

# FEMAP Neutral File Format

This Document describes the FEMAP Neutral File Format. This information is not required unless you are going to write your own interfaces to read or write Neutral Files. At the end of this file is the file format of the new FEMAP Binary Output File.

## A.1 File Structure

FEMAP Neutral files follow a very structured format that makes them relatively easy to read and write. All data is contained in "data blocks". Each data block begins with a "-1" and an ID, and also ends with a "-1". In a formatted Neutral file it looks like the following:

| Description  | File Contains  |
|--|--|
|  | Column Numbers<br>.....1.....2.....3.....4<br>1234567890123456789012345678901234567890 |
| Start of Data Block  | -1   |
| Data Block ID  | 100  |
| All of the data for this data block. This is usually multiple records. | Data   |
| End of Data Block  | -1   |

Any number of data blocks can be in the file, and they can appear in any order. Data blocks of the same type can even be repeated, when necessary.

### A.1.1 Formatted Neutral Files

Formatted Neutral Files contain free-format, record oriented data blocks. You will notice that each value is separated by a comma, and there are even trailing commas at the end of each record (line). These commas are not required, but values must be separated by at least one or more spaces. The only fixed field requirements are for the "-1" start and end of block indicators - they must always be preceded by 3 spaces and start in the fourth column. All other records should start in the first column.

#### Integer Values

Integer values are all subject to the limitations for the corresponding numbers in FEMAP. In no case can an ID ever exceed the range 1 to 99999999. Other limitations are described in the formats shown below.

#### Real Values

Real numbers can be written in either floating point or exponential format. Any reasonable number of significant digits can be included, but the total length of any line can not exceed 255 characters.

#### Character Strings

Titles and other text items are simply written as a series of characters. In a formatted file, they are always the only item in the record, so the end of the line terminates them. If the character string is really empty (has no characters), FEMAP will write the special string "<NULL>". If you are reading a Neutral file, you should interpret this as a blank string.

### A.1.2 Library File Formats

FEMAP library files (materials, properties, report formats and views) are saved in an enhanced formatted neutral file format. This format follows these rules:

1. The first line of the file is a one-line header that identifies the file as the appropriate type of library. For example, the material library must say:

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FEMAP Version 5.0 Material Library

2. Each entry in the library is preceded by a comment line that looks like:

```
$COM      0  5.0      AISI 4340 Steel
```

It must start with \$COM. The second field must be the entity type (i.e. for materials - 0=Isotropic, 1=2D Orthotropic...). The third field is the FEMAP version of the datablock. The remainder of the line is the entity title.

3. Following the comment is a standard FEMAP data block containing one, and only one entity.

If you follow these formatting rules, a FEMAP library can be read either one entity at a time with the various Load from library options, or in its entirety with the FEMAP Neutral Read Translator.

### A.2 Data Block Formats

This section defines all of the data blocks that are currently used by FEMAP. The following table lists all of the supported blocks:

| ID  | Description                       | Write  | Read |
|-----|-----------------------------------|--------|------|
| 1   | Materials (obsolete)              | No     | Yes  |
| 2   | Properties (obsolete)             | No     | Yes  |
| 3   | Nodes (obsolete)                  | No     | Yes  |
| 4   | Elements (obsolete)               | No     | Yes  |
| 5   | Coordinate Systems (obsolete)     | No     | Yes  |
| 6   | Constraints (obsolete)            | No     | Yes  |
| 7   | Loads (obsolete)                  | No     | Yes  |
| 8   | Groups (obsolete)                 | No     | Yes  |
| 9   | Display Option (obsolete)         | No     | No   |
| 10  | Window (obsolete)                 | No     | No   |
| 50  | Postprocessing Option (obsolete)  | No     | No   |
| 51  | Report Format (obsolete)          | No     | No   |
| 100 | Neutral File Header               | Yes    | Yes  |
| 101 | Variables (obsolete)              | No     | Yes  |
| 102 | Active Data (obsolete)            | No     | Yes  |
| 200 | Output Sets (obsolete)            | No     | Yes  |
| 201 | Output Data Vectors (obsolete)    | No     | Yes  |
| 401 | Materials (obsolete)              | Yes,v4 | Yes  |
| 402 | Properties                        | Yes    | Yes  |
| 403 | Nodes                             | Yes    | Yes  |
| 404 | Elements                          | Yes    | Yes  |
| 405 | Coordinate Systems                | Yes    | Yes  |
| 406 | Constraints (obsolete)            | Yes,v4 | Yes  |
| 407 | Loads (obsolete)                  | Yes,v4 | Yes  |
| 408 | Groups                            | Yes    | Yes  |
| 409 | Views                             | Yes    | Yes  |
| 410 | Variables                         | Yes    | Yes  |
| 411 | Report Formats                    | Yes    | Yes  |
| 412 | Active Data                       | Yes    | Yes  |
| 413 | <sup>(4.41+)</sup> Layer Data     | Yes    | Yes  |
| 420 | <sup>(4.3+)</sup> Functions       | Yes    | Yes  |
| 430 | <sup>(4.3+)</sup> Active Views    | Yes    | No   |
| 431 | <sup>(4.3+)</sup> Free Edge Lists | Yes    | No   |
| 432 | <sup>(4.3+)</sup> Free Face Lists | Yes    | No   |
| 433 | Model Max/Min ID Info (obsolete)  | Yes,v4 | No   |
| 450 | Output Sets                       | Yes    | Yes  |

|     |  |         |     |
|-----|--|---------|-----|
| 451 | Output Data Vectors                              | Yes     | Yes |
| 470 | Points(obsolete)                                 | Yes, v4 | Yes |
| 471 | Curves(obsolete)                                 | Yes, v4 | Yes |
| 472 | Surfaces(obsolete)                               | Yes, v4 | Yes |
| 473 | Volumes(obsolete)                                | Yes, v4 | Yes |
| 474 | Boundaries(obsolete)                             | Yes, v4 | Yes |
| 475 | Text   | Yes     | Yes |
| 506 | <sup>(5.0+)</sup> Constraints                    | Yes     | Yes |
| 507 | <sup>(5.0+)</sup> Loads                          | Yes     | Yes |
| 514 | <sup>(5.0+)</sup> Geometry Attach Info           | Yes     | Yes |
| 521 | <sup>(5.0+)</sup> Design Optimization Parameters | Yes     | Yes |
| 533 | <sup>(5.0+)</sup> Model Max/Min ID Info          | Yes     | No  |
| 540 | <sup>(5.0+)</sup> Model Notes                    | Yes     | Yes |
| 570 | <sup>(5.0+)</sup> Points                         | Yes     | Yes |
| 571 | <sup>(5.0+)</sup> Curves                         | Yes     | Yes |
| 572 | <sup>(5.0+)</sup> Surfaces                       | Yes     | Yes |
| 573 | <sup>(5.0+)</sup> Solid/Volume                   | Yes     | Yes |
| 601 | <sup>(6.0+)</sup> Materials                      | Yes     | Yes |
| 615 | <sup>(6.0+)</sup> Contact Segments               | Yes     | Yes |
| 999 | End of File                                      | No      | Yes |

Data blocks that are listed as obsolete are not written in the current version of the Neutral File. They have been superseded by another similar datablock. Since FEMAP can write Neutral files for previous versions, some of these obsolete datablocks may still be produced if you select an old version format. In that case, the datablocks are still documented. In most cases, these data blocks can still be read by FEMAP, but may be removed completely in a later release. You should never write any new interfaces that use these obsolete formats.

When you look at the following tables, the record numbers refer to the line numbers relative to the start of the datablock in a formatted neutral file. You can tell the type and size of these numbers (or characters) by referring to the "Size" column.

Changes from previous versions have a version number included in the description - like (4.1+) to mean version 4.1 and later. If you find the version number change in the Record or Field column, this implies that that record or field was added in that version - files generated in previous versions will not have this data present. If the version change is listed in the Description column, this implies that the description was changed. This usually occurs when additional options or meanings are given to an existing field.

#### Data Block 100 - Neutral File Header

| Record | Field   | Description  | Size                     |
|--------|---------|--|--------------------------|
| 1      | Title   | Database title   | character string         |
| 2      | version | The version of FEMAP used to create this file. Currently should be 6.0 | 8 byte, double precision |

#### Data Block 401 – Materials (obsolete)

| Record | Field | Description  | Size                  |
|--------|-------|--|-----------------------|
| 1      | ID    | ID of material   | 4 byte, long integers |
|        | color | ID of color  |                       |
|        | type  | Type of material (0=Iso, 1=2D Ortho, 2=3D Ortho, 3=2D Aniso, 4=3D Aniso, 5=Hyperelastic, 6=General, 7=Fluid) |                       |
|        | layer | ID of layer  |                       |

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|                         |                                    |   |                          |
|-------------------------|------------------------------------|---|--------------------------|
|                         | <sup>(4.3+)</sup> has_functions    | Function Flag (Record numbers 19 thru 34, the function references, are included only if this flag is nonzero) | 2 byte, boolean          |
| 2                       | title                              | Material Title (max 25 char)  | character string         |
| 3                       | e[0..2]                            | Young's modulus   | 8 byte, double precision |
| 4                       | g[0..2]                            | Shear modulus   |                          |
| 5                       | nu[0..2]                           | Poisson's ratio   |                          |
| 6 thru 10               | GMatrix_3D[0..20]                  | Upper triangle of 6x6 3D anisotropic elastic matrix. Written 5 entries per record, 1 in last.                 |                          |
| 11, 12                  | GMatrix_2D[0..5]                   | Upper triangle of 3x3 2D anisotropic elastic matrix. Written 5 entries per record, 1 in last.                 |                          |
| 13, 14                  | alpha[0..5]                        | Thermal expansion coefficients. 5 entries per record, 1 in last.  | 8 byte, double precision |
| 15, 16                  | k[0..5]                            | Thermal conductivity coefficients. 5 entries per record, 1 in last.   |                          |
| 17                      | thermal_cap                        | <sup>(4.3+)</sup> Specific Heat   | 8 byte, double precision |
|                         | density                            | Material density  |                          |
|                         | damping                            | Damping coefficient   |                          |
|                         | temperature                        | Reference temperature   |                          |
| 18                      | tension_limit[0..1]                | Stress Allowables in tension  |                          |
|                         | comp_limit[0..1]                   | Stress Allowables in compression  |                          |
|                         | shear_limit                        | Stress Allowable in shear   |                          |
|                         | <sup>(5.0+)</sup> tsai_wu          | Tsai_wu interaction factor  |                          |
|                         | <sup>(5.0+)</sup> has_strain_limit | Flag if material uses strain limits instead of stress limits  | 2 byte boolean           |
| <sup>(4.4+)</sup> 19-23 | Amatrix [0..20]                    | Hyperelastic Amatrix values, written 5 per record, 1 in last  | 8 byte, double precision |
| <sup>(4.4+)</sup> 24    | Dmatrix[0..4]                      | Hyperelastic Dmatrix values   |                          |
| <sup>(4.4+)</sup> 25    | Hard_slope                         | Plasticity Hardening Slope  |                          |
|                         | yield_limit[0..1]                  | Plasticity Yield Limits - Initial Yield Stress and Friction Angle   |                          |
| <sup>(4.5+)</sup> 26    | yield_limit[2..4]                  | Additional Yield limits   | 8 byte, double precision |
|                         | hard_type                          | Hardening Data Type   | 4 byte, long integer     |
|                         | yield_func                         | Yield Function  |                          |
| <sup>(4.4+)</sup> 27    | hyp_exp[0..4]                      | IDs of Hyperelastic Experimental Data Functions   | 4 byte, long integer     |
| <sup>(4.4+)</sup> 28    | hyp_polyord[0..1]                  | Strain Energy Polynomial Order for Hyperelastic   |                          |
|                         | nonlin_type                        | Nonlinear Type (0=None/Linear, 1=Nonlinear Elastic, 2=Plastic, 3=Elasto-Plastic)                              |                          |
|                         | nonlin_func                        | ID of function for Plasticity   |                          |
|                         | hard_type                          | Hardening Rule (0=Isotropic, 1=Kinematic, 2=Both)   |                          |
|                         | yield_type                         | Yield Criterion (0=von Mises, 1=Tresca, 2=Mohr-Coloumb, 3=Drucker-Prager)                                     |                          |
| <sup>(4.4+)</sup> 29    | creep_thresh                       | Creep Threshold Stress  | 8 byte, double precision |
|                         | creep_temp                         | Creep Reference Temperature   |                          |
|                         | creep_rate                         | Temperature Dependent Creep Rate  |                          |
| <sup>(4.4+)</sup> 30-31 | creep_emp [0..6]                   | Empirical Creep Law Coefficients, written 5 on first line, 2 on last.   |                          |
| <sup>(4.4+)</sup> 32    | creep_type                         | Creep Type (0=None, 1=Empirical, 2=Tabular)   | 4 byte, long integer     |

|  |                  |                                  |  |
|--|------------------|----------------------------------|--|
|  | creep_func[0..2] | Tabular Model Creep Function IDs |  |
| (4.4+)   | 33               | creep_form [0..3]                | Empirical Creep Law Format Flags   |
| The following rows contain the IDs of all functions that are referenced by this material. They are only present if the "has_functions" flag in record 1 is not zero. |                  |                                  |  |
| (4.3+)   | 34               | fe[0..2]                         | Young's modulus functions<br>4 byte, long integer  |
| (4.3+)   | 35               | fg[0..2]                         | Shear modulus functions  |
| (4.3+)   | 36               | fnu[0..2]                        | Poisson's ratio functions  |
| (4.3+)   | 37 thru 41       | fGMatrix_3D[0..21]               | 3D anisotropic elastic matrix functions.<br>Written 5 entries per record, 1 in last.     |
| (4.3+)   | 42, 43           | fGMatrix_2D[0..5]                | 2D anisotropic elastic matrix functions.<br>Written 5 entries per record, 1 in last.     |
| (4.3+)   | 44, 45           | falpha[0..5]                     | Thermal expansion coefficients functions.<br>Written 5 entries per record, 1 in last.    |
| (4.3+)   | 46, 47           | fk[0..5]                         | Thermal conductivity coefficients functions.<br>Written 5 entries per record, 1 in last. |
| (4.3+)   | 48               | fthermal_cap                     | Thermal capacity function<br>4 byte, long integer  |
|  |                  | fdensity                         | Material density function  |
|  |                  | fdamping                         | Damping coefficient function   |
|  |                  | temperature                      | Reference temperature function   |
| (4.3+)   | 49               | ftension_limit[0..1]             | Stress Allowables in tension functions   |
|  |                  | fcomp_limit[0..1]                | Stress Allowables in compression functions   |
|  |                  | fshear_limit                     | Stress Allowable in shear function   |

**Data Block 601 – Materials**

| Record     | Field                                   | Description   | Size                     |
|------------|---|---|--------------------------|
| 1          | ID                                      | ID of material  | 4 byte, long integers    |
|            | format                                  | Always set to -601  |                          |
|            | color                                   | ID of color   |                          |
|            | type                                    | Type of material (0=Iso, 1=2D Ortho, 2=3D Ortho, 3=2D Aniso, 4=3D Aniso, 5=Hyperelastic, 6=General, 7=Fluid)                            |                          |
|            | subtype                                 | Subtype for General Materials   |                          |
|            | layer                                   | ID of layer   |                          |
|            | Function Count                          | In regular Neutral Files this is always 0. If nonzero, it is the number of functions that follow the material data (used for libraries) |                          |
| 2          | title                                   | Material Title (max 25 char)  | character string         |
| 3          | Bcount                                  | Number of Boolean Flags (always 10)   | 4 byte, long integers    |
| 4          | bval[0..9]                              | Boolean flags   | 2 byte, boolean          |
| 5          | Icount                                  | Number of Integer values (always 25)  | 4 byte, long integer     |
| 6,7,8      | ival[0..24]                             | Integer values, 10 per record, 5 on last record   |                          |
| 9          | Mcount                                  | Number of Real values (always 200)  |                          |
| 10 thru 29 | mval[0..199]                            | Real values, 10 per record  | 8 byte, double precision |
| 30         | Fcount                                  | Number of Function IDs (always 50)  | 4 byte, long integer     |
| 31 thru 35 | fval[0..49]                             | Function IDs, 10 per record   |                          |
| 36         | Tcount                                  | Number of Addl Function IDs (always 70, was 60 prior to v7.1)   |                          |
| 37 thru 43 | tval[0..69] <sup>(7.1+ was 0..59)</sup> | Function IDs, 10 per record   |                          |

The remaining data is only present if “Function Count” is nonzero. The entire set of records is repeated “Function Count” times.

|           |       |  |                          |
|-----------|-------|--|--------------------------|
| 1 record  | ID    | ID of function   | 4 byte, long integer     |
|           | type  | Type of Function (see Data Block 420)                                  |                          |
| 1 record  | title | Function Title   | character string         |
| n records | index | value 1..n of function data pair (-1 for last record in this function) | 4 byte, long integer     |
|           | x     | X value  | 8 byte, double precision |
|           | y     | Y value  |                          |

The following table gives the locations in the material data tables for the data that is defined for the standard materials. Other custom materials can use these locations, or any other location, as defined in the material definition file that is described later in this document.

### Material Values

| Type                  | Value                   | Description  | Locations       |
|-----------------------|-------------------------|--|-----------------|
| <b>Integer Values</b> |                         |  |                 |
|                       | HYPER_POLYORD(i)        | Strain Energy Polynomial Order for Hyperelastic                                  | ival[0],ival[1] |
|                       | NONLINEAR_TYPE          | Nonlinear Type (0=None/Linear, 1=Nonlinear Elastic, 2=Plastic, 3=Elasto-Plastic) | ival[2]         |
|                       | HARDENING_TYPE          | Hardening Data Type  | ival[3]         |
|                       | YIELD_TYPE              | Yield Criterion (0=von Mises, 1=Tresca, 2=Mohr-Coloumb, 3=Drucker-Prager)        | ival[4]         |
|                       | CREEP_TYPE              | Creep Type (0=None, 1=Empirical, 2=Tabular)                                      | ival[5]         |
|                       | CREEP_EMPIRICAL_FORM(i) | Empirical Creep Law Format Flags   | ival[6..9]      |
|                       | DP_HARDENING_DATA_TYPE  | Drucker-Prager Hardening data type   | ival[10]        |
| <b>Boolean Values</b> |                         |  |                 |
|                       | HAS_STRAIN_LIMITS       | Flag if material uses strain limits instead of stress limits                     | bval[0]         |
|                       | FLUID IS LIQUID         | Flag if a fluid type materia is a liquid vs. a gas                               | bval[1]         |
| <b>Real Values</b>    |                         |  |                 |
|                       | E(i)                    | Young's modulus  | mval[0..2]      |
|                       | G(i)                    | Shear modulus  | mval[3..5]      |
|                       | NU(i)                   | Poisson's ratio  | mval[6..8]      |
|                       | GMATRIX_3D(i)           | Upper triangle of 6x6 3D anisotropic elastic matrix.                             | mval[9..29]     |
|                       | GMATRIX_2D(i)           | Upper triangle of 3x3 2D anisotropic elastic matrix.                             | mval[30..35]    |
|                       | THERMAL_EXPANSION(i)    | Thermal expansion coefficients.  | mval[36..41]    |
|                       | THERMAL_CONDUCTIVITY(i) | Thermal conductivity coefficients.   | mval[42..47]    |
|                       | THERMAL_CAPACITY        | Specific Heat  | mval[48]        |
|                       | DENSITY                 | Material density   | mval[49]        |
|                       | DAMPING                 | Damping coefficient  | mval[50]        |
|                       | TEMPERATURE             | Reference temperature  | mval[51]        |
|                       | TENSION_LIMIT(i)        | Stress Allowables in tension   | mval[52..53]    |
|                       | COMPRESSION_LIMIT(i)    | Stress Allowables in compression   | mval[54..55]    |
|                       | SHEAR_LIMIT             | Stress Allowable in shear  | mval[56]        |
|                       | TSAI_WU_INTERACTION     | Tsai_wu interaction factor   | mval[57]        |
|                       | AMATRIX_HYP(i)          | Hyperelastic Amatrix values  | mval[58..78]    |
|                       | DMATRIX_HYP(i)          | Hyperelastic Dmatrix values  | mval[79..83]    |

|                        |                                 |   |                        |
|------------------------|---------------------------------|---|------------------------|
|                        | HARDENING_SLOPE                 | Plasticity Hardening Slope  | mval[84]               |
|                        | YIELD_LIMITS(i)                 | Plasticity Yield Limits - Initial Yield Stress, Friction Angle, addl yield limits | mval[85..89]           |
|                        | CREEP_THRESHOLD_STRESS          | Creep Threshold Stress  | mval[90]               |
|                        | CREEP_REF_TEMP                  | Creep Reference Temperature   | mval[91]               |
|                        | CREEP_TEMP_DEP_RATE             | Temperature Dependent Creep Rate  | mval[92]               |
|                        | CREEP_EMPIRICAL_COEFF(i)        | Empirical Creep Law Coefficients  | mval[93..99]           |
|                        | HEAT GENERATION                 | Heat Generation Value   | mval[100], or tval[57] |
|                        | REFERENCE ENTHALPY              | Enthalpy for Phase Change   | mval[101]              |
|                        | PHASE CHANGE TEMP               | Temperature for Phase Change Onset  | mval[102]              |
|                        | PHASE CHANGE TEMP RANGE         | Temperature Range for Phase Change  | mval[103]              |
|                        | LATENT HEAT OF FUSION           | Latent heat of Fusion   | mval[104]              |
|                        | SPECIFIC HEAT ABOVE PHASE       | Specific heat above Phase Change Temp   | mval[105]              |
|                        | OPT EMISSIVITY                  | Optical – Emissivity  | mval[106]              |
|                        | OPT EMISSIVITY REV              | Optical – Emissivity, Reverse Side  | mval[107]              |
|                        | OPT ABSORPTIVITY                | Optical – Absorptivity  | mval[108]              |
|                        | OPT ABSORPTIVITY REV            | Optical – Absorptivity, Reverse Side  | mval[109]              |
|                        | OPT TRANSMISSIVITY SOLAR        | Optical – Solar Transmissivity  | mval[110]              |
|                        | OPT TRANSMISSIVITY IR           | Optical – InfraRed Transmissivity   | mval[111]              |
|                        | OPT REFLECTIVITY SOLAR          | Optical – Solar Reflectivity  | mval[112]              |
|                        | OPT REFLECTIVITY SOLAR REV      | Optical – Solar Reflectivity, Reverse Side  | mval[113]              |
|                        | OPT REFLECTIVITY IR             | Optical – InfraRed Reflectivity   | mval[114]              |
|                        | OPT REFLECTIVITY IR REV         | Optical – InfraRed Reflectivity, Reverse  | mval[115]              |
|                        | GAS CONSTANT                    | Fluid Gas Constant  | mval[116] or tval[58]  |
|                        | DYNAMIC VISCOSITY               | Fluid Dynamic Viscosity   | mval[117] or tval[59]  |
|                        | PRANDTL NUMBER                  | Prandtl Number  | mval[118] or tval[60]  |
|                        | ELECTRICAL RESISTIVITY          | Electrical Resistivity  | mval[119]              |
| <b>Function Values</b> |                                 |   |                        |
|                        | EXPERIMENTAL_FUNCTIONS(i)       | IDs of Hyperelastic Experimental Data Functions                                   | fval[0..4]             |
|                        | NONLINEAR_FUNCTION              | ID of function for Plasticity   | fval[5]                |
|                        | CREEP_FUNCTIONS(i)              | Tabular Model Creep Function IDs  | fval[6..8]             |
|                        | DP_YIELD_FUNCTION               | ID of Drucker-Prager Yield Function   | fval[9]                |
|                        | OPT EMISSIVITY FUNCTION         | ID of Optical Emissivity Function   | fval[10]               |
|                        | OPT_EMISSIVITY REV FUNCTION     | ID of Optical Emissivity Rev Side Function  | fval[11]               |
|                        | OPT ABSORPTIVITY FUNCTION       | ID of Optical Absorptivity Function   | fval[12]               |
|                        | OPT ABSORPTIVITY REV FUNC       | ID of Optical Absorptivity Rev Side Function                                      | fval[13]               |
|                        | OPT TRANSMISSIVITY SOLAR FUNC   | ID of Solar Transmissivity Function   | fval[14]               |
|                        | OPT TRANSMISSIVITY IR FUNC      | ID of InfraRed Transmissivity Function  | fval[15]               |
|                        | OPT REFLECTIVITY SOLAR FUNC     | ID of Solar Reflectivity Function   | fval[16]               |
|                        | OPT REFLECTIVITY SOLAR REV FUNC | ID of Solar Reflectivity, Rev Side Function                                       | fval[17]               |
|                        | OPT REFLECTIVITY IR FUNC        | ID of InfraRed Reflectivity Function  | fval[18]               |
|                        | OPT REFLECTIVITY IR REV FUNC    | ID of InfraRed Reflectivity Rev Side Function                                     | fval[19]               |
|                        | ELECTRICAL RESISTIVITY FUNC     | ID of Electrical Resistivity Function   | fval[20]               |

**Data Block 402 – Properties**

| Record | Field | Description | Size |
|--------|-------|-------------|------|
|--------|-------|-------------|------|

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|   |                           |  |                          |
|---|---------------------------|--|--------------------------|
| 1   | ID                        | ID of property   | 4 byte, long integers    |
|   | color                     | ID of color  |                          |
|   | matlID                    | ID of material   |                          |
|   | type                      | Type of property (see accompanying table)  |                          |
|   | layer                     | ID of layer  |                          |
|   | refCS                     | Reference coordinate system  |                          |
| 2   | title                     | Property Title (max 25 char)   | character string         |
| 3   | flag[0..3]                | Property flags (see accompanying table)  | 4 byte, long integers    |
| 4   | num_lam                   | Max material lamina  |                          |
| 5..N  | lam_MID<br>[0..num_lam-1] | Materials for each ply of laminate, 0 otherwise. Num_lam IDs, 8 values per record.   |                          |
| N+1   | num_val                   | Max number of property values  |                          |
| N+2 thru M  | Value[0..num_val-1]       | Property values. Num_val entries, 5 values per record. See accompanying table for interpretation of values.                    | 8 byte, double precision |
| <sup>(6.0+)</sup> M+1   | num_outline               | Max number of outline points (0 except for properties that reference a general cross section) If 0, next records do not exist. | 4 byte, long integers    |
| <sup>(6.0+)</sup> M+2 thru<br>M+2+<br>num_outline<br>(if present) | u                         | U location of point on outline of cross section  | 8 byte, double precision |
|   | v                         | V location of point on outline of cross section  |                          |
|   | draw                      | Flag indicating type of point (0=Off, 1=Normal, 2=Start of Loop, 3=End of Loop, 4=Stress Recovery)                             | 2 byte, boolean          |

## Property Values

|        | ROD             | BAR        | TUBE | LINK   | BEAM       | SPRING              |
|--------|-----------------|------------|------|--------|------------|---------------------|
| Type   | 1               | 2          | 3    | 4      | 5          | 6                   |
| Flags  |                 |            |      |        |            |                     |
| 0      |                 |            |      |        | tapered    |                     |
| 1      |                 | shape type |      |        | shape type | axial(1)/torsion(0) |
| Values |                 |            |      |        |            |                     |
| 0      | Area            | Area       | Dout | Ku_A   | Area_A     | Stiffness           |
| 1      |                 | I1         | Din  | Kv_A   | I1_A       | Damping             |
| 2      |                 | I2         |      | Kw_A   | I2_A       |                     |
| 3      |                 | I12        |      | Kthu_A | I12_A      |                     |
| 4      | J               | J          |      | Kthv_A | J_A        |                     |
| 5      | Ctors           | K1,eff     |      | Kthw_A | K1_A,eff   |                     |
| 6      |                 | K2,eff     |      | Ku_B   | K2_A,eff   |                     |
| 7      | NSM             | NSM        | NSM  | Kv_B   | NSM_A      |                     |
| 8      | Initial Tension | Yf_A1      |      | Kw_B   | Yf_A1      |                     |
| 9      |                 | Zf_A1      |      | Kthu_B | Zf_A1      |                     |
| 10     |                 | Yf_A2      |      | Kthv_B | Yf_A2      |                     |
| 11     |                 | Zf_A2      |      | Kthw_B | Zf_A2      |                     |
| 12     |                 | Yf_A3      |      |        | Yf_A3      |                     |
| 13     |                 | Zf_A3      |      |        | Zf_A3      |                     |
| 14     |                 | Yf_A4      |      |        | Yf_A4      |                     |
| 15     |                 | Zf_A4      |      |        | Zf_A4      |                     |
| 16     |                 |            |      |        | Yoff_A     |                     |
| 17     |                 |            |      |        | Zoff_A     |                     |
| 18     |                 |            |      |        | Warp_A     |                     |
| 19     |                 |            |      |        |            |                     |
| 20     |                 |            |      |        | Area_B     |                     |



|    |  |                  |  |  |                  |  |
|----|--|------------------|--|--|------------------|--|
| 21 |  |                  |  |  | I1_B             |  |
| 22 |  |                  |  |  | I2_B             |  |
| 23 |  |                  |  |  | I12_B            |  |
| 24 |  |                  |  |  | J_B              |  |
| 25 |  |                  |  |  | K1_B,eff         |  |
| 26 |  |                  |  |  | K2_B,eff         |  |
| 27 |  |                  |  |  | NSM_B            |  |
| 28 |  |                  |  |  | Yf_B1            |  |
| 29 |  |                  |  |  | Zf_B1            |  |
| 30 |  |                  |  |  | Yf_B2            |  |
| 31 |  |                  |  |  | Zf_B2            |  |
| 32 |  |                  |  |  | Yf_B3            |  |
| 33 |  |                  |  |  | Zf_B3            |  |
| 34 |  |                  |  |  | Yf_B4            |  |
| 35 |  |                  |  |  | Zf_B4            |  |
| 36 |  |                  |  |  | Yoff_B           |  |
| 37 |  |                  |  |  | Z_offB           |  |
| 38 |  |                  |  |  | Warp_B           |  |
| 39 |  |                  |  |  |                  |  |
| 40 |  | Std Shape H      |  |  | Std Shape H      |  |
| 41 |  | Std Shape R      |  |  | Std Shape R      |  |
| 42 |  | Std Shape W1     |  |  | Std Shape W1     |  |
| 43 |  | Std Shape W2     |  |  | Std Shape W2     |  |
| 44 |  | Std Shape T1     |  |  | Std Shape T1     |  |
| 45 |  | Std Shape T2     |  |  | Std Shape T2     |  |
| 46 |  | Std Shape T      |  |  | Std Shape T      |  |
| 47 |  | Std Shape SR1    |  |  | Std Shape SR1    |  |
| 48 |  | Std Shape SR2    |  |  | Std Shape SR2    |  |
| 49 |  | Std Shape SR3    |  |  | Std Shape SR3    |  |
| 50 |  | Std Shape SR4    |  |  | Std Shape SR4    |  |
| 51 |  | Std Shape Orient |  |  | Std Shape Orient |  |
| 52 |  | Std Shape RefLoc |  |  | Std Shape RefLoc |  |
| 53 |  | Shape RefY       |  |  | Shape RefY       |  |
| 54 |  | Shape RefZ       |  |  | Shape RefZ       |  |
| 55 |  | Shape Outline ID |  |  | Shape Outline ID |  |

**Property Values (continued)**

|        | DOF<br>SPRING | CURVE<br>BEAM | GAP         | SHEAR        | MEMBRANE | BENDING   |
|--------|---------------|---------------|-------------|--------------|----------|-----------|
| Type   | 7             | 8             | 9           | 11/12        | 13/14    | 15/16     |
| Flags  |               |               |             |              |          |           |
| 0      |               |               | Has CSys    |              |          |           |
| 1      |               | shape type    |             |              |          |           |
| 2      | DOF_A         |               |             |              |          |           |
| 3      | DOF_B         |               |             |              |          |           |
| Values |               |               |             |              |          |           |
| 0      | Stiffness     | Area          | Gap.initial | T            | T        | T         |
| 1      | Damping       | I1            | Stiff,tens  |              |          |           |
| 2      |               | I2            | Stiff,comp  |              |          |           |
| 3      |               | I12           | Stiff,trans |              |          |           |
| 4      |               | J             | Mu,y        |              |          |           |
| 5      |               | K1,eff        | Mu,z        |              |          |           |
| 6      |               | K2,eff        | PreloadT    |              |          |           |
| 7      |               | NSM           | Plane X     | NSM          | NSM      | NSM       |
| 8      |               | Yf_A1         | Plane Y     | F1,eff.fact. |          | Top Fiber |
| 9      |               | Zf_A1         | Plane Z     | F2,eff.fact. |          | Bot Fiber |
| 10     |               | Yf_A2         | Width/Area  |              |          | 12I/T3    |
| 11     |               | Zf_A2         | MaxPenRat   |              |          |           |

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|        |  |                  |           |  |  |  |
|--------|--|------------------|-----------|--|--|--|
| 12     |  | Yf_A3            | MaxAdjRat |  |  |  |
| 13     |  | Zf_A3            | MinPenRat |  |  |  |
| 14     |  | Yf_A4            |           |  |  |  |
| 15     |  | Zf_A4            |           |  |  |  |
| 16     |  |                  |           |  |  |  |
| 17     |  | R, bend rad      |           |  |  |  |
| 18..39 |  |                  |           |  |  |  |
| 40     |  | Std Shape H      |           |  |  |  |
| 41     |  | Std Shape R      |           |  |  |  |
| 42     |  | Std Shape W1     |           |  |  |  |
| 43     |  | Std Shape W2     |           |  |  |  |
| 44     |  | Std Shape T1     |           |  |  |  |
| 45     |  | Std Shape T2     |           |  |  |  |
| 46     |  | Std Shape T      |           |  |  |  |
| 47     |  | Std Shape SR1    |           |  |  |  |
| 48     |  | Std Shape SR2    |           |  |  |  |
| 49     |  | Std Shape SR3    |           |  |  |  |
| 50     |  | Std Shape SR4    |           |  |  |  |
| 51     |  | Std Shape Orient |           |  |  |  |
| 52     |  | Std Shape RefLoc |           |  |  |  |
| 53     |  | Shape RefY       |           |  |  |  |
| 54     |  | Shape RefZ       |           |  |  |  |
| 55     |  | Shape Outline ID |           |  |  |  |
|        |  |                  |           |  |  |  |

## Property Values (continued)

|        | PLATE     | PLANE STRAIN | LAMINATE                     | MASS       | MASS MAT | STIFF MAT |
|--------|-----------|--------------|------------------------------|------------|----------|-----------|
| Type   | 17/18     | 19/20        | 21/22                        | 27         | 28       | 30        |
| Flags  |           |              |                              |            |          |           |
| 0      |           |              | failure                      |            |          |           |
| 1      |           |              | symmetry                     |            |          |           |
| Values |           |              |                              |            |          |           |
| 0      | Tavg,T1   | T            | Bottom Fiber                 |            | M11      | K11       |
| 1      | T2        |              | NSM                          | Ixx        | M12      | K12       |
| 2      | T3        |              | <sup>(4,1+)</sup> Bond Shear | Ixy        | M13      | K13       |
| 3      | T4        |              | <sup>(4,1+)</sup> T_1        | Iyy        | M14      | K14       |
| 4      |           |              | <sup>(4,1+)</sup> Angle_1    | Izx        | M15      | K15       |
| 5      |           |              | <sup>(4,1+)</sup> T_2        | Iyz        | M16      | K16       |
| 6      |           |              | <sup>(4,1+)</sup> Angle_2    | Izz        |          |           |
| 7      | NSM       | NSM          | <sup>(4,1+)</sup> T_3        | M or Mx    | M22      | K22       |
| 8      | Top Fiber | Top Fiber    | <sup>(4,1+)</sup> Angle_3    | Xoff,refCS | M23      | K23       |
| 9      | Bot Fiber | Bot Fiber    | <sup>(4,1+)</sup> T_4        | Yoff,refCS | M24      | K24       |
| 10     | I2I/T3    |              | <sup>(4,1+)</sup> Angle_4    | Zoff,refCS | M25      | K25       |
| 11     | Ts/T      |              | <sup>(4,1+)</sup> T_5        | My         | M26      | K26       |
| 12     |           |              | <sup>(4,1+)</sup> Angle_5    | Mz         |          |           |
| 13     |           |              | <sup>(4,1+)</sup> T_6        |            |          |           |
| 14     |           |              | <sup>(4,1+)</sup> Angle_6    |            | M33      | K33       |
| 15     |           |              | <sup>(4,1+)</sup> T_7        |            | M34      | K34       |
| 16     |           |              | <sup>(4,1+)</sup> Angle_7    |            | M35      | K35       |
| 17     |           |              | <sup>(4,1+)</sup> T_8        |            | M36      | K36       |
| 18     |           |              | <sup>(4,1+)</sup> Angle_8    |            |          |           |
| 19     |           |              | <sup>(4,1+)</sup> T_9        |            |          |           |
| 20     |           |              | <sup>(4,1+)</sup> Angle_9    |            |          |           |
| 21     |           |              | <sup>(4,1+)</sup> T_10       |            | M44      | K44       |
| 22     |           |              | <sup>(4,1+)</sup> Angle_10   |            | M45      | K45       |
| 23     |           |              | <sup>(4,1+)</sup> T_11       |            | M46      | K46       |

|     |  |  |                |  |     |     |
|-----|--|--|----------------|--|-----|-----|
| 24  |  |  | (4,1+)Angle_11 |  |     |     |
| 25  |  |  | (4,1+)T_12     |  |     |     |
| 26  |  |  | (4,1+)Angle_12 |  |     |     |
| 27  |  |  | (4,1+)T_13     |  |     |     |
| 28  |  |  | (4,1+)Angle_13 |  | M55 | K55 |
| 29  |  |  | (4,1+)T_14     |  | M56 | K56 |
| 30  |  |  | (4,1+)Angle_14 |  |     |     |
| 31  |  |  | (4,1+)T_15     |  |     |     |
| 32  |  |  | (4,1+)Angle_15 |  |     |     |
| 33  |  |  | (4,1+)T_16     |  |     |     |
| 34  |  |  | (4,1+)Angle_16 |  |     |     |
| 35  |  |  | (4,1+)T_17     |  | M66 | K66 |
| 36  |  |  | (4,1+)Angle_17 |  |     |     |
| 37  |  |  | (4,1+)T_18     |  |     |     |
| 38  |  |  | (4,1+)Angle_18 |  |     |     |
| ... |  |  | (4,1+)...      |  |     |     |
| 91  |  |  | (4,1+)T_45     |  |     |     |
| 92  |  |  | (4,1+)Angle_45 |  |     |     |
| 93  |  |  | T_46           |  |     |     |
| 94  |  |  | Angle_46       |  |     |     |
| ... |  |  | ...            |  |     |     |
| 181 |  |  | T_90           |  |     |     |
| 182 |  |  | Angle_90       |  |     |     |

For Bars, Beams and Curved Beams, where shapes are available, flag[1] defines the type of shape selected. Available values are:

| Value | Shape            | Value | Shape         | Value | Shape   | Value | Shape   |
|-------|------------------|-------|---------------|-------|---------|-------|---------|
| 1     | Rectangular Bar  | 5     | Circular Bar  | 9     | I       | 13    | Z       |
| 2     | Rectangular Tube | 6     | Circular Tube | 10    | Channel | 14    | Hat     |
| 3     | Trapezoidal Bar  | 7     | Hex Bar       | 11    | Angle   | 15    | General |
| 4     | Trapezoidal Tube | 8     | Hex Tube      | 12    | T       |       |         |

The following types are also available: Plot Only (10), Plot Plate(32), Axisymmetric (23/24), Solid (25/26), and Rigid (29). When two types are listed, the first number corresponds to a linear type, the second to a parabolic type.

#### Data Block 403 - Nodes

| Record | Field           | Description   | Size                     |
|--------|-----------------|---|--------------------------|
| 1      | ID              | ID of node  | 4 byte, long integers    |
|        | define_sys      | ID of definition coordinate system                          |                          |
|        | output_sys      | ID of output coordinate system                              |                          |
|        | layer           | ID of layer   |                          |
|        | color           | ID of color   |                          |
|        | permbc[0..5]    | the six permanent constraints (0=free,1=fixed)              | 2 byte, boolean          |
|        | x               | Coordinates of node in Global Rectangular coordinate system | 8 byte, double precision |
|        | y               |   |                          |
|        | z               |   |                          |
|        | (4,4+)node_type | Type of Node (0=Node, 1=Scalar, 2=Extra)                    | 4 byte, long integer     |

#### Data Block 404 – Elements

| Record | Field | Description   | Size                  |
|--------|-------|---------------|-----------------------|
| 1      | ID    | ID of element | 4 byte, long integers |
|        | color | ID of color   |                       |

|   |   |   |                          |
|---|---|---|--------------------------|
|   | propID                                  | ID of property  |                          |
|   | type                                    | Element Type (refer to the property tables for values)  |                          |
|   | topology                                | <sup>(4,4+)</sup> Element Shape (0=Line, 2=Tri3, 3=Tri6, 4=Quad4, 5=Quad8, 6=Tetra4, 7=Wedge6, 8=Brick8, 9=Point, 10=Tetra10, 11=Wedge15, 12=Brick20, 13=Rigid, 15=MultiList, 16=Contact) | 4 byte, long integers    |
|   | layer                                   | ID of layer   |                          |
|   | orientID                                | Third node for bar/beam   |                          |
|   | matl_orflag                             | Material orientation flag (0 if not set, 1 if set)  | 2 byte, boolean          |
|   | <sup>(5,0+)</sup> geomID                | ID of associated geometry (curveID for line elem, surfaceID for planar)   | 4 byte, long integers    |
|   | <sup>(6,0+)</sup> formulation           | Flags setting specific information for this type  |                          |
|   | <sup>(6,0+)</sup> contact segment[0..1] | IDs of contact segments referenced by this element  |                          |
| 2   | node[0..9]                              | Nodes referenced by element   |                          |
| 3   | node[10..19]                            |   |                          |
| 4   | orient[0..2]                            | Element orientation vector for bar/beam. [0] contains material orientation angle for planar elements  | 8 byte, double precision |
| 5   | offset1[0..2]                           | Offsets at end1 of bar/beam   |                          |
| 6   | offset2[0..2]                           | Offsets at end2 of bar/beam   |                          |
| 7   | release1[0..5]                          | Releases at end1 of bar/beam  | 2 byte, boolean          |
|   | release2[0..5]                          | Offsets at end2 of bar/beam   |                          |
|   | <sup>(4,4+)</sup> list[0..3]            | Flag indicating lists of nodes are coming. Each nonzero requires a list   | 4 byte, long integers    |
| <sup>(4,5+)</sup> The following records are only present when one or more of the flags in the previous record are nonzero. This shows a single list, but the pattern repeats for as many lists as are required. Unused lists are not present (no terminator is required). Only topology=MultiList and RigidList use these lists to reference their nodes. |   |   |                          |
| <sup>(4,5+)</sup> 1 record for each node plus final   | nodeID                                  | ID of node referenced by Elem. This must be -1 to end the list.   | 4 byte, long integer     |
|   | faceID                                  | Element Face ID   |                          |
|   | weight                                  | Weighting Factor for Interpolation Elements   | 8 byte, double precision |
|   | dof[1..6]                               | Flags indicating active degrees of freedom for interpolation  | 4 byte, long integer     |

The nodes referenced by an element are stored in the following positions in the "node" array, based on the element topology:

#### Node Reference Entries for Elements

| Topology  | Array Entries<br>(optional/midside nodes in parentheses)            |
|-----------|---|
| Point     | 0   |
| Line      | 0,1   |
| Tri3      | 0,1,2   |
| Tri6      | 0,1,2, (4,5,6)  |
| Quad4     | 0,1,2,3   |
| Quad8     | 0,1,2,3,(4,5,6,7)   |
| Tetra4    | 0,1,2, 4  |
| Wedge6    | 0,1,2, 4,5,6  |
| Brick8    | 0,1,2,3,4,5,6,7   |
| Tetra10   | 0,1,2, 4 (8,9,10, 12,13,14)   |
| Wedge15   | 0,1,2, 4,5,6 (8,9,10, 12,13,14, 16,17,18)                           |
| Brick20   | 0,1,2,3,4,5,6,7,(8,9,10,11,12,13,14,15,16,17,18,19)                 |
| RigidList | 0=Independent, Dependent Nodes use Element Lists, not Array Entries |
| MultiList | Uses Element Lists, not Array Entries                               |

|         |  |
|---------|--|
| Contact | References Contact Segments, not nodes |
|---------|--|

**Data Block 405 - Coordinate Systems**

| Record | Field        | Description  | Size                     |
|--------|--------------|--|--------------------------|
| 1      | ID           | ID of coordinate system  | 4 byte, long integers    |
|        | define_sys   | ID of definition coordinate system   |                          |
|        | type         | Type of Coord Sys (0=Rect, 1=Cyl, 2=Sphere)  |                          |
|        | color        | ID of color  |                          |
|        | layer        | ID of layer  |                          |
| 2      | title        | CSys Title (max 25 char)   | character string         |
| 3      | origin[0..2] | Origin of coordinate system relative to Global Rectangular system.                 | 8 byte, double precision |
| 4      | rot[0..2]    | Rotation angles to orient coordinate system relative to Global Rectangular system. |                          |

**Table 1: Data Block 406 - Constraints (Obsolete)**

| Record  | Field      | Description   | Size                     |
|---|------------|---|--------------------------|
| 1   | setID      | ID of constraint set  | 4 byte, long integer     |
| 2   | title      | Constraint set title (max 25 char)  | character string         |
| 1 record for each constrained node plus final | nodeID     | Node ID where constraint is applied. nodeID must be -1 for the last record. | 4 byte, long integer     |
|   | color      | ID of color   |                          |
|   | layer      | ID of layer   |                          |
|   | DOF[0..5]  | Flags for constraints at each DOF (0=off, 1=on)                             | 2 byte, boolean          |
| 1 record for each equation plus final         | eqnID      | ID of constraint equation. eqnID must be -1 for the last equation           | 4 byte, long integer     |
|   | color      | ID of color for equation  |                          |
|   | layer      | ID of layer for equation  |                          |
| 1 record for each equation                    | num_co     | Number of coefficients for equation   | 4 byte, long integer     |
| num_co records for each equation              | eqn_nodeID | ID of node for this term in constraint equation.                            |                          |
|   | eqn_dof    | ID of DOF (1..6) for this term  |                          |
|   | coeff      | Equation Coefficient for this term.   | 8 byte, double precision |

**Data Block 506 – Constraints**

| Record | Field | Description                        | Size                 |
|--------|-------|------------------------------------|----------------------|
| 1      | setID | ID of constraint set               | 4 byte, long integer |
| 2      | title | Constraint set title (max 25 char) | character string     |

|  |            |   |                          |
|--|------------|---|--------------------------|
| 1 record for each constrained node plus final  | nodeID     | Node ID where constraint is applied. nodeID must be -1 for the last record. | 4 byte, long integer     |
|  | color      | ID of color   |                          |
|  | layer      | ID of layer   |                          |
|  | DOF[0..5]  | Flags for constraints at each DOF (0=off, 1=on)                             | 2 byte, boolean          |
|  | ex_geom    | Flag is 1 if constraint is from expanded geometry load                      |                          |
| 1 record for each point constraint plus end.   | pointID    | point ID where constraint is applied. must be -1 for the last record.       | 4 byte, long integer     |
|  | color      | ID of color   |                          |
|  | layer      | ID of layer   |                          |
|  | DOF[0..5]  | Flags for constraints at each DOF (0=off, 1=on)                             | 2 byte, boolean          |
|  | ex_geom    | Flag is 1 if geometry constraint is currently expanded as nodal constraints |                          |
| 1 record for each curve constraint plus end.   | curveID    | curve ID where constraint is applied. must be -1 for the last record.       | 4 byte, long integer     |
|  | color      | ID of color   |                          |
|  | layer      | ID of layer   |                          |
|  | DOF[0..5]  | Flags for constraints at each DOF (0=off, 1=on)                             | 2 byte, boolean          |
|  | ex_geom    | Flag is 1 if geometry constraint is currently expanded as nodal constraints |                          |
| 1 record for each surface constraint plus end. | surfaceID  | surface ID where constraint is applied. must be -1 for the last record.     | 4 byte, long integer     |
|  | color      | ID of color   |                          |
|  | layer      | ID of layer   |                          |
|  | DOF[0..5]  | Flags for constraints at each DOF (0=off, 1=on)                             | 2 byte, boolean          |
|  | ex_geom    | Flag is 1 if geometry constraint is currently expanded as nodal constraints |                          |
| 1 record for each equation plus final          | eqnID      | ID of constraint equation. eqnID must be -1 for the last equation           | 4 byte, long integer     |
|  | color      | ID of color for equation  |                          |
|  | layer      | ID of layer for equation  |                          |
| 1 record for each equation                     | num_co     | Number of coefficients for equation   | 4 byte, long integer     |
| num_co records for each equation               | eqn_nodeID | ID of node for this term in constraint equation.                            |                          |
|  | eqn_dof    | ID of DOF (1..6) for this term  |                          |
|  | coeff      | Equation Coefficient for this term.   | 8 byte, double precision |

**Table 2: Data Block 407 - Loads (Obsolete)**

| Record | Field | Description | Size |
|--------|-------|-------------|------|
|--------|-------|-------------|------|

|          |                |  |                          |
|----------|----------------|--|--------------------------|
| 1        | setID          | ID of load set   | 4 byte, long integer     |
| 2        | title          | Load set title (max 25 char)                           | character string         |
| 3        | CSys           | ID of coordinate system                                | 4 byte, long integer     |
|          | Def_temp       | Default temperature                                    | 8 byte, double precision |
|          | temp_on        | Default temperature flag (0=off, 1=on)                 | 2 byte, boolean          |
|          | grav_on        | Global acceleration flag (0=off, 1=on)                 |                          |
|          | omega_on       | Global rotation flag (0=off, 1=on)                     |                          |
| 4        | grav[0..2]     | Translational acceleration                             | 8 byte, double precision |
| 5        | grav[3..5]     | Rotational acceleration                                |                          |
| 6        | origin[0..2]   | Origin for rotational loads                            |                          |
| 7        | omega[0..2]    | Rotational velocity                                    |                          |
| (4.3+)8  | stef_boltz     | Stefan-Boltzmann Constant                              | 8 byte, double precision |
|          | abs_temp       | Offset of Temperatures from Absolute Zero              |                          |
|          | free_cnv_exp   | Free Convection Exponent                               |                          |
| (4.3+)9  | fc_flu_cond    | Forced Convection Fluid Conductivity                   | 8 byte, double precision |
|          | fc_flu_cp      | Forced Convection Fluid Specific Heat                  |                          |
|          | fc_flu_vis     | Forced Convection Fluid Viscosity                      |                          |
|          | fc_flu_dens    | Forced Convection Fluid Density                        |                          |
| (4.3+)10 | fc_cons_coeff  | Forced Convection Equation Constant Coefficient        | 8 byte, double precision |
|          | fc_reynolds    | Forced Convection Reynolds Exponent                    |                          |
|          | fc_pran_in     | Forced Convection Prandtl Exponent Into Fluid          |                          |
|          | fc_pran_out    | Forced Convection Prandtl Exponent Out of Fluid        |                          |
| (4.3+)11 | tfc_flu_cond   | Forced Convection Fluid Conductivity Function ID       | 4 byte, long integer     |
|          | tfc_flu_cp     | Forced Convection Fluid Specific Heat Function ID      |                          |
|          | tfc_flu_vis    | Forced Convection Fluid Viscosity Function ID          |                          |
| (4.3+)12 | alt_free_conv  | Flag for Alternate Free Convection Formulation         | 2 byte, boolean          |
|          | fc_flu_flag    | Flag for Alternate Forced Convection Formulation       |                          |
|          | fc_conv_flow   | Flag for Forced Convection Convective Energy Flow      |                          |
| (4.4+)13 | nl_arc_scale   | Nonlinear Arc Length Method Constraint Load Scale      | 8 byte, double precision |
|          | nl_arcmaxadj   | Nonlinear Max Arc Length Adjust                        |                          |
|          | nl_arcminadj   | Nonlinear Min Arc Length Adjust                        |                          |
|          | nl_bounds_rb   | Transient Bounds to Maintain Step                      |                          |
| (4.4+)14 | nl_conv[0..2]  | Convergence Tolerances for Displacement, Load and Work | 8 byte, double precision |
| (4.4+)15 | nl_fstress     | Stress Fraction Limit                                  | 8 byte, double precision |
|          | nl_isearch_tol | Line Search Tolerance                                  |                          |
|          | nl_mxadj_init  | Max Adjusted vs. Initial Incr                          |                          |
|          | nl_max_rot     | Max Rotation per Bisection                             |                          |
|          | nl_stab_tol    | Transient Minimum Stability Tolerance                  |                          |
|          | nl_time_inc    | Nonlinear Time Increment                               |                          |
| (4.4+)16 | dyn_damp_ov    | Overall Structural Damp Coeff                          | 8 byte, double precision |
|          | dyn_dampW3     | Frequency for System Damp                              |                          |

|  |                     |   |                      |
|--|---------------------|---|----------------------|
|  | dyn_dampW4          | Frequency for Element Damp  |                      |
|  | dyn_keep_freq[0..1] | Range of Frequencies to include in further analyses   |                      |
|  | dyn_trans_dt        | Nonlinear Transient Time Step   |                      |
| (4.4+)17                                     | nl_arc_const        | Arc Length Constraint Type  | 4 byte, long integer |
|  | nl_arc_iter         | Arc Length Desired Iterations   |                      |
|  | nl_arc_maxst        | Arc Length Max Steps  |                      |
|  | nl_div_limit        | Nonlinear Max Diverging Conditions  |                      |
|  | nl_dom_pdstp        | Transient Steps for Dominant Period   |                      |
|  | nl_increment        | Number of Increments for Nonlinear Analysis   |                      |
|  | nl_inter_out        | Intermediate Output Type  |                      |
|  | nl_kstep            | Nonlinear Iterations before Stiffness Update  |                      |
|  | nl_mx_bisect        | Max Bisections per Increment  |                      |
| (4.4+)18                                     | nl_max_iter         | Nonlinear Max Iterations per Step   | 4 byte, long integer |
|  | nl_max_lsrch        | Max Line Search per Iteration   |                      |
|  | nl_out_inter        | Output Interval   |                      |
|  | nl_quasi_newt       | Number of Quasi-Newton Vectors  |                      |
|  | nl_sol_strat        | Nonlinear Arc-Length Solution Strategy (Arc-Length if nonzero)                                  |                      |
|  | nl_stiff_meth       | Stiffness Update Method   |                      |
|  | nl_skip_adj         | Transient Time Step Skip Factor   |                      |
|  | nl_sol_over         | Solution Strategy Overrides (0=none/advanced, 1=Full Newton Raphson, 2=Modified Newton Raphson) |                      |
| (4.4+)19                                     | dyn_freq_tab        | ID of function for Solution Frequencies   | 4 byte, long integer |
|  | dyn_damptab         | ID of function for Modal Damping Table  |                      |
|  | dyn_keep_md         | Number of Modes to Keep for Further Solutions   |                      |
|  | dyn_tran_ts         | Number of Transient Time Steps  |                      |
|  | dyn_out_int         | Transient Output Interval   |                      |
|  | (4.41+)dyn_rand_psd | Random PSD Function ID  |                      |
| (4.4+)20                                     | nl_on               | Flag for Nonlinear Analysis (0=Off, 1=Static, 2=Creep, 3=Transient)                             | 2 byte, boolean      |
|  | nl_conv_flag [0..2] | On/Off Nonlinear Convergence Flags (Disp,Load,Work)   |                      |
|  | nl_mnewt_ls         | Modified Newton Line Search Override (1=Skip)   |                      |
|  | nl_mnewt_qn         | Modified Newton Quasi-Newton Override (1=Skip)  |                      |
|  | nl_mnewt_bs         | Modified Newton Bisection Override (1=Skip)   |                      |
| (4.4+)21                                     | dyn_on              | Flag for Dynamic Analysis (0=Off, 1=Direct, 2=Modal)  | 2 byte, boolean      |
|  | dyn_type            | Addl Flag for Dynamic Analysis (0=Off, 1=Transient, 2=Freq)                                     |                      |
|  | dyn_unused          | Not Currently Used  |                      |
|  | dyn_massfrm         | Dynamic Mass Formulation  |                      |
|  | dyn_datarec         | Dynamic Data Recovery   |                      |
| 1 record for each structural load plus final | loadID              | Node or element ID where load is applied. loadID must be -1 for the last record.                | 4 byte, long integer |



|   |                                   |   |                          |
|---|-----------------------------------|---|--------------------------|
|   | loadtype                          | <sup>(4.4+)</sup> Type of load (1=Nodal Force, 2=Nodal Displacement, 3=Nodal Accel, 5=Nodal Heat Generation, 6=Nodal Heat Flux, 7=Velocity, 8=Nonlinear Transient, 10=Distributed Line Load, 11=Element Face Pressure, 13=Element Heat Generation, 14=Element Heat Flux, 15=Element Convection, 16=Element Radiation) |                          |
|   | color                             | ID of color   |                          |
|   | layer                             | ID of layer   |                          |
|   | define_sys                        | Definition coordinate system for load   |                          |
|   | <sup>(4.3+)</sup> sl_funcID       | ID of function for load   | 4 byte, long integer     |
| 1 record for each structural load               | phase                             | <sup>(4.3+)</sup> Load phase (view factor for radiation)  | 8 byte, double precision |
|   | coefficient                       | <sup>(4.3+)</sup> Unused except for convection and radiation, then ambient temperature  |                          |
| 6 records per structural load, one for each DOF | dof_face                          | <sup>(4.3+)</sup> Degree of freedom flag (0=off, 1=on), or element face for pressure. For Distributed Line Load, record 1, 1=Elem X Dir, 2=Elem Y Dir, 3=Elem Z Dir, 4=Global X Dir, 5=Global Y Dir, 6=Global Z Dir   | 4 byte, long integer     |
|   | value                             | <sup>(4.3+)</sup> Load Value for this DOF. For Distributed Line Load, the first value is the value at end 1.  | 8 byte, double precision |
| <sup>(4.3+)</sup> 1 record per load             | addl_coeff                        | Absorptivity, or Diameter for Forced Convection. For Distributed Line Load, this is the value at end 2.   | 8 byte, double precision |
|   | addl_fnc[0..2]                    | [0]=Temp vs Time<br>[1]=Absorptivity vs Temp<br>[2]=View Factor vs Time   | 4 byte, long integer     |
| <sup>(4.3+)</sup> 1 record per load             | can_shade                         | Flags for View Factor Shading Calculations  | 2 byte, boolean          |
|   | can_be_shaded                     |   |                          |
|   | subtype                           | Flag that indicates Forced Convection, Vector Flux or Enclosure Radiation if nonzero  | 4 byte, long integer     |
|   | <sup>(4.4+)</sup> addl_id [0..1]  | Additional Node IDs used for Nonlinear Transient Loads  | 4 byte, long integer     |
|   | <sup>(4.4+)</sup> addl_typ [0..1] | Additional Load Types for Nonlinear Transient Loads (0=Disp, 1=Vel)   | 2 byte, boolean          |
| <sup>(4.3+)</sup> 1 record per load             | dir_func[0..2]                    | Vector Flux Time Dependence Functions   | 4 byte, long integer     |
| <sup>(4.3+)</sup> 1 record per load             | direction[0..2]                   | Vector Flux Initial Directions  | 8 byte, double precision |
| 1 record for each nodal temp plus last          | ndtempID                          | ID for nodal temperature. Must be -1 for last record.   | 4 byte, long integer     |
|   | color                             | ID of color   |                          |
|   | layer                             | ID of layer   |                          |
|   | ndtemp                            | Nodal Temperature   | 8 byte, double precision |
|   | ndtemp_co                         | Unused  |                          |
|   | <sup>(4.3+)</sup> ndt_funcID      | ID of function for Node Temp  | 4 byte, long integer     |

|  |                               |   |                          |
|--|-------------------------------|---|--------------------------|
| 1 record for each element temp plus last | eltempID                      | ID for elemental temperature. Must be -1 for last record. | 4 byte, long integer     |
|  | color                         | ID of color   |                          |
|  | layer                         | ID of layer   |                          |
|  | eltemp                        | Elemental Temperature                                     | 8 byte, double precision |
|  | eltemp_co<br>(4.3+)elt_funcID | Unused<br>ID of function for ElemTemp                     | 4 byte, long integer     |

**Data Block 507 - Loads**

| Record | Field             | Description  | Size                     |
|--------|-------------------|--|--------------------------|
| 1      | setID             | ID of load set   | 4 byte, long integer     |
| 2      | title             | Load set title (max 25 char)                               | character string         |
| 3      | CSys              | ID of coordinate system                                    | 4 byte, long integer     |
|        | Def_temp          | Default temperature  | 8 byte, double precision |
|        | temp_on           | Default temperature flag (0=off, 1=on)                     | 2 byte, boolean          |
|        | grav_on           | Global acceleration flag (0=off, 1=on)                     |                          |
|        | omega_on          | Global rotation flag (0=off, 1=on)                         |                          |
| 4      | grav[0..2]        | Translational acceleration                                 | 8 byte, double precision |
| 5      | grav[3..5]        | Rotational acceleration                                    |                          |
| 6      | origin[0..2]      | Origin for rotational loads                                |                          |
| 7      | omega[0..2]       | Rotational velocity  |                          |
| 8      | stef_boltz        | Stefan-Boltzmann Constant                                  | 8 byte, double precision |
|        | abs_temp          | Offset of Temperatures from Absolute Zero                  |                          |
|        | free_cnv_exp      | Free Convection Exponent                                   |                          |
|        | rad_space_element | ID of element used for ambient temp in enclosure radiation | 4 byte, long integer     |
| 9      | fc_flu_cond       | Forced Convection Fluid Conductivity                       | 8 byte, double precision |
|        | fc_flu_cp         | Forced Convection Fluid Specific Heat                      |                          |
|        | fc_flu_vis        | Forced Convection Fluid Viscosity                          |                          |
|        | fc_flu_dens       | Forced Convection Fluid Density                            |                          |
| 10     | fc_cons_coeff     | Forced Convection Equation Constant Coefficient            | 8 byte, double precision |
|        | fc_reynolds       | Forced Convection Reynolds Exponent                        |                          |
|        | fc_pran_in        | Forced Convection Prandtl Exponent Into Fluid              |                          |
|        | fc_pran_out       | Forced Convection Prandtl Exponent Out of Fluid            |                          |
| 11     | tfc_flu_cond      | Forced Convection Fluid Conductivity Function ID           | 4 byte, long integer     |
|        | tfc_flu_cp        | Forced Convection Fluid Specific Heat Function ID          |                          |
|        | tfc_flu_vis       | Forced Convection Fluid Viscosity Function ID              |                          |
| 12     | alt_free_conv     | Flag for Alternate Free Convection Formulation             | 2 byte, boolean          |
|        | fc_flu_flag       | Flag for Alternate Forced Convection Formulation           |                          |
|        | fc_conv_flow      | Flag for Forced Convection Convective Energy Flow          |                          |

|    |                                    |   |                          |
|----|------------------------------------|---|--------------------------|
| 13 | nl_arc_scale                       | Nonlinear Arc Length Method Constraint Load Scale   | 8 byte, double precision |
|    | nl_arcmaxadj                       | Nonlinear Max Arc Length Adjust   |                          |
|    | nl_arcminadj                       | Nonlinear Min Arc Length Adjust   |                          |
|    | nl_bounds_rb                       | Transient Bounds to Maintain Step   |                          |
| 14 | nl_conv[0..2]                      | Convergence Tolerances for Displacement, Load and Work  | 8 byte, double precision |
| 15 | nl_fstress                         | Stress Fraction Limit   | 8 byte, double precision |
|    | nl_lsearch_tol                     | Line Search Tolerance   |                          |
|    | nl_mxadj_init                      | Max Adjusted vs. Initial Incr   |                          |
|    | nl_max_rot                         | Max Rotation per Bisection  |                          |
|    | nl_stab_tol                        | Transient Minimum Stability Tolerance   |                          |
|    | nl_time_inc                        | Nonlinear Time Increment  |                          |
| 16 | dyn_damp_ov                        | Overall Structural Damp Coeff   | 8 byte, double precision |
|    | dyn_dampW3                         | Frequency for System Damp   |                          |
|    | dyn_dampW4                         | Frequency for Element Damp  |                          |
|    | dyn_keep_freq[0..1]                | Range of Frequencies to include in further analyses   |                          |
|    | dyn_trans_dt                       | Nonlinear Transient Time Step   |                          |
|    | <sup>(6.0+)</sup> dyn_min_freq     | Minimum Frequency of interest   |                          |
|    | <sup>(6.0+)</sup> dyn_max_freq     | Maximum Frequency of interest   |                          |
|    | <sup>(6.0+)</sup> dyn_cluster_freq | Spread for frequency clusters   |                          |
| 17 | nl_arc_const                       | Arc Length Constraint Type  | 4 byte, long integer     |
|    | nl_arc_iter                        | Arc Length Desired Iterations   |                          |
|    | nl_arc_maxst                       | Arc Length Max Steps  |                          |
|    | nl_div_limit                       | Nonlinear Max Diverging Conditions  |                          |
|    | nl_dom_pdstp                       | Transient Steps for Dominant Period   |                          |
|    | nl_increment                       | Number of Increments for Nonlinear Analysis   |                          |
|    | nl_inter_out                       | Intermediate Output Type  |                          |
|    | nl_kstep                           | Nonlinear Iterations before Stiffness Update  |                          |
|    | nl_mx_bisect                       | Max Bisections per Increment  |                          |
| 18 | nl_max_iter                        | Nonlinear Max Iterations per Step   | 4 byte, long integer     |
|    | nl_max_lsrch                       | Max Line Search per Iteration   |                          |
|    | nl_out_inter                       | Output Interval   |                          |
|    | nl_quasi_newt                      | Number of Quasi-Newton Vectors  |                          |
|    | nl_sol_strat                       | Nonlinear Arc-Length Solution Strategy (Arc-Length if nonzero)                                  |                          |
|    | nl_stiff_meth                      | Stiffness Update Method   |                          |
|    | nl_skip_adj                        | Transient Time Step Skip Factor   |                          |
|    | nl_sol_over                        | Solution Strategy Overrides (0=none/advanced, 1=Full Newton Raphson, 2=Modified Newton Raphson) |                          |
| 19 | dyn_freq_tab                       | ID of function for Solution Frequencies   | 4 byte, long integer     |
|    | dyn_damptab                        | ID of function for Modal Damping Table  |                          |
|    | dyn_keep_md                        | Number of Modes to Keep for Further Solutions   |                          |
|    | dyn_tran_ts                        | Number of Transient Time Steps  |                          |
|    | dyn_out_int                        | Transient Output Interval   |                          |
|    | <sup>(4.41+)</sup> dyn_rand_psd    | Random PSD Function ID  |                          |
|    | <sup>(6.0+)</sup> dyn_no_freq      | Number of Frequency intervals   |                          |
| 20 | nl_on                              | Flag for Nonlinear Analysis (0=Off, 1=Static, 2=Creep, 3=Transient)                             | 2 byte, boolean          |
|    | nl_conv_flag [0..2]                | On/Off Nonlinear Convergence Flags (Disp,Load,Work)   |                          |

|   |                                    |   |                          |
|---|------------------------------------|---|--------------------------|
|   | nl_mnewt_ls                        | Modified Newton Line Search Override<br>(1=Skip)  |                          |
|   | nl_mnewt_qn                        | Modified Newton Quasi-Newton Override<br>(1=Skip)   |                          |
|   | nl_mnewt_bs                        | Modified Newton Bisection Override<br>(1=Skip)  |                          |
| 21  | dyn_on                             | Flag for Dynamic Analysis (0=Off, 1=Direct, 2=Modal)  | 2 byte, boolean          |
|   | dyn_type                           | Addl Flag for Dynamic Analysis (0=Off, 1=Transient, 2=Freq)   |                          |
|   | dyn_damp_method                    |   |                          |
|   | dyn_massfrm                        | Dynamic Mass Formulation  |                          |
|   | dyn_datarec                        | Dynamic Data Recovery   |                          |
|   | <sup>(6.0+)</sup> dyn_log_inter    | Dynamic Frequency Log Specification   | 2 byte, boolean          |
|   | <sup>(6.0+)</sup> dyn_freq_type    | Dynamic Frequency Specification Method  | 4 byte, long integer     |
|   | <sup>(6.0+)</sup> dyn_psd_type     | Dynamic PSD Data Type   |                          |
|   | <sup>(7.0+)</sup> dyn_psd_interpol | Dynamic PSD Interpolation Method  |                          |
| 1 record for each mesh-based structural load plus final | loadID                             | Node or element ID where load is applied. loadID must be -1 for the last record.  | 4 byte, long integer     |
|   | loadtype                           | See table for types of FEA Loads...   |                          |
|   | color                              | ID of color   |                          |
|   | layer                              | ID of layer   |                          |
|   | define_sys                         | Definition coordinate system for load   |                          |
|   | subtype                            | Flag that indicates Forced Convection, Vector Flux or Enclosure Radiation if nonzero  |                          |
|   | is_expanded                        | is 1 if load was expanded from a geometry load  | 2 byte Boolean           |
| 1 record per load                                       | dof_face[0]                        | face number for elemental loads or x value on/off for nodal loads   | 4 byte, long integer     |
|   | dof_face[1]                        | y value on/off for nodal loads  |                          |
|   | dof_face[2]                        | z value on/off for nodal loads  |                          |
| 1 record per load                                       | value[0..4]                        | Single element value [0], x, y, z values[0..2],   | 8 byte, double precision |
| 1 record per load                                       | functions[0..4]                    | [0]=Load func, Emissivity func<br>[1]=Absorbitivity vs. Temp<br>[2]=Temp vs Temp<br>[3]=View Factor vs Time<br>[4]=Phase vs. Freq | 4 byte, long integer     |
| 1 record per load                                       | Enclosure Radiation                | Enclosure Radiation on or off   | 2 byte, boolean          |
|   | can_shade                          | Flags for View Factor Shading Calculations  |                          |
|   | can_be_shaded                      |   |                          |
| 1 record per load                                       | dir_func[0..2]                     | Vector Flux Time Dependence Functions   | 4 byte, long integer     |
| 1 record per load                                       | direction[0..2]                    | Vector Flux Initial Directions  | 8 byte, double precision |
| 1 record for each geometry based load plus final        | loadID                             | Node or element ID where load is applied. loadID must be -1 for the last record.  | 4 byte, long integer     |
|   | loadtype                           | See table for types of Geometry Loads   |                          |
|   | color                              | ID of color   |                          |

|                        |                     |  |                          |
|------------------------|---------------------|--|--------------------------|
|                        | layer               | ID of layer  |                          |
|                        | define_sys          | Definition coordinate system for load  |                          |
|                        | subtype             | Flag that indicates Forced Convection, Vector Flux or Enclosure Radiation if nonzero   |                          |
|                        | is_expanded         | is 1 if load was expanded from a geometry load   | 2 byte Boolean           |
| 1 record for each load | dof_face[0..2]      | x,y,z load values on/off   | 2 byte Boolean           |
| 1 record per load      | value[0..4]         | Single element value [0], x, y, z values[0..2],  | 8 byte, double precision |
| 1 record per load      | functions[0..4]     | [0]=Load func, Emissivity func<br>[1]=Absorbtivity vs. Temp<br>[2]=Temp vs Temp<br>[3]=View Factor vs Time<br>[4]=Phase vs. Freq | 4 byte, long integer     |
| 1 record per load      | Enclosure Radiation | Enclosure Radiation on or off  | 2 byte, boolean          |
|                        | can_shade           | Flags for View Factor Shading Calculations   |                          |
|                        | can_be_shaded       |  |                          |
|                        | addl_id [0..1]      | Additional Node IDs used for Nonlinear Transient Loads   | 4 byte, long integer     |
| 1 record per load      | dir_func[0..2]      | Vector Flux Time Dependence Functions  | 4 byte, long integer     |
| 1 record per load      | direction[0..2]     | Vector Flux Initial Directions   | 8 byte, double precision |
| 1 record per load      | dir_mode            | 0=Components<br>1=Vector<br>2=Along Curve<br>3=Normal to Plane<br>4=Normal to Surface  | 4 byte, long integer     |
|                        | dir_ID              | ID of Curve or Surface if dir_mode = 2 or 4  |                          |
| 1 record per load      | dir_base[0..2]      | base point of direction vector   | 8 byte, double precision |
| 1 record per load      | dir_vector[0..2]    | end point of direction vector  | 8 byte, double precision |
| 1 record per load      | var_mode            | 0=None<br>1=Equation<br>2=Function<br>3=Interpolation  | 4 byte, long integer     |
|                        | var_funcID          | ID of function for variable load   |                          |
| 1 record per load      | var_name            | name of variable used for variable load  | character string         |
| 1 record per load      | var_equation        | equation of variable load  | character string         |
| 1 record per load      | var_locate[0][0..2] | x,y,z coordinates of end 1 of an interpolated variable load  | 8 byte, double precision |
| 1 record per load      | var_locate[1][0..2] | x,y,z coordinates of end 2 of an interpolated variable load  | 8 byte, double precision |
| 1 record per load      | var_locate[2][0..2] | unused   | 8 byte, double precision |
| 1 record per load      | var_locate[3][0..2] | unused   | 8 byte, double precision |
| 1 record per load      | var_value[0..3]     | 0,1 are values of interpolated variable load at end 1 and 2 respectively. 2,3 are unused   | 8 byte, double precision |
| 1 record per load      | adjust_midside      | flag for adjusting midside node values when load is expanded. 0 no, 1 yes  | 2 byte, boolean          |
|                        | is_expanded         | flag if load is expanded. 0 no, 1 yes  | 2 byte, boolean          |

|  |             |   |                          |
|--|-------------|---|--------------------------|
| 1 record for each nodal temp plus last   | ndtempID    | ID for nodal temperature. Must be -1 for last record.     | 4 byte, long integer     |
|  | color       | ID of color   |                          |
|  | layer       | ID of layer   |                          |
|  | ndtemp      | Nodal Temperature   | 8 byte, double precision |
|  | ndtemp_co   | Unused  |                          |
|  | ndt_funcID  | ID of function for Node Temp                              | 4 byte, long integer     |
|  | is_expanded | flag is 1 if load is expanded                             | 2 byte, boolean          |
| 1 record for each element temp plus last | eltempID    | ID for elemental temperature. Must be -1 for last record. | 4 byte, long integer     |
|  | color       | ID of color   |                          |
|  | layer       | ID of layer   |                          |
|  | eltemp      | Elemental Temperature                                     | 8 byte, double precision |
|  | eltemp_co   | Unused  |                          |
|  | elt_funcID  | ID of function for ElemTemp                               | 4 byte, long integer     |
|  | is_expanded | flag is 1 if load is expanded                             | 2 byte, boolean          |

**FEA Load Types (n = Nodal; e = Elemental)**

|    |                  |    |                   |    |                |
|----|------------------|----|-------------------|----|----------------|
| 1  | nForce           | 11 | nHeatGen          | 20 | nSlipCondition |
| 2  | nMoment          | 12 | Transient         | 21 | nFanCurve      |
| 3  | nDisplacement    | 13 | nPressure         | 22 | nPeriodic      |
| 4  | nRotDisplacement | 14 | nTotalPressure    | 41 | eLineLoad      |
| 5  | nVelocity        | 15 | nScalar           | 42 | ePressure      |
| 6  | nRotVelocity     | 16 | nSteamQuality     | 44 | eHeatFlux      |
| 7  | nAcceleration    | 17 | nHumidity         | 45 | eConvection    |
| 8  | nRotAcceleration | 18 | nFluidHeight      | 46 | eRadiation     |
| 10 | nHeatFlux        | 19 | nUnknownCondition | 47 | eHeatGen       |

**Geometry Load Types (p = Point ; c = Curve ; s = Surface)**

|     |                    |     |                     |     |                   |
|-----|--------------------|-----|---------------------|-----|-------------------|
| 81  | pnForce            | 129 | cnVelocity          | 165 | snMomentPerArea   |
| 82  | pnMoment           | 130 | cnRotVelocity       | 166 | snMomentAtNode    |
| 83  | pnDisp             | 131 | cnAccel             | 167 | snDisp            |
| 84  | pnRotDisp          | 132 | cnRotAccel          | 168 | snRotDisp         |
| 85  | pnVelocity         | 133 | cnTemp              | 169 | snVelocity        |
| 86  | pnRotVelocity      | 134 | cnHeatFlux          | 170 | snRotVelocity     |
| 87  | pnAccel            | 135 | cnHeatFluxPerLength | 171 | snAccel           |
| 88  | pnRotAccel         | 136 | cnHeatFluxAtNode    | 172 | snRotAccel        |
| 89  | pnTemp             | 137 | cnHeatGen           | 173 | snTemp            |
| 90  | pnHeatFlux         | 138 | cePressure          | 174 | snHeatFlux        |
| 91  | pnHeatGen          | 139 | ceTemp              | 175 | snHeatFluxPerArea |
| 92  | pnPressure         | 140 | ceHeatFlux          | 176 | snHeatFluxAtNode  |
| 93  | pnTotalPressure    | 141 | ceConvection        | 177 | snHeatGen         |
| 94  | pnScalar           | 142 | ceRadiation         | 178 | sePressure        |
| 95  | pnSteamQuality     | 143 | ceHeatGen           | 179 | seTemp            |
| 96  | pnHumidity         | 144 | cnPressure          | 180 | seHeatFlux        |
| 97  | pnFluidHeight      | 145 | cnTotalPressure     | 181 | seConvection      |
| 98  | pnUnknownCondition | 146 | cnScalar            | 182 | seRadiation       |
| 99  | pnSlipCondition    | 147 | cnSteamQuality      | 183 | seHeatGen         |
| 100 | pnFanCurve         | 148 | cnHumidity          | 184 | snPressure        |
| 101 | pnPeriodic         | 149 | cnFluidHeight       | 185 | snTotalPressure   |

|     |                   |     |                    |     |                    |
|-----|-------------------|-----|--------------------|-----|--------------------|
| 121 | cnForce           | 150 | cnUnknownCondition | 186 | snScalar           |
| 122 | cnForcePerLength  | 151 | cnSlipCondition    | 187 | snSteamQuality     |
| 123 | cnForceAtNode     | 152 | cnFanCurve         | 188 | snHumidity         |
| 124 | cnMoment          | 153 | cnPeriodic         | 189 | snFluidHeight      |
| 125 | cnMomentPerLength | 161 | snForce            | 190 | snUnknownCondition |
| 126 | cnMomentAtNode    | 162 | snForcePerArea     | 191 | snSlipCondition    |
| 127 | cnDisp            | 163 | snForceAtNode      | 192 | snFanCurve         |
| 128 | cnRotDisp         | 164 | snMoment           | 193 | snPeriodic         |

**Data Block 408 – Groups**

| Record  | Field                       | Description  | Size                     |
|---|-----------------------------|--|--------------------------|
| 1   | ID                          | ID of group  | 4 byte, long integers    |
|   | need_eval                   | Evaluation Flag (0=already evaluated, 1=needs evaluation before next use)            |                          |
|   | <sup>(5.0+)</sup> prev_enum | Flag for preventing renumbering of a group. 1 is prevent                             | 2 byte boolean           |
| 2   | title                       | Group title (max 25 char)  | character string         |
| 3   | layer[0..1]                 | Min and Max layers in group  | 4 byte, long integers    |
|   | layer_method                | Type of layer usage (0=Off, 1=Greater, 2=Less, 3=Between, 4=Outside, 5=Single Layer) |                          |
| 4   | coclip_on                   | 1 if coordinate clipping is on, 0 otherwise  |                          |
|   | coclip_dof                  | Coordinate clipping DOF (0=X, 1=Y, 2=Z)  |                          |
|   | coclip_meth                 | Coordinate clipping method (0=Greater, 1=Less, 2=Between, 3=Outside)                 |                          |
|   | coclip_csys                 | Coordinate clipping CSys ID  |                          |
|   | coclip_min                  | Lower limit for coordinate clipping  | 8 byte, double precision |
|   | coclip_max                  | Upper limit for coordinate clipping  |                          |
| 5   | plclip_meth                 | Plane clipping method (0=Off, 1=Screen, 2=Plane, 3=Volume)                           | 4 byte, long integers    |
|   | plclip_in                   | If 1, clip inside planes, if 0, clip outside   | 2 byte, boolean          |
| 6 rec, 1 per plane(repeat with next 2 records)      | plclip_on                   | 1 if respective plane is on  |                          |
|   | plclip_neg                  | 1 if clipping negative side of plane   |                          |
| 6 records   | plclip_base[0..2]           | Coordinates of base of plane   | 8 byte, double precision |
| 6 records   | plclip_norm[0..2]           | Components of plane normal   |                          |
| 1 record  | max_rules                   | Max number of types of rules   | 4 byte, long integers    |
| repeat for each rule type, followed by next records | rule_type                   | Type of rule. Must be -1 for last record.  |                          |
| repeat for each entry in rule                       | startID                     | Minimum entity ID in rule. Must be -1 to end this rule.                              |                          |
|   | stopID                      | Maximum entity ID in rule  |                          |
|   | incID                       | ID increment   |                          |
|   | include                     | Include Flag (0=Remove, 1=Add, -1=Exclude)   |                          |
| 1 record  | max_lists                   | Max number of entity lists   |                          |
| repeat for each list type,                          | list_type                   | Type of list. Must be -1 for last record.  |                          |

|                               |          |  |  |
|-------------------------------|----------|--|--|
| followed by next records      |          |  |  |
| repeat for each entry in list | entityID | ID of entity included into group. Must be -1 to end this rule. |  |

**Group Rule Types**

|    |                  |    |                 |    |                 |
|----|------------------|----|-----------------|----|-----------------|
| 0  | CSys_ID          | 30 | Prop_ID         | 60 | Elem_byColor    |
| 1  | CSys_byDefCSys   | 31 | Prop_onElem     | 61 | Prop_byColor    |
| 2  | CSys_byType      | 32 | Prop_byMatl     | 62 | Matl_byColor    |
| 3  | Point_ID         | 33 | Prop_byType     | 63 | Text_byLayer    |
| 4  | Point_byDefCSys  | 34 | Load_byNode     | 64 | Point_byLayer   |
| 5  | Point_onCurve    | 35 | Load_byElem     | 65 | Curve_byLayer   |
| 6  | Curve_ID         | 36 | BCo_ID          | 66 | Surface_byLayer |
| 7  | Curve_byPoint    | 37 | BEq_byNode      | 67 | Volume_byLayer  |
| 8  | Curve_onSurface  | 38 | Node_atPoint    | 68 | Solid_byLayer   |
| 9  | Surface_ID       | 39 | Node_atCurve    | 69 | CSys_byLayer    |
| 10 | Surface_byCurve  | 40 | Node_atSurface  | 70 | Node_byLayer    |
| 11 | Surface_onVolume | 41 | Node_atSolid    | 71 | Elem_byLayer    |
| 12 | Volume_ID        | 42 | Elem_atPoint    | 72 | Prop_byLayer    |
| 13 | Volume_bySurface | 43 | Elem_atCurve    | 73 | Matl_byLayer    |
| 14 | Text_ID          | 44 | Elem_atSurface  | 74 | Solid_ID        |
| 15 | Boundary_ID      | 45 | Elem_atSolid    | 75 | Solid_byCurve   |
| 16 | Boundary_byCurve | 46 | Load_byPoint    | 76 | Solid_bySurface |
| 17 | Node_ID          | 47 | Load_byCurve    | 77 | Curve_onSolid   |
| 18 | Node_byDefCSys   | 48 | Load_bySurface  | 78 | Surface_onSolid |
| 19 | Node_byOutCSys   | 49 | BCo_byPoint     | 79 | Point_byProp    |
| 20 | Node_onElem      | 50 | BCo_byCurve     | 80 | Curve_byProp    |
| 21 | Elem_ID          | 51 | BCo_bySurface   | 81 | Surface_byProp  |
| 22 | Elem_byMatl      | 52 | Text_byColor    | 82 | Volume_byProp   |
| 23 | Elem_byProp      | 53 | Point_byColor   | 83 | Solid_byProp    |
| 24 | Elem_byType      | 54 | Curve_byColor   | 84 | Contact_ID      |
| 25 | Elem_byNode      | 55 | Surface_byColor | 85 | Contact_byColor |
| 26 | Matl_ID          | 56 | Volume_byColor  | 86 | Contact_byLayer |
| 27 | Matl_onProp      | 57 | Solid_byColor   | 87 | CSys_onNode     |
| 28 | Matl_onElem      | 58 | CSys_byColor    | 88 | CSys_onPoint    |
| 29 | Matl_byType      | 59 | Node_byColor    | 89 | Elem_byShape    |

**Group Entity List Types**

|   |          |    |                      |    |                   |
|---|----------|----|----------------------|----|-------------------|
| 0 | CSys     | 8  | Elem                 | 16 | Curve Loads       |
| 1 | Point    | 9  | Material             | 17 | Surface Loads     |
| 2 | Curve    | 10 | Property             | 18 | Point Constraints |
| 3 | Surface  | 11 | Nodal Load           | 19 | Curve Constraints |
| 4 | Volume   | 12 | Elem Load            | 20 | Surface Const.    |
| 5 | Text     | 13 | Constraint           | 21 | Solids            |
| 6 | Boundary | 14 | Cosntraint Equations | 22 | Contact Segments  |
| 7 | Node     | 15 | Point Loads          |    |                   |

**Data Block 409 – Views**

| Record | Field | Description | Size                  |
|--------|-------|-------------|-----------------------|
| 1      | ID    | View ID     | 4 byte, long integers |



|                            |                                     |  |  |
|----------------------------|-------------------------------------|--|--|
| 2                          | title                               | View title (max 25 char)   | character string                           |
| 3                          | mode                                | <sup>(4,3+)</sup> Drawing Style (0=Draw, 1=Feature, 2=Quick Hide, 3=Hide, 4=Free Edge, 5=Free Face, 6=XYvsID, 7=XYvsSET, 8=XYvsVALUE, 9=XYvsPOSITION, 10=XY of Function) | 4 byte, long integers                      |
|                            | form_deform                         | Deformed Style (0=Off, 1=Deformed, 2=Animate, 3=Animate MultiCase, 4=Arrow)  |  |
|                            | form_contour                        | <sup>(4,1+)</sup> Contour Style (0=Off, 1=Contour, 2=Criteria, 3=Beam Diagram, 4=IsoSurface, 5=Section Cut)  |  |
| 4                          | rotation[0..2]                      | Rotation angles  | 8 byte, double precision                   |
| 5                          | center[0..2]                        | Location of view center  |  |
| 6                          | mag                                 | Magnification factor (1=AutoScale)   |  |
|                            | aspect_rat                          | View Aspect Ratio  |  |
| <sup>(7,1+)</sup>          | use_rotation_center                 | Flag to use rotation center for dynamic rotation   | 2 byte, boolean                            |
| <sup>(7,1+)</sup>          | Rotation_center[0..2]               | Center of rotation for dynamic rotation  | 8 byte, double precision                   |
| <sup>(7,1+)</sup>          | Rotation_vector[0..2]               | Axis of rotation for dynamic rotation  | 8 byte, double precision                   |
| <sup>(4,1+)</sup> 6a       | <sup>(4,1+)</sup> prv_cen[0..2]     | <sup>(4,1+)</sup> Previous Center Location   |  |
| <sup>(4,1+)</sup> 6b       | <sup>(4,1+)</sup> prv_mag[0..2]     | <sup>(4,1+)</sup> Previous Magnification factor  |  |
| 7                          | left                                | Position of View window on screen. In percent of screen.   |  |
|                            | top                                 |  |  |
|                            | right                               |  |  |
|                            | bottom                              |  |  |
| 8                          | border                              | Border Mode  | 4 byte, long integers                      |
|                            | back_color                          | Background Color ID  |  |
|                            | title_bar                           | Flag to indicate title bar is on   | 2 byte, boolean                            |
|                            | erase_back                          | 1 if background should be erased   |  |
|                            | <sup>(4,4+)</sup> undef_anim        | 1 if Undeformed Animation  |  |
| 9                          | constID                             | Constraint SetID, or -1 for active   | 4 byte, long integers                      |
|                            | loadID                              | Load SetID, or -1 for active   |  |
|                            | groupID                             | Group SetID, or -1 for active  |  |
|                            | outsetID                            | Output Set ID for post   |  |
|                            | final_outset                        | Final Output Set ID for multibase animation  |  |
|                            | final_outinc                        | Output Set increment for multibase animation   |  |
|                            | def_vecID                           | Output Vector ID for deformation   |  |
|                            | con_vecID                           | Output Vector ID for contour   |  |
|                            | <sup>(4,3+)</sup> functionID        | Function ID for XY plot  |  |
|                            | <sup>(4,3+)</sup> display_list_size | Max Size of Display List (not currently used)  |  |
| 1 record                   | max_curves                          | Number of XY curves  |  |
| max_curves records         | xy_setID                            | Output Set ID for this curve   |  |
|                            | xy_vecID                            | Output Vector ID for this curve.   |  |
|                            | xy_entID                            | Entity ID for this curve   |  |
| <sup>(4,1+)</sup> 1 record | <sup>(4,1+)</sup> load_vec_len      | <sup>(4,1+)</sup> Length of Load Vectors   | <sup>(4,1+)</sup> 8 byte, double precision |
|                            | <sup>(4,1+)</sup> oth_vec_len       | <sup>(4,1+)</sup> Length of Other Vectors  |  |

|                            |                                     |   |  |
|----------------------------|-------------------------------------|---|--|
|                            | <sup>(4.1+)</sup> show_all_lay      | <sup>(4.1+)</sup> Flag to display all layers                | <sup>(4.1+)</sup> 2 byte, boolean          |
|                            | <sup>(4.1+)</sup> surf_div          | <sup>(4.1+)</sup> View Surface Divisions                    | <sup>(4.1+)</sup> 4 byte, long integers    |
| <sup>(4.1+)</sup> 1 record | <sup>(4.1+)</sup> sec_cut_mode      | <sup>(4.1+)</sup> Section Cut Mode                          |  |
|                            | <sup>(4.1+)</sup> sec_count         | <sup>(4.1+)</sup> Number of Cutting Planes                  |  |
|                            | <sup>(4.1+)</sup> sec_space         | <sup>(4.1+)</sup> Spacing Between Cut Planes                | <sup>(4.1+)</sup> 8 byte, double precision |
| <sup>(4.1+)</sup> 1 record | <sup>(4.1+)</sup> sec_base[0..2]    | <sup>(4.1+)</sup> Origin for First Cut Plane                |  |
| <sup>(4.1+)</sup> 1 record | <sup>(4.1+)</sup> sec_nor[0..2]     | <sup>(4.1+)</sup> Vector Normal for Cut Plane               |  |
| 1 record                   | persp_dist                          | Perspective distance  | 8 byte, double precision                   |
|                            | persp_sep                           | Perspective separation                                      |  |
|                            | shrink_fact                         | Element Shrink factor                                       |  |
|                            | curve_err                           | Curve display error value                                   |  |
| 1 record                   | unused                              | Not used  |  |
|                            | amb_light                           | Ambient light value   |  |
|                            | light[0..2]                         | Location of light source                                    |  |
|                            | <sup>(5.0+)</sup> render_mode       | Flag is 1 if in render mode                                 | 2 byte boolean                             |
|                            | <sup>(5.0+)</sup> push_factor       | Curve/line z offset factor                                  | 8 byte, double precision                   |
|                            | <sup>(5.0+)</sup> spot_distance     | Spotlight distance  |  |
|                            | <sup>(5.0+)</sup> unused            |   |  |
|                            | <sup>(5.0+)</sup> unused            |   |  |
|                            | <sup>(5.0+)</sup> unused            |   |  |
| 1 record                   | axes[0..1]                          | Location of screen axes                                     |  |
|                            | arrow_pctlab                        | Percent of post arrows to label                             |  |
|                            | def_relscale                        | Deformed relative scale factor                              |  |
|                            | def_absscale                        | Deformed absolute scale factor                              |  |
| 1 record                   | anim_frame                          | Number of animation frames                                  | 4 byte, long integers                      |
|                            | anim_delay                          | Animation delay factor                                      |  |
|                            | <sup>(4.41+)</sup> trace_opt        | Trace Option  |  |
|                            | <sup>(4.41+)</sup> trace_ID         | ID of Output Vector for Trace Plots                         |  |
|                            | <sup>(4.41+)</sup> cntvec_hide      | 1 if Contour Vectors should be included in hidden line calc | 2 byte, boolean                            |
|                            | <sup>(4.41+)</sup> cntvec_mode      | Contour Vector Output Relative To Mode                      | 4 byte, long integers                      |
|                            | <sup>(4.41+)</sup> cntvec_csys      | Contour Vector CSys   |  |
|                            | <sup>(4.41+)</sup> cntvecID[0..2]   | IDs of Output Vectors for Contour Vector                    |  |
|                            | <sup>(4.41+)</sup> cntvec_dir[0..2] | Components of Contour Vector direction                      | 8 byte, double precision                   |
| <sup>(6.0+)</sup> 1 record | cntvecID2[0..2]                     | IDs of Output Vectors for 2 <sup>nd</sup> Contour Vector    | 4 byte, long integers                      |
|                            | cntvecID3[0..2]                     | IDs of Output Vectors for 3 <sup>rd</sup> Contour Vector    | 4 byte, long integers                      |
|                            | cntvec2_color                       | Color for 2 <sup>nd</sup> Contour Vector                    |  |
|                            | cntvec3_color                       | Color for 3 <sup>rd</sup> Contour Vector                    |  |
| <sup>(6.0+)</sup> 1 record | freebody_on                         | Flag indicating Freebody is on                              | 2 byte, boolean                            |
|                            | freebody_loads[0..5]                | Flags for load types for Freebody                           |  |
|                            | freebody_force_mom[0..1]            | Show forces[0] and moments[1]                               |  |
|                            | freebody_show_internal              | Show internal freebody data                                 |  |
|                            | freebody_show_summed                | Show summed data at each node                               |  |
|                            | freebody_min_vector_flag            | Show vectors with a minimum length                          |  |
|                            | freebody_show_comp                  | Show vector components                                      |  |
|                            | freebody_show_xyz[0..2]             | Flags for X,Y,Z components                                  |  |
|                            | freebody_scale_mag                  | Scale vectors based on their magnitude                      |  |
|                            | freebody_show_resultant             | Show resultant of summed freebody info                      |  |
|                            | freebody_entity_color               | Show freebody with entity colors                            |  |

|                 |                           |   |                          |
|-----------------|---------------------------|---|--------------------------|
| (6,0+) 1 record | freebody_group            | ID of group to be used in freebody          | 4 byte, long integers    |
|                 | freebody_show_csys        | CSys ID for freebody display                |                          |
|                 | freebody_show_mag         | Minimum magnitude vector to show            | 8 byte, double precision |
|                 | freebody_show_len[0..1]   | Min/Max display length                      |                          |
|                 | freebody_result_loc[0..2] | Location for resultant vector               |                          |
|                 | freebody_res_color        | Color for resultant vector                  | 4 byte, long integers    |
| (6,0+) 1 record | elemcont_unaveraged       | Show unaveraged element contours            | 2 byte, boolean          |
|                 | elemcont_break_prop       | Don't average across properties             |                          |
|                 | elemcont_break_matl       | Don't average across materials              |                          |
|                 | elemcont_break_layer      | Don't average across layers                 |                          |
|                 | elemcont_break_geom       | Don't average across discontinuous geometry |                          |
|                 | elemcont_break_angle      | Geometry break angle                        | 8 byte, double precision |
|                 | elemcont_addl_vecID       | Additional contour vector Output ID         | 4 byte, long integer     |
| 1 record        | max_lev                   | Maximum number of contour levels            | 4 byte, long integers    |
| max_lev records | levelID                   | ID of level to set                          |                          |
|                 | level                     | Contour level value                         | 8 byte, double precision |
| 1 record        | num_userlev               | Number of user defined levels               | 4 byte, long integers    |
|                 | con_labfreq               | Contour labelling frequency                 |                          |
|                 | con_legfreq               | Contour legend labelling frequency          |                          |
|                 | (5,0+) con_labdigits      | Number of digits on contour labels          |                          |
|                 | (5,0+) con_legdigits      | Number of digits on contour legend          |                          |
|                 | (5,0+) iso_val            | Single iso-surface value                    | 8 byte, double precision |
|                 | (5,0+) load_vec_min_scale | load vector minimum scale factor            |                          |
| 1 record        | cocolor[0..5]             | Contour Base Colors                         | 4 byte, long integers    |
| 1 record        | limit_up                  | Upper Criteria limit                        | 8 byte, double precision |
|                 | limit_down                | Lower Criteria limit                        |                          |
| 1 record        | x_range[0..1]             | XY X Axis Range                             |                          |
|                 | y_range[0..1]             | XY Y Axis Range                             |                          |
| 1 record        | max_xy                    | Maximum number of XY Curves                 | 4 byte, long integers    |
| max_xy records  | xy_scale                  | Scale factor for associated XY curve.       | 8 byte, double precision |
| 1 record        | max_xyt                   | Maximum number of XY titles                 | 4 byte, long integers    |
| max_xyt records | xy_title                  | XY Plot titles                              | character string         |
| 1 record        | xy_pos_csys               | CSys for XY vs Position                     | 4 byte, long integers    |
|                 | xy_pos_dir                | Direction for XY vs Position                |                          |
|                 | xy_xtics                  | Number of Tics along X axis                 |                          |
|                 | xy_ytics                  | Number of Tics along Y axis                 |                          |
| 1 record        | prev_xyleft               | Previous sizing of XY plot in window.       | 8 byte, double precision |
|                 | prev_xytop                |   |                          |
|                 | prev_xyright              |   |                          |
|                 | prev_xybot                |   |                          |
| 1 record        | prev_xmin                 |   |                          |
|                 | prev_ymin                 |   |                          |
|                 | prev_xmax                 |   |                          |
|                 | prev_ymax                 |   |                          |
| 1 record        | num_opt                   | Number of option records to follow.         | 4 byte, long integers    |

|   |            |                         |                       |
|---|------------|-------------------------|-----------------------|
| num_opt records, in the order found in the View Option comand | color_mode | View Option Color Modes |                       |
|   | color      | View Option View Color  |                       |
|   | label      | View Option Labelling   |                       |
|   | draw       | View Option Draw Flags  | 2 byte, boolean       |
| (4,3+) num_vis records, one record per visible layer          | layerID    | ID of visible layers    | 4 byte, long integers |

**Data Block 410 - Variables**

| Record | Field         | Description                        | Size                     |
|--------|---------------|------------------------------------|--------------------------|
| 1      | num_lines     | always equals 1                    | 4 byte, long integers    |
| 2      | variable_name | full name of variable              | character string         |
| 3      | expression    | equation that defines the variable | character string         |
| 4      | value         | the stored value of the variable   | 8 byte, double precision |

**Data Block 411 - Report Formats**

| Record          | Field      | Description  | Size                  |
|-----------------|------------|--|-----------------------|
| 1               | ID         | Report ID  | 4 byte, long integers |
|                 | repTYPE    | Report for nodal (7) or elemental (8) data         |                       |
| 2               | title      | Report Title                                       | character string      |
| 3               | numhdr     | Number of header flags to follow                   | 4 byte, long integers |
| numhdr records  | autocenter | Automatic centering flag (0=off, 1=on)             | 2 byte, boolean       |
|                 | doublesp   | Double space flag (0=off, 1=on)                    |                       |
| 1 record        | rptline    | Number of report lines to follow                   | 4 byte, long integers |
| rptline records | format     | The formats for the lines in the header and report | character string      |

**Data Block 412 - Active Data**

| Record | Field      | Description                 | Size                  |
|--------|------------|-----------------------------|-----------------------|
| 1      | constraint | ID of active constraint set | 4 byte, long integers |
|        | load       | ID of active load set       |                       |
|        | group      | ID of active group          |                       |
|        | report     | ID of active report         |                       |

**Data Block 413 - Layer Data**

| Record    | Field | Description | Size                  |
|-----------|-------|-------------|-----------------------|
| (4,41+) 1 | ID    | ID of Layer | 4 byte, long integers |
|           | color | ID of Color |                       |
| (4,41+) 2 | title | Layer Title | character string      |

**Data Block 514 - Nodal Geometry Attachment Info**

| Record | Field     | Description                       | Size                  |
|--------|-----------|-----------------------------------|-----------------------|
| 1      | geom_type | 0=Point,1=Curve,2=Surface,3=Solid | 4 byte, long integers |

|   |          |   |  |
|---|----------|---|--|
|   | geom_ID  | ID of geometry of type in goem_type                                       |  |
| 2..n each line contains a list of node ID's that are attached | start_ID | starting ID of node in attached list                                      |  |
|   | end_ID   | ending ID of node in attached list. If 0 start ID is single attached node |  |
| n+1   | -1,-1    | signifies the end of the attached list of that particular geometry ID     |  |

**Data Block 615 – Contact Segment**

| Record | Field        | Description                        | Size                     |
|--------|--------------|------------------------------------|--------------------------|
| 1      | ID           | ID of segment                      | 4 byte, long integers    |
|        | color        | Color                              |                          |
|        | layer        | Layer                              |                          |
|        | output       | Output on nodes(7) or elements(8)  |                          |
|        | refnode      | Reference Node ID                  |                          |
|        | rigid        | Flag to indicate rigid segment     | 2 byte, boolean          |
| 2      | title        | Title for segment                  | character string         |
| 3      | box[0][0..2] | Minimum dimensions of contact box  | 8 byte, double precision |
|        | box[1][0..2] | Maximum dimensions of contact box  |                          |
| 4..n   | entityID     | ID of entity in contact list       | 4 byte, long integer     |
|        | faceID       | ID of entity face in contact list  |                          |
|        | entityTYPE   | type of entity in list             |                          |
|        | expanded     | flag indicating an expanded record | 2 byte, boolean          |
| n+1    | -1,-1,0,0    | signifies the end of the list      |                          |

**Data Block 420 – Functions**

| Record                                 | Field     | Description   | Size                     |
|--|-----------|---|--------------------------|
| 1                                      | ID        | ID of function  | 4 byte, long integer     |
|  | func_type | Type of function (0=Dimensionless, 1=vs. Time, 2=vs. Temp, 3=vs. Freq, 4=vs. Stress, 5=Func vs. Temp, 6=Struct Damp vs. Freq, 7=Crit Damp vs. Freq, 8=Q Damp vs. Freq, 9=vs. Strain Rate, 10=Func vs. Strain Rate, 11=vs. Curve Length, 12=vs. Curve Param, 13=Stress vs. Strain, 14=Stress vs. Plastic Strain, 15=Function vs Value, 16=Function vs. Critical Damping) | 4 byte, long integer     |
| 2                                      | title     | Function title (max 25 char)  | character string         |
| nitems records, one per function entry | entryID   | ID of entry (ascending order, must be -1 for last entry)  | 4 byte, long integer     |
|  | x         | X value for entry in function   | 8 byte, double precision |
|  | y         | Y value for entry in function   |                          |

**Data Block 521 – DesignOpts**

| Record | Field   | Description                  | Size                 |
|--------|---------|------------------------------|----------------------|
| 1      | op_type | 0=None,1=Goal,2=Vary,3=Limit | 4 byte, long integer |

|   |               |  |                          |
|---|---------------|--|--------------------------|
|   | op_goal       | Goal of optimization<br>0=None, 1=MinWeight  |                          |
|   | op_var        | Optimization variable<br>0=None, 1=RodArea, 2=RodTorsion,<br>3=BarArea, 4=BarI1, 5=BarI2,<br>6=BarTorsion, 7=PlateThickness  |                          |
|   | op_limit      | Optimization Limit   |                          |
|   | op_cycles     | Max design cycles  |                          |
| 2 | vary type     | Property=11  | 4 byte, long integer     |
|   | vary ID       | Property ID to vary  |                          |
|   | vary extra ID | unused   |                          |
|   | vary %        | max/min specified as % if true, values otherwise   | 2 byte boolean           |
|   | vary min      | Min Allowable Value for Variable   | 8 byte, double precision |
|   | vary max      | Max Allowable Value for Variable   |                          |
|   | vary delta    | Max Change in Variable before new analysis req'd   |                          |
| 3 | resp type     | Response Type:<br>0=None, 1=NodXDisp,<br>2=NodYDisp, 3=NodZDisp, 4=NodXRDisp,<br>5=NodYRDisp, 6=NodZRDisp,<br>7=RodAxialStress, 8=RodTorsionStress,<br>9=RodAxialStrain, 10=RodTorsionStrain,<br>11=BarAxialStress, 12=BarMaxStress,<br>13=BarMinStress, 14=BarAxialStrain,<br>15=BarMaxStrain, 16=BarMinStrain,<br>17=PltXNormalStress, 18=PltYNormalStress,<br>19=PltXYShearStress, 20=PltMaxPrinStress,<br>21=PltMinPrinStress, 22=PltVonMisesStress,<br>23=PltXNormalStrain,<br>24=PltYNormalStrain,<br>25=PltXYShearStrain, 26=PltMaxPrinStrain,<br>27=PltMinPrinStrain, 28=PltVonMisesStrain | 4 byte, long integer     |
|   | resp ID       | ID of Node or Property for Response  |                          |
|   | resp min      | Min Allowable Response   | 8 byte, double precision |
|   | resp max      | Max Allowable Response   |                          |
|   |               |  |                          |

**Data Block 430 - Active Views**

| Record                                   | Field | Description                          | Size                 |
|--|-------|--------------------------------------|----------------------|
| 1 record for each active view plus final | ID    | ID of view (-1 indicates final view) | 4 byte, long integer |

**Data Block 431 - Free Edge Lists**

| Record  | Field     | Description  | Size                 |
|---|-----------|--|----------------------|
| Data for this data block is only available for views where you have calculated free edges (i.e. a free edge plot). Free edges are NOT recalculated during the translation. Only written if addl info is picked. |           |  |                      |
| 1   | ID        | ID of view   | 4 byte, long integer |
| 1 record per free edge plus final   | elementID | ID of element which has free edge (-1 for last record) |                      |
|   | node1     | ID of first Node on free edge                          |                      |
|   | node2     | ID of second Node on free edge                         |                      |

**Data Block 432 - Free Face Lists**

| Record  | Field     | Description   | Size                 |
|---|-----------|---|----------------------|
| Data for this data block is only available for views where you have calculated free faces (i.e. either shown a hidden line or free face plot). Free faces are NOT recalculated during the translation. Only written if addl info is picked. |           |   |                      |
| 1   | ID        | ID of view  | 4 byte, long integer |
| 1 record per free face plus final   | elementID | ID of element which has free face (-1 for last record)          |                      |
|   | faceID    | Index of free face on element elementID - like face ID of loads |                      |

**Table 3: Data Block 433 - Model Max/Min ID Info (Obsolete)**

| Record                        | Field     | Description  | Size                 |
|-------------------------------|-----------|--|----------------------|
| (4.4+) 1 record per data type | data_type | Type of entity                                       | 2 byte integer       |
|                               | minID     | Minimum ID in Model (if less than maxID, none exist) | 4 byte, long integer |
|                               | maxID     | Maximum ID in Model                                  |                      |
|                               | inc       | Current creation increment                           |                      |
|                               | num       | Number of Entities in Model                          |                      |

**Table 4: Max/Min Entity Types**

|   |         |    |                |    |            |
|---|---------|----|----------------|----|------------|
| 3 | Point   | 9  | CSys           | 22 | View       |
| 4 | Curve   | 10 | Material       | 24 | Group      |
| 5 | Surface | 11 | Property       | 27 | Variable   |
| 6 | Volume  | 12 | Load Set       | 28 | Output Set |
| 7 | Node    | 17 | Constraint Set | 32 | Boundary   |
| 8 | Element | 21 | Text           | 35 | Function   |

**Data Block 533 - Model Max/Min ID Info**

| Record                 | Field     | Description  | Size                 |
|------------------------|-----------|--|----------------------|
| 1 record per data type | data_type | Type of entity                                       | 2 byte integer       |
|                        | minID     | Minimum ID in Model (if less than maxID, none exist) | 4 byte, long integer |
|                        | maxID     | Maximum ID in Model                                  |                      |
|                        | inc       | Current creation increment                           |                      |
|                        | num       | Number of Entities in Model                          |                      |

**Max/Min Entity Types**

|   |         |    |                |    |            |
|---|---------|----|----------------|----|------------|
| 3 | Point   | 10 | Material       | 27 | Variable   |
| 4 | Curve   | 11 | Property       | 28 | Output Set |
| 5 | Surface | 12 | Load Set       | 32 | Boundary   |
| 6 | Volume  | 17 | Constraint Set | 35 | Function   |
| 7 | Node    | 21 | Text           | 39 | Solid      |
| 8 | Element | 22 | View           |    |            |
| 9 | CSys    | 24 | Group          |    |            |

**Data Block 540 - Model Notes**

| Record | Field | Description   | Size                 |
|--------|-------|---------------|----------------------|
| 1      | setID | ID of set     | 4 byte, long integer |
|        | size  | siz of string |                      |

|  |      |                 |                             |
|--|------|-----------------|-----------------------------|
|  | text | Multi-Line text | Multi-Line character string |
|--|------|-----------------|-----------------------------|

**Data Block 450 - Output Sets**

| Record         | Field     | Description   | Size                     |
|----------------|-----------|---|--------------------------|
| 1              | ID        | ID of output set  | 4 byte, long integers    |
| 2              | title     | Output Set title (max 25 char)  | character string         |
| 3              | from_prog | <sup>(4.1+)</sup> Analysis program where output came from (0=Unknown, 1=FEMAP Generated, 2=PAL, 3=PAL 2, 4=MSC/NASTRAN, 5=ANSYS, 6=STARDYNE, 7=COSMOS, 8=PATRAN, 9=FEMAP Neutral, 10=ALGOR, 11=SSS/NASTRAN, 12=Comma Separated, 13=UAI/NASTRAN, 14=Cosmic NASTRAN, 15=STAAD, 16=ABAQUS, 17=WECAN, 18=MTAB/SAP, 19=CDA/Sprint, 20=CAEFEM, 21=I-DEAS, 22=ME/NASTRAN, 26=CSA/NASTRAN, 28=CFDesign, 31=LS-DYNA, 32=MARC, 33=SINDA ) | 4 byte, long integers    |
|                | anal_type | <sup>(4.3+)</sup> Type of analysis (0=Unknown, 1=Static, 2=Modes, 3=Transient, 4=Frequency Response, 5=Response Spectrum, 6=Random, 7=Linear Buckling, 8=Design Opt, 9=Explicit, 10=Nonlinear Static, 11=Nonlinear Buckling, 12=Nonlinear Transient, 19=Comp Fluid Dynamics, 20=Steady State Heat Transfer, 21=Transient Heat)  |                          |
| 4              | value     | Time or Frequency value for this case. 0.0 for static analysis.   | 8 byte, double precision |
| 5              | nlines    | Number of lines of text in the following notes  | 4 byte, long integers    |
| nlines records | notes     | One or more lines of text. Number in previous record.   | character string         |

**Data Block 451 - Output Data Vectors**

| Record | Field        | Description   | Size                     |
|--------|--------------|---|--------------------------|
| 1      | setID        | ID of output set  | 4 byte, long integers    |
|        | vecID        | ID of output vector, must be unique in each output set  |                          |
|        | 1            | Always 1  | 2 byte, boolean          |
| 2      | title        | Output Vector title (max 25 char)   | character string         |
| 3      | min_val      | Minimum value in vector   | 8 byte, double precision |
|        | max_val      | Maximum value in vector. If max_val < min_val, FEMAP will search the output for the max, min and abs_max values.                        |                          |
|        | abs_max      | Maximum absolute value in vector  |                          |
| 4      | comp[0..9]   | Component vectors. Either zero, or the IDs of the X,Y,Z components, or the IDs of the corresponding elemental corner output. See below. | 4 byte, long integers    |
| 5      | comp[10..19] |   |                          |
| 6      | id_min       | ID of entity where minimum value occurs. (0 if FEMAP will recalc max/min)   |                          |



|  |            |  |   |
|--|------------|--|---|
|  | id_max     | ID of entity where maximum value occurs (0 if FEMAP will recalc max/min)   |   |
|  | out_type   | Type of output (0=Any, 1=Disp, 2=Accel, 3=Force, 4=Stress, 5=Strain, 6=Temp, others=User)                              |   |
|  | ent_type   | Either nodal (7) or elemental (8) output   |   |
| 7  | calc_warn  | If 1, can not linearly combine this output   | 2 byte, boolean                         |
|  | comp_dir   | If 1, comp[0..2] are the X,Y,Z component values. If 2, data at end of Beams. If 3, reverse data at second end of beam. | <sup>(4.1+)</sup> 4 byte, long integers |
|  | cent_total | If 1, this vector has centroidal or nodal output.  | 2 byte, boolean                         |
| 1 record for each entity, plus last record | entityID   | ID of node or element for output. Must be -1 for last record.  | 4 byte, long integers                   |
|  | value      | Output value for this entity   | 8 byte, double precision                |

### Output Components

The components are 20 Vector IDs of other vectors that are "components" of the current vector. There are several possible ways these components are used:

**1. THE CURRENT VECTOR CONTAINS THE VECTOR MAGNITUDE OF 3 OTHER VECTORS THAT ARE THE GLOBAL X,Y, AND Z COMPONENTS OF SIMILAR DATA:**

In this case Components 0, 1, and 2 are the Vector IDs of the X, Y, and Z component Vectors respectively. An example of this type of usage is Vector 1 (TOTAL TRANSLATION) which has Component 0=2(X TRANSLATION), Component 1=3(Y TRANSLATION) and Component 2=4(Z TRANSLATION). These components MUST be defined for deformed/animated plotting to work correctly. Components 3 through 19 must be 0 for this case.

**2. THE CURRENT VECTOR CONTAINS DATA WHICH SHOULD BE PLOTTED IN A SPECIFIC GLOBAL DIRECTION:**

In this case, if plotting should occur in Global X then Component 0 must equal the current Vector ID. If Global Y, then Component 1 = current Vector ID, and if Global Z then Component 2 = current Vector ID. All other Components must equal 0 (i.e. only 1 nonzero component and it is equal to the current Vector ID).

**3. THE CURRENT VECTOR CONTAINS ELEMENTAL CENTROIDAL DATA FOR ELEMENTS WHICH ALSO HAVE RELATED DATA AT THE ELEMENT CORNERS:**

In this case, the number of nonzero components depends upon the number of nodes on this element type (for example, output for linear plates has 4 components-4 nodes/corners). The nonzero components must equal the Vector IDs of the same type of data at the corners of the elements. For example, if the current vector is 7033 (CENTROIDAL VON MISES STRESS) then component 0 may be 20133 (CORNER1 VON MISES STRESS) and component 1 may be 30133 (CORNER2 VON MISES STRESS) etc... If you do not have corner data, all components must be 0. If the components are defined, FEMAP will use the corner data (not the data in the current vector) when calculating data at nodes (like for contouring). If no components are defined, FEMAP will assign the centroidal value to each node when doing the calculation.

**4. THE CURRENT VECTOR CONTAINS LINE ELEMENT DATA AT ONE END OF THE ELEMENT.**

This is just like the previous case. The first component is the vector ID of the End A data, the second component is the vector ID of the End B data. This type of output also requires special settings in the "comp\_dir" variable. Set "comp\_dir" to 2 if you want FEMAP to use the data as it is specified. Set "comp\_dir" to 3 if you want FEMAP to reverse the sign of all End B data when doing a Beam Diagram. This adjusts for differences in sign conventions between the various analysis programs.

**5. ALL OTHER CASES:**

All components should be 0. This will force the data in the current vector to be used for every case. The current setting of the View Option Deformed Style - Deformed Direction option, will control the Deformed plotting direction.

### Output Vector IDs

If you are writing your own Neutral Files, you can choose any vector IDs that you want, but the normal conventions used by FEMAP are as follows:

#### Standard Output Vectors

|                |                         |
|----------------|-------------------------|
| 1 to 2999      | Nodal Output            |
| 3000 to 5999   | Line Element Output     |
| 6000 to 59999  | Plate Element Output    |
| 60000 to 89999 | Solid Element Output    |
| 90000 to 99999 | PATRAN Elemental Output |
| above 100000   | User Defined Output     |

**Table 5: Data Block 470 - Points (Obsolete)**

| Record | Field       | Description  | Size                     |
|--------|-------------|--|--------------------------|
| 1      | ID          | ID of point  | 4 byte, long integers    |
|        | define_sys  | ID of definition coordinate system                           |                          |
|        | 0 (zero)    | unused   |                          |
|        | layer       | ID of layer  |                          |
|        | color       | ID of color  |                          |
|        | FALSE[0..5] | 6 unused flags   | 2 byte, boolean          |
|        | x           | Coordinates of point in Global Rectangular coordinate system | 8 byte, double precision |
|        | y           |  |                          |
|        | z           |  |                          |

#### Data Block 570 – Points

| Record | Field                        | Description                           | Size                     |
|--------|------------------------------|---------------------------------------|--------------------------|
| 1      | ID                           | ID of point                           | 4 byte, long integer     |
|        | Type                         | Type of point                         |                          |
|        | Engine                       | Solid engine point was created in     |                          |
|        | Def Sys                      | point definition coordinate system ID |                          |
|        | Layer                        | ID of layer                           |                          |
|        | Color                        | ID of color                           |                          |
|        | Mesh Size                    | Number of elements at point           | 8 byte, double precision |
|        | <sup>(6.0+)</sup> PropertyID | ID of property attribute              | 4 byte, long integer     |
| 2      | coordinates                  | x,y,z coordinates of point            | 8 byte, double precision |

**Table 6: Data Block 471 - Curves (Obsolete)**

| Record | Field    | Description  | Size                     |
|--------|----------|--|--------------------------|
| 1      | ID       | ID of curve  | 4 byte, long integers    |
|        | color    | ID of color  |                          |
|        | type     | <sup>(4.5+)</sup> curve type (0=Line, 1=Arc, 2=Circle, 3=Spline, 4=BSpline, 5=Solid Ref) |                          |
|        | layer    | ID of layer  |                          |
|        | mesh_lem | number of elements along curve   |                          |
|        | bias     | bias factor for meshing  | 8 byte, double precision |

|   |                          |  |                          |
|---|--------------------------|--|--------------------------|
|   | <sup>(4.5+)</sup> has_bs | Flag indicating that this curve contains B-Spline info                   | 2 byte, boolean          |
| 2   | point[0..9]              | ID of points referenced by this curve. Most unused for future expansion. | 4 byte, long integers    |
| 3   | point[10..19]            |  |                          |
| 4   | point[20..29]            |  |                          |
| <sup>(4.5+)</sup> The following records are only present if has_bs is nonzero |                          |  |                          |
| <sup>(4.5+)</sup> 5   | rational                 | B-Spline = 0, NURB = 1   | 2 byte, boolean          |
|   | k                        | Spline Order   | 4 byte, long integers    |
|   | npts                     | Number of Control Points   |                          |
| <sup>(4.5+)</sup> 6   | count                    | Number of Knot and Weight Records to Follow                              |                          |
| <sup>(4.5+)</sup> 1 record for each count                                     | p                        | ID of Control Point  |                          |
|   | knot                     | Knot Value   | 8 byte, double precision |
|   | weight                   | Weight at control point  |                          |

**Data Block 571 – Curves**

| Record   | Field             | Description   | Size                     |
|--|-------------------|---|--------------------------|
| 1  | ID                | ID of curve   | 4 byte, long integer     |
|  | Color             | ID of color   |                          |
|  | Type              | Type of curve                                       |                          |
|  | Layer             | ID of layer   |                          |
|  | Mesh Elements     | Number of elements along curve                      |                          |
|  | Mesh Bias         | Bias factor for meshing                             | 8 byte, double precision |
|  | Mesh Flag         | If 1 curve will be meshed                           | 2 Byte Boolean           |
|  | Engine            | Solid engine curve was created in                   | 4 byte, long integer     |
|  | B-Spline          | If 1 curve is a B-Spline. Data will follow          | 2 Byte Boolean           |
|  | Custom Mesh       | If 1 curve has a custom mesh size. Data will follow |                          |
| <sup>(6.0+)</sup> 2                            | Property ID       | ID of Property attribute on Curve                   | 4 byte, long integer     |
|  | Orient Type       | Type of orientation for property attribute          |                          |
|  | Offset Type       | Type of offset for property attribute               |                          |
|  | Release[0][0..5]  | Releases at Beginning of curve                      | 2 byte, boolean          |
|  | Release[1][0..5]  | Releases at End of curve                            |                          |
| <sup>(6.0+)</sup> 3                            | Orientation[0..3] | Orientation Vector data                             | 8 byte, double precision |
| <sup>(6.0+)</sup> 4                            | Offset[0][0..2]   | Offset at Beginning of Curve                        |                          |
|  | Offset[1][0..2]   | Offset at End of Curve                              |                          |
| 5  | Points            | ID's of points that define the curve. 5 max         | 4 byte, long integer     |
| 6 Spline Data, exists only if B-Spline is true | Rational          | Flag if spline is rational                          | 2 Byte Boolean           |
|  | Planar            | Flag if spline is planar                            |                          |
|  | Closed            | Flag if spline is closed                            |                          |
|  | Periodic          | Flag if spline is periodic                          |                          |
|  | t0                |   | 8 byte, double precision |
|  | t1                |   |                          |
|  | # knots           | Number of Knots in Knot sequence                    | 4 byte, long integer     |
|  | # points          | Number of control points                            |                          |
| 7  | n                 | Points + Knots                                      |                          |
| 8..n   | point             | ID of point   |                          |

|   |           |   |                          |
|---|-----------|---|--------------------------|
|   | knot      | Value of knot vector                    | 8 byte, double precision |
|   | weight    | Weight factor of knot                   |                          |
| n+1<br>Custom Mesh data, exists only if "Custom Mesh" is true | m         | Number of hard points on curve          | 4 byte, long integer     |
| n+2..m  | mesh_elem | number of elements in span              |                          |
|   | bias      | bias in span                            | 8 byte, double precision |
|   | s         | parametric curve location of hard point |                          |

**Table 7: Data Block 472 - Surfaces (Obsolete)**

| Record | Field         | Description   | Size                  |
|--------|---------------|---|-----------------------|
| 1      | ID            | ID of surface   | 4 byte, long integers |
|        | color         | ID of color   |                       |
|        | type          | surface type (0=Bilinear, 1=Ruled, 2=Revolution, 3=Coons, 4=Bezier)             |                       |
|        | layer         | ID of layer   |                       |
|        | divisions_s   | number of divisions (for display purposes) in the parametric surface directions |                       |
|        | divisions_t   |   |                       |
| 2      | reverse[0..5] | Flags to tell if curve is reversed when defining surface. 1=Reversed            | 2 byte, boolean       |
| 3      | curveID[0..5] | IDs of curves that define the surface   | 4 byte, long integers |

**Data Block 572 – Surfaces**

| Record                  | Field              | Description  | Size                     |
|-------------------------|--------------------|--|--------------------------|
| 1                       | ID                 | ID of surface  | 4 byte, long integers    |
|                         | color              | ID of color  |                          |
|                         | type               | surface type (0=Bilinear, 1=Ruled, 2=Revolution, 3=Coons, 4=Bezier, 5=Solid, 6=B Spline, 7=Boundary) |                          |
|                         | layer              | ID of layer  |                          |
|                         | divisions_s        | number of divisions (for display purposes) in the parametric surface directions                      |                          |
|                         | divisions_t        |  |                          |
|                         | has_hard_points    | Flag if surface has hard points  | 2 Byte Boolean           |
|                         | do_not_mesh        | Flag if surface should not be meshed   |                          |
|                         | engine             | Solid engine surface was created in  | 4 byte, long integers    |
| (6.0+)2                 | Property ID        | ID of Property Attribute   |                          |
|                         | Offset             | Mesh Offset Distance   | 8 byte, double precision |
|                         | (7.0+)Target Size  | Growth Factor on Interior of Surface   |                          |
|                         | (7.0+)Chord Factor | Factor for Curvature Based Meshing   |                          |
| (6.0+)3                 | Approach           | Meshing Approach ID  | 4 byte, long integer     |
|                         | Approach_Data      | IDs for selected mesh approach   |                          |
| 4 if type = 0,1,2,3,4,6 | num_lines          | number of records to the end of this surface, in this case it equals 2                               |                          |
| 5 if type = 0,1,2,3,4,6 | reverse[0..5]      | Flags to tell if curve is reversed when defining surface. 1=Reversed                                 | 2 byte, boolean          |
| 6 if type =             | curveID[0..5]      | IDs of curves that define the surface  | 4 byte, long integers    |

|  |   |   |                          |
|--|---|---|--------------------------|
| 0,1,2,3,4,6                              |   |   |                          |
| 4 if type=5                              | num_lines                                 | is 0 for solid surfaces   | 4 byte, long integers    |
| 4 if type=7                              | num_lines                                 | is 109 if boundary surface (was 25 prior to v7.1)   | 4 byte, long integers    |
| 5 if type=7                              | mode                                      | mapping mode (0=planar, 3=map to surface)   |                          |
|  | surfaceID                                 | ID of surface to map onto   |                          |
|  | define_sys                                |   |                          |
|  | z_plane                                   | elevation of planar boundary  | 8 byte, double precision |
| 6 thru 8 if type=7                       | transform [0..2][0..2]                    | 3x3 transformation matrix used to align planar boundaries in global coordinates.  | 8 byte, double precision |
| 9 thru 38 if type=7                      | flag[0..749]<br><i>(7.1+ was 0..149)</i>  | Written 25 per record. Array of flags to indicate the state of reversal, and the position of the curve in the boundary. Combination of :<br>FORWARD=0x00 (Hex),<br>REVERSE=0x01,<br>STARTLOOP=0x10,<br>ENDLOOP=0x20,<br>ONHOLE=0x80 | 4 byte, long integers    |
| 39 thru 113 if type=7                    | curve[0..749]<br><i>(7.1+ was 0..149)</i> | IDs of curves on boundary and holes. Written 10 per line  |                          |
| 114+ if type=7<br><i>(7.1+)</i>          | multisurf[I]                              | IDs of underlying surfaces for multi-surface boundary. Written 1 per line. List is terminated with a -1 as the last surface. Even if not a multisurface boundary, the -1 is always written.   | 4 byte, long integers    |
| 1 record (all types) if has hard points  | n   | number of hard points   | 4 byte, long integers    |
| n records (all types) if has hard points | hard points                               | ID of point   |                          |

**Table 8: Data Block 473 - Volumes (Obsolete)**

| Record | Field                                      | Description   | Size                  |
|--------|--|---|-----------------------|
| 1      | ID   | ID of volume  | 4 byte, long integers |
|        | color                                      | ID of color   |                       |
|        | type                                       | volume type (0=Brick, 1=Wedge, 2=Pyramid, 3=Tetra)  |                       |
|        | layer                                      | ID of layer   |                       |
| 2      | ( reverse_s, reverse_t, reverse_u ) [0..5] | Array of [3][6] flags to indicate how the surface parametric directions are reversed when defining the volume. 1=Reversed | 2 byte, booleans      |
| 3      | surfID[0..6]                               | IDs of surfaces that define the volume  | 4 byte, long integers |

**Data Block 573 - Solid/Volume**

| Record | Field       | Description   | Size                  |
|--------|-------------|---|-----------------------|
| 1      | ID          | ID of SV  | 4 byte, long integers |
|        | color       | ID of color   |                       |
|        | volume_type | volume type (0=Brick, 1=Wedge, 2=Pyramid, 3=Tetra) 0 if solid |                       |
|        | engine      | Solid engine, 0 if volume                                     |                       |
|        | layer       | ID of layer   |                       |
|        | solid_type  | 6=Volume, 39=Solid  |                       |

|               | (6,0+)Property ID                          | ID of Property attribute  |                       |
|---------------|--|---|-----------------------|
| 2 if volume   | ( reverse_s, reverse_t, reverse_u ) [0..5] | Array of [3][6] flags to indicate how the surface parametric directions are reversed when defining the volume. 1=Reversed           | 2 byte, booleans      |
| 3 if volume   | surfID[0..6]                               | IDs of surfaces that define the volume  | 4 byte, long integers |
| 2 if solid    | text                                       | >>> Begin Solid Transmit >>>  | character string      |
| 3..n if solid | solid data                                 | If this is an ACIS solid, then an ACIS SAT file is embedded here. If this a Parasolid solid, then a Parasolid X_T file is embedded. |                       |
| n+1 if solid  | text                                       | <<< End Solid Transmit <<<  | character string      |

**Table 9: Data Block 474 - Boundary (Obsolete)**

| Record    | Field                  | Description   | Size                     |
|-----------|------------------------|---|--------------------------|
| 1         | ID                     | ID of boundary  | 4 byte, long integers    |
|           | color                  | ID of color   |                          |
|           | mode                   | mapping mode (0=planar, 3=map to surface)   |                          |
|           | layer                  | ID of layer   |                          |
|           | surfaceID              | ID of surface to map onto   |                          |
|           | define_sys             |   |                          |
|           | z_plane                | elevation of planar boundary  |                          |
| 2         | transform [0..2][0..2] | 3x3 transformation matrix used to align planar boundaries in global coordinates.  | 8 byte, double precision |
| 3 thru 8  | flag[0..149]           | Written 25 per record. Array of flags to indicate the state of reversal, and the position of the curve in the boundary. Combination of :<br>FORWARD=0x00 (Hex),<br>REVERSE=0x01,<br>STARTLOOP=0x10,<br>ENDLOOP=0x20,<br>ONHOLE=0x80 | 4 byte, long integers    |
| 9 thru 23 | curve[0..149]          | IDs of curves on boundary and holes   |                          |

**Data Block 475 - Text**

| Record | Field               | Description   | Size                     |
|--------|---------------------|---|--------------------------|
| 1      | ID                  | ID of text  | 4 byte, long integers    |
|        | color               | ID of text color  |                          |
|        | back_color          | ID of background color  |                          |
|        | bord_color          | ID of border color  |                          |
|        | font                | font index (refer to Create Text dialog box for interpretation of values) |                          |
|        | layer               | ID of layer   |                          |
| 2      | model_positioning   | 0=screen, 1=model positioned  | 2 byte, boolean          |
|        | horz_just           | 0=Center, 1=Left, 2=Right   | 4 byte, long integers    |
|        | vert_just           | 0=Center, 1=Top, 2=Bottom   |                          |
|        | visible             | Text is visible in all views if this is 1.                                | 2 byte, boolean          |
|        | viewID              | ID of view for single view visibility                                     | 4 byte, long integers    |
|        | draw_pointer        | Pointer drawn if =1   | 2 byte, boolean          |
|        | draw_border         | Border drawn if =1  |                          |
| 3      | text_position[0..2] | Location of text, either in model or screen coordinates                   | 8 byte, double precision |

|      |                        |   |                       |
|------|------------------------|---|-----------------------|
| 4    | pointer_position[0..2] | Location of pointer tip, either in model or screen coordinates  |                       |
| 5    | text_lines             | Number of lines (strings) of text that follow                   | 4 byte, long integers |
| 6..N | text                   | One or more lines (strings) of text. Number in previous record. | character strings     |

# ***FEMAP Material Definition File***

FEMAP has the ability to work with user-defined materials. By creating a Material Definition File, you tell FEMAP what data to include in that material, and the text to be displayed in the dialog boxes. The format of this file is as follows:

```
[ID]
Name="material type name"
FieldID[,minVAL,maxVAL]="field title"
FieldID[,minVAL,maxVAL]="field title"
Blank=
FieldID[,minVAL,maxVAL]="field title"
```

Where each of these items is defined as follows:

## **[ID]**

This is the material subtype number. These must be unique in your material definition file. If you are going to define materials for other than personal use, contact ESP to be assigned a range of subtypes. Doing this eliminates conflicts between various definitions of materials by different people.

## **Name="title"**

Here you define the title that is displayed in the FEMAP list of available material types. The title must be enclosed in quotes.

## **FieldID="field title"**

These are the actual data definition records for this material. One record is required for each data item that you want for this material type. Data fields will be displayed in the material creation dialog box in the order that you specify them in this file. The FieldID value specifies both the type of data (R=real value, I=integer value, F=function value, A=text only) and the location in the data arrays to store the value. For example R53 means select a real number and store it in mval[53], I15 means select an integer and store it in ival[15]. Allowable FieldIDs are in the range R0 thru R199, I0 thru I24 and F0 thru F49. If you start the FieldID with an 'A', you can specify any number. In this case, only the associated title will be displayed, the input field will be hidden, and no data will be stored. The field title is the text that is displayed next to this data field in the material creation dialog box. You will have to limit this text to around 25 characters or less, due to limited space in the dialog box.

## **FieldID,minVAL,maxVAL="field title"**

The simplest way to specify a data field was the previous one given above, however this will allow any value to be entered for the data. If you want to restrict input to a certain range of values, you can use the format shown here. You must specify both the minVAL (minimum) and maxVAL (maximum) values that you will accept. When a user is creating a material of this type only values between this range will be allowed.

## **Blank=**

This record is simply used to skip a space in the dialog box. It can be used to separate groups if similar input. No user input will be allowed from this position in the dialog.

To define a material type, simply create a new section in the material definition file. Make sure you choose a subtype ID that is not currently being used. The next record must be present and must be the "Name" definition. Then simply add as many field records as you need to collect the data for your material.

You can defined multiple material definition files and select them through the File Preferences Libraries option.





# FEMAP Binary Output File Format

This section of the document describes the FEMAP Binary Output File Format. Using this output format can significantly increase the speed of output transfer.

| Record Type   | Type    | Data         | Values   |
|---------------|---------|--------------|--|
| File Header   | INT4    | file_version | = 1 (we will use this for byte swap checking also)   |
|               | CHAR[4] | check string | "ESP" + NULL   |
|               |         |              |  |
| Record Header | INT4    | record type  | = 1 node id list<br>= 2 elem id list<br>= 3 output set data<br>= 4 output vector data<br>= 5 xy data (not in an output set)<br>= -1 end of file  |
|               | INT4    | counter      | = number of nodes (if record type=1)<br>= number of elements (if record type=2)<br>= Results Set/Step Number (if record type = 3)<br>= FEMAP Vector ID (if record type = 4 ) refer to post.h header file for standard FEMAP vector IDs.<br>= number of xy pairs (if record type = 5) |
|               |         |              |  |

|                               |                          |               |  |
|-------------------------------|--------------------------|---------------|--|
| Type 1:<br>Node ID<br>List    | INT4[number of nodes]    | node IDs      | FEMAP Node numbers, each output data vector that follows that is a nodal output vector will have output for these nodes, in this order.  |
|                               |                          |               |  |
| Type 2:<br>Elem ID<br>List    | INT4[number of elements] | element IDs   | FEMAP Element numbers, each output data vector that follows that is an elemental, or elemental corner output vector will have output for these elements, in this order.  |
|                               |                          |               |  |
| Type 3:<br>Output Set<br>Data | REAL8                    | Step Value    | Time for transient, nonlinear. Frequency for modal...  |
|                               | INT4                     | Analysis Type | 0 = AT_UNKNOWN<br>1 = AT_STATIC<br>2 = AT_MODES<br>3 = AT_TRANSIENT<br>4 = AT_FREQUENCY_RESPONSE<br>5 = AT_RESPONSE_SPECTRUM<br>6 = AT_RANDOM<br>7 = AT_LINEAR_BUCKLING<br>8 = AT_DESIGN_OPTIMIZATION<br>10 = AT_NONLINEAR_STATIC<br>11 = AT_NONLINEAR_BUCKLING<br>12 = AT_NONLINEAR_TRANSIENT<br>19 = AT_CFD<br>20 = AT_STEADY_STATE_HEAT<br>21 = AT_TRANSIENT_HEAT |
|                               | CHAR[26]                 | Set Title     | NULL terminated title string   |

| Type 4:<br>Output<br>Data | INT4       | data type    | 0 = nodal<br>1 = elemental<br>2 = elemental corner (beam end output =1, not =2)  |
|---------------------------|------------|--------------|--|
|                           | INT4       | output type  | 0 = OT_Any<br>1 = OT_Displacement<br>2 = OT_Accel<br>3 = OT_Force<br>4 = OT_Stress<br>5 = OT_Strain<br>6 = OT_Temp<br>7..15 = OT_User  |
|                           | INT4[8]    | components   | IDs of other vectors in this set that are “components”<br>1) if this is a “Total” vector of nodal data, (like Total Displacement), then set to: [X_Comp, Y_Comp, Z_Comp, 0, 0, 0, 0, 0]<br>2) if this is a “Component” vector of nodal data, (like X Displacement), then set to [ThisVectorID,0,0,0,...] if it is an X component vector, or [0,ThisVectorID,0,0,...] if it is a Y component vector, or [0,0,ThisVectorID,0,0,...] if it is a Z component vector.<br>3) if this is element centroidal data for an element that will also have corner data of the same type, set each component value to the vector ID of the data for the appropriate corner - BE CAREFUL:<br>Tria=[x,x,x,0,0,0,0,0], Quad=[x,x,x,x,0,0,0,0],<br>Tetra=[x,x,x,0,x,0,0,0],<br>Wedge=[x,x,x,0,x,x,x,0]<br>Brick=[x,x,x,x,x,x,x,x]<br>4) if this is output for a line element that has values at End A and End B, set [ThisVectorID,EndB,0,0,...] for End A data and [EndA,ThisVectorID,0,0,...] for End B data.<br>5) Otherwise set to all 0. |
|                           | INT4       | direction    | 0 = No Direction Components (scalar, or tri/quad/tet/wedge/brick element output)<br>1 = Global Components (nodal Total vector or nodal component vector)<br>2 = Element Components (for line element output where both End A and End B axis sign conventions are identical)<br>3 = Element Rev Components (for line element output where the sign conventions reverse at End A and End B)  |
|                           | INT4       | calc warning | 0 = Data can be linearly combined<br>1 = Data can not be linearly combined   |
|                           | INT4       | minID        | node/element ID where min value occurs (0=FEMAP calc)  |
|                           | INT4       | maxID        | node/element ID where max value occurs (0=FEMAP calc)  |
|                           | REAL8      | min value    |  |
|                           | REAL8      | max value    |  |
|                           | CHAR[26]   | title        | Title of output vector (NULL terminated)   |
|                           | REAL8[...] | data         | Either “number of nodes” or “number of elements” data values, one for each node, in the order of the last node or element list that was supplied.  |
|                           |            |              |  |

|                    |            |               |   |  |
|--------------------|------------|---------------|---|--|
| Type 5:<br>XY Data | INT4       | function type | 0 = tblNone,<br>1 = vs. Time,<br>2 = vs. Temp,<br>3 = vs. Freq<br>4 = vs. Stress<br>5 = Func vs Temp<br>6 = Structural Damp vs Freq | 7 = Crit Damp vs Freq<br>8 = Q Damp vs Freq<br>9 = vs. Strain Rate<br>10 = Function vs. Strain Rate<br>11 = vs. Curve Length<br>12 = vs. Curve Param |
|                    | CHAR[26]   | title         | Title of function (NULL terminated)   |  |
|                    | REAL8[...] | xydata        | Two times "number of xy pairs" data values, arranged as<br>X1,Y1, X2,Y2, X3,Y3, ... XN,YN   |  |

**Other Notes:**

1. All Nodal component output must be in Global Rectangular coordinates.
2. Data must be given for all elements in the active node or element list. For best speed, and smallest file size, only change the node and element list when it changes.
3. Use the FEMAP standard vector IDs given in post.h. Use the macros:
  - PO\_LAY( Layer, Vec ) for plate centroidal top, mid, bottom output (Layer=LAY\_Top, LAY\_Mid, LAY\_Bot)
  - PO\_LAY( Ply, Vec) for laminate output Ply=1..N
  - PC\_LAY( Layer\_or\_Ply, Vec, Corner ) for plate or laminate corner output - same as PO\_LAY() except you also specify the corner number 0..3 where the data resides. Corners are 0,1,2... not 1,2,3,...
  - SC\_COR( Vec, Corner ) for solid corner output - same idea, corner number is 0..7 where the data resides. Be careful, corners MUST be specified in the same pattern as the components above - corner 3 is missing for Tets and Wedges.
4. Be careful when assigning the direction field for bar/beam/rod... output. The sign convention at the ends of the element determines which it must be set. For NASTRAN we use 3..Element Rev Components for most output, other than Bar Shear Force, Bar Torque Force, Bar Axial Force, End Temperature
5. A Node List MUST appear in the file before any nodal data, an Element List MUST appear before any elemental centroidal or elemental corner data.

