

# **Engineering and Survey - Exchange (EAS-E)**

## **A Standard Engineering Data Format**

**Technical Draft - January, 2000**



**by  
Joint-Industry Consortium  
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## *Overview*

For the past two decades transportation engineering has advanced in many diverse ways. The wealth of electronic information and data generated by this industry has taken many forms. These varied forms of data are used by Department's of Transportation, design firms, surveyors, contractors, consultants and industry experts for highway transportation and infrastructure design, site preparation, modeling, data management, analysis and multiple other civil-works tasks. Often it is necessary to share and exchange this engineering data internally and between agency functional divisions, or to transfer the data between agencies and consultants. Recently, as a result of an effort to reduce cost and to promote a cost-effective workflow environment, the need for defined data formats for an open exchange of this data has emerged. Defined data formats would not only facilitate the physical sharing of data, it will allow business entities the opportunity to choose the most appropriate computer software programs to import, export, process, and archive this data for unique production tasks and future reference. As a result, entities within the industry joined forces to develop standard data formats to exchange, share, read, print, and store engineering data.

## *Background*

In June 1998, a committee meet to address the need for standard data formats. Specifically, the committee sought to define, document, and prototype a standard engineering data formats for the transportation industry. The initial committee members consisted of:

- Nebraska Department of Roads
- Oklahoma Department of Transportation
- Virginia Department of Transportation
- HDR Engineering
- HNTB
- Sverdrup Civil
- C. W. Beilfuss
- Intergraph Corporation

As a result of this conference, the Engineering and Survey - Exchange (EAS-E) was established, and a technical draft of industry-standard data formats was initiated. The primary objective of the standard is to provide data formats that are easy to read and efficient to process by computer application software.

In February 1999, a second meeting was held, with the following participants:

- Florida Department of Transportation
- Idaho Department of Transportation

- Montana Department of Transportation
- Nebraska Department of Roads
- Oklahoma Department of Transportation
- Texas Department of Transportation
- Virginia Department of Transportation
- HDR Engineering
- Sverdrup Civil
- C. W. Beilfuss
- CAICE
- GEOPAK
- AE Group
- Soft Desk
- Eagle Point
- InfraSoft
- ITT
- Trimbul
- Intergraph Corporation

As a result of this conference, the technical draft has been revised.

## ***Data Requirements***

The following objectives were identified as specific data requirements:

**Text File Format** - A defined non-proprietary text format that is easy for an individual to read, online and in hardcopy print.

**Data Exchange/Data Sharing** - A standard way to share information within internal divisions and between DOT's, federal agencies, business partners, design consultants, and contractors. A standard file language that can be imported, exported, processed, and archived with any engineering design software package.

**Construction Staking** - A standard deliverable for road contractors.

**Archive** - A cost effective way to store and preserve data for future use.

**Industry Acceptance** - To meet design specifications for American Association of State Highway and Transportation Officials (AASHTO) acceptance.

## ***Scope***

The primary focus was to define a format that human readable and that could be efficiently processed by computer application software. With this objective in mind, the initial technical focus included the following engineering data components:

- Horizontal Alignments
- Vertical Alignments
- Cross Sections
- Coordinate Geometry Elements
- Digital Surface Data

## *Data File Format*

### **Nomenclature:**

The file formats defined in this document include keywords and block data. In general the following applies to all keywords:

- Keywords must be included in square brackets.
- Keywords must appear exactly as defined within this document.
- Keywords are followed by an equals sign.
- The actual value of for each keyword is enclosed in double quotes.
- Keywords should appear in the order defined in this document.
- All keywords are required except the [Comment] keyword, which is optional.

Types of keyword data are as follows:

- *<numeric value>* indicates that the data is **numeric**.
- *<alpha-numeric value>* indicates that the actual data is an **alpha-numeric string**.
- *<date value>* indicates that the actual data can be interpreted as a **date**.
- “*<UNC file name>*” indicates a file name that the original data was defined in.
- A *[Begin Data]* and *[End Data]* are keywords that indicate the start and end of a block of data. All data within these block keywords are defined by the formats for that data type. The data that is included for each block is specific to any given data format therefore, the specific information is included below this data.

### **Comments and blank lines:**

Comments are lines that start with a :, ; or #. In addition, blank lines may be included to improve the readability of data.

## **Project Header**

[EAS-E Version] = “<numeric value>”

[Vendor/Software Version] = “<alpha-numeric value>”

[File Creation Date] = “<date value>”

[Project Name] = “<alpha-numeric value>”

[Units] = “metric” or “imperial”

[Coordinate System] = “<alpha-numeric values>”

[Scale Factor] = “<numeric value>”

[Datum] = “<alpha-numeric value>”

[File] = “<UNC file name>”

[Comments] = “<alpha-numeric value>” {optional}

## Horizontal Alignment

### Character Syntax

1. All data items are white space delimited.
2. Stationing has a minimum of 4 decimal places of accuracy.
3. Coordinates have a minimum of 6 decimal places of accuracy.
4. Radii, circular arc lengths, and spiral lengths have a minimum of 4 decimal places of accuracy.

### Definitions

- A simple curve-set is a single circular curve without leading or trailing transition spirals.
- A SCS curve-set is a single circular curve with either a leading transition spiral, a trailing transition spiral or both.
- A complex curve-set is a curve-set with two or more circular curves. A complex curve-set may have leading, trailing or compound transition spirals.
- A transition spiral is a clothoid and as defined in *Route Location and Design (Fifth Edition)* by Thomas F. Hickerson ISBN 07-028680-9.

### Horizontal Alignment File Format

[Type of Data] = "horizontal alignment"

[Horizontal Alignment Name] = "<alpha-numeric value>"

[Horizontal Alignment Description] = "<alpha-numeric value>"

[Curve Definition] = "arc" or "chord"

[Comments] = "<alpha-numeric value>" {optional}

[Begin Data]

<STATION> <X> <Y>

<STATION> <X> <Y> <R>

<STATION> <X> <Y> <Ls1> <R> <Ls2>

<STATION> <X> <Y> <Ls1> <R1> <L1> <Lsc1> <R2> <Ls2>

<STATION> <X> <Y> <Ls1> <R1> <L1> <Lsc1> <R2> <L2> <Lsc2> <R3> <Ls2>

<STATION> <Point ID>

<STATION> <Point ID> <R>

<STATION> <Point ID> <Ls1> <R> <Ls2>

<STATION> <Point ID> <Ls1> <R1> <L1> <Lsc1> <R2> <Ls2>

<STATION> <Point ID> <Ls1> <R1> <L1> <Lsc1> <R2> <L2> <Lsc2> <R3> <Ls2>

<BACK STATION> = <AHEAD STATION>

...

<STATION> <X> <Y>

[End Data]

Where,

<STATION> is the PI's station.

<X> is the PI's easting coordinate.

<Y> is the PI's northing coordinate.  
<Ls1> is the leading spiral's length.  
<Ls2> is the trailing spiral's length.  
<Lsc1> is the first compound spiral's length.  
<Lsc2> is the second compound spiral's length.  
<L1> is the first circular curve's length in a complex curve set.  
<L2> is the second circular curve's length in a complex curve set.  
<R> is the circular curve's radius in a simple curve set or a SCS curve-set.  
<R1> is the first circular curve's radius in a complex curve-set.  
<R2> is the second circular curve's radius in a complex curve-set.  
<R3> is the third circular curve's radius in a complex curve-set.  
<Point ID> is the PI's point identification and in double quotes,  
<BACK STATION> is the station equations back station. Note that this value is followed with an equals sign.  
<AHEAD STATION> is the station equation's ahead station.

For complex curve-sets, the above syntax can be expanded without limitations. For each additional circular arc add the compound spiral's length, the circular arc's radius and length (unless it is the last arc).

### Example data:

```
[EAS-E Version] = "1.0"
[Vendor/Software Version] = "InRoads SelectCAD 7.2"
[File Creation Date] = "Saturday, April 17, 1999"
[Project Name] = "EAS-E Horizontal Alignment"
[Units] = "imperial"
[Coordinate System] = ""
[Scale Factor] = "1.0"
[Datum] = ""
[File] = "\\enigma\data\ease\ease.eas"
[Comments] = ""
#
[Type of Data] = "horizontal alignment"
[Horizontal Alignment Name] = "centerline"
[Horizontal Alignment Description] = "example data for horizontal alignment"
[Curve Definition] = "arc"
[Comments] = ""
[Begin Data]
100+00.0000      520450.000000  1829350.000000
102+00.0000      520614.825238  1829463.281247
105+00.0000 = 106+00.0000
107+00.0000 (1) 520944.475713  1829689.843742
110+00.0000 = 109+00.0000
#
# The next data line defines a simple curve-set with a radius of 1500 feet.
#
111+64.0044 (2) 521409.286489  1830009.299337      1500.0000
#
#
# The next data line defines a SCS curve-set with:
# a 125 foot leading spiral,
# a circular arc with a radius of 750 feet and
# a 125 foot trailing spiral.
#
122+58.5405 (2) 522531.828775  1830011.700001  125.0000  -750.0000      125.0000
#
#
# The next data line defines a complex curve-set with:
# a 125 foot leading spiral,
```



```
# a first circular arc with a radius of 750 feet and a length of 600 feet,  
# a 125 foot compound spiral,  
# a 1250 foot second radius and  
# a 100 foot trailing spiral.  
#  
139+17.0060 (2) 523880.294626 1831006.232982 125.0000 750.0000 600.0000 125.0000  
1250.0000 100.0000  
156+00.0000 (2) 525148.083849 1829404.692071  
[End Data]
```

**Note: In the above example, the data is aligned on the decimal point for clarity and readability. This does not imply that the format is fixed width or column-based.**

## Vertical Alignment

### Character Syntax

1. All data items will be white space delimited.
2. Stationing has a minimum of 4 decimal places of accuracy.
3. Elevations have a minimum of 4 decimal places of accuracy.
4. Lengths have a minimum of 4 decimal places of accuracy.

### Vertical Alignment File Format

[Type of Data] = “vertical alignment”  
[Horizontal Alignment Name] = “<alpha-numeric value>”  
[Vertical Alignment Name] = “<alpha-numeric value>”  
[Vertical Alignment Description] = “<alpha-numeric value>”  
[Comments] = “<alpha-numeric value>” {optional}  
[Begin Data]  
<STATION> <Z>  
<STATION> <Z> <L>  
<STATION> <Z> <L1> <L2>  
...  
<STATION> <Z>  
[End Data]

Where,

<STATION> is the PI's station.

<Z> is the PI's elevation.

<L> is the symmetrical vertical's length (such as the horizontal distance from the PVC to the PVT).

<L1> is an unsymmetrical vertical's leading length (such as the horizontal distance from the PVC to the PVI).

<L2> is a unsymmetrical vertical's trailing length (such as the horizontal distance from the PVI to the PVT).

**Example data:**

```
[EAS-E Version] = "1.0"
[Vendor/Software Version] = "InRoads SelectCAD 7.2"
[File Creation Date] = "Saturday, April 17, 1999"
[Project Name] = "grand"
[Units] = "imperial"
[Coordinate System] = ""
[Scale Factor] = "1.0"
[Datum] = ""
[File] = "\\enigma\data\grand\grand72.eas"
[Comments] = ""
#
[Type of Data] = "horizontal alignment"
[Horizontal Alignment Name] = "ltd"
[Horizontal Alignment Description] = ""
[Curve Definition] = "arc"
[Comments] = ""
[Begin Data]
0+00.0000 522796.492000 1832163.479000
2+89.9730 522999.616000 1832370.421000
10+18.2908 523337.833957 1833015.444555 150.0000 449.3787 150.0000
19+84.5572 524382.996451 1832748.586379 150.0000 -315.0000 150.0000
59+53.7337 527523.726768 1835215.673226 150.0000 1206.2269 251.9422 150.0000 477.4648
48+94.2794 525672.931665 1832307.306102 200.0000 -800.0000 150.0000
64+82.0429 525939.203000 1830712.796000
[End Data]
#
[Type of Data] = "vertical alignment"
[Horizontal Alignment Name] = "ltd"
[Vertical Alignment Name] = "1"
[Vertical Alignment Description] = ""
[Comments] = ""
[Begin Data]
0+00.0000 7432.0000
13+25.3000 7477.6068 1000.0000
24+92.6580 7432.0854 391.4904
38+35.1140 7509.3404 513.0587
50+44.7760 7441.0768 400.0000
64+82.0429 7394.7096
[End Data]
#
[Type of Data] = "vertical alignment"
[Horizontal Alignment Name] = "ltd"
[Vertical Alignment Name] = "alternative 2"
[Vertical Alignment Description] = ""
[Comments] = ""
[Begin Data]
0+00.0000 7427.0000
13+25.3000 7472.6068 1000.0000
24+92.6580 7427.0854 400.0000
38+35.1140 7504.3404 500.0000
50+44.7760 7436.0768 400.0000
64+82.0429 7389.7096
[End Data]
#
[Type of Data] = "vertical alignment"
[Horizontal Alignment Name] = "ltd"
[Vertical Alignment Name] = "critical"
[Vertical Alignment Description] = "critical path"
[Comments] = ""
[Begin Data]
0+00.0000 7422.0000
13+25.3000 7467.6100 514.3374
24+92.6600 7422.0830 391.0927
38+35.1100 7499.3410 512.9584
50+44.7810 7431.0800 400.0000
64+82.0429 7384.7100
[End Data]
```

## **Cross Section**

### **Character Syntax**

1. All data items will be white space delimited.
2. Stations and offsets have a minimum of 4 decimal places of accuracy.
3. Coordinates including elevations have a minimum of 4 decimal places of accuracy.
4. Slopes have a minimum of 4 decimal places of accuracy. Slopes are expressed in either feet per foot or meter per meters.
5. Widths have a minimum of 4 decimal places of accuracy.

### **Cross Section File Format**

[Type of Data] = “cross section”  
[Horizontal Alignment Name] = “<alpha-numeric value>”  
[Surface Name] = “<alpha-numeric value>”  
[Type of Surface] = “<alpha-numeric value>”  
[Type of Cross Section Data] = “station and offset” or “coordinates”  
[Comments] = “<alpha-numeric value>” { optional}  
[Begin Data]  
<STATION> <OFFSET> <Z>  
<STATION> <OFFSET> <Z> <FEATURE>  
<STATION> <OFFSET> <Z> <FEATURE> <X> <Y>  
...  
[End Data]

[Begin Data]  
<X> <Y> <Z>  
<X> <Y> <Z> <FEATURE>  
<X> <Y> <Z> <FEATURE> <STATION> <OFFSET>  
...  
[End Data]

Where,

<STATION> is the point’s station.

<OFFSET> is the point’s offset.

<Z> is the point’s elevation.

<FEATURE> is the point’s feature. Note that this field is enclosed in quotes.

<X> is the point’s easting coordinate.

<Y> is the point’s northing coordinate.

In addition a specific format for superelevation cross sections is defined as:

[Begin Data]

[Superelevation] = “End Normal Crown”, “Begin Reverse Crown”, “Begin Full Superelevation”, “End Full Superelevation”, “End Reverse Crown”, “Begin Normal Crown”

<STATION> <OFFSET> <Z> <SLOPE> <WIDTH>

...

[End Data]

**Notes:**

1. Each cross section must be included within a [Begin Data] / [End Data].
2. Stations are from least station to greatest.
3. Sections are defined from left to right.

**Example data:**

```
[EAS-E Version] = "1.0"
[Vendor/Software Version] = "InRoads SelectCAD NR In Progress"
[File Creation Date] = "Saturday, April 17, 1999"
[Project Name] = "grand"
[Units] = "imperial"
[Coordinate System] = ""
[Scale Factor] = "1.0"
[Datum] = ""
[File] = "\\enigma\data\grand\grand72.eas"
[Comments] = ""
#
[Type of Data] = "cross section"
[Horizontal Alignment Name] = "ltd"
[Type of Cross Section Data] = "station and offset"
[Comments] = ""
[Surface Name] = "scenic"
[Type of Surface] = "existing ground line"
[Comments] = ""
```

[Begin Data]

```
0+00.0000 -100.0000 7420.7886 "" 522725.126049 1832233.528276
0+00.0000 -94.9480 7420.7574 "" 522728.731457 1832229.989387
0+00.0000 -89.9000 7420.7212 "" 522732.334010 1832226.453299
0+00.0000 -89.0670 7420.7300 "" 522732.928489 1832225.869789
0+00.0000 -78.6010 7420.5468 "" 522740.397649 1832218.538432
0+00.0000 -67.5030 7420.3980 "" 522748.317842 1832210.764363
0+00.0000 -60.8470 7420.1972 "" 522753.067960 1832206.101883
0+00.0000 -45.4220 7420.2396 "" 522764.076158 1832195.296782
0+00.0000 -26.3240 7419.9328 "" 522777.705627 1832181.918771
0+00.0000 -24.4800 7419.8612 "" 522779.021615 1832180.627063
0+00.0000 -22.7380 7419.8124 "" 522780.264810 1832179.406804
0+00.0000 -21.7710 7419.7552 "" 522780.954919 1832178.729428
0+00.0000 -20.5510 7419.9310 "" 522781.825584 1832177.874827
0+00.0000 -12.2950 7421.1724 "" 522787.717556 1832172.091559
0+00.0000 5.4330 7420.7682 "" 522800.369312 1832159.673223
0+00.0000 9.9100 7420.7232 "" 522803.564366 1832156.537117
0+00.0000 13.9240 7420.2694 "" 522806.428995 1832153.725339
0+00.0000 23.0860 7419.2460 "" 522812.967543 1832147.307424
0+00.0000 29.4390 7419.3054 "" 522817.501422 1832142.857194
0+00.0000 41.0470 7419.2860 "" 522825.785582 1832134.725874
0+00.0000 46.2750 7419.2068 "" 522829.516594 1832131.063697
0+00.0000 60.0520 7418.9214 "" 522839.348681 1832121.413009
0+00.0000 72.0370 7418.7822 "" 522847.901890 1832113.017603
0+00.0000 78.6170 7418.6852 "" 522852.597769 1832108.408360
0+00.0000 92.7100 7418.7946 "" 522862.655373 1832098.536316
0+00.0000 98.3630 7418.8596 "" 522866.689690 1832094.576430
0+00.0000 99.4950 7418.8384 "" 522867.497552 1832093.783473
0+00.0000 100.0000 7418.8272 "" 522867.857951 1832093.429724
```

[End Data]

#

[Begin Data]

```
1+00.0000 -100.0000 7423.6634 "" 522795.175326 1832304.894227
1+00.0000 -87.9310 7423.4264 "" 522803.788482 1832296.439980
1+00.0000 -87.0690 7423.4164 "" 522804.403657 1832295.836155
1+00.0000 -82.2450 7423.3100 "" 522807.846350 1832292.456978
1+00.0000 -75.3530 7423.1246 "" 522812.764892 1832287.629182
1+00.0000 -71.5740 7423.2912 "" 522815.461811 1832284.982020
1+00.0000 -70.4880 7423.3324 "" 522816.236845 1832284.221284
```

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```
1+00.0000 -58.1410 7423.2918 "" 522825.048399 1832275.572300
1+00.0000 -53.7670 7423.2574 "" 522828.169946 1832272.508345
1+00.0000 -43.4020 7423.2228 "" 522835.567026 1832265.247737
1+00.0000 -36.3220 7423.2416 "" 522840.619736 1832260.288249
1+00.0000 -27.0220 7423.2238 "" 522847.256769 1832253.773666
1+00.0000 -21.2630 7423.1956 "" 522851.366734 1832249.739528
1+00.0000 -14.7830 7423.7212 "" 522855.991248 1832245.200335
1+00.0000 -12.2070 7423.9108 "" 522857.829635 1832243.395866
1+00.0000 -7.7880 7424.0824 "" 522860.983296 1832240.300388
1+00.0000 9.6300 7424.6592 "" 522873.413817 1832228.099205
1+00.0000 19.8220 7423.5332 "" 522880.687435 1832220.959783
1+00.0000 20.5220 7423.4508 "" 522881.186997 1832220.469438
1+00.0000 21.3970 7423.2666 "" 522881.811449 1832219.856507
1+00.0000 24.8340 7422.4772 "" 522884.264296 1832217.448913
1+00.0000 29.8430 7422.4760 "" 522887.839017 1832213.940145
1+00.0000 44.4310 7422.4566 "" 522898.249882 1832203.721357
1+00.0000 52.9830 7422.3688 "" 522904.353098 1832197.730742
1+00.0000 54.5090 7422.3724 "" 522905.442142 1832196.661791
1+00.0000 56.2010 7422.3870 "" 522906.649654 1832195.476557
1+00.0000 74.0920 7422.5068 "" 522919.417736 1832182.944041
1+00.0000 79.7060 7422.4820 "" 522923.424221 1832179.011474
1+00.0000 94.2560 7422.5384 "" 522933.807967 1832168.819305
1+00.0000 100.0000 7422.6586 "" 522937.907227 1832164.795674
[End Data]
#
[Begin Data]
2+00.0000 -100.0000 7426.8078 "" 522865.224602 1832376.260177
2+00.0000 -96.6440 7426.7280 "" 522867.619643 1832373.909324
2+00.0000 -84.2410 7426.2228 "" 522876.471162 1832365.221112
2+00.0000 -77.4750 7426.1828 "" 522881.299782 1832360.481578
2+00.0000 -67.1720 7426.2666 "" 522888.652616 1832353.264401
2+00.0000 -59.7750 7426.1584 "" 522893.931556 1832348.082856
2+00.0000 -53.0230 7425.8470 "" 522898.750185 1832343.353129
2+00.0000 -44.1150 7425.8804 "" 522905.107463 1832337.113139
2+00.0000 -42.2260 7425.8060 "" 522906.455566 1832335.789908
2+00.0000 -28.8830 7426.1132 "" 522915.977925 1832326.443233
2+00.0000 -27.1470 7426.1434 "" 522917.216838 1832325.227178
2+00.0000 -26.3650 7426.1568 "" 522917.774920 1832324.679393
2+00.0000 -25.3360 7426.2044 "" 522918.509275 1832323.958586
2+00.0000 -17.2410 7426.5198 "" 522924.286349 1832318.288097
2+00.0000 -3.6710 7426.6918 "" 522933.970709 1832308.782410
2+00.0000 4.4350 7426.9608 "" 522939.755632 1832303.104216
2+00.0000 15.4440 7425.8832 "" 522947.612310 1832295.392491
2+00.0000 19.8860 7425.5430 "" 522950.782385 1832292.280902
2+00.0000 28.2350 7425.3728 "" 522956.740729 1832286.432488
2+00.0000 38.5320 7425.2662 "" 522964.089281 1832279.219514
2+00.0000 43.9240 7425.3310 "" 522967.937333 1832275.442457
2+00.0000 53.9400 7425.6894 "" 522975.085346 1832268.426321
2+00.0000 63.4090 7425.8620 "" 522981.842988 1832261.793355
2+00.0000 71.0550 7425.9026 "" 522987.299629 1832256.437388
2+00.0000 81.7130 7426.1842 "" 522994.905812 1832248.971536
2+00.0000 87.5820 7426.2478 "" 522999.094279 1832244.860344
2+00.0000 100.0000 7426.1724 "" 523007.956503 1832236.161625
[End Data]
```

## Coordinate Geometry

### Character Syntax

1. All data item will be comma and white space delimited.
2. Coordinate data excluding elevations will have a minimum of 6 decimal places of accuracy.
3. Elevation information will have a minimum of 4 decimal places of accuracy.
4. Radii and lengths will have a minimum of 4 decimal places of accuracy.
5. Directions will be defined as either north azimuths or bearings. North azimuths will be expressed in degrees, minutes and seconds. Bearings will be expressed as N/S quadrant identifier, degrees, minutes, seconds and E/W quadrant identifier. The seconds will have an accuracy of 2 decimal places.

### General Requirements

A geometry element ID must be defined before it is reused.

### Definitions

Chain - a list of elements.

### Element Types

- Points
- Lines
- Circular Arcs
- Spirals
- Chains (both open and closed)

### Coordinate Geometry File Format

[Type of File] = “coordinate geometry”

[Comments] = “<alpha-numeric value>” {optional}

The following is **point** data syntax:

[Point],<ID>,<X> <Y> <Z>,<FEATURE>,<DESCRIPTION>

Where,

[Point] is the keyword indicating that this is point data,

<ID> is the point’s identification, which is alpha numeric data. Note that this field is enclosed in double quotes.

<X> is the point’s easting coordinate.

<Y> is the point’s northing coordinate.

<Z> is the point’s elevation coordinate.

<FEATURE> is the point’s feature. Note that this field is enclosed in double quotes.

<DESCRIPTION> is the point’s alpha numeric description. Note that this field is enclosed in double quotes.

The following is **line** data syntax:

```
[Line],<ID>,<X> <Y>  
<Z1>,<Z2>,<DIRECTION>,<LENGTH>,<FEATURE>,<DESCRIPTION>
```

Where,

[Line] is the keyword indicating that this is line data,

<ID> is the line's identification, which is alpha numeric data. Note that this field is enclosed in quotes.

<X> is the line's starting easting coordinate,

<Y> is the line's starting northing coordinate,

<Z1> is the line's starting elevation coordinate,

<Z2> is the line's ending elevation coordinate,

<DIRECTION> is the line's tangential direction,

<LENGTH> is the line's horizontal length,

<FEATURE> is the line's feature. Note that this field is enclosed in double quotes.

<DESCRIPTION> is the line's alpha numeric description. Note that this field is enclosed in double quotes.

In addition, a coordinate may be replaced with a previously defined point's identification. As an example <X> <Y> <Z1> may be replaced with <POINT ID1>, where <POINT ID1> is the previously defined point's identification.

The following is **circular arc** data syntax:

```
[Arc],<ID>,<X> <Y>  
<Z1>,<Z2>,<DIRECTION>,<LENGTH>,<RADIUS>,<FEATURE>,<DESCRIPTION>
```

Where,

[Arc] is the keyword indicating that this is circular arc data,

<ID> is the circular arc's identification, which is alpha numeric data. Note that this field is enclosed in quotes.

<X> is the circular arc's starting easting coordinate.

<Y> is the circular arc's starting northing coordinate.

<Z1> is the circular arc's starting elevation coordinate.

<Z2> is the circular arc's ending elevation coordinate,

<DIRECTION> is the circular arc's tangential direction,

<LENGTH> is the circular arc's horizontal length,

<RADIUS> is the circular arc's radius. Note that this is a signed value, where a positive value is clock-wise and a negative value is counter-clockwise.

<FEATURE> is the circular arc's feature. Note that this field is enclosed in double quotes.

<DESCRIPTION> is the circular arc's alpha numeric description. Note that this field is enclosed in double quotes.

In addition, a coordinate may be replaced with a previously defined point's identification. As an example <X> <Y> <Z1> may be replaced with <POINT ID1>, where <POINT ID1> is a previously defined point's identification.



The following is **spiral** data syntax:

```
[Spiral],<ID>,<X> <Y> <Z1>,<Z2>,<DIRECTION>,<LENGTH>,<RADIUS1>,<RADIUS2>,<FEATURE>,<DESCRIPTION>
```

Where,

[Spiral] is the keyword indicating that this is transition spiral data,

<ID> is the spiral's identification, which is alpha numeric data. Note that this field is enclosed in double quotes.

<X> is the spiral's starting easting coordinate.

<Y> is the spiral's starting northing coordinate.

<Z1> is the spiral's starting elevation coordinate.

<Z2> is the spiral's ending elevation coordinate.

<DIRECTION> is the spiral's tangential north azimuth at the start point ( i.e. down station point ),

<LENGTH> is the spiral's horizontal length

<RADIUS1> is the spiral's starting radius. Note that this is a signed value, where positive value is clock-wise and a negative value is counter-clockwise. Also infinity (the radius at the TS or ST ) is defined as zero.

<RADIUS2> is the spiral's ending radius. Note that this is a signed value, where positive value is clock-wise and a negative value is counter-clockwise.

<FEATURE> is the spiral's feature. Note that this field is enclosed in double quotes.

<DESCRIPTION> is the spiral's alpha numeric description. Note that this field is enclosed in double quotes.

In addition, a coordinate may be replaced with a previously defined point's identification. As an example <X> <Y> <Z1> may be replaced with <POINT ID1>, where <POINT ID1> is a previously defined point's identification.

The following is **chain** data syntax:

```
[Chain Name] = "<alpha-numeric value>"
[Chain Feature] = "<alpha-numeric value>"
[Chain Description] = "<alpha-numeric value>"
[Curve Definition] = "arc" or "chord"
[Begin Chain Data]
[Station],<STATION>
[Station],<BACK STATION> = <AHEAD STATION>
[ID] [ID] ...[ID]
```

```
[Line],<X> <Y>
<Z1>,<Z2>,<DIRECTION>,<LENGTH>,<FEATURE>,<DESCRIPTION>
[Arc],<X> <Y>
<Z1>,<Z2>,<DIRECTION>,<LENGTH>,<RADIUS>,<FEATURE>,<DESCRIPTION>
[Spiral],<X> <Y>
<Z1>,<Z2>,<DIRECTION>,<LENGTH>,<RADIUS1>,<RADIUS2>,<FEATURE>,<DESCRIPTION>
```

...

```
[End Chain Data]
```

### Example data using element definitions with coordinates:

```
[EAS-E Version] = "1.0"
[Vendor/Software Version] = "InRoads SelectCAD 7.2"
[File Creation Date] = "Saturday, April 17, 1999"
[Project Name] = "grand"
[Units] = "imperial"
[Coordinate System] = ""
[Scale Factor] = "1.0"
[Datum] = ""
[File] = "\\enigma\data\grand\grand72.eas"
[Comments] = ""
#
[Type of Data] = "coordinate geometry"
[Comments] = ""
#
#
[Line], "LIN1", 523033.660931 1832474.110061 0.0000, 0.0000, N 27 40 12.93 E, 187.3774,
"barriers/fences", ""
[Spiral], "SPI1", 523120.675692 1832640.057993 0.0000, 0.0000, N 27 40 12.93 E, 152.9717,
0.0000, 467.3787, "barriers/fences", ""
[Arc], "CIR1", 523198.899147 1832771.305054 0.0000, 0.0000, N 37 02 47.88 E, 68.0486,
467.3787, "barriers/fences", ""
[Chain Name] = "guard1"
[Chain Description] = "barriers/fences"
[Chain Feature] = "barrier"
[Curve Definition] = "arc"
[Comments] = ""
[Begin Chain Data]
LIN1 SPI1 CIR1
[End Chain Data]
#
#
[Arc], "CIR2", 524724.015800 1832926.197674 0.0000, 0.0000, N 29 58 02.23 E, 309.4807,
1224.2269, "barriers/fences", ""
[Chain Name] = "guard2"
[Chain Description] = "barriers/fences"
[Chain Feature] = "barrier"
```

```

[Curve Definition] = "arc"
[Comments] = ""
[Begin Chain Data]
CIR2
[End Chain Data]
#
#
[Line], "LIN2", 524743.935000 1831794.486000 0.0000, 0.0000, N 28 14 53.27 E, 1380.6624,
"power", ""
[Line], "LIN3", 525397.390000 1833010.720000 0.0000, 0.0000, N 50 31 44.41 E, 1173.2226,
"power", ""
[Line], "LIN4", 526303.055000 1833756.523000 0.0000, -0.0010, N 38 53 34.54 E, 1698.0444,
"power", ""
[Chain Name] = "utility"
[Chain Description] = "power pole"
[Chain Feature] = "power"
[Curve Definition] = "arc"
[Comments] = ""
[Begin Chain Data]
LIN2 LIN3 LIN4
[End Chain Data]
#
#
[Line], "LIN5", 522794.776267 1832193.579684 7417.0000, 7422.7360, N 46 43 21.41 E,
352.7678, "water", ""
[Line], "LIN6", 523051.606533 1832435.412959 7422.7360, 7429.3474, N 29 37 32.99 E,
406.6030, "water", ""
[Line], "LIN7", 523252.604123 1832788.861608 7429.3474, 7434.0855, N 65 04 52.77 E,
291.4022, "water", ""
[Line], "LIN8", 523516.878713 1832911.638498 7434.0855, 7437.7571, S 77 48 17.38 E,
281.8003, "water", ""
[Line], "LIN9", 523792.319847 1832852.110316 7437.7571, 7420.4822, S 48 41 13.98 E,
574.8408, "water", ""
[Line], "LIN10", 524224.092464 1832472.618090 7420.4822, 7412.2071, N 80 40 08.78 E,
275.3624, "water", ""
[Line], "LIN11", 524495.811425 1832517.264232 7412.2071, 7416.2366, N 34 49 13.86 E,
475.8588, "water", ""
[Line], "LIN12", 524767.530386 1832907.917993 7416.2366, 7441.2933, N 40 58 29.94 E,
448.4350, "water", ""
[Line], "LIN13", 525061.582412 1833246.484582 7441.2933, 7466.2241, N 62 09 46.83 E,
446.1833, "water", ""
[Line], "LIN14", 525456.133222 1833454.833271 7466.2241, 7458.8641, S 79 25 22.77 E,
344.5728, "water", ""
[Line], "LIN15", 525794.851379 1833391.584564 7458.8641, 7447.1476, S 39 03 56.46 E,
253.9684, "water", ""
[Line], "LIN16", 525954.905012 1833194.397430 7447.1476, 7432.8354, S 5 30 28.55 E,
310.2349, "water", ""
[Line], "LIN17", 525984.682448 1832885.594922 7432.8354, 7400.7807, S 25 31 56.21 W,
1554.4351, "water", ""
[Line], "LIN18", 525314.690481 1831482.961899 7400.7807, 7384.7055, S 6 02 48.39 E,
318.0129, "water", ""
[Line], "LIN19", 525348.190067 1831166.718361 7384.7055, 7382.5134, S 21 41 00.44 E,
312.2984, "water", ""
[Line], "LIN20", 525463.577593 1830876.518439 7382.5134, 7383.0000, S 38 16 00.79 E,
246.4121, "water", ""
[Chain Name] = "water"
[Chain Description] = "water centerline"
[Chain Feature] = "water"
[Curve Definition] = "arc"
[Comments] = ""
[Begin Chain Data]
LIN5 LIN6 LIN7 LIN8 LIN9 LIN10 LIN11 LIN12 LIN13 LIN14 LIN15 LIN16 LIN17 LIN18 LIN19 LIN20
[End Chain Data]

```

**Example data using element definitions with point identifiers:**

```

[EAS-E Version] = "1.0"
[Vendor/Software Version] = "InRoads SelectCAD 7.2"
[File Creation Date] = "Saturday, April 17, 1999"
[Project Name] = "grand"
[Units] = "imperial"
[Coordinate System] = ""
[Scale Factor] = "1.0"
[Datum] = ""
[File] = "\\enigma\data\grand\grand72.eas"

```

```

[Comments] = ""
#
[Type of Data] = "coordinate geometry"
[Comments] = ""
[Point], "236", 522794.776267 1832193.579684 7417.0000, "utility", "power pole"
[Point], "237", 523051.606533 1832435.412959 7422.7360, "utility", "power pole"
[Point], "238", 523252.604123 1832788.861608 7429.3474, "utility", "power pole"
[Point], "239", 523516.878713 1832911.638498 7434.0855, "utility", "power pole"
[Point], "240", 523792.319847 1832852.110316 7437.7571, "utility", "power pole"
[Point], "241", 524224.092464 1832472.618090 7420.4822, "utility", "power pole"
[Point], "242", 524495.811425 1832517.264232 7412.2071, "utility", "power pole"
[Point], "243", 524767.530386 1832907.917993 7416.2366, "utility", "power pole"
[Point], "244", 525061.582412 1833246.484582 7441.2933, "utility", "power pole"
[Point], "245", 525456.133222 1833454.833271 7466.2241, "utility", "power pole"
[Point], "246", 525794.851379 1833391.584564 7458.8641, "utility", "power pole"
[Point], "247", 525954.905012 1833194.397430 7447.1476, "utility", "power pole"
[Point], "248", 525984.682448 1832885.594922 7432.8354, "utility", "power pole"
[Point], "249", 525314.690481 1831482.961899 7400.7807, "utility", "power pole"
[Point], "250", 525348.190067 1831166.718361 7384.7055, "utility", "power pole"
[Point], "251", 525463.577593 1830876.518439 7382.5134, "utility", "power pole"
[Point], "252", 525616.186854 1830683.051811 7383.0000, "default", ""
[Point], "265", 524743.935000 1831794.486000, "default", ""
[Point], "266", 525397.390000 1833010.720000, "default", ""
[Point], "267", 526303.055000 1833756.523000, "default", ""
[Point], "268", 527369.201000 1835078.146000, "default", ""
#
[Line], "LIN1", "265", 0.0000, N 28 14 53.27 E, 1380.6624, "utility", "power pole"
[Line], "LIN2", "266", 0.0000, N 50 31 44.41 E, 1173.2226, "utility", "power pole"
[Line], "LIN3", "267", 0.0000, N 38 53 34.54 E, 1698.0444, "utility", "power pole"
[Chain Name] = "utility"
[Chain Description] = "utility"
[Chain Feature] = "power pole"
[Curve Definition] = "arc"
[Comments] = ""
[Begin Chain Data]
LIN1 LIN2 LIN3
[End Chain Data]
#
[Line], "LIN4", "236", 7422.7360, N 46 43 21.41 E, 352.7678, "utility", "water"
[Line], "LIN5", "237", 7429.3474, N 29 37 32.99 E, 406.6030, "utility", "water"
[Line], "LIN6", "238", 7434.0855, N 65 04 52.77 E, 291.4022, "utility", "water"
[Line], "LIN7", "239", 7437.7571, S 77 48 17.38 E, 281.8003, "utility", "water"
[Line], "LIN8", "240", 7420.4822, S 48 41 13.98 E, 574.8408, "utility", "water"
[Line], "LIN9", "241", 7412.2071, N 80 40 08.78 E, 275.3624, "utility", "water"
[Line], "LIN10", "242", 7416.2366, N 34 49 13.86 E, 475.8588, "utility", "water"
[Line], "LIN11", "243", 7441.2933, N 40 58 29.94 E, 448.4350, "utility", "water"
[Line], "LIN12", "244", 7466.2241, N 62 09 46.83 E, 446.1833, "utility", "water"
[Line], "LIN13", "245", 7458.8641, S 79 25 22.77 E, 344.5728, "utility", "water"
[Line], "LIN14", "246", 7447.1476, S 39 03 56.46 E, 253.9684, "utility", "water"
[Line], "LIN15", "247", 7432.8354, S 5 30 28.55 E, 310.2349, "utility", "water"
[Line], "LIN16", "248", 7400.7807, S 25 31 56.21 W, 1554.4351, "utility", "water"
[Line], "LIN17", "249", 7384.7055, S 6 02 48.39 E, 318.0129, "utility", "water"
[Line], "LIN18", "250", 7382.5134, S 21 41 00.44 E, 312.2984, "utility", "water"
[Line], "LIN19", "251", 7383.0000, S 38 16 00.79 E, 246.4121, "utility", "water"
[Chain Name] = "water"
[Chain Feature] = "utility"
[Chain Feature] = "water"
[Curve Definition] = "arc"
[Comments] = ""
[Begin Chain Data]
[Station],10+00.0000
LIN4 LIN5 LIN6 LIN7 LIN8 LIN9 LIN10 LIN11 LIN12 LIN13 LIN14 LIN15 LIN16 LIN17 LIN18 LIN19
[End Chain Data]

```

## **Digital Surface Data**

### **Character Syntax**

1. All data items will be comma and white space delimited.
2. Coordinates including elevations have a minimum of 4 decimal places of accuracy.

### **Digital Surface File Format**

[Type of Data] = “digital surface”  
 [Surface Name] = “<alpha-numeric value>”  
 [Type of Surface] = “<alpha-numeric value>”  
 [Comments] = “<alpha-numeric value>” { optional}

[Begin Data]  
 <ID>,<X> <Y> <Z>,<FEATURE>,<DESCRIPTION>  
 ...  
 [End Data]

Where,

- <ID> is the point’s identifier.
- <X> is the point’s easting coordinate.
- <Y> is the point’s northing coordinate.
- <Z> is the points elevation coordinate.
- <FEATURE> is the point’s feature. Note that this field is enclosed in double quotes.
- <DESCRIPTION> is the point’s description. Note that this field is enclosed in double quotes.

[Begin Triangle Data]  
 <ID1>,<ID2>,<ID3>  
 <ID1>,<ID2>,<ID3>,<TRIANGLES FEATURE>  
 <ID1>,<ID2>,<ID3>,<TRIANGLES  
 FEATURE>,<FEATURE12>,<FEATURE23>,<FEATURE31>  
 ...  
 [End Triangle Data]

Note:

1. Vertices are defined in a counter-clockwise direction.

[Linear Data Name] = “<alpha-numeric value>”  
 [Linear Data Type] = “exterior”, “interior”, “break”, “obscures” or “contour”  
 [Linear Data Feature] = “<alpha-numeric value>”  
 [Linear Data Description] = “<alpha-numeric value>”  
 [Begin Linear Data]  
 <ID>,<ID>, ..., <ID>  
 ...  
 [End Linear Data]

Where,

<ID> is the point's identification and in quotes

**Example data:**

```
[EAS-E Version] = "1.0"
[Vendor/Software Version] = "InRoads SelectCAD NR 7.2"
[File Creation Date] = "Saturday, April 17, 1999"
[Project Name] = "grand"
[Units] = "imperial"
[Coordinate System] = ""
[Scale Factor] = "1.0"
[Datum] = ""
[File] = "\\enigma\data\grand\grand72.eas"
[Comments] = ""
#
[Type of Data] = "digital surface"
[Surface Name] = "random"
[Type of Surface] = "random points"
[Comments] = ""
#
[Begin Data]
1, 524347.926267 1832378.688925 1089.7031, "", ""
2, 524500.000000 1832500.000000 1000.0000, "", ""
3, 524354.731895 1832330.469680 1058.5070, "", ""
4, 523785.836360 1832008.621479 1083.7092, "", ""
5, 524089.281899 1832058.488723 1024.0944, "", ""
6, 523904.065065 1831741.279336 1014.1606, "", ""
7, 523767.769402 1831747.718741 1083.7123, "", ""
8, 523609.012116 1831874.584185 1026.5328, "", ""
9, 524315.759758 1832123.889889 1055.8397, "", ""
10, 523500.000000 1832500.000000 1000.0000, "", ""
11, 523527.405622 1832483.397931 1052.4735, "", ""
12, 523641.697439 1832440.214240 1050.6821, "", ""
13, 524144.642476 1831991.317484 1035.5632, "", ""
14, 523928.113651 1831579.195532 1042.6069, "", ""
15, 523758.186590 1832014.908292 1024.1676, "", ""
16, 524251.640370 1831607.425153 1001.3520, "", ""
17, 523600.589007 1831555.848872 1075.7530, "", ""
18, 524500.000000 1831500.000000 1000.0000, "", ""
19, 524483.703116 1832181.112094 1024.5064, "", ""
20, 523500.000000 1831500.000000 1000.0000, "", ""
[End Data]
#
[Begin Triangle Data]
1, 2, 3, "", "", "", ""
4, 5, 6, "", "", "", ""
7, 8, 4, "", "", "", ""
9, 5, 3, "", "", "", ""
10, 11, 8, "", "", "", ""
11, 12, 8, "", "", "", ""
5, 4, 12, "", "", "", ""
5, 9, 13, "", "", "", ""
1, 3, 5, "", "", "", ""
6, 14, 7, "", "", "", ""
15, 4, 8, "", "", "", ""
16, 14, 6, "", "", "", ""
4, 15, 12, "", "", "", ""
17, 8, 7, "", "", "", ""
16, 6, 13, "", "", "", ""
18, 16, 9, "", "", "", ""
9, 19, 18, "", "", "", ""
13, 9, 16, "", "", "", ""
5, 13, 6, "", "", "", ""
6, 7, 4, "", "", "", ""
17, 7, 14, "", "", "", ""
1, 5, 12, "", "", "", ""
2, 1, 12, "", "", "", ""
15, 8, 12, "", "", "", ""
20, 8, 17, "", "", "", ""
19, 3, 2, "", "", "", ""
```

9, 3, 19, "", "", "", ""  
 [End Triangle Data]

## ***Data conventions and limitations:***

**Coordinates** including **elevations**: Northing, easting and elevation coordinates are numeric values.

**Lengths**: A numeric value.

**Offsets**: A signed numeric value.

**Radii**: A signed numeric value. Note that this is a signed value, where a positive value is clock-wise and a negative value is counter-clockwise.

**Stationing**: A string value which may have an embedded plus sign. Acceptable formats are as follows are:

“1000.0000”

“10+00.0000”

“1+000.0000”

Stationing should only consist of numeric values, plus sign, decimal points. Negative station is also allowed, but the negative sign must be the first character after the opening quote.

In order to handle station equations, all stations after the first equation will include a numeric enclosed in an open and closing parenthesis.

So if a station occurs before the first station the station identifier is would be (0), but should be omitted.

If a station occurs after the first equation and before the second equation then it would have a station identifier of (1) and is required.

If a station occurs after the second equation and before the third equation then it would have a station identifier of (2) and is required.

This convention is applied for each successive station equation.

As an example say an alignment has the following station equations:

$$12+00.0000 = 13+00.0000$$

$$15+00.0000 = 14+00.0000$$

The following set of stations starting at 10+00 and incrementing by 50 feet.

10+00

10+50

11+00

11+50

13+00(1), which could also be defined as 12+00

13+50(1)

14+00(1)

14+50(1)

14+00(2), which could also be defined as 15+00(1)

14+50(2)

15+00(2)

**Features:** A quoted string value.

**Descriptions:** A quoted string value, which may contain any alpha-numeric characters including spaces.

**Identifiers:** A string value, which may contain alpha-numeric or special characters.