

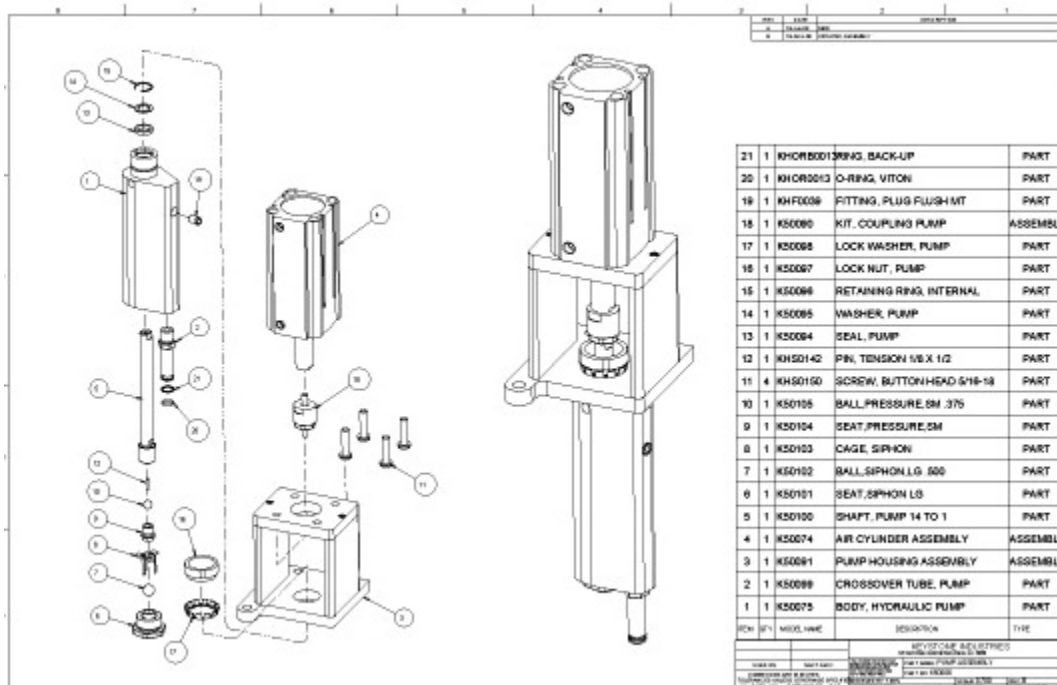
Assembly and Detail Drawings

Making decisions about how to draw an object can create problems for drafting students. May questions arise such as which views are needed, how many views are necessary, in what position should the object be drawn, which view should be the front view, why are hole locations and sizes given, why certain surfaces are finished and others not, and what is the material. These are common questions in basic drafting classes because the object (part) to be drawn is given in a pictorial (or 3D) view and the learner is asked to draw the object in orthographic projection. Seldom does the learner know what relationship the object being drawn has to other parts, if any, or why it is even being drawn.

It is important to learn the basics of orthographic projection and fundamentals of drafting. However, in an industrial setting the drafter or detailer must learn to rely on the industrial method for obtaining information necessary to complete a drawing (detail). This is done by referring to an assembly drawing. Few if any parts stand alone. All objects are **components** of what is known as an **assembly**. The assembly drawing establishes many of the questions asked in the first paragraph. All this information can be obtained from the assembly drawing because it is drawn showing all the component parts in an assembled position. Therefore the relationship of one component to another is established as well as other relevant information is supplied. The detailer will utilize the information presented on an assembly drawing to complete a detail. Therefore, it is important that the detailer/ drafter fully comprehend what an assembly drawing is, where the information is, and the relationship between an assembly and detail drawing.

The Assembly Drawing

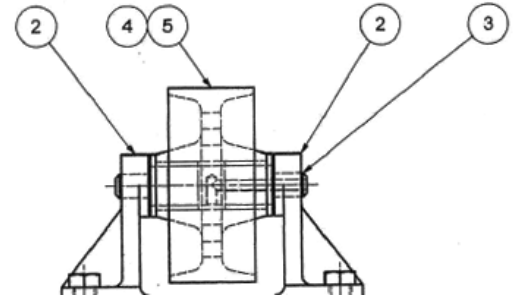
The assembly drawing is laid out showing all components in the assembled position, which illustrates the working relationship of one component to another. It is drawn clearly and concisely to allow a detailer of fabricator to locate all the components. The assembly drawing also reveals much more information, such as the **identification (ballooning)** of **components (details)**, the title block, and the **stock list**, which aids in distinguishing components which must be built (built items) from those which can be purchased (commercial items). The assembly drawing is a vital part of the design process and an important instrument that the detailer must learn to use.



Ballooning

The Identification of Assembly Components

An assembly can be a simple device with just a few components, or a very complex mechanism made up of many components. In either case, identification of each member of the assembly is extremely important. The method most commonly used on assembly drawings is called **ballooning**. The ballooning process is normally done by the designer laying out the assembly. It is a procedure in which each component of an assembly is identified by placing a balloon in an open area of the drawing. This balloon should be near the component and terminate with an arrowhead touching that item. Although sizes and configurations of balloon can vary between companies and industries, the most commonly used is a **5/8" diameter circle**. A number is then placed in the balloon which identifies the component. This number is called the **detail number** and makes future reference to that component easier.



Type of Balloons

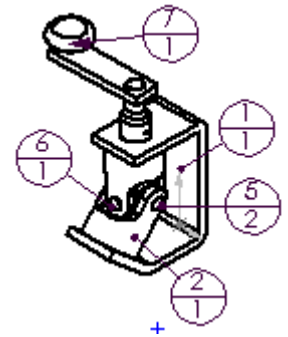
There are two common types of balloons used in industry: the full and split balloon.

The full balloon is a 5/8" diameter circle. A number is placed in the center of the circle with a height of 5/16" (.312). The number is the identification number assigned to that component of the assembly. As explained earlier, it is called the detail number. In general, full balloons are used:

- When the sheet number of the detail will appear in the stock list.
- When the assembly does not have a large number of details.
- When it is the policy of the engineering company.

The split balloon is also 5/8" in diameter; however it is divided half with a horizontal line. This is done so more information can be placed in the same area. The upper half of the balloon shows the number assigned to that component of the assembly, which again, is referred to the detail number. The number in the lower half of the balloon refers the reader to the sheet on which that particular detail will appear. The split balloons generally are used for one of the following reasons.

- The detail sheet number will not appear anywhere else on the assembly drawing.
- The assembly is of such magnitude that there will be a large number of details.
- The policy of the company doing the engineering dictates their use.



Ballooning Procedures

The methods of placing balloons on an assembly are varied and may change from company to company. Although there are some standard “rules” for the placement of balloons:

- 1) Each component is numbered in numerical order left-to-right or top-to-bottom across the drawing. This will facilitate finding the various details because they will be in numerical order. The components will dictate the order. This is particularly critical on large assembly drawings where the reader is attempting to locate details and must search for the detail number on the drawing.
- 2) A balloon should never be placed alone or off to one side of the assembly drawing. This type of placement may cause it not to be seen and be “lost” or make it difficult to locate on a large, extensive assembly drawing.
- 3) All components of the assembly are assigned detail numbers. The balloons are placed as described above, and in an open area of the paper. Build and commercial components are treated the same when assigning detail numbers. They will be specified differently in the stock list.

Types of Assembly Components

As assembly drawing is made up of primarily three types of components. The three types can be identified and referred to as build components, commercial components and altered commercial components.

Build Components

Build components are items of assembly which must be manufactured of “built”. Therefore, they must be drawn first using orthographic projection. This drawing would be referred to as a detail or detail drawing. The detail drawing will have all the views, dimensions and notes necessary to build the part.

Commercial Components

Commercial Components are parts purchased from vendors, and are sometimes referred to as “purchased items” or commercial details.

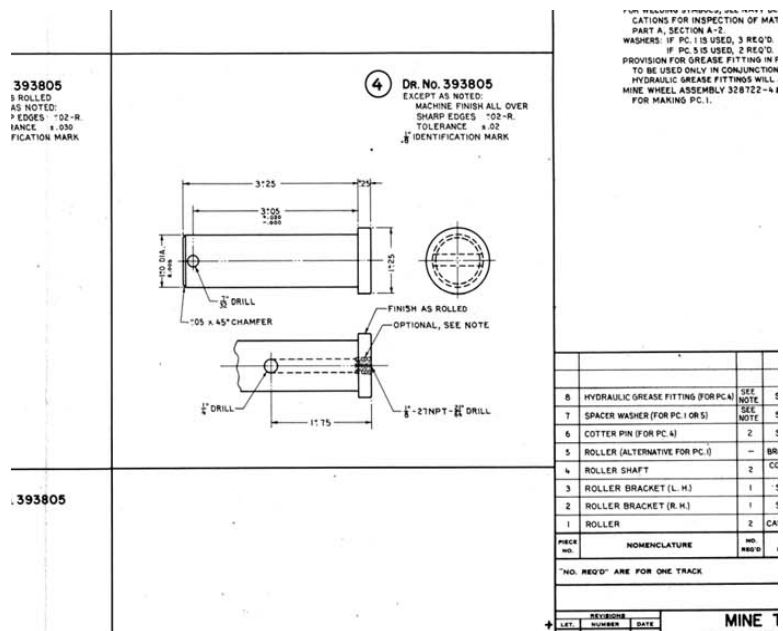
Components such as bushings, screws, bolts, pins, to name a few, fall into this category.

Designers utilize commercial components as much as possible because purchasing the component is generally less expensive than making it from scratch.

This can reduce both engineering and manufacturing costs.

Altered Commercial Components

Occasionally, a commercial component is altered. This is done because it is still less expensive to alter an existing part than built it from scratch. In this situation, the altered part must be detailed or drawn because the finished part will be different than the drawing in the catalog. This detail or drawing is similar to that completed for the build components but not as extensive. For example, if a standard fastener has been altered the only dimensions needed are on the altered areas because all the other dimensions of the part would be in a catalog or chart.



Stock List

A stock list, or list of materials or bill of materials, is a list of parts placed on an assembly drawing. It is positioned just above the title block on the lower right side of the paper. This is the area on the assembly drawing where the designer who developed the assembly gives more information about each detail. Stock lists appear in variety of forms, but still provide the same general information. The five columns typically, from left to right are, **DET**, **REQ'D**, **SHT**, **DESCRIPTION** and **MAT'L**.

1. **DET**: The detail number assigned to a particular component on the assembly (see Ballooning). This begins to tie the components of the assembly to the details.
2. **REQ'D**: The quantity required. This information tells the manufacturer how many of each item are needed per assembly.
3. **SHT**: The sheet number on which the detail will appear if it's drawn. If it is a commercial component the sheet number is not necessary because the item is not detailed.
4. **DESCRIPTION**: A descriptive name of the detail and, dependent on the type of detail, the rough stock size, and fabrication process or pattern number may be listed as well. If it is a commercial component, the information needed to order that item is included.
5. **MAT'L**: The type of material, if applicable, is placed in the last column. This can also change for commercial components.

All components of the assembly are listed in numerical order starting at the bottom and then proceeding upward. The designer completes all the information requested in each column of the stock list. A complete comprehension of the content of the stock list is vital to becoming an effective detailer. However, stock lists can vary between industries and companies. The following rules generally can be applied to the stock list:

- a. All components of an assembly will appear in the stock list
- b. The number placed in the DET column starts with #1 at the bottom and continues up in numerical order.
- c. The information for all columns is completed in total.
- d. The information in the DESCRIPTION column for many include the part name, stock size, fabrication process or pattern number.
- e. If the component description exceeds the space available, more than one line can be used.
- f. When listing commercial details in the stock list, adequate information to order the item must be noted in the DESCRIPTION column. This will include a description as well as catalog information such as the vendor's name, name of the component, and catalog number. It is general practice to omit the full name and use accepted abbreviations. The material designation is eliminated from the MAT'L column and replaced with the word PURCH.
- g. Standard fastening hardware is listed slightly different than other commercial components. In the DESCRIPTION column only the item name is designated, followed by the size, thread type and length. Some companies use the word "STD" in the MAT'L column rather than "PURCH".
- h. Altered commercial components are listed the same as the above commercial details, with adequate description and catalog information followed by the term "ALTERED" noted in the MAT'L column. Notice that a sheet number will be necessary in order to locate the altered commercial detail drawing.
- i. ANSI recommends lettering that appears in the stock list be 1/8" (.125) high. The letter size should always be maintained and not changed to squeeze something into an area. IF necessary, two or more lines can be used instead of compromising the size.

DETAILS

Once the assembly drawing has been completed by the designer and or engineer, it must be detailed. Detailing is the process of identifying the build items, and altered commercial components of the assembly and drawing each in the assembled position and in orthographic projection. The detail is drawn showing whatever views are necessary to accurately represent the part. Dimensions and notes are added to complete the detail. It is possible that more than one detail may be placed on the sheet, dependent on the size of the details and sheets being used. When a detail is complete it will give all the information needed to build the part. The orthographic views give a visual representation of the object. The dimensions tell the machinist the size and location of the part features. The notes identify any special operations and tie the detail back to the assembly. All of the above combined make a working drawing.

There are four types of detail drawings which are developed. Each of these types of details is considered to be a “build” detail” because each must be manufactured. They are categorized and named by the process or manufacturing method from which they are made. These types of details are:

- Machine from solid details.
- Casting and forging details.
- Weld details.
- Altered commercial component details.

It is possible that an assembly may be made up of any one or all of the above types of details. All the different types of details require dimensions and notes once they are drawn in order to manufacturer them. Although each type has special applications, there are many general dimension and note procedures which are common to all. These are called dimension and note conventions.

