Chapter 46
Dictionary of Options

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Dictionary of Options

This chapter provides detailed descriptions of options that you can specify in the following chart statements:

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Options are specified after the slash (/) in a chart statement. For example, to request tests for special causes with an $\bar{X}$ and R chart, you can use the TESTS= option as follows:

```
proc shewhart data=measures;
   xrchart length*sample / tests=1 to 4 ;
run;
```

The options described in this chapter are listed alphabetically. For tables of options organized by function, see the "Summary of Options" sections in the chapters for the various chart statements.

Unless indicated otherwise, the options listed here are available with every chart statement. The marginal notes *Graphics* and *Line Printer* identify options that apply only to charts displayed with graphics devices and line printers, respectively. For statements that create two charts, the term *primary chart* refers to the upper chart (for instance, the $\bar{X}$ chart created with the XRCHART statement), and the term *secondary chart* refers to the lower chart (for instance, the R chart created with the XRCHART statement). The term *primary chart* also refers to the single chart created by some statements (for instance, the p chart created with the PCHART statement).

ALLLABEL=VALUE
ALLLABEL=(*variable***)**

labels every point on the primary chart with the VALUE plotted for that subgroup or with the value of a *variable* in the input data set.

The *variable* provided in the input data set can be numeric or character. If the *variable* is a character variable, its length cannot exceed 16. For each subgroup of observations, the formatted value of the *variable* in the observations is used to label the point representing the subgroup. If you are reading a DATA= data set with multiple observations per subgroup, the values of the *variable* should be identical for observations within a subgroup. You should use this option with care to avoid cluttering the chart. By default, points are not labeled. Related options are CFRAMELAB=, OUTLABEL=, LABELFONT=, LABELHEIGHT=, and TESTLABEL=, but note that the OUTLABEL= option cannot be specified with the ALLLABEL= option.

ALLLABEL2=VALUE
ALLLABEL2=(*variable***)**

labels every point on the secondary chart with the VALUE plotted for that subgroup or with the value of a *variable* in the input data set.

The *variable* provided in the input data set can be numeric or character. If the *variable* is a character variable, its length cannot exceed 16. For each subgroup of observations, the formatted value of the *variable* in the observations is used to label the point representing the subgroup. If you are reading a DATA= data set with multiple observations per subgroup, the values of the *variable* should be identical for observations within a subgroup. You should use this option with care to avoid cluttering the chart. By default, points are not labeled. Related options are CFRAMELAB=, OUTLABEL2=, LABELFONT=, LABELHEIGHT=, and TESTLABEL2=, but note that the OUTLABEL2= option cannot be specified with the ALLLABEL2= option. The option is available in the IRCHART, MRCHART, RCHART, SCHART, XRCHART, and XSCHART statements and in the BOXCHART, MCHART, and XCHART statements with the TRENDVAR= option.

ALLN

plots summary statistics for all subgroups, regardless of whether the subgroup sample size equals the nominal control limit sample size n specified by the LIMITN= option or the variable _LIMITN_ in the LIMITS= data set. Use the ALLN option in conjunction with the LIMITN= option or the variable _LIMITN_.

The ALLN option is useful in applications where almost all of the subgroups have a common sample size n, and you want to display fixed (rather than varying) control limits corresponding to the nominal sample size n. The disadvantage of using the ALLN option with widely differing subgroup sample sizes is that the interpretation of the control limits is meaningful only for those subgroups whose sample size is equal to n. To request special symbol markers indicating that not all the sample sizes are equal to n, use the NMARKERS option in conjunction with the ALLN option.

The ALLN option is not available in the IRCHART statement.

ALPHA=*value*

requests *probability limits*. If you specify ALPHA=α, the control limits are computed so that the probability is α that a subgroup summary statistic exceeds its control limits. This assumes that the process is in statistical control and that the data follow a

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certain theoretical distribution, which depends on the chart statement. The Poisson distribution is assumed for the CCHART and UCHART statements, and the binomial distribution is assumed for the NPCHART and PCHART statements. The normal distribution is assumed for all other chart statements. For the equations used to compute probability limits, see the "Details" section in the chapter for the chart statement that you are using.

The value of α can range between 0 and 1 for most statements. However, for the MCHART statement, the MRCHART statement, and the BOXCHART statement with the CONTROLSTAT=MEDIAN option, the value of α must be one of the following: 0.001, 0.002, 0.01, 0.02, 0.025, 0.04, 0.05, 0.10, or 0.20.

Note the following:
- As an alternative to specifying ALPHA=α, you can read α from the variable _ALPHA_ in a LIMITS= data set by specifying the READALPHA option. See "Input Data Sets" in the chapter for the chart statement in which you are interested.
- As an alternative to specifying ALPHA=α (or reading the variable _ALPHA_ from a LIMITS= data set), you can request "$k\sigma$ control limits" by specifying SIGMAS=k (or reading the variable _SIGMAS_ from a LIMITS= data set).

If you specify neither the ALPHA= option nor the SIGMAS= option, the procedure computes 3σ control limits by default.

ANNOTATE=*SAS-data-set*
ANNO=*SAS-data-set*

   specifies an ANNOTATE= type data set, as described in *SAS/GRAPH Software: Reference*, that enhances a primary chart. The ANNOTATE= data set specified in a chart statement enhances all charts created by that particular statement. You can also specify an ANNOTATE= data set in the PROC SHEWHART statement to enhance all primary charts created by the procedure.

<div style="float:right;border:1px solid">*Graphics*</div>

ANNOTATE2=*SAS-data-set*
ANNO2=*SAS-data-set*

   specifies an ANNOTATE= type data set, as described in *SAS/GRAPH Software: Reference*, that enhances a secondary chart. The ANNOTATE2= data set specified in a chart statement enhances all charts created by that particular statement. You can also specify an ANNOTATE2= data set in the PROC SHEWHART statement to enhance all secondary charts created by the procedure.

<div style="float:right;border:1px solid">*Graphics*</div>

This option is available in the IRCHART, MRCHART, XRCHART, and XSCHART statements and in the BOXCHART, MCHART, and XCHART statements with the TRENDVAR= option.

BILEVEL

   arranges the Shewhart chart in two levels (rather than the default of one level) so that twice as much data can be displayed on a page or screen. The second level is a continuation of the first level, and this arrangement is continued on subsequent pages until all the subgroups are displayed. You use the NPANELPOS= option to control the number of subgroup positions in each level. If you specify the BILEVEL option in a chart statement that produces primary and secondary charts, you must also specify the SEPARATE option.

BLOCKLABELPOS=ABOVE | LEFT | RIGHT

specifies the position of a block-variable label in the block legend. As shown in Figure 46.1, the keyword ABOVE places the label immediately above the legend, LEFT places the label to the left of the legend, and RIGHT places the label to the right of the legend. Use the keywords LEFT and RIGHT with labels that are short enough to fit in the margins on each side of the chart; otherwise, they will be truncated. Use the keyword RIGHT only when the legend is below the control chart (BLOCKPOS=3 or BLOCKPOS=4). The default keyword is ABOVE. Related options are BLOCKLABTYPE=, BLOCKREP, BLOCKPOS=, CBLOCKVAR=, and CBLOCKLAB=.
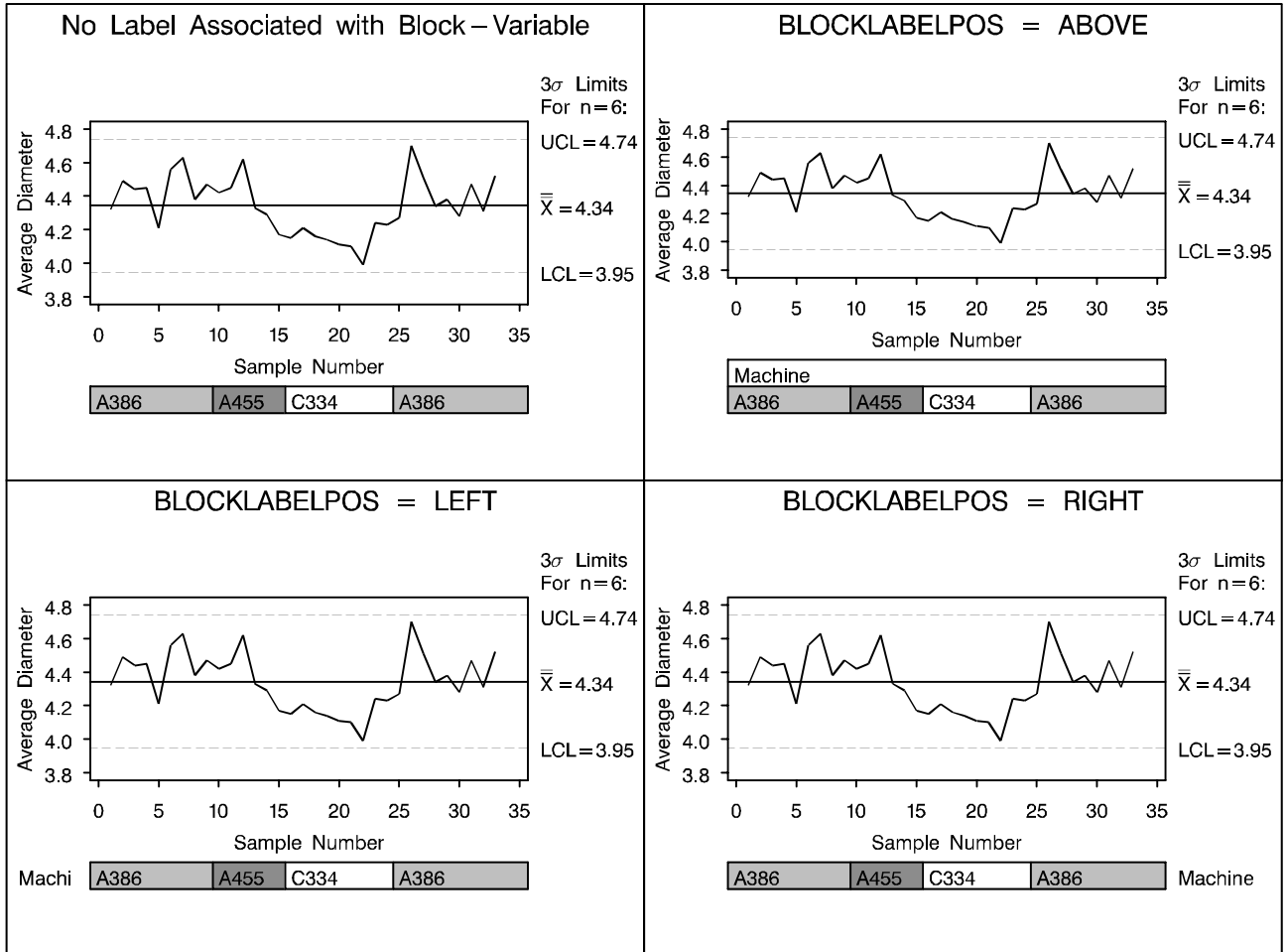

Figure 46.1. Positions for *block-variable* Labels

BLOCKLABTYPE=SCALED | TRUNCATED
BLOCKLABTYPE=*height*

Graphics

specifies how lengthy block variable values are to be treated when there is insufficient space to display them in the block legend. If you specify the BLOCKLABTYPE=SCALED option, the values are uniformly reduced in height so that they fit. If you specify the BLOCKLABTYPE=TRUNCATED option, lengthy values are truncated on the right until they fit. You can also specify a text *height* in vertical percent screen units for the values. By default, lengthy values are not displayed. Related options are BLOCKLABELPOS=, BLOCKREP, BLOCKPOS=, CBLOCKVAR=, and CBLOCKLAB=.

BLOCKPOS=n

specifies the vertical position of the legend for the values of the *block-variables* (see "Displaying Stratification in Blocks of Observations" on page 1684). Values of n and the corresponding positions are as follows. By default, BLOCKPOS=1.

n	Legend Position
1	Top of chart, offset from axis frame
2	Top of chart, immediately above axis frame
3	Bottom of chart, immediately above horizontal axis
4	Bottom of chart, below horizontal axis label

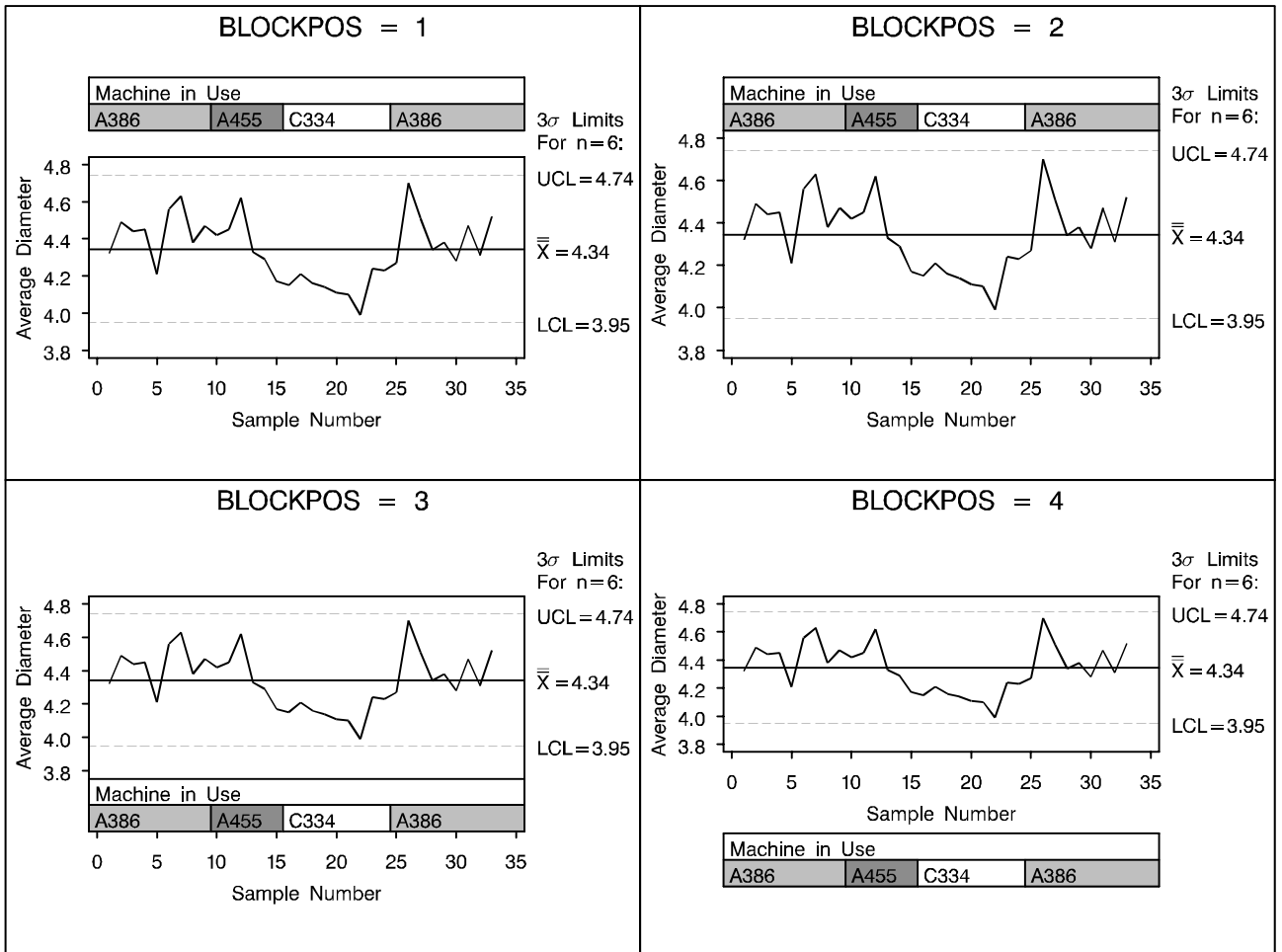Figure 46.1 illustrates the various positions that can be specified.

Figure 46.2. Positions for *block-variable* Legends

Related options are BLOCKLABELPOS=, BLOCKLABTYPE=, BLOCKREP, CBLOCKVAR=, and CBLOCKLAB=.

BLOCKREP

specifies that block variable values for all subgroups are to be displayed. By default, only the first block variable value in any block is displayed, and repeated block variable values are not displayed. Related options are BLOCKLABELPOS=, BLOCK-

LABTYPE=, BLOCKPOS=, CBLOCKVAR=, and CBLOCKLAB=. For more information on block variables, see "Displaying Stratification in Blocks of Observations" on page 1684.

BOXCONNECT
BOXCONNECT=MEAN | MEDIAN | MAX | MIN | Q1 | Q3

specifies that the points representing subgroup means, medians, maximum values, minimum values, first quartiles or third quartiles in box-and-whisker plots created with the BOXCHART statement are to be connected. If BOXCONNECT is specified without a keyword identifying the points to be connected, subgroup means are connected. By default, no points are connected. The BOXCONNECT option is available only in the BOXCHART statement.

BOXSTYLE=*keyword*

specifies the style of the box-and-whisker plots that are displayed for subgroup samples by the BOXCHART statement.

The keywords SKELETAL, SCHEMATIC, SCHEMATICID, and SCHEMATICIDFAR are useful for creating conventional box-and-whisker displays. The keywords POINTS, POINTSJOIN, POINTSBOX, POINTSID, and POINTSJOINID are used to generalize the BOXSTYLE= option and, in particular, to facilitate the creation of so-called "multi-vari" charts, as illustrated in Output 32.7.2 and Output 32.7.3.

If you specify BOXSTYLE=SKELETAL, the whiskers are drawn from the edges of the box to the extreme values of the subgroup sample. This plot is sometimes referred to as a *skeletal box-and-whisker plot*. By default, the whiskers are drawn without serifs, but you can add serifs with the SERIFS option. Figure 46.3 illustrates the elements of a typical skeletal boxplot.
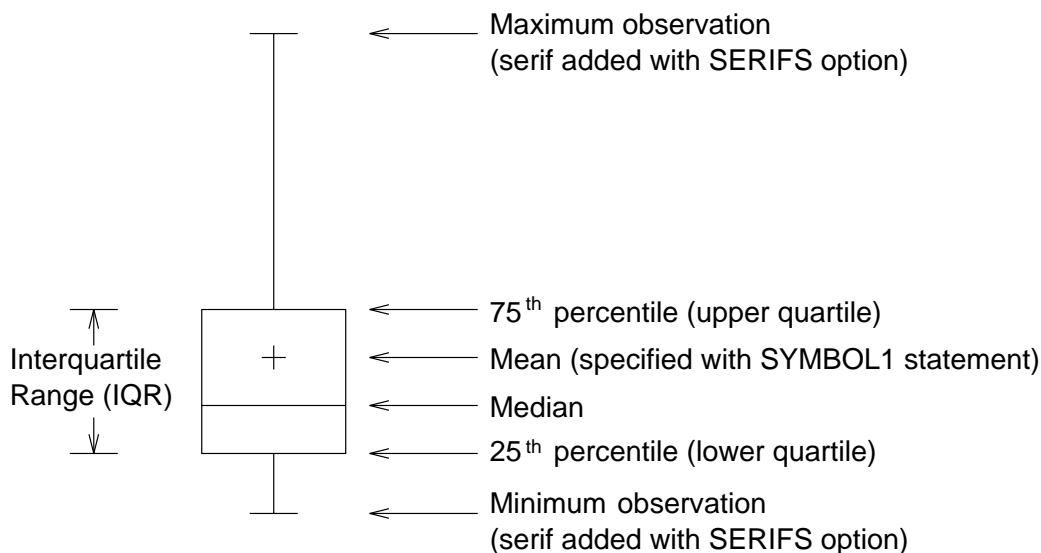

Maximum observation
(serif added with SERIFS option)

Interquartile Range (IQR)

75th percentile (upper quartile)

Mean (specified with SYMBOL1 statement)

Median

25th percentile (lower quartile)

Minimum observation
(serif added with SERIFS option)

Figure 46.3. BOXSTYLE= SKELETAL

If you specify BOXSTYLE=SCHEMATIC, a whisker is drawn from the upper edge of the box to the largest value within the upper fence and from the lower edge of the box to the smallest value within the lower fence. Figure 46.4 illustrates a typical schematic boxplot and the locations of the fences (which are not displayed in actual output). Serifs are added to the whiskers by default. Observations outside the fences

are identified with a special symbol; you can specify the shape and color for this symbol with the IDSYMBOL= and IDCOLOR= options. The default symbol is a square. This type of plot corresponds to the *schematic box-and-whisker plot* described in Chapter 2 of Tukey (1977).

If you specify BOXSTYLE=SCHEMATICID, a schematic box-and-whisker plot is displayed in which the value of the first variable listed in the ID statement is used to label the symbol marking each observation outside the upper and lower fences.

If you specify BOXSTYLE=SCHEMATICIDFAR, a schematic box-and-whisker plot is displayed in which the value of the first variable listed in the ID statement is used to label the symbol marking each observation outside the *lower* and *upper far fences*. The lower and upper far fences are located $3 \times$ IQR below the 25th percentile and above the 75th percentile, respectively. Observations between the fences and the far fences are identified with a symbol but are not labeled with the ID variable.
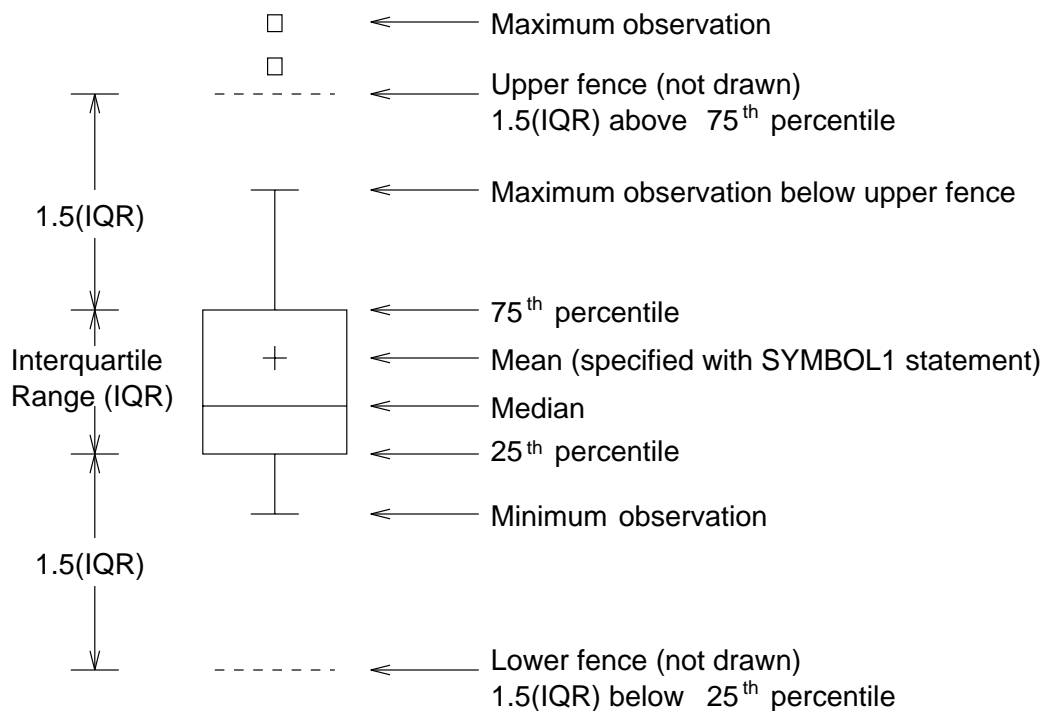

Figure 46.4. BOXSTYLE= SCHEMATIC

NOTE: To make side-by-side box charts (as opposed to a control chart with subgroup box plots), you should use the BOXCHART statement with the NOLIMITS option in addition to the BOXSTYLE= option.

If you specify BOXSTYLE=POINTS, all the values in the subgroup sample are plotted as points, and neither a box nor whiskers are drawn. By default, a square plotting symbol is used for the values. You can specify a symbol with the IDSYMBOL= option. You can specify the color of the symbols with the IDCOLOR= option (the default color is the color specified with the CBOXES= option or the second color in the device color list).

If you specify BOXSTYLE=POINTSJOIN, all the values in the subgroup sample are plotted as points joined with a vertical line. Neither a box nor whiskers are drawn. See

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Output 32.7.2 on page 1101 for an illustration. By default, a square plotting symbol is used for the values. You can specify a symbol with the IDSYMBOL= option, and you can specify the color of the symbol with the IDCOLOR= option. You can specify the color of the vertical line with the CBOXES= option.

If you specify BOXSTYLE=POINTSBOX, all the values in the subgroup sample are plotted as points enclosed in a box. By default, a square plotting symbol is used for the values. You can specify a symbol with the IDSYMBOL= option, and you can specify the color of the symbol with the IDCOLOR= option. You can specify the color of the box with the CBOXES= option, the fill color of the box with the CBOXFILL= option, and the line type of the box with the LBOXES= option.

If you specify BOXSTYLE=POINTSID, all the values in the subgroup sample are plotted using labels specified as the values of the first variable in the ID statement. See Output 32.7.3 on page 1102 for an illustration. It is recommended that you use single-character labels. You can specify a font for the labels with the IDFONT= option. You can specify the height of the labels with the IDHEIGHT= option. You can specify the color of the labels with the IDCTEXT= option.

If you specify BOXSTYLE=POINTSJOINID, all the values in the subgroup sample are plotted using labels specified as the values of the first variable in the ID statement, and the values are joined by a vertical line. It is recommended that you use single-character labels. You can specify a font for the labels with the IDFONT= option. You can specify the height of the labels with the IDHEIGHT= option. You can specify the color of the labels with the IDCTEXT= option, and you can specify the color of the vertical line with the CBOXES= option.

The BOXSTYLE= option is available only in the BOXCHART statement; see Example 32.2 on page 1089. The styles SCHEMATIC, SCHEMATICID, and SCHEMATICIDFAR are available only when the input data set is a DATA= data set. By default, BOXSTYLE=SKELETAL. Related options include BOXWIDTH=, BOXWIDTHSCALE=, IDCOLOR=, and IDSYMBOL=.

Note that the keywords POINTS, POINTSJOIN, POINTSBOX, POINTSID, and POINTSJOINID for the BOXSTYLE= option can be used in conjunction with the CPHASEBOX=, CPHASEBOXFILL=, CPHASEBOXCONNECT=, CPHASEMEANCONNECT=, and PHASEMEANSYMBOL= options to create "multi-vari" displays.

BOXWIDTH=_value_

Graphics

 specifies the width (in horizontal percent screen units) of box-and-whisker plots created with the BOXCHART statement. The default width is chosen so that the boxes are as wide as possible without colliding. You should use the BOXWIDTH= option in situations where the number of subgroups per panel is very small and you want to reduce the width. The BOXWIDTH= option is available only in the BOXCHART statement.

BOXWIDTHSCALE=_value_

Graphics

 specifies that the width of box-and-whisker plots created with the BOXCHART statement is to vary proportionately to a particular function of the subgroup sample size n. The function is determined by the _value_ and is identified on the chart with a legend.

If you specify a positive *value*, the widths are proportional to n^{value}. In particular, if you specify BOXWIDTHSCALE=1, the widths are proportional to the sample size. If you specify BOXWIDTHSCALE=0.5, the widths are proportional to $\sqrt{n}$, as described by McGill and others (1978). If you specify BOXWIDTHSCALE=0, the widths are proportional to $\log(n)$. See Example 32.4 on page 1093 for an illustration of the BOXWIDTHSCALE= option.

By default, the box widths are constant. The BOXWIDTHSCALE= option is available only in the BOXCHART statement.

CAXIS=*color*
CAXES=*color*
CA=*color*

  specifies the color for the axes and tick marks. This option overrides any COLOR= specifications in an AXIS statement. The default is the first color in the device color list. | *Graphics* |

CBLOCKLAB=*color*

  specifies a fill color for the frame that encloses the block-variable label in a block legend. By default, this area is not filled. Related options are BLOCKLABELPOS=, BLOCKLABTYPE=, BLOCKREP, BLOCKPOS=, and CBLOCKVAR=. | *Graphics* |

CBLOCKVAR=*variable* **| (***variable-list***)**

  specifies variables whose values are colors for filling the background of the legend associated with *block-variables*. Each CBLOCKVAR= variable must be a character variable of no more than eight characters in the input data set (a DATA=, HISTORY=, or TABLE= data set). A list of CBLOCKVAR= variables must be enclosed in parentheses. | *Graphics* |

The procedure matches the CBLOCKVAR= variables with *block-variables* in the order specified. That is, each block legend will be filled with the color value of the CBLOCKVAR= variable of the first observation in each block. In general, values of the ith CBLOCKVAR= variable are used to fill the block of the legend corresponding to the ith *block-variable*. For examples of the CBLOCKVAR= option, see Figure 47.4 on page 1687 and Figure 47.5 on page 1689.

By default, fill colors are not used for the *block-variable* legend. The CBLOCKVAR= option is available only when *block-variables* are used in the chart statement.

CBOXES=*color*
CBOXES=(*variable***)**

  specifies the colors for the outlines of the box-and-whisker plots created with the BOXCHART statement. You can use one of the following approaches: | *Graphics* |

- You can specify CBOXES=*color* to provide a single outline color for all the box-and-whisker plots.

- You can specify CBOXES=(*variable*) to provide a distinct outline color for *each* box-and-whisker plot as the value of the *variable*. The *variable* must be a character variable of length 8 less in the input data set, and its values must be valid SAS/GRAPH color names. The outline color of the plot displayed for a particular subgroup is the value of the *variable* in the observations correspond-

ing to this subgroup. Note that if there are multiple observations per subgroup in the input data set, the values of the *variable* should be identical for all the observations in a given subgroup.

The default *color* is the second color in the device color list. The CBOXES= option is available only in the BOXCHART statement.

CBOXFILL=*color*
CBOXFILL=(*variable***)**

Graphics

 specifies the interior fill colors for the box-and-whisker plots created with the BOX-CHART statement. You can use one of the following approaches:

- You can specify CBOXFILL=*color* to provide a single color for all of the box-and-whisker plots.

- You can specify CBOXFILL=(*variable*) to provide a distinct color for *each* box-and-whisker plot as the value of the *variable*. The *variable* must be a character variable of length 8 or less in the input data set, and its values must be valid SAS/GRAPH color names (or the value *EMPTY*, which you can use to suppress color filling). The interior color of the plot displayed for a particular subgroup is the value of the *variable* in the observations corresponding to this subgroup. Note that if there are multiple observations per subgroup in the input data set, the values of the *variable* should be identical for all the observations in a given subgroup.

By default, the interiors are not filled. The CBOXFILL= option is available only in the BOXCHART statement.

CCLIP=*color*

Graphics

 specifies a color for the plotting symbol that is specified with the CLIPSYMBOL= option to mark clipped points. The default color is the color specified in the COLOR= option in the SYMBOL1 statement.

CCONNECT=*color*

Graphics

 specifies the color for the line segments connecting points on the chart. The default color is the color specified in the COLOR= option in the SYMBOL1 statement. This option is not applicable in the BOXCHART statement unless you also specify the BOXCONNECT option.

CFRAME=*color*
CFRAME=(*color-list***)**

Graphics

 specifies the colors for filling the rectangle enclosed by the axes and the frame. By default, this area is not filled. The CFRAME= option cannot be used in conjunction with the NOFRAME option.

You can specify a single *color* to fill the entire area. Alternatively, if you are displaying phases (blocks) of data read with the READPHASES= option, you can specify a *color-list* with the CFRAME= option to fill the sub-rectangles of the framed area corresponding to the phases. The colors, in order of specification, are applied to the sub-rectangles starting from left to right. You can use the value *EMPTY* in the *color-list* to avoid filling a particular sub-rectangle. If the number of colors is less than the

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number of phases, the colors are applied cyclically. The colors are also used for phase legends requested with the PHASELEGEND option.

CFRAMELAB=*color*

specifies the color for filling rectangles that frame the point labels displayed with the ALLLABEL=, ALLLABEL2=, OUTLABEL=, and OUTLABEL2= options. By default, the points are not framed.

$\boxed{\textit{Graphics}}$

CHREF=*color*

specifies the color for the lines requested by the HREF= and HREF2= options. The default is the first color in the device color list.

$\boxed{\textit{Graphics}}$

CIINDICES <**(**<**TYPE=***keyword*><**ALPHA=***value*>**)**>

requests capability index confidence limits based on subgroup summary data. The confidence limit values calculated are approximate.

TYPE=*keyword*

specifies the type of confidence limit. Valid values are LOWER, UPPER and TWOSIDED. The default value is TWOSIDED.

ALPHA=*value*

specifies the default confidence level to compute confidence limits. The percentage for the confidence limits is $(1 - value) * 100$. For example, ALPHA=.05 results in a 95% confidence limit. The default value is .05 and the possible range of values is from 0 to 1.

CINFILL=*color*

specifies the color for the area inside the upper and lower control limits. By default, this area is not filled with a color. See also the COUTFILL= option.

$\boxed{\textit{Graphics}}$

CLIMITS=*color*

specifies the color for the control limits, the central line, and the labels for these lines. The default color is the first color in the device color list.

$\boxed{\textit{Graphics}}$

CLIPCHAR='*character***'**

specifies a plot character that identifies clipped points, as requested with the CLIPFACTOR= option. Specifying the CLIPCHAR= option is recommended when the CLIPFACTOR= option is used. The default character is an asterisk (*).

$\boxed{\textit{Line Printer}}$

CLIPFACTOR=*factor*

requests clipping of extreme points on the control chart. The *factor* that you specify determines the extent to which these values are clipped, and it must be greater than one (useful values are in the range 1.5 to 2).

For examples of the CLIPFACTOR= option, see Figure 47.28 on page 1717 and Figure 47.29 on page 1718. The CLIPFACTOR= option should not be used in any statement in which the STARVERTICES= option is also used. Related clipping options are CCLIP=, CLIPCHAR=, CLIPLEGEND=, CLIPLEGPOS=, CLIPSUBCHAR=, and CLIPSYMBOL=.

CLIPLEGEND='*label***'**

specifies the *label* for the legend that indicates the number of clipped points when the CLIPFACTOR= option is used. The *label* must be no more than 16 characters and must be enclosed in quotes. For an example, see Figure 47.29 on page 1718.

CLIPLEGPOS=TOP | BOTTOM

specifies the position for the legend that indicates the number of clipped points when the CLIPFACTOR= option is used. The keywords TOP and BOTTOM position the legend at the top or bottom of the chart, respectively. Do not specify CLIPLEGPOS=TOP together with the PHASELEGEND option or the BLOCKPOS=1 or BLOCKPOS=2 options. By default, CLIPLEGPOS=BOTTOM.

CLIPSUBCHAR='*character***'**

specifies a substitution character (such as #) for the label provided with the CLIPLEGEND= option. The substitution character is replaced with the number of points that are clipped. For example, suppose that the following statements produce a chart in which three extreme points are clipped:

```
proc shewhart data=pistons;
   xrchart diameter*hour /
      clipfactor  = 1.5
      cliplegend  = 'Points clipped=#'
      clipsubchar = '#' ;
run;
```

Then the clipping legend displayed on the chart will be

```
Points clipped=3
```

CLIPSYMBOL=*symbol*

specifies a plot symbol used to identify clipped points on the chart and in the legend when the CLIPFACTOR= option is used. You should use this option in conjunction with the CLIPFACTOR= option. The default *symbol* is CLIPSYMBOL=SQUARE.

CLIPSYMBOLHT=*value*

specifies the height for the symbol marker used to identify clipped points on the chart when the CLIPFACTOR= option is used. The default is the height specified with the H= option in the SYMBOL statement.

For general information about clipping options, refer to "Clipping Extreme Points" on page 1715.

CNEEDLES=*color*

requests that points are to be connected to the central line with vertical line segments (needles) and specifies the color of the needles. You can use needles to visually represent the process as a series of shocks or vertical displacements away from a constant mean. See Figure 47.26 on page 1714 for an example. The default *color* is the second color in the device color list. The CNEEDLES= option is available in all chart statements except the BOXCHART statement.

CONNECTCHAR='*character***'**
CCHAR='*character***'**

specifies the character used to form line segments that connect points on a chart. The default character is a plus (+) sign.

CONTROLSTAT=MEAN | MEDIAN

specifies whether the control limits displayed in a box chart are to be computed for subgroup means or for subgroup medians. By default, CONTROLSTAT=MEAN. The CONTROLSTAT= option is available only in the BOXCHART statement.

COUT=*color*

specifies the color for the plotting symbols and the portions of connecting line segments that lie outside the control limits. The default color is the second color in the device color list. This option is useful for highlighting out-of-control points.

Graphics

COUTFILL=*color*

specifies the fill color for the areas outside the control limits that lie between the connected points and the control limits and are bounded by connecting lines. This option is useful for highlighting out-of-control points. See Figure 49.11 on page 1767 for an example. By default, these areas are not filled. Note that you can use the CINFILL= option to fill the area inside the control limits.

Graphics

CPHASEBOX=*color*

specifies the color for a box that encloses all of the plotted points for a phase (group of consecutive observations that have the same value of the variable _PHASE_). By default, an enclosing box is not drawn.

CPHASEBOXFILL=*color*

specifies the fill color for a box that encloses all of the plotted points for a phase. By default, an enclosing box is not drawn.

CPHASEBOXCONNECT=*color*

specifies the color for line segments that connect the vertical edges of adjacent enclosing boxes requested with the CPHASEBOX= option or the CPHASEBOXFILL= option. The vertical coordinates of the attachment points represent the average of the values plotted inside the box. The CPHASEBOXCONNECT= option is an alternative to the CPHASEMEANCONNECT= option.

CPHASELEG=*color*

specifies a text color for the phase labels requested with the PHASELEGEND option. By default, if you specify a list of fill colors with the CFRAME= option, these colors are used for the corresponding phase labels, otherwise, the CTEXT= color is used for the phase labels.

Graphics

CPHASEMEANCONNECT=*color*

specifies the color for line segments that connect points representing the average of the values plotted within a phase. This option must be used in conjunction with the CPHASEBOX= or CPHASEBOXFILL= options, and it is an alternative to the CPHASEBOXONNECT= option. The points are centered horizontally within the enclosing boxes.

CSTARCIRCLES=*color*

specifies a color for the circles requested with the STARCIRCLES= option. See the "Displaying Auxiliary Data with Stars" section (page 1701). By default, the color specified with the CSTARS= option is used.

Graphics

CSTARFILL=_color_
CSTARFILL=(_variable_**)**

`Graphics`

specifies a color or colors for filling the interior of stars requested with the STARVERTICES= option. You can use one of the following approaches:

- Specify a single color to be used for all stars with CSTARFILL=_color_.

- Specify a distinct color for _each_ star (or subsets of stars) by providing the colors as values of a variable specified with CSTARFILL=(_variable_). The variable must be a character variable of length 8 or less in the input data set, and its values must be valid SAS/GRAPH colors or the value _EMPTY_. The color for the star positioned at the ith subgroup on the chart is the value of the CSTARFILL= _variable_ in the observations corresponding to the ith subgroup. Note that if there are multiple observations per subgroup in the input data set (for instance, if you are using the XRCHART statement in the SHEWHART procedure to analyze observations from a DATA= input data set), the values of the CSTARFILL= _variable_ should be identical for all the observations in a given subgroup.

See "Displaying Auxiliary Data with Stars" on page 1701. By default, the interior of the stars is empty.

CSTAROUT=_color_

`Graphics`

specifies a color for those portions of the outlines of stars (requested with the STARVERTICES= option) that exceed the inner or outer circles. This option applies only with the STARTYPE=RADIAL and STARTYPE=SPOKE options, and it is useful for highlighting extreme values of star vertex variables. See "Displaying Auxiliary Data with Stars" on page 1701.

CSTARS=_color_
CSTARS=(_variable_**)**

`Graphics`

specifies a color or colors for the outlines of stars requested with the STARVERTICES= option.

You can use one of the following approaches:

- You can specify a single color to be used for all the stars on the chart with CSTARS=_color_.

- You can specify a distinct outline color for _each_ star (or subsets of stars) by providing the colors as values of a variable specified with CSTARS=(_variable_). The variable must be a character variable of length 8 or less in the input data set. The outline color for the star positioned at the ith subgroup on the chart is the value of the CSTARS=_variable_ in the observations corresponding to the ith subgroup. Note that if there are multiple observations per subgroup in the input data set (for instance, if you are using the XRCHART statement in the SHEWHART procedure to analyze observations from a DATA= input data set), the values of the CSTARS= _variable_ should be identical for all the observations in a given subgroup.

See "Displaying Auxiliary Data with Stars" on page 1701. By default, the second color in the device color list is used.

CSYMBOL='*label*'
CSYMBOL=C | CBAR | CPM | CPM2 | C0

specifies a label for the central line in a *c* chart. You can use the option in two ways:

- You can specify a quoted *label* of length 16 or less.
- You can specify one of the keywords listed in the following table. Each keyword requests a label of the form *symbol=value*, where *symbol* is the symbol given in the table, and *value* is the value of the central line. If the central line is not constant, only the symbol is displayed.

	Symbol Printed on Charts Produced by	
Keyword	Graphics Devices	Line Printers
C	C	C
CBAR	$\overline{\text{C}}$	$\overline{\text{C}}$
CPM	C'	C'
CPM2	C''	C''
C0	C_0	C0

See Example 33.2 on page 1136 for an example. The default keyword is CBAR. The CSYMBOL= option is available only in the CCHART statement.

CTESTS=*color* **|** *test-color-list*
CTEST=*color* **|** *test-color-list*

specifies colors for labels indicating points where a test is positive. [Graphics]

- You can specify the *color* for the labels used to identify points at which tests for special causes specified in the TESTS= option are positive. For Tests 2 through 8, this color is also used for the line segments that connect patterns of points for which a test is positive. The default color is the second color in the device color list.

- You can specify the *test-color-list* to allow different colors to be used for the labels and highlighted line segments associated with different tests for special causes. Any positive tests for which no specific CTESTS= value is specified are displayed using the general CTESTS= color. A non-default general CTESTS= color can be specified using the CTESTS=*color* syntax.

The following options request the standard tests for special causes 1 through 4 and one user-defined test designated B.

```
TESTS  = 1 to 4 M(K=4 DIR=DEC Code=B);
CTESTS = green;
CTESTS = (1 purple 3 yellow B blue);
```

Test 1 will be displayed in purple, Test 3 in yellow, and Test B in blue. Tests 2 and 4 will be displayed in green, the general CTESTS= color.

CTEXT=*color*

specifies the color for tick mark values and axis labels. This color is also used for [Graphics] the sample size legend and for the control limit legend. The default color is the color specified in the CTEXT= option in the most recent GOPTIONS statement.

CVREF=*color*
CV=*color*

Graphics

  specifies the color for reference lines requested by the VREF= and VREF2= options. The default is the first color in the device color list.

CZONES=*color*

Graphics

  requests lines marking zones A, B, and C for the tests for special causes (see the TESTS= option) and specifies the *color* for these lines. This color is also used for labels requested with the ZONELABELS option. The default color is the first color in the device color list.

DATAUNIT=PERCENT | PROPORTION

  allows you to use proportions or percents as the values for *processes* when you are using the PCHART or NPCHART statements and reading a DATA= input data set. Specify DATAUNIT=PERCENT to indicate that the values are percents of noncon-forming items. Specify DATAUNIT=PROPORTION to indicate that the values are proportions of nonconforming items. Values for percents can range from 0 to 100, while values for proportions can range from 0 to 1. By default, the values of *processes* read from a DATA= data set for PCHART and NPCHART statements are assumed to be numbers (counts) of nonconforming items. The DATAUNIT= option is available only in the NPCHART and PCHART statements.

DESCRIPTION='*string***'**
DES='*string***'**

Graphics

  specifies a description for the primary chart of length 40 or less that appears in the PROC GREPLAY master menu. The default *string* is the variable name. A related option is NAME=.

DESCRIPTION2='*string***'**
DES2='*string***'**

Graphics

  specifies a description for the secondary chart of length 40 or less that appears in the PROC GREPLAY master menu. The default *string* is the variable name. The DESCRIPTION2= option is available in the IRCHART, MRCHART, XRCHART, and XSCHART statements, and it is used in conjunction with the SEPARATE option. A related option is NAME2=.

ENDGRID

  adds a grid to the rightmost portion of the chart, beginning with the first labeled major tick mark position that follows the last plotted point. This grid is useful in situations where you want to add points by hand after the chart is created. You can use the HAXIS= option to force space to be added to the horizontal axis.

EXCHART

  creates a control chart only when exceptions occur, specifically, when the control limits are exceeded or when any of the tests requested with the TESTS= option or the TESTS2= option are positive.

FONT=*font*

Graphics

  specifies a software font for labels and legends. You can also specify fonts for axis labels in an AXIS statement. The FONT= font takes precedence over the FTEXT= font specified in the GOPTIONS statement. Hardware characters are used by default.

GRID

adds a grid to the control chart. Grid lines are horizontal lines positioned at labeled major tick marks, and they cover the length and height of the plotting area.

HAXIS=*values*
HAXIS=AXIS*n*

specifies tick mark values for the horizontal (subgroup) axis. If the subgroup variable is numeric, the *values* must be numeric and equally spaced. Numeric values can be given in an explicit or implicit list. If the subgroup variable is character, *values* must be quoted strings of length 16 or less. If a date, time, or datetime format is associated with a numeric subgroup variable, SAS datetime literals can be used. Examples of HAXIS= lists follow:

```
haxis=0 2 4 6 8 10
haxis=0 to 10 by 2
haxis='LT12A' 'LT12B' 'LT12C' 'LT15A' 'LT15B' 'LT15C'
haxis='20MAY88'D to '20AUG88'D by 7
haxis='01JAN88'D to '31DEC88'D by 30
```

If the subgroup variable is numeric, the HAXIS= list must span the subgroup variable values, and if the subgroup variable is character, the HAXIS= list must include all of the subgroup variable values. You can add subgroup positions to the chart by specifying HAXIS= values that are not subgroup variable values.

If you specify a large number of HAXIS= values, some of these may be thinned to avoid collisions between tick mark labels. To avoid thinning, use one of the following methods:

- Shorten values of the subgroup variable by eliminating redundant characters. For example, if your subgroup variable has values LOT1, LOT2, LOT3, and so on, you can use the SUBSTR function in a DATA step to eliminate "LOT" from each value, and you can modify the horizontal axis label to indicate that the values refer to lots.
- Use the TURNHLABELS option to turn the labels vertically.
- Use the NPANELPOS= option to force fewer subgroup positions per panel.

If you are using a graphics device, you can also specify a previously defined AXIS statement with the HAXIS= option.

HEIGHT=*value*

specifies the height (in vertical screen percent units) of the text for axis labels and legends. This *value* takes precedence over the HTEXT= value specified in the GOPTIONS statement. This option is recommended for use with software fonts specified with the FONT= option or with the FTEXT= option in the GOPTIONS statement. Related options are LABELHEIGHT= and TESTHEIGHT=. | *Graphics* |

HMINOR=*n*
HM=*n*

specifies the number of minor tick marks between each major tick mark on the horizontal axis. Minor tick marks are not labeled. The default is 0. | *Graphics* |

HOFFSET=*value*

specifies the length in percent screen units of the offset at both ends of the horizontal axis. You can eliminate the offset by specifying HOFFSET=0. | *Graphics* |

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HREF=*values*
HREF=*SAS-data-set*

> draws reference lines perpendicular to the horizontal (subgroup) axis on the primary chart. You can use this option in the following ways:
>
> - You can specify the *values* for the lines with an HREF= list. If the subgroup variable is numeric, the *values* must be numeric. If the subgroup variable is character, the *values* must be quoted strings of up to 16 characters. If the subgroup variable is formatted, the *values* must be given as internal values.
>
>   Examples of HREF= *values* follow:
>   ```
>   href=5
>   href=5 10 15 20 25 30
>   href='Shift 1' 'Shift 2' 'Shift 3'
>   ```
>
> - You can specify the values for the lines as the values of a variable named _REF_ in an HREF= data set. The type and length of _REF_ must match those of the *subgroup variable* specified in the chart statement. Optionally, you can provide labels for the lines as values of a variable named _REFLAB_, which must be a character variable of length 16 or less. If you want distinct reference lines to be displayed in charts for different *processes* specified in the chart statement, you must include a character variable of length 8 or less named _VAR_, whose values are the *processes*. If you do not include the variable _VAR_, all of the lines are displayed in all of the charts.
>
>   Each observation in the HREF= data set corresponds to a reference line. If BY variables are used in the input data set (DATA=, HISTORY=, or TABLE=), the same BY variable structure must be used in the HREF= data set unless you specify the NOBYREF option.
>
> Related options are CHREF=, HREFCHAR=, HREFLABELS=, HREFLABPOS=, LHREF=, and NOBYREF.

HREF2=*values*
HREF2=*SAS-data-set*

> draws reference lines perpendicular to the horizontal (subgroup) axis on the secondary chart. The conventions for specifying the HREF2= option are identical to those for specifying the HREF= option. Related options are CHREF=, HREFCHAR=, HREF2LABELS=, HREFLABPOS=, LHREF=, and NOBYREF. The HREF2= option is available only in the IRCHART, MRCHART, XRCHART, and XSCHART statements and in the BOXCHART, MCHART, and XCHART statements with the TRENDVAR= option.

HREF2DATA=*SAS-data-set*

> draws reference lines perpendicular to the horizontal (subgroup) axis on the secondary chart. The HREF2DATA= option must be used in place of the HREF2= option to specify a data set using the quoted filename notation.

HREF2LABELS='*label1*' . . . '*labeln*'
HREF2LABEL='*label1*' . . . '*labeln*'
HREF2LAB='*label1*' . . . '*labeln*'

specifies labels for the reference lines requested by the HREF2= option. The number of labels must equal the number of lines. Enclose each label in quotes. Labels can be up to 16 characters. The HREF2LABELS= option is available only in the IRCHART, MRCHART, XRCHART, and XSCHART statements and in the BOX-CHART, MCHART, and XCHART statements with the TRENDVAR= option.

HREFCHAR='*character*'

specifies the character used to form the reference lines requested by the HREF= and HREF2= options for a line printer. The default is the vertical bar (|).

| Line Printer |

HREFDATA=*SAS-data-set*

draws reference lines perpendicular to the horizontal (subgroup) axis on the primary chart. The HREFDATA= option must be used in place of the HREF= option to specify a data set using the quoted filename notation.

HREFLABELS='*label1*' . . . '*labeln*'
HREFLABEL='*label1*' . . . '*labeln*'
HREFLAB='*label1*' . . . '*labeln*'

specifies labels for the reference lines requested by the HREF= option. The number of labels must equal the number of lines. Enclose each label in quotes. Labels can be up to 16 characters.

HREFLABPOS=*n*

specifies the vertical position of the HREFLABEL= and HREF2LABEL= labels, as described in the following table. By default, $n=2$.

1	along top of subplot area
2	staggered from top to bottom of subplot area
3	along bottom of subplot area
4	staggered from bottom to top of subplot area

Figure 46.5 illustrates label positions for values of the HREFLABPOS= option when the VREF= and VREFLABELS= options are as follows:

```
href      = 2 4 7
hreflabels = 'Two' 'Four' 'Seven'
```
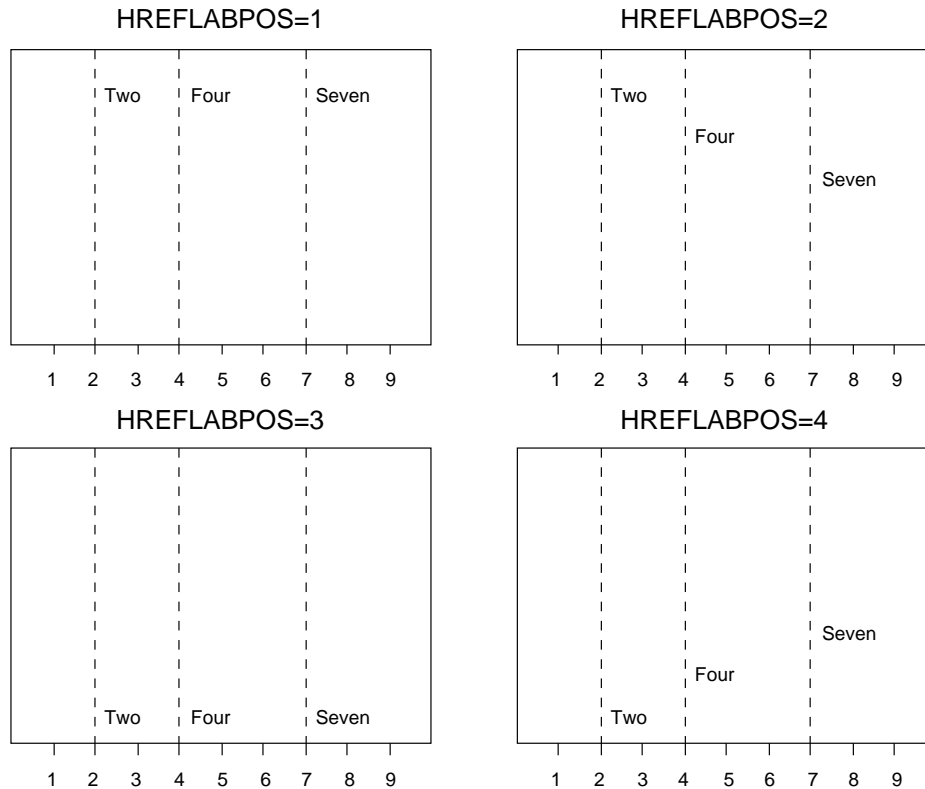
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Figure 46.5. Positions for Reference Line Labels

HTML=_variable_

specifies URLs as values of the specified character variable (or formatted values of a numeric variable). These URLs are associated with points on a control chart when high resolution graphics output is directed into HTML. The value of the HTML= variable should be the same for each observation with a given value of the subgroup variable. See the chapter "Interactive Control Charts" for more information.

HTML_LEGEND=_variable_

specifies URLs as values of the specified character variable (or formatted values of a numeric variable). These URLs are associated with symbols in the legend for the levels of a _symbol-variable_. The value of the HTML_LEGEND= variable should be the same for each observation with a given value of _symbol-variable_.

IDCOLOR=_color_

Graphics

specifies the color of the symbol marker used to identify outliers in schematic box-and-whisker plots produced with the BOXCHART statement when you use one of the following options: BOXSTYLE=SCHEMATIC, BOXSTYLE=SCHEMATICID, and BOXSTYLE=SCHEMATICIDFAR. The default _color_ is the color specified with the CBOXES= option; otherwise, the second color in the device color list is used. The IDCOLOR option is available only in the BOXCHART statement.

IDCTEXT=_color_

specifies the color for the text used to label outliers or indicate process variable values when you specify one of the keywords SCHEMATICID, SCHEMATICIDFAR, POINTSID, or POINTSJOINID with the BOXSTYLE= option. The default is the color specified with the CTEXT= option.

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IDFONT=*font*

    specifies the font for the text used to label outliers or indicate process variable values when you specify one of the keywords SCHEMATICID, SCHEMATICIDFAR, POINTSID, or POINTSJOINID with the BOXSTYLE= option. The default *font* is SIMPLEX.

IDHEIGHT=*value*

    specifies the height for the text used to label outliers or indicate process variable values when you specify one of the keywords SCHEMATICID, SCHEMATICIDFAR, POINTSID, or POINTSJOINID with the BOXSTYLE= option. The default is the height specified with the HTEXT= option in the GOPTIONS statement.

IDSYMBOL=*symbol*

    specifies the symbol marker used to identify outliers in schematic box-and-whisker plots produced with the BOXCHART statement when you use one of the following options: BOXSTYLE=SCHEMATIC, BOXSTYLE=SCHEMATICID, and BOXSTYLE=SCHEMATICIDFAR. The default *symbol* is SQUARE. The IDSYMBOL= option is available only in the BOXCHART statement.

                                                                  Graphics

INTERVAL=DAY | DTDAY | HOUR | MINUTE | MONTH | QTR | SECOND

    specifies the natural time interval between consecutive subgroup positions when a time, date, or datetime format is associated with a numeric subgroup variable. By default, the INTERVAL= option uses the number of subgroup positions per panel that you specify with the NPANELPOS= option. The default time interval keywords for various time formats are shown in the following table.

Format	Default Keyword	Format	Default Keyword
DATE	DAY	MONYY	MONTH
DATETIME	DTDAY	TIME	SECOND
DDMMYY	DAY	TOD	SECOND
HHMM	HOUR	WEEKDATE	DAY
HOUR	HOUR	WORDDATE	DAY
MMDDYY	DAY	YYMMDD	DAY
MMSS	MINUTE	YYQ	QTR

    You can use the INTERVAL= option to modify the effect of the NPANELPOS= option, which specifies the number of subgroup positions per panel (screen or page). The INTERVAL= option enables you to match the scale of the horizontal axis to the scale of the subgroup variable without having to associate a different format with the subgroup variable.

    For example, suppose your formatted subgroup values span an overall time interval of 100 days and a DATETIME format is associated with the subgroup variable. Since the default interval for the DATETIME format is DTDAY and since NPANELPOS=50 by default, the chart is displayed with two panels (screens or pages).

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Now, suppose your data span an overall time interval of 100 hours and a DATETIME format is associated with the subgroup variable. The chart for these data is created in a single panel, but the data occupy only a small fraction of the chart since the scale of the data (hours) does not match that of the horizontal axis (days). If you specify INTERVAL=HOUR, the horizontal axis is scaled for 50 hours, matching the scale of the data, and the chart is displayed with two panels.

INTSTART=*value*

specifies the starting value for a numeric horizontal axis. If the value specified is greater than the first subgroup variable value, this option has no effect.

LABELFONT=*font*
TESTFONT=*font*

$\boxed{Graphics}$ specifies a software font for labels requested with the ALLLABEL=, ALLLABEL2=, OUTLABEL=, OUTLABEL2=, STARLABEL=, TESTLABEL=, and TESTLABEL*n*= options. Hardware characters are used by default.

LABELHEIGHT=*value*
TESTHEIGHT=*value*

$\boxed{Graphics}$ specifies the height (in vertical percent screen units) for labels requested with the ALLLABEL=, ALLLABEL2=, OUTLABEL=, OUTLABEL2=, STARLABEL=, TESTLABEL=, and TESTLABEL*n*= options. The default height is the height specified with the HEIGHT= option or the HTEXT= option in the GOPTIONS statement.

LBOXES=*linetype*
LBOXES=(*variable***)**

$\boxed{Graphics}$ specifies the line types for the outlines of the box-and-whisker plots created with the BOXCHART statement. You can use one of the following approaches:
- You can specify LBOXES=*linetype* to provide a single *linetype* for all of the box-and-whisker plots.
- You can specify LBOXES=(*variable*) to provide a distinct line type for *each* box-and-whisker plot. The *variable* must be a numeric variable in the input data set, and its values must be valid SAS/GRAPH *linetype* values (numbers ranging from 1 to 46). The line type for the plot displayed for a particular subgroup is the value of the *variable* in the observations corresponding to this subgroup. Note that if there are multiple observations per subgroup in the input data set, the values of the *variable* should be identical for all of the observations in a given subgroup.

The default value is 1, which produces solid lines. The LBOXES= option is available only in the BOXCHART statement.

LCLLABEL=*'label'*

specifies a label for the lower control limit in the primary chart. The label can be of length 16 or less. Enclose the label in quotes. The default label is of the form *LCL=value* if the control limit has a fixed value; otherwise, the default label is *LCL*. Related options are LCLLABEL2=, UCLLABEL=, and UCLLABEL2=.

LCLLABEL2=*'label'*

specifies a label for the lower control limit in the secondary chart. The label can be of length 16 or less. Enclose the label in quotes. The default label is of the form *LCL=value* if the control limit has a fixed value; otherwise, the default label is *LCL*.

The LCLLABEL2= option is available in the IRCHART, MRCHART, XRCHART, and XSCHART statements. Related options are LCLLABEL=, UCLLABEL=, and UCLLABEL2=.

LENDGRID=n

specifies the line type for the grid requested with the ENDGRID option. The default is $n = 1$, which produces a solid line. If you use the LENDGRID= option, you do not need to specify the ENDGRID option. | *Graphics*

LGRID=n

specifies the line type for the grid requested with the GRID option. The default is $n = 1$, which produces a solid line. If you use the LGRID= option, you do not need to specify the GRID option. | *Graphics*

LHREF=$linetype$
LH=$linetype$

specifies the line type for reference lines requested with the HREF= and HREF2= options. The default is 2, which produces a dashed line. | *Graphics*

LIMITN=n
LIMITN=VARYING

specifies either a fixed or varying nominal sample size for the control limits.

If you specify LIMITN=n, the control limits are computed for the fixed value n, and they do not vary with the subgroup sample sizes. Moreover, subgroup summary statistics are plotted *only* for those subgroups with a sample size equal to n. You can specify ALLN in conjunction with LIMITN=n to force all of the statistics to be plotted, regardless of subgroup sample size.

If you do not specify LIMITN=n and the subgroup sample sizes are constant, the default value of n is the constant subgroup sample size.

Depending on the chart statement, there are restrictions on the value of n that you can specify with the LIMITN= option. For the MRCHART, RCHART, and XRCHART statements, $2 \leq n \leq 25$. For the SCHART and XSCHART statements, $n \geq 2$. For the BOXCHART, MCHART, and XCHART statements, $n \geq 1$. If you omit the STDDEVIATIONS option for the MCHART or XCHART statements (or use the RANGES option with the BOXCHART statement) $n < 26$. For the CCHART and UCHART statements, $n > 0$, and n can assume fractional values (for all other chart statements, n must be a whole number). For the PCHART and NPCHART statements, $n \geq 1$.

For the IRCHART statement, n has a somewhat different interpretation; it specifies the number of consecutive measurements from which the moving ranges are to be computed, and $n \geq 2$. You can think of n as a *pseudo* nominal sample size for the control limits, since the data for an individual measurements and moving range chart are not subgrouped.

Note the difference between the LIMITN= option and the SUBGROUPN= option that is available in the CCHART, NPCHART, PCHART, and UCHART statements. The LIMITN= option specifies a nominal sample size for the *control limits*, whereas the SUBGROUPN= option provides the sample sizes for the *data*.

By default, LIMITN=2 in an IRCHART statement. You cannot specify LIMITN= VARYING in an IRCHART statement. For all other chart statements, LIMITN= VARYING is the default.

The following table identifies the chart features that vary when you use LIMITN= VARYING:

Chart Statement	Features Affected by LIMITN=VARYING
BOXCHART	control limits
CCHART	control limits, central line
MCHART	control limits
MRCHART	control limits on both charts, central line on R chart
NPCHART	control limits, central line
PCHART	control limits
RCHART	control limits, central line
SCHART	control limits, central line
UCHART	control limits
XCHART	control limits
XRCHART	control limits on both charts, central line on R chart
XSCHART	control limits on both charts, central line on s chart

NOTE: As an alternative to specifying the LIMITN= option, you can read the nominal control limit sample size from the variable _LIMITN_ in a LIMITS= data set. See "Input Data Sets" in the chapter for the chart statement in which you are interested.

LIMLABSUBCHAR='*character*'

specifies a substitution character (such as #) for labels provided as quoted strings with the LCLLABEL=, LCLLABEL2=, UCLLABEL=, UCLLABEL2=, CSYMBOL=, NPSYMBOL=, PSYMBOL=, RSYMBOL=, SSYMBOL=, USYMBOL=, and XSYMBOL= options. For details concerning these options, refer to the "Dictionary of Options" beginning on page 1385 of *SAS/QC Software: Usage and Reference*. The substitution character must appear in the label. When the label is displayed on the chart, the character is replaced with the value of the corresponding control limit or center line, provided that this value is constant across subgroups. Otherwise, the default label for a varying control limit or center line is displayed.

LLIMITS=_linetype_

Graphics

specifies the line type for control limits. The default is 4, which produces a dashed line.

LSL=_value-list_

provides lower specification limits used to compute capability indices. If you provide more than one *value*, the number of *values* must match the number of *processes* listed in the chart statement. If you specify only one *value*, it is used for all the *processes*.

IMPORTANT: You can use the LSL= option only in conjunction with the OUTLIMITS= option. The SHEWHART procedure uses the specification limits

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to compute capability indices, and it saves the limits and indices in the OUTLIM-
ITS= data set. For more information, see "Capability Indices" on page 1537 and
"Output Data Sets" in the chapter for the chart statement in which you are inter-
ested. Also see the entry for the USL= option. The LSL= option is available in the
BOXCHART, IRCHART, MCHART, MRCHART, RCHART, SCHART, XCHART,
XRCHART, and XSCHART statements.

LSTARCIRCLES=_linetypes_

specifies one or more line types for the circles requested with the STARCIRCLES=   *Graphics*
option. The number of line types should match the number of circles requested, and
the line types are paired with the circles in the order specified. The default _linetype_ is
1, which produces a solid line.

Figure 46.6 illustrates circles displayed by the following LSTARCIRCLES= and
STARCIRCLES= options:

```
starcircles  = 0.0 1.0 0.25 0.5
lstarcircles = 1 1 2 2
```
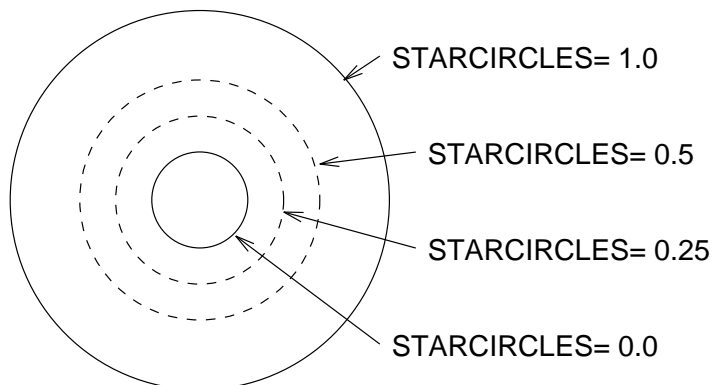

STARCIRCLES= 1.0

STARCIRCLES= 0.5

STARCIRCLES= 0.25

STARCIRCLES= 0.0

Figure 46.6.   Line Types for Reference Circles

LSTARS=_linetype_
LSTARS=(_variable_**)**

specifies the line types for the outlines of stars requested with the STARVERTICES=   *Graphics*
option. You can use one of the following approaches:

- You can specify LSTARS=_linetype_ to provide a single line type for all of the
  stars.

- You can specify LSTARS=(_variable_) to provide a distinct line type for _each_
  star. The variable must be a numeric variable in the input data set, and its val-
  ues must be valid SAS/GRAPH line types. The line type for the star positioned
  at a particular subgroup is the value of the _variable_ in the observations cor-
  responding to this subgroup. Note that if there are multiple observations per
  subgroup in the input data set, the _variable_ values should be identical for all of
  the observations in a given subgroup.

See "Displaying Auxiliary Data with Stars" on page 1701. The default _linetype_ is 1,
which produces a solid line.

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LTESTS=*linetype*
LTEST=*linetype*

Graphics

    specifies the line type for the line segments that connect patterns of points for which a test for special causes (requested with the TESTS= option) is positive. The default is 1, which produces a solid line.

LTMARGIN=*value*
LTM=*value*

Graphics

    specifies the width (in horizontal percent screen units) of the left marginal area for the plot requested with the LTMPLOT= option. The LTMARGIN= option is avalable only in the IRCHART statement.

LTMPLOT=*keyword*

Graphics

    requests a univariate plot of the control chart statistics that is positioned in the left margin of the control chart. The *keywords* that you can specify and the associated plots are listed in the following table:

Keyword	Marginal Plot
HISTOGRAM	histogram
DIGIDOT	digidot plot
SKELETAL	skeletal box-and-whisker plot
SCHEMATIC	schematic box-and-whisker plot
SCHEMATICID	schematic box-and-whisker plot with outliers labeled
SCHEMATICIDFAR	schematic box-and-whisker plot with far outliers labeled

    The LTMPLOT= option is available only in the IRCHART statement; see Example 34.3 on page 1179 for an example. Refer to Hunter (1988) for a description of digidot plots, and see the entry for the BOXSTYLE= option for a description of the various box-and-whisker plots. Related options are LTMARGIN=, RTMARGIN=, and RTMPLOT=.

LVREF=*linetype*
LV=*linetype*

Graphics

    specifies the line type for reference lines requested by the VREF= and VREF2= options. The default is 2, which produces a dashed line.

LZONES=*n*

Graphics

    specifies the line type for lines that delineate zones A, B, and C for standard tests requested with the TESTS= and/or TESTS2= options. The default is $n = 2$, which produces a dashed line.

MAXPANELS=*n*

    specifies the maximum number of pages or screens for a chart. By default, $n = 20$.

MEDCENTRAL=AVGMEAN | AVGMED | MEDMED

    identifies a method for estimating the process mean μ, which is represented by the central line on a median chart. The methods corresponding to each keyword are given in the following table:

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Keyword	Method for Estimating Process Mean
AVGMEAN	average of subgroup means
AVGMED	average of subgroup medians
MEDMED	median of subgroup medians

The default keyword is AVGMED. The MEDCENTRAL= option is available only in the MCHART and MRCHART statements and in the BOXCHART statement with the CONTROLSTAT=MEDIAN option.

MISSBREAK

determines how subgroups are formed when observations are read from a DATA= data set and a character *subgroup-variable* is provided. When you specify the MISSBREAK option, observations with missing values of the *subgroup variable* are not processed. Furthermore, the next observation with a nonmissing value of the *subgroup-variable* is treated as the beginning observation of a new subgroup even if this value is identical to the most recent nonmissing subgroup value. In other words, by specifying the option MISSBREAK and by inserting an observation with a missing *subgroup-variable* value into a group of consecutive observations with the same *subgroup-variable* value, you can split the group into two distinct subgroups of observations.

By default (if MISSBREAK is not specified), observations with missing values of the *subgroup variable* are not processed, and all remaining observations with the same consecutive value of the *subgroup-variable* are treated as a single subgroup.

MU0=value

specifies a known (standard) value μ_0 for the process mean μ. By default, μ is estimated from the data. The MU0= option is available in the BOXCHART, IRCHART, MCHART, MRCHART, XCHART, XRCHART, and XSCHART statements.

NOTE: As an alternative to specifying MU0=μ_0, you can read a predetermined value for μ_0 from the variable _MEAN_ in a LIMITS= data set. See "Input Data Sets" in the chapter for the chart statement in which you are interested.

NAME='string'

specifies a name for the primary chart of length 8 or less that appears in the PROC GREPLAY master menu. The default name is 'SHEWHART'. A related option is DESCRIPTION=.

Graphics

NAME2='string'

specifies a name for the secondary chart of length 8 or less that appears in the PROC GREPLAY master menu. The default name is 'SHEWHART'. The NAME2= option is available in the IRCHART, MRCHART, XRCHART, and XSCHART statements, and it is used in conjunction with the SEPARATE option. A related option is DE-SCRIPTION2=.

Graphics

NDECIMAL=n

specifies the number of decimal digits in the default labels for the control limits and the central line in the primary chart. The default is one more than the maximum number of decimal digits in the vertical axis tick mark labels. For example, if the vertical axis tick mark label with the largest number of digits after the decimal point is 110.05, the default is $n = 3$.

NDECIMAL2=n

specifies the number of decimal digits in the default labels for the control limits and central line in a secondary chart. The default is one more than the maximum number of decimal digits in the vertical axis tick mark labels. The NDECIMAL2= option is available in the IRCHART, MRCHART, XRCHART, and XSCHART statements.

NEEDLES

connects plotted points to the central line with vertical line segments (needles). See Example 37.2 on page 1294 for an example. By default, adjacent points are connected to one another. The NEEDLES option is available in all chart statements except the BOXCHART statement.

NMARKERS

identifies a plotted subgroup summary statistic with a special symbol marker (character) when the corresponding subgroup sample size is not equal to the nominal control limit sample size n. Specify the nominal control limit sample size n with the LIMITN= option or with the variable _LIMITN_ read from a LIMITS= data set. The following table summarizes the identification:

Sample Size	Graphics Device Symbol	Line Printer Character
$< n$	▽	L
$> n$	△	G

A legend that explains the symbols is displayed at the bottom of the chart. This legend can be suppressed with the NOLEGEND option.

The NMARKERS option is not available in the IRCHART statement. The NMARKERS option applies only when specified in conjunction with the ALLN option and a fixed nominal control limit sample size provided with the LIMITN= option or the variable _LIMITN_. See Example 43.3 on page 1544 for an illustration.

NO3SIGMACHECK

suppresses the check for 3σ limits when tests for special causes are requested. This allows tests for special causes to be applied when the SIGMAS= option is used to specify control limits other than the default 3σ limits. This option should not be used for standard control chart applications, since the standard tests for special causes assume 3σ limits.

NOBYREF

specifies that the reference line information in an HREF=, HREF2=, VREF=, or VREF2= data set is to be applied uniformly to charts created for all the BY groups in the input data set (DATA=, HISTORY=, or TABLE=). If you specify the NOBYREF option, you do not need to provide BY variables in the reference line data set. By default, you must provide BY variables.

NOCHART

suppresses the creation of the chart. You typically specify the NOCHART option when you are using the procedure to compute control limits and save them in an output data set. You can also use the NOCHART option when you are tabulating results with the TABLE and related options.

In the IRCHART, MRCHART, XRCHART, and XSCHART statements, the NOCHART option suppresses the creation of both the primary and secondary charts.

If you use a graphics device and specify the NOCHART option, the chart is not saved in a graphics catalog. To save the chart in a graphics catalog while suppressing the display of the chart, specify the NODISPLAY option in a GOPTIONS statement.

NOCHART2

suppresses the creation of a secondary chart. You typically use this option in the IRCHART statement to create a chart for individual measurements and suppress the accompanying chart for moving ranges. The NOCHART2 option is available in the IRCHART, MRCHART, XRCHART, and XSCHART statements.

NOCONNECT

suppresses line segments that connect points on the chart. By default, points are connected except in box charts produced with the BOXCHART statement (see the BOXCONNECT option).

NOCTL

suppresses the display of the central line in a primary chart.

NOCTL2

suppresses the display of the central line in a secondary chart. The NOCTL2 option is available in the IRCHART, MRCHART, XRCHART, and XSCHART statements.

NOFRAME

suppresses the default frame drawn around the chart.

NOHLABEL

suppresses the label for the horizontal (subgroup) axis. Use the NOHLABEL option when the meaning of the axis is evident from the tick mark labels, such as when a date format is associated with the subgroup variable.

NOLCL

suppresses the display of the lower control limit in a primary chart.

NOLCL2

suppresses the drawing of the lower control limit in a secondary chart. The NOLCL2 option is available in the IRCHART, MRCHART, XRCHART, and XSCHART statements.

NOLEGEND

suppresses the default legend for subgroup sample sizes, which appears by default below the chart. This option also suppresses the legend displayed by the NMARKERS option. Use the NOLEGEND option when the subgroup sample sizes are constant and equal to the control limit sample size, since the control limit sample size is displayed in the upper right corner of the chart.

NOLIMIT0

suppresses the display of a fixed lower control limit if and only if the value of the limit is zero. This option is useful in situations where a lower limit of zero is considered to be uninformative or visually distracting (for instance, on certain p charts or R charts). The NOLIMIT0 option is available with all chart statements except BOXCHART, MCHART, and XCHART. For the IRCHART, MRCHART, XRCHART, and XSCHART statements, the NOLIMIT0 option applies only to the secondary chart.

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NOLIMIT1

suppresses the display of a fixed upper control limit on a p chart if and only if the value of the control limit is 1 (or 100%), or on an np chart if and only if the value of the control limit is n. The NOLIMIT1 option is available only in the NPCHART and PCHART statements.

NOLIMITLABEL

suppresses the default labels for the control limits and central lines.

NOLIMITS

suppresses the display of control limits. This option is particularly useful if you are using the BOXCHART statement to create side by side box-and-whisker plots; in this case, you should also use one of the BOXSTYLE= options.

NOLIMITSFRAME

suppresses the default frame for the control limit information that is displayed across the top of the chart when multiple sets of control limits with distinct multiples of σ and nominal control limit sample sizes are read from a LIMITS= data set.

NOLIMITSLEGEND

suppresses the legend for the control limits (for example, *3σ Limits For n=5*), which appears by default in the upper right corner of the chart.

NOPHASEFRAME

suppresses the default frame for the legend requested by the PHASELEGEND option.

NOREADLIMITS

specifies that the control limits for each *process* listed in the chart statement are *not* to be read from the LIMITS= data set specified in the PROC SHEWHART statement. There are two basic methods of displaying control limits: calculating control limits from the data and reading control limits from a LIMITS= data set. If you want control limits calculated from the data, you can do one of the following:

1. Do not specify a LIMITS= data set.
2. If you specify a LIMITS= data set, also specify the NOREADLIMITS option.

Otherwise, if you specify a LIMITS= data set in the PROC SHEWHART statement, the procedure reads control limits from that data set.*

The following example illustrates the NOREADLIMITS option:

```
proc shewhart data=pistons limits=diamlim;
   xrchart diameter*hour;
   xrchart diameter*hour / noreadlimits;
run;
```

The first XRCHART statement reads the control limits from the first observation in the data set DIAMLIM for which the variable _VAR_ is equal to `diameter` and the variable _SUBGRP_ is equal to `hour`. The second XRCHART statement computes

---

*This is true for Release 6.10 and later releases of SAS/QC software. For Release 6.09 and earlier releases, the procedure calculates control limits from the data unless you specify a LIMITS= data set in the procedure statement **and** you specify either the READLIMITS option or the READINDEXES= option in the chart statement. The NOREADLIMITS option is not available for Release 6.09 and earlier releases. For more information, see the entry for the READLIMITS option.

the control limits from the measurements in the data set PISTONS. Note that the second XRCHART statement is equivalent to the following statements, which are more commonly used:

```
proc shewhart data=pistons;
    xrchart diameter*hour;
run;
```

For more information about reading control limits from a LIMITS= data set, see the entry for the READLIMITS option and "Displaying Multiple Sets of Control Limits" on page 1692.

NOTCHES

specifies that box-and-whisker plots created by the BOXCHART statement are to be notched. The endpoints of the notches are located at the median plus and minus $1.58(\text{IQR}/\sqrt{n})$, where IQR is the interquartile range and n is the subgroup sample size. The medians (central lines) of two box-and-whisker plots are significantly different at approximately the 0.05 level if the corresponding notches do not overlap. Refer to McGill and others (1978). Figure 46.7 illustrates the NOTCHES option. Notice the folding effect at the bottom, which happens when the endpoint of a notch is beyond its corresponding quartile. This situation occurs typically only when the subgroup sample size is small.
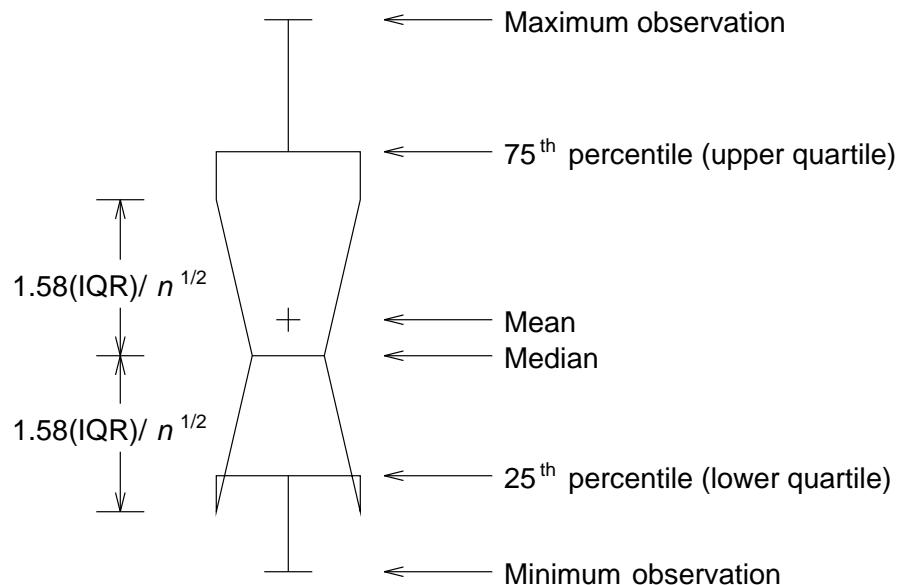
Graphics

Figure 46.7. NOTCHES Option for Box-and-Whisker Plots

The NOTCHES option is also illustrated in Output 32.3 on page 1092 and is available only in the BOXCHART statement.

NOTICKREP

applies to character-valued *subgroup-variables* and specifies that only the first occurrence of repeated, adjacent subgroup values is to be labeled on the horizontal axis.

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NOTRENDCONNECT

suppresses line segments that connect points on a trend chart. Points are connected by default. The NOTRENDCONNECT option is available only in the BOXCHART, MCHART, and XCHART statements when the TRENDVAR= option is used.

NOTRUNC

overrides the vertical axis truncation at zero, which is applied by default to c charts, moving range charts, np charts, p charts, R charts, s charts, and u charts. This option is useful if you are creating a customized version of one of these charts and want to replace the plotted statistics and control limits with values read from a TABLE= input data set that can be positive or negative. Do not use the NOTRUNC option in standard control chart applications. This option is not available in the BOXCHART, MCHART, and XCHART statements.

NOUCL

suppresses the display of the upper control limit in a primary chart.

NOUCL2

suppresses the display of the upper control limit in a secondary chart. The NOUCL2 option is available in the IRCHART, MRCHART, XRCHART, and XSCHART statements.

NOVANGLE

Graphics   requests vertical axis labels that are strung out vertically. By default, the labels are drawn at an angle of 90 degrees if a software font is used.

NPANELPOS=n
NPANEL=n

specifies the number of subgroup positions per panel on each chart. A *panel* is defined as a screen or page (or a half-screen or half-page if you are also using the BILEVEL option). You typically specify the NPANELPOS= option to display more points on a panel than the default number, which is $n = 50$ for all chart statements except the BOXCHART statement, for which the default is $n = 20$.

You can specify a positive or negative number for n. The absolute value of n must be at least 5. If n is positive, the number of positions is adjusted so that it is approximately equal to n and so that all panels display approximately the same number of subgroup positions. If n is negative, no balancing is done, and each panel (except possibly the last) displays approximately $|n|$ positions. In this case, the approximation is due only to axis scaling.

You can use the INTERVAL= option to change the effect of the NPANELPOS= option when a date or time format is associated with the *subgroup-variable*. The INTERVAL= option enables you to match the scale of the horizontal axis to the scale of the subgroup variable without having to associate a different format with the subgroup variable.

NPSYMBOL='*label*'
NPSYMBOL=NP | NPBAR | NPPM | NPPM2 | NP0

specifies a label for the central line in an np chart. You can use the option in the following ways:

- You can specify a quoted *label* up to 16 characters in length.

- You can specify one of the keywords listed in the following table. Each keyword requests a label of the form *symbol=value*, where *symbol* is one of the symbols given in the table, and *value* is the value of the central line. If the central line is not constant, only the symbol is displayed.

| | Symbol Printed on Charts Produced by | |
Keyword	Graphics Devices	Line Printers
NP	NP	NP
NPBAR	$\overline{\text{NP}}$	$\overline{\text{NP}}$
NPPM	NP'	NP'
NPPM2	NP''	NP''
NP0	NP_0	NP0

The default keyword is NPBAR. The NPSYMBOL= option is available only in the NPCHART statement.

OUTHISTORY=*SAS-data-set*

creates an output data set that contains the subgroup summary statistics. You can use an OUTHISTORY= data set as a HISTORY= input data set in a subsequent run of the procedure. You cannot request an OUTHISTORY= data set if the input data set is a TABLE= data set. See "Output Data Sets" in the chapter for the chart statement in which you are interested. A related option is OUTPHASE=.

OUTINDEX='*label***'**

specifies the value of the _INDEX_ variable in the OUTLIMITS= output data set. This is a bookkeeping variable that provides information identifying the control limits saved in the data set. See "Output Data Sets" in the chapter for the chart statement in which you are interested.

The *label* can be up to 16 characters and should be enclosed in quotes. You should use a *label* that uniquely identifies the control limits. For example, you might specify OUTINDEX='April 1-15' to indicate that the limits were computed from data collected during the first half of April.

The OUTINDEX= option is intended to be used in conjunction with the OUTLIMITS= option. The _INDEX_ variable is created only if you specify the OUTINDEX= option. If you specify the OUTINDEX= option and do not specify the name of the OUTLIMITS= data set with the OUTLIMITS= option, the procedure creates an OUTLIMITS= data set whose name is of the form WORK.DATAn.

NOTE: You cannot use the OUTINDEX= and READINDEXES= options in the same chart statement.

OUTLABEL=VALUE
OUTLABEL=(*variable***)**

labels each point that falls outside the control limits on the primary chart with the VALUE plotted for that subgroup or with the value of a *variable* in the input data set.

The *variable* provided in the input data set can be numeric or character. If the *variable* is a character variable, it can be up to 16 characters. For each subgroup of observations whose summary statistic falls outside the control limits, the formatted value of the *variable* in the observations is used to label the point representing the subgroup. If you are reading a DATA= data set with multiple observations per subgroup, the values of the *variable* should be identical for observations within a subgroup. By default, points are not labeled. The OUTLABEL= option takes precedence over the TESTLABEL= option when TESTS=1 is specified. You cannot specify both the OUTLABEL= and ALLLABEL= options.

OUTLABEL2=VALUE
OUTLABEL2=(*variable***)**

labels each point that falls outside the control limits on the secondary chart with the VALUE plotted for that subgroup or with the value of a *variable* in the input data set.

The *variable* provided in the input data set can be numeric or character. If the *variable* is a character variable, its length cannot exceed 16. For each subgroup of observations whose summary statistic falls outside the control limits, the formatted value of the *variable* in the observations is used to label the point representing the subgroup. If you are reading a DATA= data set with multiple observations per subgroup, the values of the *variable* should be identical for observations within a subgroup. By default, points are not labeled. The OUTLABEL2= option takes precedence over the TEST-LABEL2= option when TESTS2=1 is specified. You cannot specify both the OUT-LABEL2= and ALLLABEL2= options. The OUTLABEL2= option is available only in the IRCHART, MRCHART, RCHART, SCHART, XRCHART, and XSCHART statements.

OUTLIMITS=*SAS-data-set*

creates an output data set that saves the control limits. You can use an OUTLIMITS= data set as an input LIMITS= data set in a subsequent run of the procedure. See "Output Data Sets" in the chapter for the chart statement in which you are interested. A related option is OUTINDEX=.

OUTPHASE='*label***'**

specifies the value of the _PHASE_ variable in the OUTHISTORY= data set. This is a bookkeeping variable that provides information identifying the summary statistics saved in the data set. See "Output Data Sets" in the chapter for the chart statement in which you are interested.

You should use the OUTPHASE= option if you create OUTHISTORY= data sets at different stages (phases) for the same *processes* and concatenate the data sets to build a master historical data set. The _PHASE_ variable then identifies the block of observations that corresponds to each phase.

The *label* can be up to 16 characters and should be enclosed in quotes. You should use a *label* that uniquely identifies the saved data. For example, you might specify OUTPHASE='April 1-15' to indicate that the data were collected during the first half of April.

The _PHASE_ variable is created only if you specify the OUTPHASE= option. If you specify the OUTPHASE= option and do not specify the name of the OUTHIS-

TORY= data set with the OUTHISTORY= option, the procedure creates an OUT-HISTORY= data set whose name is of the form WORK.DATA*n*.

OUTTABLE=*SAS-data-set*

creates an output SAS data set that saves the information plotted on the chart, including the subgroup variable values and their corresponding summary statistics and control limits.

You can use the OUTTABLE= data set to create a customized report with the reporting procedures and methods described in *SAS Language Reference: Dictionary*. You can also use an OUTTABLE= data set as a TABLE= input data set in a subsequent run of the procedure. See "Output Data Sets" in the chapter for the chart statement in which you are interested.

P0=*value*

specifies a known (standard) value p_0 for the proportion of nonconforming items produced by the process. By default, p_0 is estimated from the data. The P0= option is available only in the NPCHART and PCHART statements.

NOTE: As an alternative to specifying P0=p_0, you can read a predetermined value for p_0 from the variable _P_ in a LIMITS= data set. See "Input Data Sets" in the chapter for the chart statement in which you are interested.

PAGENUM='*string***'**

specifies the form of the label used for pagination. | *Graphics* |

The *string* must be no longer than 16 characters, and it must include one or two occurrences of the substitution character #. The first # is replaced with the page number, and the optional second # is replaced with the total number of pages.

The PAGENUM= option is useful when you are working with a large number of subgroups, resulting in multiple pages of output. For example, suppose that each of the following XRCHART statements produces multiple pages:

```
proc shewhart data=pistons;
   xrchart diameter*hour / pagenum='Page #';
   xrchart diameter*hour / pagenum='Page # of #';
   xrchart diameter*hour / pagenum='#/#';
run;
```

The third page produced by the first statement would be labeled *Page 3*. The third page produced by the second statement would be labeled *Page 3 of 5*. The third page produced by the third statement would be labeled *3/5*.

By default, no page number is displayed.

PAGENUMPOS=TL | TR | BL | BR | TL100 | TR100 | BL0 | BR0

specifies where to position the page number requested with the PAGENUM= option. | *Graphics* |
The keywords TL, TR, BL, and BR correspond to the positions top left, top right, bottom left, and bottom right, respectively. You can use the TL100 and TR100 keywords to ensure that the page number appears at the very top of a page when a title is displayed. The BL0 and BR0 keywords ensure that the page number appears at the very bottom of a page when footnotes are displayed. The default keyword is BR.

PCTLDEF=*index*

specifies one of five definitions used to calculate percentiles in the construction of box-and-whisker plots requested with the BOXCHART statement. The *index* can be 1, 2, 3, 4, or 5. The five corresponding percentile definitions are discussed in "Percentile Definitions" on page 1083 in Chapter 32, "BOXCHART Statement." The default *index* is 5. The PCTLDEF= option is available only in the BOXCHART statement.

PHASEBREAK

specifies that the last point in a phase (defined as a block of consecutive subgroups with the same value of the _PHASE_ variable) is not to be connected to the first point in the next phase. By default, the points are connected.

PHASELABTYPE=SCALED | TRUNCATED
PHASELABTYPE=*height*

Graphics

specifies how lengthy _PHASE_ variable values are to be displayed when there is insufficient space in the legend requested with the PHASELEGEND option.

If you specify PHASELABTYPE=SCALED, the values are uniformly reduced in height so that they fit. If you specify PHASELABTYPE=TRUNCATED, lengthy values are truncated on the right until they fit. You can also specify a text *height* in vertical percent screen units for the values. By default, lengthy values are not displayed. Related options are PHASELEGEND and PHASEREF.

PHASELEGEND
PHASELEG

identifies the phases requested with the READPHASES= option in a legend across the top of the chart. Related options are PHASELABTYPE= and PHASEREF.

PHASELIMITS

specifies that the control limits and center line are to be labeled for each phase specified with the READPHASES= option, providing the limits are constant within that phase.

PHASEMEANSYMBOL=*symbol*

specifies a symbol marker for the average of the values plotted within a phase.

PHASEREF

delineates the phases specified with the READPHASES= option with reference lines drawn vertically. Related options are PHASELABTYPE= and PHASELEGEND.

PSYMBOL=’*label***’**
PSYMBOL=P | PBAR | PPM | PPM2 | P0

specifies a label for the central line in a *p* chart. You can use the option in the following ways:

- Specify a quoted *label* up to 16 characters.
- Specify one of the keywords listed in the following table. Each keyword requests a label of the form *symbol=value*, where *symbol* is the symbol given in the table, and *value* is the value of the central line. If the central line is not constant, only the symbol is displayed.

	Symbol Printed on Charts Produced by	
Keyword	Graphics Devices	Line Printers
P	P	P
PBAR	$\overline{\text{P}}$	$\overline{\text{P}}$
PPM	P'	P'
PPM2	P''	P''
P0	P_0	P0

The default keyword is PBAR. The PSYMBOL= option is available only in the PCHART statement.

RANGES

estimates the process standard deviation for a boxplot using subgroup ranges. By default the process standard deviation for a boxplot is estimated from the subgroup standard deviations.

READALPHA

specifies that the variable _ALPHA_, rather than the variable _SIGMAS_, is to be read from a LIMITS= data set when both variables are available in the data set. Thus the limits displayed are probability limits. If you do not specify the READALPHA option, then _SIGMAS_ is read by default. For details, see "Input Data Sets" in the chapter for the chart statement in which you are interested.

READINDEX=*value-list* **| ALL**
READINDEXES=*value-list* **| ALL**
READINDICES=*value-list* **| ALL**

reads one or more sets of control limits from a LIMITS= data set (specified in the PROC SHEWHART statement) for each *process* listed in the chart statement. The ith set of control limits for a particular *process* is read from the first observation in the LIMITS= data set for which

- the value of _VAR_ matches *process*
- the value of _SUBGRP_ matches the *subgroup variable*
- the value of _INDEX_ matches *value*

The *values* can be up to 16 characters and must be enclosed in quotes.

NOTE: You cannot use the READINDEX= and OUTINDEX= options in the same chart statement. Also, the READLIMITS and READINDEX= options are alternatives to each other. If the LIMITS= data set contains more than one set of control limits for the same *process*, you should use the READINDEX= option.

You can display distinct sets of control limits (read from a LIMITS= data set) with data for various *phases* (read from blocks of observations in the input data set) by using the READINDEXES= and READPHASES= options together. See the entry for the READPHASES= option.

For more information about multiple sets of control limits and about the keyword ALL, see "Displaying Multiple Sets of Control Limits" on page 1692.

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READLIMITS

specifies that the control limits are to be read from a LIMITS= data set specified in the PROC SHEWHART statement.* The control limits for each *process* listed in the chart statement are to be read from the first observation in the LIMITS= data set where

- the value of _VAR_ matches *process*
- the value of _SUBGRP_ matches the *subgroup variable*

The use of the READLIMITS option depends on the release of SAS/QC software that you are using.

- **In Release 6.10 and later releases, the READLIMITS option is not necessary.** To read control limits as described previously, you simply specify a LIMITS= data set. However, even though the READLIMITS option is redundant, it continues to function as in earlier releases. Consequently, the following two XRCHART statements are equivalent:

```
proc shewhart data=pistons limits=diamlim;
   xrchart diameter*hour;
   xrchart diameter*hour / readlimits;
run;
```

If the LIMITS= data set contains more than one set of control limits for the same *process*, you should use the READINDEX= option.

- **In Release 6.09 and earlier releases, you must specify the READLIMITS option to read control limits as described previously.** If you specify a LIMITS= data set without specifying the READLIMITS option (or the READINDEX= option), the control limits are computed from the data. Consequently, the following two XRCHART statements are **not** equivalent:

```
proc shewhart data=pistons limits=diamlim;
   xrchart diameter*hour;  /* limits computed from data */
   xrchart diameter*hour /
      readlimits;          /* limits read from DIAMLIM  */
run;
```

The READLIMITS and READINDEX= options are alternatives to each other.

You can use the READLIMITS and READPHASES= options together. In this case, the control limits are read as described previously, and the data plotted on the chart are those selected by the READPHASES= option.

READPHASES=*value-list* **| ALL**
READPHASE=*value-list* **| ALL**

selects blocks of consecutive observations to be read from the input data set. You can use the READPHASES= option only if

---

*For details about computing control limits from the data, see the entry for the NOREADLIMITS option.

- the input data set contains a _PHASE_ variable
- the _PHASE_ variable is a character variable of no more than 16 characters

The READPHASES= option selects those observations whose _PHASE_ value matches one of the *values* specified in the *value-list*. The block of consecutive observations identified by the ith *value* is referred to as the ith *phase*. The *values* can be up to 16 characters and must be enclosed in quotes. List the *values* in the same order that they appear as values of the variable _PHASE_ in the input data set.

With the READPHASES= option you can

- create control charts that label blocks of data corresponding to multiple time *phases*. See the PHASELEGEND, PHASEREF, and CFRAME= options.
- create *historical control charts* that display distinct sets of control limits for different *phases*. This also requires a LIMITS= data set and the READINDEXES= option.

If the subgroup variable is numeric, the values of the subgroup variable should be contiguous from one block of observations to the next. Otherwise, there may be a gap in the control chart between the last point in one phase and the first point in the next phase. If you read a data set that contains multiple observations for each subgroup, the value of _PHASE_ must be constant within the subgroup.

You can display distinct sets of control limits (read from a LIMITS= data set) with data for various *phases* by using the READINDEX= and READPHASES= options together. For example, consider the flange width data in the HISTORY= data set FLANGE and the LIMITS= data set FLANLIM. A partial listing of FLANGE is given in Figure 46.8 (for a complete listing of FLANGE, see Figure 47.7 on page 1693). The complete listing of FLANLIM is given in Figure 46.9.

Obs	_phase_	day	sample	flwidthx	flwidthr	flwidthn
1	Production	08FEB90	6	0.97360	0.06247	5
2	Production	09FEB90	7	1.00486	0.11478	5
3	Production	10FEB90	8	1.00251	0.13537	5
.	.	.	.	.	.	.
.	.	.	.	.	.	.
10	Production	19FEB90	15	0.99604	0.08242	5
11	Change 1	22FEB90	16	0.99218	0.09787	5
12	Change 1	23FEB90	17	0.99526	0.02017	5
.	.	.	.	.	.	.
.	.	.	.	.	.	.
20	Change 1	05MAR90	25	1.00412	0.04815	5
21	Change 2	08MAR90	26	1.00261	0.05604	5
22	Change 2	09MAR90	27	0.99553	0.02818	5
.	.	.	.	.	.	.
.	.	.	.	.	.	.
30	Change 2	19MAR90	35	1.00863	0.02649	5

Figure 46.8. Listing of the HISTORY= Data Set FLANGE

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```
Obs   _index_        _var_    _subgrp_    _type_     _limitn_    _alpha_   _sigmas_

 1    Change 1      FLWIDTH    SAMPLE    ESTIMATE        5      .0026998      3
 2    Production    FLWIDTH    SAMPLE    ESTIMATE        5      .0026998      3
 3    Start         FLWIDTH    SAMPLE    ESTIMATE        5      .0026998      3


Obs   _lclx_     _mean_     _uclx_    _lclr_      _r_        _uclr_     _stddev_

 1    0.96167    0.99924    1.03680      0       0.06513    0.13771    0.028000
 2    0.93792    0.98827    1.03862      0       0.08729    0.18458    0.037530
 3    0.87088    0.96803    1.06517      0       0.16842    0.35612    0.072409
```

Figure 46.9.   Listing of the LIMITS= Data Set FLANLIM

The following statements use the READINDEX= and READPHASES= options to
create a historical control chart for the *Production* and *Change 1* phases:

```
proc shewhart history=flange limits=flanlim;
  xchart flwidth*sample /
      readphases  = ('Production' 'Change 1')
      readindexes = ('Production' 'Change 1')
      phaseref
      phaselegend ;
run;
```
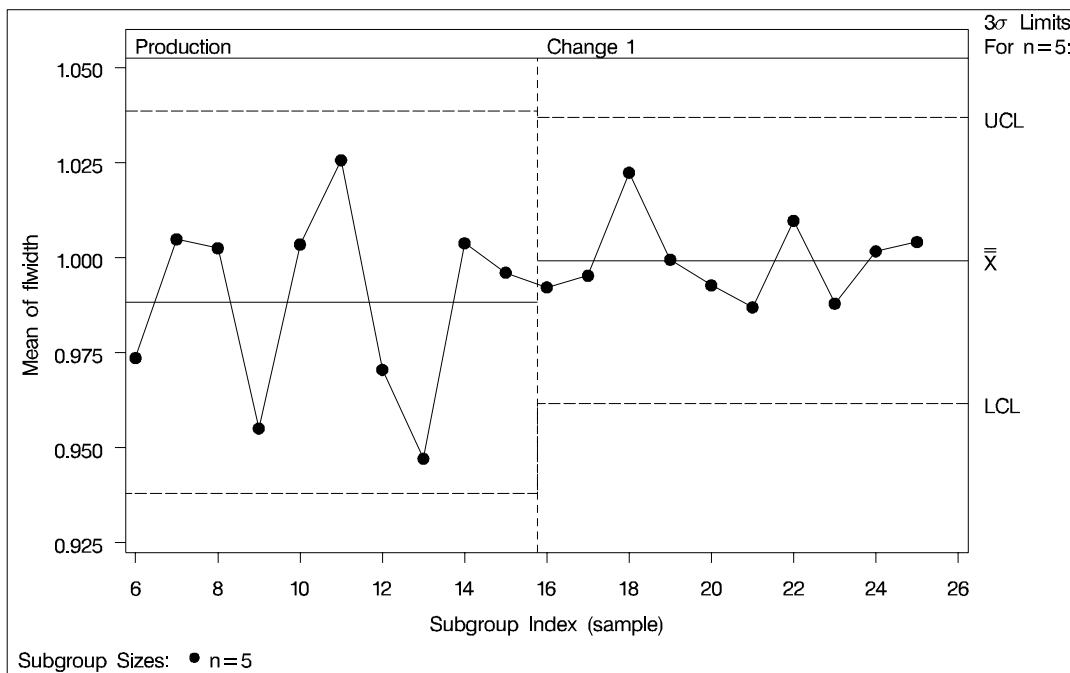
The chart is displayed in Figure 46.10.

Figure 46.10.   Multiple Control Limits for Multiple Phases

You can also use the keyword ALL with the READPHASES= option to match con-
trol limits to phases. For more information and examples about specifying multiple
control limits, including the use of the keyword ALL, see "Displaying Multiple Sets
of Control Limits" on page 1692.

REPEAT
REP

specifies that the horizontal axis of a chart that spans multiple pages is to be arranged so that the last subgroup position on a page is repeated as the first subgroup position on the next page. The REPEAT option facilitates cutting and pasting panels together. If a SAS DATETIME format is associated with the subgroup variable, REPEAT is used by default.

RSYMBOL='*label*'
RSYMBOL=R | RBAR | RPM | R0

specifies a label for the central line in an R chart. You can use the option in the following ways:

- You can specify a quoted *label* up to 16 characters.

- You can specify one of the keywords listed in the following table. Each keyword requests a label of the form *symbol=value*, where *symbol* is the symbol given in the table, and *value* is the value of the central line. If the central line is not constant, only the symbol is displayed.

	Symbol Printed on Charts Produced by	
Keyword	Graphics Devices	Line Printers
R	R	R
RBAR	$\overline{R}$	$\overline{R}$
RPM	R'	R'
R0	R_0	R0

The default keyword is RBAR. The RSYMBOL= option is available only in the IRCHART, MRCHART, RCHART, and XRCHART statements.

RTMARGIN=<i>value</i>
RTM=<i>value</i>

specifies the width (in horizontal percent screen units) of the right marginal area for the plot requested with the RTMPLOT= option. The RTMARGIN= option is available only in the IRCHART statement.

RTMPLOT=<i>keyword</i>

requests a univariate plot of the control chart statistics that is positioned in the right margin of the control chart. The *keywords* that you can specify and the associated plots are listed in the following table:

Graphics

Keyword	Marginal Plot
DIGIDOT	digidot plot
HISTOGRAM	histogram
SKELETAL	skeletal box-and-whisker plot
SCHEMATIC	schematic box-and-whisker plot
SCHEMATICID	schematic box-and-whisker plot with outliers labeled
SCHEMATICIDFAR	schematic box-and-whisker plot with far outliers labeled

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The RTMPLOT= option is available only in the IRCHART statement; see Example 34.3 on page 1179 for an example. Refer to Hunter (1988) for a description of digidot plots, and see the entry for the BOXSTYLE= option for a description of the various box-and-whisker plots. Related options are LTMARGIN=, LTMPLOT=, and RTMARGIN=.

SEPARATE

displays primary and secondary charts on separate screens or pages. This option is useful if you are displaying line printer output on a terminal and the number of lines on the screen limits the resolution of the chart. The SEPARATE option is available only in the IRCHART, MRCHART, XRCHART, and XSCHART statements.

SERIFS

adds serifs to the whiskers of *skeletal box-and-whisker charts*. The SERIFS option is available only in the BOXCHART statement.

SIGMA0=$value$

specifies a known (standard) value σ_0 for the process standard deviation σ. By default, σ_0 is estimated from the data.

The SIGMA0= option is available in the BOXCHART, IRCHART, MCHART, MRCHART, RCHART, SCHART, XCHART, XRCHART, and XSCHART statements.

NOTE: As an alternative to specifying SIGMA0=σ_0, you can read a predetermined value for σ_0 from the variable _STDDEV_ in a LIMITS= data set. For details, see "Input Data Sets" in the chapter for the chart statement in which you are interested.

SIGMAS=k

specifies the width of the control limits in terms of the multiple k of the standard error of the subgroup summary statistic plotted on the chart. The value of k must be positive. By default, $k = 3$ and the control limits are "3σ limits."

The particular subgroup summary statistic whose standard error is multiplied by k depends on the chart statement, as indicated by the following table:

Statement	Subgroup Summary Statistic
BOXCHART	mean or median
CCHART	number nonconforming
IRCHART	individual measurements and moving ranges
MCHART	median
MRCHART	median and range
NPCHART	number nonconforming
PCHART	proportion nonconforming
RCHART	range
SCHART	standard deviation
UCHART	number of nonconformities per unit
XCHART	mean
XRCHART	mean and range
XSCHART	mean and standard deviation

For details, see the Options for Specifying Control Limits table and the "Details" section in the chapter for the particular chart statement that you are using.

Note that

- as an alternative to specifying SIGMAS=k, you can read k from the variable _SIGMAS_ in a LIMITS= data set. For details, see "Input Data Sets" in the chapter for the chart statement in which you are interested.

- as an alternative to specifying SIGMAS=k (or reading _SIGMAS_ from a LIMITS= data set), you can request probability limits by specifying ALPHA=α (or reading the variable _ALPHA_ from a LIMITS= data set by specifying the READALPHA option).

SKIPHLABELS=n
SKIPHLABEL=n

specifies the number n of consecutive tick mark labels, beginning with the second tick mark label, that are thinned (not displayed) on the horizontal (subgroup) axis. For example, specifying SKIPHLABEL=1 causes every other label to be skipped (not displayed). Specifying SKIPHLABEL=2 causes the second and third labels to be skipped, the fifth and sixth labels to be skipped, and so forth.

The default value of the SKIPHLABELS= option is the smallest value n for which tick mark labels do not collide. A specified n will be overridden to avoid collision. To avoid thinning, you can use the TURNHLABELS option.

SMETHOD=NOWEIGHT | MVLUE | RMSDF | MAD | MMR

specifies a method for estimating the process standard deviation, σ, as summarized by the following table:

Keyword	Method for Estimating Standard Deviation
NOWEIGHT	estimates σ as an unweighted average of unbiased subgroup estimates of σ
MVLUE	calculates a minimum variance linear unbiased estimate for σ
RMSDF	calculates a root-mean square estimate for σ
MAD	calculates a median absolute deviation estimate for σ
MMR	calculates a median moving range estimate for σ

For formulas, see "Methods for Estimating the Process Standard Deviation" in the chapter for the particular chart statement you are using.

The default keyword is NOWEIGHT. The SMETHOD= option is available in the BOXCHART, IRCHART, MCHART, MRCHART, RCHART, SCHART, XCHART, XRCHART, and XSCHART statements. You can specify SMETHOD=RMSDF only in the BOXCHART, MCHART, XCHART, SCHART, and XSCHART statements and only when used with the STDDEVIATIONS option (or only in the absence of the RANGES option with a BOXCHART statement). You can specify SMETHOD=MAD and SMETHOD=MMR only in the IRCHART statement.

SPLIT='*character*'

specifies a special *character* that is inserted into the label of a process variable or summary statistic variable and whose purpose is to split the label into two parts. The first part is used to label the vertical axis of the primary chart, and the second part is used to label the vertical axis of the secondary chart. The *character* is not displayed in either label. See Figure 47.31 on page 1722 for an example.

The SPLIT= option is available in the IRCHART, MRCHART, XRCHART, and XSCHART statements and in the BOXCHART, MCHART, and XCHART statements with the TRENDVAR= option.

SSYMBOL='*label*'
SSYMBOL=S | SBAR | SPM | S0

specifies a label for the central line in an s chart. You can use the option in the following ways:

- You can specify a quoted *label* up to 16 characters.

- You can specify one of the keywords listed in the following table. Each keyword requests a label of the form *symbol=value*, where *symbol* is the symbol given in the table, and *value* is the value of the central line. If the central line is not constant, only the symbol is displayed.

	Symbol Printed on Charts Produced by	
Keyword	Graphics Devices	Line Printers
S	S	S
SBAR	$\overline{S}$	$\overline{S}$
SPM	S'	S'
S0	S_0	S0

The default keyword is SBAR. The SSYMBOL= option is available only in the SCHART and XSCHART statements.

STARBDRADIUS=value

Graphics specifies the radius (in horizontal percent screen units) of an imaginary circle that is the outer bound for vertices of stars requested with the STARVERTICES= option. Vertices that exceed the outer bound are truncated to this value in order to prevent gross distortion of stars due to extreme values in the data. The *value* must be greater than or equal to the value specified with the STAROUTRADIUS= option. See Figure 46.12 on page 1658 or "Displaying Auxiliary Data with Stars" on page 1701.

STARCIRCLES=values

Graphics specifies reference circles that are superimposed on the stars requested with the STARVERTICES= option. All of the circles are displayed and centered at each point plotted on the primary chart. The *value* determines the diameter of the circle as follows: a *value* of zero specifies a circle with the *inner radius*, and a value of one specifies a circle with the *outer radius*. In general, a value of h specifies a circle with a radius equal to *inradius* $+ h \times ($*outradius* $-$ *inradius*$)$.

Figure 46.11 shows four circles specified with the STARCIRCLES= option. The values 0.0 and 1.0 correspond to the *inner circle* and *outer circle* (see the entries for the STARINRADIUS= and STAROUTRADIUS= options). The value 0.5 specifies a circle with a radius of *inradius* $+ 0.5 \times$ (*outradius* $-$ *inradius*) or a circle halfway between the inner circle and the outer circle. Likewise, the value 0.25 specifies a circle one-fourth of the way from the inner circle to the outer circle. Note also that the line types for the circles are specified with the LSTARCIRCLES= option. For more information, see "Displaying Auxiliary Data with Stars" on page 1701.
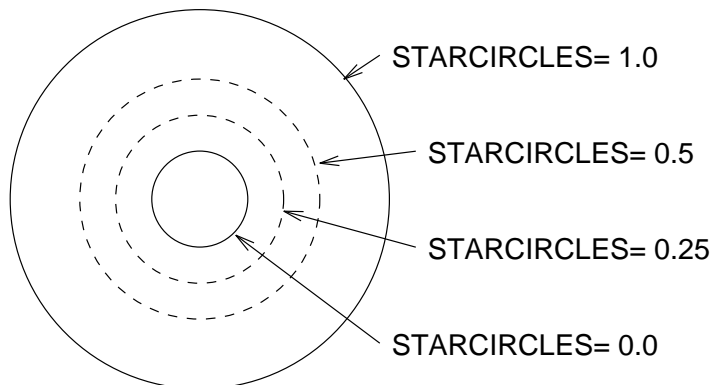
Figure 46.11. Circles Specified by STARCIRCLES=0.0 1.0 0.25 0.5

STARINRADIUS=*value*

specifies the inner radius of stars requested with the STARVERTICES= option. The *value* must be specified in horizontal percent screen values, and it must be less than the value that is specified with the STAROUTRADIUS= option. The inner radius of a star is the distance from the center of the star to the circle that represents the lower limit of the standardized vertex variables. The lower limit can correspond to the minimum value, a multiple of standard deviations below the mean, or a lower specification limit. The default *value* is one-third of the outer radius.

Graphics

Figure 46.12 illustrates five of the star options. The STARSTART= option determines the angle between the vertical axis and the first vertex. The STARINRADIUS= and STAROUTRADIUS= options specify the radii (in horizontal percent screen units) of the inner and outer circles that are associated with each star. Extremely large vertex values are truncated at the imaginary circle whose radius is specified by the STARB-DRADIUS= option. The STARTYPE=RADIAL option specifies that the vertices are to be displayed as endpoints of line segments connecting each vertex to the center point. For more information, see the entries for these options or "Displaying Auxiliary Data with Stars" on page 1701.
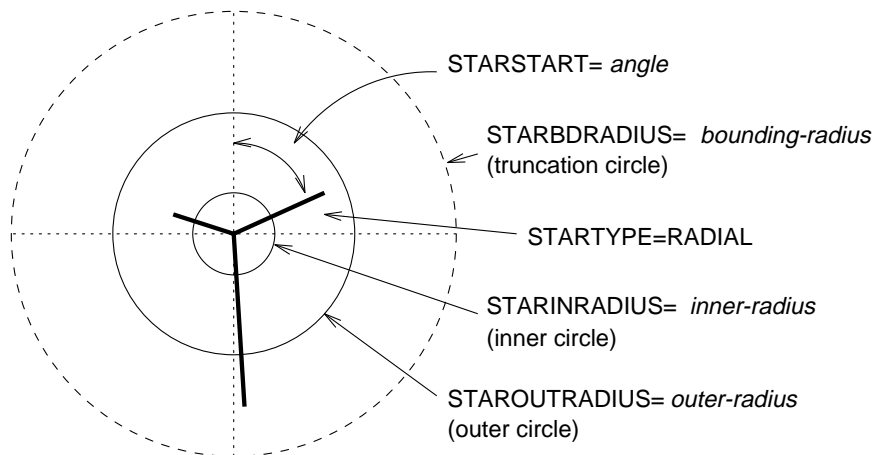
Figure 46.12.   Illustration of Star Options

STARLABEL=ALL | FIRST | HIGH | LOW | OUT

Graphics

 specifies a method for labeling the vertices of stars requested with the STARVERTICES= option. The following table describes the method corresponding to each keyword:

Keyword	Method for Labeling Star Vertices
ALL	labels all vertices of all stars
FIRST	labels all vertices of the leftmost star
HIGH	labels only vertices that lie outside the outer circle
LOW	labels only vertices that lie inside the inner circle
OUT	labels only vertices that lie inside the inner circle or outside the outer circle

The label used for a particular vertex is the value of the variable _LABEL_ in the STARSPECS= data set. If this data set is not specified, or if the _LABEL_ variable is not provided, then the name of the vertex variable is used as the label. See "Displaying Auxiliary Data with Stars" on page 1701. By default, vertices are not labeled.

STARLEGEND=CLOCK | CLOCK0 | DEGREES | NONE

Graphics

 specifies the style of the legend used to identify the vertices of stars requested with the STARVERTICES= option. The following table describes the method corresponding to each keyword:

Keyword	Star Vertices Legend Style
CLOCK	identifies the vertex variables by their positions on the clock (starting with 12:00)
CLOCK0	identifies the vertex variables by their positions on the clock (starting with 0:00)
DEGREES	identifies the vertex variables by angles in degrees, with 0 degrees corresponding to 12 o'clock
NONE	suppresses the legend

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See "Displaying Auxiliary Data with Stars" on page 1701. The default keyword is CLOCK.

STARLEGENDLAB='*label*'

specifies the label displayed to the left of the legend for stars requested with the STARLEGEND= option. The label can be up to 16 characters and must be enclosed in quotes. See "Displaying Auxiliary Data with Stars" on page 1701. The default label is *Vertices:*.

<div style="float:right">

Graphics

</div>

STAROUTRADIUS='*value*'

specifies the outer radius of stars requested with the STARVERTICES= option. The *value* must be specified in horizontal percent screen values. The outer radius of a star is the distance from the center of the star to the circle that represents the upper limit of the standardized vertex variables. The upper limit can correspond to the maximum value, a multiple of standard deviations above the mean, or an upper specification limit.

<div style="float:right">

Graphics

</div>

See Figure 46.12 on page 1658 "Displaying Auxiliary Data with Stars" on page 1701. For an example, see Figure 49.32 on page 1787. The default *value* depends on the number of subgroup positions per panel, and it is as large as possible without causing overlap of adjacent stars.

STARSPECS='*value*|*SAS-data-set*'
STARSPEC='*value*|*SAS-data-set*'

specifies the method used to standardize the star vertex variables listed with the STARVERTICES= option. The method determines how the value of a vertex variable is transformed to determine the distance between the center of the star and the vertex. The STARSPECS= option also determines how the inner and outer radii of the star are to be interpreted.

<div style="float:right">

Graphics

</div>

A *value* of zero specifies standardization by the range of the variable. In this case, the distance between the center and the vertex is proportional to the difference between the variable value and the minimum variable value (taken across all subgroups). The inner radius of the star corresponds to the minimum variable value, and the outer radius of the star corresponds to the maximum variable value.

A positive STARSPECS= value requests standardization by a multiple of standard deviations above and below the mean. For example, STARSPECS=3 specifies that the inner radius of the star corresponds to three standard deviations below the mean, and the outer radius corresponds to three standard deviations above the mean. Thus, a vertex variable value exactly equal to the mean is represented by a vertex whose distance to the center of the star is halfway between the inner and outer radii.

You can request a distinct method of standardization for each vertex variable by specifying a STARSPECS= *data set*. Each observation provides standardization and related information for a distinct vertex variable. The variables read from a STARSPECS= *data set* are described in the following table:

Variable	Description
CSPOKE	color of spokes used with STARTYPE=RADIAL and STARTYPE=SPOKE; this must be a character variable of length 8 or less
LABEL	label for identifying the vertex when you specify STARLEGEND=FIRST or STARLEGEND=ALL; this must be a character variable of up to 16 characters
LSL	lower specification limit
LSPOKE	line style for spokes used with STARTYPE=RADIAL, STARTYPE=SPOKE, and STARTYPE=WEDGE
NOMVAL	nominal value substituted for missing values
SIGMAS	multiple of standard deviations above and below the average
UBOUND	upper bound for truncating extremely high values
USL	upper specification limit
VAR	name of vertex variable; this must be a character variable of length 8 or less

Only the variable _VAR_ is mandatory. If you provide the variables _LSL_ and _USL_, standardization is based on the specification limits; in this case, the variable _LSL_ corresponds to the inner radius of the star, and the variable _USL_ corresponds to the outer radius of the star. If you do not provide the variables _LSL_ and _USL_, standardization is based on the value of the variable _SIGMAS_, and if you do not provide the variable _SIGMAS_, standardization is based on the range.

See "Displaying Auxiliary Data with Stars" on page 1701. If you do not specify the STARSPECS= option, each vertex variable is standardized by its range across subgroups. In other words, the minimum corresponds to the inner radius, and the maximum corresponds to the outer radius.

STARSTART=_value_

Graphics

specifies the vertex angle for the first variable in the STARVERTICES= list. Vertex angles for the remaining variables are uniformly spaced clockwise and assigned in the order listed. You can specify the _value_ in the following ways:

- *Clock position:* If you specify the value as a time literal (between '0:00'T and '12:00'T), the corresponding clock position is used for the first vertex variable.

- *Degrees:* If you specify the value as a nonpositive number, the absolute value in degrees is used for the first vertex angle. Here, 0 degrees corresponds to 12:00.

The default _value_ is zero, so the first vertex variable is positioned at 12:00. See Figure 46.12 on page 1658 or "Displaying Auxiliary Data with Stars" on page 1701.

STARTYPE=CORONA | POLYGON | RADIAL | SPOKE | WEDGE

Graphics

specifies the style of the stars requested with the STARVERTICES= option. The following table describes the method corresponding to each keyword.

Keyword	Star Style
CORONA	polygon with star-vertices emanating from the inner circle
POLYGON	closed polygon
RADIAL	rays emanating from the center
SPOKE	rays emanating from the inner circle
WEDGE	closed polygon with rays from the center to each vertex

See Figure 46.12 on page 1658 or "Displaying Auxiliary Data with Stars" on page 1701. "Adding Reference Circles to Stars" on page 1703 describes the inner and outer circles, and "Specifying the Style of Stars" on page 1705 provides examples of each value of the STARTYPE= option. The default keyword is POLYGON.

STARVERTICES=*variable* **| (***variable-list***)**

superimposes a star (polygon) at each point on the primary chart. The star is centered   *Graphics*
at the point, and the distance between the center and each star vertex represents the standardized value of a *variable* in the STARVERTICES= list. The *variables* must be provided in the input data set.

The star display is suggested as a method for monitoring quantitative variables (such as environmental factors) that are measured simultaneously with the process variable. For examples and details, see "Displaying Auxiliary Data with Stars" on page 1701. By default, stars are not superimposed on the chart.

STDDEVIATIONS
STDDEVS

specifies that the estimate of the process standard deviation σ is to be calculated from subgroup standard deviations. This, in turn, affects the calculation of control limits; for details, see "Methods for Estimating the Process Standard Deviation" in the chapter for the chart statement in which you are interested. By default, the estimate of σ is calculated from subgroup ranges, except with the BOXCHART statement, where subgroup standard deviations are used by default.

If you specify the STDDEVIATIONS option and read summary data from a HIS-TORY= data set, the data set must contain a subgroup standard deviation variable for each *process*. Conversely, if you omit the STDDEVIATIONS option, the HISTORY= data set must contain a subgroup range variable for each *process* listed in the chart statement.

You should specify STDDEVIATIONS when your subgroup sample sizes are large (typically, 15 or greater). The STDDEVIATIONS option is available only in the MCHART and XCHART statements.

SUBGROUPN=*value*
SUBGROUPN=*variable*

specifies the subgroup sample sizes as a constant *value* or as the values of a *variable* in the DATA= data set. The SUBGROUPN= option is available only in the CCHART, NPCHART, PCHART, and UCHART statements.

You must specify SUBGROUPN= in the NPCHART, PCHART, and UCHART statements when your input data set is a DATA= data set. If you are using a CCHART statement, the SUBGROUPN= option is available only when your input data set

is a DATA= data set. For the CCHART statement, the default value of the SUB-GROUPN= option is one.

If you specify multiple *processes* in a chart statement, the SUBGROUPN= option is used with all of the *processes* listed.

SYMBOLCHARS='*character-list*'

Line Printer

specifies a list of characters used to mark the points plotted on charts produced with a line printer when a *symbol-variable* is used. See "Displaying Stratification in Levels of a Classification Variable" on page 1683.

Each character is associated with a level (unique value) of the *symbol-variable* and is used to mark points associated with that value. For example, consider the following statements:

```
proc shewhart;
    xrchart gap*shift=machine / symbolchars='12345';
run;
```

Here the *symbol-variable* is MACHINE. The $\bar{X}$ and R charts use a '1' to mark points associated with the first unique value of MACHINE, a '2' to mark points associated with the second unique value of MACHINE, and so on.

If the number of levels of the *symbol-variable* exceeds the number of *characters*, the last character listed is used for points associated with the additional values. Thus, in the preceding example, if there are six levels of MACHINE, points with the fifth and six values are indicated by '5'.

The default *character-list* is ABCDEFGHIJKLMNOPQRSTUVWXYZ*. Thus, the procedure uses 'A' for the first unique value of the *symbol-variable*, 'B' for the second unique value, and so on. An asterisk is used for points associated with the 27th and subsequent levels when the *symbol-variable* has more than 26 levels.

SYMBOLLEGEND=LEGENDn
SYMBOLLEGEND=NONE

Graphics

controls the legend for the levels of a *symbol-variable* (see "Displaying Stratification in Levels of a Classification Variable" on page 1683). You can specify SYMBOLLEGEND=LEGEND*n*, where *n* is the number of a LEGEND statement defined previously. You can specify SYMBOLLEGEND=NONE to suppress the default legend.

SYMBOLORDER=DATA | INTERNAL | FORMATTED
SYMORD=DATA | INTERNAL | FORMATTED

specifies the order in which symbols are assigned for levels of *symbol-variable*. The DATA keyword assigns symbols to values in the order in which values appear in the input data. This is how symbols were assigned in Release 6.12 and earlier releases of SAS/QC software. The INTERNAL keyword assigns symbols based on sorted order of internal values of *symbol-variable* and FORMATTED assigns them based on sorted formatted values. The default value is FORMATTED.

TABLE <**(EXCEPTIONS)**>
TABLES <**(EXCEPTIONS)**>

>creates a basic table of the subgroup values, the subgroup sample sizes, the sub-group summary statistics, and the upper and lower control limits. Rows of the table correspond to subgroups. The keyword EXCEPTIONS (enclosed in parentheses) is optional and restricts the tabulation to those subgroups for which the control limits are exceeded or a test for special causes is positive.

>You can request extended versions of the basic table by specifying one or more of the following options: TABLEBOX, TABLECENTRAL, TABLEID, TABLELEGEND, TABLEOUTLIM, and TABLETESTS. Specifying the TABLEALL option is equivalent to specifying all of these options, and it provides the most extensive table.

TABLEALL <**(EXCEPTIONS)**>

>tabulates the information on the control chart and is equivalent to specifying all of the following options: TABLES, TABLECENTRAL, TABLEID, TABLELEGEND, TABLEOUT, and TABLETESTS. If you specify the TABLEALL option in a BOX-CHART statement, the TABLEBOX option is also implied. The keyword EXCEP-TIONS (enclosed in parentheses) is optional and restricts the tabulation to those sub-groups for which the control limits are exceeded or a test for special causes is positive. You can use the OUTTABLE= option to create a data set that saves the information tabulated with the TABLEALL option.

TABLEBOX <**(EXCEPTIONS)**>

>augments the basic table created by the TABLES option with columns for the mini-mum, 25th percentile, median, 75th percentile, and maximum of the observations in a subgroup. The TABLEBOX option is available only in the BOXCHART statement. The keyword EXCEPTIONS (enclosed in parentheses) is optional and restricts the tabulation to those subgroups for which the control limits are exceeded or a test for special causes is positive.

TABLECENTRAL <**(EXCEPTIONS)**>
TABLEC <**(EXCEPTIONS)**>

>augments the basic table created by the TABLES option with columns for the values of the central lines. The keyword EXCEPTIONS (enclosed in parentheses) is op-tional and restricts the tabulation to those subgroups for which the control limits are exceeded or a test for special causes is positive.

TABLEID <**(EXCEPTIONS)**>

>augments the basic table created by the TABLES option with a column for each of the ID variables. The keyword EXCEPTIONS (enclosed in parentheses) is optional and restricts the tabulation to those subgroups for which the control limits are exceeded or a test for special causes is positive.

TABLELEGEND <**(EXCEPTIONS)**>
TABLELEG <**(EXCEPTIONS)**>

>adds a legend to the basic table created by the TABLES option. The legend describes the tests for special causes that were requested with the TESTS= option and for which a positive signal is found for at least one subgroup. The keyword EXCEPTIONS (enclosed in parentheses) is optional and restricts the tabulation to those subgroups for which the control limits are exceeded or a test for special causes is positive.

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TABLEOUTLIM <**(EXCEPTIONS)**>
TABLEOUT <**(EXCEPTIONS)**>

augments the basic table created by the TABLES option with columns indicating which control limits (if any) are exceeded. The keyword EXCEPTIONS (enclosed in parentheses) is optional and restricts the tabulation to those subgroups for which the control limits are exceeded or a test for special causes is positive.

TABLETESTS <**(EXCEPTIONS)**>

augments the basic table created by the TABLES option with a column that indicates which of the tests for special causes (requested with the TESTS= option) are positive. The column contains the numbers of all the tests that are positive at a particular subgroup. The keyword EXCEPTIONS (enclosed in parentheses) is optional and restricts the tabulation to those subgroups for which the control limits are exceeded or a test for special causes is positive.

TARGET=*value-list*

provides target values used to compute the capability index C_{pm}, which is saved in the OUTLIMITS= data set. If you provide more than one *value*, the number of *values* must match the number of *processes* listed in the chart statement. If you specify only one *value*, it is used for all the *processes*.

IMPORTANT: You can use the TARGET= options only in conjunction with the LSL=, USL=, and OUTLIMITS= options. For more information, see "Capability Indices" on page 1537 and "Output Data Sets" in the chapter for the chart statement in which you are interested. Also see the entries for the LSL= and USL= options. The TARGET= option is available in the BOXCHART, IRCHART, MCHART, MRCHART, RCHART, SCHART, XCHART, XRCHART, and XSCHART statements.

TEST2RUN=*run-length*

specifies the length of the pattern for Test 2 requested with the TESTS= and TESTS2= options. The values allowed for the *run-length* are 7, 8, 9, 11, 14, and 20. The form of the test for each *run-length* value is given in the following table. The default *run-length* is 9. See Chapter 48, "Tests for Special Causes" on page 1731 for more information.

Run-length	Number of Points on One Side of the Central Line
7	7 in a row
8	8 in a row
9	9 in a row
11	at least 10 out of 11 in a row
14	at least 12 out of 14 in a row
20	at least 16 out of 20 in a row

TEST3RUN=*run-length*

specifies the length of the pattern for Test 3 requested with the TESTS= and TESTS2= options. Test 3 searches for a pattern of steadily increasing or decreasing values, where the length of the pattern is at least the value given as the *run-length*. The values allowed for the *run-length* are 6, 7, and 8. The default *run-length* is 6. See Chapter 48, "Tests for Special Causes" on page 1731 for more information.

TESTACROSS

    specifies that tests for special causes requested with the TESTS= or TESTS2= options are to be applied without regard to phases (blocks of consecutive subgroups) determined by the READPHASES= option and the variable _PHASE_ in the input data set. If you specify the READPHASES= option but do not specify the TESTACROSS option, tests for special causes are applied within (but not across) phases. See Chapter 48, "Tests for Special Causes" on page 1731.

TESTCHAR='*character***'**

    specifies the character for the line segments that connect any sequence of points for which a test for special causes (requested with the TESTS= or TESTS2= option) is positive. The default *character* is the number of the test (with values 1 to 8).

                                                         Line Printer

TESTFONT=*font*
LABELFONT=*font*

    specifies a software font for labels requested with the ALLLABEL=, ALLLABEL2=, OUTLABEL=, OUTLABEL2=, STARLABEL=, TESTLABEL=, and TESTLABEL*n*= options. Hardware characters are used by default.

        Graphics

TESTHEIGHT=*value*
LABELHEIGHT=*value*

    specifies the height (in vertical percent screen units) for labels requested with the ALLLABEL=, ALLLABEL2=, OUTLABEL=, OUTLABEL2=, STARLABEL=, TESTLABEL=, and TESTLABEL*n*= options. The default height is the height specified with the HEIGHT= option or the HTEXT= option in the GOPTIONS statement.

        Graphics

TESTLABEL='*label***'**
TESTLABEL=(*variable***)**
TESTLABEL=TESTINDEX
TESTLABEL=SPACE
TESTLABEL=NONE

    provides labels for points at which one of the tests for special causes (requested with the TESTS= or TESTS2= option) is positive. The values for the TESTLABEL= option are as follows:

- You can specify a *label* of up to 16 characters enclosed in quotes. This label is displayed at all points where a test is signaled.

- You can specify a *variable* (enclosed in parentheses) whose values are used as labels. The *variable* must be provided in the input data set, and it can be numeric or character. If the *variable* is character, its length cannot exceed 16. For each subgroup of observations at which a test is signaled, the formatted value of the *variable* in the observations is used to label the point representing the subgroup. If you are reading a DATA= data set with multiple observations per subgroup, the values of the *variable* should be identical for observations within a subgroup.

- You can specify TESTINDEX to label points with the single-digit *index* that requested the test in a TESTS= or TESTS2= list. If the test was requested with a customized *pattern* in a TESTS= or TESTS2= list, then points are labeled with the letter that you specified using the CODE= option.

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- You can specify SPACE to request a label of the form *Test k*. This is slightly more legible than the default label of the form *Testk* (a description of *Testk* follows).

- You can specify NONE to suppress labeling.

If you do not use the TESTLABEL= option, the default label is of the form *Testk*, where k is the index of the test as requested with the TESTS= or TESTS2= options, or k is the CODE= *character* of the test as requested in a pattern specified with the TESTS= or TESTS2= options.

See Chapter 48, "Tests for Special Causes" on page 1731. Related options include OUTLABEL=, OUTLABEL2=, TESTFONT=, TESTHEIGHT=, and TESTLABELn=.

TESTLABELn='*label***'**

specifies a *label* for points at which the test for special causes requested with the *index* n in a TESTS= or TESTS2= list is positive. The *index n* can be a number from 1 to 8. The TESTLABELn= option overrides a TESTLABEL= option and the default label *Test n*. The *label* that you specify with the TESTLABELn= option can be up to 16 characters and must be enclosed in quotes.

See Chapter 48, "Tests for Special Causes" on page 1731. Related options are TEST-FONT=, TESTHEIGHT=, and TESTLABEL=.

TESTNMETHOD=STANDARDIZE

applies the tests for special causes requested with the TESTS= and TESTS2= options to standardized test statistics when the subgroup sample sizes are not constant. This method was suggested by Nelson (1994). See Chapter 48, "Tests for Special Causes" on page 1731. By default, the tests are not applied to data with varying subgroup sample sizes.

TESTOVERLAP

applies tests for special causes (requested with the TESTS= or TESTS2= option) to overlapping patterns of points.

The TESTOVERLAP option modifies the way in which the search for a subsequent pattern is done when a pattern is encountered. If you omit the TESTOVERLAP option, the search begins with the first subgroup after the current pattern ends. If you specify the TESTOVERLAP option, the search begins with the second subgroup in the current pattern.

The following statements illustrate the use of the TESTOVERLAP option:

```
proc shewhart;
   xrchart width*hour / test=3;
   xrchart width*hour / test=3 testoverlap;
run;
```

Test 3 looks for six subgroup means in a row steadily increasing or decreasing. Suppose that the subgroup means of WIDTH are steadily increasing for HOUR=5, 6, 7, 8, 9, 10, and 11. The first XRCHART statement will signal that Test 3 is positive

at HOUR=10 but not at HOUR=11, since the search for the next pattern begins with HOUR=11. The second XRCHART statement will signal that Test 3 is positive at HOUR=10 and HOUR=11, since the search for the next pattern begins with HOUR=6 and thus finds a second pattern ending with HOUR=11. See Chapter 48, "Tests for Special Causes" on page 1731 for more information.

CAUTION: Specifying TESTOVERLAP affects the interpretation of the standard tests for special causes, because a particular point can contribute to more than one positive test. Typically, this option should not be used.

TESTS=*index-list*
TESTS=*customized-pattern-list*

requests one or more tests for special causes, which are also known as *runs tests*, *pattern tests*, and *Western Electric rules*. These tests detect particular nonrandom patterns in the points plotted on the primary control chart. The occurrence of a pattern, referred to as a *signal*, suggests the presence of a special cause of variation.

Each pattern is defined in terms of zones A, B, and C, which are constructed by dividing the interval between the control limits into six equally spaced subintervals. Zone A is the union of the subintervals immediately below the upper control limit and immediately above the lower control limit. Zone C is the union of the subintervals immediately above and below the central line. Zone B is the union of the subintervals between zones A and C. See Figure 48.1 on page 1732 for an illustration of test zones.

You can use the TESTS= option in three ways. First, you can specify an *index-list* to request a combination of standard tests (this is the approach most commonly used). Second, you can specify a *customized-pattern-list* to request a combination of tests based on customized patterns. Third, you can specify a list consisting of both *indexes* and *customized-patterns*. The first two approaches are described as follows.

Standard tests. The following table lists the standard tests that you can request by specifying TEST=*index-list*. The tests are indexed according to the sequence used by Nelson (1984, 1985).

Index	Pattern Description
1	one point beyond Zone A (outside the control limits)
2	nine points in a row in Zone C or beyond on one side of the central line (see the entry for the TEST2RUN option)
3	six points in a row steadily increasing (see the entry for the TEST3RUN option)
4	fourteen points in a row alternating up and down
5	two out of three points in a row in Zone A or beyond
6	four out of five points in a row in Zone B or beyond
7	fifteen points in a row in Zone C on either or both sides of the central line
8	eight points in a row on either or both sides of the central line with no points in Zone C

You can specify any combination of the eight *indexes* with an explicit list or with an implicit list, as in the following example:

```
proc shewhart;
   xrchart width*hour / tests=1 2 3 4;
   xrchart width*hour / tests=1 to 4;
run;
```

The TESTS= option is available in all but the RCHART and SCHART statements. Use only tests 1, 2, 3, and 4 in the CCHART, NPCHART, PCHART, and UCHART statements. By default the TESTS= option is not applied in any chart statement unless the control limits are 3σ limits. You can use the NO3SIGMACHECK option to request tests for special causes when you use the SIGMAS= option to specify control limits other than 3σ limits.

Customized tests. Although the standard tests supported by the TESTS= option are appropriate for the vast majority of control chart applications, there may be situations in which you want to work with customized tests. You can define your own tests by specifying TESTS=*customized-pattern-list*. There are two types of patterns that you can include in this list: *T-patterns* and *M-patterns*.

Use a T-pattern to request a search for k out of m points in a row in the interval (a, b). The required syntax for a T-pattern is

T(K=k **M=**m **LOWER=**a **UPPER=**b **CODE=**$character$ **LABEL=**$'label'$**)**

The default value for SCHEME= is ONESIDED. The options for a T-pattern are summarized in the following table:

Option	Description
K=k	number of points
M=m	number of consecutive points
LOWER=*value*	lower limit of interval (a, b)
UPPER=*value*	upper limit of interval (a, b)
SCHEME=ONESIDED	one-sided scheme using (a, b)
SCHEME=TWOSIDED	two-sided scheme using $(a, b) \cup (-b, -a)$
CODE=*character*	identifier for test (A-H)
LABEL=*'label'*	label for points if signal
LEGEND=*'legend'*	legend used with the TABLELEGEND option

Use an M-pattern to request a search for k points in a row increasing or decreasing. The required syntax for an M-pattern is

M(K=k **DIR=**$direction$ **CODE=**$character$ **LABEL=**$'label'$**)**

The options for an M-pattern are summarized in the following table:

Option	Description
K=k	number of points
DIR=INC	increasing pattern
DIR=DEC	decreasing pattern
CODE=*character*	identifier for test (A-H)
LABEL=*'label'*	label for points if signal
LEGEND=*'legend'*	legend used with the TABLELEGEND option

For details on the TESTS= option, see Chapter 48, "Tests for Special Causes" on page 1731. Related options include CTEST=, CZONES=, LTEST=, TABLETESTS, TABLELEGEND, TEST2RUN=, TEST3RUN=, TESTACROSS, TESTCHAR=, TESTLABEL=, TESTLABELn=, TESTNMETHOD=, TESTOVERLAP, TESTS2=, ZONES, ZONECHAR=, and ZONELABELS.

TESTS2=*index-list*
TESTS2=*customized-pattern-list*

requests one or more tests for special causes for an R chart or s chart. The syntax for the TESTS2= option is identical to the syntax for the TESTS= option. The TESTS2= option is available in the MRCHART, RCHART, SCHART, XRCHART, and XSCHART statements. For details on the TESTS2= option, see Chapter 48, "Tests for Special Causes" on page 1731. Related options include CTEST=, CZONES=, LTEST=, TABLETESTS, TABLELEGEND, TEST2RUN=, TEST3RUN=, TESTACROSS, TESTCHAR=, TESTLABEL=, TESTLABELn=, TESTNMETHOD=, TESTOVERLAP, TESTS=, ZONES2, ZONECHAR=, and ZONE2LABELS.

TESTURLS=*SAS-data-set*

names an input data set that contains variables associated with tests for special causes. A TESTURLS= data set contains variables _TEST_, _CHART_, and _URL_. _TEST_ and _CHART_ are numeric variables identifying a test for special causes (1-8) and the primary or secondary chart (1 or 2). _URL_ is a character variable containing the URL to be associated with subgroups for which the given test on the given chart is positive. See the chapter "Interactive Control Charts" for more information.

TOTPANELS=*n*

specifies the total number of panels to be used to display the chart. This option overrides the NPANEL= option.

TRENDVAR=*variable* **|** **(***variable-list***)**

specifies a list of trend variables, one for each *process* listed in the chart statement. The TRENDVAR= option is available only in the BOXCHART, MCHART, and XCHART statements and only when your input data set is a DATA= or HISTORY= data set.

The values of the trend variables are subtracted from the values of the corresponding process variables (if you read a DATA= data set) or subgroup mean variables (if you read a HISTORY= data set). The chart is then created for the residuals (differences), and the trend values are plotted in a secondary chart. If you specify a single trend variable and two or more *processes*, the trend variable is used with each *process*.

The TRENDVAR= option does not apply if you are reading a TABLE= data set. In this case, the procedure produces a trend chart only if the variable _TREND_ is included in the TABLE= data set.

For more details, see "Displaying Trends in Process Data" on page 1711. Related options include NOTRENDCONNECT, SEPARATE, SPLIT=, WTREND=, and YPCT1=.

TURNALL
TURNOUT

> turns the labels produced by the ALLLABEL=, ALLLABEL2=, OUTLABEL= and OUTLABEL2= options so that they are strung out vertically. By default, labels are arranged horizontally.

TURNHLABELS
TURNHLABEL

> turns the major tick mark labels for the horizontal (subgroup) axis so that they are strung out vertically. By default, labels are arranged horizontally.

> If you are using a graphics device, you should specify a software font (with the FONT= option) in conjunction with the TURNHLABELS option. Otherwise, the labels may be displayed with a mixture of hardware and software fonts.

> **NOTE:** Turning the labels vertically may leave insufficient room on the screen or page for a chart.

TYPE=*value*

> specifies the *value* of the _TYPE_ variable in the OUTLIMITS= data set, which in turn indicates whether certain parameter variables in this data set represent estimates or standard (known) values.

> If you are using a chart statement that creates a variables chart, _TYPE_ is a bookkeeping variable that indicates whether the values of the variables _MEAN_ and _STDDEV_ in the OUTLIMITS= data set are estimates or standard values of the process mean μ and standard deviation σ. The following table summarizes the *values* that you can specify:

Value	_MEAN_	_STDDEV_
ESTIMATE	estimate	estimate
STDMU	standard	estimate
STDSIGMA	estimate	standard
STANDARD	standard	standard

> The default *value* is ESTIMATE, unless you specify standard values for μ or σ with the MU0= or SIGMA0= options.

> For PCHART and NPCHART statements, the *value* you specify for the TYPE= option can be either ESTIMATE or STANDARD, indicating that the value of the variable _P_ in the OUTLIMITS= data set is an estimate or standard value of the proportion p of nonconforming items. The default *value* is ESTIMATE, unless you specify a standard value for p with the P0= option.

> For UCHART and CCHART statements, the *value* you specify for the TYPE= option can be either ESTIMATE or STANDARD, indicating that the value of the variable _U_ in the OUTLIMITS= data set is an estimate or standard value of the average number u of nonconformities per unit. The default *value* is ESTIMATE, unless you specify a standard value for u with the U0= option.

U0=*value*

    specifies a known (standard) value u_0 for the average number u of nonconformities per unit produced by the process. By default, u_0 is estimated from the data. The U0= option is available only in the CCHART and UCHART statements.

    NOTE: As an alternative to specifying the U0= option, you can read a predetermined value for u_0 from the variable _U_ in a LIMITS= data set. For details, see "Input Data Sets" in the chapter for the chart statement in which you are interested.

UCLLABEL='*label***'**

    specifies a label for the upper control limit in the primary chart. The label can be up to 16 characters. Enclose the label in quotes. The default label is of the form *UCL=value* if the control limit has a fixed value; otherwise, the default label is *UCL*. Related options are UCLLABEL2=, LCLLABEL=, and LCLLABEL2=.

UCLLABEL2='*label***'**

    specifies a label for the upper control limit in the secondary chart. The label can be up to 16 characters. Enclose the label in quotes. The default label is of the form *UCL=value* if the control limit has a fixed value; otherwise, the default label is *UCL*. This option is available in the IRCHART, MRCHART, XRCHART, and XSCHART statements. Related options are LCLLABEL2=, LCLLABEL=, and UCLLABEL=.

USL=*value-list*

    provides upper specification limits used to compute capability indices. If you provide more than one *value*, the number of *values* must match the number of *processes* listed in the chart statement. If you specify only one *value*, it is used for all the *processes*.

    IMPORTANT: You can use the USL= option only in conjunction with the OUTLIMITS= option. The SHEWHART procedure uses the specification limits to compute capability indices, and it saves the limits and indices in the OUTLIMITS= data set.

    For more information, see "Capability Indices" on page 1537 and "Output Data Sets" in the chapter for the chart statement in which you are interested. A related option is LSL=. The USL= option is available in the BOXCHART, IRCHART, MCHART, MRCHART, RCHART, SCHART, XCHART, XRCHART, and XSCHART statements.

USYMBOL='*label***'**
USYMBOL=U | UBAR | UPM | UPM2 | U0

    specifies a label for the central line in a u chart. You can use the option in the following ways:

- You can specify a quoted *label* up to 16 characters.

- You can specify one of the keywords listed in the following table. Each keyword requests a label of the form *symbol=value*, where *symbol* is the symbol given in the table, and *value* is the value of the central line. If the central line is not constant, only the symbol is displayed.

	Symbol Printed on Charts Produced by	
Keyword	Graphics Devices	Line Printers
U	U	U
UBAR	$\overline{\text{U}}$	$\overline{\text{U}}$
UPM	U'	U'
UPM2	U''	U''
U0	U_0	U0

The default keyword is UBAR. The USL= option is available only in the UCHART statement.

VAXIS=_value-list_
VAXIS=AXIS_n_

specifies major tick mark values for the vertical axis of a primary chart. The *values* must be listed in increasing order, must be evenly spaced, and must span the range of summary statistics and control limits displayed in the chart. You can specify the *values* with an explicit list or with an implicit list, as shown in the following example:

```
proc shewhart;
   xrchart width*hour / vaxis=0 2 4 6 8;
   xrchart width*hour / vaxis=0 to 8 by 2;
run;
```

If you are using a graphics device, you can also specify a previously defined AXIS statement with the VAXIS= option. Related options are HAXIS= and VAXIS2=.

VAXIS2=_value-list_
VAXIS2=AXIS_n_

specifies major tick mark values for the vertical axis of a secondary chart. The specifications and restrictions are the same as for the VAXIS= option. The VAXIS2= option is available in the IRCHART, MRCHART, XRCHART, and XSCHART statements and in the BOXCHART, MCHART, and XCHART statements with the TREND-VAR= option. Related options are HAXIS= and VAXIS=.

VMINOR=_n_
VM=_n_

Graphics

specifies the number of minor tick marks between each major tick mark on the vertical axis. No values are printed on the minor tick marks. By default, VMINOR=0.

VOFFSET=_value_

Graphics

specifies the length in percent screen units of the offset at the ends of the vertical axis.

VREF=_value-list_
VREF=_SAS-data-set_

draws reference lines perpendicular to the vertical axis on the primary chart. Reference line values can be expressed as simple values or as multiples of the standard error of the subgroup summary statistic. You can use this option in the following ways:

- Specify the *values* for the lines with a VREF= list. Examples of the VREF= option follow:

  ```
  vref=20
  vref=20 40 80
  vref=(2.5 sigma)
  vref=20 (1.5 2.0 2.5 sigma) 80
  ```

  Values expressed as multiples of σ must be enclosed in parentheses with the SIGMA keyword.

- Specify the values for the lines as the values of a numeric variable named _REF_ in a VREF= data set. Optionally, you can provide labels for the lines as values of a variable named _REFLAB_, which must be a character variable of length 16 or less. If you want distinct reference lines to be displayed in charts for different *processes* specified in the chart statement, you must include a character variable of length 8 or less named _VAR_, whose values are the *processes*. If you do not include the variable _VAR_, all of the lines are displayed in all of the charts. If you want to display reference lines whose values are multiples of σ, you must include a character variable named _TYPE_, whose values are "VALUES" or "SIGMAS". The value of _TYPE_ indicates whether the reference line value is expressed as a simple value or as a multiple of σ.

  Each observation in the VREF= data set corresponds to a reference line. If BY variables are used in the input data set (DATA=, HISTORY=, or TABLE=), the same BY variable structure must be used in the VREF= data set unless you specify the NOBYREF option.

This option can be used to add warning limits to be displayed on a chart.

Related options are CVREF=, LVREF=, NOBYREF, VREFCHAR=, VREFLABELS=, and VREFLABPOS=.

VREF2=*value-list*
VREF2=*SAS-data-set*

draws reference lines perpendicular to the vertical axis on the secondary chart. The conventions for specifying the VREF2= option are identical to those for specifying the VREF= option. Related options are CVREF=, LVREF=, NOBYREF, VREFCHAR=, VREF2LABELS=, and VREFLABPOS=. The VREF2= option is available in the IRCHART, MRCHART, XRCHART, and XSCHART statements and in the BOXCHART, MCHART, and XCHART statements with the TRENDVAR= option.

VREF2LABELS=*'label1'* ... *'labeln'*
VREF2LAB=*'label1'* ... *'labeln'*

specifies labels for the reference lines requested by the VREF2= option. The number of labels must equal the number of lines. Enclose each label in quotes. Labels can be up to 16 characters. The VREF2LABELS= option is available in the IRCHART, MRCHART, XRCHART, and XSCHART statements and in the BOXCHART, MCHART, and XCHART statements with the TRENDVAR= option.

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VREFCHAR='*character*'

Line Printer

  specifies the character used to form the reference lines requested by the VREF= and VREF2= options for a line printer. The default is the hyphen (-).

VREFLABELS='*label1*' ... '*labeln*'

specifies labels for the reference lines requested by the VREF= option. The number of labels must equal the number of lines. Enclose each label in quotes. Labels can be up to 16 characters.

VREFLABPOS=*n*

specifies the horizontal position of the VREFLABEL= and VREF2LABEL= labels, as described in the following table. By default, n=1.

n	Label Position
1	left-justified in subplot area
2	right-justified in subplot area
3	left-justified in right margin

Figure 46.13 illustrates label positions for values of the VREFLABPOS= option when the VREF= and VREFLABELS= options are as follows:

```
vref       = 8 9 11
vreflabels = 'Eight' 'Nine' 'Eleven'
```
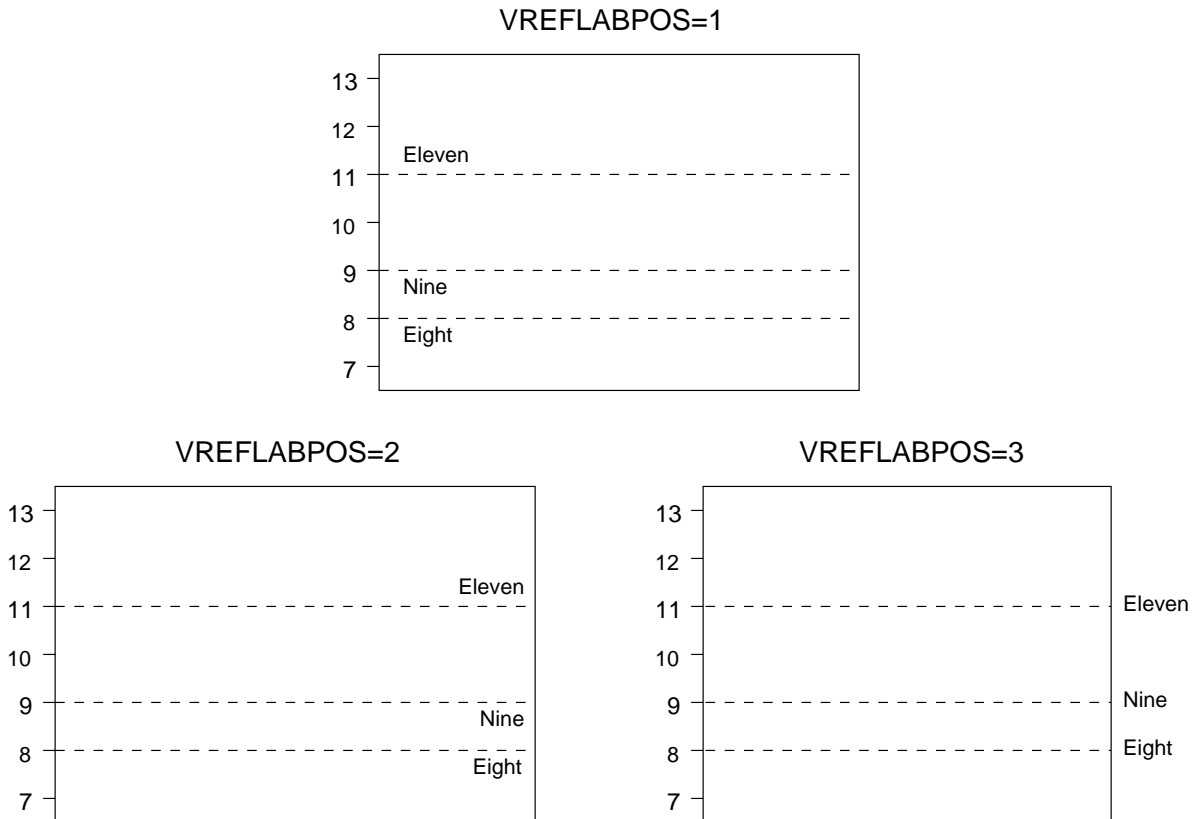

Figure 46.13.   Positions for Reference Line Labels

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VZERO

forces the origin to be included in the vertical axis for a primary chart.

VZERO2

forces the origin to be included in the vertical axis for a secondary chart.

WAXIS=n

specifies the width in pixels for the axis and frame lines. By default, $n = 1$. | *Graphics* |

WEBOUT=*SAS-data-set*

produces an output data set containing all the data in an OUTTABLE= data set plus graphics coordinates for points (subgroup summary statistics) that are displayed on a control chart. You can use an WEBOUT= data set to facilitate the development of web-based applications. See the chapter "Interactive Control Charts" for details.

WGRID=n

specifies the width in pixels for grid lines requested with the ENDGRID and GRID options. By default, $n = 1$. | *Graphics* |

WLIMITS=n

specifies the width in pixels for the control limits and central line. By default, $n = 1$. | *Graphics* |

WSTARCIRCLES=n

specifies the width in pixels of the outline of circles requested by the STARCIRCLES= option. See "Displaying Auxiliary Data with Stars" on page 1701. By default, $n = 1$. | *Graphics* |

WSTARS=n

specifies the width in pixels of the outline of stars requested by the STARVERTICES= option. See "Displaying Auxiliary Data with Stars" on page 1701. By default, $n = 1$. | *Graphics* |

WTREND=n

specifies the width in pixels of the line segments that connect points on trend charts requested with the TRENDVAR= option. By default, $n = 1$. The WTREND= option is available in the BOXCHART, MCHART, and XCHART statements. | *Graphics* |

XSYMBOL='*label*'
XSYMBOL=$keyword$

specifies a label for the central line in an $\bar{X}$ chart or a median chart. You can use the option in the following ways:

- You can specify a quoted *label* up to 16 characters.

- You can specify one of the *keywords* listed in the following table. Each *keyword* requests a label of the form *symbol=value*, where *symbol* is the symbol given in the table, and *value* is the value of the central line. If the central line is not constant, only the symbol is displayed.

	Symbol Printed on Charts Produced by	
Keyword	Graphics Devices	Line Printers
MBAR	$\overline{\mathrm{M}}$	$\overline{\mathrm{M}}$
MTIL	$\tilde{\mathrm{M}}$	$\tilde{\mathrm{M}}$
MU	μ	MU
MU0	μ_0	MU0
XBAR	$\overline{\mathrm{X}}$	$\overline{\mathrm{X}}$
XBAR2	$\overline{\overline{\mathrm{X}}}$	$\overline{\overline{\mathrm{X}}}$
XBARPM	$\overline{\mathrm{X}}'$	$\overline{\mathrm{X}}'$
XBAR0	$\overline{\mathrm{X}}_0$	$\overline{\mathrm{X}}0$
XBAR0PM	$\overline{\mathrm{X}}'_0$	$\overline{\mathrm{X}}0'$

For the IRCHART statement, the default *keyword* is XBAR. For the MCHART and MRCHART statements, the default *keyword* is MBAR. For all other chart statements, the default *keyword* is XBAR2. The XSYMBOL= option is available in the BOXCHART, IRCHART, MCHART, MRCHART, XCHART, XRCHART, and XSCHART statements.

YPCT1=_value_

specifies a percent (ranging from 0 to 100) that determines the length of the vertical axis for the primary chart in proportion to the sum of the lengths of the vertical axes for the primary and secondary charts. For example, you can specify YPCT1=50 in an XRCHART statement to request that the vertical axes for the $\bar{X}$ and R charts have the same length. The default *value* is 60. The YPCT1= option is available in the IRCHART, MRCHART, XRCHART, and XSCHART statements and in the BOXCHART, MCHART, and XCHART statements with the TRENDVAR= option.

YSCALE=PERCENT

scales the vertical axis on a p chart in percent units. The YSCALE= option is available only in the PCHART statement.

ZEROSTD

specifies that a control chart is to be constructed and displayed regardless of whether the estimated process standard deviation $\hat{\sigma}$ is zero. When $\hat{\sigma}$ is zero, the control limits are degenerate (collapsed around the central line), and the chart simply serves as a placeholder, particularly when a series of charts is to be created. By default, a chart is not displayed when $\hat{\sigma}$ is zero.

ZONE2LABELS

adds the labels A, B, and C to zone lines requested with the ZONES2 option. The ZONE2LABELS option is available in the MRCHART, RCHART, SCHART, XR-CHART, and XSCHART statements.

ZONE2VALUES

labels the secondary chart zones lines with their values. If the ZONE2VALUES option is specified the ZONES option is not required.

ZONECHAR='*character*'

specifies the character used to form the zone lines requested by the ZONES option. `Line Printer` See the entry for the TESTS= option for a description of the zones. You do not need to specify the ZONES option if you specify the ZONECHAR= option. By default, the line between Zone A and Zone B uses the character 'B', and the line between Zone B and Zone C uses the character 'C'. Related options are TESTS=, TESTS2=, ZONES, and ZONES2.

ZONELABELS

adds the labels A, B, and C to zone lines requested with the ZONES option. The ZONELABELS option is not available in the RCHART or SCHART statements.

ZONES

adds lines to a primary chart that delineate zones A, B, and C for standard tests requested with the TESTS= option. Related options are CZONES= and ZONELA-BELS. The ZONES option is not available in the RCHART or SCHART statements.

ZONES2

adds lines to an R or s chart that delineate zones A, B, and C for tests requested with the TESTS2= option. Related options are CZONES= and ZONE2LABELS. The ZONES2 option is available in the MRCHART, RCHART, SCHART, XRCHART, and XSCHART statements.

ZONEVALPOS=*n*

specifies the horizontal position of the ZONEVALUES= and ZONE2VALUES= labels, as described in the following table. By default, $n=1$.

n	Label Position
1	left-justified in subplot area
2	right-justified in subplot area
3	left-justified in right margin

ZONEVALUES

labels the primary chart zones lines with their values. If the ZONEVALUES option is specified the ZONES option is not required.

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