

Scott Metals.txt

Roger Hulett

Joined: 31 May 2004

Posts: 78

Location: South West France

Posted: Wed Aug 09, 2006 1:47 pm Post subject: Scott metal

I would like to know how one can determine the type of metal used in various Scott components. e.g. what is the flywheel made of, is the metal in a 1927 flywheel the same as in a 1947 model. What metal was used for the mainshaft in a 1927 model compared to a 1947 one. Similarly the frame, forks, foot rests etc etc
Roger Hulett

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Roger Moss

Joined: 31 May 2004

Posts: 242

Location: Leicester UK

Posted: Thu Aug 10, 2006 11:05 pm Post subject: Scott metal specs

Hi Roger H. After giving a little study of the metal and manufacturing technology in use during the years of Scott production, I came to the general conclusion that there was no great advances made between WW1 and the 1950's. The manufacturing methods used by Scotts as described in the "Automobile Engineer" in Jan 1916 were still current until the late 50's. As regards metal, then up to 1939, there were no national standards. It was only the war that obliged the government to impose a series of standard specifications on the fragmented steel industry. What we got was the "Emergency Number" (EN) series that is still very common currency here and even more so in India today. Those specifications were a compilation of common 1930's steel specifications when a host of small steel companies made to different recipes. If the original Scott drawings from the 1920's, 1930's and 1940's are studied, then the metal specification for loaded and hardened parts are just given as "3% Nickel" or "5% Nickel" for example. We can see a parallel to the EN series 33, 36, 39. There is no supplier company or product name given. I think it fair to assume that Scotts bought quality steel from small producers that they trusted. Flywheels were bought in as stampings but no steel spec was recorded. I cannot say that I have ever seen a failure which was due to inadequate metal on a Scott. If we think of long stroke cranks or early steering head stems, then the failures in these components was due to design error, as the loadings were more severe than even the best metals of the period would sustain over an extended period. If we were making the same components today, we could use steel with a similar nickel content to those specified by Scott, but we would have information on the other ingredients also.

A rambling answer perhaps, but given the lack of definitive information, an overall impression is all that can be given.

Kind Regards

Roger M

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Douglas Kephart

Scott Metals.txt

Joined: 06 Jun 2004

Posts: 11

Location: Pennsylvania, USA

Posted: Fri Aug 25, 2006 4:09 am Post subject:

A similar situation exists with Douglas motorcycles of the twenties and thirties, though on rare occasion they will call out a specification relevant to the time. So 5% nickel steel might be given as Hughes & Johnson X84 (proprietary), or S82 (a post WW1 aircraft spec.) Cross comparison, when you can find charts, would show them equivalent to EN39b. They started using material similar to EN36 going into the mid-1930s.

But the only way to really know is to have a sample item sent to a metallurgy lab and tested. Usually this is an optical emissions spectrometer, where they vaporize a small patch of the surface material. Then you get a precise record of the chemical make-up and percentages there of. The lab may tell you if it is similar to a current material, otherwise you have to find the nearest match using a metals handbook.

Chemical tests on ferrous materials were running \$30 in 1997 here in the USA. I think the price doubled since the lab I used changed ownership! Fortunately (?) there are an abundance of broken Dougie crankshafts and connecting rods about to test.

When I made new connecting rods for the Dirt Track Dougies, the nearest equivalent I could find was SAE9310. The modern steels do not have as high nickel content (4.25% is usually the highest offered), but they more than make up for it in purity, constancy, and refinement. Most of these specialty steels are made for the aerospace industry, and they do not tolerate variation, or slag inclusions! The bar stock is invariably vacuum re-melt, Timken of bearing fame does quite a sideline in specialty steel and have a good website with lots of steel spec info. Also available now is more precise control over the heat treatment process, with furnace temperature control to within two degrees and inert atmospheres. Something not available back then at all is cryogenic tempering of ferrous parts to -300 degrees F. In essence this extends the tempering range. The upper limit is fixed by drawing the hardness out of the part, but the lower limit use to be room temperature, but now it is much lower. So you can cycle the part through some seven hundred degrees rather than just say four hundred of old. End result, more refinement of the metal structure during tempering. And it is not that expensive; around \$1-2 per pound processed, or fixed prices for popular items like connecting rods, crankshafts, brake rotors, and target rifle barrels.

For highly stressed case-hardened parts SAE9310 is the best with SAE8620 almost as good but far less expensive and more readily available. For through hardened parts with the maximum shock resistance, SAE 4130, or for thicker sections SAE4340, or the ultimate and hardest to source 300M (a modified version of SAE4340) are usually the best choices. It is a pity you can not case harden some of these through hardening steels, as they have some awesome tensile and impact properties. As always, you have to match the ideal steel with the specific conditions it will be used in, and there the lab or the heat treatment firm can often provide some free advice.

-Doug

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Roger Moss

Joined: 31 May 2004

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Posts: 242

Location: Leicester UK

Posted: Fri Aug 25, 2006 9:52 am Post subject: Thanks Doug

Hi Doug. You obviously have a very good knowledge of this subject and I hope you will not mind if I copy your piece for my records.

I have really only been concerned with making new items, mostly for production machinery and tooling. You assess the duty the piece should withstand, make the design that is the best effective compromise of all the conflicting requirements and then select the appropriate material.

I am always interested to see a failure, because it can tell much about the nature of the loadings that have eventually brought about the breakage, but actually I look to the replacement with modern materials as a new problem.

Optimise the design, select the most suitable material, ensure heat treatment is correctly specified and carried out, test the results before final machining.

I was very heartened that you chose to cite 300M as an ultimate through hardening material. It is this exact material that, after considerable study, I chose to make replacement Scott long stroke cranks in 1997.

I send my sincere respect and kindest regards

Roger

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Douglas Kephart

Joined: 06 Jun 2004

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Location: Pennsylvania, USA

Posted: Fri Aug 25, 2006 11:30 pm Post subject:

Roger wrote:

...I hope you will not mind if I copy your piece for my records.

Sure.

Chemical testing of the original parts was one part curiosity, and one part to set a baseline for a minimum requirement. I found it interesting that the optimum material available today, was very similar to what they chose some eighty years ago! Of course they called it something different then and it was not so refined. Add to that cryogenics and specialty coatings, and there is no reason not to exceed the original specs (except for lack of funds!) After all we put a man on the moon; why not a Scott back on the road?

-Doug

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Roger Moss

Joined: 31 May 2004

Posts: 242

Location: Leicester UK

Posted: Sat Aug 26, 2006 9:56 am Post subject: The reason for failures

Hi Doug

I do agree that the materials, if correctly specified, were quite good in the vintage period. The short stroke cranks rarely break and so are not such an issue. The long stroke ones break, BUT, they are made of exactly the same steel with exactly the same hardening processes.

The conclusion then, is that the failures were due to design failure not material failure. The designer responsible allowed the basic design to be enlarged to a point where the available steel would not cope.

It would have been quite possible to thicken up the crank, so it would have strength to match the duty with the same material, but this would have meant other mods, which meant, in turn, spending money. When Scotts did spend money, they often got their fingers burnt. Examples, Grand Prix engine, early 3 speed gearboxes, Four speed gearboxes etc. If you have spent your life in the relevant fields of engineering, you can clearly see that, not only were the designers not supermen, but they lacked the guidance of a truly gifted design director. Our response to the long stroke crank problem was to try and find a solution within the design first, but having made what advances we could in this area, it was abundantly clear that this did not give us the margin of safety we thought necessary. We therefore had to go for the most suitable modern material available to add this extra strength. For info on this material and its heat treatment see this page---

<http://www.mossengineering.co.uk/index.php?area=5&content=98>

In short, I ascribe failures to design errors not materials.

All roads lead to human errors!

It's an interesting life!

Roger