

 The Home Shop Machinist & Machinist's Workshop Magazine's BBS > General Case hardening basics		Welcome, Michael Moore. You last visited: 04-05-2012 at 12:43 PM Private Messages : Unread 0, Total 42.	
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02-17-2012, 05:14 PM

#1 

[Jaakko Fagerlund](#) 

Senior Member

Join Date: Dec 2010
Location: Finland
Posts: 596

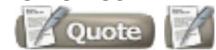
 **Case hardening basics**

I have some parts that need case hardening and tried to find some answers from the internet but didn't find anything good, so trying my luck here 😊

The objective is to use carbon packing in a sealed container to introduce the carbon in to the steel surface.

But, nowhere have I found information of how long to hold at heat to achieve certain depth, only vague "15 minutes to 72 hours" -kind of things and it would also be nice to know at what temperature this said depth in certain time is achieved.

I found from Anvilfires website some information, but would like a more comprehensive list.



02-17-2012, 05:34 PM

#2 

[RussZHC](#) 

Senior Member

Join Date: Mar 2010
Location: Winnipeg Manitoba
Posts: 991



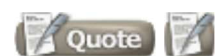
There is some discussion here:

<http://bbs.homeshopmachinist.net/showthread.php?t=34377>

there is a graph about half way down here:

web.utk.edu/~prack/MSE%20300/surface%20treatments.pdf

only other number reference I found was "red heat, 4-5 hours, can produce a depth of 3/64", but other places talk about a max of .003 in the "home shop"



02-17-2012, 08:16 PM

#3 

[Mcgyver](#) 

Senior Member

Join Date: Mar 2005
Location: Toronto
Posts: 5,225



depth is proportional to time. When not heat treating myself, the place I've used claims to be able to get a maximum depth of 50 thou, kasenit on my bench a thou or two i'd guess that's where the .003 comes from....a **pack** case with long soak at home could be a lot deeper The ASM books have all the detailed charts on time, but basically the longer you leave it the deeper, to a point.

its a great way to make tooling imo...use cheap cold rolled and then get a 50 thou case....it will still take a bruise more easily than tool steel but us home shop types aren't knuckle draggers throwing tooling against the wall. The ductile core as some advantages and you can leave it dead hard so it wears very well

Last edited by Mcgyver : 02-17-2012 at 08:20 PM.



02-17-2012, 09:31 PM

#4

CountZero
Senior Member

Join Date: Mar 2009
Location: Sweden
Posts: 135



The references I have seen talk about only packing with charcoal is not enough, you need a small amount of other stuff. I have seen references to various "carbonates" such as sodiumcarbonate or bariumcarbonate. The traditional method seems to be leather or other organic materials.

Soak time? Long enough to produce the depth you want 🎁 In other words I thing a trial run is recommended... I have yet to try it myself.



02-17-2012, 11:56 PM

#5

Jaakko Fagerlund
Senior Member

Join Date: Dec 2010
Location: Finland
Posts: 596



Thank you for the information given so far 😊 The thing is that I would not like to make extensive trial and error just to get me the case depth I want and especially as my only hardness measure at the moment is a corner of a file.

And yeah, the reason why I will use a sealed **pack** is because it can be used to get really deep case instead of just a thin crust what you get when "brushing on" a case hardening compound. I think I have a stainless steel box somewhere and fire clay can be bought from the hardware store for use as a sealant around the lid edges.

Forgot to ask, but what can be used to protect areas on the part that I don't want to case harden? Because sometimes it would be best to have threads protected or some bores and some surfaces, and I haven't seen any information on this one.



02-18-2012, 12:32 AM

#6

camdigger
Senior Member

Join Date: Jul 2007
Location: Europe-Asia border
Posts: 1,548



I do not disagree with any of the information supplied so far, but would add a couple other details.

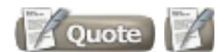
Yes, the depth of the case is a function of time. The longer the time, the deeper the case given all else is identical.

The temperature required for the carbon to be absorbed/dissolved/penetrate the steel is in the cherry red/orange color range.

The absorption rate of the carbon can be influenced by the presence of other "catalyst agents". These are what some of the other components in the magic case **pack** powder recipe are for.

The powder has to be reasonably fine because the carbon has to be in physical contact with the steel surface. The carbon will not "jump" onto the steel....

The **pack** hardening has to be done in an oxygen free/deficient environment as the steel would rather form an impermeable iron oxide scale than absorb oxygen. Some case packs include oxygen scavengers to eliminate/control scaling.



02-18-2012, 01:36 AM

#7

Jaakko Fagerlund

Senior Member

Join Date: Dec 2010
Location: Finland
Posts: 596



Quote:

Originally Posted by **camdigger**

I do not disagree with any of the information supplied so far, but would add a couple other details.

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*The **pack** hardening has to be done in an oxygen free/deficient environment as the steel would rather form an impermeable iron oxide scale than absorb oxygen. Some case packs include oxygen scavengers to eliminate/control scaling.*

Thank your for the information, though this is what I already knew. The temperature is usually measured in Celsius or Fahrenheit, not by color, so orange/red doesn't particularly mean anything, especially when the goods are packed in a sealed container inside a furnace which you don't open until the quench is about to happen.

The catalysts are usually either cyanides (usually banned from Joe Public), barium salts and a few others, but in a home shop environment or small shop not necessary. They do enhance the process, no doubt.

You are right that the **pack** has to be good, meaning no air gaps/space inside, I would just add that there is no need for any pressure or pounding the charcoal when packing, just tapping the container to settle the powder is enough. Though, the carbon doesn't transfer directly from the

charcoal but instead from carbon monoxide (CO) gas, which surely finds the part inside the box



And speaking of that, the sealed box (Brownells said that it won't require fire clay etc., just a good lid) full of charcoal is an oxygen deficient environment and some oxygen is required for the process to work. The necessary oxygen is inside the box in the air that remains between the charcoal particles and recycles during the process.

Found a nice article by Brownells from a previous topic, explains color case hardening, but I don't need pretty colors, so polishing and aerated quench tank are not needed 😊

<http://www.brownells.com/userdocs/learn/INST-531.pdf>



02-18-2012, 02:16 AM

#8

bob ward

Senior Member

Join Date: Jun 2007
Location: Laidley, SE Queensland
Posts: 592



Rosemill's PBC anti-scaling compound or similar will prevent scaling of the parts you are not trying to harden.

<http://www.rosemill.com/Default.asp>



02-18-2012, 02:43 AM

#9

Jaakko Fagerlund

Senior Member

Join Date: Dec 2010
Location: Finland
Posts: 596



Quote:

Originally Posted by **bob ward**

Rosemill's PBC anti-scaling compound or similar will prevent scaling of the parts you are not trying to harden.

<http://www.rosemill.com/Default.asp>

If I understood correctly from their brochure, it is indeed anti-scaling, not anti-hardening compound. I don't care about the possible scale (which is quite much nothing in **pack** case hardening), I want something to prevent hardening of certain parts. And even better if there is something that can be used at home or a small shop without ordering proprietary compounds containing mysterium chemicals.

I'm pretty sure there is something to use for preventing hardening on certain parts, but i don't know what would work other than copper plating, but that is quite much work to do and especially in areas like threads only.



02-18-2012, 03:11 AM

#10

CountZero

Senior Member

Join Date: Mar 2009
Location: Sweden
Posts: 135



What about wrapping a wire around the threads, perhaps with some clay? A tapped hole could be plugged with a screw.



02-18-2012, 03:48 AM

#11

Mcgyver
Senior Member

Join Date: Mar 2005
Location: Toronto
Posts: 5,225



Quote:

Originally Posted by **Jaakko Fagerlund**

*If I understood correctly from their brochure, it is indeed anti-scaling, not anti-hardening compound. I don't care about the possible scale (which is quite much nothing in **pack** case hardening),*

...I don't know this product or if it'll work but maybe what he was getting at is if it sets up a barrier for carbon migration, it'll stop it from case hardening...sort of like a resist?

Quote:

Originally Posted by **Jaakko Fagerlund**

*If I understood correctly from their brochure, it is indeed anti-scaling, not anti-hardening compound. I don't care about the possible scale (which is quite much nothing in **pack** case hardening), I want something to prevent hardening of certain parts. And even better if there is something that can be used at home or a small shop without ordering proprietary compounds containing mysterium chemicals.*

I'm pretty sure there is something to use for preventing hardening on certain parts, but i don't know what would work other than copper plating, but that is quite much work to do and especially in areas like threads only.

There is a material, sort of looks like oakum (maybe some sort of fiber glass?) that you can twist in to a tapped hole and it will seal it from the bath

Another approach I've done (on some large tool makers blocks with tapped holes all over) is send it out for the case part but not hardening - you get it back annealed. Do all the drilling and tapping and then send back for the quench. You could let it cool slowly at home after doing the **pack** case, machine, and then heat and quench

Call up some heat treatment places and chat them up. I know you plan on doing it yourself but they'll probably tell you what sort of techniques they use for a resist etc then you can decide if their approach is feasible at home.

If you do have access to a heat treater locally, the .050" case took iirc 24 hours or more..its always been easier to toss them a \$20, let them throw it in with another job and come back in week..unless of course you're going for the colours of a **pack** case.

Last edited by Mcgyver : 02-18-2012 at 04:11 AM.



02-18-2012, 03:49 AM

#12

camdigger 
Senior Member

Join Date: Jul 2007
Location: Europe-Asia border
Posts: 1,548



Quote:

Originally Posted by **Jaakko Fagerlund**

Thank your for the information, though this is what I already knew. The temperature is usually measured in Celsius or Fahrenheit, not by color, so orange/red doesn't particularly mean anything, especially when the goods are packed in a sealed container inside a furnace which you don't open until the quench is about to happen.

Your information does not agree with the research I've done. It also is on conflict with centuries of blacksmithing.

1.) Color of radiated enrgy is directly related to temperature. There's a "black body" equation in physics that describes the relationship between frequency of the radiated energy (color of the radiated light) to the temperature.

2.) the internal temperature is visibly apparent based on the percieved color. There are many examples of charts showing the relationship between color and temperature. If the exterior of an onject is cooler than the exterior, the center of mass appears darker - at least it does when I do any forge work. The opposite is true if the exterior is cooler than the center - the center of mass appears brighter. This phenomenon is readily apparent in any one of the hundreds of youtube casting and forging videos.



 02-18-2012, 05:07 AM

#13 

hojpoj 
Member

Join Date: Oct 2009
Location: Newport News, VA
Posts: 83



Quote:

Originally Posted by **camdigger**

Your information does not agree with the research I've done. It also is on conflict with centuries of blacksmithing.

1.) Color of radiated enrgy is directly related to temperature. There's a "black body" equation in physics that describes the relationship between frequency of the radiated energy (color of the radiated light) to the temperature.

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That's nice n' all, but not contrary to the OP's comments. Radiation of photons is temperature dependent- ergo, controlling to *TEMPERATURE* rather than *COLOR* will get you there in a more repeatable fashion. Especially, as the OP said, when your stuff is packed in a box with a bunch of carbon.

Defining measurable parameters is what takes things like heat treatment from an art to a science.



02-18-2012, 05:26 AM

#14

Mike Hunter

Senior Member

Join Date: Feb 2008
Posts: 233



I do quite a bit of case hardening here in the shop; I'll give you a couple of thoughts. If you're serious about doing a lot of **pack** hardening, I suggest that you get one of the older books on case hardening Pre 1940, back when **pack** hardening was commonplace. That's where you will find the charts and graphs for temps/time and depth of case. Case hardening can be done from temps ranging from 1100 deg F to 1700 deg F, and times can range from hours to days.

When heated bone/wood charcoal off gasses carbon monoxide and carbon dioxide, these carbon compounds are readily absorbed by the steel when heated above a certain temp. The **pack** compound does not necessarily need to be in direct contact with the steel, but the gasses do.

Judging temps by color can be done, but not very accurate, lots of temp controllers out there and are fairly cheap. The one I use maintains the furnace temp at +/- 2 deg F

Protecting holes and areas you don't want case hardened is fairly simple; cover with fire clay, SS foil, etc. heat block should work as long as it stays in place at temp. For screw holes, put a tight fitting screw in the hole. One gentleman used sand, he would put a layer of sand in the bottom of the box, press the press the area wanted soft into the sand, and cover the rest with **pack** material



02-18-2012, 06:17 AM

#15

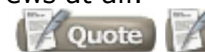
DATo

Senior Member

Join Date: May 2011
Location: St. Louis, Mo.
Posts: 425



I wanted to case a home made indicator holder for my 'Last Word' Starrett. I found that I was alternating a lot between the stem you'd put in a collet or drill chuck and the rectangular adaptor which holds the indicator in a lathe tool bit holder. So I made a rectangular piece out of CRS with a hole for the stem of the indicator and thumb screw in the side to set the stem securely. To case it I just took the torch to it till cherry red and then buried it in Kasenite. I've been using it now for a couple of years and it isn't showing any penetration of the tool block's set screws at all.



02-18-2012, 06:27 AM

#16

lazlo

Senior Member

Join Date: Jun 2006
Location: Austin, Texas
Posts: 13,944



From Kasenit

After heating the component to 1650 degress, using Method B [Method B is **pack** hardening in a tin, like you're describing]

Rates of penetration:

Case Depth Time

.005 15 minutes
 .010 30 minutes
 .015 40 minutes
 .020 50 - 55 minutes



02-18-2012, 07:40 AM

#17

Jaakko Fagerlund

Senior Member

Join Date: Dec 2010
 Location: Finland
 Posts: 596



Mcgyver, thanks for the idea of drilling holes after the case prior hardening 😊 Have o remember this if in need, I'll probably try the other options first with a piece of scrap as that way I don't need to heat the part twice.

Mike Hunter, thank you very uch for your thoughts! I think I'll go digging the local library if I can find such a book. The screw/foil/sand idea sounds fairly simple, I think I'll test with that first 😊

lazlo, thank you for that piece of information. It really shows up that the carbon penetration depth per time greatly improves at a higher temperature.

Off to the library on Monday, thanks everyone!



02-18-2012, 07:49 AM

#18

lazlo

Senior Member

Join Date: Jun 2006
 Location: Austin, Texas
 Posts: 13,944



Jakko, this is probably obvious, but that exact case depth is probably only applicable to Kasenite. Each of the case hardening formulations is different, so I have no idea how deep of a case you would get with Cherry Red, for example. But the depth per soak time will still be proportional.

As an aside, if you haven't seen Mike Hunter's color casehardening, it's spectacular! In a previous thread he rxplained he uses charcoal and bone char, in a mixture to match the blues, yellows and reds of the gun he's restoring.

<http://www.hunterrestorations.com/finishes.html>



02-18-2012, 09:37 AM

#19

RWO

Senior Member

Join Date: Mar 2010
 Posts: 240



Wrapping the threads with fine copper wire will shield them from hardening.

Bone char for **pack** hardening is sold by these people: http://www.ebonex.com/b_app.htm#gun

RWO



02-18-2012, 12:16 PM

#20

michigan doug

Member

Join Date: Nov 2011
Posts: 49

Part of the reason it's hard to find detailed rules and charts is because different steels react differently. Some steels case harden beautifully. Typically the "plain" or "cheap" steels.

Most stainless steels won't case harden at all. All the alloying stuff in there prevents carbon migration.

Finest regards,

troy



02-18-2012, 01:50 PM

#21

Jaakko Fagerlund

Senior Member

Join Date: Dec 2010
Location: Finland
Posts: 596

Quote:

Originally Posted by **lazlo**

Jakko, this is probably obvious, but that exact case depth is probably only applicable to Kasenite. Each of the case hardening formulations is different, so I have no idea how deep of a case you would get with Cherry Red, for example. But the depth per soak time will still be proportional.

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<http://www.hunterrestorations.com/finishes.html>

Thanks, pretty much what I thought to, as Kasenit has those fancy additives in it 😊

And thanks for the link, had not seen those! Have to say that the colors are very beautiful, though I'm only after the hardness. But it would sure look nice to have that sort of lathe quick change tool holders 🇺🇸

Found a nice link explaining the process and some recipes for **pack** case hardening. Also includes information on protecting areas to be left soft. Basically lists fireclay cement mixture, leaving excessive metal (to be ground away after hardening) and the copper plating method (with the recipe).

Enjoy: <http://users.beagle.com.au/lathefan/...0hardening.pdf>



02-18-2012, 05:25 PM

#22

TGTool

Senior Member

Join Date: Aug 2005
Posts: 1,827

The heat treaters we used (Hinderliter) would **pack** tapped holes with steel wool and thread stainless nuts on external threads to prevent carbon absorption and brittle threads. I know that doesn't help other areas but those are easy treatments for threads.



02-20-2012, 10:48 PM

#23



Jaakko Fagerlund

Senior Member

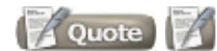
Join Date: Dec 2010
Location: Finland
Posts: 596



I found barium carbonate and calcium carbonate and copper sulfate and paraffin wax from a supplier of ceramics stuff for use in pottery and glass work, and the price is very low per bag 😊 The sulfur acid I got from the nearest auto spare parts dealer that happens to sell battery acid. And charcoal I already had for my barbeque.

Bone charcoal is just too expensive and not needed, as the secret ingredient in it would be the carbonates which are gotten far more cheaper by buying them separate and making a mixture.

Barium carbonate however is an ingredient used in rat poison and has an LD50 of 418 mg/kg, so 40 grams swallowed is considered lethal for an average person. Other than that, standard hand, eye and respiration protection against dust is enough.



02-21-2012, 04:10 AM

#24



lazlo

Senior Member

Join Date: Jun 2006
Location: Austin, Texas
Posts: 13,944



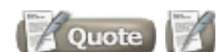
Quote:

Originally Posted by **Jaakko Fagerlund**

Barium carbonate however is an ingredient used in rat poison and has an LD50 of 418 mg/kg, so 40 grams swallowed is considered lethal for an average person. Other than that, standard hand, eye and respiration protection against dust is enough.

That's how we first "met" Mike Hunter -- I posted a thread asking about the safety of barium carbonate, described as a case hardening accelerant in the "Bullseye Mixture" in the Second Bedside Reader. A reader wrote in to the Third Bedside Reader stating the vapors from heating it were toxic. I have two young children...

We never did get an answer.



02-21-2012, 04:34 AM

#25



Jaakko Fagerlund

Senior Member

Join Date: Dec 2010
Location: Finland
Posts: 596



Quote:

Originally Posted by **lazlo**

That's how we first "met" Mike Hunter -- I posted a thread asking about the safety of

barium carbonate, described as a case hardening accelerant in the "Bullseye Mixture" in the Second Bedside Reader. A reader wrote in to the Third Bedside Reader stating the vapors from heating it were toxic. I have two young children...

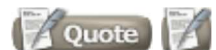
We never did get an answer.

Haven't checked yet thoroughly, but the Finnish MSDS only states that it decomposes at 1450 Celsius or above and says nothing about vapors.

Edit: It is listed as harmful chemical (Xn) and potentially lethal when ingested orally. Heating produces decomposition products carbon dioxide and barium oxide, of which the latter is also listed as harmful chemical. Irritates eyes, skin and not healthy to digest.

So I would say that barium carbonate is reasonably safe material as long as your personal safety equipment is in use and you make sure of proper ventilation.

Last edited by Jaakko Fagerlund : 02-21-2012 at 04:55 AM.



02-21-2012, 05:11 AM

#26



Jaakko Fagerlund

Senior Member

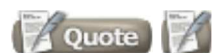


Join Date: Dec 2010
Location: Finland
Posts: 596

One more thing. The barium carbonate as such is a minimal risk for a human as it has very poor solubility in water, but the danger comes if you take it orally. It reacts with hydrochloric acid found in your stomach to form barium chloride, which is highly soluble in water and toxic for human.

So I haven't yet found any information that barium carbonate would pose serious risk when used in a case hardening compound. Especially when people have used the old Kasenit powder happily that contained 46 % of cyanide compound.

However, I will send an email to the Finnish poisoning center and another safety organisation and ask their knowabouts of this.



02-21-2012, 05:36 AM

#27



Mike Hunter

Senior Member



Join Date: Feb 2008
Posts: 233

Jaakko

Not sure why you want to mess around with barium carbonate or any other "secret ingredients", for a small scale **pack** case hardening is easy to accomplish with just wood and bone charcoal. I have sucessfully used raw bone meal found in most gardening stores/departments.

You really dont need much, a 10:1 ratio of wood to bone wont do much for colors but will harden low carbon steels.

V/R

Mike



02-21-2012, 05:51 AM

#28



Jaakko Fagerlund

Senior Member

Join Date: Dec 2010
Location: Finland
Posts: 596



Quote:

Originally Posted by **Mike Hunter**
Jaakko

*Not sure why you want to mess around with barium carbonate or any other "secret ingredients", for a small scale **pack** case hardening is easy to accomplish with just wood and bone charcoal. I have sucessfully used raw bone meal found in most gardening stores/departments.*

You really dont need much, a 10:1 ratio of wood to bone wont do much for colors but will harden low carbon steels.

V/R

Mike

Because the same chemicals that the bone includes cost far less and are more easily available, at least in here. The carbonates are in the mixture to act as a catalyst and thus they make the whole casing go faster than with only charcoal.



02-25-2012, 12:17 AM

#29



MichaelP

Senior Member

Join Date: Sep 2008
Location: WI/IL border
Posts: 911



Quote:

Originally Posted by **Jaakko Fagerlund**

The objective is to use carbon packing in a sealed container to introduce the carbon in to the steel surface.

But, nowhere have I found information of how long to hold at heat to achieve certain depth, only vague "15 minutes to 72 hours" -kind of things and it would also be nice to know at what temperature this said depth in certain time is achieved.

Make a graph based on these numbers:

1mm - 3 hours
2mm - 12 hours
3mm - 28 hours
3.5mm - 40 hours

These figures are for **pack carburizing** at **carburizing** temperature of 1700 F (925 C).

The authors warn, however, that "even with good process control, it's difficult to obtain parts with total case-depth variation of less than .25 mm (0.010") from maximum to minimum in a given furnace load...Commercial tolerances for case depth obtained in **pack carburizing** begin at +/-0.25mm (+/-0.10") and, for deeper case depths, increase to +/- 0.8mm (+/- 0.030")."

"Metals Handbook. Heat treating" 9th Edition. American Society for Metals, 1981, p. 224



02-25-2012, 07:01 AM

#30



[Jaakko Fagerlund](#)

Senior Member

Join Date: Dec 2010

Location: Finland

Posts: 596



Quote:

Originally Posted by **MichaelP**

Make a graph based on these numbers:

1mm - 3 hours

2mm - 12 hours

3mm - 28 hours

3.5mm - 40 hours

*These figures are for **pack carburizing** at **carburizing** temperature of 1700 F (925 C).*

Thank you for the nice table, have to remember this and check it afterwards 😊 Did the same article contain information of what was used for the packing? Plain charcoal or cyanides or carbonates what? Just trying to see how much difference it makes to have carbonates in the **pack**.

I just ordered a book I found, called "Lämpökäsittelyoppi" (Finnish for roughly "science of heat treatment") which is made by the leading heat treaters, some government science guys and schools in co-operation. Have to see what they have to say on this subject 😊

By the way, does anyone have any good advices or ideas of measuring the depth of the case hardening from a sample? I have access to surface grinder and a hardness meter, so would it be viable to case harden a small plate (like an inch thick), then grind one smaller side open and take measurements from near the edge in various locations away from the edge to see how hard it is? Or do you have better ideas?



02-25-2012, 07:04 AM

#31



[CountZero](#)

Senior Member

Join Date: Mar 2009

Location: Sweden

Posts: 135



If you cut it, polish the cut and etch it I think it will show.



02-25-2012, 08:27 AM

#32



[Jaakko Fagerlund](#)

Senior Member

Join Date: Dec 2010

Location: Finland

Posts: 596



Quote:

Originally Posted by **CountZero**

If you cut it, polish the cut and etch it I think it will show.

Okay, only problem is just cutting it, as the case hardening is not very nice for a hacksaw blade
 EDM and grinder are the only options I know.

Polishing is not a problem, that I'll do almost daily for mold parts, but what does that etching do to the part? And with what?



02-25-2012, 09:13 AM

#33 

MichaelP 
 Senior Member

Join Date: Sep 2008
 Location: WI/IL border
 Posts: 911



With phosphoric acid. It will reveal structure very well.

The same method is used to visually evaluate welded joints.



02-25-2012, 09:27 AM

#34 

CountZero 
 Senior Member

Join Date: Mar 2009
 Location: Sweden
 Posts: 135



You could always use an agne grinder, make a thin test bar and it should cut quick 

Nitric acid would also work I think, perhaps ferric chloride also.



02-25-2012, 09:33 AM

#35 

MichaelP 
 Senior Member

Join Date: Sep 2008
 Location: WI/IL border
 Posts: 911



Quote:

Originally Posted by **Jaakko Fagerlund**

*Thank you for the nice table, have to remember this and check it afterwards  Did the same article contain information of what was used for the packing? Plain charcoal or cyanides or carbonates what? Just trying to see how much difference it makes to have carbonates in the **pack**.*

They don't mention it directly, but it's pretty obvious that they mean common commercial **carburizing** compounds. They describe those compounds as hardwood charcoal+ coke mix with addition of 10-20% of energizers. Hardwood charcoal is more reactive as a source of carbon than coke, but coke prevents burning. Typically, the commercial compounds contain greater percentage of coke than charcoal.

The energizers increase the carbon addition rate. A typical energizer is a mix of alkaline earth metal carbonates where 70% of the mix is Barium carbonate, the principal energizer.

P.S. CountZero is absolutely correct about mentioning nitric acid as an etching solution (1 part of acid to 3 parts of water, if I remember correctly). Nitric and heated muriatic acids are classic etchants for steels. I, however, used phosphoric acid to evaluate welding penetration. In particular, so called Naval Jelly. You polish the cut very well, apply the jelly for a few minutes and rinse it away. It's easy and much safer than using the other acids.

One method to visualize hardness penetration is to etch a ground section of steel in a heated solution of hydrochloric/muriatic acid (1:1 with water). You etch it for 5 minutes at a temperature of 160 F (72 C). This recipe is taken from the book "Tool Steel Simplified" by Frank Palmer (4th Ed., 1978, p.404).

Last edited by MichaelP : 02-25-2012 at 01:42 PM.



02-25-2012, 06:33 PM

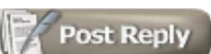
#36

Robin R
Senior Member

Join Date: May 2008
Location: Quadra Island, BC, Canada
Posts: 287



Here are the search results for heat treating on the Internet Archive, the books by Fred Colvin and Erik Oberg seem to go into the subject in some detail. <http://www.archive.org/search.php?query=heat%20treating>



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