

WASC 1901

Papers on
Reactor Cordite 1936

C686/34.

Reactor Cordite.

[See Vol. V. "Factory Cordites" p. 130]

Expts. - ^{of size} (regularity, brittleness, air inclusions, planes of weakness)

1. Effect on ^{mean} size of
 (a) New Cordite.
 (b) 1st rework.
 (c) Further reworking.

2. Effect of different temperatures of cordite discs and cordite press cylinder.

3. Effect of different pressures & speeds.

4. Effect of ^{different} ~~new~~ die (with larger aperture, & steeper slope of entry).

5. Effect of different compositions on regularity, brittleness &c &c.

SUBJECT.

Picrite Reactor Compositions

Date.	Referred to.	REMARKS.																																																																														
13.10.36.	<p>D. King</p> <p>Dr Foster</p>	<p>We spoke. Will you please suggest a range of compositions containing 50% Picrite and of heat value between 860 & 1000 w.g. which can be dealt with by the solventless process.</p> <p style="text-align: right;">W.V.</p> <p>The following table giving compositions which can be manufactured should enable a selection to be made to meet the particular requirements:-</p> <p>A <u>Picrite compositions.</u></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Picrite</th> <th>N/C 12.2%</th> <th>M/G</th> <th>barbamite</th> <th>Cal Val (W.L)</th> </tr> </thead> <tbody> <tr> <td>F489⁶ (ap)</td> <td>50</td> <td>22.5 26</td> <td>23 20</td> <td>4.5 4</td> <td>850</td> </tr> <tr> <td>F489⁵ (bp)</td> <td>50</td> <td>22.5 25</td> <td>24 32</td> <td>3.5 3</td> <td>900</td> </tr> <tr> <td>F489⁴ (cp)</td> <td>50</td> <td>19</td> <td>28</td> <td>3</td> <td>950</td> </tr> <tr> <td>F489³ (dp)</td> <td>50</td> <td>15.5</td> <td>32</td> <td>2.5</td> <td>1000</td> </tr> </tbody> </table> <p>B <u>Matrixes</u></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td>(am) ---</td> <td>45</td> <td>52</td> <td>46</td> <td>8 8</td> <td>985</td> </tr> <tr> <td>(bm) ---</td> <td>45</td> <td>50</td> <td>48</td> <td>7 7</td> <td>1085</td> </tr> <tr> <td>(cm) ---</td> <td>38</td> <td></td> <td>56</td> <td>6</td> <td>1185</td> </tr> <tr> <td>(dm) ---</td> <td>31</td> <td></td> <td>64</td> <td>5</td> <td>1285</td> </tr> </tbody> </table> <p>C</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td>(a) ---</td> <td>54</td> <td></td> <td>35</td> <td>11</td> <td>850</td> </tr> <tr> <td>(b) ---</td> <td>53</td> <td></td> <td>37</td> <td>10</td> <td>900</td> </tr> <tr> <td>(c) ---</td> <td>52</td> <td></td> <td>39</td> <td>9</td> <td>950</td> </tr> <tr> <td>(d) ---</td> <td>50.5</td> <td></td> <td>41.5</td> <td>8</td> <td>1000</td> </tr> </tbody> </table> <p style="text-align: right;">S.W.P. 14/10/56</p>		Picrite	N/C 12.2%	M/G	barbamite	Cal Val (W.L)	F489 ⁶ (ap)	50	22.5 26	23 20	4.5 4	850	F489 ⁵ (bp)	50	22.5 25	24 32	3.5 3	900	F489 ⁴ (cp)	50	19	28	3	950	F489 ³ (dp)	50	15.5	32	2.5	1000	(am) ---	45	52	46	8 8	985	(bm) ---	45	50	48	7 7	1085	(cm) ---	38		56	6	1185	(dm) ---	31		64	5	1285	(a) ---	54		35	11	850	(b) ---	53		37	10	900	(c) ---	52		39	9	950	(d) ---	50.5		41.5	8	1000
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~~D'King.~~

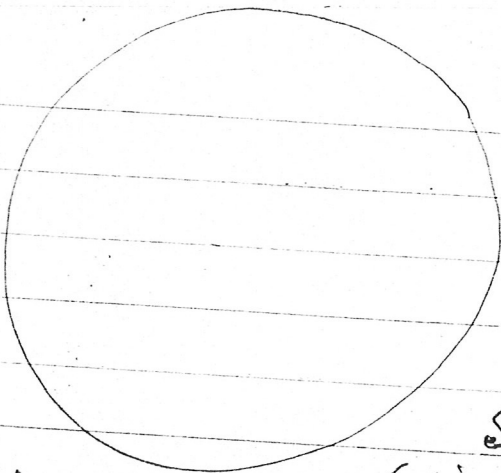
The suggested series
should cover the ground
excellently. Will you
please manufacture 5 lb
of each type pressed to
0.6" diameter for Cased

Vessel Measurements and
1 lb. size 0.2 for Cal. Val. analysis,
using the same manufacturing
technique as would be
employed for production
as reactor propellants.

// not
// quite

W.P.

14.10.36.



Solvent cyl.
8" diam.

Solventless
S44 press. (diam. of cyl. $4\frac{1}{2}$ ")

2 lengths of $17\frac{1}{2}$ " (pedestal 36" deep)
(2" diam.)

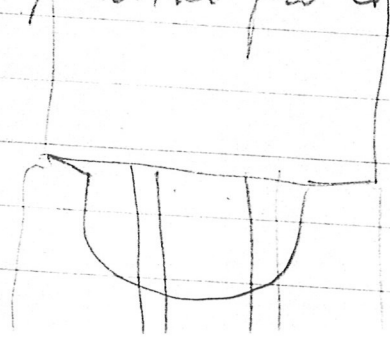
Can an 8" (int. $\frac{1}{2}$ ") cyl. be wound elec. & used in the present cradle in S44?

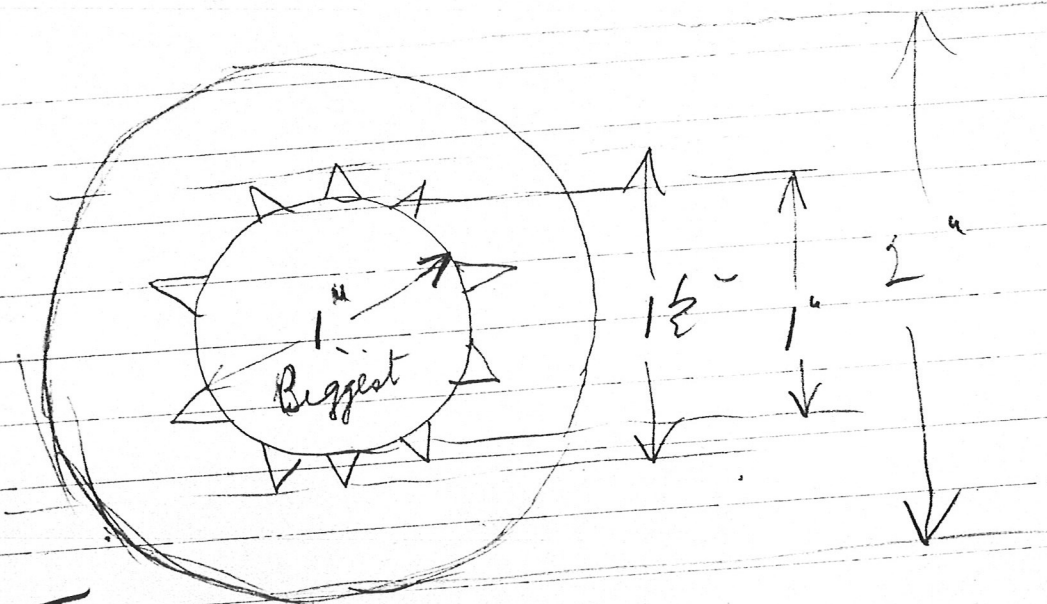
$\frac{6'' \text{ diam.} \cdot \text{length of } 30 \text{ lbs.}}{4} = \frac{21''}{(14'')}$
 $\frac{4'' \text{ diam. die. use } 8'' \text{ parallel}}{(20)} = \frac{47''}{(32'')}$

Recommend
30 lb. change
4/189
47

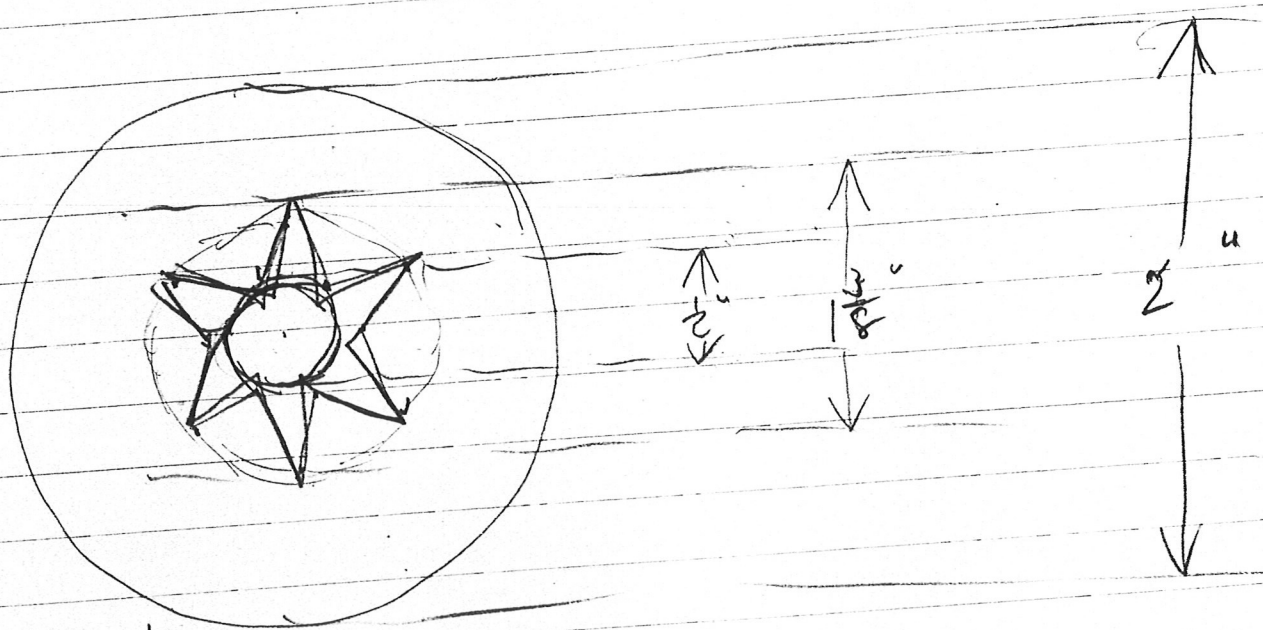
	Paper in.	
SC .26	190 x 23.9	Temp. 85°C. in S44
HSC .26"	175 x 23.9	

Solvent Press 2" thickness of metal
Cut hole in pedestal for lower part of die...





I 10 point



II 6 point

Area of holes / Total Section

I. About 4/16 } roughly.
 II. 1/16

Hole takes 11% of space.

30 lbs SC
 4" diam
 6" diam
 16" diam

Ex. Press. S.C. from wood with 0.1% Zerranol.

① In Rifle Press Cylinder, of diam^r. 2. "

Size 0.26" : Temp. abt. 83°C.

Ex. Press. F474¹⁵¹ 11/10/27 : 6½ stroke : $\left. \begin{matrix} 180 \\ 160 \\ 150 \end{matrix} \right\} \times 11.8$

~~F474¹⁵¹ 11/10/27~~ : ~~6½~~

• F474^{110B} 11/2/26 : 4½ - $\left. \begin{matrix} 200 \\ 140 \end{matrix} \right\} \times 11.8$

② In large cylinder S44

Ex. Press. was 190 x 23.9

i.e. Pressure was twice as high in the large cylinder.

The cylinder at present holds just over 50 lbs, ^{with the waste involved} which is not quite enough to give two 3" Rocket charges.

The die takes ~~out~~ up more room than necessary. It is being modified in such a way as to make room for another 2 or 3 lbs. of cordite, and it is ~~hoped~~ ^{hoped} possible that two charges may ^{then} be got from each pressing.

Measurements of outside diameter of the cordite showed that it was thinner at the "top" owing to having to support its own weight during pressing. The extreme variation was about 0.05 inch. The use of a horizontal press should obviate this difficulty.

Measurements

Lot 1: Temp. Cylinder 65°C. (die 60°C.)
" Cordite discs, ~~at~~ 75° to 80°C.

Cordite: External diameter 2.935" (2.91" to 2.96")
Internal: Gap width at root 0.20" (required 0.20")
Root diameter 1.81" (~ 1.77")
Tip ~ 0.530" (~ 0.585")

Lot 2 . Temp Cylinder 80°C (Die 70°C)

• Cordite discs 85°C.

Cordite : External diameter 2.955" (2.91" to 2.96")

Internal: Gap width at root, 0.205"

Root diameter, 1.82"

* Sectional area of ^{Lip} star ~ 0.581" ^{19.8%} of whole section

The diameter of the 3" die is 2.86", this having been calculated to give finished size 3.00".
So bring the cordite up to the required size, a new sleeve of diameter 2.90" is being made for the die.

The extrusion pressure was 1.1 tons.
The resulting cordite (in lot 2) appeared considerably ~~was much~~ less brittle than that ~~was~~ pressed at Holton Heath, this being attributable perhaps to the higher temperature of ~~pressing~~ the cordite discs (M.R.N.C.F. 54°C; at R.D. 80° to 85°C).

R.N.C.F. have expressed their desire not to have the disc temperature increased, so further expts. will be carried out in the R.D. with discs at different temperatures.

* by measurement of volume of water filling a given length, 1.570

The diameter of the 3" die is 2.86, (this having been calculated to give finished size 3.00".
To bring the cordite up to the required size, a new sleeve of diameter 2.90" is being made for the die.

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X) by measurement of volume of water filling a given length, assuming density of cordite 1.570,
or by actual measurement of dimensions of section

C686/37

First Pressings of 3" Reactor Cordite Charges. (S.C.).

An 8" Press Cylinder wound electrically was employed, the pressing being carried out in press house S.44. A cordite was obtained that was smooth and fairly regular in section.

One length of cordite of 48" weighs about 14 1/2 lb.

The cylinder at present holds just over 30 lb., which with the waste involved is not quite enough to give two 3" Reactor charges.

The die takes up more room than necessary. It is being modified in such a way as to make room for another 2 or 3 lb. of cordite, and it is possible that two charges may then be got from each pressing.

Measurements of outside diameter of the cordite showed that it was thinner at the "top" presumably owing to having to support its own weight during pressing. The extreme variation was about 0.05 inch. The use of a horizontal press should obviate this difficulty.

Measurements.

Lot 1:

Temp. Cylinder 65°C. (Die 60°C.)

" Cordite discs 75° to 80°C.

Cordite.

External Diameter 2.935" (2.91" to 2.96")

Internal. Gap width at root 0.20" (required 0.20")

Root diameter 1.81" (" 1.77")

Tip diameter 0.530" (" 0.535")

0°	45°	90°
2.936	2.940	2.907
40	37	09
43	30	03
43	37	16
43	35	21
48	33	15
50	46	28
	50	32
	59	

2.9435 2.940 Lot 2-2.917: Mean 2.933

(F490²)

Temp. Cylinder 80°C. (Die 70°C.)

" Cordite discs 85°C.

Cordite.

External diameter 2.935" (2.91" to 2.96")

Internal: Gap width at root, 0.205"

Root diameter 1.82"

Tip diameter 0.581"

The die takes up more room than necessary. It is being modified in such a way as to make room for another 2 or 3 lb. of cordite, and it is possible that two charges may then be got from each pressing.

Measurements of outside diameter of the cordite showed that it was thinner at the "top" presumably owing to having to support its own weight during pressing. The extreme variation was about 0.05 inch. The use of a horizontal press should obviate this difficulty.

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40	37	09
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Lot 22-917: Mean 2.933"

2.9435 2.940

(F490²)

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" Cordite discs 85°C.

Cordite.

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Internal: Gap width at root, 0.205"

Root diameter 1.82"

Tip diameter 0.581"

^aSectional area of star - 17.8 per cent. of whole section.

^aby measurement of volume of water filling a given length, assuming density of cordite 1.570, or by actual measurement of dimensions of section

The diameter of the 3" die ^{sleeve} is 2.96" this having been calculated to give finished size 3.00".

To bring the cordite up to the required size a new 'sleeve' of diameter 2.90" is being made for the die.

The extrusion pressure was 1.0 tons per sq.in. The resulting cordite (in lot 2) appeared, from some preliminary fracture tests, less brittle than that pressed at Holton Heath, this being attributable perhaps to the higher temperature of the cordite discs (at R.N.C.F. 54°C., at R.D. 80° to 85°C.)

R.N.C.F. have expressed their desire not to have the disc temperature increased, so further experiments will be carried out in the R.D. with discs at different temperatures.

P. C. L

Dr Barrett,

Following are the
microscopic measurements on the
cold samples of cordite. Lot 2.

External diameters only:-

A. 2.958", 2.966", 2.972"
mean 2.972"

B 2.966", 2.962", 2.977"
mean 2.968"

J. Holibe.

^{-10/2/57}
Above are 2 sections only.

In the long piece the mean
diam^r = 2.955"

11	1	45 ⁰	45 ⁰
968	926	960	964
62	47	69	53
74	41	68	42
60	37	66	53
67	29	71	53
64	53	40	52
60	53		31
	49		

Lot 2

60 one end (top)
 74 other (bottom)
 (Due to weight?
 of cordite)

Mean = 2,955

Sleeve - 2.86" to 2.90"

61	35	74	50	20
4	3	3	3	15

28) 1520 (955
 140

 120

10 th 1st. weighed	1440 gm	[43.4 (111cm)]	= 6250 gm (13.78 lb)
10 th 2nd	1454	[45.6 (116.)]	= 6630 gm (14.62 lb)

1st lot Vol. water = 815 c.c. at 15° C, length 111 cms.
 Av. area = 7.34 sq. cms

2nd
lot.

Section B. Lot 1.

<u>Inner diameter</u> :-	<u>mean</u>	aa'	bb'	cc'			
	.601"	.624	.536"	.604"			
<u>Outer diameter</u> :-	<u>mean</u>	AA'	BB'	CC'			
	1.813"	1.785	1.825"	1.828"			
<u>Width at</u> :-	<u>mean</u>	A	B	C	A'	B'	C'
	.200"	.204"	.195"	.200"	.201"	.202"	.200"
<u>Circumference to</u> :-	<u>mean</u>	A	B	C	A'	B'	C'
	.535"	.533"	.510"	.504"	.533"	.543"	.554"
<u>External diameter through</u> :-		AA'	BB'	CC'			<u>mean</u>
		2.972"	2.96	2.95			2.948"
<u>Angles</u> :-	I	II	III	IV	V	VI	
	69½°	68°	67½°	67°	66½°	66°	

Limits allowed
 3.00" to 3.03"
 (a little less)
 2.86" gave 2.93 to 2.94
 2.94" std. gave 3.01 to 3.02"

G. H. Silver
 9/2/37

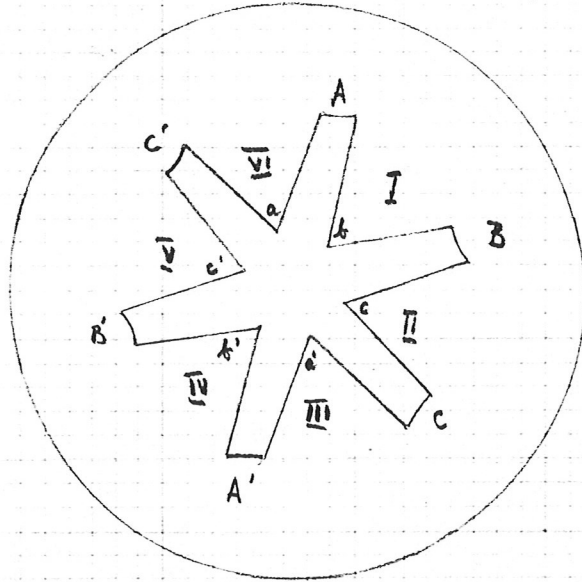
44" → Wt. nearly 15 lbs. Lot total 30 lbs + (ca. 15 kilos)

<u>Wanted</u>	Gap width at root	0.20"	<u>Pur</u>	0.200	0.205
	Root diameter	1.77"		1.81	1.82
	Gap ~	0.585"		0.530	0.581
	External diameter			2.935"	2.95

Lot 1 Size above (not exact)
 Lot 2 ~~Size~~ ~~Std.~~

Dr Barnalt,

Following are the microscopic measurements of the two pieces of cordite.



Section A. Lot 1

Inner circle. Diameter: - mean aa' .581" bb' .607" cc' .576"

Outer circle. Diameter. mean AA' 1.819" BB' 1.826" CC' 1.785"

Width at: - A .207" B .205" C .202" A' .202" B' .214" C' .198"

Circumference to: - A .536" B .520" C .500" A' .507" B' .528" C' .554"

External diameter: through AA' 2.94" BB' 2.90" CC' 2.96" mean 2.933"

Angles: I 68° II 68½° III 68° IV 67½° V 68½° VI 69°

Reactor

F490 = 3 = 8

Jan 18/87

Condite from RMC F RN 1588

Die 3" with 2.90 sleeve F1 Pin

Original F490 = 3 = 6 1st Rework F490 = 4 = 7 2nd Rework F490 = 5 = 8

Pressure F490 =		lb (7.56)	Speed/Rev	Cut
3	320	"	"	46.4"
4	300/275	"	"	46.6"
5	300	"	" Very "	45.8"
6	280/270	"	" 8'	47.9"
7	275	"	" 6 1/2'	47.7"
8	275	"	" 5 1/2'	45.1"

Temp	F490 =	Cyl.	Discs	Vol. taken	Die
	3	75°/80°C			72°/75°C
	4	84°/88°C			81°C
	5	75°C			71°C
	6	71°/74°C			70°C
	7	74°C			72°C
	8	75°/73°C			73°C

Details concerning Manufacture of Explosives (Solventless).

Batch No. F490 ^{3 to 8} Quantity required one 46" stick of each
Size required _____ Die 3-inch with 2-90" sleeve
and F1 pins
Shape _____ Finished size _____

Ingredients	Amounts	Details re. mixing.
<u>F490^{3 & 6} News/c</u>		
<u>F490^{4 & 7} First re-work</u>		
<u>F490^{5 & 8} Second re-work</u>		

Details re. Rolling _____

Remarks re. Finished Sheet _____

Details re. Pressing.

Temp. of Oven _____ Time in Oven _____

Time in Cylinder before pressing _____

Temp. of Cylinder _____ Extrusion Pressure _____

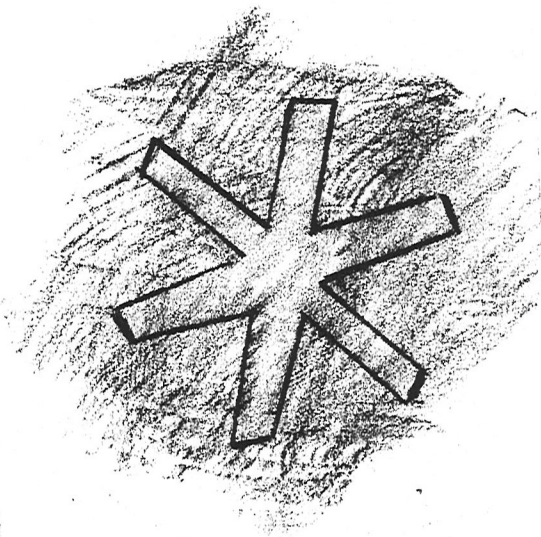
Speed of Pressing _____

Remarks re. Finished cordite See paper attached

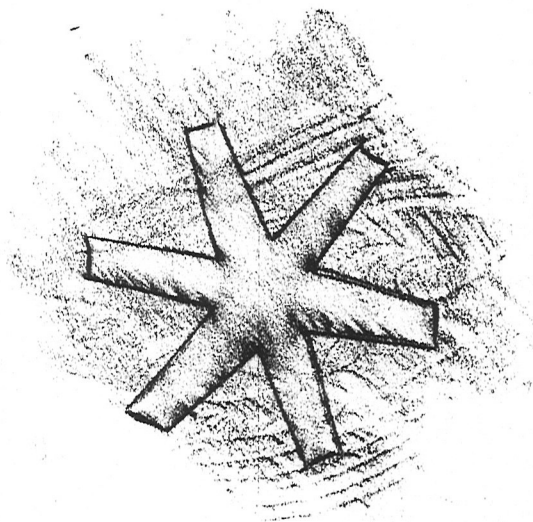
Date of completion Mar 11/37 Date of Order Febr 18/1937

Signed A. J. Clements Signed _____

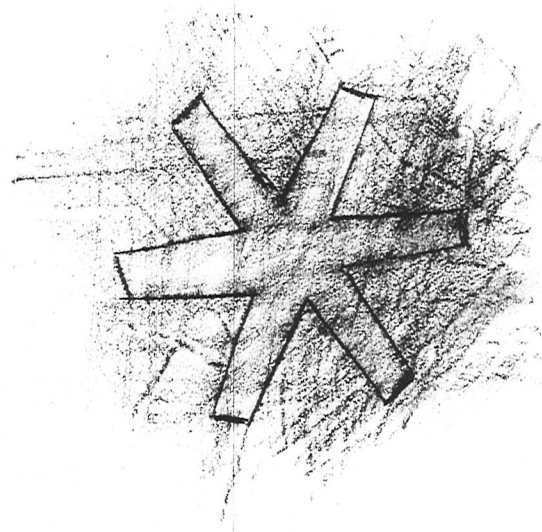
F490⁶=



F490⁷=



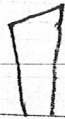
F490⁸=



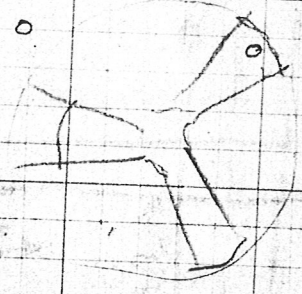
Characteristics of Various Extruded Shapes.

(a) Rational Shapes	Density of Loading (Gross)	Sliver Area (%age of Propeller Area)	Density of Loading (Nett)	Area of Lumen (Ext Dia = 2")	%age Variation of Surface (Inner Surface = 100)	Web Thickness (Ext Dia = 2")	Time of Burning Sec. at 50 ats.	Maximum Permissible Length (In.)	
7 Point Mk II	88.25 %	13.1 %	76.7 %	0.37 sq. in.	nil	0.86 cm	0.86 sec	9.0"	
8 Point Mk II	81.1 %	12.95 %	70.6 %	0.59 " "	nil	0.825 "	0.825 "	14.2"	
10 Point Mk II	71.2 %	10.8 %	63.7 %	0.915 " "	nil	0.726 "	0.726 "	18.8"	
<u>(b) Arbitrary Shapes.</u>									
6 Point Mk I	88.4 %	20.6 %	70.2 %	0.38 sq. in.	+13.1 %	0.87 cm	0.87 sec	10.4"	
10 Point Mk I	60.3 %	11.3 %	53.5 %	1.27 " "	+12.9 %	0.61 "	0.61 "	62.3"	
A Sheet I	88.7 %	5.3 %	84.0 %	0.354 sq. in.	-7.2, +14.3 %	1.27 "	1.27 "	16.2"	
F Sheet I	85.0 %	6.6 %	79.4 %	0.471 " "	-0, +12.5 %	1.06 "	1.06 "	16.8"	
D Sheet II	79.6 %	0.38 %	79.3 %	0.64 " "	-34.9, +0 %	1.27 "	1.27 "	25.6"	
E Sheet II	80.6 %	0.37 %	80.3 %	0.61 " "	-31.4, +0 %	1.27 "	1.27 "	24.2"	
F Sheet II	85.2 %	1.64 %	83.8 %	0.47 " "	-25, +0 %	1.27 "	1.27 "	18.8"	
H Sheet II	84.6 %	1.89 %	83.0 %	0.48 " "	-0, +37.5 %	1.27 "	1.27 "	26.2"	

To correct the Maximum Permissible Length to suit various other values of β divide by the new value of β .
 (This only applies when the pressure is 50 ats. and γ and ν remain constant.)



18/2/17 new parts		
	2.984	mem
0°	45°	90°
3.000	2.950	2.971



2600 gms
in die head

454 gms
5

26 5 1/2 lbs
21

~~5.8~~

52
52
5.72

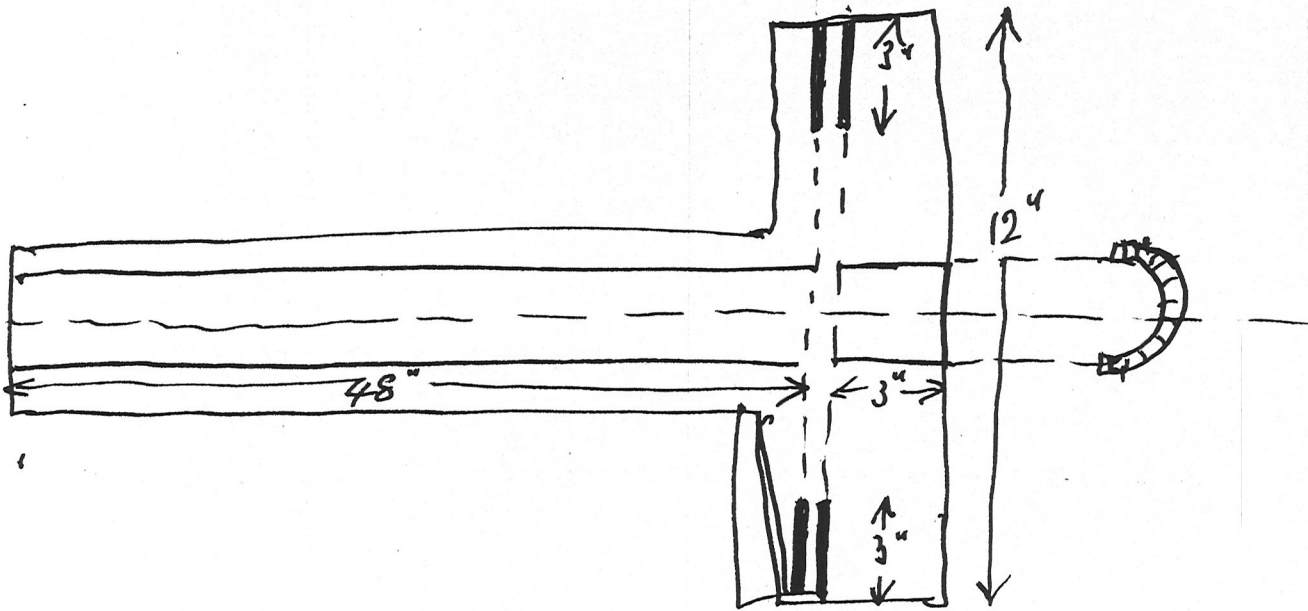
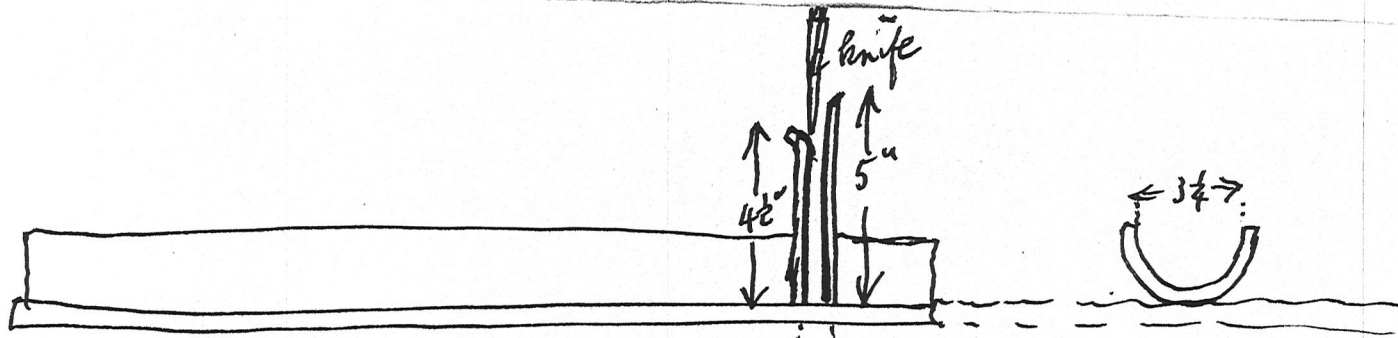
19/2/17 lat rework		
0°	45°	90°
3.046	3.052	3.005
030	25	005
027	20	2.998
014	17	3.008
020	14	2.998
015	09	2.998
017	15	2.998
014	12	2.992
005	07	2.991
		2.987

3.018 3.016 3.000

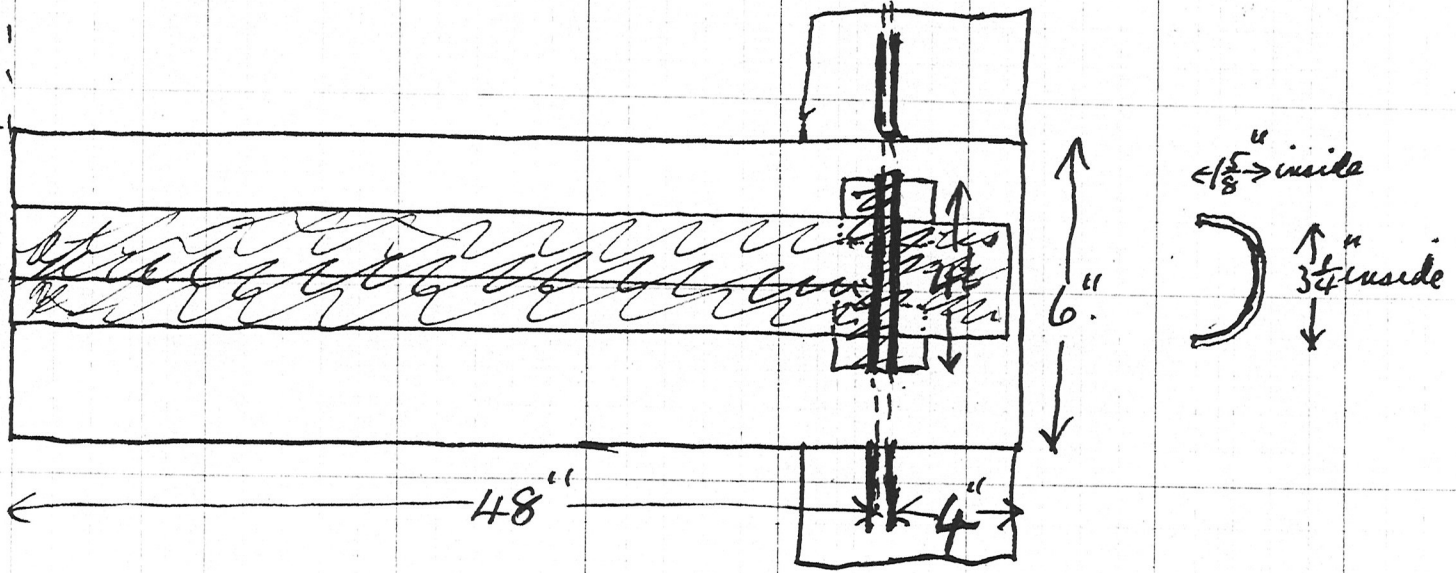
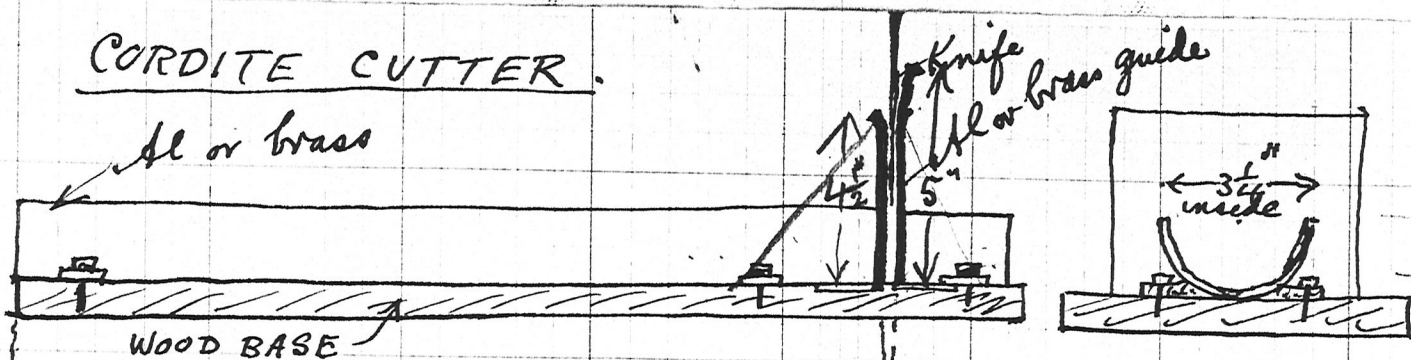
3.011
This is lat rework

3.052 to 2.987
diff .045"

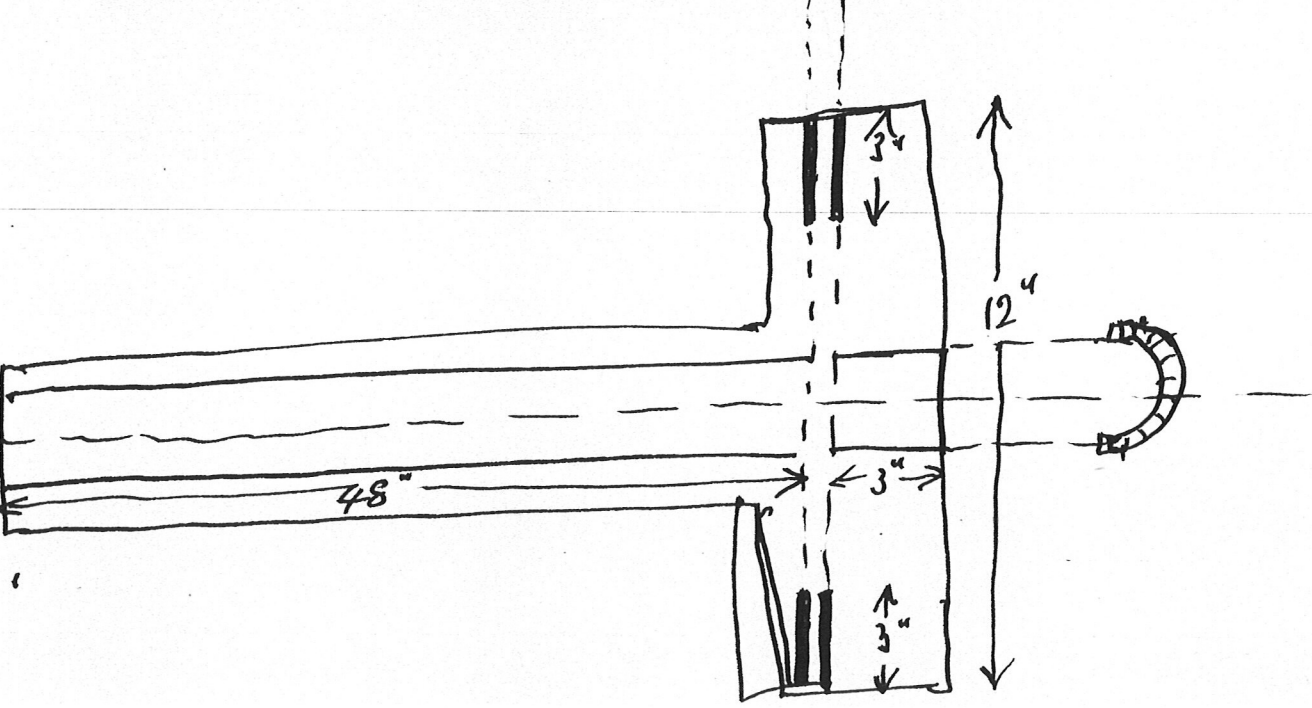
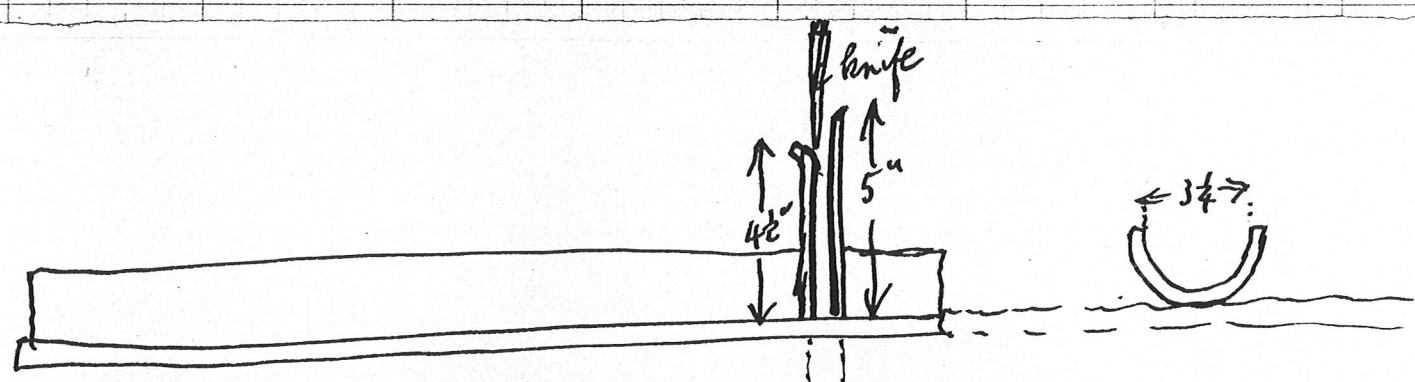
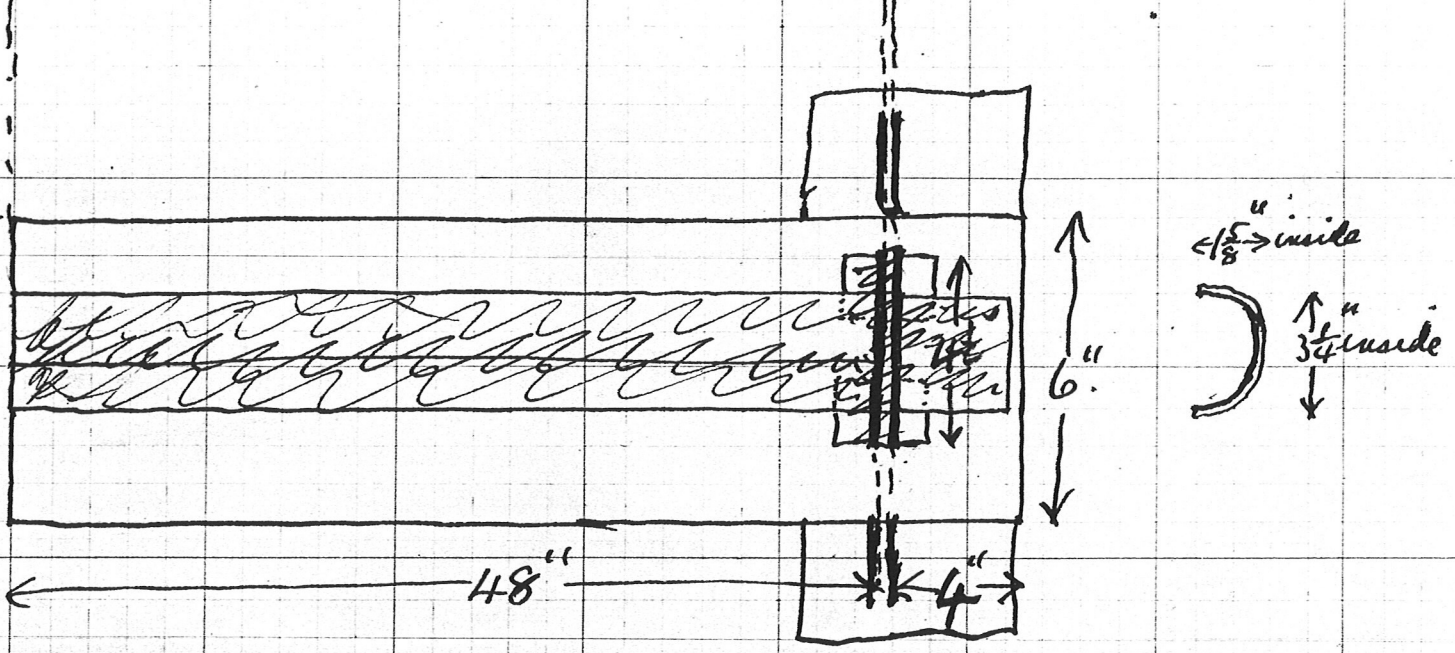
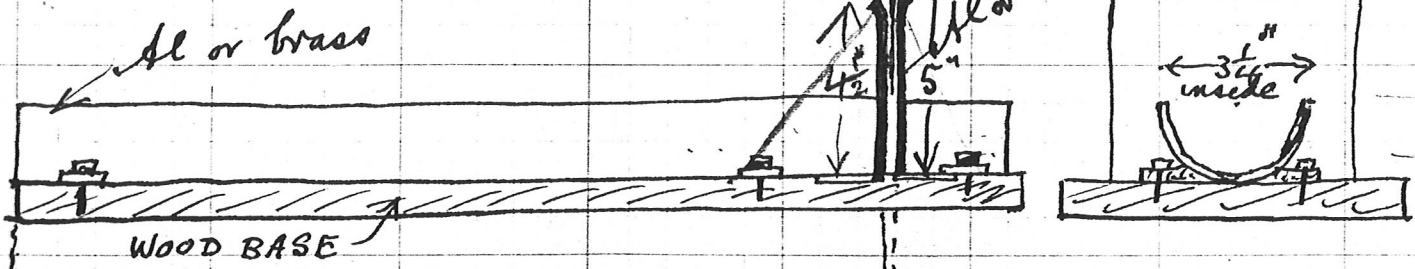
Press 300 x 7.56



CORDITE CUTTER



CORDITE CUTTER



0° 45° 90°

2.992 2.995 2.986

Max. 3.005
Min. 2.981 } 2.991

1st 2.984 (new cordite)
2nd 3.011 (1st new work)
3rd 2.991 (2nd new work)

¹⁰
 Then 6 in basket
 Then 36 hrs.
 Wed. 9.30 am
 2.30 pm.

Pressed 3 pm.
 Add 1 pint solvent per 60 lbs. charge

Load Sat.:

~~87~~: ~~13~~ - 33%

87: 13
 Keep temp. 35°C. by hot water of rec.

~~Melville~~ Melvin Glasgow.

325
 1950
 1625
 2175
 245708

256
 1792
 1280
 159
 156

$25.9 \times \frac{81}{11} = 191.4$

3 Reactor Dressing, Sleeve 2.90"

(Current Work Cordite: not reworked)

11.0

2.5 cups
 Dress on at 9.40 a.m.

10.10: Bottom of die 72°C

10.30. 72°C 77°C

1 Cyl 71.5°C

" 75°C 78°C

Top Cyl. 74°C

" 80°C.

Hot Plate 79°C, 82°, 74°, 68°, 84°C

Discs: 71° bottom: 61° top: 66½.

Disc on & her then next lot put on, old ones put on top

Top of discs, 45°

Bottom disc, 68°

All taken from bottom.

Hot Plate
 94°, 95°
 98°C

11.5: Plug just in. Top 77°C.

11.10 (just before pressing)
 Top 72°: die 78°
 Bottom 78°.

Press $3.5 \times 7.56 = 2457$ lbs/in.
 Cut at "

2-inch Reactor : 25/2/37

F1 pin : 2.00" steel sleeve; 20 sticks, each 24" (approx).
 Extrusion pressure : 110 to 120 lbs/in² (x 23.9), speed slow. = 1.2 tons/in²
 Die 71/72°C ; top of cylinder 75°C

{ Discs 55°C/75°C (most 64°/70°); hot plate about 90°C
 { 15 mins on hot plate, covered by 3 layers of baize & felt.

3 sticks taken as samples :

	A stick	B stick	C stick
Diameter, 0°, Mean	2.062	2.071	2.068
" , 90°, Max	69	76	73
" , 0°, Min	53	65	65
" , 90°, Mean	2.063	2.079	2.065
" , 90°, Max	81 (63)	82	72
" , 90°, Min	55	74	61
" Mean	2.063	2.075	2.066
" Mean of 3	2.068		
	(Max 2.082; Min. 2.055)		
Weight (gms)	1738	1741	1736
{ Length (inches) (mean)	23.77	23.50	23.63
Area of section (sq. in)	3.343	3.382	3.354
Internal volume (cc)	194	194	193
Total volume (as for solid stick) (cc)	1302	1302	1299
Star % area (area of star hole as % of total section)	15.0	14.9	14.9
Thickness of cordite at end of rays of star	0.484" (max 0.496) (min 0.472)	0.479" (max 0.484) (min 0.468)	0.472 max 0.476 min 0.468
	Max 0.496"; Min 0.468" (Mean 0.478)		
Mean diameter of star-section (end to end of rays)	1.112 inch		

Roller to move cordite, &
not vice versa

A 1" steel guard is on one
of the horizontal presses.
No rope curtains.

If hydraulic system, have
indicators to tell where
accumulators are.

"Single ended horizontal
hydraulic cordite extrusion press"

3" Reactor Pressing: 18/2/37; New Cordite (F490³)

Die size increased to 2.90". New cordite used (not rework)
Cordite discs put on hot plate at 9.40 a.m.

10.10 a.m. Bottom of die 72°C : 10.20 a.m. 72°C : 11.10 a.m. 78°C.
Cyl. 71.5° : 75° - 78°
Top - 77°C : 80° - 72°(?)
Hot plate 74° to 84°C : 94° to 98°

Extrusion Pressure $325 \times 7.56 = 2457$ lbs/sq. in.
Cut to length 47" : Wt. 6890 gms.

Finished Size 0° 45° 90°
3.007" ~ 2.980" 2.971"
(2.982" to 3.016") (2.962" to 2.998") (2.964" to 2.977")
Mean 2.984"

Weight of stick 6890 gms; length 46.3/46.4"; star % area = 17.4

19/2/37. 1st rework cordite (Die & steel = 2600 gms. cordite)
(F490⁴) Total =

Discs after 1 hour; Top 56° - 64° - 67° - 76° bottom (Hot plate 86° to 89°C)
Die 83°; Bott. Cyl. 84°; Top 95°C.

After 1 1/2 hrs. Top 54° - 61° - 64° - 70° bottom. (Hot plate 82° - 82°)
Die 81°C; Bott. Cyl. 85°; Top 88°C.

Extrusion Pressure 300 to 275 x 7.56 (slow) =

Finished Size 0° 45° 90°
3.018" 3.016" 3.000"
(3.005" to 3.030") (3.007" to 3.032") (2.989" to 3.008")
Mean 3.011"

Weight 7066 gms
Length 46.6"
Star % area
= 17.2

22/2/37 (F490⁵) 1st Second rework cordite (some much re-worked); hot-plate

Discs after one hour, interchanged 3 times: top 81° 57° - 64° - 75° - 81°C } 87 to 89°C

Die 71°C; bottom & top of cylinder 75°C

Extrusion pressure : 300 (constant) x 7.56; very slow.

Finished Size 0° 45° 90°
2.992 2.995 2.986

Finished size 3.007 2.980 2.971
 (2.982 to 3.016) (2.962 to 2.998) (2.964 to 2.977)
 Mean 2.984"

Weight of stick 6890 gms; length 46.3/46.4"; star% area = 17.4

12/1/37. 1st rework cordite (Die & reel = 2600 gms. cordite)
 (F490⁴) Total =

Discs after 1 hour; Top 56° - 64° - 67° - 76° bottom (Hot plate 86° to 87°C)
 Die 83°; Bott. Cyl. 84°; Top 95°C.

After 1 1/2 hrs. Top 54° - 61° - 64° - 70° bottom. (Hot plate 82° - 82°)
 Die 81°C; Bott. Cyl. 85°; Top 88°C.

Extrusion Pressure 300 to 275 x 7.56 (slow) =

Finished Size. 3.018" 3.016" 3.000"
 (3.005 to 3.030) (3.007 to 3.032) (2.987 to 3.008)
 Mean 3.011"

Weight 7066 gms
 Length 46.6"
 Star% area
 = 17.2

22/2/37 (F490⁵) Second re-work cordite (some much re-worked)

Discs after one hour, interchanged 3 times: top 57° - 64° - 75° - 81°C } hot-plate 87 to 89°C

Die 71°C; bottom & top of cylinder 75°C

Extrusion pressure: 300 (constant) x 7.56; very slow.

Finished Size 2.992 2.995 2.986
 (2.983 to 3.003) (2.988 to 2.998) (2.981 to 2.995)
 Mean 2.991"

Weight of stick, 6851 gms; length 45.7/45.8 inches

Area of star section = 17.2% of total section (density 1.570)

We send you 4"
 + mild steel if rec'd
 Mr. B has drawing of
 pin given dimension
 knows length of bush +
 agreed that
 longer 11" ~~is~~ advisable
 to begin with.

Should we want the 3"
 material made already?

P.M. S.R.N.C.F.

With ref to visits of your
 representatives to this Dept + dad
 of ours to R.N.C.F. it has been arranged
 that the pin for the 14" Reactor
 die shall be made in the L.D. and
 forwarded to you shortly.
 A dimensioned drawing of this
 pin ~~has been~~ was given to
 you ref. Mr. Brown's work
 on 24/2/57 and it is
 understood that ~~only~~ your
 own die is to be ~~used~~ in
 such a way that on fitting
 the pin to the die the
 the pin is to be fitted to
 one of your die which

New Rate		450	2000
15/2/57	1.004	2.980	2.069
	1.009	998	92
6895 gms	1.006	993	71
	1.006	987	71
46.3 t	1.006	984	72
46.4	1.004	991	72
	2.996	969	71
	1.998	980	68
	1.990	968	68
	1.986	965	70
	1.982	964	70

~~15/2/57~~

will be modified in such a way as to be suitable for processing the ~~reactor~~ H² Reactor cordite.

The chief modification will be

4. To make a new bush of parallel 6 1/2" and of such a diameter as to produce cordite of external diameter H² ± your rep. agrees

It was agreed that it is desirable that the length of parallel with first volume shall not be less than 6 1/2"

The bush may be made of mild steel, which if required can be supplied by the Dept.

[3" Cordite made at RNC?]]

1st revision 10:57

3" F.I. Reactor

Hot Plate 84 → 86°C

Buses 76 1st layer
 after 1 hr 67 2 -
 64 3
 56 top

One 83°C

Rot. Cyl. 84°C

Top - 95°C

1 1/2 hrs 70 1st
 69 2nd
 61 3rd
 54 top

Unrev. cyl
 one 81°C

Rot. Cyl. 85°C

Top 88

H.T. 80 - 82°C

300 - 75 x 7.56 slow

Weights when sold
 3.032 to 2.984
 Mean 3.011"

(One ...)

08

Plunger 2.2 per min.

Ex. Press. $1\frac{3}{4}$ tons per sq. in. (300 lbs. x 13)

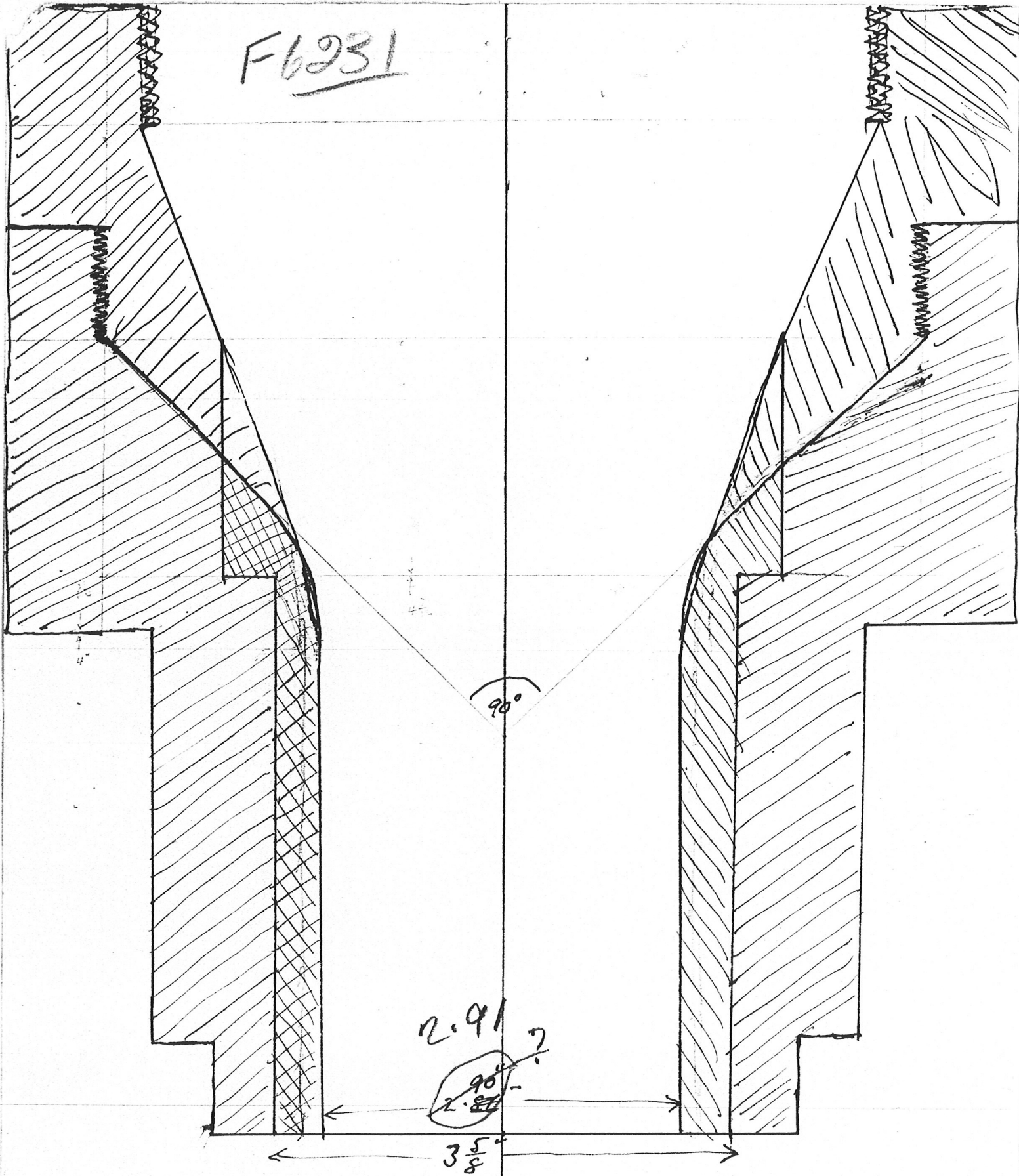
Results shows increase in diam² with incr. in gelatin.
(R.D. expts. show same increase)

Results

Material	Stick No.	External Diam.			Wall thickness at tips			Wt. of stick lb. - ozs.	Length	Wt./ins. lb.
		Mean	Max.	Min.	Mean	Max.	Min.			
Current Manuf.	1	3.910	3.939	3.872	.735	.758	.701	33 " 3	60 $\frac{5}{16}$	.551
	2							33 " 9	60 $\frac{1}{16}$	.556
	3	3.902	3.934	3.865	.728	.748	.716	32 " 14	60 $\frac{1}{64}$	.548
	4							33 " 0	60 $\frac{1}{16}$	.549
50% fresh pack + 50% rework	1	3.923	3.945	3.900	.732	.744	.721	33 " 8	60 $\frac{1}{32}$	.558
	2							33 " 7	60 $\frac{1}{32}$	.557
	3							27 " 3	49 $\frac{1}{32}$	.554
	4	3.918	3.949	3.888	.728	.738	.719	33 " 7	60 $\frac{5}{32}$	.554
100% rework	1	3.958	4.017	3.924	.736	.742	.727	33 " 13 $\frac{1}{2}$	60 $\frac{1}{8}$	.566
	2	3.938	3.970	3.915	.739	.746	.728	34 " 3 $\frac{1}{2}$	60 $\frac{1}{4}$	.568

Report asks for (1) Possⁿ of accepting air bells near surface (yes if not deep)
(2) - - using part sticks (probably yes)
(3) Type of material (rework etc) (does not matter much)

F6231



Shortened 3" die in red Original 3" die in black

Scale 1/1

~~Lot 1~~: Cylinder holds just over 30 lbs.

One 3" length of 46" weighs about $14\frac{1}{2}$ lbs.

At present only one length can be pressed from one cylinder of cordite.

~~Modifications~~ The die takes up too much room at present. It is being modified & it is possible that with ^{the increased space made available} ~~the change~~ two lengths may be pressed from each cylinder.

Measurements of outside diameter of the cordite showed that it was thinner at the "top", owing to having to support its own weight during pressing.

The extreme variation was 3.926" to 3.977".

The use of a horizontal press will obviate this difficulty.

Temp. Press Cyl. = 65°C. to 75°C.
Cordite Dies = ~~80~~ 80°C.

Meas. on Cordite: Lot 1

	Mean	Min.	Max.	(Req. 2.99" to 3.03")
External diameter	2.935"	2.91"	2.96"	

Gap width at Root 0.20" (Required 0.20")

Root diameter 1.81" (" 1.77")

Lip " 0.5³⁰~~88~~" (" 0.585")

Lot 2 (Temp. Press Cyl. = ~~80~~ 80°C. (die 70°C.)
Cordite Dies = 85°C.

Cordite
External diameter Mean 2.955" (Extremes 2.926" to 2.977")

Gap width 0.205"

Root diameter 1.82"

Lip " 0.581"

Measurements of outside diameter of the ~~rod~~ showed that it was thinner at the "top", owing to having to support its own weight during pressing. The extreme variation was 3.926" to 3.977". The use of a horizontal press will obviate this difficulty.

Temp. Press Cyl^r = 65°C. 75° to 80°C.
 Cordite Discs = ~~80°C.~~

Meas. on Cordite: Lot 1 (Mean. Min. Max. (Req'd. 2.99" to 3.03"))

External diameter:	2.935"	2.91"	2.96"	(Req'd. 2.99" to 3.03")
Gap width at Root	0.20"			(Required 0.20")
Root diameter	1.81"			(" 1.77")
Lip	0.5 88 ³⁰ "			(" 0.585")

Lot 2 (Temp. Press Cyl^r = ~~80°C.~~ (to 70°C.)
 Cordite Discs = 85°C.)

Cordite
 External diameter Mean 2.955 (Extremes 2.926 to 2.977)
 Gap width 0.205"
 Root diameter 1.82"
 Lip ~ 0.581"

Sectional area of "star" = 17.8%
 (by measurement of volume of water filling a given length, assuming density of cordite was 1.570,
 or by actual measurement of dimensions of section)

rough Copy

D.E.R. 58834

1. We visited ^{the} R.N.C.F. on 19/1/37. Some 3" Reactor cordite had been pressed (as arranged with Mr Brotherton) ~~through~~ in the new ~~to~~ 10½" horizontal press through a 3" die to which the R.D. pin had been fitted.

This product was fairly satisfactory but varied a good deal. One length of 4 feet was almost perfect, but most of the remaining 5 or 6 lengths had some defect, e.g.

A. Air bubbles [^{if} small and on surface there are unimportant].

B. Inequalities in ^{external} diameter.

C. Roughness of internal surface.

One 4' length had been ^{accidentally} dropped in the floor and had split from end to end, showing an apparent plane of weakness. In order to test whether this defect

~~tests~~ existed in other samples, another 4' length was dropped from various heights ^{up to 4 feet}. ~~It~~ It appeared rather brittle and broke up into pieces of various shapes and sizes. On the whole however it was decided that no distinct planes of weakness were apparent, (i.e. planes in which burning would proceed quicker than the average.)

The remaining lengths are to be sent to the R.D.

for examination and test when ~~so~~ we are ready to do the work. 2. Apparatus for examining defects in the

~~charge~~ ~~cordite~~ finished charges was discussed.

3. ~~The~~ The usual temperatures employed in the horizontal presses were stated to be:-

Press Cylinder 70°C; Die 55°C; Charges 54°C.

The ram speed was 1½ inches per minute.

A full charge ^{in the 10½" cylinder} is about 55 lbs. of cordite.

defect, e.g.

A. Air bubbles [^{if small and on surface there are unimportant}].

B. Inequalities in ^{external} diameter.

C. Roughness of ^{internal} surface.

One 4' length had been ^{accidentally} dropped in the flow and had split from end to end, showing an apparent plane of weakness. In order to test whether this defect

~~tests on~~ existed in other samples, another 4' length was dropped from various heights ^{up to 4 feet.} ~~It~~ It appeared rather brittle and broke up into pieces of various shapes and sizes. On the whole however it was decided that no distinct planes of weakness were apparent, (i.e. planes in which burning would proceed quicker than the average.)

The remaining lengths are to be sent to the R.D. for examination and test when we are ready to do the work.

2. Apparatus for examining defects in the ~~long~~ ~~cordite~~ finished charges was discussed.

3. ~~The~~ The usual temperatures employed in the horizontal presses were stated to be: -

Press Cylinder 70°C ; Die 55°C ; Charges 54°C .

The ram speed was $1\frac{1}{2}$ inches per minute.

A full charge ^{in the $10\frac{1}{2}$ " cylinder} is about 55 lbs. of cordite.

4. The external diameter of the cordite through the 3" die was 3.18".

3. A blueprint of the RNCF die is to be sent to the R.D. with the request that a new "pin" of the approved shape is to be made in the shops here to fit the die.
4. The $8\frac{1}{2}$ " cylinder in the R.D. is nearly ready, and it is hoped to press the 3" size here next week.

R.D. (F.)

24/11

3" Reactor (F490)

(Disks loaded into cylinder in five layers; 18 only on hot-plate for 5 mins; each disk in direct contact with hot-plate)

	F 490 ⁶	F 490 ⁷	F 490 ⁸
Cordite	New 3/c	First Re-work	Second Re-work
Date of pressing	1 st March (1976) F490 ⁶	2 nd March (1976) F490 ⁷	3 rd March (1976) F490 ⁸
Temperatures (°C)	Hot Plate	94	92
	Disks (top)	63 (min)	65/67
	Disks (bottom)	78 (max)	75/78
	Die	70	72
	Cylinder	71/74	74
Extrusion-pressure (x7.56 = lbs/in ²)	280/270	275	275
Time of pressing	8 mins	6½ mins	5½ mins
Diameter after cooling; measurements at 0°, 45°, 90°	Mean	2.951 (2.954)	2.978 (3.011)
	Max	2.978 (3.016)	2.997 (3.032)
	Min	2.928 (2.962)	2.963 (2.984)
Mean increase in diameter (top to bottom)	0.022	0.021	0.058
Length of stick (inches)	47.9 (46.35)	47.7 (46.6)	48.1 (45.75)
Weight of stick (grams)	7010 (6890)	7139 (7066)	7250 (6857)
Percentage of star-hole on cross-section of stick	16.9% (17.4)	16.5% (14.2)	17.3% (17.4)
Thickness of cordite at end of ray of star	0.0569" (.055 to .059)	0.0583 (.056 to .060)	0.0590 (.057 to .061)

Manufacture of Reactor Cordite at R.N.C.F.

Visit of R.N.C.F. Representative (Mr. Brooksbank), 11/1/37.

The matter was discussed ^{between} by ~~Mr.~~ D.B.R., Mr. Brooksbank, Dr. Poole, & Dr. Barratt.

A pressing of the 2" size of cordite was carried out in S44, and further samples were shown to Mr. Brooksbank also the ~~new~~ 3" die just completed & drawings for the 4" die. ^{was informed & answered}

Mr. Brooksbank ~~discussed~~ ^{discussed} about tolerances in external + internal size and shape, density, bubbles of air etc in the cordite, methods of keeping the long cordite sticks straight, apparatus for cutting & shaping the ends of the sticks, and other ^{matters} ~~points~~ arising in the discussion.

At R.N.C.F. three horizontal presses are available one of 8" diameter and two of 10 1/2" diameter. ^{the amount of Reactor cordite they can undertake will depend on the Cabot programme}

Mr. Brooksbank took the pin of the new 3" die, and will fit this pin to the 3" die at R.N.C.F. and press some 3" Reactor cordite within the next day or two if possible.

D.B.R. is preparing an Extract to cover 5000 lbs. of Reactor cordite to be made at R.N.C.F.

We (Dr. Poole & Barratt) propose to

external + internal size and shape, density, bubbles of air etc in the cordite, methods of keeping the long cordite sticks straight, apparatus for cutting & shaping the ends of the sticks, and other ~~points~~^{matters} arising in the discussion.

At R.N.C.F. three horizontal presses are available one of 8" diameter and two of 10 1/2" diameter. The amount of cordite they can undertake will depend on the Cabell programme. Mr. Brooksbank took the pin of the new 3" die, and will fit this pin to the 3" die at R.N.C.F. and press some 3" Reactor cordite within the next day or two if possible.

D.B.R. is preparing an Extract to cover 5000 lbs. of Reactor cordite to be made at R.N.C.F.

We (P. Poole & R. R. R.) propose to visit R.N.C.F. next week to ~~discuss the~~ ~~work~~ ~~to~~ examine the cordites being pressed this week, and to decide on further work at R.N.C.F. and in the R.D.

Manufacture in Research Department of Rocket Cordite.

The requirement to be met in the first place is specified as a cordite of 4" diameter with an internal star cavity amounting to 11 per cent. of the sectional area and volume.

With a cylinder containing a charge limited to 20-lb. of cordite this will deliver a length of cordite of this diameter of 32 inches, of which about 7 inches will remain behind in the parallel leaving 25 inches completely extruded. The extrusion pressure required for normal S.C. composition will amount to a maximum value of about 2400-lb. per sq.inch. It should be possible to produce this cordite by employing an existing cylinder of 8" internal diameter designed for solvent cordite, after due examination, testing and winding for electrical heating. A slight structural alteration to the pedestal of the press will be required and an adaptor and die will need to be provided.

In the existing vertical press, the space between the base of the cylinder and the ground will only permit of a total length of cordite of this nature of 36 inches being extruded, even if a bigger cylinder charge than the 20-lb. suggested were permissible.

The main advantage to be gained from a new press house provided with a horizontal press is to facilitate manipulation. Considerable difficulty occurs in the cutting away of the thick cordite from the die exit in the existing vertical press.

The arrangement suggested for the existing press, while suitable for preliminary tests is only an improvised one. This press will not apparently admit the use of a steam jacketed S.C. cylinder of the usual design sufficiently large for a 4" cordite.

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The arrangement suggested for the existing press, while suitable for preliminary tests is only an improvised one. This press will not apparently admit the use of a steam jacketed S.C. cylinder of the usual design sufficiently large for a 4" cordite.

Recommendations.

That arrangements be made to modify the existing press fittings so as to enable preliminary trials to be done on the production of 4" cordite, and that in the meantime plans be proceeded with for the provision of a further press house to enable the installation of a

horizontal press on the lines of the R.N.C.F. equipment.

It is necessary that the erection of this building should not take precedence over the projected explosive store, weighing house, and N.G.- separating house. The lack of these buildings causes delay in the production of the 2" cordite. Their absence would largely nullify the advantages to be gained from the second press house.

21/8/36.