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AN INTERACTIVE NASTRAN PREPROCESSOR

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SUMMARY

This paper describes a Langley Research Center version of NASTRAN Level 15.1.0 designed to provide the analyst with an added tool for debugging massive NASTRAN input data. The program checks all NASTRAN input data cards and displays on a CRT scope the graphic representation of the undeformed structure. In addition, the program permits the display and alteration of input data and allows reexecution without physically resubmitting the job. Core requirements on the CDC 6000 computer are approximately 77 000 octal words of central memory.

INTRODUCTION

As most NASTRAN users have discovered, there are input data errors made in defining a structure which are not illegal to the system but which will produce a rather oddly shaped graphic representation and erroneous analysis. It is imperative, therefore, that the structural plotter output be viewed before the user can be assured that his input data do not displace grid points or omit members. For a complex structure, it may be necessary to observe the picture from several orientations.

Motivated by the need for a complete checkout of structure-defining input data in the most rapid and efficient manner, development of an interactive type preprocessor was undertaken. Since the computer program described in reference 1 was already in existence, the decision was made to adapt it to the interacting CDC 250 CRT system. The Interactive NASTRAN Preprocessor Level 12.1.0 resulted from this adaptation. The NASTRAN portion has since been updated to Level 15.1.0.

The NASTRAN program and interactive graphic software used in the Interactive NASTRAN Preprocessor are designed to operate on the CDC 6600 computer at LRC, but the ideas are applicable to other NASTRAN computers.

PROGRAM DESCRIPTION

The following changes were made in the existing computer program (ref. 1):

1. NASTRAN routines[1] altered:

[1]Description of routines may be found in reference 2.

NAME	MODIFICATION
NASTRAN	Tape 4 declared
XSEM1	Added capability of displaying message on screen
IFP1D	Error "Plot Tape Not A Physical Tape" made nonfatal
SGINOFF	Plot file written on Tape 4
XSEM2	Added capability of displaying messages on screen
	Added labeled COMMON block with plot loop flag
	Added call to CRTPLOT subroutine
	Added statement to change a DMAP instruction parameter if plot loop flag set
PLOT	Test for physical tape ignored
PROCES	Added labeled COMMON block to hold view angles for display and alteration
	Add statements to save and restore view angles
LD50	Additions made to allow looping through PLTSET and PLOT instructions if angles altered and reexecution requested (appendix A)

2. Subroutine CRTPLOT (appendix B) was coded to read the NASTRAN General Purpose Plotter output file and translate it for display on the CDC 250 CRT terminal (fig. 1).

3. Interactive graphic routines[2] added to program:

SEMSAGE (same as MESAGE)	RSHFT
CDC250	ADVERSE

[2]See Langley Research Center Computer Programing Manual, Vol. II, Sections 3.2 and 3.11.

NEXT	SPACK (same as PACK)
PLT250	SLOCATE (same as LOCATE)
LODTBL	UNPK
DECOD3	CNTRLN
DECOD4	CREATEF
HOGWASH	DECOD1
WARTHOG	DECOD2
SCREEN	DROUTE
PLT000	EXOR
KEYBORD	I03
CRT250	NOTATE
SPCMAT	PLOTSW
KGLER	PLT9999
LOADADR	TRUNCL
CALPLT	SAVPLOT
WHERE	XMIT
ENCOD2	SCAN
STRCALL	

4. Modifications were made in the graphic routines where data statements were used to enter values for variables in labeled COMMON. Restrictions in the CDC Linkage Editor necessitated replacing the data statements with a Block Data subprogram.

5. Overlay structure (appendix C) was adjusted to incorporate graphic routines and subroutine CRTPLOT, which were added.

CAPABILITIES OF THE INTERACTIVE NASTRAN PREPROCESSOR

The Interactive NASTRAN Preprocessor has the following capabilities:

1. Analyzes all input data.

2. Displays the graphic representation of the undeformed structure on the CDC 250 CRT Scope.

3. The alphanumeric keyboard[3] on the CRT console provides a means for displaying the input and altering the input data.

4. Loops through the PLTSET and PLOT modules when only the view angle is altered are accomplished within the DMAP sequence of instructions. The program EDIT[4] initiates restarts when other input data are changed.

5. The CRT function keyboard has such options as (a) positive and negative magnification of the total display or a part of the display; (b) recording the plot vector file for postprocessing permanent hard copies; and (c) producing nonpermanent hard copies on a connected hard copy unit.

6. Executable in approximately 77 000 octal words of central memory.

LIMITATIONS OF THE INTERACTIVE NASTRAN PREPROCESSOR

The Interactive NASTRAN Preprocessor has the following limitations:

1. Operational on CDC 6000 Computer complex at LRC; however ideas are applicable to other NASTRAN computers.

2. Displacement approach must be used.

3. Does not contain NASTRAN checkpoint or restart capabilities.

4. No punch output available.

5. Alterations to input data are made internal to the computer only; therefore, the user should make note of modifications so that he may make appropriate changes in the physical deck.

OPERATIONAL INSTRUCTIONS

The interactive NASTRAN program is housed on a data cell and requires no physical tapes unless the user wishes to save the plot vector file for permanent hard copies. The EDIT program is also housed on a data cell.

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[3]Langley Research Center Computer Programing Manual, Vol. II, Section 3.6.

[4]Langley Research Center Simulation Manual, Section 2221.1.

1. Deck Setup	Col. 68	Col. 78
JOB, ...		X
USER,.....		X
FETCH(C1103, XXXX, BINARY, EDIT)	XXXX = data cell	X
LOAD (EDIT)		X
EXECUTE (BLOCKCC)		X
COMMENT.	X	
COMMENT. END CONTROL BLOCK		X
REQUEST, CRTTPE, CD. PLEASE ASSIGN XX	XX = CRT No.	
FETCH (D3790, XXXX, BINARY, PREF1)	XXXX = data cell	
NORFL.		
LINECNT (10000)		
PREF1. CATLOG (PREF)		
COMMENT. END SETUP BLOCK		
PREF.		
REWIND (SAVPLT)		
COPYBF (SAVPLT, TEMP) Required if hard copy plots desired		
BKS (TEMP, 1)		
LOAD (EDIT)		
COMMENT. END EXECUTE BLOCK		
FETCH (P0077, XXXX, BINARY, DDIPRO) DDI, 80 Postprocessor		Required for hard copy for plots
REWIND (TEMP)		
REWIND (SAVPLT)		
DDIPRO (INITIALS, BLDG. NO., Division initials, zero)		
COMMENT. END STOP BLOCK		
EXIT.		

1. Deck Setup (continued) Col. 68 Col. 78

LOAD (EXIT)

EXECUTE (RESTART)

COMMENT. END RESTART BLOCK

End of record card

NASTRAN data deck

End of file card

2. Input

Input data are the same as for a regular NASTRAN run with the exception that the user must request NASTPLT output on the PLOTTER case control card.

3. Output

The Program produces the normal NASTRAN printed output from the Preface area of the program and from the structural plot module. The graphic representation of the undeformed structure is displayed on the CRT as it is being generated. Plots may be recorded for obtaining hard copies on one of the available plotters by depressing the appropriate function key on the CRT console. The proper postprocessor control cards must have been included in the card deck.

Since changes are made internal to the computer only, the user should make note of any such modifications so that he can make the appropriate changes in the physical deck.

APPENDIX A

NASTRAN ROUTINE LD50

FOR INTERACTIVE NASTRAN PREPROCESSOR

FORTRAN Code for Subroutine LD50

```
      SUBROUTINE LD50(SUBSET)                                                  LD500002
      INTEGER RD(161)                                                          LD500003
      INTEGER RD1(61), RD2(100)                                                LD500004
      EQUIVALENCE (RD(1),RD1), (RD(62),RD2)                                    LD500005
      DATA NPTP/4HNPTP/                                                        LD500006
      INTEGER IS1(20)                                                          LD500007
      DATA IS1/1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1/                        LD500008
      DATA RD1/                                                                LD500009
     A4HBEGI, 4HN PR, 4HEFAC, 4HE - , 4HCHEC, 4HKS I, 4HNPUT, 4H AND,          LD500010
     B4H PLO, 4HTS U, 4HNDEF, 4HORME, 4HD ST, 4HRUCT, 4HURE , 4HS   ,          LD500011
     C4HGP1 , 4HGEOM, 4H1,GE, 4HOM2,, 4H/GPL, 4H,EQE, 4HXIN,, 4HGPDT,          LD500012
     D4H,CST, 4HM,BG, 4HPDT,, 4HSIL/, 4HV,N:, 4HLUSE, 4HT/C,, 4HN,12,          LD500013
     E4H3/V,, 4HN,NO, 4HGPDT, 4H $  , 4HSAVE, 4H LUS, 4HET $, 4HGP2 ,          LD500014
     F4HGEOM, 4H2,EQ, 4HEXIN, 4H/ECT, 4H $  ,                                  LD500015
     14HLABE, 4HL W1, 4H $  ,                                                  LD500016
     24HPLTS, 4HET P, 4HCDB,,                                                  LD500017
     G4HEQEX, 4HIN,E, 4HCT/P, 4HLTSE, 4HTX,P, 4HLTPA, 4HR,GP, 4HSETS,          LD500018
     Z4H,ELS, 4HETS /                                                          LD500019
      DATA RD2/                                                                LD500020
     H4H/V,N, 4H,NSI, 4HL/V,, 4HN,JU, 4HMPPL, 4HOT $, 4HSAVE, 4H NSI,          LD500021
     I4HL,JU, 4HMPPL, 4HOT $, 4HPRTM, 4HSG P, 4HLTSE, 4HTX//, 4H $  ,          LD500022
     J4HSETV, 4HAL /, 4H/V,N, 4H,PLT, 4HFLG/, 4HC,N,, 4H1//,, 4HN,PF,          LD500023
     K4HILE/, 4HC,N,  4HO $ , 4HSAVE, 4H PLT, 4HFLG,, 4HPFIL, 4HE $ ,          LD500024
     L4HCOND, 4H P1,, 4HJUMP, 4HPLOT, 4H $  , 4HPLOT, 4H PLT, 4HPAR,,          LD500025
     M4HGPSE, 4HTS,E, 4HLSET, 4HS,CA, 4HSECC, 4H,BGP, 4HDT,E, 4HQEXI,          LD500026
     N4HN,SI, 4HL,,/, 4HPLOT, 4HX1/V, 4H,N,N, 4HSIL/, 4HV,N,, 4HLUSE,          LD500027
     O4HT/V,, 4HN,JU, 4HMPPL, 4HOT/V, 4H,N,P, 4HLTPL, 4HG/V,, 4HN,PF,          LD500028
     P4HILE , 4HS   , 4HSAVE, 4H JUM, 4HPPLO, 4HT,PL, 4HTFLG, 4H,PF1,          LD500029
     Q4HLE $, 4HPRTM, 4HSG P, 4HLOTX, 4H1//$,                                  LD500030
     14HCOND, 4H W2,, 4HPFIL, 4HE $ , 4HJUMP, 4H P1 , 4HS   , 4HLABE,          LD500031
     24HL W2, 4HS   , 4HREPT, 4H W1,, 4H100 , 4HS   ,                          LD500032
     34HLABE, 4HL P1, 4HS   ,                                                  LD500033
     R4HEND , 4HS   , 4H    , 4H    , 4H    , 4H    /                         LD500034
      CALL WRITE (NPTP,RD,160,1)                                               LD500035
      CALL WRITE (NPTP,20,1,0)                                                 LD500036
      CALL WRITE (NPTP,1,1,0)                                                  LD500037
      CALL WRITE(NPTP,IS1,20,0)                                                LD500038
      CALL WRITE(NPTP,0,1,0)                                                   LD500039
      RETURN                                                                   LD500041
      END                                                                      LD500042
```

```
DMAP-DMAP INSTRUCTION
  NO.
  1 BEGIN     PREFACE - CHECKS INPUT AND PLOTS UNDEFORMED STRUCTURE $

  2 GP1       GEOM1,GEOM2,/GPL,EQEXIN,GPDT,CSTM,BGPDT,SIL/V,N,LUSET/C,N,123/
              V,N,NOGPDT $

  3 SAVE      LUSET $

  4 GP2       GEOM2,EQEXIN/ECT $

  5 LABEL     W1 $

  6 PLTSET    PCDB,EQEXIN,ECT/PLTSETX,PLTPAR,GPSETS,ELSETS /V,N,NSIL/V,N,
              JUMPPLOT $

  7 SAVE      NSIL,JUMPPLOT $

  8 PRTMSG    PLTSETX// $

  9 SETVAL    //V,N,PLTFLG/C,N,1/V,N,PFILE/C,N,0 $

 10 SAVE      PLTFLG,PFILE $

 11 COND      P1,JUMPPLOT $

 12 PLOT      PLTPAR,GPSETS,ELSETS,CASECC,BGPDT,EQEXIN,SIL,,/PLOTX1/V,N,NSIL/
              V,N,LUSET/V,N,JUMPPLOT/V,N,PLTFLG/V,N,PFILE $

 13 SAVE      JUMPPLOT,PLTFLG,PFILE $

 14 PRTMSG    PLOTX1//$

 15 COND      W2,PFILE $

 16 JUMP      P1 $

 17 LABEL     W2$

 18 REPT      W1,100 $

 19 LABEL     P1$

 20 END       $
```

APPENDIX B

FORTRAN CODED SUBROUTINE CRTPLOT

```
      SUBROUTINE CRTPLOT                                                    CRT0002
      COMMON/SPEC/NVIEW,CALPHA,CBETA,CGAMMA                                 CRT0003
      COMMON/CRT/NCRT                                                       CRT0004
      DIMENSION A(30),ID(2)                                                 CRT0005
      DIMENSION IANS(30)                                                    CRT0006
      DIMENSION STRING(60)                                                  CRT0007
      INTEGER PC,CI,TEN                                                     CRT0008
      DATA ID/3HWWS,8HBIN 2058/                                             CRT0009
      DATA STRING/                                                          CRT0010
     1  1H0,1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1HA,1HB,1HC,1HD,1HE,1HF      CRT0011
     2, 1HG,1HH,1HI,1HJ,1HK,1HL,1HM,1HN,1HO,1HP,1HQ,1HR,1HS,1HT,1HU,1HV     CRT0012
     3, 1HW,1HX,1HY,1HZ,1H(,1H),1H+,1H-,1H*,1H/,1H=,1H.,1H,,1H$,1H-,1H      CRT0013
     4, 12*0/                                                               CRT0014
      EQUIVALENCE (IANS(1),IS2), (IANS(2),IS3), (IANS(3),IS4), (IANS(4),    CRT0015
     1IR0), (IANS(5),IR1), (IANS(6),IR2), (IANS(7),IR3), (IANS(8),IR4),     CRT0016
     2(IANS(9),CI), (IANS(10),PC), (IANS(11),IU2), (IANS(12),IU3),          CRT0017
     3(IANS(13),IU4), (IANS(14),IT0), (IANS(15),IT1), (IANS(16),IT2),       CRT0018
     4(IANS(17),IT3), (IANS(18),IT4), (IANS(19),IS0), (IANS(20),IS1),       CRT0019
     5(IANS(29),IU0), (IANS(30),IU1)                                        CRT0020
      NVIEW = 0                                                             CRT0021
      NCRT=0                                                                CRT0022
      NFIRST = 0                                                            CRT0023
      REWIND 4                                                              CRT0024
      WRITE(6,1001)                                                         CRT0025
 1001 FORMAT(1H1)                                                           CRT0026
      TEN = 10                                                              CRT0027
      MASK = 77B                                                            CRT0028
      CALL CDC 250                                                          CRT0029
      CALL CALPLT(0,0,3)                                                    CRT0030
      CALL SMESAGE(1,35HBEGIN EXECUTION OF CRT PLOT PROGRAM,35)             CRT0031
      CALL PARAMS                                                           CRT0032
      CALL PARAMS(5LALPHA,CALPHA,4LBETA,CBETA,5LGAMMA,CGAMMA)               CRT0033
  800 READ(4) A                                                             CRT0034
      IF(EOF,4) 99,10                                                       CRT0035
   10 CONTINUE                                                              CRT0036
      DO 1 I=1,30,3                                                         CRT0037
      L = I+2                                                               CRT0038
      K = 0                                                                 CRT0039
      DO 15 N=I,L                                                           CRT0040
      DO 15 J=1,10                                                          CRT0041
      K= K+1                                                                CRT0042
      IF(J.EQ.1) GO TO 17                                                   CRT0043
      CALL RSHFT(A(N),6)                                                    CRT0044
   17 IANS(K) = (A(N).AND.MASK)                                             CRT0045
   15 CONTINUE                                                              CRT0046
      IF(PC.GT.6) PC=PC-10                                                  CRT0047
      IF(PC.EQ.0.OR.PC.EQ.2.OR.PC.EQ.3) GO TO 300                           CRT0048
      R = TEN*(TEN*(TEN*(TEN*IR4 +IR3)+IR2)+IR1)+IR0                        CRT0049
      S = TEN*(TEN*(TEN*(TEN*IS4 +IS3)+IS2)+IS1)+IS0                        CRT0050
      T = TEN*(TEN*(TEN*(TEN*IT4 +IT3)+IT2)+IT1)+IT0                        CRT0051
      U = TEN*(TEN*(TEN*(TEN*IU4 +IU3)+IU2)+IU1)+IU0                        CRT0052
  300 NC = PC+1                                                             CRT0053
      GO TO (401,402,403,404,405,406,406), NC                               CRT0054
C*                                                                          CRT0055
C* PLOT COMMAND IS NO OPERATION                                            CRT0056
C*                                                                          CRT0057
  401 GO TO 1                                                               CRT0058
C*                                                                          CRT0059
C* PLOT COMMAND IS START NEW PLOT                                          CRT0060
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C*                                                                      CRT0061
  402 PLOTID = R                                                        CRT0062
      XMIN = 0.0                                                        CRT0063
      YMIN = 0.0                                                        CRT0064
      XMAX = S                                                          CRT0065
      YMAX = T                                                          CRT0066
      XSCALE = 10.0/XMAX                                                CRT0067
      YSCALE = 10.0/YMAX                                                CRT0068
      GO TO 1                                                           CRT0069
C*                                                                      CRT0070
C* PLOT COMMAND IS SELECT CAMERA                                        CRT0071
C*                                                                      CRT0072
  403 GO TO 1                                                           CRT0073
C*                                                                      CRT0074
C* PLOT COMMAND IS SKIP TO A NEW FRAME                                  CRT0075
C*                                                                      CRT0076
  404 CONTINUE                                                          CRT0077
      IF(NFIRST.EQ.0) GO TO 4041                                        CRT0078
      CALL CALPLT(0.0,-3)                                               CRT0079
      CALL SMESAGE(1,32HTO RECORD PLOT, DEPRESS FN KEY 6,32)            CRT0080
      CALL SMESAGE(1,34HTO CLEAR PICTURE, DEPRESS FN KEY 2,34)          CRT0081
      CALL SMESAGE(1,37HTO GO TO NEXT FRAME, DEPRESS FN KEY 3,37)       CRT0082
      CALL CALPLT(12.0,0,-3)                                            CRT0083
      CALL SMESAGE(1,30HHIT KEY 45 TO END PLOT PROGRAM,30)              CRT0084
      CALL SMESAGE(1,39HHIT KEY 47 TO RE-DISPLAY PREVIOUS PLOTS,39)     CRT0085
      CALL SMESAGE(1,38HHIT ANY OTHER KEY TO CONTINUE PLOTTING,38)      CRT0086
      CALL NEXT(N)                                                      CRT0087
      IF(N.EQ.45) GO TO 99                                              CRT0088
      IF(N.EQ.47) GO TO 199                                             CRT0089
      GO TO 1                                                           CRT0090
 4041 CONTINUE                                                          CRT0091
      NFIRST = 1                                                        CRT0092
      GO TO 1                                                           CRT0093
C*                                                                      CRT0094
C* PLOT COMMAND IS TYPE A CHARACTER                                     CRT0095
C*                                                                      CRT0096
  405 X = R*XSCALE                                                      CRT0097
      Y = S*YSCALE                                                      CRT0098
      CALL NOTATE(X,Y,.1,STRING(C1),0.0,1)                              CRT0099
      GO TO 1                                                           CRT0100
C*                                                                      CRT0101
C* PLOT COMMAND IS DRAW A LINE OR AN AXIS.                              CRT0102
C*                                                                      CRT0103
  406 CONTINUE                                                          CRT0104
      X1 = R*XSCALE                                                     CRT0105
      Y1 = S*YSCALE                                                     CRT0106
      X2 = T*XSCALE                                                     CRT0107
      Y2 = U*YSCALE                                                     CRT0108
      CALL CALPLT(X1,Y1,3)                                              CRT0109
      CALL CALPLT(X2,Y2,2)                                              CRT0110
 4062 GO TO 1                                                           CRT0111
    1 CONTINUE                                                          CRT0112
      GO TO 800                                                         CRT0113
C*                                                                      CRT0114
C* RE-DISPLAY PHEVIOUS PLOTS                                            CRT0115
C*                                                                      CRT0116
  199 REWIND 4                                                          CRT0117
      GO TO 800                                                         CRT0118
C*                                                                      CRT0119
C* END OF PLOT TAPE                                                     CRT0120
```

```
C*                                                                      CRT0121
  99  CONTINUE                                                          CRT0122
      CALL CALPLT(0.0,999)                                              CRT0123
      CALL SMESAGE(1,20HEND OF FILE ON TAPE4,20)                        CRT0124
      REWIND 4                                                          CRT0125
C**********                                                             CRT0126
C               BREAK POINT IN PROGRAM TO ALLOW OPERATOR TO DISPLAY     CRT0127
C               AND/OR CHANGE THE CURRENTLY ESTABLISHED VIEW ANGLE.     CRT0128
C$$$$$$$$$$                                                            CRT0129
      CALL SMESAGE(1,50HTO DISPLAY AND/OR CHANGE THE CURRENTLY ESTABLISH CRT0130
     1ED.50)                                                            CRT0131
      CALL SMESAGE(1,34HVIEW ANGLE**ALPHA,BETA AND GAMMA**,34)          CRT0132
      CALL SMESAGE(1,43HALTER THE APPROPIATE ANGLE AND PRESS KEY 49.43) CRT0133
      CALL NEXT(NK)                                                     CRT0134
      IF(NK.NE.49) GO TO 499                                            CRT0135
      NVIEW = 1                                                         CRT0136
      NCRT = 2                                                          CRT0137
  499 WRITE(6,4999) NVIEW,NCRT,NK,CALPHA ,CBETA,CGAMMA                  CRT0138
 4999 FORMAT(12H0*****NVIEW=I4,7H  NCRT=I4,5H  NK=I4/                   CRT0139
     A10H0**CALPHA=E20.8,8H  CBETA=E20.8,9H  CGAMMA=E20.8)              CRT0140
      RETURN                                                            CRT0141
      END                                                               CRT0142
```

APPENDIX C

LINKAGE EDITOR CONTROL CARDS FOR

INTERACTIVE NASTRAN PREPROCESSOR

```
LINKEDIT LET,OUTFILE=NAST(T),PARAM(4)=20,PARAM(5)=50,PARAM(6)=6000,      LKED0002
 PARAM(2)=1200                                                           LKED0003
LIBRARY NASTOBJ/WWS/BNFILE/XCAL                                          LKED0004
LINK  0                                                                  LKED0005
RENAME APACTGR = ABSENT.                                                 LKED0006
RENAME LABRT = ABSENT.                                                   LKED0007
RENAME GATOR = ABSENT.                                                   LKED0008
RENAME   RECOVRY = RETURN  $$  RCV NOT AVAILABLE AT CDC DATA CENTER      LKED0009
RENAME   XWRITE(106600) = WRITEX    $---BLAST I/O FEATURE---$            LKED0010
RENAME   XREAD (106600) = READX     $---BLAST I/O FEATURE---$            LKED0011
RENAME  SYSTEM = SYSTEM.                                                 LKED0012
RENAME   PEXIT = LINK20.                                                 LKED0013
RENAME  MSGWRT = LINK20.                                                 LKED0014
RENAME  RWUNLD = RETURN                                                  LKED0015
INCLUDE NASTOBJ(GINO,         XCORSZ)                                    LKED0016
INCLUDE WWS(NASTRAN)                                                     LKED0017
INCLUDE WWS(BLKDATA(TIME))                                               LKED0018
INCLUDE NASTOBJ(NASTRAN,BLKDATA(TIME),BLKDATA(GINO66),CONMSG)            LKED0019
INCLUDE NASTOBJ(106600,DUMP,RETURN)                                      LKED0020
INCLUDE NASTOBJ(XEOT,TMTOGO,WRTTRL,RDTRL)                                LKED0021
INCLUDE NASTOBJ(WRTTRLZ,MESAGE,FNAME)                                    LKED0022
INCLUDE NASTOBJ(OPNCOR,WRTCOR,RDCOR,OPNCORZ,PRELOC,LOCATE,PRELOCZ)       LKED0023
INCLUDE NASTOBJ(GOPEN,FREAD,CLSTAB,SSWTCH)                               LKED0024
INCLUDE NASTOBJ(DSIGN) $ FIX FOR 0 ARGUMENTS                             LKED0025
INCLUDE WWS(BLKDATA(SPEC))                                               LKED0026
INCLUDE WWS(BLKDATA(CRT))                                                LKED0027
INSERT CRT                                                               LKED0028
INSERT  SYSTEM,GINOX,TIME,GINO66                                         LKED0029
INSERT  ZBLPKX,ZNTPKX,PACKX,UNPAKX                                       LKED0030
ENTRY  NASTRAN                                                           LKED0031
END                                                                      LKED0032


LINK  1                                                                  LKED0033
RENAME CORSZ = XCORSZ                                                    LKED0034
RENAME NTRAN=DUMP $ 1108 DECK ONLY                                       LKED0035
RENAME SEARCH=DUMP $ NOT USED ON THE 6400/6600                           LKED0036
RENAME   SYSTEM = SYSTEM. $ RENAME THE CDC SYSTEM ROUTINE CALLS          LKED0037
RENAME   PEXIT = LINK20.                                                 LKED 38
RENAME SEMTRN = RETURN                                                   LKEDC039
RENAME  XOR    = XORF                                                    LKED0040
RENAME  LD01 = LD50                                                      LKED0041
RENAME  LD02 = LD50                                                      LKED0042
RENAME  LD03 = LD50                                                      LKED0043
RENAME  LD04 = LD50                                                      LKED0044
RENAME  LD05 = LD50                                                      LKED0045
RENAME  LD06 = LD50                                                      LKED0046
RENAME  LD07 = LD50                                                      LKED0047
RENAME  LD08 = LD50                                                      LKED0048
RENAME  LD09 = LD50                                                      LKED0049
RENAME  LD10 = LD50                                                      LKED0050
RENAME  LD11 = LD50                                                      LKED0051
RENAME  LD12 = LD50                                                      LKED0052
RENAME  LD13 = LD50                                                      LKED0053
RENAME  LD45   = LINK20.                                                 LKED0054
RENAME  LD46   = LINK20.                                                 LKED0055
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```
RENAME  LD47    = LINK20.                                                    LKED0056
RENAME  LD48    = LINK20.                                                    LKED0057
RENAME  LD49    = LINK20.                                                    LKED0058
RENAME  LD51    = LINK20.                                                    LKED0059
RENAME BUG = RETURN                                                          LKED0060
RENAME  TTLPGE = RETURN                                                      LKED0061
INCLUDE WWS(XSEM1)                                                           LKED0062
INCLUDE NASTOBJ(XSEM1,TAPBIT,PAGE,PAGE1,PAGE2,PAGEZZZ)                       LKED0063
INCLUDE NASTOBJ(BLKDATA(XSRTBD))                                             LKED0064
INSERT  XSRTBD,ZZZPAGE,BLANK..                                               LKED0065
OVERLAY A1                                                                   LKED0066
INCLUDE NASTOBJ(MSGWRT,USRMSG)                                               LKED0067
OVERLAY A1                                                                   LKED0068
INCLUDE WWS(SMESAGE)                                                         LKED0069
INCLUDE WWS(CDC250,NEXT,PLT250)                                              LKED0070
INCLUDE WWS(LODTBL)                                                          LKED0071
INCLUDE BNFILE(CDC250,DECOD3,DECOD4,HOGWASH,LODTBL,NEXT,PLT250)              LKED0072
INCLUDE BNFILE(WARTHOG,SCREEN)                                               LKED0073
INCLUDE WWS(PLT000,KEYBORD,CRT250)                                           LKED0074
INCLUDE WWS(SPCMAT)                                                          LKED0075
INCLUDE WWS(KG1FR)                                                           LKED0076
INCLUDE XCAL(CALPLT)                                                         LKED0077
INCLUDE WWS(ENCOD2,RSHFT,ADVERSE,SPACK,SLOCATE,CALPLT,UNPK,CNTRLN)           LKED0078
INCLUDE WWS(CREATEF,DECOD1,DECOD2,DROUTE,EXOR,I03,NOTATE,PLOTSW)             LKED0079
INCLUDE WWS(PLT9999,SAVPLOT,SCAN,STRCALL,TRUNCL,WHERE,XMIT,LOADADR)          LKED0080
INCLUDE WWS(BLKDATA(GRAPHNO))                                                LKED0081
INSERT GRAPHNO,LANGLEY,TRIAL,VPARMS                                          LKED0082
OVERLAY A1                                                                   LKED0083
INCLUDE WWS(BTSTRP)                                                          LKED0084
INCLUDE NASTOBJ(BTSTRP,ENDSYSZ,ENDSYS,BGNSYS)                                LKED0085
INSERT  ZENDSYS                                                              LKED0086
OVERLAY ENDSSS                                                               LKED0087
INSERT  ENDSSS                                                               LKED0088
OVERLAY A1                                                                   LKED0089
INCLUDE NASTOBJ(XPOLCK,XFILPS,XPLEQK,XPOLCKZ)                                LKED0090
OVERLAY X1X                                                                  LKED0091
INCLUDE NASTOBJ(XCEI,XPURGE)                                                 LKED0092
OVERLAY X1X                                                                  LKED0093
INCLUDE NASTOBJ(BLKDATA(XSFA1),XSFA,XSOSGN,XCLEAN,XPUNP,XDPH)                LKED0094
INSERT  XSFA1,ZXPOLCK                                                        LKED0095
OVERLAY ESFA                                                                 LKED0096
INSERT  ESFA                                                                 LKED0097
OVERLAY A1                                                                   LKED0098
INCLUDE NASTOBJ(BLKDATA(IFPX0),BLKDATA(IFPX1),BLKDATA(UMFZZZ),SEMINT)        LKED0099
INSERT  IFPX0,XOLDPT,IFPX1,UMFZZZ                                            LKED0100
OVERLAY DD                                                                   LKED0101
INCLUDE NASTOBJ(XRCARD)                                                      LKED0102
OVERLAY D                                                                    LKED0103
INCLUDE NASTOBJ(GNFIAT,        XCSA,XRGDFM,XSBSET)                           LKED0104
INCLUDE NASTOBJ(WALTIM)                                                      LKED0105
OVERLAY E1                                                                   LKED0106
INSERT  XCSABF                                                               LKED0107
OVERLAY E1                                                                   LKED0108
INCLUDE WWS(LD50)                                                            LKED0109
OVERLAY D                                                                    LKED0110
INCLUDE NASTOBJ(SORT)                                                        LKED0111
OVERLAY DE                                                                   LKED0112
```

```
INCLUDE NASTOBJ(BLKDATA(IFP1A),FNDPLT)                                  LKED0113
INCLUDE WWS(IFP1D)                                                      LKED0114
INCLUDE NASTOBJ(IFP1,IFP1C,IFP1D,IFP1E,IFP1F,IFP1G,SWSRT)               LKED0115
INSERT  SETUP,IFP1A                                                     LKED0116
OVERLAY IFP1X                                                           LKED0117
INSERT  IFP1X                                                           LKED0118
OVERLAY DE                                                              LKED0119
INCLUDE NASTOBJ(IFP4B,IFP4C,IFP4E,IFP4F,IFP4G,B1SRCH)                   LKED0120
OVERLAY IFP45                                                           LKED0121
INCLUDE NASTOBJ(IFP4,IFP4A)                                             LKED0122
OVERLAY IFP4ZZ                                                          LKED0123
INSERT  IFP4ZZ                                                          LKED0124
OVERLAY IFP45                                                           LKED0125
INCLUDE NASTOBJ(IFP5,IFP5A)                                             LKED0126
OVERLAY IFP5ZZ                                                          LKED0127
INSERT  IFP5ZZ                                                          LKED0128
OVERLAY D                                                               LKED0129
INCLUDE NASTOBJ(XFADJ1,XRECPS,XFADJ,CRDFLG,RPAGE,XBCDBI,EXTINT,INITCO)  LKED0130
INCLUDE NASTOBJ(XPRETY,INTEXT,XRECPSZ,ISFT)                             LKED0131
INSERT  ZXRECPS                                                         LKED0132
OVERLAY UMF                                                             LKED0133
INCLUDE NASTOBJ(XSORT)                                                  LKED0134
OVERLAY ESORT                                                           LKED0135
INSERT  ESORT                                                           LKED0136
OVERLAY UMF                                                             LKED0137
INCLUDE NASTOBJ(UMFEDT)                                                 LKED0138
OVERLAY UMFXXX                                                          LKED0139
INSERT  UMFXXX                                                          LKED0140
OVERLAY D                                                               LKED0141
INCLUDE NASTOBJ(BLKDATA(XGPI2),BLKDATA(XGPIC),XGPI,XGPIDG,XGPIMW)       LKED0142
INCLUDE NASTOBJ(XGPIDGZ)                                                LKED0143
INSERT  XGPIC,XGPID,XGPI2,XGPI3,XGPI4,XGPI5,XGPI6,XGPI7,XGPI8,XGPI2X    LKED0144
INSERT  ZXGPIDG                                                         LKED0145
OVERLAY E                                                               LKED0146
INCLUDE NASTOBJ(BLKDATA(XLKSPC),XGPI8S,MPLPRT)                          LKED0147
INSERT  XLKSPC                                                          LKED0148
OVERLAY XGPI1 $ THIS MUST BE UNDER LONGEST SEGMENT UNDER OVERLAY E      LKED0149
INSERT  XGPI1                                                           LKED0150
OVERLAY E                                                               LKED0151
INCLUDE NASTOBJ(XFLORD,XFLDEF)                                          LKED0152
OVERLAY E                                                               LKED0153
INCLUDE NASTOBJ(OSCDMP)                                                 LKED0154
OVERLAY E                                                               LKED0155
INCLUDE NASTOBJ(XOSGEN,XLNKHD,XIPFL,XPARAM,XSCNDM)                      LKED0156
OVERLAY DD                                                              LKED0157
INCLUDE NASTOBJ(IFPDCO)                                                 LKED0158
INCLUDE NASTOBJ(BLKDATA(IFPDTA))                                        LKED0159
INSERT  IFPDTA                                                          LKED0160
OVERLAY DDD                                                             LKED0161
INCLUDE NASTOBJ(RCARD,IFP)                                              LKED0162
INCLUDE NASTOBJ(BLKDATA(IFPX2),BLKDATA(IFPX3),BLKDATA(IFPX4))           LKED0163
INCLUDE NASTOBJ(BLKDATA(IFPX5),BLKDATA(IFPX6),BLKDATA(IFPX7))           LKED0164
INSERT  IFPX2,IFPX3,IFPX4,IFPX5,IFPX6,IFPX7                             LKED0165
OVERLAY DD1                                                             LKED0166
INCLUDE NASTOBJ(IFS1P)                                                  LKED0167
```

```
OVERLAY DD1                                                          LKED0168
INCLUDE NASTOBJ(IFS2P)                                               LKED0169
OVERLAY IFPXX                                                        LKED0170
INSERT  IFPXX                                                        LKED0171
OVERLAY DD1                                                          LKED0172
INCLUDE NASTOBJ(IFS3P)                                               LKED0173
OVERLAY DD1                                                          LKED0174
INCLUDE NASTOBJ(IFS4P)                                               LKED0175
OVERLAY DD1                                                          LKED0176
INCLUDE NASTOBJ(IFS5P)                                               LKED0177
OVERLAY DDD                                                          LKED0178
INCLUDE NASTOBJ(BLKDATA(IFP38D),IFP3,IFP38)                          LKED0179
INSERT  IFP38D,IFP3LV                                                LKED0180
OVERLAY IFP3ZZ                                                       LKED0181
INSERT  IFP3ZZ                                                       LKED0182
ENTRY   XSEM1                                                        LKED0183
END                                                                  LKED0184

LINK  2                                                              LKED0185
RENAME CORSZ = XCORSZ                                                LKED0186
RENAME NTRAN=DUMP $ 1108 DECK ONLY                                   LKED0187
RENAME SEARCH=DUMP $ NOT USED ON THE 6400/6600                       LKED0188
RENAME   PEXIT = LINK20.                                             LKED0189
RENAME  BTSTRP = RETURN                                              LKED0190
RENAME   SYSTEM = SYSTEM.                                            LKED0191
RENAME  SETC = RETURN                                                LKED0192
RENAME  TA1D   = RETURN                                              LKED0193
RENAME  TA1E   = RETURN                                              LKED0194
RENAME TAPSWI = ABSENT.                                              LKED0195
RENAME OPMESG = ABSENT.                                              LKED0196
INCLUDE WWS(XSEM2)                                                   LKED0197
INCLUDE NASTOBJ(XSEM2,TAPBIT,INTLST)                                 LKED0198
INCLUDE NASTOBJ(RDMODE,RDMODX,RDMODXZ)                               LKED0199
INCLUDE NASTOBJ(RDMODY,RDWORD)                                       LKED0200
INSERT  ZRDMODX,BLANK..                                              LKED0201
OVERLAY ONE                                                          LKED0202
INCLUDE NASTOBJ(PAGE,PAGE1,PAGE2,PAGEZZZ)                            LKED0203
INSERT  ZZZPAGE                                                      LKED0204
OVERLAY A                                                            LKED0205
INCLUDE NASTOBJ(MSGWRT,USRMSG)                                       LKED0206
OVERLAY A                                                            LKED0207
INCLUDE WWS(SMESAGE)                                                 LKED0208
INCLUDE WWS(LODTBL)                                                  LKED0209
INCLUDE WWS(CDC250,NEXT,PLT250)                                      LKED0210
INCLUDE BNFILE(CDC250,DECOD3,DECOD4,HOGWASH,LODTBL,NEXT,PLT250)      LKED0211
INCLUDE BNFILE(WARTHOG,SCREEN)                                       LKED0212
INCLUDE WWS(PLT000,KEYBORD,CRT250)                                   LKED0213
INCLUDE WWS(SPCMAT)                                                  LKED0214
INCLUDE WWS(KG1FR)                                                   LKED0215
INCLUDE XCAL(CALPLT)                                                 LKED0216
INCLUDE WWS(ENCOD2,RSHFT,ADVERSE,SPACK,SLOCATE,CALPLT,UNPK,CNTRLN)   LKED0217
INCLUDE WWS(CREATEF,DECOD1,DECOD2,DROUTE,EXOR,I03,NOTATE,PLOTSW)     LKED0218
INCLUDE WWS(PLT9999,SAVPLOT,SCAN,STRCALL,TRUNCL,WHERE,XMIT,LOADADR)  LKED0219
INCLUDE WWS(PARAMS)                                                  LKED0220
```

```
INCLUDE WWS(CRTPLOT)                                                          LKED0221
INCLUDE WWS(BLKDATA(GRAPHNO))                                                 LKED0222
INSERT GRAPHNO,LANGLEY,TRIAL,VPARMS                                           LKED0223
OVERLAY A                                                                     LKED0224
INCLUDE NASTOBJ(ENDSYSZ,ENDSYS,BGNSYS)                                        LKED0225
INSERT  ZENDSYS                                                               LKED0226
OVERLAY ENDSSS                                                                LKED0227
INSERT  ENDSSS                                                                LKED0228
OVERLAY A                                                                     LKED0229
INCLUDE NASTOBJ(QPARAM)                                                       LKED0230
OVERLAY A                                                                     LKED0231
INCLUDE NASTOBJ(XSAVE)                                                        LKED0232
OVERLAY A                                                                     LKED0233
INCLUDE NASTOBJ(XCEI)                                                         LKED0234
OVERLAY A                                                                     LKED0235
INCLUDE NASTOBJ(XCHK)                                                         LKED0236
OVERLAY A                                                                     LKED0237
INCLUDE NASTOBJ(BLKDATA(XSFA1),XPURGE,XPUNP,XDPH)                             LKED0238
INCLUDE NASTOBJ(XPOLCK,XFILPS,XPLEQK,XPOLCKZ,XSFA,XCLEAN,XSOSGN,GNFIST)       LKED0239
INSERT  ZXPOLCK,XSFA1                                                         LKED0240
OVERLAY ESFA                                                                  LKED0241
INSERT  ESFA                                                                  LKED0242
OVERLAY A                                                                     LKED0243
INCLUDE NASTOBJ(TABPT,TABPRT)                                                 LKED0244
OVERLAY TABPRX                                                                LKED0246
INSERT  TABPRX                                                                LKED0247
OVERLAY A                                                                     LKED0248
INCLUDE NASTOBJ(PRTPRM)                                                       LKED0249
OVERLAY A                                                                     LKED0250
INCLUDE NASTOBJ(BLKDATA(INPUTA,IUNION,INPUT)                                  LKED0251
INSERT  INPUTA                                                                LKED0252
OVERLAY INPUTX                                                                LKED0253
INSERT  INPUTX                                                                LKED0254
OVERLAY A                                                                     LKED0255
INCLUDE NASTOBJ(EJECT,WRTMSG,PRTMSG)                                          LKED0256
OVERLAY XXPMSG                                                                LKED0257
INSERT  XXPMSG                                                                LKED0258
OVERLAY A                                                                     LKED0259
INCLUDE NASTOBJ(INPTT1)                                                       LKED0260
INCLUDE NASTOBJ(TPSWIT,FORFIL)                                                LKED0261
OVERLAY INP1XX                                                                LKED0262
INSERT  INP1XX                                                                LKED0263
OVERLAY A                                                                     LKED0264
INCLUDE NASTOBJ(INPTT2)                                                       LKED0265
OVERLAY INP2XX                                                                LKED0266
INSERT  INP2XX                                                                LKED0267
OVERLAY A                                                                     LKED0268
INCLUDE NASTOBJ(BLKDATA(CHAR94),AXIS,DRWCHR,IDPLOT,LINE,PLTSET,PRINT)         LKED0269
INCLUDE WWS(SGINOZZ)                                                          LKED0270
INCLUDE NASTOBJ(SCLOSE,SELCAM,SEOF,SGINOZZ,SKPFRM,SOPEN,STPLOT,SWRITE)        LKED0271
INCLUDE NASTOBJ(SYMBOL,TIPE,TYPINT,FNDPLT)                                    LKED0272
INSERT  CHAR94,CHRDRW,XXPARM,PLTDAT,SYMBLS,ZZSGINO                            LKED0273
OVERLAY DRAW                                                                  LKED0274
INCLUDE NASTOBJ(LINE10,TYPE10,WPLT10)                                         LKED0275
OVERLAY LONGST                                                                LKED0276
INCLUDE NASTOBJ(DPLOT,DRAW        )                                           LKED0277
INCLUDE NASTOBJ(ELELBL,FIND,FNDSET,        GPTLBL,GPTSYM,HEAD,INTVEC)         LKED0278
INCLUDE WWS(PLOT)                                                             LKED0279
INCLUDE WWS(PROCES)                                                           LKED0280
INCLUDE NASTOBJ(MINMAX,PARAM,PERPEC,PLOT,PLTOPR,PROCES,SHAPE,WRTPRT)          LKED0281
INSERT  DRWDAT,RSTXXX                                                         LKED0282
OVERLAY XXPLOT                                                                LKED0283
```

```
INSERT  XXPLOT                                                          LKED0284
OVERLAY DRAW                                                            LKED0285
INCLUDE NASTOBJ(LINE9,TYPE9,WPLT9)                                      LKED0286
OVERLAY ONE                                                             LKED0287
INCLUDE NASTOBJ(SETVAL)                                                 LKED0288
OVERLAY ONE                                                             LKED0289
INCLUDE NASTOBJ(BLKDATA(GPTA1),DELSET)                                  LKED0290
INSERT  GPTA1                                                           LKED0291
OVERLAY TA1GP1                                                          LKED0292
INCLUDE NASTOBJ(SORT)                                                   LKED0293
INSERT  SETUP                                                           LKED0294
OVERLAY GPx1                                                            LKED0295
INCLUDE NASTOBJ(GP1)                                                    LKED0296
OVERLAY GPA1                                                            LKED0297
INSERT  GPA1                                                            LKED0298
OVERLAY GPx1                                                            LKED0299
INCLUDE NASTOBJ(GP2)                                                    LKED0300
OVERLAY GPA2                                                            LKED0301
INSERT  GPA2                                                            LKED0302
OVERLAY TA1GP1                                                          LKED0303
INCLUDE NASTOBJ(COMECT,CNSTRC,DPLTST,SETINP)                            LKED0304
OVERLAY XXPSET                                                          LKED0305
INSERT  XXPSET                                                          LKED0306
OVERLAY ONE                                                             LKED0307
INCLUDE NASTOBJ(INPTT3)                                                 LKED0308
OVERLAY ONE                                                             LKED0309
INCLUDE NASTOBJ(INPTT4)                                                 LKED0310
ENTRY   XSEM2                                                           LKED0311
END                                                                     LKED0312


LINK 20                                                                 LKED0314
RENAME CORSZ = XCORSZ                                                   LKED0315
RENAME APACTGR = ABSENT.     $ REMOVE THIS CARD WHEN RUNNING AT CYBERNETLKED0316
RENAME   SYSTEM = SYSTEM.                                               LKED0317
RENAME   EXIT(PEXIT, * PEXIT66                                         LKED0318
INCLUDE NASTOBJ(PEXIT,MSGWRT,USRMSG,PAGE,PAGE1,PAGE2,PAGEZZZ,PEXIT66)   LKED0319
ENTRY    PEXIT                                                          LKED0320
END                                                                     LKED0321
ENDLINKS                                                                LKED0313
```

REFERENCES

1. Smith, Willianna W.: A Special NASTRAN Program for Input Checking and Undeformed Structure Plotting. NASTRAN: Users' Experiences, NASA TM X-2378, 1971, pp. 559-568.

2. Douglas, Frank J., ed.: The NASTRAN Programmer's Manual. NASA SP-233, 1970.

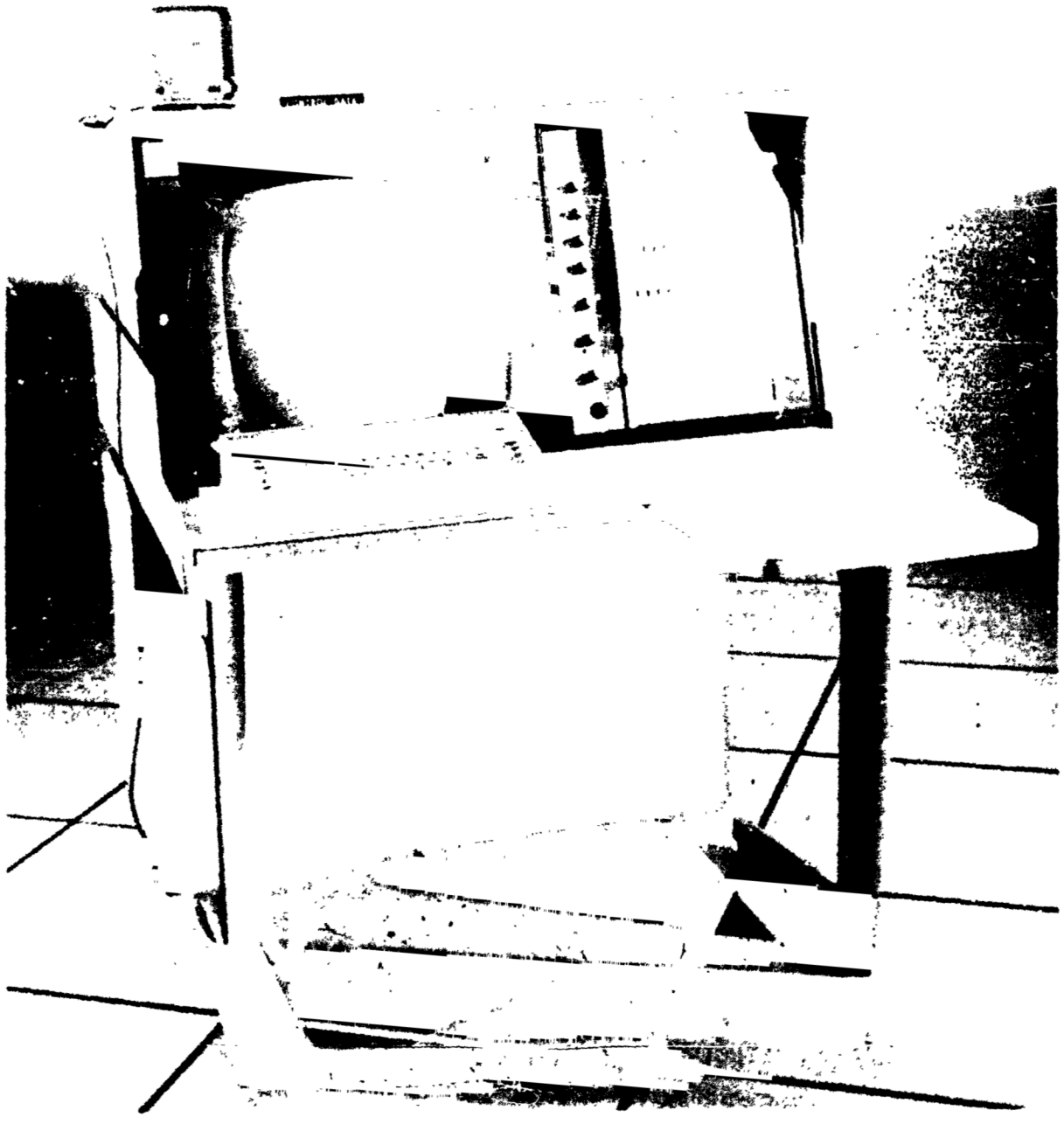

Figure 1. – CDC 250 CRT terminal.