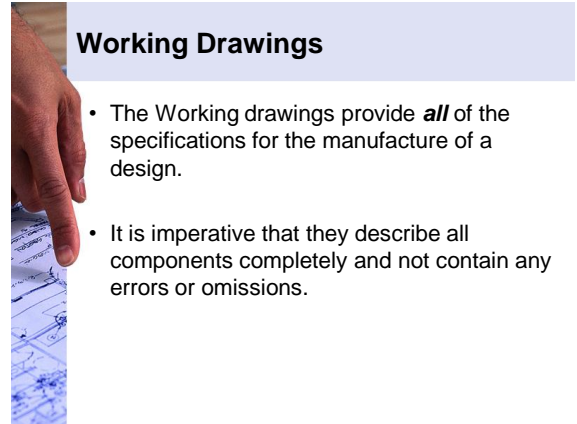




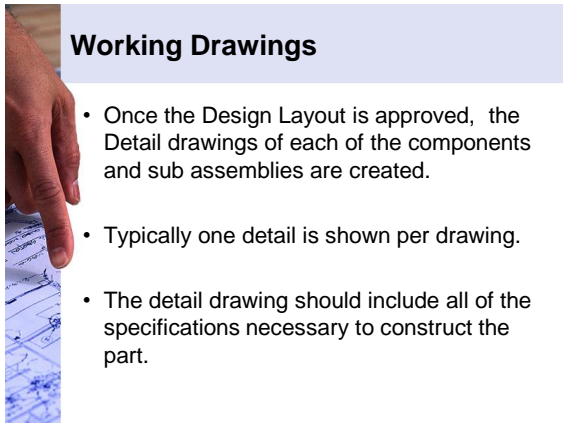
## Working Drawings

April 21, 2011



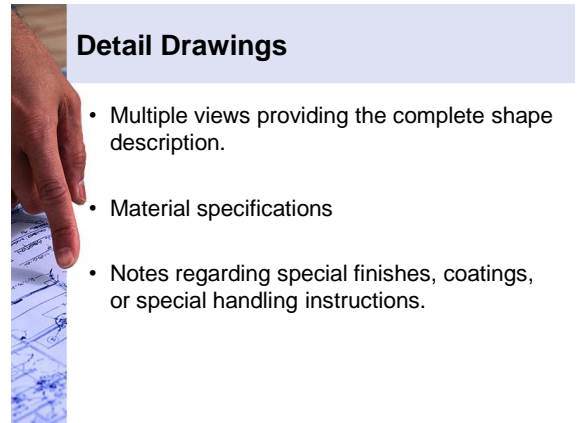
## Working Drawings

- The Working drawings provide **all** of the specifications for the manufacture of a design.
- It is imperative that they describe all components completely and not contain any errors or omissions.



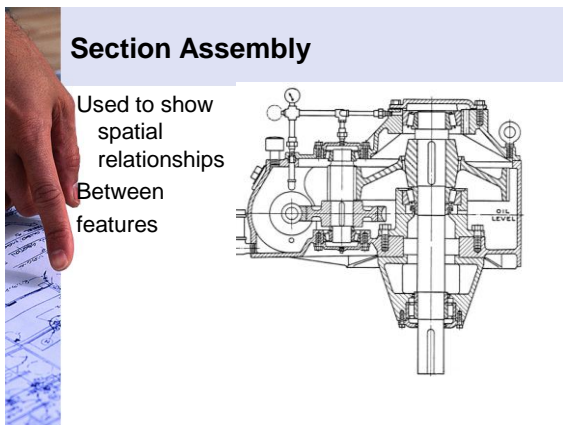
## Working Drawings

- Once the Design Layout is approved, the Detail drawings of each of the components and sub assemblies are created.
- Typically one detail is shown per drawing.
- The detail drawing should include all of the specifications necessary to construct the part.



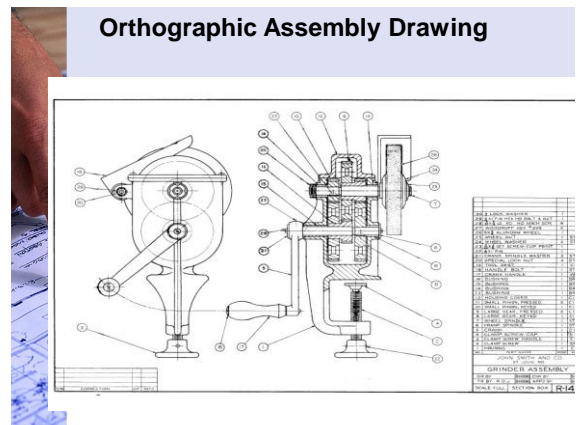
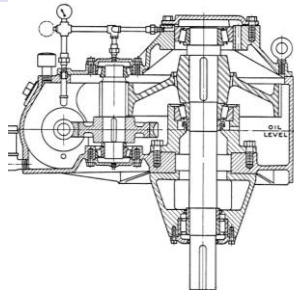
## Detail Drawings

- Multiple views providing the complete shape description.
- Material specifications
- Notes regarding special finishes, coatings, or special handling instructions.

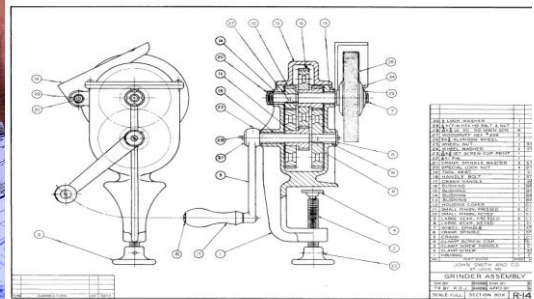


## Section Assembly

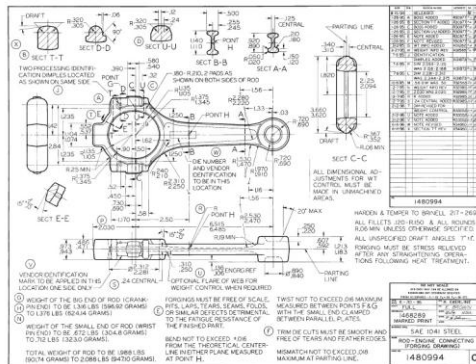
Used to show spatial relationships Between features



## Orthographic Assembly Drawing



## Working Assembly Drawing



## Assembly Drawings

- Are not necessarily orthographic.
- May be isometric, oblique, or exploded.
- The objective in creating an assembly drawing is to show as clearly as possible, the components, and their relations to each other.

## General Assembly Drawings

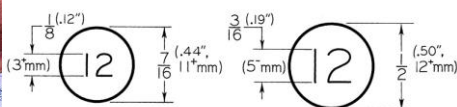
- When selecting the views to show for the assembly drawing, keep in mind that the goal is to show **how the parts fit together** and the **function of the final product**.
- The Assembly drawing does **not** need to show every detail of every component.
- The Assembly worker can check the Detail drawing if they have questions about the individual components.

## Bill of Materials Located on the Assembly Drawings

- Must include every component used to produce the product, and reference the source.
- Parts are numbered in order of importance.
- Should include
  - Item number
  - Quantity required
  - Description
  - Material of Construction
  - Source (Part numbers and manufacturer if purchased)
  - Detail Drawing number

## Identifying Components

.500" Dia Circular callouts are used to identify each component



## Types of Assembly Drawings

- Design Assembly
  - Created during the design phase.
  - Used to aid in design of components and sub assemblies
- General Assembly
  - Provides assembly information and Bill of Materials
  - References Detail drawings of components
- Working Drawing Assemblies
  - Combines details and assembly information
- Outline or Installation Assemblies
  - Specifically intended to aid in installation.
  - Shows placing information and relationships of exterior surfaces.
- Check Assemblies
  - Created specifically to check fits, and function of component parts after revisions have been made.

## General Assembly

- Includes all detail drawings
- Any Sub Assemblies
- A Final Complete Assembly (with Bill of Materials)

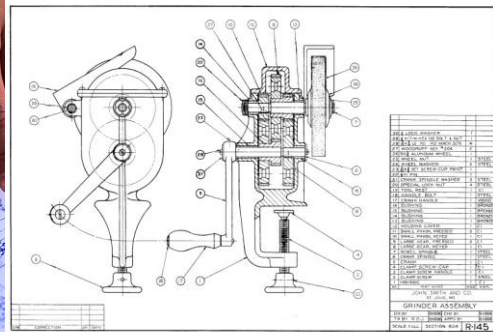
## General Assembly Drawings

- May include section views, or broken out sections to show the details of interior fits
- Do **not** normally include hidden lines, unless necessary for clarity.
- Do not include complete dimensions.
- Dimensions are given if they are required to show some function of the object as a whole.

## General Assembly Drawings

- Must identify each component and reference an item number on a Bill of Materials, which will be located above the Title Block
- The Bill of Materials, provides the quantity required of each item, the part number, source, and a brief description.

## General Assembly Drawings



## Title Block

### Required Information

- Part Description
- Drawing Number
- Date
- Drawn By:
- Check By:
- Scale
- Material
- Company Logo, Address
- General Tolerance Notes

DATE	REV	BY	CHKD	APPD	DESCRIPTION
10/15/00	1.0	J. SMITH	M. JONES	R. BROWN	GRINDER ASSEMBLY
					REV. 1.0
					DATE: 10/15/00
					DRAWN BY: J. SMITH
					CHECKED BY: M. JONES
					APPROVED BY: R. BROWN
					PART NO. 17540 B

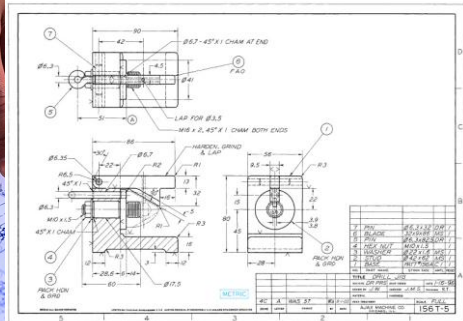
## Drawing Numbering Systems

- Drawing Numbers are never arbitrarily chosen
- Most Companies, use a numbering system, that indicates, the type of part (mechanical, electrical, piping, etc..)
- The date the drawing was completed
- The size of the Drawing, (A, B, C, D, etc...)
- The Contract or Customer identification numbers if applicable

## Drawing Numbers

- Example Numbering System
- 50 – 4010 – C
  - The number 50 is used to indicate a manufacturing process project
  - The “4000” series of numbers is used to denote piping systems.
  - The letter C indicates the drawing is a C size

## Revision Block



## Zoning

- A drawing may be broken into zones, in the same manner a map would be.
- The revision block, (in the previous example) refers to the zone in which the change was made

## Patent Drawings

- Patent submissions must include drawings to illustrate and explain the invention.
- The drawings are pictorial and not as detailed as working drawings.
- They are created on 8.5" x 11" paper with black ink.
- Shading is permissible if it improves readability

## Patent Drawings

United States Patent  
 (21) Patent No.: US 6,321,687 B1  
 (22) Date of Patent: Nov. 21, 2001

**BACKGROUND OF THE INVENTION**

1. Field of the Invention

2. Description of the Related Art

3. Summary of the Invention

4. Brief Description of the Drawings

5. Description of the Preferred Embodiment

6. Other Aspects and Advantages

7. Claims

8. Definitions

9. References Cited

10. Patent Documents

11. Other Publications

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256. Summary of the Invention

257. Brief Description of the Drawings

258. Description of the Preferred Embodiment

259. Other Aspects and Advantages

### Mechanical Drawings (MIMIC Project)

- Detail drawings required for each component
- Final Assembly Drawing with a Complete Bill of Material
- Logical Drawing Number System
- Package of Drawings to be topped with the Assembly drawing.
- Special notes for assembly if required.

### Checking of Drawings

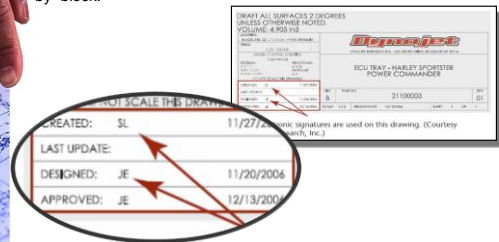
- The importance of accuracy can never be overemphasized.
- Always check drawings and have them checked.
- Typically an experienced Designer/Engineer will be the designated checker and check and sign off on all drawings

### Checking of Drawings

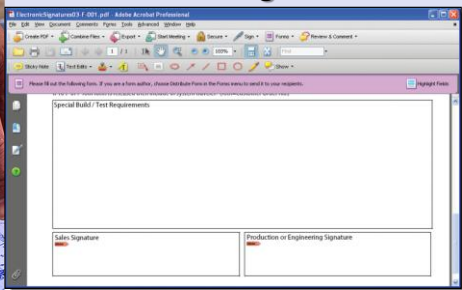
- The checker will typically check the following areas:
  - Soundness of design, ( manufacturability, ease of assembly, strength, and economy)
  - Choice of views, (partial, sections, auxiliary views)
  - Dimensions, (legibility, omissions, errors, ambiguity)
  - Standard parts (to be used whenever possible)
  - Notes, (clearness, legibility)
  - Clearances (appropriate for movement and fits)
  - Title Block, (accurate and complete)

### DRAWING APPROVAL AND RELEASE

The drawing's **creator** signs and dates the "drawn by" block, perhaps a **checker** signs off and dates the "checked by" block, and the **engineer** approves the drawing for release by signing and dating the "approved by" block.



### Electronic signature

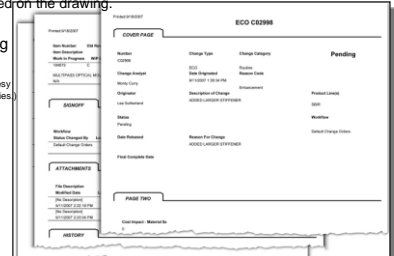


Electronic signature files are used to approve this engineering order form.

### CHANGE ORDERS

An ECO, also called an engineering change notification (ECN) and sometimes an engineering change request (ECR), details the nature of the change in a separate document. After the ECO is approved, the drawing is revised and the revision noted on the drawing.

Engineering Change Order (Courtesy of Zolo Technologies)



## REVISION BLOCK

A **revision block** describes the change and may also indicate the number of the engineering change order (which contains more information about the change). The revision block requires approval

Revision Block (Courtesy of Dynojet Research, Inc.)

REV#	REV	DESCRIPTION	DATE	APPROVED
1482	02	INCREASED WIDTH OF KEY ALONG TO EASE KEY INSTALLATION.	4/1/2008	SAS
	03	ADDED GDF TO CENTER REPAIRS ON THE SHAFT.		
1813	03	ADDED TOLERANCE TO DRIFT.	1/13/2004	SAS
3860	04	ADDED GDS CONCERNING TOLERANCE TO DRIFT.	2/1/2007	JE
	05	ADDED REQUIREMENT FOR CENTER DRILLING ONE END OF SHAFT.	5/2/2007	SAS

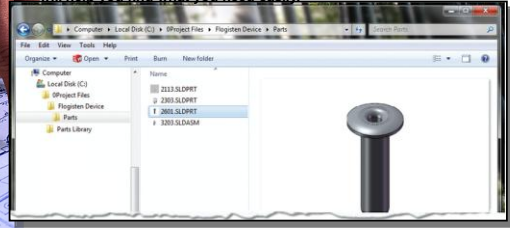
Waiting for action | My ECRs | Canceled | All | Search Results

Date	Status	ECR#	Owner	Description of change	Last Comment
3/22/2007	Complete	5060	shrd	RELEASE TO PRODUCTION. These were	
4/13/2007	Complete	5100	pkhard	RELEASE 21700004. This is the 2 <sup>nd</sup> piece.	The initial guide is being updated. The ECR for it will
4/16/2007	Complete	5109	pkhard	RELEASE LABOR PART # 10000070 AND	all 10 are powder coated.
5/4/2007	Implemented	5211	shrd	RELEASE TO PRODUCTION	Thanks!
5/7/2007	Complete	5129	sch	Add powder coating labor number 1500021.	OK. NEVER DRAWINGS ATTACHED NOW
5/8/2007	Implemented	5216	pkhard	Remove stock code 94200020. From I/A.	I've got some "1/2 Amp" orders for LV Tech Support.
5/11/2007	New	5230	shrd	RELEASE TO PRODUCTION "full part list"	Data file is attached.
5/14/2007	New	5231	shrd	RELEASE TO PRODUCTION "full part list"	A prototype can be built, and since that prototype is ok,

Engineering Change Request Tracking Software. (Courtesy of Dynojet Research, Inc.)

## ORGANIZED DIRECTORY STRUCTURES

Your CAD file directories may be project based, whereas other files may be organized differently. Making the directories work as you do will help you find what you need easily.



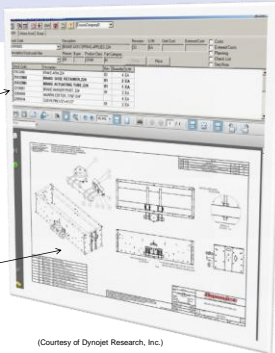
An Organized Directory Structure

## FILE NAMING CONVENTIONS

Consider:

- Company-wide policy for naming files

Part number and drawing tracking software allows the user to search the description to find a drawing or model



(Courtesy of Dynojet Research, Inc.)

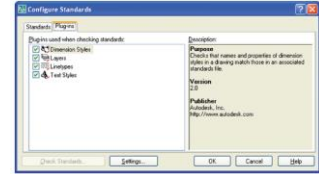
## DRAWING STANDARDS

**Drawing standards** can help you work more productively and can contribute to the usefulness of the drawings as company records.

**Company standards** may be in place to introduce consistency in the way drawings are constructed.

### Possible Standards:

- Layers / Names
- Colors
- Line types & weights
- Borders
- Fonts & Dim Styles
- Etc...



AutoCAD Software's **Configure Standards** Dialog Box. (Autodesk screen shots reproduced with the permission of Autodesk, Inc.)

## REPRODUCTION OF DRAWINGS

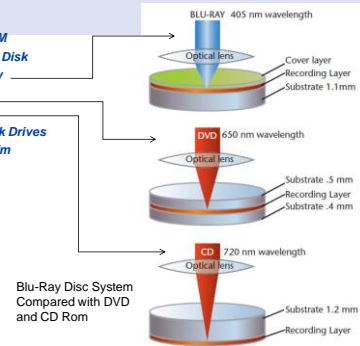
- PDF file
- Web or computer network
- Printing / Plotting on Mylar
- Diazo Process
- Xerox prints
- Fax machines



(Courtesy of Xerox Corporation.)

## STORAGE SYSTEMS

- CD-ROM
- Optical Disk
- Blu-Ray
- DVD
- CD
- Network Drives
- Microfilm



Blu-Ray Disc System Compared with DVD and CD Rom