AASHTO SDMS Technical Data Guide 2000
for Transportation Engineering Data Exchange and Archive

American Association of State Highway and Transportation Officials
444 North Capitol Street N.W., Suite 249
Washington, D.C. 20001

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Section I - Scope

Overview

This document is provided primarily to assist those who wish to develop data collectors, data interfaces, post processors, or other products compatible with the Survey Data Management System (SDMS) data structure. It provides technical specifications for the data structure and some details on the specific implementation of that structure in SDMS Collector and SDMS Processor.

The SDMS data structure can also be used to develop transportation engineering data exchange and archive specifications. Those wishing to incorporate the data structure into products or systems need not be concerned with how the data is collected, how raw data is reduced, or what post-processing is performed. It is only critical that the users know and follow the rules for structuring an SDMS data file.

The user is not required to implement all functions of the SDMS data structure, but any functions that are implemented must follow the defined SDMS data structure. The user may implement expanded functions, such as alternative traverse adjustments, alternative set reductions, improved error trapping functions, etc. However, in doing so, the user must assure no undefined data tags are used and the data structure follows SDMS rules.

The goal of this document is to provide the requisite technical information to assure data is structured according to SDMS rules.

Section II - Definitions and Conventions

Overview

This section provides definitions for the terms and conventions used in defining the SDMS data structure.

Tasks

Task is the term for the type of survey data contained in a project file. The main purpose of the various tasks is to restrict each task to specific predefined activities, data items, and sequence prompts. This is beneficial for data collection so the field user does not incorporate inappropriate data in the particular project being performed. It also simplifies data collection in that the field user does not have to remember what restrictions exist for the assigned task.

The task is identified in the project file by the TK:XXX data item. Under the current data structure each project file may contain only one task and therefore only one TK:XXX data item. The TK: data item and the valid response must be in upper case.

Some examples of the task data items include:

```
TK:TRA                  (traverse)
TK:3WR                  (three wire level)
TK:RTO                  (radial topography)
TK:XSE                  (cross-section)
```

Activities

Activity is the term for a shot or other surveying activity that is entered into the project file. Each task has certain required, optional, and prohibited activities.

Activities are the basic building blocks of each SDMS survey task. Each activity must be defined within the context of the task in which it is used. It is, therefore, necessary to document activities by task. An activity can signal:

- the start or re-start of a project
- a shot, such as a sideshot, occupied station, or backsight
- a field check, such as control check or elevation control activities
- other control functions

An activity is identified in the project file by the AC: data tag and a two-character abbreviation. Activity data items must be entered exactly as shown and must be in upper case. Activity abbreviations, like data tags, are case-sensitive. That is, ac:SS or AC:ss will not substitute for AC:SS.

Some examples of activity data items are:

```
AC:PR                  (project header)
AC:OS                  (occupied station)
```

A project file may contain an unspecified number of activities, limited only by the user's hardware and software configuration. Certain non-required activities are optional for each task. Optional activities are noted when they apply and their general use and limitations are discussed.

Shots

This document frequently refers to shots. For the purposes of this documentation, a shot is defined as an activity containing measurements and descriptive information for an object surveyed in the field. Shots usually include point number, point descriptors, and measurement data such as horizontal angles, vertical angles (zenith angle), slope distances, offsets, rod readings, instrument heights, staff heights, etc. Coordinates are typically computed for all shots. An occupied station is considered to be a shot.

Data Tags, Data Fields and Data Items

Each activity has a pre-defined set of data tags. Data tag is the term for the two-character tag and colon that uniquely identifies each piece of information in the project file, like this:

```
PD:                    point description data tag
HZ:                    horizontal angle data tag
```

Data tags are case-sensitive and must be used exactly as shown. The data values must contain only uppercase characters. This restriction must be adhered to strictly. That is, pd:Wall will not substitute for PD:WALL. The data field or value immediately follows the data tag, like this:

```
PD:ROCK                value ROCK
DS:14.5                value 14.5
```

A data tag, together with a data field or value, is called a data item. The data item is the lowest common denominator of the SDMS data structure. The following are examples of data items:

```
AC:FS                  activity foresight
PN:12                  point number, value 12
PD:NAIL                point description, value nail
```

Conventions Used in This Document

Information that represents a data item or a sample file entry is set in bold type like this:

```
PN:14
TK:COM
```

Variable items are set in bold italicized type, like this:

```
filename, where filename represents any filename
TK:XXX, where XXX represents any set of three uppercase letters
HZ:nnn.nnnn, where nnn.nnnn represents a variable number
```

Section III - Task and Activity Definitions

Overview

This section provides a detailed description of the currently defined surveying tasks using common survey terminology.

Task Specifications

The definition for each task is the default or standard technical interpretation of that task. Any limitations on activities or data items are noted.

Reserved tasks are listed by their names, but no definition will be provided in this portion of the guide at this time. The basic definition for reserved tasks can be found in the Appendix.

SDMS classifies tasks as horizontal, vertical, or computational.

Horizontal Tasks

Combined

Control Network

Global Positioning System (GPS) Vectors

Line/Offset Topography*

Photo Control

Radial Topography

Terrain Model

Traverse

Tunneling*

Note: Most horizontal tasks include trigonometric leveling functions.

Vertical Tasks (Differential Leveling)

Level Run

Three-Wire

Cross-Section

Profiling

Computational Tasks

Compute Template*

Compute Horizontal Alignment*

Compute Vertical Alignment*

Note: * These tasks are reserved and may be defined in future releases of this document.

Technical and Functional Specifications, by Task

Each SDMS task has both a technical and a functional specification. At times the technical specification cannot fully describe the functional purpose of the task.

Only specific activities are required in each project file to meet the technical requirements of an SDMS task. However, there are usually activities that are technically optional but must be included to meet the functional requirement.

For example, a radial topography file containing a project data item, a task data item, an occupied station activity and a backsight activity is technically correct. However, unless one or more sideshots are included; the file will not meet the functional purpose of the radial topography task.

The basic rules for building project files, found in Section III, Data File Specifications, apply to each task.

Activities

Activities are the basic building blocks of any SDMS survey task. Each activity must be defined within the context of a specific task and therefore it is necessary to document activities by task. The technical and functional specifications will define rules for when certain activities can be used and what their effects will be. An activity can signal:

- the start or re-start of a project
- a shot, such as a sideshot, occupied station, or backsight
- a field check, such as control check or elevation control activities
- other control functions

Reserved activities are not discussed in this portion of the guide, but their basic definition can be found in the Appendix.

Data Items in an Activity

To meet the functional definition, certain data items are required in certain activities. These will be listed with notes as to the reason for inclusion. In most cases the order of the data items within the activity is not important. If exceptions to this rule exist, they are noted.

Since having certain data items in an activity influences the function of the activity, these definitions include data item functions as well.

Certain data items may be prohibited in certain activities and under special circumstances. These limitations are noted where applicable. Except for data items explicitly excluded or included, any data item may be used in any activity. Optional data items are not documented in detail.

Descriptive data items may be added at any point in a project file without affecting computations. While sometimes listed as part of the functional definition of an activity, these data items are not explained in detail in this section. For more information on data items please see Section VII, Data Tag Definitions.

The Project Header Activity

The project header activity is defined for all tasks. It is not a shot. It is used to enter descriptive data about the project and initializes certain computational constants. It should be entered before the data to which it applies and immediately after the task data item at the beginning of the file. The project header activity contains the information about a project one would normally write at the beginning of a field book.

The project header activity can also be used to document changes midway through a project file that may occur from one day to the next during data collection. This includes data items such as the date, weather, instrument type, etc. The computational parameters, as defined in the beginning AC:PR, are used throughout the project file.

Note: SDMS allows multiple project header activities (AC:PR) in a single project file. This can occur since the project file may be the result of more than one day of work or that individual file segments have been appended into a single file for final processing. The resulting calculated file should record all the project header activities as they occur in the project file. Be sure to remember, there can be only one Task (TK:) per file. Therefore, all appended files must be of the same type.

Any number or combination of data items may be used in the project header. The following represents the most commonly used project header data items:

Data Tag	Description of Data Tag
BP:	Barometric Pressure
CF:	Combination Factor
CR:	Curvature and Refraction
DT:	Date
ID:	Project Identifier
IT:	Instrument Type

Data Tag	Description of Data Tag
L1:	Location of First Control File
L2:	Location of Second Control File
NM:	Name
OB:	Observer
RE:	Recorder
RT:	Rod Type
S1:	First Staking File
S2:	Second Staking File
SN:	Instrument Serial Number
TE:	Temperature
TM:	Time
UA:	Units of Angles
UL:	Units of Length
UP:	Units of Pressure
UT:	Units of Temperature
WE:	Weather
VR:	Software Version Number

General Conventions Used in All Tasks and Activities

1. There may be an unlimited number of data items in any given activity.

2. The AC:XX data item must be the first data item entered for each activity. Except where otherwise noted, all other data items may be entered in any order within the activity.

3. Certain data items behave as constants in a project file. That is, once entered, they hold their value and are assumed to apply to the shot in which they are entered and to all subsequent shots until a new constant value is entered.

   In SDMS Collector, some of the data items are set in the project configuration files such as the control configuration file, project configuration file, and the system configuration file. Data items pertinent to the project will automatically be displayed in the project header. Other data item constants are recorded with shot activities. The values recorded with the particular data item will be held until that data item, with a different value for the data item is encountered in the project file. These data items are:

   AC:PR

Data Tag	Description of Data Tag
CE:	Collimation Error
CF:	Combination Factor
CR:	Curvature and Refraction
PC:	Prism Correction
PO:	Prism Offset
RT:	Rod Type

Data Tag	Description of Data Tag
VE:	Vertical Index Error
W3:	Three-Wire Leveling Stadia Constant

AC:XX (any shot activity)

Data Tag	Description of Data Tag
IH:	Instrument Height
SH:	Staff Height
SI:BL	Shot ID - Begin LOC Shot
SI:EL	Shot ID - End LOC Shot
SI:RTO	Shot ID - Radial Topography
SI:XSE	Shot ID - Cross-Section
ST:	Stationing

4. When an activity contains multiple data items with the same data tag, only the last-entered data item is used in processing, for example:

```
AC:SS                      (Sideshot Activity)
PN:4                       (This point number is disregarded)
PN:5                       (This point number is used)
PD:NAIL                    (Point Description)
HZ:89.0034         (Horizontal Angle)
```

5. All horizontal angles are assumed to be angles measured to the right (clockwise).

6. All vertical angles are assumed to be measured from the zenith (90° = horizontal).

Units of Measurement

1. Certain data items contain angular data. When the units of angle measurement is degrees (UA:D), the values are expressed in ddd.mmss (degree, minute and second) format. The affected data tags are:

Data Tag	Description of Data Tag
AZ:	Azimuth
CE:	Collimation Error
DC:	Degree of Curvature
EH:	Horizontal Error
EV:	Vertical Error
HZ:	Horizontal Angle
VE:	Vertical Index Error
VT:	Vertical Angle

2. Certain data items contain length or distance data. When the unit of length measurement is feet (UL:F), the values are expressed in feet and in decimals of feet. When the unit of length measurement is meters (UL:M, M2, or M3), the values are expressed in meters and in decimals of meters. The affected data tags are:

Data Tag	Description of Data Tag
C1: through C6:	Vector Variance Covariance Elements
DS:	Slope Distance
IH:	Instrument Height
ED:	Distance Error
LO:	Length Offset
OF:	Offset
PO:	Prism Offset
PC:	Prism Correction
R1: *	Top Wire Rod Reading
R2: *	Middle Wire Rod Reading
R3: *	Bottom Wire Rod Reading
RA:	Radius
RO:	Right Angle Offset
RR: *	Rod Reading
SH:	Staff Height
ST: **	Stationing
VX:	Vector X Component
VY:	Vector Y Component
VZ:	Vector Z Component
XC:	Easting or Known X Coordinate
YC:	Northing or Known Y Coordinate
ZC:	Elevation or Known Z coordinate

Note: * These data items are also affected by the rod type (RT:) data tag.

Note: ** Values for this data item may be entered either in decimal format (ST:nnnn) , or in stationing format, with a plus sign (+) between the tens and hundreds digits (ST:nn+nn) for hundred feet stationing (UL:F); between the kilometers and meter digits (ST:m+mmm) for kilometer stationing (UL:M or M3); or, between the “hundred meter” and the “tens” meter digits (ST:mm+mm) for hundred meter stationing (UL:M2).

3. Certain data items represent a ratio or dimensionless (unit-less) number, and thus do not have an associated unit of measurement. Some of the affected data tags are:

Data Tag	Description of Data Tag
CF:	Combination Factor
PM:	PPM Factor
W3:	Three-Wire Stadia Constant

Horizontal Tasks - The Combined Task

The combined task (TK:COM) is a comprehensive horizontal task that allows control traversing, trigonometric leveling and simultaneous collection of sideshots, as well as all other common SDMS horizontal project activities.

All other SDMS horizontal tasks are variations of the combined task and will be presented and discussed in relation to the combined task definition. These variances will be explained on a task-by-task basis following the definition of the combined task.

Task Definition by Set-Up

The combined task is comprised of set-ups. A set-up consists of the occupied point, a reference backsight or station resection, and a foresight. Optionally, the set-up may contain any number of other horizontal task activities.

There are three types of set-ups: beginning, intermediate and ending. Each type of set-up has different activity and data item requirements.

The activities defined for the combined task are discussed below. The discussion is organized by set-up type as listed above. Significant data items are explained as they apply to the activity when used within the specified set-up type. All activities that may be used similarly within any set-up are discussed in detail only in the beginning station set-up. These common activities will be listed for reference in the other two set-up types.

The Beginning Set-Up

Required Activities	Optional Activities
Occupied Station	Sideshot
Backsight	Elevation Control
Station Resection (if no backsight)	Utility Elevation
Foresight*	Control Check
	Sideshot Intersect
	Tie Sequence
	Project Header
	Chain Connectivity
	Taping
	Figure
	Text
	Check

Note: * Required for closure computations. Otherwise it is optional

Occupied Station Activity

The beginning occupied station is a required activity. It is used with a backsight activity or station resection activity to establish occupied station location and backsight orientation. All subsequent shots taken from the station will be calculated using these values.

The first AC:OS data item in the file signals the beginning of computational data. All survey shots preceding this data item are ignored during computations.

The beginning occupied station activity usually contains eight data items. An AC:OS data item is always the first entry of an occupied station activity, but the other items may be entered in any order.

Data Tag	Description of Data Tag
AC:OS	Occupied Station
PN:	Point Number
PD:	Point Description
IH:	Instrument Height
SH:	Staff Height (optionally placed in backsight activity)
YC:	Northing Coordinate
XC:	Easting Coordinate
ZC:	Elevation/Z Coordinate

Instrument Height and Staff Height Data Items

The IH: and SH: entries initialize the instrument and staff height values for the project. It is not necessary to re-enter these values on subsequent shots unless they change. These data items are optional if the survey will not require accurate elevations.

If the SH: data item is not entered in the first occupied station activity, the first occurrence of SH: in a subsequent activity will define the default value until it is changed. The SH: value for any shots previous to this first occurrence will be assumed equal to 0.

Coordinate Data Items

The Northing, Easting and Elevation coordinate values of the beginning occupied station are needed for computations. If not entered, SDMS assumes the default values of YC:0, XC:0 and ZC:0.

The YC:, XC:, and ZC: data items can contain either known or assumed coordinates. Assumed coordinates (such as YC:1000, XC:1000, ZC:100) should not harm the raw data file. If edited to reflect actual values, the correct coordinates should result when re-computing the raw file.

If the coordinates are unknown and assumed values are not desired, omit these tags from the initial occupied station activity. Complete the available information for the station, then solve the station coordinates with two or three point station resection activities (described later in this section). Station resection may be used to establish both horizontal (X & Y) and vertical (Z) station location.

If the ZC: is the only unknown coordinate, enter the XC: and YC: values as usual, but omit the ZC: data tag from the activity (do not enter ZC:0, as it will be used as an actual elevation). Continue collecting data until a point of known elevation can be observed from the occupied station. If this point is not the backsight, shoot this point with an elevation control activity to update the missing elevations back to the beginning occupied station. Elevations will be computed from the first ZC: data item encountered in the file, if it is entered in an occupied station, the first backsight, the last foresight, or in the first elevation control activity in any given occupied station.

Backsight Activity

The beginning backsight activity is used with the beginning occupied station activity to establish initial station orientation (the back azimuth - see note below) and the initial reference angle. All subsequent shots taken from the occupied station will be calculated using these values.

Note: The backsight azimuth is referred to as the "back azimuth", with the value oriented from North, for the remainder of this document.

The backsight activity is a required activity unless station location is to be calculated by station resection.

If more than one backsight is encountered in a given occupied station, the reference angle is updated, but the back azimuth is not changed. Backsighting in sets is an exception. See *Special Survey Procedures Applying to All Combined Task Setups, Sets* in this Section.

If the backsight information is not available, two or three point station resection activities may be substituted. The first AC:SR will be used for the backsight.

Note: If both the backsight activity and the station resection activity are present with a particular occupied station activity in the project file, the backsight data will be used for orientation and the resection data will be used for occupied station location.

The beginning backsight activity usually contains nine data items. The AC:BS data item is always the first entry of a backsight activity, but the other items may be entered in any order.

Data Tag	Description of Data Tag
AC:BS	Backsight Activity
PN:	Point Number
PD:	Point Description
YC:	Northing Coordinate
XC:	Easting Coordinate
SH:	Staff Height
HZ:	Horizontal Angle
VT:	Vertical Angle
DS:	Slope Distance
Optionally	
AZ:	Azimuth, only if replacing both YC: and XC:
ZC:	

Northing and Easting Coordinates or Azimuth Data Items

The XC: and YC: data items are used to compute the back azimuth to orient the survey. The data items can contain either known or assumed coordinates. Assumed coordinates (such as YC:1000, XC:1000) will not harm the raw data file and can be edited to reflect actual values when the file is recomputed.

If the coordinates are not known and you do not want to use assumed values, you may enter a North azimuth instead.

If an azimuth and the Northing and Easting coordinates are entered in the backsight, the azimuth takes precedence over the coordinates.

Horizontal, Vertical and Distance Data Items

The HZ:, VT: and DS: data items use numeric values to represent the horizontal angle, vertical (zenith) angle, and slope distance measurements from the occupied station to the backsight point.

If the backsight target height (SH:) was not entered, or is different from that entered, with the occupied station activity, enter the correct value in the backsight.

Station Resection Activity

The station resection activity (sometimes called "free-stationing") is an optional activity and is used exclusively with the beginning occupied station. It is used to compute occupied station coordinates if you are unable to set up on a known station and need to solve unknown station coordinates. After the occupied station activity is entered, two or three known points are shot using the station resection activity.

If angles and distances are available on the known points, only two resection points need to be used, but as many as desired can be shot.

The default station resection activity is made up of ten data items. The AC:SR data item is always the first entry of a station resection activity, but the other items may be entered in any order.

Data Tag	Description of Data Tag
AC:SR	Station Resection Activity
PN:	Point Number
PD:	Point Description
SH:	Staff Height
HZ:	Horizontal Angle
VT:	Vertical Angle
DS:	Slope Distance
YC:	Northing Coordinate
XC:	Easting Coordinate
ZC:	Elevation/Z Coordinate

If no backsight is taken, the next to last point shot that was used for station resection (AC:SR) will be used as the backsight for subsequent data collection from the current occupied station.

Horizontal, Vertical and Distance Data Items

The HZ:, VT: and DS: data items use numeric values to represent the horizontal angle, vertical (zenith) angle, and slope distance measurements from the occupied station to the station resection point.

Coordinate Data Items

The XC:, YC:, and ZC: data items contain the known coordinates of the station resection point. XC: and YC: are required; ZC: is optional.

Foresight Activity

The foresight activity records the horizontal angle, vertical (zenith) angle and slope distance measurements from the occupied station to the foresight point.

SDMS Collector: Only one foresight per occupied station is allowed. Computations in SDMS Collector follow the rule "The last foresight point from an occupied station is always the next occupied station point, regardless of point number." Foresighting in sets is an exception. See *Special Survey Procedures Applying to All Combined Task Setups, Sets* in this Section.

SDMS Processor: The restrictions for batch computations in SDMS Collector do not apply. Therefore, any number of foresights can be taken if the project file will be processed with SDMS Processor.

The foresight activity is made up of seven data items. The AC:FS data item is always the first entry of a foresight activity, but the other items may be entered in any order.

Data Tag	Description of Data Tag
AC:FS	Foresight Activity
PN:	Point Number
PD:	Point Description
SH:	Staff Height
HZ:	Horizontal Angle
VT:	Vertical Angle
DS:	Slope Distance

Horizontal, Vertical and Distances Data Items

The HZ:, VT:, and DS: data items use numeric values to represent the horizontal circle angle, vertical (zenith) angle, and slope distance measurements from the occupied station to the foresight point.

Optional Combined Task Activities - The Beginning Set-Up

Sideshot Activity

The sideshot activity records the horizontal angle, vertical (zenith) angle and slope distance measurements from the occupied station to any point visible from that station.

Any number of sideshots may be taken from any occupied station. Limits are only determined by the hardware and software configuration.

The default sideshot activity is made up of seven data items. The AC:SS data item is always the first entry of a sideshot activity, but the other items may be entered in any order.

Data Tag	Description of Data Tag
AC:SS	Sideshot Activity
PN:	Point Number
PD:	Point Description
SH:	Staff Height
HZ:	Horizontal Angle
VT:	Vertical Angle
DS:	Slope Distance

Horizontal, Vertical and Distance Data Items

The HZ:, VT:, and DS: data items use numeric values to represent the horizontal angle, vertical (zenith) angle, and slope distance measurements from the occupied station to the sideshot point.

Elevation Control Activity

The elevation control activity records the elevation and the angle and distance measurements to a point of known elevation, such as a benchmark. It is used to establish elevations on all activities back to the occupied station when the elevation of the station is unknown.

There may be multiple elevation control activities per occupied station. If a valid ZC: data item has not previously been encountered, the first elevation control activity from the beginning occupied station will be treated as an elevation control. This means that the elevation will be established and all shots will have their elevations determined from the elevation control.

If a valid ZC: data item has already been encountered, or if this is the second elevation control shot from this occupied station, the elevation control activity will be treated as control check activity. This means that previous elevations are unchanged and the error between the entered elevation and the computed elevation will be reported.

The default elevation control activity is made up of eight data items. The AC:EC data item is always the first entry of an elevation control activity, but the other items may be entered in any order.

Data Tag	Description of Data Tag
AC:EC	Elevation Control Activity
PN:	Point Number
PD:	Point Description
SH:	Staff Height
ZC:	Elevation/Z Coordinate
HZ:	Horizontal Angle
VT:	Vertical Angle

Data Tag	Description of Data Tag
DS:	Slope Distance

Elevation/Z Coordinate Data Item

The ZC: coordinate data item contains the known elevation of a benchmark.

Horizontal, Vertical, and Distance Data Items

The HZ:, VT:, and DS: data items use numeric values to represent the horizontal angle, vertical (zenith) angle, and slope distance measurements from the occupied station to the elevation control point.

Control Check Activity

The control check activity is actually a shot to a point with known coordinates. It is used to check the accuracy of the survey by checking into a known point. This procedure can be used to verify that a set-up has not been disturbed. The control check will be recorded and reported in the results of the survey.

Any number of control check activities may be entered for any occupied station. The number is limited only by the user's hardware and software configuration.

The default control check activity is made up of ten data items. The AC:CC data item is always the first entry of a control check activity, but the other items may be entered in any order.

Data Tag	Description of Data Tag
AC:CC	Control Check Activity
PN:	Point Number
PD:	Point Description
SH:	Staff Height
YC:	Northing Coordinate
XC:	Easting Coordinate
ZC:	Elevation/Z Coordinate
HZ:	Horizontal Angle
VT:	Vertical Angle
DS:	Slope Distance

Coordinate Data Items

The XC:, YC: and ZC: data items contain known coordinate values.

Horizontal, Vertical and Distance Data Items

The HZ:, VT:, and DS: data items use numeric values to represent the horizontal angle, vertical (zenith) angle and slope distance measurements from the occupied station to the control check point.

The results of the Check Activity will be reported in the calculated file as follows:

Data Tag	Description of Data Tag
AC:CC	Control Check Activity
PN:	Point Number

Data Tag	Description of Data Tag
PD:	Point Description
SH:	Staff Height
YC:	Northing Coordinate
XC:	Easting Coordinate
ZC:	Elevation/Z Coordinate
HZ:	Horizontal Angle
VT:	Vertical Angle
DS:	Slope Distance
YY:	Computed Northing Coordinate
XX:	Computed Easting Coordinate
ZZ:	Computed Elevation
DY:	Algebraic difference of the known and computed Northing
DX:	Algebraic difference of the known and computed Easting
DZ:	Algebraic difference of the known and computed Elevation

Sideshot Intersect Activity

The sideshot intersect activity is used to locate a point upon which you cannot place the prism (sometimes called a "remote point").

The remote point is shot from two or more stations with the sideshot intersect activity (AC:SI). Only the horizontal angle, and optionally the vertical angle, is recorded.

Note: The same point number must be used each time the point is shot.

The point must be shot from at least two stations, but three or more sightings will provide more redundancy and may yield better results. The number of sideshot intersect activities in a project file is limited only by the user's hardware and software configuration.

The default sideshot intersect activity is made up of four data items. The AC:SI data item is always the first entry of a sideshot intersect activity, but the other items may be entered in any order.

Data Tag	Description of Data Tag
AC:SI	Sideshot Intersect Activity
PN:	Point Number
PD:	Point Description
HZ:	Horizontal Angle
Optionally	
VT:	Vertical Angle if elevations on the remote point are desired

Horizontal Angle Data Item

The HZ: data item represents the horizontal angle measurement from the occupied station to the sideshot intersect point.

Vertical Angle Data Item (Optional)

The VT: data item represents the vertical (zenith) angle measurement from the occupied station to the sideshot intersect point. If used, it must be measured to each sideshot intersect point from at least two occupied stations.

Utility Elevation Activity

The utility elevation activity is used to determine the elevation of an object using a combination of measurement data with the instrument and rod or tape readings to that object. The object may be above or below the level of the sideshot.

A sideshot (the "leading sideshot") is taken to the ground point directly above or below the utility, as shown in Figure 3.1, and then the utility elevation activity records the rod reading of a rod dropped or raised to the utility itself. A positive rod reading indicates a below-level utility; a negative reading indicates an above-level utility.

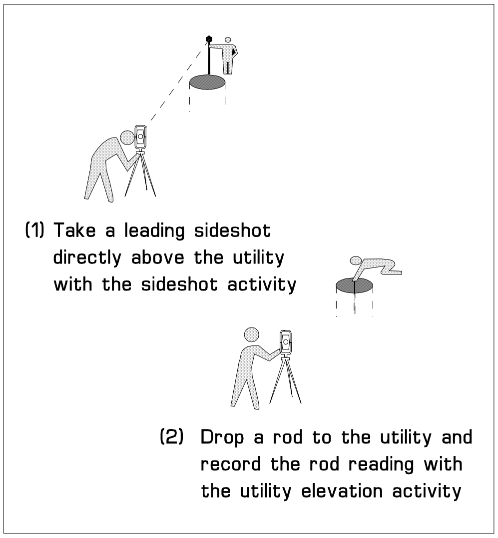


Figure 3.1 Utility Elevation

Using the AC:SS sideshot measurements and the AC:UE rod reading measurement, the results represent the actual coordinates of the utility. The Northing and Easting coordinates of the utility will be those of the leading sideshot, but the elevation coordinate is adjusted using the rod reading.

Any number of utility elevation activities may be entered for any occupied station. The number is limited only by the user's hardware and software configuration. All utility elevations must be entered after a leading sideshot and before any other activities. Multiple utility elevation activities can be "stacked" up using the same leading sideshot activity.

Note: If there is a point number (PN:) and a figure code (FG:), as well as any other attribute tags, with the utility elevation activity (AC:UE), that information should be used as the attribute data for the point computed for that activity. If there is no PN: with the AC:UE, but there is an FG:, the processing software should assign a PN: value and use any attribute information that may be recorded with the utility elevation activity. If there is no PN: or FG: with the AC:UE, the processing software should assign a PN: value and assign the same FG: that is designated with the AC:SS "leading sideshot."

The default utility elevation activity is made up of four data items. The AC:UE data item is always the first entry of a utility elevation activity, but the other items may be entered in any order.

Data Tag	Description of Data Tag
AC:UE	Utility Elevation Activity
PN:	Point Number
PD:	Point Description
RR:	Rod Reading

Rod Reading Data Item

The RR: data item uses a numeric value to represent the depth of the invert or the underground utility. Depths are entered as positive values. Heights above ground are entered as negative values. Also see *Special Survey Procedures Applying to All Combined Task Setups, Remote Elevations* in this Section.

Tie Sequence Activity

When running a control survey, the tie sequence activity can be used when there is a possibility that an existing occupied point (the "original point") may be removed or otherwise not available for future surveys. It can be used instead of the standard sideshot activity if the user desires that a post processing software or CADD use the data in a different manner or precision.

Tie sequence shots are taken collecting the horizontal angle right (HZ:), vertical (zenith) angle (VT:) and the slope distance (DS:) to two or more tie points from the original occupied point just as done using the sideshot activity.

The calculated azimuths and distances of the tie points can be used to relocate the original occupied point in the future, if necessary. Three to four tie sequence shots should yield the strongest results, but only two are required.

Any number of tie sequence activities may be entered for any occupied station. The number of tie sequence activities in a project file is limited only by the user's hardware and software configuration.

The default tie sequence activity is made up of seven data items. The AC:TS data item is always the first entry of a tie sequence activity, but the other items may be entered in any order.

Data Tag	Description of Data Tag
AC:TS	Tie Sequence Activity
PN:	Point Number
HZ:	Horizontal Angle Right
VT:	Vertical Angle
DS:	Slope Distance
FE:	Feature Code
PD:	Point Description

Horizontal, Vertical and Distance Data Items

The HZ:, VT:, and DS: data items use numeric values to represent the horizontal angle, vertical (zenith) angle, and slope distance measurements from the occupied station to the tie sequence point.

Chain Connectivity Activity

The chain connectivity activity is used to record data to generate a survey chain manually. The points that make up that chain should normally appear in the same project file in which the chain activity appears. Shot order is not critical when using the activity in this manner.

Note: The current version of SDMS Collector passes this as information only. The current version of SDMS Processor uses this information to generate the chain list at the end of a calculated project file.

The default chain connectivity activity is made up of six items. The AC:CH data item is always the first entry of a chain activity, but the other items may be entered in any order.

Data Tag	Description of Data Tag
AC:CH	Chain Activity
FE:	Feature
CD:	Chain Description
FG:	Figure Code (optional depending on connectivity method)
CH:	Chain Number
PL:	Point List

Note: The CD:, CH:, and PL: data items may be used multiple times in any order in this activity. See the section Defining Connectivity with SDMS for more details on the chain connectivity activity.

Taping Activity

The taping activity is used to record taping measurements to create open or closed survey chains when it is not convenient or desirable to shoot every point of an object, such as a building, with an instrument. It is used in situations where obtaining all required corners of an object is more practically done using other measuring devices such as a tape or range finder, or by estimation. A level or hand level may be used to establish elevation.

Before the taping activity can be used, two points must be recorded using the sideshot activity (AC:SS) to establish a beginning reference line for the taped measurements. Typically, the total station is used to measure these two points immediately before beginning the taping activity, but it is not required. The points can be recorded at any time in the project file, but must be recorded before the taping activity in which they will be used.

The backsight point number data item (BS:) and the occupied station point number data item (OS:) are used with the taping activity to specify the point numbers to be used for the backsight and occupied station respectively. The direction of the reference line for measuring and recording the angle/distance/elevation data is from the occupied station point number to the backsight point number (BS:). Horizontal angles are measured and recorded as angles to the right.

The points assigned to the OS: and BS: data items are included as part of the taped figure. In the calculated file, the figure is listed as one of the survey chains at the bottom of the file. The first point in the list will be the backsight point number, followed by the occupied station point number and the points generated from the angle distance list for the particular taping activity.

The default taping activity is made up of ten data items. The AC:TA data item is always the first entry of a taping activity, but the other items may be entered in any order.

Data Tag	Description of Data Tag
AC:TA	Taping Activity
OS:	Occupied Station Point Number (second point shot on the object)
BS:	Back Sight Point Number (first point shot on the object)
PN:	Point Number (Beginning point number to be used for the points computed)
FE:	Feature Code
CD:	Chain Description
FG:	Figure Code
AD:	Angle, Distance, and Elevation Difference
PL:	Point List (used to indicate previously shot points to include as the last points in the chain created)
CM:	Comments

Note: The AD: data item may be used multiple times in this activity. See the section Defining Connectivity with SDMS for more details on the taping activity.

Figure Activity

The figure activity is designed to store information needed to draw some standard figure, such as a drop inlet, based on certain critical points. The use of this activity and the critical points that are used must be done in a way compatible with the software system used to process the SDMS data. The basic idea is to provide the description and measurement items needed to feed a post processing system macro to draw standard items like curb and gutter sections, culverts, inlets, etc.

The default figure activity is made up of five data items. The AC:FG data item is always the first entry of a figure activity, but the other items may be entered in any order.

Data Tag	Description of Data Tag
AC:FG	Figure activity
FE:	Feature
FG:	Figure Code
PL:	Point List (containing critical points)
TY:	Type (Macro name that will be used)

Text Activity

The text activity (AC:TX) is used to define a text block, which will allow multiple point description data items (PD:) or comment data items (CM:) within the activity. The difference between the text activity and other shot activities is that the text activity can be used to provide extensive additional detail to a point that was shot previously in the project file, or about the project file itself. No shot data (HZ:, VT, DS:) can be included. The advantage of using this activity is that the point does not have to be re-shot if additional descriptive information needs to be added related to that shot.

The first method for using the text activity is to add descriptive information about a point shot previously in the project file. This method only requires that the point number of the point that the descriptive information is to be appended be included with the text activity. When the project file is processed, the descriptive information will be appended to the shot activity with that point number. No shot data (HZ:, VT, DS:) or feature code (FE:) is included.

The second method for using the text activity is to record information about the project file itself. If the text activity is used for reference purposes about the project file, the point number (PN:) number is omitted. When the activity is used in this manner, the data will be recorded in the calculated file as the last entries in the header activity (AC:PR) as descriptive information about that file.

The default text activity is made up of four data items. The AC:TX data item is always the first entry of a text activity, but the other items may be entered in any order.

Data Tag	Description of Data Tag
AC:TX	Text Activity
PN:	Point Number
CM:	Comment
PD:	Point Description

Note: The CM: data item and the PD: data item, if added, may be used multiple times in this activity.

Check Activity

The check activity is used in various situations to allow interaction by the user. Primarily, it is used to interrupt a sequence so that the user can work interactively with SDMS without having to exit from the sequence. The check activity is not saved to the project file.

The default check activity uses only the AC:CK data item.

Data Tag	Description of Data Tag
AC:CK	Check Activity

The Intermediate Set-Up

Occupied Station Activity

Intermediate set-ups are optional. The number of intermediate set-ups is limited only by the user's hardware and software configuration. Each intermediate set-up follows the same rules.

SDMS Collector: For each intermediate set-up the occupied station is a required activity. The intermediate occupied station receives coordinates from the last foresight point shot from the previous occupied station. These are computed values and should not be entered by the surveyor. In all cases it is assumed that the previous foresight is being occupied.

SDMS Processor: For each intermediate set-up the occupied station is a required activity. The intermediate occupied station receives coordinates from the point number assigned to that occupied station. These can be entered by the surveyor or come from a control file.

The intermediate occupied station activity usually contains five data items. An AC:OS data item is always the first entry of an occupied station activity, but the other items may be entered in any order:

Data Tag	Description of Data Tag
AC:OS	Occupied Station
PN:	Point Number
PD:	Point Description
IH:	Instrument Height
SH:	Staff Height (optionally placed in backsight)

Instrument Height and Staff Height Data Items

The IH: and SH: entries re-initialize the instrument and staff height values for the set-up. It is not necessary to re-enter these values on subsequent shots unless they change. These data items are optional if the survey will not require accurate elevations.

The user may choose to enter the SH: data item in the backsight activity instead of in the occupied station activity.

Elevations

If the ZC: is known for the occupied point, it may be entered. This will re-set the elevation and future elevations will be computed from this new known elevation. In addition, any error between the computed elevation and the entered elevation will be reported. This error will also be adjusted and spread over previous set-ups. This adjustment will only be made back to the last known elevation. No known elevations are ever adjusted.

If the elevation is not known for the occupied point, but can be observed at another point from this set-up, continue with project data until it is possible to do an elevation control shot to the point. The same updating and adjustments will be made.

If this known elevation is the very first encountered in the project file; that is no elevation was established in the beginning occupied station or previous intermediate stations, the elevations will be computed back to the beginning of the file, but no adjustments will be made.

Backsight Activity

The intermediate backsight activities are used to establish the initial reference direction. All subsequent shots taken from the station will be calculated using this reference direction.

If more than one backsight is encountered in a given occupied station, the reference direction is updated, but the back azimuth is not changed. Backsighting in sets is an exception. See *Special Survey Procedures Applying to All Combined Task Setups, Sets* in this Section.

An intermediate backsight activity usually contains seven data items. The AC:BS data item is always the first entry of a backsight activity, but the other items may be entered in any order:

Data Tag	Description of Data Tag
AC:BS	Backsight Activity
PN:	Point Number
PD:	Point Description
SH:	Staff Height
HZ:	Horizontal Angle
VT:	Vertical Angle
DS:	Slope Distance

Horizontal, Vertical and Distance Data Items

The HZ:, VT: and DS: data items use numeric values to represent the horizontal circle angle, vertical (zenith) angle, and slope distance measurements from the occupied station to the backsight point.

If measurement data is not present, a horizontal reference direction of 0° is assumed.

If the backsight target height was not entered, or is different from that entered for the occupied station, enter the correct value in the backsight activity.

Station Resection Activity

The station resection activity should not be used in intermediate set-ups.

Foresight Activity

Same as for the beginning set-up.

Optional Combined Task Activities - Intermediate Set-Ups

Sideshot Activity

Same as for the beginning set-up.

Elevation Control Activity

Intermediate elevation control activities re-establish elevations along the traverse. The elevation established becomes the new elevation for the current station and re-establishes the basis for the trigonometric elevations of subsequent stations and shots. The error between the newly established elevation and the previously computed elevation for the current occupied station is reported. In addition, the error is adjusted and spread back to the previous occupied point with a known elevation.

If this is the first known elevation encountered in the project, the elevation control is used to establish elevations on all activities back to the beginning occupied station, but no adjustments are made.

There may be multiple elevation control activities per occupied station. If a new valid ZC: data item was not encountered in the occupied station, the first elevation control activity will be used to establish the elevation of the current occupied station.

If a valid ZC: data item has already been encountered in the occupied station, or if this is the second elevation control shot from this occupied station, the elevation control activity will be treated as an elevation control check activity. This means that previous elevations are unchanged and the error between the entered elevation and the computed elevation will be reported.

The default elevation control activity is made up of eight data items. The AC:EC data item is always the first entry of a elevation control activity, but the other items may be entered in any order:

Data Tag	Description of Data Tag
AC:EC	Elevation Control Activity
PN:	Point Number
PD:	Point Description
SH:	Staff Height
ZC:	Elevation/Z Coordinate
HZ:	Horizontal Angle
VT:	Vertical Angle
DS:	Slope Distance

Elevation/Z Coordinate Data Item

The ZC: coordinate data item contains the known elevation of a benchmark.

Horizontal, Vertical and Distance Data Items

The HZ:, VT: and DS: data items use numeric values to represent the horizontal circle angle, vertical (zenith) angle, and slope distance measurements from the occupied station to the elevation control point.

Control Check Activity

Same as for the beginning set-up.

Sideshot Intersect Activity

Same as for the beginning set-up.

Utility Elevation Activity

Same as for the beginning set-up.

Tie Sequence Activity

Same as for the beginning set-up.

Chain Connectivity Activity

Same as for the beginning set-up.

Taping Activity

Same as for the beginning set-up.

Figure Activity

Same as for the beginning set-up.

Text Activity

Same as for the beginning set-up.

Check Activity

Same as for the beginning set-up.

The Ending Set-Up

Occupied Station Activity

The ending occupied station is a required activity. It is used to establish known ending coordinates for traverse closure and adjustment.

Once the system has a recognized beginning station it begins to search for an ending occupied station. The system will recognize an ending station in one of four ways:

1. If the end-of-file sequence is encountered, the current station is assumed to be an ending station.

2. If there are coordinates (XC: and YC:) in the occupied station, it is assumed to be an ending station.

3. If a set-up does not contain a foresight, it is assumed to be an ending station.

4. If an occupied station contains either the ES:Y or ES:YES data item, it is assumed to be an ending station.

The set-up following an ending set-up will be considered the beginning station of a new traverse.

The ES:N or ES:NO may be used to override the fact that a mid course occupied station contains coordinates. The entered coordinates are not used in doing computations, but are used in formatting.

The ending occupied station activity usually contains eight data items. An AC:OS data item is always the first entry of an occupied station activity, but the other items may be entered in any order:

Data Tag	Description of Data Tag
AC:OS	Occupied Station
PN:	Point Number
PD:	Point Description
IH:	Instrument Height
SH:	Staff Height (optionally placed in backsight)
YC:	Northing Coordinate
XC:	Easting Coordinate
ZC:	Elevation/Z Coordinate

Instrument Height and Staff Height Data Items

The IH: and SH: entries re-initialize the instrument and staff height values for the ending set-up. It is not necessary to re-enter these values on subsequent shots unless they change. These data items are optional if the survey will not require accurate elevations.

The user may choose to enter the SH: data item in the backsight activity instead of the beginning occupied station activity.

Coordinate Data Items

The Northing, Easting and elevation coordinate values of the ending occupied station are needed for computations. If not entered in the field they must be entered in the office. If not entered at all, no closure or adjustments are made.

The XC:, YC:, and ZC: data items can contain either known or assumed coordinates if closing back on the beginning point.

The traverse must end on a known point. If a closing foresight is shot, an azimuth closure and coordinate adjustment is made. If no closing foresight exists, only a coordinate adjustment is made.

If the ZC: is known for the occupied point, it may be entered. This will set the ending elevation. The error between the computed elevation and the entered elevation will be reported. This error will also be adjusted and spread over previous set-ups. This adjustment will only be made back to the last known elevation. No known elevations are ever adjusted.

If the elevation is not known for the occupied point, but can be observed at another point from this set-up, continue with project data until it is possible to do an elevation control shot or foresight to the point. The same updating and adjustments will be made.

If the known elevation is the very first in the project file; that is no elevation was established in the beginning occupied station or previous intermediate stations, the elevations will be pushed back to the beginning of the file, but no adjustments will be made.

Backsight Activity

The ending backsight activity is used to establish the initial reference direction. All subsequent shots taken from the station will be calculated using this reference direction.

SDMS Collector: Based on the SDMS Collector computations rule, the ending backsight activity will always use the previously occupied point as the backsight, regardless of point number.

SDMS Processor: The restrictions for batch computations in SDMS Collector do not apply. Therefore, any point , with a known point number can be used. The ending backsight receives coordinates from the point number assigned to that backsight. These can be entered by the surveyor or can come from a control file.

If more than one backsight is encountered in a given occupied station, the reference direction is updated, but the back azimuth is not changed. Backsighting in sets is an exception. See *Special Survey Procedures Applying to All Combined Task Setups, Sets* in this Section.

The ending backsight activity usually contains seven data items. The AC:BS data item is always the first entry of a backsight activity, but the other items may be entered in any order:

Data Tag	Description of Data Tag
AC:BS	Backsight Activity
PN:	Point Number
PD:	Point Description
SH:	Staff Height
HZ:	Horizontal Angle
VT:	Vertical Angle
DS:	Slope Distance

Horizontal, Vertical and Distance Data Items

The HZ:, VT: and DS: data items use numeric values to represent the horizontal circle angle, vertical (zenith) angle, and slope distance measurements from the occupied station to the backsight point.

If measurement data is not present, a horizontal reference angle of 0° is assumed.

If the backsight target height was not entered, or is different from that entered for the occupied station, enter the correct value in the backsight.

Station Resection Activity

The station resection activity is not used with the ending set-up.

Foresight Activity

The ending foresight activity establishes the closing azimuth for the traverse. The closing foresight may be any known point, including the beginning point.

The ending foresight is required if an azimuth adjusted closure is desired. If omitted, no azimuth adjustment will be made.

The ending foresight activity is made up of nine data items. The AC:FS data item is always the first entry of a foresight activity, but the other items may be entered in any order:

Data Tag	Description of Data Tag
AC:FS	Foresight Activity
PN:	Point Number
PD:	Point Description
SH:	Staff Height
HZ:	Horizontal Angle
VT:	Vertical Angle
DS:	Slope Distance
YC:	Northing or Y Coordinate
XC:	Easting or X Coordinate
Optionally	
AZ:	Azimuth, only if replacing both YC: and XC:
ZC:	Elevation/Z Coordinate, if the ending elevation was unknown in the ending occupied station or not established with an elevation control activity

Horizontal, Vertical and Distances Data Items

The HZ:, VT: and DS: data items use numeric values to represent the horizontal circle angle, vertical (zenith) angle, and slope distance measurements from the occupied station to the foresight point.

Northing and Easting Coordinates or Azimuth Data Items

The XC: and YC: data items are used to compute the closing azimuth. The data items can contain either known or assumed coordinates. Assumed coordinates (such as YC:1000, XC:1000) would most often be the same as the beginning backsight coordinates and the traverse would close on the beginning set-up. Using assumed coordinates should not harm the raw data file. If edited to reflect actual values, the correct coordinates should result when re-computing the raw file.

If the coordinates are not known and you do not want to use assumed values, you may enter a North azimuth instead.

If an azimuth and the Northing and Easting coordinates are entered in the foresight, the azimuth takes precedence over the coordinates.

If neither coordinates nor an azimuth are entered for the foresight in the field, they must be entered in the office. If not provided at all, no azimuth closure or angular adjustments are made.

If the elevation is not known for the ending occupied point, and has not been established through an elevation control activity, the closing elevation may be entered in the closing foresight. The same updating and adjustments will be made.

If the known elevation is the only one in the project file, the elevations will be pushed (computed) back to the beginning of the file, but no adjustments will be made.

Optional Combined Task Activities - Ending Set-Ups

Sideshot Activity

Same as for the beginning set-up.

Elevation Control Activity

An ending elevation control activity can be used to establish a closing elevation at the ending occupied station. The error between the newly established elevation and the previously computed elevation for the ending occupied station is reported. In addition, the error is adjusted and spread back to the previous occupied point with a known elevation.

If this is the first known elevation encountered in the project, the elevation control is used to establish elevations on all activities back to the beginning occupied station. No adjustments are made.

There may be multiple elevation control activities in the ending occupied station. If a new valid ZC: data item was not encountered in the occupied station, the first elevation control activity will be treated as an elevation control. This means that the elevation will be established and adjustments will be made.

If a valid ZC: data item has already been encountered in the occupied station, or if this is the second elevation control shot from this occupied station, the elevation control activity will be treated as control check activity. This means that previous elevations are unchanged and the error between the entered elevation and the computed elevation will be reported.

The default elevation control activity is made up of eight data items. The AC:EC data item is always the first entry of a elevation control activity, but the other items may be entered in any order:

Data Tag	Description of Data Tag
AC:EC	Elevation Control Activity
PN:	Point Number
PD:	Point Description
SH:	Staff Height
ZC:	Elevation/Z Coordinate
HZ:	Horizontal Angle
VT:	Vertical Angle
DS:	Slope Distance

Elevation/Z Coordinate Data Item

The ZC: coordinate data item contains the known elevation of a benchmark.

Horizontal, Vertical and Distance Data Items

The HZ:, VT: and DS: data items use numeric values to represent the horizontal circle angle, vertical (zenith) angle, and slope distance measurements from the occupied station to the elevation control point.

Control Check Activity

Same as for beginning set-up.

Sideshot Intersect Activity

Same as for beginning set-up.

Utility Elevation Activity

Same as for beginning set-up.

Tie Sequence Activity

Same as for the beginning set-up.

Chain Connectivity Activity

Same as for the beginning set-up.

Taping Activity

Same as for the beginning set-up.

Figure Activity

Same as for the beginning set-up.

Text Activity

Same as for the beginning set-up.

Check Activity

Same as for the beginning set-up.

Special Survey Procedures Applying to All Combined Task Set-Ups

Multi-Stub Shots

Multi-stub shots use the sideshot activity to take multiple sightings of the same point from different stations. In principle, a multi-stub point is just like a sideshot intersect activity, except that the prism can be placed directly on the point so full readings (HZ:, VT: and DS:) are available.

The desired point is shot from two or more stations with the sideshot activity. All angle and distance readings are collected.

Note: The same point number must be used each time the point is shot.

Perpendicular Offsets Left and Right

If the surveyor cannot sight or is unable to place the target directly on the desired point, the target may be perpendicularly offset from the line of sight to the right or left of the desired object. A sideshot is taken to the target and the taped offset is entered with the OF: (offset) data tag.

When facing the desired point from the instrument, a right offset is entered with a positive number, such as OF:13.45. A left offset is represented by a negative number, such as OF:-5.443.

The following is a sample perpendicular offset entry, with the target placed to the left of the desired point:

```
AC:SS
PN:15
PD:TREE
HZ:34.112
VT:90.251
DS:132.943
OF:-12.45
```

Length Offsets Front and Back

If the surveyor cannot sight or is unable to place the target directly on the desired point, the target may be directly offset along the line of sight in front or in back of the desired object. A sideshot is taken to the target and the taped offset is entered with the LO: (length offset) data tag.

When facing the target from the instrument, an offset in front of the point is entered with a negative number, such as LO:-15.92. An offset behind the point is represented by a positive number, such as LO:3.723.

The following is a sample length offset entry, with the target placed in front of the desired point:

```
AC:SS
PN:75
PD:TREE
HZ:34.112
VT:90.251
DS:132.943
LO:-6.227
```

Remote Elevations

A remote elevation is a special case of the utility elevation activity (AC:UE). Like the utility elevation, the remote elevation is used to determine the elevation of an object above or below the level of the sideshot. But rather than using a rod reading to indicate depth, a new vertical (zenith) angle is turned to the point.

A sideshot (the "leading sideshot") is taken to the ground point directly above or below the elevated point, as shown in Figure 3.2. Then the utility elevation activity records the vertical angle (VT:) turned to the point.

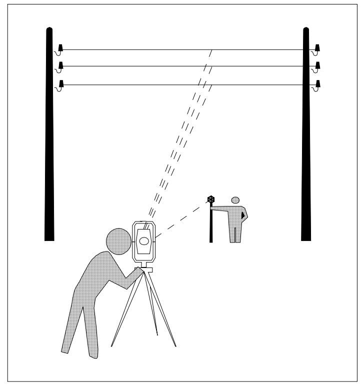


Figure 3.2 Remote Elevation

Using the AC:SS sideshot measurements and the AC:UE vertical angle, the results represent the actual coordinates of the remote point. The Northing and Easting coordinates of the remote point will be those of the leading sideshot, but the elevation coordinate is adjusted using the vertical angle.

Any number of remote elevations may be entered for any occupied station. The number is limited only by the user's hardware and software configuration. All remote elevations (AC:UE) must be entered after a leading sideshot and before any other activities. Multiple remote elevations can be "stacked" up using the same leading sideshot activity.

Note: If there is a point number (PN:) and a figure code (FG:), as well as any other attribute tags, with the utility elevation activity (AC:UE), that information should be used as the attribute data for the point computed for that activity. If there is no PN: with the AC:UE, but there is an FG:, the processing software should assign a PN: value and use any attribute information that may be recorded with the utility elevation activity. If there is no PN: or FG: with the AC:UE, the processing software should assign a PN: value and assign the same FG: that is designated with the AC:SS "leading sideshot."

The default utility elevation activity used for remote elevations is made up of four data items. The AC:UE data item is always the first entry of a utility elevation activity, but the other items may be entered in any order:

Data Tag	Description of Data Tag
AC:UE	Utility Elevation Activity
PN:	Point Number
PD:	Point Description
VT:	Vertical (zenith) Angle

Vertical Angle Data Item

The VT: data item represents the vertical (zenith) angle measurement from the occupied station to the remote point.

Sets

SDMS allows for the collection and averaging of multiple pointings. This procedure is termed collecting "sets." A set is defined in SDMS as one complete pointing to the measured object in either direct face or direct and reverse face.

The number of points per occupied station and the number of sets per point is limited only by the user's hardware and software configuration.

Each shot to be included in set computations is identified by three data items: PN: (point number) SE: (set) and FC: (face). The following examples show one set collected to a backsight. The first column shows sets in direct and reverse faces; the second column shows sets in direct face only:

Direct and Reverse Faces	Direct Face Only
AC:BS	AC:BS
SE:1	SE:1
FC:1	FC:1
PN:12	PN:14
PD:PIN	PD:BOLT
SH:5.3	SH:5.4
HZ:0	HZ:0
VT:90	VT:90
DS:100	DS:100
AC:BS	
SE:1	
FC:2	
PN:12	
HZ:180.0012	
VT:270.0005	
DS:100.001	

Additional information on sets:

- Angles may be recorded in any order, but the type of shot is defined the first time a given point number is entered.
- Descriptive data for a shot, including coordinates, staff height, or other required data, can be recorded with any of the sets.
- The instrument does not have to be zeroed when making the first backsight pointing.
- Sets can only be collected within a given occupied station. Any time a new station is occupied the set accumulators are automatically cleared and averaging starts over.

Radial Cross Sections

Radial cross sections, using an electronic total station, can be recorded in a project file. The task must be either radial topography (TK:RTO) or combined (TK:COM). This information can be used to produce a computed file with values for X, Y, and Z. Station, offset, elevation data can be computed when the data is merged with a corresponding horizontal alignment file.

The procedure requires the use of the station activity (AC:ST), stationing data item (ST:), and the shot identification data item (SI:) with the response “XSE” (SI:XSE). The shot identification data item with the “XSE” response (SI:XSE) must be inserted after the first side shot activity (AC:SS) where the cross sectioning begins, but within that activity.

The station activity (AC:ST) and the station data item (ST:) is inserted prior to the start of each group of cross section shots for a particular station. The AC:ST and ST: are inserted for each station that a cross section is being recorded.

The same file can be used to record standard radial topography data by inserting the SI: data item with the response “RTO” (SI:RTO) within the first side shot activity (AC:SS) recording the topography shot. This procedure using SI:RTO and SI:XSE can be repeated in the project file as often as is needed.

The SI: data item does not have to be entered with every shot. Only with the shot that identifies the switch from cross section shots to radial topography and vice versa.

The following is a sample radial cross section and radial topography entry:

```
AC:ST
ST:3+00
AC:SS
SI:XSE
PN:123
HZ:292.43
VT:90.365
DS:123.78
SH:8.9
AC:SS
PN:124
HZ:300.53
VT:91.1852
DS:113.05
AC:SS
SI:RT0
PN:125
FE:TR
PD:12” MAPLE
HZ:327.5752
VT:91.4654
DS:101.19
AC:ST
ST:4+00
AC:SS
SI:XSE
PN:126
HZ:46.2112
VT:90.365
DS:231.42
SH:8.9
AC:SS
PN:127
HZ:66.2712
VT:91.1852
DS:243.05
```

Horizontal Tasks - Traverse Task

A traverse task (TK:TRA) requires an initial occupied station, a backsight, a foresight to another point, and then occupying the foresight as the next traverse [occupied] station. This pattern may be repeated as many times as desired throughout the traverse.

A traverse is processed just like the combined task, except that an SDMS traverse task does not contain sideshots. Users who wish to combine traverse and radial topography capabilities should use the combined task, which permits both foresights and sideshots.

The technical specifications for each defined activity in the traverse task are contained in the information on the combined task, found earlier in this section. The following activities are defined for the traverse task:

Required Activities	Optional Activities
Occupied Station	Elevation Control
Backsight Station	Control Check
Station Resection (if no backsight)	Tie Sequence
Foresight Station	Project Header

Horizontal Tasks - Radial Topography Task

A radial topography task (TK:RTO) requires one or more radial sideshots taken from one or more occupied stations, with backsights or station resections taken for each occupied station. No foresights are collected so the surveyor may not "move up and occupy" a point shot in the field as in traverse or combined tasks.

A radial topography task is processed much like the combined task, except that an SDMS radial topography task does not contain foresights. Users who wish to combine traverse and radial topography capabilities should use the combined task, which permits both foresights and sideshots.

The technical specifications for each defined activity in the radial topography task are contained in the information on the combined task, found earlier in this section. The following activities are defined for the radial topography task:

Required Activities	Optional Activities
Occupied Station	Elevation Control
Backsight	Utility Elevation
Station Resection (if no backsight)	Control Check
Sideshot	Sideshot Intersect
	Tie Sequence
	Project Header
	Chain Connectivity
	Taping
	Figure
	Text
	Check

Horizontal Tasks - Control Network Task

The control network task (TK:CON) can use all of the activities described in the combined task. This task is most closely related to a traverse, but the control network task assumes that multiple foresights will be taken to all visible points from each occupied station. Each foresight is then occupied and all visible points are shot from those stations. This results in a project file with many possible traverse routes running through it.

The technical specifications for each defined activity in the control network task are contained in the information on the combined task, found earlier in this section.

Sideshots are optional in the control network task. If present, they are treated as sideshots when picking a traverse route through the network.

Required Activities	**Optional Activities**
Occupied Station	Elevation Control
Backsight	Utility Elevation
Station Resection (if no backsight)	Control Check
Foresight	Sideshot Intersect
	Tie Sequence
	Sideshot
	Project Header
	Text
	Check

Horizontal Tasks - Global Positioning System (GPS) Vector Task

The GPS vector task (TK:GPS) requires an initial occupied station and a minimum of one foresight to another station. Multiple occupied stations can exist in a single project file and each occupied station can be followed by one or more foresight stations.

The following activities are defined for the GPS Vector task:

Required Activities	**Optional Activities**
Project Header	
Occupied Station	
Foresight Station	

Project Header Activity

The technical specifications for the project header activity are defined earlier in this section. However, two additional data tags unique to the GPS vector task exist.

Geoid Model Data Item

The Geoid Model data item (GD:) defines the geoid model used for the survey or for a series of points. This data item isn't used for any computations but rather serves as documentation of the source of any Geoid Height data items (HG:) that may appear in the file.

Vector Type Data Item

The Vector Type data item (TV:) defines the reference point for the processed vectors appearing in the file. The vectors can be from Antenna Phase Center to Antenna Phase Center, Antenna Reference Point to Antenna Reference Point, or Mark to Mark. If the Vector Type data item is missing from the project header it is assumed the vectors in the file have been reduced to mark to mark. If the Vector Type data item is set to Antenna Phase Center, all Instrument Height data items (IH:) will be assumed to be measured to the Antenna Phase Center. If the Vector Type data item is set to anything other than Antenna Phase Center, all Instrument Height data items will be assumed to be measured to the Antenna Reference Point.

The following is a sample of a project header activity for a GPS vector task:

```
AC:PR
TK:GPS
PR:HMDAY1
UL:M
HD:NAD83
GD:GEOID03
TV:MARK
(etc…)
```

Occupied Station Activity

The occupied station is a required activity. All vectors appearing after an occupied station activity will be computed as being "from" the occupied station.

Each occupied station activity usually contains eight data items. An AC:OS is always the first entry of an occupied station activity, but the other items may be entered in any order.

Data Tag	Description of Data Tag
AC:OS	Occupied Station
PN:	Point Number
PD:	Point Description
IT:	GPS Receiver Manufacturer and Model
SN:	Serial Number for the GPS Receiver
AT:	GPS Antenna Manufacturer and Model
SN:	Serial Number for the GPS Antenna
IH:	Instrument Height

The following is a sample of an occupied station activity for a GPS vector task:

```
AC:OS
PN:WIL1
PD:NGS WIL1 CORS
IT:Trimble 4000SSI
SN:3613A15012
AT:Trimble Geodetic L1/L2 Compact +Groundplane
SN:0220054190
IH:0.000
```

Instrument Type and Serial Number Data Items

The Instrument Type data item is used to identify the manufacturer and model of the GPS receiver being used for the GPS observations at the occupied station. When followed immediately by a Serial Number data item, that serial number is associated with the preceeding instrument.

Once the Instrument Type and Serial Number is defined for an occupied station activity it can not be changed without performing another activity occupied station.

Antenna Type and Serial Number Data Items

The Antenna Type data item is used to identify the manufacturer and model of the GPS antenna being used for the GPS observations at the occupied station. When followed immediately by a Serial Number data item, that serial number is associated with the preceeding antenna.

Once the Antenna Type and Serial Number is defined for an occupied station activity it can not be changed without performing another activity occupied station.

Instrument Height Data Item

The Instrument Height data item is assumed to be measured as vertical distance from the mark to the Antenna Reference Point. If the Vector Type data item (TV:) has been defined as Antenna Phase Center, the Instrument Height data item will be assumed to be a vertical distance measured from the mark to the Antenna Phase Center.

It may be necessary to compute the instrument height using measured slant distances and/or referring to the antenna offsets provided by the manufacturer.

Foresight Station Activity

The foresight station is a required activity. All vectors appearing after a foresight station activity will be computed as being "to" the foresight station.

Each foresight station activity usually contains eleven data items. An AC:FS is always the first entry of an occupied station activity, but the other items may be entered in any order.

Data Tag	Description of Data Tag
AC:FS	Foresight Station
PN:	Point Number
PD:	Point Description
IT:	GPS Receiver Manufacturer and Model
SN:	Serial Number for the GPS Receiver
AT:	GPS Antenna Manufacturer and Model
SN:	Serial Number for the GPS Antenna
IH:	Instrument Height
VX:	Vector X Component
VY:	Vector Y Component
VZ:	Vector Z Component

Other data items that may appear with foresight station activity are listed below and may appear in any order.

Data Tag	Description of Data Tag
C1:	Variance X
C2:	Covariance XY

Data Tag	Description of Data Tag
C3:	Covariance XZ
C4:	Variance Y
C5:	Covariance YZ
C6:	Variance Z
BT:	Begin Time
ET:	End Time
SO:	Solution Type
FR:	Frequency
SV:	Minimum Number of Satellites
NS:	Number of Shots
IP:	Indicator of Precision (DOP)
AH:	Accuracy Horizontal
AV:	Accuracy Vertical

The following is a sample of a foresight activity for a GPS vector task:

```
AC:FS
PN:BASE
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:13451.012
VY:3468.604
VZ:-265.403
C1:0.00000299
C2:-0.00000456
C3:0.00000189
C4:0.000002167
C5:-0.00000703
C6:0.00000777
BT:14:54:42 04/24/2004
SO:FIXED
FR:IONO FREE
SV:7
NS:412
IP:P4.3
```

Instrument Type and Serial Number Data Items

The Instrument Type data item is used to identify the manufacturer and model of the GPS receiver being used for the GPS observations at the foresight station. When followed immediately by a Serial Number data item, that serial number is associated with the preceeding instrument.

Once the Instrument Type and Serial Number are defined for a foresight station activity it does not have to be redefined for subsequent foresight activities until an occupied station activity is performed. This allows multiple foresight station activities to be performed from a single occupied station such as one would encounter when performing a radial or real-time kinematic GPS survey.

Antenna Type and Serial Number Data Items

The Antenna Type data item is used to identify the manufacturer and model of the GPS antenna being used for the GPS observations at the foresight station. When followed immediately by a Serial Number data item, that serial number is associated with the preceeding antenna.

Once the Antenna Type and Serial Number are defined for a foresight station activity it does not have to be redefined for subsequent foresight activities until an occupied station activity is performed. This allows multiple foresight station activities to be performed from a single occupied station such as one would encounter when performing a radial or real-time kinematic GPS survey.

Instrument Height Data Item

The Instrument Height data item is assumed to be measured as vertical distance from the mark to the Antenna Reference Point. If the Vector Type data item (TV:) has been defined as Antenna Phase Center, the Instrument Height data item will be assumed to be a vertical distance measured from the mark to the Antenna Phase Center.

It may be necessary to compute the instrument height using measured slant distances and/or referring to the antenna offsets provided by the manufacturer.

Vector Component Data Items

The vector component data items are assumed to be measured from mark to mark unless the Vector Type data item (TV:) specifies other wise. The user should note that most manufacturers supply mark to mark vectors when exporting from post-processing software packages, but provide Antenna Refernce Point (ARP) to ARP vectors when exporting from a real-time kinematic (RTK) system.

Variance Covariance Data Items

The variance covariance data items are currently for documentation purposes only. Some users may view these as quality indicators to be used when analyzing vector adjustments.

Begin Time and End Time Data Items

The Begin Time and End Time data items are used for documentation purposes only. Depending on the vectors being adjusted and/or analyzed, the user may wish to apply some time dependent transformations to vectors.

Indicator of Precision Data Item

The Indicator of Precision data item (IP:) is used for documentation purposes only. Some users may view these as quality indicators to be used when analyzing vector adjustments.

Solution and Frequency Data Items

The Solution and Frequency Data Items are used for documentation purposes only. Some users may view these as quality indicators to be used when analyzing vector adjustments.

Number of Satellites and Number of Shots Data Items

The Number of Satellites and Number of Shots data items are used for documentation purposes only. Some users may view these as quality indicators to be used when analyzing vector adjustments.

Coordinate Values

Both the occupied station activity and the foresight station activity can contain coordinate values derived from GPS observations. The intent of the GPS vector task is to adjust and analyze GPS vectors so coordinate values will largely be ignored. Control coordinates for stations contained in a GPS vector task are expected to be contained in an SDMS control file. Any coordinates appearing in the GPS vector task will be assumed to be observed coordinates of questionable quality and not used for computations.

The following data items may be used to define coordinates in a GPS vector task.

Data Tag	Description of Data Tag
XX:	Computed X Coordinate
YY:	Computed Y Coordinate
ZZ:	Computed Z Coordinate
LT:	Latitude
LG:	Longitude
HE:	Height Ellipsoid
HG:	Height Geoid
HT:	Height

Horizontal Tasks - Photo Control Task

The photo control task (TK:PHO) uses all of the activities of the combined task. The intended use of the photo control task is to tie aerial survey control work into ground control work.

Therefore, the significant difference between the photo control and combined tasks is the functional use of the sideshot. The photo control task assumes that any sideshot activity is used only for picture points. All other activities are used as defined for the combined task.

Aside from the functional use of the sideshot, the technical specifications for each defined activity in the photo control task are contained in the information on the combined task, found earlier in this section.

Horizontal Tasks - Terrain Modeling Task

The terrain modeling task (TK:TMO) can use all of the activities of the combined task. The intended use of the terrain modeling task is to pick up break lines and surface points for terrain modeling.

Therefore, the significant difference between the terrain modeling and combined tasks is the functional use of the sideshot. The terrain modeling task assumes that any sideshot activity is used only for break lines and surface points. All other activities are used as defined for the combined task.

Aside from the functional use of the sideshot, the technical specifications for each defined activity in the terrain modeling task are contained in the information on the combined task, found earlier in this section.

Vertical Tasks

The vertical tasks always begin with an occupied station activity and a backsight activity to establish an elevation at the first instrument set-up. The tasks then may contain sideshot activities, elevation control activities and/or control check activities to compute or check elevations on other points visible from that set-up.

To carry elevations forward, a shot is taken on a turning point, using either the turning point or foresight activity. The instrument is moved to a new set-up and a backsight is taken on the turning point.

If surveying in tunnels or mines, it is often the case that benchmarks are on the ceiling. Invert the rod on all ceiling points, and record all inverted rod readings as negative values.

Vertical Tasks - Cross-Section Task

The cross-section task collects station, offset, and rod reading values for points located along a horizontal alignment. The task is processed to compute station, offset, and elevation. The task can be further processed by merging it with the associated horizontal alignment file to compute the XY coordinates for every cross section point.

The following discusses the activities defined for the cross-section task. Individual data items are also explained as they apply to the activity in which they are placed.

Required Activities	Optional Activities
Occupied Station	Foresight
Backsight	Turning Point
Sideshot	Control Check
Stationing	Elevation Control
	Utility Elevation
	Project Header
	Station Equation
	Text
	Check

Occupied Station Activity

The occupied station activity is a required activity. It is used with a backsight activity to establish the initial instrument set-up elevation.

The number of occupied stations in a cross-section project is limited only by the user's hardware and software configuration.

The first AC:OS signals the actual beginning of computational data. All preceding survey shots are ignored during computations. Subsequent AC:OS data items signal the end of the current level run and the beginning of another.

The default occupied station activity is made up of four data items. An AC:OS data item is always the first entry of an occupied station activity, but the other items may be entered in any order:

Data Tag	Description of Data Tag

Data Tag	Description of Data Tag
AC:OS	Occupied Station
PN:	Point Number
PD:	Point Description
ZC:	Elevation/Z Coordinate

Elevation/Z Coordinate Data Item

The elevation of the initial backsight point can be entered in the occupied station. The ZC: data item can contain either the known elevation or an assumed value. Assumed coordinates (such as ZC:100) should not harm the raw data file and if edited to reflect actual values should produce correct results when the file is recomputed.

If the ZC: is an unknown value and you do not wish to use an assumed value, a default elevation of zero (0) will be used.

Backsight Activity

The backsight activity is used after an occupied station activity to establish the elevation of the first instrument set-up. Subsequent backsights are shot from each instrument set-up to the previous turning point or foresight activity point. Occupied station activities are not allowed for these intermediate set-ups.

The backsight activity is a required activity. The number of backsights in a cross-section task is limited only by the user's hardware and software configuration.

The default backsight activity is made up of two data items. The AC:BS data item is always the first entry of a backsight activity:

Data Tag	Description of Data Tag
AC:BS	Backsight Activity
RR:	Rod Reading

Rod Reading Data Item

The RR: data item uses a numeric value to represent the rod reading when the rod is placed on the backsight point.

The known elevation for the backsight can also be entered as a ZC: after the Rod Reading data item (RR:) if it has not been entered within the previous AC:OS.

Stationing Activity

The stationing activity establishes the stationing value for each cross-section taken from the setup. The stationing activity should be the first activity entered for each cross-section. The established stationing value becomes a default for each subsequent sideshot on the cross-section and need not be re-entered for each sideshot.

The default stationing activity is made up of two data items. The AC:ST data item is always the first entry of a stationing activity:

Data Tag	Description of Data Tag
AC:ST	Stationing Activity
ST:	Stationing

Stationing Data Item

The ST: data item represents the station value along the alignment, in either stationing format (10+00) or decimal format (1000).

Foresight Activity

The foresight activity is used to carry elevations forward from the instrument set-up to a point used as a turning point, or to the closing point of the level run.

The turning point activity achieves the same effect, but is not included in the final results when the file is exported to other systems.

The default foresight activity is made up of four data items. The AC:FS data item is always the first entry of a foresight activity, but the other items may be entered in any order:

Data Tag	Description of Data Tag
AC:FS	Foresight Activity
PN:	Point Number
PD:	Point Description
RR:	Rod Reading
Optionally	
ZC: (if closing on a known elevation)	Elevation/Z Coordinate

Rod Reading Data Item

The rod reading data tags use numeric values to represent the rod reading when the rod is placed on the foresight point.

Elevation/Z Coordinate

Indicates a closing elevation point. Elevation error will be calculated and adjusted.

Sideshot Activity

The sideshot activity is not required for processing. But functionally, it is the purpose of the cross-section task. The sideshot is used to compute the offset and elevation of the sideshot point. The station of the point is taken from the previous stationing activity.

The number of sideshots in a cross-section task is limited only by the user's hardware and software configuration.

The default sideshot activity is made up of three data items. The AC:SS data item is always the first entry of a sideshot activity, but the other items may be entered in any order:

Data Tag	Description of Data Tag
AC:SS	Sideshot Activity
OF:	Offset
RR:	Rod Reading

Offset Data Item

The OF: data item records the offset of the point from the alignment. A positive number is entered for shots to the right of the alignment, a negative number is entered for shots to the left of the alignment.

Rod Reading Data Item

The RR: data item uses numeric values to represent the rod reading when the rod is placed on the sideshot point.

Control Check and Elevation Control Activities

The control check and elevation control activities are used to compare the elevations that are carried through the survey to a known benchmark.

The number of control check or elevation control activities in a project is limited only by the user's hardware and software configuration.

The default elevation control and control check activities are each made up of five data items. The AC:CC or AC:EC data item is always the first entry of a control check or elevation control activity, but the other items may be entered in any order:

Data Tag	Description of Data Tag
AC:CC or AC:EC	Control Check or Elevation Control Activity
PN:	Point Number
PD:	Point Description
RR:	Rod Reading
ZC:	Elevation/Z Coordinate

Rod Reading Data Item

The RR: data item uses numeric values to represent the rod reading when the rod is placed on the check point.

Elevation/Z Coordinate Data Item

The ZC: coordinate contains the known elevation of a benchmark.

Utility Elevation Activity

The utility elevation activity is used to determine the elevation of an underground utility. A sideshot is taken (a "leading sideshot") to a point directly above the underground utility. The utility elevation activity records the rod reading of a rod dropped down to the utility itself.

Using the AC:SS sideshot measurements and the AC:UE rod reading measurement, the results represent the actual elevation of the utility.

The number of utility elevation activities in a project file is limited only by the user's hardware and software configuration, but must be entered after the leading sideshot before any other activities are started. There may be multiple utility elevations taken from the same leading sideshot.

The default utility elevation activity is made up of four data items. The AC:UE data item is always the first entry of a utility elevation activity, but the other items may be entered in any order:

Data Tag	Description of Data Tag
AC:UE	Utility Elevation Activity
PN:	Point Number
PD:	Point Description
RR:	Rod Reading

Rod Reading Data Item

The RR: data item uses a numeric value to represent the depth to the underground utility.

Turning point Activity

The turning point rod reading is taken from the current set-up. The instrument is then moved to a new set-up and the turning point is again shot from the new set-up as a backsight.

Note: The turning point activity achieves the same computational effect as the foresight, but it is considered an intermediate and non-critical point. Therefore, an elevation coordinate for turning point activities is not normally included in the results when the file is processed. If an elevation coordinate is desire, the Point Number (PN:) data item and a valid response must be included with the turning point activity

The default turning point activity is made up of two data items. The AC:TP data item is always the first entry of a turning point activity:

Data Tag	Description of Data Tag
AC:TP	Turning Point Activity
RR:	Rod Reading

Rod Reading Data Item

The RR: data item uses numeric values to represent the rod reading when the rod is placed on the turning point.

Hand Level Shots in a Cross-Section

Sideshots are often needed in a cross-section at locations which can't be shot from the current instrument set-up. Survey crews often pick up the elevation of these shots with a hand level. The SDMS data structure provides a method of recording these hand level shots and calls them "LOC shots."

LOC shot mode is activated by a data item SI:BL (shot ID begin LOC shot) in a backsight activity. The backsight shot must be taken on the last sideshot point. All shots after the activation of LOC shot mode are processed using elevations based on the backsight shot that began the LOC shot mode. This includes turning point shots and other backsight points.

When the LOC shot mode is ended, the instrument set-up elevation is restored to the value it had at the beginning of the LOC shot mode. LOC shots are ended by entering an SI:EL (shot ID end LOC shot) data item in any activity.

Vertical Tasks - The Profile Task

The profile task (TK:PRO) is similar to the cross-section, except that each sideshot in a profile contains a stationing (ST:) data item. The offset is assumed to be zero unless otherwise specified with the offset data item (OF:). The intended use of the profile task is to pick up elevations along an alignment.

Technical specifications for all defined activities except sideshots are contained in the cross-section task definition, found earlier in this section. The activities defined for the profile task are:

Required Activities	Optional Activities
Occupied Station	Foresight
Backsight	Turning Point
Sideshot	Control Check
	Elevation Control
	Utility Elevation
	Project Header
	Station Equation
	Text
	Check

Sideshot Activity

The sideshot activity is not required for processing. But functionally, it is the purpose of the profile task. The sideshot is used to compute the elevation of the sideshot point along the alignment.

The number of sideshots in a profile task is limited only by the user's hardware and software configuration.

The default sideshot activity is made up of three data items. The AC:SS data item is always the first entry of a sideshot activity, but the other items may be entered in any order:

Data Tag	Description of Data Tag
AC:SS	Sideshot Activity
ST:	Stationing
RR:	Rod Reading

Stationing Data Item

The ST: data item records the stationing of the point along the alignment.

Rod Reading Data Item

The RR: data item uses numeric values to represent the rod reading when the rod is placed on the sideshot point.

Vertical Tasks - Three-Wire Level Task

The three-wire level task is a control differential leveling task. It collects three-wire rod readings and carries elevation values through the survey. The three-wire level task performs basically the same function as a level run task, but with a higher degree of precision by recording and averaging the top, middle and bottom stadia wire readings for each shot.

The following discusses the activities defined for the three-wire level task. Individual data items are also explained as they apply to the activity in which they are placed.

Required Activities	Optional Activities
Occupied Station	Elevation Control
Backsight	Control Check
Foresight	Sideshot*
	Turning Point
	Project Header
	Text
	Check

Occupied Station Activity

The occupied station activity is a required activity. It is used with a backsight activity to establish the initial instrument elevation.

The number of occupied stations in a three-wire level project is limited only by the user's hardware and software configuration.

The first AC:OS signals the actual beginning of computational data. Subsequent AC:OS data items indicate the end of one level run and the beginning of a new one.

The default occupied station activity is made up of four data items. An AC:OS data item is always the first entry of an occupied station activity, but the other items may be entered in any order:

Data Tag	Description of Data Tag
AC:OS	Occupied Station
PN:	Point Number
PD:	Point Description
ZC:	Elevation/Z Coordinate of sighted backsight

Elevation/Z Coordinate Data Item

The elevation of the initial backsight point can be entered in the occupied station.

The ZC: data tag can contain either the known elevation or an assumed value. Assumed coordinates (such as ZC:100) should not harm the raw data file and if edited to reflect actual values should produce correct results when the file is recomputed.

If the ZC: is an unknown coordinate and you do not wish to use an assumed value, a default elevation of zero (0) will be used.

Backsight Activity

The backsight activity is used after an occupied station activity to establish the elevation of the first instrument set-up. Subsequent backsights are shot from each instrument set-up to the previous turning point or foresight point. Occupied station activities are not allowed for these intermediate set-ups.

The backsight activity is a required activity. The number of backsights in a three-wire level task is limited only by the user's hardware and software configuration.

The default backsight activity is made up of four data items. The AC:BS data item is always the first entry of a backsight activity:

Data Tag	Description of Data Tag
AC:BS	Backsight Activity
R1:	Top Wire Rod Reading
R2:	Middle Wire Rod Reading
R3:	Bottom Wire Rod Reading

Rod Reading Data Items

The rod reading data items use numeric values to represent the three-wire rod readings at the backsight point.

The rod readings are taken from the top (R1:), middle (R2:), and bottom (R3:) stadia wires in the telescope. These values are averaged during processing to provide higher accuracy in the calculation of the elevation.

The known elevation for the backsight can also be entered as a ZC: after the R3: data item if it has not been entered within the previous AC:OS.

Foresight Activity

The foresight activity is used to carry elevations forward from the instrument set-up to a point used as a turning point, or to the closing point of the level run.

The turning point activity achieves the same effect, but is not included in the final results when the file is processed to be sent to another system.

The default foresight activity is made up of six data items. The AC:FS data item is always the first entry of a foresight activity, but the other items may be entered in any order:

Data Tag	Description of Data Tag
AC:FS	Foresight Activity
PN:	Point Number
PD:	Point Description
R1:	Top Wire Rod Reading
R2:	Middle Wire Rod Reading
R3:	Bottom Wire Rod Reading

Rod Reading Data Items

The rod reading data items use numeric values to represent the three-wire rod readings at the foresight point.

The rod readings are taken from the top (R1:), middle (R2:), and bottom (R3:) stadia wires in the telescope. These values are averaged during processing to provide higher accuracy in the calculation of the elevation.

Sideshot Activity

The sideshot activity is not a required activity. The number of sideshots in a three-wire level task is limited only by the user's hardware and software configuration.

The default sideshot activity is made up of six data items. The AC:SS data item is always the first entry of a sideshot activity, but the other items may be entered in any order:

Data Tag	Description of Data Tag
AC:SS	Sideshot Activity
PN:	Point Number
PD:	Point Description
R1:	Top Wire Rod Reading
R2:	Middle Wire Rod Reading
R3:	Bottom Wire Rod Reading

Rod Reading Data Items

The rod reading data items use numeric values to represent the three-wire rod readings at the sideshot point.

The rod readings are taken from the top (R1:), middle (R2:), and bottom (R3:) stadia wires in the telescope. These values are averaged during processing to provide higher accuracy in the calculation of the elevation.

Control Check and Elevation Control Activities

The control check and elevation control activities are used to compare the elevations that are carried through the survey to a known benchmark.

The number of control check or elevation control activities in a project is limited only by the user's hardware and software configuration.

The default elevation control or control check activities are each made up of seven data items. The AC:EC or AC:CC data item is always the first entry of a elevation control or control check activity, but the other items may be entered in any order:

Data Tag	Description of Data Tag
AC:EC or AC:CC	Elevation Control or Control Check Activity
PN:	Point Number
PD:	Point Description
R1:	Top Wire Rod Reading
R2:	Middle Wire Rod Reading
R3:	Bottom Wire Rod Reading

Data Tag	Description of Data Tag
ZC:	Elevation/Z Coordinate

Rod Reading Data Items

The rod reading data items use numeric values to represent the three-wire rod readings at the control point.

The rod readings are taken from the top (R1:), middle (R2:), and bottom (R3:) stadia wires in the telescope. These values are averaged during processing to provide higher accuracy in the calculation of the elevation.

Elevation/Z Coordinate Data Item

The ZC: coordinate contains the known elevation of a benchmark.

Turning point Activity

The turning point rod reading is taken from an instrument set-up. The instrument is then moved to a new set-up and the turning point is again shot from the new set-up as a backsight.

Note: The turning point activity achieves the same computational effect as the foresight, but it is considered an intermediate and non-critical point. Therefore, an elevation coordinate for turning point activities is not normally included in the results when the file is processed. If an elevation coordinate is desired, the Point Number (PN:) data item and a valid response must be included with the turning point activity.

The default turning point activity is made up of four data items. The AC:TP data item is always the first entry of a turning point activity:

Data Tag	Description of Data Tag
AC:TP	Turning Point Activity
R1:	Top Wire Rod Reading
R2:	Middle Wire Rod Reading
R3:	Bottom Wire Rod Reading

Rod Reading Data Items

The rod reading data items use numeric values to represent the three-wire rod readings at the turning point.

The rod readings are taken from the top (R1:), middle (R2:), and bottom (R3:) stadia wires in the telescope. These values are averaged during processing to provide higher accuracy in the calculation of the elevation.

Note: In the current release of SDMS Collector, the sequence prompts for the Three Wire Level task (TK:3WR) in the TASK.TGS file uses the RR: data item for the rod readings. This data item is interpreted as R1:, R2:, and R3: data item prompts during data collection.

Vertical Tasks - Level Run Task

The level run task (TK:LEV) is a control differential leveling task. It collects rod readings and carries elevation values through the survey. The level run task performs basically the same function as a three-wire level task, but with a lesser degree of precision than the three-wire level task (which records and averages the top, middle and bottom stadia wire readings for each shot).

A level run task is processed much like the three-wire level task, except that the three rod readings (R1:, R2:, and R3:) are replaced by a single rod reading, represented by the rod reading (RR:) data tag.

The technical specifications for each defined activity in the level run task are contained in the information on the three-wire level task, found earlier in this section. The following activities are defined for the level run task:

Required Activities	Optional Activities
Occupied Station	Elevation Control
Backsight	Control Check
Foresight	Sideshot*
	Turning Point
	Project Header
	Text
	Check

Section IV - Data File Specification

Overview

This section explains the SDMS file structure for project, control, and horizontal alignment files.

The file specifications described here are for use on an IBM-PC™ (or equivalent) hardware platform running the MS-DOS™ operating system, Version 3.3 or later. Suitable substitutions should be made for the file specifications if the user implements the SDMS data structure on an alternative hardware platform or operating system.

Project File

Project File Structure

The following data items, in the order described, are the "nuts and bolts" of a project file. In an actual project file there will be many data items appropriately inserted after each activity data item. See Section 4, *Task and Activity Definitions*, for specific information.

A project file must contain the following main data items:

Data Item	Description
PR:	The PR: data item is the first data item encountered in the project file. It takes its value from the actual project filename. REQUIRED
TK:	The TK: data item is the second data item encountered in the project file. It defines the type of survey project contained in the file. This assures that, during processing, a cross-section project will not be confused with a traverse, for example. REQUIRED Presently, ten tasks are supported in the data structure. See Section 4, *Task and Activity Definitions*, for details.
AC:PR	The AC:PR is the first activity within a PRJ file. There are an unlimited number of data items related to the project that can be entered within this activity. This activity is optional for the user, even if the user does not include this activity manually, the data collector should add this activity and

	certain project settings when the PRJ file is suspended or closed for the first time. Project configuration items, such as, CR:, CF:, UL:, UA:, UT:, UP:, and VR: should be added automatically. In addition, the data tag and names of any active control and alignment files are also added.
AC:OS	For computational purposes, survey shots before the first AC:OS in the project file are disregarded during processing. The AC:OS is followed by the data items for the occupied station (point number, coordinates, staff and instrument heights, etc.).
AC:BS	The backsight activity must immediately follow the occupied station activity if no station resection shots occur.

Project File End-of-Line Sequence

The end-of-line sequence for a project file is a carriage return/line feed (ASCII characters 013 and 010).

Project File End-of-File Sequence

An end-of-file sequence is not required in a project file. However, if present, a Control-Z (^Z, or ASCII 026) will be used to terminate the file.

Project File Type

Project files are ASCII text files.

Calculated File

Calculated File Structure

A calculated file, with the file extension ".CAL", contains the computed values of the different activities and data items in a project file based on the SDMS task used. Therefore, the calculated file format will be defined for each type of SDMS task. The data items listed, in the order described, are the "nuts and bolts" of a calculated file. In an actual calculated file there will be many data items appropriately inserted after each activity data item.

Combined Task (TK:COM)

Data Item	Description
PR:	The PR: data item is the first data item listed in the calculated file. It takes its value from the actual project filename. REQUIRED
TK:	The TK: data item is the second data item encountered in the calculated file. It should correspond to the type of survey task listed in the project file. In this case, TK:COM. This assures during processing that project files, such as cross-sectioning, will not be confused with a traverse. REQUIRED when the calculated file represents a computed project file.
AC:PR	All data before the first activity, other than a project header activity, is ignored. The project header information is for documentation only. However, systems that read and write this file may need to know some of the information, such as the metadata items for units, datum, coordinate systems, combination factors, etc. Ultimately, such information should be checked against the similar settings in the system reading this data and provide warnings or conversions as needed. Any valid SDMS descriptive

	tags can be used under this activity. The user defined items in this activity are OPTIONAL, but they are RECOMMENDED. **Note:** Even if the user doesn't enter any optional data, the current version of SDMS Collector will insert an AC:PR followed by certain project settings as outlined in the AC:PR section of the PRJ data structure described previously.
AC:	Any activity that is allowed in the combined task project file can appear in the calculated file. The order of the activities must be the same as shown in the project file that was computed. The first activity in a calculated file after the AC:PR will always be AC:OS. It will be followed by the data for the occupied station (point number, coordinates, staff and instrument heights, etc.). Any other activity may follow.
PN:	The point number data item immediately follows each activity data item. This item is REQUIRED for every activity except AC:PR. If PN: does not exist in the PRJ file, the processing software should add it to the CAL file based on the criteria established in that software as to point number ranges and to avoid duplicate point numbers.
HZ:	This data item value corresponds to the horizontal angle that appears in the project file for the particular activity and point number. The format for the value is DDD.MMSS. REQUIRED if shot data is present. **Note:** If the horizontal angles have been taken using sets, this data item will be replaced by the computed horizontal angle data item (HH:) to record the mean value for the measured horizontal angles. REQUIRED if shot data is recorded using sets.
VT:	This item value corresponds to vertical angle that appears in the project file for the particular activity and point number. The format for the value is DDD.MMSS. REQUIRED if shot data is present. **Note:** If the vertical angles have been taken using sets, this data item will be replaced by the computed vertical angle data item (VV:) to record the mean value for the measured vertical angles. REQUIRED if shot data is is recorded using sets.
DS:	This value corresponds to the slope distance that appears in the project file for the particular activity and point number. REQUIRED if shot data is present. **Note:** If the slope distances have been taken using sets, this data item will be replaced by the computed slope distance data item (DD:) to record the mean value for the slope distances measured. REQUIRED if shot data is is recorded using sets.
YY:	The computed numeric value of the Y coordinate (Northing). REQUIRED
XX:	The computed numeric value of the X coordinate (Easting). REQUIRED
ZZ:	The computed numeric value of the Z coordinate (Elevation). REQUIRED
PD:, CM:, etc.	All data items that are used as point attributes in the project file are recorded in the calculated file with that point. REQUIRED if attribute data items are present.
AC:CC	This activity, if originally included in the project file, is used to report the computed difference between known and computed coordinates for a point. The Control Check activity is treated as a side shot during processing and is not used as project control for adjustments in the survey data.
PN:	As above.
SH:	Staff Height
HZ:	As above.
VT:	As above.

DS:	As above.
YC:	Known numeric value of the Y coordinate (Northing). REQUIRED
XC:	Known numeric value of the X coordinate (Easting). REQUIRED
ZC:	Known numeric value of the Z coordinate (Elevation). REQUIRED
YY:	The computed numeric value of the Y coordinate (Northing). REQUIRED
XX:	The computed numeric value of the X coordinate (Easting). REQUIRED
ZZ:	The computed numeric value of the Z coordinate (Elevation). REQUIRED
DY:	Algebraic difference of the known and computed Y coordinates. REQUIRED
DX:	Algebraic difference of the known and computed X coordinates. REQUIRED
DZ:	Algebraic difference of the known and computed Z coordinates. REQUIRED
PD:, CM:, etc.	All data items that are used as point attributes in the project file are recorded in the calculated file with that point. REQUIRED if attribute data items are present.
***	The tags that follow are REQUIRED to define survey chain connectivity that has been collected in the project file using one of the connectivity methods defined.
CP:	The close project data item list the time and date that the project file was created. If it is not present in the project file, the CP: designates the date the calculated file was created by the post processor. REQUIRED
BG:	Used to designate the beginning of the section containing the survey chains to be listed. REQUIRED
AC:CH	This activity is used to designate the beginning of the specific chain activity. A separate activity is used for each chain defined. REQUIRED
FE:	Defines the feature code to be used for the survey chain being defined. REQUIRED
CD:	The description for the chain being defined. OPTIONAL but required if in the original file.
FG:	The figure code
PL:	List of points that make up the survey chain. The format shall be as defined in the section *Defining Connectivity With SDMS*. REQUIRED
AC:CH, Etc.	The chain activity and required data items is repeated for each chain to be listed in the file.
EG:	Defines the end of the section with the chain list. REQUIRED
CP:	The close project data item list the time and date that the calculated file was created by the post processor. REQUIRED

Note: See the end of file requirements for calculated files listed at the end of this section.

Traverse Task (TK:TRA)

The calculated traverse task file follows the same format as the combined task. RESTRICTIONS – the calculated file is restricted to the allowed activities for the traverse task.

Radial Topography Task (TK:RTO)

The calculated radial topography task file follows the same format as the combined task. RESTRICTIONS – the calculated file is restricted to the allowed activities for the radial topography task.

Control Network Task (TK:CON)

The calculated control network task file follows the same format as the combined task. RESTRICTIONS – the calculated file is restricted to the allowed activities for the control network task.

Photo Control Task (TK:PHO)

The calculated photo control task file follows the same format as the combined task. RESTRICTIONS – the calculated file is restricted to the allowed activities for the photo control task.

Terrain Model Task (TK:TMO)

The calculated terrain model task file follows the same format as the combined task. RESTRICTIONS – the calculated file is restricted to the allowed activities for the terrain model task.

3Wire Level Task (TK:3WR)

Data Item	Description
PR:	The PR: data item is the first data item listed in the calculated file. It takes its value from the actual project filename. REQUIRED
TK:	The TK: data item is the second data item encountered in the calculated file. It must correspond to the type of survey task listed in the project file. In this case TK:3WR. This assures during processing that project files, such as cross-sectioning, will not be confused with a traverse. REQUIRED when the calculated file represents a computed project file.
AC:PR	All data before the first activity, other than a project header activity, is ignored. The project header information is for documentation only. However, systems that read and write this file may need to know some of the information, such as the metadata items for units, datum, coordinate systems, combination factors, etc. Ultimately, such information should be checked against the similar settings in the system reading this data and provide warnings or conversions as needed. Any valid SDMS descriptive tags can be used under this activity. The user defined items in this activity are OPTIONAL, but they are RECOMMENDED. **Note:** Even if the user doesn't enter any optional data, the current version of SDMS Collector will insert an AC:PR followed by certain project settings as outlined in the AC:PR section of the PRJ data structure described previously.
AC:OS	The occupied station activity is a required activity. It is used with a backsight activity to establish the initial instrument elevation. REQUIRED. The first activity in a calculated file after the AC:PR will always be AC:OS. It will be followed by the data for the occupied station (point number, coordinates, staff and instrument heights, etc.). Any other activity may follow.
PN:	The point number data item immediately follows each activity data item. This item is required for every activity except AC:PR and if it does not exist in the PRJ file, SDMS Processor will add it to the CAL file following various methods. REQUIRED

ZC:	This value corresponds to the elevation or Z coordinate of the control point being shot. This value will correspond to the elevation entered in the project file from a control file during processing. REQUIRED **Note:** If this value is not entered in the AC:OS or the associated AC:BS, it will default to the assumed value used by post processing software.
PD:	Point description of the vertical control point. OPTIONAL
AC:BS	Follows the occupied station activity and its related data items.
ZZ:	The computed elevation of the instrument line of sight based on the reduced rod readings. REQUIRED
R1:	Top wire reading as recorded in the project file with the backsight activity. REQUIRED
R2:	Middle wire reading as recorded in the project file with the backsight activity. REQUIRED
R3:	Bottom wire reading as recorded in the project file with the backsight activity. REQUIRED
AC:TP	The turning point activity is recorded as it occurs in the project file. REQUIRED
PN:	Point number of the turning point. OPTIONAL
ZZ:	The computed elevation of the turning point based on the reduced rod readings. REQUIRED
R1:	Top wire reading as recorded in the project file with the turning point activity. REQUIRED.
R2:	Middle wire reading as recorded in the project file with the turning point activity. REQUIRED
R3:	Bottom wire reading as recorded in the project file with the turning point activity. REQUIRED
AC:BS	Follows the turning point activity and its related data items. REQUIRED
PN:	Point number of the backsight point. OPTIONAL
ZZ:	The computed elevation of the instrument line of sight based on the reduced rod readings. REQUIRED
R1:	Top wire reading as recorded in the project file with the turning point activity. REQUIRED.
R2:	Middle wire reading as recorded in the project file with the turning point activity. REQUIRED
R3:	Bottom wire reading as recorded in the project file with the turning point activity. REQUIRED
AC:TP	The turning point activity is recorded as it occurs in the project file. Repeat as needed to complete the level run. REQUIRED.
PN:	Point number of the turning point. OPTIONAL
ZZ:	The computed elevation of the turning point based on the reduced rod readings. REQUIRED
R1:	Top wire reading as recorded in the project file with the turning point activity. REQUIRED.
R2:	Middle wire reading as recorded in the project file with the turning point activity. REQUIRED
R3:	Bottom wire reading as recorded in the project file with the turning point activity. REQUIRED
AC:FS	The foresight activity is inserted when the shot is on a control point with a known elevation or on which adjusted elevations are desired. Repeat as needed to complete the level run. REQUIRED.

PN:	Point number of the foresight point. OPTIONAL
ZZ:	The computed elevation of the foresight point based on the reduced rod readings. Used to compare with the known elevation of the point. REQUIRED
R1:	Top wire reading as recorded in the project file with the turning point activity. REQUIRED
R2:	Middle wire reading as recorded in the project file with the turning point activity. REQUIRED
R3:	Bottom wire reading as recorded in the project file with the turning point activity. REQUIRED
ZC:	Elevation/Z Coordinate of the control point sighted.
***	To continue a level loop repeat the steps above in the same file.
AC:OS	The occupied station activity is a required activity to continue a level loop. It is used with a backsight activity to establish the instrument elevation after closing on a control point with a known elevation to continue the level loop and adjustment. The AC:OS is also used if a new run from a different control point is being recorded in the same project file.
All other activities and data items repeat as recorded in the project file.	

Leveling Task (TK:LEV)

The leveling task follows the same procedure as the three wire task with the exception that the (RR:) data item is used in place of R1, R2:, and R3:.

Cross Section Task (TK:XSE)

Data Item	Description
PR:	The PR: data item is the first data item listed in the calculated file. It takes its value from the actual project filename. REQUIRED
TK:	The TK: data item is the second data item encountered in the calculated file. It must correspond to the type of survey task listed in the project file. In this case TK:XSE. This assures during processing that project files, such as cross-sectioning, will not be confused with a traverse. REQUIRED when the calculated file represents a computed project file.
AC:PR	All data before the first activity, other than a project header activity, is ignored. The project header information is for documentation only. However, systems that read and write this file may need to know some of the information, such as the metadata items for units, datum, coordinate systems, combination factors, etc. Ultimately, such information should be checked against the similar settings in the system reading this data and provide warnings or conversions as needed. Any valid SDMS descriptive tags can be used under this activity. The user defined items in this activity are OPTIONAL, but they are RECOMMENDED.
AC:EQ	Station Equations are required if the horizontal alignment associated with the cross section task contains station equations. AC:EQ defines the location of a station equation point. All equations must be listed in the order they appear in the alignment and cannot be located on a curve or spiral element. REQUIRED if the horizontal alignment contains station equations.
EQ:#	Equation number is used to indicate the order of the equations in the list. OPTIONAL **Note:** Equations must be listed in the order they appear in the horizontal alignment.
SB:###+##	Defines the station back of the equation. REQUIRED

ST:###+##	Defines the station ahead of the equation. REQUIRED
PD:, CM:, FE:	All other tags listed with the activity are ignored, but may be included for documentation purposes.
AC:OS	The occupied station activity is a required activity. It is used with a backsight activity to establish the initial instrument elevation. REQUIRED The first activity in a calculated file after the AC:PR will always be AC:OS. It will be followed by the data for the occupied station (point number, coordinates, staff and instrument heights, etc.). Any other activity may follow.
PN:	The point number data item immediately follows each activity data item. This item is REQUIRED for every activity except AC:PR and if it does not exist in the PRJ file, SDMS Processor will add it to the CAL file following various methods.
ZC:	This value corresponds to the elevation or Z coordinate of the control point being shot. This value will correspond to the elevation entered in the project file from a control file during processing. **Note:** If this value is not entered in the AC:OS or the associated AC:BS, it will default to the assumed value used by post processing software.
PD:	Point description of the vertical control point. OPTIONAL
AC:BS	Follows the occupied station activity and its related data items. REQUIRED
RR:	Rod reading of the bench mark shot. REQUIRED
ZZ:	The computed elevation of the instrument line of sight based on the reduced rod readings. REQUIRED
AC:ST	The station activity is used to indicate that a station number for a cross section will follow. REQUIRED
ST:	The nominal station value where the cross section is taken. REQUIRED
AC:SS	The side shot activity is used to record the offset and rod reading for each shot on the particular cross section. REQUIRED
OF:	Offset of the point shot as recorded in the project file. The sign of the offset should be the same as in the project file. REQUIRED
RR:	Rod reading of the point shot as recorded in the project file. REQUIRED
ZZ:	Computed elevation of the point shot. REQUIRED
AC:SS	Repeat as needed for each shot on the cross section as recorded in the project file. REQUIRED
OF:	Same as above
RR:	Same as above
ZZ:	Same as above
AC:ST	The station activity is used to indicate that a station number for the next cross section will follow. REQUIRED
ST:	Same as above
AC:SS	Same as above
OF:	Same as above
RR:	Same as above
ZZ:	Same as above.
LOC Shots are recorded in the same manner, based on the position inserted in the project file. See Section III, *Hand Level Shots in a Cross Section*.	
AC:BS	Follows the turning point activity and its related data items. REQUIRED

RR:	Rod reading of the bench mark shot. REQUIRED
ZZ:	The computed elevation of the instrument line of sight based on the rod reduced rod readings. REQUIRED
AC:FS	The foresight activity is inserted when the shot is on an control point with a known elevation or on which adjusted elevations are desired. Repeat as needed to complete the level run. REQUIRED
PN:	Point number of the foresight point. OPTIONAL
ZZ:	The computed elevation of the foresight point based on the reduced rod readings. Used to compare with the known elevation of the point. REQUIRED
RR:	Rod reading as recorded in the project file with the foresight activity. REQUIRED.
ZC:	Elevation/Z Coordinate of the control point sighted.

All the activities and data items repeat as recorded in the project file.

Profile Task (TK:PRO)

The calculated file for the profile task allows the same responses as the cross section task with one exception. The response to the offset data item (OF:) must be zero (OF:0).

Calculated File End-of-Line Sequence

The end-of-line sequence for a calculated file is a carriage return/line feed (ASCII characters 013 and 010).

Calculated File End-of-File Sequence

An end-of-file sequence is not required in a calculated file. However, if present, a Control-Z (^Z, or ASCII 026) will be used to terminate the file.

Calculated File Type

Calculated files are ASCII text files.

Points and Chains File

Points and Chains File Structure

The points and chains file, with the file extension ".PAC", contains the computed values and attributes of the individual points and the chains (figures) that have been generated once a project file has been processed. It can also contain points and chains that were created using a CADD software program. Therefore, shot data is not included. The task used to collect the data is not required, but can be included if desired. The task will only be used for information and does not effect how the data is to be used. Since this file is not task specific, it can contain point and chain values based on multiple tasks.

Multiple header activities (AC:PR) can be included in the file if that type of information is needed. This may be desirable if a section of the file has different parameters that other sections requiring different settings. For example, The point description activity, (AC:PD), is required to be used with each point. The chain activity, (AC:CH), is required to be used with each chain listed in the file.

The data items listed are the "nuts and bolts" of a points and chains file. In an actual calculated file there will be many data items appropriately inserted after each activity data item.

Data Item	Description
PR:	The PR: data item is the first data item listed in the points and chain file. It takes its value from the actual project filename. REQUIRED
TK:	The TK: data item is the second data item encountered in the points and chain file. It can correspond to the type of survey task listed in the project file. OPTIONAL
AC:PR	All data before the first activity, other than a project header activity, is ignored. The project header information is for documentation only. However, systems that read and write this file may need to know some of the information, such as the metadata items for units, datum, coordinate systems, combination factors, etc. Ultimately, such information should be checked against the similar settings in the system reading this data and provide warnings or conversions as needed. Any valid SDMS descriptive tags can be used under this activity. The user defined items in this activity are OPTIONAL, but they are RECOMMENDED. **Note:** Even if the user doesn't enter any optional data, the current version of SDMS Collector will insert an AC:PR followed by certain project settings as outlined in the AC:PR section of the PRJ data structure described previously.
AC:PD	The activity is used as a separator between individual points. The activity will be followed by the data for the point (point number, coordinates, point attributes, etc.). REQUIRED **Note:** AC:PD is recommended, but any activity that is allowed in a task can appear in the points and chains file.
PN:	The point number data item immediately follows each activity data item. This item is REQUIRED for every activity except AC:PR.
YY:	The computed numeric value of the Y coordinate (Northing). REQUIRED
XX:	The computed numeric value of the X coordinate (Easting). REQUIRED
ZZ:	The computed numeric value of the Z coordinate (elevation). REQUIRED **Note:** Coordinates for control points can be written to the file, but YY:, XX:, ZZ: should be used. In this case it is recommended the error estimates (SX:, SY:, SZ:) be included with each point.
PD:, CM:, etc.	All data items that are used as point attributes in the project can be recorded in the points and chains file with that point. REQUIRED if attribute data items are present.
***	The tags that follow are REQUIRED to define survey chain connectivity that have been generated using one of the connectivity methods or by CADD.
CP:	The close project data item list the time and date that the project file was created. If it is not present in the project file, the CP: designates the date the points and chains file was created by the post processor or CADD. REQUIRED
BG:	Used to designate the beginning of the section containing the survey chains to be listed. REQUIRED
AC:CH	This activity is used to designate the beginning of the specific chain activity. A separate activity is used for each chain defined. REQUIRED

FE:	Defines the feature code to be used for the survey chain being defined. REQUIRED
CD:	The description for the chain being defined. OPTIONAL but required if in the original file.
FG:	The figure code
PL:	List of points that make up the survey chain. The format shall be as defined in the section *Defining Connectivity With SDMS*. REQUIRED
AC:CH Etc.	The chain activity and required data items is repeated for each chain to be listed in the file.
EG:	Defines the end of the section with the chain list. REQUIRED
CP:	The close project data item list the time and date that the calculated file was created by the post processing software. REQUIRED

Points and Chain File End-of-Line Sequence

The end-of-line sequence for a points and chains file is a carriage return/line feed (ASCII characters 013 and 010).

Points and Chain File End-of-File Sequence

An end-of-file sequence is not required in a points and chains file. However, if present, a Control-Z (^Z, or ASCII 026) will be used to terminate the file.

Points and Chain File Type

Points and chains files are ASCII text files.

Control File

A control file contains control coordinates and attribute information about each control point organized in a repeating pattern. The file extension is ".CTL"

Control File Structure

Data Item	Description
AC:PR	All data before the first activity, other than a project header activity, is ignored. The project header information is for documentation only. However, systems that read and write this file may need to know some of the information, such as the metadata items for units, datum, coordinate systems, combination factors, etc. Ultimately, such information should be checked against the similar settings in the system reading this data and provide warnings or conversions as needed. Any valid SDMS descriptive tags can be used under this activity. OPTIONAL
AC:XX	The AC:XX data item separates points in the control file. While most often this will be a sideshot activity data item (AC:OS), any activity data item may be used. REQUIRED
PN:	The point number data item immediately follows the activity data item. Each set of coordinates in the control file is located using the point number, so do not repeat point numbers in any one control file. REQUIRED
YC:	The numeric value of the Y coordinate (Northing) is entered into the control file using the YC: data tag. REQUIRED

	If this coordinate is unknown, the YC: data item must still be present in each entry. Either leave the data field blank or enter a -99999 to represent a missing coordinate.
XC:	The numeric value of the X coordinate (Easting) is entered into the control file using the XC: data tag. REQUIRED If this coordinate is unknown, the XC: data item must still be present in each entry. Either leave the data field blank or enter a -99999 to represent a missing coordinate.
ZC:	The numeric value of the Z coordinate (elevation) is entered into the control file using the ZC: data tag. REQUIRED If this coordinate is unknown, the ZC: data item must still be present in each entry. Either leave the data field blank or enter a -99999 to represent a missing coordinate.
PD:	The point description is entered using the PD: data tag. OPTIONAL
CM:, FE, etc…….	Any other descriptive data tag. A maximum number of 25 data tags are currently allowed in one activity. OPTIONAL
SX:	Error estimate in the X direction (Easting) of the control point. OPTIONAL
SY:	Error estimate in the Y direction (Northing) of the control point. OPTIONAL
SZ:	Error estimate in the Z direction (Elevation) of the control point. OPTIONAL

Control File End-of-Line Sequence

The end-of-line sequence for a control file is a carriage return/line feed (ASCII characters 013 and 010).

Control File End-of-File Sequence

An end-of-file sequence is not required. However, if present, a Control-Z (^Z, or ASCII 026) will be used to terminate the file.

Control File Type

Control files are ASCII text files.

Horizontal Alignment File

Horizontal Alignment File Structure

PC/PT Definition

The PC/PT definition for horizontal alignments defines the coordinates, stationing, and curvature elements for the key break points for each horizontal alignment chain. The PC/PT defined horizontal alignment uses the coordinates of the PC along with the curve radius and coordinates of the PT for each curve in the alignment. The stationing is defined in the first alignment point. This information is used for conversions between X, Y coordinates and station-offset values. ALI is used as the file extension.

The PC/PT definition horizontal alignment only supports tangents, circular curves, and points on tangent (POT's). Spirals, compound curves, and station equations are not supported.

Note: POT's can be angle points with no curve data by leaving out the RA:

Before The First Alignment Segment

Data Item	Description
AC:PR	All data before the first activity, other than a project header activity, is ignored. The project header information is for documentation only. However, systems that read and write this file may need to know some of the information, such as the metadata items for units, datum, coordinate systems, combination factors, etc. Ultimately, such information should be checked against the similar settings in the system reading this data and provide warnings or conversions as needed. Any valid SDMS descriptive tags can be used under this activity. OPTIONAL

First Alignment Segment

Data Item	Description
AC:xx	The alignment description begins here. Use any activity data item except AC:PR. Normally this will be OS or SS. REQUIRED.
PN:nnn	The point number correlates the PI point with the point in the project control file. OPTIONAL
ST:##+##	This is the stationing value at the beginning of the alignment. Enter the value in either stationing format or in decimal format. If omitted, the default beginning station will be zero. The UL response listed in the PROJECT.CFG file will define units and stationing. OPTIONAL.
XC:xxxxxx.xxx	X coordinate for the origin point of the alignment. REQUIRED.
YC:xxxxxx.xxx	Y coordinate for the origin point of the alignment. REQUIRED.
ZC:xxxxxx.xxx	The elevation (Z coordinate). OPTIONAL.
SI:xx	In an alignment file, the shot ID data tag identifies the type of segment being defined. OPTIONAL, but should be included for clarity: SI:PT is a point of tangency. It starts a straight line segment. SI:PC is a point of curvature. It starts a circular curve segment. SI:PI is the point where two tangent lines meet. If this item is not included, then a POT or PT point is assumed. If an RA: data item is included, a PC is assumed.
RA:nnn	All SI:PC points require a radius. Based on the direction of the alignment being defined, a positive value indicates a curve to the right and a negative value indicates a curve to the left.
PD:, CM:, FE:	All other data items in the activity are ignored, but may be include for documentation purposes.

Note: Each subsequent point in a PC/PT defined SDMS horizontal alignment follows the same basic format as the intermediate alignment point defined above. For the alignment to be valid, every PC point must be followed by a PT point. The last point in the alignment can be either the PT of a circular curve or a POT.

The subsequent segments (repeated as necessary)

Data Item	Description
AC:xx	As above

PN:nnn	As above
ST:##+##	Optional. The stationing of the beginning of this segment.
XC:xxxxxx.xxx	As above
YC:xxxxxx.xxx	As above
ZC:xxxxxx.xxx	As above
SI:xx	As above
RA:nnn	If SI:PC.
RA:nnn	As above
PD:, CM:	As above

See the Appendix for an example of an alignment file based on the PC/PT definition.

PI Definition

The PI definition for horizontal alignments defines the coordinates, stationing, and curvature elements for the key break points for each horizontal alignment chain. The PI defined horizontal alignment uses the coordinates of the PI points along with the key curve and/or spiral elements for each curve in the alignment. The stationing is defined in the first alignment point. This information is used for conversions between X, Y coordinates and station-offset values

The PI definition supports angle points with no curve data, circular curves, spiral curves, compound curves and station equations. The first and last PI listed in the file must not have curve or spiral data included. ALI is used as the file extension for Alignment files.

Note: The PI Definition requires the inclusion of "TY:PI" in the alignment file. The TY:PI must appear after AC:PR, if present, and before the first equation or point activity for defining an alignment point.

The first segment in an alignment file is shown in the following table:

Data Item	Description
AC:PR	All data before the first activity, other than a project header activity, is ignored. The project header information is for documentation only. However, systems that read and write this file may need to know some of the information, such as the metadata items for units, datum, coordinate systems, combination factors, etc. Ultimately, such information should be checked against the similar settings in the system reading this data and provide warnings or conversions as needed. Any valid SDMS descriptive tags can be used under this activity. OPTIONAL
TY:PI	Indicates the PI Definition is to be used. REQUIRED.
AC:EQ	The Station Equations Activity is required to define the location of station equation points if the alignment contains station equations. All equations must be listed in the order they appear in the alignment and cannot be located on a curve or spiral element.
EQ:#	Equation number is used to indicate the number of the equation in the alignment and can be used as the identifier of the station equation point as needed by other software interpreting the alignment. OPTIONAL
SB:###+##	Defines the station back of the equation. REQUIRED
ST:###+##	Defines the station ahead of the equation. REQUIRED

PD:, CM:, FE:	All other tags listed with the activity are ignored in computatons, but may be included for documentation purposes.
AC:xx	The alignment description begins here. Use any activity data item except AC:PR or EQ:. REQUIRED **Note:** The alignment must start at a PI with no curve or spiral data. It must be a point on the tangent before the first curve or spiral point in that alignment.
PN:nnn	The point number correlates the PI point with the point in the project control file. OPTIONAL
ST:##+##	This is the stationing value at the beginning of the alignment. Enter the value in either stationing format or in decimal format. If omitted, the default beginning station will be zero. The UL: response listed in the PROJECT.CFG file will define units and stationing. OPTIONAL but RECOMMENDED.
XC:xxxxxx.xxx	Defines the X coordinate of the starting point of the alignment. REQUIRED.
YC:xxxxxx.xxx	Defines the Y coordinate of the starting point of the alignment. REQUIRED
ZC:xxxxxx.xxx	The Z coordinate (elevation). OPTIONAL
SI:PI	SI:PI is the point where two tangent lines meet. It defines the circle arc segment. A shot identification should be entered for each segment. REQUIRED
AC:xx	Activity for the next segment in the alignment. Use any activity data item except AC:PR or EQ:. REQUIRED
PN:nnn	The point number correlates the PI point with the point in the project control file. OPTIONAL
ST:##+##	The stationing of each intermediate PI for the horizontal alignment being defined. OPTIONAL. **Note:** ST: can be included for informational purposes, but should be ignored in computations. All data is computed based on the first point station (ST:) value and any station equations defined by AC:EQ.
XC:xxxxxx.xxx	Defines the X coordinate of an intermediate point in the alignment. REQUIRED.
YC:xxxxxx.xxx	Defines the Y coordinate of an intermediate point in the alignment. REQUIRED
ZC:xxxxxx.xxx	The Z coordinate (elevation). OPTIONAL
RA:nnn	Defines the radius of a curve or curve/spiral combination. Based on the direction of the alignment being defined, a positive value indicates a curve to the right and a negative value indicates a curve to the left. REQUIRED **Note:** A radius is not required for PIs with no curve defined (normally called an angle point).
PD:, CM:	All other tags listed with the activity are ignored in computations, but may be included for documentation purposes.
*	Any of the tags that follow can be used as attributes for a simple curve. These tags are not used in computations.
TL:nnn	The tangent length (distance from the PI to the PC or PT).
EX:nnn	The external (distance from the PI to the curve midpoint).
MO:nnn	The middle ordinate (distance from the curve midpoint to the long chord midpoint).

LC:nnn	The long chord (distance from the PC to the PT).
DA:	The delta angle on the direction of the alignment being defined, a positive value indicates a curve to the right and a negative value indicates a curve to the left.
PD:, CM:, FE:	All other tags in the shot are ignored, but may be include for documentation purposes.
*	The tags that follow are required to define the various curve/spiral combinations. Supported combinations are defined following the table.
R1:nnn	Defines the beginning radius for certain spiral curve combinations.
R2:nnn	Defines the ending radius for certain spiral curve combinations.
S1:nnn	The length of an entry spiral.
S2:nnn	The length of an exit spiral.
S3:nnn	The length of a connecting spiral.

The subsequent segments (repeated as necessary)

Data Item	Description
AC:xx	As above. The activity is used to define each intermediate PI in the horizontal alignment. Use any activity data item except AC:PR or EQ:.
PN:nnn	As above.
ST:##+##	The stationing of each intermediate PI for the horizontal alignment being defined. As above. OPTIONAL
XC:xxxxxx.xxx	Defines the X coordinate of each intermediate PI in the alignment. REQUIRED
YC:xxxxxx.xxx	Defines the Y coordinate of each intermediate PI in the alignment. REQUIRED
ZC:xxxxxx.xxx	As above.
SI:PI	As above.
RA:nnn	As above, including additional tags required to define spiral/curve combinations.
PD:, CM:	As above.
***	**Note:** The alignment must end at a PI with no curve or spiral data. It must be a point on the tangent after the last curve or spiral point in that alignment. The data that follows is needed for the Final Point in an alignment.
AC:xx	As above. REQUIRED
PN:nnn	As above. REQUIRED
ST:##+##,n	The stationing of the final PI for the horizontal alignment being defined. As above. OPTIONAL
XC:xxxxxx.xxx	Defines the X coordinate of the final point in the alignment. REQUIRED
YC:xxxxxx.xxx	Defines the Y coordinate of the final point in the alignment. REQUIRED
ZC:xxxxxx.xxx	As above.
SI:PI	As above.
PD:, CM:	As above.

See the Appendix for an example of an alignment file based on the PI definition.

Horizontal Alignment File End-of-Line Sequence

The end-of-line sequence for a horizontal alignment file is a carriage return/line feed (ASCII characters 013 and 010).

Horizontal Alignment File End-of-File Sequence

An end-of-file sequence is not required. However, if present, a Ctrl-Z (^Z, or ASCII 026) will be used to terminate the file.

Horizontal Alignment File Type

Horizontal alignment files are ASCII text files.

Vertical Alignment File

Vertical Alignment File Structure

A vertical alignment file defines the VPI points specified by station and elevation. This information is used to compute the profile grade line elevation at any station along the alignment. Symmetrical and asymmetrical vertical curves are specified by defining the lengths of the parabolic curves along the vertical alignment. The first and last VPI points listed in the file are beginning and ending point, respectively, and cannot have vertical curve lengths listed with them. PRO is used as the file extension for Vertical Alignment files.

Note: The vertical alignment control points (VPT, VPI, VPT) do not have to correspond to control points in the associated horizontal alignment file. But, the stationing used for the vertical alignment control points must be within the stationing defined in the associated horizontal alignment file.

The first segment in a vertical alignment file is shown in the following table:

Data Item	Description
AC:PR	All data before the first activity, other than a project header activity, is ignored. The project header information is for documentation only. However, systems that read and write this file may need to know some of the information, such as the metadata items for units, datum, coordinate systems, combination factors, etc. Ultimately, such information should be checked against the similar settings in the system reading this data and provide warnings or conversions as needed. Any valid SDMS descriptive tags can be used under this activity. OPTIONAL
AC:EQ	Station Equations are optional in the profile file. The equations define the location of a station equation point on the horizontal alignment. The equations cannot be related to the vertical alignment itself. All equations must be listed in the order they appear in the horizontal alignment and cannot be located on a curve or spiral element.
EQ:#	Equation number is used to indicate the number of the equation in the alignment and can be used as the ID of the station equation point as needed by other software interpreting the alignment. OPTIONAL.
SB:###+##	Defines the station back of the equation. REQUIRED
ST:###+##	Defines the station ahead of the equation. REQUIRED
PD:, CM:, FE:	All other tags in the shot are ignored, but may be include for

	documentation purposes.
AC:xx	The alignment description begins here. Use any activity data item except AC:PR or EQ:.
PN:nnn	The point number correlates the PI point with the point in the project control file. OPTIONAL
ST:##+##,n	This is the stationing value at the beginning of the vertical alignment (VPI). The value may be either stationing format or decimal format. If no station is defined the default value is zero. REQUIRED. **Note:** The vertical alignment control points (VPT, VPI, VPT) do not have to correspond to control points in the associated horizontal alignment file. But, the stationing used for the vertical alignment control points must be within the stationing limits defined in the associated horizontal alignment file. **Note:** If the station value could occur at two or more locations, the format "###+##,n" is used. "n" is a positive integer value used to indicate the section of the alignment in which the equation is located (n=1, meaning between the beginning of the alignment and the first station equation; n=2, second section; etc.). If "n" is not given, the first section of the alignment is assumed. In other words, there are no station equations involved.
XC:xxxxxx.xxx	The X coordinate for the beginning point of the vertical alignment, based on the stationing of the horizontal alignment being used. OPTIONAL.
YC:xxxxxx.xxx	The Y coordinate for the beginning point of the vertical alignment, based on the stationing of the horizontal alignment being used. OPTIONAL.
ZC:xxxxxx.xxx	The elevation of the beginning point of the vertical alignment. REQUIRED.
SI:VPI	VPI for the point at the beginning and end of the vertical alignment and where two vertical slope lines meet. REQUIRED.
L1:xxxx	Defines the length of vertical curve from the VPC to the VPI along the station axis. REQUIRED.
L2:xxxx	Defines the length of vertical curve from the VPI to the VPT along the station axis. This value will equal L1: for symmetrical curves, but must be listed. REQUIRED.
AC:xx	The description of the next segment begins here. Use any activity data item except AC:PR or EQ. REQUIRED.
PN:nnn	The point number correlates the PI point with the point in the project control file. OPTIONAL
ST:##+##,n	This is the stationing value of the second VPI of the vertical alignment. The value may be either stationing format or decimal format. REQUIRED **Note:** If the station value could occur at two or more locations, the format "###+##,n" is used. "n" is a positive integer value used to indicate the section of the alignment in which the equation is located (n=1, meaning between the beginning of the alignment and the first station equation; n=2, second section; etc.). If "n" is not given, the first section of the alignment is assumed. In other words, there are no station equations involved.
XC:xxxxxx.xxx	The X coordinate for the second VPI of the vertical alignment, based on the stationing of the associated horizontal alignment. OPTIONAL.
YC:xxxxxx.xxx	The Y coordinate for the second VPI of the vertical alignment, based on the stationing of the associated horizontal alignment. OPTIONAL.
ZC:xxxxxx.xxx	The elevation for the second VPI of the vertical alignment. REQUIRED
SI:VPI	As above

L1:xxxx	As above
L2:xxxx	As above
AC:	Repeat as above to define each VPI in the vertical alignment. Remember that the last VPI cannot contain vertical curve data.

See the Appendix for an example of a vertical alignment file.

Vertical Alignment File End-of-Line Sequence

The end-of-line sequence for a vertical alignment file is a carriage return/line feed (ASCII characters 013 and 010).

Vertical Alignment File End-of-File Sequence

An end-of-file sequence is not required. However, if present, a Ctrl-Z (^Z, or ASCII 026) will be used to terminate the file.

Vertical Alignment File Type

Vertical alignment files are ASCII text files.

Superelevation File

Superelevation File Structure

A superelevation file defines the vertical/horizontal slope ratio to be used at any given station along the roadway being defined. The file is structured to indicate the station number and slope ratio to the left and right of centerline. SUP is used as the file extension for Superelevation files.

This information is used in stake out to determine the left and right side slopes of the roadway surface at any station along the alignment. Transition sections are computed based on interpolation between the stations listed in the file.

Data Item	Description
AC:PR	All data before the first activity, other than a project header activity, is ignored. The project header information is for documentation only. However, systems that read and write this file may need to know some of the information, such as the metadata items for units, datum, coordinate systems, combination factors, etc. Ultimately, such information should be checked against the similar settings in the system reading this data and provide warnings or conversions as needed. Any valid SDMS descriptive tags can be used under this activity. OPTIONAL
AC:EQ	Station Equations are optional in the superelevation file. Equations, if listed, must be the same equations listed in the horizontal alignment file. All equations must be listed in the order they appear in the alignment and cannot be located on a curve or spiral element .
EQ:#	Equation number is used to indicate the number of the equation in the alignment and can be used as the ID of the station equation point as needed by other software interpreting the alignment. OPTIONAL.
SB:###+##	Defines the station back of the equation. REQUIRED
ST:###+##	Defines the station ahead of the equation. REQUIRED
PD:, CM:,	All attribute tags in the shot are ignored in computations, but may be

FE:, etc.	included for documentation purposes.
AC:xx	The alignment description begins here. Use any activity data item except AC:PR or EQ:.
ST:nn+nn	This is the beginning stationing value at the beginning or within the stationing defined by the horizontal alignment. The value may be either stationing format or decimal.
E1:xxxx	Defines the superelevation slope rate on the left side. Slopes are expressed in feet/feet or meter/meter (i.e. -0.02 is a 2% slope downwards)
E2:xxxx	Defines the superelevation slope rate on the right side. Slopes are expressed in feet/feet or meter/meter (i.e. -0.02 is a 2% slope downwards)
PD:,CM:	Can be used to tell what the transition is. For example, CM:End Normal Crown Section.
AC:xx	A new activity is used for each change in superelevation transition to be defined, whether on one side or both sides of the horizontal alignment. Use any activity data item except AC:PR or EQ:.
ST:##+##,n	This is the stationing value for the transition being defined. The value may be either stationing format or decimal format. REQUIRED **Note:** If the station value could occur at two or more locations, the format "###+##,n" is used. "n" is a positive integer value used to indicate the section of the alignment in which the equation is located (n=1, meaning between the beginning of the alignment and the first station equation; n=2, second section; etc.). If "n" is not given, the first section of the alignment is assumed. In other words, there are no station equations involved.
E1:xxxx	Defines the superelevation slope rate on the left side. Slopes are expressed in feet/feet or meter/meter (i.e. -0.02 is a 2% slope downwards)
E2:xxxx	Defines the superelevation slope rate on the right side. Slopes are expressed in feet/feet or meter/meter (i.e. -0.02 is a 2% slope downwards)
PD:,CM:	Can be used to tell what the transition is. For example, CM:End Full Super Section.
AC:	Repeat activities, as required, to define superelevation transitions.

See the Appendix for an example of a superelevation file.

Superelevation File End-of-Line Sequence

The end-of-line sequence for a superelevation file is a carriage return/line feed (ASCII characters 013 and 010).

Superelevation File End-of-File Sequence

An end-of-file sequence is not required. However, if present, a Ctrl-Z (^Z, or ASCII 026) will be used to terminate the file.

Superelevation File Type

Superelevation files are ASCII text files.

Section V - General Rules of SDMS Tasks and Activities

Overview

There are a number of basic rules that should be used and followed in the development of data collection and processing software using SDMS. These rules have an effect on the actual field data collection procedures, as well as the way the processing software uses the field generated project file information.

Rules

The following lists contain some of the basic rules that should be followed in the data collection and processing software.

1. Only certain activities are allowed with a given task. These are somewhat definable by the user in the TASK.TGS file, but there are also some restrictions imposed by the processing routines. For example, an activity of stationing to define the nominal station is not valid when doing a traversing task and even if the user figured out a way to edit that tag into the TASK.TGS file, the processing software would not understand how to use it.

2. SDMS Collector does not change to the default sequence for the activity currently displayed until the user presses <ENTER> on that new AC. Therefore, nothing in the previously completed activity is stored to the project file until the new activity is accepted. This feature allows the user to modify items in the previously completed activity without having to use the Edit command. This is done by moving the cursor over the currently displayed activity and typing in any valid data tag. The data tag and response will be added to the bottom of the previous activity. SDMS Collector will then redisplay the next activity prompt. This procedure allows the user to either add an item to an activity that is not in the default prompts for an activity listed in the TASK.TGS file, or to change an already entered item in the activity by entering the same data tag and a new response.

3. Within any activity, only the last occurrence of a data tag is used by the processing software. The purpose of this rule relates to the rule in surveying of never erasing in a field book. For example, if a mistake was made by recording a feature as FE:CURB that should have been FE:EC, another line with FE:EC can be added following the incorrect entry and the processing software will assume this last line is the correct one.

   There are a few exceptions to this rule for data that does not fit in the 25 characters allowed per data item. Presently, five data tags can be listed multiple times within an activity. The data tags are: comments (CM:), point lists (PL:), point descriptions (PD:), chain descriptions (CD:), and chain lists (CH:). Each appearance of these data tags and the responses will be passed to the calculated file by the post processing software.

4. Certain data tags are treated as toggles by the processing software. This means if these data items are defined in one activity, they will be used as defined in all subsequent activities and computations where they are needed as if they are the same as last defined.

   Two primary examples of this rule are staff height (SH:), and instrument height (IH:). If an AC:SS is performed to measure a sideshot point and SH:5.5 is entered, then 5.5 feet will be used in computing all subsequent AC:SS coordinate values, even if the SH data tag does not appear within those subsequent sideshot activities. If the user does not define the SH: or IH: in any activity in the data set, then the processing software uses a built-in default value. Sometimes this built-in value is user definable, and sometimes it is “hard coded” by the program developer.

   Other data tags that follow this rule are combination factor (CF:); all of the data tags used to define Header, Units, and Datum information; instrument type (IT:); and, other data tags related to instrument constants. There is also the SI data tag that defines the shot identification and once designated will apply to all succeeding shots until the response is changed. As an example, this is used to designate which shots in a PRJ are to be used for cross section purposes only and which are to be used for topography.

   Related to this rule is how the prompting schemes work in SDMS Collector. If the user defines a certain activity to prompt for certain data tags every time that activity is used, then SDMS Collector will present the prompt with the data field filled in with the entry made the last time that data tag was used. This rule is true for most descriptive data tags. A few exceptions are those related to Point Numbers (PN:); origin/Destination (OD:); Set (SE:); and, Face (FC:). The data fields can be defined to increment from the last entry for these data tags.

5. If a data tag is being prompted for but no data entry is desired for that particular tag, the user can press <ENTER> with a blank data field and the software will eliminate that line from the data set as if the prompt had never been made. If the user never wants that prompt to appear, it can be removed from the definition of that activity within that Task in the TASK.TGS file.

6. When the proceessing software encounters a normally required coordinate data tag response field that has no value available, -99999 shall be used to fill that field to indicate the value is missing. This includes XC:, YC:, ZC:, XX:, YY:, and ZZ:. SDMS files (PRJ, CAL, CTL) compiled with SDMS Release 3.2 and earlier may also have a null value for the PD: data tag. This value is not to be confused with the possibility of negative coordinates being encountered. The

only exception is the DOS version of SDMS Collector (Release 3.4x and earlier). Those versions use -99999.000 to indicate the NULL value.

SDMS contains many tags that can be used by a survey crew to communicate how points are to be connected in a drawing, used in a DTM routine, etc.

7. The Geometry (GM:) data tag is used to define a point as a line point or a curve point. If the activity has a GM:C line, this indicates to CADD software that this point is on a curved line. Various algorithms can also be developed to evaluate how many points in succession are defined as C (curve points) to determine if the points are to be connected with straight line segments or curved line segments. If the user does not define this GM: data tag, the default value of line point (GM:P) is normally assumed and all connections would be made with straight line segments. The user would have to review their CADD processing software rules to know how GM: may be interpreted and what happens in various combinations of points with GM: values.

8. The Class (CL:) data tag can be used to define a point as a Feature point or a Ground point for DTM software. This allows the user to collect information on points for two dimensional (2D) presentations that do not have valid or accurate elevations or for use in three dimensional (3D) computations or presentations that do have valid or accurate elevations. The options are currently CL:F for a 2D feature point and CL:G for a 3D ground point. The default in this case would probably be GM:G, but the various third party processing software systems may treat this differently and may employ other interpretation rules and responses to define various situations.

   Some processing software actually key the nature of a point off of the FE: data field. The reason for this is that 95% of the time if the feature is known, it is also known whether the point should be 2D or 3D. If the surveyor needs to override this FE: related definition of a point, he may choose to use the CL: data field after the FE: data field to override the default for that FE:.

9. The FE: and CL: tags can also be used by processing software to define feature and class of other objects being measured and defined such as chains.

10. The SDMS data structure allows the developer of processing software to assign their own rules for how point identifications are assigned. One current processing tool merges the FE: and PN: data fields to form an alphanumeric point identifier. Therefore, an AC:SS with a PN:498 and a FE:CULV would become CULV498 in the processing software. Currently, only numeric point numbers are supported in SDMS Collector.

These are just a few examples of how SDMS tags can be used to communicate more information to a processing software system. Many similar rules can be established, but they would need to be defined in the documentation for that tool and then communicated to the surveyor collecting the field data.

Section VI - Defining Connectivity with SDMS

Overview

This section provides a detailed explanation of how SDMS defines connectivity (surveyed figures and/or chains). Data collection procedures and processing software results are defined for each method of connectivity listed.

Defining Connectivity in the SDMS Project File

Defining connectivity refers to the method used to indicate which surveyed points should be connected together to form linear and curvilinear features such as centerlines, edges of pavements, break lines, fences, and so on. The word chains will be used to refer to the figures formed by connecting points. The definition of chains is vital to producing good maps and accurate digital terrain model surfaces. Obtaining accurate measurements is the first priority of a survey crew. However, just knowing the positions of the points is not very helpful if there is no information related to what the points represent and how they are connected to one another. The decision on which connectivity method is used has an enormous impact on the procedures used by the field crew.

SDMS Collector records data in the same order the measurements were taken in the field. It would be fairly easy to define point connectivity if the field crew was forced to collect points along a chain from one end to the other, and was not allowed to take other shots that are not part of that chain. However, this is not always an efficient way to operate. A more efficient procedure is to move the instrument along a corridor or to different spots around a site and to take as many measurements from each set up position as possible. This method results in a file where the points on any given chain are scattered throughout the file, and in which several chains may be in progress simultaneously.

Connecting the points to define chains is the job of the post-processing software that interprets the SDMS data. But the field data collection procedure needs to provide the post-processing system with the intelligence to do that correctly. SDMS has several different methods of tagging points for chain definition. Each method has its advantages and the selection is to some extent a matter of personal preference. These methods include:

- Connectivity By Figure Code
- Connectivity by Origin-Destination
- Connectivity with the Chain Activity
- Connectivity by Feature Code
- Connectivity by Taping

Other information may also be needed when defining chains. This can be accomplished by adding data tags to define attributes of the chain being defined. Tags can be used to designate such things as:

- The chain feature code
- Whether the chain represents a surface break line or just a planimetric feature
- Which points in the chain are angle points and which are points on curves
- Graphical attributes such as level, color, and line style

The SDMS Collector software provides a wide variety of methods to define connectivity. Details on several of these methods are provided in the sections that follow. It is important to remember that the method used for defining connectivity and assigning attributes to chains must be compatible with the post-processing software that interprets the SDMS data file.

Defining Connectivity in the SDMS Calculated File

The Chain Activity (AC:CH) is used in the calculated file (.CAL) to define the point connectivity and other chain information. The post processing software interprets the connectivity information in the SDMS project file (.PRJ) to build the various chains. This process produces a separate Chain Activity (AC:CH) for each chain defined in the project file.

All of the Chain Activities that are generated by SDMS Processor will be shown at the bottom of the SDMS calculated file and will always follow the points in the calculated (CAL) file. The CAD software being used needs to be able to read and interpret the SDMS calculated file to display the points and chains.

The user can also manually create additional chains during field data collection, as well as during the post-processing phase. An existing chain activity can be edited or a new chain activity can be manually entered into the project file. The user will have to reprocess the data in the project file for any edited information to be passed to the calculated (CAL) file. The chains listed at the bottom of the calculated file can also be edited or new chain activities can be added manually. No further checks will be made by the processing software to verify the information is correct. Therefore, the user must be sure the points being used in the manually created chain activities are in the calculated file.

Note: The chain list at the bottom of the file will always be preceded by the Close Project (CP:) data item. If the project file being processed has the Suspend Project (SP:) data item or no data item indicating the end of the project file, then the Close Project (CP:) data item must be added by the post processing software to separate the chain list generated from the field generated shot data.

Connectivity by Figure Code

The Figure data item (FG:) offers a simple way of defining connectivity. In this method each chain is assigned a unique figure code and every measured point that is part of a chain is tagged with the figure code of that chain. The survey of a roadway is an example. The left edge-of-pavement is designated as Figure 1 (FG:1) and the right edge-of-pavement as Figure 2 (FG:2). Every point measured on the left pavement edge must include the data item FG:1 and every point on the right edge must include FG:2. The post-processing software should then form a chain for the left edge by connecting all of the points tagged with FG:1. Depending on the algorithm used by the post processor system, connecting of points with common FG numbers can either be in shot order or by point number. Likewise, the post-processing software should form a chain for the right edge by connecting all points tagged with FG:2.

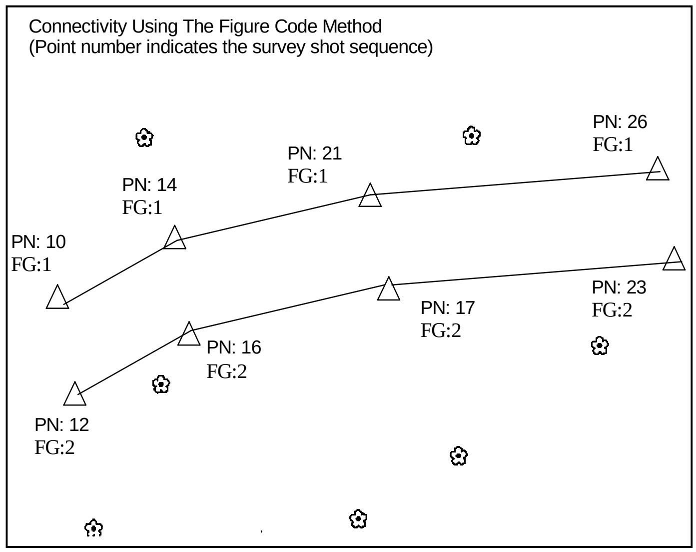


Figure 6.1 – Connectivity by Figure Code

SDMS Processor connects points in shot order by default. Chains connected by point number can be generated using the Chain Activity (AC:CH) at any time during the data collection session.

Project File for Connectivity by Figure Code

The information shown in Figure 6.1 will be used to create a chain using Figure Codes (FG:). Each point is labeled with its point number (PN:) and Figure Code (FG:). The point numbers correspond to the shot sequence used in the field.

```
AC:SS
PN:10
FG:1
FE:EPL
CD:LEFT PAVEMENT EDGE
SH:5
HZ:45.2354
VT:90.3045
DS:100.44
AC:SS
PN:14
FG:1
FE:EPL
SH:5
HZ:55.2853
VT:90.3006
```

```
DS:180.94
AC:SS
PN:21
FG:1
FE:EPL
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
...., ETC.
CP:09/18/1999 18:46:43
```

This data represents the first three points that make up the chain defined by Figure 1 (FG:1). The FG: data item tells the processing software to generate Figure 1, and to connect PN:10 to PN:14 to PN:21. The chain would continue based on all points found in the file with FG:1 as the assigned Figure Code.

This method does impose the restriction that the points on a given chain must be measured in shot order working from one end of the chain towards the other, but not necessarily in sequential shots. It does allow any number of chains to be in progress simultaneously. The field crew must keep track of the Figure Codes used for each chain. The other chain attributes, such as the feature code, are usually defined as data items on the first point of each chain.

The Calculated File for Connectivity by Figure Code

The shot sequence used in the Project File for Connectivity by Figure Code section, would be listed in the SDMS calculated file (.CAL) as:

```
AC:SS
PN:10
FG:1
FE:EPL
CD:LEFT PAVEMENT EDGE
SH:5
HZ:45.2354
VT:90.3045
DS:100.44
XX:####        (Calculated X coordinate)
YY:####        (Calculated Y coordinate)
ZZ:####        (Calculated Z coordinate)
AC:SS
PN:14
FG:1
FE:EPL
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
XX:####
YY:####
ZZ:#####
AC:SS
PN:21
FG:1
FE:EPL
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
XX:####
YY:####
ZZ:#####
...., ETC.
CP:09/18/1999 18:46:43
BG:Begin Chain List
AC:CH
FG:1
```

```
FE:EPL
CD:LEFT PAVEMENT EDGE
PL:10,14,21
….ETC.
EG:End Chain List
CP:09/27/1999  13:15:18
```

Connectivity by Origin-Destination

Connectivity using origin-destination (OD:) is designed to let each point on a chain indicate the point number of the next point on that chain. This method does not require the FG: data item be included with each side shot activity (AC:SS) that will be part of the figure in the project file. A feature code data item (FE:) is recommended for each chain point, but it is not required. The feature code used does not have to be the same for every point. The points do not have to be sequential in the project data file, that is measured one after the other, but they must be within the project file for the chain being defined.

The post processing software will use the feature code of the first point encountered with an OD: data item in the project file for a particular figure and assign that feature to the chain to be created. If no feature code (FE:) is recorded for that chain point in the project file, the processing software being used should assign a user defined or default feature code for the chain created. The post processing software will also assign a figure code number (FG:) to identify the figure. Normally, the value assigned will be in a range that would not be assigned in the field or is set by the user in the post processing software. Most post processing software will make a series of two point chains when this technique is used. The figure created will appear in the chain list at the bottom of the calculated file or points and chain file.

Figure 6.2 shows a sample data set for which chains were defined with the Origin-Destination method. The labels on each point give the point number and Origin-Destination data item. The point number corresponds to the shot sequence. This method allows chain points to be collected out of sequence. This method can also be used along with the Figure Code method to designate that a certain point can be part of one chain based on the figure code (FG:) and part of another chain based on the origin/destination (OD:).

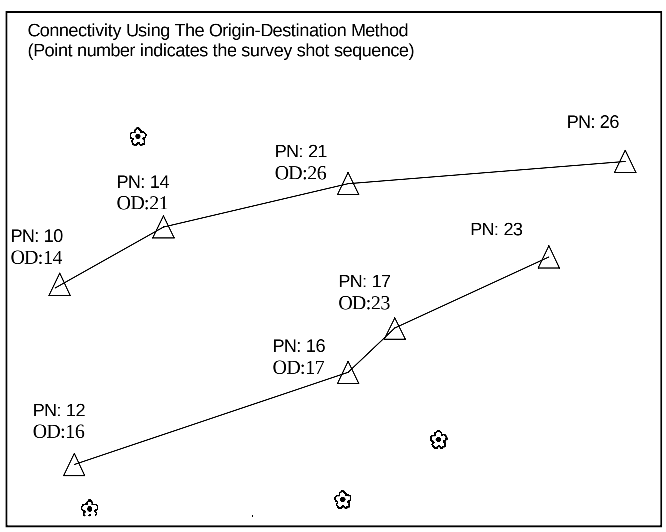


Figure 6.2 – Connectivity by origin/destination

Project File for Connectivity by Origin-Destination

An example of how this method works uses the information shown in Figure 6.2. If PN:10 is side shot from the current occupied station, and it is part of a chain for which the next point is PN:14, the following information might be recorded:

```
AC:SS
PN:10
FE:CURB       (defines the feature code of the first chain as CURB)
CD:CURB LINE
SH:5
HZ:45.2354
VT:90.3045
DS:100.44
OD:14         (points to point number 14 as the next point in the CURB
              chain)
AC:SS
PN:12
FE:FENCE      (defines the feature code of the next chain as FENCE)
SH:5
HZ:45.2354
VT:90.3045
DS:100.44
OD:16         (points to point number 16 as the next point in the
              FENCE chain)
AC:SS
PN:14
FE:CURB
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
OD:21
AC:SS
PN:16
FE:FENCE
SH:5
HZ:45.2354
VT:90.3045
DS:100.44
OD:17
AC:SS
PN:17
FE:FENCE
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
OD:23
...., ETC.
CP:09/18/1999 18:46:43
```

The OD: data item under the shot activity for PN:10 tells the processing software to create a figure, using a Figure Code (FG:) assigned by the post processor, to connect PN:10 to PN:14 using the feature code CURB (FE:CURB). The OD: data item under the shot activity for PN:14 tells the post-processing software to add PN:21 to the chain.

The Calculated file for Connectivity by Origin-Destination

The shot sequence used in the Project File for Connectivity by Origin-Destination section, would be listed in the SDMS calculated file (.CAL) as:

```
AC:SS
PN:10
FE:CURB
CD:CURB LINE
SH:5
HZ:45.2354
```

```
VT:90.3045
DS:100.44
XX:####        (Calculated X coordinate)
YY:####        (Calculated Y coordinate)
ZZ:####        (Calculated Z coordinate)
OD:14
AC:SS
PN:14
FE:CURB
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
XX:####
YY:####
ZZ:#####
OD:21
...., ETC.
CP:09/18/1999 18:46:43
BG:Begin Chain List
AC:CH
FG:1000        (Figure Code assigned by the post processing software
               since not given)
FE:CURB
CD:CURB LINE
PL:10,14
AC:CH
FG:1001        (Figure Code assigned by the post processing software
               since not given)
FE:CURB
CD:CURB LINE
PL:14,21
AC:CH
FG:1002        (Figure Code assigned by the post processing software
               since not given)
FE:FENCE
CD:6’ CHAIN LINK FENCE
PL:12,16
AC:CH
FG:1003        (Figure Code assigned by the post processing software
               since not given)
FE:FENCE
CD:6’ CHAIN LINK FENCE
PL:16,17
AC:CH
FG:1002        (Figure Code assigned by the post processing software
               since not given)
FE:FENCE
CD:6’ CHAIN LINK FENCE
PL:17,23
….ETC.
EG:End Chain List
CP:09/27/1999  13:15:18
```

Connectivity with the Chain Activity and Chain Data Item

Chain Activity

The chain activity (AC:CH) can be used in the project file during data collection and in the resulting calculated file to define a chain manually. It can be used along with any of the other connectivity methods described. Shot order is not critical when using the chain activity in this manner, but the points listed must be in the project file in which the manually added chain activity appears. The point list (PL:) and chain list (CH:) data items are used to specify which points connect in what order.

The PL: data item is an exception to the rule that only the last occurrence of a data item in an activity is significant. All PL: data items in the chain activity are used to create the list of points to be connected. The post processing software should interpret the last point of any PL line as connecting to the first point in the next PL line. This rule is followed for each PL: data item encountered within a specific chain activity (AC:CH).

The primary advantage to this method is that points may be shot in any order. Another advantage is that it is easy to use the same measured point in more than one chain, so that chains join and intersect cleanly at the same common point.

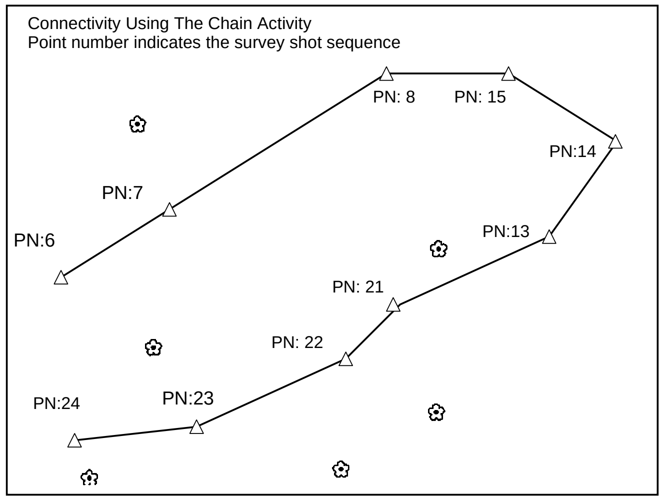


Figure 6.3 – The Chain Activity

For example, the topography shown in Figure 6.3 could be listed in the project file as:

```
AC:CH
FE:FENCE
CD:OUR FENCE LINE
FG:10
PL:6-8,15-13
PL:21-24
```

The chain activity (AC:CH) defines a chain whose feature code is FENCE, and which connects points 6, 7, 8, 15, 14, 13, 21, 22, 23, and 24 in that order. Notice that the PL: data item is an exception to the rule that only the last occurrence of a data item in an activity is significant. All PL: data items in the chain activity are used to create the list of points to be connected. The calculated file would first list the shot information and computed coordinates for the points in the list.

The chain created would be listed at the bottom of the calculated file as:

```
BG:Begin Chain List
AC:CH
FE:FENCE
CD:OUR FENCE LINE
FG:10
PL:6-8,15-13,21-24
EG:End Chain List
CP:09/27/1999  13:15:18
```

Creating a Gap With the Chain Activity

A gap can be created in the chain by including two commas in a row. For example,

```
AC:CH
FE:FENCE
CD:OUR FENCE LINE
FG:10
```

```
PL:6-8,,15-13
PL:21-24
```

will create a gap between points 8 and 15, as shown in Figure 6.4.

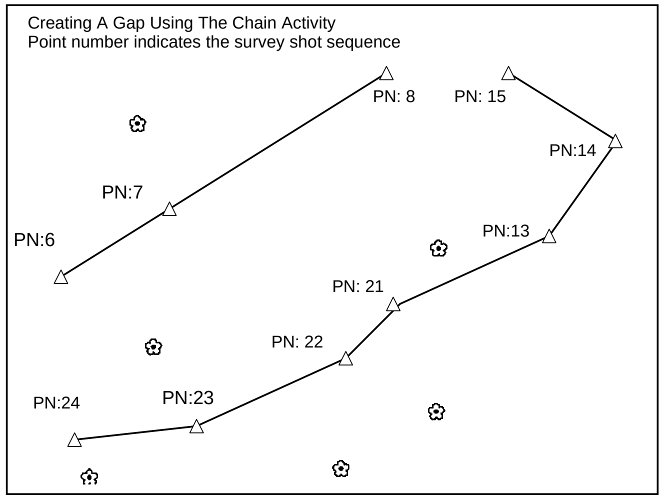


Figure 6.4 – Gap in a Chain

The chain created will be listed at the bottom of the calculated file as:

```
BG:Begin Chain List
AC:CH
FE:FENCE
CD:OUR FENCE LINE
FG:10
PL:6-8,,15-13,21-24
EG:End Chain List
CP:09/27/1999  13:15:18
```

Creating a Closed Chain with Chain Activity

The chain can be closed by adding the first point in the point list to the end of the point list. For example,

```
AC:CH
FE:FENCE
CD:OUR FENCE LINE
FG:10
PL:6-8,15-13
PL:21-24,6
```

will close the figure, as shown in Figure 6.5.

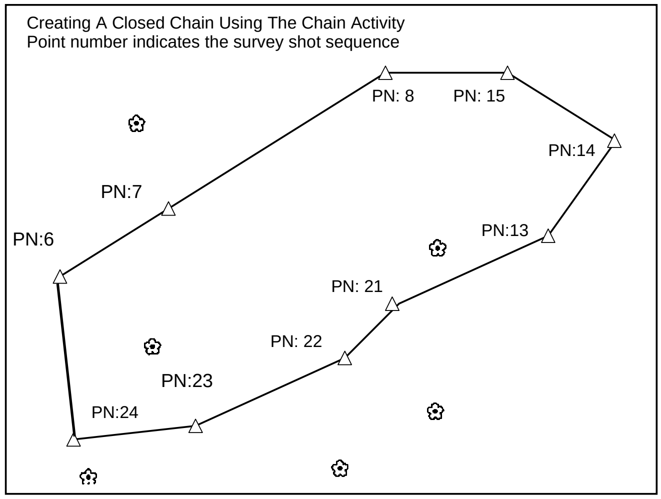


Figure 6.5 – Creating a Closed Chain

The chain created will be listed at the bottom of the calculated file as:

```
BG:Begin Chain List
AC:CH
FE:FENCE
CD:OUR FENCE LINE
FG:10
PL:6-8,15-13,21-24,6
EG:End Chain List
CP:09/27/1999  13:15:18
```

Chain (CH:) Data Item

The CH: data item (not to be confused with the Chain Activity, AC:CH) can be used to include the points in a previously defined chain. For example, the sequence

```
AC:CH
FE:EPL
CD:LEFT PAVEMENT EDGE ENTIRE PROJECT
FG:11
PL:1-3
CH:10
PL:31,32
```

Defines a chain with feature code EPL that connects points 1, 2, and 3 to the points already listed for the chain stored as Figure 10 (FG:10), then connects to points 31 and 32. This chain is stored as Figure 11 (FG:11). Multiple CH: data items may also be used in the chain activity. The calculated file would list the shot information and computed coordinates for the points in the list. The chain will be listed at the bottom of the calculated file as:

```
BG:Begin Chain List
AC:CH
FE:EPL
CD:LEFT PAVEMENT EDGE ENTIRE PROJECT
FG:11
PL:1-3,6-8,15-13,21-24,31,32
EG:End Chain List
CP:09/27/1999  13:15:18
```

Connectivity by Feature Code

The feature code methodology defines connectivity by using the same unique feature code for all of the points on a given chain. This method is similar to the figure code method, except that instead of giving the feature code and figure code as separate data items, the figure code is directly linked to the feature code. Project sites usually have more than one chain of the same type. Therefore, some procedure must be used to indicate when a specific chain begins and ends.

One procedure is to assign a unique feature code (FE:) for each chain that will be encountered. The project header must indicate this procedure is being used by adding the the chain desciription data tag (CD:) with the response “FE” (CD:FE).

The second procedure uses the same feature code for chains of the same type and designates where each individual chain begins and ends by using the shot identification (SI:) data tag. The project header must indicate this procedure is being used by adding the chain description data tag (CD:) with the response “BE” (CD:BE).

Connectivity by Feature Code normally does not require using the figure code (FG:) data tag to assign a figure number to the chain created. This is normally done by the post processing software. Some post processing software will also assign point numbers to the points shot, eliminating the need to add them in the data collection file. Be sure to determine the capabilities of the post processing software being used before eliminating the figure codes and point numbers in the field generated data collection files.

Each procedure will be defined in detail. But, the examples will display the results in only one format. The example for unique feature codes will show the results in the calculated file (CAL) format. The shot identification example will show the results in the Points and ChainS (PAC) file format. Point Numbers will be used in the examples.

Unique Feature Codes for Each Chain

Individual chains can be created by assigning unique alpha or alphanumeric feature codes to distinguish between each chain. For example, the points on one edge-of-pavement chain may be given feature code EP1 as shown in Figure 6.6. Points on some other edge of pavement may be assigned EP2, and so on.

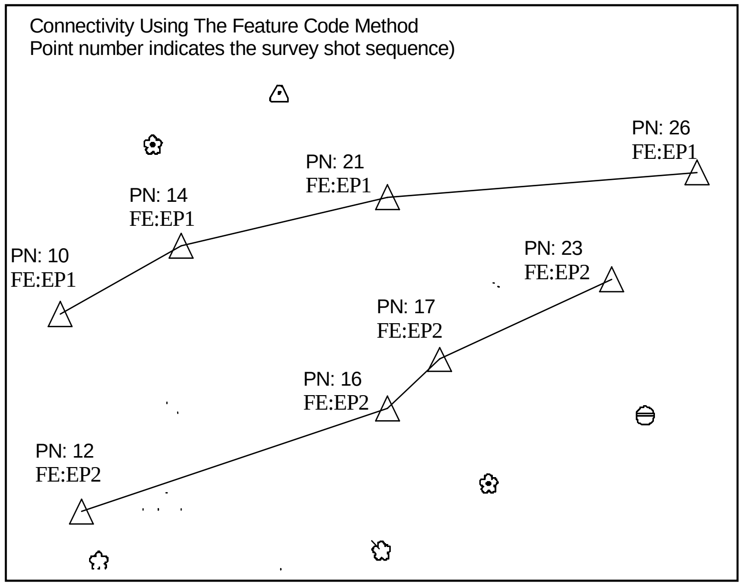


Figure 6.6 – Connectivity by Unique Feature Code

The resulting project file is shown below.

```
AC:SS
PN:10
FE:EP1
HZ:256.0033
VT:87.2649
DS:109.090
AC:SS
PN:12
FE:EP2
HZ:266.1432
VT:87.2312
DS:114.870
AC:SS
PN:14
FE:EP1
HZ:252.3530
VT:87.4540
DS:192.990
AC:SS
PN:16
FE:EP2
HZ:258.5637
VT:87.4154
DS:195.240
AC:SS
PN:17
FE:EP2
HZ:254.1241
VT:87.5102
DS:341.690
AC:SS
PN:21
FE:EP1
HZ:250.2943
VT:87.5554
DS:338.430
AC:SS
PN:23
FE:EP2
HZ:252.3759
VT:87.2757
DS:414.940
AC:SS
```

```
PN:26
FE:EP1
HZ:249.1628
VT:88.0814
DS:400.230
...,ETC
CP:04/30/2001 21:13:26
```

Any number of chains may be in progress simultaneously. The points on any one chain must be measured in order (but not necessarily in a point number sequence) working from one end of the chain to the other.

Side shots to single point features can be collected also. In this case, the post processing software has to recognize, by the feature code used, that the point being measured is not part of a chain. This may require some type of “lookup” table to specify which feature code prefixes designate chains and which are used for individual points. For example, points with a feature code TREE (FE:TREE) would normally not be connected in a chain. The post processing software must finally generate the chain list using the chain activity (AC:CH) to be added at the end of the calculated file.

The Calculated File for Connectivity by Unique Feature Codes for Each Chain

The shot sequence using connectivity by feature code, would be listed in the SDMS calculated file (.CAL) as:

```
AC:SS
PN:10
FE:EP1
XX:9480.1798
YY:10561.1445
ZZ:504.8596
HZ:256.0033
VT:87.2649
DS:109.0900
AC:SS
PN:12
FE:EP2
XX:9500.9082
YY:10562.3545
ZZ:505.2378
HZ:266.1432
VT:87.2312
DS:114.8700
AC:SS
PN:14
FE:EP1
XX:9479.8421
YY:10645.4492
ZZ:507.5401
HZ:252.3530
VT:87.4540
DS:192.9900
AC:SS
PN:16
FE:EP2
XX:9501.4436
YY:10644.9117
ZZ:507.8418
HZ:258.5637
VT:87.4154
DS:195.2400
AC:SS
PN:17
FE:EP2
XX:9500.3157
YY:10792.8177
```

```
ZZ:512.8179
HZ:254.1241
VT:87.5102
DS:341.6900
AC:SS
PN:21
FE:EP1
XX:9478.1080
YY:10791.1057
ZZ:512.2168
HZ:250.2943
VT:87.5554
DS:338.4300
AC:SS
PN:23
FE:EP2
XX:9496.3387
YY:10866.5262
ZZ:518.3502
HZ:252.3759
VT:87.2757
DS:414.9400
AC:SS
PN:26
FE:EP1
XX:9471.8457
YY:10853.0941
ZZ:513.0131
HZ:249.1628
VT:88.0814
DS:400.2300
BG:BEGIN CHAIN LIST
AC:CH
FE:EP1
FG:309         (Figure Number Assigned by post processing Software)
PL:10,14,21,26
AC:CH
FE:EP2
FG:310         (Figure Number Assigned by post processing Software)
PL:12,16,17,23
EG:END CHAIN LIST
CP:05/01/2001 09:05:35
```

Beginning and Ending Chains Using Common Feature Codes and Shot Identification

Individual chains can also be created using the same feature code for chains of the same type by indicating when each particular chain begins and ends. This is done by adding the shot identification tag with the begin chain (SI:BC) response to the shot where the chain begins and adding the shot identification tag with the end chain (SI:EC) response to the shot where the chain ends. For example, the points for the left and right edge-of-pavement chain may be given feature code EP as shown in Figure 6.7.

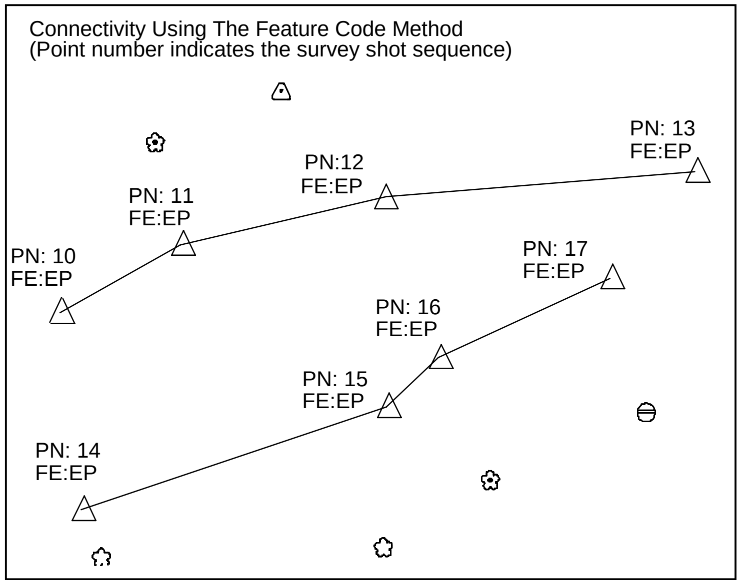


Figure 6.7 – Connectivity by Feature Code and Shot Identification

The project file using the shot identification to begin and end a chain would contain the data that follows.

```
AC:SS
PN:10
FE:EP
HZ:256.0033
VT:87.2649
DS:109.090
SI:BC          (Begin Left Pavement Edge)
PN:11
FE:EP
HZ:252.3530
VT:87.4540
DS:192.990
AC:SS
PN:12
FE:EP
HZ:250.2943
VT:87.5554
DS:338.430
AC:SS
PN:13
FE:EP
HZ:249.1628
VT:88.0814
DS:400.230
SI:EC          (End Left Pavement Edge)
AC:SS
PN:14
FE:EP
HZ:266.1432
VT:87.2312
DS:114.870
SI:BC          (Begin Right Pavement Edge)
AC:SS
PN:15
FE:EP
HZ:258.5637
VT:87.4154
DS:195.240
AC:SS
PN:16
FE:EP
HZ:254.1241
```

```
VT:87.5102
DS:341.690
AC:SS
PN:17
FE:EP
HZ:252.3759
VT:87.2757
DS:414.940
SI:EC          (End Right Pavement Edge)
...., ETC.
CP:09/18/1999 18:46:43
```

Note: The point numbers may be left out of the data collection file if the post processing software will assign them during processing.

This method requires that each chain be completed before another chain using the same feature code is started. The points on any one chain must be collected in sequential order (but not necessarily in point number sequence) working from one end of the chain to the other. The post processing software then generates the chain list using the chain activity (AC:CH) and adds the data to the end of the calculated file and/or PAC file.

The PAC File for Connectivity by Feature Code Using Shot Identification to Begin and End a Chain

The shot sequence using connectivity by feature code and the shot identification data tag to begin and end a chain would be listed in the SDMS Points and Chains file (.PAC) as:

```
AC:SS
PN:10
FE:EP
XX:9480.1798
YY:10561.1445
ZZ:504.8596
HZ:256.0033
VT:87.2649
DS:109.0900
AC:SS
PN:11
FE:EP
XX:9479.8421
YY:10645.4492
ZZ:507.5401
HZ:252.3530
VT:87.4540
DS:192.9900
AC:SS
PN:12
FE:EP
XX:9478.1080
YY:10791.1057
ZZ:512.2168
HZ:250.2943
VT:87.5554
DS:338.4300
AC:SS
PN:13
FE:EP
XX:9471.8457
YY:10853.0941
ZZ:513.0131
HZ:249.1628
VT:88.0814
DS:400.2300
AC:SS
```

```
PN:14
FE:EP
XX:9500.9082
YY:10562.3545
ZZ:505.2378
HZ:266.1432
VT:87.2312
DS:114.8700
AC:SS
PN:15
FE:EP
XX:9501.4436
YY:10644.9117
ZZ:507.8418
HZ:258.5637
VT:87.4154
DS:195.2400
AC:SS
PN:16
FE:EP
XX:9500.3157
YY:10792.8177
ZZ:512.8179
HZ:254.1241
VT:87.5102
DS:341.6900
AC:SS
PN:17
FE:EP
XX:9496.3387
YY:10866.5262
ZZ:518.3502
HZ:252.3759
VT:87.2757
DS:414.9400
BG:BEGIN CHAIN LIST
AC:CH
FE:EP
FG:309         (Figure Number Assigned by post processing Software)
PL:10,11,12,13
AC:CH
FE:EP
FG:310         (Figure Number Assigned by post processing Software)
PL:14,15,16,17
EG:END CHAIN LIST
CP:05/01/2001 09:05:35
```

Creating Closed Chains

There are three methods available to create a closed chain. The first method closes the chain by inserting ",C" after the Figure Code (FG:#,C). The second method creates a closed chain by using the Origin-Destination (OD:) data tag, as previously explained. The third method creates a closed chain by using Activity Chain (AC:CH).

Closed Chains Using "FG:#,C"

When FG:#,C is used within a shot activity, the post processing software interprets this to mean that the user wants to connect the current shot to the first shot in the file that contains the same FG:#. This effectively closes the chain that includes all the shots with FG:#. For example:

```
AC:SS
PN:10
FE:EPL
```

```
CD:LEFT PAVEMENT EDGE
FG:1
SH:5
HZ:45.2354
VT:90.3045
DS:100.44
AC:SS
PN:14
FE:EPL
FG:1
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
AC:SS
PN:21
FE:EPL
FG:1,C          (Close the chain created by FG:1 on the first point in
                FG:1)
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
CP:09/18/1999 18:46:43
```

The Calculated File for a Closed Chain using Figure Code

The “FG:1,C” listed with the shot data for Point 21 tells the post processing software to close the chain (FG:1) on PN:10, which is the first point in the chain. The calculated file will have the computed point information and will show the chain created as:

```
AC:SS
PN:10
FE:EPL
CD:LEFT PAVEMENT EDGE
SH:5
HZ:45.2354
VT:90.3045
DS:100.44
XX:####         (Calculated X coordinate)
YY:####         (Calculated Y coordinate)
ZZ:####         (Calculated Z coordinate)
AC:SS
PN:14
FE:EPL
FG:1
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
XX:####
YY:####
ZZ:#####
AC:SS
PN:21
FE:EPL
FG:1,C
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
XX:####
YY:####
ZZ:#####
...., ETC.
CP:09/18/1999 18:46:43
BG:Begin Chain List
AC:CH
FG:1
```

```
FE:EPL
CD:LEFT PAVEMENT EDGE
PL:10, 14, 21,10
EG:End Chain List
CP:09/27/1999  13:15:18
```

Closed Chains Using OD:

The OD: data item can also be used to close a figure by inserting the point number that is to be closed upon as the response to the OD: data item for the last point shot to close that figure. Using the previous example, to close the figure from PN:21 back to PN:10, the field data in the project file would be as follows:

```
AC:SS
PN:10
FE:EPL
CD:LEFT PAVEMENT EDGE
FG:1
SH:5
HZ:45.2354
VT:90.3045
DS:100.44
AC:SS
PN:14
FE:EPL
FG:1
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
AC:SS
PN:21
FE:EPL
FG:1
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
OD:10          (Close the chain created by FG:1 on the first point in
               FG:1, PN:10)
CP:09/18/1999 18:46:43
```

Note that this method of closing a chain does not require the closing point to be the first point collected in a chain which would be required if the “,C” method were used. The disadvantage of the Origin–Destination method is the user has to remember the point number for the closing point.

The Calculated File for a Closed Chain using Origin Destination

The OD:10 listed with the shot data for PN:21 tells the post processing software to close the chain (FG:1) on PN:10, which is the first point in the chain. The calculated file will have the computed point information and will show the chain created as:

```
AC:SS
PN:10
FE:EPL
CD:LEFT PAVEMENT EDGE
SH:5
HZ:45.2354
VT:90.3045
DS:100.44
XX:####        (Calculated X coordinate)
YY:####        (Calculated Y coordinate)
ZZ:####        (Calculated Z coordinate)
AC:SS
PN:14
```

```
FE:EPL
FG:1
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
XX:####
YY:####
ZZ:#####
AC:SS
PN:21
FE:EPL
FG:1
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
OD:10
XX:####
YY:####
ZZ:#####
...., ETC.
CP:09/18/1999 18:46:43
BG:Begin Chain List
AC:CH
FG:1
FE:EPL
CD:LEFT PAVEMENT EDGE
PL:10, 14, 21,10
EG:End Chain List
CP:09/27/1999  13:15:18
```

Closed Chains using the Chain Activity AC:CH

Figures can also be closed using the Chain Activity. This method is explained in the discussion of the Chain Activity later in this section.

Closed Chains using FE:*,C

When FE:*,C is used within a shot activity, the post processing software interprets this to mean that the user wants to connect the current shot to the first shot in the file that contains the same FE:. This effectively closes the chain that includes all the shots with FE:#. This is true regardless if the the chain was collected using unique feature codes for each chain or if shot identification was used. For example:

```
AC:SS
PN:1
FE:CONC
SI:BC
XX:####
YY:####
ZZ:####
AC:SS
PN:1
FE:CONC
XX:####
YY:####
ZZ:####
AC:SS
PN:1
FE:CONC
XX:####
YY:####
ZZ:####
AC:SS
PN:1
FE:CONC,C
```

```
XX:####
YY:####
ZZ:####
```

Creating Gaps in Chains

A gap can be created in a chain by adding ",G" after the Figure Code (FG:#,G). This tells the post processing software to create a chain with the Figure Code and feature assigned and to place a gap in the chain between the point where the ",G" appears and the next point in that chain. The gap created will be shown in the PL (Point List) field of a calculated file as two commas in a row between the points where the gap is to occur. A gap can also be created by manually entering an extra comma between points in a PL field in an AC:CH as explained in the discussion of the Chain Activity later in this section.

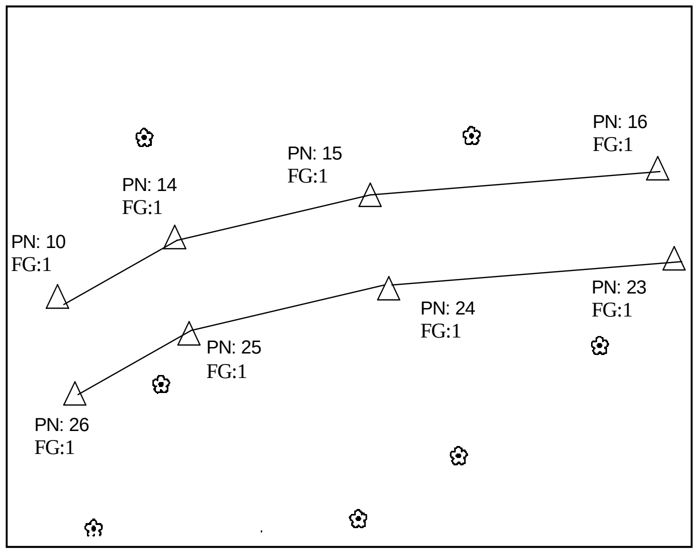


Figure 6.8 – Creating a gap in a Survey Chain

Project file for Creating a Gap

In the project file, to create the gap between PN:16 and PN:23 shown in Figure 6.8, the shot at PN:16 would contain the line "FG:1,G" along with the feature code FE:EPL. This information tells SDMS Processor to break the connection between PN:16 and PN:23, which in this case is the next point with the same figure code. Then, the figure is to continue once past the break, based on the other points listed. The project file will have the point information and will indicate how the chain is to be created:

```
AC:SS
PN:10
FE:EPL
CD:LEFT PAVEMENT EDGE
FG:1
SH:5
HZ:45.2354
VT:90.3045
DS:100.44
AC:SS
PN:14
FE:EPL
FG:1
SH:5
HZ:55.2853
```

```
VT:90.3006
DS:150.94
AC:SS
PN:15
FE:EPL
FG:1
SH:5
HZ:56.2853
VT:90.3006
DS:180.94
AC:SS
PN:16
FE:EPL
FG:1,G         (Place a gap in the chain starting at PN:16 and ending
               at the next point shot.)
SH:5
HZ:57.2853
VT:90.3006
DS:195.94
AC:SS
PN:23          (Gap ends at the next point shot, PN:23. The figure will
               then continue.)
FE:EPL
FG:1
SH:5
HZ:59.2927
VT:89.1642
DS:210.24
AC:SS
PN:24
FE:EPL
FG:1
HZ:55.3947
VT:90.1432
DS:190.28
AC:SS
PN:25
FE:EPL
FG:1
HZ:50.5917
VT:89.1642
DS:180.24
AC:SS
PN:26
FE:EPL
FG:1
HZ:41.2017
VT:89.1642
DS:155.24
CP:09/18/1999 18:46:43
```

The Calculated File for creating a gap

The “FG:1,G” listed with the shot data for PN:16 tells SDMS Processor to place a gap in the chain (FG:1) between PN:16 and PN:23, then continue the chain with the points shot having the same figure code. The calculated file will have the computed point information and will show the chain created as:

```
AC:SS
PN:10
FE:EPL
CD:LEFT PAVEMENT EDGE
FG:1
SH:5
HZ:45.2354
VT:90.3045
DS:100.44
XX:####
YY:####
ZZ:#####
```

```
AC:SS
PN:14
FE:EPL
FG:1
SH:5
HZ:55.2853
VT:90.3006
DS:150.94
XX:####
YY:####
ZZ:#####
AC:SS
PN:15
FE:EPL
FG:1
SH:5
HZ:56.2853
VT:90.3006
DS:180.94
XX:####
YY:####
ZZ:#####
AC:SS
PN:16
FE:EPL
FG:1,G          (Start the gap in the chain and end the gap at the next
                point shot with the same figure code.)
SH:5
HZ:57.2853
VT:90.3006
DS:195.94
XX:####
YY:####
ZZ:#####
AC:SS
PN:23           (Gap ends at this point. The figure will then continue.)
FE:EPL
FG:1
SH:5
HZ:59.2927
VT:89.1642
DS:210.24
XX:####
YY:####
ZZ:#####
AC:SS
PN:24
FE:EPL
FG:1
HZ:55.3947
VT:90.1432
DS:190.28
XX:####
YY:####
ZZ:#####
AC:SS
PN:25
FE:EPL
FG:1
HZ:50.5917
VT:89.1642
DS:180.24
XX:####
YY:####
ZZ:#####
AC:SS
PN:26
FE:EPL
FG:1
HZ:41.2017
VT:89.1642
```

```
DS:155.24
XX:####
YY:####
ZZ:#####
CP:09/18/1999 18:46:43
BG:Begin Chain List
AC:CH
FG:1
FE:EPL
CD:LEFT PAVEMENT EDGE
PL:10,14,15,16,,23,24,25,26
EG:End Chain List
CP:09/27/1999  13:15:18
```

Connectivity by Taping

Taping is an activity specifically designed for defining chains around buildings or other figures when it may not be practical or desirable to use an electronic instrument to collect all of the points that define that building or figure. This procedure allows the user to tape the horizontal distance along each side, to approximate the direction, and to indicate the approximate difference in elevation between two angle points.

Before the taping activity can be used, two points must be recorded, using the sideshot activity, to establish a beginning reference line for the taped measurements. Typically, the total station is used to measure these two points immediately before beginning the taping activity, but this is not required. The points can be recorded at any time in the project file, but must be recorded before the taping activity in which they will be used.

The backsight point number data item (BS:) and the occupied station point number data item (OS:) are used with the taping activity to specify the point numbers to be used for the backsight and occupied station respectively. Within the taping activity, taped measurements begin at the occupied station point number (OS:). The direction of the reference line is from the occupied station point number (OS:) to the backsight point number (BS:). The points assigned to the OS: and BS: are included as part of the taped figure.

Note: The point number of the first point in the point list created by the taping activity will be the point number used with the BS: data item, followed by the point number of the OS: data item. The points created from the data with each AD: data item will follow in sequence.

The default sequence for this activity is:

```
AC:TA
OS:     (Point Number of the point to be use as the occupied station.
        The second point of chain created within the taping activity.)
BS:     (Point Number of the point to be used as the back sight. The
        first point of chain created within the taping activity.)
PN:     (Beginning Point Number to be used for the points computed
        within the taping activity)
FE:     (Feature Code to be used for the new chain)
CD:     (Chain Description to be used for the new chain)
FG:     (Figure Code to be used for the chain)
AD:     (Angle, distance, and difference in elevation to the next
        point)
AD:     (Angle, distance, and difference in elevation to all other
        points, as needed)
PL:     (Point List to indicate previously shot points to include as
        the last points in the chain created)
CM:     (Add at any time)
```

Two radial measurements establish the first segment of the chain within each taping activity. These points are used as the back sight (BS:) and occupied station (OS:) to start defining the figure to be taped.

Note: The BS: and OS: data items are required for the post processing software to generate data for the taped points. Therefore, both data items must contain a response for each taping activity entered in a project file.

The Point Number (PN:) indicates the point number to be used for the first point taped. Subsequent point numbers will increment as defined in the TAGS.HLP file. The feature code data item (FE:) designates the feature of the chain being built by the taping activity. The figure code data item (FG:) designates the Figure Code of the chain being defined.

The angle distance list defines the direction, horizontal distance, and difference in elevation from the preceding point to the point that follows. The format is:

AD:Direction,Horizontal Distance,Vertical Distance

Note: The AD: line must include at least the direction and horizontal distance (DH:). If there is no change in elevation, the vertical distance (DV:) can be shown as zero (0) or left blank. There is no comma required following the vertical distance (DV:).

The direction to each point is indicated by looking from the “current“ occupied point” toward the “current“ back sight point and measuring the horizontal angle right to the next point to be taped. The direction of the line can be indicated by:

F (Forward) = 180°

B (Back) = 0°

L (Left) = 270°

R (Right) = 90°

HZ (Horizontal Angle Right) = 0° - 360°

The direction in the angle distance lists (AD:) can be listed as:

- All alpha designated angles (F, B, R, L)
- All numeric angles (Horizontal Angles Right, HZ:)
- A combination of alpha designated angles (F, B, R, L) and numeric angles (Horizontal Angles Right, HZ:).

The following sections give details on the various ways the taping activity information can be recorded in the project file. The post processing software uses this data to compute coordinates for these points.

The points created are shown in the SDMS Calculated (CAL) file as a traverse around the taped object. Each point includes the shot identification data item with the response of TA (SI:TA) to indicate the points were created by taping. The chain (figure) created will be listed at the bottom of the file. The points created are shown in the SDMS Points and Chain (PAC) file as points (AC:SS) and also have the shot identification data item and response of TA (SI:TA). The chain (figure) created will be listed at the bottom of the file.

Note: Taped objects with angles other than 90 degrees may not be supported by the post processing software being used. In that case, it will be necessary to collect the data as side shots and define their connectivity using the chain activity.

Direction Options for the Taping Activity

Currently, there are two options available to indicate the direction being taped. The first option uses the alpha characters F, B, L, R to define the direction. The second option uses the horizontal angle right (HZ:) to define the direction. These options are defined in detail at the beginning of Section VI. The sections that follow will explain how these options are used in a project file.

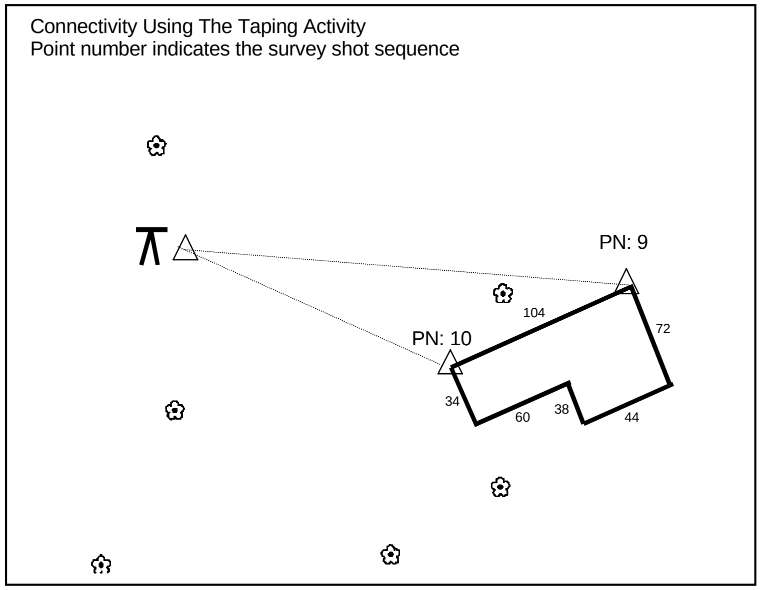


Figure 6.9 – The Taping Activity

Direction using alpha characters

Most taping will consist of measuring around objects with 90 ° angles, and at time, forward and back. Therefore, the use of alpha characters to represent those angles provides a short hand method for data entry. For example, the sequence to tape around the building in Figure 6.9 is:

```
AC:SS
PN:9
FE:HOUSE
SH:5
HZ:19.3538
VT:90.3045
DS:254.93
AC:SS
PN:10
FE:HOUSE
SH:5
HZ:0
VT:90.3006
DS:180.94
AC:TA
OS:10          (Point Number of the point to be used as the occupied
               station. This is the second point in the chain being
               defined within the taping activity.)
BS:9           (Point Number of the point to be used as the back sight.
               This is first point in the chain being defined within
               the taping activity.)
PN:100         (Beginning point number to be used for the points
               computed within the taping activity)
FE:HOUSE       (Feature to be used for the new chain)
FG:5           (Figure Code to be used for the chain)
CD:OUR HOUSE   (Chain Description)
AD:R,34,       (90° HZ Right 34 feet, use the same elevation as PN:10)
```

```
AD:R,60,3.2    (90° HZ Right 60 feet. Add 3.2 feet to the elevation of
               the preceding point)
AD:L,38,0      (90° HZ Left, 38 feet. Elevation the same as the
               preceding point.)
AD:R,44,       (90° HZ Right 44 feet. Elevation the same as the
               preceding point.)
AD:R,72, -3.2  (90° HZ Right 71 feet. Subtract 3.2 feet from the
               elevation of the preceding point.)
AD:R,104       (90° HZ Right 104 feet. Elevation the same as the
               preceding point.)
CP:09/18/1999 18:46:43
```

Direction using horizontal angles right (HZ)

The user may need to tape around objects that have angles other than 90 degrees involved. This can be done using a horizontal angles right (HZ:) to indicate the direction along each side of the object being measured. Using horizontal angles right, the preceding taping activity would be:

```
AC:SS
PN:9
FE:HOUSE
SH:5
HZ:19.3538
VT:90.3045
DS:254.93
AC:SS
PN:10
FE:HOUSE
SH:5
HZ:0
VT:90.3006
DS:180.94
AC:TA
OS:10          (Point Number of the point to be used as the occupied
               station. This is the second point in the chain being
               defined within the taping activity.)
BS:9           (Point Number of the point to be used as the back sight.
               This is first point in the chain being defined within
               the taping activity.)
PN:100         (Beginning point number to be used for the points
               computed within the taping activity)
FE:HOUSE       (Feature to be used for the new chain)
FG:5           (Figure Code to be used for the chain)
CD:OUR HOUSE   (Chain Description)
AD:90,34,      (90° Horizontal Right 34 feet, use the same elevation as
               PN:10)
AD:R,60,3.2    (90° HZ Right 60 feet. Add 3.2 feet to the elevation of
               the preceding point)
AD:L,38,0      (90° HZ Left, 38 feet. Elevation the same as the
               preceding point.)
AD:R,44,       (90° HZ Right 44 feet. Elevation the same as the
               preceding point.)
AD:R,72, -3.2  (90° HZ Right 71 feet. Subtract 3.2 feet from the
               elevation of the preceding point.)
AD:R,104       (90° HZ Right 104 feet. Elevation the same as the
               preceding point.)
CP:09/18/1999 18:46:43
```

The Calculated (CAL) File

The shot sequence used and the resulting chain list (AC:CH) would be listed in the SDMS calculated file (.CAL) as:

```
AC:SS
PN:9
FE:BU
XX:10085.4876
YY:10240.1582
ZZ:497.7211
```

```
SH:5.0000
HZ:19.3538
VT:90.3045
DS:254.9300
AC:SS
PN:10
FE:SU
XX:10000.0000
YY:10180.9330
ZZ:498.4164
SH:5.0000
HZ:.0000
VT:90.3006
DS:180.9400
AC:TA
OS:10
BS:9
PN:100
CD:OUR HOUSE
AD:R,34,
AD:R,60,3.2
AD:L,38,0
AD:R,44,
AD:R,72,-3.2
AD:R,104
AC:OS
PN:10
FE:HOUSE
XC:10000.0000
YC:10180.9330
ZC:-99999
XX:10000.0000
YY:10180.9330
ZZ:498.4164
SI:TA          (Assigned to all taped points in the AC:TA by the post
               processing software)
IH:.0000
AC:BS
PN:9
FE:HOUSE
XX:10085.4876
YY:10240.1582
ZZ:497.7211
SI:TA
SH:.0000
HZ:.0000
AC:SS
PN:100         (PN: assigned to the first taped point by the post
               processing software)
FE:HOUSE
XX:10019.3623
YY:10152.9848
ZZ:498.4165
SI:TA
SH:.0000
HZ:90.0000
VT:90.0000
DS:34.0000
AC:OS
PN:100
FE:HOUSE
XX:10019.3623
YY:10152.9848
ZZ:498.4165
SI:TA
IH:.0000
AC:BS
PN:10
FE:HOUSE
XC:10000.0000
YC:10180.9330
```

```
ZC:-99999
XX:10000.0000
YY:10180.9330
ZZ:498.4164
SI:TA
SH:.0000
HZ:.0000
AC:SS
PN:101         (PN: assigned to the next taped point by the post
               processing software)
FE:HOUSE
XX:10068.6824
YY:10187.1534
ZZ:501.6167
SI:TA
SH:.0000
HZ:90.0000
VT:86.5650
DS:60.0850
AC:OS
PN:101
FE:HOUSE
XX:10068.6824
YY:10187.1534
ZZ:501.6167
SI:TA
IH:.0000
AC:BS
PN:100
FE:HOUSE
XX:10019.3623
YY:10152.9848
ZZ:498.4165
SI:TA
SH:.0000
HZ:.0000
AC:SS
PN:102         (PN: assigned to the next taped point by the post
               processing software)
FE:HOUSE
XX:10090.3226
YY:10155.9172
ZZ:501.6167
SI:TA
SH:.0000
HZ:270.0000
VT:90.0000
DS:38.0000
AC:OS
PN:102
FE:HOUSE
XX:10090.3226
YY:10155.9172
ZZ:501.6167
SI:TA
IH:.0000
AC:BS
PN:101
FE:HOUSE
XX:10068.6824
YY:10187.1534
ZZ:501.6167
SI:TA
SH:.0000
HZ:.0000
AC:SS
PN:103         (PN: assigned to the next taped point by the post
               processing software)
FE:HOUSE
XX:10126.4909
YY:10180.9743
```

```
ZZ:501.6168
SI:TA
SH:.0000
HZ:90.0000
VT:90.0000
DS:44.0000
AC:OS
PN:103
FE:HOUSE
XX:10126.4909
YY:10180.9743
ZZ:501.6168
SI:TA
IH:.0000
AC:BS
PN:102
FE:HOUSE
XX:10090.3226
YY:10155.9172
ZZ:501.6167
SI:TA
SH:.0000
HZ:.0000
AC:SS
PN:104          (PN: assigned to the next taped point by the post
                processing software)
FE:HOUSE
XX:10085.4884
YY:10240.1587
ZZ:498.4170
SI:TA
SH:.0000
HZ:90.0000
VT:92.3241
DS:72.0710
AC:OS
PN:104
FE:HOUSE
XX:10085.4884
YY:10240.1587
ZZ:498.4170
SI:TA
IH:.0000
AC:BS
PN:103
FE:HOUSE
XX:10126.4909
YY:10180.9743
ZZ:501.6168
SI:TA
SH:.0000
HZ:.0000
AC:SS
PN:105          (PN: assigned to the last taped point by the post
                processing software)
FE:HOUSE
XX:9999.9998
YY:10180.9328
ZZ:498.4172
BG:BEGIN CHAIN LIST
AC:CH
FE:HOUSE
FG:5
PL:9,10,100,101,102,103,104,105
EG:END CHAIN LIST
CP:06/08/2000 14:08:15
```

It should be noted that in this case, PN:104 will be at or near PN:9 and PN:105 will be at or near PN:10. This is due to the lower precision of the position of the point that normally results from taping.

The Points and Chain (PAC) File

The points created by the taping activity and the resulting chain list (AC:CH) would be listed in the SDMS Points and Chains (.PAC) file as:

```
AC:SS
PN:9
FE:BU
XX:10085.4876
YY:10240.1582
ZZ:497.7211
AC:SS
PN:10
FE:SU
XX:10000.0000
YY:10180.9330
ZZ:498.4164
AC:SS
PN:100         (PN: assigned to the first taped point by the post
               processing software)
FE:HOUSE
XX:10019.3623
YY:10152.9848
ZZ:498.4165
SI:TA          (Assigned to all taped points in the AC:TA by the post
               processing software)
AC:SS
PN:101         (PN: assigned to the next taped point by the post
               processing software)
FE:HOUSE
XX:10068.6824
YY:10187.1534
ZZ:501.6167
SI:TA
AC:SS
PN:102         (PN: assigned to the next taped point by the post
               processing software)
FE:HOUSE
XX:10090.3226
YY:10155.9172
ZZ:501.6167
SI:TA
AC:SS
PN:103         (PN: assigned to the next taped point by the post
               processing software)
FE:HOUSE
XX:10126.4909
YY:10180.9743
ZZ:501.6168
SI:TA
AC:SS
PN:104         (PN: assigned to the next taped point by the post
               processing software)
FE:HOUSE
XX:10085.4884
YY:10240.1587
ZZ:498.4170
SI:TA
AC:SS
PN:105         (PN: assigned to the last taped point by the post
               processing software)
FE:HOUSE
XX:9999.9998
YY:10180.9328
ZZ:498.4172
BG:BEGIN CHAIN LIST
AC:CH
FE:HOUSE
FG:5
PL:9,10,100,101,102,103,104,105
EG:END CHAIN LIST
```

Note: The list of points in a Points and Chain (PAC) file, defined by the any of the taping activity scenarios supported by SDMS, will be similar to the sample shown above. Therefore, sample PAC files will not be listed for each of the sections that follow.

Closing a Taped Object

The procedures described above will create duplicate points of the occupied station (OS:) point and the back sight (BS:) point used at the beginning of a taping activity (PN:9 and PN:10). Since the taped measurements and vertical differences are not intended to be at the same precision as those shot with the total station, the closing points may miss the intended location desired. A better method would be to use either the Origin-Destination (OD:) data item, or add ",C" to the last angle distance list, to tell the post processing software to close the figure on a specified point.

Project file Closing AC:TA with Origin-Destination (OD:)

Using the same example shown in Figure 6.9, and the OD: tag to tell the post processing software to close the figure on a specified point, the data will be collected in the project file as:

```
AC:SS
PN:9
FE:HOUSE
SH:5
HZ:19.3538
VT:90.3045
DS:254.93
AC:SS
PN:10
FE:HOUSE
SH:5
HZ:0
VT:90.3006
DS:180.94
AC:TA
OS:10          (Point Number of the point to be used as the occupied
               station. This is the second point in the chain being
               defined within the taping activity.)
BS:9           (Point Number of the point to be used as the back sight.
               This is first point in the chain being defined within
               the taping activity.)
PN:100         (Beginning Point Number to be used for the points
               computed within the taping activity)
FE:HOUSE       (Feature to be used for the new chain)
FG:5           (Figure Code to be used for the chain)
CD:OUR HOUSE   (Chain Description)
AD:R,34,       (Right 34 feet, use the same elevation as PN:10)
AD:R,60,3.2    (Right 60 feet. Add 3.2 feet to the elevation of the
               preceding point)
AD:L,38,0      (Left 38 feet. Elevation the same as the preceding
               point.)
AD:R,44,       (Right 44 feet. Elevation the same as the preceding
               point.)
OD:9           (Close the new chain on point number 9)
CP:09/18/1999 18:46:43
```

Calculated File with OD: in the Taping Activity

Using OD: to close the figure, the post processing software would display the calculated shot information and describe the chain in the SDMS calculated file (.CAL) as

```
AC:SS
```

```
PN:9
FE:BU
XX:10085.4876
YY:10240.1582
ZZ:497.7211
SH:5.0000
HZ:19.3538
VT:90.3045
DS:254.9300
AC:SS
PN:10
FE:SU
XX:10000.0000
YY:10180.9330
ZZ:498.4164
SH:5.0000
HZ:.0000
VT:90.3006
DS:180.9400
AC:TA
OS:10
BS:9
PN:100
CD:OUR HOUSE
AD:R,34,
AD:R,60,3.2
AD:L,38,0
AD:R,44,
OD:9
AC:OS
PN:10
FE:HOUSE
XC:10000.0000
YC:10180.9330
ZC:-99999
XX:10000.0000
YY:10180.9330
ZZ:498.4164
SI:TA          (Assigned to all taped points in the AC:TA by the post
               processing software)
IH:.0000
AC:BS
PN:9
FE:HOUSE
XX:10085.4876
YY:10240.1582
ZZ:497.7211
SI:TA
SH:.0000
HZ:.0000
AC:SS
PN:100         (PN: assigned to the first taped point by the post
               processing software)
FE:HOUSE
XX:10019.3623
YY:10152.9848
ZZ:498.4165
SI:TA
SH:.0000
HZ:90.0000
VT:90.0000
DS:34.0000
AC:OS
PN:100
FE:HOUSE
XX:10019.3623
YY:10152.9848
ZZ:498.4165
SI:TA
IH:.0000
AC:BS
```

```
PN:10
FE:HOUSE
XC:10000.0000
YC:10180.9330
ZC:-99999
XX:10000.0000
YY:10180.9330
ZZ:498.4164
SI:TA
SH:.0000
HZ:.0000
AC:SS
PN:101          (PN: assigned to the next taped point by the post
                processing software)
FE:HOUSE
XX:10068.6824
YY:10187.1534
ZZ:501.6167
SI:TA
SH:.0000
HZ:90.0000
VT:86.5650
DS:60.0850
AC:OS
PN:101
FE:HOUSE
XX:10068.6824
YY:10187.1534
ZZ:501.6167
SI:TA
IH:.0000
AC:BS
PN:100
FE:HOUSE
XX:10019.3623
YY:10152.9848
ZZ:498.4165
SI:TA
SH:.0000
HZ:.0000
AC:SS
PN:102          (PN: assigned to the next taped point by the post
                processing software)
FE:HOUSE
XX:10090.3226
YY:10155.9172
ZZ:501.6167
SI:TA
SH:.0000
HZ:270.0000
VT:90.0000
DS:38.0000
AC:OS
PN:102
FE:HOUSE
XX:10090.3226
YY:10155.9172
ZZ:501.6167
SI:TA
IH:.0000
AC:BS
PN:101
FE:HOUSE
XX:10068.6824
YY:10187.1534
ZZ:501.6167
SI:TA
SH:.0000
HZ:.0000
AC:SS
```

```
PN:103          (PN: assigned to the last taped point by the post
                processing software)
FE:HOUSE
XX:10126.4909
YY:10180.9743
ZZ:501.6168
SI:TA
SH:.0000
HZ:90.0000
VT:90.0000
DS:44.0000
BG:BEGIN CHAIN LIST
AC:CH
FE:HOUSE
FG:5
PL:9,10,100,101,102,103,9
EG:END CHAIN LIST
CP:06/08/2000 14:08:15
```

The Project file Closing AC:TA using "C" in the Angle Distance (AD) List

Using the example shown in Figure 6.9, the building can also be closed by adding the letter C, preceded by a comma (,C), at the end of the last angle distance (AD:) list. Using this method tells SDMS Processor to close the figure on the back sight point that is listed with the particular taping activity. The data will be collected in the project file as:

```
AC:SS
PN:9
FE:HOUSE
SH:5
HZ:19.3538
VT:90.3045
DS:254.93
AC:SS
PN:10
FE:HOUSE
SH:5
HZ:0
VT:90.3006
DS:180.94
AC:TA
OS:10           (Point Number of the point to be used as the occupied
                station. This is the second point in the chain being
                defined within the taping activity.)
BS:9            (Point Number of the point to be used as the back sight.
                This is the first point in the chain being defined
                within the taping activity.)
PN:100          (Beginning Point Number to be used for the points
                computed within the taping activity)
FE:HOUSE        (Feature to be used for the new chain)
FG:5            (Figure Code to be used for the chain)
CD:OUR HOUSE    (Chain Description)
AD:R,34,        (Right 34 feet, use the same elevation as PN:10)
AD:R,60,3.2     (Right 60 feet. Add 3.2 feet to the elevation of the
                preceding point.)
AD:L,38,0       (Left 38 feet. Elevation the same as the preceding
                point.)
AD:R,44,C       (Right 44 feet. Elevation the same as the preceding
                point, Close on the back sight point)
CP:09/18/1999 18:46:43
```

The Calculated File with ",C" in the Taping Activity

Using ",C" to close the figure, the post processing software would display the calculated shot information and describe the chain in the SDMS calculated file (.CAL) as

```
AC:SS
PN:9
FE:BU
XX:10085.4876
YY:10240.1582
ZZ:497.7211
SH:5.0000
HZ:19.3538
VT:90.3045
DS:254.9300
AC:SS
PN:10
FE:SU
XX:10000.0000
YY:10180.9330
ZZ:498.4164
SH:5.0000
HZ:.0000
VT:90.3006
DS:180.9400
AC:TA
OS:10
BS:9
PN:100
CD:OUR HOUSE
AD:R,34,
AD:R,60,3.2
AD:L,38,0
AD:R,44,C
AC:OS
PN:10
FE:HOUSE
XC:10000.0000
YC:10180.9330
ZC:-99999
XX:10000.0000
YY:10180.9330
ZZ:498.4164
SI:TA          (Assigned to all taped points in the AC:TA by the post
               processing software)
IH:.0000
AC:BS
PN:9
FE:HOUSE
XX:10085.4876
YY:10240.1582
ZZ:497.7211
SI:TA
SH:.0000
HZ:.0000
AC:SS
PN:100         (PN: assigned to the first taped point by the post
               processing software)
FE:HOUSE
XX:10019.3623
YY:10152.9848
ZZ:498.4165
SI:TA
SH:.0000
HZ:90.0000
VT:90.0000
DS:34.0000
AC:OS
PN:100
FE:HOUSE
XX:10019.3623
YY:10152.9848
ZZ:498.4165
SI:TA
IH:.0000
AC:BS
```

```
PN:10
FE:HOUSE
XC:10000.0000
YC:10180.9330
ZC:-99999
XX:10000.0000
YY:10180.9330
ZZ:498.4164
SI:TA
SH:.0000
HZ:.0000
AC:SS
PN:101          (PN: assigned to the next taped point by the post
                processing software)
FE:HOUSE
XX:10068.6824
YY:10187.1534
ZZ:501.6167
SI:TA
SH:.0000
HZ:90.0000
VT:86.5650
DS:60.0850
AC:OS
PN:101
FE:HOUSE
XX:10068.6824
YY:10187.1534
ZZ:501.6167
SI:TA
IH:.0000
AC:BS
PN:100
FE:HOUSE
XX:10019.3623
YY:10152.9848
ZZ:498.4165
SI:TA
SH:.0000
HZ:.0000
AC:SS
PN:102          (PN: assigned to the next taped point by the post
                processing software)
FE:HOUSE
XX:10090.3226
YY:10155.9172
ZZ:501.6167
SI:TA
SH:.0000
HZ:270.0000
VT:90.0000
DS:38.0000
AC:OS
PN:102
FE:HOUSE
XX:10090.3226
YY:10155.9172
ZZ:501.6167
SI:TA
IH:.0000
AC:BS
PN:101
FE:HOUSE
XX:10068.6824
YY:10187.1534
ZZ:501.6167
SI:TA
SH:.0000
HZ:.0000
AC:SS
```

```
PN:103          (PN: assigned to the last taped point by the post
                processing software)
FE:HOUSE
XX:10126.4909
YY:10180.9743
ZZ:501.6168
SI:TA
SH:.0000
HZ:90.0000
VT:90.0000
DS:44.0000
BG:BEGIN CHAIN LIST
AC:CH
FE:HOUSE
FG:5
PL:9,10,100,101,102,103,9
EG:END CHAIN LIST
CP:06/08/2000 14:08:15
```

Ending a Figure Using the Taping Activity

The taping activity can also be used to define a taped figure that ends and is not intended to create a closed object. A chain created by the taping activity can be stopped at any point by ending with an AD: in the project file.

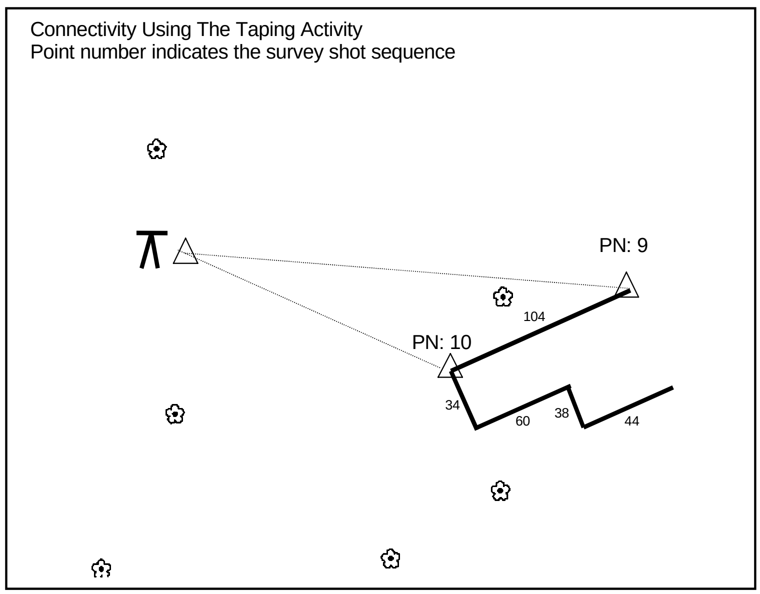


Figure 6.10 – Taping Activity - Ending a Figure

Using the example in Figure 6.10 to end a chain, the taping activity will be:

```
AC:SS
PN:9
FE:HOUSE
SH:5
HZ:19.3538
VT:90.3045
DS:254.93
AC:SS
PN:10
FE:HOUSE
SH:5
HZ:0
VT:90.3006
DS:180.94
AC:TA
```

```
OS:10          (Point Number of the point to be used as the occupied
               station. This is the second point in the chain being
               defined within the taping activity.)
BS:9           (Point Number of the point to be used as the back sight.
               This is the first point in the chain being defined
               within the taping activity.)
PN:100         (Beginning Point Number to be used for the points
               computed within the taping activity)
FE:HOUSE       (Feature to be used for the new chain)
FG:5           (Figure Code to be used for the chain)
CD:PART OF OUR HOUSE          (Chain Description)
AD:R,34,       (Right 34 feet, use the same elevation as PN:10)
AD:R,60,3.2    (Right 60 feet. Add 3.2 feet to the elevation of the
               preceding point)
AD:L,38,0      (Left 38 feet. Elevation the same as the preceding
               point.)
AD:R,44,       (Right 44 feet. Elevation the same as the preceding
               point, and the end of the chain.)
CP:09/18/1999 18:46:43
```

The Calculated file

Using the shot sequence listed, the post processing software would display the calculated shot information and describe the chain in the SDMS calculated file (.CAL) as:

```
AC:SS
PN:9
FE:BU
XX:10085.4876
YY:10240.1582
ZZ:497.7211
SH:5.0000
HZ:19.3538
VT:90.3045
DS:254.9300
AC:SS
PN:10
FE:SU
XX:10000.0000
YY:10180.9330
ZZ:498.4164
SH:5.0000
HZ:.0000
VT:90.3006
DS:180.9400
AC:TA
OS:10
BS:9
PN:100
CD:OUR HOUSE
AD:R,34,
AD:R,60,3.2
AD:L,38,0
AD:R,44,
AC:OS
PN:10
FE:HOUSE
XC:10000.0000
YC:10180.9330
ZC:-99999
XX:10000.0000
YY:10180.9330
ZZ:498.4164
SI:TA          (Assigned to all taped points in the AC:TA by the post
               processing software)
IH:.0000
AC:BS
PN:9
FE:HOUSE
```

```
XX:10085.4876
YY:10240.1582
ZZ:497.7211
SI:TA
SH:.0000
HZ:.0000
AC:SS
PN:100          (PN: assigned to the first taped point by the post
                processing software)
FE:HOUSE
XX:10019.3623
YY:10152.9848
ZZ:498.4165
SI:TA
SH:.0000
HZ:90.0000
VT:90.0000
DS:34.0000
AC:OS
PN:100
FE:HOUSE
XX:10019.3623
YY:10152.9848
ZZ:498.4165
SI:TA
IH:.0000
AC:BS
PN:10
FE:HOUSE
XC:10000.0000
YC:10180.9330
ZC:-99999
XX:10000.0000
YY:10180.9330
ZZ:498.4164
SI:TA
SH:.0000
HZ:.0000
AC:SS
PN:101          (PN: assigned to the next taped point by the post
                processing software)
FE:HOUSE
XX:10068.6824
YY:10187.1534
ZZ:501.6167
SI:TA
SH:.0000
HZ:90.0000
VT:86.5650
DS:60.0850
AC:OS
PN:101
FE:HOUSE
XX:10068.6824
YY:10187.1534
ZZ:501.6167
SI:TA
IH:.0000
AC:BS
PN:100
FE:HOUSE
XX:10019.3623
YY:10152.9848
ZZ:498.4165
SI:TA
SH:.0000
HZ:.0000
AC:SS
PN:102          (PN: assigned to the next taped point by the post
                processing software)
FE:HOUSE
```

```
XX:10090.3226
YY:10155.9172
ZZ:501.6167
SI:TA
SH:.0000
HZ:270.0000
VT:90.0000
DS:38.0000
AC:OS
PN:102
FE:HOUSE
XX:10090.3226
YY:10155.9172
ZZ:501.6167
SI:TA
IH:.0000
AC:BS
PN:101
FE:HOUSE
XX:10068.6824
YY:10187.1534
ZZ:501.6167
SI:TA
SH:.0000
HZ:.0000
AC:SS
PN:103          (PN: assigned to the last taped point by the post
                processing software)
FE:HOUSE
XX:10126.4909
YY:10180.9743
ZZ:501.6168
SI:TA
SH:.0000
HZ:90.0000
VT:90.0000
DS:44.0000
BG:BEGIN CHAIN LIST
AC:CH
FE:HOUSE
FG:5
PL:9,10,100,101,102,103
EG:END CHAIN LIST
CP:06/08/2000 14:08:15
```

Generating Chains and Points Parallel to Previously Defined Points or Chains

A chain parallel to a list of points shot previously or parallel to a chain (figure) defined previously in the same file can also be generated by the post processing software. This is accomplished by adding horizontal offsets (OF:) and/or vertical distances (DV:) to the Chain Activity (AC:CH). This process also generates the points that make up the new chain.

```
AC:CH
FE:CURB
FG:12
BN:50000
PL:1-3
CH:10           (CH:10 is made of PN's 40-42 for this example)
PL:31,32
OF:0.5
DV:0.5
...., ETC.
CP:09/18/1999 18:46:43.
```

The example chain activity shown above indicates a chain with the feature “CURB” is to be generated 0.5 feet right and 0.5 feet above each point of the chain defined by the points list and chain list included. The Figure Code (FG:) is used as the identifier of the chain to be created. The point number for each point generated will be based on the point number that has been entered in that particular chain activity. For example, in the chain activity listed above, the first point generated parallel to PN:1 will be PN:50001. A new point will be generated for every point in the point list and for every point making up a chain in the chain list (CH). The chain that is created will be FG:12.

The post processing software generates points to represent the new positions defined by the offsets. The chain generated will be listed at the bottom of the calculated file with any other chains that are defined in the project file.

Note: PN: may or may not be required, depending on the post processing software used. Consult the user guide for that software to determine the actual requirements.

The Calculated File

Using this method, the post processing software would include the additional points generated by the offsets and would list the information in the SDMS calculated file as shown in the example that follows.

```
AC:SS
PN:1
FE:CURB
SH:5
HZ:45.2354
VT:90.3045
DS:100.44
XX:###
YY:###
ZZ:####
AC:SS
PN:2
FE:CURB
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
XX:###
YY:###
ZZ:####
AC:SS
PN:31
FE:CURB
SH:5
HZ:56.2853
VT:90.3006
DS:190.94
XX:###
YY:###
ZZ:####
AC:SS
PN:32
FE:CURB
SH:5
HZ:57.2853
VT:90.3006
DS:195.94
XX:###
YY:###
ZZ:####
AC:SS
PN:40
FE:EPL
```

```
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
XX:###
YY:###
ZZ:####
AC:SS
PN:41
FE:EPL
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
XX:###
YY:###
ZZ:####
AC:SS
PN:42
FE:EPL
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
XX:###
YY:###
ZZ:####
AC:CH
FE:CURB
FG:12
BN:50000
PL:1-3
CH:10          (CH:10 is made of PN’s 40-42 for this example)
PL:31,32
OF:0.5
DV:0.5
AC:SS
PN:50001       (First point generated by the offsets being included in
               the chain activity at PN:1)
FE:CURB
XX:###
YY:###
ZZ:####
AC:SS
PN:50002       (Second point generated by the offsets being included in
               the chain activity at PN:2)
FE:CURB
XX:###
YY:###
ZZ:####
AC:SS
PN:50003       (Third point generated by the offsets being included in
               the chain activity at PN:3)
FE:CURB
XX:###
YY:###
ZZ:####
AC:SS
PN:50040       (Fourth point generated by the offsets being included in
               the chain activity at PN:40)
FE:CURB
XX:###
YY:###
ZZ:####
AC:SS
PN:50041       (Fifth point generated by the offsets being included in
               the chain activity at PN:41)
FE:CURB
XX:###
YY:###
ZZ:####
```

```
AC:SS
PN:50042       (Sixth point generated by the offsets being included in
               the chain activity at PN:42)
FE:CURB
XX:###
YY:###
ZZ:####
AC:SS
PN:50031       (Seventh point generated by the offsets being included
               in the chain activity at PN:31)
FE:CURB
XX:###
YY:###
ZZ:####
AC:SS
PN:50032       (Eighth point generated by the offsets being included in
               the chain activity at PN:32)
FE:CURB
XX:###
YY:###
ZZ:####
...., ETC.
CP:09/18/1999 18:46:43
BG:Begin Chain List
AC:CH
FE:EPL
FG:10
PL:40-42 (OR 40,41,42)
AC:CH
FE:CURB
FG:12
PL:50000-50007
EG:End Chain List
CP:09/27/1999  13:15:18
```

The first chain listed in the calculated file would have been generated from the field shots on the points. The second chain would have been generated by the designated offsets. New points were also generated to represent the calculated positions.

The user can edit the chains listed and also create additional chains during the post-processing phase. This can be done by manually editing an existing chain or by making a new chain list in the project file. If edits or new chains are introduced, the file must be reprocessed. The post processing software would need to review the entire file to check for any edited or added chains. The points generated would then be listed in the required format. All of the chains created using the parallel chain function will be listed at the end of the calculated file in the AC:CH format along with the other chains created in the project file.

How Points are Created for a Parallel Chain

The points that will need to be computed to create the parallel chain will depend on the configuration of the chain or points being paralleled. The examples that follow indicate what points need to be stored in the actual SDMS Calculated file (CAL) and/or Points and Chains file (PAC) for export to a CADD or for archive purposes.

Chains Consisting of Two Points

Points are created perpendicular and at the offset distance specified, to the right or left of the points in the points or chain being paralleled. Figure 6.11 shows the chain and two of the points that would be created using part of the information from the example above.

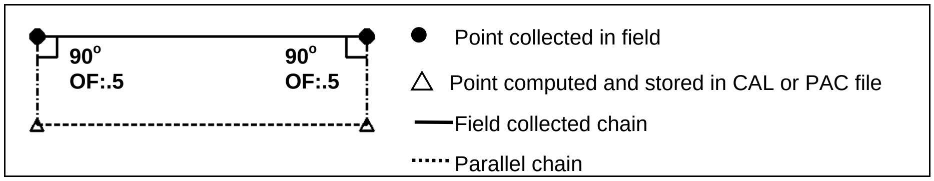


Figure 6.11 – Points and Chains Computed Parallel to a Two-Point Figure

Chains Consisting of More than Two Points

The majority of chains collected will consist of more than two points and will be an irregular shape with intersecting angles less than or greater than 180°. Therefore, the points that are created for the parallel figure and stored in the SDMS calculated file (CAL) and/or Points and Chain file (PAC) are not actually perpendicular to the points in the chain being paralleled. Since these points actually lie on the bisector of the angle, they will not be at the offset distance specified in the chain activity containing that data. This requires two temporary points be computed by the post processing software on each end of the line as is done for a two-point chain.

For intersection angles greater than 180°, it is necessary to compute temporary points as shown in Figure 6.12.

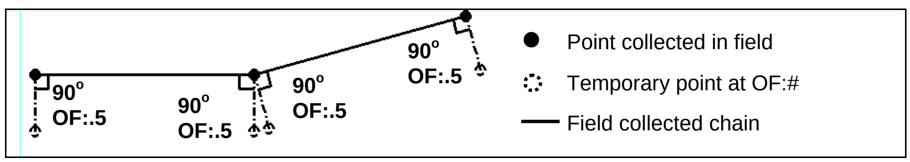


Figure 6.12 – Points Computed Parallel to an Irregular Shaped Figure with Angles Greater than 180°

The temporary points are then used to compute the intersect point that will actually be created and stored for defining the parallel figure. This point should be on the bisect of the angle between the two temporary points, as shown in Figure 6.13.

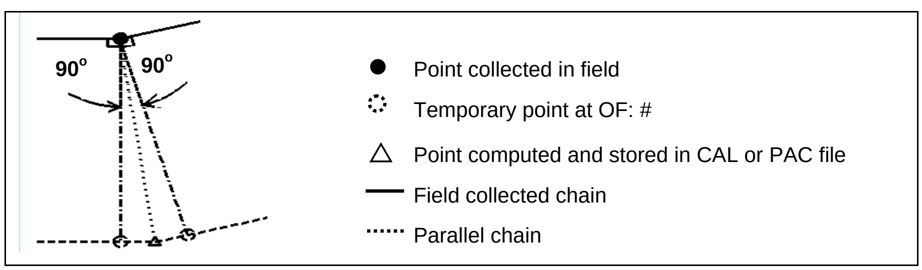


Figure 6.13 – Location of the Point to be Stored

The actual points and figure that will be stored are shown in Figure 6.14.

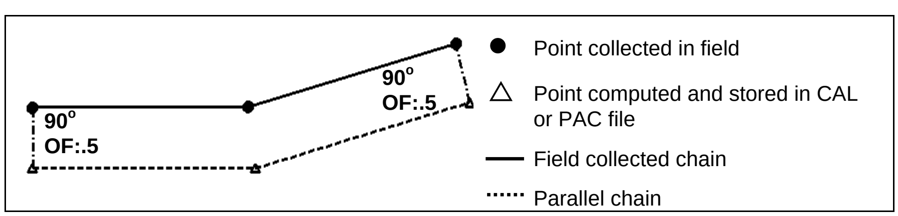


Figure 6.14 – Actual Points and Chains Computed Parallel to an Irregular Shaped Chain with Angles Greater than 180°

Note: The temporary points do not need to be stored in the CAL or PAC file.

Another scenario to consider is parallel offsets to a figure formed with angles less than 180º. The temporary points are computed in the same manner as for a two-point chain. But in this case, the temporary points will fall beyond the actual point and parallel chain location, as shown in Figure 6.15 should be placed in the same way as the closed figure.

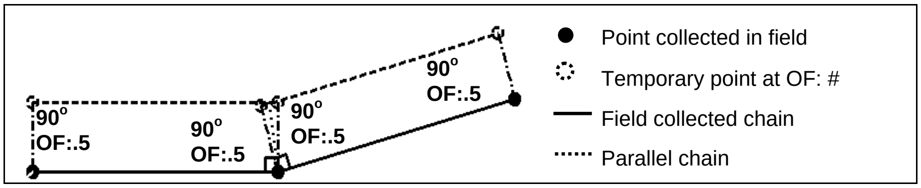


Figure 6.15 – Points Computed Parallel to an Irregular Shaped Figure with Angles Less than 180°

This point should be on the bisector of the angle between the two temporary points, as shown in Figure 6.16. The new point is generated at the intersection of the parallel chain if they were extended to the temporary points.

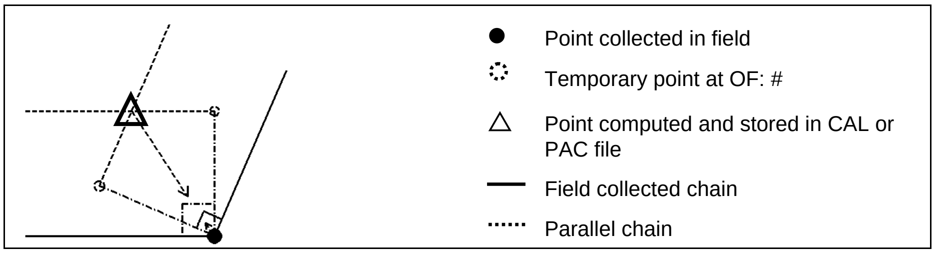


Figure 6.16 – Temporary Points Will Overlap for Angles Less than 180°

The actual point and figure that will be stored are shown in Figure 6.17.

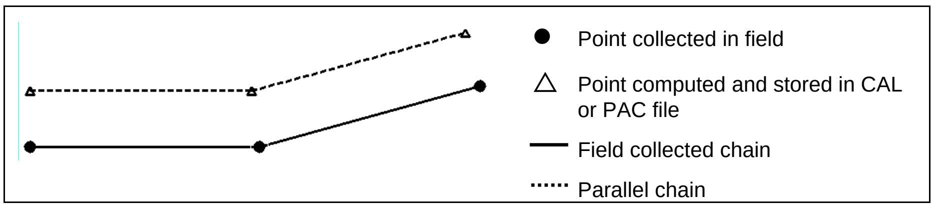


Figure 6.17 – Actual Points and Chains Stored Parallel to an Irregular Shaped Figure with Angles Less than 180°

Creating Points and Chains Parallel to Closed Figures

Points and chains can be computed parallel to the outside and inside of a closed figure. Temporary points must be computed to generate the required points for the parallel chain.

A parallel chain outside the closed figure will generate the temporary points shown in Figure 6.18

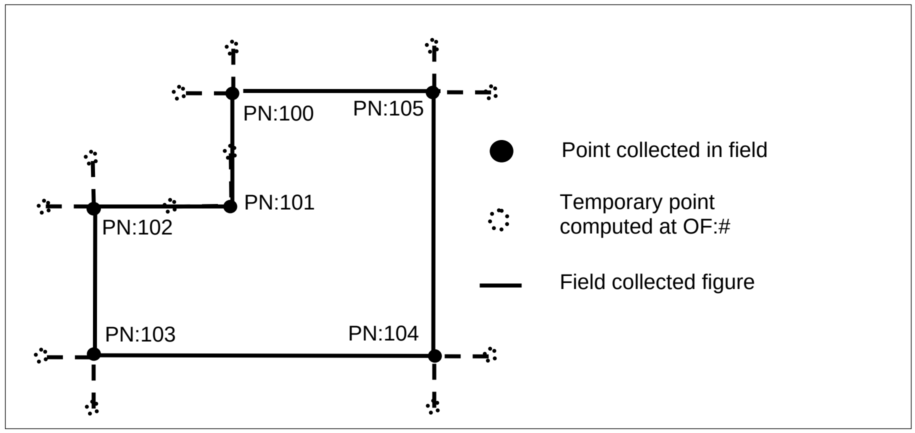


Figure 6.18 – Temporary Points for a Parallel Chain Outside the Closed Figure

The actual points and chain to be stored in the calculated (CAL) file and/or points and chain (PAC) file are shown in Figure 6.19.

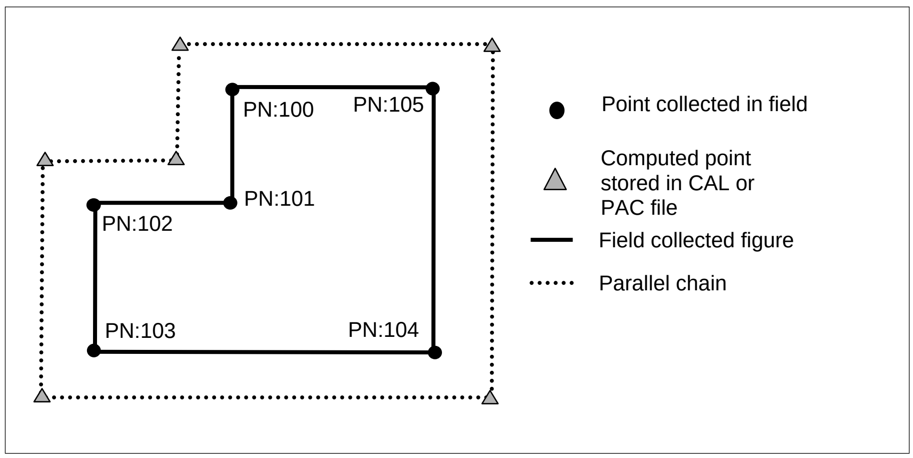


Figure 6.19 – A Parallel Chain Generated Outside a Closed Figure

A parallel chain lying inside the closed figure will generate the temporary points shown in Figure 6-20.

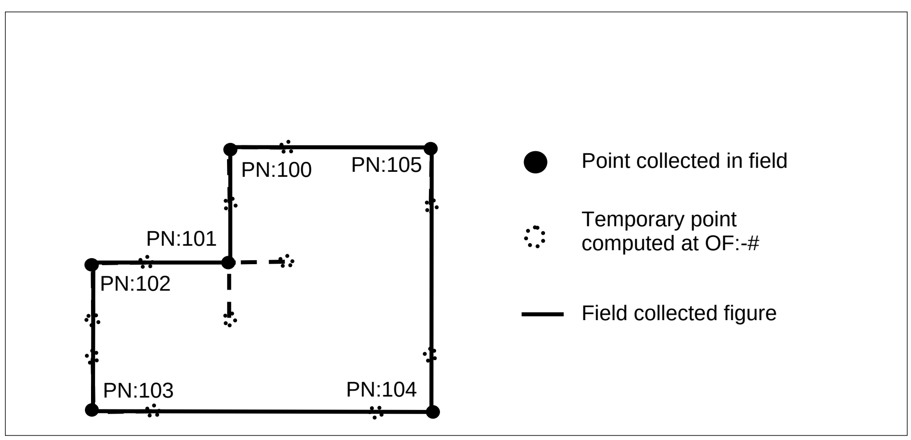


Figure 6.20 – Temporary Points for a Parallel Figure Within the Closed Figure

The actual points and chain to be stored in the calculated (CAL) file and/or points and chain (PAC) file are shown in Figure 6.21.

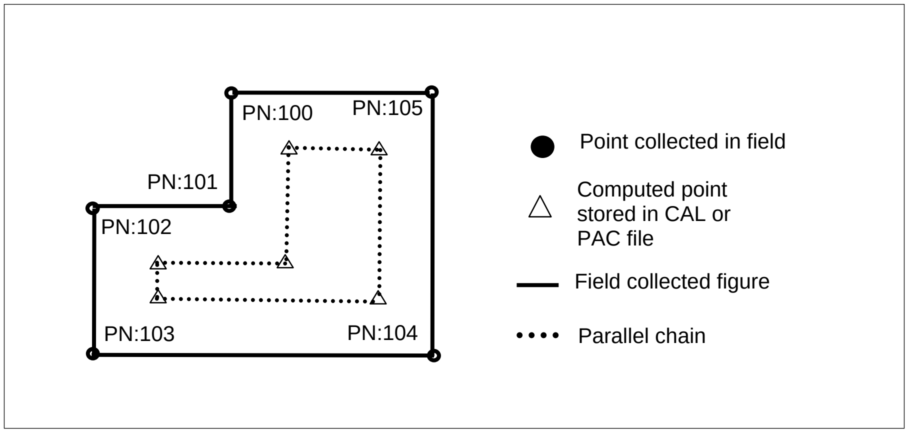


Figure 6.21 – A Parallel Figure Generated Within a Closed Figure

Section VII - Data Tag Definitions

Overview

Under the SDMS data structure, data item entries in the project file consist of a two character data tag, followed by a colon, followed by the data or other qualifying information. For example:

```
BP:29.5                 barometric pressure, value 29.5
WD:12.6                 width, value 12.6
```

Based on its definition, an SDMS data tag can be used to provide detailed descriptive information about a point or to provide information required to perform computations. Descriptive tags, as defined, do not affect computations. Certain data tags are used in specific ways that affect computations or transfer of data to third party systems.

Each data tag in the SDMS data structure is individually documented in this section. Some data tags have secondary definitions and restrictions that should be noted. Individual definitions begin on the following page.

Tag definitions are listed alphabetically by the two letter data tag. An alphabetized listing by the data tags that have been defined, as well as by the long name for that tag can be found in the Appendix.

Note: A data item may have more than one definition depending on what file it is used in. The software would know which definition to use depending on where the data item is found. Multiple definitions for data items are restricted to those specifically listed in this definitions section.

Attribute 0 through Attribute 9 - A0: through A9:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value for user defined point attributes

Description/Definition

Primary Usage

The ten attribute data tags (A0:, A1:, A2:, A3:, A4:, A5:, A6:, A7:, A8:, and A9:) are used to create user-defined data items to further describe the object in the current activity. The information collected is shot-specific. The use is often temporary, allowing the user to pick up additional descriptive data for a specific circumstance or project.

Secondary Usage

To create user-defined data items to further describe the project in general, or to meet any other unique user specific need.

Restrictions

No restrictions on content. These tags should not be used in lieu of an existing data tag, or an existing data tag that is appropriately close to the user's intended need.

Sample Placement in an Activity

The user-defined attribute tags may be used anywhere in the project file. As an example, assume that it is necessary to record the street address for certain shots. The A1: data tag could be defined to mean STREET ADDRESS.

```
AC:SS
PN:100
PD:MAIL BOX
HZ:43.4567
VT:89.2312
DS:987.34
A1:4228 PORTLAND      (A1: used here to collect a street address)
(etc.)
```

Computed Area - AA:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the computed area

Description/Definition

The area-computed data item (AA:) displays the computed area of a stored closed chain (figure). This data tag is not entered by the user as part of any activity, but is produced by the system as part of the data reduction process. The units of the computed area will be based on the Units of Length (UL:) defined for the project.

Sample Placement in an Activity

```
AC:SS
PN:100
FE:IP
PD:3/8″REBAR
HZ:150.4534
```

```
VT:90.4534
DS:134.20
AC:CH
CH:2
AA:1298.08
AC:SS
(etc)
```

Activity - AC:

Synonyms

Shot, record

Allowed Responses

```
BA
BS
CA
CC
CE
CH
CK
DE
EC
EQ
FG
FS
OS
PD
PR
RG
SS
SI
SR
ST
TA
TP
TS
TX
UE
```

SDMS Activity	Name and Description
AC:BA	Begin Alignment – Used with the compute horizontal alignment task (TK:CHA) and compute vertical alignment task (TK:CVA) to indicate where to start computations of an alignment.
AC:BS	Back Sight - used to measure a backsight shot to a defined point
AC:CA	Continue Alignment - Used with the compute horizontal alignment task (TK:CHA) and compute vertical alignment task (TK:CVA) to indicate additional alignment segments are included for computations and will be related to the SI: for that segment (PC, PT, PRC, PCC, SC, CS, ST, PI, POT, etc.). RESERVED.
AC:CC	Control Check - used to shoot from the current station to a point with known X,Y,Z coordinates as a check on the current position and elevation.
AC:CE	Collimation Error - used to record measurements to compute the instrument collimation error. RESERVED.
AC:CH	Chain List - used define a chain by giving a list of previously defined points and chains, regardless of any connectivity methods used.

SDMS Activity	Name and Description
AC:CK	Check Mode - used to suspend prompted operations to allow the user to work interactively with SDMS, then continue the operation.
AC:EC	Elevation Control - used with tasks that use an electronic total station instrument to shoot from the current occupied station to a point with known elevation to compute the elevation of the current occupied station.
AC:EQ	Equation – used to define a station equation in an alignment file. Station equations are shown in a list and must be placed at the beginning of the alignment file, after the project header (AC:PR) and before the initial PI point.
AC:FG	Figure - used to record critical points from which standard figures (such as an inlet) can be extrapolated.
AC:FS	Foresight - used to make a foresight shot from the current station.
AC:OS	Occupied Station - used to set up the instrument on a known or previously measured point.
AC:PD	Point Description – used in the Points and Chain file to define a point and its attributes.
AC:PR	Project Header - defines the project name, the task, and global settings for a project.
AC:RS	Ring Shot – used to record shot data related to a tunnel survey. RESERVED
AC:SS	Sideshot - used to make a sideshot from the current station.
AC:SI	Sideshot Intersect - used to measure a horizontal angle from the current station to a sideshot point. A sideshot intersect to the same point from at least two different stations will allow the sideshot point coordinates to be computed.
AC:SR	Station Resection - used to measure distances and angles from the current station to points with known coordinates. Resection measurements from an occupied station to two or more different known points will allow the occupied station coordinates to be computed.
AC:ST	Stationing - used to define a station on a baseline or alignment for cross sectioning.
AC:TA	Taping - used to collect taped measurements along figures to define a chain.
AC:TP	Turn Point - used for a turning point (foresight) in the level or 3-wire level task.
AC:TS	Tie Sequence –can be used to reference a control points.
AC:TX	Place Text - used to define a text block which allows multi-line comments or point descriptions.
AC:UE	Utility Elevation - used to measure an elevation for an object, directly above or below the level of the sideshot.

Description/Definition

Primary Usage

The activity data item (AC:) is a system data item. It defines the type of shot being taken or the type of data being recorded. The AC: tag is also used as a record separator. It marks the end of one activity and the beginning of a new activity. It must be entered with, and be the first entry of, any new activity. Its value does not carry forward to subsequent activities.

All data in the project or control file is recognized and uniquely processed according to the AC: data item. The AC: tag separates specific activities which ensures, for example, that backsighhts are not treated as sideshots.

Restrictions

Only the two-character combinations listed above are permitted in the data structure. Users may not define their own activities, nor should they use activities in other than the way they are defined.

Sample Placement in an Activity

The activity data item signals the end of the previous activity and the beginning of a new one.

```
PR:DOT1023
TK:RTO
AC:PR          (start new activity, project header)
ID:US HWY 10
DT:10/15/89
AC:OS          (end project header, start occupied station)
(etc.)
```

Angle Distance List - AD:

Synonyms

Not applicable.

Allowed Responses

Alphanumeric value of the angle and distances

Description/Definition

The Angle-Distance data item (AD:) is used in the Taping activity to record the measured angles, horizontal distance and vertical distance for object such as buildings when it is not practical to record the shots with an instrument. Measured values in the list are in the form Direction, Horizontal Distance, Vertical Distance.

The direction is recorded as a horizontal angle right. That is the angle measured or approximated by looking back from the current occupied point to the current backsight point and measuring the horizontal angle right to the next point to be taped.

The AD: line must include at least the direction and horizontal distance (DH:). If there is no change in elevation, the vertical distance (DV:) can be shown as zero (0) or left blank. Each horizontal distance in the list must be prefixed with an angle followed by a comma.

It should be understood that measurements made by tape will be of a lower order of precision than those measured electronically.

See Section VI, *Conectivity by Taping* for more details.

Sample Placement in an Activity.

```
AC:SS
PN:9
FE:HOUSE
SH:5
HZ:45.2354
VT:90.3045
DS:100.44
AC:SS
PN:10
FE:HOUSE
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
AC:TA
OS:10          (Point Number of the point to be use as the occupied
               station)
BS:9           (Point Number of the point to be used as the backsight)
PN:100         (Beginning Point Number to be for the points computed)
FE:HOUSE       (Feature to be used for the new chain)
FG:5           (Figure Number to be used for the chain)
AD:90,34,      (Right 34 feet, use the same elevation as PN:10)
AD:90,60,3.2   (Right 60 feet. Add 3.2 feet to the previous elevation)
AD:270,38,0    (Left, 38 feet. Elevation the same as the previously
               defined point. Could be blank.),
AD:90,44,      (Right 44 feet. Same elevation as the previously defined
               point.)
AD:90,72, -3.2 (Right 71 feet. Subtract 3.2 feet from the elevation of
               the previously defined point.)
AD:90,104      (Right 104 feet to the first point defining the chain)
(etc)
```

Accuracy Horizontal - AH:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value for the horizontal accuracy

Description/Definition

The Accuracy Horizontal data item (AH:) is used in a project file or control file to designate the horizontal precision of a point if recorded with that point, or for all the points in a file if recorded in the project header. Examples are AH:A (could be equivalent to NGS Order A of 0.1 PPM); AH:F (could be equivalent to NGS First Order of 10.0 PPM). This data item may also appear as a numeric value if derived from a Global Positioning System (GPS) receiver. An example is AH:0.13 which would relate to 0.13 of the current project units.

Primary Usage

The horizontal accuracy (AH:) data tag is used in a project file or control file to designate the precision of a point if recorded with that point. If the data tag is used in the project file header, the precision will be applied to all the points.

Sample Placement in an Activity

```
AC:OS
PN:1
PD:GPS MON. #600030
FE:CTL
XC:1228961.0830
YC:127554.6980
ZC:352.22
AH:A           (Order A (.1 PPM))
AV: F1
(etc.)
```

Area - AR:

Synonyms

Not applicable.

Allowed Responses

Numeric value of a known chain area

Description/Definition

The Area data item (AR:) defines the known area of a chain. It may be used in conjunction with the chain activity (AC:CH) to specify the known or designed area of a figure.

Restrictions

The AR: data item is only used within the chain activity.

Sample Placement in an Activity

```
AC:CH
FE:PARCEL
FG:10
CD:PROPERTY LINE
OW:MG&E
PL:4-6, 10-8
AR:43560
(etc.)
```

Antenna Type - AT:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value for the antenna name.

Description/Definition

The Antenna Type data item (AT:) is used to record the type of antenna used in conjunction with the the Instrument Type data item (IT:) for the project or point data collection.

Sample Placement in an Activity

```
AC:OS
PN:WIL1
IT:Trimble 4000SSI
SN:3613A15012
AT:Trimble Geodetic L1/L2 Compact +Groundplane
SN:0220054190
IH:0.000
AC:FS
PN:BASE
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:13451.012
VY:3468.604
VZ:-265.403
C1:0.00000299
C2:-0.00000456
C3:0.00000189
C4:0.000002167
C5:-0.00000703
C6:0.00000777
BT:14:54:42 04/24/2004
SO:FIXED
FR:IONO FREE
SV:7
NS:412
IP:P4.3
```

Accuracy Vertical - AV:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value for the vertical accuracy

Description/Definition

The vertical accuracy (AV:) data tag is used in a project file or control to designate the precision of a point if recorded with that point. If the data tag is used in the project file header, the precision will be applied to all the points.

This data item may also appear as a numeric value if derived from a Global Positioning System (GPS) receiver. An example is AH:0.13 which would relate to 0.13 of the current project units.

Sample Placement in an Activity

```
AC:OS
PN:1
PD:GPS MON. #600030
FE:CTL
XC:1228961.0830
YC:127554.6980
ZC:352.22
AH:A
AV:F1          (First Order (10 PPM))
(etc.)
```

Azimuth - AZ:

Synonyms

Back(sight) azimuth, forward azimuth, closing azimuth, reference azimuth

Allowed Responses

Numeric angular value of the azimuth from North, 0° to 360° (DDD.MMSSS)

Description/Definition

The azimuth data item (AZ:) indicates the azimuth from North (North is 0.000000°), of a line of sight from the occupied point to the referenced object. The referenced object will be either the initial backsight or the closing foresight.

The azimuth is measured clockwise from North. The format for the angular value is DDD.MMSSS.

The azimuth data item is source data. That is, it must be specifically entered into the activity to which it applies and is unique to that activity. Therefore, to be used in computations, it must be entered with the initial backsight activity for each particular traverse. If an azimuth closure is to be computed, the closing azimuth must be entered with the final foresight for that traverse. The azimuth does not have to be recorded if coordinates have been entered for these points.

If the AZ: data item appears in an activity where coordinate data is present, the value of the azimuth takes precedence and the coordinates are ignored during computations.

Sample Placement in an Activity

```
AC:BS
PN:1
PD:GPS MON. #600030
HZ:0.0
VT:89.331
DS:104.312
AZ:0
AC:SS
(etc.)
```

Begin Group (List) - BG:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value

Description/Definition

The Begin Group data item (BG:) is used in the SDMS calculated file (.CAL) to indicate the beginning of the list of chains generated by the post processing software from the shot attribute information listed in the project (.PRJ) file being processed. The BG: data item will be placed after the CP: data item that normally follows the last shot activity in the calculated file. The BG: data item is used by CADD software as an indicator of where to begin reading chain data from the calculated file.

A calculated (.CAL) file will contain one BG: tag and it will be updated in the calculated file each time the project file or calculated file is reprocessed. The BG: data item response may contain any response or may be left blank. The BG: tag does not affect computations.

Note: If no CP: data item and response is present following the last shot activity in the project file, it must be added by the post processing software.

Sample Placement in an Activity

The BG: data item must be placed after the CP: data item that follows the last shot activity in the project file.

```
AC:SS          (Last Shot Activity in the calculated (CAL) file)
PN:100
FE:WV
PD:WATER VALVE FOR 2" PVC LINE
OW:CITY
HZ:5.3423
VT:90.4534
DS:250.54
XX:45217.875
YY:11214.556
ZZ:395.22
CP:09/18/1999 18:46:43
BG:Begin Chain List
AC:CH
FE:HOUSE
CD:OUR HOUSE
FG:5
PL:10,100,101,102,103,104
AC:CH
FE:EPL
CD:LEFT PAVEMENT EDGE ENTIRE PROJECT
FG:11
PL:1-3,6-8,15-13,21-24,31,32
AC:CH
FE:FENCE
CD:OUR FENCE LINE
FG:10
PL:6-8,15-13,21-24,6
EG:End Chain List
CP:09/27/1999  13:15:18
```

Barometric Pressure - BP:

Synonyms

Not applicable.

Allowed Responses

Numeric value for the barometric pressure, inches, bars

Description/Definition

The barometric pressure data item (BP:) is used to record the barometric pressure in the units designated by the UP: data item.

Sample Placement is an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
NM:S5111
OB:JDH
RE:JDH
I5:DJS
I6:AMC
WE:CLOUDY
BP:29.94
CM:MANSION SURVEY
(etc)
```

Bearing - BR:

Synonyms

Not applicable.

Allowed Responses

Alphanumeric angular value of the bearing

Description/Definition

The bearing data item (BR:) is used to record or display the bearing measured or computed between two known points. This will normally be used in stakeout or coordinate geometry computations.

The format for recording and archival is: (N or S)DD.MMSSS(E or W).

The display format is the choice of the user or as allowed by the data collection and processing software being used.

Sample Format

```
BR:N03.2212E
BR:S03.2212E
BR:S10.32212W
BR:N10.32212W
```

Backsight Point Number - BS:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value for the backsight point number when taping

Description/Definition

The Back Sight Point Number data item (BS:) is used with the Taping Activity (AC:TA) to list the point number to use as the back sight to initiate the taping routine.

Sample Placement in an Activity

```
AC:SS
PN:9
FE:HOUSE
SH:5
HZ:45.2354
VT:90.3045
DS:100.44
AC:SS
PN:10
FE:HOUSE
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
AC:TA
OS:10          (Point Number of the point to be use as the occupied
               station)10
BS:9           (Point Number of the point to be used as the backsight)
PN:100         (Beginning Point Number to be used for the points
               computed)
FE:HOUSE       (Feature to be used for the chain generated)
FG:5           (Figure Number to be used for the chain generated)
AD:90,34,      (Right 34 feet, use the same elevation as PN:10)
AD:90,60,3.2   (Right 60 feet. Add 3.2 feet to the previous elevation)
AD:270,38,0    (Left, 38 feet. Elevation the same as the previously
               defined point. Could be blank.),
AD:90,44,      (Right 44 feet. Same elevation as the previously defined
               point.)
AD:90,72, -3.2 (Right 71 feet. Subtract 3.2 feet from the elevation of
               the previously defined point.)
AD:90,104      (Right 104 feet to the first point defining the chain)
(etc)
```

Begin Time - BT:

Synonyms

Not applicable.

Allowed Responses

Numeric value of Global Positioning (GPS) Time in the HH:MM:SS format followed by a blank space and then the numeric value of the date in the MM/DD/YYYY format.

Description/Definition

The Begin Time data item (BT:) stores the starting time of a GPS observation session for a point or processed vector.

Sample Placement in an Activity

```
AC:FS
PN:BASE
IT:Topcon Legacy E
SN:LE2550
```

```
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:13451.012
VY:3468.604
VZ:-265.403
C1:0.00000299
C2:-0.00000456
C3:0.00000189
C4:0.000002167
C5:-0.00000703
C6:0.00000777
BT:14:54:42 04/24/2004
SO:FIXED
FR:IONO FREE
SV:7
NS:412
IP:P4.3
```

Variance X - C1:

Synonyms

Not applicable.

Allowed Responses

Numeric value representing the variance of the X component of a processed Global Positioning System (GPS) vector.

Description/Definition

The Variance X data item (C1:) stores the variance of the X component of a processed GPS vector. This value is obtained from the processed vector's variance covariance matrix which is a symmetric 3 by 3 matrix where the diagonal contains the variance of the X, Y, Z components and the off diagonal elements contain the covariances of these elements.

Sample Placement in an Activity

```
AC:FS
PN:BASE
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:13451.012
VY:3468.604
VZ:-265.403
C1:0.00000299
C2:-0.00000456
C3:0.00000189
C4:0.000002167
C5:-0.00000703
C6:0.00000777
BT:14:54:42 04/24/2004
SO:FIXED
FR:IONO FREE
SV:7
NS:412
IP:P4.3
```

Covariance XY - C2:

Synonyms

Not applicable.

Allowed Responses

Numeric value representing the covariance of the X and Y components of a processed Global Positioning System (GPS) vector.

Description/Definition

The Covariance XY data item (C2:) stores the covariance of the X and Y components of a processed GPS vector. This value is obtained from the processed vector's variance covariance matrix which is a symmetric 3 by 3 matrix where the diagonal contains the variance of the X, Y, Z components and the off diagonal elements contain the covariances of these elements.

Sample Placement in an Activity

```
AC:FS
PN:BASE
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:13451.012
VY:3468.604
VZ:-265.403
C1:0.00000299
C2:-0.00000456
C3:0.00000189
C4:0.000002167
C5:-0.00000703
C6:0.00000777
BT:14:54:42 04/24/2004
SO:FIXED
FR:IONO FREE
SV:7
NS:412
IP:P4.3
```

Covariance XZ - C3:

Synonyms

Not applicable.

Allowed Responses

Numeric value representing the covariance of the X and Z components of a processed Global Positioning System (GPS) vector.

Description/Definition

The Covariance XZ data item (C3:) stores the covariance of the X and Z components of a processed GPS vector. This value is obtained from the processed vector's variance covariance matrix which is a symmetric 3 by 3 matrix where the diagonal contains the variance of the X, Y, Z components and the off diagonal elements contain the covariances of these elements.

Sample Placement in an Activity

```
AC:FS
PN:BASE
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:13451.012
VY:3468.604
VZ:-265.403
C1:0.00000299
C2:-0.00000456
C3:0.00000189
C4:0.000002167
C5:-0.00000703
C6:0.00000777
BT:14:54:42 04/24/2004
SO:FIXED
FR:IONO FREE
SV:7
NS:412
IP:P4.3
```

Variance Y - C4:

Synonyms

Not applicable.

Allowed Responses

Numeric value representing the variance of the Y component of a processed Global Positioning System (GPS) vector.

Description/Definition

The Variance Y data item (C4:) stores the variance of the Y component of a processed GPS vector. This value is obtained from the processed vector's variance covariance matrix which is a symmetric 3 by 3 matrix where the diagonal contains the variance of the X, Y, Z components and the off diagonal elements contain the covariances of these elements.

Sample Placement in an Activity

```
AC:FS
PN:BASE
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:13451.012
VY:3468.604
VZ:-265.403
C1:0.00000299
C2:-0.00000456
C3:0.00000189
C4:0.000002167
C5:-0.00000703
```

```
C6:0.00000777
BT:14:54:42 04/24/2004
SO:FIXED
FR:IONO FREE
SV:7
NS:412
IP:P4.3
```

Covariance YZ - C5:

Synonyms

Not applicable.

Allowed Responses

Numeric value representing the covariance of the Y and Z components of a processed Global Positioning System (GPS) vector.

Description/Definition

The Covariance YZ data item (C5:) stores the covariance of the Y and Z components of a processed GPS vector. This value is obtained from the processed vector's variance covariance matrix which is a symmetric 3 by 3 matrix where the diagonal contains the variance of the X, Y, Z components and the off diagonal elements contain the covariances of these elements.

Sample Placement in an Activity

```
AC:FS
PN:BASE
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:13451.012
VY:3468.604
VZ:-265.403
C1:0.00000299
C2:-0.00000456
C3:0.00000189
C4:0.000002167
C5:-0.00000703
C6:0.00000777
BT:14:54:42 04/24/2004
SO:FIXED
FR:IONO FREE
SV:7
NS:412
IP:P4.3
```

Variance Z - C6:

Synonyms

Not applicable.

Allowed Responses

Numeric value representing the variance of the Z component of a processed Global Positioning System (GPS) vector.

Description/Definition

The Variance Z data item (C6:) stores the variance of the Z component of a processed GPS vector. This value is obtained from the processed vector's variance covariance matrix which is a symmetric 3 by 3 matrix where the diagonal contains the variance of the X, Y, Z components and the off diagonal elements contain the covariances of these elements.

Sample Placement in an Activity

```
AC:FS
PN:BASE
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:13451.012
VY:3468.604
VZ:-265.403
C1:0.00000299
C2:-0.00000456
C3:0.00000189
C4:0.000002167
C5:-0.00000703
C6:0.00000777
BT:14:54:42 04/24/2004
SO:FIXED
FR:IONO FREE
SV:7
NS:412
IP:P4.3
```

Convergence Angle - CA:

Synonyms

Mapping angle

Allowed Responses

Numeric value for the convergence angle

Description/Definition

The convergence angle data item (CA:) is used to record the difference between grid north and forward geodetic north at a point. A forward geodetic azimuth at a station is the angle from geodetic north to another station.

The format is:

Positive angle, CA:ddd.mmssssss

Negative angle, CA:-ddd.mmssssss

Note: Geodetic north lines converge to the north pole, and therefore, are only parallel at the equator. Grid north (state plane north) lines are parallel to one another.

The convergence angle is zero at the central meridian because grid north and geodetic north coincide.

The equation which relates azimuths in the two systems is:

grid azimuth = (geodetic azimuth) - (convergence angle) + (T-t correction)

or

geodetic azimuth = (grid azimuth) + (convergence angle) - (T-t correction)

Convergence angles are negative when west of the central meridian and positive when east of the central meridian. The T-t (second term) correction is insignificant on typical survey distances but can become a few seconds for lines longer than a mile near the edge of a zone.

Horizontal angles are reduced to grid by only T-t correction:

grid angle = (geodetic angle) + (foresight T-t correction) – (backsight T-t correction)

The second term correction (T-t correction) is due to the fact that horizontal angles measured on a curved earth need to be reduced to the flat state plane grid. If a geodetic azimuth for a line is converted to a grid azimuth (or vice-versa), a small correction must be applied to the convergence angle which accounts for the fact that a geodetic azimuth exists on a curved surface (the earth) and a grid azimuth is on a flat surface (the projection). It is a function of the length of the line and its location in the zone, and is generally less than an arc second. The second term correction rarely exceeds tenths of seconds. This correction must also be applied to horizontal angles to reduce them to their grid equivalents. The second term correction must also be applied to horizontal angles to obtain the grid equivalent value, though the correction is often less than 0.1 seconds, so it is insignificant.

Note: When retracing original survey lines normally requires converting bearings derived from GPS (geodetic) to grid.

Sample Placement in an Activity

```
AC:OS
PN:1
FE:CTL
PD:STANDARD GPS MONUMENT
XC:659149.034220
YC:765243.031048
ZC:1078.019000
SY:0.004
SX:0.002
SZ:0.005
CA:-1.22568916
CF:1.000002867
(etc.)
```

Chain Description - CD:

Synonyms

Figure description, string description

Allowed Responses

User defined alphanumeric value of the chain description

Description/Definition

The chain description data item (CD:) is used to describe a survey or geometry chain. The CD: data item is placed with the first sideshot activity (AC:SS) containing the figure code data item (FG:) that identifies the beginning of a survey chain. The CD: data item is also used with the chain activity (AC:CH) for chains described in the field and in post processing. The CD: data item is passed by post processing software with the chain that is being described

The chain description data item is alphanumeric and does not affect computations.

Sample Placement in an Activity

The CD: data item may be placed anywhere within an activity.

```
AC:SS
PN:200
PD:SHOT ON WATER LINE
FG:15
CD:6” PVC
HZ:365.821
VT:88.312
DS:132.047
AC:SS
(etc.)
AC:CH
CH:20
CD:FIBER OPTIC CABLE
FE:FOC
PL:220,234,235,237,244
(etc.)
```

Collimation Error - CE:

Synonyms

Horizontal collimation error

Allowed Responses

The angular value of the collimation error, numeric (s.sss)

Description/Definition

The collimation error (CE:) data item records the angular horizontal collimation error as determined by the surveyor when testing the collimation of the measurement instrument. The format is units of seconds of arc expressed as a decimal (s.sssss). For example, CE:5.00202 is a value of 5.00202 seconds.

The CE: data item does not affect coordinate computations. Rather, it is used to document the instrument error.

Sample Placement in an Activity

The CE: data item may be placed anywhere within the project file, although it is most appropriately placed in the project header activity.

```
PR:NSP147
TK:RTO
AC:PR
NM:F. ROOS
TE:62
BP:29
NM:B. JOHNSON
IT:AGA440
SN:420331
CE:.0030
AC:OS
(etc.)
```

Combination Factor - CF:

Synonyms

Not applicable.

Allowed Responses

The numeric value of the combination factor

Description/Definition

The combination factor (CF:) data item is used to reduce ground distances to grid distances, and vice versa.

The combination factor data item affects the project as a whole, rather than an individual shot or activity.

Sample Placement in an Activity

The CF: data item may be placed anywhere within an activity, although it is most appropriately placed in the project header activity.

```
PR:RTE 10
TK:TRA
AC:PR
CF:1.00
TE:62
BP:29
NM:B JOHNSON
IT:AGA440
SN:420331
AC:OS
(etc.)
```

Chain Number - CH:

Synonyms

Not applicable.

Allowed Responses

A list of previously stored chain numbers, alphanumeric

Description/Definition

The chain number (CH:) data item is used in conjunction with the chain activity AC:CH. The points in any chains listed in the CH: data item are included in the chain being defined with the chain activity. The CH: data item is also used in conjunction with the PL: data item, which lists individual points to include in the chain being defined.

Sample Placement in an Activity

The CH: data item is only used within the chain activity (AC:CH).

```
AC: CH         (begins the CHAIN activity)
FE: TEL        (feature code of the chain)
DP: 5          (depth of cover)
FG: 10         (defines the chain as figure 10)
CD: UG TELEPHONE CABLE (200 PAIR)
OW: AT&T
CH: 1-3        (includes the points in chains 1, 2, and 3 in the chain
               being created)
PL: 4-6, 10-8  (includes points 4, 5, 6, 10, 9, and 8 in the chain
               being created)
CH: 5          (includes the points in chain 5 in the chain being
               created)
(etc.)
```

City - CI:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value for the city

Description/Definition

The City data item (CI:) is used to record the city where the survey took place.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
CI:LITTLE ROCK
HD:REL
VD:NAVD88
IT:LIETZ_SET
```

```
SN:25825
NM:S5111
OB:JDH
RE:JDH
I5:DJS
I6:AMC
WE:CLOUDY
BP:29.94
CM:MANSION SURVEY
(etc.)
```

Class - CL:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value of the class

Description/Definition

The Class data item (CL:) is used to record a classification code for a point or survey chain. This can tell a CADD system how to use the point when plotted. For example:

CL:G (Ground) could indicate the point is to be used in the DTM as well as topography;

CL:F (Feature) could indicate the point is to be used only for topography;

CL:U (User Defined) could indicate that the point is to be defined by the user after it is passed to the CADD system.

Sample Placement in an Activity

```
AC:SS
PN:10402
FE:FE
FG:359
CL:F           (Point is to be plotted as a feature and not part of DTM
               surface)
GM:P
HZ:117.4029
VT:89.4127
DS:111.530
(etc.)
```

Comment - CM:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value of the comment

Description/Definition

The Comment data item (CM:) is used to record a comment about a point or observation.

Sample Placement in an Activity

```
AC:FS
PN:11203
FE:IP
TY:CTL
SE:1
FC:1
CL:F
HZ:194.5505
VT:88.3446
DS:431.130
PD:6"X10" STONE INSCRIBED “E S S”
PD:ON THE SOUTH FACE
CM:OWNER STATED STONE WAS SET IN 1889
CM:DURING THE ORIGINAL PROPERTY SURVEY
CM:DOES NOT KNOW WHAT THE INSCRIPTION
CM:STANDS FOR.        (Multiple comments are allowed in an Activity)
(etc.)
```

Condition - CN:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value for the condition

Description/Definition

The Condition data item (CN:) is used to record the condition of surveyed objects, such as inlets, pipes, bridges, etc. This data item is often used in inspection surveys.

Sample Placement in an Activity

```
AC:SS
PN:10200
FE:CU
FG:326
CL:G
GM:P
HZ:251.5305
VT:89.1852
DS:83.010
DI:24
TY:CMP
PD:INLET 24” CMP
CN:FAIR, 25% FILLED
(etc.)
```

County - CO:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value for the county name

Description/Definition

The County data item (CO:) is used to record the county where the survey took place.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
CI:LITTLE ROCK
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
NM:S5111
OB:JDH
RE:JDH
I5:DJS
I6:AMC
WE:CLOUDY
BP:29.94
CM:MANSION SURVEY
(etc.)
```

Close Project - CP:

Synonyms

End of survey

Allowed Responses

System defined alphanumeric value

Description/Definition

The close project data item (CP:) indicates where a project ended. The use of the CP: tag indicates the user's intent that the project was complete and not to be continued. The CP: data field may contain any value or may be left blank. Some suggestions would be to document the date and time the project was closed or last edited. Or it may indicate whether field book protection, if implemented in the user's system, was ON or OFF.

A file may contain multiple CP: tags, as a closed (or suspended) project may be restarted anytime for continued work. The CP: tag does not affect computations.

See also SP:, Suspend Project

Sample Placement in an Activity

```
AC:SS
PN:26
PD:FENCE LINE
HZ:23.002
VT:89.331
DS:554.312
CP:09/27/1999 13:16:17        (project was closed here)
```

Curvature and Refraction - CR:

Synonyms

Not applicable.

Allowed Responses

Yes or No

Description/Definition

The curvature and refraction data item (CR:) indicates whether or not the distances in the project file have been corrected for the Earth's curvature and atmospheric refraction. The raw data is never changed, but remains as collected from the instrument.

The curvature and refraction data item affects the project as a whole, rather than an individual shot or activity. The entry of the data item in the project file will allow the surveyor to pre-specify or over-ride this option for the office reduction system. It should be recorded in the project header or the first occupied station. If omitted, the office reduction system will use its own defaults.

Sample Placement in an Activity

The CR: data item may be placed anywhere within an activity, although it is most appropriately placed in the project header activity.

```
AC:PR
PR:SAMPLE
CF:1.00
CR:YES          (indicates Curvature and Refraction adjustment has been
                applied to the distance in the data file.)
TE:62
BP:29
NM:B JOHNSON
IT:AGA440
SN:420331
AC:OS
(etc.)
```

Coordinate System - CS:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value for the coordinate system

Description/Definition

The Coordinate System data item (CS:) is used in a project or control file to indicate the coordinate system used as the basis of the point coordinates found in that file. Examples are: State Plane Coordinate systems; County Coordinate systems; and, local coordinate systems.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
CI:LITTLE ROCK
CS:ARSPCS
HD:ARSPCS
VD:NAVD88
ZN:NORTH
IT:LIETZ_SET
SN:25825
NM:S5111
OB:JDH
RE:JDH
I5:DJS
I6:AMC
WE:CLOUDY
BP:29.94
CM:MANSION SURVEY
(etc.)
```

Deflection Angle - DA:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the deflection angle of a PI (DDD.MMSSS)

Description/Definition

The deflection angle (DA:) data item is used to record deflection angles at PI points for computation of a horizontal alignment. The deflection angle is defined by extending the back tangent direction ahead of the PI and measuring the subtended angle. The format for the angle is DDD.MMSSS. An angle left is indicated by preceding the angle with a negative (-) sign. An angle right is positive and no sign is required, but may be included.

Sample Placement in an Activity

```
AC:OS
SI:PI
YC:207400.163795
XC:759447.697336
RA:-435.000000
DA:-35.3454           (indicates the angle it to the left)
(etc.)
```

Degree of Curvature - DC:

Synonyms

Not applicable.

Allowed Responses

Numeric angular value of the degree of curvature (DDD.MMSSS)

Description/Definition

The degree of curvature data item (DC:) contains a numeric angular value to define the radius of a circular curve by arc definition. The format of angle DDD.MMSSS.

It is intended for use in the SDMS horizontal alignment file, but it may also be entered into a project file to document the degree of curvature.

Sample Placement in an Activity

```
AC:OS
SI:PI
YC:207400.163795
XC:759447.697336
RA:1637.0222
DC:3.3000
(etc.)
```

Computed Distance - DD:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the computed distance

Description/Definition

The distance-computed data item (DD:) is used when multiple observations are made to a point from the same station. This data item records the averaged slope distance measured to that point.

In SDMS this data item will be displayed in the calculated (.CAL) file for points with multiple observations.

Sample Placement in an Activity

```
AC:SS
PN:233
HH:210.0125
VV:95.0925
DD:37.971      (Averaged slope distance from multiple observations
XX:414521.317
YY:542573.745
ZZ:73.657
FE:IP
PD:3/8” Rebar
(etc.)
```

Distance Horizontal - DH:

Synonyms

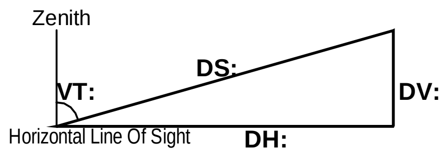
Not applicable.

Allowed Responses

Numeric value of the horizontal distance

Description/Definition

The distance horizontal (DH:) data item defines a measured horizontal distance from the current station. It is consistent in data structure and usage with the DS: (Distance Slope) data item. The elevation of the point being measured to is assumed to be the same as the current station.



Sample Placement in an Activity

```
AC:BS
PN:1
PD:FENCE LINE
HZ:0
DH:104.312
AC:SS
(etc.)
```

Note: It is strongly recommended that HZ:, VT:, DS: be used to record measurement data from an EDM for post processing.

Diameter - DI:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the diameter

Description/Definition

The Diameter data item (DI:) is used to record the diameter of a surveyed object, such as a culvert pipe or a tree.

Sample Placement in an Activity

```
PN:10200
FE:CU
FG:326
CL:G
GM:P
HZ:251.5305
```

```
VT:89.1852
DS:83.010
DI:24”
LN:40’
TY:CMP
PD:INLET 24” CMP
CN:FAIR, 25% FILLED
(etc.)
```

Delete Shot/Station - DL:

Synonyms

Delete a shot, delete a station and its related shots

Allowed Responses

SH (to delete a shot/activity)

ST (to delete an occupied station and all related shots)

Description/Definition

The delete shot/station data item (DL:) does not remove data from a file, but marks a specific activity or station to be disregarded during processing or computations.

DL:SH marks all data in the current activity, including the activity data item, for deletion.

DL:ST marks all activities and data in the current set-up, including the last occupied station data item (AC:OS), for deletion.

Restrictions

Only the two-character combinations listed above are permitted in the data structure.

Sample Placement in an Activity

```
AC:OS
PN:2
PD:USGS 1031
AC:BS
PN:1
PD:USGS 1031A
HZ:0
VT:89.4554
DS:500.34
DL:ST         (Deletes the OS and all shots at that OS)
 (etc.)
…………
AC:OS
PN:2
PD:USGS 1031
AC:BS
PN:1
PD:USGS 1031A
HZ:0
VT:89.4554
DS:500.34
AC:SS
PN:422
PD:CONTROL MON
HZ:270.222
VT:100.222
DL:SH         (Deletes the SS only)
```

```
(etc.)
```

Direction of Offset - DO:

Synonyms

Prism orientation

Allowed Responses

H or V

Description/Definition

The direction of offset data item (DO:) records the horizontal or vertical orientation of the prism in an activity. Its intended use is in tunneling work, where the prism may be offset from the tunnel ring either horizontally or vertically.

There are two possible responses:

H horizontal orientation

V vertical orientation

This tag affects computations and must be entered into each activity to which it applies.

See also PO: Prism Offset

Sample Placement in an Activity

The DO: data item may be placed anywhere within an activity.

```
C:SS
PN:62
PD:CONCRETE
HZ:3.440
VT:88.998
DS:0.238
DO:V
(etc.)
```

Depth - DP:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the depth

Description/Definition

The Depth data item (DP:) is used to record the depth of cover of a surveyed object. The value must always be positive.

Sample Placement in an Activity

```
PN:10200
FE:WA
FG:326
CL:F
GM:P
HZ:251.5305
VT:89.1852
DS:83.010
DI:6
TY:PVC
PD:INLET 24” CMP
DP:4.0         (Indicates 4.0 feet of cover over the water line)
(etc.)
```

Distance Slope - DS:

Synonyms

Slope distance

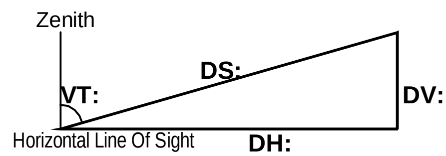
Allowed Responses

Numeric value of the slope distance

Description/Definition

The distance slope data item (DS:) represents the slope distance measurement from the occupied station to the desired object.

The distance slope data item must be specifically entered into the activity it applies to and is unique to that activity.



Sample Placement in an Activity

```
The DS:        (data item may be placed anywhere within an activity)
AC:BS
PN:1
PD:FENCE LINE
HZ:0.0
VT:89.331
DS:104.312
AC:SS
(etc.)
```

Date - DT:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the date (mm/dd/yyyy)

Description/Definition

The Date data item (DT:) is used to record the date. The format is mm/dd/yyyy.

Sample Placement in an Activity

```
AC:OS
DT:03/19/1999
TM:13:04:56
PM:0
PN:600029
FE:SU
TY:CTL
PD:GPS-REBAR & CAP
```

Distance Vertical - DV:

Synonyms

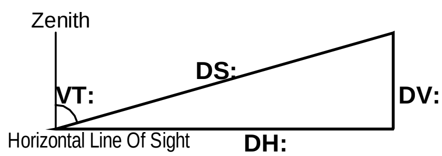
Not applicable.

Allowed Responses

Numeric value of the vertical distance

Description/Definition

The Distance Vertical data item (DV:) is used to record or display the vertical distance between two known or computed points.



DV: also represents the vertical "leg" of the triangle created when the line of sight of the telescope of a measuring instrument is transited above or below the line of sight when the telescope is horizontal (level).

Sample Placement in an Activity

Note: SDMS currently requires that HZ:, VT:, DS: be used to record measurement data from an EDM for post processing. The vertical distance is currently used with the taping activity (AC:TA) as part of the Angle-Distance (AD:) record, but the data item itself is not used. See Connectivity by Taping for details.

Delta X - DX:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the difference between the known and computed X coordinate

Description/Definition

The Delta X data item (DX:) used in live and batch computations to record the algebraic difference between the known X Coordinate (XC:) of a point and the computed X Coordinate (XX:) of a point based on the shots taken to that point in a project file.

In the SDMS software, this data item will normally appear in the calculated (CAL) file and on the live computations screen.

Sample Placement in an Activity

```
AC:SS
PN:233
HH:210.0125
VV:95.0925
DD:37.971
XX:414521.317
YY:542573.745
ZZ:73.657
XC:414521.325
YC:542573.740
ZC:73.650
DX:-0.008
DY:0.005
DZ:-0.007
FE:IP
PD:3/8″ Rebar
(etc.)
```

Delta Y - DY:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the difference between the known and computed Y coordinate

Description/Definition

The Delta Y data item (DY:) is used in live and batch computations to record the algebraic difference between the known Y Coordinate (YC:) of a point and the computed Y Coordinate (YY:) of a point based on the shots taken to that point in a project file.

In the SDMS software, this data item will normally appear in the calculated (CAL) file and on the live computations screen.

Sample Placement in an Activity

```
AC:SS
PN:233
HH:210.0125
VV:95.0925
DD:37.971
XX:414521.317
YY:542573.745
```

```
ZZ:73.657
XC:414521.325
YC:542573.740
ZC:73.650
DX:-0.008
DY:0.005
DZ:-0.007
FE:IP
PD:3/8” Rebar
(etc.)
```

Delta Z - DZ:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the difference of the known and computed elevation

Description/Definition

The Delta Z data item (DZ:) is used in live and batch computations to record the algebraic difference between the known Z Coordinate (ZC:) of a point and the computed Z Coordinate (ZZ:) of a point based on the shots taken to that point in a project file.

In the SDMS software, this data item will normally appear in the calculated (CAL) file and on the live computations screen.

Sample Placement in an Activity

```
AC:SS
PN:233
HH:210.0125
VV:95.0925
DD:37.971
XX:414521.317
YY:542573.745
ZZ:73.657
XC:414521.325
YC:542573.740
ZC:73.650
DX:-0.008
DY:0.005
DZ:-0.007
FE:IP
PD:3/8” Rebar
(ect.)
```

Left Side Slope - E1:

Synonyms

Superelevation slope left

Allowed Responses

Numeric value of the left side slope

Description/Definition

The Left Side Slope (E1:) data item is used in the superelevation file to define the slope of the roadway surface to the left of the centerline. Variable slopes can be recorded at defined stations to indicate a transition slope is to be computed between those stations for stake out.

Sample Placement in an Activity

```
AC:PR
PR:STH67.SUP
NM:STATE HWY A – HWY B
CM:DESIGN SUPERELEVATION FILE THROUGH
CM:THE FIRST CURVE
DT:03/26/1998
UL:M3
VD:NGVD 29
HD:NAD 83 (1991)
ZN:4802
RE:GENO
AC:OS
ST:10+973.656
E1:-0.020000
E2:-0.020000
AC:OS
(etc.)
```

Right Side Slope - E2:

Synonyms

Superelevation slope right

Allowed Responses

Numeric ration of the right side slope

Description/Definition

The Right Side Slope (E2:) data item is used in the superelevation file to define the slope of the roadway surface to the right of the centerline. Variable slopes can be recorded at defined stations to indicate a transition slope is to be computed between those stations for stake out.

Sample Placement in an Activity

```
AC:PR
PR:STH67.SUP
NM:STATE HWY A – HWY B
CM:DESIGN SUPERELEVATION FILE THROUGH
CM:THE FIRST CURVE
DT:03/26/1998
UL:M3
VD:NGVD 29
HD:NAD 83 (1991)
ZN:4802
RE:GENO
AC:OS
ST:10+973.656
E1:-0.020000
E2:-0.020000
AC:OS
(etc.)
```

Error Distance - ED:

Synonyms

Standard deviation of the distance

Allowed Responses

Numeric value of the error in the mean of the sum of the distance measurements

Description/Definition

The distance error data item (ED:) is used to record the standard deviation in the mean of multiple distance measurements made between two points.

The ED: data item does not affect computations, but is reserved for future implementation in computations.

Sample Placement in an Activity

The ED: data item may be placed anywhere within an activity.

```
AC:SS
PN:14
PD:TREE
HZ:43.1221
VT:90.1122
DS:289.445
EH:.0012
EV:.0008
ED:.223
(etc.)
```

Elevation Factor - EF:

Synonyms

Sea Level Factor

Allowed Responses

The numeric value of the elevation factor

Description/Definition

The elevation factor (EF:) data item is used as part of the equation to convert to a higher precision a surface distance to a geodetic distance. It is necessary to convert the surface distance to geodetic distance (reduced to sea level) before converting to a grid distance.

EF: is computed from the following equation:

EF = (Rm*) / (Rm + Point Elevation + Geoid Height)

*Rm - Mean radius of the earth (20,906,000 feet)

The format is EF :#.######## (8 decimals)

The elevation factor data item should be stored with each individual point. It is normal procedure to use the average elevation between two points when computing the geodetic distance.

Sample Placement in Activity

The SF: data item may be placed anywhere within a point specific activity.

PAC File

```
AC:PD
PN:3220
FE:RW
PD:STANDARD ROW MONUMENT
YY:81464.3627
XX:73576.8971
ZZ:1180.839
XE:0.0541
YE:0.0517
ZE:0.0963
SY:0.0960
SX:0.0965
SZ:0.1667
EF:.0.99998804
(etc.)
```

End Group - EG:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value

Description/Definition

The End Group data item (EG:) is used in the SDMS calculated file (CAL) to indicate the end of the list of chains generated by SDMS Processor, or other post processing software, from the shot attribute information listed in that file. The EG: data item will be placed after the last chain in the list and before the final CP: data item that is placed at the end of the list to post the date and time the chain list was generated. The EG: data item is used by CADD software as an indicator of where to end reading chain data from the calculated file.

The use of the EG: data item will be an indicator that the list of chains is complete and has not been terminated leaving chains unlisted due to some extenuating circumstance. The EG: data field may contain any value or may be left blank. SDMS Processor will document the date and time of the listing was computed, based on the settings of the particular computer being used.

A calculated (CAL) file will contain one EG: tag and will be updated in the calculated file each time the project file or calculated file is reprocessed. The EG: tag does not affect computations.

Sample Placement in an Activity

```
AC:SS          (Last Shot Activity in the calculated (CAL) file)
PN:100
FE:WV
PD:WATER VALVE FOR 2" PVC LINE
OW:CITY
HZ:5.3423
VT:90.4534
DS:250.54
XX:45217.875
```

```
YY:11214.556
ZZ:395.22
CP:09/18/1999 18:46:43
BG:Begin Chain List
AC:CH
FE:HOUSE
CD:OUR HOUSE
FG:5
PL:10,100,101,102,103,104
AC:CH
FE:EPL
CD:LEFT PAVEMENT EDGE ENTIRE PROJECT
FG:11
PL:1-3,6-8,15-13,21-24,31,32
AC:CH
FE:FENCE
CD:OUR FENCE LINE
FG:10
PL:6-8,15-13,21-24,6
EG:End Chain List
CP:09/27/1999 13:15:18
```

Error Horizontal Angle - EH:

Synonyms

Standard deviation of the horizontal angle

Allowed Responses

Numeric angular value of the error in the mean of sum of the horizontal angles (s.sss)

Description/Definition

The horizontal error data item (EH:) is used to record the standard deviation in the mean of multiple horizontal angle measurements to a single point. The format is in seconds of arc recorded as a decimal (s.sss).

The EH: data item does not affect computations, but is reserved for future implementation in computations.

Sample Placement in an Activity

The EH: data item may be placed anywhere within an activity.

```
AC:SS
PN:14
PD:TREE
HZ:43.1221
VT:90.1122
DS:289.445
EH:.0013
EV:.0011
ED:.0103
(etc.)
```

Equation Number - EQ:

Synonyms

Station equation number

Allowed Responses

Alphanumeric value used to uniquely identify an equation point

Description/Definition

The equation number data item (EQ:) is used with the horizontal alignment file to identify the point numbers of station equations in that alignment. The station equations must be listed in order of occurrence in an alignment file before the first alignment point. The EQ: data item can be used to define a point where the equation occurs.

Sample Placement in an Activity

The EQ: data item may be placed anywhere within an equation activity.

```
AC:PR
PR:STH67
NM:STATE HWY A – HWY B
CM:DESIGN HORIZONTAL ALIGNMENT
DT:03/26/1998
UL:M3
VD:NGVD 29
HD:NAD 83 (1991)
ZN:4802
RE:GENO
DT:03/26/1998
RE:GENO
TY:PI
AC:EQ
EQ:1
SB:11+374.836
ST:11+400.000
AC:EQ
EQ:2
SB:12+172.297
ST:12+140.000
 (etc.)
```

Ending Station - ES:

Synonyms

Last traverse station, station on which to close traverse

Allowed Responses

Y or YES, N or NO

Description/Definition

The ending station data item (ES:) records the ending station of a traverse. This tag advises the processing software that this is the last station on which to close the traverse and perform computations.

An occupied station is considered to be an ending station if:

- an end-of-file sequence is encountered
- it contains coordinates and does not contain an ES:N or ES:NO data item
- there are no foresights taken from the station
- it contains the ES:Y or ES:YES data item

Sample Placement in an Activity

An ES: data item may be entered only in an occupied station activity (AC:OS).

AC:OS	AC:OS
PN:49	PN:59
PD:CONTRL MON	PD:TRAV STN
IH:5.2	YC:1000
SH:6.1	XC:1000
XC:1000	ZC:100
YC:1000	**ES:Y**
ZC:100	(etc.)
ES:NO	
(etc.)	

End Time - ET:

Synonyms

Not applicable.

Allowed Responses

Numeric value of Global Positioning (GPS) Time in the HH:MM:SS format followed by a blank space and then the numeric value of the date in the MM/DD/YYYY format.

Description/Definition

The End Time data item (ET:) stores the ending time of a GPS observation session for a point or processed vector.

Sample Placement in an Activity

```
AC:FS
PN:BASE
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:13451.012
VY:3468.604
VZ:-265.403
C1:0.00000299
C2:-0.00000456
C3:0.00000189
C4:0.000002167
C5:-0.00000703
C6:0.00000777
BT:14:54:42 04/24/2004
```

```
ET:15:29:15 04/24/2004
SO:FIXED
FR:IONO FREE
SV:7
NS:412
IP:P4.3
```

Error Vertical Angle - EV:

Synonyms

Standard deviation of the vertical angle

Allowed Responses

Numeric angular value of the error in the mean of the vertical angle measurement (s.sss)

Description/Definition

The error vertical data item (EV:) is used to record the standard deviation in the mean of multiple vertical angle measurements. The format is in seconds of arc recorded as a decimal (s.sss).

The EV: data item does not affect computations, but is reserved for future implementation in computations.

Sample Placement in an Activity

The EV: data item may be placed anywhere within an activity.

```
AC:SS
PN:14
PD:TREE
HZ:43.1221
VT:90.1122
DS:289.445
EH:.0013
EV:.0011
ED:.0103
(etc.)
```

External Distance Circular Curve - EX:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the external distance of a curve

Description/Definition

The external distance (EX:) data item is used with a horizontal alignment to record the distance from the PI to the center of a simple curve.

Sample Placement in an Activity

```
AC:OS
```

```
SI:PI
YC:207400.163795
XC:759447.697336
RA:-1150.0000
DA:-35.3454
EX:54.430
(etc.)
```

Face Number - FC:

Synonyms

Direction (normal or reversed)

Allowed Responses

1 or 2

Description/Definition

The face number data item (FC:) records which face of the instrument was used to record the activity during sets data collection. There are two choices:

- direct (face number 1)
- reverse (face number 2, plunging the scope 180° from direct face)

Collecting data in sets is defined in the data structure as recording several shots to the same point or group of points to obtain certain averaging information about those shots.

The FC: data item is always used in conjunction with the set (SE:) data item. Together, these two data items identify to which set the shot belongs, and which face of the instrument was used in shooting the point.

See also SE:, Set

Sample Placement in an Activity

The SE: and FC: tags may be placed in any order following the activity data item:

```
AC:FS
SE:1
FC:1
PN:49
PD:TRAV STN
(etc.)
AC:FS
SE:1
FC:2
PN:49
PD:TRAV STN
(etc.)
```

Feature Code - FE:

Synonyms

Information code, cell code, information key

Allowed Responses

Alphanumeric description of the feature

Description/Definition

The feature code data item (FE:) designates the feature code or functional equivalent for CADD systems.

See also FG: Figure, GM: Geometry, PH: Physical, and TY: Type

Sample Placement in an Activity

The FE: data item may be placed anywhere within the activity.

```
AC:SS
PN:2
PD:12 IN WHITE PINE
FE:CONIFER
HZ:365.821
VT:88.312
DS:132.047
AC:SS
(etc.)
```

Figure Code - FG:

Synonyms

String, chain

Allowed Responses

Alphanumeric description of the figure

Description/Definition

The figure code data item (FG:) designates the figure or chain code for CADD systems. When formatting, all points with the same figure code can be grouped and stored as a connected line. Points will be connected in point number order or shot order depending on the software that interprets the SDMS file. More detail can be found in Section VII, *Defining Connectivity with SDMS*.

See also FE: Feature, GM: Geometry, PH: Physical, and TY: Type

Sample Placement in an Activity

The FG: data item may be placed anywhere within an activity.

```
AC:SS
PN:2
PD:BACK OF CURB
FG:15
HZ:365.821
VT:88.312
DS:132.047
AC:SS
(etc.)
```

F-Statistic Multiplier - FM:

Synonyms

NA

Allowed Responses

Numeric value of the f-statistic multiplier

Description/Definition

The F-Statistic Multiplier (FM:) is used in the PAC file to record the F Statistic Multiplier of each point in that file. This value is used with the One-sigma Error Estimates data tags (SX:, SY:, SZ:) and the Standard Error Estimate data tags (XE:, YE:, ZE:) to compute the standard error of unit weight for use of that point data in the least squares analysis.process.

To achieve more than the one sigma (67%) confidence level (SX:, SY:, SZ), requires converting the standard deviation standard errors and error ellipse dimensions to the 95% confidence level using the F statistic multiplier. The size of the multiplier is a function of the 95% confidence level and the number of degrees of freedom. In statistics, the multiplier decreases in size as the number of degrees of freedom increases.

Sample Placement in an Activity

PAC File

```
AC:PD
PN:3220
FE:RW
PD:STANDARD ROW MONUMENT
YY:81464.3627
XX:73576.8971
ZZ:1180.839
XE:0.0541
YE:0.0517
ZE:0.0963
SY:0.0960
SX:0.0965
SZ:0.1667
FM:2.45
(etc.)
```

Frequency - FR:

Synonyms

Not applicable.

Allowed Responses

UNKOWN, L1, L2, L22, WIDE LANE, NARROW LANE, IONO FREE

Description/Definition

The Frequency data item (FR:) stores the frequency combination used to process a Global Positioning System (GPS) vector. The data item is for documentation purposes but may also serve as a quality indicator as well.

Sample Placement in an Activity

```
AC:FS
PN:BASE
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:13451.012
VY:3468.604
VZ:-265.403
C1:0.00000299
C2:-0.00000456
C3:0.00000189
C4:0.000002167
C5:-0.00000703
C6:0.00000777
BT:14:54:42 04/24/2004
SO:FIXED
FR:IONO FREE
SV:7
NS:412
IP:P4.3
```

Geoid Model - GD:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric name of the geoid model.

Description/Definition

The Geoid Model data item (GD:) specified the geoid model used for the survey or for a series of points.

The GD: data tag acts as a constant for all activities until it is changed, and is currently for documentation purposes only.

The format follows naming practices put in place by the National Geodetic Survey (NGS) for their geoid models. Typically this is the word GEOID in all capital letters followed immediately by a two digit year representing the year the geoid model was released. Some examples are:

GD:GEOID06

GD:GEOID99

Sample Placement in an Activity

The GD: data item may be placed anywhere within a project file, although it is most appropriately placed in the project header activity:

```
PR:USHWY10
TK:RTO
AC:PR
IT:OMNI01
SN:7224
NM:D.MOZUCH
GD:GEOID99
TE:50
```

```
BP:30
OB:SEZ
RE:DLN
DT:10/15/86
WE:CLOUDY
PM:2.2
(etc.)
```

Geometry Type - GM:

Synonyms

Line type, figure type, point type

Allowed Responses

C (CURVE) or P (POINT)

Description/Definition

The Geometry Type data item (GM:) is used to define the geometric type of a point in a chain. For example, if GM:C (curve) is used, it means the point falls on a curved section of a chain. If GM:P (Point) is used, it means the point is on a straight line section of a chain.

If no GM: data item and response is stored with a point., that point is to be read as GM:P.

See also FE: Feature, FG: Figure, PH: Physical, and TY: Type

Sample Placement in an Activity

The GM: data item may be placed anywhere within the activity.

```
AC:SS
PN:2
PD:BACK OF CURB
GM:C          (Point to be used as in a curve by the CADD)
HZ:365.821
VT:88.312
DS:132.047
AC:SS
(etc.)
```

Group - GR:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value of the group

Description/Definition

The Group data item (GR:) can be used to group sets of surveyed object together in the post-processing software database. Items with the same group tag should be placed on the same level, layer, zone etc.

Sample Placement in an Activity

```
AC:SS
PN:2
PD:BACK OF CURB
GM:C
GR:5
HZ:365.821
VT:88.312
DS:132.047
AC:SS
(etc.)
```

Help 1 - H1:

Synonyms

On-line help, user assistance

Allowed Responses

User defined alphanumeric message

Description/Definition

The H1: data item provides an "on-line" help message during data collection. Use of this data item is reserved for data collection implementation and is to be used with a default or user defined sequence to remind the user to check something or take some type of action. Therefore, the H1: data item and response are not typically made part of a project file.

This data item is not used in computations.

Sample Placement in an Activity

The H1: data item may be placed anywhere in the prompts for an activity. Do not record this data in the project file.

Sequence where H1: appears:

```
AC:PR
ID:
CO:
IT:LIETZ_SET
HI:INSERT THE INSTRUMENT SERIAL NUMBER FOR SN:
SN:
NM:
OB:
RE:
WE:
HD:
VD:
CM:
```

Resulting Project file with data entered:

```
AC:PR
DT:05/26/99
TM:07:19:46
ID:RX0030
HY:15
CO:CLEVELAND
IT:LIETZ_SET
SN:109414      (User inserted serial number. H1: is not recorded.)
NM:S5114
OB:TPS
```

```
RE:SB
WE:70 & CLOUDY
HD:REL
VD:REL
```

Horizontal Alignment File Name - HA:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value of the horizontal alignment file name

Description/Definition

The Horizontal Alignment Name data item (HA:) is used to designate the name of the file that defines the geometry of the horizontal alignment.

In the SDMS software, the alignment geometry is used for station-offset calculations.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
NM:S5111
OB:JDH
RE:JDH
I5:DJS
I6:AMC
WE:CLOUDY
CM:MANSION SURVEY
CR:No
CF:1.000000
UL:M
UA:D
UT:F
UP:I
VR:SDMS Ver# 3.3
L1:SR70106.CTL
S1:SR70106.CTL
WC:SR70106W.CTL
HA:ER70106.ALI
VA:ER70106.PRO
SF:ER70106.SUP
(etc.)
```

Horizontal Datum - HD:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric name of the X,Y datum

Description/Definition

The horizontal datum data item (HD:) specifies the horizontal datum on which the coordinate system projection is based. It replaces the old XD: data tag, which has been removed from the SDMS Technical Guide.

The current release of SDMS Processor uses the horizontal datum data item (HD:) and the coordinate system (CS:) or zone data item (ZN:) to determine what parameters to use to reduce the project data to state plan grid coordinates. Both data items must exist in the project file. If only the HD: data item is in the project file, it is considered as documentation only and treated as a metadata constant for all activities until it is changed.

The format is: Datum Acronym(space)Year(yyyy)(space)Year of Adjustment (if applicable)(yyyy). Some examples are:

HD:NAD 1927

HD:NAD 1983 (1996),

Sample Placement in an Activity

The HD: data item may be placed anywhere within a project file, although it is most appropriately placed in the project header activity:

```
PR:USHWY10
TK:RTO
AC:PR
IT:OMNI01
SN:7224
NM:D.MOZUCH
HD:NAD 1927
TE:50
BP:30
OB:SEZ
RE:DLN
DT:10/15/86
WE:CLOUDY
PM:2.2
(etc.)
```

Height Ellipsoid - HE:

Synonyms

Ellipsoid height, height above the ellipsoid

Allowed Responses

User defined numeric value of the ellipsoid height

Description/Definition

The Height Ellipsoid data item (HE:) is used to record the distance, measured along the normal to the ellipsoid, between a point on the ground and the surface of the ellipsoid as defined in geodesy and used with the Global Positioning System (GPS).

Sample Placement in an Activity

```
AC:OS
PN:1
PD:GPS MON #600030
FE:CTL
XC:1135641.641
YC:518578.574
ZC:1400.22
AH:A
AV:F1
HE:77.054
HG:-27.279
 (etc.)
```

Height Geoid - HG:

Synonyms

Not applicable.

Allowed Responses

User defined numeric value of the geoid height

Description/Definition

The Height Geoid data item (HG:) is used to record the distance between the geoid and ellipsoid at a given point as defined in geodesy and used with the Global Positioning System (GPS). The geoid can be above or below the ellipsoid defined.

Sample Placement in an Activity

```
AC:OS
PN:1
PD:GPS MON #600030
FE:CTL
XC:1135641.641
YC:518578.574
ZC:1400.22
AH:A
AV:F1
HE:77.054
HG:-27.279
(etc.)
```

Computed Horizontal Angle - HH:

Synonyms

Not applicable.

Allowed Responses

Numeric angular value of the average horizontal angle (DDD.MMSSS)

Description/Definition

The Computed Horizontal Angle data item is used for the average horizontal angle computed from repeated observations to a point from the same station. The format is DDD.MMSSS.

In the SDMS software this data item is displayed in the calculated (CAL) project file.

Sample Placement in an Activity

```
AC:SS
PN:233
HH:210.0125
VV:95.0925
DD:37.971
XX:414521.317
YY:542573.745
ZZ:73.657
FE:IP
PD:3/8″ REBAR
```

Horizontal Offset - HO:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the horizontal offset

Description/Definition

The Horizontal Offset (HO:) data item is used to indicate and record the position of a point that has been set (staked out) or is to be set that is set as a reference for the actual point desired. The value will be the distance measured between the reference point and the true point, based on a right angle from a point on a baseline or horizontal alignment through the points. A measurement to the right of the point is positive. A measurement to the left of the point is negative. If there is no sign, the value will be interpreted as positive.

The HO: data item does not have the same usage as the OF: data item.

In the SDMS software the (HO:) data item is used in 3D stake out functions to compute the position left or right of a point with a known position (which may be at an offset (OF:) from an alignment or baseline) that is to be staked out as a reference to the known point.

Sample Placement in an Activity

The data item may be placed anywhere in an activity used to record the data related to the point being set.

Height - HT:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the height

Description/Definition

The Height data item (HT:) is used to record the user-specified height of a surveyed object, such as a tree or fence.

Sample Placement in an Activity

```
AC:SS
PN:10410
FE:FE
FG:359
CL:F
GM:P
HZ:87.4313
VT:92.5254
DS:223.750
PD:FENCE
TY:CHAIN LINK
HT:6.0
(etc.)
```

Highway - HY:

Synonyms

Route name/number

Allowed Responses

User defined alphanumeric value for the highway name

Description/Definition

The Highway data item (HY:) is used to record the name of a highway or road.

Sample Placement in an Activity

```
AC:PR
PR:STH67.PRO
NM:STATE HWY A – HWY B
ID:JOB 050067
HY:STH 67
CM:DESIGN CENTERLINE
DT:03/26/1998
RE:GENO
UL:M3
(etc.)
```

Horizontal Angle - HZ:

Synonyms

Horizontal circle angle

Allowed Responses

Numeric angular value of the horizontal angle (DDD.MMSSS)

Description/Definition

The horizontal angle data item (HZ:) indicates an angle on the horizontal plane. The directions may be to objects in the horizontal plane, or they may be the lines of intersection of the horizontal plane with the vertical planes containing the objects.

Horizontal angles are measured and recorded to the right (clockwise).

The Horizontal Angle format is DDD.MMSSS.

The HZ: data item must be specifically entered into the activity to which it applies and is unique to that activity.

Sample Placement in an Activity

The HZ: data item may be placed anywhere within an activity.

```
AC:BS
PN:1
PD:FENCE LINE
HZ:0.0
VT:89.331
DS:104.312
AC:SS
(etc.)
```

Information 0 through Information 9 - I0: through I9:

Synonyms

Not applicable.

Allowed Responses

User-defined alphanumeric value of the information tag

Description/Definition

Primary Usage

The ten information data tags (I0:, I1:, I2:, I3:, I4:, I5:, I6:, I7:, I8:, and I9:) are used to create user-defined data items to further describe the project in general.

Secondary Usage

Can be used to create user-defined data items to further describe the object currently being shot. The information collected is shot-specific. The use is often temporary, allowing the user to pick up additional descriptive data for a specific circumstance or project. The information data tags can be use to meet any other unique user-specific need.

Restrictions

No restrictions on content. These tags should not be used in lieu of an existing data tag, or an existing data tag that is appropriately close to the user's intended need.

Sample Placement in an Activity

The user-defined information tags may be used anywhere in the project file. As an example, assume that it is necessary to record the mile marker at which the project began. The I1: data tag could be defined to mean MILE MARKER.

```
PR:DOT1023
TK:RTO
IT:KERN
SN:12345
NM:R. OWENS
RE:B. PERKINS
WE:GOOD
I1:231         (used here to collect a mile marker reference)
AC:OS
PN:101
(etc.)
```

Project Identification - ID:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value of the project identification

Description/Definition

The Project Identification data item (ID:) is used to- record the name or identification number of the project in the project header.

Sample Placement in an Activity

```
AC:PR
PR:STH67.PRO
NM:STATE HWY A – HWY B
ID:JOB 050067
HY:67
CM:DESIGN CENTERLINE
DT:03/26/1998
RE:GENO
UL:M3
(etc.)
```

Instrument Height - IH:

Synonyms

Height of an instrument, measure-up

Allowed Responses

Numeric value of the instrument height

Description/Definition

The instrument height data item (IH:) records the height of the instrument at the occupied station. This is the vertical distance from the survey point to the vertical index of the instrument. If not entered, a default value is usually assigned by the processing software being used.

The IH: item acts as a constant during computations. It is implied for the shot in which it is placed and all subsequent shots until a new instrument height is entered.

Sample Placement in an Activity

The IH: data item should be placed in an occupied station activity:

```
AC:OS
PN:2
PD:CONTRL MON
IH:5.2
SH:5.2
YC:10122.832
XC:958.334
AC:BS
PN:1
(etc.)
```

Indicator of Precision - IP:

Synonyms

Dilution of Precision (DOP), Positional Dilution of Precision (PDOP), Geometric Dilution of Prescision (GDOP), Horizontal Dilution of Precision (HDOP), Vertical Dilution of Precision (VDOP), Relative Dilution of Precision (RDOP), Time Dilution of Precision (TDOP)

Allowed Responses

Single alpha character P, G, H, V, R, T (PDOP, GDOP, HDOP, VDOP, RDOP, TDOP) followed by a real number with one decimal place. Multiple dilutions of precision can appear on the same line separated by a comma.

Description/Definition

The Indicator of Precision data item (IP:) is used to store any dilution of precision values that may be associated with a point or vector. These values may provide an indication as to the quality of the observed point and/or processed vector and as such are used for documentation purposes only.

Sample Placement in an Activity

```
AC:FS
PN:BASE
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:13451.012
VY:3468.604
VZ:-265.403
C1:0.00000299
C2:-0.00000456
C3:0.00000189
C4:0.000002167
C5:-0.00000703
C6:0.00000777
BT:14:54:42 04/24/2004
SO:FIXED
```

```
FR:IONO FREE
SV:7
NS:412
IP:P4.3,R5.2
```

Instrument Type - IT:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value for the instrument name

Description/Definition

The Instrument Type data item (IT:) is used to record the type of surveying instrument used for the project data collection.

In the SDMS software, this information tells SDMS which device driver to use. For example, IT:MANUAL indicates that all measurements will be entered manually.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
CI:LITTLE ROCK
CS:LOCAL STATE PLANE
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
NM:S5111
OB:JDH
RE:JDH
I5:DJS
I6:AMC
WE:CLOUDY
CM:MANSION SURVEY
(etc.)
```

Length First Curve - L1:

Synonyms

Not applicable

Allowed Responses

Numeric value of the first curve length

Description/Definition

Vertical Alignments

The length first curve (L1:) data item is used with a vertical alignment to record the length of a vertical curve for symmetrical curves or the curve length from the VPC to the VPI for asymmetrical curves.

Horizontal Alignments

The first curve length (L1:) data item is used with a horizontal alignment (PI definition) to define the arc length of a circular curve or the arc length of the first curve for compound circular curves as located from the PC of a circular curve or the SC of a spiral.

Sample Placement in an Activity

In a Vertical Alignment File

```
AC:PR
PR:STH67.PRO
NM:STATE HWY A – HWY B
CM:DESIGN CENTERLINE PROFILE
DT:03/26/1998
RE:GENO
UL:M3
AC:OS
ST:10+974.000
ZC:299.024000
L1:125.000000
L2:125.000000
AC:OS
(etc.)
```

Location 1 Control File Name - L1:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric control file name

Description/Definition

The Location 1 Control File Name data item (L1:) is used to indicate the name of the primary control point file.

In the SDMS software, the L1: data item is located in the Control Configuration file. The file named will be displayed in the project data file.

In the SDMS software, by default, referenced control points are searched for in this file first, and in the Location 2 file second.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
```

```
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
NM:S5111
OB:JDH
RE:JDH
I5:DJS
I6:AMC
WE:CLOUDY
CM:MANSION SURVEY
CR:No
CF:1.000000
UL:M
UA:D
UT:F
UP:I
VR:SDMS Ver# 3.3
L1:SR70106.CTL
S1:SR70106.CTL
WC:SR70106W.CTL
HA:ER70106.ALI
VA:ER70106.PRO
SF:ER70106.SUP
(etc.)
```

Length Second Curve - L2:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the second curve length

Description/Definition

Vertical Alignments

The length second curve (L2:) data item is used with a vertical alignment to record the vertical curve length from the VPI to the VPT for asymmetrical curves. If this tag is not included, the vertical curve will be defined as symmetrical.

Horizontal Alignments

The second curve length (L2:) data item is used with a horizontal alignment (PI definition) to define the arc length of the second curve for compound circular curves as located from the PC. It is also used to define the length of a circular curve or the SC of a spiral.

Sample Placement in an Activity

```
AC:PR
PR:STH67.PRO
NM:STATE HWY A – HWY B
CM:DESIGN CENTERLINE PROFILE
DT:03/26/1998
RE:GENO
UL:M3
AC:OS
ST:10+974.000
ZC:299.024000
```

```
L1:125.000000
L2:125.000000
AC:OS
(etc.)
```

Location 2 Control File Name - L2:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric control filename

Description/Definition

The Location 2 Control File data item (L2:) is used to indicate the name of the secondary control point file.

In the SDMS Collector software, the L2: data item is located in the Control Configuration file. The file named will be displayed in the project data file.

In the SDMS Collector software, by default, referenced control points are searched for in this file first, and in the Location 2 control file second.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
NM:S5111
OB:JDH
RE:JDH
I5:DJS
I6:AMC
WE:CLOUDY
CM:MANSION SURVEY
CR:No
CF:1.000000
UL:M
UA:D
UT:F
UP:I
VR:SDMS Ver# 3.3
L1:SR70106.CTL
L2:SR70106A.CTL
S1:SR70106.CTL
WC:SR70106W.CTL
HA:ER70106.ALI
VA:ER70106.PRO
SF:ER70106.SUP
(etc.)
```

Long Chord - LC:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the long chord

Description/Definition

The long chord (LC:) data item is used with a horizontal alignment to record the distance represented by a straight line between the PC and the PT of a curve.

Sample Placement in an Activity

In a Horizontal Alignment file

```
AC:OS
SI:PI
YC:207400.163795
XC:759447.697336
RA:-435.000000
DA:-35.3454
LC:506.221
(etc.)
```

Longitude - LG:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the longitude (DDD.MMSSSS)

Description/Definition

The Longitude data item (LG:) is used to record the longitude of a point. The format is DDD.MMSSSS

Sample Placement in an Activity

```
AC:OS
PN:1
PD:GPS MON. #600030
FE:CTL
LG:92.35433
LT:35.45235
XC:1135641.641
YC:518578.574
ZC:1400.22
AH:A
AV:F1
(etc.)
```

Length - LN:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the length

Description/Definition

The Length (LN:) data item is used to record the length of a surveyed object, such as a pipe. It is also used to define the length of a curve.

Sample Placement in an Activity

```
PN:10200
FE:CU
FG:326
CL:G
GM:P
HZ:251.5305
VT:89.1852
DS:83.010
DI:24”
LN:40’
TY:CMP
PD:INLET 24” CMP
CN:FAIR, 25% FILLED
(etc.)
```

Length Offset - LO:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the length offset

Description/Definition

When the target cannot be placed directly on the desired point, the length offset data item (LO:) records the distance to the target either in front of or back of a point. The LO: data item affects only the shot in which it is placed.

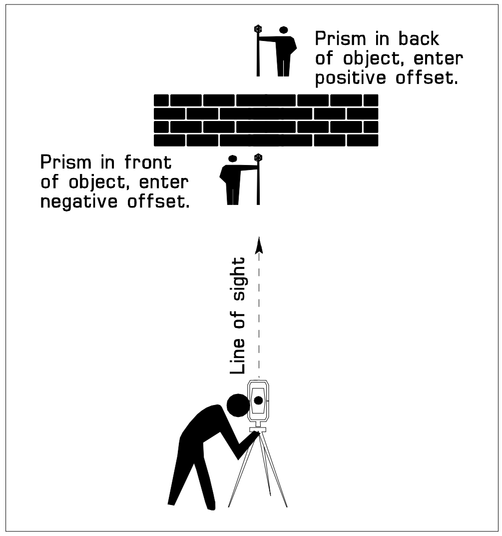
An offset with the target placed in front of the point is entered as a negative number.

LO:-3.4

An offset with the target placed in back of the point is entered as a positive number:

LO:3.4

Whether the target is placed in front or behind the point, the target must be on the line of sight to the point.



Sample Placement in an Activity

```
AC:SS
PN:6
PD:SE COR BLDG
HZ:243.222
VT:88.3035
DS:265.934
LO:-15.22
AC:SS
PN:8
(etc.)
```

Latitude - LT:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the latitude (DDD.MMSSSS)

Description/Definition

The latitude (LT:) data item records the latitude of a point. The format is DDD.MMSSS

Sample Placement in an Activity

```
AC:OS
PN:1
PD:GPS MON. #600030
FE:CTL
LG:92.35433
LT:35.45235
XC:1135641.641
YC:518578.574
ZC:1400.22
AH:A
AV: F1
HE:
```

```
HG:
```

Mid Ordinate Circular Curve - MO:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the middle ordinate

Description/Definition

The middle ordinate circular curve (MO:) data item is used with a horizontal alignment to record the distance from the center of the curve to the midpoint of the long chord for that curve.

Sample Placement in an Activity

In a horizontal alignment file

```
AC:OS
SI:PI
YC:207400.163795
XC:759447.697336
RA:-435.000000
DA:-35.3454
MO:81.220
(etc.)
```

Map Scale - MS:

Synonyms

Scale Ratio

Allowed Responses

Numeric value of the map scale

Description/Definition

The Map Scale (MS:) data item is used to record the map scale to be used for the map generated from the data in the file. Distance on the map = corresponding distance on the object represented This data item will normally be part of the project header.

The format is :

Distance on the map = corresponding distance on the object represented

or

Distance on the map:corresponding distance on the object represented

Sample Placement in an Activity

```
PR:USHWY10
TK:RTO
```

```
AC:PR
IT:OMNI01
SN:7224
NM:D.MOZUCH
TE:50
BP:30
OB:SEZ
RE:DLN
DT:10/15/86
WE:CLOUDY
PM:2.2
MS:1 inch = 100 feet (1”=100’) or 1:100*
(etc.)
```

Name - NM:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value for the name

Description/Definition

The Name data item (NM:) is used as a general purpose Name field. It could be used to record project names, point and chain names, name of a building, etc.

Sample Placement in an Activity

```
AC:PR
PR:STH67.PRO
NM:STATE HWY A – HWY B
CM:DESIGN CENTERLINE PROFILE
DT:03/26/1998
RE:GENO
UL:M3
AC:OS
ST:10+974.000
ZC:299.024000
L1:125.000000
L2:125.000000
AC:OS
(etc.)
```

Number of Shots - NS:

Synonyms

Not applicable.

Allowed Responses

Numeric value for the number of shots

Description/Definition

The Number of Shots data item (NS:) is used to indicate the number of shots that have been taken on a point from the same station.

This data item can also be used to indicate the number of epochs used to compute a Global Positioning System (GPS) derived position or processed vector.

It can also be used by post-processing software to indicate in the calculated file (CAL) the number of shots that have been taken on a point from the same station.

Sample Placement in an Activity

```
AC:FS
PN:20
PD:CONTRL MON
IH:5.2
SH:5.2
YC:10122.832
XC:958.334
HZ:125.3454
VT:89.4556
DS:200.03
NS:4
(etc.)
```

Observer - OB:

Synonyms

Instrument operator

Allowed Responses

User defined alphanumeric value for the observer

Description/Definition

The Observer data item (OB:) is used to record the name or initials of the intrument operator on the survey crew.

Sample Placement in an Activity

```
PR:USHWY10
TK:RTO
AC:PR
IT:OMNI01
SN:7224
NM:D.MOZUCH
TE:50
BP:30
OB:SEZ
RE:DLN
DT:10/15/86
WE:CLOUDY
PM:2.2
(etc.)
```

Origin/Destination Point Number - OD:

Synonyms

Draw-to point

Allowed Responses

User defined alphanumeric value of the point number of the next point

Description/Definition

The origin/destination point number data item (OD:) is used to indicate the point that the current point will connect to. It is a means of drawing lines and is an alternative or supplement to the figure code data item (FG:). More detail can be found in Section VI, *Defining Connectivity with SDMS*.

Sample Placement in an Activity

The OD: data item be placed anywhere within an activity. It affects only the activity in which the data item is placed.

```
AC:SS
PN:34
PD:TREE
HZ:78.023
VT:30.113
DS:100.00
OD:35         (line is drawn or continued from pt 34 to pt 35)
(etc.)
```

Offset - OF:

Synonyms

Perpendicular offset, eccentric sighting

Allowed Responses

Numeric value of the perpendicular offset

Description/Definition

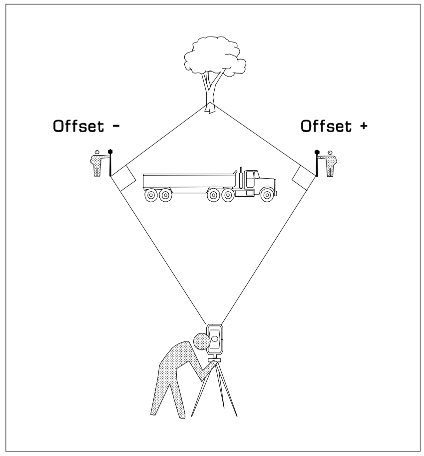
The offset (OF:) data item is used in the profile and cross section tasks, and, in computations and stake out o define the distance right or left of the specified alignment a shot represents. Left and right are determined by facing in the direction that the alignment stationing increases.

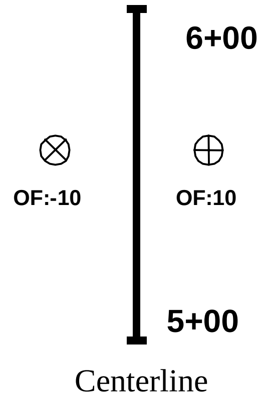
The offset (OF:) data item is at this time also used when the target cannot be placed directly on the desired point. The perpendicular offset (OF:) data item records the distance to the target set to the left or right of a point.

In the SDMS software, when collecting project data, a perpendicular offset to the left of the point (in the line of sight when facing the point from the instrument) is entered as a negative number (OF:-3.4). A perpendicular offset to the right of the point being shot (in the line of sight when facing the point from the instrument) is entered as a positive number (OF:3.4).

See RO: Right Angle Offset.

Note: Future updates to this document will replace the dual use of the OF: data item that is currently being used to record the line of sight offsets with the Right Angle Offset data item (RO:).





Offset line of sight left or right of surveyed object

Offset from a horizontal alignment

Sample Placement in an Activity

```
AC:SS
PN:6
PD:SE COR BLDG
HZ:243.222
VT:88.3035
DS:265.934
OF:8.72
(etc)
```

Offset-Computed - OO:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the computed offset.

Description/Definition

The offset-computed data item (OO:) is used to record the computed offset of a point relative to a horizontal alignment when the point was measured by radial setup.

In the SDMS software, this OO: data item would normally appear in the calculated (.CAL) project file.

Sample Placement in an Activity

```
AC:SS
PN:6
PD:SE COR BLDG
XX:122356.789
YY:423567.899
HZ:243.222
VT:88.3035
DS:265.934
SS:235+01
```

```
OO:8.75
AC:SS
PN:8
(etc.)
```

Occupied Station Point Number - OS:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value for the occupied station point number when taping

Description/Definition

The Occupied Station Point Number data item (OS:) is used with the Taping Activity (AC:TA) to list the point number to use as the occupied station to initiate the taping routine.

Sample Placement in an Activity

```
AC:SS
PN:9
FE:HOUSE
SH:5
HZ:45.2354
VT:90.3045
DS:100.44
AC:SS
PN:10
FE:HOUSE
SH:5
HZ:55.2853
VT:90.3006
DS:180.94
AC:TA
OS:10          (Point Number of the point to be use as the occupied
               station)
BS:9           (Point Number of the point to be used as the backsight)
PN:100         (Beginning Point Number to be for the points computed)
FE:HOUSE       (Feature to be used for the new chain)
FG:5           (Figure Number to be used for the chain)
AD:90,34,      (Right 34 feet, use the same elevation as PN:10)
AD:90,60,3.2   (Right 60 feet. Add 3.2 feet to the previous elevation)
AD:270,38,0    (Left, 38 feet. Elevation the same as the previously
               defined point. Could be blank.),
AD:90,44,      (Right 44 feet. Same elevation as the previously defined
               point.)
AD:90,72, -3.2        (Right 71 feet. Subtract 3.2 feet from the
                      elevation of the previously defined point.)
AD:90,104      (Right 104 feet to the first point defining the chain)
(etc)
```

Owner - OW:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric description of an owner as it relates to a survey or point

Description/Definition

The owner data item (OW:) identifies an owner that is, in some respect, relevant to the survey. This could be an owner of a parcel, utility, building, etc.

The owner data item may be entered anywhere within an activity. Any combination of letters and numbers may be used.

Sample Placement in an Activity

The OW: data item may be placed anywhere within an activity and does not affect computations.

```
AC:SS
PN:25
PD:OVERHEAD WIRE
HZ:6.443
VT:9.048
DS:18.54
OW:NORTHERN STATES POWER
(etc.)
```

Prism Correction - PC:

Synonyms

Prism constant

Allowed Responses

Numeric value of the prism correction

Description/Definition

The prism correction data item (PC:) is used to correct the measured slope distance for the difference between the optical center of the prism and the axis of the prism housing. The prism correction should be entered as a length in current units.

If the instrument is capable of providing the necessary correction on its own, the user should allow the instrument to do so. The PC: data item should not be entered into the project file, or it should be entered as zero (0) if the instrument is making the correction. Warning: Do not make the prism correction in both places.

The PC: data item acts as a constant during computations. The default value is zero (0). The PC: data item affects the shot in which it is entered and all shots that follow until a new prism correction is found.

A correction is made during processing by adding the PC: to the measured slope distance. Refer to the instrument user's manual for details on using this correction in the instrument.

Sample Placement in an Activity

The PC: data item is usually encountered in either the beginning occupied station activity or in the project header activity, but may be placed within any activity if the prism correction changes.

```
AC:OS
```

```
PN:2
PD:CONTRL ON
SH:5.2
YC:10122.82
XC:958.334
PC:-.098
AC:BS
PN:1
(etc.)
```

Point Description - PD:

Synonyms

Object description, shot description

Allowed Responses

User defined alphanumeric value

Description/Definition

The point description data item (PD:) describes the current shot. While there are other data tags that can describe a shot (such as FE:, OW:, TY: etc.), the point description should be used as an overall or qualifying description of the point. The point description is the value most often passed to other, simpler COGO systems. Use PD: to provide a meaningful short description of the point.

The point description data item is alphanumeric descriptive data and does not affect computations. It must be specifically entered for the activity to which it applies and is unique to that activity.

Sample Placement in an Activity

The PD: data item may be placed anywhere within an activity.

```
AC:OS
PN:2
PD:IRON PIN FOUND
PD:NEXT TO 6"X10" STONE INSCRIBED
PD:ON THE SOUTH FACE          (Multiple point descriptions are allowed
                              in an Activity)
FE:IP
IH:5.2
SH:6.0
YC:1527.85
XC:473128.36
ZC:443
AC:BS
PN:1
(etc.)
```

Physical Attribute - PH:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value of a physical characteristic

Description/Definition

The physical data item (PH:) describes the overall physical attribute of a point, with the type (TY:) and (OW:) data tags, etc., providing qualification. The PH: tag is used by some third party processing systems to assign a cell name and a level number for the point when it is imported into a CADD system.

See also FE: Feature, FG: Figure, GM: Geometry, TY: Type, and OW: Owner.

Sample Placement in an Activity

The PH: data item may be placed anywhere within the activity.

```
AC:SS
PN:2
PD:TOP OF CULVERT LEFT
PH:CUL  code for culvert
TY:CM          (code for corrugated metal; qualifier for PH:CUL)
HZ:365.821
VT:88.312
DS:132.047
AC:SS
(etc.)
```

Point List - PL:

Synonyms

Not applicable.

Allowed Responses

List of alphanumeric point numbers

Description/Definition

The point list (PL:) data item is used in conjunction with the chain activity (AC:CH) to define a list of points, and the order, to be added to the chain being created. The format of the point list is:

1. Comma delimited between individual point numbers in any order that with no blank spaces between characters – PL:1,2,3,4
2. Double comma to indicate a gap between two or more of the points with no blank spaces between characters – PL:1,2,,3
3. A dash between numbers to indicate inclusion of all points between those numbers with no blank spaces between characters - PL: 4-6
4. A combination of 1, 2, or 3 – PL:1,2,,3,4-6,9,10

Sample Placement in an Activity

The PL: data item is only used within the chain activity (AC:CH).

```
AC: CH
FE: TEL
DP: 5
FG: 10
CD: UG TELEPHONE CABLE
OW: MG&E
```

```
PL: 4-6, 10-8          (includes points 4, 5, 6, 10, 9, and 8 in the
                       chain being created)
(etc)
```

PPM Factor - PM:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the instrument parts per million systematic error

Description/Definition

The PPM Factor data item (PM:) is used to record a parts-per-million systematic error factor usually associated with the distance measured with a total station measuring device.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
CI:LITTLE ROCK
CS:LOCAL STATE PLANE
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
PM:2           (Instrument being used has an accuracy of +/-(2mm + 2
               ppm))
NM:S5111
OB:JDH
RE:JDH
I5:DJS
I6:AMC
WE:CLOUDY
CM:MANSION SURVEY
(etc.)
```

Point Number - PN:

Synonyms

Shot number, station number

Allowed Responses

Alphanumeric value used to uniquely identify a point

Description/Definition

The point number data item (PN:) identifies the current shot. It must be specifically entered into the activity to which it applies and is unique to that activity.

The point number can potentially affect computations, as shots are processed and organized by point number when doing sets, multi-stubs and sideshot intersects. In addition, point numbers are often used in formatting and may be required by other COGO/CADD systems.

Sample Placement in an Activity

The PN: data item may be placed anywhere within an activity.

```
AC:OS
PN:2
PD:CONTROL MON
IH:5.2
SH:6.0
YC:1527.85
XC:473128.36
ZC:443
AC:BS
PN:1
(etc.)
```

Prism Offset - PO:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the prism offset

Description/Definition

The prism offset data item (PO:) records the distance from the desired point to a prism placed on the point.

The intended use of PO: data item is for tunneling work where the prism may be offset from the tunnel ring. PO:should be used with the Direction Offset (DO:) tag, which indicates whether the prism is set in a horizontal or vertical orientation.

If, when facing the point, the prism offset is to the left, enter a positive offset value:

PO:14.225

If, when facing the point, the prism offset is to the right, enter a negative offset value:

PO:-14.225

See also DO: Direction Offset

Sample Placement in an Activity

```
AC:SS
RN:61
RD:SAFETY WALK
HZ:32.692
VT:8.305
DS:25.4
PO:5.22
DO:H
AC:RG
RN:62
(etc.)
```

Project Name - PR:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric name of the project

Description/Definition

The project name data item (PR:) identifies the filename of the file used to collect the survey data. Only one PR: data item may be used per project file. The maximum length for the project name is 8 characters. The name must satisfy the file naming rules for the data collector operating system.

Sample Placement in an Activity

The PR: data item is, without exception, the first data item in a project file.

```
PR:USHWY10
TK:RTO
AC:PR
IT:OMNI01
SN:7224
NM:D.MOZUCH
TE:50
BP:30
OB:SEZ
RE:DLN
DT:10/15/86
WE:CLOUDY
PM:2.2
(etc.)
```

Radius-First Curve - R1:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the curve radius.

Description/Definition

The Radius-First Curve data item (R1:) is used with a horizontal alignment to record the radius of the first circular curve of a compound curve and also defines the beginning radius to use for a connecting spiral between compound curves.

Sample Placement in an Activity

In a horizontal alignment file:

```
AC:OS
SI:PI
YC:208076.928466
XC:759174.304456
R1:300.000000
```

```
R2:400.000000
S3:150.000000
(etc.)
```

Top Wire Rod Reading (3 Wire Level Task) - R1:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the top stadia wire in a three-wire level task.

Description/Definition

The Rod Reading-Top Wire data item (R1:) is used in a 3 Wire level task to record the top wire rod reading. It must be used in conjunction with R2: and R3:.

Sample Placement in an Activity

3Wire Level Task

```
AC:FS
PN:50
PD:BOLT
R1:6.15
R2:5.99
R3:5.83
(etc.)
```

Radius-Second Curve - R2:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the radius.

Description/Definition

The Radius–Second Curve data item (R2:) is used with a horizontal alignment to record the radius of the second circular curve of a compound curve and also defines the beginning radius to use for a ending spiral between compound curves.

Sample Placement in an Activity

IN a horizontal alignment file:

```
AC:OS
SI:PI
YC:208076.928466
XC:759174.304456
R1:300.000000
R2:400.000000
S3:150.000000
(etc.)
```

Middle Wire Rod Reading (3 Wire Level Task) - R2:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the middle stadia wire in a three-wire level task

Description/Definition

The Rod Reading-Middle Wire data item (R2:) is used in a 3 Wire level task to record the middle wire rod reading. It must be used in conjunction with R1: and R3:.

Sample Placement in an Activity

3Wire Level Task

```
AC:FS
PN:50
PD:BOLT
R1:6.15
R2:5.99
R3:5.83
(etc.)
```

Bottom Wire Rod Reading (3 Wire Level Run) - R3:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the bottom stadia wire in a three-wire level task.

Description/Definition

The Rod Reading-Bottom Wire data item (R3:) is used in a 3 Wire level task to record the bottom wire rod reading. It must be used in conjunction with R1: and R2:.

Sample Placement in an Activity

3Wire Level Task

```
AC:FS
PN:50
PD:BOLT
R1:6.15
R2:5.99
R3:5.83
(etc.)
```

Radius - RA:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the radius

Description/Definition

The radius data item (RA:) records the radius of the curve. A curve to the right is entered as a positive value for the radius (+###) or with no sign recorded. A curve to the left is entered as a negative value for the radius (-###).

Sample Placement in an Activity

```
AC:SS
PN:14
SI:PI
RA:300.000
(etc.)
```

Ring Description - RD:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value used to describe the current ring in a tunneling task

Description/Definition

The ring description data item (RD:) describes the current ring.

The ring description data item is alphanumeric descriptive data and does not affect computations.

The RD: data item is used in tunneling and is not recommended for general use.

Sample Placement in an Activity

The RD: data item may be placed anywhere within an activity.

```
AC:SS
RN:43
RD:START FLOATING SLAB
PO:2.2
SD:UP
(etc.)
```

Recorder - RE:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value for the recorder

Description/Definition

The Recorder data item (RE:) is used to record the name or initials of the note taker or recorder on the survey crew.

Sample Placement in an Activity

```
PR:USHWY10
TK:RTO
AC:PR
IT:OMNI01
SN:7224
NM:D.MOZUCH
TE:50
BP:30
OB:SEZ
RE:DLN
DT:10/15/86
WE:CLOUDY
PM:2.2
(etc.)
```

Ring Number - RN:

Synonyms

Point number (as applied to a ring activity)

Allowed Responses

Numeric value used to uniquely identify a ring in a tunneling task

Description/Definition

The ring number data item (RN:) identifies the current ring being shot in a tunnel.

The RN: data item is used in tunneling and is not recommended for general use.

Sample Placement in an Activity

The RN: data item may be placed anywhere within an activity.

```
AC:SS
RN:2
PD:SAFETY WALK
SD:DOWN
AC:SS
PN:201
(etc.)
```

Right Angle Offset - RO:

Synonyms:

Not applicable.

Allowed Responses

Numeric value of the right angle offset

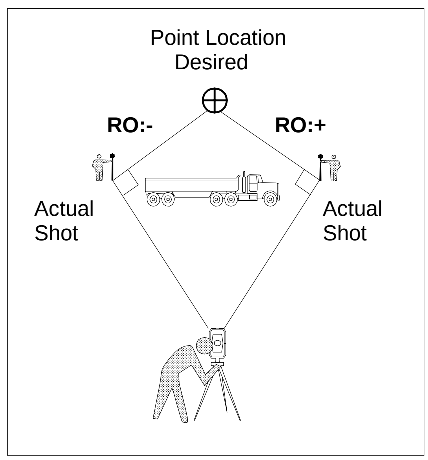
Description/Definition

The right angle offset data item (RO:) is the offset left or right of the line of sight in relation to the instrument. The right angle offset (RO:) data item is used when the target cannot be placed directly on the desired point and indicates the distance to the target either set to the left or right of a point.

A perpendicular offset to the left of the point (in the line of sight when facing the point from the instrument) is displayed as a negative number (RO:-3.4). A perpendicular offset to the right of the point being shot (in the line of sight when facing the point from the instrument) is displayed as a positive number (RO:3.4).

Future updates to this document will replace the dual use of the OF: data item that is currently being used to record the line of sight offset in a project file

(See OF: Offset).



Sample Placement in an Activity

```
AC:SS
PN:6
PD24″ OAK
HZ:243.222
VT:88.3035
DS:265.934
RO:8.72
(etc)
```

Rod Reading - RR:

Synonyms

Rod height

Allowed Responses

Numeric value of the rod reading

Description/Definition

The rod reading data item (RR:) records the rod measurement in vertical tasks and in activities such as utility elevation in horizontal tasks.

The RR: data item is unique to the activity in which it is entered and must be entered each time the rod reading is needed.

RR: data items must be in units consistent with the rod type.

The sign of the rod reading is dependant on the task. In vertical tasks all rod readings are positive, unless the rod is read in an inverted position. Inverted rod readings are common in mining or tunneling surveys and are entered as negative values.

In horizontal tasks the RR: data item is used in utility elevation activities to record the depth of an invert or an underground utility. Depths are entered as positive values. If the measured object is above the prism, the RR: represents a remote elevation. Remote elevations are entered as negative values.

See also RT: Rod Type

Sample Placement in an Activity

The RR: data item may be placed anywhere within any activity.

Level Task	Cross Section Task	Horizontal Task
AC:OS	AC:ST	AC:SS
PN:1	ST:10+00	PN:100
PD:USCGS 3005A	OF:0	PD:MANHOLE
ZC:1016.723	**RR:1.35**	HZ:91.046
AC:BS	AC:ST	VT:89.304
RR:2.15	(etc.)	DS:52.528
AC:TP		AC:UE
RR:5.115		PN:101
(etc.)		PD:GAS LINE
		RR:3.55 (depth below casting)
		(etc.)

Ring Style - RS:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric type of ring observed, such as: CIRC, BOX, ARCH

Description/Definition

The ring style data item (RS:) indicates the type of ring observed. It is placed in a ring shot in a tunneling project and may be entered in any ring shot in the project file. The RS: data item is used to specify the ring geometry for processing.

The RS: data item is normally used in tunneling surveys and is not recommended for general use.

Sample Placement in an Activity

The RS: data item must be placed in any AC:SS shot. It affects the current ring and all subsequent rings until changed.

```
AC:SS
RN:227
PD:START OF SAFETY WALK
RS:CIRC
SD:UP
(etc.)
```

Rod Type - RT:

Synonyms

Rod graduation

Allowed Responses

YARD, FOOT, METER

Description/Definition

The rod type data item (RT:) documents which type of rod is used in the task. This data item affects computations by producing results according to the type of rod used.

The RT: data item affects the project as a whole.

If the rod type is either FOOT or METER, no unit conversion is performed. If the rod type is YARD, rod readings are converted to feet.

Sample Placement in an Activity

The RT: data item may be placed within any activity, but is most commonly found in the project header activity.

```
AC:PR
ID:SHATTO PL
NM:J JONES
RT:FOOT
AC:ST
(etc.)
```

Entry Spiral Length - S1:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the beginning spiral in length

Description/Definition

The entry spiral length (S1:) data item is used with a horizontal alignment to record the spiral length to use at the beginning (TS) of a spiral curve.

Sample Placement in an Activity

In a horizontal alignment

```
AC:OS
SI:PI                 ***(Spiral Curve Spiral)***
YC:206655.052023
XC:759712.393480
S1:30.000000
S2:30.000000
RA:435.000000
AC:OS
SI:PI                 ***(Spiral Curve Spiral)***
YC:206971.980072
XC:759516.707250
S1:50.000000
S2:50.000000
RA:592.379000
AC:OS
 (etc.)
```

Staking 1 Control File Name - S1:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric file name

Description/Definition

The Staking 1 Control File Name data item (S1:) is used to indicate the name of the primary staking control point file. The file named will be displayed in the project data file.

Normally, referenced stake out points are searched for in the Staking 1 control file first, and in the Staking 2 control file second.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
NM:S5111
OB:JDH
RE:JDH
I5:DJS
```

```
I6:AMC
WE:CLOUDY
CM:MANSION SURVEY
CR:No
CF:1.000000
UL:M
UA:D
UT:F
UP:I
VR:SDMS Ver# 3.3
L1:SR70106.CTL
S1:SR70106.CTL
WC:SR70106W.CTL
HA:ER70106.ALI
VA:ER70106.PRO
SF:ER70106.SUP
(etc.)
```

Exit Spiral Length - S2:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the spiral out length

Description/Definition

The exit spiral length (S2:) data item is used with a horizontal alignment to record the spiral length to use at the end (SC) of a spiral curve.

Sample Placement in an Activity

In a horizontal alignment

```
AC:OS
SI:PI                     ***(Spiral Curve Spiral)***
YC:206655.052023
XC:759712.393480
S1:30.000000
S2:30.000000
RA:435.000000
AC:OS
SI:PI                     ***(Spiral Curve Spiral)***
YC:206971.980072
XC:759516.707250
S1:50.000000
S2:50.000000
RA:592.379000
AC:OS
(etc.)
```

Staking 2 Control File Name - S2:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric file name

Description/Definition

The Staking 2 Control File Name data item (S2:) is used to indicate the name of the secondary staking control point file. The file named will be displayed in the project data file.

Normally, referenced stake out points are searched for in the Staking 1 control file first, and in the Staking 2 control file second.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
NM:S5111
OB:JDH
RE:JDH
I5:DJS
I6:AMC
WE:CLOUDY
CM:MANSION SURVEY
CR:No
CF:1.000000
UL:M
UA:D
UT:F
UP:I
VR:SDMS Ver# 3.3
L1:SR70106.CTL
S1:SR70106.CTL
S2:SR70106A.CTL
HA:ER70106.ALI
VA:ER70106.PRO
SF:ER70106.SUP
(etc.)
```

Connecting Spiral Length - S3:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the spiral length between compound curves

Description/Definition

The connecting spiral length (S3:) data item is used with a horizontal alignment to record the spiral length to use between compound circular curves.

Sample Placement in an Activity

In a horizontal alignment

```
AC:OS
SI:PI                    ***(RSR - Radius Spiral Radius)***
YC:208076.928466
XC:759174.304456
R1:300.000000
R2:400.000000
S3:150.000000
AC:OS
SI:PI                    ***(Ending PI)***
YC:208605.886025
XC:759457.507387
(etc.)
```

Station Back - SB:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the station back in a station equation

Description/Definition

The station back (SB:) data item is used to indicate the stationing back to be used for a horizontal or vertical alignment from a specific SI: back along the alignment.

Sample Placement in an Activity

In a horizontal alignment

```
AC:PR
PR:STH67
NM:STATE HWY A – HWY B
CM:DESIGN HORIZONTAL ALIGNMENT
DT:03/26/1998
UL:M3
VD:NGVD 29
HD:NAD 83 (1991)
ZN:4802
RE:GENO
DT:03/26/1998
RE:GENO
AC:EQ          (All  equations  are  listed  immediately  following  AC:PR
               and its related data items)
PN:1
SB:11+374.836
ST:11+400.000
AC:EQ
PN:2
SB:12+172.297
ST:12+140.000
AC:OS
(etc.)
```

Station Direction - SD:

Synonyms

Not applicable.

Allowed Responses

UP, DOWN

Description/Definition

The station direction data item (SD:) indicates whether shots are currently being taken looking up station (increasing station values) or down station (decreasing station values). It is placed in a ring shot in a tunneling project and may be entered in any ring shot in the project file.

The SD: data item is normally used in tunneling surveys and is not recommended for general use.

Sample Placement in an Activity

The SD: data item must be placed in any AC:SS shot. It affects the current ring and all subsequent rings until changed.

```
AC:SS
RN:227
RD:START OF SAFETY WALK
RS:CIRC
SD:UP
(etc.)
```

Set Number - SE:

Synonyms

Doubled angles, averaging angles

Allowed Responses

Numeric value of the set number)

Description/Definition

The set number data item (SE:) identifies the set of direct and reverse angles of which the current shot is a part.

Collecting data in sets is defined in the data structure as recording several shots to the same point or group of points to obtain averaging information about those shots. Each shot to be included in set results must include the FC: and SE: data tags.

The SE: data item is always used in conjunction with the face (FC:) data item. Together, these two tags identify the set to which the shot belongs, and the face of the instrument used to shoot the point.

See also FC: Face

Sample Placement in an Activity

The SE: and FC: tags may be placed in any order following the activity data item:

```
AC:FS
SE:1
FC:1
PN:49
PD:TRAV STN
HZ:62.0120
VT:90.0003
DS:100.31
(etc.)
AC:FS
SE:1
FC:2
PN:49
PD:TRAV STN
HZ: 242.0130
VT: 270.0001
DS:100.31
(etc.)
```

Scale Factor - SF:

Synonyms

Not applicable

Allowed Responses

Numeric value of the scale factor

Description/Definition

The Scale Factor (SF:) data item is used to record the scale factor for the State Plane Coordinate System being used. The scale factor will normally be related to a control point.

The Scale Factor data item can be used for both the Lambert Polyconic projection and the Transverse Mercator projection and follows the standard definition for each projection. In the Lambert projection, the scale factor is a function of latitude. For the Mercator projection, the scale factor is based on the distance that the point is east or west of the central meridian.

Sample Placement in an Activity

Control File

```
AC:OS
PN:1
FE:CTL
PD:STANDARD GPS MONUMENT
YC:553899.076
XC:396230.999
ZC:80.839
SF:0.9999412
CF:0.9998958
SY:0.001
SX:0.001
SZ:0.005
(etc.)
```

Superelevation File Name - SF:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric file name

Description/Definition

The Superelevation File Name data item (SF:) is used to specify the name of the file where the superelevation values for a roadway cross section is defined. The stationing in the superelevation file must correlate to the named horizontal alignment file.

The file named will be displayed in the project header activity (AC:PR) of a project data file.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
NM:S5111
OB:JDH
RE:JDH
I5:DJS
I6:AMC
WE:CLOUDY
CM:MANSION SURVEY
CR:No
CF:1.000000
UL:M
UA:D
UT:F
UP:I
VR:SDMS Ver# 3.3
L1:SR70106.CTL
S1:SR70106.CTL
HA:ER70106.ALI
VA:ER70106.PRO
SF:ER70106.SUP
(etc.)
```

Staff Height - SH:

Synonyms

Signal height, rod height, target height, prism height

Allowed Responses

Numeric value of the staff height

Description/Definition

The staff height data item (SH:) records the height of the staff, target, rod or prism on each shot. If not entered the post processing software used will usually assign a default value.

The SH: data item acts as a constant during computations. It is used for the shot in which it is placed and is implied all subsequent shots until a new staff height is entered.

Sample Placement in an Activity

The SH: may be initialized in the occupied station, but must be entered in any activities for which the staff height is changed (this includes changing back to a previously set value).

```
AC:OS
PN:2
PD:CONTRL MON
IH:5.2
SH:5.2
YC:10122.832
XC:958.334
AC:BS
PN:1
(etc.)
AC:FS
PN:63
PD:TRAV PT
HZ:143.388
VT:91.222
DS:116.992
SH:4.9
AC:OS
PN:63
(etc.)
```

Shot Identification - SI:

Synonyms

Not applicable.

Allowed Responses

```
STK
BL
PI
POC
RTO
EL
PT
XSE
PC
POT
```

Description/Definition

The shot identification data item (SI:) is used to give special meaning to a shot. Certain data items are constants (designated in this definition by "constant") and apply to the shot in which they are entered and all subsequent shots. Other data items apply only to the shot in which they are placed (designated in this definition by "each").

The SI: data item should only contain the responses allowed by the data structure; users should never make up their own field values.

SI:STK	staked point (each)
SI:BC	begin chain/figure
SI:BL	begin LOC shot (constant)
SI:EC	end chain/figure
SI:EL	end LOC shot (constant)
SI:RTO	radial topography shot (constant)
SI:XSE	cross-section shot (constant)
SI:PC	point of curvature (each)
SI:PI	point of intersection of tangents (each)
SI:POC	point on curve (each)
SI:PT	tangent point (constant)
SI:POT	point on tangent, second shot (each)

Sample Placement in an Activity

The SI: data item may be placed anywhere in the activity to which it applies.

```
AC:SS
PN:2
PD:CORNER
HZ:181.554
VT:90.302
DS:150.981
SI:STK         (identifies this as a staking point)
AC:SS
PN:4
(etc.)
```

Serial Number - SN:

Synonyms

Not applicable.

Allowed Responses

Alphanumeric value of the instrument or antenna serial number

Description/Definition

The serial number data item (SN:) is used to record the serial number of the instrument or antenna being used.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
CI:LITTLE ROCK
CS:LOCAL STATE PLANE
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
```

```
PM:2
NM:S5111
OB:JDH
RE:JDH
I5:DJS
I6:AMC
WE:CLOUDY
CM:MANSION SURVEY
(etc.)
```

Solution Type - SO:

Synonyms

Not applicable.

Allowed Responses

UNKOWN, CODE, FLOAT [RTK, NETWORK, WAAS], FIXED [RTK, NETWORK, WAAS]

Description/Definition

The Solution Type data item (SO:) defines the type of solution obtained on Global Positioning System (GPS) determined points or vectors. This data item serves as a quality indicator and as such is for documentation purposes only.

Sample Placement in an Activity

```
AC:FS
PN:BASE
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:13451.012
VY:3468.604
VZ:-265.403
C1:0.00000299
C2:-0.00000456
C3:0.00000189
C4:0.000002167
C5:-0.00000703
C6:0.00000777
BT:14:54:42 04/24/2004
SO:FIXED
FR:IONO FREE
SV:7
NS:412
IP:P4.3
```

Suspend Project - SP:

Synonyms

Temporary end of survey

Allowed Responses

Usually system-defined

Description/Definition

The suspend project data item (SP:) documents where a project file was suspended. The data field may contain any value or may be left blank. A suggested response would be to document the date and time the project was suspended or last edited. It may also indicate whether field book protection, if implemented in the system, was ON or OFF.

A file may contain multiple SP: tags, as a suspended (or closed) project may be restarted for continued work. The SP: tag does not affect computations.

See also CP: Close Project

Sample Placement in an Activity

```
AC:SS
PN:26
PD:FENCE LINE
HZ:23.002
VT:89.331
DS:554.312
SP:02/24/2000  15:34:46       (project was suspended here)
(etc.)
```

Scale Ratio - SR:

Synonyms

Map Scale

Allowed Responses

Numeric value of the scale ratio

Description/Definition

The Scale Ratio (SR:) data item is used to record the scale ratio to be used for the map generated from the data in the file. This data item will normally be part of the project header.

The format is : 1:#####.

Sample Placement in an Activity

```
PR:USHWY10
TK:RTO
AC:PR
IT:OMNI01
SN:7224
NM:D.MOZUCH
TE:50
BP:30
OB:SEZ
RE:DLN
DT:10/15/86
WE:CLOUDY
PM:2.2
SR:1:100,000
(etc.)
```

Computed Stationing - SS:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the computed station

Description/Definition

The Stationing-Computed data item (SS:) is used to display the station value of a measured point relative to a defined horizontal alignment.

This data item will normally appear in the calculated (CAL) project file.

Sample Placement in an Activity

```
PN:233
HH:210.0125
VV:95.0925
DD:37.971
XX:414521.317
YY:542573.745
ZZ:73.657
FE:IP
PD:3/8″ Rebar
ST:1000.32
SS:1001.34
```

Stationing - ST:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the alignment station

Description/Definition

The stationing data item (ST:) specifies the distance along an alignment from some arbitrary starting point. The value may be entered in either decimal or plus format (e.g., 1200.34 or 12+00.34).

The ST: data item is most often entered in the stationing activity (AC:ST) and the equation activity (AC:EQ). If entered in the AC:ST activity, the stationing value applies to all subsequent shots until changed in a new AC:ST activity.

The ST: data item is also used in the Stake Out routines.

Sample Placement in an Activity

The ST: data item may be placed anywhere within an activity.

```
AC:ST
PN:2
ST:100+00
AC:SS
```

```
PN:4
PD:TOP OF SLOPE
OF:45
RR:7.9
(etc.)
```

Minimum Number of Satellites - SV:

Synonyms

Not applicable.

Allowed Responses

Integer value.

Description/Definition

The Minimum Number of Satellites data item (SV:) stores the minimum number of satellites used to compute a GPS vector or position. This data item may serve as a quality indicator and as such is used for documentation purposes only.

Sample Placement in an Activity

```
AC:FS
PN:BASE
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:13451.012
VY:3468.604
VZ:-265.403
C1:0.00000299
C2:-0.00000456
C3:0.00000189
C4:0.000002167
C5:-0.00000703
C6:0.00000777
BT:14:54:42 04/24/2004
SO:FIXED
FR:IONO FREE
SV:7
NS:412
IP:P4.3
```

X Coordinate One-Sigma Error Estimate - SX:

Synonyms

Not applicable.

Allowed Responses

User defined numeric value

Description/Definition

The X Coordinate One-Sigma Error Estimate data item (SX:) defines the one-sigma error estimate in the X component (Easting) of the coordinate for that point to be used during the least squares analysis process. The SX: data item will normally be used in the SDMS Control File (CTL), but can also be used in the Points and Chains (PAC) file. If the SX: data item is used in the PAC file, then the XE: data item must also be included.

A control coordinate (horizontal or vertical) can be treated as a measurement with an appropriate error estimate if desired. This will allow control to adjust along with the rest of the measurements. The response represents the statistical result of one sigma (1s) which means that approximately 67% of the measurements have residuals smaller than the error estimate. One sigma represents a smaller error estimate than what results from the statistical 95% confidence level. Therefore, the one sigma value is the required response.

In statistics, at the one sigma level, which is where error estimation takes place, it is expected that 33% of the measurement residuals will be larger than the error estimate. These are not blunders, but instead, are expected. A general rule of thumb is if any residuals are more than three times the size of their respective error estimates, statistically, it is 95% certain there is something wrong with at least one of the measurements or control coordinates.

It needs to be understood that the response to the SX data item is not "it shall not be exceeded." For example, if the control fits the measurements, an error est. of 0.02 ft. in a Northing coordinate (same for Easting or Elevation) may not be any better than an error estimate of 10 feet. This is due to the fact that if control points and the measurements are in harmony the control points will actually adjust very little.

The error estimate on control essentially says how much freedom is being given to those coordinates to allow them to adjust to harmonize with the measurements. If held fixed, any error in control is propagated into the measurement residuals. The error has to go somewhere.

Normally, the user may not wish to allow control to adjust initially. Therefore, in SDMS Processor, default error estimates of 0.001 feet (or meter) are assigned if no value for SX: is given. This error estimate is so superior to other measurements that control will not adjust.

Allowing control to adjust based on non-fixed error estimates has several outstanding abilities. Used with robustness during the least squares analysis process, it is a powerful tool in finding control problems such as, using the wrong point number, incorrect station naming, or incorrect data entry. It also lets the user evaluate the quality of the measurements without errors in the control coordinates having an affect on the results. It also allows for assigning different weights to individual control points relative to one another, based on the estimated precision of each individual point.

It should also be noted for any post adjustment processing, the one sigma error estimate is considered "a priori," meaning it is based on the assumption of a very good error estimate model. During the post adjustment processing, a standard error of unit weight will be computed to convert that estimate by applying a multiplier to account for pessimism/optimism.

Sample Placement in an Activity

Control File

```
AC:OS
PN:1
```

```
FE:CTL
PD:STANDARD GPS MONUMENT
YC:553899.076
XC:396230.999
ZC:80.839
SY:0.001
SX:0.001
SZ:0.005
(etc.)
```

PAC File

```
AC:PD
PN:3220
FE:RW
PD:STANDARD ROW MONUMENT
YY:84671.4601
XX:70385.3870
ZZ:1180.839
XE:0.0963
YE:0.0957
ZE:0.0963
SY:0.0960
SX:0.0965
SZ:0.1667
(etc.)
```

Y Coordinate One-Sigma Error Estimate - SY:

Synonyms

Not applicable.

Allowed Responses

User defined numeric value

Description/Definition

The Y Coordinate One-Sigma Error Estimate data item (SY:) defines the one-sigma error estimate in the Y component (Northing) of the coordinate to be used during the least squares analysis process. The SY: data item will normally be used in the SDMS Control File (CTL), but can also be used in the Points and Chains (PAC) file. If the SY: data item is used in the PAC file, the XY: data item must also be included.

See SX: for additional details.

Sample Placement in an Activity

Control File

```
AC:OS
PN:1
FE:CTL
PD:STANDARD GPS MONUMENT
YC:553899.076
XC:396230.999
ZC:80.839
SY:0.001
SX:0.001
SZ:0.005
(etc.)
```

PAC File

```
AC:PD
```

```
PN:3220
FE:RW
PD:STANDARD ROW MONUMENT
YY:84671.4601
XX:70385.3870
ZZ:1180.839
XE:0.0963
YE:0.0957
ZE:0.0963
SY:0.0960
SX:0.0965
SZ:0.1667
(etc.)
```

Z Coordinate One-Sigma Error Estimate - SZ:

Synonyms

Not applicable.

Allowed Responses

User defined numeric value

Description/Definition

The Z Coordinate One-Sigma Error Estimate data item (SZ:) defines an error estimate in the Z component (Elevation) of the coordinate to be used during the least squares analysis process. The SZ: data item will normally be used in the SDMS Control File (CTL), but can also be used in the Points and Chains (PAC) file. If the SZ: data item is used in the PAC file, then the XY: data itme must also be included.

See SX: for additional details.

Sample Placement in an Activity

Control File

```
AC:OS
PN:1
FE:CTL
PD:STANDARD GPS MONUMENT
YC:553899.076
XC:396230.999
ZC:80.839
SY:0.001
SX:0.001
SZ:0.005
(etc.)
```

PAC File

```
AC:PD
PN:3220
FE:RW
PD:STANDARD ROW MONUMENT
YY:84671.4601
XX:70385.3870
ZZ:1180.839
XE:0.0963
YE:0.0957
ZE:0.0963
SY:0.0960
SX:0.0965
SZ:0.1667
```

```
(etc.)
```

Tunnel Direction - TD:

Synonyms

Not applicable.

Allowed Responses

User or system defined, such as INBOUND or OUTBOUND

Description/Definition

The Tunnel Direction data item (TD:) is used to record the direction of a tunnel, such as INBOUND or OUTBOUND.

Sample Placement in an Activity

```
AC:SS
RN:227
PD:START OF SAFETY WALK
RS:CIRC
TD:OUTBOUND
SD:UP
(etc.)
```

Temperature - TE:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the temperature, such as Fahrenheit, Celsius

Description/Definition

The Temperature data item (TE:) is used to record the current temperature in the units designated by the units of temperature (UT:) data item.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
CI:LITTLE ROCK
CS:LOCAL STATE PLANE
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
PM:2
NM:S5111
OB:JDH
RE:JDH
I5:DJS
```

```
I6:AMC
WE:CLOUDY
TE:82
CM:MANSION SURVEY
(etc.)
```

Tunnel Identification - TI:

Synonyms

Not applicable.

Allowed Responses

User defined alpha numeric value

Description/Definition

The Tunnel Identification data item (TI:) is used to record the name or number of a tunnel.

Sample Placement in an Activity

```
AC:SS
RN:227
PD:START OF SAFETY WALK
RS:CIRC
TI:1
TD:OUTBOUND
SD:UP
(etc.)
```

Task - TK:

Synonyms

Type of survey, type of project

Allowed Responses

```
3WR
CHA
COM
CON
CTM
CVA
GPS
LEV
LTO
PHO
PRO
RTO
TMO
TRA
TUN
XSE
```

SDMS Task Name	Name and Description
TK:3WR	Three Wire Level - Used for a three wire leveling run
TK:CTM	Compute Template - Used to input design cross section template for computations. RESERVED.
TK:COM	Combined – Traverse and Radial Topography, used to combine one or more single thread traverses (with sideshots) and radial topography measurements in one project.
TK:CON	Control Network Used to establish a control network of traverses. This allows least squares adjustment of the traverses by the post-processing software. Sideshots are not allowed.
TK:CHA	Compute Horizontal Alignment - Used to compute a horizontal alignment(HA:) in SDMS. RESERVED
TK:CVA	Compute Vertical Alignment - Used to compute a vertical alignment (VA:) in SDMS. RESERVED.
TK:GPS	GPS – Used to store processed GPS Vectors and related information.
TK:LEV	Level Run - Used for a single wire level run.
TK:LTO	Line/Offset Topography - Used to record topography, cross section, and break line data from a baseline or horizontal alignment using a tape, level, and level rod. Basically, it is a Cross Section Task (TK:XSE) that allows the user to include descriptive and connectivity activities and data tags. A horizontal alignment (PI Definition) must be defined and named in control configuration when this task is used. The named alignment file must be available with the project file for post processing. RESERVED
TK:PHO	Photogrammetry Control - Used to establish photo control points.
TK:PRO	Profile - Used to measure points along a profile.
TK:RTO	Radial Topography - Used for radial topography measurements, both for data collection and stakeout.
TK:TMO	Terrain Model - Used for Terrain Model measurements.
TK:TRA	Traverse - Also used for control networks. Used for one or more single thread traverses. Sideshots are not allowed.
TK:XSE	Cross Section - Used for cross section measurements done with a level.

Description/Definition

The task data item (TK:) defines the type of survey that is being conducted, such as a traverse (TK:TRA), level run (TK:LEV), or radial topography (TK:RTO). There may be only one TK: data item per project.

Depending on the task being used, certain activities may or may not be available for use in the project file For example, sideshots are not allowed in a traverse, and foresights are not allowed in radial topography.

Restrictions

Only the three character combinations listed above are permitted in the data structure.

Sample Placement in a Project

The task data item is, without exception, the second data item in a project file.

```
PR:JOB1
TK:RTO         (must be the second entry in the file)
AC:PR
DT:10/15/89
AC:OS
PN:2
PD:USGS 1031
(etc.)
```

Tangent Length Circular Curve - TL:

Synonyms1

Not applicable.

Allowed Responses

Numeric value of the tangent length of a curve

Description/Definition

The Tangent Length Circular Curve (TL:) data item is used with a horizontal alignment to record the distance from the PI to the PC and PT to the PT of a simple curve.

Sample Placement in an Activity

```
AC:OS
SI:PI
YC:207400.163795
XC:759447.697336
RA:-1150.00
DA:-35.3454
TL:369.02
(etc.)
```

Time - TM:

Synonyms

Not applicable.

Allowed Responses

Numeric value of time (HH:MM:SSS)

Description/Definition

The Time data item (TM:) is used to record the time of the survey if included in the project header or the time of the shot if recorded with the shot.

In the SDMS software, the format is HH:MM:SS.

Sample Placement in an Activity

```
AC:OS
```

```
PN:2
PD:CONTROL MON
IH:5.2
SH:6.0
YC:1527.85
XC:473128.36
ZC:443
TM:15:52:14
AC:BS
PN:1
(etc.)
```

Traverse Number - TN:

Synonyms

Not applicable.

Allowed Responses

Numeric value of traverse number

Description/Definition

The Traverse Number data item (TN:) is used to tag which traverse a point belongs to when multiple traverses are in the same project.

Sample Placement in an Activity

```
AC:OS
PN:2
PD:CONTROL MON
IH:5.2
SH:6.0
TN:2
YC:1527.85
XC:473128.36
ZC:443
TM:15:52:14
AC:BS
PN:1
TN:2
(etc.)
```

Vector Type - TV:

Synonyms

Type of vectors.

Allowed Responses

ARP (Antenna Reference Point), APC (Antenna Phase Center), MARK (Ground Mark)

Description/Definition

The Vector Type data item (TV:) is used to define the types of vectors contained in a survey or for a series of vectors. It is assumed that all vectors are processed to and from the same type of refence point, ARP to ARP, APC to APC, or MARK to MARK only.

Sample Placement in an Activity

```
AC:PR
TK:GPS
PR:HMDAY1
UL:M
HD:NAD83
GD:GEOID03
TV:MARK
(etc…)
```

Type - TY:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value for a description

Description/Definition

The type data item (TY:) is used as a sub-qualifier of a shot to provide additional descriptive information. It can also be used to specify the level on which to draw the object once the project data is passed to a CADD system.

See also FE: Feature, FG: Figure, GM: Geometry, PH: Physical, and OW: Owner

Sample Placement in an Activity

The TY: data item may be placed anywhere within the activity.

```
AC:SS
PN:2
PD:START OF DRIVE
PH:DRV
TY:ASPHALT
HZ:365.821
VT:88.312
DS:132.047
AC:SS
(etc.)
```

Units of Angles - UA:

Synonyms

Not applicable.

Allowed Responses

Alphanumeric value for the units of angles, such as D,DEGREES

Description/Definition

The Units of Angles data item (UA:) is used to specify the units that will be used in angle measurements. The most common response is displayed and recorded in Degrees. Units sometimes used include Rads and Gons.

Normally, the UA data item and response will be displayed in the project header of a project data file.

See HZ:, HH:, VT:, and VV:.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
NM:S5111
OB:JDH
RE:JDH
I5:DJS
I6:AMC
WE:CLOUDY
CM:MANSION SURVEY
CR:No
CF:1.000000
UL:M
UA:D
UT:F
UP:I
VR:SDMS Ver# 3.3
L1:SR70106.CTL
S1:SR70106.CTL
HA:ER70106.ALI
(etc.)
```

Units of Length - UL:

Synonyms

Not applicable.

Allowed Responses

User or system defined alphanumeric value of the units of length, such as F, Foot, M, Meters

Description/Definition

The Units of Length data item (UL:) specifies the units used in length and distance measurements, coordinates, station values, etc.

Normally, the UL: data item and response will be displayed in the project header activity (AC:PR) of a project data file.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
```

```
AC:PR
ID:6905_4
CO:PULASKI
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
NM:S5111
OB:JDH
RE:JDH
I5:DJS
I6:AMC
WE:CLOUDY
CM:MANSION SURVEY
CR:No
CF:1.000000
UL:M
UA:D
UT:F
UP:I
VR:SDMS Ver# 3.3
L1:SR70106.CTL
S1:SR70106.CTL
HA:ER70106.ALI
(etc.)
```

Units of Pressure - UP:

Synonyms

Not applicable.

Allowed Responses

User or system defined alphanumeric value of the unit of pressure, such as B, Bars, I, Inches

Description/Definition

The units of pressure data item (UP:) is used to specify the units used for recording barometric pressure with the BP data item.

Normally, the UP: data item and response will be displayed in the project header activity (AC:PR) of a project data file.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
NM:S5111
OB:JDH
RE:JDH
I5:DJS
I6:AMC
WE:CLOUDY
CM:MANSION SURVEY
CR:No
CF:1.000000
```

```
UL:M
UA:D
UT:F
UP:I
VR:SDMS Ver# 3.3
L1:SR70106.CTL
S1:SR70106.CTL
HA:ER70106.ALI
(etc.)
```

Units of Temperature - UT:

Synonyms

Not applicable.

Allowed Responses

F, Fahrenheit

C, Celsius

Description/Definition

The Units of Temperature data item (UT:) is used to specify the units used for recording temperature.

Normally, the UP: data item and response will be displayed in the project header activity (AC:PR) of a project data file.

Allowable responses are F (Fahrenheit) and C (Celsius).

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
NM:S5111
OB:JDH
RE:JDH
I5:DJS
I6:AMC
WE:CLOUDY
CM:MANSION SURVEY
CR:No
CF:1.000000
UL:M
UA:D
UT:F
UP:I
VR:SDMS Ver# 3.3
L1:SR70106.CTL
S1:SR70106.CTL
HA:ER70106.ALI
(etc.)
```

Vertical Alignment File Name - VA:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value for the vertical alignment filename

Description/Definition

The Vertical Alignment File Name data item (VA:) is used to specify the name of the file where the active vertical alignment geometry is defined.

Normally, the VA: data item and response will be displayed in the project header activity (AC:PR) of a project data file.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
NM:S5111
OB:JDH
RE:JDH
I5:DJS
I6:AMC
WE:CLOUDY
CM:MANSION SURVEY
CR:No
CF:1.000000
UL:M
UA:D
UT:F
UP:I
VR:SDMS Ver# 3.3
L1:SR70106.CTL
S1:SR70106.CTL
HA:ER70106.ALI
VA:ER70106.PRO
SF:ER70106.SUP
(etc.)
```

Vertical Datum - VD:

Synonyms

Elevation datum

Allowed Responses

User defined alphanumeric name of the vertical datum

Description/Definition

The Vertical datum data item (VD:) specifies the vertical datum for the survey or for a series of points.

The VD: data tag acts as a constant for all activities until it is changed, and is currently used for documentation purposes only.

Note: This data tag replaces the ZD: data tag, which has been removed from the SDMS Technical Guide.

The format is: Datum Acronym(space)Year(yyyy)(space)Year of Adjustment (if applicable)(yyyy). Some examples are:

VD:NGVD 1929

VD ST. PAUL DATUM

Sample Placement in an Activity

The VD: data item may be placed anywhere within a project file, although it is most appropriately placed in the project header activity:

```
PR:USHWY10
TK:RTO
AC:PR
IT:OMNI01
SN:7224
NM:D.MOZUCH
VD:NGVD 1929
TE:50
BP:30
OB:SEZ
RE:DLN
DT:10/15/86
WE:CLOUDY
PM:2.2
(etc.)
```

Vertical Index Error - VE:

Synonyms

Vertical collimation error

Allowed Responses

Numeric angular value of the index error in seconds of arc

Description/Definition

The vertical index error data item (VE:) records the angular vertical collimation error in seconds of arc as determined by the surveyor when testing the collimation of the instrument.

The VE: data item affects coordinate computations. The error is subtracted from the vertical angle measured by the instrument. Raw data is never changed.

The default value is zero (0).

Sample Placement in an Activity

The VE: data item may be placed anywhere within the project file, although it is most appropriately placed in the project header activity.

```
PR:NSP147
TK:RTO
AC:PR
NM:F. ROOS
TE:62
BP:29
NM:B JOHNSON
IT:AGA440
SN:420331
VE:.0010
AC:OS
(etc.)
```

Vertical/Horizontal Ratio - VH:

Synonyms

Slope ratio

Allowed Responses

Numeric value of the vertical/horizontal ratio

Description/Definition

The vertical/horizontal ratio (VH:) data item is defined as the slope of the line between two points at some known horizontal and vertical distance apart, expressed as m/m (metric), ft/ft (English), or a percent expressed as the decimal equivalent, by dividing the vertical component by the horizontal component (vertical distance/horizontal distance).

In the SDMS software, the VH: data item is expressed as a decimal equivalent and is used with the stake out functions to compute the position of a points based on the 3D data known. For example, a roadway surface with a cross slope of 0.02 feet per foot will be displayed as VH:0.02.

Sample Placement in an Activity

```
AC:SS
PN:1000
ST:123+98
OF:125
VO:23.5
FE:XS
ZC:123.57
VH:0.02
PD: CATCH POINT FOR BACK SLOPE
CM: SLOPE STAKE SET
(etc.)
```

Vertical Offset - VO:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the vertical offset

Description/Definition

The Vertical Offset data item is used to indicate the height above or below a known point that is to be used to compute the elevation for a point to be set or staked out.

In the SDMS software the VO: data item is used in 3D stake out functions to compute the elevation to be used to set a stake above or below a point with a known elevation and position as a reference to that point.

Sample Placement in an Activity

The data item may be placed anywhere in an activity used to record the data related to the point being set.

```
AC:SS
PN:1000
ST:123+98
OF:125
VO:23.5        (Point is 23.5 feet higher than centerline elevetion)
FE:XS
ZC:123.57
VH:0.02
PD: CATCH POINT FOR BACK SLOPE
CM: SLOPE STAKE SET
(etc.)
```

Version Number - VR:

Synonyms

Not applicable.

Allowed Responses

System defined alphanumeric value

Description/Definition

The Version Number data item (VR:) is used to record the version number of the software being used for data collection and processing.

In the SDMS software this will be recorded in the project header activity (AC:PR) of a project file (PRJ) file. It is also used to record the version number or source of information in a calculated (CAL) file.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
NM:S5111
OB:JDH
RE:JDH
```

```
I5:DJS
I6:AMC
WE:CLOUDY
CM:MANSION SURVEY
CR:No
CF:1.000000
UL:M
UA:D
UT:F
UP:I
VR:SDMS Ver# 3.4
L1:SR70106.CTL
S1:SR70106.CTL
HA:ER70106.ALI
VA:ER70106.PRO
SF:ER70106.SUP
(etc.)
```

Vertical Angle - VT:

Synonyms

Vertical circle angle, zenith angle

Allowed Responses

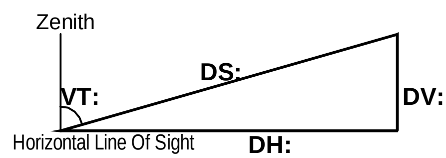
Numeric angular value of the vertical angle (DDD.MMSSS)

Description/Definition

The vertical angle data item (VT:) indicates the zenith angle measured to the target. The format is DDD.MMSSS.

A vertical angle with the telescope horizontal (level) and in the normal position is recorded as 90.0000°. A vertical angle with the telescope pointing vertically toward the zenith is recorded as 0.0000°.

The vertical angle data item is source measurement data. That is, it must be specifically entered in the activity to which it applies and is unique to that activity.



Sample Placement in an Activity

The VT: data item may be placed anywhere within an activity.

```
AC:BS
PN:1
PD:8″ SPIKE
HZ:0.0
VT:89.3319
DS:104.312
AC:SS
(etc.)
```

Vertical Angle-Computed - VV:

Synonyms

Computed vertical circle angle, computed zenith angle.

Allowed Responses

Numeric value

Description/Definition

The vertical angle-computed data item (VV:) is used where multiple observations are made of a point from the same occupied station. This data item records the averaged vertical angle.

In the SDMS software this data item is used in the calculated (CAL) project file.

Sample Placement in an Activity

```
AC:SS
PN:233
HH:210.0125
VV:95.0925
DD:37.971
XX:414521.317
YY:542573.745
ZZ:73.657
FE:IP
PD:3/8” Rebar
(etc.)
```

Vector X Component - VX:

Synonyms

Delta X (DX), Change in X.

Allowed Responses

Numeric value of the X component of the processed Global Positioning System (GPS) vector.

Description/Definition

The Vector X Component data item (VX:) defines the X component of a processed GPS vector from the occupied station to the foresight station.

Sample Placement in an Activity

```
AC:FS
PN:BASE
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:13451.012
VY:3468.604
VZ:-265.403
C1:0.00000299
```

```
C2:-0.00000456
C3:0.00000189
C4:0.000002167
C5:-0.00000703
C6:0.00000777
BT:14:54:42 04/24/2004
SO:FIXED
FR:IONO FREE
SV:7
NS:412
IP:P4.3
```

Vector Y Component - VY:

Synonyms

Delta Y (DY), Change in Y.

Allowed Responses

Numeric value of the Y component of the processed Global Positioning System (GPS) vector.

Description/Definition

The Vector Y Component data item (VY:) defines the Y component of a processed GPS vector from the occupied station to the foresigh station.

Sample Placement in an Activity

```
AC:FS
PN:BASE
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:13451.012
VY:3468.604
VZ:-265.403
C1:0.00000299
C2:-0.00000456
C3:0.00000189
C4:0.000002167
C5:-0.00000703
C6:0.00000777
BT:14:54:42 04/24/2004
SO:FIXED
FR:IONO FREE
SV:7
NS:412
IP:P4.3
```

Vector Z Component - VZ:

Synonyms

Delta Z (DZ), Change in Z.

Allowed Responses

Numeric value of the Z component of the processed Global Positioning System (GPS) vector.

Description/Definition

The Vector Z component data item (VZ:) defines the Z component of a processed GPS vector from the occupied station to the foresight station.

Sample Placement in an Activity

```
AC:FS
PN:BASE
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:13451.012
VY:3468.604
VZ:-265.403
C1:0.00000299
C2:-0.00000456
C3:0.00000189
C4:0.000002167
C5:-0.00000703
C6:0.00000777
BT:14:54:42 04/24/2004
SO:FIXED
FR:IONO FREE
SV:7
NS:412
IP:P4.3
```

Three-Wire Stadia Constant - W3:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the three-wire stadia constant

Description/Definition

The three wire level stadia constant data item (W3:) is used to compute distance by stadia. Normally, the W3: data item and response will be displayed in the project header activity (AC:PR) of a project data file.

The constant must be consistent with the rod type (RT:) selected.

Sample Placement in an Activity

The W3: data item may be placed anywhere within an activity before the next activity is started and does affect computations.

```
AC:PR
ID:41663
IT:WILD T1000
SN:8821094
NM:J. JONES
```

```
TE:60
BP:29
W3:333.3333
CR:N
CF:1.00
(etc.)
```

Write Control File Name - WC:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric write control filename

Description/Definition

The write control filename (WC:) data item is a user specified control file used to write control points that have been calculated but not necessarily adjusted.

Normally, the WC: data item and response will be displayed in the project header activity (AC:PR) of a project data file.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
NM:S5111
OB:JDH
RE:JDH
I5:DJS
I6:AMC
WE:CLOUDY
CM:MANSION SURVEY
CR:No
CF:1.000000
UL:M
UA:D
UT:F
UP:I
VR:SDMS Ver# 3.3
L1:SR70106.CTL
S1:SR70106.CTL
WC:SR70106W.CTL
HA:ER70106.ALI
VA:ER70106.PRO
SF:ER70106.SUP
(etc.)
```

Width - WD:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the width

Description/Definition

The width (WD:) data item is used to record the width of a surveyed object, such as a box culvert.

Sample Placement in an Activity

```
PN:10200
FE:CU
FG:326
CL:G
GM:P
HZ:251.5305
VT:89.1852
DS:83.010
WD:48”
HT:48”
LN:40’
TY:BOX
PD:INLET 4X4X40 RC BOX
CN:FAIR, 25% FILLED
(etc.)
```

Weather - WE:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value for the weather conditions

Description/Definition

The weather (WE:) data item is used to record user defined weather condition descriptions.

Sample Placement in an Activity

```
PR:6905_4LQ.PRJ
TK:COM
AC:PR
ID:6905_4
CO:PULASKI
HD:REL
VD:NAVD88
IT:LIETZ_SET
SN:25825
NM:S5111
OB:JDH
```

```
RE:JDH
I5:DJS
I6:AMC
WE:CLOUDY
CM:MANSION SURVEY
CR:No
CF:1.000000
UL:M
UA:D
UT:F
UP:I
VR:SDMS Ver# 3.3
L1:SR70106.CTL
S1:SR70106.CTL
WC:SR70106W.CTL
HA:ER70106.ALI
VA:ER70106.PRO
SF:ER70106.SUP
(etc.)
```

Witness Description - WI:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric value for the witness description

Description/Definition

The witness description (WI:) data item is used to record information about a witness or accessory points.

Sample Placement in an Activity

```
AC:FS
PN:1500
PD:8″ SPIKE
HZ:152.45320.0
VT:89.3319
DS:104.312
WI:RESECT REFERENCE FOR PN:600030
(etc.)
```

Known X Coordinate - XC:

Synonyms

Easting coordinate

Allowed Responses

Numeric value of the known X coordinate.

Description/Definition

The X Coordinate-Known data item (XC:) specifies the known value of the X or Easting coordinate. It is immaterial which coordinate system is used on a project, as long as the entire project is collected and processed on the same coordinate system.

XC: is source data. That is, it must be specifically entered into the activity to which it applies and is unique to that activity.

Sample Placement in an Activity

The XC: data item may be placed anywhere within an activity.

```
AC:OS
PN:2
PD:CONTROL MON
IH:5.2
SH:6.0
YC:1527.85
XC:473128.36
ZC:443
AC:BS
PN:1
(etc.)
```

X Coordinate Standard Error Estimate - XE:

Synonyms

NA

Allowed Responses

Numeric value of the 95% error estimate of the X (Easting) coordinate

Description/Definition

The Standard Error Estimate X Coordinate is used to record the statistical error estimate of the X Coordinate of each point in that file at the 95% confidence interval. The statistical errors in X (and Y) means if you did the same survey over under the same conditions you are 95% confident that the repeatability of that coordinate will be within the range of the coordinate value plus or minus the error estimate. In statistics, the standard error estimate at the 95% confidence interval equals the one-sigma error estimate times the standard error of unit weight times the F statistic multiplier. That is:

XE=(SX)(Standard Error of Unit Weight)(F-statistic multiplier)

This data item will normally be recorded with a point in the Points and Chain (PAC) file. If it is required to use post adjustment standard deviations for any additional least squares analysis, then the SX: data item must also be included. The one sigma error estimate will be considered as "a priori", meaning it is based on the assumption of a very good error estimate model. From this information, f-statistic multiplier can be computed as a constant for use in additional analysis. .

The Standard Error Estimate X Coordinate data item (XE:) is source data. That is, it must be specifically entered with the point to which it applies and is unique to that point

Sample Placement in an Activity

The XE: data item may be placed anywhere within a point attribute list.

PAC File

```
AC:PD
PN:3220
FE:RW
PD:STANDARD ROW MONUMENT
YY:84671.4601
XX:70385.3870
ZZ:1180.839
XE:0.0963
YE:0.0957
ZE:0.0963
SY:0.0960
SX:0.0965
SZ:0.1667
(etc.)
```

Computed X Coordinate - XX:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the computed X (Easting) coordinate

Description/Definition

The X Coordinate-Computed data item (XX:) is used to record the computed X coordinate value for a point.

In the SDMS software this data item is used in the calculated (CAL) project file.

Sample Placement in an Activity

```
PN:1004
PD:NE COR BLDG
HZ:251.5246
VT:88.2942
DS:271.581
SH:6.0
AC:UE
XX:472889.227
YY:1656.383
ZZ:585.279
(etc.)
```

Known Y Coordinate - YC:

Synonyms

Northing coordinate

Allowed Responses

Numeric value of the known Y coordinate.

Description/Definition

The Y Coordinate-Known data item (YC:) specifies the known value of the Y or Northing coordinate. It is immaterial which coordinate system is used on a project, as long as the entire project is collected and processed on the same coordinate system.

YC: is source data. That is, it must be specifically entered into the activity to which it applies and is unique to that activity.

Sample Placement in an Activity

The YC: data item may be placed anywhere within an activity.

```
AC:OS
PN:2
PD:CONTROL MON
IH:5.2
SH:6.0
YC:1527.85
XC:473128.36
ZC:443
AC:BS
PN:1
(etc.)
```

Y Coordinate Standard Error Estimate - YE:

Synonyms

NA

Allowed Responses

Numeric value of the 95% error estimate of the Y (Northing) coordinate

Description/Definition

The Standard Error Estimate Y Coordinate is used to record the statistical error estimate of the Y Coordinate of each point in that file at the 95% confidence interval. The statistical errors in Y (and X) means if you did the same survey over under the same conditions you are 95% confident that the repeatability of that coordinate will be within the range of the coordinate value plus or minus the error estimate. In statistics, the Standard Error Estimate = (one-sigma error estimate)(standard error of unit weight)(F statistic multiplier).

This data item will normally be recorded with a point in the Points and Chain (PAC) file If it is required to use post adjustment standard deviations for any additional least squares analysis, then the SY: data item must also be included.

The Standard Error Estimate Y Coordinate data item (YE:) is source data. That is, it must be specifically entered with the point to which it applies and is unique to that point

Sample Placement in an Activity

The YE: data item may be placed anywhere within a point attribute list.

PAC File

```
AC:PD
PN:3220
FE:RW
PD:STANDARD ROW MONUMENT
```

```
YY:84671.4601
XX:70385.3870
ZZ:1180.839
XE:0.0963
YE:0.0957
ZE:0.0963
SY:0.0960
SX:0.0965
SZ:0.1667
(etc.)
```

Computed Y Coordinate - YY:

Synonyms

Not applicable.

Allowed Responses

Numeric value of the computed Y coordinate

Description/Definition

The Y Coordinate-Computed data item (YY:) is used to record a computed Y coordinate value of a point.

In the SDMS software this data item is used in the calculated (CAL) project file.

Sample Placement in an Activity

```
PN:1004
PD:NE COR BLDG
HZ:251.5246
VT:88.2942
DS:271.581
SH:6.0
AC:UE
XX:472889.227
YY:1656.383
ZZ:585.279
(etc.)
```

Known Z Coordinate - ZC:

Synonyms

Elevation coordinate

Allowed Responses

Numeric value of the known Z coordinate

Description/Definition

The Z Coordinate-Known data item (ZC:) specifies the known value of the Z coordinate or elevation. It is immaterial which coordinate system is used on a project, as long as the entire project is collected and processed on the same coordinate system.

ZC: is source data. That is, it must be specifically entered into the activity to which it applies and is unique to that activity.

Sample Placement in an Activity

The ZC: data item may be placed anywhere within an activity.

```
AC:OS
PN:2
PD:CONTROL MON
IH:5.2
SH:6.0
YC:1527.85
XC:473128.36
ZC:443
AC:BS
PN:1
(etc.)
```

Z Coordinate Standard Error Estimate - ZE:

Synonyms

NA

Allowed Responses

Numeric value of the 95% error estimate of the Z (Elevation) coordinate

Description/Definition

The Standard Error Estimate Z Coordinate is used to record the statistical error estimate of the Z(Elevation) Coordinate of each point in that file at the 95% confidence interval. The statistical errors in Y (and X) means if you did the same survey over under the same conditions you are 95% confident that the repeatability of that coordinate will be within the range of the coordinate value plus or minus the error estimate. In statistics, the Standard Error Estimate = (one-sigma error estimate)(standard error of unit weight)(F statistic multiplier).

This data item will normally be recorded with a point in the Points and Chain (PAC) file. If it is required to use post adjustment standard deviations for any additional least squares analysis, then the SZ: data item must also be included.

The Standard Error Estimate Z Coordinate data item (ZE:) is source data. That is, it must be specifically entered with the point to which it applies and is unique to that point

Sample Placement in an Activity

The ZE: data item may be placed anywhere within a point attribute list.

PAC File

```
AC:PD
PN:3220
FE:RW
PD:STANDARD ROW MONUMENT
YY:84671.4601
XX:70385.3870
ZZ:1180.839
XE:0.0963
YE:0.0957
ZE:0.0963
```

```
SY:0.0960
SX:0.0965
SZ:0.1667
(etc.)
```

Datum Projection Zone - ZN:

Synonyms

Not applicable.

Allowed Responses

User defined alphanumeric name of the coordinate system projection zone

Description/Definition

The Coordinate Projection Zone (ZN:) data tag defines the zone for the horizontal coordinate system being used. The response ZN: is user defined. An examples is ZN:4803 for the Wisconsin State Plane Coordinate System, Southern Zone.

Post processing software can uses the coordinate system zone data item (ZN:) and the horizontal datum data item (HD:) to reduce the project data to state plan grid. Both data items must exist in the project file. If only the ZN: data item is in the project file, it is considered as documentation only and treated as a metadata constant for all activities until it is changed.

Sample Placement in an Activity

The ZN: data item may be placed anywhere within a project file, although it is most appropriately placed in the project header activity.

```
PR:USHWY10
TK:RTO
AC:PR
IT:OMNI01
SN:7224
NM:D.MOZUCH
VD:NGVD27
ZN:0903
TE:50
BP:30
OB:SEZ
RE:DLN
DT:10/15/86
WE:CLOUDY
PM:2.2
(etc.)
```

Z Coordinate-Computed - ZZ:

Synonyms

Computed Elevation

Allowed Responses

Numeric value of the computed elevation

Description/Definition

The Z Coordinate-Computed data item (ZZ:) is used to record a computed Z coordinate value for a point in a calculated (CAL) project file.

Note: Level tasks (TK:LEV, TK:3WR, TK:XSE) calculated files – The ZZ: is used to record elevation of the line of sight of the level when used with the backsight activity (AC:BS). All other activities use ZZ: to record the elevation of the point being measured.

Sample Placement in an Activity

```
PN:1004
PD:NE COR BLDG
HZ:251.5246
VT:88.2942
DS:271.581
SH:6.0
AC:UE
XX:472889.227
YY:1656.383
ZZ:585.279
(etc.)
```

Nested Sequence - //:

Synonyms

Not applicable.

Allowed Responses

Filename of a defined sequence

Description/Definition

The Nested Sequence data item (//:) is used to nest one user-defined sequence inside of another. If //:*file name* is found in a sequence, the sequence in the given file is invoked. Once the nested sequence is completed, the original sequence continues.

Restrictions

Only the two-character combination listed above are permitted in the data structure. Users may not define their own tag.

Sample Placement in A User Defined Sequence

```
AC:OS
PN:
FE:
PD:
AC:BS
PN:
PD:
HZ:
VT:
DS:
AC:SS
PN:100
FE:FENCE
PD:6’ CHAIN LINK
```

```
HZ:
VT:
DS:
//:TREE.SEQ            (The sequence TREE.SEQ will be used(
AC:SS                  (Returns to the sequence originally activated)
PN:500
FE:EP
PD:RIGHT PAVEMENT EDGE
HZ:
VT:
DS:
(etc)
```

Wild Card - --:

Synonyms

Not applicable.

Allowed Responses

No response required

Description/Definition

The Wild Card data item (--:) is presently used in building a user defined sequence to indicate that the standard shot for the current activity should be inserted in place of the (--:).

The --: data item must be placed immediately following the activity data item.

Restrictions

Only the two-character combination listed above is permitted in the data structure. Users may not define their own tag.

Sample Placement in a User Defined Sequence

```
AC:SS
PN:
FE:
PD:
DI:
CO:
HZ:
VT:
DS:
AC:SS
--:            (indicates the standard shot for a sideshot is to be
               used)
AC:SS          (Returns to the sequence originally activated)
PN:
FE:
PD:
DI:
CO:
HZ:
VT:
DS:
(etc.)
```

Section VIII - Data Standard Review and Modification Procedures

Overview

The establishment of a data standard is not a static process. It is expected that the documentation of the standard will change to accommodate new standards as they are adopted. Tasks, activities, data tags, files, and other system components will be added to or modified as needed. The crucial first step will be to establish rules and procedures regarding how these changes are made.

The SDMS Technical Review Task Force

As stated earlier, this document provides the foundation for the SDMS survey data structure. There will be times when the use or definition of an existing data item will need to be expanded, or when new data tags, new activities, and even new tasks may be required in the data structure to keep up with the industry's technical advances.

One of the main functions of the SDMS Task Force is to review, evaluate and implement requests for new or expanded uses and definitions.

How to Make Changes to the SDMS Data Structure

It is important that users do not autonomously add or delete data tags, activities or tasks, or change the established uses and definitions. Users wishing to make changes to the data structure must submit a written request to the SDMS Task Force documenting:

- the reason for the change
- the technical use and definition of the change
- how the change will fit in with the overall data structure

The SDMS Task Force will review the proposed changes annually and will publish those which will be included. Should a request be rejected, a written explanation or suggested workaround will be provided to the person requesting the change.

Appendix

SDMS Tasks

SDMS classifies tasks as horizontal, vertical, or computational. The following table shows each task with its data item and definition.

SDMS Task Name	Name and Description
TK:3WR	Three Wire Level – Used for a three wire leveling run
TK:CTM	Compute Template – Used to input design cross section template for computations. RESERVED.
TK:COM	Combined – Traverse and Radial Topography, used to combine one or more single thread traverses (with sideshots) and radial topography measurements in one project.
TK:CON	Control Network – Used to establish a control network of traverses. This allows least squares adjustment of the traverses by the post-processing software. Sideshots are not allowed.
TK:CHA	Compute Horizontal Alignment – Used to compute a horizontal alignment (HA. RESERVED.
TK:CVA	Compute Vertical Alignment – Used to compute a vertical alignment (VA:). RESERVED.
TK:GPS	GPS – Used to store processed GPS Vectors and related information.
TK:LEV	Level Run - Used for a single wire level run.
TK:LTO	Line/Offset Topography – Used to record topography, cross section, and break line data from a baseline or horizontal alignment using a tape, level, and level rod. Basically, it is a Cross Section Task (TK:XSE) that allows the user to include descriptive and connectivity activities and data tags. A horizontal alignment (PI Definition) must be defined and named in control configuration when this task is used. The named alignment file must be available with the project file for post processing. RESERVED.
TK:PHO	Photogrammetry Control – Used to establish photo control points.
TK:PRO	Profile – Used to measure points along a profile.
TK:RTO	Radial Topography – Used for radial topography measurements, both for data collection and stakeout.
TK:TMO	Terrain Model – Used for Terrain Model measurements.

SDMS Task Name	Name and Description
TK:TRA	Traverse – Also used for control networks. Used for one or more single thread traverses. Sideshots are not allowed.
TK:XSE	Cross Section – Used for cross section measurements observed with a level.

SDMS Activities

The following table shows each activity with it data item and definition.

SDMS Activity	Name and Description
AC:BA	Begin Alignment – Used with the compute horizontal alignment task (TK:CHA) and compute vertical alignment task (TK:CVA) to indicate where to start computations of an alignment.
AC:BS	Back Sight – Used to measure a backsight shot to a defined point
AC:CA	Continue Alignment – Used with the compute horizontal alignment task (TK:CHA) and compute vertical alignment task (TK:CVA) to indicate additional alignment segments are included for computations and will be related to the SI: for that segment (PC, PT, PRC, PCC, SC, CS, ST, PI, POT, etc.). RESERVED.
AC:CC	Control Check – Used to shoot from the current station to a point with known X,Y,Z coordinates as a check on the current position and elevation.
AC:CE	Collimation Error – Used to record measurements required to compute the instrument collimation error. RESERVED.
AC:CH	Chain List – Used to define a chain by listing previously defined points and chains, regardless of connectivity methods used.
AC:CK	Check Mode – Used to suspend prompted operations to allow the user to work interactively with SDMS, then continue the operation.
AC:EC	Elevation Control – Used with tasks that use an electronic total station instrument to shoot from the current occupied station to a point with known elevation to compute the elevation of the current occupied station.
AC:EQ	Equation – Used to define a station equation in an alignment file. Station equations are shown in a list and must be placed at the beginning of the alignment file, after the project header (AC:PR) and before the initial PI point.
AC:FG	Figure – Used to record critical points from which standard figures (such as an inlet) can be extrapolated.
AC:FS	Foresight – Used to make a foresight shot from the current station.
AC:OS	Occupied Station – Used to set up the instrument on a known or previously measured point.
AC:PD	Point Description – Used in the Points and Chain file to define a point and its attributes.
AC:PR	Project Header – Used to define the project name, the task, and global settings for a project.
AC:RS	Ring Shot – Used to record shot data related to a tunnel survey. RESERVED.
AC:SS	Sideshot – Used to make a sideshot from the current station.
AC:SI	Sideshot Intersect – Used to measure a horizontal angle from the current station to a sideshot point. A sideshot intersect to the same point from at

SDMS Activity	Name and Description
	least two different stations will allow the sideshot point coordinates to be computed.
AC:SR	Station Resection – Used to measure distances and angles from the current station to points with known coordinates. Resection measurements from an occupied station to two or more different known points will allow the occupied station coordinates to be computed.
AC:ST	Stationing – Used to define a station on a baseline or alignment for cross sectioning.
AC:TA	Taping – Used to collect taped measurements along figures to define a chain.
AC:TP	Turn Point – Used for a turning point (foresight) in the level or 3-wire level task.
AC:TS	Tie Sequence – Can be used to reference a control points.
AC:TX	Place Text – Used to define a text block which allows multi-line comments or point descriptions.
AC:UE	Utility Elevation – Used to measure an elevation for an object, directly above or below the level of the sideshot.

List of Defined Data Tags Sorted By Data Tag

Data Tag	Tag Name
++:*	Blank Fill
--:	Standard Shot
//:	Nested Sequence
_E:*	Superelevation Rate
A0:	Attribute 0
A1:	Attribute 1
A2:	Attribute 2
A3:	Attribute 3
A4:	Attribute 4
A5:	Attribute 5
A6:	Attribute 6
A7:	Attribute 7
A8:	Attribute 8
A9:	Attribute 9
AA:	Area-Computed
AC:	Activity
AD:	Angle Distance List
AD: (config)	Auto Date/Time Stamp
AH:	Accuracy Horizontal
AR:	Area
AS: (config)	Auto Save
AT:	Antenna Type
AV:	Accuracy Vertical

Data Tag	Tag Name
AZ:	Azimuth
B1: (config)	Baud Rate
BG:	Begin Group
BN:*	Base Number
BP:	Barometric Pressure
BR:	Bearing
BS:	Back Sight Point Number
BT:	Begin Time
C1:	Variance X
C2:	Covariance XY
C3:	Covariance XZ
C4:	Variance Y
C5:	Covariance YZ
C6:	Variance Z
CA:	Convergence Angle
CD:	Chain Description
CD: (config)	Communication Device
CE:	Collimation Error
CF:	Combination Factor
CH:	Chain Number
CI:	City
CL:	Class
CM:	Comment
CN:	Condition
CO:	County
CP:	Close Project
CR:	Curvature and Refraction
CS:	Coordinate System
D1: (config)	Data Bits
DA:	Deflection Angle
DC:	Degree of Curvature
DD:	Distance-Computed
DH:	Distance Horizontal
DI:	Diameter
DL:	Delete Shot/Station
DO:	Direction of Offset
DP:	Depth
DP: (config)	Data Path
DS:	Distance Slope
DS: (config)	Distance Tolerance Sets
DT:	Date

Data Tag	Tag Name
DT: (config)	Date Stamp
DV:	Distance Vertical
DX:	Delta X
DY:	Delta Y
DZ:	Delta Z
E1:	Left Side Slope
E2:	Right Side Slope
ED:	Error Distance
EF:	Elevation (Sea Level) Factor
EG:	End Group
EH:	Error Horizontal Angle
EQ:	Equation Number
ER: (config)	Error Radial Topography Radius
ES:	Ending Station
ET:	End Time
EV:	Error Vertical Angle
EX:	External Distance Horizontal Curve
FC:	Face Number
FE:	Feature Code
FG:	Figure Code
FM:	F-Statistic Multiplier
FP: (config)	Format Path
FR:	Frequency
G1:*	Grade 1
G2:*	Grade 2
GD:	Geoid Model
GM:	Geometry Type
GR:	Group
H1:	Help
HA:	Horizontal Alignment File Name
HA: (config)	Horizontal Angle Set Difference
HD:	Horizontal Datum
HE:	Height Ellipsoid
HG:	Height Geoid
HH:	Horizontal Angle-Computed
HO:*	Horizontal Offset
HT:	Height
HY:	Highway
HZ:	Horizontal Angle
I0:	Information 0
I1:	Information 1

Data Tag	Tag Name
I2:	Information 2
I3:	Information 3
I4:	Information 4
I5:	Information 5
I6:	Information 6
I7:	Information 7
I8:	Information 8
I9:	Information 9
ID:	Project Identification
IH:	Instrument Height
IP:	Indicator of Precision
IT:	Instrument Type
L1: (Config)	Location 1 Control File Name
L1:	Length First Curve
L2: (Config)	Location 2 Control File Name
L2:	Length Second Curve
LC:	Long Chord
LG:	Longitude
LN:	Length
LO:	Length Offset
LP: (config)	Log to Printer
LS:*	Length of Spiral
LT:	Latitude
MM: (config)	Memory Cache
MO:	Mid Ordinate Circular Curve
MP: (config)	Macro Pause
MS:	Map Scale
MS: (config)	Multi-Stub
NC:*	Normal Crown
NM:	Name
NS:	Number of Shots
NS: (config)	New Project Sequence
OA: (config)	Overwrite/Append
OB:	Observer
OD:	Origin/Destination Point Number
OF:	Offset
OO:	Offset-Computed
OP: (config)	Overwrite Protection
OS:	Occupied Station Point Number
OS: (config)	Old Project Sequence
OW:	Owner

Data Tag	Tag Name
P1: (config)	Parity
PC:	Prism Correction
PD:	Point Description
PD: (config)	Print Device
PF: (config)	Print Footer
PG:*	Profile Grade
PG: (config)	Page Numbering
PH:	Physical Characteristic
PH: (config)	Print Header
PL:	Point List
PL: (config)	Page Length
PM:	PPM Factor
PN:	Point Number
PO:	Prism Offset
PR:	Project Name
PP: (config)	Project Path
PR: (config)	Protocol
PW: (config)	Page Width
QP: (config)	Sequence Path
R1:(TK:3WR)	Rod Reading-Top Wire
R1:	Radius-First Curve
R2:(TK:3WR)	Rod Reading-Middle Wire
R2:	Radius-Second Curve
R3:(TK:3WR)	Rod Reading-Bottom Wire
RA:	Radius
RA: (config)	Reciprocal Angle Difference
RD:	Ring Description
RE:	Recorder
RN:	Ring Number
RO:	Right Angle Offset
RP:*	Ratio
RP: (config)	Removal Protection
RP: *	Ratio of Precision
RR:	Rod Reading
RS:	Ring Style
RT:	Rod Type
RT: (config)	Resection Tolerance
RU:*	Runoff Superelevation
RV:*	Revolve Superelevation
S1: (config)	Stop Bit Length
S1: (config)	Staking 1 Control File Name

Data Tag	Tag Name
S1:	Entry Spiral Length
S2: (config)	Staking 2 Control File Name
S2:	Exit Spiral Length
S3:	Connecting Spiral Length
SB:	Station Back
SD:	Station Direction
SD: (config)	Nominal Station Deviation
SE:	Set Number
SF:	Scale Factor
SF: (config)	Superelevation File Name
SH:	Staff Height
SI:	Shot Identification
SL:*	Superelevation Transition Length
SN:	Serial Number
SO:	Solution Type
SP:	Suspend Project
SP: (config)	Screen Pause
SR:	Scale Ratio
SS:	Stationing-Computed
ST:	Stationing
ST: (config)	Three Wire Stadia Tolerance
SV:	Minimum Number of Satellites
SX:	X Coordinate One-Sigma Error Estimate
SY:	Y Coordinate One-Sigma Error Estimate
SZ:	Z Coordinate One-Sigma Error Estimate
T1:*	Tangent One
T2:*	Tangent Two
TA: (config)	Traverse Horizontal Angle Closure
TC:*	Tangent Curve
TD:	Tunnel Direction
TE:	Temperature
TE: (config)	Traverse Elevation Closure
TI:	Tunnel Identification
TK:	Task
TL:	Tangent Length
TM:	Time
TN:	Traverse Number
TP: (config)	Temporary Path
TR:*	Tangent Runout
TS: (config)	Time Stamp
TT: (config)	Maximum Stations Traverse

Data Tag	Tag Name
TV:	Vector Type
TY:	Type
UA:	Units of Angles
UL:	Units of Length
UP:	Units of Pressure
UT:	Units of Temperature
VA: (config)	Vertical Alignment Control File Name
VA: (config)	Vertical Angle Sets Difference
VC:*	Vertical Offset Normal Crown
VD:	Vertical Datum
VE:	Vertical Index Error
VH:	Vertical/Horizontal Ratio
VI: (config)	Vertical Intersect Tolerance
VO:	Vertical Offset
VR:	Version Number
VT:	Vertical Angle
VT: (config)	Maximum Vertical Stations
VV:	Vertical Angle-Computed
VX:	Vector X Component
VY:	Vector Y Component
VZ:	Vector Z Component
W3: (config)	Three-Wire Stadia Constant
W3: (config)	Three Wire Level Closure
WC: (config)	Write Control Filename
WD:	Width
WE:	Weather
WI:	Witness Description
XC:	X Coordinate-Known
XC: (config)	Cross Section Closure Tolerance
XE:	X Coordinate Standard Error Estimate
XX:	X Coordinate-Computed
YC:	Y Coordinate-Known
YE:	Y Coordinate Standard Error Estimate
YY:	Y Coordinate-Computed
ZC:	Z Coordinate-Known
ZE:	Z Coordinate Standard Error Estiamte
ZN:	Datum Projection Zone
ZZ:	Z Coordinate-Computed

Note: * = Reserved Data Tag

List of Defined Data Tags Sorted By Tag Name

Tag Name	Data Tag
Accuracy Horizontal	AH:
Accuracy Vertical	AV:
Activity	AC:
Angle Distance List	AD:
Antenna Type	AT:
Area	AR:
Area-Computed	AA:
Attribute 0	A0:
Attribute 1	A1:
Attribute 2	A2:
Attribute 3	A3:
Attribute 4	A4:
Attribute 5	A5:
Attribute 6	A6:
Attribute 7	A7:
Attribute 8	A8:
Attribute 9	A9:
Auto Date/Time Stamp	AD: (config)
Auto Save	AS: (config)
Azimuth	AZ:
Back Sight Point Number	BS:
Barometric Pressure	BP:
Base Number	BN:*
Baud Rate	B1: (config)
Bearing	BR:
Begin Group	BG:
Begin Time	BT:
Blank Fill	++:*
Chain Description	CD:
Chain Number	CH:
City	CI:
Class	CL:
Close Project	CP:
Collimation Error	CE:
Combination Factor	CF:
Comment	CM:
Communication Device	CD: (config)
Condition	CN:
Connecting Spiral Length	S3:

Tag Name	Data Tag
Convergence Angle	CA:
Coordinate System	CS:
County	CO:
Covariance XY	C2:
Covariance XZ	C3:
Covariance YZ	C5:
Cross Section Closure Tolerance	XC: (config)
Curvature and Refraction	CR:
Data Bits	D1: (config)
Data Path	DP: (config)
Date	DT:
Date Stamp	DT: (config)
Datum Projection Zone	ZN:
Deflection Angle	DA:
Degree of Curvature	DC:
Delete Shot/Station	DL:
Delta X	DX:
Delta Y	DY:
Delta Z	DZ:
Depth	DP:
Diameter	DI:
Direction of Offset	DO:
Distance-Computed	DD:
Distance Horizontal	DH:
Distance Slope	DS:
Distance Tolerance Sets	DS: (config)
Distance Vertical	DV:
Elevation (Sea Level) Factor	EF:
End Group	EG:
End Time	ET:
Ending Station	ES:
Entry Spiral Length	S1:
Equation Number	EQ:
Error Distance	ED:
Error Horizontal Angle	EH:
Error Radial Topography Radius	ER: (config)
Error Vertical Angle	EV:
Exit Spiral Length	S2:
External Distance Horizontal Curve	EX:
Face Number	FC:
Feature Code	FE:

Tag Name	Data Tag
Figure Code	FG:
F-Statistic Multiplier	FM:
Format Path	FP: (config)
Frequency	FR:
Geoid Model	GD:
Geometry Type	GM:
Grade 1	G1:*
Grade 2	G2:*
Group	GR:
Height	HT:
Height Ellipsoid	HE:
Height Geoid	HG:
Help	H1:
Highway	HY:
Horizontal Alignment File Name	HA:
Horizontal Angle	HZ:
Horizontal Angle-Computed	HH:
Horizontal Angle Set Difference	HA: (config)
Horizontal Datum	HD:
Horizontal Offset	HO:*
Indicator of Precision	IP:
Information 0	I0:
Information 1	I1:
Information 2	I2:
Information 3	I3:
Information 4	I4:
Information 5	I5:
Information 6	I6:
Information 7	I7:
Information 8	I8:
Information 9	I9:
Instrument Height	IH:
Instrument Type	IT:
Latitude	LT:
Left Side Slope	E1:
Length	LN:
Length First Curve	L1:
Length Offset	LO:
Length of Spiral	LS:*
Length Second Curve	L2:
Location 1 Control File Name	L1: (Config)

Tag Name	Data Tag
Location 2 Control File Name	L2: (Config)
Log to Printer	LP: (config)
Long Chord	LC:
Longitude	LG:
Macro Pause	MP: (config)
Map Scale	MS:
Maximum Stations Traverse	TT: (config)
Maximum Vertical Stations	VT: (config)
Memory Cache	MM: (config)
Mid Ordinate Circular Curve	MO:
Minimum Number of Satellites	SV:
Multi-Stub	MS: (config)
Name	NM:
Nested Sequence	//:
New Project Sequence	NS: (config)
Nominal Station Deviation	SD: (config)
Normal Crown	NC:*
Number of Shots	NS:
Observer	OB:
Occupied Station Point Number	OS:
Offset	OF:
Offset-Computed	OO:
Old Project Sequence	OS: (config)
Origin/Destination Point Number	OD:
Owner	OW:
Overwrite/Append	OA: (config)
Overwrite Protection	OP: (config)
Page Length	PL: (config)
Page Numbering	PG: (config)
Page Width	PW: (config)
Parity	P1: (config)
Physical Characteristic	PH:
Point Description	PD:
Point List	PL:
Point Number	PN:
PPM Factor	PM:
Print Device	PD: (config)
Print Footer	PF: (config)
Print Header	PH: (config)
Prism Correction	PC:
Prism Offset	PO:

Tag Name	Data Tag
Profile Grade	PG:*
Project Identification	ID:
Project Name	PR:
Project Path	PP: (config)
Protocol	PR: (config)
Radius	RA:
Radius-First Curve	R1:
Radius-Second Curve	R2:
Ratio	RP:*
Ratio of Precision	RP: *
Recorder	RE:
Reciprocal Angle Difference	RA: (config)
Removal Protection	RP: (config)
Resection Tolerance	RT: (config)
Revolve Superelevation	RV:*
Right Angle Offset	RO:
Right Side Slope	E2:
Ring Description	RD:
Ring Number	RN:
Ring Style	RS:
Rod Reading	RR:
Rod Reading-Bottom Wire	R3:(TK:3WR)
Rod Reading-Middle Wire	R2:(TK:3WR)
Rod Reading-Top Wire	R1:(TK:3WR)
Rod Type	RT:
Runoff Superelevation	RU:*
Scale Factor	SF:
Scale Ratio	SR:
Screen Pause	SP: (config)
Sequence Path	QP: (config)
Serial Number	SN:
Set Number	SE:
Shot Identification	SI:
Solution Type	SO:
Staff Height	SH:
Staking 1 Control File Name	S1: (config)
Staking 2 Control File Name	S2: (config)
Standard Shot	--:
Station Back	SB:
Station Direction	SD:
Stationing	ST:

Tag Name	Data Tag
Stationing-Computed	SS:
Stop Bit Length	S1: (config)
Superelevation File Name	SF: (config)
Superelevation Rate	_E:*
Superelevation Transition Length	SL:*
Suspend Project	SP:
Tangent Curve	TC:*
Tangent Length	TL:
Tangent One	T1:*
Tangent Runout	TR:*
Tangent Two	T2:*
Task	TK:
Temperature	TE:
Temporary Path	TP: (config)
Three Wire Level Closure	W3: (config)
Three-Wire Stadia Constant	W3: (config)
Three Wire Stadia Tolerance	ST: (config)
Time	TM:
Time Stamp	TS: (config)
Traverse Elevation Closure	TE: (config)
Traverse Horizontal Angle Closure	TA: (config)
Traverse Number	TN:
Tunnel Direction	TD:
Tunnel Identification	TI:
Type	TY:
Units of Angles	UA:
Units of Length	UL:
Units of Pressure	UP:
Units of Temperature	UT:
Variance X	C1:
Variance Y	C4:
Variance Z	C6:
Vector Type	TV:
Vector X Component	VX:
Vector Y Component	VY:
Vector Z Component	VZ:
Vertical Alignment Control File Name	VA: (config)
Vertical Angle	VT:
Vertical Angle-Computed	VV:
Vertical Angle Sets Difference	VA: (config)
Vertical Datum	VD:

Tag Name	Data Tag
Vertical/Horizontal Ratio	VH:
Vertical Index Error	VE:
Vertical Intersect Tolerance	VI: (config)
Version Number	VR:
Vertical Offset	VO:
Vertical Offset Normal Crown	VC:*
Weather	WE:
Width	WD:
Witness Description	WI:
Write Control Filename	WC: (config)
X Coordinate-Computed	XX:
X Coordinate-Known	XC:
X Coordinate One-Sigma Error Estimate	SX:
X Coordinate Standard Error Estimate	XE:
Y Coordinate-Computed	YY:
Y Coordinate-Known	YC:
Y Coordinate One-Sigma Error Estimate	SY:
Y Coordinate Standard Error Estimate	YE:
Z Coordinate-Computed	ZZ:
Z Coordinate-Known	ZC:
Z Coordinate One-Sigma Error Estimate	SZ:
Z Coordinate Standard Error Estiamte	ZE:

Note: * = Reserved Data Tag

SDMS Data Tags Used To Configure The AASHTOWare SDMS Collector Software

Data Tag	Description
AD:(config)	Auto Date/Time Stamp – Used in the SYS.CFG file to designate when or if to automatically date and time stamp the project file. Responses include OFF, PROJ (in project header only), STAT (at each OS activity), and SHOT (at each activity).
AS:(config)	Auto Save – Used in the SYS.CFG file to indicate whether or not to save files automatically. Yes indicates that files will be automatically saved. No indicates that the user will prompted whether or not to save files.
B1:(config)	Baud Rate – Used in the IO.CFG file to designate the communications device baud rate (B1:9600 = 9600 baud). Does not apply to the measuring device.
CD:(config)	Communication Device – Used in the IO.CFG file to designate the name of the serial communications device port (COM1, COM2 etc.)
D1:(config)	Data Character Length – Used in the IO.CFG file to designate the serial communications character length in data bits (7 or 8).

Data Tag	Description
DP:(config)	Data Path – Used in the IO.CFG file to designate the default directory path for SDMS project files.
DS:(config)	Distance Tolerance Sets – Used in the TOL.CFG file to specify the standard deviation of a measured distance from the mean.
DT:(config)	Date Stamp – Used in the IO.CFG file to indicate whether or not to stamp the date on each page of SDMS reports and printouts. Responses are Yes or No.
ER:(config)	Error Radial Topography Radius – Used in the TOL.CFG file to define the radial topography error radius tolerance value.
FP:(config)	Format Path – Used in the IO.CFG file to designate the default directory path for predefined output formats.
HA:(config)	Horizontal Angle Set Difference – Used in TOL.CFG to set the tolerance allowed between an individual horizontal angle measured in sets and the mean horizontal angle computed from the sets. Horizontal angles that exceed the difference will be omitted from final computations
L1:(config)	Location 1 Control File – Used in CNTL.CFG to indicate the name of the primary control point file. By default, referenced control points are searched for in this file first, and in the Location 2 file second.
L2:(config)	Location 2 Control File – Used in CNTL.CFG to indicate the name of the secondary control point file.
LP:(config)	Log to Printer – Used in the SYS.CFG file to indicate if any screen reports are to be logged to the printer automatically. The options are Yes or No.
MM:(config)	Memory Cache – Used in the PROJECT.CFG file to designate the amount of hard disk space below which the user is warned.
MP:(config)	Macro Pause – Used in the SYS.CFG file to designate the step delay time for macro execution in 1/18th second increments (MP:2 designates 2/18th seconds pause time).
MS:(config)	Multi-Stub – Used in the TOL.CFG file to define the error radius allowed on multi-stub intersections.
NS:(config)	New Project Sequence – Used in the PROJECT.CFG file to designate the name of the sequence file to execute when starting a new project.
OA:(config)	Overwrite/Append – Used in the SYS.CFG file. “O” indicates that current data overwrites existing files, and “A” indicates that current data is appended to existing files.
OP:(config)	Overwrite Protection – Used in the SYS.CFG file to designate overwrite protection is on or off. YES indicates files may not be overwritten.
OS:(config)	Old Project Sequence – Used in the PROJECT.CFG file to designate the name of the sequence file to execute when starting SDMS to continue with an existing project.
P1:(config)	Parity – Used in the IO.CFG file to designate the type of parity used for serial communications (NONE, ODD, or EVEN).
PD:(config)	Print Device – Used in the IO.CFG file to designate the name of the printer device port (LPT1, LPT2, COM1, COM2, or CON).
PF:(config)	Print Footer – Used in the IO.CFG file to define a line of text to be used as a footer in SDMS reports and printouts.
PG:(config)	Page Numbering – Used in the IO.CFG file to indicate whether or not to number pages in SDMS reports and printouts. Responses are Yes or No
PH:(config)	Print Header – Used in the IO.CFG file to define a line of text to be used as a header in SDMS reports and printouts.

Data Tag	Description
PL:(config)	Page Length – Used in the IO.CFG file to designate the number of lines per page for SDMS reports and printouts.
PP:(config)	Project Path – Used in the IO.CFG file to designate the default directory path for creating and editing projects.
PR:(config)	Protocol – Used in the IO.CFG file to designate the communications protocol (NONE or XON/XOFF).
PW:(config)	Page Width – Used in the IO.CFG file to designate the width of the page in characters for SDMS reports and printouts. Defaults to PW:40 for screen output, and PW:80 for printer output. SDMS assumes that a constant width character font is being used.
QP:(config)	Sequence Path – Used in the IO.CFG file to designate the default path for finding sequence files.
RA:(config)	Reciprocal Angle Difference Tolerance – Used to define the reciprocal vertical angle closure tolerance value. Usually used in the tolerance configuration for a traverse task to specify how far a shot in the double reciprocal angle calculation may be out of tolerance. When the tolerance is exceeded, the error is reported and the shot that caused the error would be discarded. Then the double reciprocal angle is recalculated. RESERVED.
RP:(config)	Removal Protection – Used in the SYS.CFG file to indicate whether the removal protection is on. YES indicates files may not be deleted.
RP:(config)	Ratio of Precision – Used in the TOL.CFG file to define the position closure tolerance in traverses. A warning is issued if the computed closure is worse.
RT:(config)	Resection Tolerance – Used in the TOL.CFG file to define the resection tolerance value in UL.
S1:(config)	Stop Bit Length – Used in the IO.CFG file to designate the number of stop bits for serial communications (1 or 2). Staking 1 Control File – Used in the CNTL.CFG file to indicate the name of the primary staking point file. This file defines coordinates for points to be staked out in the field.
S2:(config)	Staking 2 Control File – Used in the CNTL.CFG file to indicate the name of the secondary staking point file.
SD:(config)	Nominal Station Deviation – Used in the TOL.CFG file to define the station deviation tolerance value.
SF:(config)	Superelevation File Name – Used in CNTL.CFG to specify the name of the file where the cross slopes for the sub-grade or pavement based on the horizontal alignment specified are defined.
SP:(config)	Screen Pause – Used in the IO.CFG file to designate the amount of time for pausing the screen display for scrolling screen reports in 1/18th second increments (SP:2 = 2/18th sec. pause).
ST:(config)	Three Wire Stadia Tolerance – Used in the TOL.CFG file to designate the 3 write stadia difference tolerance.
TA:(config)	Traverse Horizontal Angle Closure – Used in the TOL.CFG file to define the angular closure error tolerance value.
TE:(config)	Traverse Elevation Closure – Used in the TOL.CFG file to define the traverse elevation closure tolerance value.
TP:(config)	Temporary Path – Used in the IO.CFG file to designate the default directory path for temporary files.
TS:(config)	Time Stamp – Used in the IO.CFG file, to indicate whether or not to time stamp each page for SDMS reports and printouts. Responses are YES or

Data Tag	Description
	NO.
TT:(config)	Maximum Stations Traverse – Used in the TOL.CFG file to set the maximum number of occupied stations allowed in a traverse.
VA:(config)	Vertical Angle Sets Difference – Used in the TOL.CFG file to set the maximum deviation allowed between and individual vertical angle measured in sets and the mean vertical angle computed form sets. Vertical angles that exceed the difference will not be used in final computations
VI:(config)	Vertical Intersects Tolerance – Used in the TOL.CFG file to define the tolerance allowed when comparing computed elevations for a point shot from various occupied stations during a sideshot intersection activity (AC:SI).
VT:(config)	Maximum Vertical Stations – Used in the TOL.CFG file to define the maximum number of occupied stations that can be recorded in a vertical task between two Bench Marks.
W1:(config)	Single Wire Level Closure – Used in the TOL.CFG file to define the single wire leveling closure tolerance.
W3:(config)	Three Wire Stadia Constant – Used in the PROJECT.CFG to record the Three Wire stadia constant value. This value should be consistent with the selected rod type (RT). Three Wire Level Closure – Used in the TOL.CFG file to indicate the allowable closure error allowed between Bench Marks.
XC:(config)	Cross Section Closure Tolerance – Used in the TOL.CFG file to define the profile and cross section closure tolerance value.

SDMS Data Tags Reserved for Future Use

Data Tag	Name and Description
++:	Blank fill
_E:	Superelevation Rate – Used with TK:CHA and TK:CTM file to define the maximum super elevation rate for a specific curve expressed as m/m (metric) ft/ft (English), or as a decimal equivalent. The units (metric or feet) will be those stored in the Project file.
BN:	Base Number – Used to set the constant that is to be added algebraically to an existing numeric value to define the numeric value that will be used for a point generated when processing a project file.
FP:(config)	Format path – Used in IO.CFG to tell SDMS Collector where to store and recall file format definitions to reformat files to the SDMS format. The path entered here is used as a default only, and is suggested by SDMS Collector whenever the user makes a file selection for third-party files. This default may be overridden or changed anytime.
G1:	Grade 1 – Used with TK:CVA to define the percent grade, expressed as a percentage (±), of the tangent between the vertical point of curvature (VPC) and the vertical point of intersection (VPI).
G2:	Grade 2 – Used with TK:CVA to define the percent grade, expressed as a percentage (±), of the tangent between the vertical point of intersection (VPI) and the vertical point of tangent (VPT).
HO:	Horizontal Offset – Used in 3D stake out to indicate the poition left or right of a known point that is to be computed for stake out.
LS:	Length of Spiral – Used to specify the length of a spiral in the PC/PT

Data Tag	Name and Description
	defined horizontal alignment file.
NC:	Normal Crown – Used with TK:CHA and TK:CTM to define the normal crown slope expressed as meter/meter, feet/feet, or as a percentage expressed as the decimal equivalent. The units will be based on that stored in the Project file (F, M, M1, M3).
PG:	Profile Grade – Used with TK:CHA, TK:CVA, and TK:CTM to define the profile grade at a specified point along the alignment. The profile grade becomes the theoretical centerline when the superelevation is rotated about the left or the right pavement edge.
RP:	Ratio – Used to record the scale of an object or the precision of a point.
RU:	Superelevation Runoff – Used with TK:CHA and TK:CTM to define the length of highway needed to accomplish the change in cross slope from a section with adverse crown removed to a fully superelevated section, or vice versa. This length will normally correspond to the value specified in *A Policy on Geometric Design of Highways and Streets*, by AASHTO.
RV:	Revolve Super – Used with TK:CHA and TK:CTM to define the method to be used for attaining maximimum superelevation, based on the direction of station, by revolving about: CLC=Centerline, crowned section; IEC=Inside edge, crowned section; IES=Inside edge, straight slope; OEC=Outside edge, crowned section; OES=Outside edge, straight slope. For Non Divided Highways, the inside edge is defined in the direction of stationing as the edge toward the CC of a curve. For example a roadway with stations increasing from West to East, the right side of the road surface will be the inside edge for a curve to the right. Traveling in the same direction, a curve to the left would have the inside edge to the left edge, toward the CC of that curve. For Divided Highways, the inside edge is defined in the direction of stationing as the edge of the traveled surface nearest the centerline of median without regard to the curve direction. The profile grade and rotation for superelevation is always at this point.
SL:	Superelevation Transition Length – Used with TK:CHA to define the length of superelevation transition and is equal to the Runout plus the Runoff (TR + RU). The value for the superelevation transition length into a curve and out of the same curve do not have to be equal.
T1:	Tangent One – Used with TK:CHA and horizontal alignments with transition spirals to indicate the long tangent length of a spiral curve in and out.
T2:	Tangent Two – Used with TK:CHA and horizontal alignments with transition spirals to indicate the short tangent length of a spiral in and out.
TC:	Tangent Curve – Used with horizontal alignments with transition spirals to indicate the tangent length of the circular curve portion.
TR:	Tangent Runout POB/POE* - Used with a TK:CHA to define the distance back of the PC (circular curve) or TS (transition spiral) to begin the runout, or the distance ahead of the PT or ST to end the runout of a superelevated curve. The distance is normally expressed as a proportion of the superelevation length SL (Runout + Runoff. For example., TR:0.667(2/3SL,); TR:0.75 (3/4SL); TR:0.5(1/2SL). The beginning and ending point for runout will vary from state to state based on their design criteria. * POB – Point of Beginning; POE – End Point. **Note:** Runout is defined in *A Policy on Geometric Design of Highways and Streets*, by AASHTO, as the length of highway needed to accomplish the change in cross slope from a normal section to a section with the adverse slope removed, or vice versa.

Data Tag	Name and Description
VC:	Vertical Offset Normal Crown – Used with TK:CHA and TK:CVA to define the vertical offset computed for a normal crowned section with a specified width of surface VC=(WS/2)(NC)
VS:	Vertical Offset Superelevation Section - Used TK:CHA and TK:CVA to define the vertical offset computed in the transition section (SL) of a superelevated section at any point in the transition. VS=±((L)(WS/2)(SR))/(SL)
WS:	Width Surface – Used with TK:CHA and TK:CVA to define the total width of surface for which the superelevation will be computed.

Sample SDMS Files

The Combined Task (TK:COM) Sample SDMS Project File

```
PR:P89123
TK:COM
AC:PR
ID:HWY 136
IT:GEO440
SN:76428
NM:PROJECT 89-123
TE:28
BP:29.3
OB:K ADAMS
RE:K ADAMS
DT:06/14/1999
WE:CLEAR
CR:Y
CF:1
UL:F
UA:D
UT:F
UP:I
VR:SDMS Collector 3.4.0
AC:OS
PD:TRAV PT SAMSON
PN:2
IH:5.25
SH:6
YC:5580.962
XC:5221.601
AC:BS
PN:1
PD:TRAV POINT DAVID
HZ:34.2514
VT:89.0501
DS:734.048
YC:6258.469
XC:4939.307
AC:SS
PN:100
PD:R/W MON B-26
HZ:96.1640
VT:88.5242
DS:546.797
AC:SS
PN:101
PD:R/W MON B-45
HZ:228.3749
VT:87.5846
```

```
DS:531.080
AC:SI
PN:102
PD:WDGY TOWER
HZ:82.1353
VT:86.5559
AC:FS
PN:3
PD:TRAV PT
HZ:134.5308
VT:90.5813
DS:1126.370
AC:OS
PN:3
IH:5.40
SH:6
AC:BS
PN:2
HZ:24.5604
VT:88.5748
DS:1126.370
AC:EC
PN:103
PD:BM 2356-1
HZ:59.1705
VT:88.5333
DS:381.168
ZC:899.31
AC:SS
PN:104
PD:IP SW COR LOT44 BLK12
HZ:134.0738
VT:87.2455
DS:230.603
AC:SS
PN:105
PD:R/W MON B-27
HZ:171.2949
VT:86.2818
DS:676.971
CM:MULTI-STUB
CM:TO PT 105
AC:SS
PN:106
HZ:230.5505
VT:88.5542
DS:566.994
AC:SS
PN:107
HZ:308.0349
VT:87.1111
DS:415.505
AC:FS
PN:4
PD:TRAV PT JOSHUA
HZ:198.2428
VT:89.3422
DS:1348.459
AC:OS
PN:4
IH:5.30
SH:6
YC:6250.00
XC:7599.932
ZC:902.03
AC:BS
PN:3
HZ:354.5026
VT:90.2230
DS:1348.459
AC:FS
```

```
PN:5
PD:NGS PT JONES
HZ:226.3004
VT:88.1906
DS:1136.218
YC:5631.775
XC:8552.676
AC:SS
PN:108
PD:NE COR SEC 6
HZ:292.2006
VT:85.4946
DS:369.439
AC:SS
PN:105
PD:R/W MON B-27
HZ:17.0809
VT:87.4228
DS:806.761
AC:SI
PN:102
PD:WDGY TOWER
HZ:53.2135
VT:86.2102
DS:1933.977
CP:06/14/1999 11:19:43
```

Computed Combined Task Example (.CAL) File

```
PR:P89123
TK:COM
AC:PR
ID:HWY 136
IT:GEO440
SN:76428
NM:PROJECT 89-123
TE:28
BP:29.3
OB:K ADAMS
RE:K ADAMS
DT:06/14/1999
WE:CLEAR
CR:Y
CF:1
UL:F
UA:D
UT:F
UP:I
VR:SDMS Collector 3.4.0
AC:OS
PD:TRAV PT SAMSON
PN:2
IH:5.25
SH:6
YC:5580.962
XC:5221.601
YY:5580.962
XX:5221.601
ZZ:912.337
AC:BS
PN:1
PD:TRAV POINT DAVID
HZ:34.2514
VT:89.0501
DS:734.048
YC:6258.469
XC:4939.307
YY:6258.469
XX:4939.307
ZZ:923.338
```

```
AC:SS
PN:100
PD:R/W MON B-26
HZ:96.1640
VT:88.5242
DS:546.797
YY:6004.392
XX:5567.403
ZZ:922.297
AC:SS
PN:101
PD:R/W MON B-45
HZ:228.3749
VT:87.5846
DS:531.080
YY:5055.920
XX:5299.227
ZZ:930.318
AC:SI
PN:102
PD:WDGY TOWER
HZ:82.1353
VT:86.5559
YY:7486.443
XX:6117.887
ZZ:1030.508
AC:FS
PN:3
PD:TRAV PT
HZ:134.5308
VT:90.5813
DS:1126.370
YY:5818.090
XX:6322.562
ZZ:892.540
AC:OS
PN:3
IH:5.40
SH:6
YY:5818.088
XX:6322.550
ZZ:892.536
AC:BS
PN:2
HZ:24.5604
VT:88.5748
DS:1126.370
YY:5580.964
XX:5221.611
ZZ:912.341
AC:EC
PN:103
PD:BM 2356-1
HZ:59.1705
VT:88.5333
DS:381.168
ZC:899.31
YY:5962.054
XX:5969.693
ZZ:899.310
AC:SS
PN:104
PD:IP SW COR LOT 44 BLK 12
HZ:134.0738
VT:87.2455
DS:230.603
YY:6046.721
XX:6350.777
ZZ:902.336
AC:SS
PN:105
```

```
PD:R/W MON B-27
HZ:171.2949
VT:86.2818
DS:676.971
CM:MULTI-STUB
CM:TO PT 105
YY:6300.797
XX:6795.394
ZZ:933.609
AC:SS
PN:106
HZ:230.5505
VT:88.5542
DS:566.994
YY:5682.589
XX:6873.013
ZZ:902.547
AC:SS
PN:107
HZ:308.0349
VT:87.1111
DS:415.505
YY:5403.144
XX:6315.493
ZZ:912.335
AC:FS
PN:4
PD:TRAV PT JOSHUA
HZ:198.2428
VT:89.3422
DS:1348.459
YY:6249.999
XX:7599.929
ZZ:902.028
AC:OS
PN:4
IH:5.30
SH:6
YC:6250.00
XC:7599.932
ZC:902.03
YY:6250.000
XX:7599.932
ZZ:902.030
AC:BS
PN:3
HZ:354.5026
VT:90.2230
DS:1348.459
YY:5818.086
XX:6322.545
ZZ:892.543
AC:FS
PN:5
PD:NGS PT JONES
HZ:226.3004
VT:88.1906
DS:1136.218
YC:5631.775
XC:8552.676
YY:5631.775
XX:8552.676
ZZ:934.701
AC:SS
PN:108
PD:NE COR SEC 6
HZ:292.2006
VT:85.4946
DS:369.439
YY:5885.889
XX:7543.480
```

```
ZZ:928.201
AC:SS
PN:105
PD:R/W MON B-27
HZ:17.0809
VT:87.4228
DS:806.761
YY:6300.797
XX:6795.394
ZZ:933.609
AC:SI
PN:102
PD:WDGY TOWER
HZ:53.2135
VT:86.2102
DS:1933.977
YY:7486.443
XX:6117.887
ZZ:1030.508
CP:06/14/1999 11:19:43
```

Computed Combined Task Example Saved As A Control (.CTL) File

```
AC:PR
NM:JOB P89123
ID:STATE HWY 136
CM:CONTROL FILE
DT:03/26/2000
HD:NAD 1983 (1886)     (Any SDMS compliant data tag
VD:NAVD  1988          may follow the AC:PR)
UL:F
AC:OS
PN:2
YC:5580.962
XC:5221.601
ZC:912.337
PD:TRAV PT SAMSON
AC:BS
PN:1
YC:6258.469
XC:4939.307
ZC:923.338
PD:TRAV POINT DAVID
AC:SS
PN:100
YC:6004.392
XC:5567.403
ZC:922.297
PD:R/W MON B-26
AC:SS
PN:101
YC:5055.920
XC:5299.227
ZC:930.318
PD:R/W MON B-45
AC:SI
PN:102
YC:7486.443
XC:6117.887
ZC:1030.508
PD:WDGY TOWER
AC:OS
PN:3
YC:5818.088
XC:6322.550
ZC:892.536
PD:
AC:EC
```

```
PN:103
YC:5962.054
XC:5969.693
ZC:899.310
PD:BM 2356-1
AC:SS
PN:104
YC:6046.721
XC:6350.777
ZC:902.336
PD:IP SW COR LOT 44 BLK 12
AC:SS
PN:105
YC:6300.797
XC:6795.394
ZC:933.609
PD:R/W MON B-27
AC:SS
PN:106
YC:5682.589
XC:6873.013
ZC:902.547
PD:
AC:SS
PN:107
YC:5403.144
XC:6315.493
ZC:912.335
PD:
AC:OS
PN:4
YC:6250.000
XC:7599.932
ZC:902.030
PD:
AC:SS
PN:108
YC:5885.889
XC:7543.480
ZC:928.201
PD:NE COR SEC 6
AC:SS
PN:105
YC:6300.797
XC:6795.394
ZC:933.609
PD:R/W MON B-27
AC:SI
PN:102
YC:7486.443
XC:6117.887
ZC:1030.508
PD:WDGY TOWER
AC:FS
PN:5
YC:5631.775
XC:8552.676
ZC:934.701
PD:NGS PT JONES
```

Radial Topography Task (TK:RTO) Example Project (.PRJ) File

```
PR:RTOTEST.PRJ
TK:RTO
AC:PR
ID:HWY 136
IT:GEO440
SN:76428
```

```
NM:PROJECT 89-123
TE:28
BP:29.3
OB:K ADAMS
RE:K ADAMS
DT:06/14/1999
WE:CLEAR
CR:Y
CF:1
UL:F
UA:D
UT:F
UP:I
VR:SDMS Collector 3.4.0
AC:OS
PN:215
IH:5.45
SH:6.0
YC:1527.8
XC:473128.36
PD:CTRL MON
FE:CTL
AC:BS
PN:216
PD:CTRL MON
FE:CTL
YC:2244.08
XC:473879.91
HZ:0
VT:89.5930
DS:1038.182
AC:EC
PN:57
PD:TBM
FE:CTL
ZC:448.391
HZ:5.4530
VT:89.2244
DS:838.541
AC:SS
PN:1000
PD:24″ MAPLE
FE:TR
HZ:16.3741
VT:90.2550
DS:565.855
LO:-1
AC:SS
PN:1001
PD:SAN MH
FE:SSMH
HZ:70.3524
VT:91.1548
DS:436.472
AC:UE
PN:1002
PD:8″ VCP
FE:SS
RR:10.3
AC:SS
PN:1003
PD:SE COR BLDG
FE:BU
FG:1
CD:BUILDING FRONT
HZ:225.1422
VT:88.3035
DS:265.934
SH:8.50
AC:SS
PN:1004
```

```
PD:NE COR BLDG
FE:BU
FG:1
HZ:251.5246
VT:88.2942
DS:271.581
SH:6.0
AC:UE
PN:1005
PD:NE COR BLDG
PD:ROOF
FE:BU
VT:61.4352
CP:06/14/1999 11:19:43
```

Computed Radial Topography Example (.CAL) File

```
PR:RTOTEST.PRJ
TK:RTO
AC:PR
ID:HWY 136
IT:GEO440
SN:76428
NM:PROJECT 89-123
TE:28
BP:29.3
OB:K ADAMS
RE:K ADAMS
DT:06/14/1999
WE:CLEAR
CR:Y
CF:1
UL:F
UA:D
UT:F
UP:I
VR:SDMS Collector 3.4.0
AC:OS
ZZ:439.837
PN:215
IH:5.45
SH:6.0
PD:CTRL MON
FE:CTL
YC:1527.85
XC:473128.36
CR:Yes
CF:1.000000
UL:M
UA:D
UT:C
UP:B
VR:SDMS Ver# 3.3
L1:GSCNTL.CTL
AC:BS
ZZ:439.460
PN:216
PD:CTRL MON
FE:CTL
YC:2244.08
XC:473879.91
HZ:0.0
VT:89.5930
DS:1038.182
AC:EC
XX:473790.331
YY:2042.498
PN:57
PD:TBM
FE:CTL
```

```
ZC:448.391
HZ:5.4530
VT:89.2244
DS:838.541
AC:SS
XX:473633.447
YY:1785.132
ZZ:435.041
PN:1000
PD:24” MAPLE
FE:TR
HZ:16.3741
VT:90.2550
DS:565.855
LO:-1
AC:SS
XX:473517.274
YY:1329.958
ZZ:429.667
PN:1001
PD:SAN MH
FE:SSMH
HZ:70.3524
VT:91.1548
DS:436.472
AC:UE
XX:473517.274
YY:1329.958
ZZ:419.367
PN:1002
PD:8” PVC
FE:SS
RR:10.3
AC:SS
XX:472862.622
YY:1535.356
ZZ:443.704
PN:1003
PD:SE COR BLDG
FE:BU
FG:1
CD:BUILDING FRONT
HZ:225.1422
VT:88.3035
DS:265.934
SH:8.50
AC:SS
XX:472889.227
YY:1656.383
ZZ:446.421
PN:1004
PD:NE COR BLDG
FE:BU
FG:1
HZ:251.5246
VT:88.2942
DS:271.581
SH:6.0
AC:UE
XX:472889.227
YY:1656.383
ZZ:585.279
PN:1005
PD:NE COR BLDG
PD:ROOF
FE:BU
VT:61.4352
CP:06/14/1999 11:19:43
BG:Begin Chain List
AC:CH
FG:1
```

```
FE:BU
CD:BUILDING FRONT
PL:1003,1004
EG:End Chain List
CP:11/19/1999 11:19:43
```

Computed Radial Topography Example Saved As A Control (.CTL) File

```
AC:PR
NM:JOB RTOTEST
ID:STATE HWY 136
CM:CONTROL FILE
DT:03/26/2000
HD:NAD 1983 (1996)     (Any SDMS compliant data tags
VD:NAVD 1988            may follow the AC:PR)
ZN4802
UL:F
AC:OS
PN:215
YC:1527.850
XC:473128.360
ZC:439.837
PD:CTRL MON
FE:CTL
AC:BS
PN:216
YC:2244.080
XC:473879.910
ZC:439.460
PD:CTRL MON
FE:CTL
AC:EC
PN:57
YC:2042.498
XC:473790.331
ZC:448.391
PD:TBM
FE:CTL
AC:SS
PN:1000
YC:1785.132
XC:473633.447
ZC:435.041
PD:24" MAPLE
FE:TR
AC:SS
PN:1001
YC:1329.958
XC:473517.274
ZC:429.667
PD:SAN MH
FE:SSMH
AC:UE
PN:1002
YC:1329.958
XC:473517.274
ZC:419.367
PD:8" PVC
FE:SS
AC:SS
PN:1003
YC:1535.356
XC:472862.622
ZC:443.704
PD:SE COR BLDG
FE:BU
AC:SS
PN:1004
```

```
YC:1656.383
XC:472889.227
ZC:446.421
PD:NE COR BLDG
FE:BU
AC:UE
PN:1005
YC:1656.383
XC:472889.227
ZC:585.279
PD:NE COR BLDG ROOF
FE:BU
```

Radial Cross Section Example Using The Radial Topography Task (TK:RTO)

```
PR:X3RIVER2
TK:RTO
AC:PR
ID:7200-04-00
HY:STH 35
ID:RF / STAGELINE RD
CO:ST CROIX
ID:GPS ID
NM:SURVEY2
OB:S IVES
OB:D HENKEL
OB:G GOSNELL
TE:76
BP:28.8
WE:PCLOUDY
DT:08/14/1995
CR:Y
CF:1.00
UL:F
UA:D
UT:F
UP:I
VR:SDMS Ver# 3.1
L1:CL101493
AC:OS
PN:2125
PD:SR 2125 HUB
FE:CP
YC:402168.536
XC:1280328.492
IH:5.53
SH:5.25
AC:BS
PN:212
PD:GPS 212 REBAR/RED
YC:401692.521
XC:1280267.955
ZC:948.850
FE:CP
SH:5.25
HZ:0
VT:91.2736
DS:480.05
AC:EC
PN:212
PD:GPS 212 REBAR/RED
ZC:948.850
HZ:0
VT:91.2744
DS:480.09
AC:ST
ST:376+00
AC:SS
```

```
SI:XSE
PN:1294
HZ:12.2924
VT:93.165
DS:141.43
SH:8.9
AC:SS
PN:1295
HZ:19.5012
VT:93.1058
DS:163.54
AC:SS
PN:1296
HZ:24.1952
VT:93.1302
DS:183.83
FG:1
AC:SS
PN:1297
HZ:27.2712
VT:93.072
DS:199.78
AC:SS
PN:1298
HZ:31.0932
VT:92.482
DS:224.77
AC:SS
PN:1299
HZ:33.4616
VT:92.2604
DS:247.94
AC:ST
ST:376+30
AC:SS
PN:1336
HZ:39.3548
VT:92.4502
DS:225.52
AC:SS
PN:1337
HZ:38.2014
VT:93.014
DS:213.71
AC:SS
PN:1338
HZ:36.1204
VT:93.1148
DS:193.66
AC:SS
PN:1339
HZ:32.5414
VT:93.3038
DS:169.65
FG:1
AC:SS
PN:1340
HZ:29.3154
VT:93.4456
DS:150.71
AC:SS
PN:1341
HZ:25.1514
VT:93.4852
DS:132.18
AC:ST
ST:376+50
AC:SS
PN:1364
HZ:30.5242
VT:94.0808
```

```
DS:114.78
AC:SS
PN:1365
HZ:36.0436
VT:94.0048
DS:139.38
AC:SS
PN:1366
HZ:39.162
VT:93.4224
DS:161.87
FG:1
AC:SS
PN:1367
HZ:41.3208
VT:93.2208
DS:184.54
AC:SS
PN:1368
HZ:43.2018
VT:93.073
DS:206.37
AC:SS
PN:1369
HZ:44.2818
VT:92.4752
DS:221.97
AC:ST
ST:377+00
AC:SS
PN:1404
HZ:57.4836
VT:92.4444
DS:223.9
SH:8.4
AC:SS
PN:1405
HZ:57.4044
VT:93.0258
DS:214.8
AC:SS
PN:1406
HZ:57.3424
VT:93.2744
DS:190.42
AC:SS
PN:1407
HZ:57.2624
VT:93.4942
DS:167.98
AC:SS
PN:1408
HZ:57.2156
VT:94.0448
DS:153.76
FG:1
AC:SS
PN:1409
HZ:57.1238
VT:94.3428
DS:128.25
AC:SS
PN:1410
HZ:57.124
VT:95.0118
DS:102.16
CP:08/14/1995  16:34:43
```

Computed Radial Cross Section Example using TK:RTO Radial Topography (.CAL File)

```
PR:X3RIVER2
TK:RTO
AC:PR
ID:7200-04-00
HY:STH 35
ID:RF / STAGELINE RD
CO:ST CROIX
ID:GPS ID
NM:SURVEY2
OB:S IVES
OB:D HENKEL
OB:G GOSNELL
TE:76
BP:28.8
WE:PCLOUDY
DT:08/14/1995
CR:Y
CF:1.00
UL:F
UA:D
UT:F
UP:I
VR:SDMS Ver# 3.1
VR:SDMS Collector 3.4.0
L1:CL101493
AC:OS
PN:2125
PD:SR 2125 HUB
FE:CP
YC:402168.536
XC:1280328.492
IH:5.53
SH:5.25
YY:402168.536
XX:1280328.492
ZZ:960.796
AC:BS
PN:212
PD:GPS 212 REBAR/RED
YC:401692.521
XC:1280267.955
ZC:948.850
FE:CP
SH:5.25
HZ:0
VT:91.2736
DS:480.05
YY:401692.521
XX:1280267.955
ZZ:948.850
AC:EC
PN:212
PD:GPS 212 REBAR/RED
ZC:948.850
HZ:0
VT:91.2744
DS:480.09
YY:401692.437
XX:1280267.944
ZZ:948.850
AC:ST
ST:376+00
YY:-99999
XX:-99999
ZZ:-99999
AC:SS
SI:XSE
```

```
PN:1294
HZ:12.2924
VT:93.165
DS:141.43
YY:402035.633
XX:1280280.807
ZZ:949.334
AC:SS
PN:1295
HZ:19.5012
VT:93.1058
DS:163.54
YY:402023.155
XX:1280254.147
ZZ:948.347
AC:SS
PN:1296
HZ:24.1952
VT:93.1302
DS:183.83
YY:402012.174
XX:1280232.377
ZZ:947.110
AC:SS
PN:1297
HZ:27.2712
VT:93.072
DS:199.78
YY:402004.534
XX:1280214.927
ZZ:946.546
AC:SS
PN:1298
HZ:31.0932
VT:92.482
DS:224.77
YY:401992.612
XX:1280189.024
ZZ:946.426
AC:SS
PN:1299
HZ:33.4616
VT:92.2604
DS:247.94
YY:401981.635
XX:1280165.914
ZZ:946.896
AC:ST
ST:376+30
YY:-99999
XX:-99999
ZZ:-99999
AC:SS
PN:1336
HZ:39.3548
VT:92.4502
DS:225.52
YY:402014.462
XX:1280164.165
ZZ:946.605
AC:SS
PN:1337
HZ:38.2014
VT:93.014
DS:213.71
YY:402019.179
XX:1280176.055
ZZ:946.139
AC:SS
PN:1338
HZ:36.1204
```

```
VT:93.1148
DS:193.66
YY:402028.160
XX:1280195.518
ZZ:946.628
AC:SS
PN:1339
HZ:32.5414
VT:93.3038
DS:169.65
YY:402039.109
XX:1280219.305
ZZ:947.039
AC:SS
PN:1340
HZ:29.3154
VT:93.4456
DS:150.71
YY:402048.083
XX:1280238.450
ZZ:947.573
AC:SS
PN:1341
HZ:25.1514
VT:93.4852
DS:132.18
YY:402057.305
XX:1280257.626
ZZ:948.634
AC:ST
ST:376+50
YY:-99999
XX:-99999
ZZ:-99999
AC:SS
PN:1364
HZ:30.5242
VT:94.0808
DS:114.78
YY:402078.479
XX:1280257.812
ZZ:949.149
AC:SS
PN:1365
HZ:36.0436
VT:94.0048
DS:139.38
YY:402067.388
XX:1280233.094
ZZ:947.672
AC:SS
PN:1366
HZ:39.162
VT:93.4224
DS:161.87
YY:402057.386
XX:1280211.283
ZZ:946.962
AC:SS
PN:1367
HZ:41.3208
VT:93.2208
DS:184.54
YY:402047.151
XX:1280189.917
ZZ:946.583
AC:SS
PN:1368
HZ:43.2018
VT:93.073
DS:206.37
```

```
YY:402037.702
XX:1280169.292
ZZ:946.177
AC:SS
PN:1369
HZ:44.2818
VT:92.4752
DS:221.97
YY:402031.186
XX:1280154.456
ZZ:946.593
AC:ST
ST:377+00
YY:-99999
XX:-99999
ZZ:-99999
AC:SS
PN:1404
HZ:57.4836
VT:92.4444
DS:223.9
SH:8.4
YY:402074.224
XX:1280125.708
ZZ:946.703
AC:SS
PN:1405
HZ:57.4044
VT:93.0258
DS:214.8
YY:402077.637
XX:1280134.209
ZZ:946.001
AC:SS
PN:1406
HZ:57.3424
VT:93.2744
DS:190.42
YY:402087.670
XX:1280156.480
ZZ:945.928
AC:SS
PN:1407
HZ:57.2624
VT:93.4942
DS:167.98
YY:402096.876
XX:1280176.978
ZZ:946.211
AC:SS
PN:1408
HZ:57.2156
VT:94.0448
DS:153.76
YY:402102.782
XX:1280189.932
ZZ:946.487
AC:SS
PN:1409
HZ:57.1238
VT:94.3428
DS:128.25
YY:402113.415
XX:1280213.144
ZZ:947.198
AC:SS
PN:1410
HZ:57.124
VT:95.0118
DS:102.16
YY:402124.658
```

```
XX:1280236.669
ZZ:948.484
CP:11/15/1999  16:34:21
BG:Begin Chain List
AC:CH
FG:1
FE:CL
CD:Centerline Highway
PL:1296,1339,1366,1408,
PL:1436,1476,1505,
PL:1544,1575,1611,1620
EG:End Chain List
CP:11/30/1999 13:40:00
```

Horizontal Alignment (.ALI) for the Radial Cross Section Example

```
AC:PR
TY:PI
AC:OS
ST:273+91.820
YC:395055.255546
XC:1287570.442257
AC:OS
SI:PI
YC:395655.611997
XC:1287221.448369
RA:-3819.718600
AC:OS
SI:PI
YC:399699.523000
XC:1282267.595000
AC:OS
SI:PI
YC:400968.442332
XC:1280713.148696
RA:2864.789000
AC:OS
SI:PI
YC:401978.547000
XC:1280247.466000
AC:OS
SI:PI
YC:402939.008427
XC:1279804.669808
RA:-5729.578000
AC:OS
SI:PI
YC:405025.138463
XC:1277994.204798
RA:3819.718600
AC:OS
SI:PI
YC:406667.042806
XC:1277083.317397
RA:-5729.578000
AC:OS
SI:PI
YC:411116.692918
XC:1274103.039958
RA:-5729.578000
AC:OS
SI:PI
YC:411965.563000
XC:1273294.969000
AC:OS
SI:PI
YC:413853.236303
XC:1271498.021412
```

```
RA:5729.578000
AC:OS
SI:PI
YC:418302.515668
XC:1270939.849402
RA:2864.789000
AC:OS
SI:PI
YC:421062.045789
XC:1271206.875130
RA:-22918.311800
AC:OS
SI:PI
YC:421899.816000
XC:1271239.791000
```

Computed (.CAL) Radial Cross Section Example Resulting by Merging The Horizontal Alignment with the Computed Radial Cross Section File

```
PR:X3RIVER2
TK:RTO
AC:PR
ID:7200-04-00
HY:STH 35
ID:RF / STAGELINE RD
CO:ST CROIX
ID:GPS ID
NM:SURVEY2
OB:S IVES
OB:D HENKEL
OB:G GOSNELL
TE:76
BP:28.8
WE:PCLOUDY
DT:08/14/1995
CR:Y
CF:1.00
UL:F
UA:D
UT:F
UP:I
VR:SDMS Ver# 3.1
VR:SDMS Collector 3.4.0
L1:CL101493
AC:ST
ST:376+00
AC:SS
PN:1299
HZ:33.4616
VT:92.2604
DS:247.94
YY:401981.635
XX:1280165.914
ZZ:946.896
SS:375+99.071
OO:-72.768
AC:SS
PN:1298
HZ:31.0932
VT:92.482
DS:224.77
YY:401992.612
XX:1280189.024
ZZ:946.426
SS:375+99.364
OO:-47.185
AC:SS
```

```
PN:1297
HZ:27.2712
VT:93.072
DS:199.78
YY:402004.534
XX:1280214.927
ZZ:946.546
SS:375+99.346
OO:-18.670
AC:SS
PN:1296
HZ:24.1952
VT:93.1302
DS:183.83
YY:402012.174
XX:1280232.377
ZZ:947.110
SS:375+98.979
OO:0.376
FG:1
AC:SS
PN:1295
HZ:19.5012
VT:93.1058
DS:163.54
YY:402023.155
XX:1280254.147
ZZ:948.347
SS:375+99.836
OO:24.743
AC:SS
PN:1294
HZ:12.2924
VT:93.165
DS:141.43
YY:402035.633
XX:1280280.807
ZZ:949.334
SS:376+00.006
OO:54.179
AC:ST
ST:376+30
AC:SS
PN:1336
HZ:39.3548
VT:92.4502
DS:225.52
YY:402014.462
XX:1280164.165
ZZ:946.605
SS:376+29.615
OO:-60.612
AC:SS
PN:1337
HZ:38.2014
VT:93.014
DS:213.71
YY:402019.179
XX:1280176.055
ZZ:946.139
SS:376+28.921
OO:-47.839
AC:SS
PN:1338
HZ:36.1204
VT:93.1148
DS:193.66
YY:402028.160
XX:1280195.518
ZZ:946.628
SS:376+28.928
```

```
OO:-26.404
AC:SS
PN:1339
HZ:32.5414
VT:93.3038
DS:169.65
YY:402039.109
XX:1280219.305
ZZ:947.039
SS:376+28.912
OO:-0.218
FG:1
AC:SS
PN:1340
HZ:29.3154
VT:93.4456
DS:150.71
YY:402048.083
XX:1280238.450
ZZ:947.573
SS:376+29.046
OO:20.925
AC:SS
PN:1341
HZ:25.1514
VT:93.4852
DS:132.18
YY:402057.305
XX:1280257.626
ZZ:948.634
SS:376+29.393
OO:42.201
AC:ST
ST:376+50
AC:SS
PN:1369
HZ:44.2818
VT:92.4752
DS:221.97
YY:402031.186
XX:1280154.456
ZZ:946.593
SS:376+48.868
OO:-62.427
AC:SS
PN:1368
HZ:43.2018
VT:93.073
DS:206.37
YY:402037.702
XX:1280169.292
ZZ:946.177
SS:376+48.574
OO:-46.226
AC:SS
PN:1367
HZ:41.3208
VT:93.2208
DS:184.54
YY:402047.151
XX:1280189.917
ZZ:946.583
SS:376+48.519
OO:-23.540
AC:SS
PN:1366
HZ:39.162
VT:93.4224
DS:161.87
YY:402057.386
XX:1280211.283
```

```
ZZ:946.962
SS:376+48.869
OO:0.149
FG:1
AC:SS
PN:1365
HZ:36.0436
VT:94.0048
DS:139.38
YY:402067.388
XX:1280233.094
ZZ:947.672
SS:376+48.82
OO:24.144
AC:SS
PN:1364
HZ:30.5242
VT:94.0808
DS:114.78
YY:402078.479
XX:1280257.812
ZZ:949.149
SS:376+48.544
OO:51.234
AC:ST
ST:377+00
AC:SS
PN:1404
HZ:57.4836
VT:92.4444
DS:223.9
SH:8.9
YY:402074.224
XX:1280125.708
ZZ:946.703
SS:376+99.988
OO:-70.516
AC:SS
PN:1405
HZ:57.4044
VT:93.0258
DS:214.8
YY:402077.637
XX:1280134.209
ZZ:946.001
SS:376+99.528
OO:-61.367
AC:SS
PN:1406
HZ:57.3424
VT:93.2744
DS:190.42
YY:402087.670
XX:1280156.480
ZZ:945.928
SS:376+99.315
OO:-36.941
AC:SS
PN:1407
HZ:57.2624
VT:93.4942
DS:167.98
YY:402096.876
XX:1280176.978
ZZ:946.211
SS:376+99.094
OO:-14.472
AC:SS
PN:1408
HZ:57.2156
VT:94.0448
```

```
DS:153.76
YY:402102.782
XX:1280189.932
ZZ:946.487
SS:376+99.034
OO:-0.235
FG:1
AC:SS
PN:1409
HZ:57.1238
VT:94.3428
DS:128.25
YY:402113.415
XX:1280213.144
ZZ:947.198
SS:376+98.972
OO:25.297
AC:SS
PN:1410
HZ:57.124
VT:95.0118
DS:102.16
YY:402124.658
XX:1280236.669
ZZ:948.484
SS:376+99.333
OO:51.368
CP:11/30/1999 13:20:00
BG:Begin Chain List
AC:CH
FG:1
FE:CL
CD:Centerline Highway
PL:1296,1339,1366,1408,
PL:1436,1476,1505,1544,
PL:1575,1611,1620
EG:End Chain List
CP:11/30/1999 13:40:00
```

Traverse Task (TK:TRA) Example Project (.PRJ) File

```
PR:TRAEXAM
TK:TRA
AC:PR
ID:HWY 136
IT:GEO440
SN:76428
NM:PROJECT 89-123
TE:28
BP:29.3
OB:K ADAMS
RE:K ADAMS
DT:89/11/35 09:23
WE:CLEAR
CR:Y
CF:1
UL:F
UA:D
UT:F
UP:I
VR:SDMS Collector 3.4.0
AC:OS
PN:27
PD:CTRL PT
IH:5.2
SH:5.7
YC:80281.016
XC:853432.237
```

```
ZC:448.225
AC:BS
PN:26
PD:CTRL PT
HZ:0
VT:91.0200
DS:558.181
YC:80101.427
XC:853960.738
AC:FS
PN:101
PD:TRAV PT
HZ:54.4048
VT:90.2550
DS:610.061
SH:4.9
AC:OS
PN:101
PD:TRAV PT
IH:5.2
SH:4.9
AC:BS
PN:27
PD:CTRL PT
HZ:0
VT:87.3846
DS:610.061
AC:FS
PN:102
PD:TRAV PT
HZ:173.3938
VT:87.3846
DS:698.496
SH:5.3
AC:OS
PN:102
PD:TRAV PT
IH:5.42
SH:5.3
AC:BS
PN:101
PD:TRAV PT
HZ:0
VT:92.2114
DS:698.496
AC:FS
PN:103
PD:TRAV PT
HZ:159.2402
VT:90.5815
DS:793.877
SH:5.1
AC:OS
PN:103
PD:TRAV PT
IH:5.45
SH:5.1
AC:BS
PN:102
PD:TRAV PT
HZ:0
VT:89.0145
DS:793.877
AC:FS
PN:35
PD:CTRL PT
HZ:133.0802
VT:91.1010
DS:1228.112
SH:4.84
AC:OS
```

```
PN:35
PD:CTRL PT
IH:4.9
SH:4.84
YC:78484.989
XC:855651.663
AC:BS
PN:103
PD:TRAV PT
HZ:0
VT:88.4950
DS:1228.112
AC:FS
PN:36
PD:CTRL PT
HZ:181.5540
VT:90.3020
DS:835.533
SH:5.1
AZ:91.3352
CP:04/14/95 15:32:09
```

Computed Traverse (.CAL) File

```
PR:TRAEXAM.PRJ
TK:TRA
AC:PR
ID:HWY 136
IT:GEO440
SN:76428
NM:PROJECT 89-123
TE:28
BP:29.3
OB:K ADAMS
RE:K ADAMS
DT:89/11/35 09:23
WE:CLEAR
CR:Y
CF:1
UL:F
UA:D
UT:F
UP:I
VR:SDMS Collector 3.4.0
AC:OS
XX:853432.237
YY:80281.016
ZZ:448.225
PN:27
PD:CTRL PT
IH:5.2
SH:5.7
YC:80281.016
XC:853432.237
ZC:448.225
CR:Yes
CF:1.000000
UL:M
UA:D
UT:C
UP:B
VR:SDMS Ver# 3.3
L1:151.CTL
S1:151.CTL
AC:BS
XX:853960.652
YY:80101.456
ZZ:438.652
PN:26
SH:5.7
```

```
PD:CTRL PT
HZ:0.0
VT:91.0200
DS:558.181
YC:80101.427
XC:853960.738
AC:FS
XX:853606.076
YY:79696.227
ZZ:444.133
PN:101
SH:4.9
PD:TRAV PT
HZ:54.4048
VT:90.2550
DS:610.061
AC:OS
XX:853606.076
YY:79696.227
ZZ:444.133
PN:101
IH:5.2
PD:TRAV PT
AC:BS
XX:853432.237
YY:80281.016
ZZ:448.225
PN:27
SH:4.9
PD:CTRL PT
HZ:0
VT:89.3410
DS:610.061
AC:FS
XX:853877.605
YY:79053.258
ZZ:472.511
PN:102
SH:4.9
PD:TRAV PT
HZ:173.3938
VT:87.3846
DS:698.496
SH:5.3
AC:OS
XX:853877.605
YY:79053.258
ZZ:472.511
PN:102
IH:5.42
PD:TRAV PT
AC:BS
XX:853606.076
YY:79696.227
ZZ:444.133
PN:101
SH:5.3
PD:TRAV PT
HZ:0
VT:92.2114
DS:698.496
AC:FS
XX:854423.960
YY:78477.371
ZZ:458.927
PN:103
SH:5.1
PD:TRAV PT
HZ:159.2402
VT:90.5815
DS:793.877
```

```
AC:OS
XX:854423.960
YY:78477.371
ZZ:458.927
PN:103
IH:5.45
PD:TRAV PT
AC:BS
XX:853877.605
YY:79053.258
ZZ:472.511
PN:102
SH:5.1
PD:TRAV PT
HZ:0
VT:89.0145
DS:793.877
AC:FS
XX:855651.863
YY:78484.989
ZZ:433.482
PN:104
SH:4.84
PD:TRAV PT
PN:35
PD:CTRL PT
HZ:133.0802
VT:91.1010
DS:1228.112
AC:OS
XX:855651.863
YY:78484.989
ZZ:433.482
PN:35
IH:4.90
PD:CTRL PT
YC:78484.989
XC:855651.863
AC:BS
XX:854423.960
YY:78477.371
PN:103
SH:4.84
PD:CTRL PT
HZ:0
VT:88.4950
DS:1228.112
AC:FS
XX:856487.098
YY:78462.065
PN:36
SH:5.10
PD:CTRL PT
HZ:181.5540
VT:90.3020
DS:835.533
AZ:91.3352
CP:07/03/96 09:17:26
```

Computed Traverse Example Saved As A Control (.CTL) File

```
AC:PR
NM:JOB TRAVEXAM
ID:STATE HWY 1136
CM:CONTROL FILE
DT:03/26/1998
HD:NAD 1983 (1996)     (Any SDMS compliant data tags
VD:NAVD 1988            may follow the AC:PR)
```

```
UL:M3
ZN:4802
AC:OS
PN:27
YC:80281.016
XC:853432.237
ZC:448.225
PD:CTRL PT
AC:BS
PN:26
YC:80101.427
XC:853960.738
ZC:438.652
PD:CTRL PT
AC:OS
PN:101
YC:79696.227
XC:853606.076
ZC:444.133
PD:TRAV PT
AC:OS
PN:102
YC:79053.258
XC:853877.605
ZC:472.511
PD:TRAV PT
AC:OS
PN:103
YC:78477.371
XC:854423.960
ZC:458.927
PD:TRAV PT
AC:OS
PN:35
YC:78484.989
XC:855651.863
ZC:433.482
PD:CTRL PT
AC:FS
PN:36
YC:78462.065
XC:856487.098
ZC:
PD:CTRL PT
```

Level Run Task (TK:LEV) Example Project (.PRJ) File

```
PR:LEVEXAM.PRJ
TK:LEV
AC:PR
ID:HWY 136
IT:SOKKIA B1
SN:76428
NM:PROJECT 89-123
TE:28
BP:29.3
OB:K ADAMS
RE:K ADAMS
DT:89/11/35 09:23
WE:CLEAR
CR:Y
CF:1
UL:F
UA:D
UT:F
UP:I
VR:SDMS Collector 3.4.0
AC:OS
```

```
PN:1
PD:USGS 31D 1957
ZC:835.61
AC:BS
RR:6.29
AC:TP
RR:1.36
AC:BS
RR:7.94
AC:FS
PN:2
PD:USGS 31E 1957
RR:9.37
ZC:839.123
CP: 09/21/95 0:02:27
```

Computed Level Run (.CAL) File

```
PR:LEVEXAM.PRJ
TK:LEV
AC:PR
ID:HWY 136
IT:SOKKIA B1
SN:76428
NM:PROJECT 89-123
TE:28
BP:29.3
OB:K ADAMS
RE:K ADAMS
DT:89/11/35 09:23
WE:CLEAR
CR:Y
CF:1
UL:F
UA:D
UT:F
UP:I
VR:SDMS Collector 3.4.0
AC:OS
PN:1
PD:USGS 31D 1957
ZC:835.61
AC:BS
ZZ:841.900
RR:6.29
AC:TP
ZZ:840.546
RR:1.36
AC:BS
ZZ:848.480
RR:7.94
AC:FS
ZZ:839.123
PN:2
PD:USGS 31E 1957
RR:9.37
ZC:839.123
CP:07/03/96 09:53:21
```

Computed Level Run Saved As A Control (.CTL) File

```
AC:PR
NM:JOB LEVEXAM
ID:STATE HWY 1136
CM:CONTROL FILE
DT:03/26/1998         (Any SDMS compliant data tags
VD:NAVD 1988           may follow the AC:PR)
```

```
UL:F
ZN:4802
AC:OS
PN:1
ZC:835.610
PD:USGS 31D 1957
AC:FS
PN:2
ZC:839.123
PD:USGS 31E 1957
```

Three-Wire Level Task (TK:3WR) Example Project (.PRJ) File

```
PR:3WREXAM
TK:3WR
AC:PR
ID:HWY 136
IT:SOKKIA B1
SN:76428
NM:PROJECT 89-123
TE:28
BP:29.3
OB:K ADAMS
RE:K ADAMS
DT:89/11/35 09:23
WE:CLEAR
CR:Y
CF:1
UL:F
UA:D
UT:F
UP:I
VR:SDMS Collector 3.4.0
AC:OS
PN:1
PD:USCGS 3005A
ZC:1016.723
AC:BS
R1:2.928
R2:2.815
R3:2.702
AC:TP
R1:2.228
R2:2.115
R3:2.003
AC:BS
R1:1.722
R2:1.603
R3:1.485
AC:FS
PN:2
PD:USCGS 3005B
R1:2.675
R2:2.550
R3:2.425
ZC:1015.986
CP:08/24/95 09:04:23
```

Computed Three-Wire Level Example (.CAL) File

```
RP:3WREXAM
TK:3WR
AC:PR
ID:HWY 136
IT:SOKKIA B1
SN:76428
NM:PROJECT 89-123
```

```
TE:28
BP:29.3
OB:K ADAMS
RE:K ADAMS
DT:89/11/35 09:23
WE:CLEAR
CR:Y
CF:1
UL:F
UA:D
UT:F
UP:I
VR:SDMS Collector 3.4.0
AC:OS
PN:1
PD:USCGS 3005A
ZC:1016.723
AC:BS
ZZ:1019.420
R1:2.928
R2:2.815
R3:2.702
AC:TP
ZZ:1017.187
R1:2.228
R2:2.115
R3:2.003
AC:BS
ZZ:1018.667
R1:1.722
R2:1.603
R3:1.485
AC:FS
ZZ:1015.986
PN:2
PD:USCGS 3005B
R1:2.675
R2:2.550
R3:2.425
ZC:1015.986
CP:08/24/95 09:04:23
```

Computed Three-Wire Level Example Saved As A Control (.CTL) File

```
AC:PR
PR:JOB TRAVEXAM
NM:STATE HWY 1136
CM:CONTROL FILE
DT:03/26/1998         (Any SDMS compliant data tags
VD:NAVD 1988           may follow the AC:PR)
UL:M3
ZN:4802
PN:1
ZC:1016.723
PD:USCGS 3005A
AC:FS
PN:2
ZC:1015.986
PD:USCGS 3005B
```

Cross-Section Task (TK:XSE) Example Project (.PRJ) File

```
PR:XSEEXAM
TK:XSE
AC:PR
```

```
ID:HWY 136
IT:SOKKIA B1
SN:76428
NM:PROJECT 89-123
TE:28
BP:29.3
OB:K ADAMS
RE:K ADAMS
DT:89/11/35 09:23
WE:CLEAR
CR:Y
CF:1
UL:F
UA:D
UT:F
UP:I
VR:SDMS Collector 3.4.0
AC:OS
PN:1
PD:DOT 8241
ZC:1292.316
AC:BS
RR:8.41
AC:ST
ST:10+00
AC:SS
OF:0
RR:6.4
AC:SS
OF:-25
RR:7.3
AC:SS
OF:-50
RR:6.0
AC:SS
OF:25
RR:7.5
AC:SS
OF:50
RR:8.1
AC:ST
ST:10+41
CM:C/L 20 ENT LT
AC:SS
OF:0
RR:5.1
PD:C/L
AC:SS
OF:-15
RR:5.4
PD:C/L ENT
AC:SS
OF:-25
RR:5.8
PD:C/L ENT
AC:SS
OF:-52
RR:6.4
PD:END ENT LT
AC:ST
ST:10+50
AC:SS
OF:0
RR:4.2
AC:SS
OF:-25
RR:5.0
AC:SS
OF:-50
RR:3.6
AC:BS
```

```
RR:7.2
SI:BL
AC:SS
OF:-75
RR:1.5
AC:TP
RR:1.5
AC:BS
RR:6.3
AC:SS
OF:-100
RR:2.5
SI:EL
AC:SS
OF:25
RR:5.8
AC:SS
OF:50
RR:6.4
AC:FS
PN:2
PD:SPK IN PP
RR:2.18
ST:10+80
OF:-62
AC:BS
RR:6.87
AC:ST
ST:11+00
AC:SS
OF:0
RR:7.1
AC:SS
OF:-25
RR:7.8
AC:SS
OF:-50
RR:7.0
AC:SS
OF:25
RR:8.2
AC:ST
ST:11+39
AC:SS
OF:-69
RR:6.83
PN:200
ST:11+39
AC:UE
PN:201
PD:24” VCP NW
RR:8.32
AC:UE
PN:202
PD:36” RCP
RR:14.84
AC:FS
PN:3
PD:DOT 8242
RR:4.15
ZC:1301.242
CP:08/23/9516:43:37
```

Computed Cross-Section Example (.CAL) File

```
PR:XSEEXAM
TK:XSE
AC:PR
ID:HWY 136
IT:SOKKIA B1
```

```
SN:76428
NM:PROJECT 89-123
TE:28
BP:29.3
OB:K ADAMS
RE:K ADAMS
DT:89/11/35 09:23
WE:CLEAR
CR:Y
CF:1
UL:F
UA:D
UT:F
UP:I
VR:SDMS Collector 3.4.0
AC:OS
PN:1
PD:DOT 8241
ZC:1292.316
AC:BS
RR:8.41
ZZ:1300.726
AC:ST
ST:10+00
AC:SS
ZZ:1294.314
OF:0
RR:6.4
AC:SS
ZZ:1293.414
OF:-25
RR:7.3
AC:SS
ZZ:1294.714
OF:-50
RR:6.0
AC:SS
ZZ:1293.214
OF:25
RR:7.5
AC:SS
ZZ:1292.614
OF:50
RR:8.1
AC:ST
ST:10+41
CM:C/L 20 ENT LT
AC:SS
ZZ:1295.614
OF:0
RR:5.1
PD:C/L
AC:SS
ZZ:1295.314
OF:-15
RR:5.4
PD:C/L ENT
AC:SS
ZZ:1294.914
OF:-25
RR:5.8
PD:C/L ENT
AC:SS
ZZ:1294.314
OF:-52
RR:6.4
PD:END ENT LT
AC:ST
ST:10+50
AC:SS
ZZ:1296.514
```

```
OF:0
RR:4.2
AC:SS
ZZ:1295.714
OF:-25
RR:5.0
AC:SS
ZZ:1297.114
OF:-50
RR:3.6
AC:BS
RR:7.2
SI:BL
ZZ:1304.314
AC:SS
OF:-75
RR:1.5
ZZ:1302.814
AC:TP
RR:1.5
ZZ:1302.814
AC:BS
RR:6.3
ZZ:1309.114
AC:SS
OF:-100
RR:2.5
ZZ:1306.614
SI:EL
AC:SS
ZZ:1294.914
OF:25
RR:5.8
AC:SS
ZZ:1294.314
OF:50
RR:6.4
AC:FS
ZZ:1298.534
PN:2
PD:SPK IN PP
RR:2.18
ST:10+80
OF:-62
AC:BS
RR:6.87
ZZ:1305.392
AC:ST
ST:11+00
AC:SS
ZZ:1298.392
OF:0
RR:7.1
AC:SS
ZZ:1297.692
OF:-25
RR:7.8
AC:SS
ZZ:1298.492
OF:-50
RR:7.0
AC:SS
ZZ:1297.292
OF:25
RR:8.2
AC:ST
ST:11+39
AC:SS
ZZ:1298.562
OF:-69
RR:6.83
```

```
PN:200
ST:11+39
AC:UE
ZZ:1290.242
PN:201
PD:24″ VCP NW
RR:8.32
AC:UE
ZZ:1283.722
PN:202
PD:36 ″ RCP
RR:14.84
AC:FS
ZZ:1301.242
PN:3
PD:DOT 8242
RR:4.15
ZC:1301.242
CP:08/23/95 16:43:37
```

Computed Cross-Section Example Saved As A Control (.CTL) File

```
AC:PR
NM:JOB TRAVEXAM
ID:STATE HWY 1136
CM:CONTROL FILE
DT:03/26/1998
HD:NAD 1983 (1996)     (Any SDMS compliant data tags
VD:NAVD 1988            may follow the AC:PR)
UL:F
ZN:4802
AC:OS
PN:1
YC:
XC:
ZC:1292.316
PD:DOT 8241
AC:FS
PN:2
YC:
XC:
ZC:1298.534
PD:SPK IN PP
AC:SS
PN:200
YC:
XC:
ZC:1298.562
PD:
AC:UE
PN:201
YC:
XC:
ZC:1290.242
PD:24″ VCP NW
AC:UE
PN:202
YC:
XC:
ZC:1283.722
PD:36″ RCP
AC:FS
PN:3
YC:
XC:
ZC:1301.242
PD:DOT 8242
```

Profile Task (TK:PRO) Example Project (.PRJ) File

```
PR:PROEXAM
TK:PRO
AC:PR
ID:HWY 136
IT:SOKKIA B1
SN:76428
NM:PROJECT 89-123
TE:28
BP:29.3
OB:K ADAMS
RE:K ADAMS
DT:89/11/35 09:23
WE:CLEAR
CR:Y
CF:1
UL:F
UA:D
UT:F
UP:I
VR:SDMS Collector 3.4.0
AC:OS
PN:1
PD:USGS 81L 1964
ZC:236.413
AC:BS
RR:5.43
AC:SS
ST:8+60
OF:0
RR:1.35
AC:SS
ST:9+00
OF:0
RR:2.15
AC:SS
ST:10+00
OF:0
RR:4.26
AC:SS
ST:11+00
OF:0
RR:7.4
AC:SS
ST:12+00
OF:0
RR:7.0
AC:SS
ST:12+20
OF:0
RR:6.9
AC:FS
PN:2
PD:SPK IN PP
RR:6.27
ST:12+60
OF:-45
AC:BS
RR:5.19
AC:SS
ST:13+00
OF:0
RR:6.05
AC:SS
ST:13+60
OF:0
RR:5.49
AC:SS
ST:14+00
OF:0
```

```
RR:5.83
AC:SS
ST:14+45
OF:0
RR:6.10
AC:SS
ST:15+00
OF:0
RR:6.01
AC:SS
ST:16+00
OF:0
RR:5.75
AC:FS
PN:3
PD:WWALL USGS
PD:81M 1964
RR:6.92
ZC:233.860
CP: 08/25/95  15:34:39
```

Computed Profile Example .CAL File

```
PR:PROEXAM
TK:PRO
AC:PR
ID:HWY 136
IT:SOKKIA B1
SN:76428
NM:PROJECT 89-123
TE:28
BP:29.3
OB:K ADAMS
RE:K ADAMS
DT:89/11/35 09:23
WE:CLEAR
CR:Y
CF:1
UL:F
UA:D
UT:F
UP:I
VR:SDMS Collector 3.4.0
AC:OS
PN:1
PD:USGS 81L 1964
ZC:236.413
AC:BS
RR:5.43
AC:SS
ZZ:240.493
ST:8+60
OF:0
RR:1.35
AC:SS
ZZ:239.693
ST:9+00
OF:0
RR:2.15
AC:SS
ZZ:237.583
ST:10+00
OF:0
RR:4.26
AC:SS
ZZ:234.443
ST:11+00
OF:0
RR:7.4
AC:SS
```

```
ZZ:234.843
ST:12+00
OF:0
RR:7.0
AC:SS
ZZ:234.943
ST:12+20
OF:0
RR:6.9
AC:FS
ZZ:235.573
PN:2
PD:SPK IN PP
RR:6.27
ST:12+60
OF:-45
AC:BS
RR:5.19
AC:SS
ZZ:234.713
ST:13+00
OF:0
RR:6.05
AC:SS
ZZ:235.273
ST:13+60
OF:0
RR:5.49
AC:SS
ZZ:234.933
ST:14+00
OF:0
RR:5.83
AC:SS
ZZ:234.663
ST:14+45
OF:0
RR:6.10
AC:SS
ZZ:234.753
ST:15+00
OF:0
RR:6.01
AC:SS
ZZ:235.013
ST:16+00
OF:0
RR:5.75
AC:FS
ZZ:233.843
PN:3
PD:WWALL USGS
PD:81M 1964
RR:6.92
ZC:233.860
CP: 08/25/95  15:34:39
```

Computed Profile Example Saved As A Control (.CTL) File

```
AC:PR
NM:JOB TRAVEXAM
ID:STATE HWY 1136
CM:CONTROL FILE
DT:03/26/1998
HD:NAD 1983 (1996)     (Any SDMS compliant data tags
VD:NAVD 1988            may follow the AC:PR)
UL:M3
ZN:4802
```

```
AC:OS
PN:1
YC:
XC:
ZC:236.413
PD:USGS 81L 1964
AC:FS
PN:2
YC:
XC:
ZC:235.573
PD:SPK IN PP
AC:FS
PN:3
YC:
XC:
ZC:233.860
PD:WWALL USGS
PD:81M 1964
```

Points and Chains (.PAC) Example File in List Format

```
PR:P89123
AC:PR
ID:HWY 136
NM:PROJECT 89-123
CF:1
UL:F
VR:SDMS Processor 1.0.0
HD:NAD 1983 (1996)
VD:NGVD 1988
AC:PD
PN:1
FE:PK
XC:953938.2430
YC:3077822.5002
ZC:216.6866
SX:0.008
SY:0.008
SZ:0.01
PD:HUB W\TACK
AC:PD
PN:2
XC:953942.0290
YC:3077866.1300
ZC:216.0000
SX:0.008
SY:0.008
SZ:0.01
PD:HUB W\ TACK
AC:PD
PN:3
FE:PK
XC:954000.6134
YC:3077868.2169
ZC:213.6494
SX:0.008
SY:0.008
SZ:0.01
PD:HUB W\ TACK
AC:PD
PN:4
FE:PK
XC:954007.0994
YC:3077838.4456
ZC:212.4197
SX:0.008
SY:0.008
```

```
SZ:0.01
PD:HUB W\ TACK
AC:PD
PN:5
FE:PK
XC:954001.4947
YC:3077835.3753
ZC:215.8340
SX:0.005
SY:0.005
SZ:0.01
PD:PK NAIL
AC:PD
PN:8
FE:PK
XC:954091.8797
YC:3077882.1416
ZC:211.1989
SX:0.008
SY:0.008
SZ:0.01
PD:HUB W\ TACK
AC:PD
PN:100
FE:WDFN
XX:953941.1292
YY:3077817.8150
ZZ:216.8406
PD:6 FEET
AC:PD
PN:101
FE:WDFN
XX:953955.9434
YY:3077819.9821
ZZ:216.6823
PD:6 FEET
AC:PD
PN:102
FE:WDFN
XX:953973.9444
YY:3077822.6456
ZZ:216.3115
PD:6 FEET
AC:PD
PN:103
FE:WDFN
XX:953984.5563
YY:3077824.1751
ZZ:216.0284
PD:6 FEET
PD:CHECK FOR SHD
AC:PD
PN:155
FE:CRB
XX:953962.6131
YY:3077860.0483
ZZ:215.9680
PD:CURB
AC:PD
PN:164
FE:LB
XX:953991.7944
YY:3077845.4622
ZZ:215.7971
PD:LIGHT POLE
AC:PD
PN:165
FE:TR
XX:953992.5699
YY:3077840.6766
ZZ:215.7721
```

```
DI:6″
TY:RED OAK
PD:6″ RED OAK
AC:PD
PN:166
FE:TR
XX:953975.2685
YY:3077828.1031
ZZ:216.2482
DI:6″
TY:POST OAK
PD: 6″ POST OAK
AC:PD
PN:169
FE:LB
XX:953955.2911
YY:3077839.9260
ZZ:216.4941
PD:LIGHT BASE
AC:PD
PN:172
FE:TR
XX:953938.1949
YY:3077857.4539
ZZ:216.6564
DI:10″
TY:RED OAK
PD:10″ RED OAK
AC:PD
PN:177
FE:SHB
XX:953936.6997
YY:3077836.2297
ZZ:216.6283
PD:SHRUB
AC:PD
PN:178
FE:SHB
XX:953937.5817
YY:3077837.2750
ZZ:216.5867
PD:SHRUB
AC:PD
PN:179
FE:SHB
XX:953940.0963
YY:3077820.2295
ZZ:216.8043
PD:SHRUB
AC:PD
PN:180
FE:MB
XX:953937.6555
YY:3077815.5765
ZZ:216.5747
PD:MAIL BOX
AC:PD
PN:181
FE:CRB
XX:953937.0465
YY:3077815.9621
ZZ:216.4061
PD:CURB
AC:PD
PN:182
FE:CRB
XX:953936.2261
YY:3077820.9586
ZZ:216.4196
PD:CURB
AC:PD
```

```
PN:183
FE:CRB
XX:953934.3313
YY:3077832.7634
ZZ:216.4754
PD:CURB
DS:10.9880
AC:PD
PN:184
FE:CRB
XX:953934.3313
YY:3077832.7634
ZZ:216.4754
PD:CURB
AC:PD
PN:185
FE:CRB
XX:953929.4551
YY:3077863.1040
ZZ:216.8770
PD:CURB
AC:PD
PN:186
FE:CRB
XX:953929.4551
YY:3077863.1040
ZZ:216.8770
PD:CURB
AC:PD
PN:198
FE:CRB
XX:953929.3230
YY:3077864.0279
ZZ:216.8966
PD:CURB
AC:PD
PN:199
FE:CRB
XX:953929.3230
YY:3077864.0279
ZZ:216.8966
PD:CURB
AC:PD
PN:200
FE:SGN
XX:953930.4811
YY:3077862.9019
ZZ:216.9851
PD:STOP SIGN
AC:PD
PN:201
FE:SE
XX:953924.3834
YY:3077863.1003
ZZ:217.1493
PD:CP
AC:PD
PN:204
FE:SE
XX:953931.4089
YY:3077814.9614
ZZ:216.6121
PD:CP
AC:PD
PN:221
FE:PST
XX:953919.3462
YY:3077841.8708
ZZ:217.1022
PD:DBL SUPPORT SIGN 6X3
AC:PD
```

```
PN:222
FE:PST
XX:953918.1347
YY:3077841.6774
ZZ:217.2759
PD:DBL SUPPORT SIGN 6X3
AC:PD
PN:223
FE:GUY
XX:953923.4531
YY:3077821.1248
ZZ:216.9862
PD:GUY WIRE
AC:PD
PN:224
FE:PP
XX:953924.9132
YY:3077813.2947
ZZ:217.0123
PD:POWER POLE
AC:PD
PN:300
FE:EP
XX:953929.3185
YY:3077864.0838
ZZ:216.8991
PD:EP
AC:PD
PN:301
GM:C
FE:EP
XX:953929.2643
YY:3077865.3516
ZZ:216.9531
PD:EP
AC:PD
PN:302
GM:C
FE:EP
XX:953931.5271
YY:3077868.6067
ZZ:216.9396
PD:EP
AC:PD
PN:303
GM:C
FE:EP
XX:953934.7388
YY:3077870.0975
ZZ:216.8883
PD:EP
AC:PD
PN:304
FE:EP
XX:954094.7414
YY:3077895.3984
ZZ:210.5560
PD:EP
AC:PD
PN:322
FE:FH
XX:953940.4961
YY:3077859.9321
ZZ:216.7157
PD:FIRE HYD
AC:PD
PN:323
FE:PP
XX:953937.0903
YY:3077860.3064
ZZ:215.7059
```

```
PD:POWER POLE
AC:PD
PN:330
FE:OE
XX:953930.7877
YY:3077859.1410
ZZ:216.8991
PD:OVER ELEC
AC:PD
PN:331
FE:OE
XX:954082.3645
YY:3077883.7289
ZZ:211.2560
PD:OVER ELEC
AC:PD
PN:332
FE:PP
XX:954076.3572
YY:3077882.7110
ZZ:211.0813
PD:POWER POLE
AC:PD
PN:333
FE:GUY
XX:954067.8379
YY:3077881.0999
ZZ:211.5055
PD:GUY ANCHOR
AC:PD
PN:343
FE:SGN
XX:954040.7426
YY:3077884.6238
ZZ:212.3596
PD:SIGN
AC:PD
PN:344
FE:PP
XX:953999.7431
YY:3077870.4005
ZZ:214.0668
PD:POWER POLE
AC:PD
PN:357
FE:SW
XX:953997.9114
YY:3077866.6324
ZZ:215.1754
PD:SIDEWALK ROCK
AC:PD
PN:358
FE:SW
XX:953998.8953
YY:3077866.9369
ZZ:215.1296
PD:SIDEWALK ROCK
DS:56.8800
AC:PD
PN:359
FE:RW
XX:953999.5062
YY:3077867.6955
ZZ:213.8196
PD:SIDEWALK ROCK
PD:TOE OF ROCK WALL
AC:PD
PN:360
FE:RW
XX:954000.4766
YY:3077866.2010
```

```
ZZ:213.2449
PD:TOE OF ROCK WALL
AC:PD
PN:362
FE:RW
XX:954001.2832
YY:3077863.8824
ZZ:212.7785
PD:TOE OF WALL
AC:PD
PN:363
FE:RW
XX:954002.1648
YY:3077861.1981
ZZ:212.4926
PD:TOE OF WALL
AC:PD
PN:364
FE:RW
XX:954004.4344
YY:3077848.3485
ZZ:212.4027
PD:TOE OF WALL
AC:PD
PN:365
FE:RW
XX:954005.5983
YY:3077842.5158
ZZ:212.4196
PD:TOE OF WALL
AC:PD
PN:366
FE:RW
XX:954007.9595
YY:3077830.5586
ZZ:212.4468
PD:TOE OF WALL
AC:PD
PN:367
FE:RW
XX:954008.2383
YY:3077828.0784
ZZ:213.0342
PD:TOE OF WALL
AC:PD
PN:376
FE:BLD
XX:954011.1045
YY:3077829.6266
ZZ:212.3909
PD:SW CORNER OF BLDG
AC:PD
PN:377
FE:STP
XX:954008.5266
YY:3077834.9133
ZZ:212.3655
PD:STAIR WAY
PD:8 STEPS
AC:PD
PN:378
FE:STP
XX:954009.5838
YY:3077835.1315
ZZ:212.3807
PD:STAIR WAY
AC:PD
PN:379
FE:STP
XX:954009.9297
YY:3077833.1776
```

```
ZZ:213.8163
PD:STAIR WAY
AC:PD
PN:380
FE:STP
XX:954008.8653
YY:3077832.9899
ZZ:213.8188
PD:STAIR WAY
AC:PD
PN:381
FE:STP
XX:954010.1251
YY:3077832.0015
ZZ:213.8115
PD:STAIR WAY
AC:PD
PN:382
FE:STP
XX:954009.0443
YY:3077831.8497
ZZ:213.8082
PD:STAIR WAY
AC:PD
PN:383
FE:BLD
XX:954005.7758
YY:3077862.4625
ZZ:212.2597
PD:NW BLDG CORNER
AC:PD
PN:404
FE:BLD
XX:954075.1680
YY:3077873.6706
ZZ:212.3185
PD:NE CORNER OF BLDG
AC:PD
PN:405
FE:SW
XX:953999.8469
YY:3077861.8124
ZZ:215.5752
PD:ROCK WALK
AC:PD
PN:406
FE:SW
XX:954001.8156
YY:3077848.9826
ZZ:215.9295
PD:ROCK WALK
PD:CONC SW
AC:PD
PN:407
FE:SW
XX:954001.9672
YY:3077848.0970
ZZ:215.8967
PD:ROCK WALK
AC:PD
PN:408
FE:SW
XX:954002.9400
YY:3077842.0984
ZZ:215.8570
PD:ROCK WALK
AC:PD
PN:409
FE:SW
XX:954003.1686
YY:3077841.1065
```

```
ZZ:215.9248
PD:ROCK WALK
AC:PD
PN:411
FE:WDFN
XX:954003.0793
YY:3077826.9855
ZZ:215.4660
PD:WOOD FENCE 6 FT
AC:PD
PN:412
FE:WDFN
XX:954005.0586
YY:3077827.8070
ZZ:215.0940
PD:WOOD FENCE 6 FT
AC:PD
PN:413
FE:WDFN
XX:954007.2269
YY:3077827.2442
ZZ:213.8427
PD:WOOD FENCE 6 FT
AC:PD
PN:414
FE:WDFN
XX:954012.4792
YY:3077828.5974
ZZ:212.4440
PD:WOOD FENCE 6 FT
AC:PD
PN:415
FE:RW
XX:954004.2499
YY:3077827.9463
ZZ:215.4362
PD:TOP RET WALL
AC:PD
PN:416
FE:RW
XX:954006.4272
YY:3077828.1917
ZZ:215.2019
PD:TOP RET WALL
AC:PD
PN:417
FE:RW
XX:954003.7935
YY:3077841.8470
ZZ:215.3016
PD:TOP RET WALL
AC:PD
PN:418
FE:RW
XX:954000.0027
YY:3077862.5103
ZZ:215.0025
PD:TOP RET WALL
AC:PD
PN:423
FE:SW
XX:954005.0104
YY:3077829.2335
ZZ:216.0000
PD:SIDEWALK
AC:PD
PN:424
FE:SW
XX:954003.8887
YY:3077829.0941
ZZ:215.9732
```

```
PD:SIDEWALK
AC:PD
PN:425
FE:SW
XX:954001.9317
YY:3077840.8960
ZZ:215.9464
PD:SIDEWALK
AC:PD
PN:426
FE:SW
XX:954001.7336
YY:3077841.9177
ZZ:215.8201
PD:SIDEWALK
AC:PD
PN:427
FE:SW
XX:954000.7567
YY:3077847.9391
ZZ:215.8242
PD:SIDEWALK
AC:PD
PN:428
FE:SW
XX:954000.6508
YY:3077848.8228
ZZ:215.9669
PD:SIDEWALK
AC:PD
PN:433
FE:STP
XX:954005.9395
YY:3077831.3123
ZZ:215.9548
PD:STAIRS
AC:PD
PN:434
FE:STP
XX:954004.7365
YY:3077831.1119
ZZ:215.9705
PD:STAIRS
AC:PD
PN:435
FE:STP
XX:954004.5228
YY:3077832.1706
ZZ:215.9613
PD:STAIRS
AC:PD
PN:436
FE:STP
XX:954005.7614
YY:3077832.3942
ZZ:215.9561
PD:STAIRS
PD:12 STEPS
AC:PD
PN:437
FE:BLD
XX:954080.5070
YY:3077840.8663
ZZ:211.9630
PD:SE BLDG CORNER
CP:04/05/2000 15:15:10
BG:BEGIN CHAIN LIST
AC:CH
FE:CRB
FG:7
PL:181-183,185,198
```

```
AC:CH
FE:EP
FG:8
PL:300-304
AC:CH
FE:OE
FG:18
PL:330,331
AC:CH
FE:SW
FG:24
PL:357,358,405,406-409,423-428
AC:CH
FE:RW
FG:25
PL:359,360,362,363-367
AC:CH
FE:BLD
FG:27
PL:376,383,404,437
AC:CH
FE:STP
FG:28
PL:377-382,433-436
AC:CH
FE:WDFN
FG:1
PL:411-414,100-103
AC:CH
FE:RW
FG:31
PL:415-418
AC:CH
FE:BE
FG:33
PL:429-432
EG:END CHAIN LIST
CP:04/05/2000 15:15:10
```

Sample Control File

```
AC:PR                  (Optional but recommended)
PR:JOB 001234
NM:STATE HWY 1– HWY 71
CM:CONTROL FILE
DT:03/26/1998
HD:NAD 1983 (1996)    (Any SDMS compliant data tags
VD:NAVD 1988           may follow the AC:PR)
UL:M
ZN:4802
AC:OS
PN:1
YC:207471.554
XC:759409.835
ZC:282.994
FE:CONTROL
PD:5/8 REBAR
SX:0.005
SY:0.005
SZ:0.02
AC:OS
PN:2
YC:206635.500
XC:759717.549
ZC:307.162
FE:CONTROL            (Any SDMS descriptive data tags
PD:REBAR AND CAP       may added but none are required)
ST:10+00
OF:50
SX:0.008
```

```
SY:0.008
SZ:0.01
```

Sample Horizontal Alignment File (ALI) - PC/PT Definition

```
AC:PR
PR:JOB 001234
NM:STATE HWY 1– HWY 71
CM:CONTROL FILE
DT:03/26/1998
HD:NAD 1983 (1996)     (Any SDMS compliant data tags
VD:NAVD 1988            may follow the AC:PR) **
UL:M3
ZN:4802
AC:SS
PN:1
ST:14+33.60
YC:30000.0000
XC:60000.0000
AC:SS
PN:2
ST:32+77.64
YC:29962.9903
XC:61843.6648
SI:PC
RA:3819.7187
AC:SS
PN:4
ST:45+80.97
YC:29717.1740
XC:63117.1778
SI:PT
AC:SS
PN:5
ST:53+80.98
YC:29434.3893
XC:63865.5458
SI:PC
RA:-2864.7890
AC:SS
PN:7
ST:6315.15
YC:29251.2244
XC:64777.364165
SI:PT
AC:SS
PN:8
ST:65+54.32
YC:29242.8080
XC:65016.3860
```

Sample Horizontal Alignment File (.ALI) with Spirals and Equations - PI Definition in List Format

```
AC:PR
PR:STH67
NM:STATE HWY A – HWY B
CM:DESIGN HORIZONTAL ALIGNMENT
DT:03/26/1998
UL:M3
HD:NAD 1983 (1996)
VD:NAVD 1988
ZN:4802
RE:GENO
DT:03/26/1998
RE:GENO
```

```
TY:PI
AC:EQ  (All equations listed immediately following AC:PR)
EQ:1
SB:11+374.836
ST:11+400.000
AC:EQ
EQ:2
SB:12+172.297
ST:12+140.000
AC:OS                         ***(Beginning PI)***
ST:10+973.656
YC:206370.369000
XC:759735.757000
AC:OS
SI:PI                         ***(Spiral Curve Spiral)***
YC:206655.052023
XC:759712.393480
S1:30.000000
S2:30.000000
RA:435.000000
AC:OS
SI:PI                         ***(Spiral Curve Spiral)***
YC:206971.980072
XC:759516.707250
S1:50.000000
S2:50.000000
RA:592.379000
AC:OS
SI:PI                         ***(Simple Curve)***
YC:207400.163795
XC:759447.697336
RA:-435.000000
AC:OS
SI:PI                         ***(Simple Curve)***
YC:207594.266000
XC:759322.394000
RA:-582.126000
AC:OS
SI:PI                         ***(Simple Curve)***
YC:207777.366789
XC:759158.093290
RA:480.000000
AC:OS
SI:PI                  ***(RSR - Radius Spiral Radius)***
YC:208076.928466
XC:759174.304456
R1:300.000000
R2:400.000000
S3:150.000000
AC:OS
SI:PI                         ***(Ending PI)***
YC:208605.886025
XC:759457.507387
```

Sample Vertical Alignment File (.PRO) - PI Definition

```
AC:PR
PR:STH67.PRO
NM:STATE HWY A – HWY B
CM:DESIGN CENTERLINE PROFILE
DT:03/26/1998
RE:GENO
UL:M3
AC:OS
SI:VPI
ST:10+974.000
ZC:299.024000
L1:0.000000
```

```
L2:0.000000
AC:OS
SI:VPI
ST:11+240.000
ZC:307.998840
L1:225.000000
L2:225.000000
AC:OS
SI:VPI
ST:11+725.164,2        (Second Occurrence of the Station)
ZC:284.000640
L1:125.000000
L2:125.000000
AC:OS
SI:VPI
ST:12+142.867,3        (Third Occurrence of the Station)
ZC:284.000640
L1:100.000000
L2:100.000000
AC:OS
SI:VPI
ST:12+342.867,3        (Third Occurrence of the Station)
ZC:275.500640
L1:100.000000
L2:100.000000
AC:OS
SI:VPI
ST:12+494.867,3        (Third Occurrence of the Station)
ZC:275.500640
L1:0.000000
L2:0.000000
AC:OS
SI:VPI
ST:13+402.462,3        (Third Occurrence of the Station)
ZC:279.999998
L1:0.000000
L2:0.000000
```

Sample Superelevation File (.SUP) - PI Definition

```
AC:PR
PR:STH67.SUP
NM:STATE HWY A – HWY B
CM:DESIGN SUPERELEVATION FILE THROUGH
CM:THE FIRST CURVE
DT:03/26/1998
UL:M3
VD:NGVD 1929
HD:NAD 1983 (1991)
ZN:4802
RE:GENO
AC:OS
ST:10+973.656
E1:-0.020000
E2:-0.020000
AC:OS
ST:11+129.667
E1:-0.020000
E2:-0.020000
AC:OS
ST:11+139.836
E1:-0.020000
E2:0.000000
AC:OS
ST:11+169.836
E1:-0.059000
E2:0.059000
AC:OS
ST:11+344.836
E1:-0.059000
```

```
E2:0.059000
AC:OS
ST:11+400.000
E1:-0.020000
E2:0.000000
AC:OS
ST:11+410.169
E1:-0.020000
E2:-0.020000
```

The GPS Task (TK:GPS) Sample SDMS Project File

```
AC:PR
TK:GPS
PR:HMDAY1
UL:M
HD:NAD83
GD:GEOID03
TV:MARK
AC:OS
PN:WIL1
IT:Trimble 4000SSI
SN:3613A15012
AT:Trimble Geodetic L1/L2 Compact +Groundplane
SN:0220054190
IH:0.000
AC:FS
PN:BASE
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:13451.012
VY:3468.604
VZ:-265.403
C1:0.00000299
C2:-0.00000456
C3:0.00000189
C4:0.000002167
C5:-0.00000703
C6:0.00000777
BT:14:54:42 04/24/2004
SO:FIXED
FR:IONO FREE
SV:7
NS:412
IP:P4.3
AC:OS
PN:BASE
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
AC:FS
PN:TP1
IT:Topcon Legacy E
SN:LE2053
AT:Javad Legant 2
SN:223-0486
IH:2.000
VX:-100.030
VY:-718.126
VZ:-763.969
C1:0.00000048
C2:-0.00000071
C3:0.00000030
C4:0.00000339
```

```
C5:-0.00000113
C6:0.00000126
BT:14:54:42 04/24/2004
AC:OS
PN:TP1
IT:Topcon Legacy E
SN:LE2053
AT:Javad Legant 2
SN:223-0486
IH:2.000
AC:FS
PN:HOME
IT:Topcon Legacy E
SN:LE2168
AT:Javad Legant E
SN:LA3215
IH:0.000
VX:2866.705
VY:-2906.210
VZ:-3826.202
C1:0.00000147
C2:-0.00000185
C3:0.00000126
C4:0.00000695
C5:-0.00000398
C6:0.00000559
BT:15:35:47 04/24/2004
AC:OS
PN:HOME
IT:Topcon Legacy E
SN:LE2168
AT:Javad Legant E
SN:LA3215
IH:0.000
AC:FS
PN:TP10
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:-8188.220
VY:-2763.893
VZ:-967.204
C1:0.00000050
C2:-0.00000043
C3:0.00000023
C4:0.00000261
C5:-0.00000123
C6:0.00000202
BT:18:45:22 04/24/2004
AC:OS
PN:TP10
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
AC:FS
PN:TP11
IT:Topcon Legacy E
SN:LE2053
AT:Javad Legant 2
SN:223-0486
IH:2.000
VX:-1109.109
VY:-402.026
VZ:-139.195
C1:0.00000035
C2:-0.00000014
C3:0.00000020
```

```
C4:0.00000169
C5:-0.00000091
C6:0.00000210
BT:18:45:22 04/24/2004
AC:OS
PN:TP11
IT:Topcon Legacy E
SN:LE2053
AT:Javad Legant 2
SN:223-0486
IH:2.000
AC:FS
PN:TP12
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
VX:-399.389
VY:-676.790
VZ:-638.797
C1:0.00000063
C2:-0.00000078
C3:0.00000042
C4:0.00000692
C5:-0.00000276
C6:0.00000155
BT:17:39:12 04/24/2004
AC:OS
PN:TP12
IT:Topcon Legacy E
SN:LE2550
AT:Javad Legant E
SN:LA3530
IH:2.000
AC:FS
PN:WIL1
IT:Trimble 4000SSI
SN:3613A15012
AT:Trimble Geodetic L1/L2 Compact +Groundplane
SN:0220054190
IH:0.000
VX:-6520.978
VY:3998.397
VZ:6600.799
C1:0.00000283
C2:-0.00000446
C3:0.00000239
C4:0.00002745
C5:-0.00001158
C6:0.00000642
BT:17:39:02 04/24/2004
```