Examination of Fractured Motorcycle Fork Leg

Date: 3/15/09

Background:

Portions of fractured fork leg (lowers) were submitted to the writer for a visual examination. The samples were from a motorcycle that was involved in a crash due to fork assembly failure. It was specifically requested that an opinion be rendered as to presence or absence of fatigue fracture mode.

Conclusion:

No evidence of fatigue fracture was seen. Fracture was due to a one time overload.

Investigation and Results:

Four pieces in total were received, as shown in Figure 1. The samples had come from both fork legs. Three pieces contained fractures; one did not. The samples were examined with the unaided eye as well as a 10x pocket magnifier and the following characteristics noted:

Fractures did not show any evidence of fatigue initiation or propagation. Fracture mode was entirely due to a one time overload event or sequence of several overload events. Fracture texture suggested that the method of manufacture was sand casting rather than high pressure die casting. The fracture was free of gross casting flaws, such as inclusions, porosity, or cold shuts. The bore of the fork legs exhibited areas of "orange peel" finish, which suggests that the bore surface was finished by a roller burnishing process. The bore was free of microporosity. In several areas adjacent to the fractures, numerous small cracks were noted that were oriented parallel to the major fractures. This condition was present on all fracture pieces. Several dozen of these small

cracks were noted on the three fractured pieces. These small cracks were arrayed into clusters parallel to the main fracture and were several tiers deep, i.e. they were not all in line.

Figure 2 shows (arrows) one area where the crack network was present and the orange peel texture of the bore can also be noted.

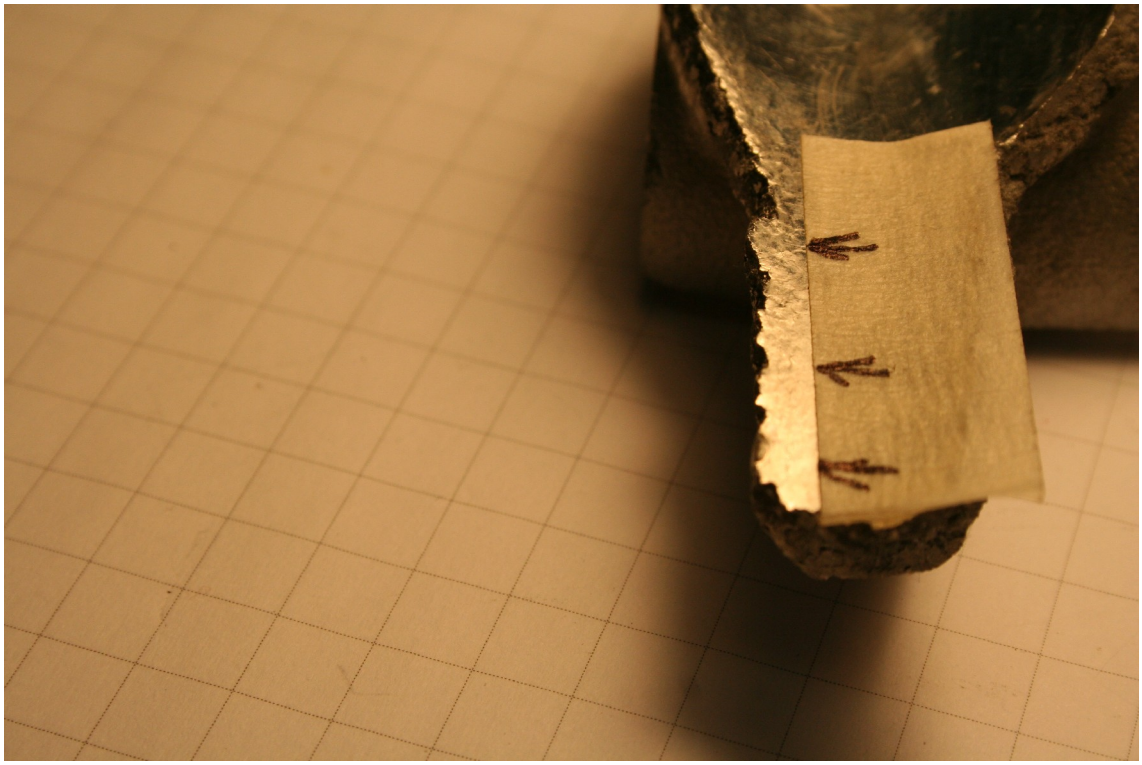
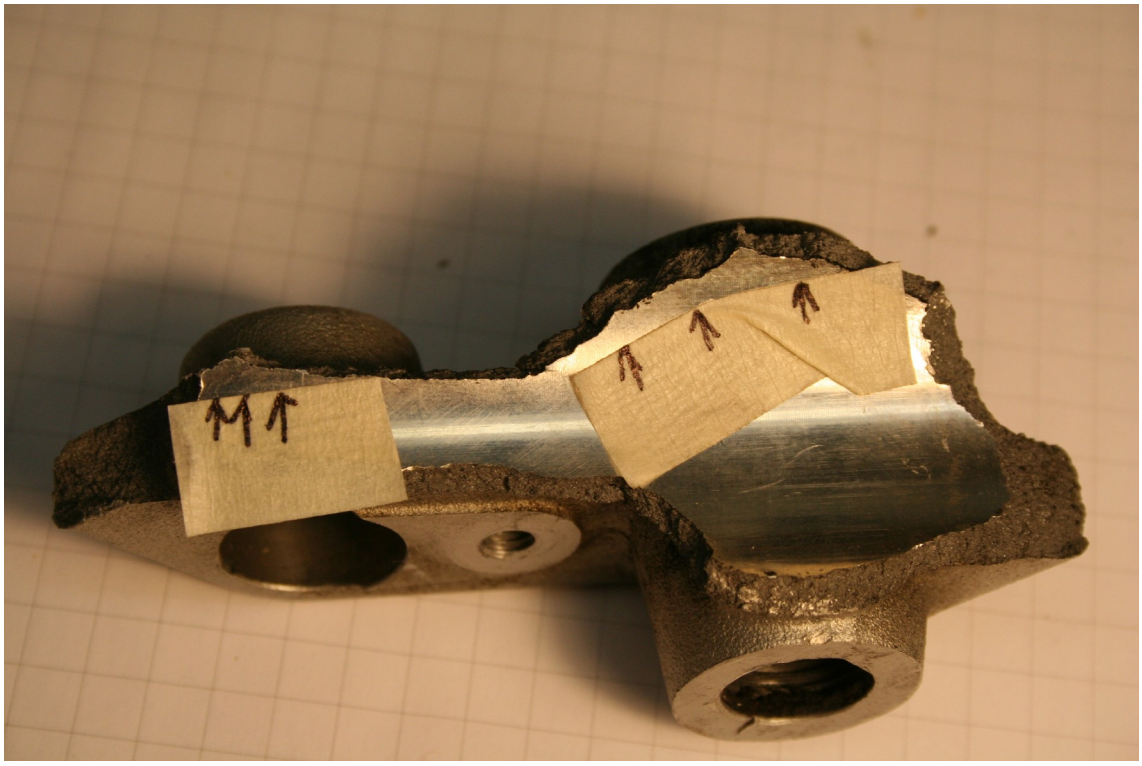


Figure 3 shows another section where these network cracks were present; location has been marked with arrows.



It was also noted that the external surfaces of the fork legs had been shot peened and a clear finish was present. A check with an ohm meter showed that the finish was non-conductive, which is characteristic of a paint type coating or anodizing. Scraping with a knife showed the coating to come off, which is consistent with a paint (clear coat) type of coating. Anodize would have resisted scraping.

Discussion:

The presence of the clusters of small cracks adjacent and parallel to the main fractures suggests that they were present prior to final fracture. Although some small, secondary cracks in the vicinity of the main fracture could be expected with overload fractures of cast aluminum components, the cracks observed were far too numerous to have been a result of the final overload. Instead, they appeared to be some of sort of pre-existing condition. There are several potential sources of such cracks:

1) A network of hot tears in the casting.
2) Cracking during roller burnishing of the bore.
3) Cracking during a thermal deburr process after machining.
4) An interdendritic weakness resulting from an over temperature condition during heat treating, i.e. eutectic melting. This condition could have led to cracking during maching or roller burnishing.

Steven E. Wall, Metallurgical Engineer, P.E.