



Snowmobile straightline performance

Understanding the dynamic capabilities of a motor vehicle is crucial when reconstructing an accident. As experts, we are often asked to determine vehicle speed and driver avoidance scenarios. The acceleration and braking capabilities of vehicles, along with a multitude of other factors, must be considered and understood in such an assessment.

Research into road vehicle dynamics has been ongoing for decades, and the pool of resources relevant to road vehicle dynamics is vast. The same cannot be said about snowmobiles. They have been around almost as long as wheeled vehicles, and there are more registered snowmobiles in Canada than motorcycles and mopeds combined. Moreover, nearly 200 fatalities and 14,000 injuries are associated with snowmobile use in North America each year. Despite these facts, only limited research data exists on the performance characteristics of modern snowmobiles. And without reliable scientific data, assumptions and creative comparisons are often necessary when analyzing a snowmobile accident.

To help fill this knowledge gap, we decided to test and measure the acceleration and braking characteristics of a variety of modern snowmobiles last winter. Our array of test sleds included both 2 and 4-stroke engine styles, with engine power ranges from 80 to 135 horsepower. This covered the majority of snowmobiles found on Canadian and US trails. Each of the snowmobiles was instru-

mented to allow us to gather detailed data on the snowmobile's motion, in addition to information about the track speed, brake hydraulic pressure, and throttle application. We chose to test on a groomed/packed snow surface to simulate a snowmobile trail.

To limit fluctuations in human performance, we had a professional rider perform all of the tests. The rider was asked to accelerate up to a specific speed, then either brake to a stop or let the snowmobile rolldown (engine brake) to a stop. For the rolldown tests, we asked him to release the throttle and simultaneously cut the engine power (kill switch), or simply just release the throttle and coast to a stop.



From our acceleration results, significant differences existed between snowmobiles. We expected a clear trend; the more horsepower, the faster the acceleration. An increasing trend was observed, however, the 2-stroke 800cc engine (rated at 135 hp) did not perform any better than the 4-stroke

1000cc engine (rated at 120 hp). This surprised us, particularly because the 1000cc snowmobile was much heavier than the 800cc snowmobile. In our tests, the lowest acceleration we observed (quarter throttle) was 0.27g, while the highest acceleration (full throttle) was 0.7g.

From our braking data, we found a significant difference between full braking and rolldown. This was expected since rolldown relies entirely on engine drag to slow the sled, while for full braking the track



is locked and drags along the snow. The full braking deceleration rates across all of the sleds were relatively consistent and ranged from 0.32 to 0.42g. In rolldown, the snowmobiles decelerated at about 0.2g, regardless of whether engine power was on or off. In essence, snowmobiles do not accelerate or decelerate like road vehicles. The acceleration rates we observed were simi-

lar to those seen in motorcycles, and about twice that of most cars. And yet, the locked track deceleration rates are only about half of what is observed for cars and motorcycles emergency braking on dry asphalt. With this new research data, a reconstruction expert can more reliably calculate snowmobile speeds if the brake distance or acceleration distance is known.

Further, more accurate avoidance analyses are possible since the straight-line dynamic capabilities of snowmobiles are now better understood. Yet, there is still much more to learn. Enormous gaps currently exist in snowmobile research, which is why we plan on continuing our research in the coming years.



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