Wonderware® FactorySuite®
SPC Pro

User's Guide

Revision A
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Trademarks

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Welcome to SPC Pro

Welcome to the Wonderware® InTouch™, SPC Pro add-on program. The SPC Pro program has been designed to provide fully integrated SPC features for use with Wonderware InTouch. SPC Pro provides you with the tools for creating InTouch applications that perform Statistical Process Control.

SPC is the acronym for Statistical Process Control. Statistical Process Control is a method of gathering and analyzing data from a process to solve practical quality problems. The term Statistical means that decisions will be based on numerical analysis. The term Process refers to the concern for a specific production process and its ability to produce output of consistent quality. The term Control means monitoring a process and adjusting it whenever necessary in order for the process to perform optimally. In summary, SPC is a method for monitoring and controlling a process by gathering data about the characteristics of the output, analyzing the data, and drawing conclusions based on that data.

Control and data entry for SPC is performed in runtime through either built-in dialog boxes or through DDE.

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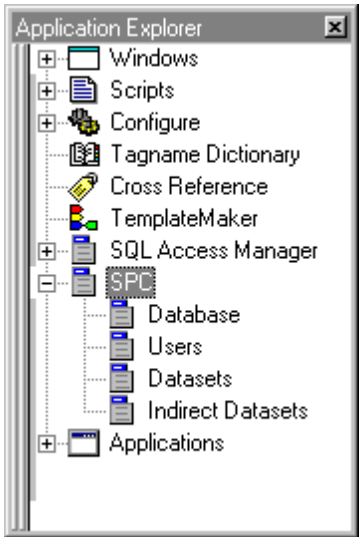
Installing SPC Pro

The Wonderware FactorySuite installation program is used to install InTouch and all of its add-on programs including, SPC Pro. InTouch runs on Microsoft Windows 95 or Windows NT operating systems. The installation program creates directories as needed, copies files from the compact disk to your hard drive, and adds the **InTouch for Windows** program to your Windows **Programs** menu. When you point to **InTouch for Windows**, a submenu appears listing all of the components of InTouch. For example, WindowMaker and WindowViewer.

📖 For complete installation instructions, refer to your FactorySuite installation booklet, or your *FactorySuite System Administrator's Guide*.

You will use the InTouch WindowMaker development environment to create and modify your SPC Pro applications. Control and data entry for SPC Pro is performed in the InTouch WindowViewer runtime environment either through built-in program dialog boxes or through DDE.

When you install the SPC Pro add-on program, it is automatically added to the WindowMaker Application Explorer. The Application Explorer provides you with quick access to all of the SPC Pro program's configuration commands. For example:



📖 For more information on the WindowMaker Application Explorer, see you *InTouch User's Guide*.

System Requirements

To run InTouch, we recommend the following hardware and software:

- Any IBM® compatible PC with a Pentium 100Mhz processor or higher.
- At least 100MB of free hard disk space.
- At least 32MB of random-access memory (RAM).

Note We recommend 5MB of RAM per 5K tagnames. For example, 32MB of RAM for 32K tagname support and 128MB of RAM for 60K tagname support.

- SVGA display adapter (2MB RAM recommended).
- Pointing device. For example, mouse, trackball, touch screen.
- Microsoft® Windows® 95 or Windows NT™ operating systems.
- For the Windows 95 operating system to implement the distributed functionality of InTouch, Wonderware NetDDE must be installed and operational.

Note Beginning with Wonderware FactorySuite InTouch Version 7.0, InTouch no longer supports the Microsoft Windows 3.x or Microsoft Windows for Workgroups operating systems.

SPC Pro Minimum Hardware requirements are a Pentium 133 with 32 meg ram for 10 automatic collection datasets or less. If more then 10 datasets use a Pentium Pro 200 with 64 meg ram.

The Basis of SPC

The quantitative measurement of quality characteristics is the basis of SPC. The idea is to gather enough samples so that you get to know the process you are monitoring. You know whether the process is running well or not, but more importantly, you get to know exactly what the limits of the process really are. Knowing the limits of a process is essential because every process and every system, *no matter how tightly controlled*, has some variation. This variation is the cumulative error of every element in the system. It is a built-in component and can only be changed by making changes in the system.

Normal process variations are known to have Common Causes. A system that produces output within the limits of its natural variations is considered to be in control. When a system is in control, it is operating optimally and therefore should be left alone.

For example, consider a requirement to drill a hole in a block of metal 1.0 inch from the edge. This requires that the metal block be positioned properly in the tool. The accuracy of the hole position might be ±.002 inches, due to the irregularities of the block itself, thus this represents the limits of this drilling process. No adjustment in the block positioning will improve these limits; in fact, making adjustments to this "in control" system would only make things worse. This knowledge of a system's natural variation is the essence of SPC. If the natural variation is known, one can focus on ways to reduce it. Small incremental changes, designed to improve process consistency, can be analyzed objectively rather than subjectively.

There are many causes of variation in a process that can be identified and eliminated rather easily. For example, when a tool wears down it can be replaced, when measuring instruments are not properly calibrated they can be reset, or when faulty raw materials are received, they can be returned to the vendor. These are called Assignable Causes, or Special Causes. Once an engineer can quantify Special Causes that are responsible for out-of-control conditions in the process, he can focus on the most frequent offenders and devise improvements to reduce their occurrence. This allows SPC to play an important role in implementing Total Quality Management (TQM).

In SPC terms, the natural variations of a process are referred to as the control limits. They are determined from many measurements of data taken over a long period of time. Within the scope of SPC, a measurement refers to a single instance of data, for example, a temperature is 78 degrees. A measurement is also called a reading or observation. A sample is a collection of one or more measurements used to calculate a point on an SPC chart. A group is any complete set of samples that is used to create an SPC chart. When multiple measurements are used as a sample, they are sometimes referred to as a sub-group.

Although the mathematical calculations involved in determining system control limits aren't that difficult, the theory behind them is obscure to most. The end result is that the control limits calculated for a given process represent a range into which 99.7% of the in control samples will fall. The calculation of control limits is an iterative process. In the first pass, all samples are used and initial limits are defined. Then, samples falling outside of the limits are eliminated and the limits are recalculated. This process continues until all remaining samples fall within the control limits, which represent true common cause control limits. Future samples can now be graphed against these limits. When a process is in control, a completely random pattern will emerge in the charts. The user can use these plots to monitor how the process is doing. Any discernible trends, unusual cycles or out-of-limit samples will be cause for alarm.

Typical SPC charts deal with two types of data: Variable and Attribute. Variable data consists of measurable parameters such as diameters, weights, temperatures, etc. Attribute data is a quantitative measurement, such as the number of rejected parts, number of defects per assembly, etc.

There are two distinct phases involved in setting up a quality program for a manufacturing process. The first phase is analytical. Quality Control engineers must evaluate the process to determine what data should be monitored and how often samples should be collected. Data must then be collected to obtain a history of the process. A process description can be derived from this history that will indicate the center of the process and natural variation.

Phase two of the program involves using the process description as a control element for alarm monitoring and optimization. Samples are collected on a regular basis and plotted on control charts whose centerline and range were determined by the historical data. The user can monitor these charts on their user interface screens, to see if the process is stable and within limits as it runs on the factory floor. If there are Special Cause variations in the operation, appropriate actions can be taken based on these observations to correct out-of-limit operation. In addition, the effects of any process setpoint changes or optimization strategies can also be observed and evaluated objectively. These continual improvement and optimization strategies are at the heart of practical implementation of Total Quality Management (TQM).

SPC Program Design Considerations

SPC has been designed to primarily address the needs of the plant floor user. By this we mean that the focus of the product is to provide immediate, real-time feedback on the process of interest. It has been designed to be a "tool" to assist the user; not to be just another job that the user is required to perform. As such, we have concentrated on making it easy to enter data, change the view of data, review alarms and assign comments and causes to the SPC samples. It lets the user ask "How am I doing?"; "Should I adjust it or should I leave it alone?"

Very little knowledge of SPC is required of the runtime operator. The application developer must be able to configure the SPC Datasets and create the SPC objects, but the operator only needs to know how to enter the data (which could also be automated) and how to respond to alarm conditions.

Production and process engineers will find the SPC program useful in the implementation of Total Quality Management strategies which call for continuously improving the process variability. By having the user assign Special Causes to any out of control alarm conditions, the engineer can focus improvement efforts on the most frequently occurring special causes. Also, the merits of small changes to the system can be objectively evaluated.

SPC can be up and running very quickly. The Dataset configurations are easy to setup and there are many built-in features like Value Windows, Manual Input Dialogs, SPC Limit Wizards and Detail Information Dialogs. Complete custom SPC applications can be created by using the large number of DDE items and SPC functions for SPC Pro charts and through the database tables. All data, both current and historical is available. Any database reporting tool can be used to create custom reports.

Note While it is true that communications between InTouch and SPC Pro use DDE, SPC Pro takes advantage of Wonderware's SuiteLink protocol capabilities to acquire data from the plant.

SPC Pro Features

The SPC Pro add-on program provides you with the following features:

SPC Chart Wizards

The whole purpose of using SPC is to alert the operator if the process is not normal. A normal process creates a chart with a completely random distribution of data. Using three standard deviations as the control limits ensures the statistical probability that 997 out of 1000 samples will be within the control limits. Any observed trends, cycles or out-of-limit samples are cause for alarm. The appearance of any alarm should require the user to make an acknowledgment and input the suspected cause.

The SPC Pro program provides you with three SPC Chart wizards: Control Chart, Histogram and Pareto. You can configure the Control Chart wizard to display X Individual, X bar - R, X bar - s, Moving-X Moving-R, CUSUM, EWMA, C, P, U, and NP Charts.

For more information on using the SPC Chart Wizards, see Chapter 3, "Using the SPC Chart Wizards."

Variable Sized Display Windows

Charts can be sized for full screen display or sized to allow many charts per screen.

SPC Analysis

The following briefly describes each supported SPC Analysis type:

X Individual

This type of chart is used for a single value of variable data to determine the stability of the center of the process. The control limits for these charts are determined by calculating the standard deviation of the sample population.

X bar, R chart

These types of charts are used for multiple values of variable data to determine the stability of the center and range of the process. The width is determined by subtracting the minimum value from the maximum value.

X bar, s charts

These types of charts are used for multiple values of variable data to determine the stability of the center and standard deviation of the process. The width is determined by calculating the standard deviation of the measurements.

Moving X, Moving R charts

These types of charts are also used for a single value of variable data to determine the stability of the center and range of the process. These charts are usually used for slow processes where samples are generated infrequently. A sample consists of the current measurement and some number of historical measurements.

C charts

C charts (number of nonconformity's) are used for monitoring the number of defects in a fixed sample size. The scale is the count.

P charts

P charts (fraction nonconforming measurements) are used for monitoring the proportion of defects for any given sample size. The scale is the fractional defects.

NP charts

NP charts (number of nonconforming items) are used in lieu of a *P* chart when the sample size is constant.

U charts

U charts (nonconformity's per unit) are used in lieu of a *C* chart when the sample size is not constant.

EWMA charts

EWMA charts (exponentially-weighted moving averages) are created to place more emphasis on recent samples and less on the values some distance back in the collected data.

CUSUM charts

CUSUM control charts (cumulative sum) can detect small process shifts faster than standard control charts. But they are not a direct substitute for standard control charts, they should be used in combination with standard control charts.

Integrated Alarming

SPC alarms are associated with InTouch tagnames and are displayed and acknowledged the same as any other InTouch alarm. Alarms can also be acknowledged by right-clicking the sample to display the SPC menu, and then clicking Acknowledge Alarm. Alarm monitoring can be selected for out-of-limit conditions, four custom run rules and seven different Western Electric run rules.

Distributed SPC

SPC allows you to build Distributed ODBC Based SPC Applications. Distributed SPC allows remote modification of datasets, automatic update of displayed data with values from remote datasets, and the displaying of products in charts that are not being collected.

Multiple Data Entry Schemes

A variety of methods are available for entering SPC data. Automatic data collection can be based on time or by event. Manual data entry can be accomplished either through the **Manual Input** dialog box or through user defined manual entry windows. These methods can accommodate an SPC sample consisting of multiple measurements of the same tagname or SPC samples consisting of multiple tagnames. They include:

Automatic Time Based Collection

When a single tagname is the source of an SPC sample, the time between samples and the time between measurements can be configured for automatic data collection. This is accomplished in the Dataset Configuration dialog box. Automatic collection can be enabled or disabled during runtime. For example, an extruder temperature is being monitored using Xbar-R analysis. A sample is required every 30 minutes. The sample consists of 5 temperature readings taken 1 minute apart.

Event Driven Automatic/Manual Collection

In addition to the above scheduled collection, an automatic collection cycle can be manually or automatically triggered through dataset configuration or pushbuttons or InTouch scripting methods.

Manual Data Collection

SPC samples can be manually entered either through the **Manual Input** dialog box or through user created InTouch windows. The built in dialog verifies that the correct number of samples have been entered before accepting the data. The custom entry windows allow the user to enter measurement data through DDE.

Note While it is true that communications between InTouch and SPC Pro use DDE, SPC Pro takes advantage of Wonderware's SuiteLink protocol capabilities to acquire data from the plant.

Automatic Control Limit Calculation

Control limits can be automatically calculated based on a user selectable number of samples or can be calculated on demand. Control limits can also be manually entered. Control Limit calculation is done in an iterative fashion which eliminates out-of-limit samples from the calculation.

Multiple Products or Batches per Dataset

Multiple product definitions can be configured within the same Dataset. This accommodates situations where the collection tagname is used for many products. For example, let's assume that a mixer temperature is being monitored. The mean temperature when making product "A" is 55 Deg.F and is 75 Deg.F when making product "B". Only data for the currently selected product is used for calculations. When a product is changed, it uses its last recorded values as its start point. New product or batch names can be created during runtime. These new products will use the last recorded sample limits as their start point. This allows new charts to be created and stored for each new batch or lot number.

Detailed Sample Information

Detailed sample information can be displayed for any sample. Details consist of: USL, LSL, UCL, LCL, Target, Xbar, All Individual measurements, Sample Number, Alarms, Date, Time, Comments, and Special Cause. Information is displayed through the **Sample Information** dialog box, or through user created InTouch windows through DDE.

Special Cause/Comment Entry

Each sample can have a Special Cause and comment field associated with it. Special Causes can then be displayed in a Pareto chart.

Text associated with Sample Number

Each sample can have a text note displayed near the sample up to 12 characters.

Flagged Samples

Samples can be flagged to alert the user.

Historical Data Review

Historical data can be viewed for any product without affecting the current data collection.

SPC Pro Common Dialog Box Features

To avoid redundancy, all buttons that are common to the SPC Pro program's dialog boxes are described below:

Button	Description
	Configures a new Dataset, Indirect Dataset, a new Product or a new User.
	Clears any changes made and re-displays the original data in the dialog box prior to saving. If Save is selected, the data cannot be restored.
	Displays the **Select a Dataset** dialog box listing all defined Dataset Names.
	Note In the case of **Indirect Datasets**, when the Select button is selected, the Select a Dataset dialog box will display the names of defined Indirect Datasets.
	Accesses the previous configuration saved in the file.
	Accesses the next configuration saved in the file.
	Saves the configuration input for a new Database, User, Dataset, or Indirect Dataset and saves changes made to an existing configuration.
	Verifies the database connection status.
	Deletes a displayed selection in the configuration. A message box will appear confirming the action. (The selection cannot be deleted if WindowViewer is running.)
	Answers **Yes** to a prompted message to continue processing the current command or action.
	Answers **No** to a prompted message and cancels the current command or action. (This button functions the same as the Cancel button.)
	Saves the current input and/or changes and closes the dialog box.
	Cancels the current unsaved input and/or changes and closes the dialog box.

About this Manual

This manual is divided into a series of logical building block chapters that describe the various aspects of using SPC Pro. It is written in a "procedural" format that tells you in numbered steps how to perform most functions or tasks.

If you are viewing this manual online, when you see a cross reference like this one, it is actually a "hot link" to the referenced section or chapter. Click it to "jump" to that section or chapter. When you jump to another section or chapter and you want to come back to the original section, a "back" option is provided.

These types of cross references indicate that you need to look in another FactorySuite book for more information.

These are "tips" that tell you an easier or quicker way to accomplish a function or task.

The *FactorySuite Systems Administrator's Guide* provides you with complete information on the other component programs in the suite, system requirements, networking considerations, product integration, technical support, and so on.

The *InTouch User's Guide* will help familiarize you with the WindowMaker development environment and its tools, read Chapter 1, "WindowMaker Program Elements." To learn about working with windows, graphic objects, wizards, ActiveX controls and so on, read Chapter 2, "Using WindowMaker."

For details on InTouch runtime environment (WindowViewer), see your online *InTouch Runtime User's Guide*.

In addition, the *InTouch Reference Guide* provides you with an in-depth reference to the InTouch script language, system tagnames, and tagname **.fields**.

Online documentation is included in your FactorySuite software package for all FactorySuite components included in your package. For example, FactorySuite System Administrator's Guide, SPC Pro, Recipe Manager, IndustrialSQL Sever, InControl and all Wonderware 32-bit I/O Servers. If you purchase FactorySuite+ you also get the online documentation for the InTrack and InBatch components.

Assumptions

This manual assumes you are:

- Familiar with the Windows 95 and/or Windows NT operating system working environment.
- Knowledgeable of how to use of a mouse, Windows menus, select options, and accessing online Help.
- Experienced with a programming or macro language. For best results, you should have an understanding of programming concepts such as variables, statements, functions and methods.

Technical Support

Wonderware Technical Support offers a variety of support options to answer any questions on Wonderware products and their implementation.

Prior to contacting technical support, please refer to the relevant chapter(s) in your *SPC Pro User's Guide* for a possible solution to any problem you may have with your system. If you find it necessary to contact technical support for assistance, please have the following information available:

1. Your software serial number.
2. The version of InTouch you are running.
3. The type and version of the operating system you are using. For example, Microsoft Windows NT Version 4.0 workstation.
4. The exact wording of system error messages encountered.
5. Any relevant output listing from the Wonderware Logger, the Microsoft Diagnostic utility (MSD), or any other diagnostic applications.
6. Details of the attempts you made to solve the problem(s) and your results.
7. Details of how to recreate the problem.
8. If known, the Wonderware Technical Support case number assigned to your problem (if this is an on-going problem).

📖 For more information on Technical Support, see your online *FactorySuite System Administrator's Guide*.

Viewing Your FactorySuite License

Your FactorySuite system license information can be viewed through the license viewing utility that is launched from the WindowMaker Help **About** dialog box.

To access the **About** dialog box, select the **About** command on the InTouch **Help** menu.

📖 For more information on the licensing viewing utility, see your *FactorySuite System Administrator's Guide*.

CHAPTER 1

Configuring an ODBC Database

You will need to configure SPC Pro before you can correctly use it. You must have Microsoft ODBC drivers installed to use SPC Pro. The two ODBC drivers that SPC Pro currently support are: Microsoft Access driver version 3.50.342800 and Microsoft SQL Server version 2.65.0213.

It is extremely important to setup your new SPC Pro database and to import any datasets previously created with SPC (version 6.0 or earlier) prior to running your InTouch application. This chapter explains how to configure a Microsoft Access database, or a Microsoft SQL Server database, and how to setup user ID's.

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Configuring an SPC Database

Before you can use SPC Pro, you must select a database to store your SPC configuration and collection data. You must decide what type of database to use. You have a choice of Microsoft Access or Microsoft SQL Server. The type of SPC Pro application you want to configure will determine which database you will use. If you are configuring a single node SPC Pro application, you can use Microsoft Access or Microsoft SQL Server. If you are configuring a multi-node SPC Pro application, you must use Microsoft SQL Server.

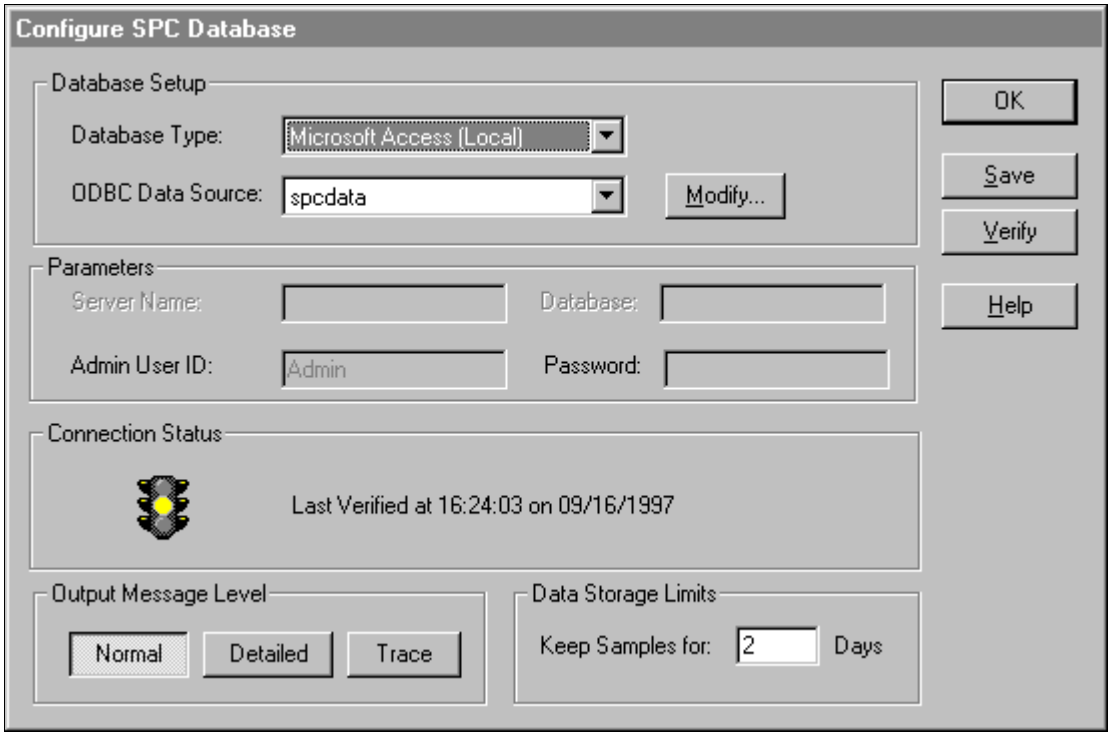
Note If your application is configured to use a specific database and you decide to change to another database, WindowMaker MUST be shut down and restarted inorder for database changes to take effect.

Configuring a Single Node Application's Database

The SPC Pro **Database** command is used to configure your database and your ODBC source.

➢ **To configure a single node database:**

1. Start WindowMaker.
2. On the **Special** menu, point to **SPC**, and then click **Database**, or in the Application Explorer under **SPC**, double-click **Database**. The **Configure SPC Database** dialog box appears:

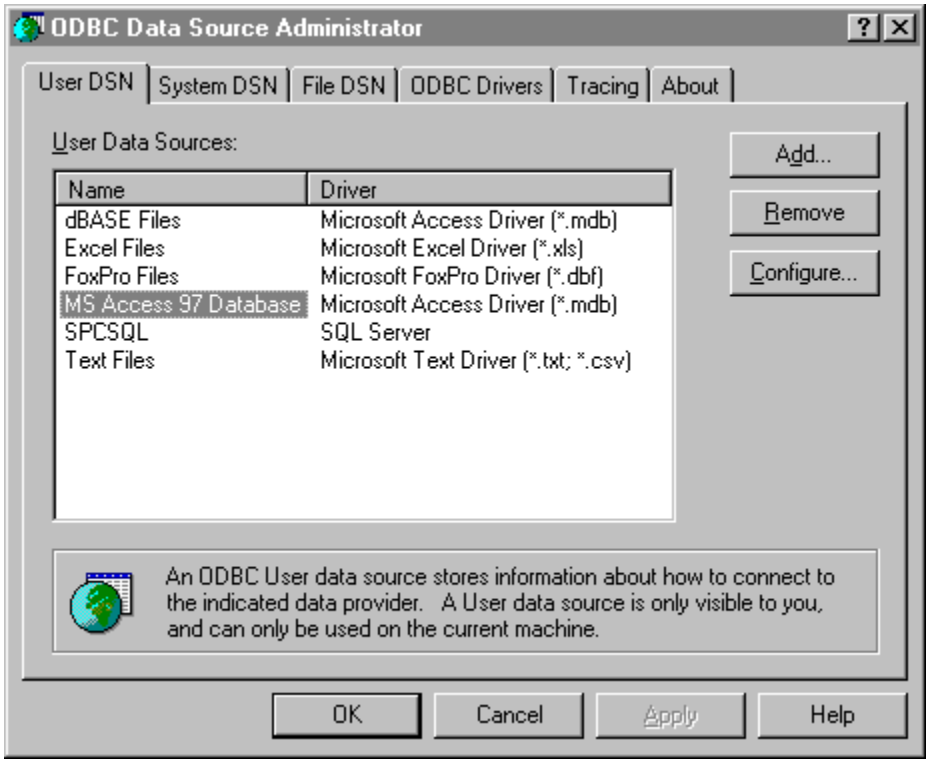


3. In the **Database Type** list box, select the name of the database that you want to use, or click the arrow, and then select Microsoft Access (Local).

   The following steps describe a single node Microsoft Access (Local) configuration.

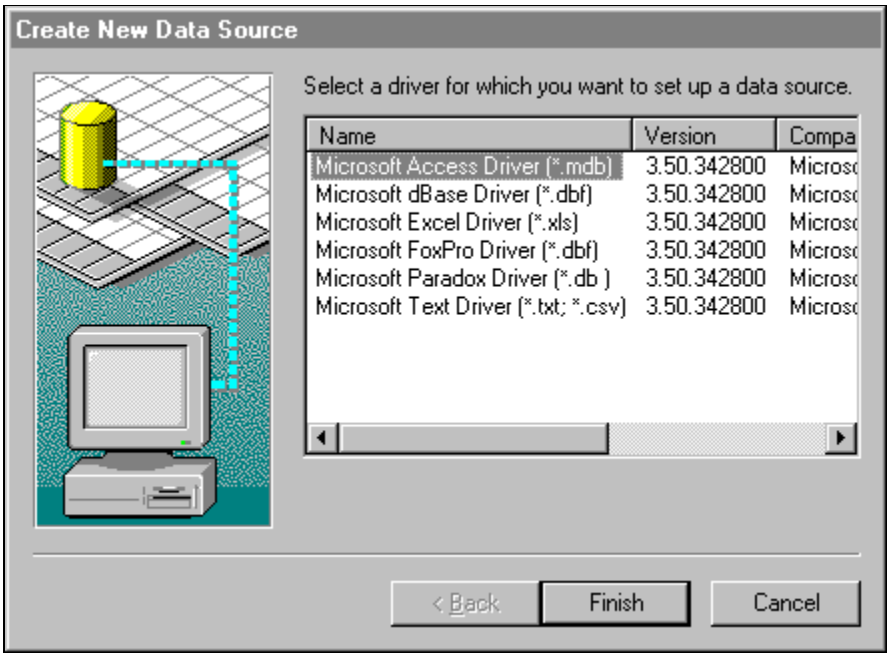
   For more information on configuring a Microsoft SQL Server, see "Configuring a Distributed Application's Database."

4. In the **ODBC Data Source** box, type the name of your ODBC Data Source, or click **Modify**. The **ODBC Data Source Administrator** dialog box appears:



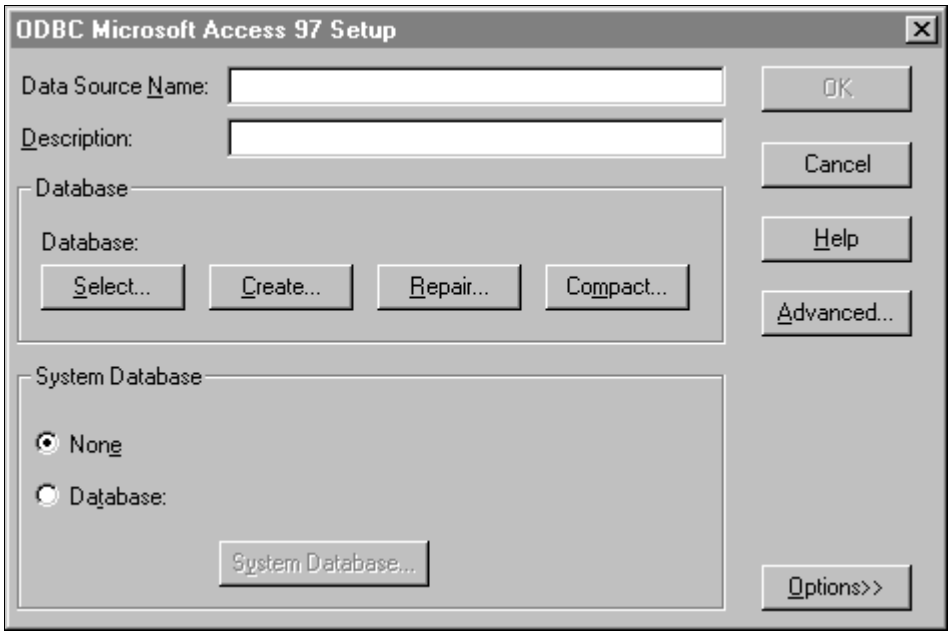
4a. Click the **User DSN** tab, and then select the ODBC data source that you want to use.

4b. or click **Add**. The **Create New Data Source** dialog box appears:



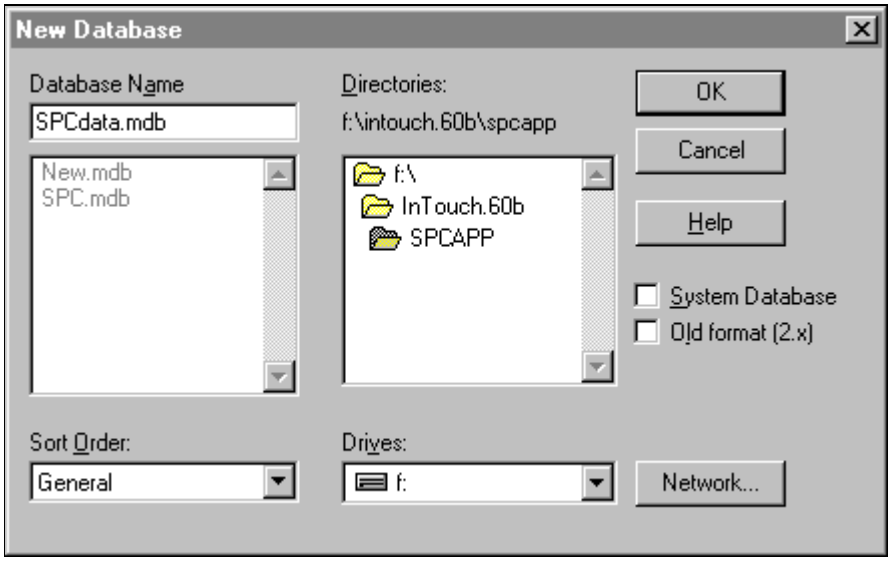
5. Select the ODBC driver that you want to use.

6. Click **Finish**. The **ODBC Microsoft Access 97 Setup** dialog box appears:



7. In the **Data Source Name** box, type a unique name for your data source. For example, "SPCdata."

8. Click **Create**. The **New Database** dialog box appears:



9. In the **Database Name** box, type a new name for your database. For example "SPCdata.mdb." Select a directory to store your new database file, and then click **OK**. A message box will appear confirming the successful creation of the database.

10. Click **OK**. The **ODBC Microsoft Access Setup** dialog box will reappear. Click **OK**. The **ODBC Data Source Administrator** dialog box will reappear. Select your newly created User Data Source, for example SPCdata. Click **OK**. The **Configure SPC Database** dialog will reappear.

11. Click **Save**. A message box will appear informing you that the new database is not initialized.
12. Click **Yes** to initialize the database. A message box will appear informing you that the database was successfully initialized.
13. Click **OK**.
14. Click **Verify**. The connection status for the ODBC database will be verified.

    A green light should be displayed in the dialog box.

15. Click **OK**.

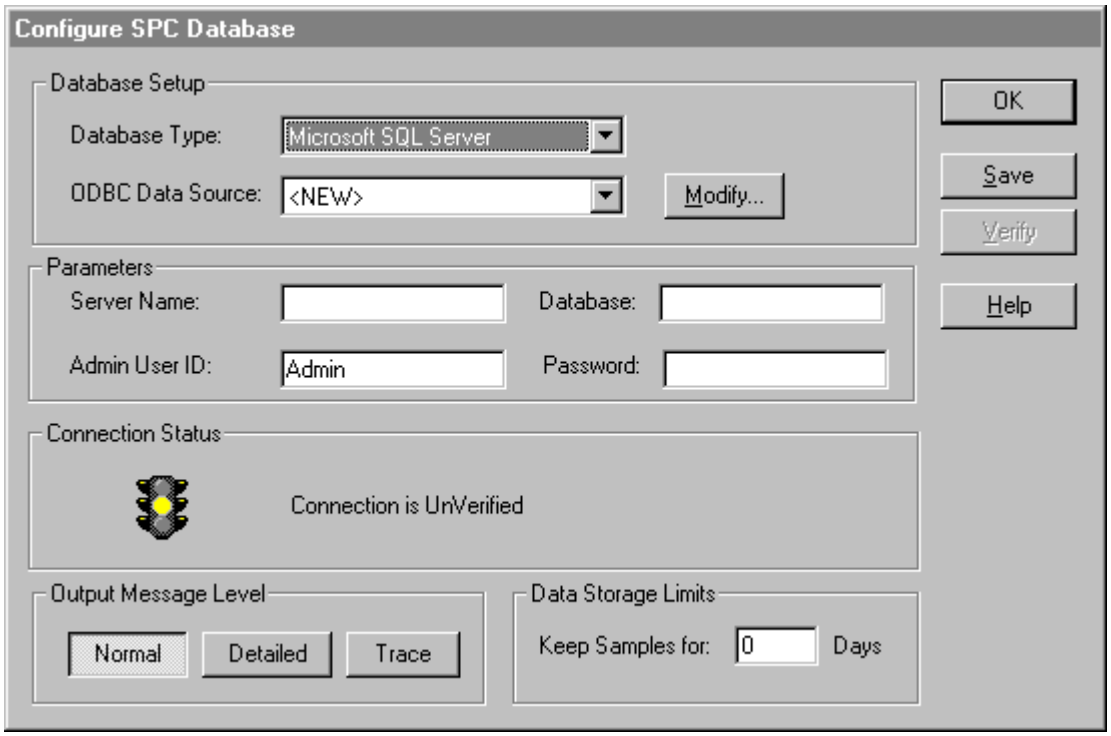
Configuring a Distributed Application's Database

➢ **To configure a Microsoft SQL Server database:**

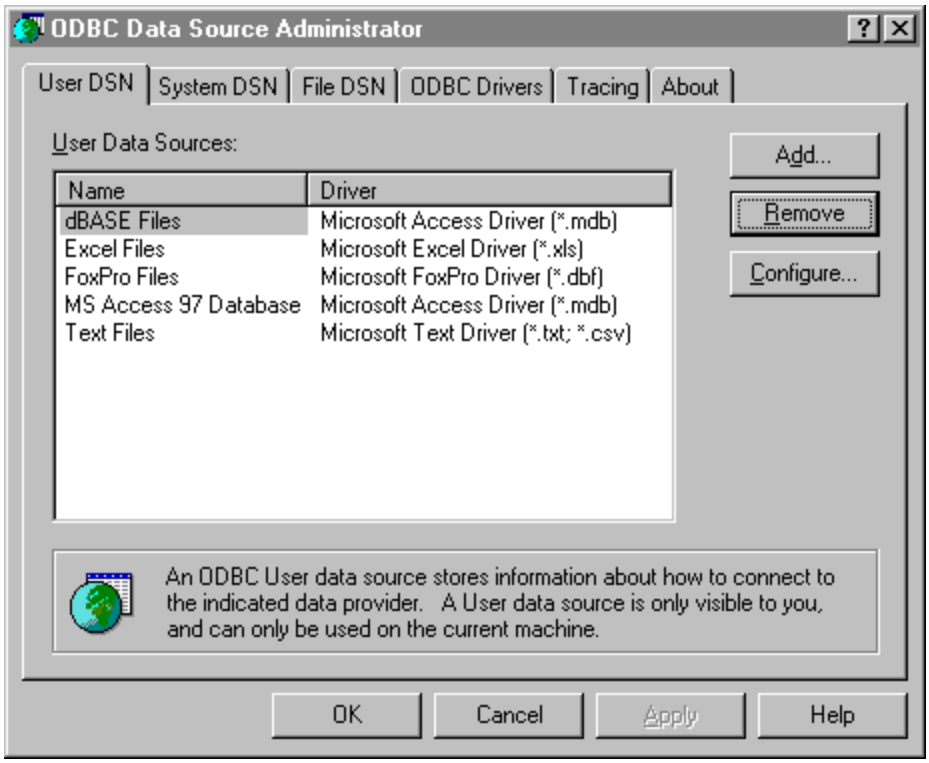
1. Start WindowMaker.
2. On the **Special** menu, point to **SPC**, and then click **Database**, or in the Application Explorer under **SPC**, double-click **Database**. The **Configure SPC Database** dialog box appears:

Note You must have Microsoft SQL Server 6.50 or the Microsoft Enterprise Manager installed to create the database prior to configuring SPC Pro. You must also be set up to use Administrator privileges (SA).

If you are using Wonderware FactorySuite IndustrialSQL Server to store data for SPC Pro, use these instructions to connect to your database.

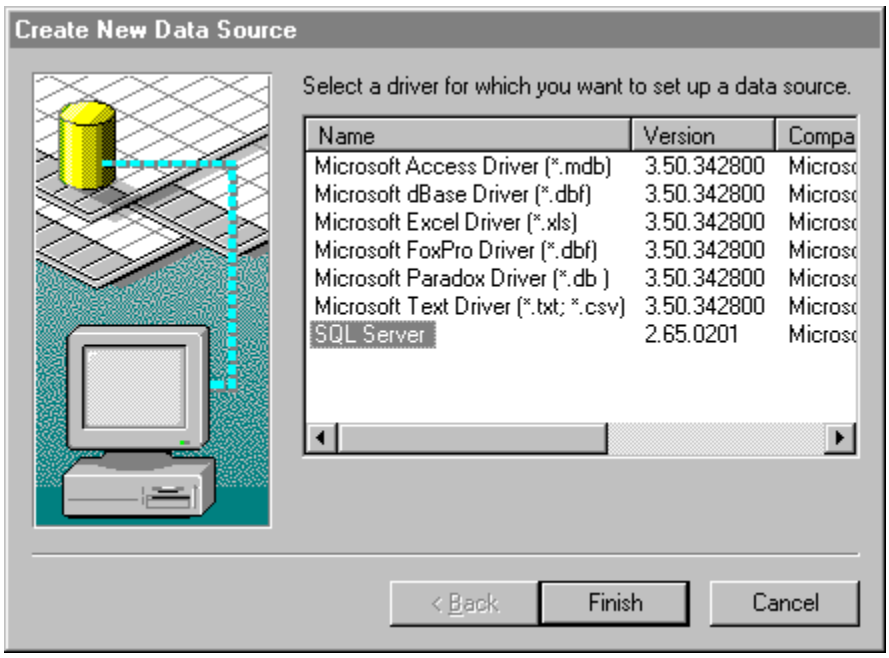


3. In the **Database Type** list box, select Microsoft SQL Server.
4. In the **ODBC Data Source** list box, select the ODBC Data Source you want to use, or click **Modify**. The **ODBC Data Source Administrator** dialog box appears:



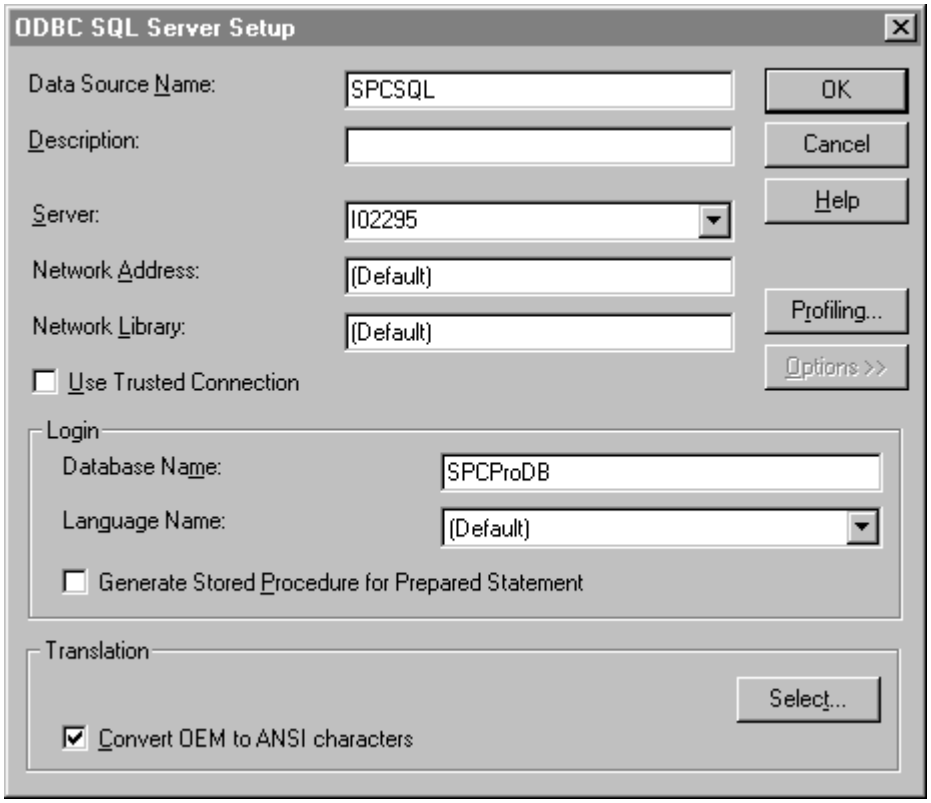
4a. Click the **User DSN** tab, and then select the ODBC data source that you want to use.

4b. or click **Add**. The **Create New Data Source** dialog box appears:



5. Select the ODBC driver that you want to use. For example, SQL Server.

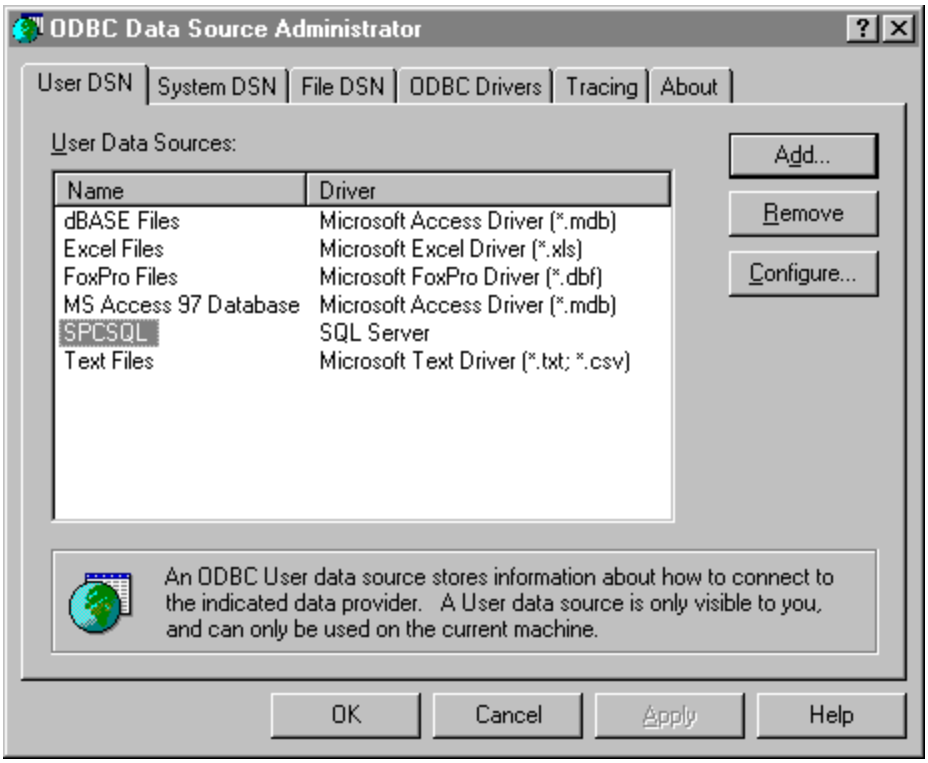
6. Click **Finish**. The **ODBC SQL Server Setup** dialog box appears.
7. Click **Options**. The **ODBC SQL Server Setup** dialog box will appears with the Login Database information:



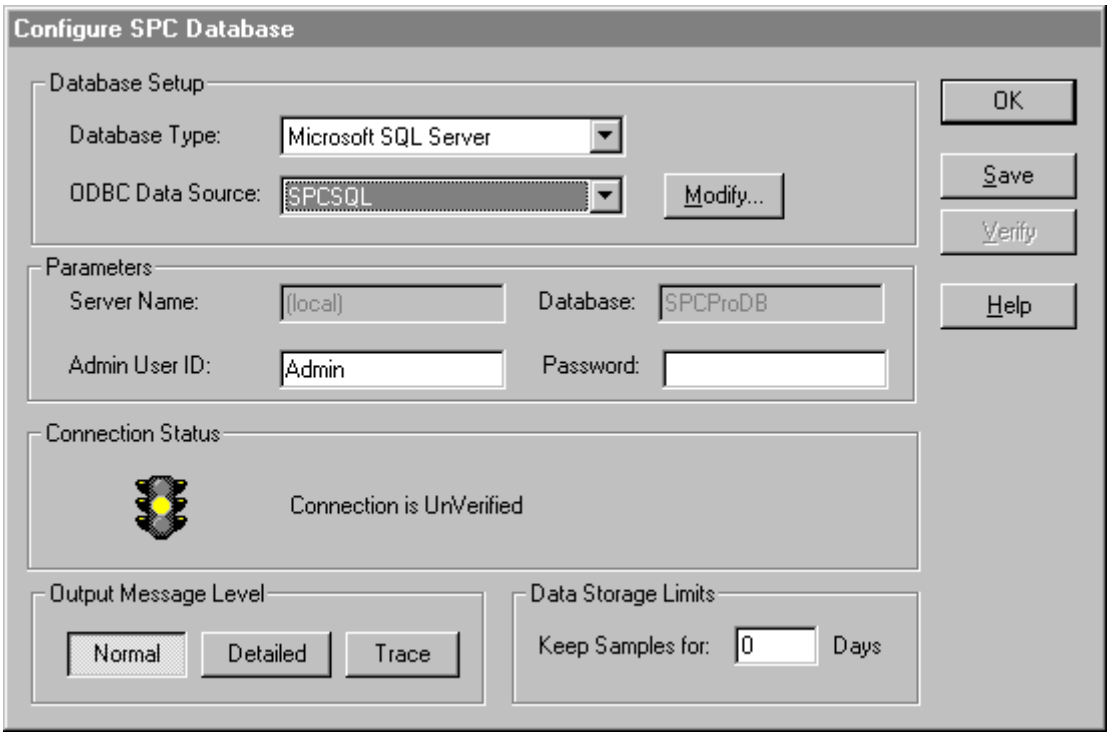
8. In the **Data Source Name** box, type a unique name for your data source. For example, "SPCSQL."
9. In the **Server** list box, use the arrow key to select the server you need.
10. In the **Database Name** box, type the name of your database that will be used for storing SPC data. For example "SPCProDB." It can be an existing database or a newly created one. In either case, it must exist. SPC Pro will not create the database for you.

    - Un-select the **Generate Stored Procedure for Prepared Statement** if it is selected.

11. Click **OK**. The **ODBC Data Source Administrator** dialog will reappear:



12. Click **OK**. The **Configure SPC Database** dialog box will reappear:



13. In the **Admin User ID** box, type the user name for your logon account to the SQL Server.

14. In the **Password**, type a password for the logon account.

    A user account is comprised of the **Admin User ID** name and **Password**. A user account must be associated with the right to create tables, insert data, and retrieve data or the log on will fail. For more information on user accounts, contact your system administrator.

15. In the **Output Message Level** group, select the option that you want to use as follows:

    - **Normal** default will report errors only in the Wonderware Logger.
    - **Detailed** and **Trace** should only be selected when troubleshooting your application. Additional ODBC messages will appear in the Wonderware Logger.

      Selecting **Detailed** or **Trace** may impact system performance.

16. In the **Data Storage Limits** box, type the number of days of data that you want retained.

    Data is retained until the specified number of days is exceeded. Once the number of days is exceeded, the data is automatically purged. For example, if 2 is entered, by the 4th day, the first day's data files is purged. There will actually be 3 days of data; the previous two day's plus the current day's.

    By default, this field is set to zero (0) (represents infinity) and the data is never deleted. If you use the default, it is recommended that you periodically either purge the older data, or archive it to avoid running out of disk space.

17. Click **Save**, then click **OK** to close the dialog box.

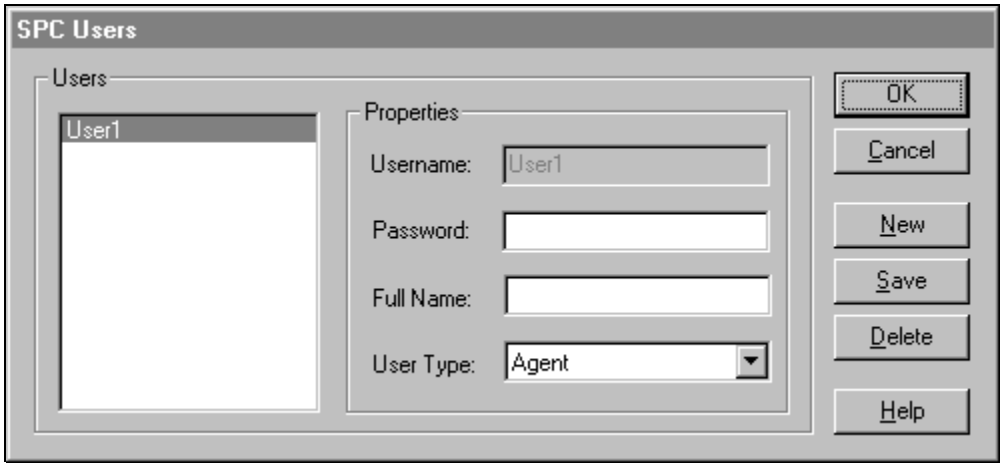
Configuring SPC Database Users

In order to perform automatic dataset collections, you must configure the SPC database users and passwords. However, if manual data collections will be performed, an SPC user does not need to be configured.

Note Your database must be configured prior to setting up user files.

➢ **To configure an SPC database user:**

1. Start WindowMaker.
2. On the **Special** menu, point to **SPC**, and then click **Users**, or in the Application Explorer under **SPC**, double-click **Users**. The **SPC Users** dialog box appears:



3. Click **New** to activate the **Properties** options.
4. In the **Username** box, type in your user name.
5. In the **Password** box, type your password.

   This may be left blank for databases not requiring passwords.

Note The password is used in the **SPCConnect** function to connect to the database.

7. In the **Full Name** box, type in your full name.

   This is an optional descriptive field.

8. In the **User Type** box, click the arrow and select **Agent**.
9. Click **OK**, or click **Save** to configure another user, and then click **OK**.

Note SPC users are for SPC only and not SQL Server. These users are not added to the SQL Server's user list.

CHAPTER 2

Creating SPC Datasets

In order to use SPC Pro, you must create SPC Pro Datasets, Indirect Datasets, and Products for each Dataset. This chapter will cover how to create datasets and how to import and convert Datasets created in older versions of SPC to use with SPC Pro.

Contents

Configuring SPC Datasets

You must configure Datasets or Indirect Datasets to be used with your SPC applications.

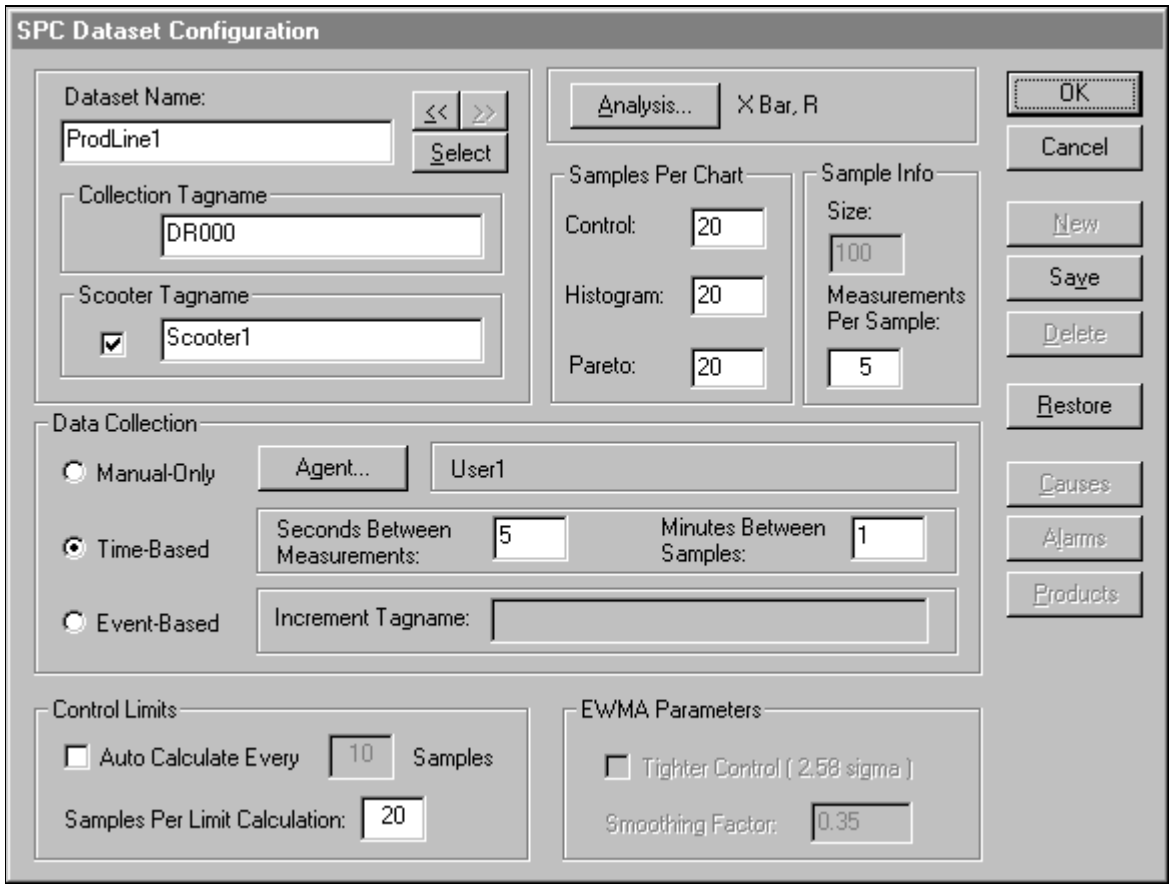
You can also use the SPC Pro Server utility (SPCPRO.EXE) to define Datasets or Indirect Datasets.

Note Before you can configure your SPC Dataset, you must define a tagname in the InTouch Tagname Dictionary that you will use for the SPC **Collection Tagname**. Additionally, if you want to use a scooter with your SPC Chart, you will need to define a tagname to be used for the scooter. If you plan to use Event-Based collections, you will also need to define a tagname that you can increment.

For more information on defining InTouch tagnames, see your *InTouch User's Guide*.

➢ **To configure a SPC dataset:**

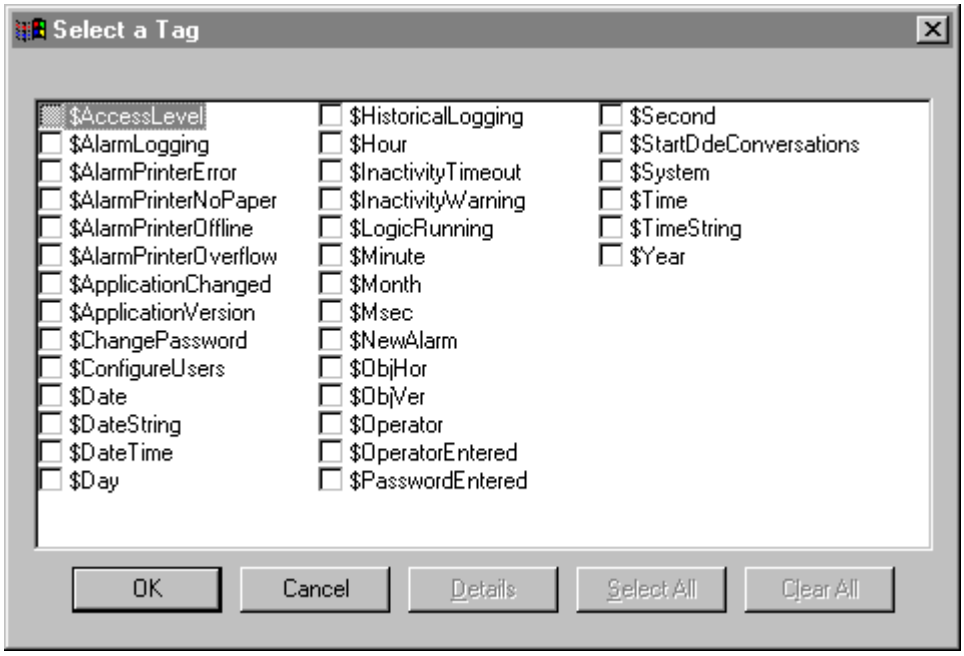
1. Start WindowMaker.
2. On the **Special** menu, point to **SPC**, and then click **Datasets**, or in the Application Explorer under **SPC**, double-click **Datasets**. The **SPC Datasets Configuration** dialog box appears:



3. Click **New** to create a new dataset or click select to view an existing dataset.

4. In the **Dataset Name** box, type a new unique dataset name, or click **Select** (to choose an existing Dataset). The **Select a Dataset** dialog box will appear. Select the Dataset that you want to use. The dialog box will close, and the selected Dataset name will automatically be inserted into the **Dataset Name** box.

5. In the **Collection Tagname** box, type an Analog (Real or Integer) type tagname, or double-click the blank field. The following dialog box will appear displaying all tagnames currently defined in the Tagname Dictionary:

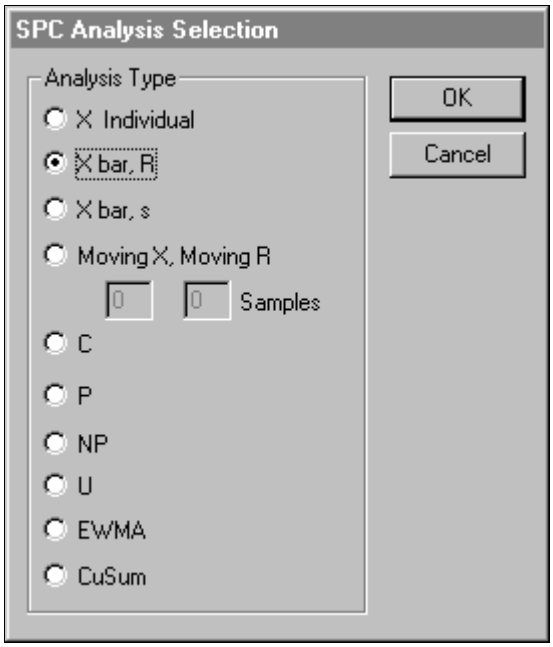


6. Select the tagname that you previously defined to be used for data collection. The dialog box will close and the selected tagname will automatically be inserted into the **Collection Tagname** box.

7. Select the **Scooter Tagname** option if you plan to use a scooter with your SPC chart, and then type a Analog (Real or Integer) memory type tagname in the box, or double-click the blank box and select the tagname as described above.

   You must define the tagname that you plan to use for the scooter prior to configuring the Dataset.

8. Click the **Analysis** button. The SPC Analysis Selection dialog box appears:



In the **Analysis Type** group, select the analysis type that you want to use for this dataset, and then click **OK**.

For more information on SPC Analysis Types see the "Welcome to SPC Pro" section.

9. In the **Samples Per Chart** group boxes, type the valid number of samples to be displayed for each SPC Chart type, or use the default of 20.

For more information on the SPC Chart types, see Chapter 3, "Using the SPC Chart Wizards."

10. The **Sample Info** boxes become active based upon the type of Analysis selected as follows:

Sample Size	Appears when the Analysis Type NP chart is selected. Enter the sample size needed.
Measurements Per Sample	Activates when the Analysis Type X Bar, R or X bar, s chart is selected. Enter a valid number from 2 - 300 used to calculate the sample point.

11. In the **Data Collection** group, select one of the following:

Manual-Only	Select if you are using InTouch QuickScripts to log samples to the dataset. This can be automated by using a timed script, or click on the SPC Chart to enter a sample.
Time-Based	Select when you want SPC Pro to do automatic data collection. When you select this option, you must select an agent for automatic data collection by clicking the **Agent** button.
Seconds Between Measurements	Enter the number of seconds that will elapse between readings (measurements) of the collection tagname.

Minutes Between Samples	Enter the number of minutes that will elapse between samples.
Event-Based	Select when you want to do event based data collection. An InTouch tagname must be typed in the **Increment Tagname** box. An increment tagname is a discrete type, memory or DDE. For example, when an InTouch tagname changes, data is logged. If multiple measurements per sample is selected, each time the tagname changes a measurement is logged. When the measurements per sample is reached the sample is written to the dataset. When you select this option, you must also select an **Agent** for event-based collection.

12. In the **Control Limits** group, select the following:

Auto Calculate Every Samples	Select if you want SPC Pro to automatically calculate your control limits. Enter the frequency at which the automatic control limit calculation is performed. For example every 20 samples.
Samples Per Limit Calculation	Type the number of samples to include in the calculation. For example include 20 samples in the calculation.

☞ For more information on initiating a control limit calculation through DDE, see Chapter 5, "SPC DDE Item Names and SPC Functions."

13. The **EWMA Parameters** group becomes active when the Analysis Type EWMA is selected.

Tighter Control (2.58 sigma)	Can be selected for the EWMA analysis. This entry is used with the Control Limits calculation fields.
Smoothing Factor	Type the smoothing factor that you want to use (default is 0.35).

14. Click **Save**. The **Products**, **Alarms**, and **Causes** buttons will become active.

Note Once you have configured a new Dataset, you must configure at least one Product for it before you can close the **SPC Database Configuration** dialog box.

☞ For more information on configuring a Product see "Configuring Dataset Products."

Configuring Dataset Products

An SPC dataset must have at least one Product defined for it. However, it can have an unlimited number of Products defined. The use of multiple Products is intended to accommodate situations where the same equipment is used to make a variety of different products.

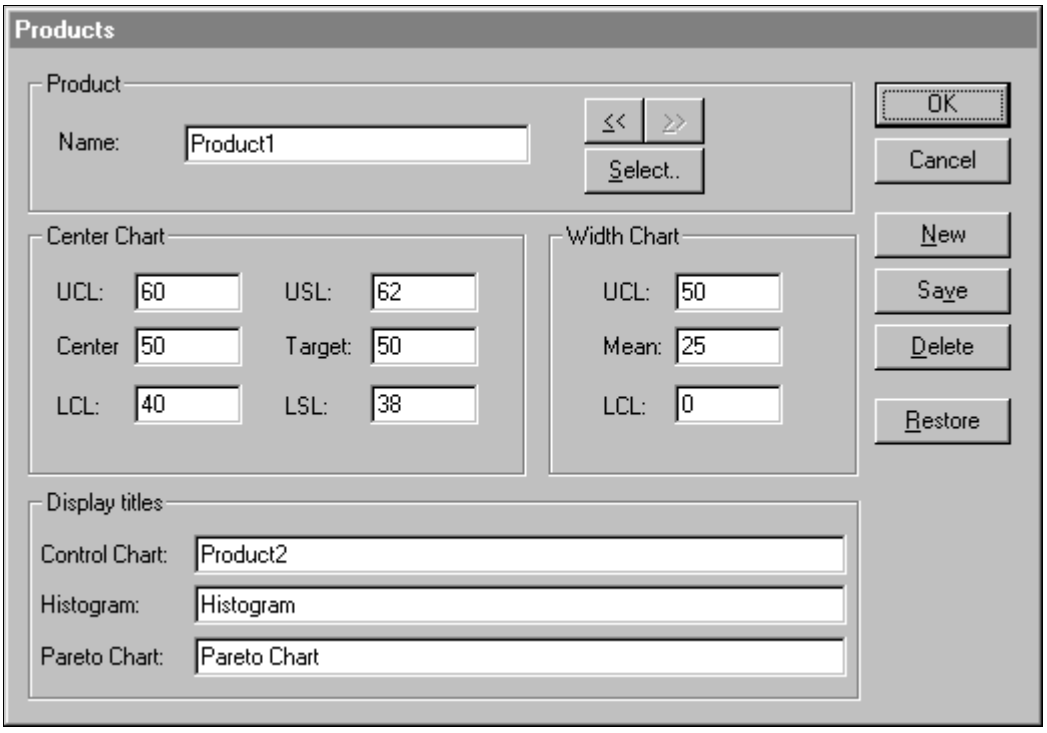
For example, the SPC dataset might be monitoring the temperature of a mixer. When the mixer changes products the temperature setpoint and system response are different. With multiple Product Names you can automatically change all of the chart variables whenever you change products by using the DDE item **ProductCollected**.

When a change occurs in this item, the SPC program searches its files for the last time the product was run and uses the last chart variables as the starting point for the new data collection.

➢ **To configure products for Datasets:**

Note Once you have configured a new Dataset, you must configure at least one Product for it before you can close the **SPC Database Configuration** dialog box.

1. Start WindowMaker.
2. On the **Special** menu, point to **SPC**, and then click **Datasets**, or in the Application Explorer under **SPC**, double-click **Datasets**. The **SPC Datasets Configuration** dialog box will appear.
3. Click **Products**. The **Products** dialog box appears:



4. In the **Name** box, type the name that you want to use for the product.
5. The **Center Chart** group's options are used to set chart values for the control limits, specification limits, centerline, and target.

6. The **Width Chart** group's options are used to set the mean and the control limits of Range or Standard Deviation charts. Enter a reasonable value in each box. (The values can be changed at any time.) The new values will be reflected in the next entered sample. These options can also be changed through DDE in Runtime. The Dataset keeps a separate copy of chart values for each configured product. This option is available for X bar, R, X bar, s and Moving X, Moving R charts.
7. In the **Display Titles** group type the titles that you want to use for each display for every product. A separate title can be displayed for each type of chart.

   If multiple products are defined for this Dataset, click **Save** after each defined product, and then click **New** to define the next product.
8. Click **OK** when the last Product is defined. The **SPC Dataset Configuration** dialog box will reappear.

➢ **To edit an existing product:**

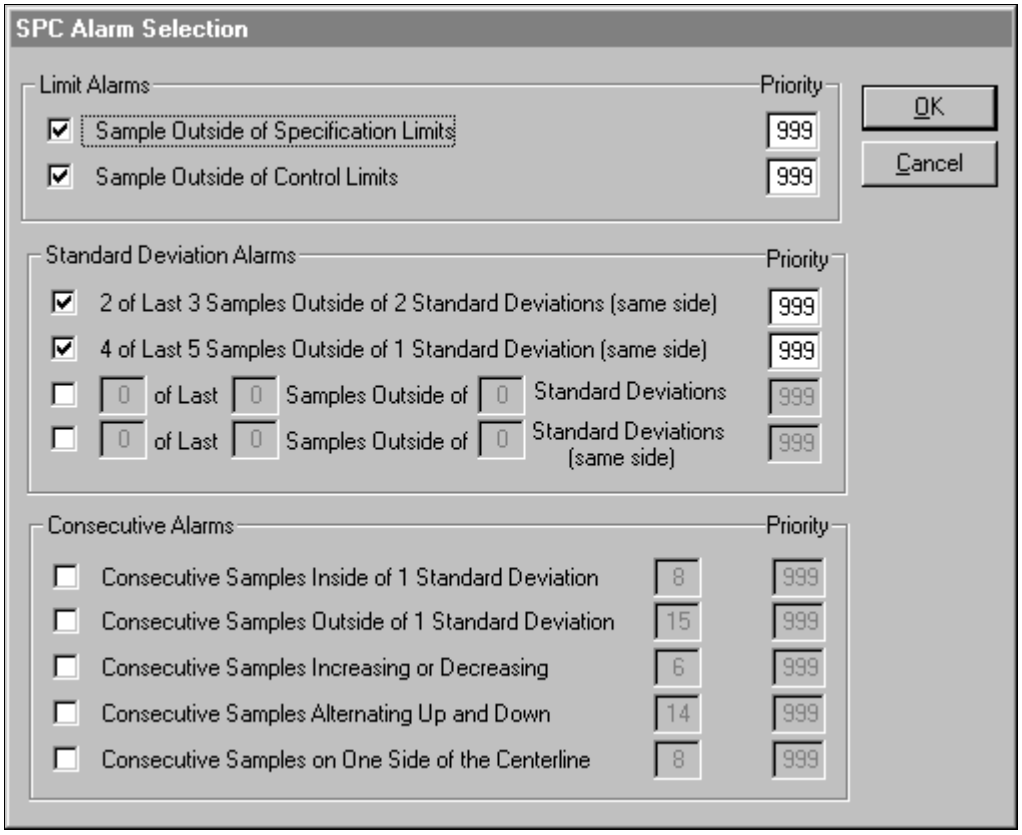
1. Start WindowMaker.
2. On the **Special** menu, point to **SPC**, and then click **Datasets**, or in the Application Explorer under **SPC**, double-click **Datasets**. The **SPC Datasets Configuration** dialog box will appear.
3. Click **Products**. The **Products** dialog box will appear.
4. Click **Select**. The **Select a Product** dialog box will appear.
5. Select the product that you want to modify. The **Products** dialog box will reappear displaying the selected product's configuration settings.
6. Make the required modifications, and then click **OK**.

Configuring SPC Alarms

The SPC program can analyze the collected data for various alarm conditions. It will check for out of limit conditions and seven different Western Electric run rules. An alarm in any one of the selected conditions below will be reported to the InTouch database and the tagname specified in the Dataset configuration will be notified. The specific SPC alarm can be viewed in the **Sample Information** dialog box, or through one of the SPC Alarm message DDE items.

➢ **To configure alarm conditions:**

1. Start WindowMaker.
2. On the **Special** menu, point to **SPC**, and then click **Datasets**, or in the Application Explorer under **SPC**, double-click **Datasets**. The **SPC Datasets Configuration** dialog box will appear.
3. In the **SPC Dataset Configuration** dialog box, click **Alarms**. The **SPC Alarms Selection** dialog box appears.



4. Select the desired SPC Alarm options that you want to be monitored by the SPC program. There are three types of alarm areas, **Limit Alarms**, **Standard Deviation Alarms**, and **Consecutive Alarms**. Here are a few tips:

   - In the ☐ **of Last** ☐ **Samples Outside of** ☐ **Standard Deviations**, type three numbers for the alarm. This alarm can include points on both sides of the center line. The second alarm option is the same, except all points are either above or below the center line. Also, the first two fields are integers and the last field is a real.

     If the **Consecutive Samples Outside of 1 Standard Deviation** option is set to 8, this will allow eight conditions outside of the standard deviation range to be reached before the alarm condition would be reported to the dataset.

5. All of the Alarm options have a **Priority** level. A valid priority level is between 1 and 999. This value represents the severity of the alarm with 1 being the most severe. By creating alarm ranges using priorities and assigning alarms to each, you can easily filter out critical alarms from non-critical ones.

   📖 For more information on alarm priorities, refer to your *InTouch User's Guide*.

6. Click **OK**.

Monitoring the Alarm State of an SPC Tagname

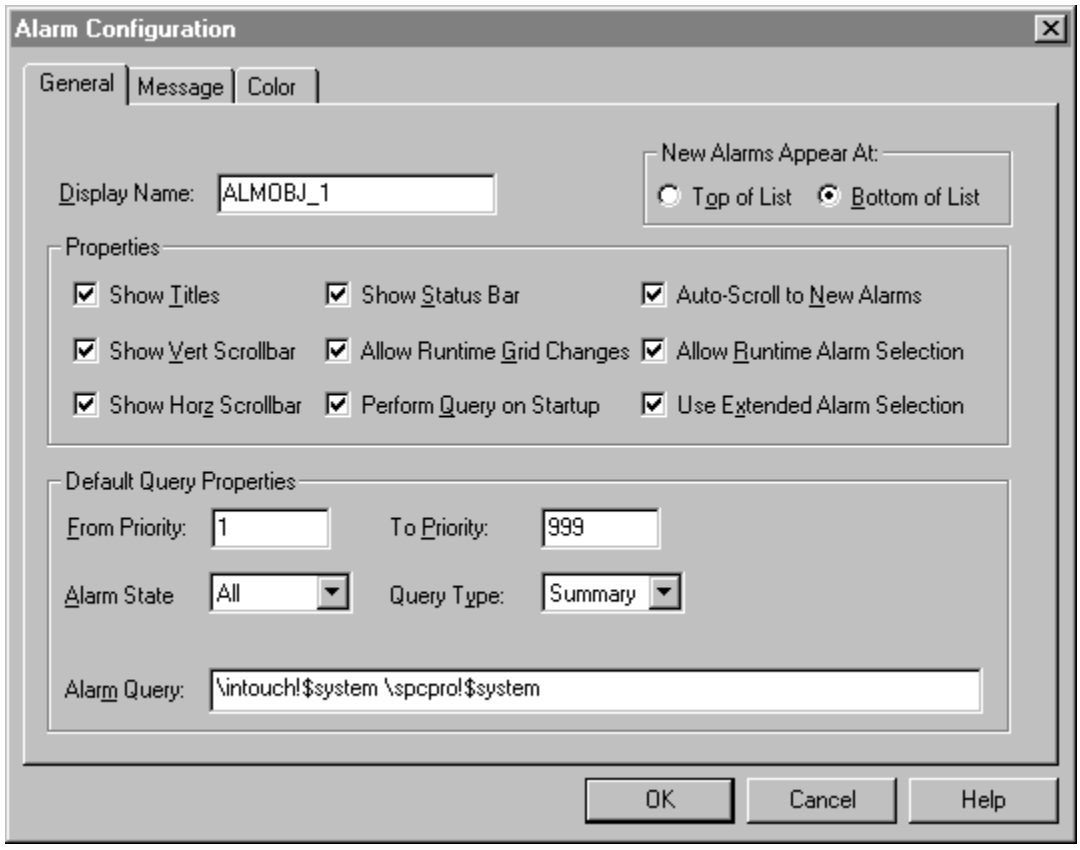
SPC communicates with the InTouch Alarm manager. Alarms are written directly to the distributed alarm object. Alarms can be acknowledged by a right-click on the alarm sample. Click **Ack Alarm** and the alarm will be acknowledged in the SPC chart and the distributed alarm object. Alarms can also be acknowledged from the distributed alarm object which will then update the SPC sample chart.

➢ **To Configure the Distributed Alarm Object for SPC Pro Alarms:**

1. SPC Pro is an Alarm provider and must be configured as an alarm provider in the Alarm Object.

Date	Time	Class	Type	Pri	Name	Group	Prov
06 Oct	14:03	Value	HIHI	1	Alarm1	GroupName	Provider
06 Oct	14:03	Value	HI	250	Alarm2	GroupName	Provider
06 Oct	14:03	Value	LO	500	Alarm3	GroupName	Provider
06 Oct	14:03	Value	LOLO	750	Alarm4	GroupName	Provider

2. Double click on the Distributed Alarm Object above. The **Alarm Configuration** dialog box appears:

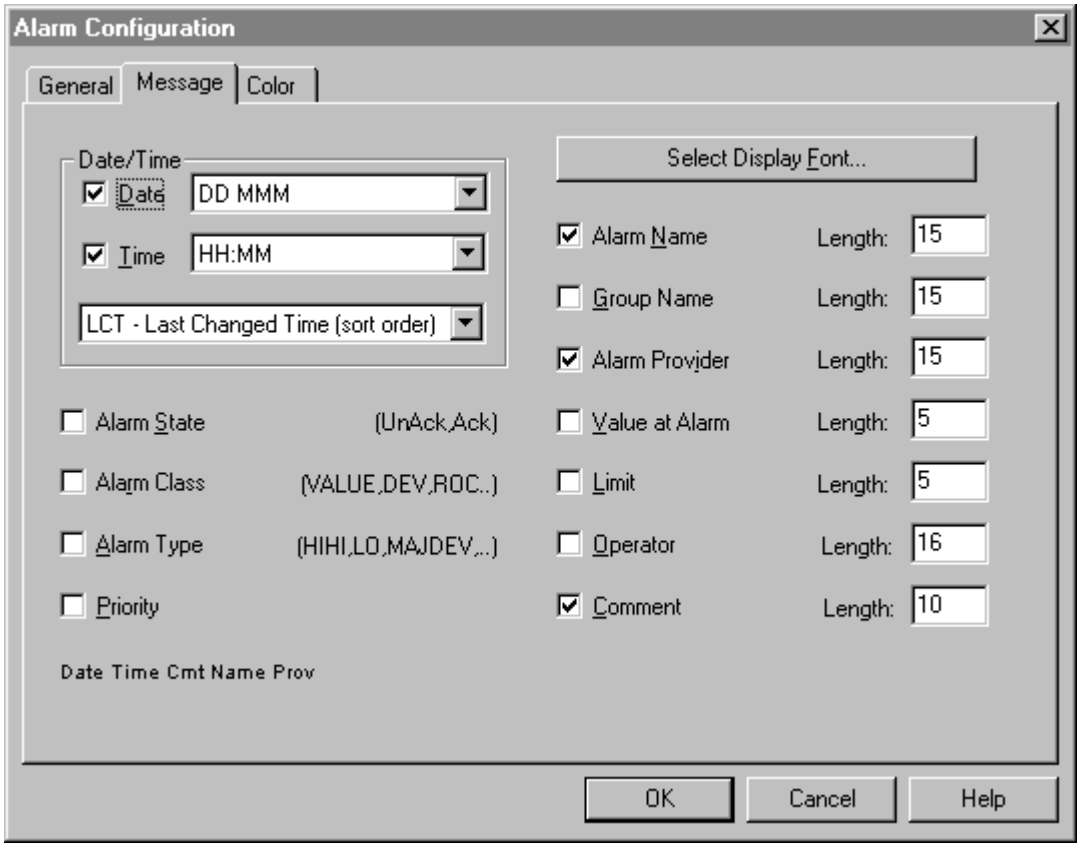


3. In the **Alarm Query** box, type in the following, depending if your computer is an SPC Pro server or client or both:

\spcpro!$system	This will display the local SPC Pro servers alarms.
\\NodeName\spcpro!$system	This will display the SPC Pro servers alarms on the client nodes.

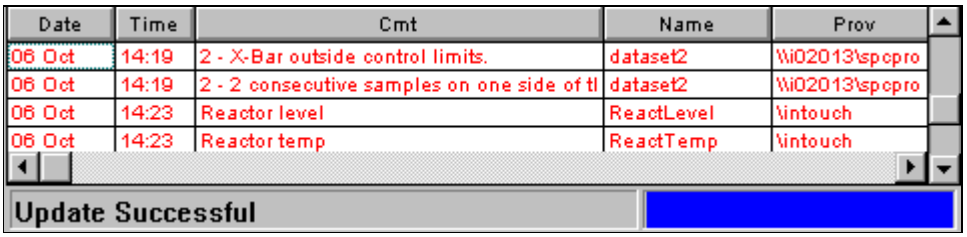
   - Both can be used as the Alarm Query provider. If there are two providers make sure you separate the provider names with a space. For example: **\InTouch!$system** *(space)* **\spcpro!$system**

4. Click the **Message** tab to activate the **Message** property sheet:



5. Configure your **Message** property sheet. In the dialog below, the following configuration was selected.

   - **Date/Time** shows the SPC Sample alarm date.
   - **Time** shows the SPC Sample alarm time.
   - **Comment** shows the sample number and description of the SPC alarm.
   - **Alarm Name** shows the dataset name associated with the SPC Sample alarm.
   - **Alarm Provider** shows the node and the application that provided the alarm.

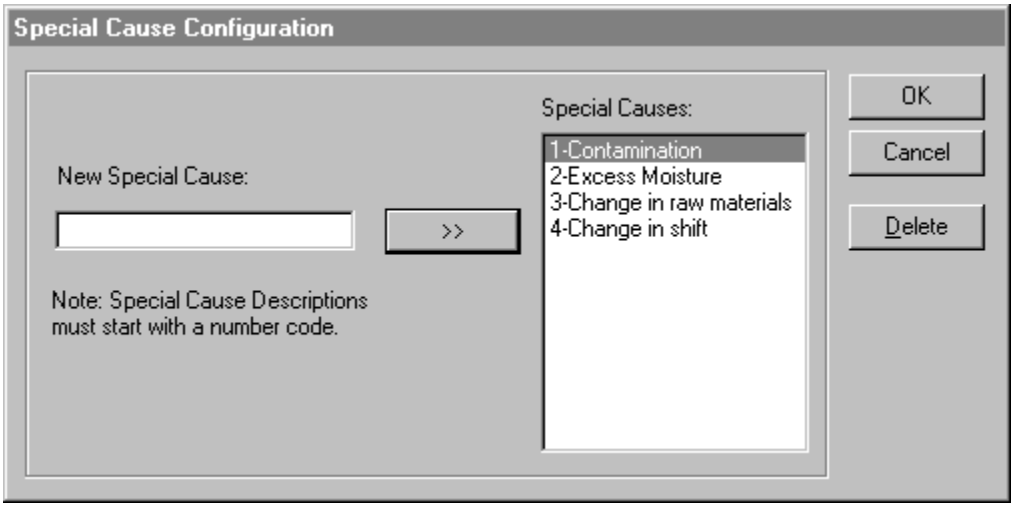


Configuring Special Causes

SPC samples that are out of control may have Special Causes. Defining special causes is done in WindowMaker through the **Special Cause Configuration** dialog box. You can attach a Special Cause to any sample in WindowViewer, either through the DDE item (for example **CurrentCauseCode**) or through the Sample Information dialog box. A summary of these causes can then be displayed on a Pareto chart to determine the most offending causes.

➢ **To configure special causes for a Dataset:**

1. Start WindowMaker.
2. On the **Special** menu, point to **SPC**, and then click **Datasets**, or in the Application Explorer under **SPC**, double-click **Datasets**. The **SPC Datasets Configuration** dialog box will appear.
3. In the **SPC Dataset Configuration** dialog box, click **Causes**. The **Special Cause Configuration** dialog box appears:



4. In the **New Special Cause** box, type a cause description with a code number. Then click the >> button or the ENTER key, to add the new special cause to the Special Causes list box. This number is used to identify the columns in the Pareto display chart. For example, type 1-Startup
5. Add as many special cause descriptions as you need. Each special cause configured will be displayed in the list box.

Note Special Causes can be attached to any sample during runtime through the **Sample Information** dialog box or through DDE.

6. Click **OK**.

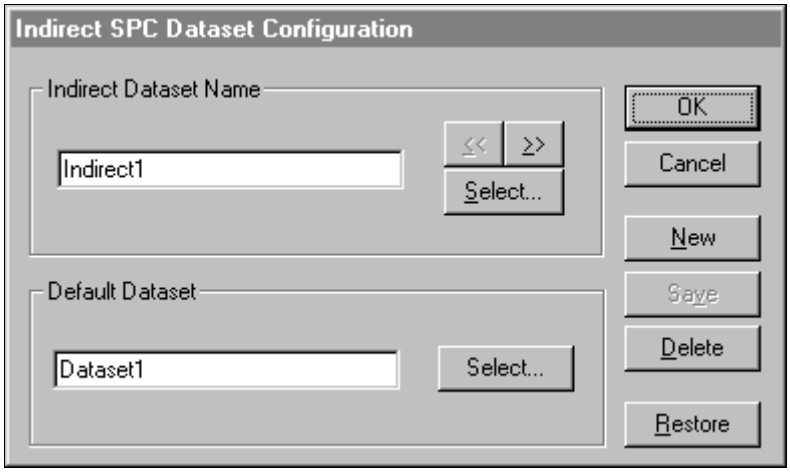
   The **Special Cause Configuration** dialog box can be displayed in runtime by right-clicking a sample, and then selecting **Add/Delete Causes**.

Configuring Indirect Datasets

Indirect Datasets allow SPC charts to be dynamically linked in runtime to any dataset. With Indirect Datasets you can use the same SPC chart to display multiple Datasets. When you configure an SPC chart, you must link it to an SPC Dataset. If you link the SPC chart to an Indirect Dataset, that chart can display any dataset. This is accomplished in runtime by changing the **DatasetName** DDE item. When this item is changed, the Indirect Dataset takes on all of the properties and item values of the Dataset to which it is linked.

➢ **To configure an Indirect Dataset:**

1. Start WindowMaker.
2. On the **Special** menu, point to **SPC**, and then click **Indirect Datasets**, or in the Application Explorer under **SPC**, double-click **Indirect Datasets**. The **Indirect SPC Datasets Configuration** dialog box appears.



3. In the **Indirect Dataset Name** box, type a unique name for the indirect dataset (maximum of 31 characters).
4. In the **Default Dataset** box, type the name of the Dataset to which you want to link the Indirect Dataset (maximum of 31 characters), or click **Select**. The **Select a Dataset** dialog box will appear.
5. All currently defined Datasets will be displayed in the **Select a Dataset** dialog box. Select the Dataset name to which you want to link the Indirect Dataset.

   The dialog box will close and the selected Dataset name will appear in the **Default Dataset** box.

   To change the link at runtime, you can set the DDE item **DatasetName** to the desired dataset.

   For more information on changing a link in Runtime, see Chapter 5, SPC DDE Items and SPC Functions."

Importing SPC Datasets

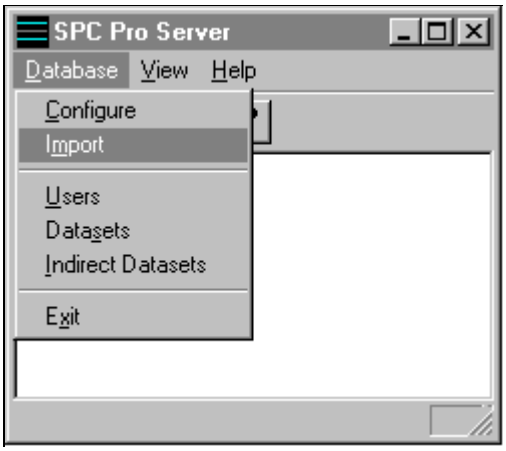
Any dataset that you were using with version 6.0 or earlier, must be converted to the new SPC Pro format before running your InTouch application.

When you install InTouch, the executable utility, SPCPRO.EXE, is automatically installed in your InTouch directory. This is the utility that you will use to import your datasets.

Note You must create a new database to store your converted dataset files. The database you create must be empty. You can only import old datasets to an empty database. No predefined datasets in the database when importing Datasets. Tagnames must be manually defined in the tagname dictionary first.

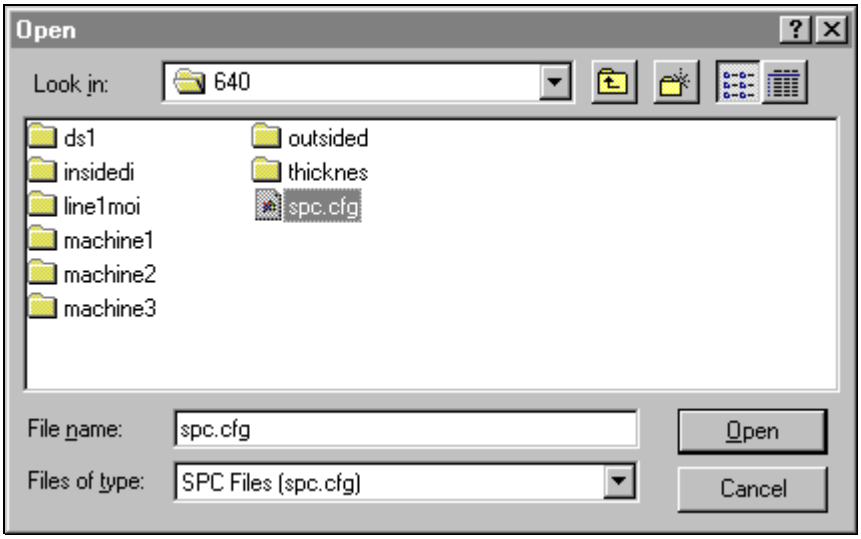
➢ **To import SPC datasets:**

1. Start the SPCPRO.EXE utility. The **SPC Pro Server** utility program appears:

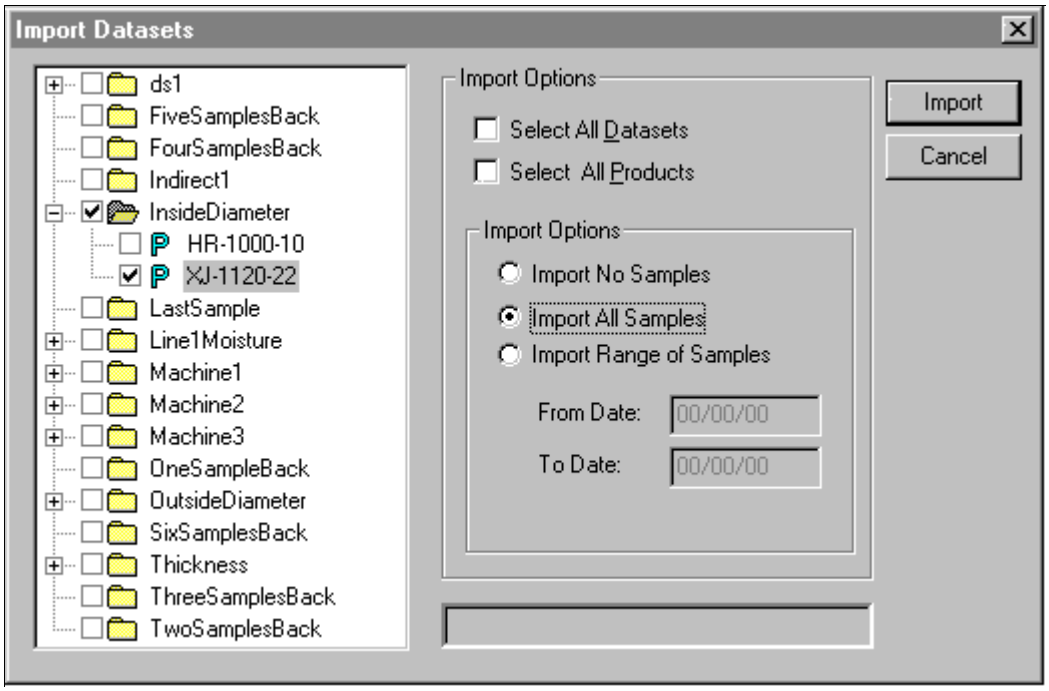


Note You can use the **SPC Pro Server** utility to perform all SPC Pro functions. For example, configure a Database, configure users, and create Datasets and Indirect Datasets. By using the **SPC Pro Server** utility, you do not need to configure SPC from within WindowMaker.

2. On the **Database** menu, click **Import**. The **Open** dialog box appears:



3. Double-click the application directory for the SPC application whose datasets you want to convert or select it, and then click **Open**. The **Import Datasets** dialog box will appear.



4. In the **Import Options** group, select the **Select All Datasets** option to import all Datasets from the selected application, or **Select All Products** to import all Products from the selected application, or pick and choose the datasets and products from the listing on the left.

5. Select what samples you want to import in the second **Import Options** group as follows:

Import No Samples	Import only the Dataset configurations.
Import All Samples	Import all samples in the Dataset.
Import Range of Samples	Import only the samples for the specified **From Date** and **To Date**.

6. Click **Import**. The datasets will be imported and converted to the new SPC Pro format and are now ready to view in SPC Pro.

Note If there is a lot of data to import, this process could take some time.

CHAPTER 3

Using the SPC Chart Wizards

SPC Chart wizards are used to display the contents of Datasets. There are three types of SPC chart objects available: Control Chart, Histogram and Pareto charts. SPC chart objects are "wizards" that are simply pasted into your window and then configured and linked to a Dataset.

You can configure the SPC Control Chart wizard to display X Individual, X bar - R, X bar - s, Moving-X Moving-R, CUSUM, EWMA, C, P, U, and NP Charts.

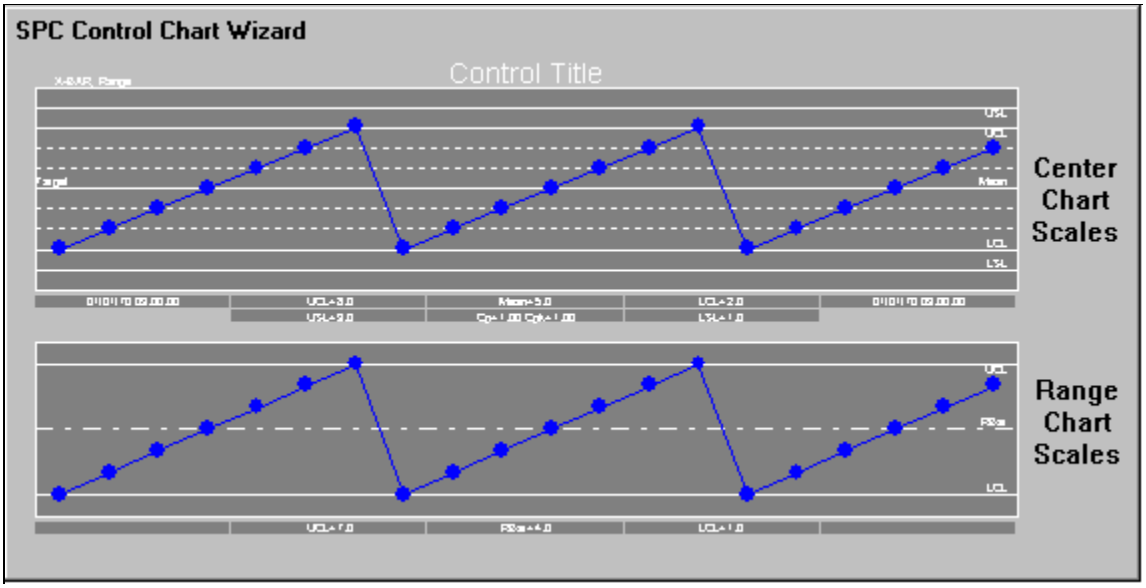
For more information on configuring Datasets, see Chapter 2, "Creating SPC Datasets."

Contents

Control Charts

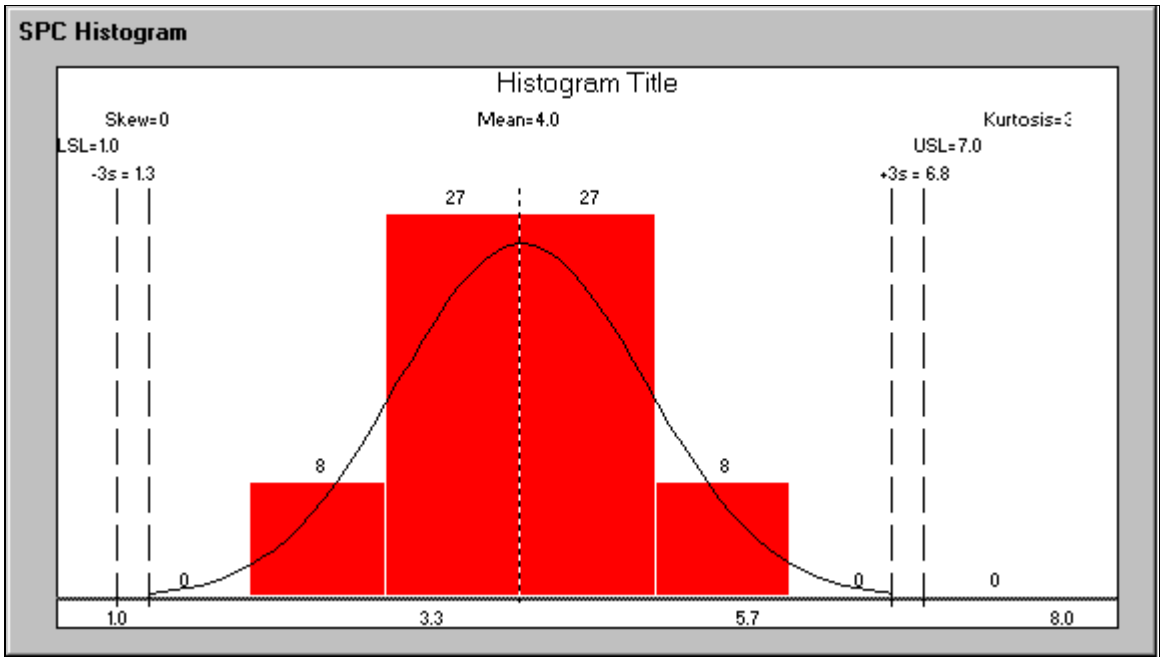
SPC data is displayed using X-Y charts, calculating a point for each sample or sub-group. The points are connected by lines to form a control chart, which provides graphical feedback to the user about the process being monitored. A centerline is used to show the average of all points in a group. An upper control limit line is displayed at three standard deviations above the centerline. The lower control limit line is the centerline minus three standard deviations. Upper and lower specification limit lines show the arbitrary top and bottom limits of acceptable output. A target line shows the desired average value of the process (which should be the same as the centerline) and zone lines are reference lines that are plus and minus one and two standard deviations away from the centerline.

If a sample falls outside of the control limits (or breaks one of the run rules), an alarm will be generated and the user may note the Special Cause that produced the out of control sample. The following is an example of the SPC Control Chart wizard:



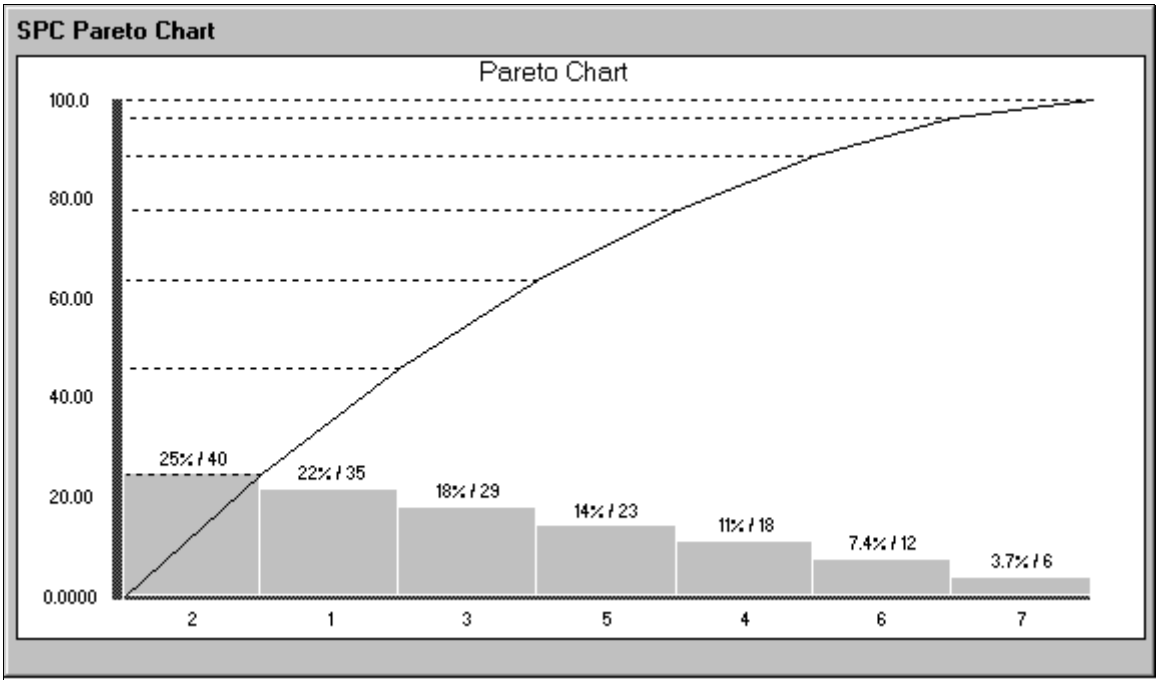
Histograms

Histograms are created from the raw measurement data used for the control charts and are used to display the distribution and frequency of the collected data. A normal process will have a bell-shaped distribution of data values. Any other distribution shape is cause for investigation. The following is an example of the SPC Histogram wizard:



Pareto Charts

Pareto charts are used to graphically present the number of occurrences of Special Causes. Since the user usually enters Special Cause notations when acknowledging alarms, the Pareto chart would use these entries over some specified number of samples and present them in the form of a descending bar graph. While there are many possible causes for out of control samples, it is usually only one or two Special Causes that produce the bulk of bad samples. Pareto charts help zero in on the most offensive causes. The following is an example of the SPC Pareto Chart wizard:



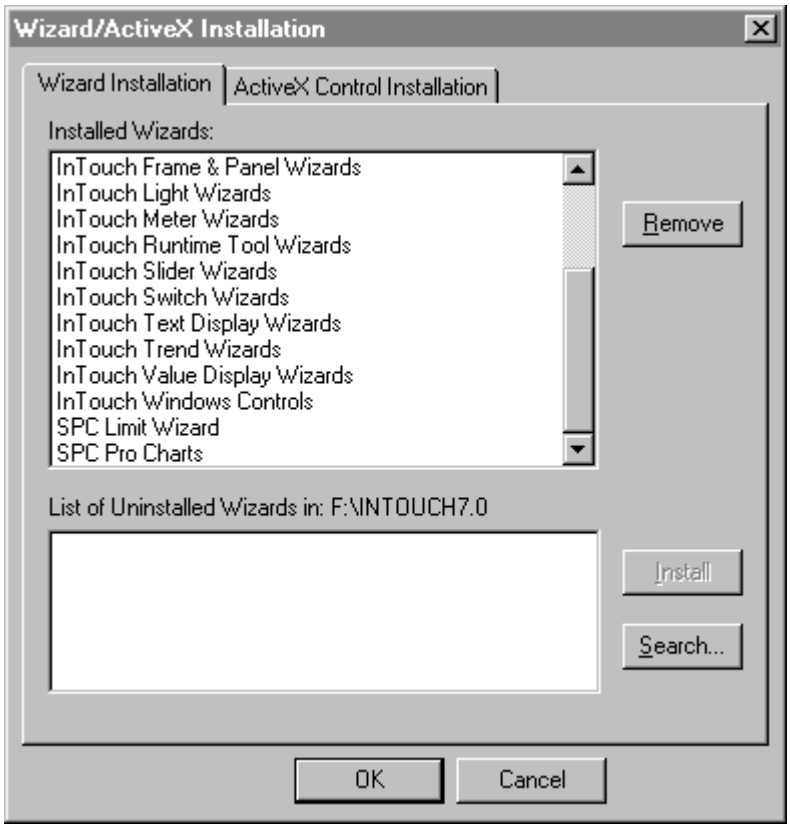
Installing the SPC Chart Wizards

The SPC Pro program supplies you with three SPC Chart wizards and a SPC Limits wizard. To use the wizards, you must first install them in WindowMaker. Once installed, you paste the SPC Chart wizard that you want to use into a WindowMaker window, and then configure it and link it to a Dataset.

➢ **To install the SPC Chart wizards:**

1. Start WindowMaker.
2. On the **Special** menu, point to **Configure**, and then click **Wizard/ActiveX Installation**, or in the Application Explorer, double-click **Wizard/ActiveX Installation**. The **Wizard/ActiveX Installation** dialog box appears with the **Wizard Installation** property sheet active:

   ☞ In the Application Explorer, you can also right-click **Wizard/ActiveX Installation**, and then click **Open**.

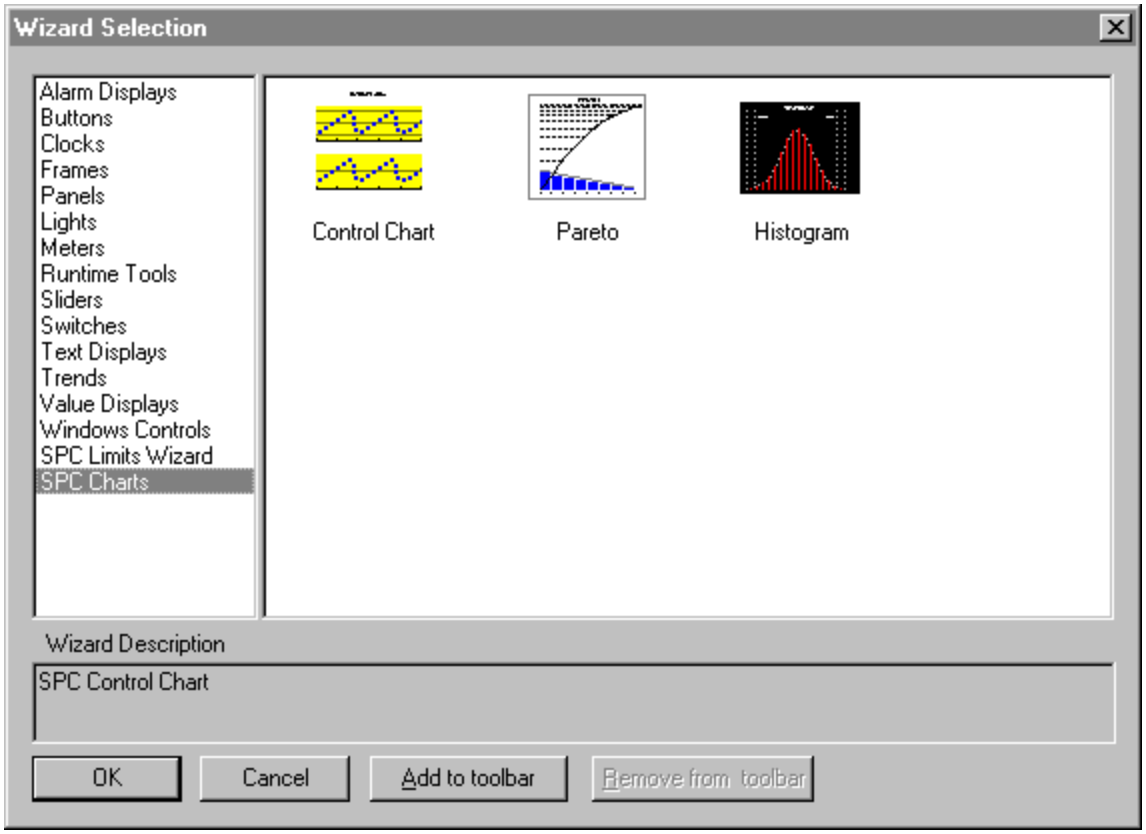


3. Once the **Wizard/ActiveX Installation** dialog appears, click **OK**. Your SPC Chart wizards will be installed.

Note DO NOT use the **Remove** button to remove the SPC Chart Wizards.

➢ **To use the SPC Chart wizards:**

1. Click the Wizard Dialog tool in the **Wizards/ActiveX Toolbar**. The **Wizard Selection** dialog box appears:



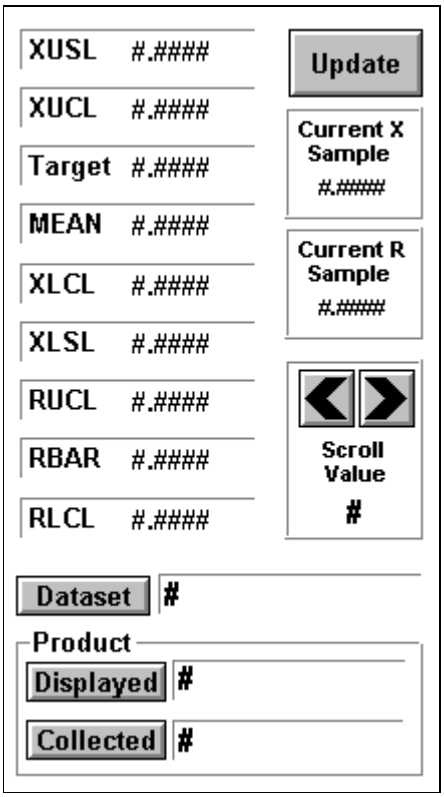
Note If SPC Chart wizards do not appear in the **Wizard Selection** dialog box, you will need to initialize them. On the **Special** menu, point to **Configure**, and then click **Wizard/ActiveX Installation**. You must click the **OK** button to install SPC Chart wizards.

2. In the list of wizards, click the **SPC Charts** category.
3. In the display area, select the SPC chart wizard that you want to use, and then click **OK** or double-click the wizard. The dialog box will close and your window will reappear.

   To add the wizard to the **Wizards/ActiveX Toolbar**, select the wizard, and then click **Add to toolbar**. Once you add a wizard to the **Wizards/ActiveX Toolbar**, you can select it and paste it into your open window at any time.
4. The cursor will change to a corner symbol when you return to the window. Click the location in the window where you want to paste the wizard.
5. Double-click the wizard to configure it.

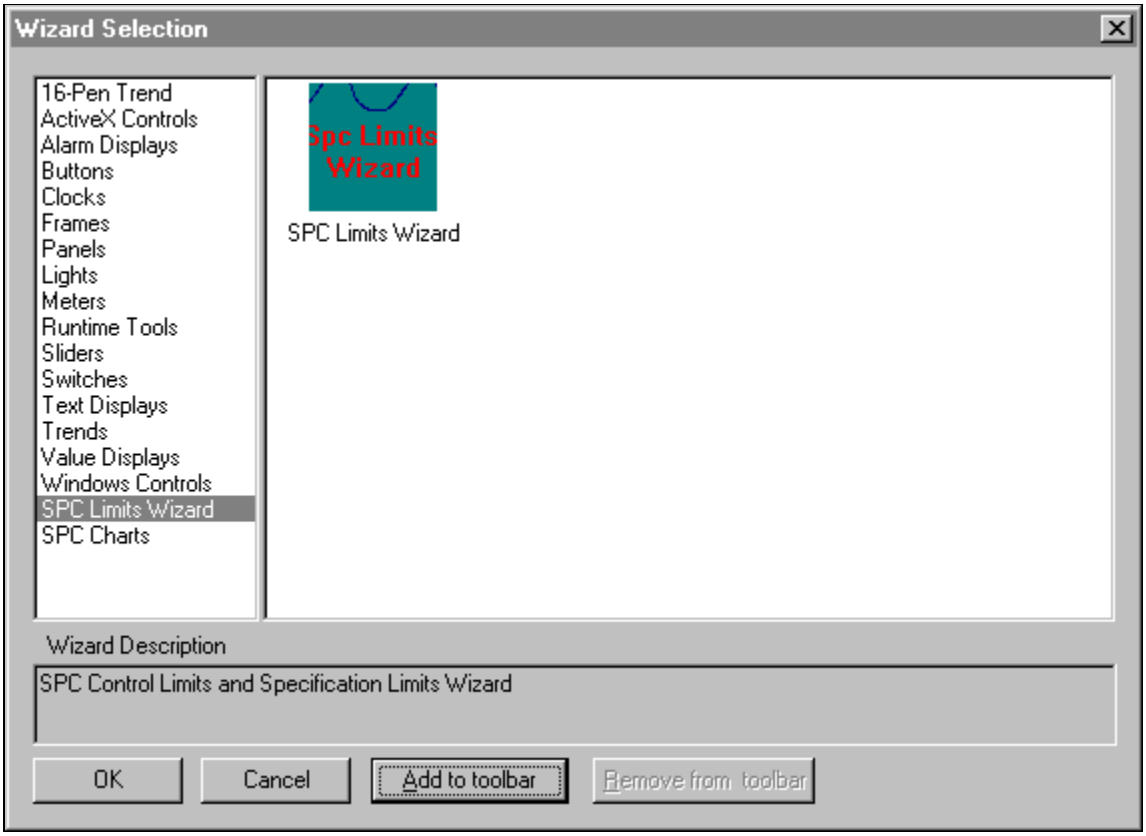
SPC Limits Wizard

The SPC Limits wizard is a SPC control panel wizard that allows you to update and view SPC specification limits and SPC control limits. It also allows you to switch datasets, switch products, and to scroll the SPC Chart.



➢ **To use the SPC Limit wizard:**

1. Click the Wizard Dialog tool in the **Wizards/ActiveX Toolbar**. The **Wizard Selection** dialog box appears:



2. In the list of wizards, click the **SPC Limits Wizard** category.
3. Select the **SPC Limits Wizard** in the display area, and then click **OK** or double-click the wizard. The dialog box will close and your window will reappear.

   To add the wizard to the **Wizards/ActiveX Toolbar**, select the wizard, and then click **Add to toolbar**. Once you add a wizard to the **Wizards/ActiveX Toolbar**, you can select it and paste it into your open window at any time.
4. The cursor will change to a corner symbol when you return to the window. Click the location in the window where you want to paste the wizard.
5. Double-click the wizard to configure it.

➢  **To remove the SPC Chart wizards from the toolbar:**

1. Click the Wizard Dialog tool in the **Wizard/ActiveX Toolbar**. The **Wizard Selection** dialog box will appear.
2. Click **Remove from toolbar**. The **Remove Wizard from Toolbar** dialog box appears:

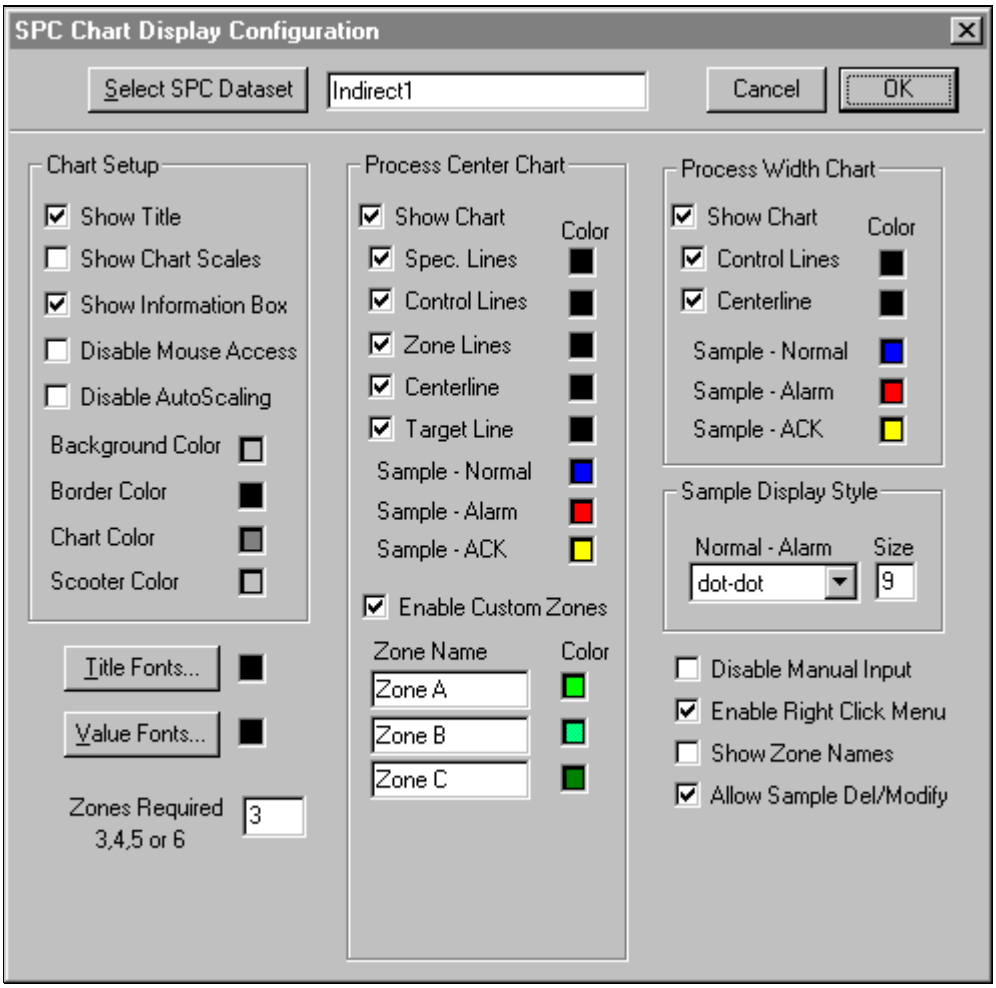
3. Select the wizard(s) that you want to remove from the toolbar.
4. Click **OK**.

Configuring the SPC Control Chart Wizard

When the SPC Control Chart wizard is used, it must be configured with the information required to link the SPC Control Chart to your SPC Dataset.

➢ **To configure a Control Chart:**

1. Paste the SPC Control Chart wizard into your window, and then double-click it. The **SPC Chart Display Configuration** dialog box appears:



2. Type the Dataset name in the input box, or click **Select SPC Dataset**. The **Select a Dataset** dialog box will appear.

   - A previously defined dataset name must be entered to configure the SPC Control Chart.

3. Select the desired dataset name.

   - The dialog box will close and the selected Dataset name will automatically be inserted into the input box.

4. The **Chart Setup** group's options are used to set up and help define your chart as follows:

Show Title	Select to display the chart's title.
Show Chart Scales	Select to display the chart's scales adjacent to the chart.
Show Information Box	Select to display the time, date, specifications, limits and the Cp/Cpk (capability calculations) beneath the chart.
Disable Mouse Access	Select to disable the touch-sensitivity of the chart in runtime. If this option is **not selected** and you click a sample character in the chart in runtime, the **Sample Information** dialog box will appear. ☞ For more information on the **Sample Information** dialog box see, "Detailed Sample Information."
Disable AutoScaling	Select to effect the way the chart calculates the display range. Normally the chart display range is calculated to accommodate all of the displayed samples, control limits and specification limits. If this option is selected, the chart range is determined as follows: • If the chart is configured to display control limits and specification limits, the range will accommodate all displayed control and specification limit values. • If the chart is configured to display control limits and not specification limits, the range will accommodate all displayed control limit values. • If neither the control limits nor the specification limits have been configured for display, the range of the chart will be set by the current specification limit values.
Background Color, **Border Color** **Chart Color**, **Scooter Color**	Click the respective color box to choose the color in the color palette that you want to use in the chart for each item.

5. Click **Title Fonts**, to open the **Font** dialog box. Select the font, font style and size for the chart's Title. Click the color box to select the color in the color palette that you want to use for the Title.

6. Click **Value Fonts**, to open the **Font** dialog box. Select the font, font style and size for the values displayed on the chart. Click the color box to select the color in the color palette that you want to use for the values.

7. The **Process Center Chart** group's options are used to define and display a Center Chart. You must select the **Show Chart** option to configure the lines you want displayed on your Center Chart. Click each color box to select the color in the color palette that you want to use for the **Spec. Lines**, **Control Lines**, **Zone Lines**, **Centerline** and **Target Line**.

   The **Normal**, **Alarm** and **ACK** sample points can also be set to different colors. This helps to distinguish the **Normal Sample** points from the **Alarm** and **ACK** samples.

8. The **Enable Custom Zones**, **Zones Required 3,4,5, or 6**, and **Zone Name** options all define the zones used within your Center Chart as follows:

   Enable Custom Zones — Select to display levels of zones within your Center Chart. The area between the target and control limit will be equally divided into the number of zones specified.

   Zones Required 3,4,5, or 6 — Select the number of Custom Zones for the Center Chart.

   - Once you have specified the number of zones required, you can then enter a different **Zone Name** to define the zone level and associate a **Color** for each of the zones.

   - When in Runtime, right click on the chart, and then select the **Zone Center** option. All the chart samples plotted will now appear in the center of your custom zones.

9. The **Process Width Chart** group's options are used to define and display a Width Chart. You must select the **Show Chart** option to configure the lines you want displayed on your Width Chart:

   Control Lines and **Centerline** on your Width Chart can be a different color. Click the color box to select another color in the color palette.

   The **Normal**, **Alarm**, and **ACK** sample points can also be set to different colors. This helps to distinguish the **Normal Sample** points from the **Alarm** and **ACK** samples. Click the color box to select another color in the color palette.

10. In the **Sample Display Style** group's options you can change the sample style and the point character size used in both your Center Chart and your Width Chart.

11. Select **Disable Manual Input** to disable entering manual sample inputs from the chart in runtime.

    - Manual samples can also be entered by using InTouch scripting.

12. Select **Enable Right Click Menu** to enable the right-click sample menu. This menu includes Acknowledging Alarms, Deleting samples, Modifying samples, Zone Centering option and Adding and Deleting Special Causes.

13. Select **Show Zone Names** to display the zone names on your Center Chart.

14. Select **Allow Sample Del/Modify** to allow the user to delete and modify sample values through the right-click menu.

    - All sample modifications and deletions are logged to a file named SPCXACT.LOG which is stored in your application directory.

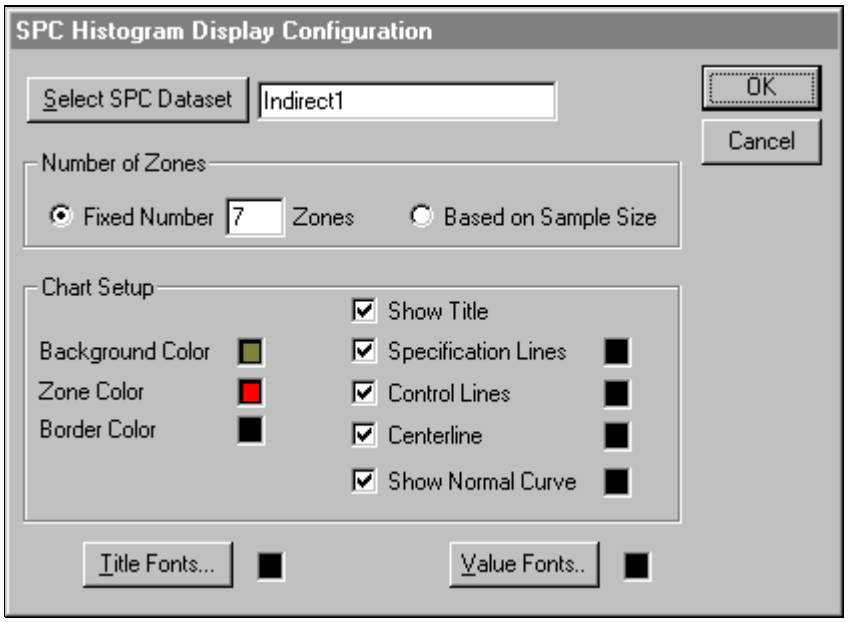
15. Click **OK** to save.

Configuring the SPC Histogram Wizard

When the SPC Histogram wizard is used, it must be configured with the information required to link the SPC Histogram to your SPC Dataset.

➢ **To configure a SPC Histogram wizard:**

1. Paste the SPC Histogram wizard into your window, and then double-click it. The **SPC Histogram Display Configuration** dialog box appears:



2. Type the Dataset name in the input box, or click **Select SPC Dataset**. The **Select a Dataset** dialog box will appear.

   - A previously defined dataset name must be entered to configure the SPC Histogram.

3. Select the desired dataset name.

   - The dialog box will close and the selected Dataset name will automatically be inserted into the input box.

4. The **Number of Zones** group's options are used to configure the number of displayed zones on the Histogram chart. This allows you to choose a fixed number of samples. For example, if your sample size was 300, and your chart was based on sample size, your graph would end up unreadable.

Fixed Number	Select to specify the number of zones to limit your sample size.
Based on Sample Size	Select if you want the Number of Zones displayed on the Histogram to be based on your sample size.

5. The **Chart Setup** group's options are used to set up and help define your chart as follows:

Background Color, **Zone Color Border Color**	Click the respective color box to choose the color in the color palette that you want to use in the chart for each item.
Show Title	Select to display the chart's title.
Specification Lines, **Control Lines Centerline**	Click the respective color box to choose the color in the color palette that you want to use in the chart for each item.
Show Normal Curve	Select to display a normal distribution curve line to the Histogram chart. Choose a color you want associated with this curve line by clicking on the option. The InTouch color palette will appear.

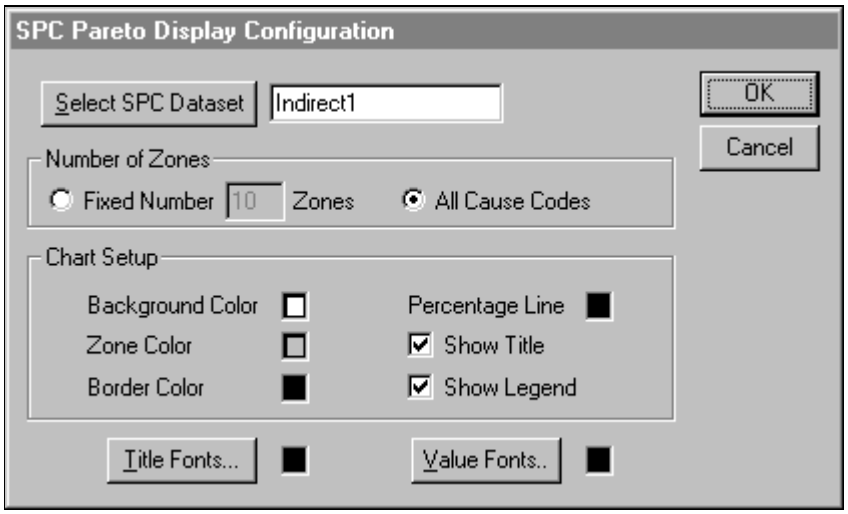
6. Click **Title Fonts**, to open the **Font** dialog box. Select the font, font style and size for the chart's Title. Click the color box to select the color in the color palette that you want to use for the Title.
7. Click **Value Fonts**, to open the **Font** dialog box. Select the font, font style and size for the values displayed on the chart. Click the color box to select the color in the color palette that you want to use for the values.
8. Click **OK** to save.

Configuring the SPC Pareto Chart Wizard

When the SPC Pareto wizard is used, it must be configured with the information required to link the SPC Pareto to your SPC Dataset.

➢ **To configure a Pareto Chart:**

1. Paste the SPC Pareto wizard into your window, and then double-click it. The **SPC Pareto Display Configuration** dialog box appears:



2. Type the Dataset name in the input box, or click **Select SPC Dataset**. The **Select a Dataset** dialog box will appear.

   - A previously defined dataset name must be entered to configure the SPC Pareto chart.

3. Select the desired dataset name.

   - The dialog box will close and the selected Dataset name will automatically be inserted into the input box.

4. The **Number of Zones** group's options are used to configure the number of displayed zones on the Pareto chart.

Fixed Number	Select to specify the number of zones (causes) to display.
All Cause Codes	Select if you want the Number of Zones displayed on the Pareto to be equal to the number of Special Cause codes.

5. The **Chart Setup** group's options are used to set up and help define your chart as follows:

Background Color, **Zone Color Border Color**, **Percentage Line**	Click the respective color box to choose the color in the color palette that you want to use in the chart for each item.
Show Title	Select to display the chart's title.
Show Legend	Select to display the Pareto Chart's legend of all Special Causes.

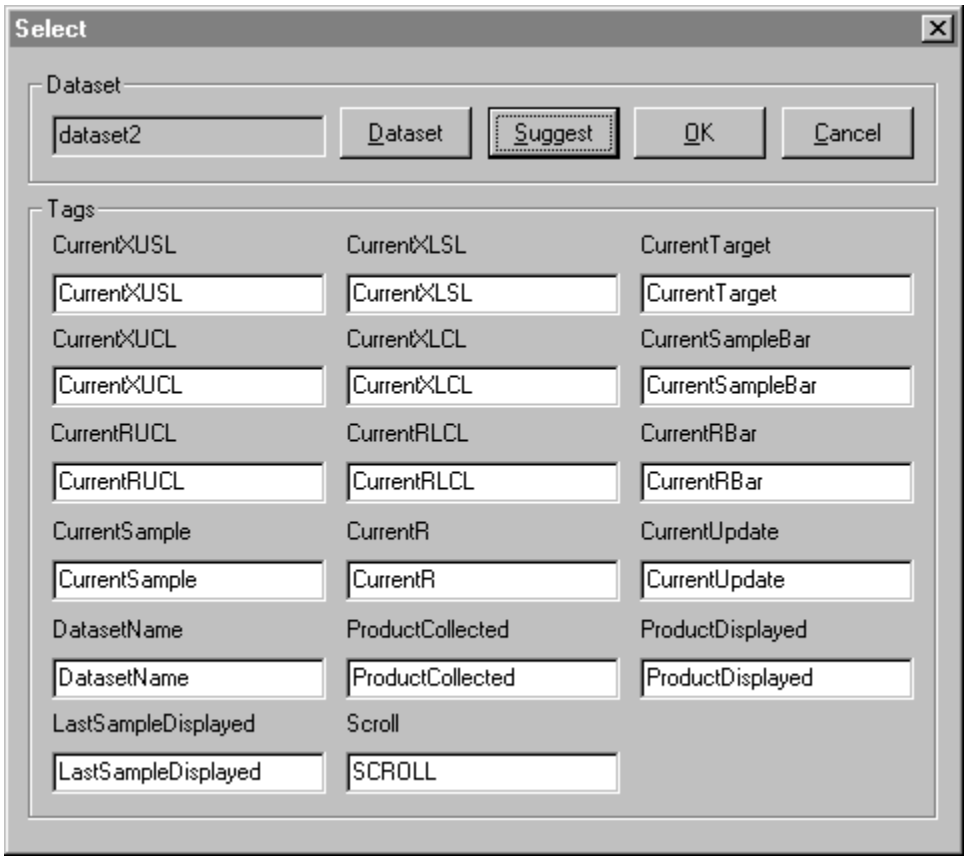
6. Click **Title Fonts**, to open the **Font** dialog box. Select the font, font style and size for the chart's Title. Click the color box to select the color in the color palette that you want to use for the Title.
7. Click **Value Fonts**, to open the **Font** dialog box. Select the font, font style and size for the values displayed on the chart. Click the color box to select the color in the color palette that you want to use for the values.
8. Click **OK** to save.

Configuring the SPC Limit Wizard

When the SPC Limit wizard is used, it must be configured with the information required to link it to your SPC Dataset.

➢ **To configure the SPC Limit wizard:**

1. Paste the SPC Limit wizard into your window, and then double-click it. The **SPC Limit Display Configuration** dialog box appears:



2. Type the Dataset name in the input box, or click **Select SPC Dataset**. The **Select a Dataset** dialog box will appear.

   - A previously defined dataset name must be entered to configure the SPC Limit wizard.

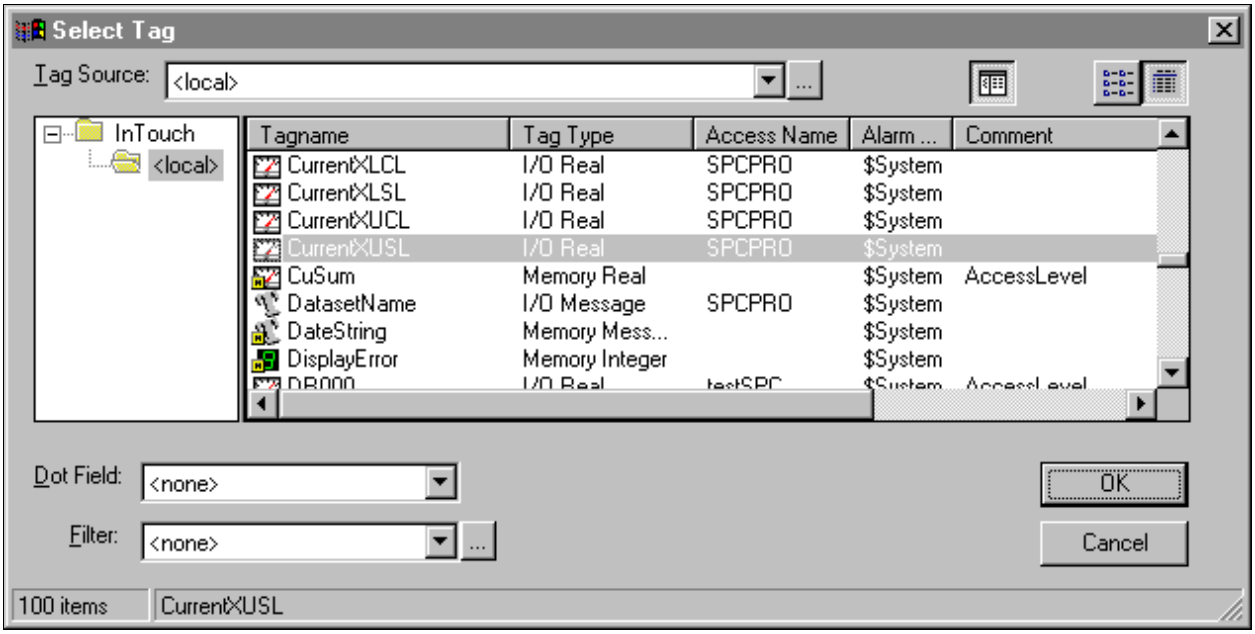
3. Select the desired dataset name.

   - The dialog box will close and the selected Dataset name will automatically be inserted into the input box.

4. In the **Tags** group boxes, type the tagnames that you have defined in your Tagname Dictionary for the various items, or click **Suggest** for the wizard to automatically suggest tagnames for each item.

Note If you type tagnames, or the wizard suggests tagnames that are not currently defined in the Tagname Dictionary, you will be prompted to define them now.

If you double-click on the blank **Tags** input box, the Tag Browser will appear displaying all tagnames defined for the selected tag source. For example:



Double-click the tagname that you want to use, or select it, and then click **OK**. The tag browser will close and the selected tagname will automatically be inserted into the selected field.

For more information on using the Tag Browser, see your *InTouch User's Guide*.

5. Click **OK** to save.

CHAPTER 4

SPC Application Techniques

This chapter describes the SPC application techniques which allow the operator to dynamically change datasets, manipulate Control Charts, obtain detailed sample information, and perform corrective action for a sample.

Contents

Changing Datasets

This section describes how to change Indirect Datasets, change products within a Dataset, and how to create new products in runtime.

Changing Indirect Datasets

Indirect Datasets can be reassigned in runtime to different Datasets through DDE or SPC Functions. This allows you to create a single SPC Chart that can display any configured Dataset.

➢ **To change a chart's Dataset:**

1. Create an I/O Message tagname. For example, **Indirect_DatasetName**.
2. Associate this tagname to an InTouch Access Name using SPC for the *application name* and a valid configured InDirect Dataset Name for the *topic name*.
3. Type the SPC DDE Item Name **DatasetName** in the tagname's **Item** input box.
4. a) Create an InTouch QuickScript to change the Dataset name. For example:
   ```
   Indirect_DatasetName = "SPC1";
   ```
   b) or create the following to allow the user to select the Dataset name. For example:
   ```
   Indirect_DatasetName = SPCSelectDataset();
   ```

   Where: SPC1 is a valid Dataset name. When this QuickScript executes, the specified Dataset name (in this case, SPC1) will be written to the I/O Message tagname **Indirect_DatasetName**.

   Note If the topic name associated with the I/O Message tagname is not a valid Indirect Dataset name, the statement will be ignored.

5. Once the QuickScript executes, the SPC Chart will display the configuration settings for the specified Dataset name. For example, the control limits, and the last samples collected. (The last collected sample will be the last sample displayed in the chart.)

Changing Collected Products within a Dataset

The SPC program allows you to dynamically change the product that is being collected by the Dataset in runtime.

➢ **To change a Dataset's product:**

1. Create an I/O Message tagname. For example, **ProductCollected**.
2. Associate this tagname to an InTouch Access Name using SPC for the *application name* and a valid configured Dataset Name for the *topic name*.
3. Type the SPC DDE Item Name **ProductCollected** in the tagname's **Item** input box.
4. a) Create an InTouch QuickScript to change the Product name. For example:
   ```
   ProductCollected = "Product1";
   ```
   b) or create the following to allow the user to select the Product name. For example:
   ```
   ProductCollected = SPCSelectProduct("Dataset");
   ```
5. Where: Product1 is a valid Product name defined in the Dataset specified as the topic name in the InTouch Access Name.

   Note If the topic name associated with the I/O Message tagname is not a valid Dataset name, the statement will be ignored.

6. Once this QuickScript executes, the specified Product name (in this case, Product1) is written to the I/O Message tagname, **ProductCollected**.

Changing Displayed Products within a Dataset

The SPC program allows you to dynamically change the product that is being displayed by the Dataset in runtime.

➢ **To change the product within a dataset:**

1. Create an I/O Message tagname. For example, **ProductDisplayed**.
2. Associate this tagname to an InTouch Access Name using SPC for the *application name* and a valid configured Dataset Name for the *topic name*.
3. Type the SPC DDE Item Name **ProductDisplayed** in the tagname's **Item** input box.
4. a) Create an InTouch QuickScript to change the Product name. For example:
   ```
   ProductDisplayed = "Product1";
   ```
   b) or create the following to allow the user to select the Product name. For example:
   ```
   ProductDisplayed = SPCSelectProduct("Dataset");
   ```
5. Where: Product1 is a valid Product name defined in the Dataset specified as the topic name in the InTouch Access Name.

   Note If the topic name associated with the I/O Message tagname is not a valid Dataset name, the statement will be ignored.

6. Once this QuickScript executes, the specified Product name (in this case, Product1) is written to the I/O Message tagname, **ProductDisplayed**. The SPC Chart will display the current **ProductDisplayed**'s configuration settings. For example, the control limits, and the last samples collected. (The last collected sample will be the last sample displayed in the chart.)

Creating New Products in Runtime

The SPC program allows you to create a new product within an existing Dataset. Creating a product is accomplished by setting the SPC DDE item **NewProduct**. Creating new product names can also be used for creating separate product files for new lot numbers of a similar product.

➢ **To create a new product in runtime:**

1. Create an I/O Message tagname. For example, **NewProduct**.
2. Associate this tagname to an InTouch Access Name using SPC for the *application name* and a valid Dataset Name for the *topic name*.
3. Type the SPC DDE Item Name **NewProduct** in the tagname's **Item** input box.
4. Create an InTouch QuickScript to change the Product name. For example:
   ```
   NewProduct = "Product2";
   ```
5. Where: Product2 is not an existing Product name defined in the Dataset specified as the topic name in the InTouch Access Name.
6. When this script executes, the specified Product name (in this case, Product2) is written to the I/O Message tagname **NewProduct**. SPC will also automatically set the value of the SPC DDE Item **ProductCollected** to the value of **NewProduct**.

Manipulating Control Charts

The SPC charts normally display current data. By setting various SPC DDE Items, you can manipulate the SPC chart's display of historical data in runtime. This section describes the various methods that can be used to manipulate the SPC Chart's display.

Scrolling a Chart

You can create a 3-D button and attach a **Touch Pushbutton - Action** script to scroll forward and/or backwards through the currently displayed Dataset's historical data. This is accomplished by changing the value of the SPC DDE Item **LastSampleDisplayed** in the scripts linked to the objects. Another SPC DDE Item, **SamplesPerControlChart** can also be used to control how much data is displayed in a chart.

- A Limit Wizard can be used to scroll forward and/or backwards through the currently displayed Dataset's historical data.

➢ **To scroll backwards through the history:**

1. Create a graphic object such as a 3-D button, and attach the following **Touch Pushbutton - Action** script to it:

```
LastSampleDisplayed = LastSampleDisplayed -
SamplesPerControlChart;
```

2. In runtime, when the operator clicks the 3-D button, the script will execute causing SPC to subtract the value of **SamplesPerControlChart** from the current **LastSampleDisplayed** number and automatically scroll the chart backwards to display the resulting sample number as the last sample in the chart.

   For example, if the current **LastSampleDisplayed** is number 860 and **SamplesPerControlChart** item's value is 20, the chart will scroll backwards twenty samples resulting in sample number 821 being the first sample displayed in the chart and sample number 840 being the last sample displayed.

➢ **To scroll forward through the history:**

1. Create a graphic object such as a 3-D button, and attach the following **Touch Pushbutton - Action** script to it:

```
LastSampleDisplayed = LastSampleDisplayed +
SamplesPerControlChart;
```

2. In runtime, when the operator clicks the 3-D button, the script will execute causing SPC to add the value of **SamplesPerControlChart** to the current **LastSampleDisplayed** number and automatically scroll the chart forward to display the resulting sample number as the last sample in the chart.

   For example, if the current **LastSampleDisplayed** is number 860 and **SamplesPerControlChart** item's value is 20, the chart will scroll forward twenty samples resulting in sample number 861 being the first sample displayed in the chart and sample number 880 being the last sample displayed.

Note Whenever the SPC chart is not displaying the current sample number, the word "Historical" will appear in the chart.

Filling a Chart with Current Sample Data

It might be necessary to fill the SPC Control Chart with current sample data. This can easily be accomplished by creating a 3-D button and attaching a **Touch Pushbutton - Action** script it to fill the chart with the current sample data.

➢ **To fill the chart with current sample data:**

1. Create a graphic object such as a 3-D button, and attach the following **Touch Pushbutton - Action** script to it:
   ```
   LastSampleDisplayed = CurrentSampleNumber;
   ```
   Where: **CurrentSampleNumber** is a SPC DDE Item of the Dataset.
2. In runtime, when the operator clicks the 3-D button, the script will execute causing SPC to set the **LastSampleDisplayed** item equal to the **CurrentSampleNumber** and fill the chart with previous samples according to the value of the **SamplesPerControlChart** item's value, including the **CurrentSampleNumber**.

   For example if the **CurrentSampleNumber** number is 860 and the value of **SamplesPerControlChart** is 20, the chart will display sample number 841 as the first sample and 860 as the last sample.

Entering Data into Attribute Charts

Chart Type	DDE Items Used	Comment
C-Chart	MI_M1	Enter the reject count.
P-Chart	MI_M1 and MI_M2	Enter the number of rejects and Sample Size. The Scale goes from 0.00 to 1.00. Example 0.50 = 50% rejects.
NP-Chart	MI_M1	Enter the number of defects (Set sample size in DS Configuration Dialog).
U-Chart	MI_M1 and MI_M2	Enter the Defects in MI_M1 and the sample size in MI_M2.

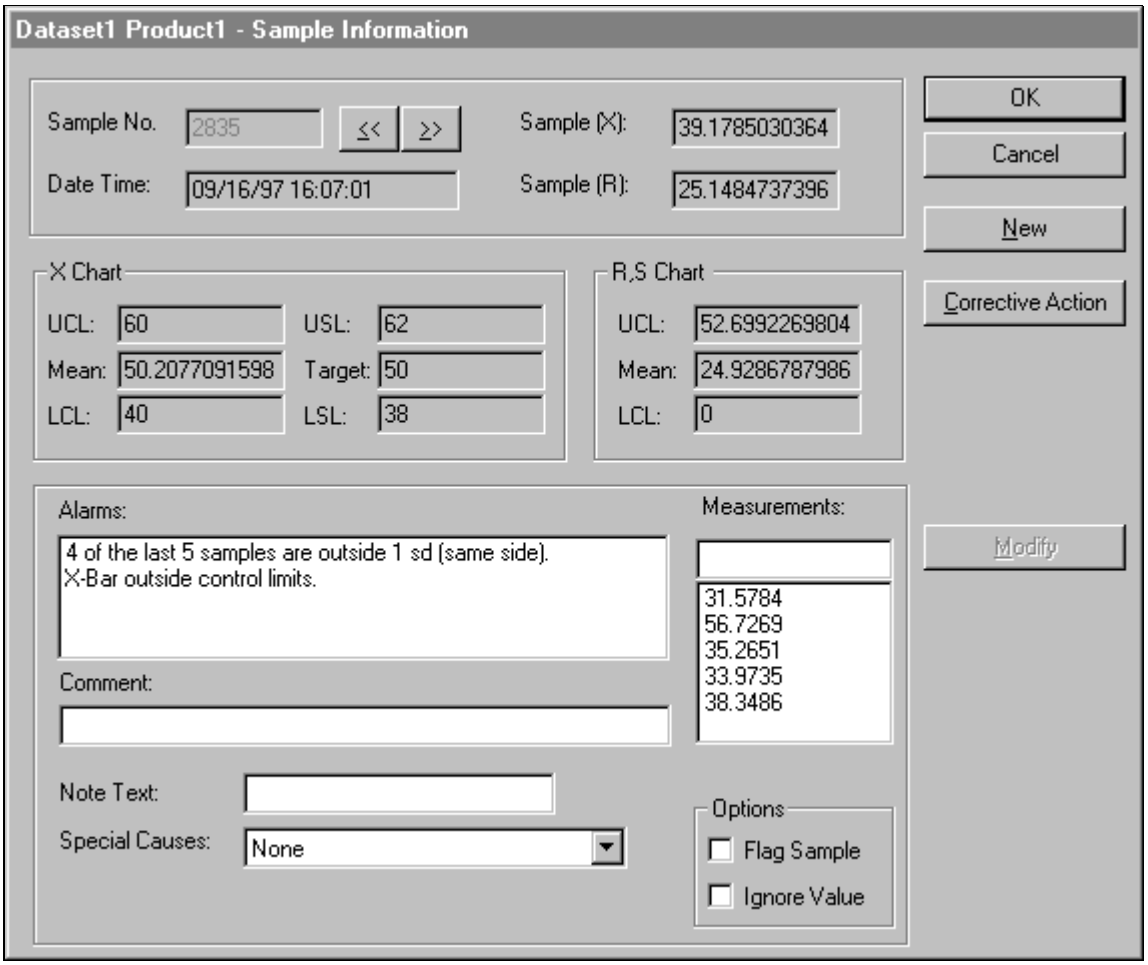
Detailed Sample Information

Detailed sample information can be obtained for any sample point. Comments and Special Causes can also be associated with any sample. Sample information is available either through DDE or through the **Sample Information** dialog box that appears in runtime when the operator clicks a sample.

➢ **To access the Sample Information dialog:**

1. In runtime, click the sample currently displayed (unless your mouse access is disabled) in the SPC Control Chart. The **Sample Information** dialog box appears:

   For more information on enabling mouse access, see "Configuring the SPC Control Chart Wizard."



2. The **Sample No.** box displays the number for the sample that was clicked in the SPC Control Chart.
3. The **Date Time** box displays the date and time the sample was taken.
4. Chart values for the Analysis Type selected are displayed.
5. The **Alarms** window displays all alarm conditions for the displayed sample.
6. The **Measurements** list displays the actual values of all the measurements used in the calculation of the sample.

7. In the **Comment** box, type any comments relating to the sample (maximum of 50 characters.)
8. In the **Note Text** box, enter up to 12 characters to be displayed as a note on the chart.
9. The **Symbol** option is currently not used.
10. Click the **Special Causes** arrow to select a Special Cause for the sample.
11. Select **Flag Sample** if you want to flag the sample on the chart.
12. Select **Ignore Value** to force the SPC Control Chart to be redrawn, ignoring the selected sample from the auto-scaling calculation.

    The sample will still be plotted but will appear to be off the chart display. The sample value will also be ignored in the Histogram plot.

    Note Selecting this option will not exclude the point during control limit calculation, just in the SPC Control Chart display.

13. Click **New** to access the **Manual Input** dialog box to manually enter measurements for the sample.

    For more information on this dialog box, see "Manual Input Information."

14. Click **Corrective Action** to access the **Corrective Action** dialog box to take corrective action on the sample.

    For more information on this dialog box, see "Performing Corrective Action on a Sample."

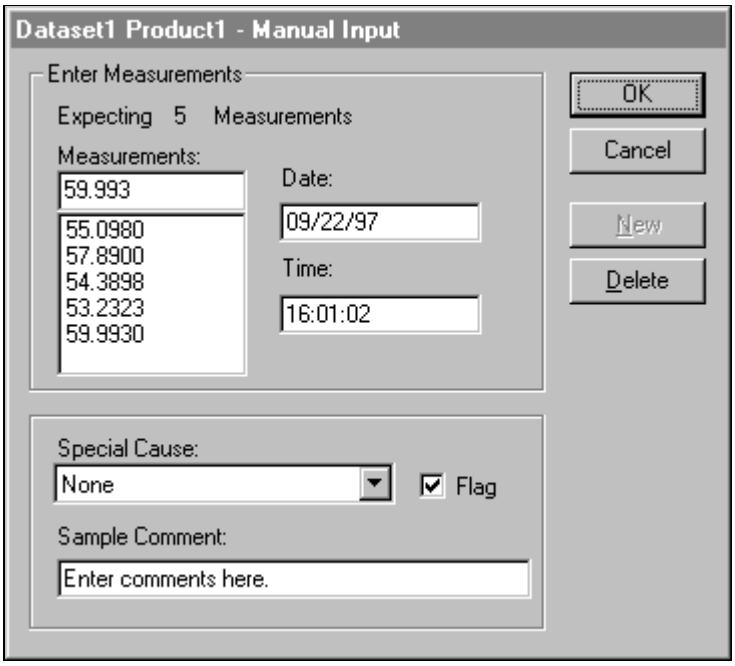
15. Click **OK**.

Manual Input Information

New samples can be added to the Dataset in runtime either through DDE by setting the **ManualInputDialog** DDE Item Name to one (1), or by accessing the **Manual Input** dialog box. This **Manual Input** dialog box is also used to manually add measurements for a new sample.

➢ **To access the Manual Input dialog:**

1. Click a sample on the SPC Control Chart. The **Sample Information** dialog box will appear.
2. Click **New**. The **Manual Input** dialog box will appear:



3. In the **Measurements** box, type the value of each measurement taken for the sample, and then press the ENTER key. (The value is entered into the box below the input box.)

   The number of required measurements is specified above the input box. You cannot click **OK** to save the input until all the expected number of measurements are entered. The dialog box only accept the specified number of measurements for the sample.

4. By default, the **Date** and **Time** boxes, will display the current date and time that will be associated with this new sample. To change the date or time, type the new information into the respective input boxes.
5. If required, click the **Special Cause** arrow to select a Special Cause to the sample. Otherwise, the default of **None** will be used.
6. Select **Flag** to flag the sample on the SPC Control Chart.

7. In the **Sample Comment** box, type any comments relating to the sample (maximum of 50 characters).
8. Click **OK** to add the measurements to the Dataset and close the dialog box. The **Sample Information** dialog box will reappear.
9. Click **OK**.

Note Manual input windows can be created by using the appropriate DDE items. Through DDE, manual inputs can easily be automated using an InTouch Data Change or Condition Script.

For more information on Manual Input DDE Items see, Chapter 5, "SPC DDE Items and SPC Functions."

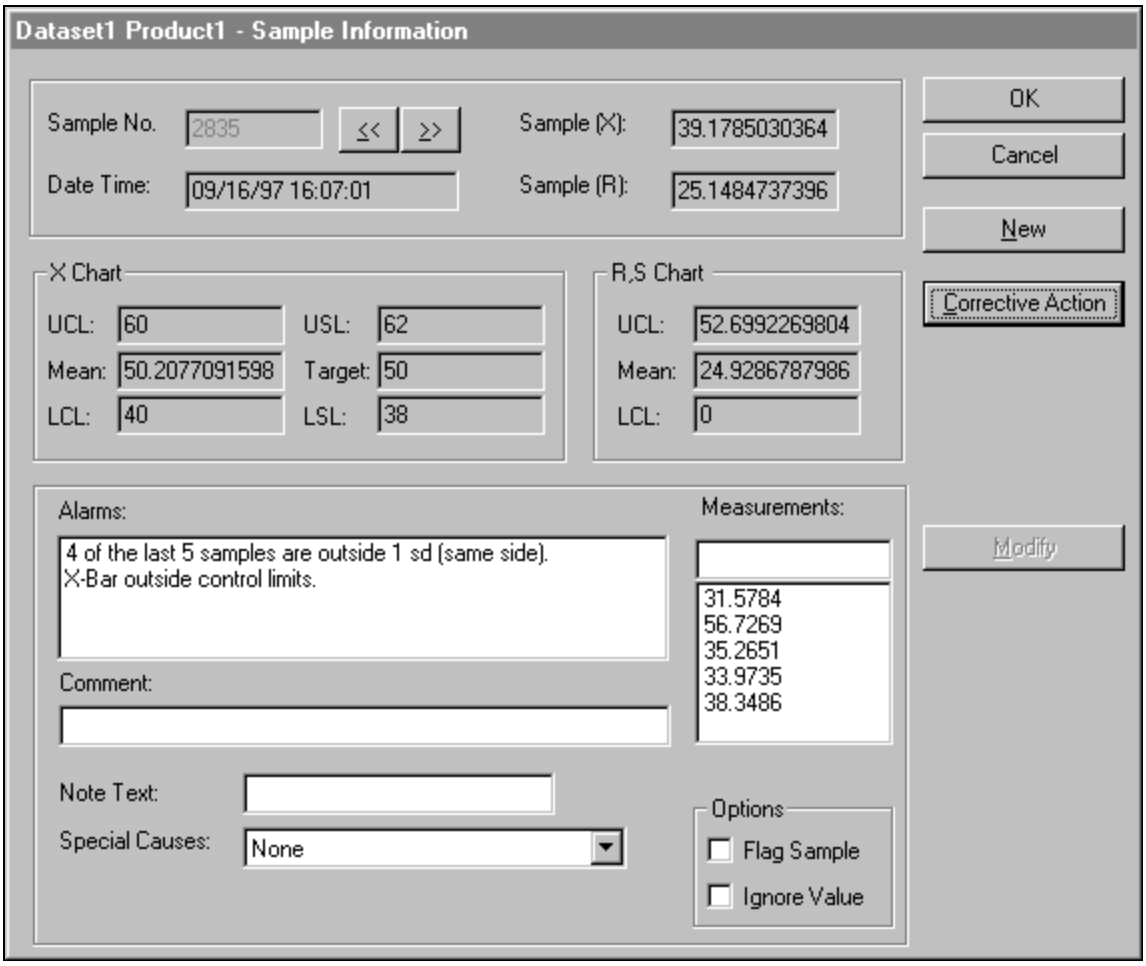
Performing Corrective Action on a Sample

Corrective action or control move is the operator's way of informing the SPC program that a change or modification has been made to the system. Corrective action also allows the operator to document his changes in a log that is attached to the sample number.

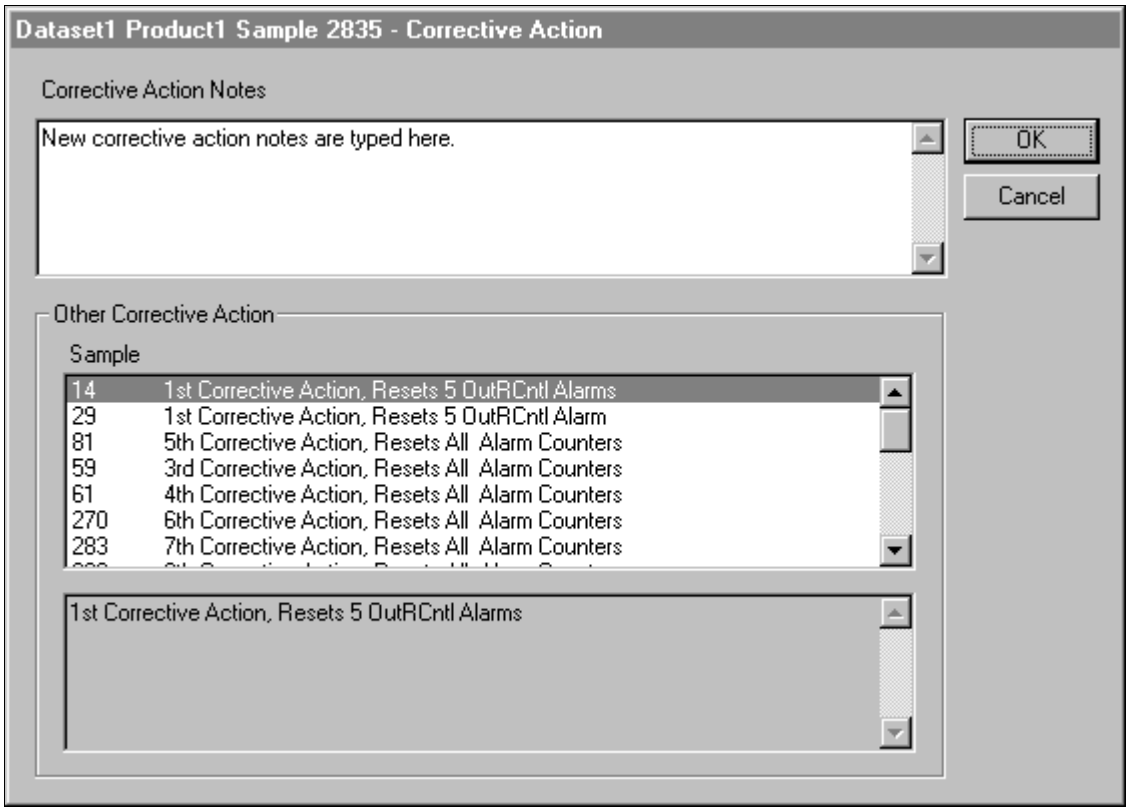
For example, let's assume that the operator who is controlling the process notices an alarmed point on the Control Chart. As he is watching the process, he notices that a control valve is only opening partially, when it should be opening full. He goes out to the valve and notices that the valve is not functioning properly. Therefore, he decides to replace the valve with a new one. When he's done, he would now perform the following steps to perform corrective action on the sample.

➢ **To enter a corrective action:**

1. Click the alarmed sample in the SPC Control Chart. The **Sample Information** dialog box appears:



2. Click **Corrective Action**. The **Corrective Action** dialog box appears:



3. In the **Corrective Action Notes** window, type the notes regarding the corrective action taken for the sample.

   The **Other Corrective Action** window will list all corrective actions taken for samples in the SPC Dataset linked to the SPC Control Chart. If you select a listed correction action, its respective notes will be displayed in the lower window.

   You can scroll through the text. You can also select the text, press the CTRL+C keys to copy it, and then press the CTRL+V keys to paste the text in the **Correction Action Notes** window. You can then modify the text as required for your corrective action.

4. Click **OK**. A message box will appear asking if you are sure you want to perform the corrective action for the sample. Click **Yes** to insert the corrective action into the SPC Database, or click **No** to cancel the action. The **Corrective Action** dialog box reappears.

5. Click **OK**. The **Sample Information** dialog box reappears.

6. Click **OK**.

   The sample will be marked with the symbol **[cm]** in the SPC Control Chart to indicate that corrective action has been taken for the sample and the SPC alarm counters will reset, according to the switch setting in the SPC.INI file. Taking a Corrective Action will also reset the SPC Pro Run Rule Counts.

Note When a corrective action is taken the SPC Alarm counters will automatically be reset to zero. This reset is controlled through a switch setting in the SPC.INI file. The default setting is to reset only those alarms that exist for the sample for which the correction action was performed. However, you can change this to resetting all SPC alarm counters by including the following line in your SPC.INI file:

[General]
ResetAllAlarmCounters=1

Changing the Default Corrective Action Name

The corrective action name is controlled through a switch setting in the SPC.INI file in your InTouch application directory.. By default the name, *Corrective Action* will be used. However, you can change the name to *Control Move* by typing the following line in the SPC.INI file:

[General]
CorrectiveAction=0

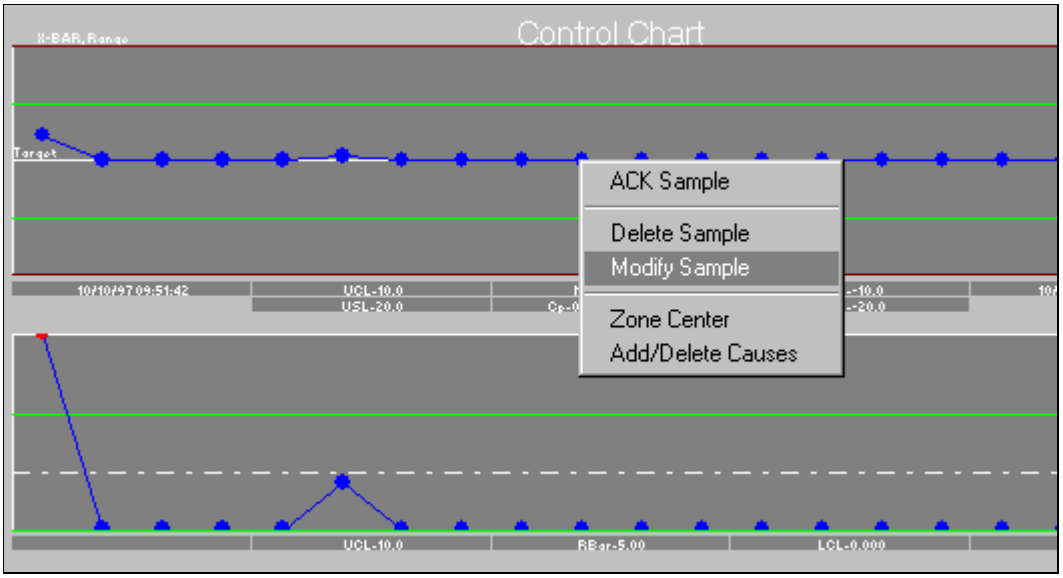
This would change the name to *Control Move*.

Modifying and Deleting Samples

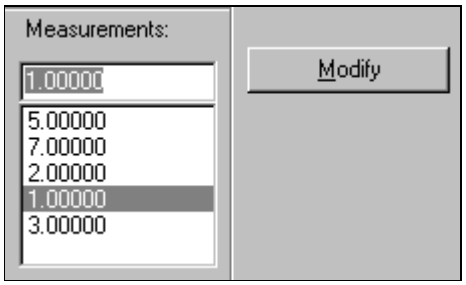
Control Chart sample information can easily be modified and deleted, however this option is not available for the CuSum, EWMA, Moving X and Moving R dataset types.

➢ **To Modify a Sample**

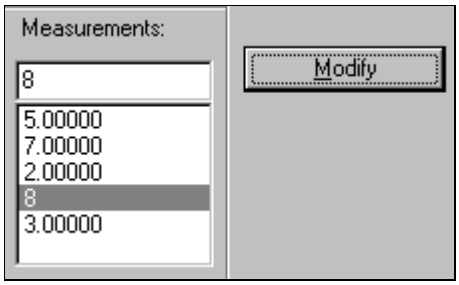
1. To Modify a Sample, right click on the point that you want to modify.



2. Select the Modify Sample option.
3. The **Sample Information** dialog box will appear with the Modify button available.
4. Highlight the Measurement that you would like to change.



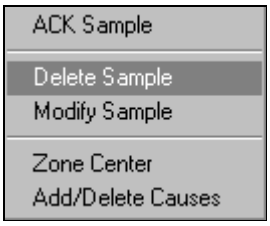
5. Enter the new Measurement and click **Modify**.



6. The Measurement will now reflect your change. Click **OK**.

➢ **To Delete a Sample**

1. To Delete a Sample, right click on the point that you want to delete.

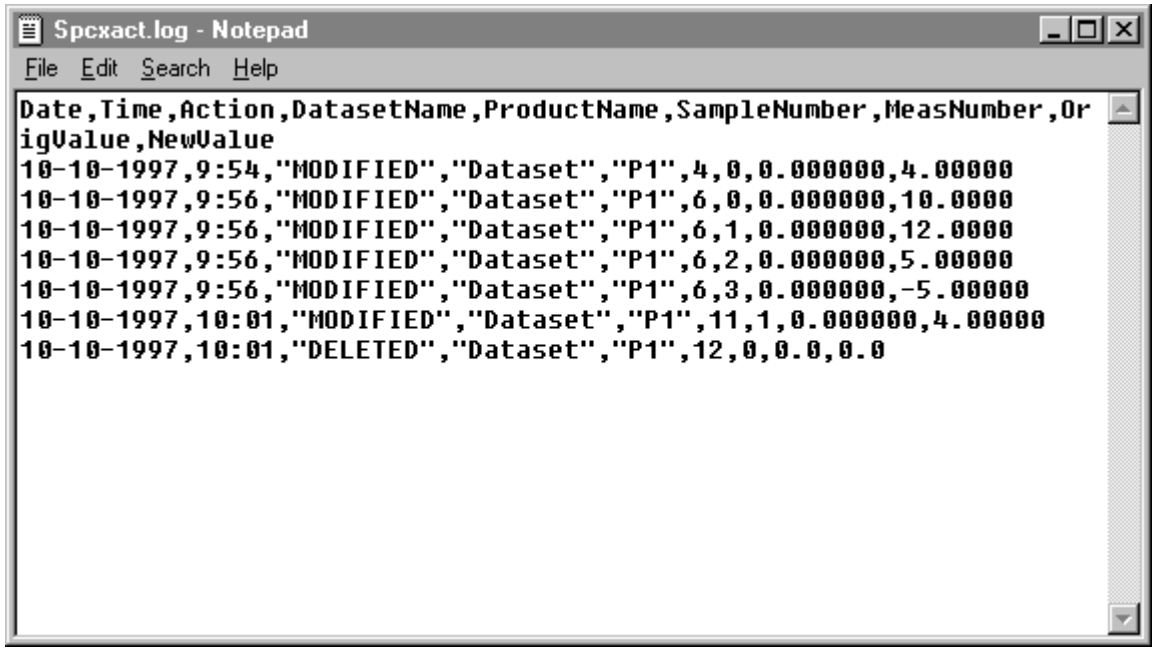


2. Select the Delete Sample option. The following message box will appear:

3. Click **Yes** to confirm the deletion.

➢ **To review all changes**

Every time you delete or modify a sample, SPC Pro keeps a transaction log of the changes made. This log is kept in the application directory and is titled SPCXACT.LOG.



CHAPTER 5

SPC DDE Items and SPC Functions

The SPC displays can be controlled at runtime through a variety of methods. You can create SPC applications that are controlled either by mouse clicks or by keyboard entries. SPC Functions and DDE allow you extensive control of the chart objects and SPC data. This chapter describes the SPC DDE Items and the SPC Functions that you can use to control your SPC applications in runtime.

Contents

Using SPC DDE Items

DDE items are available for obtaining Dataset information and for controlling chart operations. The *application name* is SPC. The *topic name* is the Dataset name.

SPC Control and Display DDE Items

The Control and Display DDE Items are used to control and display information about the topic Dataset. Control DDE items are shared by all nodes. They are the dataset values for the collected product of the remote dataset. Display DDE items are local to each node. They are the sample values for the displayed product on the local node.

Sample modifications can be applied to collected and displayed products of locally any datasets. Modification made by clicking on a chart display will affect the displayed product. The SPC DDE items modify the collected product. The displayed product and the collected product have their own current samples which is the most recently recorded sample.

Alarms are evaluated and stored for collected and displayed products. They are only reported during runtime for the collected product.

Note With the addition of displayed and collected products, many SPC DDE Items apply only to the collected product. These items are flagged in the following lists by an asterisk (*) preceding the SPC DDE Item name.

Item Name	DDE Type	Access	Description
AutoCollection	Discrete	R/W	Enables/disables automatic data collection.
***CalculateControlLimits**	Discrete	R/W	Set to 1 to start control limit calculation.
DatasetName	Message (32)	R/W	Sets the Dataset Name used by an Indirect Dataset.
HistogramLCL	Real	RO	Displays the Histogram's Lower Control Limits based on population.
HistogramUCL	Real	RO	Displays the Histogram's Upper Control Limits based on population.
Kurtosis	Real	RO	Distribution shape of Histograms.
LastSampleDisplayed	Integer	R/W	Sets the last sample number displayed by the Dataset.
***ManualInputDialog**	Discrete	R/W	Set to 1 to display built-in Manual Input Dialog Box.
MeasurementsPerSample	Integer	RO	Displays the configured number of measurements per sample.
NewProduct	Message (32)	R/W	Used to create new Product Name.

Item Name	DDE Type	Access	Description
***ProductCollected**	Message (32)	R/W	Changes the Product Name collected by the Dataset.
ProductDisplayed	Message (32)	R/W	Changes the Product Name displayed by the Dataset.
SampleSize	Integer	RO	Sample size for NP Dataset.
SamplesPerControlChart	Integer	R/W	Sets the number of samples displayed in a Control Chart.
SamplesPerHistogram	Integer	R/W	Sets the number of samples displayed in a Histogram.
SamplesPerLimitCalc	Integer	R/W	Sets the number of samples used in a control limit calculation.
SamplesPerPareto	Integer	R/W	Sets the number of samples used in a Pareto Chart display.
SelSPCOutSpecMsg	Message	RO	Alarm Message tag for "Sample outside specification Limit."
Skewness	Real	RO	Displays the variance from the mean on Histograms.
SPCAllowSampDelMod	Discrete	R/W	Toggles right click menu options Delete and Modify sample options on and off.
SPCConnection	Discrete	RO	Set to 0 if the connection is lost to the server.
SPCConnectType	Message	RO	Displays whether the node is connected as a agent (Server) or Client.
SPCLowDBSpace	Discrete	RO	Used to monitor the Microsoft SQL Server Database. This Item only works with Microsoft SQL Server Databases. It will equal 1 when the database is low on space. Can be used to stop AutoCollection, and alert an operator to allocate more space or free hard disk space for SPC Pro. It will automatically toggle between 1 and 0 depending upon the status of the SQL Database.
StartCollection	Discrete	R/W	Set to 1 to start an Auto collection cycle.

SPC Current Sample DDE Items

All Current Sample DDE Items pertain to the last collected sample of a given Dataset. They can be used to change the raw data and the limits associated with the Dataset Name. To change information about the current sample, you must write to the appropriate DDE Item then set the **CurrentUpdate** DDE Item to 1. This will have the effect of re-entering the sample and will cause any required calculations to be performed. The SPC program will reset the **CurrentUpdate** DDE Item to **0** after the sample has been entered. Once the next sample to be collected has started a collection cycle, the current sample DDE items can no longer be updated.

Current sample DDE items are shared among all nodes. These item values represent the last collected sample of a collected product.

For distributed SPC, initially all the values are set to zero. SPC connects to the database and checks for new data every 5 seconds. The item values are updated whenever new information is found. Modifications to the current sample values are buffered locally until the **CurrentUpdate** item is set to 1. Then the values are placed in a current sample packet and sent to the remote dataset node for analysis and storage. Current sample modifications that indicate a different collected product and a current sample number that is not the last recorded sample will be rejected by the Server.

Note With the addition of displayed and collected products, all of the "Current" SPC DDE Items apply only to the collected product.

Item Name	DDE Type	Access	Description
CurrentCauseCode	Integer	R/W	Sets the Special Cause Code number for the current sample.
CurrentCauseString	Message (128)	RO	Displays the description of the Special Cause Code number for the current sample.
CurrentComment	Message (50)	R/W	Used to read/write any miscellaneous comments associated with the current sample.
CurrentCp	Real	RO	Displays the capability for the current sample.
CurrentCpk	Real	RO	Displays the centered capability for the current sample.
CurrentDate	Message (10)	R/W	Sets the Date for the current sample in the format **DD/MM/YY** or **DD/MM/YYYY**. If incorrectly entered, defaults to the current Date.
CurrentFlag	Discrete	R/W	Sets a Flag for the current sample.
CurrentIgnoreValue	Discrete	R/W	Sets the current sample to be ignored when the Control Chart is AutoScaled.
CurrentM*x*	Real	R/W	Sets the individual measurement value for the current sample. (*x*=1 to 25.)
CurrentR	Real	RO	Displays the range for the current sample.
CurrentRBar	Real	R/W	Sets the average range at the current sample.
CurrentRLCL	Real	R/W	Sets the range Lower Control Limit.

Item Name	DDE Type	Access	Description
CurrentRUCL	Real	R/W	Sets the range Upper Control Limit.
CurrentSample	Real	RO	Displays the value of the last sample point (i.e., X, C, P).
CurrentSampleBar	Real	R/W	Sets the current sample average at this sample point.
CurrentSampleNumber	Integer	RO	Displays the last sample number collected.
CurrentTarget	Real	R/W	Sets the target value at this sample point.
CurrentTime	Message (8)	R/W	Sets the Time for the current sample in the format **HH:MM:SS**. If incorrectly entered, defaults to the current Time.
CurrentUpdate	Discrete	R/W	To change information entered about the sample in any of the current fields, set this Item to 1.
CurrentXLCL	Real	R/W	Sets current sample Lower Control Limit (LCL).
CurrentXLSL	Real	R/W	Sets current sample Lower Specification Limit (LSL).
CurrentXUCL	Real	R/W	Sets current sample Upper Control Limit (UCL).
CurrentXUSL	Real	R/W	Sets current sample Upper Specification Limit (USL).
SPC2L3Out2SD	Integer	RO	Alarm counter for Alarm "2 of the last 3 samples outside of 2 standard Deviation SS."
SPC2L3Out2SDMsg	Message	RO	Alarm Message tag for "2 of the last 3 samples outside of 2 standard Deviation SS."
SPC4L5Out1SD	Integer	RO	Alarm counter for Alarm "4 of the last 5 samples outside of 1 standard Deviation SS."
SPC4L5Out1SDMsg	Message	RO	Alarm Message tag for "4 of the last 5 samples outside of 1 standard Deviation SS."
SPCConSampAltUpDn	Integer	RO	Alarm counter for Alarm "Consecutive samples Alternating Up and Down."
SPCConSampAltUpDnMsg	Message	RO	Alarm Message tag for "Consecutive samples Alternating Up and Down."
SPCConSampln1SD	Integer	RO	Alarm counter for Alarm "Consecutive samples Inside 1 standard Deviation."
SPCConSampln1SDMsg	Message	RO	Alarm Message tag for "Consecutive samples Inside 1 standard Deviation."

Item Name	DDE Type	Access	Description
SPCConSamplncDec	Integer	RO	Alarm counter for Alarm "Consecutive samples Increasing or Decreasing."
SPCConSamplncDecMsg	Message	RO	Alarm Message tag for "Consecutive samples Increasing or Decreasing."
SPCConSampOneSideCL	Integer	RO	Alarm counter for Alarm "Consecutive samples on one side of centerline."
SPCConSampOneSideCLMsg	Message	RO	Alarm Message tag for "Consecutive samples on one side of centerline."
SPCConSampOut1SD	Integer	RO	Alarm counter for Alarm "Consecutive samples outside 1 standard Deviation."
SPCConSampOut1SDMsg	Message	RO	Alarm Message tag for "Consecutive samples outside 1 standard Deviation."
SPCNLNOutNSD	Integer	RO	Alarm counter for Alarm "? Of the last ? samples outside ? standard deviations."
SPCNLNOutNSDMsg	Message	RO	Alarm Message Tag for "? Of the last ? samples outside ? standard deviations."
SPCNLNOutNSDSS	Integer	RO	Alarm counter for Alarm "? Of the last ? samples outside ? standard deviations SS."
SPCNLNOutNSDSSMsg	Message	RO	Alarm Message tag for "? Of the last ? samples outside ? standard deviations SS."
SPCOutRCtrl	Integer	RO	Alarm counter for the Range Chart Alarm "Range outside Control Limit."
SPCOutRCtrlMsg	Message	RO	Alarm Message for the Range Chart Alarm "Range outside Control Limit."
SPCOutXCtrl	Integer	RO	Alarm counter for the X Chart Alarm "Sample outside Control Limit."
SPCOutXCtrlMsg	Message	RO	Alarm Message for the X Chart Alarm "Sample outside Control Limit."
SPCOutSpec	Integer	RO	Alarm counter for Alarm "Sample outside specification Limit."
SPCOutSpecMsg	Message	RO	Alarm Message tag for "Sample outside specification Limit."
SPCResetAlarmCounters	Discrete	R/W	Resets all alarm counters.

SPC Manual Input DDE Items

The Manual Input DDE Items are used to create custom manual input windows. To use the manual input items, set the values of the appropriate items and then set the **MI_Save** DDE Item to 1. This will cause the information in the other MI fields to be entered as a new sample. The SPC program will reset the **MI_Save** DDE Item to 0 (zero) after the sample has been entered.

For distributed SPC, manual input DDE items are private to each node. The values are buffered locally at each node until the DDE item **MI_Save** is set to 1. Once **MI_Save** is set to 1, the values are placed in a manual input packet and sent to the remote dataset node for analysis and storage.

Note With the addition of displayed and collected products, all of the "Manual" SPC DDE Items apply only to the collected product.

Item Name	DDE Type	Access	Description
MI_CauseCode	Integer	R/W	Sets the Special Cause Code number for the manually input sample.
MI_CauseString	Message (127)	RO	Displays the description of the Special Cause Code number input for the sample.
MI_Comment	Message (50)	R/W	Used to read/write any miscellaneous comments entered for the sample.
MI_Date	Message (10)	R/W	Sets the Date for the current sample. The Date must be entered in the format **DD/MM/YY** or **DD/MM/YYYY**. If incorrectly entered, the Date will default to the current Date.
MI_Flag	Discrete	R/W	Sets a flag for the manually input sample.
MI_IgnoreValue	Discrete	R/W	Sets the current sample to be ignored when the Control Chart is AutoScaled.
MI_M*x*	Real	R/W	Sets the value for the designated manually input measurement (*x*=1 to 25).

Item Name	DDE Type	Access	Description
MI_Save	Discrete	R/W	Saves the information manually entered in the other MI fields as a new sample.
			Note When the **MI_Save** item is set to 1, the value of all **MI** items are written to the respective **Current** DDE Items and the **CurrentSampleNumber** item is indexed by 1.
MI_Time	Message (8)	R/W	Sets the Time for the current sample. The Time must be entered in the format **HH:MM:SS**. If incorrectly entered, the Time will default to the current time.

SPC Selection DDE Items

The Selection DDE Items can be used to view detailed information about any sample. The DDE Item Selection is used to enter the number of the sample to be displayed. Once entered, the SPC program will update all of the other Selection Items with the detailed information for the Selection sample number.

Old data cannot be changed, but Special Cause Codes, Flags and/or Comments can be added by setting the appropriate items then setting the **SelectionUpdate** item to 1. This will cause the selection sample record to be modified with the new values. The SPC program will reset the **SelectionUpdate** DDE item to 0 (zero) after the updated sample has been entered.

For distributed SPC, selected sample DDE items are private to each node. They are the sample values recorded by the remote node for a specified sample number of the collected product. When the Selection DDE item is set to a sample number, the sample information is retrieved from the remote node's sample file. Old data cannot be changed, but Special Cause Codes, Flags, and Comments can be added by changing the appropriate DDE item and setting the **SelectionUpdate** item to 1. When **SelectionUpdate** is set to 1, the Special Cause Code, Comment, Flag, and Ignore Value items are sent to the remote node in a packet for storage.

Note With the addition of displayed and collected products, all of the "Selection" SPC DDE Items apply only to the collected product.

Item Name	DDE Type	Access	Description
Selection	Integer	R/W	Setting this item to a sample number will update all of the selection items with the appropriate data for that sample.
SelectionCauseCode	Integer	R/W	Sets the Special Cause Code number for the selected sample.
SelectionCauseString	Message (128)	RO	Displays the description of the entered Special Cause Code.
SelectionComment	Message (50)	R/W	Used to read/write any miscellaneous comments entered for the selected sample.
SelectionCp	Real	RO	Displays the capability for the selected sample.
SelectionCpk	Real	RO	Displays the centered capability for the selected sample.
SelectionDate	Message (10)	RO	Displays the date for the selected sample.
SelectionFlag	Discrete	R/W	Sets a Flag of the selected sample.
SelectionIgnoreValue	Discrete	R/W	Sets the selected sample to be ignored when the Control Chart is AutoScaled.
SelectionMx	Real	RO	Displays the value for the individual measurements (*x*=1-25) comprising the sample.
SelectionProduct	Message (32)	RO	Displays the Product Name for the selected sample.

Item Name	DDE Type	Access	Description
SelectionRUCL	Real	RO	Displays the range **UCL** for the selected sample.
SelectionRLCL	Real	RO	Displays the range **LCL** for the selected sample.
SelectionR	Real	RO	Displays the **range** for the selected sample.
SelectionRBAR	Real	RO	Displays the **average** range at the selected sample.
SelectionSample	Real	RO	Displays the value of the selected sample point.
SelectionSampleBar	Real	RO	Displays the selected sample average at the selected sample point.
SelectionTarget	Real	RO	Displays the **target** value at the selected sample.
SelectionTime	Message (8)	RO	Displays the **Time** for the selected sample.
SelectionUpdate	Discrete	R/W	Updates changes in Selection fields.
SelectionXUSL	Real	RO	Displays sample Upper Specification Limit.
SelectionXLSL	Real	RO	Displays sample Lower Specification Limit.
SelectionXUCL	Real	RO	Displays sample Upper Control Limit.
SelectionXLCL	Real	RO	Displays sample Lower Control Limit.
SelSPC2L3Out2SDMsg	Message	RO	Alarm Message tag for "2 of the last 3 samples outside of 2 standard Deviations SS."
SelSPC4L5Out1SDMsg	Message	RO	Alarm Message tag for "4 of the last 5 samples outside of 1 standard Deviation SS."
SelSPCConSampAltUpDnMsg	Integer	RO	Alarm message for Alarm "Consecutive samples Alternating Up and Down."
SelSPCConSampln1SDMsg	Message	RO	Alarm Message tag for "Consecutive samples Inside 1 standard Deviation."
SelSPCConSamplncDecMsg	Message	RO	Alarm Message tag for "Consecutive samples Increasing or Decreasing."
SelSPCConSampOneSideCLMsg	Message	RO	Alarm Message tag for "Consecutive samples on one side of centerline."
SelSPCConSampOut1SDMsg	Message	RO	Alarm Message tag for "Consecutive samples outside 1 standard Deviation."
SelSPCNLNOutNSDMsg	Message	RO	Alarm Message Tag for "? Of the last ? samples outside ? standard deviations."

Item Name	DDE Type	Access	Description
SelSPCNLNOutNSDSSMsg	Message	RO	Alarm Message tag for "? Of the last ? samples outside ? standard deviations SS."
SelSPCOutRCtrlMsg	Message	RO	Alarm Message for the Range Chart Alarm "Range outside Control Limit."
SelSPCOutXCtrlMsg	Message	RO	Alarm Message for the X Chart Alarm "Sample outside Control Limit."
SelSPCOutSpecMsg	Message	RO	Alarm Message tag for "Sample outside specification Limit."

Note Multiple Indirect Datasets can be setup and linked to the same real Dataset. Then the Selection value of each Indirect Dataset can be set to a different sample number. This allows you to view detail information of multiple samples within a Dataset.

SPC Functions

You can control the SPC program from WindowViewer by using the SPC Functions described below in InTouch scripts.

📖 For detailed information on all SPC Functions, see your online *InTouch Reference Guide*.

Function	Description
SPCConnect	Used to connect an Agent to the SPC Pro database. Before an Automatic data collection dataset will start collecting data, this function must be used to indicate to SPC which User this node is. You may use this function to connect to the database on Application StartUp. You can use the DDE Message Tag **SPCConnectType** to monitor whether you are connected as a Client or Agent (Server).
SPCDisconnect	Used to disconnect an Agent from a SPC Pro database. When this function is used, all datasets that were assigned to the Agent that was disconnected will stop collecting.
SPCDisplayData	Designed to allow convenient scrolling of the chart to any date and time. You can use a tag name to monitor the status of the SPC data search. It will return **0** if SPC found data and 1 if it could not find data for the specified time period.
SPCLocateScooter	Designed to allow convenient scrolling of the Scooter to any valid sample number. The Scooter tagname defined in the dataset will be updated with the X-Bar sample value. Setting **SampleNumber** to **0** hides/disables the Scooter.
SPCMoveScooter	Designed to allow convenient scrolling of the Scooter to any valid sample number. The Scooter tagname defined in the dataset will be updated with the X-Bar sample value.
SPCSaveSample	Used in conjunction with the **SPCSetMeasurement()** function to save a manually input sample by executing the following script: `SPCSaveSample("Dataset");`
SPCSelectDataset	Used to select a direct Dataset by executing the following script: `DatasetName = SPCSelectDataset();` When this script is executed, the **Select a Dataset** dialog box will appear.
SPCSelectProduct	Used to select a product in a given Dataset by executing the following script: `ProductName = SPCSelectProduct("Dataset");` When this script is executed, the **Select a Product** dialog box will appear.

Function	Description
SPCSetControlLimits	Designed to allow convenient manual or event driven input of the control limit values for a Control Chart by executing the following script: `SPCSetControlLimits("Dataset",XUCL,XLCL);`
SPCSetMeasurement	Designed to allow convenient manual or event driven inputs of analog measurement values by executing the following script: `SPCSetMeasurement("Dataset",Measurement, Value);`
SPCSetProductCollected	Used to change the product being collected in a specified dataset by executing the following script: `SPCSetProductCollected("Dataset"," Product");` **Important Note!** This function **does not** change the product being displayed. In SPC versions prior to 5.6, only the product being collected for a dataset could be displayed in a chart. With SPC Version 5.6 this has changed. You now have the ability to collect data for one product and display data for another by using this function to collect and the **SPCSetProductDisplayed** function to display.
SPCSetProductDisplayed	Used to change the product being displayed in a specified dataset by executing the following script: `SPCSetProductDisplayed("Dataset", "Product");` **Note** This function **does not** change the product being collected. In SPC versions prior to 5.6, only the product being collected for a dataset could be displayed in a chart. With SPC Version 5.6 this has changed. You now have the ability to collect data for one product and display data for another by using this function to display and the **SPCSetProductCollected** function to collect.
SPCSetRangeLimits	Designed to allow convenient manual or event driven input of the Control Limits for a Range Chart by executing the following script: `SPCSetRangeLimits("Dataset",RUCL,RLCL);`
SPCSetSpecLimits	Designed to allow convenient manual or event driven input of the specification limit values for a Control Chart by executing the following script: `SPCSetSpecLimits("Dataset",XUSL,XLSL);`

CHAPTER 6

Technical References

This chapter describes the formulas that each type of SPC chart uses to perform its calculations. The iterative process for calculating control limits, a Bibliography and Glossary of Terms are also included.

Contents

SPC Calculations

The SPC calculations are performed in the following manner.

X Individual

Xbar (Centerline) = $\mathbf{S}$ X / N

where: X = Individual Sample Values
N = Number of samples used in the control limit calculation (configured in the Dataset definition)

Control Limits
Xbar +/- 3s

where: s = Standard Deviation = SQRT(($\sum X^2$ - N*Xbar^2) / (N -1))

Xbar - s

Xbar = $\mathbf{S}$ X / n

where: X = Individual Measurement Values
n = Number of measurements used for the sample (configured in the Dataset definition)

Xbarbar(Centerline) = $\mathbf{S}$ Xbar / N

where: Xbar = Individual Sample Values
N = Number of samples used in the control limit calculation (configured in the Dataset definition)

s = Standard Deviation = SQRT(($\sum X^2$ - n*Xbar^2) / (n -1))

sbar = $\mathbf{S}$ s / N

Control Limits (XUCL, XLCL)
Xbarbar +/- A3 * sbar

where: A3 = statistical constant based on subgroup size

Control Limits (sUCL, sLCL)
sUCL = B4* sbar

where: B4 = statistical constant based on subgroup size

sLCL = B3* sbar
where: B3 = statistical constant based on subgroup size

Xbar - R, Xmoving - Rmoving

Xbar = S X / n

where: X = Individual Measurement Values
n = number of measurements used for the sample (configured in the Dataset definition)

Xbarbar(Centerline) = S Xbar / N

where: Xbar = Individual Sample Values
N = number of samples used in the control limit calculation (configured in the Dataset definition)

R = Xmax - Xmin (per sample)

Rbar (Centerline) = S R / N
Control Limits (XUCL, XLCL)

Xbarbar +/- A2 * Rbar

where: A2 = statistical constant based on subgroup size
Control Limits (RUCL, RLCL)

RUCL = D4* Rbar
where: D4 = statistical constant based on subgroup size

RLCL = D3* Rbar
where: D3 = statistical constant based on subgroup size

Note On Xmoving - Rmoving charts any samples that do not contain the correct amount of measurements are eliminated from the calculation. For example - if an Xmoving - Rmoving dataset is configured to use 2 samples then the first collected sample in the dataset will not be used in any calculations.

C chart

Cbar(Centerline) = S C / N

where: C = Individual counts
N = Number of samples used in the control limit calculation (configured in the Dataset definition)

Control Limits
CUCL = Cbar + 3 * SQRT(Cbar)
CLCL = Cbar - 3 * SQRT(Cbar)

P chart

Pbar(Centerline) = S NP/S Nn

where: P = Individual % Defective samples
N = Number of samples used in the control limit calculation (configured in the Dataset definition)
NP = Total number of rejects (not defects)
n = Sample size
nBAR = S n/N

Control Limits
PUCL = Pbar + 3 * SQRT(Pbar * (1-Pbar) / nBAR)
PLCL = Pbar - 3 * SQRT(Pbar * (1-Pbar) / nBAR)

NP chart

NPbar = S NP / N
Pbar = NPbar / n

The NP chart is similar to the C chart.

where: n = sample size used in the calculation (configured in the Dataset definition)
NP = total number of rejects (not defects)
N = the number of samples used in Control Limit calculation

Control Limits
UCL = NPbar + 3 * SQRT(NPbar * (1-Pbar))
LCL = NPbar - 3 * SQRT(NPbar * (1-Pbar))

U chart

Ubar = S(Ci) / S (ni)
Nbar = Average of ni

The U chart is similar to the P chart.

where: ni = sample size
Ci = total number of defects (not rejects)

Control Limits
UCL = Ubar + 3 * SQRT(Ubar / Nbar)
LCL = Ubar - 3 * SQRT(Ubar / Nbar)

EWMA chart

The inputs for configuring the dataset are the Smoothing Factor and the Tighter Controls.

The input for the chart is Xi values. For each Xi value entered, the EWMA Points are calculated and plotted on the screen.

EWMA (i) = (Smoothing Factor) Xi + (1 - Smoothing Factor) EWMA (i - 1)

Control Limits
UCL = Xbar + 3 s *** SQRT(Smoothing Factor / (2 - Smoothing Factor))**
LCL = Xbar - 3 s *** SQRT(Smoothing Factor / (2 - Smoothing Factor))**

If Tighter Control is checked in the dataset configuration, the UCL and LCL values are calculated with 2.58 instead of 3.0

where: Smoothing Factor / Weighting Factor = alpha symbol
Xbar = Average of Xi values
s = Standard Deviation

Also, you can input the samples by MI_M1 and MI_Save.
Your input Xi value is saved as an Input Sample in the database.

CuSum chart

There is no specific input required for configuring the datasets. There is Control limit calculations for this chart.

The input for the chart is Xi value. The calculated CuSum Score is plotted on the screen.

Where: CuSum(i) = CuSum(I-1) + (Xi-Target) and CuSum (0) = 0
X = individual sample value.

Note In the sample input, you can enter Multiple Xi's, not the measurements. In CuSum chart, Measurement / Sample = 1.

Also, you can input the samples by MI_M1 and MI_Save.
Your input Xi value is saved as an Input Sample in the database.

Histogram

Mean = $\mathbf{S}$ X / n*N

where: X = Individual Measurement Values
n = Number of measurements/sample
N = Number of samples used in the display

Control Limits
UCL = Mean + 3s
LCL = Mean - 3s

where: s = Standard Deviation = SQRT((n_t*ΣX^2 - (Σ X)^2) / n_t*(n_t -1))

where: n_t = n*N

Skewness = m_3 / (m_2)$^{3/2}$

where: m_3 and m_2 are the third and second moments about the mean of the sample.

Kurtosis = m_4 / (m_2)^2

where: m_4 and m_2 are the fourth and second moments about the mean of the sample.

Capability

C*p* = (USL - LSL) / 6s

where: s = Standard Deviation = SQRT((n*$\sum X^2$ - ($\sum$ X)^2) / n*(n -1))

C*pk* = (minimum of (USL - Mean) OR (Mean - LSL)) / 3s

Iterative Calculation Method

Control limits are calculated in an iterative process. This is done to provide control limits that will reflect only "Common Cause" samples. An example of the process is as follows:

Assume an Xbar - R dataset configured to use 24 samples per control limit calculation.

1. After the 24th sample the SPC program will query the database for the records of the last 24 samples.
2. Rbar is calculated using the sample range values.
3. Upper and lower range control limits are calculated.
4. Individual sample ranges are compared against the control limits.
5. If any samples fall outside the control limits the SPC program will eliminate the worst offending sample and repeat steps 1 through 4. This process will continue until all samples fall within the control limits.
6. Xbar is calculated using all remaining samples. Samples that were eliminated in the Range calculations are not used in the Xbar calculation.
7. Upper and Lower control limits are calculated.
8. Individual samples are compared against the control limits. If any samples fall outside the control limits the SPC program will eliminate the worst offending sample and repeat steps 1 through 6. This process will continue until all samples fall within the control limits.

The maximum number of samples that can be eliminated by the iterative process is half of the starting number.

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Glossary of Terms

Assignable Causes ..... Significant, identifiable changes in the relationships of materials, methods, machines and people. (The extraordinary reason that something is wrong.)

Bell-shaped Curve ..... A curve or distribution showing a central peak and tapering off smoothly and symmetrically to "tails" on both sides. A normal (Gaussian) curve is an example.

c Chart ..... A control chart of the total number of defects per unit *for a constant sample size*.

Capability (of process) ..... The uniformity of product which a process is capable of producing.

Centerline ..... For control charts: the horizontal line marking the center of the chart, usually indicating the grand average of the quantity being charted.

Common Causes ..... The sources of variability in a process which are truly random and affect all samples.

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 and/or variations with known sources). When monitoring control with control charts, a state of control is exhibited when all points remain between set control limits.

Control Chart ..... A graphical representation of some parameter of process performance, usually determined by regular sampling of the product. The control limits are also plotted for comparison. The parameter plotted may be the mean value of a particular measurement for a product sample of specified size (x chart), the range of values in the sample (R chart), the percent of defective units in the sample (p-chart), etc.

Control limits ..... The boundaries within which the product of a process is required to remain. If the process leaves the limits, it is said to be "out-of-control." This is a signal that action should be taken to identify the cause and eliminate it if possible. There are two control limits for each chart: the *Upper Control Limit* (UCL) and the *Lower Control Limit* (LCL). Control limits are based on the variation of the process itself.

C*p* ..... For process capability studies. Cp is a capability index defined by a formula. Cp shows the process capability potential but does not consider how centered the process is. Cp may range in value from 0 to infinity, with a large value indicating greater potential capability. A value of 1.33 or greater is usually desired.

C*pk* ..... For process capability studies. An index combining Cp and k to indicate whether the process will produce units within the tolerance limits. Cpk has a value equal to Cp if the process is centered on the nominal; if Cpk is negative, the process mean is outside the specification limits; if Cpk is between 0 and 1 then some of the 6 sigma spread falls outside the tolerance limits. If Cpk is larger than 1, the 6 sigma spread is completely within the tolerance limits. A value of 1.33 or greater is usually desired.

CuSum Chart ..... Cumulative Sum Chart. CUSUM control charts can detect small process shifts faster than standard control charts. But they are not a direct substitute for standard control charts, they should be used in combination with standard control charts.

Cycles ..... Cycles are short, repeated patterns in the chart, having alternative high peaks and low valleys. These are the result of causes that come and go on a regular basis.

Defective Unit ..... A sample (part) which contains one or more defects, making it unacceptable for its intended, normal usage.

EWMA Chart ..... Exponentially Weighted Moving Averages Chart. EWMA Charts are created to place more emphasis on recent samples and less on the values some distance back in the collected data.

Frequency distribution ..... A tabular summary of a set of data showing the frequency, or number of observations, of a particular value or within a specified group. (See **Histogram**.)

Histogram ..... A graphic representation of a frequency distribution. The range of the variable is divided into a number of intervals of equal size (called zones) and an accumulation is made of the number of observations falling into each zone. The histogram is essentially a bar graph of the results of this accumulation.

Instability (of a process) ..... A process is said to show instability if it exhibits variations larger than its control limits, or shows a systematic pattern of variation.

Individuals Chart with Moving Range ..... A control chart used when working with one sample per subgroup. The individual samples are plotted on the x chart rather than subgroup averages. The individuals chart is always accompanied by a moving range chart, usually using two subgroups (two individual readings) to calculate the moving range points.

Kurtosis..... A measure of the shape of a distribution. If the distribution has longer tails than a normal distribution of the same standard deviation, then it is said to have positive kurtosis; if it has shorter tails, then it has negative kurtosis. For a normal curve, this measure is **3**. For a curve that is more pointed or has longer tails than a normal curve, the kurtosis is greater than 3. For fatter curves, the kurtosis is less than 3. This measurement is primarily used to make a quick assessment of the normality of the data.

LCL ..... (Lower Control Limit) For control charts: the limit above which the process subgroup statistics (x, r) remain when the process is in control.

Lower Control Limit..... See **LCL**.

Lower Specification Limit ..... See **LSL**.

LSL..... (Lower Specification Limit) The lowest value of a product measurement which is acceptable.

Mean..... The mean of a set of data is the average value of the data. Mean is computed by adding the values of the individual measurements and dividing this result by the number of measurements.

Moving Average Range Charts..... A control chart which uses the current sample and some number of previous samples as the subgroup for center and range analysis. Often used in continuous process industries, such as chemical process, where single samples are analyzed.

Normal Distribution..... A probability distribution of data given mathematically by a formula.

Normal Curve ..... A curve which represents how often each of the various data values will occur as the process continues. This curve is referred to as the "frequency curve" for the process. The shape of the frequency curve is dependent on the process being analyzed. For variable data gathered from a mechanical process, such as part diameters, the shape of the curve is approximately "Normal" (or "Bell shaped").

NP Chart..... Number of Nonconforming items. Are used in lieu of a *P* chart when the sample size is constant.

Out of Control..... A process which exhibits variations larger than the control limits is said to be out of control.

p Chart (percent defective) ..... For attributes data: a control chart of the percentage of defective units (or fraction defective) in a subgroup.

Pareto Analysis ..... An analysis of the frequency of occurrence of various possible concerns. This is a useful way to decide quality control priorities when more than one concern is present. The underlying "Pareto Principle" states that a very small number of concerns is usually responsible for most quality problems.

Pareto Chart..... A "bar graph" which displays the most critical quality problems. The "y-axis" of the Pareto Chart is the frequency of occurrence. The "x-axis" is the types of defects which are plotted according to the frequency of occurrence - the most frequent being plotted first. This type of chart is useful for determining which types of defects occur most often.

Percent Defective ..... For acceptance sampling: the percentage of units in a lot which are defective, i.e., of unacceptable quality.

Process Capability ..... The level of uniformity of product which a process is capable of yielding.

Range ..... The range is defined as the distance between the largest individual measurement and the smallest individual measurement.

RChart..... A control chart of the range of variation among the individual elements of a sample.

Sample ..... A representative group selected from a population. The sample is used to determine the properties of the population.

Sample Size ..... The number of elements, observations or measurements, in a sample.

Skewness ..... A measure of the distribution's symmetry. A skewed distribution shows a longer than normal tail on the right or left side of a distribution. "Normal" curve is symmetric about the mean value. The measure of symmetry, called the **Skewness**, is zero for such a curve. A curve with the tail off toward the small individual measurements has negative skewness. This measurement is primarily used to make a quick assessment of the Normality of the curve.

Standard Deviation ..... A measure of the "deviation" or distance, of the individual measurements from the mean.

Statistical Control (of a process) ..... A process is said to be in a state of statistical control when it exhibits only random variations.

Subgroups ..... For control charts: a sample of measurements from a given process, all taken at or near the same time.

Tolerance ..... The permissible range of variation in a particular dimension of a product. Tolerances are often set by engineering requirements to ensure that components will function together properly.

Total Quality Control (TQC) ..... A management philosophy of integrated controls, including engineering, purchasing, financial administration, marketing and manufacturing, to ensure customer quality satisfaction and economical costs of quality.

Trends ..... A trend is the result of some cause that gradually affects the quality characteristics of the product and causes the points on a control chart to gradually move up or down from the centerline.

U Chart ..... Nonconformity's per unit. Are used in lieu of a *C* chart when the sample size is not constant.

UCL ..... (Upper Control Limit) For control charts: the upper limit below which a process remains if it is in control.

Upper Control Limit ..... See **UCL**.

Upper Specification Limit ..... See **USL**.

USL ..... (Upper Specification Limit) The highest value of a product dimension or measurement which is acceptable.

Variables..... Quantities which are subject to change or variability.

X and R Charts ..... For variables data: control charts for the average and range of subgroups of data. (See **Control Chart**)

X Individual Charts..... These charts are primarily used for situations where data is accumulated slowly.

Xbar Charts ..... These charts are primarily used for situations of medium to high volume production were data is quickly available for control purposes. The Xbar chart is insensitive to the basic shape of the process distribution.

Zone Centering..... Zone centering is available with all control charts except the CuSum Chart. This will be enabled if there is no control limit calculation on the screen. It can be enabled/disabled using right mouse click only. The points appear exactly on the zone lines/limit lines. All the other points will be centered in the zones they fall into.

Zones..... The distance between the centerline and each control limit divided into three equal parts. Zone A is the farthest from the centerline, zone B is in the middle, and zone C is closest to the centerline. If the process is in control, about two-thirds of the points will be in zone C (combined) and about 5 percent of them will be in zone A (combined).

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