

CHAPTER IV. PROCUREMENT PRACTICES AND PROBLEMS

Details of the Procurement Procedure---The procurement procedure on the helmet liner had several unusual characteristics which, to some extent, were responsible for difficulties that arose. Procurements for the Army, which included the parachutist liners for airborne troops, were made by the Chicago Depot on procurement directives from the Office of The Quartermaster General, according to the customary pattern for all Quartermaster supply items. For the Navy and Marines, whose organizations requested the Quartermaster Corps to purchase liners beginning with mid-1942, the procurements were by sale directive. Under this procedure the Office of The Quartermaster General would receive the order from the agency desiring the liners, whereupon a letter would be sent the Chicago Depot forwarding the sale directive number and instructions for the transfer of the liners to the Navy supply office, "with reimbursement in accordance with AR 35-880."¹

When first procurements of the helmet liner were made, the liner shells were secured from the 10 firms assigned contracts, with suspension and neck strap installed and the chin strap attached. Headband and neckband were not to be supplied by the liner contractors. The nature of the helmet liner made impracticable and almost impossible the

¹ Army Regulations No. 35-880 specified the method of settlement on supplies or services furnished by a War Department Supply service to other executive departments or independent agencies of the Government. Briefly, the department making the purchase, in this case the Navy, indicated the appropriation against which the helmet liner costs were to be charged, and this information appeared on the sale directive to the Depot, so that when delivery of the liners had been made, the Navy disbursing officer could be notified to reimburse the Quartermaster Corps.

purchase of the unit completely assembled. The fiber and the original plastic liner had 13 different sizes of headband, based on the tariff sizes set up for usual Army issue,² and three sizes of neckbands--- large, medium and small. Obviously, if head- and neckbands were installed by the liner manufacturer, many difficulties would arise in maintaining proper stock levels; the better procedure, and the one decided upon, was to issue separately the liner and its various-sized headbands and neckbands, so that each soldier could be properly fitted with a comfortable and secure hat. Thus, in order to control more easily the supply of liner "sizes"³ the Quartermaster Corps itself procured the headbands and neckbands directly, through the Chicago Quartermaster Depot. When the adjustable headband was adopted, eliminating the 13 sizes, the practice of direct Depot purchase of headbands and neckbands was continued, since it still was preferable to have the individual soldier insert his own headband. By this time the chin strap had been made detachable,⁴ and purchase of replacements of this component became the responsibility of the Chicago Depot also. Thus the liner as a complete item became a divided responsibility

²A size tariff is a schedule showing in what proportions it is to be expected that the Army will require the various sizes of an item. The tariff is made from the experience records of the Army, on the basis of how many individuals out of each 1,000, for example, wear the various sizes.

³The liner shells were of course all equal in size, but the various headbands and neckbands made adjustment possible to any size head.

⁴Discussion of this and other changes in design will be found in Chapter V.

between the contractors and the Chicago Depot, the former handling the shell and its fixed parts, and the latter, the three detachable parts.

The liner shell manufacturers were made prime contractors. They were to deal with suppliers of the hardware and harness installed in the liner, and were responsible for maintaining all standards of the component items as set forth in the specifications. They might manufacture these component items themselves or subcontract their manufacture, the plan actually followed in all cases. This course of handling had been recommended as one of two alternatives by the Standardization Branch of the Office of The Quartermaster General in the early stages of procurement planning. Arguments in its favor were that more drive could be put into production and the Quartermaster Corps would have greater control of quality and rate of production; also that the prime contractor entering into a firm contract with the Quartermaster Corps would have to allow a considerable margin of safety if he had subsequently to secure production from subcontractors.⁵

More than 50 manufacturers came to be involved in making the liner and its components as subcontractors or suppliers.⁶ Some prime contractors utilized as many as 23 individual firms. Manufacturers of duck and resin for the liner shell, chin straps and the garter studs and cap tacks which fastened them, suspensions, rivets, washers, eyelets,

⁵ Memo of Colonel Grice, cited in footnote 21, p.14. The other method suggested was for the Quartermaster Corps to procure all molds and impregnated cloth from prime contractors; then to contract for molding and painting helmet liners with a number of concerns which would also manufacture suspensions, and assemble and pack the liners.

⁶ List of suppliers given in Appendix II.

webbing, paint and buckles---all were potential suppliers in the helmet liner fabrication; and behind them lay thread spinning firms and tanners. Among the main subcontractors of items were Johnson & Johnson, surgical supply company in Chicago, which turned out several million suspensions or hammocks before ceasing to seek contracts in 1943; the Scholl Manufacturing Company, Chicago foot-aid manufacturers who made the suspensions and chin straps for the liner manufacturers; the United-Carr Fastener Company, makers of the garter studs by which the chin strap was hooked to the liner; and Thompson & Company and the Forbes Paint Company, which supplied the liner coating material. The prime contractors handled all dealings with these subcontractors, and the Chicago Quartermaster Depot made no attempt to influence price levels or otherwise to control the sub-items. Effort was made by the Depot, however, to be in full possession of market facts at all times, and to coordinate this information so that it was useful to both suppliers and prime contractors.

Headbands and neckbands for the liners, bought directly by the Quartermaster Corps, were procured from approximately 30 manufacturers, during 1942 and 1943.⁷ A number of these manufacturers also made suspensions for the prime contractors.⁸ The Depot procurement

⁷ Headbands and neckbands for the fiber liners were procured by the McCord Radiator and Manufacturing Company as prime contractors, according to information from files of the Johnson & Johnson Company cited by J. Nelson Stuart, assistant general manager, in a telephone conversation. These procurements occurred from July 1941 to August 1942.

⁸ List of headband and neckband contractors appears in Appendix II.

procedure on the headbands and neckbands was to send out informal invitations to potential contractors for bid, and to make a choice of the offers, keeping in mind the request of the War Production Board that plants in non-critical labor areas and the smaller war plants be given first preference on awards.⁹

Production Scheduling on the Liner---Production scheduling on the helmet liner in the various plants was accomplished by the contracting officer at the Chicago Quartermaster Depot on the basis of procurement directives received from the Office of The Quartermaster General and according to demands of the Master Production Schedule of the Office of The Quartermaster General.¹⁰ In the early stages of plastic liner production, production scheduling in the factories was hardly feasible, since the plastic liner was so new an item and trained workers and foremen were not available. For example, it was expected that the firm which had been given the order to make a low-pressure hat---

⁹ For extended discussion of headband and neckband procurements, see p. 74.

¹⁰ The main steps in production scheduling of the helmet liner might be considered as three: (1) estimating by the Army Supply Program of the number of the item needed annually; (2) work-up of the Master Production Schedule, for the procurement agency involved, by the Military Planning Division of the OQMG; (3) handing over the Master Production Schedule to the Depot to carry through production as scheduled, with certain flexibility to meet constant changes in requirements. Introduction of the Controlled Materials Plan (see p. 67) for conserving steel, copper and aluminum, the first two of which were used at various times in the helmet liner, complicated the system, to some degree, since the computation of requirements, production scheduling, and the handing down of allotments to procuring depots out across the functional responsibilities of various divisions in the OQMG. In the winter of 1943, however, CMP controls were more closely integrated under the Military Planning Division by OQMG office orders Nos. 25-54 B, 25-60 and 25-61.

the St. Clair Rubber Company---would be able to produce a large portion of its million-unit order within a few months. However, certain bottlenecks which resulted from an apparently inadequate understanding of all aspects of the production caused this order to lag considerably.¹¹ The firms which had been given contracts to manufacture the high-pressure liner in its introductory production were instructed to proceed as rapidly as they could, with due consideration of the difficulties that would be expected to arise. The experience of the months June to December 1942, which found all but one of the liner contracting firms in fair production, gave the Chicago Quartermaster Depot sufficient facts to enable the contracting officer to advise Washington^{Just now} how difficult it would be to carry through any proposed schedule. By this time---January 1943---or a little later, total production of one million plastic liners a month could be expected. When 1944 contracts were let, in the fall of 1943, the whole year's quota of approximately 7,000,000 liners was broken down month by month for each of the six firms. Beginning in January 1944, delivery of 900,000 liners was scheduled; 700,000 were to be made in February; 600,000 each in March, April, May and June; and 400,000 each in the last six months of the year.¹² At this time, because the manufacturers making the liners were as thoroughly familiar with the item as the Chicago Depot, it was much more practicable to set up a production schedule and control it accordingly.

¹¹ Interview with Major Pratt, March 9, 1944.

¹² Additional order for 3,000,000 more liners increased these monthly quotas.

Aside from determining when finished liners would be available to meet Army supply needs, careful and dependable production scheduling by the Quartermaster Corps was an aid toward keeping manufacturers of both the liner and its parts constantly furnished with work. The advantage of this condition was the continuance of the contractor's interest in producing the liner for the Army, and his resultant ability to avoid periods of lay-off for employees which might bring about loss of the especially trained help. Along with production scheduling as a factor in keeping the liner manufacturers busy, was the well-timed issuance of procurement directives which authorized the Depot to let new contracts. In accordance with instructions from the Office of The Quartermaster General,¹³ when it became evident that prime contractors were nearing completion of their contracts and no additional award was authorized, the Chicago Depot prepared a memorandum to Washington, "attention Director of Procurement," giving the name of contractor, item furnished, end date of production on current contract, the quantity contractor could manufacture in a specified period, and the estimated dollar value. From this information the Office of The Quartermaster General could give consideration to issuing the next procurement directive.¹⁴

¹³ OQMG Circular Letter No. 250, June 18, 1942: Continuation of Contracts.

¹⁴ The policy of the OQMG on continuation of contracts went through several phases. While Circular Letter 250 and Circular Letter 175 which preceded it in April 1942 emphasized that it was the Government's desire to maintain continuous production in a plant once it had been started and was progressing satisfactory, Circular Letter No. 285, July 14, 1942, modified somewhat the order on production continuity by

There is some evidence in the files of the Helmet Liner Section at the Chicago Quartermaster Depot that Washington did not always move fast enough to suit the helmet liner manufacturers, or at least those who made the components. The Vogt Manufacturing Company, manufacturers of headbands and neckbands, wrote Maj. Harold B. Florsheim, procurement officer, in June 1942, expressing its concern for future business and future deliveries, "feeling that your method of purchasing is a little bit too close to your required delivery schedule."¹⁵ In September 1942, Johnson & Johnson wrote Major Pratt that its suppliers had been on tenterhooks because of not knowing what kind of orders, if any, to expect on items such as webbing and hardware. Johnson & Johnson itself wished to make plans for future use of machines and personnel and was eager to get some kind of answer from the Quartermaster Corps on future contracts.¹⁶ Letters from Gem-Dandy, Inc., a headband manufacturer which had completed delivery on 400,000 headbands against its Quartermaster contract two days ahead of schedule, in December 1942, sought an

these words: "Other things being equal, contracts should be awarded to those already in production who have demonstrated their ability to produce articles of an accepted quality and at a rate required. The awards, however, should not be made in order to keep a firm in production to the exclusion of another firm tendering lower prices and which has adequate facilities and unquestioned ability to satisfactorily perform."

¹⁵C. A. Lilley, Vogt Mfg. Corp., Rochester, N. Y., to Maj. H. B. Florsheim, CCMD, June 18, 1942.

¹⁶J. Nelson Stuart, Asst. Gen. Mgr., Johnson & Johnson Company, to Major Pratt, CCMD, Sept. 24, 1942.

additional contract on the plea that they had only 200,000 bands to work on for the next five months, whereas they had stepped up production to 11,000 a day. Major Pratt was forced to answer that the Depot had no directives at present to purchase additional headbands, and that before new contracts would be made, a probable change was forthcoming in the clip attaching the headband to the suspension.¹⁷

Procurement Problems---Once specifications were written and issued on the plastic helmet liner, and the manufacturers were tooled up for making the item, deliveries of first production within the next few weeks might reasonably have been anticipated. Actually, however, procurement problems were just about to manifest themselves, as the Chicago Quartermaster Depot soon discovered.

Delinquencies in meeting the delivery schedule, which were to be expected in the first month or so because of the priority difficulty on steel for the molds, continued to pile up. By the end of September 1942, the date when delivery had been scheduled by the Chicago Quartermaster Depot and the Office of The Quartermaster General for a total of 4,605,500 of the new plastic helmet liners, approximately 1,500,000 had come off the production line---only one-third the number anticipated. Report on the status of contracts as of September 30 showed, moreover, that three of the firms---Capac, Hood and International Molded Plastics---though scheduled to have made 390,000 liners by that date, had not arrived at the point where they could report an actual production rate at all.

¹⁷Correspondence, Gem-Dandy, Inc., Madison, N.C. - Major Pratt, Dec. 23, 30, 1942.

The St. Clair Rubber Company, despite the fact it was the first firm to turn out a liner and utilized the supposedly simpler low-pressure process, had delivered but 120,000 liners on its two contracts, whereas by September 30 deliveries were supposed to total 1,250,000. The Firestone company had delivered 16,530 liners of a scheduled total of 300,000 for September 30; while Mine Safety Appliances had been able to produce only 56,140 of an expected 372,000, and the Seaman Paper Company, 18,720 of 175,000. The production figures from the Westinghouse Electric Company and the Inland Manufacturing Division of General Motors were somewhat more encouraging. Westinghouse had more than completed its first contract for 707,000 liners, and was producing the item at the rate of 11,000 a day. Three other Westinghouse contracts on which 359,000 liners were due September 30, however, had not been touched. Inland Manufacturing had produced about 75,000 more liners than the 622,500 due September 30 on one contract, and was putting them out at the rate of 18,000 a day; but the delivery date on 400,000 liners assigned in a second contract had not been met. On the fiber liners, the McCord Radiator Company, now handling the Hawley Products production, reported that 819,785 units had been delivered September 12 against the total of 1,000,000 counted on for September 23d. Daily production rate was approximately 20,000.¹⁸

In the early stages of plastic helmet liner production,

¹⁸All figures referred to above resulted from analysis of report on Current Contracts for Helmet Liners as of Sept. 30, 1942.

several methods for improving production control were considered. The Office of The Quartermaster General talked of having the McCord Radiator Company take over the St. Clair contract and supervise its execution, and of transferring the contract of Mine Safety Appliances to the Westinghouse Electric Company. Major Allesee, who had been assigned to the Office of The Quartermaster General, in the Clothing and Equipage Branch of the Supply Division, told Captain Pratt that "some sort of organization from the production angle" should be set up, since "we have to follow these things through to the ultimate end."¹⁹ One device for getting a more accurate line on production was the introduction of production engineers by several of the contractors, a move made on urging of the Office of The Quartermaster General. As indicated previously, production of the helmet liners in the majority of the plants was on a 7-day week, 24-hour day basis for molding operations, and an 8- or 14-hour, 6-day week for assembling. Some of the companies devised special incentives to increase production.²⁰ They also sped up steps in the liner manufacture by reducing the molding cure from 12 to 2

¹⁹Telephone Conversation, Major Allesee-Captain Pratt, July 21, 1942.

²⁰Mine-Safety Appliances Co. put the quality of molding on an open competitive basis by daily postings of moldor versus moldor. The Westinghouse company put helmet production on the standard time system, assigning time for each operation and granting a bonus payment to workers for efficiency exceeding this assigned time; average efficiencies ran 130 percent of base rates. The St. Clair Rubber Company used a progress chart board in the factory and put the "shifts" on a friendly competitive basis. Letters from Mine-Safety Appliances Co., International Molded Plastics, Westinghouse Electric and Mfg. Co., St. Clair Rubber Co., to Historical Branch, CQMD, Feb.-Mar. 1944.

minutes,²¹ and by installing infra-red ovens to reduce paint-baking time from 30 to 1½ minutes. However, the most successful measure toward improving production apparently was the constant contact, through personal visits or telephone, which the Chicago Quartermaster Depot and the Office of The Quartermaster General set up with manufacturers. Capt. E. I. Hobson, as well as civilian technicians of the Standardization Branch, Office of The Quartermaster General, made numerous field trips to liner manufacturers during this period, while the contracting officer and principal inspector from the Chicago Depot spent a large proportion of their time "on the road." The day-to-day attention directed toward filling the desired production schedule bore fruit after the first months. By mid-December of 1942, overall delivery on helmet liners came to be adequate. At this time Captain Brady of the Office of The Quartermaster General told Major Pratt that the Chicago Depot had delivered more than was requested according to the confidential figures on production desired by Washington.²²

Production Delinquencies and Their Causes---The reasons for the early delinquencies in helmet liner production were many. There was, as has been mentioned before, the initial delay in securing steel for the molds required by these manufacturers doing high-pressure molding. Technical difficulties that cropped up as soon as production started were legion. Component suppliers to the liner manufacturers

²¹This was done at Mine Safety Appliances. The fast cure was a development that came with the helmet liner; resin formulations were made available which provided 3-to-5 minute cures and no cooling of the molds was necessary.

²²Telephone conversation, Major Pratt-Captain Brady, Dec. 14, 1942.

found it hard to secure critical materials on some items because Quartermaster items held relatively low priorities. There was still some doubt on specifications, which were in the process of being changed. And on the administrative side, the dichotomy of direction between the Office of The Quartermaster General and the Chicago Quartermaster Depot tended to be misunderstood and to slow up action by the manufacturers. Each of these contributing factors and several additional ones which hampered early production warrant some explanation, since the story of helmet liner procurement at this time most clearly shows the necessity for smooth functioning of communication and exact definition of lines of responsibility between Government and industry under pressure of war, when production of supplies must go into its fastest tempo. The lack of skilled operators faced by manufacturers and difficulty in securing proper inspection of the new items, outstanding among the additional factors causing delay, also are discussed in this chapter.

Technical Difficulties---The fact that the specifications for the helmet liner in effect on the first contracts were rather broadly written was, indirectly, one of the causes of technical difficulties. For example, the preforms used in fabricating the liner before the molding operation, were permitted to differ in whatever way the manufacturer saw fit; the only requirement was that the finished product meet the prescribed tests. The reason for permitting the preforms to vary was that the Office of The Quartermaster General thought it best to give the manufacturers of this new item every

possible freedom in production methods.²³ As a result, however, the manufacturers soon found that they could not depend upon their selected preform to turn out a steadily acceptable liner. Differences in resins and differences in the duck fabric which most of them used as the base for the plastic also brought troubles. The outer finish which, according to specifications, merely had to be "smooth and dull, non-light-reflecting, suitably resistant to abrasion and scuffing,"²⁴ was difficult to attain with the paints available. On the first lot of liners produced by the St. Clair Rubber Company, samples of which were sent in to the Chicago Quartermaster Depot for inspection after they had been rejected by the field inspector at the plant, the following reasons for rejection were noted: blisters, pinholes, dents, interior wrinkles, rough edges, misshaped visor, corrugation, rear edge cracks, edge surface fractures, side crown cracks, and faulty filler.²⁵ Although some of these faults were due to the operators, the majority resulted from the unanticipated reaction of materials in the preforming process. Other plants found similar faults from similar causes appearing in their liners, and a

²³ First contracts carried the following statements: that the award was made and helmets were to be completed in accordance with OQMG Spec. No. 42, Feb. 13, 1942; that blueprints furnished by the Chicago Quartermaster Depot would serve only as a guide for manufacturing purposes and were not to be considered so far as specifications were concerned; that if any manufacturer was in a position to complete and deliver liners before July 15, 1942, permission would be granted upon request to vary the weight of the webbing and the location of the suspension until the new specifications were completed. Sample liners, assembled, had to be approved by OQMD before production started, however.

²⁴ Tentative Specification, OQMG No. 42, Feb. 13, 1942.

²⁵ Invoice No. 78834, St. Clair Rubber Company to OQMD, July 17, 1942.

period of experimentation became necessary, which of course set back production. The Standardization Branch of the Office of The Quartermaster General went to work on the problem of making the paint adhere to the smooth finish of the phenolic resin which had no pores, and advised that the liner surfaces should be sanded with coarse sandpaper before they were spray painted; or that an etched mold be employed.²⁶ A change was made in the paint from a phenolic base to an alkaline base. Manufacturers who followed these suggestions found this trouble alleviated, though they were to face other paint problems in the future.²⁷

The newness of the helmet liner as a product also made difficult a constant level of acceptable production. Only two firms---Mine Safety Appliances and the Micarta Department of the Westinghouse Company---had made anything like the item previously. The other manufacturers were in the position of novices. Not only had they to introduce new tools

²⁶ Capt. Edwin L. Hobson, OCMG, to CQMD, June 24, 1942.

²⁷ Because of the shortage of many materials that went into paint manufacture, the paint firms apparently could not promise the same product for two orders in a row. Consequently, although a brand of paint was called acceptable in one lot of liners, by the time the next order of it was in use, the result might fail to meet specifications. In January 1943, months after the first liners had come off the production line, the finish still was causing dissatisfaction, and manufacturers reported to Captain Hobson of the OCMG Standardization Branch that it was "the same all the way through." (Telephone conversation, Captain Hobson - Major Pratt, Jan. 9, 1943.) A paint made by Forbes, it appeared, was recommended to contractors for coating the liners, but was disliked because it could not be baked quickly with the infra-red ray. A coating made by the Thompson Co., Pittsburgh, was a favorite with several of the companies, but it did not stand up in the field; so all manufacturers were forbidden to use it until the Mine Safety Appliances Company, which wished very much to continue its use, had completed research and tests to the satisfaction of the Research and Development Section of the Military Planning Division, OCMG. Sharbaugh, Mine Safety Appliances Co., to Major Pratt, CQMD, Jan. 16, 1943.

into their plants but also to train operators in a new skill. To solve this problem the St. Clair Rubber Company built a miniature training production line of 20 pots and trained workers on these before putting them on general production.²⁸ In the case of the Hawley Products Company, the firm producing fiber liners, 80 percent of the people on the production line had to be trained for the work.²⁹

A supervisory board was made up of the experienced employees and one of them assigned to every eight employees on the line. Superintendents, department foremen, sub-foremen and operators at this plant were given the Job Instruction Training³⁰ course sponsored by the Government. Where training new employees was not the problem, another difficulty arose in making the supervisors and foremen realize the intricacies of the helmet liner manufacturing process. Frequently they did not give to each liner as it went through the molding process the individual attention that was found to be absolutely necessary. The nature of the process, involving as it did precise laying of the fabric in the proform, was one which required constant carefulness on the part of the operator, who too often was prone to regard it as being like any other assembly-line job.³¹

²⁸ St. Clair Rubber Co. to Capt. J. H. Burkhardt, Historical Officer, CQMD, Feb. 22, 1944.

²⁹ "E" Award letter on Hawley Products Co., cited p.12, footnote 16.

³⁰ "JIT" was one of several training course made available by the War Department to personnel in military installations and to factories producing war materials, to improve the quality of work turned out.

³¹ Interview with Richard Lim, Principal Inspector on Helmet Liners, CQMD.

Only when the Government inspector rejected the finished product because it showed wrinkles or rough edges was the lesson learned.

Critical Materials in Liner Manufacture---Fabrication of the plastic helmet liner involved a number of materials which appeared on the restricted list of the Office of Production Management with the first stages of the war. Beginning with the steel necessary to make the molds used in the high-pressure process, the first step in starting liner production, and ranging down through the duck and phenolic resin used for the shell, the webbing for the suspension, and the leather and hardware in the other components, nearly every item came under some form of control by the Office of Production Management, later the War Production Board.

Against the duck and webbing, most of the available supply of which was procured by and pooled at the Jeffersonville Quartermaster Depot beginning in 1942, the War Production Board had placed General Preference Order No. M-517, which limited use of the material to certain purposes, including the helmet liner. Such regulation was in the nature of a protection, and could cause no difficulty. Under another regulation, the liner manufacturers who impregnated the duck with phenolic resin instead of buying it already prepared for molding went directly to the War Production Board to secure approval of delivery and use of the quantity of resin they required each month. On other component parts, the priorities system established by the War Production Board applied.

As previously indicated,³² the preference rating of A-1-1

³² See footnote 31, p. 29.

was assigned the helmet liner in the earliest days of procurement. Not only was such a rating insufficiently high to secure steel for making molds,³³ but within a short time liner manufacturers and the component suppliers found that they could not secure materials they needed because their suppliers of raw material in turn gave precedence to orders from other sources which carried higher priority ratings. The A-1-a preference authorization was supposed to permit the contractor to buy amounts of material such as rosin, duck and hardware sufficient to complete each helmet liner contract,³⁴ priority rating certificates for needed machinery and equipment, however, had to be applied for through the Priorities Branch of the Chicago Quartermaster Depot, which forwarded the request through the Office of The Quartermaster General to the War Production Board in Washington for decision. This system was cumbersome, especially when the War Production Board decentralized the priority granting authority to regional offices, which frequently referred "border-line" cases to Washington,³⁵ however, it was considered a necessary control.

The AA-rating, which was made effective in early 1943,³⁶

³³It will be recalled that the Army and Navy Munitions Board had to extend an A-1-a priority on the molds as a special gesture to get the liner into production.

³⁴In the earliest days of the fiber liner production, the prime contractor secured a priority or preference rating on each production material on the OPM Critical List by applying to the Priorities Branch, CQMD, which granted the preference rating certificate or forwarded the request to the OPM.

³⁵Interview with Maj. F. C. Basler, officer in charge, Priorities Branch, CQMD.

³⁶See footnote 31, p. 29.

considerably alleviated the pressure on liner manufacturers in securing their materials. The same system of writing the preference rating into the contract was followed, and the rating did not cover machinery. At this time the webbing components carried a rating of AA-2x and all metal components of AA-1.

Inauguration of the Controlled Materials Plan³⁷ in early 1943, which allocated the use of steel, copper and aluminum, introduced a new approach in priorities handling as affecting the helmet liner. Under this plan the prime contractors were made responsible for obtaining the material requirements of the sub-contractors. From the Depot the prime contractors would receive a list of all "CMP"

³⁷The Controlled Materials Plan was the third step in a series of plans established by the War Production Board in an attempt to set up a system of allocation on production using critical materials. The first of these plans was the priorities system under which producers were permitted to fabricate their products according to respective need for them, and were given preference ratings for critical raw materials accordingly. The second plan, called Production Requirements Plan, or PRP, was an approach to material authorization; under it, every prime contractor and every sub-contractor submitted to the WPB his quarterly estimated critical material requirements. Each firm received its individual authorization from the WPB on a priority basis, but even with a high priority rating the manufacturer could not be sure he would get enough material of the right kind at the right time. Applicable only to firms utilizing large amounts of critical material in their business annually, PRP did not affect the helmet liner, for the amount of steel or other critical materials used in its manufacture, did not run so high. The Controlled Materials Plan, which became effective in early 1943, on the other hand, did. Its object was to hammer down demand in line with supply on steel, copper and aluminum. Its most important feature was the scheduling of production programs so that raw materials, fabricated parts, and sub-assemblies would be made available at the right time and place during the successive stages of manufacture until the end product was completed according to schedule. CMP did not supplant PRP and the Priorities system except with respect to "controlled" Class A materials. Interviews with Maj. F. C. Basler, officer in charge, Priorities Branch, CQMD, and 2d Lt. Henry W. Thiele, in charge of CMP, Priorities Branch.

parts in the end product, the helmet liner.³⁸ Thus informed of components on which allotments were needed, the manufacturer determined the requirements of his production and sent his application for allotment to the Depot, which forwarded it to the Office of The Quartermaster General for issue of allotments of these raw materials on a quarterly basis. By July 1, 1943, the Depot itself was given the allocation of material to cover each new directive, and therefore could receive contractor applications and issue allotments directly, returning any excess or forwarding request for supplement to the Office of The Quartermaster General.

Although, under the first year of operation of the Controlled Materials Plan sub-contractors and even prime contractors tended to blame shortages and delinquencies in production on the reported fact that allocations were not applied for on time, or that suppliers did not receive their allocations promptly so that they could make the component items according to schedule, the ultimate objective was a boon, for it assured the sufficiency of materials. To eliminate the causes for blame, the Chicago Quartermaster Depot asked the Office of The Quartermaster General to issue procurement directives on the helmet liners

³⁸ Under the CLIP plan all products were broken down into "A" products (tailor made) and "B" products (shelf stock). A prime contractor was given a block allotment by the Claimant Agency requesting his production for all "A" products which had to be specially made for the end item. (The OCMG, like other War Department agencies, was classified as a Claimant Agency and permitted to make its own allotments on "A" products instead of having to forward applications to the WPB for approval.) In the case of "B" or standard type items, the allotment was given to the manufacturer directly by the WPB on the basis of the manufacturer's own production and any "A" product components. After several changes in the concept of which components of the helmet liner were "A" and which "B," in May 1943, all products except snap fasteners, rivets and eyelets were made "A" products, and this was the status quo as of January 1, 1944. Included in the "A" list were buckles, holders, garter studs, cap tacks, and washers. Interview with Lieutenant Thiele, OCMG.

as far in advance as possible, so that the component contractors and suppliers could put in their request for allocations and secure them with adequate leeway of time. As a result, the procurement directives for helmet liner purchases for the entire year 1944 reached the Chicago Depot in September 1943. At this time, also, it was decided to have the information on material requirements for the entire year forwarded from the basic "A" product suppliers to component suppliers, and on to prime contractors. The theory was that the Chicago Depot then could determine necessary allotments of controlled materials, mainly steel, from manufacturers of the basic parts.³⁹ This plan appeared to function smoothly.

Effect of War Production Board Controls on Leather Components---

The restriction on the processing of hides, first imposed by the War Production Board in 1942,⁴⁰ a move intended to assure the Government the leather needed for military purposes, threatened to have somewhat the reverse of this effect with regard to the helmet liner components utilizing leather. Soon after the "freeze" order became effective, A. F. Gallun & Sons Corporation, one of the main suppliers of tanned hides to manufacturers of chin straps, suspensions and head- and neckbands, informed the Chicago Depot that the allotment of skins for July 1942 was falling far short of the actual number contracted

³⁹ To check on the working out of this plan, the CMP Branch of the Depot asked to see copies of the purchase orders of the prime contractors. Ibid.

⁴⁰ Conservation Order M-194, issued July 3, 1942, restricted the purchase, sale, delivery and use of cattle hides, calf and kip skins, which were used in the manufacture of the chin straps, suspensions and head- and neckbands of the helmet liner.

for delivery for Government use in general. This firm suggested that the only way out of the difficulty was for the Quartermaster Corps to place its orders far enough in advance to enable obtaining of material when it was needed, and to make emphatic requests to the War Production Board if an increase in the allotment of hides to the tanners became necessary.⁴¹ Although as it turned out, helmet liner manufacture did not suffer to any great extent through 1942 from the hide-tanning curtailment, since the production of helmet headband and chinstrap leathers did not begin in volume until near the close of the year, the shortage situation again arose and was intensified in the summer of 1943, when subsequent curtailment directives of the War Production Board⁴² further reduced the number of hides for tanners to work up. At this time the R. Newmann Company,⁴³ with whom orders had been placed for 60 percent of the leather required for two Quartermaster contracts, notified the Chicago Quartermaster Depot that the new War Production Board regulations would result in a 50 percent cut in leather deliveries for the ensuing three months. The Gallum company, again writing, said its plant would have to reduce operations approximately 17 per cent, and besought the Depot to state its case to the War Production Board.⁴⁴ At this point the Hides

⁴¹A. F. Gallum & Sons Corp. to Captain Pratt, CQSD, July 15 and 24, 1942.

⁴²General Preference Order M-310, issued June 23, 1943; revised Sept. 20, 1943 (WPB 4272); and amended Nov. 1, 1943 (WPB-4535).

⁴³Hoboken, N.J.

⁴⁴Copies of letters from A. F. Gallum & Sons and American Stay Co., forwarded by CQMD to the OQMG with letter SPQDI 421 PCEPX July 9, 1943: Leather for Headbands and Chin Straps.

Allocation Unit of the Textile, Clothing Division of the War Production Board informed the Office of The Quartermaster General that production of the lightweight leathers used in the helmet liner components had been relatively low because tanners found it more attractive to process the heavier weights. It was pointed out that a similar situation had confronted the Quartermaster Corps the year before, and that it had been overcome by the Hides Allocation Unit's ascertaining requirements of each tanner supplying leather for these items and seeing that the allocations were channeled accordingly.⁴⁵ The chief of the Leather Control Section of the War Production Board, William B. Haight, held the opinion that the shortage of calfskin reported by the contractors was the result of placing most of the orders in the hands of one tanner.⁴⁶ He said that there were more tanners now interested in producing the vegetable-tanned hides, which might conceivably end the shortage.⁴⁷ However, in November 1943, the condition was little better, and delinquencies continued because the headband manufacturers could not place orders for leather. Finally, all complaint letters of the manufacturers were forwarded by the Chicago Depot to the Military Planning Division of the Office of The Quartermaster General, which took up the matter with the Leather Control Section of the War Production Board, stating definitely the total number of square feet of leather required for the quality of headbands the Quartermaster Corps was buying, so that an allocation could be set up

⁴⁵ Quoted in Reports of Delinquency on Smaller War Plants File.

⁴⁶ The Gallun company, largest tanner of vegetable-tanned hides, which were required for the leather parts of the liner because chrome-tanned leather might irritate certain types of wearers' skins.

⁴⁷ WPB (N.Y.) Memo on Delinquencies on Contracts for Chin Straps and Headbands, Sept. 7, 1943.

on the hides.⁴⁸ The substitution of whole kip sides or kip skins where calf skins were not available⁴⁹ remedied the leather shortage as of late 1943 and early 1944.

Relaxations of Specifications in Shortage Periods---The answer to the shortage or "slow supply" problem in some cases was to relax the specification for brief periods. Such relaxation was instigated at various times by the Chicago Depot, with Washington approval, regarding the webbing used in the suspension, the leather for the headbands and chin straps,⁵⁰ and even the finish of the clips used to fasten the adjustable headband to the suspension, as well as the other hardware. Caution and a sense of cause and effect were necessary in making the decision to relax any of the specifications, for repercussions in affected industries might quickly follow.

When the temporary relaxation was issued on combed mercerized yarn in the suspensions,⁵¹ for example, suppliers of this yarn found their contracts with the suspension manufacturers were running out; whereupon they immediately advised the War Production Board, which in turn wrote the Chicago Quartermaster Depot to point out that it had

⁴⁸Telephone conversations, Captain Bailey, CQMD - Major Pratt, CQMD, Nov. 5, 6, 1943.

⁴⁹Specification CQD No. 63, June 19, 1942, already permitted this substitution, with the qualification that the kip must meet requirements of calfskin. Later (Jan. 1944) exceptions were permitted, which made less stringent the requirements as to tensile strength, elongation and tear.

⁵⁰See above.

⁵¹The relaxation permitting carded yarn as substitute for the combed mercerized yarn was in effect from June 12 to Sept. 30, 1943. Letters from the CQMD to contractors, June 12, Sept. 24, 1943.

been difficult in the first place to persuade manufacturers to spin the type of yarn the Army wanted unless they were assured of a substantial run. The implication, of course, was that something should be done; the explanation by Major Pratt was that carded yarn was temporarily being accepted instead of the combed mercerized material until the shortage of the latter cleared up.⁵²

In some cases, as with the leather, the Government inspectors were informed verbally by the Depot about exceptions: for instance, when delinquencies were alarming, they were told that they might accept headbands whose leather showed a flanky condition at the ends;⁵³ then they would be informed later by letter that the relaxation was at an end.⁵⁴

In the instance where a limitation order of the War Production Board resulted in the discontinuance of production of cotton fabric used in certain parts of the helmet liner, Quartermaster Corps contractors were notified that the fabric named as an alternate on the contract might be substituted, but that before making the substitution the Depot must be notified so that a change order modifying the specifications according to the contract could be issued.⁵⁵

⁵² Correspondence, Adam Clement, Chief, Narrow Fabrics Section, Textile, Clothing & Leather Division, WPB, and Major Pratt, QCMD, July 22-24, 1943.

⁵³ Letter to inspectors, May 1943.

⁵⁴ QCMD to inspectors, Oct. 30, 1943.

⁵⁵ Colonel Elliott, QCMD, to contractors, June 16, 1943.

Occasionally temporary relaxations of the specifications were granted with the hope of increasing the production rate. Such a relaxation occurred in the test requirements on the steel clips for the redesigned headband which, according to original specifications, had to be coated with urea formaldehyde. The application of this coating required several days for drying; so for a period of about one month, beginning May 18, 1943, the coating was dispensed with in favor of an alternate, quick-drying coat,⁵⁶ if the manufacturer wished it. At no time did the relaxation of specifications relieve the prime contractors of the obligation to make their own analyses and tests of all materials, component parts and finished articles so that they could be positive of full conformance with contractual requirements.⁵⁷

Utilization of Smaller War Plants---In compliance with instructions from the War Department, disseminated through the chiefs of the various supply services, the Chicago Quartermaster Depot attempted to utilize the smaller war plants for manufacture of headbands, neckbands and chin straps which it procured directly.⁵⁸

⁵⁶ Letters to contractors; May 18, June 25, 1943.

⁵⁷ Major Pratt, CQMD, to contractors, May 18, 1943.

⁵⁸ Public Law 603 (77th Cong., approved June 11, 1942) created the "Smaller War Plants Corporation" and gave the chairman of the WPB certain new powers incident to placement of Government contracts with smaller war plants. (This was in line with a move to include the smaller businesses in war work which had been started at the beginning of the defense period, in mid-1940.) Section 3 of the Act authorized the chairman of the WPB to certify small business concerns or groups of such concerns to the Secretary of War with respect to capacity and credit as to a specific Government procurement contract. The Act recognized that small plants frequently were unable to produce at as low unit costs as larger plants and that, as a consequence, it might (cont'd.)

It was not always easy for the smaller plants to produce according to schedule, and the cost of their product to the Army in many cases was definitely higher than if large manufacturers had been patronized. As many as 20 manufacturers were utilized for 4,000,000 headbands on one directive, for example, only two of the manufacturers being in the large-plant class. Prices on the headbands from the smaller plants ranged up to 28 cents apiece, while 21.9 cents was the best price from all plants bidding on the order.⁵⁹ According to Major Pratt, at the time the Depot "could buy all it wanted for 25 cents,"⁶⁰

be necessary for the Government to pay a higher unit price for articles obtained from such plants. The procedure in spreading awards to the smaller war plants was as follows: the Army supply program was reviewed to select products suitable for production by small plants; when actual procurements were made, an agreed portion was allotted for placement with small plants, recommended by the WPB, whose utilization would increase the volume or speed of production or aid in clearing bottlenecks. To carry out the program the WPB assigned a representative to each of the supply services and to each office originating procurement directives, and a Liaison Specialist to each contracting office. Each contracting office like the COMD also had a Smaller War Plants Contact Officer. Procurement Regulations, Ppchs. 225 - 228.

⁵⁹ Authority existed to pay the smaller war plants a price premium up to 15 percent over the "base price" of an item; in the case of the headband, the base price was considered to be 24 to 26 cents.

⁶⁰ Telephone conversation, Captain Bladel, OQMG - Major Pratt, COMD, May 17, 1943. This low price appears to have been rather optimistic, however. Contracts made on a directive for 2,214,000 headbands later in 1943 showed a low price of \$0.25, a high of \$0.28, and an average of \$0.2647. Still later in the year, contracts for 14,000,000 bands were awarded at the lowest bid of \$0.245, \$0.2725 high, and average \$0.2613, including both small war plant and other contractors. A report prepared by the COMD Contract Price Analyst, J. P. Reedy, at the time of the latter bids, indicated wide variance in overhead costs submitted by contractors and in charges to administrative expense. The arbitrary standard arrived at in the cost price analysis set the total cost at \$0.24, with labor, overhead and administrative expenses totaling \$0.0798 and materials \$0.1602; an additional \$0.02 would not have been out of the way in figuring the standard, however, according to an interview by the writer with Mr. Reedy.

Furthermore, when the Office of The Quartermaster General ordered headbands for overseas shipment, which required special packing, six to eight contractors had to be called upon for as few as 288,000 bands, instead of the two or three which could have been utilized if the contracts had not been so thoroughly split up.⁶¹ Since the objective of the War Department, however, was to spread contracts among small as well as large plants, without too much regard for difference in costs, the Chicago Depot was anxious to perform its duty despite delinquencies in production and other difficulties. When the production of smaller plants lagged too far behind, the purchasing officer notified the Liaison Specialist representing the Smaller War Plants Corporation at the Depot, requesting that action be taken so that deliveries would be expedited. During the two years 1942 and 1943, approximately 13 percent of all neckbands contracted for and approximately 30 percent of the number of headbands were made by firms designated as Smaller War Plants.⁶²

The decentralizing of procurement activity resulting from the establishment of procurement districts⁶³ brought about the

⁶¹ Telephone conversation, Captain Brady, CQMG - Major Pratt, CQMD, July 17, 1943.

⁶² See contractors marked with "s" in Appendix I. The percentages may well be larger in actuality, since several of the firms designated as Smaller War Plants in one contract were not so indicated in other cases.

⁶³ This move occurred with issue of CQMG Circ. Let. No. 409; Quartermaster Procurement Districts, Nov. 14, 1942. Fifteen distributing depots were each assigned a procurement district coterminous with their distributing areas. The letter gave the chief of each district authority to act as an agency of another district or depot, and delegated to him functions including the surveying of facilities to determine justification of an award, receiving and forwarding

utilization of two Smaller War Plants on chin strap contracts in the spring of 1943.⁶⁴ At this time the Chicago Depot invited plants in the southwest which were likely producers of chin straps to bid on 250,000 straps ordered by directive of the Office of The Quartermaster General to be handled as a decentralized procurement,⁶⁵ and the Fort Worth Quartermaster Depot, closest procurement district headquarters, was forwarded information to enable it to make awards. Inspection duties were assumed by the Fort Worth depot, which also made payment to the contractor, by a sub-allotting of funds completed when the Chicago Depot was notified of the amount needed.⁶⁶ The San Antonio depot took care of a second purchase of 250,000 chin straps in August 1943 which ended the district procedure of procuring helmet liner components.⁶⁷

Correlation of Parts Suppliers Necessary---Smooth and

constant production of the helmet liner obviously could be obtained only through the correlation of all parts suppliers. These producers

of bids, negotiating of contracts, investigation of delinquent deliveries, and furnishing of inspectors. The procuring depots were to use this authority where feasible and practicable in the interest of awarding contracts to small business, and in having other procurement districts perform missions they were qualified to perform in order to expedite procurement, and conserve time and travel.

⁶⁴ See Appendix I.

⁶⁵ Instructions to this effect were contained in Procurement Directive No. C-GC-113(43).

⁶⁶ This procedure was indicated in OQMG Circ. Let. No. 409, Supplement No. 1, Dec. 3, 1942, and Supplement No. 2, Dec. 10, 1942.

⁶⁷ Control was too difficult, according to Major Pratt.

were depended upon to work actually as a team whose output was rather carefully scheduled and had to be delivered on time. What happened when the manufacturer of only one part of the helmet liner assembly failed to produce according to schedule was indicated in the situation that arose when the Dowst Company, sole makers of headband clips at the time, broke a die. The Dowst factory had very nearly to cease production for six days, the one die available turning out only 30,000 clips a day. The Office of The Quartermaster General, meanwhile, had promised 3,500,000 headbands for the month, and the Depot was placed in a sorry plight because the headband manufacturers, the Bates, Sun and Midwest Shoe companies, were clamoring for clips it could not produce. The fault here, in part, was that only one manufacturer had been assigned a contract for the clips.⁶⁸

The "Double-Headed" Management of Production---There was one other contributing cause to delinquent production which arose as a result of the great anxiety of those in the Office of The Quartermaster General to see the new helmets and liners on the heads of soldiers as soon as possible. This cause was the double-headed management of production early in the assignment of the liner procurement to the Chicago Quartermaster Depot; the outcome, as can well be understood, was the crossing of wires in instructions to manufacturers and a consequent slow-down of production.

The Office of The Quartermaster General had in its product

⁶⁸ Telephone Conversation, Maj. Pratt-Captain Hobson and Mr. Stevens, OQMG, Sept. 21, 1942. As a result of this impasse, several of the headband manufacturers set up their own dies to make clips.

development branch various civilian specialists who worked on problems in Washington and now and then went into the field to see how manufacturers of Quartermaster items were getting along. The first days of helmet liner production found visits by these technologists to the liner plants frequent. At the same time, the Chicago Depot in an endeavor to hasten the output of the new item sent a "trouble-shooting" officer or civilian into the plants where there seemed to be difficulties. Sometimes the advice of the representatives of the two offices, Washington and Chicago, dovetailed; but sometimes it conflicted. The final result, after this procedure had gone on for several weeks was a "situation" which cleared the air and put the production advisors completely under control of the Chicago Depot. The occasion was the visit of one of the technologists of the Plastic Section, Resources Division, Office of The Quartermaster General, to the International Molded Plastics Company, in Cleveland, Ohio. After spending one day in the plant the technologist offered the report that the contractor was not competent. At the same time, the Chicago Quartermaster Depot procurement chief, Lt. Col. C. N. Elliott, who had been trying to encourage the contractor in his troubles of getting under way, had sent one of his officers over to inspect the International Molded Plastics plant, and the officer had returned with a favorable impression. The divided opinion of the contractor's efforts, and the coincidence of two representatives of the Quartermaster Corps inspecting the plant at practically the same time, led Colonel Elliott to write Brig. Gen. C. L. Corbin, chief of the Supply Division, Office of The Quartermaster General,

a protesting letter to the effect that the procedure of having two offices attempt to control the production, type of equipment, and other details of the manufacturing plants was undesirable in the extreme, and he requested that investigation from the Washington end should be stopped. General Corbin's reply indicated the decision to leave production advising to the Chicago Depot. He wrote that thereafter when the Office of The Quartermaster General deemed a visit to the plants making helmet liners necessary, whatever representative of the Office of The Quartermaster General was sent on the trip would clear first with the Depot and would visit the contractor only as a representative of the contracting officer of the Depot. In addition, the Washington plastics technologist was assigned temporarily to the Chicago Quartermaster Depot.⁶⁹

Inability to clear the specifications for the newly designed parts of the helmet liner as they were accepted also tended to hamper early production. Fairly numerous are the indications in the Chicago Depot files that officers there chafed no little at the procrastination on the part of the Standardization Branch of the Office of The Quartermaster General in making specifications final. It is true that improvements on many details of the liner were worked out in a remarkably short period, from the time of first procurement of the fiber-type liner in April 1942, to the summer of that year. These improvements, which came out of joint suggestions of technicians

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Correspondence between Lt. Colonel Elliott and Brig. General Corbin, July 18, 21, 1942.

in the Office of The Quartermaster General, the Chicago Depot, and cooperating industry, included the adjustable headband with new clips, the new chin strap, buckle and attachment, and several other items. The final wording and drawings of the specifications to be issued contractors, however, were the responsibility of the Standardization Branch, Office of The Quartermaster General, and it is not apparent that this responsibility was ever properly delegated to the Chicago Quartermaster Depot by order. The frustrations involved in trying to advise contractors which direction to follow when there was disagreement between specification and drawing, and in deciding how much production they should be allowed under the design which specified the earlier type of parts, led to dissatisfaction on the part of the officers in charge of the liner procurement at the Chicago Quartermaster Depot, according to the records of several telephone conversations in the spring of 1942. The gist of them can be quoted in Major Florsheim's comment to Major Allesee of the Office of The Quartermaster General: "You can fix the responsibility for the delay on the helmets on two main things: One on the priorities and, two, on Standardization."⁷⁰

Hiring Inspectors for the Liners---Securing field inspectors for the helmet liner in its first days of production offered a special problem because of the newness of the product and because the specifications, not yet validated, could not always be followed to the letter in deciding acceptances. The best man for the inspecting job was one who, noting

⁷⁰ Telephone conversation, Major Florsheim, COMD-Major Allesee, OQMG, May 28, 1942.

technical deficiencies upon eye-inspection, could immediately suggest corrective engineering measures where necessary, so that acceptable production could be constant. For instance, if the liners came off the assembly line with rough edges, resin spots on the top of crown, or wrinkles and pits, the inspector would be at an advantage if he could suggest the exact step in production which was causing the deficiencies, since more often than not, the foreman might be as unfamiliar with the process as his workers. Although a theoretical knowledge of the behavior of plastics seemingly would be almost a prerequisite in the inspector, the Chicago Quartermaster Depot, searching for hires for the position, found that such knowledge did not necessarily make the wisest examiner. Rather, the man who was a close observer of the cause and effect of changes in certain operations in the plasticizing process, and who was ingenious in remedying the faults of defective liner shells, was the best choice for the position.⁷¹ Inspection on the very earliest production of liners was carried on largely by one man, Richard C. Linn, assigned to the Chicago Quartermaster Depot shortly after production started, though, as stated before, both officers and civilians from the research and development staff of the Office of The Quartermaster General and procurement officers at the Chicago Depot performed inspection duties of a sort as they made their frequent visits to the plants in an effort to iron out difficulties.

⁷¹ Interview with Richard Linn, principal inspector on helmet liners, CQMD.

It was not possible to offer stock answers as solutions to problems on some of the most interesting points. Determining the time of the "cure"⁷² was not a matter of merely working out a formula ahead of time. The only way to make a cure that was foolproof was to experiment and check the results by the delousing and deflection tests⁷³ the inspector made at the plant which showed whether or not the liner would hold its shape, as demanded in the specifications.⁷⁴

⁷²The chemical change which the phenolic resin impregnated cloth undergoes from the heat and pressure in the thermosetting process is called the cure.

⁷³The delousing test was made to ascertain whether the liner would stand up under the live steam used in the field to cleanse it of vermin. The deflection test measured resistance to projectiles.

⁷⁴The value of the delousing and deflection tests was explained to inspectors in a COMD memo of May 28, 1942, which gives a concise explanation of the behavior of the plastic making the liner shell: Phenolic resin impregnated cloth is a thermosetting resin and takes on the texture necessary to our purpose only after the impregnating material has undergone a chemical change produced by heat and pressure. When the chemical change is complete and adequate the resulting material has water-steam resistance, high impact resistance, and some flexibility. When the chemical change (CURE) is not complete, resistance to water-steam is low, impact resistance is lowered, and flexing produces delaminations. When it is overcured the material is brittle, cracks under impact or flexing, and is highly water resistant....When the cure is not complete, the delousing test---exposure to live steam under 17 lbs. pressure, 253 degrees, for 30 min.---carries the cure forward and sets up stresses which reveal themselves by distortions of shape....If the liner delaminates under 15 ft. pounds impact with the iron ball, the resin is not cured at all but merely cemented together by a fluxing of the surface resin and the volatile. It will also absorb much water and can be checked by the immersion test; 24 hours immersion in water at normal room temperature. Unless the cure is complete and stopped upon completion, the liners will not come through the deflection tests conducted at 40 below zero, for cold renders resin brittle. Defective liners will stand the deflection tests at high temperatures, for heat renders the material more flexible."

As in the case of many other Quartermaster items, inspection was to be made throughout the manufacturing process. Including the delousing and the deflection tests of the liner, there were nearly a dozen tests which the inspectors were expected to make at the plant, occasionally forwarding samples to the Depot for inspection there.⁷⁵

Briefly, the main tests were:

(1) Moisture absorption. The uncoated liner body should not increase in weight more than 5 percent when immersed in water for 24 hours at 77°F. ± 4°F. When removed from the water and dried in a forced draft oven at 140°F. ± 5°F. for 24 hours, the decrease in weight from wet weight should not exceed 6 percent. The coated liner body should not increase in weight more than 5 percent when immersed in water under the same conditions, and should show no peeling, cracking, blushing, checking, blistering or other failure when examined 4 hours after removed from water. Dimensional stability under the immersion test had to be within 0.5 percent and .002 inch in mean diameter and mean thickness.

(2) Ball Test. The uncoated liner body without suspension should withstand the impact force of an 8-pound iron ball of approximately 3.9 inch diameter dropped on its top from a distance of 15 inches, or 10 foot-pound impact. Deflection on impact should not exceed more than 1.25 inches and permanent deformation not more than 0.1 inch. Fabric break, splintering or delamination on impact brought a rejection. The same ball was dropped at a distance of 22 1/2 inches, or 15 foot-pounds impact, with no fabric break, splintering or delamination of the liner body permitted, though the surface could be dented. Repeated on the coated liner body, these same tests were to result in no flaking, cracking, peeling, checking, blistering, loss of adhesion or other failure of coating.

(3) Delousing Treatment. The uncoated liner body should withstand saturated steam at 17 pounds per square inch (255°F.) for 30 minutes without substantial change in dimensions, physical characteristics and appearance which would affect the serviceability of the liner body.⁷⁶

(4) Flammability. The phenolic resin impregnated fabric shall consist of either non-flammable or slow burning material, the rate of burning not to exceed 4 inches per minute.

⁷⁵See Specifications, Appendix III.

⁷⁶The liner specification of later date, 65B, issued in October, 1943, required a 1-hour exposure to methylbromide vapor in a closed chamber. By that date, methylbromide had come into general use as a delousing chemical in the field, first having been used in the North African expedition of November 1942.

(5) Flexibility. No breaking, cracking, or delamination of the liner body should occur when it is subjected to the flexing test described in F-3g of specifications.

(6) Weather Resistance. When a cut section of the coated liner body is subjected to a recognized standard weathering test for a period of time comparable to one year's Florida sun exposure, no blushing, cracking, checking, blistering, peeling, loss of adhesion or other failure of surface should occur, and the fading of color should be slight.

(7) Ballistics Impact Resistance--- Placed inside a standard helmet, steel, M-1, body, with full suspension installed, the liner was to be mounted on a wooden head. A .45 caliber pistol with regular Army ball type ammunition was to be fired at the steel helmet, one at the right temporal, one at the left temporal, and at the occipital region, with a velocity of impact of approximately 790 feet per second. Considerable indentation of the steel, but no penetration, was permissible. The liner body should show only fracture within areas of impact with no fragmentation in any instance. If fabric were torn, no loose particles should show, and there should be no flaking off of interior finish.

The projectile impact resistance test was the final one,⁷⁷ and was made with the least difficulty at the McCord Radiator Company, where the steel helmets were easily available and the Ordnance Department offered the test equipment. The practice, therefore, was to make the tests at intervals on samples selected from each manufacturer's output and sent to Detroit.

The number of inspectors on helmet liners varied from 33 to 40, including those on duty at headband and neckband manufacturing plants. Those appointed in the spring of 1942 as production was getting under way were given training at the McCord Radiator and Manufacturing Company and the Inland Manufacturing Division of General Motors, with an officer and inspectors from the Chicago Depot supervising instruction. Until mid-February 1944, when the Quartermaster

⁷⁷Webbing for the suspensions and leather used in the headband, neckband and chin strap also had special tests, indicated in the Specifications found in Appendix III.

Inspection Zone system⁷⁸ became effective for the Chicago Depot, the helmet liner inspectors all worked under jurisdiction of Mr. Lim, the principal inspector on plastics and chemical products, who spent much of his time in the field. With activation of the Chicago Inspection Zone, product inspection at two helmet liner plants---Capac and Seaman---remained in the zone, with headquarters at the Chicago Depot; sample liners and headbands and neckbands were sent by the other inspection zones to the Chicago Depot, but by the time judgment was passed on the samples, the production from which they were taken would long since have been shipped out. The Westinghouse company and Mine-Safety Appliances fell in the Philadelphia Inspection Zone, the Firestone Company went to Boston, and International Molded Plastics to Jeffersonville. At the time of this writing, it was difficult to tell whether the quality of output could as easily be controlled by the procuring depot under the zone inspection plan as when the procuring depot had direct charge of inspections. The theory behind the Inspection Zone plan, of course, was that the

⁷⁸ Under the Quartermaster Corps Inspection Zone system, set up in the autumn of 1943, Inspection Zones with headquarters at 10 depots were designated to inspect all items except subsistence and fuel procured by the Quartermaster Corps within specified areas; this plan replaced a system under which each of the procuring depots supervised inspection of those items it procured throughout the country. The purpose of the inspection zone plan, officially authorized under OQMG Circ. Let. 149, Sept. 27, 1943, was to standardize inspection procedures, make for flexibility of personnel, and unify the "paper work"; also to divorce the inspection function completely from the procurement function.

control toward standardization of products would be tightened rather than relaxed.

Helmet Liner Distribution Procedure---Since distribution usually is considered the end-step in the procurement function, following purchase and inspection, description of the system of delivering the helmet liners, and the problems that arose, is presented here. As in the case of many other supply items, the helmet liner distribution was worked out in the Storage and Distribution Division of the Office of The Quartermaster General, where the most up-to-the-minute information possible was centralized on the needs of camps, posts and stations in this country, and on overseas requirements. The distribution orders, or "DO's," were given the Chicago Depot semi-monthly, because the liners were such a new item and it was difficult to stabilize stocks.⁷⁹ The destination points, which the Distribution Orders designated, were either depots such as Atlanta, Kansas City, Chicago, Memphis, Richmond, and Schenectady, from which requisitions from camps, posts and stations would be filled; or ports of embarkation depots.⁸⁰ Scheduling of distribution according to the DO's was the problem of

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In view of the fact that delivery schedules on contracts provided for monthly deliveries, Major Pratt in January 1943 asked the OQMG if distribution could not be given at monthly periods; he was told that this might be possible later. Major Pratt to OQMG, Jan. 8, 1943.

⁸⁰

To simplify distribution of liners for overseas destination, all of this class were prepared and packaged by the Westinghouse and Firestone companies until April 1944, when overseas requisitions became so numerous that all manufacturers were asked to pack portions of their output for export.

the Chicago Depot.⁸¹

With the exception of sale directives, on which Navy and Marine Corps shipments were handled, the distribution of the liner shells and headbands and neckbands was carried on separately.⁸² When production first became available, shipping instructions on the liners, headbands and neckbands came from the Office of The Quartermaster General in detail; and only two or three depots were used as distribution centers, since the number of liners being manufactured was low. By January 1943, however, when it was planned to issue the liners at reception centers, supplying all troops, the distribution scheduling became more complicated.

The main problem, in the case of the helmet liner, was

⁸¹The Helmet Liner unit at the Depot first prepared and issued the distribution schedules to designated depots for each production period, so that these depots could set up dues-in for the period; then Government bills of lading were requested from the Transportation Division of CQMD to transfer shipments from the contractor's plant to the designated depot, and the contractor was informed as to his schedule. These requests furnished all pertinent information such as contract number, FOB point, name of shipper, destination, item and estimated weight and number of bills of lading needed to cover shipment. The inspector at the contractor's plant then received these bills of lading and when shipment actually was made he returned a copy of the B/L to the Depot; at this point the inspector rendered a receiving report to the Helmet Liner Section for the quantity accepted and ready for shipment, which was checked by the Section for accuracy and approved.

⁸²This caused some confusion at CQMD at first. When DO #10, October 1942, did not correspond, taking into consideration the destination, priority and condition, Major Pratt suggested to Washington that by the end of the month the various destinations would not have appropriate quantities of headbands and neckbands for the liners. He was informed by Lt. Col. Morris J. Herbert of the OQMG that the distribution furnished CQMD was based on studies prepared in Washington which took into consideration stock on hand, dues in, dues out, etc., including depot transfer orders, thus causing a difference in the quantities of liners, headbands and neckbands to be shipped. Major Pratt-Colonel Herbert, Oct. 12, 17, 1942.

to maintain an even flow from factory to distributing point. The Office of The Quartermaster General attempted to keep the production picture current through monthly forecasts by the Chicago Depot, and through, at first, daily production reports from inspectors at the plants. Despite the centralization of all distribution orders by the Office of The Quartermaster General, and the close reporting system, it became difficult "to keep the figures straight." The Chicago Depot's reports of shipments and the places where they had gone frequently did not coincide with figures the Office of The Quartermaster General received from manufacturers, which caused consternation in the Storage & Distribution Division in Washington. As the Chicago Depot pointed out on frequent occasions, however, it was turning in reports as of the tenth of the month on production which covered only through the fifth of the month in actuality, while manufacturers' reports going in to the Office of The Quartermaster General were really of the tenth.⁸³

Many months passed before the distribution function was working satisfactorily but by the fall of 1943 the flow was better established, production troubles had been cleared up, the first pressing needs of supply had been taken care of, and the process became more routine-like, even as with the steel helmets for whose distribution scheduling the Chicago Quartermaster Depot had been

⁸³ Interview with Major Pratt.

responsible since their first manufacture in the spring of 1942.⁸⁴

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On the steel helmets, the Office of The Quartermaster General sent the Distribution Orders to the Chicago Depot, and the Ordnance Districts, procuring the helmets, furnished the remainder of the information necessary: the contract number, name of contractors, etc. From this, the Chicago Depot set up the distribution schedule. Procurement of steel helmets, which had been an Ordnance Department function in World War I and continued so in the opening days of Army expansion in 1941, was also in the hands of the Quartermaster Corps for a brief period in early 1943. Account of the handling of the procurement mission, which was assigned to the Chicago Depot, may be found in Appendix VI.