

OPERATIONS and TIME REQUIRED TO DO THE MACHINE WORK  
on 9.2 HIGH EXPLOSIVE SHELLS, by the system used by  
the VICKERS CO. England.

They take the rough forging, trim off the open end, and face the base. The shell is then centered on the solid end, and the outside diameter is rough turned. These operations would require approximately 4 hours, and under the Vickers system, they make these entirely distinct from the machining of the shells.

Oper. 1 Rough and finish the bore of shell

This rough and finish cut extends only to where the curve begins toward the bottom of the inside of shell.

Time 2 hours and 15 mins.

Oper. 2 Rough and finish the profile, and face to length

This is finishing the bottom of the inside, boring and facing open end of shell.

Time 2 hours.

Oper. 3 Cone for heading and facing the base

This we understand to be the shape of the outside diameter in the open end of shell, which has been determined as being the correct size and shape, so that when the shell is headed and placed under Hydraulic Press, the shell nose will form to the correct shape. This operation we also understand means the open end of shell. At this time the base is also faced.

Time 35 mins.

Oper. 4 Grinding the inside

This is done for the purpose of removing any marks left by the boring tools, so that there will be a perfectly smooth surface.

Time 25 mins.

Oper. 5 Heading shell nose to shape

Shell will be heated in suitable furnace, and formed to shape under Hydraulic Press. Two men are required for this operation.

Time 30 mins. apiece.

Oper. 6 Bore and face the nose, after it has been headed to shape

Time 20 mins.



Oper. 7     Finish turn body of shell

This is simply a straight finishing cut over outside diameter.

Time 45 mins.

Oper. 8     Finish turn radius

This operation finish turns the nose of shell to the exact shape.

Time 1 hr. and 33 mins.

Oper. 9     Groove and under cut

This operation cuts down the stock to about the outside diameter of the wave ribs, and does the undercutting.

Time 25 mins.

Oper. 10   Wave groove     This operation takes care of the various grooves called for.

Time 18 mins.

Oper. 11<sup>2</sup>   Draw back neck to weight

This operation bores out the inside of the shell, back of where the thread will be.

Time 1 hour and 15 mins.

Oper. 12   Face off the center, counterbore and cut the thread for the base plug.

Time 1 hour and 30 mins.

Oper. 13   Threading nose for bush

Time 22-1/2 mins.

Oper. 14   Relieving the body to weight.

This apparently requires a cut to be taken on the body of the finished shell, from the nose to near the copper band seat.

Time 40 mins.

Oper. 15   Fit in and face disc

This refers to screwing the plug into the base of shell, having covered the threads with Pettman cement, and after plug has been well fitted, facing off flush with base.

Time 1 hour and 15 mins.



Oper. 16 Chip, file and crosscut wave groove

To allow air to escape when copper band is placed in place.

Time 8 mins.

Oper. 17 Anneal and press copper band to place

Time 10 mins.

Oper. 18 Turn driving band

Time 40mins.

Oper. 19 Varnishing

Time 30 mins.

Oper. 20 Final gauge weight and stamp

Time 20 mins.

Oper. 21 Grease and pack in boxes.

Time 8mins.

Total time of above operations for one man 16 hours 4-1/2 mins.

This information given by Mr. Carnaigle to Mr. Henry Bertram,  
August 30th, 1915.



PROPOSED METHOD and EQUIPMENT for doing the work on  
9.2 HIGH EXPLOSIVE SHELLS.

By this method we will use Bertram Axle Lathes exclusively for the boring, turning and cutting off operations.

The allowance for time on the different operations is very liberal, and in a short time after equipment is put in use, we believe a considerable reduction can be made.

Forgings are furnished.

Oper. 1    Cut off open end and measure from bottom of inside

1- Bertram Double Head Axle Cutting Off Machine, one end of machine to be used for this operation.

TIME 45 mins.

Oper. 2    Facing the bottom to 2" diam.

Using the same machine as above, but the other end.

TIME 45 mins.

Oper. 3    Rough turn body, finish body of shell up to wave groove, rough out the wave groove and round the corner.

1- Bertram #3 Single Axle Lathe.

TIME 2-1/2 hours.

Oper. 4    Boring hole in shell

1- Bert. #3 Axle Lathe, with head arranged to hold the shell. Lathe to have slide on carriage, operated by special taper attachment to suit the bore of shell. Boring bar to be 8" diameter, and secured by 2 clamps on the carriage. Bar will be tapered, and the end arranged for boring tools of high speed steel.

TIME 3 hours

Oper. 5    Forming the nose

Shell would be heated in furnace operated either by gas or fuel oil under pressure, and would have three holes of suitable size for the shell to be pushed into the heating chamber.

At the outside of the furnace there would be a series of holes whereby a jet of steam would be played around the circumference of the shell, thereby preventing the heat from running back on the shell.

The forming would require 2 heatings, and would be performed on 350 ton Hyd. Press, with accumulator and pump.

TIME 15 mins.



Oper. 6    Finish bore nose, face and thread

- 1- Bert. #3 Axle Lathe, with heavy four tool turret tool post, and suitable tools.  
For threading use circular chaser with section cut off. Chaser to have not less than six threads.

TIME 1 hour

Oper. 7    Finish turn body

- 1- Bert. #3 Sing. Axle Lathe, with form for giving perfect shape.

TIME 1-1/4 hours

Oper. 8    Face to weight, counterbore the base and thread the base.

- 1- Bert. #3 SingleAxle Lathe

TIME 1-1/2 hours

Oper. 9    Waving and Undercutting

- 1- Bert. #3 Axle Lathe

TIME 30 mins.

Oper. 10    Facing off base plug after having screwed it in with Pettman cement.

- 1- Bertram #3 Single Axle Lathe

TIME 30 mins.

Oper. 11    Pressing copper band to place

- For this operation use gas heating furnace, with opening in the front 12" wide and 6" high.  
1- 1100# Steam Hammer, fitted with half dies of desired shape.

TIME 5 mins.

Oper. 12    Turning copper band

- 1- Bert. #3 Sing. Axle Lathe fitted with front and back tool fixture.

TIME 15 mins.

Oper. 13    Screwing socket nose to place and finishing same.

- 1- Bert. Single Axle Lathe.

TIME 15 mins.

In addition to the above provision must be made to do the varnishing.



August 28 1915

PROPOSED METHOD and EQUIPMENT for doing the  
MACHINE WORK on 12" High Explosive Shells

By this method we will use Bertram Axle Lathes exclusively for the turning, boring and cutting-off operations.

Equipment recommended will take care of 20 shells per day working 20 hours.

Allowance for time on the different operations is very liberal, and in a short time after equipment is put in use we believe a considerable reduction can be made.

Forgings are furnished.

OPER. #1 -- Cut off open end measuring from bottom of inside.

1- Bertram Double Head Axle Cutting-Off Machine  
One end of machine to be used for this operation.

TIME: 1 hour.

OPER. #2 -- Facing the bottom to 5" diameter.

Using the same machine as above but the other end

TIME: 1 hour

OPER. #3 -- Rough turn finish body of shell up to wave groove, rough out wave groove and round corner.

1- Bertram No. 3 Single Axle Lathe

TIME: 3 hours

OPER. #4 -- Bore 5" hole in base

For this operation we would utilize

1- Bertram Horizontal Boring Machine  
or  
1- Bertram 6 ft Radial Drill

TIME: Either of these machines will bore this hole in one hour.

OPER #5 -- Boring the hole in shell

1- Bertram No. 3 Axle Lathe with two heads, arranged to hold the turned shell centrally. Lathe to have slide on carriage operated by special taper attachment to suit the bore of shell. Boring bar to be 10" diameter secured by two clamps & to be tapered with the end arranged for boring tools of high speed steel.

TIME: 3½ hours



PROPOSED METHOD and EQUIPMENT  
for  
12" H.E. Shells (Continued)

OPER. #6 -- Forming the nose

The shell would be heated in furnace operated either by gas or fuel oil under pressure, and would have three holes of suitable size for the shell to be pushed into the heating chamber.

At the outside of the furnace there would be a series of holes whereby a jet of steam would be played around the circumference of the shell, thereby preventing the heat from running back on the shell.

The forming will require two heatings and will be performed on 500 ton Hydraulic Press with accumulator and pump.

TIME: After getting started on this job you should be able to nose one shell in 15 minutes.

OPER. #7 -- Finish bore nose, face and thread

- 1- Bertram No.3 Axle Lathe with heavy four-tool turret toolpost and suitable tools .  
For threading use circular chaser with section cut out. Chaser to have not less than six threads.

TIME: For complete operation, one hour.

OPER. #8 -- Finish turn body

- 1- Bertram No.3 Single Axle Lathe  
with form for giving perfect shape

TIME: 1½ hours

OPER. #9 -- Face to weight, counterboring the base and threading the base.

- 1- Bertram No.3 Single Axle Lathe

TIME: 2 hours

OPER. #10 -- Waving and Undercutting

- 1- Bertram No.3 Axle Lathe

TIME: 30 minutes



PROPOSED METHOD and EQUIPMENT  
for  
12" HIGH EXPLOSIVE SHELLS (Continued)

OPER. #11 -- Facing adapter in place after having screwed it in with Pettman Cement.

1- Bertram No.3 Single Axle Lathe

TIME: 30 minutes

OPER. #12 -- Pressing band to place

For this operation use gas heating furnace with opening in the front 12" wide x 6" high, and  
1- 1500# Double Frame Steam Hammer, fitted with half dies of shape desired.

TIME: 5 minutes

OPER. #13 -- Turning copper band

1- Bertram No.3 Single Axle Lathe  
fitted with front and back tool fixture.

TIME: 15 minutes

OPERATION #14 -- Screwing socket nose to place and finishing same

1- Bertram Single Axle Lathe

TIME: 15 minutes

OPER. #15 -- Making adapter

1- Bertram Single Axle Lathe  
with four tool turret toolpost

TIME: 2½ hours

In addition to the above operations provision must be made to varnish the shell inside. Before shipment is made they paint the outside with vaseline to prevent rust.

With the layout along the lines mentioned it would require 22-Axle Lathes arranged for the various operations.

1- Double Cut-Off Machine, which we already have in stock

1- 1500# D.F. Steam Hammer, which we have in stock.

The Nosing press, Hydraulic Accumulator and motor driven pump, would have to be secured and shipment could be obtained in about 8 weeks from date order is placed.

We are of the opinion that if work was started at once, we would be able to turn out complete shells in January.



## Proposed method

for producing 7.2 High Explosive Shell Mark II

Steel billet to be cast about 11" diam  
and of sufficient length for 40% of  
ingot to be cut off as per regulations.  
Ingot to be forged to about 10"  
diameter.

Bottom of forging to be squared  
and shell cut off to desired over-  
all length.

Machining operations as follows

Oper 1 - Centering  
using drill press and centering  
drill  
Time 5 minutes

Oper 2 - Rough turning  
32" or 36" lathe could be used  
would recommend # Bertram axle  
lathe  
Time 2 1/2 hours



# 2

Oper 3 - Rough turning  
using axle lathe with square  
Tool Bar  
Time 3 hours

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Oper 4 - Finish turn body  
use Bertram #3 axle lathe  
arranged with special tool slides  
Time 1 hour

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Oper 5 - Bore, Thread & Face nose  
use axle lathe with  
Turner tool post &  
Special Chuck  
Time 1 1/2 hours

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Oper 6 - Making base flange  
from forging  
use axle lathe  
Time 2 hours



# 3

Oper 7 — Screw plug + face  
base to length  
Time 1 hour <sup>use axle lathe</sup>

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Oper 8 — W are + undercut  
Time  $\frac{1}{2}$  hour <sup>use axle lathe</sup>

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Oper 9 — Press copper band to place  
use 1500 lb Hammer  
Time 5 minutes, bands to be heated

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Oper 10 — Turn Copper band  
Bertram axle lathe +  
equipment  
Time 15 minutes

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Oper 11 — Mark Base  
Special marking machine B.B.  
type. Time 5 minutes



#4

Apr 12 - Screw socket in place  
Hold shell in ring chuck  
use Drill press for driver  
Time 5 minutes

Apr 13 - Turn socket  
on lathe with equipment  
Time 15 minutes

Total machine time  
12 hour 20 minutes



The following method is being used on the various operations performed on 12" High Explosive Shells, the forgings having been provided.

Oper. 1 The rough shell is bored out in the base, size of hole being about 5". One method of doing this is under a 4 Spindle Drill Press, powerful enough to do the drilling of the 5" hole at once, using pilot drill and cutter bars. The shell is centered by dropping it over a stud of the same shape as the inside of the shell forging. This stud is attached to a base, which is operated by compressed air against a stop, bringing the shell perfectly central.

Using a 4 Spind. Drill Press of heavy design, 4 shells can be drilled in the base at once. The thickness of metal to be drilled is at least 7", and the time required to bore the hole is 46 minutes.



Oper. 2- Rough turning shell forging. For this operation 42" Triple Geared Lathes are used, using plug in the base of shell already bored out, said plug to be centered, and driving the shell by a large cast iron center screwed to the spindle of the lathe, and having three driving pins of hardened steel, operated by an eccentric against the inside of the shell at the mouth.

With this operation they will rough turn the shell, cut off the open end, and face off the base. Time required 3-1/2 hours.



Oper. 3 Boring taper hole in 12" shell. This is done on 36" Triple Geared Lathe, using a pot chuck bolted to the large faceplate, and running the open end of the shell in a steady rest. The boring bar is a tapered bar, the tapering length being a little greater than the depth of the taper hole in the shell, the body of the bar being about 10" in diameter, and secured by extra heavy cast iron clamp, which takes the place of the ordinary cross-slide on the lathe. This bar holder is arranged as per sketch, and has no crossfeed of any kind, except such as is given by the taper attachment shown on sketch. The tools used on this taper bar are ordinary forged tools held into place by key or set screw.

Boring operation takes about 4 hours.



Oper. 4 Closing or forming nose of 12" shell. In one concern they had prepared to do this operation on a 1200 ton Press, but were finding difficulty in getting results, as they tried to completely form the shell at one operation.

At another plant they were preparing to do this on a 200 ton Press, making two operations.

In the opinion of the writer it would be wise to provide a 500 ton Press, and perform the operation in two heats, using furnace with either gas or fuel oil, and each furnace to be arranged with jets of steam to blow up around the shell, thereby preventing the heat from working farther than is required.

For this operation, doing it in two heats, should be done in ten minutes after job has got started.



Oper. 5 Boring nose, face end, tap, and form inside.  
Using for this operation 32" lathe, with heavy turret  
on cross-slide. Operation should be completed in  
one hour.



Oper. 6 Finish turn the body.

This can be done on 26" Heavy duty lathe, with forming attachment, and time required 1-1/2 hours.



Oper. 7 Counterbore, tap and face to weight  
32" lathe is used, with circular chaser for the threading.  
Chaser to be the width of about 6 threads. This operation  
to be performed in 1-3/4 hours.



Oper. 8 Wave ribbing. This operation will be performed  
on a 32" Heavy Duty Engine Lathe, with special equipment.  
Time one hour each.



Oper. 9      Screwing the adaptor in place, and facing.  
Using 32" lathe, pot chuck, steady rest and ordinary tools.  
Operating time 30 minutes.



Oper. 10 Pressing copper band in place.

This is heated in furnace, slipped over the body of shell, and pressed in place under a steam hammer, of about 1500# capacity, although 1100# hammer would do the work. The dies are cut away to receive the copper band, and the shell is turned during the operation.

About 5 blows forces the blow to place.



Oper. 11 Copper band turning. This is done on 32" lathe, with single point tool, and tool holder working against a form. Requires for this operation 30 minutes.

They are however preparing to finish forming with one tool cut on the angle, and fitted to a slide which will be drawn right under the shell. This will reduce the time very much.



Presses recommended for piercing and drawing 6" shells

1- 420 ton Piercing Press, provided with an ejector cylinder, and weighing 60,000#.

1- 200 ton Drawing Press with 200 tons push and 135 tons pulling capacity, and weighing 45,000#

This equipment would require a 14" x 12' stroke accumulator, which complete with steel ballast, weighs 50,000#

For operating we would recommend 150 gal. motor driven pump, the motor should be 200 HP capacity, and should run 500 R.P.M.

For 9" shells we would recommend

1- 300 ton 4 column Piercing Press, with 6 ft stroke and 10 ft opening between the tables.

This press complete with valve and ejector cylinder, weighs 110,000#

For drawing we would recommend 1- 300 ton Horizontal Drawing Press, which has a 14' opening between the table and ram.

and 12 ft stroke. It also has two die heads, and weighs 80,000#.

For operating the above we would furnish 1- 18" x 15' stroke accumulator, which weighs complete with steel ballast casing 90,000#.

This would require a 200 gal. per minute motor driven pump, and size of motor required would be 275 horse power, running at 700 rpm.

For 12" shells, we recommend

1- 500 ton Piercing Press. This has 8 ft stroke, and 12 ft opening between tables, complete with the operating valves and ejector cylinder, this weighs 160,000#.

For drawing we offer 1- 500 ton Drawing Press, with 15 ft stroke, and 18 ft between tables. This has two die heads and weighs 100,000#

For operating we would recommend 1- 21" x 15' stroke accumulator which with steel ballast casing weighs 120,000#. We would recommend 1- 200 gal. per minute motor driven pump. This would require 275 HP motor, running 700 rpm.



Time required for boring one 6", 8" and 12" shrapnel,  
made by the Washington Steel & Ordnance Co., from solid bar.

6" Shrapnel, bored from solid, hole 4.6, powder chamber 3.89,  
total depth of hole 12.6". Time one hour.  
rough turn and face 40 mins. wave and undercut 20 mins.  
turn copper band 15 mins.

8" shrapnel, bored from solid, hole 6", powder chamber 5",  
total depth of hole 19-1/4". Time one hour and 20 mins.  
Rough turn and face 1 hour, wave and undercut 25 mins.  
Turn copper band 20 mins.

12" shrapnel, bored from solid, hole 8.6", depth 42.8"  
Time four hours.  
Rough turn 4 hours, turn copper band 40 mins.  
wave and undercut 35 mins.

The Washington Steel & Ordnance Co. consider that on  
shrapnel, they save money and time by boring these larger shells  
from the solid. There is no operation for forming the nose,  
as on the 18 pr. shrapnel and 4.5 shells. The tools are very  
plain strong tools, with no fancy finish.



Copy for Mr. H. Bertrams  
information

JX  $\frac{13}{8}$   
 $\frac{18}{18}$

H.C. 466-18-4-D  
C.D. 45-Z

August 13th, 1918

Machines, Milling Rifling Grooves,  
B.L. 9.2-inch IX - X\* Guns, Mark II:-  
Cutters, Rifling, stes.

Gentlemen,

By request of the Director of Contracts  
Department of Militia and Defence, Ottawa, I am for-  
warding to you today, via Canadian Express, prepaid,  
the following articles :-

Cutters, rifling ... .. 2

Ring gauge for form of rifling . 1

with regard to which I understand the Director of  
Contracts is communicating with you.

For your information I would say that the  
2 cutters sent are quite new, and their form and  
dimensions must be strictly adhered to.

The ring for form of Rifling is to govern  
the contour of the milling edges of the cutters.

You will notice this gauge has six groups  
of rifling grooves produced in it. The group that  
the cutters must conform to is marked

Mark I 37 Grooves

The steel in the A tubes of these guns is  
hard and tough and tempering of the cutters should  
be governed accordingly.

Yours truly,

J. H. Keightley

Major,  
Chief Inspector of Artillery Stores

Messrs. Pratt & Whitney,  
Engineers Tool Manufacturers & Machinists,  
Dundas, Ont.

RECEIVED  
THE JOHN BERTRAM  
SONS CO. LTD.

AUG 14 4 59 P. 1918

TREASURERS OFFICE



## MILITIA AND DEFENCE.

No. ....

*Private*306 Spark Street  
Ottawa August 13<sup>th</sup> 1918

Dear Mr. Bestman.

I have sent to Pratt & Whitney's Dundas to-day. 2. Milling Cutters for the Rifling of B.L. 7.2 inch guns as samples. also 1 Ring gauge for the form of the Milling Edges of the Cutters. The Director of Contracts is Communicating with the firm with regard to Quotations for the supply of some of these Cutters.

I have explained in my letter accompanying the Samples what is required so there should be no difficulty in the manufacture of them.

My object in writing to you with regard to the matter is to let you know that this job is one of many which is coming along for manufacture of Ordnance Equipment in Canada hitherto for the supply of which we have been almost solely dependant on Woolwich for. - It is the maturing of a general scheme to get everything possible made in this Country. Connected with Ordnance manufacture and you will be pleased to learn that the prospects are Good.

You may have heard that for some 3 or 4 months past I have been scouring the Country visiting and reporting upon the possibilities of the manufacture of Gun Steel and my mission in that respect



## MILITIA AND DEFENCE.

Continued

No.....

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was completed last week by winding up with a visit to Sydney. (Dominion of St. Louis;) and New Glasgow (Nova Scotia St. Louis;) N.S.

I have been able to render a very lengthy report to the Head Quarters. which I think has brought matters to a head as regards the St. Louis supply, of which if sufficient encouragement is given to the manufacturer there is not the slightest doubt about its being easily produced. only requiring the same amount of enterprise and energy thrown into it as was done in the manufacture of Munitions.

I am in hopes within a few days that the actual manufacture of guns in Canada will have commenced in a small way - for we are expecting to place orders for two small Breech loading Rifles aiming of 1" Bore with the Ottawa Car Coy.

I thought you would be interested to hear about progress in this direction.

Probably you will see to it that the "Rifling Cutters" get good attention. and expeditions ashore.

I had a long Chat with Gen. Bertram recently in the train between Montreal & Ottawa.

With kind regards

Yours Very truly

J. H. Keightley, Major  
C. I. A. S. M. F. B.

Henry Bertram Esq  
Dundas



August 16th 1918

Major W.J. Keightley,  
Department of Militia & Defence,  
306 Spark Street,  
Ottawa Ont.

Dear Major Keightley,

X I wish to acknowledge your favor of the 13th with which you enclose copy of letter to Pratt & Whitney Company of Dundas, regarding forming cutters for rifling 9.2 gun tubes, and to say I have held over replying until the samples have reached us.

This will acknowledge receipt of the samples today and we have carefully examined same and a price will be sent to the Purchasing Department at the earliest possible moment.

We notice the templet gives the form of contour on the groove of the gun but if we could obtain it, it would be of some advantage if we had an enlarged drawing giving the exact dimensions followed in the forming of these grooves. As matters now stand we would use these cutters which have not been in use on regular work for the making of our templet, and we would see to it that these cutters were carefully handled for this purpose. With this end in view we are retaining these samples until we hear from your Purchasing Department and I sincerely hope we will be able to make these cutters for this important branch of our Service. A

I am very much interested in the contents of your letter and wish to say that I congratulate you on the interest



Major W.H.Keightley - Ottawa Ont.

Aug. 16/18

you have worked up in connection with the manufacture of big guns in Canada. I know that nearly three years ago we agitated this scheme without very much success at the time, but I believe the best interests of the Empire will be taken care of by educating a staff of men in the Colonies and different parts of the world to produce all sorts of munitions required for defensive work, and not confine it to England alone, and I believe the work you have done is going to stall this difficulty very materially.

With kind regards,

Yours very truly,

HB/EMC