RIO GRANDE®
Since 1944

Sharing your passion for making jewelry.
Products. Service. Know-how.

Instructions for Durston® Hand-Powered Mill Usage, Maintenance & Safety

Including some techniques for jewellery manufacturing

Congratulations on choosing a Durston rolling mill that will give you many years of trouble-free and high-performance use. Please read the instructions contained in this handbook, especially those on page 4, "Rolling Mill Safety, Care and Tips" before unpacking and using your new mill.

DURSTON
ROLLING MILLS

INSTRUCTIONS/MAINTENANCE FOR HAND OPERATED ROLLING MILLS

Unpacking and preparing your new mill for use.

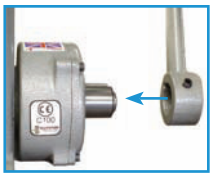
Lifting.

Please unpack rolling mill very carefully. For all mills, have at least two people lifting and moving mill onto its final place. Never lift using the hand wheel. Always lift from the base of the mill or, for the D2 130 and D4 158, lay the mill down and lift from both ends. The approximate weights of the machines are as follows: Micro Mill, 9kgs; Mini Mill, 16kgs; DRM 100, 32kgs; DRM 130 & DRM 150, 50 kgs; D2 130, 75kgs and D4 158, 85kgs.

Securing.

Bolt machine securely to a Durston stand or a strong secure bench. Ensure that the stand or bench is bolted down to the floor.

Fitting turning lever.



You now need to fit the lever. Slide the lever on as shown in picture (you may need to tap it) and do up the 10mm grub screw with the Allen key provided. Do not over tighten, you may damage the shaft. Check that this screw is tight every three months.

Removing rust preventative.

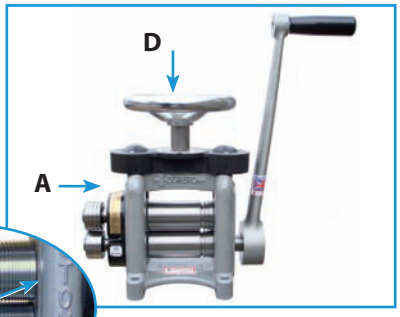
You will now need to remove the rust preventative on the rolls. Close the rolls and then open the rolls one turn of the hand wheel (D). Apply some white spirit (ordinary household paint solvent) sparingly onto a clean cloth, hold the cloth into the gap of the rolls and roll backwards. It will take a little longer on the grooves as you have to do one at a time. Do not use any liquid stronger than white spirit/lacquer thinners.

All Durston Rolling Mills have:

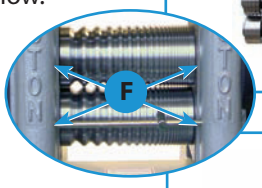
- Calibrated dials fitted to the top and are marked in 0.001" and 0.025mm increments giving the roll gap. These dials are useful for repetition work and will assist in providing a constant product size.
- Extension rollers with "4" half rounds. 4, 3, 2 and 1.5mm. Other sizes can be ordered.
- Guards (black covers) covering all gears.
- Reduction gearbox (not Mini or Economy models) making turning easier.

MAINTENANCE

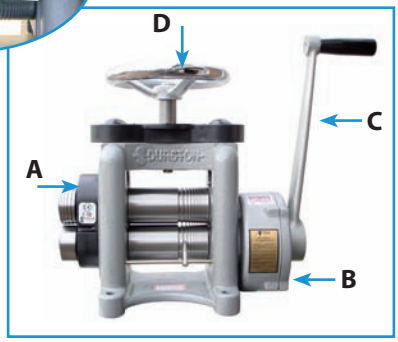
MICRO MILL 70, MINI MILL 80 and MINI MILL 100



- The bearings are self-lubricating and need no maintenance.
- The drive gears at left hand end (behind guard A) should be greased every six months. Remove the circlips and extension rollers and then the two screws for the cover for access to the two gears. Use standard gear grease.
- Oil the four end faces of the rolls daily. (F) See enlarged view of rolls below.

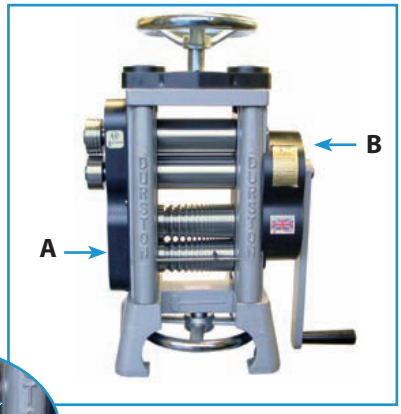


DRM 100, DRM 130 and DRM 150

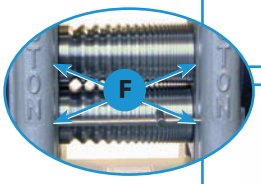


- The bearings are self-lubricating and need no maintenance.
- The drive gears at left hand end (behind guard A) should be greased every six months. Remove the circlips and extension rollers and then the two screws for the cover for access to the two gears. Use standard gear grease.
- The gearbox at the right hand end (B) should be greased every six months. Remove the turninglever (C). Slacken the 10mm set-screw first (5mm Allen key). The lever should slide off. If not, gently tap it. Now remove the four 5mm cap screws (4mm Allen key). The lid of the gearbox should now come off. You may need to gently tap this as well.Use standard gear grease (not applicable for economy models).
- Oil the four end faces of the rolls daily (F). See enlarged view of rolls above.

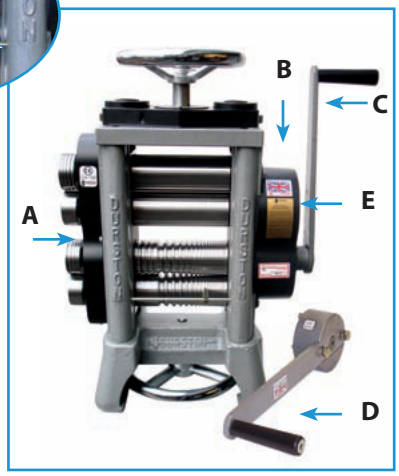
D2 130 and D4 158



- The bearings are self-lubricating and need no maintenance.
- The drive gears at left hand end (behind guard A) should be greased every six months. Remove the circlips and extension rollers and then the two screws for the cover for access to the four gears.
- The gearbox at the right hand end (B) should be greased every six months. Remove the lever. Slacken the 10mm set screw first (5mm Allan key). The lever should slide off. If not, gently tap it. Now unscrew the four screws holding on the black guard. The cover can now be removed. Use standard gear grease.
- Oil the eight end faces of the rolls daily (F). See enlarged view of rolls at right.



D4 158

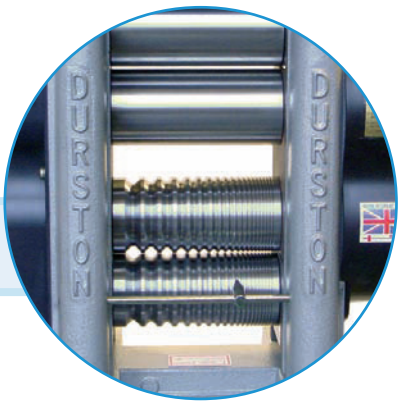


- The D4 158 has a second lever (D) which is used for doubling the turning speed of the rolls. This second lever is useful when you are rolling out the smaller jobs where not so much effort is required, making the rolling quicker. For the larger jobs the lower lever (C), which is located on the wire roll, is the best to use as it gives you the maximum reduction ratio on the gearbox.
- To change from the standard lever (C) (lower lever on wire roll) to the second lever. Remove the circlip on the wire roll right hand side and the first lever will slide off. Now insert the second lever (D) into cover (E) on the lower sheet roll. The two hardened dowels will locate into the gear. Now tighten the two 10mm bolts (17mm spanner).
- When turning with standard lever, turn lever anti-clockwise. When using second lever, turn clockwise.

PROCEDURE FOR ROLLING

Please note that the following is only a guide.

1. Anneal the piece of sheet or ingot, pickle it, and rinse it with clean water. Now dry it.
2. Feed the dry metal into the mill, applying snug (but not overpowering) pressure on rollers.
3. After rolling metal through the mill, flip the piece end to end before you roll it through again. You will get a more even roll.
4. Before passing the metal through the rollers, lower the rollers until you again have a snug fit (as in step 2).
5. If the metal becomes too hard to roll, it must be annealed again. Then roll the piece through the rollers, repeating as necessary until the desired thickness is achieved.
6. When rolling silver sheet, it may be necessary to anneal the sheet after rolling it from 3.0mm to 1.0mm in thickness. For 14Kt gold, the annealing may be necessary after rolling from 3.0mm to 2.0mm.



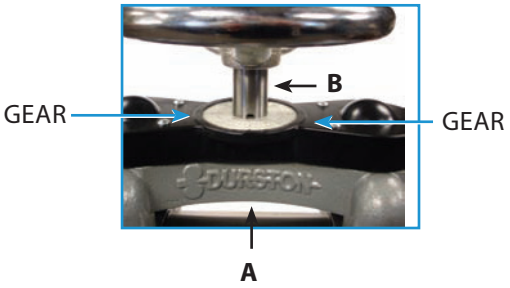
WIRE ROLLING

Please note that the following is only a guide.

Reduce wire by rolling two or three times in each groove, rotating the wire 90 degrees on each pass. Rolls should be nearly closed for last pass before moving to the next groove. Depending on material, passes of up to 30% can be achieved. The material should be annealed as often as necessary to avoid excessive force when rolling. Indications of excess hardness are frayed edges, wrinkling of surface, surface cracking or excessive force needed to turn the rolls.

ROLLING MILL SAFETY, CARE AND TIPS

1. ALWAYS bolt down your rolling mill to a secure bench or secure stand for stability and safety.
2. Ensure guards are in place at ALL times. The guards are the black plastic covers, covering the gears.
3. When the rolling mill is not in use, apply a thin coating of rust preventative liquid (we recommend that you use Durston rust preventative). Using a clean and dry paint brush (approximately 12mm wide), apply the rust preventative across the rolls. Turn the rolls as you do this. Make sure the rolls are nearly closed. This will spread the liquid evenly over the surface. It is very important that your rolls are always protected, especially in moist/wet/hot conditions or where temperatures are changing. Once your rolls are marked/rusty/corroded, they will be like this for life until you have them removed and reground. (Please note, however, that it is almost impossible that you will end up with perfect rolls; over time and use they will get slightly marked). It is also recommended that you cover your mill when not in use. This is to prevent the rust preventative from collecting dust and dirt. When using your mill again remove all rust preventative and ensure your rolls are clean and dry before you start to roll material. See "Removing rust preventative" on page 2.
4. KEEP ROLLS CLEAN. Do not touch the rolls. Oils and acids from your body can damage the rolls leaving behind small marks and eventually rust. Only roll through dry materials.
5. DO NOT use your mill with the rolls completely closed.
6. DO NOT roll ferrous metals such as iron or steel through the mill.
7. ALWAYS release pressure on rollers after you have completed your job.
8. Do not lift mill using the hand wheel. Only lift from base. (See "lifting" on page 2)
9. To PARALLEL the rolls remove circlip ("A") (black ring) at the bottom of the centre shaft. (This is the shaft ("B") with the hand wheel). Lift the whole shaft out with the centre gear attached. You will now see the outside part of two gears. Rotate either gear by 1 tooth at a time until rolls are parallel.



TROUBLESHOOTING

PROBLEM	CAUSE	SOLUTION
The edges of the metal are cracking.	When the metal was poured, the ingot was not uniform in shape or the metal was rolled too much without annealing.	Remove the part of the metal with the crack (by sawing), anneal, and then hammer out the metal around the missing section until the edges are even. Anneal again and then re-roll.
The surface of the metal is flaking and/or cracking.	When the metal was poured, the ingot mould was cold -or- there may be too much old metal in the ingot -or- the ingot was annealed too much -or- there may be foreign metal in the ingot.	Melt the ingot and reform it in the ingot mould. Roll it out again. If the problem persists, it may be necessary to refine the metal before you use it again.
When wire is rolled out, it is wavy or bent.	a) There was not enough tension applied to the free end of the wire. b) Too much pressure is being exerted by the rollers.	a) Hold the free end of the wire one hand. b) Remove sheet, anneal it, plannish the distorted sections, and re-roll. Apply less pressure on the rollers.
When rolling sheet, it buckles.	Sheet was pushed through rollers after flipping end to end without annealing.	Remove sheet, anneal and re-roll.

ROLLING MILL PRINTING

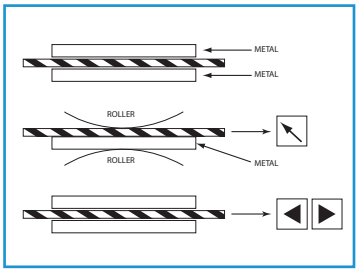
The following ideas and techniques of jewellery manufacturing are reproduced with the kind permission of Sandra Noble Goss.

(These advanced techniques assume that you have basic jewellery and metalworking skills. We offer these technical papers, originally presented as workshops, in a spirit of sharing information. We assume no liability for safety and health issues—those are your responsibility.)

THE ROLLING MILL

The rolling mill is a machine designed to produce thinner gauges of sheet metal and wire. Most studio jewellers use a hand cranked mill (although automated mills are used as well). Each mill consists of two smooth, highly polished, hardened steel rolls, mounted in the housing parallel to each other. The rolling mill us used for reducing the thickness of sheet metal. The rolls for wire are cut with 'V' shaped grooves arranged in decreasing sizes, allowing for gradual reduction of wire diameter and producing a square cross section of wire. Most studio jewellers choose a 'combination' mill – half of the roll is smooth (for sheet metal) and half is grooved (for wire). This limits the width of metal to be rolled (averaging about 2"–2.5").

INTRODUCTION TO PRINTING



Metal which is passed through the rolling mill under pressure with another material will become embossed with a pattern exactly the same as the material being used. Any small particle trapped between the metal and roll will 'imprint' on the metal. If you are attempting to roll a perfectly smooth piece of metal, this is not desirable. But the principle can be put to use to create embossed patterns and designs on metal.

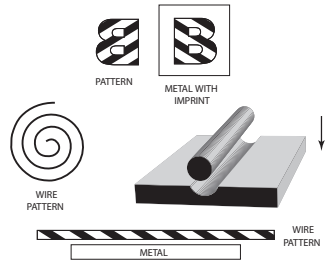
The best way to imprint metal is to create a 'metal sandwich' with two pieces of metal (to be impressed) on the outside (the 'bread' in the 'sandwich') and the material being used as pattern between them (the 'filling').

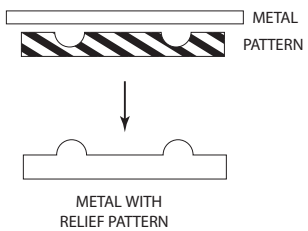
ONE-SIDED VS. TWO-SIDED IMPRINTING

If you wish to imprint on one sheet of metal only, roll the metal together with the imprinting material, using the roll as the other side of the 'sandwich'. This technique is preferable when using expensive materials (gold and sterling) but has its drawbacks, as there is more possibility of damaging the rolling mills if materials that are too hard are used for imprinting. It is best to make a 'metal sandwich' whenever possible – it produces two pieces of usable, imprinted metal with mirror image imprints (especially useful for earrings, being symmetrical, but reversed).

ROLL PRINTING PROCESS:

1. Metal to be imprinted must be annealed, dry and clean. Depending on the use of the metal after being imprinted, you may wish an emery finish or tripoli or rouge polish. Usually the metal that is the pattern (the 'filling' in the sandwich) should not be annealed—if it is hard metal you will get a better imprint and may be reusable.
2. Pattern imprinted will be a reverse of the design (important to remember if using letters and numbers in the design).
3. An object placed between two pieces of metal will create a recess in the metal (intaglio; a mechanical 'etching' effect). As the 'metal sandwich' passes between the rolls and is compressed, the imprinting material is pushed into the metal. Be careful not to roll the imprint so that the metal becomes too thin.
4. Make one pass only! Carefully adjust the gap by attempting to roll the first ½" (1cm) or so. Trial and error and experience, along with written notes, are all part of this process. Once the correct gap is calculated, roll the whole piece in one continuous roll. Try not to stop part way through the pass.
5. To emboss: use a plate with negative spaces so that when rolled the metal plates push into the recessed shapes on the pattern.



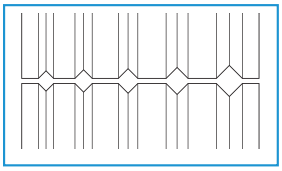


METHODS OF ROLLER PRINTING

OBJECTS AND MATERIALS THAT CAN BE USED TO MAKE PATTERNS:

Objects that are too thick or three-dimensional may not be appropriate for roller printing (the metal is usually not thick enough to encompass the object and give a good imprint). Hard metal objects (steel) should only be used in the two-sided ('metal sandwich') method, as they may damage the steel rolls. The rolls should be cleaned thoroughly after using gritty materials like sandpaper. Thin metal should only be used with thin objects—thick imprinting patterns will make the metal too thin and weak. Some materials and objects that can be used (and there are many more; experiment and document):

• Paper	• Metal	• Lace	• Washers	• Leaves	• Sandpaper
• Fabric	• Screen	• Wire	• Plastics	• Doilies	• Netting
• Thread	• Feathers	• Masking tape	• Sequins	• Thin keys	• Chain



WIRE SECTION OF ROLLING MILL:

Rolling sheet metal through the grooved wire section of the rolls produces a corrugated effect. If the metal is passed through again at a different angle a cross-hatched pattern is achieved. Turned 90 degrees produces a chequered effect.

MASKING TAPE:

Masking tape will provide a textured pattern recessed into the surface of the metal. Lay tape out on a sheet of glass and cut desired shapes with a blade. Because the shape adheres to the metal, there is little movement of the design during the rolling process. Multiple layers can be used to give variety of depths.

PAPER:

Paper provides a wonderful, sharply detailed imprint on well-annealed metal. The metal picks up a matte texture from the paper. Where shapes have been cut out, metal will contact metal leaving a shiny pattern in contrast to the paper texture. Shapes can be cut out with a knife, with fine nail scissors or by folding the paper and cutting into the folds (good for an overall repeat pattern). Multiple layers of paper can be used – giving both embossed and recessed designs. A paper pattern can only be used one time. If you wish to repeat a pattern you can photocopy the design and cut out each time. Experiment with different sorts of paper from regular bond, to tissue to heavy watercolour papers.

Treasure Pin: Brass (roller-printed using pierced metal), sterling silver (fused); 5.5cm dia. ©Sandra Noble Goss

METAL PATTERNS AND PIERCED DESIGNS:

A variety of different shapes can be cut out of metal and used to imprint. Cutting into a sheet of metal can produce intricate designs that will emboss the finished piece. Drilled holes will produce small raised circles; saw cuts will produce fine raised lines. Since saw piercing goes right through the metal pattern, a two-sided imprint will work. Wire can be used effectively to create linear intaglio patterns.

HAMMER AND PUNCH TEXTURES:

Designs can be made into a sheet of unannealed metal using punches, coarse files and hammers. This piece of patterned metal can be used for a one-sided imprint (making one copy only). Since the pattern is recessed into the pattern plate, the resulting pattern on the finished piece of metal will be embossed (raised above the surface). An old hammer face can be engraved or filed with textures. When it is hammered onto metal it leaves an embossed pattern. These can be used to give added texture to a pattern.

ROLLED PLATE AS PATTERN:

Designs can be imprinted onto a metal sheet which in turn can be used as a pattern. If the original design is recessed, it will produce an embossed pattern which has an interesting quality as it is one step removed from the original process.

ALUMINIUM PLATE:

Aluminium plates can be engraved easily with gravers or dental burrs on the flexible shaft. They are good for only one or two (at the most) passes. The thicker the aluminium plate, the deeper the cuts and the deeper the embossing.

ETCHED PLATE PATTERN:

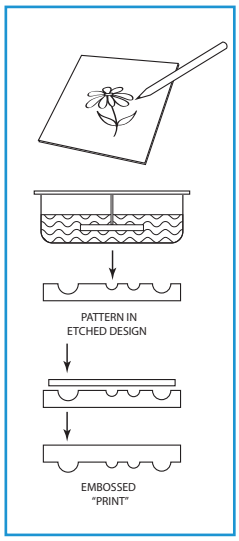
Brass, bronze, copper and mild steel can be acid-etched to create patterns for roller printing. Steel is useful for a plate you may wish to re-use many times. Thick brass and bronze will also produce plates that can be re-used.

TO ETCH STEEL:

Use one part nitric acid to three parts water (1:3) or two parts hydrochloric acid (muriatic) to one part water (2:1). ***ALWAYS MEASURE WATER FIRST AND ADD ACID TO THE WATER—NEVER THE OPPOSITE! If you are not familiar with acids and their dangers, DO NOT try this! Consult in a printmaking book for more details before you proceed.***

Use resists that a printmaker would use (asphaltum, etc.). Use in well ventilated area. Wear rubber gloves and eye protection. Do not inhale fumes.

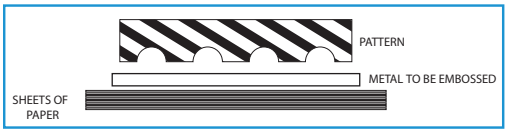
NON-ACID ETCHING OF COPPER, BRONZE AND BRASS:



Ferric chloride is a salt that gives a clean etch to copper-based alloys. Follow directions on the bottle. Wear rubber or latex gloves. Tape such as electrical tape or brown packing tape can be used as resists. The real bonus of this material is that permanent markers used for writing on plastic will resist the etching action, which allows you to draw or write (remember to reverse the letters for imprinting) directly on the metal. The ink can be removed with methyl hydrate (alcohol—use a fume hood and rubber gloves). The piece to be etched must be suspended upside down (design facing down) below the surface of the ferric chloride. Agitate occasionally for better action. Check the depth of the bite frequently. Clean the metal very well with dish detergent and water. **Important!** After the metal is clean, clean again with toothbrush or brass brush and baking soda to ensure the acid is neutralised. The finished piece can then be used to imprint—the etched away sections will emboss.

INCREASE EMBOSSING EFFECT:

When roller printing a thin gauge of metal, you can enhance the embossing by padding the back of the metal with layers of paper and rolling with more compression.



METHODS OF ROLLER PRINTING

SOLDER INLAY: Designs can be impressed into a sheet of metal and the recesses filled with solder.

FOLD FORMING: Linear patterns can be produced on metal by folding and unfolding the metal. Because metal has a memory due to work-hardening, the fold remains as a raised line on the service(surface??). Fold metal and pass through the rolling mill to compress the fold. Anneal, unfold the metal and pass through to compress and flatten the top of the fold line. Metal can be folded and unfolded many times, creating parallel or intersecting lines.

TWISTED WIRE LAMINATION: Twisted and braided wires of different metals, soldered together, can be rolled to create square decorative wires.

MOKUMÉ GANE (means "woodgrain")**:** A Japanese technique of soldering thin sheets of different coloured metal together, rolling them through a rolling mill and relaminating those layers together again. The resulting sheet is then distorted and the layers revealed by grinding the surface down.

MAKING FLAT OVALS: If you pass a circular piece of metal or circular jump ring (wire) through the mill under pressure it will be stretched to an oval shape.

OTHER DISTORTIONS: Metal shapes can be purposefully distorted using the rolling mill. Drilled holes can become perfect ovals (similar but opposite to making an oval from a circle); edges are softened and straight edges become organic curves. Rolling wire in a paper sandwich gives slightly raised edges to the wire which now has a soft paper texture and is broadened.

ROLLING A TAPER: Wire can be forged into a graceful tapered end which can be used in many ways (spirals or tendrils etc). The rolling mill provides a shortcut version. Anneal the wire to be tapered. Begin rolling at the first groove and roll as far up the wire as you wish the taper to extend. Move to the next groove along and roll party way up the wire, leaving part of the first rolled section unchanged. Continue rolling until the wire tapers in a series of 'steps'. Once you have rolled the taper continue refining the taper with a hammer on an anvil. Smooth the ridges between the steps with the hammer, turning the wire as you work to round out the squared off edges. If you wish squared taper, do not turn the wire. Once the ridges are smoothed out, file, sand and polish the tapered wire. If you wish to shape the taper, anneal and pickle before sanding and polishing.