CoA Note Mat. 1 (Part II)

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THE COLLEGE OF AERONAUTICS

DEPARTMENT OF MATERIALS

Characteristics of the high temperature mechanisms of creep and recovery in graphite

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A. YOUNGER.

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Cranfield, Bletchley,
Bucks., England.

1. Statement of work carried out

The research plans outlined in our previous report have been followed. Difficulties have been encountered on the tensile creep apparatus: these have been concerned with fracture of the specimen grips and with ignition of the gas escaping around the loading train. The former problem has been solved by small design changes but further work is required to prevent a recurrence of the ignition problem.

The hydraulic system of the torsional rig has been modified. The creep load is applied by a dead weight supported on a piston which compresses the hydraulic system. There is sufficient piston volume to accommodate the creep movement of the actuator and seepage losses for the normal duration of our tests. It is also possible to raise the weights again during a test without disturbing the creep load by isolating the actuator during this process.

A series of experiments have been carried out on the ATJ graphite supplied by the Jet Propulsion Laboratory, Passadena. The graphite was in plate-form and rods were cut and machined from it (figure 1). The plate was slightly bowed and only five standard specimens could be produced. However, the remainder, together with some smaller pieces, have been machined into slightly smaller specimens and modifications are being made to enable these to be tested. The creep strain under a load of 2000 p.s.i. shows the expected increase with temperature for a given loading time. (figure 2). The total strain (figure 3) however, does not present such a clear-cut picture, the initial extension being greater at 2250°C than at 2400°C. The amount of recovery is also greater at 2250°C than at 2400°C and 2500°C (figure 4). Unlike our earlier results on Morgan's EY9 the difference obtained by subtracting the recovery from the forward creep does not increase with time but remains almost constant (figure 5). This may arise because, in the experiments, we have not passed beyond the primary stage of creep. This point is being investigated using the smaller specimens. The amount of the resultant difference does, however, increase with temperature above 2250°C, 0.340° at 2250°C, 0.6° at 2400°C and 2.4° at 2550°C.

2. Research plans

These remain as stated in our previous report together with the extension of the ATJ results reported here to higher stress levels to enable us to reach steady-state creep conditions.

3. Personnel, administrative actions, etc.

Mr. R.C. Walding left during the period of this report and has been replaced by another technician, Mr. T. Biston. This change has necessarily incurred a time delay during his training. The departmental workshop has contributed some 100 man-hours to this project.

4. Utilisation of funds

These have been fully utilised.

5. Important property aquired.

None

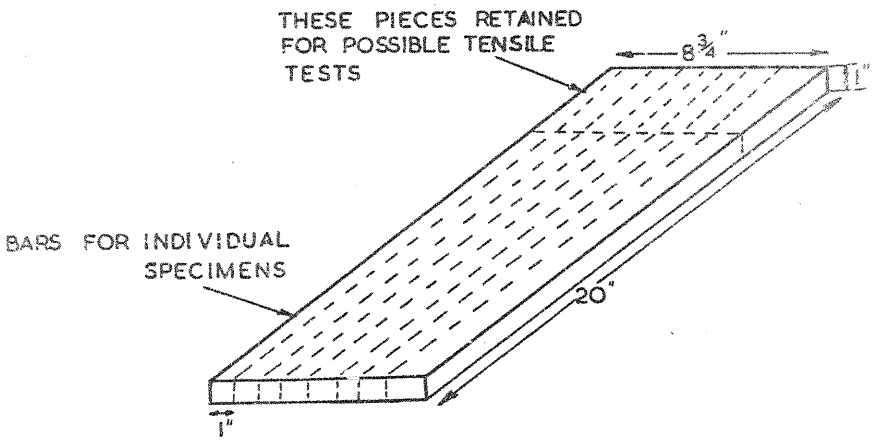

FIG. 1. POSITION OF SPECIMENS IN ATJ GRAPHITE PLATE

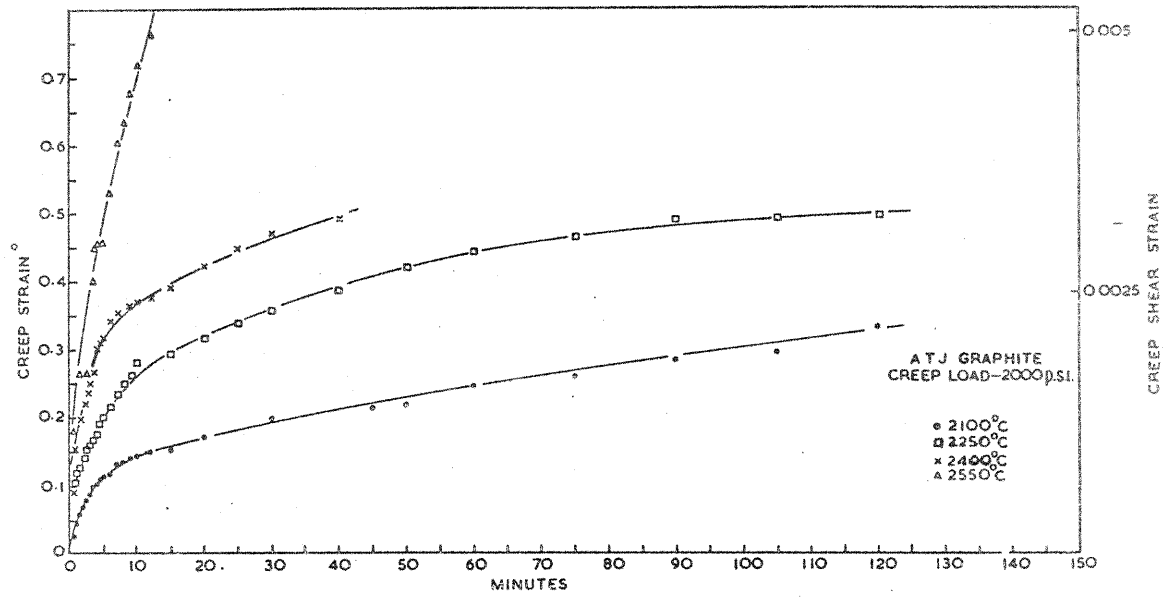

FIG. 2. CREEP STRAIN VERSUS TIME FOR ATJ GRAPHITE AT A RANGE OF TEMPERATURES UNDER 2000 psi LOAD

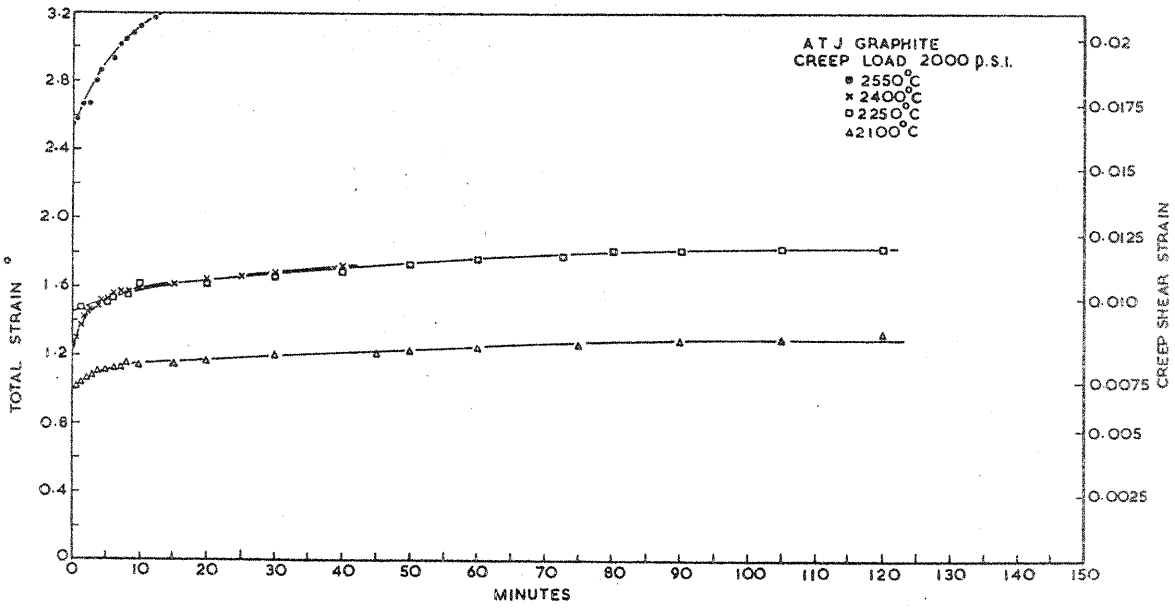

FIG. 3. TOTAL STRAIN VERSUS TIME FOR ATJ GRAPHITE AT A RANGE OF TEMPERATURES UNDER 2000 psi LOAD

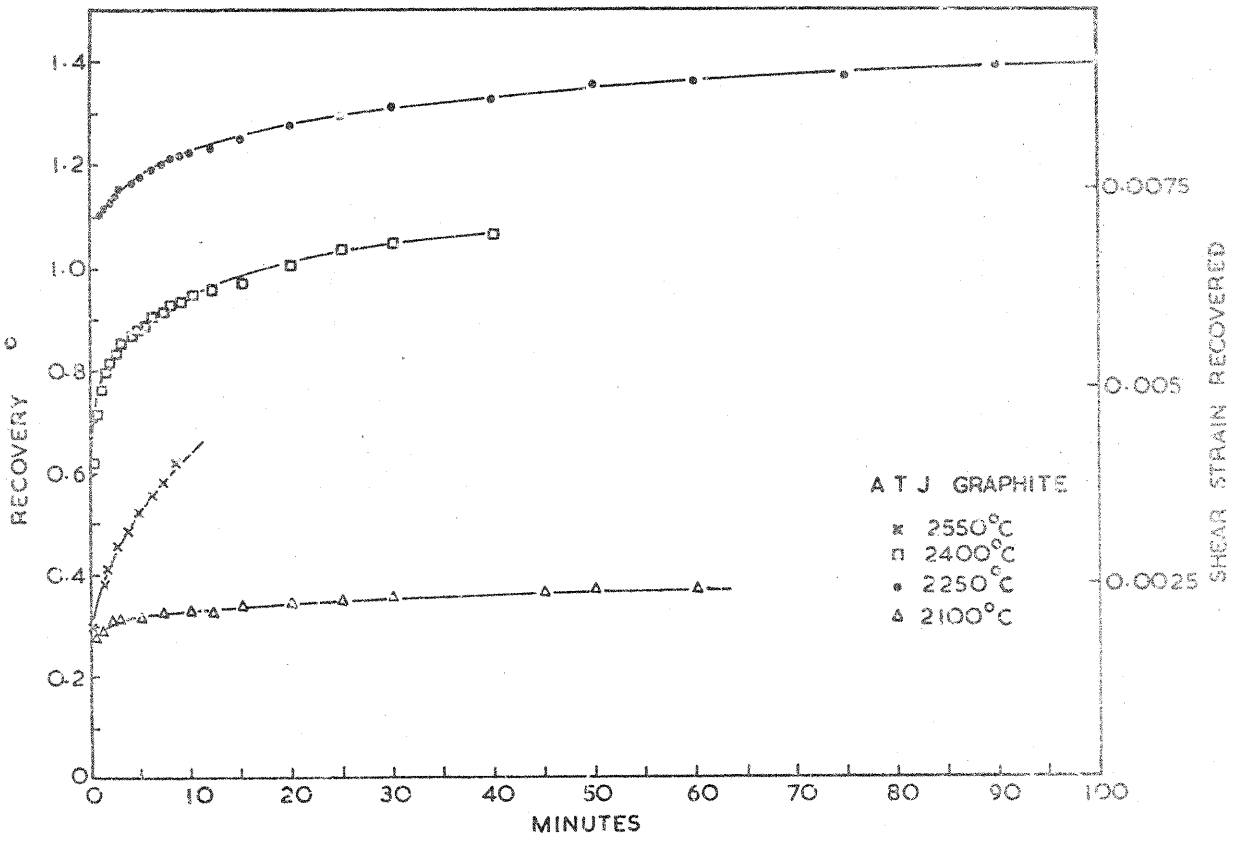

FIG. 4. RECOVERY VERSUS TIME FOR ATJ GRAPHITE AT A RANGE OF TEMPERATURES

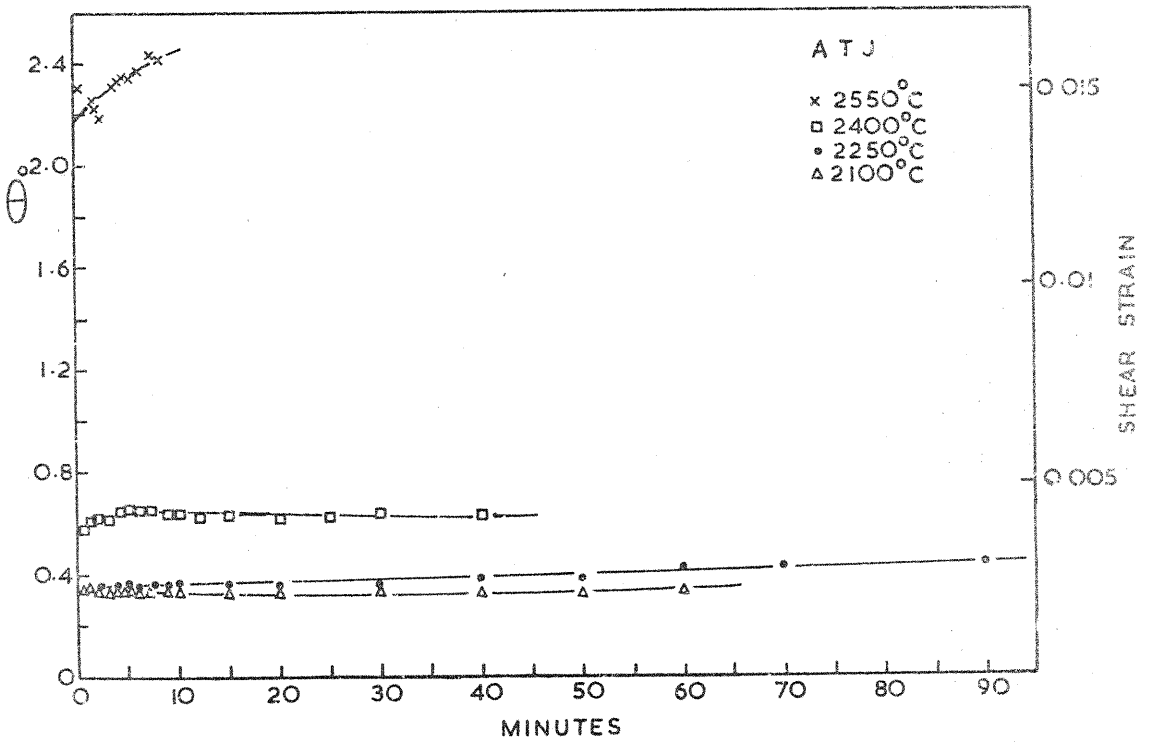

FIG. 5. (TOTAL STRAIN - RECOVERY) VERSUS TIME FOR ATJ GRAPHITE AT A RANGE OF TEMPERATURES