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IMPACLIB:
A MATERIAL PROPERTY DATA LIBRARY FOR IMPACT ANALYSIS OF RADIOACTIVE MATERIAL TRANSPORT CASKS

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IMPACLIB: A Material Property Data Library for Impact Analysis of Radioactive Material Transport Casks

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The paper describes the structural data library and graphical program for impact and stress analyses of radioactive material transport casks. Four kinds of material data, structure steels, stainless steels, leads and woods are compiled. These materials are main structural elements of casks. Structural data such as, coefficient of thermal expansion, modulus of longitudinal elasticity, modulus of transverse elasticity, Poisson's ratio and stress-strain relationship have been tabulated.

Main features of IMPACLIB are as follows:

(1) data have been tabulated against temperature or strain rate,

(2) thirteen kinds of polynominal fitting for stress-strain curve are available,

(3) it is capable of graphical representations for structural data and

(4) the IMPACLIB is able to be used on not only main frame computers but also work stations (OS UNIX) and personal computers (OS Windows 3.1).

In the paper, brief illustration of data library is presented in the first section. The second section presents descriptions of structural data. The third section provides a user's guide for computer program and input data for the IMPACLIB.

Keywords: Computer Program, Data library, Structural Data, Stress Analysis, Impact Analysis, Drop Impact, Transport Cask, Cask

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ＩＭＰＡＣＬＩＢ：放射性物質輸送容器の衝突解析用材料物性データライブラリー

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（1997年11月５日受理）

本報告書は放射性物質輸送容器の落下や衝突解析に必要な材料の衝撃特性データ、ならびに応力解析に必要なデータのライブラリーおよびその図形処理プログラムＩＭＰＡＣＬＩＢについてまとめたものである。データライブラリーに含まれる材料の種類は、輸送容器の主要構成材料である構造用鋼、ステンレス鋼、鉛および木材である。材料データの種類は熱膨張率、縦弾性係数、横弾性係数、ポアソン比および応力－ひずみ特性である。

ＩＭＰＡＣＬＩＢの主要な特徴は次の通りである。

(1) データは温度の関数あるいはひずみ速度の関数として与えられている。
(2) 応力－ひずみ特性に関して13種類の近似式で表示できる。
(3) データは図表で表示できる。
(4) 大型計算機以外にもワークステーション（OS UNIX）およびパーソナルコンピュータ（OS Windows 3.1）によっても使用できる。

本報告書はデータライブラリーの説明、ＩＭＰＡＣＬＩＢプログラムおよび入力データ等のユーザーガイドについて記述したものである。

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1. Introduction

In the drop impact and stress analyses for radioactive transport casks, it has become possible to perform them in detail by using interaction evaluation, computer programs, such as DYNA2D[1], DYNA3D[2], NIKE2D[3], NIKE3D[4], PISCES[5] and HONDO[6]. Availability of these computer programs, makes it possible to accurately solve large numbers of problems involving a wide variety of material data provided that accurate input data are used. The structural properties of the materials, including coefficient of thermal expansion, modulus of longitudinal elasticity, modulus of transverse elasticity, Poisson's ratio and stress-strain relationship (temperature and/or strain rate dependent data) should be known as accurately as possible. Some of these properties are difficult to measure. In paticular, stress-strain relationships may vary from data to data depending on test methods. Therfore, when used in calculations, the possible inaccuracy of variability of structural data should be accounted for to properly interpret the results. For this reason, we have made an effort to collect stress-strain data and make it available in a form convenient for handling by computer.

Four kinds of materials data, structure steels (mild steel or carbon steel), stainless steels, leads and woods have been compiled, and are summerized in this report. The structural data library IMPACLIB (one computer program of CASKET[7]-[19] code system as shown in Fig. 1.1) for impact and stress analyses has been developed.

Main features of the computer program IMPACLIB are as follows;

(1) data have been tabulated against temperature or strain rate,

(2) thirteen kinds of polynominal fitting functions for stress-strain curve are available,

(3) it is capable of graphical representations for structural data and

(4) the IMPACLIB is able to be used on not only main frame computers but also work stations (OS UNIX) and personal computers (OS Windows 3.1).

In the paper, brief illustration of data library is presented in the first section. The second section presents descriptions of structural data. The third section provides a user's guide for the IMPACLIB.

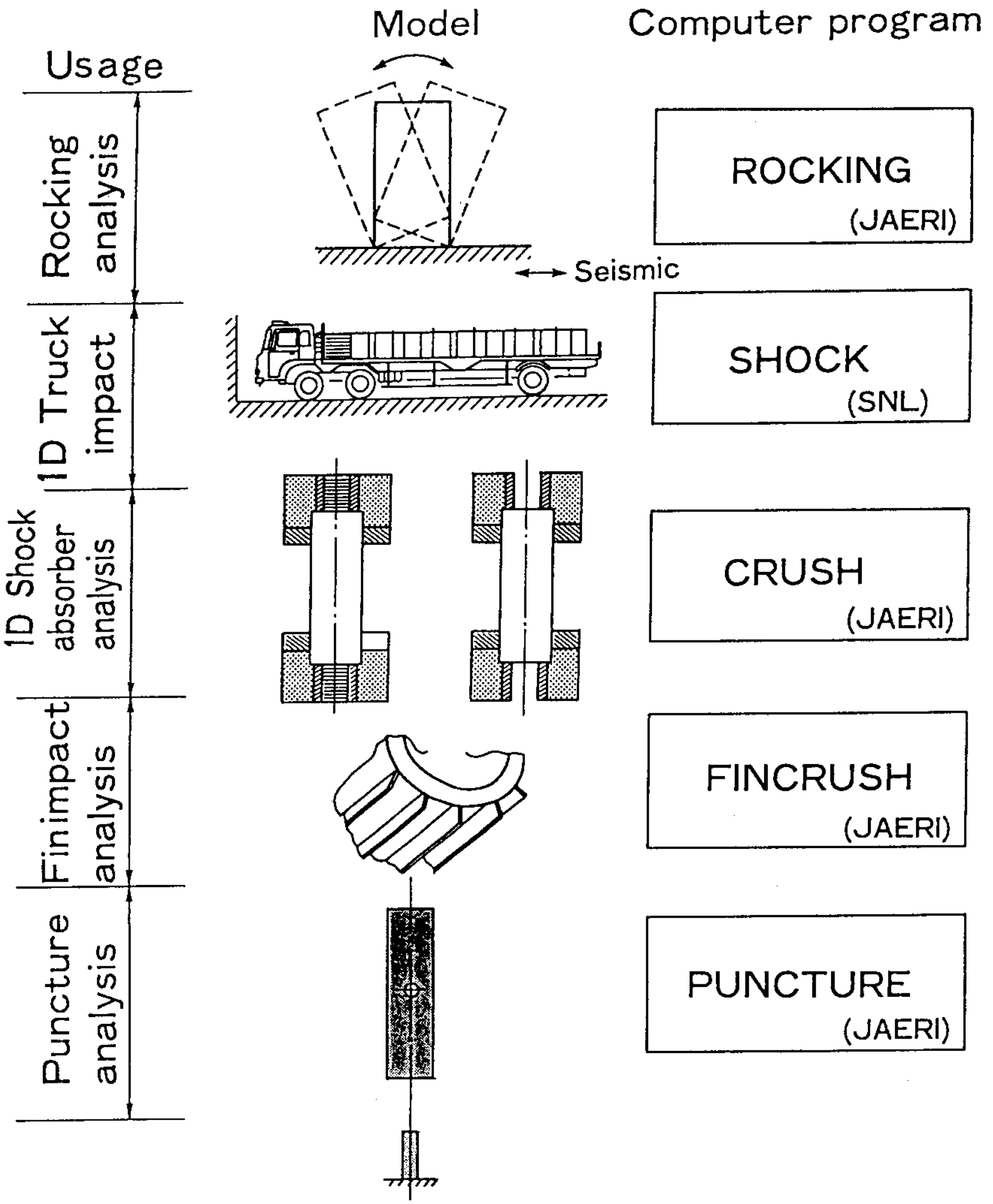

Fig. 1.1 Simplified analysis computer programs

2. Description of Structural Material Property Data

The strucutural property data are necessitated for impact analysis of casks using the computer programs such as DYNA2D, DYNA3D, NIKE2D, NIKE3D, PISCES, HONDO and so on. Therfore, the computer program IMPACLIB for a material property data library and data processing has been developed. Four kinds of materials data, structure steels (mild steel and carbon steel), stainless steels, leads and woods have been compiled and are summerized.

The structural property data including coefficient of thermal expansion, modulus of longitudinal elasticity, modulus of transverse elasticity, Poisson's ratio and stress-strain relationship have been tabulated against temperature and/or strain rate for more than 100 materials. These data have been collected from over 50 references. The data have been arranged in computer card image and stored in magnetic disks (hard or floppy disks) in a format suitable for computer processing, with the material identified numerically according to a general and flexible classification system. An accompanying numerical index, also in card image form, describes each material, assigns it an identification number, references the sources of the data by code number. The SI unit system is used for all data, and if desired, data can be converted the MKS (meter-kilogram-second) unit system. In addition the data are obtained from a source list. The IMPACLIB has been written to search the material data list for specific material identification number.

3. Material Property Data Library

The computer program IMPACLIB has been developed. Four kinds of materials data, structure steels (mild steel and carbon steel), stainless steels, leads and woods have been compiled and are summerized.

(1) structure steels (14 materials)
- ① carbon steel (JIS SS41) (8 materials)
- ② mild steel (JIS SS4100) (1 material)
- ③ structure steel (JIS S35C) (1 material)
- ④ structure steel (JIS S45C) (2 materials)
- ⑤ structure steel (JIS S55C) (1 material)
- ⑥ mild steel (AISC 1020) (1 material)

(2) stainless steels (35 materials)
- ① stainless steel (JIS SUS302) (1 material)
- ② stainless steel (JIS SUS303) (1 material)
- ③ stainless steel (JIS SUS304) (24 materials)
- ④ stainless steel (JIS SUS304L) (1 material)
- ⑤ stainless steel (JIS SUS316) (3 materials)
- ⑥ stainless steel (JIS SUS316L) (2 materials)
- ⑦ stainless steel (AISC 1316L) (1 material)
- ⑧ stainless steel (JIS SUS316H) (1 material)
- ⑨ stainless steel (JIS SUS316) (1 material)

(3) leads (20 materials)
- ① pure lead (17 materials)
- ② hard lead (3 materials)

(4) woods (24 materials)
- ① oak tree (19 materials)
- ② playwood (3 materials)
- ③ balsa wood (2 materials)

The structural properties of materials, including coefficient of thermal expansion, modulus of longitudinal elasticity, modulus of transverse elasticity, Poisson's ratio and stress-strain relationship have been compiled and are summerized.

(a) coefficient of thermal expansion (temperature dependent)

(b) modulus of longitudinal elasticity (temperature dependent)

(c) modulus of transverse elasticity (temperature dependent)

(d) Poisson's ratio (temperature dependent)

(e) stress-strain relationship (temperature dependent or strain rate dependent)

Table 3.1 shows relationships among material names, identification numbers, property data and refereence numbers in the data library. Tabel 3.2 shows relationships between material identification numbers and reference numbers. Table3.3 are listed constitutive equations in built in the computer program the IMPACLIB. The data formats of the structural property data are listed in Table 3.4. Table 3.5 shows the reference number for material property data in the library.

Table 3.1 Material name, identification number, reference and data in library

Category	Material name	ID number	Reference	Data
Structure steel	AISC1020	1001	R−7	σ−ε
	S45C	1002	R−24	σ−ε
	STEEL	1003	R−36	σ−ε
	STEEL	1004	R−36	σ−ε
	STEEL	1005	R−52	σ−ε
	STEEL	1006	R−52	σ−ε
	STEEL	1007	R−53	σ−ε
	STEEL	1008	R−55	σ−ε
	STEEL	1009	R−56	σ−ε
	SS41	1010	R−86	σ−ε
	S35C	1011	R−86	σ−ε
	S45C	1012	R−86	σ−ε
	S55C	1013	R−86	σ−ε
	STEEL	1100	—	α, E, G, ν
Stainless steel	SUS302	2001	R−1	σ−ε
	SUS303	2002	R−1	σ−ε
	SUS304	2003	R−1	σ−ε
	SUS316H	2004	R−1	σ−ε
	SUS304	2005	R−45	σ−ε
	AISI316L	2006	R−3	σ−ε
	SUS304L	2007	R−7	σ−ε
	SUS304	2008	R−10	σ−ε
	SUS316	2009	R−10	σ−ε
	SUS304	2010	R−10	σ−ε
	SUS316	2011	R−10	σ−ε
	SUS316L	2012	R−27	σ−ε
	SUS316L	2013	R−27	σ−ε
	SUS304	2014	R−4	σ−ε
	SUS(18−8)	2015	R−46	σ−ε
	SUS304	2016	R−46	σ−ε
	SUS304	2017	R−48	σ−ε
	SUS304	2018	R−48	σ−ε
	SUS304	2019	R−48	σ−ε
	SUS304	2020	R−48	σ−ε
	SUS304	2021	R−48	σ−ε
	SUS304	2022	R−48	σ−ε
	SUS304	2023	R−48	σ−ε
	SUS304	2024	R−48	σ−ε
	SUS304	2025	R−48	σ−ε
	SUS304	2026	R−48	σ−ε
	SUS304	2027	R−48	σ−ε
	SUS304	2028	R−48	σ−ε
	SUS304	2029	R−48	σ−ε
	SUS304	2030	R−48	σ−ε
	SUS304	2031	R−48	σ−ε
	SUS304	2032	R−48	σ−ε
	SUS304	2033	R−51	σ−ε
	SUS304	2100	—	α, E, G, ν
	SUS316	2200	—	α, E, G, ν
Lead	PURE LEAD	3001	R−1	σ−ε
	PURE LEAD	3002	R−1	σ−ε
	PURE LEAD	3003	R−1	σ−ε
	LEAD	3004	R−1	σ−ε
	PURE LEAD	3005	R−10	σ−ε
	PURE LEAD	3006	R−10	σ−ε

Table 3.1 (Continued)

Category	Material name	ID number	Reference	Data
Lead	PURE LEAD	3007	R-1	$\sigma-\varepsilon$
	PURE LEAD	3008	R-1	$\sigma-\varepsilon$
	PURE LEAD	3009	R-1	$\sigma-\varepsilon$
	PURE LEAD	3010	R-4	$\sigma-\varepsilon$
	PURE LEAD	3011	R-4	$\sigma-\varepsilon$
	PURE LEAD	3012	R-4	$\sigma-\varepsilon$
	PURE LEAD	3013	R-12	$\sigma-\varepsilon$
	PURE LEAD	3014	R-12	$\sigma-\varepsilon$
	PURE LEAD	3015	R-12	$\sigma-\varepsilon$
	PB	3016	R-85	$\sigma-\varepsilon$
	PB2	3017	R-85	$\sigma-\varepsilon$
	PB4	3018	R-85	$\sigma-\varepsilon$
	PB6	3019	R-85	$\sigma-\varepsilon$
	LEAD	3100	–	α, E, G, ν
Wood	OAK	4001	R-41	$\sigma-\varepsilon$
	OAK	4002	R-41	$\sigma-\varepsilon$
	PLYWOOD	4003	R-41	$\sigma-\varepsilon$
	PLYWOOD	4004	R-41	$\sigma-\varepsilon$
	BALSA	4005	R-42	$\sigma-\varepsilon$
	BALSA	4006	R-42	$\sigma-\varepsilon$
	BALSA	4007	R-42	$\sigma-\varepsilon$
	BALSA	4008	R-42	$\sigma-\varepsilon$
	BALSA	4009	R-42	$\sigma-\varepsilon$
	BALSA	4010	R-42	$\sigma-\varepsilon$
	BALSA	4011	R-42	$\sigma-\varepsilon$
	BALSA	4012	R-42	$\sigma-\varepsilon$
	BALSA	4013	R-42	$\sigma-\varepsilon$
	BALSA	4014	R-42	$\sigma-\varepsilon$
	BALSA	4015	R-44	$\sigma-\varepsilon$
	BALSA	4016	R-44	$\sigma-\varepsilon$
	BALSA	4017	R-44	$\sigma-\varepsilon$
	BALSA	4018	R-49	$\sigma-\varepsilon$
	BALSA	4019	R-49	$\sigma-\varepsilon$
	BALSA	4020	R-49	$\sigma-\varepsilon$
	BALSA	4021	R-49	$\sigma-\varepsilon$
	BALSA	4022	R-49	$\sigma-\varepsilon$
	BALSA	4023	R-49	$\sigma-\varepsilon$
	PLYWOOD	4100	–	α, E, G, ν

Table 3.2 Relatioship between reference number and identification number

Reference	Identification number
R－7	1001, 2007
R－24	1002
R－25	1002
R－36	1003, 1004
R－52	1005, 1006
R－53	1007
R－55	1008
R－56	1009
R－1	2001, 2002, 2003, 2004, 3001, 3002, 3003, 3004, 3007, 3008
R－45	2005
R－3	2006
R－10	2008, 2009, 2011, 3003, 3005, 3006
R－27	2012, 2013
R－4	2014, 3009, 3010, 3011, 3012
R－46	2015, 2016
R－48	2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032
R－51	2033
R－12	3013, 3014, 3015
R－41	4001, 4002, 4003, 4004
R－42	4005, 4006, 4008, 4009, 4010, 4011, 4012, 4013, 4014
R－44	4015, 4016, 4017
R－49	4018, 4019, 4021, 4022, 4023
R－85	3016, 3017, 3018, 3019
R－86	1001, 1011, 1012, 1013

Table 3.3 Constitutive equations built in IMPACLIB

Constitutive equations	Input parameters	Applied material
1. $\sigma_t = K\ \varepsilon_t^{\ n}$	n, K	Lead
2. $\sigma_t = K\ (C + \varepsilon_p)^n$	n, K, C, E	
3. $\sigma_t = \sigma_0 + K\ \varepsilon_p^{\ n}$	n, K, σ_0, E	
4. $\sigma_t = \sigma_c + K\ (\varepsilon_t - \sigma_c/E)^n$	n, K, σ_c, E	Stainless steel
6. $\sigma_t = \sigma_0 + A\ (1 - e^{-n\varepsilon_p})$	n, A, σ_0, E	Stainless steel
7. $\sigma_t = (\sigma_c - \sigma_\infty)\ e^{-\varepsilon_p/m} + \sigma_\infty$	m, σ_c, σ_∞, E	
8. $\sigma_t = A - B\ \varepsilon_t^{\ -n}$	n, A, B	Stainless steel
10. $\sigma_t = \sum_{i=0}^{n} K_i\ \varepsilon_t^{\ i}$	n, K_0, K_1, K_2, K_3, K_4	Stainless steel
11. $\sigma_t = A\ (1 + B\ \log \dot{\varepsilon})\ \varepsilon_t^{\ n}$	n, A, B	Stainless steel Carbon steel
12. $\sigma_t = K\ (1 + C\ \dot{\varepsilon}^m)\ \varepsilon_t^{\ n}$	m, n, K, C	Lead
13. $\sigma_t = \sigma_y\ [1 + (\dot{\varepsilon}/C)^{1/m}]$ $\times [1 + (H/\sigma_y)\ \varepsilon_p]$	m, C, H, σ_y, E	Lead
14. $\sigma_t = K\ (\varepsilon) + C\ \log \dot{\varepsilon}$	K, C	
15. $\sigma_t = K\ \dot{\varepsilon}^m\ \varepsilon_t^{\ n}$	m, n, K	

σ_t :True stress, σ_y :Yield stress, σ_0 :Proportional limit of stress-strain,

ε_p :True plastic strain, ε_t :True stress, $\dot{\varepsilon}$:Strain rate,

E : Modulus of longtudial elasticity, e :Root of natural logarithm,

A, B, C, H, K, P, m, n, l, σ_c, σ_∞, ε_c :Constant.

Table 3.4 Format for material data

Data No.	Variables	Data type	Descriptions
Data set No.A-1 : MAT data set.			
1st data	NFLAG	Character	Flag for material data. 'MAT'.
2nd data	MTNAME	Character	Material name. Maximum characters are 16.
3rd data	MATNO	Integer	Material identification number. 1000 ~ 1999 : Structure steel. 2000 ~ 2999 : Stainless steel. 3000 ~ 3999 : Lead. 4000 ~ 4999 : Wood.
4th data	NALPHA	Integer	Number of data pairs listed in the table of coefficient of thermal expansion versus temperature.
5th data	NEMOD	Integer	Number of data pairs listed in the table of modulus of longitudinal elasticity versus temperature.
6th data	NSMOD	Integer	Number of data pairs listed in the table of modulus of transeverse elasticity versus temperature.
7th data	NEMYU	Integer	Number of data pairs listed in the table of Poisson's ratio versus temperature.
8th data	NSSR	Integer	Number of data pairs listed in the table of stress-strain data versus temperature.
9th data	ALPHA0	Real	Coefficient of thermal expansion, if constant or if the temperature dependence is unknown.
10th data	EMOD0	Real	Modulus of longitudinal elasticity, if constant or if the temperature dependence is unknown.
11th data	SMOD0	Real	Modulus of transeverse elasticity, if constant or if the temperature dependence is unknown.
12th data	EMYU0	Real	Poisson's ratio, if costant or if the temperature dependence is unknown.

Table 3.4 (Continued)

Data No.	Variables	Data type	Descriptions
Data set No.A-2 : MAT data set(continued).			
			(Only included if at least two data pairs are listed.)
1st data	ALPHA(1)	Real	Coefficient of thermal expansion at the temperature specified.
2nd data	TALPH(1)	Real	Temperature at which the material has the coefficient of thermal expansion specified.
3rd data	ALPHA(2)	Real	Coefficient of thermal expansion at the temperature specified.
4th data	TALPH(2)	Real	Temperature at which the material has the coefficient of thermal expansion specified.
.....	(ALPHA(I),TALPH(I)),I=1,NALPHA)		
.....			The thermal expansion table may list up to NALPHA pairs.
Data set No.A-3 : MAT data set(continued).			
			(Only included if at least two data pairs are listed.)
1st data	EMOD(1)	Real	Modulus of longitudinal elasticity at the temperature specified.
2nd data	TEMOD(1)	Real	Temperature at which the material has the modulus of longitudinal elasticity specified.
3rd data	EMOD(2)	Real	Modulus of longitudinal elasticity at the temperature specified.
4th data	TEMOD(2)	Real	Temperature at which the material has the modulus of longitudinal elasticity specified.
.....	(EMOD(I),TEMOD(I)),I=1,NEMOD)		
.....			The modulus of longitudinal elasticity table may list up to NEMOD pairs.

Table 3.4 (Continued)

Data No.	Variables	Data type	Descriptions
Data set No.A-4 : MAT data set(continued).			
			(Only included if at least two data pairs are listed.)
1st data	SMOD(1)	Real	Modulus of transverse elasticity at the temperature specified.
2nd data	TSMOD(1)	Real	Temperature at which the material has the modulus of transverse elasticity specified.
3rd data	SMOD(2)	Real	Modulus of transverse elasticity at the temperature specified.
4th data	TSMOD(2)	Real	Temperature at which the material has the modulus of transverse elasticity specified.
.....	(SMOD(I),TSMOD(I)),I=1,NSMOD)		
.....			
			The modulus of transverse elasticity table may list up to NSMOD pairs.
Data set No.A-5 : MAT data set(continued).			
			(Only included if at least two data pairs are listed.)
1st data	EMYU(1)	Real	Poisson's ratio at the temperature specified.
2nd data	TEMYU(1)	Real	Temperature at which the material has the Poisson's ratio specified.
3rd data	EMYU(2)	Real	Poisson's ratio at the temperature specified.
4th data	TEMYU(2)	Real	Temperature at which the material has the Poisson's ratio specified.
.....	(EMYU(I),TEMYU(I)),I=1,NEMYU)		
.....			
			The thermal expansion table data may list up to NEMYU pairs.

Table 3.4 (Continued)

Data No.	Variables	Data type	Descriptions
Data set No.B : REF data set.			
1st data	NFLAG	Character	Flag for reference number of original data. 'REF'.
2nd data	NREF	Integer	Number of references.
3rd data	REF(1)	Character	Reference number 1. Maximum characters of one reference are 8.
4th data	REF(2)	Character	Reference number 2.
......	....		....
	(REF(I),I=1,NREF)		
Data set No.C : COM data set.			
1st data	NFLAG	Character	Flag for comment data. 'COM'.
2nd data	COMMEN	Character	Job description. Maximum characters are 72.
Data set No.D-1 : SSR data set.			
1st data	NFLAG	Character	Flag for material data. 'SSR'.
2nd data	TSSR	Real	Temperature specified for stress-strain data.
3rd data	DFTYPE	Character	Flag for material test method. 'C' : compression. 'T' : tension.
4th data	FIBDRC	Character	Flag for direction of force against wood fiber. 0 : 0 degree(parallel to wood fiber). 30 : 30 degrees. 45 : 45 degrees. 60 : 60 degrees. 90 : 90 degrees. NORM : Perpendicular to wood fiber.
5th data	NESPDT	Integer	Number of data for strain rate.
Data set No.D-2 : SSR data set(continued).			
1st data	EPSIDT(1)	Real	Strain rate.
2nd data	NSSD(1)	Integer	Number of stress strain data pairs.

Table 3.4 (Continued)

Data No.	Variables	Data type	Descriptions
3rd data	EPS(1,1)	Real	Strain.
4th data	STRESS(1,1)	Real	Stress.
5th data	EPS(1,2)	Real	Strain.
6th data	STRESS(1,2)	Real	Stress.
.....	......	...	....
.....	......	...	....
	[EPSIDT(I),NSSD(I),{EPS(I,J),STRESS(I,J)J=1,NSDD(I)},I=1,NEPSDT]		
Data set No.E-1 : SSR2 data set.			
1st data	NFLAG	Character	Flag for material data. 'SSR2'.
2nd data	TSSR	Real	Temperature specified for stress-strain data.
3rd data	DFTYPE	Character	Flag for material test method. 'C' : compression. 'T' : tension.
4th data	FIBDRC	Character	Flag for direction of force against wood fiber. 0 : 0 degree(pallarel to wood fiber). 30 : 30 degrees. 45 : 45 degrees. 60 : 60 degrees. 90 : 90 degrees. NORM : Perpendicular to wood fiber.
5th data	NESPDT	Integer	Number of data for strain rate dependence data.
6th data	NEPSR	Integer	Number of data for strain dependence data.
Data set No.E-2 : SSR2 data set(continued).			
1rd data	EPS(1)	Real	Strain.
2th data	EPS(2)	Real	Strain.
.....	......	...	....
	{EPS(J),J=1,NEPSR}		

Table 3.4 (Continued)

Data No.	Variables	Data type	Descriptions
Data set No.E-3 : SSR2 data set(continued).			
1st data	EPSDOT(1)	Real	Strain rate.
2nd data	NSIG(1)	Integer	Number of data for strain dependence. stress.
3rd data	STRESS(1,1)	Real	Stress.
4th data	STRESS(1,2)	Real	Stress.
. . . . .	. . . . . .	. . .	. . . .
. . . . .	. . . . . .	. . .	. . . .
	[EPSDOT(I),NSIG(I),{STRESS(I,J)J=1,NSIG(I)},I=1,NEPSDT]		
Data set No.F : * data set.			
1st data	NFLAG	Character	Flag for comment. '*'.
2nd data	COMMEN	Character	Comment, maximum characters are 72.
Data set No.G : END data set.			
1st data	NFLAG	Character	Flag for data end. 'END'.

Table 3.5 Reference Number for Material Property Data

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4. Computer Program

4.1 Program Description

The computer program IMPACLIB consists of three parts. These are the material property library obtained by many research institutes, the data retrieval program and plotting program for the data used with DYNA2D, DYNA3D, NIKE2D, NIKE3D, PISCES, HONDO, CRUSH1[14], CRUSH2[15], FINCRUSH[16] and PUNCTURE[17] computer programs. The CRUSH1, CRUSH2, FINCRUSH and PUNCTURE are static calculation programs and the other are dynamic finite element programs capable of evaluating the maximum acceleration of the cask body, the maximum deformation and so on.

The computer program IMPACLIB consists of a main routine and thirty five subroutines. These are MAIN, BLOCKDATA, MLBST, MLBPT, RDSQF, RDCHS, ISBST, MLBEX, EXCOM, EXCOMQ, EXCOM1, EXCOM2, EXCOM3, EXQRY, EXDAT, MLBFD, GTPROP, GTEPSS, GTSIG, GTEMOD, EXUNI, EXUNI2, EXOUT, EXFIT, EXFIT1, EXFIT2, EXFIT3, EXMINX, EXLSTP, EXGRA, CURVE, AXFUN1, PLTAX2, PLTAXL, PLTLGV and DTLIST. Overall structure of the IMPACLIB is shown in Fig. 4.1. Functions of subroutines are as follows:

MAIN : initializes start of run,
BLOCKDATA : initializes data set,
MLBST : prepares to read material data library(1),
MLBPT : handling material data library,
RDSQF : prepares to read material data library(2),
RDCHS : sets input data parameters,
ISBST : changes from character type data to integer type data,
MLBEX : controls IMPACLIB program,
EXCOM : reads input data(1),
EXCOMQ : reads input data(2),
EXCOM1 : reads input data(3),
EXCOM2 : reads input data(4),
EXCOM3 : reads input data(5),
EXQRY : prints of output data,

EXDAT : prepares to print output data,

MLBFD : reads material data(1),

GTPROP : searches material property data,

GTEPSS : searches stress-strain data(1),

GTSIG : searches stress-strain data(2),

GTEMOD : reads material data(2),

EXUNI : changes data unit(1),

EXUNI2 : changes data unit(2),

EXOUT : prepares to print output data,

EXFIT : prepares data fitting output,

EXFIT1 : prepares data curve fitting(1),

EXFIT2 : prepares data curve fitting(2),

EXFIT3 : prepares data curve fitting(3),

EXMINX : searches maximum and minimum values,

EXLSTP : prepares to draw material property data,

EXGRA : prepares to draw stress-strain curves,

CURVE : draws stress-strain curves,

AXFUN1 : prepares to draw axis,

PLTAX2 : draws axis,

PLTAXL : draws grid lines,

PLTLGV : prepares to grid lines,

DTLIST : prints of input data.

A macroscopic flow chart of the IMPACLIB is shown in Fig. 4.2.

4.2 Description of Input Data

This section describes the input data required by the IMPACLIB. The input data consist of a material title, the material selection, a data fitting curve selection and options for output plotting. The input instruction is simple and easy follow. The input data forms are presented in Tables 4.1, 4.2 and 4.3 and Fig. 4.3..

4.3 Description of Output Data

This section describes the output data forms of the IMPACLIB. The contents of these various quantities are described in the followings.

(1) Input data

The input data are printed in two formats. The first print format is exactly the same as they were read. Second, the computer program lists the input data as interpreted by the IMPACLIB.

(2) Material property data

The material property data are compiled from the data library file and printed out on output sheets.

(3) Graphical output

The IMPACLIB provides users with the graphical output of the material property data.

Table 4.1 Input data for IMPACLIB

(1) ENTRY command

ENTRY command.
Function : Job entry. Prompt : ENTRY? (0:1:2:3) Input data : 0 : EXIT. 1 : QUERY. 2 : GRAPHICS. 3 : INPUT ECHO.

(2) QUERY command

QUERY command.
Function : Selection of job. Prompt : QUERY? (0:1:2:3:4:5:6:7:8) Input data : 0 : RETURN. 1 : MATERIAL NAME LIST. 2 : STRUCTURE STEEL NAME LIST. 3 : STAINLESS STEEL NAME LIST. 4 : LEAD NAME LIST. 5 : WOOD NAME LIST. 6 : REFERENCE LIST. 7 : MATERIAL DATA. 8 : MATERIAL INDEX.

(3) Graphic commands
(a) TITLE command

TITLE command.
Function : Job description. Prompt : TITLE? ('.......') Input data : '............'

Table 4.1 (Continued)

(b) MATERIALS command

MATERIALS command.
Function : Selection of material, number of materials and material index. Prompt : MATERIALS? (PROP, NMAT, MATNO, ...) Input data : PROP 0 : RETURN. 1 : COEFFICIENT OF THERMAL EXPANSION. 2 : MODULUS OF LONGITUDINAL ELASTICITY. 3 : MODULUS OF TRANSVERSE ELASTICITY. 4 : POISSON'S RATIO. 5 : STRESS-STRAIN CURVE. 6 : STRESS-STRAIN CURVE DEPENDENT ON STRAIN RATE. NMAT : NUMBER OF MATERIALS. MATNO : MATERIAL INDEX NUMBER.

(c) PARAMETERS command

PARAMETERS command.
Function : Selection of data parameters, such as material test method, direction of compression or tensile force against wood fiber, tempereture ranges, stress-strain cureve and stress-strain curve dependent on strain rate. Prompt : PARAMETERS? (0:1:2:3:4:5) Input data : 0 : RETURN. 1 : DEFORMATION TYPE(material test method). 2 : FIBER DIRECTION OF WOOD(direction of force against wood fiber). 3 : TEMPERATURE(temperature range). 4 : STRAIN RATE. 5 : STRAIN.

Table 4.1 (Continued)

(c-1) DEFORMATION TYPE subcommand

DEFORMATION TYPE subcommand.
Function : Selection of material test method. Prompt : DEFORMATION TYPE? (0:1:2:3:) Input data : 0 : RETURN. 1 : COMPRESSION. 2 : TENSION. 3 : COMPRESSION & TENSION.

(c-2) FIBER DIRECTION OF WOOD subcommand

FIBER DIRECTION OF WOOD subcommand.
Function : Selection of material test direction of compression or tensile force against wood fiber. Prompt : FIBER DIRECTION OF WOOD? (0:1:2:3:4:5:6) Input data : 0 : RETURN. 1 : 0 DEG. 2 : 30 DEG. 3 : 45 DEG. 4 : 60 DEG. 5 : 90 DEG. 6 : NORMAL.

(c-3) TEMPERATURE subcommand

TEMPERATURE subcommand.
Function : Selection of temperature ranges. Prompt : TEMPERATURE? (NIN,MAX) Input data : MIN : MINIMUM TEMPERATURE. MAX : MAXIMUM TEMPERATURE.

Table 4.1 (Continued)

(c-4) STRAIN RATE subcommand

STRAIN RATE subcommand.
Function : Selection of stress-strain cureve dependent on strain rate. Prompt : STRAIN RATE? (NIN,MAX) Input data : MIN : MINIMUM STRAIN RATE. MAX : MAXIMUM STRAIN RATE.

(c-5) STRAIN subcommand

STRAIN RATE subcommand.
Function : Selection of strains. Prompt : STRAIN ? (NSTRN, STRN1, STRN2, ...) Input data : NSTRN : NUMBER OF STRAINS(number of data dependent on strain). STRN1 : STRAIN. STRN2 : STRAIN. .... : ....

(d) SYSTEM OF UNITS command

SYSTEM OF UNITS command.
Function : Selection of units. Prompt : SYSTEM OF UNITS? (1:2) Input data : 1 : SI (SI unit). 2 : MKS (MKS unit).

Table 4.1 (Continued)

(e) OUTPUT command

OUTPUT command.
Function : Selection of output forms. Prompt : OUTPUT? (0:001:010:011:100:101:111) Input data : 0 : RETURN. 001 : LISTING. 010 : PLOTTING. 011 : LISTING & PLOTTING. 100 : FITTING. 110 : FITTING & PLOTTING. 111 : FITTING & PLOTTING & LISTING.

(e-1) PLOT OPTIONS subcommand

PLOT OPTIONS subcommand.
Function : Selection of graphical output forms. Prompt : PLOT OPTIONS? (0:1:2:3:4:5) Input data : 0 : RETURN. 1 : DATA RANGES. 2 : TYPE OF AXES. 3 : STRING. 4 : MESH. 5 : COMMENT OF CURVES.

(e-2) DATA RANGES subcommand

DATA RANGES subcommand.
Function : Selection of data ranges for graphical plot. Prompt : DATA RANGES? (XMIN, XMAX, YMIN, YMAX) Input data : XMIN : MINIMUM VALUE ON X-AXIS. XMAX : MAXIMUM VALUE ON X-AXIS. YMIN : MINIMUM VALUE ON Y-AXIS. YMAX : MAXIMUM VALUE ON Y-AXIS.

Table 4.1 (Continued)

(e-3) TYPE OF AXES subcommand

TYPE OF AXES subcommand.
Function : Selection of scale types for graphical plot axes. Prompt : TYPE OF AXES? (1:2:3:4) Input data : 1 : BOTH X AND Y ARE LINEAR SCALE (both X- axis and Y-axis are linear scales). 2 : X IS LOG SCALE, Y IS LINEAR SCALE (X-axis is log scale and Y-axis is linear scale). 3 : X IS LINEAR SCALE, Y IS LOG SCALE (X-axis is linear scale and Y-axis is log scale). 4 : BOTH X AND Y ARE LOG SCALE (both X-axis and Y-axis are log scales).

(e-4) STRING subcommand

STRING subcommand.
Function : Selection of string types. Prompt : STRING? (0:1) Input data : 0 : NO (do not draws). 1 : YES (draws line between plot marks).

(e-5) MESH subcommand

MESH subcommand.
Function : Selection of mesh drawing. Prompt : MESH? (0:1:2) Input data : 0 : NONE (do not draws). 1 : DASH LINE (draws straight line mesh). 2 : LINE (draws dotted line mesh).

Table 4.1 (Continued)

(e-6) COMMENT OF CURVES subcommand

COMMENT OF CURVES subcommand.
Function : Writes a comment on a curve. Prompt : COMMENT OF CURVES? (CURVE-NO., '...COMMENT...') Input data : CURVE-NO. 0 : RETURN. >1 : DEFINITION. <20 : DEFINITION. '...COMMENT...' (writes a comment on the curve).

(f) FITTING commands

FITTING command.
Function : Selection of curve fitting. Prompt : FITTING? (0:1:2:3) Input data : 0 : RETURN. 1 : INPUT X-Y DATA (input X-Y data for fixed points). 2 : LINEAR REGRESSION (linear regression). 3 : BUILT IN EQUATIONS (use of built in equations).

(f-1) X-Y DATA subcommand

X-Y DATA subcommand.
Function : Read X-Y data for fixed points. Prompt : X-Y DATA? (N, X1, Y1, ..., XN, YN)) Input data : N : number of X and Y data for fixed ponts (maximum number is 50). X1 : X DATA. Y1 : Y DATA. ..... : .... : .... XN : X DATA. YN : Y DATA.

Table 4.1 (Continued)

(f-2) LINEAR REGRESSION subcommand

LINEAR REGRESSION subcommand.
Function : Seeks coefficient of linear regression. Prompt : LINEAR REGRESSION? (A, B) Input data : A : coefficient of A. B : coefficient of B. Y = A×X + B

(f-3) EQUATION NUMBER subcommand

EQUATION NUMBER subcommand.
Function : Selection of equation number of built in function based on linear regression.. Prompt : EQUATION NUMBER? (1:2:3:.........:15) Input data : 0 : RETURN. 1 : EQUATION NUMBER 1. 2 : EQUATION NUMBER 2. .. : .... 15 : EQUATION NUMBER 15.

(4) EXIT/RESET command

EXIT/RESET command.
Function : Selection of job exit or reset. Prompt : EXIT/RESET? (1:2:3:4:5:6) Input data: 0 : EXIT. 1 : QUERY. 2 : TITLE,........................... 3 : MATERIALS,................ 4 : PARAMETERS,............. 5 : SYSTEM OF UNITS. 6 : OUTPUT.

Table 4.2 Relationship between output plot selection and input data

X-axis	Y-axis	Input data(commands)						
		MATERIALS		PARAMETERS				
		PROP	MATNO	1:Direction of test force	2:Fiber direction of wood	3:Temperature	4:Strain rate	5:Strain
Temperature	Coefficient of thermal expansion	1	◎					
Temperature	Modulus of longitudinal elasticity	2	◎					
Temperature	Modulus of transverse elasticity	3	◎					
Temperature	Poisson's ratio	4	◎					
Strain	Stress	5	◎	○	○	○	○	
Strain rate	Stress	6	◎	○	○	○		◎

Legend : ◎ : Necessity
○ : Option

Table 4.3 Commands for IMPACLIB

Commands/Subcommands	Functions
ENTRY	Job entry.
QUERY	Selection of job.
GRAPHICS	Graphic output.
MATERIALS	Job description.
PARAMETERS	Selection of material.
DEFORMATION TYPE	Selection of material test method.
FIBER DIRECTION OF WOOD	Selection of material test direction against wood fiber.
TEMPERATURE	Selection of temperature ranges.
STRAIN RATE	Selection of stress-strain curve dependent on strain rate.
STRAIN	Selection of strain.
SYSTEM OF UNITS	Selection of units
OUTPUT	Selection of output forms.
PLOT OPTIONS	Selection of graphical output forms.
DATA RANGES	Selection of data ranges for graphical plot.
TYPE OF AXES	Selection of scale types for graphical plot axes.
STRING	Selection of string types.
MESH	Selection of mesh drawing.
COMMENT OF CURVES	Write a comment on a curve.
FITTING	Selection of data fitting.
X-Y DATA	Read X-Y data for fixed points
LINEAR REGRESSION	Seeks coefficient of linear regression.
EQUATION NUMBER	Selection of equation number of built in function based on linear regression.
EXIT/RESET	Selection of job exit or reset.

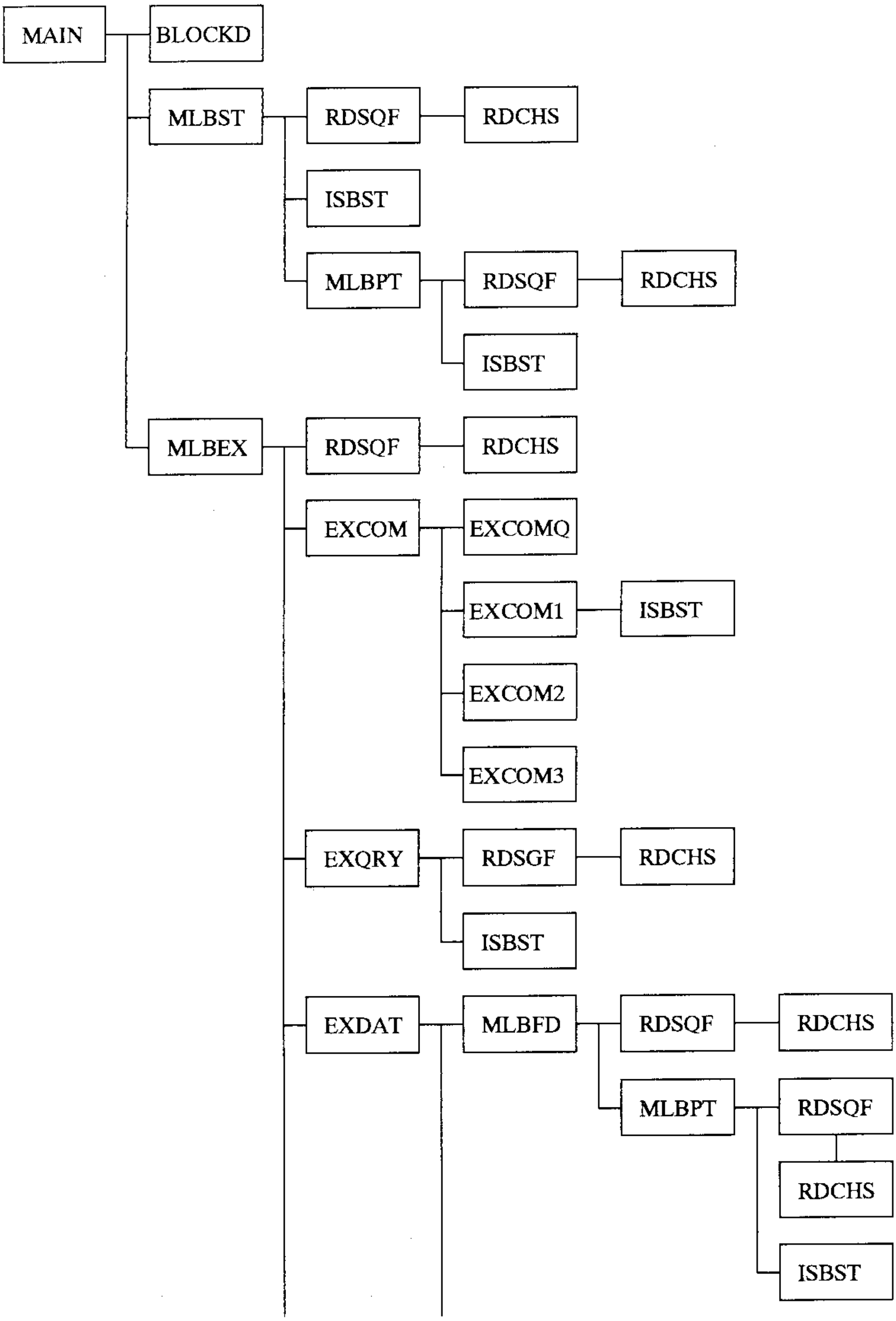

Fig. 4.1 Structure of computer program IMPACLIB(1/2)

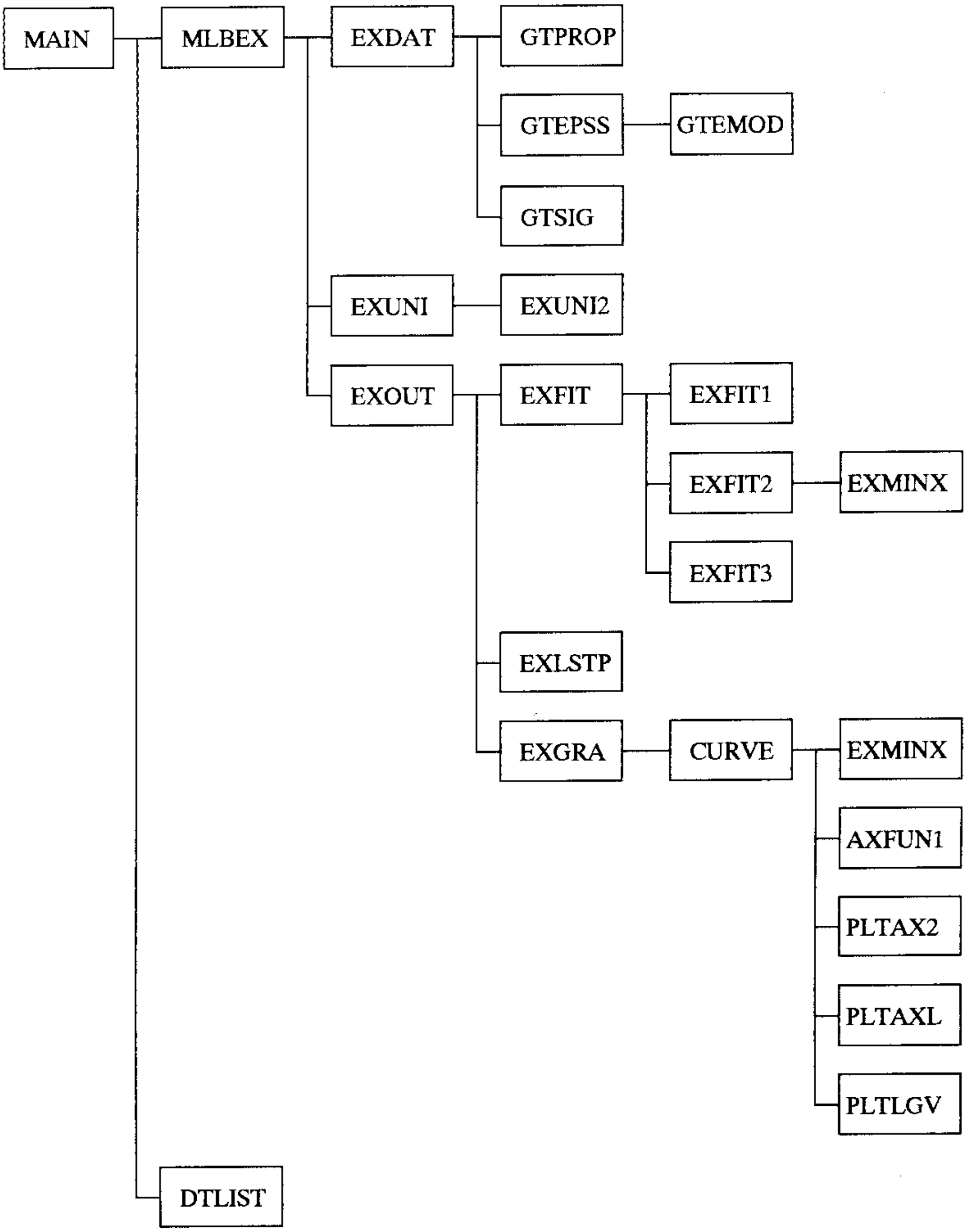

Fig. 4.1 Structure of computer program IMPACLIB(2/2)

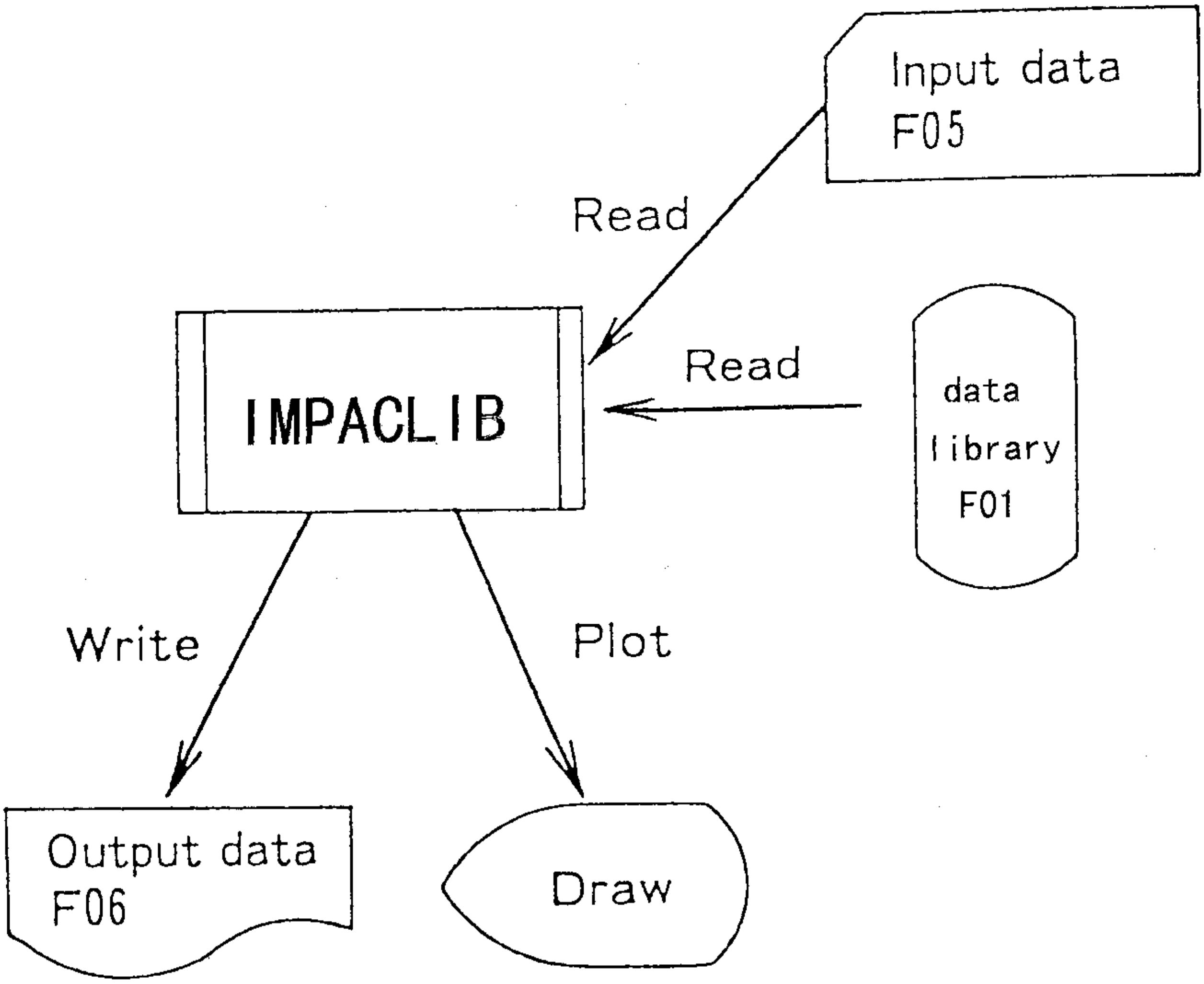

Fig. 4.2 Program flow

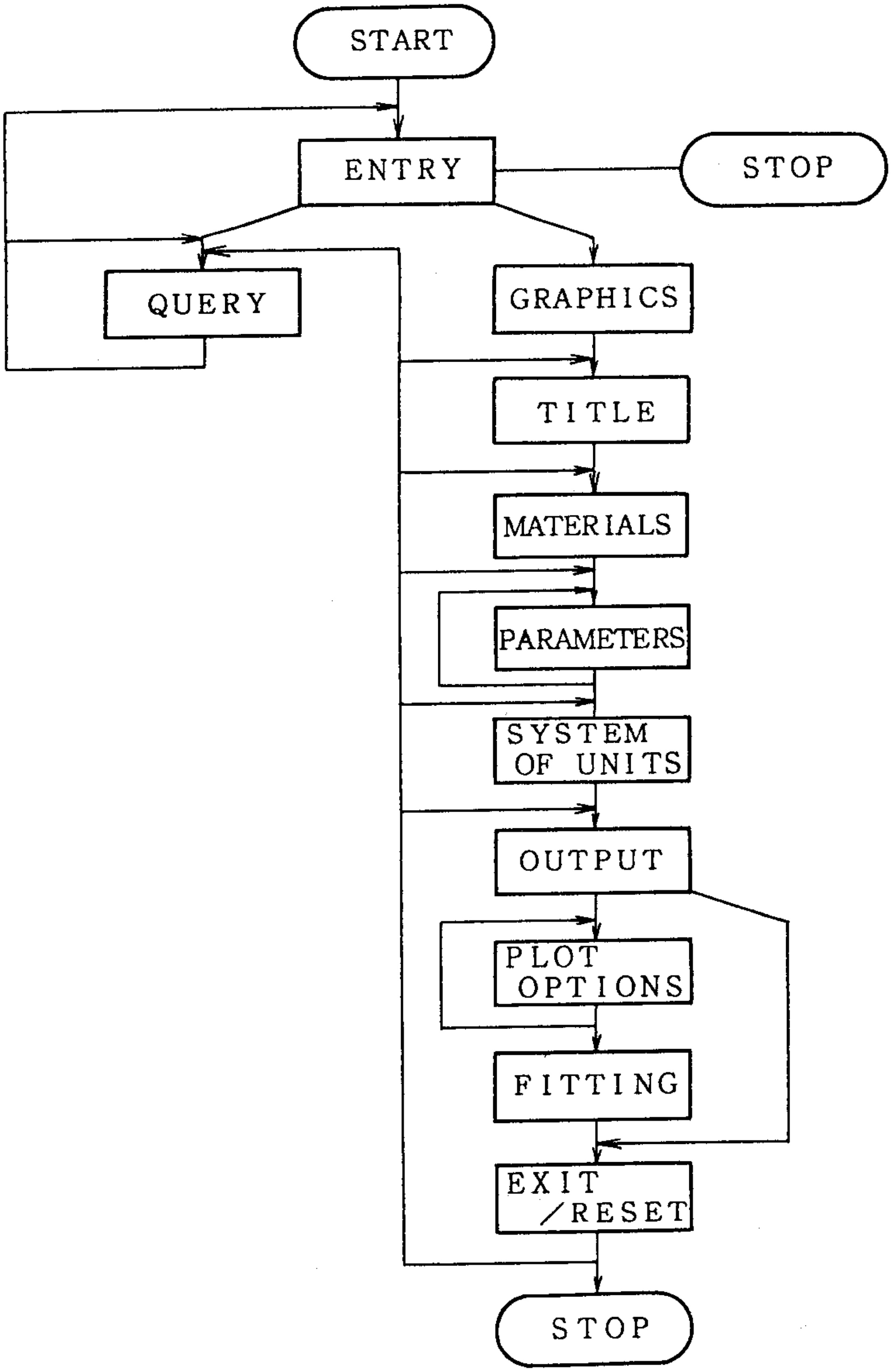

Fig. 4.3 Flow sheet of command

5. Conclusions

In regard to the evaluation of acceleration, deformation, stress and strain of casks in the case of drop impact, structural property data are necessary. A structural property data library IMPACLIB has developed for impact analysis programs such as DYNA2D, DYNA3D, NIKE2D, NIKE3D, PISCES, HONDO, CRUSH1, CRUSH2, FINCRUSH, PUNCTURE and so on. The IMPACLIB is further being utilized satisfactory for general purpose stress analysis programs.

Ackowledgements

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5. Conclusions

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Ackowledgements

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Appendix A Sample Problem Input

INPUT DATA ECHO

```
         1         2         3         4         5         6         7         8
----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

2                                       *START
'STRESS STRAIN CURVES OF STEEL  TEMP.=293.0'   *TITLE ?   R-86
5,1,1012                                *MATERIALS ?
3                                       *OPTION ?
290.0,295.0                             *TEMPERATURE RANGES ?
0                                       *PARAMETERS ?
1                                       *SYSTEM OF UNITS ?
11                                      *OUTPUT ?
1                                       *PLOT OPTIONS ?
0.0, 0.24, 0.0, 1600.                   *DATA RANGES ?
5                                       *PLOT OPTIONS ?
 1 'STRAIN RATE  2.1E-4 '               *CURVE NO. COMMENT
 2 'STRAIN RATE  2.1E-3 '               *CURVE NO. COMMENT
 3 'STRAIN RATE  2.1E-2 '               *CURVE NO. COMMENT
 4 'STRAIN RATE  2.1E-1 '               *CURVE NO. COMMENT
 5 'STRAIN RATE  9.9E-1 '               *CURVE NO. COMMENT
 6 'STRAIN RATE  1.3    '               *CURVE NO. COMMENT
 7 'STRAIN RATE  1.3E+1 '               *CURVE NO. COMMENT
 8 'STRAIN RATE  1.3E+2 '               *CURVE NO. COMMENT
 9 'STRAIN RATE  3.0E+2 '               *CURVE NO. COMMENT
 10 'STRAIN RATE  4.0E+2 '              *CURVE NO. COMMENT
 0 ' '                                  *CURVE NO. COMMENT END
0                                       *PLOT OPTIONS ? -------------
 0                                      *END MARK            -------

----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
         1         2         3         4         5         6         7         8
```

Appendix B Sample Problem Output

```
ENTRY? (0:1:2:3)
   0; EXIT
   1; QUERY
   2; GRAPHICS
   3; INPUT ECHO
 >>  2
TITLE? ('...')
 >> STRESS STRAIN CURVES OF STEEL  TEMP.=293.0
MATERIALS? (PROP,NMAT,MATNO,...)
   PROPERTY
     0; RETURN
     1; COEFFICIENT OF THERMAL EXPANSION
     2; MODULUS OF LONGITUDINAL ELASTICITY
     3; MODULUS OF TRANSVERSE ELASTICITY
     4; POISSON'S RATIO
     5; STRESS-STRAIN
     6; STRESS-STRAIN RATE
   NMAT ; NUMBER OF MATERIALS
   MATNO; MATERIAL NUMBER
 >>  5  1 1012
PARAMETERS? (0:1:2:3:4:5)
   0; RETURN
   1; DEFORMATION TYPE
   2; FIBRE DIRECTION OF WOOD
   3; TEMPERATURE
   4; STRAIN RATE
   5; STRAIN
 >>  3
TEMPERATURE? (MIN,MAX)
 >>   290.000   295.000
PARAMETERS? (0:1:2:3:4:5)
   0; RETURN
   1; DEFORMATION TYPE
   2; FIBRE DIRECTION OF WOOD
   3; TEMPERATURE
   4; STRAIN RATE
   5; STRAIN
 >>  0
SYSTEM OF UNITS? (1:2)
   1; SI
   2; MKS
 >>  1
OUTPUT? (0:001:010:100)
     0; RETURN
   001; LISTING
   010; PLOTTING
   100; FITTING
 >> 11
PLOT OPTIONS? (0:1:2:3:4:5)
   0; RETURN
   1; DATA RANGES
   2; TYPE OF AXES
   3; STRING
   4; MESH
   5; COMMENT OF CURVES
 >>  1
```

Appendix B (Continued)

```
DATA RANGES? (XMIN,XMAX,YMIN,YMAX)
   XMIN; MINIMUN VALUE ON X-AXIS
   XMAX; MAXIMUM VALUE ON X-AXIS
   YMIN; MINIMUM VALUE ON Y-AXIS
   YMAX; MAXIMUM VALUE ON Y-AXIS
 >>        0.00       0.24       0.00    1600.00
PLOT OPTIONS? (0:1:2:3:4:5)
   0; RETURN
   1; DATA RANGES
   2; TYPE OF AXES
   3; STRING
   4; MESH
   5; COMMENT OF CURVES
 >>  5
COMMENT OF CURVES? (CURVE-NO,'..COMMENT..')
    CURVE-NO= 0; RETURN
            > 0; DEFINITION
            <11; DEFINITION
 >>  1, STRAIN RATE  2.1E-4
COMMENT OF CURVES? (CURVE-NO,'..COMMENT..')
    CURVE-NO= 0; RETURN
            > 0; DEFINITION
            <11; DEFINITION
 >>  2, STRAIN RATE  2.1E-3
COMMENT OF CURVES? (CURVE-NO,'..COMMENT..')
    CURVE-NO= 0; RETURN
            > 0; DEFINITION
            <11; DEFINITION
 >>  3, STRAIN RATE  2.1E-2
COMMENT OF CURVES? (CURVE-NO,'..COMMENT..')
    CURVE-NO= 0; RETURN
            > 0; DEFINITION
            <11; DEFINITION
 >>  4, STRAIN RATE  2.1E-1
COMMENT OF CURVES? (CURVE-NO,'..COMMENT..')
    CURVE-NO= 0; RETURN
            > 0; DEFINITION
            <11; DEFINITION
 >>  5, STRAIN RATE  9.9E-1
COMMENT OF CURVES? (CURVE-NO,'..COMMENT..')
    CURVE-NO= 0; RETURN
            > 0; DEFINITION
            <11; DEFINITION
 >>  6, STRAIN RATE  1.3
COMMENT OF CURVES? (CURVE-NO,'..COMMENT..')
    CURVE-NO= 0; RETURN
            > 0; DEFINITION
            <11; DEFINITION
 >>  7, STRAIN RATE  1.3E+1
COMMENT OF CURVES? (CURVE-NO,'..COMMENT..')
    CURVE-NO= 0; RETURN
            > 0; DEFINITION
            <11; DEFINITION
 >>  8, STRAIN RATE  1.3E+2
```

Appendix B (Continued)

```
COMMENT OF CURVES? (CURVE-NO,'..COMMENT..')
   CURVE-NO= 0; RETURN
           > 0; DEFINITION
           <11; DEFINITION
 >>  9, STRAIN RATE  3.0E+2
COMMENT OF CURVES? (CURVE-NO,'..COMMENT..')
   CURVE-NO= 0; RETURN
           > 0; DEFINITION
           <11; DEFINITION
 >> 10, STRAIN RATE  4.0E+2
COMMENT OF CURVES? (CURVE-NO,'..COMMENT..')
   CURVE-NO= 0; RETURN
           > 0; DEFINITION
           <11; DEFINITION
 >>  0,
PLOT OPTIONS? (0:1:2:3:4:5)
   0; RETURN
   1; DATA RANGES
   2; TYPE OF AXES
   3; STRING
   4; MESH
   5; COMMENT OF CURVES
 >>  0
EXIT/RESET? (0:1:2:3:4:5:6)
   0; EXIT
   1; QUERY
   2; TITLE,...
   3; MATERIALS,...
   4; PARAMETERS,...
   5; SYSTEM OF UNITS
   6; OUTPUT
 >>  0
JWE0002I STOP EXIT
```

Appendix C Graphical Output

MATERIAL (CURVE NO.1)

NAME: S45C REFERENCES: R-86
NO. 1012

DEFORMATION TYPE	COMPRESSION
TEMPERATURE (K)	293.00
STRAIN RATE (1/S)	2.100E-04

STRAIN (-)	STRESS (MPA)
1.000E-02	3.530E+02
2.000E-02	4.020E+02
3.000E-02	4.610E+02
4.000E-02	5.050E+02
5.000E-02	5.390E+02
6.000E-02	5.640E+02
7.000E-02	5.880E+02
8.000E-02	6.080E+02
9.000E-02	6.220E+02
1.000E-01	6.370E+02
1.100E-01	6.520E+02
1.200E-01	6.620E+02
1.300E-01	6.760E+02
1.400E-01	6.820E+02
1.500E-01	6.910E+02
1.600E-01	6.960E+02
1.700E-01	7.060E+02
1.800E-01	7.150E+02
1.900E-01	7.250E+02
2.000E-01	7.300E+02

Fig. C.1 Graphical Output of IMPACLIB(1)

MATERIAL (CURVE NO.2)

NAME: S45C REFERENCES: R-86
NO. 1012

DEFORMATION TYPE	COMPRESSION
TEMPERATURE (K)	293.00
STRAIN RATE (1/S)	2.100E-03

STRAIN (-)	STRESS (MPA)
1.000E-02	3.530E+02
2.000E-02	4.020E+02
3.000E-02	4.700E+02
4.000E-02	5.150E+02
5.000E-02	5.540E+02
6.000E-02	5.780E+02
7.000E-02	6.030E+02
8.000E-02	6.220E+02
9.000E-02	6.370E+02
1.000E-01	6.520E+02
1.100E-01	6.710E+02
1.200E-01	6.810E+02
1.300E-01	6.960E+02
1.400E-01	7.060E+02
1.500E-01	7.150E+02
1.600E-01	7.250E+02
1.700E-01	7.300E+02
1.800E-01	7.400E+02
1.900E-01	7.500E+02
2.000E-01	7.600E+02

Fig. C.2 Graphical Output of IMPACLIB(2)

MATERIAL (CURVE NO.3)
NAME: S45C REFERENCES: R-86
NO. 1012

DEFORMATION TYPE	COMPRESSION
TEMPERATURE (K)	293.00
STRAIN RATE (1/S)	2.100E-02

STRAIN (-)	STRESS (MPA)
1.000E-02	3.720E+02
2.000E-02	4.170E+02
3.000E-02	4.800E+02
4.000E-02	5.240E+02
5.000E-02	5.640E+02
6.000E-02	5.980E+02
7.000E-02	6.170E+02
8.000E-02	6.370E+02
9.000E-02	6.570E+02
1.000E-01	6.710E+02
1.100E-01	6.820E+02
1.200E-01	6.960E+02
1.300E-01	7.110E+02
1.400E-01	7.200E+02
1.500E-01	7.250E+02
1.600E-01	7.350E+02
1.700E-01	7.450E+02
1.800E-01	7.500E+02
1.900E-01	7.600E+02
2.000E-01	7.690E+02

Fig. C.3 Graphical Output of IMPACLIB(3)

MATERIAL (CURVE NO.4)
NAME: S45C REFERENCES: R-86
NO. 1012

DEFORMATION TYPE	COMPRESSION
TEMPERATURE (K)	293.00
STRAIN RATE (1/S)	2.100E-01

STRAIN (-)	STRESS (MPA)
1.000E-02	3.920E+02
2.000E-02	4.310E+02
3.000E-02	4.950E+02
4.000E-02	5.440E+02
5.000E-02	5.780E+02
6.000E-02	6.130E+02
7.000E-02	6.370E+02
8.000E-02	6.570E+02
9.000E-02	6.710E+02
1.000E-01	6.910E+02
1.100E-01	7.060E+02
1.200E-01	7.150E+02
1.300E-01	7.250E+02
1.400E-01	7.350E+02
1.500E-01	7.450E+02
1.600E-01	7.500E+02
1.700E-01	7.600E+02
1.800E-01	7.690E+02
1.900E-01	7.740E+02
2.000E-01	7.840E+02

Fig. C.4 Graphical Output of IMPACLIB(4)

MATERIAL (CURVE NO.5)

NAME: S45C REFERENCES: R-86
NO. 1012

DEFORMATION TYPE	COMPRESSION
TEMPERATURE (K)	293.00
STRAIN RATE (1/S)	9.900E-01

STRAIN (-)	STRESS (MPA)
1.000E-02	4.610E+02
2.000E-02	4.410E+02
3.000E-02	4.900E+02
4.000E-02	5.390E+02
5.000E-02	5.780E+02
6.000E-02	6.080E+02
7.000E-02	6.370E+02
8.000E-02	6.570E+02
9.000E-02	6.760E+02
1.000E-01	6.910E+02
1.100E-01	7.060E+02
1.200E-01	7.200E+02
1.300E-01	7.300E+02
1.400E-01	7.350E+02
1.500E-01	7.450E+02

Fig. C.5 Graphical Output of IMPACLIB(5)

MATERIAL (CURVE NO.6)

NAME: S45C REFERENCES: R-86
NO. 1012

DEFORMATION TYPE	COMPRESSION
TEMPERATURE (K)	293.00
STRAIN RATE (1/S)	1.300E+00

STRAIN (-)	STRESS (MPA)
1.000E-02	4.700E+02
2.000E-02	4.510E+02
3.000E-02	5.190E+02
4.000E-02	5.590E+02
5.000E-02	5.980E+02
6.000E-02	6.370E+02
7.000E-02	6.660E+02
8.000E-02	6.860E+02
9.000E-02	7.060E+02
1.000E-01	7.250E+02
1.100E-01	7.350E+02
1.200E-01	7.500E+02
1.300E-01	7.600E+02
1.400E-01	7.690E+02
1.500E-01	7.740E+02
1.600E-01	7.840E+02
1.700E-01	7.890E+02
1.800E-01	7.940E+02

Fig. C.6 Graphical Output of IMPACLIB(6)

MATERIAL (CURVE NO.7)

NAME: S45C REFERENCES: R-86

NO. 1012

DEFORMATION TYPE	COMPRESSION
TEMPERATURE (K)	293.00
STRAIN RATE (1/S)	1.300E+01

STRAIN (-)	STRESS (MPA)
1.000E-02	4.900E+02
2.000E-02	5.000E+02
3.000E-02	5.190E+02
4.000E-02	5.980E+02
5.000E-02	6.370E+02
6.000E-02	6.650E+02
7.000E-02	6.960E+02
8.000E-02	7.150E+02
9.000E-02	7.250E+02
1.000E-01	7.350E+02
1.100E-01	7.450E+02

Fig. C.7 Graphical Output of IMPACLIB(7)

MATERIAL (CURVE NO.8)

NAME: S45C REFERENCES: R-86

NO. 1012

DEFORMATION TYPE	COMPRESSION
TEMPERATURE (K)	293.00
STRAIN RATE (1/S)	1.500E+02

STRAIN (-)	STRESS (MPA)
1.000E-02	6.080E+02
2.000E-02	5.880E+02
3.000E-02	6.030E+02
4.000E-02	6.420E+02
5.000E-02	6.860E+02
6.000E-02	7.060E+02
7.000E-02	7.250E+02
8.000E-02	7.350E+02
9.000E-02	7.640E+02
1.000E-01	7.740E+02

Fig. C.8 Graphical Output of IMPACLIB(8)

MATERIAL (CURVE NO.9)

NAME: S45C REFERENCES: R-86
NO. 1012

DEFORMATION TYPE	COMPRESSION
TEMPERATURE (K)	293.00
STRAIN RATE (1/S)	3.000E+02

STRAIN (-)	STRESS (MPA)
1.000E-02	5.980E+02
2.000E-02	5.880E+02
3.000E-02	6.270E+02
4.000E-02	6.660E+02
5.000E-02	6.950E+02
6.000E-02	7.250E+02
7.000E-02	7.500E+02
8.000E-02	7.740E+02
9.000E-02	8.040E+02
1.000E-01	8.230E+02
1.100E-01	8.330E+02
1.200E-01	8.430E+02
1.300E-01	8.470E+02
1.400E-01	8.520E+02

Fig. C.9 Graphical Output of IMPACLIB(9)

MATERIAL (CURVE NO.10)

NAME: S45C REFERENCES: R-86
NO. 1012

DEFORMATION TYPE	COMPRESSION
TEMPERATURE (K)	293.00
STRAIN RATE (1/S)	4.000E+02

STRAIN (-)	STRESS (MPA)
1.000E-02	5.880E+02
2.000E-02	6.080E+02
3.000E-02	6.370E+02
4.000E-02	6.760E+02
5.000E-02	7.110E+02
6.000E-02	7.350E+02
7.000E-02	7.600E+02
8.000E-02	7.790E+02
9.000E-02	7.980E+02
1.000E-01	8.130E+02
1.100E-01	8.280E+02
1.200E-01	8.370E+02
1.300E-01	8.530E+02
1.400E-01	8.820E+02
1.500E-01	8.920E+02
1.600E-01	9.020E+02
1.700E-01	9.070E+02
1.800E-01	9.110E+02
1.900E-01	9.210E+02
2.000E-01	9.210E+02

Fig. C.10 Graphical Output of IMPACLIB(10)

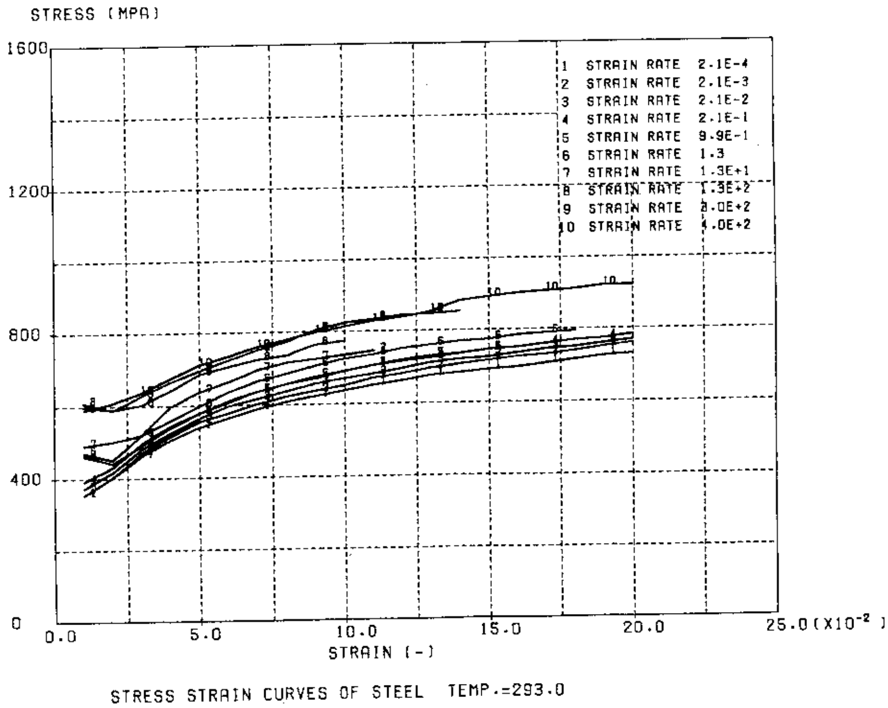

Fig. C.11 Graphical Output of IMPACLIB(11)

Appendix D Job Control Data

The job control data for IMPACLIB execution on the computer FACOM M-780 in JAERI is as follows:

```
//JCLG JOB
// EXEC JCLG
//SYSIN DD DATA,DLM='++'
// JUSER XXXXXXXX.XX,XXXXXXXX,XXXX.XX,IMPLIB
// T.01 C.02 W.01 I.02 CLS GRP
// OPTP MSGCLASS=A,MSGLEVEL=(2,0,1),CLASS=B,NOTIFY=JXXXX
// OPTP PASSWORD=XXXXXXXX
// EXEC LMGOEX,LM=J2322.LMIMPLIB,PNM=IMPACLIB
// EXPAND GRNLP
//SYSIN      DD DSN=JXXXX.DTIMPLIN.DATA,DISP=SHR,LABEL=(,,,IN)
//FT01F001 DD DSN=JXXXX.DTFINDAT.DATA,DISP=SHR
//FT02F001 DD DSN=SPACE=(TRK,(5,5)),UNIT=TSSWK
//FT20F001 DD DSN=JXXXX.DTIMPLIB.DATA,DISP=SHR
++
//
```

Appendix E Program Abstract

1. Name :
   IMPLIB.
2. Computer for which the program is designed and others upon which it is possible:
   FACOM M-780, SUN4 or IBM-PC.
3. Nature of physical problem solved:
   Structural data at high speed test from USA and Japanese experimental data.
4. Method of solutions:
   -
5. Restrictions on the complexity of the problem:
   None.
6. Typical running time:
   FACOM-M780 : 1 seconds.
   SUN4 : 2 seconds.
   IBM-PC : 3 seconds.
7. Unusual features of the program:
   None.
8. Related and auxiliary program:
   None.
9. Status:
   -
10. References:
    (1)Ikushima,T. and Hode S.,"Simplified Analysis Computer Program and Their Adequacy for Radioactive Materials Shipping casks", PATRAM'89,pp.1202-1209, Washington DC, USA ,June 11-16,(1989).
    (2)Ikushima,T. et al.,"Simplified Computer Codes for Cask Impact Analysis", PATRAM'92, pp.1419-1426, Yokohama, Japan, September 13-18,(1992).
    (3)Ikushima,T., Ohshika,J. and Ishiwata,T.,"Computer Code System for Structural Anaalysis of Radioactive Materials Transport", PATRAM'95, pp.1174-1181, Las Vegas, USA, December 3-8,(1995).
    (4)Ikushima,T.,"FINCRUSH:A Computer Program for Impact Analysis of Radioactive Material Transport Cask with Fins",JAERI-Data/Code 97-018(1997).
11. Machine requirement:
    Required 1100 k bytes of core memory.
12. Program language used:
    FORTRAN-77.
13. Operating system or monitor under which the program is executed:
    FACOM M-780 : MSP.
    SUN4 : Solaris 2.1.
    IBM PC : Windows 3.1.
14. Any other programming or operating information or restrictions:
    The program is approximately 3800 source steps(including comment lines).
    The graphical programs are as follows:
    FACOM M-780 : CALCOMP plotter or the compatible ones.
    SUN4 : X-windows.
    IBM PC : windows 3.1.
15. Name and establishment of author:
    T. Ikushima
    Japan Atomic Energy Research Institute,
    Tokai Research Establishment,
    Department of Fuel Cycle Safety Research,
    Tokai-mura, Naka-gun, Ibaraki-ken, 319-11
    Japan
16. Material available:
    Program source and data library.

Appendix F Program Source List

```
C*********************************************************************
C*  MAIN PROGRAM  *
C         MATERIAL DATA LIBRARY FOR 'CASKETSS'
C*********************************************************************
      COMMON /MLBALC/  LMLB, IMA1,IMA2,IMA3,IMA4,IMA5,IMA6,IMA7,IMA8
     1               ,  IMA9,IMA10,IMA11,IMA12,IMA13,IMA14,IMA15,IMA16
     2               ,  IMA17,IMA18
      COMMON /MLBMAX/  MMLB, MMAT, MCS, MSS, MPB, MWD, MPTEMP, MWDFIB
     1               ,  MTEMP, MEPSR, MEPSS, MREFF, MCOMM
      COMMON /       /  MLB(50000)
C
      IADJST (IMA)  = (IMA+2)/2*2-1
C
      CALL DTLIST(5,6)
C*  MEMORY ALLOCATION  *
      LMAT  = 18+8*MPTEMP+(2+3*MEPSR)*MTEMP+MEPSS + 10
      LMATO = 5*(MCS+MSS+MPB+MWD)+12*MMAT+4*MWDFIB+MWD+2*MREFF+20*MCOMM
      MMLB  = (LMLB-LMATO)/LMAT
      IF ( MMLB.LE.0 )          THEN
      LMAT  = LMAT-LMATO
      WRITE(6,6100)   LMAT, LMLB
 6100 FORMAT( 22H0  *****  ERROR  *****
     1       / 33H      INSUFFICIENT WORKING AREA
     2       / 23H           NECESSARY ...,I8
     3       / 23H           GIVEN .......,I8 )
      STOP 'QUIT'
                                ENDIF
C
      IMA1  = 1
      IMA2  = IMA1 +5*MCS
      IMA3  = IMA2 +5*MSS
      IMA4  = IMA3 +5*MPB
      IMA5  = IMA4 +5*MWD
      IMA6  = IMA5 +12*MMAT
      IMA7  = IMA6 +MMLB*10
      IMA7  = IADJST (IMA7)
      IMA8  = IMA7 +MMLB*4
      IMA9  = IMA8 +MMLB*MPTEMP*8
      IMA10 = IMA9 +MMLB*4
      IMA11 = IMA10+MWDFIB*MWD*2
      IMA12 = IMA11+MWDFIB*MWD*2
      IMA12 = IADJST (IMA12)
      IMA13 = IMA12+MMLB*MTEMP
      IMA14 = IMA13+MMLB*MTEMP
      IMA14 = IADJST (IMA14)
      IMA15 = IMA14+MMLB*MTEMP*MEPSR
      IMA16 = IMA15+MMLB*MTEMP*MEPSR*2
      IMA16 = IADJST (IMA16)
      IMA17 = IMA16+MEPSS*MMLB
      IMA18 = IMA17+MREFF*2
      CALL  MLBST  ( MLB(IMA1), MLB(IMA2), MLB(IMA3), MLB(IMA4)
     1              , MLB(IMA5), MLB(IMA6), MLB)
      CALL  MLBEX  (MLB)
      STOP  'EXIT'
      END
```

Appendix F (Continued)

```
      BLOCK DATA
      CHARACTER*8       AMAT1,      ANAME , UNAME
      CHARACTER*4       ATITLE, XXNAME, YYNAME, IEQCF, ICYNAM, CQRD
      CHARACTER*4       CDA
      CHARACTER         IRCBF2*4
      CHARACTER         IRCBF1*1
      COMMON /COMPL1/  ATITLE(18), XXNAME(10), YYNAME(10)
     1               ,  XDATA( 50,20), YDATA( 50,20)
      COMMON /COMPL2/  PXMIN, PXMAX, PYMIN, PYMAX, XL1, YL1, NPLOT
     1               ,  NDATA, NDATAX(20), NGRAPH
      COMMON /COMPL3/  AMAT1(20), ANAME(20), UNAME(3)
      COMMON /MLBALC/  LMLB, IMA1,IMA2,IMA3,IMA4,IMA5,IMA6,IMA7,IMA8
     1               ,  IMA9,IMA10,IMA11,IMA12,IMA13,IMA14,IMA15,IMA16
     2               ,  IMA17,IMA18
      COMMON /MLBFNO/  IFNC, IFNM, IFNP, IFNR
      COMMON /MLBFT1/  KFIT, IEQFIT, NCOEF(16), COEF(6), COEFO(6,16)
     1               ,  NXY, NXYD(5), XYD(2,50,5), MXY, MXYD
      COMMON /MLBFT2/  NEQCF(16), IEQCF(6,16)
      COMMON /MLBIDX/  JMAT, IMAT, ICS, ISS, IPB, IWD, JWDFIB, JTEMP
     1               ,  JEPSR, JREFF
      COMMON /MLBMAX/  MMLB, MMAT, MCS, MSS, MPB, MWD, MPTEMP, MWDFIB
     1               ,  MTEMP, MEPSR, MEPSS, MREFF, MCOMM
      COMMON /MLBNUM/  NMLB, NMAT, NCS, NSS, NPB, NWD, NPROP(5), NDFT
     1               ,  NWDF, NTMP, NEPSR, NEPS, NREFF, NCOMM
      COMMON /MLBPL1/  IAXES(2), KMESH, KCVNAM, JCVNAM(20), ICVNAM(5,20)
      COMMON /MLBQR1/  KQR(10), IQRD(10), CQRD(4,10), JIQRD, JCQRD
      COMMON /MLBRF1/  KRFM1, KRFM2, KEXC, MRFM, NRFM, IRFM(10), KARG(4)
     1               ,  NRFC(8), IRFC(10,8), RRFC(2,10,8), KSYSU
      COMMON /MLBRF2/  MRFX, NRFX, ICND(8,20), RCND(8,20), NXEPS(20)
     1               ,  XEPS(50,20), XSIG(50,20), NRFXX, JRFXX(2,20)
      COMMON /MLBRF3/  ICNDP(8,20), RCNDP(8,20)
      COMMON /MLBTCS/  ICPS, ITERM, ISCAL, XGO, YGO
      COMMON /RDBUF1/  MBF, IFNBF1(3), IFNBF2(100), ICHSBF(2,3)
     1               ,  IRCBF1(80), IPOSR(3)
      COMMON /RDBUF2/  IRCBF2(4,30,3)
      COMMON /RDBUF3/  CDA(10), IDA(10), RDA(50)
C
C*  /COMPL1/  *
      DATA  ATITLE,    XXNAME,    YYNAME /
     1   18*4H     ,10*4H     ,10*4H      /
C
C*  /COMPL2/  *
      DATA  NPLOT,NDATA,NGRAPH /
     1           0,     0,      0 /
C
C*  /MLBALC/  *
      DATA  LMLB    / 50000 /
C*  /MLBFNO/  *
      DATA  IFNC,IFNM,IFNP,IFNR /
     1            5,  11,  20,  10 /
C*  /MLBFT1/  *
      DATA  KFIT,IEQFIT,NCOEF /
     1           0,      0, 2,4,4,4,4,4,4,3,4,0,3,4,5,2,3,0 /
      DATA  COEF  /  6*0.      /
      DATA  COEFO / 96*0.      /
      DATA  NXY,NXYD,    XYD,MXY,MXYD /
     1          0, 5*0, 500*0.,  5,  50 /
C*  /MLBFT2/  *
      DATA  NEQCF / 2,3,4,4,3,4,6,3,4,4,3,3,5,2,3,0 /
      DATA  IEQCF / 4HN, K, 4H ) ,                          4*4H
```

Appendix F (Continued)

```
     1              , 4HN, K, 4H, C,, 4H E ),                          3*4H
     2              , 4HN, K, 4H, SI, 4HG-O,, 4H E ),                  2*4H
     3              , 4HN, K, 4H, SI, 4HG-C,, 4H E ),                  2*4H
     4              , 4HL, M, 4H, N,, 4H K ),                          3*4H
     5              , 4HN, A, 4H, SI, 4HG-O,, 4H E ),                  2*4H
     6              , 4HM, S, 4HIG-C, 4H, SI, 4HG-IN, 4HF, E, 4H )
     7              , 4HN, A, 4H, B , 4H)    ,                         3*4H
     8              , 4HC, H, 4H, P,, 4H SIG, 4H-O ),                  2*4H
     9              , 4HN, K, 4HO,.., 4H., K, 4HN ) ,                  2*4H
     *              , 4HN, A, 4H, B , 4H)    ,                         3*4H
     A              , 4HM, N, 4H, K,, 4H C ),                          3*4H
     B              , 4HM, C, 4H, H,, 4H SIG, 4H-Y, , 4HE ) , 4H
     C              , 4HK, C, 4H )  ,                                  4*4H
     D              , 4HM, N, 4H, K , 4H)    ,                         3*4H
     E              ,                                                  6*4H    /
C*   /MLBIDX/  *
      DATA  JMAT,IMAT,ICS,ISS,IPB,IWD,JWDFIB,JTEMP,JEPSR, JREFF /
     1          0,   0,  0,  0,  0,  0,     0,    0,    0,     0 /
C*   /MLBMAX/  *
      DATA  MMLB,MMAT,MCS,MSS,MPB,MWD,MPTEMP,MWDFIB,MTEMP,MEPSR,MEPSS /
     1          0, 100, 30, 50, 30, 30,    20,     6,   20,   20,  500 /
     2      ,MREFF,MCOMM                                                 /
     3         100,  100                                                 /
C*   /MLBNUM/  *
      DATA  NMLB,NMAT,NCS,NSS,NPB,NWD,NPROP,NDFT,NWDF,NTMP,NEPSR,NEPS /
     1          0,   0,  0,  0,  0,  0,  5*0,   0,   0,   0,    0,   0 /
     2      ,NREFF,NCOMM                                                 /
     3           0,    0                                                 /
C*   /MLBPL1/  *
      DATA  IAXES,KMESH /
     1         2*0,    1 /
C*   /MLBQR1/  *
      DATA  KQR, IQRD,       CQRD,JIQRD,JCQRD /
     1      10*0, 10*0, 40*4H    ,    1,    1 /
C*   /MLBRF1/  *
      DATA  KRFM1,KRFM2,KEXC,MRFM,NRFM,IRFM,   KARG /
     1          0,    0,   0,  10,   0,10*0, 3*0, 1 /
      DATA  NRFC, KSYSU /
     1       8*0,     1 /
C*   /MLBRF2/  *
      DATA  MRFX, NRFX, NRFXX /
     1        20,    0,     0 /
C*   /MLBTCS/  *
      DATA  ICPS, ITERM, ISCAL, XGO, YGO /
     1       120,     3,  1024,  0.,  0. /
C*   /RDBUF1/  *
      DATA  MBF,IFNBF1,IFNBF2,ICHSBF,IPOSR /
     1        3,   3*0, 100*0,   6*0,  3*0 /
C*   /RDBUF3/  *
      DATA  CDA      / 10*'    ' /
      DATA  IDA      / 10*0      /
      DATA  RDA      / 50*0.     /
C*   /COMPL2/  *
      DATA  XL1      / 200. /
      DATA  YL1      / 160. /
      END
```

Appendix F (Continued)

```
      SUBROUTINE  MLBST ( NAMCS, NAMSS, NAMPB, NAMWD, NAMMAT, MATDIR
     1                  , MLB)
C
      INTEGER     NAMCS(5,1), NAMSS(5,1), NAMPB(5,1), NAMWD(5,1)
      INTEGER     NAMMAT(12,1), MATDIR(10,1)
      INTEGER     MLB(1)
      COMMON /MLBFNO/  IFNC, IFNM, IFNP, IFNR
      COMMON /MLBIDX/  JMAT, IMAT, ICS, ISS, IPB, IWD, JWDFIB, JTEMP
     1               , JEPSR, JREFF
      COMMON /MLBALC/  LMLB, IMA1,IMA2,IMA3,IMA4,IMA5,IMA6,IMA7,IMA8
     1               , IMA9,IMA10,IMA11,IMA12,IMA13,IMA14,IMA15,IMA16
     2               , IMA17,IMA18
      COMMON /MLBMAX/  MMLB, MMAT, MCS, MSS, MPB, MWD, MPTEMP, MWDFIB
     1               , MTEMP, MEPSR, MEPSS, MREFF, MCOMM
      COMMON /MLBNUM/  NMLB, NMAT, NCS, NSS, NPB, NWD, NPROP(5), NDFT
     1               , NWDF, NTMP, NEPSR, NEPS, NREFF, NCOMM
      COMMON /MLBRF1/  KRFM1, KRFM2, KEXC, MRFM, NRFM, IRFM(10), KARG(4)
     1               , NRFC(8), IRFC(10,8), RRFC(2,10,8), KSYSU
      COMMON /RDBUF3/  CDA(10), IDA(10), RDA(50)
      CHARACTER*4 CDA
      INTEGER     KMTYP(4), IFMT1(2,3)
      CHARACTER*4 KEND, KMATE
C
      DATA  KMTYP   / 2000, 3000, 4000, 5000 /
      DATA  IFMT1   / 101, 0, 104, 0, 201, 0 /
      DATA  KEND  , KMATE  /
     1      'END ', 'MAT ' /
C
      CALL  RDSQF  (0,IFNM, IFMT1 ,0, KSTAT, CDA, IDA, RDA, JPOSR)
  100       CONTINUE
      IFMT1(2,1) = 0
      CALL  RDSQF  (1,IFNM, IFMT1(1,1) ,1, KSTAT, CDA(1), IDA, RDA
     1              , JPOSR)
      IF ( CDA(1).EQ.KEND
     *.OR. CDA(1).EQ.KMATE )        GOTO 140
C*  ERROR  *
      WRITE(6,6120)   CDA(1)
 6120 FORMAT( 22HO  *****  ERROR  *****
     1       / 34H       INCORRECT HEADER LABEL ... ',A4,1H' )
      GOTO 100
C
  140 IF ( NMAT.GT.0 )
     *NAMMAT(2,NMAT) = JPOSR-NAMMAT(1,NMAT)-1
      IF ( CDA(1).EQ.KEND )         GOTO 400
      NMAT           = NMAT+1
      IMAT           = NMAT
      NAMMAT(1,NMAT) = JPOSR-1
      IFMT1(2,2)     = 0
      IFMT1(2,3)     = 0
      CALL  RDSQF  (1,IFNM, IFMT1(1,2) ,2, KSTAT, CDA(1), IDA(1), RDA
     1              , JPOSR)
C
      DO 160 I= 1,4
      IF (IDA(1).GE.KMTYP(I) )      GOTO 160
      IMTYP = I
      GOTO 200
  160 CONTINUE
C*  ERROR  *
      WRITE(6,6180)   IDA(1)
 6180 FORMAT( 22HO  *****  ERROR  *****
```

Appendix F (Continued)

```
     1          / 33H      MISSING MATERIAL NUMBER ...,I8 )
      GOTO 100
C
  200 NAMMAT(5,NMAT) = ISBST(CDA(1))
      NAMMAT(6,NMAT) = ISBST(CDA(2))
      NAMMAT(7,NMAT) = ISBST(CDA(3))
      NAMMAT(8,NMAT) = ISBST(CDA(4))
      NAMMAT(9,NMAT) = ISBST(IDA(1))
      NAMMAT(10,NMAT)= 0
      NAMMAT(11,NMAT)= 0
      NAMMAT(12,NMAT)= 0
      IWD            = 0
      GOTO ( 210,220,230,240 ),  IMTYP
  210 NCS           = NCS+1
      NXX           = NCS
      DO 215 I= 1,4
      NAMCS(I,NCS) = ISBST(CDA(I))
  215 CONTINUE
      GOTO 300
  220 NSS           = NSS+1
      NXX           = NSS
      DO 225 I= 1,4
      NAMSS(I,NSS) = ISBST(CDA(I))
  225 CONTINUE
      GOTO 300
  230 NPB           = NPB+1
      NXX           = NPB
      DO 235 I= 1,4
      NAMPB(I,NPB) = ISBST(CDA(I))
  235 CONTINUE
      GOTO 300
  240 NWD           = NWD+1
      NXX           = NWD
      IWD           = NWD
      DO 245 I= 1,4
      NAMWD(I,NWD) = ISBST(CDA(I))
  245 CONTINUE
  300 IF ( NMAT.LE.MMLB )          THEN
      JMAT   = NMAT
      NMLB   = NMAT
      MATDIR(1,JMAT) = JMAT
      MATDIR(2,JMAT) = NMAT
      MATDIR(3,JMAT) = IMTYP
      MATDIR(4,JMAT) = NAMMAT(9,NMAT)
                                   ELSE
      JMAT   = 0
                                   ENDIF
      NAMMAT(3,NMAT) = JMAT
      NAMMAT(4,NMAT) = IMTYP*10000+NXX
      CALL  MLBPT  (NAMMAT(1,1), MLB(IMA6), MLB(IMA7), MLB(IMA8)
     1             , MLB(IMA9), MLB(IMA10), MLB(IMA11), MLB(IMA12)
     2             , MLB(IMA13), MLB(IMA14), MLB(IMA15), MLB(IMA16)
     3             , MLB(IMA17), MLB(IMA18)
     4             ,MPTEMP+MPTEMP,MWDFIB,MTEMP,MEPSR,MEPSS)
      GOTO 100
  400 KRFM1  = 1
      KRFM2  = NMLB
      CALL  RDSQF  (4,IFNM, IFMT1 ,0, KSTAT, CDA, IDA, RDA, JPOSR)
      RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  MLBPT (NAMMAT, MATDIR, PROP1, PROP2, IDFTYP, WDFIBR
     1                  , IWDFIB, DTEMP, ITEMP, DEPSR, IEPSR, EPSS
     2                  , IREFF, ICOMM
     3                  ,MPTMP2,MWDFIB,MTEMP,MEPSR,MEPSS)
C
      INTEGER      NAMMAT(12,1), MATDIR(10,1), IDFTYP(2,2,1)
      INTEGER      WDFIBR(2,MWDFIB,1)
      INTEGER      IWDFIB(2,MWDFIB,1), ITEMP(MTEMP,1)
      INTEGER      IEPSR(2,MEPSR,MTEMP,1)
      INTEGER      IREFF(2,1), ICOMM(20,1)
      REAL         PROP1(4,1), PROP2(MPTMP2,4,1)
      REAL         DTEMP(MTEMP,1), DEPSR(MEPSR,MTEMP,1)
      REAL         EPSS(MEPSS,1)
      COMMON /MLBNUM/  NMLB, NMAT, NCS, NSS, NPB, NWD, NPROP(5), NDFT
     1              ,  NWDF, NTMP, NEPSR, NEPS, NREFF, NCOMM
      COMMON /MLBIDX/  JMAT, IMAT, ICS, ISS, IPB, IWD, JWDFIB, JTEMP
     1              ,  JEPSR, JREFF
      COMMON /MLBFNO/  IFNC, IFNM, IFNP, IFNR
      COMMON /RDBUF3/  CDA(10), IDA(10), RDA(50)
      CHARACTER*4      CDA
C
      CHARACTER*4 KSSR, KSSR2, KREF, KCOM, KDFTO, KWDFO, KBLNK
      CHARACTER*4 KDFTYP(4)
      INTEGER     IFMT1(2,15), IFMT2(2,10), IFMT3(2,4), IFMT4(2,3)
C
      DATA   KSSR   / 'SSR ' /
      DATA   KSSR2  / 'SSR2' /
      DATA   KREF   / 'REF ' /
      DATA   KCOM   / 'COM ' /
      DATA   KDFTYP / 'C   ','T   ','C&T ','CT  ' /
      DATA   KDFTO  / '    ' /
      DATA   KWDFO  / '    ' /
      DATA   KBLNK  / '    ' /
      DATA   IFMT1  / 101, 0, 104, 0, 201, 0, 201, 0, 201, 0, 201, 0
     1              , 201, 0, 201, 0, 301, 0, 301, 0, 301, 0, 301, 0
     2              , 301, 0, 301, 0,  -2, 0  /
      DATA   IFMT2  / 101, 0, 301, 0, 101, 0, 101, 0, 201, 0, 301, 0
     1              , 201, 0, 301, 0, 301, 0,  -2, 0  /
      DATA   IFMT3  / 101, 0, 201, 0, 102, 0,  -1, 0  /
      DATA   IFMT4  / 101, 0, 120, 0,  -1, 0  /
      DATA   MXEPSS / 0  /
C
      DO  10 I= 4,12
   10 IFMT1(2,I) = 0
      CALL  RDSQF  (1,IFNM, IFMT1(1,4) ,9, KSTAT, CDA, IDA(1), RDA(1)
     1              , JPOSR)
      DO  20 I= 1,5
      NPROP(I)= IDA(I)
   20 CONTINUE
C
      IF ( JMAT.GT.0 )                THEN
      MATDIR(2,JMAT) = IMAT
      MATDIR(3,JMAT) = NAMMAT(4,IMAT)/10000
      MATDIR(4,JMAT) = NAMMAT(9,IMAT)
      DO  40 I= 1,4
      MATDIR(I+4,JMAT)= NPROP(I)
      PROP1(I,JMAT)    = RDA(I)
   40 CONTINUE
                                      ENDIF
C
```

Appendix F (Continued)

```
      DO  80 I= 1,4
      IF ( NPROP(I).GT.0 )             THEN
      NITM  = NPROP(I)+NPROP(I)
      CALL  RDSQF  (1,IFNM, IFMT1(1,13) ,NITM, KSTAT, CDA, IDA, RDA(1)
     1             , JPOSR)
      IF ( JMAT.GT.0 )                           THEN
      DO  60 J= 1,NITM
      PROP2(J,I,JMAT) = RDA(J)
   60 CONTINUE
                                                 ENDIF
                                       ENDIF
   80 CONTINUE
C
      CALL  RDSQF  (3,IFNM, IFMT3(1,1) ,1, KSTAT, CDA(1), IDA, RDA
     1             , JPOSR)
      IF ( CDA(1).EQ.KREF )            THEN
      CALL  RDSQF  (1,IFNM, IFMT3(1,1) ,2, KSTAT, CDA(1), IDA(1), RDA
     1             , JPOSR)
      IF ( IDA(1).GT.0 )                         THEN
      JREFF = NREFF+1
      NREFF = NREFF+IDA(1)
      NAMMAT(11,IMAT) = JREFF
      NAMMAT(12,IMAT) = IDA(1)
      CALL  RDSQF  (1,IFNM, IFMT3(1,3) ,IDA(1), KSTAT, IREFF(1,JREFF)
     1             , IDA, RDA, JPOSR)
                                                 ENDIF
      CALL  RDSQF  (3,IFNM, IFMT3(1,1) ,1, KSTAT, CDA(1), IDA, RDA
     1             , JPOSR)
                                       ENDIF
C
      IF ( CDA(1).EQ.KCOM )            THEN
      NCOMM = NCOMM+1
      CALL  RDSQF  (1,IFNM, IFMT4(1,1) ,1, KSTAT, CDA(1), IDA, RDA
     1             , JPOSR)
C/    CALL  RDSQF  (1,IFNM, IFMT4(1,2) ,5, KSTAT, ICOMM(1,NCOMM), IDA
      CALL  RDSQF  (1,IFNM, IFMT4(1,2) ,1, KSTAT, ICOMM(1,NCOMM), IDA
     1             , RDA, JPOSR)
C
      IF ( JMAT.GT.0 )
     *MATDIR(10,JMAT) = NCOMM
                                       ENDIF
C
      IF ( NPROP(5).GT.0 )             THEN
      NSSR  = NPROP(5)
      KDFTO = KBLNK
      KWDFO = KBLNK
      JWDFIB= 0
      JTEMP = 1
      JDFT  = 1
      JEPSS = 1
      IF ( JMAT.GT.0 )                           THEN
      IDFTYP(1,1,JMAT) = 0
      IDFTYP(2,1,JMAT) = 0
      IDFTYP(1,2,JMAT) = 0
      IDFTYP(2,2,JMAT) = 0
                                                 ENDIF
C
      DO 300 I= 1,NSSR
  100      CONTINUE
      IFMT2(2,1) = 0
```

Appendix F (Continued)

```
      CALL  RDSQF  (1,IFNM, IFMT2(1,1) ,1, KSTAT, CDA(1), IDA, RDA
     1             , JPOSR)
      IF ( CDA(1).NE.KSSR
     *.AND.CDA(1).NE.KSSR2)   GOTO 100
      IFMT2(2,4) = 0
      IFMT2(2,5) = 0
      IFMT2(2,6) = 0
      IFMT2(2,7) = 0
      CALL  RDSQF  (1,IFNM, IFMT2(1,2) ,4, KSTAT, CDA(2), IDA(1), RDA(1)
     1             , JPOSR)
C
      IF ( JMAT.GT.0 )                           THEN
      IF ( MATDIR(3,JMAT).EQ.4 )                       THEN
      IF ( CDA(3).NE.KWDFO )                                 THEN
      JWDFIB= JWDFIB+1
      KWDFO = CDA(3)
      WDFIBR(1,JWDFIB,IWD) = ISBST(CDA(3))
      IWDFIB(1,JWDFIB,IWD) = JTEMP
                                                             ENDIF
      IWDFIB(2,JWDFIB,IWD) = JTEMP-IWDFIB(1,JWDFIB,IWD)+1
      JTEMP = JWDFIB
                                                       ENDIF
C
      IF ( CDA(2).NE.KDFTO )                           THEN
      DO 120 J= 1,4
      IF ( CDA(2).EQ.KDFTYP(J) )                             THEN
      JDFT  = J
      GOTO 140
                                                             ENDIF
  120 CONTINUE
C
  140 MATDIR(9,JMAT) = JDFT
      IF ( KDFTO.NE.KBLNK )
     *MATDIR(9,JMAT) = 3
      KDFTO            = CDA(2)
      IF ( JDFT .EQ.4 )
     *JDFT             = 1
      IDFTYP(1,JDFT,JMAT)= JTEMP
                                                       ENDIF
      IDFTYP(2,JDFT,JMAT)= JTEMP-IDFTYP(1,JDFT,JMAT)+1
      DTEMP(JTEMP,JMAT)  = RDA(1)
      ITEMP(JTEMP,JMAT)  = IDA(1)
                                                 ENDIF
C
      IF ( CDA(1).EQ.KSSR )                      THEN
      IF ( JMAT.GT.0 )
     *IEPSR(1,MEPSR,JTEMP,JMAT)= 1
                                                 ELSE
      CALL  RDSQF  (1,IFNM, IFMT2(1,5) ,1, KSTAT, CDA, NEPSX, RDA
     1             , JPOSR)
      IF ( NEPSX.GT.0 )                                THEN
      CALL  RDSQF  (1,IFNM, IFMT2(1,9) ,NEPSX, KSTAT, CDA, IDA, RDA(1)
     1             , JPOSR)
      IF ( JMAT.GT.0 )                                       THEN
      IEPSR(1,MEPSR,JTEMP,JMAT)= 2
      IEPSR(2,MEPSR,JTEMP,JMAT)= JEPSS
      DO 180 J=1,NEPSX
      EPSS(JEPSS,JMAT) = RDA(J)
      JEPSS            = JEPSS+1
  180 CONTINUE
```

Appendix F (Continued)

```
                                          ENDIF
                                      ENDIF
                                  ENDIF
C
      NEPSR = IDA(1)
      IF ( NEPSR.GT.0 )                   THEN
C
      DO 240 J= 1,NEPSR
      CALL  RDSQF  (1,IFNM, IFMT2(1,6) ,2, KSTAT, CDA, IDA(1), RDA(1)
     1              , JPOSR)
      EPSR  = RDA(1)
      NEPS  = IDA(1)
      NEPSS = IDA(1)+IDA(1)
      IF ( CDA(1).EQ.KSSR2 )
     *NEPSS = IDA(1)
      IF ( NEPSS.GT.0 )                       THEN

      CALL  RDSQF  (1,IFNM, IFMT2(1,8) ,NEPSS, KSTAT, CDA, IDA, RDA(1)
     1              , JPOSR)
      IF ( JMAT.GT.0 )                            THEN
      DEPSR(J,JTEMP,JMAT)    = EPSR
      IEPSR(1,J,JTEMP,JMAT) = JEPSS
      IEPSR(2,J,JTEMP,JMAT) = NEPS
      DO 220 K= 1,NEPSS
      EPSS(JEPSS,JMAT) = RDA(K)
      JEPSS            = JEPSS+1
  220 CONTINUE
                                              ENDIF
                                          ENDIF

  240 CONTINUE
                                  ENDIF
C
      CALL  RDSQF  (3,IFNM, IFMT4(1,1) ,1, KSTAT, CDA(1), IDA, RDA
     1              , JPOSR)
      IF ( CDA(1).EQ.KCOM )               THEN
      NCOMM = NCOMM+1
      CALL  RDSQF  (1,IFNM, IFMT4(1,1) ,1, KSTAT, CDA(1), IDA, RDA
     1              , JPOSR)
C     CALL  RDSQF  (1,IFNM, IFMT4(1,2) ,5, KSTAT, ICOMM(1,NCOMM), IDA
      CALL  RDSQF  (1,IFNM, IFMT4(1,2) ,1, KSTAT, ICOMM(1,NCOMM), IDA
     1              , RDA, JPOSR)
      IF ( JMAT.GT.0 )
     *ITEMP(JTEMP,JMAT) = 1000*NCOMM+ITEMP(JTEMP,JMAT)
                                  ENDIF
      JTEMP = JTEMP+1
  300 CONTINUE
      IF ( JEPSS.GT.MEPSS )               THEN
      WRITE(6,6310)   JEPSS, MEPSS
 6310 FORMAT( '0  *****  ERROR  ***** '
     1       / '       INSUFFICIENT WORKING AREA FOR STRESS-STRAIN DATA'
     2       / '           NECESSARY ...',I8
     3       / '           GIVEN .......',I8 )
      STOP 'QUIT'
                                  ENDIF
                              ENDIF
      RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  RDSQF (KFN,IFN, IFMT ,NITM, KSTAT, CDA, IDA, RDA
     1                  , JPOSR)
C
      INTEGER      IFMT(2,1)
      INTEGER      CDA(1)
      INTEGER      IDA(1)
      REAL         RDA(1)
      COMMON /RDBUF1/  MBF, IFNBF1(3), IFNBF2(100), ICHSBF(2,3)
     1              ,  IRCBF1(80), IPOSR(3)
      CHARACTER        IRCBF1*1
      COMMON /RDBUF2/  IRCBF2(4,30,3)
      CHARACTER        IRCBF2*4
      CHARACTER*16     IRCD1, IRCD2, KRCD
      INTEGER      JDA(3)
      CHARACTER*1 KASTR
      EQUIVALENCE ( JDA(1), JCDA ), ( JDA(2), JIDA ), ( JDA(3), JRDA )
C
      DATA   KASTR  / '*'   /
      DATA   MCHS   / 30    /
      DATA   MCHBF  / 16    /
      DATA   KRCD   / '                ' /
C
      JDA(1)= 0
      JDA(2)= 0
      JDA(3)= 0
C*  CHECK INPUT PARAMETERS  *
      KSTAT = -1
      IF ( KFN.LT.-1
     *.OR. KFN.GT.4  )        GOTO 800
      IF ( IFN.LE.0
     *.OR. IFN.GT.99 )        GOTO 800
      IBF   = IFNBF2(IFN)
      IF ( IBF.LE.0
     *.AND.KFN.NE.0 )         GOTO 800
      KSTAT = 0
C*  GET RECORD POSITION  *
      IF ( KFN.NE.-1 )        GOTO  10
      JPOSR = IPOSR(IBF)
      GOTO 900
C*  OPEN/REWIND FILE  *
   10 IF ( KFN.NE.0 )         GOTO  60
      IF ( IBF.NE.0 )         GOTO  40
      DO  20 I= 1,MBF
      IF ( IFNBF1(I).NE.0 )   GOTO  20
      IBF          = I
      IFNBF1(IBF) = IFN
      IFNBF2(IFN) = IBF
      GOTO 40
   20 CONTINUE
      KSTAT = -4
      GOTO 900
C
   40 ICHSBF(1,IBF) = 0
      ICHSBF(2,IBF) = 0
      REWIND  IFN
      IPOSR(IBF)     = 0
      JPOSR          = 0
      GOTO 900
C*  CLOSE FILE  *
   60 IF ( KFN.NE.4 )         GOTO  70
```

Appendix F (Continued)

```
      JPOSR        = IPOSR(IBF)
      IFNBF1(IBF) = 0
      IFNBF2(IFN) = 0
      GOTO 900
C*  SKIP/BACK RECORDS  *
   70 IF ( KFN.NE.2 )          GOTO  80
      NRC    = NITM
      IF ( NRC.EQ.0 )          GOTO 900
      JPOSR        = JPOSR+NRC
      IPOSR(IBF) = JPOSR
      IF ( NRC.GT.0 )          THEN
      DO  72 I= 1,NRC
      READ(IFN,5140,END=74)
   72 CONTINUE
      GOTO 900
   74 KSTAT = -2
                               ELSE
      NRC    = -NRC
      DO  76 I= 1,NRC
      BACK SPACE  IFN
   76 CONTINUE
                               ENDIF
      GOTO 900
C*  READ HEADER  *
   80 IF ( KFN.NE.3 )          GOTO 100
      NCHS  = 0
      JCHS  = 0
      GOTO 110
C*  READ FILE  *
  100 IF ( KFN.NE.1 )          GOTO 800
  110 IF ( NITM.LT.1 )         GOTO 900
      NCHS  = ICHSBF(1,IBF)
      JCHS  = ICHSBF(2,IBF)
      JFMT  = 0
C
      DO 300 I= 1,NITM
      IF ( JCHS.LT.NCHS )       GOTO 200
  120          CONTINUE
      READ(IFN,5140,END=160)    IRCBF1
 5140 FORMAT( 80A1 )
      IPOSR(IBF) = IPOSR(IBF)+1
      GOTO 180
  160 KSTAT = -2
      GOTO 900
C
  180 IF ( IRCBF1(1).EQ.KASTR )GOTO 120
      JCHS  = 0
      NCHS  = 0
      CALL  RDCHS  (IRCBF1(1), IRCBF2(1,1,IBF), NCHS,MCHS)
      IF ( NCHS.LT.1 )          GOTO 120
C
  200 JCHS  = JCHS+1
      JFMT  = JFMT+1
      KSTAT = KSTAT+1
C
  210          CONTINUE
      KFMT  = IFMT(1,JFMT)
      IF ( KFMT.GT.0 )          GOTO 220
      IF ( KFMT.EQ.0 )          GOTO 320
      JFMT  = JFMT+KFMT
```

Appendix F (Continued)

```
      GOTO 210
C
  220 KFMT          = KFMT/100
      NWDS          = IFMT(1,JFMT)-KFMT*100
      JDA(KFMT)     = JDA(KFMT)+1
      IFMT(2,JFMT)= JDA(KFMT)
C
      J2     = 0
      DO 230 J= 1,4
      J1     = J2+1
      J2     = J2+4
      IRCD1(J1:J2) = IRCBF2(J,JCHS,IBF)
  230 CONTINUE
C
C*  CHARACTERS  *
      IF ( KFMT.GT.1 )              GOTO 260
  240 DO 245 J= 1,NWDS
      READ(IRCBF2(J,JCHS,IBF),'(A4)')    CDA(JCDA)
      JCDA         = JCDA+1
  245 CONTINUE
      JCDA         = JCDA-1
      IF ( NWDS.EQ.20 )
     *JCHS         = JCHS+4
      IF ( KFN.EQ.3 )
     *JCHS         = 0
      GOTO 300
C
  260 J1           = MCHBF
      DO 265 J= 1,MCHBF
      IF ( IRCD1(J1:J1).NE.' ' )GOTO 270
      J1           = J1-1
  265 CONTINUE
      IDA(JIDA) = 0
      GOTO 300
  270 J2           = MCHBF-J1+1
      IRCD2        = KRCD
      IRCD2(J2:MCHBF) = IRCD1(1:J1)
C*  INTEGER  *
      IF ( KFMT.NE.2 )              GOTO 280
      READ(IRCD2,'(I16)')    IDA(JIDA)
      GOTO 300
C*  REAL  *
  280 IF ( KFMT.EQ.3 )
     *READ(IRCD2,'(E16.0)') RDA(JRDA)
  300 CONTINUE
C
  320 ICHSBF(1,IBF) = NCHS
      ICHSBF(2,IBF) = JCHS
      JPOSR             = IPOSR(IBF)
      GOTO 900
C*  ERROR  *
  800 WRITE(6,6820)  KFN, IFN
 6820 FORMAT( 36H0  *****  ERROR  *****     SUB. RDSQF
     1         / 22H       INPUT PARAMETERS
     2         / 17H            KFN ...,I8
     3         / 17H            IFN ...,I8 )
  900  CONTINUE
      RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  RDCHS (ICHR, ICHS, NCHS,MCHS)
C
      CHARACTER   ICHR(1)*1
      CHARACTER   ICHS(4,1)*4
      CHARACTER   CBLNK*4
      CHARACTER*1 ICHBF(16)
      LOGICAL     ISTRG, IBLNK
      DIMENSION   KCHR(4)
      CHARACTER*1 KCHR, KCOMA, KBLNK
      EQUIVALENCE ( KCHR(3), KCOMA ), (KCHR(4), KBLNK )
C
      DATA   CBLNK  / '    ' /
      DATA   KCHR   / 1H', 1H", 1H,, 1H  /
      DATA   MCHR   / 80 /
      DATA   MCHBF  / 16 /
C
      NCHS  = 0
      JCHR  = 0
      JCHR1 = 1
C
 100        CONTINUE
      JSTR1 = 0
      JSTR2 = 0
      IQUOT = 0
      ISTRG = .FALSE.
      IBLNK = .FALSE.
      DO 300 I= JCHR1,MCHR
      IF ( IQUOT.NE.0 )                GOTO 200
      IF ( ICHR(I).NE.KCOMA )          GOTO 110
      IF ( ISTRG .AND. JSTR2.EQ.0 )
     *JSTR2 = I-1
      JCHR  = I
      ISTRG = .TRUE.
      GOTO 400
 110  IF ( ICHR(I).NE.KBLNK )          GOTO 130
      IF ( .NOT.ISTRG .OR. IBLNK ) GOTO 300
      IBLNK = .TRUE.
      JSTR2 = I-1
      JCHR  = I
      GOTO 300
 130  IF ( ISTRG )                     GOTO 170
      ISTRG = .TRUE.
      DO 150 J= 1,2
      IF ( ICHR(I).NE.KCHR(J) )        GOTO 150
      IQUOT = J
      JQUOT = I
      JSTR1 = I+1
      GOTO 300
 150  CONTINUE
      JSTR1 = I
 170  IF ( .NOT.IBLNK )                GOTO 300
      JCHR  = I-1
      GOTO 400
 200  DO 220 J= 1,2
      IF ( ICHR(I).NE.KCHR(J) )        GOTO 220
      IF ( IQUOT.NE.J )                GOTO 300
      ICHR(I)      = KBLNK
      ICHR(JQUOT)  = KBLNK
      JQUOT        = 0
      IQUOT        = 0
```

Appendix F (Continued)

```
      JSTR2        = I-1
      GOTO 300
 220  CONTINUE
 300  CONTINUE
 400  IF ( .NOT.ISTRG )                GOTO 900
      IF ( NCHS.GE.MCHS )              GOTO 900
      IF ( JSTR1.NE.0 )                THEN
      NCHBF = JSTR2-JSTR1
      NCHSX = (NCHBF+MCHBF)/MCHBF
      IF ( NCHS+NCHSX.GT.MCHS )
     *NCHSX = MCHS-NCHS
      J2     = JSTR1-1
      IF ( NCHBF.GE.16 )
     *NCHSX = 5
      DO 450 I= 1,NCHSX
      NCHS   = NCHS+1
      J1     = J2+1
      J2     = J2+MCHBF
      IF ( J2.GT.JSTR2 )
     *J2     = JSTR2
      IF ( J1.LE.J2 )                        THEN
      K      = 1
      DO 410 J= J1,J2
      ICHBF(K)= ICHR(J)
      K      = K+1
 410  CONTINUE
      IF ( K.LE.MCHBF )                            THEN
      DO 420 J= K,MCHBF
      ICHBF(J)= KBLNK
 420  CONTINUE
                                                   ENDIF
                                             ELSE
      DO 430 J=1,MCHBF
      ICHBF(J)= KBLNK
 430  CONTINUE
                                             ENDIF
      K1     = 1
      K2     = 4
      K3     = 0
      DO 440 J= 1,MCHBF,4
      K3     = K3+1
      WRITE(ICHS(K3,NCHS),'(4A1)')   (ICHBF(K),K=K1,K2)
      K1     = K2+1
      K2     = K2+4
 440  CONTINUE
 450  CONTINUE
                                       ELSE
      NCHS   = NCHS+1
      DO 470 I= 1,4
      ICHS(I,NCHS) = CBLNK
 470  CONTINUE
                                       ENDIF
      IF ( JCHR.GE.MCHR )              GOTO 900
      JCHR1 = JCHR+1
      GOTO 100
 900  RETURN
      END
```

Appendix F (Continued)

```
      FUNCTION  ISBST (CHAR)
C
      CHARACTER CHAR*4
      CHARACTER CHARX*4
C
      CHARX = CHAR
      READ(CHARX,'(A4)')  ISBST
      RETURN
      END



      SUBROUTINE  MLBEX (MLB)
C
      INTEGER      MLB(1)
      COMMON /MLBRF1/  KRFM1, KRFM2, KEXC, MRFM, NRFM, IRFM(10), KARG(4)
     1               ,  NRFC(8), IRFC(10,8), RRFC(2,10,8), KSYSU
      COMMON /MLBALC/  LMLB, IMA1,IMA2,IMA3,IMA4,IMA5,IMA6,IMA7,IMA8
     1               ,  IMA9,IMA10,IMA11,IMA12,IMA13,IMA14,IMA15,IMA16
     2               ,  IMA17,IMA18
      COMMON /MLBFNO/  IFNC, IFNM, IFNP, IFNR
      COMMON /RDBUF3/  CDA(10), IDA(10), RDA(50)
      CHARACTER*4      CDA
C
C
      CALL  RDSQF  (0,IFNM, IFMT ,0, KSTAT, CDA, IDA, RDA, JPOSR)
  100       CONTINUE
C
C
      CALL  EXCOM  (MLB(IMA5), KLST, KPLT, KFIT)
C
C
      IF ( KEXC.LE.0 )         GOTO 200
      IF ( KEXC.EQ.1 )         THEN
      CALL  EXQRY  (MLB(IMA5),MLB(IMA1),MLB(IMA2),MLB(IMA3),MLB(IMA4)
     1              ,MLB(IMA17))
                               ELSE
C
C
      CALL  EXDAT  (MLB(IMA5), MLB )
C
C
      CALL  EXUNI
C
C
      CALL  EXOUT  (KLST,KPLT,KFIT,MLB(IMA17))
                               ENDIF
C
C
      GOTO 100
C
C
  200 CALL  PLOT   (0.,0.,999)
C
      RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  EXCOM (NAMMAT, KLST, KPLT, KFITT)
C
      INTEGER      NAMMAT(12,1)
      COMMON /MLBNUM/  NMLB, NMAT, NCS, NSS, NPB, NWD, NPROP(5), NDFT
     1               ,  NWDF, NTMP, NEPSR, NEPS, NREFF, NCOMM
      COMMON /MLBRF1/  KRFM1, KRFM2, KEXC, MRFM, NRFM, IRFM(10), KARG(4)
     1               ,  NRFC(8), IRFC(10,8), RRFC(2,10,8), KSYSU
      COMMON /MLBPL1/  IAXES(2), KMESH, KCVNAM, JCVNAM(20), ICVNAM(5,20)
      CHARACTER*4      ICVNAM
      COMMON /MLBFT1/  KFIT, IEQFIT, NCOEF(16), COEF(6), COEFO(6,16)
     1               ,  NXY, NXYD(5), XYD(2,50,5), MXY, MXYD
      COMMON /COMPL1/  ATITLE(18), XXNAME(10), YYNAME(10)
     1               ,  XDATA( 50,20), YDATA( 50,20)
      INTEGER          ATITLE, XXNAME, YYNAME
      COMMON /COMPL2/  PXMIN, PXMAX, PYMIN, PYMAX, XL1, YL1, NPLOT
     1               ,  NDATA, NDATAX(20), NGRAPH
      COMMON /RDBUF3/  CDA(10), IDA(10), RDA(50)
      CHARACTER*4      CDA
      CHARACTER*72     CTITLE, CBLNK
      DATA   CBLNK           / '
     1                                  ' /
      DATA   KEXC1, KEXC2    / 2*0 /
      DATA   KECHO           /   1 /
C
      KLST  = 0
      KPLT  = 0
      KFITT = 0
      IF ( KEXC.GT.1 )         GOTO 100
      IF ( KEXC.EQ.1 )         GOTO 150
   70       CONTINUE
      WRITE(6,6080)
 6080 FORMAT( ' ENTRY? (0:1:2:3)'
     1       / '    0; EXIT       '
     2       / '    1; QUERY      '
     3       / '    2; GRAPHICS   '
     4       / '    3; INPUT ECHO')
      READ(5,*)     KEXC
      IF ( KECHO.NE.0 ) WRITE(6,6125) KEXC
      IF ( KEXC.LE.0 )         GOTO 900
      IF ( KEXC.EQ.1 )         GOTO 150
      IF ( KEXC.EQ.2 )         GOTO 250
      IF ( KEXC.EQ.3 )         THEN
      WRITE(6,6090)
 6090 FORMAT( ' INPUT ECHO? (0:1)'
     1       / '    0; OFF        '
     2       / '    1; ON         ' )
      READ(5,*)     KEXC1
      IF ( KECHO.NE.0 ) WRITE(6,6125) KEXC1
      KECHO = KEXC1
                               ENDIF
      GOTO 70
C
  100       CONTINUE
      WRITE(6,6120)
 6120 FORMAT( ' EXIT/RESET? (0:1:2:3:4:5:6) '
     1       / '    0; EXIT              '
     2       / '    1; QUERY             '
     3       / '    2; TITLE,...         '
     4       / '    3; MATERIALS,...     '
     5       / '    4; PARAMETERS,...    '
```

Appendix F (Continued)

```
     6        / '     5; SYSTEM OF UNITS'
     7        / '     6; OUTPUT              ' )
      READ(5,*)     KEXC
      IF ( KECHO.NE.0 ) WRITE(6,6125) KEXC
 6125 FORMAT( '  >>',I3 )
      IF ( KEXC.LE.0 )          GOTO 900
      IF ( KEXC.GT.6 )          GOTO 100
      IF ( KEXC.GT.1 )          GOTO 240
  150 CALL  EXCOMQ ( KEXC1,KECHO)
      IF ( KEXC1.LE.0 )         GOTO  70
      GOTO 900
C
  200 KEXC  = KEXC+KEXC1+KEXC2
      KEXC1 = 0
      KEXC2 = 0
      IF ( KEXC.LT.0 )          GOTO 900
C
  220 KEXC  = KEXC+1
  240 IF ( KEXC.NE.2 )          GOTO 280
  250 CTITLE= CBLNK
      WRITE(6,6260)
 6260 FORMAT( 15H TITLE? ('...') )
      READ(5,*,END=900)  CTITLE
      IF ( KECHO.NE.0 ) WRITE(6,6265) CTITLE
 6265 FORMAT( '  >> ',A50 )
      READ(CTITLE,'(18A4)')   (ATITLE(I),I=1,18)
      GOTO 220
C
  280 IF ( KEXC.NE.3 )          GOTO 400
  300 WRITE(6,6320)
 6320 FORMAT( ' MATERIALS? (PROP,NMAT,MATNO,...)'
     1        / '     PROPERTY                          '
     2        / '       0; RETURN                       '
     3        / '       1; COEFFICIENT OF THERMAL EXPANSION   '
     4        / '       2; MODULUS OF LONGITUDINAL ELASTICITY '
     5        / '       3; MODULUS OF TRANSVERSE ELASTICITY   '
     6        / '       4; POISSON''S RATIO            '
     7        / '       5; STRESS-STRAIN               '
     8        / '       6; STRESS-STRAIN RATE          '
     9        / '     NMAT ; NUMBER OF MATERIALS      '
     A        / '     MATNO; MATERIAL NUMBER          ' )
      READ(5,*)     KEXC1, NMATS, (IDA(I),I=1,NMATS)
      IF ( KECHO.NE.0 ) WRITE(6,6325) KEXC1, NMATS, (IDA(I),I=1,NMATS)
 6325 FORMAT( '  >>',2I3,10I5 : ( 10X,10I5 ) )
      IF ( KEXC1.NE.-9 )        GOTO 330
      KECHO   = IDA(1)
      GOTO 300
  330 IF ( KEXC1.LE.0 )         GOTO 200
      IF ( KEXC1.GT.6 )         GOTO 300
      IF ( NMATS.GT.NMAT )      GOTO 300
      KARG(1) = 7
      KARG(2) = KEXC1
      KARG(3) = KEXC1
      IF ( KEXC1.EQ.5 )         THEN
      KARG(1) = 9
      KARG(2) = 10
                                ELSE
      IF ( KEXC1.EQ.6 )               THEN
      KARG(1) = 8
      KARG(2) = 10
```

Appendix F (Continued)

```
                                      ENDIF
                                ENDIF
      NRFM    = 0
      DO 360 I= 1,NMATS
      DO 340 J= 1,NMAT
      IF ( IDA(I).NE.NAMMAT(9,J) ) GOTO 340
      IF ( NRFM.GE.MRFM )          GOTO 380
      NRFM        = NRFM+1
      IRFM(NRFM) = IDA(I)
      GOTO 360
  340 CONTINUE
  360 CONTINUE
  380 KEXC  = KEXC+1
      IF ( KARG(3).NE.5 .AND. KARG(3).NE.6 ) GO TO 220
      GOTO 420
  400 IF ( KEXC.NE.4 )          GOTO 450
      IF ( KARG(3).NE.5 .AND. KARG(3).NE.6 ) GO TO 100
C*  PROPERTY  *
  420 CALL  EXCOM1 ( KEXC1, KEXC2,KECHO)
      IF ( KEXC1.LE.0 .OR. KEXC2.LE.0 ) GO TO 200
  450 IF ( KEXC.NE.5 )          GOTO 500
  460 WRITE(6,6470)
 6470 FORMAT( ' SYSTEM OF UNITS? (1:2) '
     1        / '     1; SI                  '
     2        / '     2; MKS                 ' )
      READ(5,*)     KEXC1
      IF ( KECHO.NE.0 ) WRITE(6,6125) KEXC1
      IF ( KEXC1.LT.0 )         GOTO 200
      IF ( KEXC1.NE.1 .AND. KEXC1.NE.2 ) GO TO 460
      KSYSU = KEXC1
      KEXC  = KEXC+1
  500 IF ( KEXC.LT.6 )          GOTO 100
  520 WRITE(6,6540)
 6540 FORMAT( ' OUTPUT? (0:001:010:100)  '
     1        / '       0; RETURN          '
     2        / '     001; LISTING         '
     3        / '     010; PLOTTING        '
     4        / '     100; FITTING         ' )
      READ(5,*)     KEXC1
      IF ( KECHO.NE.0 ) WRITE(6,6125) KEXC1
      IF ( KEXC1.EQ.0 .OR. KEXC1.LT.-5 ) GO TO 100
      IF ( KEXC1.NE.  1 .AND. KEXC1.NE.1 .AND. KEXC1.NE.11
     1.AND.KEXC1.NE.100 .AND. KEXC1.NE.101 .AND. KEXC1.NE.110
     2.AND.KEXC1.NE.111 )     GOTO 520
      KLST  = 0
      IF ( KEXC1-KEXC1/10*10.NE.0 ) KLST = 1
      KEXC1 = KEXC1-KLST
      KPLT  = KEXC1-KEXC1/100*100
      KFITT =(KEXC1-KPLT)/100
      KPLT  = KPLT/10
      KEXC1 = KLST+KPLT
      KEXC  = KEXC+KEXC1
      IF ( KPLT.NE.0 ) CALL EXCOM2 ( KEXC1, KECHO )
      IF ( KFITT.NE.0 )         THEN
      CALL  EXCOM3 ( KEXC1,KECHO)
      KFITT = KFIT
                                ENDIF
  900  CONTINUE
      RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  EXCOMQ ( KEXC1,KECHO)
      COMMON /MLBQR1/  KQR(10), IQRD(10), CQRD(4,10), JIQRD, JCQRD
      CHARACTER*4      CQRD
      CHARACTER*17 MNAM1, BLNK1
      CHARACTER*1  MNAM2(17), BLNK2
      DATA    BLNK1 / '                 ' /
      DATA.   BLNK2 / ' '               /
  120       CONTINUE
      WRITE(6,6140)
 6140 FORMAT( ' QUERY? (0:1:2:3:4:5:6:7:8:9) '
     1        / '     0; RETURN                 '
     2        / '     1; MATERIAL NAME LIST     '
     3        / '     2; CARBON STEEL NAME LIST '
     4        / '     3; STAINLESS STEEL NAME LIST'
     5        / '     4; LEAD NAME LIST         '
     6        / '     5; WOOD NAME LIST         '
     7        / '     6; REFERENCE LIST         '
     8        / '     7; MATERIAL DATA          '
     9        / '     8; MATERIAL NO. BY NAME   '
     *        / '     9; MATERIAL NO. BY REFERENCE ')
      READ(5,*)     KEXC1
      IF ( KECHO.NE.0 ) WRITE(6,6145) KEXC1
 6145 FORMAT( '  >>',I3 )
      IF ( KEXC1.LE.0 )       GOTO 900
      IF ( KEXC1.GT.9 )       GOTO 120
      KQR(1)  = KEXC1
      IF ( KEXC1.EQ.7 )       THEN
      WRITE(6,6220)
 6220 FORMAT( ' MATERIAL DATA? (MAT-NO.) ' )
      READ(5,*)     KEXC2
      IF ( KECHO.NE.0 ) WRITE(6,6225) KEXC2
 6225 FORMAT( '  >>',I5 )
      KQR(2)      = JIQRD
      IQRD(JIQRD)= KEXC2
      JIQRD       = JIQRD+1
      IF ( JIQRD.GT.10 ) JIQRD = 1
                              ELSE
      IF ( KEXC1.GE.8 )              THEN
      IF ( KEXC1.EQ.8 ) WRITE(6,6240)
 6240 FORMAT( 28H MATERIAL NO.? ('MAT-NAME')  )
      IF ( KEXC1.EQ.9 ) WRITE(6,6242)
 6242 FORMAT( 29H MATERIAL NO.? ('REFERENCE')  )
      MNAM1   = BLNK1
      READ(5,*)     MNAM1
      IF ( KECHO.NE.0 ) WRITE(6,6245) MNAM1
 6245 FORMAT( '  >> ',A17 )
      READ(MNAM1,'(17A1)')   (MNAM2(I),I=1,17)
  260 WRITE(MNAM1,'(16A1)')  (MNAM2(I),I=1,16)
      READ (MNAM1,'(4A4)')   (CQRD(I,JCQRD),I=1,4)
      KQR(2)  = JCQRD
      JCQRD   = JCQRD+1
      IF ( JCQRD.GT.10 ) JCQRD = 1
                                     ENDIF
                              ENDIF
  900 RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  EXCOM1 ( KEXC1, KEXC2,KECHO)
C
      COMMON /MLBRF1/  KRFM1, KRFM2, KEXC, MRFM, NRFM, IRFM(10), KARG(4)
     1               , NRFC(8), IRFC(10,8), RRFC(2,10,8), KSYSU
      COMMON /RDBUF3/  CDA(10), IDA(10), RDA(50)
      CHARACTER*4      CDA
      CHARACTER*4 KFIBR(8)
C
      DATA         KFIBR  / '0   ', '30  ', '45  ', '60  '
     1                    , '90  ', 'NORM', '    ', '    ' /
C
      DO 100 I= 1,8
      NRFC(1) = 0
  100 CONTINUE
C
  120 KEXC2   = 0
      WRITE(6,6140)
 6140 FORMAT( ' PARAMETERS? (0:1:2:3:4:5)'
     1        / '     0; RETURN               '
     2        / '     1; DEFORMATION TYPE     '
     3        / '     2; FIBRE DIRECTION OF WOOD '
     4        / '     3; TEMPERATURE          '
     5        / '     4; STRAIN RATE          '
     6        / '     5; STRAIN               ' )
      READ(5,*)     KEXC1
      IF ( KECHO.NE.0 ) WRITE(6,6145) KEXC1
 6145 FORMAT( '  >>',I3 )
      IF ( KEXC1.LE.0 )       GOTO 900
      IF ( KEXC1.GT.5 )       GOTO 120
      IF ( KEXC1.NE.1 )       GOTO 300
C
  200 WRITE(6,6220)
 6220 FORMAT( ' DEFORMATION TYPE? (0:1:2:3) '
     1        / '     0; RETURN                  '
     2        / '     1; COMPRESSION             '
     3        / '     2; TENSION                 '
     4        / '     3; COMPRESSION & TENSION ' )
      READ(5,*)     KEXC2
      IF ( KECHO.NE.0 ) WRITE(6,6145) KEXC2
      IF ( KEXC2.LT.0 )       GOTO 900
      IF ( KEXC2.EQ.0 )       GOTO 120
      IF ( KEXC2.GT.3 )       GOTO 200
      NRFC(KEXC1)    = (KEXC2+1)/2
      IRFC(1,KEXC1) = KEXC2
      IF ( KEXC2.LE.2 )       GOTO 120
      IRFC(1,KEXC1) = 1
      IRFC(2,KEXC1) = 2
      GOTO 120
C
  300 IF ( KEXC1.NE.2 )       GOTO 400
  320 WRITE(6,6340)
 6340 FORMAT( ' FIBRE DIRECTION OF WOOD? (0:1:2:3:4:5:6) '
     1        / '     0; RETURN  '
     2        / '     1;  0 DEG  '
     3        / '     2; 30 DEG  '
     4        / '     3; 45 DEG  '
     5        / '     4; 60 DEG  '
     6        / '     5; 90 DEG  '
     7        / '     6; NORMAL  ' )
      READ(5,*)     KEXC2
```

Appendix F (Continued)

```
      IF ( KECHO.NE.0 ) WRITE(6,6145) KEXC2
      IF ( KEXC2.LT.0 )         GOTO 900
      IF ( KEXC2.EQ.0 )         GOTO 120
      IF ( KEXC2.GT.6 )         GOTO 320
      NRFC(KEXC1)    = NRFC(KEXC1)+1
      J              = NRFC(KEXC1)
      IRFC(J,KEXC1) = ISBST(KFIBR(KEXC2))
      GOTO 120
C
  400 IF ( KEXC1.NE.3 )         GOTO 500
  420 WRITE(6,6440)
 6440 FORMAT( ' TEMPERATURE? (MIN,MAX) ' )
      READ(5,*)        RMIN, RMAX
      IF ( KECHO.NE.0 ) WRITE(6,6445) RMIN, RMAX
 6445 FORMAT( '  >>',2F10.3 )
      IF ( RMIN.GT.-9999. )    GOTO 460
      KEXC2 = -9
      GOTO 900
  460 IF ( RMIN.GT.RMAX )      GOTO 420
      NRFC(KEXC1)     = NRFC(KEXC1)+1
      J               = NRFC(KEXC1)
      RRFC(1,J,KEXC1)= RMIN
      RRFC(2,J,KEXC1)= RMAX
      GOTO 120
  500 IF ( KEXC1.NE.4 )         GOTO 600
      IF ( KARG(1).EQ.8 )      GOTO 120
  520 WRITE(6,6540)
 6540 FORMAT( ' STRAIN RATE? (MIN,MAX) ' )
      READ(5,*)        RMIN, RMAX
      IF ( KECHO.NE.0 ) WRITE(6,6445) RMIN, RMAX
      IF ( RMIN.GT.-9999. )    GOTO 560
      KEXC2 = -9
      GOTO 900
  560 IF ( RMIN.GT.RMAX )      GOTO 520
      NRFC(KEXC1)     = NRFC(KEXC1)+1
      J               = NRFC(KEXC1)
      RRFC(1,J,KEXC1)= RMIN
      RRFC(2,J,KEXC1)= RMAX
      GOTO 120
  600 IF ( KEXC1.NE.5 )         GOTO 120
      IF ( KARG(1).EQ.9 )      GOTO 120
  620 WRITE(6,6640)
 6640 FORMAT( ' STRAIN? (NSTRN,STRN,...)        '
     1       / '    NSTRN; NUMBER OF STRAINS '
     2       / '    STRN ; STRAIN              ' )
      READ(5,*)     KEXC2, (RDA(I),I=1,KEXC2)
      IF ( KECHO.NE.0 ) WRITE(6,6645) KEXC2, (RDA(I),I=1,KEXC2)
 6645 FORMAT( '  >>',I3,5F10.4 : ( 7X,5F10.4 ) )
      IF ( KEXC2.LT.0 )         GOTO 900
      IF ( KEXC2.EQ.0 )         GOTO 120
      J              = NRFC(KEXC1)
      NRFC(KEXC1) = NRFC(KEXC1)+KEXC2
      DO 660 I= 1,KEXC2
      J                  = J+1
      RRFC(1,J,KEXC1) = RDA(I)
      RRFC(2,J,KEXC1) = RDA(I)
  660 CONTINUE
      GOTO 120
  900 RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  EXCOM2 ( KEXC1,KECHO)
C
      COMMON /COMPL2/  PXMIN, PXMAX, PYMIN, PYMAX, XL1, YL1, NPLOT
     1               ,  NDATA, NDATAX(20), NGRAPH
      COMMON /MLBPL1/  IAXES(2), KMESH, KCVNAM, JCVNAM(20), ICVNAM(5,20)
      CHARACTER*4       ICVNAM
      COMMON /MLBRF1/  KRFM1, KRFM2, KEXC, MRFM, NRFM, IRFM(10), KARG(4)
     1               ,  NRFC(8), IRFC(10,8), RRFC(2,10,8), KSYSU
      CHARACTER*22  CVNAM1, BLNK1
      CHARACTER*1   CVNAM2(22), BLNK2
C
      DATA  BLNK1   /  '                        ' /
      DATA  BLNK2   /  ' '                           /
C
C
C
  120 WRITE(6,6140)
 6140 FORMAT( ' PLOT OPTIONS? (0:1:2:3:4:5) '
     1       / '     0; RETURN                 '
     2       / '     1; DATA RANGES            '
     3       / '     2; TYPE OF AXES           '
     4       / '     3; STRING                 '
     5       / '     4; MESH                   '
     6       / '     5; COMMENT OF CURVES      ' )
      READ(5,*)      KEXC1
      IF( KECHO.NE.0 ) WRITE(6,6145) KEXC1
 6145 FORMAT( '  >>',I3 )
      IF ( KEXC1.LE.0 )         GOTO 900
      IF ( KEXC1.GT.5 )         GOTO 120
C
C
C
      IF ( KEXC1.NE.1 )         GOTO 250
  200 WRITE(6,6220)
 6220 FORMAT( ' DATA RANGES? (XMIN,XMAX,YMIN,YMAX)'
     1       / '     XMIN; MINIMUN VALUE ON X-AXIS  '
     2       / '     XMAX; MAXIMUM VALUE ON X-AXIS  '
     3       / '     YMIN; MINIMUN VALUE ON Y-AXIS  '
     4       / '     YMAX; MAXIMUM VALUE ON Y-AXIS  ' )
      READ(5,*)     PXMIN, PXMAX, PYMIN, PYMAX
      IF ( KECHO.NE.0 ) WRITE(6,6225) PXMIN, PXMAX, PYMIN, PYMAX
 6225 FORMAT( '  >>',4F10.2 )
      IF ( PXMIN.GT.PXMAX .OR. PYMIN.GT.PYMAX ) GO TO 200
      GOTO 120
C
C
C
  250 IF ( KEXC1.NE.2 )         GOTO 300
  260 WRITE(6,6280)
 6280 FORMAT( ' TYPE OF AXES? (1:2:3:4) '
     1       / '     1; BOTH X AND Y ARE LINEAR SCALE       '
     2       / '     2; X IS LOG SCALE, Y IS LINEAR SCALE '
     3       / '     3; X IS LINEAR SCALE, Y IS LOG SCALE '
     4       / '     4; BOTH X AND Y ARE LOG SCALE          ' )
      READ(5,*)     KEXC2
      IF ( KECHO.NE.0 ) WRITE(6,6145) KEXC2
      IF ( KEXC2.LT.1 .OR. KEXC2.GT.4 ) GO TO 260
      KEXC2    = KEXC2-1
      IAXES(2)= KEXC2/2
      IAXES(1)= KEXC2-2*IAXES(2)
```

Appendix F (Continued)

```
      GOTO 120
C
C
C
  300 IF ( KEXC1.NE.3 )        GOTO 350
  320 WRITE(6,6340)
 6340 FORMAT( ' STRING? (0:1) '
     1        / '     0; NO         '
     2        / '     1; YES        ' )
      READ(5,*)     KEXC2
      IF ( KECHO.NE.0 ) WRITE(6,6145) KEXC2
      IF ( KEXC2.LT.0 .OR. KEXC2.GT.1) GO TO 320
      KARG(4) = KEXC2
      GOTO 120
C
C
C
  350 IF ( KEXC1.NE.4 )        GOTO 400
  360 WRITE(6,6380)
 6380 FORMAT( ' MESH? (0:1:2)  '
     1        / '     0; NONE       '
     2        / '     1; DASH LINE'
     3        / '     2; LINE       ' )
      READ(5,*)     KEXC2
      IF ( KECHO.NE.0 ) WRITE(6,6145) KEXC2
      IF ( KEXC2.LT.0 .OR. KEXC2.GT.2 ) GO TO 360
      KMESH    = KEXC2
      GOTO 120
C
C
C
  400 IF ( KEXC1.NE.5 )        GOTO 120
      IF ( KCVNAM.NE.0 )       THEN
      KCVNAM  = 0
      DO 410 I=1,20
      JCVNAM(1) = 0
  410 CONTINUE
                               ENDIF
  420 WRITE(6,6440)
 6440 FORMAT( ' COMMENT OF CURVES? (CURVE-NO,''..COMMENT..'')'
     1        / '     CURVE-NO= 0; RETURN        '
     2        / '              > 0; DEFINITION  '
     3        / '              <11; DEFINITION  ' )
      CVNAM1= BLNK1
      READ(5,*)     KEXC2, CVNAM1
      IF ( KECHO.NE.0 ) WRITE(6,6450) KEXC2, CVNAM1
 6450 FORMAT( '  >>',I3,2H, ,A22 )
      IF ( KEXC2.EQ.0 )        GOTO 120
      IF ( KEXC2.LT.0 .OR. KEXC2.GT.20 ) GO TO 420
      JCVN         = KEXC2
      JCVNAM(JCVN)= JCVN
      READ(CVNAM1,'(22A1)')    (CVNAM2(I),I=1,22)
  470 WRITE(CVNAM1,'(20A1)')    (CVNAM2(I),I=1,20)
      READ (CVNAM1,'(5A4)')     (ICVNAM(I,JCVN),I=1,5)
      KCVNAM= KCVNAM+1
      GOTO 420
  900  CONTINUE
      RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  EXCOM3 ( KEXC1,KECHO)
C
      COMMON /MLBFT1/  KFIT, IEQFIT, NCDEF(16), COEF(6), COEFO(6,16)
     1                ,  NXY, NXYD(5), XYD(2,50,5), MXY, MXYD
      COMMON /MLBFT2/  NEQCF(16), IEQCF(6,16)
      CHARACTER*4      IEQCF
      COMMON /MLBRF1/  KRFM1, KRFM2, KEXC, MRFM, NRFM, IRFM(10), KARG(4)
     1                ,  NRFC(8), IRFC(10,8), RRFC(2,10,8), KSYSU
C
  120 WRITE(6,6140)
 6140 FORMAT( ' FITTING? (0:1:2:3)          '
     1        / '     0; RETURN               '
     2        / '     1; INPUT X-Y DATA       '
     3        / '     2; LINEAR REGRESSION    '
     4        / '     3; BUILD IN EQUATIONS ' )
C
C
C
      READ(5,*)     KEXC1
      IF ( KECHO.NE.0 ) WRITE(6,6145) KEXC1
 6145 FORMAT( '  >>',I3 )
      IF ( KEXC1.LE.0 )        GOTO 900
      IF ( KEXC1.GT.3 )        GOTO 120
C
C
C
      IF ( KARG(4).EQ.0 ) KARG(4) = -1
      KFIT     = KEXC1
      IF ( KEXC1.NE.1 )        GOTO 250
      NXY      = 0
  200 NXY      = NXY+1
      WRITE(6,6220)
 6220 FORMAT( ' X-Y DATA? (N,X1,Y1,...,XN,YN)  '
     1        / '     N; NUMBER OF X,Y DATA (<51) '
     2        / '     X; X DATA                   '
     3        / '     Y; Y DATA                   ' )
C
C
C
      READ(5,*)     KEXC2, ((XYD(I,J,NXY),I=1,2),J=1,KEXC2)
      IF ( KECHO.NE.0 )
     *WRITE(6,6225)KEXC2, ((XYD(I,J,NXY),I=1,2),J=1,KEXC2)
 6225 FORMAT( '  >>',I4,1P6E11.3: / ( 8X,6E11.3 ) )
      IF ( KEXC2.GT.0 )        GOTO 240
      NXY      = NXY-1
      GOTO 900
C
C
C
  240 IF ( KEXC2.GT.MXYD ) KEXC2 = MXXYD
      NXYD(NXY)= KEXC2
      GOTO 200
C
C
C
  250 IF ( KEXC1.NE.2 )        GOTO 300
      WRITE(6,6260)
 6260 FORMAT( ' LINEAR REGRESSION? (A,B) '
     1        / '     Y = A*X + B           ' )
C
```

Appendix F (Continued)

```
C
C
      READ(5,*)     A, B
      IF ( KECHO.NE.0 ) WRITE(6,6270) A, B
 6270 FORMAT( '  >> ',2F10.2 )
      COEF(1)= A
      COEF(2)= B
      GOTO 900
C
C
C
  300 IF ( KEXC1.NE.3 )        GOTO 120
      IEQFIT  = 0
  310 WRITE(6,6320)
 6320 FORMAT( ' EQUATION NUMBER? (0:1,...,15) '
     1       / '     0; RETURN                 '
     2       / '     1; EQUATION NUMBER  1     '
     3       / '             ...               '
     4       / '    15; EQUATION NUMBER 15     ' )
C
C
C
      READ(5,*)     KEXC2
      IF ( KECHO.NE.0 ) WRITE(6,6145) KEXC2
      IF ( KEXC2.LE.0  )       GOTO 900
      IF ( KEXC2.GT.15 )       GOTO 300
C
C
C
      IEQFIT  = KEXC2
      NEQC    = NEQCF(IEQFIT)
      NCOE    = NCOEF(IEQFIT)
      WRITE(6,6340) IEQFIT, (IEQCF(I,IEQFIT),I=1,NEQC)
 6340 FORMAT( ' COEFFICIENT OF THE EQUATION',I3,' ? ( ',6A4 )
C
C
C
      IF ( IEQFIT.EQ.10 )      THEN
      READ(5,*)     NCOE, COEF(2), (COEF(I+2),I=1,NCOE)
      COEF(1) = NCOE
      IF ( KECHO.NE.0 )
     *WRITE(6,6345)NCOE, COEF(2), (COEF(I+2),I=1,NCOE)
 6345 FORMAT( '  >>',I2,8F9.3 )
      NCOEF(10) = NCOE+2
C
C
C
                               ELSE
      READ(5,*)     (COEF(I),I=1,NCOE)
      IF ( KECHO.NE.0 )
     *WRITE(6,6347)(COEF(I),I=1,NCOE)
 6347 FORMAT( '  >>',8F9.3 )
                               ENDIF
C
C
C
  900 RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  EXQRY (NAMMAT,NAMCS,NAMSS,NAMPB,NAMWD,IREFF)
C
      DIMENSION   NAMMAT(12,1)
      DIMENSION   NAMCS(5,1), NAMSS(5,1), NAMPB(5,1), NAMWD(5,1)
      DIMENSION   IREFF(2,1)
      INTEGER     ICQRD(4)
      COMMON /MLBFNO/  IFNC, IFNM, IFNP, IFNR
      COMMON /MLBQR1/  KQR(10), IQRD(10), CQRD(4,10), JIQRD, JCQRD
      CHARACTER*4      CQRD
      COMMON /MLBNUM/  NMLB, NMAT, NCS, NSS, NPB, NWD, NPROP(5), NDFT
     1               , NWDF, NTMP, NEPSR, NEPS, NREFF, NCOMM
      COMMON /RDBUF3/  CDA(10), IDA(10), RDA(50)
      CHARACTER        CDA*4
      CHARACTER        CDAX(20)*4
      EQUIVALENCE    ( CDA(1), CDAX(1) )
C
      KQR1    = KQR(1)
      IF ( KQR1.LT.1
     *.OR. KQR1.GT.9 )         GOTO 900
      GOTO ( 110,120,130,140,150,160,170,180,190 ), KQR1
C
C*    MATERIAL NAME
  110 WRITE(6,6112)    ((NAMMAT(J,I),J=5,9),I=1,NMAT)
 6112 FORMAT( 27H0* MATERIAL NAME *  NO.  *  /
     1        ( 3X,4A4,I4 ) )
      GOTO 900
C
C*    CARBON STEEL NAME
  120 IF ( NCS.GT.0 )          THEN
      WRITE(6,6122)    ((NAMCS(J,I),J=1,4),I=1,NCS)
 6122 FORMAT( 23H0* CARBON STEEL NAME * /
     1        ( 3X,4A4 ) )
                               ELSE
      WRITE(6,6124)
 6124 FORMAT( 23H0* NONE CARBON STEEL * )
                               ENDIF
      GOTO 900
C
C*    STAINLESS STEEL NAME
  130 IF ( NSS.GT.0 )          THEN
      WRITE(6,6132)    ((NAMSS(J,I),J=1,4),I=1,NSS)
 6132 FORMAT( 25H0* STAINLESS STEEL NAME * /
     1        ( 3X,4A4 ) )
                               ELSE
      WRITE(6,6134)
 6134 FORMAT( 25H0* NONE STAINLESS STEEL * )
                               ENDIF
      GOTO 900
C
C*    LEAD NAME
  140 IF ( NPB.GT.0 )          THEN
      WRITE(6,6142)    ((NAMPB(J,I),J=1,4),I=1,NPB)
 6142 FORMAT( 14H0* LEAD NAME * /
     1        ( 3X,4A4 ) )
                               ELSE
      WRITE(6,6144)
 6144 FORMAT( 14H0* NONE LEAD * )
                               ENDIF
      GOTO 900
C
```

Appendix F (Continued)

```
C*     WOOD NAME
  150 IF ( NWD.GT.0 )           THEN
      WRITE(6,6152)    ((NAMWD(J,I),J=1,4),I=1,NWD)
 6152 FORMAT( 14H0* WOOD NAME * /
     1       ( 3X,4A4 ) )
                                ELSE
      WRITE(6,6154)
 6154 FORMAT( 14H0* NONE WOOD * )
                                ENDIF
      GOTO 900
C
C*     REFERENCE LIST
  160 IF ( NREFF.GT.0 )         THEN
      DO 167 I=1,NREFF
      IF ( I.EQ.1 )                     THEN
      WRITE(6,6162)     (IREFF(J,I),J=1,2)
 6162 FORMAT( 16H0* REFERENCES * /
     1          3X,2A4 )
                                        ELSE
      I1        = I-1
      DO 164 J=1,I1
      IF ( IREFF(1,J).NE.IREFF(1,I) )    GOTO 164
      IF ( IREFF(2,J).EQ.IREFF(2,I) )    GOTO 166
  164 CONTINUE
      WRITE(6,6165)     (IREFF(J,I),J=1,2)
 6165 FORMAT( 3X,2A4 )
  166  CONTINUE
                                        ENDIF
  167 CONTINUE
                                ELSE
      WRITE(6,6168)
 6168 FORMAT( 20H0* NONE REFERENCE * )
                                ENDIF
      GOTO 900
C
C*     MATERIAL DATA
  170 JIQRD    = KQR(2)
      MATNO    = IQRD(JIQRD)
      DO 172 I=1,NMAT
      IF ( NAMMAT(9,I).NE.MATNO )  GOTO 172
      IMAT     = I
      GOTO 174
  172 CONTINUE
      WRITE(6,6173)     MATNO
 6173 FORMAT( 26H0* NONE MATERIAL DATA, NO.,I5,2H * )
      GOTO 900
C
  174 JPOS     = NAMMAT(1,I)
      NREC     = NAMMAT(2,I)
      CALL  RDSQF  (-1,IFNM, IFMT ,0, KSTAT, CDA, IDA, RDA, JPOSR)
      NRCS     = JPOS-JPOSR
      IF ( NRCS.GE.0 )          THEN
      CALL  RDSQF  (2,IFNM, IFMT ,NRCS, KSTAT, CDA, IDA, RDA, JPOSR)
                                ELSE
      CALL  RDSQF  (0,IFNM, IFMT ,0, KSTAT, CDA, IDA, RDA, JPOSR)
      CALL  RDSQF  (2,IFNM, IFMT ,JPOS, KSTAT, CDA, IDA, RDA, JPOSR)
                                ENDIF
      WRITE(6,6175)
 6175 FORMAT( 18H0* MATERIAL DATA * )
      DO 178 I=1,NREC
```

Appendix F (Continued)

```
      READ(IFNM,5176)  (CDA(J),J=1,20)
 5176 FORMAT( 20A4 )
CJAE  WRITE(6,6177)     (CDAX(J),J=1,20)
      WRITE(6,6177)     (CDAX(J),J=1,18)
 6177 FORMAT( 1X,17A4,A3 )
  178 CONTINUE
      CALL  RDSQF  (0,IFNM, IFMT ,0, KSTAT, CDA, IDA, RDA, JPOSR)
      GOTO 900
C
C*     MATERIAL NO. BY NAME
  180 JCQRD    = KQR(2)
      DO 181 I=1,4
      ICQRD(I)= ISBST(CQRD(I,JCQRD))
  181 CONTINUE
      KQ       = 0
      DO 184 I=1,NMAT
      IF ( NAMMAT(5,I).NE.ICQRD(1) ) GOTO 184
      IF ( NAMMAT(6,I).NE.ICQRD(2) ) GOTO 184
      IF ( NAMMAT(7,I).NE.ICQRD(3) ) GOTO 184
      IF ( NAMMAT(8,I).NE.ICQRD(4) ) GOTO 184
      IF ( KQ.EQ.0 )
     *WRITE(6,6182)
 6182 FORMAT( 16H0* MATERIAL NO * )
      WRITE(6,6183)     NAMMAT(9,I)
 6183 FORMAT( 1H ,I10 )
      KQ       = KQ+1
  184 CONTINUE
      IF ( KQ.EQ.0 )
     *WRITE(6,6185)    (CQRD(I,JCQRD),I=1,4)
 6185 FORMAT( 28H0* NONE MATERIAL NO., NAME: ,4A4,2H * )
      GOTO 900
C
C*     MATERIAL NO. BY REFERENCE
  190 JCQRD    = KQR(2)
      DO 191 I=1,4
      ICQRD(I)= ISBST(CQRD(I,JCQRD))
  191 CONTINUE
      KQ       = 0
      DO 194 I=1,NMAT
      IF ( NAMMAT(12,I).LE.0 )        GOTO 194
      NRF      = NAMMAT(12,I)
      JRF      = NAMMAT(11,I)
      DO 193 J=1,NRF
      IF ( IREFF(1,JRF).NE.ICQRD(1) )  GOTO 192
      IF ( IREFF(2,JRF).NE.ICQRD(2) )  GOTO 192
      IF ( KQ.EQ.0 )
     *WRITE(6,6182)
      WRITE(6,6183)     NAMMAT(9,I)
      KQ       = KQ+1
  192 JRF      = JRF+1
  193 CONTINUE
  194 CONTINUE
      IF ( KQ.EQ.0 )
     *WRITE(6,6195)    (CQRD(I,JCQRD),I=1,2)
 6195 FORMAT( 33H0* NONE MATERIAL NO., REFERENCE: ,2A4,2H * )
C
  900 RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  EXDAT (NAMMAT, MLB )
C
      INTEGER      NAMMAT(12,1), MLB(1)
      COMMON /MLBMAX/  MMLB, MMAT, MCS, MSS, MPB, MWD, MPTEMP, MWDFIB
     1              ,  MTEMP, MEPSR, MEPSS, MREFF, MCOMM
      COMMON /MLBIDX/  JMAT, IMAT, ICS, ISS, IPB, IWD, JWDFIB, JTEMP
     1              ,  JEPSR, JREFF
      COMMON /MLBALC/  LMLB, IMA1,IMA2,IMA3,IMA4,IMA5,IMA6,IMA7,IMA8
     1              ,  IMA9,IMA10,IMA11,IMA12,IMA13,IMA14,IMA15,IMA16
     2              ,  IMA17,IMA18
      COMMON /MLBRF1/  KRFM1, KRFM2, KEXC, MRFM, NRFM, IRFM(10), KARG(4)
     1              ,  NRFC(8), IRFC(10,8), RRFC(2,10,8), KSYSU
      COMMON /MLBRF2/  MRFX, NRFX, ICND(8,20), RCND(8,20), NXEPS(20)
     1              ,  XEPS(50,20), XSIG(50,20), NRFXX, JRFXX(2,20)
      COMMON /MLBRF3/  ICNDP(8,20), RCNDP(8,20)
      COMMON /COMPL1/  ATITLE(18), XXNAME(10), YYNAME(10)
     1              ,  XDATA( 50,20), YDATA( 50,20)
      COMMON /COMPL2/  PXMIN, PXMAX, PYMIN, PYMAX, XL1, YL1, NPLOT
     1              ,  NDATA, NDATAX(20), NGRAPH
      COMMON /COMPL3/  AMAT1(20), ANAME(20), UNAME(3)
      CHARACTER*8      AMAT1    , ANAME    , UNAME
      CHARACTER*8      RRDATA, AMAT1X   , ANAMEX
      CHARACTER*8      CDATA
      CHARACTER*4      ATITLE, XXNAME, YYNAME
      CHARACTER*4      IDATA(2)
      CHARACTER*4      KBLNK
      EQUIVALENCE    ( IDATA(1) , RRDATA )
C
      DATA     KBLNK / '    ' /
C
      NPLOT = 0
      IF ( NRFM.LE.0 )         GOTO 900
C
C
C
      DO 200 I= 1,NRFM
      CALL  MLBFD  (IRFM(I), MLB(IMA5) , MLB(IMA6), MLB)
      IF ( IMAT.LE.0 )         GOTO 200
      WRITE(ANAMEX,'(2A4)')  (NAMMAT(J,IMAT),J=5,6)
      WRITE(CDATA,'(I4)')      NAMMAT(9,IMAT)
      READ (CDATA,'(A4)')      IDATA(1)
      READ (KBLNK,'(A4)')      IDATA(2)
      AMAT1X  = RRDATA
C
C
C
      IF ( NPLOT.LT.20 )       GOTO 110
      WRITE(6,6108)     (NAMMAT(J,IMAT),J=5,6), NAMMAT(9,IMAT)
 6108 FORMAT( '  ****  OVERFLOW  ****  TOO MANY CURVES TO PLOT ( ',
     1          2A4,',',I5,' )' )
      GOTO 200
C
C
C
  110 IF ( KARG(3).GE.1 .AND. KARG(3).LE.4 ) THEN
      NPLOT = NPLOT+1
      CALL  GTPROP ( NDATAX(NPLOT), YDATA(1,NPLOT), XDATA(1,NPLOT)
     1             ,MLB(IMA6),MLB(IMA7),MLB(IMA8),MPTEMP)
      ANAME(NPLOT)    = ANAMEX
      AMAT1(NPLOT)    = AMAT1X
```

Appendix F (Continued)

```
      ICNDP(1,NPLOT) = NAMMAT(9,IMAT)
      ICNDP(4,NPLOT) = 100*NAMMAT(11,IMAT)+NAMMAT(12,IMAT)
      ICNDP(5,NPLOT) = NAMMAT(5,IMAT)
      ICNDP(6,NPLOT) = NAMMAT(6,IMAT)
      ICNDP(7,NPLOT) = NAMMAT(7,IMAT)
      ICNDP(8,NPLOT) = NAMMAT(8,IMAT)
                               ELSE
      CALL  GTEPSS (MLB(IMA6),MLB(IMA7),MLB(IMA8),MLB(IMA9),MLB(IMA10)
     1             ,MLB(IMA11),MLB(IMA12),MLB(IMA13),MLB(IMA14)
     2             ,MLB(IMA15),MLB(IMA16),MPTEMP,MWDFIB,MTEMP,MEPSR
     3             ,MEPSS)
      IF ( NRFX.GT.0 )                  THEN
      IF ( KARG(3).EQ.5 )                     THEN
C
C
C
      DO 140 J= 1,NRFX
      IF ( NPLOT.LT.20 )       GOTO 115
      WRITE(6,6108)     (NAMMAT(K,IMAT),K=5,6), NAMMAT(9,IMAT)
      GOTO 140
C
C
C
  115 NPLOT          = NPLOT+1
      ANAME(NPLOT) = ANAMEX
      AMAT1(NPLOT) = AMAT1X
      NDATAX(NPLOT)= NXEPS(J)
      NDATA          = NXEPS(J)
      DO 120 K= 1,NDATA
      XDATA(K,NPLOT)= XEPS(K,J)
      YDATA(K,NPLOT)= XSIG(K,J)
  120 CONTINUE
C
C
C
      ICNDP(1,NPLOT) = NAMMAT(9,IMAT)
      ICNDP(2,NPLOT) = ICND(2,J)
      ICNDP(3,NPLOT) = ICND(3,J)
      ICNDP(4,NPLOT) = 100*NAMMAT(11,IMAT)+NAMMAT(12,IMAT)
      ICNDP(5,NPLOT) = NAMMAT(5,IMAT)
      ICNDP(6,NPLOT) = NAMMAT(6,IMAT)
      ICNDP(7,NPLOT) = NAMMAT(7,IMAT)
      ICNDP(8,NPLOT) = NAMMAT(8,IMAT)
      RCNDP(4,NPLOT) = RCND(4,J)
      RCNDP(5,NPLOT) = RCND(5,J)
      RCNDP(6,NPLOT) = RCND(6,J)
      RCNDP(7,NPLOT) = RCND(7,J)
  140 CONTINUE
C
C
C
                                          ELSE
      IF ( KARG(3).EQ.6 ) CALL GTSIG ( NAMMAT( 1, IMAT ) )
                                          ENDIF
                                    ENDIF
                              ENDIF
  200 CONTINUE
  900 RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  MLBFD (KMAT, NAMMAT, MATDIR ,MLB)
C
      INTEGER      NAMMAT(12,1), MATDIR(10,1), MLB(1)
      COMMON /MLBALC/  LMLB, IMA1,IMA2,IMA3,IMA4,IMA5,IMA6,IMA7,IMA8
     1              ,  IMA9,IMA10,IMA11,IMA12,IMA13,IMA14,IMA15,IMA16
     2              ,  IMA17,IMA18
      COMMON /MLBMAX/  MMLB, MMAT, MCS, MSS, MPB, MWD, MPTEMP, MWDFIB
     1              ,  MTEMP, MEPSR, MEPSS, MREFF, MCOMM
      COMMON /MLBNUM/  NMLB, NMAT, NCS, NSS, NPB, NWD, NPROP(5), NDFT
     1              ,  NWDF, NTMP, NEPSR, NEPS, NREFF, NCOMM
      COMMON /MLBIDX/  JMAT, IMAT, ICS, ISS, IPB, IWD, JWDFIB, JTEMP
     1              ,  JEPSR, JREFF
      COMMON /MLBRF1/  KRFM1, KRFM2, KEXC, MRFM, NRFM, IRFM(10), KARG(4)
     1              ,  NRFC(8), IRFC(10,8), RRFC(2,10,8), KSYSU
      COMMON /MLBFNO/  IFNC, IFNM, IFNP, IFNR
      COMMON /RDBUF3/  CDA(10), IDA(10), RDA(50)
      CHARACTER*4      CDA
      INTEGER          IFMT1(2,3)
      CHARACTER*4      KMATE
C
      DATA   IFMT1  / 101, 0, 104, 0, 201, 0 /
      DATA   KMATE  / 'MAT '  /
C
      DO  20 I= 1,NMAT
      IF ( KMAT.NE.NAMMAT(9,I) )   GOTO  20
      IMAT  = I
      GOTO 40
   20 CONTINUE
      GOTO 800
C
   40 IWD   = 0
      IF ( NAMMAT(4,IMAT).GE.40000 )    THEN
      IWD   = NAMMAT(4,IMAT)/40000
      IWD   = NAMMAT(4,IMAT)-40000*IWD
                                        ENDIF
C
      JMAT  = NAMMAT(3,IMAT)
      IF ( JMAT.LE.0 )              THEN
      DO  60 I= 1,NMLB
      IF ( KRFM1.LT.MATDIR(1,I) )  GOTO  60
      JMAT  = I
      GOTO 100
   60 CONTINUE
      JMAT  = 1
C
  100 KRFM1           = KRFM1+1
      IMATX           = MATDIR(2,JMAT)
      NAMMAT(3,IMATX)= 0
      NAMMAT(3,IMAT) = JMAT
      JPOSRM          = NAMMAT(1,IMAT)
C
      CALL  RDSQF  (-1,IFNM, IFTM1 ,0, KSTAT, CDA, IDA, RDA, JPOSR)
C
      IF ( JPOSR.NE.JPOSRM )            THEN
      CALL  RDSQF  (0,IFNM, IFTM1 ,0, KSTAT, CDA, IDA, RDA, JPOSR)
C
      IF ( JPOSRM.GT.0 )                          THEN
      CALL  RDSQF  (2,IFNM, IFTM1 ,JPOSRM, KSTAT, CDA, IDA, RDA, JPOSR)
                                                  ENDIF
                                        ENDIF
```

Appendix F (Continued)

```
C
      CALL  RDSQF  (1,IFNM, IFMT1(1,1) ,3, KSTAT, CDA(1), IDA(1), RDA
     1             , JPOSR)
C
      IF ( CDA(1).NE.KMATE )                 GOTO 800
      CALL  MLBPT  (NAMMAT(1,1), MLB(IMA6), MLB(IMA7), MLB(IMA8)
     1             , MLB(IMA9), MLB(IMA10), MLB(IMA11), MLB(IMA12)
     2             , MLB(IMA13), MLB(IMA14), MLB(IMA15), MLB(IMA16)
     3             , MLB(IMA17), MLB(IMA18)
     4             ,MPTEMP+MPTEMP,MWDFIB,MTEMP,MEPSR,MEPSS)
                                   ENDIF
C
      KRFM2 = KRFM2+1
      MATDIR(1,JMAT) = KRFM2
      GOTO 900
C
  800 IMAT  = 0
C
  900 RETURN
      END



      SUBROUTINE  GTPROP ( NPTEMP, PROP, PTEMP,MATDIR,PROP1,PROP2
     1                  ,MPTEMP)
C
      REAL          PROP(1), PTEMP(1)
      INTEGER       MATDIR(10,1)
      REAL          PROP1(4,1), PROP2(2,MPTEMP,4,1)
      COMMON /MLBIDX/  JMAT, IMAT, ICS, ISS, IPB, IWD, JWDFIB, JTEMP
     1              ,  JEPSR, JREFF
      COMMON /MLBRF1/  KRFM1, KRFM2, KEXC, MRFM, NRFM, IRFM(10), KARG(4)
     1              ,  NRFC(8), IRFC(10,8), RRFC(2,10,8), KSYSU
C
      JARG1 = KARG(3)
      JARG2 = JARG1+4
      NPTEMP= MATDIR(JARG2,JMAT)
      IF ( NPTEMP.LE.0 )            THEN
      NPTEMP  = 0
      PROP(1) = PROP1(JARG1,JMAT)
      PROP(2) = PROP1(JARG1,JMAT)
      PTEMP(1)= 0.
      PTEMP(2)= 1.
                                    ELSE
      DO 110 I= 1,NPTEMP
      PROP(I) = PROP2(1,I,JARG1,JMAT)
      PTEMP(I)= PROP2(2,I,JARG1,JMAT)
  110 CONTINUE
                                    ENDIF
C
      RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  GTEPSS (MATDIR,PROP1,PROP2,IDFTYP,WDFIBR,IWDFIB
     1                   ,DTEMP,ITEMP,DEPSR,IEPSR,EPSS,MPTEMP,MWDFIB
     2                   ,MTEMP,MEPSR,MEPSS)
      INTEGER      MATDIR(10,1), IDFTYP(2,2,1)
      INTEGER      WDFIBR(2,MWDFIB,1)
      INTEGER      IWDFIB(2,MWDFIB,1)
      INTEGER      ITEMP(MTEMP,1), IEPSR(2,MEPSR,MTEMP,1)
      REAL         PROP1(1), PROP2(1)
      REAL         DTEMP(MTEMP,1), DEPSR(  MEPSR,MTEMP,1)
      REAL         EPSS(MEPSS,1)
      COMMON /MLBNUM/  NMLB, NMAT, NCS, NSS, NPB, NWD, NPROP(5), NDFT
     1              ,  NWDF, NTMP, NEPSR, NEPS, NREFF, NCOMM
      COMMON /MLBIDX/  JMAT, IMAT, ICS, ISS, IPB, IWD, JWDFIB, JTEMP
     1              ,  JEPSR, JREFF
      COMMON /MLBRF1/  KRFM1, KRFM2, KEXC, MRFM, NRFM, IRFM(10), KARG(4)
     1              ,  NRFC(8), IRFC(10,8), RRFC(2,10,8), KSYSU
      COMMON /MLBRF2/  MRFX, NRFX, ICND(8,20), RCND(8,20), NXEPS(20)
     1              ,  XEPS(50,20), XSIG(50,20), NRFXX, JRFXX(2,20)
      DATA     TOLE  / 1.E-10 /
      NRFX  = 0
      NRFXX = 0
      IDF1  = MATDIR(9,JMAT)
      IF ( IDF1.EQ.4 ) IDF1 = 1
      IDF2  = IDF1
      IF ( IDF1.EQ.3 )         THEN
      IDF1  = 1
      IDF2  = 2
                               ENDIF
      DO 700 I= IDF1,IDF2
C*  DEFORMATION TYPE  *
      IF ( NRFC(1).LE.0 )      GOTO 140
      NRFCX = NRFC(1)
      DO 120 J= 1,NRFCX
      IF ( IRFC(J,1).EQ.I )    GOTO 140
  120 CONTINUE
      GOTO 700
  140 JTMP1 = IDFTYP(1,1,JMAT)
      JTMP2 = IDFTYP(2,1,JMAT)+JTMP1-1
      JWDF1 = JTMP1
      JWDF2 = JTMP2
      IF ( IWD.LE.0 )          THEN
      JWDF1 = 1
      JWDF2 = 1
                               ENDIF
      DO 600 J= JWDF1,JWDF2
      IF ( IWD.GT.0 )          THEN
      JTMP1 = IWDFIB(1,J,IWD)
      JTMP2 = IWDFIB(2,J,IWD)+JTMP1-1
C*  FIBRE DIRECTION OF WOOD  *
      IF ( NRFC(2).LE.0 )                     GOTO 170
      NRFCX = NRFC(2)
      DO 160 K= 1,NRFCX
      IF ( WDFIBR(1,J,IWD).EQ.IRFC(K,2) )  GOTO 170
  160 CONTINUE
      GOTO 600
                               ENDIF
  170 DO 500 K= JTMP1,JTMP2
C*  TEMPERATURE  *
      IF ( NRFC(3).LE.0 )                           GOTO 200
      NRFCX = NRFC(3)
```

Appendix F (Continued)

```
      DO 180 L= 1,NRFCX
      IF ( DTEMP(K,JMAT).GE.RRFC(1,L,3)-TOLE
     *.AND.DTEMP(K,JMAT).LE.RRFC(2,L,3)+TOLE )  GOTO 200
  180 CONTINUE
      GOTO 500
  200 IF ( NRFXX.GE.MRFX )                      GOTO 500
      NRFXX            = NRFXX+1
      JRFXX(1,NRFXX) = NRFX +1
      NEPSR            = ITEMP(K,JMAT)
      DO 400 L= 1,NEPSR
C*  STRAIN RATE  *
      IF ( NRFC(4).LE.0 )                       GOTO 300
      NRFCX = NRFC(4)
      DO 220 M= 1,NRFCX
      IF ( DEPSR(L,K,JMAT).GE.RRFC(1,M,4)-TOLE
     *.AND.DEPSR(L,K,JMAT).LE.RRFC(2,M,4)+TOLE )GOTO 300
  220 CONTINUE
      GOTO 400
  300 IF ( NRFX.GE.MRFX )      GOTO 400
      NRFX  = NRFX+1
      JEPSS = IEPSR(1,L,K,JMAT)
      NEPS  = IEPSR(2,L,K,JMAT)
      ISSR  = IEPSR(1,MEPSR,K,JMAT)
      JEPS  = IEPSR(2,MEPSR,K,JMAT)
      IF ( ISSR.EQ.1 )         THEN
      DO 320 M= 1,NEPS
      XEPS(M,NRFX) = EPSS(JEPSS  ,JMAT)
      XSIG(M,NRFX) = EPSS(JEPSS+1,JMAT)
      JEPSS         =JEPSS+2
  320 CONTINUE
                               ELSE
      IF ( ISSR.EQ.2 )               THEN
      DO 340 M=1,NEPS
      XEPS(M,NRFX) = EPSS(JEPS ,JMAT)
      XSIG(M,NRFX) = EPSS(JEPSS,JMAT)
      JEPS          = JEPS +1
      JEPSS         = JEPSS+1
  340 CONTINUE
                                     ENDIF
                               ENDIF
      ICND(1,NRFX) = MATDIR(4,JMAT)
      ICND(2,NRFX) = I
      IF ( MATDIR(9,JMAT).EQ.4 ) ICND(2,NRFX) = 3
      ICND(3,NRFX) = 0
      IF ( IWD.GT.0 ) ICND(3,NRFX) = WDFIBR(1,J,IWD)
      RCND(4,NRFX) = DTEMP(K,JMAT)
      RCND(5,NRFX) = DEPSR(L,K,JMAT)
      NXEPS(NRFX)  = NEPS
      CALL  GTEMOD (DTEMP(K,JMAT),MATDIR(1,1),PROP1(1),PROP2(1),MPTEMP
     1              , RCND(7,NRFX))
  400 CONTINUE
      JRFXX(2,NRFXX) = NRFX
  500 CONTINUE
  600 CONTINUE
  700 CONTINUE
      RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  GTSIG  (NAMMAT)
C
      INTEGER      NAMMAT(12)
      COMMON /MLBRF1/  KRFM1, KRFM2, KEXC, MRFM, NRFM, IRFM(10), KARG(4)
     1               ,  NRFC(8), IRFC(10,8), RRFC(2,10,8), KSYSU
      COMMON /MLBRF2/  MRFX, NRFX, ICND(8,20), RCND(8,20), NXEPS(20)
     1               ,  XEPS(50,20), XSIG(50,20), NRFXX, JRFXX(2,20)
      COMMON /MLBRF3/  ICNDP(8,20), RCNDP(8,20)
      COMMON /COMPL1/  ATITLE(18), XXNAME(10), YYNAME(10)
     1               ,  XDATA( 50,20), YDATA( 50,20)
      COMMON /COMPL2/  PXMIN, PXMAX, PYMIN, PYMAX, XL1, YL1, NPLOT
     1               ,  NDATA, NDATAX(20), NGRAPH
      COMMON /COMPL3/  AMAT1(20), ANAME(20), UNAME(3)
      CHARACTER*8      AMAT1     , ANAME     , UNAME
      CHARACTER*8      AMAT1X    , ANAMEX
      CHARACTER*8      CDATA
      CHARACTER*4      ATITLE, XXNAME, YYNAME
      CHARACTER*4      IDATA(2) , KSTRA(2)
      EQUIVALENCE    ( IDATA(1) , AMAT1X )
      EQUIVALENCE    ( KSTRA(1) , ANAMEX )
C
      DATA      KSTRA / 'STRA', 'IN =' /
C
C
C
      NRFEPS  = NRFC(5)
      IF ( NRFEPS.LT.1 )       GOTO 900
C
C
C
      DO 210 I= 1,NRFEPS
      EPS      = RRFC(1,I,5)
      WRITE(CDATA,'(F8.4)')   EPS
      READ (CDATA,'(2A4)')   (IDATA(J),J=1,2)
C
C
C
      DO 190 J= 1,NRFXX
      IF ( NPLOT.LT.20 )       GOTO 109
      WRITE(6,6108)     (NAMMAT(K),K=5,6), NAMMAT(9)
 6108 FORMAT( '  ****  OVERFLOW  ****  TOO MANY CURVES TO PLOT ( ',
     1          2A4,',',I5,' )' )
      GOTO 190
C
C
C
  109 NPLOT           = NPLOT+1
      AMAT1(NPLOT)   = AMAT1X
      ANAME(NPLOT)   = ANAMEX
      NDATAX(NPLOT) = 0
      XDATA(1,NPLOT)= 0.
      XDATA(2,NPLOT)= 1.
      YDATA(1,NPLOT)= 0.
C
C
C
      JEPSR1= JRFXX(1,J)
      JEPSR2= JRFXX(2,J)
C
C
```

Appendix F (Continued)

```
C
      IF ( JEPSR1.LE.JEPSR2 ) THEN
      NDATA = 0
C
C
C
      DO 170 K= JEPSR1,JEPSR2
      NEPS  = NXEPS(K)
      IF ( NEPS.LE.0 )         GOTO 170
      EPS2  = 0.
      SIG2  = 0.
C
C
C
      DO 110 L= 1,NEPS
      EPS1  = EPS2
      SIG1  = SIG2
      EPS2  = XEPS(L,K)
      SIG2  = XSIG(L,K)
      IF ( EPS1.LE.EPS .AND. EPS.LE.EPS2 ) GO TO 130
  110 CONTINUE
C
C
C
  130 NDATA                  = NDATA+1
      XDATA(NDATA,NPLOT)= RCND(5,K)
      YDATA(NDATA,NPLOT)= SIG2
      IF ( EPS1.NE.EPS2 )
     *YDATA(NDATA,NPLOT)= ((SIG2-SIG1)/(EPS2-EPS1))*(EPS-EPS1)+SIG1
  170 CONTINUE
C
C
C
      NDATAX(NPLOT) = NDATA
      IF ( NDATA.EQ.1 )                 THEN
      NDATAX(NPLOT) = 0
      XDATA(1,NPLOT)= 0.
                                        ENDIF
                                  ENDIF
      ICNDP(1,NPLOT)= NAMMAT(9)
      ICNDP(2,NPLOT)= ICND(2,JEPSR1)
      ICNDP(3,NPLOT)= ICND(3,JEPSR1)
      ICNDP(4,NPLOT) = 100*NAMMAT(11)+NAMMAT(12)
      ICNDP(5,NPLOT)= NAMMAT(5)
C
C
C
      ICNDP(6,NPLOT)= NAMMAT(6)
      ICNDP(7,NPLOT)= NAMMAT(7)
      ICNDP(8,NPLOT)= NAMMAT(8)
      RCNDP(4,NPLOT)= RCND(4,JEPSR1)
      RCNDP(6,NPLOT)= EPS
  190 CONTINUE
  210 CONTINUE
C
C
C
  900 RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  GTEMOD (TEMP,MATDIR,PROP1,PROP2,MPTEMP, EMOD)
C
      INTEGER       MATDIR(10,1)
      REAL          PROP1(4,1), PROP2(2,MPTEMP,4,1)
      COMMON /MLBIDX/  JMAT, IMAT, ICS, ISS, IPB, IWD, JWDFIB, JTEMP
     1              ,  JEPSR, JREFF
C
      EMOD  = PROP1(2,JMAT)
      NTMP  = MATDIR(6,JMAT)
      IF ( NTMP.LT.2 )        GOTO 300
C
      DO 200 I=2,NTMP
      IF ( TEMP.LT.PROP2(2,I-1,2,JMAT)
     *.OR. TEMP.GT.PROP2(2,I  ,2,JMAT) ) GOTO 200
      EMD1  = PROP2(1,I-1,2,JMAT)
      TMP1  = PROP2(2,I-1,2,JMAT)
      EMD2  = PROP2(1,I  ,2,JMAT)
      TMP2  = PROP2(2,I  ,2,JMAT)
      IF ( TMP1.EQ.TMP2 )     THEN
      EMOD  = EMD1
                              ELSE
      EMOD  = (EMD2-EMD1)/(TMP2-TMP1)*(TEMP-TMP1)+EMD1
                              ENDIF
      GOTO 300
  200 CONTINUE
  300 IF ( EMOD.LE.0. )
     *EMOD  = 1.E+50
      RETURN
      END



      SUBROUTINE  EXUNI
C
      COMMON /MLBRF1/  KRFM1, KRFM2, KEXC, MRFM, NRFM, IRFM(10), KARG(4)
     1              ,  NRFC(8), IRFC(10,8), RRFC(2,10,8), KSYSU
      COMMON /COMPL1/  ATITLE(18), XXNAME(10), YYNAME(10)
     1              ,  XDATA( 50,20), YDATA( 50,20)
      CHARACTER*4      ATITLE, XXNAME, YYNAME
      COMMON /COMPL2/  PXMIN, PXMAX, PYMIN, PYMAX, XL1, YL1, NPLOT
     1              ,  NDATA, NDATAX(20), NGRAPH
C
      IF ( KSYSU.NE.2 .OR. NPLOT.LE.0 ) GO TO 900
C
      DO 200 I=1,NPLOT
      NDAT  = IABS (NDATAX(I))
      IF ( NDAT.EQ.0 ) NDAT = 2
C
      CALL  EXUNI2 (KARG(1), XDATA(1,I) ,NDAT)
      CALL  EXUNI2 (KARG(2), YDATA(1,I) ,NDAT)
  200 CONTINUE
C
  900 RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  EXUNI2 (KDTYP, DATA ,NDATA)
C
      DIMENSION   DATA(1)
C
      IF ( KDTYP.LT.1
     *.OR. KDTYP.GT.10 )   GOTO 900
C
      GOTO ( 110,120,130,140,150,160,170,180,190,200 ), KDTYP
C
C*    COEF. OF THERMAL EXPANSION
  110  CONTINUE
      GOTO 900
C
C*    YOUNG'S MODULUS
  120 DO 125 I=1,NDATA
      DATA(I) = 0.101972*DATA(I)
  125 CONTINUE
      GOTO 900
C
C*    SHEAR MODULUS
  130 DO 135 I=1,NDATA
      DATA(I) = 0.101972*DATA(I)
  135 CONTINUE
      GOTO 900
C
C*    POISSON'S RATIO
  140  CONTINUE
      GOTO 900
C
C*    DEFORMATION TYPE
  150  CONTINUE
      GOTO 900
C
C*    FIBRE DIRECTION OF WOOD
  160  CONTINUE
      GOTO 900
C
C*    TEMPERATURE
  170 DO 175 I=1,NDATA
      DATA(I) = DATA(I)-273.
  175 CONTINUE
      GOTO 900
C
C*    STRAIN RATE
  180  CONTINUE
      GOTO 900
C
C*    STRAIN
  190  CONTINUE
      GOTO 900
C
C*    STRESS
  200 DO 205 I=1,NDATA
      DATA(I) = 0.101972*DATA(I)
  205 CONTINUE
C
  900 RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  EXOUT (KLST,KPLT,KFIT,IREFF)
C
      INTEGER      IREFF(1)
      COMMON /MLBFNO/  IFNC, IFNM, IFNP, IFNR
      COMMON /MLBRF1/  KRFM1, KRFM2, KEXC, MRFM, NRFM, IRFM(10), KARG(4)
     1             ,   NRFC(8), IRFC(10,8), RRFC(2,10,8), KSYSU
      COMMON /COMPL1/  ATITLE(18), XXNAME(10), YYNAME(10)
     1             ,   XDATA( 50,20), YDATA( 50,20)
      COMMON /COMPL2/  PXMIN, PXMAX, PYMIN, PYMAX, XL1, YL1, NPLOT
     1             ,   NDATA, NDATAX(20), NGRAPH
      COMMON /COMPL3/  AMAT1(20), ANAME(20), UNAME(3)
      CHARACTER*8      AMAT1    , ANAME    , UNAME
      CHARACTER*8      KBLNK
      CHARACTER*4      ATITLE, XXNAME, YYNAME
      CHARACTER*4      TITLES(6,11)
      CHARACTER*4      TITLEM(6,11)
C
C
C
      DATA   TITLES / 4HTHER, 4HMAL , 4HEXPA, 4HNSIO, 4HN (1, 4H/K)
     2              , 4H   E, 4H MOD, 4HULUS, 4H (MP, 4HA)  , 4H
     3              , 4H   G, 4H MOD, 4HULUS, 4H (MP, 4HA)  , 4H
     4              , 4HPOIS, 4HSON', 4HS RA, 4HTIO , 4H(-) , 4H
     5              , 4HDEFO, 4HRMAT, 4HION , 4HTYPE, 4H    , 4H
     6              , 4HFIBR, 4HE DI, 4HRECT, 4HION , 4HOF W, 4HOOD
     7              , 4HTEMP, 4HERAT, 4HURE , 4H(K) , 4H    , 4H
     8              , 4HSTRA, 4HIN R, 4HATE , 4H(1/S, 4H)   , 4H
     9              , 4H    , 4H STR, 4HAIN , 4H(-) , 4H    , 4H
     A              , 4H    , 4H STR, 4HESS , 4H(MPA, 4H)   , 4H
     B              , 4H    , 4H    , 4H    , 4H    , 4H    , 4H      /
      DATA   TITLEM / 4HTHER, 4HMAL , 4HEXPA, 4HNSIO, 4HN (1, 4H/C)
     2              , 4H   E, 4H MOD, 4HULUS, 4H (KG, 4HF/MM, 4H**2)
     3              , 4H   G, 4H MOD, 4HULUS, 4H (KG, 4HF/MM, 4H**2)
     4              , 4HPOIS, 4HSON', 4HS RA, 4HTIO , 4H(-) , 4H
     5              , 4HDEFO, 4HRMAT, 4HION , 4HTYPE, 4H    , 4H
     6              , 4HFIBR, 4HE DI, 4HRECT, 4HION , 4HOF W, 4HOOD
     7              , 4HTEMP, 4HERAT, 4HURE , 4H(C) , 4H    , 4H
     8              , 4HSTRA, 4HIN R, 4HATE , 4H(1/S, 4H)   , 4H
     9              , 4H    , 4H STR, 4HAIN , 4H(-) , 4H    , 4H
     A              , 4H    , 4H STR, 4HESS , 4H(KGF, 4H/MM*, 4H*2)
     B              , 4H    , 4H    , 4H    , 4H    , 4H    , 4H      /
      DATA   KBLNK  / 4H    /
C
C
C
      IF ( KFIT.NE.0 ) CALL EXFIT
C
C
C
      CALL  NEWPEN (2)
      IF ( KLST.NE.0 .OR. KPLT.NE.0 ) NGRAPH = NGRAPH + 1
      IF ( NGRAPH.EQ.1 )        THEN
C  (1)
      CALL  PLOTS  (0.,0.)
C  (2)
      CALL  PLOT   (0.,0.,-3)
                                ENDIF
      J        = KARG(1)
      IF ( J.LT.1 .OR. J.GT.10 ) J = 11
      IF ( KSYSU .EQ. 2 ) GOTO 200
```

Appendix F (Continued)

```
C
C     UNIT IS SI
C
      DO 120 I= 1,6
      XXNAME(I) = TITLES(I,J)
  120 CONTINUE
C
C
C
      J        = KARG(2)
      IF ( J.LT.1 .OR. J.GT.10 ) J = 11
      DO 140 I= 1,6
      YYNAME(I) = TITLES(I,J)
  140 CONTINUE
C
C
C
      DO 160 I= 1,3
      UNAME(I)= KBLNK
  160 CONTINUE
      GO TO 300
C
C     UNIT IS MKS
C
  200 CONTINUE
      DO 220 I= 1,6
      XXNAME(I) = TITLEM(I,J)
  220 CONTINUE
C
C
C
      J        = KARG(2)
      IF ( J.LT.1 .OR. J.GT.10 ) J = 11
      DO 240 I= 1,6
      YYNAME(I) = TITLEM(I,J)
  240 CONTINUE
C
C
C
      DO 260 I= 1,3
      UNAME(I)= KBLNK
  260 CONTINUE
  300 CONTINUE
C
C
C
      IF ( KLST.NE.0 )          THEN
      CALL  EXLSTP (IREFF(1))
                                ENDIF
      IF ( KPLT.NE.0 ) CALL EXGRA( IREFF(1) )
      CALL  NEWPEN (1)
      RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  EXFIT
C
      COMMON /MLBFT1/  KFIT, IEQFIT, NCOEF(16), COEF(6), COEFO(6,16)
     1              ,  NXY, NXYD(5), XYD(2,50,5), MXY, MXYD
      COMMON /MLBRF3/  ICNDP(8,20), RCNDP(8,20)
      COMMON /COMPL1/  ATITLE(18), XXNAME(10), YYNAME(10)
     1              ,  XDATA( 50,20), YDATA( 50,20)
      CHARACTER*4      ATITLE, XXNAME, YYNAME
      COMMON /COMPL2/  PXMIN, PXMAX, PYMIN, PYMAX, XL1, YL1, NPLOT
     1              ,  NDATA, NDATAX(20), NGRAPH
      COMMON /COMPL3/  AMAT1(20), ANAME(20), UNAME(3)
      CHARACTER*8      AMAT1    , ANAME    , UNAME
      CHARACTER*8      AMAT1X   , ANAMEX
      INTEGER          IFITXY(16)
      CHARACTER*4     IDATA(4)
      EQUIVALENCE  ( IDATA(1),AMAT1X ), (IDATA(3),ANAMEX )
C
      DATA   IFITXY / 2,1,1,2,2,1,1,2,2,2,2,2,1,2,2,2 /
      DATA   IDATA  / 'PRE.', 'DATA', 'FITT', 'ING '  /
C
      IF ( KFIT.NE.1 )          GOTO 200
      CALL  EXFIT1
      GOTO 900
  200 IF ( NPLOT.LE.0 )         GOTO 900
      IF ( NPLOT.LE.20)         GOTO 210
      WRITE(6,6208)
 6208 FORMAT( '  ****  OVERFLOW  ****  TOO MANY CURVES TO PLOT ' )
      NPLOT = 20
  210 NPLT  = NPLOT
      NPLOT = NPLOT+NPLOT
      JPLT1 = NPLT
      JPLT2 = NPLOT
      DO 500 I= 1,NPLT
      ANAME(JPLT2)    = ANAMEX
      AMAT1(JPLT2)    = AMAT1X
      NDATA           = NDATAX(JPLT1)
      IF ( NDATA.EQ.0 )         THEN
      NDATAX(JPLT2)   = 0
      DO 220 J= 1,2
      XDATA(J,JPLT2) = XDATA(J,JPLT1)
      YDATA(J,JPLT2) = YDATA(J,JPLT1)
  220 CONTINUE
      DO 230 J= 1,8
      ICNDP(J,JPLT2) = ICNDP(J,JPLT1)
      RCNDP(J,JPLT2) = RCNDP(J,JPLT1)
  230 CONTINUE
                                ELSE
      IF ( KFIT.EQ.2 )                 THEN
      IF ( COEF(1).EQ.0. .AND. COEF(2).EQ.0. )  THEN
      CALL  EXFIT2 (XDATA(1,JPLT1),YDATA(1,JPLT1),NDATA, A, B)
                                            ELSE
      A               = COEF(1)
      B               = COEF(2)
                                            ENDIF
      NDATAX(JPLT2)   = -2
      XDATA(1,JPLT2) = PXMIN
      XDATA(2,JPLT2) = PXMAX
      XDATA(9,JPLT2) = -9999.
      XDATA(8,JPLT2) = A
      XDATA(7,JPLT2) = B
```

Appendix F (Continued)

```
      DO 240 J= 1,2
      YDATA(J,JPLT2) = B*XDATA(J,JPLT2)+A
  240 CONTINUE
      WRITE(6,6250)
 6250 FORMAT( / 12X,'X',15X,'Y',9X,'FITTING',5X,'PERCENT' / )
      DO 270 J=1,NDATA
      FIT    = A*XDATA(J,JPLT1)+B
      IF ( ABS (FIT) .LE.1.0E-50 )   THEN
      ERR    = YDATA(J,JPLT1)
                                     ELSE
      ERR    = (YDATA(J,JPLT1)-FIT)/FIT*100.
                                     ENDIF
      WRITE(6,6260)  XDATA(J,JPLT1), YDATA(J,JPLT1), FIT, ERR
 6260 FORMAT( 1X,1P2E16.3,E13.3,0PF10.1 )
  270 CONTINUE
                                   ENDIF
      IF ( KFIT.EQ.3 )             THEN
      CALL  EXFIT3 (XDATA(1,JPLT1),YDATA(1,JPLT1),NDATAX(JPLT1)
     1             ,RCNDP(1,JPLT1), XDATA(1,JPLT2), YDATA(1,JPLT2)
     2             , NDATAX(JPLT2))
      WRITE(6,6250)
      DO 275 J=1,NDATA
      IF ( IFITXY(IEQFIT).EQ.1 )    THEN
      FIT    = XDATA(J,JPLT2)
      IF ( ABS (FIT) .LE.1.0E-50 )   THEN
      ERR    = XDATA(J,JPLT1)
                                     ELSE
      ERR    = (XDATA(J,JPLT1)-FIT)/FIT*100.
                                     ENDIF
                                    ELSE
      FIT    = YDATA(J,JPLT2)
      IF ( ABS (FIT) .LE.1.0E-50 )   THEN
      ERR    = YDATA(J,JPLT1)
                                     ELSE
      ERR    = (YDATA(J,JPLT1)-FIT)/FIT*100.
                                     ENDIF
                                    ENDIF
      WRITE(6,6260)  XDATA(J,JPLT1), YDATA(J,JPLT1), FIT, ERR
  275 CONTINUE
                                   ENDIF
                              ENDIF
      JPLT2           = JPLT2-1
      ANAME(JPLT2)    = ANAME(JPLT1)
      AMAT1(JPLT2)    = AMAT1(JPLT1)
      NDATAX(JPLT2)   = NDATAX(JPLT1)
      NDATA           = NDATAX(JPLT1)
      IF ( NDATA.EQ.0 ) NDATQA = -2
      DO 280 J= 1,NDATA
      XDATA(J,JPLT2) = XDATA(J,JPLT1)
      YDATA(J,JPLT2) = YDATA(J,JPLT1)
  280 CONTINUE
      DO 290 J= 1,8
      ICNDP(J,JPLT2) = ICNDP(J,JPLT1)
      RCNDP(J,JPLT2) = RCNDP(J,JPLT1)
  290 CONTINUE
      JPLT2           = JPLT2-1
      JPLT1           = JPLT1-1
  500 CONTINUE
  900 RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  EXFIT1
C
      COMMON /MLBFT1/  KFIT, IEQFIT, NCOEF(16), COEF(6), COEFO(6,16)
     1               ,  NXY, NXYD(5), XYD(2,50,5), MXY, MXYD
      COMMON /COMPL1/  ATITLE(18), XXNAME(10), YYNAME(10)
     1               ,  XDATA( 50,20), YDATA( 50,20)
      CHARACTER*4      ATITLE, XXNAME, YYNAME
      COMMON /COMPL2/  PXMIN, PXMAX, PYMIN, PYMAX, XL1, YL1, NPLOT
     1               ,  NDATA, NDATAX(20), NGRAPH
C
C
C
      IF ( NXY.LE.0 )    GOTO 900
      DO 140 I=1,NXY
      NDATA   = NXYD(I)
      IF ( NDATA.LE.0 )  GOTO 140
      NPLOT         = NPLOT+1
      NDATAX(NPLOT)=-NDATA
C
C
C
      DO 120 J=1,NDATA
      XDATA(J,NPLOT)= XYD(1,J,I)
      YDATA(J,NPLOT)= XYD(2,J,I)
  120 CONTINUE
  140 CONTINUE
C
C
C
  900 RETURN
      END


      SUBROUTINE  EXMINX (DATA,MD1,NPLOT,NDATAX, DMIN, DMAX)
C
      DIMENSION   DATA(MD1,1), NDATAX(1)
      DATA   DMINO, DMAXO  / 1.E70, -1.E70 /
C
      DMIN  = 0.
      DMAX  = 0.
      IF ( NPLOT.LE.0 )       GOTO 900
      DMIN  = DMINO
      DMAX  = DMAXO
C
      DO 200 I= 1,NPLOT
      NDATA = IABS (NDATAX(I))
      IF ( NDATA.EQ.0 ) NDATA = 2
      DO 100 J= 1,NDATA
      DMIN  = AMIN1 (DMIN,DATA(J,I))
      DMAX  = AMAX1 (DMAX,DATA(J,I))
  100 CONTINUE
  200 CONTINUE
C
  900 RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  EXFIT2 (XDATA,YDATA,NDATA, A, B)
      DIMENSION  XDATA(1), YDATA(1)
      DIMENSION  AA(2), BB(2), SE(2)
      EQUIVALENCE ( AA(1),A1 ), ( BB(1),B1 ), ( SE(1),SE1 )
      EQUIVALENCE ( AA(2),A2 ), ( BB(2),B2 ), ( SE(2),SE2 )
      DATA   EPS  / 1.E-10 /
      SE(1) = -1.
      SE(2) = -1.
      A2     = 0.
      B2     = 0.
      IF ( NDATA.LE.1 )        GOTO  80
      XM     = XDATA(1)
      YM     = YDATA(1)
      DO  20 I= 2,NDATA
      XM     = XDATA(I)+XM
      YM     = YDATA(I)+YM
   20 CONTINUE
      XM     = XM/NDATA
      YM     = YM/NDATA
      SX     = 0.
      SY     = 0.
      SXY    = 0.
      DO  40 I= 1,NDATA
      RX     = XDATA(I)-XM
      RY     = YDATA(I)-YM
      SX     = RX*RX+SX
      SY     = RY*RY+SY
      SXY    = RX*RY+SXY
   40 CONTINUE
C
C
C
      IF ( SX.LT.EPS )         GOTO  60
      B1     = SXY/SX
      A1     = YM-B1*XM
      SE1    = SY-B1*SXY
   60 IF ( SY.LT.EPS )         GOTO  80
      B2     = SXY/SY
      A2     = XM-B2*YM
      SE2    = SX-B2*SXY
      C      = ABS (B2)
      IF ( C.LT.EPS )          GOTO  80
      C      = B2
      B2     = 1.0/C
      A2     = -A2/C
      GOTO 100
C
C
C
   80 A      = 0.
      B      = 0.
  100 I      = 1
      IF ( SE(1).GT.SE(2) ) I = 2
      IF ( SE(I).LT.0. )    I = I + 1
      IF ( I.GT.2 )         I = 1
      B      = BB(I)
      A      = AA(I)
      RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  EXFIT3 (XDATA1,YDATA1,NDATA1,RCND1, XDATA, YDATA
     1                   , NDATAX)
C
      DIMENSION   XDATA1(1), YDATA1(1), RCND1(8), XDATA(1), YDATA(1)
      COMMON /MLBFT1/  KFIT, IEQFIT, NCOEF(16), COEF(6), COEFO(6,16)
     1              ,  NXY, NXYD(5), XYD(2,50,5), MXY, MXYD
      COMMON /MLBFT2/  NEQCF(16), IEQCF(6,16)
      CHARACTER*4      IEQCF
      COMMON /MLBRF1/  KRFM1, KRFM2, KEXC, MRFM, NRFM, IRFM(10), KARG(4)
     1              ,  NRFC(8), IRFC(10,8), RRFC(2,10,8), KSYSU
C
      DATA  EE      / 2.71828 /
      DATA  NXX     / 50      /
      DATA  TOLLE   / 1.0E-10 /
C
C
      CALL  EXMINX (XDATA1(1),NDATA1,1,NDATA1, XMN1, XMX1)
      DX       = XMX1-XMN1
      IF ( DX.GT.TOLLE )       GOTO 120
      NDATAX  = 0
      XDATA(1)= XDATA1(1)
      XDATA(2)= XDATA1(1)
      YDATA(1)= YDATA1(1)
      YDATA(2)= YDATA1(1)
      GOTO 900
  120 DX       = DX/NXX
      XMN      = XMN1-DX
C
C
      IF ( IEQFIT .LT. 1 .OR. IEQFIT.GT.15 ) GO TO 700
      IF ( KARG(2).NE.10 )  GOTO 800
      IF ( KARG(1).EQ. 9 .AND. ( IEQFIT.LE.13 .OR. IEQFIT.EQ.15 ) )
     1   GO TO 200
      IF ( KARG(1).EQ. 8 .AND. IEQFIT.GE.11 ) GO TO 200
C
C
  200 GOTO ( 210,220,230,240,250,260,270,280,290,300
     1      , 310,320,330,340,350 ), IEQFIT
C
C
  210 N        = COEF(1)+0.01
      XK       = COEF(2)
      NDATAX   = -NDATA1
      NDATA    =  NDATA1
      DO 212 I=1,NDATA
      XDATA(I)= XDATA1(I)
      YDATA(I)= (XDATA(I)**N)*XK
  212 CONTINUE
      GOTO 900
C
C
  220 DVN      = 1./COEF(1)
      XK       = COEF(2)
      C        = COEF(3)
      E        = COEF(4)
      IF ( E.LE.0. ) E = RCND1(7)
      NDATAX   = -NDATA1
      NDATA    =  NDATA1
      DO 222 I=1,NDATA
      XDATA(I)= YDATA1(I)/E-C+(YDATA1(I)/XK)**DVN
```

Appendix F (Continued)

```
      YDATA(I)= YDATA1(I)
  222 CONTINUE
      GOTO 900
C
C
  230 DVN      = 1./COEF(1)
      XK       = COEF(2)
      SIGO     = COEF(3)
      E        = COEF(4)
      IF ( E.LE.0. ) E = RCND1(7)
      NDATAX   = -NDATA1
      NDATA    =  NDATA1
      DO 232 I=1,NDATA
      XDATA(I)= YDATA1(I)/E+((YDATA1(I)-SIGO)/XK)**DVN
      YDATA(I)= YDATA1(I)
  232 CONTINUE
      GOTO 900
C
C
  240 N        = COEF(1)+0.01
      XK       = COEF(2)
      SIGC     = COEF(3)
      E        = COEF(4)
      IF ( E.LE.0. ) E = RCND1(7)
      EPSC     = SIGC/E
      NDATAX   = -NDATA1
      NDATA    =  NDATA1
      DO 242 I=1,NDATA
      XDATA(I)= XDATA1(I)
      YDATA(I)= ((XDATA1(I)-EPSC)**N)*XK+SIGC
  242 CONTINUE
      GOTO 900
C
C
  250 L        = COEF(1)+0.01
      M        = COEF(2)+0.01
      N        = COEF(3)+0.01
      EL       = EE**L
      EM       = EE**M
      NDATAX   = -NDATA1
      NDATA    =  NDATA1
      DO 252 I=1,NDATA
      EPSP     = XDATA1(I)
      XDATA(I)= EPSP
      YDATA(I)= COEF(4)*EPSP**N+EL*EM**EPSP
  252 CONTINUE
      GOTO 900
C
C
  260 DVN      = 1./COEF(1)
      A        = COEF(2)
      SIGO     = COEF(3)
      E        = COEF(4)
      IF ( E.LE.0. ) E = RCND1(7)
      NDATAX   = -NDATA1
      NDATA    =  NDATA1
      DO 262 I=1,NDATA
      XX1      = 1.-(YDATA1(I)-SIGO)/A
      IF ( XX1.LE.0. ) XX1 = 1.
      XDATA(I)= YDATA1(I)/E-DVN*ALOG(XX1)
```

Appendix F (Continued)

```
      YDATA(I)= YDATA1(I)
  262 CONTINUE
      GOTO 900
C
C
  270 DVM      = 1./COEF(1)
      XM       = COEF(1)
      SIGC     = COEF(2)
      SIGI     = COEF(3)
      E        = COEF(4)
      IF ( E.LE.O. ) E = RCND1(7)
      XX1      = XM*SIGI
      XX2      = 1./(SIGC-SIGI)
      NDATAX   = -NDATA1
      NDATA    =  NDATA1
      DO 272 I=1,NDATA
      XX3      = YDATA1(I)*XX2
      IF ( XX3.LE.O. ) XX3 = 1.
      XDATA(I)= YDATA1(I)/E+XX1-XM*ALOG(XX3)
      YDATA(I)= YDATA1(I)
  272 CONTINUE
      GOTO 900
C
C
  280 N        = COEF(1)+0.01
      N        = -N
      A        = COEF(2)
      B        = COEF(3)
      NDATAX   = -NDATA1
      NDATA    =  NDATA1
      DO 282 I=1,NDATA
      XDATA(I)= XDATA1(I)
      YDATA(I)= A-B*XDATA1(I)**N
  282 CONTINUE
      GOTO 900
C
C
  290 C        = COEF(1)
      H        = COEF(2)
      P        = COEF(3)
      SIGO     = COEF(4)
      CP       = C*P
      NDATAX   = -NDATA1
      NDATA    =  NDATA1
      DO 292 I=1,NDATA
      EPSP     = XDATA1(I)
      XDATA(I)= EPSP
      YDATA(I)= SIGO+CP*EPSP/(1.+P*EPSP)+H*EPSP
  292 CONTINUE
      GOTO 900
C
C
  300 N        = COEF(1)+0.01
      N2       = N+2
      NDATAX   = -NDATA1
      NDATA    =  NDATA1
      DO 304 I=1,NDATA
      XDATA(I)= XDATA1(I)
      YDATA(I)= COEF(2)
      DO 302 J=3,N2
```

Appendix F (Continued)

```
      YDATA(I)= YDATA(I)+ COEF(J)*(XDATA(I)**(J-2))
  302 CONTINUE
  304 CONTINUE
      GOTO 900
C
C
  310 N        = COEF(1)+0.01
      A        = COEF(2)
      B        = COEF(3)
      NDATAX   = -NDATA1
      NDATA    =  NDATA1
      IF ( KARG(1).EQ.8 )    THEN
      EPSN     = RCND1(6)**N
      DO 312 I=1,NDATA
      XDATA(I)= XDATA1(I)
      YDATA(I)= A*(1.+B*ALOG(XDATA1(I)))*EPSN
  312 CONTINUE
                             ELSE
      EPSR     = RCND1(5)
      XX1      = A*(1.+B*ALOG(EPSR))
      DO 314 I=1,NDATA
      XDATA(I)= XDATA1(I)
      YDATA(I)= XX1*(XDATA1(I)**N)
  314 CONTINUE
                             ENDIF
      GOTO 900
C
C
  320 M        = COEF(1)+0.01
      N        = COEF(2)+0.01
      XK       = COEF(3)
      C        = COEF(4)
      NDATAX   = -NDATA1
      NDATA    =  NDATA1
      IF ( KARG(1).EQ.8 )    THEN
      EPSN     = RCND1(6)**N
      DO 322 I=1,NDATA
      XDATA(I)= XDATA1(I)
      YDATA(I)= XK*(1.+C*(XDATA1(I)**M))*EPSN
  322 CONTINUE
                             ELSE
      EPSR     = RCND1(5)
      XX1      = XK*(1.+C*(EPSR**M))
      DO 324 I=1,NDATA
      XDATA(I)= XDATA1(I)
      YDATA(I)= XX1*(XDATA1(I)**N)
  324 CONTINUE
                             ENDIF
      GOTO 900
C
C
  330 DVM      = 1./COEF(1)
      M        = COEF(1)+0.01
      C        = COEF(2)
      H        = COEF(3)
      SIGY     = COEF(4)
      E        = COEF(5)
      IF ( E.LE.O. ) E = RCND1(7)
      HSIGY    = H*SIGY
      NDATAX   = -NDATA1
```

Appendix F (Continued)

```
      NDATA    =  NDATA1
      IF ( KARG(1).EQ.8 )   THEN
      EPS      = RCND1(6)
      XX1      = SIGY*(1.+HSIGY*EPSP)
      DO 332 I=1,NDATA
      EPSP     = EPS-YDATA1(I)/E
      XDATA(I)= C*(YDATA1(I)/(H*EPSP+SIGY)-1.)**M
      YDATA(I)= YDATA1(I)
  332 CONTINUE
                             ELSE
      EPSR     = RCND1(5)
      XX1      = SIGY/H
      XX2      = 1./(SIGY*(1.+(EPSR/C)**DVM))
      DO 334 I=1,NDATA
      XDATA(I)= YDATA1(I)/E+XX1*(YDATA1(I)*XX2-1.)
      YDATA(I)= YDATA1(I)
  334 CONTINUE
                             ENDIF
      GOTO 900
C
C
  340 XK       = COEF(1)
      C        = COEF(2)
      NDATAX   = -NDATA1
      NDATA    =  NDATA1
      DO 342 I=1,NDATA
      XDATA(I)= XDATA1(I)
      YDATA(I)= XK+C*ALOG(XDATA1(I))
  342 CONTINUE
      GOTO 900
C
C
  350 M        = COEF(1)+0.01
      N        = COEF(2)+0.01
      XK       = COEF(3)
      NDATAX   = -NDATA1
      NDATA    =  NDATA1
      IF ( KARG(1).EQ.8 )   THEN
      EPSN     = RCND1(6)
      XX1      = XK*(EPSN**N)
      DO 352 I=1,NDATA
      XDATA(I)= XDATA1(I)
      YDATA(I)= XX1*(XDATA1(I)**M)
  352 CONTINUE
                             ELSE
      EPSR     = RCND1(5)
      XX1      = XK*(EPSR**M)
      DO 354 I=1,NDATA
      XDATA(I)= XDATA1(I)
      YDATA(I)= XX1*(XDATA1(I)**N)
  354 CONTINUE
                             ENDIF
      GOTO 900
  700 WRITE(6,6710)   IEQFIT
 6710 FORMAT( 15HO* EQUATION NO.,I3,19H IS NOT AVAILABLE * )
      GOTO 900
  800 WRITE(6,6810)
 6810 FORMAT( 30HO* UNMATCH DATA AND EQUATION * )
  900 RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  EXLSTP (IREFF)
C
      INTEGER      IREFF(2,1)
      COMMON /MLBIDX/  JMAT, IMAT, ICS, ISS, IPB, IWD, JWDFIB, JTEMP
     1              ,  JEPSR, JREFF
      COMMON /MLBRF1/  KRFM1, KRFM2, KEXC, MRFM, NRFM, IRFM(10), KARG(4)
     1              ,  NRFC(8), IRFC(10,8), RRFC(2,10,8), KSYSU
      COMMON /MLBRF3/  ICNDP(8,20), RCNDP(8,20)
      COMMON /COMPL1/  ATITLE(18), XXNAME(10), YYNAME(10)
     1              ,  XDATA( 50,20), YDATA( 50,20)
      COMMON /COMPL2/  PXMIN, PXMAX, PYMIN, PYMAX, XL1, YL1, NPLOT
     1              ,  NDATA, NDATAX(20), NGRAPH
      CHARACTER ICHAR*120
      CHARACTER ICHA(3)*4
      CHARACTER KDFTYP(3,3)*4
      CHARACTER IXVSY(6,10,2)*4
      CHARACTER*72      CTITL1
      CHARACTER*4       ATITLE, XXNAME, YYNAME
      CHARACTER*1       CTITL2(72), CBLNK
      DATA   CBLNK / ' ' /
C
      DATA       KDFTYP / 4HCOMP,4HRESS,4HION
     1                  , 4HTENS,4HION ,4H
     2                  , 4H    ,4H    ,4H        /
      DATA       IXVSY  / 4H THE,4HRMAL,4H EXP,4HANSI,4HON (,4H1/K)
     1                  , 4HYOUN,4HG'S ,4HMODU,4HLUS ,4H(MPA,4H)
     2                  , 4H SHE,4HAR M,4HODUL,4HUS (,4HMPA),4H
     3                  , 4H POI,4HSSON,4H'S R,4HATIO,4H (-),4H
     4                  ,      12*4H
     5                  , 4H   T,4HEMPE,4HRATU,4HRE (,4HK)   ,4H
     6                  , 4H  ST,4HRAIN,4H RAT,4HE (1,4H/S) ,4H
     7                  , 4H    ,4H STR,4HAIN ,4H(-) ,4H     ,4H
     8                  , 4H    ,4HSTRE,4HSS (,4HMPA),4H     ,4H
     9                  , 4H THE,4HRMAL,4H EXP,4HANSI,4HON (,4H1/C)
     A                  , 4H   E,4H MOD,4HULUS,4H (KG,4HF/MM,4H**2)
     B                  , 4H   G,4H MOD,4HULUS,4H (KG,4HF/MM,4H**2)
     C                  , 4H POI,4HSSON,4H'S R,4HATIO,4H (-),4H
     D                  ,      12*4H
     E                  , 4H   T,4HEMPE,4HRATU,4HRE (,4HC)   ,4H
     F                  , 4H  ST,4HRAIN,4H RAT,4HE (1,4H/S) ,4H
     G                  , 4H    ,4H STR,4HAIN ,4H(-) ,4H     ,4H
     H                  , 4H  ST,4HRESS,4H (KG,4HF/MM,4H**2),4H      /
C
C*  PLOT MATERIAL DATA  *
C
C*  TITLE  *
      CALL  PLOT   (0.,0.,666)
      CALL  NEWPEN (1)
      WRITE(CTITL1,'(18A4)')  (ATITLE(I),I=1,18)
      READ (CTITL1,'(72A1)')  (CTITL2(I),I=1,72)
      DO 500 I=1,NPLOT
      CALL  SYMBOL (  5.0,190.,3.,'TABLE    -   ',0.,13)
      JK     = 73
      DO 100 IK=2,72
      JK      = JK-1
      IF ( CTITL2(JK).EQ.CBLNK) GOTO 100
      CALL  SYMBOL (50.,190.,3.,CTITL2(1),0.,JK)
      GOTO 110
  100 CONTINUE
  110 CONTINUE
```

Appendix F (Continued)

```
      XX     = 0.0
      YY     = 180.0
C
      X      = XX+5.0
      Y      = YY-4.0
      CALL  SYMBOL (X     ,Y,3.0,'MATERIAL',0.0,8)
      CALL  SYMBOL (X+39.0,Y,3.0,'(CURVE NO.',0.0,10)
      X      = X+69.0
      RI     = I
      CALL  NUMBER (X,Y,3.0,RI,0.0,-1)
      IF ( I.GE.10 ) X = X + 3.0
      CALL  SYMBOL (X+3.0,Y,3.0,')',0.0,1)
      YY     = Y
C
      NDATA = IABS (NDATAX(I))
      IF ( XDATA(9,I).EQ.-9999.0 .AND. NDATA.EQ.2 ) THEN
      X      = XX+14.0
      Y      = YY- 7.0
      CALL  SYMBOL (X,Y,3.0,'FITTING BY LINEAR REGRESSION',0.0,28)
      Y      = Y-5.0
      CALL  SYMBOL (X,Y,3.0,'   Y = A * X + B  ',0.0,18)
      Y      = Y-5.0
      CALL  SYMBOL (X,Y,3.0,'   A = ',0.0,7)
      WRITE(ICHAR,'(1PE10.3)')  XDATA(7,I)
      READ (ICHAR,'(3A4)'    )  (ICHA(J),J=1,3)
      CALL  SYMBOL (X+21.0,Y,3.0,ICHA(1),0.0,10)
      Y      = Y-5.0
      CALL  SYMBOL (X,Y,3.0,'   B = ',0.0,7)
      WRITE(ICHAR,'(1PE10.3)')  XDATA(8,I)
      READ (ICHAR,'(3A4)'    )  (ICHA(J),J=1,3)
      CALL  SYMBOL (X+21.0,Y,3.0,ICHA(1),0.0,10)
      YY     = Y
                          ELSE
C
      IF ( NDATAX(I).GT.0 ) THEN
      X      = XX+14.0
      Y      = YY- 7.0
      CALL  SYMBOL (X,Y,3.0,'NAME:',0.0,5)
      X1     = X+18.0
      CALL  SYMBOL (X1,Y,3.0,ICNDP(5,I),0.0,16)
C
      JRF    = ICNDP(4,I)/100
      NRF    = ICNDP(4,I)-100*JRF
      IF ( NRF.LE.0 )        GOTO 160
      X2     = X+74.0
      CALL  SYMBOL (X2,Y,3.0,'REFERENCES:',0.0,11)
      X2     = X+110.0
      DO 155 J=1,NRF
      CALL  SYMBOL (X2,Y,3.0,IREFF(1,JRF),0.0,8)
      X2     = X2+27.0
      JRF    = JRF+1
  155 CONTINUE
C
C
  160 Y      = Y-5.0
      CALL  SYMBOL (X,Y,3.0,'NO.',0.0,3)
      RI     = ICNDP(1,I)
      CALL  NUMBER (X+18.0,Y,3.0,RI,0.0,-1)
      YY     = Y
C
```

Appendix F (Continued)

```
C
      X      = XX+10.0
      Y      = YY- 4.0
      IF ( KARG(3).EQ.5 .OR. KARG(3).EQ.6 ) THEN
      X1     = X+4.0
      Y1     = Y-5.0
      K      = ICNDP(2,I)
      CALL  SYMBOL (X1,Y1,3.0,'DEFORMATION TYPE',0.0,16)
      X2     = X+61.0
      CALL  SYMBOL (X2,Y1,3.0,KDFTYP(1,K),0.0,12)
      X2     = X+61.0
      CALL  PLOT   (X+98.0,Y1-2.0,3)
      CALL  PLOT   (X     ,Y1-2.0,2)
C
C
      IF ( IWD.GT.0 )                THEN
      Y1     = Y1-7.0
      CALL  SYMBOL (X1,Y1,3.0,'FIBRE DIRECTION',0.0,15)
      CALL  SYMBOL (X2,Y1,3.0,ICNDP(3,I),0.0,4)
      CALL  PLOT   (X+98.0,Y1-2.0,3)
      CALL  PLOT   (X     ,Y1-2.0,2)
                                     ENDIF
C
C
      Y1     = Y1-7.0
      CALL  SYMBOL (X1    ,Y1,3.0,'TEMPERATURE (K)',0.0,15)
      CALL  NUMBER (X2+3.0,Y1,3.0,RCNDP(4,I),0.0,2)
      CALL  PLOT   (X+98.0,Y1-2.0,3)
      CALL  PLOT   (X     ,Y1-2.0,2)
C
C
      Y1     = Y1-7.0
      IF ( KARG(3).EQ.5 )            THEN
      WRITE(ICHAR,'(1PE10.3)')       RCNDP(5,I)
      CALL  SYMBOL (X1,Y1,3.0,'STRAIN RATE (1/S)',0.0,17)
                                     ELSE
      WRITE(ICHAR,'(1PE10.3)')       RCNDP(6,I)
      CALL  SYMBOL (X1,Y1,3.0,'STRAIN (-)',0.0,10)
                                     ENDIF
      READ (ICHAR,'(3A4)'    )       (ICHA(J),J=1,3)
      CALL  SYMBOL (X2,Y1,3.0,ICHA(1),0.0,10)
C
C
      YY     = Y1-2.0
      X1     = X+98.0
      X2     = X+57.0
C
C
      CALL  PLOT   (X ,YY,3)
      CALL  PLOT   (X1,YY,2)
      CALL  PLOT   (X1,Y ,2)
      CALL  PLOT   (X ,Y ,2)
      CALL  PLOT   (X ,YY,2)
      CALL  PLOT   (X2,YY,3)
      CALL  PLOT   (X2,Y ,2)
                              ENDIF
                            ENDIF
                         ENDIF
C
C
```

Appendix F (Continued)

```
      Y      = YY- 4.0
      X      = XX+10.0
      XX3    = X - 4.0
      DO 350 J=1,NDATA,30
      JJ     = J+29
      IF ( JJ.GT.NDATA ) JJ = NDATA
      XX1    = XX3+ 4.0
      XX2    = XX1+57.0
      XX3    = XX2+57.0
      XT     = XX1+ 2.0
      YT     = Y  - 4.25
C
C
      DO 230 K=1,2
      KVS    = KARG(K)
      CSZ    = 2.5
      IF ( KVS.EQ.1 ) CSZ = 2.2
      CALL  SYMBOL (XT,YT,CSZ,IXVSY(1,KVS,KSYSU),0.0,24)
      XT     = XT+57.0
  230 CONTINUE
C
C
      Y2     = Y  - 6.0
      Y1     = Y2 - 0.5
      X1     = XX1+17.5
      X2     = XX2+17.5
C
C
      DO 310 K=J,JJ
      Y1     = Y1-4.0
      WRITE(ICHAR,'(1PE10.3)')   XDATA(K,I)
      READ (ICHAR,'(3A4)'     )   (ICHA(L),L=1,3)
      CALL  SYMBOL (X1,Y1,2.5,ICHA(1),0.0,10)
      WRITE(ICHAR,'(1PE10.3)')   YDATA(K,I)
      READ (ICHAR,'(3A4)'     )   (ICHA(L),L=1,3)
      CALL  SYMBOL (X2,Y1,2.5,ICHA(1),0.0,10)
  310 CONTINUE
C
C
      Y1     = Y1-2.0
      CALL  PLOT   (XX1,Y1,3)
      CALL  PLOT   (XX3,Y1,2)
      CALL  PLOT   (XX3,Y ,2)
      CALL  PLOT   (XX1,Y ,2)
      CALL  PLOT   (XX1,Y1,2)
      CALL  PLOT   (XX2,Y1,3)
      CALL  PLOT   (XX2,Y ,2)
      CALL  PLOT   (XX1,Y2,3)
      CALL  PLOT   (XX3,Y2,2)
  350 CONTINUE
C
      CALL  PLOT   (300.,0.,-3)
C   (3)
      CALL  PLOT   (0.,0.,777)
      CALL  PLOT   (0.,0.,666)
      CALL  PLOT   (0.,0.,888)
  500 CONTINUE
C
      RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  EXGRA(IREFF)
C
      INTEGER     IREFF(2,1)
C
      COMMON /MLBRF3/  ICNDP(8,20), RCNDP(8,20)
      COMMON /MLBRF1/  KRFM1, KRFM2, KEXC, MRFM, NRFM, IRFM(10), KARG(4)
     1              ,  NRFC(8), IRFC(10,8), RRFC(2,10,8), KSYSU
      COMMON /COMPL1/  ATITLE(18), XXNAME(10), YYNAME(10)
     1              ,  XDATA( 50,20), YDATA( 50,20)
      COMMON /COMPL2/  PXMIN, PXMAX, PYMIN, PYMAX, XL1, YL1, NPLOT
     1              ,  NDATA, NDATAX(20), NGRAPH
C
      CHARACTER*72     CTITL1
      CHARACTER*4      ATITLE, XXNAME, YYNAME
      CHARACTER*1      CTITL2(72), CBLNK
C
      DATA   CBLNK      / ' ' /
      DATA   XBOX, YBOX      / 300., 210. /
C
C
C
      IF ( NPLOT.LE.0 )       GOTO 900
C
C*  BOX  *
C
      CALL  NEWPEN (1)
      XBOXX = XBOX-20.
      XBST  = -20.
C
C
C
      CALL  PLOT   (0.,0.,666)
      CALL  PLOT   (XBST,-5.0,3)
      CALL  PLOT   (XBOXX,-5.0,2)
      CALL  PLOT   (XBOXX,YBOX,2)
      CALL  PLOT   (XBST ,YBOX,2)
      CALL  PLOT   (XBST ,-5.0,2)
      CALL  PLOT   (0.,0.,3)
      CALL  NEWPEN (1)
C
C*  TITLE  *
C
      CALL  SYMBOL ( 10.0,8.,3.,'FIG.   .   ',0.,11)
      WRITE(CTITL1,'(18A4)')  (ATITLE(I),I=1,18)
      READ (CTITL1,'(72A1)')  (CTITL2(I),I=1,72)
C
C
C
      J      = 73
      DO 220 I=2,72
      J      = J-1
      IF ( CTITL2(J).EQ.CBLNK) GOTO 220
      CALL  SYMBOL (50.,8.,3.,CTITL2(1),0.,J)
      GOTO 300
  220 CONTINUE
C
C
C
  300 CONTINUE
      X      = 50.0
```

Appendix F (Continued)

```
      Y      = 0.0
      I      = 1
      CALL  SYMBOL (X,Y,3.0,'MATERIAL NAME:',0.0,14)
      X1     = X+45.0
      CALL  SYMBOL (X1,Y,3.0,ICNDP(5,I),0.0,16)
C
C
C
      JRF    = ICNDP(4,I)/100
      NRF    = ICNDP(4,I)-100*JRF
C
C
C
      X2     = X+74.0
      CALL  SYMBOL (X2,Y,3.0,'MATERIAL NO.:',0.0,13)
      RI     = ICNDP(1,I)
      CALL  NUMBER (X2+42.0,Y,3.0,RI,0.0,-1)
C
C
C
      IF ( NRF.LE.0 )          GOTO 160
      X2     = X+143.0
      CALL  SYMBOL (X2,Y,3.0,'REFERENCE NO.:',0.0,14)
C
C
C
      X2     = X+188.0
      DO 155 J=1,NRF
      CALL  SYMBOL (X2,Y,3.0,IREFF(1,JRF),0.0,8)
      X2     = X2+20.0
      JRF    = JRF+1
  155 CONTINUE
  160 CONTINUE
C
C*  PLOT CURVES  *
C
      CALL  CURVE
C
C
C
      CALL  PLOT   (300.,0.,-3)
C
C   (3)
C
      CALL  PLOT   (0.,0.,777)
      CALL  PLOT   (0.,0.,666)
      CALL  PLOT   (0.,0.,888)
C
C
C
C
  900 RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE CURVE
C***********************************************************************
C
C     PLOTTING PROGRAM
C
C         INPUT DATA
C            ATITLE (18)    =  HEADING  (MAX. 72 CHARS.)
C            XTITLE (10)     =  TITLE OF X-AXIS  (MAX. 40 CHARS.)
C            YTITLE (10)     =  TITLE OF Y-AXIS  (MAX. 40 CHARS.)
C            IPARM           =  PARM.   =1  LINEAR,  =2  SMOOTHING
C            PXMIN,PXMAX     =  USER DEFINED MIN. AND MAX. VALUE OF X-AXIS
C                               IF PXMIN=PXMAX=0.0  THEN  AUTOMATIC SCALE.
C            PYMIN,PYMAX     =  USER DEFINED MIN. AND MAX. VALUE OF Y-AXIS
C                               IF PYMIN=PYMAX=0.0  THEN  AUTOMATIC SCALE.
C            NPLOT           =  NUM. OF PLOTTING CURVE/GRAPH  (MAX. 20)
C            NDATA           =  NUM. OF PLOTTING DATA/CURVE  (MAX. 1000)
C            XDATA  (NDATA)  =  XDATA OF 1-ST CURVE
C            YDATA  (NDATA)  =  YDATA OF 1-ST CURVE
C            XDATA  (NDATA)  =  XDATA OF 2-ND CURVE
C            YDATA  (NDATA)  =  YDATA OF 2-ND CURVE
C          END  OR  IF YOU WANT NEXT GRAPH THEN REPEAT FROM ATITLE DATA.
C
C***********************************************************************
C
      COMMON /MLBRF1/  KRFM1, KRFM2, KEXC, MRFM, NRFM, IRFM(10), KARG(4)
     1               ,  NRFC(8), IRFC(10,8), RRFC(2,10,8), KSYSU
      COMMON /MLBPL1/  IAXES(2), KMESH, KCVNAM, JCVNAM(20), ICVNAM(5,20)
      CHARACTER*4      ICVNAM
      COMMON /COMPL1/ ATITLE(18),XXNAME(10),YYNAME(10)
     *               ,XDATA(  50,20),YDATA(  50,20)
      CHARACTER*4      ATITLE, XXNAME, YYNAME
      COMMON /COMPL2/ PXMIN,PXMAX,PYMIN,PYMAX,XL1,YL1,NPLOT,NDATA
     1               ,NDATAX(20), NGRAPH
      COMMON /COMPL3/ AMAT1(20),ANAME(20),UNAME(3)
      CHARACTER*8      AMAT1    , ANAME    , UNAME
      COMMON /NAL/ NALPHA
      CHARACTER*2  CNUM1(20)
      DATA CNUM1 /' 1',' 2',' 3',' 4',' 5',' 6',' 7',' 8',' 9','10',
     1             '11','12','13','14','15','16','17','18','19','20'/
C*********  PLOT INITIAL VALUE SET
      IPARM=1
C
C...PLOT  INITIAL SET
C...PLOT NODE SYMBOL
      XX1 = 178.5
      YY1 = 182.0
      DO 100 I=1,NPLOT
      YY2 = YY1 - (I-1)*5.0
      FPN1= I+0.005
      IF ( I .GE. 10 ) GO TO 90
      CALL NUMBER(XX1-2.0,YY2,2.4,FPN1     ,0.0,-1)
      GO TO 95
   90 CONTINUE
      CALL NUMBER(XX1-3.5,YY2,2.4,FPN1     ,0.0,-1)
   95 CONTINUE
      JCVN= JCVNAM(I)
      IF ( JCVN.EQ.0 )       THEN
      CALL SYMBOL(XX1+ 5.0,YY2,2.4,ANAME(I),0.0, 8)
      CALL SYMBOL(XX1+30.0,YY2,2.4,AMAT1(I),0.0, 8)
                             ELSE
```

Appendix F (Continued)

```
      XX  = XX1+5.0
      CALL SYMBOL(XX,YY2,2.4,ICVNAM(1,I),0.0,20)
                              ENDIF
  100 CONTINUE
C
C...SET INSIDE BOX ORIGIN
C
      CALL PLOT(35.0,30.0,-3)
      CALL PLOT( 0.0, 0.0, 3)
      CALL PLOT( 0.0, YL1, 2)
      CALL PLOT( XL1, YL1, 2)
      CALL PLOT( XL1, 0.0, 2)
      CALL PLOT( 0.0, 0.0, 2)
      IF ( KMESH.NE.0 ) THEN
      IF ( IAXES(2).EQ.0 )  THEN
      CALL NEWPEN(1)
      XXXL1=XL1
      DO 150 I=1,7
      YYHEIT= 20.0 * FLOAT(I)
      IF ( I.GT.6 ) XXXL1=140.0
      CALL PLOT( 0.0, YYHEIT, 3 )
      IF ( KMESH.EQ.1 )             THEN
      CALL DASHP (  XXXL1, YYHEIT, 1.1 )
                                    ELSE
      IF ( KMESH.EQ.2 )                 THEN
      CALL PLOT  (  XXXL1, YYHEIT,   2 )
                                        ENDIF
                                    ENDIF
  150 CONTINUE
                                ENDIF
      IF ( IAXES(1).EQ.0 )  THEN
      YYYL1=YL1
      DO 200 I=1,9
      XXWITH= 20.0 * FLOAT(I)
      IF ( I.GT.7 ) YYYL1=120.0
      CALL PLOT( XXWITH, 0.0, 3 )
      IF ( KMESH.EQ.1 )             THEN
      CALL DASHP ( XXWITH, YYYL1, 1.1 )
                                    ELSE
      IF ( KMESH.EQ.2 )                 THEN
      CALL PLOT  ( XXWITH, YYYL1,   2 )
                                        ENDIF
                                    ENDIF
  200 CONTINUE
                                ENDIF
                            ENDIF
      CALL NEWPEN(1)
      VX= XL1
      VY= YL1
C...PLOT  TITLE
      YTPNUM=-20.0
      IF( NALPHA.EQ.4 ) YTPNUM=-22.5
      IF( NALPHA.EQ.5 ) YTPNUM=-25.0
      IF( NALPHA.EQ.6 ) YTPNUM=-27.5
      CALL SYMBOL( 60.0,-11.0,3.0,XXNAME,0.,20)
CPLOT10(2)
      CALL SYMBOL(YTPNUM,YL1+8.,3.0,YYNAME, 0.,24)
C
C...MIN.,MAX.
C
```

Appendix F (Continued)

```
      DO 450 I=1,NPLOT
      IF (NDATAX(I) .NE. 1)                     GOTO   450
      NDATAX(I) = 2
      XDATA(2,I) = XDATA(1,I) * 1.01
      YDATA(2,I) = YDATA(1,I)
  450 CONTINUE
C
C
C
      IF (PXMIN.NE.0.0 .OR.PXMAX.NE.0.0)        GOTO   500
      CALL EXMINX(XDATA(1,1), 50,NPLOT,NDATAX(1), PXMIN, PXMAX)
  500 CONTINUE
      IF (PYMIN.NE.0.0 .OR.PYMAX.NE.0.0)        GOTO   600
      CALL EXMINX(YDATA(1,1), 50,NPLOT,NDATAX(1), PYMIN, PYMAX)
C
C...DEFAULT  YMIN = 0.0
C
      IF (PYMIN.GE.0.0)    PYMIN = 0.0
  600 CONTINUE
C...PLOT AXIS
C... X-AXIS
C
      IF ( IAXES(1).EQ.0 )  THEN
      DX1 = (PXMAX-PXMIN)/5.0
      CALL AXFUN1(DX1,SDX,ISUFX)
      DX  = SDX*5.0/VX
      PXMAX1 = PXMIN + SDX*5.0
      PXMIN1 = PXMIN
      CALL PLTAX2(1,VX,PXMIN1,PXMAX1,SDX,ISUFX)
                              ELSE
      IF ( IAXES(1).EQ.1 )        THEN
      CALL PLTAXL(1,VX,PXMIN,PXMAX, PXMIN1, PXMAX1)
      DX    = (PXMAX1-PXMIN1)/VX
      CALL PLTLGV( XDATA(1,1) , 50,NPLOT,NDATAX(1))
                                  ENDIF
                              ENDIF
C
C... Y-AXIS
C
      IF ( IAXES(2).EQ.0 )  THEN
      IF (PYMIN.GE.0.0)     GO TO  650
      TYM1 = -PYMIN
      DY1  =  PYMAX/3.0
      IF (DY1.LT.TYM1)   CALL AXFUN1(TYM1,SDY,ISUFY)
      IF (DY1.GE.TYM1)   CALL AXFUN1(DY1 ,SDY,ISUFY)
      PYMAX1 = SDY*3.0
      PYMIN1 = -SDY
                    GO TO  660
  650 CONTINUE
      DY1 = (PYMAX-PYMIN)/4.0
      CALL AXFUN1(DY1,SDY,ISUFY)
      PYMAX1 = PYMIN + SDY*4.0
      PYMIN1 = PYMIN
  660 CONTINUE
      DY  = SDY*4.0/VY
      CALL PLTAX2(2,VY,PYMIN1,PYMAX1,SDY,ISUFY)
                              ELSE
      IF ( IAXES(2).EQ.1 )        THEN
      CALL PLTAXL(2,VY,PYMIN,PYMAX, PYMIN1, PYMAX1)
      DY    = (PYMAX1-PYMIN1)/VY
```

Appendix F (Continued)

```
      CALL PLTLGV( YDATA(1,1) , 50,NPLOT,NDATAX(1))
                               ENDIF
                           ENDIF
C
C...PLOT CURVE
C
      DO 800 I=1,NPLOT
        NDATA = IABS (NDATAX(I))
        IF(NDATA.EQ.0)             GO TO  680
        XDATA(NDATA+1,I)=PXMIN1
        XDATA(NDATA+2,I)=DX
        YDATA(NDATA+1,I)=PYMIN1
        YDATA(NDATA+2,I)=DY
                                   GO TO  690
  680 CONTINUE
C
C...CONSTANT VALUE
C
        XDATA(1,I) = PXMIN1
        XDATA(2,I) = PXMAX1
        XDATA(3,I) = PXMIN1
        XDATA(4,I) = DX
        YDATA(3,I) = PYMIN1
        YDATA(4,I) = DY
        NDATA      = 2
  690 CONTINUE
C
C  (5)
C
        IF( ( NDATAX(I).GE.0 .AND. KARG(4).GT.0 )
     *.OR.  ( NDATAX(I).LT.0 .AND. KARG(4).NE.0 )
     *.OR.( NDATA  .EQ.2 .AND. XDATA(9,I).EQ.-9999. ))
     *                            THEN
      CALL NEWPEN(2)
       CALL LINE(XDATA(1,I),YDATA(1,I),NDATA,1,0,IDMY)
      CALL NEWPEN(1)
        TTMP1=NDATA/6
        TTMP2=TTMP1/NPLOT
      DO 700 KKK=1,NDATA,2
        TX=(XDATA(KKK,I)-XDATA(NDATA+1,I))/XDATA(NDATA+2,I)
        TY=(YDATA(KKK,I)-YDATA(NDATA+1,I))/YDATA(NDATA+2,I)
        CALL SYMBOL(TX,TY,2.0,CNUM1(I),0.,2)
  700 CONTINUE
C
C  (3)
C
                                  ELSE
      CALL NEWPEN(2)
       CALL LINE(XDATA(1,I),YDATA(1,I),NDATA,1,-1,I)
      CALL NEWPEN(1)
                                  ENDIF
  800 CONTINUE
 9000 CONTINUE
C
C...RESET ORIGIN
C
      CALL PLOT(-35.0,-30.0,-3)
      RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE AXFUN1(DX1,SDX,ISUFX)
C**********************************************************************
C
C     AXIS FUNCTION  (ROUND  N*10**ISUFX )
C
C**********************************************************************
C
      TX = ALOG10(DX1)
      IF (TX.LT.0.0)   TX = TX-1.0
      KX1 = IFIX(TX)
      ISUFX = KX1
      SX1 = FLOAT(KX1)
      F   = DX1/(10.0**KX1)
C
C...DX1 = F*10**KX1  ( 1<= F <10 )
C
      IF (F.GT.5.0)    GO TO  100
      IF (F.GT.4.0)    GO TO  200
      IF (F.GT.3.0)    GO TO  300
      IF (F.GT.2.0)    GO TO  400
      IF (F.GT.1.0)    GO TO  500
C
C
C
      SDX = 10.0**SX1
      RETURN
C
C
C
  100 CONTINUE
      SDX = 10.0**(SX1+1.0)
      RETURN
C
C
C
  200 CONTINUE
      SDX =  5.0*10.0**SX1
      RETURN
C
C
C
  300 CONTINUE
      SDX =  4.0*10.0**SX1
      RETURN
C
C
C
  400 CONTINUE
      SDX =  3.0*10.0**SX1
      RETURN
C
C
C
  500 CONTINUE
      SDX =  2.0*10.0**SX1
      RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE PLTAX2(IXY,ALEN,XMIN,XMAX,SD,ISUF)
C***********************************************************************
C
C     PLOT AXIS    ( ORIGIN=(0.0,0.0) )
C
C        INPUT
C           IXY    = 1  XAXIS  / =2  YAXIS
C           ALEN   = LENGTH OF AXIS
C           XMIN   = MIN. OF AXIS
C           XMAX   = MAX. OF AXIS
C           SD     =
C           ISUF   = 10.0** ISUF
C
C
C***********************************************************************
C
      COMMON /NAL/ NALPHA
      IX1 = ISUF
      KX1 = ISUF
      KX2 = KX1-2
C
C
C
      IF (KX1.EQ.0)   KX2 = KX1
      IF (KX1.EQ.1)   KX2 = KX1 - 1
C
C...
C
      DELX = SD
      IF (IXY.EQ.2)            GOTO   400
C
C
C
      DA = ALEN/5.0
      DO 100 I=1,20
      TX=DA*I
      IF (TX.GE.ALEN)          GOTO   100
      CALL PLOT(TX,1.0,3)
      CALL PLOT(TX,-1.0,2)
  100 CONTINUE
C
C
C
      DO 200 I=1,20
      TX=DA*(I-1)-3.0
      TY=-5.0
      IF ( TX      .GT.ALEN)   GOTO   200
      TN=XMIN+ DELX*(I-1)
      IF (IX1.LE.-2)      TN=TN*10.**(-IX1)
      CALL NUMBER(TX,TY,3.0,TN,0.0, 1)
  200 CONTINUE
C
C
C
      IF (IX1.GT.-2)           GOTO   300
      CALL SYMBOL( ALEN +10.,-5.0,3.0,'(X10  )',0.0,7)
      TN=IX1
      CALL NUMBER( ALEN +10.+12.,-3.0,2.0,TN,0.0,-1)
C
CPLOT10(1)
```

Appendix F (Continued)

```
C
  300 CONTINUE
                               GOTO   700
  400 CONTINUE
C
C...PLOT Y-AXIS
C
      DA = ALEN/4.0
      DO 500 I=1,20
      TY=DA*I
      IF (TY.GE.ALEN)          GOTO   500
      CALL PLOT(-1.0,TY,3)
      CALL PLOT( 1.0,TY,2)
  500 CONTINUE
C
C
C
      MMNUM=NALPHA
      IF(NALPHA.EQ.0) MMNUM=2
      YPNUMB=-15.0
      IF(NALPHA.EQ.3) YPNUMB=-17.0
      IF(NALPHA.EQ.4) YPNUMB=-19.5
      IF(NALPHA.EQ.5) YPNUMB=-22.5
      IF(NALPHA.EQ.6) YPNUMB=-25.0
C
C
C
      DO 600 I=1,20
      TX=-12.0
      TY=DA*(I-1)-1.0
      IF ((TY    ).GT.ALEN)   GOTO   600
      TN=XMIN+ DELX*(I-1)
      TN = TN*10.0 **(-KX2)
      CALL NUMBER(TX,TY,3.0,TN,0.0,-1)
                            GO TO 600
  550 CONTINUE
C
C...PLOT  X.XX
C
      CALL NUMBER(YPNUMB, TY,3.0,TN,0.0,MMNUM )
  600 CONTINUE
      IF (KX2.EQ. 0)           GOTO   700
      CALL SYMBOL(-20.0, ALEN  +3.0,3.0,'(X10  )',0.0,7)
      TN=KX2
      CALL NUMBER( -8.0, ALEN  +5.0,2.0,TN,0.0,-1)
C
CPLOT10(1)
C
  700 CONTINUE
      WRITE(50,6000)
      WRITE(50,6010) IXY,ALEN,XMIN,XMAX
      WRITE(50,6020)        IX1,DELX,DA,KX1,KX2
 6000 FORMAT('0',' *** PLOTAX CHECK LIST *** ')
 6010 FORMAT(' ',' IXY=',I2,3X,'ALEN=',F10.3,3X,'MIN=',E12.4,
     1        3X,'MAX=',E12.4)
 6020 FORMAT(' ',                             3X,'IX1=',I5,3X,'DELX=',
     1        E12.4,3X,'DA=',E12.4, '  KX1=',I5,'  KX2=',I5 )
      RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  PLTAXL (KXY,AXLEN,XMIN,XMAX, XMIN1, XMAX1)
C
      COMMON /COMPL2/  PXMIN, PXMAX, PYMIN, PYMAX, XL1, YL1, NPLOT
     1               ,  NDATA, NDATAX(20), NGRAPH
      COMMON /MLBPL1/  IAXES(2), KMESH, KCVNAM, JCVNAM(20), ICVNAM(5,20)
      CHARACTER*4      ICVNAM
C
      DATA  XXL1, YYL1 / 140., 120. /
      DATA  EPSO       / 1.E-50     /
C
C*    LA
      IF ( XMIN.GE.1.0 )       THEN
      LA    = ALOG10 (XMIN)
                               ELSE
      IF ( XMIN.LE.EPSO )            THEN
      LA    = 0
                                     ELSE
      LA    = ALOG10 (1.0/XMIN)
      LA    = -(LA+1)
                                     ENDIF
                               ENDIF
C*    LB
      IF ( XMAX.GE.1.0 )       THEN
      LB    = ALOG10 (XMAX)
      D     = 10.**LB
      D     = XMAX-D
      IF ( D.GT.EPSO ) LB = LB + 1
                               ELSE
      LB    = ALOG10 (1.0/XMAX)
      LB    = -LB
                               ENDIF
C
      XMIN1 = LA
      XMAX1 = LB
      XD    = XMAX1-XMIN1
      IF ( XD.LE.EPSO )        GOTO 900
      XD    = AXLEN/XD
      L     = LA-1
      N     = LB-L
C
      GOTO ( 100,200 ), KXY
C*    X AXIS
  100 Y     = YL1
      DO 140 I=1,N
      L     = L+1
      X     = L
      X10   = 10.**L
      XN    = (X-XMIN1)*XD
      CALL  PLOT   (XN, 1.0,3)
      CALL  PLOT   (XN,-1.0,2)
      CALL  SYMBOL (XN-4.5,-5.5,3.0,'10',0., 2)
CPLOT10(1)
      CALL  NUMBER (XN    ,-3.5,2.0,X   ,0.,-1)
C
      IF ( I.EQ.1 .OR. I.EQ.N ) GO TO 110
      IF ( KMESH.NE.0 )        THEN
      IF ( XN.GT.XXL1 ) Y = YYL1
      CALL  PLOT   (XN,Y,3)
      IF ( KMESH.EQ.1 ) CALL DASHP ( XN, 0.0, 1.1 )
      IF ( KMESH.EQ.2 ) CALL PLOT ( XN, 0.0, 2 )
```

Appendix F (Continued)

```
                               ENDIF
  110 IF ( I.GE.N )            GOTO 140
      DO 120 J=2,9
      XJ    = J*X10
      XX    = (ALOG10 (XJ) -XMIN1)*XD
      CALL  PLOT   (XX,1.0,3)
      CALL  PLOT   (XX,0.0,2)
  120 CONTINUE
  140 CONTINUE
C
      IF ( KMESH.NE.0 )        THEN
      CALL  PLOT   (XXL1,YL1,3)
      IF ( KMESH.EQ.1) CALL DASHP ( XXL1, YYL1, 1.1 )
      IF ( KMESH.EQ.2) CALL PLOT  ( XXL1, YYL1, 2 )
                               ENDIF
      GOTO 900
C*    Y AXIS
  200 X     = XL1
      DO 240 I=1,N
      L     = L+1
      Y     = L
      Y10   = 10.**L
      LAA   = IABS (L)
      AA    = LAA
      NA    = ALOG10 (AA+0.1) +1.
      IF ( L.LT.0 ) NA = NA + 1
C
      XN    = -NA*2.0-8.5
      YN    = (Y-XMIN1)*XD
      CALL  PLOT   ( 1.0,YN,3)
      CALL  PLOT   (-1.0,YN 2)
      CALL  SYMBOL (XN    ,YN-2.0,3.0,'10',0., 2)
CPLOT10(1)
      CALL  NUMBER (XN+4.5,YN    ,2.0,Y   ,0.,-1)
C
      IF ( I.EQ.1 .OR. I.EQ.N ) GO TO 210
      IF ( KMESH.NE.0 )        THEN
      IF ( YN.GT.YYL1 ) X = XXL1
      CALL  PLOT   (X,YN,3)
      IF ( KMESH.EQ.1 ) CALL DASHP ( 0.0, YN, 1.1 )
      IF ( KMESH.EQ.2 ) CALL PLOT  ( 0.0, YN, 2 )
                               ENDIF
  210 IF ( I.GE.N )            GOTO 240
      DO 220 J=2,9
      YJ    = J*Y10
      YY    = (ALOG10 (YJ) -XMIN1)*XD
      CALL  PLOT   (1.0,YY,3)
      CALL  PLOT   (0.0,YY,2)
  220 CONTINUE
  240 CONTINUE
C
      IF ( KMESH.NE.0 )        THEN
      CALL  PLOT   (XL1,YYL1,3)
      IF ( KMESH.EQ.1) CALL DASHP ( XXL1, YYL1, 1.1 )
      IF ( KMESH.EQ.2) CALL PLOT  ( XXL1, YYL1, 2 )
                               ENDIF
C
  900 RETURN
      END
```

Appendix F (Continued)

```
      SUBROUTINE  PLTLGV ( PDATA ,MPD,NPLOT,NDATAP)
      DIMENSION   PDATA(MPD,1), NDATAP(1)
      IF ( NPLOT.LE.0 )    GOTO 900
      DO 200 I=1,NPLOT
      NDATA    = IABS (NDATAP(I))
      IF ( NDATA.EQ.0 ) NDATA = 2
      DO 150 J=1,NDATA
      IF ( PDATA(J,I).LE.0. ) THEN
      PDATA(J,I)= 0.
                               ELSE
      PDATA(J,I)= ALOG10 (PDATA(J,I))
                               ENDIF
  150 CONTINUE
  200 CONTINUE
  900 RETURN
      END


      SUBROUTINE DTLIST(LU1,LU2)
      DIMENSION IA(20)
      REWIND LU1
      N = 1
      L = 51
   15 IF ( L .LE. 50 ) GO TO 30
   20 WRITE(LU2,2)
      WRITE(LU2,3) ( I, I=1,8 )
      WRITE(LU2,4)
      L = 1
   30 READ(LU1,1,END=50) ( IA(I),I=1,20 )
      WRITE(LU2,5)      N,( IA(I),I=1,20 ),N
      IF ( L .NE. 50 ) GO TO 40
      WRITE(LU2,6)
      WRITE(LU2,10) ( I, I=1,8 )
      WRITE(LU2,7)
   40 L = L + 1
      N = N + 1
      GO TO 15
   50 CONTINUE
      WRITE(LU2,6)
      WRITE(LU2,10) ( I, I=1,8 )
      WRITE(LU2,8)
      WRITE(LU2,9) LU1
      REWIND LU1
    1 FORMAT( 20A4 )
    2 FORMAT( 1H1, //, 50X, '    INPUT DATA ECHO ' / )
    3 FORMAT( 16X, 'DATA ', 4X, 8( 9X, I1 ) )
    4 FORMAT( 14X, 'SEQ. NO.', 3X, 8('----5----0'), / )
    5 FORMAT( 16X, I4, 5X, 20A4, 2X, I4 )
    6 FORMAT( 1H0, 24X, 8('----5----0') )
    7 FORMAT(1H0, 30X, '* * *  CONTINUE  * * *' )
    8 FORMAT(1H0, 30X, '* * *  INPUT DATA END  * * *' )
    9 FORMAT(1H0,30X,'* * *  INPUT DATA FROM FILE NO. =',I3,' * * *' )
   10 FORMAT( 25X, 8(9X,I1) )
   11 FORMAT(1H0)
      RETURN
      END
```

Appendix G Data Library

```
         1         2         3         4         5         6         7         8
----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

MAT  'AISC1020'      1001,0,0,0,0,1
     0.   0.   0.   0.
REF  1   'R-7'
SSR  293.,C,,1
     +1.E-2,10,0.01 223.,0.02 379.,0.05 611.,0.11 717.,0.16 767.0,
               0.22 794.,0.29 840.,0.36 841.,0.51 836.,0.69 857.0
*
MAT  'S45C'          1002,0,0,0,0,1
     0.   0.   0.   0.
REF  2   'R-24','R-25'
SSR  293.,T,,3
     6.3E-4, 9,0.003  374., 0.009  349., 0.03   525., 0.049  610.,
               0.095  711., 0.14   757., 0.18   784., 0.22   780.,
               0.26   724.
     4.2E+2,10,0.0061 591., 0.0096 900., 0.0156 659., 0.03   795.,
               0.049  861., 0.095  938., 0.14   955., 0.18   946.,
               0.22   903., 0.25   818.
     1.5E+3,10,0.0061 591.,0.0115 1100., 0.0185 726., 0.030  808.,
               0.049  884., 0.095  971., 0.14  1002., 0.18   990.,
               0.22   946., 0.26   815.
*
MAT 'STEEL'          1003,0,0,0,0,2
     0.   0.   0.   0.
REF  1   'R-36'
COM  'C 0.14, SI 0.20, MN 0.49, P 0.008, S 0.013, NI 0.04 '
SSR  293.,C,,5
     2.0E-4, 4,0.002 181., 0.1  430., 0.2  526., 0.3  593.
     5.0E-3,14,0.002 181., 0.02 228., 0.04 291., 0.06 341., 0.08 389.,
               0.10  427., 0.12 456., 0.14 481., 0.16 500., 0.18 515.,
               0.20  529., 0.25 558., 0.30 573., 0.35 583.
     3.0E-1,14,0.002 241., 0.02 286., 0.04 336., 0.06 385., 0.08 425.,
               0.10  458., 0.12 483., 0.14 506., 0.16 529., 0.18 545.,
               0.20  563., 0.25 593., 0.30 612., 0.35 625.
     4.3   , 4,0.002 310., 0.1  482., 0.20 570., 0.3  634.
     3.7E+2,14,0.002 431., 0.02 448., 0.04 469., 0.06 498., 0.08 507.,
               0.10  525., 0.12 544., 0.14 555., 0.16 572., 0.18 586.,
               0.20  599., 0.25 627., 0.30 647., 0.35 666.
SSR  293.,T,,5
     1.0E-3, 3,0.002 228., 0.1  409., 0.2  499.
     1.2E-2,11,0.002 228., 0.02 261., 0.04 317., 0.06 354., 0.08 389.,
               0.10  412., 0.12 436., 0.14 456., 0.16 473., 0.18 492.,
               0.20  500.
     1.0E-1,11,0.002 232., 0.02 299., 0.04 350., 0.06 385., 0.08 419.,
               0.10  444., 0.12 466., 0.14 483., 0.16 498., 0.18 509.,
               0.20  522.
     1.2   , 3,0.002 294., 0.1  499., 0.2  537.
     1.1E+2,10,0.002 414., 0.02 448., 0.04 466., 0.06 483., 0.08 498.,
               0.10  515., 0.12 530., 0.14 541., 0.16 551., 0.18 555.
*
MAT 'STEEL'          1004,0,0,0,0,3

----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
         1         2         3         4         5         6         7         8
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Appendix G (Continued)

```
         1         2         3         4         5         6         7         8
----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

     0.   0.   0.   0.
REF  1   'R-36'
COM  'C 0.14, SI 0.20, MN 0.49, P 0.008, S 0.013, NI 0.04'
SSR  373.,T,,3
     1.0E-3, 1,0.002 196.
     1.2   , 1,0.002 273.
     1.1E+2, 1,0.002 342.
SSR  473.,T,,5
     1.0E-3, 1,0.002 206.
     1.2E-2, 1,0.002 195.
     1.0E-1, 1,0.002 185.
     1.2   , 1,0.002 226.
     1.1E+2, 1,0.002 294.
SSR2 195.,C,,3,5
               0.002, 0.05, 0.10, 0.15, 0.20
     5.0E-3, 5, 238.  373.  481.  537.  578.
     3.0E-1, 5, 327.  425.  502.  556.  595.
     3.7E+2, 5, 521.  555.  591.  621.  647.
*
MAT 'STEEL'          1005,0,0,0,0,3
     0.   0.   0.   0.
REF  1   'R-52'
COM  'C 0.32, SI 0.24, MN 0.62, S 0.037, P 0.025 : PRESSURE TEST MACHINE'
SSR  189.,C,,1
     1.0E-6, 6,0.002 344., 0.015 388., 0.02  430., 0.025 467.,
               0.03  499., 0.035 528.
SSR  232.,C,,1
     1.0E-6, 7,0.002 310., 0.01  328., 0.015 360., 0.02  396.,
               0.025 433., 0.03  460., 0.035 486.
SSR  288.,C,,1
     1.0E-6, 7,0.002 276., 0.01  298., 0.015 335., 0.02  367.,
               0.025 399., 0.03  428., 0.035 452.
*
MAT 'STEEL'          1006,0,0,0,0,3
     0.   0.   0.   0.
REF  1   'R-52'
COM  'C 0.32, SI 0.24, MN 0.62, S 0.037, P 0.025 : FALL'
SSR  189.,C,,2
     260.  , 1,0.002 827.
     350.  , 1,0.002 827.
SSR  232.,C,,3
     260.  , 1,0.002 717.
     380.  , 1,0.002 723.
     470.  , 1,0.002 737.
SSR  288.,C,,3
     440.  , 1,0.002 634.
     570.  , 1,0.002 641.
     670.  , 1,0.002 648.
*
MAT 'STEEL'          1007,0,0,0,0,1

----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
         1         2         3         4         5         6         7         8
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Appendix G (Continued)

```
DATA        1         2         3         4         5         6         7         8
SEQ. NO. ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

      0.   0.   0.   0.
REF   1   'R-53'
COM   'C 0.24, SI 0.07, MN 0.72, S 0.02, P 0.03, MO 0.016'
SSR   293.,C,,7
      1.0E-4, 8,0.002 256.,0.002 244., 0.01 249., 0.02 305., 0.03 350.,
                0.04  385., 0.05 412., 0.06 437.
      135.  , 1,0.002 695.
      455.  , 1,0.03  553.
      474.  , 1,0.04  580.
      683.  , 1,0.02  545.
      860.  , 1,0.01  552.
      944.  , 1,0.0111 540.
*
MAT 'STEEL'           1008,0,0,0,0,1
      0.   0.   0.   0.
REF   1   'R-55'
COM   'C 0.19, MN 0.6, P 0.013, S 0.017'
SSR   293.,C,,4
      3.8E-4, 6,0.002 224., 0.02 251., 0.04 324., 0.08 415., 0.12 465.,
                0.16  503.
      1.5E-2, 4,0.002 243., 0.04 339., 0.08 430., 0.12 483.
      4.3E-1, 4,0.002 308., 0.04 383., 0.08 481., 0.12 542.
      3.8E+2, 6,0.002 518., 0.02 520., 0.04 574., 0.08 624., 0.12 662.,
                0.16  685.
*
MAT 'STEEL'           1009,0,0,0,0,1
      0.   0.   0.   0.
REF   1   'R-56'
COM   'C 0.20, MN 0.73, P 0.020, S 0.018'
SSR2 293.,C,,2,7
                 0.01, 0.02, 0.03, 0.04, 0.05, 0.06, 0.07
      1.0E-4, 7, 203.  260.  318.  351.  379.  405.  424.
      90.   , 7, 494.  465.  481.  507.  539.  561.  576.
*
MAT  'SS41'           1010,0,0,0,0,5
      0.   0.   0.   0.
REF   1   'R-86'
COM   'KANAZAWA UNIVERSITY TEST DATA'
SSR2 293.,C,,10,20
                 0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                 0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
      2.0E-4,20, 259. 276. 318. 350. 376. 395. 415. 430. 447. 456.,
                 467. 478. 489. 498. 508. 512. 522. 527. 531. 539.
      2.0E-3,20, 270. 278. 319. 353. 378. 402. 424. 439. 459. 470.,
                 481. 493. 505. 511. 525. 532. 539. 543. 547. 557.
      2.0E-2,20, 298. 295. 321. 360. 392. 413. 431. 453. 468. 480.,
                 493. 504. 514. 525. 534. 542. 550. 559. 566. 570.
      2.0E-1,20, 319. 312. 330. 368. 400. 424. 450. 467. 481. 496.,
                 510. 521. 531. 542. 550. 561. 567. 575. 580. 586.
      1.1   ,20, 366. 343. 343. 371. 398. 421. 443. 464. 484. 500.,

         ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                  1         2         3         4         5         6         7         8
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Appendix G (Continued)

```
DATA        1         2         3         4         5         6         7         8
SEQ. NO. ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

                 512. 527. 536. 545. 553. 561. 567. 574. 578. 585.
      1.4   ,20, 392. 352. 356. 386. 416. 446. 470. 489. 506. 525.,
                 546. 553. 567. 576. 585. 591. 600. 602. 608. 609.
      15.   ,12, 465. 444. 416. 427. 444. 465. 487. 509. 520. 526.,
                 537. 541.
      280.  ,15, 459. 455. 474. 493. 519. 535. 551. 564. 576. 600.,
                 610. 628. 637. 639. 640.
      420.  ,13, 488. 471. 494. 513. 536. 556. 574. 587. 603. 613.,
                 622. 632. 631.
      500.  ,20, 470. 479. 497. 522. 542. 562. 573. 588. 600. 612.,
                 623. 632. 640. 648. 664. 676. 676. 712. 720. 727.
SSR2 473.,C,,4,20
                 0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                 0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
      2.1E-4,13, 242. 296. 354. 390. 410. 435. 451. 471. 491. 504.,
                 515. 528. 537.
      4.2E-2,16, 251. 262. 292. 325. 345. 360. 379. 390. 400. 412.,
                 421. 431. 434. 440. 446. 448.
      0.63  ,20, 261. 281. 314. 339. 364. 381. 397. 410. 422. 434.,
                 443. 449. 456. 465. 472. 480. 483. 491. 500. 500.
      400.  ,12, 368. 381. 413. 439. 465. 484. 502. 522. 538. 555.,
                 565. 579.
SSR2 373.,C,,4,14
                 0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                 0.11,0.12,0.13,0.14
      2.1E-4,13, 268. 299. 339. 364. 390. 408. 424. 438. 453. 462.,
                 473. 483. 490.
      4.2E-2,14, 272. 286. 324. 357. 381. 402. 417. 431. 445. 457.,
                 462. 474. 483. 495.
      0.63  ,13, 297. 368. 415. 446. 470. 492. 511. 522. 531. 547.,
                 556. 567. 569.
      370.  ,11, 409. 422. 437. 467. 488. 507. 526. 543. 562. 568.,
                 576.
SSR2 273.,C,,4,15
                 0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                 0.11,0.12,0.13,0.14,0.15
      2.1E-4,14, 242. 259. 295. 328. 348. 371. 391. 404. 418. 427.,
                 440. 445. 456. 459.
      4.2E-2,13, 311. 315. 350. 382. 423. 441. 468. 484. 500. 519.,
                 527. 547. 555.
      0.63  ,15, 305. 298. 322. 355. 382. 399. 426. 441. 457. 471.,
                 484. 493. 499. 509. 509.
      300.  ,15, 487. 484. 509. 528. 546. 568. 583. 595. 600. 639.,
                 649. 659. 664. 677. 678.
SSR2 223.,C,,4,17
                 0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                 0.11,0.12,0.13,0.14,0.15,0.16,0.17
      2.0E-4,15, 267. 276. 316. 351. 383. 405. 423. 441. 454. 468.,
                 485. 493. 506. 521. 536.
      4.1E-2,14, 303. 304. 341. 375. 404. 431. 459. 469. 488. 507.,

         ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                  1         2         3         4         5         6         7         8
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Appendix G (Continued)

```
             1         2         3         4         5         6         7         8
    ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

                519. 530. 543. 565.
      0.61  ,17, 338. 337. 343. 371. 397. 427. 447. 462. 483. 501.,
                508. 519. 539. 548. 563. 571. 587.
      230.  ,14, 624. 595. 595. 604. 629. 649. 664. 705. 710. 722.,
                732. 741. 748. 749.
*
MAT  'S35C'          1011,0,0,0,0,1
     0.   0.   0.   0.
REF  1    'R-86'
COM  'KANAZAWA UNIVERSITY TEST DATA'
SSR2 293.,C,,10,20
                0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
      2.1E-4,20, 288. 347. 408. 451. 485. 514. 537. 552. 571. 586.,
                600. 609. 623. 633. 640. 649. 657. 662. 669. 675.
      2.1E-3,20, 293. 348. 413. 454. 494. 521. 546. 563. 580. 598.,
                610. 620. 634. 642. 651. 659. 668. 686. 687. 690.
      2.1E-2,20, 305. 360. 424. 468. 505. 537. 560. 579. 598. 613.,
                628. 638. 648. 661. 668. 674. 684. 695. 700. 707.
      2.1E-1,20, 336. 385. 437. 488. 523. 554. 581. 602. 620. 635.,
                650. 660. 670. 679. 690. 697. 703. 712. 718. 723.
      1.0   ,17, 414. 403. 448. 495. 534. 563. 593. 615. 634. 647.,
                664. 672. 682. 691. 696. 698. 704.
      1.3   ,20, 435. 412. 445. 496. 537. 571. 604. 619. 639. 653.,
                672. 680. 691. 700. 709. 715. 722. 728. 730. 733.
      13.   ,13, 427. 445. 486. 529. 568. 602. 640. 655. 676. 688.,
                699. 714. 724.
      200.  ,13, 524. 535. 568. 616. 640. 662. 678. 689. 700. 720.,
                738. 749. 753.
      300.  ,15, 554. 562. 581. 618. 646. 670. 687. 706. 723. 733.,
                745. 761. 777. 791. 792.
      430.  ,20, 539. 552. 598. 630. 657. 683. 696. 721. 735. 752.,
                760. 771. 784. 785. 823. 841. 843. 854. 858. 869.
*
MAT  'S45C'          1012,0,0,0,0,5
     0.   0.   0.   0.
REF  1    'R-86'
COM  'KANAZAWA UNIVERSITY TEST DATA'
SSR2 293.,C,,10,20
                0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
      2.1E-4,20, 353. 402. 461. 505. 539. 564. 588. 608. 622. 637.,
                652. 662. 676. 682. 691. 696. 706. 715. 725. 730.
      2.1E-3,20, 353. 402. 470. 515. 554. 578. 603. 622. 637. 652.,
                671. 681. 696. 706. 715. 725. 730. 740. 750. 760.
      2.1E-2,20, 372. 417. 480. 524. 564. 598. 617. 637. 657. 671.,
                682. 696. 711. 720. 725. 735. 745. 750. 760. 769.
      2.1E-1,20, 392. 431. 495. 544. 578. 613. 637. 657. 671. 691.,
                706. 715. 725. 735. 745. 750. 760. 769. 774. 784.
      0.99  ,15, 461. 441. 490. 539. 578. 608. 637. 657. 676. 691.,

    ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
             1         2         3         4         5         6         7         8
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Appendix G (Continued)

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             1         2         3         4         5         6         7         8
    ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

                706. 720. 730. 735. 745.
      1.3   ,18, 470. 451. 519. 559. 598. 637. 666. 686. 706. 725.,
                735. 750. 760. 769. 774. 784. 789. 794.
      13.   ,11, 490. 500. 519. 598. 637. 665. 696. 715. 725. 735.,
                745.
      150.  ,10, 608. 588. 603. 642. 686. 706. 725. 735. 764. 774.
      300.  ,14, 598. 588. 627. 666. 695. 725. 750. 774. 804. 823.
                833. 843. 847. 852.
      400.  ,20, 588. 608. 637. 676. 711. 735. 760. 779. 798. 813.,
                828. 837. 853. 882. 892. 902. 907. 911. 921. 921.
SSR2 473.,C,,4,15
                0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                0.11,0.12,0.13,0.14,0.15
      2.1E-4,11, 304. 392. 446. 485. 519. 549. 568. 583. 598. 617.,
                627.
      4.1E-2,12, 314. 372. 421. 461. 495. 519. 534. 549. 573. 578.,
                588. 597.
      0.62  ,15, 343. 392. 441. 480. 510. 529. 549. 564. 578. 593.,
                608. 617. 626. 632. 637.
      340.  , 9, 420. 441. 490. 539. 578. 603. 627. 647. 657.
SSR2 373.,C,,4,14
                0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                0.11,0.12,0.13,0.14
      2.1E-4,13, 343. 392. 441. 480. 515. 539. 559. 573. 593. 603.,
                613. 627. 632.
      4.2E-2,12, 353. 402. 461. 508. 539. 568. 588. 608. 617. 632.
                642. 652.
      0.63  ,14, 363. 392. 451. 490. 519. 549. 568. 588. 603. 622.,
                632. 642. 646. 650.
      250.  , 7, 510. 529. 578. 613. 657. 681. 696.
SSR2 273.,C,,4,15
                0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                0.11,0.12,0.13,0.14,0.15
      2.1E-4,12, 343. 363. 417. 480. 505. 529. 554. 568. 583. 598.,
                617. 632.
      4.2E-2,14, 402. 397. 470. 524. 563. 598. 627. 652. 676. 696.,
                706. 725. 740. 750.
      0.63  ,15, 343. 363. 417. 456. 495. 515. 539. 564. 573. 588.,
                603. 613. 622. 627. 627.
      180.  ,11, 637. 603. 622. 657. 696. 725. 745. 755. 769. 779.,
                784.
SSR2 223.,C,,4,16
                0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                0.11,0.12,0.13,0.14,0.15,0.16
      2.2E-4,14, 343. 392. 451. 490. 529. 559. 578. 603. 613. 617.,
                637. 657. 666. 671.
      4.3E-2,10, 353. 392. 451. 500. 539. 568. 588. 617. 627. 647.
      0.65  ,16, 412. 407. 461. 515. 554. 583. 608. 637. 652. 671.,
                691. 701. 711. 725. 735. 740.
      110.  ,10, 755. 740. 764. 774. 784. 813. 828. 833. 835. 838.

    ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
             1         2         3         4         5         6         7         8
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Appendix G (Continued)

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DATA              1         2         3         4         5         6         7         8
SEQ. NO.  ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

          *
          MAT 'S55C'           1013,0,0,0,0,1
                0.   0.   0.   0.
          REF  1   'R-86'
          COM  'KANAZAWA UNIVERSITY TEST DATA'
          SSR2 293.,C,,10,20
                              0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                              0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
                2.0E-4,18, 372. 470. 539. 593. 637. 671. 696. 715. 730. 745.,
                           755. 769. 784. 794. 804. 809. 818. 823.
                2.0E-3,18, 373. 471. 544. 603. 647. 676. 706. 725. 740. 755.,
                           770. 779. 794. 804. 813. 823. 828. 833.
                2.0E-2,20, 358. 436. 524. 588. 642. 676. 711. 730. 750. 769.,
                           789. 799. 809. 818. 828. 838. 848. 853. 862. 862.
                2.0E-1,20, 402. 446. 529. 598. 652. 696. 720. 750. 769. 784.,
                           799. 813. 823. 833. 848. 853. 862. 872. 877. 882.
                0.99   ,13, 470. 490. 559. 613. 662. 706. 725. 750. 774. 789.,
                           804. 813. 823.
                1.3    ,17, 490. 480. 568. 647. 696. 735. 764. 794. 813. 823.,
                           843. 862. 872. 877. 882. 882. 887.
                10.5   , 9, 510. 558. 627. 686. 725. 764. 784. 794. 794.
                140.   , 9, 627. 637. 686. 740. 774. 794. 809. 818. 818.
                260.   ,12, 637. 647. 686. 735. 774. 804. 828. 858. 867. 877.,
                           887. 892.
                350.   ,18, 696. 676. 725. 774. 813. 833. 858. 887. 907. 921.,
                           941. 960. 970. 985. 990. 1000 1005 1010
          *
          MAT   'STEEL'          1100,6,6,0,0,0
                12.1E-6, 211400., 81600., 0.293
                12.1E-6  293., 12.1E-6  373., 12.9E-6  473., 13.8E-6  673.,
                14.5E-6  873., 14.6E-6  1073.
                192000. 294.1, 191000. 366.3, 186000. 477.4, 178000. 588.6,
                162000. 699.7, 106000. 810.8
          *
          MAT   'SUS302'         2001,0,0,0,0,3
                0.   0.   0.   0.
          REF   1   'R-1'
          SSR   273.,C,,3
                4.0E-1, 1,0.69 513.
                2.0E+1, 1,0.69 555.
                2.0E+2, 1,0.69 596.
          SSR   473.,C,,3
                4.0E-1, 1,0.69 345.
                7.0   , 1,0.69 353.
                6.0E+1, 1,0.69 373.
          SSR   673.,C,,6
                4.0E-1, 1,0.69 237.
                1.6   , 1,0.69 245.
                7.0   , 1,0.69 256.
                2.0E+1, 1,0.69 266.

          ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                   1         2         3         4         5         6         7         8
```

Appendix G (Continued)

```
DATA              1         2         3         4         5         6         7         8
SEQ. NO.  ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

                6.0E+1, 1,0.69 290.
                2.0E+2, 1,0.69 309.
          *
          MAT   'SUS303'         2002,0,0,0,0,1
                0.   0.   0.   0.
          REF   1   'R-1'
          SSR   273.0,T,,9
                1.2E+2, 4, 0.41 1047., 0.44 1198., 0.45 1156., 0.46 1283.
                2.6E+2, 1, 0.46 1129.
                2.7E+2, 2, 0.43 1105., 0.44 1145.
                4.5E+2, 1, 0.47 1240.
                4.6E+2, 1, 0.45 1156.
                4.7E+2, 1, 0.44 1190.
                6.8E+2, 1, 0.47 1165.
                6.9E+2, 1, 0.44 1191.
                9.1E+2, 2, 0.45 1292., 0.46 1210.
          *
          MAT   'SUS304'         2003,0,0,0,0,10
                0.   0.   0.   0.
          REF   1   'R-1'
          SSR2 294.,C,,8,3
                           0.01, 0.02, 0.04
                1.0E-4, 3, 255.  293.  359.
                1.0E-1, 3, 307.  348.  414.
                1.0   , 3, 331.  372.  434.
                1.0E+1, 3, 365.  410.  472.
                1.0E+2, 3, 403.  452.  510.
                398.1 , 3, 441.  483.  538.
                630.96, 3, 441.  483.  538.
                1.0E+3, 3, 441.  483.  538.
          SSR   294.,T,,3
                4.0E-5, 3, 0.54  994., 0.57  956., 0.62 1000.
                4.15E-5,4, 0.57 1032., 0.59 1037., 0.60 1033., 0.62 1022.
                4.0E-4, 1, 0.50  860.
          SSR   366.,T,,2
                4.2E-5, 1, 0.47  747.
                4.5E-4, 1, 0.47  706.
          SSR   373.,T,,2
                4.2E-5, 1, 0.47  747.
                4.5E-4, 1, 0.47  706.
          SSR   473.,T,,2
                4.8E-5, 1, 0.34  590.
                5.0E-4, 1, 0.38  583.
          SSR   477.,T,,2
                4.8E-5, 1, 0.34  590.
                5.0E-4, 1, 0.38  583.
          SSR   533.,T,,3
                4.7E-5, 2, 0.36  555., 0.39  604.
                4.6E-4, 1, 0.39  581.
                4.6E-3, 1, 0.38  565.

          ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                   1         2         3         4         5         6         7         8
```

Appendix G (Continued)

```
DATA           1         2         3         4         5         6         7         8
SEQ. NO.  ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

          SSR  589.,T,,2
               5.9E-5, 1, 0.33  606.
               4.7E-5, 1, 0.35  614.
          SSR  623.,T,,1
               4.7E-4, 1, 0.36  661.
          SSR  700.,T,,5
               6.0E-5, 1, 0.32  590.
               4.8E-5, 1, 0.33  595.
               4.6E-5, 1, 0.38  605.
               4.6E-4, 1, 0.38  574.
               4.6E-3, 1, 0.38  560.
          *
          MAT  'SUS316H'      2004,0,0,0,0,2
               0.   0.   0.   0.
          REF  1   'R-1'
          SSR  295.,T,,1
               2.0E-5, 4, 0.35  860., 0.37  912., 0.39  923., 0.40  918.
          SSR  371.,T,,1
               2.0E-5, 1, 0.34  767.
          *
          MAT  'SUS304'       2005,0,0,0,0,1
               0.   0.   0.   0.
          REF  1   'R-45'
          COM  'C 0.05, SI 0.48, MN 1.83, P 0.040, S 0.006, NI 9.10, CR 18.40'
          SSR  300.,C,,1
               5.5E+3, 6, 0.018 456., 0.030 519., 0.047 580., 0.069 631.,
                          0.086 673., 0.108 722.
          *
          MAT  'AISI316L'     2006,0,0,0,0,1
               0.   0.   0.   0.
          REF  1   'R-3'
          SSR2 293.,T,,4,7
                          0.02, 0.05, 0.10, 0.15, 0.20, 0.30, 0.40
               3.0E-3, 7, 381.  445.  541.  625.  703.  841.  953.
               12.   , 6, 517.  567.  647.  721.  790.  894.
               36.   , 6, 567.  629.  708.  790.  843.  967.
               360.  , 5, 604.  669.  757.  842.  911.
          *
          MAT  'SUS304L'      2007,0,0,0,0,1
               0.   0.   0.   0.
          REF  1   'R-7'
          SSR  293.,C,,1
               +1.E-2, 9, 0.01   63., 0.02  150., 0.05  483., 0.11  896.,
                          0.16  878., 0.22  938., 0.29 1080., 0.36 1190.,
                          0.43 1210.
          *
          MAT  'SUS304'       2008,0,0,0,0,8
               0.   0.   0.   0.
          REF  1   'R-10'
          COM  'C 0.08,MN 2.0,SI 1.0,P 0.045,S 0.03,CR 18.0-20.0,NI 8.0-10.5,MO 2.0-3.0'

          ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                   1         2         3         4         5         6         7         8
```

Appendix G (Continued)

```
DATA           1         2         3         4         5         6         7         8
SEQ. NO.  ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

          SSR  223.,T,,1
               1.0E-4, 4, 0.0002 170., 0.0005 198., 0.0010 233., 0.0020 237.
          SSR  253.,T,,1
               1.0E-4, 4, 0.0002 193., 0.0005 216., 0.0010 229., 0.0020 241.
          SSR  273.,T,,1
               1.0E-4, 4, 0.0002 198., 0.0005 219., 0.0010 232., 0.0020 243.
          SSR  293.,T,,1
               1.0E-4, 4, 0.0002 194., 0.0005 207., 0.0010 217., 0.0020 226.
          SSR  373.,T,,1
               1.0E-4, 4, 0.0002 136., 0.0005 148., 0.0010 157., 0.0020 167.
          SSR  473.,T,,1
               1.0E-4, 4, 0.0002 105., 0.0005 123., 0.0010 131., 0.0020 139.
          SSR  573.,T,,1
               1.0E-4, 4, 0.0002 98.5, 0.0005 114., 0.0010 122., 0.0020 130.
          SSR  673.,T,,1
               1.0E-4, 4, 0.0002 88.2, 0.0005 107., 0.0010 114., 0.0020 121.
          *
          MAT  'SUS316'       2009,0,0,0,0,8
               0.   0.   0.   0.
          REF  1   'R-10'
          COM  'C 0.08,MN 2.0,SI 1.0,P 0.045,S 0.03,CR 16.0-18.0,NI 10.0-14.0,MO 2.0-3.0'
          SSR  223.,T,,1
               1.0E-4, 4, 0.0002 256., 0.0005 292., 0.0010 312., 0.0020 337.
          SSR  253.,T,,1
               1.0E-4, 4, 0.0002 232., 0.0005 259., 0.0010 275., 0.0020 288.
          SSR  273.,T,,1
               1.0E-4, 4, 0.0002 208., 0.0005 233., 0.0010 253., 0.0020 262.
          SSR  293.,T,,1
               1.0E-4, 4, 0.0002 198., 0.0005 213., 0.0010 223., 0.0020 235.
          SSR  373.,T,,1
               1.0E-4, 4, 0.0002 152., 0.0005 165., 0.0010 176., 0.0020 184.
          SSR  473.,T,,1
               1.0E-4, 4, 0.0002 128., 0.0005 137., 0.0010 143., 0.0020 152.
          SSR  573.,T,,1
               1.0E-4, 4, 0.0002 121., 0.0005 127., 0.0010 131., 0.0020 139.
          SSR  673.,T,,1
               1.0E-4, 4, 0.0002 111., 0.0005 117., 0.0010 122., 0.0020 130.
          *
          MAT  'SUS304'       2010,0,0,0,0,4
               0.   0.   0.   0.
          REF  1   'R-10'
          SSR  297.,T,,1
               1.0E-4, 7, 0.002 235.5, 0.005 276.5, 0.010 295. , 0.015 306. ,
                          0.020 317. , 0.030 336.5, 0.040 405.
          SSR  366.,T,,1
               1.0E-4, 7, 0.002 198. , 0.005 228.5, 0.010 251.5, 0.015 263.5,
                          0.020 271.5, 0.030 283.5, 0.040 296.5
          SSR  477.,T,,1
               1.0E-4, 7, 0.002 169. , 0.005 194. , 0.010 216. , 0.015 229.5,
                          0.020 243.5, 0.030 267. , 0.040 290.5

          ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                   1         2         3         4         5         6         7         8
```

Appendix G (Continued)

```
DATA              1         2         3         4         5         6         7         8
SEQ. NO.     ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

SSR  589.,T,,1
     1.0E-4, 7, 0.002 149.5, 0.005 172. , 0.010 190. , 0.015 201.5,
                0.020 211.5, 0.030 231. , 0.040 248.
*
MAT  'SUS316'        2011,0,0,0,0,4
     0.   0.   0.   0.
REF  1   'R-10'
SSR  297.,T,,1
     1.0E-4, 7, 0.002 264. , 0.005 308. , 0.010 330. , 0.015 344.5,
                0.020 371.5, 0.030 393. , 0.040 418.
SSR  366.,T,,1
     1.0E-4, 7, 0.002 233.5, 0.005 276.5, 0.010 299.5, 0.015 315.5,
                0.020 338.5, 0.030 354.5, 0.040 351.
SSR  477.,T,,1
     1.0E-4, 7, 0.002 200.5, 0.005 232.5, 0.010 255. , 0.015 269. ,
                0.020 292.5, 0.030 308. , 0.040 327.
SSR  589.,T,,1
     1.0E-4, 7, 0.002 192.5, 0.005 216. , 0.010 234. , 0.015 250.5,
                0.020 273. , 0.030 294. , 0.040 319.5
*
MAT  'SUS316L'       2012,0,0,0,0,2
     0.   0.   0.   0.
REF  1   'R-27'
SSR2 293.,T,,4,9
                0.02, 0.05, 0.10, 0.14, 0.18, 0.22, 0.26, 0.34, 0.41
     3.9E-3, 9, 383.  450.  538.  612.  680.  743.  797.  892.  965.
     1.5E+1, 8, 515.  571.  642.  708.  768.  818.  863.  952.
     4.3E+1, 8, 567.  626.  691.  768.  827.  873.  919. 1001.
     4.1E+2, 7, 605.  691.  755.  827.  890.  936.  971.
SSR2 673.,T,,4,7
                0.02, 0.05, 0.10, 0.14, 0.18, 0.22, 0.26
     2.9E-3, 7, 309.  362.  433.  494.  547.  594.  623.
     4.4E+1, 6, 368.  416.  473.  531.  561.  589.
     6.9E+1, 6, 403.  452.  505.  550.  579.  599.
     4.6E+2, 5, 367.  435.  496.  551.  574.
*
MAT  'SUS316L'       2013,0,0,0,0,2
     0.   0.   0.   0.
REF  1   'R-27'
SSR  293.,T,,5
     1.0E-2, 1, 0.002 314.
     1.0E-1, 1, 0.002 356.
     1.0   , 1, 0.002 394.
     1.0E+1, 1, 0.002 437.
     1.0E+2, 1, 0.002 481.
SSR  673.,T,,5
     1.0E-2, 1, 0.002 242.
     1.0E-1, 1, 0.002 255.
     1.0   , 1, 0.002 270.
     1.0E+1, 1, 0.002 286.

             ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                      1         2         3         4         5         6         7         8
```

Appendix G (Continued)

```
DATA              1         2         3         4         5         6         7         8
SEQ. NO.     ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

     1.0E+2, 1, 0.002 331.
*
MAT  'SUS304'        2014,0,0,0,0,1
     0.   0.   0.   0.
REF  1   'R-4'
SSR  293.,T,,10
     1.000E-3, 1, 0.002 237.
     1.001E-3, 1, 0.002 250.
     1.002E-3, 1, 0.002 336.
     1.003E-3, 1, 0.002 272.
     1.004E-3, 1, 0.002 273.
     1.005E-3, 1, 0.002 346.
     1.006E-3, 1, 0.002 270.
     1.007E-3, 1, 0.002 230.
     1.008E-3, 1, 0.002 320.
     1.009E-3, 1, 0.002 344.
*               SUS 18-8
MAT  'SUS 18-8'      2015,0,0,0,0,2
     0.   0.   0.   0.
REF  1   'R-46'
COM  'NI 9.15,CR 18.27,C 0.06,MN 1.62,S 0.01,N 0.019,SI 0.39,P 0.026,CU 0.01'
SSR2 206.,T,,3,9
                0.026,0.052,0.078,0.104,0.154,0.208,0.260,0.313,0.365
     5.45E-4,8,  366.  446.  555.  664.  869. 1087. 1281. 1396.
     4.99E-2,9,  431.  494.  555.  621.  784.  969. 1132. 1311. 1426.
     4.8E+1 ,9,  564.  642.  719.  784.  913. 1034. 1176. 1258. 1278.
SSR  293.,T,,3
     5.05E-4,9, 0.026 315., 0.053 362., 0.077 407., 0.102 446.,
                0.147 514., 0.202 597., 0.250 666., 0.303 733.,
                0.351 801.
     6.26E-2,9, 0.026 335., 0.053 382., 0.077 428., 0.102 467.,
                0.147 538., 0.202 614., 0.250 691., 0.303 746.,
                0.351 814.
     5.48E+1,9, 0.027 457., 0.053 499., 0.077 534., 0.102 573.,
                0.152 641., 0.202 727., 0.250 792., 0.303 861.,
                0.351 920.
*
MAT  'SUS304'        2016,0,0,0,0,2
     0.   0.   0.   0.
REF  1   'R-46'
COM  'N 9.15,CR 18.27,C 0.06,SI 0.39,MN 1.62,P 0.026,S 0.010'
SSR  207.,T,,3
     5.45E-4,9, 0.      273., 0.024  360., 0.049  447., 0.076  556.,
                0.104  665., 0.152  866., 0.200 1085., 0.251 1272.,
                0.300 1400.
     4.99E-2,9, 0.      337., 0.024  435., 0.049  490.,
                0.104  621., 0.152  790., 0.200  964., 0.251 1143.,
                0.300 1309., 0.352 1428.
     4.8E+1,10, 0.      463., 0.024  553., 0.049  643., 0.076  714.,
                0.104  785., 0.152  904., 0.200 1037., 0.251 1177.,

             ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                      1         2         3         4         5         6         7         8
```

Appendix G (Continued)

```
 DATA             1         2         3         4         5         6         7         8
SEQ. NO.  ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

                    0.300 1251., 0.352 1283.
          SSR2 293.,T,,3,10
                  0.    ,0.026,0.052,0.078,0.104,0.154,0.206,0.257,0.308,0.358
            5.05E-4,10, 249.  313.  362.  408.  446.  519.  596.  671.  734.  804.
            6.26E-2,10, 257.  335.  388.  428.  471.  541.  612.  694.  749.  812.
            5.48E+1,10, 392.  458.  500.  538.  576.  638.  730.  792.  867.  926.
          *
          MAT  'SUS304'       2017,0,0,0,0,1
               0.   0.   0.   0.
          REF  1   'R-48'
          COM 'C 0.079,SI 0.360,MN 1.660,CR 18.350,NI 10.030,MO 0.060'
          SSR2 293.,C,,4,8
                    0.0253,0.0513,0.0780,0.1054,0.1335,0.1625,0.1924,0.2231
               1.1E-4, 6, 413.   466.   508.   556.   622.   687.
               1.1E-2, 8, 413.   475.   535.   591.   652.   716.   784.   855.
               1.3E+2, 4, 586.   624.   662.   697.
               3.1E+2, 6, 599.   642.   710.   773.   831.   894.
          *
          MAT  'SUS304'       2018,0,0,0,0,1
               0.   0.   0.   0.
          REF  1   'R-48'
          COM  'C 0.079,SI 0.360,MN 1.660,CR 18.350,NI 10.030,MO 0.060'
          SSR2 293.,C,,4,7
                    0.0253,0.0513,0.0780,0.1054,0.1335,0.1625,0.1924
               1.2E-4, 5, 387.   439.   505.   562.   623.
               1.2E-2, 6, 400.   473.   540.   607.   683.   759.
               2.1E+2, 5, 584.   646.   700.   755.   814.
               3.9E+2, 7, 584.   646.   712.   775.   839.   902.   963.
          *
          MAT  'SUS304'       2019,0,0,0,0,1
               0.   0.   0.   0.
          REF  1   'R-48'
          COM  'C 0.077,SI 0.280,MN 1.730,CR 18.490,NI 8.920,MO 0.050'
          SSR2 293.,C,,4,8
                    0.0253,0.0513,0.0780,0.1054,0.1335,0.1625,0.1924,0.2233
               1.1E-4, 4, 413.   466.   521.   591.
               1.1E-2, 8, 423.   484.   553.   613.   682.   758.   841.   925.
               1.5E+2, 4, 595.   633.   675.   697.
               2.8E+2, 6, 624.   680.   734.   785.   840.   875.
          *
          MAT  'SUS304'       2020,0,0,0,0,1
               0.   0.   0.   0.
          REF  1   'R-48'
          COM  'C 0.077,SI 0.280,MN 1.730,CR 18.490,NI 8,920,MO 0.050'
          SSR2 293.,C,,4,8
                    0.0253,0.0513,0.0780,0.1054,0.1335,0.1625,0.1924,0.2231
               1.2E-4, 5, 375.   433.   490.   560.   639.
               1.2E-2, 8, 394.   461.   512.   573.   639.   708.   784.   870.
               2.7E+2, 5, 538.   587.   639.   692.   750.
               3.8E+2, 8, 605.   661.   725.   785.   849.   908.   962.   996.

          ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                   1         2         3         4         5         6         7         8
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Appendix G (Continued)

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 DATA             1         2         3         4         5         6         7         8
SEQ. NO.  ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

          *
          MAT  'SUS304'       2021,0,0,0,0,1
               0.   0.   0.   0.
          REF  1   'R-48'
          COM  'C 0.080,SI 0.280,MN 1.710,CR 18.050,NI 7.890,MO 0.050'
          SSR2 293.,C,,4,7
                    0.0253,0.0513,0.0780,0.1054,0.1335,0.1625,0.1924
               1.0E-4, 4, 408.   475.   539.   609.
               1.0E-2, 7, 442.   498.   567.   639.   716.   791.   885.
               6.3E+1, 4, 592.   653.   721.   775.
               3.4E+2, 6, 643.   698.   752.   807.   866.   908.
          *
          MAT  'SUS304'       2022,0,0,0,0,1
               0.   0.   0.   0.
          REF  1   'R-48'
          COM  'C 0.080,SI 0.280,MN 1.710,CR 18.050,NI 7.890,MO 0.050'
          SSR2 293.,C,,4,6
                    0.0253,0.0513,0.0780,0.1054,0.1335,0.1625
               1.2E-4, 5, 389.   448.   502.   558.   613.
               1.2E-2, 6, 401.   471.   534.   603.   673.   738.
               1.9E+2, 4, 547.   601.   649.   709.
               3.9E+2, 6, 577.   637.   694.   758.   814.   876.
          *
          MAT  'SUS304'       2023,0,0,0,0,1
               0.   0.   0.   0.
          REF  1   'R-48'
          COM  'C 0.069,SI 0.380,MN 1.800,CR 18.580,NI 10.350,MO 0.020'
          SSR2 293.,C,,4,8
                    0.0253,0.0513,0.0780,0.1054,0.1335,0.1625,0.1924,0.2231
               1.0E-4, 5, 331.   386.   435.   494.   562.
               1.0E-2, 8, 355.   400.   449.   507.   557.   612.   671.   733.
               1.9E+2, 4, 475.   521.   576.   626.
               3.8E+2, 7, 499.   545.   594.   644.   699.   762.   809.
          *
          MAT  'SUS304'       2024,0,0,0,0,1
               0.   0.   0.   0.
          REF  1   'R-48'
          COM  'C 0.069,SI 0.380,MN 1.800,CR 18.580,NI 10.350,MO 0.020'
          SSR2 293.,C,,4,8
                    0.0253,0.0513,0.0780,0.1054,0.1335,0.1625,0.1924,0.2231
               1.2E-4, 5, 307.   363.   412.   467.   536.
               1.2E-2, 8, 312.   368.   422.   476.   540.   608.   679.   753.
               2.8E+2, 6, 456.   507.   571.   631.   690.   758.
               5.3E+2, 8, 461.   521.   580.   635.   699.   762.   825.   886.
          *
          MAT  'SUS304'       2025,0,0,0,0,1
               0.   0.   0.   0.
          REF  1   'R-48'
          COM  'C 0.079,SI 0.320,MN 1.660,CR 18.160,NI 10.140,MO 0.060'
          SSR2 293.,C,,4,8

          ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                   1         2         3         4         5         6         7         8
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Appendix G (Continued)

```
DATA          1         2         3         4         5         6         7         8
SEQ. NO. ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

                     0.0253,0.0513,0.0780,0.1054,0.1335,0.1625,0.1924,0.2231
         1.1E-4, 6, 451.   512.   553.   613.   677.   733.
         1.1E-2, 8, 466.   535.   589.   653.   737.   808.   889.   964.
         7.8E+1, 3, 668.   709.   751.
         2.4E+2, 5, 730.   768.   807.   842.   858.
*
MAT  'SUS304'       2026,0,0,0,0,1
     0.   0.   0.   0.
REF  1   'R-48'
COM  'C 0.079,SI 0.320,MN 1.660,CR 18.160,NI 10.140,MO 0.060'
SSR2 293.,C,,4,8
                     0.0253,0.0513,0.0780,0.1054,0.1335,0.1625,0.1924,0.2231
         1.2E-4, 4, 346.   405.   453.   520.
         1.2E-2, 8, 375.   433.   485.   538.   600.   662.   728.   804.
         1.6E+2, 4, 634.   679.   722.   751.
         3.0E+2, 5, 668.   724.   769.   813.   846.
*
MAT  'SUS304'       2027,0,0,0,0,1
     0.   0.   0.   0.
REF  1   'R-48'
COM  'C 0.016,SI 0.310,MN 1.830,CR 18.300,NI 10.330,MO 0.030'
SSR2 293.,C,,4,6
                     0.0253,0.0513,0.0780,0.1054,0.1335,0.1625
         1.1E-4, 5, 370.   419.   467.   520.   579.
         1.1E-2, 6, 394.   452.   512.   551.   609.   675.
         1.7E+2, 4, 562.   605.   648.   675.
         3.5E+2, 6, 576.   638.   684.   741.   793.   841.
*
MAT  'SUS304'       2028,0,0,0,0,1
     0.   0.   0.   0.
REF  1   'R-48'
COM  'C 0.016,SI 0.310,MN 1.830,CR 18.300,NI 10.330,MO 0.030'
SSR2 293.,C,,4,7
                     0.0253,0.0513,0.0780,0.1054,0.1335,0.1625,0.1924
         1.2E-4, 5, 334.   389.   448.   503.   558.
         1.2E-2, 6, 370.   429.   484.   542.   598.   654.
         2.4E+2, 5, 543.   591.   648.   706.   755.
         4.8E+2, 7, 567.   614.   675.   723.   789.   825.   861.
*
MAT  'SUS304'       2029,0,0,0,0,1
     0.   0.   0.   0.
REF  1   'R-48'
COM  'C 0.047,SI 0.320,MN 1.720,CR 18.470,NI 10.060,MO 0.060'
SSR2 293.,C,,4,6
                     0.0253,0.0513,0.0780,0.1054,0.1335,0.1625
         1.1E-4, 5, 394.   442.   503.   551.   609.
         1.1E-2, 6, 420.   478.   532.   588.   642.   683.
         1.5E+2, 4, 567.   605.   635.   662.
         3.1E+2, 6, 595.   642.   703.   754.   802.   841.
*

         ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                  1         2         3         4         5         6         7         8
```

Appendix G (Continued)

```
DATA          1         2         3         4         5         6         7         8
SEQ. NO. ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

MAT  'SUS304'       2030,0,0,0,0,1
     0.   0.   0.   0.
REF  1   'R-48'
COM  'C 0.047,SI 0.320,MN 1.720,CR 18.470,NI 10.060,MO 0.060'
SSR2 293.,C,,4,8
                     0.0253,0.0513,0.0780,0.1054,0.1335,0.1625,0.1924,0.2231
         1.2E-4, 6, 365.   419.   480.   529.   587.   658.
         1.2E-2, 8, 384.   438.   490.   556.   609.   671.   744.   808.
         2.2E+2, 5, 571.   624.   671.   714.   746.
         4.3E+2, 7, 576.   633.   680.   750.   815.   875.   938.
*
MAT  'SUS304'       2031,0,0,0,0,1
     0.   0.   0.   0.
REF  1   'R-48'
COM  'C 0.073,SI 0.570,MN 1.600,CR 18.760,NI 8.370,MO 0.210'
SSR2 293.,C,,4,7
                     0.0253,0.0513,0.0780,0.1054,0.1335,0.1625,0.1924
         1.1E-4, 4, 384.   447.   521.   604.
         1.1E-2, 7, 399.   461.   521.   600.   673.   754.   845.
         1.7E+2, 4, 538.   587.   621.   662.
         3.5E+2, 5, 547.   605.   671.   745.   815.
*
MAT  'SUS304'       2032,0,0,0,0,1
     0.   0.   0.   0.
REF  1   'R-48'
COM  'C 0.073,SI 0.570,MN 1.600,CR 18.760,NI 8.370,MO 0.210'
SSR2 293.,C,,4,7
                     0.0253,0.0513,0.0780,0.1054,0.1335,0.1625,0.1924
         1.2E-4, 5, 341.   410.   490.   564.   656.
         1.2E-2, 7, 360.   438.   512.   591.   669.   758.   857.
         2.4E+2, 5, 509.   577.   644.   710.   750.
         4.8E+2, 7, 499.   568.   640.   708.   755.   816.   873.
*
MAT  'SUS304'       2033,0,0,0,0,2
     0.   0.   0.   0.
REF  1   'R-51'
COM  'NI 8.90,CR 18.63,C 0.08,SI 0.71,MN 1.67,P 0.028,S 0.008'
SSR  293.,T,,10
     1.010E-4 ,1, 0.009  375.
     9.8      ,1, 0.019  453.
     5.8E+1 ,1, 0.028  504.
     1.7E+2 ,1, 0.058  572.
     3.5E+2 ,1, 0.110  674.
     4.0E+2 ,1, 0.162  763.
     4.95E+2,1, 0.209  845.
     5.81E+2,1, 0.295 1000.
     5.92E+2,1, 0.418 1165.
     8.29E+2,1, 0.450 1203.
SSR  673.,T,,6
     1.000E-4, 1, 0.110  379.

         ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                  1         2         3         4         5         6         7         8
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Appendix G (Continued)

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         1         2         3         4         5         6         7         8
----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

        1.001E-4, 1, 0.162  437.
        1.002E-4, 1, 0.209  493.
        7.4    , 1, 0.295  561.
        7.5    , 1, 0.063  295.
        9.3    , 1, 0.256  528.
*
MAT     'SUS304'        2034,0,0,0,0,1
        0.    0.    0.    0.
REF     1    'R-51'
COM     'NI 8.90,CR 18.63,C 0.08,SI 0.71,MN 1.67,P 0.028,S 0.008'
SSR     293.,T,,1
        2.0E+1, 6, 0.0016 294., 0.0027 354., 0.0102 423., 0.0131 438.,
                   0.0161 445., 0.0198 460.
*
MAT     'SUS304'        2100,7,7,7,7,0
        14.3E-6, 194000., 76700., 0.266
        14.3E-6  293., 15.1E-6  373., 16.1E-6  473., 16.9E-6  573.,
        17.3E-6  673., 17.9E-6  773., 18.3E-6  873.
        194000.  293., 190000.  373., 184000.  473., 177000.  573.,
        169000.  673., 159000.  773., 149000.  873.
        76700.   293., 74800.   373., 72100.   473., 68600.   573.,
        65100.   673., 61000.   773., 56900.   873.
        0.266    293., 0.272    373., 0.279    473., 0.287    573.,
        0.295    673., 0.302    773., 0.310    873.
*
MAT     'SUS316'        2200,7,7,7,7,0
        15.2E-6, 194000., 76700., 0.266
        15.2E-6  293., 15.8E-6  373., 16.5E-6  473., 17.2E-6  573.,
        17.7E-6  673., 18.1E-6  773., 18.6E-6  873.
        194000.  293., 190000.  373., 184000.  473., 177000.  573.,
        169000.  673., 159000.  773., 149000.  873.
        76700.   293., 74800.   373., 72100.   473., 68600.   573.,
        65100.   673., 61000.   773., 56900.   873.
        0.266    293., 0.272    373., 0.279    473., 0.287    573.,
        0.295    673., 0.302    773., 0.310    873.
*
MAT     'PURE LEAD'     3001,0,0,0,0,5
        0.    0.    0.    0.
REF 1       'R-1'
SSR2 295.,C,,4,7
                  0.1,  0.2,  0.3,  0.5,  1.0,  1.5,  2.0
        0.4    , 7, 11.0  16.5  20.7  26.2  32.4  34.4  34.4
        9.0    , 7, 15.2  21.4  25.5  31.0  37.9  39.3  40.0
        101.   , 7, 18.6  24.1  27.6  33.1  40.0  42.0  43.4
        311.   , 7, 21.4  26.2  29.6  35.1  41.3  44.8  46.2
SSR2 383.,C,,4,7
                  0.1,  0.2,  0.3,  0.5,  1.0,  1.5,  2.0
        0.4    , 7, 12.4  15.8  16.8  15.3  13.1  12.4  12.1
        9.0    , 7, 17.2  20.0  22.6  22.0  19.8  18.9  18.2
        101.   , 7, 19.3  26.0  29.5  29.8  27.6  26.5  25.6

----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
         1         2         3         4         5         6         7         8
```

Appendix G (Continued)

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         1         2         3         4         5         6         7         8
----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

        311.   , 7, 24.8  30.0  33.1  33.6  31.7  30.3  29.8
SSR2 443.,C,,4,7
                  0.1,  0.2,  0.3,  0.5,  1.0,  1.5,  2.0
        0.4    , 7, 11.0  13.8  12.4  11.0  10.5  10.3  10.2
        9.0    , 7, 13.8  17.8  17.9  15.6  13.5  13.5  13.6
        101.   , 7, 18.3  21.4  24.0  24.7  21.5  20.7  20.7
        311.   , 7, 23.4  28.0  29.8  30.2  26.9  25.2  24.4
SSR2 533.,C,,4,7
                  0.1,  0.2,  0.3,  0.5,  1.0,  1.5,  2.0
        0.4    , 7,  4.1   5.2   3.9   3.2   2.8   2.8   2.8
        9.0    , 7,  8.8   9.9  10.5   9.2   8.3   7.7   7.4
        101.   , 7, 12.1  14.1  14.9  14.7  13.8  13.1  12.6
        311.   , 7, 14.9  16.8  18.1  18.9  17.9  17.2  16.7
SSR2 573.,C,,4,8
                  0.05, 0.1,  0.2,  0.3,  0.5,  1.0,  1.5,  2.0
        0.4    , 8, 3.10  3.65  3.65  3.10  2.48  2.07  2.03  2.07
        9.0    , 8, 5.51  6.82  7.58  7.72  7.44  7.03  7.03  6.89
        101.   , 8, 10.0  10.7  11.9  12.7  13.0  11.4  11.1  11.1
        311.   , 8, 12.4  13.2  14.8  15.6  16.0  15.4  15.2  15.1
*
MAT     'PURE LEAD'     3002,0,0,0,0,1
        0.    0.    0.    0.
REF 1       'R-1'
SSR2 275.,C,,2,6
                  0.02, 0.04, 0.08, 0.16, 0.24, 0.32
        3.33E-4,6, 8.96  11.7  13.8  17.2  19.3  21.4
        2.0E+3 ,6, 13.8  17.9  23.4  28.9  33.1  35.8
*
MAT     'PURE LEAD'     3003,0,0,0,0,3
       0.     0.    0.    0.
REF 2       'R-1','R-10'
SSR2 273.,C,,2,5
                  0.11, 0.22, 0.36, 0.51, 0.69
        0.8    , 5, 19.6  25.8  28.8  32.6  32.6
        10.0   , 5, 21.2  28.0  33.3  36.4  39.4
SSR2 293.,C,,2,5
                  0.11, 0.22, 0.36, 0.51, 0.69
        0.8    , 5, 19.6  25.8  28.8  31.8  31.8
        10.0   , 5, 19.6  26.5  31.1  34.1  36.4
SSR     383.,C,,2
        0.8    , 5, 0.11 15.2, 0.22 18.2, 0.36 16.7, 0.51 15.9, 0.69 15.9
        10.0   , 5, 0.11 16.7, 0.22 21.2, 0.36 24.3, 0.56 24.3, 0.60 23.5
*
MAT     'LEAD'          3004,0,0,0,0,1
        0.    0.    0.    0.
REF 1       'R-1'
SSR     295.,C,,1
        5.0E+4, 8, 0.012  55.1, 0.020  89.6, 0.025 117.1, 0.032 137.8,
                   0.041 151.6, 0.050 151.6, 0.057 117.1, 0.065  68.9
*

----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
         1         2         3         4         5         6         7         8
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Appendix G (Continued)

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 DATA              1         2         3         4         5         6         7         8
SEQ. NO.  ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

  901     MAT  'PURE LEAD'    3005,0,0,0,0,4
  902          0.   0.   0.   0.
  903     REF 1      'R-10'
  904     SSR2 311.,T,,2,8
  905                    0.01, 0.03, 0.05, 0.10, 0.18, 0.26, 0.34, 0.41
  906          8.3E-5, 5, 2.16  2.98  3.69  5.15  7.52
  907          1.0E-3, 8, 2.82  5.54  7.74 10.91 14.68 16.00 11.58  0.31
  908     SSR2 352.,T,,2,9
  909                    0.01, 0.03, 0.05, 0.10, 0.18, 0.26, 0.34, 0.41, 0.47
  910          8.3E-5, 5, 1.95  2.66  3.22  4.28  5.79
  911          1.0E-3, 9, 2.80  5.04  6.51  8.72  9.43  8.15  7.23  5.58  2.15
  912     SSR2 393.,T,,2,9
  913                    0.01, 0.03, 0.05, 0.10, 0.18, 0.26, 0.34, 0.41, 0.47
  914          8.3E-5, 5, 1.57  1.99  2.32  2.99  4.05
  915          1.0E-3, 9, 2.37  3.90  4.77  5.87  5.21  5.02  4.92  4.86  4.30
  916     SSR2 436.,T,,2,9
  917                    0.01, 0.03, 0.05, 0.10, 0.18, 0.26, 0.34, 0.41, 0.47
  918          8.3E-5, 5, 1.18  1.42  1.63  1.97  2.56
  919          1.0E-3, 9, 1.74  2.63  3.18  3.68  3.22  3.18  3.09  3.05  2.98
  920     *
  921     MAT  'PURE LEAD'    3006,0,0,0,0,6
  922          0.   0.   0.   0.
  923     REF  1   'R-10'
  924     SSR2 311.,T,,2,6
  925                    0.02, 0.05, 0.10, 0.18, 0.26, 0.34
  926          8.3E-5, 6, 3.80  6.37  8.94  11.12 6.94  2.12
  927          8.3E-4, 6, 3.80  6.95  10.61 14.55 15.94 11.09
  928     SSR2 393.,T,,2,8
  929                    0.02, 0.05, 0.10, 0.18, 0.26, 0.34, 0.41, 0.47
  930          8.3E-5, 8, 2.53  3.65  3.79  5.21  3.58  3.47  3.10  1.38
  931          8.3E-4, 8, 3.37  4.70  5.84  5.29  5.02  4.82  4.81  4.41
  932     SSR2 311.,C,,1,6
  933                    0.002,0.005,0.01, 0.02, 0.03, 0.04
  934          2.5E-4, 6, 2.24  4.64  5.94  7.59  8.94  10.14
  935     SSR2 352.,C,,1,6
  936                    0.002,0.005,0.01, 0.02, 0.03, 0.04
  937          2.5E-4, 6, 1.17  3.15  4.21  5.48  6.39  7.04
  938     SSR2 393.,C,,1,6
  939                    0.002,0.005,0.01, 0.02, 0.03, 0.04
  940          2.5E-4, 6, 1.17  2.67  3.24  4.01  4.47  4.12
  941     SSR2 436.,C,,1,6
  942                    0.002,0.005,0.01, 0.02, 0.03, 0.04
  943          2.5E-4, 6, 0.76  1.90  2.23  2.67  3.09  3.08
  944     *
  945     MAT  'PURE LEAD'    3007,0,0,0,0,3
  946          0.   0.   0.   0.
  947     REF  1   'R-1'
  948     SSR2 295.,C,,9,4
  949                    0.03, 0.10, 0.30, 0.50
  950          1.0E-4, 4, 8.89  12.1  16.3  16.3

          ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                   1         2         3         4         5         6         7         8
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Appendix G (Continued)

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 DATA              1         2         3         4         5         6         7         8
SEQ. NO.  ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

  951          1.0E-3, 4, 9.85  13.8  19.6  19.6
  952          1.0E-2, 4, 10.8  15.6  22.6  23.3
  953          1.0E-1, 4, 11.8  17.4  25.3  27.0
  954          1.0   , 4, 12.7  19.2  28.0  30.9
  955          1.0E+1, 4, 13.9  20.7  31.0  34.8
  956          1.0E+2, 4, 14.7  22.7  33.8  38.5
  957          1.0E+3, 4, 15.8  24.4  36.5  42.3
  958          1.0E+4, 4, 16.7  25.4  39.3  46.0
  959     SSR   311.,C,,1
  960          1.0E-4, 2, 0.002 2.72 , -0.   6.13
  961     SSR   441.,C,,1
  962          1.0E-4, 2, 0.002 0.083, -0.   3.91
  963     *
  964     MAT  'PURE LEAD'    3008,0,0,0,0,3
  965          0.   0.   0.   0.
  966     REF  1   'R-1'
  967     SSR  293.,C,,9
  968          11.    , 1, 0.07  15.8
  969          12.    , 1, 0.13  21.4
  970          12.5   , 1, 0.21  24.8
  971          14.    , 1, 0.29  28.2
  972          15.    , 1, 0.38  31.0
  973          16.5   , 1, 0.47  33.8
  974          18.    , 1, 0.56  35.1
  975          21.    , 1, 0.70  36.5
  976          23.5   , 1, 0.83  37.9
  977     SSR2 295.,C,,7,6
  978                    0.03, 0.06, 0.12, 0.18, 0.24, 0.30
  979          1.0E-3, 6, 11.4  13.7  16.5  18.7  20.3  21.9
  980          1.0E-2, 6, 12.1  14.9  18.2  20.7  22.5  24.3
  981          1.0E-1, 6, 12.9  16.1  19.8  22.5  24.7  26.5
  982          1.0   , 6, 13.8  17.4  21.6  24.5  26.9  28.8
  983          1.0E+1, 6, 14.5  18.7  23.3  26.4  29.1  31.2
  984          1.0E+2, 6, 15.4  19.8  25.1  28.4  31.2  33.3
  985          1.0E+3, 6, 16.1  21.2  26.9  30.2  33.3  35.6
  986     SSR  503.,C,,5
  987          5.75   , 1, 0.11  16.5
  988          6.5    , 1, 0.22  21.4
  989          7.4    , 1, 0.36  23.4
  990          8.75   , 1, 0.51  23.4
  991          10.2   , 1, 0.64  22.7
  992     *
  993     MAT  'PURE LEAD'    3009,0,0,0,0,3
  994          0.   0.   0.   0.
  995     REF  1   'R-4'
  996     SSR  233.,C,,1
  997          1.7E-5, 1, 0.002  8.9
  998     SSR2 293.,C,,1,5
  999                    0.0020, 0.0021, 0.0022, 0.0023, 0.0024
 1000          1.7E-5, 5, 3.1   10.9  4.4   5.6   4.5

          ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                   1         2         3         4         5         6         7         8
```

Appendix G (Continued)

```
            1         2         3         4         5         6         7         8
   ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

   SSR  450.,C,,1
        1.7E-5, 1, 0.002  1.3
   *
   MAT  'PURE LEAD'    3010,0,1,0,0,6
        0.   1000.     0.   0.
        1000. 293.
   REF  1   'R-4'
   SSR  233.,C,,1
        1.0E-4, 1, 0.0020  2.08
   SSR  233.,C,,1
        1.001E-4, 1, 0.0020  9.02
   SSR  293.,C,,1
        1.00E-4, 1, 0.0020  3.23
   SSR  293.,C,,1
        1.001E-4, 1, 0.0020  1.45
   SSR  293.,C,,1
        1.002-4, 1, 0.0020  11.1
   SSR  450.,C,,1
        1.0E-4, 1, 0.0020  1.27
   *
   MAT  'PURE LEAD'    3011,0,1,0,0,4
        0.   0.   0.   0.
        1000. 293.
   REF  1   'R-4'
   SSR  293.,C,,1
        1.0E-4, 1, 0.0020  0.97
   SSR  293.,C,,1
        1.001E-4, 1, 0.0020  1.45
   SSR  293.,C,,1
        1.002E-4, 1, 0.0020  4.51
   SSR  293.,C,,1
        1.003E-4, 1,  0.0020  5.68
   *
   MAT  'PURE LEAD'    3012,0,1,0,0,2
        0.   0.   0.   0.
        1000. 293.
   REF  1   'R-4'
   SSR  293.,C,,1
        1.0E-4, 1, 0.0020  1.24
   SSR  293.,C,,1
        1.001E-4, 1, 0.0020  4.61
   *
   MAT  'PURE LEAD'    3013,0,0,0,0,1
        0.   0.   0.   0.
   REF  1   'R-12'
   SSR  293.,C,,3
        2.66E-5,7, 0.04  7.4, 0.10 10.8, 0.20 13.3, 0.30 14.2, 0.40 14.0,
                   0.50 13.4, 0.70 12.9
        7.82E-3,7, 0.04 11.7, 0.10 16.9, 0.20 20.4, 0.30 22.0, 0.40 22.5,
                   0.50 22.6, 0.70 22.3

   ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
            1         2         3         4         5         6         7         8
```

Appendix G (Continued)

```
            1         2         3         4         5         6         7         8
   ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

        2.31E-2,7, 0.03 10.3, 0.10 16.9, 0.20 20.4, 0.30 22.5, 0.40 23.7,
                   0.50 24.3, 0.70 24.3
   *
   MAT  'PURE LEAD'    3014,0,0,0,0,1
        0.   0.   0.   0.
   REF  1   'R-12'
   SSR  293.,T,,4
        1.02E-4,6, 0.03  4.2, 0.05  6.9, 0.10 11.4, 0.15 13.0, 0.20 14.0,
                   0.25 14.6
        1.02E-3,6, 0.03  4.2, 0.05  6.9, 0.10 12.6, 0.15 14.7, 0.20 15.8,
                   0.25 16.5
        1.02E-2,5, 0.04  6.1, 0.10 15.3, 0.15 16.8, 0.20 17.5, 0.25 17.8
        1.02E-1,5, 0.03  4.2, 0.10 15.6, 0.15 17.5, 0.20 18.2, 0.25 18.4
   *
   MAT  'PURE LEAD'    3015,0,0,0,0,1
        0.   0.   0.   0.
   REF  1   'R-12'
   SSR2 293.,C,,1,9
                   0.03, 0.05, 0.10, 0.20, 0.30, 0.40, 0.50, 0.60, 0.70
        400.  , 9, 8.3   14.5  22.3  29.4  33.2  35.7  37.5  38.8  39.9
   *
   MAT  'PB'           3016,0,0,0,0,4
        0.   0.   0.   0.
   REF  1   'R-B5'
   COM  'KANAZAWA UNIVERSITY TEST DATA'
   SSR2 423.,C,,4,20
                   0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                   0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
        8.3E-4,20,  5.4  7.4  9.2 10.3 11.2 12.0 12.5 12.7 13.1 13.5
                   13.7 13.5 13.5 13.5 13.4 13.3 13.3 13.3 13.2 13.2
        1.7E-2,20,  9.0 12.8 15.4 16.6 17.2 17.9 18.5 18.8 19.1 19.6
                   19.9 20.0 20.2 20.3 20.3 20.4 20.5 20.5 20.4 20.5
        1.7E-1,20, 10.3 13.7 15.8 17.2 18.3 19.4 20.4 21.0 21.6 22.2
                   22.6 22.8 23.0 23.1 23.2 23.3 23.2 23.4 23.4 23.3
        650.  ,20,  7.2 13.8 18.2 20.8 22.8 24.2 25.7 27.2 28.2 29.5
                   30.3 31.0 31.7 32.4 33.1 33.6 34.5 35.1 35.7 36.0
   SSR2 373.,C,,3,20
                   0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                   0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
        8.3E-4,15,  5.1  7.4  9.2 10.2 11.0 11.8 12.4 12.6 12.8 12.8
                   12.6 12.5 12.3 12.3 12.3
        1.7E-2,20,  9.6 14.2 16.5 17.7 18.8 19.3 20.0 20.3 20.8 21.3
                   21.6 21.5 21.7 21.9 22.1 22.2 22.1 22.3 22.3 22.5
        1.7E-1,20,  9.4 13.9 16.3 18.1 19.5 20.1 20.8 21.6 22.5 23.0
                   23.4 23.8 23.9 24.4 24.4 24.7 24.9 24.9 24.8 24.6
   SSR2 293.,C,,8,20
                   0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                   0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
        1.7E-4,20,  5.1  7.6  9.1 10.2 11.3 11.7 12.0 12.4 12.8 13.1
                   13.3 13.3 13.3 13.4 13.4 13.5 13.5 13.6 13.6 13.7

   ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
            1         2         3         4         5         6         7         8
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Appendix G (Continued)

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DATA           1         2         3         4         5         6         7         8
SEQ. NO.  ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

          3.2E-4,17,  6.5  7.6  9.0 10.4 11.7 12.4 13.2 13.8 14.8 15.5
                     16.3 16.8 17.2 17.6 17.9 18.3 18.8
          9.7E-3,12,  6.8  8.6 10.0 11.6 12.5 13.4 14.4 15.4 16.2 16.8
                     17.3 17.8
          1.7E-2,20,  8.3 11.2 13.1 15.0 16.5 17.6 18.3 19.4 19.8 20.7
                     21.1 21.6 21.9 22.4 22.6 22.6 22.7 22.8 23.1 23.2
          1.7E-1,20,  8.0 12.0 14.5 16.7 18.6 19.7 20.7 21.5 21.9 22.1
                     22.6 23.0 23.2 23.6 23.7 24.0 24.1 24.3 24.3 24.4
          0.89   ,20,  7.7  8.6 10.0 11.5 12.3 13.8 14.9 15.9 16.8 17.5
                     18.4 19.1 19.8 20.2 20.7 21.1 21.7 22.1 22.5 23.0
          400.   ,13,  9.7 12.9 14.7 17.0 18.1 19.4 20.6 22.0 23.3 24.4
                     25.3 26.3 27.1
          650.   ,20, 11.8 16.5 19.4 21.9 24.4 26.2 27.9 29.7 31.1 32.2
                     33.1 34.1 34.8 35.4 36.3 36.8 37.6 38.0 38.7 39.2
      SSR2 223.,C,,4,20
                     0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                     0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
          8.3E-4,20,  6.4  8.9 10.5 12.1 13.4 14.6 15.5 16.3 16.9 17.5
                     17.7 18.2 18.6 19.2 19.2 19.3 19.3 19.3 19.2 19.1
          1.7E-2,20,  9.4 12.2 14.5 16.1 17.3 18.3 19.0 19.9 20.4 20.9
                     21.6 22.1 22.3 22.5 22.7 22.8 23.1 23.1 23.4 23.4
          1.7E-1,20, 10.6 13.8 16.0 17.8 19.3 20.6 21.8 22.8 23.4 23.9
                     24.5 24.9 25.3 25.4 25.6 26.0 26.1 26.1 26.3 26.1
          650.   ,20, 13.7 16.2 19.3 21.9 23.8 25.9 27.7 29.2 30.4 31.5
                     32.6 33.4 34.1 35.3 36.2 36.7 37.4 38.3 38.6 39.1
      *
      MAT  'PB2'            3017,0,0,0,0,4
           0.   0.   0.   0.
      REF  1   'R-85'
      COM  'KANAZAWA UNIVERSITY TEST DATA'
      SSR2 423.,C,,4,20
                     0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                     0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
          8.3E-4,20, 12.7 15.1 16.4 16.9 17.5 18.1 18.4 18.6 19.0 19.3
                     19.5 19.9 20.5 20.7 21.0 21.3 21.4 21.9 21.6 21.8
          1.7E-2,20, 18.1 20.2 21.7 23.1 24.2 24.9 25.5 26.2 26.6 26.9
                     27.3 27.8 28.1 28.2 28.6 28.8 28.8 28.6 28.7 28.6
          1.7E-1,20, 17.6 21.0 23.1 24.7 26.4 27.7 28.3 29.3 30.1 30.8
                     31.6 32.2 32.4 33.2 33.7 34.2 34.6 35.1 35.3 35.4
          650.   ,20, 10.9 17.9 23.5 27.4 30.5 32.6 34.8 36.5 37.5 38.9
                     40.2 41.1 41.8 42.4 43.1 43.7 44.1 44.6 45.2 45.8
      SSR2 373.,C,,3,20
                     0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                     0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
          8.3E-4,20, 13.9 16.5 17.6 18.2 19.0 19.3 19.5 19.8 20.0 20.4
                     20.7 20.7 20.9 21.2 21.5 21.5 21.9 21.9 22.0 22.2
          1.7E-2,20, 19.2 21.6 23.3 24.7 26.2 26.8 27.4 28.4 28.7 28.9
                     29.1 29.3 29.7 29.9 30.1 30.2 30.3 30.4 30.4 30.5
          1.7E-1,20, 16.7 20.6 23.1 24.9 26.3 27.7 28.8 30.2 31.0 32.0
                     32.8 33.8 34.0 34.5 35.1 35.5 35.9 36.3 36.7 37.0

          ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                   1         2         3         4         5         6         7         8
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Appendix G (Continued)

```
DATA           1         2         3         4         5         6         7         8
SEQ. NO.  ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

      SSR2 293.,C,,8,20
                     0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                     0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
          1.7E-4,20, 13.4 16.1 17.8 19.2 20.5 21.4 22.6 23.3 24.2 25.1
                     25.5 25.9 26.6 26.9 27.3 27.8 28.2 28.7 28.9 29.2
          3.2E-4,16, 16.3 19.7 21.9 22.6 23.3 24.2 25.1 26.0 26.5 26.9
                     27.2 27.6 27.9 28.3 28.7 29.0
          1.5E-2,18, 16.5 20.7 22.8 25.0 26.6 27.9 28.5 29.6 30.5 31.1
                     31.4 31.8 32.0 32.3 32.7 33.2 33.5 33.8
          1.7E-2,20, 16.0 20.1 22.3 24.0 25.0 26.5 27.3 28.5 29.7 30.5
                     31.4 32.5 32.9 33.7 34.3 34.8 35.3 35.8 36.2 36.5
          1.7E-1,20, 16.8 20.9 23.9 26.7 28.8 30.4 31.9 33.4 34.6 35.5
                     36.2 37.0 37.6 38.1 38.6 38.8 39.1 39.4 39.5 39.7
          0.96   ,19, 17.9 20.2 23.8 25.9 27.9 29.5 30.9 31.2 32.4 33.2
                     33.8 34.3 34.9 35.4 35.9 36.4 36.8 36.8 37.2
          430.   ,16, 19.4 25.0 28.5 31.6 33.1 34.6 35.7 37.0 38.0 39.0
                     40.0 40.7 41.6 42.6 42.8 43.2
          650.   ,20, 25.3 30.0 33.5 35.6 37.8 39.6 41.1 42.8 44.2 45.6
                     47.0 47.9 49.1 50.1 51.1 51.6 52.3 53.1 53.8 54.2
      SSR2 233.,C,,4,20
                     0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                     0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
          8.3E-4,20, 12.4 15.9 18.8 20.5 22.0 23.5 24.4 25.5 26.2 27.1
                     27.9 29.0 29.6 30.4 31.1 31.7 32.2 32.8 33.2 33.6
          1.7E-2,20, 18.6 22.8 25.6 27.3 28.3 29.5 30.3 31.6 32.5 33.4
                     34.1 35.0 35.5 36.0 36.8 37.4 37.8 38.4 38.8 39.2
          1.7E-1,20, 20.6 24.8 27.7 29.7 31.1 32.7 33.9 35.3 36.0 37.1
                     37.9 39.0 39.6 40.5 41.4 41.9 42.4 43.0 43.4 44.2
          650.   ,20, 23.4 28.3 33.0 36.3 39.6 42.0 44.0 45.9 47.4 48.7
                     49.7 50.9 51.9 52.6 53.8 54.3 55.0 55.9 56.5 57.1
      *
      MAT  'PB4'            3018,0,0,0,0,4
           0.   0.   0.   0.
      REF  1   'R-85'
      COM  'KANAZAWA UNIVERSITY TEST DATA'
      SSR2 423.,C,,4,20
                     0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                     0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
          8.3E-4,20, 15.5 17.9 19.2 19.9 20.6 21.0 21.7 22.2 22.5 22.9
                     23.3 23.4 23.7 24.0 24.2 24.5 24.7 24.9 24.9 25.0
          1.7E-2,20, 21.9 25.8 27.3 28.7 29.3 29.6 30.3 30.9 31.3 31.5
                     31.8 31.9 32.5 32.8 32.8 32.9 33.0 32.8 32.9 32.8
          1.7E-1,20, 22.2 25.5 27.9 29.7 31.1 32.5 33.4 34.2 35.1 35.8
                     36.3 37.2 37.6 38.1 38.7 39.1 39.3 39.7 40.4 40.6
          650.   ,20, 15.6 24.3 30.9 34.9 38.0 40.4 42.6 45.0 46.4 47.8
                     49.0 50.4 51.3 52.4 53.4 53.9 54.8 55.3 55.7 56.3
      SSR2 373.,C,,3,20
                     0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                     0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
          8.3E-4,20, 16.2 18.5 19.7 20.6 21.2 21.7 22.0 22.5 22.5 22.9

          ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                   1         2         3         4         5         6         7         8
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Appendix G (Continued)

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DATA              1         2         3         4         5         6         7         8
SEQ. NO.  ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

                    23.2 23.5 23.5 23.6 23.8 23.9 23.9 24.1 24.4 24.2
          1.7E-2,20, 21.5 24.2 26.0 27.5 28.7 29.6 30.5 31.3 31.9 32.5
                    33.1 33.5 33.8 34.1 34.5 34.6 34.6 34.9 34.9 34.9
          1.7E-1,20, 22.2 25.3 27.6 29.6 31.2 32.4 33.3 34.4 35.3 36.2
                    37.1 37.8 38.2 38.7 39.3 39.9 40.3 40.6 41.2 41.7
     SSR2 293.,C,,8,20
                    0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                    0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
          1.7E-4,20, 16.3 18.6 20.3 21.6 23.1 24.1 24.9 26.1 26.7 27.5
                    28.2 29.0 29.3 29.6 30.2 30.4 30.8 31.3 31.6 31.8
          2.9E-4,16, 17.9 22.5 25.7 26.9 27.5 29.1 30.2 31.2 31.9 32.6
                    33.3 33.9 34.4 34.9 35.2 35.5
          1.6E-2,18, 18.4 24.0 27.1 28.7 30.3 31.7 33.1 33.9 34.7 35.5
                    36.0 36.5 37.0 37.5 37.9 38.4 38.9 39.1
          1.7E-2,20, 21.6 26.9 29.5 31.3 32.4 33.7 35.0 36.0 37.1 37.7
                    38.5 39.2 39.5 40.1 40.9 41.3 41.6 42.3 42.7 42.9
          1.7E-1,20, 21.4 25.1 28.2 30.5 32.8 34.4 36.3 37.7 39.1 40.3
                    41.4 42.6 43.2 44.2 45.3 46.0 46.9 47.5 48.3 48.9
          0.80  ,18, 22.8 26.0 29.5 32.2 34.3 36.0 37.7 38.4 39.4 40.1
                    40.9 41.6 42.1 42.7 43.6 44.0 44.4 44.6
          420.  ,15, 24.7 29.3 34.7 36.8 38.9 40.6 41.6 42.7 43.9 44.8
                    45.3 45.9 46.5 46.8 47.2
          650.  ,20, 32.8 38.1 42.0 45.9 48.7 50.9 53.1 54.7 56.1 57.3
                    58.2 59.4 60.2 61.0 62.3 62.8 63.6 64.2 65.0 65.4
     SSR2 233.,C,,4,20
                    0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                    0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
          8.3E-4,20, 18.5 21.8 24.3 26.1 27.4 28.7 29.5 30.2 31.1 31.8
                    32.5 33.1 33.7 34.2 34.8 35.3 35.8 36.3 36.5 36.9
          1.7E-2,20, 24.3 29.7 32.3 34.1 35.4 36.1 37.3 38.2 38.9 39.5
                    40.2 40.8 41.1 41.7 42.1 42.4 42.7 43.3 43.8 44.0
          1.7E-1,20, 23.4 27.8 30.9 33.2 35.4 37.3 39.0 40.5 41.9 43.0
                    44.1 45.3 46.5 47.6 48.7 49.4 50.2 51.1 51.6 52.5
          650.  ,20, 33.7 38.2 42.3 46.0 49.0 51.6 54.0 55.4 57.1 58.7
                    60.0 61.2 62.5 63.4 64.3 65.2 65.9 66.8 67.3 67.7
     *
     MAT  'PB6'          3019,0,0,0,0,4
          0.   0.   0.   0.
     REF  1   'R-85'
     COM  'KANAZAWA UNIVERSITY TEST DATA'
     SSR2 423.,C,,4,20
                    0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                    0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
          8.3E-4,20, 19.5 21.9 23.0 23.8 24.3 24.8 25.4 25.9 26.0 26.4
                    26.7 27.0 27.0 27.3 27.4 27.6 27.7 27.6 27.8 27.8
          1.7E-2,20, 24.4 27.8 29.2 30.1 30.9 31.6 32.1 32.7 32.9 33.4
                    33.5 33.9 34.2 34.5 34.6 34.8 34.7 34.9 34.8 34.8
          1.7E-1,20, 25.4 29.4 31.9 33.2 34.9 36.1 37.2 37.9 38.7 39.3
                    40.2 41.1 41.7 42.3 43.1 43.5 43.7 44.2 44.4 44.7
          650.  ,20, 26.8 33.7 38.1 41.7 44.3 46.8 48.7 50.6 52.1 53.0

          ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                   1         2         3         4         5         6         7         8
```

Appendix G (Continued)

```
DATA              1         2         3         4         5         6         7         8
SEQ. NO.  ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

                    54.2 55.1 55.7 56.2 56.8 57.4 57.7 58.4 58.8 59.2
     SSR2 373.,C,,3,20
                    0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                    0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
          8.3E-4,20, 19.6 23.8 24.9 25.4 25.9 26.2 26.6 27.0 27.3 27.4
                    27.6 28.0 28.1 28.3 28.7 28.9 29.0 29.3 29.4 29.5
          1.7E-2,20, 24.0 27.1 29.1 30.4 31.4 32.5 33.1 33.9 34.3 34.8
                    35.1 35.6 35.9 36.1 36.3 36.3 36.9 36.8 37.2 37.1
          1.7E-1,20, 26.0 30.5 32.9 34.7 36.5 37.4 38.3 39.4 40.1 41.4
                    42.1 42.8 43.4 43.9 44.5 45.0 45.5 45.9 46.5 46.8
     SSR2 293.,C,,8,20
                    0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                    0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
          1.7E-4,20, 18.2 21.0 23.2 24.4 25.6 26.6 27.7 28.7 29.3 30.3
                    30.9 31.7 31.9 32.4 32.9 33.1 33.6 34.0 34.4 34.8
          3.0E-4,16, 19.7 22.1 25.2 26.4 27.4 28.1 28.8 29.4 30.0 30.6
                    31.2 31.8 32.3 33.0 33.7 34.5
          1.7E-2,20, 21.9 26.9 29.0 31.1 32.6 33.7 34.7 35.8 36.8 37.4
                    37.9 38.4 39.2 39.2 39.9 40.3 40.5 41.0 41.6 41.9
          1.7E-2,20, 26.3 30.1 32.2 34.0 35.6 36.6 37.8 39.0 40.1 41.0
                    41.9 42.7 43.4 44.1 44.8 45.3 46.0 46.6 47.1 47.5
          1.7E-1,20, 28.4 33.3 36.5 38.0 39.4 40.7 42.2 43.7 44.6 45.8
                    46.4 47.5 48.2 49.0 49.8 50.5 51.3 52.0 53.1 53.9
          0.89  ,20, 23.3 27.8 31.9 33.9 35.9 36.8 37.9 39.0 40.0 40.9
                    41.6 42.1 42.9 43.7 44.1 44.7 44.9 45.3 45.4 45.6
          410.  ,17, 25.2 31.7 36.7 39.3 41.9 43.1 44.8 46.2 47.2 48.3
                    49.4 50.2 51.2 51.9 52.5 52.8 53.3
          650.  ,20, 38.9 45.0 49.7 52.6 55.6 57.9 60.0 61.7 63.0 64.5
                    65.9 67.1 67.9 68.9 70.1 70.9 71.6 72.5 73.3 74.1
     SSR2 233.,C,,4,20
                    0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08,0.09,0.10,
                    0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18,0.19,0.20
          8.3E-4,20, 24.3 27.4 30.2 32.0 33.5 34.6 35.9 36.6 37.3 38.1
                    38.5 39.0 39.0 39.7 40.2 40.5 41.1 41.5 41.9 42.2
          1.7E-2,20, 30.1 34.5 37.7 39.8 41.2 42.6 43.5 44.2 45.1 46.0
                    46.8 47.6 48.2 48.6 49.2 49.9 50.3 50.6 51.3 51.7
          1.7E-1,20, 33.2 37.9 40.5 43.0 45.2 46.8 48.5 49.6 50.8 51.7
                    52.7 53.5 54.4 55.0 55.9 56.5 57.1 57.7 58.2 58.7
          650.  ,20, 41.1 45.9 50.6 54.9 58.2 60.4 62.7 64.8 66.5 67.7
                    69.1 70.2 71.0 72.0 72.9 73.7 74.2 75.0 75.6 75.7
     *
     MAT  'LEAD'         3100,4,0,0,0,0
          29.0E-6,  16100.,  5590., 0.44
          29.0E-6  293., 29.1E-6  373., 30.0E-6  473., 31.3E-6  573.
     *
     MAT  'OAK'          4001,0,0,0,0,3
          0.   0.   0.   0.
     REF  1   'R-41'
     SSR  293.,C,0,1
          1.0E-4,11, 0.01   9.8, 0.02  47.9, 0.03  49.8, 0.041 49.8,

          ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                   1         2         3         4         5         6         7         8
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Appendix G (Continued)

```
DATA               1         2         3         4         5         6         7         8
SEQ. NO.   ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

                     0.051 49.8, 0.105 50.7, 0.163 52.3, 0.223 53.9,
                     0.357 60.5, 0.511 75.7, 0.693 99.0
           SSR  293.,C,45,1
                1.0E-4,11, 0.01  0.78, 0.02  3.53, 0.03  9.22, 0.041 12.8,
                     0.051 15.4, 0.105 21.0, 0.163 24.5, 0.223 28.4,
                     0.357 36.8, 0.511 50.1, 0.693 70.5
           SSR  293.,C,90,1
                1.0E-4,12, 0.01  0.69, 0.02  3.53, 0.03  5.49, 0.041 6.28,
                     0.051 6.77, 0.105 8.43, 0.163 9.41, 0.223 10.4,
                     0.357 12.6, 0.511 16.9, 0.693 29.4, 0.92  76.2
           *
           MAT  'OAK'          4002,0,0,0,0,3
                0.   0.   0.   0.
           REF  1   'R-41'
           COM  '9 M FALL               '
           SSR  293.,C,0,1
                +1.E-2,11, 0.02  22.3, 0.041 50.8, 0.062 71.8, 0.105 69.5,
                     0.151 61.4, 0.223 59.3, 0.288 60.2, 0.357 66.0,
                     0.431 77.6, 0.511 74.1, 0.693 80.2
           SSR  293.,C,45,1
                +1.E-2,12, 0.02  6.96, 0.041 33.7, 0.062 39.2, 0.105 31.7,
                     0.151 27.2, 0.223 34.3, 0.288 34.3, 0.357 36.6,
                     0.431 35.8, 0.511 42.4, 0.693 62.0, 0.92  68.6
           SSR  293.,C,90,1
                +1.E-2,13, 0.02  1.37, 0.041 15.2, 0.062 16.1, 0.105 14.2,
                     0.151 12.9, 0.223 15.2, 0.288 16.1, 0.357 16.8,
                     0.431 20.5, 0.511 21.4, 0.693 28.5, 0.92  68.6,
                     1.2   90.0
           *
           MAT  'PLYWOOD'      4003,0,0,0,0,3
                0.   0.   0.   0.
           REF  1   'R-41'
           SSR  293.,C,0,1
                1.0E-4,11, 0.01  0.294, 0.02  0.588, 0.03  2.45 , 0.041  4.31,
                     0.051 6.28 , 0.105 8.83 , 0.163 10.4 , 0.223  12.6,
                     0.357 19.6 , 0.511 32.2 , 0.598 45.2
           SSR  293.,C,45,1
                1.0E-4,13, 0.01  2.45 , 0.02  10.9 , 0.03  19.6 , 0.041  21.0,
                     0.051 22.1 , 0.105 25.6 , 0.163 27.9 , 0.223  29.8,
                     0.357 32.6 , 0.511 34.4 , 0.693 39.2 , 0.92   50.6,
                     1.2   86.9
           SSR  293.,C,90,1
                1.0E-4,13, 0.01  2.45 , 0.02  19.6 , 0.03  21.1 , 0.041  20.7,
                     0.051 19.6 , 0.105 17.5 , 0.163 18.8 , 0.223  20.7,
                     0.357 22.5 , 0.511 23.4 , 0.693 27.1 , 0.92   37.9,
                     1.2   75.7
           *
           MAT  'PLYWOOD'      4004,0,0,0,0,3
                0.   0.   0.   0.
           REF  1   'R-41'

           ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                    1         2         3         4         5         6         7         8
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Appendix G (Continued)

```
DATA               1         2         3         4         5         6         7         8
SEQ. NO.   ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

           COM  '9 M FALL               '
           SSR  293.,C,0,1
                +1.E-2,11, 0.02  2.26 , 0.041 5.79 , 0.062 9.81 , 0.083  12.5,
                     0.128 11.8 , 0.174 15.2 , 0.223 15.2 , 0.288  16.5,
                     0.357 30.3 , 0.511 46.4 , 0.693 104.
           SSR  293.,C,45,1
                +1.E-2,13, 0.02  1.96 , 0.041 4.9  , 0.062 10.7 , 0.083  24.0,
                     0.105 27.2 , 0.128 27.2 , 0.174 27.2 , 0.223  26.8,
                     0.357 32.3 , 0.511 33.0 , 0.693 33.8 , 0.92   49. ,
                     1.2   67.7
           SSR  293.,C,90,1
                +1.E-2,13, 0.02  0.88 , 0.041 7.16 , 0.062 12.1 , 0.083  17.4,
                     0.128 32.3 , 0.174 29.4 , 0.223 25.9 , 0.288  29.4,
                     0.357 25.0 , 0.511 31.2 , 0.693 32.2 , 0.92   40.1,
                     1.2   53.6
           *
           MAT  'BALSA'        4005,0,0,0,0,1
                0.   0.   0.   0.
           REF  1   'R-42'
           COM  'SPECIFIC GRAVITY 0.17'
           SSR  293.,C,90,1
                1.0E-4, 4, 0.1  1.0, 0.2  1.2, 0.3  1.6, 0.4  2.2
           *
           MAT  'BALSA'        4006,0,0,0,0,1
                0.   0.   0.   0.
           REF  1   'R-42'
           COM  'SPECIFIC GRAVITY 0.18'
           SSR  293.,C,90,1
                1.1E+2, 4, 0.1  3.3, 0.2  2.9, 0.3  2.8, 0.4  2.9
           *
           MAT  'BALSA'        4007,0,0,0,0,1
                0.   0.   0.   0.
           REF  1   'R-42'
           COM  'SPECIFIC GRAVITY 0.18'
           SSR  293.,C,90,1
                1.1E+2, 4, 0.1  2.0, 0.2  2.1, 0.3  2.5, 0.4  2.9
           *
           MAT  'BALSA'        4008,0,0,0,0,2
                0.   0.   0.   0.
           REF  1   'R-42'
           COM  'SPECIFIC GRAVITY 0.20'
           SSR  293.,C,45,2
                1.0E-4, 4, 0.1  3.2, 0.2  3.6, 0.3  4.0, 0.4  4.6
                1.1E+2, 4, 0.1  5.5, 0.2  6.4, 0.3  7.4, 0.4  8.3
           SSR  293.,C,90,1
                1.3E+2, 4, 0.1 16.9, 0.2 16.8, 0.3 16.7, 0.4 16.5
           *
           MAT  'BALSA'        4009,0,0,0,0,1
                0.   0.   0.   0.
           REF  1   'R-42'

           ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                    1         2         3         4         5         6         7         8
```

Appendix G (Continued)

```
           1         2         3         4         5         6         7         8
----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

COM  'SPECIFIC GRAVITY 0.21'
SSR  293.,C,0,1
     1.0E-4, 4, 0.1 14.7, 0.2 14.9, 0.3 15.2, 0.4 15.7
*
MAT  'BALSA'          4010,0,0,0,0,1
     0.   0.   0.   0.
REF  1   'R-42'
COM  'SPECIFIC GRAVITY 0.21'
SSR  293.,C,0,1
     1.0E-4, 4, 0.1 14.0, 0.2 14.1, 0.3 14.4, 0.4 14.9
*
MAT  'BALSA'          4011,0,0,0,0,2
     0.   0.   0.   0.
REF  1   'R-42'
COM  'SPECIFIC GRAVITY 0.25'
SSR  293.,C,0,1
     1.1E+2, 4, 0.1 22.3, 0.2 22.1, 0.3 21.9, 0.4 21.7
SSR  293.,C,45,1
     1.3E+2, 4, 0.1  8.1, 0.2  9.5, 0.3 10.9, 0.4 12.3
*
MAT  'BALSA'          4012,0,0,0,0,3
     0.   0.   0.   0.
REF  1   'R-42'
COM  'SPECIFIC GRAVITY 0.26'
SSR  293.,C,90,2
     1.0E-4, 4, 0.1  2.2, 0.2  2.8, 0.3  3.4, 0.4  4.5
     1.3E+2, 4, 0.1  5.1, 0.2  5.9, 0.3  6.8, 0.4  7.8
SSR  293.,C,45,1
     1.0E-4, 4, 0.1  4.9, 0.2  5.8, 0.3  6.7, 0.4  7.8
SSR  293.,C,0,1
     1.0E-4, 4, 0.1 19.1, 0.2 20.1, 0.3 21.1, 0.4 22.2
*
MAT  'BALSA'          4013,0,0,0,0,1
     0.   0.   0.   0.
REF  1   'R-42'
COM  'SPECIFIC GRAVITY 0.26'
SSR  293.,C,0,1
     1.0E-4, 4, 0.1 22.3, 0.2 21.8, 0.3 21.5, 0.4 21.2
*
MAT  'BALSA'          4014,0,0,0,0,1
     0.   0.   0.   0.
REF  1   'R-42'
COM  'SPECIFIC GRAVITY 0.26'
SSR  293.,C,45,1
     1.0E-4, 4, 0.1  3.3, 0.2  5.6, 0.3  7.9, 0.4 10.4
*
MAT  'BALSA'          4015,0,0,0,0,4
     0.   0.   0.   0.
REF  1   'R-44'
COM  'SPECIFIC GRAVITY 0.09'

----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
         1         2         3         4         5         6         7         8
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Appendix G (Continued)

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           1         2         3         4         5         6         7         8
----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

SSR  293.,C, 0,1
     1.0E-4, 7, 0.02 4.16,0.1 4.59, 0.2 4.60, 0.3 4.61, 0.4 4.60,
                0.5 4.60, 0.6 4.56
SSR  293.,C,45,1
     1.0E-4, 7, 0.02 0.54,0.1 0.91, 0.2 0.99, 0.3 1.05, 0.4 1.13,
                0.5 1.27, 0.6 1.51
SSR  293.,C,60,1
     1.0E-4, 7, 0.02 0.38,0.1 0.60, 0.2 0.66, 0.3 0.69, 0.4 0.77,
                0.5 0.86, 0.6 1.01
SSR  293.,C,90,1
     1.0E-4, 7, 0.02 0.25,0.1 0.44, 0.2 0.47, 0.3 0.50, 0.4 0.55,
                0.5 0.60, 0.6 0.66
*
MAT  'BALSA'          4016,0,0,0,0,1
     0.   0.   0.   0.
REF  1   'R-44'
COM  'SPECIFIC GRAVITY 0.18'
SSR  293.,C, 0,1
     1.0E-4, 7, 0.02 10.4, 0.1 10.9, 0.2 10.95, 0.3 10.94, 0.4 10.9,
                0.5  10.7, 0.6 10.7
*
MAT  'BALSA'          4017,0,0,0,0,1
     0.   0.   0.   0.
REF  1   'R-44'
COM  'SPECIFIC GRAVITY 0.31'
SSR  293.,C, 0,1
     1.0E-4, 7, 0.02 22.19, 0.1 22.6, 0.2 22.5, 0.3 22.5, 0.4 22.4,
                0.5  22.3 , 0.6 21.3
*
MAT  'BALSA'          4018,0,0,0,0,1
     0.   0.   0.   0.
REF  1   'R-49'
COM  'SPECIFIC GRAVITY 0.22'
SSR  293.,C,90,1
     +1.E-2, 9, 0.01 0.776, 0.02 1.34, 0.05 2.05, 0.11 2.29, 0.22 2.35,
                0.36 2.40 , 0.51 2.35, 0.69 2.45, 0.92 2.67
*
MAT  'BALSA'          4019,0,0,0,0,1
     0.   0.   0.   0.
REF  1   'R-49'
COM  'SPECIFIC GRAVITY 0.22'
SSR  293.,C, 0,1
     +1.E-2, 8, 0.02  7.7, 0.04 15.1, 0.06 22.1, 0.08 27.4, 0.16 23.8,
                0.29 20.2, 0.36 18.2, 0.43 14.1
*
MAT  'BALSA'          4020,0,0,0,0,1
     0.   0.   0.   0.
REF  1   'R-49'
COM  'SPECIFIC GRAVITY 0.22'
SSR  293.,C, 0,1

----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
         1         2         3         4         5         6         7         8
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Appendix G (Continued)

```
DATA              1         2         3         4         5         6         7         8
SEQ. NO.  ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

              1.0E-4,13, 0.02  7.7, 0.04 15.1, 0.06 22.1, 0.08 27.4, 0.16 23.B,
                         0.29 20.0, 0.36 18.4, 0.43 16.6, 0.51 14.1, 0.60 10.8,
                         0.69 B.23, 0.74 7.54, 0.80 7.06
          *
          MAT 'BALSA'       4021,0,0,0,0,1
              0.  0.  0.  0.
          REF 1  'R-49'
          COM 'SPECIFIC GRAVITY 0.22'
          SSR 293.,C, 0,1
              +1.E-2,15, 0.02  7.7, 0.04 15.1, 0.06 22.1, 0.08 27.4, 0.16 23.2,
                         0.29 18.7, 0.36 16.6, 0.43 14.3, 0.51 11.9, 0.60 10.0,
                         0.69 8.72, 0.74 8.29, 0.80 8.55, 0.92 8.62, 1.05 7.27
          *
          MAT 'BALSA'       4022,0,0,0,0,1
              0.  0.  0.  0.
          REF 1  'R-49'
          COM 'SPECIFIC GRAVITY 0.22'
          SSR 293.,C,90,1
              +1.E-2, 9, 0.01 0.776, 0.02 1.34, 0.05 2.05, 0.11 2.29, 0.22 2.20,
                         0.36 2.20 , 0.51 2.12, 0.69 2.16, 0.92 2.12
          *
          MAT 'BALSA'       4023,0,0,0,0,1
              0.  0.  0.  0.
          REF 1  'R-49'
          COM 'SPECIFIC GRAVITY 0.22'
          SSR 293.,C,90,1
              +1.E-2, 9, 0.01 0.776, 0.02 1.34, 0.05 2.05, 0.11 2.29, 0.22 2.20,
                         0.36 2.20 , 0.51 2.23, 0.69 2.35, 0.92 2.43
          *
          MAT 'PLYWOOD'     4100,0,0,0,0,0
               1.0E-6,  18.0,  7.1, 0.26
          *
          END
          MAT 'SUS304'      2033,0,0,0,0,2
              0.  0.  0.  0.
          REF 1  'R-51'
          COM 'NI B.90,CR 18.63,C 0.08,SI 0.71,MN 1.67,P 0.028,S 0.008'
          SSR 293.,T,,14
              1.000E-4 ,1, 0.002  196.
              1.010E-4 ,1, 0.009  375.
              9.8      ,1, 0.019  453.
              5.8E+1   ,1, 0.028  504.
              1.7E+2   ,1, 0.058  572.
              3.5E+2   ,1, 0.110  674.
              4.0E+2   ,1, 0.162  763.
              4.95E+2,1, 0.209  845.
              5.81E+2,1, 0.295 1000.
              5.83E+2,1, 0.252  918.
              5.92E+2,1, 0.418 1165.
              5.95E+2,1, 0.380 1116.

          ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                   1         2         3         4         5         6         7         8
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Appendix G (Continued)

```
DATA              1         2         3         4         5         6         7         8
SEQ. NO.  ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0

              5.97E+2,1, 0.341 1067.
              8.29E+2,1, 0.450 1203.
          SSR 673.,T,,6
              1.000E-4, 1, 0.110  379.
              1.001E-4, 1, 0.162  437.
              1.002E-4, 1, 0.209  493.
              7.4     , 1, 0.295  561.
              7.5     , 1, 0.063  295.
              9.3     , 1, 0.256  528.
          *
          END

          ----5----0----5----0----5----0----5----0----5----0----5----0----5----0----5----0
                   1         2         3         4         5         6         7         8
```