Advanced Product Quality Planning and Control Plan

(APQP)

OPEL

VAUXHALL

ADVANCED PRODUCT QUALITY PLANNING (APQP) AND CONTROL PLAN

Reference Manual

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FOREWORD

This Reference Manual and Reporting Format were developed by the Advanced Product Quality Planning (APQP) and the Control Plan teams that were sanctioned by Chrysler, Ford, General Motors Supplier Quality Requirements Task Force.

The Task Force charter is to standardize the reference manuals, procedures, reporting formats, and technical nomenclature used by Chrysler, Ford, and General Motors in their respective supplier quality systems. Accordingly, this manual and format, approved and endorsed by Chrysler, Ford and General Motors, should be used by suppliers implementing APQP techniques into their design/manufacturing processes.

In the past, Chrysler, Ford, and General Motors each had their own guidelines and formats for ensuring supplier APQP compliance. Differences between these guidelines and formats resulted in additional demands on supplier resources. To improve upon this situation, Chrysler, Ford and General Motors agreed to develop and distribute this Manual. The work group responsible for this Manual was led by Mike Mazur of Ford Motor Company.

This manual provides general guidelines for preparing plans and checklists for ensuring that Advanced Product Quality Planning is in actuality carried out at the supplier. It does not give specific instructions on how to arrive at each APQP or Control Plan entry, a task best left to each component review team.

While these guidelines are intended to cover all situations normally occurring either in the early planning, design phase, or process analysis, there will be questions that arise. These questions should be directed to your customer's Supplier Quality activity. If you are uncertain as to how to contact the appropriate activity, contact your buyer in your customer's Purchasing office.

The Task Force gratefully acknowledges: the leadership and commitment of Vice Presidents Thomas T. Stallkamp at Chrysler, Norman F. Ehlers at Ford, and G. Richard Wagoner, Jr. of General Motors; the assistance of the AIAG in the development, production, and distribution of this manual; and the guidance of Task Force Principals Russell Jacobs (Chrysler), Radley Smith (Ford), and Dan Reid (General Motors).

June 1994

ACKNOWLEDGEMENT

This document, which includes a reference manual and reporting format, represents the consensus of the members of the Advanced Product Quality Planning and Control Plan teams sanctioned by the Chrysler, Ford, General Motors Supplier Quality Requirements Task Force. Team members, whose names appear below, wish to acknowledge the many contributions made by individuals from within their respective organizations, individuals without whose support and assistance this document would not have been possible.

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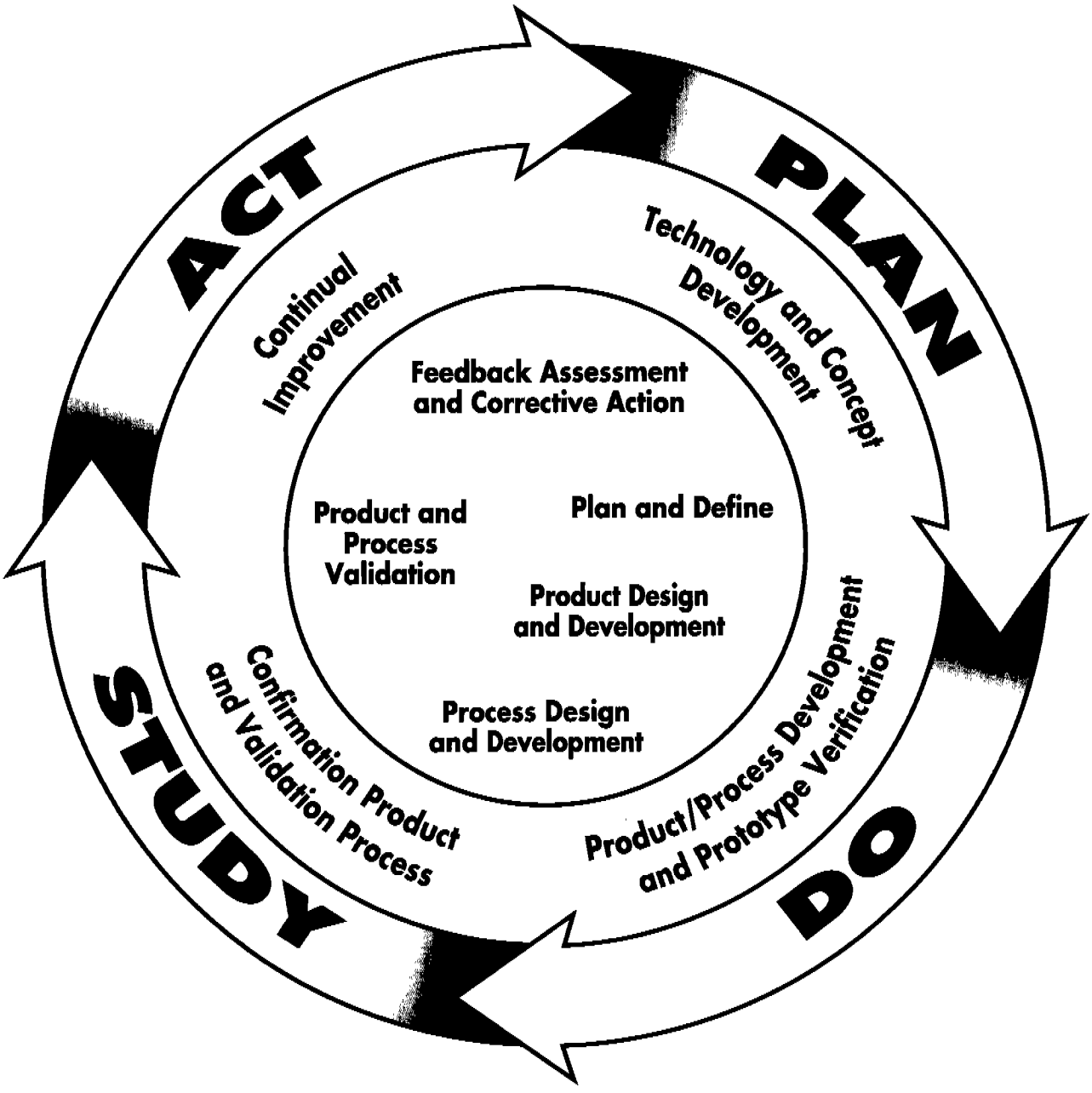
PRODUCT QUALITY PLANNING CYCLE



INTRODUCTION

The purpose of this manual is to communicate to suppliers (internal and external) and subcontractors, common Product Quality Planning and Control Plan guidelines developed jointly by Chrysler, Ford and General Motors. The manual provides guidelines designed to produce a product quality plan which will support the development of a product or service that will satisfy the customer (see Section 1.6). The term "product" will be used throughout this manual and is meant as either product or service. The term "supplier" will also be used throughout this manual and is meant to apply to suppliers and subcontractors. Some of the expected benefits in using these guidelines are:

- A reduction in the complexity of product quality planning for the customers and suppliers.
- A means for suppliers to easily communicate product quality planning requirements to subcontractors.

This reference manual contains guidelines that support the requirements described in the *Chrysler, Ford, and General Motors Quality System Requirements*.

All forms in this manual are provided as examples only. The purpose is to assist the Product Quality Planning Team in developing the appropriate communication forms to support meeting customer requirements, needs, and expectations.

The words "shall," "will" and "must" indicate mandatory requirements. The word "should" indicates a preferred approach. Suppliers choosing other approaches must be able to show that their approach meets the intent of this manual. Where the words "typical" and "examples" are used, the appropriate alternative for the particular commodity or process should be chosen.

The Product Quality Planning Cycle shown on the facing page is a graphic depiction of a typical program. The various phases are sequenced to represent planned timing to execute the functions described. The purpose of the Product Quality Planning Cycle is to emphasize:

- Up-front planning. The first three quarters of the cycle are devoted to up-front product quality planning through product/process validation.
- The act of implementation. The fourth quarter is the stage where the importance of evaluating the output serves two functions: to determine if customers are satisfied, and to support the pursuit of continual improvement.

Depicting product quality planning as a cycle illustrates the never-ending pursuit of continual improvement that can only be achieved by taking the experience in one program and applying that acquired knowledge to the next program.

PRODUCT QUALITY PLANNING RESPONSIBILITY MATRIX

The matrix shown below depicts the Product Quality Planning Functions for three types of suppliers. It is to assist suppliers in defining the scope of their planning responsibilities. Refer to Fundamentals of Product Quality Planning on the next page. The matrix does not depict all the different types of product quality planning relationships that could exist among suppliers, subcontractors, and customers.

	***Design Responsible**	***Manufacturing Only**	***Service Supplier i.e. Heat Treat, Warehousing, Transportation, etc.**
Define the Scope	X	X	X
Plan and Define Section 1.0	X		
Product Design and Development Section 2.0	X		
Feasibility Section 2.13	X	X	X
Process Design and Development Section 3.0	X	X	X
Product and Process Validation Section 4.0	X	X	X
Feedback, Assessment and Corrective Action Section 5.0	X	X	X
Control Plan Methodology Section 6.0	X	X	X

* Refer to the *Chrysler, Ford, and General Motors Quality System Requirements* introduction section under "applicability" to determine the appropriate sections of the manual that apply.

FUNDAMENTALS OF PRODUCT QUALITY PLANNING

Product Quality Planning is a structured method of defining and establishing the steps necessary to assure that a product satisfies the customer. The goal of product quality planning is to facilitate communication with everyone involved to assure that all required steps are completed on time. Effective product quality planning depends on a company's top management commitment to the effort required in achieving customer satisfaction. Some of the benefits of Product Quality Planning are:

- To direct resources to satisfy the customer.
- To promote early identification of required changes.
- To avoid late changes.
- To provide a quality product on time at the lowest cost.

The work practices, tools, and analytical techniques described in this manual are listed in a logical sequence to make it easy to follow. Each Product Quality Plan is unique. The actual timing and sequence of execution is dependent on customer needs and expectations and/or other practical matters. The earlier a work practice, tool, and/or analytical technique can be implemented in the Product Quality Planning Cycle, the better.

ORGANIZE THE TEAM

The supplier's first step in Product Quality Planning is to assign responsibility to a cross functional team. Effective product quality planning requires the involvement of more than just the quality department. The initial team should include representatives from engineering, manufacturing, material control, purchasing, quality, sales, field service, subcontractors, and customers, as appropriate.

DEFINE THE SCOPE

It is important for the Product Quality Planning Team in the earliest stage of the product program to identify customer needs, expectations, and requirements. At a minimum, the team must meet to:

- Select a project team leader responsible for overseeing the planning process. (In some cases it may be advantageous to rotate the team leader during the planning cycle.)
- Define the roles and responsibilities of each area represented.
- Identify the customers - internal and external.
- Define customer requirements. (Use QFD if applicable, as referenced in Appendix B.)
- Select the disciplines, individuals, and/or subcontractors that must be added to the team, and those not required.
- Understand customer expectations, i.e., design, number of tests.
- Assess the feasibility of the proposed design, performance requirements and manufacturing process.

- Identify costs, timing, and constraints that must be considered.
- Determine assistance required from the customer.
- Identify documentation process or method.

TEAM-TO-TEAM

The Product Quality Planning Team must establish lines of communication with other customer and supplier teams. This may include regular meetings with other teams. The extent of team-to-team contact is dependent upon the number of issues requiring resolution.

TRAINING

The success of a Product Quality Plan is dependent upon an effective training program that communicates all the requirements and development skills to fulfill customer needs and expectations.

CUSTOMER AND SUPPLIER INVOLVEMENT

The primary customer may initiate the quality planning process with a supplier. However, the supplier has an obligation to establish a cross functional team to manage the Product Quality Planning process. Suppliers must expect the same performance from their subcontractors.

SIMULTANEOUS ENGINEERING

Simultaneous Engineering is a process where cross functional teams strive for a common goal. It replaces the sequential series of phases where results are transmitted to the next area for execution. The purpose is to expedite the introduction of quality products sooner. The Product Quality Planning Team assures that other areas/teams plan and execute activities that support the common goal or goals.

CONTROL PLANS

Control Plans are written descriptions of the systems for controlling parts and processes. Separate Control Plans cover three distinct phases:

- Prototype – A description of the dimensional measurements and material and performance tests that will occur during Prototype build.
- Pre-launch – A description of the dimensional measurements and material and performance tests that will occur after Prototype and before full Production.
- Production – A comprehensive documentation of product/process characteristics, process controls, tests, and measurement systems that will occur during mass production.

CONCERN RESOLUTION

During the planning process, the team will encounter product design and/or processing concerns. These concerns should be documented on a matrix with assigned responsibility and timing. Disciplined problem-solving methods are recommended in difficult situations. Analytical techniques described in Appendix B should be used as appropriate.

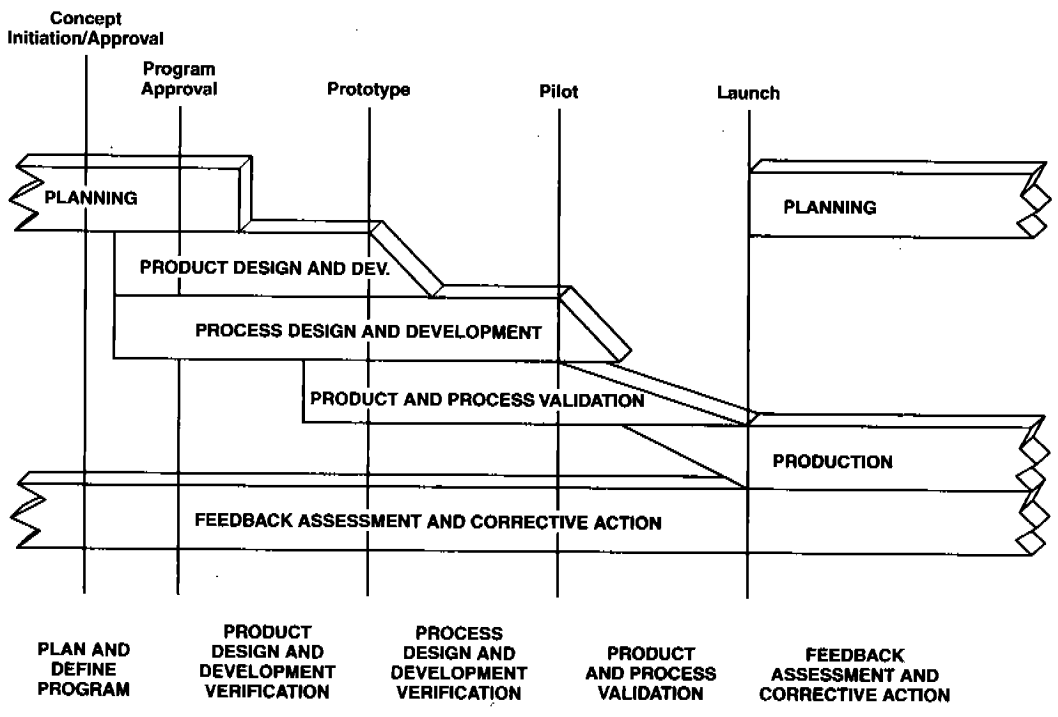
PRODUCT QUALITY TIMING PLAN

The Product Quality Planning Team's first order of business following organizational activities should be the development of a Timing Plan. The type of product, complexity and customer expectations should be considered in selecting the timing elements that must be planned and charted. All team members should agree with each event, action, and timing. A well-organized timing chart should list tasks, assignments, and/or other events. (The Critical Path Method may be appropriate; reference Appendix B.) Also, the chart provides the planning team with a consistent format for tracking progress and setting meeting agendas. To facilitate status reporting, each event must have a "start" and a "completion" date with the actual point of progress recorded. Effective status reporting supports program monitoring with a focus on identifying items that require special attention.

PLANS RELATIVE TO THE TIMING CHART

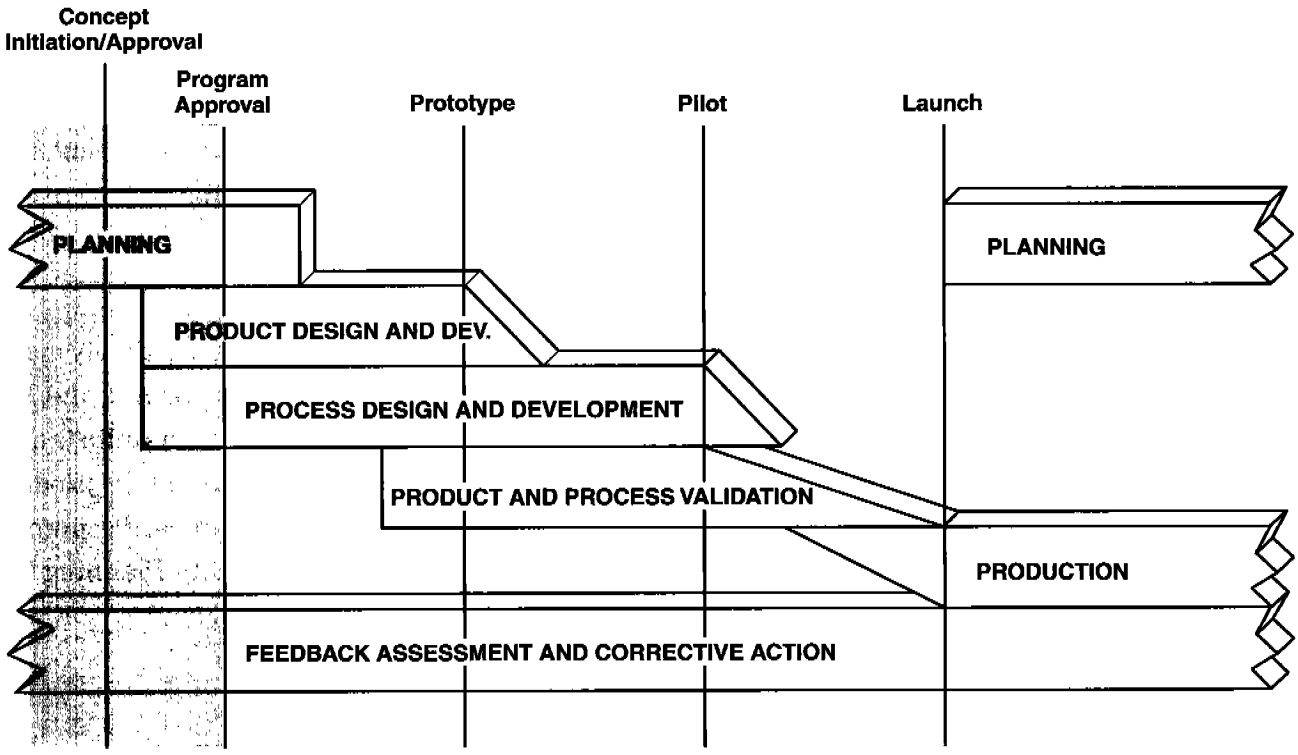
The success of any program depends on meeting customer needs and expectations in a timely manner at a cost that represents value. The Product Quality Planning Timing Chart below and the Product Quality Planning Cycle described previously require a planning team to concentrate its efforts on defect prevention. Defect prevention is driven by Simultaneous Engineering performed by product and manufacturing engineering activities working concurrently. Planning teams must be prepared to modify product quality plans to meet customer expectations. The Product Quality Planning Team is responsible for assuring that timing meets or exceeds the customer timing plan.

PRODUCT QUALITY PLANNING TIMING CHART



1.0 PLAN AND DEFINE PROGRAM

PRODUCT QUALITY PLANNING TIMING CHART



OUTPUTS:

- Design Goals
- Reliability and Quality Goals
- Preliminary Bill of Material
- Preliminary Process Flow Chart
- Preliminary Listing of Special Product and Process Characteristics
- Product Assurance Plan
- Management Support

INTRODUCTION

This section describes how to determine customer needs and expectations in order to plan and define a quality program. All work must be done with the customer in mind, providing better products and services than the competition. The early stage of the product quality planning process is designed to assure that customer needs and expectations are clearly understood.

The inputs and outputs applicable to the process may vary according to the product process and customer needs and expectations. Some recommendations discussed in this section are as follows:

INPUTS

- Voice of the Customer
  - Market Research
  - Historical Warranty and Quality Information
  - Team Experience
- Business Plan/Marketing Strategy
- Product/Process Benchmark Data
- Product/Process Assumptions
- Product Reliability Studies
- Customer Inputs

OUTPUTS (Become inputs for Section 2.0.)

- Design Goals
- Reliability and Quality Goals
- Preliminary Bill of Material
- Preliminary Process Flow Chart
- Preliminary Listing of Special Product and Process Characteristics
- Product Assurance Plan
- Management Support

1.1 VOICE OF THE CUSTOMER

The "Voice of the Customer" encompasses complaints, recommendations, data and information obtained from internal and/or external customers. Some methods for gathering this information appear in the following paragraphs.

1.1.1 MARKET RESEARCH

The Product Quality Planning Team may need to obtain market research data and information reflecting the Voice of the Customer. The following sources can assist in identifying customer concerns/wants and translating those concerns into product and process characteristics:

- Customer interviews
- Customer questionnaires and surveys
- Market test and positioning reports
- New product quality and reliability studies
- Competitive product quality studies
- Things Gone Right (TGR) reports

1.1.2 HISTORICAL WARRANTY AND QUALITY INFORMATION

A list of historical customer concerns/wants should be prepared to assess the potential for recurrence during the design, manufacture, installation and use of the product. These should be considered as an extension of the other design requirements and included in the analysis of customer needs.

Many of the following items can assist the team in identifying customer concerns/wants and prioritizing appropriate resolutions.

- Things Gone Wrong (TGW) reports
- Warranty reports
- Capability indicators
- Supplier plant internal quality reports
- Problem resolution reports
- Customer plant returns and rejections
- Field return product analysis

1.1.3 TEAM EXPERIENCE

The team may use any source of any information as appropriate, including the following:

- Input from higher system level or past Quality Function Deployment (QFD) projects
- Media commentary and analysis: magazine and newspaper reports, etc.
- Customer letters and suggestions
- TGR/TGW reports

- Dealer comments
- Fleet Operator's comments
- Field service reports
- Internal evaluations using surrogate customers
- Road trips
- Management comments or direction
- Problems and issues reported from internal customers
- Government requirements and regulations
- Contract review

1.2 BUSINESS PLAN/MARKETING STRATEGY

The customer business plan and marketing strategy will set the framework for the product quality plan. The business plan may place constraints (e.g., timing, cost, investment, product positioning, research and development (R&D) resources) on the team that affect the direction taken. The marketing strategy will define the target customer, the key sales points, and key competitors.

1.3 PRODUCT/PROCESS BENCHMARK DATA

The use of Benchmarking (referenced in Appendix B) will provide input to establishing product/process performance targets. Research and development may also provide benchmarks and concept ideas. One method to successful benchmarking is:

- Identify the appropriate benchmarks.
- Understand the reason for the gap between your current status and the benchmark.
- Develop a plan to either close the gap, match the benchmark, or exceed the benchmark.

1.4 PRODUCT/PROCESS ASSUMPTIONS

There will be assumptions that the product has certain features, design, or process concepts. These include technical innovations, advanced materials, reliability assessments, and new technology. All should be utilized as inputs.

1.5 PRODUCT RELIABILITY STUDIES

This type of data considers frequency of repair or replacement of components within designated periods of time and the results of long-term reliability/durability tests.

1.6 CUSTOMER INPUTS

The next users of the product can provide valuable information relating to their needs and expectations. In addition, the next product users may have already conducted some or all of the aforementioned

reviews and studies. These inputs should be used by the customer and/or supplier to develop agreed upon measures of customer satisfaction.

1.7 DESIGN GOALS

Design goals are a translation of the Voice of the Customer into tentative and measurable design objectives. The proper selection of Design Goals assures that the Voice of the Customer is not lost in subsequent design activity.

1.8 RELIABILITY AND QUALITY GOALS

Reliability goals are established based on customer wants and expectations, program objectives, and reliability benchmarks. Examples of customer wants and expectations could be no safety failures or serviceability. Some reliability benchmarks could be competitor product reliability, consumer reports, or frequency of repair over a set time period. Overall reliability goals should be expressed in terms of probability and confidence limits. Quality goals are targets based on continual improvement. Some examples are parts per million, defect levels, or scrap reduction.

1.9 PRELIMINARY BILL OF MATERIAL

The team should establish a preliminary bill of material based on product/process assumptions and include an early subcontractor list. In order to identify the preliminary special product/process characteristics it is necessary to have selected the appropriate design and manufacturing process.

1.10 PRELIMINARY PROCESS FLOW CHART

The anticipated manufacturing process should be described using a process flow chart developed from the preliminary bill of material and product/process assumptions.

1.11 PRELIMINARY LISTING OF SPECIAL PRODUCT AND PROCESS CHARACTERISTICS

Special product and process characteristics are identified by the customer in addition to those selected by the supplier through knowledge of the product and process. At this stage, the team should assure that a preliminary list of special product and process characteristics resulting from the analysis of the inputs pertaining to customer needs and expectations is developed. This listing could be developed from but is not limited to the following:

- Product assumptions based on the analysis of customer needs and expectations.
- Identification of reliability goals/requirements.
- Identification of special process characteristics from the anticipated manufacturing process.
- Similar part FMEAs.

1.12 PRODUCT ASSURANCE PLAN

The Product Assurance Plan translates design goals into design requirements. The amount of effort devoted to the Product Assurance Plan by the Product Quality Planning Team depends on the customer needs, expectations, and requirements. This manual does not prescribe a method for preparing a Product Assurance Plan. The Product Assurance Plan can be developed in any understandable format and should include, but is not limited to the following actions:

- Outlining of program requirements.
- Identification of reliability, durability, and apportionment/allocation goals and/or requirements.
- Assessment of new technology, complexity, materials, application, environment, packaging, service, and manufacturing requirements, or any other factor that may place the program at risk.
- Development of Failure Mode Analysis (FMA) (referenced in Appendix H).
- Development of preliminary engineering standards requirements.

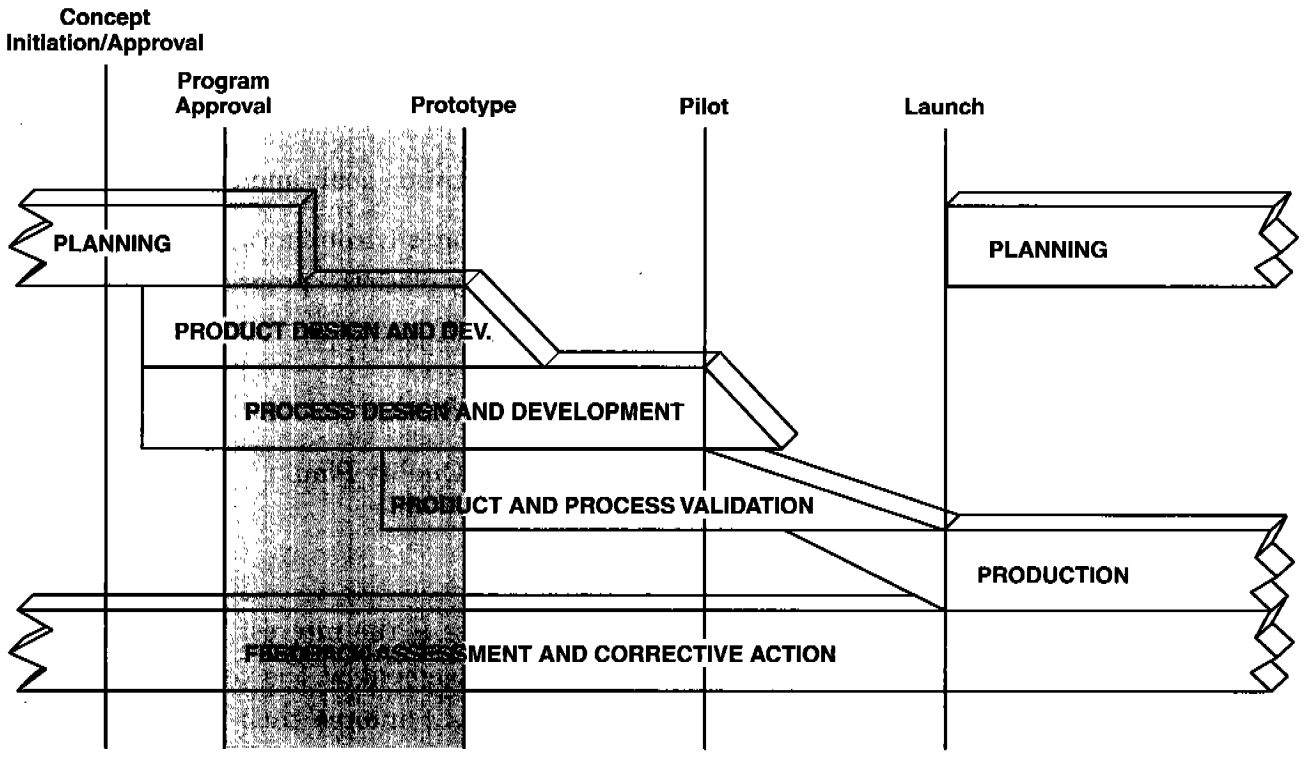
The Product Assurance Plan is an important part of the Product Quality Plan.

1.13 MANAGEMENT SUPPORT

One of the keys to the Product Quality Planning Team's success is the interest, commitment and support of upper management. The team should update management at the conclusion of every product quality planning phase to maintain their interest, plus reinforce their commitment and support. Updates and/or requests for assistance can occur more frequently as the team requires. The updates should be formal with the opportunity for questions and answers. A functional goal of the Product Quality Planning Team is to maintain management support by demonstrating that all planning requirements have been met and/or concerns documented and scheduled for resolution. Participation by management in product quality planning meetings is vital to ensuring the success of the program.

2.0 PRODUCT DESIGN AND DEVELOPMENT

PRODUCT QUALITY PLANNING TIMING CHART



OUTPUTS BY DESIGN RESPONSIBLE ACTIVITY

- Design Failure Mode and Effects Analysis (DFMEA)
- Design For Manufacturability and Assembly
- Design Verification
- Design Reviews
- Prototype Build
- Engineering Drawings (Including Math Data)
- Engineering Specifications
- Material Specifications
- Drawing and Specification Changes

OUTPUTS BY ADVANCED PRODUCT QUALITY PLANNING TEAM

- New Equipment, Tooling and Facilities Requirements
- Special Product and Process Characteristics
- Prototype Control Plan
- Gages/Testing Equipment Requirements
- Team Feasibility Commitment & Management Support

INTRODUCTION

This section discusses the elements of the planning process during which design features and characteristics are developed into a near final form. The Product Quality Planning Team should consider all design factors in the planning process even if the design is owned by the customer or shared. The steps include prototype build to verify that the product or service meets the objectives of the Voice of the Customer. A feasible design must permit meeting production volumes and schedules, and be consistent with the ability to meet engineering requirements, along with quality, reliability, investment cost, weight, unit cost and timing objectives. Although feasibility studies and control plans are primarily based on engineering drawings and specification requirements, valuable information can be derived from the analytical tools described in this section to further define and prioritize the characteristics that may need special product and process controls.

In this section, the Product Quality Planning Process is designed to assure a comprehensive and critical review of engineering requirements and other related technical information. At this stage of the process, a preliminary feasibility analysis will be made to assess the potential problems that could occur during manufacturing.

The inputs and outputs applicable to this section are as follows:

INPUTS (Derived from the outputs of Section 1.0.)

- Design Goals
- Reliability and Quality Goals
- Preliminary Bill of Material
- Preliminary Process Flow Chart
- Preliminary Listing of Special Product and Process Characteristics
- Product Assurance Plan
- Management Support

OUTPUTS BY DESIGN RESPONSIBLE ACTIVITY (Become inputs for Section 3.0.)

- Design Failure Mode and Effects Analysis (DFMEA)
- Design for Manufacturability and Assembly
- Design Verification
- Design Reviews
- Prototype Build – Control Plan
- Engineering Drawings (Including Math Data)
- Engineering Specifications

- Material Specifications
- Drawing and Specification Changes

OUTPUTS BY PRODUCT QUALITY PLANNING TEAM (Becomes Inputs for Section 3.0.)

- New Equipment, Tooling and Facilities Requirements
- Special Product and Process Characteristics
- Gages/Testing Equipment Requirements
- Team Feasibility Commitment and Management Support

2.1 DESIGN FAILURE MODE AND EFFECTS ANALYSIS (DFMEA)

The DFMEA is a disciplined analytical technique that assesses the probability of failure as well as the effect of such failure. A form of DFMEA is a Systems Failure Mode and Effects Analysis (SFMEA). A DFMEA is a living document continually updated as customer needs and expectations require. Preparing the DFMEA provides the team an opportunity to review the previously selected product and process characteristics and make necessary additions, changes, and deletions. The *Chrysler, Ford and General Motors Potential Failure Mode and Effects Analysis* reference manual should be used for the acceptable method of preparing a DFMEA. The Design FMEA Checklist in Appendix A-1 should also be reviewed to assure that the appropriate design characteristics have been considered.

2.2 DESIGN FOR MANUFACTURABILITY AND ASSEMBLY

Design for Manufacturability and Assembly is a Simultaneous Engineering process designed to optimize the relationship between design function, manufacturability, and ease of assembly. The scope of customer needs and expectations defined in Section 1.0 will determine the extent of the supplier's Product Quality Planning Team involvement in this activity. This manual does not include or refer to a formal method of preparing a Design for Manufacturability and Assembly Plan. At a minimum, the items listed here should be considered by the Product Quality Planning Team:

- Design, concept, function, and sensitivity to manufacturing variation
- Manufacturing and/or assembly process
- Dimensional tolerances
- Performance requirements
- Number of components
- Process adjustments
- Material Handling

The Product Quality Planning Team's knowledge, experience, the product/process, government regulations, and service requirements may require other factors to be considered.

2.3 DESIGN VERIFICATION

Design Verification verifies that the product design meets the customer requirements derived from the activities described in Section 1.0.

2.4 DESIGN REVIEWS

Design Reviews are regularly scheduled meetings led by the supplier's design engineering activity and must include other affected areas. The Design Review is an effective method to prevent problems and misunderstandings; it also provides a mechanism to monitor progress and report to management.

Design Reviews are a series of verification activities that are more than an engineering inspection. At a minimum Design Reviews should include evaluation of:

- Design/Functional requirement(s) considerations
- Formal reliability and confidence goals
- Component/subsystem/system duty cycles
- Computer simulation and bench test results
- DFMEA(s)
- Review of the Design For Manufacturability and Assembly effort
- Design Of Experiments (DOE) and assembly build variation results (Refer to Appendix B.)
- Test failures
- Design Verification progress

A major function of Design Reviews is the tracking of design verification progress. The supplier should track design verification progress through the use of a plan and report format, referred to as Design Verification Plan and Report (DVP&R) by Chrysler and Ford. The plan and report is a formal method to assure:

- Design verification
- Product and process validation of components and assemblies through the application of a comprehensive test plan and report.

The Product Quality Planning Team is not limited to the items listed. The team should consider and use as appropriate, the analytical techniques listed in Appendix B.

2.5 PROTOTYPE BUILD – CONTROL PLAN

Prototype Control Plans are a description of the dimensional measurements and material and functional tests that will occur during prototype build. The Product Quality Planning Team should ensure that a prototype control plan is prepared. Control plan methodology is described in Section 6. A Control Plan Checklist is provided in both Appendix A-8 and Section 6 to assist in the preparation of the prototype control plan.

The manufacture of prototype parts provides an excellent opportunity for the team and the customer to evaluate how well the product or service meets Voice of the Customer objectives. All prototypes that are the Product Quality Planning Team's responsibility should be reviewed to:

- Assure that the product or service meets specification and report data as required.
- Ensure that particular attention has been given to special product and process characteristics.
- Use data and experience to establish preliminary process parameters and packaging requirements.
- Communicate any concerns, deviations, and/or cost impact to the customer.

2.6 ENGINEERING DRAWINGS (Including Math Data)

Customer designs do not preclude the planning team's responsibility to review engineering drawings in the following manner. Engineering drawings may include special (governmental regulatory and safety) characteristics that must be shown on the control plan. When customer engineering drawings are nonexistent, the controlling drawings should be reviewed by the planning team to determine which characteristics affect fit, function, durability and/or governmental regulatory safety requirements.

Drawings should be reviewed to determine if there is sufficient information for a dimensional layout of the individual parts. Control or datum surfaces/locators should be clearly identified so that appropriate functional gages and equipment can be designed for ongoing controls. Dimensions should be evaluated to assure feasibility and compatibility with industry manufacturing and measuring standards. If appropriate, the team should assure that math data is compatible with the customer's system for effective two-way communications.

2.7 ENGINEERING SPECIFICATIONS

A detailed review and understanding of the controlling specifications will help the Product Quality Planning Team to identify the functional, durability and appearance requirements of the subject component or assembly. Sample size, frequency, and acceptance criteria of these parameters are generally defined in the in-process test section of the Engineering Specification. Otherwise, the sample size and frequency are to be determined by the supplier and listed in the control plan. In either case, the supplier should determine which characteristics affect or control the results that fulfill meeting functional, durability, and appearance requirements.

2.8 MATERIAL SPECIFICATIONS

In addition to drawings and performance specifications, material specifications should be reviewed for Special Characteristics relating to physical properties, performance, environmental, handling, and storage requirements. These characteristics should also be included in the control plan.

2.9 DRAWING AND SPECIFICATION CHANGES

Where drawing and specification changes are required, the team must ensure that the changes are promptly communicated and properly documented to all affected areas.

2.10 NEW EQUIPMENT, TOOLING AND FACILITIES REQUIREMENTS

The DFMEA, Product Assurance Plan and/or Design Reviews may identify new equipment and facilities requirements. The Product Quality Planning Team should address these requirements by adding the items to the Timing Chart. The team should ensure that the new equipment and tooling is capable and delivered on time. Facilities progress should be monitored to assure completion to surpass planned production tryout. Refer to the New Equipment, Tooling and Test Equipment Checklist in Appendix A-3.

2.11 SPECIAL PRODUCT AND PROCESS CHARACTERISTICS

In the stage of quality planning described in Section 1.0, the team identified preliminary special product and process characteristics resulting from understanding the Voice of the Customer. The Product Quality Planning Team should build on this listing and reach consensus during the review and development of design features through the evaluation of the technical information. Appendix C contains a table describing the symbols Chrysler, Ford and General Motors use to denote Special Characteristics. The consensus is to be documented on the appropriate Control Plan. The Control Plan Special Characteristics and Data Point Coordinates forms referenced in Section 6, Supplements K and L, are recommended methods to document and update Special Characteristics, as required, to support the Prototype, Pre-Launch, and Production Control Plans. The supplier can use any form that accomplishes the same documentation requirement. Customers may have unique approval requirements. Refer to *Chrysler, Ford, and General Motors Quality System Requirements,* Section III for details.

2.12 GAGES/TESTING EQUIPMENT REQUIREMENTS

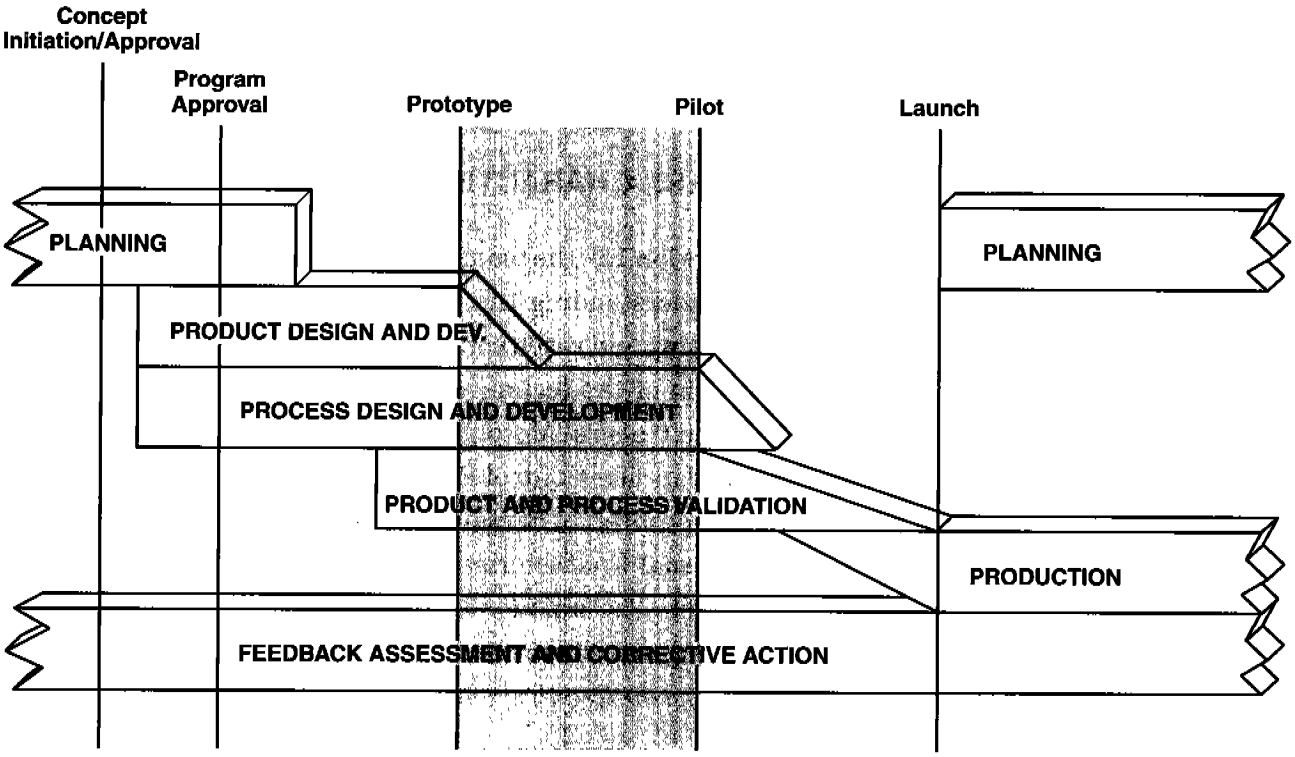
Gages/testing equipment requirements may also be identified at this time. The Product Quality Planning Team should add these requirements to the Timing Chart. Progress will then be monitored to assure that required timing is met.

2.13 TEAM FEASIBILITY COMMITMENT AND MANAGEMENT SUPPORT

The Product Quality Planning Team must assess the feasibility of the proposed design at this time. Customer design ownership does not preclude the supplier's obligation to assess design feasibility. The team must be satisfied that the proposed design can be manufactured, assembled, tested, packaged, and delivered in sufficient quantity, at an acceptable cost to the customer on schedule. The Design Information Checklist in Appendix A-2 allows the team to review its efforts in this section and make an evaluation of its effectiveness. This checklist will also serve as a basis for the open issues discussed in the Team Feasibility Commitment, Appendix E. The team consensus that the proposed design is feasible should be documented along with all open issues that require resolution and presented to management for their support. The Team Feasibility Commitment form shown in Appendix E is an example of the type of written record recommended.

3.0 PROCESS DESIGN AND DEVELOPMENT

PRODUCT QUALITY PLANNING TIMING CHART



OUTPUTS:

- Packaging Standards
- Product/Process Quality System Review
- Process Flow Chart
- Floor Plan Layout
- Characteristics Matrix
- PFMEA
- Pre-Launch Control Plan
- Process Instructions
- Measurement Systems Analysis Plan
- Preliminary Process Capability Study Plan
- Packaging Specifications
- Management Support

INTRODUCTION

This section discusses the major features of developing a manufacturing system and its related control plans to achieve quality products. The tasks to be accomplished at this step of the product quality planning process depend upon the successful completion of the prior stages contained in the first two sections. This next step is designed to ensure the comprehensive development of an effective manufacturing system. The manufacturing system must assure that customer requirements, needs and expectations are met.

The inputs and outputs applicable to the process step in this section are as follows:

INPUTS (Derived from the outputs of Section 2.0.)

- Design Failure Mode and Effects Analysis (DFMEA)
- Design for Manufacturability and Assembly
- Design Verification
- Design Reviews
- Prototype Build – Control Plan
- Engineering Drawings (Including Math Data)
- Engineering Specifications
- Material Specifications
- Drawing and Specification Changes
- New Equipment, Tooling and Facilities Requirements
- Special Product and Process Characteristics
- Gages/Testing Equipment Requirements
- Team Feasibility Commitment and Management Support

OUTPUTS (Become inputs for Section 4.0.)

- Packaging Standards
- Product/Process Quality System Review
- Process Flow Chart
- Floor Plan Layout
- Characteristics Matrix
- Process Failure Mode and Effects Analysis (PFMEA)
- Pre-Launch Control Plan
- Process Instructions

- Measurement Systems Analysis Plan
- Preliminary Process Capability Study Plan
- Packaging Specifications
- Management Support

3.1 PACKAGING STANDARDS

The customer will usually have packaging standards that should be incorporated into any packaging specifications for the product. If none are provided, the packaging design should ensure product integrity at point of use.

3.2 PRODUCT/PROCESS QUALITY SYSTEM REVIEW

The Product Quality Planning Team should review the manufacturing location's *Quality System Manual*. Any additional controls and/or procedural changes required to produce the product should be updated in the *Quality System Manual* and should also be included in the manufacturing control plan. This is an opportunity for the Product Quality Planning Team to improve the existing quality system based on customer input, team expertise, and previous experience. The Product/Process Quality Checklist provided in Appendix A-4 can be used by the Product Quality Planning Team to assist in its evaluation.

3.3 PROCESS FLOW CHART

The process flow chart is a schematic representation of the current or proposed process flow. It can be used to analyze sources of variations of machines, materials, methods, and manpower from the beginning to end of a manufacturing or assembly process. It is used to emphasize the impact of sources of variation on the process. The flow chart helps to analyze the total process rather than individual steps in the process. The flow chart assists the Product Quality Planning Team to focus on the process when conducting the PFMEA and designing the Control Plan. The Process Flow Chart Checklist in Appendix A-6 can be used by the Product Quality Planning Team to assist in its evaluation.

3.4 FLOOR PLAN LAYOUT

The floor plan should be developed and reviewed to determine the acceptability of inspection points, control chart location, applicability of visual aids, interim repair stations, and storage areas to contain defective material. All material flow should be keyed to the process flow chart and control plan. The Floor Plan Checklist in Appendix A-5 can be used by the Product Quality Planning Team to assist in its evaluation.

3.5 CHARACTERISTICS MATRIX

A characteristics matrix is a recommended analytical technique for displaying the relationship between process parameters and manufacturing stations. See Analytical Techniques in Appendix B for further detail.

3.6 PROCESS FAILURE MODE AND EFFECTS ANALYSIS (PFMEA)

A PFMEA should be conducted during product quality planning and before beginning production. It is a disciplined review and analysis of a new/revised process and is conducted to anticipate, resolve, or monitor potential process problems for a new/revised product program. A PFMEA is a living document and needs to be reviewed and updated as new failure modes are discovered.

For further information on the creation and maintenance of PFMEAs refer to *Chrysler, Ford and General Motors Potential Failure Mode and Effects Analysis* (FMEA) reference manual. The Process FMEA Checklist in Appendix A-7 can be used by the Product Quality Planning Team to assist in its evaluation.

3.7 PRE-LAUNCH CONTROL PLAN

Pre-launch Control Plans are a description of the dimensional measurements and material and functional tests that will occur after prototype and before full production. The pre-launch control plan should include additional product/process controls to be implemented until the production process is validated. The purpose of the pre-launch control plan is to contain potential nonconformances during or prior to initial production runs. Examples are:

- More frequent inspection
- More in-process and final check points
- Statistical evaluations
- Increased audits

For further information on the creation and maintenance of control plans refer to Section 6. The Control Plan Checklist in Appendix A-8 can be used by the Product Quality Planning Team to assist in its evaluation.

3.8 PROCESS INSTRUCTIONS

The Product Quality Planning Team should ensure that understandable process instructions provide sufficient detail for all operating personnel who have direct responsibility for the operation of the processes. These instructions should be developed from the following sources:

- FMEAs
- Control plan(s)
- Engineering drawings, performance specifications, material specifications, visual standards and industry standards
- Process flow chart
- Floor plan layout
- Characteristics matrix

- Packaging standards
- Process parameters
- Producer expertise and knowledge of the processes and products
- Handling requirements
- Operators of the Process

The process instructions for standard operating procedures should be posted and should include set-up parameters such as: machine speeds, feeds, cycle times, etc., and should be accessible to the operators and supervisors. Additional information for process instruction preparation can be found in the *Chrysler, Ford, and General Motors Quality System Requirements*.

3.9 MEASUREMENT SYSTEMS ANALYSIS PLAN

The Product Quality Planning Team should ensure that a plan to accomplish the required measurement systems analysis is developed. This plan should include, at a minimum, the responsibility to ensure gage linearity, accuracy, repeatability, reproducibility, and correlation for duplicate gages. Refer to the *Chrysler, Ford, and General Motors Measurement Systems Analysis Reference Manual.*

3.10 PRELIMINARY PROCESS CAPABILITY STUDY PLAN

The Product Quality Planning Team should ensure the development of a preliminary process capability plan. The characteristics identified in the control plan will serve as the basis for the preliminary process capability study plan. Reference the *Chrysler, Ford, and General Motors Production Part Approval Process* manual and *Chrysler, Ford, and General Motors Fundamental Statistical Process Control Reference Manual* for further definition.

3.11 PACKAGING SPECIFICATIONS

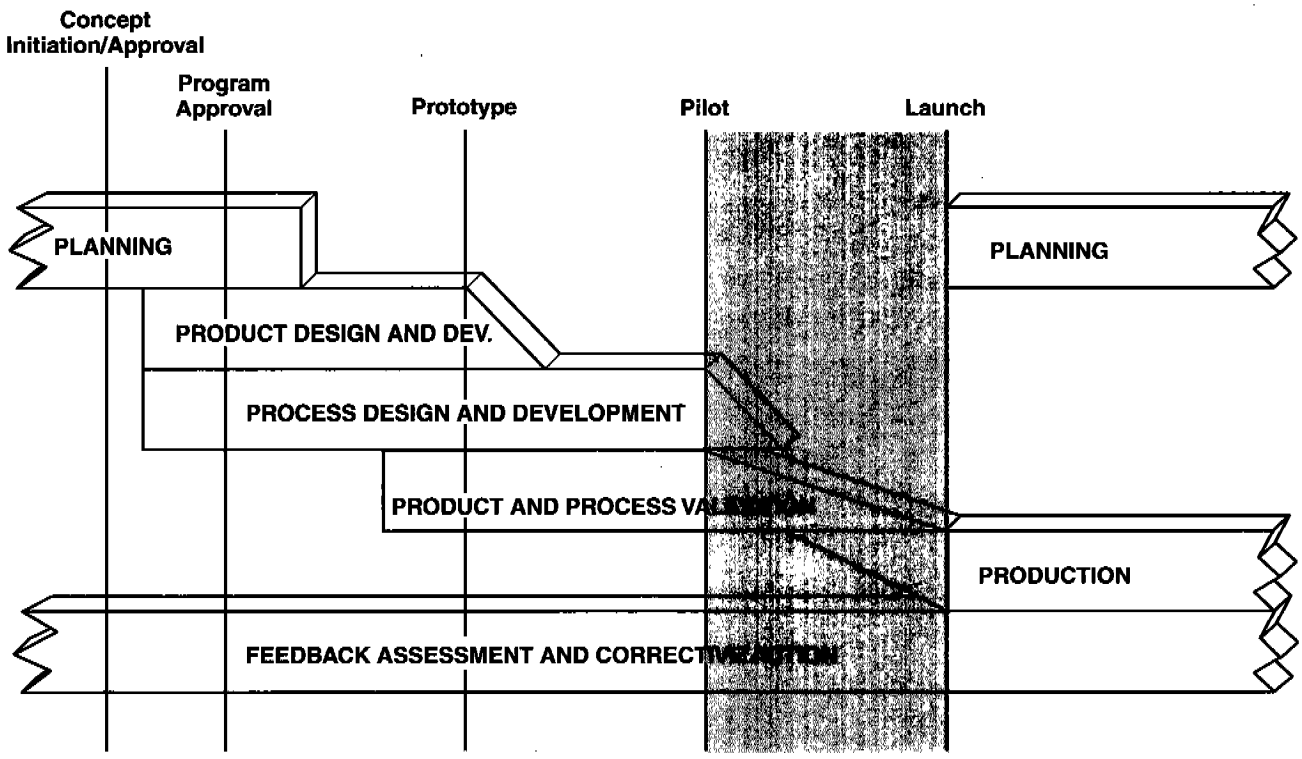
The Product Quality Planning Team should ensure that individual product packaging (including interior partitions) is designed and developed. Customer packaging standards or generic packaging requirements should be used when appropriate. In all cases the packaging design must assure that the product performance and characteristics will remain unchanged during packing, transit, and unpacking. The packaging should have compatibility with all material handling equipment including robots.

3.12 MANAGEMENT SUPPORT

The Product Quality Planning Team is required to schedule the formal review designed to reinforce management commitment at the conclusion of the process design and development phase. The purpose of this review is to inform upper management of program status and gain their commitment to assist in resolution of any open issues.

4.0 PRODUCT AND PROCESS VALIDATION

PRODUCT QUALITY PLANNING TIMING CHART



OUTPUTS:

- Production Trial Run
- Measurement Systems Evaluation
- Preliminary Process Capability Study
- Production Part Approval
- Production Validation Testing
- Packaging Evaluation
- Production Control Plan
- Quality Planning Sign-Off and Management Support

INTRODUCTION

This section discusses the major features of validating the manufacturing process through an evaluation of a production trial run. During a production trial run, the Product Quality Planning Team should validate that the control plan and process flow chart are being followed and the products meet customer requirements. Additional concerns should be identified for investigation and resolution prior to regular production runs.

The inputs and outputs applicable to the process steps in this section are as follows:

INPUTS (Derived from the outputs of Section 3.0.)

- Packaging Standards
- Product/Process Quality System Review
- Process Flow Chart
- Floor Plan Layout
- Characteristics Matrix
- Process Failure Mode and Effects Analysis (PFMEA)
- Pre-Launch Control Plan
- Process Instructions
- Measurement Systems Analysis Plan
- Preliminary Process Capability Study Plan
- Packaging Specifications
- Management Support

OUTPUTS (Become inputs for Section 5.0.)

- Production Trial Run
- Measurement Systems Evaluation
- Preliminary Process Capability Study
- Production Part Approval
- Production Validation Testing
- Packaging Evaluation
- Production Control Plan
- Quality Planning Sign-Off and Management Support

4.1 PRODUCTION TRIAL RUN

The production trial run must be conducted using production tooling, equipment, environment (including production operators), facility, and cycle time. The validation of the effectiveness of the

manufacturing process begins with the production trial run. The minimum quantity for a production trial run is usually set by the customer but can be exceeded by the Product Quality Planning Team. Output of the production trial run (product) is used for:

- Preliminary process capability study
- Measurement systems evaluation
- Final feasibility
- Process review
- Production validation testing
- Production part approval
- Packaging evaluation
- First time capability (FTC)
- Quality planning sign-off

4.2 MEASUREMENT SYSTEMS EVALUATION

The specified measurement devices and methods should be used to check the control plan identified characteristics to engineering specification and be subjected to measurement system evaluation during or prior to the production trial run. Refer to the *Chrysler, Ford, and General Motors Measurement Systems Analysis Reference Manual.*

4.3 PRELIMINARY PROCESS CAPABILITY STUDY

The preliminary process capability study should be performed on characteristics identified in the control plan. The study provides an assessment of the readiness of the process for production. Refer to the *Chrysler, Ford, and General Motors Production Part Approval Process* reference manual and *Chrysler, Ford, and General Motors Fundamental Statistical Process Control Reference Manual* for details concerning the preliminary process capability study.

4.4 PRODUCTION PART APPROVAL

The intent of production part approval is to validate that products made from production tools and processes meet engineering requirements. Refer to the *Chrysler, Ford, and General Motors Production Part Approval Process* reference manual.

4.5 PRODUCTION VALIDATION TESTING

Production validation testing refers to engineering tests that validate that products made from production tools and processes meet engineering standards. Refer to the *Chrysler, Ford, and General Motors Quality System Requirements* for specific requirements.

4.6 PACKAGING EVALUATION

All test shipments (where feasible) and test methods must assess the protection of the product from normal transportation damage and adverse environmental factors. Customer-specified packaging does not preclude the Product Quality Planning Team involvement in evaluating the packaging method.

4.7 PRODUCTION CONTROL PLAN

The production control plan is a written description of the systems for controlling parts and processes. The production control plan is a living document and should be updated to reflect the addition/deletion of controls based on experience gained by producing parts. (Approval of the procuring organization(s) may be required.) The production control plan is a logical extension of the pre-launch control plan. Mass production provides the producer the opportunity to evaluate output, review the control plan and make appropriate changes. Section 6 and Appendix A-8 present Control Plan Methodology and a checklist to assist the producer in this review. There can be other types of control plans. An example is the Ford Dynamic Control Plan (DCP) described in Appendix B and detailed in Appendix G.

4.8 QUALITY PLANNING SIGN-OFF AND MANAGEMENT SUPPORT

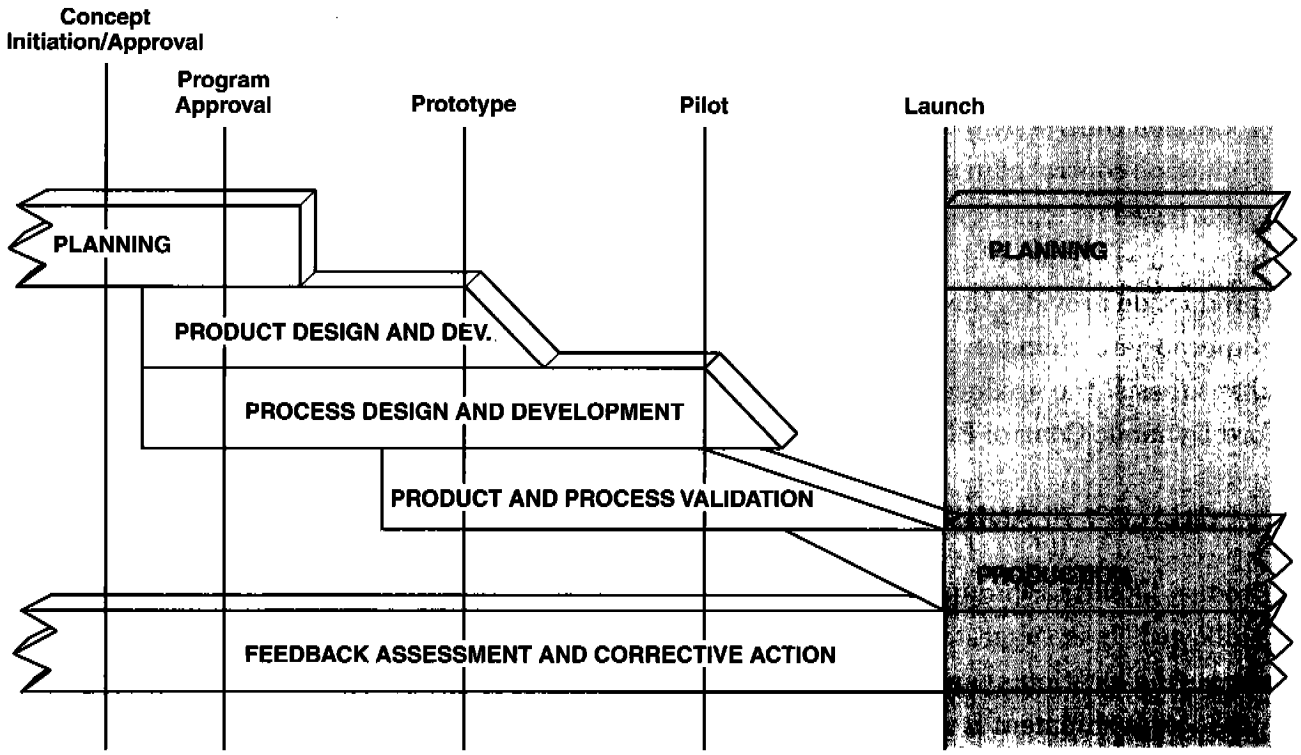
The Product Quality Planning Team should ensure that all control plans and process flow charts are being followed. It is suggested that the Product Quality Planning Team performs its review at the manufacturing location(s) and coordinates a formal sign-off. A review of the following items prior to first production shipment is required:

- Control Plans. Control plans should exist and be available at all times for all affected operations.
- Process Instructions. Verify that these documents contain all the Special Characteristics specified in the control plan and that all PFMEA recommendations have been addressed. Compare the process instructions and process flow chart to the control plan.
- Gage and Test Equipment. Where special gages, fixtures, or test equipment are required per the control plan, verify gage repeatability and reproducibility (GR&R) and proper usage. (Refer to Appendix D for Measurement Systems Analysis reference manual information.)

Management support is necessary prior to the quality planning sign-off. The team should be able to show that all planning requirements are met or concerns documented and schedule a management review. The purpose of this review is to inform upper management of program status and gain their commitment to assist in any open issues. The Product Quality Planning Summary and Sign-Off report shown in Appendix F is an example of the documentation required to support an effective quality planning sign-off.

5.0 FEEDBACK, ASSESSMENT AND CORRECTIVE ACTION

PRODUCT QUALITY PLANNING TIMING CHART



OUTPUTS:

- **Reduced Variation**
- **Customer Satisfaction**
- **Delivery and Service**

INTRODUCTION

Quality planning does not end with process validation and installation. It is the component manufacturing stage where output can be evaluated when all special and common causes of variation are present. This is also the time to evaluate the effectiveness of the product quality planning effort. The production control plan is the basis for evaluating product or service at this stage. Variable and attribute data must be evaluated. Appropriate actions as described in the *Chrysler, Ford, and General Motors Fundamental Statistical Process Control Reference Manual* must be taken. It is the obligation of all suppliers to meet customer requirements on all characteristics. Special Characteristics must meet the indices specified by the customer.

The inputs and outputs applicable to the process step in this section are as follows:

INPUTS (Derived from the outputs of Section 4.0.)

- Production Trial Run
- Measurement Systems Evaluation
- Preliminary Process Capability Study
- Production Part Approval
- Production Validation Testing
- Packaging Evaluation
- Production Control Plan
- Quality Planning Sign-Off and Management Support

OUTPUTS

- Reduced Variation
- Customer Satisfaction
- Delivery and Service

5.1 REDUCED VARIATION

Control charts and other statistical techniques should be used as tools to identify process variation. Analysis and corrective actions should be used to reduce variation. Continual improvement requires attention not only to the special causes of variation but understanding common causes and seeking ways to reduce these sources of variation. Proposals should be developed including costs, timing, and anticipated improvement for customer review. Often the reduction or elimination of a common cause results in lower costs. Suppliers should not be reluctant to prepare proposals based on value analysis, reduction of variation, etc. The decision to implement, negotiate, or progress to the next product design

level is the customer's prerogative. Refer to the *Chrysler, Ford, and General Motors Fundamental Statistical Process Control Reference Manual* for details on long-term capability, special and common causes of variation.

5.2 CUSTOMER SATISFACTION

Detailed planning activities and demonstrated process capability of a product or service do not always guarantee customer satisfaction. The product or service must perform in the customer environment. The product usage stage requires supplier participation. It is in this stage where the most can be learned by both the supplier and customer. The effectiveness of the Product Quality Planning efforts can be evaluated in this stage. The supplier and customer must be partners in making the changes necessary to correct deficiencies to achieve customer satisfaction.

5.3 DELIVERY AND SERVICE

The delivery and service stage of quality planning continues the supplier/customer partnership in solving problems and continual improvement. The customer's replacement parts and service operations always merit the same consideration in quality, cost, and delivery. Failure to correct a problem the first time always damages the supplier's reputation and customer partnership. It is important that both supplier and customer listen to the Voice of the Customer.

The experience gained in this stage provides the customer and supplier with the necessary knowledge to recommend price reductions achieved by reducing process, inventory, and quality costs and to provide the right component or system for the next product.

CONTROL PLAN

METHODOLOGY

CONTROL PLAN Page ____ Of____

☐ Prototype ☐ Pre-launch ☐ Production Control Plan Number	Key Contact/Phone	Date (Orig.)	Date (Rev.)
Part Number/Latest Change Level	Core Team	Customer Engineering Approval/Date (If Req'd.)	
Part Name/Description	Supplier/Plant Approval/Date	Customer Quality Approval/Date (If Req'd.)	
Supplier/Plant / Supplier Code	Other Approval/Date (If Req'd.)	Other Approval/Date (If Req'd.)	

Part/ Process Number	Process Name/ Operation Description	Machine, Device, Jig, Tools For Mfg.	Characteristics			Spacial Char. Class.	Methods					Reaction Plan
			No.	Product	Process		Product/Process Specification/ Tolerance	Evaluation/ Measurement Technique	Sample Size	Sample Freq.	Control Method	

6.1 TABLE OF CONTENTS

6.2 OVERVIEW

The purpose of this Control Plan methodology is to aid in the manufacture of quality products according to customer requirements. It does this by providing a structured approach for the design, selection and implementation of value-added control methods for the total system. Controls Plans provide a written summary description of the systems used in minimizing process and product variation. The intent of the Control Plan form displayed in this section is to provide an example of how this information can be documented. An alternate format may be used as long as it contains the same information, as a minimum. The Control Plan does not replace the information contained in detailed operator instructions. This methodology is applicable to a wide range of manufacturing processes and technologies. The Control Plan is an integral part of an overall quality process and is to be utilized as a living document. Therefore this section should be used in conjunction with other related documents.

An important phase of the process for quality planning is the development of a Control Plan. A Control Plan is a written description of the system for controlling parts and processes. A single Control Plan may apply to a group or family of products that are produced by the same process at the same source. Sketches, as necessary, may be attached to the Control Plan for illustration purposes. In support of a Control Plan, process monitoring instructions should be defined and used continually.

In effect, the Control Plan describes the actions that are required at each phase of the process including receiving, in-process, out-going, and periodic requirements to assure that all process outputs will be in a state of control. During regular production runs, the Control Plan provides the process monitoring and control methods that will be used to control characteristics. Since processes are expected to be continually updated and improved, the Control Plan reflects a strategy that is responsive to these changing process conditions.

The Control Plan is maintained and used throughout the product life cycle. Early in the product life cycle its primary purpose is to document and communicate the initial plan for process control. Subsequently, it guides manufacturing in how to control the process and ensure product quality. Ultimately, the Control Plan remains a living document, reflecting the current methods of control, and measurement systems used. The Control Plan is updated as measurement systems and control methods are evaluated and improved.

CONTROL PLAN

(1) Page _____ of _____

☐ Prototype ☐ Pre-launch ☐ Production Control Plan Number (2)	Key Contact/Phone (7)	Date (Orig.) (10)	Date (Rev.) (11)
Part Number/Latest Change Level (3)	Core Team (8)	Customer Engineering Approval/Date (If Req'd.) (12)	
Part Name/Description (4)	Supplier/Plant Approval/Date (9)	Customer Quality Approval/Date (If Req'd.) (13)	
Supplier/Plant (5) / Supplier Code (6)	Other Approval/Date (If Req'd.) (14)	Other Approval/Date (If Req'd.) (14)	

Part/ Process Number (15)	Process Name/ Operation Description (16)	Machine, Device, Jig, Tools For Mfg. (17)	Characteristics			Special Char. Class. (21)	Methods					Reaction Plan (26)
			No. (18)	Product (19)	Process (20)		Product/Process Specification/ Tolerance (22)	Evaluation/ Measurement Technique (23)	(24) Sample Size	(24) Sample Freq.	Control Method (25)	

For process control and improvement to be effective, a basic understanding of the process must be obtained. A multi-disciplined team is established to develop the Control Plan by utilizing all the available information to gain a better understanding of the process, such as:

- Process Flow Diagram
- System/Design/Process Failure Mode and Effects Analysis
- Special Characteristics
- Lessons Learned from Similar Parts
- Team's Knowledge of the Process
- Design Reviews
- Optimization Methods (e.g., QFD, DOE, etc.)

The benefits of developing and implementing a Control Plan include:

Quality: The Control Plan Methodology reduces waste and improves the quality of products during design, manufacturing, and assembly. This structured discipline provides a thorough evaluation of the product and process. Control Plans identify process characteristics and help to identify their sources of variation (input variables), which cause variation in product characteristics (output variables).

Customer Satisfaction: Control Plans focus resources on processes and products related to characteristics that are important to the customer. The proper allocation of resources on these major items helps to reduce costs without sacrificing quality.

Communication: As a living document the Control Plan identifies and communicates changes in the product/process characteristics, control method, and characteristic measurement.

CONTROL PLAN

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(1)

Prototype ☐ Pre-launch ☐ Production

Control Plan Number (2)

Part Number/Latest Change Level (3)

Part Name/Description (4)

Supplier/Plant (5)

Supplier Code (6)

Key Contact/Phone (7)

Core Team (8)

Supplier/Plant Approval/Date (9)

Other Approval/Date (If Req'd.) (14)

Date (Orig.) (10)

Date (Rev.) (11)

Customer Engineering Approval/Date (If Req'd.) (12)

Customer Quality Approval/Date (If Req'd.) (13)

Other Approval/Date (If Req'd.) (14)

Part/ Process Number (15)	Process Name/ Operation Description (16)	Machine, Device, Jig, Tools For Mfg. (17)	Characteristics			Special Char. Class. (21)	Methods					Reaction Plan (26)
			No. (18)	Product (19)	Process (20)		Product/Process Specification/ Tolerance (22)	Evaluation/ Measurement Technique (23)	Sample (24) Size	Sample (24) Freq.	Control Method (25)	

6.3 CONTROL PLAN COLUMN DESCRIPTIONS

1)	PROTOTYPE, PRE-LAUNCH, PRODUCTION	Indicate the appropriate category. • Prototype - A description of the dimensional measurements material and performance tests occurring during Prototype build. • Pre-launch - A description of the dimensional measurements, material and performance tests that will occur after Prototype and before normal Production. • Production - A comprehensive documentation of product/process characteristics, process controls, tests, and measurement systems occurring during normal production.
2)	CONTROL PLAN NUMBER	Enter the control plan document number used for tracking, if applicable. For multiple control pages, enter page number (page __ of __).
3)	PART NUMBER LATEST CHANGE LEVEL	Enter the number of the system, subsystem or component being controlled. When applicable, enter the latest engineering change level and/or issue date from the drawing specification.
4)	PART NAME/ DESCRIPTION	Enter the name and description of the product/process being controlled.
5)	SUPPLIER/PLANT	Enter the name of the company and the appropriate division/plant/department preparing the control plan.
6)	SUPPLIER CODE	Enter the identification number (Duns, Z-Code, GSDB...) as requested by the procuring organization.
7)	KEY CONTACT/ PHONE	Enter the name and telephone number of the primary contact responsible for the control plan.
8)	CORE TEAM	Enter the name(s) and telephone number(s) of the individual(s) responsible for preparing the Control Plan to the latest revision. It is recommended that all of the team members' names, phone numbers, and locations be included on an attached distribution list.
9)	SUPPLIER/PLANT APPROVAL/DATE	Obtain the responsible manufacturing plant approval (if required).

CONTROL PLAN

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(1) ☐ Prototype ☐ Pre-launch ☐ Production Control Plan Number (2)	Key Contact/Phone (7)	Date (Orig.) (10)	Date (Rev.) (11)
Part Number/Latest Change Level (3)	Core Team (8)	Customer Engineering Approval/Date (If Req'd.) (12)	
Part Name/Description (4)	Supplier/Plant Approval/Date (9)	Customer Quality Approval/Date (If Req'd.) (13)	
Supplier/Plant (5)	Supplier Code (6)	Other Approval/Date (If Req'd.) (14)	Other Approval/Date (If Req'd.) (14)

Part/ Process Number (15)	Process Name/ Operation Description (16)	Machine, Device, Jig, Tools For Mfg. (17)	Characteristics			Special Char. Class. (21)	Methods					Reaction Plan (26)
			No. (18)	Product (19)	Process (20)		Product/Process Specification/ Tolerance (22)	Evaluation/ Measurement Technique (23)	Sample (24) Size	Sample (24) Freq.	Control Method (25)	

10)	DATE (ORIG.)	Enter the date that the original control plan was compiled.
11)	DATE (REV.)	Enter the date of the latest Control Plan updates.
12)	CUSTOMER ENGINEERING APPROVAL/DATE	Obtain the responsible engineering approval (if required).
13)	CUSTOMER QUALITY APPROVAL/DATE	Obtain the responsible supplier quality representative approval (if required).
14)	OTHER APPROVAL/ DATE	Obtain any other agreed upon approval (if required).
15)	PART/PROCESS NUMBER	This item number is usually referenced from the Process Flow Chart. If multiple part numbers exist (assembly), list the individual part numbers and their processes accordingly.
16)	PROCESS NAME/ OPERATION DESCRIPTION	All steps in the manufacturing of a system, subsystem, or component are described in a process flow diagram. Identify the process/operation name from the flow diagram that best describes the activity being addressed.
17)	MACHINE, DEVICE, JIG, TOOLS FOR MANUFACTURING	For each operation that is described, identify the processing equipment, e.g., machine, device, jig, or other tools for manufacturing, as appropriate.

CHARACTERISTICS A distinguishing feature, dimension or property of a process or its output (product) on which variable or attribute data can be collected. Use visual aids where applicable.

18)	NUMBER	Enter a cross reference number from all applicable documents such as, but not limited to, process flow diagram, numbered blue print, FMEAs, and sketches (computer generated or otherwise), if required. Optional example work sheets and explanation of these work sheets are located in Supplements K and L of this section.

CONTROL PLAN

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☐ Prototype ☐ Pre-launch ☐ Production Control Plan Number (2)	Key Contact/Phone (7)	Date (Orig.) (10)	Date (Rev.) (11)
Part Number/Latest Change Level (3)	Core Team (8)	Customer Engineering Approval/Date (If Req'd.) (12)	
Part Name/Description (4)	Supplier/Plant Approval/Date (9)	Customer Quality Approval/Date (If Req'd.) (13)	
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Part/ Process Number (15)	Process Name/ Operation Description (16)	Machine, Device, Jig, Tools For Mfg. (17)	Characteristics			Special Char. Class (21)	Methods					Reaction Plan (26)
			No. (18)	Product (19)	Process (20)		Product/Process Specification/ Tolerance (22)	Evaluation/ Measurement Technique (23)	Sample (24) Size	Sample (24) Freq.	Control Method (25)	

19)	PRODUCT	Product Characteristics are the features or properties of a part, component or assembly that are described on drawings or other primary engineering information. The Core Team should identify the Special Product Characteristics that are a compilation of important Product Characteristics from all sources. All Special Characteristics must be listed on the Control Plan. In addition, the manufacturer may list other Product Characteristics for which process controls are routinely tracked during normal operations.
20)	PROCESS	Process Characteristics are the process variables (input variables) that have a cause and effect relationship with the identified Product Characteristic. A Process Characteristic can only be measured at the time it occurs. The Core Team should identify Process Characteristics for which variation must be controlled to minimize product variation. There could be one or more Process Characteristics listed for each Product Characteristic. In some processes one Process Characteristic may affect several Product Characteristics.
21)	SPECIAL CHARACTERISTIC CLASSIFICATION	Use the appropriate classification as required by the OEM, to designate the type of special characteristic or this field can be left blank for other undesignated characteristics. Customers may use unique symbols to identify important characteristics, such as those that affect customer safety, compliance with regulations, function, fit, or appearance. These characteristics are variously termed, "Critical," "Key," "Safety," or "Significant." Appendix C provides a cross reference to these symbols and descriptive terms.

CONTROL PLAN

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(1) ☐ Prototype ☐ Pre-launch ☐ Production Control Plan Number (2)	Key Contact/Phone (7)	Date (Orig.) (10)	Date (Rev.) (11)
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Part Name/Description (4)	Supplier/Plant Approval/Date (9)	Customer Quality Approval/Date (If Req'd.) (13)	
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Part/ Process Number (15)	Process Name/ Operation Description (16)	Machine, Device, Jig, Tools For Mfg. (17)	Characteristics			Special Char. Class. (21)	Methods				Control Method (25)	Reaction Plan (26)
			No. (18)	Product (19)	Process (20)		Product/Process Specification/ Tolerance (22)	Evaluation/ Measurement Technique (23)	Sample (24) Size	Sample (24) Freq.		

METHODS A systematic plan using procedures and other tools to control a process.

22) PRODUCT/PROCESS SPECIFICATION/ TOLERANCE

Specifications/tolerance may be obtained from various engineering documents, such as, but not limited to, drawings, design reviews, material standard, computer-aided design data, manufacturing, and/or assembly requirements.

23) EVALUATION/ MEASUREMENT TECHNIQUE

This column identifies the measurement system being used. This could include gages, fixtures, tools, and/or test equipment required to measure the part/process/manufacturing equipment. An analysis of the linearity, reproducibility, repeatability, stability and accuracy of the measurement system should be done prior to relying on a measurement system and improvements made accordingly.

24) SAMPLE SIZE/ FREQUENCY

When sampling is required list the corresponding sample size and frequency.

25) CONTROL METHOD

This column contains a brief description of how the operation will be controlled, including procedure numbers where applicable. The control method utilized should be based on effective analysis of the process. The control method is determined by the type of process that exists. Operations may be controlled by, but are not limited to, Statistical Process Control, inspection, attribute data, mistake-proofing, (automated/non-automated), and sampling plans. Refer to the examples for how typical processes are controlled. The Control Plan descriptions should reflect the planning and strategy being implemented in the manufacturing process. If elaborate control procedures are used, the plan will typically reference the procedure document by a specific identification name and/or number.

The method of control should be continually evaluated for effectiveness of process control. For example, significant changes in the process or process capability should lead to an evaluation of the control method.

CONTROL PLAN

(1) Page _____ of _____

☐ Prototype ☐ Pre-launch ☐ Production Control Plan Number (2)	Key Contact/Phone (7)	Date (Orig.) (10)	Date (Rev.) (11)
Part Number/Latest Change Level (3)	Core Team (8)	Customer Engineering Approval/Date (If Req'd.) (12)	
Part Name/Description (4)	Supplier/Plant Approval/Date (9)	Customer Quality Approval/Date (If Req'd.) (13)	
Supplier/Plant (5) / Supplier Code (6)	Other Approval/Date (If Req'd.) (14)	Other Approval/Date (If Req'd.) (14)	

Part/ Process Number (15)	Process Name/ Operation Description (16)	Machine, Device, Jig, Tools For Mfg. (17)	Characteristics			Special Char. Class. (21)	Methods					Reaction Plan (26)
			No. (18)	Product (19)	Process (20)		Product/Process Specification/ Tolerance (22)	Evaluation/ Measurement Technique (23)	Sample (24) Size	Sample (24) Freq.	Control Method (25)	

26) REACTION PLAN

The reaction plan specifies the corrective actions necessary to avoid producing nonconforming products or operating out of control. The actions should normally be the responsibility of the people closest to the process, the operator, jobsetter, or supervisor, and be clearly designated in the plan. Provisions should be made for documenting.

In all cases, suspect and nonconforming products must be clearly identified and quarantined, and disposition made by the responsible person designated in the reaction plan. This column may also refer to a specific reaction plan number and identify the person responsible for the reaction plan.

6.4 PROCESS ANALYSIS

Different types of processes present challenges and opportunities for control and reduction of variation. The process types can be related to their most common sources of variation or the dominant factors in determining the quality of the product. There are many effective methods of performing process analysis. It is up to the supplier to determine the best method to analyze the process. Examples are:

- Fault Tree Analysis
- Design of Experiments
- Cause and Effect (see Figure 1)

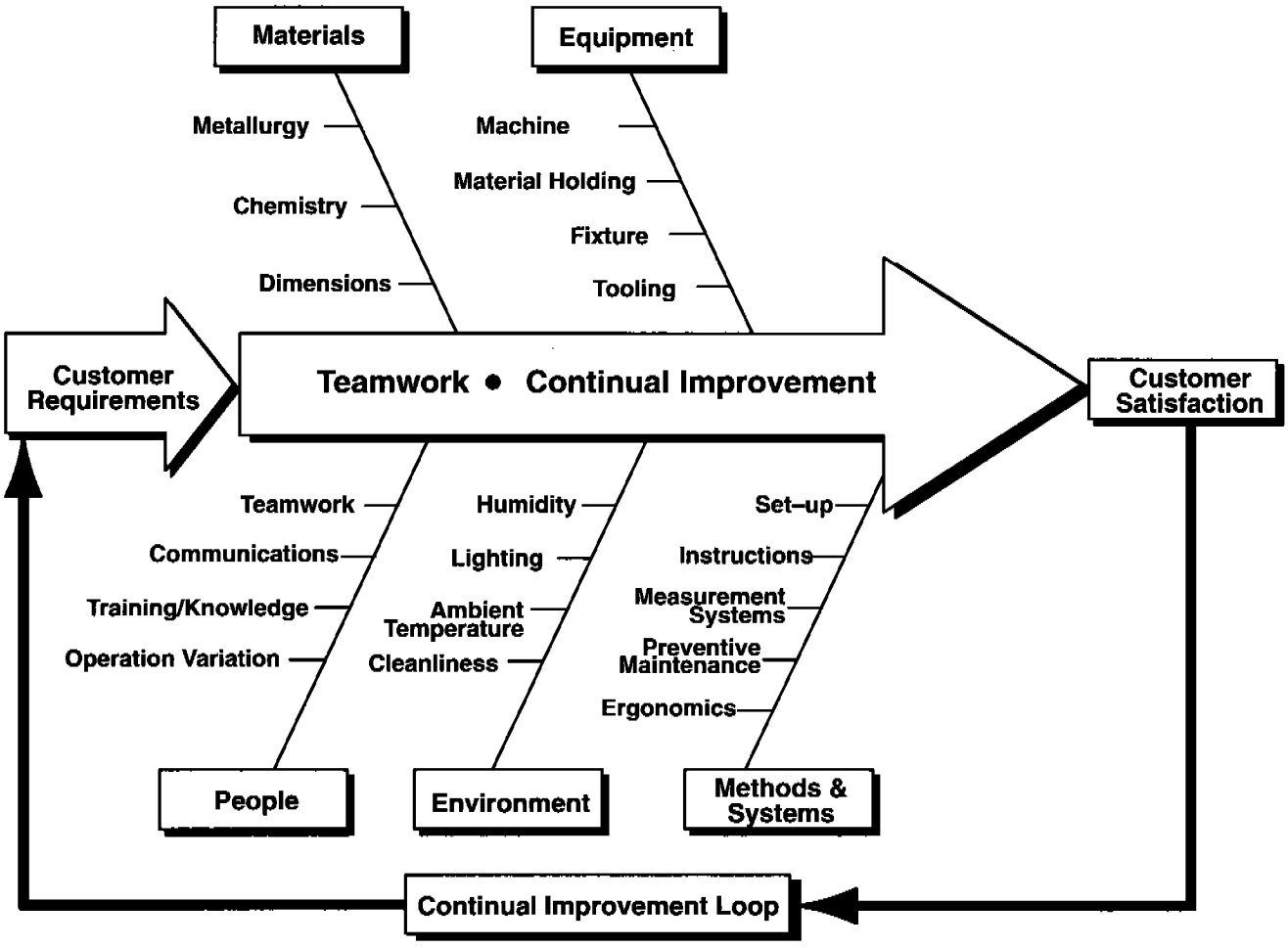


Figure 1

Figure 1 organizes the types of processes into the cause and effect model, where the primary groupings are: People, Materials, Equipment, Methods and Systems, and Environment. Examples describe manufacturing and assembly situations with a corresponding Control Plan to show a typical document as depicted in the following pages. The key to successful development of cost effective processes is identification of the sources of variation and appropriate control methods.

6.5 SUPPLEMENTS

EQUIPMENT: SET-UP DOMINANT PROCESS: The process is highly capable and stable, therefore set-up is major variable impacting product variation. Automobile grills are produced on plastic injection molding machines. After set-up of the mold, the machine must be adjusted to produce a dimensionally-correct part. Parts must also be free of blemishes, flow lines and sink marks on the surface. The molding machine is highly repeatable because all parameters are computer controlled. A set-up card provides specifications for setting all controls on the machine. After setting the machine to the specifications a sample part is produced. This part is checked for the key control dimensions for mounting holes and perimeter fit, and visually inspected.

- The set-up is the critical variable in this type of process. Capability studies on the product characteristics show that when properly set up, the operation is highly capable and stable. The set-up specifications become the process characteristics that affect the product characteristic.
- Types of controls for the process characteristic include first piece check procedures, and verification that machine settings are correct to authorized set-up cards.
- Product characteristics are measured to insure the set-up is correct and that no unusual special cause has occurred. In some cases lot control may be appropriate between checks.

CONTROL PLAN

Page 4 of 23

[ ] Prototype [ ] Pre-launch [X] Production Control Plan Number: 001	Key Contact/Phone J. Davis /313-555-5555	Date (Orig.) 1-26-92	Date (Rev.) 2-2-92
Part Number/Latest Change Level 22521211/G 11-2-92	Core Team Product Development Team (E01) - See List	Customer Engineering Approval/Date (If Req'd)	
Part Name/Description Plastic Injection Molded Grill	Supplier/Plant Approval/Date	Customer Quality Approval/Date (If Req'd)	
Supplier/Plant 4-B Grill Co. Plant #3 / Supplier Code: 0123	Other Approval/Date (If Req'd)	Other Approval/Date (If Req'd)	

Part/ Process Number	Process Name/ Operation Description	Machine, Device, Jig, Tools For Mfg.	Characteristics			Special Char. Class.	Methods						Reaction Plan
			No.	Product	Process		Product/Process Specification/ Tolerance	Evaluation Measurement Technique	Sample Size	Sample Freq.	Control Method		
3	Plastic Injection Molding	Machine No. 1–5	18	Appearance		*	Free of blemishes	Visual inspection	100%	Continuous	100% inspection		Notify supervisor
				No blemishes			flowlines	1st piece buy–off			Check sheet		Adjust/re-check
							sink marks	1st piece buy-off			Check sheet		Adjust/re-check
		Machine No. 1–5	19	Mounting hole loc.		*	Hole "X" location	Fixture #10	1st piece	buy–off per run	Check sheet		Adjust/re-check
							25 ± 1mm		5 pcs	hr	$\bar{x}$–R chart		Quarantine and adjust
		Machine No. 1–5	20	Dimension		*	Gap 3 ± .5mm	Fixture #10	1st piece	buy–off per run	Check sheet		Adjust and recheck
		Fixture #10	21	Perimeter fit		*	Gap 3 ± .5mm	Check gap to fixture 4 locations	5 pcs	hr	$\bar{x}$–R chart		Quarantine and adjust
		Machine No. 1–5	22		Set–up of mold machine		See attached set-up card	Review of set–up card and machine settings		Each set–up	1st Piece buy–off		Adjust and reset machine
											Inspector verifies settings		

* Reference Appendix C

EXAMPLES ARE FOR REFERENCE ONLY. REFER TO SPECIFIC CUSTOMER REQUIREMENTS.

EQUIPMENT: MACHINE DOMINANT PROCESS: Machine parameters are the variables affecting the process output.

A supplier manufactures a circuit board with electronic components soldered on the board. Properly soldered connections are the major product characteristics. Two major process characteristics for the wave solder machine, are solder level and flux concentration. An automated feeder controls the solder level by sensing the level of solder and feeding in additional solder as the level is reduced. The flux must be sampled and tested for the concentration level. The Special Product Characteristic is measured 100% by checking electrically for continuity.

- Machine settings are the variables that have the major effect on the output for this type of process. These process characteristics are the variables that need to be controlled and measured to ensure that all products meet the customer's requirements.
- Types of controls include self-adjusting devices on the parameters and statistical measurements taken on the process parameters and recorded on control charts (i.e. $\bar{x}$-bar R charts).
- Product characteristics are measured using error proofing methods or statistical sampling to insure that all products meet the customer's requirements.

CONTROL PLAN

[ ] Prototype [ ] Pre-launch [X] Production Control Plan Number 002	Key Contact/Phone T. Smith/313-555-5555	Date (Orig.) 1-1-92	Date (Rev.) 2-20-93
Part Number/Latest Change Level Circuit 10/8	Core Team See attached	Customer Engineering Approval/Date (If Req'd)	
Part Name/Description Electronic Circuit Board	Supplier/Plant Approval/Date	Customer Quality Approval/Date (If Req'd)	
Supplier/Plant ACR Control / Supplier Code 439412	Other Approval/Date (If Req'd)	Other Approval/Date (If Req'd)	

Part/ Process Number	Process Name/ Operation Description	Machine, Device, Jig, Tools For Mfg.	Characteristics			Special Char. Class.	Methods						Reaction Plan
			No.	Product	Process		Product/Process Specification/ Tolerance	Evaluation Measurement Technique	Sample Size	Sample Freq.	Control Method		
2	Soldering connections	Wave solder machine		Wave solder height		*	2.0 ± 0.25mc	Sensor continuity check	100%	Continuous	Automated inspection (error proofing)		Adjust and retest
					Flux concentration		Standard #302B	Test sampling lab environment	1 pc	4 hours	x–MR chart		Segregate and retest

* Reference Appendix C

EXAMPLES ARE FOR REFERENCE ONLY. REFER TO SPECIFIC CUSTOMER REQUIREMENTS.

EQUIPMENT: FIXTURE/PALLET DOMINANT PROCESS: Fixture-to-fixture variation causes product variation.

Metal castings are loaded on a seven-stage rotary machine with several fixtures which rotary machine rotates under a cutting head. Each part has a machined surface on which perpendicularity and depth of cut are critical. The depth of cut and perpendicularity are major product characteristics. Besides the cutting tool, the removal of debris and proper adjustment of the fixtures can significantly affect the special product characteristic.

- The process characteristic includes variation between fixtures or pallets. The dimensional differences between fixtures or pallets and part location contribute to product variation. In addition, debris accumulated on the fixture can cause fixture-to-fixture variation of part location.
- Types of controls for fixture/pallet process characteristics are driven by loading procedures, fixture/pallet adjustments and maintenance (i.e. cleaning).
- Process characteristics are often difficult to measure in fixture/pallet dominant processes. Therefore, frequent statistical product sampling may be required for Special Product Characteristics.

CONTROL PLAN

Page 1 of 10

[ ] Prototype [ ] Pre-launch [X] Production Control Plan Number 12345M	Key Contact/Phone A. B. Casting 813-123-4567	Date (Orig.) 9-9-92	Date (Rev.) 2-20-93
Part Number/Latest Change Level 54321231/D	Core Team See attached list	Customer Engineering Approval/Date (If Req'd)	
Part Name/Description Engine Block	Supplier/Plant Approval/Date	Customer Quality Approval/Date (If Req'd)	
Supplier/Plant ABC Company/Plant #2 / Supplier Code 12345M	Other Approval/Date (If Req'd)	Other Approval/Date (If Req'd)	

Part/ Process Number	Process Name/ Operation Description	Machine, Device, Jig, Tools For Mfg.	Characteristics			Special Char. Class.	Methods					Reaction Plan
			No.	Product	Process		Product/Process Specification/ Tolerance	Evaluation Measurement Technique	Sample Size	Sample Freq.	Control Method	
3	Machine surface "A"	Rotary machine	51	Depth of cut		*	2 ± 0.25"	Depth gage	5	per hr per fixture	$\bar{x}$ –R chart	Quarantine adjust and reset
		Holding fixture #10	52	Perpendicular cut		*	90° ± 1°	Gage 050	1 pc	every 4 hrs	x –MR chart	Quarantine adjust and reset
		Holding fixture #10	53		Hold casting in fixture for proper orientation		Fixture free from debris	Visual inspection	1 pc	After each cycle	Air blow–off	Readjust air blow–off

* Reference Appendix C

EXAMPLES ARE FOR REFERENCE ONLY. REFER TO SPECIFIC CUSTOMER REQUIREMENTS.

EQUIPMENT: TOOLING DOMINANT PROCESS: Tool life and design characteristics are the variables affecting the process output.

A sheet metal stamping die is used to form a steel bracket that has several angles and a pierced hole. The pierced hole diameter will not vary significantly; therefore it is not marked as a Special Characteristic. The presence of the hole is critical to the part. The angles on the part are critical and two angles are marked as Special Characteristics. Historically, broken hole punches are a problem with this type of tooling. Further, moving parts in the tool can vary when forming the angles in the bracket.

- The process characteristic is the tooling. Tools can have details that break or moving parts that intermittently/permanently fail to move. Tools can also wear or be repaired incorrectly. The product characteristics are affected by these tooling problems.
- Types of controls for tooling dominant processes are mainly seen in the product. First piece check can verify that a tool has been properly repaired. When in operation a tool failure may go unnoticed except in the part, therefore lot control is appropriate. Error proofing techniques that check for holes or a dimension are also needed.
- Product characteristics are a very important measure of proper tool life performance.

CONTROL PLAN

[ ] Prototype [ ] Pre-launch [X] Production Control Plan Number 004	Key Contact/Phone A. C Brown/206-555-1234	Date (Orig.) 9-9-92	Date (Rev.) 2-4-93
Part Number/Latest Change Level 4321234/E	Core Team See attached list	Customer Engineering Approval/Date (If Req'd)	
Part Name/Description Seat Bracket	Supplier/Plant Approval/Date	Customer Quality Approval/Date (If Req'd)	
Supplier/Plant Ace Stamping / Supplier Code 23456N	Other Approval/Date (If Req'd)	Other Approval/Date (If Req'd)	

Part/ Process Number	Process Name/ Operation Description	Machine, Device, Jig, Tools For Mfg.	Characteristics			Special Char. Class.	Methods				Control Method	Reaction Plan
			No.	Product	Process		Product/Process Specification/ Tolerance	Evaluation Measurement Technique	Sample Size	Sample Freq.		
4	Form metal bracket	Stamping die (13–19)	6	Hole			Presence of hole	Light beam/light sensor	100%	ongoing	Automated inspection (error proofing)	Segregate and replace hole punch

* Reference Appendix C

EQUIPMENT: TOOLING DOMINANT PROCESS: Tool life and design characteristics are the variables affecting the process output.

A broach is used to form the internal spline teeth on a steel propshaft yoke. The pitch diameter of internal spline teeth is the Special Product Characteristic.

- The sharpened tool is checked on a visual comparator for correct pitch diameter and relief angle prior to being approved for production.
- First piece of a production run is checked for sharpness of cut and correct pitch diameter.

CONTROL PLAN

[ ] Prototype [ ] Pre-launch [X] Production Control Plan Number **002**	Key Contact/Phone **T. Thomas 313-555-1234**	Date (Orig.) **3-7-93**	Date (Rev.)
Part Number/Latest Change Level **9873245/A**	Core Team **See attached list**	Customer Engineering Approval/Date (If Req'd)	
Part Name/Description **Yoke Propshaft**	Supplier/Plant Approval/Date	Customer Quality Approval/Date (If Req'd)	
Supplier/Plant **Key Machine** / Supplier Code **17532B**	Other Approval/Date (If Req'd)	Other Approval/Date (If Req'd)	

Part/ Process Number	Process Name/ Operation Description	Machine, Device, Jig, Tools For Mfg.	Characteristics			Special Char. Class.	Methods					Reaction Plan
			No.	Product	Process		Product/Process Specification/ Tolerance	Evaluation Measurement Technique	Sample Size	Sample Freq.	Control Method	
30	**Broach internal spline**	**Acme Broach B–752**		**Yoke**			**Pitch dia. .7510 .7525**	**Visual comparator**	**1st pc**	**buy-off per run**	**Set–up sheet**	**Repair tool and recheck**
								Special dial indicator T–0375	**2 pcs**	**each shift**	**Tool control check sheet**	**Contain parts, replace tool and recheck**

* Reference Appendix C

PEOPLE: OPERATOR DOMINANT PROCESS: The system is sensitive/dependent upon operator knowledge and control.

Headlamp aim is one of the final operations during car and truck assembly. An aiming device, which contains two bubble levels, attaches to the headlamp. The operator adjusts the headlamps by turning aiming screws until the bubbles center in the level. Proper headlamp aim is an FMVSS requirement and therefore a Special Product Characteristic. The Special Process Characteristic is operator knowledge and control, ensuring the two bubble levels center during aiming. The Special Product Characteristic is measured by shining the headlamps on a headlamp aim board that measures beam pattern.

CONTROL PLAN

[ ] Prototype [ ] Pre-launch [X] Production Control Plan Number 005		Key Contact/Phone B. J. Aim	Date (Orig.) 7-8-92	Date (Rev.) 2-10-93
Part Number/Latest Change Level 54321234/B		Core Team Ben Aim, Ken Light, Nancy Drew	Customer Engineering Approval/Date (If Req'd)	
Part Name/Description Headlight Aim		Supplier/Plant Approval/Date	Customer Quality Approval/Date (If Req'd)	
Supplier/Plant Final Line	Supplier Code Dept 31	Other Approval/Date (If Req'd)	Other Approval/Date (If Req'd)	

Part/ Process Number	Process Name/ Operation Description	Machine, Device, Jig, Tools For Mfg.	Characteristics			Special Char. Class.	Methods						Reaction Plan
			No.	Product	Process		Product/Process Specification/ Tolerance	Evaluation Measurement Technique	Sample Size	Sample Freq.	Control Method		
5	Aiming headlights	Aiming device		Adjusted lamp		*	Lighting inspection code SPE J599 May '81	Bubble position on the level to be centered	100%	ongoing	p-chart		Adjust and retest
		Aiming device		Adjusted lamp		*	Lighting inspection code SPE J599 May '81	Bubble position on the level to be centered	5	Audit to check aim per 1000 vehicles	Check sheet		Contain and requalify

* Reference Appendix C

MATERIAL: MATERIAL OR COMPONENT DOMINANT PROCESS: Characteristics of materials/components are the variables affecting the process output.

An automobile hood is made of SMC. SMC is a molding compound that is temperature sensitive, has a specific shelf life, and for which mixing is critical. The parts produced from this material can become brittle when the material is improperly mixed, handled, or rotated. A force specification on one end of the bracket is a Special Product Characteristic. The Special Process Characteristics are the proper formulation, storage, and use of material date control. The customer requires a laboratory report on each lot of compound and the lots of material are dated for proper rotation.

- The materials or components are the process characteristics for this process. The variation found in the materials or components will affect the output of the process.
- Types of controls for the process characteristics include the various ways of testing and controlling the specification on the material or component being used (i.e. control charts, lab reports, error proofing).

CONTROL PLAN

Page 1 of 1

[ ] Prototype [ ] Pre-launch [X] Production Control Plan Number	Key Contact/Phone S. Specs 555-8888	Date (Orig.) 11/20/92	Date (Rev.) 1/25/93
Part Number/Latest Change Level 54312345 C 10/31/92	Core Team J. Smith 555-2404 K. Jones 555-3050 F. Petuil 555-1234 C. Miller 555-4114	Customer Engineering Approval/Date (If Req'd)	
Part Name/Description Automobile Hood	Supplier/Plant Approval/Date	Customer Quality Approval/Date (If Req'd)	
Supplier/Plant Q.C./Suppco / Supplier Code 4000-1	Other Approval/Date (If Req'd)	Other Approval/Date (If Req'd)	

Part/ Process Number	Process Name/ Operation Description	Machine, Device, Jig, Tools For Mfg.	Characteristics			Special Char. Class.	Methods					Reaction Plan
			No.	Product	Process		Product/Process Specification/ Tolerance	Evaluation Measurement Technique	Sample Size	Sample Freq.	Control Method	
1	Mold part	Mech. #20 Tool IS–IB		Force		*	Must withstand 10N vertical force	Izod impact test	1st 5	per hour	Failure reliability chart test to 11N	Segregate, analyze ____ material
2	Material receiving				Material content			Incoming inspection	1 pc	lot	Lab report #G 9441	Return to supplier
3	Mixing operation	Mixer Group #23			Mix ratio		3:1:2	Lab equip #11 Lab equip #22	1 pc	lot	Lab report #G 9442	Segregate and adjust ratio
4	Store material				Storage		Shelf life	1st piece visual lot control	1 pc	lot	Document "last use" of each mix	Dispose and/or return to supplier
					Temperature		65–72 °F	Temperature sensor	100%	Continuous	Error proof by using an auto–adjust back–up alarm for temp. limits	Recalibrate

* Reference Appendix C

EXAMPLES ARE FOR REFERENCE ONLY. REFER TO SPECIFIC CUSTOMER REQUIREMENTS.

METHODS: PREVENTIVE MAINTENANCE DOMINANT PROCESS: Equipment maintenance is the main variable that affects the process output.

A painting operation for decorative parts requires clean equipment and a dirt-free work area. Dirt-free paint is a Special Product Characteristic. Periodic cleaning of the paint equipment and paint room prevents the problem of dirt in the paint. The process characteristic is a scheduled routine cleaning, repair, and replacement.

- Periodic maintenance is the process characteristic. Where input variables exist, replacing worn out parts, cleaning, calibration, tool adjustments, and other maintenance activities have an effect on the product characteristics, and must be controlled.
- Types of controls for these process characteristics include scheduled maintenance programs and warning devices for monitoring.
- Product characteristics are checked after each maintenance to verify the process is properly performed.

CONTROL PLAN

[ ] Prototype [ ] Pre-launch [X] Production Control Plan Number 007	Key Contact/Phone F. Mercury 123-456-78910	Date (Orig.) 6-3-93	Date (Rev.) 8-4-93
Part Number/Latest Change Level 1234/B	Core Team Erin Hope, Alan Burt	Customer Engineering Approval/Date (If Req'd)	
Part Name/Description Grille	Supplier/Plant Approval/Date	Customer Quality Approval/Date (If Req'd)	
Supplier/Plant Lynch Inc. / Supplier Code 0010	Other Approval/Date (If Req'd)	Other Approval/Date (If Req'd)	

Part/ Process Number	Process Name/ Operation Description	Machine, Device, Jig, Tools For Mfg.	Characteristics			Special Char. Class.	Methods						Reaction Plan
			No.	Product	Process		Product/Process Specification/ Tolerance	Evaluation Measurement Technique	Sample Size	Sample Freq.	Control Method		
1	Spray paint	Electrostatic Bell #110			Spray painting		Less than 6 particles per square inch	Visual	100%	Inspection	Check sheet		Clean guns and recheck
		Fluid controller			Fluid control		Per J2154	Fluid meter and controller		Continuous	Automatic fluid meter prevents film build		Recalibrate and adjust

• Reference Appendix C

ENVIRONMENT: CLIMATE DOMINANT PROCESS: Climate variables such as temperature, humidity, noise, vibrations, have major impact on the process outputs.

Humidity adversely affects the function of plastic injection molding machines. Plastic material absorbs dampness from the air, causing defects in the molded part. Material dryers are installed on the molding machines to eliminate the problem.

- The proper functioning of the dryer is the process characteristic in having the process perform properly.
- Type of control for this process characteristic is a planned, periodic check to make sure the dryer is turned on and performing properly.
- Product characteristics are checked by visual examination during first piece check and by subsequent periodic checks.

CONTROL PLAN

Page 1 of 1

[ ] Prototype [ ] Pre-launch [X] Production Control Plan Number **1240**	Key Contact/Phone **A. P. Smith 313-472-0001**	Date (Orig.) **9-9-92**	Date (Rev.) **2-4-93**
Part Number/Latest Change Level **3212345 F**	Core Team **See attached list**	Customer Engineering Approval/Date (If Req'd)	
Part Name/Description **I/P Clip (Plastic)**	Supplier/Plant Approval/Date	Customer Quality Approval/Date (If Req'd)	
Supplier/Plant **Ajm Plastic Co., Iowa Plant** / Supplier Code **34567J**	Other Approval/Date (If Req'd)	Other Approval/Date (If Req'd)	

Part/ Process Number	Process Name/ Operation Description	Machine, Device, Jig, Tools For Mfg.	Characteristics			Special Char. Class.	Methods					Reaction Plan
			No.	Product	Process		Product/Process Specification/ Tolerance	Evaluation Measurement Technique	Sample Size	Sample Freq.	Control Method	
8	**Injected mold plastic parts**	**Injection mold machine #22**	**12**		**Raw material (pellet) dryer**		**.1% max. rel. humidity**	**Humidity gage on dryer**	**1**	**hour**	**Record sheet**	**Adjust dryer, dry material and requalify**

* Reference Appendix C

EXAMPLES ARE FOR REFERENCE ONLY. REFER TO SPECIFIC CUSTOMER REQUIREMENTS.

CONTROL PLAN

Page _____ of _____

[ ] Prototype [ ] Pre-launch [X] Production Control Plan Number		Key Contact/Phone	Date (Orig.)	Date (Rev.)
Part Number/Latest Change Level		Core Team	Customer Engineering Approval/Date (If Req'd)	
Part Name/Description		Supplier/Plant Approval/Date	Customer Quality Approval/Date (If Req'd)	
Supplier/Plant	Supplier Code	Other Approval/Date (If Req'd)	Other Approval/Date (If Req'd)	

Part/ Process Number	Process Name/ Operation Description	Machine, Device, Jig, Tools For Mfg.	Characteristics			Special Char. Class.	Methods					Reaction Plan
			No.	Product	Process		Product/Process Specification/ Tolerance	Evaluation Measurement Technique	Sample Size	Sample Freq.	Control Method	

* Reference Appendix C

CONTROL PLAN CHECKLIST

Customer or Internal Part No. _____

	Question	Yes	No	Comment/Action Required	Person Responsible	Due Date
1	Was the control plan methodology referenced in Section 6 used in preparing the control plan?					
2	Have all known customer concerns been identified to facilitate the selection of special product/process characteristics?					
3	Are all special product/process characteristics included in the control plan?					
4	Were SFMEA, DFMEA, and PFMEA used to prepare the control plan?					
5	Are material specifications requiring inspection identified?					
6	Does the control plan address incoming (material/components) through processing/assembly including packaging?					
7	Are engineering performance testing requirements identified?					
8	Are gages and test equipment available as required by the control plan?					
9	If required, has the customer approved the control plan?					
10	Are gage methods compatible between supplier and customer?					

Revision Date _____

Pg. 1 of 1

Prepared By: _____

The Control Plan Special Characteristics Worksheet (Supplement K)

The Description/Rationale column includes all special process and product characteristics agreed upon by the cross functional team. A sequential Number (No.) is assigned to each characteristic listed to ensure none are overlooked by the supplier when the Control Plan (Part 2) is completed. Develop a rationale for each special characteristic and add this information to the list for clarification. When considered necessary, a Supplemental Form (Supplement L) will depict measurement points and coordinates. This form, when used, will be considered an extension of the Control Plan.

CONTROL PLAN SPECIAL CHARACTERISTICS (OPTIONAL)

Page _____ of _____

☐ Prototype ☐ Pre-launch ☐ Production Control Plan Number		Key Contact/Phone	Date (Orig.)	Date (Rev.)
Part Number/Latest Change Level		Core Team	Customer Engineering Approval/Date (If Req'd)	
Part Name/Description		Supplier/Plant Approval/Date	Customer Quality Approval/Date (If Req'd)	
Supplier/Plant	Supplier Code	Other Approval/Date (If Req'd)	Other Approval/Date (If Req'd)	

No.	Description/Rationale	Specification/Tolerance	Class.	Illustration/Pictorial

DATA POINT COORDINATES (OPTIONAL)

Control Plan No. Page ______ of ______

Customer: Date (Orig): Date (Rev):

Char. No.	Point Ident.	X	Y	Z	Char. No.	Point Ident.	X	Y	Z	Char. No.	Point Ident.	X	Y	Z

APPENDIX A - PRODUCT QUALITY PLANNING CHECKLISTS

A-1 DESIGN FMEA CHECKLIST

Customer or Internal Part No. _____

	Question	Yes	No	Comment/Action Required	Person Responsible	Due Date
1	Was the SFMEA and /or DFMEA prepared using the *Chrysler, Ford and General Motors Potential Failure Mode and Effects Analysis (FMEA)* reference manual?					
2	Have historical campaign and warranty data been reviewed?					
3	Have similar part DFMEAs been considered?					
4	Does the SFMEA and/or DFMEA identify Special Characteristics?					
5	Have design characteristics that affect high risk priority failure modes been identified?					
6	Have appropriate corrective actions been assigned to high risk priority numbers?					
7	Have appropriate corrective actions been assigned to high severity numbers?					
8	Have risk priorities been revised when corrective actions have been completed and verified?					

Revision Date _____

Prepared By: _____

A-2 DESIGN INFORMATION CHECKLIST

Customer or Internal Part No. _____

	Question	Yes	No	Comment/Action Required	Person Responsible	Due Date
	A. General					
	Does the design require:					
1	• New materials?					
2	• Special tooling?					
3	Has assembly build variation analysis been considered?					
4	Has Design of Experiments been considered?					
5	Is there a plan for prototypes in place?					
6	Has a DFMEA been completed?					
7	Has a DFMA been completed?					
8	Have service and maintenance issues been considered?					
9	Has the Design Verification Plan been completed?					
10	If yes, was it completed by a cross functional team?					
11	Are all specified tests, methods, equipment and acceptance criteria clearly defined and understood?					
12	Have Special Characteristics been selected?					

Revision Date _____

A-2 DESIGN INFORMATION CHECKLIST - CONTINUED

Customer or Internal Part No. _____

	Question	Yes	No	Comment/Action Required	Person Responsible	Due Date
	A. General - Continued					
13	Is bill of material complete?					
14	Are Special Characteristics properly documented?					
	B. Engineering Drawings					
15	Have dimensions that affect fit, function and durability been identified?					
16	Are reference dimensions identified to minimize inspection layout time?					
17	Are sufficient control points and datum surfaces identified to design functional gages?					
18	Are tolerances compatible with accepted manufacturing standards?					
19	Are there any requirements specified that cannot be evaluated using known inspection techniques?					
	C. Engineering Performance Specifications					
20	Have all special characteristics been identified?					
21	Is test loading sufficient to provide all conditions, i.e., production validation and end use?					
22	Have parts manufactured at minimum and maximum specifications been tested?					
23	Can additional samples be tested when a reaction plan requires it, and still conduct regularly scheduled in-process tests?					
24	Will all product testing be done in-house?					
25	If not, is it done by an approved subcontractor?					

Revision Date _____

A-2 DESIGN INFORMATION CHECKLIST - CONTINUED

Customer or Internal Part No. _____

	Question	Yes	No	Comment/Action Required	Person Responsible	Due Date
	C. Engineering Performance Specifications - Continued					
26	Is the specified test sampling size and/or frequency feasible?					
27	If required, has customer approval been obtained for test equipment?					
	D. Material Specification					
28	Are special material characteristics identified?					
29	Are specified materials, heat treat and surface treatments compatible with the durability requirements in the identified environment?					
30	Are the intended material suppliers on the customer approved list?					
31	Will material suppliers be required to provide certification with each shipment?					
32	Have material characteristics requiring inspection been identified? If so,					
33	• Will characteristics be checked in-house?					
34	• Is test equipment available?					
35	• Will training be required to assure accurate results?					
36	Will outside laboratories be used?					
37	Are all laboratories used accredited (if required)?					

Revision Date _____

A-2 DESIGN INFORMATION CHECKLIST - CONTINUED

Customer or Internal Part No. _____

	Question	Yes	No	Comment/Action Required	Person Responsible	Due Date
	D. Material Specification - Continued					
	Have the following material requirements been considered:					
38	• Handling?					
39	• Storage?					
40	• Environmental?					

Revision Date _____

Prepared By: _____

A-3 NEW EQUIPMENT, TOOLING AND TEST EQUIPMENT CHECKLIST

Customer or Internal Part No. _____

	Question	Yes	No	Comment/Action Required	Person Responsible	Due Date
	Has tool and equipment design provided for:					
1	• Flexible system, e.g. cell mfg.?					
2	• Quick change?					
3	• Volume fluctuations?					
4	• Mistake proofing?					
	Have lists been prepared identifying:					
5	• New equipment?					
6	• New tooling?					
7	• New test equipment?					
	Has acceptance criteria been agreed upon for:					
8	• New equipment?					
9	• New tooling?					
10	• New test equipment?					
11	Will a preliminary capability study be conducted at the tooling and/or equipment manufacturer?					
12	Has test equipment feasibility and accuracy been established?					
13	Is a preventive maintenance plan complete for equipment and tooling?					
14	Are setup instructions for new equipment and tooling complete and understandable?					

Revision Date _____

A-3 NEW EQUIPMENT, TOOLING AND TEST EQUIPMENT CHECKLIST - CONTINUED

Customer or Internal Part No. _____

	Question	Yes	No	Comment/Action Required	Person Responsible	Due Date
15	Will capable gages be available to run preliminary process capability studies at the equipment supplier's facility?					
16	Will preliminary process capability studies be run at the producing plant?					
17	Have process characteristics that affect special product characteristics been identified?					
18	Were special product characteristics used in determining acceptance criteria?					
19	Does the manufacturing equipment have sufficient capacity to handle forecasted production and service volumes?					
20	Is testing capacity sufficient to provide adequate testing?					

Revision Date _____

Prepared By: _____

A-4 PRODUCT/PROCESS QUALITY CHECKLIST

Customer or Internal Part No. _____

	Question	Yes	No	Comment/Action Required	Person Responsible	Due Date
1	Is the assistance of the customer's quality assurance or product engineering activity needed to develop or concur to the control plan?					
2	Has the supplier identified who will be the quality liaison with the customer?					
3	Has the supplier identified who will be the quality liaison with its suppliers?					
4	Has the quality system been reviewed using the Chrysler, Ford, and General Motors Quality System Assessment?					
	Are there sufficient personnel identified to cover:					
5	• Control plan requirements?					
6	• Layout inspection?					
7	• Engineering performance testing?					
8	• Problem resolution analysis?					
	Is there a documented training program that:					
9	• Includes all employees?					
10	• Lists whose been trained?					
11	• Provides a training schedule?					
	Has training been completed for:					
12	• Statistical process control?					

Revision Date _____

THIS CHECKLIST IS NOT INTENDED TO REPLACE THE CHRYSLER, FORD AND GENERAL MOTORS QUALITY SYSTEM ASSESSMENT.

A-4 PRODUCT/PROCESS QUALITY CHECKLIST - CONTINUED

Customer or Internal Part No. _____

	Question	Yes	No	Comment/Action Required	Person Responsible	Due Date
	Has training been completed for: - Continued					
13	• Capability studies?					
14	• Problem solving?					
15	• Mistake proofing?					
16	• Other topics as identified?					
17	Is each operation provided with process instructions that are keyed to the control plan?					
18	Are standard operator instructions available at each operation?					
19	Were operator/team leaders involved in developing standard operator instructions?					
	Do inspection instructions include:					
20	• Easily understood engineering performance specifications?					
21	• Test frequencies?					
22	• Sample sizes?					
23	• Reaction plans?					
24	• Documentations?					
	Are visual aids:					
25	• Easily understood?					
26	• Available?					

Revision Date _____

A-4 PRODUCT/PROCESS QUALITY CHECKLIST - CONTINUED

Customer or Internal Part No. _____

	Question	Yes	No	Comment/Action Required	Person Responsible	Due Date
	Are visual aids: - Continued					
27	• Accessible?					
28	• Approved?					
29	• Dated and current?					
30	Is there a procedure to implement, maintain, and establish reaction plans for statistical control charts?					
31	Is there an effective root cause analysis system in place?					
32	Have provisions been made to place the latest drawings and specifications at the point of inspection?					
33	Are forms/logs available for appropriate personnel to record inspection results?					
	Have provisions been made to place the following at the monitored operation:					
34	• Inspection gages?					
35	• Gage instructions?					
36	• Reference samples?					
37	• Inspection logs?					
38	Have provisions been made to certify and routinely calibrate gages and test equipment?					
	Have required measurement system capability studies been:					
39	• Completed?					

Revision Date _____

A-4 PRODUCT/PROCESS QUALITY CHECKLIST - CONTINUED

Customer or Internal Part No. _____

	Question	Yes	No	Comment/Action Required	Person Responsible	Due Date
	Have required measurement system capability studies been: - Continued					
40	• Acceptable?					
41	Are layout inspection equipment and facilities adequate to provide initial and ongoing layout of all details and components?					
	Is there a procedure for controlling incoming products that identifies:					
42	• Characteristics to be inspected?					
43	• Frequency of inspection?					
44	• Sample size?					
45	• Designated location for approved product?					
46	• Disposition of nonconforming products?					
47	Is there a procedure to identify, segregate and control nonconforming products to prevent shipment?					
48	Are rework/repair procedures available?					
49	Is there a procedure to requalify repaired/reworked material?					
50	Is there an appropriate Lot Traceability system?					
51	Are periodic audits of outgoing products planned and implemented?					
52	Are periodic surveys of the quality system planned and implemented?					
53	Has the customer approved the packaging specification?					

Revision Date _____

Prepared By: _____

A-5 FLOOR PLAN CHECKLIST

Customer or Internal Part No. _____

	Question	Yes	No	Comment/Action Required	Person Responsible	Due Date
1	Does the floor plan identify all required process and inspection points?					
2	Have clearly marked areas for all material, tools, and equipment at each operation been considered?					
3	Has sufficient space been allocated for all equipment?					
	Are process and inspection areas:					
4	• Of adequate size?					
5	• Properly lighted?					
6	Do inspection areas contain necessary equipment and files?					
	Are there adequate:					
7	• Staging areas?					
8	• Impound areas?					
9	Are inspection points logically located to prevent shipment of nonconforming products?					
10	Have controls been established to eliminate the potential for an operation, including outside processing, to contaminate or mix similar products?					
11	Is material protected from overhead or air handling systems contamination?					

Revision Date _____

A-5 FLOOR PLAN CHECKLIST - CONTINUED

Customer or Internal Part No. _____

	Question	Yes	No	Comment/Action Required	Person Responsible	Due Date
12	Have final audit facilities been provided?					
13	Are controls adequate to prevent movement of nonconforming incoming material to storage or point of use?					

Revision Date _____

Prepared By: _____

A-6 PROCESS FLOW CHART CHECKLIST

Customer or Internal Part No. _____

	Question	Yes	No	Comment/Action Required	Person Responsible	Due Date
1	Does the flow chart illustrate the sequence of production and inspection stations?					
2	Were all the appropriate FMEAs (SFMEA, DFMEA) available and used as aids to develop the process flow chart?					
3	Is the flow chart keyed to product and process checks in the control plan?					
4	Does the flow chart describe how the product will move, i.e., roller conveyor, slide containers, etc.?					
5	Has the pull system/optimization been considered for this process?					
6	Have provisions been made to identify and inspect reworked products before being used?					
7	Have potential quality problems due to handling and outside processing been identified and corrected?					

Revision Date _____

Prepared By: _____

A-7 PROCESS FMEA CHECKLIST

Customer or Internal Part No. _____

	Question	Yes	No	Comment/Action Required	Person Responsible	Due Date
1	Was the Process FMEA prepared using the Chrysler, Ford, and General Motors guidelines?					
2	Have all operations affecting fit, function, durability, governmental regulations and safety been identified and listed sequentially?					
3	Were similar part FMEAs considered?					
4	Have historical campaign and warranty data been reviewed?					
5	Have appropriate corrective actions been planned or taken for high risk priority numbers?					
6	Have appropriate corrective actions been planned or taken for high severity numbers?					
7	Were risk priorities numbers revised when corrective action was completed?					
8	Were high severity numbers revised when a design change was completed?					
9	Do the effects consider the customer in terms of the subsequent operation, assembly and product?					
10	Was warranty information used as an aid in developing the Process FMEA?					
11	Were customer plant problems used as an aid in developing the Process FMEA?					
12	Have the causes been described in terms of something that can be fixed or controlled?					
13	Where detection is the major factor, have provisions been made to control the cause prior to the next operation?					

Revision Date _____

Prepared By: _____

A-8 CONTROL PLAN CHECKLIST

Customer or Internal Part No. _____

	Question	Yes	No	Comment/Action Required	Person Responsible	Due Date
1	Was the control plan methodology referenced in Section 6 used in preparing the control plan?					
2	Have all known customer concerns been identified to facilitate the selection of special product/process characteristics?					
3	Are all special product/process characteristics included in the control plan?					
4	Were SFMEA, DFMEA, and PFMEA used to prepare the control plan?					
5	Are material specifications requiring inspection identified?					
6	Does the control plan address incoming (material/components) through processing/assembly including packaging?					
7	Are engineering performance testing requirements identified?					
8	Are gages and test equipment available as required by the control plan?					
9	If required, has the customer approved the control plan?					
10	Are gage methods compatible between supplier and customer?					

Revision Date _____

Pg. 1 of 1

Prepared By: _____

APPENDIX B - ANALYTICAL TECHNIQUES

ASSEMBLY BUILD VARIATION ANALYSIS

An assembly build variation analysis is an analysis that simulates the buildup of an assembly and examines tolerance accumulation, statistical parameters, sensitivity, and "what if" investigation.

BENCHMARKING

Benchmarking is a systematic approach to identifying standards for comparison. It provides input to the establishment of measurable performance targets, as well as ideas for product design and process design. It can also provide ideas for improving business processes and work procedures.

Product and process benchmarking should include the identification of world class or best-in-class based on objective performance measures and research into how this performance was achieved. Benchmarking should provide a stepping stone for developing new designs and processes that exceed the capabilities of the benchmark companies.

CAUSE AND EFFECT DIAGRAM

The "cause and effect" diagram is an analytical tool to indicate the relationship between an "effect" and all possible "causes" influencing it. This is sometimes referred to as fishbone diagram, Ishikawa diagram, or feather diagram.

CHARACTERISTICS MATRIX

A characteristics matrix is a display of the relationships between process parameters and manufacturing stations. The recommended method of developing the characteristics matrix is to number the dimensions and/or features on the part print and each manufacturing operation. All manufacturing operations and stations appear across the top, and the process parameters are listed down the left-hand column. The more manufacturing relationships there are, the more important the control of a characteristic becomes. Regardless of matrix size, the upstream relationships of characteristics are evident. A typical matrix is shown.

CHARACTERISTICS MATRIX
(EXAMPLE)

DIM NO.	DESCRIPTION	TOLERANCE	OPERATION NOS.			
			05	10	20	30
1	ID		X	C		X
2	FACE			X	C	C
3				X	L	L
4					X	
5					X	
6	OD				X	

C = Characteristic at an operation used for clamping
L = Characteristic at an operation used for locating
X = Characteristic created or changed by this operation should match the process flow diagram form

CRITICAL PATH METHOD

The critical path method can be a Pert or Gantt Chart that shows the chronological sequence of tasks that require the greatest expected time to accomplish. It can provide valuable information as to:

- Interrelationships
- Early Forecast of Problems
- Identification of Responsibility
- Resource Identification, Allocation and Leveling

DESIGN OF EXPERIMENTS (DOE)

A designed experiment is a test or sequence of tests where potential influential process variables are systematically changed according to a prescribed design matrix. The response of interest is evaluated under the various conditions to: (1) identify the influential variables among the ones tested, (2) quantify the effects across the range represented by the levels of the variables, (3) gain a better understanding of the nature of the causal system at work in the process, and (4) compare the effects and interactions. Application early in the product/process development cycle can result in: (1) improved process yields, (2) reduced variability around a nominal or target value, (3) reduced development time, and (4) reduced overall costs.

DESIGN FOR MANUFACTURABILITY AND ASSEMBLY

Design for Manufacturability and Assembly is a Simultaneous Engineering process designed to optimize the relationship between design function, manufacturability, and ease of assembly. The enhance-

ment of designs for assembly and manufacturing is an important step. Plant representatives should be consulted early in the design process to review components or systems and provide input on specific assembly and manufacturing requirements. Specific dimensional tolerances should be determined based on the like process. This will assist in identifying the equipment required and any process changes necessary.

DESIGN VERIFICATION PLAN AND REPORT (DVP&R)

The Design Verification Plan and Report (DVP&R) is a method to plan and document testing activity through each phase of product/process development from inception to ongoing refinement. This method is used by Chrysler and Ford.

An effective DVP&R provides a concise working document that aids engineering personnel in the following areas:

- Facilitates the development of a logical testing sequence by requiring the responsible areas to thoroughly plan the tests needed to assure that the component or system meets all engineering requirements.
- Assures product reliability meets customer-driven objectives.
- Highlights situations where customer timing requires an accelerated test plan.
- Serves as a working tool for responsible area(s) by:
  - Summarizing functional, durability, and reliability testing requirements and results in one document for ease of reference.
  - Providing the ability to easily prepare test status and progress reports for Design Reviews.

Detailed instructions can be obtained from the appropriate Chrysler and Ford Quality or Engineering areas.

DIMENSIONAL CONTROL PLAN (DCP)

See Dynamic Control Plan.

DYNAMIC CONTROL PLAN (DCP)

Ford Motor Company is currently using a DCP (Dynamic Control Plan) process in some operations. The basis for this process is the Characteristics Matrix described previously in this Appendix. It is a structured methodology that integrates the control plan, FMEA and the Gage R&R information to ensure that customer expectations in the form of product design requirements are understood, deployed, and controlled in the manufacturing and assembly process. DCP is a systematic, comprehensive methodology for implementing total production process planning. Refer to Appendix G for an explanation of the Dynamic Control Planning Process.

MISTAKE PROOFING (POKA-YOKE)

Mistake proofing (Poka-Yoke) is a technique to eliminate errors often referred to as "fail-safeing." Mistake proofing should be used as a preventive technique to control repetitive tasks or actions. This technique is designed to reduce customer concerns.

PROCESS FLOW CHARTING

Process flow charting is a visual approach to describing and developing sequential or related work activities. It provides both a means of communication and analysis for planning, development activities, and manufacturing processes.

Since one goal of quality assurance is to eliminate defects and improve the efficiency of manufacturing and assembly processes, advance product quality plans should include illustrations of the controls and resources involved. These process flow charts should be used to identify improvements and to locate significant or critical product and process characteristics that will be addressed in control plans to be developed later.

QUALITY FUNCTION DEPLOYMENT (QFD)

QFD is a systematic procedure for translating the Voice of the Customer into technical requirements and operational terms, displaying and documenting the translated information in matrix form. QFD focuses on the most important items and provides the mechanism to target selected areas to enhance competitive advantages.

Depending upon the specific product, the technique of QFD may be used as a structure for the quality planning process. In particular, QFD Phase I - Product Planning translates customer requirements, i.e., Voice of the Customer, into counterpart control characteristics or design requirements. QFD provides a means of converting general customer requirements into specified final product and process control characteristics.

A. ASPECTS OF QFD

The two dimensions of QFD are:

- Quality Deployment: Translation of Customer Requirements into Product Design Requirements.
- Function Deployment: Translation of Design Requirements into appropriate Part, Process and Production Requirements.

B. BENEFITS OF QFD

Several benefits of QFD are that it:

- Increases the assurance of meeting the Voice of the Customer.

- Reduces number of changes due to engineering knowledge.
- Identifies conflicting design requirements.
- Focuses various company activities on customer-oriented objectives.
- Reduces product development cycle time.
- Reduces costs of engineering, manufacturing, and service.
- Improves quality of product and services.

SYSTEM FAILURE MODE AND EFFECTS ANALYSIS (SFMEA)

An SFMEA is an analytical technique that is used to identify potential weaknesses in an overall system design. It is a "top-down" functional analysis. It is used to analyze system weaknesses in the early concept stage before hardware has been defined. The SFMEA focuses on potential failures associated with the functions performed at the system, subsystem, and lower functional levels. The SFMEA also focuses on the interaction between systems, between subsystems, and the interface between system elements.

APPENDIX C - SPECIAL CHARACTERISTICS SYMBOLS

Chrysler, Ford and General Motors Special Characteristics and Symbols

	GENERAL MOTORS	FORD MOTOR CO.	CHRYSLER	
Definition: Non-Key Characteristic "Standard"	Is a product characteristic for which reasonably anticipated variation is unlikely to significantly affect a product's safety, compliance with governmental regulations, fit/function.	NOT USED	NOT USED	
Nomenclature Symbol	STANDARD NONE			
Definition: Key Characteristic (Not Relating to Safety or Legal Considerations)	A product characteristic for which reasonably anticipated variation is likely to significantly affect customer satisfaction with a product (other than S/C) such as its fits, function, mounting or appearance, or the ability to process or build the product.	The characteristics that are important to the customer and that must be included on the Control Plan.	Identifies specific critical characteristics that are process driven (controlled) and therefore require SPC to measure process stability, capability, and control for the life of the part.	Is limited to highlighting Critical characteristics on (Production) part drawings, tools and fixture, and tooling aid procedures where verification is mandatory, but where ongoing process control is not automatically mandated.
Nomenclature Symbol	FIT/FUNCTION - <F/F> ◇	SIGNIFICANT/ CHARACTERISTIC - S/C NONE	DIAMOND - <D> ◇	PENTAGON - <P> ⬠
Definition: Key Characteristic (With Safety or Legal Considerations)	Is a product characteristic for which reasonably anticipated variation could significantly affect the product's safety or its compliance with government regulations (such as: flammability, occupant protection, steering control, braking, etc. . .), emissions, noise, radio frequency interference, etc. . . .	Are those product requirements (Dimensions, Specifications Tests) or process parameters which can affect compliance with government regulations or safe Vehicle/Product Function and which require specific producer, assembly, shipping or monitoring actions and inclusion on the Control Plan.	Safety characteristics are defined as engineering designated specifications or product requirements applicable to component material, assembly operation(s) which require special manufacturing control to assure compliance with governmental vehicle safety, emissions, noise, or theft prevention requirements.	
Nomenclature Symbol	SAFETY/COMPLIANCE - <S> ⊽	CRITICAL CHARACTERISTIC - CC ▽	SHIELD - <S> ⬡	

APPENDIX D - REFERENCE MATERIAL

CHRYSLER, FORD, AND GENERAL MOTORS FUNDAMENTAL STATISTICAL PROCESS CONTROL REFERENCE MANUAL

This is a reference manual prepared by quality and supplier assessment personnel from Chrysler, Ford, and General Motors. The manual presents a unified reference for statistical process control. Copies of this manual can be obtained from the Automotive Industry Action Group (AIAG) at (810) 358-3570.

CHRYSLER, FORD, AND GENERAL MOTORS MEASUREMENT SYSTEMS ANALYSIS REFERENCE MANUAL

A reference manual developed by Chrysler, Ford, and General Motors that describes common methods of evaluating measurement system variation. Copies of this manual can be obtained from AIAG at (810) 358-3570.

CHRYSLER, FORD, AND GENERAL MOTORS POTENTIAL FAILURE MODE AND EFFECTS ANALYSIS (FMEA)

This manual introduces the topic of potential Failure Mode and Effects Analysis (FMEA) and gives general guidance in the application of techniques. The joint consensus on the contents of this reference manual was effected through task team members from Chrysler, Ford, General Motors, Bosch, Goodyear, and Kelsey-Hayes. Copies of this manual can be obtained from AIAG at (810) 358-3570.

CHRYSLER, FORD, AND GENERAL MOTORS PRODUCTION PART APPROVAL PROCESS

This procedure was developed by the Quality and Part Approval staffs at Chrysler, Ford, and General Motors. The procedure covers generic requirements for production part approval for all production and service commodities. Customer specific instructions are also included. Copies of this manual can be obtained from AIAG at (810) 358-3570.

CHRYSLER, FORD, AND GENERAL MOTORS QUALITY SYSTEM REQUIREMENTS

This quality system requirement defines the expectations of Chrysler, Ford, and General Motors for internal and external suppliers. These three companies recognize ISO 9001 as the foundation for this standard. Copies of this manual can be obtained from AIAG at (810) 358-3570.

ZERO QUALITY CONTROL: SOURCE INSPECTION AND THE POKA-YOKE SYSTEM, SHIGEO SHINGO, CAMBRIDGE, MA: PRODUCTIVITY PRESS, 1986.

This book describes the techniques of mistake proofing developed by Shigeo Shingo.

APPENDIX E - TEAM FEASIBILITY COMMITMENT

Date:_____

Customer:_____ Part Name:_____

Part Number:_____

Feasibility Considerations

Our product quality planning team has considered the following questions, not intended to be all-inclusive in performing a feasibility evaluation. The drawings and/or specifications provided have been used as a basis for analyzing the ability to meet all specified requirements. All "no" answers are supported with attached comments identifying our concerns and/or proposed changes to enable us to meet the specified requirements.

YES	NO	CONSIDERATION
		Is product adequately defined (application requirements, etc.) to enable feasibility evaluation?
		Can Engineering Performance Specifications be met as written?
		Can product be manufactured to tolerances specified on drawing?
		Can product be manufactured with Cpk's that meet requirements?
		Is there adequate capacity to produce product?
		Does the design allow the use of efficient material handling techniques?
		Can the product be manufactured without incurring any unusual:
		• Costs for capital equipment?
		• Costs for tooling?
		• Alternative manufacturing methods?
		Is statistical process control required on product?
		Is statistical process control presently used on similar products?
		Where statistical process control is used on similar products:
		• Are the processes in control and stable?
		• Are Cpk's greater than 1.33?

Conclusion

☐	Feasible	Product can be produced as specified with no revisions.
☐	Feasible	Changes recommended (see attached).
☐	Not Feasible	Design revision required to produce product within the specified requirements.

Sign–Off

_____ _____

Team Member/Title/Date Team Member/Title/Date

_____ _____

Team Member/Title/Date Team Member/Title/Date

_____ _____

Team Member/Title/Date Team Member/Title/Date

APPENDIX F - PRODUCT QUALITY PLANNING SUMMARY AND SIGN-OFF

DATE:_____

PRODUCT NAME:_____ PART NUMBER:_____

CUSTOMER:_____ MANUFACTURING PLANT:_____

1. PRELIMINARY PROCESS CAPABILITY STUDY

	QUANTITY		
	REQUIRED	ACCEPTABLE	PENDING*
Ppk - SPECIAL CHARACTERISTICS			

2. CONTROL PLAN APPROVAL (If Required) APPROVED: YES/NO* DATE APPROVED_____

3. INITIAL PRODUCTION SAMPLES
CHARACTERISTIC CATEGORY

	QUANTITY			
	SAMPLES	CHARACTERISTICS PER SAMPLE	ACCEPTABLE	PENDING*
DIMENSIONAL				
VISUAL				
LABORATORY				
PERFORMANCE				

4. GAGE AND TEST EQUIPMENT
MEASUREMENT SYSTEM ANALYSIS

	QUANTITY		
	REQUIRED	ACCEPTABLE	PENDING*
SPECIAL CHARACTERISTIC			

5. PROCESS MONITORING

	QUANTITY		
	REQUIRED	ACCEPTABLE	PENDING*
PROCESS MONITORING INSTRUCTIONS			
PROCESS SHEETS			
VISUAL AIDS			

6. PACKAGING/SHIPPING

	QUANTITY		
	REQUIRED	ACCEPTABLE	PENDING*
PACKAGING APPROVAL			
SHIPPING TRIALS			

7. SIGN-OFF

_____ _____

TEAM MEMBER/TITLE/DATE TEAM MEMBER/TITLE/DATE

_____ _____

TEAM MEMBER/TITLE/DATE TEAM MEMBER/TITLE/DATE

_____ _____

TEAM MEMBER/TITLE/DATE TEAM MEMBER/TITLE/DATE

* REQUIRES PREPARATION OF AN ACTION PLAN TO TRACK PROGRESS.

PRODUCT QUALITY PLANNING SUMMARY AND SIGN-OFF – INSTRUCTIONS

SECTION

1 Under "required," for each item indicate the number of characteristics required.

Under "acceptable," for each item indicate the quantity that was accepted per *Chrysler, Ford and General Motors Production Part Approval Process* manual or customer requirements.

Under "pending," for each item indicate the quantity not accepted. Attach action plan for each item.

2 Indicate if control plan has been approved by the customer (if required) by circling yes or no. If yes, indicate date approved. If no, attach action plan.

3 Under "samples," indicate the quantity of samples inspected for each item.

Under "characteristics per sample," for each item indicate the number of characteristics inspected on each sample for each category.

Under "acceptable," for each item indicate the quantity of characteristics acceptable on all samples.

Under "pending," for each item indicate the quantity of characteristics not accepted. Attach action plan for each item.

4 Under "required," for each item indicate the number of characteristics required.

Under "acceptable," for each item indicate the quantity acceptable per *Chrysler, Ford and General Motors Measurement Systems Analysis Reference Manual*.

Under "pending," for each item indicate quantity not accepted. Attach action plan for each item.

5 Under "required," for each item indicate the quantity required.

Under "acceptable," for each item indicate the quantity accepted.

Under "pending," for each item indicate quantity not accepted. Attach action plan for each item.

6 Under "required," for each item indicate yes or no to indicate if item is required.

Under "acceptable," for each item indicate yes or no to indicate acceptance.

Under "pending," if answer under "acceptable" is no – attach action plan.

7 Each team member should sign form and indicate title and date of signature.

APPENDIX G - FORD'S POWERTRAIN DYNAMIC CONTROL PLANNING

Description of Ford Powertrain Dynamic Control Planning (DCP)

Definition

DCP is a team approach to the step-wise understanding and control of manufacturing processes.

Team experience, analysis tools, and planning skills are used to produce a cohesive system of knowledge. Process controls are developed and implemented from the system of knowledge. The goal of DCP is to develop a manufacturing process able to produce high quality products, at a competitive cost, on a timely schedule.

Expectations

All processes must produce all characteristics to specification on a production basis. If these expectations are not met, there must be a plan to correct the problem and protect the customer. Significant Characteristics (SCs) must be in a state of statistical control with Ppk $\geq$ 1.67 and Cpk $\geq$ 1.33. DCP is applied to all characteristics, not just SCs.

Scope

Who does DCP? Cross-functional teams of hourly and salary personnel carry out the DCP process. DCP is required of all Ford Powertrain Operations (PTO) plants and all PTO suppliers. Other Ford operations also use DCP and request it of their suppliers.

Who approves a Control Plan? The control plan must be signed/approved by a DCP team representative, the Product Engineer, the SQE Engineer (for suppliers), and with an opportunity for approval by the using plant.

When is the Control Plan implemented? Initial DCP implementation must coincide with the Production Part Approval Process (PPAP). The team exists for the life of the product. DCP update and improvement is an ongoing task of the team.

Vision

- Production people are the primary **DCP customers**. Successful DCP results in useful job instructions, effective control methods, and reliable reaction plans.
- **Teamwork** is crucial. The DCP team consists of production people, product engineers, manufacturing engineers, customers, suppliers, and any others needed by the team. Strong upper-management support is required to ensure team success.
- DCP is **manufacturing-process focused**, from raw materials through assembly. Product and process characteristics are considered together for each manufacturing operation. DCP works for both the development of new manufacturing processes and the optimization of existing processes.
- DCP is **content driven**. The team strives to build and effectively use knowledge. DCP documents are simply the way the knowledge is recorded and shared.

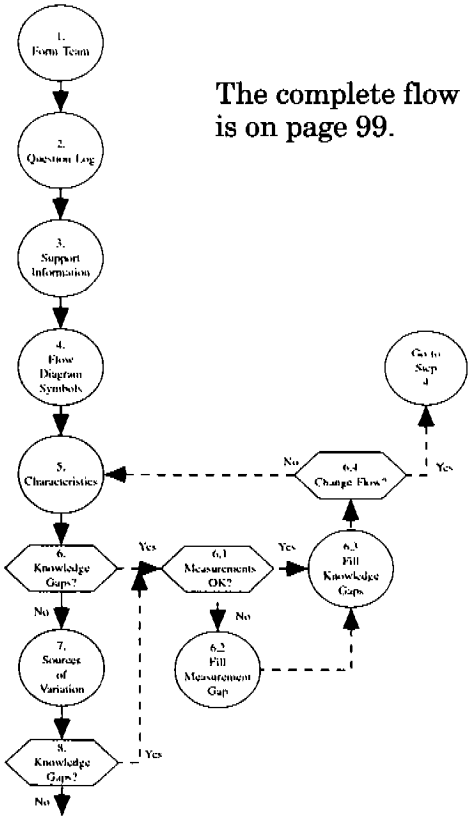
The DCP Journey

A Four-Stage Process Supported by the DCP Elements

The Elements of DCP

- DCP Team
- Question Log
- Support Information
- Process Flow Diagram
- Measurement Systems
- Process Capability
- Characteristic Matrix
- Characteristic Type
- Operational Importance
- Process FMEA
- Control Factors
- Control Classifications
- Control Methods
- Illustrations and Instructions

Stage I. Understand the Manufacturing Process. (Steps 1 through 8)



The complete flow is on page 99.

The most important task a DCP team undertakes is gaining and documenting a deep understanding of their manufacturing process.

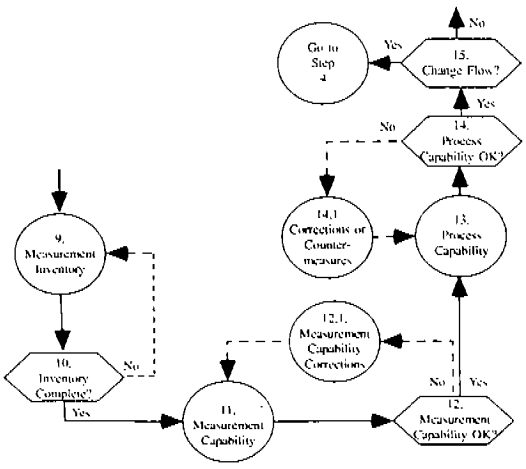
All other DCP tasks depend upon the success of this activity.

The team must:

- Establish a Question Log.
- Gather important reference documents such as the Design Failure Mode and Effects Analysis (FMEA) and System FMEA.
- Define how process and product characteristics flow together.
- Establish measurement systems to support knowledge-gap investigation.
- Establish targets and tolerances.
- Identify variation sources.

It is important that the team considers variation paths and works to fill knowledge gaps.

Stage II. Establish Capability. (Steps 9 through 15)

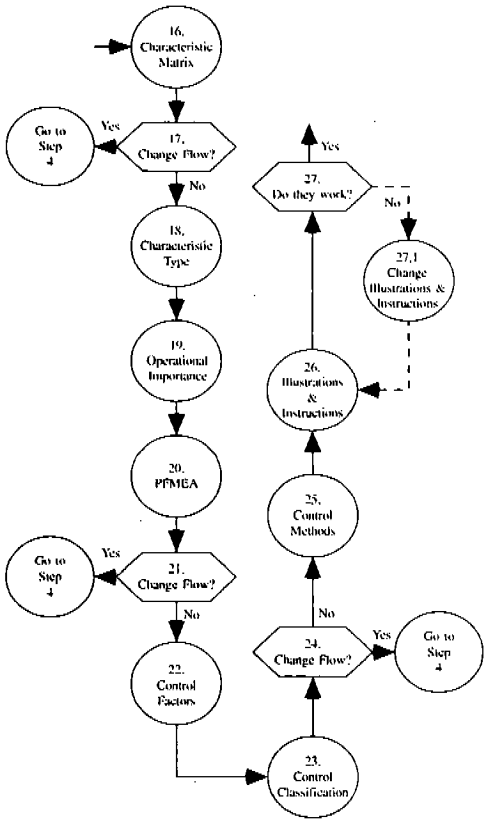


True process understanding demands capable measuring systems and processes.

The team must:

- Establish measurement capability.
- Use the measurement system to check process output.
- Assess whether each step will perform to the target and within the tolerance the team has specified.
- Make corrections to process capability problems or establish countermeasures.
- Assure that when a single production process produces a family of parts that the process is capable over the entire range of parts in the family.

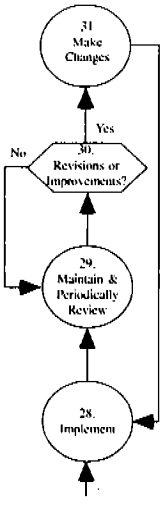
Stage III. Develop Process Controls. (Steps 16 through 27)



Effective process controls are based on:

- Relationships between characteristics and process steps.
- Measurement and process capability.
- Characteristic effects from conditions both within and outside of specification.
- Control Methods that address variation/target movement within specification and/or causes of failure.
- Current Controls that prevent and/or detect failure modes.
- Illustrations, instructions, and Reaction Plans that really work.

Stage IV. Implement and Improve. (Steps 28 through 31)

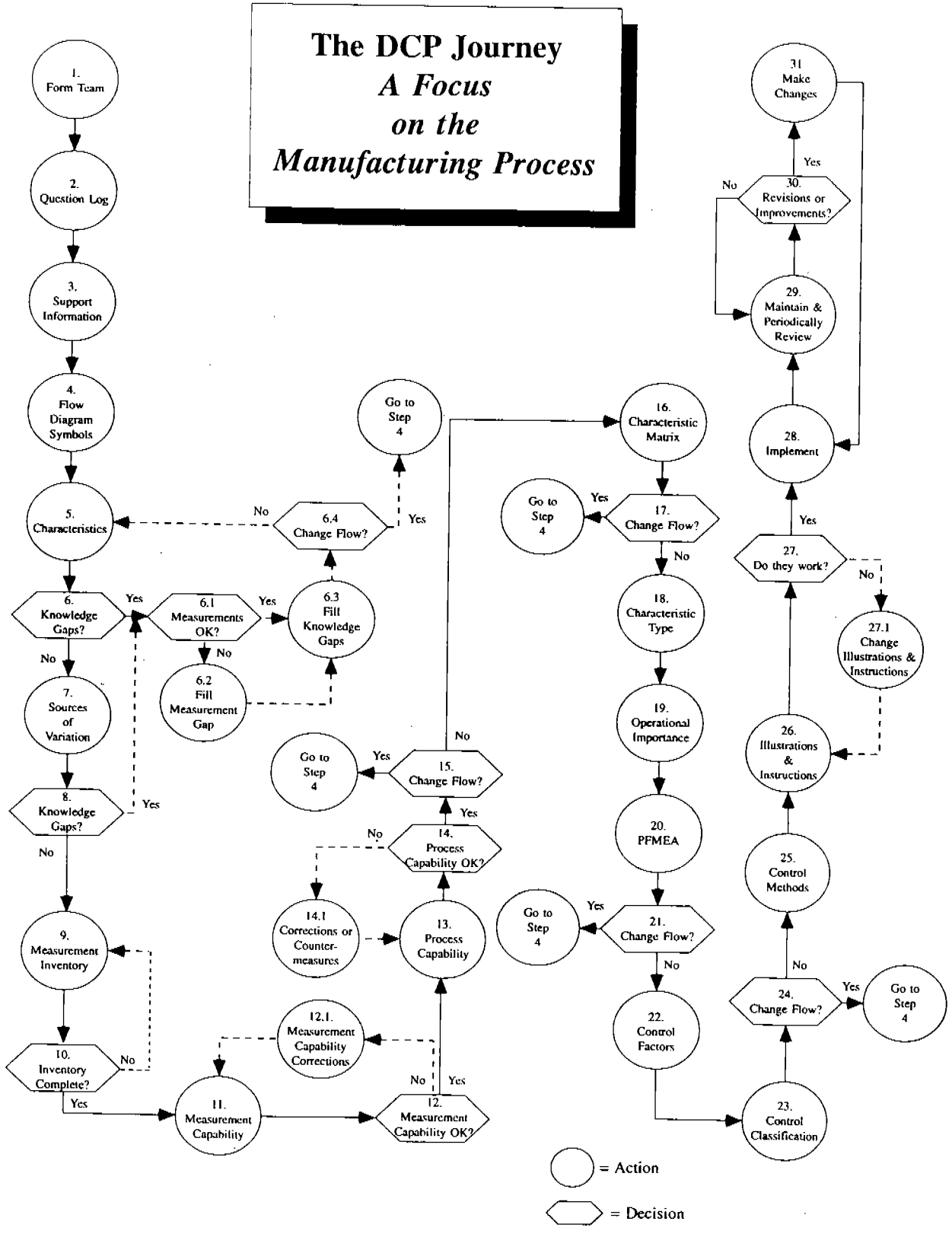


The DCP vision is to provide value-added, user-friendly information to all levels of the plant.

To successfully provide this information, the DCP team must:

- Carefully plan and execute implementation of controls, illustrations, and instructions.
- Monitor and respond to product changes, process changes and innovations.

DCP is an important tool for managing change. The team must continue to meet regularly to respond to change.


The DCP Journey
A Focus
on the
Manufacturing Process
1. Form Team
2. Question Log
3. Support Information
4. Flow Diagram Symbols
5. Characteristics
6. Knowledge Gaps?
7. Sources of Variation
8. Knowledge Gaps?
9. Measurement Inventory
10. Inventory Complete?
11. Measurement Capability
12. Measurement Capability OK?
12.1. Measurement Capability Corrections
13. Process Capability
14. Process Capability OK?
14.1 Corrections or Counter-measures
15. Change Flow?
Go to Step 4
6.1 Measurements OK?
6.2 Fill Measurement Gap
6.3 Fill Knowledge Gaps
6.4 Change Flow?
16. Characteristic Matrix
17. Change Flow?
18. Characteristic Type
19. Operational Importance
20. PFMEA
21. Change Flow?
22. Control Factors
23. Control Classification
24. Change Flow?
25. Control Methods
26. Illustrations & Instructions
27. Do they work?
27.1 Change Illustrations & Instructions
28. Implement
29. Maintain & Periodically Review
30. Revisions or Improvements?
31 Make Changes
Yes
No
= Action
= Decision

Dynamic Control Plan
Master Copy

Company/Plant: **Department:** **Process:** **Operation:** **Machine:** **Station:** **Part Name:** **Part Number:** **Control plan revision date:** **Process sheet revision date:** **Page:** **of:** **B/P revision date:**

																Previous											
Char #	Characteristic Description (Product & Process)	Spec	Type	Imp	Failure Mode	Effects of Failure	SEV	Causes of Failure	OCC	Current Controls	DET	RPN	Recom. Actions	Area Respon. & Date	Actions Taken	SEV	OCC	DET	RPN	Ctrl. Fact.	Class	Control Method	Tool	Gage desc, master, detail	GR&R & Date	Cp/Cpk (target) & Date	Reaction Plans

Dynamic Control Plan
Operator Copy

Department: **Operation:** **Part Name:** **Control plan revision date:** **Page: of:**
Process: **Machine:** **Part Number:** **Process sheet revision date:** **B/P revision date:**

Char #	Characteristic Description	Spec	Class	Control Method	Current Controls	Gage desc, master, detail	Reaction Plans

APPENDIX H - GLOSSARY

Apportionment: Referred to in this manual as a part of Reliability Engineering. Synonymous with the term Reliability Apportionment, which is the assignment of reliability goals from system to subsystem in such a way that the whole system will have the required reliability.

Benchmark Data: The results of an investigation to determine how competitors and/or best-in-class companies achieve their level of performance.

Bill of Material: Total list of all components/materials required to manufacture the product.

Characteristics Matrix: An analytical technique for displaying the relationship between process parameters and manufacturing stations.

Design Failure Mode and Effects Analysis (DFMEA): An analytical technique used by a design responsible engineer/team as a means to assure, to the extent possible, that potential failure modes and their associated causes/mechanisms have been considered and addressed.

Design for Manufacturability and Assembly: A simultaneous engineering process designed to optimize the relationship between design function, manufacturability, and ease of assembly.

Design Information Checklist: A mistake proofing checklist designed to assure that all important items were considered in establishing design requirements.

Design Reviews: A proactive process to prevent problems and misunderstandings.

Design Validation: Testing to ensure that product conforms to defined user needs and/or requirements. Design validation follows successful design verification and is normally performed on the final product under defined operating conditions. Multiple validations may be performed if there are different intended uses.

Design Verification: Testing to ensure that all design outputs meet design input requirements. Design verification may include activities such as:

- Design Review
- Performing Alternate Calculations
- Understanding Tests and Demonstrations
- Review of Design Stage Documents Before Release

Durability: The probability that an item will continue to function at customer expectation levels, at the useful life without requiring overhaul or rebuild due to wearout.

Failure Modes Analysis (FMA): A formal, structured procedure used to analyze failure mode data from both current and prior processes to prevent occurrence of those failure modes in the future.

Feasibility: A determination that a process, design, procedure, or plan can be successfully accomplished in the required time frame.

Finite Element Analysis: A technique for modeling a complex structure. When the mathematical model is subjected to known loads, the displacement of the structure may be determined.

Kaizen: Taken from the Japanese words *kai* and *zen* where *kai* means **change** and *zen* means **good**. The popular meaning is continual improvement of all areas of a company not just quality.

Maintainability: The probability that a failed system can be made operable in a specified interval or downtime.

Packaging: A unit that provides protection and containment of items plus ease of handling by manual or mechanical means.

Preliminary Bill of Material: An initial Bill of Material completed prior to design and print release.

Preliminary Process Flow Chart: An early depiction of the anticipated manufacturing process for a product.

Process Failure Mode and Effects Analysis (PFMEA): An analytical technique used by a manufacturing responsible engineer/team as a means to assure that, to the extent possible, potential failure modes and their associated causes/mechanisms have been considered and addressed.

Product Assurance Plan: A part of the Product Quality Plan. It is a prevention-oriented management tool that addresses product design, process design, and when applicable software design.

Production Trial Run: Product made using all production tools, processes, equipment, environment, facility, and cycle time.

Quality Planning Sign-Off: A review and commitment by the Product Quality Planning Team that all planned controls and processes are being followed.

Reliability: The probability that an item will continue to function at customer expectation levels at a measurement point, under specified environmental and duty cycle conditions.

Reliability Apportionment: See Apportionment.

Simulation: The practice of mimicking some or all of the behavior of one system with a different, dissimilar system.

Simultaneous Engineering: A way of simultaneously designing products, and the processes for manufacturing those products, through the use of cross functional teams to assure manufacturability and to reduce cycle time.

Special Characteristics: Product and process characteristics designated by the customer, including governmental regulatory and safety, and/or selected by the supplier through knowledge of the product and process.

Subsystem: A major part of a system which itself has the characteristics of a system, usually consisting of several components.

System: A combination of several components or pieces of equipment integrated to perform a specific function.

Team Feasibility Commitment: A commitment by the Product Quality Planning Team that the design can be manufactured, assembled, tested, packaged, and shipped in sufficient quantity at an acceptable cost, and on schedule.

Timing Plan: A plan that lists tasks, assignments, events, and timing required to provide a product that meets customer needs and expectations.

Value Engineering/Value Analysis: A planned, clean sheet approach to problem solving, focusing on specific product design and process characteristics. Where value analysis is employed to improve value after production has begun, value engineering is employed to maximize value prior to expenditures of facilities and tooling money.

Voice of the Customer: Customer feedback both positive and negative including likes, dislikes, problems and suggestions.

Voice of the Process: Statistical data that is feedback to the people in the process to make decisions about the process stability and/or capability as a tool for continual improvement.

APPENDIX I – ACRONYMS

AIAG	Automotive Industry Action Group
CFT	Cross Functional Team
DCP	Dynamic Control Plan (Dimensional Control Plan)
DFMEA	Design Failure Mode and Effects Analysis
DOE	Design of Experiments
DVP&R	Design Verification Plan and Report
FMA	Failure Mode Analysis
FMEA	Failure Mode and Effects Analysis
FTC	First Time Capability
GR&R	Gage Repeatability and Reproducibility
PFMEA	Process Failure Mode and Effects Analysis
PQP	Product Quality Planning
PQPT	Product Quality Planning Team
QFD	Quality Function Deployment
QSR	Quality System Requirements
SFMEA	System Failure Mode and Effects Analysis
TGR	Things Gone Right
TGW	Things Gone Wrong
VE/VA	Value Engineering/Value Analysis

APPENDIX J – BIBLIOGRAPHY

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AIAG Publications

The Chrysler, Ford and GM documents published by AIAG currently available are:

- Measurement Systems Analysis
- Fundamental Statistical Process Control
- The Production Part Approval Process
- Failure Mode and Effects Analysis

Planned for publication during the life of this document:

- Quality System Requirements

Ordering information is available from the Automotive Industry Action Group by calling 810-358-3003.

APPENDIX K – INDEX

O

P

Q

R

S

T

V

W

APPENDIX L – FORMS

CONTROL PLAN

Page _____ of _____

☐ Prototype ☐ Pre-launch ☒ Production Control Plan Number	Key Contact/Phone	Date (Orig.)	Date (Rev.)
Part Number/Latest Change Level	Core Team	Customer Engineering Approval/Date (If Req'd)	
Part Name/Description	Supplier/Plant Approval/Date	Customer Quality Approval/Date (If Req'd)	
Supplier/Plant / Supplier Code	Other Approval/Date (If Req'd)	Other Approval/Date (If Req'd)	

Part/ Process Number	Process Name/ Operation Description	Machine, Device, Jig, Tools For Mfg.	Characteristics			Special Char. Class.	Methods					Reaction Plan
			No.	Product	Process		Product/Process Specification/ Tolerance	Evaluation Measurement Technique	Sample		Control Method	
									Size	Freq.		

CONTROL PLAN SPECIAL CHARACTERISTICS (OPTIONAL)

☐ Prototype ☐ Pre-launch ☐ Production Control Plan Number		Key Contact/Phone	Date (Orig.)	Date (Rev.)
Part Number/Latest Change Level		Core Team	Customer Engineering Approval/Date (If Req'd)	
Part Name/Description		Supplier/Plant Approval/Date	Customer Quality Approval/Date (If Req'd)	
Supplier/Plant	Supplier Code	Other Approval/Date (If Req'd)	Other Approval/Date (If Req'd)	

No.	Description/Nickname	Specification/Tolerance	Class	Illustration/Pictorial

DATA POINT COORDINATES (OPTIONAL)

Control Plan No. Page _____ of _____

Customer: Date (Orig): Date (Rev):

Char. No.	Point Ident.	X	Y	Z	Char. No.	Point Ident.	X	Y	Z	Char. No.	Point Ident.	X	Y	Z

TEAM FEASIBILITY COMMITMENT

Date:_____

Customer:_____ Part Name:_____

Part Number:_____

Feasibility Considerations

Our product quality planning team has considered the following questions, not intended to be all-inclusive in performing a feasibility evaluation. The drawings and/or specifications provided have been used as a basis for analyzing the ability to meet all specified requirements. All "no" answers are supported with attached comments identifying our concerns and/or proposed changes to enable us to meet the specified requirements.

YES	NO	CONSIDERATION
		Is product adequately defined (application requirements, etc.) to enable feasibility evaluation?
		Can Engineering Performance Specifications be met as written?
		Can product be manufactured to tolerances specified on drawing?
		Can product be manufactured with Cpk's that meet requirements?
		Is there adequate capacity to produce product?
		Does the design allow the use of efficient material handling techniques?
		Can the product be manufactured without incurring any unusual:
		• Costs for capital equipment?
		• Costs for tooling?
		• Alternative manufacturing methods?
		Is statistical process control required on product?
		Is statistical process control presently used on similar products?
		Where statistical process control is used on similar products:
		• Are the processes in control and stable?
		• Are Cpk's greater than 1.33?

Conclusion

☐	Feasible	Product can be produced as specified with no revisions.
☐	Feasible	Changes recommended (see attached).
☐	Not Feasible	Design revision required to produce product within the specified requirements.

Sign–Off

_____ _____

Team Member/Title/Date Team Member/Title/Date

_____ _____

Team Member/Title/Date Team Member/Title/Date

_____ _____

Team Member/Title/Date Team Member/Title/Date

PRODUCT QUALITY PLANNING SUMMARY AND SIGN-OFF

DATE:_____

PRODUCT NAME:_____ PART NUMBER:_____

CUSTOMER:_____ MANUFACTURING PLANT:_____

1. PRELIMINARY PROCESS CAPABILITY STUDY

QUANTITY

	REQUIRED	ACCEPTABLE	PENDING*
Ppk - SPECIAL CHARACTERISTICS			

2. CONTROL PLAN APPROVAL (If Required)

APPROVED: YES/NO* DATE APPROVED_____

3. INITIAL PRODUCTION SAMPLES
CHARACTERISTIC CATEGORY

QUANTITY

	SAMPLES	CHARACTERISTICS PER SAMPLE	ACCEPTABLE	PENDING*
DIMENSIONAL				
VISUAL				
LABORATORY				
PERFORMANCE				

4. GAGE AND TEST EQUIPMENT
MEASUREMENT SYSTEM ANALYSIS

QUANTITY

	REQUIRED	ACCEPTABLE	PENDING*
SPECIAL CHARACTERISTIC			

5. PROCESS MONITORING

QUANTITY

	REQUIRED	ACCEPTABLE	PENDING*
PROCESS MONITORING INSTRUCTIONS			
PROCESS SHEETS			
VISUAL AIDS			

6. PACKAGING/SHIPPING

QUANTITY

	REQUIRED	ACCEPTABLE	PENDING*
PACKAGING APPROVAL			
SHIPPING TRIALS			

7. SIGN-OFF

_____ _____

TEAM MEMBER/TITLE/DATE TEAM MEMBER/TITLE/DATE

_____ _____

TEAM MEMBER/TITLE/DATE TEAM MEMBER/TITLE/DATE

_____ _____

TEAM MEMBER/TITLE/DATE TEAM MEMBER/TITLE/DATE

* REQUIRES PREPARATION OF AN ACTION PLAN TO TRACK PROGRESS.