
Subject: Hinges and Axels

Posted by [pzich](#) on Sat, 08 Nov 2008 01:32:29 GMT

[View Forum Message](#) <> [Reply to Message](#)

I've heard from other articles that interlocking pieces that need to move should be 1cm apart, however for things like hinges or car axels that would be too much (for a small car), if I printed an axel, hinge or track with 1-5mm space separately would they fit together? Let me know if I didn't explain this clearly enough.

Subject: Re: Hinges and Axels

Posted by [Whystler](#) on Sat, 08 Nov 2008 05:46:53 GMT

[View Forum Message](#) <> [Reply to Message](#)

Good news! I dont think it's 1 cm apart. I think you may have misread...

Someone could easily have cautioned you to make sure they were 1mm apart though. What post did you read this in?

-Whystler

Subject: Re: Hinges and Axels

Posted by [pzich](#) on Sat, 08 Nov 2008 13:44:47 GMT

[View Forum Message](#) <> [Reply to Message](#)

I can't remember. I posted this because I couldn't find the ones I looked at. 1mm makes far more sense, but is this space required so it doesn't print the two parts as one or because the final result has a margin of error? e.g. if I printed two objects separately with only .5mm or even .2mm would they still fit together?

Subject: Re: Hinges and Axels

Posted by [Xcapee](#) on Sun, 09 Nov 2008 01:44:07 GMT

[View Forum Message](#) <> [Reply to Message](#)

Actually, in this thread WetMorgoth suggests Quote:Right now I believe our minimum tolerance is 0.1mm. Anything less than that will be fused by our backend processing. but also suggests keeping gaps above 0.25mm.

I have to say that would be great news if the gaps can be 0.25mm, but I'm not sure if they really

can be.

Hopefully someone will show us their experiments when they do them

Subject: Re: Hinges and Axels
Posted by [pete](#) on Sun, 09 Nov 2008 15:56:35 GMT
[View Forum Message](#) <> [Reply to Message](#)

Perhaps if someone has time to make some small models to test this? If small enough, we could build them and add photos to the site in a tutorial.

Any takers?

regards,
Peter

Subject: Re: Hinges and Axels
Posted by [pzich](#) on Sun, 09 Nov 2008 16:12:20 GMT
[View Forum Message](#) <> [Reply to Message](#)

I'm up for building stuff. I can make a hinge parts that fit together with about 1mm of clearence, then we can try printing them together in place or separately and fitting them together. If you have other ideas or suggestions let me know.

Subject: Re: Hinges and Axels
Posted by [pzich](#) on Sun, 09 Nov 2008 23:57:07 GMT
[View Forum Message](#) <> [Reply to Message](#)

I've made:

http://www.shapeways.com/model/8473/hinge_test__separated_.html

and

http://www.shapeways.com/model/8474/hinge_test__in_place_.html

I'm also planning on making a little cylinder (about 5mm radius) and a cube with cylinders cut out of it (5, 5.05, 5.1, 5.15 radii or something like that) to test the accuracy of the material.

Subject: Re: Hinges and Axels
Posted by [Dalhimar](#) on Mon, 10 Nov 2008 01:55:15 GMT
[View Forum Message](#) <> [Reply to Message](#)

As a side project im currently working on making something like a rollerblade wheel, so it will have bearings, axle, screws and some other close tolerances.
Depending on how much it cost for the size i want, i will print it and get some videos demonstrating it.

Subject: Re: Hinges and Axels
Posted by [pzich](#) on Mon, 10 Nov 2008 01:59:32 GMT
[View Forum Message](#) <> [Reply to Message](#)

Awesome, I happened to see some videos on youtube with ball bearing rollers. I'm curious how that will work out with friction etc.

Youtube links:

<http://www.youtube.com/watch?v=u7h09dTVkdw>

<http://www.youtube.com/watch?v=qwSxUzrOzSE>

Subject: Re: Hinges and Axels
Posted by [Xcapee](#) on Mon, 10 Nov 2008 11:45:55 GMT
[View Forum Message](#) <> [Reply to Message](#)

pzich, great work. Can you clarify the comment in the models. Is it 1mm radius or diameter clearance? In other words if the pin is dead centre in the sleeve, is there 1mm either side, or 0.5mm either side making 1mm in total?

Also the cube with varying size holes is a great idea.

If you print these, please be sure to post a video.

Subject: Re: Hinges and Axels
Posted by [pzich](#) on Mon, 10 Nov 2008 12:53:44 GMT
[View Forum Message](#) <> [Reply to Message](#)

It's a good thing you asked. I was initially designing it with 1mm clearance on all sides, but I just measured it and there is .5mm clearance.

Subject: Re: Hinges and Axels
Posted by [pzich](#) on Mon, 10 Nov 2008 16:26:50 GMT
[View Forum Message](#) <> [Reply to Message](#)

I might print them but I'm not sure if it'd be better for me to or our friends at shapeways. I don't have much use for them and it would probably be at least two weeks to get them to my house.

Subject: Re: Hinges and Axels
Posted by [pete](#) on Mon, 10 Nov 2008 22:26:08 GMT
[View Forum Message](#) <> [Reply to Message](#)

Hey Peter,

thanks for uploading the models so quickly. Could you perhaps clip the 'wings' a little? If it is really small we can print it as an add on. After that I will make pictures and post them.

Actually made some nice hinges and gears pictures today.
Will post a blog tomorrow.

regards,
Peter

Subject: Re: Hinges and Axels
Posted by [pzich](#) on Mon, 10 Nov 2008 22:47:12 GMT
[View Forum Message](#) <> [Reply to Message](#)

I've cut the model size down quite a bit, the actual length of the hinge has been cut in half and the wings have been cut down quite a bit, price has also been cut in to one third of the original price.

http://www.shapeways.com/model/8553/hinge_test_mini__in_place_.html

http://www.shapeways.com/model/8554/hinge_test_mini__separated_.html

Subject: Re: Hinges and Axels
Posted by [pete](#) on Mon, 10 Nov 2008 23:41:01 GMT
[View Forum Message](#) <> [Reply to Message](#)

Hi Peter,

thanks. Will have them made and make some pictures.

regards,
Peter

Subject: Re: Hinges and Axels
Posted by [pzich](#) on Tue, 11 Nov 2008 03:45:40 GMT
[View Forum Message](#) <> [Reply to Message](#)

I have also created the Pin and Holes model I was talking about:

http://www.shapeways.com/model/8558/pin_and_holes.html

Subject: Re: Hinges and Axels
Posted by [bartv](#) on Tue, 11 Nov 2008 15:35:02 GMT
[View Forum Message](#) <> [Reply to Message](#)

I just created and ordered this model to check out tolerances and friction:

http://www.shapeways.com/model/8592/friction_tolerance_test.html

Once it's in, I'll do a blog post about it.

Cheers,

Bart

Subject: Re: Hinges and Axels
Posted by [pzich](#) on Tue, 11 Nov 2008 22:30:42 GMT
[View Forum Message](#) <> [Reply to Message](#)

Very nice, although I think it would be interesting to see a circular hole, just to see how the pixelization factors in, since it is printing in a grid. Both would be great to know, I've got a few things in mind (engine, car, etc.) that have rotating parts, I'm hoping for very little spacing for the axes/crankshaft/hinges. Keep us posted.

Subject: Re: Hinges and Axels
Posted by [pete](#) on Tue, 11 Nov 2008 22:50:53 GMT
[View Forum Message](#) <> [Reply to Message](#)

Hi,

this one is also in production:
www.shapeways.com/model/8553/hinge_test_mini__in_place_.html

regards,
Peter

Subject: Re: Hinges and Axels
Posted by [Dalhimar](#) on Wed, 12 Nov 2008 14:21:02 GMT
[View Forum Message](#) <> [Reply to Message](#)

I was wondering about the materials friction, Would you think it be best to use a roller type bearing or ball bearings with the ST&F material?

Subject: Re: Hinges and Axels
Posted by [bartv](#) on Wed, 19 Nov 2008 15:29:57 GMT
[View Forum Message](#) <> [Reply to Message](#)

Hi guys,

the test prints came in today! We made a quick movie with a mobile phone to show you how they work - sorry about the shaky quality We'll turn it into a proper blog post later this week but I wanted to share this here first.

Enjoy!

Bart

@pzich: we'll send those samples your way, thanks!

File Attachments

1) [hinge-demo.mp4](#), downloaded 400 times

Subject: Re: Hinges and Axels

Posted by [bartv](#) on Wed, 19 Nov 2008 15:37:13 GMT

[View Forum Message](#) <> [Reply to Message](#)

And a close-up pics to show some detail.

Cheers,

Bart

File Attachments

1) [detail.jpg](#), downloaded 398 times

Subject: Re: Hinges and Axels

Posted by [pzich](#) on Sat, 22 Nov 2008 03:36:25 GMT

[View Forum Message](#) <> [Reply to Message](#)

Thanks for testing this for us! I'm happy to report my axel test

http://www.shapeways.com/model/8514/test_car.html worked beautifully. The axels move freely and with little friction, overall a huge success.

Subject: Re: Hinges and Axels

Posted by [pete](#) on Wed, 26 Nov 2008 22:39:05 GMT

[View Forum Message](#) <> [Reply to Message](#)

Hi Peter,

we also printed your pin and holes (link)

However none of the combinations work even with some force.

0.1 mm is not enough clearance, but only just.

regards,
Peter

Subject: Re: Hinges and Axels
Posted by [madox](#) on Tue, 02 Dec 2008 14:46:14 GMT
[View Forum Message](#) <> [Reply to Message](#)

I wonder what was the clearance on that axle on a car frame test?

'Almost 0.1mm' seems nice...waiting for the blog post

Nvm found the blog post
<http://www.shapeways.com/blog/archives/141-Creating-hinges-and-moving-parts.html>

Subject: Re: Hinges and Axels
Posted by [madox](#) on Wed, 03 Dec 2008 14:17:47 GMT
[View Forum Message](#) <> [Reply to Message](#)

http://www.shapeways.com/model/10080/mechanical_iris___single_assembly.html

I've just uploaded the ultimate in clearance tests. Going to order this tomorrow morning and see how it goes (too late/dark to look for my wallet)

File Attachments

1) [Iris2Assembly.jpg](#), downloaded 1381 times

Subject: Re: Hinges and Axels
Posted by [fracai](#) on Wed, 03 Dec 2008 15:22:20 GMT
[View Forum Message](#) <> [Reply to Message](#)

That looks incredible. I take it that you're ordering it already assembled? I hope it comes out functional.

Subject: Re: Hinges and Axels

Posted by [madox](#) on Thu, 04 Dec 2008 10:34:56 GMT

[View Forum Message](#) <> [Reply to Message](#)

I pray it comes out functional too and not fused together ... got 0.25mm to 0.4mm gaps everywhere...

Ordered it this morning so hopefully will get to play with it before xmas

Subject: Re: Hinges and Axels

Posted by [pzich](#) on Fri, 05 Dec 2008 21:02:38 GMT

[View Forum Message](#) <> [Reply to Message](#)

That looks awesome, please let us know how it turns out. And if you don't mind, could you tell us about what software and methods you used to make this? Thank you.

Subject: Re: Hinges and Axels

Posted by [oribotic](#) on Mon, 08 Dec 2008 14:39:30 GMT

[View Forum Message](#) <> [Reply to Message](#)

I read this thread and also this link.

I misread the tolerance guidance for moving parts, stating it should be GREATER THAN 0.25mm. I made all hinge tolerances in this model 0.25mm. All the joints fused during printing

EDIT - My tolerances were - 0.125mm not 0.25mm!!!
0.25mm may still work, but I'll have to reprint my model to find out.

I'm trying again with 0.5mm as the tolerance in all of the hinges. Hopefully it will work, its only my first 3D printing experiment.

To give you all a better idea of what I'm making, its a small mechanical design that will actuate a complex origami membrane as part of my ongoing ArtScience called oribotics, there are a total of 15 hinges that operate with a hand-like open and closing.

File Attachments

1) [oribot-net-0.5mm.png](#), downloaded 1288 times

Subject: Re: Hinges and Axels
Posted by [pzich](#) on Mon, 08 Dec 2008 14:44:43 GMT
[View Forum Message](#) <> [Reply to Message](#)

.25mm fused? That's unfortunate, also a bad sign for some of the models I'm making...

Subject: Re: Hinges and Axels
Posted by [oribotic](#) on Mon, 08 Dec 2008 15:00:48 GMT
[View Forum Message](#) <> [Reply to Message](#)

Oh no! I realised typing this that my rod was 1mm and my holes are 1.25mm (duh), meaning my gaps are on 0.125 mm (my mistake and a really silly one)... I'll edit my previous post to correct this misinformation.

I also think that the design of the model may be a contributing factor. So the next design I will print, I've tried to add as much air as I can around the hinge joints so that the unfused material can be easily cleaned out. 0.25mm is tiny gap to stick something between.

Subject: Re: Hinges and Axels
Posted by [pzich](#) on Mon, 08 Dec 2008 16:45:13 GMT
[View Forum Message](#) <> [Reply to Message](#)

Thanks for checking on this. I also found out the model I was worrying about has .5mm, not .25mm clearance (I forgot I left myself some space). Hope your project is successful.

Subject: Re: Hinges and Axels
Posted by [robert](#) on Mon, 08 Dec 2008 20:47:49 GMT
[View Forum Message](#) <> [Reply to Message](#)

Hi guys!

Please let us know when you are experimenting with tolerances for Living Hinges! We are very interested in the results but can also help out on the evaluation if the hinges are going to work.

When you order such a model just enter a message for me in the contact form with your order/invoice number and we will take special care of it.

You can find the contact form at <http://www.shapeways.com/contact/contact-form>

Cheers!

Robert

Subject: Re: Hinges and Axels

Posted by [madox](#) on Mon, 08 Dec 2008 21:02:16 GMT

[View Forum Message](#) <> [Reply to Message](#)

oribotic wrote on Mon, 08 December 2008 10:00Oh no! I realised typing this that my rod was 1mm and my holes are 1.25mm (duh), meaning my gaps are on 0.125 mm (my mistake and a really silly one)... I'll edit my previous post to correct this misinformation.

I also think that the design of the model may be a contributing factor. So the next design I will print, I've tried to add as much air as I can around the hinge joints so that the unfused material can be easily cleaned out. 0.25mm is tiny gap to stick something between.

I'm sorry it feels wrong but I was relieved to see your mistake.

Hehe when I read your first post I was certain that my model (with 0.25+ gaps) was going to be \$40 wasted on a fused blob.

Robert Special care? Mines already in production...OH MY GOD ITS SHIPPED! And with tracking number and all Shapeways has improved a lot Expected delivery 11Dec

Subject: Re: Hinges and Axels

Posted by [oribotic](#) on Mon, 08 Dec 2008 21:37:41 GMT

[View Forum Message](#) <> [Reply to Message](#)

@madox its cool, I'm glad I found the error. It was your question that prompted me to double check, so thanks. I also did a 2nd test in the batch, with the same model just scaled 1.25 times, so the tolerance was 0.15mm (still too small). Good luck with your project. Let us know how it goes.

@Robert, thanks for letting us know we can get some expert help on this, its cool stuff, and I've more ideas I'd like to experiment with.
