

# How to Make Chain Mail

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Chainmail (aka: chainmaille, chain mail, chain maille, maille or mail) is made up of a pattern (called a weave) of interlocking rings. Because the [design](#) tends to spread the force of an edged weapon (a sword or axe, for example) over a wider area, chainmail was historically used as armor (see [warnings](#) below). Today it may be used for costuming, reenactment, or in [jewelry](#), belts, or other decorative pieces. Fine chainmail is still used for suits that resist [shark](#) bites. Click any image to enlarge it.



## Steps

1. 1



 A European 4-in-1 weave example.

**Choose a weave that you like.** This article describes one method of weaving the European 4-in-1 weave, a common and widely used weave. The weave gets its name from the fact that each non-edge ring has four other rings connected to it. See the external links section (sources and citations) for many more ideas on weaving methods and weaves.

2. 2

**Choose your material.** Decide whether you will make your own rings from wire or purchase rings. Rings are available in a variety of combinations of inside diameters (distance between the inside edges of the ring (abbreviated ID)) and gauges (wire thickness, or wire diameter (abbreviated WD)). The relationship between these two numbers, using the formula  $ID/WD$ , is the aspect ratio (abbreviated AR). Bigger rings will cover an area with fewer rings and less weight, but the texture will be coarser, regardless of AR. Rings with a larger AR will not be as strong as smaller AR rings of the same material, regardless of the material. Wire of a thicker gauge will be more durable, but also weigh more and be harder to work with.

3. 3




**Choose a design you like.** If you are just beginning, start with something fairly small and simple until you get the hang of it. A full chainmail shirt has thousands of rings in it and can weigh more than 30 pounds. Instead, try a [bracelet](#), belt, key chain, or other smaller, simpler design.

4. 4



 An assortment of mandrels.



 Wind the wire.


**Wind the wire (if you are starting with wire) firmly around a metal rod.** Steel rods can be purchased from hardware stores, and most home improvement stores. You could also use a Phillips screwdriver shaft or any other long, round metal objects you might have laying around. Wooden dowels and pencils are not recommended as the forces applied while coiling your wire will compress the wood and give you rings of unequal dimensions. You may need to control one or both ends with pliers. Aim for even, consistent loops and try to avoid putting tight kinks in the wire. If the wire came in a coil



or spool, wind with the curvature that the wire already has. Also try to keep the "spring" as tight together as possible. The more spaced the rings are, the longer the rings actually become.

5. 5



 Cutting the rings with a pair of diagonal cutters.

**Cut the rings (if you started with wire).** It's especially important to wear eye protection for this step, as the rings can go flying. Aim for full, 360° rings, evenly cut. Cutting on a slight diagonal will help to achieve a tight closure with no gap. If you want a flatter, cleaner cut, you can put the coil in a vice (preferably with the rod still inside) and cut it with a hacksaw. Doing this eliminates the sharp points in the ends of the ring that can get caught on clothes and skin.

6. 6



🔍 Four closed rings on a fifth ring.

**Close four rings, using pliers.** Thread all four onto a fifth ring (shown here in red) and close the fifth ring.

7. 7



🔍 Arrange the rings.

**Arrange the five rings as shown, with two over and two under.** This looks awkward right now because the rest of the pattern isn't around it to even things out.

8. 8




🔍 Two closed rings on an open ring.

**Close two more rings.** Link both into another ring (also red), but do not close the red ring yet.

9. 9



 Loop in as shown.

**Loop the red ring through both of the bottom two rings, as shown, from bottom to top.** Arrange the two bottom-most rings so that they are in the pattern.

10. 10



 Repeat.

**Repeat steps 8 and 9 until you have a strip that is the length you want.**

11. 11



🔍 Two closed rings on an open ring.

**Place two closed rings on a third ring (shown here in blue).**

12. 12



🔍 A second row.

**Begin building the next row.** Pass the blue ring through the top two gold rings from the first row. Be sure that it ends up oriented the same as the red ring adjacent to it.

13. 13

**Place one closed ring on another ring (blue).**

14. 14





**Add it to the pattern, linking this blue ring through *three* other rings.**

15. 15



**Repeat steps 13 and 14 to build the rest of the row .**

16. 16

**Repeat steps 11 through 15 to add each new row until the piece is as large as you would like.**

17. 17

**Now start making a second piece, repeating steps 11 through 15 to make the back.**

## Tips

- Fully close all rings to give the piece an even, finished appearance and to prevent it from catching hair. For opening and closing the rings, twist the ends of the ring away from



each other. **Do not pull the ends straight away from each other**, as you will not get the ring to be round again. Depending on your material, you may have to close the ring past the final position you want, then bring it back.

- Materials for rings are not limited to plain iron or steel. You can also get rings in galvanized steel, stainless steel, aluminum, titanium, inconel, niobium, silver, gold, and rubber. You can also get rings in a variety of colors and create many different inlays with them.
  - An easy source of wire to get started is coat hangers. They are fairly easy to bend. The downside is that you have to cut your own rings and the result is not very strong.
  - Another easy (but not as easy) source for wire is to go to a hardware store and go into the Fencing section and buy a spool of electric fence wire; this type of wire is typically available very inexpensively.
  - Try craft wire or heavy gauge, single strand electrical wire.
- Look around for projects that others have done for inspiration. Be aware, though, that while imitation may be the sincerest form of flattery, give credit where credit is due. If you make something based on someone else's item, make sure you give that person credit as your inspiration.
- Try chainmail jewelry for an unusual and elegant piece that you can wear for any occasion.
  - When choosing wire for jewelry purposes, smaller wire will be better accepted by the general public. 18 gauge down to 20 or 22 gauge is common. 24 gauge and smaller wire is starting to get into rings where you may need magnification to work them well. 16 gauge and up tends to produce thicker, more bulky pieces that have limited appeal.
- It can be useful to tack down the chainmail with yarn onto a muslin backing (or some similar arrangement) to help maintain the shape as well as make the pattern more apparent.
- Learn about aspect ratio (abbreviated AR) as it applies to mailling. It will make construction and planning of your projects much easier.



- Match your pliers to your material. The pliers you would use on heavy gauge stainless steel will not be the same pliers you use on fine gauge silver.
- Some maille weaves can be much easier to construct when they are hanging from a string, wire, or rod. It can mean the difference between success and failure, especially for a neophyte mailer.

## Warnings

- It is important to note that the instructions provided here detail the construction of butted maille, which is maille where the ends of the rings are just pressed (butted) against each other. Sufficient force can and will spread the ends of butted rings apart, damaging the maille and possibly what is behind it. Historical armor was made of riveted links, a much more complicated and time intensive construction method, but a method which secured the ends of the rings to each other. **Neither method, however, produces maille that is bulletproof.**
- If you plan to use chainmail for swordplay rather than for fashion, costume, or decoration, make certain that it is strong enough for what you intend to do. Two methods which work rather well are welding each ring shut and riveting the rings shut (as was done on historical chainmail). Maille with rings that are not welded or riveted shut, or rings made out of aluminum (common for costume maille as it is lighter) will NOT provide sufficient protection from period weapons. Realize that even the best chainmaille only turns a fast-moving sharp sword into a fast-moving metal bat: you won't be sliced open, but it won't prevent you from bruising and/or breaking bones.
- Cut wire ends can be sharp. Handle rings carefully and wear eye protection. Store loose rings in a sturdy container with a lid.
- Sharp edges of rings are quite hard on fabric, and some metals will cause gray or very dark gray deposits on fabric. Wear special undergarments of heavy or durable fabric.
- Some metals may give off a distasteful odor (namely galvanized steel), will discolor skin, or be corroded by a person's body chemistry. Copper and aluminum are known for discoloring skin, green and black respectively.



- Chainmaille jewelry or headpieces can become entangled in the hair. You may want to consider sanding ring edges for specialty pieces and ensuring rings fit smoothly with no gaps at the joints. If you are doing a large project, tumbling all your rings at once is a much more efficient use of your time than sanding each one individually. A scarf or padded fabric head covering worn under chain mail can keep headpieces from damaging hair or scalp.

## Things You'll Need

- **A work surface.** Preferably flat and well lit.
- **Two pairs of pliers.** The teeth (the serrations on the jaws) on many standard pliers may damage the metal finish of your rings, especially on smaller wire and/or softer materials. For delicate (relatively speaking) ring materials, look for toothless pliers, or even tweezers if you are working with very small wire. You can also look around for plier jaw covers. A cheap alternative to plier jaw covers is plastic tubing of the correct gauge; slip the tubing over the ends of your pliers. The pliers must be strong enough to bend the metal you are using and fine enough to handle the ring size you choose.
- **Rings.** Choose a size and gauge suited to your purpose and consider the material and finish. Do you want color? Light weight? Corrosion resistance? Jewelry or armor? Do you want to buy precut rings or make your own? If you make your own rings, you will also need the following to make your rings:
  - **Wire.** Available in all kinds of materials and all kinds of sizes from all kinds of sources. Check your local hardware stores, farm supply stores, welding supply stores, craft stores, and even craft and hardware in your local department store.
  - **A metal rod or mandrel** should be used to coil your wire to a spring shape. Wooden dowels are not recommended due to the fact that they have a tendency to compress when used to coil wire around resulting in rings of uneven size. Not real critical if you are just playing around, but should be avoided for serious work. Wooden dowels are also weaker than metal rods, so are more susceptible to breaking under coiling stress.



- **A means of cutting your coiled wire.** Diagonal cutters, aviation/tin snips, flush cutters, nail clippers, bolt cutters, hacksaws, jeweler's saws, coping saws, rotary tools (Dremel) with cutting disks, and slotting saws are a few different tools/methods for cutting coils into rings. Some pliers have a wire cutting tool built right in. Be aware that different cutting tools will leave different cuts. *Pinch cuts* are cuts where the two ends of wire are pointed, which, when closed, leave small notches in your ring: ><. *Semi-flush cuts* have one flat end and one pointed end and have slightly smaller notches compared to pinch cut wire: >|. *Shear cuts* leave a fairly smooth, angled cut, but may deform your rings slightly: //. *Flush cuts* are generally cuts left by some sort of sawing method, are generally perfectly parallel, and reduce your actual ring diameter by the width of the cutting blade: ||.

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