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Revision 1

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HTGR

H-451 GRAPHITE IRRADIATION CREEP DESIGN MODEL

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H-451 GRAPHITE IRRADIATION CREEP DESIGN MODEL

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Subject: HTGR Document

Dear Andy:

Enclosed for your use is the following document:

DOE-HTGR-88097, Rev. 1, "H-451 Graphite
Irradiation Creep Design Model", July 1988

Very truly yours,

G. C. Bramblett, Manager
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1. SUMMARY AND INTRODUCTION

1.1. SUMMARY

Available irradiation creep data on H-451 graphite are analyzed and fitted to the proposed creep model in a standard linear solid (a linear viscoelastic model). A creep equation is obtained and recommended for preliminary design use. It is found that the regression is significant and the creep equation is a good predictor. The standard error (SE) of the estimate (see Table 2, page 5-5) is smaller than that used in the core graphite criteria development. This smaller SE shall be used in all future work related to criteria development.

The creep coefficient and/or model can be further improved if additional creep data can be obtained. For this purpose several creep experiments are recommended (see Section 6). The immediate one is to negotiate with JAERI to include three H-451 creep specimens in the capsule 87M-2A currently under design.

1.2. INTRODUCTION

The fuel and reflector elements in the reactor core of a Modular High-Temperature Gas-Cooled Reactor (MHTGR) use nuclear grade graphite H-451. During the reactor operating condition these graphite core elements are subjected to spatially varying as well as time-varying fields of temperature and fast neutron flux. As the result of a non-uniform temperature distribution, differential thermal strain ($\Delta\epsilon^{\theta}$) leads to a self-equilibrium (internal) stress field. Graphite is also known to show stress-free dimensional change under neutron irradiation. This is called irradiation-strain (ϵ^I) or irradiation-induced dimensional change. Nonuniform ϵ^I will also result in an internal stress field.

Internal stress build up in the graphite core element by the above active mechanisms is relieved by a passive mechanism called irradiation (-induced) creep. It is a stress-dependent irradiation-induced strain component (ϵ^C). Usually, the higher the temperature, stress or fluence, the higher the creep rate. This creep mechanism normally relaxes out the stress field during the reactor operating condition, thus reducing the peak stress. However, at shutdown, when the time-varying thermal strain field is removed, a residual stress field remains partially as the result of the irradiation creep.

Experience shows that ϵ^θ , ϵ^I , and ϵ^C are the three most important contributors to the uncertainty on predicting the graphite core stress. Material properties used to calculate the first two contributors are relatively easy to obtain and comparatively well known. However, the irradiation creep is the least known, because the experiments to determine it are expensive and difficult to perform. In addition, a constitutive theory is required to model the behavior of graphite under irradiation.

This report deals exclusively with the irradiation creep of graphite H-451. In the next section, the history of graphite irradiation creep work will be briefly reviewed. This is followed by the rheological model proposed for core graphite. After that the creep data of H-451 graphite are discussed and used to obtain a set of creep coefficients for design use as well as for structural criteria development.

2. BRIEF REVIEW OF PRIOR WORK ON IRRADIATION CREEP

A brief review of the experimental technique for obtaining irradiation creep data in graphite is given in Ref. 1 and in the references cited therein. The three commonly used ones are:

1. Restrained shrinkage test. Stress in the specimen is induced by the differential thermal and/or irradiation strains. Many data points with reduced accuracy can be obtained. The out-of-pile measurement of the deformation at the end of the experiment does not permit the separation of the transient creep strain from the total creep strain.
2. Fully instrumented creep test. The test provides high precision in-pile measurement with detail record. The transient creep data discussed in this report are all from this type of test. Due to the high cost, a very small number of specimen can be tested. Therefore, the difference between one specimen and average value may be large.
3. Controlled load test with out-of-pile measurement. The behavior of stressed and unstressed controlled specimens are compared. Out-of-pile measurement increases the number of specimens. Repeated recapsulation and reirradiation of the same specimen augments the data base. Good precision is expected. No transient response can be obtained from the long-term test.

Techniques discussed here are all subjected to relatively large cumulative errors from various sources, such as measurements of temperature, fluence, load and displacement, assembly tolerances, binding of the specimen, dependence on other material properties that are used

in the post-test analysis, arbitrariness in partitioning the measured strain, etc. This is manifested in the large coefficient of variation (COV) of creep strain at more than two times the COV for most of the other material properties. Mechanical behavior of graphite under irradiation has always been modeled for the MHTGR as a standard linear solid, as ascribed to Head (Ref. 2). The one-dimensional standard linear solid consists of a Kelvin element (spring and dashpot in parallel) and a Maxwell element (spring and dashpot in series) in series. The Kelvin element represents the transient response, and the Maxwell element is the steady-state response. Beside the above two elements, there are two black box elements to represent the thermal and irradiation strain components.

Price reviewed all published irradiation creep data in 1972 (Ref. 3) and again in 1981 (Ref. 1). Since there has never been sufficient data in H-451 or any other single type of graphite for correlation with the proposed model, creep data of all available graphite grades collected in different experiments were pooled together in order to obtain a set of creep parameters. Neither the difference in graphite grade nor the accuracy of various experiments are considered in the correlation. A set of one-dimensional standard linear solid model parameters has been proposed from his work (Refs. 1 and 3) for design use.

Since the evaluation by Price, additional creep data were obtained on H-451 graphite and on other types of graphite. For H-451 there are ORNL compressive creep series (600° and 900°C, 2000 and 300 psi compressive stress) and Petten tensile creep series, D-156 (Refs. 4 and 5). These H-451 data together with some assumptions derived from the pooled creep data of all available graphite grades are used here to derive a creep equation exclusively on H-451 for use in design.

3. RHEOLOGICAL MODEL

In the proposed standard linear solid model, the total strain at any generic point in an irradiated material body can be conveniently partitioned into the following five components:

1. Thermal strain, ϵ^{θ} .
2. Irradiation strain, ϵ^I .
3. Elastic strain, ϵ^E .
4. Transient creep strain, ϵ^T .
5. Steady-state creep strain, ϵ^S .

ϵ^{θ} and ϵ^I are the stress-free strain components. ϵ^{θ} and ϵ^E are instantaneously recoverable, but the amount recovered may differ from the initial strain imposed, because material properties change with irradiation. ϵ^T has delayed recovery. ϵ^I and ϵ^S are irrecoverable. The one-dimensional model is schematically depicted in Fig. 1. The sum of ϵ^E , ϵ^T , and ϵ^S is sometimes called mechanical strain, denoted by ϵ^M .

The thermal strain, ϵ^{θ} , can be calculated for a given temperature distribution and thermal expansivity at any given instant. The irradiation strain, ϵ^I , can be obtained from the proper irradiation-induced dimensional change curve. In both cases, shifting rule is required for nonisothermal condition. While these two strain components are given for a core element, the remaining three strain components are calculated through a system of coupled differential equations given below for the multiaxial case.

Fig. 1. Rheological model for mechanical behavior of graphite

Generalization of the one-dimensional model to multiaxial case can be done by expressing the remaining three strain components as a system of matrix differential equations. These are:

Elastic

$$\underline{\sigma} = \underline{E}^E \underline{\epsilon}^E, \quad (1)$$

Transient Creep

$$\underline{\epsilon}^T = \underline{M}^T (\underline{\sigma} - \underline{E}^T \underline{\epsilon}^T), \quad (2)$$

Steady Creep

$$\underline{\epsilon}^S = \underline{M}^S \underline{\sigma}, \quad (3)$$

where the dot represents differentiation with respect to fluence.

Equations 1 to 3 are coupled by the fact that the total strain, $\underline{\epsilon}$, is the sum of five components:

$$\underline{\epsilon} = \underline{\epsilon}^E + \underline{\epsilon}^T + \underline{\epsilon}^S + \underline{\epsilon}^\theta + \underline{\epsilon}^I. \quad (4)$$

In the last four equations, $\underline{\sigma}$ and all $\underline{\epsilon}$'s are all (6 x 1) vectors, while the material properties $\underline{E}^E$, $\underline{E}^T$, $\underline{M}^S$, and $\underline{M}^T$ are (6 x 6) matrices. Using the assumption of transverse isotropy and referring to a rectangular Cartesian coordinate system, typical vectors and matrices of these quantities can be represented in component form as:

$$\underline{\sigma} = \{\sigma_x, \sigma_y, \sigma_z, \tau_{xy}, \tau_{yz}, \tau_{zx}\}, \quad (5)$$

$$\underline{\epsilon} = \{\epsilon_x, \epsilon_y, \epsilon_z, \gamma_{xy}, \gamma_{yz}, \gamma_{zx}\}, \quad (6)$$

and

$$(\underline{E}^T)^{-1} = \begin{bmatrix} \frac{1}{E_x^T} - \frac{\nu_{xy}^T}{E_x^T} - \frac{\nu_{zx}^T}{E_z^T} & 0 & 0 & 0 \\ & \frac{1}{E_x^T} - \frac{\nu_{zx}^T}{E_z^T} & 0 & 0 & 0 \\ & & \frac{1}{E_z^T} & 0 & 0 & 0 \\ & & & \frac{2(1+\nu_{xy}^T)}{E_x^T} & 0 & 0 \\ \text{Symmetric} & & & & \frac{1}{G_{zx}^T} & 0 \\ & & & & & \frac{1}{G_{zx}^T} \end{bmatrix} \quad (7)$$

$$\underline{M}^S = \begin{bmatrix} M_x^S & -\nu_{xy}^S M_x^S & -\nu_{zx}^S M_z^S & 0 & 0 & 0 \\ & M_x^S & -\nu_{zx}^S M_z^S & 0 & 0 & 0 \\ & & M_z^S & 0 & 0 & 0 \\ & & & 2(1+\nu_{xy}^S) M_x^S & 0 & 0 \\ & \text{Symmetric} & & & M_{zx}^S & 0 \\ & & & & & M_{zx}^S \end{bmatrix}, \quad (8)$$

$$\underline{M}^e = \frac{E_z}{\xi} \begin{bmatrix} \eta(1-\eta\nu_{zx}^2) & \eta(\nu_{xy}+\eta\nu_{zx}^2) & \eta\delta & 0 & 0 & 0 \\ & \eta(1-\eta\nu_{zx}^2) & \eta\delta & 0 & 0 & 0 \\ & & 1-\nu_{xy}^2 & 0 & 0 & 0 \\ & & & \frac{\eta\psi}{2} & 0 & 0 \\ & \text{Symmetric} & & & G_{zx} \frac{\xi}{E_z} & 0 \\ & & & & & G_{zx} \frac{\xi}{E_z} \end{bmatrix}, \quad (9)$$

where

$$\begin{aligned}\eta &= \frac{E_x}{E_z} , \\ \psi &= 1 - \nu_{xy} - 2\eta \nu_{zx}^2 \\ \xi &= (1 + \nu_{xy}) \psi , \\ \delta &= \nu_{zx} (1 + \nu_{xy}) .\end{aligned}\tag{10}$$

As direct consequences of the transversely isotropic assumption, there are only five independent material parameters contained in each of the material property matrices (all 6 x 6 matrices). From now on, the Z-axis is assumed to be the axis of symmetry (perpendicular to the isotropic plane).

A further reduction in the number of primitive material parameters is made by assuming:

$$\tilde{M}^T \tilde{E}^T = \frac{\tilde{I}}{\tilde{\Phi}_R} ,\tag{11}$$

where $\tilde{I}$ is an identity matrix and $\tilde{\Phi}_R$ is a scalar called the "relaxation time." With this assumption, the matrix Eq. 2 becomes:

$$\dot{\tilde{\epsilon}}^T = \frac{1}{\tilde{\Phi}_R} \left[(\tilde{E}^T)^{-1} \tilde{\sigma} - \tilde{\epsilon}^T \right] ,\tag{12}$$

which is decoupled and, therefore, can be integrated easily. The physical implication of the assumption (12) is that the relaxation time constant is the same in all directions and that the Poisson's ratios are the same in both the parallel spring and the dashpot mechanisms, $\tilde{M}^T$ and $\tilde{E}^T$.

Owing to the lack of any experimental data, an intuitive assumption is introduced for G_{zx} , M_{zx}^S , and G_{zx}^T :

$$G_{zx} = \frac{\frac{1}{2} (E_x + E_z)}{2 (1 + \nu_{zx})} \quad , \quad (13)$$

$$\frac{1}{M_{zx}^S} = \frac{\frac{1}{2} \left(\frac{1}{M_x^S} + \frac{1}{M_z^S} \right)}{2 (1 + \nu_{zx}^S)} \quad , \quad (14)$$

$$G_{zx}^T = \frac{\frac{1}{2} \begin{pmatrix} E_x^T & E_z^T \\ x & z \end{pmatrix}}{2 (1 + \nu_{zx}^T)} \quad . \quad (15)$$

After the last two assumptions, the independent material parameters for the viscoelastic response of core graphite are:

Elastic

$$E_x, E_z, \nu_{xy}, \nu_{zx} \quad ,$$

Steady Creep

$$M_x^S, M_z^S, \nu_{xy}^S, \nu_{zx}^S \quad ,$$

Transient Creep

$$\phi_R, E_x^T, E_z^T, \nu_{xy}^T, \nu_{zx}^T \quad .$$

Note that the superscript, E, for the elastic material properties has been dropped for convenience.

The linear elastic material properties are not the concerns in this report, and can be easily obtained through a conventional test program.

Further assumptions are needed to reduce the number of remaining material properties for practical purposes.

All the Poisson's ratios in creep, namely, ν_{xy}^S , ν_{zx}^S , ν_{xy}^T , and ν_{zx}^T are assumed to be constant. This is due to two considerations. First, the creep data is not sufficient and accurate to derive a set of values as a function of temperature and fluence. Second, the more important one is that the stress results are not sensitive to the creep Poisson's ratios. Based on the OC creep series, the following value is recommended for use (Ref. 6):

$$\begin{aligned}\nu_{xy}^S &= \nu_{zx}^S = 0.5 \\ \nu_{xy}^T &= \nu_{zx}^T = 0\end{aligned}\quad (16)$$

The "relaxation time," Φ_R , is best estimated to be 4×10^{19} n/cm² ($E > 0.18$ MeV, HTGR) from pooled data of all available graphite experiments (Ref. 1). This value is assumed to apply to H-451 graphite. The relaxation time does not have significant effect on the irradiation stress at or beyond a fluence of, say, five times the "relaxation time."

The transient creep elastic moduli, E_x^T and E_z^T , are taken to equal to the respective elastic moduli at the "time" loading or unloading occurred (Ref. 1).

The remaining last two material properties are the steady creep mobility coefficients (or called steady-state creep coefficients), M_x^S and M_z^S . Due to small number of radial creep specimens, it is reasonable to assume:

$$M_x^S = M_z^S \quad (17)$$

4. IRRADIATION CREEP DATA ON H-451

Table 1 summarizes all irradiation-creep experiments performed on H-451 graphite so far. The associated data as received from ORNL are given in Appendix A.

The following points can be drawn from the data set:

1. Within the scatter of the data, there is little difference between the compressive and tensile creep strain (as compared at the same stress level as well as temperature and fluence conditions). The maximum fluence is limited to $4.1 \times 10^{21} \text{ n/cm}^2$ ($E > 0.18 \text{ MeV}$).
2. The creep strains were measured out-of-pile and hence only at some discrete fluence points. It is therefore not possible to separate the transient and steady-state creep strain components.
3. In the OC-1, OC-3, and OC-5 series, several specimens were initially overloaded due to binding as a result of thermal expansion of the push rod in the assembly. The stress in these specimens are not known. These specimens have a subfile name in Appendix A ending in O.
4. E_0 (the unirradiated elastic modulus at room temperature) for OC-1, OC-3, and OC-5 specimens is the sonic modulus. All OC series specimens are from the same parent log. E_0 for D-156 specimens was obtained mechanically.

TABLE 1
SUMMARY OF H-451 IRRADIATION CREEP EXPERIMENTS

Experiment	Tensile Petten D-156	ORNL Compressive OC-2 and OC-4	ORNL Compressive OC-1, OC-3, and OC-5
Irradiation temperature, °C	900	600	900
Maximum fast fluence 10^{21} n/cm ² (E > 0.18 MeV)	13.5	4	4.1
Applied stress, psi	+870	-2000 and -3000	-2000 and -3000
Number of data points	24	44	66

5. A severe limitation on the interpretation of data is that the experiments were only performed at two (irradiation) temperatures.

5. DETERMINATION OF STEADY-STATE CREEP COEFFICIENT

In Section 3, the only unknown material parameter in the system of constitutive equations 1 to 3 is M , which is conventionally called the steady-state creep coefficient. Because of insufficient creep data, a number of assumptions are required of the pooled creep data published on various graphites to interpret the data. The assumptions are as follows.

Long-term creep test data support a linear stress dependence of the steady-state creep strain rate, $\dot{\epsilon}^s$, for low and intermediate stress levels (Ref. 1). Therefore, M is independent of stress.

The steady-state creep coefficient, M , is derived from test data that show wide scatter. At a given irradiation temperature, the maximum M can be as much as three times the minimum M . However, if the product of M and E_0 (the unirradiated elastic modulus) for each specimen is plotted as a function of temperature, the scatter is greatly reduced (Ref. 1). There is no more than 50% difference between the maximum and the minimum of ME_0 at a given temperature. This supports an inverse relationship between M and E_0 ; that is:

$$M = M' (T, \Phi) / E_0 \quad , \quad (18)$$

where T = the irradiation temperature.

M has been assumed to be independent of fast neutron flux. This is due to the fact that the experimental data obtained so far, although covering more than one order of magnitude in neutron flux does not conclude anything for or against the existence of a flux dependence.

Equation 3 is now simplified to a single scalar equation:

$$E_0 \epsilon^S / \sigma = M' (T, \Phi) \quad . \quad (19)$$

The left-hand side can be expressed as:

$$\begin{aligned} E_0 \epsilon^S / \sigma &= \frac{E_0}{\sigma} (\epsilon^C - \epsilon^T) \\ &= \frac{E_0 \epsilon^C}{\sigma} - 1 \quad , \end{aligned} \quad (20)$$

where ϵ^C is the observed creep strain (the sum of ϵ^S and ϵ^T).

The last step assumed that Φ is at least 2×10^{20} n/cm², equivalently five times the relaxation time, Φ_R . The maximum transient creep strain is also assumed to equal the instantaneous elastic strain. This assumption is approximately true for the creep data initially stressed at $\Phi = 0$.

It has been noted in Ref. 1 that M' remains relative constant at an irradiation temperature less than about 600°C. The present limited H-451 creep data do not either support or deny the above conclusion. The creep coefficient, M' , at 600°C is therefore assumed to apply for all irradiation temperatures <600°C.

Since the creep coefficient will be used for design of the graphite core elements and for development of structural criteria, the primary range of interest of the operating parameters needs to be specified in order to make optimal use of the available creep data. Without the specification of the range of interest, the limited data set has to fit over a relatively wide range of fluence and temperature, severely reducing the accuracy and increasing the uncertainty of the creep

coefficient. The following table shows the range that envelops the reactor operating condition for core graphite:

Temperature (T), °C	300 to 700	700 to 1200	1200
Fast fluence, (Φ), 10 ²¹ n/cm ² (E > 0.18 MeV)	4.5	9.4 - 0.007T	1.0

Ninety percent of all creep data reported in Section 4 are within the above range. The exception is the 12 high fluence data points in the Petten D156 experiment. The fluence is about two or more times the maximum fluence in MHTGR core graphite. It is therefore excluded in the determination of M'.

For obvious reasons, the specimens overloaded in the creep experiment are excluded from the correlation.

The creep data used in the determination of M' are listed in Appendix B. E₀ for OC-2 and OC-4 specimens is not available. E₀ listed in Appendix B is the average E₀ of all OC-1, OC-3, and OC-5 specimens, since all OC series specimens are from the same log.

M' is assumed to be represented as a polynomial in Φ and T. Since there is only two temperatures, M' at this moment is linear in T. The following equation is used in the regression analysis.

$$M' = a \Phi + b \Phi T + c \Phi^2 + d \Phi^2 T + e \Phi^3 + f \Phi^3 T$$

The FORTRAN routine, G02CHF, of Ref. 7 is utilized to perform polynomial regression. The user's program is given in Appendix C. The results are shown in Table 2.

TABLE 2
RESULTS OF LINEAR REGRESSION ANALYSIS

H-451 Irradiation Creep Results

Variable	Coefficient	Standard Error	T-Value
1	2.87128	0.00000	0.4072E-01
2	0.14853	2.51639	0.0000E+00
3	-2.48083	0.30075	0.1141E+01
4	0.25992	1.96775	0.4939E+00
5	0.44420	0.23008	-0.1261E+01
6	-0.05671	0.35275	0.1130E+01

Analysis of Regression Table

Source	Summary of Square	DF	Mean Square	F-Value
Due to regression	4101.42	6	683.57	672.79
About regression	<u>90.43</u>	89	1.0160	
Total	4191.85			

Standard error of estimate = 1.0080
 Multiple correlation (R) = 0.9892
 Determination (R squared) = 0.9784
 Corrected R squared = 0.9770

The least square fit results in the following creep equation:

1. For $T \geq 600^\circ\text{C}$ and $\Phi \leq 4.5 \times 10^{21} \text{ n/cm}^2$ ($E > 0.18 \text{ MeV}$)

$$\begin{aligned} \epsilon^C E_0 / \sigma = & 1 - \exp(-\Phi/0.04) + 2.87128 \Phi + 0.14853 \Phi T \\ & - 2.48083 \Phi^2 + 0.25992 \Phi^2 T + 0.44420 \Phi^3 \\ & - 0.05671 \Phi^3 T, \end{aligned} \quad (21)$$

where ϵ^C = creep strain,

E_0 = elastic modulus at the fluence loading or unloading occurred (MPa),

σ = applied stress (MPa),

Φ = fast neutron fluence ($\text{n/cm}^2 \times 10^{-21}$)
($E > 0.18 \text{ MeV}$),

T = temperature ($^\circ\text{C}/100$).

2. For $T < 600^\circ\text{C}$, the creep equation at 600°C should be used.

Examining the regression equation and the associated statistics (Table 2) the following fine points are drawn:

1. The regression $R^2 = 97.84\%$ implies that the regression equation obtained explains 97.8% of the total variation.
2. The 99% point of $F(6, 89, 0.99) = 3.04$. The regression $F = 672.79 > 3.04$. The regression is significant.
3. The SE (standard error) of estimate = 1.008. The SE as percentage of the mean decreases with the fluence. The percentage is less than 15% with the fluence $> 0.8 \times 10^{21} \text{ n/cm}^2$. In

the fluence range where the maximum fuel element stress is expected to occur, the percentage is only about half of the value used in the criteria development (~22%).

4. Residual of the regression (defined here as the difference between the predicted and observed values of ϵ^{SE_0}/σ) is plotted in Fig. 2. It appears that the regression model is adequate. But there is some evidence that the larger observed values were underpredicted by the model. The model might be amended to provide better prediction. It is also expected that when data at temperatures other than 600° and 900°C are obtained and a new regression model (at least quadratic in T) is used, the prediction will improve.

Residual plots for the three data sets are given in Figs. 3, 4, and 5. The steady-state creep strain is normalized with respect to the initial elastic strain, i.e., σ/E_0 . Examining these plots reveals the following:

1. The creep equation overpredicts the tensile creep data. The amount is approximately equal to the initial elastic strain (the same as the transient creep strain too). It is also about the magnitude of one standard error.
2. The extreme point in Fig. 3 (with residual of +4.09) is potentially an outlier. The raw data given in Appendix A is very much out of line with the rest of the data. The sample is No. 11, a specimen used to replace the broken specimen (sample No. 7) at about 1/3 through the experiment.
3. The creep equation gives the 600°C compressive creep an excellent prediction. All data are within one standard error of the prediction (Fig. 4).

RESIDUALS OF LINEAR REGRESSION ANALYSIS

Fig. 2. Residuals of linear regression analysis

RESIDUALS OF PETTEN TENSILE CREEP DATA

Fig. 3. Residuals of petten tensile creep data

RESIDUALS OF ORNL 600C COMPRESSION CREEP DATA

Fig. 4. Residuals of ORNL 600C compression creep data

RESIDUALS OF ORNL 900C COMPRESSION CREEP DATA

Fig. 5. Residuals of ORNL 900C compression creep data

4. The creep equation underpredict the 900°C compressive creep in the high creep strain range, as shown in Fig. 5.
5. The data indicates that apparently there are differences between the tensile and compressive creeps. The difference is about the order of the magnitude of the initial elastic strain.

The creep Eq. 21 is plotted in Fig. 6 only for the envelope of the core graphite design interset.

Fig. 6. Irradiation creep design curves

6. CONCLUSIONS AND RECOMMENDATIONS

1. The empirical creep equation (21) should be used for the design and analysis of the core graphite components in the preliminary design phase. The associated statistics should be employed for the criteria development.
2. Transient creep strain data at a "fluence" time of 4×10^{19} n/cm² or less immediately after loading change (not necessarily at zero fluence time) should be obtained. This is needed to confirm the transient creep model, and the value of E_0 .
3. The creep equation is assumed to be linear in T because creep data is only available at two temperatures. Data are needed at other temperatures. We recommended the following three additional temperatures: 400°, 750°, and 1100°C with a maximum fast fluence of at least 4.5, 4.5, and 1×10^{21} n/cm², respectively. Creep capsule 86M-2A, at JAERI, contains three H-451 specimens and is scheduled to be completed in December 1988. The irradiation temperature is 400°C and the target fluence is 2×10^{21} n/cm². This test will provide invaluable tensile creep information at low temperature. It is also worthwhile to recapsule these three creep specimens and continue testing to $>4 \times 10^{21}$ n/cm². Another JAREI capsule, 87M-2A, is currently under design. It is targeted at 1000°C and 2×10^{21} n/cm² maximum. It is strongly recommended that we negotiate with JAREI to include three H-451 creep specimens in this capsule.

4. When the JAERI creep data are available, statistical test shall be performed to test the significance of difference between tensile and compressive creeps (it is assumed to be identical here).

7. REFERENCES

1. Price, R. J., "Review of Irradiation-Induced Creep in Graphite: A Review," GA-A16402, August 1981.
2. Head, J. L., "The Transient Creep of Graphite in a Reactor Environment," Proceedings, Third SMIRT Conference, London, United Kingdom, September 1 to 5, 1975, Paper C1/6.
3. Price, R. J., "Review of Irradiation-Induced Creep in Graphite Under HTGR Conditions," Gulf-GA-A12332, November 1, 1972.
4. The following ORNL's Annual Progress Reports on HTGR Technology Development Program: ORNL-5412 (1977), ORNL-5536 (1978), ORNL-5643 (1979), ORNL-5753 (1980), ORNL-5871 (1981), ORNL-5960 (1982), and ORNL-6053 (1983).
5. "Monthly Progress Report for February 1982, HTR Technology Program," ORNL/GCR/B-87/2, March 1987.
6. "Monthly Progress Report for February 1982, HTR Technology Program," ORNL/GCR/B-82/2, March 1982.
7. "The NAG FORTRAN Manual," Vol. 5, Mark 12, Numerical Algorithms Group Inc., March 1987.
8. "Graphite Technology Development Plan," DOE-HTGR-86037/Rev. 0, July 1986.

APPENDIX A
LIST OF RAW DATA RECEIVED FROM ORNL

Explanation:

1. Subfile Name

40-A-C, 41-AX-CON, 40-A-2-0, 40-A-3-AN

where A or AX = axial specimen,

R or RA = radial specimen,

C or CON = control specimen,

2 or 3 = specimen subjected to 2000 or 3000 psi
compressive stress,

0 = overloaded specimen (see text),

AN = annealed specimen (load removed).

2. Variable No. 1 (Spec. No.)

abcd.efghi (e.g., 3201.11100)

where a = experiment number, i.e., 1, 2, 3, 4, or 5,

b = column number,

cd = position number,

efg = specimen I.D. number,

hi = not used.

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX X
OAK RIDGE, TENNESSEE 37831

April 27, 1988

Dr. Fu Ho
General Atomics
P. O. Box 85608
San Diego, California 92138

Dear Fu:

Enclosed are the data you requested and the extended abstracts for CARBON '88. Please throw away the old data that I gave you previously in that it contains poor dosimetry. I have carefully examined the dosimetry reports for these experiments and did uncover some errors in the method of reporting. The problem stemmed from the fact that during the summer months the ORR was forced to operate at a reduced power level and the fuel cycle was extended to fully burn out the fuel. The dosimetry was reported as flux rather than total fluence independent of the reactor power, and created some confusion in the overall calculations of total fluence. The reduced power also had an influence on the axial flux distribution compared to full power cycles. The values listed in the enclosed files have been rechecked and should be fairly accurate (with 10%).

Sincerely,

C. R. Kennedy
Ceramic Processing Development
Metals and Ceramics Division

CRK:mw

Enclosures

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*****
*                               DATA MANIPULATION                               *
*****

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DATA FROM EXPMT'S DC1,3,45

Data file name: DC1_3_55:CS80,702,1

Data type is: Raw data

Number of observations: 166
Number of variables: 21

Variable names:

1. SPEC NO
2. LENGTH %
3. DIA %
4. VOL %
5. DENSITY
6. MAT & TEST
7. 50 keV
8. SONIC EO
9. SONIC E
10. R SIDE
11. R ENDS
12. 800 CTE
13. A
14. B
15. CALC CREEP
16. AX % CREEP
17. Z/STRESS
18. G
19. PR
20. ATT
21. E RATIO

Subfile name	beginning observation	number of observations
1. 40-A-C	1	43
2. 40-A-2	44	19
3. 40-A-2-0	63	11
4. 40-A-2-AN	74	3
5. 40-A-3	77	11
6. 40-A-3-0	88	7
7. 40-A-3-AN	95	2
8. 40-R-C	97	6
9. 40-R-2	103	3
10. 40-R-2-0	106	3
11. 41-A-C	109	6
12. 41-A-2	115	3
13. 41-A-2-0	118	3
14. 41-A2-C	121	6
15. 41-A2-2	127	3
16. 41-A2-2-0	130	3
17. 3-A-C	133	6
18. 3-A-2	139	3
19. 3-A-2-0	142	3
20. 3-R-C	145	6
21. 3-R-2	151	3
22. 3-R-2-0	154	3
23. AXF-C	157	4
24. AXF-3	161	3
25. AXF-3-0	164	3

DATA FROM EXPMT'S OC1,3, #5

Data type is: Raw data

URS#	Variable # 1 (SPEC NO)	Variable # 2 (LENGTH %)	Variable # 3 (DIA %)	Variable # 4 (VOL %)	Variable # 5 (DENSITY)
1	3201.11100	-.31200	-.21000	-1.03000	1.72000
2	1103.09700	-.07300	.02400	-.04000	1.70900
3	1104.11200	-.11000	.01400	-.08800	1.72300
4	1105.09900	-.09000	-.03700	-.19100	1.70400
5	3203.20600	-.19000	-.11900	-.49600	1.70600
6	5212.11700	-.76700	-.44300	-1.85700	1.73600
7	1108.08600	-.12000	.01200	.11000	1.70600
8	5211.10200	-.89500	-.50300	-2.12800	1.73900
9	1110.11400	-.13000	.03500	-.07600	1.71900
10	1111.10100	-.12700	.04000	5.000000E-03	1.70300
11	1112.11600	-.12700	.03100	-.08500	1.71700
12	5210.11500	-.99500	-.56800	-2.36300	1.76100
13	1201.11100	-.08700	-.03100	-.19700	1.70200
14	5208.08700	-1.06900	-.59600	-2.38300	1.74700
15	1203.09800	-.09700	.01700	-.08900	1.70400
16	1204.11300	-.08700	.02500	-.06500	1.72100
17	1205.10000	-.11500	.02200	.04000	1.70300
18	5205.20700	-.57800	-.32900	-1.36600	1.72200
19	5204.12500	-.48300	-.28300	-1.16500	1.73200
20	1208.08700	-.11000	.01800	-.04200	1.70600
21	5203.20600	-.47000	-.25000	-1.11700	1.71600
22	1210.11500	-.10500	.02400	-.14500	1.72200
23	1211.10200	-.11800	.03700	-.06100	1.70400
24	1212.11700	-.09700	.04300	-.03300	1.70500
25	5201.11100	-.52200	-.46100	-1.65300	1.72300
26	3204.12500	-.19500	-.12100	-.49700	1.72100
27	5112.12600	-9999999.99999	-9999999.99999	-9999999.99999	1.73100
28	3103.09700	-.39500	-.22200	-1.10800	1.72700
29	5111.10100	-.29000	-.12900	-.55000	1.71200
30	3205.20700	-.23800	-.13300	-.57700	1.70800
31	5110.11400	-.32000	-.15100	-.69500	1.72900
32	5108.08600	-.32200	-.16500	-.73900	1.71700
33	3101.12400	-.18000	-.11900	-.48000	1.71900
34	5105.09900	-.26000	-.18600	-.93500	1.71700
35	5104.11200	-.24700	-.10700	-.32700	1.72700
36	3208.08700	-.53500	-.29300	-1.34700	1.73000
37	5103.09700	-.71000	-.41900	-1.71300	1.73800
38	5101.12400	-.31300	-.19000	-.78600	1.72400
39	3210.11500	-.52200	-.28300	-1.42700	1.74100
40	3211.10200	-.46500	-.25300	-1.29500	1.72500
41	3212.11700	-.40000	-.22100	-1.13400	1.72100
42	1101.10900	-.09300	-.01800	-.17400	1.70200
43	3112.12600	-.22000	-.13200	-.54900	1.72000
44	3308.02300	-2.00200	.24700	-1.56600	1.74200
45	3305.17200	-1.39400	.21700	-1.00700	1.73000
46	3303.03400	-1.70000	.24600	-1.26000	1.72300
47	5311.03800	-2.79100	.07200	-2.81300	1.75500
48	3301.04600	-1.45000	.20300	-1.09700	1.72700
49	5403.17100	-2.19000	.10700	-2.08200	1.73600
50	3403.17100	-1.36100	.19400	-1.03800	1.71900
51	3405.17300	-1.49600	.17900	-1.15700	1.72400
52	5308.02300	-2.99700	.04300	-3.08600	1.76900
53	1311.03800	-.78000	.18600	-.43400	1.71400
54	1308.02300	-.80200	.20000	-.41800	1.72300
55	1305.03600	-.74000	.20800	-.34600	1.71200
56	1303.03400	-.70700	.19700	-.33100	1.71300
57	1301.04600	-.65300	.15000	-.36000	1.71400
58	5305.17200	-2.33500	.12800	-2.19100	1.73800
59	5301.04600	-2.07000	.10100	-1.97900	1.74200
60	5405.17300	-2.60300	.05800	-2.58100	1.74800
61	3311.03800	-1.90000	.20400	-1.56200	1.73400
62	5303.03400	-2.45700	.13300	-2.33000	1.74700
63	1408.02400	-1.39500	.36800	-.68000	1.72200
64	5401.04800	-2.72600	.22100	-2.31400	1.74400
65	3408.02400	-2.54500	.37700	-1.84200	1.74300
66	1405.03700	-1.43000	.36100	-.74600	1.72200
67	1411.03900	-1.29500	.32200	-.58500	1.72100
68	1401.04800	-1.38000	.30500	-.59800	1.71700
69	3411.03900	-2.28000	.32800	-1.58800	1.73900
70	1403.03500	-1.37500	.34700	-.72000	1.72100
71	3401.04600	-2.05800	.33300	-1.34200	1.72800
72	5408.02400	-3.64700	.10300	-3.57700	1.77200
73	5411.03900	-3.27000	.15300	-3.02600	1.76300
74	3111.03700	-.65800	-.46400	-.81800	1.73300
75	3105.03600	-.62300	-.30200	-.83900	1.72300
76	3110.03500	-.63300	-.97600	-2.11200	1.75600
77	1310.03100	-1.08700	.22400	-.67800	1.73400
78	1304.04900	-.99600	.21700	-.59900	1.73500
79	5404.06200	-3.26600	.32100	-2.82000	1.76600
80	5304.05100	-2.92200	.35200	-2.39600	1.75900

DOE-HTGR-88097/1

91	3412.05100	-2.89700	.48900	-1.82100	1.75400
92	3412.05300	-1.02000	.21400	-1.82100	1.73100
93	3404.05200	-1.94200	.44500	-1.14100	1.73800
94	3410.05100	-3.85400	.30400	-3.52900	1.78300
95	3404.05100	-1.79200	.42800	-1.01300	1.73600
96	3412.05300	-3.44200	.32100	-3.00700	1.75500
97	3412.05300	-2.39500	.44300	-1.55200	1.74800
98	3412.05400	-3.87700	.79700	-2.39700	1.75600
99	3410.05200	-2.51400	.57900	-1.44100	1.74300
100	3412.05400	-2.63400	.59000	-1.57400	1.74000
101	3412.05400	-4.74000	.61000	-3.85400	1.77900
102	3404.05000	-2.75900	.59600	-1.68600	1.75300
103	3410.05200	-4.82500	.52200	-4.09500	1.78900
104	3410.05200	-3.86400	.74700	-2.45700	1.76200
105	3104.04900	-.04300	-.32400	-33.43800	1.73900
106	3108.05000	.43500	-.50800	-.66500	1.75700
107	1209.09200	-.06500	.02200	-.03900	1.70400
108	1109.09100	-.07700	.01700	-.05700	1.69900
109	5209.09200	-.67800	-.70900	-2.34100	1.74300
110	5109.09500	-.41000	-.56700	-1.71200	1.72800
111	3109.09500	-.17000	-.24000	-.72800	1.71200
112	3209.09200	-.33500	-.35700	-1.47600	1.72300
113	1309.02600	-.85000	.18300	-.50200	1.71300
114	5309.02800	-2.97700	-.01700	-3.18700	1.75900
115	3309.02800	-2.06700	.15100	-1.84700	1.73700
116	1409.02900	-1.63300	.35400	-.96800	1.72500
117	5409.02900	-3.62000	.10300	-3.77100	1.77300
118	3409.02900	-2.67800	.32600	-2.10700	1.74700
119	1206.07700	-.09700	1.00000E-03	-.11400	1.71200
120	3106.08000	-.36700	-.17100	-.80400	1.70600
121	5206.07600	-.80000	-.59300	-2.19900	1.75000
122	3206.07600	-.44000	-.33000	-1.14000	1.73100
123	1106.07600	-.08000	.02100	-.05200	1.71300
124	5106.08000	-.71100	-.37500	-1.62800	1.72000
125	1306.01300	-.78500	.20000	-.39900	1.71200
126	5306.01300	-2.84300	.02800	-2.87500	1.76200
127	3306.01300	-1.94300	.23600	-1.52100	1.73900
128	1406.01400	-1.43500	.36000	-.75000	1.72000
129	5406.01400	-3.59400	.13500	-3.53700	1.76700
130	3406.01400	-2.54400	.35700	-1.90100	1.74000
131	3107.08500	-.25750	-.16800	-3.70300	1.73000
132	5207.08200	-.89500	-.55400	-2.22400	1.76300
133	5107.08500	-.59800	-.37900	-1.49300	1.74400
134	1107.08100	-.09500	.03900	-.03400	1.72800
135	3207.08200	-.44700	-.28200	-1.34600	1.74400
136	1207.08200	-.09000	.01900	-.06900	1.72600
137	5307.01800	-2.67200	.03600	-2.72800	1.78000
138	3307.01800	-1.76000	.21700	-1.35600	1.75600
139	1307.01800	-.68700	.19600	-.30800	1.73900
140	3407.01900	-2.20700	.29000	-1.64200	1.75900
141	5407.01900	-3.23200	.08900	-3.19700	1.78500
142	1407.01900	-1.20700	.44800	-.33000	1.74100
143	5202.06600	-.79700	-.27800	-1.49500	1.79800
144	1202.06600	-.14500	.04000	-.09000	1.77300
145	5102.06900	-.28200	-.22600	-.75500	1.77500
146	3202.06600	-.48200	-.17900	-1.04900	1.78800
147	1102.06800	-.18200	1.00000E-03	-.21600	1.76800
148	3102.06900	-.27200	-.13900	-.62900	1.77300
149	5302.00500	-1.95900	.08200	-1.85600	1.80200
150	1302.00500	-.60000	.11100	-.39200	1.77600
151	3302.00500	-1.35700	.12100	-1.12900	1.79000
152	1402.00300	-1.43400	.39500	-.67600	1.78200
153	5402.00300	-2.22900	.41400	-1.41300	1.79600
154	3402.00300	-2.89400	.35000	-2.28900	1.81100
155	3113.07400	-.13500	-.13700	-.47700	1.77200
156	3213.07100	-.22300	-.22900	-.95500	1.78500
157	1213.07100	-.04300	.05400	-.04900	1.77000
158	5113.07000	-.06500	.06100	-.05300	1.76000
159	3213.07100	-.37500	-.53000	-1.58100	1.79900
160	5113.07400	-.24500	-.30400	-.97200	1.78100
161	1313.00700	-1.11000	.16000	-.81300	1.77500
162	3313.00700	-2.01700	.15400	-1.74300	1.79200
163	5313.00700	-2.60000	.17500	-2.32900	1.80200
164	3413.00800	-3.14300	.43900	-2.32600	1.80700
165	5413.00800	-3.72000	.47100	-2.94000	1.81700
166	1413.00800	-2.41900	.45400	-1.63300	1.79400
167	5114.02500	-.20100	.71900	-1.34100	1.89600
168	3114.02500	.02000	.97400	-1.99700	1.88400
169	3214.03400	-.77900	-.54300	-3.06000	1.80700
170	5214.03400	-.82900	-.46800	-1.52100	1.80300
171	3314.00300	-.94100	.19800	-.53900	1.85600
172	5314.00300	-1.09600	.16400	-.79500	1.85000
173	1314.00300	-.47300	.26600	-.06000	1.84400
174	3414.00400	-.61000	.19400	-18.10900	1.87100
175	5414.00400	-.59300	.27300	-.04100	1.86700
176	1414.00400	-.51300	.13800	-.24700	1.87100

	Variable # 6 (HAT & TEST)	Variable # 7 (50 keV)	Variable # 8 (SONIC E0)	Variable # 9 (SONIC E)	Variable #10 (R SIDE)
089#					
1	11110.00000	.21000	8.34295	13.30000	19.60000
2	11110.00000	.08000	8.41190	11.08000	15.84000
3	11110.00000	.08500	8.61875	11.83000	16.04000
4	11110.00000	.09500	8.34295	11.54000	16.34000
5	11110.00000	.17000	8.96350	12.99000	18.20000
6	11110.00000	.50000	8.41190	15.15000	23.00000
7	11110.00000	.11300	8.89455	11.49000	16.46000
8	11110.00000	.52000	8.34295	15.77000	22.90000
9	11110.00000	.11500	8.48085	11.90000	15.83000
10	11110.00000	.11300	8.34295	11.26000	16.46000
11	11110.00000	.10900	8.68770	11.72000	15.27000
12	11110.00000	.53000	8.54980	16.16000	22.30000
13	11110.00000	.06400	8.34295	11.06000	13.48000
14	11110.00000	.52000	8.48085	15.75000	22.80000
15	11110.00000	.08000	8.41190	11.23000	15.45000
16	11110.00000	.08500	8.54980	11.86000	13.38000
17	11110.00000	.09500	8.34295	11.39000	14.87000
18	11110.00000	.34100	8.96350	14.54000	21.80000
19	11110.00000	.31000	8.96350	14.64000	21.30000
20	11110.00000	.11300	8.48085	11.62000	16.60000
21	11110.00000	.28000	8.96350	14.22000	21.30000
22	11110.00000	.11500	8.54980	11.91000	18.02000
23	11110.00000	.11300	8.34295	11.49000	15.54000
24	11110.00000	.10900	8.41190	11.34000	14.24000
25	11110.00000	.30000	8.34295	14.82000	22.50000
26	11110.00000	.19000	8.96350	13.33000	18.40000
27	11110.00000	.49000	8.96350	16.39000	22.10000
28	11110.00000	.26000	8.27400	13.95000	20.90000
29	11110.00000	.27000	8.34295	16.10000	22.30000
30	11110.00000	.21000	8.96350	13.21000	18.60000
31	11110.00000	.27000	8.48085	16.08000	21.90000
32	11110.00000	.27000	8.89455	16.97000	22.20000
33	11110.00000	.14000	8.96350	13.11000	18.20000
34	11110.00000	.23000	8.34295	15.21000	22.80000
35	11110.00000	.20000	8.61875	16.96000	21.30000
36	11110.00000	.35000	8.48085	14.35000	20.90000
37	11110.00000	.37000	8.41190	16.73000	23.00000
38	11110.00000	.23000	8.96350	15.85000	21.10000
39	11110.00000	.37000	8.54980	14.49000	19.90000
40	11110.00000	.37000	8.34295	14.22000	20.50000
41	11110.00000	.35000	8.41190	13.98000	20.60000
42	11110.00000	.06400	8.27400	10.90000	14.26000
43	11110.00000	.24000	8.96350	13.47000	18.50000
44	11120.00000	.36000	8.61875	13.91000	20.00000
45	11120.00000	.31000	8.82560	13.18000	19.20000
46	11120.00000	.17000	8.27400	13.30000	20.50000
47	11120.00000	.52000	8.27400	15.48000	23.50000
48	11120.00000	.21000	8.20505	13.50000	15.20000
49	11120.00000	.28000	8.82560	14.13000	22.30000
50	11120.00000	.17000	8.82560	11.42000	19.10000
51	11120.00000	.21000	8.82560	11.70000	19.80000
52	11120.00000	.52000	8.61875	16.13000	23.90000
53	11120.00000	.11300	8.27400	11.37000	17.50000
54	11120.00000	.11300	8.61875	11.89000	18.20000
55	11120.00000	.09500	8.20505	11.32000	17.60000
56	11120.00000	.08000	8.27400	11.25000	17.30000
57	11120.00000	.06400	8.20505	10.39000	15.80000
58	11120.00000	.34000	8.82560	14.46000	23.20000
59	11120.00000	.23000	8.20505	14.89000	22.70000
60	11120.00000	.34000	8.82560	14.62000	23.00000
61	11120.00000	.37000	8.27400	13.05000	21.10000
62	11120.00000	.37000	8.27400	15.33000	23.60000
63	11121.00000	.11300	8.27400	11.18000	18.30000
64	11121.00000	.23000	8.13610	14.87000	23.40000
65	11121.00000	.36000	8.27400	13.50000	21.10000
66	11121.00000	.09500	8.13610	10.78000	21.30000
67	11121.00000	.11300	8.27400	10.96000	18.30000
68	11121.00000	.06400	8.13610	10.19000	16.10000
69	11121.00000	.37000	8.27400	12.73000	21.10000
70	11121.00000	.08000	8.27400	10.60000	17.10000
71	11121.00000	.21000	8.13610	12.03000	20.20000
72	11121.00000	.52000	8.27400	16.31000	24.70000
73	11121.00000	.52000	8.27400	15.45000	24.70000
74	11122.00000	.34500	8.13610	-9999999.99999	-9999999.99999
75	11122.00000	.31000	8.20505	-9999999.99999	-9999999.99999
76	11122.00000	.34000	8.27400	-9999999.99999	-9999999.99999
77	11130.00000	.11500	8.48085	11.84000	18.10000
78	11130.00000	.08500	8.48085	11.82000	17.50000
79	11130.00000	.31000	8.89455	14.90000	25.20000
80	11130.00000	.31000	8.82560	14.80000	23.90000

81	11130.00000	.37000	8.48085	13.88000	21.90000
82	11130.00000	.10900	8.48085	11.52000	17.10000
83	11130.00000	.19000	8.89455	11.81000	20.50000
84	11130.00000	.53000	8.48085	16.27000	25.50000
85	11130.00000	.19000	8.82560	12.98000	19.80000
86	11130.00000	.50000	8.48085	15.80000	25.20000
87	11130.00000	.35000	8.48085	13.10000	21.50000
88	11131.00000	.35000	8.82560	12.18000	22.30000
89	11131.00000	.11500	8.48085	10.32000	18.00000
90	11131.00000	.10900	8.82560	9.97800	18.00000
91	11131.00000	.50000	8.82560	15.54000	25.00000
92	11131.00000	.08500	8.48085	10.17000	18.70000
93	11131.00000	.53000	8.48085	16.33000	25.60000
94	11131.00000	.37000	8.48085	12.72000	22.40000
95	11132.00000	.27000	8.48085	-999999.99999	-999999.99999
96	11132.00000	.33500	8.48085	-999999.99999	-999999.99999
97	12110.00000	.11600	7.58450	10.52000	19.76000
98	12110.00000	.11600	7.65345	10.32000	18.29000
99	12110.00000	.53000	7.58450	14.32000	23.90000
100	12110.00000	.42000	7.65345	13.33000	24.10000
101	12110.00000	.26000	7.65345	11.73000	20.70000
102	12110.00000	.37000	7.58450	12.56000	21.50000
103	12120.00000	.11600	7.58450	10.57000	18.50000
104	12120.00000	.53000	7.58450	14.60000	24.50000
105	12120.00000	.37000	7.58450	12.25000	21.80000
106	12121.00000	.11600	7.86030	9.95500	19.20000
107	12121.00000	.53000	7.86030	14.88000	24.50000
108	12121.00000	.37000	7.86030	11.68000	22.10000
109	21110.00000	.10100	8.41190	11.75000	15.36000
110	21110.00000	.22500	8.89455	13.15000	19.90000
111	21110.00000	.36000	8.34295	15.70000	22.20000
112	21110.00000	.21000	8.34295	14.21000	20.30000
113	21110.00000	.10100	8.34295	11.77000	16.35000
114	21110.00000	.36000	8.89455	16.29000	23.60000
115	21120.00000	.10100	8.61875	11.70000	17.30000
116	21120.00000	.46000	8.61875	15.86000	23.90000
117	21120.00000	.33000	8.61875	14.15000	20.60000
118	21121.00000	.10100	8.34295	11.08000	17.90000
119	21121.00000	.46000	8.34295	16.16000	23.70000
120	21121.00000	.33000	8.34295	12.56000	21.10000
121	21210.00000	.24000	8.34295	14.21000	18.60000
122	21210.00000	.50000	8.68770	16.77000	21.90000
123	21210.00000	.39000	8.34295	17.24000	22.30000
124	21210.00000	.11100	8.89455	12.25000	16.05000
125	21210.00000	.35000	8.68770	14.96000	19.70000
126	21210.00000	.11100	8.68770	12.30000	15.77000
127	21220.00000	.50000	8.96350	17.19000	22.50000
128	21220.00000	.35000	8.96350	14.77000	19.70000
129	21220.00000	.11100	8.96350	12.62000	19.70000
130	21221.00000	.35000	8.96350	13.34000	19.80000
131	21221.00000	.50000	8.96350	17.02000	23.10000
132	21221.00000	.11100	8.96350	12.14000	17.10000
133	31110.00000	.33000	12.13520	14.57000	20.70000
134	31110.00000	.07200	12.27310	11.83000	8.47000
135	31110.00000	.26000	12.89365	17.51000	20.90000
136	31110.00000	.23000	12.13520	17.99000	18.50000
137	31110.00000	.07200	12.13520	10.72000	10.63000
138	31110.00000	.16000	12.89365	17.66000	16.90000
139	31120.00000	.33000	11.92835	18.89000	21.30000
140	31120.00000	.07200	11.92835	11.01000	15.40000
141	31120.00000	.23000	11.92835	15.76000	15.70000
142	31121.00000	.07200	11.72150	10.70000	11.60000
143	31121.00000	.23000	11.72150	14.90000	16.40000
144	31121.00000	.33000	11.72150	18.30000	22.20000
145	32110.00000	.21000	5.86075	.52000	18.90000
146	32110.00000	.29000	5.86075	-999999.99999	22.80000
147	32110.00000	.09700	5.86075	8.21800	18.63000
148	32110.00000	.09700	5.86075	6.82000	21.13000
149	32110.00000	.41000	5.86075	11.02000	22.50000
150	32110.00000	.33000	8.34295	10.38000	22.90000
151	32120.00000	.09700	7.17080	6.45700	16.40000
152	32120.00000	.29000	7.17080	9.79000	23.30000
153	32120.00000	.41000	7.17080	11.87000	23.50000
154	32121.00000	.29000	6.20550	15.28000	21.00000
155	32121.00000	.41000	6.20550	11.92000	23.50000
156	32121.00000	.09700	6.20550	7.15100	22.60000
157	41110.00000	.27000	8.20505	-999999.99999	-999999.99999
158	41110.00000	.17000	8.20505	2.91000	-999999.99999
159	41110.00000	.17000	8.61875	17.14000	-999999.99999
160	41110.00000	.27000	8.75665	-999999.99999	-999999.99999
161	41130.00000	.27000	20.61605	27.23000	19.70000
162	41130.00000	.35000	20.61605	33.95000	23.00000
163	41130.00000	.07900	20.61605	19.90000	18.60000
164	41131.00000	.27000	28.26950	32.80000	19.90000
165	41131.00000	.35000	28.26950	40.10000	22.60000
166	41131.00000	.07900	28.26950	29.19000	18.80000

	Variable #11 (R ENDS)	Variable #12 (BOO CTE)	Variable #13 (A)	Variable #14 (B)	Variable #15 (CALC CREEP)
0881					
1	20.00000	3.60000	1.86000	1.25000	0.00000
2	-9999999.99999	3.85000	2.60000	1.55000	0.00000
3	-9999999.99999	3.82000	2.36000	1.75000	0.00000
4	-9999999.99999	3.74000	2.36000	1.71000	0.00000
5	18.40000	4.21000	2.12000	2.80000	0.00000
6	23.40000	4.55000	3.24000	1.38000	0.00000
7	-9999999.99999	4.28000	2.76000	1.97000	0.00000
8	23.20000	4.19000	3.60000	1.53000	0.00000
9	-9999999.99999	4.04000	2.61000	1.80000	0.00000
10	-9999999.99999	4.16000	2.64000	1.91000	0.00000
11	-9999999.99999	4.16000	2.71000	1.80000	0.00000
12	19.30000	3.96000	2.72000	1.64000	0.00000
13	-9999999.99999	3.81000	2.42000	1.78000	0.00000
14	23.50000	3.83000	2.98000	1.04000	0.00000
15	-9999999.99999	4.03000	2.66000	1.77000	0.00000
16	-9999999.99999	4.21000	2.66000	1.89000	0.00000
17	-9999999.99999	3.87000	2.40000	1.86000	0.00000
18	22.20000	4.04000	2.64000	1.67000	0.00000
19	21.30000	3.98000	2.61000	1.71000	0.00000
20	-9999999.99999	3.79000	2.43000	1.72000	0.00000
21	22.40000	4.04000	2.65000	1.65000	0.00000
22	-9999999.99999	3.92000	2.46000	1.84000	0.00000
23	-9999999.99999	3.69000	2.25000	1.82000	0.00000
24	-9999999.99999	3.96000	2.60000	1.70000	0.00000
25	22.60000	3.99000	2.87000	1.38000	0.00000
26	18.40000	4.20000	2.53000	2.28000	0.00000
27	21.40000	4.11000	2.80000	1.68000	0.00000
28	26.30000	3.99000	1.39000	1.24000	0.00000
29	22.70000	4.84000	3.64000	1.60000	0.00000
30	19.20000	4.35000	2.13000	2.34000	0.00000
31	21.00000	4.93000	4.12000	.88000	0.00000
32	29.10000	4.64000	3.40000	1.72000	0.00000
33	21.70000	3.90000	2.25000	.87000	0.00000
34	29.10000	4.29000	3.00000	1.62000	0.00000
35	26.80000	3.93000	2.60000	1.98000	0.00000
36	21.30000	4.00000	2.27000	2.29000	0.00000
37	30.40000	4.33000	2.80000	1.83000	0.00000
38	28.20000	3.99000	3.06000	1.29000	0.00000
39	20.40000	3.99000	2.07000	2.54000	0.00000
40	21.20000	4.14000	2.56000	2.20000	0.00000
41	20.80000	3.89000	2.57000	2.09000	0.00000
42	-9999999.99999	3.89000	2.54000	1.67000	0.00000
43	17.70000	4.00000	2.02000	1.36000	0.00000
44	20.30000	4.50000	2.97000	1.04000	-1.50140
45	21.40000	4.51000	3.35000	1.65000	-.94200
46	20.40000	4.65000	3.44000	1.72000	-1.47720
47	23.20000	5.29000	4.00000	1.84000	-1.88620
48	20.80000	4.39000	2.72000	1.89000	-1.15000
49	22.20000	4.89000	3.56000	1.70000	-1.73800
50	23.40000	4.92000	3.31000	1.92000	-1.13800
51	20.00000	4.35000	2.69000	1.05000	-1.24600
52	23.10000	5.10000	3.82000	1.82000	-1.95630
53	18.00000	4.54000	2.80000	2.20000	-.67270
54	18.20000	4.56000	2.65000	2.25000	-.68975
55	18.20000	4.53000	2.72000	2.28000	-.63360
56	17.60000	4.54000	2.79000	2.21000	-.61040
57	15.90000	4.59000	3.00000	1.90000	-.57099
58	22.70000	5.00000	3.82000	1.53000	-1.43019
59	22.40000	4.74000	3.48000	1.70000	-1.56934
60	22.70000	4.83000	3.28000	2.02000	-1.69819
61	20.10000	4.97000	3.39000	.99000	-1.42443
62	23.00000	4.95000	3.72000	2.34000	-1.72569
63	18.40000	4.88000	2.92000	2.36000	-1.28275
64	22.30000	5.11000	3.82000	1.57000	-2.22534
65	20.80000	5.27000	3.57000	1.13000	-2.06943
66	18.30000	4.59000	2.74000	2.31000	-1.32364
67	18.00000	4.62000	2.94000	2.11000	-1.18766
68	16.40000	4.56000	3.10000	1.80000	-1.29799
69	20.60000	4.95000	3.31000	.99000	-1.80443
70	17.70000	4.56000	2.98000	2.10000	-1.27840
71	20.10000	5.22000	3.26000	1.51000	-1.77862
72	23.60000	5.31000	3.92000	1.84000	-2.60631
73	21.80000	5.44000	4.25000	1.57000	-2.36520
74	-9999999.99999	-9999999.99999	-9999999.99999	-9999999.99999	0.00000
75	-9999999.99999	-9999999.99999	-9999999.99999	-9999999.99999	0.00000
76	-9999999.99999	-9999999.99999	-9999999.99999	-9999999.99999	0.00000
77	19.10000	4.71000	2.98000	2.15000	-.97672
78	18.50000	4.57000	2.96000	2.03000	-.89355
79	23.00000	5.36000	3.90000	1.74000	-2.43330
80	23.00000	5.59000	4.28000	1.66000	-2.09932

80	23.00000	5.59000	4.28000	1.66000	-2.09932
81	19.50000	5.45000	3.73000	1.38000	-1.12934
82	18.29000	4.35000	3.05000	2.10000	-0.91660
83	24.70000	5.14000	3.52000	1.09000	-1.70600
84	24.00000	5.80000	4.74000	1.50000	-0.28903
85	22.00000	5.10000	3.45000	2.24000	-1.55595
86	23.80000	5.66000	4.86000	1.86000	-2.61932
87	19.70000	5.32000	3.31000	1.65000	-1.96630
88	21.10000	6.09000	4.12000	1.47000	-3.44829
89	18.90000	5.71000	3.59000	2.58000	-2.40372
90	18.70000	5.73000	3.76000	2.48000	-2.53057
91	23.70000	6.09000	4.94000	1.78000	-3.91732
92	19.20000	5.81000	3.65000	2.72000	-2.56550
93	23.40000	5.80000	4.52000	1.42000	-3.73135
94	22.00000	5.49000	3.48000	1.47000	-3.36334
95	-9999999.99999	-9999999.99999	2.36000	1.07000	0.00000
96	-9999999.99999	-9999999.99999	-9999999.99999	-9999999.99999	0.00000
97	-9999999.99999	4.51000	3.15000	1.75000	0.00000
98	-9999999.99999	4.68000	3.35000	1.67000	0.00000
99	21.90000	4.45000	3.20000	1.49000	0.00000
100	29.10000	4.41000	3.42000	1.32000	0.00000
101	23.70000	4.70000	2.91000	1.30000	0.00000
102	19.90000	4.65000	2.80000	2.46000	0.00000
103	17.50000	5.19000	3.55000	2.35000	-0.78297
104	22.20000	6.16000	5.30000	1.38000	-2.29695
105	20.90000	5.56000	3.75000	1.33000	-1.75534
106	17.70000	5.51000	3.68000	2.31000	0.00000
107	22.20000	6.34000	5.32000	1.62000	-1.56597
108	20.30000	5.38000	3.72000	1.07000	-2.34654
109	-9999999.99999	3.79000	2.44000	1.68000	0.00000
110	24.70000	3.95000	2.36000	1.07000	0.00000
111	22.80000	3.60000	2.14000	1.96000	0.00000
112	21.10000	4.20000	2.10000	2.76000	0.00000
113	-9999999.99999	3.78000	2.46000	1.46000	0.00000
114	30.60000	4.18000	3.25000	1.25000	0.00000
115	17.60000	4.52000	2.79000	2.21000	0.00000
116	22.80000	4.93000	3.62000	1.58000	0.00000
117	20.40000	4.59000	2.93000	1.19000	0.00000
118	18.30000	4.58000	2.78000	2.32000	0.00000
119	23.10000	5.09000	3.61000	1.91000	0.00000
120	20.50000	5.15000	3.52000	1.08000	0.00000
121	23.70000	3.90000	2.26000	1.13000	0.00000
122	22.20000	3.81000	2.30000	1.90000	0.00000
123	29.10000	3.88000	2.43000	1.90000	0.00000
124	-9999999.99999	3.66000	2.47000	1.57000	0.00000
125	20.30000	4.15000	2.00000	3.00000	0.00000
126	-9999999.99999	3.73000	2.51000	1.55000	0.00000
127	22.10000	4.80000	3.25000	1.99000	0.00000
128	20.90000	4.79000	3.51000	.64000	0.00000
129	17.40000	4.59000	2.80000	2.35000	0.00000
130	20.40000	4.81000	2.51000	1.32000	0.00000
131	22.30000	5.15000	3.73000	1.81000	0.00000
132	17.60000	4.48000	2.88000	2.26000	0.00000
133	27.90000	1.80000	.51000	1.84000	0.00000
134	-9999999.99999	1.90000	.72000	1.54000	0.00000
135	34.90000	1.79000	.46000	1.74000	0.00000
136	23.20000	2.15000	.71000	1.74000	0.00000
137	-9999999.99999	1.57000	.54000	1.30000	0.00000
138	26.80000	1.75000	.48000	.83000	0.00000
139	25.60000	2.65000	1.26000	1.66000	0.00000
140	18.80000	1.88000	1.30000	1.30000	0.00000
141	18.40000	2.50000	1.05000	1.82000	0.00000
142	18.30000	2.44000	.70000	2.20000	0.00000
143	22.40000	2.69000	1.00000	1.13000	0.00000
144	25.10000	2.84000	1.20000	1.86000	0.00000
145	15.80000	-9999999.99999	2.01000	1.04000	0.00000
146	17.40000	3.56000	1.79000	2.33000	0.00000
147	-9999999.99999	3.41000	2.16000	1.60000	0.00000
148	-9999999.99999	3.38000	1.94000	1.79000	0.00000
149	19.70000	3.55000	1.88000	2.07000	0.00000
150	22.70000	3.71000	2.32000	1.63000	0.00000
151	15.90000	4.24000	2.55000	2.41000	0.00000
152	21.90000	5.07000	3.24000	1.28000	0.00000
153	21.80000	5.15000	3.33000	2.17000	0.00000
154	18.80000	5.35000	2.75000	2.23000	0.00000
155	20.80000	5.61000	3.38000	2.58000	0.00000
156	15.80000	5.14000	2.43000	2.37000	0.00000
157	-9999999.99999	3.99000	-9999999.99999	-9999999.99999	0.00000
158	-9999999.99999	2.75000	1.52000	.64000	0.00000
159	-9999999.99999	3.09000	1.86000	1.82000	0.00000
160	-9999999.99999	-9999999.99999	-9999999.99999	-9999999.99999	0.00000
161	21.30000	3.47000	1.35000	1.45000	0.00000
162	20.30000	3.39000	2.22000	1.43000	0.00000
163	20.00000	-9999999.99999	2.69000	1.68000	0.00000
164	19.00000	2.45000	.97000	.30000	0.00000
165	20.80000	2.51000	1.30000	1.56000	0.00000
166	19.30000	-9999999.99999	1.75000	1.49000	0.00000

	Variable #16 (AX % CREEP)	Variable #17 (Z/STRESS)	Variable #18 (G)	Variable #19 (PR)	Variable #20 (ATT)
085#					
1	0.00000	0.00000	5.50000	0.00000	2.99212
2	0.00000	0.00000	4.58000	.21000	3.50393
3	0.00000	0.00000	4.67000	.21000	3.07086
4	0.00000	0.00000	4.78000	.21000	3.66141
5	0.00000	0.00000	5.44000	0.00000	3.11023
6	0.00000	0.00000	6.20000	0.00000	2.99212
7	0.00000	0.00000	4.73000	.21000	3.38582
8	0.00000	0.00000	6.51000	0.00000	2.79527
9	0.00000	0.00000	4.92000	.21000	3.14960
10	0.00000	0.00000	4.65000	.21000	3.58267
11	0.00000	0.00000	4.80000	.22000	3.14960
12	0.00000	0.00000	6.63000	0.00000	2.55905
13	0.00000	0.00000	4.57000	.21000	3.46456
14	0.00000	0.00000	6.44000	0.00000	2.95275
15	0.00000	0.00000	4.69000	.20000	3.46456
16	0.00000	0.00000	4.89000	.21000	3.14960
17	0.00000	0.00000	4.74000	.20000	3.50393
18	0.00000	0.00000	5.99000	0.00000	3.11023
19	0.00000	0.00000	5.99000	0.00000	2.71653
20	0.00000	0.00000	4.82000	.20000	3.30708
21	0.00000	0.00000	5.84000	0.00000	3.14960
22	0.00000	0.00000	4.93000	.21000	2.87401
23	0.00000	0.00000	4.74000	.21000	3.18897
24	0.00000	0.00000	4.70000	.21000	3.46456
25	0.00000	0.00000	6.05000	0.00000	2.99212
26	0.00000	0.00000	5.55000	0.00000	2.75590
27	0.00000	0.00000	6.31000	0.00000	2.83464
28	0.00000	0.00000	5.81000	0.00000	3.03149
29	0.00000	0.00000	6.44000	0.00000	3.14960
30	0.00000	0.00000	5.53000	0.00000	3.11023
31	0.00000	0.00000	6.74000	0.00000	2.63779
32	0.00000	0.00000	6.70000	0.00000	2.91338
33	0.00000	0.00000	5.42000	0.00000	2.91338
34	0.00000	0.00000	6.23000	0.00000	3.14960
35	0.00000	0.00000	6.57000	0.00000	2.55905
36	0.00000	0.00000	6.04000	0.00000	2.95275
37	0.00000	0.00000	6.61000	0.00000	3.11023
38	0.00000	0.00000	7.03000	0.00000	2.75590
39	0.00000	0.00000	5.99000	0.00000	2.48031
40	0.00000	0.00000	5.93000	0.00000	2.87401
41	0.00000	0.00000	5.83000	0.00000	2.95275
42	0.00000	0.00000	4.48000	.22000	3.70078
43	0.00000	0.00000	5.57000	0.00000	2.75590
44	-1.46200	-1.0602	5.81000	0.00000	2.48031
45	-1.15400	-.08368	5.66000	0.00000	3.03149
46	-1.30000	-.09427	5.51000	0.00000	2.75590
47	-1.89100	-.13713	6.44000	0.00000	2.87401
48	-1.14000	-.08267	5.66000	0.00000	2.87401
49	-1.72000	-.12473	5.88000	0.00000	3.03149
50	-1.17100	-.08492	4.51000	0.00000	3.03149
51	-1.25600	-.09108	4.67000	0.00000	2.87401
52	-1.92700	-.13974	6.76000	0.00000	2.51968
53	-.66000	-.04786	4.83000	.18000	3.46456
54	-.68700	-.04982	4.96000	.20000	3.11023
55	-.61500	-.04460	4.79000	.18000	-9999999.99999
56	-.62200	-.04510	4.73000	.19000	3.22834
57	-.56300	-.04083	4.67000	.11000	3.30708
58	-1.74500	-.12654	6.05000	0.00000	2.83464
59	-1.55000	-.11240	6.22000	0.00000	2.75590
60	-2.01300	-.14597	6.11000	0.00000	2.83464
61	-1.43000	-.10370	5.34000	0.00000	2.95275
62	-1.74700	-.12669	6.44000	0.00000	2.71653
63	-1.28000	-.09282	4.90000	.14000	3.30708
64	-2.20600	-.15997	6.23000	0.00000	2.75590
65	-2.00500	-.14539	5.04000	0.00000	2.59842
66	-1.30500	-.09463	4.65000	.16000	-9999999.99999
67	-1.17500	-.08521	4.80000	.14000	3.07086
68	-1.29000	-.09355	4.34000	.17000	3.46456
69	-1.81000	-.13125	5.11000	0.00000	2.59842
70	-1.29000	-.09355	4.59000	.15000	-9999999.99999
71	-1.74800	-.12676	4.79000	0.00000	2.83464
72	-2.57700	-.18687	6.91000	0.00000	2.44094
73	-2.57700	-.18687	6.47000	0.00000	2.51968
74	0.00000	0.00000	-9999999.99999	0.00000	-9999999.99999
75	0.00000	0.00000	-9999999.99999	0.00000	-9999999.99999
76	0.00000	0.00000	-9999999.99999	0.00000	-9999999.99999
77	-.94000	-.04540	5.00000	.19000	2.87401
78	-.89600	-.04332	5.07000	.17000	-9999999.99999
79	-2.77600	-.13420	6.38000	0.00000	2.63779
80	-2.44200	-.11806	6.25000	0.00000	2.63779

81	-2.29000	-.11070	5.94000	0.00000	2.48031
82	-.90500	-.04375	4.92000	.17000	3.07086
83	-1.74700	-.08446	4.73000	0.00000	2.67716
84	-2.88400	-.13942	6.92000	0.00000	2.44094
85	-1.59700	-.07721	5.53000	0.00000	2.75590
86	-2.77200	-.13401	6.70000	0.00000	2.44094
87	-1.99500	-.09645	5.41000	0.00000	2.55905
88	-3.47700	-.16809	4.93000	0.00000	2.71653
89	-2.36400	-.11429	4.77000	.08100	3.38582
90	-2.51100	-.12139	4.52000	.10000	3.58267
91	-4.07000	-.19676	6.70000	0.00000	2.67716
92	-2.65900	-.12855	4.77000	.06500	-9999999.99999
93	-3.83800	-.18554	7.12000	0.00000	2.55905
94	-3.34400	-.16166	5.18000	0.00000	2.51968
95	0.00000	0.00000	-9999999.99999	0.00000	-9999999.99999
96	0.00000	0.00000	-9999999.99999	0.00000	-9999999.99999
97	0.00000	0.00000	4.54000	.16000	3.50393
98	0.00000	0.00000	4.47000	.15000	3.70078
99	0.00000	0.00000	6.13000	0.00000	3.18897
100	0.00000	0.00000	5.60000	0.00000	3.34645
101	0.00000	0.00000	5.01000	0.00000	3.46456
102	0.00000	0.00000	5.37000	0.00000	3.14960
103	-.78000	-.05656	4.63000	.14000	3.30708
104	-2.29700	-.16657	6.28000	0.00000	2.75590
105	-1.74700	-.12669	5.17000	0.00000	2.79527
106	-1.56300	-.11334	4.55000	.09300	3.46456
107	-2.94000	-.21320	6.50000	0.00000	2.71653
108	-2.33800	-.16954	4.78000	0.00000	2.71653
109	0.00000	0.00000	4.90000	.20000	3.26771
110	0.00000	0.00000	5.37000	0.00000	2.99212
111	0.00000	0.00000	6.38000	0.00000	2.79527
112	0.00000	0.00000	5.86000	0.00000	2.79527
113	0.00000	0.00000	4.84000	.21000	3.30708
114	0.00000	0.00000	6.37000	0.00000	2.99212
115	-.70000	-.05076	4.98000	.17000	3.22834
116	-2.08800	-.15141	6.63000	0.00000	2.59842
117	-1.50300	-.10899	5.98000	0.00000	2.67716
118	-1.35000	-.09790	4.82000	.15000	3.46456
119	-2.79400	-.20261	6.79000	0.00000	2.75590
120	-2.10400	-.15257	5.03000	0.00000	2.83464
121	0.00000	0.00000	5.92000	0.00000	2.48031
122	0.00000	0.00000	6.91000	0.00000	2.48031
123	0.00000	0.00000	6.80000	0.00000	2.55905
124	0.00000	0.00000	5.08000	.21000	2.83464
125	0.00000	0.00000	6.20000	0.00000	2.40157
126	0.00000	0.00000	5.11000	.20000	3.81889
127	-1.77200	-.12850	7.26000	0.00000	2.20472
128	-1.31000	-.09500	6.17000	0.00000	2.08661
129	-.59700	-.04329	5.27000	.20000	2.55905
130	-1.75700	-.12741	5.33000	0.00000	2.08661
131	-2.33200	-.16911	7.14000	0.00000	2.12598
132	-1.11100	-.08057	5.22000	.16000	2.12598
133	0.00000	0.00000	5.32000	0.00000	3.89763
134	0.00000	0.00000	4.99000	.19000	4.33070
135	0.00000	0.00000	6.68000	0.00000	3.07086
136	0.00000	0.00000	7.22000	0.00000	2.95275
137	0.00000	0.00000	4.28000	.25000	4.25196
138	0.00000	0.00000	7.38000	0.00000	3.03149
139	-1.15900	-.08405	7.35000	0.00000	3.50393
140	-.45000	-.03263	4.57000	.20000	4.13385
141	-.87700	-.06360	6.39000	0.00000	2.79527
142	-1.28400	-.09311	4.17000	.28000	-9999999.99999
143	-1.74900	-.12683	5.72000	0.00000	2.83464
144	-2.09400	-.15185	7.14000	0.00000	3.50393
145	0.00000	0.00000	7.48000	0.00000	3.14960
146	0.00000	0.00000	8.52000	0.00000	3.26771
147	0.00000	0.00000	3.48000	.18000	-9999999.99999
148	0.00000	0.00000	3.43000	-5.600000E-03	3.14960
149	0.00000	0.00000	4.55000	0.00000	3.34645
150	0.00000	0.00000	4.28000	0.00000	3.50393
151	-1.05500	-.07650	3.81000	-.15000	-9999999.99999
152	-1.79700	-.13031	6.71000	0.00000	3.11023
153	-2.22000	-.16099	5.06000	0.00000	3.03149
154	-2.92300	-.21196	6.87000	0.00000	3.07086
155	-3.34000	-.24220	5.19000	0.00000	2.99212
156	-2.36400	-.17143	5.11000	0.00000	-9999999.99999
157	0.00000	0.00000	-9999999.99999	0.00000	-9999999.99999
158	0.00000	0.00000	14.67000	0.00000	.59055
159	0.00000	0.00000	9.56000	0.00000	.70866
160	0.00000	0.00000	-9999999.99999	0.00000	-9999999.99999
161	-9999999.99999	-9999999.99999	11.42000	0.00000	.82677
162	-9999999.99999	-9999999.99999	13.86000	0.00000	.70866
163	-9999999.99999	-9999999.99999	7.94000	.25000	2.04724
164	-9999999.99999	-9999999.99999	13.14000	0.00000	.59055
165	-9999999.99999	-9999999.99999	16.30000	0.00000	.39370
166	-9999999.99999	-9999999.99999	12.00000	0.00000	1.96850

Variable #21
(E RATIO)

```

00001 1.59416
00002 1.31718
00003 1.37259
00004 1.38320
00005 1.44921
00006 1.80102
00007 1.29180
00008 1.89022
00009 1.40316
00010 1.34964
00011 1.34903
00012 1.89010
00013 1.32567
00014 1.85713
00015 1.33501
00016 1.38717
00017 1.36522
00018 1.62213
00019 1.63329
00020 1.37015
00021 1.58643
00022 1.39302
00023 1.37721
00024 1.34809
00025 1.77635
00026 1.48714
00027 1.82853
00028 1.68600
00029 1.92977
00030 1.47375
00031 1.89604
00032 1.90791
00033 1.46260
00034 1.82310
00035 1.96780
00036 1.69205
00037 1.98885
00038 1.76828
00039 1.69478
00040 1.70443
00041 1.66193
00042 1.31738
00043 1.50276
00044 1.61392
00045 1.49338
00046 1.60745
00047 1.87092
00048 1.64533
00049 1.60102
00050 1.29396
00051 1.32569
00052 1.87150
00053 1.37418
00054 1.37955
00055 1.37964
00056 1.35968
00057 1.26629
00058 1.63842
00059 1.81474
00060 1.65654
00061 1.57723
00062 1.85279
00063 1.35122
00064 1.82766
00065 1.63162
00066 1.32496
00067 1.32463
00068 1.25244
00069 1.53855
00070 1.28112
00071 1.47860
00072 1.97124
00073 1.86730
00074 -999999.99999
00075 -999999.99999
00076 -999999.99999
00077 1.39609
00078 1.39373
00079 1.67518
00080 1.67694

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81	1.63663
82	1.35835
83	1.32778
84	1.91844
85	1.47072
86	1.66302
87	1.54400
88	1.38008
89	1.21886
90	1.13057
91	1.76079
92	1.19917
93	1.92551
94	1.49985
95	-999999.99999
96	-999999.99999
97	1.38704
98	1.34841
99	1.88806
100	1.74170
101	1.53264
102	1.65601
103	1.39363
104	1.92498
105	1.61514
106	1.26649
107	1.89306
108	1.48595
109	1.39683
110	1.47843
111	1.88183
112	1.70323
113	1.41077
114	1.83146
115	1.35751
116	1.84017
117	1.64177
118	1.32807
119	1.93696
120	1.50546
121	1.70323
122	1.93032
123	2.06642
124	1.37725
125	1.72197
126	1.41579
127	1.91778
128	1.64779
129	1.40793
130	1.48826
131	1.89881
132	1.35438
133	1.20064
134	.96390
135	1.35803
136	1.48246
137	.88338
138	1.36967
139	1.58362
140	.92301
141	1.32122
142	.91285
143	1.27117
144	1.56123
145	.08873
146	-999999.99999
147	1.40221
148	1.16367
149	1.88031
150	1.24416
151	.90046
152	1.36526
153	1.65532
154	2.46233
155	1.92088
156	1.15236
157	-999999.99999
158	.35466
159	1.98869
160	-999999.99999
161	1.32082
162	1.64678
163	.96527
164	1.16026
165	1.41849
166	1.03256

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*****
*                               DATA MANIPULATION                               *
*****
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CREEP DATA FROM OC2 AND OC4 (6000)

Data file name: OC246:CS80,702,1

Data type is: Raw data

Number of observations: 128
Number of variables: 19

Variable names:

1. SPED NO.
2. 50 keV
3. L LENGTH
4. L DIA
5. TEST & MAT
6. CON LEN %
7. CREEP %
8. CRE/STR
9. L VOL
10. DEN
11. E
12. G
13. PR
14. ATT
15. RES A/G
16. RES W/G
17. CTE
18. .18 H2O
19. .18 HTGR

Subfile name	beginning observation	number of observations
1. 40-AX-CON	1	32
2. 40-AX-2	33	20
3. 40-AX-3	53	12
4. 40-RA-CON	65	4
5. 40-RA-2	69	4
6. 41-AX-CON	73	4
7. 41-AX-2	77	4
8. 41-AX2-CON	81	4
9. 41-AX2-2	85	4
10. 327-AX-CON	89	4
11. 327-AX-2	93	4
12. 327-RA-CON	97	8
13. 327-RA-2	105	8
14. AXF-CON	113	12
15. AXF-3	125	4

CREEP DATA FROM OC2 AND OC4 (600C)

Data type is: Raw data

	Variable # 1 (SPEC NO.)	Variable # 2 (50 keV)	Variable # 3 (% LENGTH)	Variable # 4 (% DIA)	Variable # 5 (TEST & MAT)
08S#					
1	2101.10700	.09500	-.06800	-.08200	1111.00000
2	2201.10800	.09500	-.07500	-.09200	1111.00000
3	2103.10300	.15200	-.12000	-.12500	1111.00000
4	2203.10400	.15200	-.13000	-.11700	1111.00000
5	2104.11800	.17700	-.13500	-.15000	1111.00000
6	2204.11900	.17700	-.15000	-.15000	1111.00000
7	2112.12200	.20500	-.15500	-.15400	1111.00000
8	2212.12300	.20500	-.26800	-.17500	1111.00000
9	2205.10500	.19900	-.19300	-.17600	1111.00000
10	2105.10500	.19900	-.16300	-.16000	1111.00000
11	2111.09000	.22500	-.18200	-.18700	1111.00000
12	2211.11000	.22500	-.13300	-.20100	1111.00000
13	2110.12000	.23700	-.20300	-.19300	1111.00000
14	2210.12100	.23700	-.22500	-.21200	1111.00000
15	2108.08800	.23900	-.20500	-.20500	1111.00000
16	2208.08900	.23900	-.23500	-.21500	1111.00000
17	4201.10500	.25100	-.19800	-.22100	1111.00000
18	4101.10700	.25100	-.22500	-.22500	1111.00000
19	4203.10400	.25300	-.24500	-.33000	1111.00000
20	4103.10500	.25300	-.34500	-.31800	1111.00000
21	4104.11500	.40800	-.43500	-.37900	1111.00000
22	4204.11500	.40800	-.40500	-.38400	1111.00000
23	4112.12200	.43800	-.47000	-.37900	1111.00000
24	4212.12300	.43800	-.47000	-.41700	1111.00000
25	4205.10500	.44600	-.46800	-.43500	1111.00000
26	4105.10500	.44600	-.47500	-.40900	1111.00000
27	4111.09000	.47700	-.51200	-.44400	1111.00000
28	4211.11000	.47700	-.50300	-.47400	1111.00000
29	4210.12100	.50200	-.52800	-.50400	1111.00000
30	4110.12000	.50200	-.54300	-.46500	1111.00000
31	4102.08800	.51200	-.59000	-.53000	1111.00000
32	4202.08900	.51200	-.57300	-.53000	1111.00000
33	2301.04400	.09500	-.71000	.06500	1112.00000
34	2401.04500	.09500	-.68000	.06500	1112.00000
35	2303.04000	.15200	-.83000	.04900	1112.00000
36	2403.04100	.15200	-.82000	.04900	1112.00000
37	2305.04200	.19900	-.95000	.04200	1112.00000
38	2405.04300	.19900	-.95000	.03300	1112.00000
39	2411.04700	.22500	-1.06000	.02400	1112.00000
40	2311.02700	.22500	-1.01000	.03500	1112.00000
41	2408.02500	.23900	-1.05000	.02100	1112.00000
42	2308.02500	.23900	-1.05000	.01900	1112.00000
43	4301.04500	.25100	-1.18000	-.01700	1112.00000
44	4401.04500	.25100	-1.17000	-.03300	1112.00000
45	4403.04100	.36300	-1.43000	-.07900	1112.00000
46	4303.04000	.36300	-1.42500	-.07200	1112.00000
47	4405.04300	.44600	-1.69000	-.13500	1112.00000
48	4305.04200	.44600	-1.66000	-.12500	1112.00000
49	4311.02700	.47700	-1.68000	-.13500	1112.00000
50	4411.04700	.47700	-1.76000	-.14700	1112.00000
51	4403.02500	.51200	-1.36000	-.16500	1112.00000
52	4302.02500	.51200	-1.76000	-.17500	1112.00000
53	2404.05500	.17700	-1.28000	.14400	1113.00000
54	2304.05500	.17700	-1.35000	.13900	1113.00000
55	2312.05900	.20600	-1.34000	.10400	1113.00000
56	2412.05000	.20600	-1.39000	.11400	1113.00000
57	2410.05500	.23700	-1.55000	.13100	1113.00000
58	2310.05700	.23700	-1.53000	.11100	1113.00000
59	4204.05500	.40800	-2.15000	8.000000E-03	1113.00000
60	4404.05500	.40800	-2.19000	.02900	1113.00000

61	4410.06800	.45800	-1.24000	-3.000000E-03	1113.00000
62	4310.05900	.43300	-1.14000	-.02700	1113.00000
63	4410.05800	.50200	-1.54000	-.02400	1113.00000
64	4310.05700	.50200	-1.40000	-.03900	1113.00000
65	2209.09400	.24100	-.13200	-.23600	1211.00000
66	2109.09300	.24100	-.17500	-.22500	1211.00000
67	4109.09300	.51300	-.50500	-.52300	1211.00000
68	4209.09400	.51300	-.46200	-.54400	1211.00000
69	2409.03100	.24100	-1.24000	-6.000000E-03	1212.00000
70	2309.03000	.24100	-1.18000	.01800	1212.00000
71	4309.03000	.51300	-1.90000	-.16900	1212.00000
72	4409.03100	.51300	-2.02000	-.19300	1212.00000
73	2108.07300	.21700	-.18000	-.16100	2111.00000
74	2208.07900	.21700	-.19500	-.18500	2111.00000
75	4208.07900	.47700	-.47000	-.46400	2111.00000
76	4108.07800	.47700	-.51200	-.43300	2111.00000
77	2308.01500	.21700	-.99000	.02200	2112.00000
78	2408.01600	.21700	-.99000	.03100	2112.00000
79	4308.01500	.47700	-1.65000	-.15400	2112.00000
80	4408.01600	.47700	-1.74000	-.13600	2112.00000
81	2207.08400	.23000	-.20500	-.19700	2121.00000
82	2107.08300	.23000	-.18500	-.18900	2121.00000
83	4207.08400	.49900	-.43700	-.49200	2121.00000
84	4107.08300	.49900	-.53000	-.46200	2121.00000
85	2307.02000	.23000	-.94000	.01500	2122.00000
86	2407.02100	.23000	-.96000	7.000000E-03	2122.00000
87	4407.02100	.49900	-1.68000	-.17600	2122.00000
88	4307.02100	.49900	-1.60000	-.17400	2122.00000
89	2102.06500	.12500	-.07800	-.09700	3111.00000
90	2202.06700	.12500	-.07500	-.08700	3111.00000
91	4202.06700	.31400	-.31000	-.27100	3111.00000
92	4102.06500	.31400	-.30500	-.26500	3111.00000
93	2402.00400	.12500	-.63000	.03900	3112.00000
94	2302.00200	.12500	-.62000	.04300	3112.00000
95	4402.00400	.31400	-1.18000	-.07600	3112.00000
96	4302.00200	.31400	-1.20000	-.07500	3112.00000
97	2213.07300	.17700	-.12800	-.05000	3211.00000
98	2113.07200	.17700	-.11200	-.05000	3211.00000
99	2113.07200	.17700	-.11200	-.13300	3211.00000
100	2213.07300	.17700	-.12800	-.10000	3211.00000
101	4113.07200	.38200	-.35500	-.43300	3211.00000
102	4113.07200	.38200	-.35500	-.30000	3211.00000
103	4213.07300	.38200	-.33000	-.35500	3211.00000
104	4213.07300	.38200	-.33000	-.48000	3211.00000
105	2413.01000	.17700	-1.35000	-.13300	3212.00000
106	2313.00900	.17700	-1.36000	-.13300	3212.00000
107	2313.00900	.17700	-1.36000	.01700	3212.00000
108	2413.01000	.17700	-1.35000	.11700	3212.00000
109	4313.00900	.38200	-1.96000	-.25700	3212.00000
110	4313.00900	.38200	-1.96000	.11700	3212.00000
111	4413.01000	.38200	-2.14000	.10000	3212.00000
112	4413.01000	.38200	-2.14000	-.26700	3212.00000
113	2214.02200	.14000	-.06100	.04500	4111.00000
114	2214.03200	.14000	-.07100	.20900	4111.00000
115	2114.01200	.14000	-.06600	.22900	4111.00000
116	2114.01300	.14000	-.02500	.07200	4111.00000
117	2114.01700	.14000	-.03300	-.01300	4111.00000
118	2214.03000	.14000	-.03300	.17900	4111.00000
119	4114.01200	.30900	-.15800	.02700	4111.00000
120	4114.01700	.30900	-.16800	.01300	4111.00000
121	4214.03000	.30900	-.14500	-.10800	4111.00000
122	4214.03200	.30900	-.16000	-.08400	4111.00000
123	4114.01300	.30900	-.11400	.19300	4111.00000
124	4214.03200	.30900	-.18300	-.10700	4111.00000
125	2314.09100	.14000	-.48000	.09700	4113.00000
126	2414.03200	.14000	-.50000	.09900	4113.00000
127	4314.09100	.30900	-.82000	.14100	4113.00000
128	4414.09200	.30900	-.86000	.09200	4113.00000

	Variable # 6 (DDM LEN %)	Variable # 7 (COREN %)	Variable # 8 (CORE/STR)	Variable # 9 (M VOL)	Variable #10 (DEN)
088#					
1	-.06800	-.999999999999	-.999999999999	-.16900	1.70580
2	-.07800	-.999999999999	-.999999999999	-.24100	1.70690
3	-.12000	-.999999999999	-.999999999999	-.40700	1.71200
4	-.13000	-.999999999999	-.999999999999	-.39800	1.71280
5	-.13300	-.999999999999	-.999999999999	-.47500	1.70990
6	-.13500	-.999999999999	-.999999999999	-.49500	1.71190
7	-.16800	-.999999999999	-.999999999999	-.54000	1.72260
8	-.26800	-.999999999999	-.999999999999	-.67700	1.72600
9	-.16300	-.999999999999	-.999999999999	-.59000	1.71440
10	-.16300	-.999999999999	-.999999999999	-.52900	1.71310
11	-.18200	-.999999999999	-.999999999999	-.60900	1.71350
12	-.13300	-.999999999999	-.999999999999	-.58700	1.71200
13	-.20300	-.999999999999	-.999999999999	-.64500	1.71340
14	-.22500	-.999999999999	-.999999999999	-.71500	1.71290
15	-.20500	-.999999999999	-.999999999999	-.67200	1.71410
16	-.23500	-.999999999999	-.999999999999	-.73500	1.71640
17	-.19800	-.999999999999	-.999999999999	-.72700	1.71430
18	-.22800	-.999999999999	-.999999999999	-.77600	1.71460
19	-.24500	-.999999999999	-.999999999999	-1.01100	1.72330
20	-.34500	-.999999999999	-.999999999999	-1.09800	1.72380
21	-.43300	-.999999999999	-.999999999999	-1.31900	1.72430
22	-.40500	-.999999999999	-.999999999999	-1.30800	1.72580
23	-.47000	-.999999999999	-.999999999999	-1.35500	1.73660
24	-.47000	-.999999999999	-.999999999999	-1.45100	1.73930
25	-.46800	-.999999999999	-.999999999999	-1.49900	1.72990
26	-.47500	-.999999999999	-.999999999999	-1.43500	1.72850
27	-.51200	-.999999999999	-.999999999999	-1.55200	1.72960
28	-.50300	-.999999999999	-.999999999999	-1.61600	1.72950
29	-.52800	-.999999999999	-.999999999999	-1.71100	1.72980
30	-.54300	-.999999999999	-.999999999999	-1.83400	1.73020
31	-.59000	-.999999999999	-.999999999999	-1.74000	1.73230
32	-.57300	-.999999999999	-.999999999999	-1.81200	1.73470
33	-.07300	-.83700	-.04620	-.59500	1.71580
34	-.07300	-.80700	-.04402	-.57400	1.71410
35	-.12500	-.70500	-.05113	-.76000	1.72120
36	-.12500	-.69500	-.05040	-.71000	1.71990
37	-.17300	-.77700	-.05635	-.88900	1.72290
38	-.17300	-.78700	-.05707	-.91600	1.72440
39	-.15800	-.90200	-.06541	-1.04000	1.72190
40	-.15800	-.85200	-.06179	-.96200	1.72590
41	-.22000	-.83000	-.06019	-1.03300	1.72590
42	-.22000	-.83000	-.06019	-1.04200	1.72410
43	-.21300	-.86700	-.07013	-1.23100	1.72660
44	-.21300	-.95700	-.06940	-1.28700	1.72620
45	-.34800	-1.08200	-.07847	-1.55900	1.73610
46	-.34800	-1.07700	-.07810	-1.56100	1.73490
47	-.47200	-1.21800	-.08833	-2.00000	1.74290
48	-.47200	-1.18800	-.08615	-1.93700	1.74180
49	-.50800	-1.17200	-.08499	-2.03800	1.74430
50	-.50800	-1.27200	-.08225	-2.16200	1.74110
51	-.56100	-1.27900	-.08275	-2.33000	1.74800
52	-.56100	-1.17900	-.08550	-2.26900	1.74400
53	-.14100	-1.13900	-.05507	-1.02700	1.73270
54	-.14100	-1.20900	-.05785	-1.13200	1.73340
55	-.16800	-1.17200	-.05667	-1.09500	1.73540
56	-.16800	-1.22200	-.05908	-1.20800	1.74110
57	-.21400	-1.33600	-.06459	-1.33500	1.73820
58	-.21400	-1.31600	-.06363	-1.36400	1.73740
59	-.41900	-1.73100	-.08369	-2.23800	1.75230
60	-.41900	-1.77100	-.08563	-2.23400	1.75340

61	-1.47000	-1.77000	-1.08555	-1.37100	1.76120
62	-1.47000	-1.87000	-1.08074	-1.22200	1.75476
63	-1.53500	-1.90500	-1.09594	-1.73400	1.75000
64	-1.53500	-1.82500	-1.09017	-2.08500	1.75370
65	-1.15200	-999999.99999	-999999.99999	-1.73000	1.70860
66	-1.17500	-999999.99999	-999999.99999	-1.68100	1.70940
67	-1.50500	-999999.99999	-999999.99999	-1.72200	1.72710
68	-1.45200	-999999.99999	-999999.99999	-1.72900	1.72550
69	-1.18300	-1.05700	-1.07665	-1.28500	1.72510
70	-1.18300	-1.99700	-1.07230	-1.18200	1.72350
71	-1.48300	-1.41700	-1.10276	-1.33600	1.74310
72	-1.48300	-1.53700	-1.11146	-2.52600	1.74630
73	-1.18000	-999999.99999	-999999.99999	-1.55100	1.71010
74	-1.19500	-999999.99999	-999999.99999	-1.62200	1.70940
75	-1.47000	-999999.99999	-999999.99999	-1.55300	1.72420
76	-1.51200	-999999.99999	-999999.99999	-1.53500	1.72680
77	-1.18700	-1.80300	-1.05823	-1.97300	1.72560
78	-1.18700	-1.79300	-1.05751	-1.94400	1.72240
79	-1.49200	-1.15800	-1.08398	-1.94400	1.74220
80	-1.49200	-1.24300	-1.09050	-2.10200	1.74220
81	-1.20500	-999999.99999	-999999.99999	-1.65700	1.73310
82	-1.12500	-999999.99999	-999999.99999	-1.62900	1.73170
83	-1.43900	-999999.99999	-999999.99999	-1.64400	1.75010
84	-1.53000	-999999.99999	-999999.99999	-1.60100	1.74840
85	-1.19500	-1.74500	-1.05403	-1.93800	1.74100
86	-1.19500	-1.75500	-1.05548	-1.96900	1.74380
87	-1.46500	-1.19300	-1.08666	-2.11100	1.75360
88	-1.46500	-1.11500	-1.08086	-2.02200	1.75970
89	-1.09800	-999999.99999	-999999.99999	-1.30100	1.76910
90	-1.07500	-999999.99999	-999999.99999	-1.27500	1.77320
91	-1.31000	-999999.99999	-999999.99999	-1.72900	1.78120
92	-1.30500	-999999.99999	-999999.99999	-1.92100	1.79000
93	-1.08700	-1.54300	-1.03938	-1.56700	1.77720
94	-1.08700	-1.59300	-1.04300	-1.60700	1.77790
95	-1.30700	-1.67300	-1.06331	-1.37400	1.79140
96	-1.30700	-1.89300	-1.06476	-1.38500	1.79160
97	-1.12800	-999999.99999	-999999.99999	-1.51300	1.76550
98	-1.11200	-999999.99999	-999999.99999	-1.43000	1.77030
99	-1.11200	-999999.99999	-999999.99999	-1.43000	1.77030
100	-1.12800	-999999.99999	-999999.99999	-1.51300	1.76550
101	-1.35500	-999999.99999	-999999.99999	-1.23500	1.78450
102	-1.35500	-999999.99999	-999999.99999	-1.23500	1.78450
103	-1.33000	-999999.99999	-999999.99999	-1.26000	1.77860
104	-1.33000	-999999.99999	-999999.99999	-1.26000	1.77860
105	-1.12000	-1.23000	-1.08920	-1.41500	1.79360
106	-1.12000	-1.24000	-1.08992	-1.44600	1.80300
107	-1.12000	-1.24000	-1.08992	-1.44600	1.80300
108	-1.12000	-1.23000	-1.08920	-1.41500	1.79360
109	-1.34200	-1.61800	-1.11734	-2.14100	1.81530
110	-1.34200	-1.61800	-1.11734	2.14100	1.81530
111	-1.34200	-1.79800	-1.13039	-2.38800	1.81090
112	-1.34200	-1.79800	-1.13039	-2.38800	1.81090
113	-1.06100	-999999.99999	-999999.99999	1.38000	1.91150
114	-1.07100	-999999.99999	-999999.99999	-999999.99999	1.88100
115	-1.06600	-999999.99999	-999999.99999	1.38100	1.91050
116	-1.02500	-999999.99999	-999999.99999	-999999.99999	1.91010
117	-1.03300	-999999.99999	-999999.99999	-999999.99999	1.91280
118	-1.03300	-999999.99999	-999999.99999	-999999.99999	1.93560
119	-1.15800	-999999.99999	-999999.99999	1.03200	1.91840
120	-1.16800	-999999.99999	-999999.99999	1.04600	1.91280
121	-1.14500	-999999.99999	-999999.99999	-1.29000	1.94830
122	-1.16000	-999999.99999	-999999.99999	-1.30700	1.91690
123	-1.11400	-999999.99999	-999999.99999	-1.35400	1.90560
124	-1.18300	-999999.99999	-999999.99999	-1.30200	1.89420
125	-1.04800	-1.43200	-1.03133	-1.26800	1.90420
126	-1.04800	-1.45200	-1.03276	-1.29100	1.89370
127	-1.15500	-1.66500	-1.04823	-1.54000	1.90930
128	-1.15500	-1.70500	-1.05113	-1.66200	1.90070

	Variable #11 (E)	Variable #12 (E)	Variable #13 (PR)	Variable #14 (AT)	Variable #15 (RES W/E)
089=					
1	15.70000	6.43000	.21000	2.88000	23.40000
2	15.77000	6.50000	.21000	2.95000	23.00000
3	15.20000	6.59000	.21000	2.58000	23.90000
4	15.11000	6.60000	.21000	2.84000	23.60000
5	15.09000	6.64000	.21000	2.84000	24.20000
6	15.08000	6.65000	.21000	2.84000	24.00000
7	15.64000	6.55000	.21000	2.60000	23.80000
8	15.49000	6.16000	.26000	2.57000	24.30000
9	15.30000	6.74000	.21000	2.76000	24.60000
10	15.44000	6.80000	.21000	2.72000	24.40000
11	15.27000	6.71000	.21000	2.76000	24.90000
12	15.43000	6.82000	.20000	2.80000	24.90000
13	15.24000	6.69000	.21000	2.96000	24.80000
14	15.35000	6.59000	.20000	2.84000	25.30000
15	15.55000	6.82000	.21000	2.72000	24.90000
16	15.52000	6.63000	.21000	2.72000	25.30000
17	17.62000	7.52000	.17000	2.52000	25.70000
18	17.58000	7.53000	.17000	2.87000	26.20000
19	15.16000	7.78000	.17000	2.90000	26.00000
20	15.19000	7.79000	.17000	2.87000	26.50000
21	15.18000	7.82000	.16000	2.72000	26.80000
22	15.09000	7.68000	.18000	2.84000	27.10000
23	15.77000	8.10000	.16000	3.31000	26.20000
24	15.98000	8.11000	.17000	2.52000	26.40000
25	15.52000	7.92000	.17000	2.76000	26.90000
26	15.29000	7.81000	.17000	2.84000	26.50000
27	15.36000	7.92000	.16000	2.56000	27.30000
28	15.36000	8.00000	.15000	2.84000	27.10000
29	15.71000	8.03000	.16000	2.91000	27.30000
30	15.31000	7.81000	.17000	2.84000	26.90000
31	15.45000	7.85000	.17000	3.11000	26.90000
32	15.94000	8.10000	.17000	2.76000	27.70000
33	15.29000	6.30000	.21000	2.66000	23.00000
34	15.52000	6.46000	.20000	2.70000	23.20000
35	15.95000	6.65000	.20000	2.62000	23.30000
36	15.00000	6.65000	.20000	2.54000	23.60000
37	15.14000	6.74000	.20000	2.70000	23.90000
38	15.28000	6.81000	.19000	2.70000	23.80000
39	15.30000	6.87000	.19000	2.67000	24.60000
40	15.40000	6.98000	.19000	2.63000	24.10000
41	15.56000	6.93000	.20000	2.59000	24.40000
42	15.43000	6.86000	.20000	2.43000	24.30000
43	17.14000	7.33000	.17000	2.56000	25.40000
44	17.26000	7.43000	.16000	2.59000	25.70000
45	15.03000	7.86000	.14000	2.46000	25.90000
46	17.62000	7.51000	.17000	2.60000	25.80000
47	15.26000	7.87000	.16000	2.68000	25.60000
48	15.13000	7.98000	.14000	2.60000	26.00000
49	15.37000	7.91000	.16000	2.45000	26.20000
50	15.49000	8.09000	.14000	2.64000	26.60000
51	15.38000	7.93000	.16000	2.46000	26.10000
52	15.56000	8.14000	.14000	2.36000	26.30000
53	15.76000	8.61000	.19000	2.79000	25.40000
54	15.83000	8.69000	.18000	2.76000	25.70000
55	15.13000	6.82000	.18000	2.59000	24.90000
56	15.24000	6.66000	.18000	2.56000	25.20000
57	15.01000	6.79000	.18000	2.64000	26.00000
58	15.04000	6.80000	.18000	2.84000	25.90000
59	17.96000	7.95000	.13000	2.65000	27.40000
60	17.70000	7.80000	.13000	2.64000	27.20000

59	17.96000	7.95000	.13000	2.68000	27.40000
60	17.70000	7.80000	.13000	2.64000	27.20000
61	18.28000	8.06000	.13000	2.48000	27.40000
62	17.79000	7.95000	.12000	2.44000	27.90000
63	17.55000	7.95000	.12000	2.80000	27.70000
64	17.87000	7.91000	.13000	2.60000	27.80000
65	14.91000	8.33000	.17000	3.11000	24.30000
66	14.93000	8.38000	.17000	3.00000	24.00000
67	16.95000	7.47000	.13000	2.91000	27.80000
68	-999999.99999	-999999.99999	-999999.99999	3.15000	27.80000
69	14.80000	8.48000	.14000	2.83000	24.10000
70	14.37000	8.51000	.14000	2.95000	27.50000
71	-999999.99999	-999999.99999	-999999.99999	2.76000	27.90000
72	16.00000	-999999.99999	-999999.99999	2.78000	26.90000
73	16.61000	8.86000	.21000	2.88000	24.70000
74	15.49000	8.82000	.21000	2.84000	24.40000
75	18.68000	7.97000	.17000	2.76000	26.80000
76	18.47000	7.84000	.18000	2.28000	27.10000
77	15.40000	8.84000	.20000	2.66000	24.00000
78	18.34000	8.82000	.20000	2.66000	23.80000
79	18.51000	8.02000	.15000	2.60000	26.10000
80	18.25000	8.94000	.15000	2.60000	25.70000
81	17.50000	7.30000	.20000	2.29000	23.80000
82	17.45000	7.21000	.21000	2.32000	23.30000
83	19.82000	8.51000	.17000	2.65000	25.30000
84	18.86000	7.99000	.19000	2.76000	25.10000
85	17.36000	7.26000	.19000	2.07000	23.00000
86	17.44000	7.30000	.20000	2.11000	23.20000
87	17.22000	8.27000	.16000	2.05000	25.00000
88	18.99000	8.52000	.11000	2.09000	25.00000
89	14.47000	5.71000	.33000	2.95000	27.90000
90	18.89000	7.35000	.25000	2.92000	27.90000
91	22.05000	8.58000	.29000	2.91000	32.50000
92	23.22000	7.17000	.27000	2.76000	32.30000
93	18.98000	7.52000	.25000	2.81000	27.70000
94	22.20000	8.84000	.28000	2.89000	27.00000
95	21.36000	9.31000	.15000	3.47000	30.70000
96	23.24000	9.44000	.23000	2.80000	29.80000
97	12.37000	5.67000	.09000	3.47000	24.90000
98	11.27000	5.67000	-5.000000E-03	3.47000	25.20000
99	11.27000	5.67000	-5.000000E-03	3.47000	25.20000
100	12.37000	5.67000	.09000	3.47000	24.90000
101	13.68000	7.36000	.07000	-999999.99999	29.20000
102	13.68000	7.36000	.07000	-999999.99999	29.20000
103	13.92000	7.48000	.07000	3.35000	31.10000
104	13.92000	7.48000	.07000	3.35000	31.10000
105	11.72000	4.95000	.18000	3.11000	25.50000
106	12.20000	5.28000	.15000	2.97000	24.50000
107	12.20000	5.28000	.15000	2.97000	24.50000
108	11.72000	4.95000	.18000	3.11000	25.50000
109	13.26000	5.62000	.18000	2.90000	30.60000
110	13.26000	5.62000	.18000	2.90000	30.60000
111	13.33000	9.37000	.40000	2.97000	30.00000
112	13.33000	9.37000	.40000	2.97000	30.00000
113	24.38000	9.90000	.23000	.68000	10.90000
114	25.39000	10.40000	.22000	.56000	-999999.99999
115	23.95000	9.75000	.23000	.72000	10.90000
116	23.97000	9.70000	.22000	.68000	-999999.99999
117	24.76000	10.20000	.21000	.68000	-999999.99999
118	25.65000	10.50000	.22000	.56000	-999999.99999
119	28.11000	11.33000	.24000	-999999.99999	91.50000
120	28.56000	11.53000	.24000	-999999.99999	-999999.99999
121	-999999.99999	-999999.99999	-999999.99999	-999999.99999	-999999.99999
122	27.98000	11.41000	.23000	-999999.99999	87.10000
123	27.37000	11.07000	.24000	-999999.99999	-999999.99999
124	-999999.99999	-999999.99999	-999999.99999	-999999.99999	-999999.99999
125	22.01000	9.08000	.21000	.59000	22.30000
126	22.78000	9.48000	.20000	.23000	21.50000
127	24.92000	10.19000	.22000	.43000	23.10000
128	25.28000	10.72000	.23000	.43000	22.00000

	variable #16 (RES H78)	variable #17 (OTE)	variable #18 (.18 H20)	variable #19 (.18 HTER)
083#				
1	21.00000	3.65000	.08047	.07249
2	21.20000	3.55000	.08047	.07249
3	22.20000	3.72000	.12874	.11598
4	21.90000	3.65000	.12874	.11598
5	23.00000	3.83000	.14992	.13505
6	23.50000	3.67000	.14992	.13505
7	22.20000	3.86000	.17448	.15718
8	22.50000	3.67000	.17448	.15718
9	22.00000	3.62000	.16855	.15184
10	22.80000	3.86000	.16855	.15184
11	22.50000	3.71000	.19058	.17167
12	24.90000	3.52000	.19058	.17167
13	23.20000	3.61000	.20074	.18083
14	23.20000	3.70000	.20074	.18083
15	22.90000	3.60000	.20243	.18236
16	23.40000	3.60000	.20243	.18236
17	23.70000	3.60000	.22107	.19914
18	24.00000	3.15000	.22107	.19914
19	24.00000	3.42000	.30746	.27697
20	24.50000	3.06000	.30746	.27697
21	25.30000	3.35000	.34558	.31130
22	23.50000	3.52000	.34558	.31130
23	23.60000	3.36000	.37099	.33419
24	23.90000	3.32000	.37099	.33419
25	24.30000	3.40000	.37776	.34030
26	24.30000	3.33000	.37776	.34030
27	23.70000	3.94000	.40402	.36395
28	25.40000	3.55000	.40402	.36395
29	24.60000	3.97000	.42519	.38303
30	24.00000	3.68000	.42519	.38303
31	25.00000	3.68000	.43366	.39066
32	23.60000	3.60000	.43366	.39066
33	18.60000	4.30000	.08047	.07249
34	21.60000	4.28000	.08047	.07249
35	24.20000	4.50000	.12874	.11598
36	24.20000	4.07000	.12874	.11598
37	25.10000	4.56000	.16855	.15184
38	24.20000	4.20000	.16855	.15184
39	27.20000	4.73000	.19058	.17167
40	24.90000	4.09000	.19058	.17167
41	26.00000	4.12000	.20243	.18236
42	26.40000	4.68000	.20243	.18236
43	25.10000	4.79000	.22107	.19914
44	25.10000	4.51000	.22107	.19914
45	24.40000	4.13000	.30746	.27697
46	24.70000	3.95000	.30746	.27697
47	24.60000	4.33000	.37776	.34030
48	25.00000	4.00000	.37776	.34030
49	25.80000	4.59000	.40402	.36395
50	25.50000	4.35000	.40402	.36395
51	24.60000	3.93000	.43366	.39066
52	25.60000	4.68000	.43366	.39066
53	24.10000	4.93000	.14992	.13505
54	23.60000	4.87000	.14992	.13505
55	25.90000	3.58000	.17448	.15718
56	24.60000	4.78000	.17448	.15718
57	24.70000	4.75000	.20074	.18083
58	24.90000	4.87000	.20074	.18083
59	25.90000	4.66000	.34558	.31130
60	25.80000	4.95000	.34558	.31130

61	26.40000	4.94000	.37099	.33419
62	26.70000	5.03000	.37099	.33419
63	26.20000	4.93000	.42519	.36303
64	26.20000	5.06000	.42519	.36303
65	26.10000	4.37000	.20413	.16388
66	26.70000	4.20000	.20413	.16388
67	24.70000	4.25000	.43451	.39142
68	25.10000	4.26000	.43451	.39142
69	27.40000	5.13000	.20413	.16388
70	25.90000	5.24000	.20413	.16388
71	25.30000	5.27000	.43451	.39142
72	25.50000	5.00000	.43451	.39142
73	23.00000	3.81000	.18380	.16557
74	22.90000	3.85000	.18380	.16557
75	24.80000	3.74000	.40402	.36395
76	24.20000	3.50000	.40402	.36395
77	24.70000	4.50000	.16380	.16557
78	25.00000	4.45000	.18380	.16557
79	25.40000	4.61000	.40402	.36395
80	25.10000	4.49000	.40402	.36395
81	21.40000	3.55000	.19481	.17549
82	22.50000	3.72000	.19481	.17549
83	24.00000	3.70000	.42265	.38074
84	24.00000	3.26000	.42265	.38074
85	23.50000	4.57000	.19481	.17549
86	23.80000	4.81000	.19481	.17549
87	24.10000	3.94000	.42265	.38074
88	24.80000	4.31000	.42265	.38074
89	16.70000	1.26000	.10588	.09537
90	16.70000	1.60000	.10588	.09537
91	17.70000	1.31000	.26596	.23958
92	17.80000	.96000	.26596	.23958
93	18.00000	1.85000	.10588	.09537
94	18.80000	2.00000	.10588	.09537
95	18.80000	1.75000	.26596	.23958
96	19.10000	1.57000	.26596	.23958
97	32.30000	3.08000	.14992	.13505
98	32.30000	3.21000	.14992	.13505
99	32.30000	3.21000	.14992	.13505
100	32.30000	3.08000	.14992	.13505
101	21.40000	2.87000	.32355	.29147
102	21.40000	2.87000	.32355	.29147
103	19.10000	2.59000	.32355	.29147
104	19.10000	2.59000	.32355	.29147
105	18.90000	4.00000	.14992	.13505
106	19.20000	4.28000	.14992	.13505
107	19.20000	4.28000	.14992	.13505
108	18.90000	4.00000	.14992	.13505
109	19.50000	4.30000	.32355	.29147
110	19.50000	4.30000	.32355	.29147
111	20.30000	4.25000	.32355	.29147
112	20.30000	4.25000	.32355	.29147
113	12.20000	5.92000	.11858	.10682
114	-9999999.99999	5.39000	.11858	.10682
115	12.20000	6.20000	.11858	.10682
116	-9999999.99999	6.12000	.11858	.10682
117	-9999999.99999	5.71000	.11858	.10682
118	-9999999.99999	5.59000	.11858	.10682
119	-9999999.99999	5.25000	.26172	.23577
120	-9999999.99999	5.71000	.26172	.23577
121	-9999999.99999	-9999999.99999	.26172	.23577
122	-9999999.99999	5.39000	.26172	.23577
123	-9999999.99999	5.57000	.26172	.23577
124	-9999999.99999	-9999999.99999	.26172	.23577
125	25.80000	5.92000	.11858	.10682
126	22.00000	5.65000	.11858	.10682
127	23.00000	6.31000	.26172	.23577
128	22.80000	5.56000	.26172	.23577

D156 GRAPHITE CREEP EXPERIMENTS - RAW DATA - AXIAL MEASUREMENT

All Axial Samples

GRAPHITE TYPE. H451 SAMPLE LOAD
TEMPERATURE 900°C 6 MPaCORRECTION CURVES^E

Sample	E ₀ %	α_0 %	156-30-III			156-31-III			156-34			156-37		
			x	a %	b %	x	a %	b %	x	a %	b %	x	a %	b %
1	0.075		0.47	-0.056	+0.127	2.9	-1.235	-0.501	5.8	-3.174	-1.900	7.3	-3.971	-1.893
2	0.075		0.54	-0.072	+0.143	3.4	-1.793	-1.013	6.7	-3.255	-2.074	8.4	-2.673	-1.047
4	0.069		0.53	-0.063	+0.122	3.4	-1.750	-1.026	6.6	-3.259	-2.193	8.2	-2.543	-1.368
5	0.071		0.48	-0.050	+0.137	3.2	-1.528	-0.794	6.1	-3.317	-2.108	7.6	-2.939	-1.816
7	0.073		0.39	-0.029	+0.133	2.4	-0.901	-0.159						
11									2.1	-0.296	+0.171	3.2	-1.169	-0.304
			ϕt_{EDN}	Control	Tensile									
			$10^{21} \eta / \text{cm}^2$											

24/10/86

27.11.86

D156 GRAPHITE CREEP EXPERIMENTS - RAW DATA - AXIAL

GRAPHITE TYPE H451
TEMPERATURE 900°C

SAMPLE LOAD
6 MPa

CORRECTION CURVES $\begin{matrix} E \\ \alpha \end{matrix}$

Sample	E ₀ %	α_0 %	156-40			156-			156-			156-		
			x	a %	b %	x	a %	b %	x	a %	b %	x	a %	b %
1			8,5	-2,647	-1,370									
2			9,8	-1,531										
4			9,5	-1,807	+0,467									
5			8,8	-2,459	-0,874									
11			4,1	-1,974	-1,154									

8/12/86

D156 GRAPHITE CREEP EXPTS - RAW DATA RADIAL MEASUREMENT

GRAPHITE TYPE H451 SAMPLE LOAD

6 MPa.

TEMP 900°C

Sample	E _o %	α_o %	156-30-III			156-31-III			156-34			156-37		
			α	a %	b %	α	a %	b %	α	a %	b %	α	a %	b %
1			0,47	-0,108	-0,046	2,9	-0,745	-1,045	5,8	-1,338	-1,650	7,3	-0,723	-0,901
2			0,54	+0,021	-0,014	3,4	-0,870	-1,455	6,7	-0,882	-1,101	8,4	+0,880	+0,637 ⁵
4			0,53	-0,140	-0,053	3,4	-1,140	-1,445	6,6	-1,053	-1,480	8,2	+0,152	+0,419
5			0,48	+0,034	-0,052	3,2	-0,818	-1,266	6,1	-1,244	-1,363	7,6	-0,232	-0,648
11									2,1	-0,335	-1,138	3,2	-0,673	-1,096
7			0,39	-0,091	-0,068	2,4	-0,654	-						

24/1/86

27/11/86

D156 GRAPHITE CREEP EXPERIMENTS - RAW DATA RADIAL MEASUREMENT

GRAPHITE TYPE H451
TEMPERATURE 900°C

SAMPLE LOAD

CORRECTION CURVES
E
α

Sample	E ₀ %	α ₀ %	156-40				156-				156-			
			x	a %	b %		x	a %	b %		x	a %	b %	
1			8,5	+0,520	+0,342									
2			9,8	+3,443	-									
4			9,5	+1,749	13,109									
5			8,8	+1,478	+1,165									
11			4,1	-1,346	-1,452									

8/12/86

APPENDIX B
LIST OF CREEP DATA USED TO DETERMINE THE CREEP COEFFICIENT

Specimen I.D.	E_0 , GPa	Φ_{HTGR} , 10^{21} n/cm ²	$\epsilon^c E_0 / \sigma - 1$	Φ_{HTGR} , 10^{21} n/cm ²	$\epsilon^c E_0 / \sigma - 1$
(1) ORNL 600°C OC-2 and OC-4 Series					
44	(8.50)	0.725	2.927	1.991	4.959
45	(8.50)	0.725	2.740	1.991	4.899
40	(8.50)	1.160	3.344	2.770	5.639
41	(8.50)	1.160	3.284	2.770	5.673
42	(8.50)	1.518	3.791	3.403	6.323
43	(8.50)	1.518	3.854	3.403	6.506
47	(8.50)	1.717	4.559	3.640	6.841
27	(8.50)	1.717	4.253	3.640	6.225
26	(8.50)	1.824	4.117	3.907	6.884
25	(8.50)	1.824	4.117	3.907	6.268
56	(8.50)	1.3505	3.684	3.113	6.276
55	(8.50)	1.3505	3.917	3.113	6.115
59	(8.50)	1.572	3.820	3.342	5.860
60	(8.50)	1.572	4.024	3.342	6.276
58	(8.50)	1.808	4.491	3.830	7.237
57	(8.50)	1.808	4.406	3.830	6.667
31	(7.72)	1.839	4.917	3.914	7.608
30	(7.72)	1.839	4.582	3.914	6.940
15	(8.50)	1.656	3.947	3.640	6.140
16	(8.50)	1.656	3.888	3.640	6.693
20	(8.50)	1.755	3.590	3.807	5.877
21	(8.50)	1.755	3.718	3.807	6.370
(2) ORNL 900°C OC-1, OC-3, and OC-5 Series					
23	8.619	0.863	3.292	2.748	8.136
	8.619	3.969	11.041		
34	8.274	0.611	2.732	1.298	6.802
	8.274	3.969	10.342		
46	8.205	0.489	2.347	1.603	5.784
	8.205	1.756	8.221		

APPENDIX B
LIST OF CREEP DATA USED TO DETERMINE THE CREEP COEFFICIENT
(Continued)

Specimen I.D.	E_o , GPa	ϕ_{HTGR} , 10^{21} n/cm ²	$\epsilon^c E_o / \sigma - 1$	ϕ_{HTGR} , 10^{21} n/cm ²	$\epsilon^c E_o / \sigma - 1$
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(2) ORNL 900°C OC-1, OC-3, and OC-5 Series (Continued)

36	8.205	0.725	2.658	--	--
171	8.826	1.298	6.493	2.137	10.009
172	8.826	2.366	6.387	2.595	10.168
173	8.826	1.603	7.040	2.595	11.889
51	8.481	0.878 4.046	2.850 10.822	2.824	8.388
53	8.481	0.832 3.817	2.710 10.364	2.672	7.183
49	8.481	0.649	2.672		
62	8.895	1.450	6.516	2.366	10.941
61	8.826	1.450	5.814	2.366	9.426
28	7.585	0.885 4.046	3.292 11.635	2.824	8.609
13	8.619	0.771 3.511	3.379 12.049	2.519	8.395
18	8.964	0.847 3.817	2.881 10.519	2.672	7.516

(3) Petten 900°C D156 Experiment

1	8.00	0.667	1.44	4.12	8.787
2	8.00	0.767	1.867	4.83	9.40
4	8.70	0.753	1.682	4.83	9.498
5	8.45	0.682	1.634	4.54	9.337
7	8.22	0.554	1.219	3.41	9.165
11	(8.27)	2.98	5.437	4.54	10.923

APPENDIX C
USER'S PROGRAM AND INPUT DATA IN THE REGRESSION ANALYSIS

The control statement in the VAX computer is:

```
$ FOR CREEP  
$ LINK CREEP, NAG/LIB  
$ RUN CREEP
```

CREEP.FOR

20-MAY-88

11:00:39

```

C      STEADY STATE CREEP STRAIN IS FITTED WITH A POLYNOMIAL
C      IN T(TEMP IN DEGREE C/100) AND F(FLUENCE IN N/CM SQUARE
C      *E-21). NO CONSTANT TERM. THERE ARE 95 POINTS.
C
C      USING G02BDF OF NAG FORTRAN LIBRARY TO COMPUTE SUMS
C      OF SQUARES AND CROSS-PRODUCT ABOUT ZERO, AND CORRELATION-
C      LIKE COEFF FOR THE ARRAY(95*7) OF THE SEVEN VARIABLES.
C      THE OUTPUT IS THEN USED IN G02CHF FOR REGRESSION ANALYSIS.
C
      DOUBLE PRECISION TITLE(7),A(95,7),AMEAN(7),STD(7),SSP(7,7)
      * ,CORR(7,7),PE(12),B,OC(44),OS(39),RESULT(13),COEFF(6,3),
      * RINV(6,6),C(6,6),W(7,7)
      OPEN(UNIT=10,FILE='CREEP.DAT',STATUS='UNKNOWN')
      OPEN(UNIT=11,FILE='CREEP.FIT',STATUS='UNKNOWN')
      M=7
      N=95
      READ (10,999) TITLE
999  FORMAT(7A4)
      WRITE(11,998) (TITLE(I),I=1,6)
998  FORMAT(2(1X/),1H ,6A4,7HRESULTS/1X)
      READ (10,*) (PE(II),II=1,12)
C      READ FLUENCE AT EACH PETTEN 900C DATA POINT
C      UNIT IS 1.E21 N/CM/CM (E GREATER THAN .18 MEV)
      DO 111 KK=1,12
      DO 112 JJ=1,2
      B=9.**(JJ-1)
      JA=JJ+2
      JB=JJ+4
      A(KK,JJ)=PE(KK)*B
      A(KK,JA)=A(KK,JJ)*PE(KK)
112  A(KK,JB)=A(KK,JA)*PE(KK)
111  CONTINUE
      READ (10,*) (OC(IJ),IJ=1,44)
C      READ FLUENCE AT EACH ORNL 600C DATA POINT
      DO 115 KK=1,44
      KJ=KK+12
      DO 116 JJ=1,2
      B=6.**(JJ-1)
      JA=JJ+2
      JB=JJ+4
      A(KJ,JJ)=OC(KK)*B
      A(KJ,JA)=A(KJ,JJ)*OC(KK)
116  A(KJ,JB)=A(KJ,JA)*OC(KK)
115  CONTINUE
      READ (10,*) (OS(IK),IK=1,39)
C      READ FLUENCE AT EACH ORNL 900C DATA POINT
      DO 118 KK=1,39
      KJ=KK+56
      DO 119 JJ=1,2
      B=9.**(JJ-1)

```

CREEP.FOR

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      JA=JJ+2
      JB=JJ+4
      A(KJ,JJ)=OS(KK)*B
      A(KJ,JA)=A(KJ,JJ)*OS(KK)
119  A(KJ,JB)=A(KJ,JA)*OS(KK)
118  CONTINUE
      READ (10,*) (A(I,7),I=1,95)
C      READ ALL (STEADY STATE CREEP STRAIN*INITIAL
C      ELASTIC MODULUS/APPLIED STRESS) DATA
      IFAIL=0
      CALL GO2BDF(N,M,A,95,AMEAN,STD,SSP,7,CORR,7,IFAIL)
      IF(IFAIL) 22,44,22
22  WRITE(11,995) IFAIL
995  FORMAT(22H ROUTINE FAILS, IFAIL=, I2)
44  CONTINUE
      JFAIL=0
      CALL GO2CHF(95,7,6,SSP,7,CORR,7,RESULT,COEFF,7,
*  RINV,6,C,6,W,7,JFAIL)
      IF(JFAIL)20,40,20
20  CONTINUE
      WRITE(11,989)JFAIL
      GO TO 60
40  CONTINUE
      WRITE(11,988) (I,(COEFF(I,J),J=1,3),I=1,6)
      WRITE(11,987) (RESULT(I),I=1,13)
60  CONTINUE
989  FORMAT(22H ROUTINE FAILS, JFAIL=, I2)
988  FORMAT(43H VRBLE      COEFF      STD ERR      T-VALUE/
* 6(1H , I3,2F14.5,E15.4/))
987  FORMAT(32H ANALYSIS OF REGRESSION TABLE : //13H      SOURCE,
* 55H      SUM OF SQUARE  D.F.      MEAN SQUARE      F-VALUE /
* 18H DUE TO REGRESSION, F14.2, F8.0, 2F14.2/14H ABOUT REGRES,
* 4HSION, F14.2, F8.0, F14.4/18H TOTAL      , F14.2,
* F8.0///29H STANDARD ERROR OF ESTIMATE =, F8.4/11H MULTIPLE C,
* 18HORRELATION (R)  =, F8.4/29H DETERMINATION (R SQUARED)  =,
* F8.4/29H CORRECTED R SQUARED      =, F8.4/)
      STOP
      END

```

CREEP.DAT

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H-451 IRRADIATION CREEP DATA

0.667	4.12	0.767	4.83	0.753	4.83	0.682	4.54
0.554	3.41	2.98	4.54				
0.725	1.991	0.725	1.991	1.16	2.77	1.16	2.77
1.518	3.403	1.518	3.403	1.717	3.64	1.717	3.64
1.824	3.907	1.824	3.907	1.3505	3.113	1.3505	3.113
1.572	3.342	1.572	3.342	1.808	3.83	1.808	3.83
1.839	3.914	1.839	3.914	1.656	3.64	1.656	3.64
1.755	3.807	1.755	3.807				
0.863	2.748	3.969	0.611	1.298	2.824	0.863	2.824
3.969	0.489	1.603	1.756	0.725	1.298	2.137	2.366
2.595	1.603	2.595	0.878	2.824	4.046	0.832	2.672
3.817	0.649	1.45	2.366	1.45	2.366	0.885	2.824
4.046	0.771	2.519	3.511	0.847	2.672	3.817	
1.44	8.787	1.867	9.4	1.682	9.498	1.634	9.337
1.219	9.165	5.437	10.923	2.927	4.959	2.74	4.899
3.344	5.639	3.284	5.673	3.791	6.323	3.854	6.506
4.559	6.841	4.253	6.225	4.117	6.884	4.117	6.268
3.684	6.276	3.917	6.115	3.82	5.86	4.024	6.276
4.491	7.237	4.406	6.667	4.917	7.608	4.582	6.936
3.947	6.14	3.888	6.693	3.59	5.877	3.718	6.37
3.292	8.136	11.041	2.732	6.802	9.482	2.962	7.579
10.342	2.347	5.784	8.221	2.658	6.493	10.009	6.387
10.168	7.04	11.889	2.85	8.388	10.822	2.71	7.183
10.364	2.672	6.516	10.941	5.814	9.426	3.292	8.609
11.635	3.379	8.395	12.049	2.881	7.516	10.519	

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