NOT MEASUREMENT SENSITIVE

NOTICE OF CHANGE

MIL-HDBK-683(AT)
NOTICE 1
23 November 1993

MILITARY HANDBOOK

STATISTICAL PROCESS CONTROL (SPC) IMPLEMENTATION AND EVALUATION AID

TO ALL HOLDERS of MIL-HDBK-683(AT).

1. The following pages of MIL-HDBK-683(AT) have been revised and supersede the pages listed:

New page	Date	Superseded page	Date
3	23 November 1993	3	30 October 1991
4	23 November 1993	4	30 October 1991
11	23 November 1993	11	30 October 1991
12	23 November 1993	12	30 October 1991
13	23 November 1993	13	30 October 1991
14	30 October 1993	14	Reprinted without change
19	23 November 1993	19	30 October 1991
20	23 November 1993	20	30 October 1991
25	23 November 1993	25	30 October 1991
26	30 October 1991	26	Reprinted without change
31	30 October 1991	31	Reprinted without change
32	23 November 1993	32	30 October 1991
33	23 November 1993	33	30 October 1991
34	30 October 1991	34	Reprinted without change
35	30 October 1991	35	Reprinted without change
36	23 November 1993	36	30 October 1991
41	23 November 1993	41	30 October 1991
42	23 November 1993	42	30 October 1991
53	23 November 1993	53	30 October 1991
54	30 October 1991	54	Reprinted without change
59	30 October 1991	59	Reprinted without change
60	23 November 1993	60	30 October 1991

AMSC N/A

FSC QCIC

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

2. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

3. Holders of MIL-HDBK-683(AT) will verify that page changes and additions indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the military handbook is completely revised or cancelled.

4. Changes from previous issues. The margins of this handbook are marked with vertical lines to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies for these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodian:
Army - AT

Preparing activity:
Army - AT

(Project QCIC-A140)

CHAPTER 2
DEFINITIONS

2.1 Glossary. This chapter contains a glossary of statistical terms and symbols commonly used in statistical work.

2.2 Definition of terms.

2.2.1 Advanced statistical methods. More sophisticated and less widely applicable techniques of statistical process analysis and control than is included in basic statistical methods. This can include more advanced control chart techniques, regression analysis, design of experiments, advanced problem-solving techniques, etc.

2.2.2 Attributes data. Qualitative data (characteristics) than can be counted for recording and analysis. Examples include characteristics, such as, the presence of a required label, the installation of all required fasteners, the absence of errors on an expense report. Other examples are characteristics that are inherently measurable (i.e., could be treated as variables data), but where the results are recorded in a simple yes/no fashion, such as, the acceptability of a shaft diameter when checked on a go/no-go gage or the presence of any engineering changes on a drawing. Attributes data are usually gathered in the form of nonconforming units or of nonconformities; they are analyzed by p, np, c and u control charts (see also variables data).

2.2.3 Average. The sum of values divided by the number (sample size) of values; designated by a bar over the symbol for the values being averaged: e.g., $\bar{X}$ (X bar) is the average of the X values within a subgroup; $\bar{\bar{X}}$ (X double bar) is the average of subgroup averages; $\bar{p}$ (p bar) is the average of p's from all the subgroups (see also mean).

2.2.4 Awareness. Personal understanding of the interrelationship between quality and productivity, directing attention to the requirement for management commitment and statistical thinking to achieve never-ending improvement.

2.2.5 Basic statistical methods. Applies the theory of variation through the use of basic problem-solving techniques and statistical process control, and includes control chart construction and interpretation (for both variables and attributes data) and capability analysis.

2.2.6 Basic statistics. Applies the theory of variation through the use of applied statistics in collecting and summarizing data, analyzes grouped as well as individual data, includes histogram construction and interpretation.

2.2.7 Capability. Capability can be determined only after the process is in statistical control. A process is said to be capable when the process average plus and minus the 3-sigma spread of the distribution of individuals ($X \pm 3$) is contained within the specification tolerance (variables data), or (attributes data). Efforts to improve capability must continue, however, consistent with the operational philosophy of never-ending improvement in quality and productivity.

2.2.8 Cause-and-effect diagram. A simple tool for individual or group problem-solving that uses a graphic description of the various process elements to analyze potential sources of process variation. Also called "fishbone diagram" (after its appearance) or "Ishikawa diagram" (after its developer).

2.2.9 Central line. The line on a control chart that represents the average or median value of the items being plotted.

2.2.10 Characteristic. A distinguishing feature of a process or its output on which variables or attributes data can be collected.

2.2.11 Common cause. A source of variation that affects all the individual values of the process output being studied. In control chart analysis it appears as part of the random process variation.

2.2.12 Consecutive. Units of output produced in succession; a basis for selecting subgroup samples.

2.2.13 Control chart. A graphic representation of a characteristic of a process characteristic showing plotted values of some statistic gathered from that characteristic, a central line, and one or two control limits. Its primary function is to discern assignable from random causes of variation. It has two basic uses: as a judgement to determine if a process has been operating in statistical control, and as an operation to aid in maintaining statistical control.

2.2.14 Control limit. A line (or lines) on a control chart used as a basis for judging the significance of the variation from subgroup to subgroup. Variation beyond a control limit is evidence that special causes are affecting the process. Control limits are calculated from process data and are not to be confused with engineering specifications.

2.2.15 Detection. A past-oriented strategy that attempts to identify unacceptable output after it has been produced and then separate it from the good output (see also prevention).

Symbol	Definition
n	- The number of individuals in a subgroup, the subgroup sample size.
$\bar{n}$	- The average subgroup sample size.
np	- The number of nonconforming items in a sample of size n.
$n\bar{p}$	- The average number of nonconforming items in samples of constant size n.
p	- The proportion of units nonconforming in a sample.
$\bar{p}$	- The average proportion of units nonconforming in a series of samples (weighted by sample size).
PCR	- The Process Capability Ratio, defined as 6σ/total tolerance, where total tolerance = (upper spec. limit) - (lower spec. limit).
R	- The subgroup range (highest minus lowest value).
$\bar{R}$	- The average range of a series of subgroups of constant size.
s	- The sample standard deviation (parameter).
σ	- The universe standard deviation (statistic).
$\bar{s}$	- The average sample standard deviation of a series of subgroups, weighted if necessary, by sample size.
SL	- A unilateral engineering specification limit.
u	- The number of nonconformities per unit in a sample which may contain more than one unit.
$\bar{u}$	- The average number of nonconformities per unit in samples not necessarily of the same size.
UCL	- The upper control limit: $UCL_{\bar{X}}$, UCL_R, UCL_p, etc., are, respectively, the upper control limits for averages, ranges, proportion nonconforming, etc.

Symbol	Definition
$UCL_{\bar{X}}$	- Upper control limit for averages.
UCL_R	- Upper control limit for ranges.
UCL_p	- Upper control limit for proportion nonconforming.
USL	- The upper engineering specification limit.
$\bar{X}$	- An individual value, upon which other subgroup statistics are based.
$\bar{\bar{X}}$	- The average of values in a subgroup.
X	- The average of subgroup averages (weighted if necessary by sample size); the measured process average.
Z	- The number of standard deviation units from the process average to a value of interest such as an engineering specification. When used in capability assessment, Z_{USL} is the distance to the upper specification limit, Z_{LSL} is the distance to the lower specification limit, and Z_{min} is the distance to the nearest specification limit.
Z_{LSL}	- $\frac{\bar{\bar{X}} - LSL}{}$
Z_{USL}	- $\frac{USL - \bar{\bar{X}}}{}$
Z_{min}	- The minimum value of the (Z_{LSL}, Z_{USL}).
σ (sigma)	- Formula for the Universe Standard deviation (parameter): $\sigma = \sqrt{\frac{\sum (X_i - \mu)^2}{N}}$
s	- Formula for the Sample Standard deviation (statistic): $s = \sqrt{\frac{\sum (X_i - \bar{\bar{X}})^2}{n-1}}$

Supersedes page 12 of MIL-HDBK-683(AT).

$S_{\bar{X}}$ - An estimate of the standard deviation of the distribution of individual values of a process characteristic, defined as: R/d_2.

$$S_{\bar{X}} = \sqrt{\frac{(\bar{X}_i - \bar{X}_{\bar{X}})^2}{n-1}}$$

where:

n = the subgroup sample size.

CHAPTER 3
ADVANTAGES AND GOALS OF SPC

3.1 Advantages of SPC. The advantages of SPC are:

a. Ability to understand process variation. SPC is the application of statistical techniques to management of an operation or process. It involves the identification of events that are beyond the natural variation of the process and the systematic elimination of the causes of such events. When appropriate statistical techniques are built into the process or operation, management gains the ability to understand the nature of the process variation and to bring the variation within the desired limits.

There is a natural variation inherent in any process. The diameter of a drilled hole, for example, will vary due to wear of the drill bit, material hardness, operator skill and accuracy, and ambient temperature. For another example, time to receive your food in a restaurant will vary according to the efficiency of the serving person, the reliability of the cook, the availability of ingredients, and the workload on the restaurant personnel.

b. Ability to control process variation. Variation will exist within the process. Parts will be acceptable only when they conform to the specification. However, to control a process, reduce variation, and ensure that the output continues to meet the expressed requirements, the causes of variation must be identified in the data or in dispersion (spread) of the data. Collection of these data are characterized as mathematical models called "distributions" that are used to predict the overall performance. Certain factors which may cause a variation that cannot be adequately explained by the process distribution are called "assignable causes". Unless these assignable causes are identified and removed, they will continue to affect the process in an unpredictable manner. A process is said to be in statistical control when the only source variation is the natural process variation and "assignable causes" have been eliminated.

Variation that is outside of the desired process distribution can usually be corrected by someone directly connected with the process. For example, a machine set improperly may produce defective parts. The responsibility for corrective/preventive action in this case belongs to the operator, who can readjust the machine to prevent recurring defects.

c. Ability to effectively manage process variation. Causes of natural variation may only be correctable by management action such as capital investment in new equipment or a redesign of the material processing. It may, in fact, be determined that enough variation cannot be economically eliminated to produce items consistently within specification.

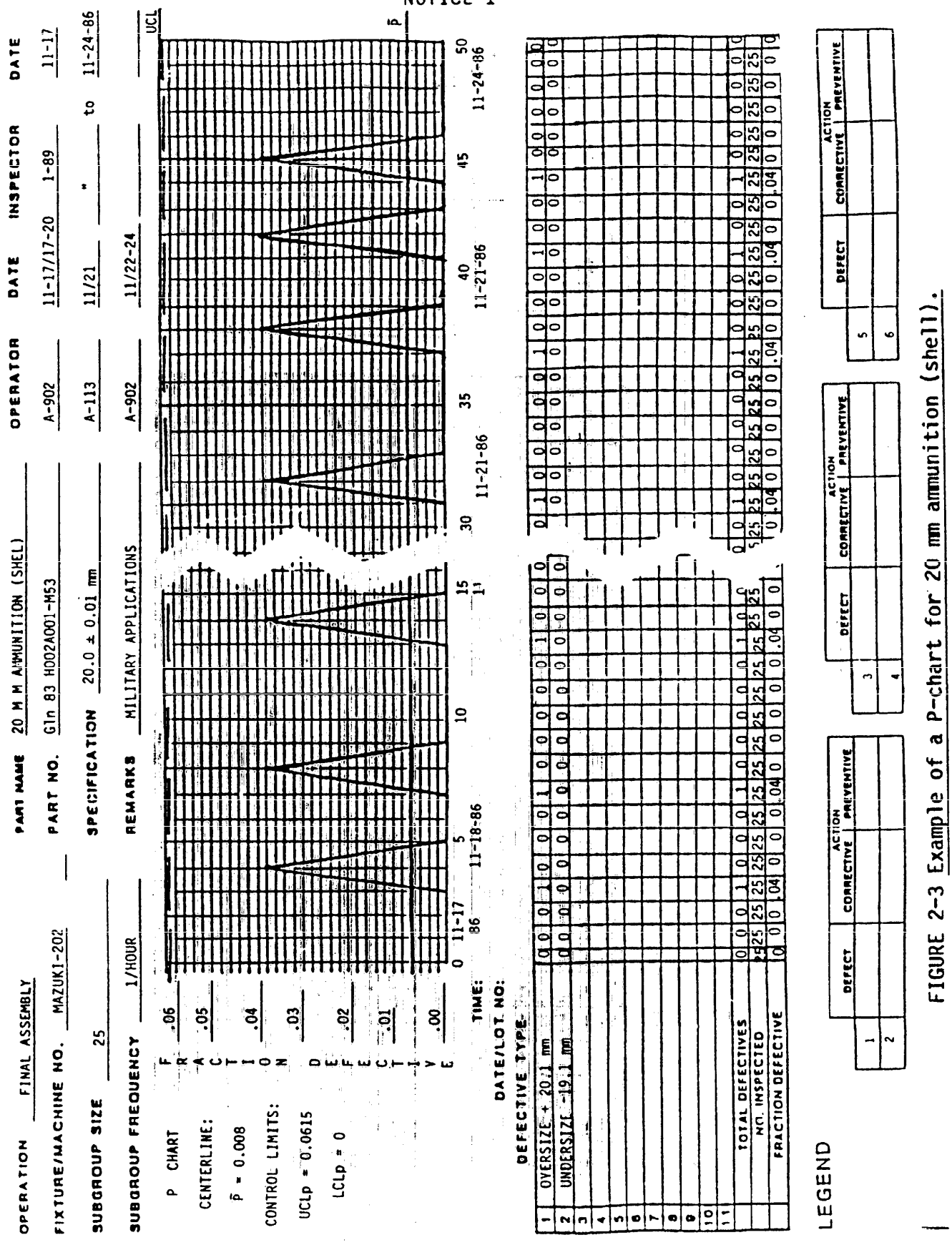


FIGURE 2-3 Example of a P-chart for 20 mm ammunition (shell).

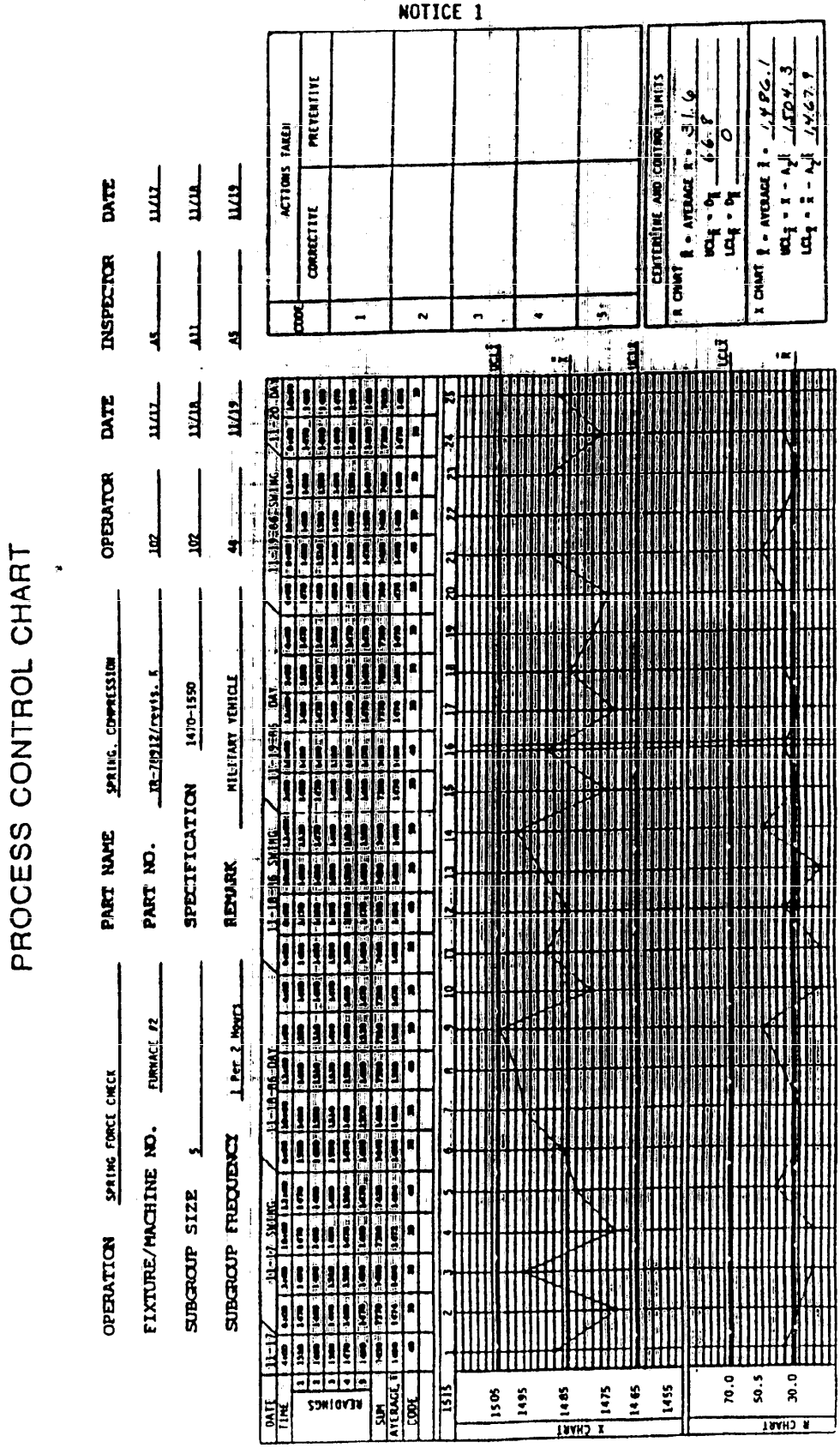


FIGURE 3-3 Example of an average($\bar{X}$) and (R) chart for a compression spring.

Supersedes page 20 of MIL-HDBK-683(AT).

b. For the sake of brevity, two potential failure modes were selected: (1) fracture of the umbrella shaft, and (2) separation of the stitching of the umbrella fabric.

c. Based on these two potential failure modes, the effects of these failures are recorded. The effect of the first failure would be catastrophic in that the umbrella would be rendered useless. The second failure effect may range from a cosmetic problem to leaks.

d. The next step is to determine the cause of failure. In the example, the fracture of the umbrella shaft could have been caused in two ways. The shaft material may be thinner than specified or the environmental conditions (severe high winds) may have exceeded design expectations. Regarding the umbrella cover where the stitching separates, the cause of failure is attributed to poor workmanship.

e. In the risk analysis phase of FMEA, the probability of the occurrence of failure is considered and rated. The failure is then weighted for severity and capability to escape detection. These are subjective factors based on the engineer's experience and previous history on similar items. Also, each failure mode is independently evaluated.

(1) With regard to the first failure mode---shaft fractures, the cause of failure due to thin material was considered not especially likely to occur and was given a low rating of three; whereas, the failure due to severe high winds was even less likely to occur and was given a very low rating of one. Regarding the second failure mode---stitching separates, the sole cause of failure due to poor workmanship was considered to almost always occur and was given a very high rating of nine.

(2) Next, the severity/criticality of the failure was analysed. Since failure of the shaft made the umbrella unusable, it was given a very high severity rating of nine. On the other hand, stitch separation did not render the umbrella unusable although it may adversely impact on user acceptability. It was given a moderate severity rating of five.

(3) Since the escape detection factor is essentially a function of inspection, the probability of detecting a weak umbrella shaft was considered to be slightly better than average and was given a rating of six. Detecting poor workmanship in the stitching was considered excellent; hence was given a very high rating of nine.

f. The next step in FMEA is to assign a risk priority number to each cause of failure. This is accomplished by multiplying together each of the risk factors rated in the aforementioned risk analysis phase and recording them on the worksheet. Top priority for corrective action should be given to the cause of failure with the highest risk priority number and all causes of failure reviewed in descending order from highest to lowest risk priority number.

g. The final step in the FMEA is to identify the corrective actions required to eliminate the cause of each failure and to select the most appropriate ones for implementation.

This example is intended to demonstrate the concept that failure modes and causes may be ranked by the risk priority number and addressed in order of significance.

4.6 Organizational structure. The implementation of SPC requires a cultural change. The first action required in order to achieve the necessary culture change is to establish the organizational structure which will provide the foundation, direction and support for SPC process implementation. Change begins at the top and it will naturally cascade down to every level of the corporate structure. The organizational structure described is not intended to replace the existing structure of the company. It shall function as an integral complimentary framework having the purpose and objective of implementing SPC through a systematic process. the main elements of the structure should include the following:

a. President's Quality Council

b. Steering Committee

c. Project Teams

d. Team Leaders

e. Team

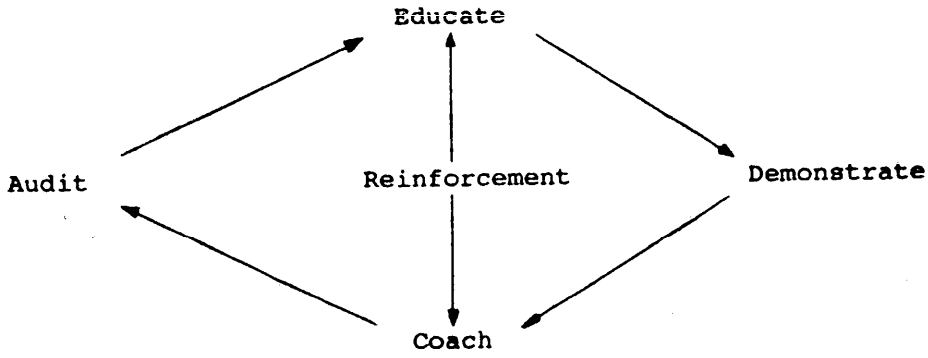
f. Facilitators

4.6.1 President's quality council. The Executive Board is the highest authority within the structure. Its members are primarily vice presidents whose operations have a direct influence on the costs of quality relating to prevention, appraisal and internal and external failure. Typically these members come from the functions of product development, design engineering, manufacturing, finance, quality control and customer service.

The President's Quality Council is chaired by an individual whose position holds the responsibility and influential control over a majority of the board's resources. This individual will also have the most to gain from success of the program. Typical positions that carry such responsibility and influence include the President, Executive Vice President and Vice President of Operations.

4.6.2 Steering committees. Steering Committees report to the Executive Board and are composed of individuals who have the responsibility to direct and support the activities of the individual teams implementing SPC. Members of Steering Committees primarily consist of middle managers who are directly responsible for, or support the processes being addressed. Typical Manufacturing Steering Committee members are Quality Engineering Manager, Manufacturing Engineering Manager, Design Engineering Manager and a Finance Manager. The chairman and leader of this committee, when addressing production processes, is most frequently the Plant Manager, Manufacturing Manager, or General Manager. This individual usually has the most to gain from the results of SPC and is the one who typically manages most of the resources required to implement such a program.

The role of the facilitator is to educate, demonstrate, coach and audit the results of SPC implementation. The approach can be viewed like the facilitation closed loop illustrated below.



4.6.6.1 Skills of the facilitator. The facilitator must be skilled in the areas of motivating people, knowledge of the systematic process, coaching and technical knowledge. He must have the ability to make things happen and in-depth experience in the manufacturing, service or administrative areas.

When using a facilitator, a person from within or outside the organization, it is important to clarify the working arrangement by establishing mutually agreed upon guidelines. These guidelines should be consistent with the roles and responsibilities of the Team Leader and the facilitator.

An effective facilitator will guide the Team through the program and assure timeliness of action, optimum results, objectivity and a standard approach throughout the company. A facilitator is to the implementation of SPC, as SPC is to the control of a process. Results will be realized in a quicker time because the facilitator guides the Team around obstacles and ensures that it is done right the first time.

4.7 SPC implementation plan. The implementation plan should contain the sections listed below. For an example of an SPC implementation plan, see figure 8-4.

a. Contractor's policy statement

b. Contractor's goals

c. Master milestone plan

d. Project milestone plan

e. Project detailed plan

Reprinted without change.

f. Management structure

g. Training plan

h. Supplier SPC philosophy and policy

i. Systematic process

4.7.1 Contractor's policy statement. The policy statement states the detailed requirements of SPC and who is responsible for implementing the requirements.

4.7.2 Contractor's goals. The goals clearly define the scope of the products and processes to be addressed by SPC and the expectations for quality levels at each operation. The quality targets for each product should be established by the contractor and subject to Government approval.

4.7.3 Master milestone plan. The Master Milestone Plan identifies the products and processes where SPC is to be implemented in accordance to a time phased schedule. The schedule would reflect the month to start the SPC implementation and the month that the process will be in control and achieve the quality target for the process. The Master Milestone Plan is to be initially approved by the Government prior to implementation by the contractor. Also all revisions require Government approval. The status of the Master Milestone Plan should be issued monthly by the contractor, or on some other cyclic basis as required by the Government.

4.7.4 Project milestone plan. A Project Milestone Plan identifies the key activities of each project where SPC will be implemented in accordance to a time phase schedule. The activities would be the process which is advocated. The schedule would reflect the week "to start" each activity and the week "to complete" each activity.

The Project Milestone Plan would be submitted for Government approval and should contain all projects planned to be started in the first three (3) months of the Master Milestone Plan. Each month, one additional month is added to it. The following activities should be planned in the Project Milestone Plan and approved by the Government:

a. Determine the classification of characteristics

b. Conduct inspection capability study

c. Conduct process capability study

d. Prepare the repair and corrective actions

e. Prepare the process control procedure

f. Implement process control charts

g. Audit

4.7.5 Project detailed plan. The Project Detailed Plan should specify the following:

a. Identification, name and description of the process

b. Characteristics to be measured (variable or attribute)

c. Production

d. Number of redundant tools, machines, or stations

e. Production rate per hour

f. Number of shifts

g. Number of operators

h. Inspections, include the following:

(1) Number of inspection gages

(2) Variable or attribute characteristics

(3) Number of inspectors

(4) Number of shifts

(5) Inspection time and unit

(6) Time difference between production and inspection of the part

i. Charts, include the following:

(1) The type of the chart selected

(2) Number of charts to be used

(3) Location of charts to be posted

4.7.6 Management structure. The management structure should include an organization chart which reflects the responsibilities to implement and sustain SPC.

Each level should be supported by a section for roles and responsibilities. Names of the President's Quality Council; steering committees, and team leaders should be identified. A company Process Control Procedure should be available which reflects responsibilities for all the actions relative to implementing and sustaining SPC. This procedure should be customized for each process, however, many will be identical. The contents of the organization chart should specify the following:

a. Who performs the inspections

b. Who posts control charts

c. Who establishes and updates control limits

d. Who responds on out-of-control conditions

e. Who provides corrective and preventive action

f. Who audits the process

4.7.7 Training plan. The training plan should include the following:

a. The content of training by level of participants

b. The number of seminar hours

c. The sample of handout material

d. The mode of training

e. Qualifications of instructor

f. The location of training

g. The number of hours on-job-training (OJT)

h. OJT by whom and qualifications

i. The testing to assure competence

4.7.8 Supplier SPC philosophy and policy. Supplier controls require the supplier, vendor, or the subcontractor to have SPC on all critical and major characteristics.

The suppliers are required to submit a copy of the process control chart for each process with SPC along with a certification of "lot integrity" indicating the parts were produced under the process control chart that was submitted.

What are the auditing techniques to assure the quality is the same level as indicated by the control charts.

4.7.9 Systematic process. Since many steps [c/] in applying SPC are common, the following systematic approach is recommended.

[c/] See reference, 9.4.a, for details to each step.

Reprinted without change.

Step 1. Identification - The purpose of this step is to immediately define the process and characteristics to have SPC implemented. A systematic process is necessary for the following reasons.

a. It provides a comprehensive and fast process to effectively implement SPC.

b. It provides a consistent method of implementing and sustaining SPC.

c. It provides the foundation for a culture change. It provides a plan, the how to's and means, to monitor success and to measure its effectiveness.

The process is defined, including a flow chart and the selection of characteristics to be controlled by SPC is made.

A formal definition of critical, major, minor and incidental classification of characteristics should be issued to each contractor. A meeting between the Government and the contractor should be used to reach agreement on what characteristics are to be classified as critical, major, and minor.

Characteristics identified as critical and major must have SPC implemented. Exceptions are not to be permitted.

Step 2. Planning and reporting - The purpose of this step is to create the foundation for effectively managing the resources allocated to the team, and to assure the timely completion of the overall project.

This is an administrative step to assist the team leader in managing the project. It is designed as a means to keep the project on plan, both in terms of timing and performance of the project goals.

The team must draft a Milestone Plan indicating the start and completion of each of the 12 steps along with any subordinate tasks identified at this time. The team will also generate a Progress Report immediately following each meeting showing team objectives, status of the project, accomplishments since the last meeting, exceptions to the plan and responsibilities, risks and exposures requiring management action, the outlook for task completion, and detailed assignments to team members.

Step 3. Performance measurements - This step establishes a method to measure performance in quality, productivity and schedule.

Performance measurements should be developed in order to monitor the success level achieved by the team relative to time that reflects the criteria sighted in the project objectives. A simple graph is adequate as long as it is published regularly and the responsibility for maintaining the measurement is clearly understood.

Step 4. Problem analysis and solution - This is the first step directed at actual improvement of the process. It is accomplished by applying problem solving techniques as specified in 4.5. The process dispersion must represent the normal curve prior to determining if the process is capable or incapable.

Step 5. Inspection capability study - An inspection capability is a measure of how good the inspection measurement is.

The study should be conducted on all gages and instruments authorized per the inspection instructions and on all appraisers. The study would be applicable to both variables and attributes data. The inspection system is certified only when the gages, instruments, and appraisers results are determined to be acceptable.

Standards for rating the study acceptable, marginal, or unacceptable will be issued by the Government.

Step 6. Process capability study - A process capability study will be conducted on all machines, fixtures, stations and operators involved in the process to determine the capability of the process and natural and unnatural variations. It must be conducted on critical and major characteristics. This study is applicable to both variables and attributes data.

When the results of the study are acceptable, the operators are certified to perform the process. Acceptable ranges for capability ratios will be determined by the Government. Unless otherwise specified, a process capability of 1.33 requires that 8-sigma (X bar + and - 4 sigma) +it within the specification, resulting in only 63 PPM defective.

Step 7. Corrective and preventive action matrix - A corrective and preventive action matrix provides specific actions which should be taken to bring the process back in control.

It is a document posted with each control chart that lists all known defects or out-of-control conditions which can exist in the process. With each defect or condition, action is specified to correct the process. In essence, it is a prioritized trouble shooting guide.

Along with the document, a procedure should be defined for review and update of the matrix as new defects and solutions are identified.

Step 8. Process control procedure - The process control procedure documents the method for introducing and sustaining SPC. It establishes responsibilities to all the various activities. It is a procedure that must be provided for each of the following processes:

TABLE I-4. Pitfalls and solutions to implementing an SPC process - Continued.

Pitfall	Solution
The persons conducting the advanced seminars (for example, design of experiments) do not have any formal education in statistics. These people may have degrees or advanced degrees in other fields, but without formal education in statistics, they cannot assume they are qualified to teach statistics.	Require the seminar leader to have a formal foundation in statistics. Someone in the organization must have a masters or doctorate in statistics.
People can become most dangerous players once they attain ample education, have successful experiences, and are ready to be on their own. The problem comes when more people get educated in SPC, they go off in different directions. All may be acceptable, but few may be effective, some may be semi-effective and others are ineffective. Consequently, no one way gets implemented. Hence, the process does not become internalized by the personnel and it may become habit forming to a point it is the company's culture.	The 12-step systematic process specified in 4.7.9.
Education in statistics only is given to personnel. Consequently, the SPC charts are wallpaper and only a few are in control. A culture change has not transformed.	Educate personnel on problem solving techniques, high performance attitudes and systematic approach.
People have fear of being part of the problem rather than part of the solution.	Upper management announces they take responsibility for the past. The teams have responsibility for improving the processes in the future.
Management does not give any clear expectations of what needs to be accomplished.	Clear, concise statements must be documented on the teams progress reports regarding expectations.

TABLE I.4. Pitfalls and solutions to implementing an SPC process - Continued.

Pitfall	Solution
Management does not assign responsibility for the expectations or results.	A process control procedure, a step in the systematic approach addresses this issue.
Management does not feedback evaluations, positive or negative, on a regular basis.	Hold monthly meetings with steering committees and quarterly progress reviews. These are detailed in the systematic process (see 4.7.9).
Lack of recognition by management. A once highly energized process starts to die.	Have a structured recognition program for results.
Team leaders are weak. Not all personnel want to be team leaders.	a. Further educate. b. Coach. c. Clarify expectations. d. Remove.

E. Project detailed plan.				
Key activity	Final Inspection	Brazing	Grinding	Bonding
Production:				
Critical characteristics	2	1	1	1
Major characteristics	1	0	0	0
Redundant machines	1	3	2	N/A
No. fixtures	0	N/A	N/A	N/A
Shifts	2	1	2	2
No. operators/shift	4/4	3/0	2/2	6/3
Production rate	30/hr	240/hr	200/hr	30/hr
Inspection:				
No. gages	1	3	1	1
Variable	N	Y	Y	Y
Attribute	Y	N	N	N
No. inspectors/shift	2/2	1/0	1/1	1/1
Inspection time/unit	.6	3 min	.3 min	2 min
Time difference between production and inspection	on-line	on-line	on-line	on-line
Process control charts:				
Type selected	C	X,R	X,R	X,R
No. of charts	2	3	2	14
Locations of charts	@ process	@ process	@ process	@ process

FIGURE 8-4. Example of SPC implementation plan - Continued.

F. Management structure.

Team leader	-	Bill Elm
Quality engineer	-	Stan Hickory
Manufacturing engineer	-	John Black
Production supervisor	-	Nellie Gale
Production operator	-	Jim Blott

Steering committee chairman	-	John Nablo, Plant Manager
Quality engineer manager	-	Harry Katz
Manufacturing engineer manager	-	Willie Wilson
Production manager	-	Jill St. George

President's Quality Council

President	-	James
V.P. operations	-	Sam
V.P. quality	-	Jack
V.P. engineering	-	Bill
V.P. field service	-	Phil
V.P. marketing	-	Bob

G. Training requirements.

1. Type of training. The training will be given in the form of a "seminar-workshop" on implementing SPC. This training is mandatory for all personnel designated to attend. It will be conducted in a classroom environment and will require active participation by the attendees.

2. Purpose. The seminar-workshop presents a grounding in the fundamentals of SPC. The emphasis is on implementation of these techniques. Participants will learn the principles of control charts, the fundamentals of inspection and process capability studies, and the procedures for effective implementation of these techniques.

FIGURE 8-4. Example of SPC implementation plan - Continued.

SEMINAR-WORKSHOP
IMPLEMENTING STATISTICAL PROCESS CONTROL
(24 HOURS)

	TOPICS	HOURS
o	INTRODUCTION/OVERVIEW	0.5
o	BASIC STATISTICAL CONCEPTS	1.5
o	DATA COLLECTION/ANALYSIS	1.0
o	NORMAL PROBABILITY PAPER	1.0
o	CONTROL CHART CONCEPTS	1.0
o	X-BAR/R CHARTS	2.0
o	INDIVIDUAL/MODIFIED LIMIT CHARTS	1.0
o	p, Np CHARTS	2.0
o	C, U CHARTS	2.0
o	IMPLEMENTING CONTROL CHARTS	4.0
	o FLOW CHARTS o EVENTS LOG o CORRECTIVE/PREVENTIVE ACTION MATRIX o SHIFTS/TRENDS	
o	INSPECTION CAPABILITY STUDIES	2.0
o	PROCESS CAPABILITY STUDIES	4.0
o	IMPLEMENTATION PITFALLS	1.5
o	SUMMARY EVALUATION	0.5

NOTES:

a.	Length of course	-	24 Hrs.
b.	Mode of training	-	Class room - workshop
c.	Training location	-	Training room - company
d.	Handout material	-	To be provided
e.	OJT	-	N/A OJT
f.	Instructor qualifications	-	M.S. Statistics
g.	Testing required	-	Each attendee will be tested

FIGURE 9-4. Sample agenda for SPC seminar-workshop.

Reprinted without change.

CHAPTER 5
EVALUATION GUIDE FOR A SUPPLIER'S SPC PROGRAM

5.1 Methods for evaluating a supplier's SPC program. This chapter provides methods for conducting a systematic evaluation of an SPC program at a supplier (the term "supplier" denotes all prime contractors, subcontractors and vendors) and methods for conducting compliance audits on supplier's who have implemented some level of SPC.

SPC compliance audits are best integrated with an overall quality audit because the SPC activities must be integrated with the other quality, engineering and manufacturing control systems in order to be effective. The checklists should also be used independently to conduct follow-up evaluations of specific SPC program elements.

Audit methods are used to minimize the time and money spent conducting the evaluation while still gaining a thorough understanding of how completely the organization has adopted the attitude of controlling process variations during production.

5.2 Other types of SPC audits. Similar evaluation methods may be used by a customer to determine if a current supplier has properly implemented SPC techniques or by company personnel to conduct a self-assessment.

Conducting an audit of a potential supplier differs from auditing a current supplier primarily because the business relationship does not have a historical perspective. The potential supplier evaluation is made more difficult by the lack of experience with change order implementation, a lack of common understanding about drawing and specification interpretations, workmanship standards, and all of the other elements which define a total business relationship. Evaluation of a current supplier will tend to be more critical because each of the contractual elements which have created problems between supplier and customer should be fully examined and preventive measures developed to control any negative impact on the SPC program.

Self assessment audits by a manufacturing organization are valuable to the extent that the auditors are impartial and receive recognition for their services by the company management.

5.3 Preparation for the audit.

5.3.1 Management responsibilities. Establishing the audit objectives and selection of the audit team are management responsibilities. The philosophy for SPC audits should be documented in a policy statement which establishes the members and leadership of the audit team, the reporting responsibilities of the audit team, provides funding for the audit process and establishes the relationship of the SPC audit to the overall procurement activity of the customer.