Quality Assurance

ITMT 186
Chapter 42 & 43

Interchangeable Manufacturing

- Definite size, shape and finish specifications
- Allows for fabrication to exacting dimensions and close tolerances
- Leads to a higher standard of living
  - Standardization of products and methods of manufacting
    - Ease of assembly and Repair

Quality Control

- Identify and respond to nonconformities
  - defects
- Very **Reactive** as a group

Quality Assurance

- Responsible for:
  - Quality planning
  - Instituting system improvements
    - Defect prevention and reliability
- Group is very **Proactive**

Total Quality Management

- Three (3) Fundamental Principles
  - Emphasis on customer (internal & external)
  - Improving work process to produce consistently
  - Emphasis on involvement of the TOTAL organization

- Quality must be designed and built into a product
- Defect prevention
- Philosophy
  - Continuous improvement
  - Controlling the processes, not the parts produced

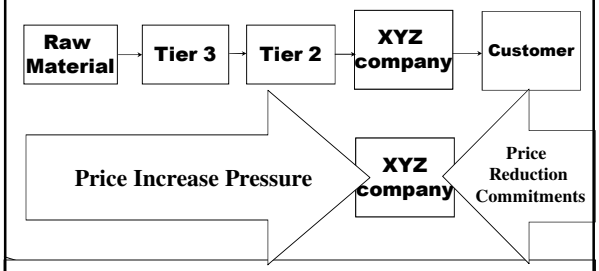
W. Edwards Deming

1. "Create constancy of purpose towards improvement". Replace short-term reaction with long-term planning.
2. "Adopt the new philosophy".
3. "Cease dependence on inspection".
4. "Move towards a single supplier for any one item."
5. "Improve constantly and forever".
6. "Institute training on the job". If people are inadequately trained, they will not all work the same way, and this will introduce variation.
7. "Institute leadership".
8. "Drive out fear". Deming sees management by fear as counter- productive in the long term
9. "Break down barriers between departments". Another idea central to TQM is the concept of the 'internal customer', that each department serves not the management, but the other departments that use its outputs.
10. "Eliminate slogans".
11. "Eliminate management by objectives".
12. "Remove barriers to pride of workmanship".
13. "Institute education and self-improvement".
14. "The transformation is everyone's job".

ISO 9000

- International Organization for Standardization
  - Generic series/models of quality system management standards
  - Become a world standard
- Each Tier of the supply chain has this demand on the other
- Companies establish own criteria and practices
  - Has to be in compliance
  - Quality Process Certification

The BIG SQUEEZE....



The Marketplace Has Changed Dramatically Over The Past Several Years

ISO Branches

- **9001** – Model for QA in design/development, production, installation and servicing
- **9002** – Model for QA in production and installation
- **9003** – Model for QA in final inspection and test
- **9004** – Quality management and quality system elements: Guidelines
- **14000** – Environmental Management System
  - Internal or external
  - Production to disposal
  - Effects on environment

QS 9000

- Chrysler, Ford and GM – developed this standard for conformity
- ISO framework with a lot of extras

QS 9000

- Three sections
  - **Section 1**
    - All 20 ISO 9001 clauses
  - **Section 2**
    - PPAP (production part approval process)
    - Continuous improvement
    - Manufacturing capabilities
  - **Section 3** (Customer-Specific Requirements)
    - Chrysler
    - GM
    - Ford
    - Truck Manufacturers

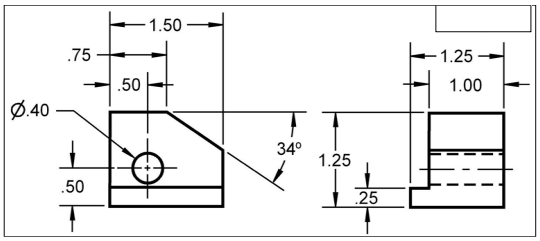
ISO/TS 16949

- Jointly developed by the IATF (International Automotive Task Force)
- Common automotive quality system requirements based on ISO 9001:2000, AVSQ (Italian), EAQF (French), QS-9000 (US), VDA6.1 (German)
- Ford/GM – December 14, 2006
- Daimler-Chrysler – July 1, 2004

Quality Assurance Functions

- **Quality Specifications** – dimensions, tolerances and other requirements
- **Inspection**
- **Quality Analysis** – recorded for review
  - What to do with the ***PROCESS***
  - What to do with the ***PRODUCT***
- **Quality Control**
  - Quality is consistent with quality-economic standard
  - Quality does not mean "the BEST" (best for the MONEY)

Dimensioning



Tolerancing / Interchangeability

- Tolerancing is dimensioning for interchangeability.
- What is interchangeability?

An interchangeable part is simply a mass produced part (a replacement part).

Tolerancing / Interchangeability

- How is a feature on an interchangeable part dimensioned?
  - The feature is not dimensioned using a single value, but a range of values.

$$1.00 \rightarrow \begin{matrix} 1.005 \\ .994 \end{matrix}$$

Tolerancing / Interchangeability

- A tolerance is the amount of size variation permitted.
  - You can choose a tolerance that specifies a large or small variation.

Size limits = $\begin{matrix}1.005\\.994\end{matrix}$

Tolerance = 1.005 - .994 = .011

Tolerancing / Interchangeability

- Why do we want a part's size to be controlled by two limits?

It is necessary because it is impossible to manufacture parts without some variation.

The stated limits are a form of quality control.

1. Limit Dimensions

- Limits are the maximum and minimum size that a part can obtain and still pass inspection.
  - For example, the diameter of a shaft might be specified as follows.

$\varnothing^{1.001}_{.999}$ or $\varnothing 1.001 - .999$

1. Limit Dimension Order

- External dimensions:
  - The larger dimension is first or on top and the smaller dimension is last or on the bottom.
- Internal dimensions:
  - The smaller dimension is first and the larger dimension is last.

1. Limit Dimension Order

- Why? Does the order matter?
- This convention is used to avoid machining mistakes.

➢ Is the following dimension for a shaft or hole?

$\varnothing^{1.001}_{.999}$ or $\varnothing 1.001 - .999$ Shaft

2. Plus or Minus Tolerances

- Plus or minus tolerances give a basic size and the variation that can occur around that basic size.

$10.0\ ^{+0.1}_{-0.2}$

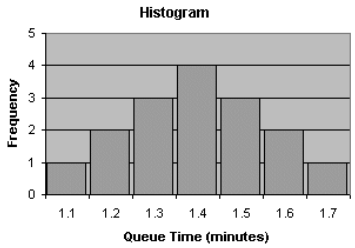
3. Page or Block Tolerances

- A page tolerance is actually a general note that applies to all dimensions not covered by some other tolerancing type.

UNLESS OTHERWISE SPECIFIED ALL:
.XX = ± .010 inch
.XXX = ± .005 inch
.XXXX = ± .002 inch

Statistical Process Control (SPC)

- Charting Tools



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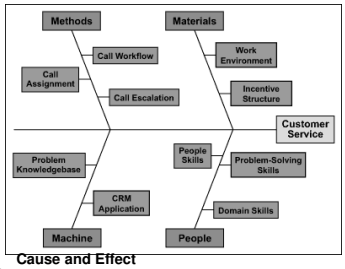

Cause and Effect

Statistical Process Control (SPC)

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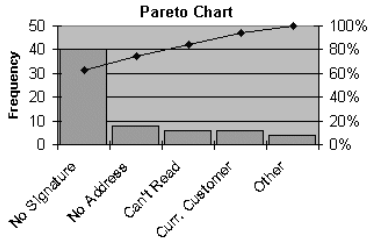

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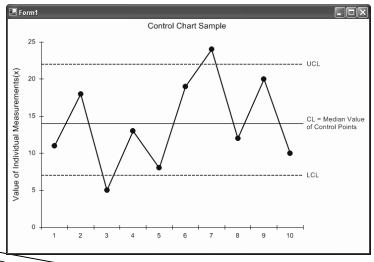

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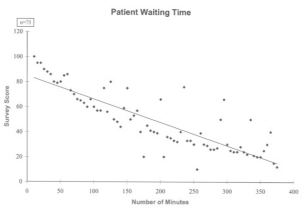
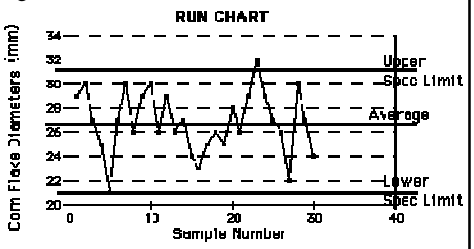


Scatter Diagram

Statistical Process Control (SPC)

- Charting Tools



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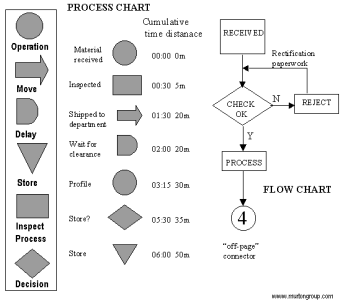
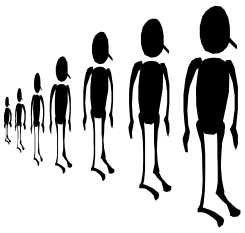


SPC



- **Sample Size (n)**
  - Number of parts to be inspected in a sample
- **Mean ($\overline{X}$) - average**
- **Standard Deviation** (s) – estimated dispersion
- **Range (R)** – $x_{max} - x_{min}$

Formulas

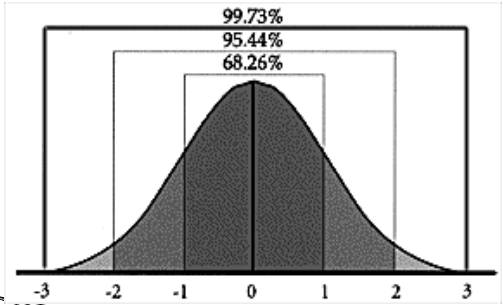
- Mean

$$\overline{X} = \frac{(x_1 + x_2 + x_3 \ldots\ldots x_n)}{n}$$

- Standard Deviation

$$S = \sqrt{\frac{(x_1 - \overline{x})^2 + (x_2 - \overline{x})^2 + \ldots\ldots}{n-1}}$$

Normal Distribution Curve



- Six Sigma

Upper and Lower Control Limits

- **UCL** = $\overline{x} + 3\sigma$
- **LCL** = $\overline{x} - 3\sigma$