Annealing mild steel sheet

60,000 question-and-answer topics -- Education, Aloha, and Fun topic 55257 June 24, 2010 Q. Hey guys, I've been looking into making some electromagnets and have had a lot of trouble finding iron or ductile iron anywhere to make my cores. Can soft steel be heated to a cherry red glow and cooled slowly to make it softer? I read about it somewhere and wondered if it was true. Thanks for all the answers Shaun Heatly - Perth West Australia October 13, 2012 Q. How can you anneal soft steel? I understand that you are supposed to heat it above a critical temperature, I do not know what it is. It is for the experience to have him manage more magnetism aka Gauss. I also understand that the cooling rate is important as well... So what's the best? So how does this change for the thickness of the soft steel? Thank you, Richard Richard Raynault - Surrey, B.C., Canada October 13, 2012 A. Hi Shaun; hi Richard. Yes, the optimal annealing conditions depend on the thickness of the steel (because the cooling rate does), but also on the composition of the steel, including the percentage of carbon. There is a short but exceptional introduction to thermal treatment, including annealing and temperance, with beautiful tables and graphics, to: threeplanes.net/toolsteel.html This page should answer your immediate questions of thermal/annealing treatment. On the other hand, thermal processing is a subject that fills the shelves (if not the aisles), technical libraries, so you can take it as deeply as you like. Sorry, I don't know the magnetic properties. For a school science project, it may be enough to know that you need to get the hot red steel (about 1400 degrees F) and then slowly cool it down to soften it, or quickly cool it down to harden it. A few times I needed curved sewing needles to repair car upholstery, etc., and made them from straight needles very simply. Simply put the needle on a burner on an electric kitchen stove until it is red hot, then turn off the burner. After it cools slowly, it is soft and you can fold it as you like. Then put the curved needle back on the burner until it is hot, pick it up with pliers and place it in a shallow oil dish for quick cooling, and it is good enough for use once. Wear googles though because you haven't tempered it for hardness and it could break like glass :-) P.S.: I'm not sure the term soft steel is a good example because many people consider soft steel as low-carbon steel that can't be hardened by the thermal in this way. If you try the same kitchen science project that I mentioned on a shirt pin it doesn't work; you can't get it hard because it doesn't have enough carbon. Looks, Ted Mooney, P.E. finishing.com - Pine Beach, New Jersey Striving to Live Aloha January 15, 2017 Q. I want to reuse my broken dumbbells. They've cracked and are brittling. What do I need to do to be able to bend within a 15-inch radius? Is the annealing with a torch going to be enough? Open to all suggestions! Stephanie Retz Maker with a degree in industrial design - - Massachusetts USA January 2017 A. Hi Stephanie. I don't know much about heat treatment, but until someone reads what does, I'm going to say no. I don't think you can get enough of it hot, and make it cool quite slowly, with a torch. I think you need to make a blacksmith forge :-) Ted Mooney, P.E. RET finishing.com - Pine Beach, New Jersey Aloha - an idea worth airing adv. Annealing is a thermal treatment process that softens steel. This can make it easier to train or machine. It is especially useful if you need to cut something that has been welded, like when you need to repair the wires stripped on a tree. The metal is composed of a crystalline structure that relates directly to its mechanical properties. If you can change the structure, you can adjust its hardness, malleability, robustness, tense strength, and a whole host of other things. So how can you anneal steel? For anneal steel, heat it about 100 degrees F above its critical temperature, soak it at that temperature for 1 hour per inch thick, and let it cool to a maximum of 70 F per hour. Ok, that's the short answer. Let's take into account how to do it in real life, depending on the tools you have access to, with some tips and tricks to help you get it (mostly) right the first time. How Anneal Steel In order to anneal steel, you are going to need a way to heat the metal until it is bright red, hold it at that temperature for a while, then very slowly allow it to cool down. There are two main approaches to this: using a torch, forging the oven, or other unsettled source of heat, or using a programmable heat treatment furnace. Using a heat treatment oven Benefits: Most controlled process, most consistent resultsLike the best means of fully anneal steel, right to the heartIf the oven is programmable, you can adjust it and go AwayReally effective for variable thickness parts Disadvantages: May be unnecessarily long for small parts, or if a full anneal is not importantHeat oven treatment are not easily accessible to many people , it is best to know the exact quality of the steel you work with. If you have purchased the steel from a supplier, check with them for the recommended annealing temperature. To be honest, it doesn't really vary all that much - usually you'll be annealing in the range of 1450-1650 F or more, but it's still ideal for getting an exact temperature for anneal all metal. If you really have no idea what steel is, I usually start at 1500 F and again at 1550 F if it does not work as expected (repeat in increments of 50 if necessary). Not the most effective method by a long shot, but it usually works. It's ok to go a little too hot as long as you don't melt the steel. Once the oven is at temperature, you're going to need to let the metal soak - which just means keeping it at that temperature. What this does is allow the metal to get quite hot inside, so it will be fully yearned throughout. A rule of thumb for this is to soak the for one hour for every inch thick. If you are working with a really incoherent piece of steel that is thicker in some sections than others, just go with the thickest section. So if the piece is a tree that is 4 diameter on the thick end and 2 diameter on the small end, let it soak for 4 hours. The good thing about using heat treatment ovens is that in addition to having a really accurate temperature, slow cooling is very easy. Just turn off the oven and keep the door closed. Fire bricks will hold heat long enough to really control cooling. Alternatively, some ovens will allow you to schedule the rate of charging time. In this case, set it to 70 F per hour. You can remove the part before it's completely cool - that's fine if it's still a few hundred degrees. I find that usually if I program the oven in the afternoon and start the cycle, the party will be ready to go out in the morning. Unless it's a massive block of 8 thick, that is - it would take 8 hours just to soak it! Once it's cool enough to touch, test it with your favorite method to check hardness to make sure the process worked as expected. Using a Torch Pros: Very fast for small parts, As wires or clipsA torch is usually more accessible to most peopleOnce you have an eye for steel colors at high temperatures, you don't necessarily need to know the exact quality of steel Cons: Trickier to get a full ring, achieving maximum malleability Takes more skillsTime consume for large partsVery difficult for parts with varying thicknesses , in my opinion, is the runner-up in terms of annealing process. If you can use an oven, you will get pretty good always better results with it instead of a torch. That said, using a torch will work very well most of the time. Here's the process, with some tips to make success more likely: Especially if you're working on larger parts (like 1 or thicker) try using a rosebud tip on an oxyfuel system. You will find it easier to heat the metal consistently, without overheating some sections. Keep the flame away from all small, thin sections of the room. These will be really easy to get too hot and melt. If there are varying thicknesses, try putting the flame on the thickest part and let the heat work its way to the thinner sections. Get a pretty orany red piece. If there's one thing to memorize from this, that's it: cherry red is for heat treatment, is for annealing. If you're not sure about the color of the steel at different temperatures, I've made this resource downloadable: SteelDownload Heat Colors It also includes colors at lower temperatures, which are usually used to temper. Print it out and stick it on your toolbox. Keep in mind, however, that depending on your printer ink, monitor screen, and steel quality, it may not perfectly match the actual temperature of the hot metal. It's not perfect, but it's a decent guide to start with. Another tip: Try to avoid ringing in full sun. Sun. Make it really difficult to judge the color of the steel, so you could easily end up overcooking. Do it inside a store or garage if you can. Another way to check that the steel is hot enough is to check it with a magnet. Steel loses its magnetism once it is at its critical temperature. So go break an old TV or microwave forone of these big chunky magnets in the name of good performance! Once it loses its magnetism, let it continue to brighten up a bit, since the annealing must be done about 100 F above the critical temperature. Heat the metal nice and regularly, and give it enough time to get hot in the center, too. Once it is this beautiful orange-red, now comes the delicate part: slow down the freshness. Slow Cooling Options Air cooling is too fast for ringing, so you will need to help the room retain its heat once the torch is turned off. Here are some ways to do this: Dry Sand or Vermiculite This can be an effective way to keep the room warmer longer. Vermiculite is something that is added to the soil to make plants happy, and it is also an excellent insulator. The sand is great for retaining heat, too. One thing to note is that it should be quite pure, you don't want roots or mud in the mix if possible. The construction or sand game works well. Do not use sand or wet vermiculite. Moisture - glowing metal - unsustainable results. Basically, it just won't hold back the heat, the part will cool too quickly, and you'll have to redo the annealing. There are also stories floating around the internet about things that explode when there is moisture. I think it's more of a problem with larger stones/bricks, which can crack and explode when moisture turns to steam, but it's best to err on the side of caution and avoid explosions when possible. It is best to bury the metal completely to really insulate it. If you are doing something the size of a knife, then let it sit in a 5 gallon bucket of the substance. It's cheap and reusable so don't be stingy. If you're looking for vermiculite, you can pick it up on Amazon pretty cheaply, or you can check around the local home/garden shops. Insulating cover This is convenient as there is less of a potential to make a mess, and you can roll it up and put it back on the shelf very easily. There are a few different types that work perfectly well. You can get blankets for fireplaces and wood stoves that are really effective. Another good option is to pick up a fiber insulation roller from which will usually be pretty easy on the budget and will last you a while. Tip for cooling small rooms Some parts are small enough to be almost impossible to cool unless they are in an oven. Here's a way around this: Heat a larger block of metal or two with the small part you're annealing. When you put it in the insulation, put the larger hot block (s) in contact with the small piece. This will keep it warm long enough to get a nice, slow freshness for This is a solid way to make steel take many hours to cool down. The ideal cooling rate for annealing steel is about 70 F per hour, up to about 500 F. In other words, a piece of steel that cools from 1500 F to 500 F should ideally take about 14 hours. The actual ideal times will vary by steel category, but this is a decent rule of thumb. A lot of guys like to let it take 24 hours, but personally I find it a bit pointless unless it's a special category of steel. What steels can be annealed in general are the tool steels that are most often ringed. You will need to soften the steel to be able to cut or fold it. Alloy steels can also be useful to Anneal, but this is where you should know your grades. Depending on the alloy, annealing temperatures can vary much more than you expect. Anything that can be hardened can be ringed. You won't see much change in something that is really low carbon, like soft steel 1018. In something like a 4140, however, the results can be very visible. How to tell what material you are working with is the tricky part. Ideally, you bought the metal from a supplier, and they can tell you the exact quality and temperatures of heat treatment. In real life, however, this is not always the case. This is where the torch annealing really shines. Just heat it orange-red, cool it slowly, and don't worry about it. Otherwise, it's really helpful to know what types of steel are common for different applications. Google is also your friend. Just try to look for something like what steel quality is made from and see what happens. Here are some guidelines for common mystery metals: ShaftsFor light trees, usually a soft steel is used, which will not need annealing. Heavier trees are often made from 4140 steel. Anneal at 1600 F.SpringsLeaf springs and reel springs from vehicles are usually made from a 5160 steel or equivalent. Not always, though. For 5160, anneal it at 1450 F.RebarYour guess is as good as mine. The rebar is made from any scrap is available, and it's not very consistent, either. You might have one end of the bar that is dead in soft steel, and the other end of the same bar that is entirely hard. Just ring torch through the eyes and hope for the better. If you want to learn more about rebar, check out this article on what it's made from. Rail Spike/TrackAgain, not always the most consistent in terms of composition. Usually, tracks tend to be more treatable to heat The spikes. Quite often, it will be something similar to an A36, which can be annealed at about 1550-1600 F. Check out this article for spikes and this article for tracks to learn more about common compositions. Structural steel (beams I, channel C, etc.) The most common structural steel is the A36, although there are variations. This is more systematically used for heavy stuff, such as industrial construction. For the little things, it could still be A36, or it could just as probably be something else. Anneal at 1550-1600 1550-1600 Related Questions What is the difference between yearning and tempering? Annealing completely softens the metal, making it malleable, while temperance simply reduces the fragility of the metal. Annealing is done at high temperatures, usually about 1500 F for steels. Temperature is done at low temperatures, usually up to about 500 F. In general, tempering occurs after a hardening process to relieve internal stresses and prevent future catastrophic failures. What is the difference between yearning and standardization? Annealing is a very slow and controlled cooling process, while normalization is cooled much faster in the open air. Standardization is mainly done to reduce internal stress and make the cereal structure more uniform. Standardized steel is usually partially hard, instead of being entirely soft like ringed steel. Standardization is also much less expensive, as parts are cooled outdoors instead of sitting inside an expensive oven, which slows down production. Can I anneal other metals, such as copper? Copper can be ringed, although the process is slightly different. The temperature for ringing copper is typically 700 F, or a glowing color. The main difference is that ringing copper does not require slow cooling; in fact, a quick sealing of the water will probably give the best results. Other metals can be ringed depending on grade and type. Brass, silver and certain categories of aluminum can be softened by this process. Process.