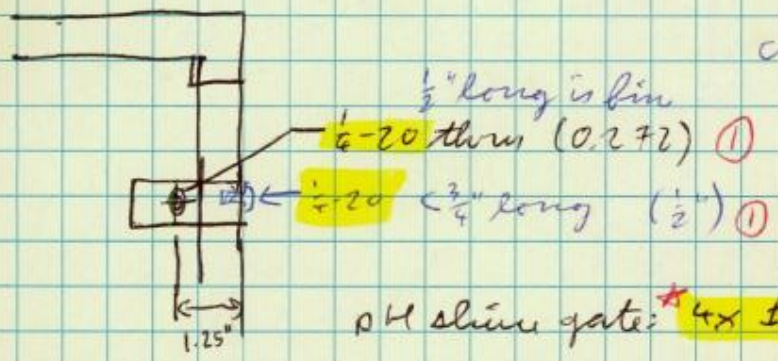
~~[illegible]~~

Spring Mount Block B on lid side (long one)

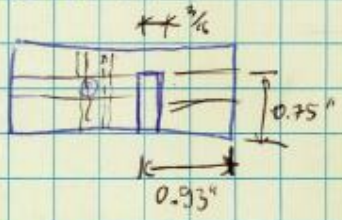
- slides in under lip 5/16" thru
- theoretical: ~~[illegible]~~ thru (0.272)

.455 vs
.388
.067 degrees





cut block!



½" long is fine

pH shine gate: ★ 4× #10 × ½ ✓

Hinge Bar: Flushes with side, notch on bottom

Hinge mounts with 5 ¼-20 × 7/16 (5) w/lock
to lid w/ 4 ¼-20 × 7/16 (4) w/lock, nut

punch first hole, drill through 2-5
strip to machine mount! 5× ¼-20 × 7/16 (5)
or similar

Left side: drill hole thru with washers/spacers if needed

Modifications:

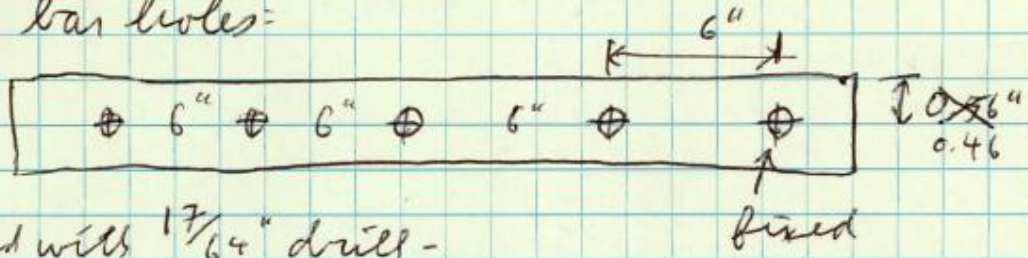
hinge strip - bevel edge ✓
- mill out around screws ✓
- mill slot for inlet box edge ✓

Gas spring block
- mill slot ✓

Gas sb B: bevel edge ✓

#3 Splish Splash - Design Notes, ctd. 8/12

Hinge bar holes:

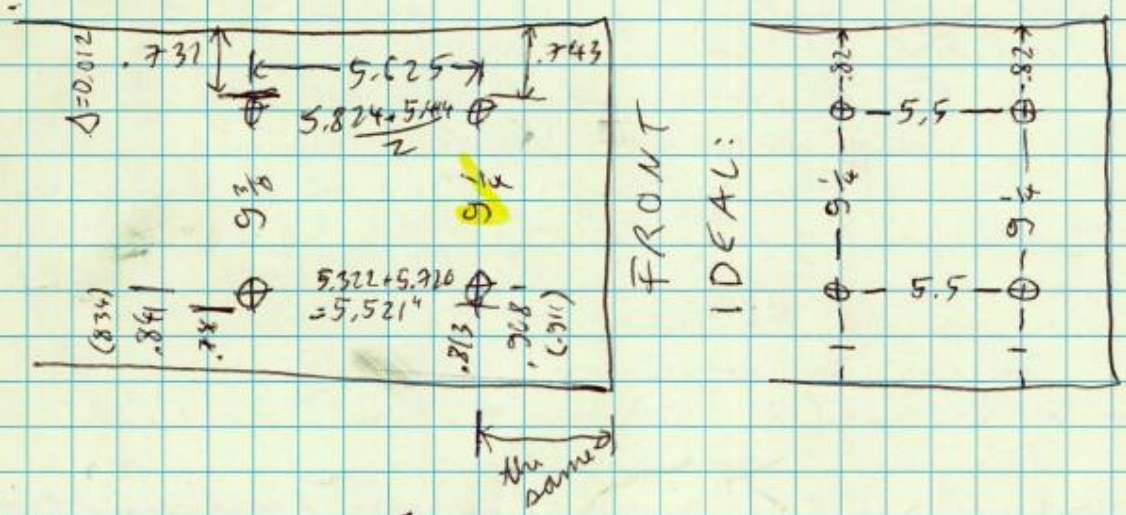


Drilled with 17/64" drill -
finish when lid is ready to make sure holes align
(may need to file out fixed hole).
start enough to make divot, then drill with
1/4-20 tap drill #7 (0.201) or 13/64" (0.203)

pH holder: 1.446" actual 1.45" specified
fattest spot on probe 1.445"
94/64 = 1.469" = 1 30/64 = 1 15/32"
93/64 = 1.453" = 1 29/64" ← ideal
92/64 = 1.438" = 1 28/64 = 1 7/16" ← fits
dowel: 1/4" × 1"
Hand reamer → ream to 1.454"
↳ fits great!

Gas spring: 8.75 - 2.625 = 6.125" stroke 8/13

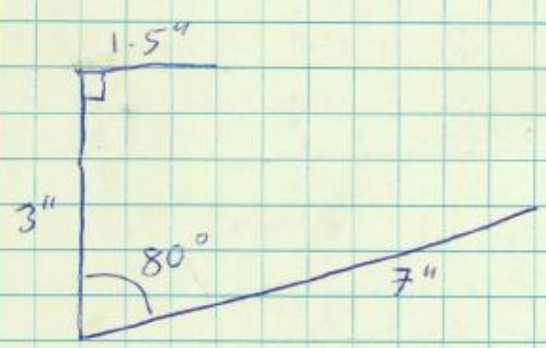
Need 2 5/16 screws 3/4" long or 2
One long 1/4-20 flat head (maybe 1") for L side

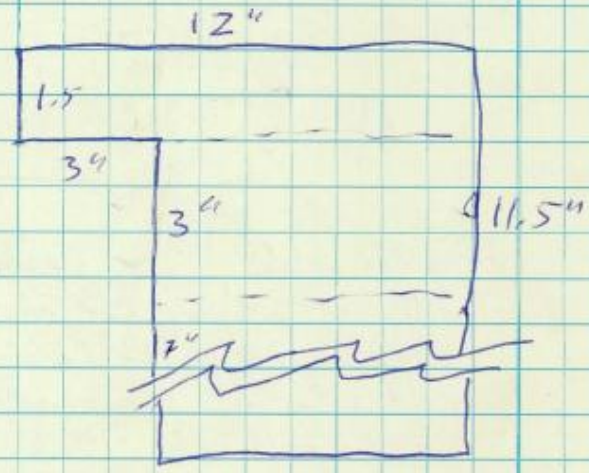


Missing drill bit: 7/64"
Missing Allen key: 3/16"

#3 Splish Splash - Assembly Notes

8/14





8/15 Slider Housing - piston holes not ~~1.5"~~ tapped straight! Remake part?
Forgot rod extension - submitted today
Also submitted Air Valve Shelf (bracket) above

Funnel lids - O-rings are undersized, ~0.265 not 0.275. Stretched, rings can be 0.255 and groove is 0.010" undersized so
0.265 → 0.015" over × 2 = 0.030"
groove is 0.010" under → 0.020" ~~t~~ interference (0.010" per side)
Should've been 0.050" over, 0.040" interference, 0.020" per side
→ Kevin working on it

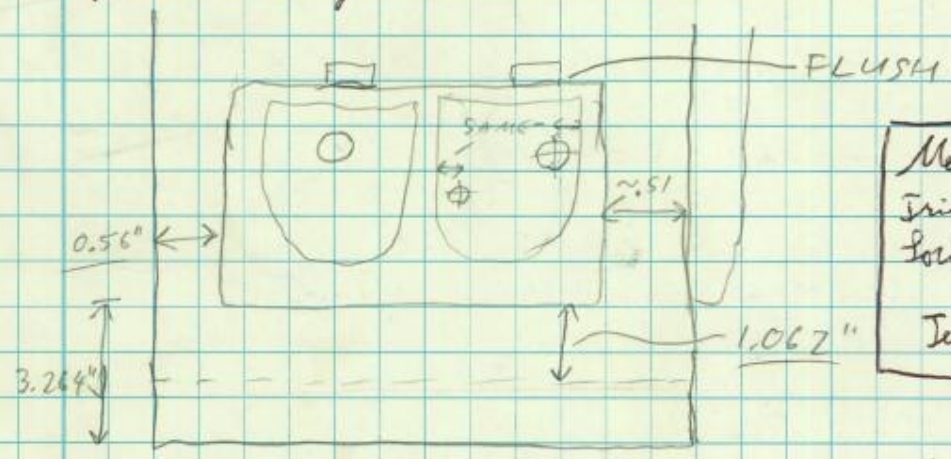
TASKS
✓ Screens: file to fit (grinder?) bend?
Handle: 4 × #8 × ¾" screws ✓ + ✓8 × #10 × ½" phillips McM
sliders: polish until fit ✓ ✓ get big screw from PT
housing: polish everything! ✓ ↗ drill pistons so fittings align
fit on machine & drill holes ↗
screws: change to 1.25"
18 × ¼-20 × 1.~~375~~" flat heads (McM) ✓
tie housing together
✓ 4 × ¼-20 × 1.5" (1.75" max, 1.25" min) caps - regular
tie funnel to housing w/washers
McM ✓ Dowel 2" × ¼"Ø - ream out holes - ~~.249 Underread?~~ or .25" reamer
✓ 4 × ¼-20 × 1.75" caps, maybe 2"
tie assembly to lid w/washers
✓ 4 × ¼-20 × 1.25" cap ½" thread + ¾ depth
attach funnel center plate to base no wash
~~McM~~ ✓ 2 × ¼-20 × 0.75" caps - Insulate to center P. ½" thread + ¼" depth

#3 Splish Splash - Assembly Notes, ctd 8/15

Air valve mounting:
- ✓ 3 × #8-32 × 3" (McM) 92196A209 valves
- ✓ 2 × #8-32 × 1" manifold
- ✓ + 5 × washers #8

¼" shaft buffing wheel w/ compound

- ✓ Housing screws: get ¼-20 × 1.25" flat heads
- ✓ mill flat on rod extension (Maybe)
- ✓ fit housing & mark holes



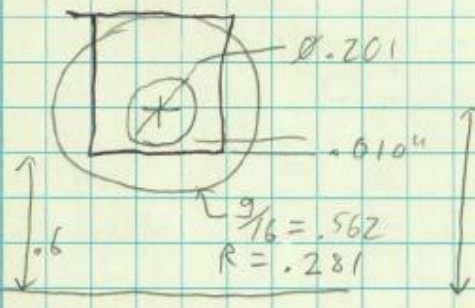
FYI

Metasilicate = 1.235"	17 g	R
Tripoly P : 1.189"	11 g	L
Soda-ash : 0.609"	6 g	C
Jergitol = LIQ.	22 g	

.6+.375=.975 Front-back
4.639+.362=5.002 R

- ✓ Fit air valve shelf bracket
- ✓ Mount valves on shelf
- ✓ Mount manifold on shelf
- ✓ Mount DIN rail
- ✓ Remain tubing, drill holes, grommets

washer for #10: 9/16" OD, ¼" ID = .156 thick w/ .201 screw = .357 offset
we have .375 so centers



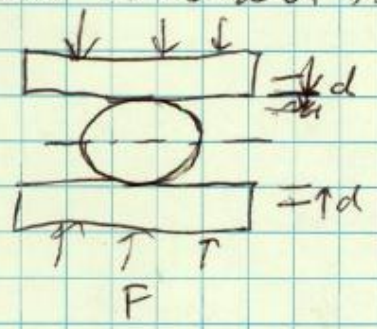
hole offset = .6+.01+.10 = .710"

Funnels
- holes for back slope
- 1.5" sides for center to side plate C&R else 1"
- Front & back plate hole spacing off (8.8") ✓
- Back slope too long ~8.6"

- ✓ Glue in grommets
- ✓ assemble funnels
- ✓ finish pH holders & seal
- ☐ calibrate sliders & enlarge holes

#3 Splish Splash - Assembly Notes, ctd. 8/18

Lid contact mechanics



interference = 2 d

$$\cancel{F = \frac{4}{3} E^* R^{1/2} d^{3/2}} \text{ sphere}$$

$$\frac{1}{E^*} = \frac{1-\nu_1^2}{E_1} + \cancel{\frac{1-\nu_2^2}{E_2}}^{\,0}$$

$$E^* = \frac{E}{1-\nu^2} \qquad F = \frac{\pi}{4} E^* L d$$

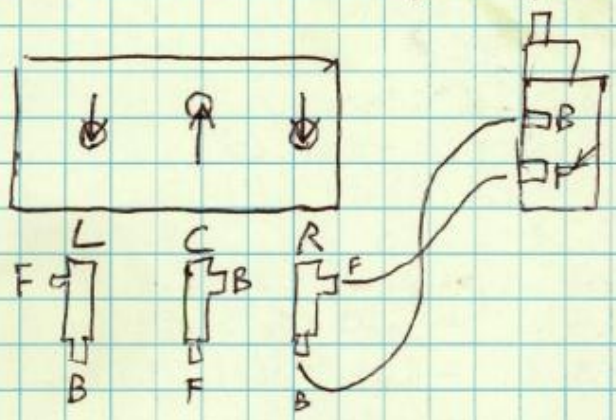
Go to Cup Filler Stuff.xls, lid interference tab
0.010" interference (5.010", 0.005" per side)
should be N = 45 lbs, f = 18 lbs

8/25 10:45 glued 3 panels down to center plate
2 slopes on R side - difficult to fixture
10:55 glued front slope down
11:40 finished gluing in grommets 1-6
glue starting to swell
• supplied water to funnels
3:00 PM - glued second bottom \ /,
back \ / and last 2 sidewalls and
the back slope.

Remaining:
- ~~gasket~~ silicone sealing on glued edges
- front & back plates
- Lid plate

3:56 PM - re-glue L F grommet

AIR: normally in fill position



Normally air goes to front

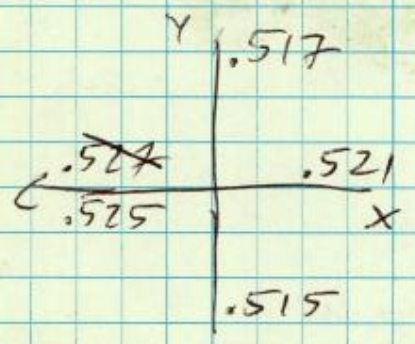
#3 Splish Splash - Assembly Notes, ctd.

8/26 9:35 - glue on back plate
- no moisture this time!

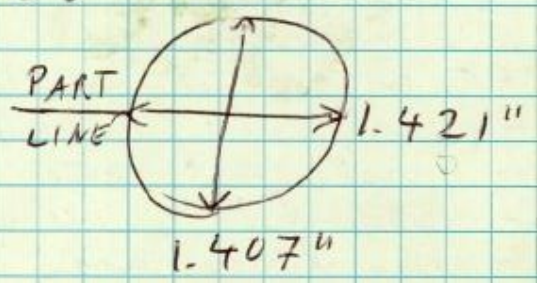
3PM - glue on lid plate, seal front & back plates, scrape excess glue

Last step: seal lid plate
seal to mounting plate (no glue!

pH probe: 1.258" travel in Y (X approximate)
→ 0.629" centers
X lits @ +0.662, -0.598 Σ = 1.260"
→ 0.630" centers, move to +0.032"
-0.629, +0.632 in Y → move to 0.001 and re-zero



Indicator = 0.375"
10



Hole: 1.427" @ top
1.425 - 1.430 @ bottom

Pump: roller gap is 0.21" for 5/8 tubing, 3/8 ID
→ $\frac{.04}{.25}$ = 16% compression

For 1/4" OD, 1/8" ID, wall = .125
- .020 compression
.105" space (x2)

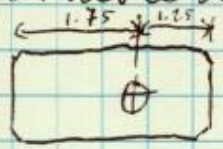
Roller OD = 2.35 - .21×2
= 1.93"
~~→ 2.035~~ new OD desired
1.93 + 0.200 → 2.14" new OD desired

Tube pinching:
Inlet 0.36" vs 0.5", outlet ~0
want 0.18" vs 0.25" → .18" less

3/8 Tubing: wall = 3/16 (0.188) - 0.030" = .158" space × 2 = 0.315
1.93 + 0.315 = 2.245" new housing OD

#3 Splish Splash - Assembly Notes, ctd. 9/8/14

Dispenser sliders:
- small slides, in retracted position, is ~~flush~~ tangent with hole. Due to misalignment, powder could leak
- fill hole doesn't look centered



theoretical

*PL → add 3/8" washer - smaller than 0.9" OD

Pump head
- ✓ - can't read ¼ OD, ⅓ ID
- ✓ - need relief for middle circle (which also guides the rollers) ~~→ need washer~~ 1.227×2=2.454" OD
- ✗ - injection port for grease no longer aligns → add channel
- ✓ - tube pinchers are useless, flat top → need washer
- ✓ - need more material to cut away (0.020" → 0.030")
- ✓ - version # & date
- *PL ✓ - get washer ¼" ID anti-walk
- *PL ✓ - need longer hose
- ✗ - catch hose for auto feed - is too problematic - might jam

151.3 g in 3 minutes w/ ¼/ ⅛" hose (180 sec)
147.8 g in 3 min - beaker → 0.821 g/sec
→ 26.8 sec for 22 g

#1)	22.22 g	#6)	22.08 g
	22.76 g		21.70
	22.36 g		21.97
	22.20 g		22.14 g
#5)	22.16	#10)	22.19 g

see p. 111 for amount

9/10 Funnel - big leak in four bay, tip of triangle toward inside of machine, back
tiny trickle @ opposite side near dowel pin
other trickles inside between compartments
(trickle = 1 drop every few seconds, no big deal)
* 4" screw on funnel can only be inserted with funnel off - move out! use 1" screw for now. Replace with hex heads!
→ continue p. 116

#3 Splish Splash - RFID Tests

RF shielding: Holes must be smaller than the wavelength

900 MHz ⟺ 13" wavelength

For static fields,

attenuation $\eta = \dfrac{9\mu}{(2\mu+1)(\mu+2) - 2\left(\frac{a}{b}\right)^3(\mu-1)}$

μ	η	
1	1	(bad)
0	0	(good)
∞	0	

For decent shielding, $\eta\mu \gg 1$

$$\eta \approx \frac{9}{2}\,\frac{1}{\left(1-\frac{a^3}{b^3}\right)\mu}$$

Aluminum = really bad! ~1
Austenitic stainless = bad, 1-7
Martensitic stainless = OK, 40-95
Nickel = 100-600
Carbon steel = 100
Ferritic SS annealed = 1000 - 1800
Cobalt-Iron = 18,000
MATWEB: SS 700-1000 — 400, 416, 430, 434 (easy to machine) — M, M, M, No — 612, 612 strips only

316 SS = 1.01!
BUT - frequency is a factor. Nickel-zinc @ 1MHz
Test reader with various metal pieces
Reality: any metal easily screens, even if behind the antenna

316 SS, 16 gauge - this notebook as spacer
↳ can read above @ 17-18 dB, not below @ 28 dB

Perforated screen, Innovation Fan spacer (½")
- read @ 18 barely no below @ max (31)

4×4 mesh, 1F spacer
- read @ 17 intermittent no below @ max

4×4 mesh, 2×1F spacer ~1½
- nonstop @ 17, 16.5, 16, 15, 13, 12 - intermittent 11.5 - occasional

curved surface 4×4
- read below chair occasional 16 dB

Grounding seems to help - even touching more metal
In-situ test: inside A1: 395 92: 179 reads @ 17 dB in ~12" away - false positive 27 got false + @ 3-4'
Ground: 17 dB A1 @ 483 92 @ 184
Stuff sides with Al foil - no difference!
5"×5" directional antenna: still plenty of false pos @ 12 dB

#3 Split Splash - Dispense Tests 9/10

Major issue - powder works its way around the slides and eventually causes it to jam. Accumulation at piston end, wedged in via 45° bevel, slides gets completely stuck.
Removing bevel would help, but we need to be reliable!
TPP... try MS while we're here.

Metasilicate - much coarser
- did better but also jammed RATS!!!
- also, big lumps caught in screen, just over ¼"

Potential solutions:
- replace with SS sheets - one piece? 200 vs 2-3 GPa
- replace with thicker sheets
- o Test by replacing plate on prototype
  ↳ machine myself?
- replace slides with another material
  - PTFE?
  - Delrin?
  - ABS?
  - Black PC?
  - Rubber?? JB cladding
- o Try out on prototype first
- If prototype jams, cut relief & let powder escape
- Remove tapes on slides
- Add piston motion sensor
- Use bigger piston (1.06") 61 lbs vs 35 lbs
- Redesign with augers
- Powder relief into bags under cover
- o Repeat problem & observe top vs bottom vs end
- Replace top plate but with observation holes
- Easy access blow-in and blow-out holes
- Automatic air puff purge

9/11 MS in hopper - stuck after 3X
- wiggle piston → released
TPP - stuck in 2x, no wiggle in 5X
But stuck in forward position! not retracted/fill
PLAN:
- remake bottom in steel
- thread repair piston holes

#3 Splish Splash - Peristaltic Pump Connections

Tubing: 3/16" tubing needs 3/16" ID Nylon hose

3/16 - 3/16 adapters	×	11	× 2 →	~~2~~ 4
3/16 barb to 1/8" NPTM	×	1		~~4~~ 2
3/8" washer	×	1		2 2

- OR - use 1/4" ID Nylon hose or 1/8" ID Nylon hose

1/4" ID hose → still need 3/16" barb to 1/4 NPT

1/8" barb to 1/8" NPT	×	111	(leave 8)	< 1 male 2 female
3/16 barb to 1/8 NPT	×	11	buy 5 above	< male NPT!
3/8" washer	×	1	same	

~~1/4" - already exists, just need end adapter~~

~~If we use 3/16" tubing, would need~~

current hose is ~~5/8 × 3/8~~! 1/2 × 1/4

One more 1/4" ID pump

1/4 - 1/4 adapter × 11 + clamps - use existing

They have reducing couplings! but only 1/8 - 1/4 & 1/4 - 3/8

Could use 3/8 - 1/4 @ machine but better to leave machine end the same, just plug in 1/4 tub × 1/8" NPTM adapter

#3 Splish Splash - Magnolia Trip 9/17

Dryer temp - dryer #3 - drying "A" = VF wash

0 - 78°F Start 12:49:00

:50 1 - 109.3°F Pressure ~7 in H_2O

2 - 119.7° "Med" heat, 20 min + 5 cool

3 - 126.7°

4 - 130.9° operator - Angela

5 - 135.0°

:55 6 - 138.8°

7 - 139.9° Start #2 @ 12:56:25 still ~7

8 - 141.3°

9 - 139.7°

10 - 142.9°

:00 11 - 145.6°

12 - 148.8°

13 - 151.8°

14 - 154.1

15 - 156.4

:05 16 - 164.8

17 - 167.7

18 - 178.6

19 - 180.1 ↑

20 - 170.5 ↑

:10 21 - 160.7 ↑

22 - 145.2 ↑

23 - 138.6 ↓

24 - 131.2 ↓

25 - 139.3 OFF

:15 26 138.6

feels dry

door open

1	133.3°	@ 57:30
2	137.6°	
3	140.0°	
4	144.2	
5	148.3°	
6	151.7°	
7	151.7°	
8	155.9°	
9	161.2°	
10	146.8°	
11	162.0°	
12	151	↓ fast
13	160.2	↑
14	143.9	↓
15	155	↑
16	144.1	
17	143.0	↑
18	144	no flame
19	145	↑ flame on 159.0 max
20	150.9	↓ 136°F min
21	142.3	
1:18:00 22	134.9	↓ Done (cooling)
23	122.0	↓
:20.5 24	113.1	↓
25	106.6	↓
26	101.5	↓ 100.3 - off @ 1:22:50
27	100.1	~

103

111.8

Feels dry, first impression - a touch more damp, but hard to say. Also cooler.

#3 Splish Splash - Magnolia Trip, ctd.

Metasilicate: "Metso Pentabead 20"
PQ Corporation 50 lb bag
Disodium Trioxosilicate UN 3253

TSPP: Innophos, Inc Sodium Tripolyphosphate
50 lb bag Light density technical grade granular

Sour-Side U.N.X Incorporated
50 lb. bucket Sodium Silicofluoride
CAS Number 16893-85-9

Tergitol 15-S-9 Dow Chemical
sold by Univar 55 gal drum from 2007
secondary alcohol ethoxylate 97%

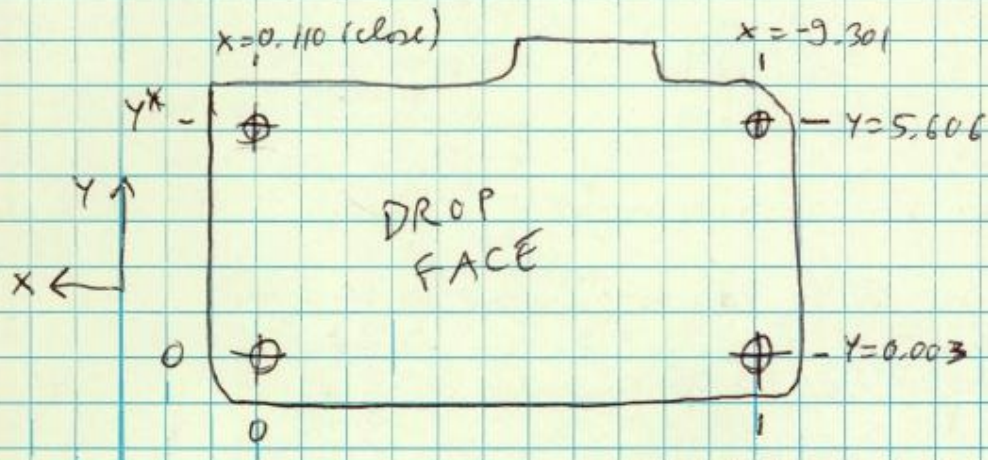
From Univar MS = Item # 636156 44¢/lb x 200
(425) 889-3400 Washington State

Dryer #3 - second time - 243 bath oz
2:36 144.4 steady slow climb
2:37 146.2
2:41 154.3
2:43 162.5
2:45 175.5 climbing fast
2:47 195.5 — max 169 - buzz
2:50 149.1 steady fall - done (cooling)

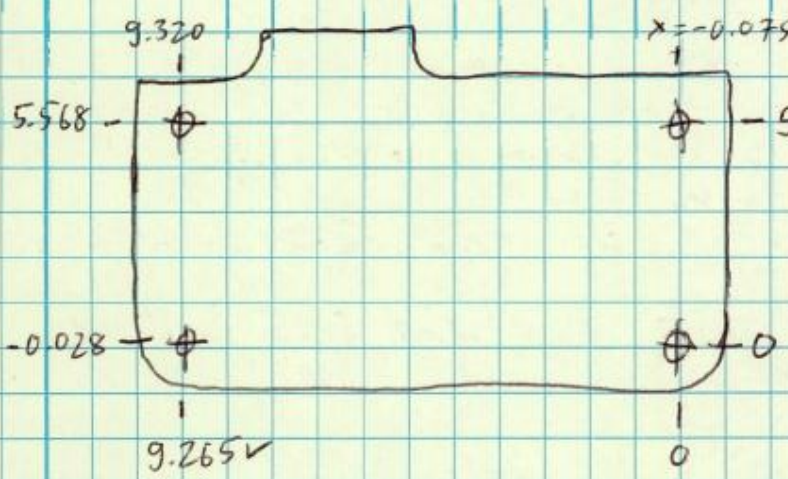
#3 Splish Splash - Assembly Notes

9/19

Dispenser plate:



* Y > 5.495 move hole

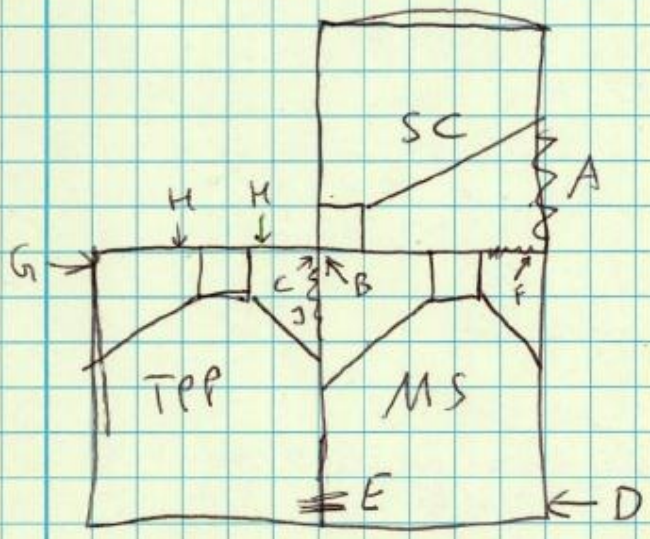


Not sure why coordinates changed, but it should fit.

Sliders move easily with screws torqued hard, but no play! DO NOT tighten air cylinders 100%.

Funnel: (Top view)

Leaks (from water test)



A - @ side wall of incline
B - Bottom inside cavity
C - some on upper big cavity edge
D - small 2/3 cups
E - between compartments

A is only concern
B, C, E should be sealed up
D is tiny

9/19: A is water-tight! (all of SC)

D is fixed, E - about 1 drop per second
F - leak out of pin, into sealed space, MS OK
G - tiny at bottom H - both roll pins J - fast leak

#3 Splish Splash - Assembly Notes, ctd. 9/19

J - starts @ C & runs over? Could improve even more but all leaks are internal except G, H

pH cavity - sealed @ 4 PM, 9/19
Funnel - touched up @ 4:30 PM

Check funnel one more time. 9/22
SC still water tight!
MS water tight too? slow drips at bottom may be around dust tape... D, E fixed
B, F may have hairpin leak, but almost perfect.
TPP has tiny leak @ G, H is fixed, J is fixed
Good enough!!! Dried @ 10 am

10:45 add MS - 20 doses no problem!
10 more for calibration - ✓
4 more - jam! ☹ But move after 20 sec
next one - jam again
Looks like powder is on bottom between slides & steel
11:35 move 20x no detergent on TPP side - no problem
After 104 - almost stick
110 - good stick
Low - no jam, but build-up

---

info is stored in C:\ProgramData\CMIS\Ver5\Data\CMIS.DBS 9/24
last use 9/23/2014 3:58 PM 2,192 KB
start Drain Timing
↳ file size jumps to 2200 now 2204... 2208..
About 3 min to drain - due to restriction plate 228 sec
finish @ 2212 KB ... "date modified" still 9/23 3:58 PM
Dispenser: try to jam MS again. Add about 450 ml
20x - no problem - fill back to top ~350 ml
small amount falls down on backstroke
20 more (40) - sounding crumbly
20 more - 60! +20 = 80, 100, 120, 140, 160, 180, 200
differences: lower detergent level, fewer screws used. Add full jar again. +25, 50, 75, 100 - don't refill. 125, 150, 175, 200, 250 - almost empty - paused, then saw delay on 2, 3, 4, 5 pause 6 - big delay!! 7 - 8.0 sec 8 - long 9 - 10.4 sec 10 - 9.4 so 45 cycles

-OVER-

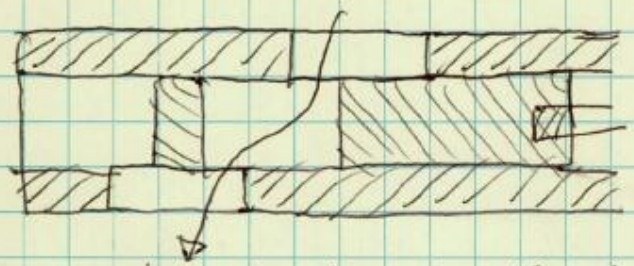
#3 Splish Splash - Assembly Notes, ctd.

Machined square step into block to replace the bevel. About 0.1" x 0.1" on bottom, 0.07" x 0.07" on sides & top @ 0.03 x 0.03.
Screws all tight this time.
Add 550 ml MS 2:50 pm
25V 50V 75V 100V 125V (squeak @ 123) 150V 175V 200V
Full container 16 ... some stick/slip 17 - no retract
3:18 PM clean & inspect

9/25 Estimate of deburredge:

~~MS~~	top	bottom
MS	1.265"	~~1.260~~ 1.255"
TPP	1.203"	1.220"
S-C	0.663"	0.655"

9/29 Try new, bigger holes with no debur
500 ml Metasilicate
- spilled some because slider was partially retracted
- moved about 10 x no problem
- powder may be lumpy - rainy day
- dump in everything!
18 doses, then jam. (28 total) in dispense position
No powder at all behind slider!
None on top plate (fill face)
All from hole motion
↳ powder very sticky
Gradual upturn = slower slider!



tiny leak - no big deal, saves space, but indication!
Clean funnel, housing, try again
500 ml MS
11 X - startup, 10 more, then do quick 20, dump entire container
#24 - start stick #25 - stick ≐ 66 total
4:23 take apart again - dusting behind slider
small amount on top now, plate still lead water similar pattern on bottom plate

9/30 Foam slider - prototype too weak, not sure
order PTFE film - need 10" x 8" x 2 - try it tomorrow!

#3 Iplish Splash - Assembly Notes, ctd. 10/1

Added 0.010" Teflon lines on top & bottom of slider housing.
Teflon holes are smaller than drop holes but bigger than slider holes.
Tore out a big chunk of PTFE from somewhere...
now stick/slip than before
Could approach
① - make sure PTFE extends beyond hole and points out so no edge to catch
② - make sure PTFE is inside the steel and flat, carved down

① Test on middle hole
Weight of powder would pull top down
→ big on top, small on bottom?

left hole - #5 caught something (top edge)
Bits of PTFE get caught, cause more damage
Middle - 32 × no problem. 33 × more
but not moving as spritely
↳ confirmed, no damage in middle
↳ actually, not! tear at edge of hole. :(
Bottom is fine, but there is buildup on PTFE.

Metasilicate tests 10/6

Anhydrous: @ 150F (66°C), solubility is about 400 g/l vs 1300 g/l pentahydrate - but pentahydrate only has 50% actives. Curves are roughly double until about 50°C. We are using 17 g in ~11 gallons or 0.4 g/l - solubility should not be an issue.
Janice Hamilton - NTNL silicates
bulletin: Pentabead equilibrium 35%-55% RH
Beads 2048 equilibrium 0%-35%
Pentabead could lose some weight if Dry-rite is too dry!
Probably not a problem, but 2048 more stable.
"Rarely a problem in practice"
Let Metasilicate dry in a beaker with Dririte

Beaker: 52.58 g sealed 3:30 PM 10/6/14
Pouch: 59.16 g (mostly dririte)
MS + Beaker: 146.68 g → 94.1 g MS
MS + B + P + Tape: 206.20 g MS + B + P + T + foil = 208.70 g

#3 Splish Splash - Metasilicate weighing 10/7

Weigh Metasilicate

Tray	Initial		2 PM	4:52
1	1.2808g	soggy chunk →	8.0359g	5.9288
2	1.2810g	slightly less soggy →	8.5884	6.3353
3	1.2856g	powder from jar →	8.0283	5.7235
4	1.2825g	powder from jar 2 →	7.9230g	5.6625

Heat to 132°F @ 1:58 PM 10/7

Note: 3 & 4 rose like yeast dough and became hard & crusty! 1 & 2 had smaller bubbles.

10/8 Use glass instead - looks like eyeglass lens from lab 11

Tray	Tray wt	initial	1 PM
1	26.8189	28.1144	27.6733
2	26.2562	27.7960	27.2678
3	31.6582	35.0953	33.8641
4	31.8501	34.4525	33.4614

start 9:19 am 10:05: #2 is 27.4453 (-23%)
11:22: #2 is 27.3115

Note: #3 is baked together, partially melted, with bubble in middle (same as #4)

Set temp to 133°F, (55°C) on dial. Previous temp was 130°C! Actually melting point is "160°F" so ✓ go to 140°F (set 143) (60°C) → 65°. set to 133°F → 58°C 137°F → 60°C

Tray	Tray wt	Initial	
1	26.8168	27.9623	27.8623
2	26.2561	27.5432	27.4455
3	31.5915	32.8853	32.7949
4	31.8026	32.8314	32.7582
		2:20 PM	10/9 8:50 am

heat up to 110°C 8:50 am

1	27.6674
2	27.2109 → 27.2091
3	32.5033
4	32.5069

9:54 am Temp reached 123°C

#3 Splish Splash - Metasilicate weighing, ctd. 10/15

Try brand new Metasilicate
Pentabead 20 = hydrated
Beads 2048 = anhydrous
Note: Beads are still sticky & lumpy fresh from the bag, but a little dessicant seems to help a lot. Test as-is

2:30 PM Anhydrous powder - has big clumps
1.5 cycles and ~~to~~ powder doesn't flow
stir/break up - 2 more cycles then no flow at all
Funnel screws are rusting - need SS

3:50 P.M. Try fresh Pentabead
550 ml 30 x - no problems
now weigh beaker 33.731 (not clean)
→ add 17.415 g $\sigma = 0.47\%$
21 x weighed - very steady
10 x more - 17.37 avg
25 more - 86 x total +27 = 113 + 27 = 140
+29 + 29 = 198 + 29 = 227 + 29 = 256 + 29
(@29, half of screen mesh is showing - every time!
4:08 +29 = 314 + 29 = 343 + 29 = 372 + 29 + 29 = 430 + 29 + 29
4:30 = 488 + 12 = 500! + 10 weighed + 20 to empty (530)
average 17.671 g. Slight build-up in back and front - fairly even. Washes off with almost no wiping, just water stream very slight marks on top-side edges. Nothing at all on plastic-housing or slider.

#3 Splish Splash - NFPA 2112 Recipe Notes 10/16

Program to match Magnolia NFPA2112.lpf

Motor action 2: 20 sec CW, 4 sec off, 20 sec CCW
→ need to verify / match Magnolia curve
Water level: 5" (4" 1st fill) and 10"
→ check with tape!
Wash temp: 150°F
want to match 36 RPM → 0.55 g's
35 RPM → 0.54, 36 → 0.58 set to 36
acceleration: up to speed in < 2 sec
try 20 RPM/sec
30 sec powder flush, 1x7, 1x9
Sergitol - want 22 g
water is filled at 0.821 ml/sec → run 26.8 sec
→ calibrate, but start @ 27 sec

Drain - constant 66 RPM - use action 4 (2:30 should be enough to drain). Max allowed is 48 RPM (1 G)
- set to 48, probably not good...

Sour - call it ~~pre-rinse~~ main wash

Extract - nominal 663 RPM (187 G) actual 623 (165 G)
set to 610 RPM = 165 G's
main dry - use action # 4. Speed not set-able! ☺ 48 RPM
→ same as first drain??

max outlet temp: cycle 160F to 136F
- set to 160, hysteresis 24°F
→ verify!
- max inlet 356°F default - leave alone
- time is 20 minutes (18 - 24 at Magnolia)

cool-down: outlet air = 122°F, 5:00 min
→ does it go to temp or time?

10/17 Run and: - record motor action
- verify water levels
- is drain reversing? too fast?
- dryer turn speed
- temp hysteresis (will fabric)
- try heating pause

#3 Splish Splash - Machine Tuning

10/17

First, water level
5" ± 5mm - level = 156 mm I s level = 153 mm
level mm drum = 153
5" = 127 mm! are we 29 mm low? 26 mm low?

10" tape mark - level = 277 mm I s level = 274
level mm drum = 274
should be 10" = 254 23 or 20 mm low?

~~change~~ change level offset from 0 to 23 mm
5" tape mark → Is level = 152 lev drum = 129
(2 mm ~~lower~~ higher than actual)
10" tape → Is level = 275 lev drum = 252
(2 mm lower than actual)
BUT - will RFID tumble fill with water now?
empty 47:08 → 48:45 (5") → 50:09 (0") → 51:02 no more flow @ block so 3 minutes to drain!
Move up the sluice gate a tad
drain from 253 → start 57:15 58:55 @ 5" 10:00:08 0"
10:00:48 done only a few sec faster
Gate set to 1 screwdriver shaft bit (1/4")
drain 252 7:00 8:05 @ 5" 8:55 @ 0" 9:20 done
so 1:55 to drain to 0" - could go even faster, but OK
Now test tumble question - set offset to 40 to see!
Run RFID tumble → no problem, offset is the other way!
change back to 23 mm
start → see pump 10 after 4.26 seconds - but program run started late, door lock...
manual press - 2.84 seconds after program run, 10 is on
OK, run NFPA 2112 10:21:30 start
→ 2 videos to analyze w/ stop & start
water level appears ~10 mm high
need tape to stop @ bottom...
→ 1 video while draining, 38 RPM setpoint???
rinse - water level pretty darn close, 3 mm high? 5?
drain @ 48 - seems pretty violent
10" level - pretty darn close
! Note - water only reaches zero, doesn't actually drain completely
→ set drain delay higher! 25 seconds drain completely...
did liq 10 come on? Must've missed it water def. a bit high
11:08 start drying - heats very slowly!! linear ramp?
→ 1 more video 11:12 set heat pause - no effect 11:14 un-dock set to 160°F, heat off

#3 Splish Splash - Machine Tuning, ctd.

Outlet temp just doesn't cycle as fast as at Magnolia. ~~7.5 min to drop~~ 4.5 min drops 20°F
135° → kicked on! ~5 minutes to drop 24°
reached 160°F again right @ 20 min, go to cool down
→ outlet air will not reach 122° in 5 minutes
drum speed is 48 Elapsed time 1:13:31
cools until temp is reached (actually 1:06:05 start → 7:26)

Add 25 sec drain time (distribution)
check pump, detergent at start
don't like 48 RPM drain - drain slower than Magnolia
heat cycle 155° to 141°F → max 155 heat. 14
set drain RPM to 30 (0.4 G) the default
End dry ⊕ may dry to temp, then stop

liq 10 on for 1 sec with 8, ~~[illegible]~~ pump didn't turn
definitely drained all the way - could go less
start drain 2:31 3:43 drum level = 3 (26 is), motor off
then motor goes to 735 RPM until 4:11 (28 seconds for distribution??) → drum speed 75 RPM
Try 25 sec drain time. Also try end-dry to 140°F, 1 min
☆ liq 1 is on but pump doesn't turn
start drain @ 1:41 level = 3 @ ~~4:25~~ 2:51 Is = 26
Is level = 0 @ 2:57 3:14 start rinse
so 23 sec after level hits zero... times based on level
ALSO: level = abs(is-level - offset)! |is level - offset|
probably OK to wait 6 seconds... wait 10?
rapid advance only goes to extract!!
RESULT: ~~end~~ end dry is same as main dry - goes 1 min
Also: Pre-dry allows for motor speed setting! But main-dry and end-dry do not.
It is impossible to set distribution speed.
Acc RPM/min → G's/min makes no sense
~~α = ω/R but~~ α = ω̇ ΔW ≠ Δα/R...

Main dry - 120°	step	2 min	"drying"
Pre dry - 130°		3 min	speed 4 is too slow
End-dry - 140°		5 min	
cool-down - 130°		1 min	

Pre-dry reached in 1 min
User can change programs while drying???
15 RPM - motor won't turn 130F after 3:44, inlet heat off
7 min then end-dry, motor turns again, run 1 min, cold down instant

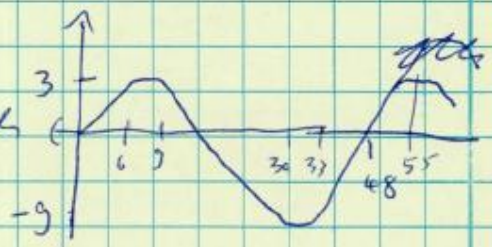
#3 Splish Splash - Machine Tuning, ctd.

Drum speed 25 is OK
Pre-drying: reached 130, heater off but overshoot
4:14 back to 130F
5:21 outlet temp @ 125F, heat again
7:00 end-drying starts
8:00 cool-down from 137F
turning knob changes step!
"change time step" change 5 min → 0 min
seems to disable this nonsense
still, we are pre-drying for 7 minutes not 2
130F → overshoot to 133F, undershoot to 125F
Then end dry 1 min, cool down to 120F
I can rapid advance inside program but not
wash → dry

Program:		spec	actual
	pre-dry	2	7
	end-dry	5	1
	cool down	1	4:50 (to temp)

10/30 Re-shoot video
4:12 Start
shoot - wash x
wash 3449 → pause is 1.4 sec too long
action 2: 20 sec on, 4 sec off
wash 3450
4:24 drain 3451
~~dryg~~
extract 3452
dry 3453

Try 3 sec off, 21 sec on. Match



(Should be 1½ rotations)

→ Should be 0:21 CW, 0:03 off, 0:20 CCW?
leave 0:21 0:03 0:21, close enough

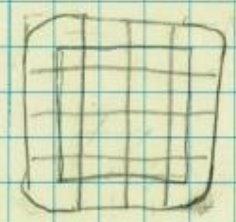
#3 Splish Splash - Hopper gate designs

10/20

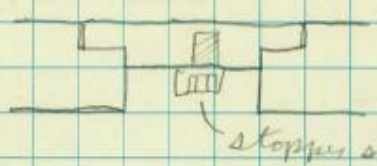
Hoppers need a shut-off gate for easy cleaning.
3 Options: - between Hopper ("Funnel assy") and
Ⓐ Funnel Mounting Block (FMB)
- mid-way in FMB at shoulder step
Ⓑ (Replace or modify)
Ⓒ - between FMB and Housing

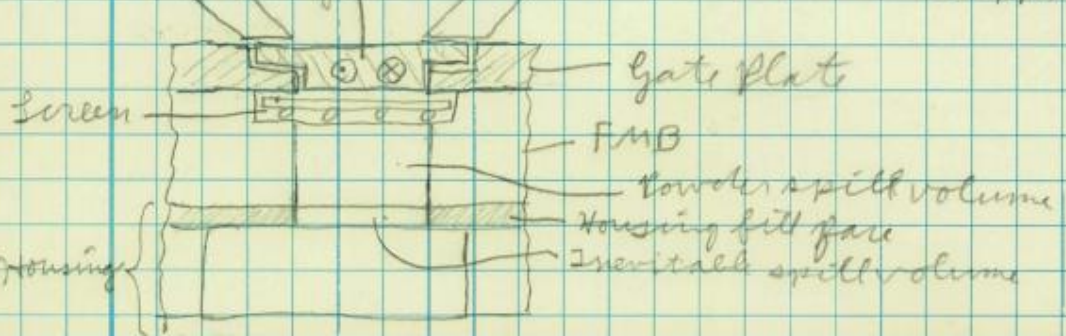
Tradeoffs:
- Ⓐ is above the catch screen. This is good for cleaning, but screen prism can get lost or jammed by gate. Maybe redesign bigger.
- Ⓑ is difficult to machine
- Ⓒ ~~to~~ would obstruct visibility
- Ⓐ ~~wall~~ would result in wasting the detergent that is in the FMB space
- To clean screen, shut gate, flip hopper upside-down, and un-screw FMB. Could screw shut-off lower into either part. (Ⓐ). Ⓑ would spill some amount as would Ⓒ.

My initial idea was Ⓒ, but Ⓐ is probably simpler and more elegant. If sliders jam, then we leave small piles of detergent on top of the sliders. If we can predict slowdown then we can probably dump first.
I also like that Ⓑ would have me pushing very close to the actual funnel (no bridging issues) and the gates would not interfere with other stuff.



Gate Plate - attaches to hoppers or just pressed between FMB & hopper





#3 Splish Splash – Hopper gate design, ctd. 10/21

Stopper screw is a problem – if peg in front, create cavity for powder to fill

need a notch here

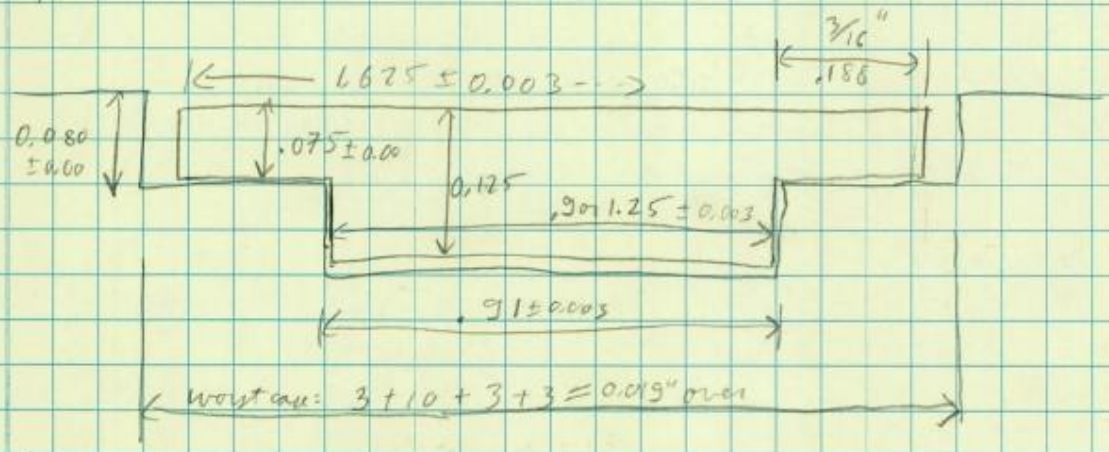
If we set the notch back, we get a powder hole there and probably run out of room

Best option is having a stopper outside

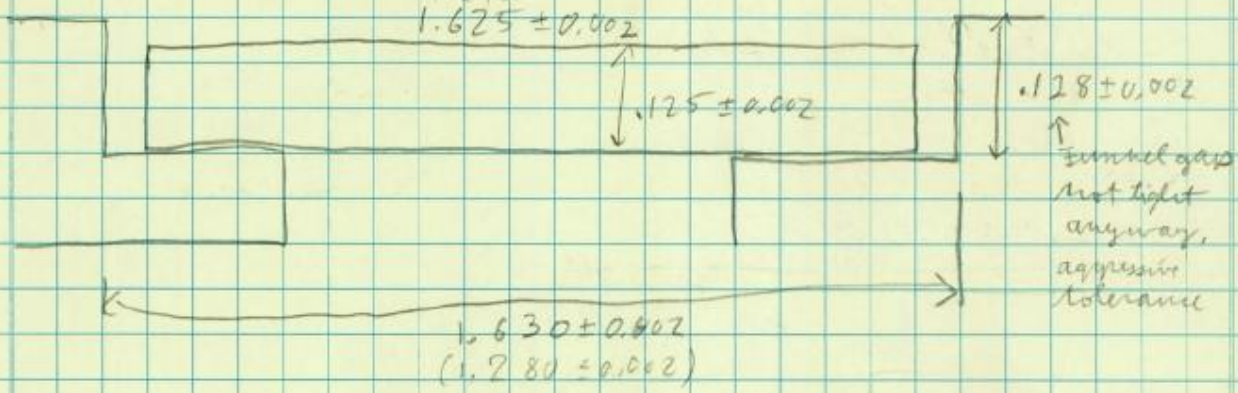
Mount to funnel spacing: 0.5 – 3.7 – 2.875 0.5

9

Fit:



! Take out step, use rectangular block



#3 Spill Splash - Chemicals & step

10/28

Store liquid chemicals on wire shelving
- ideally with a basket
Grainger item # 9AAM6 is too big & expensive
$477.50, 63" tall x 48" wide x 24" deep - but the right idea.
Home depot has small stuff:
Model # SHF-02216 $35.92 black table w/ basket
16" tall, 14" wide, 15" deep
★ Bought 10/29 (chrome available as SHF-01503 $42.65)
Model # WS 1003B $38.06 3 tiers adjustable wire shelving
30" tall, 23" wide, 13" tall
may be able to flip shelves to have shallow basket
Similar on Office Depot $33 #24887632

McMaster - could buy shelves and add ledge
5101T143 $123.49 24"W x 18"D x 35"H

Ladder: we have about 14" space, ground level out to 12". Most commercial ladders are 24" wide, but some step stands etc ~18"
★ Bought 10/29 Catalog p. 2147 deep step looks nice 4336T81
17¾" base, 27½" deep, 43" high, 17½" step height
Only narrower option is wall-mount 7925T36

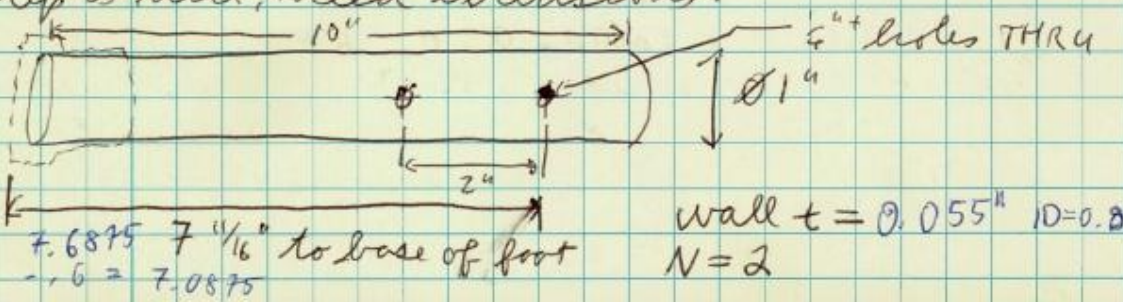
Space in back: 13" clear of green, 17" at base, 18" wide
18" if straddle drain x 15.5" x plenty hi

In space on side: 20" x 36"+ x ∞ H

15" x 16" x 14" should fit - straddle pipe if needed

Consider for later: 7948T75 ladder leveler pair $80.57
steel frame fitting 2534T31 Parallel for 1.07" OD pipe
sticker for RFID 4643T41 3" round, yellow/black

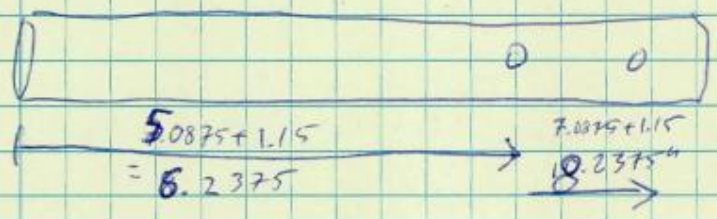
10/30 Step is nice, need extensions:



wall t = 0.055" ID=0.89"
N=2

#3 Splish Splash – Chemicals & steps, ctd. 10/30

7 "1/16" is apparently way off...
Leg should be about 1.75" - 0.6" longer = 1.15"
so drill holes at



Inventory:
Tergitol – 42 lb drum – clicker cabinet 11
– 1 gal jar – behind washing machine

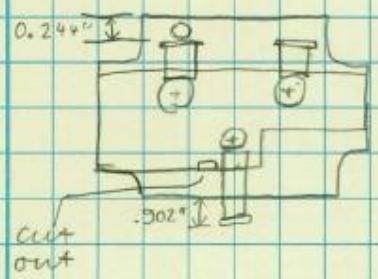
Metso Bead 2048 Anhydrous –
– 12.5 gal bucket – in bag

– 1 gal jar – behind washer – label ✓

Metso Potabead 20
– 12.5 gal bucket, in bag
– 10 gal bucket – in P-lab

Tripolyphosphate – 1 gal jar to be made
– 1 gal jar from Magnolia – return
– 50 lb bag label 037945 → bucket 12.5 gal
– rest in 10 gal bucket
Sour-acid powder (Sodium Fluorosilicate)
– 1 gal jar from Magnolia – return
– 12.5 gal bucket contain bag 037943

1 gallon jar for Tergitol – drill lid with 23/64" bit – just under 3/8" and force in tube
Hopper gates need stoppers: 11/11



with #10 stud, Ø = 0.190" R = 0.095"
→ 0.149" from edge thread is 0.054" in
#8 stud – Ø = 0.164" R = 0.082"
→ offset is 0.162" clearance 0.080"
Height: 0.822" 1.5" screw would clear if 5/8" deep (0.6" available)
#8 tap drill: #29 0.136"

#3 Splish Splash - Alpha Trial 11/17

- Not bypassing hot water (first or second time when temp↑)
- Not counting cycles from zero (RFID trouble)
- Not decrementing cycles remaining
- Start button check is slow
- Runs indefinitely beyond # cycles set
- pH ~~too~~ log not formatted properly (CSV commas)
- pH log overwrote, didn't append
- not logging end of program or anything else

After some work:

- pH appears to log every 11 seconds as long as the program is running
- spaces between lines in the log file

11/19 Bobby got machine to run 30 cycles!
bypass setpoint read in on cycle #30 → 110 F
CMIS: Bobby 2 start @ 7:45:05
pH drain log @ 7:45:03
log always 2 seconds after "start" - isn't really end?
Ran 31 times
last CMIS "start": 8:59:20 log @ 8:59:18
process file (.xML) created @ 9:01 am - 8:59 is actual start
logging when program starts?! temp = 100°F! Even the setpoint → 110
9:21 set to 1 cycle, 120°F
but start @ 9:22 temp = 98°F ~~R~~ never went to 120.
cycles start counting up

11/21 If drain AND running AND drain start
↳ total-drain ref time + current time > 10 sec
↳ set drain start to false
add Read Drain Inputs to top of queue (0)

drain	dsf	pH time		
open	F	F	wait on drain clear	✓
closed	F → T	F	set drain alert flag	✓
open	T	F	wait on drain open, set time & pH	
open	T	T	wait 10 sec then log, pH & ds → F	

(F, F)

what if start drain b

#3 Splish Splash - Diagram Bobby's Program

Boot-up: Read inputs, set outputs
Drain start → F, Drain Ref time → 0
Drain trigger → T
Add Initialize to state queue
some Admin stuff
Add Reset Indicators to queue
updates display panels (clears lights)
No states in list so run MAIN ???
handle UI events
Add Check Inputs, Update Indicators to Q
build T/pH array & ~~[illegible]~~ overwrite field 4
read digital inputs
check Inp. Adds → still in Q
Check hot water - 3 sec wait when @ temp?
Dispense powder check → dispense powder to Q
Liquid Pumps — channel in → out
Start — bound of logic
Outputs — write outputs to DAQ
Run — read run from UD
RFID tumble — update tumble light
Cycle Count — tricky
Update indicators — set lights
Door — read door closed/locked
Door Open Simulate — reboot, log to file, set outputs, wait 2 sec
Check Drain — call Read Drain Inp. if time lapsed *
END — set completed cycles → 0

Dispense Powder: 3 substates: nothing
start dispense
3 ← continue
done - 1

- Read Drain Inputs — write to file when asked
Vectors are 10, 11, 12, ~~13~~.

* if done draining, no check

Probe 4 - time elapsed
Drain check - ds false + drain on -

ds false + drain off →	nothing	F, F ✓
ds false + drain on →	set drain start time, drain start → time	F, T ✓
ds true + not elapsed →	wait on time (1 sec)	T, F
ds true + elapsed →	log data, set drain start → false	T, T

drain check not right!

#3 Splish Splash - Programming Notes

Bypass:

Indicator 6 = Bypass valve
Input 17 = Hot water valve
Ind. 4 = Measured temp
Control 1 = Temp setpoint & Completed cycles [?] = 90

Out:
Indicator #4 = Run pause
Indicator #6 = Bypass valve

Output 14 = Bypass valve
Output 13 = Run pause
Number ind. = Array w/ temp, pH
} set to init @ T ! (no pause, no bypass)

☆ Bypass didn't log temp

Hot water valve is initially F

☆ set initial state
☆ number controls not initialized unless Δ'd

EI 26

12/4 Fit to screen ✓
- Log powder request time ✓
- change bypass timer to DBL ✓
- log bypass duration ✓
- rename bypass to "hydrating" ✓
- add temp setpoint event response ✓
- make bypass if temp setpoint Δ → ~~update temp~~ only if not already filling ☆
- change label to "next state" under update indicators ✓
- ☆ Bootup dispenses powder (POWDER 1,2,3 & T) ✓
- ☆ " starts wash ✓
- move "door" to Machine tab ✓
- reset drain counts for log pH & temp (start wash) ☆ not right
- rename "start wash" to "start wash cycle" ✓
- log start wash event ✓
- log start new wash ✓ removed
- log wash completed ✓
- Powder in 2 sec increments ✓
- Fix DO v0 01 in initialization ✓
- Make bypass state type definite ✓

#3 Splish Splash - Programming Notes, ctd.

Check temperature of drain
- off by 30+ degrees! Seems to be buffering or averaging like crazy or mechanical inertia or broken?

	command		actual
Pumps: simultaneous start	1	=	1.51
	2	=	2.31
	3	=	2.97
	4	=	3.78
	5	=	4.49
	27	=	26.9, 27.0, 26.87, 27.21, 26.71, 27.83

Powder: always 1.45 - 1.6

↳ older data

!4 sec powder request! (in RFID timeout)

Again:	1	=	1.51,	1.51	1.46
	2	=	2.31,	2.32	2.16
	3	=	3.12,	3.12	2.97
Powder 1&2 dispense	4	=	3.72,	4.59	4.43
	5	=	5.29,	5.29	5.24

Again

< Powder 1&2 dispense

- Add logging events for wash start, end, etc ✓
- Messaging at end of RFID tumble - locks up but OK ✓
  - hangs up? yes
- Fix reset drain counter? ☆
- Add ~~drain~~ fill timer ✓
- Log fill-drain time = wash time ✓
- Remote drain logic as 2×2 boolean case ✓
- Resize to fit screen ✓
- Restart waits 1 sec to close door ✓

pH calibration: last calibration 9/16 12/8

	4.0 buffer	7.0 buffer
12/8 before:	4.31 (~2sec)	7.31 (~2sec) response time
after	4.00	7.00

PASSWORD = 0800

- create calibration function (very tricky)

28 sec on → 25.74 g Tangitol want 22 g

24 sec on → 22.31 g, 22.15 g

brand new probe is also slow spec: <10 seconds!

#3 Splish Splash - Programming Notes, ctd. / pH Probe

- set AFID tumble time to 20 sec
- set NFPA 2112 liquid 1 time to 24 sec
- set " soak time to 2 sec

New probe response time:

1:53	74.8F put in hot water
54:0	in
54:20	82.3
:40	96.2
55:00	103.3
55:30	110.7
56:00	115.6, move to cold - actually 1 to 117 then ↓
56:20	111.8
56:45	100.7
57	95.7
57:30	89.2
58:00	85.1 → 84.6
58:20	89.2
59	104.4
2:00	113.2

- Reboot computer to get CMIS working
- computer (CMIS) writes .XMC file when door opened not when program ends
- improve next state display
- add cycle count to RFID - no ballast wash

4:12 PM - start wash w/ chemicals lots of foam!
First drain: 4:26:13 pH 9.3 → 9.4
✓ ☆ pH, temp decimals formatting changed
✓ ☆ show hot water fill status
? ☆ why were powders on 1.5 sec? better now
Second drain: pH = 9.1
Fluid: 7.95 foam bad
Fourth: 7.46
✓ ☆ Extend hybernation time 4:45 → 50 min
Fifth: 7.16 pH = 4.71
OK ☆ Pre-drying did not heat for 5-6 minutes! ☹
drum speed is now 48 RPM
✓ ☆ change "door open sim" to Hot Water Fill ✓
↳ change control later (caused problems later... bad)

#7 Splish Splash - pH Probe Testing 12/9

Run another wash, confirm wash water temp manually

9:37 start - bypass @ 210° F!!

Machine showing 112° F, 150° setpoint

9:50 drain @ 105.5°F - drum says 106° pH 9.49

2nd wash - (1st rinse) - heating "on"

water level is 132 vs 159, now @ 139

9:58 drain @ 108.6° F - drum says 109°

cold water filling @ full throttle

10:01 drain 116.1° F 116

10:06 drain 111.5 112 7.52

almost no foam left. Bypass to 201°F

10:12 drain 101.4 vs 102 7.34

10:20 final drain 98.8 99 5.15

flat part with no heat is extract!

heat on as soon as pre-dry starts.

pH log
9.33
9.20
8.14
7.52
7.27
5.56

! Program set to hot water fill only will reach temp

3:07 Bypass @ 194°F

Temperature dropped from detergent flush?

only at 128

Also, "Hot water flush" is on - maybe this is confusing it?

3:18 drain 123.7 124 9.32

much less foam!!

rinse 146? (slow) 154 8.99

rinse 151.9 152

~149 ?

137.6 135 7.55

124.0 122

102.1 103 9.62

Created flush program to clean out detergent bags hopefully with cold water - yup!

set to hot water flush - still cold

all steam must be coming up the drain

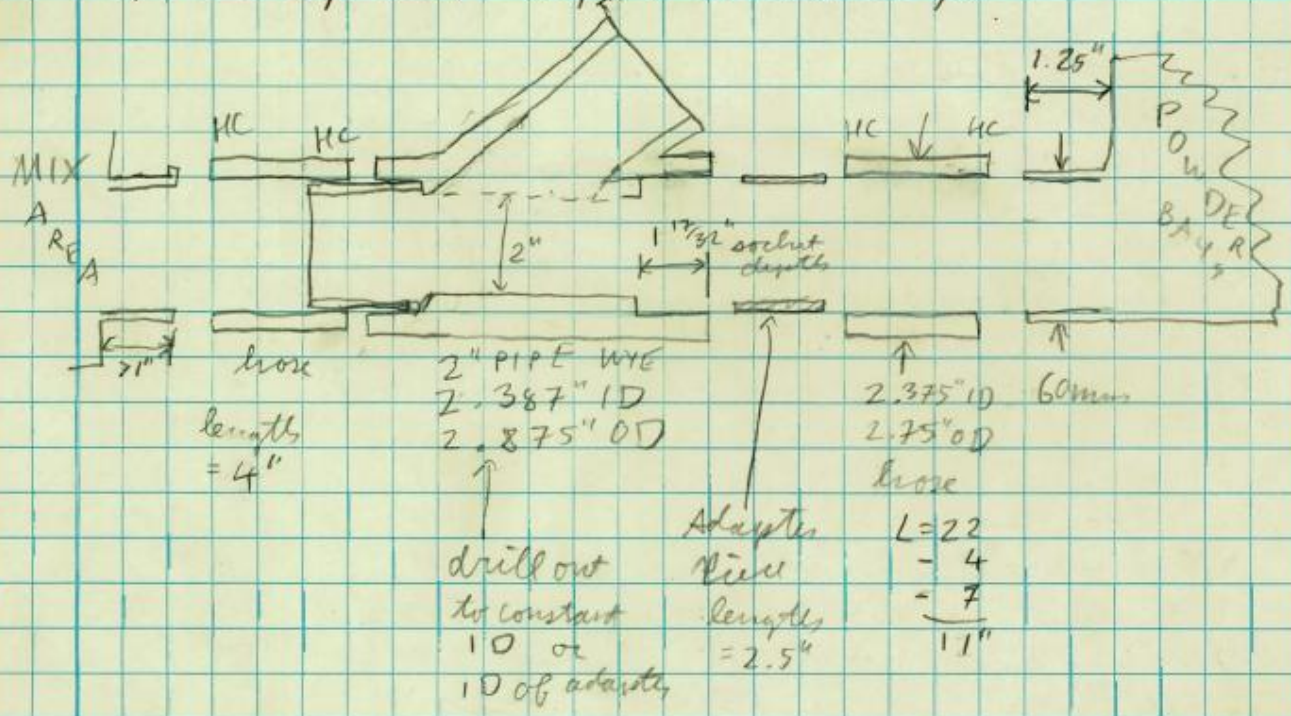
drain hose = 60 mm ID (2.375") 22" long

tried blowing back steam with fan - worked!

ordered PPE T/C today

now design fan blow

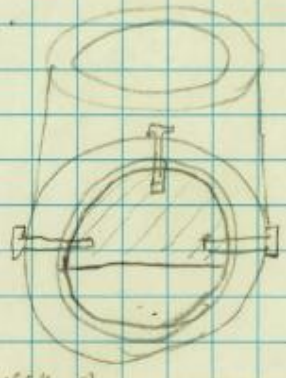
#3 Splish Splash - Vapor Fan Design



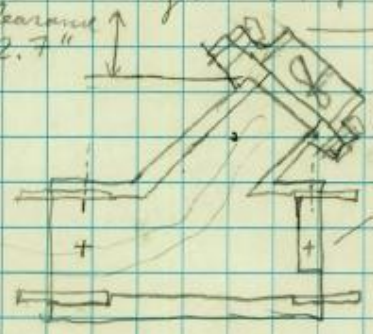
Adapter piece = 2 in PVC pipe? ID only 2"
30455 pipe = 2.245" ID (0.065" wall)
$67.80

HC = Hose Clamp for 2 7/8" ID
Use PVC cement on socket adapters or screw if needed

Why: insert blockage disc
use to screw in adapter
on one side



Inlet: glue on plate along 2.0"
clearance ~2.7"
• plenty!



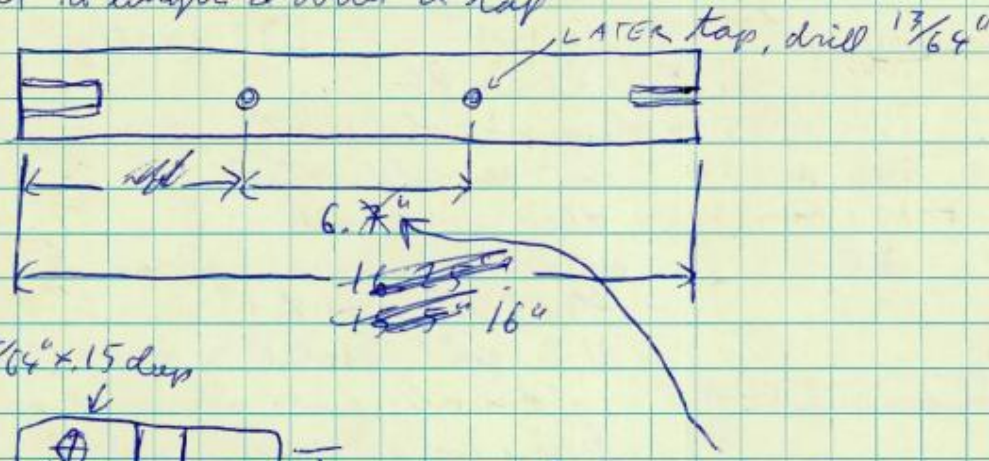
- #8 screws (0.164" OD)
0.135" tap #29

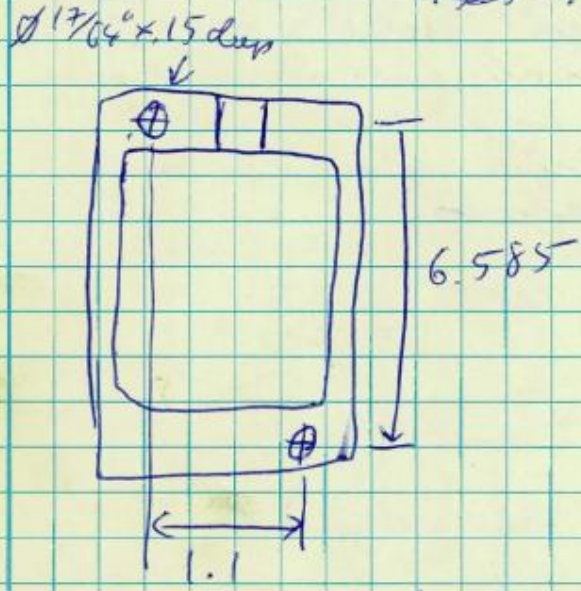
will tube fit? new hose is fairly stiff

- could make adapter longer & slide back
(3.5" adapter, 10" hose)

#3 Splish Splash - Antenna Mount, Tuning

Cut threaded rod in half
cut to length & drill & tap:





drag = 6.676"

Working great! Lots of programming 12/18
- add hot water bypass timeout
- just heated to 11 seconds!
- piston move timeouts
- T/C is calibrated - very linear
- numeric indicators get reset somewhere, doesn't show until first update, indicators executes

OK, work on temp tuning.
Set water heater to 5 inches as recommended by Ernesto - probably max not inches
rinse - set to 10

Actual wash temps:

	Set	1st	log	2nd	log	Try: XV2	
						change to min → 1 min resolution	
Main	150	139	137	"139", 139 actual	139	fill to / all	140 146→140
rinse	150	145 (143 @ end)	144	160→128→145, 143	144	next	140
rinse	135	"114", 152 actual!	152	"144", 150 actual	152	/ stage	132
rinse	118	"102", 143 actual	137	101, 138 act.	140	H+C temp check @ start	115
rinse	100	"88", 124 actual	124	89, 126 act.	127	H+C	102
Main	100	"108", 109 actual	110	104, 104	106	H+C	100.5

#3 Split Splash - Wash Turning

2-step fill process

Before:

1st level [98] 2nd [159] @150° ☐ = above floor!

reaches 150 when level is 80

154 @ 85 → dumps cold water time = 1:08

drops to 145 @ 1:17 so 9 sec cold water?

bottoms at 126 @ 1:38 then comes back up to

135 @ 1:52 overshoots level to 163 → drain? NO just

139 stop fill, drift to 139

N.B. cold flush @ 98 mm! :57

~~New plan: fill to~~ cold water hits around same time as setpoint reached

* need to add flush water before setpoint is reached
* fill H+C is much more stable

PLAN: first fill to 70 (all hot) only 1" above drum!

2 min hot + rinse to 130 temp set to 160 ± 3

8 min H+C fill to 159 150 ± 10

Rinse @ 150 - same thing 2 min / 3 min

rinse @ 135 - 28 mm (25 3 above drum)

First wash hit 150 exactly, 1 min too long

drops to 145 when done filling

also, keeps dumping water due to 5 mm hysteresis

rapid advance wash → drains @144°F

2nd time - no flush water - overshot & crashed

but temp = 147

2nd rinse - finish @ 141°F → drains 140°F

135 rinse - set 150°/228 fill to 140

→ quickly overshot, crashed, hot fill only

hit 156, cools again ñ to 126, recovers to 156

What was first fill level? oops!

118° rinse - 116° } another belch

130° rinse - 102° } good enough! about

XV2 - Temp = 148, some belching, level @ 180

why overfill? or did it? temp still 146

water level is @ bottom of lower rope mark

LINT FILTER is wet with steam!

belched again

135 rinse @ 132 for what it's worth

#3 Splish Splash - Programming Notes

12/19 2014

Tested Improvements to add to EL x 30:

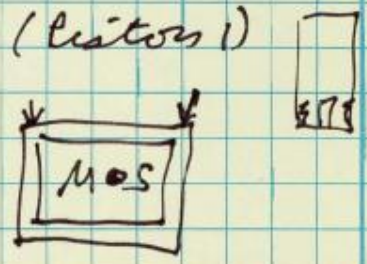
- ✓ • stop request button
- ✓ • powder jam stops machine
- ✓ ✓ • RFID tumble light turns off
- ✓ ✓ • Default temp = 170°
- ✓ • Bypass at start of wash every time (>10 mins)
- ✓ ✓ • Drain state type def
- ✓ • ~~Partially (EOF)~~ don't log blank ~~low level~~ liquid tank empty M 20
- ✓ • start counting detergent. ~~counts M 21~~
- ✓ • write to light & buzzer Red - M2. 22
  - Y - M2 23
  - G - M2 24
  - Buzz - M2 25
- ✓ • rinse # is reset when program starts, but log was from end of dry cycle!
- ✓ RFID tumble detect ran when looping in ~~[illegible]~~ RFID manual cycle mode (confirm) OK??
- ✓ • check Dispense Powder array size issues when using digital or manual override FIXED
  - starts as 3 element thus > 0
- ✓ ☆ tell Bobby open door not PNDR4
- ✓ Status light doesn't turn green on wash start
- ✓ • log wash start via RFID check (only has RFID begins & ends)
- • G/Y/R light order is messed up! Can't control
- ✓ • if stop after this cycle complete, reset button
- • message if no log
- ✓ • Powder calls slow pistons
- ✓ • check pH range
- • add ~~detergent~~ probe flush
- ☆ in manual mode then start seeing signal flickers ask Tommy
  - ↳ came back, may be hardware after all
- ! Added signal filtering
- • ~~to~~ change to Rinse #N completed log
  - status light not on for RFID start

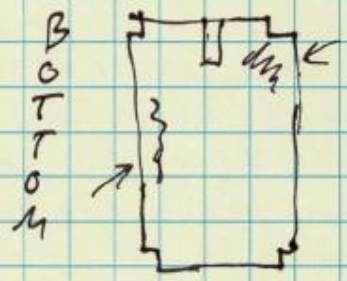
#5 Splish Splash – Wash & Sample Notes 1/5

Back from holidays!
Unwashed & lightly washed – box wt = 11.9 lbs
Box itself - 1.15 lbs
Fabric: 10.75 lbs

11:07 wash with 10 pieces
Dry rit is quite pink – need to dry
Log not working due to old version
Need to find her log set

1/9 put MS slides in upside down (listers!)
- seems to move smoother
  NOPE, total bind
- MS back upper corners rub





7 washes 1/6 into rit, jam @ 0:15
1 wash 1/7 9:52 end (jam)
1 wash 1/7 10:46 – 12:00 end (jam)
start 6 more 11:47

1/15 Final prep for goal:
- have 20 pieces w/ sewn ID tags
- weigh samples
- maybe: log recipe & cycle w/ drain #7
- count washes properly
- practice scanning samples
- inventory while they run:
  1-2: tested & cut 2 lb
  3-10: washed 25x (3 accidentally + 10 w @ 20 lb)
  11-12: washed 15x (12 " " " "
  6 13-18: unwashed, plan for 2 lb trial
  19-20: #not used
  (42) 21-63: washed 10x in 20 lb wash
  4 64-67: unwashed extra
  10 ctd..

#3 Splish Splash - Sample Notes & Bleed Valve

Completely unwashed Oliver samples:
2 B15, B16 (white)
3 D15, 16, 17 (navy 5565)
3 F15, 16, 17 (khaki)
2 H15, 16 (navy 5590)
3 K15, 16, 17 (grey 5562?)
(1) K29 - just barely washed

13 unwashed

7 samples w/ tags sewn in, washed ? times

samples lightly washed +10X on Oliver from SS

1 piece of fresh 5570 red

9 pieces washed 100X at SS

1 box of cut-up leftovers

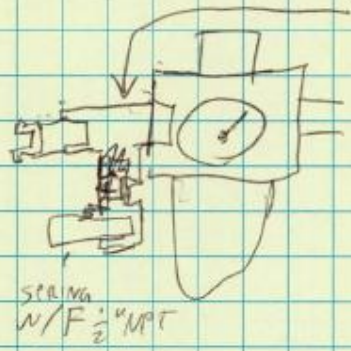
1/22

Tried to diagnose jam - couldn't reproduce in P-lab!

1/26

Piston jammed - powder has roughed up sides

Regulator - 0.83" thread OD = ½" NPTF
Have ½" NPT male to ⅜" push-connect fitting
Also could replace ½" NPT F-F ball valve with ~~4093T23~~
also need to replace 90° elbow b/c all valves fill centers.
Just get 4088T11 spring close lever valve + T
½" F×M×M ~~4638K368 $12.02~~
DAMNA BIT! M×M×M or F×F×M
get nipple so F×F×M
+ 4540K571 $1.34 M×M

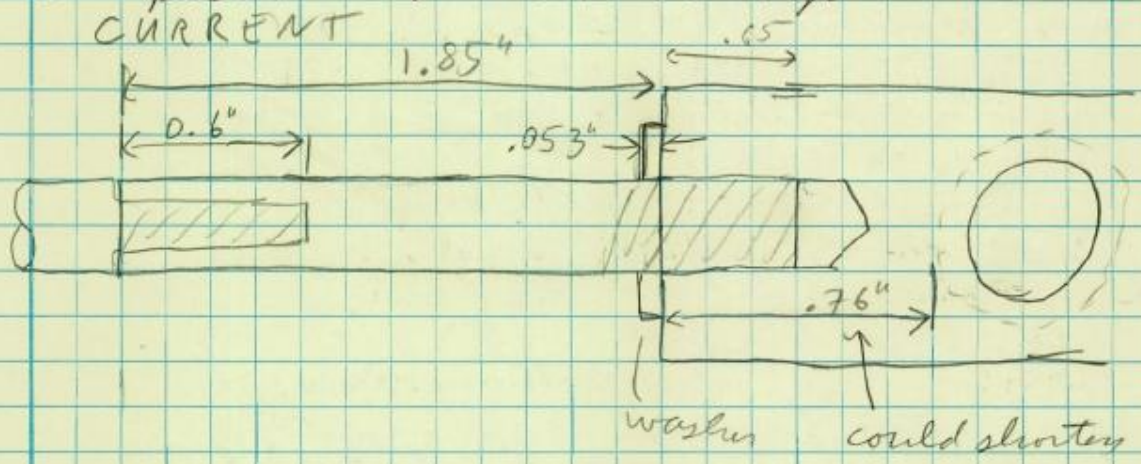


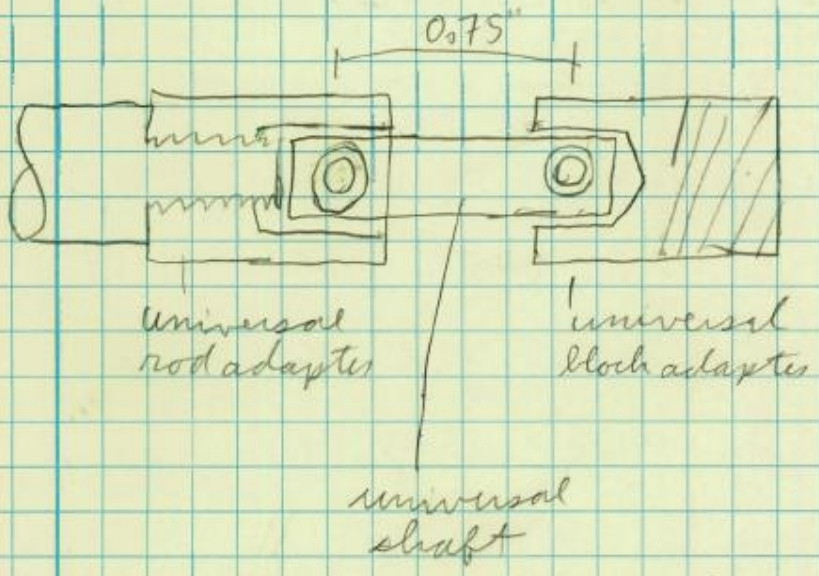
OR replace elbow with F×F×M
bleed downstream

#3 Splish Splash - Universal Coupling Design

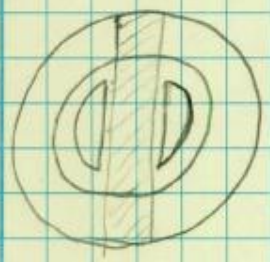
Compact universal linkage:

CURRENT

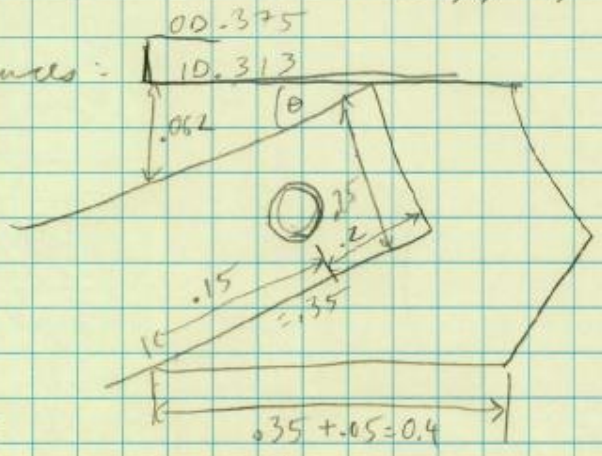




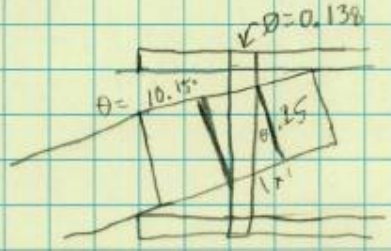
have set screw screwed into adapter so it doesn't protrude even more when wiggling or fall out



Clearances:



$\theta = \frac{0.062}{0.35} = 0.177 = 10.15°$



$x = .25 \cdot \theta = .044$

hole $= .138 + .044 = 0.182$

#3 Splish Splash - Universal Coupling, Folding, Sliders

Vertical misalign tolerance: 0.75" x .177 = 0.133"
plus hole clearance! Too sloppy, cut in half.
3/8 rod in 7/16 hole: ± 0.031 clearance vs .022
so ID = .281 → .031 clearance
→ θ = 0.0886 = 5°
→ x = 0.25·θ = 0.022"
→ hole = 0.160" (0.161")
vertical tolerance = 0.065"
slop = 2x = 0.044"
(stroke is ±.125" so plenty extra)

Assumes 0.65" engaged on block like before
↳ can grind off material if not deep enough

folding problem 1/28

- current samples after 14 washes + 4 are as follows
colored: mostly OK, some balling
red: just starting to fold! round edges seem to fight the tendency → flattened

	25w		50w		75w		100w
13	S	14	S	15	S	16	S
17	S	18	C/R	64	C/R+H ✓	65	C
66	C, F+H ✓	67	C	68	S	69	C
70	S	71	S	72	S	73	S
74	C/R	75	R	76	C, F	77	R

) ✓) ✓

C = creased/folded badly F = flattened
S = small, bunched but not as creased
R = rounded corners protect some, about half folded
C/R = 80% folded but one corner is OK
) = joined together +H = add half a piece

64: 161.2g
66: 170.3g
67/75: 127.5g
69/77: 128.2g
Total = 222 - 2.15 = 20.05 lbs

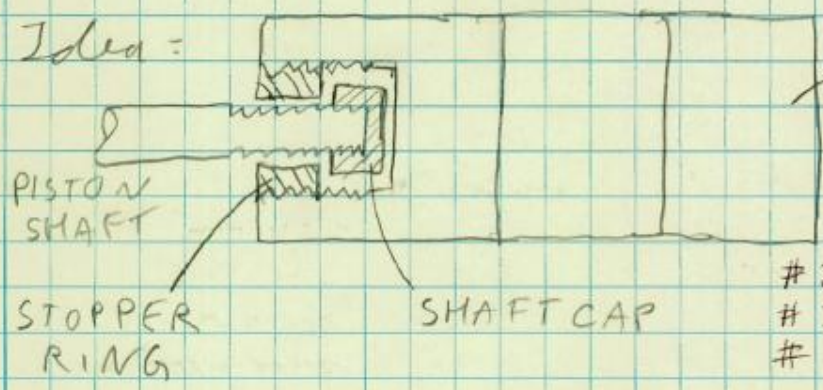
Sliders dimensions:

	hole	mid	end	
MS block, current (1.272)	1.491	1.491	1.489	width
	0.896	0.898	0.898	height
MS New block (1.158)	1.490	1.491	1.491	W
	0.899	0.898	0.899	H
Housing ★out of tolerance★	1.494	1.496	1.497	W
(obviously groove is longer)	0.901	0.902	0.903	H
clearance (thousandths) Δ	3-4	5	6	W
Δ	2	4	4	H

#3 Splish Splash - Big Slider Coupling Design

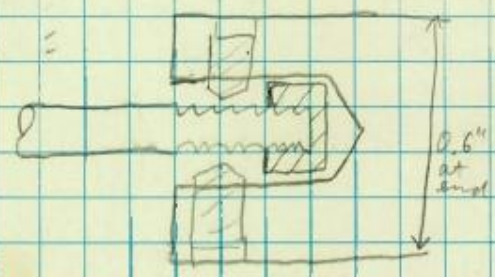
Big slider couplings:

Idea:



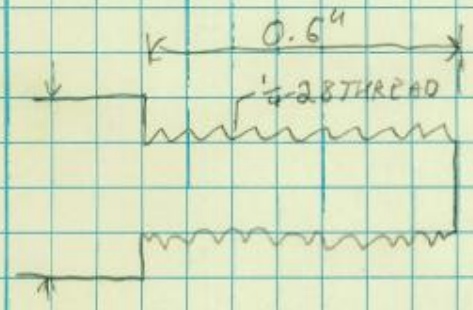
Break loose pressure:
#2: <8 PSI ☺
#3: <10 PSI
#1: 21 PSI start
30* PSI bottom out
*sometimes 40

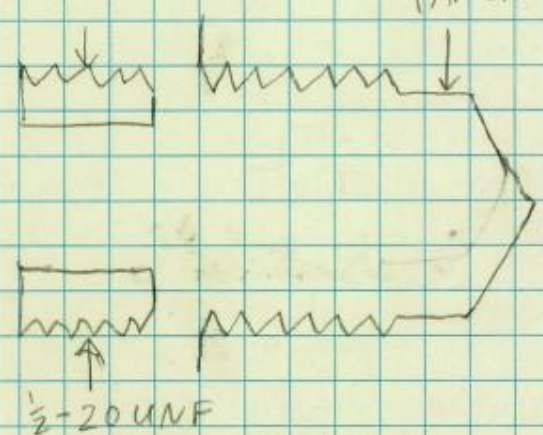
Alternative:



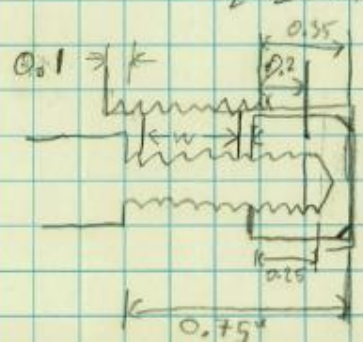
set screws hold it in... insert screws into back... insert slider in from side...

Go with #1. Make sure stopper bottoms out first.
Slider currently bottoms out w/ piston, so ideally make up 1/8" ... b/c piston threaded out we're OK (result of going to magnetic piston)
~1/4 turn @ 5/8-18 = 1/4·18 = 0.013" only





Cap OD = 0.375"
cap l = 0.35"
about 0.1" longer
→ 0.75"
current hole is 1" deep!



radial clearance: 453 − 375 = 78 at cap

hole = 0.85 deep, >0.5 → 0.6" threaded (0.85 − 0.35)
w = 0.75 − 0.35 − 0.03" − clearance
= 0.37" − clearance = 0.3"
ID > 0.25 & < 0.375 − 0.03 = 0.345
0.281, 0.35 0.3125 = 5/16 r.c = 0.0625

#3 Splish Splash - Slider dims & Dust Deputy start

Piston moves: #1 < 8PSI (first)
2, 3 while I wrote this!!
#3 was last but all below gauge limit

Small slider

	end	mid	shaft	
W	1.242	1.243	1.242	new one
	1.2425	1.244	1.242	old one
	1.249	1.250	1.249	groove
	1.2505	1.247 1.246	1.248	groove, bottom
H	0.898	0.898	0.898	new one
	0.896	0.8965	0.8965	old one

groove seems tight in one place..
cut to 1.245

Dust Deputy test: emulate 300 CFM with shop vac? 2/24
what size tubing & connectors do I need?

Shop vac #1 - red
6.0 HP 170 MPH Craftsman Model 113.177611
120V 11A Hose: ~1 3/4" ID 2" OD

~200 CFM

Shop vac #2 - black wet/dry
5.0 HP 150 MPH Sears Craftsman Model 113.177000
Hose: ~1 3/4" ID no connectors just crimped

~190 CFM

#3 in E-lab: has connector, same as #2
#4 in E-lab: 2.8 HP Stanley mini 7A 70 CFM
wet/dry, silver model SL 18129
#5 D-lab JET dust collector 1.5 HP
3450 RPM motor Model DC-1100RC
4" spiral hose (transparent) w/ 4" hose clamps
Airflow 1100 CFM!!

1100

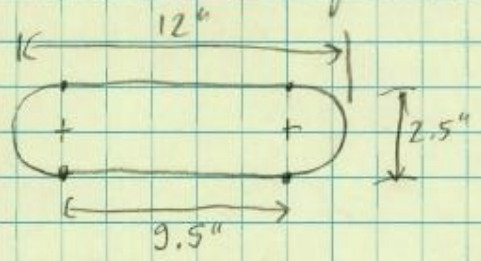
other 6.25 HP vac is in D-lab

WD5240: dust is 6" going back - 2.5" × 12" oval (frondrum)
7" Ø up to fan

#3 Split Splash - Dust Deputy start

Potential setup:

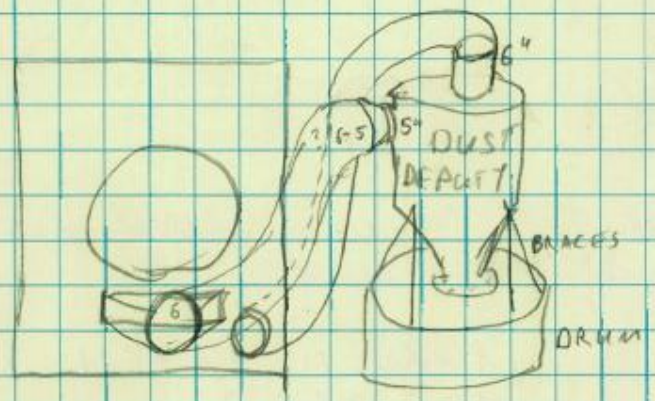
Outlet at washing machine



Perimeter = $9.5 \times 2 + 2.5 \times \pi$
$\approx 26.85"$
eqv to $8.5" \times \pi$
largest bend-and-stay is 8" ID
25.1" circumf.

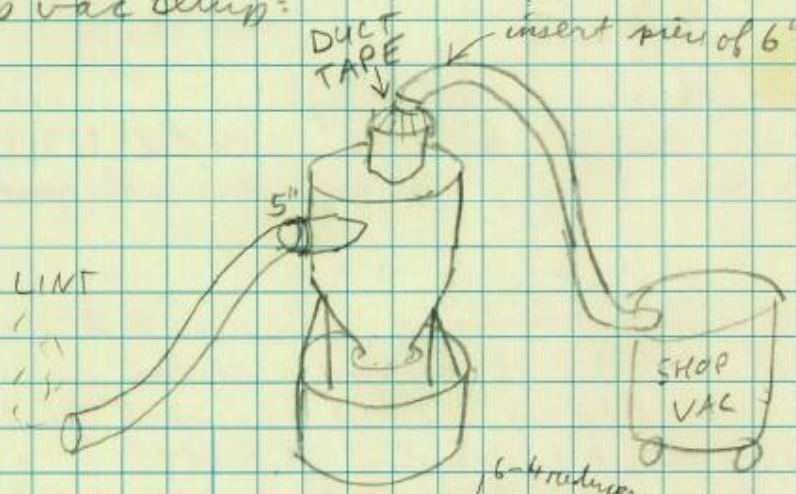
not rated for vacuum... probably need custom work

MCM 1844K35 is $2\frac{1}{4} \times 12" \rightarrow 6"\varnothing$ $8.57 galv. steel



Alpine: $2\frac{1}{4} \times 12$ to 4" or 6" Boot
End registers boot

Shop vac setup:



BUY
DD & drum
braces
6" hose
5" hose
2 × hose clamps
6" hose adapter

Dust collector setup:

#3 Splish Splash - Dust Deputy start, ctd. 3/4/15

Test with shop vac 6.25 HP in D-lab
cleaned filter & drum
air speed = 1950 FPM avg ~ 1900 on 5" duct?
inlet vacuum 0.1 in H_2O
$\pi 5^2 = 19.6$ in^2 ~ 259 CFM!
very close match.
vacuum @ outlet: 0.60 vs 0.04 ambient
0.01 and 0.03 off
~0.6 in H_2O
Measure at vacuum inlet: 0.66/0.77
DD outlet → ← inlet

~~remove inlet~~ straighten inlet duct: DD 0.55/SV 0.65

no inlet duct (unclamp): 0.45/0.53

open drum 0.16/0.22

un-tape outlet 0/0.15

	[based on hose end]	[DD outlet]
Inlet hose:	0.12	0.10
Vortex:	0.31	0.29
Housing:	0.07	0.16?
outlet hose:	0.15	

Fabview: DI array gets [illegible] during initiation

Oneida Dust Deputy: Cathy Super DD: 200-550 CFM 3/11
Super DD XL: 500-900 CFM
Consider metal dust deputy, FR hoses such as Goodflex found online.

Foxboro - Cevin Reed - case # 301576803
go to calibrate - manual (NOT solution) - default
also see diagnostics - view history - look for "call Foxboro" msgs
→ no faults. Power restored 1/22 - clock not set?

External lint filter (Stay Good): TJERNLUND may not make them anymore micron rated filtration fabric
PET up to 325°F PP up to 200°F act 2 15/4/15 act 3 4/6/4
Anti-stick: DRAIN 10 sec 1 sec distrib, 30 RPM action 2 10 RPM/10 ✓
EXTRACT 0:15 350 RPM ✓ DRAIN 40 sec 1 sdist 30 RPM act 2 10 RPMS ✓
EXTRACT 0:08 500 RPM ✓ DRAIN 50 sec 1 sdist 30 2 10 ✓
EXTRACT 6:10 890 RPM DRAIN 450 0s 24 RPM/24 RPMS
PRE-DRY 2:10 24 RPM action 3

#3 Splish Splash - Olivers turning 3/16

Current extract @ 610 RPM, 165 G's

CHLOR BLEACH: after every rinse
drain 10 sec 1 sec distribute 24 RPM action 2 → 1
+ extract 40 sec 350 RPM
currently drain 25 sec @ 30 RPM
current:
Main wash = action 2 drain = action 4 = dry
pre-dry start = action 3 (not used yet)
new drain = action 1 (set to 15/4/15

current: pre-dry 25 min 356 P/155 F action 4 48 RPM
add: pre-dry 2 min 24 RPM action 3
~~drain 10 sec after 5 min~~
pre-dry 3 min
drain 10 sec
pre-dry 70 min
Total weight in batch 203 = 1.65 lbs
Issues:
✓ Drain count is off for rinse #1 in Ad-hoc wash
✓ Cycle count is also off - not working at all?
* Rinse 1 on previous cycle #, 2 → Rinse #1 on new set
did some dispense tests then washed
✓ dry may leak air due to sloppy mount
✓ lots of water in drain - try drain later in cycle
Drain ct set @ adhoc wash start - drain is already closed by then - allow reset in ~~wait~~ drain closed state? But not wait on water state!
Forgot |+| in adhoc start!
✓ count deterg not implemented
ok count lint.

3/23 Measure air flow with the dust deputy on lines
DD inlet open - 2200 FPM @ 5" ø in fairly uniform, if not faster - 2400 @ edges 2300 ↔ 314 CFM
manometer @ DD in = 1.16 in H_2O vacuum with low-drum
1.35 in H_2O @ steady state, now 2.44" @ drum return
write as 1.35/2.44 1.49/2.65 with wet laundry (initial) 30 left
1.58/2.71 w/23 min left 1.86/3.04 w/15 min left
2.11/3.29 w/9 left 2.20/3.40 w/6 left 2.25/3.45 final (5 cool)
2.39/3.57 cool end

#3 Splish Splash – Oliver tuning, ctd. 3/24

5" duct

In 6" duct, 510 m³/h = 300 CFM ⇒ 25 ft/sec = 1530'/min 22⁰⁰
540 m³/h = 318 CFM ⇒ 27 ft/sec = 1620'/min 23³⁰

Keep drying and measure air flow 0
Start 1.02 / 2.24 ~800 FPM maybe 850
1.21 / 2.47 17 min left
New wash/dry cycle
0.94 / 2.14 start maybe 850 FPM @ 4" deep
1.03 / 2.22 27 left max 900 @ bottom edge
1.06 / 2.33 23 min left
1.16 / 2.48 18 min left
1.37 / 2.73 13 min left
1.48 / 2.86 9 min left 700, 800 @ 4"
1.61 / 3.01 5 min left
1.73 / 3.17 1 min left (final)
~600 @ 4" cool down

Play with sour solubility again. 4/2
8.3g sour → 16.9g total: dense, milky solution (1:1)
falls out in seconds
→ 29.8g total: falls out in 5-6 seconds (3:1)
→ 41.5g (4:1) same
→ 81.1g (9:1) about 50 when water stops moving, in 20 sec completely still

Pour out: 10.1g residue
Mix with 58g/l NaCl
14.2g salt → need 245ml, 259g total wt ✓
5.68g Na_2SiF_6 → add salt water
→ 18.5g total: dissolved a bit better
precipitate in 5 seconds
→ 61.68g: 5 seconds, no change
at a few drops, powder doesn't even wet out
IPA: 16.4g with unmeasured powder (guess 4g)
→ wetted out well but still not soluble
Acetone: no luck Acetone + Methanol: no magic
Corn oil: 3.9g Na_2SiF_6 17.4g total
better... but now nonpolar. add soap
16.9g + soap = 17.5g no but drops float down
density? powder is 109g for 65ml ~1.68g/cc
138g ~74ml 146g ~80ml so + 37g water, 43cc
hence 2.53g/cc "true" density

#3 Splish Splash - Dust Deputy tests

4/8

Dan says fan set to 500 fpm @ 12"Ø duct = 394 CFM
Area still a mess... fan running... busy until tomorrow morning
Seeing about 1800 fpm @ 6" duct with DD disconnected - just the sock filter, which is partially dislodged - Fan at 44.9 Hz
remove sock, reconnect DD & dryer
Pressure at DD inlet/outlet = 2.33/3.53 in H_2O
air flow @ outlet 6": ~1600 max on R side 51.5 Hz
~~can't run with no duct b/c no vacuum~~
no duct - surge to over 5000 FPM then steady at 4000
27.6 Hz → 50 Hz → 20 Hz → 60 Hz → 28 → 60
air flow 6000 → 3900
with fresh panel air filter, DD reconnected
1500 fpm max, ~1000 in center of duct 54.8 Hz
→ 44.2 Hz → 52.5 → 44.5 → 52.1 → 43.8
duct outer circumference = 38.1" → 12.1" so yes, 12" duct
air pressure 1.94/3.29 reduced fan much lots
48.2 Hz → 49.5 → 45.9 → 47.9
actual wash air ~1100 fpm, Hz oscilating 46.3 - 51.1
2.31/3.75 in H_2O @ 100 min (start @ 90.5 min)
2.37/3.61 @ 106 min
2.46/3.70 @ 112 min fan @ 48.64 Hz → 49.94 → 46.6
outlet temp only 114 ~900 fpm

Back to regular lint box 41.7 → 52.1 → 44.9 → 46.8 Drum is full why not around 20 Hz?
Empty drum 43 → 51.6 → 47.6 → 45.7 → 46.1
M 1.1 flashing so no change w/ empty drum
Normal wash and then dry begin ~ 3:45 PM
Actual dry began 4:50 PM
Fan 46.95 Hz → 43.3 → 46.78 → 45.88 @ 4:58 PM
Inlet temp plateau @ 271 F after 74 min (13 min of drying)
5:17 PM 46.4 → 44.9 → 46.3 → 44.5
Max air out temp was 127, max in 277 F
Regular 20 lb dry max 136, max in 338 F
Found 1.68 g lint in trap!

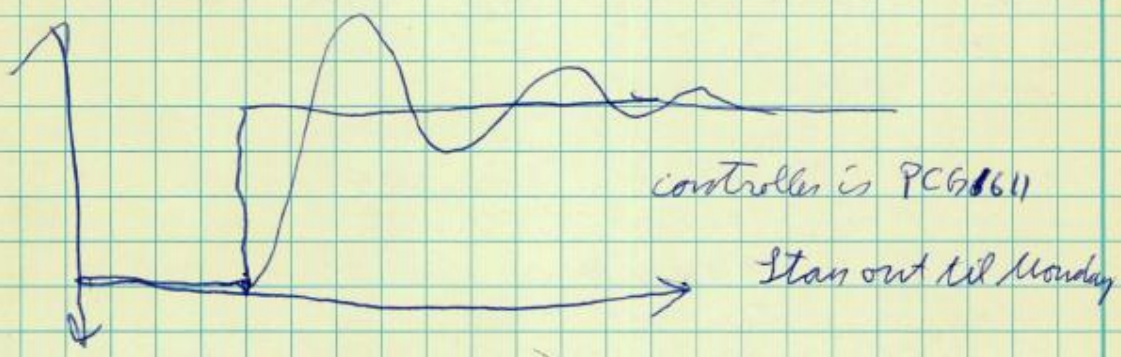
Want 510-540 m³/h (525) = 309 ft³/min - 393 ft/min @ 12" const. speed
M 1.1 = reference ~~point~~ parameter M1.8 = motor RPM

#3 Splish Splash - Johnson Controls 4/9

on motor drive:
Go to [LOC/REM] set to I/O → controller control
Set to keypad
hit green button until arrow on RUN hit OK
hit down button
when done, hit LOC/REM again to I/O

with left arrow on MON, flashing M1.1, hit up or down M1.8 = motor RPM

Main controller: bluetooth thing plugged into bottom where it says sensor
Network inputs - view details - edit
default value = 393, Apply, Close
At 200°F, output on right → OFF
This is not a KMC controller, incompatible with drive
Glass lab to have 1 or 18 Johnson Controller
393 → 20 Hz → 42 Hz → 27 → 41 → 23



Features - Advanced - no logging

To motor: Fib - open THEN Load
PID loops: commission
Login - Activity Inputs
Output control - VFD Control
Fan performance with standard limit box:

Hz	fpm	fpm	
20	37.1 - 39.3	231 @1 min ↓ 24 @@2, 190, 217, 191, 214... @4 min	60→20
30	34.9	468 @1 min, 491, 473 @2, 462, 470, 484, 503 @4 min	60→30
40		488 @1 min, 487, 490, 482, 489, 483 @4 min	30→40
50		561 @1 min, 556, 572, 557, 583, 552, 573 "	40→50
60	37.4 fpm	647 - 675 - 657 - 670...	20→60
60B	VFDCNTRL FPM {UI IN 1} (Inputs)	615 @30 sec 667 @45, 676, 1 min	20→60

#3 Splish Splash - Johnson Controller, Ltd

4/14 2015

New timing & wiring - run at 56 ms loops (20 Hz) with about 4% CPU usage vs 12%+ before! Also feels much more responsive.
Now check on fan - wash with regular air filter
2:21 - 5 min left then start drying
2:27 - 232 fpm VFD CNTRL SL% = 2.9%
drain @ 6.1% 22.4 Hz
2:32 - 295 fpm 20.26 Hz sudden jump
VFD % = 0.8%
2:34 finally 8.7%, 301 fpm, 23.4 Hz
2:35 drain back at 1.1% and we still haven't reached setpoint!
2:36 316 fpm
2:37 10% on drain, 24.8 Hz, 299 FPM → 313
21 mins
2:39 378 fpm, drain @ 1.6%, 20.5 Hz 326 FPM
2:40 11.4% 26 Hz, 328 ... 15%
2:42 388! 8.8%, 21.6 Hz 407! 389
2:45 362, 12.9% → 7.6% 396 temp = 110°F
2:46 393.9, 5.4%, 22 Hz
2:48 376 9.4%
2:51 378 7.1%, 23.7 Hz
What is this lead compensator?
2:54 - 0, flow = 362 ??
2:56 - 157 fpm → 106 2:57 - 40 fpm
dry should start at 4 pm even
4:01 start @ 20 Hz VFD CNTRL = 0% 4:01:00 pretty much
02 38 FPM, 5%
4:03 145 FPM → 187 back to 0% compute restart
04 sitting at 0% 06 ... still 20.0 Hz 08 21.6 Hz
10 - 21.4 Hz, 291 FPM 12 - 300 FPM, 7% T = 100.2°F 5.8%
14 - 5.6%, 325 FPM 15 - 9.7% - 9.1% why drop???
17 - 363, 6.3% → 5.7% 18 - 354, 7.8% 20 - 364, 8.1%
21 - 372, 7.7% 22 - 370, 8.7% 23 - 378, 7.9%
25 - 374, 8.2% 26 - 10.1%, 376 ~~27 - 389, 7.4%~~
28 - 389, 7.7% 29 - 380, 9.0% (23.8 Hz)
30 - 380, 9.9% 31 - 389, 8.6% 32 - OFF
16
27