

## Design and Engineering Forum


[Home](#)
[Engineering Forum Home](#)
[CAD Forum](#)
[Engineering Design Data](#)
[Engineers Store](#)
[Engineering News](#)
[Engineering Calculators](#)
[Engineering Downloads](#)
[Engineering Specification](#)
[Newsletter Register](#)

Forum Moderators: *Marky, randykimball, Administrator* | [POSTING POLICY / RULES](#) | [How to post an Image](#)

## Heat treating 4340

[Post Reply](#)
[Engineering Forum](#)

Posted by: Amax<sup>®</sup>

12/15/2009, 07:49:06

[Author Profile](#)
[eMail author](#)
[Edit](#)

What happens to the physical size of 4340 during heat treating? I have some shafts to machine from 4340 5-1/2" dia stock, to an average size of 5.000" dia x 18" long. Will the material grow or shrink and by how much? It will be quenched and tempered to 40-44 RC.

Thanks for any help,

Dave Cooke

Amax Machining

[Post Reply](#)
[Tell a Friend \(must be logged in\)](#)
[Alert Admin About Post](#)
[View All](#)
[| Next |](#)
[Share |](#)

### Replies to this message

## : Heat treating 4340

: Heat treating 4340 – Amax

[Post Reply](#)
[Top of thread](#)
[Engineering Forum](#)

Posted by: kmintexas<sup>®</sup>

01/17/2010, 07:50:26

[Author Profile](#)
[eMail author](#)
[Edit](#)

I can tell you from first hand experience the material is going to go crazy on you. I have always heat treat to full hard then draw three times to desired RC. If you can watch the three draws you'll notice the first draw will take it to the desired RC, The second draw at same temp it will go up in RC. The third draw will make it go back down and really really stabilize it for you. leave your

self some machine stock. If you have any dowel holes be prepared to chase the holes with a carbide reamer. Be careful if you have to chase a taped thread.

[Post Reply](#)

[Tell a Friend \(must be logged in\)](#)

[Alert Admin About Post](#)

[Where am I? Original Top of thread](#)

| |

## : Heat treating 4340

: [Heat treating 4340](#) – Amax

[Post Reply](#)

[Top of thread](#)

[Engineering  
Forum](#)

Posted by: **RWOLFEJR<sup>®</sup>**

12/15/2009, 18:29:52

[Author Profile](#)

[eMail author](#)

[Edit](#)

Hi Dave,  
Preface... I'm not a heat treater but deal with our heat treater often so can probably head you in the right direction. First off... simple enough to ask your heat treater. They won't mind flexing their know-how for you. I have had lengthy conversations with one particular heat treater we use and he's a wealth of information and just an all around good guy. We're buds and more than once he's extended our tooling life by better understanding what we were doing with a tool. Maybe varying our hardness or suggesting a different grade of material etc...

That said... They'll shrink some. They'll also be prone to bending if not positioned correct or supported by something flat during heat treat. You need to ask your heat treater if he can stand them up on end without having them fall etc. Longer shafts it's nice if you can drill & tap shaft end and supply hooks in each shaft on one end so they can be lifted for quench. These are short enough they shouldn't be a problem. They'll fit in a basket but they'll stay straighter if they can stay standing up on end.

Far as how much they're going to shrink? Ask your heat treater. It won't be much. Maybe .002-.004 if I had to guess. The bending potential CAN be more of the issue. But... if I were making these things... and spoke with the heat treater about keeping them upright I'd still allow for approx. .03-.04 total (.015-.02 per side) to be machined after heat treat for clean-up. That cut might drop your hardness by a point... if that. If your heat treater whines about giving them special care... find another heat

treater.

When you say average size of 5.000 I expect there are steps in this part. Best to keep generous radii at all transitions prior to heat treat also. This is to reduce likelihood of cracking during quench. External corners need to at least be broken before heat treat, as they too are a stress concentration area.

You can look up... Jominy test 4340... on the www or ask your heat treater what the depth of hardness might end up at. A part that thick will still be soft in the center. I'd expect that the heat affected zone will only be about 1/2" deep with hardness tapering off closer to center you get. That's usually not a bad thing in the applications I've seen this material used. Tough center with wear resistant surface. Keep this in mind when rough machining. If steps on these shafts are deep you will lose hardness at the smaller diameters.

Also always a good practice to call out a double temper on things like this. This will help ensure a complete transition of the grain. This is more critical in different grades and depends some on the application, but just a good habit to get into. Costs you an extra 50 bucks or whatever but can make or break a tool. Especially in more critical tooling applications. Tooling built for any sort of shock loads... like Hot work tool steels or S grades etc. are much tougher or less susceptible to cracking if a double or triple temper is performed. Need that smooth transition of grain and nice even equally sized grain.

Another tid bit. We've used vacuum heat treat on 4140-4340 in the past and although we had a little less distortion... the gas quench couldn't strip the heat out of the material quickly enough to get the hardness up at the initial quench like good old oil can. Meaning I doubt you'll achieve 44 RC surface on 5 inch diameter in a vacuum furnace. Might be wrong though? Could look into that if these aren't critical and you don't want to do a finish cut.

Hope that helps you out?  
Bob

[Post Reply](#)[Tell a Friend \(must be logged in\)](#)[Alert Admin About Post](#)[Where am I? Original Top of thread](#)

||

## : : Heat treating 4340

[: : Heat treating 4340 -- RWOLFEJR](#)[Post Reply](#)[Top of thread](#)[Engineering  
Forum](#)Posted by: Amax<sup>®</sup>

12/15/2009, 19:03:51

[Author Profile](#)[eMail author](#)[Edit](#)

Thanks for the info. Yes there are steps in the shafts but not much difference in diameter. The diameters are critical so finishing after heat treating will be necessary, I was going to leave .06 to make sure straightness wont be a problem. They do have the means (high tonage press) to straighten them if necessary. There are 3/4-10 holes in each end so lifting by hooks will be provided. Thanks again for the info so I feel I would be safe with my original plan. 40 RC wont be that hard to cut for some finishing and to correct the length.

Dave

[Post Reply](#)[Tell a Friend \(must be logged in\)](#)[Alert Admin About Post](#)[Where am I? Original Top of thread](#)

||

## : : : Heat treating 4340

[: : : Heat treating 4340 -- Amax](#)[Post Reply](#)[Top of thread](#)[Engineering  
Forum](#)Posted by: Kestas<sup>®</sup>

01/16/2010, 12:17:42

[Author Profile](#)[eMail author](#)[Edit](#)

Quenching and tempering steel will actually grow the part.

After heat treating, the part is hardest just under the surface. Plus, the very surface can have decarb and grain boundary oxide, both of which are undesirable.

Since you'll be grinding the shaft to finish dimensions, material growth and undesirable surface effects will be removed and you'll be left with hard and healthy material at the susrface (assuming the part doesn't suffer grinding burn during final machining).

[Post Reply](#)

[Tell a Friend \(must be logged in\)](#)

[Alert Admin About Post](#)

[Where am I? Original Top of thread](#)

| |

© Copyright 2000 - 2015, by Engineers Edge, LLC All rights reserved. ***Disclaimer***