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NR 20501 E70

E.R.D.E. - R.A.E./R.P.D.

Working Party No. 2 on Solid Propellants

Minutes of the Twentieth Meeting held at
Westcott on 16th September, 1955

Present: Dr. J. H. Crook (Chairman)
Dr. B. H. Newman
Mr. R. Heron
Mr. G. O. Lloyd
Mr. R. J. Walley
Mr. R. Campbell
Mr. J. Woodward
Dr. J. A. Rolfe (Secretary)

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158. Minutes of the Nineteenth Meeting.

These were approved subject to the following amendments:

- page 2, section 149, para. 5, for "turbo-starters" read "turbo-alternator sets".
- page 4, section 150, para. 10, to read "no additional catalytic effect had been observed".
- page 4, section 150, para. 13, for "coarser" read "corset".
- page 5, section 151, para. 3, for "twice" read "thrice".
- page 6, section 152, para. 1, delete clause "but the charges were too big to fit into Magpie tubes".
- page 6, section 152, para. 2, for "purported" read "reported".
- page 7, section 153, para. 3, line 6, for "strand burner" read "strand burners".
- page 8, section 153, para. 5 to read "due to side burning or to premature collapse".
- page 8, section 156, para. 1, for "15" read "8.6" and delete "Mr. Hewson expressed interest".
- page 9, action 125, for "turbo-starters" read "turbo-alternator sets".

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Actions 132 and 133 were to be discussed later.

160. Extruded Colloidal Propellant

(a) Platonized and Mesa Compositions

(i) Slow Burning Rocket Compositions

Dr. Crook said that the burning rate of the propellant (F488/867) that had been sent to Westcott for Blue Sky turbo-alternator sets was lower than that of earlier batches, but could probably be made to suit by an adjustment in the size of the nozzle. He said that there was an urgent requirement for a propellant of the same burning rate (0.275 in./sec.) for Scarab motors for Beverley Aircraft, but a higher S.I. than that of F488/867 would be desirable. Mr. Lloyd again stressed the difficulty of making platonized propellant with burning rates in this region. Dr. Crook said that a certain flexibility in the working pressure might be permissible provided no unstable burning developed and provided the nozzle size was not so great as to increase the erosion unduly. Mr. Lloyd said that he would ask Bishopton to make some charges in F488/867 to be sent to R.P.D. for trials.

(ii) Slow Burning Charges for Auxiliary Charges

Mr. Lloyd said that auxiliary charges in F547/65 and F547/67 had been sent to Westcott and charges in F547/72 would be sent in the near future. Dr. Crook said that they would be fired shortly. He emphasized the need for propellants of lower burning rates i.e. of the order 0.08-0.09 in./sec. or lower.

(iii) Fast Burning Rocket Compositions

Mr. Lloyd said that using lead stannate catalyst, compositions with calorimetric values of 1,070 cal/gm. and with good tensile strengths could be extruded. The burning rate was unaffected by storage. Dr. Crook agreed that such a composition might be a good replacement for F488/649. Mr. Lloyd said that compositions with higher rates of burning (0.8-0.9 in./sec.) were not easily reproducible because of batch to batch variation in the properties of lead stannate.

Dr. Crook said that the small tubular sticks of (F488/807) propellant supplied by E.R.D.E. for side thrust units, had given burning times in motors twice those expected. He did not think that E.R.D.E. need be unduly concerned with this as the times of burning were very small (of the order of milliseconds). The reason for the anomaly was obscure as strand burning determinations indicated that the propellant had the correct burning rate.

Mr. Heron said that considerable evidence had now been accumulated as to variations in the rate of burning and the form of the rate of burning/pressure curve of samples of F488/649. The problem of maintaining repeatable ballistics with platonized compositions was an urgent one and Dr. Maxwell had written a letter to the Ordnance Board on the subject of harmonization of production of propellants. There was a difference in burning rates between the mean rates derived from all samples from R.N.P.F. Caerwent and R.O.F. Bishopton, and between different samples from the same factory, though samples from Caerwent were rather more consistent than those from Bishopton. Dr. Newman suggested that differences in the method of sampling at the two factories might be responsible for these. In reply to Mr. Walley's query, Mr. Heron said that there was insufficient evidence to suggest that the differences were due to the method of sampling.

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increase the ammonium perchlorate particle size or to find a better coolant than ammonium picrate. Dr. Crook said that if a faster burning propellant (containing 50% picrate and with burning rate of about 0.15 in./sec.) were used, a larger throat and hence larger conduit would be necessary and the total impulse would be very little better than the same motor using R.D. 2332. Dr. Newman said that so far no coolant with as satisfactory properties as ammonium picrate had been met with. Many others had been tried but most, e.g. cellulose acetate, had an adverse effect on the rheological properties and could not be added in any great quantity. Work had been resumed on oxamide propellants; catalysts other than titanium oxide were being tried in conjunction with this coolant and copper oxide seemed to be an improvement.

Using additional P.I.B. as a coolant lowered the specific impulse without causing much reduction in the burning rate. Dr. Newman said that although at present there seemed no obvious way of meeting the requirement there was always a chance that some composition might be hit upon in the next few months.

(b) Boost Compositions

Dr. Crook reported that a Gosling motor had been filled with R.D. 2307 pressed with a Mayfly former and fired giving a specific impulse of 210 and a total impulse of 84,000 lb. sec. The total thrust/time integral was 35% higher than that of the cordite Gosling.

52 Mayfly IV's had been fired successively without failure, B.A.C. were considering using Mayfly IV on some vehicles in place of Gosling.

Dr. Crook produced some soiled pieces of propellant. These were samples of some R.D. 2312 supplied to R.P.D. by E.R.D.E. Two boxes from lot No. WA 11 contained a number of such soiled pieces. Dr. Newman said he would investigate the matter.

Dr. Newman said that E.R.D.E. had been in search of new designs for propellant boxes. Some were being sent to R.P.D. Dr. Crook said he thought the need for boxes would be lessening but Dr. Newman said that the rate of condemnation was so high that in spite of the diminishing demand there was a constant shortage.

In reply to Dr. Newman's query, Dr. Crook said that the 3 inch former, borrowed from R.P.D. by E.R.D.E., had not yet been returned.

Dr. Crook said that two versions of Lobster were going forward. One was to give a maximum overall performance. The other was a rather longer motor more likely to be of practical value. Dr. Newman said that a plastic propellant containing 9% binder and an improved wetting agent, with a specific impulse of 240 and a rate of burning of the same order as R.D. 2311 had been developed. Dr. Crook said he would bear this in mind.

(c) Platonized Compositions

These had already been dealt with.

(d) Rheological Properties

Dr. Newman said that a copy of a specification for plastic propellant had been sent to R.P.D. As he had received no comment he had assumed that R.P.D. were satisfied with it. Dr. Crook agreed.

162. Cast Double Base Propellant

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sound low acetyl C.A. had been successfully fired at ambient temperature at W.P.D. Long hot storage and temperature cycling trials were being carried out. A means had been found to expand low acetyl C.A. tubes but so far no tubes had been satisfactorily swaged on to charges.

165. Compatibility Problems

Mr. Selley said that Araldite 2002B had been cleared for compatibility in contact with colloidal propellant. Araldites 1 and 5 had been tested at I.C.I. Summerfield and found to be incompatible when mixed with propellant.