

Ticket #921

Ticket Status: Closed

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Field of Study: Mechanical Engineering

Subject: Yale

05/18/2015 10:35 pm Philip Piper

Hi Formula Hybrid support,

At the suggestion of Dr. Douglas Van Citters we are submitting the Bulldogs Racing 2016 chassis for review prior to starting fabrication. Since we are limited to attaching non-CAD files, we have come up with a PDF drawing highlighting a few points on the chassis that may be of interest.

Notes:

- The half inch outer diameter members listed as (1) are purely for torsional rigidity, and do not fulfill any rule requirements.
- The jacking point member listed as (2) will be connected with steel tabs even though it is currently not connected to the chassis.

Questions:

- Does the cross member listed as (3) on the front bulkhead have to have 0.065" wall thickness like the four members making the front bulkhead?
- Are the members listed as (4) considered the front hoop braces, or have we misread T3.13?

We appreciate the time you take out of your busy schedules to support us!

Chassis Rules Inquiry on 051815.PDF(69.6 kb)

05/19/2015 10:26 am

Philip,

Dr. van Citters made an excellent suggestion. I fully support it, and have recommended to Doug Fraser and Amy Keeler that we open up for formal SES submissions as soon as the Rules are published.

To answer your questions:

1. The diagonal #3 on your drawings can be 1.00" x 0.049". It is only required if you are using the Standard FSAE IA AND your IA Anti-Intrusion Plate extends beyond the foam of the IA more than 1" on any side. BUT you can only use the Standard FSAE IA if you meet the second note of T3.21.3! If you do not meet this latter requirement, you must test your IA, and then the diagonal is only required if you need it to meet the last part of T3.21.10.

2. The members you have as #4 are considered the Front Hoop Braces in your design.

In general, your design looks pretty good. As soon as you have an idea of your tube sizes, please send that information and we will review it.

Also, I routinely ask the following questions:

a). How are you planning on mounting your suspension pieces? Are you planning on doing so by drilling holes in a regulated tube, or will you be welding tabs/brackets onto the tubes? If you are going to drill holes, than I will need to see the

designs of the tube inserts.

b). How and where are you planning on attaching the lap and sub belts?

Michael Royce.

05/19/2015 9:59 pm Philip Piper

Michael,

1. We are planning on testing a custom honeycomb impact attenuator and have determined through FEA that a 1" outer diameter by 0.035" wall thickness steel cross member should give us plenty of room in passing T3.21.10. Of course we will see if this is actually the case when we carry through with the test this coming fall. Additionally, is there a rule that I am missing stipulating that this cross member would have to be 1" outer diameter by 0.049" wall thickness even if a smaller thickness is enough to pass T3.21.10?

a). We are planning on mounting our suspension A-arms to tabs that are welded to triangulated nodes on the sides and bottom of the car. The attached drawing named "Suspension Points 051915.pdf" labels these points.

b). In the drawing labeled "Wall Thicknesses 051915.pdf" the point labeled with a B* is the lap and submarine belt mounting member. The mounting points are at the ends of this member where it is triangulated with the rest of the frame. Tabs meeting the thickness and area requirements of T5.2.2 (b) and (c) will be welded to these corners such that both the lap belt and submarine belt are attached in double shear. Additionally the firewall closes out at the back-most point of the member labeled B*, so the seat belt mounting tabs are forward of the firewall according to T5.2.3. We are planning on using a six point harness since our driver will sit in a reclined position at about a 45 degree angle.

The "Wall Thicknesses 051915.pdf" file also labels the wall thicknesses of the tubes on the car. Any tube that does not have a label in any of the three views has an outer diameter of 1" and a wall thickness of 0.049". I tried labeling all of these tubes as well as the others but the drawing became too cluttered.

Thanks again for looking through all of these rules with us. I am sure it will end up saving both of us time come next year's competition.

Philip Piper

Wall Thicknesses 051915.PDF(67.6 kb) Suspension Points 051915.PDF(84.4 kb)

05/19/2015 9:59 pm Philip Piper

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Philip Piper

Wall Thicknesses 051915.PDF(67.6 kb) Suspension Points 051915.PDF(84.4 kb)

05/20/2015 3:27 pm

Philip,

For teams building their own IA and testing it, there is no mandatory tube size for a diagonal in the Front Bulkhead. You need whatever works.

a). Looks like your suspension A-arms will be at nodes, which is good engineering. But what about the position of the rocker arm pivots and the shock/strut anchors?! Where will they be?

The tube sizes and configuration look good for the mandated tubes.

Sounds like you will not be needing tube inserts, assuming that you do not need to drill holes in the Shoulder Harness Bar for the shoulder harness!

For a safety harness, as you will have a reclined driver, don't forget that you will need tilt-lock adjusters on both your sub belts (or 2 sets of sub belts). Be careful from whom you buy your belts, as some suppliers don't know what we are talking about!

I suggest that when you come to assemble your frame, you leave welding in the shoulder harness bar until you can get a seat and driver in the frame. That way you can get the height of the bar correct for the should belt angles.

Also, make assure Percy fits easily and don't design line to line to the templates! Things like shifters can get in the way of the cockpit opening template, and wires, tubes and cables in the way of the cross-section template. And frames do tend to move a little when they get welded up.

Press on, and good luck.

Michael Royce.

05/20/2015 9:35 pm Philip Piper

Michael,

a). Ah yes, the bell cranks and shocks, "minor" detail. I have attached another drawing labeled "Bell Cranks and Shocks 052015.pdf" that points out the location of the rockers and shocks for the front and rear of the car. Push rods will be used on the rear of the car while pull rods will be used on the front. The rear springs will be mounted on the main hoop braces such that only compression/tension forces are passed through the braces and the front springs will be mounted below the front suspension points. Both sets of springs will be mounted outside of the main structure of the space frame, but within the roll envelope of the car.

We are not entirely sure how we are mounting the shoulder harness to the shoulder harness bar. In previous years I think we welded on tabs, which we will likely do again this year to avoid rules concerning drilling holes into regulated tubing.

I have also included an older assembly that uses a nearly up-to-date revision of the chassis I have been sending to you with the file name "Full Assembly.pdf". That shows percy fitting in the car, and we have another assembly for the templates which we are giving at least 0.25" of clearance on all sides.

I like the suggestion on welding the shoulder harness mounting bar last though because it is hard to tell how Percy's shoulders will map to our various drivers' shoulders.

Best,

Philip Piper

Bell Cranks and Shocks 052015.PDF(66.2 kb) Full Assembly.pdf(164.1 kb)

05/22/2015 9:11 am

Philip,

Hmmm. Putting suspension loads (bell cranks or spring/damper mountings) in the middle of a tube is not a good idea. And anchoring your rear springs on the Main Hoop Braces will likely get you into problems with T3.12.7. The "envelope of the Primary Structure" of T3.12./7 is not the same as the roll-over envelope shown in Figure 24.

Press on and good luck.

Michael Royce.

05/24/2015 10:17 pm Philip Piper

Michael,

Could you explain the issue with putting suspension loads in the middle of a tube? We were under the impression that because the loads would be purely axial, it wouldn't be a problem. Additionally we can put the springs and rockers on the inside of the primary structure to account for T3.12.7 (didn't remember that rule, good catch!).

If it was the front suspension you were worried about, the schematic I sent you may not have done what we have in mind justice. The springs and rockers in the front will all be attached at chassis nodes (this is based off of our design from BR14).

Philip Piper

05/26/2015 11:19 am

Philip,

Other than T3.12.7, there is no actual rule against putting suspension loads into the middle of a tube. However, my understanding is that the Design Judges look askance at it. (We do have one on the Shoulder Harness mounting, T5.4.1.)

One thing that I did overlook is that I would ask you to put a 1.00" x 0.049" diagonal in that transverse bay at the very back above the jacking bar to provide better rear impact protection to meet EV3.4.2.2, as I believe that it is your electric motor right at the very back.

Michael Royce.

05/26/2015 9:30 pm Philip Piper

Michael,

What if we moved the rear shocks to the positions specified in the attached "Shock Points 052615.pdf" file? The bell cranks would be positioned in the same spot such that they move through around 90 degrees rather than 180 degrees.

I have also added the rear diagonal although it is hard to see in the views I gave you (see the top one).

Philip Piper

Shock Points 052615.PDF(65.6 kb)

05/28/2015 8:46 am

Philip,

As long as you do not contravene a rule, how you mount your springs and shocks is a design issue and not a rules issue! I am not supposed to give design guidance. So, I am going to let you figure that one out.

I did forget that on the SES we also have a tab for EV3.4.2, Tractive System Accumulator Container-Mechanical Configuration. On that tab you will need to convince me that your design meets EV3.4.2. Pay particular attention to Rule EV3.4.2.a.

With that rear diagonal, (I can just see it) it appears you do meet EV4.2.2. The rear wheels effectively give the motor protection from side impacts, and the accumulator has good side impact protection.

Michael Royce.

05/30/2015 11:03 am Philip Piper

Michael,

Sounds good on the springs.

I am currently working on the accumulator enclosure, and will likely have it finished within the next two weeks at which point I can submit it in a separate ticket (unless using the same ticket is easier on your end). Two years ago we used a Kevlar accumulator enclosure with a lot of success. However we want to be able to race in Formula Lincoln as well as Formula Hybrid, and their rules specify a fairly robust steel enclosure that may be difficult to match the design characteristics of using Kevlar (requires SES). Still not sure where I will go with that, but I will definitely be back soon in a separate ticket!

Thanks again for the help, its a long way off but we're really looking forward to next year's competition!

Philip Piper

Please Wait!

Please wait... it will take a second!