Data format sd_mater

Summarized:

One describes here data structures built from the description and of the value of the various parameters associated with the behaviors of a material (compor, MATER, cham_mater, cham_mater_code).

The two types of data structures are presented:

- the SD in access by name: to subdue,
- the SD in access by address: mater_code (which replaces the preceding one in the TExxxx routines).

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1

the material appear in many commands of the Code_Aster *and* intervene in most routines of computation of the elementary terms (TExxxx). Indeed

, and contrary to other codes, in *Code_Aster, one* distinguishes the notion of "material", definite by the command DEFI _MATERIAU, and being able to be filed in the form of catalog, (see command INCLUDE _MATERIAU [U 4.43.02]) of the notion of behavior used during a given computation. The material is composed of values of parameters associated with a certain number of models with behaviors. In practice these parameters are defined via simple key words, under key words factors of the command DEFI _MATERIAU. These key words factors (for example ELAS , ECRO_LINE , CIN1_CHAB , LEMAITRE) make it possible to define whole or part of the parameters necessary to a model of behavior. For example, behavior (chosen by the user in STAT_NON_LINE or DYNA_NON_LINE under factor key word the COMP_INCR) VMIS_CINE_LINE will use the material parameters defined under factor keywords ELAS and ECRO_LINE of DEFI _MATERIAU. Behavior VISC_CIN1_CHAB will use those definite by ELAS , CIN1_CHAB and possibly LEMAITRE . By

abuse language, in this document, one will factor key word call "behavior" of DEFI _MATERIAU. Moreover

, some commands total (MECA_STATIQUE, THER_LINEAIRE ,…) do not allow the user to choose the behavior used for computation. It is necessary thus that computation (for example of the stiffness matrix in the preceding examples) can be done without ambiguity. This is why it is necessary that certain behaviors of comparable nature (ELAS_xxx, THER _xx) are single in the material. By convention of language in this document, one will say that all the behaviors of comparable nature (even prefix: ELAS , THER) belong to the same "phenomenon". Certain "behaviors" can thus be classified by "phenomenon" in which they are excluded mutually.

The data structure associated with the material and the contains the name values associated with the parameters describing each behavior. The parameters can be of type real, complex or function. Within this data structure one reaches the values of the parameters by name. For

reasons of performances of the code (in particular in the case of linear behaviors not -), the coded material was introduced. The data structure associated with the coded material is temporary, it contains the addresses of the various objects constituting the data structure MATER the access to the values of the parameters does not require more in this case a setting in memory of the JEVEUX objects and a search by name with each time one uses the material. The access by name to the parameters remains nevertheless. These

two data structures lean on structures of type function (constant function, function of a parameter or three-dimensions function) and objects simple JEVEUX of type vector.

The creation of a data structure function (. &&RDEP) prefixed by the name of the material makes it possible to then have a permanent space of memory necessary to the interpolation of the three-dimensions functions defining curves of tension depending on the temperature. This data structure is created on the GLOBALE data base in order to be exchanged between the various commands of the code.

2 The MATER data structure and cham _mater

the name of the “phenomenon” is the root of the name of the “behavior”. In the command where the user does not choose a behavior the model, it is necessary to know to find without ambiguity the material characteristics necessary, for example, the computation of the stiffness matrixes through command MECA_STATIQUE cannot make the distinction between ELAS and ELAS _ORTHO, this is why these two behaviors are excluded. On the other hand, a material can contain phenomena ELAS and THER . For the mechanical nonlinear behaviors, unicity is not necessary, because the user chooses a behavior model on the level of the command total (STAT_NON_LINE). For example

, behaviors ELAS , ELAS_FLUI , ELAS_ISTR , ELAS_ORTH , ELAS _THM, ELAS_COQUE constitute phenomenon ELAS .

The MATER data structure is made up:

- several phenomena (K10： name of the key word factor “behaviors” truncated with the first 10 characters), possibly
- of a function && RDEP for behaviors TENSION and META_TRACTION , possibly
- of a function && MZP for parameter RELA _MZ of behavior DIS_CONTACT . to subdue

```
(K8  ):: = record ".
   MATERIAU.NOMRC":    OJB S V K16 %
Behavior Elastic Generals |
           /" .ELAS  ":      COMPOR            /"
                 .ELAS_FLUI": COMPOR           /"
                 .ELAS_ISTR": COMPOR           /"
                 .ELAS_ORTH": COMPOR           /"
                 .ELAS_THM":  COMPOR           /"
                 .ELAS_COQUE": COMPOR               -
-
%
General Nonlinear Structural mechanics behaviors |'
           .TRACTION      ":  COMPOR            ".
                 &&RDEP': FONCTION                |'
                 .ECRO_LINE ": COMPOR             |"
           .PRAGER        ":    COMPOR           |"
                 .CIN1_CHAB ": COMPOR             |"
                 .CIN2_CHAB ": COMPOR             |
           ".      TAHERI ":    COMPOR            |
           /"   .LEMAITRE  ":  COMPOR             |
           ".      NORTON_HOFF': COMPOR           %
Behaviors related to the damage and the fracture…
           Note:
```

:

The MATER data structure does not contain information on the form of the constitutive laws: elasticity, Lemaitre, etc… These last do not exist in the form of data structures, but only in “tough” in FORTRAN. Contents

2.1 of the s.d to subdue .MATERIAU

```
.NOMRC: SVK16       Vector
```

of the type CHARACTER *16 dimensioned to the number of behaviors present at the time of the definition of the material.

The name of the behaviors affected in command DEFI_ MATERIAU or COMPOSITE DEFI _ contains. COMPOSITE

command DEFI_ stores there the name of behavior ELAS_ COQMU or THER _ COQMU, a white character string and the name of each material for each layer. Parameter LONMAX (attribute length of the associated JEVEUX object) of this object is recovered in various routines to obtain the number of layers. &&RDEP

```
: FONCTION              Is present
```

that if behaviors TENSION and META_TRACTION appear in the material. It is a function of a variable dimensioned with the maximum number of points of the functions composing curves of tension depending on the temperature. &&MZP

```
: FONCTION              Is present
```

that if parameter RELA_ MZ of behavior DIS_CONTACT appears in the material. It is a function representing the curve □ (moment) according to □ DR. (degree of rotation). The material
such as it was defined above is not usable for elementary computations, it is still necessary to assign this last to mesh groups. The data structure cham_ to subdue makes it possible to define this relation. Cham_

```
MATER (K8)  :: = record ".CHAMP
      _MAT": carte_nommater      ".TEMP
      _REF":       carte_temp_r ".SECH
      _REF":       carte_temp_r Note:
```

: It can

be necessary to repeat several times the affection of the same material with a different reference temperature. In

> *the case of the mono and polycrystalline materials, it can be necessary to define several materials by assignment (command DEFI_ COMPOR allowing for choice of the characteristics material to be affected). This is why the quantity associated with FIELD _MAT is NOMMATER , which has several components. In practice one will not be able to define more than 28 different materials in a given place (mesh or group _ma). The data structure*

3 compor One first of all

defines a data structure related to each behavior which can define the material. A behavior is a set of named parameters (K8) associated with a value. If the value is a K8 the parameter is associated with a function. compor

```
(K19):: = record ".VALK

   ": OBJ S     V K8 ".VALR
   ": OBJ S     V R ".VALC
  ": OBJ S      V C the complete
```

name of the data structure compor (K19) is consisted the name user of the material (K8) followed of one "." followed by the first ten characters of the key word factor appearing in catalog of the command DEFI_ MATERIAU. It is

thus imperative to differentiate all the key keys factors of the command DEFI_ MATERIAU on the first ten characters. Contents

3.1 of the S.D. compor VALK

: SVK8 Vector

of the type CHARACTER *8 dimensioned to 2 times the maximum number of parameters (it is necessary to be able to store all the names of parameters and all the names of functions, if all the parameters are associated with functions (2*NBPAR)) for the constitutive law considered. For example E and NU are parameters of elastic behavior ELAS. Contains

in the order: names

- of the parameters associated with actual values, names
- of the parameters associated with complex values, names
- of the parameters associated with functions, names
- of the functions. COMPOSITE

command DEFI_ fills this object with names with parameters associated with the coefficients homogenized like for each layer. An actual value is stored for each one. .VALR

: SVR Vector

of the type REAL* 8 dimensioned with the maximum number of parameters (NBPAR) for the constitutive law considered. Contains

the values associated with the real parameters. .VALC

: SVC Vector

of the type COMPLEX *16 dimensioned to the maximum number of parameters (NBPAR) for the constitutive law considered. Contains

the values associated with the complex parameters. The data structure

4 MATER_code and cham_mater_code It is

a temporary data structure (created on VOLATILE data base) containing the memory addresses of the JEVEUX objects constituting a material (SD MATER). MATER

```
_code (K19)  :: = record ".CODI
      ": OBJ     S V I the name
```

of this data structure is indexed on the occurrence of the material in the cham_ MATER It is

the analog of the data structure cham_ to subdue for a coded material. The card created on the GLOBALE data base refers to objects of VOLATILE data base , it must thus be reactualized in poursuite. Cham_

```
mater_code (K8):: = record ". .MATE
       _CODE= carte_adrsjeve      (I) to subdue
```

4.1 _code .CODI

: S V I Vector

of the type INTEGER on which dimension depends amongst behaviors described in the data structures temporary MATER JEVEUX object created on VOLATILE data base. Parameters

are associated with the material coded LMAT

: many parameters associated with behavior LFCT
: many parameters associated with the concepts (functions, arrays) LSUP
: many additional parameters (functions &&RDEP , &&MZP) This vector

are length 2 + NBCM *LMAT + NBCO*LFCT + NBT*LSUP where NBCM

: many behaviors present in material NBCO
: many concepts (functions, arrays) present in material NBT
: many curves of tension present in the material This vector

contain the memory addresses of the objects composing the data structure MATER CODI (

1): Many materials various (N) CODI (
2): Index in CODI of the first material. CODI (
3): Index in CODI of the second material (if necessary) .....
…. CODI (
n+1): Index in CODI of nth material (if necessary) CODI (

n+2): addresses .MATERIAU .NOMRC. (for the first material) CODI (
n+3): NBCM many behaviors present in the material. CODI (
n+2+1: n+2+NBCM): of the Kth behavior in CODI, for K=1 with NBCM for pointer

each Kth behavior of material 1 is

ipi = CODI (n+2+K) CODI (

n+2+k): ipi, pointer of Kth behavior CODI (
ipi): many parameters associated with realities. CODI (
ipi+1): many parameters associated with complexes. CODI (
ipi+2): many parameters associated with concepts (functions, arrays) CODI (
ipi+3): memory address of object .VALK . CODI (
ipi+4): memory address of object .VALR . CODI (
ipi+5): memory address of object .VALC . for

Lième concept of the type counts associated with a parameter with the Kth behavior , that is to say
ipif = ipi+LMAT-1 CODI (

ipif+LFCT* (L-1)) : the array is transformed into a list of realities (LIST_R8) memory address of object .VALE of LIST_R8 CODI (
ipif+LFCT* (L-1) +1): 0 (
CODI

```
ipif+LFCT*  (L-1)  +2):  0 (
CODI
ipif+LFCT*   (L-1)   +3): () CODI (
ISNNEM
ipif+LFCT*   (L-1)   +4): () CODI (
ISNNEM
ipif+LFCT*   (L-1)   +5): () CODI (
ISNNEM
ipif+LFCT*   (L-1)   +6): () CODI (
ISNNEM
ipif+LFCT*   (L-1)   +7): () CODI (
ISNNEM
ipif+LFCT*   (L-1)   +8): () for
ISNNEM
```

Lième concept of type function associated with a parameter with the Kth behavior , is
ipif = ipi+LMAT-1 CODI (

ipif+LFCT* (L-1)) : many points of the associated function. CODI (
ipif+LFCT* (L-1) +1): of object .PROL . CODI (
memory address
ipif+LFCT* (L-1) +2): of object .VALE . CODI (
memory address
ipif+LFCT* (L-1) +3): of the pointer length for a three-dimensions function.
memory address CODI (
ipif+LFCT* (L-1) +4): of object .PARA for a three-dimensions function CODI
memory address (
ipif+LFCT* (L-1) +5): LONUTI of object .PARA for a three-dimensions
attribute function. CODI (
ipif+LFCT* (L-1) +6): in CODI for curves of tension &&RDEP or fuel
pointer assemblies &&MZP CODI (
ipif+LFCT* (L-1) +7): index of the interval of interpolation saves. CODI (
ipif+LFCT* (L-1) +8): of an index of search (nonlinear equation in thermal).
saves that is to say

ipifc = CODI (ipif+LFCT* (L-1) +6) CODI (

ipifc): memory of object &&MZP .PROL. CODI (
address
ipifc+1): of object &&MZP .VALE or
memory address

CODI (

ipifc): memory of object &&RDEP .PROL. CODI (
address
ipifc+1): of object &&RDEP .VALE. Example
memory address

5 (SD MATER and SD cham_ to subdue) Command file

5.1 the commands

below make it possible to define 3 constitutive laws: elasticity, plasticity with curve of tension depending on the temperature and linear thermal. … MY

```
   =LIRE
_MAILLAGE () # # given

of modelization # F_E
=
DEFI_FONCTION (NOM_PARA = "TEMP    ", PROL_DROITE
                      = "LINEAIRE", PROL_GAUCHE
                      = "LINEAIRE", VALE
                      = (0. ,  200.E   +03, 50. ,
                               198.E   +03,),)  # F
                    _NU

= DEFI_CONSTANTE (VALE = 0.3) # F      _AL

= DEFI_CONSTANTE (VALE = 10.E+06) # FONCTION
1
= DEFI_FONCTION (NOM_PARA = "EPSI    ", PROL_DROITE
                       = "LINEAIRE", PROL_GAUCHE
                       = "LINEAIRE", VALE
                       = (0.200  E-02, 400. ,   0.400
                                 E-02, 500. ,   ),)  # FONCTION

2
= DEFI_FONCTION (NOM_PARA = "EPSI    ", PROL_DROITE
                       = "LINEAIRE", PROL_GAUCHE
                       = "LINEAIRE", VALE
                       = (0.100  E-02, 200. ,   0.300
                                 E-02, 300. ,   ),)  # CTRACB


= DEFI_NAPPE (NOM_PARA = "TEMP    ", PROL_DROITE
                      = "LINEAIRE", PROL_GAUCHE
                      = "LINEAIRE", PARA
                      = (     0. ,  50. ,     ), FONCTION
                      = (FCT1,  FCT2,   ),)  # #
                    material

isotropic # MAT
=
DEFI_MATERIAU (THER  =_F (     RHO_CP = 0.0E-03, LAMBDA  = 1.0E-03,),
ELAS_FO
                       =_F (  E = F_E, NU =  F_NU, ALPHA  = F_AL,
                                    TEMP_DEF_ALPHA=20.0,), TENSION
                       =_F (SIGM = CTRACB,),) # IMPR


_
CO (CO = MAT) #  MAT2

= DEFI_MATERIAU (ELAS_FO  =_F (  E = F_E, NU =  F_NU, ALPHA  = F_AL, TEMP_
                                  DEF_ALPHA=40.), ECRO_
                                  LINE=_F (SY=200., D_SIGM_EPSI=2000.)) #
#
                     #IMPR
```

```
_CO (CO = MAT2) #  CHMAT

= AFFE_MATERIAU (MAILLAGE  =MA, AFFE=
             (_F (GROUP_MA  = ("GM1",), MATER
                       = (MAT, MAT2), TEMP_REF = 20. ), _F       (
                  GROUP_MA  = (' GM2',), MATER
                       = MAT, TEMP_REF = 50. ),),       ) # IMPR


_
CO (CO = CHMAT) #  ............

            SOLNL
=STAT_NON_LINE (MODELE=EPD3, CHAM_
                    MATER=CHMAT, EXCIT
                    =_F (CHARGE=COND_LIM, TYPE_
                              CHARGE=' FIXE_CSTE',), COMP_
                    INCR=_F (RELATION=' ELAS', DEFORMATION
                                = ' PETIT', TOUT=
                                "OUI',), INCREMENT
                    =_F (LIST_INST=LINST, NUME_
                                INST_FIN=1,), TITER

                    = ' TEST',); Printing
```

5.2 of the data structure Data structure

```
: CHMAT?????   ?????????? ====>

IMPR_CO OF DATA STRUCTURE: MAT?????     ?????????? ATTRIBUT
 : F CONTENU  : T BASE  : >G< MANY
 OBJECTS (OR COLLECTIONS) FIND: 12 =====

================================================================================
PRINTING
  OF THE CONTENU OF THE OBJECTS FIND:
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT. &&RDEP     .PROL    < >>>        >>
 1 - >
      FONCTION <>LIN        LIN <>EPSI         < 4 -           >
      TOUTRESU <> <        > <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT. &&RDEP     .VALE    < >>>        >>
 1 -
      0.00000  E+00 0.00000  E+00 0.00000  E+00 0.00000  E+00 0.00000  E+00 6 -
      0.00000  E+00 0.00000  E+00 0.00000  E+00
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .ELAS     .VALC      < >>>        >>
 1 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00) 3 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00) 5 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00) 7 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00)
--------------------------------------------------------------------------------
PRINTING
```

```
 SEGMENT OF VALUES >MAT .ELAS     .VALK      < >>>        >>
 1 - >
      B_ENDOGE<>K_DESSIC<>PRECISIO<>TEMP_DEF<>E <>ALPHA       <>NU   < 8 -      >
      F_E <>F_AL     <>F_NU    <> <    > <        > <        > <        15
-
     > <> <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .ELAS     .VALR      < >>>        >>
 1 -
      0.00000  E+00 0.00000  E+00 1.00000  E+00 2.00000  E+01 0.00000  E+00 6 -
      0.00000  E+00 0.00000  E+00 0.00000  E+00
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .MATERIAU     .NOMRC < >>>         >>
 1 - >
      TENSION <>THER        <>ELAS            <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .THER     .VALC      < >>>        >>
 1 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00)
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .THER     .VALK      < >>>        >>
 1 - >

      RHO_CP <>LAMBDA  <> <  > <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .THER     .VALR      < >>>        >>
 1 -

      0.00000  E+00 1.00000  E-03
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .TRACTION     .VALC  < >>>        >>
 1 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00)
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .TRACTION     .VALK  < >>>        >>
 1 - >

      SIGM <>CTRACB    <> <  > <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .TRACTION     .VALR  < >>>        >>
 1 -

      0.00000  E+00 0.00000  E+00 ====>
 FIN IMPR_CO OF DATA STRUCTURE: MAT?????     ?????????? ====>

 IMPR_CO OF DATA STRUCTURE: CHMAT?????   ?????????? ATTRIBUT
 : F CONTENU  : T BASE  : >G< MANY
 OBJECTS (OR COLLECTIONS) FIND: 10 =====
```

```
================================================================================
PRINTING
  OF THE CONTENU OF THE OBJECTS FIND:
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >CHMAT .CHAMP   _MAT .DESC < >>>        >>
 1 -
      76 2           2            3            1            6 -
      3 2            6            2
--------------------------------------------------------------------------------
PRINTING

 OF THE COLLECTION: CHMAT .CHAMP   _MAT .LIMA PRINTING

 OBJET OF COLLECTION CONTIGUE>CHMAT .CHAMP   _MAT .LIMA< OC:  1 >>>      >>
 1 -

      1 PRINTING

 OBJET OF COLLECTION CONTIGUE>CHMAT .CHAMP   _MAT .LIMA< OC:  2 >>>      >>
 1 -

      2
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >CHMAT .CHAMP   _MAT .NOLI < >>>        >>
 1 - >
      <> <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >CHMAT .CHAMP   _MAT .NOMA < >>>        >>
 1 - >

      MY <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >CHMAT .CHAMP   _MAT .VALE < >>>        >>
 1 - >
      MAT <>MAT     2 <> <    > <        > <        > <        > <        8 -
>
      <> <        > <        > <        > <        > <        > <        15
-
     > <> <        > <        > <        > <        > <        > <        22
-
     > <> <        > <        > <        > <        > <        > <        29
-
     > <> <        >MAT        <> <     > <        > <        > <        36
-
     > <> <        > <        > <        > <        > <        > <        43
-
     > <> <        > <        > <        > <        > <        > <        50
-
     > <> <        > <        > <        > <        > <        > <        57
-
     > <> <        > <        > <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >CHMAT .TEMPE   _REF .DESC < >>>        >>
 1 -
      108          2 2            3            1            6 -
```

```
      3 2            2            2
--------------------------------------------------------------------------------
PRINTING
 OF THE COLLECTION: CHMAT .TEMPE   _REF .LIMA PRINTING

 OBJET OF COLLECTION CONTIGUE>CHMAT .TEMPE   _REF .LIMA< OC:  1 >>>      >>
 1 -

      1 PRINTING

 OBJET OF COLLECTION CONTIGUE>CHMAT .TEMPE   _REF .LIMA< OC:  2 >>>      >>
 1 -

      2
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >CHMAT .TEMPE   _REF .NOLI < >>>        >>
 1 - >
      <> <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >CHMAT .TEMPE   _REF .NOMA < >>>        >>
 1 - >

      MY <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >CHMAT .TEMPE   _REF .VALE < >>>        >>
 1 -
      2.00000  E+01 0.00000  E+00 0.00000  E+00 0.00000  E+00 5.00000  E+01 6 -
      0.00000  E+00 0.00000  E+00 0.00000  E+00 ====>
 FIN IMPR_CO OF DATA STRUCTURE: CHMAT?????   ??????????? Moreover



the S.D mater_code was printed in STA_NON_LINE (routine RCMFMC): ====>

IMPR_CO OF DATA STRUCTURE: MAT???????????????????? ATTRIBUT
 : T CONTENU  : T BASE  : > < COLLECTION
 (OR) OBJECT MANY FIND: 32 =====

================================================================================
PRINTING
  OF THE ATTRIBUTES OF THE OBJECTS FIND:
--------------------------------------------------------------------------------
<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT. &&RDEP     .PROL    < > <
      CLAS
     >G< GENR  >V< TYPE  >K< LTYP  16 DOCU  > <  DATES    0 ORIG  > <
      LONMAX        6 LONUTI  6 LONO  6 IADM  2166556  IADD 0 LADD  0 USE  >U D<
      --------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT. &&RDEP     .VALE    < > <
      CLAS
     >G< GENR  >V< TYPE  >R< LTYP  8 DOCU  > <  DATES    0 ORIG  > <  LONMAX
     8 LONUTI  8 LONO  8 IADM  2166592  IADD 0 LADD  0 USE  >U D<
--------------------------------------------------------------------------------

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0001     .CODI      < > <
      CLAS
```

```
>V< GENR  >V< TYPE  >I< LTYP  4 DOCU  > <  DATES    0 ORIG  > <  LONMAX
```

```
     109 LONUTI  109 LONO  109 IADM  2255598  IADD 0 LADD  0 USE  >U D<
      --------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0002     .CODI      < > <
      CLAS
     >V< GENR  >V< TYPE  >I< LTYP  4 DOCU  > <  DATES    0 ORIG  > <  LONMAX
     64 LONUTI  64 LONO  64 IADM  2256097  IADD 0 LADD  0 USE  >U D<
-------------------------------------------------------------------------------

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0010001001     .VALC< > <
      CLAS
     >V< GENR  >V< TYPE  >C< LTYP  16 DOCU  > <  DATES    707052303  ORIG > <
      LONMAX        2 LONUTI  0 LONO  2 IADM  2255210  IADD 0 LADD  0 USE  >U D<
      --------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0010001001     .VALK< > <
      CLAS
     >V< GENR  >V< TYPE  >K< LTYP  8 DOCU  > <  DATES    707052303  ORIG > <
      LONMAX        4 LONUTI  2 LONO  4 IADM  2255230  IADD 0 LADD  0 USE  >U D<
      --------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0010001001     .VALR< > <
      CLAS
     >V< GENR  >V< TYPE  >R< LTYP  8 DOCU  > <  DATES    707052303  ORIG > <
      LONMAX        2 LONUTI  0 LONO  2 IADM  2255196  IADD 0 LADD  0 USE  >U D<
      --------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0010002001     .VALC< > <
      CLAS
     >V< GENR  >V< TYPE  >C< LTYP  16 DOCU  > <  DATES    707052303  ORIG > <
      LONMAX        2 LONUTI  0 LONO  2 IADM  2255895  IADD 0 LADD  0 USE  >U D<
      --------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0010002001     .VALK< > <
      CLAS
     >V< GENR  >V< TYPE  >K< LTYP  8 DOCU  > <  DATES    707052303  ORIG > <
      LONMAX        4 LONUTI  2 LONO  4 IADM  2255915  IADD 0 LADD  0 USE  >U D<
      --------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0010002001     .VALR< > <
      CLAS
     >V< GENR  >V< TYPE  >R< LTYP  8 DOCU  > <  DATES    707052303  ORIG > <
      LONMAX        2 LONUTI  0 LONO  2 IADM  2255881  IADD 0 LADD  0 USE  >U D<
      --------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0020001001     .VALC< > <
      CLAS
     >V< GENR  >V< TYPE  >C< LTYP  16 DOCU  > <  DATES    707052303  ORIG > <
      LONMAX        2 LONUTI  0 LONO  2 IADM  2255262  IADD 0 LADD  0 USE  >U D<
```

```
      ------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0020001001     .VALK< > <
      CLAS
     >V< GENR  >V< TYPE  >K< LTYP  8 DOCU  > <  DATES    707052303  ORIG > <
      LONMAX        4 LONUTI  2 LONO  4 IADM  2255282  IADD 0 LADD  0 USE  >U D<
      ------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0020001001     .VALR< > <
      CLAS
     >V< GENR  >V< TYPE  >R< LTYP  8 DOCU  > <  DATES    707052303  ORIG > <
      LONMAX        2 LONUTI  2 LONO  2 IADM  2255248  IADD 0 LADD  0 USE  >U D<
      ------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0020002001     .VALC< > <
      CLAS
     >V< GENR  >V< TYPE  >C< LTYP  16 DOCU  > <  DATES    707052303  ORIG > <
      LONMAX        2 LONUTI  0 LONO  2 IADM  2255947  IADD 0 LADD  0 USE  >U D<
      ------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0020002001     .VALK< > <
      CLAS
     >V< GENR  >V< TYPE  >K< LTYP  8 DOCU  > <  DATES    707052303  ORIG > <
      LONMAX        4 LONUTI  2 LONO  4 IADM  2255967  IADD 0 LADD  0 USE  >U D<
      ------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0020002001     .VALR< > <
      CLAS
     >V< GENR  >V< TYPE  >R< LTYP  8 DOCU  > <  DATES    707052303  ORIG > <
      LONMAX        2 LONUTI  2 LONO  2 IADM  2255933  IADD 0 LADD  0 USE  >U D<
      ------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0030001001     .VALC< > <
      CLAS
     >V< GENR  >V< TYPE  >C< LTYP  16 DOCU  > <  DATES    707052303  ORIG > <
      LONMAX        8 LONUTI  0 LONO  8 IADM  2255326  IADD 0 LADD  0 USE  >U D<
      ------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0030001001     .VALK< > <
      CLAS
     >V< GENR  >V< TYPE  >K< LTYP  8 DOCU  > <  DATES    GE  707052303 ORIG >
      <        LONMAX 16  LONUTI 10  LONO 16  IADM  2255370 IADD 0  LADD THE 0
USA >
     U D<
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<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0030001001     .VALR< > <
      CLAS
     >V< GENR  >V< TYPE  >R< LTYP  8 DOCU  > <  DATES    707052303  ORIG > <
      LONMAX        8 LONUTI  4 LONO  8 IADM  2255300  IADD 0 LADD  0 USE  >U D<
```

```
      ------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0030002001     .VALC< > <
      CLAS
     >V< GENR  >V< TYPE  >C< LTYP  16 DOCU  > <  DATES    707052303  ORIG > <
      LONMAX        8 LONUTI  0 LONO  8 IADM  2256011  IADD 0 LADD  0 USE  >U D<
      ------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0030002001     .VALK< > <
      CLAS
     >V< GENR  >V< TYPE  >K< LTYP  8 DOCU  > <  DATES    GE  707052303 ORIG >
      <        LONMAX 16  LONUTI 10  LONO 16  IADM  2256055 IADD 0  LADD THE 0
USA >
     U D<
------------------------------------------------------------------------

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .0030002001     .VALR< > <
      CLAS
     >V< GENR  >V< TYPE  >R< LTYP  8 DOCU  > <  DATES    707052303  ORIG > <
      LONMAX        8 LONUTI  4 LONO  8 IADM  2255985  IADD 0 LADD  0 USE  >U D<
      ------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .ELAS     .VALC      < > <
      CLAS
     >G< GENR  >V< TYPE  >C< LTYP  16 DOCU  > <  DATES    0 ORIG  > <
      LONMAX        8 LONUTI  0 LONO  8 IADM  2166696  IADD 0 LADD  0 USE  >X D<
      ------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .ELAS     .VALK      < > <
      CLAS
     >G< GENR  >V< TYPE  >K< LTYP  8 DOCU  > <  DATES    0 ORIG  > <  LONMAX
     16 LONUTI  10 LONO  16 IADM  2166740  IADD 0 LADD  0 USE  >U D<
------------------------------------------------------------------------

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .ELAS     .VALR      < > <
      CLAS
     >G< GENR  >V< TYPE  >R< LTYP  8 DOCU  > <  DATES    0 ORIG  > <  LONMAX
     8 LONUTI  4 LONO  8 IADM  2166670  IADD 0 LADD  0 USE  >U D<
------------------------------------------------------------------------

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .MATERIAU     .NOMRC < > <
      CLAS
     >G< GENR  >V< TYPE  >K< LTYP  16 DOCU  > <  DATES    0 ORIG  > <
      LONMAX        3 LONUTI  3 LONO  3 IADM  2166410  IADD 0 LADD  0 USE  >U D<
      ------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .THER     .VALC      < > <
      CLAS
     >G< GENR  >V< TYPE  >C< LTYP  16 DOCU  > <  DATES    0 ORIG  > <
      LONMAX        2 LONUTI  0 LONO  2 IADM  2166632  IADD 0 LADD  0 USE  >X D<
      ------------------------------------------------------------------------
----
```

```
<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .THER     .VALK      < > <
      CLAS
     >G< GENR  >V< TYPE  >K< LTYP  8 DOCU  > <  DATES    0 ORIG  > <  LONMAX
     4 LONUTI  2 LONO  4 IADM  2166652  IADD 0 LADD  0 USE  >X D<
--------------------------------------------------------------------------------

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .THER     .VALR      < > <
      CLAS
     >G< GENR  >V< TYPE  >R< LTYP  8 DOCU  > <  DATES    0 ORIG  > <  LONMAX
     2 LONUTI  2 LONO  2 IADM  2166618  IADD 0 LADD  0 USE  >X D<
--------------------------------------------------------------------------------

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .TRACTION     .VALC  < > <
      CLAS
     >G< GENR  >V< TYPE  >C< LTYP  16 DOCU  > <  DATES    0 ORIG  > <
      LONMAX        2 LONUTI  0 LONO  2 IADM  2166470  IADD 0 LADD  0 USE  >X D<
      --------------------------------------------------------------------------
----

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .TRACTION     .VALK  < > <
      CLAS
     >G< GENR  >V< TYPE  >K< LTYP  8 DOCU  > <  DATES    0 ORIG  > <  LONMAX
     4 LONUTI  2 LONO  4 IADM  2166490  IADD 0 LADD  0 USE  >X D<
--------------------------------------------------------------------------------

<X> <
 JEIMPA> PRINTING OF THE ATTRIBUTES OF >MAT .TRACTION     .VALR  < > <
      CLAS
     >G< GENR  >V< TYPE  >R< LTYP  8 DOCU  > <  DATES    0 ORIG  > <  LONMAX
     2 LONUTI  0 LONO  2 IADM  2166456  IADD 0 LADD  0 USE  >X D<  =====

================================================================================
PRINTING
  OF THE CONTENU FROM THE OBJECTS FIND:
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT. &&RDEP     .PROL    < >>>        >>
 1 - >
      FONCTION <>LIN        LIN <>EPSI         < 4 -           >
      TOUTRESU <> <        > <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT. &&RDEP     .VALE    < >>>        >>
 1 -
      0.00000  E+00 0.00000  E+00 0.00000  E+00 0.00000  E+00 0.00000  E+00 6 -
      0.00000  E+00 0.00000  E+00 0.00000  E+00
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .0001     .CODI      < >>>        >>
 1 -
      2 -46973472              -46973471    5 66           6          -
      -23508908    3 -93946422              -93946405    -93946399    11 -
     0 0            1           -46973407              -46973422    16 -
     -23486706    2147483647   -23509252    -47018426    -94036872    21 -
     -47018476    2 -93946407              1 1            26           -
     -23508872    -47017724    2 0           0            31           -
     -46973381    -46973396    -23486693    4 0            36           -
     3 -46973337              -46973370    -23486677    2 41           -
     -23510835    -47021644    2147483647   2147483647   2147483647   46 -
```

```
     2147483647   1 1            1            -23486580               51 -
     -46973142    2147483647   2147483647   2147483647   2147483647   56 -
     1 1            1            -23510520               -47021022    61 -
     2147483647   2147483647   2147483647   2147483647   1 66            -
     1 -23508815               2 -93946362               -93946356    71 -
     2 0            0            -46973288               -46973303    76 -
     -23486646    4 0            3            -46973244               81 -
     -46973277    -23486630    2 -23510835               -47021644    86 -
     2147483647   2147483647   2147483647   2147483647   1 91            -
     1 1            -23486568               -46973119    2147483647   96 -
     2147483647   2147483647   2147483647   1 1            101            -
    1 -23510520               -47021022    2147483647   2147483647   106 -
    2147483647   2147483647   1 1
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .0002     .CODI      < >>>        >>
 1 -
      1 -46973470               3 -23508908               3 6 -
      -93945925    -93945908    -93945902    0 0            11            -
     1 -46973065               -46973080    -23486535    2147483647   16 -
     -23509252    -47018426    -94036872    -47018476    2 21            -
     -93945910    1 1            -23508872               -47017724    26 -
     2 0            0            -46973039               -46973054    31 -
     -23486522    4 0            3            -46972995               36 -
     -46973028    -23486506    2 -23510835               -47021644    41 -
     2147483647   2147483647   2147483647   2147483647   1 46            -
     1 1            -23486469               -46972920    2147483647   51 -
     2147483647   2147483647   2147483647   1 1            56            -
     1 -23510520               -47021022    2147483647   2147483647   61 -
     2147483647   2147483647   1 1
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .0010001001     .VALC < >>>        >>
 1 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00)
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .0010001001     .VALK < >>>        >>
 1 - >

      SIGM <>CTRACB    <> <  > <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .0010001001     .VALR < >>>        >>
 1 -

      0.00000  E+00 0.00000  E+00
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .0010002001     .VALC < >>>        >>
 1 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00)
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .0010002001     .VALK < >>>        >>
 1 - >

      SIGM <>CTRACB    <> <  > <
--------------------------------------------------------------------------------
PRINTING
```

```
 SEGMENT OF VALUES >MAT .0010002001     .VALR < >>>        >>
 1 -

      0.00000  E+00 0.00000  E+00
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .0020001001     .VALC < >>>        >>
 1 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00)
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .0020001001     .VALK < >>>        >>
 1 - >

      RHO_CP <>LAMBDA  <> <  > <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .0020001001     .VALR < >>>        >>
 1 -

      0.00000  E+00 1.00000  E-03
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .0020002001     .VALC < >>>        >>
 1 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00)
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .0020002001     .VALK < >>>        >>
 1 - >

      RHO_CP <>LAMBDA  <> <  > <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .0020002001     .VALR < >>>        >>
 1 -

      0.00000  E+00 1.00000  E-03
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .0030001001     .VALC < >>>        >>
 1 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00) 3 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00) 5 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00) 7 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00)
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .0030001001     .VALK < >>>        >>
 1 - >
      B_ENDOGE<>K_DESSIC<>PRECISIO<>TEMP_DEF<>E <>ALPHA       <>NU   < 8 -      >
      F_E <>&&000000     <>F_NU <> <    > <        > <        > <        15
-
     > <> <
--------------------------------------------------------------------------------
PRINTING
```

```
 SEGMENT OF VALUES >MAT .0030001001     .VALR < >>>        >>
 1 -
      0.00000  E+00 0.00000  E+00 1.00000  E+00 2.00000  E+01 0.00000  E+00 6 -
      0.00000  E+00 0.00000  E+00 0.00000  E+00
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .0030002001     .VALC < >>>        >>
 1 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00) 3 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00) 5 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00) 7 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00)
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .0030002001     .VALK < >>>        >>
 1 - >
      B_ENDOGE<>K_DESSIC<>PRECISIO<>TEMP_DEF<>E <>ALPHA       <>NU   < 8 -      >
      F_E <>&&000002     <>F_NU <> <    > <        > <        > <        15
-
     > <> <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .0030002001     .VALR < >>>        >>
 1 -
      0.00000  E+00 0.00000  E+00 1.00000  E+00 2.00000  E+01 0.00000  E+00 6 -
      0.00000  E+00 0.00000  E+00 0.00000  E+00
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .ELAS     .VALC      < >>>        >>
 1 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00) 3 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00) 5 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00) 7 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00)
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .ELAS     .VALK      < >>>        >>
 1 - >
      B_ENDOGE<>K_DESSIC<>PRECISIO<>TEMP_DEF<>E <>ALPHA       <>NU   < 8 -      >
      F_E <>F_AL     <>F_NU    <> <    > <        > <        > <        15
-
     > <> <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .ELAS     .VALR      < >>>        >>
 1 -
      0.00000  E+00 0.00000  E+00 1.00000  E+00 2.00000  E+01 0.00000  E+00 6 -
      0.00000  E+00 0.00000  E+00 0.00000  E+00
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .MATERIAU     .NOMRC < >>>         >>
 1 - >
      TENSION <>THER        <>ELAS            <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .THER     .VALC      < >>>        >>
 1 - (
```

```
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00)
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .THER     .VALK      < >>>        >>
 1 - >

      RHO_CP <>LAMBDA  <> <  > <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .THER     .VALR      < >>>        >>
 1 -

      0.00000  E+00 1.00000  E-03
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .TRACTION     .VALC  < >>>        >>
 1 - (
      0.00000E+00, 0.00000E+00) (0.00000E+00, 0.00000E+00)
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .TRACTION     .VALK  < >>>        >>
 1 - >

      SIGM <>CTRACB    <> <  > <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >MAT .TRACTION     .VALR  < >>>        >>
 1 -

      0.00000  E+00 0.00000  E+00 ====>
 FIN IMPR_CO OF DATA STRUCTURE: MAT??????????????????
```