

Experimental evaluation of traction and coupling properties of snowmobile motor vehicles

Evgeny Klubnichkin^{1,*}, and *Vladislav Klubnichkin*¹

¹Bauman Moscow State Technical University, Department of Wheeled Vehicles, 105005 Moscow, Russian Federation

Abstract. The article demonstrates the results of the experimental estimate of the drawbar properties of the oversnow equipment during which parameters and indicators allowing for their use during designing of new generation of oversnow vehicles have been determined. This work demonstrates the results of the tests in determining maximum drawbar pull, determining motion resistance force with the arrested and released brake of the Russkaya Mekhanika's oversnow vehicles, models RM Buran Leader, RM Tayga Varyag 550, RM Tayga Patrul 800 SWT, RM Vector 551i and over companies' oversnow vehicles, models BRP Lynx Xtrim Commander 800 E-TEC, Arctic Cat Pantera 7000 XT LTD, Polaris 800 Titan Adventure 155.

1 Place of test

The tests to determine drawbar properties of the oversnow equipment were conducted in vicinity of Rybinsk, Yaroslavl oblast, Russia at the horizontal terrain sections with the maximum slope of 1%.

During the test:

The test site was covered with compacted snow 5 to 7 cm deep, the snow was uniform along the entire depth, with a temperature of minus 6 °C.

The tests were conducted in dry windless weather at an ambient temperature of minus 6 °C, atmospheric pressure of 748 mm Hg and air relative humidity of 86 % [1-3].

2 Measuring equipment

Weight measuring strain gauge C2-5.0-C3 and digital tension gauge ZET were used as measuring instruments to determine the oversnow drawbar properties including maximum drawbar pull and motion resistance force [4].

Digital dynamometer C2-5.0-C3 represents a strain gauge-based device. The strain gauge is connected in series with the power diagram. Dynamometer C2-5.0-C3 is composed of a weight measuring strain gauge working in tension and compression, a secondary measuring

* Corresponding author: klubnichkin@mgul.ac.ru

converter and a connecting cable. Model ZET is used in dynamometer as a secondary measuring converter.

Dynamometers with measuring terminal ZET operating through interface ZET 7174 converter are delivered with software ZETLAB used to present those measurements in the form of real-time measurement process charts.

Dynamometer C2-5.0-C3 is designed to measure tension force (with upper measurement limit of 50 KN, accuracy class 2 according to GOST P 8.726-2010).

3 Determining maximum drawbar pull

The maximum drawbar pull was determined for the Russkaya Mekhanika's oversnow vehicles, models RM Buran Leader, RM Tayga Varyag 550, RM Tayga Patrol 800 SWT, RM Vector 551i and over companies' oversnow vehicles, models BRP Lynx Xtrim Commander 800 E-TEC, Arctic Cat Pantera 7000 XT LTD, Polaris 800 Titan Adventure 155 equipped with caterpillar tracks with snow grip from 10 to 45.7 mm.

The maximum possible drawbar pull of the oversnow vehicle (within the pull force margins) was determined with the CVT being in first gear range. With that the tested oversnow vehicle was accelerated to reach maximum RPM, and then smoothly slowed down via a cable with a dynamometer strain gauge to a full stop when a tracked running gear was fully slipping [5, 6].

The results of the drawbar pull measurement are presented in Table 1.

Table 1. Results of maximum drawbar pull measurement

Oversnow vehicle	Height of track snow grip, mm	Maximum drawbar pull, N
RM Buran Leader	10	1975
RM Tayga Varyag 550	30	2346
RM Tayga Patrol 800 SWT	30	3276
RM Vector 551i	30	3092
BRP Lynx Xtrim Commander 800 E-TEC	44	3786
Arctic Cat Pantera 7000 XT LTD	35	3841 - low gear 5978 - super low gear
Polaris 800 Titan Adventure 155	45.7	3590

Fragments of the oversnow vehicle tests to determine maximum drawbar pull are presented in Figure 1.

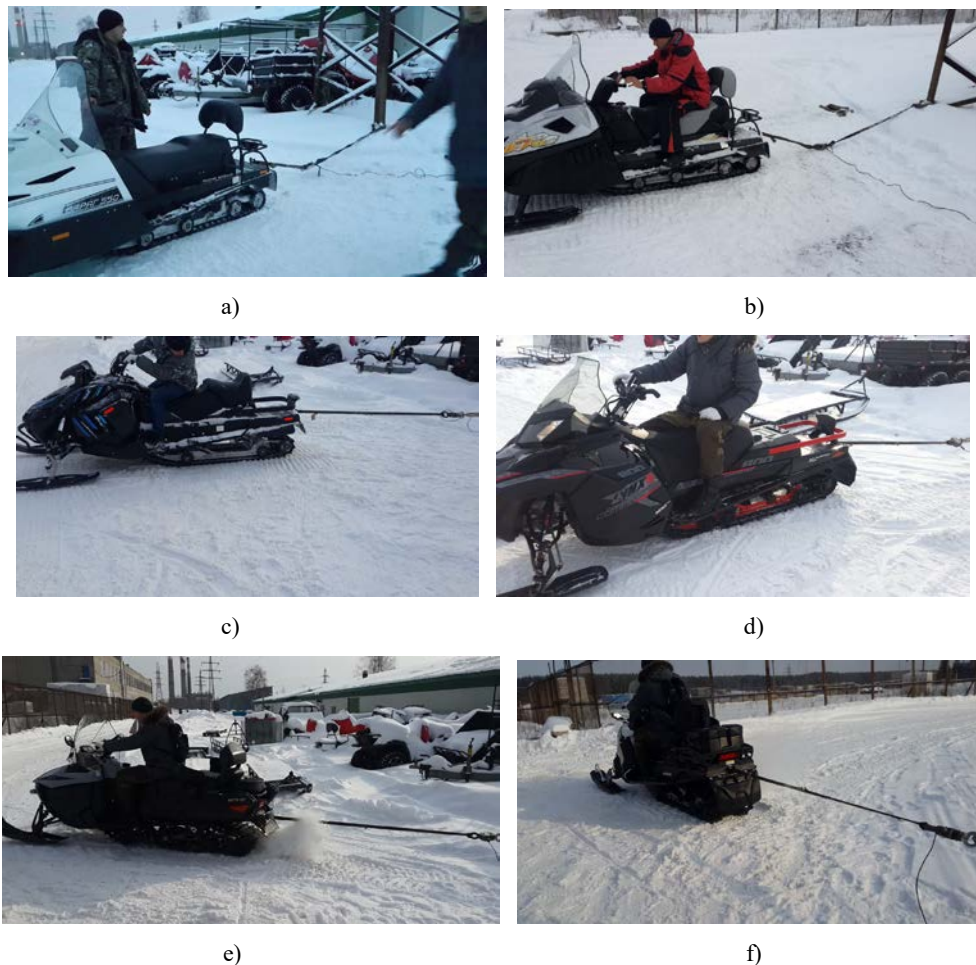


Fig. 1. Fragments of the oversnow vehicle tests to determine maximum drawbar pull: a) RM Tayga Varyag 550; b) RM Tayga Patrul 800 SWT; c) RM Vector 551i; d) BRP Lynx Xtrim Commander 800 E-TEC; e) Arctic Cat Pantera 7000 XT LTD; f) Polaris 800 Titan Adventure 155

4 Determining motion resistance force

The motion resistance force was determined for the Russkaya Mekhanika's oversnow vehicles, models RM Buran Leader, RM Tayga Varyag 550, RM Tayga Patrul 800 SWT, RM Vector 551i and over companies' oversnow vehicles, models BRP Lynx Xtrim Commander 800 E-TEC, Arctic Cat Pantera 7000 XT LTD, Polaris 800 Titan Adventure 155.

The motion resistance force was determined by the tested vehicle towing method. The oversnow vehicle was towed with a cable with strain gauge C2-5.0-C3 at a speed of 1 m/s by an oversnow vehicle or 4-wheeler, with that the transmission of the tested oversnow vehicle was in neutral gear and brakes either: case 1 - released; case 2 - applied [7].

4.1 Determining the oversnow vehicle's motion resistance force with the brakes released

Table 2 contains the results of measurement of the oversnow vehicle's motion resistance force with the brakes released.

Table 2. Results of measurement of the oversnow vehicle's motion resistance force with the brakes released

Oversnow vehicle	Height of track snow grip, mm	Motion resistance force, N
RM Buran Leader	10	950
RM Tayga Varyag 550	30	920
RM Tayga Patrul 800 SWT	30	1105
BRP Lynx Xtrim Commander 800 E-TEC	44	890
Arctic Cat Pantera 7000 XT LTD	35	1370
Polaris 800 Titan Adventure 155	45.7	2579

4.2 Determining the oversnow vehicle's motion resistance force with the brakes applied

Table 3 contains the results of measurement of the oversnow vehicle's motion resistance force with the brakes applied.

Table 3. Results of measurement of the oversnow vehicle's motion resistance force with the brakes applied

Oversnow vehicle	Height of track snow grip, mm	Motion resistance force, N
RM Buran Leader	10	2916.6
RM Tayga Varyag 550	30	2118.2
RM Tayga Patrul 800 SWT	30	3119
BRP Lynx Xtrim Commander 800 E-TEC	44	3670.4
Arctic Cat Pantera 7000 XT LTD	35	4472.6
Polaris 800 Titan Adventure 155	45.7	4157

5 Outcomes

The RM Buran Leader oversnow vehicle's maximum drawbar pull stood at 1850 N.

The RM Tayga Varyag 550 oversnow vehicle's maximum drawbar pull stood at 2750 N.

The RM Tayga Patrul 800 SWT oversnow vehicle's maximum drawbar pull stood at 3000 N.

The RM Vector 551i oversnow vehicle's maximum drawbar pull stood at 3092 N.

The BRP Lynx Xtrim Commander 800 E-TEC oversnow vehicle's maximum drawbar pull stood at 3786 N.

The Arctic Cat Pantera 7000 XT LTD oversnow vehicle's maximum drawbar pull stood at 3841 N in low gear and 5978 N in super low gear.

The Polaris 800 Titan Adventure 155 oversnow vehicle's maximum drawbar pull stood at 3590 N.

The RM Buran Leader oversnow vehicle's maximum motion resistance force stood at 950 N with the brakes released.

The RM Tayga Varyag 550 oversnow vehicle's maximum motion resistance force stood at 920 N with the brakes released.

The RM Tayga Patrul 800 SWT oversnow vehicle's maximum motion resistance force stood at 1105 N with the brakes released.

The BRP Lynx Xtrim Commander 800 E-TEC oversnow vehicle's maximum motion resistance force stood at 890 N with the brakes released.

The Arctic Cat Pantera 7000 XT LTD oversnow vehicle's maximum motion resistance force stood at 1370 N with the brakes released.

The Polaris 800 Titan Adventure 155 oversnow vehicle's maximum motion resistance force stood at 2579 N with the brakes released.

The RM Buran Leader oversnow vehicle's maximum motion resistance force stood at 2916.6 N with the brakes applied.

The RM Tayga Varyag 550 oversnow vehicle's maximum motion resistance force stood at 2118.2 N with the brakes applied.

The RM Tayga Patrul 800 SWT oversnow vehicle's maximum motion resistance force stood at 3119 N with the brakes applied.

The BRP Lynx Xtrim Commander 800 E-TEC oversnow vehicle's maximum motion resistance force stood at 3670.4 N with the brakes applied.

The Arctic Cat Pantera 7000 XT LTD oversnow vehicle's maximum motion resistance force stood at 4472.6 N with the brakes applied.

The Polaris 800 Titan Adventure 155 oversnow vehicle's maximum motion resistance force stood at 4157 N with the brakes applied.

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