APPENDIX A

ABBREVIATIONS

ALLOW	Allowance
ALY	Alloy
AL	Aluminum
ASSY	Assembly
BEV	Bevel
CBORE	Counter bore
CI	Cast Iron
CL	Center Line
CHAM	Chamfer
CLS	Cold-rolled steel
CORR	Corrosive
CRES	Corrosive resistant steel
CRS	Countersink
CDK	Countersink
CSTG	Casting
CTR	Center
CONN	Connector
C/**T**	Common to
(°)DEG	Degree
DIA	Diameter
DIM	Dimension
DWG	Drawing
ELEC	Eletrical
FTG	Fitting
FWD	Forward
GRD	Ground (El.)
GEN	Generator
ID	Inside diameter
INSP	Inspection
INSTL	Installation
JIT	Just in time
L	Left
LH	Left-hand
LIM	Limits
LWR	Lower
MATL	Material
MAX	Maximum
MFG	Manufacturing
MIN	Minimum
MSDS	Material Safety Data Sheet
NATL	National
NTS	Not to scale
OD	Outside diameter
OPP	Opposite
POS	Position
PSI	Pounds/Sq.In.
QTY	Quantity
R	Radius
REF	Reference
REQ	Required
REV	Revise
RH	Right hand
SCR	Screw
SEC	Section
SHT	Sheet
SPHER	Spherical
S/F	Spot faced
SQ	Square
STD	Standard
STK	Stock
SUR	Surface
SYM	Symmetrical
TAB	Tabulation
THD	Thread
TOL	Tolerance
UPR	Upper
USCS	United States Customary System
USG	United States Gage
USS	United States Standard
WI	Wrought Iron

APPENDIX B

GLOSSARY/DEFINITIONS

Benchmark model - the best possible model, based on the provided date, as determined by three experts.

Cell - a small unit of one or more workstations.

Cellular Manufacturing - a way of implementing Group Technology

Clamps - used as hold downs and hold things together.

Computer Aided Process Planning (CAPP) in an integrated system.

Coordinated effectively and efficiently
CAPP linked by CAD-CAM in total integrated mfg. system.
CAPP effective for small volume and high variety of parts

CAPP ADVANTAGES	
Standardization of process	*More productive planning*
Reduce lead time	*Reduce planning costs*
Consistent quality	*More reliable*

CAPP SOFTWARE ELEMENTS		
Machines, Tools, Dies	*Processes*	*Particular part*
Capabilities	*Process variables*	*Material*
Properties	*Dimensions*	*Surface*
Tolerance dimensions	*Feeds*	*Shape*
	Speeds	*Dimensions*
	Times	*Tolerances*
	Power requirements	

Computer Aided Process Planning (CAPP) does all this as an integrated system.

Two types of CAPP Systems
Retrieval - computer files of process plan, search for part code, then retrieved, displayed, printed as route sheet

Generative system - generates a process plan based on a complex logic of the planner.

Computer process planning can be integrated into product planning and controls.

Costs - reflects the expense of producing an item and price is the wholesale or retail amount to be paid for the item. Costs include the following:

1. Materials
2. Labor
   Direct - direct mfg. of the part
   Indirect - servicing total mfg. process such as supervision, maintenance, repairs, engineering, quality control, management, office support, research and development, sales
3. Tooling
4. Fixed
   Taxes, rent, real estate, power, insurance, fuel
5. Capital - land, buildings, machinery, equipment (including interest and depreciation)

Cutting - Factors influencing cutting process

Cutting speed, depth of cut, cutting fluid	Build-up edge chip	Tool wear
tool angle	Discontinuous chip	Machinability
continuous chip	Temperature rise	

Database - any collection of related data that is stored on one file, disk, or CD, any collection of related data for a computer system.

Dimensioning

1st, techniques of dimensioning including
character of line
spacing dimensions,
making arrowheads

2nd, rules of placement of dimensioning, assure practical and logical arrangement for sake of legibility

3rd, choice of dimensions - function vs. shop process.

Dimension line. Customary to place dimension figure between broken dimension line. Dimension line nearest object should be at least 3/8″ away. All others at least 1/4″ and uniform through out the drawing. Dimension lines meet extension lines at right angles with exceptions. 1/16″ between extension line and object. O.K. to have intersecting extension lines but not dimension lines.

Discrimination - making distinctions among people based on age, gender, religion, race or ethnic group for the purpose of providing unequal opportunities.

Drawing types:

Assembly drawings	Isometric
Installation drawings	Orthographic
Detail drawings	Oblique
Pattern drawings	Perspective
Forge/Casting drawings	

Drawing must give size description as well as shape description.

Effective - produce the desired consequences or outcomes

Efficient - use a minimum of time and resources

Equality - all involved have the same opportunity to participate and/or compete for employment and advancement based solely on personal attributes knowledge and skills.

Equitable - according to natural right or natural justice, marked by due consideration for what is fair, unbiased, or impartial. **The Law Dictionary**, Second Edition, Steven H. Gifis.

Ethical characteristics - characteristics and behaviors that a) enable the individual to grow and prosper in the work environment, b) help others in the workplace do the same and c) do not take advantage of, nor hurt others, nor the company.

Ethical Business Behavior - concerned with and enables, to that degree possible, all involved to grow and prosper.

Finishing - includes grinding, ultrasonic, abrasive-jet, deburring, honing, polishing, buffing.

Fixtures - designed for specific purpose placed on or taken off of machines; often are replicas of parts. (Usually a holding device)

Sample Fixtures: Step Blocks, Hold down strips, Push sticks

Flexible Manufacturing Systems

Integrates all elements of mfg. highly automated
no. of cells each with a robot and CNC machines and automated material handling all interfaced with central computer
Cellular Manufacturing = a way of implementing Group Technology
Flexible (variety of products) manufacturing cells
usually unmanned
Handle a variety of parts configuration and in any order.

Forging - shaped by compressive force through dies and tools.

Group dynamic - how the various personalities, individual backgrounds and jobs/positions function in a group, on a crew, on a team, or committee and interact within the cultures of workplace/organization.

Group Technology - (GT) a concept based on design and process similarities among and diversity of parts. Classifies and codes part by geometric similarities and/or manufacturing similarities.

CLASSIFICATION AND CODING BY	
DESIGN ATTRIBUTES	***MANUFACTURING ATTRIBUTES***
Internal/external shape/dimensions	*Primary processes*
Aspect ratio (length/width - dia.)	*Secondary and finishing processes*
Tolerance	*Tolerances and surface finish*
Surface finish	*Sequence of operations*
Function	*Tools. dies, fixtures, machinery*
	Production quantity and rate

GT is far more flexible for customer requirement for smaller quantities with greater variety. Batch operations are difficult yet most production is batch.

GROUP TECHNOLOGY (GT) ADVANTAGES	
Standardize parts	*Scheduling more efficient*
Reduce design duplication	*Machine use more efficient*
Faster learning for designer & Engineers	*Statistic available on processes, Materials, Parts*
Cost estimates more accurate	*Setup time reduced*
Process planning standardized	*More consistent parts*
NC Programming more automatic	*With CIM, CAD-CAM batch production approaches cost of mass production*

Interpret - an assessment of adequacy or inadequacy in reference to some standard.

Jigs - references surfaces and points for accurate alignment of parts and tools; often used for mass production. Samples:

Angle cut jibs	*Spacing jigs*	*Bending jigs*
Miter jigs	*V-block jigs*	

Just-in-time inventory - the minimum inventory required to meet the production schedule or having available only what is needed for the immediately job.

Harassment - any exercise of authority in such manner as to be unnecessarily oppressive; connotes purposeful actions and conduct motivated by a malicious or discriminatory purpose. Sexual harassment - "an employee policy or acquiescence in a practice of compelling female employees to submit to the sexual advances of their male superiors." 552d. 1032. Discrimination on the bases of gender have applied to both men and women and apply in instances of verbal and physical harassment. Source: **The Law Dictionary**, Second Edition, Steven H. Gifis, p. 210.

Leader - a thin solid line leading from a note or dimensions and terminated by an arrowhead or a dot touching the part to which attention is directed. Arrowhead on edge of object. Dot within object.

Manufacturing Process Materials and Variables

MATERIAL AND PROCESS VARIABLES	
Tools, molds and dies wear	*Machine conditions & maintenance*
Lubricants and metalworking fluids	*Environmental conditions on people and machines*
Difference in. shipments of raw materials	*Operator skills - fatigue, attention*

Master scheduling - the process of scheduling, tracking and meeting project deadlines and time constraints for all processes related to production/manufacturing operation and is necessary for all planning, determining costs and budgeting, and implementation stages for any project.

Material Handling - the functions and systems associated with the transportation, storage, and control of materials and parts in the total manufacturing cycle of a product.

Mating Parts, Fits between

1. Clearance fit - leaves a space between parts
2. Interference fit - internal member is larger than external.
3. Transition fit - Could be either 1 or 2.

Measurement

1. General measurements

   A measurement to a level of accuracy typical of estimates and common household measurement instruments. A measurement to the 1/64" level of accuracy common to a steel rule.

   Examples: rulers and tape measures (down to 1/8" to 1/16"), liquid and dry volume measurements

2. Precision measurements

A relative but higher level of accuracy within certain tolerance limits. The tolerance for decimal dimensions is generally .002 inches. (unless otherwise stated)

Examples: - Calipers (Dial and digital), Lasers

MEASUREMENTS

Direct measurements - linear, angular/radial

Materials Measurements:	***Tooling Measurements:***
Height	*Bends*
Width	*Joggles*
Thickness	*Bores*
Weight/Density	*Reams*
Hardness	*Taps*
Strength Measurements	***Efficiency Measurements:***
Tensile	*Time*
Compression	*Rework*
Shear	

Calculated measurements - areas, volume

Measurement Instruments

Combination set	Thread pitch gage	Radius gage
Feeler gauges	Thread ring gage	Layout height gage
6″ Steel rule	Go-no-go thread gage	Garr plates
Steel tape	Edge finder	Drill gages
	Telescoping gages	Radius gages
	Machine finish gauge	Levels

Notes, general - refer to material call-out, tolerances, heat treatment, pattern information, surface quality and related symbols. General notes apply throughout the drawing and are generally located in the title block of a machine drawings , otherwise they are above or to the left of the title block or lower right-hand corner of the drawing.

Overhead costs - general expenditures that cannot be attributed to any one department or product, excluding cost of materials, labor and selling.

Producibility - ease of manufacturing and assembly at a minimum production cost.

Profit - revenue minus cost.
Revenue is the number of units sold times the price per unit
Costs are all expenditures involved in creating and getting a product to the market place.

Quality assurance - conforming to specification.

Reference dimensions (REF) - provide location information for greater accuracy and are not intended to be measured nor determine shop operations. They are calculated dimensions.

Routing sheet - identifies the process sequence, operation and standardized times for each operation.

Scales
Metric scale
Decimal scale
Steel rule
Engineering scale
Architect's scale

Size - see Dimensioning

Statistics - Collection, analysis, interpretation and presentation of large amount of numerical data.

Frequency Distribution - Distribution - spread of sample variance

Average (arithmetic means) $\bar{x} = \frac{x_1 + x_2 + x_3 \ldots . x_n}{n}$

Dispersion (width of curve) $R = x_{max} - x_{min}$

Standard deviation

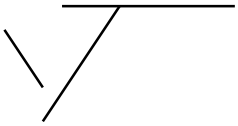
$$\sigma = \sqrt{\frac{(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + (x_3 - \bar{x})^2 + (x_n - \bar{x})^2}{n - 1}}$$

x = the measurement of each part

Statistical Quality Control

BASIC ELEMENTS OF SQC		
Sample size	*Distribution*	*Lot size*
Random sampling	*Population*	*Frequency distribution*

Control limits - formulas - but within 3σ range
TQC - quality designed into the product, defect prevent
Deming method
Taguchi method

Surface quality symbol 

Tabular dimensions - a series having similar features but different dimension. A,B,C then dimensions listed in a table.

Tests

NON-DESTRUCTIVE TESTS		
Thermalgraphic (heat sensitive paint)	*Magnetic-particle inspection*	*Eddy current inspection*
Acoustic-emission	*Acoustic-impact*	*X-ray (radiography)*
Thermal	*Ultrasonic*	*Liquid penetration*
Holography	*holographic interferometry*	*acoustic holography*

Tolerances

Every dimension on a drawing should have a tolerance, either by general or local note.

Definition of Terms

Nominal Size - purpose of general identification, e.g. nominal size of both the hole and the shaft is 1 1/4″

Basic size - the exact size from which limits of size are derived. It is the decimal equivalent of the nominal size, e.g. 1.250″

Tolerance - Total amount of variance

Limits - max. and min. size indicated in tolerance dimension.

Allowance - Minimum clearance space

Tolerance shown by:

1. Limit dimensioning - ← .500-.502 →

2. Plus and Minus dimensioning

Unilateral ←$1.878^{+.000}_{-.002}$ →

Bilateral ←$1.876^{+.002}_{-.001}$ →

←1.750 ±.002→

3. Single limit dimensioning
   .05 R MAX.

4. Angular Dimensioning
   30° ±1°

Value - the ratio of product function and performance to the cost of production.

Value added - the cost of something specified by the customer or a step in the process necessary to meet customer specifications or any activity or resource within a process which is necessary to meet the configuration of the end product. Doing the job right the first time and thinking of the next group in the production process as customers are value added because they ultimately save money and improve the quality of the product.

Non-value added are costs that are of no value to the customer such as repeated inspections, rework, delays and storage.

Value engineering - system that evaluates all steps and elements of the total process as they contribute to the products intended performance as the lowest possible costs.

Workstation - one or more machines with different operations.