

SECRET

WORKING PARTY ON THE SUPPLY OF PROPELLANTS FOR ROCKETS.

MINUTES.

Third Meeting of the Working Party held in Room 723, Shell Mex House, on the 9th October, 1951 at 2.30 p.m.

Present:-	Mr. C.S. Bryant	D.M.X.R.D. (Chairman until 3.30 p.m.)
	Mr. F.G. Willson	A.D.M.X.R.D. (Chairman from 3.30 p.m.)
	Mr. F.C. Everett	Secretary, E.D.P.C.
	Mr. A.W. Leonard.	Ann. P. (X).
	Mr. J. Lyall	A.D.E.
	Dr. S. Masterman	D.G.W.R.D.
	Mr. L.A. Wiseman	E.R.D.E.
	Dr. C.G. Lawson	E.R.D.E.
	Mr. P.R. Freeman	E.R.D.E. (Secretary).

Apologies for absence were received from Mr. A. Brewin (E.R.D.E.) and Miss I.B. Stewart (D.G.W.R.D.).

14. Minutes of the Second Meeting and Matters Arising.

The minutes of the second meeting were read and accepted.

Mr. Wiseman pointed out that his statement (Minute 8) on an Admiralty Requirement for liquid propellant for catapults did not necessarily mean that the Admiralty would use a liquid propellant for this purpose.

Dr. Masterman said that the figure for the requirement of Messrs De Havilland for H.T.P. (Minute 11) should be revised to "500 tons of H.T.P. in 1953 and 2000 tons in 1954 and 1955"

Action 6. Comparison of propellant requirements with production capacity.

This action had been carried out by Mr. Leonard, although an assessment of cordite press size requirements had not yet been made, and would appear as an item on the agenda.

Action 8. Purification of xylene-styrene.

Mr. Leonard said that Messrs. Monsanto had agreed to try to purify the material to be supplied by Messrs Dorman Long.

Action 9. Preparation of a Progress Report.

This action had not yet been carried out since a Progress Report would be mainly based upon Mr. Leonard's paper which had only just come to hand.

Actions 10 and 12. Revision of G.W(P) 306 and X.R. 1570/1.

These actions had been carried out by Dr. Masterman and Dr. Lawson. The revised version of X.R. 1570/1 was distributed.

15. Propellant Requirements and Production Capacity - Report by Mr. Leonard

Mr. Leonard said that his report was based largely upon official estimates recently given as a result of a three year programme of rearmament. Consequently many of the figures for propellant requirements would differ from those given in X.R. 1570/1. Although there were no new figures available for 1954-1956, he had adjusted these where necessary to bring them into agreement with the 1951 to 1954 figures.

Mr. Leonard pointed out the very large requirement for a 6.5 inch Field Artillery Rocket: this would require 35,000 tons per annum of propellant in the first year of war compared with a total capacity of 27,500 tons at Bishopton and Ranskill in 1945.

As the "first year of war", Mr. Leonard said that he had taken the 1955 figure in the absence of other information.

Dr. Masterman pointed out that in many cases development of a weapon would not be completed until after 1955 and it was obvious that the "first year of war requirement" would depend upon the state of development when war broke out. A decision would have to be taken at the outbreak of war whether weapons under development should be proceeded with or not. He considered that, as far as guided weapons were concerned, the fairest figure to take for the first year of war should correspond to the first year in which there was a large increase in requirement, signifying completion of development.

The Chairman said that it had been agreed that only the next four years should be considered. He suggested that for this period, two tables could be given one based on peace, and the other on war requirements.

Dr. Lawson agreed that the figures given for propellant requirements in Mr. Leonard's report were probably more accurate than those in X.R.1570/1 but pointed out that the figures for the proportion of inhibition in the latter were the more accurate. He also pointed out that Mr. Leonard's paper did not contain any figures for igniter requirements.

Mr. Leonard then dealt with the part of his paper giving requirements for chemicals. He said that, since the 6.5 inch rocket constituted over 50 per cent of the total requirement, he had made two tables, one including the 6.5 inch rocket and the other excluding it. The peace-time requirements for the major propellant constituents could be met if the 6.5 inch rocket were excluded, otherwise there would be difficulties.

In the case of triacetin, difficulty in obtaining supplies is anticipated since the total U.K. capacity is less than 200 tons per annum, and this is barely sufficient to meet civilian needs. 2-Nitrodiphenylamine will also be difficult to obtain since there is no production in U.K. Mr. Leonard noted that E.R.D.E. had placed an order for 5 tons although the total rocket requirement for 1951 - 1956 was only 7 tons if the 6.5 inch rocket were excluded.

Dr. Lawson said that he considered an order for 5 tons reasonable since it would be less than two years' supply for the research and development work to be carried out at E.R.D.E. He also expressed his opinion that carbamate should be replaced by 2-nitrodiphenylamine, in the case of certain stores using extruded cordite, in order to increase the Service life of the propellant.

Mr. Leonard said that other chemicals which are difficult to obtain are guanidine nitrate and dinitroresorcinol, which are required by I.C.I. for their experimental "pressed" propellants.

Mr. Willson said that the low temperature carbonisation of coal yielded considerable quantities of dehydroxybenzenes and suggested Messrs Low Temperature Combustion Ltd., as a possible source of resorcinol.

At this stage the Chair was vacated by Mr. C.S. Bryant and taken by Mr. F.G. Willson.

16. First Progress Report.

Mr. Everett emphasised the need for obtaining a progress report for distribution to the E.D.P.C. in time for the November meeting. He considered that the latest date for distribution was November 3rd. He pointed out that a number of clear-cut issues had been raised at the Working Party meetings, and these should be included in the report. An example was the fact that cast double-base propellant required N.C. powder for which manufacturing capacity was totally inadequate.

The Chairman said that the use of N.C. powder could be avoided if Western Cartridge ball powder proved acceptable. The French are trying this but attempts at manufacture by E.R.D.E. had not yet given a satisfactory product.

Mr. Leonard remarked that new plant would be required for N.C. powder but the Chairman considered such plant to be very much simpler than that necessary for making rifle powders.

Dr. Masterman said that consideration should be given to propellants which are still in a research and development stage since these may create new requirements. The trouble with resorcinol already mentioned by Mr. Leonard was a case in point. Other new chemicals which may be required include ammonium dichromate, cuprous chloride, guanidine nitrate and polyisobutylene.

The Chairman said that the lines to be taken in preparing the progress report appeared fairly clear. The main basis of the report would be the tables prepared by Mr. Leonard. Liquid propellants would have to be considered although the requirements for these appeared rather nebulous, especially that relating to a fighter aircraft using H.T.P.

Dr. Masterman said that he hoped to be able to clarify the position with regard to liquid propellants in the near future.

The Chairman suggested to the Secretary that Mr. Leonard and Mr. Everett should be consulted in drawing up the draft of the progress report.

17. Date of Next Meeting.

The next meeting of the Working Party will be held on Thursday 25th October, 1951, in Room 723, Shell Mex House, at 2.30 p.m.

Action.

9. The Secretary to prepare a Progress Report in consultation with Mr. Everett and Mr. Leonard.

Members of D.M.X.R.D.'s Working Party on the Supply of Propellants for Rockets.

Summary of Materials
Requirements.

1. The attached tabulations represent an attempt to break down into a statement of the requirements for reasonable intermediates for solid propellants, the information on the weapon production programmes contained in E.D.P.C. 257 and 268, as supplemented by information supplied by C.E.A.D. (Mr. Lyall) and by A.D./G.W.(P) in his G.W. (P) 303.
2. It will be noted that there are many weapons still "in development"; indeed it would be truer to include in the category at least one of those listed as "in Service" - the 6.5" Army Artillery Rocket, in spite of the production schedule stated by D.G. of A.
3. In several cases information as to the rate at which production should build up is uncertain or completely lacking.
4. Information on inhibition is not precise. Ethyl cellulose could in some cases be substituted by cellulose acetate.
5. It will be seen that 7 colloidal propellants are envisaged in the data available. They total about 66,000 tons in the first year of war.
6. There is, apparently, a (diminishing) requirement for only one Plastic Propellant, but this must depend on further trials.
7. In view of the quantities of propellant involved it would seem desirable that an enquiry be held into the likelihood of obtaining all the other components of the stores mentioned - including arrangements for ironmongery.
8. No attempt has been made to rewrite the requirements for liquid propellants given in G.W.(P) 303. No other statement on requirements for liquids is known.
9. As agreed at the second meeting, requirements for engine starters are not included.
10. Data on ignition is not complete, but approximate estimates are included. In some cases of flashless requirements, gunpowder G 20 may replace SR.371C. Every igniter will require a low-tension puffer, necessitating some 15-20 million in the first year of war.

E.R.D.E.

Waltham Abbey.

Revised 19th September, 1951.

Copies to: D.M.X.R.D. (Mr. Bryant).
A.D./Amm.P.(X). (Mr. Leonard).
C.E.A.D. (Mr. Lyall).
A.D./G.W.(P). (Dr. Masterman).
S.P.R.II. (Mr. Wiseman).
Secretary, E.D.P.C. (Mr. Everett).
Secretary, Working Party (Mr. Freeman).

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WORKING PARTY ON THE SUPPLY OF PROPELLANTS FOR ROCKETS

Minutes.

Second Meeting of the Working Party held in Room 723, Shell Mex House, on the 13th September, 1951 at 2.30 p.m.

Present:-

Mr. F.G. Willson
Mr. F.C. Everett
Mr. A.W. Leonard
Mr. J. Lyall
Dr. Masterman
Miss I.B. Stuart
Mr. L.A. Wiseman
Dr. C.G. Lawson
Mr. P.R. Freeman

A.D./M.X.R.D.2 (Chairman).
Secretary E.D.P.C.
Amm. P.(X)
A.D.E.
D.G.W.R.D.
D.G.W.R.D.
E.R.D.E.
E.R.D.E.
E.R.D.E. (Secretary)

8. Minutes of the First Meeting and Matters Arising.

The minutes of the first meeting were confirmed.

Mr. Everett stated that the revised terms of reference for the Working Party (Minute 1) had been approved by the E.D.P.C.

Actions 1, 2, 4 and 5. Estimates of Solid and Liquid Propellant Requirements.

These actions had been carried out by Dr. Masterman and Mr. Brewin and would be dealt with under item 4 of the agenda.

Action 3. Admiralty Requirement for Liquid Propellants for Catapults.

Mr. Wiseman said that this project was still in the assessment stage. The Admiralty hoped to have a prototype by 1955, but no appreciable quantities of liquid propellant for catapults would be required until 1958-59.

Action 6. Comparison of Propellant Requirements with Production Capacity.

Mr. Leonard said that he had only just received Mr. Brewin's statement of propellant requirements. He would make the comparisons with production capacity at the earliest opportunity.

Action 7. Correspondence dealing with Xylene-Styrene.

Mr. Leonard said that there is no definite correspondence on this subject. The position is that Messrs. Dorman Long have 1,500 lbs of xylene-styrene contaminated with free xylene, but they are not in a position to purify it. An order for the alternative, "polymeths", had been placed but there were difficulties in obtaining this material owing to the dollar situation and the limitation of supplies to the United Kingdom by the Dow Chemical Corporation.

Dr. Lawson suggested that it might be possible to find another firm willing to purify the xylene-styrene. He emphasised the urgency of obtaining xylene-styrene or polymeths since the existing stock of material at Waltham Abbey will last only until December.

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SECRET

The Chairman said that indigenous material is to be preferred. He said that a similar difficulty with purifying dyestuffs had been overcome by a contract with the Soudes Place Research Institute at Dorking. It was possible that this firm might be willing to undertake the purification of xylene-styrene.

Mr. Leonard said that he would approach industrial firms with the problem.

9. E.D.P.C. Minute 228.

Mr. Everett stated that this minute contained the proposal to set up a Working Party on the Supply of Propellants for Rockets. He emphasised that E.D.P.C. considered that every attempt should be made to minimize the number of types of propellant under development.

Dr. Masterman considered that this was already being done in the United Kingdom. He agreed that the I.C.I. were planning to use American-type N.C. for the production of cast double-base but this was an interim measure and British Service N.C. would probably be used when, and if, the feasibility of doing so is demonstrated by E.R.D.E.

Mr. Everett further stated that E.D.P.C. have asked for a written report of the progress of the Working Party to be considered at their next meeting in November.

The Chairman said that a First Progress Report would be prepared by the Secretary for submission to C.S.(M) according to the terms of reference; the draft of this report would be considered at the next meeting.

10. G.W.(P) 306. Statement of Propellant Requirements for Rockets by D.G.W.R.D.

Dr. Masterman said that the figures given in this statement should be accurate within a factor of 2. The data given apply only to actual G.W. projects and do not include rockets for experimental purposes. Amendment to the figures is necessary owing to a decision to increase the size of the "Red Shoes" boost from "Mayfly" to "Gannet". This will increase the tonnage of cordite required from 1953 onwards. He would send all recipients of G.W.(P)306 a list of amendments.

In response to a question, Dr. Masterman said that the figures referred to war-time requirements. He agreed that the number of rockets given in the table was small compared with Service requirements for conventional rockets but pointed out that the lethality of a G.W. should be very high, about 1 in 3 or 4. The figures were based on this, and on a consideration of the probable strength of enemy air forces. Furthermore, the propellant required for guided weapons should replace some of the existing Service Requirements. On a weight for weight basis guided weapons should be much more economical than conventional weapons in propellant requirements.

Mr. Everett asked whether the requirements given were reasonable from the point of view of other materials required for guided weapons and propellant producing capacity.

Dr. Masterman stated that requirements for materials other than propellants could be met but that a statement of the feasibility of producing the propellants must await the analysis to be made by Amm.P(X).

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SECRET

The Chairman remarked that the requirement for plastic propellant is very small.

Dr. Masterman said that there might be additional requirements for plastic propellants but this was problematical. He had advised Messrs. Napier to consult E.R.D.E. on the subject of solid propellants for sustainer motors and a plastic propellant may be used for this.

Dr. Lawson pointed out that this would require the newer type of plastic propellant based on polyisobutylene, for which a clearance trial would be necessary. The Ordnance Board trial for the older type of plastic propellant, (R.D.2201), took about two years for completion largely owing to the D.G.W.R.D.'s demand for boost motors. He anticipated that any future trial would take as long unless Waltham Abbey were relieved from the task of manufacturing G.W. boosts.

Dr. Masterman said that he had hoped that the 100 tons of plastic propellant required for 1952 would be manufactured in an ordnance factory. Although he had supplied Amm.P(X) with a list of plant requirements for this, his only reply from D.G.O.F.(X) was a plan for manufacturing 100 tons per week. This scheme would cost £3,000,000 and, at the present stage, the G.W. Directorate were not prepared to give it their backing.

Mr. Leonard said that he would find out from D.G.O.F.(X) the prospect of an ordnance factory manufacturing the plastic propellant boosts required for next year.

The Chairman said that the requirement given for nitric acid in G.W.(P)306 could readily be met, and that the H.T.P. requirement would give no trouble until 1956. He asked what material would be wanted for the solid sustainer motors.

Dr. Masterman said that this had not yet been decided. It could be cordite, cast double base, plastic or other propellant.

11. 1736/Eng.R.D.6/092. Statement of Propellant Requirements for Rockets by D.Eng.R.D.

Mr. Leonard pointed out some typographical errors in this statement and also that the requirements were given in long tons instead of short tons.

The Chairman observed that the requirements were for A.T.O. and aircraft propulsion purposes only and were additional to those already given by D.G.W.R.D. No charge sizes were stated but these would be required for the report to be made to C.S.(M).

Dr. Masterman said that the "Ladybird" A.T.O. unit required a 6.5 inch charge. The requirements given in the statement were for 1954-55; only 45 tons per annum of cordite would be required for A.T.O. purposes for 1953 and '54. The figures given for liquid fuel for a rocket-propelled fighter were conjectural and this requirement might not arise if sufficient progress is made with guided weapons and other types of jet aircraft. In any case Messrs. De Havilland will require 1,000 tons of H.T.P. in 1953 and 2,000 tons in 1954 and '55.

The Chairman said that the Navy might also have a very considerable

Mr. Leonard pointed out that D.Eng.R.D.'s statement did not include methanol.

Mr. Wiseman said that the requirement for methanol would be about one quarter that for liquid oxygen. Ethanol or propanol would be alternatives.

Mr. Leonard said that preference should be given to ethanol since there were prospects of ample supplies in the future from the petroleum industry. He asked whether any indication could be given of peace-time requirements.

Dr. Masterman said that the peace-time requirement of propellant for A.T.O.s would be about one-tenth, and for rocket propelled interceptors, about one-quarter the war-time requirement.

12. X.R.1570/1. Statement by Mr. Brewin on Requirements of Materials

The Chairman observed that this statement included all the figures provided by A.D.G.W.R.D. and C.E.A.D. (Mr. Lyall). There appeared to be a few minor alterations needed in the heading of the table and the figures for "Mayfly" and "Gannet" motors would need revision in the light of D.G.W.R.D.'s more recent statement. He did not consider it a function of the Working Party to consider requirements for engine starters since these are already included in "Service Requirements". On the other hand, he suggested that requirements for igniter systems should be included in the report to C.S.(M)

Mr. Wiseman pointed out that the figures for "Mayfly" did not appear to agree with those originally given by D.G.W.R.D.

Dr. Lawson said that he would revise the table where required. He also pointed out that the use of Propellant OIO necessitated the use of several new ingredients requiring special plant.

Mr. Lyall gave further particulars of inhibition coatings for the propellant charges tabulated in X.R. 1570/1.

The Chairman said that the paper should form a good basis for the Report to C.S.(M). He suggested that the First Report should only deal with requirements for the next few years and, in view of this, the next item on the agenda, "Future Requirements for Rocket Propellants", should be deferred.

13. Date of Next Meeting

The next meeting of the Working Party will be held on Tuesday, October 9th, 1951, at 2.30 p.m. in Room 723, Shell Mex House.

Actions

6. Mr. Leonard to compare requirements for propellant intermediates with production capacity.

8. Mr. Leonard to approach industrial firms with the problem of purifying xylene-styrene.

9. The Secretary to prepare a Progress Report for submission to C.S.(M).

10. Dr. Masterman to provide all recipients of G.W.(P) 306 with a list of amendments.

11. Mr. Leonard to find out from D.G.O.F.(X) the prospect of an ordnance factory manufacturing the plastic propellant boosts required for 1952.

12. Dr. Lawson to revise and amend X.R.1570/1.

EXPLORER
ADD DEVELOPMENT
7275
12 JUL 1951
WALTHAM ABBEY.

S E C R E T
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Notes of a Meeting held in Room 723, Shell-Mex House on the 21st June, 1951, beginning at 2.30 p.m.

Subject:- Proposed Working Party to study Propellants for Rockets

<u>Present:-</u>	Mr. C.S. Bryant	D.M.X.R.D. (Chairman)
	Mr. A. Brewin	E.R.D.E.
	Mr. F.C. Everett	Secretary, E.D.P.C.
	Mr. A.W. Leonard	Ann.P.(X.)
	Mr. J.C. Litton	C.E.A.D.
	Mr. J. Lyall	C.E.A.D.
	Dr. S. Masterman	G.4.2 (A.D.G.W.R.D.)
	Mr. L.A. Wiseman	E.R.D.E.
	Dr. C.G. Lawson	E.R.D.E.

1. Introduction

The Chairman explained that the Chief Scientist had asked P.D.S.R.(D.) to set up a Working Party to make a broad survey of the raw materials and basic chemicals required for the production of propellants for rockets with particular reference to Guided Weapons. The E.D.P.C. had concurred in the need for such a body.

2. Terms of Reference

The following terms of reference had been proposed:-

(1) To review:-

- (i) Work in Ministry of Supply Establishments
- (ii) Research and development contracts with industry
- (iii) Raw materials
- (iv) Production potential at Royal Ordnance Factories, Agency Factories, and in industry.

(2) To report to C.E.(G.W.) and C.S.(M.), through P.D.S.R.(D.)

Following a general discussion the following amended terms of reference were agreed:-

(1) To review actual and potential requirements for propellants for rockets having regard to:-

- (i) Probable demands
- (ii) Raw materials
- (iii) Production potential at Royal Ordnance Factories, Agency Factories, and in industry.

(2) To review research and development in the light of (i) above.

(3) To report to C.S.(M.) and C.E.(G.W.), through P.D.S.R.(D.)

3. Representation

It was agreed that for the present the representation at the present meeting should be adequate. C.S.A.R. had at the last E.D.P.C. meeting suggested representation from A.R.E. The Chairman undertook to explain to C.S.A.R. that this was not considered necessary at any rate at present.

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- 2 -

SECRET

4. Arrangements for the first meeting proper of Working Party

It was agreed that the first meeting of the Working Party would be held on the 19th July, 1951, and that in the meantime Mr. Everett would make available the Papers E.D.P.C. 213, 256, 257 and 268 to be used as a basis for discussion.

5. Secretary

The Chairman agreed to ask C.S./E.R.D.E. if Mr. P.R. Freeman (E.R.D.E.) could be made available to act as Secretary of the Working Party.

(Sgd.) C.S. BRYANT

D.M.X.R.D.

11.7.'51
Rm. 723, Shell-Mex Hse., M.O.S.
Tel.: GER. 6933, Ext. 193

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