Jerry Redder **6/10/02**

Chuck G.

Attached are 55 pages of data from old documents that spells out the various process flows used at New River.

Produced were
- Bag Charges
- Igniter Charges
- Increment Charges
- Flash Reducer Charges

Hopefully this data will give you and others what is needed.

CC John Tresnor, 2 copies

NEW RIVER ORDNANCE PLANT

The information shown below was taken from the Mobilization Planning Report for Radford completed in 1950. All information may not be authentic at this time.

Disposed of by Real Property Sale Not Subject to Recapture

Bag Mfg. Facilities
Change Houses
Central Boiler Plant
Administration Buildings
Hospital
Fire House
Combined Shops
Laundry
Garage
Fuel Storage

Disposed of by Real Property Sale -- Subject to Recapture under the National Security Clause

Incinerator
Water Plant
Pumping Station
Sewage Disposal
Scale House
Inert Storage Warehouse

MANUFACTURING BUILDINGS AND MAGAZINES

I.	Bag Loading Lines	4 complete
	Line 1 for 155 MM Howitzer	
	Line 2 for 105 MM Howitzer	
	Line 3 for 105 MM Howitzer	
	Line 4 for 105 MM Howitzer	
	Line 5 (Not completed - a 155 MM Howitzer Line)	1 incomplete
II.	Flash Reducer (Units)	8
	~~(For 155 MM Gun)~~	
III.	Igniter Lines	2
	~~(For 155 MM Howitzer)~~	
IV.	Black Powder Drying Plant	3 buildings
V.	Magazines	
	Igloos - capacity 500,000 pounds, Class II	89
	Richmond-type - capacity 300,000 pounds, Class II	59
	TOTAL (62,200,000 pound capacity).....	148

EXTERNAL FACILITIES CHECK LIST

	No.	Capacity
I. Water Supply System		
Wells or Pumps	5	3,700 GPM
Filtration Plants and Chem.Treatment Plants	3	2,225,000 Gals/Day
Reservoirs	2	1,000,000 Gals. Tot.
Elevated Tanks	1	300,000 Gals.
Standpipe	1	1,700,000 Gals.

	No.	Capacity
Pumping Plants and Booster Stations		
Pumping Stations	1	
Pumps	5	3,700 G.P.M.

(The above all sold but subject to recapture)

II. Sewage Disposal

Collection System Lineal Ft. of Sewer Lines	42,080
(All but 13,200 ft. sold - can be recaptured)	
Treatment Plant -- Dorr Primary	450,000 Gals/D
(Sold - subject to recapture)	
Disposal Equipment for Industrial Waste - Retention Basin	2,000,000 Gals/D
(Rebuilt by Burlington Mills - subject to recapture)	

III. Electrical - Demand		72,000 K.W.
Generators		None
Transformers	3	(Sold)
Capacity		2,500 K.V.A.
Distribution System -- Primary		65,250 Lin.Ft
Secondary		35,000 Lin.Ft
No. of Transformers	163	
Total Capacity		2,788 K.V.A.

(All but 20,000 Lineal Ft. of Secondary Wiring sold. Electric distribution system within filtration and inert warehouse areas subject to recapture.)

IV. Central Power Plant (Sold)

V. Roads - Hard Surfaced 50 Miles

vi. Railroads (Lineal Ft. of track installed) 51,163 Ft.

Classification Yard	6 Tracks
Lineal Ft. of Track	9,600

(19,200 Lineal Ft. of Siding and Miscellaneous Track sold subject to recapture under National Security Clause)

VII. Signal and Communication System

Telephone - Trunk Lines	4
Capacity of Switchboard	80 Lines
Fire Reporting System (Sold -- not subject to recapture)	35 Telephon
Radio - Fixed Transmitting Station	1

New River

Methods and equipment varied according to the various types of charges. The charges ranged from the 75MM Howitzer Charge, containing slightly less than one pound of powder, to the 16" Gun Charges, containing over 800 pounds of powder.

Hercules Incorporated contracted on December 17, 1940 to design build, and operate plant at New River, Dublin Va.

Line 4 Started production on September 24, 1940

Line 3 Started production in October, 1940

Line 2 Started production in November, 1941

Line 1 Started production in January, 1942.

Line 5 never completed.

The propelling charge to be bagged consisted of smokeless powder whereas the igniting element for the charge consisted of black powder. Separate loading lines existed for these two types of loading.

The Loading Line Office was under the direction of the superintendent of bag loading. Here the necessary production and personnel records were maintained. Terminations, transfers, rate increases, store orders, time reports, absence leaves, accident reports, shift schedules, loading reports, material reports, inventory reports, etc., were handled in this office. Here the new employees were received and assigned to the lines after having received a safety and production talk. A log book was maintained for the direction and coordination of production on the three shifts.

c. Organization Chart

Organization charts will be found on the following pages: 446-449.

4. Summary of Operations

a. Start-up

The crew which was trained in the Warehouse with inert materials was assigned to actual powder loading at 6 P.M., September 24, 1941. Loading Line No. 4 was the first line to be put into operation. After this date as soon as each Loading Line and Igniter Line was completed, it was immediately brought into production. Four loading lines and two Igniter lines were in operation by January 1, 1942.

b. Bag Loading Operations

(1) Dates Production Started and Types of Charges Loaded

The Loading lines were constructed to load the following types of charges, the production of which began on dates listed:

Line 4 - Production started September 24, 1941, in Building "A". The 105 MM How., M2, M2A1 type of charge was loaded. The charge is classed as semifixed loading.

Line 3 - Production started in October, 1941, with the 105 MM How., M2, M2A1 being the first type charge loaded. The following types were loaded at later dates: loaded at later dates: 105 MM How., M2, A.T.; 8" How., M2, White Bag; 8" How., M1, Green Bag; 105 MM How., M3; and 155 MM How., M3, Green Bag.

Charts to small to Read

446, 447, 448, & 449

Line 2 - Production started in November, 1941, with the 155 MM How., M2, White Bag being the first type of charge loaded. The following types were loaded at later dates: 155 MM How., M3, Green Bag; 105 MM How., M3 A.T.; and 105 MM How., M3.

Line 1 - Production started in January, 1942. The 155 MM Gun, M1 was the first type charge loaded on this line. The following types were loaded at later dates: 8" Gun, MKVI; 10" Gun; and 12" Gun.

(2) Types of Powder Loaded

As previously stated, the function of this department was to prepare powder charges ready for insertion into the powder chambers of guns or into cartridge cases, depending on the type of gun in which the charge was to be used. This meant that two types of powders (smokeless and black) had to be loaded into bags; then the two types of loaded bags were combined into the completed powder charge.

The propelling charge to be bagged consisted of smokeless powder, whereas the igniting element for the charge consisted of black powder. Separate loading lines existed for these two types of loading.

(3) Determination of Bag Sizes

Each lot of smokeless powder, prior to receipt at the Loading Plant, had to be tested for the amount of powder required to give the desired muzzle velocity. Not only did this amount vary between lots, but the bulk or volume of the powder between lots also varied. It was therefore necessary to determine for each lot of powder to be bagged the size of the bag to hold the proper charge of powder by weight and volume.

Tests to determine this information were made several lots in advance in order that the bags might be prepared by the Bag Manufacturing Department in time for use by the Bag Loading Department when the lines were ready to load the particular lots. Tests were conducted in the following manner:

1 Powder lots by number, in the order in which they were to be loaded, were furnished the Control Department by the War Department.

2 The supervisor of the Control Department contacted the superintendent of bag loading for the time and date at which he wished to make the test. The Bag Manufacturing Department kept a sufficient number of lots ahead in order not to delay the Loading Line Operations.

3 Both the Bag Loading and Bag Manufacturing departments were furnished copies of expenditure orders, giving the required weight of each charge (zone). From the given weight of each charge, the superintendent of bag manufacturing made up a trial set (required number per set) of bags for each powder lot that was to be tested.

4 The superintendent of bag loading ordered powder from the lots that were to be tested delivered to the Line Building where the test was to be conducted.

5 Representatives from the Bag Manufacturing Department, Scale Shops, and Control Department met with the superintendent of bag loading, the shift supervisor, and the line foreman in the building where the test was to be made.

6 The representative of the Scale Shop adjusted scales according to weight to be used. The scales were graduated to weight within 0.01 ounce, since each charge (zone) was weighed within 0.01 of an ounce.

7 Two operators were selected to assist in weighing, loading, and sewing the bags. Three bags were loaded for each zone on each lot tested.

8 Bags were inspected for looseness so as to allow for easy sewing. The loaded bags were then assembled in the usual manner by an assembly room operator.

9 The assembled charges were checked for tightness and gauged for diameter and height. For example, the 155 MM Howitzer, M1A1 had to gauge for length-minimum of 19 inches with the maximum not to exceed 21 inches. The diameter was not to exceed the maximum of 5.8 inches.

10 The charges were then sent to the Packing Room where they were packed in the regular containers and air-tested and checked in the regular manner.

11 The loaded containers were then returned to the room in which the bag tests were being conducted.

12 The charges were then removed from the containers andrechecked for tightness, height, and diameter.

The group conducting the bag test decided from these checks whether the type (trial bags made) of bags used met all specifications. If the desired results were obtained, the order for bags for lots tested was placed with the Bag Manufacturing Department according to the dimensions of the bags used in the test.

(4) Processing a Powder Lot

A new powder lot was started on the line in the following manner:

1 It was determined that the correct amount of powder was on hand in the Powder Magazine in conformity with Job order specifications prior to the start of the Powder Lot Operation.

2 Scales and weights were checked to size of charge to be filled and check weighed as to the correct powder lot number.

3 A check was made for availability of powder trucks and equipment for Line Operations.

4 Personnel assignments were made in accordance with the best judgment of line supervision.

5 Powder was transferred from Magazines to hoppers.

6 Operators in the loading booths, checking lanes, and Assembly and Packing rooms performed duties as assigned; and charges were loaded, assembled, inspected, packed, and sealed for Government acceptance.

7 All reports in regard to charges filled and packed on lots had to agree at all times with the Government inspector's check. Disagreements

were settled by recounting of materials by the store's foreman and the government men.

(5) Loading Methods - Smokeless Powder

Four general methods were used at New River in loading smokeless powder into bags. They were as follows:

(a) Loose Pour Method

The loose pour method was the simplest and fastest method of loading powder. It was used with semifixed ammunition. The powder was poured into a tub on a table in the loading booth from a powder hopper which was supplied from the second floor through copper tubing. The operator used a volumetric cup in transferring the powder from the tub to the calibrated powder cup on the scale. The cup of powder was weighed and necessary changes were made. The cup was passed to another operator who check-weighed the cup and powder on another scale. If correct the powder was poured into the increment charge bag by means of a funnel. The opening of the bag was sewed by the next operator. It was then ready for inspection and packing.

Detailed loading procedure follows:

105 MM Howitzer Loading

The steps in loading the charge for a 105 MM Howitzer, M2, M2A1 were as follows:

1 the powder was supplied to Service Magazines from Igloos by motor trucks

2 the powder cans were removed from Magazines to Powder Service Halls on the second floor of the loading line where the powder was dumped into hoppers as needed. The hoppers supplied tubs in the loading booths.

3 a weigher in the loading booth filled the weight cup with powder, placed it on the scale, and brought it to the desired weight of charge.

4 a check weigher rechecked the weight of powder and poured it into bag through a funnel.

5 A sewing machine operator sewed the opening in the bag and then placed the charges in the transfer chute.

6 The charges were removed from the transfer chute and inspected. They were then transferred to the Assembly Room.

7 The charges were then stacked on trays in order of the increment charges, with Charges 2, 3, 4, 5, 6, and 7 on top of the base charge - with large numbers up. These trays were distributed to the assembly tables.

8 The charges were assembled with a needle and silk thread according to specifications. Then they were transferred to the process scale inspector.

9 The charges were checked for total weight and proper sequence and were then sent to the Packing Room through transfer chutes.

10- The waterproof bags were placed in containers, with the top end down over the top edge of the container.

11 The container was weighed before packing.

12 The container was placed in front of the transfer chute, and as the charges were removed, they were placed in rows in the container.

13 The waterproof bag was twisted together at the top and ties with hemp twine.

14 The top was placed on a container, fastened with a hoop, and sealed with a lead seal.

15 The container was weighed to check for the correct number of charges.

16--The sealed loaded containers were placed on a truck and carried to the Service Magazines, where they were stacked to await shipping orders.

A total of fifty-five operators were required for a single operation in one building on the 105 MM Howitzer, M2, M2A1; the operators were

organized as follows:

Incoming Powder Men	- 2	Process Inspectors & Service Operators	- 3
Sewing Machine Operators	- 6	Service Operators for Assembly Room	- 2
Upstairs Powder Men	- 2	Weighers	- 8
Outgoing Powder Men	- 2	Assemblers	- 12
Packing Operators	- 2	Janitor	- 1
Check Weighers	- 8		

The building was under the supervision of 3 house foremen, 1 area foreman, and 1 line foreman.

The personnel of the buildings for other types of charges was organized in a similar manner.

155 MM Howitzer

The 155 MM Howitzer, M4A1, Charge (separate loading) was also loaded by the Loose Pour Method.

The steps in loading this charge were as follows:

1 Powder was brought to the Service Magazine by motor truck. The powder cans were taken to the second floor of the Operating Building on a service truck.

2 Powder was dumped into hoppers as needed. The hoppers supplied the tubs in the loading booths.

3 A weigher in the loading booth filled the weigh cup with powder and brought it to the desired weight of charge.

4 A check weigher checked for properly loaded igniters; rechecked the weight of the powder; and, if correct, poured it into the bag through a funnel.

5 A sewing machine operator sewed the opening in the bag, checked the work, and placed the charges in transfer chutes.

(The above procedure applied to all five individual charges that were assembled to make the complete 155 MM Howitzer, M4A1, White Bag Charge. The weight of the individual charges ranged from approximately 1 to 4 pounds; and of the completed charge, around 13½ pounds.

6 Charges were removed from the transfer chutes to the Service Hall, where they were inspected before being moved to the Assembly Room.

7 Charges were distributed in the Assembly Room to the assembly table, where they were placed in numerical order in front of each assembler, starting with Base Charge No. 3 through Charge No. 7. Base charges were placed with the igniter down and large numbers up and stacked with Charges 4, 5, 6, and 7 on top of the base in numerical ascending order - with the large number up.

8 Each pairof opposite typing straps were tied on top of the assembly with a double twist; the charge was rolled; and the straps were tightened and tied into a hard knot so that the charge was bound securely.

9 The charge was passed through the diameter and length gauge and weighed on the process scale for the correct weight of the complete charge.

10 A felt pad was placed in a paper sleeve in the protector cap, which fitted over the igniter on the base end of the charge, and was tied securely with a bow knot.

11. Charges were placed in the transfer chutes, which lead to the Packing Room.

12- Tops were removed from the M13 containers; paper linings were inserted, with an overlap of at least 4"; and fiber-board discs were inserted in the bottom of containers.

13 Charges with igniters down were placed into containers.

14 Sufficient number of wooden blocks and fibre fillers were added to take up excess space and to hold the charge firmly in place. One wooden filler with a groove was placed on top with the groove up.

15 The top was placed and tightened securely by hand and then given a $\frac{1}{4}$ to a $\frac{1}{2}$ turn with a wrench.

16 After a check was made for a washer, the air test plug was inserted and tightened, and a maximum amount of three lbs. of air was inset ed.

17 After a one-minute interval, an air check was made to determine whether there were container leaks.

18 The air valve was removed; another check for a washer was made; and a graphited brass plug was inserted and tightened.

19 Containers were sealed with a lead seal and put on a truck for the outgoing Service Magazine.

20 Containers were properly stenciled - indicating charge, powder lot, date, etc.

21 Loaded containers were stacked in the Service Magazine to await shipment orders.

(b) Loose Pour and Laced Method

The bags were filled according to the Loose Pour Method. The increment charges where then laced to reduce the diameter of the charge. The lacing was done with non-ferrous needles with a specified thread through corded seams provided for that purpose. The lacing at first was not very tight, but the bag was rolled and the lacing tightened until the charge was of the necessary diameter. The charge was then gauged and check weighed. If it was satisfactory, the igniter protector caps were attached. Final inspection and packing were then next steps.

(c) Loose Pour and Wrapped Method

The bags were filled according to the previously described method. The increment charge was placed in a canvas or in a conductive-rubber cradle provided with rollers. A puttee tape extended from a roll fixed above the wrapping machine, with the end of the tape placed between the increment charge and the cradle. The rolls were tightened and the wrapping was begun. The tape was fed automatically and wrapped around the increment in much the same manner that a bandage is wrapped around an arm or leg or that a soldier wraps puttees around his legs. The tape was cut to leave an extra end, which was half the length of the increment charge. This was pulled back under the

puttee wrapping with a tool made of spring steel with an eye in the end. This tool was approximately ¼" wide and of sufficient length to slide under the wrapping.

(d) Stacked Charge Method

The stacked type of loading resulted from the need to reduce the diameter and length of the charge for large caliber guns, such as the 10", 12", 14", and 16" guns. The powder grains were stacked vertically end-on-end inside the bag by the following methods:

There was a special table with a round hole with a diameter to match the diameter of the charge. It had a flat piece of brass that closed the hole by fitting closely to the table from underneath. It was known as a slide gate. Directly under the hole in the table was a screw attachment on which was set a cylinder with a false bottom, which could be raised and lowered as needed. There was a rack with holes resembling those of a honeycomb. It was the same height as the powder grains and was called the stacking tray.

A cylinder of spring brass was made to meet the maximum height that a charge might be and still meet Government specifications. The cylinder was to be cut its full length, with holes drilled on each side of the split and with sufficient overlap to make the cylinder adjustable. This would permit loading charges of different diameter for the same calibre gun.

The following was the method used to adjust the cylinder to the correct diameter:

1 Weighed out the full amount of the complete charge and calculated the number of grains for powder in it (by weighing and counting grains in one pound to use as a guide).

2 Measured grains of powder to determine the average length of each. Divided the length of the grain into the maximum length of charge. This determined the number of layers ofpowder necessary for the required length of the charge.

3 Adjusted the cylinder to the proper diameter by dividing the number of layers to be used into the number of grains in the complete charge. Then placed these grains end-on-end, making a circle.

4 Gave these dimensions to the superintendent of bag manufacture for a sample bag to be made in order to make trail loading.

Detailed Loading Procedure

1 The powder was received from the hoper from the second floor on to the top of the table.

2 Grains of powder were placed into holes in the stacking tray. All holes in the stacking tray were plugged except the ones necessary to make the correct number for the desired diameter.

3 Removed stacking tray from powder, leaving powder in an upright position.

4 Brought all of the grains close together to form a circle with a leather strap of width equal to the length of the grains of powder and of sufficient length for this purpose.

5 Slid circle of powder, while leather strap was around it, over into the hole in the table onto the slide gate; then removed leather strap.

6 Pulled slide gate back, by means of hand lever, dropping the powder grains onto the false bottom of the cylinder in an upright position.

7 Closed slide gate, ready for next layer.

8 Lowered the false bottom of the clyinder with powder, by means of the screw attachment, just enough for another layer.

9 Repeated beginning with Step No. 2 through Setp No. 8 until required number of layers had been put into the cylinder to give the desired weight, length, and diameter as required by the expenditure order.

10 Removed cylinder with powder from the stacking table and placed it on a small table in an upright position.'

11 Took the bag and pulled it over the outside of cylinder until the bottom of bag fitted snugly over top of cylinder.

12 Then turned cylinder over, placing the end with the bag on the table.

13 Removed cylinder from the bag by holding the bottom of the cylinder and lifting straight upward. This permitted the powder to remain in the bag in layers, standing end-on-end.

14 Placed the bag on scale and checked for correct weight. It had to be handled carefully to avoid upsetting the layers of powder grains.

15 Folded the top of the bag and closed the opening with silk lacing twine of required strength. The bag had eyelets on each edge of the opening.

16 There were two flaps the full length of the charge that had to be laced in order to give proper tightness to hold the grains of powder in place. This also governed the diameter of the charge. The lacing could not be pulled too tight at first or it would not remain straight and neat.

17 The charge was then gauged for proper length and diameter.

Packing of Stacked Charges

1 Metal containers were thoroughly cleaned of rust both inside and out. If necessary, they were painted both inside and out.

2 Containers were properly stenciled according to specifications.

3 Chestnut boards were placed in bottoms of containers.

4 Containers were lined with waterproof liners, overlapping approximately six inches.

5 Brass funels were placed in containers over paper liners in order to keep the liner in place while the charge was being inserted.

6 The igniter pad was tied to the end of the charge by straps provided for this purpose.

7 Placed protector caps over the end of charge to which the igniter pad was tied to protect the igniter from jar. The knot was tied securely.

8 Inserted charge into the container through funnel.

9 Removed funnel.

10 Placed a chestnut board disc over the top of the charge; then filled the remainder of space with dry wooden blocks.

11 Checked for rubber gasket in correct place. Then placed the top on the container and saw that the spider prongs were securely in place.

12 Tightened top hand tight. Then gave top $\frac{1}{4}$ - to - $\frac{1}{2}$ turn with a wrench.

13 Removed brass plug from top and inserted air plug. Then inserted from 3-to-5 pounds of air into containers, according to the amount shown in specifications; the container was under pressure for the time specified.

14 Removed air plug, and if container had not leaked, placed a mixture of graphite and grease on the threads of the brass plug and screwed it into the hole after inserting a small leather washer to make container air tight.

15 Placed lead seal on top of container according to specification. This was sealed by means of a Government sealer.

The charges were now ready for shipment.

(6) Powder Lot Changes - Smokeless Powder

Prior to the completion of a lot which was in process, line foremen anticipated the exact use of bags on hand by comparing the number of bags with the amount of powder remaining unloaded. This was determined by checking the powder remaining in the hoppers and adding to this the amount of powder in unassembled charges. This total weight was dividid by weight of a complete charge to determine the number of different zones needed to complete

the lot. Inventory was now made of unfilled increment bags, and re-run was placed with the Sewing Room if necessary. This check was made in sufficient time to avoid stoppage of operations.

1. The shift supervisor would learn from the control record of charges manufactured approximately when the lot would be completed. If the change was perdicted during either of the night shifts, the day shift would make a general check of powder and materials and place orders for bags, etc. Ample time was given for bag completion.

2 When it was time for the check to be made, the line foremen were contacted to instruct powder men to dump small quantities of powder in the hopper thirty minutes in advance. This made it easier to measure the powder which piled up in the hoppers.

3 Stock foremen were instructed to make actual physical count of all material, issued, or unissued, on the line.

4 Assembly men counted all unassembled zones. House foremen expedited this check by detailing extra men to clean Assembly and Packing rooms of charges prior to the check. When the count had been made, the number of increments for each zone was recorded and all increments coming through chutes were added until the lot was finished.

5 Government inspectors were asked to count the remaining data tags and identification plates in order for the two to compare in the final check.

6 Line foremen with two powder men would measure the powder in tubs and containers in the following order: Loading Booths; Elevator Room; Hopper Room; Rest House; and Incoming Magazine. Containers were checked as follows:

Carpenter	- 23" deep	5 lbs. per inch
Navy	- 25" deep	5 lbs. per inch
Copper Tubs	- 14" deep	10 lbs. per inch
Copper Tubs	- 7" deep	10 lbs. per inch

Before arriving at a final figure, the supervisor had to concur with the magazine foreman that all powder of that lot was in the Line Magazine.

7 A computation was made of the inventory figures, and an order was placed with the Bag Manufacturing Department for bags needed to complete a lot, allowing a few extra bags for rejects.

8 The time of the powder lot change was estimated, and the following were notified of the time and new powder lot: Scale, Bag Manufacturing, Printing, Magazine Area, senior Government inspector, and Hercules inspector.

9 As a lot was finished, all extra material was returned to the Warehouse. Tubs were wiped, hopper stoppers pulled, and booths were cleaned.

10 Magazine Area foremen were notified to relieve the Line Magazine of packed charges and empty powder cans. Attention was then given to obtaining material for the new lot.

(7) Process Inspection

During Loading Operations, it was necessary for bags to be inspected for proper seams with no loose ends and for proper markings that were clearly showing on the bags.

In general, the following factors were considered in Bag Loading Inspection:

1 Saw that there was no improper stitching.

2 Made sure that the stitching was not more than $\frac{1}{2}$" from the edge of the cloth and not less than $\frac{1}{4}$", with a tolerance of 1/8".

3 Made sure that the zone and lot numbers were not obscured by holes in the cloth.

4 Made sure that the printing was readable.

5 Saw that the seams over the powder holes were closed

6 Noted any defects in weaving.

7 Gauged bag for maximum and minimum length and diameter.

8 Containers were checked for packing to determine that no damage or fault existed whereby air or moisture could come in contact with the powder.

9 Saw that end plates were properly stencilled for correct lot.

10 Aluminum identification plates were checked for correct lot number and ballistic data.

11 Finally, checked package for proper packing and absence of any loose play that would cause package to become damaged in transit.

Process inspectors were on the lines and inspected the material as it was assembled andpacked.

After the charges were loaded and assembled, they were gauged in diameter and length to insure the final diminsions to be within the limits prescribed in the specifications. On account of the human error involved in weighing powder for the charges, each charge was check-weighed by an independent operator. Igniter charges were often measured by volumetric weighing, and to insure the accuracy of the weights of these charges, every tenth charge was check-weighed on an analytical balance or its equivalent.

c. Loading Igniter Charges

(1) Black Powder

Propellant charges of all types required an igniter charge of black powder to be sewed to the base end of the charge. This black powder had to be of a certain chemical composition, grain size, and moisture content to meet Government specifications.

Black powder is of two general compositions; namely, that composed of potassium nitrate, charclore, and sulphar and that composed of sodium nitrate. charcoal, and sulphur. The potescium nitrate composition was used in all miliary powders except in the igniters for saluting ammunition.

Black powder is hygroscopic and required drying before use as igniters unless the moisture content was five tenths of one per cent or less. If drying was required, the powder was first screened to secure sizes required by the specifications. It was then placed on trays, with twenty-five pounds on each tray. The trays were all copper with a fine copper-wire bottom. The trays were then placed in an enclosed cabinet in the Powder Room, where air, at a temperature of 150 degrees Fahrenheit, was circulated from 4-to-6 hours to bring the moisture down to the requirements of the specifications.

The grades of black powder are classified according to the size of grains that will pass through wire screens of a designated number of meshes per inch. The following table from Specifications 50-14-18 of June 12, 1934, shows the various sizes as screened:

Grade	Size No.	Passer Screen	Duster Screen	Production Per 8 Hours
A	1	4	8	2400 lbs.
A	3	12	16	2400 lbs.
A	4	16	40	1500 lbs.
A	5	40	100	1500 lbs.
A	6	100	140	1500 lbs.

Grade A1 Powder is that which will pass through a U. S. Standard Number 4 Screen but will remain on a Number 8 Screen.

Grade A1 Powder is prescribed for igniters used in the 155 MM Howitzers, 155 MM Guns, and 8-inch to include 16-inch guns.

Since black powder is very sensitive to jars and friction, great care must be exercised at all times in its handling. A large red figure "4" was painted on the outside of all Operating buildings and Service Magazines where black powder was handled to designate the presence of a dangerous explosive.

(2) Building Facilities

Each operating building was composed of individual rooms with one operator in each. They were known as Roper rooms, loading rooms

(volumetric machine), Sewing Machine rooms, and Inspection and Packing rooms. Safety transfer chutes led from each room. This was a safety precaution for the operators.

The Service Magazines were located at distances from the Operating buildings according to the "Distance Table" in the Ordnance Safety Manual. The distances were those required for the maximum amount of powder to be on hand at one time.

(3) Loading Procedure

Black powder was transferred from the Magazine to a Rest House, which was usually located approximately halfway between the Service Magazines and the Operating buildings, in small quantities of 1 to 2 cans (25-lb. cans) per trip.

The lid of the powder container was loosened with a wrench and removed by hand. Cans were then carried to the Hopper rooms and dumped into hoppers, the powder traveling by gravity through a copper tube into a volumetric machine in the Loading Room.

The volumetric machine could be adjusted to load igniters of different sizes and types, the volume varying according to the type of gun in which the igniter would be used. The setting of the volumetric machine was always checked by emptying the full charge into a weigh cup and by weighing the charge on the scale to see that the setting would volume the required weight of powder, as called for in the specifications. When the machines were correctly set, the operators loaded igniter bags volumetrically and check-weighed every tenth charge. The purpose in check-weighing every tenth charge was to keep the volumetric machine set correctly for accurate loading.

Several things had to be considered by the volumetric machine operators in order to get uniform results. The speed with which the handle was moved was most important. Instruments could not be struck too hard with the handle; smooth movements produced the best results.

The two methods of loading the measured powder into igniter bags (pads) were pour loading and blow loading.

In pour loading, a funnel was attached to the outlet of the volumetric machine; the igniter bag was placed on the funnel; and the black powder was then dropped from the machine into the bag.

The Blow Loading Method was used only in loading quilted igniter bags (pads) and charges carrying two igniter pads with a core through the center of the charge leading from one igniter pad on one end of the base charge to the igniter pad on the other end. A copper tube with an air attachment fitted into the quilted igniter pad and core.

The powder was blown through this tube into the igniter pad and core with air pressure of about fifteen pounds.

After loading, the igniter bags were passed into a Sewing Room through a safety chute, where another operator sewed up the opening. The openings in the igniter bags were kept closed by clamps while they were being transferred from the Loading Room to the Sewing Room. The clamps were removed before the openings were closed by the sewing machine operators. Phosphorbronze needles were used, and each bag was double-stitched to prevent any powder from leaking.

The bags were then inspected for workmanship and weight. Igniter charges weighing less than 8 ounces were allowed a tolerance of plus or minus 0.10 ounces. If they contained over 8 ounces, a tolerance of plus or minus 0.20 ounces was allowed. Bags were then packed into boxes or containers and made air tight. They were then ready for transfer to the Smokeless Loading Lines for final assembly with the smokeless-powder charges.

d. Scale Shop

The Scale Shop was maintained for the purpose of repairing scales, sewing machines, and other line equipment; and for building check weights and weight cups.

The work of the Scale Shop was as follows:

(1) Received and handled Job Orders; stated size of charge to be loaded, with correct weight of each charge.

(2) Checked Job Orders against Expenditure Orders for accuracy.

(3) Shop mechanics built check weights for each zone of the charge in the following manner:

(a) Brass stock of desired length was cut on a screw cutting lathe of 9" swing and 4-1/2 ft. base.

(b) A hole was bored in one end that was deep enough to add lead shot to bring the check weight to within ten grains of desired weight.

(c) Lot number, zone number, and weight were stamped on the brass cap which was soldered onto weight.

(d) Weights were then checked on master scale to 1/1750 of 1 ounce, and any difference was corrected with a piece of emery cloth.

(e) The Government inspector verified each weight. Each weight was approved before being assigned to the lines for loading.

(4) When the lot was completed, all check weights were picked up and brought back to the Scale Shop, at which time immediate removal was made of the lot number and weight figures. This prevented mix-up of lot numbers or weights.

(5) Scales of different size and type were prepared for the various lines according to the different types of charges loaded on that line. Scales were returned to the Shop for repair. They were repaired in the following manner:

(a) The front platter, case from scale base, and the front and rear outriders were removed.

(b) The dash pot plunger from the scale lever was disengaged.

(c) The lower end of the flex spring was loosened and pushed back, and the abutment plates were removed from the center yoke.

(d) The lever was lifted out of a gate bearing, and the pivots were checked for rough edges or chipped places.

(e) The pivot alignment was checked, and pivots were honed to a razor edge with fine stone.

(f) The bearings were checked for cracks and alignment.

(g) The dash pot was checked, cleaned, and refilled with new oil.

(h) After thorough checking and cleaning was completed, the scale was ready for re-assembly. The lever was replaced and the flex spring and the dash pot plunger rehooked. The abutment plate in the center yoke, the front and rear riders, and the front platter were then replaced in order named. Flex springs were set to the desired tension according to the sensitivity of the scale. Then with weights, the scale was checked to its capacity. If checks were accurate, the front platter was removed and the case replaced. Then the front platter was again replaced.

(i) A final check was made and if correct, the scale was put in stock until needed on the line.

(6) Aluminum or copper cups were calibrated and stamped according to the size charge to be weighed. This was necessary because of the use of a Shadowgraph Zero Reading Scale, since the weight had been built up inside to represent the weight of the cup against the cup content weight, thereby affording the correct weighing of the charge.

(7) Sewing machines were repaired and adjusted by experienced

mechanics. All parts were purchased from manufacturing companies. All of the sewing machines were made by the Singer Sewing Machine Company. They were special machines made for explosive work. The New River Plant mechanics added improvements to the machines, such as individual bobbin winders and special thread cutters.

The New River scale mechanics added the following improvements to the scales, which improvements were adopted for use by other plants:

(a) Extra mirrors added to the scales for the use of operators who must sit as they weigh.

(b) Extra openings made in the scale case which allowed light bulbs to be changed without removing scale cases.

The Scale Shop used the following equipment: power buffer, drill press, emery wheel, vise, blow torch, acetylene torch, set of metal number and letter stencils, complete set of small hand tools, carborundum finishing stones, complete set of lathe tools, and set of drill press tools.

5. Safety Precautions

a. Equipment, Clothing, and Practices

All equipment in the Powder lines was grounded to drain static electricity. All of the floors in the Black Powder and Smokeless Powder buildings were made of Bubbelite, which carried the static electricity from operators to a ground wire. Safety shoes were made of conductive materials for this purpose.

The rooms in the Explosive buildings were separated with explosive or fireproof walls which were 10 to 12 inches thick and made of steel reinforced concrete.

Tables, transfer chutes, sewing-machine needles, and all pieces of

equipment were made from non-sparkling metals. Bronze, brass, copper, and aluminum were the non-ferrous materials which will not produce sparks.

Fireproof safety coveralls were worn by all operators in the Powder buildings. Operators working in black powder during Screening, Drying, and Igniter Loading were required to wear safety clothing, the change being made in the regular Change Houses. On these lines the rooms were washed and scoured at the close of the shift to eliminate collection of powder dust.

In each room instructions were posted, showing the number of operators and transients permitted at any one time. The limit was set according to the type of room and the type and amount of powder which was present at any one time. This referred to the maximum amount of powder which allowed operation to proceed efficiently without unnecessary exposure.

Standard rules for safety procedure were stressed at all times. A certain number of operators from each building were periodically selected to be present at safety meetings. These meetings were conducted expressly for the purpose of acquainting the operators with the plants' interest in safety, and of stimulating their desire to participate, to the extent that they were able, in making useful and practical suggestions in that part of the work in which they were most familiar. The employees participating in these weekly meetings included those from the Scale Division, Warehouse Section, Bag Loading lines, and Igloo Area, as well as the powder truck drivers.

As a measure of safety and cleanliness, janitors were stationed on all lines of this department. They were responsible for maintaining neat appearance of toilets, Canteens, and anterooms on the lines, being directly responsible to the explosive foremen. They were required to keep close watch on general appearances of the buildings, including all fixtures, floors, tables, desks, benches, etc., and would at no time permit the piling up of loose scrap or waste within the buildings.

b. Fire Drills

Fire drills were practiced as a regular safety measure in this department. It was for the purpose of systematic and orderly vacating of a building by its occupants in case of emergency, panic, or fire - in the least possible time.

The employees of the department were organized into groups of foremen, watchmen, searchers, street alarm box runners, fire brigade, exit guards, squad minitors, rescue squads, switchmen, and hydrant men.

Employees were trained to vacate all Explosives buildings as quickly as possible and were organized into orderly groups before reporting back to the buildings.

Fire drills were held at least once a month at various hours of the day with all employees participating.

c. Blackouts

Blackouts were practiced at this plant in order that employees could be moved to places of safety in case of approaching enemy planes.

The superintendent of bag loading received the first report that enemy planes were approaching. He remained on the alert and in full readiness to notify wardens as soon as reports indicated that the planes were headed in the direction of the New River Ordnance Plant.

The head warden was the shift supervisor on duty, stationed at the field office, so that he could receive and relay information to the line warden as to approaching enemy craft. His notification to the line wardens carried authoritative instructions as to the evacuation of all lines.

The line warden was the line foreman, who received the message from the head warden and took his place at the Line Canteen and from there ordered his line evacuated immediately when the siren was heard. He kept his station so as to be convenient to telephone contact with buildings on his line. As the operations proceeded, each building warden would report to him.

The building warden was the house foreman on duty in each Operating Building. He remained in the office of the building until employees had been vacated to Line Canteen, except the ones designated to special duty. They were to report to line wardens.

Assistant building wardens were those selected as searchmen in Fire Drill Operations; they would immediately search buildings assigned to them in order that no personnel remained behind. The personnel then reported to the building warden for instructions.

The rescue squad consisted of those designated for rescue work in the Fire Drill Operations. They removed any injured to safe quarters for treatment.

The fire watchers remained in readiness in case incendiary bombs were dropped, whereupon they would use sand which was provided in the house adjacent to the Hydrant House. They would notify fire fighters who would assist them in this work.

The fire fighters were stationed at the Hydrant House in readiness to assist fire watchers in using sand and shovels in fighting fires which might be started by bombs or other explosives. The use of the hose provided at this point would be handled by these men when necessity justified it.

The runners were the men designated as "traffic men" for fire drills. They carried messages from various wardens wherever communications justified runners in preference to telephone communications or in the absence of these communications.

All other operators not assigned to specific duties would immediately, upon orders from building wardens, assemble at respective Canteens and remain there under immediate supervision of line wardens.

The Scale Department men were subject to the orders of the head warden.

6. Training Program

a. Foremen Training

Weekly discussion groups, consisting of foremen from all of the

Smokeless lines, met in the Field Office Canteen. The meetings were conducted in the form of a round-table discussion. Management Bulletins were used as source material. Two foremen were selected in advance to lead the discussions at these meetings. Problems pertinent to production and personnel management were discussed.

These discussion groups aided the foremen in handling the daily problems which might arise on the lines. Some of the topics for those round-table discussions were cleanliness, safety, quality, methods of production, training, company policies, absenteeism, employee suggestions, morale, and other related topics.

b. New Operator Training

New operators were given safety talks by both the Safety and the Production departments before they were assigned to the Operating lines. The Production Department instruction stressed safety, quality, and production on the lines.

Upon reaching the lines, new operators were carefully instructed in the steps of the operation to which they were assigned. They were instructed by the foremen, and in most cases they were trained along with experienced operators until the trainees had attained the efficiency required to become independent operators.

Operators were taught to weigh the charges very carefully, as the accuracy of the guns used by the Army depended upon this. On account of the variations in the ballistics of the smokeless powder made by the various manufacturers, the weights of the charges varied between lots of powder loaded.

The weighers and check weighers for all lines were taught to be absolutely accurate in all Weighing Operations.

Specifications allowed some tolerance in the weights of each zone assembled for a complete charge. Tolerance is the amount of variation allowed above or below the specified weight of a zone. A tolerance of plus or minus

.07 was allowed for the complete charge of a 105 MM Howitzer, with a plus or minus .01 allowed for each zone. The tolerance varied for each type of charge and was set by the Ordnance Department.

7. New River Stops Production

On May 24, 1943, in accordance with instructions from the Ordnance Department and confirmed in writing as of that date, which formal confirmation was embodied in Supplement No. 6, dated January 25, 1944, the Bag Loading Operations ceased, and action was started immediately to put the Production Units of the plant in standby condition. The Storage Magazines were operated from May 25, 1943, to September 19, 1943, as an Ammunition Storage Depot.

During the period from May 25, 1943, to September 19, 1943, inclusive, several hundred employees remained on the New River payroll putting the Production Units of the plant in standby condition.

When production ceased at New River, some of the Hercules key men were reassigned as follows:

To Port Ewen, N. Y. (11): Messrs. John Glover, Charles Seadek, Arthur Scheff, Hunter Hunkle, P. C. Furbeck, James W. Dugan, A. J. P. Seitz, C. D. Baker, W. J. Joyner, John F. Schappel, and J. J. Tossi.

To Radford Ordnance Works (4): Messrs. J. T. Sydnor, N. H. Hurd, E.V. Kenney, and Jay Harned.

Prior to production stoppage, the War Manpower Commission had notified Holston Ordnance Works, Kingsport, Tennessee; Triumph Explosives Company, Elkton, Maryland; du Pont Works, Richmond, Virginia; and the Celanese Plant, Narrows, Virginia, of the experienced workers that would be released. Representatives of these companies came to interview employees. The employees were given opportunity to accept jobs without loss of time. A number accepted employment.

Effective at 12:01 A. M. September 19, 1943, the status of the New River Ordnance Plant operating as an independent plant was changed to make it a unit

of the Radford Ordnance Works under Contract W-ORD-462.

8. Production and Personnel Statistics to May 25, 1943

Monthly production and personnel statistics, from the date that production started in September, 1941, through the date that production ceased on May 24, 1943, will be found at the end of this chapter.

9. Work during Standby Period

The Operating Force thoroughly cleaned all Loading Line buildings after production had been discontinued. This work was completed within a few days after the shutdown order was received, and all employees of the Bag Loading Department were terminated or transferred to other Hercules plants.

The Maintenance Department retained a sufficient number of men to check, clean, and grease equipment; and to place it in a standby condition. Approximately thirty days after this work had started, additional orders came to remove and crate all equipment. It was shipped to other Ordnance plants in various states. This included hospital, cafeteria, and all production equipment except enough maintenance material to keep trucks and the Magazine area in operating condition.

The Magazine Area continued to store surplus powder that was shipped from other plants and reshipped powder as orders were received. This work continued under the New River Ordnance Plant Management until September 19, 1943. At that time the records were closed, and the Magazine Area went under the direction of Radford Ordnance Works.

10. Trench-mortar Increment Packaging

Introduction

Propellant powder for trench mortars was produced in the form of increments. Each increment consisted of a number of sheets of rolled powder sewed together in the form of a small book. Increments were assembled onto the base or fins of the trench-mortar shell before the shell was shipped to the

fighting front. Shells were shipped in cardboard containers impregnated with asphalt, and, as a result, were partially protected from the elements. However, on long storage in the South Pacific Area, there was considerable moisture vapor transfer through the cardboard container, withtthe result that the propellant powder absorbed appreciable amounts of moisture; consequently, the performance of the ammunition was adversely affected. After the ammunition was received at the fighting point, it was removed from the cardboard containers and stacked conveniently around the mortar in which it was to be fired. In this form the powder was completley exposed to the elements, and in case of rain or snow, it would become very wet. This caused considerable difficulty on both the South Pacific and European fronts.

The Ordnance Department investigated means of protecting the propellant charge from the elements by inclosing each powder increment in a moisture-proof bag. Various packaging materials were tried but none were entirely successful. The best material found by the Ordnance Department was Saran-coated Cellophane. This was developed and produced by the Sylvania Industrial Company solely for use in packaging trench-mortar increments. The Ordnance Department investigated sources of bags made of this cellophane as well as means of seling the bags after insertion of the trench-mortar increment. They recommended that bags manufactured by the Ivers-Lee Company of Newark, New Jersey, be used and that "Wrapade" crimpers be used for sealing the bags.

At this point the packaging problem was turned over to Hercules Powder Company with a contract for the installation of necessary equipment for packaging 400,000 increments daily. Hercules Engineering departments at Wilmington and Radford, together with the Operating Department, investigated the problem. Safety considerations made some changes in the "Wrapade" crimper necessary. Other changes were authorized because of the inability to obtain certain parts for these crimpers. No suitable location was available at the Redford Plant for this operation, but the loading buildings at New River Ordnance Plant

seemed fairly well adapted, and as New River was not operating at the time, Line 4 was selected and converted to increment packaging. Equipment was installed in Loading Buildings "A" and "B" for the Packaging Operation. The Igniter Magazines were used for packing. The middle Magazine was converted to a Powder-conditioning Building by the installation of air-conditioning equipment. Since conditioning of the powder was not found to be necessary, this building was used for storage of non-explosive materials and for box preparation. The other two Magazines were used for incoming and outgoing powder.

Considerable attention was paid to the safety of the operation. Powder and personnel limits were set very low to minimize the possibility of a serious accident.

At the time these facilities were installed, the Ivers-Lee Company was engaged in the development of an automatic packaging machine which they believed could be adapted to the packaging of trench-mortar increments. Two of these machines were purchased for trial, and later more were purchased so that eventually all the Packaging Operations at New River were carried out with these machines.

A procedure for the salvaging of under-weight increments was developed, and the necessary facilities for carrying out this operation were installed at New River.

b. Resume' of Operation

Increment Packaging Operations at New River Ordnance Plant began in November, 1943. This operation was part of the Smokeless Powder Department at Radford and was under the supervision of the smokeless powder superintendent. Mr. J. T. Syndor was area supervisor of the operation. The smokeless technical assistant and smokeless chemical engineers aided in both the technical problems and the supervisory problems encountered in this operation. After a brief training period with dummy powder, actual packaging of trench-mortar increments was started on November 13, 1943. Originally only M3 increments for the 60 MM

Trench Morter were packaged; later, M1, M2, and M2A1 increments for the 81 MM Trench Morter were packaged.

At the start of the operations, each cellophane bag or envelope was opened, and the powder increment was inserted by hand. This process was extremely slow. Poor quality resulted from straining and tearing the bags when the increments were inserted. The Radford Maintenance Department designed and built a simple machine for performing this operation. Powder increments were stacked in a vertical magazine, and a foot-operated plunger pushed the increment from the magazine into the cellophane bag. This left both of the operator's hands free for opening the bags and handling the packaged increments. At the start, this increased the number of increments an operator could bag from a range of 10 to 16 per minute to 25 to 30 per minute. After operators gained skill with the stuffing machine, much better efficiency was obtained. Maximum efficiency was usually not obtained until an operator had from nine months-to-a-year's experience with this machine. A major improvement in the quality of the packaged increment was obtained by the use of the stuffing machine.

Some modifications of the crimper were necessary to improve efficiency of the operation and the quality of the product. The crimpers were equipped with a clutch so that they would normally be stopped between the crimping of each bag. By the installation of a flase top on the crimper so that the increments would be at the same level as the slot in the feed plate, it was much easier for the operators to insert the bags into the crimper, thus permitting the machine to run continuously. This not only increased the efficiency of the operation but also reduced the number of bags which were pleated and wrinkled by the crimper. Before satisfactory operation o f the crimper was obtained, it was necessary to realign the crimper jaws and in some cases "lap" the jaws together for better fitting. Eventually stainless steel was found to be a more satisfactory material for the crimping jaws than the bronze which was originally furnished; hence all jaws were changed to the stainless-steel type. The crimping

Pages 480 to 494
Not of value to Flow of Process

11. Flash Reducer Developments and Production

a. Introduction

In World War II it was found that during the invasions in North Africa, Sicily, and Italy there was an urgent need for the 155 MM Gun, M1 because of its accuracy and effectiveness. The flash of these guns, when fired at night, permitted the enemy to plot the gun locations.

The Ordnance Department had done some development work after World War I looking toward eliminating the muzzle flash, but it was not carried to a conclusion.

Mr. W. S. McGilvray of the Technical Division, Army Ordnance, Washington, D. C., was assigned the duty of developing a means of eliminating the flash of guns when fired. His study began in 1942, and for months experiments were made without good results. In 1943, a formula was found which began to effect better performance.

By the early part of 1944, Mr. McGilvray had developed a flash-reducer charge that could be fastened around the propelling charge; from a laboratory standpoint, satisfactory results for this charge were indicated. This development was carried on at Picatinny Arsenal, Dover, New Jersey, and at Aberdeen (Md.) Proving Grounds. The required number of charges were loaded and fired. The results were found to be satisfactory.

Hoosier Ordnance Plant, Charlestown, Indiana, and Coosa River Ordnance Plant, Talladega, Alabama, the two Bag loading plants already in production, were offered the manufacture of flash-reducer charges on a production basis, but they did not care to accept the orders, as production scheduled at that time would not readily permit such an expansion.

New River Ordnance Plant was selected as the logical plant to produce this charge, as an organization was at hand and expansion could easily be adjusted within the organization.

In the spring of 1944, Mr. A. R. Hance, superintendent of the New River Ordnance Plant, with Mr. Henry K. Marsh, manager of the Smokeless Powder Operations for Hercules Powder Company, conferred in Washington with Mr. McGilvray and bag-loading officials from Picatinny Arsenal. Anticipated production difficulties were pointed out by Mr. Hance and Mr. Marsh. Suggestion for designing a flash-reducer charge bag that could be readily loaded on a production basis was made by Mr. Hance. This design was accepted and arrangement for production was approved.

An alteration was ultimately made by the Radford Contract providing for the manufacture of 300,000 flash-reducer charges per month. This charge was originally known as Flash Reducer T1; then as perfection was established, the designation was removed from the technical status, and the item was designated Flash Reducer M1.

b. Pilot Lot Production

Hercules was requested to draw up plans for the rehabilitation of the Igniter lines for Flash Reducer Loading.

By May 22, 1944, the Engineering Department had completed conversion of the Igniter Line No. 2, and loading of the pilot lots was started by the New River Bag Loading Department. Pilot lots produced were tested at the Firing Range at Radford Ordnance Works. Satisfactory results were finally obtained after several changes were made in the method of loading the flash-reducer charge cells in order to increase efficiency and to speed up loading without affecting the firing results. Cups of various sizes were developed in order to increase the uniformity of weight of each charge dipped. The potassium sulphate grains were not uniform in size, resulting in erratic portioning of the dipped charges. The size and shape of the loading funnel was altered to overcome problems that presented themselves in the loading operations, such as potassium sulphate grains hanging in the funnel.

The flash-reducer charge was designed for use with the 155 MM guns - M1917, M1918, M1 - and modifications. The charge, composed of two red cotton strips separated 6" apart, was wrapped around the propelling charge for these

guns and tied in place with seven cotton or silk tie tapes evenly distributed throughout the length of the charge. Each strip of the charge was approximately 4.75 inches wide and 36 inches long. The strip was composed of two sections; the upper-and lower-base charge section was 25 inches long, whereas the increment charge was 11 inches long. Each of three charges in each strip was divided lengthwise into three channels; each channel was in turn divided crosswise at the center by a seam, making 6 cells in each one of the 6 parts of the charge, or 36 cells in all. The two outside rows in each strip were filled with a mixture of 60% potassium sulphate and 40% black powder. The center rows contained straight black powder. The increment charges were attached to the end of the lower-base charge by a tab of white cloth stitched to each charge. This provided an easy means of separating the increment from the base section in the event that the normal 155 MM Gun Propelling Charge was to be fired. In case the supercharge was to be fired, the increment section remained a part of the flash-reducer charge. See photographs on Pages 510 and 511.

Potassium sulphate, when fired with black powder, was vaporized, producing a dense white smoke-screen effect that masked the muzzle flash normally visible during night firing.

The screening and drying of black powder began May 19, 1944.

The Flash Reducer Line at New River Ordnance Plant, converted Igniter Line No. 2, was opened on May 22, 1944, under the direction of Mr. Sydnor as supervisor, Mr. Kenney as shift supervisor, and Mr. Sherman Henderson as house foreman, with nine female operators. One complete charge was loaded during this shift. The second shift on the same day completed fifty charges.

Production on the first five days was as follows:

May 22..... 51 Charges

May 23.....176 Charges

May 24.....151 Charges

May 25.....213 Charges

May 26.....191 Charges

This completed the first pilot lot, which consisted of 750 charges.

On May 24, some of the charges were made with silk assembly tape; some with cotton assembly tape; and some were assembled by means of zig-zag sewing.

The building was then cleaned and re-opened on June 1, 1944. The second pilot lot, No. 263, was loaded. It consisted of 90 charges. The first bags of Lot No. 263 were made with outside channels of 1 inch width and center channels of 1 1/8 inch width. Of the 90 charges loaded on this lot, 10 were of special mixture.

The building was again cleaned, and on June 21, 1944, Pilot Lot No. 277 was started. Special potassium sulphated black powder blended with regular black powder with A-1 mixture was used to load 50 charges of that lot. This special powder was made by Hercules. It reduced the flash but not as effectively as the regular mixture.

On Lot No. 278, a special blend of potassium sulphated black powder, consisting of Grades A-1, A-8, A-12, A-3, and A-4, was used to load 55 complete charges.

The regular blend, which consisted of 60 percent K_2SO_4 and 40 percent of regular black powder was used to load 48 charges on Lot No. 279.

The third shift started on July 2, 1944.

On account of irregular granulations of the sulphate, it was very difficult to maintain a uniform mixture of black powder and sulphate. A box with a screen of No. 16 Mesh was used to screen out the fine grains and leave on top the grains which were to be used.

Flash reducers were first loaded by hand. By this method an operator could average from 75 to 100 single bags per shift.

The Hand Loading Method began as follows:

Black powder and sulphate were blended in a tub in the Rest House.

The black powder and the mixture were then carried to the Hopper rooms where the hoppers were filled.

In loading booths, the blend and the black powder were weighed for each

individual channel and poured through the funnels into the channel.

This method was very slow, and after a few days the mechanics developed volumetric cups for measuring the blend and the black powder. The cups were check-weighed with every tenth charge loaded. See photographs on pages 500-501.

This type of loading failed to work satisfactorily on account of the inability to maintain a uniform mixture. This had proved satisfactory in laboratory experiments, but was not satisfactory for production because the necessary percentages of black powder and sulphate could not be maintained with the irregular granulations of sulphate. As a result there was too much variation in each channel.

Volumetric cups were then changed to allow the black powder and sulphate to be volumed separately and each charge mixed in a special mixing cup in order to maintain the correct percentage of each. The black powder for the center channel was volumed in the same manner and loaded through the funnel into the channel. Photographs of Pilot Lot Production Loading and Sewing Operations are found on pages 502-504.

This type of loading produced such a limited number of charges that it was impossible to fill the quota needed by the armed services. Flash reducers were produced only at the New River Ordnance Plant. After the invasion of France began on D-Day, flash reducers were flown by cargo planes directly to the battle areas as soon as a complete shipment was loaded.

A request was made by the superintendent of bag loading, Mr. J. T. Sydnor, for a volumetric machine to be developed which would eliminate this slower method of loading flash-reducer charges. Mr. John Hunter, of the Inspection Division of the War Department, made an outline for setting up such a machine and turned it over to the Hercules Engineering Department for development.

Smokeless Line 1 was opened on September 25, 1944, for the production of flash reducers. Production was continued on this line until December 31, 1944, then transferred to Line 3A until January 20, 1945.

500 to 504
Photographs

c. Standard Production Line

Production was started in the newly constructed Flash Reducer Houses as rapidly as construction was completed and as equipment was installed ready for use. Buildings were opened and operation commenced on the following dates:

Flash Reducer House No. 1 - November 20, 1944

Flash Reducer House No. 2 - November 26, 1944

Flash Reducer House No. 3 - December 6, 1944

Flash Reducer House No. 4 - December 31, 1944

Flash Reducer House No. 5 - January 9, 1945

Flash Reducer House No. 6 - January 18, 1945

Flash Reducer House No. 7 - January 29, 1945

Flash Reducer House No. 8 - February 7, 1945

The Flash Reducer Screen and Dry Line was completed and ready for operation on March 25, 1945. The distance provided between the Black Powder Incoming House and the Screen House, as well as between the Screen House and the Dry House, permitted the line to be operated at approximately 60% of its designed capacity. By virtue of the fact that New River was not rehabilitated to its anticipated full capacity, demands on the Screening and Drying Facilities, which included Screen and Dry Line No. 1, did not exceed its capacity. It was then not necessary to correct the condition at the Flash Reducer Screen and Dry Line in order to process sufficient black powder to operate satisfactorily.

Production output had been sufficiently increased by March 6, 1945, to permit Hand Loading Operation at the Igniter lines to be discontinued. Flash Reducer lines were designed to produce five hundred charges per house per shift. This quota was reached during the month of January, 1945.

d. Flash Reducer Loading

(1) Job Orders and Production Reports

Job Orders for the loading of flash reducers were received by the supervisor of production of Black Powder Loading. When it was determined that

materials were available and information was correct, a copy of the Job Order was delivered to the shift supervisor and subsequently to the line foreman responsible for loading a particular lot of charges.

Arrangements were made with departments concerned for the delivery of supplies and powder in quantities in keeping with good production requirements and safety limitations.

Building Production Reports were made out in duplicate by the house foreman, one copy being retained and the original transmitted to the supervisor's office after being countersigned by the line foreman. Building reports were consolidated into a general report, summarizing daily production and carrying accumulative production to date for each type of charge loaded. Copies of the general report were sent to the Planning and Control Division and to the assistant operating manager, with the file copy being retained.

(2) Flash Reducer Line Arrangement

The Flash Reducer Line was provided with a separate Screen and Dry Line for processing black powder used in loading flash-reducer charges. Eight Loading buildings were serviced by an Opening-up and Rest House, an Inert Store House, an Empty Box Store House, an Outgoing Rest House, and a Maintenance Shop. Flash Reducer Loading buildings were identical except that No. 1 and No. 8 had two additional Inspection rooms used by Hercules final inspectors and Government inspectors. All Loading buildings had 6 Hopper rooms, 6 loading booths, 4 sewing booths, 1 Inspection Room, and 1 Packing Room. Inspection rooms and Packing rooms were equipped with high-speed super-sensitive sprinkler systems.

(a) Screen and Dry Line

The Screen House was divided into an Opening-up Room and a Screener Room. Adjacent to the Screen House was the Motor Room housing the Powder Unit which drove the screener.

The screener, supplied by the J. H. Day Company, Cincinnati, Ohio, was a No. 32 Rubber Bearing Powder Sifter of all-wood, dust-tight con-

struction, having inter-changeable screen surfaces, each 20"-x-48", complete with screen cloth. The eccentric drive was enclosed in a dust-tight copper housing and a moulded rubber diaphragm seal. Metal parts of the eccentric drive, screen box, sieve frames, etc., were wired in series to the ground.

The sifter was powered by a one h. p. electric motor in the Motor House through a 12'-x-1½" bronze drive shaft.

Powder was fed to the sifter through a copper regulating feed hopper with a wood pulling valve. This was mounted on an independent supporting frame attached to the base of the sifter.

The Dry House was equipped with a Carrier Corporation Black Powder Drying Unit approximately 12' long and 6' wide by 7'2" high, divided into eight sections or compartments, each having a capacity to hold twelve trays approximately 22 3/4"-by-33" deep. Each tray held 25 lbs. of black powder. The capacity of the unit was 2400 lbs. of black powder. The dryer was a Carrier Standard, double-walled panel construction; door latches and hinges were brass - of the ice-box type. Copper flanges separated the point of contact between doors and panels.

Air centered the air plenum chamber from the top of the dryer and passed horizontally over the trays down through the tray mesh into the exhaust plenum.

Conditioned air was supplied to the dryer from the adjoining Fan House or Apparatus Room by a Carrier Silica Gel Unit, a dry air cooler activation booster heater, a Carrier 39R Fan Unit and 4-row water-cooling coil, and Dustop filters. Air was drawn from the outside through a set of Dustop filters, and during the dehumidification season, it was forced through the Silica Gel Unit, which action removed moisture. Dry air was passed through the Aerofin Non-freeze Booster Heater and the water-cooling coil and fan to the dryer.

The booster heater was capable of heating 3000 CFM of supply air from 0°F to 100°F. The water coil prevented the air from exceeding 150°F at the dryer. This coil was furnished as a safety precaution and was not used continuously. Air was exhausted to the outside from the dryer.

Safety controls were as follows: A thermostat was located in the air supply to the dryer, set at 150°F so as to shut off the fan and steam and ring an alarm. A second thermostat was located in the same position, set to control the booster heater to deliver air at 145°F. If the temperature should rise above 147°F, a third thermostat would activate the water-cooling coil to cool the supply air to 147°F. Controls were arranged so that the outside air damper and exhaust air damper were closed when the fan shut off.

(b) Loading Buildings

Each Hopper Room was provided with two copper hoppers 10"-x-12" rectangular tops, three sides tapering at about 60° to an outlet at the bottom connected to a 1" copper tube protruding at an angle through the wall to the volumetric dispenser in the loading booth. The hoppers were elevated to permit gravity flow. One hopper was used to supply black powder, the other was for potassium sulphate.

Loading booths were each equipped with a volumetric dispenser designed to load three separate channels of the flash-reducer bag at one time. The two outside channels were to be filled with a mixture of black powder and potassium sulphate, and the center channel with straight black powder. A cylindrical proportioner was rotated approximately one-fourth turn and back by use of a crank-type handle to complete one filling stroke. Plungers penetrating the three funnel stems served to remove all particles of the charge from the dispenser. This was actuated by a separate lever. The dispensers were mounted on brackets above copper-covered wood tables. Transfer chutes designed to prevent propogation of flame connected the loading booths with the sewing booths. The chutes were closed with counterbalanced vertical sliding copper or aluminum doors on each side. A sliding bar locked one door in place while the other was

being opened, thereby isolating the rooms from each other at all times.

Each sewing booth was equipped with two Model 17-16 Singer Sewing machines. These machines sewed with a lock stitch. Sewing-machine table tops were copper-covered. A special copper platform at the sewing-plate level was provided on machines used for joining and assembling charges.

Power was transmitted by a 1 h. p. motor driving two machines through a drive shaft and a flat belt to the transmitter and a round belt drive to the sewing-machine head. A five-sided, copper-covered wood table was mounted directly below the Loading Room transfer chute to permit a flow of charges from the closing machine to the joining machine.

Inspection rooms and Packing rooms were equipped with copper-covered steel tables - 30"-x-72" tops, 36" high, for inspecting and wrapping charges.

(c) Service Buildings

Hold Houses and Rest Houses were of flame-resistant frame construction, barricaded on sides facing Operating and Storage buildings and located at distances from other buildings in agreement with the quantity - distance tables provided in the Ordnance Safety Manual. Store Houses were of frame construction and located at points accessible to operation. The Machine Shop was equipped with benches and tools necessary in maintenance of sewing machines and dispensing machines.

(3) Personnel

Personnel required to operate the Flash Reducer Line on a one-shift basis was as follows:

Line Foremen	- 2 (for area)
Area Foremen	- 2 (for area)
House Foreman	- 1 (per bldg.)
Powder Man	- 1 (per bldg.)
Volumetric Operators	- 6 (per bldg.)

Sewing Machine Operators	- 8 (per bldg.)
Inspectors	- 3 (per bldg.)
Packers	- 2 (per bldg.)
Service Man	- 1 (per bldg.)
Check-Weigh Inspector	- 1 (per bldg.)
Relief Operators	- 3 (per bldg.)
Mechanics	- 1 (per bldg.)
Janitors	- 2 (for area)
Material Handler and Checker	- 1 (for area)

(4) Materials

Essential materials for a flash reducer consisted of empty charge bags, Scutan bags, adhesive tape, thread, tabs, and potassium sulphate. These supplies were received at the Inert Storehouse for distribution to the Operating buildings. Shipping boxes were stored in the Empty Box Storehouse. The material checker maintained complete records of all materials distributed. It was his responsibility to see that an adequate working supply was maintained and that the Service Department deliveries were made according to schedule.

Black-powder cars received at the Magazine Area were sampled upon arrival, tested for moisture content, and complete analyses made on the product. Results of the test were forwarded to the superintendent of black powder. Black powder was dried if the moisture content was above the allowable maximum.

(5) Screen and Dry Operations

The black powder was delivered to the Screen and Dry Area by the Magazine Department trucks. The cans of powder were placed in the Incoming Magazine and set in "pyramid" fashion 3 cans high, with 12 cans comprising one "pyramid." This method of stacking enabled the cans to be counted quickly and easily.

The powder was hand-trucked to the Rest Room of the Screener Building utilizing a four-wheeled cart for the purpose. This vehicle was equipped with a

rack that prevented cans from falling off. Approximately 4 to 6 cans were hauled at one time; the trucker also checked the powder lot number as an added precaution.

Non-sparking tools of beryllium copper were used to open the cans in the Rest Room, and the contents of each can were poured into the metal transport shells. This allowed easier and faster handling of the powder at the screener proper, since the opening in the manufacturer's container was small. When emptied, the latter cans were flushed out with water, carted back to the platform at the Incoming Magazine, and subsequently hauled away by the powder truck. They were later flattened out and disposed of.

The powder was then poured from the shell into the hopper of the screener, and the contents of one can (approximately 25 lbs.) were screened at one time. A four-mesh screen cloth was used to separate the powder. Two metal cans were placed at the base of the screener, one for the acceptable powder and one for the oversize. These cans were held in a rack which prevented them from toppling over when the screener was operating. All personnel were evacuated from the room, the doors closed, and the screener was set in motion by pressing an outside switch located near the Rest Room. The plug in the hopper was removed, from a remote position, and the powder flowed over the screen. All powder passing through the screen was acceptable powder; it entered one of the receiving cans, whereas any foreign matter and oversize grains passed into the other can. The screening was completed when the sound of the powder falling into the cans ceased. The "stop" button on the switch was pressed, and one operator removed the receiving cans while another put the hopper plug into place and poured contents of another can into the hopper. Empty receiving cans were set in their proper sections in the rack, and the operation was then repeated.

The acceptable powder was brought tothe Rest Room, and if necessary, additional screened powder was poured into the can to bring its contents up to twenty-five lbs. A scale was provided in the room for this purpose. Having each

can contain a uniform amount enabled the records of the consumption of the powder to be easily compiled. The lid of the can was then placed into position, care being taken to insure the presence of the necessary gasket. A slip showing the lot number and the grade of the powder was secured to the top of the lid by the spider clamp screw, which was then adjusted to make the can air-tight. All powder that was to be dried was hand-trucked to the Screener Magazine, whereas powder that had an acceptable moisture content was taken directly to the Outgoing Magazine. A four-wheeled hand-propelled cart, equipped with the necessary rack, was utilized for this purpose.

Cans containing powder that was to be dried were allowed to accumulate in the Screener Magazine; and when approximately 2,000 lbs. were available, the powder was hand-trucked to the Dry House. The Heating Unit had been previously started, thus allowing the unit to heat up. The trays were taken out of the dryer and placed on a table provided for thatpurpose, and the contents of the cans were spread out on the trays. One tray was filled and put back in the dryer before the succeeding tray was filled. The doors to the dryer had to be closed each time, thereby allowing only twenty-five lbs. of black powder to be exposed at one time. After the unit was loaded and its doors secured in place, the doors to the room were locked, thus preventing anyone entering while the unit was in operation. The heat in the dryer would level off at approximately 146 to 148 degrees, and a check of the recording chart would show the time it leveled off. The powder was allowed to dry for 3½ hours, at which time the Heating Unit was shut off and the dryer emptied. The dried powder was poured from the trays into the cans through a hopper designed for this purpose. Again only twenty-five lbs. of exposed powder was to be allowed at one time, the exception being, of course, when the dryer doors were opened to remove a tray. This also held true when loading the unit. The cans again were checked for gaskets, identification slips were put in place, and lids were secured. The cans of dried powder were then hand-trucked to the Outgoing Magazine, and the dryer and the room were thoroughly cleaned.

Delivery tickets for all powder removed from the line were made out by the foreman, who retained one copy that was sent to the office with his report.

All equipment was grounded and hand rails were provided at the entrances of Operating rooms, which fact allowed the persons entering to discharge any static electricity from their bodies.

Continual washing out, cleaning, and mopping up were in order on this line as often as necessary.

"Personnel and Explosives Limits" had to be maintained, and operating procedure followed.

(6) Flash Reducer Operation

(a) Operating Supplies

Dry, screened black powder was delivered to the Opening-up Room in quantities that did not exceed 500 lbs. in the room at any one time. Containers were wheeled to the Loading Building by the powder man; the black-powder hoppers were filled; and a working supply was maintained.

Potassium sulphate was transferred by the powder man from the barrels in which it was received at the Inert Storehouse to containers holding about twenty-five lbs. Potassium sulphate hoppers were filled and replenished as required.

The service man received a working supply of empty flash-reducer bags, Scutan bags, adhesive tape, tabs, and thread from the Inert Storehouse for distribution to the operating booths. Empty bags were delivered to the loading booths, tabs and thread to the sewing booths, and Scutan bags and adhesive tape to the Packing Room.

(b) Volumetric Loading Room Operation

Before loading, the flash-reducer bag was composed of an upper-base section, a lower-base section, and an increment section. The sections were made up of 2 identical parts, each divided into 6 cells. The two parts of

the section were attached parallel approximately 6" apart with cotton tape. The base sections were the same size and smaller than the increment.

Four booths were assigned to load base charges and two to load increments. Volumetric dispensers were adjusted accordingly. All booths operated in the same manner.

The operator, seated before the dispenser, slipped the openings of one end of one half of a section over the three funnel stems. The dispenser lever was moved to the upward position; the plungers were actuated sharply; and the lever was returned to the original position. The filled channels were removed, and the corresponding end of the other half of the section loaded. The open ends were placed together and folded to prevent powder spillage, and a clamp was attached. The operation was repeated for the other ends of the sections, making certain at all times that no powder was spilled from the channels. Loaded sections were placed in the transfer chute to the sewing booth, the operation proceeding until fifteen sections were loaded. The transfer chute door was closed, the lock bar pulled, and the operation repeated.

Accuracy of the dispenser was checked at frequent intervals by the check-weigh inspector. Portions dispensed were accurately weighed, and adjustments were made when indicated.

(c) Closing - Joining - Assembling

Base-closing and joining sewing booths were each serviced by upper-base and lower-base loading booths; the increment-closing and assembly booth was serviced by an increment-loading booth, joined bases to be attached to the increment section being transferred through a chute by the base-joining operator.

Sewing machines were started by throwing a starter switch on the outside of the booth. The operator was seated and made certain that the machines were properly threaded before the operation was started.

The base-closing operator removed loaded charges from the transfer chutes and placed them at the right of the sewing machine. The clip from one end of the cells was removed, and two straight seams were sewed across the dotted guide line of each part of the section, 1/16" apart. Threads were cut; the clamp was removed from the other end of the section; and the operation was repeated. Clamps were returned to the loading booth as a new supply of charges was taken from the transfer chutes.

The upper and lower base sections were attached by the joining operator at the second machine. Closures were overlapped at guide points and sewed with a double seam. Joined sections were transferred through a chute to the assembler in the adjoining booth.

Increment sections were closed in the same manner as the bases. The assembler joined the increment to the upper base by attaching each to a cloth tab 1" wide with a single seam through each section.

Assembled charges were placed in containers for transfer to the Inspection Room. Photographs showing Flash Reducer Loading, Closing, and Joining Operations are found on pages 518-520.

(d) Process Inspection

Each charge was thoroughly inspected to make certain that all specifications were met. Charges were removed from containers and placed on the inspection table. One inspector weighed the charges, and after physical inspection, folded them, placing five on a tray for transfer through a chute to the packing booth. Two inspectors examined the weighed charges for the following conditions:

Stitching closed and spaced correctly.

Channels filled with proper amount of powder.

Upper base attached to lower base with double stitch.

Straps not twisted.

Correct stencil markings on bags.

C- LINE PULP

Description Sheet Solvent Powder

GODE 24640

Date 9-4-53 Type 105 MM HOW. M-1 STRAW

Solvent 58 pph Dry Powder Ether 65 pph

Alcohol 35 pph Acetone ____ pph

Formula:

N.C.	86	%
DNT	10	%
DBP	5	%
DPA (ADD)	1	%
	100	%
		%

DPA Mix Formula: 25 MILES

ETHER	3800	Lb.
DPA	100	Lb.
DBP	457	Lb.

Dehy Block Charge 4 BLOCKS

Dry N.C.	86	Lb.
Alcohol	20	Lb.

Final Mix Charge:

Solvent Mix	Lb.
Dehydrated N.C.	Lb.
	Lb.
	Lb.

Agate .070 Pin .034 No. Pins 1

Cut S.A. 160/189 Head ____ Rolls 1½"

Geartrain 66x180x Die .080 Web .086

S.R. Cycle LOAD 40°C; 4 HRS 50-55°C; 28 HRS 65°C

W.D. Cycle 2 DAYS 65°C

Coating NONE

Glazing NONE

Finishing Grain L .212 D .0482 IW

OW ____ AW .0140 TV or M & V 1.15 MAX %

R.S. .75 MAX %

A-LINE

POUP

Description Sheet Solvent Powder

ITEM 30621

Date 1-14-54 Type 155 How. M-1

Solvent 58 pph Dry Powder Ether 65 pph

Alcohol 35 pph Acetone ____ pph

Formula:

N.P.	85	
DNT	10	
DBP	5	
DPA	1 (ADD)	
K_2SO_4	1 (ADD)	
	100	%

DPA Mix Formula: 25 MIXES

ETHER	3750	Lb
DPA	100	Lb
DBP	450	Lb

Dehy Block Charge 8 BLOCKS

Dry N.C. 425 Lb

Alcohol 85 Lb

Final Mix Charge:

Solvent Mix ____ Lb

Dehydrated N.C. ____ Lb

____ Lb

____ Lb

Agate .245 Pin .018 No. Pins 7

Cut SA Head ____ Rolls 1-1/2

Geartrain 45/180 Die .256 Web .256

S.R. Cycle ____

W.D. Cycle ____

Coating ____

Glazing ____

Finishing Grain L ____ D ____ IW ____

OW ____ AW .0335 TV or M & V ____

C-LINE PULP

Description Sheet Solvent Powder

ITEM 30621 SOUF

Date 1-14-54 Type 155 NOW M-1

Solvent 58 pph Dry Powder Ether 65 pph

Alcohol 35 pph Acetone ____ pph

Formula:

N.P.	85	%
DNT	16	%
DBP	5	%
DPA	1 (ADD)	%
K_2SO_4	1 (ADD)	%
	100	%

DPA Mix Formula: 25 MIXES

ETHER	3050	Lb.
DPA	100	Lb.
DBP	450	Lb.

Dehy Block Charge 4 BLOCKS

Dry N.C. 85 Lb.

Alcohol 20.5 Lb.

Final Mix Charge:

Solvent Mix ____ Lb.

Dehydrated N.C. ____ Lb.

____ Lb.

____ Lb.

Agate .275 Pin .018 No. Pins 7

Cut 5.9 160 Head ____ Rolls 1-½

Geartrain 5 x 180 x Die .256 Web .256

S.R. Cycle LOAD AT 46°C; 4 HRS. 50-55°C; 36 HRS. 55°C

W.D. Cycle 4 DAYS 65°C.

Coating ____

Glazing ____

Finishing Grain L. .411 D. .179 IW

OH ____ AW .034 TV or M & V 2.05

C-LINE PULP

Description Sheet Solvent Powder

ITEM 30621 SOLF

Date 1-14-54 Type 155 How M-1

Solvent 38 pph Dry Powder Ether 65 pph

Alcohol 35 pph Acetone ____ pph

Formula:

N.P.	85	%
DNT	10	%
DBP	5	%
DPA	1 (ADD)	%
K_2SO_4	1 (ADD)	%
	100	%

DPA Mix Formula: 25 MIXES

ETHER	3750	Lb.
DPA	100	Lb.
DBP	450	Lb.

Dehy Block Charge 4 BLOCKS

Dry N.C.	85	Lb.
Alcohol	20.5	Lb.

Final Mix Charge:

Solvent Mix		Lb.
Dehydrated N.C.		Lb.
		Lb.
		Lb.

Agate .215 Pin .018 No. Pins 7

Cut 5.4 Head ____ Rolls 1-12

Geartrain 5 x 180 x 160 x 84 Die .256 Web .256

S.R. Cycle LOAD AT 40°C; 4 HRS. 50-55°C; 36 HRS. 55°C

W.D. Cycle 4 DAYS 65°C.

Coating —

Glazing —

Finishing Grain L .411 D .179 IW ____

OW ____ AW .034 TV or M & V 2.05

B-LINE PULP

Description Sheet Solvent Powder

ITEM 30621 SUCC.

Date 1-14-54 Type 155 How. M-1

Solvent 56 pph Dry Powder Ether 65 pph

Alcohol 35 pph Acetone ____ pph

Formula:

N.P.	85	%
DNT	10	%
DBP	5	%
DPA	1 (ADD)	%
K_2SO_4	1 (ADD)	%
	100	%

DPA Mix Formula: 25 MIXES

ETHER	3600	Lb.
DPA	95	Lb.
DBP	450	Lb.

Dehy Block Charge 4 BLOCKS

Dry N.C.	85	Lb.
Alcohol	20	Lb.

Final Mix Charge:

Solvent Mix	Lb.
Dehydrated N.C.	Lb.
	Lb.
	Lb.

Agate .245 Pin .018 No. Pins 7

Cut SA Head ____ Rolls 1 1/2"

Geartrain 45 X 180 A 160 x 80 Die .256 Web .256

S.R. Cycle LOAD 40°C; 4 HRS. 50-65°C; 36 HRS. 55°C

W.D. Cycle 4 DAYS 65°C

Coating —

Glazing —

Finishing Grain L .411 D .179 IW

OW ____ AW .034 TV or M & V 20570 NAA

60

B-LINE

PULP

Description Sheet Solvent Powder

ITEM 30621 SOLF.

Date 1-14-54 Type 155 HOW. M-1

Solvent 56 pph Dry Powder Ether 65 pph

Alcohol 35 pph Acetone ____ pph

Formula:

N.P.	85	%
DNT	10	%
DBP	5	%
DPA	1 (ADD)	%
K_2SO_4	1 (ADD)	%
	100	%

DPA Mix Formula: 25 MIXES

ETHER	3600	Lb.
DPA	95	Lb.
DBP	450	Lb.

Dehy Block Charge 4 BLOCKS

Dry N.C.	85	Lb.
Alcohol	20	Lb.

Final Mix Charge:

Solvent Mix		Lb.
Dehydrated N.C.		Lb.
		Lb.
		Lb.

Agate .245 Pin .018 No. Pins 7

Cut SA Head ____ Rolls 1½"

Geartrain 45 X 180A 160 X 87 Die .256 Web .256

S.R. Cycle LOAD 40°C; 4 HRS. 50-65°C; 36 HRS. 55°C

W.D. Cycle 4 DAYS 65°C

Coating —

Glazing —

Finishing Grain L .411 D .179 IW

OW ____ AW .037 TV or M & V 3.037 MAX