FactoryLink 7

Version 7.0

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PowerSPC Configuration Guide

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PowerSPC Configuration Guide

Preface

Purpose

FactoryLink PowerSPC is a quality management tool that monitors the quality level at which a manufacturing process produces outcome.

This guide is prepared to present the technical information that programmers of this system need to complete their applications.

The following guidelines help focus our purpose and goals to meet customer requirements:

- Accuracy is paramount—This FactoryLink documentation must provide accurate and reliable information and procedures.
- Time is valuable—This FactoryLink documentation must guide the programmer through what he needs to know quickly and efficiently.

Audience

The major audience of this guide is individuals who develop automation processing programs to track measurements and inspect results to gain and keep control of the manufacturing processes.

In addition, FactoryLink Customer Support Services personnel use the procedures and examples included here to help you develop and troubleshoot your applications.

Structure of the *PowerSPC Configuration Guide*

The *FactoryLink ECS PowerSPC Configuration Guide* is an additional manual in the overall FactoryLink Documentation Set. For the structure of the entire Documentation Set, refer to the Preface in *FactoryLink ECS Fundamentals*.

This guide is divided into twelve chapters:

- Overview
- Getting Started with PowerSPC
- Tutorial for the Dimensional Application
- Tutorial for the Characteristic Application
- Creating a Powerful SPC Sample Plan
- Configuring the Processes
- Drawing and Animating Display Charts
- Configuring SPC Charts
- Customizing Your Process

- Configuring Panel Quick Reference
- Cleanup Utility
- User-defined Control Limit Calculation Factors

How to Use This Guide

The material in this guide is presented sequentially in learning order. We recommend you familiarize yourself with the material before you proceed to develop your application.

PowerSPC at a Glance

Located at the beginning of this guide is a section named PowerSPC at a Glance. This section provides hypertext links to locations for quick access to information to perform the procedures detailed in each chapter.

Conventions

The material in the Documentation Set adheres to the guidelines published in *The Digital Technical Documentation Handbook* by Schultz, Darrow, Kavanagh, and Morse; *Developing International User Information* by Jones, Kennelly, Mueller, Sweezy, Thomas, and Velez; and corporate style guidelines. The *FactoryLink ECS PowerSPC Configuration Guide* is also referred to as *PowerSPC Configuration Guide*.

PowerSPC Configuration Guide uses the following conventions.

Convention	Description
…	Horizontal ellipsis points indicate the omission of material from an example. The information is omitted because it is not important to the topic being discussed.
. . .	Vertical ellipsis points indicate the omission of information from an example or command format. The information is omitted because it is not important to the topic being discussed.
italic type	Italic type is used to denote user-supplied variables in command examples. Italic type also sets off references to specific documents.

Convention	Description
monospace type	Monospace type is used to denote command names and code examples or example output.
bold monospace type	Bold monospace type is used in command examples to indicate words that must be typed literally.
sans serif type	Sans Serif type is used to set off field names, button names, and keys on the keyboard.
blue type	Blue type is used for headings and to call attention to information within the text.
press nnnnn	Press is used to denote a key on the keyboard. The key name will appear in a sans serif type.
click nnnnn	Click is used to denote a button on the screen. The button name will appear in a sans serif type.
Shift+F1	The + indicates the keys must be pressed simultaneously. Shift+F1 indicates you hold down the Shift key while you press another key or mouse button (indicated here by F1). Other key combinations are presented in the same manner.
F1 F2 F3	The space between the key callouts indicates press and release. The key sequence F1 F2 F3 indicates you press and release F1, then F2, and then F3. Other key combinations are presented in the same manner.
File>Open	The > indicates a progression through a menu sequence. File>Open indicates you choose Open from the File menu to perform the required action. Other menu sequences are presented in the same manner.

Convention	Description
FLAPP\user\drw\mydrw.g	The \ indicates the directory structure for the listed file. FLAPP\user\drw\mydrw.g indicates the drawing file mydrw.g is located in the drw sub-directory of the user sub-directory to the FLAPP directory. Other directory structures are presented in the same manner.
[ ]	Brackets indicate an optional argument. You can choose none, one, or all of the options.
{ } and |	Braces indicate a choice. You must choose one of the elements. The vertical bar separates choices within braces.

Example Syntax

Example syntax using these conventions is provided below:

command *input_file* [*input_file*…] {*a*|*b*} *output_file*

where

command	is typed as it is displayed in the syntax.
input_file	indicates a variable the user supplies.
[*input_file*…]	indicates the user can optionally supply multiple input file names, each name separated by a space.
{*a*|*b*}	indicates either the a or b must be specified as an argument.
output_file	indicates the user must specify an output file.

Getting Help

Contact your Sales or Customer Support Representative for help with troubleshooting problems.

Also, help files are included for each configuration panel. Click Help on the panel menu bar to access these files.

PowerSPC at a Glance

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For details on performing the following steps...	**Go to...**
1. Read about Principles of PowerSPC Operation, Domain Considerations, Sample Plans, Data Collection, PowerSPC Calculations, PowerSPC Charts, Process Evaluation, and Tag Constant Field.	Chapter 1, “Overview”
2. Read about Setting Up an Application, Converting SPC Historical Data to PowerSPC, Starting with a Sample Application, and Ensuring the Correct Tasks Start Automatically, Setting Command Line Switches.	*Chapter 2, “Getting Started with PowerSPC”*
3. Complete a tutorial about Build Sequence for the PowerSPC Dimension Application, Overview of the Dimension Application, Configuring the Sample Plan, Configuring the Historian for the PowerSPC Process, Configuring the PowerSPC Process, Drawing and Animating the PowerSPC Screen, Configuring the PowerSPC Charts, Customizing Your Process, and Testing the Application.	Chapter 3, “Tutorial for the Dimension Application”
4. Complete a tutorial about Build Sequence for the PowerSPC Characteristic Application, Overview of the Characteristic Application, Configuring the Sample Plan, Configuring the Historian for the PowerSPC Process, Configuring the PowerSPC Process, Drawing and Animating the PowerSPC Screen, Configuring the PowerSPC Charts, Customizing Your Process, and Testing the Application.	Chapter 4, “Tutorial for the Characteristic Application”

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5. Read about Application/Sample Plan Design Note, Accessing the PowerSPC Sample Plan Option, Defining Sample Plan, Defining Data to Collect, Defining the Sample Plan Calculation, and Establishing the Sample Plan Run Rules.	Chapter 5, “Creating a PowerSPC Sample Plan”
6. Read about Accessing the PowerSPC Process Option, Defining the Process to Be Monitored, Defining the Raw Data to Be Collected, Defining the Auxiliary Data to Be Collected, Establishing Acceptance Sampling, Defining the Calculation, and Establishing the Run Rules.	Chapter 6, “Configuring the Processes”
7. Read about Drawing and Animating the Chart, Adding Legends to the Chart, Adding a Value Cursor to the Chart, Adding a Real-time and Historical Mode Switching, and Animating Additional Objects for Miscellaneous Functions.	Chapter 7, “Drawing and Animating Display Charts”
8. Read about the Overview of Linking a Chart to PowerSPC, Autosaving, Accessing the PowerSPC Chart Option, Linking the PowerSPC Components, Customizing a Control Chart, Displaying Auxiliary Data for a Point on a Control Chart, Configuring a Bar Chart, Setting up SPC to Perform Population Calculations, Creating an Ad Hoc Control Chart, and Customizing Color, Line, and Point Styles.	Chapter 8, “Configuring SPC Charts”
9. Read about Defining Custom Cause Codes, Defining Custom Run Rules, Defining Database Columns for Storing Auxiliary Data, and Modifying Auxiliary Data Column in the Database.	Chapter 9, “Customizing Your Process”
10. Quick way to reference the configuration panels.	Chapter 10, “Configuration Panel Quick Reference”
11. How to configure the PowerSPC database cleanup panels.	Chapter 11, “Cleanup Utility”

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12. Define your own Control Limit Factors.	Chapter 12, “User-defined Control Limit Calculation Factors”

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Chapter 1

Overview

Statistical Process Control (SPC) is a quality management tool that monitors the quality level of a manufacturing process. SPC measures, inspects, and evaluates the level of quality of products based on predefined criteria.

FactoryLink's PowerSPC module

- Automates your quality management so you no longer have to manually track the measurements or inspection results
- Helps you gain and keep control of your manufacturing process
- Helps you produce units consistently to meet customer requirements

Using PowerSPC, you measure the performance of processes. If you need to make adjustments to a process based on its performance, PowerSPC allows you to measure how that adjustment affects the process. You can do this whether you want to bring a process under control or implement a higher level of performance. PowerSPC is a quality management tool that uses FactoryLink's patented Real-Time Database environment and other unique features to perform the following functions:

- Collect real-time product data from an array of sources, such as external devices, databases, and communication protocols, to determine the strengths and weaknesses of the production process at your company, and devise ways and means to improve upon the current process.
- Calculate various statistics to indicate the state of the process.
- Graphically display data in statistical control charts. Data can be displayed:
    1. As monitored—Displays data as it is monitored in real-time mode
    2. Historically—Displays data that was collected previous to the current time
    3. Ad hoc—Displays data in what if scenarios using real-time or historical data
- Continually monitor and evaluate the state of statistical calculations for a process as data is collected as well as evaluate the capability of a process. The evaluation provides a way to measure whether the process is producing products that meet specifications.

This chapter introduces concepts you must understand to configure PowerSPC.

Principles of PowerSPC Operation

The PowerSPC module consists of two separate but related tasks:

- PowerSPC Data—Collects, calculates, evaluates, and archives SPC data. It also sends alarm information to the Alarm Supervisor module, which you need to configure.
- PowerSPC Graph—Retrieves current or previously collected SPC data from the database via the Historian and sends it to the Graphics task at run time for display on a graphic screen.

Together, these tasks collect, calculate, evaluate, and archive data, then display this data in charts on graphics screens.

Both of these tasks, collectively referred to as PowerSPC or just SPC, work in conjunction with a FactoryLink Historian to gather data in a relational database and with the FactoryLink Graphics task at run time to display the data to you. Because PowerSPC Data can send data directly to a relational database for storage, you do not need to use the FactoryLink Database Logger module.

Communicating with a Relational Database

PowerSPC stores its collected data in a relational database, such as Oracle or dBASE IV. It communicates with the database through a FactoryLink Historian.

At run time, PowerSPC can access as many databases at the same time as system resources allow. Other FactoryLink Historian-client tasks, such as Trending and Browser, can also access the same or other databases at the same time; however, connecting to a large number of databases at once may affect system performance.

A -W[5-36,000] or -w[5-36,000] program argument specifies the maximum timeout in seconds for PowerSPC to wait for a response from the Historian task. The default is 30 seconds.

Intermodule Communications

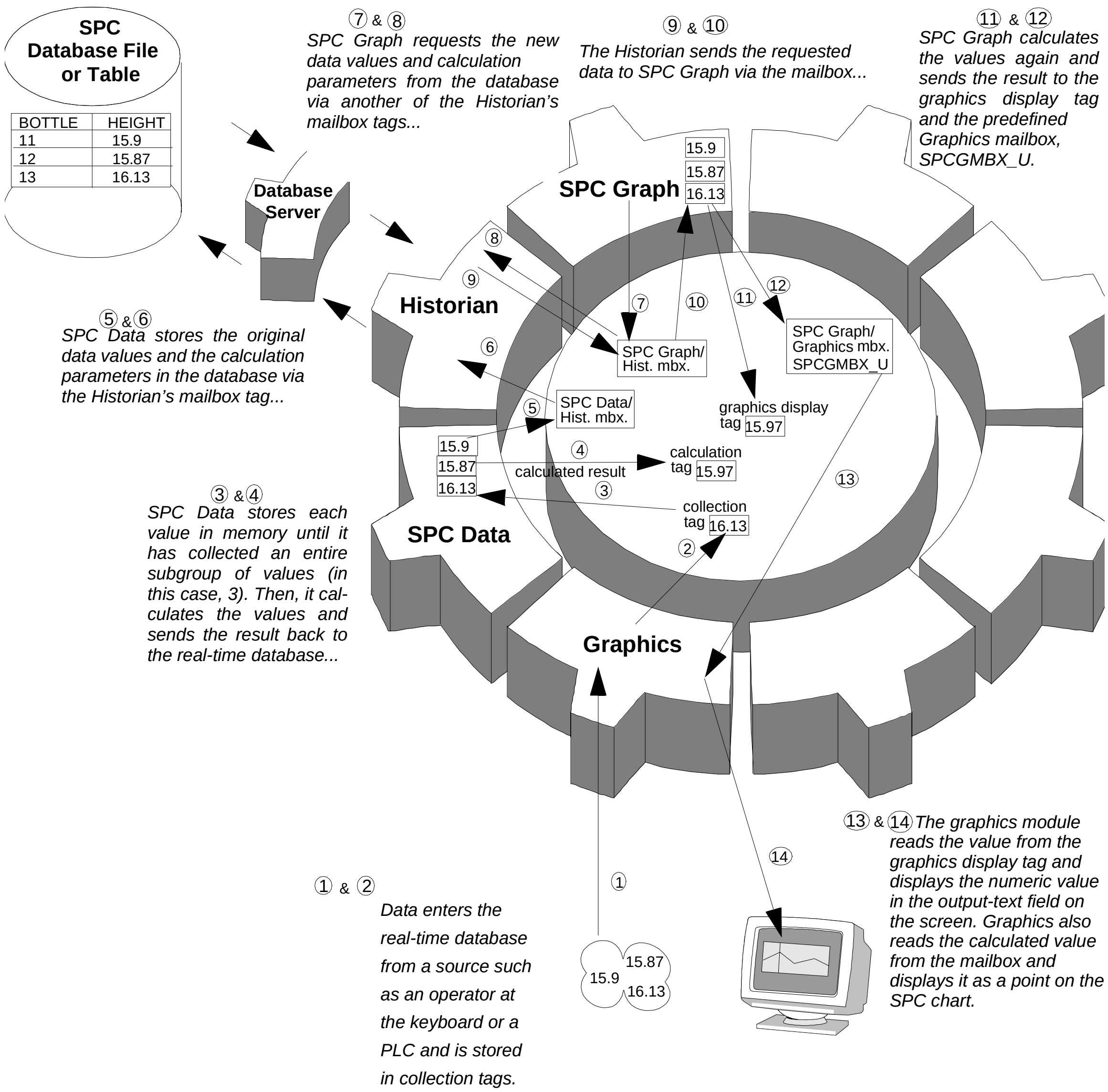
The SPC Data, SPC Graph, Graphics, and Historian tasks use mailbox tags to communicate:

- SPC Data/Historian mailbox tag lets SPC Data tell the Historian which data needs to be stored in the database.
- SPC Graph/Historian mailbox tag lets SPC Graph tell the Historian which data needs to be retrieved from the database.
- SPC Graph/Graphics mailbox tag, SPCGMBX_U, lets SPC Graph tell Graphics what to display and how to display it. This mailbox also lets Graphics tell SPC Graph what charts are being displayed and changed.

The following figure illustrates these principles. Notice in Step 4, SPC Data writes the calculated value to a calculation tag. In Step 11, SPC Graph writes the calculated value to a graphics display tag. Neither Graphics nor the Historian needs to read these tags. Their purpose is up to you.

For example, if you want to display the calculated value on a graphics screen in numerical form rather than a plotted point on a chart, animate an output-text field on a graphics screen using the graphics display tag.

Then, whenever SPC Graph calculates a new value, it writes the value to both the mailbox and the graphics display tag. The Graphics module reads the value from the graphics display tag and displays the numeric value in the output-text field on the screen. Graphics also reads the calculated value from the mailbox and displays it as a point on the SPC chart.


SPC Database File or Table
BOTTLE HEIGHT
11 15.9
12 15.87
13 16.13
Database Server
7 & 8
SPC Graph requests the new data values and calculation parameters from the database via another of the Historian's mailbox tags...
9 & 10
The Historian sends the requested data to SPC Graph via the mailbox...
11 & 12
SPC Graph calculates the values again and sends the result to the graphics display tag and the predefined Graphics mailbox, SPCGMBX_U.
5 & 6
SPC Data stores the original data values and the calculation parameters in the database via the Historian's mailbox tag...
3 & 4
SPC Data stores each value in memory until it has collected an entire subgroup of values (in this case, 3). Then, it calculates the values and sends the result back to the real-time database...
SPC Graph
Historian
SPC Data
Graphics
15.9
15.87
16.13
SPC Graph/ Hist. mbx.
SPC Graph/ Graphics mbx. SPCGMBX_U
SPC Data/ Hist. mbx.
graphics display tag 15.97
calculation tag 15.97
calculated result
collection tag 16.13
13 & 14 The graphics module reads the value from the graphics display tag and displays the numeric value in the output-text field on the screen. Graphics also reads the calculated value from the mailbox and displays it as a point on the SPC chart.
1 & 2
Data enters the real-time database from a source such as an operator at the keyboard or a PLC and is stored in collection tags.

Domain Considerations

You must configure and run SPC in the appropriate domain for it to run effectively. Before configuring a panel for any SPC option, ensure that the domain selected is the correct one in the Configuration Manager Domain Selection box. Use the following guidelines to determine which is the correct domain:

- Configure the processes panels in the SHARED domain.
- Draw and animate the SPC charts in the Application Editor in the USER domain. This is the default.

  Each operator should be able to control the data that he or she views; therefore, SPC Graph and all view control tags, such as animated buttons for selecting data, should run in the USER domain. Since different operators can look at different data, what one operator changes does not affect what another operator sees.
- Even though graphic screens are configured in the USER domain, pay close attention to the domain you define each tag in. When needed, define tags, especially those for data collection, in the SHARED domain. Remember the USER domain can read SHARED domain tags but the SHARED domain cannot read or write to USER domain tags.
- Configure the charts panels in the USER domain.
- Configure the Historian information in the SHARED domain to maintain the integrity of the database. Since SPC collects data and stores it in the database via the Historian, the portion of PowerSPC that controls the collection of data (the processes portion) must also run in the SHARED domain. Conversely, each operator should be able to control the data he or she views; therefore, all view control tags, such as animated buttons for selecting data, should run in the USER domain. Since different operators can look at different data, what one operator changes does not affect what another operator sees.
- Since SPC Data collects data and stores it in the database via the Historian, it must also run in the SHARED domain. This is the default.
- Configure the SPC to PowerSPC Database Conversion panel in the SHARED domain. Configure this panel if you are converting data archived using a previous version of SPC.

You do not need to select a domain for the Sample Plans and User-Defined Auxiliary Data, Run Rules, and Cause Codes panels. These panels are independent from domains. After configuring these panels, you can see the same configuration information in either domain.

Sample Plans

Mature quality management programs often include a set of predefined methods and practices to measure and evaluate quality. PowerSPC provides the means for implementing such methods and practices with sample plans. When setting up a sample plan, specify predefined instructions for a process, such as the following items:

- Sampling method to use
- Calculations to perform on the collected data
- Type of control monitoring to perform

PowerSPC sample plans are flexible enough to let you either set guidelines requiring strict compliance or more general ones. When using a sample plan, you can choose to allow run-time changes to the preset parameters for the sample plan. The idea behind sample plans is to help you set up a statistical process control program to suit your needs.

Typically, you create at least one sample plan for each process. Because sample plans are not dependent on the data being collected, where the data is being stored, or the location of the data being collected, you can reuse PowerSPC sample plans for multiple processes.

It is useful to have more than one sample plan available for a process. If you create one sample plan with increased sample sizes to use during equipment startup, create another with reduced sample sizes to use after the process has reached steady-state conditions.

When the process starts, the process equipment needs to warm up before it reaches a steady level of quality production. Until the equipment warms up, use an increased sample size to determine whether the equipment is producing quality parts. Load the sample plan with the increased sample size. After the process has been running for a while, you know the equipment has warmed up and is producing quality parts, then you can load the sample plan with the reduced sample size.

Whenever you load a sample plan, the system writes the sample plan values. If you want to view or modify these values, define corresponding tags in the processes panels. SPC then collects data and performs calculations based on the new set of instructions.

Sampling Methods

Since it may be impractical to measure every product manufactured, use statistics to estimate the level of variation among all products in a subgroup without inspecting each product. If you measure a sample or random portion of the products manufactured, you can estimate the level of variation among all of the products manufactured without measuring all of them.

PowerSPC supports two sampling methods: process sampling and acceptance sampling. Which method to use depends on whether you want to identify quality problems while units are being produced or measure and evaluate a subset of units after the units are produced, and then pass or fail the entire group of units based on specified criteria.

Process Sampling

Use process sampling to identify quality problems while units are being produced. Process sampling is measuring and inspecting the units as they are being produced and displaying the results on charts so the operator can see when a problem begins.

If incoming data contains random variability within established control limits, SPC considers the process to be in control. If PowerSPC detects that unit(s) measured or inspected varies beyond established control limits, it notifies the operator that something is wrong. The operator might discard the units if they vary too far from the requirements and try to determine what caused the variation. Assign a cause (called an assignable cause) for what caused the variation.

Acceptance Sampling

If the quality of your products depends on the quality of raw material or another incoming product, use acceptance sampling to prevent introducing quality problems into your production line.

To perform acceptance sampling, measure and inspect a specified number of the samples (called the sample size) from the lot (also called a batch). Then, use accept criteria to assess the quality. Accept criteria specifies the minimum number of units or portion of the unit in the inspected group that must meet all specification requirements before SPC will pass the entire lot. The product specifications define the criteria that the units must meet.

Acceptance sampling may be useful if you purchase goods from another manufacturer and want to ensure that they meet an expected level of quality before accepting and agreeing to pay for them.

Measurement and Inspection

With PowerSPC, you might monitor dimensions and characteristics of the product or process to determine variations in quality. Before deciding on what aspects to monitor, keep in mind that PowerSPC provides partitioning of data by process subgroup. Data collected under the same process subgroup can be analyzed and displayed together. Currently PowerSPC does not provide the joining or analysis of data from different process subgroups.

For example, one of the manufacturing processes in your factory produces glass beverage bottles in two sizes, 20 oz. and 16 oz. Because they are different sizes, you use different criteria to determine whether they meet quality specifications; therefore, group the data into two subgroups: one subgroup for each size.

Dimensions

If the size of a product is important, monitor the dimensions of it, such as length, width, depth, and weight. Likewise, if the temperature, speed, or viscosity are important for determining the level of quality in the process, also measure these process dimensions. The data you obtain from such measurements is called dimension data (also known as variable data).

To determine the accuracy of a method for measuring dimensions, use a Gage Repeatability and Reliability Study (Gage R & R). A Gage R & R tests the reliability of a measuring device based on the repeated measurement of one particular item. For example, to determine the degree of accuracy of a scale, you could weigh one product fifty times, then use a statistical method to evaluate the resulting measurements. While PowerSPC gives you the capability of collecting the measurements, it cannot evaluate those measurements for the purpose of a Gage R & R.

Characteristics

Although the dimensions of a product may meet quality criteria, the product may still not meet acceptable levels of quality if it contains defects, such as cracks, scratches, dents, chips, missing or misplaced labels, or incorrect colors; therefore, you may also want to inspect the product for the existence of certain characteristics, such as specific defects. The data you obtain from such inspections is called characteristic data (also known as attribute data). Characteristics are classified as defect characteristics or defective characteristics.

You can measure the quality of a unit based on the presence of undesirable characteristics. If a unit contains an undesirable characteristic or does not contain a required characteristic, it is measured as bad. Otherwise, the unit is good. A unit is either defective or it is not.

Depending on the characteristic, its presence on a unit may not render it as bad. For example, if a unit contains air bubbles, which are undesirable, it contains defects, but it still may be usable; therefore, the unit is not defective, but it does contain defects. On the other hand, if a unit is cracked, it is unusable and is thus defective.

PowerSPC uses statistical methods of assigning numbers to the results of inspections for characteristics. Once it has numbers for the results, it can perform specific calculations on the results and show them on a chart. For example, PowerSPC can keep a count of the total number of bubbles that appear on all units in a subgroup.

Calculations

Based on the sampling method used and the type of data collected (dimension and/or characteristic), decide what calculations PowerSPC will perform to provide the information needed to monitor your process. For a detailed list of calculations supported by PowerSPC, refer to “PowerSPC Calculations” on page 26 of this chapter.

Monitor Control

The last information specified in a sample plan concerns how PowerSPC monitors the calculations and evaluates the process. PowerSPC uses run rules to identify trends or patterns in variations of a product. For more details about run rules, refer to“Run Rules” on page 40 of this chapter.

DATA COLLECTION

PowerSPC collects various types of dimensional and characteristic product information from an external device, such as a programmable logic controller (PLC), a database, or operator input.

Types of Data Collected

PowerSPC can collect two types of information about a process:

- Raw data—Any measurement or inspection result collected from a unit
- Auxiliary data—Additional, descriptive information about a sample, such as an operator's name, the process line, part number, lot number, or shift number

Raw data

You can measure more than one dimension (variable) and/or inspect more than one characteristic (attribute) on the same product in the same sample. For example, you can measure the height and circumference of a bottle at the same time. You can also inspect the bottle for cracks, scratches, dents, and chips.

Monitoring more than one dimension or characteristic within the same sample lets you perform correlation tests between the results. For example, you can test whether the temperature of a liquid affects its viscosity.

Although typically you might inspect more units for characteristics than you would need to measure for correct dimensions, you can also measure dimensions and inspect characteristics from the same product in the same sample. For example, you can measure width, height, diameter, number of cracks, scratches, dents, and chips in the same sample.

Monitoring several dimensions and several characteristics within the same sample lets you obtain all the necessary data at one time without entering it at separate times or from separate stations, and without handling the product multiple times.

Auxiliary Data

Auxiliary data is additional, descriptive information about a sample, such as an operator name, process line, part number, lot number, or shift number. PowerSPC does not perform calculations on auxiliary data.

Collecting auxiliary data can be useful for reference purposes, such as determining whether greater variations in quality occur just after startup of a process.

Efficient Use of Disk Space for Archiving

PowerSPC's relational database design efficiently uses disk space to archive process data. To conserve disk space, SPC stores auxiliary data in a separate database table from raw data; however, it still retains relationships between auxiliary data and raw data. For example, SPC can track who the operator was when bottle #13 was measured at 15.26 cm. The operator and the bottle number are both auxiliary data, and the measurement is the raw data.

Considerations for Data Collection

Carefully consider the auxiliary data to be collected with raw data because any auxiliary data uses up disk space. Identify which auxiliary data will be most valuable for later analysis as early as possible. Information, such as operator name, or machine and part identification, for example, can be useful for a variety of purposes. You can always remove unnecessary information later, but you might not be able to associate the information if you add auxiliary data later instead of doing it initially.

Keep in mind, however, that collecting too much information can hinder the effectiveness of the operator entering the information. It is best to have any auxiliary data you collect automatically accessible through a FactoryLink tag.

Although PowerSPC does not allow you to select or search for data based on the contents in an auxiliary field, you can still trace parts by storing the part number in an auxiliary database column. Then, you can search for information about specific parts by either:

- Using FactoryLink's Database Browser module. See *FactoryLink ECS Configuration Guide* Chapter 28, "Database Browser."
- Manually searching for the auxiliary data by viewing the raw data associated with it. For information about viewing raw data, refer to "Displaying Raw Data for a Point on a Control Chart" on page 213 of this guide.

POWERSPC CALCULATIONS

Once PowerSPC collects a sample of data from a subgroup, it can compute the result that represents all of those samples. Then, it plots this result as a point on a chart.

For example, if you measure the height of five bottles (sample is 5 bottles, and subgroup is height) and then want to determine the following information based on your measurements:

- Average height of the five bottles
- How far the smallest measurement from the group varied from the largest measurement (the range)

Use PowerSPC to get this information by performing the following actions:

1. Collect and store the height measurement of each bottle.
2. Select the XBARR calculation to signal PowerSPC to add the five measurements together to find the sum. Then, divide the sum by five (the sample size). The result is the average height of the five bottles.
3. Select the RANGE calculation to signal PowerSPC to subtract the smallest measurement from the largest measurement.

The types of calculations you perform vary by the type of data collected, dimensional or characteristic, and what you want to know about the data. For example, the C calculation tells you the number of defects in a sample while the U calculation tells you the ratio of defects to the number of units sampled.

PowerSPC performs calculations on samples of data (statistically summarize five raw values to make one point) and on populations of data. A population is all the points currently visible on a chart.

Performing Calculations on Samples of Data

Choose the most appropriate calculation(s) to summarize samples of raw dimension data.

The dimension calculation . . .	Calculates the . . .
Individual	Value of each raw data sample as it is collected.
Average	Results of dividing the sum of a group of measurements by the number of units measured.
Range (R)	Differences between the largest and smallest raw data values in a subgroup.
Standard Deviation	Amount that a process varies from the center line (mean).
XBARR	Average value (mean) of a group of data values and calculates the control limit lines on the chart using the Range calculation.
XBARS	Average value (mean) of a group of data values and calculates the control limits on the chart using the Standard Deviation calculation.
Split	Average value (mean) of a group of data values. The Split chart contains two center lines, and the data that falls between the lines is considered acceptable. This chart type is useful for bimodal or heterogeneous process distributions.

Moving statistics use a sliding window when referencing data for calculations rather than exclusive subgroups. The subgroup or Calc Size determines the width in number of raw data values of the window. When you have collected more data values than are needed to fill a window, the oldest data value moves out of the calculation window as the next data value is available.

For example, if the Calc Size is 25, when the twenty-sixth data value becomes available, the first data value is removed from the calculation window; likewise with the twenty-seventh and second data value. The calculation is performed with each new data value.

The dimension calculation . . .	Calculates the . . .
Moving Range	The range calculation for a moving window of data.
Moving Average	The average calculation for a moving window of data.
EWMA	The exponentially weighted moving average for a window of data; however, less and less weight is given to a point as it ages.
Cp	Potential ability of a process to produce units within the tolerance limits. Cp is a moving calculation in that once the first calculation is made, the succeeding calculations are performed on a moving window basis (oldest value discarded as newest value comes in).
Cpk	How capable a process is of producing units within the tolerance limits when operating at the current process setup. Cpk is a moving calculation in that once the first calculation is made, the succeeding calculations are performed on a moving window basis (oldest value discarded as newest value comes in).

Statistics available for characteristic data include the following.

The characteristic calculation . . .	Calculates the . . .
C	Number of defects in a sample. This is useful when each unit might have more than one defect, such as several bubbles, or when each unit may have more than one type of defect, such as a bubble and a dent.
U	Ratio of the number of defects to the number of units inspected, the average number of defects per unit.
NP	Number of defective units, such as leaking units, the wrong color, or missing a label.
P	Ratio of defective units to the number of units inspected, the average number of defective units per subgroup.

Performing Calculations on Populations of Data

PowerSPC can perform calculations on a population of data, which is all the points currently visible on a chart. The calculations can be performed on all of the raw data represented by the points on the chart or on the grouped data (the points). PowerSPC displays the result in an output-text tag displayed on a screen or used by another FactoryLink task.

Raw Data Calculations for a Population

For example, if an Average chart (a chart plotting the average value of each subgroup) shows 10 points, each point is the average of five values. To find the average of the 50 values that make up the 10 points, average all 50 raw data values together. Then, PowerSPC displays the resulting numeric value. PowerSPC can perform other calculations (listed in the following table) on populations of raw data, not just averages.

Choose the most appropriate calculation to calculate the raw data from a population.

The population calculation . . .	Calculates the . . .
Average	Results of dividing the sum of all raw data measurements in a population by the number of units measured.
Standard Deviation	Amount a process varies from the center line (mean or average).
Range (R)	Differences between the largest and smallest raw data values that make up a population.
Minimum	Minimum raw data value from all raw data values in a population.
Maximum	Maximum raw data value from all raw data values in a population.
Kurtosis	Relative flatness or peakedness of the distribution values in a population. Use the result of the kurtosis calculation to identify symmetrical, but not normal, distributions. If the kurtosis value is positive, the distribution is flatter than a normal distribution; if it is negative, the distribution is more peaked. If the kurtosis value is **0**, the distribution is normal.
Skewness	Population symmetry on each side of the center line (mean). A skewed population is not symmetrical on each side of the center line and has a longer than normal tail on one side.
Cp	Potential ability of a process to produce units within the tolerance limits. When configured as a population calculation, the Cp index represents all the data currently visible on the chart.
Cpk	How capable a process is of producing units within the tolerance limits when operating at the current process setup. When configured as a population calculation, the Cpk index represents all the data currently visible on the chart.

The population calculation . . .	Calculates the . . .
C	Total number of defects in a population. This is useful when each unit might have more than one defect, such as several bubbles, or when each unit may have more than one type of defect, such as a bubble and a dent.
U	Ratio of the number of defects to the number of units inspected.
P	Ratio of defective units to the number of units inspected in a population.
NP	Total number of defective units in a population, such as leaking units, the wrong color, or missing a label.

Grouped Data Calculations for a Population

When you average a population of grouped data values, the result is called Bar. If you average 10 points of data from a Range chart, the calculation and the result are called RBAR (or $\overline{R}$). Likewise, if you average 10 points from a C chart, the calculation and the result are called CBAR (or $\overline{C}$).

Choose the most appropriate calculation to calculate statistics on subgroup data (points).

The population calculation . . .	Calculates the . . .
RBAR	Average of all points (calculated values) on a Range chart, the average range.
SBAR	Average of all points on a Standard Deviation chart, the average standard deviation.
POINTSBAR	Average of all points on any control chart. Refer to the Glossary for details about POINTSBAR.
Grand X	Average of all points on an XBARR, XBARS, Average, Split, or Individual chart.

RBAR, SBAR, and GRANDX may also be requested for other chart types. In these cases, PowerSPC computes each Subgroup's Range, Standard Deviation, or Average, and then averages these values.

POWERSPC CHARTS

Graphically displaying the results of the data collected and calculated helps to determine how good or bad the parts produced actually are and how well the process is operating; therefore, it is usually a good idea to display the results of calculations on an SPC chart.

PowerSPC can display data on either a

- Bar chart or
- Control chart

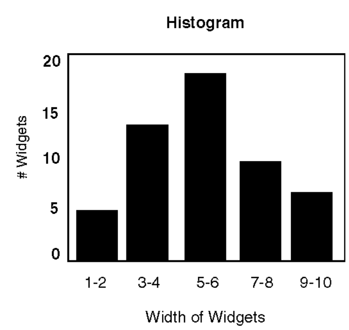
Bar Charts

There are three types of bar charts:

- Histogram
- Pareto
- Pareto-Defect

Histogram

A histogram displays measurement information about dimensional data. Each bar on the chart represents the frequency of values collected between a set of measurement values. For example, a bar shows the number of units whose height measurements fall between 4.5 cm and 6.5 cm. The next bar shows the number of units whose height measurements fall between 6.5 cm and 8.5 cm, and so on.

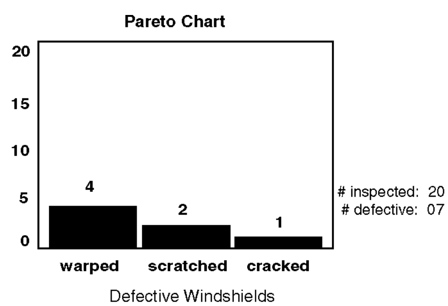


A histogram is a summary of a process. It shows the spread of measurements and the number of measurements. You can use a histogram to record the variations in a process over a given period of time or within a production lot.

For example, you can identify whether the width of a group of widgets varies from the product specifications and to what degree. Suppose out of 20 widgets you produce, the width varies from 1 mm to 10 mm; but, for quality widgets, the width must range only from 5 mm to 6 mm. Then you know the width variance is too great for quality widgets and you must adjust the process.

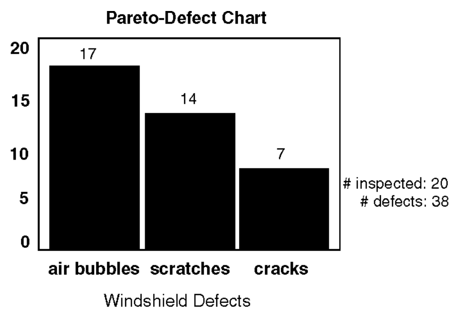
Pareto

Use Pareto charts to display the number of defective units because they contain certain characteristics. Each bar on the chart represents the number of units that are defective because they contain a certain characteristic, such as a crack. Each bar represents a different characteristic. The chart displays the bars in order of frequency. For example, the characteristic with the largest number of defective units displays on the left side of the chart if chart is configured with scroll direction ➡. The largest will be on the right side if scroll direction is ⬅ .)



Pareto-Defect

Use Pareto-Defect charts to display inspection information about characteristic data. Each bar on the chart represents the number of times a certain defect (characteristic) occurs on the units inspected. The chart displays the bars in order of frequency. For example, the defect that occurs most often displays on the left side of the chart if the chart is configured with scroll direction.



The quantity of defects can exceed the number of units inspected if the units have several defects each.

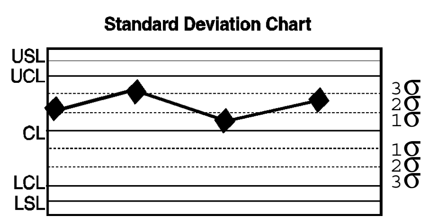
Control Charts

Control charts (also called line charts) plot points that represent a specific dimension or characteristic. The horizontal legend represents time, and the vertical legend represents data value.

Control charts are useful for monitoring an ongoing process. You use different types of control charts, depending on the calculation performed and the type of data being collected. For example, a control chart can plot the average height of 15 glass bottles (XBARR chart), the range of heights from the 15 bottles (R chart), and the percent of those 15 bottles that are defective (P chart).

Where applicable, control charts can also plot control limits (LCL and UCL) for comparison. Control limits are the boundaries on a control chart a process is operating acceptably within. Control limits are based on past performance, and they show what you can expect from the process as long as nothing changes. If some of the points on a control chart fall outside the control limits, you know that something has happened, and the process is no longer operating normally. The chart indicates the problem so you can take action to correct it.

A typical control chart



In addition to control limits, a chart displaying raw data may use specification limits (LSL and USL) that show acceptable product specification.

PowerSPC provides several features that enhance chart displays:

- Chart type scrolling—PowerSPC places all charts configured in a sample plan into an internal list. At run time, the operator can view any of these charts in the same chart object by clicking an animated button to scroll through the list of chart types.
- Data retrieval by date and time—You can request and retrieve PowerSPC data from the database by specifying its date and time.
- Value cursor—Each chart contains a value cursor that can be moved to the desired location on a chart. The operator only needs to point to the location and click the mouse button. Output text fields display the value of the selected point and/or the values of the raw data and/or auxiliary data associated with that point, if configured to do so.

Control Charts for Dimensional Data

Control charts for dimensional data display data collected for the measurements, such as length, width, or temperature, of a unit. PowerSPC supports the following types of control charts for dimensional data.

This control chart . . .	Shows the . . .
Average	Results of dividing the sum of a group of measurements by the number of units measured.
Individual	Value of each raw data sample as it is collected. Generally this chart is accompanied with a range chart or standard deviation chart.
Range (R)	Differences between the largest and smallest raw data values in a subgroup that make up each point.
Moving Range	The range calculation for a moving window of data.
Moving Average	The average calculation for a moving window of data.
EWMA	The exponentially weighted moving average for a window of data.
Standard Deviation	Amount that a process varies from the center line (mean or average).

This control chart . . .	Shows the . . .
XBARR	Average value (mean) of each group of data values. The XBARR chart shows control limits that are calculated using the Range calculation to estimate σ (sigma).
XBARS	Average value (mean) of each group of data values. The XBARS chart shows control limits that are calculated using the Standard Deviation calculation to estimate σ (sigma).
Split	Average value (mean) of each group of data values. The Split chart contains two center lines and the data that falls between the two center lines is considered acceptable. This chart type is useful for bimodal or heterogeneous process distributions.
Cp	Cp for the subgroups displayed in the charts.
Cpk	Cpk for the subgroups displayed in the charts.

Control Charts for Characteristic Data

Control charts for characteristic data display data collected for the presence or absence of specific characteristics, such as bubbles, dents, or scratches, of a unit. PowerSPC supports the following types of control charts for characteristic data.

This control chart . . .	Shows the . . .
C	Number of defects in a subgroup. This is useful when each unit might have more than one defect, such as several bubbles, or when each unit may have more than one type of defect, such as a bubble and a dent.
U	Ratio of the number of defects to the number of units inspected. This chart type is useful for processes where subgroup size varies.
P	Ratio of defective units to the number of units inspected. This chart type is useful for processes where subgroup size varies.

This control chart . . .	Shows the . . .
NP	Number of defective units, such as leaking units, the wrong color, or missing a label.

Control Chart Reference Books

It requires your study and consideration when deciding which control chart methods are appropriate for your particular application.

The following references provide excellent information on the advantages, disadvantages, and objectives of the various SPC control chart methods available.

- *American National Standard*

  This technical reference set includes three ANSI standards for using and evaluating Statistical Process Control:

  Guide for Quality Control Charts
  Control Chart Method of Analyzing Data
  Control Chart Method of Controlling Quality During Production

  You can obtain this reference set from:

  American Society for Quality Control
  611 East Wisconsin Avenue
  Milwaukee, WI 53202

  Reference publication codes:

  ANSI Z1.1-1985
  ANSI Z1.2-1985
  ANSI Z1.3-1985

- *Manual on Presentation of Data and Control Chart Analysis*

  This reference manual covers the use of control charts and is available from:

  American Society for Testing and Materials
  1916 Race Street
  Philadelphia, PA 19103

  Reference publication code: 28-007089-34

PROCESS EVALUATION

PowerSPC supports several ways to monitor and evaluate your process. Use of these methods allows you to test whether the process is producing products that conform to the specifications. They also provide run-time indications that allows an operator to adjust a process before it gets out of control. The evaluation tools include the following items:

- Run rules
- Assignable cause codes
- Two modes (as monitored and ad hoc) for viewing your process
- Process capability

Run Rules

You can specify run rules for each calculation used that PowerSPC evaluates after it performs each calculation. Run rules identify trends or patterns in variations in a product and define how many data points can fall above or below a specified level or fall within a specified range on a chart before the process is considered out of control. Patterns, such as trends, or several consecutive values near a control limit, can indicate the presence of non-random variation. When a process begins to violate run rules, you can take action to correct the problem before any defective parts are produced.

For example, when measuring six successive bottles, each one measures taller than its predecessor. This is possibly a statistically significant trend you might project to continue to the point when bottles will exceed the specification limits. The run rule violation provides notification in time to correct the problem before a bottle that is too tall is produced.

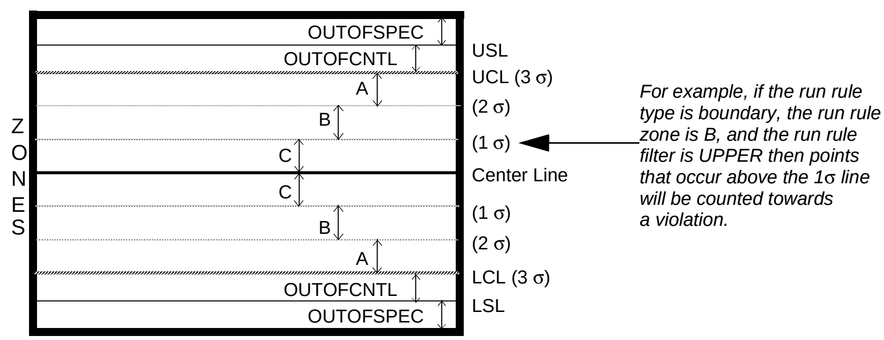
You can use five industry standard Western Electric run rules provided with PowerSPC, and you can define up to 59 of your own.

PowerSPC uses the following criteria to evaluate Run Rules:

- Run Rule Zone—Identifies the zone you want PowerSPC to apply the Run Rule Type to.
- Run Rule Type—Identifies where a point must fall in relation to a line or zone to violate the run rule: within, outside.

For the type. . .	To violate the run rule, the points. . .
BOUNDARY	Above the center line must fall above a specified boundary line set by the Run Rule Zone. Points below the center line must fall below a specified boundary line.
ZONE	Must fall within the zone specified by the Run Rule Zone. This includes values on the zone lines.
TREND	Must consecutively continue to increase or decrease. For example, an increase of six points in a row.

- Run Rule Filter—Selects whether points that occur above/below the center line are included for run rule evaluation.



For the type. . .	To violate the run rule, if the points are. . .
UPPER	Above the center line, PowerSPC reports a run rule violation. Points on the lower side of the center line do not count toward a violation.
LOWER	Below the center line, PowerSPC reports a run rule violation. Points on the upper side of the center line do not count toward a violation.
BOTH	Both above and below the center line, PowerSPC reports a run rule violation regardless of the point's relationship to the center.
EITHER	Either above or below the center line, PowerSPC reports run rule violations. Points on opposite sides of the center line do not count toward the same violation instance.

- Number of Points to Investigate—Indicates the maximum number of points (up to 99) that PowerSPC must investigate or evaluate for a violation.
- Number of Points for Violation —Identifies the number of points (up to 99) that must fail the evaluation of the type and zone you define to classify the latest point as a violation of the run rule. The number of points for violation must fall within the window defined by the number of points to investigate.

Whenever a run rule is violated at run time, its name displays in an output-text field on the screen. To do this, you must configure the output-text field.

You can define your own run rules or use any of the following standard Western Electric run rules.

Western Electric Rule	Definition
20F3	2 out of 3 points lie on one side of the Center Line in Zone A or beyond.
4OF5	4 out of 5 points lie on one side of the Center Line in Zone B or beyond.

Western Electric Rule	Definition
TREND	7 points in a row are rising or falling on either side of the center line.
8CONS	8 points in a row lie on one side of the Center Line.
3SIGMA	One or more points lie outside of control limits.

Assignable Cause Codes

PowerSPC considers a process to be in control when data being monitored varies randomly but only slightly (called random variation). If it detects one of the units being measured varies more than usual, PowerSPC alerts you that something is wrong. You can then discard the defective unit(s) and try to determine the cause of the variation.

If you discover what caused the variation, you can assign a cause code to it. You may configure PowerSPC to exclude points assigned cause codes from control limit calculations, thereby giving a better picture of what the process is capable of producing.

If the process produces unacceptable units, PowerSPC may consider the process to be out of control. At this point, you can decide to investigate the situation with a goal of finding corrective action(s).

As Monitored vs. Ad Hoc Mode

Unless otherwise specified, PowerSPC monitors and evaluates the state of statistical control for a process as data is collected using actual, or as monitored, charts. When you define a control chart to display actual data, the chart contains information exactly as PowerSPC calculated and monitored it during the collection phase.

At times, you might want to experiment with what-if scenarios, such as changing the subgroup size, control limits, specification limits, and/or run rules to improve the precision and accuracy of data analysis.

You can create an ad hoc chart that lets you view and edit values at run time without actually affecting how the process is running and archiving data. An ad hoc chart can be a duplicate of the currently active control chart that you can change for hypothetical purposes. You can also create an ad hoc chart without having an as monitored chart created. Changes to the ad hoc chart do not affect the actual chart or the sample plan.

For example, you can change the calculation size, control limits, and run rules to see how the new values affect the data on the chart. This can help you determine whether it would be more effective to use different run rules, subgroup size, or control limits than what is currently set up in the sample plan. Because you change only the values on the ad hoc chart and not those on the actual chart, the values in the sample plan are not affected. Data is still archived based on the sample plan even while you are viewing the data on an ad hoc chart.

You can make a new sample plan or modify an existing sample plan using scenarios evaluated under ad hoc mode.

Process Capability

PowerSPC evaluates process capability through the calculated indices CP and CPK. You can set up PowerSPC to calculate these indices for real-time or historical dimensional data displayed on any type of chart.

SPC must be able to determine a manufacturing process is capable of consistently producing products that meet or exceed the specified criteria to ensure the production of quality products.

To obtain this assurance, SPC must identify:

- Level of quality that a process can produce
- Criteria the product must meet to be acceptable
- Ability of the process to consistently produce products that meet the criteria

PowerSPC calculates a process’ capability index to show the potential ability of a process to produce units that meet customer requirements.

TAG/CONSTANT FIELD

PowerSPC contains Tag/Constant fields. Tag/Constant fields let you enter either a tag name or a numeric or character string. If you enter a tag name, you or another module can change the value of the tag at run time. If you enter a numeric or character string (constant value), no one is able to alter that field value at run time. Depending on the needs of your application, you will want to use tags in some instances and constant values in others. Tag/constant fields contain an asterisk (*) in their field name. For example, *Sample Plan Name.

Constant character strings must be preceded by a single quote (‘) to distinguish them from tag names.

Cleanup Utility

The purpose of the cleanup utility is to delete rows from the tables. This function is triggered by a user-supplied tag.

For complete information on this utility, refer to Chapter 11, “Cleanup Utility,” of this guide.

Chapter 2 . . . .

Getting Started with PowerSPC

PowerSPC is delivered with the following tools to help you build an application:

- A chart power pack

  PowerSPC has a power pack file, powerspc.gp, that contains two chart power objects that contain several output fields for displaying information about the chart. One power object is specifically designed as a single chart; the other is designed to allow you to change the type of chart shown in the chart object by selecting one from a list of available charts.

  You can use these chart power objects as a starting point when creating your charts for displaying collected data. Copy and paste as many chart power objects into a drawing file as you need for your application.

- Two sample PowerSPC applications

  One sample application, pspcdimn.mps, monitors dimension data and contains two control charts: XBARR chart and Range chart.

  The other application, pspcchar.mps, monitors characteristic data and contains two C control charts and one bar chart (Pareto-Defect chart). Use either of these applications for your manufacturing process or combine them into one application and use them both. If you choose to use a sample application, you need to make a few changes to it to customize it for your particular process. For details on how to do this, refer to “Starting with a Sample Application” on page 51 of this chapter.

Setting Up an Application

Listed below is a general overview of the steps to follow to set up a PowerSPC application. These procedures assume you have already loaded FactoryLink and PowerSPC on your system. If you need any help with these procedures, refer to the *FactoryLink ECS Installation Guide*.

1 Restore the multiplatform save file {FLINK}/mps/flnew.mps to an empty directory off the root directory. Do not restore it to any subdirectory under the {FLINK} directory or any directory that is not empty. The complete procedure for restoring an application is described in the *Installation Guide*.

2 Plan and design the application and determine how the application will work at run time. This makes configuration decisions easier.

3 Set up the sample plans. See Chapter 5, “Creating a PowerSPC Sample Plan,” of this guide.

4 Set up the processes to be monitored. See Chapter 6, “Configuring the Processes.”

5 Set up the Historian so the Historian knows where to check for data being collected for the process. For details on setting up Historian, refer to the Historian chapter of your choice in the *FactoryLink ECS Configuration Guide*.

6 Draw and animate the graphic screens, including the chart and legend objects. See Chapter 7, “Drawing and Animating Display Charts.”

7 Set up the PowerSPC charts. See Chapter 8, “Configuring SPC Charts.”

8 Optionally, customize your process by defining custom cause codes, run rules, and auxiliary database columns. See Chapter 9, “Customizing Your Process.”

UPGRADING AN APPLICATION TO POWERSPC

Perform the following steps if you are upgrading to a newer version of PowerSPC and have an existing application built under an older version:

1. Follow the upgrade procedure described in the *FactoryLink ECS Installation Guide*. This entails:
   - Saving your original application using FLSAVE.
   - Installing the latest version of FactoryLink and PowerSPC.
   - Running the conversion utility, FLCONV. This must be run if you have upgraded your PowerSPC software, even if you have not upgraded your FactoryLink software.
2. After running FLCONV, you must convert the SPC configuration tables to be compatible with the latest version of PowerSPC. To do this, enter the following command at the command prompt:

   CV_SPCCT {FLAPP}

Converting SPC Historical Data to PowerSPC

While much of the operation of SPC IV is analogous to PowerSPC and can be migrated, the converted application does not behave exactly the same with PowerSPC as it did with SPC IV. This is because of the changes made to provide enhancements and more efficient disk space usage for archiving data. We recommend you create the SPC configuration using the new PowerSPC guidelines to fully utilize the enhancements and advantages of PowerSPC.

STARTING WITH A SAMPLE APPLICATION

The easiest way to begin using PowerSPC is to modify either of the two sample applications provided with PowerSPC rather than creating one from scratch; however, if you are an experienced PowerSPC user, you may want to create your own using the starter application and the chart power pack.

If you use either of the sample applications, you need to change it to customize it for your particular process. We suggest you restore and run the applications first to decide whether you want to use them.

Restoring a Starter Application

The complete procedure for restoring an application is described in the *Installation Guide*. The names and location of the two applications you can elect to restore are

- Dimension application—{FLINK}/mps/en/pspcdimn.mps
- Characteristic application—{FLINK}/mps/en/pspcchar.mps

Restore the desired file to any empty directory off the root. Do not restore it to any subdirectory under the {FLINK} directory or any directory that is not empty.

Running the Dimension Starter Application

Perform the following steps to start and run the dimension starter application. This procedure assumes you know how to start and traverse the Run-Time Manager.

1. Start the dimension application in run-time mode.
2. Click the PowerSPC button at the bottom of the screen to display an XBARR chart and a Range chart. The charts are empty and the values are all at zero.

   The application is set up to monitor the height of glass bottles. For quality bottles, each bottle should measure between 15.85 cm and 16.15. The target height is 16.0 cm.
3. Type a value (for a bottle's height) in the Enter the Dimn Value input field to begin collecting data. Click Accept Value.
4. Repeat this five times. After you enter five values, SPC displays the first point on both charts.
5. If you want to assign a cause code to any point, click the point and click the button in the Assign Cause Code field. Type one of the following cause codes: AIRLOW, AIRHIGH, TEMPLOW, TEMPHIGH. Click the button again.
6. Click Run Manager to exit the application. The Run-Time Manager screen displays.

7 Click Stop Application.

Running the Characteristic Starter Application

Perform the following steps to start and run the characteristic starter application. This procedure assumes you know how to start and traverse the Run-Time Manager.

1 Start the characteristic application in run-time mode.

2 Click the PowerSPC button at the bottom of the screen to display two C charts and a Pareto-Defect chart. The charts are empty, and the values are all at zero.

The application is set up to monitor whether glass bottles have bubbles and/or cracks. For quality bottles, each bottle should have 0 crack and less than 6 bubbles.

3 Type a value (for the number of bubbles) in the input field. Click Accept Values to display bars on the Pareto-Defect chart.

4 Repeat this five times. After you enter five pairs of values, SPC displays the first point on both charts.

5 Click the point and click the Edit Mode button if you want to assign a cause code to any point. Type one of the following cause codes: AIRLOW, AIRHIGH, TEMPLOW, TEMPHIGH. Click the button again.

6 Click Run Manager to exit the application. The Run-Time Manager screen reappears.

7 Click Stop Application.

Ensuring the Correct Tasks Start Automatically

Besides the defaults of the Run-Time Manager in both domains and the Application Editor in the USER domain, the SPCDATA, SPCGRAPH, dBASE IV, and other chosen Historian tasks must also be active at run time.

1. Ensure the current domain is SHARED in the Configuration Manager Domain Selection box.
2. Choose System Configuration from the Configuration Manager Main Menu.
3. Place an R flag (to automatically start the task) on the SPCDATA, DB4HIST, and other Historian tasks. Click Enter.
4. Choose USER from the Domain Selection box without exiting the System Configuration panel. The System Configuration panel now displays a list of the USER domain tasks.
5. Place an R flag on the SPCGRAPH task.
6. Click Enter and exit the System Configuration panel.
7. Exit or minimize the Configuration Manager.

Configuring PowerSPC Program Arguments

Configure the following system configuration program arguments to affect functionality of the SPCGRAPH and SPCDATA tasks:

-L<n> or -l<n>	Enables logging of errors to the log file. By default, the PowerSPC tasks do not log errors. The value of n determines the level of logging enabled, ranging from 1 (Fatal Level messages only) to 3 (System level, Error level, and Fatal error messages).
-V<n> or -v<n>	Writes the SQL statements generated by SPCGRAPH or SPCDATA to the log file. The corresponding task must have logging enabled for this program switch to work. The default is to not write the SQL statements to the log file. The value of n determines the level of data logged, ranging from 1 (Fatal level errors only) to 12.
-W[5-36,000] or -w[5-36,000]	Sets the maximum timeout in seconds for the SPCDATA or SPCGRAPH tasks to wait for a response from the Historian task. The default is 30 seconds.

For values less than 30 seconds, this switch will only work correctly when the Historian initially achieved a successful connection with the database server. If the Historian failed to successfully connect with the database server, SPCDATA or SPCGRAPH will time out in 30 seconds regardless of this switch setting.

Perform the following steps to configure one or more arguments:

1. Ensure the current domain selected is correct in the Configuration Manager Domain Selection box to modify the SPCDATA and SPCGRAPH entries in the System Configuration panel.
2. Choose System Configuration on the Configuration Manager Main Menu to display the System Configuration Information panel.
3. Enter one or more arguments separated by spaces in the Program Arguments field for the DBBROWSE task.

Chapter 3 . . . .

Tutorial for the Dimension Application

A sample dimension application named pspcdimn.mps is copied to the {FLINK}/mps/en directory during the option installation of mps English files. This sample application monitors dimension data and contains two control charts:

- XBARR
- RANGE

This chapter is a tutorial on how this application was built. It describes the steps taken to build the dimension application. In this tutorial, you build a finished application that resembles the sample application by following the directions provided.

The procedures in this chapter assume you understand PowerSPC usage of tag/constant fields and you have basic knowledge of entering data into panels in the Configuration Manager. If you are not familiar with this, refer to *FactoryLink ECS Fundamentals*.

BUILD SEQUENCE FOR THE POWERSPC DIMENSION APPLICATION

Perform the following steps to build a dimension application. While some of these steps could be performed in a different order, we recommend using the following order to facilitate your application development. Each of these steps is detailed for each application in the following sections.

1 Restore the FactoryLink new application, {FLINK}/mps/en/flnew.mps. For details on restoring applications, refer to the *FactoryLink ECS Installation Guide*.

2 Set the {FLAPP} to reference the directory where the flnew application is located.

3 Set up the sample plan. See “Configuring the Sample Plan” on page 58 of this chapter.

4 Set up the Historian. See “Configuring the Historian for the PowerSPC Process” on page 65 of this chapter.

5 Configure the PowerSPC process. See “Configuring the PowerSPC Processes” on page 67 of this chapter.

6 Draw and animate the PowerSPC screen. See “Drawing and Animating the PowerSPC Screen” on page 70 of this chapter.

7 Configure the PowerSPC charts. See “Configuring the PowerSPC Charts” on page 73 of this chapter.

8 Customize your process. See “Customizing Your Process” on page 81 of this chapter.

9 Test the application. See “Testing the Application” on page 83 of this chapter.

As you develop each part of the application, test often as it simplifies troubleshooting if the application does not function as expected at run time. After configuring the SPC processes, test the application to ensure that data is being logged. After configuring the SPC charts, test to ensure that the charts are functioning properly. If you customize your process by defining run rules, cause codes, or auxiliary data collection, test that functionality.

For the purposes of this quick start, we will only test the application once after it is completed.

OVERVIEW OF THE DIMENSION APPLICATION

In addition to the default Run-Time Manager and Alarm screens, the sample dimension application contains one screen, named SPCDIMN. This screen contains an input text field that allows you to enter raw data and then click a button to accept the data.

The application collects raw data about the height of bottles. After collecting and accepting each set of five raw data values, the application does an XBARR and RANGE calculation and displays those results on charts. Output text fields also display these values according to the location of the cursor on the chart. Additional output text fields display the CPK value for the XBARR chart and the RBAR value for the RANGE chart.

The application monitors run rules and, when a violation occurs, displays the highest priority run rule being violated in an output text field. It also allows you to select a point and assign a cause code to it.

The following paragraphs provide step-by-step directions for building the PowerSPC dimension application.

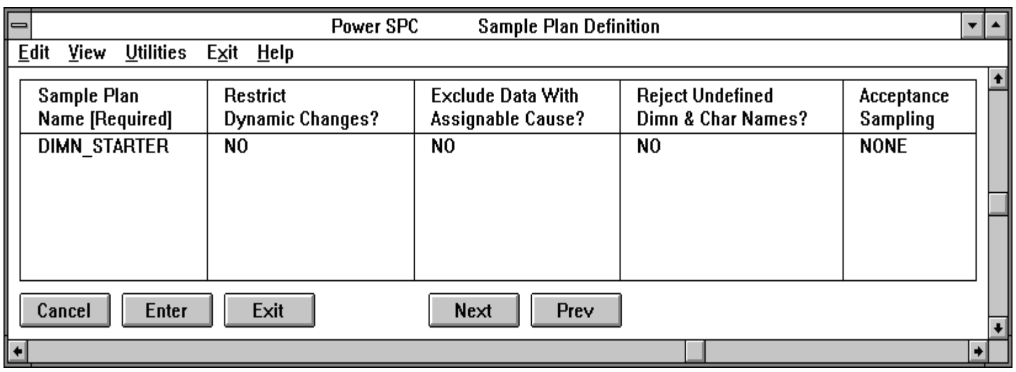
CONFIGURING THE SAMPLE PLAN

Perform the following steps to configure the sample plan:

1 Start the Configuration Manager.

2 Choose PowerSPC Sample Plans from the Configuration Manager Main Menu to display multiple structure panels.

For detailed field descriptions, refer to Chapter 5, “Creating a PowerSPC Sample Plan,” of this guide.



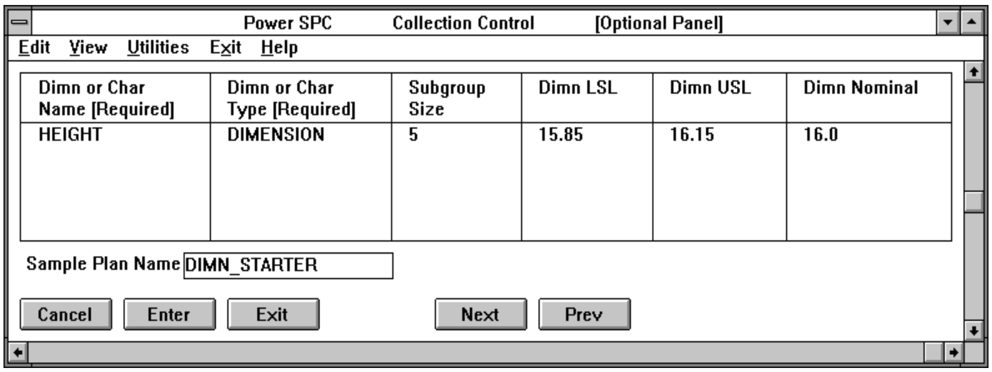
3 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

Sample Plan Name	Name of sample plan used when defining the process(es) on the Process Definition panel to link the plan name with the process.
Restrict Dynamic Changes	Indicates the sample plan values can be changed at run time.
Exclude Data with Assignable Causes	Indicates points with cause codes are included in control limit calculations.
Reject Undefined Dimn & Char Names	Indicates raw data names can be changed at run time using tags.
Acceptance Sampling	Indicates this sample plan is for process sampling, not acceptance sampling.

4 Click Enter or press the Enter key to save the information.

5 Ensure the cursor is on the line for the DIMN_STARTER sample plan and click Next to display the Collection Control panel.

For information about dimensions, characteristics, and subgroups, refer to Chapter 1, “Overview,” of this guide. For detailed field descriptions, refer to Chapter 5, “Creating a PowerSPC Sample Plan.”



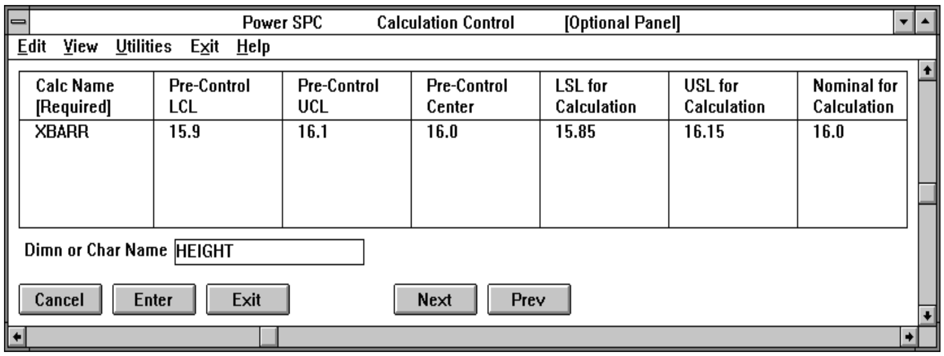
6 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

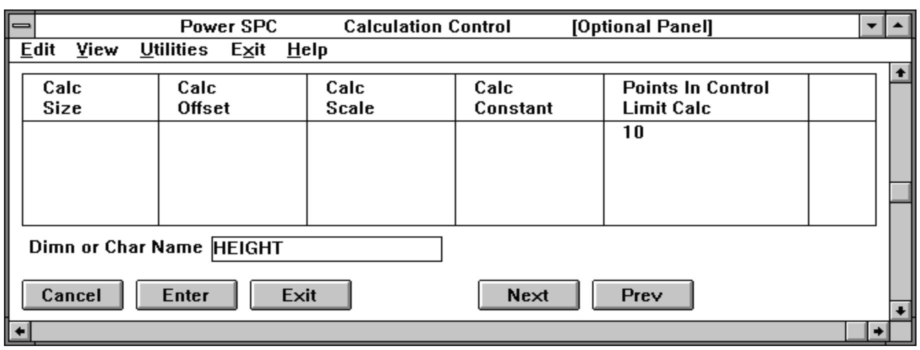
Dimn or Char Name	Name of dimension used when defining the process(es) in the Data Collection panel. In this example, the application collects information only about the height of a bottle.
Dimn or Char Type	Indicates the dimension type.Press Ctrl + K to bring up the key file containing valid entries for this field and double click the desired entry.
Subgroup Size	Defines number of raw data entries (five) in a subgroup.
Dimn LSL	Defines Lower Spec Limit; allows CPK calculation and out-of-spec run rules.
Dimn USL	Defines Upper Spec Limit; allows CPK calculation and out-of-spec run rules.
Dimn Nominal	Defines expected or nominal average Spec. value; allows CPK calculation and out-of-spec run rules.

7 Ensure the cursor is on the HEIGHT row and click Next to save the data.

8 Complete the first row of the Calculation Control panel, defining the XBARR calculation. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

For information about dimensions, characteristics, and subgroups, refer to Chapter 1, “Overview,” of this guide. For detailed field descriptions, refer to Chapter 5, “Creating a PowerSPC Sample Plan.”





9 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

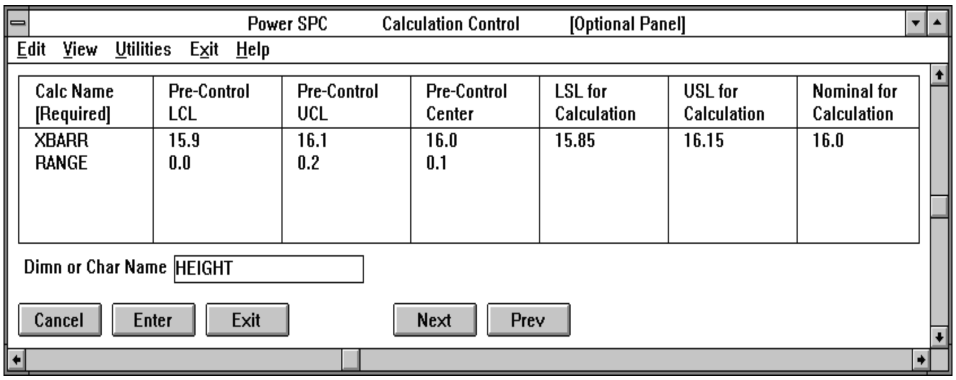
Calc Name	Indicates the type of calculation. Press Ctrl + K to bring up the key file that contains the valid types of calculations.
Pre-Control LCL	Defines the Lower Control Limit displayed on the chart as a yellow line.
Pre-Control UCL	Defines the Upper Control Limit displayed on the chart as a yellow line.
Pre-Control Center	Defines the average Control value displayed on the chart as a yellow line.
LSL for Calculation	Defines the Lower Spec Limit displayed on the chart as a yellow line.

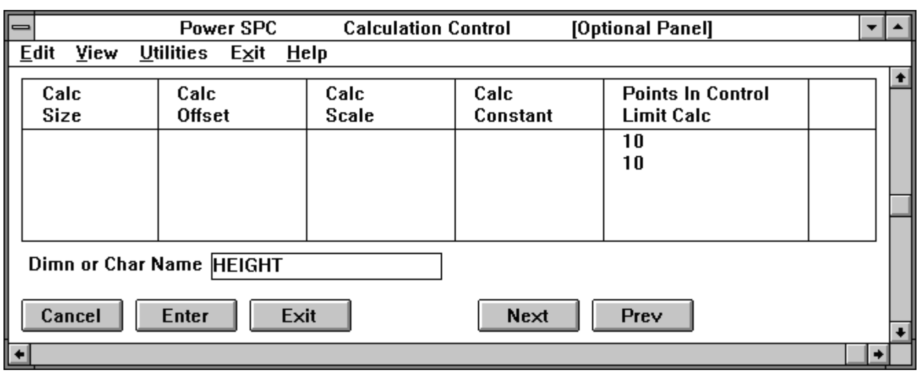
USL for Calculation Defines the Upper Spec Limit displayed on the chart as a yellow line.

Nominal for Calculation Defines the expected or desired average Spec value displayed on the chart as a yellow line.

Points In Control Limit Calc PowerSPC uses ten subgroup values to calculate the control limits.

10 Complete the second row of the Calculation Control panel, defining the RANGE calculation.





11 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

Calc Name Indicates the type of calculation. Press Ctrl + K to bring up the key file that contains the valid types of calculations.

Pre-Control LCL Defines the Lower Control Limit displayed on the chart as a yellow line.

Pre-Control UCL Defines the Upper Control Limit displayed on the chart as a yellow line.

Pre-Control Center Defines the average Control value displayed on the chart as a yellow line.

LSL for Calculation Defines the Lower Spec Limit displayed on the chart as a yellow line.

USL for Calculation Defines the Upper Spec Limit displayed on the chart as a yellow line.

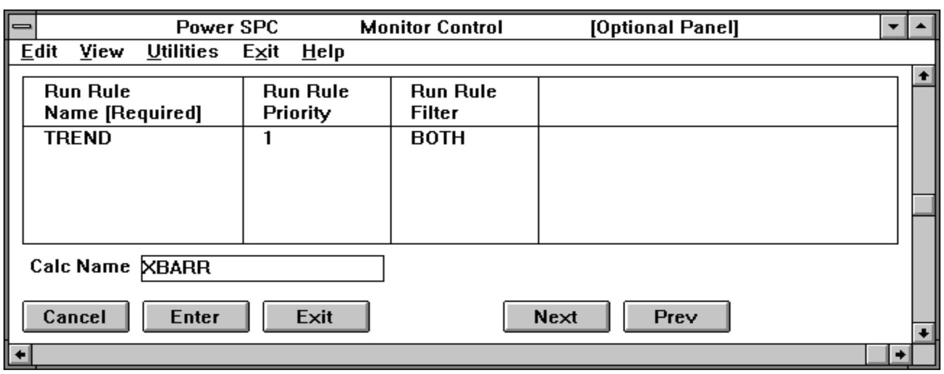
Nominal for Calculation Defines the expected or desired average Spec value displayed on the chart as a yellow line.

Points In Control Limit Calc PowerSPC uses ten subgroup values to calculate the control limits.

12 Save the data. Then, ensure the cursor is on the XBARR calculation and click Next to display the Monitor Control panel to specify the run rules to be monitored for the two calculations you just configured.

For general information about run rules, refer to Chapter 1, “Overview,” of this guide.

13 Complete the Monitor Control panel the XBARR calculation. For details about each field on this panel, refer to Chapter 5, “Creating a PowerSPC Sample Plan,” of this guide.



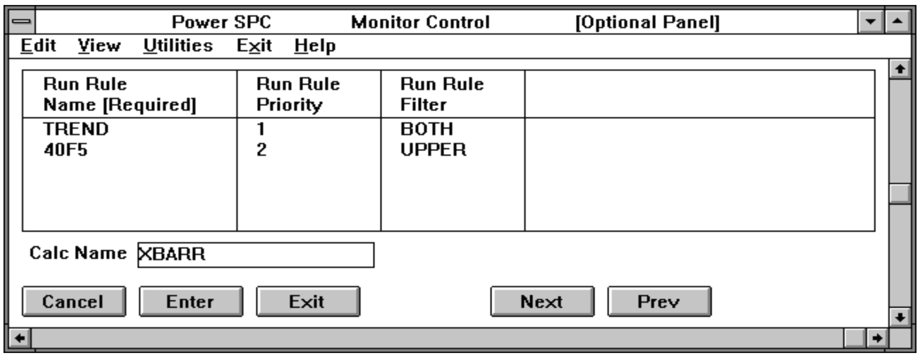
14 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

Run Rule Name Press the Ctrl + K keys to bring up the key file that contains the predefined valid run rules.

Run Rule Priority You must select a unique priority on this panel for this calculation.

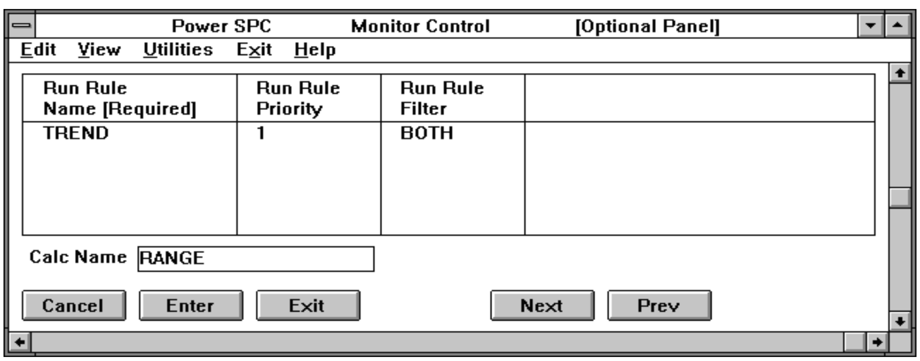
Run Rule Filter	Press Ctrl + K to bring up the key file that contains the valid filters.

15 On the second row of this panel, specify you want to monitor a run rule named 4OF5 that has a priority of 2 and uses the UPPER filter.



16 Save the data and click Previous.

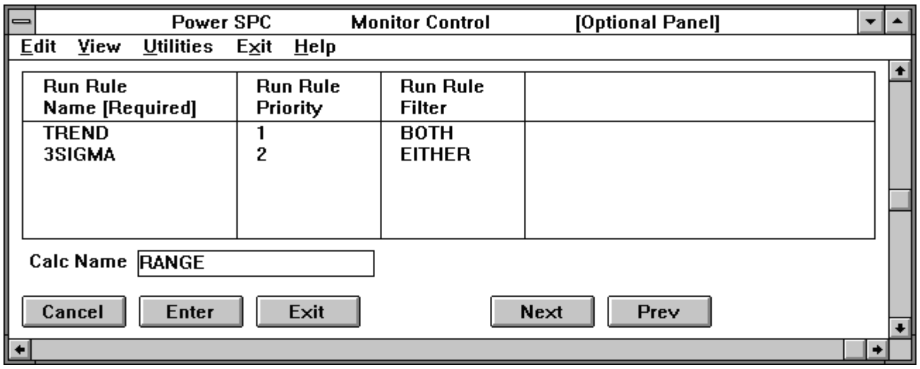
17 Ensure the cursor is on the RANGE calculation and click Next to display the Monitor Control panel to specify the run rules to be monitored for the RANGE calculation.



18 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

Run Rule Name	Press Ctrl + K to bring up the key file that contains the valid run rules.
Run Rule Priority	You must select a unique priority on this panel for this calculation.
Run Rule Filter	Press Ctrl + K to bring up the key file that contains the valid filters.

19 On the second row of this panel, specify you want to monitor a run rule named 3SIGMA that has a priority of 2 and uses the EITHER filter.



20 Save the data and click Exit to exit PowerSPC Sample Plans.

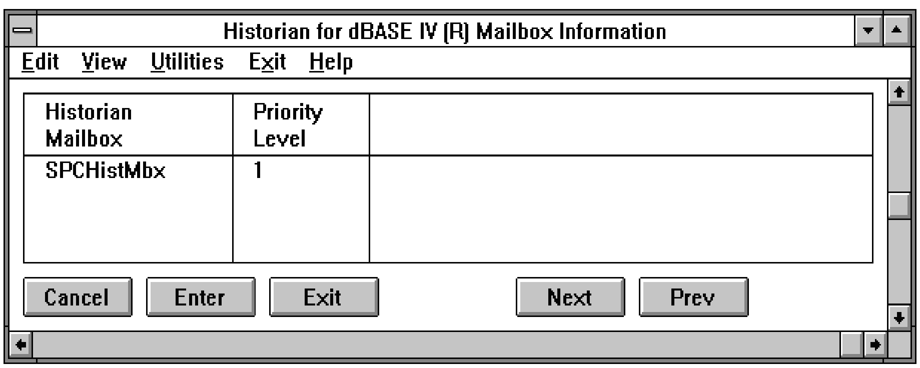
CONFIGURING THE HISTORIAN FOR THE POWERSPC PROCESS

When defining the SPC processes you want to collect data for and then monitor, keep in mind you must also configure the Historian so that when the SPCDATA task collects the data and sends it to the Historian for archiving, the Historian knows what mailbox to check for data and where to put it.

For this sample application, configure the Historian for dBASE IV. For details about configuring the dBASE IV Historian or another Historian, refer to the appropriate Historian chapter in the *FactoryLink ECS Configuration Guide.*

1 Ensure the current domain selected is SHARED in the Configuration Manager Domain Selection box.

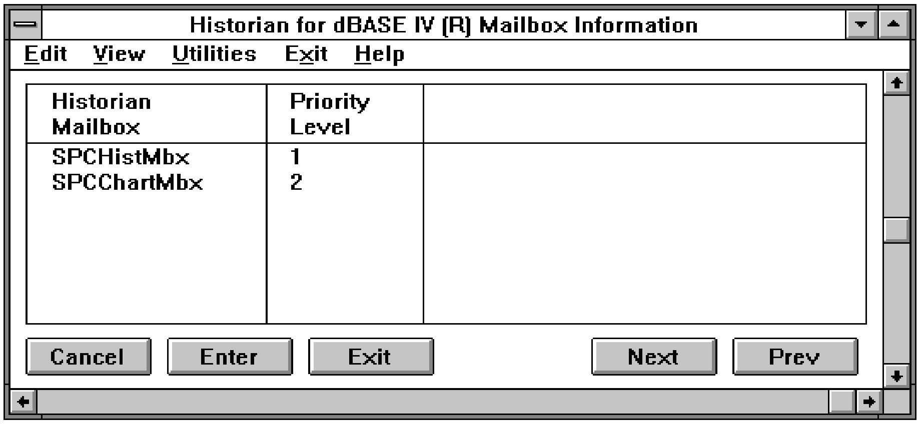
2 Choose Historian for dBASE IV from the Configuration Manager Main Menu to display the Historian for dBASE IV Mailbox Information panel.



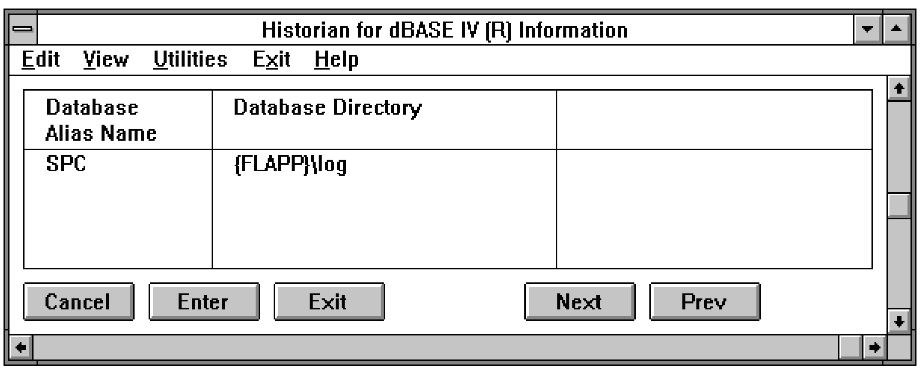
3 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

Historian Mailbox Refer to this SHARED mailbox tag when defining the processes.

4 Define a second mailbox tag named SPCChartMbx and assign it a priority of 2. This mailbox tag is used for chart information.



5 Save the data and click Next to display the Historian Information panel.



6 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

Database Alias Name	Refer to this name when defining the process and also configuring the SPC chart.
Database Directory	The data is archived to the log subdirectory in the {FLAPP} directory.

7 Save the data and exit the Historian.

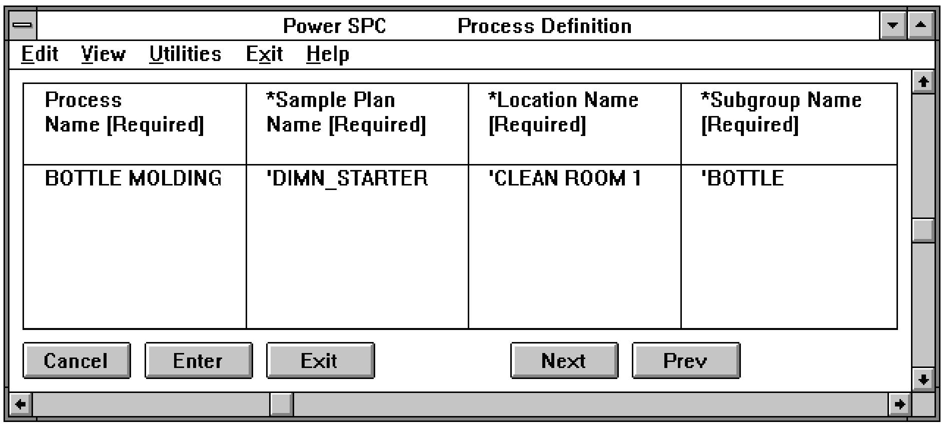
CONFIGURING THE POWERSPC PROCESSES

Perform the following steps to configure the process:

1 Ensure the current domain selected is SHARED in the Configuration Manager Domain Selection box.

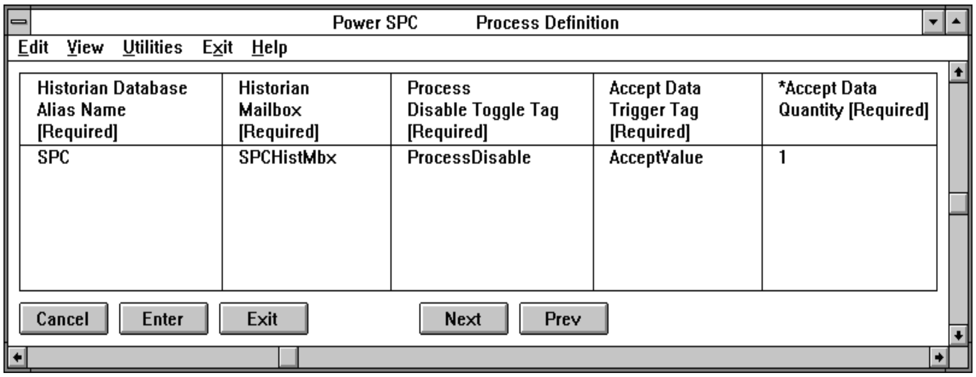
2 Choose PowerSPC Processes from the Configuration Manager Main Menu to display the Process Definition panel.

For details about each field on this panel, refer to Chapter 6, "Configuring the Processes," of this guide.

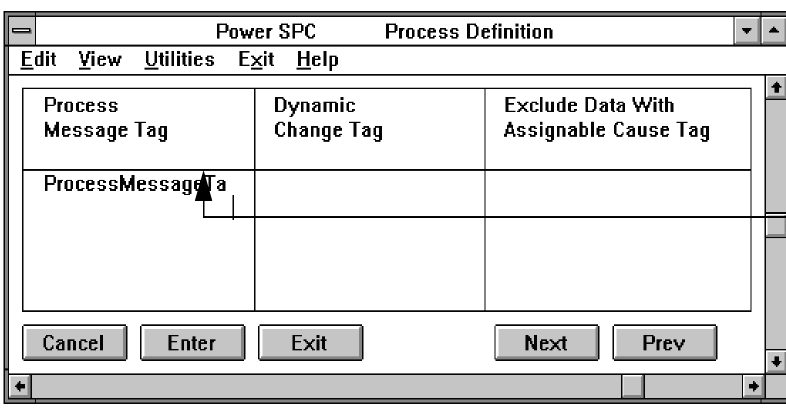


3 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

Process Name	Name of the process.
*Sample Plan Name	Entry must match name in the Sample Plan Definition panel.
*Location Name	Create a location name; repeat this name in the Chart Definition panel.
*Subgroup Name	Create a subgroup name; repeat this name in the Chart Definition panel.



Historian Database Alias Name	Name must match name entered in the Historian Information panel.
Historian Mailbox	Name must match name entered in the Historian Mailbox Information panel.
Process Disable Toggle Tag	Digital tag that allows the operator to enable/disable this process at run time.
Accept Data Trigger Tag	Digital tag; corresponds to animated button on screen to accept data.
*Accept Data Quantity	Indicates how many raw values to process.

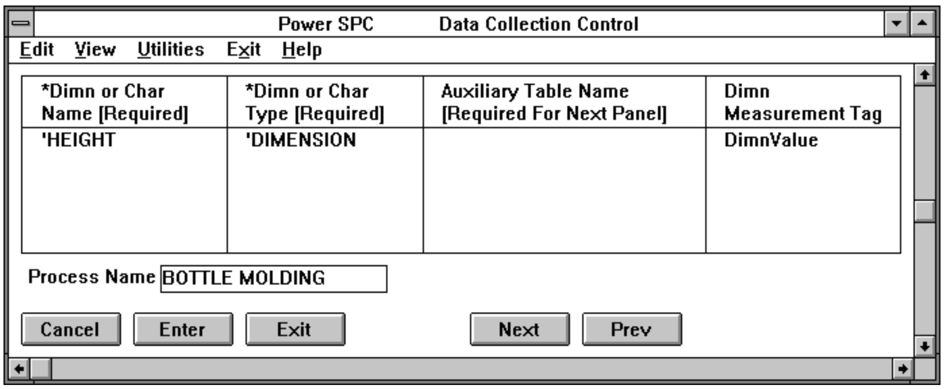


Complete data entry is:
ProcessMessageTag

Process Message Tag	Message tag that corresponds to output text field on screen.

4 Save the data. Ensure the cursor is on the bottle molding process and click Next to display the Data Collection Control panel.

For details about each field on this panel, refer to Chapter 6, “Configuring the Processes,” of this guide.



5 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

*Dimn or Char Name	Name of the dimension. Name must match name entered in Sample Plan panel.
*Dimn or Char Type	Press Ctrl + K to bring up the key file that contains the valid types
Dimn Measurement Tag	Floating-point tag that corresponds to Input Text field on the screen operator enters values in to be logged.

6 Save the data and exit.

DRAWING AND ANIMATING THE POWERSPC SCREEN

This section provides directions to build a screen that performs the following functions:

- Allows the operator to input raw data values
- Triggers acceptance of the raw data values
- Displays the XBARR and RANGE charts
- Displays the calculated value at the cursor location
- Displays the population value
- Displays run rule violations
- Accepts assignable cause code entries

Since you have not seen the actual screen in the pspcdimn application, your screen may differ slightly from it in colors and location of input and output text fields; however, the functionality of your screen is the same.

Creating the Screen Using the Chart Power Pack

Perform the following steps to create your screen using the Chart Power Pack:

1. Ensure the current domain selected is USER in the Configuration Manager Domain Selection box.
2. Choose Application Editor.
3. Choose File>Open Power Pack. For details about power packs, refer to *FactoryLink ECS Application Editor*.
4. Choose POWERSPC>Basic Chart object (it is a combined object).
5. Choose File>Open.
6. Create a new file named SPCDIMN and open it.
7. Use Attributes>Screen Color to change the screen background to your desired color.
8. Since you selected a Power Pack object, you should be in Paste mode as you enter the SPCDIMN screen (your cursor is a large +). Position your cursor to paste the chart object in the upper half of the screen (you will be pasting another chart in the lower half of the screen).

9 Prompts display when you click the mouse button to paste the object. Answer the prompts in the following manner, and then click OK.

At this prompt...	Type this value...
Enter unique chart identifier (i.e., xbarr or chart3)	xbarr
Enter population calculation name (i.e., Cpk)	cpk

10 Select the chart object that you just pasted (it is a combined object). Press Ctrl and click the mouse button to select only the chart itself. A green check mark displays on the Chart Animation icon of the toolbox to confirm you have selected only the chart.

11 Choose Attributes>Object Name. Change the name of the chart object to DimnChart1. You refer to this name when you configure the chart. For reference purposes, it is easier to refer to a meaningful object name than a number.

12 Choose Edit>Paste or click the Paste icon in the tool box to paste the second chart object into your drawing in the lower right half of the screen.

13 Prompts display when you click the mouse button to paste the object. Answer the prompts in the following manner, and then click OK.

At this prompt...	Type this value...
Enter unique chart identifier (i.e., xbarr or chart3)	range
Enter population calculation name (i.e., Cpk)	rbar

14 Select the chart object that you just pasted. Select the chart itself as done previously.

15 Choose Attributes>Object Name. Change the name of the chart object to DimnChart2.

Adding Functionality to the Screen

Perform the following steps to add objects, such as an input text field for entering raw data, to the screen:

1 Select a location on your screen to draw a text object with the format XX.XX. The location you choose should have room under the text object to add a button. Draw the text object and then

animate it as an Input Text. On the Input Text animation panel, enter a tag name of DimnValue, which you previously defined when you defined the process. Select the box to activate Background Updates.

2 Add a box under the output text field just created.

3 Animate the box as a button and select an Action of TGL.

4 Enter AcceptValue in the Destination Tag field. You defined this tag when you configured the process.

5 Add a text object ACCEPT inside the box just created. Choose Attributes>Fill. Select a Solid style and foreground color (FG) of red.

6 Animate the ACCEPT text object using the Paint animation option. Enter a tag of AcceptValue. For the paint color changes, select a foreground color of grey at a Limit of 0 and a foreground color of red at a Limit of 1.

7 Add a text object with the format of 20 Xs and animate it as Output Text that displays the tag ProcessMessageTag. You defined this tag when you configured the process.

8 Add a text object with the format of 20 Xs and animate it as Output Text that displays the tag ChartMessageTag (a USER domain message tag). Use this tag when configuring the charts.

9 Add a button to provide access to the Run-Time Manager screen at run time. Animate the button with an action of DRW and enter RUNMGRU in the Source Value field.

10 Choose File>Save to save your drawing.

11 Choose File>Open to open the RUNMGRU file.

12 Modify the animation on the Return to Application button by changing the Source Value field to SPCDIMN to access your SPCDIMN drawing at run time.

13 Save the RUNMGRU drawing and exit the Graphics Editor.

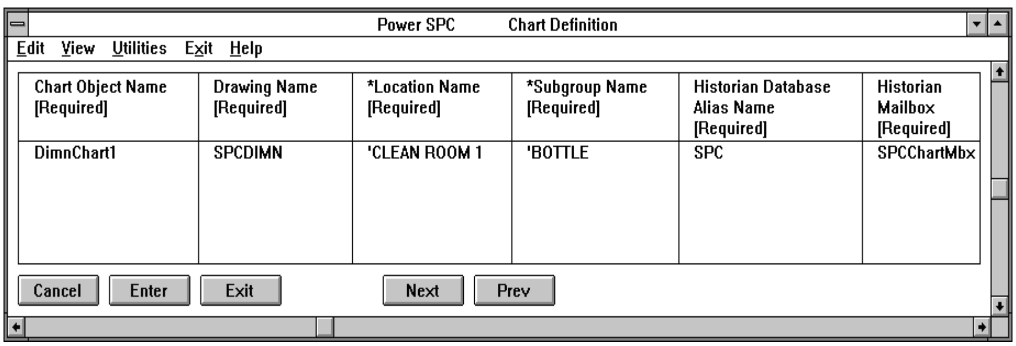
CONFIGURING THE POWERSPC CHARTS

Perform the following steps to configure the SPC charts:

1. Ensure the current domain selected is USER in the Configuration Manager Domain Selection box.

2. Choose PowerSPC Charts from the Configuration Manager Main Menu to display the Chart Definition panel for the first chart (object name DimnChart1).

   For details about each field on this panel, refer to Chapter 8, “Configuring SPC Charts,” of this guide.



3. Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

Chart Object Name	Name of object. Entry must match object name defined in the Graphics Editor.
Drawing Name	Name of drawing. Entry must match the drawing name created in the Application Editor and contains the DimnChart1 chart object.
*Location Name	Entry must match a location specified in the Process Definition panel.
*Subgroup Name	Entry must match a location specified in the Process Definition panel.
Historian Database Alias Name	Entry must match the alias name defined in the Historian Information panel.
Historian Mailbox	Entry must match mailbox name in the Historian Mailbox Information panel.

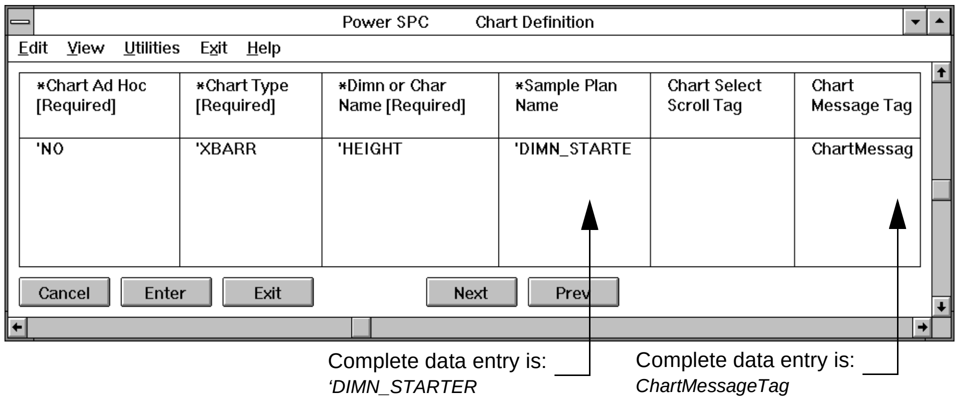
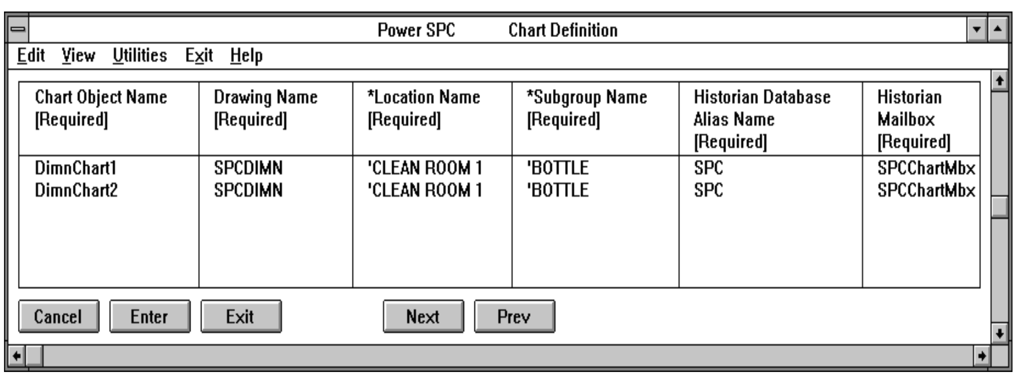
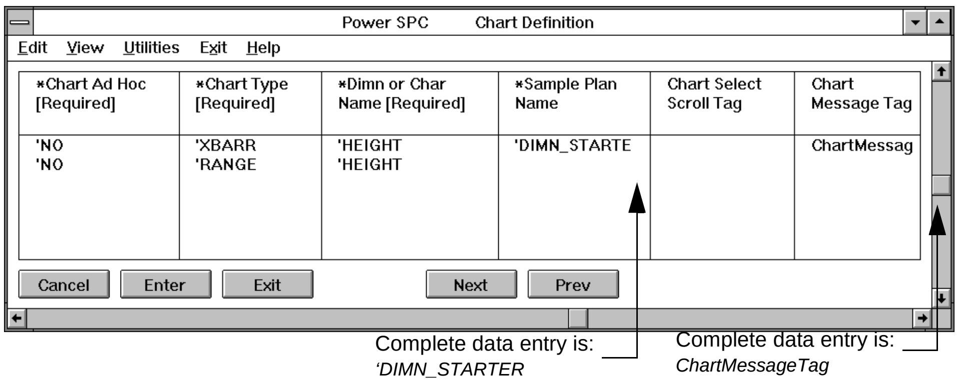


*Chart Ad Hoc	Chart will be an as monitored chart.
*Chart Type	Press Ctrl + K to bring up the key file that contains the valid chart types.
*Dimn or Char Name	Entry must match the name defined in the Sample Plans Collection Control panel.
Sample Plan Name	Entry must match name in the Sample Plan Definition Panel.Sample Plan name is required for Cp and Cpk Chart Info.
Chart Message Tag	Message tag that corresponds to output text field on SPCDIMN screen.

4 Save the data for the first chart and complete the Chart Definition panel for the second chart (object name DimnChart2).





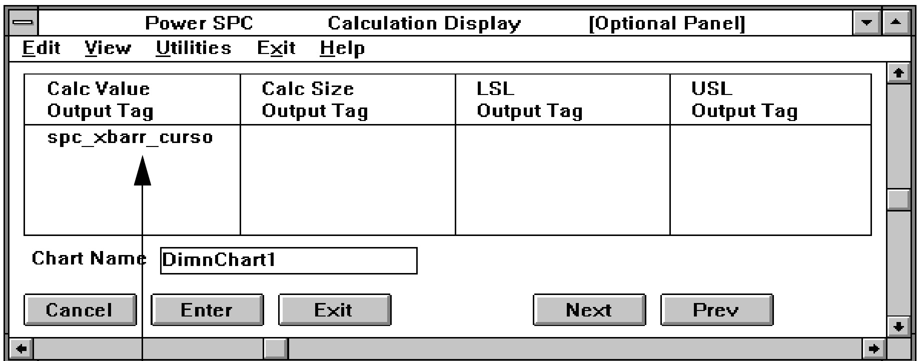
5 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

Chart Object Name	Name of object. Entry must match object name defined in the Graphics Editor.
Drawing Name	Name of drawing. Entry must match the drawing name created in the Application Editor and contains the DimnChart1 chart object.
*Location Name	Entry must match a location specified in the Process Definition panel.
*Subgroup Name	Entry must match a location specified in the Process Definition panel.
Historian Database Alias Name	Entry must match the alias name defined in the Historian Information panel.
Historian Mailbox	Entry must match mailbox name in the Historian Mailbox Information panel.
*Chart Ad Hoc	Chart will be an as monitored chart.
*Chart Type	Press Ctrl + K to bring up the key file that contains the valid chart types.
*Dimn or Char Name	Entry must match the name defined in the Sample Plans Collection Control panel.
Sample Plan Name	Entry must match name in the Sample Plan Definition Panel.Sample Plan name is required for Cp and Cpk Chart Info.
Chart Message Tag	Message tag that corresponds to output text field on SPCDIMN screen.

Save the data for the first chart and complete the Chart Definition panel for the second chart (object name DimnChart2).

6 Save the data. Ensure the cursor is on the chart named DimnChart1 and click Next to display the Calculation Display panel for the chart named DimnChart1.

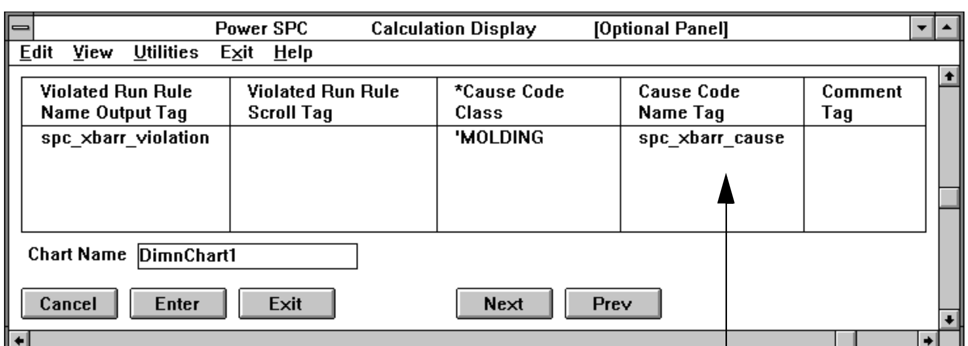
For details about each field on this panel, refer to Chapter 8, “Configuring SPC Charts,”of this guide.



Complete data entry is:
spc_xbarr_cursorvalue

7 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

Calc Value Output Tag	This tag was created from your responses when pasting the chart power object.

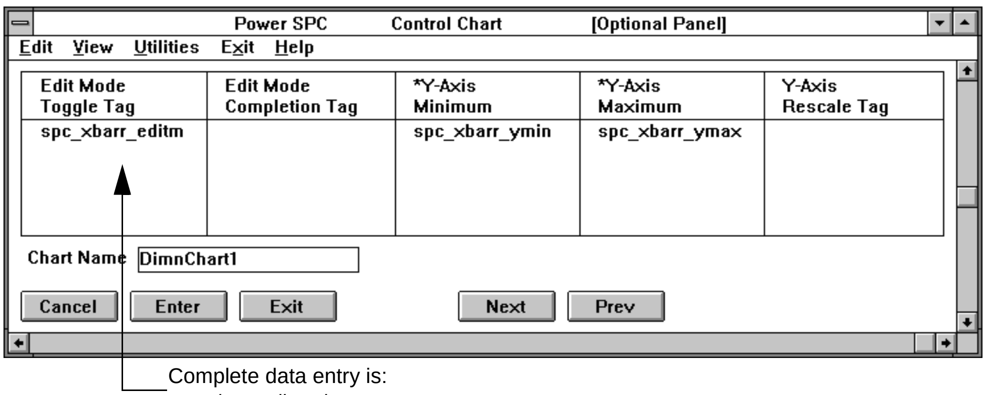


Complete data entry is:
spc_xbarr_causecode

Violated Run Rule Name Output Tag	This tag was created from your responses when pasting the chart power object.
*Cause Code Class	Entry is referred to when you define the cause codes.
Cause Code Name Tag	This tag was created from your responses when pasting the chart power object.

8 Save the data and click Next until the Control Chart panel is displayed.

For details about each field on this panel, refer to Chapter 8, “Configuring SPC Charts,” of this guide.



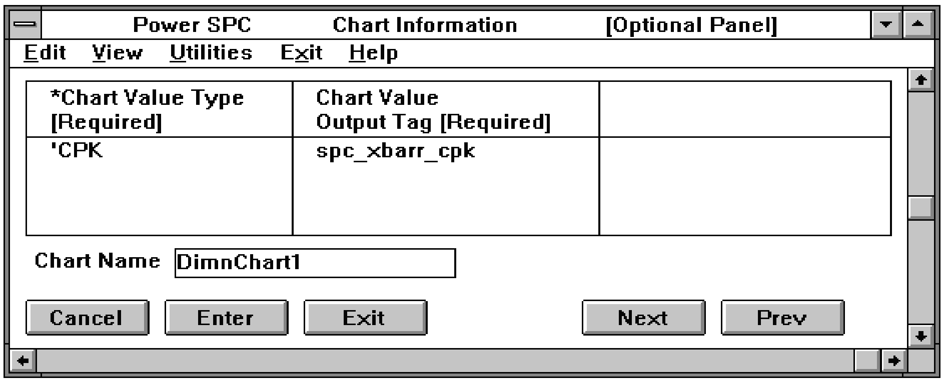
Complete data entry is:
spc_xbarr_editmode

9 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

Edit Mode Toggle Tag	This tag was created from your responses when pasting the chart power object.
*Y-Axis Minimum	This tag was created from your responses when pasting the chart power object.
*Y-Axis Maximum	This tag was created from your responses when pasting the chart power object.

10 Save the data and click Next until the Chart Information panel is displayed.

For details about each field on this panel, refer to Chapter 8, “Configuring SPC Charts,” of this guide.

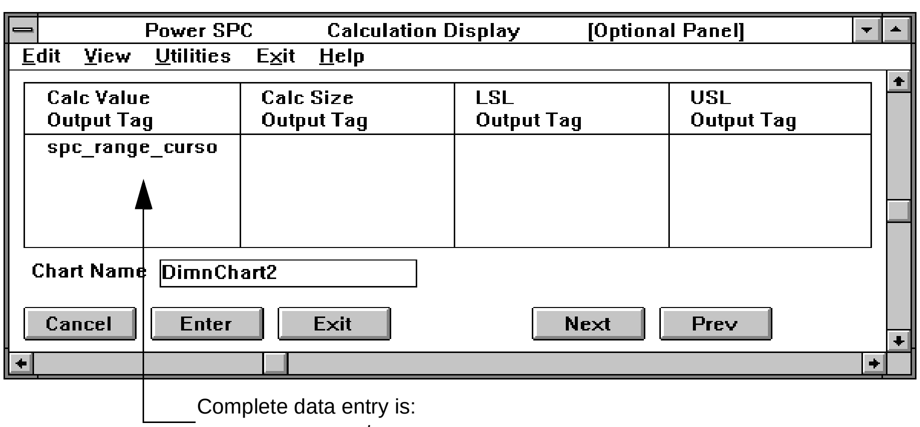


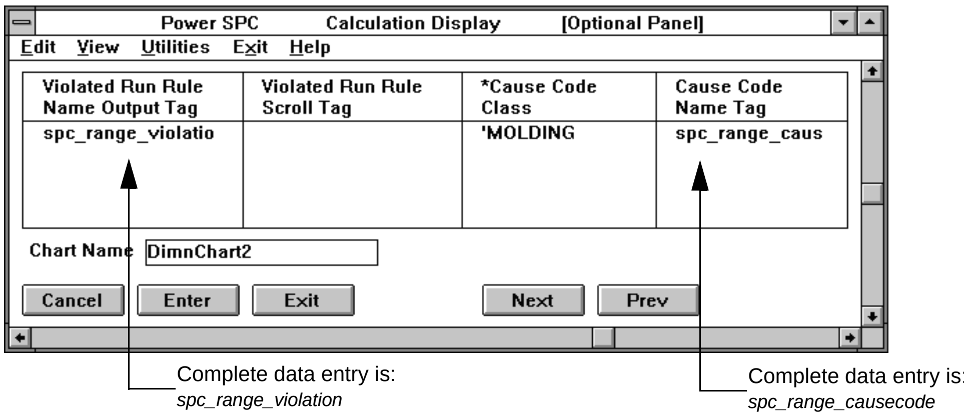
11 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

*Chart Value Type	Press Ctrl + K to bring up the key file that contains the valid chart types.
Chart Value Output Tag	This tag was created from your responses when pasting the chart power object.

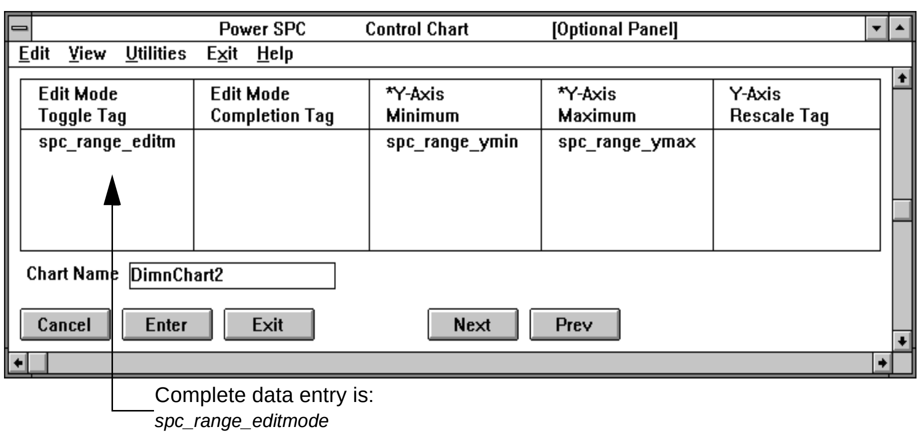
12 Save the data and click Next to display the Chart Definition panel again. Now, complete the same panels you just configured, except for the chart name DimnChart2.

13 Ensure your cursor is on the DimnChart2 chart and click Next to display the Calculation Display panel for DimnChart2.

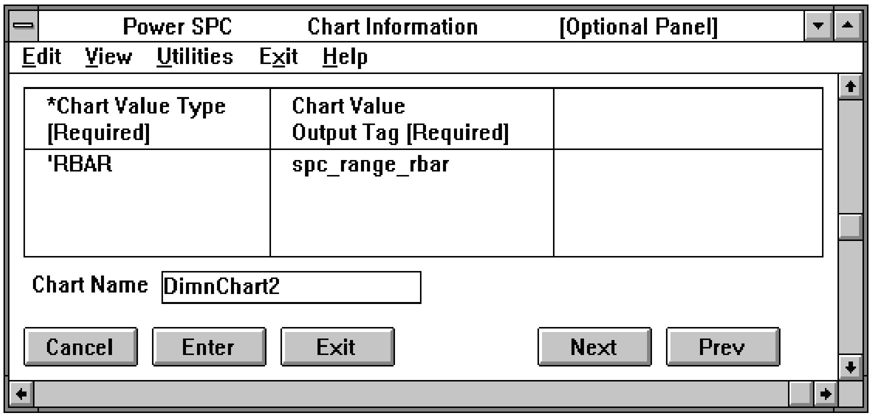




14 Save the data and click Next to display the Control Chart panel. Complete the panel for DimnChart2.



15 Save the data and click Next to display the Chart Information panel. Complete the panel for DimnChart2.



16 Save the data and exit.

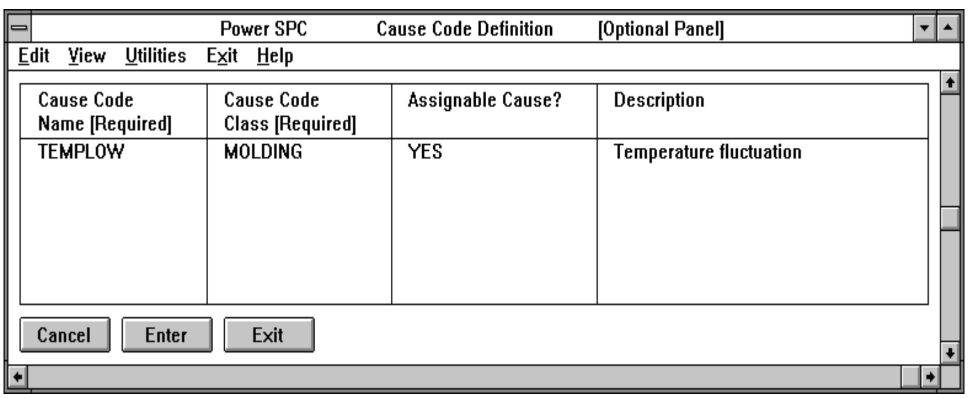
Customizing Your Process

Customize your process by defining assignable cause codes, specifying standard or user-defined run rules, and configuring auxiliary database fields for the collection of auxiliary data. Use the standard Western Electric run rules for this application to define assignable cause codes.

> **Note:** Defining cause codes does not require selection of a domain in the Configuration Manager.

1 Choose PowerSPC User-Defined Cause Codes from the Configuration Manager Main Menu to display the User-Defined Cause Codes panel.

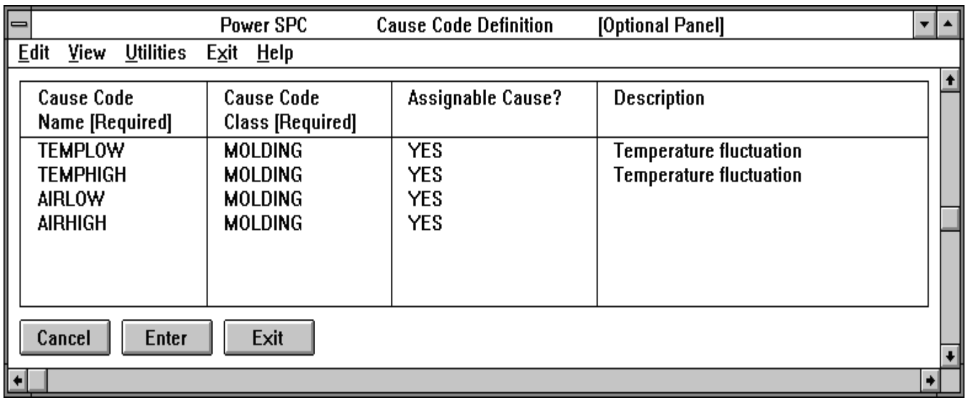
For details about each field on this panel, refer to Chapter 9, “Customizing Your Process,” of this guide.



2 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

Cause Code Name	Create a cause code name the operator can assign at run time.
Cause Code Class	This class must match the one entered in the Charts Calculation Display panel or a tag containing the class name.
Assignable Cause	Choose YES to exclude cause code items in calculations.

3 Create three more cause codes: TEMPHIGH, AIRLOW, and AIRHIGH. All codes are in the MOLDING class and have Assignable Cause entries of YES. Optionally, enter a description for each code.



4 Save the data and exit cause codes.

TESTING THE APPLICATION

Perform the following steps to run and test your application:

1. Run the application (FLRUN). For details on starting FactoryLink, refer to *FactoryLink ECS Fundamentals*.
2. Click Return to Application when the USER Domain Run-Time Manager displays.
3. The SPCDIMN screen displays. Create data to be logged by entering five values between 15.90 and 16.10 in the input text field (displays as 0.00 at startup). Click ACCEPT after entering each value.
4. A point displays on each chart after you have entered the fifth value; the subgroup size of 5 specifies a calculation will be performed after five points are collected. The Point Value field displays the calculated value (the point plotted on the chart) at the default cursor location (left of chart for this chart). Click the cursor anywhere in the chart, and the Point Value field displays the calculated value of that point. The Population Value field displays the calculated value for all points on the chart; therefore, it is updated each time a point is plotted.
5. Enter five more values accepting after each, with several of your entries being outside of the 15.90 to 16.10 area. This allows you to test if your run rule violation displays.
6. Click Edit Mode to allow chart editing to test your cause codes. Edit Mode turns green to indicate editing is allowed. In the Cause Code input text field, type any of the cause codes you defined in the User-Defined Cause Codes panel: TEMPLOW, TEMPHIGH, AIRLOW, AIRHIGH.
7. Click Edit Mode again to complete the cause code assignment. The cause code you entered displays next to the point it is assigned to. Edit Mode turns red to indicate Edit Mode has been exited.
8. Select the button you animated to return to the Run-Time Manager screen.
9. Stop the FactoryLink application. If any portions of your test did not work, return to that portion of the configuration and check your entries.

Chapter 4 . . . .

Tutorial for the Characteristic Application

A sample characteristic application named pspcchar.mps is copied to the {FLINK}/mps/en directory during option installation of mps English files. This sample application monitors characteristic data and contains two C control charts and one bar chart (Pareto-Defect).

This chapter is a tutorial on how this application is built. It describes the steps taken to build the characteristic application. By following the directions provided, you build a finished application that resembles the sample application.

The procedures in this chapter assume you understand PowerSPC's use of tag/constant fields and you have basic knowledge of entering data into panels in the Configuration Manager. Refer to *FactoryLink ECS Fundamentals* if you are not familiar with this.

BUILD SEQUENCE FOR THE POWERSPC CHARACTERISTIC APPLICATION

Perform the following steps to configure the application. While some of these steps could be performed in a different order, we recommend using the following order to facilitate your application development. Each of these steps is detailed in the following sections.

1. Restore the FactoryLink new application, {FLINK}/mps/en/flnew.mps. For details on restoring application, refer to *FactoryLink ECS Installation Guide*.
2. Set the {FLAPP} to reference the directory where the FLNEW application is located.
3. Set up the sample plan. See "Configuring the Sample Plan" on page 88 of this chapter.
4. Set up the Historian. See "Configuring the Historian for the PowerSPC Process" on page 95 of this chapter.
5. Configure the PowerSPC process. See "Configuring the PowerSPC Processes" on page 97 of this chapter.
6. Draw and animate the PowerSPC screen. See "Drawing and Animating the PowerSPC Screen" on page 101 of this chapter
7. Configure the PowerSPC charts. See "Configuring the PowerSPC Charts" on page 105 of this chapter.
8. Customize your process. See "Customizing your Process" on page 116 of this chapter.
9. Test the application. See "Testing the Application" on page 118 of this chapter.

As you develop each part of the application, test often as it simplifies troubleshooting if the application does not function as expected at run time. After configuring the PowerSPC processes, test the application to ensure data is being logged. After configuring the PowerSPC charts, test to ensure the charts are functioning properly. If you customize your process by defining run rules, cause codes, or auxiliary data collection, test that functionality.

For the purposes of this quick start, you test the application only once after it is completed.

Overview of the Characteristic Application

The sample characteristic application contains one screen, named SPCCHAR, in addition to the default Run-Time Manager and Alarm screens. This screen contains two input text fields that allow you to enter raw data and then click a button to accept the data.

The application collects raw data about an inspection process that measures the number of cracks and bubbles in bottles. You inspect five objects, entering the number of defects (bubbles and cracks) found on each and accepting the values after each inspection. After collecting and accepting each set of five raw data values, the application does a C calculation for each characteristic and displays those results on two charts, one for bubbles and the other for cracks. Output text fields also display these values according to the location of the cursor on the chart. Additional output text fields display the population values for each chart.

In addition to the C charts, the screen also contains a Pareto-Defect chart. PowerSPC updates this chart as each sample is inspected, displaying the total number of bubbles and cracks found to that point in the process.

The application monitors run rules and, when a violation occurs, it displays the highest priority run rule being violated in an output text field. It also allows you to select a point and assign a cause code to it.

The following sections provide step-by-step directions for building the PowerSPC characteristic application, according to the suggested order in the previous page.

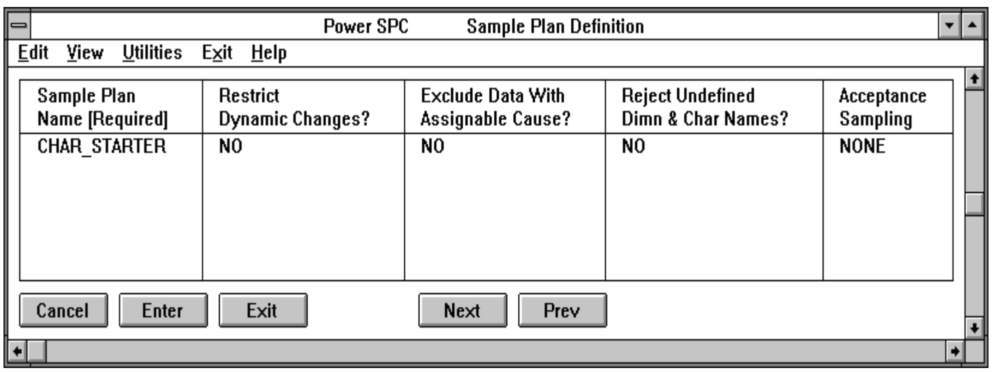
Configuring the Sample Plan

Perform the following steps to configure the sample plan:

1 Start the FactoryLink Configuration Manager.

2 Choose PowerSPC Sample Plans from the Configuration Manager Main Menu to display the Sample Plan Definition panel.

For details about each field on this panel, refer to Chapter 5, "Creating a PowerSPC Sample Plan," of this guide.



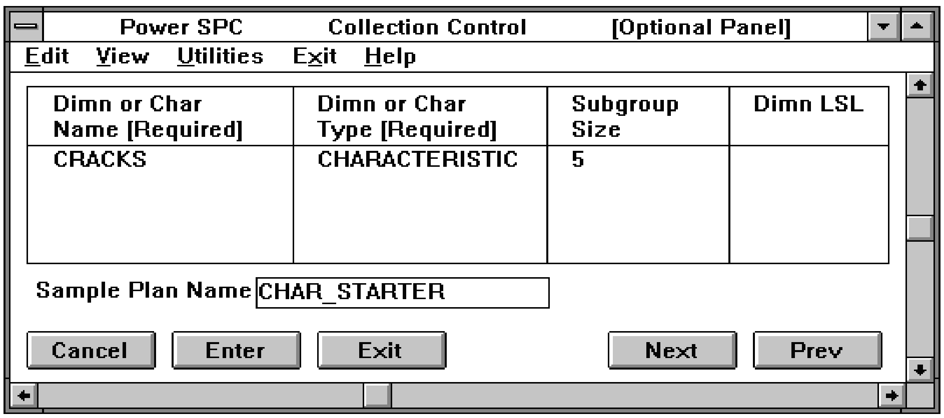
3 Specify the following information on this panel. Type the entries exactly as shown on this and all future panels, including upper and/or lower case.

Sample Plan Name	Name of sample plan. This name is used when defining the processes on the Process Definition panel to link the plan name with the process.
Restrict Dynamic Changes	Indicates the sample plan values can be changed at run time.
Exclude Data with Assignable Causes	Indicates points with cause codes are included in control limit calculations.
Reject Undefined Dimn & Char Names	Indicates raw data names can be changed at run time using tags.
Acceptance Sampling	Indicates this sample plan is for process sampling, not acceptance sampling.

4 Click Enter or press the Enter key to save the data on this or any panel.

5 Ensure the cursor is on the line for the CHAR_STARTER sample plan and click Next to display the Collection Control panel.

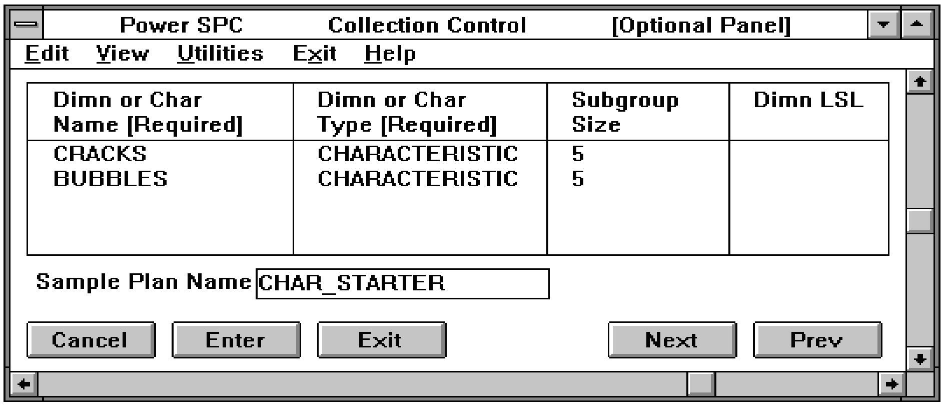
For details about each field on this panel, refer to Chapter 1, “Overview,” of this guide. For information about dimensions, characteristics, and subgroups, refer to Chapter 5, “Creating a PowerSPC Sample Plan.”



6 Specify the following information on this panel. Type the entries exactly as shown on this and all future panels, including upper and/or lower case.

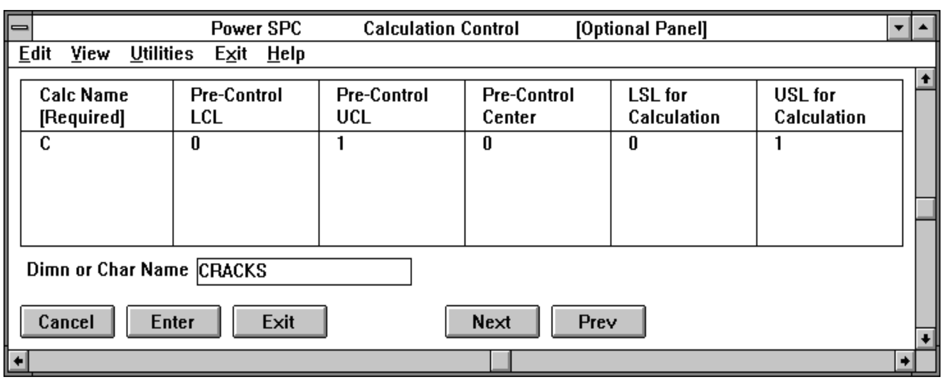
Dimn or Char Name	Name of dimension used when defining the process(es) in the Data Collection panel. In this example, the application collects information only about the number of cracks.
Dimn or Char Type	Indicates the dimension type. Press Ctrl + K to bring up the key file containing valid entries for this field; double-click the desired entry.
Subgroup Size	Defines number of raw data entries (five) in a subgroup.

7 Save the data and enter the following information on the next row of the Collection Control panel. You are collecting data for two characteristics: cracks and bubbles.



8 Save the data. Ensure the cursor is on the CRACKS character name and click Next to display the Calculation Control panel for CRACKS.

For details about each field on this panel, refer to Chapter 5, “Creating a PowerSPC Sample Plan.” For a list of the calculations supported by PowerSPC, refer to Chapter 1, “Overview.”



9 Specify the following information on this panel. Type the entries exactly as shown on this and all future panels, including upper and/or lower case.

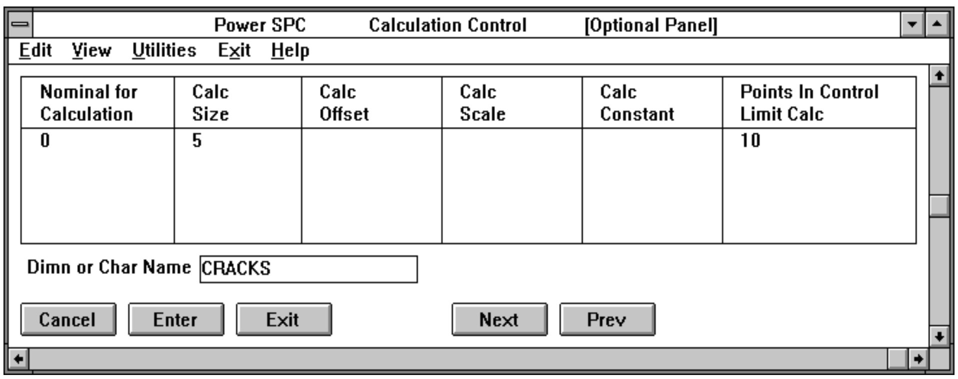
Calc Name	Indicates the type of calculation. Press Ctrl + K to bring up the key file that contains the valid types of calculations.
Pre-Control LCL	Defines the Lower Control Limit; is displayed on the chart as a yellow line.

Pre-Control UCL Defines the Upper Control Limit; is displayed on the chart as a yellow line.

Pre-Control Center Defines the expected or desired average Control value; is displayed on the chart as a yellow line.

LSL for Calculation Defines the Lower Spec Limit; is displayed on the chart as a yellow line.

USL for Calculation Defines the Upper Spec Limit; is displayed on the chart as a yellow line.



Nominal for Calculation Defines the expected or desired average Spec value; is displayed on the chart as a yellow line.

Calc Size Amount of raw data to be used for the C calculation.

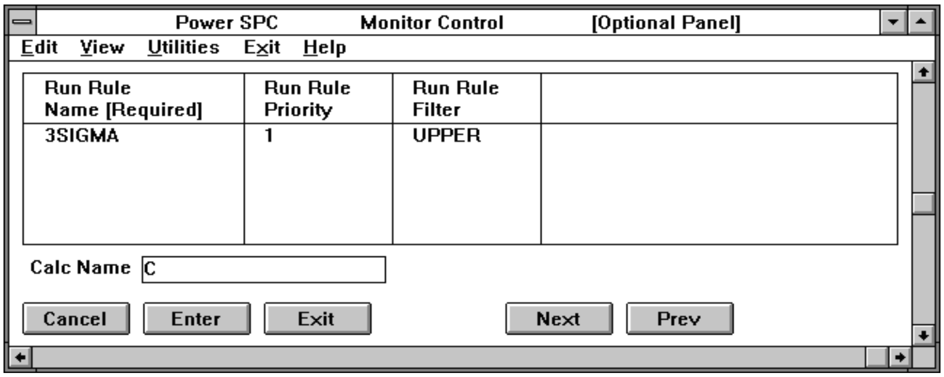
Points In Con-trol Limit Calc PowerSPC uses ten subgroup values to calculate the control limits.

10 Save the data. Then, ensure the cursor is on the C calculation and click Next. In the next step, you configure run rules for the C calculation that you just configured.

For general information about run rules, refer to Chapter 1, “Overview,” of this guide.

11 Complete the Monitor Control panel to specify the run rules to be monitored for the C calculation.

For details about each field on this panel, refer to Chapter 5, “Creating a PowerSPC Sample Plan,” of this guide.



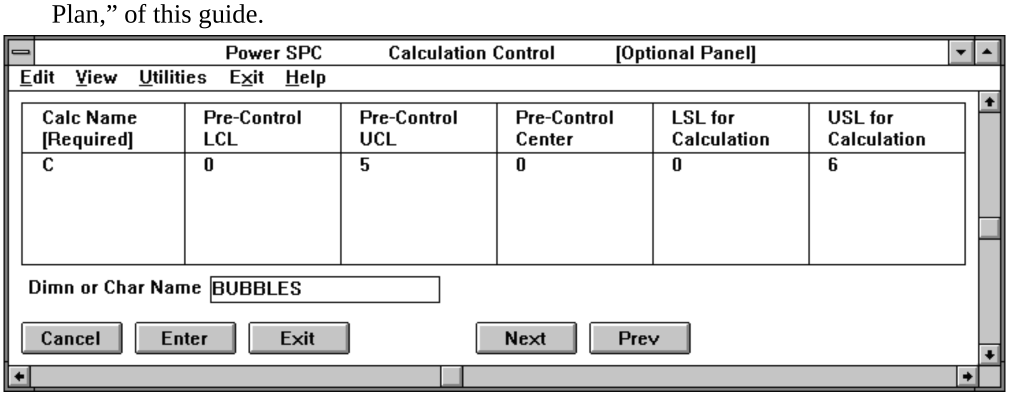
12 Specify the following information on this panel. Type the entries exactly as shown on this and all future panels, including upper and/or lower case.

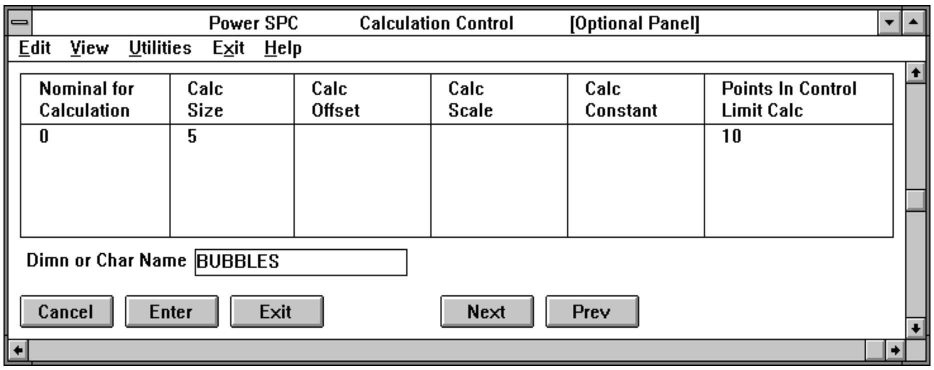
Run Rule Name	Press the Ctrl + K keys to bring up the key file that contains the valid predefined run rules.
Run Rule Priority	You must select a unique priority on this panel (for this calculation).
Run Rule Filter	Press the Ctrl + K keys to bring up the key file that contains the valid filters.

13 Save the data and click Previous until the Collection Control panel displays.

14 Ensure the cursor is on the BUBBLES character name and click Next to display the Calculation Control panel for BUBBLES.

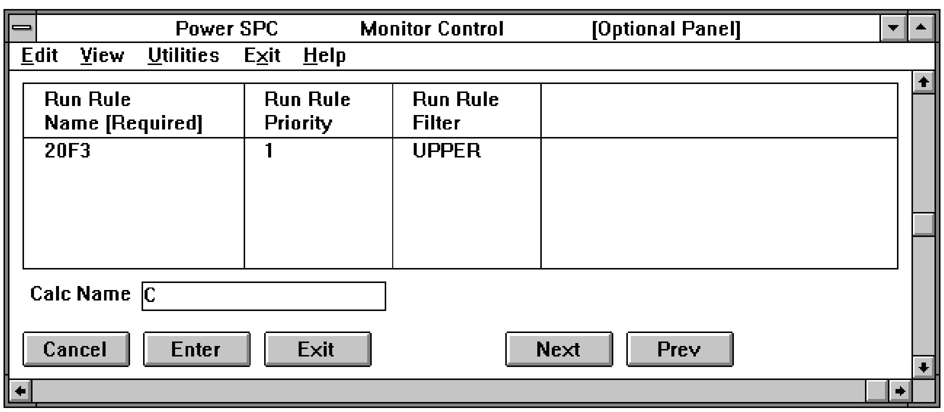
For details about each field on this panel, refer to Chapter 5, “Creating a PowerSPC Sample Plan,” of this guide.



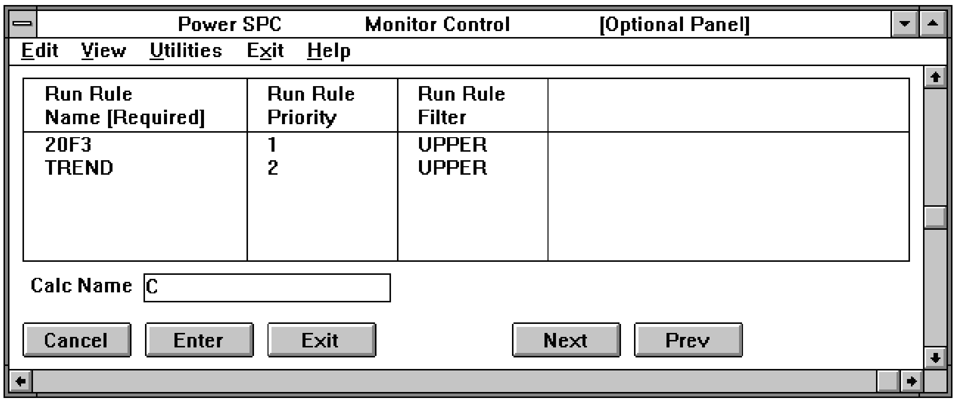


15 Save the data. Ensure the cursor is on the C calculation and click Next.

16 Complete the Monitor Control panel to specify the run rules to be monitored for the C calculation.



17 On the second row of this panel, specify you want to monitor a run rule named TREND that has a priority of 2 and uses the UPPER filter.



18 Save the data and click Exit to exit PowerSPC Sample Plans.

CONFIGURING THE HISTORIAN FOR THE POWERSPC PROCESS

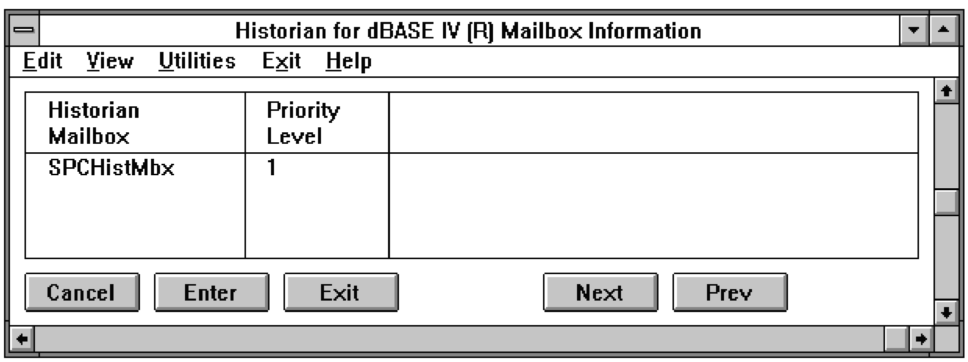
When defining the SPC processes you want to collect data for and then monitor, you must also configure the Historian so that when the SPCDATA task collects the data and sends it to the Historian for archiving, the Historian knows what mailbox to check for data and where to put it.

Configure the Historian for dBASE IV for this sample application.

For details about configuring the dBASE IV Historian or another Historian, refer to the appropriate Historian chapter in the *FactoryLink ECS Configuration Guide*.

1 Ensure the current domain selected is SHARED in the Configuration Manager Domain Selection box.

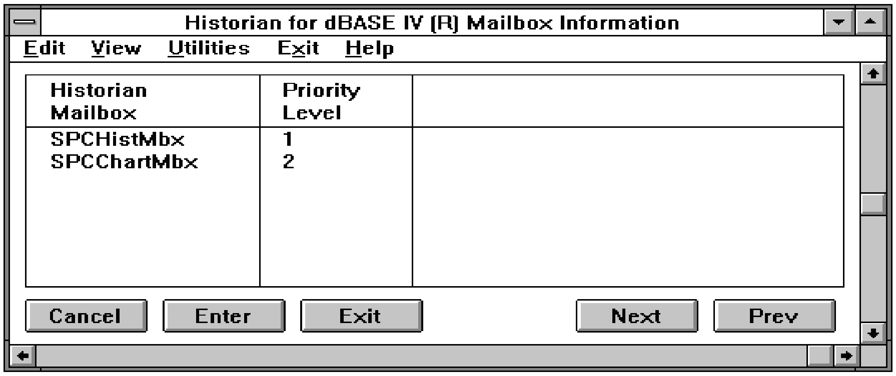
2 Choose Historian for dBASE IV from the Configuration Manager Main Menu to display the Historian Mailbox Information panel.



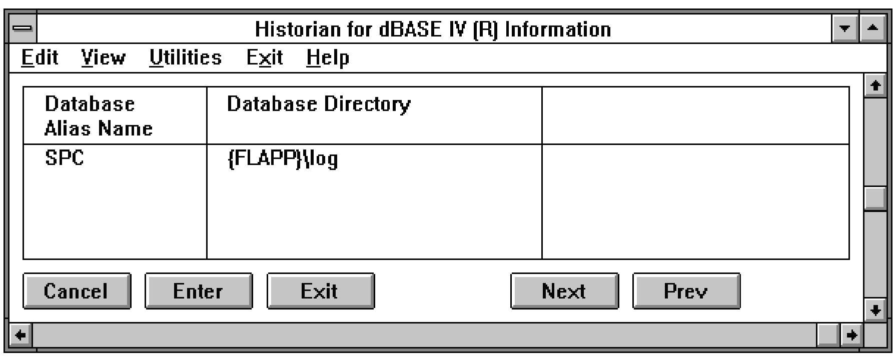
3 Specify the following information for this panel:

Historian Mailbox — This SHARED mailbox tag is referred to when defining the process(es).

4 Define a second mailbox tag named SPCChartMbx and assign it a priority of 2. This mailbox tag is used for chart information.



5 Save the data and click Next to display the Historian Information panel.



6 Specify the following information for this panel:

Database Alias Name	Refer to this name when defining the process and also configuring the SPC chart.
Database Directory	The data is archived to the log subdirectory in the {FLAPP} directory.

7 Save the data and exit the Historian.

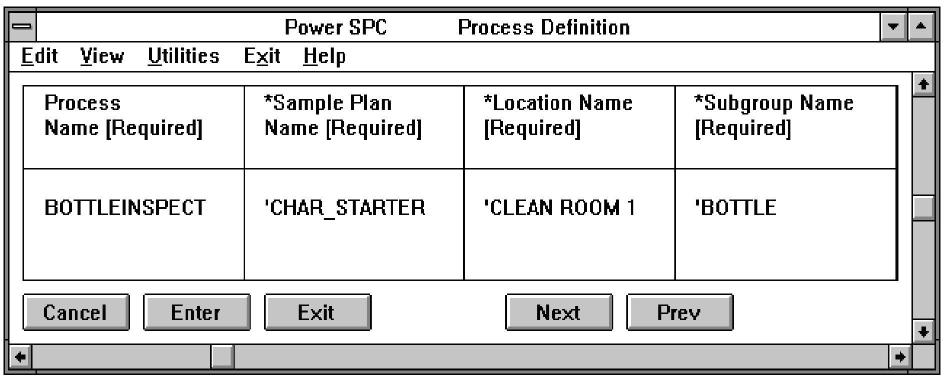
CONFIGURING THE POWERSPC PROCESSES

Perform the following steps to configure the process:

1 Ensure the current domain selected is SHARED in the Configuration Manager Domain Selection box.

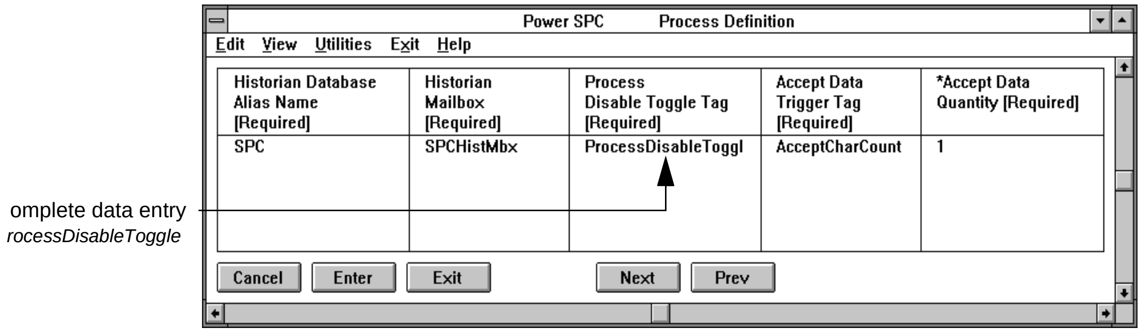
2 Choose PowerSPC Processes from the Configuration Manager Main Menu to display the Process Definition panel.

For details about each field on this panel, refer to Chapter 6, “Configuring the Processes,” of this guide.



3 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

Process Name	Name of the process.
*Sample Plan Name	Entry must match name in the Sample Plan Definition panel.
*Location Name	Create a location name; repeat this name in the Chart Definition panel.
*Subgroup Name	Create a subgroup name; repeat this name in the Chart Definition panel.



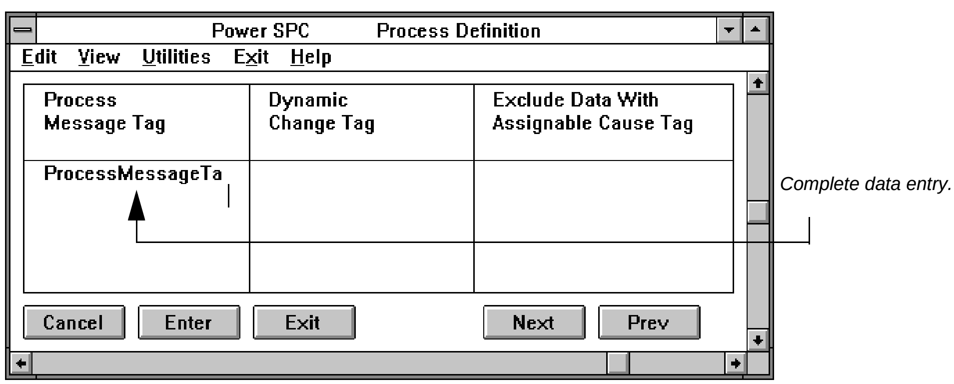
Historian Database Alias Name — Name must match name entered in the Historian Information panel.

Historian Mailbox — Name must match name entered in the Historian Mailbox Information panel.

Process Disable Toggle Tag — Digital tag that allows you to enable/disable this process at run time.

Accept Data Trigger Tag — Digital tag; corresponds to animated button on screen to accept data.

*Accept Data Quantity — Indicates how many raw values to process.

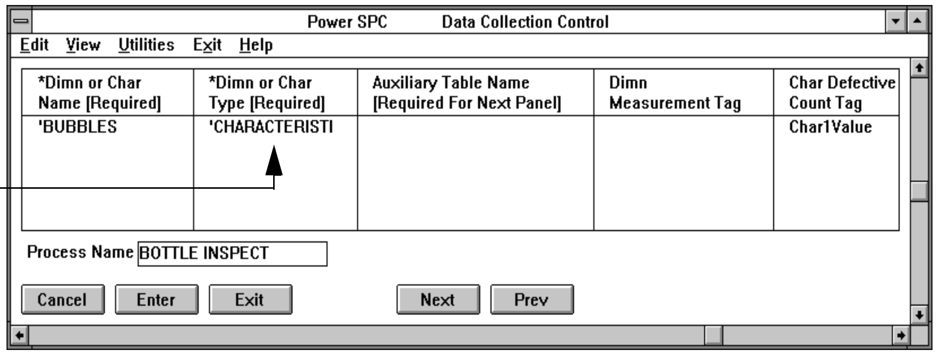


Process Message Tag — Message tag that corresponds to output text field on screen.

4 Save the data. Ensure the cursor is on the BOTTLE INSPECT process and click Next to display the Data Collection Control panel.

For details about each field on this panel, refer to Chapter 6, “Configuring the Processes,”of this guide.

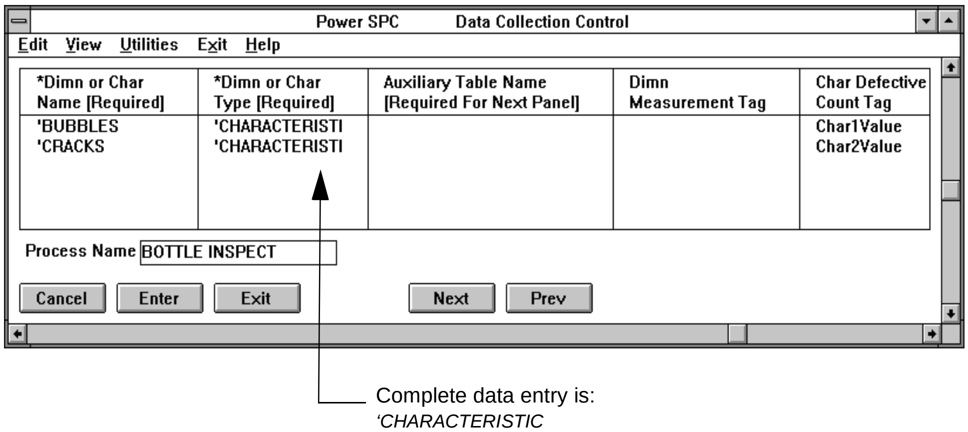
Complete data entry



5 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

*Dimn or Char Name	Name of the dimension. Name must match name entered in Sample Plan Option Collection Control panel.
*Dimn or Char Type	Press Ctrl + K to bring up the key file that contains the valid types.
Char Defect Count Tag	Analog tag that corresponds to input text field on the screen you enter values to be logged (number of bubbles) into.

6 Save the data. Then complete the second row of the Data Collection Control panel for a **“**CRACKS” CHARACTERISTIC with a Char Defect Count Tag of Char2Value (ANALOG tag).



7 Exit the panels.

DRAWING AND ANIMATING THE POWERSPC SCREEN

This section provides directions to build a screen that performs the following functions:

- Allows you to input raw data values
- Triggers acceptance of the raw data values
- Displays the C chart for CRACKS and the C chart for BUBBLES
- Displays the Pareto-Defect chart
- Displays the calculated value at the cursor location
- Displays the population value
- Displays run rule violations
- Accepts assignable cause code entries

Since you have not seen the actual screen in the PSPCCHAR application, your screen may differ slightly from it in colors and location of input and output text fields; however, the functionality of your screen is the same.

Creating the Screen Using the Chart Power Pack

Perform the following steps to create your screen:

1. Ensure the current domain selected is USER in the Configuration Manager Domain Selection box.
2. Choose Application Editor.
3. Choose File>Open Power Pack. Refer to the *FactoryLink ECS Application Editor* for details about power packs.
4. Choose POWERSPC>Basic Chart object (it is a combined object).
5. Choose File>Open.
6. Create a new file named SPCCHAR and open it.
7. Choose Attributes>Screen Color to change the screen background to your desired color.
8. Since you selected a Power Pack object, you should be in Paste mode as you enter the SPCCHAR screen (your cursor is a large +). Position your cursor to paste the chart object in the upper right half of the screen. You will paste another chart in the lower right half of the screen and another in the upper left of the screen.

9 Prompts display when you click the mouse button to paste the object. Answer the prompts in the following manner, then click OK.

At this prompt...	Type this value...
Enter unique chart identifier (i.e., xbarr or chart3)	c_char1
Enter population calculation name (i.e., Cpk)	pop

10 Select the chart object you just pasted (it is a combined object). Press Ctrl and click the mouse button to select only the chart itself. A green check mark displays on the Chart Animation icon of the toolbox to confirm you have selected only the chart.

11 Choose Attributes>Object Name. Change the name of the chart object to CharChart1. You refer to this name when you configure the chart and for reference purposes, it is easier to refer to a meaningful object name than a number.

12 Choose Edit>Paste or click the Paste icon in the tool box to paste the second chart object into your drawing in the lower right half of the screen.

13 Prompts display when you click the mouse button to paste the object. Answer the prompts in the following manner, then click OK.

At this prompt...	Type this value...
Enter unique chart identifier (i.e., xbarr or chart3)	c_char2
Enter population calculation name (i.e., Cpk)	rbar

14 Select the chart object that you just pasted. Select the chart itself as you did previously.

15 Choose Attributes>Object Name. Change the name of the chart object to CharChart2.

16 Return to the power pack (POWERSPC.GP). For the final chart, paste only the actual chart excluding the output text fields on the right of the object. Select the combined object, then use the CTRL click method to select only the chart including the legends portion of the Basic Chart power object.

17 Use the Windows pull-down menu to change back to the SPCCHAR drawing. You should be in Paste mode when you enter the drawing. Paste the chart object in the upper left half of the screen.

18 A prompt displays when you click the mouse button to paste the object. Answer the prompt in the following manner, then click OK.

At this prompt...	Type this value...
Enter unique chart identifier (i.e. xbarr or chart3)	pareto_char

19 Select the chart object that you just pasted. Select the chart itself as you did previously.

20 Choose Attributes> Object Name. Change the name of the chart object to CharChart3.

21 Select the X legend of the chart CharChart3 (last one pasted).

22 Choose Attributes>Object Name. Change the name of the legend object to ParetoDXLegend.

Adding Functionality to the Screen

Perform the following steps to add objects to the screen, such as input text fields for entering raw data:

1 Type the static text Selected Defect Count under the chart on the upper left half of the screen.

2 Create a text object with format XXXXXXXX under that static text. Animate the text object as Output Text to display the value of the tag named spc_pareto_defect_cursorvalue (a USER domain FLOAT tag). This tag will be referred to later when you configure this chart.

3 Type the following three lines of static text under the Output Text object just created:

For each bottle, type:

# of Bubbles

# of Cracks

4 Draw a text object with the format XX to the right of the # of Bubbles text. Animate it as an Input Text. Enter a tag name of Char1Value on the Input Text animation panel. You defined this tag when you defined the process. Select the box to activate Background Updates.

5 Draw a text object with the format XX to the right of the # of Cracks text. Animate it as an Input Text. Enter a tag name of Char2Value on the Input Text animation panel. You defined this tag when you defined the process. Select the box to activate Background Updates.

6 Add a box under the output text field just created.

7 Animate the box as a button and choose an action of TGL.

8 Enter AcceptCharCount in the Destination Tag field. You defined this tag when you configured the process.

9 Add a text object ACCEPT inside the box just created.

10 Choose Attributes>Fill. Select a Solid style and foreground color (FG) of red.

11 Animate the ACCEPT text object using the Paint animation option. Enter a tag of AcceptCharCount. Select a foreground color of grey at a Limit of 0 and a foreground color of red at a Limit of 1 for the paint color changes.

12 Add a text object with the format of 60 Xs and animate it as Output Text that displays the tag CharProcessMessageTag. You defined this tag when you configured the process.

13 Add a text object with the format of 60 Xs and animate it as Output Text that displays the tag CharChartMessageTag (a USER domain MESSAGE tag). Use this tag when configuring the charts.

14 Add a button to provide access to the Run-Time Manager screen at run time. Animate the button with an action of DRW, and enter RUNMGRU in the Source Value field.

15 Choose File>Save to save your drawing.

16 Choose File>Open and open the RUNMGRU file.

17 Modify the animation on the Return to Application button by changing the Source Value field to SPCCHAR in order to access your SPCCHAR drawing at run time.

18 Save the RUNMGRU drawing and exit the Application Editor.

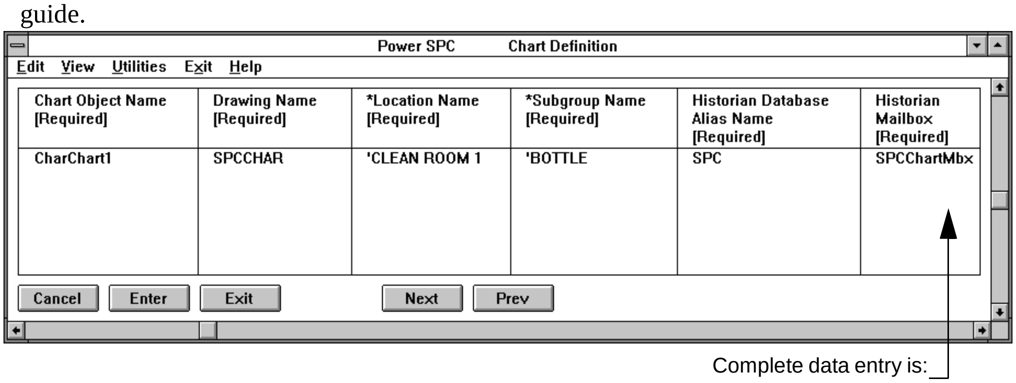
CONFIGURING THE POWERSPC CHARTS

Perform the following steps to configure the SPC charts:

1 Ensure the currently selected domain is USER in the Configuration Manager Domain Selection box.

2 Choose PowerSPC Charts from the Configuration Manager Main Menu to display the Chart Definition panel for the first C chart (object name CharChart1).

For details about each field on this panel, refer to Chapter 8, “Configuring SPC Charts,” of this guide.



Complete data entry is:
SPCChartMbx

3 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

Chart Object ID Number	ID of object. Entry must match object ID defined in the Application Editor.
Drawing Name	Name of drawing. Entry must match the drawing name that was created in the Application Editor and contains the CharChart1 chart object.
*Location Name	Entry must match a location specified in the Process Definition panel.
*Subgroup Name	Entry must match a location specified in the Process Definition panel.
Historian Database Alias Name	Entry must match the alias name defined in the Historian Information panel.
Historian Mailbox	Entry must match mailbox name in the Historian Mailbox Information panel.

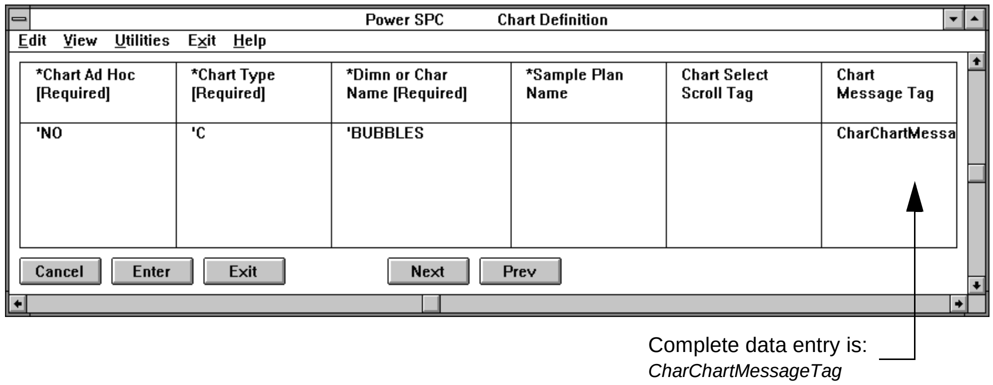
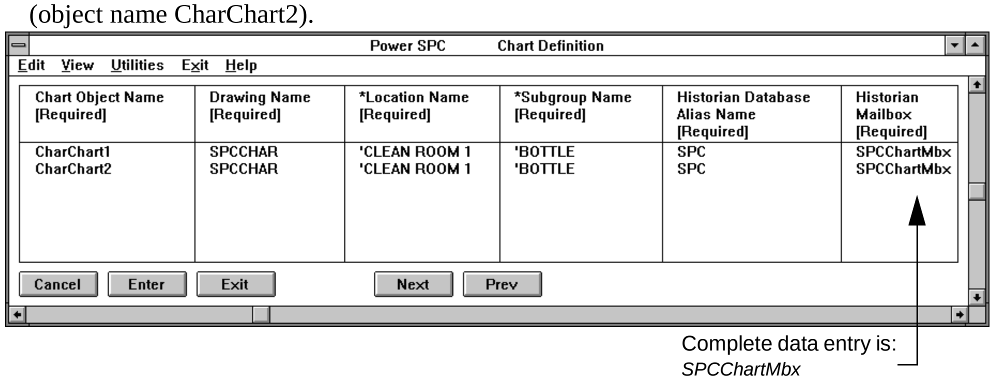
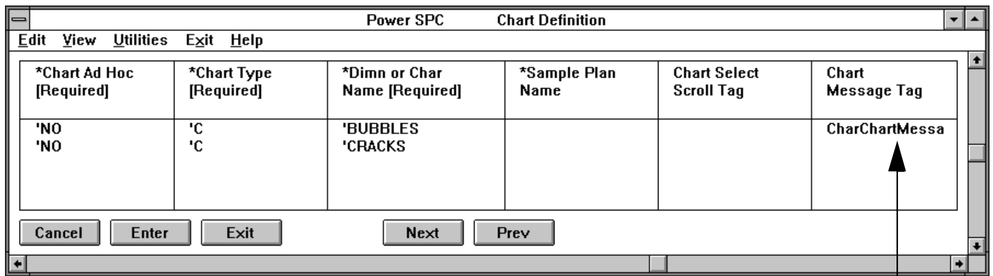


*Chart Ad Hoc	Chart is an as monitored chart.
*Chart Type	Press Ctrl + K to bring up the key file that contains the valid chart types.
*Dimn or Char Name	Entry must match the name defined in the Sample Plans Collection Control panel.
Chart Message Tag	Message tag that corresponds to output text field on SPCDIMN screen.

4 Save the data for the first chart and complete the Chart Definition panel for the second C chart (object name CharChart2).



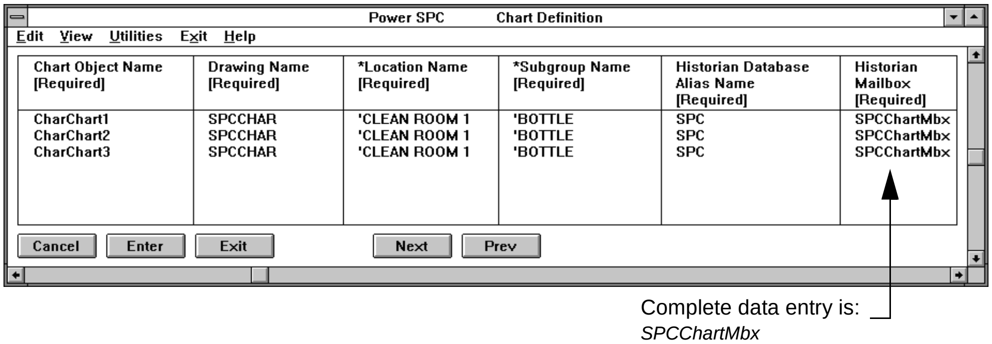


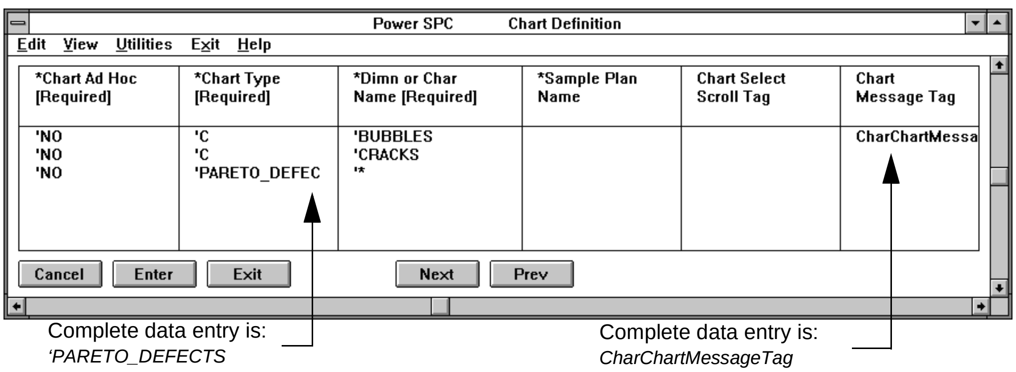
Complete data entry is:
CharChartMessageTag

5 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

Chart Object Name	Name of object. Entry must match object name defined in the Application Editor.
Drawing Name	Name of drawing. Entry must match the drawing name that was created in the Application Editor and contains the CharChart1 chart object.
*Location Name	Entry must match a location specified in the Process Definition panel.
*Subgroup Name	Entry must match a location specified in the Process Definition panel.
Historian Database Alias Name	Entry must match the alias name defined in the Historian Information panel.
Historian Mailbox	Entry must match mailbox name in the Historian Mailbox Information panel.
*Chart Ad Hoc	Chart is an as monitored chart.
*Chart Type	Press Ctrl + K to bring up the key file that contains the valid chart types.
*Dimn or Char Name	Entry must match the name defined in the Sample Plans Collection Control panel.
Chart Message Tag	Message tag that corresponds to output text field on SPCDIMN screen.

6 Save the data for the second chart and complete the Chart Definition panel for the Pareto-Defect chart (object name CharChart3).





Note: * Entry defines this chart to display data for both BUBBLES and CRACKS.

7 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

Chart Object Name	Name of object. Entry must match object name defined in the Application Editor.
Drawing Name	Name of drawing. Entry must match the drawing name that was created in the Application Editor and contains the CharChart1 chart object.
*Location Name	Entry must match a location specified in the Process Definition panel.
*Subgroup Name	Entry must match a location specified in the Process Definition panel.

Historian Database Alias Name Entry must match the alias name defined in the Historian Information panel.

Historian Mailbox Entry must match mailbox name in the Historian Mailbox Information panel.

***Chart Ad Hoc** Chart is an as monitored chart.

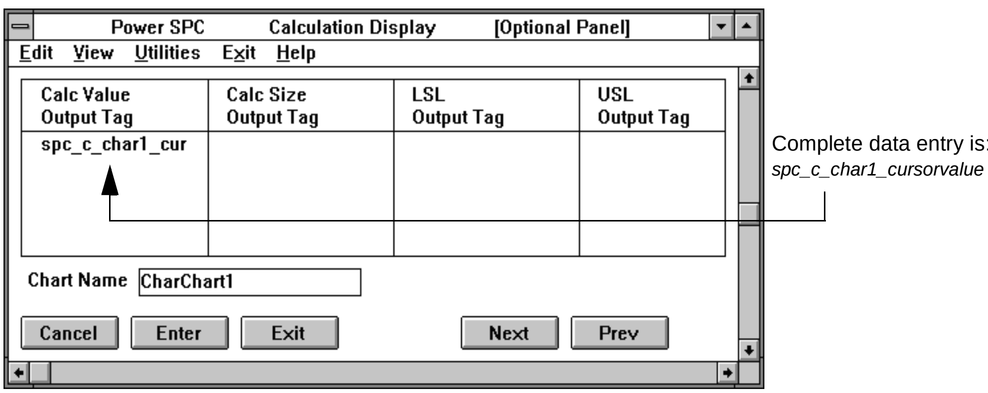
***Chart Type** Press Ctrl + K to bring up the key file that contains the valid chart types.

***Dimn or Char Name** Entry must match the name defined in the Sample Plans Collection Control panel.

Chart Message Tag Message tag that corresponds to output text field on SPCDIMN screen.

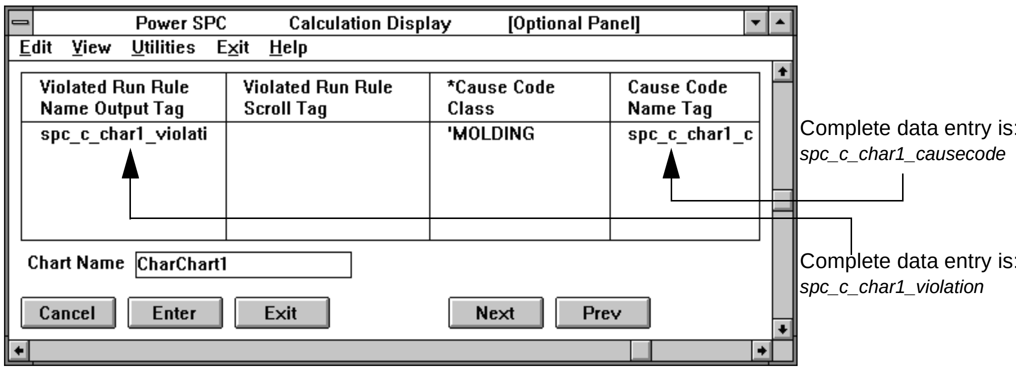
8 Save the data. Ensure the cursor is on the chart named CharChart1 and choose Next to display the Calculation Display panel for the chart named CharChart1.

For details about each field on this panel, refer to Chapter 8, “Configuring SPC Charts,” of this guide.



9 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

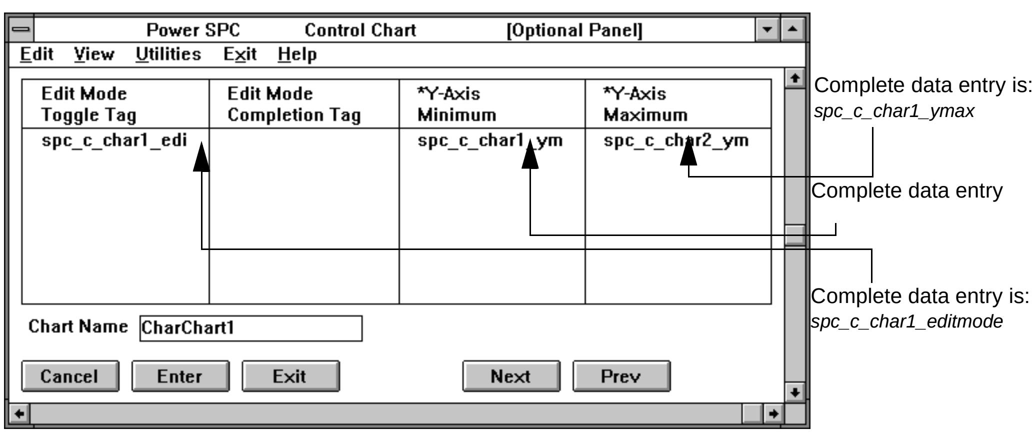
Calc Value Output Tag You created this tag with the responses when pasting the chart power object.



Violated Run Rule Name Output Tag	You created this tag with the responses when pasting the chart power object.
*Cause Code Class	Entry is referred to when you define the cause codes.
Cause Code Name Tag	You created this tag with the responses when pasting the chart power object.

10 Save the data and choose Next to display the Control Chart panel.

For details about each field on this panel, refer to Chapter 8, “Configuring SPC Charts,” of this guide.

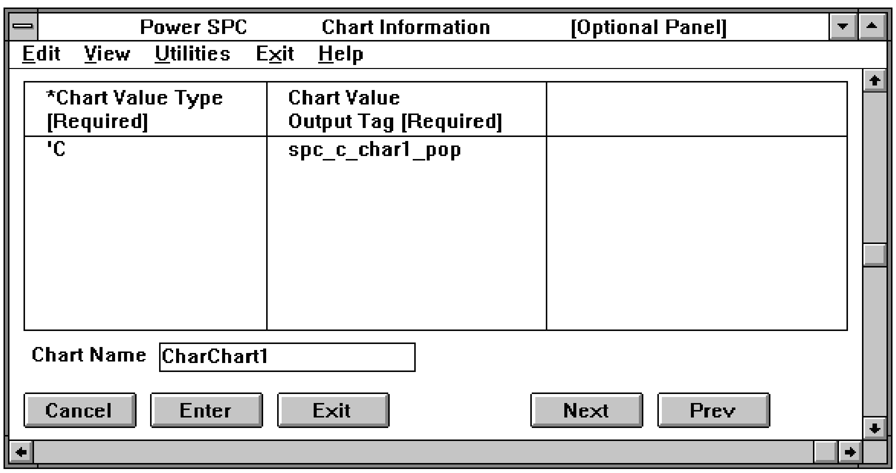


11 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

Edit Mode Toggle Tag	This tag corresponds to edit button on chart.
*Y-Axis Minimum	You created this tag with your responses when pasting the chart power object.
*Y-Axis Maximum	You created this tag with your responses when pasting the chart power object.

12 Save the data and choose Next to display the Chart Information panel.

For details about each field on this panel, refer to Chapter 8, "Configuring SPC Charts," of this guide.



13 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

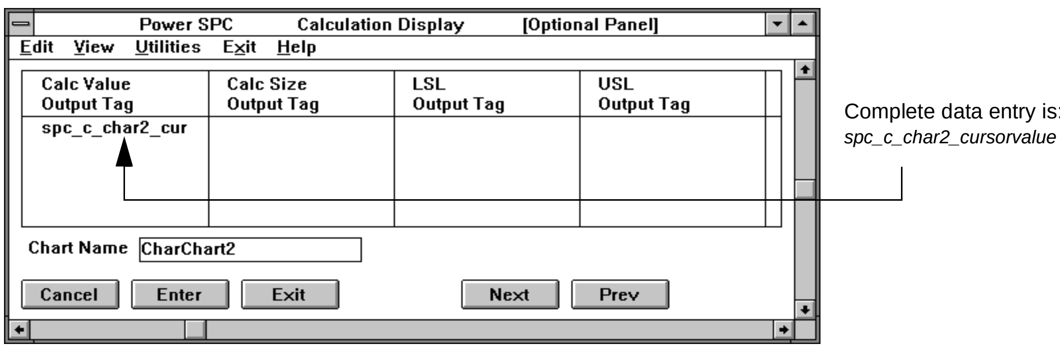
*Chart Value Type	Press the Ctrl + K keys to bring up the key file that contains the valid chart types.
Chart Value Output Tag	You created this tag with your responses when pasting the chart power object.

14 Save the data and choose Next to display the Chart Definition panel again. Complete the same panels you just configured, except for the chart name CharChart2.

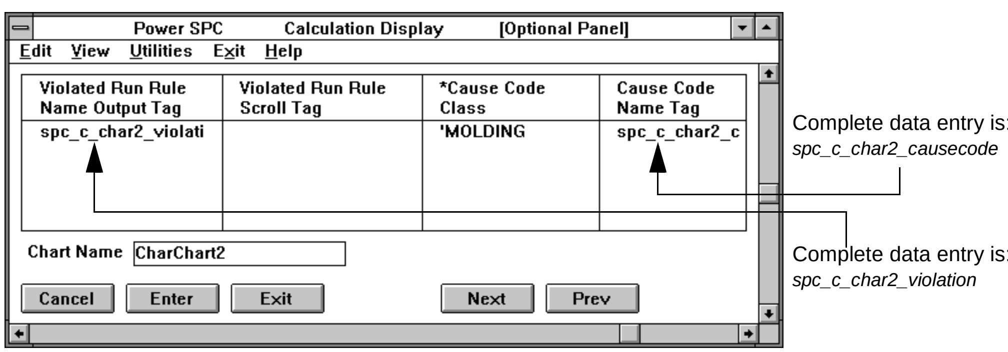
15 Ensure your cursor is on theCharChart2 chart and choose Next.

16 Complete the Calculation Display panel for CharChart2.

For details about each field on this panel, refer to Chapter 8, “Configuring SPC Charts,” of this guide.

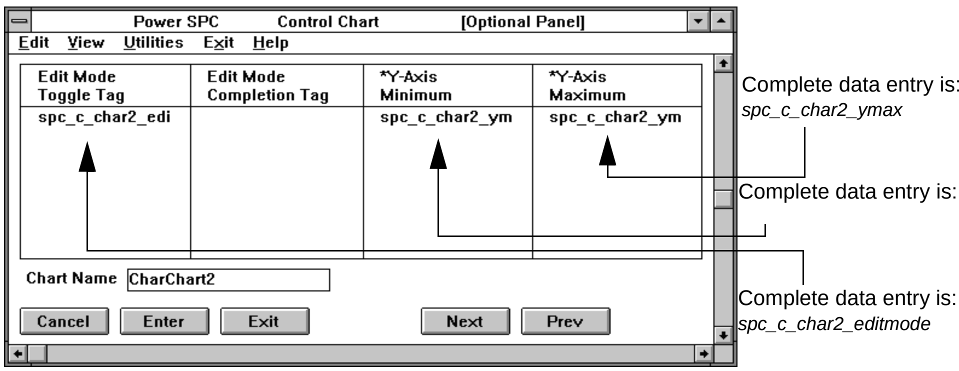


l.



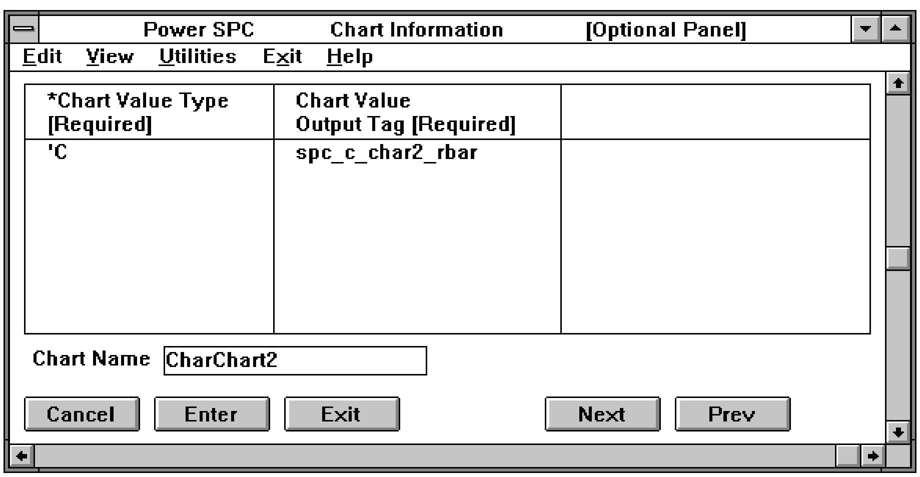
17 Save the data and choose Next to display the Control Chart panel. Complete the panel for CharChart2.

For details about each field on this panel, refer to Chapter 8, “Configuring SPC Charts,” of this guide.



18 Save the data and choose Next to display the Chart Information panel. Complete the panel for DimnChart2.

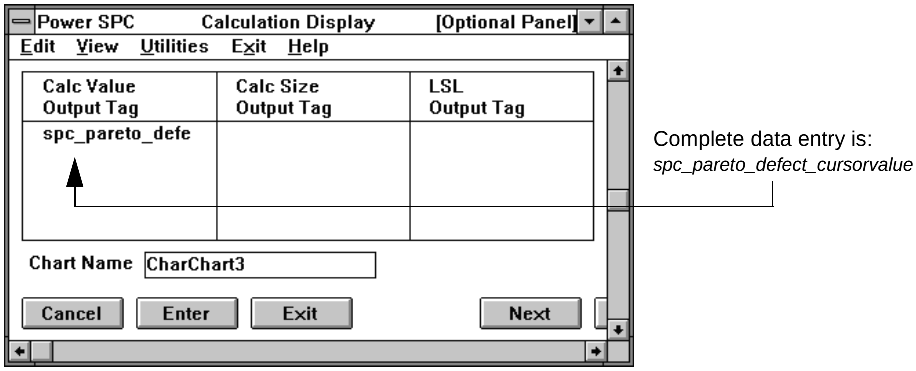
For details about each field on this panel, refer to Chapter 8, “Configuring SPC Charts,” of this guide.



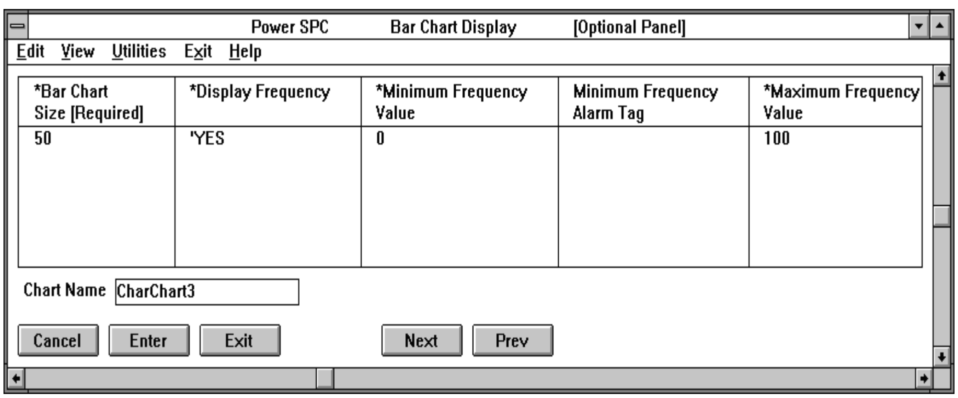
19 Save the data and choose Next to display the Chart Definition panel again. Complete the same panels and one additional panel you just configured for the chart name CharChart3.

20 Ensure your cursor is on theCharChart3 chart and choose Next.

21 Complete the Calculation Display panel for CharChart3.

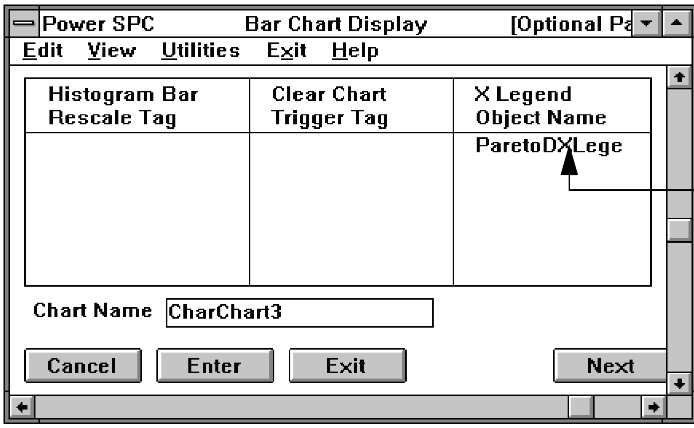


22 Save the data and choose Next to display the Bar Chart Display panel.



23 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

*Bar Chart Size	Number of raw data values distributed into the bars.
*Display Frequency	Numeric value representing the frequency for the bar display on the chart.
*Minimum Frequency Value	Minimum number of defects that must occur for a bar to display.
*Maximum Frequency Value	Maximum number of defects to display on the chart.



Complete data entry is:
ParetoDXLegend

X Legend Object Name	Object name of the X Legend for the Pareto-Defect chart; displays the defect name(s) at run time.

24 Save the data and exit.

CUSTOMIZING YOUR PROCESS

Customize your process by:

- Defining assignable cause codes
- Specifying standard or user-defined run rules
- Configuring auxiliary database columns for the collection of auxiliary data

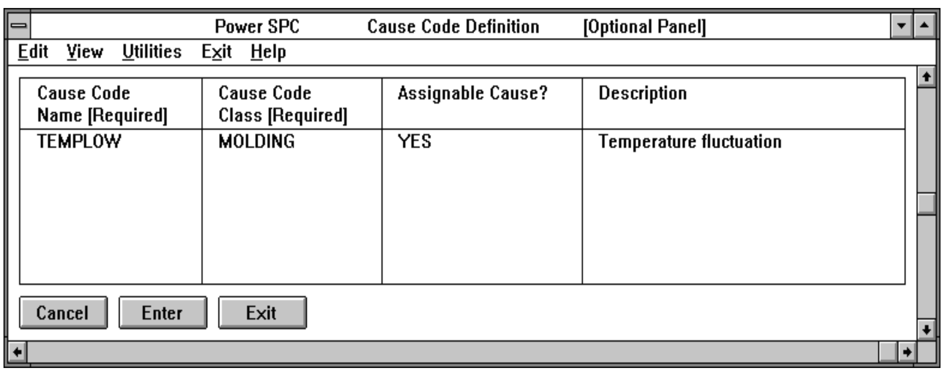
Use standard Western Electric run rules for this application.

Perform the following steps to define assignable cause codes:

> **Note:** Defining cause codes does not require selection of a domain in the Configuration Manager.

1 Choose PowerSPC>PowerSPC User-Defined Cause Codes from the Configuration Manager Main Menu to display the User-Defined Cause Codes panel.

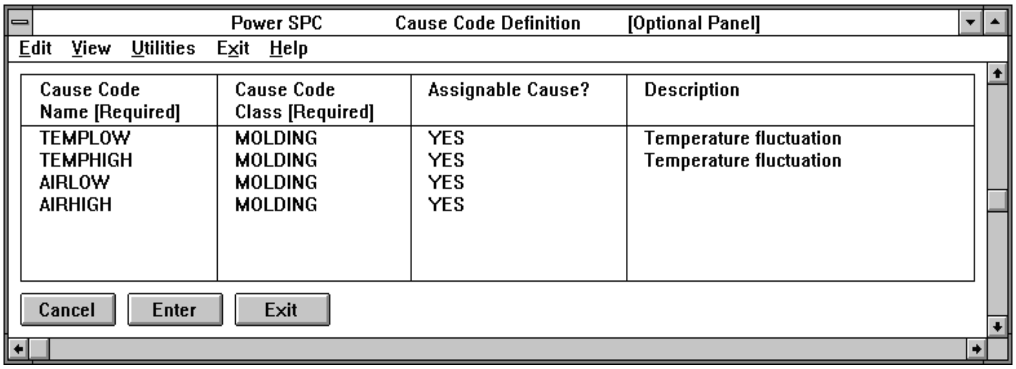
For details about each field on this panel, refer to Chapter 9, "Customizing Your Process," of this guide.



2 Specify the following information for this panel. Type the entries exactly as shown, including upper and/or lower case. Leave all other fields blank.

Cause Code Name	Create a cause code name to assign at run time.
Cause Code Class	Must match the one entered in the Charts Calculation Display panel or a tag name containing the class name.
Assignable Cause	Choose YES to exclude cause code items in calculations.

3 Create three more cause codes: TEMPHIGH, AIRLOW, and AIRHIGH. All codes are in the MOLDING class and have Assignable Cause entries of YES. Optionally, you can enter a description for each code.



4 Save the data and exit cause codes.

TESTING THE APPLICATION

Perform the following steps to run and test your application:

1. Run the application (FLRUN). For your operating system for details on starting FactoryLink, refer to *FactoryLink ECS Fundamentals*.
2. Choose Return to Application when the User Domain Run-Time Manager displays the SPCCHAR screen.
3. Enter a value between or including 0 and 6 in the input text Bubbles field (displays as 0 at startup) to create data to be logged. Enter a value of 0 or 1 in the input text Cracks field. Click ACCEPT after entering these two values.
4. Repeat this process four more times. The Pareto-Defect chart in the upper left of the screen updates as you enter values for the types of defects. The Selected Defect Count output text field updates as the number of defects increases.
5. A point displays on each C chart after you have accepted the fifth set of values. The Point Value field displays the calculated value (the point plotted on the chart) at the default cursor location (left of chart for this chart). If you click the cursor anywhere in the chart, the Point Value field displays the calculated value of that point. The Population Value field displays the calculated value for all points on the chart; therefore, it is updated each time a point is plotted.
6. Enter five more values (accepting after each) with several of your entries outside of the 0-6 range for bubbles and 0-1 range for cracks to test if your run rule violation displays.
7. Click Edit Mode (for the bottom C chart) to allow chart editing to test your cause codes. Edit Mode turns green to indicate editing is allowed. Type any of the cause codes you defined in the User-Defined Cause Codes pane: TEMPLOW, TEMPHIGH, AIRLOW, AIRHIGH, in the Cause Code input text field.
8. Click Edit Mode again to complete the cause code assignment. The cause code you entered displays next to the point it was assigned to. Edit Mode turns red to indicate you have exited Edit Mode.
9. Select the button you animated to return to the Run-Time Manager screen.

   Note: If you enter more than sum total of 100 defects for either bubbles or cracks, the corresponding bar disappears from the Pareto chart because a maximum of 100 is defined in the Bar Chart Display panel.

10. Stop the FactoryLink application. If any portions of your test did not work, return to that portion of the configuration and check your entries.

Chapter 5 . . . .

Creating a PowerSPC Sample Plan

The sample plan defines a set of values and instructions that controls what data the system collects, calculates, evaluates, and displays. It also defines the contents of each sample, including its dimensions and characteristics. Organize the sample plan by the data items you want to collect, configure calculations for each data item, and then configure the run rules for each calculation. Sample plans contain only hard-coded values, not tags, because sample plans provide initial values for processes.

You create a sample plan by configuring the Sample Plan table. There are four panels to this table:

- Sample Plan Definition—Defines controls for how the plan functions during data collection, calculation, and monitoring. See “Defining Sample Plans” on page 122.
- Collection Control—Defines the variable and attribute data to be collected for the sample plan. See “Defining Data to Collect” on page 126.
- Calculations Control—Defines calculations performed by SPC on each group of data defined in the Collection Control panel. See “Defining the Sample Plan Calculations” on page 130.
- Monitor Control—Defines the run rules for each calculation defined in the Calculations Control panel. See “Establishing the Sample Plan Run Rules” on page 136.

SPC uses the values in the sample plan to build lists of calculations, run rules, and charts you can choose from at run time. At system startup, SPC loads the indicated sample plan values. Define corresponding tags in the Processes and Charts panels described in Chapter 6, “Configuring the Processes,” and Chapter 8, “Configuring SPC Charts,” in this guide to view and/or change these values.

This chapter describes these configuration panels and explains how to complete them. The procedures in this chapter assume you know how to start and traverse the Configuration Manager. If you need help with this, refer to *FactoryLink ECS Fundamentals*.

Application/Sample Plan Design Note

SPC applications can become very large. Keep in mind that as you increase the number of variables collected, statistics performed, run rules monitored, and charts displayed, the demand on your computer's resources increases.

At run time, PowerSPC only monitors those SPC application components that are currently active in a process (SPCDATA task) or graph (SPCGRAPH task). SPC considers a component active when it meets at least one of the following conditions:

- It is either hard-coded or contained in a sample plan of a running process.
- It is either hard-coded or contained in a sample plan of a displayed chart; the chart does not need to be displayed in the top window, and the chart is active if it is in any window.

All active components are readily available for use in a running application. For example, it takes relatively few computer resources to switch between statistics or chart types defined within a sample plan.

Inactive SPC components require initialization. For example, it takes considerably more computer resources to switch a process or chart to another sample plan because of the required initialization.

Keep the following guidelines in mind when setting up your sample plans to set up a fast application that utilizes memory efficiently:

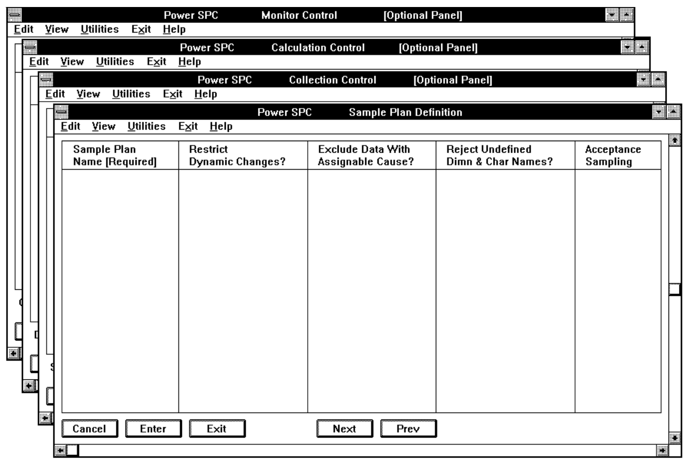
- Provide enough sample plan flexibility (statistics, run rules) so a process or chart requires only infrequent changes of sample plans
- Make the sample plans lean to minimize the overhead needed to maintain infrequently used components

ACCESSING THE POWERSPC SAMPLE PLAN OPTION

Double-click SPC Sample Plans on the Configuration Manager Main Menu to open the SPC Sample Plans option. Four panels open:

The first panel, Sample Plan Definition, is the only one you're required to configure.All the others are optional.

In addition, some fields are optional. Fields that require an entry contain "[Required]" below the name.



You do not need to select a domain for the Sample Plan panels. These panels are independent of domains. You can see the same configuration information in either domain after you configure these panels.

Note: If you perform the export utility for the Sample Plan panels, you can then import the Sample Plan entries to a different application whether the SHARED or the USER domain is selected. If you perform the import command from the Main Menu utilities option for both the SHARED and the USER domains, this results in duplicate entries in the Sample Plan tables. The duplicate entries should be deleted before running the application.

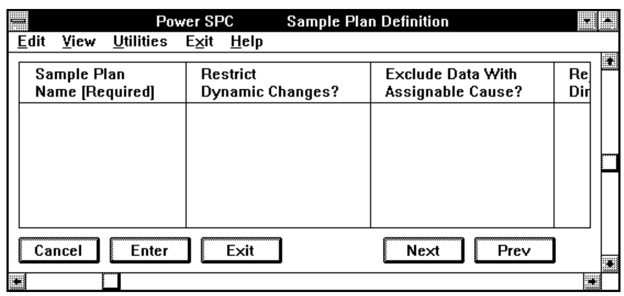
DEFINING SAMPLE PLANS

Configure the Sample Plan Definition panel to define a sample plan. Generally you should define at least one sample plan for each process you want to measure or monitor although you can use the same sample plan for more than one process.

You can define more than one sample plan for the same process because process conditions often require you to change the sample or subgroup sizes; however, you can use only one sample plan at a time for a given process.

Use this panel to configure the values that apply to the entire plan regardless of what is being collected, calculated, and monitored, such as whether you can make dynamic changes while the plan is being used at run time and whether you want to use acceptance sampling.

This panel contains eight fields. To display additional fields, press Tab.



Specify the following information in this panel:

Sample Plan Name
: (Required) Alphanumeric name of 1 to 16 characters to specify the name for this sample plan. Create a meaningful name that corresponds to the data the sample plan monitors. For example, if you are monitoring the dimensions of glass beverage bottles, you might name the sample plan GLASS BOTTLES.

: You can define more than one sample plan for the same process. This is useful if, for example, each time the process being monitored starts up, you typically collect more samples for the first 30 minutes after startup. After the process equipment has warmed up, you collect fewer samples. In this case, you would define two sample plans, one that collects more samples than the other. At run time, you or another FactoryLink module, such as Math & Logic, can alternate between the two sample plans.

Restrict Dynamic Changes?
: (Optional) Indicate whether, after FactoryLink loads the sample plan values into the tags in an SPC process or an SPC chart, you or another FactoryLink module can dynamically change or override the values established by the sample plan. This can be one of the following:

YES — Do not permit dynamic changes. SPC rejects all changes to the tags controlling the SPC process or chart and uses the values defined in the sample plan.

NO — Permit dynamic changes. This is the default.

For information on dynamically changing values defined for the sample plan, refer to “Defining Data to Collect” on page 126 of this chapter.

Exclude Data With Assignable Cause (Optional) Indicate whether the control limit calculations should include data with an assignable cause. This can be one of the following:

YES — Exclude assignable cause data from control limit calculations. You must specify which cause codes to exclude in the Cause Code panel described in Chapter 9, “Customizing Your Process,” of this guide.

Excluding data points from control limit calculations can be useful if the points are out of control and they have an assignable cause.

NO — Include assignable cause data in control limit calculations. This is the default.

Reject Undefined Dimn & Char Names? (Optional) Indicate whether or not SPC should reject names of dimensions or characteristics not defined in the Collection Control panel. This can be one of the following:

YES — SPC rejects the data collected. Choose YES if you want to restrict the operator from changing dimensions and characteristics at run time.

We recommend if you let the operator select dimensions or characteristics at run time, you supply a list of options rather than allowing the operator to type names in. This prevents possible problems caused by typographical errors.

NO — SPC accepts the data collected. Choose NO if you want the operator to be able to change the dimensions and characteristics at run time. This is the default.

For example, the operator intends to collect data on the height of a bottle but accidentally enters heiht in the input field. If you entered YES in this field, SPC rejects that data about the bottle and sends a warning message to the Process Message tag; however, if you entered NO, SPC accepts the data it collects and logs it as a dimension named heiht.

Note: This option permits new variables to be added to an SPC application. To implement this capability, one must:

- Provide data collection capability in the PowerSPC Process—Data Collection Control panel (required).
- Configure real-time calculations in the PowerSPC Process—Calculation Control panel (optional).
- Specify variable names in the PowerSPC Chart Definition panels (required).
- If new variables are added to an application, then the Chart cannot use a Sample Plan. Charts that do not specify Sample Plans have restricted functionality. See “Sample Plan Name” on page 203 of this guide.

Acceptance Sampling
(Optional) Indicate whether or not this sample plan uses acceptance sampling on collected sample data. Acceptance sampling measures or evaluates a specified number of samples from a lot (also called a batch). Of the samples evaluated, a certain number (specified in the Accept Criteria field) must pass all measurements and/or evaluations before the entire lot passes. Acceptance sampling is useful if you are measuring the quality of goods received from a supplier. This can be one of the following:

NONE
Do not use acceptance sampling for this sample plan. This is the default.

FIXED
Use acceptance sampling for a sample that contains a fixed number of subgroups. When SPC collects the number of samples you type in the Sample Size field, SPC closes the sample and evaluates it.

VARIABLE
Acceptance sampling for a sample that varies in size. If you choose this option, also define a Close Sample Trigger in the Acceptance Sampling panel. The Close Sample Trigger triggers SPC to close the sample and evaluate it. See Chapter 6, “Configuring the Processes,” of this guide.

You can use acceptance sampling with characteristic and dimension data. If you are using dimension data, also complete the Dimn LSL, Dimn USL and Dimn Nominal fields in the Collection Control panel.

If this sample plan is using acceptance sampling, also configure the Acceptance Sampling panel from the Processes menu option.

Define the following three fields for acceptance sampling only. Leave these fields blank if you entered NONE in the Acceptance Sampling field.

Accept Criteria (Optional) Unique number between 0 and 999999 that specifies the number of units from the sample group that must pass all defined measurements and/or inspections for the entire lot to pass.

For inspections, SPC uses the number of defective units, not the number of defects, to determine the number of units that pass.

Use this field only if you typed either FIXED or VARIABLE in the Acceptance Sampling field.

Sample Size (Optional) Unique number between 0 and 999999 that specifies the number of units to be evaluated.

Use this field only if you typed either FIXED or VARIABLE in the Acceptance Sampling field.

Lot Size (Optional) Unique number between 0 and 999999 that specifies the total number of units in the lot (batch) from which the sample group is taken.

Use this field only if you typed either FIXED or VARIABLE in the Acceptance Sampling field.

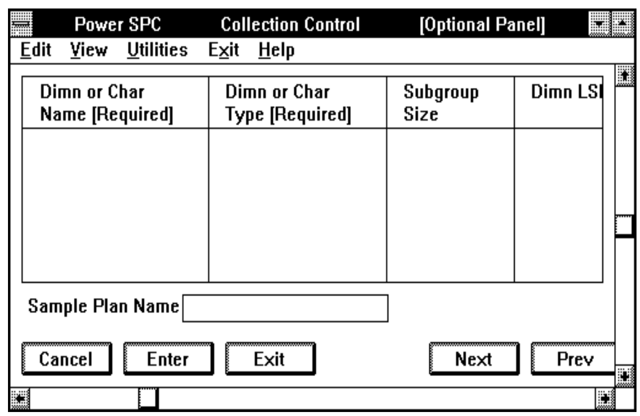
Click Enter to save the information.

DEFINING DATA TO COLLECT

You can define the dimensions and/or characteristics (variable and attribute data) to be collected for each sample plan you defined in the Sample Plan Definition panel.

Configure the Collection Control panel to define the dimensions and characteristics to collect. Notice this panel contains the name of the sample plan you defined in the Sample Plan Definition panel. Make an entry in the Collection Control panel for each subgroup to be collected.

This panel contains six fields. To display additional fields, press Tab.



Specify the following information in this panel:

Dimn or Char Name (Required) Type an alphanumeric string of 1 to 16 characters that specifies the name of either the dimension to collect, such as length, or the characteristic to inspect, such as dent or bubble.

Enter all dimension and characteristic names in this field if you choose to reject undefined names in the Sample Plan Definition panel,

Enter an asterisk (*) in this field instead of a name if you want SPC to perform the calculations defined in the Calculation Control panel for this entry on the combined total of all types of characteristics in this panel rather than on each separate characteristic. This is useful if you want to find the total number of defects on a unit.

For example, if you are inspecting glass bottles for three characteristics: bubbles, cracks, and chips, and you want to find out the total number of defects on each bottle, use * to configure SPC to perform a C calculation on the total of all three types of defects rather than performing it on each defect separately.

Instead of three separate totals, one for each type of defect on one unit as follows:

Bottle 12 has 3 bubbles; c = 3
Bottle 12 has 2 cracks; c = 2
Bottle 12 has 1 chip; c = 1

You have one grand total of all defects on one unit:

Bottle 12 has: 3 bubbles + 2 cracks + 1 chip; c = 6

Dimn or Char Type — (Required) Indicate whether the name specified in the Dimn or Char Name field is a dimension or a characteristic. This can be one of the following:

DIMENSION	Specifies you are collecting a measurement, such as length or temperature). This is the default.
CHARACTERISTIC	Specifies you are collecting occurrences of a defect or defective part, such as dents, bubbles, wrong color, or missing label. Specify this option if you typed * in the Dimn or Char Name field of this panel.

Subgroup Size — (Optional) Unique number between 0 and 9999 that specifies the number of samples in a subgroup or the number of measurements or characteristics to be grouped together and collected before SPC automatically performs a calculation on the data.

In other words, the entry in this field determines the subgroup size for all dimensions and characteristics; however, you can override this subgroup size for a particular calculation with the Calc Size field in the Calculation Control panel described in “Defining the Sample Plan Calculations” on page 130 of this chapter.

Complete the next two fields to determine pass/fail criteria for dimensions only if this sample plan is:

- Using acceptance sampling
- SPC will perform calculations on populations of data. A population is all the points currently visible on a chart. The Sample Plan Collection Control LSL and USL are required for chart Info Cp and Cpk calculations. If a process does not correspond to the correct Sample Plan, the Cp and Cpk calculation results will be wrong. Refer to “Setting up SPC to Perform Population Calculations” on page 226 of this guide. For information about population calculations, such as Cp or Cpk, see the Glossary or Chapter 1, “Overview,” of this guide.

The limits in these fields do not show as lines on the chart unless you also fill out the LSL for Calculation, USL for Calculation, and Nominal for Calculation fields on the Calculation Control panel of this table.

The example at the end of this section illustrates the next two fields.

Dimn LSL	(Optional) Type a floating-point number that specifies the lower specification limit (LSL) for a dimension. If this sample plan is using acceptance sampling on dimension data, type the minimum acceptable value for the dimension. If you are inspecting a characteristic, leave this field blank.
Dimn USL	(Optional) Type a floating-point number that specifies the upper specification limit (USL) for a dimension. If this sample plan is using acceptance sampling on dimension data, type the maximum acceptable value for the dimension. If you are inspecting a characteristic, leave this field blank. For example, suppose that you want SPC to measure a glass bottle with a target (nominal) height of 16 cm. The component's specification allows it to measure anywhere between 15.85 cm and 16.15 cm high (these are the lower and upper tolerances). To comply with the specification, you would enter 15.85 in the Dimn LSL field, and 16.15 in the Dimn USL field.
Dimn Nominal	Type a floating-point number that specifies the target value for a dimension. If this sample plan is using acceptance sampling on dimension data, type the target value for the dimension.

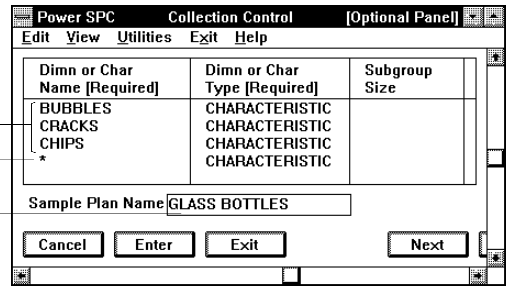
Click Enter to save the information.

For example, suppose SPC is collecting information about bubbles, cracks, and chips on bottles. You want SPC to perform a C and a U calculation on the combined data for all three characteristics. You also want SPC to perform a P and an NP calculation on the data for cracks. You would fill out this panel and the Calculation Control panel as shown below.

For the sample plan GLASS BOTTLES...

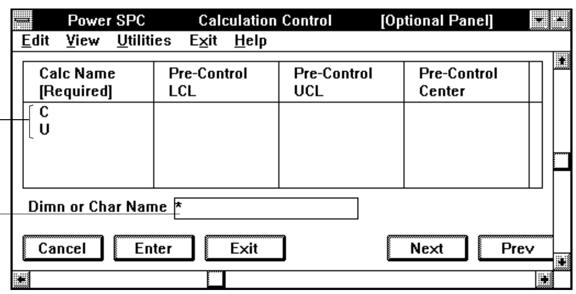
...SPC collects information about three characteristics, BUBBLES, CRACKS, and CHIPS.

*The * here...*



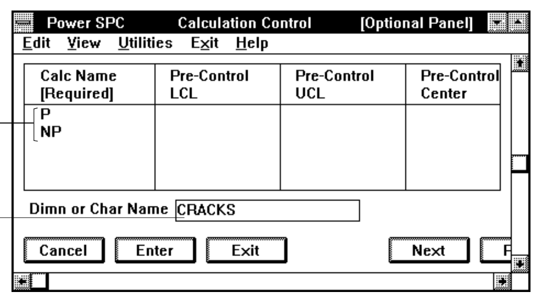
...and here...

...indicates that SPC performs a C and a P calculation on the data for all three characteristics.



The characteristic name here...

...indicates that SPC also performs a P and an NP calculation on the data for CRACKS.

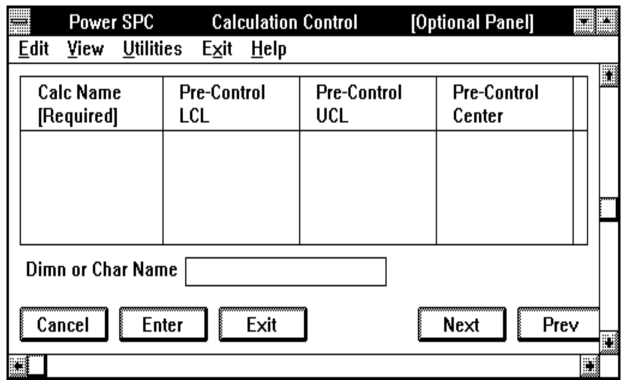


DEFINING THE SAMPLE PLAN CALCULATIONS

Configure the Calculation Control panel to define the calculations SPC performs on each group of dimensions or characteristics you defined in the Collection Control panel. You can configure one or more calculations for each dimension and characteristic defined in the Collection Control panel. Notice that the selected Dimn or Char Name from the Collection Control panel displays at the bottom of this panel.

This panel contains 12 fields. To display additional fields, press Tab.

Make a unique entry in this panel for each calculation to be performed on the specified dimension or characteristic.



Specify the following information for this panel:

Calc Name (Required) Type the calculation to perform on the dimension or characteristic you typed in the Dimn or Char field on the Collection Control panel. The following table lists valid entries for both dimension and characteristic data. For descriptions of these calculations, refer to the Glossary or Chapter 1, “Overview,” of this guide.

For Dimensions		For Characteristics
XBARR	MOVAVG	NP
XBARS	MOVRNG	P
RANGE	EWMA	C
STDDEV	INDIV	U
SPLIT	CP	

For Dimensions		For Characteristics
AVG	CPK	

Note: If you are configuring this panel for a bar chart, type any calculation name in this field. Although SPC does not perform calculations for bar charts, the system requires you type something in this field

The next three fields let you type the initial control limits for the calculation. At system startup, SPC uses these control limits to evaluate run rules and plot charts until you or a FactoryLink module triggers SPC to recalculate new control limits or changes the values.

If you want SPC to recalculate the control limits from these fields, also define a tag to trigger SPC to recalculate them. Define this tag in the Control Limit Trigger Tag field in the Processes Option Calculation Control panel. If you do not want SPC to recalculate these control limits, do not define the Control Limit Trigger Tag. Then, SPC always uses the control limits in these fields unless the operation or another task changes the control limits at run time while the process is disabled

Pre-Control LCL: (Optional) Type a floating-point number that specifies the initial lower control limit for the calculation. The entry in this field applies only to the calculation displayed in this row.

Pre-Control UCL: (Optional) Type a floating-point number that specifies the initial upper control limit for the calculation. The entry in this field applies only to the calculation displayed in this row.

If this control limit value is for a Split calculation, type a value halfway between the width of the two center lines. Specify the width for the center lines in the Calc Constant field on the Calculation Control panel.

For example, if you enter 10 as the width in the Calc Constant field and you want the center lines to be at 15 and 25, type 20 in the Pre-Control UCL field.

Pre-Control Center: (Optional) Type a floating-point number that specifies the initial center value for the calculation. The entry in this field applies only to the calculation displayed in this row.

The next three fields let you display specification limit lines for dimensions on the SPC chart. If you type limits in these fields, SPC uses them to perform the calculation in the Calc Name field and to recalculate control limits. Be careful when you use these fields because specification limits can affect calculation results.

For example, to avoid confusing specification limits with control limits, you may not want to configure SPC to evaluate or graphically display specification limits for statistical calculations, such as XBARR or XBARS. Typically, specification limits are useful only when compared to raw data, such as on INDIV charts.

If you want to perform a calculation on a population or if this sample plan is using acceptance sampling, define specification limits in the Collection Control panel. If you want to display them, also fill out the following three fields. Typically you enter the same values in both sets of fields; however, you can enter different values for greater control.

The LSL and USL in this panel are used for subgroup based Cp and Cpk calculation in the SPC Process and for Run Rule monitoring.

Leave these fields blank if you are configuring a calculation for a characteristic.

LSL for Calculation (Optional) Type a floating-point number that specifies the lower specification limit for a dimension.

USL for Calculation (Optional) Type a floating-point number that specifies the upper specification limit for a dimension.

Nominal for Calculation (Optional) Type a floating-point number that specifies the target value for a dimension.

Calc Size (Optional) If you want to override the subgroup size you defined in the Collection Control panel, type the amount of data SPC is to use for the calculation. The entry in this field applies only to the calculation you type in the Calc Name field.

Leave this field blank if you want SPC to perform a calculation according to the subgroup size you defined in the Collection Control panel. At run time, SPC performs all calculations that do not have an entry in this field at the same time and on the same data. This is useful for synchronizing XBARR and Range calculations on the same subgroup.

If you enter a value in this field, SPC does not perform this calculation the same time as the rest of the calculations based on the subgroup size defined in the Collection Control panel. This can be one of the following:

1	INDIV
2 - 9999	CP, CPK, MOVRNG, MOVAVG, EWMA (For these, SPC performs a calculation each time it collects a new value; however, it performs the calculation on the new value + the number of values you type in this field. For example, if you type 5 in this field for a moving average calculation, each time SPC collects a new value, it averages the current value and the 4 previous values together. This is useful for

values collected at long intervals.)

1 - 9999 Other calculations

For EWMA calculations, the value you type in this field depends on the value you type in the Calc Constant field. Generally, a value between 0.1 and 0.3 is used for λ. At a value of 0.3 for λ, a calc size of around 25 is recommended; 0.2 for λ, a calc size of 50; and 0.1 for λ, a calc size of 75.

Calc Offset (Optional) Type a floating-point number that specifies a constant value to normalize each calculation result on a per-calculation basis. SPC subtracts the offset from the calculated value. This field is useful with mean-type calculations, such as XBARR and INDIV. We recommend you not use it for STDDEV and RANGE calculations.

For example, if you are producing 5-lb. bags of sugar, you want to ensure each bag contains 5 lbs. of sugar. The bag itself, however, weighs.3 lbs. Because you cannot include the weight of the packaging in the overall weight of the product, you set the offset value to the weight of the bag (.3). SPC collects the actual weight of each bag of sugar, and when a display is requested, it automatically subtracts.3 lbs. from the total weight and displays the actual product weight on the chart and in the calculated result.

Although the calculated data reflects the true product weight of 5 lbs., the raw data stored in the database will still be 5.3 lbs.

If you also specify a scale value in the Calc Scale field, SPC subtracts the offset from the calculated value and divides the result by the scale value. See Example 2 in the Calc Scale field description.

Calc Scale (Optional) Type a floating-point number that specifies a constant value to normalize each calculation result. SPC divides the calculated value by the scale value and displays the converted value. The data is archived as its original values. This field is useful with mean-type calculations, such as XBARR and INDIV. We recommend you not use it for STDDEV and RANGE calculations.

For example, if you are measuring the amount of liquid produced and your measuring instrument measures the liquid in ounces but you want to plot the data in gallons, you can enter a scale value of 128 because there are 128 ounces in a gallon. By doing this, the measuring instrument reports the amount of liquid produced in ounces and SPC divides this value by 128 to display the amount of liquid in gallons.

Similarly, if your measurement is in grams but you want to plot the data in kilograms, you can set the Calc Scale value to 1000 so SPC will divide the weight in grams by 1000.

If you also specify an offset value in the Calc Offset field, SPC subtracts the offset from the calculated value and then divides the result by the scale value in this field.

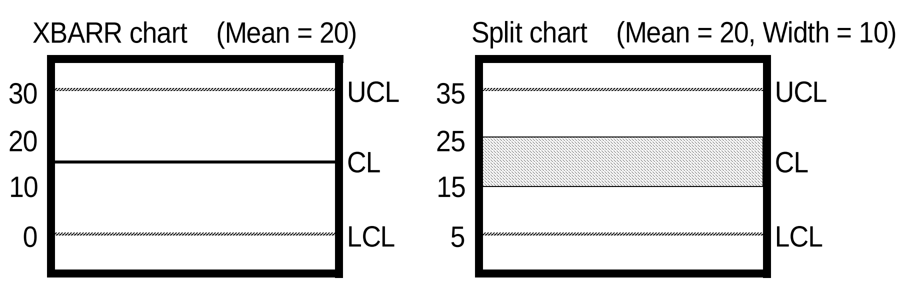
A second example is if you are measuring the temperature of a liquid and you want to record the temperature in Celsius but the measuring instruments measure it in Fahrenheit, you enter 32 for the Calc Offset and 1.8 for the Calc Scale to convert the temperature from Fahrenheit to Celsius.

Calc Constant

(Optional. Use this field only for EWMA, Cp, Cpk, or Split calculations.) Type the constant value SPC uses for the calculation. Type 0 unless you are configuring an EWMA, Cp, Cpk, or Split calculation.

If you are using Cp or Cpk, the number in this field fits into the Cp and Cpk calculations as in the table below. The most common value is 3 (indicating 3 sigma). We recommend you use 3.

If you are using Split, type the width of the center line in this field. The width is the range of values between the two center lines. For example, if you want the center line (mean) at 25 and 15, type 10 in this field. Also, type a value midway between the width of the center line in the Pre-Control Center field of the Calculation Control panel. We recommend you not define a tag in the Control Limit Trigger Tag field in the Processes Option Calculation Control panel.



Caution: We recommend you use this field only if you are knowledgeable and experienced with adjusting these calculations.

Used for	Default value	Meaning what	Constraint
CP, CPK	3	3 sigma	>0
EWMA	1	λ	
Split	0	distance between means	>= 0
All others		NA	

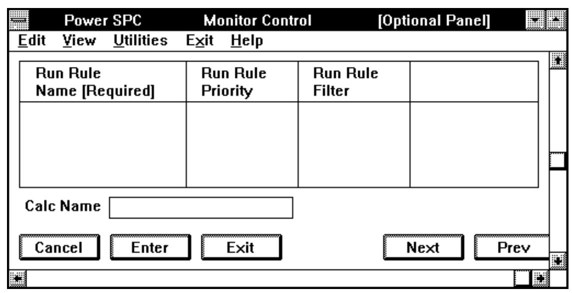
Points in Control Limit Calc — (Optional) Unique number between 1 and 9999 specifies the number of points or calculated values SPC uses to calculate the control limits.

ESTABLISHING THE SAMPLE PLAN RUN RULES

You can specify run rules for each calculation you defined in the Calculation Control panel. Run rules define how many data points can fall above or below a specified line on a chart before the process is considered out of control. Run rules identify trends or patterns in variations in a product. When a process begins to violate run rules, you must take action to correct the problem before too many more defective parts are produced.

You can use five standard Western Electric run rules provided with PowerSPC, and you can define your own. If you want to define your own, first define them in the PowerSPC User-Defined Run Rules Definition panel, and then reference them in this panel. Refer to Chapter 6, “Configuring the Processes,” of this guide.

Type an entry in this panel for each run rule to be evaluated against the calculation shown in the Calc Name field. Each entry must have a unique run rule name. Configure one of these panels for each calculation defined in the Calculation Control panel.



Specify the following information in this panel:

Run Rule Name (Required) Type either a standard Western Electric run rule name or any run rule you define in the User-Defined Run Rule Definition panel. For information about the Western Electric run rules, refer to the Glossary entry “Western Electric run rule” in this guide.

We recommend you not use more than ten run rules per calculation.

Any user-defined run rule name (Format: alphanumeric string of up to 16 characters)
2OF3
4OF5
3SIGMA
8CONS
TREND

Run Rule Priority (Optional) If you configure several run rules for the same calculation, type a value in this field to specify the order SPC reports run rule violations in. If you leave this field blank, SPC uses any default priorities specified in the user-defined run rules. If there are no default priorities, evaluate the run rules in the order in which you enter them in this panel.

If you assign priorities and configure only one output-text tag to display the violated run rule, SPC displays the highest priority run rule violated. This can be one of the following:

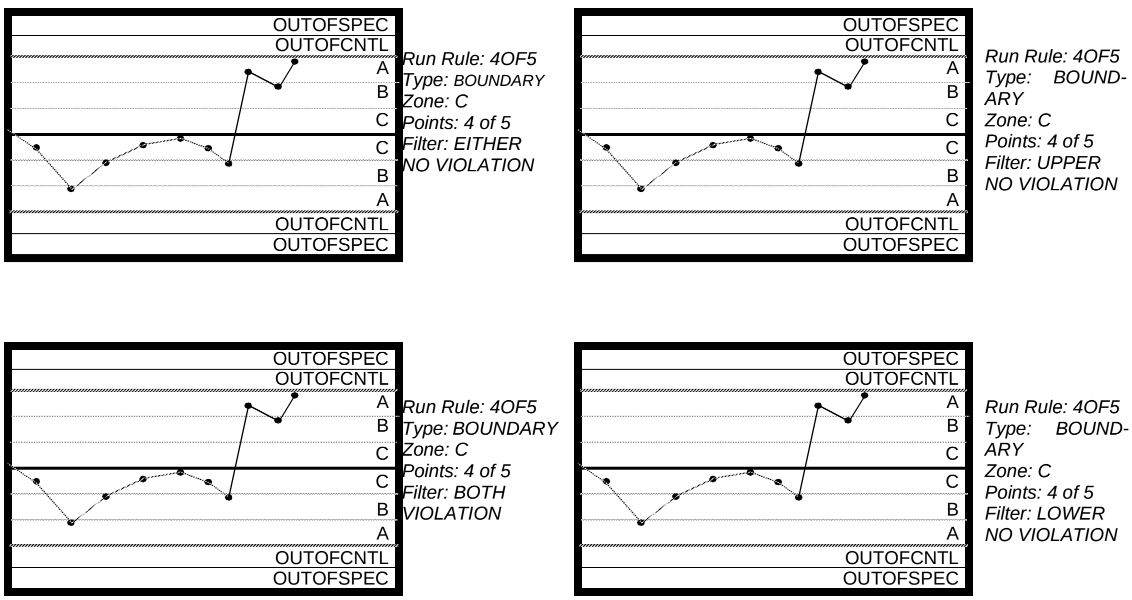
0	Rules with equal priority
1 - 32,767	1 is the highest priority; 32,767 is the lowest.

Run Rule Filter

(Optional) Indicate how you want SPC to report and record run rule violations. Use this field to filter out violations if you do not want data above and/or below the center value to signify a violation. This can be one of the following:

EITHER	(Default) SPC detects/reports both upper and lower zone violations. If all the points violating the run rule lie either above or below the center line, SPC reports run rule violations. Points on opposite sides of the center line do not count toward the same violation instance.
UPPER	SPC detects/reports only upper zone violations. If all the points violating the run rule lie above the center line, SPC reports a run rule violation. Points on the lower side of the center line do not count toward a violation.
LOWER	SPC detects/reports only lower zone violations. If all the points violating the run rule lie below the center line, SPC reports a run rule violation. Points on upper side of the center line do not count toward a violation.
BOTH	SPC detects/reports zone violations both above and below the center line. SPC reports run rule violations regardless of the point relation to the center.

Examples of how SPC uses the filters are shown in the following graphic. While four of the last five points fall outside the specified zone, SPC detects a violation only if the Run Rule Filter is BOTH. With the EITHER filter, only three points count toward a violation since one point lies on the opposite side of the line.



Click Enter to save the information.

Click Exit to close the Sample Plans panels.

Chapter 6 . . . .

Configuring the Processes

You must configure a PowerSPC process for each manufacturing process you want SPC to monitor. When you configure a process, you are instructing PowerSPC how to use the sample plan to monitor that process, such as what data to collect, what calculations to perform, and what run rules to evaluate the data against.

In the PowerSPC process, you can set up tags to let the operator change many aspects of the process at run time, such as which sample plan the process uses, which run rules SPC evaluates, which calculations SPC performs, and whether SPC performs acceptance sampling.

You configure a PowerSPC process by configuring the six panels in the PowerSPC Processes table:

- Process Definition—Defines the processes SPC monitors. See “Defining the Processes to Be Monitored” on page 141 of this guide.
- Data Collection Control—Defines the raw data to be collected. See “Defining the Raw Data to Be Collected” on page 150.
- Auxiliary Collection—Defines the auxiliary data to be collected. See “Defining the Auxiliary Data to Be Collected” on page 156.
- Acceptance Sampling —Defines acceptance sampling criteria. See “Establishing Acceptance Sampling” on page 159.
- Calculation Control—Defines the calculations to run on this process. See “Defining the Calculations” on page 163.
- Monitor Control—Defines the run rules that control this process. See “Establishing the Run Rules” on page 174.

This chapter describes these configuration panels and explains how to complete them. The procedures in this chapter assume you know how to start and traverse the Configuration Manager. For details about these procedures, refer to *FactoryLink ECS Fundamentals*.

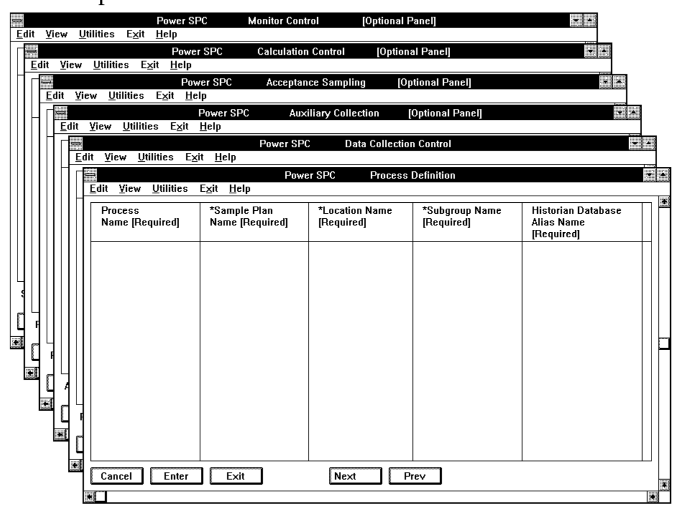
ACCESSING THE POWERSPC PROCESSES OPTION

Perform the following steps to access the PowerSPC Processes option:

1. Ensure the current domain selected is SHARED in the Configuration Manager Domain Selection box.
2. Double-click PowerSPC Processes on the Configuration Manager Main Menu to display the six panels of the PowerSPC Processes option.

The first panel, Process Definition, and the second panel, Data Collection Control, are the only ones you are required to configure. All the others are optional

Some fields are optional. Fields that require an entry contain [Required]" below the name.

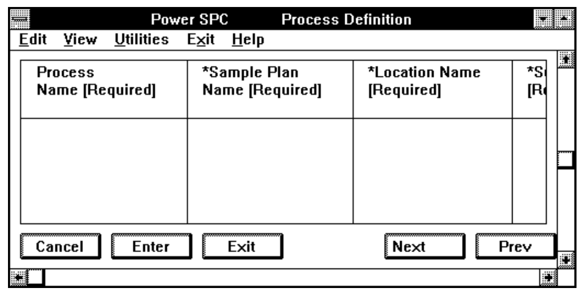


DEFINING THE PROCESSES TO BE MONITORED

Use the Process Definition panel to define the processes SPC monitors, such as bottling cola, molding glass windshields, or making golf balls. When you activate the SPC process at run time, FactoryLink loads the tags you enter in this panel with the values from the sample plan. The operator or another FactoryLink module, such as Math & Logic, can change the values of the tags at run time to affect the way SPC monitors the current process. You do not affect the sample plan by changing the tags.

You can define an unlimited number of processes. You can run as many of the processes at one time as the RAM available on the system allows.

This panel contains 15 fields. Press Tab to display additional fields.



Specify the following information in this panel:

Process Name (Required) Alphanumeric string of up to 16 characters that specifies the process to be monitored, for example, Cola.

Sample Plan Name (Required) Sample plan the process will use. You defined all sample plans in the Sample Plan option’s Sample Plan Definition panel. This can be one of the following:

- **Constant** Alphanumeric string of 1 to 16 characters preceded by a single quote that specifies a sample plan name.
- **Variable** Name of a tag that indicates the Sample Plan. The data type for this tag is message. If you enter a tag name, the operator can change the sample plan used by the process at run time.

  Using a tag in this field is useful if you define more than one sample plan for the same process. When you define this tag, we recommend you define a default value for it that matches a valid Sample Plan name.

  For example, each time the operator starts up the process being monitored, he/she collects more samples for the first

30 minutes after startup. After the process equipment has warmed up, the operator collects fewer samples. To enable the operator to do this, define two sample plans. One sample plan collects more samples than the other. You also define a tag in this field so the operator can alternate between the two sample plans.

Note: Before changing the sample plan in use, the operator must stop the SPC process but not the SPC module, SPC DATA or SPC GRAPH, or the application. When the operator restarts the process, SPC loads the new sample plan values into the tags defined in this panel. For information about stopping the process, refer to the Process Disable Toggle field in "Process Disable Toggle Tag" on page 144 of this chapter.

Location Name (Required) Process location. This enables FactoryLink to distinguish between multiple instances of the same process. Charts retrieve data by process name, location, and/or subgroup. Write this name down because later you will enter the same location in the Chart Definition panel. Refer to Chapter 8, "Configuring SPC Charts," in this guide. This can be one of the following:

Constant Alphanumeric string of 1 to 16 characters preceded by a single quote that specifies a location, such as a node name, a city, or a floor in the building, for example, 'Pittsburgh.

Variable Name of a tag that indicates the location. If you use a tag for this field, we recommend you define a default value for it that matches a valid location name.

The data type for this tag is message.

If you leave this field blank, the system enters LOCAL.

For example, suppose you have two factories producing the same cola, one in Pittsburgh and one in Chicago. Each factory is using the same process and the same sample plan.

To view data from the COLA process in Pittsburgh, enter ’Pittsburgh.

To view data from the COLA process in Chicago, enter ’Chicago.

For a constant value, remember to have an alphanumeric string of up to 42 characters precede the string with a single quote.

Before changing the location in use, the operator must stop the SPC process but not the SPC modules or the application. When the operator restarts the process, SPC loads the new location defined in this panel.

Subgroup Name (Required) Indicate the name of the subgroup SPC collects the raw data from. This can be one of the following:

- **Constant** Alphanumeric string of 1 to 42 characters preceded by a single quote that specifies a subgroup name, for example, ’Glassbottles.
- **Variable** Name of a tag that identifies the subgroup name for the data being collected. Define message as the data type for this tag. If you use a tag for this field, we recommend you define a default value for it that matches a valid subgroup name.

Write this name down because later you will enter the same subgroup name in the Chart Definition panel. If more than one process is active at the same time, the concatenation of location name plus subgroup name must be unique for each process.

Before changing the subgroup, the operator must stop the SPC process but not the SPC module or the application. When the operator restarts the process, SPC loads the new subgroup defined in this panel.

Historian Database Alias Name (Required) Alphanumeric string of up to 16 characters that specifies the alias name of the database you defined in the Database Alias Name field in the Historian Information panel.

Historian Mailbox (Required) Name of the mailbox tag you defined in the Historian Mailbox field in the Historian Mailbox Information panel. SPC routes data through this tag to the database. We recommend you use the same mailbox for all the processes. If your application requires more than 300 processes, you may need to use a second mailbox tag. Define mailbox as the data type for this tag.

The combination of subgroup and location names should be unique among processes. If they are not, the Historian will not function properly. PowerSPC will not allow a process to start if it has the subgroup and location name combination identical to a process already running. If subgroup name and location names are dynamically changed in running processes and a combination is not unique among running processes, then possible database damage may result.

Process Disable Toggle Tag (Required) Name of a tag that stops and restarts the SPC process at run time. You can tie this tag to a button on a graphics screen so the operator can toggle the process on and off at run time. The data type for this tag can be digital, analog, longana, or float, depending on the kind of data stored in the tag. The default is digital.

To stop the process at run time, set this tag to 1 or any non-zero value. To restart the process, set the tag back to 0.

This tag is useful if the operator wants to change something in the process, such as the sample plan used, the run rules evaluated or the subgroup size. To change these, the operator must first stop the process, make the change, and then restart it.

However, the operator can change some tags, such as the Dimn or Char Name or Type without stopping the process. Find out which tags the operator can change without suspending the process and which he/she can change only after suspending it. The Process disable/enable cycle requires significant processor overhead.

Accept Data Trigger Tag (Required) Name of a tag that triggers SPC to accept and store the collected data in the database. When this tag is 1(ON) or greater, SPC accepts and stores the collected data. The data type for this tag can be digital, analog, longana, or float, depending on the kind of data stored in the tag. The default is digital.

When SPC is ready to accept more data, it sets this tag back to 0 (OFF). When this tag is set back to 0, you know that SPC is no longer busy. Therefore, do not set this tag back to 0. For subsequent entries, force this tag to 1. However, if you want to know when the data reaches the database, use the Accept Data Completion Tag.

This tag can be used to discard invalid collected data if the Collect Data Trigger field is configured. This may be accomplished by setting the Accept Data Quantity to 0 and then triggering the Accept Data Trigger tag.

For example, if a measuring instrument fails while measuring the height of a glass bottle, it may incorrectly record the height of the bottle to be 0 cm. Because a bottle must be taller than 0 cm, the measurement record is invalid; therefore, the measuring instrument must remeasure the bottle before SPC accepts and stores the record in the database.

To prevent SPC from accepting invalid data, either an operator or Math & Logic can evaluate all data collected for validity before SPC stores it in the database.

You can use this field in conjunction with the Collect Data Trigger Tag field to collect multiple values and store them together in one location in the database. For more information, see the Collect Data Trigger Tag field in "Collect Data Trigger Tag" on page 146 of this chapter.

At run time, the operator or another FactoryLink module can trigger this tag without stopping the process.

Accept Data Quantity (Required) This field has a constant value of 1-9999. For dimension data, enter a value or a tag that will be set to the number of values that will be accepted before collecting Dimension data. This entry is normally 1 for Dimension data. If you use an Accept Data Quantity value greater than 1 when collecting one raw data value at a time and then accepting it, be aware that INDIVIDUAL calculated values will actually be the average of the values accepted.

For characteristic data, you can enter a value greater than 1, and SPC will record the defect or defective quantities as representing more than 1 unit inspected.

The data type for this tag can be digital, analog, longana, or float, depending on the kind of data stored in the tag. The default is analog.

If you enter a tag in this field and the operator or another module sets it to 0 and triggers the Accept Data Trigger tag, SPC deletes all data collected since the last time the data was accepted. This can be useful when the collected data is invalid.

Example 1

Suppose the operator inspects 6 bottles for bubbles and the results are:

bottle 1 = 2 bubbles
bottle 2 = 2 bubbles
bottle 3 = 0 bubbles
bottle 4 = 1 bubble
bottle 5 = 4 bubbles
bottle 6 = 2 bubbles

and the operator enters the quantity of bubbles for each bottle (6 operator entries in all). Because each operator entry represents one unit inspected, enter 1 in this field.

Example 2

Suppose the operator inspects 6 bottles for cracks and the results are:

bottle 1 = none
bottle 2 = none
bottle 3 = none

bottle 4 = none
bottle 5 = 2 cracks
bottle 6 = none

and the operator enters a single quantity (2) for all bottles inspected. Because the entry represents 6 units inspected, enter 6 in this field.

At run time, the operator or another FactoryLink module can change this tag without stopping the process.

Accept Data Completion Tag

(Optional) Name of a tag that indicates the system has accepted and finished storing the data in the database. When the system successfully writes the data to the database, it force writes ACCEPT (or a 1 for non-message tag types) to this tag.

The data type for this tag can be digital, analog, longana, float, or message, depending on the kind of data stored in the tag. The default is message.

At run time, the operator or another FactoryLink module can change this tag without stopping the process. If you define this tag as digital, SPC force writes a 1 to it whenever it completes an attempt to send data to the database, whether the data is successfully stored or not.

When this tag value is...	Then SPC...
0 or NODATA	Is waiting for data to send to the database.
1 or ACCEPT	Has successfully sent the data out to the database.
-1 or ERROR	Wasn’t able to send the data to the database.

Collect Data Trigger Tag

(Optional) Name of a tag that triggers the system to collect the data from the tags you specify in the Data Collection Control panel and hold their values in memory until SPC collects all data for the unit. You can collect as many values before accepting them into the database as available memory can handle.

The data type for this tag can be digital, analog, longana, or float, depending on the kind of data stored in the tag. The default is digital.

Use this tag in conjunction with the Accept Data Trigger Tag to instruct SPC to store all the data it collects as one transaction. If you leave this field blank, the Accept Data Trigger Tag triggers SPC to collect the data and store it in the database, but each piece of data is stored separately.

You can also use this field in conjunction with the Accept Data Quantity Tag to hold values in memory while verifying if they are valid before storing them in the database.

PowerSPC resets the Collect Data Trigger Tag to 0 by PowerSPC when the collection has been completed.

Example 1

This field is useful if you want to collect more than one piece of information about the same unit in one tag. For example, if you want to measure both the height and circumference of a glass bottle, use this tag to trigger SPC to collect data for the height and to collect data for the circumference. SPC stores these values in memory. Then, use the Accept Data Trigger Tag to trigger SPC to store both values together in the database as one transaction (set of multiple, related records).

At run time, the operator or another FactoryLink module can trigger this tag without disabling the process.

Example 2

The Collect Data Trigger Tag, Accept Data Trigger Tag, and Accept Data Quantity fields may be used to create a gap record. To do this, both of the trigger tags must be configured. Then trigger the Accept Data Trigger Tag without triggering the Collect Data Trigger Tag, using a nonzero Accept Data Quantity value. A gap record will show up on your control charts as a gap in the data and any control or specification lines. This may be useful to indicate shift, lot, or product changes.

Process Status Tag — (Optional) Name of a tag that indicates whether the process is active or inactive. The data type for this tag can be analog, longana, float, or message, depending on the kind of data stored in the tag. The default is analog.

When this tag value is...	Then...
-2	SPC is loading the process's configuration.
-1	SPC has successfully loaded the configuration and has started loading the sample plan.
0	SPC has successfully loaded the sample plan; the process is still inactive.

When this tag value is...	Then...
1	The process is active.

Even if you define this tag as message data type, the tag value is numeric.

Process Message Tag (Optional) Name of a tag that displays a status or error message about the process. You can tie this tag to an output-text object on a graphics screen to display status and error messages to the operator at run time. The data type for this tag is message.

Dynamic Change Tag (Optional) If you want to override the Restrict Dynamic Changes value you entered in the Sample Plan Definition panel, enter the name of a tag that indicates whether, after FactoryLink loads the sample plan values into the tags in this process or an SPC chart, the operator or another FactoryLink module can dynamically change (override) the values established by the sample plan.

The data type for this tag can be digital, analog, longana, or float, depending on the kind of data stored in the tag. The default is digital.

When this tag is greater than 0, SPC rejects all changes to the tags controlling the process or chart and uses the values defined in the sample plan.

When this tag is 0, SPC allows the operator or another module to change the tags controlling this process.

When the initial Sample Plan is loaded or a new Sample Plan is loaded, the value for this tag will be cleared.

Exclude Data With Assignable Cause Tag (Optional) If you want to override the Exclude Data with Assignable Cause value you defined in the Sample Plan Definition panel, enter the name of a tag that lets the operator determine whether the control limit calculations should include data that has an assignable cause.

The data type for this tag can be digital, analog, longana, float, or message, depending on the kind of data stored in the tag. The default is digital.

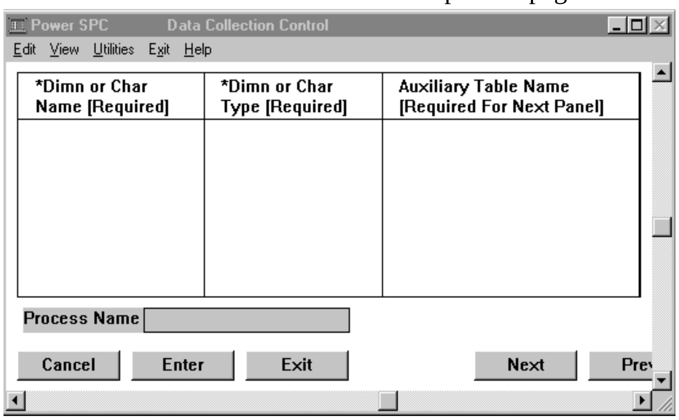
Excluding data points from control limit calculations can be useful if the points are out of control and they have an assignable cause. When the tag is 1 (ON), SPC performs the control limit calculation without the subgroup of data values associated with the point.

At run time, the operator or another FactoryLink module can change this tag without stopping the process. When the initial Sample Plan is loaded or a new Sample Plan is loaded, the value for this tag will be cleared.

3 Click Enter to save the information.

DEFINING THE RAW DATA TO BE COLLECTED

Configure the Data Collection Control panel to define the raw data you want SPC to collect, such as the height or circumference of glass bottles or the number of bubbles on each glass bottle, the type of data SPC will collect (either dimensional or characteristic), and where you want SPC to store it. The values and tags you enter in this panel control what data SPC collects and where it stores it. Refer to "Example" on page 156 of this chapter.



This panel contains six fields. To see more fields, press Tab.

Note: At run time, the operator or another FactoryLink module can change the value of any of the tags in this panel without disabling the process.

The first two fields identify what raw data SPC collects and whether that data is dimensional or characteristic.

1 Specify the following information in this panel:

Dimn or Char Name — (Required) Dimension or characteristic to display on the chart. This can be one of the following:

- Constant — Alphanumeric string of 1 to 16 characters preceded by a single quote that specifies the name of the dimension or characteristic to display; for example, 'dent. If you do not precede the name with a single quote, SPC uses it as a tag name.
- Variable — Name of a tag that identifies the dimension or characteristic to display on the chart. Define message as the data type for this tag.

If you enter a tag name in this field and specify a default value, SPC loads the default dimension or characteristic at startup. If you do not specify a default value, SPC loads one of the dimensions or characteristics configured in the sample plan.

* Indicates you want SPC to perform the specified calculation on all characteristics. Only valid for calculations on characteristics (such as np, p, c, and u).

Note: Remember to indicate the type of calculation in the Calc Name field.

Dimn or Char Type — (Required) Defines whether the name entered in the Dimn or Char Name field is a dimension or a characteristic. This can be one of the following:

Constant — Name preceded by a single quote that specifies type. This can be either ‘DIMENSION or ‘CHARACTERISTIC.

Use ‘DIMENSION if you are collecting a measurement, (for example, length or temperature).

Use ‘CHARACTERISTIC if you are collecting occurrences of a defect or defective part (for example, dents or bubbles).

Variable — Name of a tag that indicates whether it is a dimension or a characteristic.The data type for this tag can be digital, analog, longana, float, or message, depending on the kind of data stored in the tag. The default is digital.

The next four fields identify where SPC stores the data it collects.

Auxiliary Table Name — (Required if you want to use the next optional Auxiliary Collection panel) Alphanumeric string of up to 16 characters if you want to collect auxiliary data that corresponds to the raw data value specified in this panel. This name displays at the bottom of the next panel, Auxiliary Collection, and identifies the group of tags that contain the collected auxiliary values. This field lets you associate multiple auxiliary data tags with each raw data tag. Define the auxiliary data tags in the next panel, Auxiliary Collection.

If you are not collecting auxiliary data, leave this field blank. Also, leave the Auxiliary Collection panel blank.

Dimn Measurement Tag (Optional) If you are measuring a dimension (you entered ‘DIMENSION in the Dimn or Char Type field), enter a tag in this field to contain the resulting measurement of that dimension. For example, if SPC collects the height of a glass bottle that is 5 cm tall, this tag value is 5.

The data type for this tag can be digital, analog, longana, or float, depending on the kind of data stored in the tag. The default is float.

The operator uses this tag to enter the raw data value or a PLC or other external device uses it to gather the data and send it to FactoryLink.

To instruct SPC to collect this value, also define an Accept Data Trigger Tag in the Process Definition panel.

If you are inspecting for a characteristic (you entered ‘CHARACTERISTIC in the Dimn or Char Type field), leave this field blank.

Char Defective Count Tag (Optional) If you are counting defectives (you entered ‘CHARACTERISTIC in the Dimn or Char Type field), enter a tag in this field to contain the resulting count value for the data. For example, if a bottle is not accepted because it has 2 cracks and is defective, the tag value is 2.

The data type for this tag can be digital, analog, longana, or float, depending on the kind of data stored in the tag. The default is analog.

The operator uses this tag to enter the raw data value, or a PLC or other external device uses it to gather the data and send it to FactoryLink.

If you define this tag as digital, it does not count the number of defective units, but rather it indicates whether a particular unit is defective (1 for defective, 0 for OK).

> **Note:** If you are using acceptance sampling, you may want to define this tag as digital. This way, you can inspect a unit and if it’s defective, force write a 1 (YES) to this tag. If it is not defective, force write a 0 (NO). The Acceptance Sampling panel, described in “Establishing Acceptance Sampling” on page 159 of this chapter, lets you define another tag for keeping a count of the defective units.

To instruct SPC to collect this value, also define an Accept Data Trigger Tag in the Process Definition panel.

If the value defined in the Accept Data Quantity field is greater than 1, SPC stores the data as gathered from more than 1 unit.

If you are measuring a dimension (you entered ‘DIMENSION in the Dimn or Char Type field), leave this field blank.

Char Defect Count Tag	(Optional) If you are counting defects (you entered ‘CHARACTERISTIC in the Dimn or Char Type field), enter a tag in this field to contain the number of instances of that characteristic (defect). For example, if SPC collects the number of bubbles appearing on a glass bottle that has 3 bubbles, this tag value would be 3. The data type for this tag can be digital, analog, longana, or float, depending on the kind of data stored in the tag. The default is analog. The operator uses this tag to enter the raw data value or a PLC or other external device uses it to gather the data and send it to FactoryLink. If you define this tag as digital, it does not count the number of defects, but rather it indicates whether a particular unit contains defects (1 for defects, 0 for no defects). If the value defined in the Accept Data Quantity field is greater than 1, then SPC stores the data as gathered from more than 1 unit. To instruct SPC to collect this value, define an Accept Data Trigger Tag in the Process Definition panel. If you are measuring a dimension (you entered 'DIMENSION in the Dimn or Char Type field), leave this field blank.

Note: Although the three previous fields are all marked as optional fields, for each entry in the Data Collection Control panel one appropriate field must be defined. The other two fields will be invalid choices for that entry unless you want a value counted as both a defect and defective.

2 Click Enter to save the information.

Examples

Sample Data Collection Control Panel		
Field Name	**Sample Entry**	**Explanation**
Dimn or Char Name	‘height	SPC collects the height of each bottle.
Dimn or Char Type	‘DIMENSION	‘height is defined as a dimension.
Dimn Measurement Tag	bottle_height	SPC collects the value of each bottle’s height from this tag.

Sample Plan Collection Control Panel		
Field Name	**Sample Entry**	**Explanation**
Dimn or Char Name	‘cracks	SPC collects the number of cracks on bottles.
Dimn or Char Type	‘CHARACTERISTIC	‘cracks is defined as a characteristic.
Char Defective Count Tag	cracked_bottles	SPC collects the number of cracks found in the sample from this tag.

Sample Data Collection Control Panel		
Field Name	**Sample Entry**	**Explanation**
Dimn or Char Name	‘bubbles	SPC collects the number of bubbles on bottles.
Dimn or Char Type	‘CHARACTERISTIC	‘bubbles is defined as a characteristic.
Char Defect Count Tag	bottle_bubbles	SPC collects the number of bubbles found in the sample from this tag.

You may simultaneously collect multiple values using multiple collect tags and triggering the Collect Data Trigger tag once. In the Process Definition panel, the Accept Data Quantity value or tag containing value must be set to the appropriate number you are collecting.

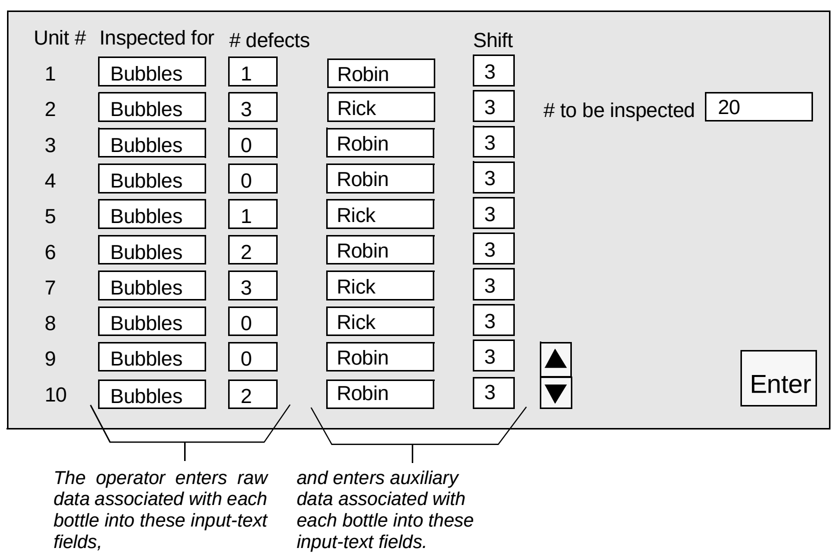
For example, you could define 2 records in the Collection Control Panel for height, calling them height1 and height2, with tags bottle_height1 and bottle_height2. Then once the values to be collected have been entered into the two tags, trigger Collect and Accept with Accept Data Quantity set to 2.

DEFINING THE AUXILIARY DATA TO BE COLLECTED

If you want SPC to collect auxiliary data about a sample and store it in a database, use the Auxiliary Collection panel to define the auxiliary data you want SPC to collect. Auxiliary data is additional, descriptive information about a sample, such as an operator's name, the process line, lot number, or shift number, on which SPC does not perform calculations. It only reads the auxiliary data from the tags as it accepts the data into the database. Auxiliary data corresponds to the raw data collected from a unit.

Example

Suppose at one of the checkpoints in a bottling process, two operators inspect glass bottles for bubbles. The operators inspect each bottle manually. For each bottle inspected, the operator enters the number of bubbles found on the bottle (raw data) into input-text fields on a FactoryLink graphics screen. The operator also enters his/her name and the shift number for each bottle he/she inspects (auxiliary data). This way, the plant manager knows how many bottles each operator inspected during that shift.



Note: Define the auxiliary data database tables and columns in the User-Defined Auxiliary Information panels to store the auxiliary data in the database.

To display this information on a graphics screen, also configure the Raw Data Display and Auxiliary Data Display panels from the SPC Charts panels.

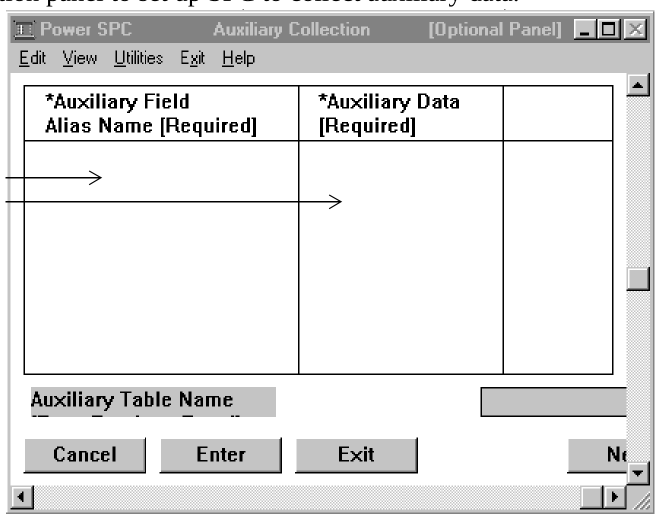
Although SPC does not allow the operator to select or search for data based on the contents in an auxiliary field, you can still trace parts by storing the part number in an auxiliary database column. Then, you can search for information about specific parts by either:

- Using FactoryLink’s Database Browser module
- Manually searching for the auxiliary data by viewing the raw data associated with it

Configure the Auxiliary Collection panel to set up SPC to collect auxiliary data.

For each set of auxiliary information you want to collect, enter the database column alias name or tag indicating the name...

... and a tag that will hold the auxiliary data value.



Note: At run time, the operator or another FactoryLink module can change the value of any of the tags in this panel without disabling the process.

1 Specify the following information for this panel:

Auxiliary Field Alias Name	(Required) Tag name or an alphanumeric name of 1 to 16 characters preceded by a single quote to specify the alias name of the database column that stores the auxiliary data being collected. You will specify the data to be collected in the next field, Auxiliary Data. The data type for this tag is message. Enter either the same name you defined in the Auxiliary Field Alias Name field in the Auxiliary Schema Definition panel or a tag that indicates the name in the Auxiliary Field Alias Name field.

For each item of auxiliary information you want to collect, define a name or a tag in this field and one in the next.

For example, if you want to collect the operator name and the shift with each transaction of raw data, enter two Auxiliary Field Alias Names or tags: one for the database column that stores operator names, such as OPERATOR, and the other for the database column that stores shift numbers, such as SHIFT.

Auxiliary Data	(Required) Tag name or a constant value of an alphanumeric string of 1 to 48 characters preceded by a single quote that holds collected auxiliary data values to be stored in the database column indicated in the Auxiliary Field Alias Name field. The data type for this tag can be digital, analog, longana, float, or message, depending on the kind of data stored in the tag. The default is message. For example, if you want to collect the operator name and the shift with each transaction of raw data, configure two Auxiliary Data tags: one to contain the operator name, such as operator_name, and one to contain the shift number, such as shift_number. Specify the type of data this tag will store.

2 Click Enter to save the information.

ESTABLISHING ACCEPTANCE SAMPLING

Configure the Acceptance Sampling panel if you want SPC to perform acceptance sampling and you want the operator to be able to dynamically change how SPC performs acceptance sampling. Acceptance sampling is a method of inspecting or measuring a specified number of samples from a lot. Of the samples collected, a certain number must pass all measurements and/or evaluations before the entire lot passes. Acceptance Sampling is used to estimate the quality level of product after production is finished. This is useful if you are measuring the quality of goods produced by another manufacturer.

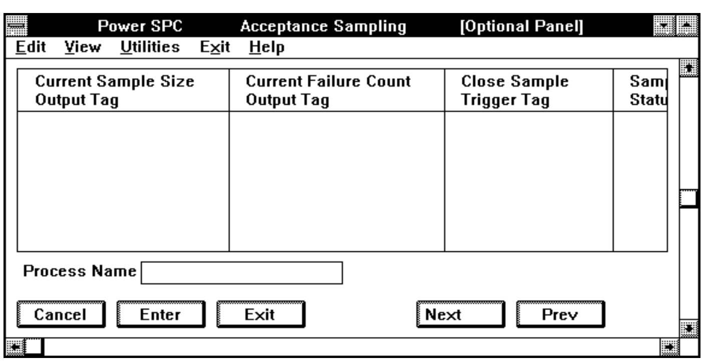
You can set sample size, lot size, acceptance criteria (number of units from the sample that must pass measurement/inspection), a trigger tag to force the closure of a sample, and an indicator showing whether SPC uses acceptance sampling.

For example, suppose you receive 200 cases of parts from a supplier. Each case contains 1,000 parts (40 bags, each containing 25 parts). You and the supplier agree that 22 out of 25 parts must meet a certain standard of quality or you can refuse the entire case (lot). Use acceptance sampling to determine whether 22 out of 25 parts meet this standard.

You measure and/or inspect 25 random parts from the lot of 1,000 (one bag from the case) and input the results to SPC. SPC determines how many parts are within the specifications and how many parts are defective. It compares these values to the acceptance criteria (22 out of 25) and determines whether the sample passes. If 22 parts are acceptable, the entire lot (case) passes. Repeat this procedure for each case.

If you do not want to perform acceptance sampling or do not want the operator to change the acceptance sampling set up in the sample plan, leave this panel blank.

> **Note:** To use acceptance sampling, also define an Accept Data Trigger Tag in the Process Definition panel and one of the following in the Data Collection panel: Dimn Measurement Tag, Char Defective Count Tag, or Char Defect Count Tag.



This panel contains eight fields. Press Tab to display additional fields.

1 Specify the following information in this panel:

Current Sample Size Output Tag	(Optional) Name of a tag that indicates the number of units measured or inspected so far. SPC increments the value of this tag as it accepts each new value into the SPC database. When SPC closes a sample, it resets this tag to 0. The data type for this tag can be analog, longana, float, or message, depending on the kind of data stored in the tag. The default is analog.
Current Failure Count Output Tag	(Optional) Name of a tag that indicates the number of units from the lot that failed the acceptance sampling. The data type for this tag can be analog, longana, float, or message, depending on the kind of data stored in the tag. The default is analog.
Close Sample Trigger Tag	(Optional) Name of a tag that forces SPC to close the sample. If you are performing acceptance sampling on a sample of varying size, enter a tag in this field. If you are performing it on a sample of a fixed size, leave this field blank. The data type for this tag can be digital, analog, longana, or float, depending on the kind of data stored in the tag. The default is digital. At run time, the operator or another FactoryLink module can trigger this tag without stopping the process.
Sample Pass/Fail Status Tag	(Optional) Name of a tag that indicates whether the latest closed sample has successfully passed the acceptance sampling criteria. The data type for this tag can be digital, analog, longana, float, or message, depending on the kind of data stored in the tag. The default is message. At run time, the operator or another FactoryLink module can change this tag without stopping the process.
Acceptance Sampling	(Optional) Name of a tag that controls whether SPC performs acceptance sampling for this process. You can use acceptance sampling with characteristic and dimension data. The data type for this tag can be either analog or message, depending on the kind of data stored in the tag. The default is message.

Before changing this tag, the operator must stop the SPC process but not the SPC module or the application. When the operator restarts the process, SPC loads the new sampling method.

When this tag is...	Then...
0 or NONE	(Default) For this sample, use process sampling instead of acceptance sampling.
1 or FIXED	Use acceptance sampling for a sample that contains a fixed number of subgroups. When SPC collects the number of samples you specify either in the Sample Plan panels or in the Sample Size field, SPC closes the sample and evaluates it.
2 or VARIABLE	Use acceptance sampling for a sample that varies in size.

Accept Criteria (Optional) Name of a tag that indicates the number of units that must pass all defined measurements and/or inspections for the entire lot to pass. Refer to the Data Collection panel for the Sample Plans and Processes options. The data type for this tag can be digital, analog, longana, or float, depending on the kind of data stored in the tag. The default is analog.

Before changing this tag, the operator must stop the SPC process but not the SPC modules or the application. When the operator restarts the process, SPC loads the new accept criteria.

Sample Size (Optional) Name of a tag that defines the number of units to be evaluated. The data type for this tag can be digital, analog, longana, or float, depending on the kind of data stored in the tag. The default is analog.

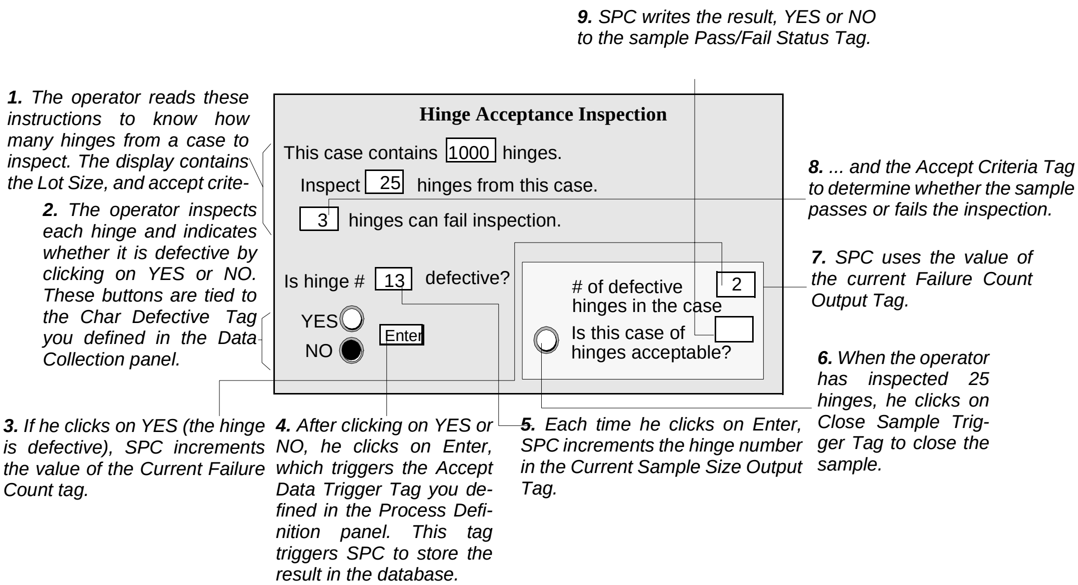
Before changing this tag, the operator must stop the SPC process but not the SPC modules or the application. When the operator restarts the process, SPC loads the new sample size.

Lot Size (Optional) Name of a tag that defines the total number of units in the lot (batch) SPC takes the sample group from. The data type for this tag can be digital, analog, longana, or float, depending on the kind of data stored in the tag. The default is analog.

Before changing this tag, the operator must stop the SPC process but not the SPC module or the application. When the operator restarts the process, SPC loads the new lot size.

2 Click Enter to save the information.

Sample Illustration



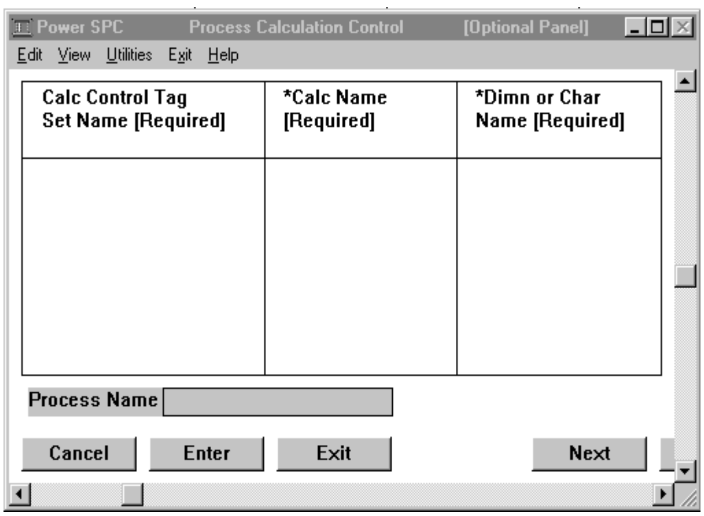
DEFINING THE CALCULATIONS

To specify the calculations, control limits, amount of data for each calculation, and run rules to be evaluated, configure tags in the Calculation Control panel. You can define calculation completion tags and force SPC to perform calculations. Most SPC processes need only one set of these tags as each set can control any of the configured calculations.

The operator can change any of these settings at run time by suspending the process but not the SPC module or the application, making the desired changes, and reactivating the process.

To automate editing of calculations using the simplest method, define at least as many calculation tag sets (calculation type and dimension or characteristic name) as there are calculations in the sample plan. Since process activation is always performed last, any changes made will be written to these tags before the process becomes active.

To automate editing of calculations using another, more complex, method, define a single calculation tag set, scroll calculations through that one set, and edit as the calculations are scrolled. Whenever a calculation is scrolled, a value of zero is force-written to the scroll tag. This serves as a scroll completion trigger. When the scroll is complete, you are allowed to edit the calculation.



This panel contains 22 fields. To see all fields, press Tab.

If you leave this panel blank, SPC performs only the calculations listed in the Sample Plan Calculation Control panel.

1 Specify the following information in this panel:

Calc Control Tag Set Name (Required) Alphanumeric string of up to 16 characters that specifies the set of calculation control tags that you define in this panel.

Calc Name (Required) Indicate the calculation to be performed. Enter either the name of the calculation or the name of a tag that indicates the calculation. This can be one of the following:

Constant Name of the calc name to display preceded by a single quote. This can be one of the following:

‘XBARR	‘MOVRNG	‘NP
‘XBARS	‘MOVRNG	‘P
‘RANGE	‘EWMA	‘C
‘STDDEV	‘INDIV	‘U
‘SPLIT	‘CP	
‘AVG	‘CPK	

Variable Name of a tag that indicates the data type. The data types can be analog or message depending on the kind of data stored in the tag.

If you define a tag in this field, at run time the operator or another FactoryLink module can change between calculations defined in the sample plan without suspending the process.

To change to a calculation not defined in the sample plan, define a tag in this field. At run time, the operator or another FactoryLink module can edit the calculation being performed by writing to this tag if the following conditions exist:

- The sample plan must have restrict changes defined as NO.
- The operator or the module must first suspend the process. This means that the value of the Process Status Tag (defined in the Process Definition Control panel) is 0.

If you define this tag as analog, the operator selects the number for the desired calculation. If you define it as message, the operator selects the name of the desired calculation. These numbers correspond to the calculations as shown below:

Calculation	Analog Value	Calculation	Analog Value
XBARR	1	EWMA	9
XBARS	2	INDIV	10
AVG	3	C	11
STDDEV	4	U	12
RANGE	5	NP	13
SPLIT	6	P	14
MOVAVG	7	CP	15
MOVRNG	8	CPK	16

Dimn or Char Name (Required) Name of the dimension or the characteristic SPC is to perform the calculation on. You can enter either a constant name or the name of a tag that indicates the dimension or characteristic.

Constant — Alphanumeric string of 1 to 16 characters preceded by a single quote that specifies the name of the dimension or characteristic to display; for example, ‘DENT or ‘LENGTH. If you do not precede the name with a single quote, SPC uses it as a tag name.

Variable — Name of a tag that indicates the data type. The data type for this tag is message.

If you define a tag in this field, at run time the operator or another FactoryLink module can change between dimensions and characteristics defined in the sample plan without suspending the process.

* — Indicates you want SPC to perform the specified calculation on all characteristics. Only for calculations on characteristics (such as np, p, c, and u).

Since SPC cannot perform a calculation on all dimensions, if you enter DIMENSION in the Dimn or Char Type field, do not enter ***** in this field.

Note: Remember to indicate the type of calculation in the Char Name field.

The operator must change the values in both this field and the Calc Name field to dynamically change the values that control a calculation,. To edit the values at run time, the same conditions must be met as when calculation type is edited:

- Sample plan must have restrict changes defined as NO.
- Operator or the module must first suspend the process. This means the value of the Process Status Tag (defined in the Process Definition Control panel) is 0.

For example, suppose you want the system to perform an XBARR calculation on length and width. To configure this, enter XBARR on two lines in the Calc Name field. Then, in the Dimn or Char Name field, enter ’length on one line and ’width on the other.

Calc Selection Scroll Tag
(Optional) Name of a tag that lets the operator scroll through one by one and select from a list of calculations configured in the sample plan. SPC displays the available calculation names in the Calc Name tag. Remember to animate Calc Name as an input-text object in the Application Editor. To scroll through the configured calculations, the operator increments or decrements the value of the Calc Selection Scroll Tag.

The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is analog.

At run time, the operator or another FactoryLink module can scroll through and select from the values in this tag without stopping the process.

Current Calc Size Output Tag
(Optional) Name of a tag that indicates the number of measurements or inspections SPC has collected so far. The value of this tag increments by the number of measurements or inspections accepted. After performing a calculation, SPC resets this tag to 0 (OFF).

The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is analog.

Calc Trigger Tag
(Optional) Name of a tag that triggers SPC to perform the calculation you specified in the Calc Name and Dimn or Char Name fields. The operator can trigger this tag to perform calculations early—before SPC has collected an entire sample or subgroup of data.

The data type for this tag can be digital, analog, longana, or float, depending on the kind of data stored in the tag. The default is digital.

At run time, the operator or another FactoryLink module can trigger this tag without disabling the process.

Calc Output Tag (Optional) Name of a tag that contains the result from the last time SPC performed the selected calculation. The output value represents the calculation performed on the latest subgroup of data.

The data type for this tag can be analog, longana, float, or message, depending on the kind of data stored in the tag. The default is float.

Control Limit Trigger Tag (Optional) Name of a tag that triggers SPC to recalculate the control limits for the calculation. When SPC is to recalculate the control limits, FactoryLink sets this value to 1 (ON).

The data type for this tag can be digital, analog, longana, or float, depending on the kind of data stored in the tag. The default is digital.

At run time, the operator or another FactoryLink module can trigger this tag without disabling the process.

If you want to recalculate control limits, we recommend you not set the Calc Size to larger than 25. If you need the Calc Size to be larger than 25, you must specify a factor in the Factors Table for SPC to use to recalculate the control limits.

We recommend you not set up the application to trigger this tag too often because performance slows down while SPC recalculates the control limits.

Control Limit Calc Completion Tag (Optional) Name of a tag that indicates when SPC is done recalculating the control limits. Because the system slows down while SPC recalculates the control limits, you can use this tag to alert the operator or another module or to trigger an action when SPC has finished the recalculation.

The data type for this tag can be digital, analog, longana, or float, depending on the kind of data stored in the tag. The default is digital.

LCL Value (Optional) If you want to override the LCL value you defined in the Sample Plan Calculation Control panel, enter the name of a tag that identifies the lower control limit the last time SPC performed the selected calculation.

The data type for this tag can be analog, longana, float, or message, depending on the kind of data stored in the tag. The default is float.

When the initial sample plan is loaded or a new sample plan is loaded, the value for this tag will be cleared.

If this value is edited, the new LCL value will apply to future calculations.

UCL Value

(Optional) If you want to override the UCL value you defined in the Sample Plan Calculation Control panel, enter the name of a tag that identifies what the upper control limit was the last time SPC performed the selected calculation. To display this limit on the screen and let the operator view and edit this limit at run time, animate this tag as an input-text object in the Application Editor.

The data type for this tag can be analog, longana, float, or message, depending on the kind of data stored in the tag. The default is float.

When the initial sample plan is loaded or a new sample plan is loaded, the value for this tag will be cleared.

The edited value applies to future calculations.

Center Value

(Optional) If you want to override the Center Value you defined in the Sample Plan Calculation Control panel, enter the name of a tag that identifies what the center value was the last time SPC performed the selected calculation. To display this limit on the screen and let the operator edit this limit at run time, animate this tag as an input-text object in the Application Editor.

The data type for this tag can be analog, longana, float, or message, depending on the kind of data stored in the tag. The default is float.

When the initial sample plan is loaded or a new sample plan is loaded, the value for this tag will be cleared.

Highest Priority Run Rule Violation Output Tag

(Optional) Name of a tag that identifies the highest priority run rule that was violated the last time SPC performed the selected calculation.

The data type for this tag can be digital, or message, depending on the kind of data stored in the tag. The default is message.

If you define this tag as digital, when a violation occurs, SPC writes a 1 to this tag. This is useful for acting as an alarm. If you define this tag as message, SPC displays the name of the run rule violated.

Dimn LSL Value

(Optional) If you want to override the LSL value you defined in the Sample Plan Calculation Control panel, enter the name of a tag that indicates what the lower specification limit was the last time SPC performed the selected calculation. To display this limit on the screen and let the operator view and edit this limit at run time, animate this tag as an input-text object in the Application Editor.

The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is float.

When the initial sample plan is loaded or a new sample plan is loaded, the value for this tag will be cleared.

The new value applies to future calculations.

Dimn USL Value (Optional) If you want to override the USL value you defined in the Sample Plan Calculation Control panel, enter the name of a tag that indicates what the upper specification limit was the last time SPC performed the selected calculation. To display this limit on the screen and let the operator view and edit this limit at run time, animate this tag as an input-text object in the Application Editor.

The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is float.

When the initial sample plan is loaded or a new sample plan is loaded, the value for this tag will be cleared. New value applies to future calculations.

Dimn Nominal Value (Optional) If you want to override the Nominal value you defined in the Sample Plan Calculation Control panel, enter the name of a tag that indicates what the target dimension was the last time SPC performed the selected calculation. To display this limit on the screen and let the operator view and edit this limit at run time, animate this tag as an input-text object in the Application Editor.

The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is float.

When the initial sample plan is loaded or a new sample plan is loaded, the value for this tag will be cleared.

Calc Size (Optional) If you want to override the subgroup size you defined in the Sample Plan option's Collection Control panel, enter the name of a tag that indicates the amount of data SPC is to use for the calculation. The tag in this field applies only to the calculation you enter in the Calc Name field.

The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is analog.

If you want SPC to perform the calculation according to the subgroup size defined in the Sample Plan panels, leave this field blank.

If you enter a tag name in this field, SPC does not perform the calculation at the same time as the rest of the calculations that are based on the subgroup size defined in the Sample Plan panels.

When the initial sample plan is loaded or a new sample plan is loaded, the value for this tag will be cleared. If this tag is defined with a default value, that value will be cleared when the initial sample plan is loaded or a new sample plan is loaded.

Before changing the value of this tag at run time, the operator or another module must first suspend the process. The new value applies to future calculations.

Calc Offset Value (Optional) If you want to override the Calc Offset value you defined in the Sample Plan Calculation Control panel, enter the name of a tag that normalizes each calculation result on a per-calculation basis. SPC subtracts the offset from the calculated value. This value affects the data display only. SPC records and archives the original data without subtracting this value. This field is useful with mean-type calculations such as XBARR and Individual. We recommend you not use it for Standard Deviation and Range calculations.

The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is float.

For example, if you are producing 5-pound. bags of sugar, you want to ensure each bag contains 5 pounds of sugar. The bag itself, for this production run, weighs 0.3 pound, but the bag weight is not constant for the next production run. Because you cannot include the weight of the packaging in the overall weight of the product, set the offset value to the weight of the bag (0.3). SPC collects the combined weight of each bag of sugar and when a display is requested, it automatically subtracts 0.3 pound from the total weight and displays the actual product weight on the chart and in the calculated result.

> **Note:** Although the calculated data reflects the true product weight of 5 pounds, the raw data stored in the database is still 5.3 pounds.

If you also specify a scale value in the Calc Scale Value field, SPC then subtracts the offset from the calculated value and divides the result by the scale value. See Example 2 in the Calc Scale Value field description in the next page.

When the initial sample plan is loaded or a new sample plan is loaded, the value for this tag will be cleared.

Before changing the value of this tag at run time, the operator or another module must first suspend the process. The new value applies to future calculations.

Calc Scale Value (Optional) If you want to override the Calc Scale Value you defined in the Sample Plan Calculation Control panel, enter the name of a tag that normalizes each calculation result. SPC divides the calculated value by the scale value. This value will affect data display only. SPC records and archives the original data values without scaling. This field is useful with mean-type calculations, such as XBARR and Individual. We recommend you not use it for Standard Deviation and Range calculations.

The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is float.

Example 1

If you are measuring the amount of liquid produced from a well with a measuring instrument that measures the liquid in ounces, but you want to plot the data in gallons, you can set the Calc Scale Value tag to 128 (ounces in a gallon). By doing this, the measuring instrument reports the amount of liquid produced in ounces but when a display is requested, SPC divides this value by 128 to record and display the amount of liquid in gallons.

Similarly, if your measurement is in grams, but you want to plot the data in kilograms, you can set the Calc Scale Value tag to 1,000 so SPC will divide the weight in grams by 1,000.

If you also specify an offset value tag in the Calc Offset Value field, SPC subtracts the offset from the calculated value and then divides the result by the scale value.

Example 2

If you are measuring the temperature of a liquid and you want to display the temperature in Celsius but you switch to a measuring instrument that measures it in Fahrenheit, you set the Calc Offset tag to 32 and the Calc Scale tag to 1.8 to convert the temperature from Fahrenheit to Celsius.

When the initial sample plan is loaded or a new sample plan is loaded, the value for this tag will be cleared.

Before changing the value of this tag at run time, the operator or another module must first suspend the process. The new value applies to future calculations.

Calc Constant Value

$$CP = \frac{(USL - LSL)}{2 \times cc \times \sigma}$$

$$CPK = \frac{(\bar{X} - LSL)}{cc \times \sigma}$$

cc = calc constant value.

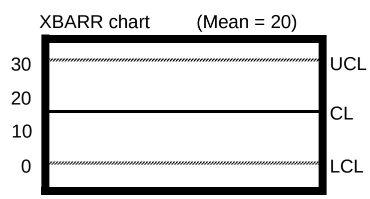
cc is usually 3σ. However, you can use other σ values, such as 2σ.

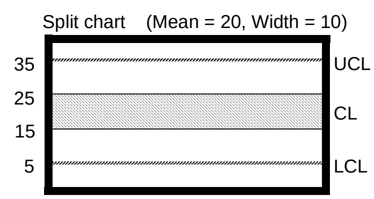
(Optional. Use this field only for EWMA, Cp, Cpk, or Split calculations.) If you want to override the Calc Constant value you defined in the Sample Plan Calculation Control panel, enter a tag name that indicates the value SPC uses for the calculation.

Unless you are configuring an EWMA, Split, Cp, or Cpk calculation, leave this field blank.

If you are using Cp or Cpk, this tag fits into the Cp and Cpk calculations as shown to the left.

If you are using Split, this tag indicates the width of the center line. The width is the range of values between the two center lines. For example, if you want the center line (mean) at 25 and 15, set this tag to 10.





If you are using EMWA, this tag represents the λ value, such as .3λ.

For information about valid constant values for each type of calculation, see the Calc Constant field description in "Defining the Sample Plan Calculations" on page 130 of this guide.

When the initial sample plan is loaded or a new sample plan is loaded, the value for this tag will be cleared.

The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is float.

Before changing the value of this tag at run time, the operator or another module must first suspend the process. The new value applies to future calculations.

> **Note:** We recommend you use this field only if you are knowledgeable and experienced with adjusting these calculations.

Points In Control Limit Calc

(Optional) If you want to override Sample Plan value, enter the name of a tag that defines the number of points (calculated values) SPC is to consider when performing the control limit calculation.

The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is analog.

Before changing the value of this tag at run time, the operator or another module must first suspend the process. The new value applies to future calculations.

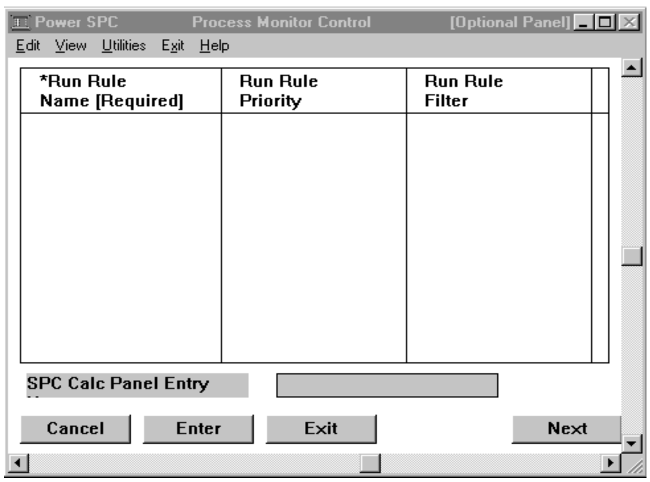
If you are excluding points with assignable cause, fewer points may be used if any is actually excluded.

2 Click Enter to save the information.

ESTABLISHING THE RUN RULES

If you want SPC to use run rules to evaluate a series of calculated results for unusual patterns or values indicating variations in quality, configure the Monitor Control panel. If you configure this panel, SPC obtains a history of the number of calculations, or points, that the run rule must evaluate to detect variations in the level of quality. You can use this panel to override or disable Run Rules configured in the Sample Plan Monitor Control panel for future calculations.

You can use the Monitor Control panel to determine how SPC evaluates each run rule. You can also determine how SPC reports and records run rule violations.



This panel contains six fields. To see more fields, press Tab.

1 Specify the following information in this panel:

Run Rule Name (Required) Run rule name. This can be one of the following:

- **Constant** Alphanumeric string of 1 to 16 characters preceded by a single quote that specifies a Run Rule name. The name can be either a standard Western Electric run rule name (for information about these, see the Glossary entry “Western Electric Run Rule” in this guide) or any run rule you define in the PowerSPC User-defined Run Rule Configuration panel.
- **Variable** Name of a tag that identifies a run rule. The data type for this tag is message. Because you configure run rules on a per-calculation basis, using tags to view or change a run rule configuration affects only one instance of a rule.

If you define a tag in this field, at run time, the operator or another FactoryLink module can change between run rules referenced in the sample plan without suspending the process; however, to change to a run rule that is not referenced in the sample plan, the operator or a module must first suspend the process.

If the tag value is set to a Run Rule name defined in the Sample Plan Monitor Control panel, then the sample plan values will be overwritten for that run rule.

When the initial sample plan is loaded or a new sample plan is loaded, the value in this tag will be cleared but constant values will not be cleared.

Notice that the SPC Calc Panel Entry field at the bottom of this panel contains the Calc Control Tag Set Name you entered in the Calculation Control panel. This name indicates which set of monitor control tags is associated with which set of Calculation Control panel tags.

Run Rule Priority

(Optional) If you configured several run rules for the same calculation, you can enter the name of a tag in this field that specifies the order in which SPC reports run rule violations. If you leave this field blank and default priorities have not been entered in User Defined Run Rules panel, SPC evaluates the run rules in the order you enter them in the panel.

The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is analog. If you assign priorities and configure only one output-text field tag to display the violated run rule, SPC displays the highest priority run rule violated. Before changing the value of this tag at run time, the operator or another module must first suspend the process.

If this tag is...	Then...
0 (default)	Rules have equal priority.
1 - 32,767	1 is the highest; 32,767 is the lowest.

Note: After loading the sample plan, run rules with no priorities (0) will have priority of 32,767 as output to this tag.

Run Rule Filter

(Optional) Name of a tag whose value indicates how you want SPC to report and record run rule violations. Use this field to filter out violations that may occur above and/or below the center value.

The data type for this tag can be analog, longana, float, or message, depending on the kind of data stored in the tag. The default is message.

If you leave this field blank, SPC uses the run rule filter you defined in the Sample Plan Monitor Control panel.

Before changing the value of this tag at run time, the operator or another module must first suspend the process.)

If this tag is either...	Then SPC...
0 or EITHER	(Default) Detects/reports both upper and lower zone violations. If the Number of Points for Violation lies either above or below the center line, SPC reports run rule violations. This filter can validate a Trend run rule that crosses the center line.
1 or UPPER	Detects/reports only upper zone violations. If the Number of Points for Violation lies above the center line, SPC reports a run rule violation.
2 or LOWER	Detects/reports only lower zone violations. If the Number of Points for Violation lies below the center line, SPC reports a run rule violation.
3 or BOTH	Detects/reports zone violations either above or below the center line. SPC reports run rule violations regardless of the point's proximity to the center.

Run Rule Enable Tag

(Optional) Name of a tag that enables or disables the evaluation of the selected run rule. The data type for this tag can be digital, analog, longana, float, or message, depending on the kind of data stored in the tag. The default is digital.

For each run rule configured for a calculation, SPC reads the value of the Run Rule Enable Tag to determine whether to evaluate the run rule at startup. When this tag is greater than 0, SPC evaluates the run rule.

Before changing the value of this tag at run time, the operator or another module must first suspend the process. If you define this tag as message, its value can be YES or NO.

Run Rule Violation Alarm Tag (Optional) Name of a tag that indicates when a process violates a run rule. When a process violates a run rule, SPC sets this tag to a value greater than 0. When a process is not violating a run rule, this tag's value is 0.

The data type for this tag can be digital, analog, longana, float, or message, depending on the kind of data stored in the tag. The default is digital.

You can configure one violation alarm tag for each run rule being evaluated or one being monitored. If you configure only one tag, any run rule violation triggers the alarm tag.

If you define this tag as digital, analog, longana, or float, its value can be 1 or 0. If you define this tag as message, its value can be YES or NO.

Run Rule Selection Scroll Tag (Optional) Name of a tag that lets the operator select a run rule. To scroll through the configured run rules, the operator increments or decrements the value of this tag.

The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is analog.

To display these run rule choices on a graphics screen, tie this tag to an output-text object in the Application Editor.

At run time, the operator or another FactoryLink module can trigger this tag without disabling the process.

2. Click Enter to save the information.
3. Click Exit to close the Process panels.

Chapter 7 . . . .

Drawing and Animating Display Charts

7

Drawing & Animating Display Charts

You can graphically display the results of data collected and calculated on SPC charts. The operator can use these charts to view real-time or historical data.

Create these charts using the FactoryLink Application Editor. The procedure to create and animate SPC charts is as follows:

1 Draw and animate one or more charts. See “Drawing and Animating the Chart” on page 180 of this chapter.

2 Give the chart Y- and X-axis legends. See “Adding Legends to the Chart” on page 183.

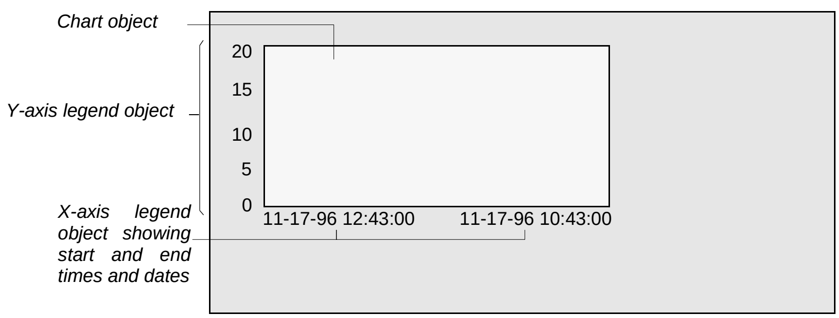
3 Optionally add a value cursor and input- or output-text fields to the chart. See “Adding a Value Cursor to the Chart” on page 187.

4 Optionally add transition buttons to the chart. See “Adding Real-time and Historical Mode Switching” on page 188 and “Animating Additional Objects for Miscellaneous Functions” on page 191.

This chapter contains instructions for drawing and animating SPC charts.

DRAWING AND ANIMATING THE CHART

You can use the same chart object to display any type of chart. At run time, the operator can change the type of chart being viewed.



Note: Legend objects must be solid filled. Non-solid legends will not be cleared before legend updates, resulting in repeated overwriting of legend values.

Two ways you can create a chart object are:

- Using the chart power object provided with PowerSPC
- Drawing a chart from scratch

Using the Chart Power Object

Perform the following steps to draw and animate a chart using the chart power object:

1. Open or create a drawing file in the Application Editor in the USER domain to contain the SPC chart.
2. Choose a screen color for the drawing.
3. Open the Power Pack file (POWERSPC.GP) for PowerSPC and copy the Basic Chart object.
4. Return to your drawing file and paste the chart object to display a template dialog.
5. Enter a unique chart ID name and press Tab.
6. Enter a calculation name and click OK to display a combined object for chart and two legends. The names you choose for the calculation and the chart can be anything you want, but do not repeat the chart ID name for any other chart you create on the same screen.

7 Select the chart object inside the combined object.

8 Choose Attributes>Object Name and record the object number or change it to a name for this chart object. If the chart is for a Histogram or Pareto Chart, also select the X-legend in the combined object and record the object number or change it to a name for the X-legend.

9 Save the drawing. The chart power object configures all required chart animation and legend animation along with six tags using the chart ID name and the calculation name you entered in the template dialog.

For example, if you entered:

chart identifier = chart1

calculation name = avgcalc

These are the tags that are created:	This is the panel and field in the PowerSPC Charts option where you use the tag name:
spc_chart1_cursorvalue	Display panel - Calc Value Output Tag field.
spc_chart1_violation	Calculation Display panel - Violated Run Rule Name Output Tag field.
spc_chart1_causecode	Calculation Display panel - Cause Code Name Tag field.
spc_chart1_editmode	Control Chart panel - Edit Mode Toggle Tag field.
spc_chart1_ymin	Control Chart panel - Y-axis Minimum field.
spc_chart1_ymax	Control Chart panel - Y-axis Maximum field.
spc_chart1_avgcalc	Chart Information panel - Chart Value Output Tag field.

Drawing Without the Chart Power Object

Perform the following steps to draw and animate a chart without the chart power object:

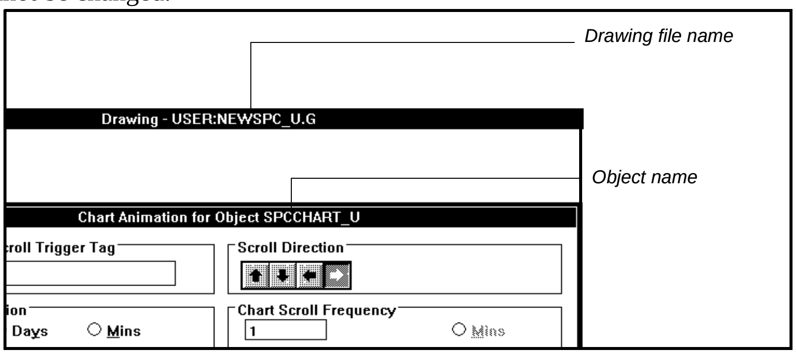
1 Open or create a drawing file in the Application Editor in the USER domain to contain the SPC chart.

2 Choose a screen color for the drawing.

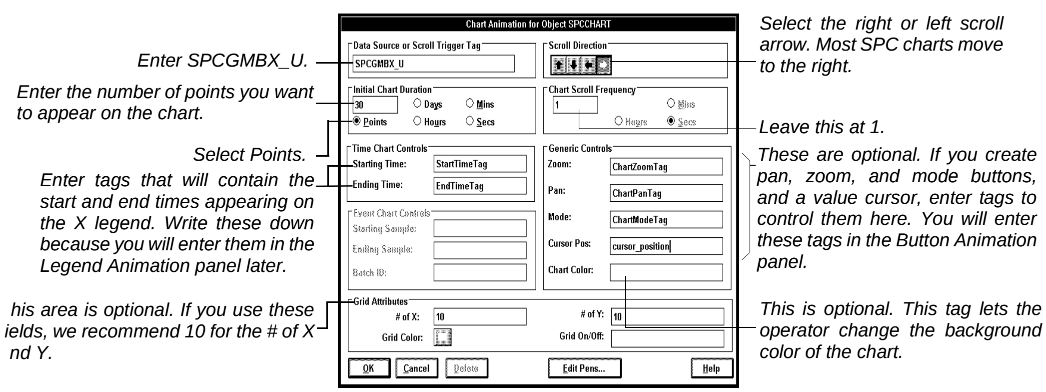
3 Draw a box and choose the line and fill colors.

4 Select the box, then choose Attributes>Object Name. When the Object Name panel displays, enter in a descriptive name for the box. Click OK.

5 Choose Animation>Chart. When the Chart Animation panel displays, write down the object name of the chart and the drawing file name it resides in. Later, you will enter the object ID and drawing file name in the Chart Definition panel. Use Ctrl + N to view the object ID. This cannot be changed.



6 Enter information about this chart according to the task requirements. SPC needs definitions only for the following items. Define the fields as follows.



7 Click OK to save the information.

ADDING LEGENDS TO THE CHART

Perform the following steps to animate a legend for the chart:

> **Note:** Draw the legend and select a line and fill color. We recommend you choose a solid fill and for the line, leave Visible unchecked so the line will be invisible.
>
> For bar charts, the X legend must have a solid fill.

1. Select the legend, then choose Attributes>Object Name. When the Object Name panel displays, enter a descriptive name for the legend object.
2. Choose Animation>Legend. When the Legend Animation panel displays, write down the object name of the legend. Later, you will enter the object and drawing file names in the Chart Definition panel.
3. Complete the fields according to the axis the legend runs along. Most charts have two legends, one for the X axis and the other for the Y axis. Complete the Legend Animation panel once for each legend. Complete the fields as follows for the appropriate legend.

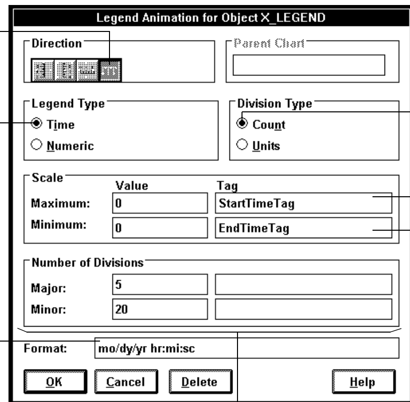
X Legend

Select the 4th direction. The legend will be horizontal and display at the bottom of the chart.

Select Time.

Enter any numbers you want in the Value fields. SPC ignores these values but you must enter them for FactoryLink to run properly.

Enter a time format. We suggest setting it for either a shortened date or time, such as mo/dy/yr or hr:mi:sc. If the chart is used to display a histogram, enter a numeric format such as, XXX.X or X.XXXX



Select Count for most SPC charts. Count causes the top value to be a whole number. Units calculates the top value by the number of tic marks.

Enter the tag from the Starting Time field in the Chart Animation panel.

Enter the tag from the Ending Time field in the Chart Animation panel.

These are optional. We recommend you complete the Value fields for most charts. If you want the operator to be able to change these values at run time, complete the Tag fields, too.

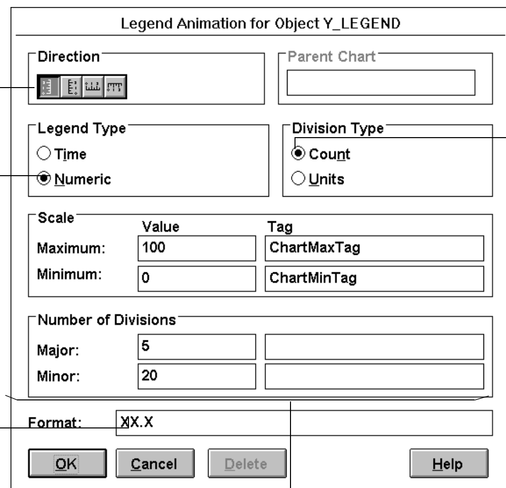
Y Legend

Select the 1st direction. The legend will be vertical and display on the left

Select Numeric.

Enter any numbers you want in the Value fields. SPC ignores these values but you must enter them for FactoryLink to run properly.

Optional
Enter a numeric format, for the numbers that label the legend, such as XX.X.



Select Count for most SPC charts. Count causes the top value to be a whole number. Units calculates the top value by the number of tic marks.

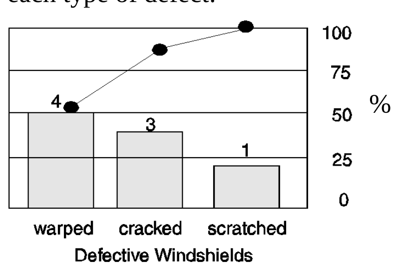
Enter tags here. Write them down because you will enter them in the Control Chart panel later.

These are optional. We suggest you fill out the Value fields for most charts. If you want the operator to be able to change these values at run time, fill out the Tag fields, too.

Y Legend on a Pareto/Pareto-Defect Chart

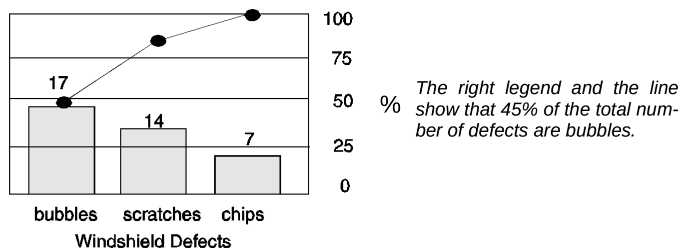
For Pareto and Pareto-Defect charts, you may want to add a Y legend to the right side of the chart instead of to the left, or you can add a Y legend to both the right and left sides.

On a Pareto Chart, the right legend shows the percentage of the total number of defective units caused by each type of defect.

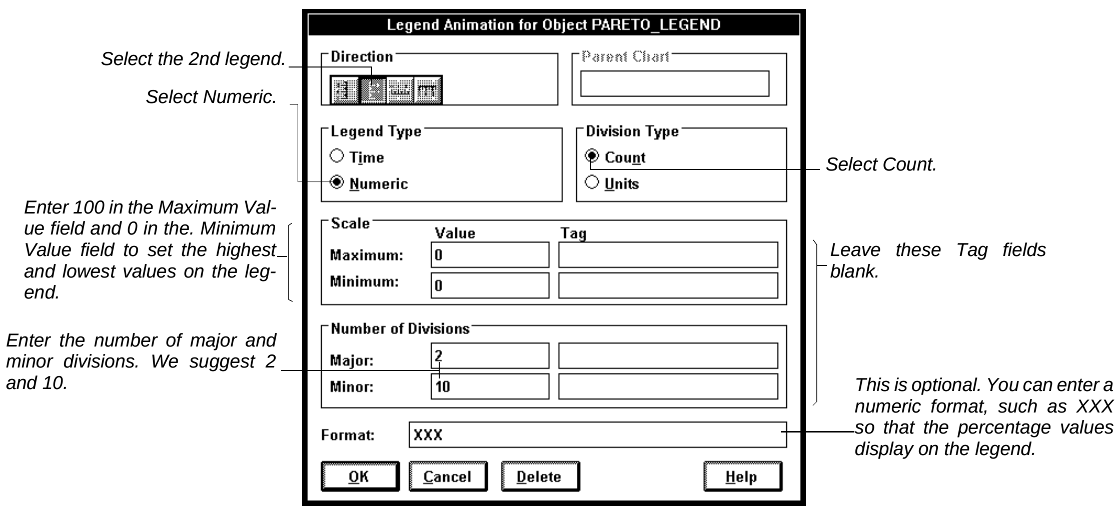


The right legend and the line show that 57% of the total number of defective units are warped.

On a Pareto-Defect Chart, the right legend shows the percentage of the total number of defects found that belong to each defect category.



Complete the Legend Animation panel for a right Y legend as follows.

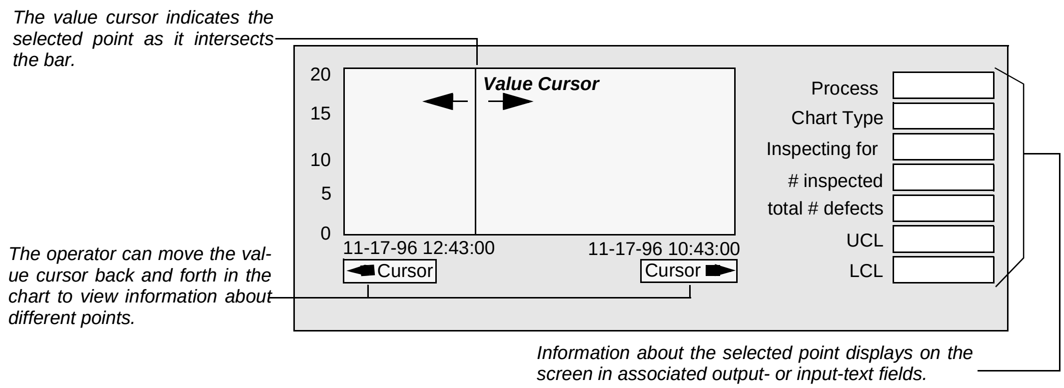


4 Click OK to save the information.

5 Save the drawing.

ADDING A VALUE CURSOR TO THE CHART

Optionally, you can add a value cursor to a chart. At run time, when the operator clicks anywhere in the chart, the value cursor, which looks like a vertical bar, displays. This is useful for selecting a point on the chart to display information associated with that point. If you create a value cursor, also animate buttons to scroll the value cursor left and right and create input- or output-text fields to contain the information about the point. For more information about this, refer to “Displaying Miscellaneous Information About a Point on a Control Chart” on page 208 of this guide.



ADDING REAL-TIME AND HISTORICAL MODE SWITCHING

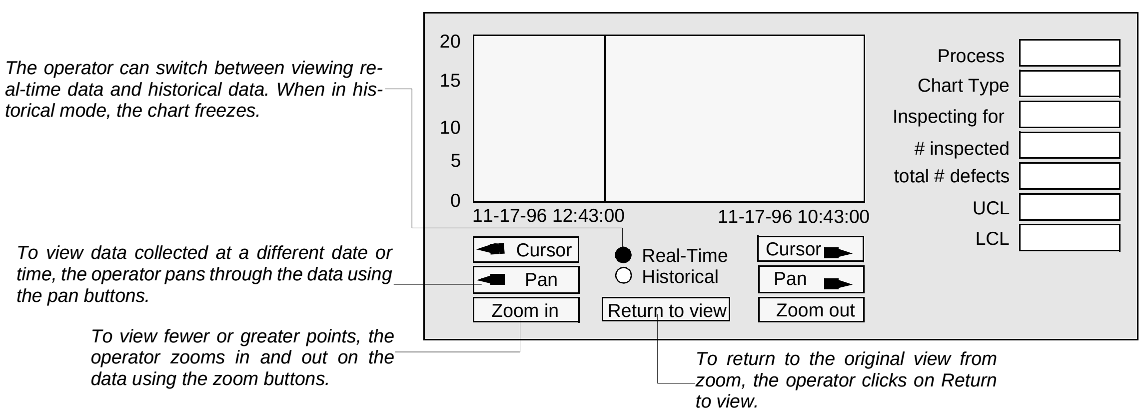
Optionally, you can add buttons under the chart to let the operator switch between viewing real-time and historical data.

- When in real-time mode, an SPC chart shows data as it is occurring.
- When in historical mode, the chart shows data from the past.

Adding Pan and Zoom Buttons for Historical Mode

At run time, the operator can pan back to see data from a previous date and time and pan forward to see later data. With the zoom buttons, the operator can zoom in to see fewer points and zoom out to see more points.

The Zoom and Pan operations in PowerSPC automatically take you to historical mode. The Return to original view button returns you to real-time mode.



Animating the Buttons

When you animate the chart object, you may create tags for the pan, zoom, and mode buttons in the Zoom, Pan, and Mode fields of the Chart Animation panel.

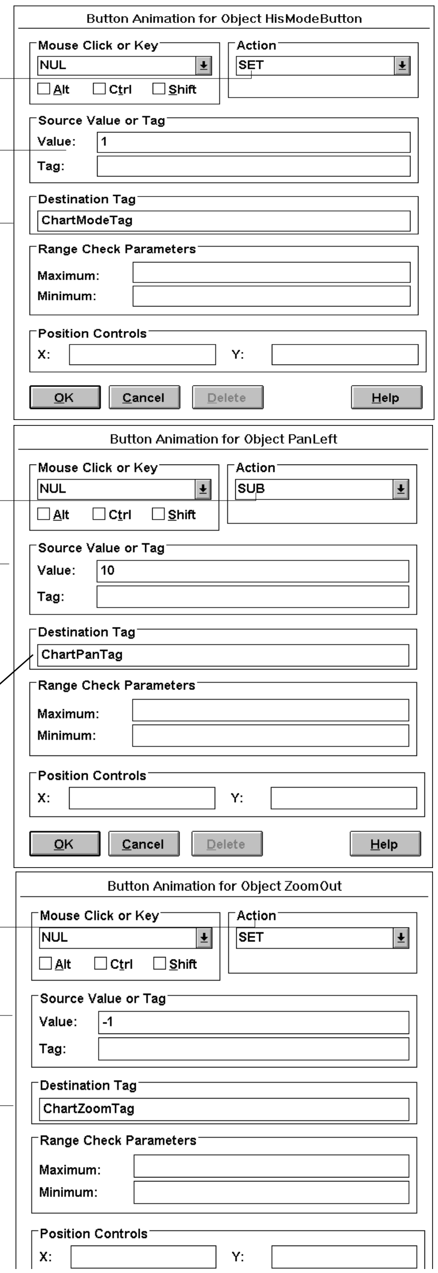
Complete a Button Animation panel for the desired zoom, pan, and mode buttons.

- Use the same Zoom tag for all three zoom buttons
- Use the same Pan tag for both Pan buttons
- Use the same Mode tag for both mode buttons

See the following examples.

Adding a zoom button either doubles the amount of data that is displayed or decreases the amount displayed by half. If you require more control over the number of points displayed, then configure a tag for the Number of Points field in the Chart Definition panel.

For information about animating buttons, refer to the *FactoryLink ECS Application Editor Guide*.



For the Mode buttons, use the Set Action.

*For the Historical Mode button, enter 1 here.
For the Real-Time Mode button, enter 0.*

Enter the same tag for both Mode but-

For the Pan buttons, use the SUB Action.

Enter the number of points you wish to Pan. If you enter 10, then each time you activate the Pan left button, the chart will Pan 10 points to the left. Setting the Pan tag to 0 brings the chart back to the most current time. You cannot Pan beyond the most recently collected data. Use the ADD action to go to the left, use the SUB action to go to the right.

Enter the same tag for both Pan buttons.

For the Zoom buttons, use the SET Action.
For the Zoom In button, enter 1

*For the Zoom Out button, enter -1.
For the Return to Original View button, enter 0.*

Use the same tag for all three Zoom buttons.

Animating Additional Objects for Miscellaneous Functions

Add buttons to switch between the current screen and other screens in the application, such as the Run-Time Manager screen and an ad hoc screen. For information about ad hoc screens and charts, refer to "Setting Up a Chart to Show Only Ad Hoc Data" on page 228 of this guide.

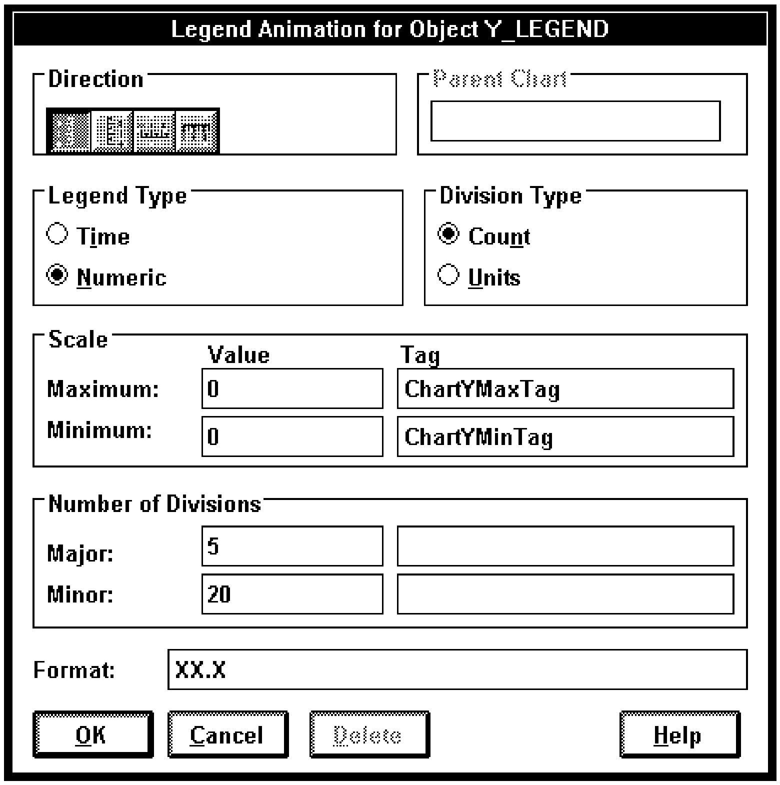
> **Note:** Chart objects automatically connect to the database whenever they are in a window, even if the window is behind another window, and require system resources to maintain. If switching drawing display between different charts is time critical and your system has enough memory resources, however, you can make one drawing per window and switch top window display. This gives significantly faster chart display.

Some buttons you can create are for

- Suspending and restarting the process
- Entering and exiting edit mode
- Accepting the edits
- Changing values on the legends for input-text fields
- Displaying calculation results for output-text fields

For information about animating these items, refer to the *FactoryLink ECS Application Editor Guide*.

Zoom In divides the number of chart points displayed by 2. Zoom Out multiplies the number of chart points displayed by 2. Zoom Out takes more system resources as it must access the Historian to get data for these extra points. Setting the Zoom Tag to 0 brings the chart back to the original number of chart point settings.


Legend Animation for Object Y_LEGEND
Direction
Parent Chart
Legend Type
Time
Numeric
Division Type
Count
Units
Scale
Value
Tag
Maximum:
0
ChartYMaxTag
Minimum:
0
ChartYMinTag
Number of Divisions
Major:
5
Minor:
20
Format:
XX.X
OK
Cancel
Delete
Help

Chapter 8 . . . .

Configuring SPC Charts

In the previous chapter, you drew baseline charts using FactoryLink Application Editor. However, you must link SPC to these charts so they will display the data collected by SPC. You define these links in the SPC Charts table. You can also customize the appearance of the charts, such as colors and line styles and their run-time functionality from this table. There are nine panels to this table:

- Chart Definition—Defines link between a drawing file containing a chart and a sample plan, a process, and a database. See “Linking the PowerSPC Components” on page 198 of this chapter.
- Calculation Display—Customizes calculations performed on data displayed in a control chart. See Case 2 in “Panning Case Examples” on page 207.
- Bar Chart Display—Customizes a bar chart. See “Configuring a Bar Chart” on page 221.
- Auxiliary Data Display—Customizes a chart to display auxiliary data. See “Displaying Auxiliary Data for a Point on a Control Chart” on page 216.
- Control Chart—Sets up values for the y-axis of a control chart. See “Setting Up Y-axis Values and Changing Them at Run Time” on page 218.
- Chart Information—Defines calculations on populations of data. See “Setting up SPC to Perform Population Calculations” on page 226.
- Ad Hoc Chart Calculation—Creates a chart that lets the operator view and edit values at run time. See “Creating an Ad Hoc Control Chart” on page 228.
- Chart Style—Customizes appearance of lines, bar colors, and data points. See “Customizing Color, Line, and Point Styles” on page 235.

Overview of Linking a Chart to PowerSPC

Perform the following steps to link a chart to PowerSPC:

1 Access the PowerSPC Charts option in the USER domain.

2 Configure the link between the components in the Chart Definition panel by matching the drawing file name and object name from the chart with the sample plan, the process, and the database.

After you configure the Chart Definition panel and click Enter, the chart is ready to run. The chart displays as follows:

- The legends are adjusted appropriately for each chart type. For details on setting up autoscaling, refer to “Autoscaling” on page 195 of this chapter.
- If you configured the Chart Animation and Legend Animation dialogs as instructed in *Chapter 2, “Getting Started with PowerSPC*,"
  - For all chart types, the start and end time, and date display beneath the x-axis.
  - For all chart types, the frequency displays on the y-axis.
  - For Histograms, the center value of the bar displays beneath each bar.
  - For Pareto and Pareto-Defect Charts, the name of the defect displays beneath each bar.
- For control charts, the lines are displayed where appropriate and have the following appearance:
  - Data line is solid green with circle markers for points.
  - Violation lines are solid red with circle markers for points.
  - Upper and lower control limit lines are dashed yellow.
  - Center control limit lines are dotted yellow.
  - Sigma lines are dot-dashed yellow.
  - Specification limit lines are solid blue.
- For bar charts:
  - Bars are cyan.
  - Frequency line is solid red.

You can change any of the defaults and add or change many of the options on the chart.

AUTOSCALING

The Y minimum and maximum tags must be shared for Y legends to work in tandem with PowerSPC.

PowerSPC	Legend Animation
*Y-Axis Minimum	Minimum Tag.
*Y-Axis Maximum	Maximum Tag.

Autoset vs Constrained

Three tag constant pairs (Y-axis min/max, Histogram value min/max, Frequency min/max) have two modes of operation:

- Autoset—The range of values the tag constant is associated with is set by PowerSPC. For example, when displaying a chart of XBARR calculations using autosetting Y-axis tag constants, the Y-minimum and Y-maximum displayed are determined by the task based on the range of XBARR calculation values found within the chart.
- Constrained—The range of values the tag constant is associated with is constrained by constants the user enters. For example, when displaying a chart of XBARR calculations using constrained Y-axis tag constants, the chart axis is fixed, and those calculated values falling outside this range are not visible even though lines leading to them may be.

The rules governing selection of mode are:

- If no entry is made into both members of the tag constant pair, the mode is always autoset. For example, if neither a Y-axis minimum or maximum tag constant is configured, the associated chart will always self-adjust its Y-axis.
- If a constant entry is made into either member of the tag constant pair, the mode is always constrained. For example, if the expected range of calculated values is 0 to 60 and constants with these values are entered into the Y-axis minimum and maximum fields, the chart displays only this fixed range of data.
- If tags have been configured for both members of the tag constant pair, both autoset and constrained modes of operation are available. The mode is autoset until a value is explicitly entered into either of the tags. When in autoset mode, the tags are output mechanisms that show the current value or what is the Y-axis minimum of the chart. Once a value is entered into either of the tags, the tag constant pair shifts to constrained mode, or the Y-axis can be given at run time a finite range of values to display.

The mode can be shifted from constrained to autoset if you write a zero to both members of the pair.

Rescale Tag

The Y-axis and X-axis rescale tag adjusts the range of values along the given axis by the given percentage. When the chart initially displays, the percentage is set at 100%. You can adjust the range later by changing this percentage. The original view returns when the percentage is set back to 100%.

If related tags have been configured (X-Axis = Histogram value min/max; Y-Axis = Y-Axis min/max), they reflect the adjusted values; however, any input to these tags sets the percentage back to 100%, which returns the original view.

Frequency Minimum/Maximum

The behavior of the autoset/constrained tag-constant pair depends on the chart type:

- For Histograms, constraining these values only establishes boundaries the frequency alarms fire on.
- For Pareto Charts, constraining these values establishes alarm boundaries, and the cells displayed on the chart are constrained by these values as well. This latter functionality is useful for reducing the number of cells to make the x-legend legible. This is only an issue for Pareto Charts; Histograms use number of points or zooming to reduce the number of cells.

Chart Updates with Multiple Users

When multiple users are configured for an application, data edits, such as cause codes and data values, will not be reflected on other users' views until an event causes the data to be freshly fetched from the Historian. These events include:

- Chart scrolling
- Zooming, panning
- Chart type scrolling or changing
- Shutdown

ACCESSING THE POWERSPC CHARTS OPTION

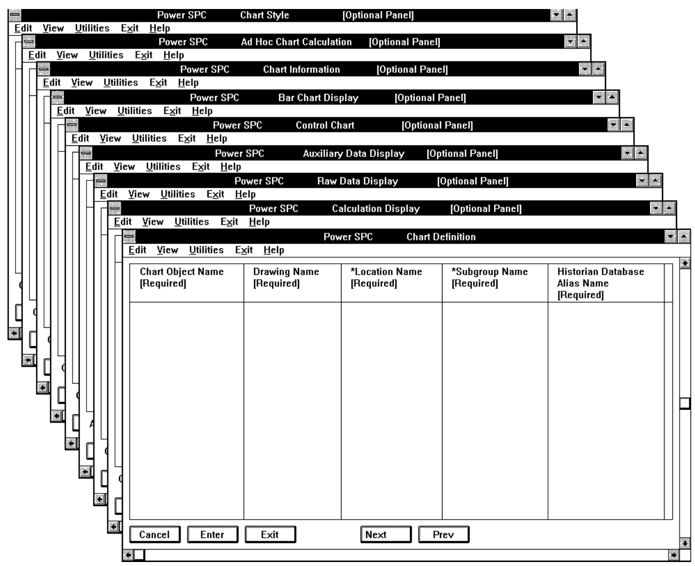
Perform the following steps to access the SPC Charts option:

1 Ensure the domain currently selected is USER in the Configuration Manager Domain Selection box.

2 Choose PowerSPC Charts on the Configuration Manager Main Menu to display the nine panels.

The first panel, Chart Definition, is the only panel you are required to configure. All the others are optional.

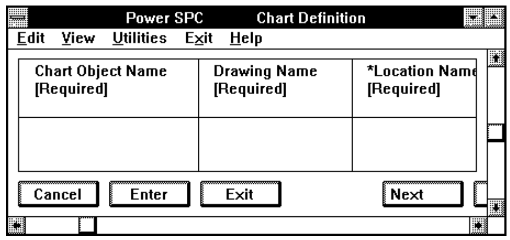
In addition, some fields are optional. Fields that require an entry contain "[Required]" below the name.



LINKING THE POWERSPC COMPONENTS

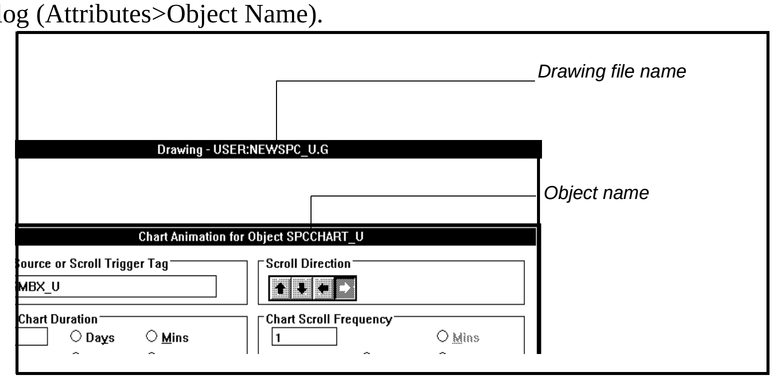
Configure the Chart Definition panel to link the drawing file containing the chart and legend objects to a sample plan, the process, and the database.

This panel contains 15 fields. Press Tab to display additional fields.



1 Specify the following information in this panel:

Chart Object ID
(Required) Alphanumeric string of up to 16 characters that specifies the object ID of the chart. The object ID displays at the top of the Object Name dialog (Attributes>Object Name).



If the chart object is a subobject of a combined object, enter the chart object ID number, not the name of the combined object.

Drawing Name
(Required) Alphanumeric string of up to 8 characters that specifies the name of the drawing file the chart appears on. Do not enter the .G file extension. (For example, enter RUNMGRU.)

Location Name
(Required) Location of the process that collects the data for this chart. This enables SPC to distinguish between multiple instances of the same process. Remember to use the same location you used in the Process Definition panel. This can be one of the following:

Constant
Alphanumeric string of 1 to 16 characters preceded by a single quote that specifies a location, such as a node name,

a city, or a floor in the building, for example, 'PITTSBURGH.

Variable — Name of a tag that indicates the location. The data type for this tag is message.

The location defaults to LOCAL if you leave this field blank.

> **Note:** The combination of Location Name and Subgroup Name must be unique in this panel. The combination of Location Name and Subgroup Name specifies the location to log data. If multiple processes contain the same Location Name and Subgroup Name, then the database may be corrupted.

For example, suppose you have two factories producing the same cola, one in Pittsburgh and one in Chicago. Each factory is using the same process and the same sample plan. To differentiate between the two factories, you enter:

'Pittsburgh to view the data from the COLA process in Pittsburgh.

'Chicago to view the data from the COLA process in Chicago.

Subgroup Name — (Required) Name of the subgroup SPC collects the raw data from. Remember to use the same subgroup name you used in the Process Definition panel. This can be one of the following:

Constant — Alphanumeric string of 1 to 42 characters preceded by a single quote that specifies a subgroup name.

Variable — Name of a tag that indicates a subgroup name. The data type for this tag is message.

Historian Database Alias Name — (Required) Alphanumeric string of up to 16 characters that specifies the alias name of the database that you defined in the Database Alias Name field in the Historian Information panel.

Historian Mailbox — (Required) Name of the mailbox tag you defined in the Historian Mailbox field in the Historian Mailbox Information panel. SPC obtains data for the chart from a database through this tag. Define mailbox as the data type for this tag.

Chart Ad Hoc — (Required) Actual (also called as monitored) chart or an ad hoc chart. An ad hoc chart is a copy of the currently active control chart that the operator changes to run hypothetical scenarios. Changes to the ad hoc chart do not affect the actual chart or the sample plan. (See “Creating an Ad Hoc Control Chart” on page 228 of this chapter.) This can be one of the following:

Constant	Enter either YES or NO. If you enter YES, this chart will be an ad hoc chart that displays only hypothetical data. If you enter NO, this chart will be an actual chart that displays only the actual data.
Variable	Name of a tag that contains YES (1) or NO (0). The data type for this tag is message. If you enter a tag name, this chart changes back and forth from actual to ad hoc. When the tag is 1, the chart is ad hoc; when the tag is 0, the chart is actual. The data type for this tag can be digital, analog, longana, float or message, depending on the kind of data stored in the tag. The default is digital.

Chart Type (Required) Type of chart to display. This can be one of the following:

Constant: Name of the chart type to display preceded by a single quote.

Chart Type	Analog Value (from Key File)
’XBARR	1
’XBARS	2
’AVG	3
’STDDEV	4
’RANGE	5
’SPLIT	6
’MOVAVG	7
’MOVRNG	8
’EWMA	9
’INDIV	10
’C	11
’U	12
'NP	13
’P	14
’CP	15
’CPK	16
’HIST	17
’PARETO	18
’PARETO-DEFECTS	19

Variable Name of a tag that indicates the chart type. The data type for this tag can be analog, longana, float or message, depending on the kind of data stored in the tag. The default is message.

If you enter a tag name in this field and specify a default value, SPC loads the default chart at startup. If you do not specify a default value, SPC loads one of the chart types configured in the sample plan.

Also, if you enter a tag name in this field, you can configure a Chart Select Scroll Tag to let the operator select from all chart types defined in the sample plan.

Note: If a variable is used to specify chart types, assumptions must be made when formatting Histogram Charts. The variable may not produce legible Histogram X-Legends. If legible Histogram X-Legends are required, then use the ’HIST constant to specify chart type. Using a constant prohibits chart type switching in an application.

Remember to configure the Dimn or Char Name field.

Note: Refer to the Glossary in this guide for formulas for each calculation.

Dimn or Char Name — (Required) Dimension or characteristic to display on the chart. This can be one of the following:

Constant — Alphanumeric string of 1 to 16 characters preceded by a single quote that specifies the name of the dimension or characteristic to display; for example, ’DENT. If you do not precede the name with a single quote, SPC uses it as a tag name.

Variable — Name of a tag that identifies the dimension or characteristic to display on the chart. Define message as the data type for this tag.

If you enter a tag name in this field and specify a default value, SPC loads the default dimension or characteristic at startup. If you do not specify a default value, SPC loads one of the dimensions or characteristics configured in the sample plan.

Also, if you enter a tag name in this field, you can configure a Chart Select Scroll Tag, described in “Linking the PowerSPC Components” on page 198 of this

chapter, to let the operator select from all dimensions and characteristics defined in the sample plan.

* Indicates that you want SPC to perform the specified calculation on all characteristics, only for calculations on characteristics (such as np, p, c, and u).

Remember to indicate the type of calculation in the Calc Name field.

Sample Plan Name (Optional) Name of a sample plan you defined in the Sample Plan Definition panel. Typically, this is the same sample plan you specified in the Process Definition panel. Use this field only if the chart is an ad hoc chart, Cp or Cpk Chart Info values, or if the operator scrolls through chart types at run time to pick a chart type to be displayed in this chart. This can be one of the following:

Constant — Alphanumeric string of 1 to 16 characters preceded by a single quote that specifies the sample plan.

Variable — Name of a tag that indicates the sample plan name For example, the tag bottle_plans can indicate the sample plan GLASS BOTTLES

Define message as the data type for this tag.

Chart Select Scroll Tag (Optional) Name of a tag that selects a chart type from all the charts you configured for the active sample plan. The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is analog.

The operator can increment or decrement the value of this tag to scroll through a list of configured charts. In the Application Editor, you can tie this tag to:

- A button object to scroll through the available charts
- An output text object to display the names of the available charts

Chart Message Tag (Optional) Name of a tag to contain messages about the status and errors SPC encounters at run time when sending data to the Graphics task for display on an SPC chart. You can animate output text fields on a graphics screen to contain these messages. (Most messages have less than 50 characters.) Define mailbox as the data type for this tag.

Number of Points Tag (Optional) Name of a tag that indicates the number of data points displayed on the chart. The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. We recommend you enter a tag in this field.

If you animate this tag as an input-text object, the operator can enter the number of points he/she wants displayed on the chart. If you animate this tag as an output-text object, it displays the current number of points but the operator cannot edit the number of points on the chart using this tag. The operator can, however, use zoom buttons to zoom in and out and display more and fewer points.

This tag corresponds to the number of points you entered in the Initial Chart Duration field on the Chart Animation dialog when you animated the chart object in the Application Editor. At startup, the chart and this tag show the number of points entered in the Initial Chart Duration field. If the operator edits the value of this tag or zooms in or out, both the chart and this tag show the latest value.

Remember to enter this tag name in the Tag field of either the Input Text Animation panel or the Output Text Animation dialog.

For example, if you entered 30 in the Initial Chart Duration field, the chart shows 30 data points; however, if the operator wants to view 45 points, he can enter 45 in an input field tied to this tag on the graphics screen. Also, the operator can view fewer data points by entering a number smaller than 30 in the input field.

The next four fields let you enter tags that let the operator enter dates and times for points he/she wants to see on the chart and tags that show the date/time of the oldest and newest points on the chart.

If you define these tags as a message data type, the operator needs to enter dates in the input field at run time in the following format:

year/mo/dy hr:mi:sc

For example,

1997/12/22 10:22:03

If you define these tags as a long analog data type, the operator can enter the date in any format you define when you draw the input-text field in the Application Editor.

> **Note:** Enter the same format into the Format field of the Legend Animation dialog.

For example,

If you enter:	Then the date will appear as:
yr-mo-dy	97-10-17
yr/mo/dy	97/10/17

Input Oldest Date/Time Tag (Optional) Name of a tag that indicates the date and/or time of the oldest point on the chart. The data type for this tag can be longana or message, depending on the kind of data stored in the tag. The default is longana.

You can use this tag to let the operator request that data from this date to the Newest Date/Time Tag value be displayed on the chart.

You can also use this tag to display the date and time of the oldest point currently showing on the chart.

Use this tag in conjunction with the Newest Date/Time Tag to show the range of points displayed on the chart.

Input Newest Date/Time Tag (Optional) Name of a tag that indicates the date and/or time of the newest point on the chart. The data type for this tag can be longana or message, depending on the kind of data stored in the tag. The default is longana.

Use this tag to let the operator display data immediately preceding the specified date and time. To do this, define this tag and create and animate an input object in the Application Editor.

Also use this tag to display the date and time of the newest point currently showing on the chart. To do this, define this tag and create and animate an output object in the Application Editor.

Use this tag in conjunction with the Oldest Date/Time Tag to show the range of points displayed on the chart.

Output Oldest Date/Time Tag (Optional) Name of a tag that indicates the date and/or time of the oldest point on the chart. The data type for this tag can be longana or message, depending on the kind of data stored in the tag. The default is longana.

Also create and animate an output object in the Application Editor.

Use this tag in conjunction with the Output Newest Date/Time Tag to show the range of points displayed on the chart.

Output Newest Date/Time Tag (Optional) Name of a tag that indicates the date and/or time of the newest point on the chart. The data type for this tag can be longana or message, depending on the kind of data stored in the tag. The default is longana.

Also create and animate an output object in the Application Editor.

Use this tag in conjunction with the Output Oldest Date/Time Tag to show the range of points displayed on the chart.

2 Click Enter to save the information.

If you configure only the Chart Definition panel, your chart displays as described on page 194 of this chapter.

If you want to change any of the defaults listed on page 194, configure the Chart Style panel discussed on page 235 of this chapter.

Also, if you want to add functionality to a chart, such as scroll tags, input and output display tags, configure the appropriate panels discussed in the following sections of this chapter:

- For a control chart, refer to “Customizing a Control Chart” on page 208 of this guide.
- For a bar chart, refer to “Configuring a Bar Chart” on page 221 of this guide.

Absolute Panning for PowerSPC Charts

To retrieve data from a specific date and time (Absolute Pan) and display it on the chart type in tag names in the Input Oldest Data/Time Tag and Input Newest Date/Time Tag fields of the Chart Definition panel. To display the values of these two tags, type in two different tag names in the Output Oldest Date/Time Tag and Output Newest Date/Time Tag fields. Define all tags as message types.

In the Chart animate two input text fields using 17 X’s for each field and type in the tags corresponding to the Input Oldest Date/Time Tag field and Input Newest Date/Time Tag in the tag field for each animation with SET action. Each input text field will look like: XXXXXXXXXXXXXXXXX.

The two output texts can be animated using standard output format such as: mo/dy/yr hr:mi:sc. The tag fields will contain the tags specified in Output Oldest Date/Time Tag and Output Newest Date/Time Tag fields.

The X-legend will have the format mo/dy/yr hr:mi:sc, too.

At run time it is strongly recommended to retrieve data on the chart by using either the Input Newest Date/Time Tag or the Input Oldest Date/Time Tag, but not both. This is because the number of points selected between these two tags may not match the specified number of points to be displayed on the chart. See the panning case examples below.

Data input into the input text fields must be of the format yr/mo/dy hr:mi:sc. After entering this data, hit the <Enter> key. The year must be entered first for the animation to work.

Panning Case Examples

The data is always fetched with respect to the Newest Date/Time tag, and the way the Pan works is dependent on this.

Case 1: When only the Input Newest Data/Time tag is specified, the data is fetched and displayed from the newest time to the newest time plus the number of points it can plot on the chart. If it has enough points to plot, use Pan to pan all the way to the oldest time of transaction available.

Case 2: When only the Input Oldest Data/Time tag is specified, the data is fetched and displayed from the last collection time to the oldest time specified. If the number of points fetched exceeds the points that can be plotted on the chart, it will only show until the last collection time plus number of points it can display. Use Pan to display or go to the points beyond and till the oldest time specified.

Case 3: When both tags are specified, the data is fetched from the newest to the oldest time, and the points are plotted from the newest to the newest plus the number of points on chart. In case the number of points fetched exceeds the number of points on chart, use Pan to display data till the oldest time specified.

Customizing a Control Chart

You can customize a control chart to

- Display miscellaneous information—cause codes, run rules violated, control limits—about a selected point on a chart
- Display raw data for a selected point on a chart
- Display auxiliary data for a selected point on a chart
- Let the operator edit miscellaneous values—cause codes, cause code classes, cause code comments, and raw and auxiliary data values—at run time
- Change the values on the Y-axis and/or let the operator change them at run time

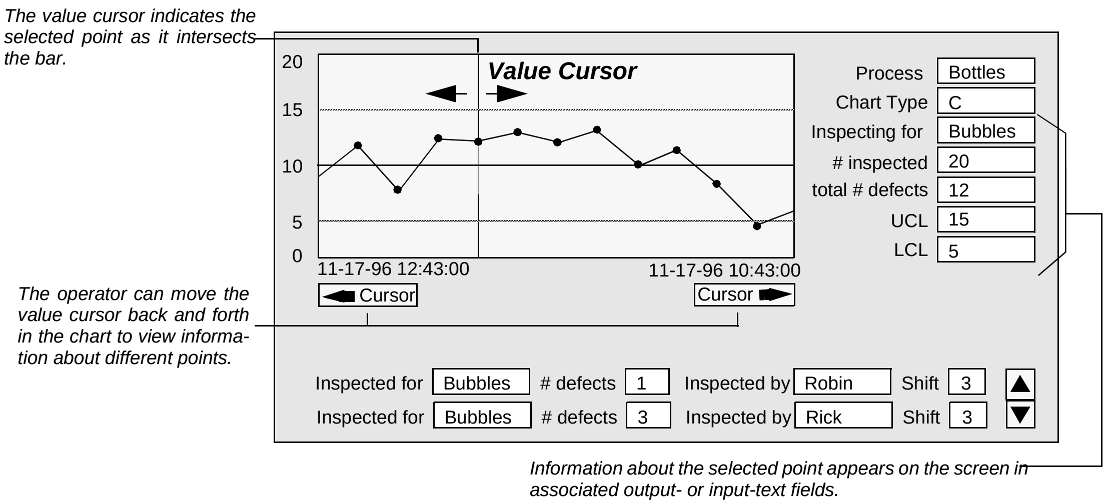
Displaying Miscellaneous Information About a Point on a Control Chart

You can configure SPC to display information associated with any point on a chart. SPC can display

- Calculated value
- Calculation size
- Date and time SPC performed the calculation
- Control limits
- Specification limits
- Run rules violated
- Cause codes and classes
- Comments about the point
- Raw and auxiliary data values— For information about displaying raw and auxiliary data, refer to “Displaying Raw Data for a Point on a Control Chart” on page 213, and “Displaying Auxiliary Data for a Point on a Control Chart” on page 216 of this chapter.

> **Note:** You can also let the operator edit any of the following values at run time: cause codes and classes, comments, raw data values, and auxiliary data values. See the information on page 209 of this chapter.

At run time, the operator can select a point on a chart to display information associated with that point. To select a point, the operator clicks anywhere on the screen and a vertical bar, called a value cursor, displays.

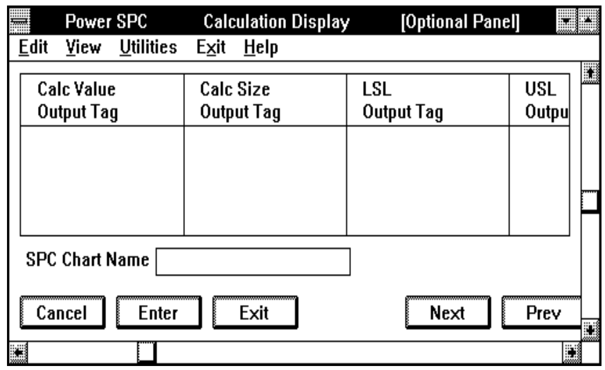


To display information about a point, use the Application Editor to create a value cursor, animate buttons to scroll the chart value cursor left and right, and animate the necessary output- or input-text fields. Input-text fields display the data and let the operator edit it. For information about creating and animating the graphics, refer to *FactoryLink ECS Application Editor*.

If you want the operator to be able to edit the cause codes, cause classes, or comments, configure the Edit Mode Toggle tag in the Control Chart panel, and make these input-text fields instead of output. For information about editing the cause codes, cause classes, or comments, refer to "Edit Mode Toggle Tag" on page 218 of this chapter.

Then, configure the Calculation Display panel.

This panel contains 15 fields. Press Tab to display additional fields.



1 Specify a tag for each type of information to be displayed or edited, such as tags for the control limits and tags for the subgroup size and calculated value for that point.

Calc Value Output Tag (Optional) Name of a tag that displays the calculated result of the selected point. The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is float.

Calc Size Output Tag (Optional) Name of a tag that displays the calculation size. The value of this tag is always the same as the amount of data represented by each point. For example, if SPC calculates ten raw data values to plot the selected point, the value of this tag will be 10. The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is analog.

LSL Output Tag (Optional) Name of a tag that displays the lower specification limit for the dimension of the selected point. The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is float.

USL Output Tag (Optional) Name of a tag that displays the upper specification limit for the dimension of the selected point. The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is float.

Nominal Spec Value Output Tag (Optional) Name of a tag that displays the nominal (target) specification for the dimension of the selected point. The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is float.

LCL Output Tag (Optional) Name of a tag that displays the lower control limit for the dimension of the selected point. The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is float.

UCL Output Tag (Optional) Name of a tag that displays the upper control limit for the dimension of the selected point. The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is float.

Center Value Output Tag (Optional) Name of a tag that displays the center value for the dimension of the selected point. The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is float.

Date/Time Output Tag (Optional) Name of a tag that displays the date and time at which SPC calculates the value of the selected point. The data type for this tag can be longana or message, depending on the kind of data stored in the tag. The default is longana.

If you define this tag as a message data type, the date and time display in the following format:

year/mo/dy hr:mi:sc

For example,

1997/12/22 10:22:03

If you define this tag as a long analog data type, the date and time display in any format you define when you draw the output-text field in the Application Editor.

For example, I

If you enter:	Then the date will appear as:
yr-mo-dy	97-10-17
yr/mo/dy	97/10/17

Raw Data Page Tag (Optional) Name of a tag that lets the operator page through the raw data associated with the selected point. SPC displays this data in the raw data tags you define in the next panel, Raw Data Display. The number of raw data tags you define determines the size of the raw data page. As the operator increments or decrements the value of the Raw Data Page Tag by 1, SPC displays a new page of raw data values in the tags. This tag works similarly to a Page Up or Page Down key.

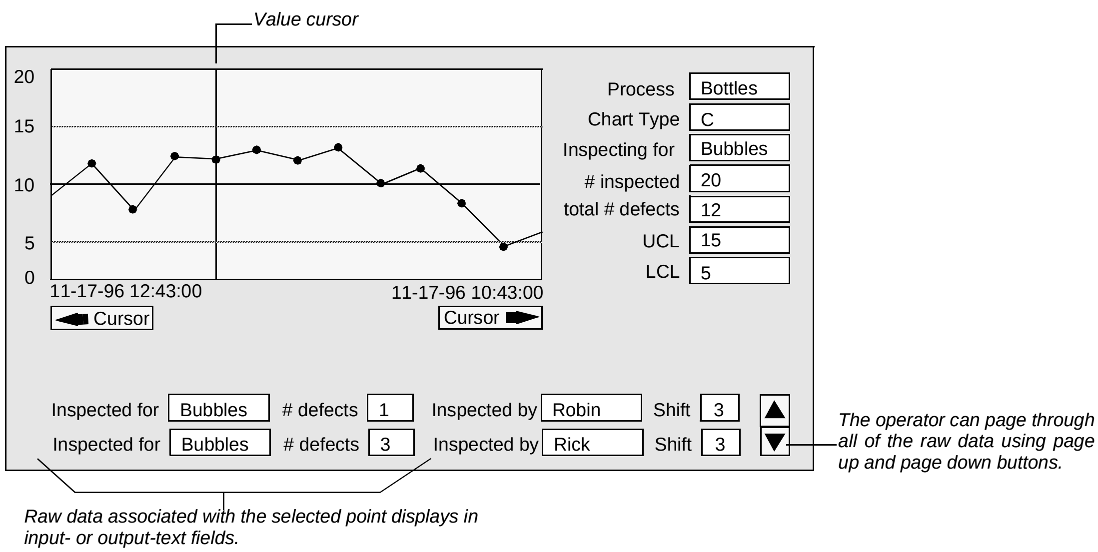
The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is analog.

Violated Run Rule Name Output Tag	(Optional) Name of a tag that displays the run rules violated at the selected point. This tag displays the highest priority rule violated. You can configure a Violated Run Rule Scroll Tag to enable the operator to scroll through other run rule violations. The data type for this tag is message.
Violated Run Rule Scroll Tag	(Optional) Name of a tag that lets the operator scroll one by one through the names of the run rules violated for the selected point. The violated run rule names display in the output field tied to the Violated Run Rule Name Output Tag. The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is analog.
Cause Code Class	(Optional) Cause code class to be displayed or edited for the selected point. This can be one of the following: Constant — Alphanumeric name of 1 to 16 characters preceded by a single quote that specifies a cause code class. Variable — Name of a tag that contains the class. Define message as the data type for this tag. For information about cause code classes, refer to "Defining Custom Cause Codes" on page 238 of this chapter.
Cause Code Name Tag	(Optional) Name of a tag that displays and allows the operator to edit the cause code assigned to the selected point. The data type for this tag is message.
Comment Tag	(Optional) Name of a tag that displays and allows the operator to edit comments about the selected point. Comments can contain up to 56 characters. The data type for this tag is message.

2 Click Enter to save the information.

Displaying Raw Data for a Point on a Control Chart

You can configure SPC so when the operator selects a point on a chart, the raw data values calculated for that point display on the screen.

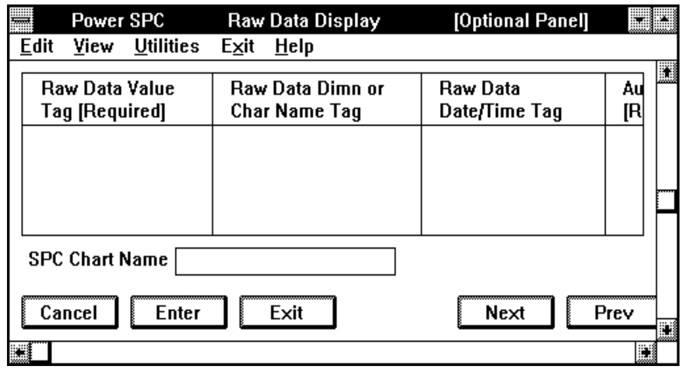


Configure tags to contain the raw data values. Depending on the number of raw data values associated with a point, you may not be able to display all the raw data values on the screen at once. If this is the case, define a Raw Data Page Tag in the previous panel and tie it to a button object to page through the raw data values. For example, if a point has 10 raw data values associated with it, but you have defined only 5 raw data output tags, the operator can click Raw Data Page Tag to see the second set of five values.

> **Note:** If you want the operator to be able to edit the raw data, configure the Edit Mode Toggle tag on the Control Chart panel and make these input-text fields instead of output. For information about editing the raw data, refer to "Edit Mode Toggle Tag" on page 218 of this chapter.

Configure the Raw Data Display panel to display raw data for a point on a chart.

This panel contains seven fields. Press Tab to display additional fields.



1 Specify a tag for each type of raw data value to be displayed, such as a tag to display the dimension measured, or the date or time the raw data value was collected.

> **Note:** You can also instruct SPC to display the corresponding auxiliary values with each raw data value. To do this, configure the Auxiliary Data Display panel discussed on page 216 of this chapter.

Raw Data Value Tag (Required) Name of a tag that displays the raw data values used to calculate the selected point's value. The data type for this tag can be digital, analog, longana, float or message, depending on the kind of data stored in the tag. The default is float.

Raw Data Dimn or Char Name Tag (Optional) Name of a tag that displays the dimension or characteristic name for the corresponding raw data value. Define message as the tag type for this tag.

Raw Data Date/Time Tag (Optional) Name of a tag that displays the date and time for the corresponding raw data value. The data type for this tag can be longana or message, depending on the kind of data stored in the tag. The default is longana.

If you define this tag as a message data type, the date and time appear in the following format:

yr/mo/dy hr:mi:sc

For example,

97/12/22 12:22:03

If you define this tag as a long analog data type, the date and time display in any format you define when you draw the output-text field in the Application Editor.

For example,

If you enter:	Then the date will appear as:
yr-mo-dy	97-10-17
yr/mo/dy	97/10/17

Accept Quantity Tag — (Optional) Name of a tag that indicates the number of units measured or inspected for the current point. You can define this tag and animate it as an output-text object to display this value on a graphics screen.

The data type for this tag can be analog, longana, float or message, depending on the kind of data stored in the tag. The default is analog.

Accept ID Tag — (Optional) Name of a tag that indicates to which transaction the data for the selected point belongs. The data type for this tag can be analog, longana, float or message, depending on the kind of data stored in the tag. The default is analog.

Auxiliary Table Name — (Required for Auxiliary Data Display panel) If you want to display the auxiliary data that corresponds to the raw data value specified in this panel, enter an alphanumeric string of 1 to 16 characters in this field. This name displays at the bottom of the next panel, Auxiliary Data Display, and identifies the group of tags that displays the auxiliary data. This field lets you associate multiple auxiliary data tags with each raw data tag. Define the auxiliary data tags in the Auxiliary Data Display panel.

If you are not collecting or displaying auxiliary data, leave this field blank. Also, leave the Auxiliary Data Display panel blank.

Auxiliary Page Position Tag — (Optional) Name of a tag that lets the operator page through the auxiliary data associated with the raw data tag specified in this panel. SPC displays this auxiliary data in the auxiliary data tags you define in the next panel, Auxiliary Data Display. The number of auxiliary data tags you define determines the size of the auxiliary data page. As the operator increments or decrements the value of the Auxiliary Page Position Tag, SPC displays a new page of auxiliary data values in the tags.

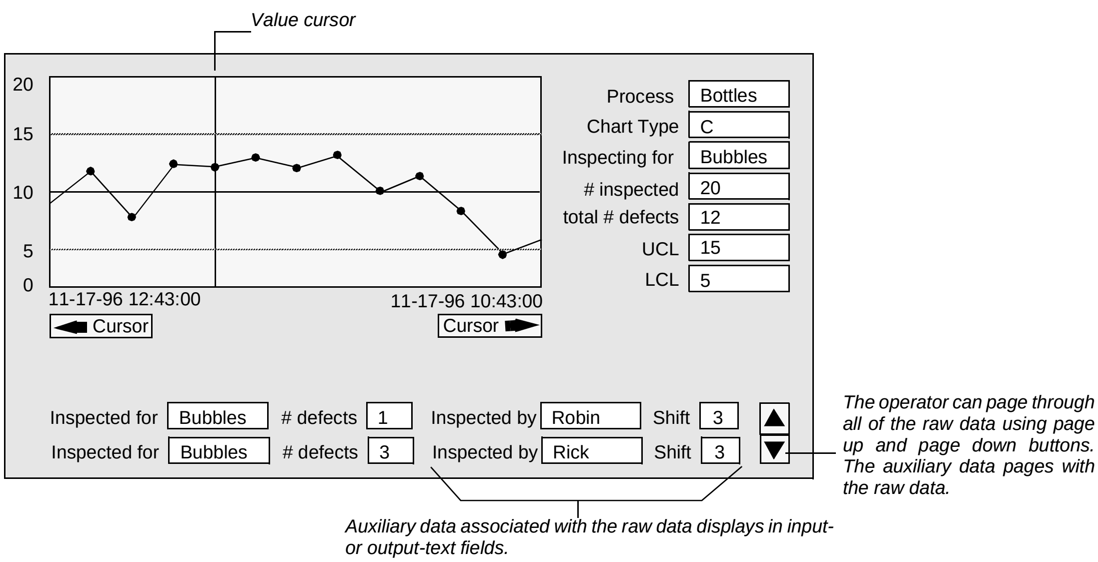
Also, remember to complete the previous field, Auxiliary Table Name.

The data type for this tag can be analog, longana, or float, depending on the kind of data stored in the tag. The default is analog.

2 Click Enter to save the information.

Displaying Auxiliary Data for a Point on a Control Chart

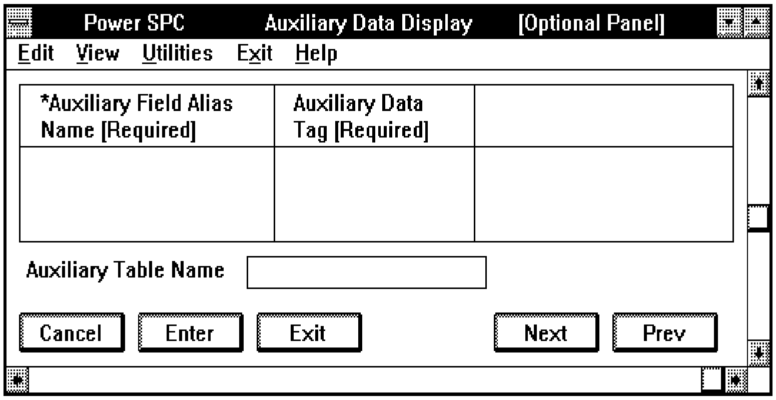
You can configure SPC so when the operator selects a point on a chart, the auxiliary data corresponding to raw data for that point displays on the screen.



Configure tags to contain the auxiliary data values. Depending on the number of auxiliary data values associated with a point, you may not be able to display all the auxiliary data values on the screen at once. If this is the case, define Auxiliary Page Position Tag in the Raw Data Display panel and tie it to a button object to page through the auxiliary data values. For example, if a point has 10 auxiliary data values associated with it, but you have defined only five auxiliary data output tags, the operator can click Auxiliary Page Position Tag to see the second set of five values.

> **Note:** If you want the operator to be able to edit the auxiliary data, configure the Edit Mode Toggle tag on the Control Chart panel and make these input-text fields instead of output-text fields. For information about editing the auxiliary data, refer to the Edit Mode Toggle Tag field on page 218 of this chapter.

Configure the Auxiliary Data Display panel.



1 Specify a tag for each type of auxiliary data value to be displayed, such as a tag to display the operator name or the temperature in the factory.

Auxiliary Field Alias Name
: (Required) Alias name of the database column containing the auxiliary data you want SPC to display in the Auxiliary Data Tag output field on the graphics screen. You defined this alias name in the Auxiliary Field Alias Name field in the Auxiliary Schema Definition panel. For information about defining custom cause codes, run rules, and auxiliary database columns, refer to Chapter 9, “Customizing Your Process," of this guide.

  This can be one of the following:

  Constant
  : Alphanumeric string of 1 to 16 characters preceded by a single quote that defines the alias name. For example, if you want to display the operator on duty at the time the raw data is collected, enter the alias name ’OPERATOR in this field.

  Variable
  : Name of a tag that contains the alias name. Define message as the data type for this tag.

Auxiliary Data Tag
: (Required) Name of a tag that displays the auxiliary data value. Define message as the data type for this tag.

  At run time, SPC displays the value that corresponds to the name in the Auxiliary Field Alias Name tag. For example, if the operator enters ’Operator in the input-text field associated with the Auxiliary Field Alias Name, the operator’s name stored in the auxiliary database displays in the output-text field for this tag.

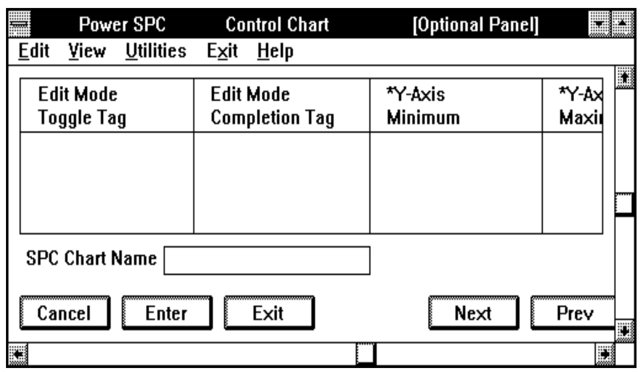
2 Click Enter to save the information.

Setting Up Y-axis Values and Changing Them at Run Time

You can set up the values on a control chart y-axis. If you want, you can also set up SPC so the operator can manipulate the values on the y-axis at run time.

To do this, configure the Control Chart panel.

This panel contains five fields.To display additional fields, press Tab.



Note: The first two fields are unrelated to the y-axis. Use them to create an Edit toggle tag so the operator can edit values about a point on a chart at run time. See "Displaying Miscellaneous Information About a Point on a Control Chart" on page 208 of this chapter.

1 Specify the following information for this panel:

Edit Mode Toggle Tag (Optional) Name of a tag that lets the operator toggle in and out of an edit session. While in edit mode, the operator can edit cause codes, cause codes classes, comments, raw data values, and auxiliary data values. When the value of this tag is greater than 0 (OFF), SPC enters edit mode. When the value is 0 (OFF), SPC exits edit mode and makes the changes.

The data type for this tag can be digital, analog, longana or float, depending on the kind of data stored in the tag. The default is digital.

Edit Mode Completion Tag (Optional) Name of a tag that indicates when edits are complete and SPC has applied the changes to the database. When changes are complete, SPC sets the value of this tag to 1 (ON). This tag is useful if the operator or another FactoryLink task needs to know when SPC writes the changed values to the database. You can tie this tag to an object on a graphics screen or use it to trigger a Math & Logic procedure.

The data type for this tag can be digital, analog, longana, float or message, depending on the kind of data stored in the tag. The default is digital.

Use the next four fields to set up the values and divisions displayed on the y-axis of the chart. If your chart has a Y legend, you must configure these fields. If your chart does not have a Y legend, leave these fields blank.

If you want the values on the Y legend to always remain the same, enter constant values in these fields.

If you want the values on the Y legend to change in sync with the data on the chart or if you want the operator to be able to change the values, enter the same tags you entered in the Maximum Tag and Minimum Tag fields on the Legend Animation dialog for the Y legend object.

Y-Axis Minimum (Optional) Lowest value on the y-axis of the chart. This can be one of the following:

- Constant — Any numeric value.
- Variable — Name of a tag that contains this value. If you enter a tag name, the operator can use it at run time to change the lowest value.

  If you enter a tag name, enter the same name you entered in the Minimum Tag field on the Legend Animation dialog when you animated the legend object in the Application Editor. See “Adding Legends to the Chart” in Chapter 7, “Drawing and Animating Display Charts," of this guide.

  The data type for this tag can be analog, longana, float or message, depending on the kind of data stored in the tag. The default is float.

  If you define this tag as message, its value will still be a number.

Y-Axis Maximum (Optional) Highest value on the y-axis of the chart. This can be one of the following:

- Variable — Any numeric value.
- Constant — Name of a tag that contains this value. If you enter a tag name, the operator can use it at run time to change the highest value.

  If you enter a tag name, enter the same name you entered in the Maximum Tag field on the Legend Animation dialog when you animated the legend object in the Application Editor. See “Adding Legends to the Chart” in Chapter 7, “Drawing and Animating Display Charts."

The data type for this tag can be analog, longana, float or message, depending on the kind of data stored in the tag. The default is float.

If you define this tag as message, its value will still be a number.

Y-Axis Rescale Tag — (Optional) Name of a tag that moves the range of values up or down on the y-axis of the chart. If you enter a tag name, the operator can enter a percentage at run time to adjust both the minimum and maximum values on the y-axis.

The data type for this tag can be analog, longana or float, depending on the kind of data stored in the tag. The default is analog.

Example

Suppose the y-axis of a chart shows values ranging from 50 to 150. If you create tags for the Y-Axis Minimum, Maximum, and Rescale Tag, the operator can change the range of values displayed by changing the value of one or more of the tags:

- If SPC plots points with values ranging between 60 and 175, the operator cannot see the points that go off the chart. To view these points, the operator can enter a higher value, such as 180, in the input-text field for the Y-Axis Maximum tag. Then, SPC displays the points with values between 50 and 180.
- If SPC plots points with values ranging from 6 to 143, the operator can enter a lower value, such as 0, in the input-text field for the Y-Axis Minimum tag. Then, SPC can display the points with values between 0 and 150.
- If SPC plots points with values ranging between 25 and 175, the operator can rescale the range of values shown on the chart by a percentage (for this example, by 200%). To do this, the operator types 200% in the input-text field for the Y-Axis Rescale tag.

  SPC doubles the range of data displayed (expand the data by 200%). Since the current range is 100 (50 to 150), SPC expands the range by increasing the maximum value (150) and decreasing the minimum value (50) by equal amounts (50).

  Now, SPC can display the points with values between 0 and 200. To return to the original view, the operator can enter 50%.

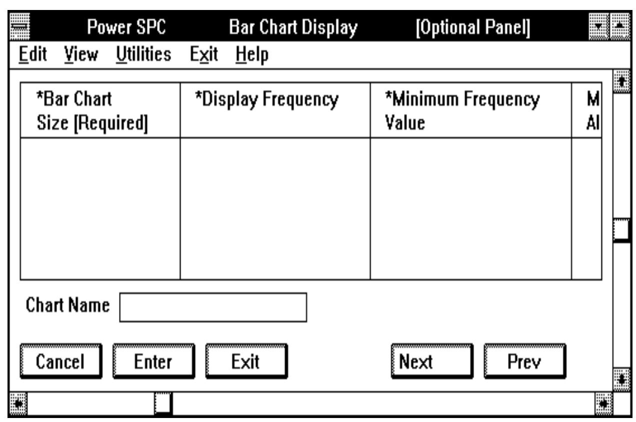
CONFIGURING A BAR CHART

If you are using a bar chart (Histogram, Pareto, or Pareto-Defect) in your application, you can customize the default settings by configuring tags and values that control how SPC displays bar charts. You can also:

- Turn the frequency line on or off
- Let the operator turn the frequency line on and off
- Change the height and width of the bars
- Let the operator change the height and width of the bars
- Define the number of values displayed on the chart
- Let the operator change the number of values displayed on the chart
- Let the operator clear (refresh) the chart at run time

Configure the Bar Chart Display panel to change the default settings discussed on page 194 of this guide or add any of the items listed above.

This panel contains 13 fields. Press Tab to display additional fields.



Bar Chart Size (Required) Number of raw data values distributed into the bars of the histogram. This can be one of the following:

Constant — Any positive non-zero number. The default is 10.

Variable — Name of a tag that indicates the number. If you enter a tag name, the operator or another FactoryLink task can change the number of values at run time.

The data type for this tag can be digital, analog, longana, float or message, depending on the kind of data stored in the tag. The default is analog.

Display Frequency	(Optional) Numeric value representing the frequency for the bar to display above the bar on the chart or not. This can be one of the following: Constant — Either YES or NO. If you enter YES, values are displayed above the bar. If you enter NO, values are not displayed. The default is YES. Variable — Name of a tag that indicates YES (1) or NO (0). The data type for this tag can be digital, analog, longana, float or message, depending on the kind of data stored in the tag. The default is digital.
Minimum Frequency Value	(Optional) For a Pareto-Defect Chart, minimum number of defects that must occur for a bar to display. For a Pareto Chart, minimum number of units that must be defective for a bar to display. For a Histogram, minimum number of measurements that must fall within a cell for a bar to display. This can be one of the following: Constant — Any positive number beginning with zero (0). Variable — Name of a tag that indicates the value. The data type for this tag can be digital, analog, longana, float or message, depending on the kind of data stored in the tag. The default is analog. If you leave this field blank, SPC displays a bar for any defect that occurs, for any unit that is defective, or for any measurement. You can use this field in conjunction with the Minimum Frequency Alarm Tag field to notify the operator or another FactoryLink task any time a defect, a defective unit, or a measurement within a cell occurs fewer times than specified by the value in this field.
Minimum Frequency Alarm Tag	(Optional) Name of an alarm tag that notifies the operator or another FactoryLink task if a defect, a defective unit, or a measurement displays fewer times than you specified in the Minimum Frequency Value field. The data type for this tag can be digital, analog, longana or float, depending on the kind of data stored in the tag. The default is digital.
Maximum Frequency Value	(Optional) For a Pareto-Defect Chart, specify the maximum number of defects to show on the chart for the characteristic being charted. For a Pareto Chart, specify the maximum number of defective units to show on the chart for that characteristic.

For a Histogram, specify the maximum number of measurements within the same cell to show on the chart for that characteristic.

This can be one of the following:

Constant	Any positive number beginning with zero (0).
Variable	Name of a tag that indicates the value. The data type for this tag can be digital, analog, longana, float or message, depending on the kind of data stored in the tag. The default is analog.

If the number of defects, the number of defective units, or the number of measurements within a cell exceeds this value, the bar remains at the maximum value. You can use this field in conjunction with the Maximum Frequency Alarm Tag field, however, to define an alarm that notifies the operator or another FactoryLink task if a value exceeds this limit.

If you leave this field blank, the chart shows all values greater than 0.

Maximum Frequency Alarm Tag

(Optional) Name of an alarm tag that notifies the operator or another FactoryLink task if more defects occur, if more units are defective, or if more measurements occur in a cell than you specified in the Maximum Frequency Value field. The alarm notifies the operator that one of the bars exceeds the maximum.

The data type for this tag can be digital, analog, longana or float, depending on the kind of data stored in the tag. The default is digital.

Histogram Minimum Value

(Optional) Specify the lower limit sample values must fall above to appear on the chart. This can be one of the following:

Constant	Any number.
Variable	Name of a tag that indicates the value. The data type for this tag can be digital, analog, longana, float or message, depending on the kind of data stored in the tag. The default is float.

The value in this field, along with the value in the Histogram Maximum Value field, determines the range of data displayed in the Histogram. To narrow or widen the view of the data, the operator adjusts one or both of the values.

To determine the range of data to display, SPC subtracts the value in this field from the value in the Histogram Maximum Value field.

To determine the range of data for each bar on the chart, SPC divides the range by the number of bars displayed. If you leave both this field and the Histogram Maximum Value field blank, SPC uses the minimum and maximum values displayed on the chart.

You can use this field in conjunction with the Histogram Minimum Alarm Tag field to notify the operator or another FactoryLink task any time a sample falls below the value in this field.

Histogram Minimum Alarm Tag (Optional) Name of an alarm tag that notifies the operator or another FactoryLink task if a sample value falls below the minimum you specified in the Histogram Minimum Value field.

The data type for this tag can be digital, analog, longana or float, depending on the kind of data stored in the tag. The default is digital.

Histogram Maximum Value (Optional) Upper limit sample values must fall below. This can be one of the following:

Constant	Any number.
Variable	Name of a tag that indicates the value. The data type for this tag can be digital, analog, longana, float or message, depending on the kind of data stored in the tag. The default is float.

To determine the range of data to display, SPC subtracts the value in the Histogram Minimum Value field from the value in this field.

To determine the range of data for each bar on the chart, SPC divides the range by the number of bars displayed. If you leave both this field and the Histogram Minimum Value field blank, SPC uses the minimum and maximum values displayed on the chart.

You can use this field in conjunction with the Histogram Maximum Alarm Tag field to notify the operator or another FactoryLink task any time a sample falls above the value in this field.

Histogram Maximum Value Alarm Tag (Optional) Name of an alarm tag that notifies the operator or another FactoryLink task if a sample value falls above the maximum you specified in the Histogram Maximum Value field.

The data type for this tag can be digital, analog, longana or float, depending on the kind of data stored in the tag. The default is digital.

Histogram Bar Rescale Tag (Optional) Name of a tag that lets the operator or another FactoryLink module change the range of data shown in the bars displayed on a histogram. This is useful if the operator wants to break the bars up into smaller ranges to see a more detailed distribution of values. The operator enters a percentage value.

For example, if a Histogram currently displays 40 values in 8 bars, the operator can enter 50 in an input field to display 50% of the 40 values in the 8 bars. SPC distributes the 20 values into the 8 bars.

To again display 40 values, the operator can enter 200 to double the number of values in the same 8 bars.

The data type for this tag can be digital, analog, longana, float or message, depending on the kind of data stored in the tag. The default is float.

Clear Chart Trigger Tag (Optional) Name of a tag that lets the operator or another FactoryLink task clear a bar chart of data and begin accumulating data as SPC collects it.

The data type for this tag can be digital, analog, longana, float or message, depending on the kind of data stored in the tag. The default is digital.

X Legend Object Name (Optional) Alphanumeric string of 1 to 100 character that defines the X legend object ID number. This legend shows the middle value of each bar or the defect name for Pareto and Pareto-Defect Charts.

SETTING UP SPC TO PERFORM POPULATION CALCULATIONS

You can set up SPC to let the operator or another FactoryLink task trigger SPC to perform calculations on populations of data in a chart at run time. In PowerSPC, a population is the set of all data points displayed on a chart at a given time. This can be useful for calculating skewness or kurtosis to determine whether a frequency distribution is normal.

Set up a list of possible calculations from which the operator can choose and configure an output field to display the calculated result.

The operator can change the size of the population by adjusting the number of points displayed on the chart (using the Bar Chart Size, Histogram Minimum Value, and Histogram Maximum Value tags, from the Bar Chart Display panel. See “Configuring a Bar Chart” on page 221 of this chapter). For example, to find the standard deviation on 100 points, the operator can expand the chart to display 100 points, then trigger SPC to perform the SBAR calculation.

Configure the Chart Information panel to set this up.

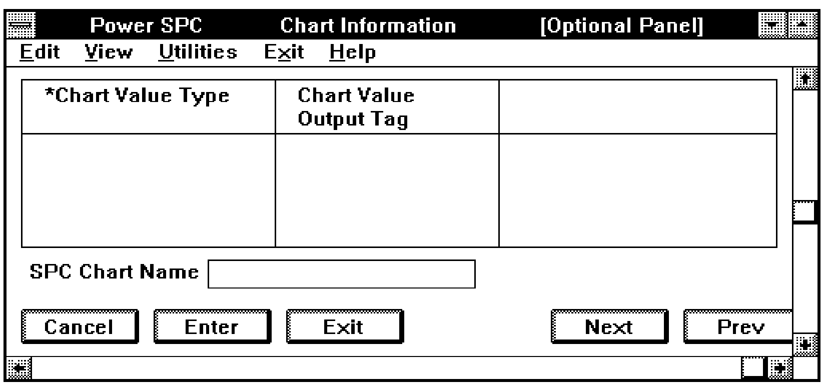


Chart Value Type — (Required) Type of calculation you want SPC to perform on the chart. This can be one of the following:

Constant — Name of calculation preceded by a single quote. Population calculations fall into two categories:

Population Raw Data—SPC performs the specified calculation (such as Range or C) on the raw data for all points currently showing on the chart. This can be one of the following

.

’STDDEV	’RANGE	’MINIMUM
’MAXIMUM	’KURTOSIS	’SKEWNESS
’GRANDX	’AVG	’CP
’CPK	’C	’U
’P		’NP

Population Bar—SPC averages all of the calculated values points currently showing on the chart. This can be one of the following:

SBAR'

RBAR'

POINTSBAR

If you enter **’**POINTSBAR, SPC performs the appropriate bar calculation for the chart type. For details about POINTSBAR, refer to the Glossary definition in this guide.

Variable — Name of a tag that contains a calculation name. The data type for this tag can be analog, longana, float or message, depending on the kind of data stored in the tag. The default is message.

If you want the operator to be able to change calculations, enter a tag name.

Note: Cp and Cpk require LSL and USL specified in the Sample Plan Collection Control panel. Refer to the Chart Definition panel to specify a Sample Plan for a chart.

Chart Value Output Tag — (Required) Name of a tag that displays the result of the calculation selected in the Chart Value Type field. This result is for the population of data currently shown in the chart.

The data type for this tag can be digital, analog, longana, float or message, depending on the kind of data stored in the tag. The default is float.

Creating an Ad Hoc Control Chart

You can create an ad hoc chart that lets the operator view and edit values at run time. An ad hoc chart is a duplicate of the currently active control chart that the operator changes to view hypothetical scenarios. Changes to the ad hoc chart do not affect the actual chart or the sample plan.

Because the ad hoc chart is a duplicate of the actual control chart, it shows the same type of data (either real-time only or both historical and real-time) that you configured for the actual chart in the Charts panel.

For example, the operator can change the calculation size, control limits, and run rules to see how the new values affect the data on the chart. This can help in determining whether it would be more effective to use different run rules, subgroup size, or control limits, than what is currently set up in the sample plan. Because the operator changes only the values on the ad hoc chart and not those on the actual chart, the values in the sample plan are not affected.

Because showing an ad hoc chart requires more system resources than showing an actual chart, we recommend the operator display it only when the process can tolerate the slower system performance.

You can set up a chart to:

- Show only ad hoc data. You can place it either:
  1. Next to the actual chart on the same screen or
  2. On a separate screen. You can either place the screen in the same window as the actual chart screen or in a separate window. If you place the ad hoc chart screen in a separate window, the operator can view both charts at the same time.
- Toggle between showing actual data and ad hoc data

Setting Up a Chart to Show Only Ad Hoc Data

Placing the Ad Hoc Chart on the Same Screen as the Actual Chart

Perform the following steps to place an ad hoc chart on the same screen as an actual chart:

1. Create and animate an ad hoc chart object on the same graphics screen as the actual chart. Remember to clearly label the ad hoc chart and the actual chart so the operator knows which is which.
2. Create and animate input-text fields for each value you want the operator to be able to change in ad hoc mode. Define unique tags for these input fields.

Caution: Do not use tags defined elsewhere or the operator will not be able to change their values.

3 Configure the Chart Definition panel for the ad hoc chart object. Remember to enter YES in the Chart Ad Hoc field for the ad hoc chart and NO in the Chart Ad Hoc field for the actual chart object. See “Linking the PowerSPC Components” on page 198 of this chapter.

4 Configure the Ad Hoc Chart Calculation panel. Use the tags you defined for the ad hoc chart input-text fields. See “Configuring the Ad Hoc Chart Calculation Panel” on page 230 of this chapter.

Placing the Ad Hoc Chart on a Separate Screen

Perform the following steps to place the ad hoc chart on a separate screen:

1 Create and animate a graphics screen containing the ad hoc chart object and input-text fields for each value you want the operator to be able to change. Define unique tags for these input fields.

Caution: Do not use tags defined elsewhere or the operator will not be able to change their values.

Remember to clearly label the ad hoc screen so the operator knows what type of data he sees.

2 Do one of the following:

- Place the ad hoc screen in the same window as the actual chart screen. Then, configure a button object on both the actual chart screen and the ad hoc chart screen so the operator can switch between the two screens.
- Place the ad hoc screen in its own window so the operator can view both screens at once.

3 Configure the Chart Definition panel for the ad hoc chart object and drawing. Remember to enter YES in the Chart Ad Hoc field in the row for the ad hoc chart’s object name. See “Linking the PowerSPC Components” on page 198 of this chapter.

4 Configure the Ad Hoc Chart Calculation panel. Use the same tags you defined for the input-text fields. See “Configuring the Ad Hoc Chart Calculation Panel” on page 230 of this chapter.

Setting Up a Chart That Toggles Between Actual and Ad Hoc

Perform the following steps to set up a chart that toggles between actual and ad hoc:

1 Add input-text fields for each value you want the operator to be able to change to the graphics screen containing the chart object. Define unique tags for these input fields.

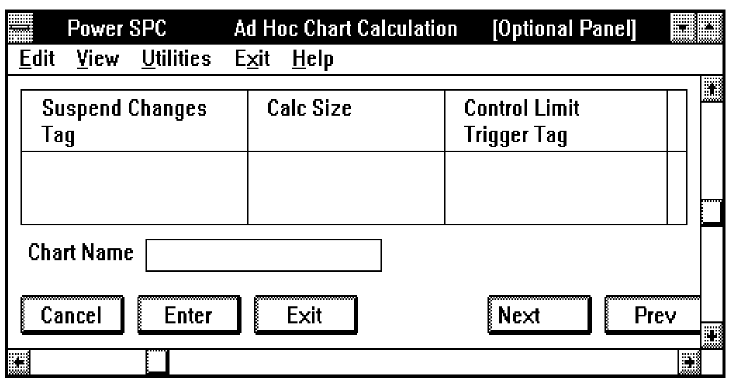
Caution: Do not use tags defined elsewhere or the operator will not be able to change their values.

2 Configure a button object on the screen so the operator can toggle between viewing the chart in ad hoc mode and viewing it in actual mode. Remember to clearly label the button so the operator knows which mode the chart is in. You can animate the button as a paint object to reflect the two states.

3 Configure the Chart Definition panel for the chart object. Remember to enter the button object tag name in the Chart Ad Hoc field. See "Linking the PowerSPC Components" on page 198 o this chapter.

4 Configure the Ad Hoc Chart Calculation panel. Use the same tags you defined for the input-text fields. See the next section.

Configuring the Ad Hoc Chart Calculation Panel



1 Specify the following information for this panel:

Suspend Changes Tag (Optional) Name of a tag that lets the operator change multiple values before SPC applies the changes to the chart. This saves time since SPC does not have to recalculate the chart each time the operator enters a new value.

If you do not define this tag, SPC recalculates all data on the chart each time the operator enters a new value.

To suspend changes until all changes are complete, the operator toggles into suspend-change mode by changing this tag to 1(ON), makes all desired edits, and toggles back out of suspend-change mode by changing the tag back to 0 (OFF). Then, when this tag is 0, SPC applies all changes to the chart at once.

The data type for this tag can be digital, analog, longana, float or message, depending on the kind of data stored in the tag. The default is digital.

Calc Size (Optional) Name of a tag that determines the amount of data SPC uses for the calculation selected for the current chart.

The data type for this tag can be digital, analog, longana, float or message, depending on the kind of data stored in the tag. The default is analog.

Control Limit Trigger Tag (Optional) Name of a tag that determines the amount of data to use when calculating control limits. This tag specifies how many points to include in the calculation.

The data type for this tag can be digital, analog, longana or float, depending on the kind of data stored in the tag. The default is digital.

Note: Because the operator can change the subgroup size on an ad hoc chart, SPC does not exclude data associated with a point that has an assignable cause.

LCL Value (Optional) Name of a tag that determines the lower control limit for the data displayed on the chart. The data type for this tag can be analog, longana or float, depending on the kind of data stored in the tag. The default is float.

UCL Value (Optional) Name of a tag that determines the upper control limit for the data displayed on the chart. The data type for this tag can be analog, longana or float, depending on the kind of data stored in the tag. The default is float.

Center Value (Optional) Name of a tag that determines the center value for the data displayed on the chart. The data type for this tag can be analog, longana or float, depending on the kind of data stored in the tag. The default is float.

Dimn LSL Value (Optional) Name of a tag that determines the lower specification limit for the dimension displayed on the chart. This tag does not apply to characteristics. The data type for this tag can be analog, longana or float, depending on the kind of data stored in the tag. The default is float.

Dimn USL Value (Optional) Name of a tag that determines the upper specification limit for the dimension displayed on the chart. This tag does not apply to characteristics. The data type for this tag can be analog, longana or float, depending on the kind of data stored in the tag. The default is float.

Dimn Nominal Value (Optional) Name of a tag that determines the target measurement for the dimension. This tag does not apply to characteristics. The data type for this tag can be analog, longana or float, depending on the kind of data stored in the tag. The default is float.

Calc Offset (Optional) Name of a tag that normalizes each calculation result. SPC subtracts the offset from the calculated value. This field is useful with mean-type calculations like XBARR or INDIV.

The data type for this tag can be analog, longana or float, depending on the kind of data stored in the tag. The default is float.

If you also enter a scale value in the Calc Scale field, SPC divides the adjusted result by the scale value.

Refer to the Calc Offset field description in "Defining Sample Plans" on page 122 of this guide for an example.

Calc Scale (Optional) Name of a tag that normalizes each calculation result. SPC divides the calculated value by the scale value.

If you also enter an offset value in the Calc Offset field, SPC subtracts the offset from the calculated value and then divides the result by the scale value.

Refer to the Calc Scale field description in "Defining Sample Plans" on page 122 of this guide for an example.

The data type for this tag can be analog, longana or float, depending on the kind of data stored in the tag. The default is float.

Calc Constant (Optional; only for use with EWMA, Cp, Cpk, and Split calculations) Name of a tag that adjusts the constant value SPC uses in the specified calculation. For example, the EWMA calculation uses a λ value. If you want the operator to be able to change the λ value the EWMA calculation uses, enter a tag in this field.

The data type for this tag can be analog, longana or float, depending on the kind of data stored in the tag. The default is float.

For information about valid constant values for each type of calculation, refer to the Calc Constant field description in "Defining Sample Plans" on page 122 of this guide.

Caution: We recommend you use this field only if you are knowledgeable and experienced with adjusting these calculations.

Run Rule Scroll Tag (Optional) Name of a tag that lets the operator scroll through a list of run rules and select the run rule he/she wants to display and control.

The data type for this tag can be analog, longana or float, depending on the kind of data stored in the tag. The default is analog.

Use this tag in conjunction with the next four fields.

Run Rule Name Tag (Optional) Name of a tag that displays the run rule SPC performs on the selected chart and calculation. Define message as the data type for this tag.

Run Rule Enable Tag (Optional) Name of a tag that controls the evaluation of the selected run rule for a chart. When this tag is 1, the run rule is enabled. When this tag is 0, the run rule is disabled.

The data type for this tag can be digital, analog, longana, float or message, depending on the kind of data stored in the tag. The default is digital.

Run Rule Priority Tag (Optional) Name of a tag that displays and controls the priority of the selected run rule. The data type for this tag can be digital, analog, longana, float or message, depending on the kind of data stored in the tag. The default is analog.

If the value of this tag is...	Then...
0 (default)	Rules have equal priority.
1 - 32767	1 is the highest; 32767 is the lowest.

Run Rule Filter Tag (Optional) Name of a tag that displays and controls a run rule filter. Use this tag to filter out violations that may occur above and below the center value.

The data type for this tag can be digital, analog, longana, float or message, depending on the kind of data stored in the tag. The default is analog.

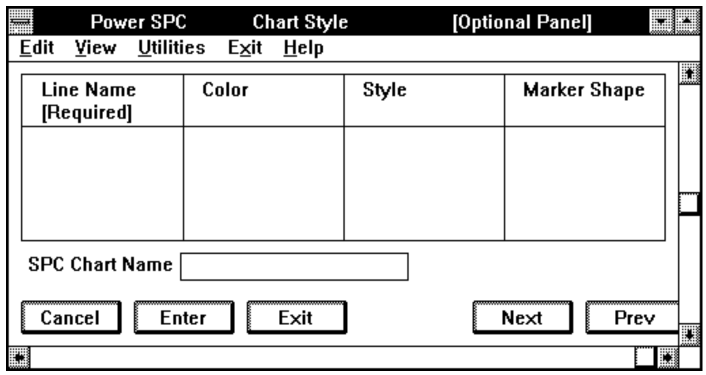
If the value of this tag is...	Then SPC...
EITHER	(Default) Detects and reports both upper and lower zone violations. If all the Number of Points for Violation lie either above or below the center line, SPC reports run rule violations. This filter can validate a Trend run rule that crosses the center line.
UPPER	Detects and reports only upper zone violations. If all the Number of Points for Violation are above the center line, SPC reports a run rule violation.
LOWER	Detects and reports only lower zone violations. If all the Number of Points for Violation lie below the center line, SPC reports a run rule violation.

If the value of this tag is...	Then SPC...
BOTH	Detects and reports zone violations either above or below the center line. SPC reports run rule violations regardless of the point's proximity to the center.

CUSTOMIZING COLOR, LINE, AND POINT STYLES

You can customize the appearance of lines, bar colors, and data points. See “Overview of Linking a Chart to PowerSPC” on page 194 of this chapter. Configure the Chart Style panel to specify chart lines and define the style and color of each line, bar, and data point on the chart.

This panel contains four fields.



1 Specify the following information for this panel:

Line Name — (Required) Line type for each line you want to display on the chart. This can be one of the following:

DATA_LINE	Line connecting the calculated data points or in a bar chart change the colors of the bars.
VIOLATION	Line connecting the calculated data points that have violated a run rule
UCL	Upper Control Limit line
CENTER	Center Control Limit line
LCL	Lower Control Limit line
USL	Upper Specification Line
NOMINAL	Nominal (target) Specification Line
LSL	Lower Specification Line
SIGMA	Sigma (standard deviation) lines at $\pm$ 1 sigma and $\pm$ 2 sigma
FREQUENCY	Frequency line

Note: Choose DATA_LINE as the line name to customize the color of the bars on a bar chart. Then, complete the Color field.

Color (Optional) Color for each line and data point on the chart. This can be one of the following.

BLACK	CYAN	BLUE
MAGENTA	RED	YELLOW
GREEN	WHITE	

Style (Optional) Line style for each line on the chart. This can be one of the following.

SOLID	DOT_DASHED	DOTTED
NO_LINE	DASHED	

Marker Shape (Optional) Shape you want plotted at each calculated data point on the data line. Enter a shape only for the DATA_LINE and VIOLATION entries in the Line Name field. SPC ignores this field for all other types of lines.

BOX	CROSS	PLUS
TRIANGLE	CIRCLE	DIAMOND
NONE		

Chapter 9 . . . .

Customizing Your Process

You can customize your process by defining:

- Custom cause codes
- Run rules
- Storage of auxiliary data

Process customization is configured from the User-Defined Cause Code table. This table has three panels:

- Cause Code Definition—Defines codes that identify the causes of changes or adjustments that commonly occur during a process, such as a raw material change or a shift change. Operators can use these cause codes to assign a cause to any point on a chart, such as one that violates a run rule or goes out of control, and to display the cause description on screen. See “Defining Custom Cause Codes” on page 238 of this chapter.
- Run Rule Definition—Defines run rules that specify criteria for judging whether or not a process is out of control. See “Defining Custom Run Rules” on page 240 of this guide.
- Auxiliary Schema Definition—Defines where to store auxiliary data collected. See “Defining Database Columns for Storing Auxiliary Data” on page 245 of this chapter.

This chapter describes these configuration panels and explains how to complete them. The procedures in this chapter assume you know how to start and traverse the Configuration Manager. If you need help with this, refer to *FactoryLink ECS Fundamentals*.

DEFINING CUSTOM CAUSE CODES

You can define codes that identify causes of changes or adjustments that commonly occur during a process, such as a raw material change or a shift change. Codes let the operator assign a cause to any point on a chart, such as one that violates a run rule or goes out of control, and to display the cause code name on screen. The operator can view and edit cause codes for each point on a chart to indicate that a process adjustment has occurred. You can define as many cause codes as available memory allows.

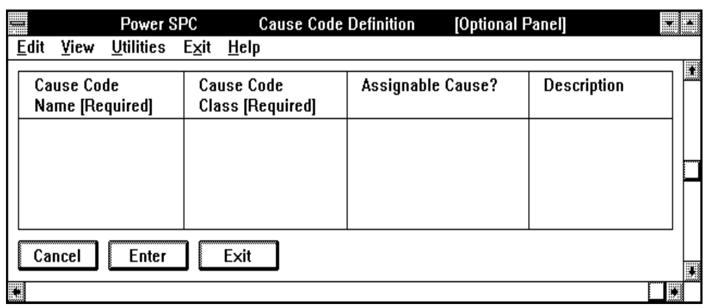
You can also classify the cause codes. You can use class names to differentiate between similar codes, or to narrow the list of cause codes that the operator can assign. For example, if a process is out of control, the operator can be restricted from entering cause codes from a certain class. The class can indicate a type of cause code, a type of chart, or a process. For example, it is not appropriate to enter a cause code for a worn tool on a chart showing the temperature of a bath of liquid.

Configure the Cause Code Definition panel to define cause codes.

1 Choose PowerSPC User-Defined Cause Codes on the Configuration Manager Main Menu to display the Cause Code Definition panel.

This panel contains four fields.

Make an entry for each cause code you want to define.



You do not need to select a domain for the User-Defined Cause Codes panels. These panels are independent from domains. After you configure these panels, you can see the same configuration information in either domain.

2 Specify the following information for this panel:

Cause Code Name (Required) Alphanumeric string of 1 to 16 characters that specifies the unique cause code name.

Cause Code Class (Required) Alphanumeric string of 1 to 16 characters that specifies the name of the class the cause code is to belong to.

Assignable Cause? (Optional) Whether this cause code is an assignable cause. This can be one of the following:

YES SPC will not use the data for that point in the control limit calculations. This is the default.

If you classify the code as an assignable cause, assign the code to a point on a chart, and enter YES in the field. You must also specify YES in the Exclude Data with Assignable Cause? field in the Sample Plan panel of the PowerSPC Sample Plans option.

NO SPC uses the data.

An assignable cause is the cause of a variation in a non-random process; that is, an operator can determine and perhaps eliminate the source of the variation, for example, a power outage or equipment malfunction.

If you configure the Sample Plan to exclude data associated with points that have an assignable cause, SPC uses this field to determine which cause codes result in data being excluded from all control limit calculations. Refer to Chapter 5, "Creating a PowerSPC Sample Plan," of this guide, which describes the "Points In Control Limit Calc" field.

Description (Optional) Cause code. You can assign and enter an alphanumeric string of 1 to 48 characters that specifies the description of what the cause code means. SPC does not use this information, and it does not display this information on screen for the operator to view.

For example, if one of the causes of variation in your process is known to be a power spike, you can configure a cause code as follows.

Sample Cause Code Definition Panel	
Field Name	**Sample Entry**
Cause Code Name	SPIKE
Cause Code Class	POWER
Assignable Cause?	YES
Description	A surge or spike from Power Supply

DEFINING CUSTOM RUN RULES

For each calculation you specify in the Sample Plans or Processes panels, you can specify run rules that SPC evaluates after it performs each calculation. Run rules define how many data points can fall above or below a specified line or fall within a specified range on a chart before the process is considered out of control.

Run rules identify trends or patterns that indicate significant variations in the level of quality over a period of time. For example, when a process begins to violate run rules, the operator can take action to correct the problem before any more defective parts are produced.

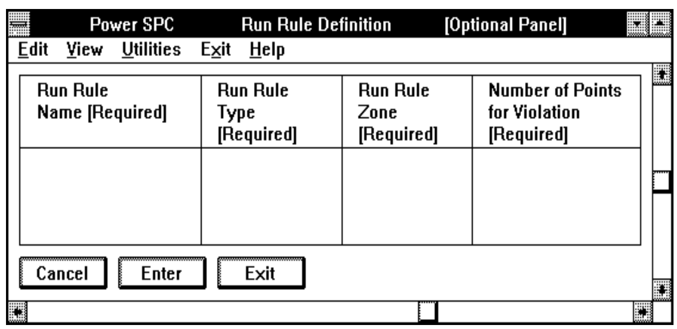
SPC provides five standard Western Electric run rules—3 SIGMA, 2OF3, 4OF5, TREND, and 8CONS—that you can use. (See the table on page 243 of this chapter.) You can also define up to 59 of your own run rules (use the Western Electric run rules as a guide).

Perform the following steps to define custom run rules:

1 Choose PowerSPC User-Defined Run Rules on the Configuration Manager Main Menu to display the Run Rule Definition panel.

This panel contains seven fields.

Press Tab to display additional fields.



Note: If you use only the system-defined Western Electric run rules, you do not need to configure this panel.

You do not need to select a domain for the User-Defined Run Rules panels. These panels are independent from domains. After you configure these panels, you can see the same configuration information in either domain.

2 Specify the following information for this panel:

Run Rule Name — (Required) Alphanumeric string of 1 to 16 characters that specifies the unique run rule name. Remember to use a unique name for each run rule. If you use the name of a predefined run rule, FactoryLink overwrites the previous definition, including the Western Electric defaults.

Run Rule Type (Required) How you want SPC to evaluate the points. For example, where must a point fall in relation to a line or zone to violate the run rule? Within or outside? This can be one of the following:

BOUNDARY	To violate the run rule, points above the center line must fall within or above the boundary line set by the next field, Run Rule Zone. Points below the center line must fall within or below the boundary line.
ZONE	To violate the run rule, the points must fall within the zone specified by the Run Rule Zone. This includes values on the zone line.
TREND	To violate the run rule, the points must consecutively continue to increase or decrease. The Western Electric TREND run rule looks for seven points.

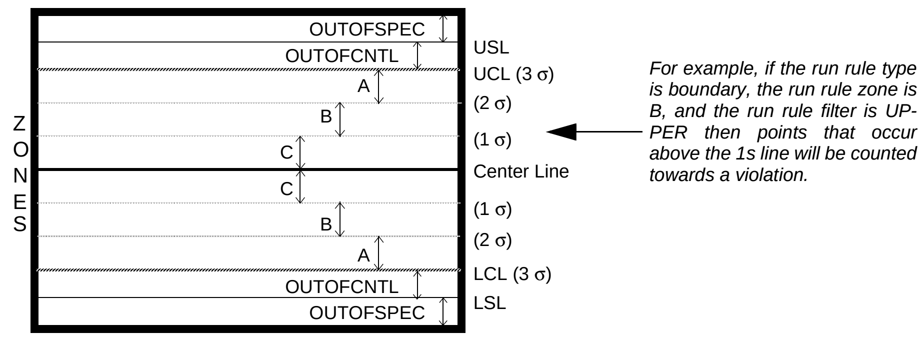
Note: You can filter points in relation to the center line. Remember to specify filters in the Sample Plan panels.

Run Rule Zone (Required) Zone you want SPC to apply the Run Rule Type to. For example, for a BOUNDARY-type rule, a value must fall beyond the zone you enter in this field.

Note: If you want SPC to apply ZONE_A, ZONE_B, ZONE_C, or ZONE_OUTOFCNTL to a run rule, we recommend you define control limits in the Sample Plan option Calculation Control panel. Define them in the Pre-Control LCL, Pre-Control UCL, and Pre-Control Center fields.

If you want SPC to apply ZONE_OUTOFSPEC to a run rule, we recommend you define specification limits in the same panel, Calculation Control. Define them in the LSL for Calculation, USL for Calculation, and Nominal for Calculation fields. This can be one of the following:

ZONE_A	ZONE_B	ZONE_C
ZONE_OUTOFCNTL		ZONE_OUTOFSPEC



Number of Points for Violation (Required) Unique number between 1 and 99 that specifies the number of points that must fail the evaluation of the type and zone you just defined to classify the latest point as a violation of this run rule.

Number of Points to Investigate (Required) Unique number between 1 and 99 that specifies the maximum number of points SPC must investigate or evaluate for a violation.

Run Rule Display Name (Optional) Unique number between 1 and 99 that specifies the name of the run rule, such as 9OF12. Whenever this run rule is violated, this name displays in the output-text field you defined in the Violated Run Rule Name Output Tag field from the Processes option panel Monitor Control. You may want to display a shorter code rather than the entire name.

You can assign and enter an alphanumeric string of 1 to 32 characters (you can use spaces between characters).

Default Run Rule Priority (Optional) If you want SPC to report the run rule violations in a specific order, enter a priority value in this field. Run Rule priorities configured in the Sample Plan panels will override these default priorities.

For example, you may consider your custom rules most important and want those to display first in the Run Rule Violation Alarm Tags you define in the Process option Monitor Control panel. See “Establishing the Run Rules” on page 174 of this guide.

You can assign and enter an alphanumeric string of 1 to 32767 characters, with 1 having the highest priority and 32767 the lowest.

The following table shows how the five standard Western Electric run rules are configured. Use these as a guide for the user-defined run rules.

Western Electric Run Rule	Run Rule Description	Zone	Type	Number of Points for Violation	Number of Points to Investigate	* Filter	Default Priority
2OF3	2 out of 3 points lie on one side of the Center Line in Zone A or beyond.	A	BOUNDARY	2	3	EITHER	2
4OF5	4 out of 5 points lie on one side of the Center Line in Zone B or beyond.	B	BOUNDARY	4	5	EITHER	3
TREND	7 points in a row are rising or falling on either side of the center line.	C	TREND	7	7	BOTH	5
8CONS	8 points in a row lie on one side of the Center Line.	C	BOUNDARY	8	8	EITHER	4
3SIGMA	One or more points lie outside control limits.	Out of Control	BOUNDARY	1	1	BOTH/ EITHER	1
* Define filters in the Processes option’s Monitor Control panel.							

For example, if your company has developed its own run rules to monitor its process, such as 90% of 25 in Zone C, define a custom run rule as follows:

90% * 25 = 23:

Field Name	Sample Entry
Run Rule Name	90%OF25
Run Rule Type	ZONE
Run Rule Zone	C
Number of Points for Violation	23

Field Name	Sample Entry
Number of Points to Investigate	25

DEFINING DATABASE COLUMNS FOR STORING AUXILIARY DATA

If you define auxiliary data in the Processes panels that you want SPC to collect, you need to define database columns to store the data in. Auxiliary data is additional, descriptive information about a sample, such as an operator name, the process line, lot number, or shift number, SPC does not perform calculations on; it only reads the auxiliary data from the tags as it accepts the data into the database.

While SPC does not allow an operator to select data based on the contents in an auxiliary field, he/she can still trace parts by storing a part number in an auxiliary database column. Then, you can search for information about specific parts using FactoryLink's Database Browser module or manually searching for the auxiliary data by viewing the raw data associated with it.

When you assign a unique Auxiliary Field Alias Name to each column in the auxiliary data database table, you can associate it with a specific database column name, data type, and width that SPC will use to store the collected auxiliary data. At run time, SPC stores the values in the auxiliary data tags in the column identified by the Auxiliary Field Alias Name Tag. At startup, FactoryLink uses these columns to create the auxiliary data tables.

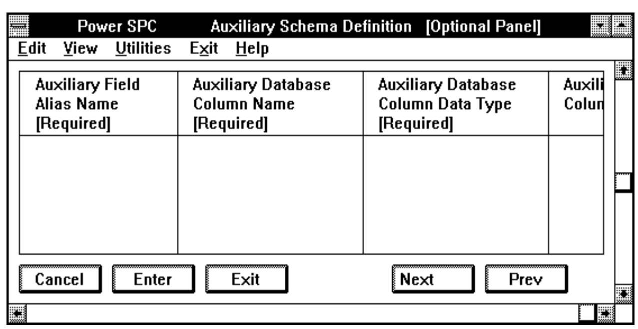
We recommend you define all of the auxiliary data columns the first time you configure this panel. If you add new auxiliary data columns later, you must run a reconciliation utility while the SPC application is inactive. For information about this utility, refer to "Modifying Auxiliary Data Columns in the Database" on page 248 of this chapter.

> **Note:** The number of columns and tables you can define for a database depends on the requirements of the database software in use. For information about these requirements, refer to *FactoryLink ECS Fundamentals* for the appropriate database.

Perform the following steps to define database columns for storing auxiliary data:

1 Choose PowerSPC User-Defined Auxiliary Information on the Configuration Manager Main Menu to display two panels. Configure the Auxiliary Schema Definition panel first.

This panel contains four fields.



You do not need to select a domain for the User-Defined Auxiliary Data panels. These panels are independent from domains. After you configure these panels, you can see the same configuration information in either domain.

2 Specify the following information for this panel:

Auxiliary Field Alias Name	(Required) Alphanumeric string of 1 to 16 characters that specifies the alias name for the database column that stores the auxiliary data being collected. Also enter this alias name in the Auxiliary Field Alias Name field on the Processes option Auxiliary Collection panel. FactoryLink automatically stores the value from the tag defined in the Auxiliary Data field from the Auxiliary Collection panel into the database column associated with the Auxiliary Field Alias Name. SPC collects auxiliary data only for database columns defined in this panel.
Auxiliary Database Column Name	(Required) Alphanumeric string of 1 to 16 characters that specifies the column name in the auxiliary database where the auxiliary data will be stored. **Note:** The maximum character length is 16 for all databases, except dBASE IV, who has an alphanumeric string of 1 to 10 only. Do not use reserved keywords like FLOAT as a column name. At startup, SPC creates this database column. If you define a new column after the first time you configure this panel, remember to configure and run the reconciliation utility so SPC will create the new database columns. See "Modifying Auxiliary Data Columns in the Database" on page 248 of this chapter. **Note:** If you change the columns in the table after the first time you configure this panel, remember to redefine all columns you want in the updated table, even if they already exist; otherwise, SPC deletes the data for any column not listed in this panel.
Auxiliary Database Column Data Type	(Required) Data type of the auxiliary database column that stores collected auxiliary data. This can be one of the following: CHAR (default) FLOAT INT SMALLINT

Auxiliary Database Column Width

(Optional) If you entered CHAR in the Auxiliary Database Column Data Type field, enter the width of the column you specified in the Auxiliary Database Column Name field. If the data type is anything other than CHAR, leave this field blank. You assign and enter a 1 to 256 (default = 16) valid entry.

For example, suppose along with the raw data, you want to collect a 16-character part ID, the name of the inspector, and the temperature in the factory. To do this, configure this panel as follows.

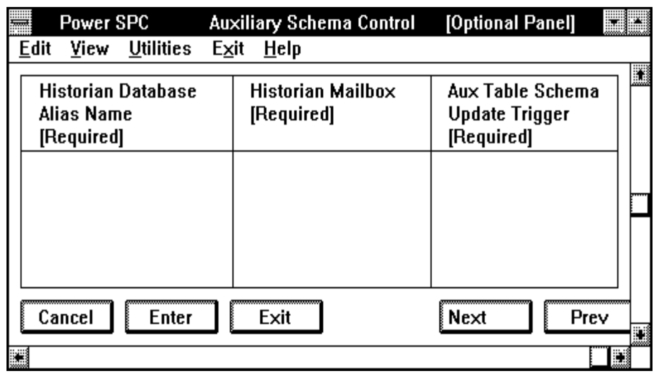
Sample Auxiliary Schema Definition panel	
Field Name	**Sample Entry**
Auxiliary Field Alias Name	PART INSPECTOR TEMP
Auxiliary Database Column Name	PART_ID INSP FACTORY_TEMP
Auxiliary Database Column Type	CHAR CHAR FLOAT
Auxiliary Database Column Width	17 12

MODIFYING AUXILIARY DATA COLUMNS IN THE DATABASE

Configure the Auxiliary Schema Control panel if you add, delete, or change auxiliary data columns in the Auxiliary Schema Definition panel after the first time you configured it. Then, the next time you run SPC, you can trigger it to rebuild and update the database to include the changes. When you trigger SPC to rebuild the database, remember that all SPC Processes are shut down.

Configure the Auxiliary Schema Control panel to define the update trigger.

This panel contains three fields.



1 Specify the following information for this panel:

Historian Database Alias Name (Required) Alphanumeric string of 1 to 16 characters that specifies the alias name of the database you defined in the Database Alias Name field in the Historian Information panel.

Historian Mailbox (Required) Name of the mailbox tag you defined in the Historian Mailbox field in the Historian Mailbox Information panel. SPC sends data to the database through this tag. MAILBOX is the only valid entry.

Aux Table Schema Update Trigger (Required) Name of a tag that triggers SPC to update the columns in the database you specified in the previous two fields. Specify the type of data this tag will store. This can be digital, analog, longana, or float.

Chapter 10 . . . .

Configuration Panel Quick Reference

10

Configuration Panel Quick Reference

This chapter contains a table listing of all Power SPC Main Menu options, panels, fields, and valid entry types. The table below explains each valid entry type.

If the valid entry column of this table shows...	Type... in the field
DALFM (Or any combination of these five letters, such as LM)	A tag name. Define it as any of the listed data types. D - Digital A - Analog L - Long Analog F - Floating-point M - Message
Mbx	A tag name. Define it as mailbox.
Char	An alphanumeric string.
Constant Char	An alphanumeric string. Precede the name with a single quote (**’**).
Number	A number.
YES or NO	Either YES or NO.
Press Ctrl-K	To find out valid entries for this field, place the pointer on the field and click once to place the cursor in the field. Then, press Ctrl and K simultaneously. A dialog box appears showing valid entries for that field.

In some fields, you can enter either a tag or a name, or a tag or a number. These are Tag/Constant fields. If you type a name in a tag/constant field, precede the name with a single quote (’).

The table in this chapter also shows which tags require the operator to stop the SPC process before changing, which do not, and which require the operator to toggle into edit mode to change them. The table below explains each type.

If the Disable? column of this table shows...	The operator...
NA	Does not change this value because this field is not a tag.
Enabled	Can change the value of this tag while the process is active.
Disable	Must stop the process to change the value of this tag.
Modify anytime	Can change the value of this tag while the process is active or inactive whether in Edit Mode or not.
Output only	Does not change the value of this tag because it is output only.
Edit Mode	Must toggle into Edit Mode (for text displays only) to change the value of this tag. You can use Edit Mode to edit raw data values.

Refer to the appropriate configuration chapter in this manual for descriptions of each panel and field and exact valid entries.

The following tables describe the field names, valid entries, and disabling options in the PowerSPC Sample Plan for each panel name.

Panel Name: Sample Plan Definition		
Field Name	**Valid Entries**	**Disable?**
Sample Plan Name [Required]	Char	NA
Restrict Dynamic Changes?	YES or NO	NA
Exclude Data with Assignable Cause?	YES or NO	NA

Panel Name: Sample Plan Definition		
Field Name	**Valid Entries**	**Disable?**
Reject Undefined Dimn & Char Names?	YES or NO	NA
Acceptance Sampling	Press Ctrl-K	NA
Accept Criteria	Number	NA
Sample Size	Number	NA
Lot Size	Number	NA

Panel Name: Collection Control [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Dimn or Char Name [Required]	Char	NA
Dimn or Char Type [Required]	Press Ctrl-K	NA
Subgroup Size	Number	NA
Dimn LSL	Number	NA
Dimn USL	Number	NA
Dimn Nominal	Number	NA

Panel Name: Calculation Control [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Calc Name [Required]	Press Ctrl-K	NA
Pre-Control LCL	Number	NA
Pre-Control UCL	Number	NA

Panel Name: Calculation Control [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Pre-Control Center	Number	NA
LSL for Calculation	Number	NA
USL for Calculation	Number	NA
Nominal for Calculation	Number	NA
Calc Size	Number	NA
Calc Offset	Number	NA
Calc Scale	Number	NA
Calc Constant	Number	NA
Points In Control Limit Calc	Number	NA

Panel Name: Monitor Control [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Run Rule Name [Required]	Char or Press Ctrl-K	NA
Run Rule Priority	Number	NA
Run Rule Filter	Press Ctrl-K	NA

The following tables describe the field names, valid entries, and disabling options in the PowerSPC Process for each panel name.

Panel Name: Process Definition		
Field Name	**Valid Entries**	**Disable?**
Process Name [Required]	Char	NA

Panel Name: Process Definition		
Field Name	**Valid Entries**	**Disable?**
Sample Plan Name [Required]	M or Constant char	Requires Disabled
Location Name [Required]	M or Constant char	Requires Disabled
Subgroup Name [Required]	M or Constant char	Requires Disabled
Historian Database Alias Name [Required]	Char	Output only
Historian Mailbox [Required]	Mbx	Output only
Process Disable Toggle Tag [Required]	DALF	Modify anytime
Accept Data Trigger Tag [Required]	DALF	Requires enabled
Accept Data Quantity [Required]	DALF or Number	Requires enabled
Accept Data Completion Tag	DALFM	Output Only
Collect Data Trigger Tag	DALF	Requires enabled
Process Status Tag	ALFM	Output only
Process Message Tag	M	Output only
Dynamic Change Tag	DALF	Output only
Exclude Data with Assignable Cause Tag	DALFM	Requires enabled

Panel Name: Data Collection Control		
Field Name	**Valid Entries**	**Disable?**
Dimn or Char Name [Required]	M or Constant char	Requires enabled
Dimn or Char Type [Required]	DALFM or Press Ctrl-K	Requires enabled
Auxiliary Table Name [Required for Next Panel]	Char	NA
Dimn Measurement Tag	DALF	Requires enabled
Char Defective Count Tag	DALF	Requires enabled
Char Defect Count Tag	DALF	Requires enabled

Panel Name: Auxiliary Collection [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Auxiliary Field Alias Name [Required]	M or Constant char	Requires enabled
Auxiliary Data [Required]	DALFM or Constant char	Requires enabled

Panel Name: Acceptance Sampling [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Current Sample Size Output Tag	ALFM	Output only
Current Failure Count Output Tag	ALFM	Output only
Close Sample Trigger Tag	DALF	Requires enabled
Sample Pass/Fail Status Tag	DALFM	Requires enabled
Acceptance Sampling	AM	Requires Disabled
Accept Criteria	DALF	Requires Disabled
Sample Size	DALF	Requires Disabled
Lot Size	DALF	Requires Disabled

Panel Name: Calculations Control [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Calc Control Tag Set Name [Required]	Char	Output only
Calc Name [Required]	AM or Press Ctrl-K	Modify anytime
Dimn or Char Name [Required]	M or Constant char	Modify anytime
Calc Selection Scroll Tag	ALF	Modify anytime
Current Calc Size Output Tag	ALF	Output only
Calc Trigger Tag	DALF	Requires enabled

Panel Name: Calculations Control [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Calc Output Tag	ALFM	Output only
Control Limit Trigger Tag	DALF	Requires enabled
Control Limit Calc Completion Tag	DALF	Output only
LCL Value	ALFM	Requires enabled
UCL Value	ALFM	Requires enabled
Center Value	ALFM	Requires enabled
Highest Priority Run Rule Violation Output Tag	DM	Output only
Dimn LSL Value	ALF	Requires enabled
Dimn USL Value	ALF	Requires enabled
Dimn Nominal Value	ALF	Requires enabled
Calc Size	ALF	Requires Disabled
Calc Offset Value	ALF	Requires Disabled
Calc Scale Value	ALF	Requires Disabled
Calc Constant Value	ALF	Requires Disabled
Points In Control Limit Calc	ALF	Requires Disabled

Panel Name: Monitor Control [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Run Rule Name [Required]	M or Press Ctrl-K	Modify anytime
Run Rule Priority	ALF	Requires Disabled
Run Rule Filter	ALFM	Requires Disabled
Run Rule Enable Tag	DALFM	Requires Disabled
Run Rule Violation Alarm Tag	DALFM	Output only
Run Rule Selection Scroll Tag	ALF	Modify anytime

The following tables describe the field names, valid entries, and disabling options in the PowerSPC Chart for each panel name.

Panel Name: Chart Definition		
Field Name	**Valid Entries**	**Disable?**
Chart Object ID [Required]	Char	NA
Drawing Name [Required]	Char	NA
Location Name [Required]	M or Constant char	Modify anytime
Subgroup Name [Required]	M or Constant char	Modify anytime
Historian Database Alias Name [Required]	Char	NA
Historian Mailbox [Required]	Mbx	Output only
Chart Ad Hoc [Required]	ALFM or ’YES or ’NO	Modify anytime
Chart Type [Required]	ALFM or Press Ctrl-K	Modify anytime

Panel Name: Chart Definition		
Field Name	**Valid Entries**	**Disable?**
Dimn or Char Name [Required]	M or Constant char	Modify anytime
Sample Plan Name	M or Constant char	Modify anytime
Chart Select Scroll Tag	ALF	Modify anytime
Chart Message Tag	M	Output only
Number of Points Tag	ALF	Modify anytime
Input Oldest Date/Time Tag	LM	Modify anytime
Input Newest Date/Time Tag	LM	Modify anytime
Output Oldest Date/Time Tag	LM	Output only
Output Newest Date/Time Tag	LM	Output only

Panel Name: Calculation Display [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Output Newest Date/Time Tag	LM	Output Only
Calc Value Output Tag	ALF	Output Only
Calc Size Output Tag	ALF	Output Only
LSL Output Tag	ALF	Output Only
USL Output Tag	ALF	Output Only
Nominal Spec Value Output Tag	ALF	Output Only
LCL Output Tag	ALF	Output Only
UCL Output Tag	ALF	Output Only

Panel Name: Calculation Display [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Center Value Output Tag	ALF	Output Only
Date/Time Output Tag	LM	Output Only
Raw Data Page Tag	ALF	Modify anytime
Violated Run Rule Name Output Tag	M	Output Only
Violated Run Rule Scroll Tag	ALF	Modify anytime
Cause Code Class	M or Constant char	Edit Mode
Cause Code Name Tag	M	Edit Mode
Comment Tag	M	Edit Mode

Panel Name: Raw Data Display [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Raw Data Value Tag [Required]	DALFM	Edit Mode
Raw Data Dimn or Char Name Tag	M	Output Only
Raw Data Date/Time Tag	LM	Output Only
Accept Quantity Tag	ALFM	Output Only
Accept ID Tag	ALFM	Output Only
Auxiliary Table Name [Required for next panel]	Char	Output Only

Panel Name: Raw Data Display [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Auxiliary Page Position Tag	ALF	Output Only

Panel Name: Auxiliary Data Display [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Auxiliary Field Alias Name [Required]	M or Constant char	Modify anytime
Auxiliary Data Tag [Required]	M	Edit Mode

Panel Name: Control Chart [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Edit Mode Toggle Tag	DALF	Modify anytime
Edit Mode Completion Tag	DALFM	Modify anytime
Y-Axis Minimum	ALFM or Number	Modify anytime
Y-Axis Maximum	ALFM or Number	Modify anytime
Y-Axis Rescale Tag	ALF	Modify anytime

Panel Name: Bar Chart Display [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Bar Chart Size [Required]	DALFM or Number	Modify anytime
Display Frequency	DALFM or ’YES or ’NO	Modify anytime
Minimum Frequency Value	DALFM or Number	Modify anytime
Minimum Frequency Alarm Tag	DALF	Modify anytime
Maximum Frequency Value	DALFM or Number	Modify anytime
Maximum Frequency Alarm Tag	DALF	Modify anytime
Histogram Minimum Value	DALFM or Number	Modify anytime
Histogram Minimum Alarm Tag	DALF	Modify anytime
Histogram Maximum Value	DALFM or Number	Modify anytime
Histogram Maximum Value Alarm Tag	DALF	Modify anytime
Histogram Bar Rescale Tag	DALFM	Modify anytime
Clear Chart Trigger Tag	DALF	Modify anytime
X Legend Object Name [Required]	Char	Modify anytime

Panel Name: Chart Information [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Chart Value Type [Required]	DALFM or Press Ctrl-K	Modify anytime
Chart Value Output Tag [Required]	DALFM	Output Only

Panel Name: Ad Hoc Chart Calculation [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Suspend Changes Tag	DALFM	Modify anytime
Calc Size	DALFM	Modify anytime
Control Limit Trigger Tag	DALF	Modify anytime
LCL Value	ALF	Modify anytime
UCL Value	ALF	Modify anytime
Center Value	ALF	Modify anytime
Dimn LSL Value	ALF	Modify anytime
Dimn Nominal Value	ALF	Modify anytime
Calc Offset	ALF	Modify anytime
Calc Scale	ALF	Modify anytime
Calc Constant	ALF	Modify anytime
Run Rule Scroll Tag	ALF	Modify anytime
Run Rule Name Tag	M	Modify anytime

Panel Name: Ad Hoc Chart Calculation [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Run Rule Enable Tag	DALFM	Modify anytime
Run Rule Priority Tag	DALFM	Modify anytime
Run Rule Filter Tag	DALFM	Modify anytime

Panel Name: Chart Style [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Line Name [Required]	Press Ctrl-K	NA
Color	Press Ctrl-K	NA
Style	Press Ctrl-K	NA
Marker Shape	Press Ctrl-K	NA

The following tables describe the field names, valid entries, and disabling options in the PowerSPC User Defined Information, Cause Codes, and Run Rules for each panel name.

Panel Name: Auxiliary Schema Definition [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Auxiliary Field Alias Name [Required]	Char	NA
Auxiliary Database Column Name [Required]	Char	NA
Auxiliary Database Column Data Type [Required]	Char or Press Ctrl-K	NA
Auxiliary Database Column Width	Number	NA

Panel Name: Auxiliary Schema Control [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Historian Database Alias Name [Required]	Char	NA
Historian Mailbox [Required]	Mbx	Output only
Aux Table Schema Update Trigger [Required]	DALF	Requires Disabled

Panel Name: Cause Code Definition [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Cause Code Name [Required]	Char	NA
Cause Code Class [Required]	Char	NA
Assignable Cause?	YES or NO	NA
Description	Char	NA

Panel Name: Run Rule Definition [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Run Rule Name [Required]	Char	NA
Run Rule Type [Required]	Press Ctrl-K	NA
Run Rule Zone [Required]	Press Ctrl-K	NA

Panel Name: Run Rule Definition [Optional Panel]		
Field Name	**Valid Entries**	**Disable?**
Number of Points for Violation [Required]	Number	NA
Number of Points to Investigate [Required]	Number	NA
Run Rule Display Name	Char	NA
Default Run Rule Priority	Number	NA

- **CONFIGURATION PANEL QUICK REFERENCE**
-
-
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Chapter 11 . . . .

Cleanup Utility

The purpose of the cleanup utility is to delete rows from the tables. This function is triggered by a user-supplied tag.

This utility requires you configure two panels:

- PowerSPC Database Cleanup panel
- PowerSPC Database Cleanup Information panel

Configuring the PowerSPC Database Cleanup Panels

Caution: Remember to back up your database before invoking this utility because once the delete has happened, you cannot retrieve the information.

Perform the following steps to configure the Database Cleanup panels:

1. Ensure the current domain selected is SHARED in the Configuration Manager Main Menu Domain Selection box.
2. Choose PowerSPC Cleanup in the Configuration Manager Main Menu to display the Database Cleanup panel.
3. Specify the following information for this panel:

Database Alias Name	String of up to 31 characters that represents a database connection. This name must be unique and match the database name defined in the Database Alias Name field in the Historian Information panel.
Historian Mailbox	Name that identifies the mailbox Historian receives data from. This name must match the name defined in the Historian Mailbox field in the Historian Information panel.
Receiving Mailbox	Name that identifies the mailbox in the cleanup utility that receives data from Historian.

Caution: The Receiving Mailbox field is for future use and is inactive at this time. Although a mailbox tag must be defined in this field, a tag must not be defined in the historian panel. If a tag is defined in the historian panel, various problems will occur.

Startup Trigger	Name of the tag that starts or triggers the database cleanup process. This tag can be digital or analog. The default is digital.
Backup Database Alias	Reserved for future use.

4. Click Enter to save the information.
5. Click Next to access the PowerSPC Database Cleanup Information panel.
6. Specify the following information for this panel:

*Location Name	Identifies which sample plan (which set of tables) the rows will be deleted from. This is either a tag or a constant. If you place an asterisk as the entry in this field, you are telling the program to delete all the occurrences of this field. For example, an asterisk in the this field indicates information in all locations is to be deleted.
*Subgroup Name	Identifies which sample plan (which set of tables) the rows will be deleted from. This is either a tag or a constant. If you place an asterisk as the entry in this field, you are telling the program to delete all the occurrences of this field. For example, an asterisk in the this field indicates information in all subgroups is to be deleted.
*Dimn or Char Name	Identifies which sample plan (which set of tables) the rows will be deleted from. This is either a tag or a constant. If you place an asterisk as the entry in this field, you are telling the program to delete all the occurrences of this field. For example, an asterisk in the this field indicates information identified with *Dimn or Char Name is to be deleted.
Dimn or Char	Identifies which sample plan (which set of tables) the rows will be deleted from. This is a key. Press Ctrl + K to access the list of key words you can choose your entry from. If you place an asterisk as the entry in this field, you are telling the program to delete all the occurrences of this field. For example, an asterisk in the this field indicates information in all information identified as Dimn or Char is to be deleted.
*Points to Retain	Number of points you want to save. For example, if you have a total of 100 points and you indicate 10 points in this field, 90 points will be deleted.
*Days, *Hours, *Mins, *Secs	These four fields indicate length of time to retain data before deleting. If you enter 2 in the Days field, your data will not be deleted for 2 days.

Note: If you enter a value in the *Points to Retain field and in the *Days, *Hours, *Mins, and *Secs fields, the larger number or point is the default.

7 Click Enter to save the information.

8 Click Exit to return to the Main Menu.

Note: The oldest subgroup for the existing data may become incomplete for each calculation due to variable subgroup sizes for each dimension, different calculations within a dimension, or user's choice of number of points to retain by SPCDBCLN.

Setting the Run-Time Parameters

Perform the following steps to set the run-time parameters for this utility:

1. Ensure the current domain selected is SHARED in the Configuration Manager Main Menu Domain Selection box.
2. Choose System Configuration from the Configuration Manager Main Menu to display the System Configuration Information panel. Each FactoryLink task is a separate line item on this panel.
3. Specify the following information in the following fields for this panel:

Flags	Enter an F and R in this field.
Task Name	Enter SPCDBCLN in this field.
Description	Alphanumeric string that identifies the task.
Executable File	Enter bin/spcdbcln in this field.
Program Argument	The following argument can be used:

-W<n>	Sets timeout wait duration. Sets the number of seconds to wait for a response from the Historian before timing out. Default is 30 seconds. Can be set up to 36,000 seconds (10 hours). Used for all client tasks.

Chapter 12. . . .

User-defined Control Limit Calculation Factors

SPC control limit factors are used to estimate three-sigma control limits, LCL and UCL, for the various control charts. PowerSPC uses specific control limit factors for up through 25 raw data values in a subgroup; the first part of this chapter documents those factors.

PowerSPC allows you to define your own control limit factors, described in the second part of this chapter.

PowerSPC Control Limit Calculation Factors

PowerSPC has predefined control limit calculation factors set up for subgroup sizes up through 25; the table on the following page lists these factors.

The *n* column refers to the number of raw data values in a subgroup; in PowerSPC *n* is the calc size.

The headings at the top of the table list the types of factors, which are used in the following ways:

- A_2: Used to compute UCL and LCL for xbar and median-bar of XBARR and Median charts, respectively.
  UCL, LCL = GRANDX +/- A_2 * RBAR, or
  UCL, LCL = MedianBAR +/- A_2 * RBAR.
  (Currently, PowerSPC does not support Median Charts.)
- A_3: Used to compute UCL and LCL for xbar of XBARS charts.
  UCL, LCL = GRANDX +/- A_3 * SBAR
- B_3: Used to compute LCL for standard deviation in Standard Deviation charts.
  LCL = B_3 * SBAR
- B_4: Used to compute UCL for standard deviation in Standard Deviation charts.
  UCL = B_4* SBAR
- c_4: Used to estimate the process sigma.
  sigma ~ = SBAR / c_4
- D_3: Used to compute LCL for Range and Moving Range in Range and Moving Range charts.
  LCL = D_3 * RBAR
  LCL = D_3 * MOVRNGBAR
- D_4: Used to compute UCL for Range and Moving Range in Range and Moving Range charts.
  UCL = D_4 * RBAR
  UCL = D_4 * MOVRNGBAR
- d_2: Used to estimate the process sigma.
  sigma ~ = RBAR / d_2
- E_2: Used to compute UCL and LCL for raw data of INDIV charts.
  UCL, LCL = XBAR +/- E_2 * RBAR
- d_3, D_2, and E_3: Currently not used.
- Control Limit formulas for P, NP, C, and U charts:
  UCL, LCL for P charts: PBAR +/-3 * sqrt ((PBAR * (1 - PBAR)) /n)
  UCL, LCL for NP charts: NPBAR +/-3 * sqrt (NPBAR * (1 - PBAR))
  UCL, LCL for C charts: CBAR +/-3 * sqrt (CBAR)

UCL, LCL for U charts: UBAR +/-3 * sqrt (UBAR/n)
where n is the sum of all accepted subgroup quantities divided by the number of subgroups.

n	A_2	A_3	B_3	B_4	c_4	d_2	d3*	D2*	D_3	D_4	E_2	E3*
2	1.880	2.659	0	3.267	0.7979	1.128	0.853	3.686	0	3.267	2.659	3.760
3	1.023	1.954	0	2.568	0.8862	1.693	0.888	4.358	0	2.575	1.772	3.385
4	0.729	1.628	0	2.266	0.9213	2.059	0.880	4.698	0	2.282	1.457	3.256
5	0.577	1.427	0	2.089	0.9400	2.326	0.864	4.918	0	2.114	1.290	3.192
6	0.483	1.287	0.030	1.970	0.9515	2.534	0.848	5.079	0	2.004	1.184	3.153
7	0.419	1.182	0.118	1.882	0.9594	2.704	0.833	5.204	0.076	1.924	1.109	3.127
8	0.373	1.099	0.185	1.815	0.9650	2.847	0.820	5.307	0.136	1.864	1.054	3.109
9	0.337	1.032	0.239	1.761	0.9693	2.970	0.808	5.393	0.184	1.816	1.010	3.095
10	0.308	0.975	0.284	1.716	0.9727	3.078	0.797	5.469	0.223	1.777	0.975	3.084
11	0.285	0.927	0.321	1.679	0.9754	3.173	0.787	5.535	0.256	1.744	0.946	3.076
12	0.266	0.886	0.354	1.646	0.9776	3.258	0.778	5.594	0.283	1.717	0.921	3.069
13	0.249	0.850	0.382	1.618	0.9794	3.336	0.770	5.647	0.307	1.693	0.899	3.063
14	0.235	0.817	0.406	1.594	0.9810	3.407	0.763	5.696	0.328	1.672	0.881	3.058
15	0.223	0.789	0.428	1.572	0.9823	3.472	0.756	5.740	0.347	1.653	0.864	3.054
16	0.212	0.763	0.448	1.552	0.9835	3.532	0.750	5.782	0.363	1.637	0.849	3.050
17	0.203	0.739	0.466	1.534	0.9845	3.588	0.744	5.820	0.378	1.622	0.836	3.047
18	0.194	0.718	0.482	1.518	0.9854	3.640	0.739	5.856	0.391	1.609	0.824	3.044
19	0.187	0.698	0.497	1.503	0.9862	3.689	0.733	5.889	0.404	1.596	0.813	3.042
20	0.180	0.680	0.510	1.490	0.9869	3.735	0.729	5.921	0.415	1.585	0.803	3.040
21	0.173	0.663	0.523	1.477	0.9876	3.778	0.724	5.951	0.425	1.575	0.794	3.038
22	0.167	0.647	0.534	1.466	0.9882	3.819	0.720	5.979	0.435	1.565	0.785	3.036

n	A_2	A_3	B_3	B_4	c_4	d_2	d3*	D2*	D_3	D_4	E_2	E3*
23	0.162	0.633	0.545	1.455	0.9887	3.858	0.716	6.006	0.443	1.557	0.778	3.034
24	0.157	0.619	0.555	1.445	0.9892	3.895	0.712	6.032	0.452	1.548	0.770	3.033
25	0.153	0.606	0.565	1.435	0.9896	3.931	0.708	6.056	0.459	1.541	0.763	3.031
>												

* Currently not used.

USER-DEFINED CONTROL LIMIT CALCULATION FACTORS

Some SPC organizations use control limits that are above or below three sigma, extend their tables beyond n = 25, or for some other reason prefer other factors. PowerSPC allows you to define your own control limit calculation factors through the PowerSPC Control Limit Factors option in the Configuration Manager. If you define your own limits, they replace existing factors as described in the preceding section of this chapter.

In the event that PowerSPC does not find a factor for a specified subgroup size at run time, it displays an error message. For example, if you use a subgroup size of 30 (PowerSPC only defines up through 25) and you did not define a control limit calculation factor for that size, you will receive an error message at run time.

Perform the following steps to specify your own control limit calculation factors including modifying existing factors:

1. Choose PowerSPC Control Limit Factors from the Configuration Manager Main Menu (no domain selection is required).
2. Enter a factor name (e.g., A_2, D_3,...) in the Factor Name field in the SPC Control Limit Calculation Factor Names panel. Optionally, enter a description in the Factor Description field.
3. Save the data and click Next.
4. Enter the subgroup sizes and the factor values in the provided fields in the SPC Control Limit Calculation Factor Values panel.

- **USER-DEFINED CONTROL LIMIT CALCULATION FACTORS**
- *User-defined Control Limit Calculation Factors*
-
-

Glossary . . .

A

acceptance criteria (For acceptance sampling) Number of units from the sample group that must pass all defined measurements and/or inspections to pass the entire lot. See also, "acceptance sampling."

acceptance sampling Method of measuring or evaluating a specified number of sample units from a lot. Of the samples collected, a certain number must pass all measurements and/or evaluations before the entire lot passes. This is useful if you are measuring the quality of goods produced by another manufacturer. See also, "acceptance criteria."

accepting data After evaluating the collected raw data to determine whether it is valid, SPC "accepts" the valid data and stores it in the database. If the data is invalid (this can happen if the measuring device fails), SPC can reject the data until it is re-measured, re-evaluated, and determined to be valid.

actual chart An SPC control chart displaying data exactly as SPC monitors and calculates it during collection. An "actual" chart is also called an "as monitored" chart. See also, "Ad Hoc chart."

Ad Hoc chart Copy of an SPC control chart that reflects hypothetical values. The operator can define and change hypothetical values at run time and see their effects on the ad hoc chart without affecting the actual chart. (SPC continues to operate as configured in the sample plan.) Ad hoc charts let the operator look at "what if" scenarios, such as what would the data look like if he or she changed the run rules, subgroup size, and/or control limits. This can help in determining whether it would be more effective to use different run rules, subgroup size, or control limits, than what is currently set up in the sample plan. See also, "As Monitored chart."

> **Note:** Because showing an ad hoc chart requires more system resources than showing just an actual chart, we recommend that the operator display it only when the process can tolerate the slower system performance.

As Monitored chart An SPC control chart displaying data exactly as SPC monitors and calculates it during collection. An "as monitored" chart is usually called an "actual" chart. See also, "Ad Hoc chart."

assignable cause (of variation) Cause of a variation in a process that is not random; that is, an operator can determine and perhaps eliminate the source of the variation. For example, a power outage or equipment malfunction could be an assignable cause. You can configure SPC to consider data attributed to an assignable cause invalid and to exclude it from control limit recalculations.

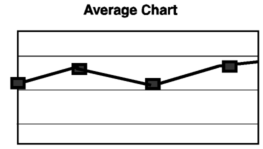
attribute data See “characteristic data.”

auxiliary data Additional data about a sample upon which SPC does not perform a calculation, such as an operator’s name or the process line number. SPC stores this data in the database along with the raw data.

average calculation Result of dividing the sum of a group of measurements by the number of units measured, as shown in the formula. This is also called “mean.” The result is shown on an average chart. See also, “mean” and “XBAR.”

$$AVG = \frac{\Sigma X}{n}$$

average chart Control chart showing the result of an average calculation. See also, “average calculation.”



AVG See “average calculation.”

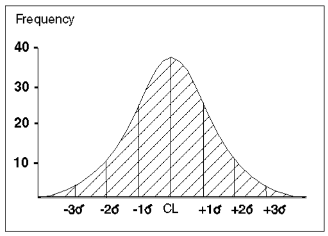
B

BAR calculation An average across subgrouped data. For example, RBAR is the average of the ranges for the subgroups in a plot. See also, “XBAR,” “RBAR,” “SBAR,” and “POINTSBAR.”

bar chart Chart that shows either the results of a frequency distribution or the number of defects or defective units in a subgroup. SPC supports three types of bar charts: histogram, pareto, and pareto-defect.

batch See “lot.”

bell-shaped curve
A curve that has the shape of a bell. The normal or Gaussian distribution of values is an example of a bell-shaped curve. The mean (average) value is the most frequent value in a bell-shaped curve.



Bell-Shaped Curve

C

c calculation
(For characteristic data) Calculation that determines the number of defects in a subgroup of a fixed size. This calculation is useful when each unit might have more than one defect, such as several bubbles, or when each unit may have more than one type of defect, such as a bubble and a dent. You can display the results on a c chart.

Example

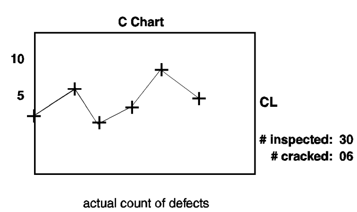
If calc size = 5 and those 5 units have a total of 8 bubbles, 3 dents, and 1 scratch, then c for bubbles = 8, c for dents = 3, and c for scratch = 1.

Use this calculation only when the subgroup size remains constant. If the subgroup size is not constant, use a u calculation. If you are calculating defectives, use p or np.

See also, “c chart.”

c chart
(For characteristic data) Control chart showing the number of defects found in a subgroup of a fixed size. The center line is the average “c” across all subgroups plotted. (See also, “CBAR.”)

See also, “c calculation” and “u chart.”



calculation Mathematical process performed on data. SPC can perform the following calculations:

XBARRANGESTDDEV (Standard Deviation)	CP CPKMINIMUMMAXIMUMGR AND XRBAR
AVERAGEINDIV (Individual)	($\overline{R}$)SBAR ($\overline{S}$)KURTOSISSKEWNESSPOI NTSBAR
SPLIT (Split Mean)	
EWMAMOVAVG (Moving Average)	
MOVRNG (Moving Range) CUNPP	

capability index (Cp and Cpk) Number that shows the capability of a process or machine to produce units that meet engineering specifications. SPC provides the industry standard Cp or Cpk calculation. See also, “Cp,”, “Cpk,” “machine capability,” and “process capability.”

cause Reason that a variation in quality exists for a particular time period or point of data for a manufacturing process. Causes are either random causes (also called “chance” or “common” causes), such as a shift change, or assignable causes.

cause class Group name of cause codes that are related by some factor. See also, “cause code.”

cause code Code that you define to identify the cause of a change or adjustment that commonly occurs during a process, such as a shift change. You can group related cause codes into categories called classes. See also, “cause class.”

CBAR The average of the c values for all subgroups on a chart, as shown in the formula. See also, “c chart.”

$$\text{CBAR} = \frac{\Sigma c}{k}$$

where k = number of subgroups

cell (of frequency distribution and/or histogram) Bar that appears on a histogram or Pareto or Pareto-defect chart. A bar’s height indicates the number of times a condition occurred.

center line
: (For control charts) Horizontal line marking the center of the chart, usually indicating the nominal expected value of the quantity being charted. SPC can calculate an actual center line as part of the control limits. The calculated center line is one of the BAR calculations.

characteristic data
: Data collected about either the number of defects, such as bubbles or dents, or the number of defective units. The data is usually either a count of the defects found or a yes/no or pass/fail determination of whether the unit conforms to standards. The data may or may not include weighting by seriousness of defect, etc. Characteristic data is also called “attribute data.”

chart
: Graphical representation of data collected by SPC. SPC supports both bar charts and control charts.

common cause
: Cause of a variation that the operator cannot do anything about because it is built into the process. Common causes are continuously active in the process. Common causes are also called “random” or “chance” causes.

constant
: Unchanging quantity; that is, any numeric or string expression that contains no variables.

continuous data
: Measurement data for a continuous variable. This variable data can assume any value within a specified range. The data’s possible value is constrained only by the measuring device and computational precision. For example, a laser can measure a particular dimension at 5.8216 while an operator can manually only measure it at 5.8. See also, “continuous variable.”

continuous variable
: Variable used to represent continuous data that can assume any of a range of values; for example, the measured length of a part.

control
: See “statistical control (of a process).”

control (of process) (manufacturing)
: A process is said to be in a state of control if its variations fall within specified control limits. (This has no relation to “statistical control.”)

control chart
: Graphical representation of the results from an SPC calculation(s). A control chart plots a particular parameter of process performance. The parameter plotted is usually determined by regular sampling of the product, as a function of time, unit number, or any other chronological variable. The control limits may also plotted for comparison. The parameter plotted can be the average value of a particular measurement for a product sample of a specified size (XBARR chart), the range of values in the sample (R chart), the percent of defective units in the sample (P chart), etc.

SPC supports the following types of control charts:

INDIV (Individual raw data values)	STDDEV (Standard Deviation)
EWMAMOVRNG (Moving Range)	RANGE SPLITCU NPP
MOVAVG (Moving Average)	
AVG (Average)XBARRXBARSCP CPK	

control limits A process is said to be in control if the process that produces the product remains inside boundaries referred to as control limits. You can preset the control limits to existing values and/or trigger SPC to recalculate them based on the data. On a control chart, the upper control limit and the lower control limit are a default distance of 3σ on either side of the center line.

Cp (For process capability studies) Capability index that uses the Cp formula to measure the potential ability of a process to produce units within the tolerance limits. Cp is a gauge of the actual process or product variability to the desired variability. Cp can range in value from **0** to infinity, with a larger value indicating a more capable process. A value above 1.0 signifies that the process is capable of producing a product at a 3σ quality level.See also, “capability index (Cp and Cpk).”

$$Cp = \frac{Total\ Tolerance}{6 \times \sigma} = \frac{USL - LSL}{6\sigma}$$

Cpk (For process capability studies) Capability index that measures how capable a process is of producing units within the specifications or tolerance limits. If the process is centered on the mean specification, Cpk has a value equal to Cp. If Cpk is negative, the process mean is outside the specification limits; if Cpk is between 0 and 1, some of the 6σ spread falls outside the tolerance limits. If Cpk is larger than 1, the 6σ spread is completely within the tolerance limits. See also, “capability index (Cp and Cpk).”

$$Cpk_l = \frac{\bar{x} - LSL}{3\sigma}$$

$$Cpk_u = \frac{USL - \bar{x}}{3\sigma}$$

$$Cpk = min(Cpk_l, Cpk_u)$$

Cpk Formula

where

USL = Upper specifications limit
LSL = Lower specification limit
$\bar{\chi}$ = Grand average from control chart (X-Bar)

D

database alias name Alias name you assign to each database defined in the Historian Information panel. SPC uses this alias name to access the corresponding database. For information, see the *FactoryLink ECS Configuration Guide.*

dimension data Data collected by measuring a dimension, such as the length, weight, or temperature, of a unit (as opposed to “characteristic data”). The value of the dimension for each unit varies depending on the precision of the measuring instrument. For example, the measurement may vary between 5.100 and 5.250 from unit to unit. This is also called “variable data” or “continuous data.”

E

Exponential Weighted Moving Average (EWMA) calculation

Calculation that gives less and less weight to data as the data gets older and older. This is similar to a Moving Average calculation, but SPC applies less weight to older data. SPC displays the results of this calculation on an EWMA chart. The higher the number (λ), the shorter the memory and the less influence that older points have. Recommended (λ)values are 0.2 ± 0.1. See also, "EWMA chart."

$$EWMA = \hat{y}_t + \lambda(y_t + \hat{y}_t)$$

Where

y_t = Observed value at time t

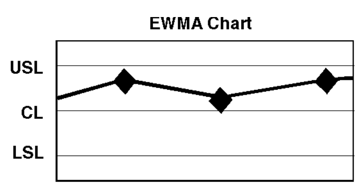
$\hat{y}_t$ = Predicted value at time t (oldEWMA)

$e_i = y_t + \hat{y}_t$ = Observed error at run-time of t

$\lambda = (0 < \lambda < 1)$ = Depth of Memory of EWMA

EWMA chart

Control chart showing the results of an EWMA calculation. You can give a plotted point on an EWMA chart a long memory (small λ), thus providing a chart similar to the ordinary CUSUM chart; or you can give it a short memory (large λ)and provide a chart analogous to a Shewhart (XBAR) chart. See also, "Exponential Weighted Moving Average (EWMA) calculation."



F

frequency distribution

The number of times each value from a population sample occurs. Data is grouped to show the desired number of intervals, called "bars" or "cells." SPC displays the results on a histogram. See also, "histogram."

G

gap record

A "gap" record will show up on your control charts as a gap in the data and any control or specification lines. This maybe useful to indicate shift, lot, or product changes.

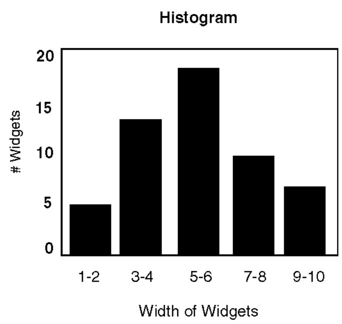
Grand X calculation Calculation to determine the average of the entire population of data represented in a chart. Grand X calculates the average of the subgroup values. Grand X is equal to XBAR when the calc. size has not changed across subgroups. SPC can perform Grand X calculations for the following control charts: H

$$\frac{\bar{x}_1 + \bar{x}_2 + \ldots + \bar{x}_k}{k}$$

XBARR	Split
XBARS	Moving Average
AVG (Average)	Moving Range
STDDEV (Standard Deviation)	EWMA
RANGE	Individual

H

histogram Bar chart that displays the frequency distribution of a variable. The range of the variable is separated into intervals of equal size. The number of observations in each interval is counted, and that number is represented by the bar of the appropriate height for that interval. The X axis shows the center value for each cell; the Y axis shows the frequency. See also, "frequency distribution."

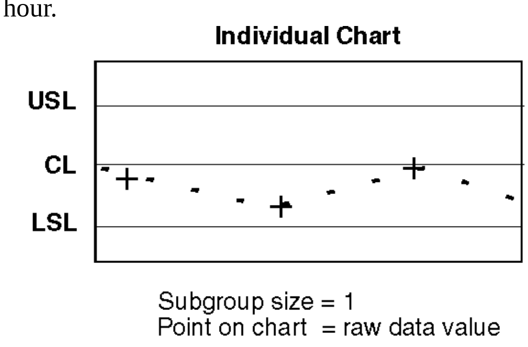


I

in control (chart) Condition in which the points plotted on a control chart vary, but remain within the control limits.

in control (process) Manufacturing process that is determined to be producing products within acceptable quality levels.

individual chart (INDIV) Control chart on which each plotted point represents one raw data sample. An individual chart is generally accompanied by a moving range chart, which normally spans a range of two points. These charts are typically used for processes that produce very few units over time; for example, one per hour.



K

kurtosis calculation Population calculation to indicate the relative flatness or peakedness of the distribution. Use the result of the kurtosis calculation to identify distributions that are symmetrical, but not normal. If the kurtosis value is positive, the distribution is flatter than a normal distribution; if it is negative, the distribution has shorter tails. If the kurtosis value is 0, the distribution is normal.

$$Kurtosis = \frac{\Sigma(x-\bar{x})^4}{N\left(\frac{\Sigma(x-\bar{x}^2)}{N}\right)^2} - 3$$

L

LCL Lower Control Limit. For control charts, the limit above which the process statistic remains when it is in control. Typically, SPC calculates the lower control limit by subtracting 3σ from the center value (center line). See also, Appendix B, “User-defined control limit calculation factors.”

LCL = center line - 3σ

LSL Lower Specification Limit. The lowest acceptable value of a product dimension or measurement according to the engineering specification.

lot The group (such as a shipment, case, etc.) from which SPC samples and measures units. Lot is also called a “batch.” See also, “lot size.”

lot size Number of units in the lot from which SPC takes samples. Lot size is often used in acceptance sampling to define the size of the group (such as a shipment, case, etc.) from which the units will be taken and measured (sample size). SPC applies the results of the measurement or inspection of the sample to the entire lot.

M

machine capability Short-term ability of a machine to make a uniform product. You can measure this by comparing the specified dimension to the spread (6σ) of the dimension that the machine is producing. See also, “capability index (Cp and Cpk).”

master table Database table that contains a list of names and corresponding IDs. SPC references these tables frequently, but rarely updates them. See also, “transaction table.”

maximum calculation Population calculation to determine the maximum raw data value from all points shown on a chart.

mean Average value of a group of data values. Mean is also called “average.” To determine the mean value, use the average calculation. See also, “average calculation.”

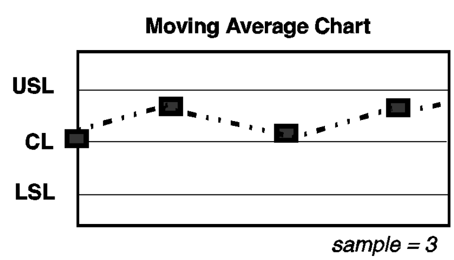
median Midpoint of a group of data values; 50% of the data values fall above the median value and 50% fall below.

minimum calculation Population calculation to determine the minimum raw data value from all points shown on a chart.

mode The most common data value in a group of data values.

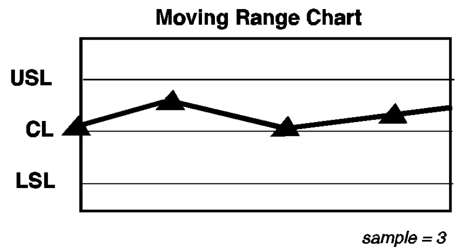
moving average calculation Same calculation as the average except that after the first calculation, SPC performs the calculation each time it gathers a raw data sample, providing a moving window of average values. Used to dampen the effects of a single reading when very few readings are made in a period, or when a process is strongly linked to a previous period’s output.

moving average chart Control chart showing points that are averages of the previous day’s (or hour’s or shift’s) data carried forward to the current day (or hour or shift). See also, “moving average calculation.”



moving range calculation Same calculation as the Range except that after the first calculation, SPC performs the calculation each time it gathers a raw data sample, providing a moving window of range values. Used to dampen the effects of a single reading when very few readings are made in a period, or when a process is strongly linked to a previous period's output.

moving range chart — Control chart showing points that are ranges of the previous day's (or hour's or shift's) data carried forward to the current day (or hour or shift). See also, "moving average calculation."



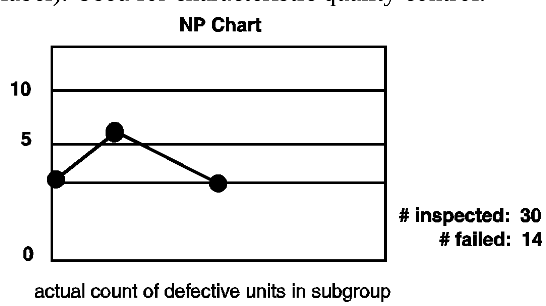
N

n — The number of raw data values used in a subgroup.

np calculation — (For characteristic data) Calculation that determines the number of defective units. SPC displays the results on an np chart.

Use this calculation only when the subgroup size remains constant. If the subgroup size is variable, use a p calculation. If you are calculating defects, use c or u.

np chart — (For characteristic data) Control chart showing the number of units that are defective (such as units that are leaking, the wrong color, or missing a label). Used for characteristic quality control.



normal distribution — Type of distribution in which the measurements tend to cluster around the middle. Many naturally occurring events fall into normal distribution. This is also called a "bell-shaped curve." Abnormal distributions tend to be asymmetrical, with a larger tail on one side, or appearing too flat or peaked. See also, "bell-shaped curve," "kurtosis," and "skewness."

O

out of control (Out of CNTL) Condition in which the points plotted on a control chart go outside the control limits. These points can have assignable causes and/or can cause violations of run rules. Control limits are commonly set at plus or minus three sigma from the mean.

out of specification (Out of Spec.) Condition when points plotted on a control chart fall outside of the Specification Limit lines.

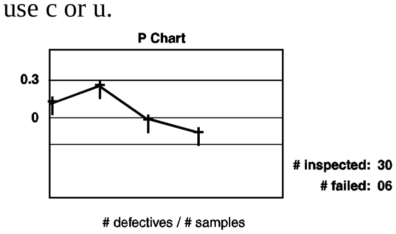
P

p calculation (For characteristic data) The fraction of defective units to total units in a subgroup. SPC displays the results on an p chart. This is used in place of an np calculation when subgroup sizes are unequal. See also, “percent defective.”

$$p = \frac{\text{number of defective units}}{\text{total units in subgroup}}$$

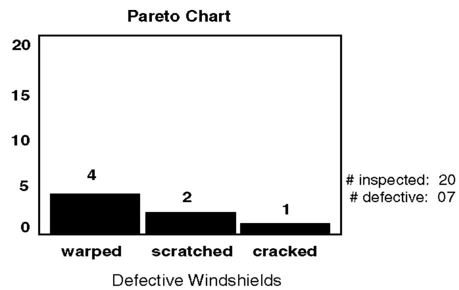
p chart (For characteristic data) Control chart showing the ratio of defective units to the number of units inspected.

Use this calculation when the subgroup size is variable. If the subgroup size is constant, you may use an np calculation. If you are calculating defects, use c or u.

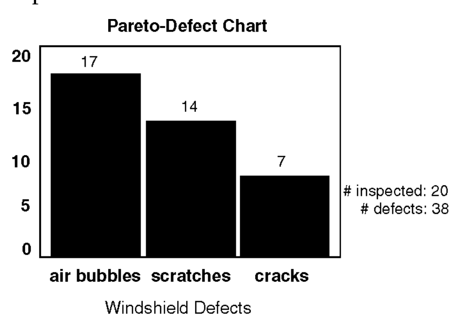


Pareto analysis Analysis of how often each type of problem (or defect) occurs. This helps you to decide which problems to solve first by ranking the problems by how often they occur. The principle is that only a small number of concerns are responsible for most quality problems. (For example, 20% of the concerns might cause 80% of the problems.) The results can be plotted on a Pareto or Pareto-defect chart. See also, “Pareto chart” and “Pareto-defect chart.”

Pareto chart — Bar chart showing the number of defective units. A unit is classified as defective for only one reason. The total number of defective units must be less than or equal to the number of units sampled. The chart shows the most frequently occurring defect (which caused the units to be defective) first, the next most frequently occurring defect second, and so forth.



Pareto-defect chart — Bar chart showing how often various defects occurred. The chart shows the most frequently occurring defect first, the next most frequently occurring defect second, and so forth. Because a defective part may have multiple defects, the total number of defects can be greater than the number of units sampled.



percent defective — (For acceptance sampling) Percentage value obtained from the ratio of the number of defective units (of unacceptable quality) in a lot to the number of units in a lot.

point (on a chart) — Marker on a chart representing the calculated value of all raw data values for a dimension collected from a subgroup or, in the case of INDIV charts, a single raw data value.

Example

Suppose that SPC measures the height of a subgroup of five glass bottles. Each subgroup of five values would produce a calculated value that would be plotted on a chart. In the case of an average chart, SPC averages the five raw data values for height. In this manner, each point represents the average of five raw data values.

POINTSBAR calculation — Population calculation to determine the average of all points (calculated values) on a chart. Power SPC allows one chart graphics object to be used by multiple types of charts (see Chart Select Scroll Tag on Chart Definition panel). The POINTSBAR calculation allows a relevant population statistic to be displayed regardless of the chart type. You can configure SPC to let the operator perform POINTSBAR calculations on any control chart in the table below. SPC displays the result in an output-text tag.

The type of POINTSBAR calculation SPC performs varies depending on the chart type. This correlation is shown below:

Type of Chart	Name of Points BAR Calculation and Result
XBARR	* Grand X
XBARS	* Grand X
Average	* Grand X
Standard Deviation	SBAR
R (range)	RBAR
Split	* Grand X
Moving Average	MOVAVGBAR
Moving Range	MOVRNGBAR
EWMA	EWMABAR
Individual	* Grand X
c	CBAR

Type of Chart	Name of Points BAR Calculation and Result
u	UBAR
np	NPBAR
p	PBAR

population Set of all data displayed on a chart at a given time. The chart population can increase or decrease in size by changing the number of points displayed on a chart. SPC can perform the following calculations on the entire population:

See also, “population calculation.”

POINTSBAR	Minimum	Average	NP
Cp	Maximum	Standard Deviation	P
Cpk	RBAR	Range	
Grand X	SBAR	C	
Kurtosis	Skewness	U	

population calculation Any calculation performed on all data displayed on a chart at a given time.

PowerSPC debug switches The following table describes the various session levels of debug switches for PowerSPC log files.

Type of Debug Switch	Definition for Message
-l1 -v4 (LEVEL_FATAL)	Reports fatal level messages
-l2 -v4 (LEVEL_ERROR)	Reports error level messages
-l3 -v4 (LEVEL_SYST)	Reports system level messages
-l4 -v4 (LEVEL_WARN)	Reports warning level messages

Type of Debug Switch	Definition for Message
-l5 -v4 (LEVEL_INFO)	Reports informational level messages
-l6 -v4 (LEVEL_CODE)	Reports code level messages
-l7 -v4 (LEVEL_TEST)	Reports test level messages
-l8 -v4 (LEVEL_FUNCT)	Reports high level function calls
-l9 -v4 (LEVEL_CLOG)	Reports client log SQL statements
-l10 -v4 (LEVEL_LLFUNCT)	Reports all low level calls (RTDB)
-l11 -v4 (LEVEL_DBFUNCT)	Reports all low level database calls
-l12 -v4 (LEVEL_TIMING)	Reports time with low level calls

process Manufacturing operation that produces specific products.

process capability Long-term ability of a process to make a uniform and acceptable product. You can measure this by comparing the spread (6σ) of the data to the specified dimension. You can express process capability by the percentage of defective products, the range or standard deviation of some product dimension, etc. You can usually determine process capability by collecting measurements on some (or all) of the product units produced by the process. See also, “capability index (Cp and Cpk).”

process sampling Method of measuring or inspecting units as they are being produced and displaying the results on charts so that the operator can see when a problem begins.

Q

quality characteristic Particular aspect of a product that relates to its ability to perform its intended function.

R

R (range) calculation Calculation to determine the difference between the largest and smallest raw data values in a subgroup. This statistic requires a subgroup size of at least two.

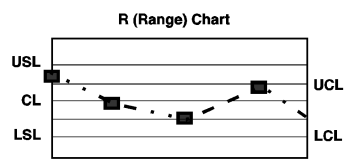
$$R = X_S - X_L$$

where

X_S = smallest value in subgroup

X_L = largest value in subgroup

R (range) chart A control chart displaying the range of variation among the raw data values that make up each subgroup; that is, the difference between the largest and smallest values—as a function of time.



RBAR ($\overline{R}$) calculation

Population calculation to determine the average range of all the points (calculated values) shown on a chart. SPC can perform RBAR calculations on the following control charts:

$$RBAR = \frac{\sum_{i=1}^{k} R_i}{k}$$

XBARR	Split
XBARS	Moving Average
Average	Moving Range
Standard Deviation	EWMA
R (range)	Individual

relational subgrouping

(For control charts) Subgroup of units selected to minimize differences due to assignable causes. If the sample size correctly represents the variability of the process, then samples taken consecutively from a process operating under the same conditions usually meet this requirement.

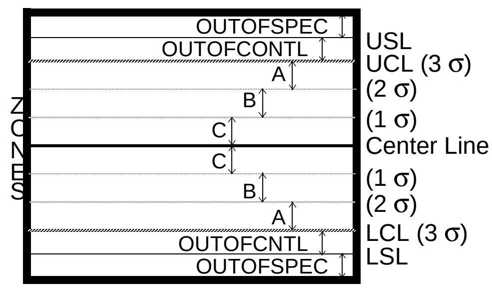
Example

If a bottle capping machine applies caps to six bottles at a time using a subgroup size of six, then samples taken most clearly represent the variability between the six capping heads.

run rule — Analysis of patterns in the points on a control chart to identify a process that is out of statistical control. Patterns such as trends, or several consecutive values near a control limit, can indicate the presence of non-random variation.

The graphic to the right shows the chart zones on which the FactoryLink SPC run rules are based.

You can define your own run rules or use any of the following standard Western Electric run rules:



2OF3	8CONS
4OF5	3SIGMA
TREND	

For definitions of these run rules, see "Western Electric run rule."

run rule filter — Means of either ignoring violations that occur on a particular side of the center line, or of resetting a violation count at the point that a plotted line crosses the center line.

S

sample — (For acceptance sampling) Representative group of units selected from a lot. The sample is used to estimate the properties of the lot.

sample plan Set of values and instructions that controls what data the system collects, calculates, evaluates, stores, and displays. It also defines the contents of each sample, including its dimensions and characteristics. SPC uses the values in the sample plan to build lists of calculations, run rules, and charts that the operator can choose from at run time.

sample size (For acceptance sampling) Number of units to be evaluated in a sample group (generally referred to as "n").

sampling See "acceptance sampling."

sampling variation Variation of a sample's properties from the properties of the lot from which it was drawn. If the sampled variation is a function of subgroup size, then the larger the sample size, the smaller the sampling variation.

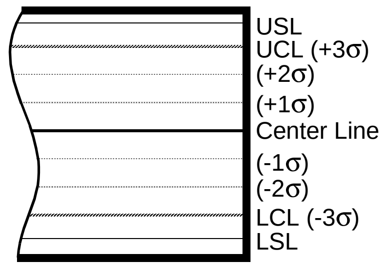
SBAR ($\overline{S}$) calculation Population calculation to determine the average standard deviation of all of the points of data (calculated values) represented in a chart. SPC can perform SBAR calculations on the following control charts:

$$\bar{s} = \frac{\sum_{i=1}^{k} s_i}{k}$$

XBARR	Split
XBARS	Moving Average
Average	Moving Range
Standard Deviation	EWMA
R (range)	Individual

sigma (σ) Standard deviation of a statistical population. See also, "Standard Deviation calculation (sample)."

sigma (σ) limits Lines marked on a chart that indicate standard deviations above and below the center line (mean). If you specify that you want sigma (σ) limits to appear on a chart, SPC draws the limit lines at $\pm 1\sigma$ and $\pm 2\sigma$, and draws the control limit lines at $\pm 3\sigma$.



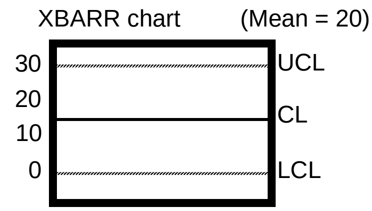
skewness calculation Calculation to determine a population's symmetry about the center line (mean). A skewed population is not symmetrical, having a longer than normal tail on one side.

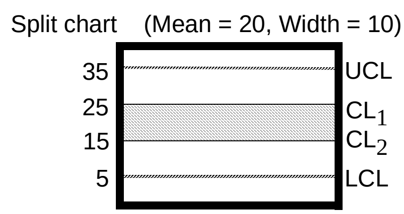
$$skewness = \frac{\Sigma(X - \bar{X})^3}{N^* \left(\frac{\Sigma(X - \bar{X})^2}{N}\right)^{1.5}} - 3$$

SPC Statistical Process Control. Method of gathering and analyzing data grouped into sets or subgroups, and using calculations to make judgments on the quality level of a process.

specification limits (USL, LSL, and nominal) Product specification tolerance limits (USL, LSL, and nominal) that are externally determined by management, engineers, product developers, or possibly customers. Generally, parts must fall within specification limits to be acceptable.

split chart or split mean chart
This chart contains two center lines. This generally results from a process that has two or more underlying distributions. The upper center line and UCL corresponds to a distribution with a larger average and the lower center line and LCL corresponds to a distribution with a smaller average.



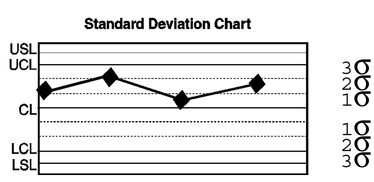


stability (of a process)
A process is said to be “stable” if it shows no recognizable pattern of change and it produces products of consistent quality.

Standard Deviation calculation (sample)
Calculation to determine the amount of variation in a process; describes the amount of deviation from the mean. SPC displays the results on a Standard Deviation (S) chart. See also, “Standard Deviation (S) chart.” A sample standard deviation uses an n-1 denominator whereas a population standard deviation uses an n denominator. As sample size becomes large and approaches the population size, these two standard deviations converge.

$$s = \sqrt{\frac{\sum (X - \bar{X})^2}{n - 1}}$$

Standard Deviation (S) chart
Control chart that displays the results of a Standard Deviation calculation. Each subgroup’s standard deviation is plotted on the chart and the centerline is SBAR. See also, “Standard Deviation calculation,” and “SBAR.”



statistical control (of a process) A process is said to be in a state of statistical control if the process exhibits only random variations (as opposed to systematic variations which may derive from known sources, such as those with assignable causes).

subgroup (For control charts) One or more units measured or inspected from a population; generally measured or inspected at or near the same time.

subgroup size Number of units (usually consecutive) for which SPC will collect data before performing a calculation on the data, generally referred with the variable "n."

T

tolerance The range of variation that is considered acceptable in a particular dimension of a product. Tolerances are often set by engineering requirements to ensure that components will function together properly. See also, "USL" and "LSL."

transaction Each new set of raw or calculated data values stored in the database. See also, "transaction table."

transaction table Database table that stores transactions of data. See also, "transaction" and "master table."

trend A pattern of systematic change with time or another variable. SPC uses run rules to look for variables with an increasing or decreasing tendency. For example, the standard Western Electric run rule TREND looks for seven consecutive points that all increase or all decrease.

U

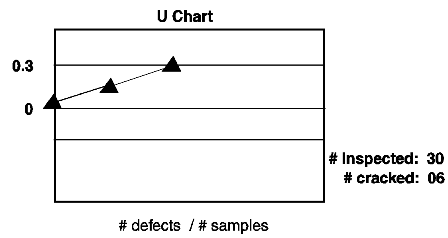
u calculation (For characteristic data) Calculation that determines a ratio of the number of defects to the number of units inspected. SPC displays the results on a u chart.

Use this calculation if your subgroup size is variable; otherwise, a c calculation could be used. Also, use the u calculation if you want the chart to display the average number of defects per unit. If you are calculating defectives, use p or np.

Example

If	Then
subgroup size = 5 and those 5 units have a total of 8 bubbles, 3 cracks, and 1 scratch	for bubbles, u = 8/5 = 1.6 for cracks, u = 3/5 = .6 for scratches, u = 1/5 = .2

u chart — (For characteristic data) Control chart comparing the average number of defects per subgroup over time. See also, "u calculation, "c chart," and "UBAR."



UBAR or $\bar{u}$ — The average u calculation across all subgroups in a population. This is often used as a center line for a u chart.

$$\bar{u} = \frac{\sum_{i=1}^{k} u_i}{k}$$

UCL — Upper Control Limit. For control charts, the upper limit below which a process remains if it is in control. To calculate this limit, SPC uses the formula shown. See also, "control limits." Also see, Appendix B, "User-defined control limit calculation factors."

$$UCL = center\ line + 3\sigma$$

unit — A product being manufactured.

USL — Upper Specification Limit. The highest acceptable value of a product dimension according to engineering specifications.

V

value cursor	Power SPC allows users to query any point on a chart via a movable cursor. The value cursor is a vertical bar that appears on a control chart when the operator clicks anywhere on the chart. The operator selects a point on the chart. The value cursor indicates the selected point as it intersects the bar. This is useful for selecting a point on the chart to display information associated with that point.
variable data	See “dimension data.”
variables	Quantities that are subject to change or variability.
variance	Square of the standard deviation (= $\mathbf{s}^2$). See also, “standard deviation.”
violation of a run rule	Condition where a specified number of points meet the criteria for violating a run rule. SPC reports run rules violations to the operator through alarm tags that you define in the Process Options Monitor Control panel. When a process begins to violate run rules, the operator needs to take action to correct the problem before any or more defective parts are produced.

W

Western Electric run rule Rules developed by Western Electric and adopted as industry standards. At run time, these rules help determine whether a process is in control. See also, “run rule.”

Note: If you specify a run rule filter during configuration, the run rule behavior shown above is modified.

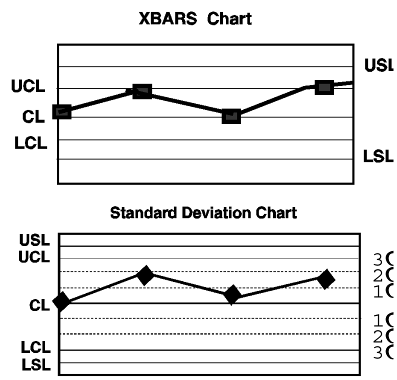
Rule	Definition
20F3	2 out of 3 points lie on one side of the Center Line in Zone A or beyond.
4OF5	4 out of 5 points lie on one side of the Center Line in Zone B or beyond.
TREND	7 points in a row are rising or falling on either side of the center line.
8CONS	8 points in a row lie on one side of the Center Line.
3SIGMA	One or more points lie outside of control limits.

-W[5-36,000] or -w[5-36,000] Sets the maximum timeout in seconds for PowerSPC to wait for a response from the Historian task. The default is 30 seconds.

For values less than 30 seconds, this switch will only work correctly when the Historian initially achieved a successful connection with the database server. If the Historian has never successfully connected with the database, PowerSPC will time out in 30 seconds regardless of this switch setting. The -w switch always works for timeouts set at more than 30 seconds, whether the Historian initially achieved a successful connection with the database sever or not.

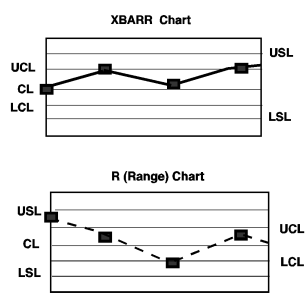
X

X Bar and R charts Two separate control charts typically displayed next to each other. One is an X Bar chart whose control limits are calculated using the range calculation (also called an XBARR chart). The other chart (called the R chart) displays the data based on the Range calculation.



X Bar and S charts Two separate control charts typically displayed next to each other. One is an XBARS chart, whose control limits are calculated using the standard deviation calculation. The other chart (called an S chart) displays the data based on the Standard Deviation calculation.

The S chart is considered a more accurate indication of process variability than the R chart.

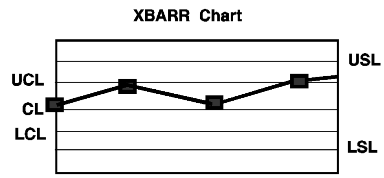


XBAR or $\overline{X}$ Another name for the arithmetic average. See also, “average calculation.”

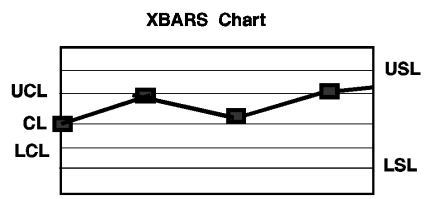
$$\overline{X} = \frac{\Sigma X}{n}$$

XBARR chart X Bar control chart in which control limits are calculated using the range calculation to estimate σ. The plotted line is XBAR.

See also, Appendix B, "User-defined control limit calculation factors."



XBARS chart X Bar control chart in which control limits are calculated using the Standard Deviation calculation to estimate σ.



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