

NAFLIC

National Association For Leisure Industry Certification

Standards & Related Documents Committee

TECHNICAL BULLETIN - OCTOBER 2002

253. Log Flume Accident

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We have been informed of a recent Log Flume accident which resulted in the single passenger receiving severe facial injuries requiring hospital treatment. In the circumstances the injury severity could have been much worse.

The accident followed in-service fatigue failure of a running wheel stub axle on a Log Flume ride manufactured by Mimifab / WGH in 1987. It is thought that the same design may have been employed on log flumes manufactured by Mimafab, Big Country Motioneering, and WGH.

Because the absence of a front wheel allowed the “log” boat to penetrate deeper into the water than during normal operation, it came to an abrupt halt as it struck the water splash in the run out area. The braking deceleration caused by the resistance force of the water acting on the boat was increased to such a degree that the boat totally stopped in the run out area. The passenger, who was seated at the rear, was thrown forwards against the front interior of the boat.

One end of the stainless steel wheel axle consists of a shaft which is inserted into a hole passing through a steel boss forming part of the chassis structure. It is thought that the original design would have involved an appropriate interference fit between the hole and shaft. To help retain the axle shaft in position it has a circumferential “countersunk” weld at the opposite side of the boss.

The free end of the shaft carries the wheel and, because of axle bearing wear, complete axles are sometimes replaced. It is important that replacement parts achieve the right hole / shaft fit since the locating weld, and the shaft in that locality, carry levels of load and stress which would not otherwise occur.

The fatigue failure occurred in the axle shaft at the heat affected zone near the root of the circumferential weld. Due to the design, the region of interest cannot be subject to a penetrant method of NDT and it is felt that there isn't a suitable ultrasonic technique either.

Bearing in mind the severity of accidents that occur when logs strike water with too much draught, we wish to draw the attention of dutyholders to the potential problem and some courses of action that might be considered in the case of this Mimafab / BCM / WGH design.

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We do not have access to detailed axle design specifications, calculations etc., so we cannot confirm whether failure would be expected to occur in assembled units fully conforming with the original design specification. If the original design specification has been confirmed on the basis of a design maturity risk assessment, controllers may need to consider whether more detailed design review is required.

It is very likely that tolerances on hole / shaft fit are safety-critical parameters. It is therefore important that any replacement axle, in conjunction with the female part of the boss, is in conformity with the original design specification, if this has been confirmed safe, or with a new specification confirmed by design review.

Where it is not possible to conclude that the risk of in-service axle failure is sufficiently low, due consideration needs to be given to the virtual impossibility of carrying out reliable inspection. It may be necessary to consider change of design which would either adequately reduce the risk (e.g. by increasing the shaft / hole sizes) or permit reliable inspection (e.g. by modification to allow removal of the axle for a simplified NDT technique).

It may be possible to avoid detailed calculation work, or complicated re-design, if the distance through which a log may drop, in the event of axle failure, can be restricted to a suitably small value, for instance by the addition of catcher plates which will slide on the rails. This type of secondary device might also cover the possibility of wheel break up.

Most of the matters discussed in the 4 preceding paragraphs involve safety critical design modifications which would need to be submitted for Design Review, etc., in accordance with HSG175.

Some of this Technical Bulletin may have implications for other Log Flume devices that are not of the same manufacture.