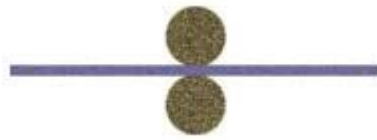




# All You Ever Wanted To Know About Etching Presses

## If It's So Simple, Why Is It So Complicated?

According to John Maitland Graves, [Rembrandt Graphic Arts](#)' resident expert, etching presses haven't changed in essence since Dürer's time in the late 15th century. The basic diagram looks like this:



But let's not get ahead of ourselves. Let's let Graves explain the issues starting at the beginning and going into all the detail he needs. We're not in a hurry and we do admit, there is a lot we need to know about etching presses. Over to you, Mr. Graves:

## How Intaglio Prints Get Onto The Paper

Intaglio prints are impressed into paper by a design that consists of lines and textures that are cut or etched into a plate's surface. The plates may be of various materials like copper, steel, iron, various bronzes, zinc or plastics. Greasy printer's ink is wiped onto the plate. After the surface is carefully wiped, ink remains in the lines and tones of the plate. Great pressure is needed to make a print because the paper must be squeezed into the incised image.

To obtain satisfactory results application of pressure to the plate must be perfectly even in both dimensions. There are two basic methods by which this can be accomplished: 1/ a pair of flat plates which are squeezed together with great force or 2/ a flat plate squeezed between a pair of parallel, rotating rollers.

To squeeze a pair of flat plates together with enough uniform force to print an etching would require an extremely heavy-duty, relatively complex mechanical and/or hydraulic system. The resulting press would be heavy, cumbersome and expensive. There have been several attempts at this but none was



Illustrations by John Maitland Graves

practicable for intaglio printing. On the other hand, this approach is used to great effect for relief images because ink is printed from a raised surface onto relatively smooth paper, so the necessary pressure is much less.

It is much less complicated to use a supporting plate placed between a pair of rollers to generate the large pressures needed to force paper into the inked image. While forces sufficient for any particular plate, blanket and paper are bound to vary it has been estimated that etching presses should be able to exert about 1,500 pounds per inch of roller length. For example a 30 inch wide press should be able to withstand a total of 45,000 pounds (20,454.5 kg).

### **The Modern Intaglio Press**

The modern intaglio press, therefore, need not be a complicated device. The main moving parts consist of a flat, steel plate placed between two revolving metal cylinders and a drive system which may be as simple as a hub and wheel or spokes and a frame on which to mount the parts. In order to make turning the cylinders easier, most all but the smallest modern presses use some sort of gearing or chain reduction system.

Most modern presses used high strength aluminum or hot and cold rolled steel alloys with a least 40,000 pound per square inch yield strength For frames flame cut steel plate (heavy and expensive), structural and "mild" steel is normally adequate if not used in high stress areas. Many older presses used cast iron frames which included the high-stress roller mechanism area. These frames were expensive to machine partly because the casting process uses sand and partly they were large, heavy and required large jigs, one for each side, and special tooling. Perhaps even worse is the fact that cast iron is not very strong and is brittle and therefore easily cracked or broken. Incidentally, If you have ever visited an iron foundry you would discover that it is a very dirty process.

### **Drive And Roller Bearings**

Properly sized, sealed, self-aligning ball and roller bearings will run longer and require about 1% as much effort as plane, brass or bronze bushings. Ball and roller bearings are, though more expensive, definitely worth the added cost. Brass or bronze



bushings are generally used for economy models and can reflect a cheapening of materials and sometimes workmanship. In either case it is vitally important that each bearing have a grease fitting. Drive shaft bearings are usually  $3/4$  to  $1\ 3/8$  inch. The self-aligning bearings used for the rollers should be around  $1/3$  the diameter of the roller for a very long, trouble free life, printing at the heaviest pressures. Many presses use smaller sizes which can break down when printing editions of larger photogravures or deeply etched plates using harder papers.

For long lasting, smooth, easy operation all rotating parts should be mounted in self-aligning ball or roller bearings. These bearings should be oversized. It costs very little extra to use the next larger size and the gains in performance and durability are great.



### **The Bed**

Because a substantial portion of the weight of an etching press is the bed many have tried lighter alternatives to steel such as various wood based materials like highly compressed wood fiber, fiberglass or phenolic resin fiber/paper substances. Until now no substitute has proved adequate because they warped or broke down too quickly.

The steel bed, which also provides additional stiffness, may be either hot or cold rolled steel that must be properly heat treated to relieve internal stresses prior to a final grinding process that assures a high degree of parallelism. The finished thickness for a small press about 18 by 24 inches should be no less than  $7/8$  inch,  $1\ 1/8$  inch for a 24 by 36 inch press and no less than  $1\ 1/4$  inch for a 30 by 50 inch bed. Bed length and width is determined by the largest size paper you will use. It should be about 6 to 12 inches longer and about 2 inches wider. The felt blankets may be as long as the bed and about  $1/2$  inch narrower. Experience has demonstrated that these dimensions are adequate, with proper care, to produce a long wearing press bed which can be reground when necessary. Some very old presses used machined, cast-iron beds. They were usually rather thick and were manufactured with hollows for weight savings. Additional life may be obtained by periodically turning the bed over.



### **The Rollers**

Many presses use steel for both upper and lower

rollers. Rollers may be hollow or solid and, depending on the design, the diameter should be no less than about 1/4 to 1/3 the width of the bed if the roller is hollow. The roller wall should be about 5/8 to 1 inch thick. The diameter of solid rollers should be no less than about a 1/4 the width of the bed. Both upper and lower roller must be precision machined for true, concentric rotation. The upper roller should be made of steel, though aluminum with a 3/8 inch coating of 90 to 100 durometer rubber has been used successfully. The lower roller may be of any durable, stiff metal. Most etching presse manufacturers use steel. Many older presses used rather large diameter lower rollers which reduced bed distortion. Most modern presses, however use considerably smaller diameter steel that will cold work the bed far more rapidly.

The use of high grade, aircraft aluminum for the lower roller eliminates almost all bed distortion or the need to turn the bed over. Fifteen to 30 times the number of printing cycles can be expected when compared to a similarly sized steel lower roller. Some press manufacturers have machined their light-weight rollers with a slight crown in an attempt to compensate for bending. The problem with this approach is that the amount of crown will properly compensate only at one setting. Because print makers use various weight papers, thickness of blankets and plates the settings and the forces are not always the same which modify the amount the roller will bend and may result in uneven pressure on the plate.



### **Your Average Printmaker**

Because the average print maker is not equipped with devices to measure minute deflections, there is no way predict what setting will exactly compensate for the roller's crown. Proper profiling of a rotating part is an expensive process and unnecessary in this application when the roller is adequately sized to begin with.

### **The Drive System**

Drive systems must be robust and should be engineered so that the least expensive, easiest to repair part fails first. It is far cheaper to replace a chain or link, for example, than a gearbox or drive shaft.

### The Frame

Most modern presses are of welded or bolted steel construction and should be checked for bent parts. Occasionally presses have been dropped during transport or installation. If the frame or other parts are made of cast iron inspect carefully for cracks or suspicious welds. Legs and feet are particularly vulnerable.



### Spare Parts

Spare parts should be cheap as well as easy to find and replace.

### Installation

The importance of proper alignment at installation cannot be overemphasized. When the rollers are not parallel from end to end twisting forces are exerted on the bed and sooner or later it will distort.

Normally it is sufficient to level the press, particularly from end to end. A straight bar and a spirit level placed in turn across each end of the press can be used to observe if the frame is twisted. Normally this procedure insures roller parallelism. The bed should rock end to end only minimally, if at all. A visual inspection for twist must be made. If the press can be rocked side to side or diagonally it is not square! This problem **MUST** be corrected before operation under pressure; otherwise you can be sure that the bed will become twisted and eventually useless. This assumes that the idler wheels have been adjusted as best as you can. Use common sense.



### Care And Maintenance

Etching presses are happy enough to get a minimal attention such as an occasional wiping with a bit of mineral spirits, grease in the bearings. Chains should be oiled and occasionally tightened. Etching presses are not high tech devices but they can rust or corrode. Occasionally you will find presses with stainless or chrome plated parts such as rollers. But most will appreciate being coated with oil and covered with a plastic dust cover if left unused for more than a week or two. While others may disagree it has been found that wiping with an oily rag and using a thin coat of oil **UNDER** the bed will prevent the lower roller and bed from becoming, especially in damp climates, corroded or oxidized. This procedure does not interfere with the operation of the press.

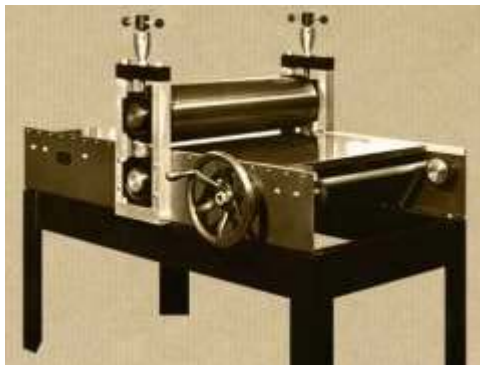
### Permit Us A Few Questions, Maestro...

Is it fair to say that, all else being equal, a heavier press is a better press?

No it is not. Quality, performance and being "better" does not translate into mass. A heavier press does not in any way translate to a higher quality press. It may be that the designer's lack of understanding of basic mechanical principals, materials and structural engineering required him to specify unneeded material in the mistaken belief that "more is better." Since an etching press was not meant to fly it is often wise to specify a larger ball bearing or wall thickness rather than suffer a smaller element which is apt to break. The next size larger bearing, for example, may be only a few pounds heavier but provide far greater durability.



A simple, logically designed structure and strategic use of high quality aluminum, one third the weight of steel, can result in great weight saving. From the small manufacturer's point it is less expensive to spend a bit more on the machine rather than service a warranty somewhere on the other side of the world! Strength and rigidity are related to materials used and structural design.



This is the 30x52" Elephant Etching Press.

Modesty aside, the 30 x 52-inch Elephant Etching Press (which I designed) weighs about 1,200 pounds (545.5 kg). Similar sized press of other brands weigh around 2,400 pounds (1,091.0 kg). The Elephant uses a solid aluminum lower (drive roller) and a hollow 8-inch steel upper roller with a 1-inch wall. Both are supported by 2 15/16-inch self aligning ball bearings. Printing forces are supported by take-up units, not the press frame.



This permits the use of a light weight frame which need only carry the weight of the press bed, about 550 pounds (250.0 kg) carried across at least four

idler wheels and the lower roller, and the forces exerted by the drive system. This is far less than the up-to 45,000-pound (20,454.6 kg) printing forces exerted by the rollers. Most conventional presses do not use the same type of take up unit construction as, for example, the Elephant. Those designs depend on the strength frame to resist the printing forces and, therefore, must be considerably heavier. The Elephant press uses a welded steel base to carry the printing section and leveling screws for final alignment.

#### **Where "Brand X" Press Manufacturers Cut Corners**

Many other manufacturers tend to use very heavy framework and side frames. These presses are expensive to ship and install and the extra weight does not influence the quality of the print. Many etching presses on the market today were not actually engineered. Rather, they were copied or drawn up by a machinist who thought little or nothing other than that "heavier is better." Many of these presses develop warped beds because no thought was put into the materials used. High-grade, alloy 6060-T6 aluminum with a yield strength of about 45,000 pounds per square inch, for example is stronger than "mild steel" that gives at about 20,000 to 30,000 pounds per square inch.



The structure of inferior press rollers is less substantial, being made of a through shaft and end plates welded into position then machined. The wall thickness of the these press rollers is usually around 5/8 inch. The roller journals and bearings on these presses tend to be relatively small and can crack in the weld areas because they are not properly sized or heat treated.

#### **Cast Iron Is For Lawn Benches And Manhole Covers**

Some presses use cast-iron frames. Cast iron is brittle and, on average, has about one half the strength of most steels (cold rolled, hot rolled, cast, forged). Therefore, the cast iron should be, on average, about twice the weight of steel to withstand the same loads.

Cast iron, also, is weaker in tension than compression. Another weight saving in the design of all my press designs is the use of alloy 6060-T6 aluminum for the lower rollers rather than steel. They are solid because it is less expensive to

machine a roller from a solid piece than build one from components. When properly sized they provide sufficient resistance to bending and they allow many, many more operations without bed distortion. The reason for this is that aluminum is more resilient than steel and reduces local contact pressures by a factor of about 27 according to the roller equations.



This works something like a rubber tire. Can you imagine what the roads would look like if we used steel tire on cement roads? The resilience of the tire spreads the load over a considerably larger area.

**Prices? What's The Minimum Price You Have To Pay For A Good, Solid, Mid-Sized Press?**

Say \$6,300 for a 24 by 48-inch press. An 18 by 36-inch press should run about \$4,500. The press should have decent-sized sealed self-aligning ball bearings throughout, a reduction drive system, steel bed and microgauges.

**What About Accessories For The Press?**

A 1/4 inch Lexan sheet to cover an engineer's drafting grid makes it easy to position plates accurately. Microgauges are also quite nice, though, to be perfectly honest, anyone who can count and keep notes can save a few pennies. They do look nice and I use them. You can also make a "blanket holder" which holds the blankets for you while printing. Woven felt blankets will last longest. The sizing catcher can be washed. It is my humble opinion that, unless you are printing colographs or very deeply bitten images, one can dispense with the 1/4- inch blanket. The fewer and thinner the greater the pinch pressure. Thicker blankets will spread the same forces over a larger area thus reducing local pressure. (See the above rubber tire example.) If you try to print with too many blankets it would be like running your car with soft tires which requires more effort from the engine.



**What About Buying A Used Press, Are There "Tests" For Checking Out The Roundness Of Its Cylinders, Etc.?**

Yes. First you should inspect for general condition, gouges, dents, deposits of rust on top and bottom of the bed and both rollers. Most minor defects can be neglected. If more than about a 1/32 of an inch distortion near the center of the upper roller the press can be disassembled and offending parts re-machined. The lower roller does not have to be so pretty. You should inspect the bed for distortion. You

can use a steel straight edge and level. A slight bow is acceptable but a twist is a no-no and indicates that the press was not properly leveled and/or the rollers are not parallel and could indicate uneven bearing wear.

A slight bow may be corrected by flipping the bed over so that it gradually bends in the opposite direction. To the best of my knowledge the only cure for a twisted bed is, if no more than about a 1/16 inch, is to take it to be reground otherwise it might be cheaper to buy a new one. Adjust the press so that upper roller just barely contacts the bed. Making certain there is nothing on the bed shine a light from behind the roller and observe the line of contact for obvious irregularities as you run the bed through the rollers. Remember, however, that nothing is perfect.

Then you can make a test surface print without blankets. Coat a large litho plate evenly with ink. When making the trial print adjust the press so that upper roller just barely skims over the bed. Without a blanket there may be some uneven areas. Totally blank areas indicate flat spots on the roller or a depression in the bed. You might want to make this test with a sizing catcher and 1/8 inch felt blanket. If you really want to get a good fix on trueness of the cylinders you can buy a dial indicator with a stand or, better still, pay a local machinist to check it. If the bed is warped you will be able to check roundness at only in one place at a time.

### **Summing Up**

The ideal intaglio press should be able to reliably exert forces to satisfactorily produce the largest print you intend to make. Its design should be gimmick free and incorporate the fewest parts possible to satisfactorily fulfill its function. It should be safe, easy to operate, run smoothly, be easy to maintain and remain trouble free when used normally. It should be able to accommodate other media such as lithographic plates or wood blocks without special parts or structural modification.

It should not be excessively heavy. Intelligent, untrained personnel should be able to install and align presses of less than about 30 by 50 inches with appropriate equipment. Be sure that larger presses can be fit through doorways, passageways or into elevators safely without exceeding the building's load

capacities! Presses that can be broken down into two basic parts (a base and printing section containing the rollers, bed and drive) are easier to maneuver.

Presses that are designed as a single unit must usually be taken apart and reassembled by knowledgeable personnel. It is necessary to use professional help to install very large or heavy presses. Because of liability and safety concerns powered etching presses are not commonly manufactured.

(Parting note from ***World Printmakers***: Our sincere thanks to John Maitland Graves and [Rembrandt Graphic Arts](#) for this authentic master class in etching presses!)

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