

Attached are the pictures from the crack testing that was accomplished by magnetic particle inspection. The testing process was done to the ASTM E1444/E1444M-11 (military) standards and are described below:

1. Testing must happen in a number of different areas. Each individual hole whether it be a lug mounting hole or the windows around the perimeter of the center must be magnetized for testing. This happens by inserting various sized copper conductor rods through the hole and then mounting the wheel with a rod passed horizontally through the hole to be magnetized. The machine that it is mounted in has a headstock that is pedal controlled to open and close like a clamp. There is an area in front of the headstock that has a lattice work of square copper rods creating a table like surface allowing for parts to set on them so the magnafluxing fluid can be flowed over the part. Below is a tank that contains the magnafluxing fluid that is constantly being pumped through a hand held hose. The inspector opens the headstock and inserts the wheel rod combination in between two copper mesh panels that are hooked to an electric controlled magnet. He then closes the headstock capturing the wheel and rod assembly with enough force to allow the inspector to remove his hands and lock the load in place.

2. The inspector then sets the amperage amount on the test stand that will be pulsed through the wheel fixture, this ranges from 0-4,500 Amps. A handheld ammeter is used to verify the test stand digital readout. There is a formula for each size hole and material that the item being tested is manufactured from. Our testing ran from 350 Amps for the small lug mounting holes to 4,300 Amps for the larger center hub hole. The inspector then charges the machine and releases the pulse with the push of a button and there is a noticeable mechanical sound of a large breaker that fills the room. The sound is not loud but you can tell it is powerful. There are very few Volts used in this process so being electrocuted is not a concern for the inspector working on the testing platform.

3. Again each hole must be magnetized with a proper sized copper conductor rod being used for different sized holes. The wheel is rotated to each hole position and the electrical magnetic charge is pulsed into that area. Only after all of the holes are magnetically charged is this process step complete, or so I thought.

4. After all of the holes and windows have been charged the copper conductor rod is removed from wheel and set aside. The inspector then takes the wheel and turns it on its horizontal plane and actually clamps the wheel into the headstock. This is done to charge the wheel in both the horizontal and vertical planes. Before he magnetically charges the wheel for testing he must check the direction and strength of the charge. He puts a small piece of metal on the wheel and charges the test stand, then he runs the detection fluid across the metal chip. A very faint small line appears in the metal, this line indicates the direction and to some degree the relative strength the magnetic charge. If the direction and strength are correct he will magnetically charge the wheel, in this case with 4,300 Amps. Now the wheel is completely charged and ready to be inspected.

5. The wheel is then taken off the headstock put on the square copper rod table and turned towards the inspector who now has a portable black light in his hand. The light is directed around the wheel in areas that he wants to check. The areas of critical concern are the lug bolt holes, window openings around the edges, hub center, all welds, and the edges of the wheel itself. If any crack is apparent it will phosphoresce (glow) fluorescent green in the crack with the green look of the inspection fluid when lit with black light. It was very clear when a crack or defect was identified it would mimic the line of the defect or crack perfectly and made it very easy to see.

6. Wheels that are identified as having manufacturers defects or cracks were set aside and the inspection process continued through all eight wheels. Two wheels had issues that need to be dealt with. One front wheel was identified to have a manufacturer's defect due to a cold strike problem. This is caused when two metal components do not fully meld together when being pressed. This defect has the potential to cause the wheel to come apart at speed. This wheel is to be relegated to the waste bin, a small price to pay when a human life is in the balance. The other wheel had two identified areas of small cracks that appeared around the lug bolt mounting holes. These can be ground out welded and re-machined to save the wheel. It should then be retested to certify it for high speed use.

7. After testing the wheels must be un-magnetized. Imagine if the wheels stayed magnetized? All forms of ferrous items like metal chips and nuts and bolts would stick to the wheels. To reverse the magnetic field the wheel is inserted into the center of a large "C" shaped demagnetizing fixture that is then pulsed to reverse the magnetic field. This neutralizes the magnetic charge. The wheel is put in both the vertical and horizontal planes to fully demagnetize the wheel. This process is double checked with a handheld item similar to a compass. If the needle is unaffected as the instrument is moved around and across the wheels is the wheel deemed magnetic field free and it is now finished with the testing regimen.

Following the balancing of the wheel unto themselves with welded tables we will then start our powder coating processes. More story and pictures to come.

As you can see this is an involved process that works well for items that have critical usage that must pass these types of testing to be used for specialty high performance applications. Andrews Powder Coating, Inc. is happy to be involved with this project and we are making sure that we provide quality services for the Speed Demon land speed racing team. Speed is in the details.

Thanks again,
Scott

PS: This testing is done in the dark. I had to use flash photography in the testing cell to allow a proper view of the test in process. But just

know that this is normally done in the dark with just the light from the black light to illuminate the area. The magnafluxing fluid is red-ish brown in standard or Sun lights. It has a bright green look when black light lit and in the dark. This is an unusual way to work for sure but this is a black art that is not well understood. It was very informative for me to see and especially since I had done simple magnafluxing and dye penetrant testing when I worked in a high performance cylinder head shop during my high school days. This was a far cry from those rudimentary tests. Also included are two pictures of the work order and the certification of compliance.