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2025 ASTM F1805 Study Report

Executive Summary

Introduction:

The SRTT 16" produced unexpected results for candidate tires when compared to historical 3PMSF test data vs. the formerly used SRTT 14". Significant changes in snow performance were observed with the SRTT 16", both within the first 100 spins and during extended use over several thousand spins. A best practice was introduced to reduce the impact of the 16” volatility on results.

While the best practice reduced the change of results over spins, it allowed a potential residual change between 0%-6.4% in results compared to the witness SRTT 16”.

The 17” winter SRTT was seen as a potential new reference tire for the ASTM F1805 test standard, due to its winter design with higher grip levels in the performance area of the 3PMSF requirement.

2024 tests also showed that a 200 mile break in stabilizes the SRTT 16” tire's performance.

The 2025 test plan was a continuation of studies conducted in 2023 and 2024

Historical Reminder:

The 14” SRTT was referenced by ASTM F1805 starting around 1997. 14” SRTT production stopped at the end of 2020.

The 16” SRTT was tested vs the 14” SRTT using the ASTM F1805 method starting around 2001. A correlation factor of 0.987 linking the 16” SRTT to the 14” SRTT was included in ASTM F1805-20 (2020), which was mostly based on data collected from 2016-2018.

The 17” winter SRTT was tested in 2024 and 2025 to evaluate if this tire would be a better control tire in ASTM F1805 than the 16” SRTT.

2025 Test Plan Overview:

3 studies and daily 17” winter SRTT checks were conducted in 2025 to consider using the 17” winter SRTT (ASTM F3675) as the future recommended SRTT for ASTM F1805. An additional Study 2 was originally planned to compare 16” SRTTs from Ardmore vs Poland, but it was canceled since SRTTs from Poland were not available in 2025.

1. Study 1:

   a. Testing of multiple candidate tires at 3 vendors through-out the 2025 winter campaign vs 16" SRTTs, 17" winter SRTTs and 14" SRTTs to quantify the rating sensitivities.
   b. One 17" winter SRTTs also accumulated ~2,600 spins to quantify the change in performance.
   c. Multiple 16" SRTTs with 200 miles were tested to quantify the change & stability of performance.
2. Study 3: Testing candidate tires vs the 17" winter SRTT which have a known rating vs the 14" SRTT in order to estimate the correlation factor between the 17" and the 14" SRTTs.
3. Study 4: Testing multiple new 17" winter SRTTs and 17" winter SRTTs with 200 miles and 200 spins to quantify the change in performance.

Key Objectives and Conclusions:

1. Quantify and compare the rating reproducibility (site to site) & repeatability (day to day within a site) vs. 16" SRTTs, 17" winter SRTTs and 14" SRTTs. (based on study 1).
   a. Ratings vs the 17" winter SRTT have similar reproducibility compared to the 5 year old 14" SRTT ratings or the New 16" Ardmore witness SRTT ratings.
   b. 17" correlation between locations is improved compared to the best practice Primary 16"

Reference tire	Average delta vs ideal slope of 1.0 between locations A, B and C
14" SRTT (5 year old)	0,102
Primary 16" (best practice)	0,126
New 16" Ardmore (witness)	0,094
17" SRTT Winter	0,089
Conti Control	0,071
200 mile 16"	0,059

the lower the value the closer is the slope of the correlations between the different locations to the ideal value of 1.0

   c. The 17" winter SRTT repeatability based on the coefficient of variation (within a single test site) is similar to the Primary 16" SRTT, new 16" SRTT, 200 mile 16" SRTT or 5 year old 14" SRTT
2. Quantify the change in performance of 17" winter SRTTs over ~2,600 spins.

   a. 17” winter SRTT did not measurably evolve over ~2,600 spins on snow when compared to a 17” winter SRTT with low spins which confirms a similar conclusion from 2024.

3. Quantify the change in low spin performance of multiple new 17” winter SRTTs.
   a. The 17” winter SRTT did not measurably evolve beyond the inherent variability of the test from 0-100 spins in multiple studies.

4. Quantify the relative performance of 17” winter SRTTs with 200 miles break-in plus 200 spins. (based on study 4)
   a. The 17” winter SRTT performance changed about -4% after 200 miles break-in plus 200 spins.

5. Quantify relative performance of multiple new 17” winter SRTTs the within the same production batch. (based on study 4)
   a. Multiple 17” winter SRTTs from the same batch had the same snow performance
6. Estimate a correlation factor for the 17” winter SRTT by:
   a. Testing candidate tires vs the 17” winter SRTT which have a known rating vs the 14” SRTT.
      i. Using the 8 tires in study 3 has a correlation factor range of about 1.07 to 1.34 with an average of 1.21.
      ii. Using the 3 Continental control tires in study 1 following the same analysis results in a correlation factor range of about 1.21 to 1.30 with an average of ~1.25.
      iii. Using the SRMT tires in study 1 following the same analysis results in a correlation factor range of about 1.06 to 1.25 with an average of ~1.15
      iv. Using 6 tires from an external study following the same analysis results in a correlation factor range of about 1.12 to 1.18 with an average of ~1.15.
   b. Testing the relative performance of a 17” winter SRTT vs. a 2024 16” witness throughout the test season at many locations. (Study 0)
      i. Based on the 116 data points collected in 2025, the 17”/new 2024 16” has a range of 0.96 to 1.33 with an average of 1.12. Assuming a 6% change since 2017 yields a 17”/2017 16” correlation factor of ~1.18
      ii. The average 17”/new 2024 16” of each location had a range of 1.04 to 1.28. Excluding one tester, the range changes to 1.04 to 1.11.

iii. The estimated 17" vs. a 14" SRTT using the 0.987 correlation factor from ASTM F1805-20 & assuming 6% change since 2017 yields a correlation factor of about 1.17.

iv. The main purpose of this study was to better understand sensitivities, and not to estimate the correlation factor.

c. Using Study 1 data with the 5 year old 14" SRTT and 17" winter SRTT.

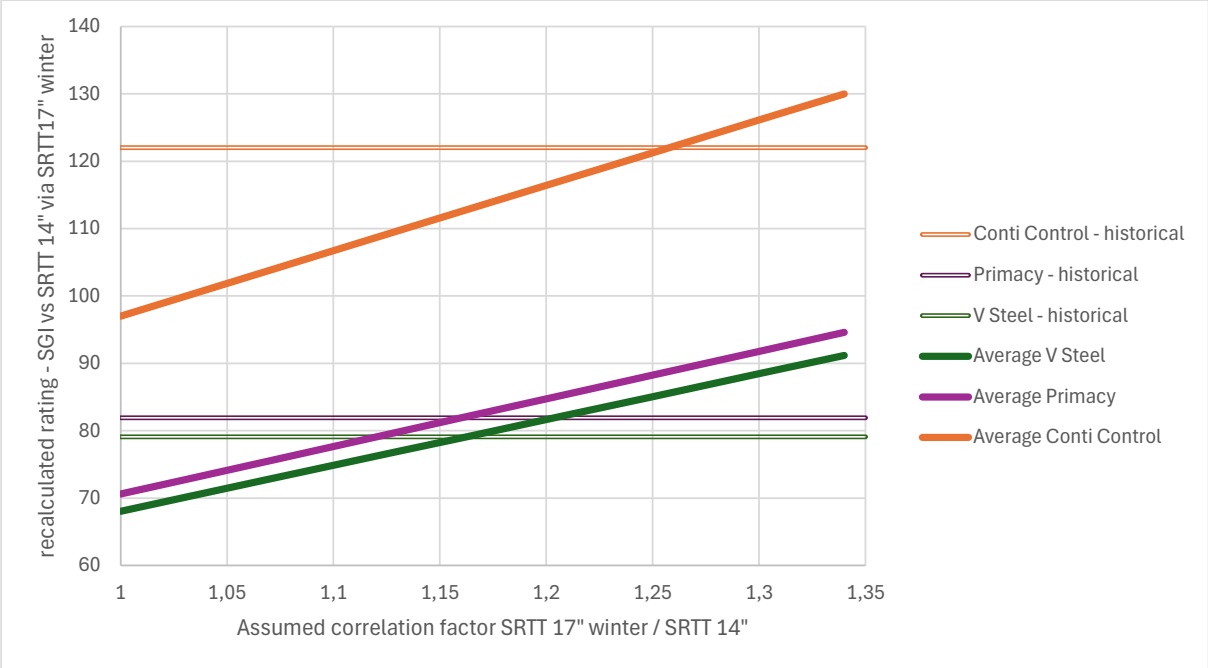
i. If the 14" SRTT did not change in performance after 5 years of storage, then the average correlation factor would be 1.18 and 1.12 if it degraded 5%.

ii. If the historical 14" SRTT performance was actually at a 0.936 level due to usage, then the average correlation factor would be 1.26 and 1.19.

iii. Averaging all 4 scenarios together yields a correlation factor of 1.188.

d. The range of correlation factors from 6.a is 1.03 to 1.34. Performing a weighted average for all of the studies results in a 1.169 correlation factor.

e. Impact of correlation factors on tires with known performance



7. Investigate significant factors influencing tire ratings vs the 17" winter SRTT *(Note: The inverse sensitivities exist when using the 16" SRTT vs some tires)*

a. CTI may have more than 10% influence on ratings for some tires.

b. 17" winter SRTT grip level more than 10% influence on ratings for some tires, but this is confounded with CTI.

c. The number of spins on most candidate tires tested over 12 days is insufficient to evaluate the sensitivity. See the ASTM F1805 report from 2024 for additional information.
d. Ambient and surface temperatures are not likely significant factors influencing tire ratings vs the 17" winter SRTT.
e. Slope of the 17" winter SRTT mu-slip curve does not have a clear trend on tire ratings vs the 17" winter SRTT.

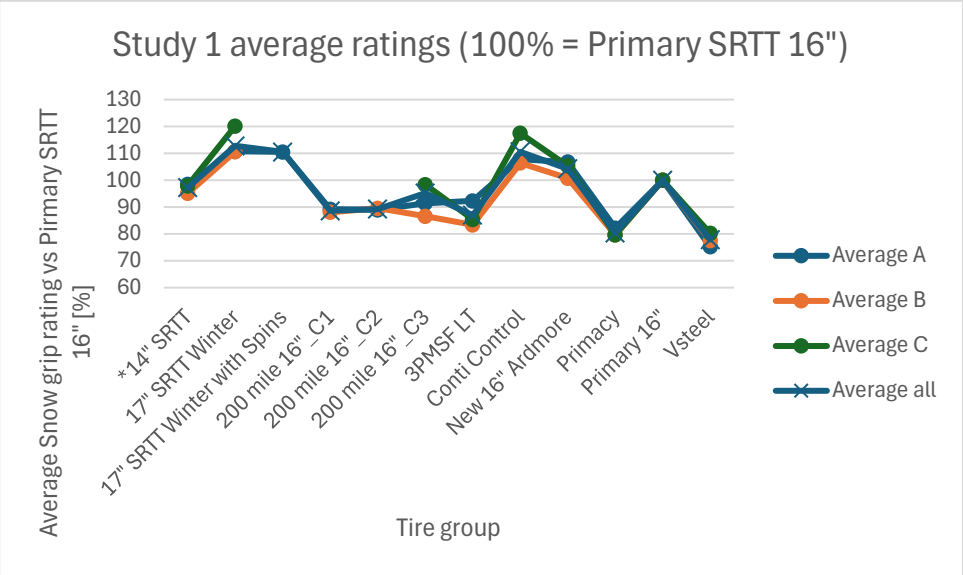
8. Establish a 17" winter SRTT grip level range for table A2.1
    a. A reasonable 17" winter SRTT grip level range for table A2.1 is 0.29 to 0.44.

9. Quantify the relative level, change, and stability of performance of multiple 16" SRTTs with 200 miles break-in.
    a. The 16" SRTT with 200 miles has minimal evolution over ~1,250 spins.
    b. The three 200 mile break-in circuits resulted in a similar performance level.
    c. The performance at three snow test locations is 84% (all 3 circuits), 85% (all 3 circuits), and 94% (only circuit 3) vs a "new" 16" SRTT.
    d. The performance at three snow test locations is 92%, 93%, and 100% vs a 5 year old 14" SRTT.
    e. The correlation between locations A, B and C is increased by 70% when using the 200 mile SRTT 16" as reference (set to 100%) instead of the best practice primary SRTT 16"
10. Future Analysis - Provide analysis of potential reproducibility improvements.
    a. It is probably not feasible to adjust tire performance ratings based on the difference in snow hardness sensitivity between the candidate tire and the reference tire (primary SRTT).
    b. Using a snow Surface Rating Monitoring Tire at each test site with known performance vs the control tire did not improve reproducibility of results in study 1. Track monitoring tires are still a recommended best practice.
    c. Setting boundaries for curve shapes of μ slip curves could possibly improve reproducibility of results between different locations. This item requires more work.
    d. Modified CTI limits did not improve reproducibility based on Study 1 results between different locations.
    e. Using more than one correlation factor would probably not improve reproducibility .
    f. One evaluation method for F1805 could improve interpretation and clarity. This item requires more work.

Objective 1: Quantify and compare the rating sensitivities vs. 16” SRTTs, 17” winter SRTTs and 14” SRTTs.

To understand the evaluation of study 1 in detail, the setup and single results of the 3 locations which took part in this study with 12 test days at each location (A, B, C) can be found in the appendix. Note: not all tires in the study were tested on all days and at all locations (A, B, C).

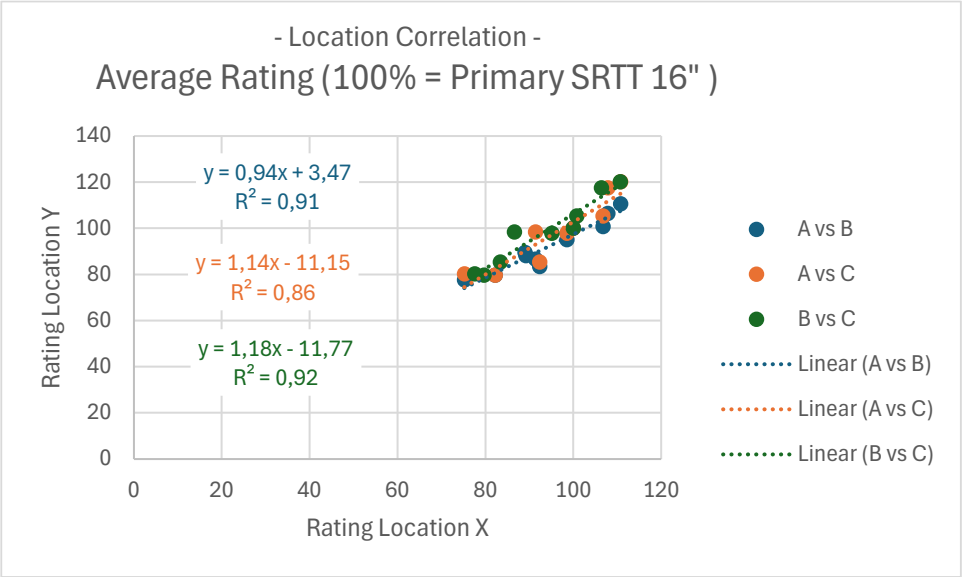
Average results vs the Primary SRTT 16” are shown in the following diagram.



Year – 2025; Locations – 3; Days – 12; All tires in Study 1

As we can observe not all tires always show the same rating vs SRTT 16” Primary at all locations.

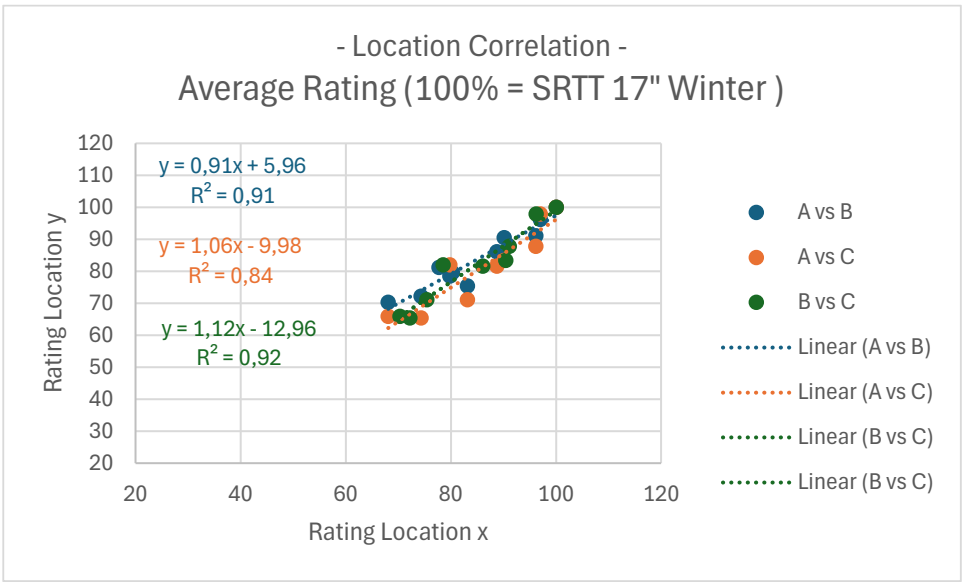
Looking at the reproducibility for the different locations. The rating of location A can be correlated to location B, and A vs C as well as B vs C. This results in the following diagram.



Year – 2025; Locations – 3; Days – 12; All tires in Study 1

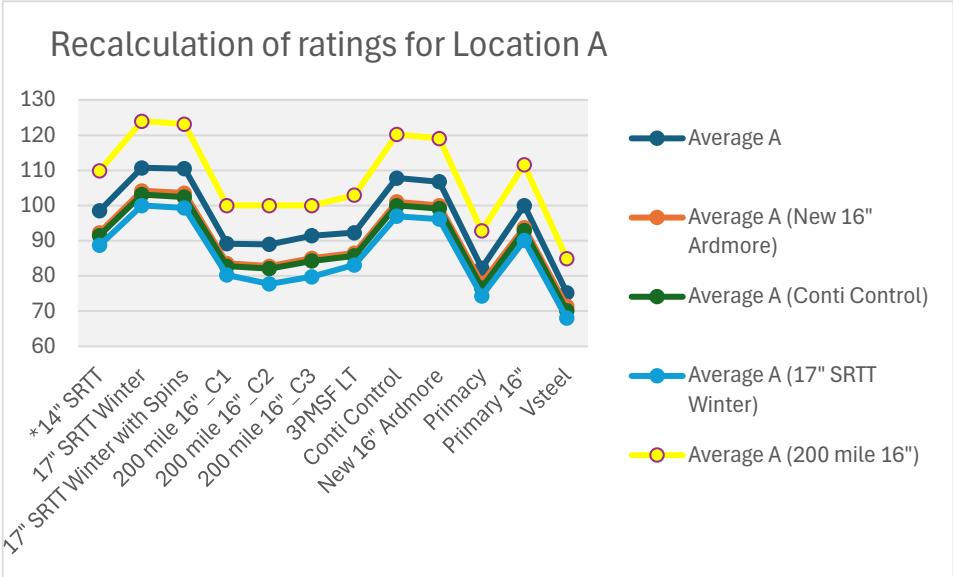
The slope of the correlation curves are 0.94 for A vs B, 1.14 for A vs C and 1.18 for B vs C. The slope equal to 1.0 would indicate same spread of the overall test field in comparison for the different locations.

The same correlation graph is shown below using the 17” winter SRTT as the reference.



As the usage state of the Primary SRTT 16” could be different for different locations, the question came up, if the correlation would be improved using a different tire set as reference for each location. Therefore, the ratings are recalculated setting a different tire group than the Primary SRTT 16” as 100%. This leads to a shifting of the results depending,

which tire group is set to 100%. This is visualized for exemplary for location A in the following diagram.



Year – 2025; Locations – 1; Days – 12; All tires in Study 1

Doing this for all locations and different tires leads to the following table showing the ratings per location as well as the resulting average for all locations. The correlation between the different locations and the slope of the correlation can be calculated as well for various reference tires. These numbers are shown on the right side of the table.

	location A, B, C	*14" SRTT	17" SRTT Winter	17" SRTT Winter with Spins	200 mile 16"_C1	200 mile 16"_C2	200 mile 16"_C3	3PMSF LT	Conti Control	New 16" Ardmore	Primacy	Primary 16"	Vsteel
Average A	A	99	111	111	89	89	91	92	108	107	82	100	75
Average B	B	95	111		88	90	87	83	106	101	80	100	78
Average C	C	98	120				98	85	118	105	80	100	80
Average all	Grand Total	97	113	111	89	89	95	87	111	104	80	100	78
Average A	A	92	104	104	84	83	85	86	101	100	78	94	71
Average B	B	94	110		87	88	85	83	106	100	79	99	77
Average C	C	93	114				94	81	112	100	76	95	77
Average all	Grand Total	93	109	104	86	85	91	83	106	100	78	96	75
Average A	A	91	103	102	83	82	84	86	100	99	77	93	70
Average B	B	89	104		83	84	81	78	100	95	75	94	73
Average C	C	83	102				84	73	100	90	67	85	68
Average all	Grand Total	88	103	102	83	83	83	79	100	95	72	91	70
Average A	A	89	100	99	80	78	80	83	97	96	74	90	68
Average B	B	86	100		80	81	79	75	96	91	72	90	70
Average C	C	82	100				82	71	98	88	65	83	66
Average all	Grand Total	85	100	99	80	79	81	77	97	92	70	88	68
Average A	A	110	124	123	100			103	120	119	93	112	85
Average B	B	108	126		100			95	121	114	91	114	88
Average C	C	100	122		100			87	119	107	80	102	81
Average all	Grand Total	106	124	123	100	100	100	95	120	114	87	109	85
Average A	A	100	113	112	91	91	93	94	109	108	85	102	77
Average B	B	100	116		93	94	91	88	112	106	84	105	82
Average C	C	100	123				101	87	120	108	83	102	83
Average all	Grand Total	100	117	112	92	92	98	90	114	107	84	103	81
"Aging" 14" SRTT to 0.95													
Average A	A	95	107	107	86	86	88	89	104	103	80	96	74
Average B	B	95	111		88	90	87	83	106	101	80	100	78
Average C	C	95	117				96	83	114	102	78	97	79
Average all	Grand Total	95	112	107	87	88	93	85	108	102	79	98	77

Comparison	correlation slope	delta of slope to 1
A vs B	0,94	0,061
A vs C	1,14	0,139
B vs C	1,18	0,179
	Average delta	0,126
A vs B	1,02	0,02
A vs C	1,16	0,16
B vs C	1,11	0,11
	Average delta	0,094
A vs B	0,94	0,06
A vs C	1,07	0,07
B vs C	1,09	0,09
	Average delta	0,071
A vs B	0,91	0,09
A vs C	1,06	0,06
B vs C	1,12	0,12
	Average delta	0,089
A vs B	0,98	0,02
A vs C	1,06	0,06
B vs C	1,09	0,09
	Average delta	0,059
A vs B	0,99	0,01
A vs C	1,16	0,16
B vs C	1,14	0,14
	Average delta	0,102
A vs B	0,99	0,01
A vs C	1,16	0,16
B vs C	1,14	0,14
	Average delta	0,102

Conclusion A: Ratings vs the 17” winter SRTT have similar reproducibility compared to the 5 year old 14” SRTT ratings or the New 16” Ardmore witness SRTT ratings.

As the ideal slope of the correlation would be 1.0, the difference to this ideal value and the resulting average delta is calculated and summarized in the following table.

Reference tire	Average delta vs ideal slope of 1.0 between locations A, B and C
14" SRTT (5 year old)	0,102
Primary 16" (best practice)	0,126
New 16" Ardmore (witness)	0,094
17" SRTT Winter	0,089
Conti Control	0,071
200 mile 16"	0,059

The lower the value the closer is the slope of the correlations between the different locations to the ideal value of 1.0

Recalculating the ratings to the average of the 200 mile SRTT 16" for each location leads to the lowest average delta of 0.059. If 200 mile break-in of reference tires should be avoided, the next possible option is taking the SRTT 17" Winter as reference with an average delta of 0.089. The witness SRTT 16" (New 16" Ardmore) with 0.094 and the 5 year old 14" SRTT with 0.102 show higher values and therefore less reproducibility between the different locations A, B and C.

Conclusion B: With 17" winter SRTT, the correlation between locations is improved compared to the best practice Primary 16"

The Primary 16" following the best practice with 0.126 shows higher values and therefore less reproducibility between the different locations A, B and C.

Conclusion C: The 17" winter SRTT repeatability (within a single test site) is similar to the Primary 16" SRTT, new 16" SRTT, 200 mile 16" SRTT or 5 year old 14" SRTT.

The repeatability within a site can be estimated by calculating the coefficient of variation for the candidate tire ratings over the 12 days of testing. The coefficient of variation is used rather than just the standard deviation because ratings vs the 17" winter SRTT are significantly lower than other SRTTs which artificially makes the 17" winter SRTT appear better.

The table below shows the coefficient of variation for ratings from locations A, B & C. There are 5 sections in the table using the 5 different SRTTs as the reference tire so that the rating repeatability using each reference tire can be compared. The reference tire standard deviation is always blue since the value is 0.

	location A, B	*14" SRTT	17" SRTT Winter	17" SRTT Winter with Spins	200 mile 16"_C1	200 mile 16"_C2	200 mile 16"_C3	3PMSF LT	Conti Control	New 16" Ardmore	Primacy	Primary 16"	Vsteel
Average of average all eval criteria (Basis Primary)													
Coef of Variation A		0.03	0.04	0.06	0.03	0.00	0.03	0.02	0.04	0.03	0.05	0.00	0.05
Coef of Variation B		0.02	0.02		0.04	0.04	0.02	0.05	0.03	0.01	0.05	0.00	0.02
Coef of Variation C		0.05	0.04				0.03	0.05	0.04	0.05	0.06	0.00	0.05
Average of average all eval criteria (Basis recalculated to New 16" Ardmore (Witness = 100))													
Coef of Variation A		0.02	0.04	0.06	0.04	0.02	0.04	0.02	0.04	0.00	0.06	0.03	0.07
Coef of Variation B		0.02	0.02		0.04	0.03	0.00	0.04	0.03	0.00	0.05	0.01	0.02
Coef of Variation C		0.04	0.06				0.05	0.06	0.05	0.00	0.08	0.05	0.08
Average of average all eval criteria (Basis recalculated to Conti Control = 100)													
Coef of Variation A		0.03	0.02	0.03	0.03	0.03	0.01	0.04	0.00	0.04	0.03	0.04	0.05
Coef of Variation B		0.04	0.02		0.04	0.03	0.03	0.04	0.00	0.03	0.05	0.03	0.04
Coef of Variation C		0.06	0.04				0.02	0.03	0.00	0.05	0.06	0.04	0.05
Average of average all eval criteria (Basis recalculated to SRTT 17" Winter = 100))													
Coef of Variation A		0.03	0.00	0.03	0.04	0.02	0.02	0.03	0.03	0.02	0.06	0.04	0.07
Coef of Variation B		0.03	0.00		0.03	0.02	0.02	0.05	0.01	0.02	0.04	0.02	0.03
Coef of Variation C		0.06	0.00				0.04	0.04	0.04	0.05	0.06	0.04	0.07
Average of average all eval criteria (Basis recalculated to 200 mile SRTT 16" = 100))													
Coef of Variation A		0.02	0.03	0.05	0.00			0.03	0.02	0.03	0.04	0.03	0.05
Coef of Variation B		0.03	0.03		0.00			0.04	0.04	0.03	0.03	0.04	0.03
Coef of Variation C		0.06	0.04		0.00			0.04	0.02	0.05	0.04	0.03	0.04
Average of average all eval criteria (Basis recalculated to SRTT 14" = 100))													
Coef of Variation A		0.00	0.03	0.05	0.03	0.03	0.04	0.02	0.03	0.02	0.05	0.03	0.06
Coef of Variation B		0.00	0.03		0.03	0.04	0.01	0.05	0.04	0.02	0.04	0.02	0.02
Coef of Variation C		0.00	0.07				0.06	0.07	0.06	0.04	0.07	0.05	0.05

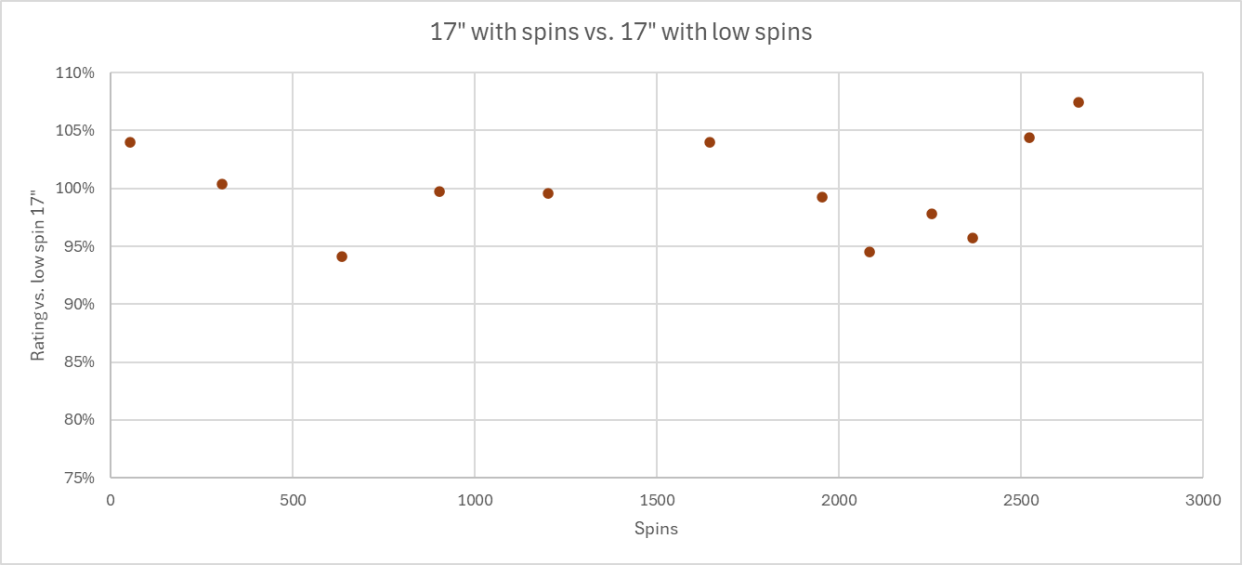
Overall, the repeatability of the 17” winter SRTT is similar to the other reference tires shown in the table.

Objective 2: Quantify the change in performance of 17” winter SRTTs over ~2,600 spins.

The 17” winter SRTT is measured against a 16” primary SRTT 12 times with 100-400 spins added between observations up to 2600 total spins on the 17” winter SRTT for the final observation. New 16” SRTT observations are performed each day to measure the primary 16” SRTT performance level. The primary 16” SRTT is used following the best practice recommendation for 2025 and replaced when the witness observation falls outside the recommended performance window. A 17” winter SRTT with few added spins (less than 360 final spins at the end of the study) was also run in the same test sequence as the 17” winter SRTT with many added spins to provide a direct comparison of 17” winter SRTT evolution over spins.

The 17” winter SRTT in the graph below showed a 13% range in performance without degradation vs. the low spin 17” winter SRTT through all environmental conditions over the 2600 spins. This aligns with results from previous years 17” winter SRTT studies. For comparison, in 2023 studies, the 16” SRTT showed a 10% performance degradation with 1800 added spins vs. a new 16” SRTT. This shows minimal evolution over many spins on

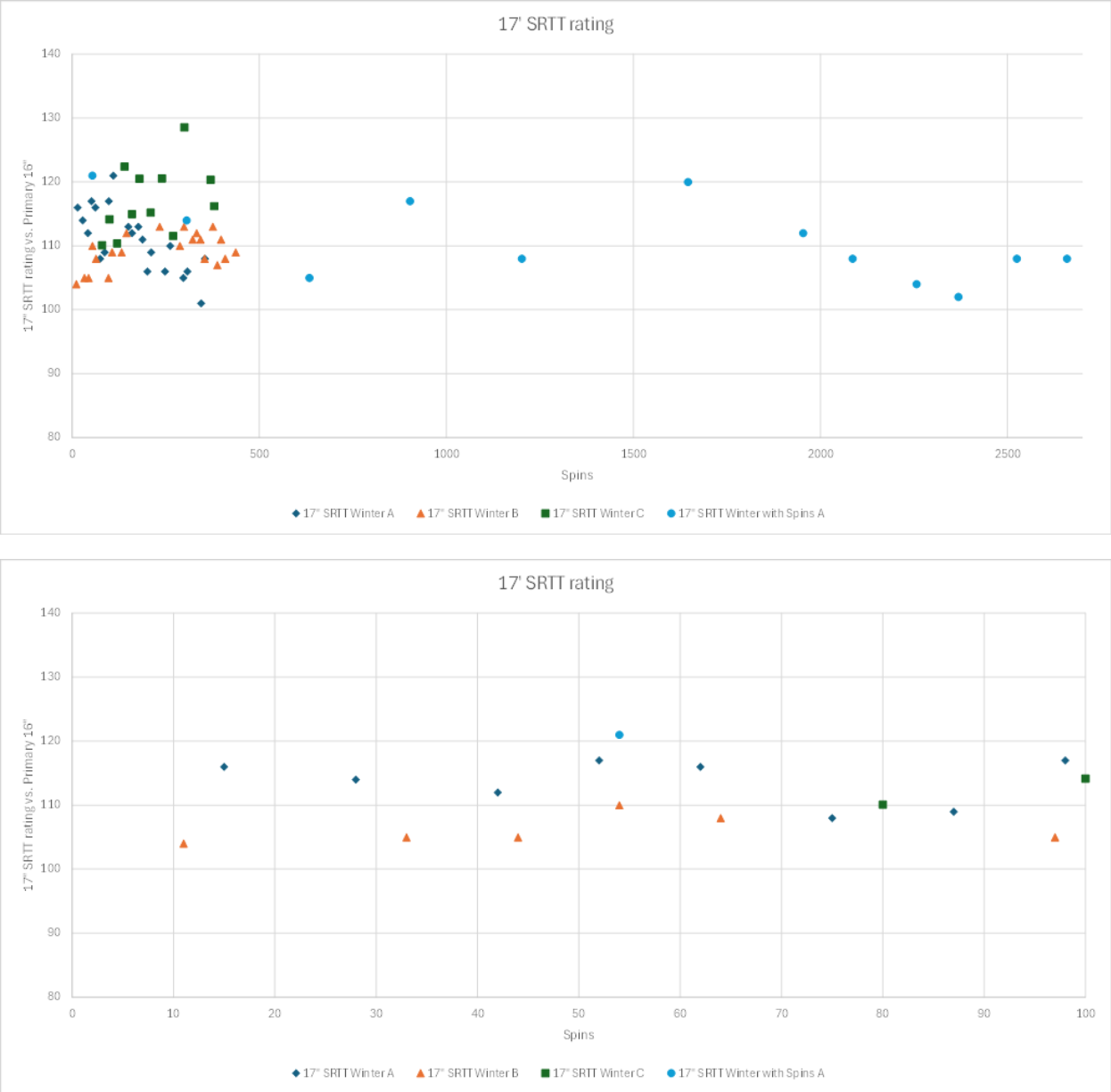
the 17” winter SRTT when directly compared to a low spin 17” winter SRTT. The mu-slip curves for this data are shown in the appendix on page 76. The mu-slip curves show similar performance over the 12 days.



Year – 2025; Days - 12; Locations – 1; 1 tire vs 1 tire

Objective 3: Quantify the change in low spin performance of multiple new 17” winter SRTTs.

Study 1 included a 17” winter SRTT at each location with one or two observations each testing day shown in the graph below. These SRTTs accumulated less than 500 spins over the entire study. The 0-100 spin range in this data was closely studied on the 17” winter SRTT to determine the effect of spins in the early stages of use. The second graph shows only the data points in the 0-100 spin range. The average low spin 17" winter SRTT rating (<100 spins) is 111 vs a 16" primary SRTT. The average for less than 50 spins is 110. The 16 available data points with less than 100 spins from study 1 show no trend in rating for the first 100 spins on a 17" winter SRTT. The average of a 111 for a low spin 17" winter SRTT aligns well with the average rating of all 17" winter SRTT observations in study 1 of 111 vs the primary 16" SRTT. For comparison, the 16" SRTT has historically shown a 3-5% increase in the first 50 spins vs a brand new 16" SRTT.

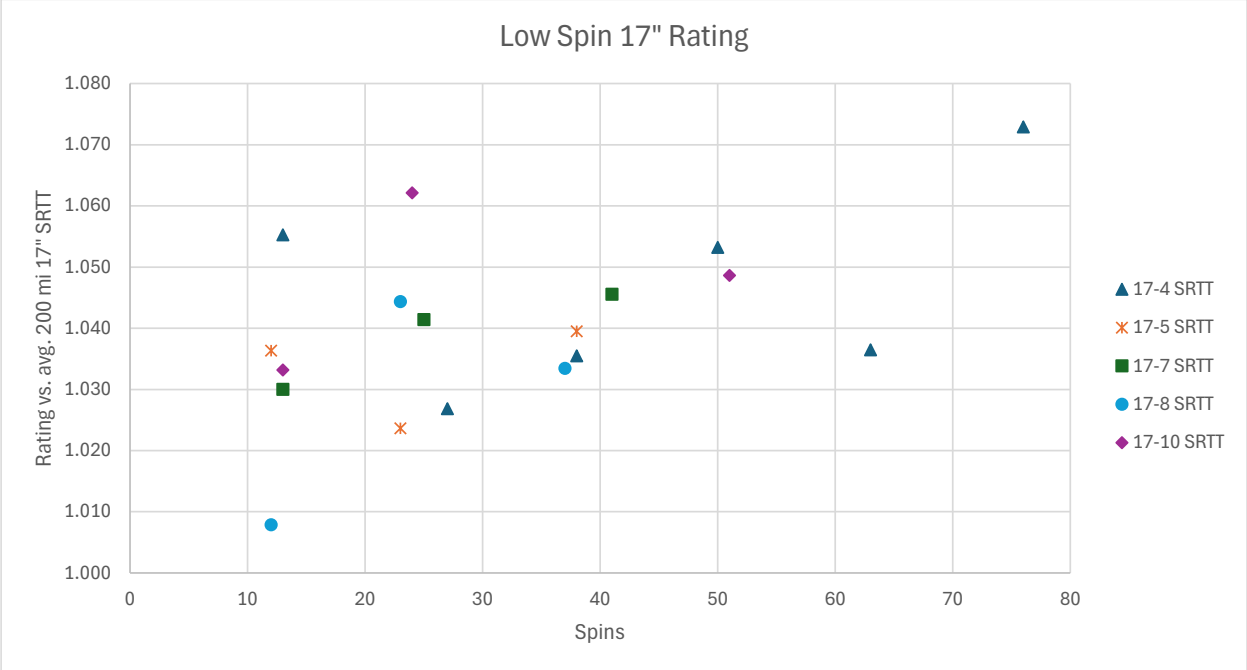


Year – 2025; Locations – 3; Days – 12; 1 to 2 17” winter SRTTs per location

Study 4 also included data on low spin 17” winter SRTTs that can be used to analyze the influence of spins on performance in the low spin range. The graph below shows 5 different 17” winter SRTTs tested a 1 location over 3 different days. The run sequence also included 2- 200 mile 17” winter SRTTs each day. The daily average of these two coefficients are used to provide the most stable reference point available for this analysis.

The 4 tires with a single observation each day (SRTT 5,7,8,10) show an average increase of 1.5% from the first observation (0-10 spins) to the final observation with an average of 41 final spins. One tire, 17-4 SRTT, was run twice each day. This tire shows a decrease of 2% from the first observation to the third observation which was on the second day with 38 final spins. This compares a tire with the same number of spins as the first 4 tires with observations on a different day demonstrating the influence of course preparation or environment has a stronger effect on relative performance than the low spin count evolution of the 17" winter SRTT. To remove some uncertainty of a single observation, the average change in performance of 17-4 SRTT from day 1 (observations 1-2, spins 0-27) to day 3 (observations 5-6, spins 50-76) is an increase of 1.4%.

Although this data may show a slight increase in performance, ~1.5%, this study demonstrates the environmental factors on a given test day outweigh the influence of the low spin evolution of a 17" winter SRTT. The mu-slip curves for this data are included in the appendix on page 91.

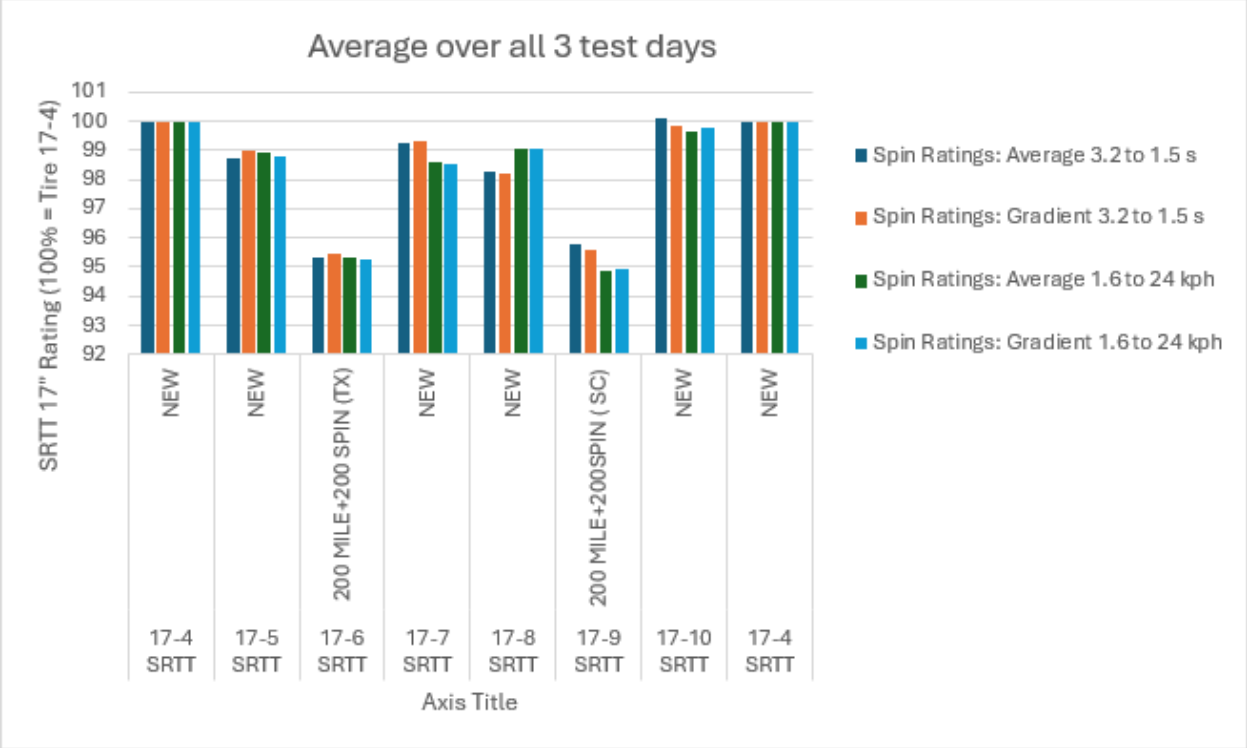


Year – 2025; Locations – 1; Days – 3; 5 17" winter SRTTs per location

Objective 4: Quantify the relative performance of 17" winter SRTTs with 200 miles break-in plus 200 spins.

Study 4 consisted of a plan to evaluate and validate the 17" Winter SRTT. Eight 17" Winter SRTTs were used including two witness tires, three new tires and two tires conditioned at different locations. Constraints for the tire conditioning or "break-in" consisted of dry roads, any temperature, always following the directional arrow, SRTT load (within 10%) and pressure, rotate tires so each position is driven for 25%, straight road, low accelerations and the vehicle properly aligned.

Both the 2Div +1.5 sec rating and the 1-15 Div rating show similar trends. The new tire is always within 2% of the reference. Both conditioned tires saw a 4% decrease in rating which is significantly less than the ~10%-13% change on the 16" SRTT after 200 miles.

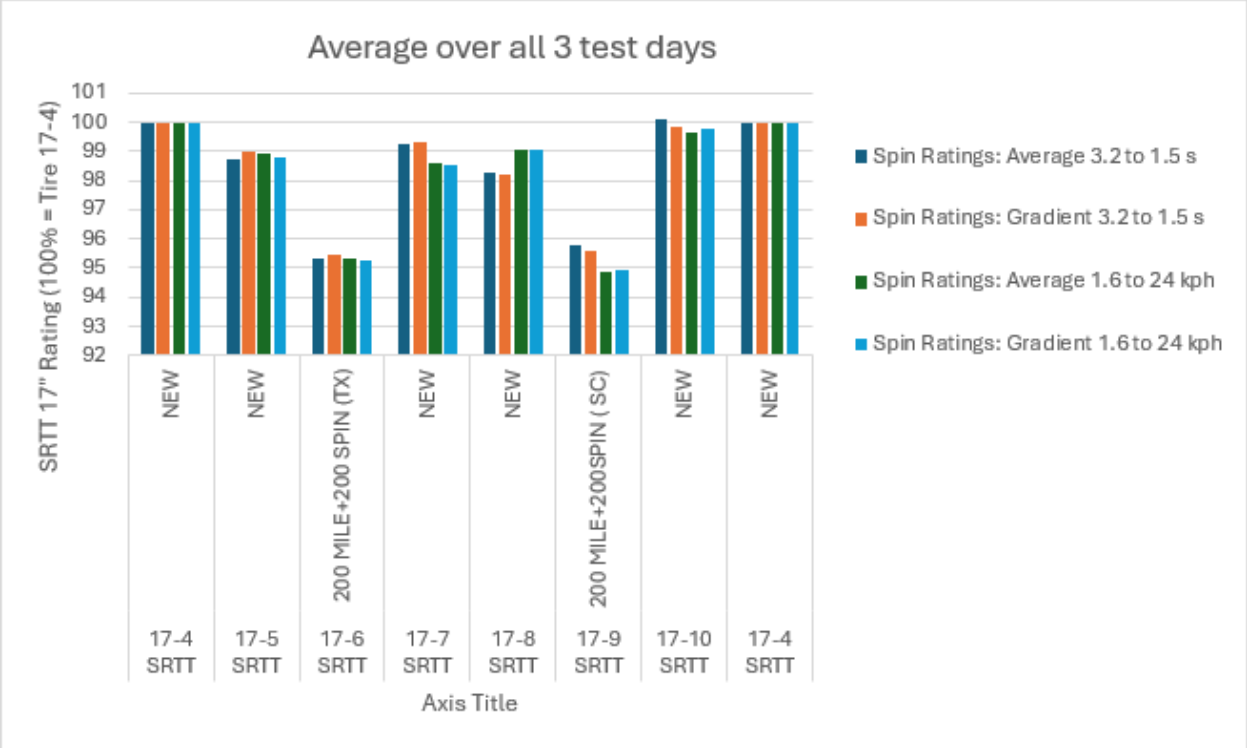


Year – 2025; Locations – 1; Days – 3; 7 17" winter SRTTs per location

See Appendix 2 for the mu-slip curves for this study, the curves trend slightly upward for 3 days of testing. The absolute mu value seems to depend on temperature and CTI. The influence of 200 miles drive in and 200 spins only led to a small influence in performance.

Objective 5: Quantify relative performance of multiple new 17” winter SRTTs within the same production batch.

Study 4 consisted of a plan to evaluate and validate the consistency of the 17” Winter SRTT. Both the 2Div +1.5 sec rating and the 1-15 Div rating show similar trends. The new tire is always within 2% of the reference tire.



Year – 2025; Locations – 1; Days – 3; 5 17” winter SRTTs per location

Objective 6: Estimate a correlation factor for the 17” SRTT vs the 14” SRTT with normal usage.

Objective 6A: Testing candidate tires vs the 17” winter SRTT which have a known rating vs the 14” SRTT.

Study 3 Test Plan and Methodology:

The purpose of study 3 is to estimate the ratio of the 17” winter SRTT vs the 14” SRTT snow traction performance without having a “new” 14” SRTT from 2025. 14” SRTTs stopped being manufactured in 2020, and ASTM F1805 limits the tire age to 2 years.

The ratio (correlation factor to the 14” SRTT) can be estimated using the formula shown below:

$$\frac{17"_{2025}}{14"_{2018}} = \frac{CandidateA_{2018}/14"_{2018}}{CandidateA_{2025}/17"_{2025}}$$

$$= {}^{17"_{2025}}/_{\cancel{CandidateA_{2025}}} \times {}^{\cancel{CandidateA_{2018}}}/_{14"_{2018}}$$

Assumptions:

$CandidateA_{2018} = CandidateA_{2025}$

14” SRTT degradation due to spins is typical for historical results

Note – The candidate tire is used as a “bridge” to link the 17” winter SRTT to the 14” SRTT, but it cancels out leaving only the ratio of the 17” winter SRTT to the 14” SRTT.

i. The 4 tires in Study 3 have a correlation factor range of about 1.07 to 1.34 with an average of 1.21 with no adjustment for 14” SRTT degradation.

The 2025 test sequence is shown below which includes 2 test locations and 3 test days per location.

Test Sequence							
Location 1	1	2	3	4	5	6	7
Test Day 1	17" winter SRTT_1	Tire_1	Tire_2	17" winter SRTT_1	Tire_3	Tire_4	17" winter SRTT_1
Test Day 2	17" winter SRTT_1	Tire_1	Tire_2	17" winter SRTT_1	Tire_3	Tire_4	17" winter SRTT_1
Test Day 3	17" winter SRTT_1	Tire_1	Tire_2	17" winter SRTT_1	Tire_3	Tire_4	17" winter SRTT_1
Location 2	1	2	3	4	5	6	7
Test Day 1	17" winter SRTT_1	Tire_1	Tire_2	17" winter SRTT_1	Tire_3	Tire_4	17" winter SRTT_1
Test Day 2	17" winter SRTT_1	Tire_1	Tire_2	17" winter SRTT_1	Tire_3	Tire_4	17" winter SRTT_1
Test Day 3	17" winter SRTT_1	Tire_1	Tire_2	17" winter SRTT_1	Tire_3	Tire_4	17" winter SRTT_1

The candidate tires must have test results vs the 14” SRTT and the tire design remain exactly the same since the 14” SRTT tests. This drastically limited the number of tires available as candidates for this study. 4 candidate tires were provided by tire companies.

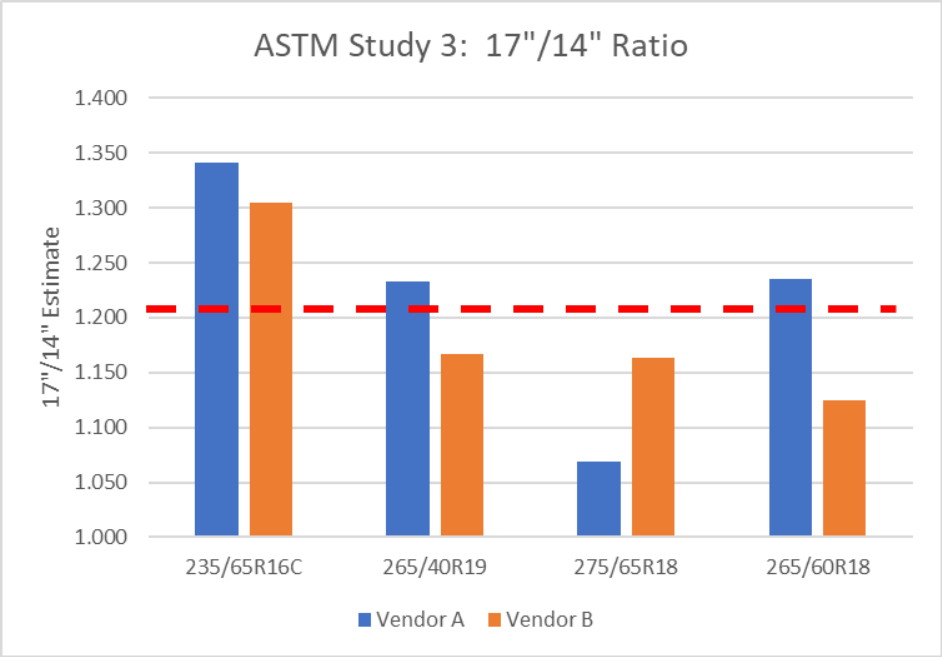
The historical 14” SRTT ratings and the 17” winter SRTT ratings are shown below. Each candidate tire only has 14” SRTT ratings from a single location between 2018 to 2021, but the 17” winter SRTT ratings are from 2 locations in 2025.
The number of spins on the 14” SRTT was also estimated so that the level of degradation could be roughly estimated assuming ~ -2.3% per 1000 spins, however the accuracy of this estimate is unknown.

		SRTT 14" - Rating				SRTT 17" Winter - Rating		17" / 14" ratio
Tire	Size	Vendor old 14" Rating - Test Year	Estimated spin count on 14" SRTT	Estimated degradation based on 2017 study	14" Rating average all methods	Vendor for SRTT 17" Winter Rating - 2025	17" Rating average all methods	Correlation Factor
Conti 1	**235/65R16C**	**Vendor C -2021**	**2124 - 2340**	**5.1**	**118.4**	**Vendor A - 2025**	**88.3**	**1.342**
Conti 2	**265/40R19**	**Vendor A -2018**	**1000-1150**	**2.5**	**120.5**	**Vendor A - 2025**	**97.8**	**1.233**
Conti 1	**235/65R16C**	**Vendor C -2021**	**2124 - 2340**	**5.1**	**118.4**	**Vendor B - 2025**	**90.8**	**1.305**
Conti 2	**265/40R19**	**Vendor A -2018**	**1000-1150**	**2.5**	**120.5**	**Vendor B - 2025**	**103.3**	**1.167**
Mich 1	**275/65R18**	**Vendor A - 2020**	**60-300**	**0.4**	**80.3**	**Vendor A - 2025**	**75.1**	**1.069**
Mich 2	**265/60R18**	**Vendor A - 2020**	**4000-5000**	**10.4**	**83.3**	**Vendor A - 2025**	**67.5**	**1.235**
Mich 1	**275/65R18**	**Vendor A - 2020**	**60-300**	**0.4**	**80.3**	**Vendor B - 2025**	**69.0**	**1.163**
Mich 2	**265/60R18**	**Vendor A - 2020**	**4000-5000**	**10.4**	**83.3**	**Vendor B - 2025**	**74.1**	**1.125**
							Average	**1.205**

Note: The estimated degradation of the 14” SRTT is not included an any adjustment math, but rather it’s only included to indicate the 14” SRTT was not “new” and could have degraded due to testing.

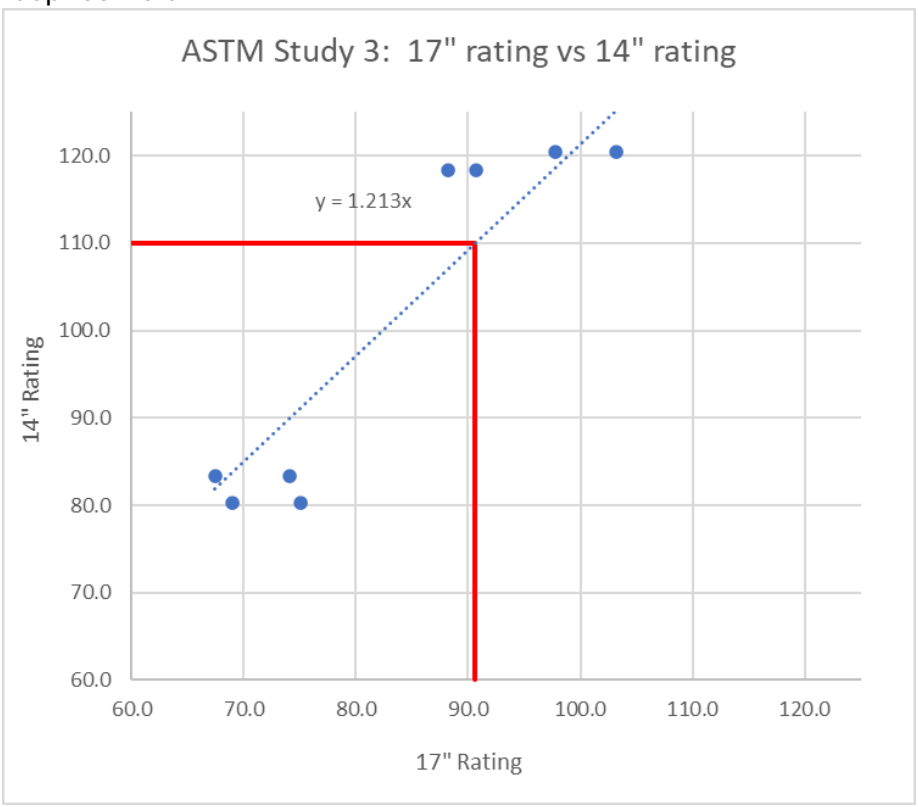
Study 3 Rating Analysis:

The correlation factors to the 14” SRTT rating from both locations are shown for each tire and has an average value of 1.205 with a range from 1.069 to 1.342. The range of correlation factors could be due to test variation, different levels of 14” SRTT degradation due to spins (higher degradation = higher correlation factor), or changes in the candidate tire snow performance since the original test vs the 14” (lower snow traction in 2025 = higher correlation factor). Appendix 2; Study 3 mu-slip curve analysis is helpful to better understand that both vendors in 2025 produced similar trends.



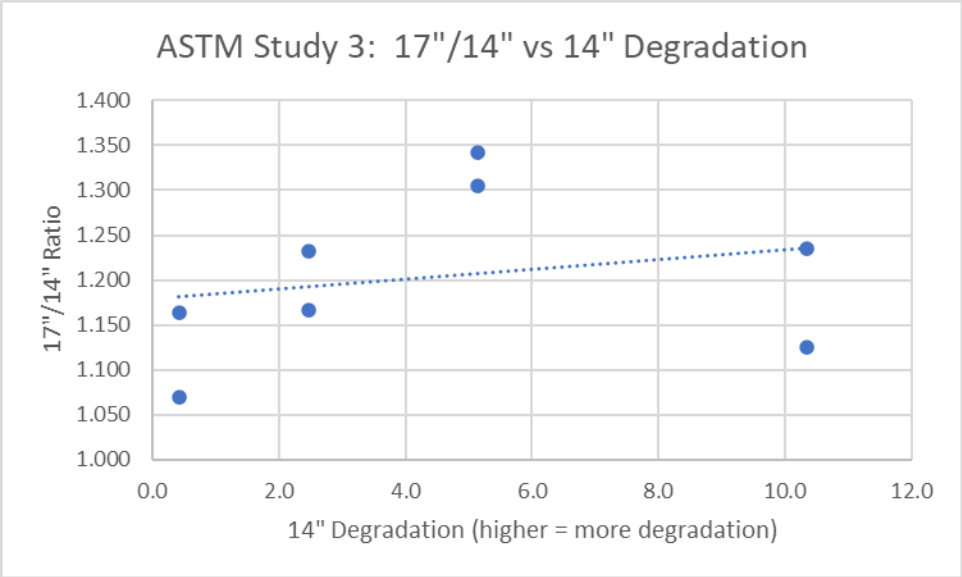
Year – 2025 vs 2018/2020/2021; Locations – 2; Days – 3 per location; 1 tire per location

Alternatively, the correlation factor can be estimated using a linear trend line on the 14" SRTT rating vs 17" winter SRTT rating graph as shown below. The slope of the line is 1.213 with a y-intercept set to 0.



Year – 2025 vs 2018/2020/2021; Locations – 2; Days – 3 per location; 1 tire per location

The 17”/14” ratio increases as the level of 14” SRTT degradation increases, however the estimate of 14” SRTT degradation is not very accurate. Although, the estimated 14” SRTT degradation does not explain the observed range of correlation factors.



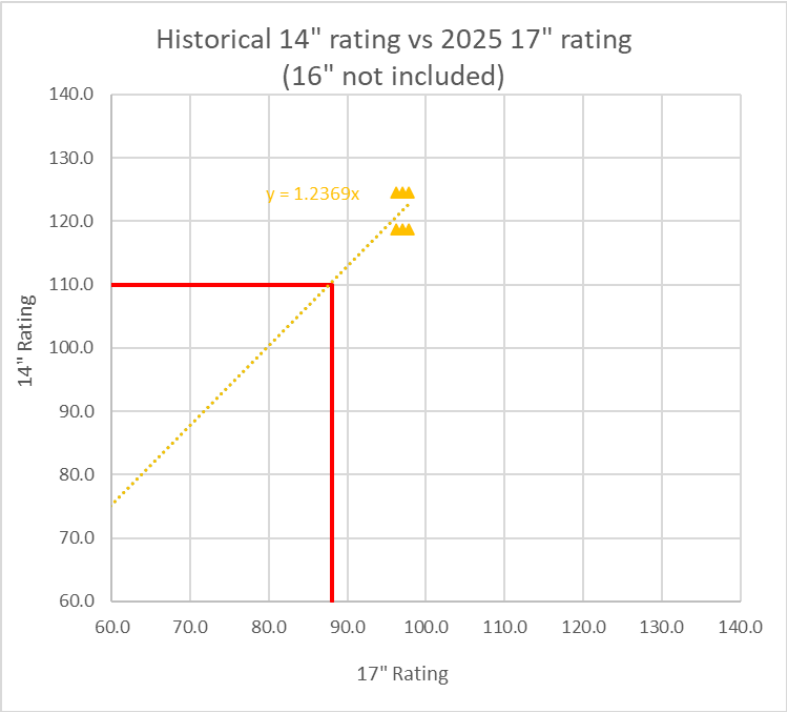
Year – 2025 vs 2018/2020/2021; Locations – 2; Days – 3 per location; 1 tire per location

ii. 3 Continental control tires in Study 1 following the same analysis methodology as Study 3 yielded a correlation factor range of about 1.21 to 1.30 with an average of ~1.25 with no adjustment for 14” SRTT degradation.

The Conti Control was tested vs the 14” SRTT at 2 vendors in North America and then it was tested by 3 vendors in 2025 with Study 1. The ratings are shown in the table below along with the average correlation factor of 1.25.

		SRTT 14" - Rating			SRTT 17" Winter - Rating		17" / 14" ratio
Tire	Size	Vendor old 14" Rating - Test Year	SRTT 14" Status in original test	14" Rating average all methods	Vendor for SRTT 17" Winter Rating - 2025	17" Rating average all methods	Correlation Factor
Conti Contr	205/55 R16	Vendor A - 2018	1450-1650 spins; sec	118.8	Location A - 202	97.0	1.224
Conti Contr	205/55 R16	Vendor A - 2018	1450-1650 spins; sec	118.8	Location B - 202	96.2	1.235
Conti Contr	205/55 R16	Vendor A - 2018	1450-1650 spins; sec	118.8	Location C - 202	97.9	1.214
Conti Contr	205/55 R16	Vendor C - 2019	3552 - 3948 spins	124.6	Location A - 202	97.0	1.285
Conti Contr	205/55 R16	Vendor C - 2019	3552 - 3948 spins	124.6	Location B - 202	96.2	1.296
Conti Contr	205/55 R16	Vendor C - 2019	3552 - 3948 spins	124.6	Location C - 202	97.9	1.273
						Average	1.25

Alternatively, the correlation factor can be estimated using a linear trend line on the 14” SRTT rating vs 17” winter SRTT rating graph as shown below. The slope of the line is 1.237 with a y-intercept set to 0.



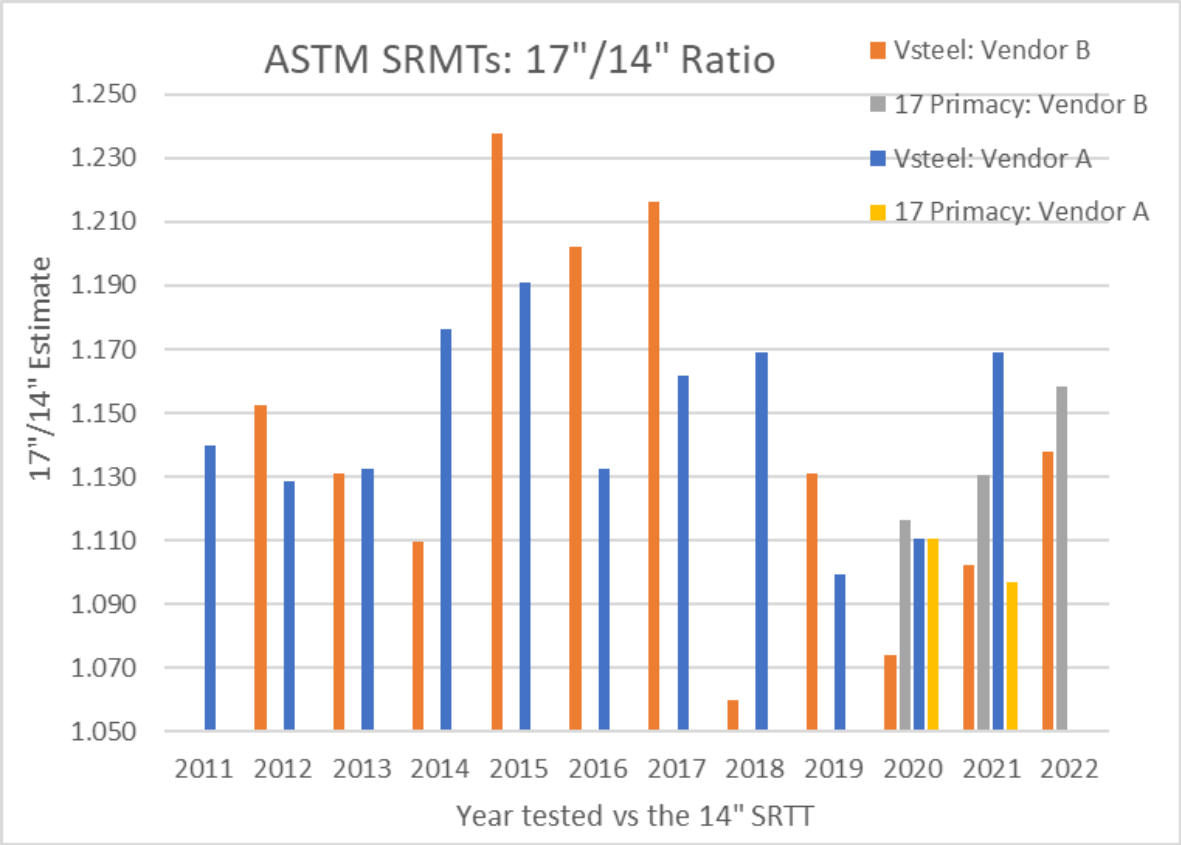
Year – 2025 vs 2018/2019; Locations – 2 & 3; Days – 3 per location; 1 tire per location

iii. 4 SRMT tires in Study 1 following the same analysis methodology as Study 3 yielded a correlation factor range of about 1.06 to 1.25 with an average of ~1.15

Surface Rating Monitoring Tires (SRMT) also have historical 14" SRTT ratings from 2011 to 2022 at 2 vendors in North America. The 17" winter SRTT ratings for two SRMTs in study 1can be calculated to estimate the correlation factor. Although vendor C did not test the SRMTs vs the 14" SRTT historically, SRMT ratings vs the 17" are available in 2025 from study 1 so this is also included. The ratings are shown in the table below along with the average correlation factor of ~1.15. Both vendors with historical SRMT data have an average of ~1.14, and vendor C has an average of ~1.23.

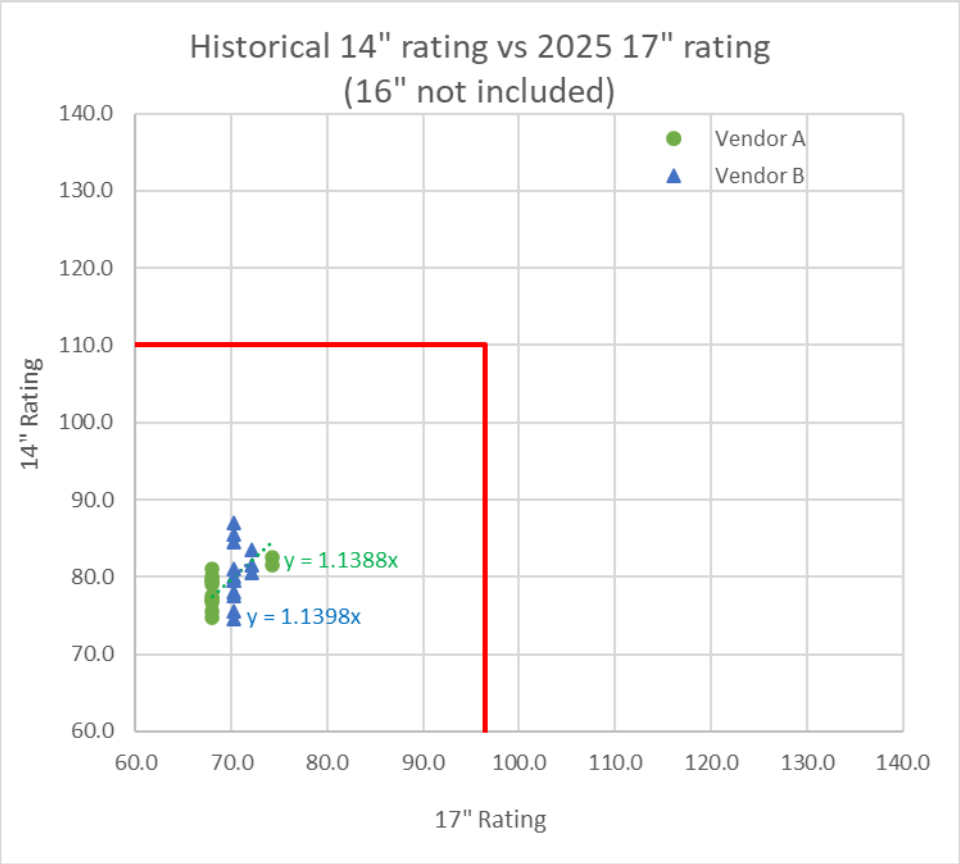
			SRTT 14" - Rating			SRTT 17" Winter - Rating		17" / 14" ratio
Year	Tire	Size	Vendor old 14" Rating - Test Year	SRTT 14" Status in original test	14" Rating average all methods	Vendor for SRTT 17" Winter Rating - 2025	17" Rating average all methods	Correlation Factor
2011	Vsteel	LT245/75/R1	Vendor A	<5% vs secondary	77.5	Vendor A - 2025	68.0	1.140
2012	Vsteel	LT245/75/R1	Vendor A	<5% vs secondary	76.8	Vendor A - 2025	68.0	1.129
2013	Vsteel	LT245/75/R1	Vendor A	<5% vs secondary	77.0	Vendor A - 2025	68.0	1.132
2014	Vsteel	LT245/75/R1	Vendor A	<5% vs secondary	80.0	Vendor A - 2025	68.0	1.176
2015	Vsteel	LT245/75/R1	Vendor A	<5% vs secondary	81.0	Vendor A - 2025	68.0	1.191
2016	Vsteel	LT245/75/R1	Vendor A	<5% vs secondary	77.0	Vendor A - 2025	68.0	1.132
2017	Vsteel	LT245/75/R1	Vendor A	<5% vs secondary	79.0	Vendor A - 2025	68.0	1.162
2018	Vsteel	LT245/75/R1	Vendor A	<5% vs secondary	79.5	Vendor A - 2025	68.0	1.169
2019	Vsteel	LT245/75/R1	Vendor A	<5% vs secondary	74.8	Vendor A - 2025	68.0	1.099
2020	Vsteel	LT245/75/R1	Vendor A	<5% vs secondary	75.5	Vendor A - 2025	68.0	1.110
2021	Vsteel	LT245/75/R1	Vendor A	<5% vs secondary	79.5	Vendor A - 2025	68.0	1.169
2020	17 Primacy	LT235/80R17	Vendor A	<5% vs secondary	82.5	Vendor A - 2025	74.3	1.110
2021	17 Primacy	LT235/80R17	Vendor A	<5% vs secondary	81.5	Vendor A - 2025	74.3	1.097
2012	Vsteel	LT245/75/R1	Vendor B	<5% vs secondary	81.0	Vendor B - 2025	70.3	1.152
2013	Vsteel	LT245/75/R1	Vendor B	<5% vs secondary	79.5	Vendor B - 2025	70.3	1.131
2014	Vsteel	LT245/75/R1	Vendor B	<5% vs secondary	78.0	Vendor B - 2025	70.3	1.110
2015	Vsteel	LT245/75/R1	Vendor B	<5% vs secondary	87.0	Vendor B - 2025	70.3	1.238
2016	Vsteel	LT245/75/R1	Vendor B	<5% vs secondary	84.5	Vendor B - 2025	70.3	1.202
2017	Vsteel	LT245/75/R1	Vendor B	<5% vs secondary	85.5	Vendor B - 2025	70.3	1.216
2018	Vsteel	LT245/75/R1	Vendor B	<5% vs secondary	74.5	Vendor B - 2025	70.3	1.060
2019	Vsteel	LT245/75/R1	Vendor B	<5% vs secondary	79.5	Vendor B - 2025	70.3	1.131
2020	Vsteel	LT245/75/R1	Vendor B	<5% vs secondary	75.5	Vendor B - 2025	70.3	1.074
2021	Vsteel	LT245/75/R1	Vendor B	<5% vs secondary	77.5	Vendor B - 2025	70.3	1.102
2022	Vsteel	LT245/75/R1	Vendor B	<5% vs secondary	80.0	Vendor B - 2025	70.3	1.138
2020	17 Primacy	LT235/80R17	Vendor B	<5% vs secondary	80.5	Vendor B - 2025	72.1	1.117
2021	17 Primacy	LT235/80R17	Vendor B	<5% vs secondary	81.5	Vendor B - 2025	72.1	1.130
2022	17 Primacy	LT235/80R17	Vendor B	<5% vs secondary	83.5	Vendor B - 2025	72.1	1.158
2011-2022	Vsteel	LT245/75/R1	Vendor A & B Averag	<5% vs secondary	79.1	Vendor C - 2025	65.9	1.201
2020-2022	17 Primacy	LT235/80R17	Vendor A & B Averag	<5% vs secondary	81.9	Vendor C - 2025	65.4	1.253

The bar chart below shows the correlation factor estimate based on multiple years of data. The change in correlation factor could be due to test variation or changes in the snow performance of the SRMTs from year to year vs SRTT 14” reference tire.



Year – 2025 & multiple years before 2022; Locations – 2; Days – 5 to 12 per location; 1 tire per location

Alternatively, the correlation factor can be estimated using a linear trend line on the 14" SRTT rating vs 17" winter SRTT rating graph as shown below. The slope of the line is 1.140 with a y-intercept set to 0.



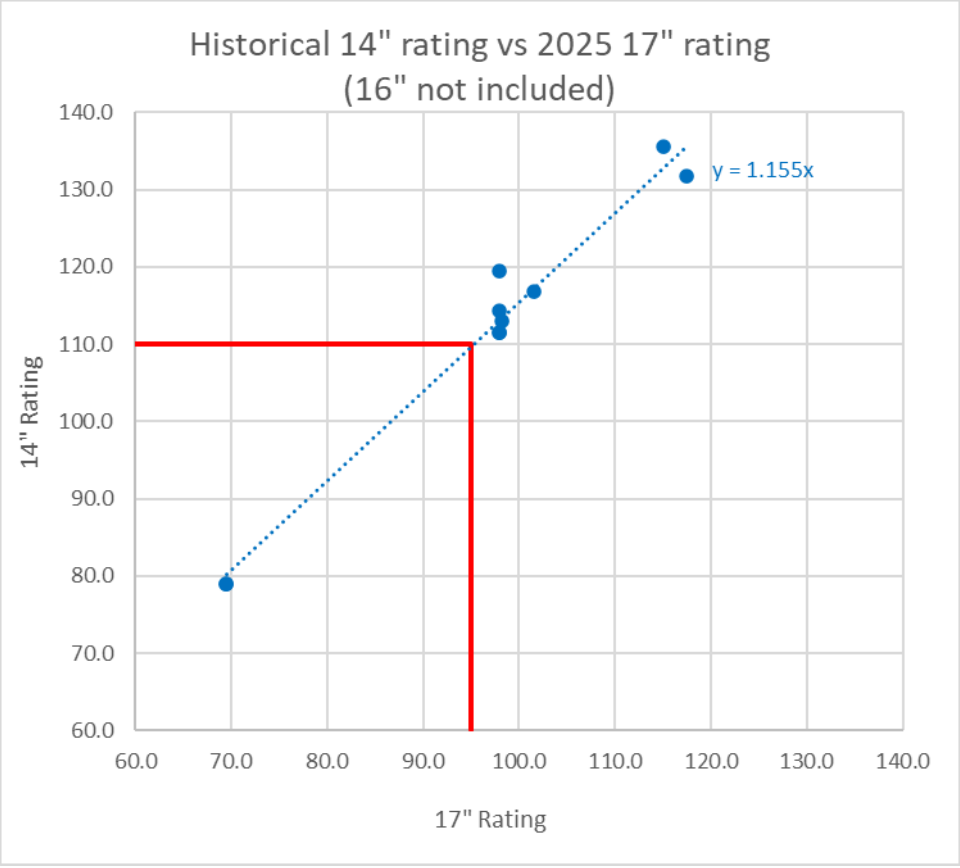
Year – 2025 & multiple years before 2022; Locations – 2; Days – 5 to 12 per location; 1 tire per location

iv. Using 6 tire types from an external study following the same analysis results in a correlation factor range of about 1.12 to 1.18 with an average of 1.15.

An external data set included 6 additional tire types tested 2020-2021 in North America with the 14” SRTT and using the 17” winter SRTT in 2025. 3 of the tire types had multiple test results with different tires vs the 14” SRTT. The snow performance vs the 14” SRTT ranged from 79 to 136 with similar correlation factors estimate across the range. The average correlation is 1.15 shown in the table below.

			SRTT 14" - Rating			SRTT 17" Winter - Rating		17" / 14" ratio
Year	Tire	Size	Vendor old 14" Rating - Test Year	SRTT 14" Status in original test	14" Rating average all methods	Vendor for SRTT 17" Winter Rating - 2025	17" Rating average all methods	Correlation Factor
Vendor A - 2020	**Tire 1a**	**265/60R18**	**Vendor A - 2020**	**<5% vs secondary**	**79**	**Vendor A - 2025**	**70**	**1.14**
Vendor A - 2020	**Tire 1b**	**265/60R18**	**Vendor A - 2020**	**<5% vs secondary**	**79**	**Vendor A - 2025**	**70**	**1.14**
Vendor A - 2021	**Tire 2a**	**205/55R16**	**Vendor A - 2021**	**<5% vs secondary**	**114**	**Vendor A - 2025**	**98**	**1.17**
Vendor A - 2020	**Tire 2b**	**205/55R16**	**Vendor A - 2020**	**<5% vs secondary**	**112**	**Vendor A - 2025**	**98**	**1.14**
Vendor A - 2021	**Tire 2c**	**205/55R16**	**Vendor A - 2021**	**<5% vs secondary**	**112**	**Vendor A - 2025**	**98**	**1.14**
Vendor A - 2021	**Tire 3**	**275/45R22**	**Vendor A - 2021**	**<5% vs secondary**	**132**	**Vendor A - 2025**	**118**	**1.12**
Vendor A - 2021	**Tire 4**	**225/50R18**	**Vendor A - 2021**	**<5% vs secondary**	**136**	**Vendor A - 2025**	**115**	**1.18**
Vendor A - 2021	**Tire 5**	**205/55R16**	**Vendor A - 2021**	**<5% vs secondary**	**113**	**Vendor B - 2025**	**98**	**1.15**
Vendor A - 2021	**Tire 6**	**205/60R16**	**Vendor A - 2021**	**<5% vs secondary**	**117**	**Vendor B - 2025**	**102**	**1.15**
							Average	1.15

Alternatively, the correlation factor can be estimated using a linear trend line on the 14" SRTT rating vs 17" winter SRTT rating graph as shown below. The slope of the line is 1.155 with a y-intercept set to 0.



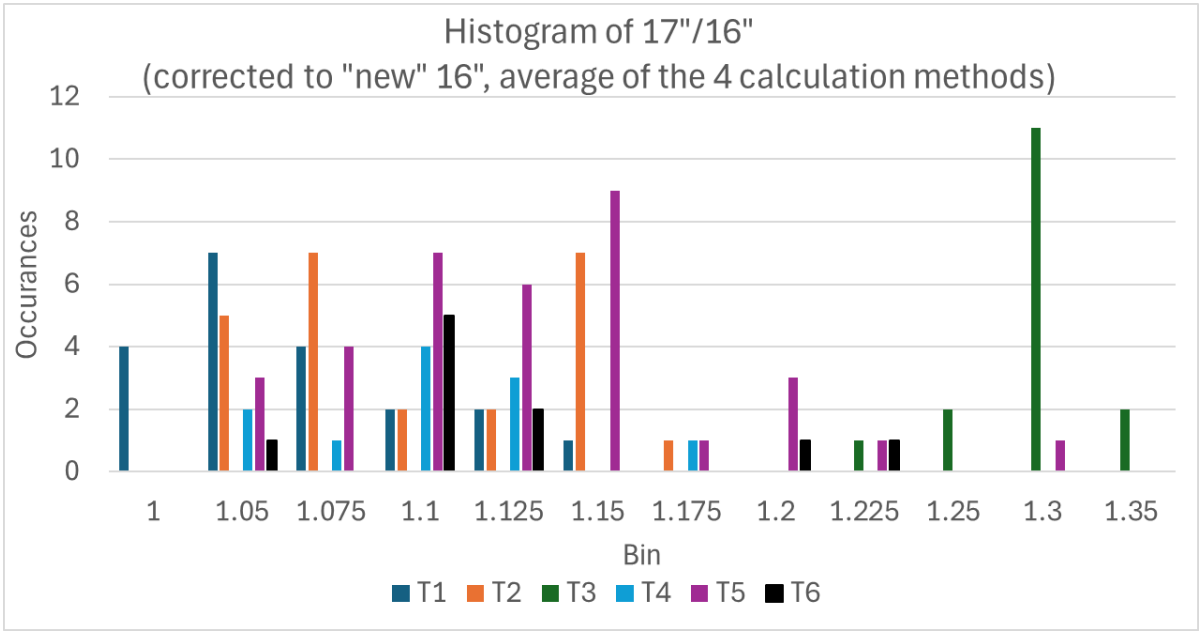
Year – 2025 & multiple years before 2022; Locations – 2; Days – 3 to 16 per tire; 1 to 3 tires per location

Objective 6B: Testing the relative performance of a 17” winter SRTT vs. a 2024 16” witness throughout the test season at many locations.

The daily witness checks use new 2024 16” SRTT and 17” winter SRTTs at 6 locations as shown in the table below. The 2024 16” SRTT may have ~6% higher snow performance than the 2017 16” SRTT. Just like in Objective 6a, the ratings for four calculation methods are averaged together which yields an **average value from the 6 test locations of 1.12**. Four test locations were very similar on average (1.09 to 1.11), but there were two test locations which were different (1.04 & 1.28). A total of 116 ratings are included in this analysis.

Row Labels	Average	Count	Max	Min	StdDev
T1	1.04	20	1.15	0.96	0.052
T2	1.09	24	1.16	1.02	0.045
T3	1.28	16	1.33	1.21	0.028
T4	1.09	11	1.16	1.04	0.035
T5	1.11	35	1.29	1.01	0.054
T6	1.11	10	1.21	1.05	0.050
Grand Total	**1.12**	**116**	**1.33**	**0.96**	

The histogram for each test location is shown below.

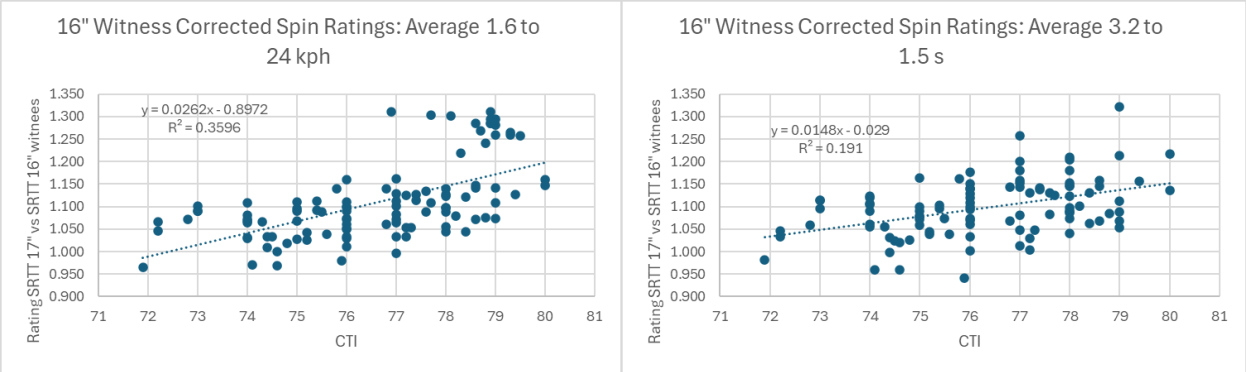


Year – 2025; Locations – 6; Days – 10 to 35 per location; 1 17” winter SRTT per location

Assuming that the New 2024 16” SRTT is 6% better than 16” SRTTs from 2017 the correlation factor would be 1.06 times higher.

Since the 14” rating can be estimated using a correlation factor of 0.987, the 17” winter SRTT/14” SRTT can be estimated. Based on the average 17/16 ratio of 1.12 & assuming a ~6% increase in snow performance since 2017, the **17” winter/14” SRTT can be estimated using the following calculation → 1.117*0.987 =1.102 x 1.06 = 1.169.**

The sensitivity of the 17” winter SRTT to CTI is different than the 16” SRTT as discussed later in Objective 7. The graph below shows that the correlation factor between the 17” winter SRTT and 16” SRTT increases more than 10% as CTI increases based on data from the 6 test locations. Based on the trendline slope, the change in ratings from 70 to 80 CTI would be ~15 to 26%. This trend is observed for 4 out of 6 testers; tester 3 & 6 did not show a trend.

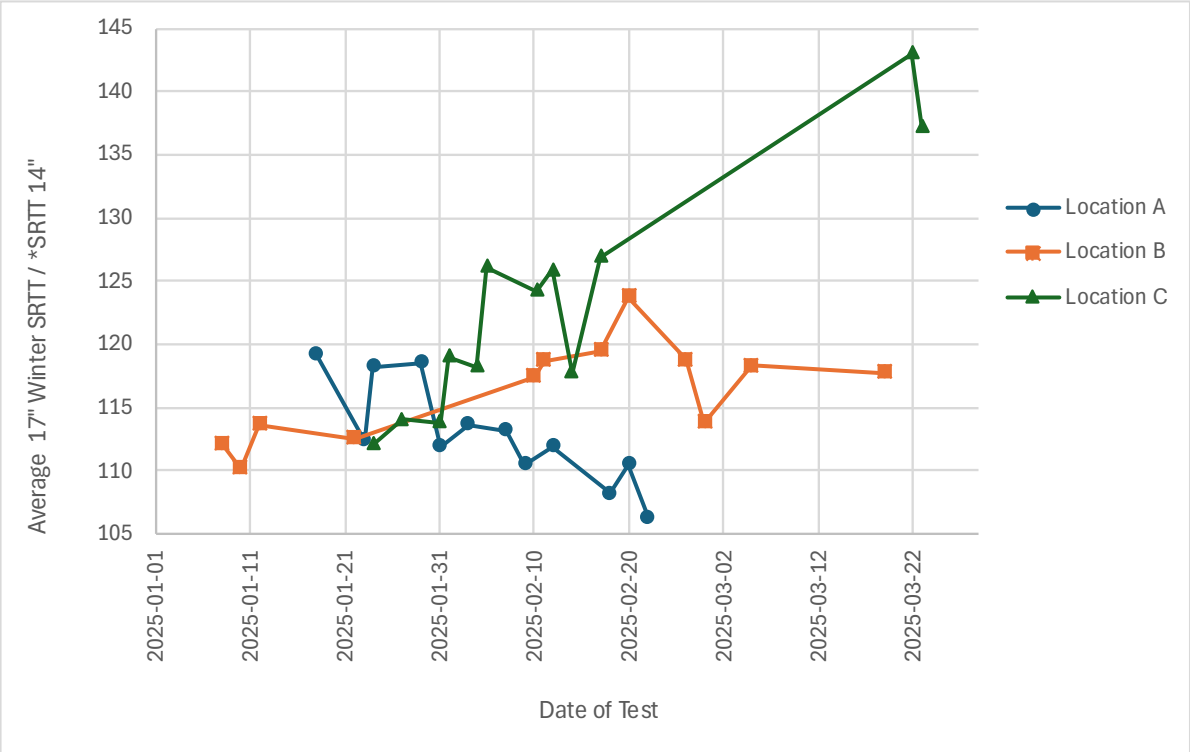


Objective 6C: Using Study 1 data with the 14” SRTT and 17” winter SRTT.

Since Study 1 contained ratings calculated from both the 14” SRTT and 17” winter SRTT, the ratio between the tires can be calculated based on the 12 days of testing at the 3 locations. The 14” SRTT tested in study 1 was about 5 years old, so the snow performance is assumed to potentially be 5% less than new. If the 14” SRTT is assumed to degrade about 5%, then the correlation factor is reduced. If the 14” SRTT did not change in performance after 5 years of storage, then **the average correlation factor would be 1.175 and 1.116 if it degraded 5%. If we assume the average historical 14” degradation is -6.4%, then the adjusted correlation factor would be 1.255 and 1.192 if it degraded 5%.**

	Assuming the 14” SRTT had no degradation due to spins		Adjusted by ~6.4% due to 14” SRTT degradation from spins	
	17” winter SRTT/14” SRTT	17” winter SRTT/14” SRTT * 0.95	17” winter SRTT/14” SRTT/0.936	17” winter SRTT/14” SRTT*0.95/0.936
Location A	112.9	107.2	120.6	114.5
Location B	116.3	110.5	124.3	118.1
Location C	123.2	117.0	131.6	125.0
Grand Total	**117.5**	**111.6**	125.5	119.2
Overall Average	118.8			

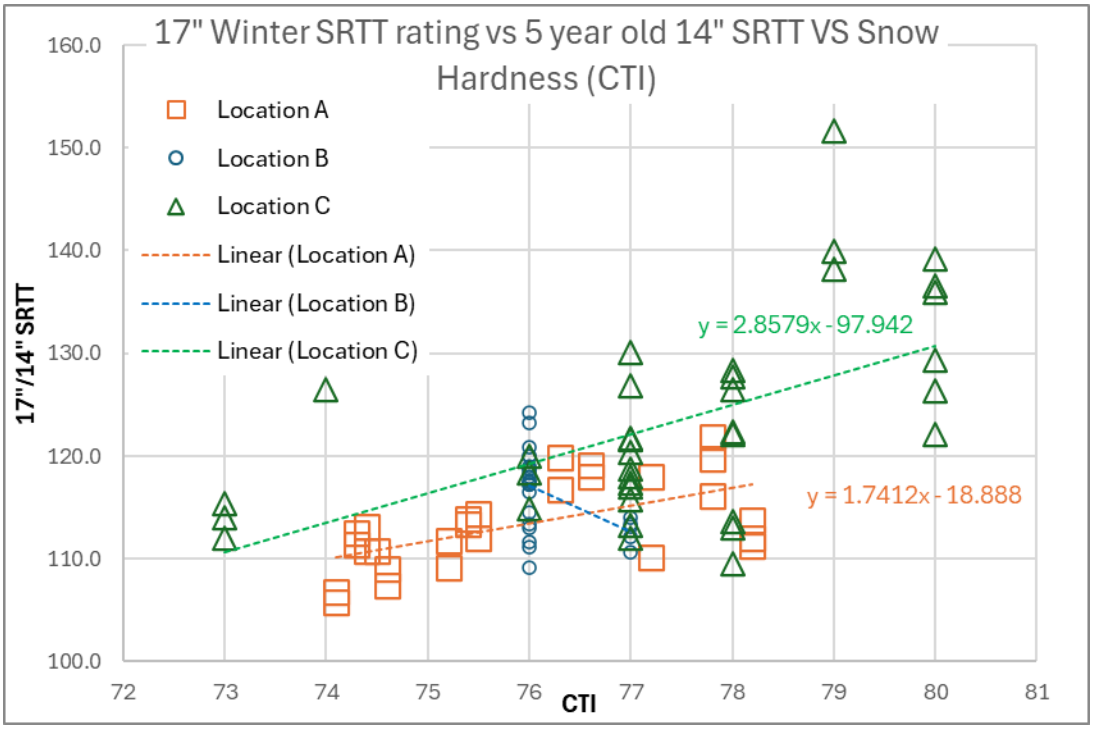
The three test locations produced more similar results for the first 6 day of test. The variation was significant across the 12 days of testing.



Year – 2025; Locations – 3; Days – 12 per location; 1 14” and 1 17” per location

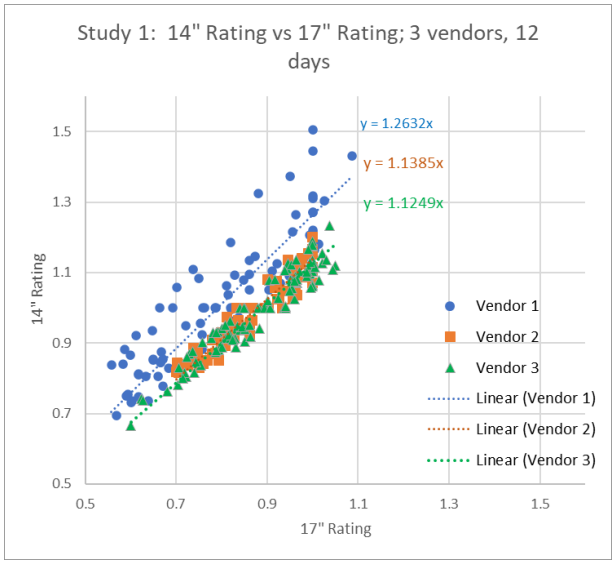
Study 1 data also shows the correlation factor between the 17” winter SRTT and 14” SRTT could be a function of the snow hardness. The correlation factor likely changes more than 10% over the full range of 70 to 80 CTI on average based on the data from 2 locations. Location B had a very small range of CTI values so the sensitivity cannot be accurately

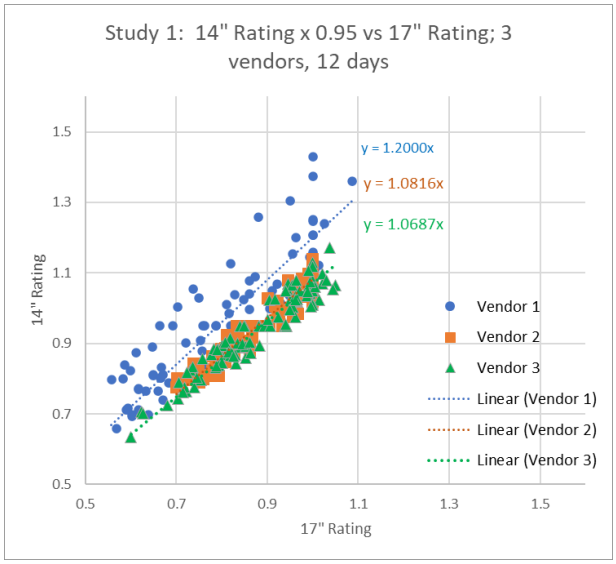
estimated. Based on the trendline slope, the change in ratings from 70 to 80 CTI would be ~17 to 29%.



Year – 2025; Locations – 3; Days – 12 per location; 1 14" and 1 17" per location

The 286 candidate tire ratings vs the 14" SRTT and 17" winter SRTT can also be shown for each location. These graphs show that the simple calculation of 17" winter SRTT/14" SRTT shows virtually the same correlation factor regardless of the candidate tire being tested (when testing under the same conditions).





Year – 2025; Locations – 3; Days – 12 per location; All tires from Study 1

Summary of Correlation Factor Analyses

The table below shows the correlation factor from multiple analyses. The correlation factor is the 17" winter SRTT / 14" SRTT with normal usage. The average of the multiple studies is ~1.169.

Name of Study	**Average Correlation Factor (17"/14")**	**14" Rating Robustness Comment**	**17" Rating Robustness Comment**
2025 ASTM Study 3	1.21 *σ = 0.09*	12 mounts,1 year per tire, 1 location per tire, 3 days per tire	24 mounts, 2025, 2 locations, 3 days
2025 Conti Control – Study 1	1.25 *σ = 0.03*	6 mounts,1 year per tire, 2 locations per tire, 3 days per tire	36 mounts, 2025, 3 locations, 12 days per location
2025 SRMTs – Study 1	1.15 *σ = 0.05*	189 mounts (*estimated*), 12 years per tire, 2 locations, ~7 days per tire	46 mounts, 2025, 3 locations, 7 to 9 days per location
External Study	1.15 *σ = 0.02*	43 mounts, 1 to 2 years per tire, 1 location, 3-16 days per tire	18 mounts, 2025, 1 location, 3 days per location
2025 Daily Checks (17" vs new 16", 1.117 x 1.06 x 0.987) *[assuming the 16" increased 6%]*	1.17 *σ = 0.06-0.08*	N/A – relies on 0.987 correlation factor and a 1.06 factor to adjust for the increase in snow performance	116 mounts, 2025, 6 location, 11-35 days per location

2025 ASTM Study 1 with 17” vs 14” (averaging all 4 scenarios together)	1.188 *σ = ~0.08*	Unknown degradation of 14” due to being 5 years old, but potentially -5%. Unknown degradation of 14” due to spins, but potentially -6.4%.	36 mounts (for comparison purposes), 2025, 3 locations, 27 to 36 repetitions per location (12 days)
Average	***~1.186***	***σ = 0.04***	
Weighted Average by sum of 14” & 17” mounts	***~1.169***		

The calculation for the weighted average is shown below:

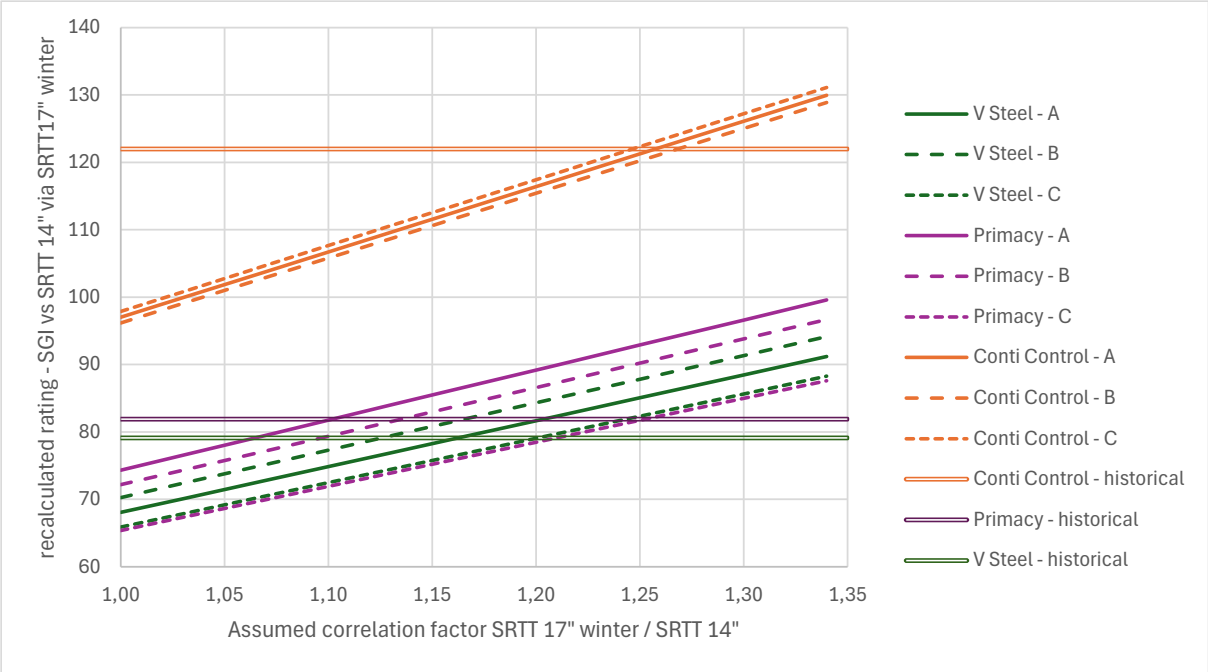
Average Correlation Factor	14" Mounts historically	17" Mounts in 2025	Sum of Mounts	% of mounts	Avg x % mounts
1.21	12	24	36	7%	0.08
1.25	6	36	42	8%	0.10
1.15	189	46	235	45%	0.51
1.15	43	18	61	12%	0.13
1.17	0	116	116	22%	0.26
1.188	0	36	36	7%	0.08
				weighted average	1.169

The impact of correlation factors on tires with known performance is shown below. The SRMT ratings vs the 17” winter SRTT from each location is calculated based on data from Study 1. However, the SRMTs were tested only on 7 to 9 days in 2025 which limits the accuracy of the ratings.

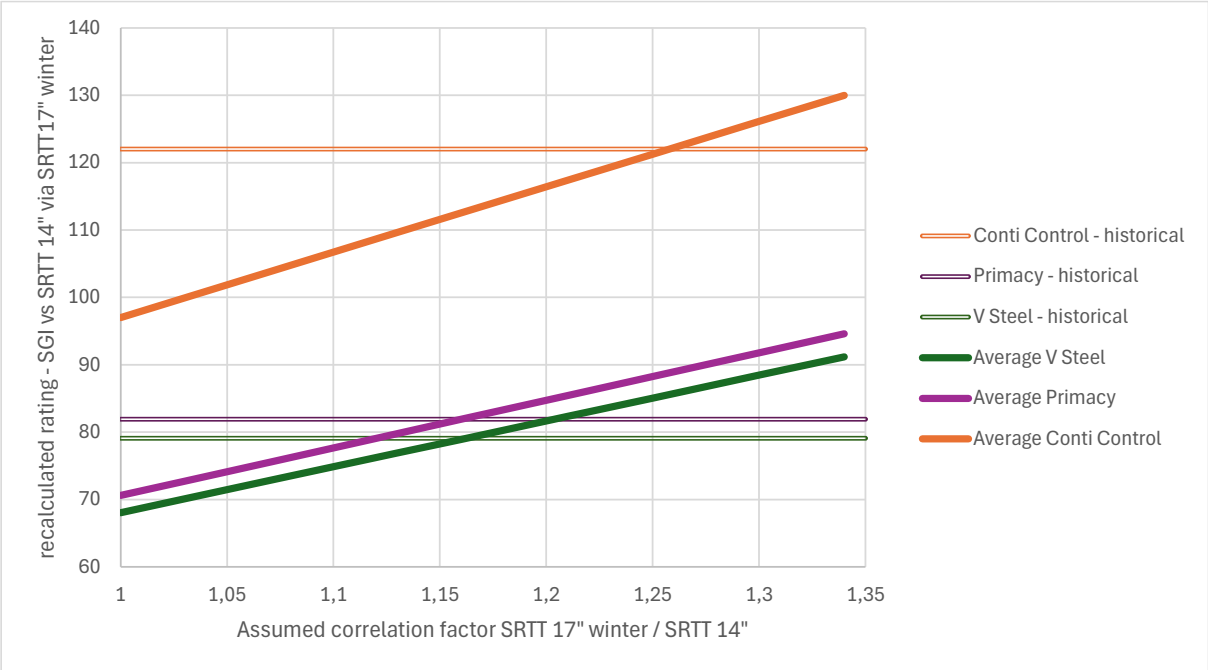
Location	A	B	C	A	B	C	A	B	C
Factor	**SMRT V Steel**			**SMRT Primacy**			**Conti Control**		
SRTT 17" / SRTT 14"	V Steel - A	V Steel - B	V Steel - C	Primacy - A	Primacy - B	Primacy - C	Conti Control - A	Conti Control - B	Conti Control - C
1,00	68	70	66	74	72	65	97	96	98
1,03	70	72	68	77	74	67	100	99	101
1,07	73	75	70	80	77	70	104	103	105
1,13	77	79	74	84	82	74	110	109	111
1,16	79	81	76	86	84	76	113	112	114
1,21	82	85	80	90	87	79	117	116	118
1,25	85	88	82	93	90	82	121	120	122
1,30	88	91	86	97	94	85	126	125	127
1,34	91	94	88	100	97	88	130	129	131
Historical average vs SRTT 14"	**79,1**			**81,9**			**122**		

In the following diagram, the values are recalculated for location A,B and C and plotted vs the estimated correlation factor 17” winter SRTT winter / 14” SRTT. The horizontal lines show the historical rating of the Conti Control and the SRMTs. The X axis value where the

lines intersect shows the optimal correlation factor. There are different intersection points depending on tire and test location.



The graph above can be simplified by averaging the locations together. This simplified graph is shown below.



For the Conti Control, the best correspondence would be with a correlation factor around 1.25, while the SRMT Tires would generate a best fit with 1.16 to 1.17.

Objective 7: Investigate significant factors influencing tire ratings vs the 17” winter SRTT.

The rating sensitivities from study 1 due to CTI, temperature and 17” winter SRTT grip level can be analyzed using a multivariate ANOVA approach and using the P-value to determine which parameters are statistically significant. If the P-value is less than 0.05, then it’s likely that the variable has an impact on tire ratings. P-values are shown in the tables below.

P-value

17" Spin Ratings: Average 1.6 to 24 kph	14" SRTT	200 mile 16"	3PMSF LT	Conti Control	New 16" Ardmore	Primacy	Primary 16"	Vsteel
Intercept	0.00	0.00	0.00	0.00	0.00	0.78	0.00	0.10
17" 1.6 to 24 kph grip	0.00	0.34	0.76	0.39	0.00	0.13	0.00	0.26
CTI	0.03	0.38	0.00	0.20	0.01	0.26	0.00	0.88
Ambient Temperature °C	0.68	0.81	0.08	0.47	0.11	0.17	0.00	0.09
Surface Temperature °C	0.70	0.43	0.93	0.05	0.54	0.57	0.00	0.16

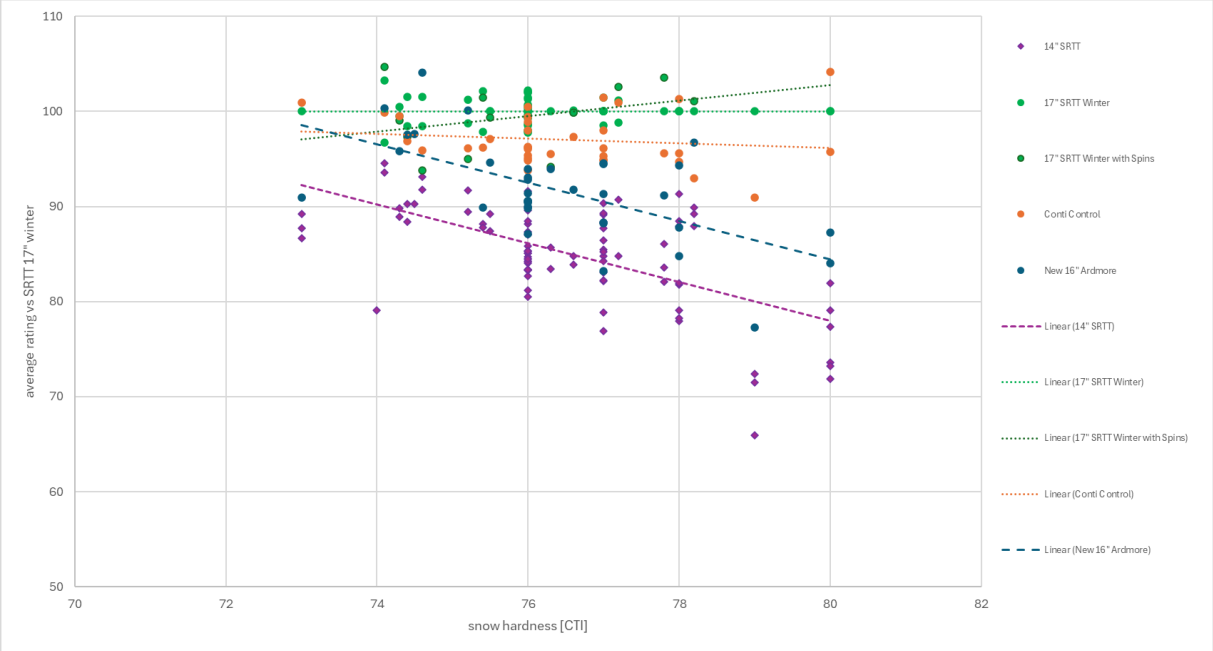
17" Spin Ratings: Average 3.2 to 1.5 s	14" SRTT	200 mile 16"	3PMSF LT	Conti Control	New 16" Ardmore	Primacy	Primary 16"	Vsteel
Intercept	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.02
17" 1.6 to 24 kph grip	0.00	0.06	0.92	0.15	0.03	0.06	0.00	0.17
CTI	0.00	0.34	0.00	0.97	0.00	0.79	0.00	0.32
Ambient Temperature °C	0.20	0.33	0.08	0.17	0.02	0.22	0.65	0.52
Surface Temperature °C	0.56	0.15	0.37	0.19	0.18	0.94	0.01	0.88

Ambient and surface temperatures are not likely significant factors influencing tire ratings vs the 17” winter SRTT. 17” winter SRTT grip level and CTI may have some influence on ratings for some tires. CTI appears to effect 4 out of 8 tires, and 17” winter SRTT grip level effects 3 out of 8 tires.

(Note: The inverse sensitivities exist when using the 16” SRTT as the reference tire vs some candidate tires. For example, if the Conti Control is the tested vs the 16” SRTT, then the ratings will change significantly with CTI and grip level because the Conti Control has similar sensitivities as the 17” winter SRTT.)

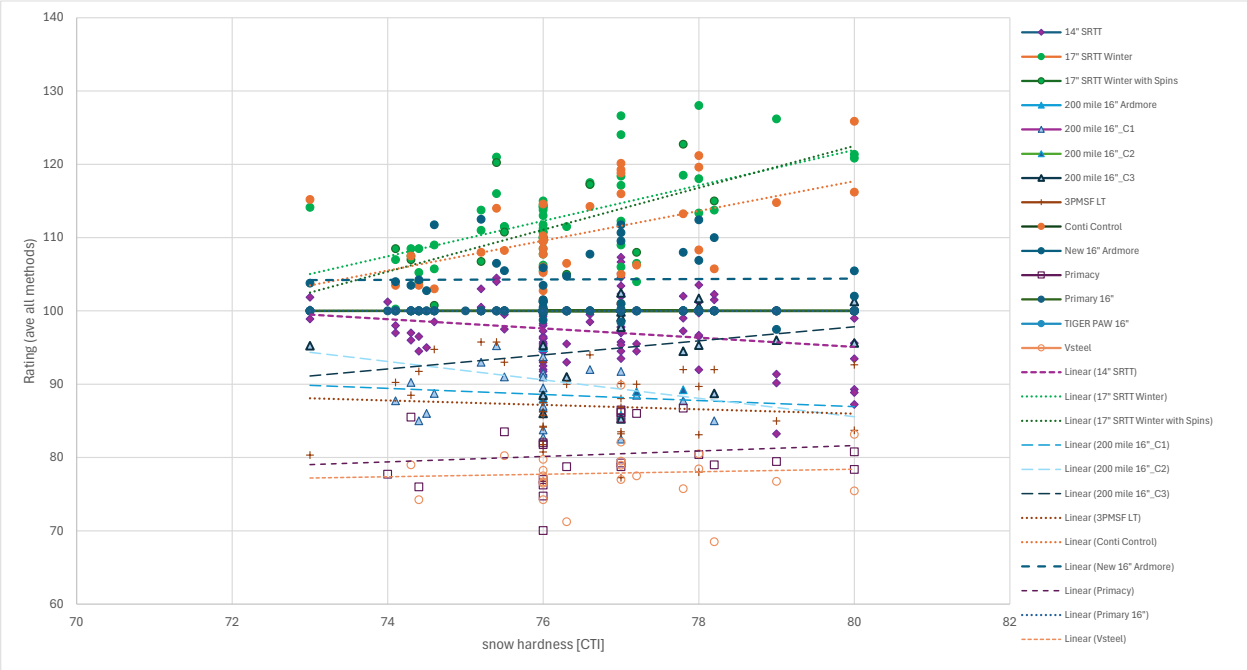
CTI

The rating vs CTI graph below shows that the 16” SRTT or 14” SRTT have very different sensitivities to CTI than the 17” SRTT. When testing the 16” SRTT or 14” SRTT as a candidate tire vs the 17” SRTT, the rating decreases more than 10% when the CTI changes from 73 to 80. The 14” and 16” SRTTs appear to have a similar sensitivity to CTI.



Year – 2025; Locations – 3; Days – 12 per location

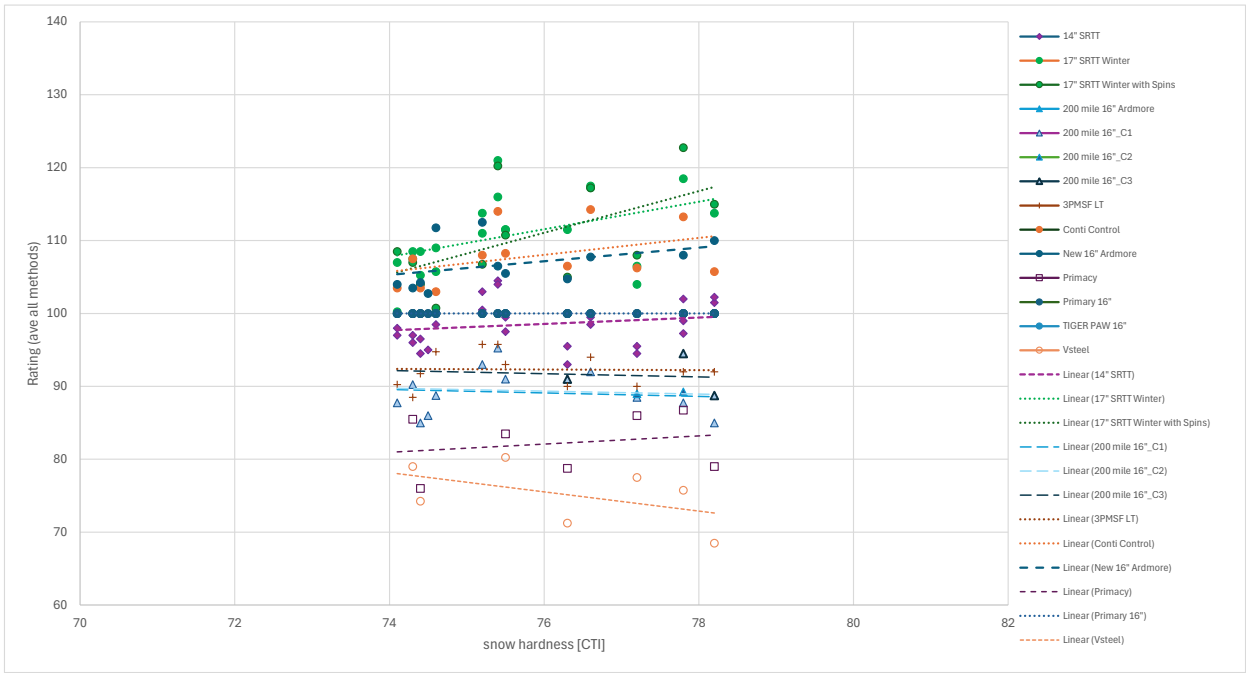
The same trend can be observed looking at all candidate tire ratings vs the primary 16” SRTT in study 1 as shown below. The CTI range from study 1 was about 73 to 80, so sensitivities beyond this CTI range have not been quantified. **All candidate tires in study 1 except the 17” winter SRTT and Conti Control had similar sensitivity to CTI.** Both the 17” winter SRTT and Conti Control have similar sensitivities to snow hardness and their ratings increased about 10-12% vs the 16” SRTT as the CTI increases. Although CTI does not fully characterize the snow properties, the **17” winter SRTT could increase in ratings greater than 1% per 1 CTI value relative to the 16” SRTT** on medium compaction snow.



Year – 2025; Locations – 3; Days – 12 per location; All tires from Study 1

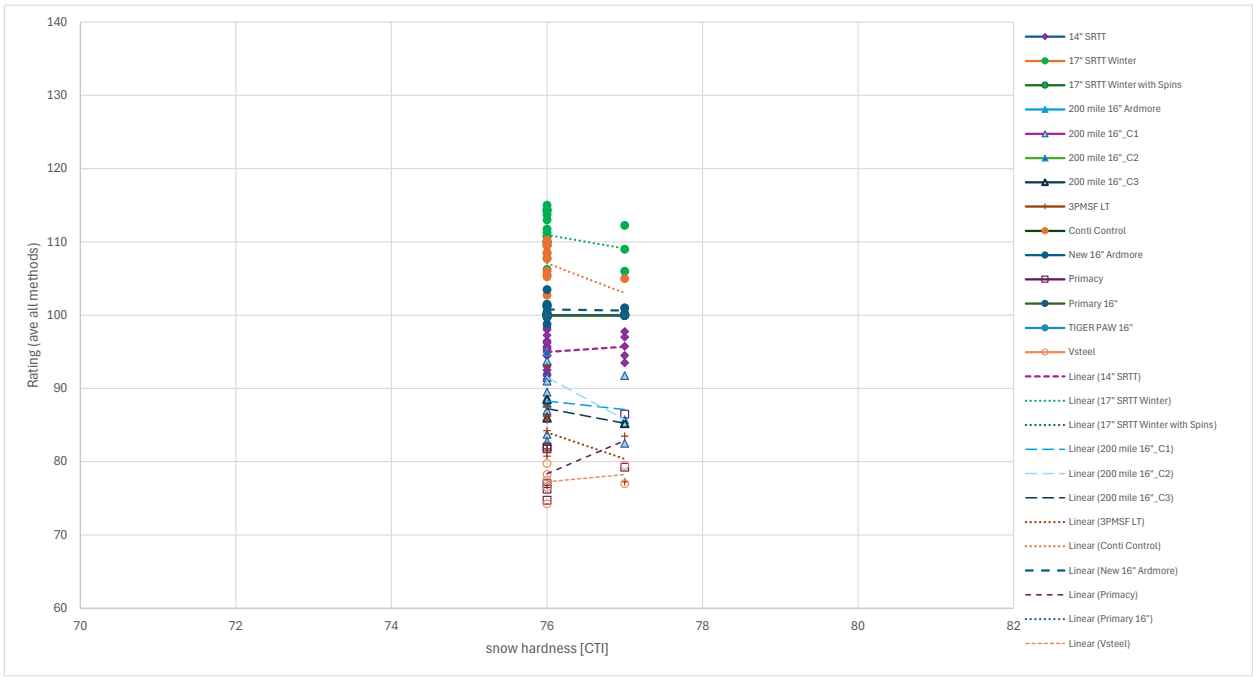
The 3 graphs below show the data separately for each location. The range of CTI for locations A, B & C are 74-78, 76-77 & 73-80 respectively. Since location B only had a CTI range of 76 to 77, sensitivity to CTI cannot be estimated. Location A and C show very similar trends although location C had the widest range of CTI values (73 to 80).

Location A



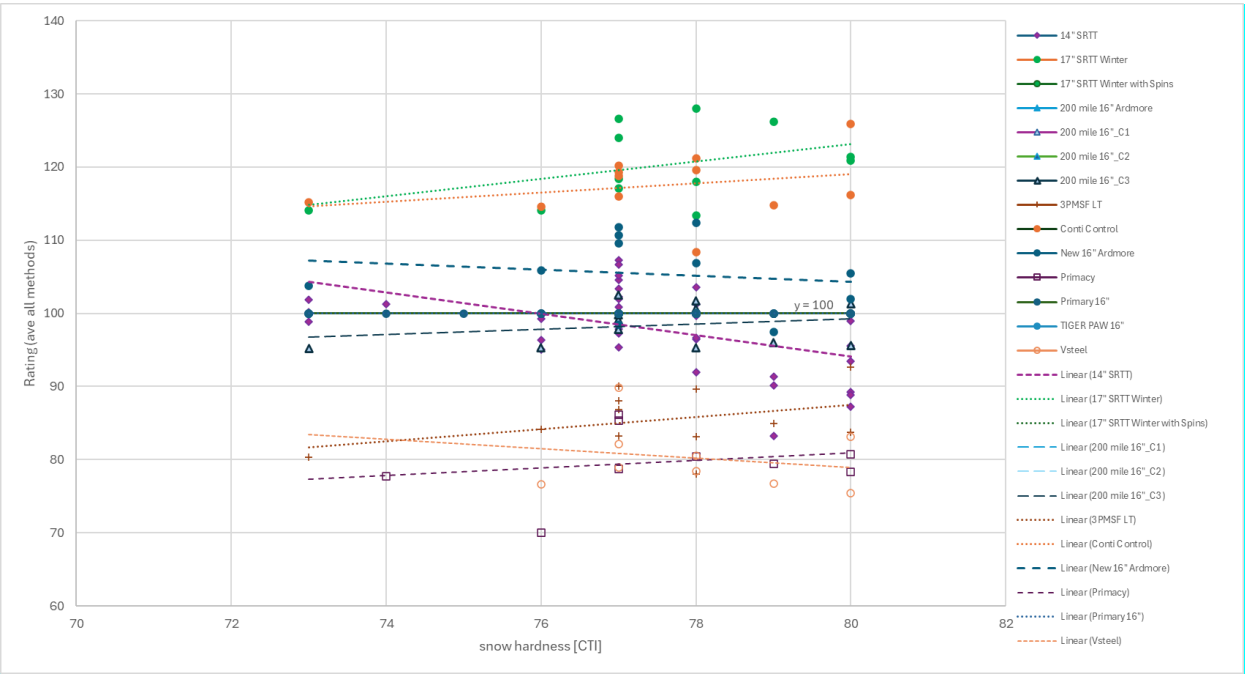
Year – 2025; Locations – 1; Days – 12 per location; All tires from Study 1

Location B



Year – 2025; Locations – 1; Days – 12 per location; All tires from Study 1

Location C

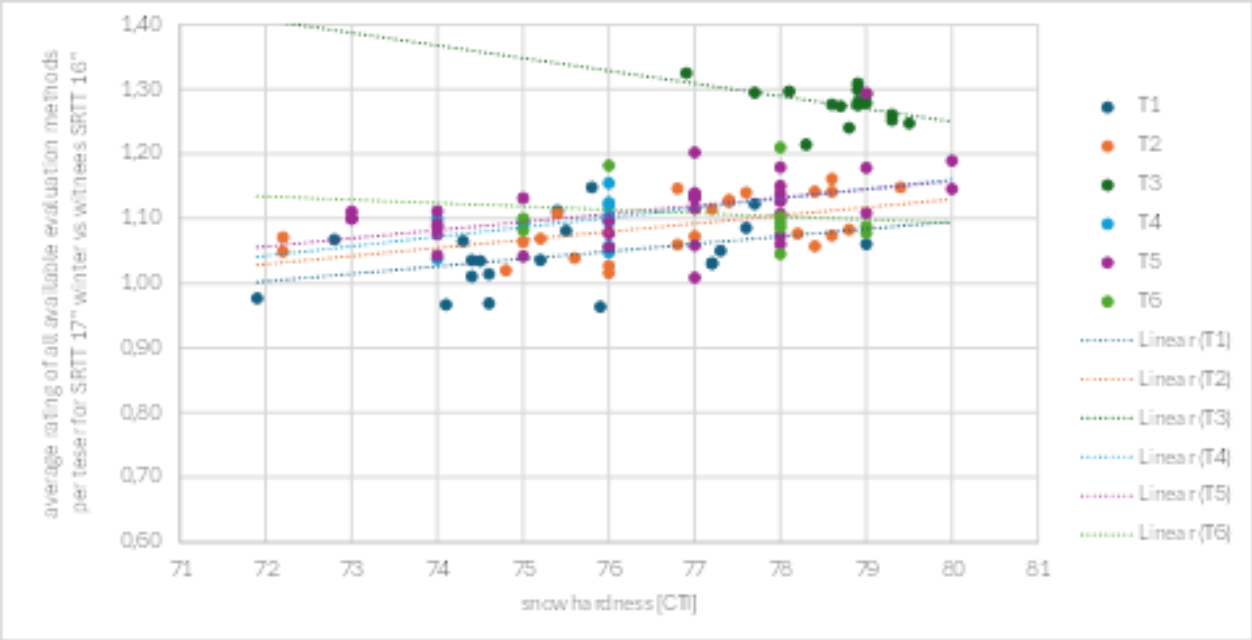


Year – 2025; Locations – 1; Days – 12 per location; All tires from Study 1

Expectation of the impact when using the 17” winter SRTT as the control tire:

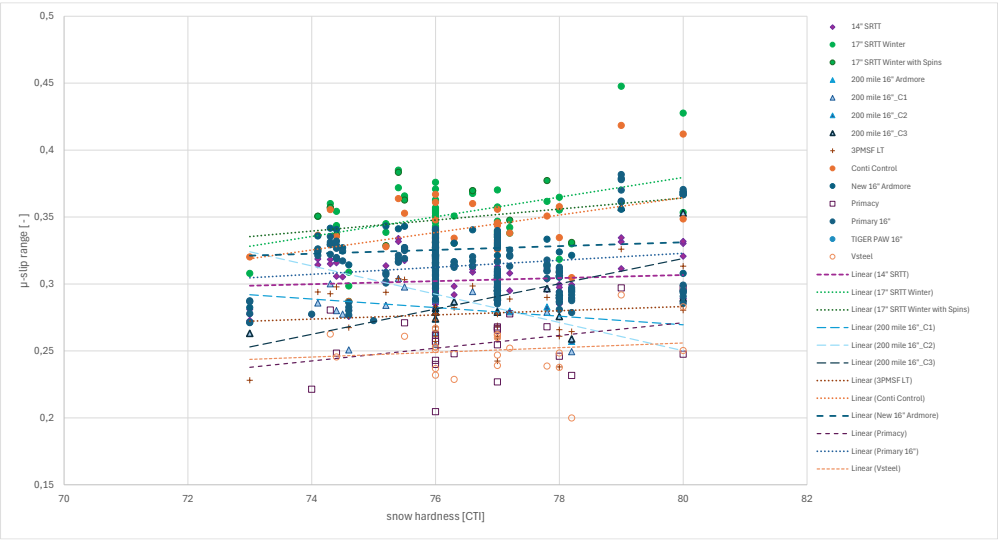
- All Season M+S tires without 3PMSF: lower rating at high CTI (greater than 1% change per 1 CTI point expected)
- Some All Season with 3PMSF (larger block structure instead of multiple sipes, e.g. All Terrain tires) likely show lower rating at higher CTI
- Tires that have similar tread pattern geometry and flexibility as the 17” winter SRTT are expected to show similar rating over a wider range of CTI
- Nordic tires would require further investigation, but should perform better than the 17” winter SRTT under all conditions

As shown in the graph below, witness checks at 6 locations show a similar trend of ~10 % change in 17” ratings over 72 to 80 CTI. The average CTI at the 6 locations is 76.7.

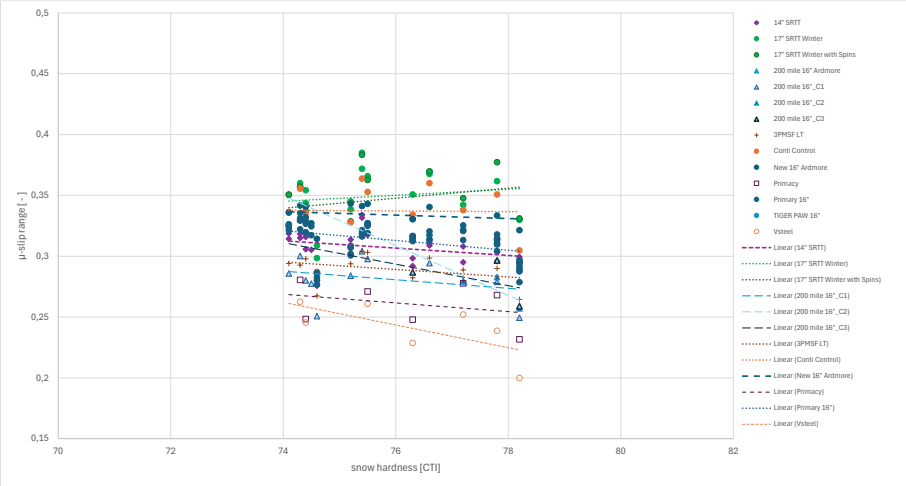


Year – 2025; Locations – 6; Days – 10 to 35 per location; 1 17” winter SRTT per location

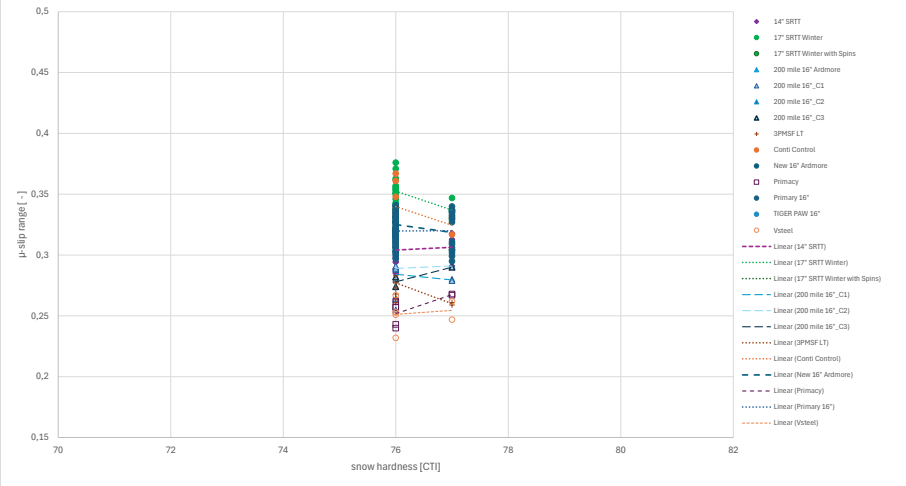
The grip level vs CTI is shown below for a more advanced understanding of the data.



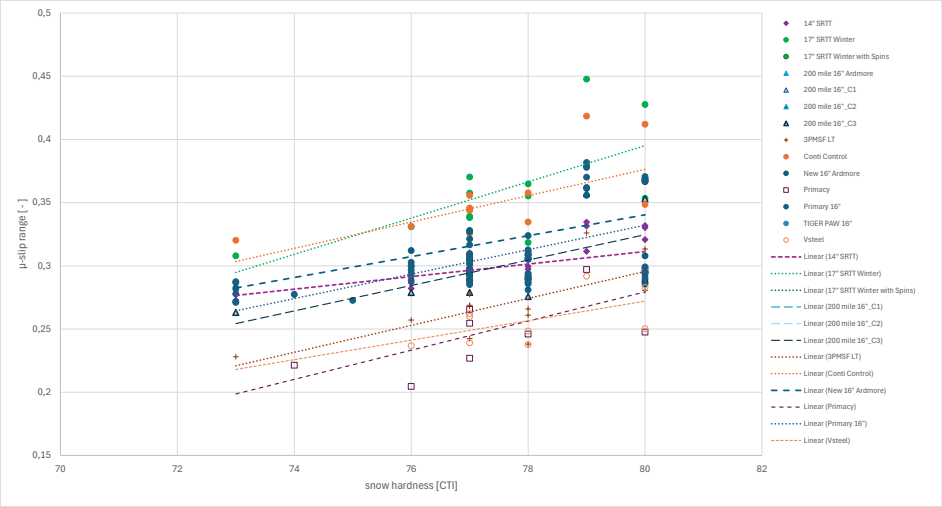
for all Locations



location A only



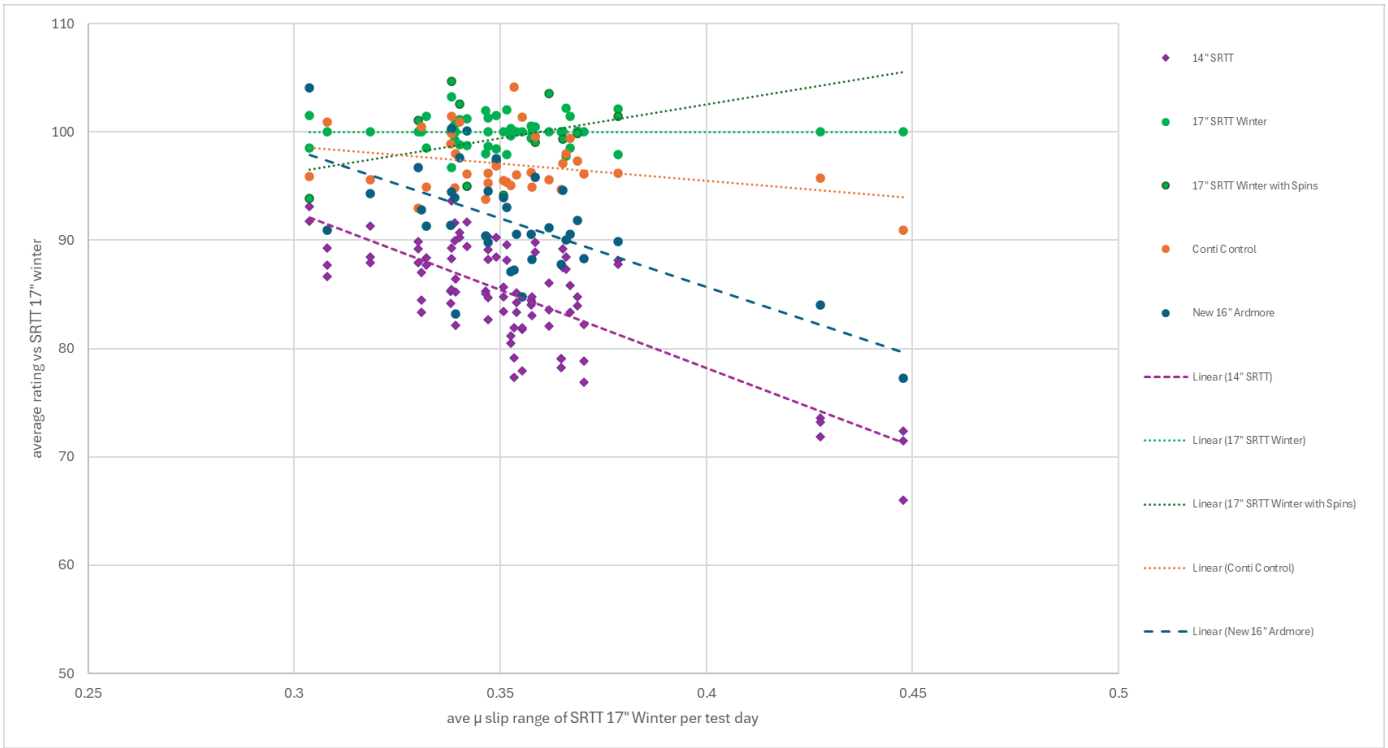
Location B only



Location C only

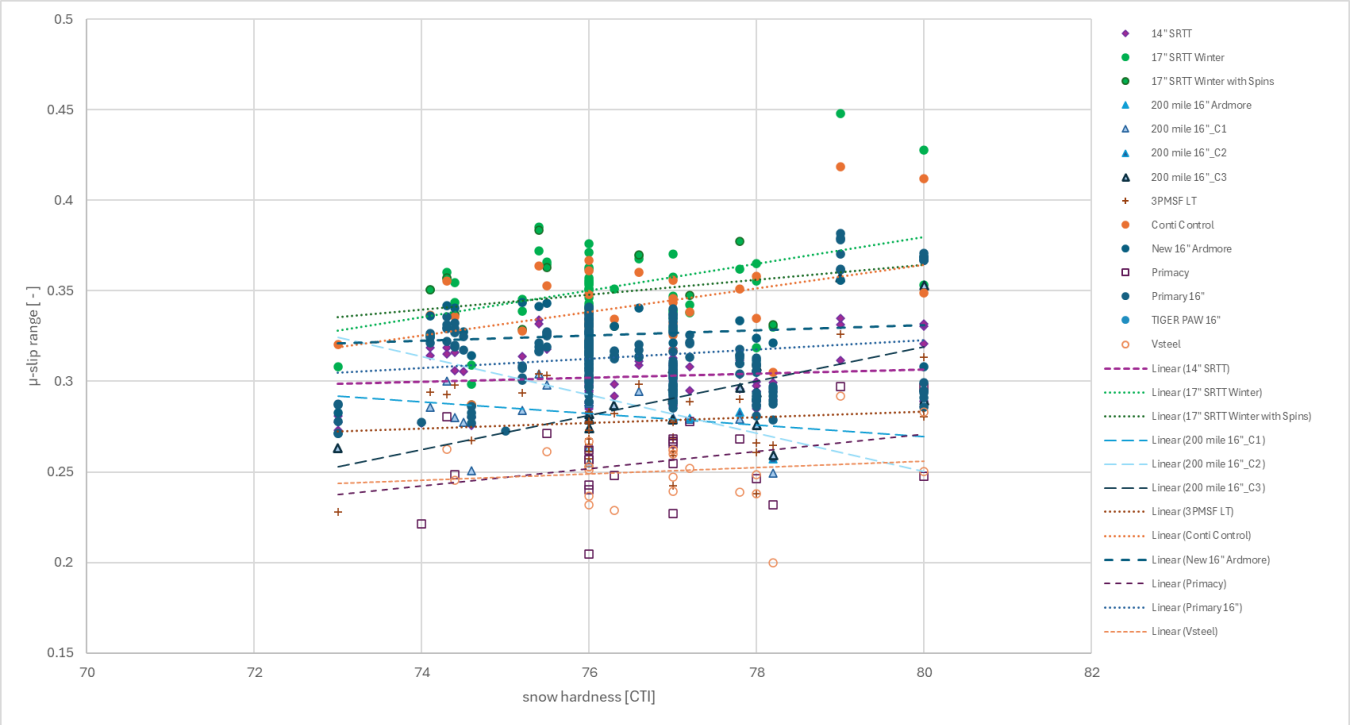
Grip Level

The graph below of ratings vs 17” grip level shows that the 16” SRTT and 14” SRTT have different sensitivities to the snow’s grip level than the 17” winter SRTT. Ratings may change more than 10% as the 17” grip level goes from ~0.3 to ~0.45.



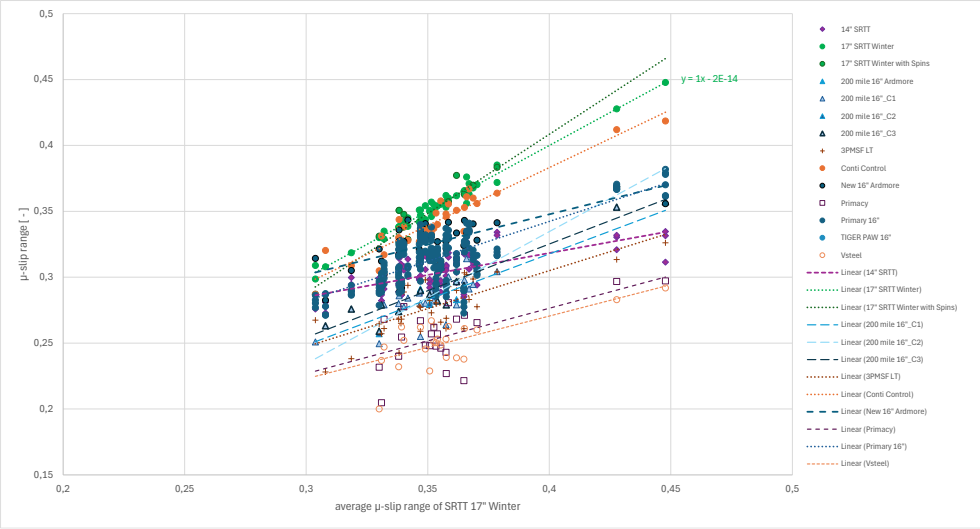
Year – 2025; Locations – 3; Days – 12 per location

The 17” winter SRTT grip level is confounded with CTI, since the 17” winter SRTT usually has more grip at 80 CTI than 73 CTI. Therefore, the sensitivity to CTI is not additive to the sensitivity to grip level. The graph below shows grip level vs CTI and the 17” winter SRTT tends to have a slightly higher slope than the 16” SRTT.

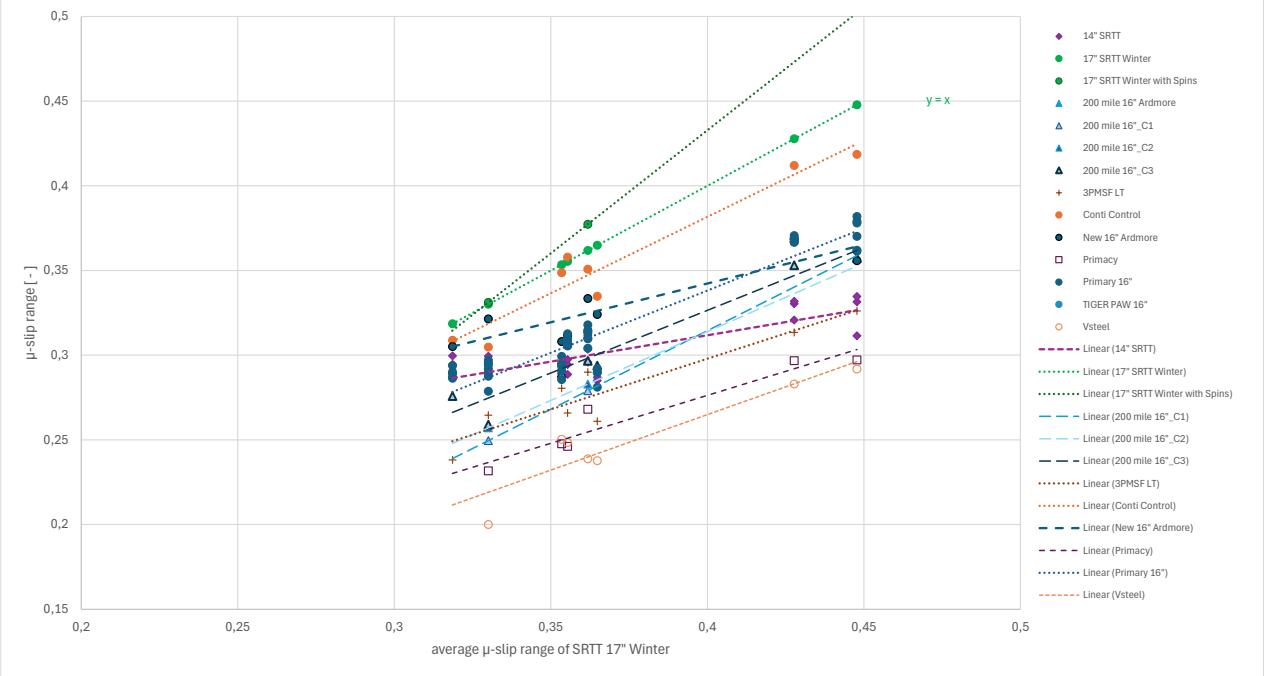


Year – 2025; Locations – 3; Days – 12 per location

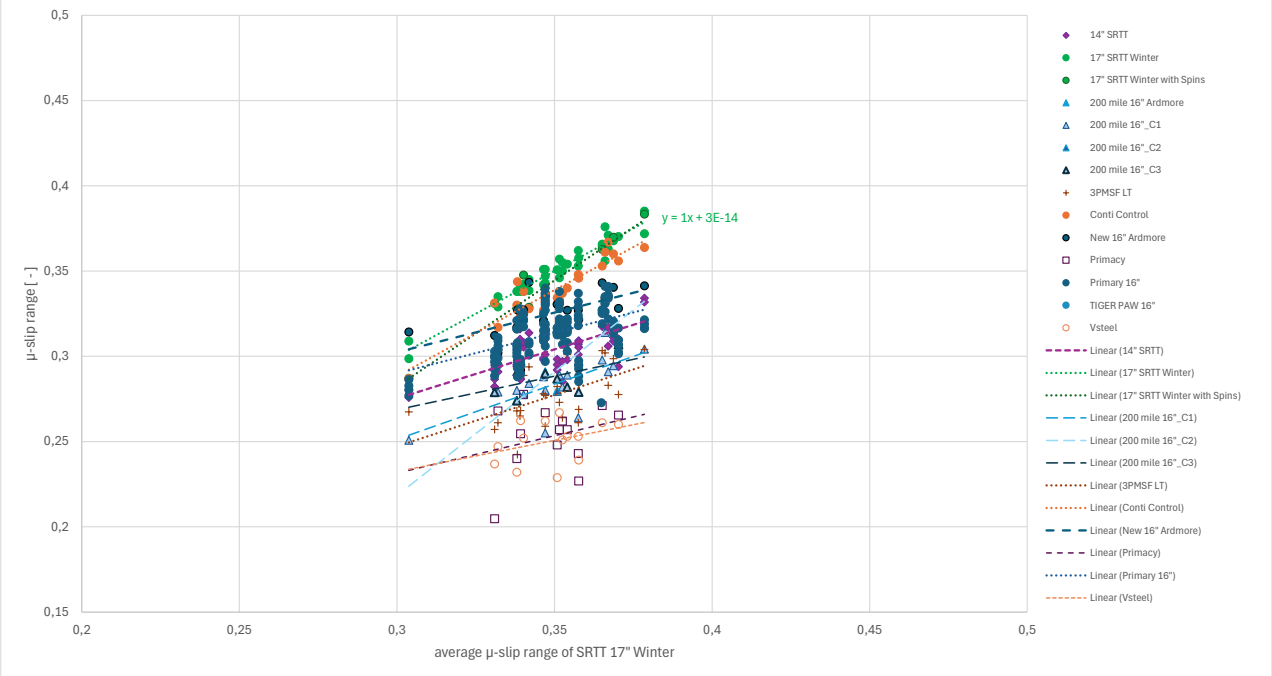
The grip level of all tires vs 17" winter SRTT grip level is shown below for a more advanced understanding of the data. The graph below shows that some snow conditions in study 1 produced higher grip levels for all tires. The grip level of the snow, based on the 17" winter SRTT, will influence the rating of candidate tires in a different way than the 16" SRTT.



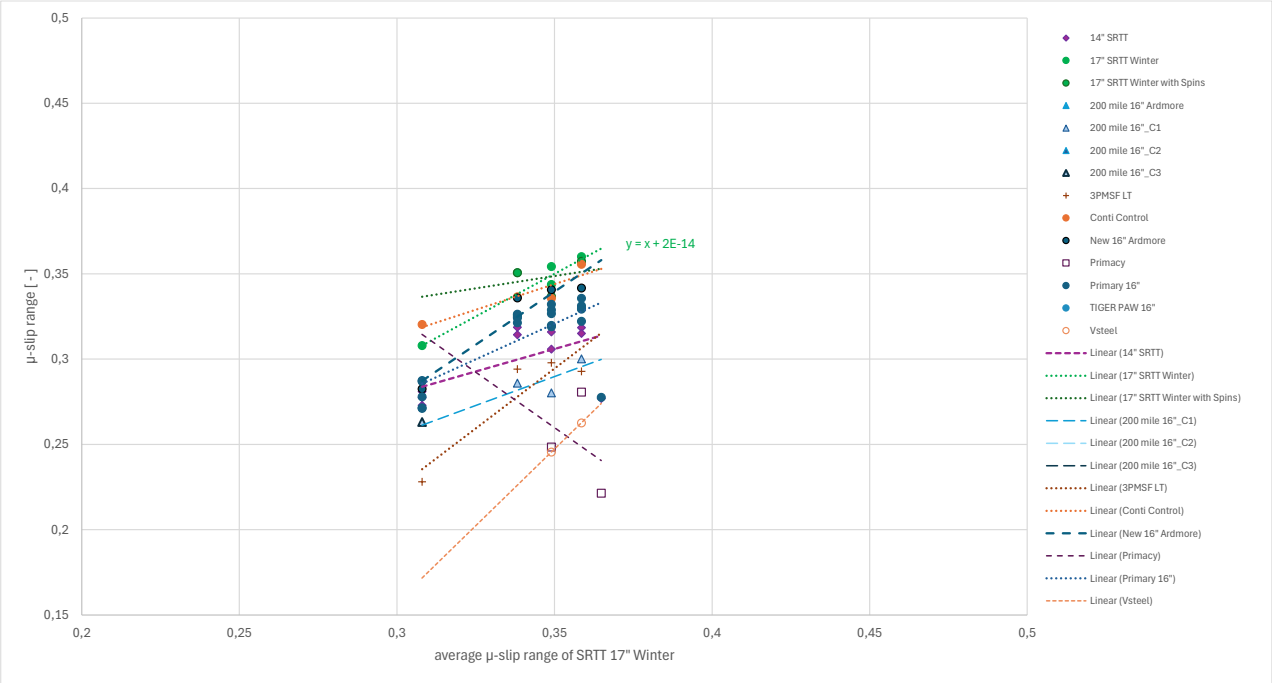
The graphs below are filtered for CTI



for high CTI values



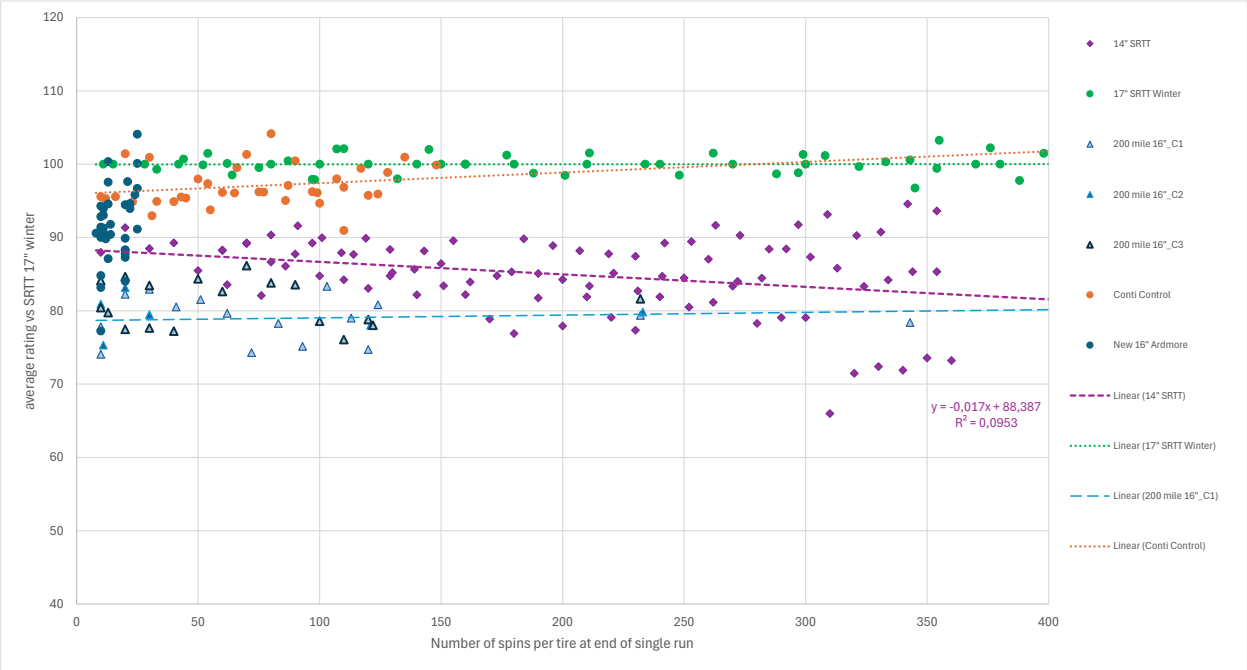
Medium CTI values



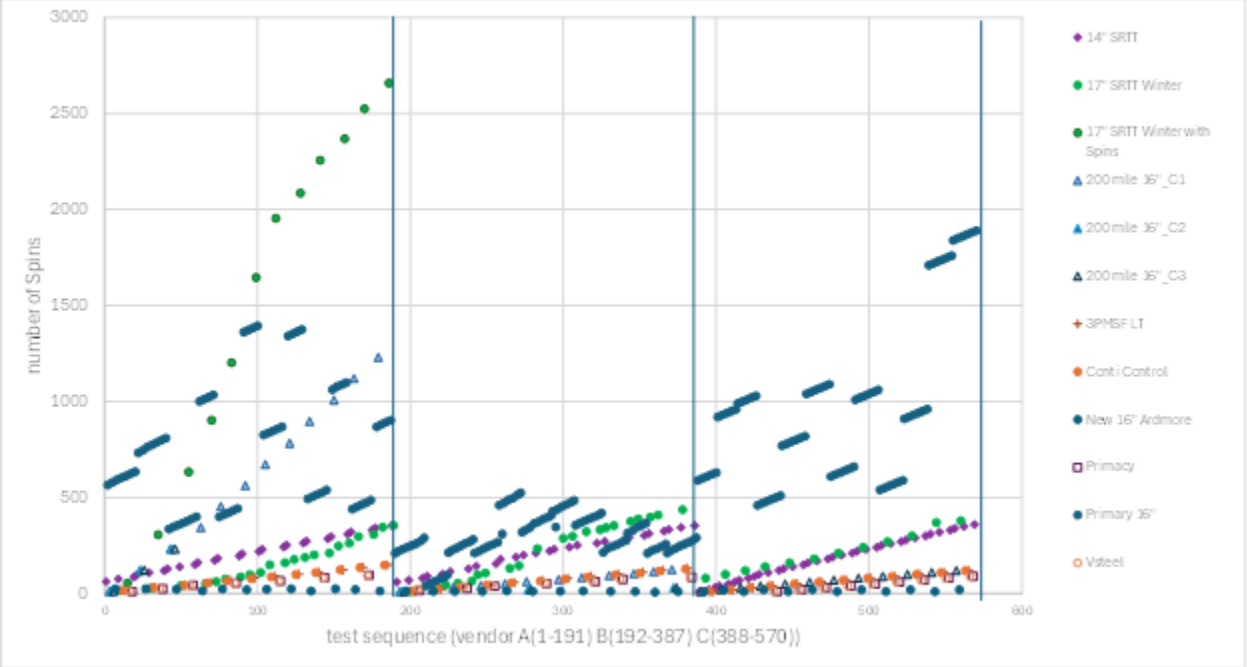
low CTI Values

Number of Spins

Some tires in Study 1 show stable performance with increasing number of spins like the SRTT 17” Winter and the 200 mile 16”, which were studied with high number of spins. The trendline of the five year old SRTT 14” shows a decrease of 6% performance within the first 360 of spins, which is more than expected. The expectation for new SRTT 14” tires from former studies was around 2% decrease per 1000 Spins. It may be confounded with the CTI snow hardness or other environmental factors.



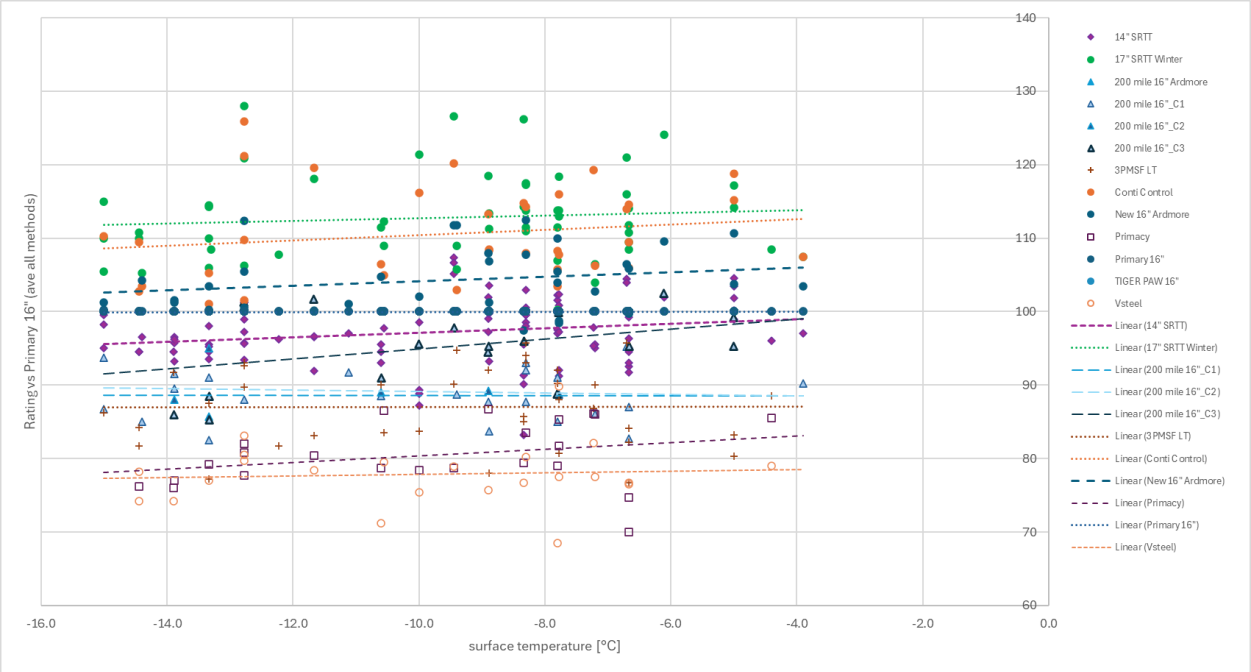
Year – 2025; Locations – 3; Days – 12 per location

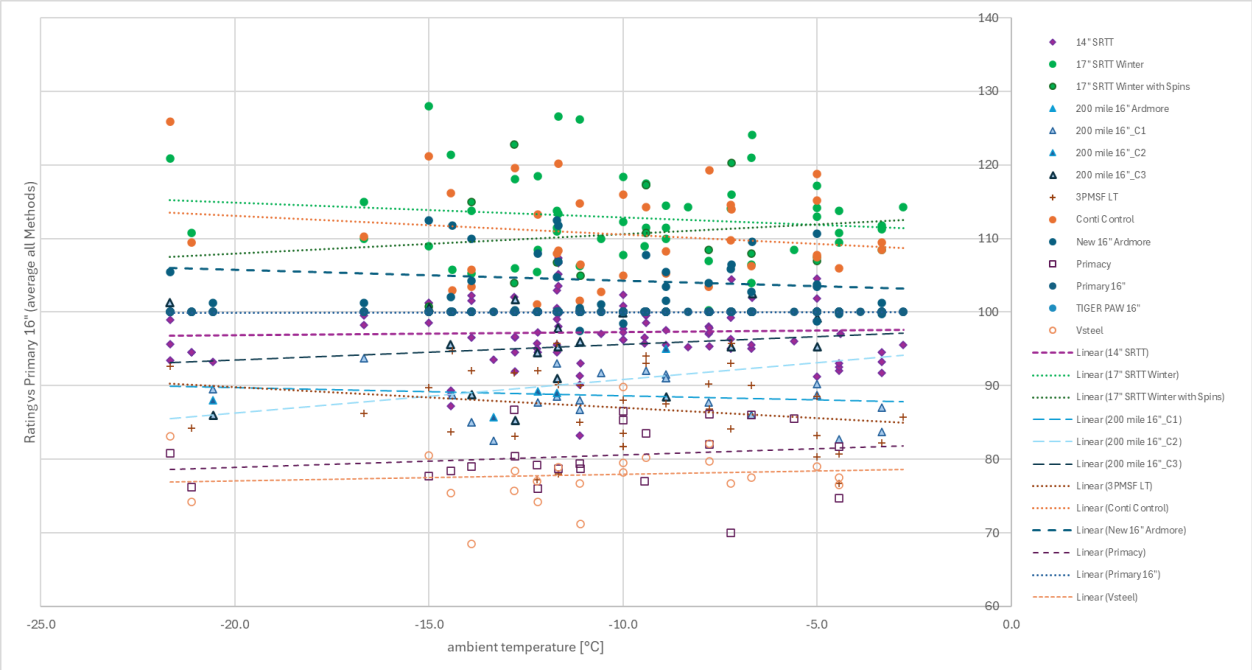


Year – 2025; Locations – 3; Days – 12 per location

Temperature

The change in ratings from -15C to -4C is typically less than the test variation as shown below.



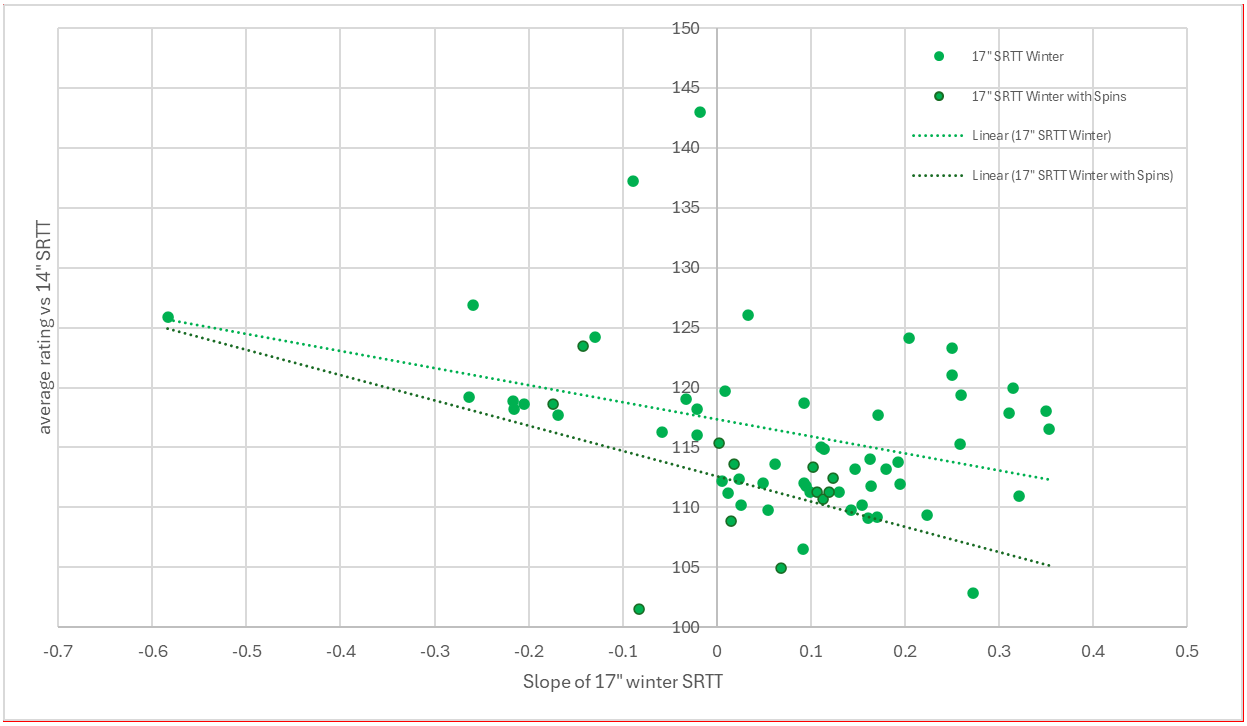


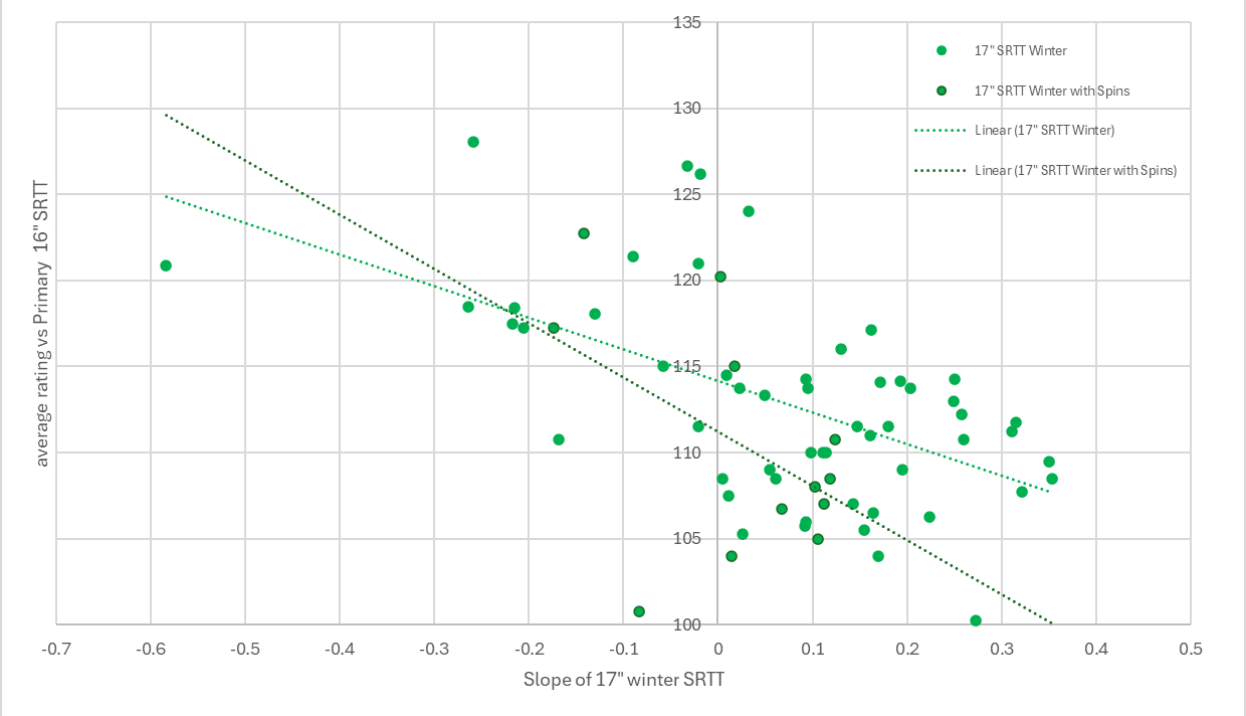
Year – 2025; Locations – 3; Days – 12 per location

Slope

The rating of the 17” winter SRTT vs the 14” and 16” SRTT may have some sensitivity to the slope of the 17” winter SRTT’s mu-slip curve although the trend is not clear. When the

slope is negative in study 1, the average 17”/14” & 17”/16” rating was typically higher. See appendix for additional charts showing the slopes of each tire in study 1.

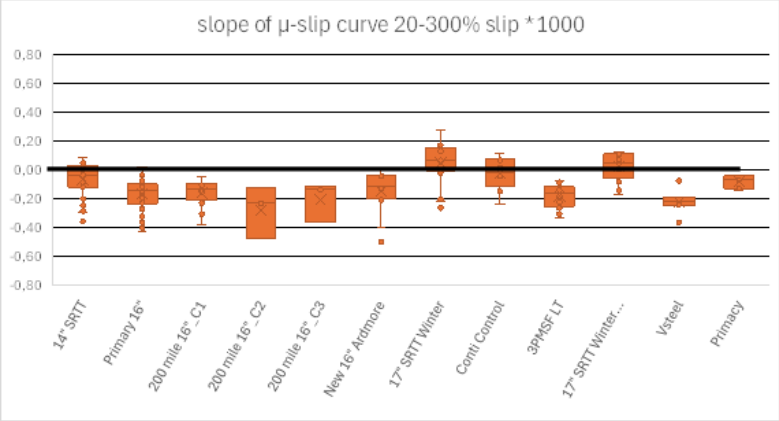




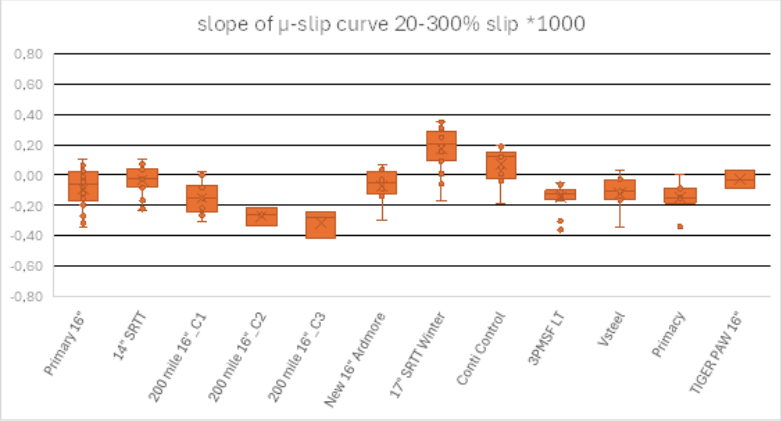
Year – 2025; Locations – 3; Days – 12 per location

The study of the mu-slip curves reveals interesting trends and patterns, however at this time we do not have sufficient information to recommend constraints on the slope in ASTM F1805.

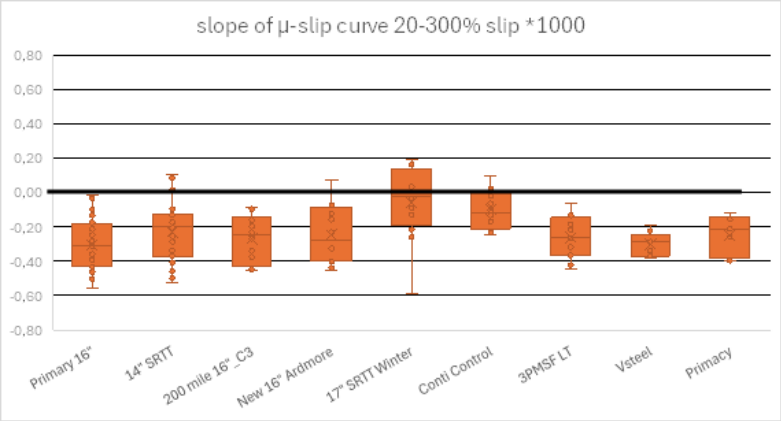
The slope of the 17" winter SRTT in Study 1 is always the highest at all 3 locations, but slopes are different at each location. Typically, the slope of the 17" winter SRTT is in the range of -0.2 to 0.3.



Location A

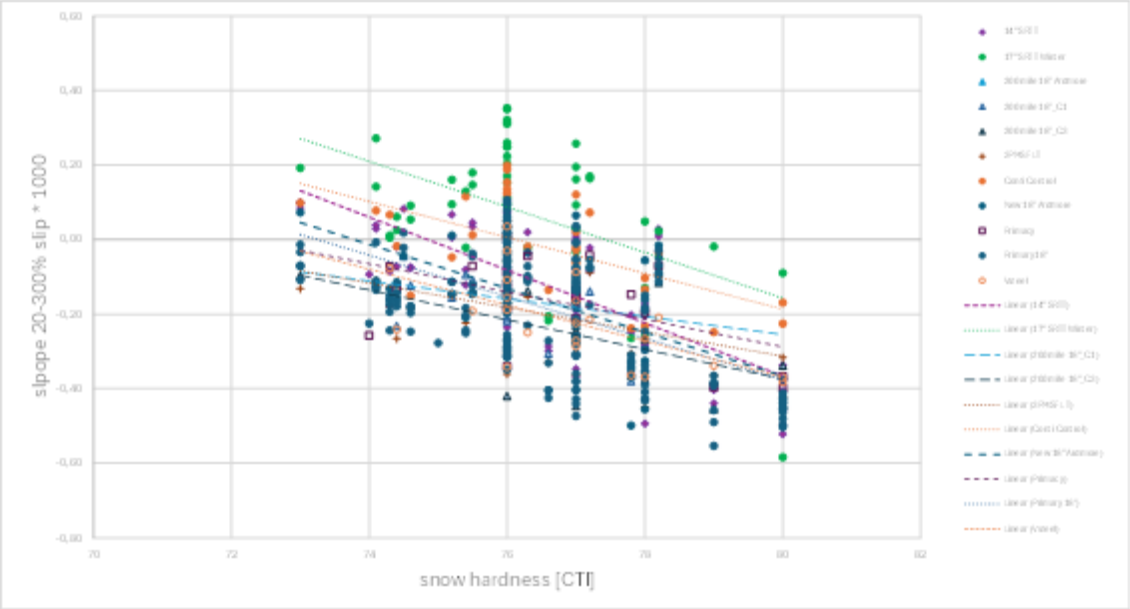


Location B



Location C

The slope of all tires in Study 1 tends to decrease as the snow compaction increases (higher CTI).



Year – 2025; Locations – 3; Days – 12 per location

Including μ-slip curve data in ASTM F1805 reports could generate more understanding and additional analysis in the future.

Objective 8: Establish a 17” winter SRTT grip level range for table A2.1

The driving coefficient limits are provided in table A2.1, and the future table should also include 17” SRTT values for medium compaction snow. Since data for the 17” SRTT has only be collected on medium compaction snow, the other surfaces would not have limits based on the 17” SRTT.

TABLE A2.1 Course Characteristics

NOTE 1—Determining the need for regrooming is largely subjective; however, regrooming is required after the test course has been fully utilized.

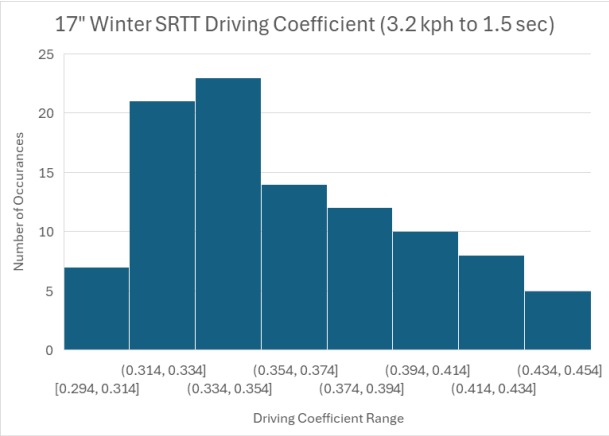
NOTE 2—A packed base is generally obtained by mechanically smoothing and packing the test course and allowing the resultant smooth surface to set up in the overnight cold temperatures (preferably –12°C (10°F) or less).

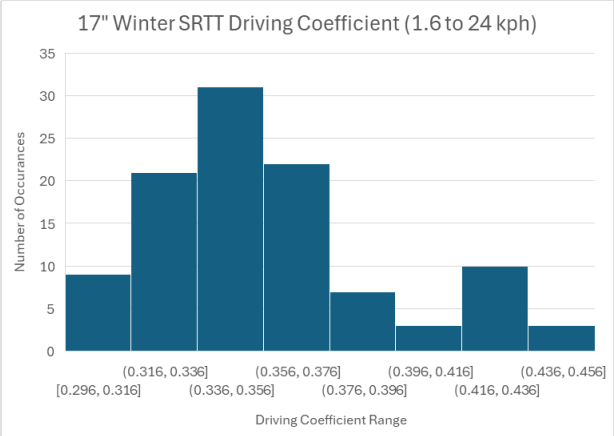
Surface Description	Temperatures			Penetrometer Snow Compaction	SRTT F2493 (SRTT E1136) Driving Coefficient[A]	Surface and Footprint Characteristics[B]	Remarks
		Surface					
	Amb. Max	Min.	Max.				
Soft pack (new) snow	+3°C (+38°F)	–15°C (+5°F)	–4°C (+25°F)	50–70	0.17–0.21 (0.18–0.22)	5.0–7.5 cm (2–3 in.) loose snow. Distinctive footprint.	[C]
Medium pack snow	+3°C (+38°F)	–15°C (+5°F)	–4°C (+25°F)	70–80	0.23–0.38 (0.25–0.38)	2.5–5.0 cm (1–2 in.) loose snow. Distinctive footprint.	[D]
Medium hard pack snow	+3°C (+38°F)	–15°C (+5°F)	–4°C (+25°F)	80–84	0.25–0.38 (0.25–0.36)	1.0–2.0 cm (0.4–0.8 in.) loose snow. Slight footprint.	[E]
Hard pack snow	+3°C (+38°F)	–15°C (+5°F)	–4°C (+25°F)	84–93	0.15–0.23 (0.15–0.20)	No loose snow. Little or no footprint.	[F]
Ice-wet	0°C (+32°F)	–8°C (+18°F)	0°C (+32°F)	93–98	0.06–0.13 (0.06–0.12)	Smooth ice with no loose materials. No footprint.	[G]
Ice-dry	0°C (+32°F)	–20°C (–4°F)	–7°C (+20°F)	93–98	0.08–0.13 (0.06–0.14)	Smooth ice with no loose materials. No footprint.	[G]

[A] See Specification F2493 or E1136.
[B] Footprint characteristics are determined by walking or driving on the prepared surface and examining the extent of the imprint or lack thereof.
[C] Freshly fallen snow or deeply groomed base snow.
[D] Generally obtained by grooming packed base prior to testing in morning.
[E] Typical surface for snow tire/vehicle handling tests.
[F] Packed base with no grooming.
[G] Avoid bright sun on course. Broom or resurface as required.

Options for Estimating Driving Coefficient Limits

For reference, the 17” SRTT grip levels from 2025 at 6 locations are shown below with a **range of about 0.3 to 0.46**. These grip levels represent typical medium snow compaction conditions throughout a winter campaign.

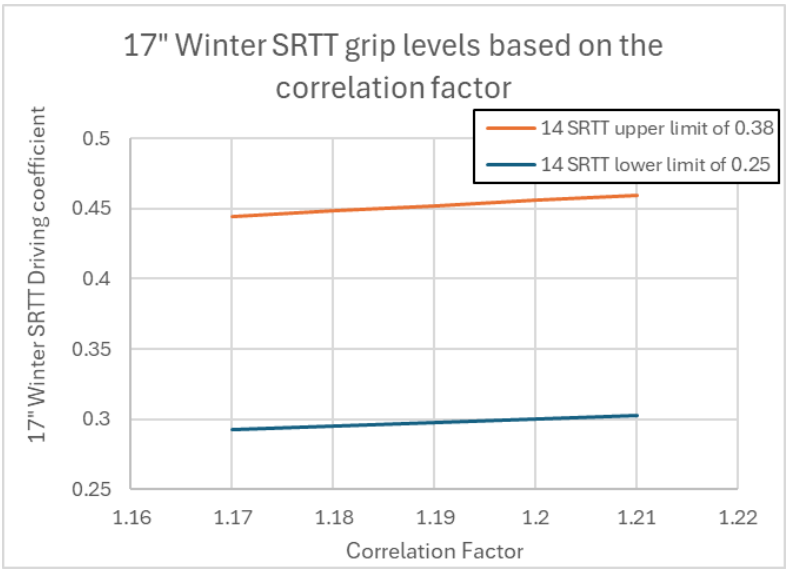




Year – 2025; Locations – 6; Days – 10 to 35 per location; 1 17" per location

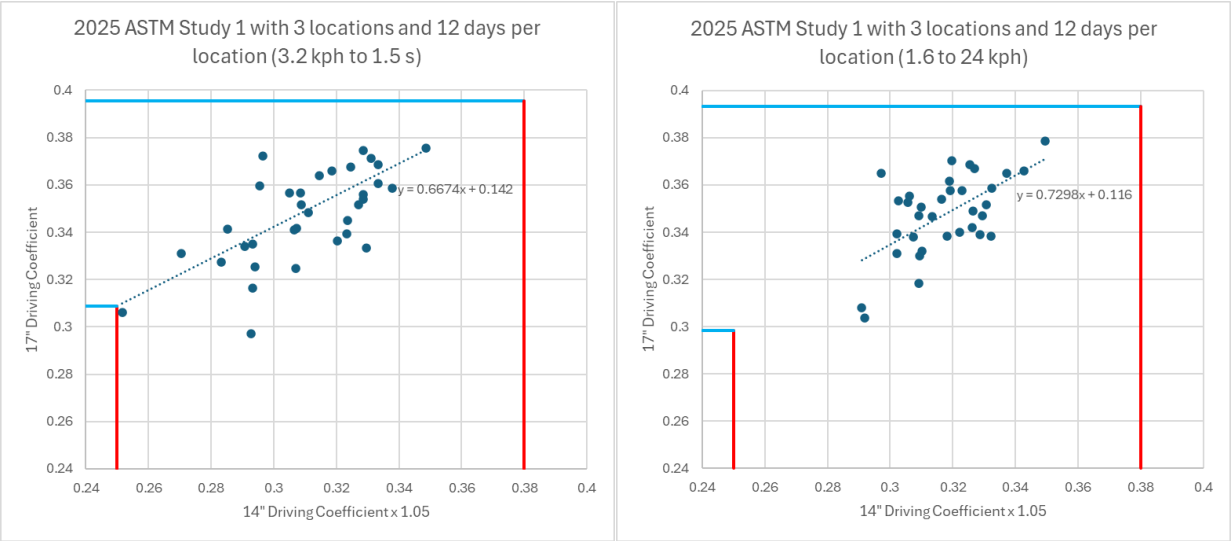
Limits based on 17" to 14" Correlation Factor

Although the correlation factor linking the 17" SRTT to the 14" SRTT could be a function of weather conditions, it's feasible to mathematically calculate the 17" driving coefficient limits based on the 14" SRTT limits. A correlation factor range between 1.17 and 1.21 aligns to the 17" grip limits estimated by the other methodologies in this section of the report. The graph below shows the 17" SRTT upper and lower limits based on the range of potential correlation factors. The 14" SRTT had a lower limit of 0.25 so the 17" limit would be 0.25 x correlation factor (same concept for the 14" upper limit of 0.38). These **limit estimates of ~0.30 to ~0.45** are technically feasible given the typical 17" SRTT driving coefficients measured in 2025.



Limits based on the 17” vs 14” data from Study 1

Study 1 included a 5 year old 14” SRTT, so the 17” SRTT limits can be estimated based on the 14” vs 17” driving coefficients from study 1. The 5 year old 14” SRTT is assumed to have degraded about 5%, so the 14” driving coefficients are multiplied by 1.05 to adjust for the degradation.

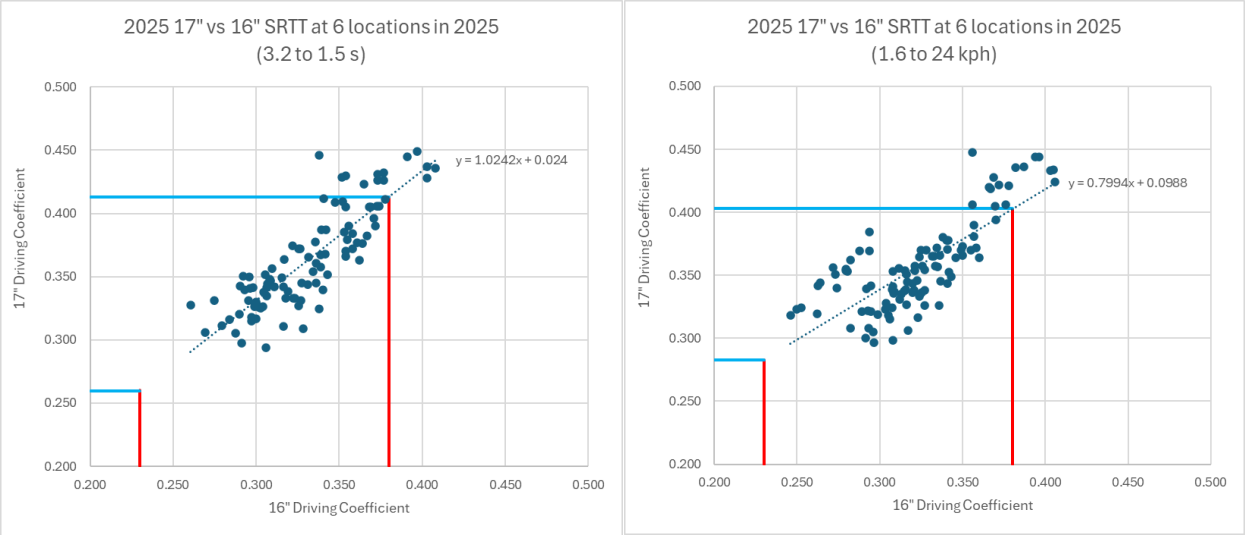


Year – 2025; Locations – 3; Days – 12 per location; 1 14” and 1 17” per location

These **limit estimates of approximately 0.3 to 0.4** could slightly restrict testing conditions based on the 2025 range of 17” SRTT driving coefficients.

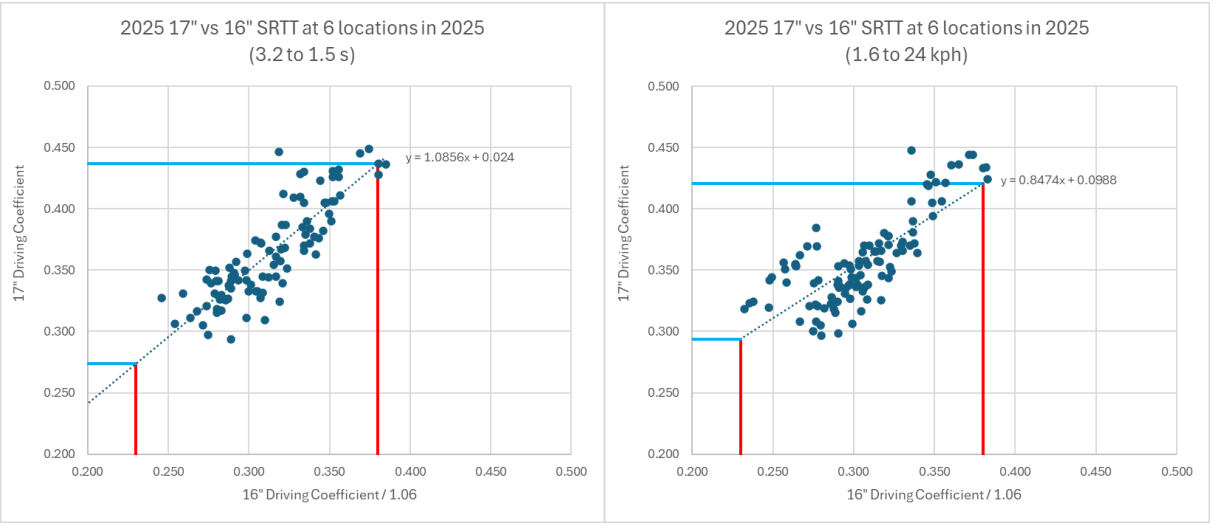
Limits based on 2025 17” vs 16” witness Driving Coefficients

6 locations also collected 16” vs 17” driving coefficients in 2025 which can be used to estimate limits as shown in the graphs below. The 16” SRTT coefficients could also be lowered by 6% to be more similar to the 2017 16” SRTT driving coefficient. During testing, the primary 16” could have degraded and been within the 0.38 limit but after mathematical correction the grip level would increase as shown below.

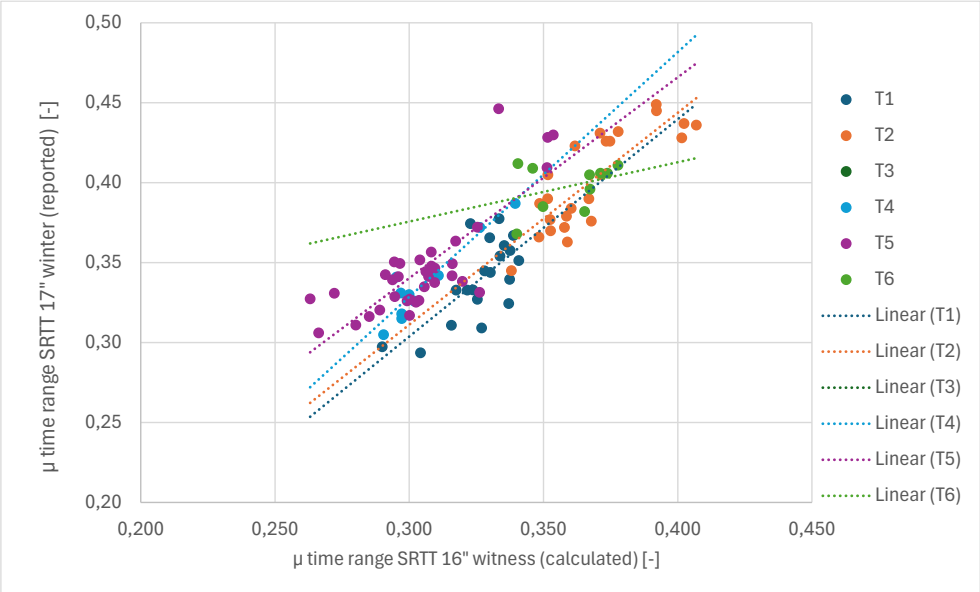


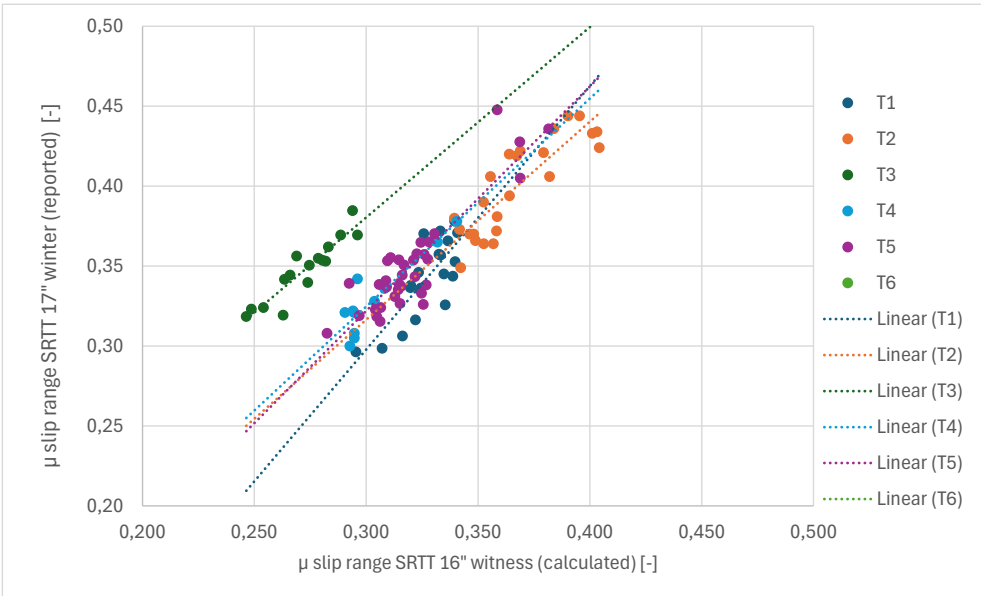
Year – 2025; Locations – 6; Days – 10 to 35 per location; 1 17” per location

The 16” SRTT coefficients could also be lowered by 6% to be more similar to the 2017 16” SRTT driving coefficient. **Adjusting by 1.06 produces estimates of approximately 0.28 to 0.43.**



Year – 2025; Locations – 6; Days – 10 to 35 per location; 1 17” per location





Year – 2025; Locations – 6; Days – 10 to 35 per location; 1 17" per location

μ ranges of SRTT 17" winter vs calculated SRTT 16" winter μ level from daily checks at different testers T1 to T6

Averaging Limit Values and the updated table A2.1

The 3 calculation methods are similar and one is not significantly more accurate than another. Therefore, simply averaging all 3 together as shown in the table below could be considered when selecting future limits.

	Lower	Upper
17" to 14" Correlation Factor	~0.3	~0.45
17" vs 14" Study 1	0.3	0.4

17” vs 16” Witness Checks	0.28	0.43
Average	**0.29**	**0.43**

0.29 to 0.44 is a reasonable range for snow grip levels.

The updated table A2.1 is shown below:

TABLE A2.1 Course Characteristics

NOTE 1—Determining the need for regrooming is largely subjective; however, regrooming is required after the test course has been fully utilized.

NOTE 2—A packed base is generally obtained by mechanically smoothing and packing the test course and allowing the resultant smooth surface to set up in the overnight cold temperatures (preferably –12°C (10°F) or less).

Surface Description	Temperatures			Penetrometer Snow Compaction	SRTT F2493 (SRTT E1136) *SRTT F3675* Driving Coefficient[A]	Surface and Footprint Characteristics[B]	Remarks
	Amb. Max	Surface Min.	Surface Max.				
Soft pack (new) snow	+3°C (+38°F)	–15°C (+5°F)	–4°C (+25°F)	50–70	0.17–0.21 (0.18–0.22)	5.0–7.5 cm (2–3 in.) loose snow. Distinctive footprint.	[C]
Medium pack snow	+3°C (+38°F)	–15°C (+5°F)	–4°C (+25°F)	70–80	0.23–0.38 (0.25–0.38) *0.29-0.44*	2.5–5.0 cm (1–2 in.) loose snow. Distinctive footprint.	[D]
Medium hard pack snow	+3°C (+38°F)	–15°C (+5°F)	–4°C (+25°F)	80–84	0.25–0.38 (0.25–0.36)	1.0–2.0 cm (0.4–0.8 in.) loose snow. Slight footprint.	[E]
Hard pack snow	+3°C (+38°F)	–15°C (+5°F)	–4°C (+25°F)	84–93	0.15–0.23 (0.15–0.20)	No loose snow. Little or no footprint.	[F]
Ice-wet	0°C (+32°F)	–8°C (+18°F)	0°C (+32°F)	93–98	0.06–0.13 (0.06–0.12)	Smooth ice with no loose materials. No footprint.	[G]
Ice-dry	0°C (+32°F)	–20°C (–4°F)	–7°C (+20°F)	93–98	0.08–0.13 (0.06–0.14)	Smooth ice with no loose materials. No footprint.	[G]

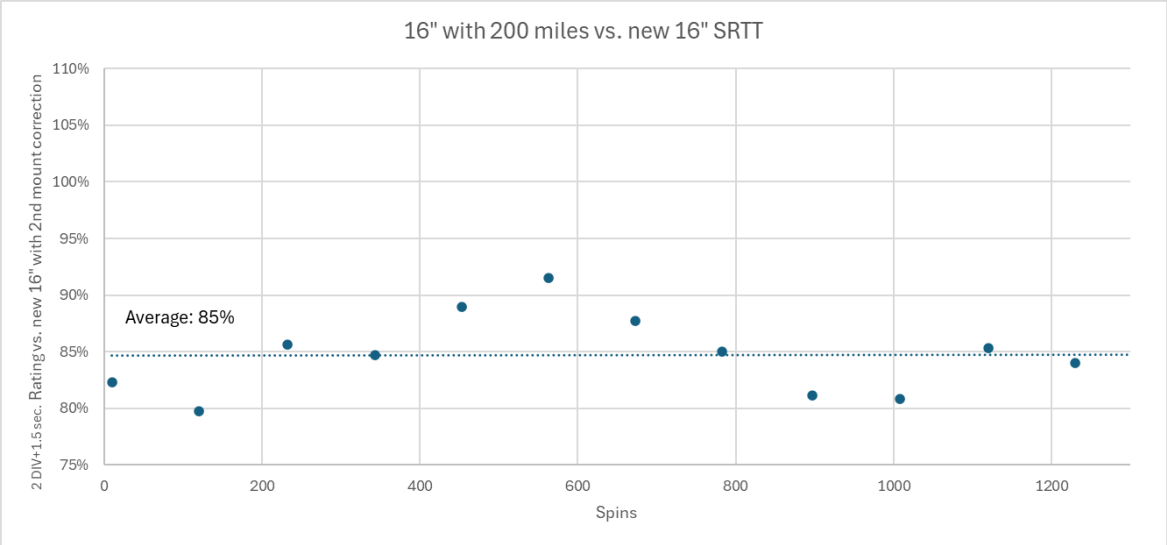
[A] See Specification F2493 or E1136.
[B] Footprint characteristics are determined by walking or driving on the prepared surface and examining the extent of the imprint or lack thereof.
[C] Freshly fallen snow or deeply groomed base snow.
[D] Generally obtained by grooming packed base prior to testing in morning. Coefficients listed are from a new witness SRTT.
[E] Typical surface for snow tire/vehicle handling tests.
[F] Packed base with no grooming.
[G] Avoid bright sun on course. Broom or resurface as required.

Objective 9: Quantify the relative level, change, and stability of performance of multiple 16” SRTTs with 200 miles break-in.

A: 200-mile 16” SRTT evolution over spins

The 16” SRTT with 200-mile preconditioning is measured against a 16” primary SRTT 12 times with approximately 100 spins added between observations up to 1200 total spins for the final observation. New 16” SRTT observations are performed each day to measure the primary SRTT performance level. The primary SRTT is used following the best practice recommendation for 2025 and replaced when the witness observation falls outside the recommended performance window.

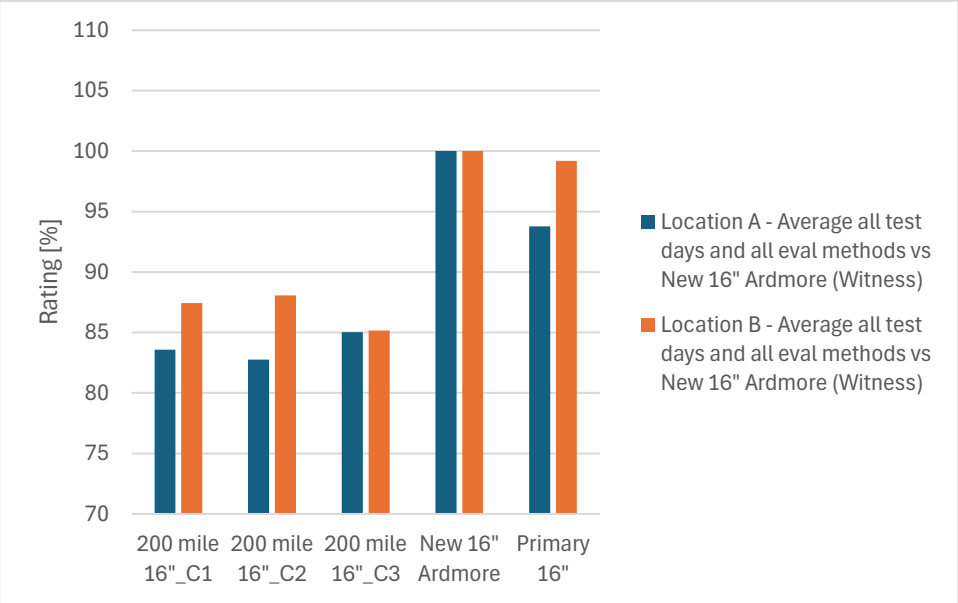
The 200 mile- 16” SRTT showed a 12% range in performance at one location when rated directly back to a new 16” SRTT over the 1250 spins. The trendline in the graph below indicates little evolution in the 200 mile 16” SRTT performance with added spins. The 16” SRTT without preconditioning showed a 10% degradation with 1800 added spins vs. a new 16” SRTT in 2023 studies.



Year – 2025; Days - 12; Locations – 1; 1 tire vs 1 tire

B: Compare resulting performance level of different 200-mile break-in circuits

The graph below shows a similar performance of 200-mile 16” SRTTs broken in on 3 different circuits. At location A the performance of the three circuits is 84%, 83%, 85%. At location B the performance of the three circuits is 87%, 88%, 85%.



Year – 2025; Days – 3 to 12; Locations – 2; 1 tire per circuit per location

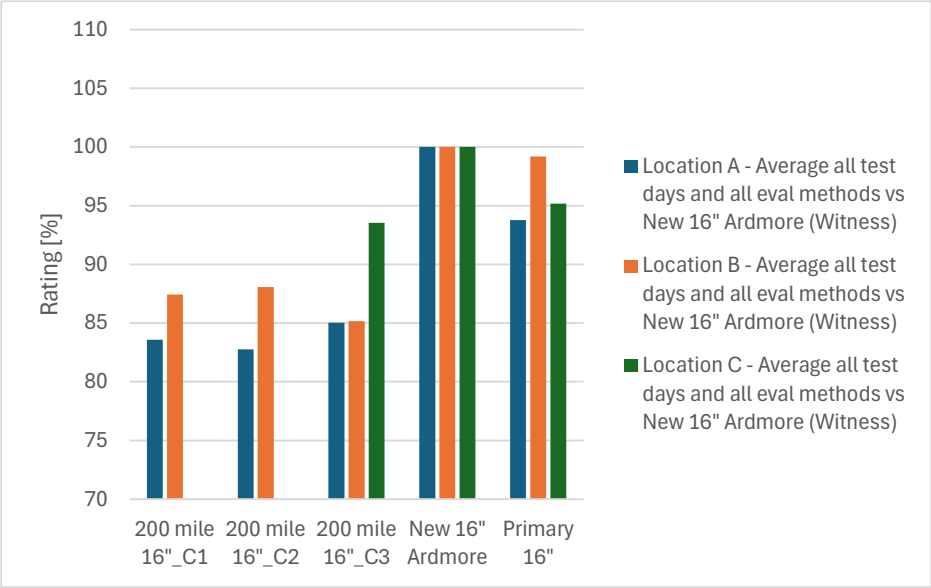
The pictures below show the same 16” SRTT in the new state and after 200 mile preconditioning. The 200 mile preconditioning appears to remove some of the sharp edges of the tread as well as the mold flashes seen on the new tire.

New 16” SRTT

200-mile 16” SRTT

C: Performance level vs 16” witness at three locations

The graph below shows the performance of the 200-mile 16” SRTT vs a witness 16” SRTT. The performance at three locations is 84%, 85%, and 94% vs a “new” 16” SRTT. The influence of tire conditioning seems to depend on the snow conditions of each location. See appendix for more details.



Year – 2025; Days – 3 to 12; Locations – 3; 1 tire per circuit per location

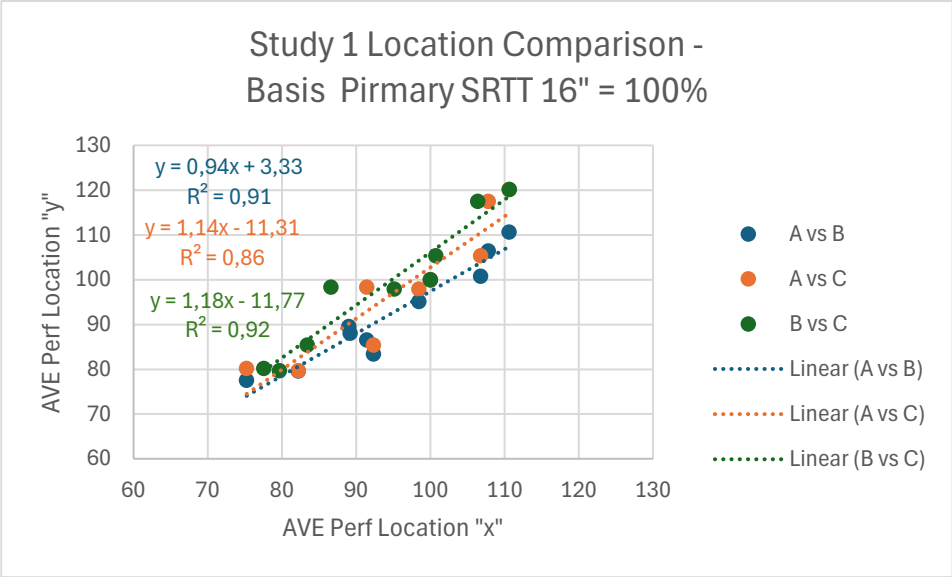
Study 1 - Average performance of 200 mile 16" SRTT vs New 16” Ardmore SRTT- all locations (A,B and C)

D: Performance level vs 14” SRTT at three locations

The performance of the 200-mile 16” SRTT vs a 5 year old 14” SRTT. The performance at three locations is 92%, 93%, and 100% vs a 5 year old 14” SRTT.

E: Correlation between locations A, B and C

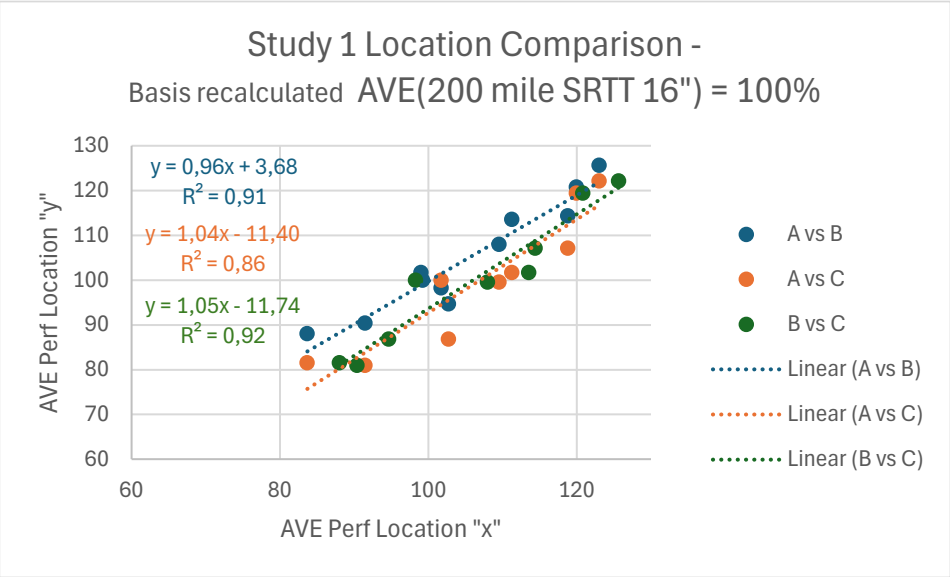
To compare the results of the different locations directly a correlation plot is generated with the average performance rating of all four available evaluation methods for each location. The comparison is done by correlating the results of Location A vs the results of Location B, A vs C and B vs C to cover all 3 possible combinations. To judge the correlation the functions for the linear regressions are determined. If the slope of the correlation is equal to *1,00*, the spread of the test field is the same for both locations.



Year – 2025; Locations – 3; Days – 12; All tires in Study 1

Figure 1 - Study 1 - Correlation between Locations A, B, C - Basis Primary 16" = 100% for each location

If the Primary 16” is used as basis the slopes of the correlations are not equal to 1. The comparison of A vs B leads to *0,94*, A vs C to *1,14* and B vs C to *1,18 (see* Figure 1*)*.



Year – 2025; Locations – 3; Days – 12; All tires in Study 1

Figure 2 - Study 1 - Correlation between Locations A, B, C – Basis average of 200 mile SRTT 16" = 100% for each location

Taking driven-in 200 mile SRTT 16” as basis (average of all 200 mile tires, if more than one tested at the location, as in direct comparison they were all very similar) the comparison between different locations is much better. The slopes of the correlations are much closer to 1 (range of 0.96-1.05). indicating a much more similar spread for the overall test field at the different locations (see Figure 2). Therefore, the sensitivity by location of the new Ardmore SRTT 16” is reduced by performing a 200-mile preconditioning on the tire. the simple drive in of the SRTT 16” with 200 miles is stabilizing the spread of the overall test field for the different locations to a significantly more comparable level.

To quantify this improvement, we look at the average deviation of the location slopes from the perfect slope 1.00 (ideal correlation between two locations), see bottom of **Error! Reference source not found.**:

For Primary 16” as basis:

Deviation slope A vs. B: |1.00-0.94|= 0.06

Deviation slope A vs. C: |1.00-1.14|=0.14

Deviation slope B vs. C: |1.00-1.18|=0.18

Average Deviation: (0.06+0.14+0.18)/3=0.127

For 200 miles broken-in SRTT 16”as basis:

Deviation slope A vs. B: |1.00-0.96|= 0.04

Deviation slope A vs. C: |1.00-1.04|=0.04

Deviation slope B vs. C: |1.00-1.05|=0.05

Average Deviation: (0.04+0.04+0.05)/3=0.043

Improvement by using 200-miles broken-in 16” as basis:

(0.127-0.04)/0.127=0.685

The correlation between locations A, B and C is increased by 69% when using the 200 mile SRTT 16” as basis (set to 100%) instead of the primary SRTT 16” as basis.

Objective 10: Provide analysis of potential reproducibility improvements.

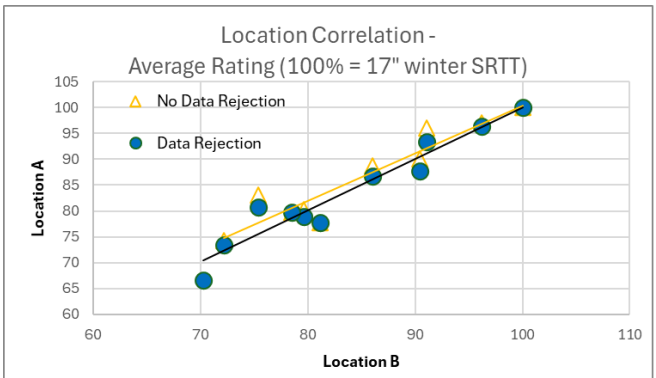
A: It is probably not feasible to adjust tire performance ratings based on the difference in snow hardness sensitivity between the candidate tire and the reference tire (primary SRTT).

The ratings of a candidate tire could change **more than 10%** as the snow compaction changes from the 73 to 80 CTI. The difference in sensitivity depends on the candidate tire and the primary SRTT. It is not easy to determine which candidate tires have different sensitivity than the reference tire, and therefore applying a mathematical correction based on the candidate tire is probably not feasible.

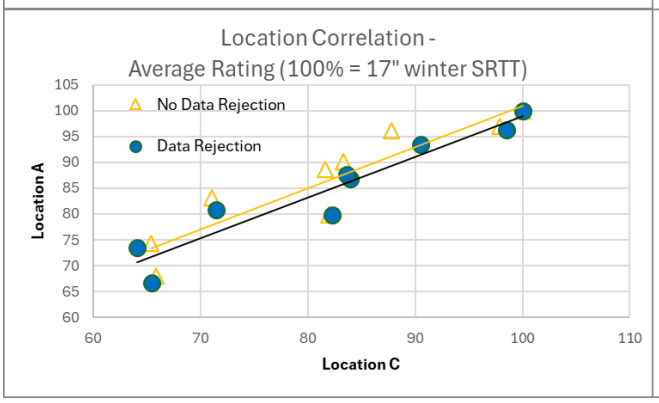
Refer to Objective 7 for more details about the sensitivity of CTI and other snow conditions.

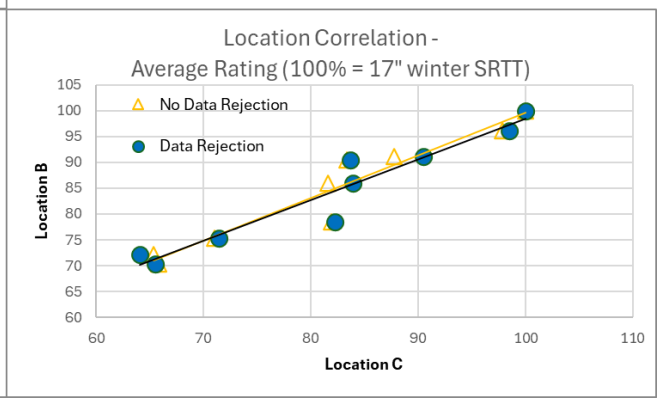
B: Using a snow Surface Rating Monitoring Tire at each test site with known performance vs the control tire did not improve reproducibility of results in study 1. Track monitoring tires are still a recommended best practice.

When calculating study 1 ratings using the 17" winter SRTT, the overall average rating of a "new" 2024 16" SRTT from the three locations was 92. Each day, a snow surface could be considered to produce reasonable ratings if the "new" 16" SRTT rating was 92 +/- 5. The graphs below show the average ratings with and without data rejection, however data rejection usually doesn't change the average significantly. The average delta to slope of 1 was originally 0.89 and became slightly less reproducible (1.28) after rejecting data as shown below.



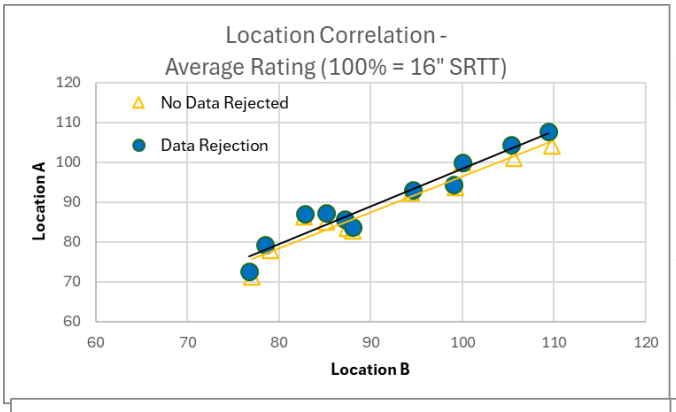
correlation slope between locations - Best fit = 1.00		
A vs B	0.93	0.066
A vs C	1.15	0.147
B vs C	1.17	0.171
	Average d	**0.128**



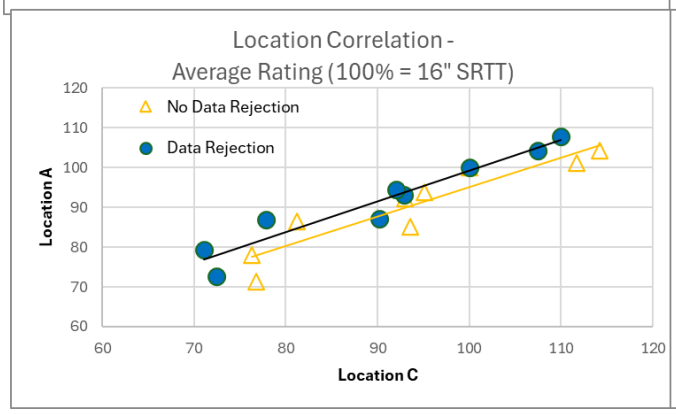


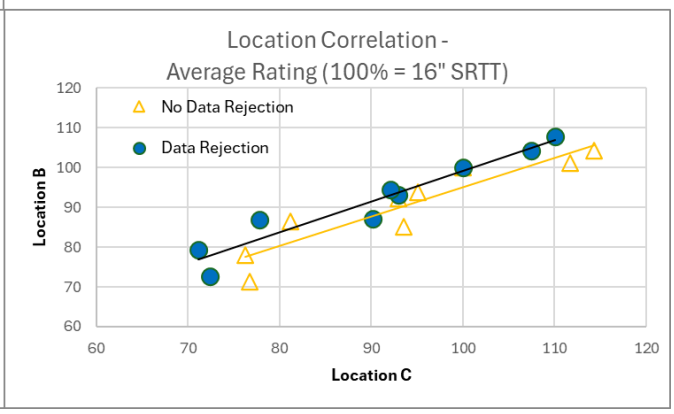
When calculating study 1 ratings using the "new" 2024 16" SRTT as base 100, the overall average rating of a 17" winter SRTT from the three locations was 109. Each day, a snow surface could be considered to produce reasonable ratings if the 17" winter SRTT rating was 109 +/- 5. The graphs below show the average ratings with and without data rejection, however data rejection usually doesn't change the average significantly. The average delta

to slope of 1 was originally 0.94 and became slightly less reproducible (1.20) after rejecting data as shown below.

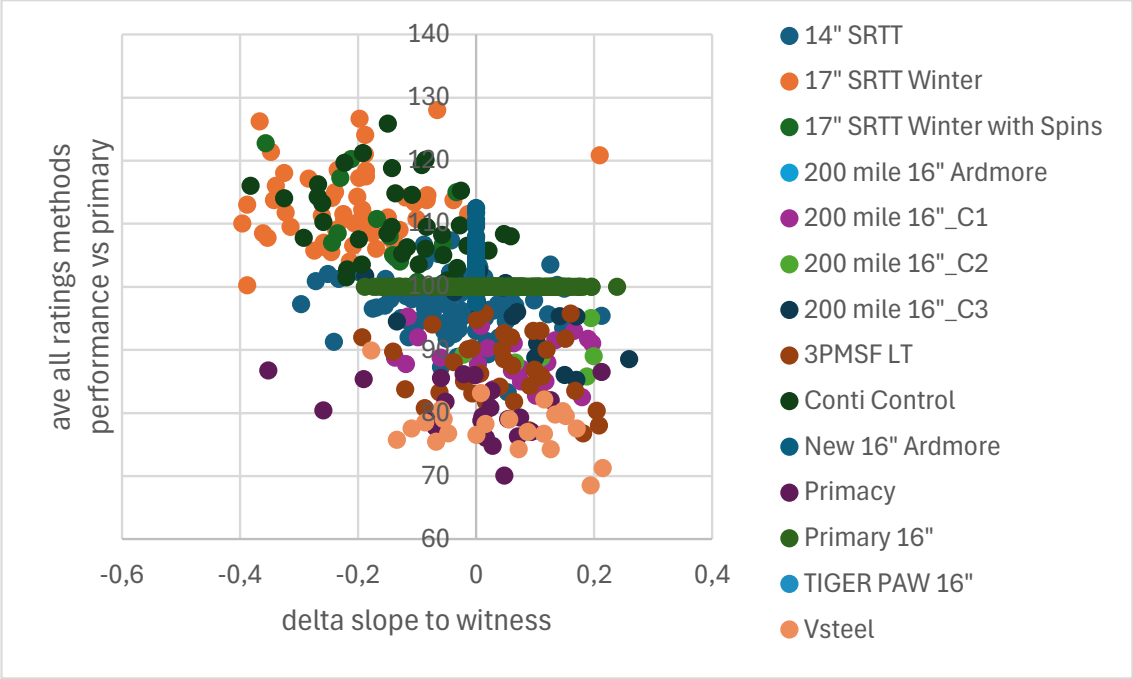


correlation slope between loca		Abs (delta to 1.0)
A vs B	0.99	0.014
A vs C	1.20	0.195
B vs C	1.15	0.150
	Average d	**0.120**





C: Setting boundaries for curve shapes of μ slip curves could possibly improve reproducibility of results between different locations.



Year – 2025; Locations – 3; Days – 12; All tires in Study 1

Figure 3 - average rating of tire variants vs delta slope (= slope witness - slope candidate) in μ slip curves (different weighting of different vendors for different tires included) E.g. a negative delta value means that the tire's mue-slip curve inclines relative to the witness' mue-slip curve

Year – 2025; Locations – 3; Days – 12; All tires in Study 1

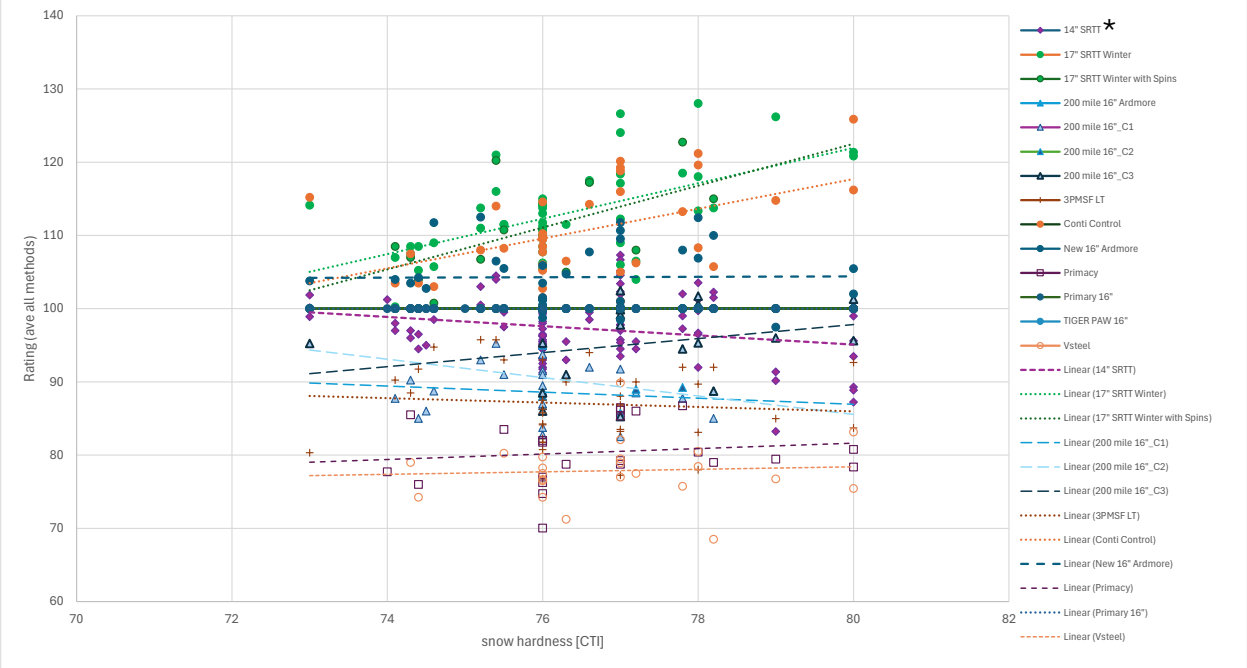
Figure 3 shows comparison of the μ-slip curve slope of various tire types vs the New 16" Ardmore (Witness). The calculated value delta slope is the difference between the slope value of the witness and the slope value of the candidate. The New 16" Ardmore have a range on the zero delta slope line (vertically aligned blue dots), because it is the reference for the slopes. The reference for the performance ratings is the Primary 16" (horizontally aligned green dots). Looking at the various results of the tested tire types the negative delta slope values show a higher performance rating and the positive delta slope values a lower one. This means tires where the μ-slip slope increases relative to the witness slope generate better performance ratings and vice versa tires where the μ-slip slope decreases relative to the witness slope generate lower performance ratings.

D: Modified CTI limits did not improve reproducibility based on Study 1 results between different locations.

Perhaps one option to improve reproducibility and have a more stable correlation factor is to constrain the snow conditions more than is currently allowed in ASTM F1805-20. A dedicated study in 2026 could help to define feasible constraints on snow conditions. The improvement to reproducibility depends on which tires are selected in the study as well as the range of snow conditions specified because the rating sensitivity to snow conditions is a function of how differently the candidate tire reacts vs the control tire.

The reproducibility of ASTM F1805 will probably not change significantly by just changing from the 16" SRTT to the 17" winter SRTT because each tire has a different sensitivity to snow conditions.

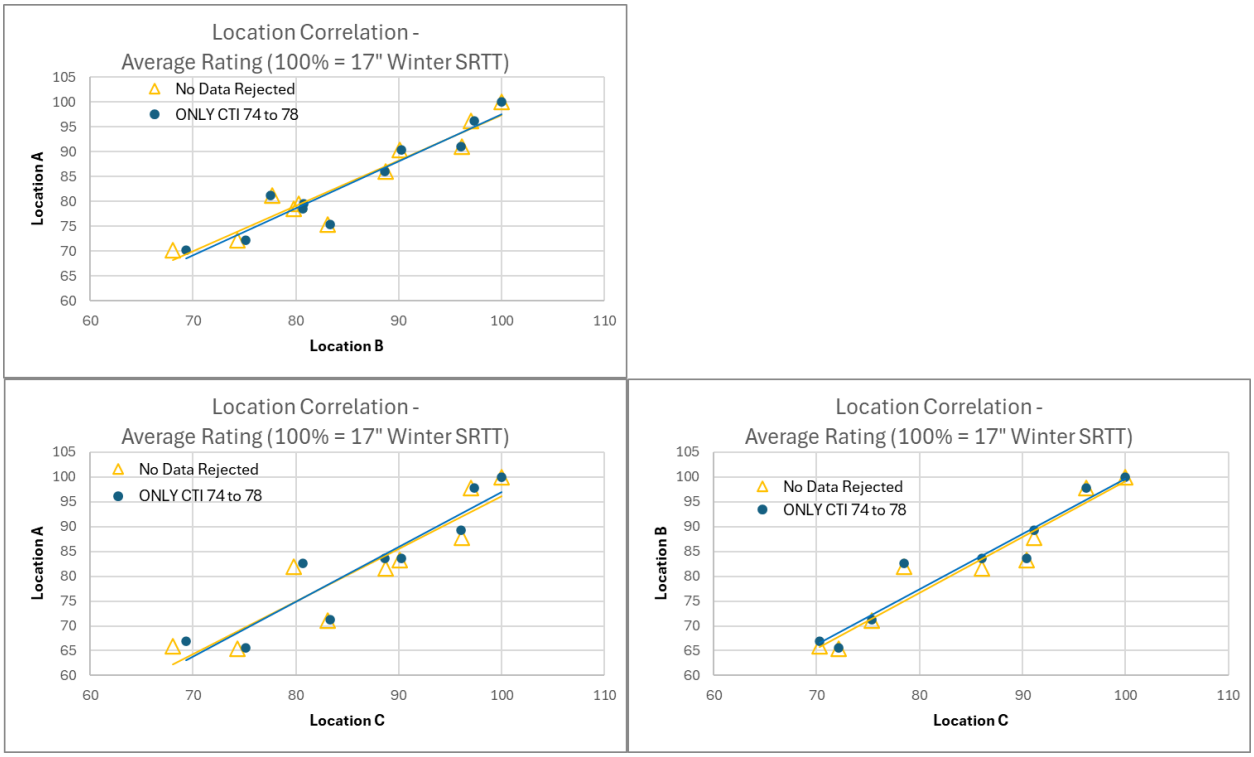
The following **Error! Reference source not found.**shows ratings of study 1 for all locations vs snow hardness CTI.



Year – 2025; Locations – 3; Days – 12; All tires in Study 1

Figure 4 - Study 1 average rating vs snow hardness CTI (different weighting of different vendors for different tires included)

The site to site correlation remains virtually the same after removing data with CTI values above 78 and below 74, however this could be because only ~13% of the data was outside of those limits. Only 5 out of 36 days of data was removed since those days had CTI values outside of 74-78. 1, 0 and 4 days of data were removed from location A, B & C respectively.



Theoretically, limiting the average CTI values to a more narrow range would improve reproducibility when comparing data from CTI of 73 vs 80. Therefore it is recommended to further study this topic.

E: Using more than one correlation factor would probably not improve reproducibility.

Since we know the correlation factor changes with CTI, we could set the correlation factor to 1.16 when the CTI is equal to or below 76 and 1.20 when the CTI is above 76. However, this would not improve the reproducibility for the Conti Control tire because the it typically always has a rating of about 97 vs the 17" winter SRTT. An example is shown below.

Conti Control: CTI = 76; 97 x 1.16 = 112.5

Conti Control: CTI = 77; 97 x 1.20 = 116.4

Therefore, the Conti Control rating would change by 4% simply because of the math. The reproducibility of ASTM F1805 may not improve by using multiple correlation factors because it may not be feasible to determine which tires require different correlation factors.

Appendix 1: Test Plan Detail

Study 1: Overview test program and results

In study 1, different vendors A, B, C tested different tire types listed in the table below (row labels). The numbers show how often each tire type was tested during the 12 single test days at each vendor. Depending on the test sequence chosen by the vendor, the number is varying mainly between 3 and 80. (The TIGER PAW 16” is a secondary SRTT 16” tire, which was used next to Primary 16”, New 16” Ardmore (Witness) additionally by vendor B on two test days.) Overall the Primary 16” tire was tested the most times due to the standard sequence using Primary, Candidate 1, Candidate 2, Primary, Candidate 3, … . Sometimes single Candidates were tested before the first bracket of the primary, having no gradient corrected evaluation values, but just average evaluation.

Row Labels	A	B	C	Grand Total
14" SRTT	27	27	36	90
17" SRTT Winter	21	21	12	54
17" SRTT Winter with Spins	12			12
200 mile 16"_C1	12	12		24
200 mile 16"_C2	3	3		6
200 mile 16"_C3	3	3	12	18
3PMSF LT	12	12	12	36
Conti Control	12	12	12	36
New 16" Ardmore	12	12	12	36
Primacy	7	7	9	23
Primary 16"	61	80	69	210
TIGER PAW 16"		2		2
Vsteel	7	7	9	23
Grand Total	**189**	**198**	**183**	**570**

Figure 5 - Table 1: Study 1 overview test list with number of repetitions of single tire variants (in automatic pivot table order by row label name)

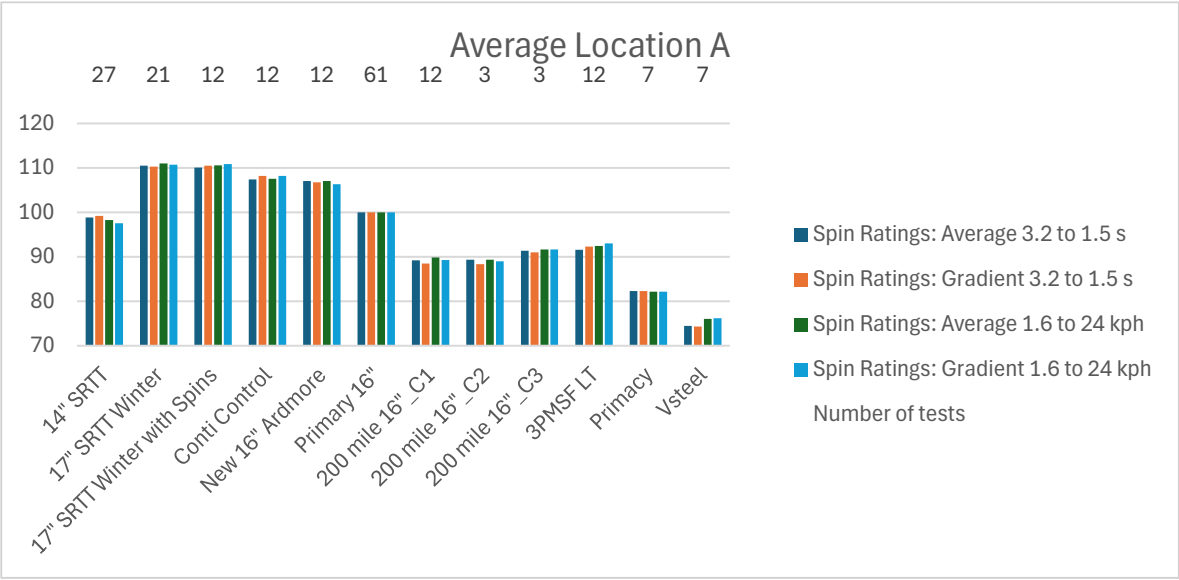
	A												A Total	B												B Total	C												C Total	Grand Total
Row Labels	1	2	3	4	5	6	7	8	9	10	11	12		13	14	15	16	17	18	19	20	21	22	23	24		25	26	27	28	29	30	31	32	33	34	35	36		
14" SRTT	3	3	3	2	2	2	2	2	2	2	2	2	27	3	2	2	2	2	3	2	2	2	2	2	3	27	3	3	3	3	3	3	3	3	3	3	3	3	36	90
17" SRTT Winter	1	1	1	2	2	2	2	2	2	2	2	2	21	1	2	2	2	2	1	2	2	2	2	2	1	21	1	1	1	1	1	1	1	1	1	1	1	1	12	54
17" SRTT Winter with Spins	1	1	1	1	1	1	1	1	1	1	1	1	12																											12
200 mile 16"_C1	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	12														24
200 mile 16"_C2	1	1	1										3	1					1						1	3														6
200 mile 16"_C3	1	1	1										3	1					1						1	3	1	1	1	1	1	1	1	1	1	1	1	1	12	18
3PMSF LT	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	12	36
Conti Control	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	12	36
New 16" Ardmore	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	12	36
Primacy	1	1	1		1		1		1		1		7	1		1	1		1		1	1	1		1	7			1	1	1	1	1	1	1	1	1		9	23
Primary 16"	7	7	7	4	5	4	5	4	5	4	5	4	61	8	6	7	6	7	8	7	7	6	5	5	8	80	5	5	5	6	6	6	6	6	6	6	6	6	69	210
TIGER PAW 16"															1						1					2														2
Vsteel	1	1	1		1		1		1		1		7	1		1	1		1		1	1	1		1	7			1	1	1	1	1	1	1	1	1		9	23
Grand Total	20	20	20	13	16	13	16	13	16	13	16	13	189	20	15	17	16	15	20	15	18	16	13	13	20	198	13	13	13	16	16	16	16	16	16	16	16	16	183	570

Figure 6 - Table 2: Study 1 overview test list with number of repetitions of single tire variants per single test day

As all the tests are performed in the test sequence with the highest quality for evaluation of the variants in direct comparison vs the primary SRTT 16", this is the first view to look at for the different vendors in the next diagrams. The list of the variants is sorted in a different order than alphabetical to do most relevant comparisons in an easier way.

In the average of all locations different weighting for different locations of the different variants due to different number of tests per variant is included. Therefore, we need to look at the results of the different locations in more detail.

Location A Analysis



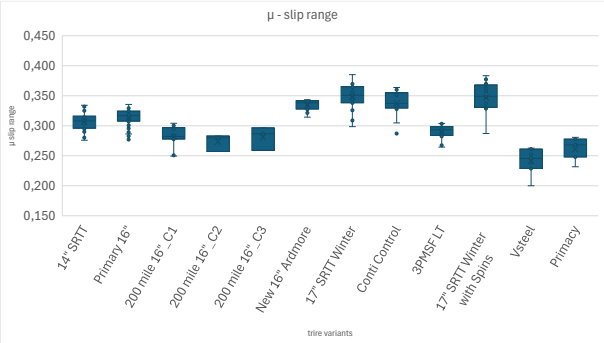
Note: The 14" SRTT is 5 years old

- All averages of the four different evaluation criteria are relatively close together
- Witness (New 16" Ardmore) on higher level than primary SRTT 16"
- 200 mile SRTT 16" significantly lower average performance than Primary and Witness SRTT 16"
- 200 mile SRTT 16" significantly lower average performance than 5 year old 14"
- Conti Control Tire just slightly better than witness (New 16" Ardmore)
- SRTT 17" Winter and SRTT 17" Winter with additional spins on same level
- 5 year old 14" SRTT just slightly below Primary SRTT 16"
- 3PMSF LT tire ca. 20% lower than witness (New 16" Ardmore), but above 200 mile SRTT 16" tires
- Primacy clearly better than Vsteel
- Slope of average μ slip curve very flat around zero for SRTT 17" winter and Conti Control Tire (see later diagrams); all other tires with negative slope

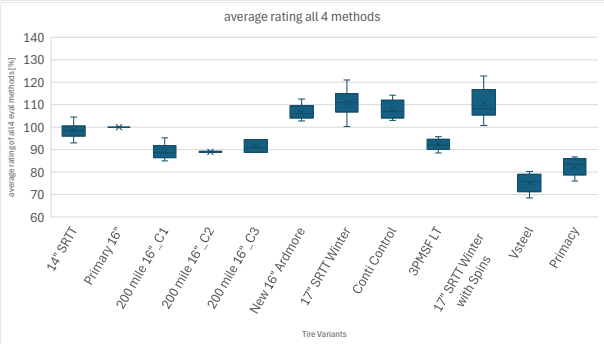
- Small range of absolute μ at low slip 20-30% for all tire variants between 0,28 and 0,34

  To evaluate the slope of the μ-slip-curves a linear regression of the μ-slip data in the evaluation range between 20-300% slip is calculated. As this value is a very low number it is multiplied by the factor of 1000, to get an easier to digest number. This slope is positive if the μ slip curve is increasing and negative if the linear regression shows a decreasing trend with increasing slip.
  This is an objective number describing the tire and surface force transmission mechanisms. An evaluation of this number for the same tire at different locations can be related to the snow surface properties. Diagrams for all 12 test days for each vendor are displayed with selection of different tire variants on later pages, to get an impression of the variation from day to day. Using same tire and test vehicle at each location makes the influence of snow track and weather conditions on test results clearly visible. Note: The average curve diagrams also contain different weighting for different test days for some tire variants, as not all tires were tested on each day (see figure 2)

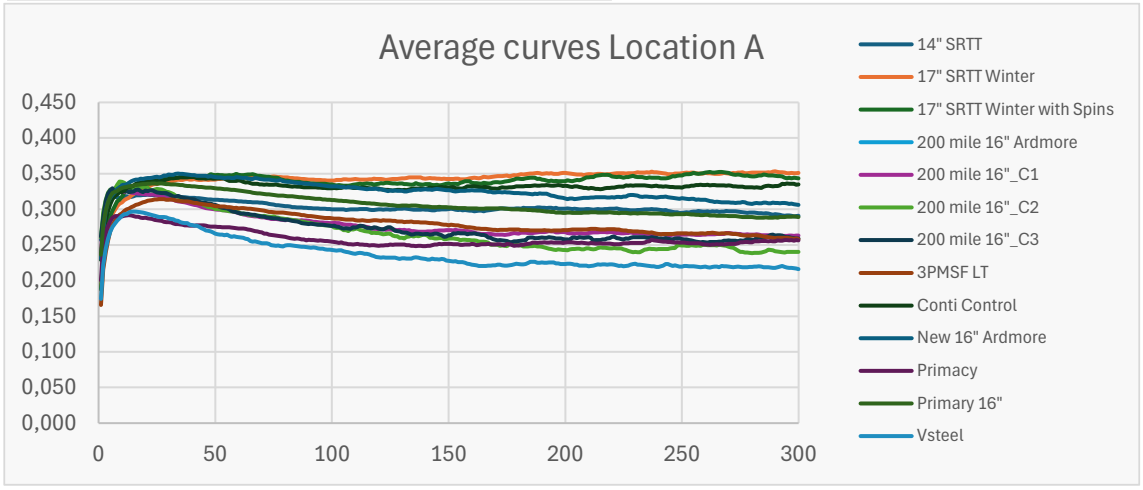
all diagrams on this page for Vendor A - Study 1

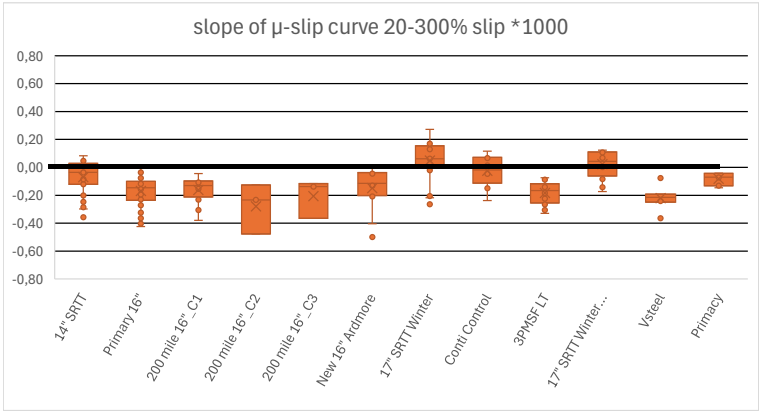


absolute level of μ slip range average and variation per tire

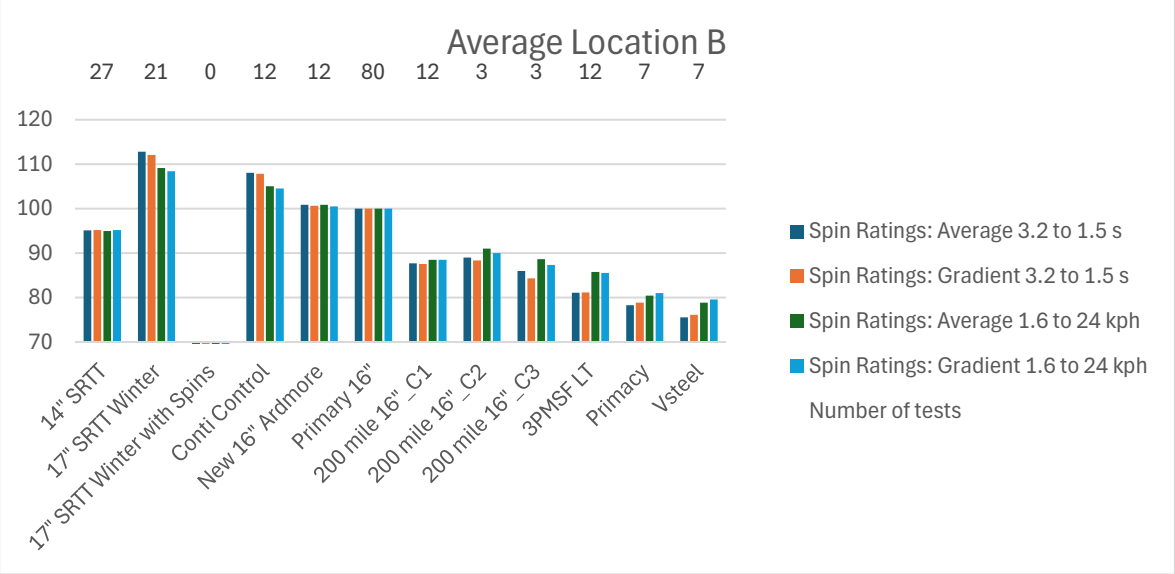


average over all 4 evaluation criteria – Primary = 100%





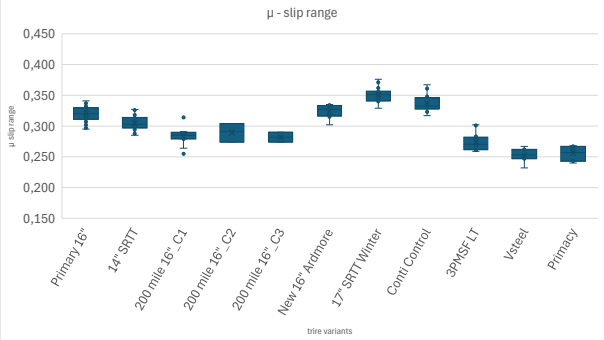
Location B Analysis

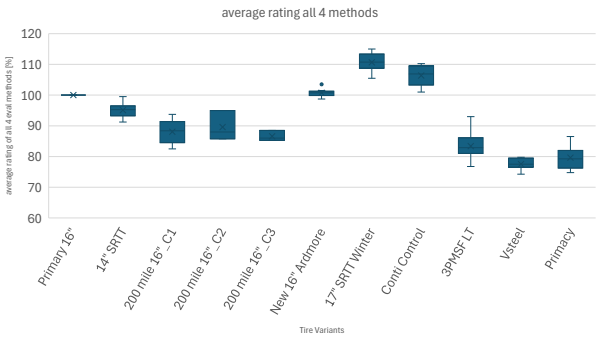


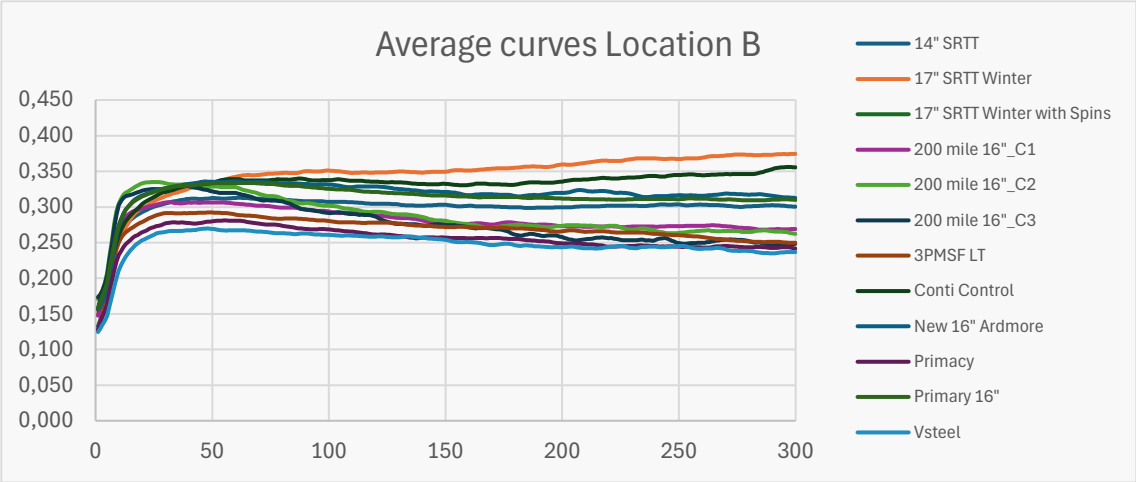
Note: The 14" SRTT is 5 years old

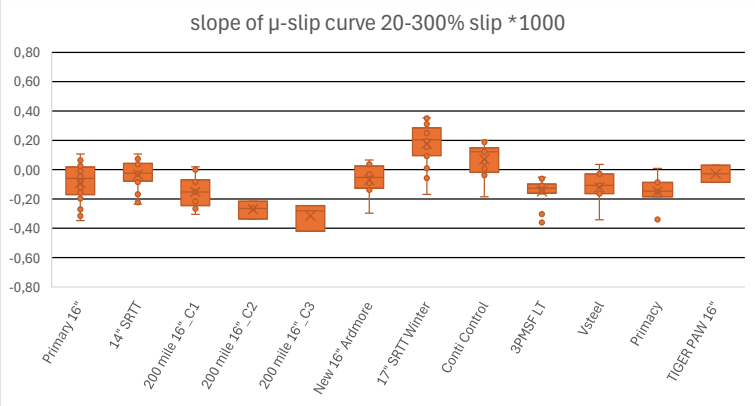
- Different evaluation criteria show different spread of tire variants
- Witness (New 16" Ardmore) on same level as primary SRTT 16"
- 200 mile SRTT 16" significantly lower average performance than Primary and Witness SRTT 16" similar to Location A
- 200 mile SRTT 16" significantly lower average performance than 5 year old 14"
- Conti Control Tire better than witness; slightly higher spread than location A
- SRTT 17" Winter best overall performance, but clear dependency of result based on evaluation method,
- 5 year old 14" SRTT below Primary SRTT 16"
- 3PMSF LT depending on evaluation method ca. 15-20% below witness (New 16" Ardmore) and even below 200 mile 16" variants, high dependency on evaluation method
- Primacy slightly better than Vsteel
- SRTT 17" winter and Conti Control Tire clearly positive average slope of μ-slip curve, other variants less negative slopes than at location A, but bigger deviation between different tires at low slip (20-30% slip) with average μ values between 0.25 and 0.34

All diagrams for Study 1 – Vendor B

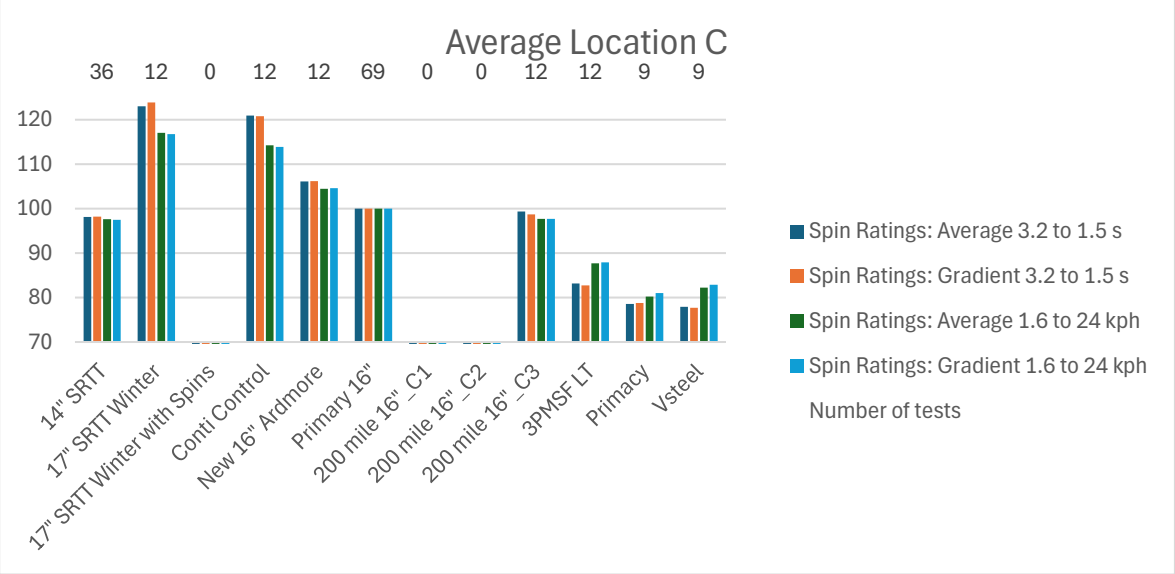








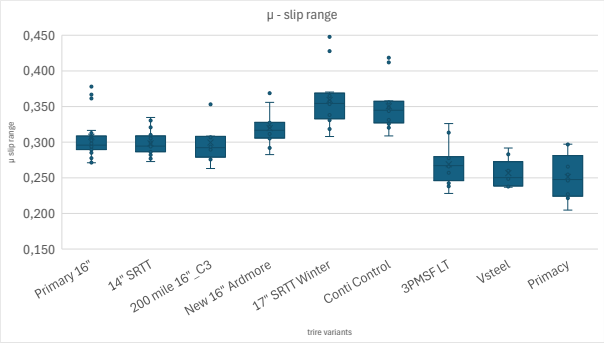
Location C Analysis

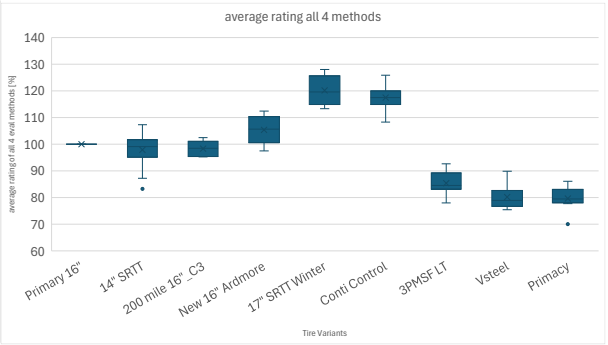


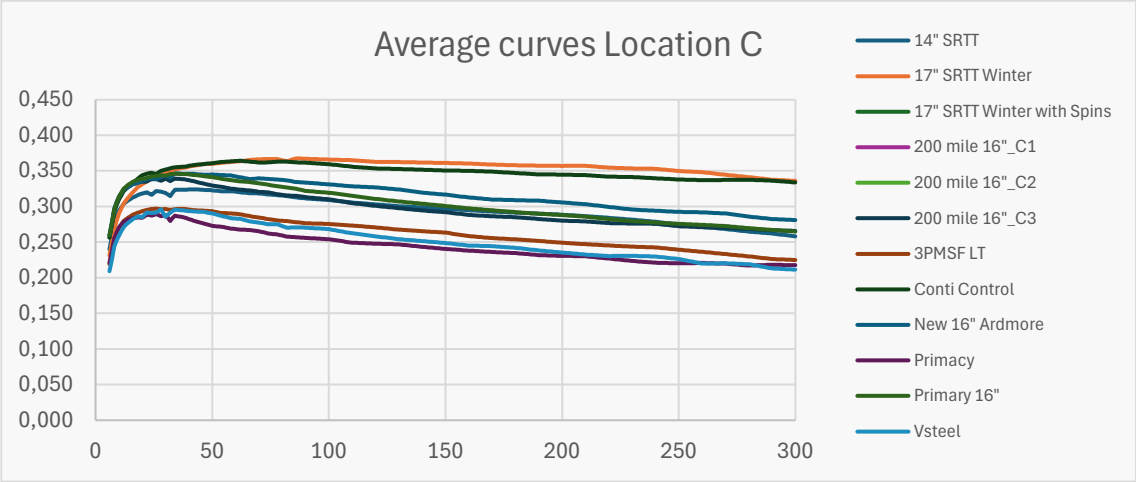
Note: The 14" SRTT is 5 years old

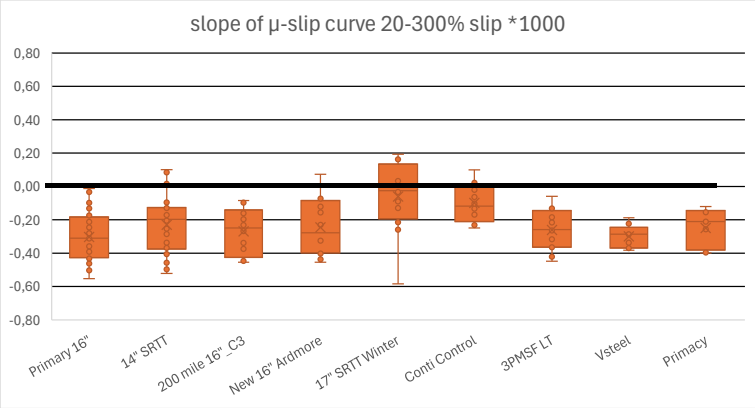
- Different evaluation criteria show different spread of tire variants, leading even to change in ranking between Vsteel and Primacy
- Witness (New 16" Ardmore) slightly better level than primary SRTT 16"
- 200 mile SRTT 16" just very slightly lower average performance than Primary and Witness SRTT 16" different than Location A and B
- 200 mile SRTT 16" slightly lower average performance than 5 year old 14"
- Conti Control Tire better than witness SRTT 16"
- SRTT 17" Winter clear dependency of result based on evaluation method
- 5 year old 14" SRTT below Primary SRTT 16"
- 3PMSF LT high dependency on evaluation method
- SRTT 17" winter and Conti Control Tire very variable slope of μ-slip curves for all tires
- High sensitivity of shape of μ slip curve and track condition of the day, but no clear correlation to recorded track parameters like CTI or track temperature

All diagrams for study 1 – Vendor C









Appendix 2: μslip Curves

Study 1: μslip Curves Analysis

On the following pages, the μslip curves from each vendor of Study 1 for each test day are displayed to get an overview of how different the tires react depending on the snow surface

and the forces are transmitted. The shape of the curves is varying significantly depending on weather and snow track properties. To get a clearer picture about the variations the diagrams are filtered for curves with only single tires or different groups of tires.

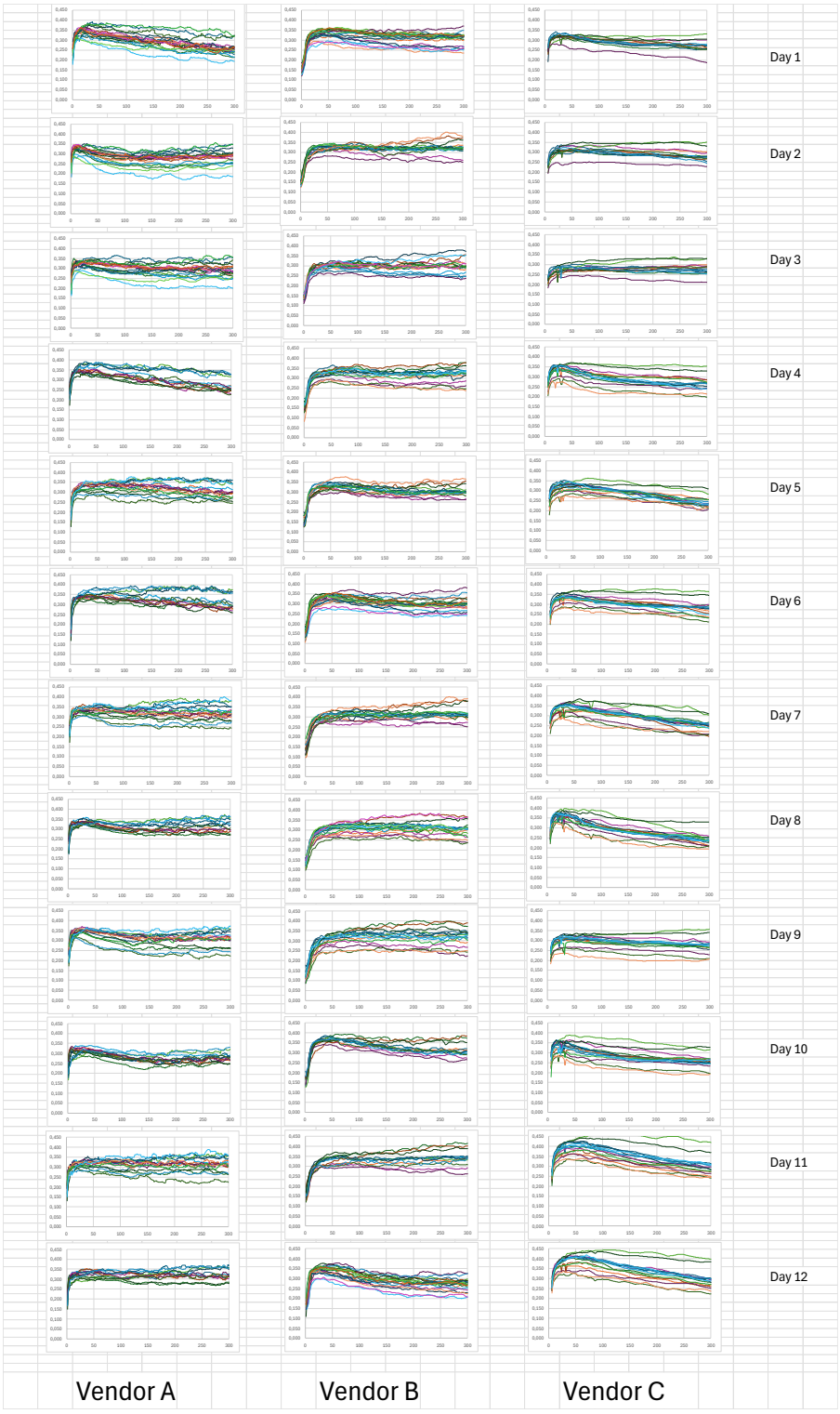


Figure 7- Study 1 - μ slip curves of all 12 days for 3 locations (due to different test orders not all colors are always the same tires) - rough overview for different behavior on different days and for different tires

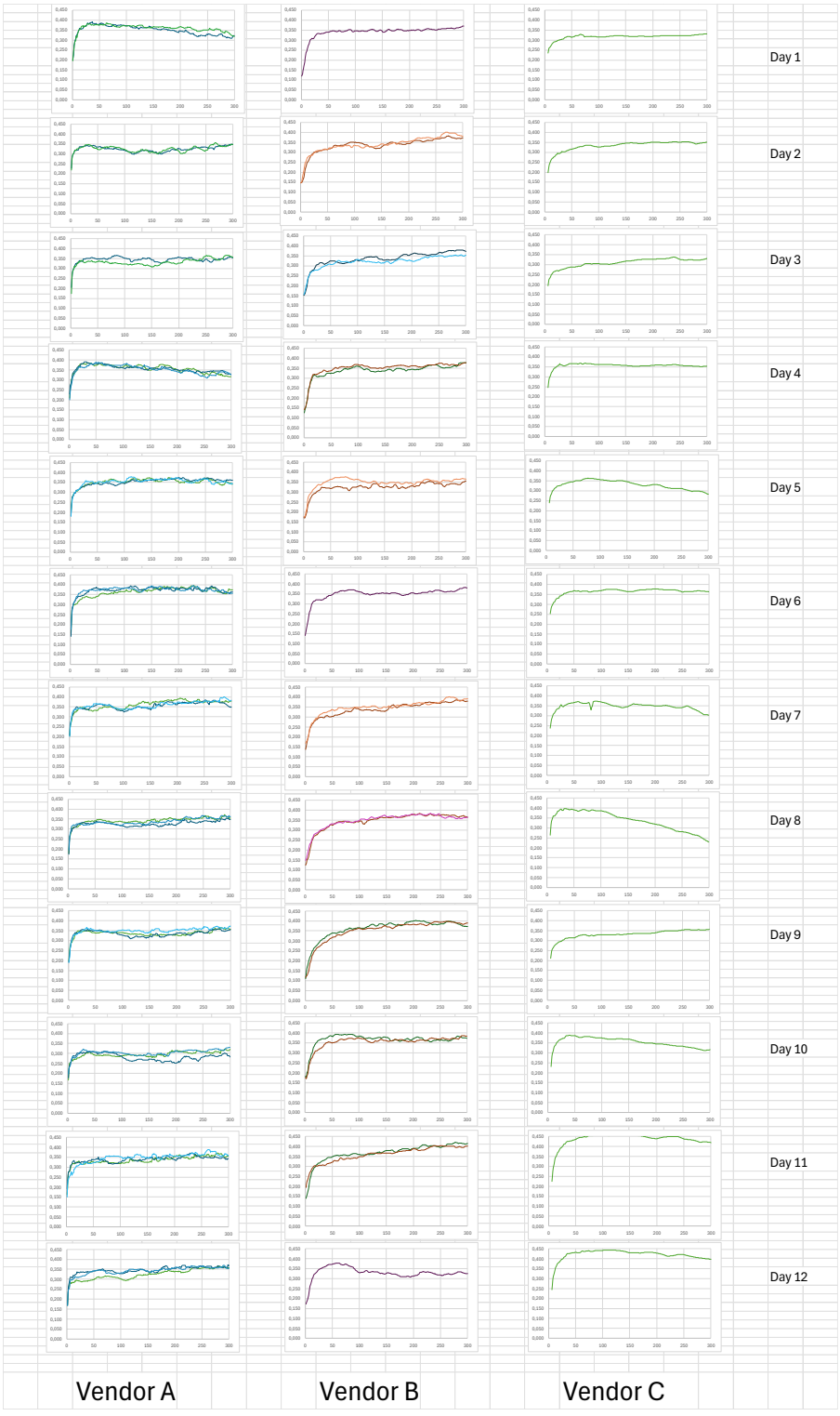


Figure 8 - Study 1 - μ slip curves - ***SRTT 17" winter and SRTT 17" winter with additional spins only*** *at vendor A, at vendor B and C repetitions of SRTT 17" winter on same or different day and very slight increase in number of spins only*

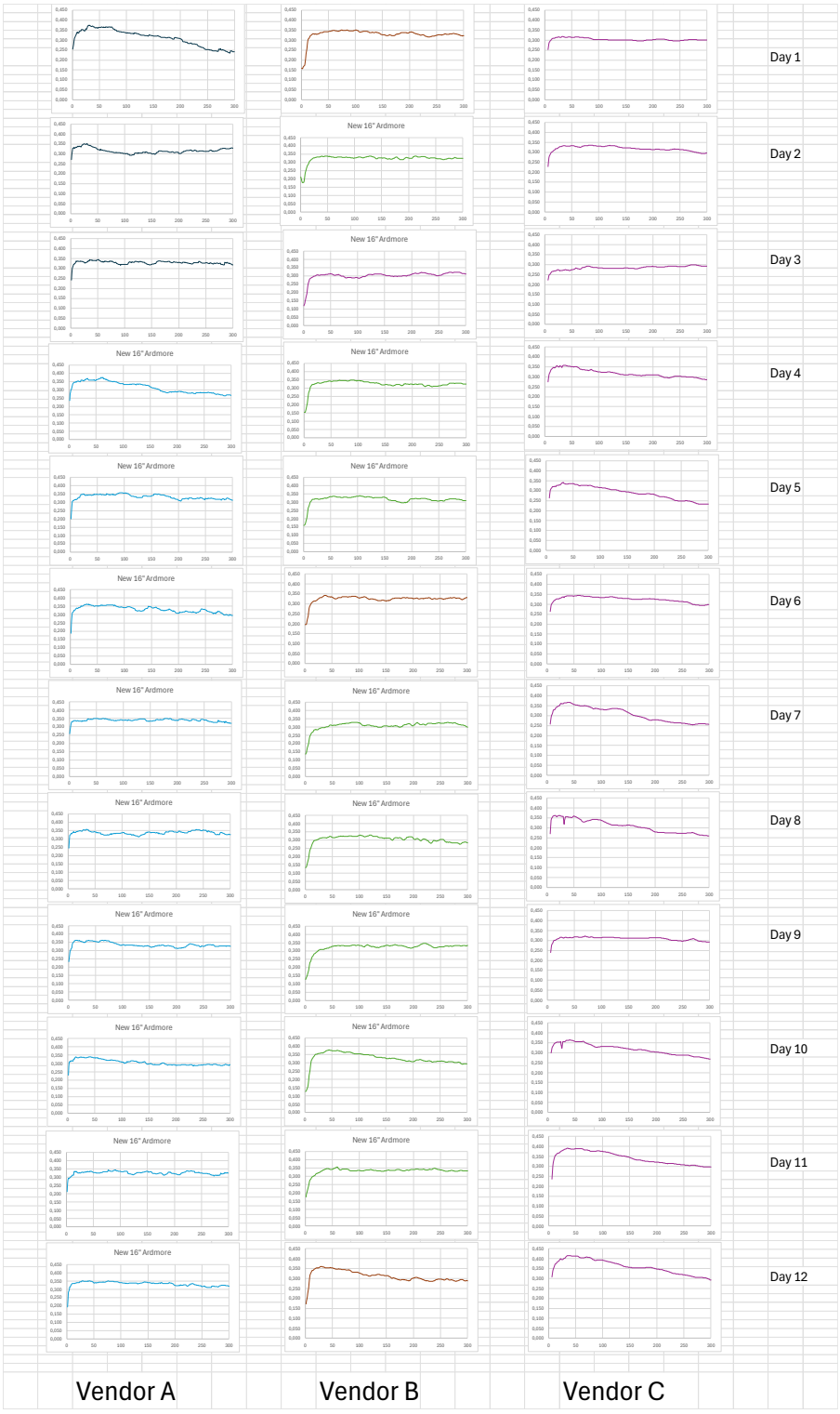


Figure 9 - Study 1 - μ slip curves SRTT 16" new Ardmore (Witness) tires only

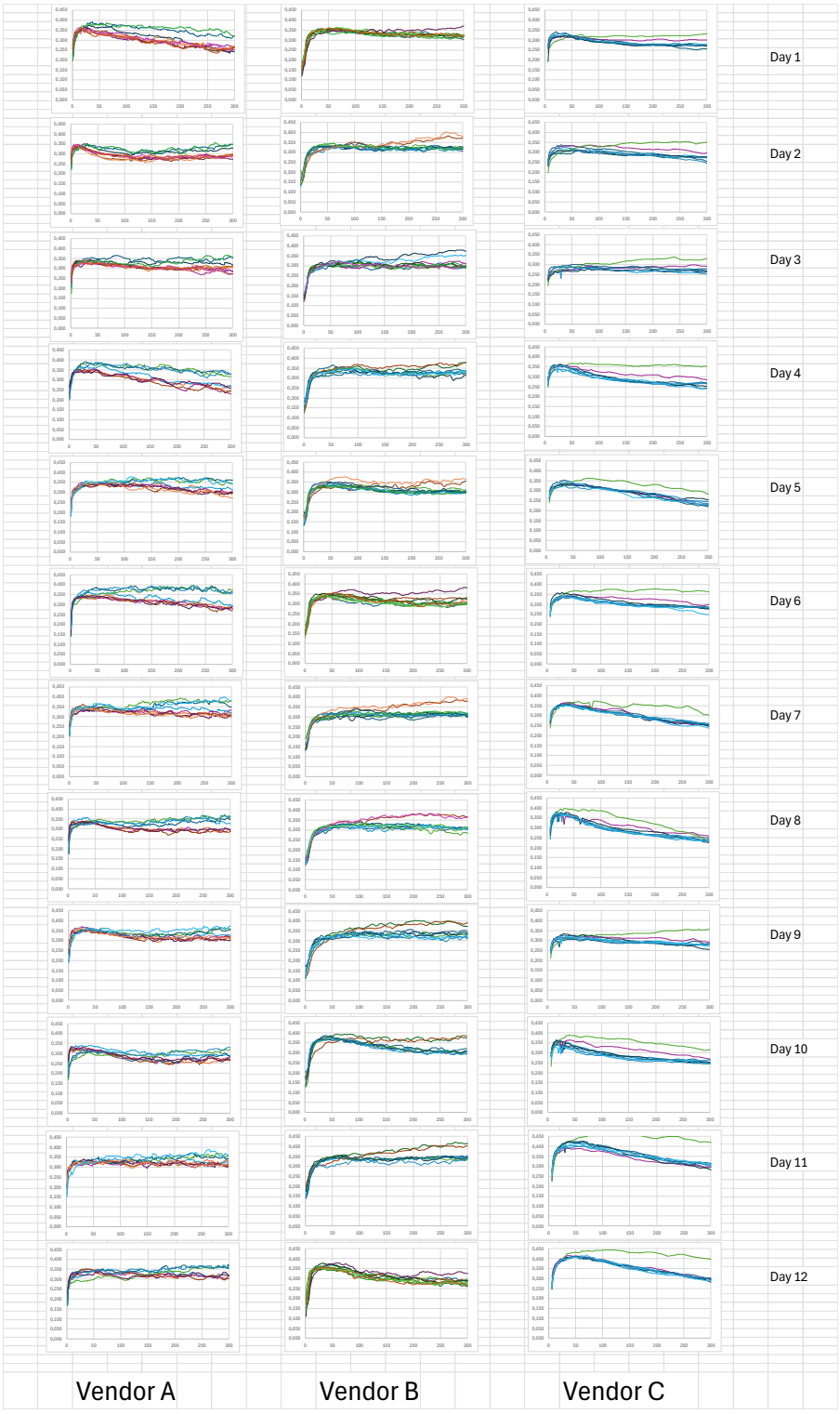


Figure 10 – Study 1 - μ slip curves SRTT 16" new Ardmore (Witness) tires, SRTT 16" Primary and SRTT 17" Winter and SRTT 17" Winter with additional spins

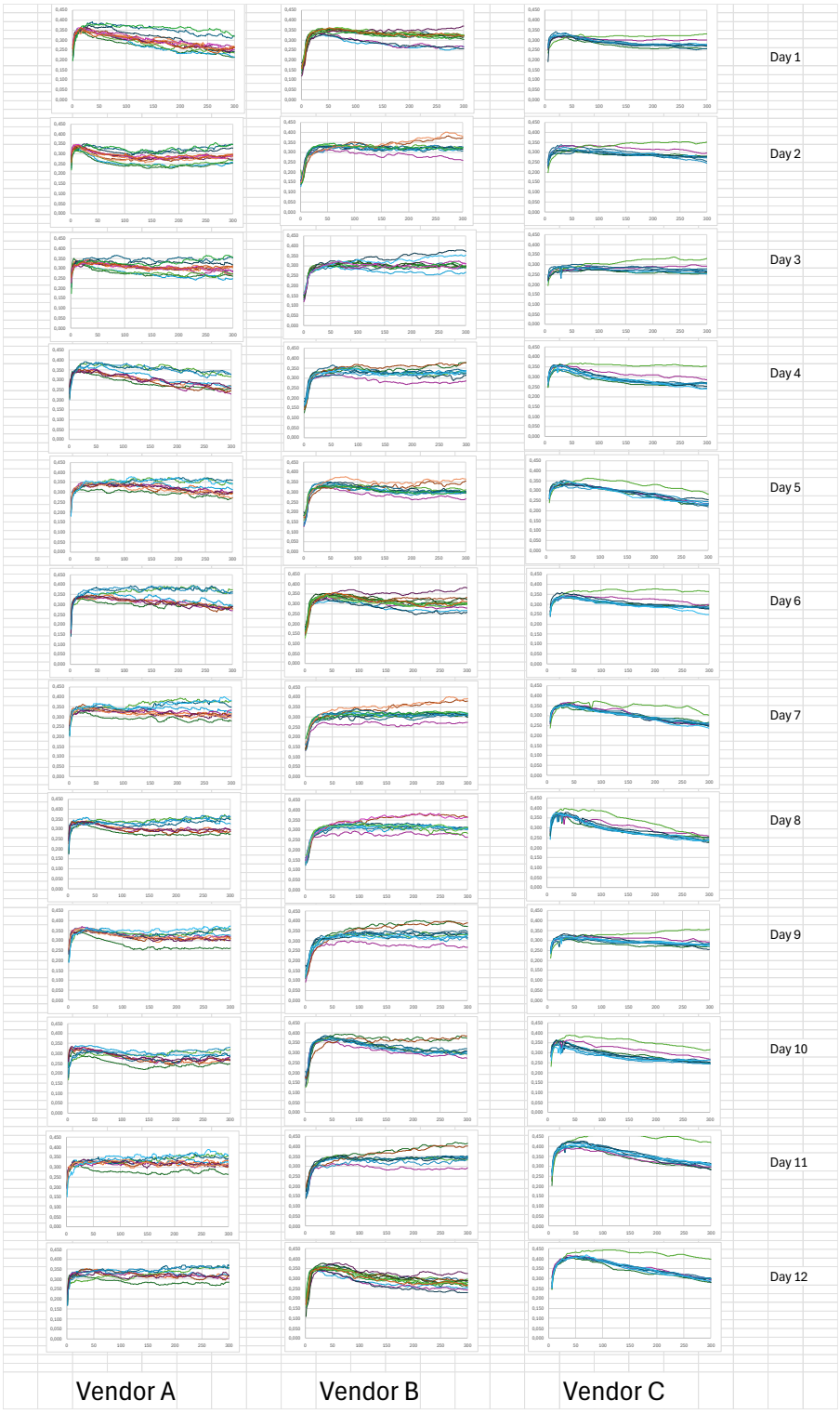


Figure 11- Study 1 - μ slip curves SRTT 16" new Ardmore (Witness) tires, SRTT 16" Primary and SRTT 17" Winter and SRTT 17" Winter with additional spins and additional 200 mile SRTT 16" variants C1, C2 and C3

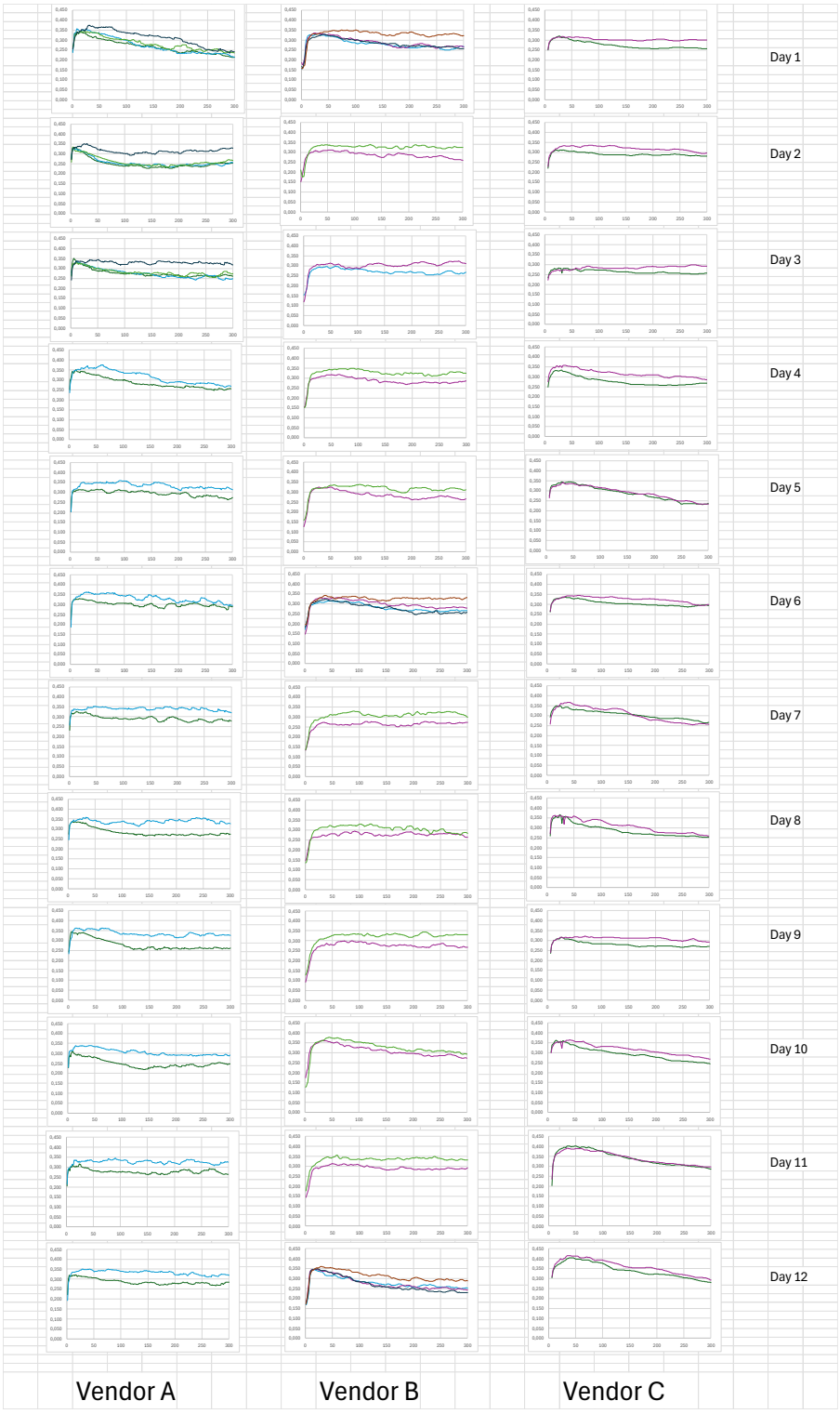


Figure 12 - Study 1 - μ slip curves SRTT 16" new Ardmore (Witness) tires and 200 mile SRTT 16" variants C1, C2 and C3 (without Primary SRTT 16")

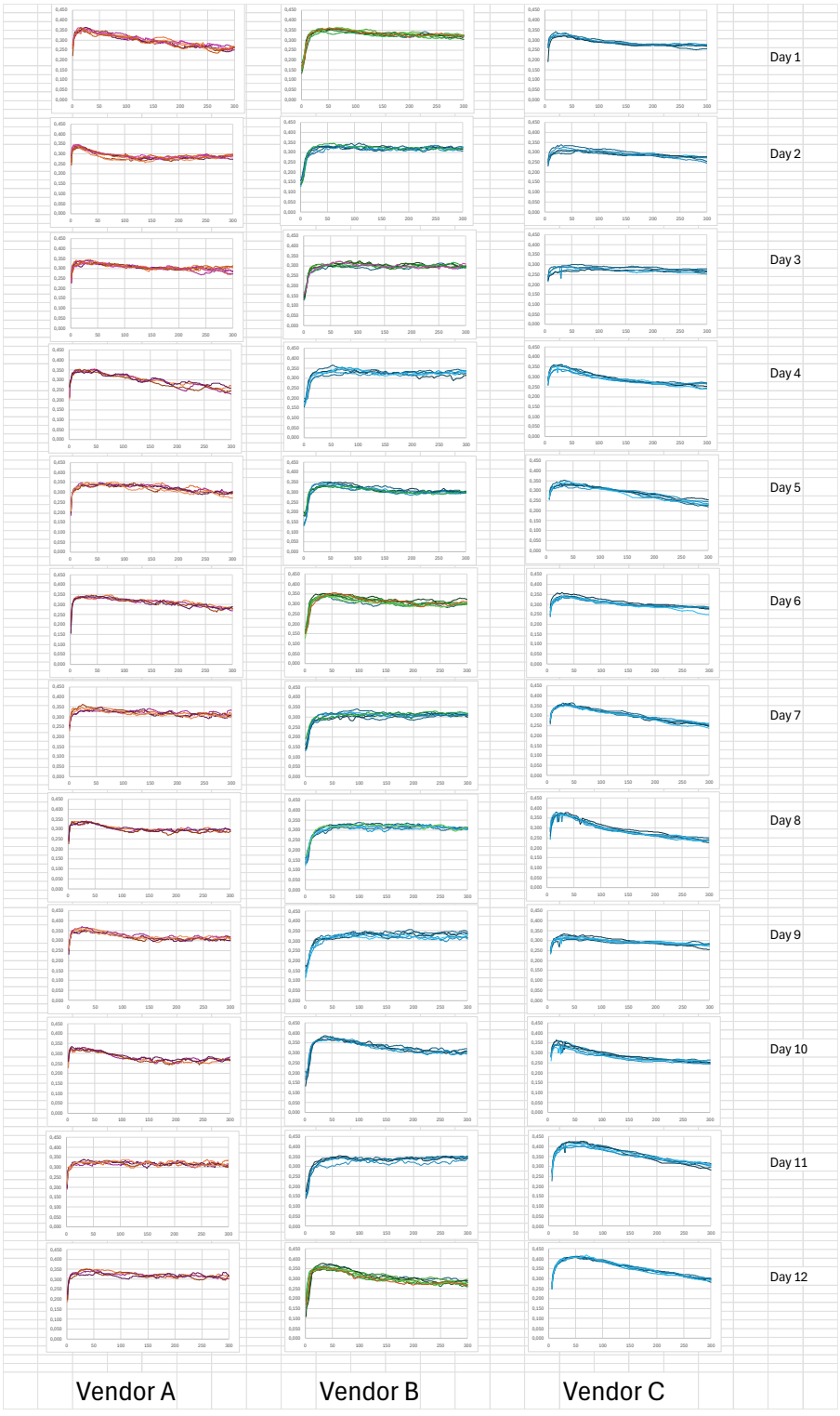


Figure 13 - Study 1 - only SRTT 16" Primary tires

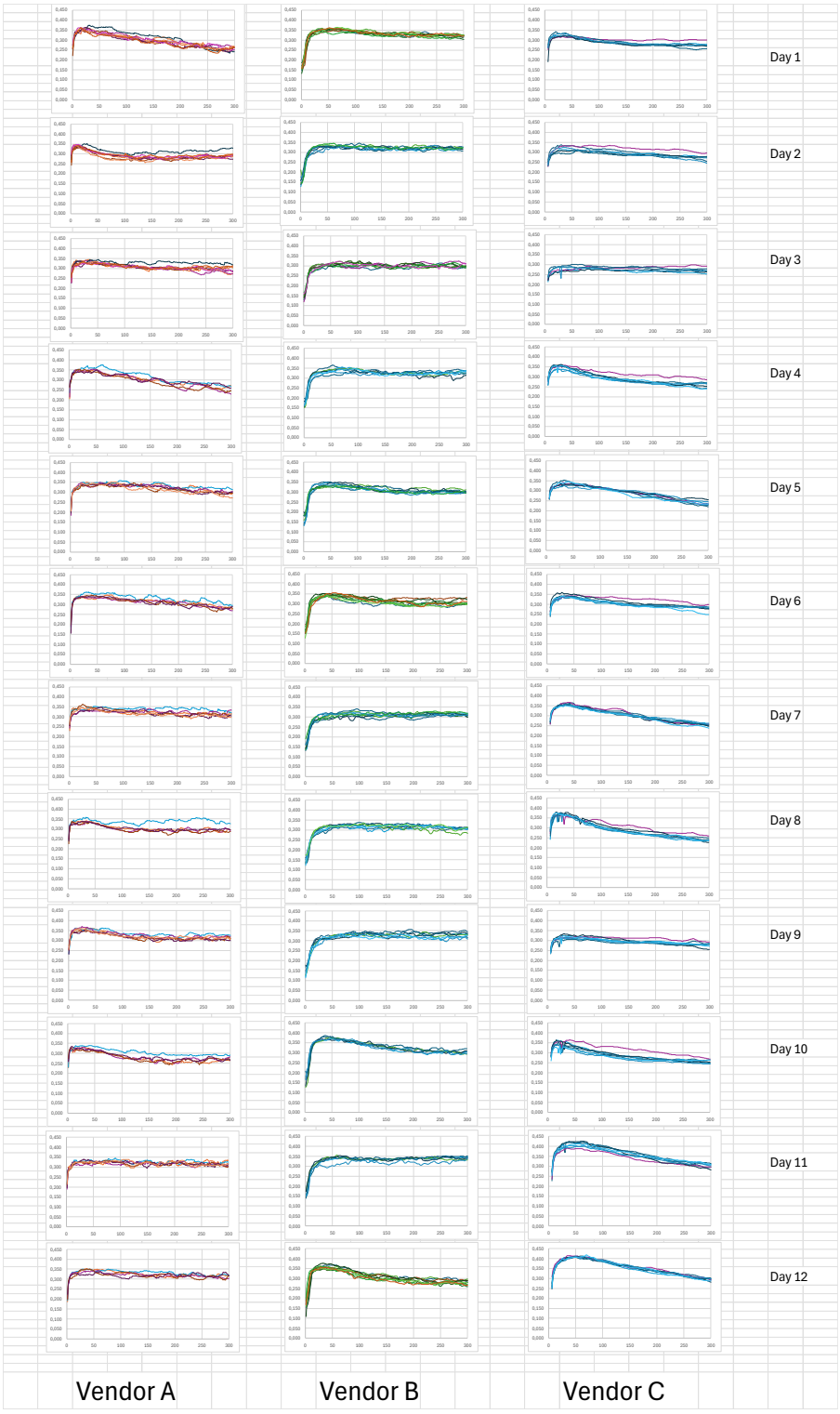


Figure 14 – Study 1 – SRTT 16" Primary and witness tires

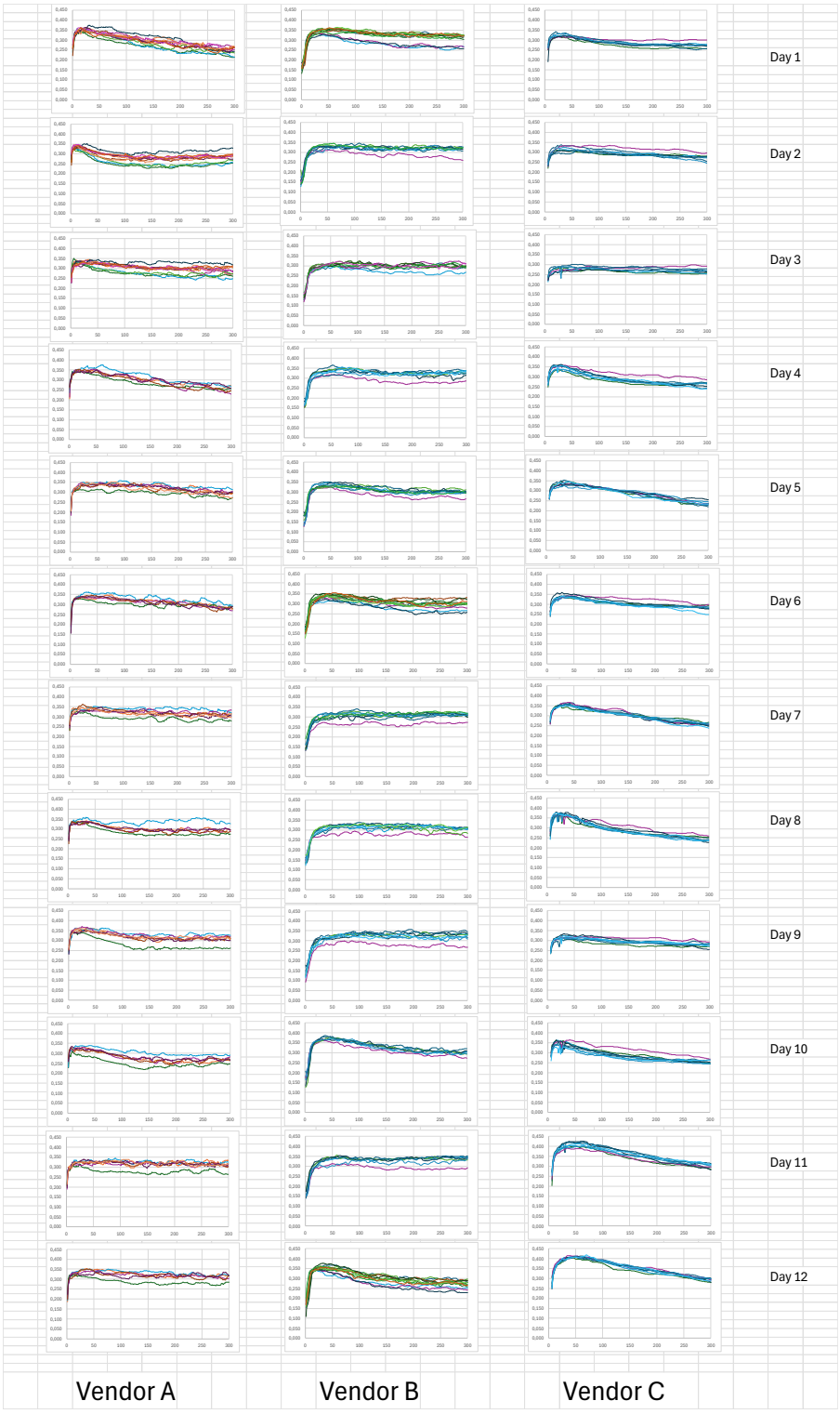


Figure 15 - Study 1 - SRTT 16" Primary, witness and 200 mile driven in variants C1, C2 and C3

Daily checks 17” winter SRTT

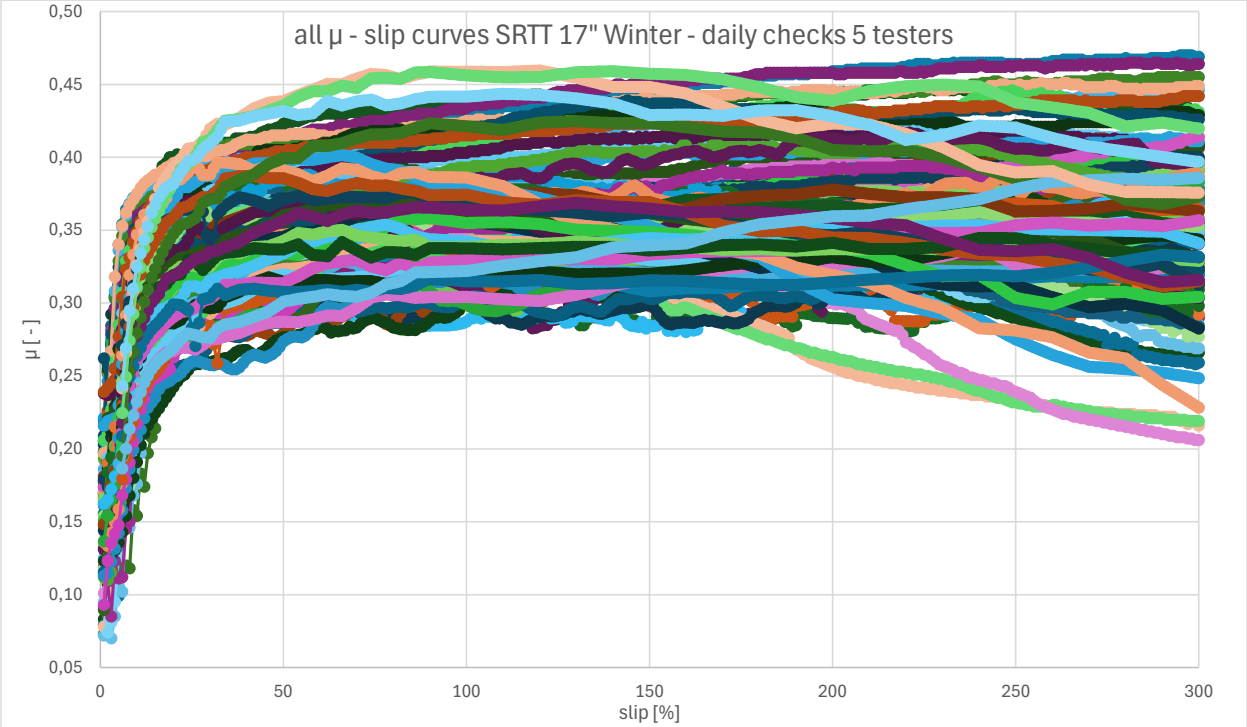


Figure 16 - μ slip curves of SRTT 17" winter from daily checks from 5 testers

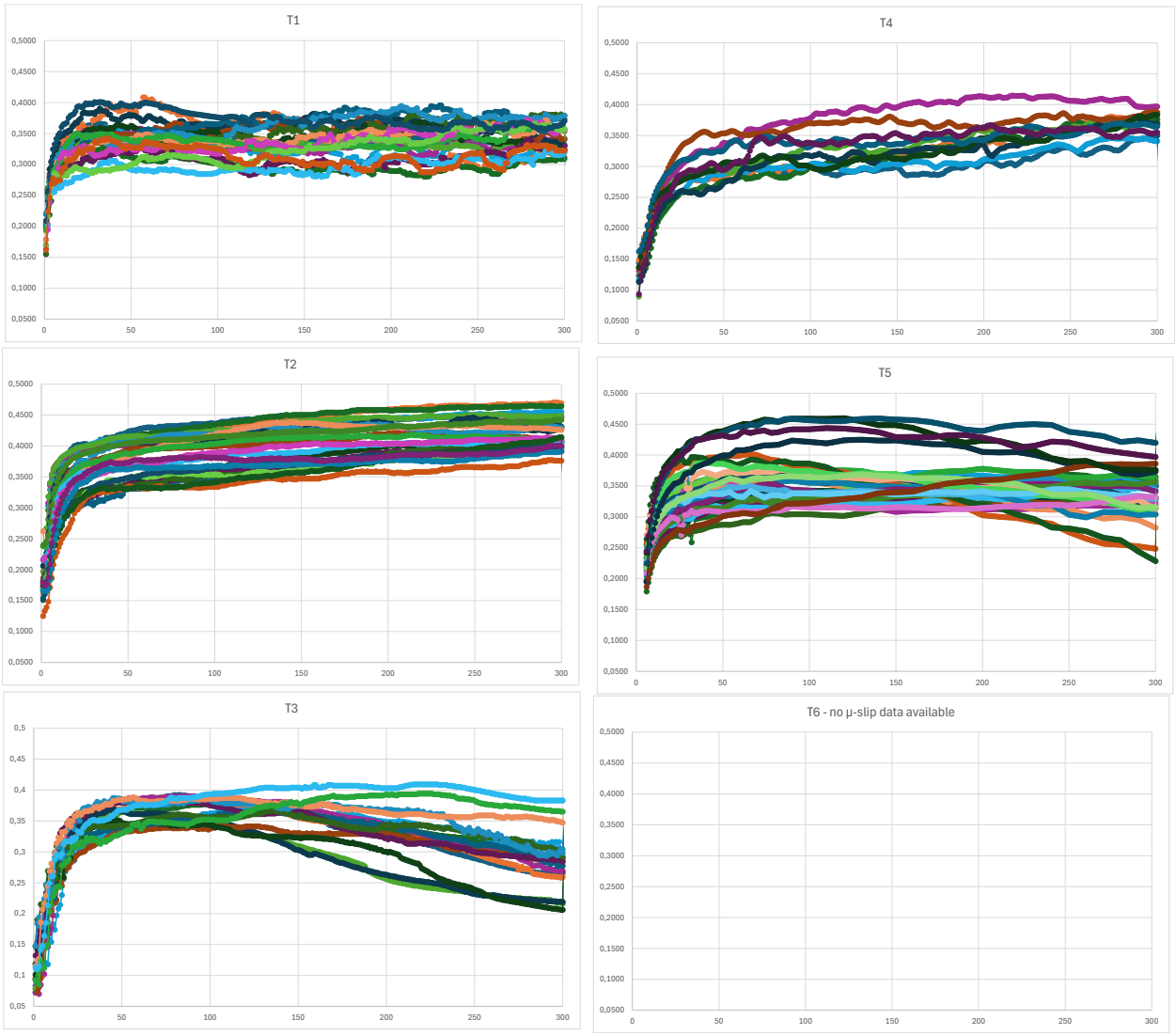


Figure 17 - µ slip curves of SRTT 17" winter from daily checks from 5 testers – separated by tester T1 to T5 (T6 just delivered ratings, but no µ-slip curve data)

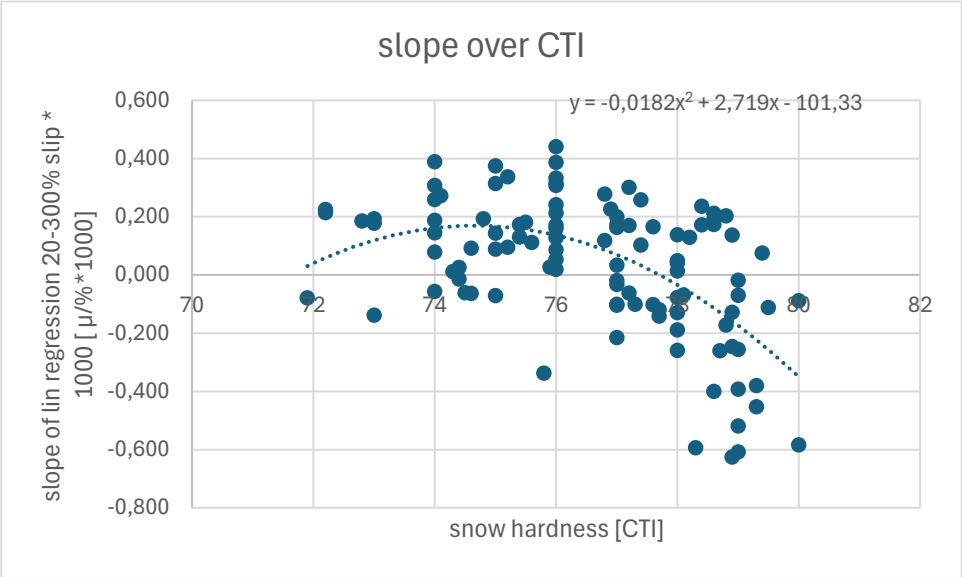


Figure 18 - slope of µ slip curve of SRTT 17" winter at different locations vs snow hardness from daily checks

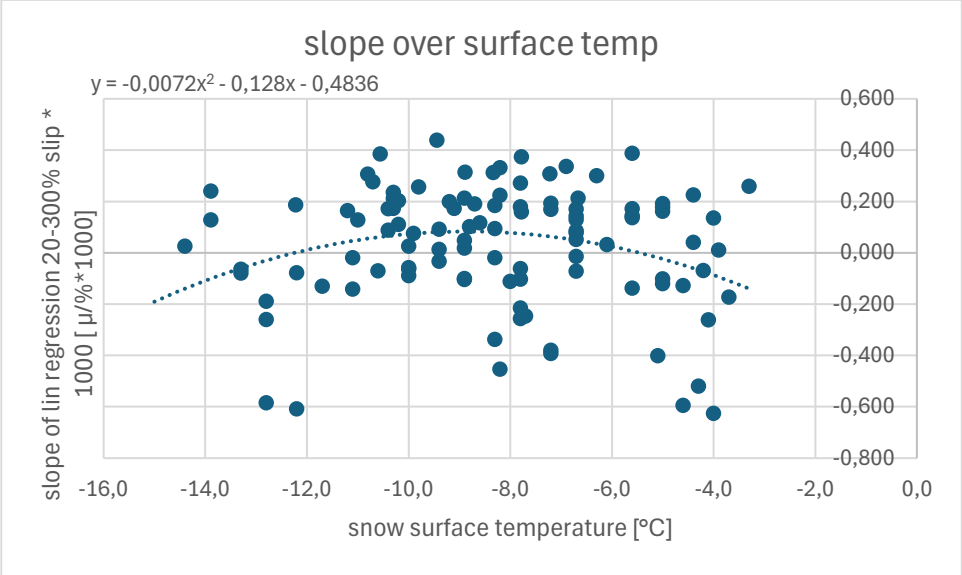


Figure 19 - slope of µ slip curve of SRTT 17" winter at different locations vs snow surface temperature from daily checks

No clear tendency for temperature dependency.

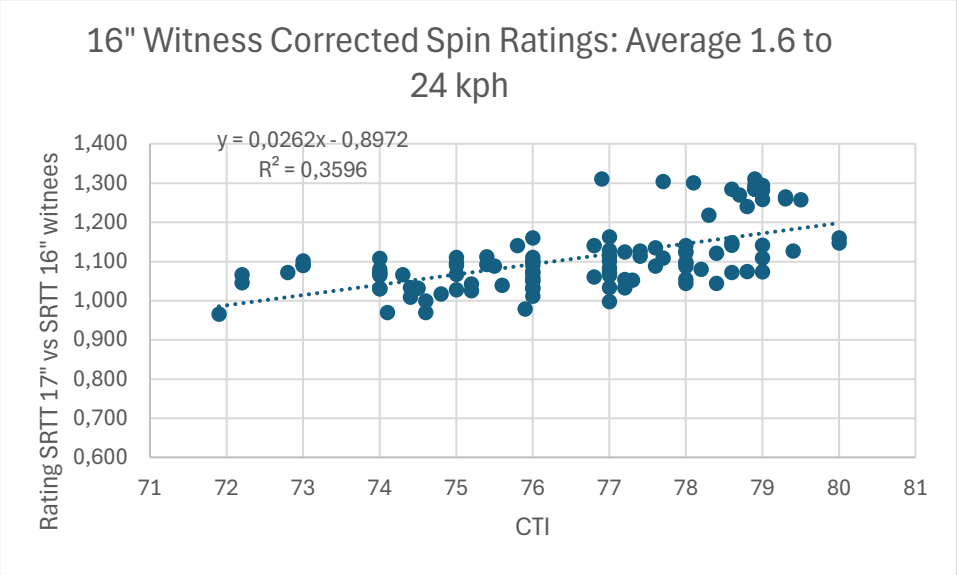


Figure 20 – average slip range rating of SRTT 17" winter vs SRTT 16" witness vs snow hardness from daily checks

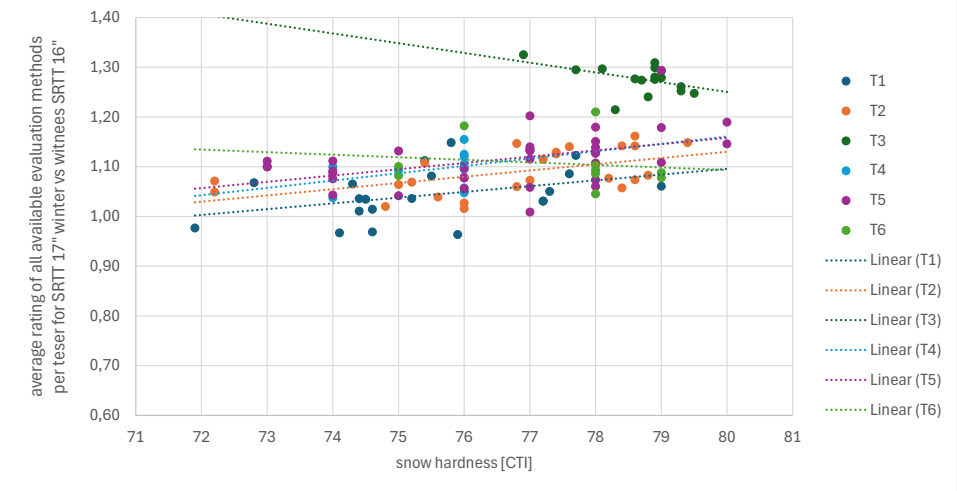


Figure 21 - average rating of SRTT 17" winter vs snow hardness - separated data sets for each tester

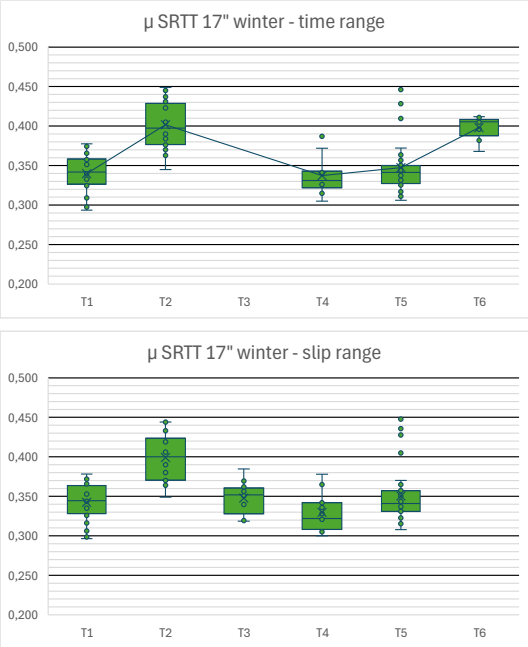


Figure 22 - absolute μ values for SRTT 17" winter for slip range and time range evaluation

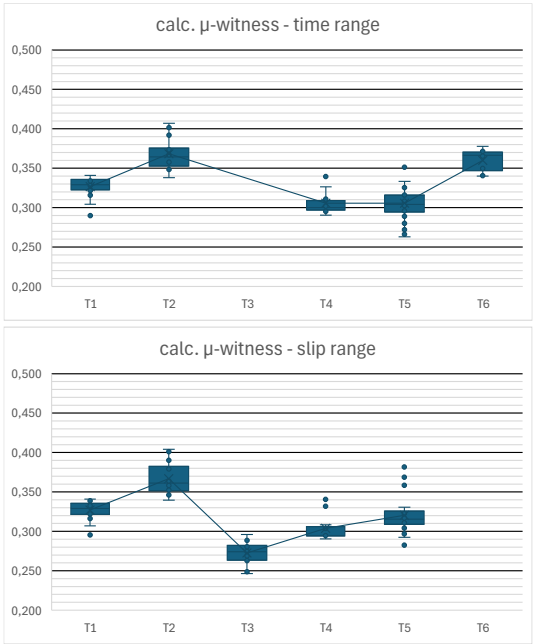
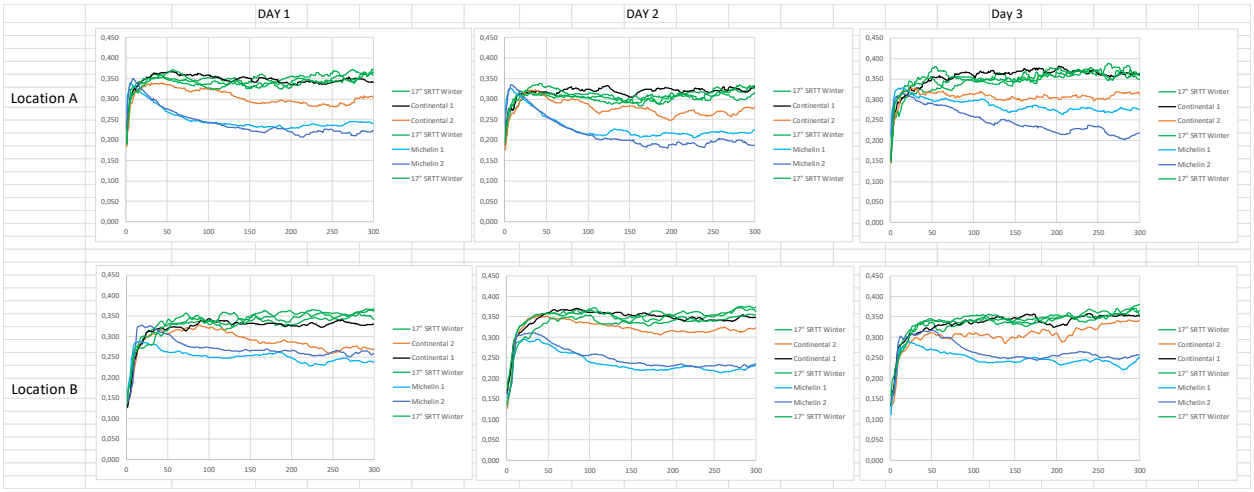


Figure 23 - recalculated μ witness SRTT 16" tire from reported ratings of SRTT 17" winter

Study 3 μslip Curve Analysis

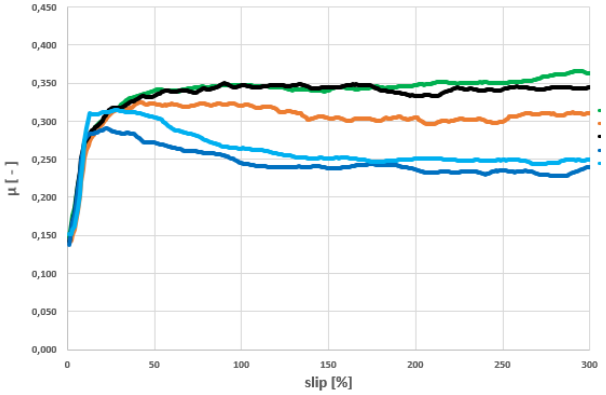
Mu-Slip curves from 2025 can be compared to mu-slip curves from before 2022 with the 14" SRTT. The 3 candidate tires have similar shape mu-slip curves between 2025 and prior years, except the orange curves are slightly different.


DAY 1
DAY 2
Day 3
Location A
Location B
17" SRTT Winter
Continental 1
Continental 2
Michelin 1
Michelin 2

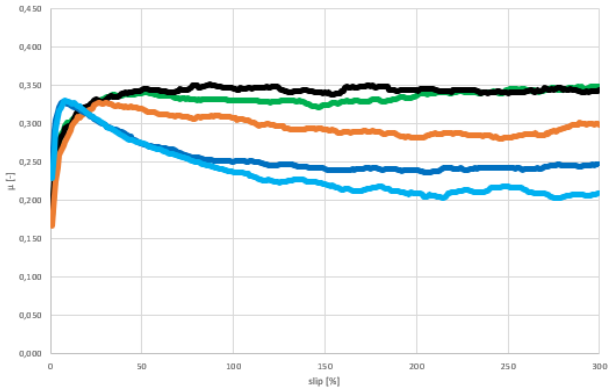
SRTT 17” winter – green curves
Conti 1 - black curves
Conti 2 – orange curves
Mich 1 – light blue
Mich 2 – blue
SRTT 14” – purple

2025 Data from 2 vendors

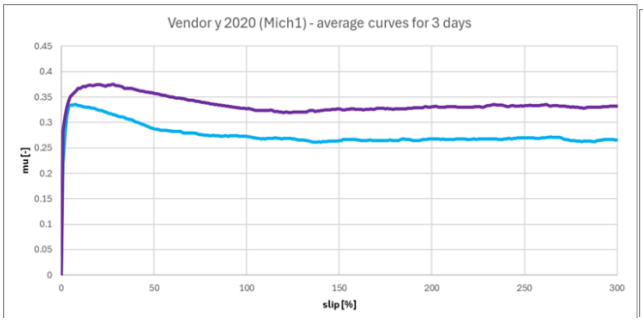
Vendor x

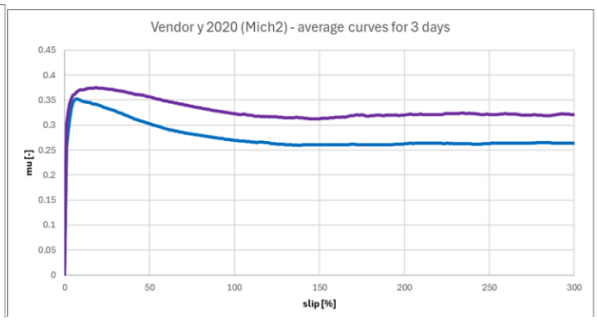


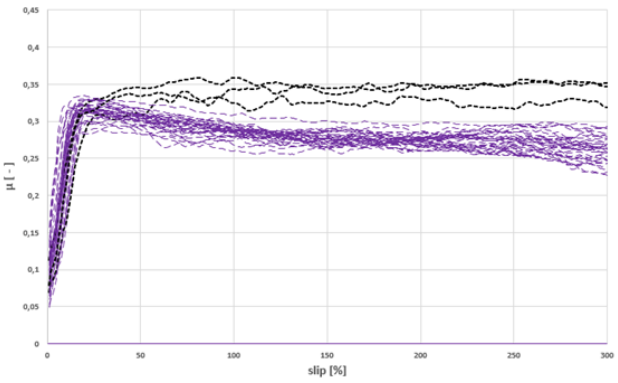
Vendor y

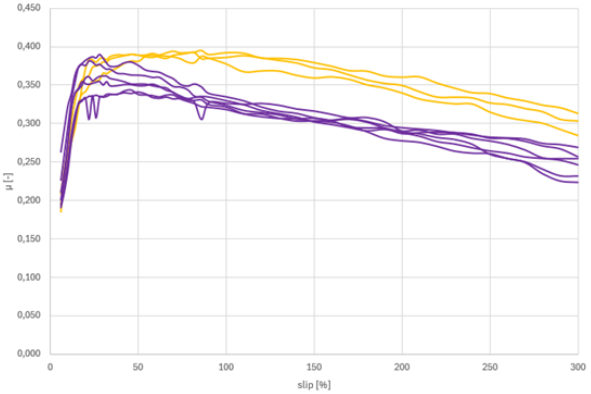


Data from Before 2022 (multiple Vendors)

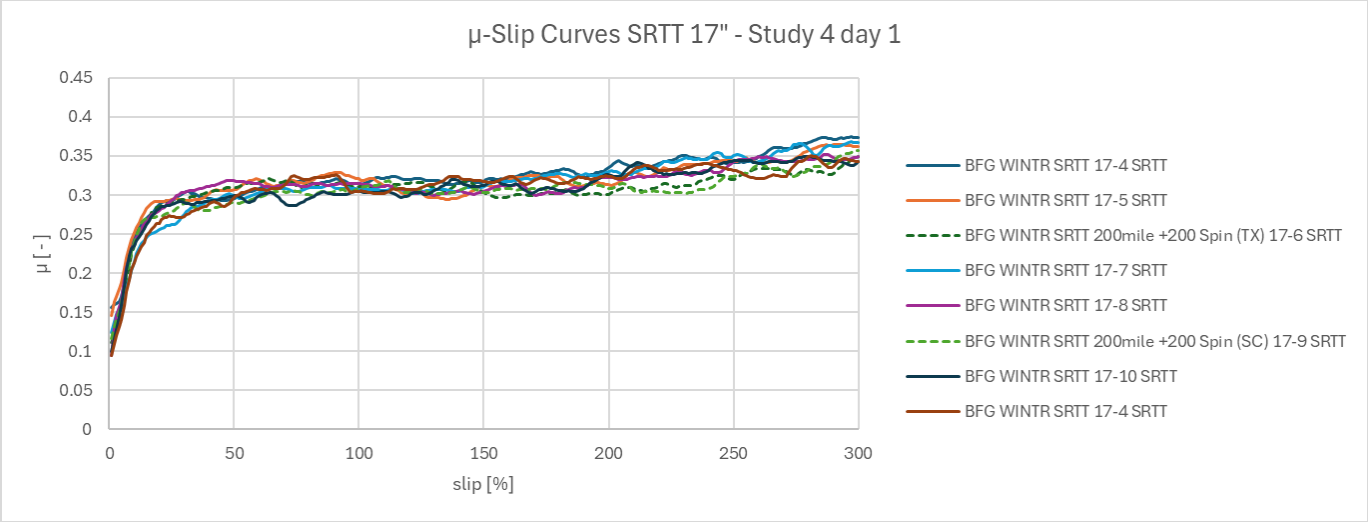


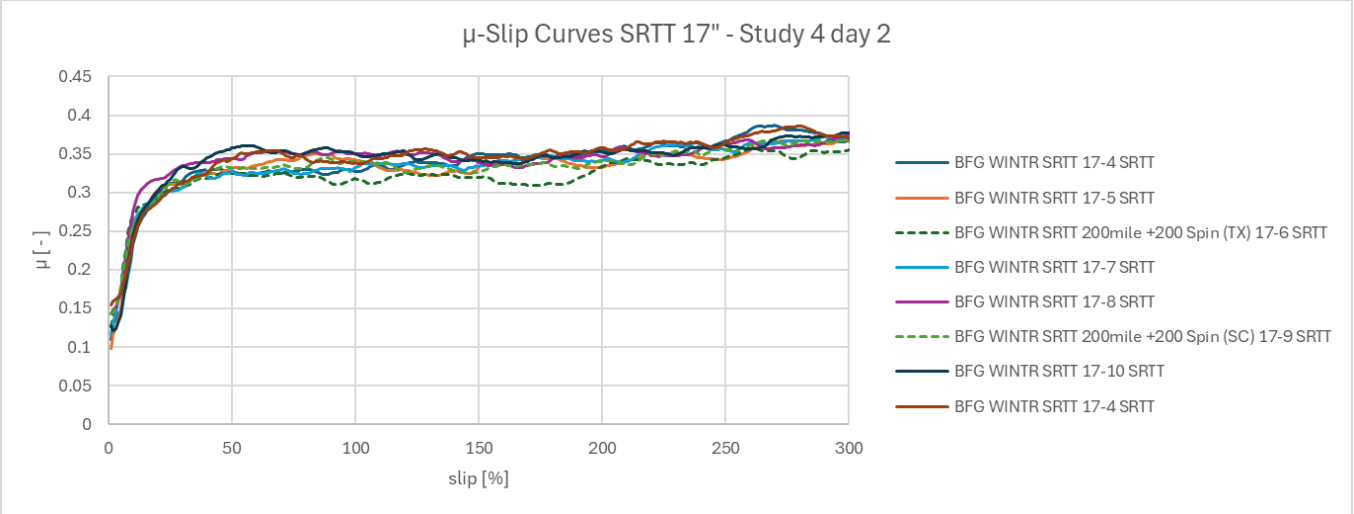


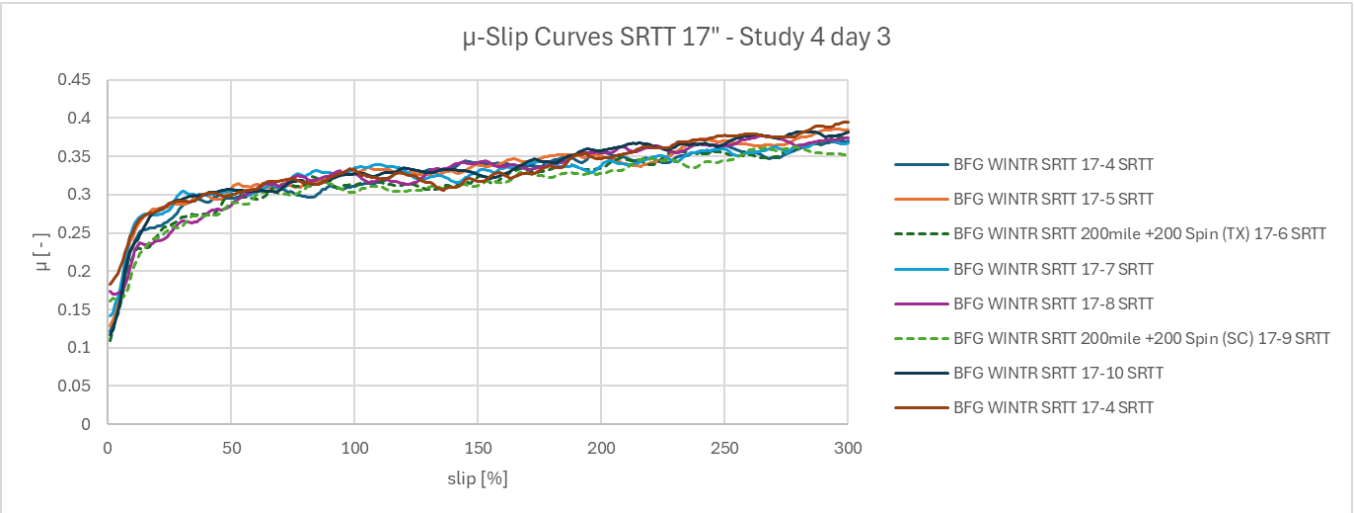




Study 4 17” SRTT Winter Validation







Appendix 3: CTI, Temperature and μslip Curve Slope Sensitivities

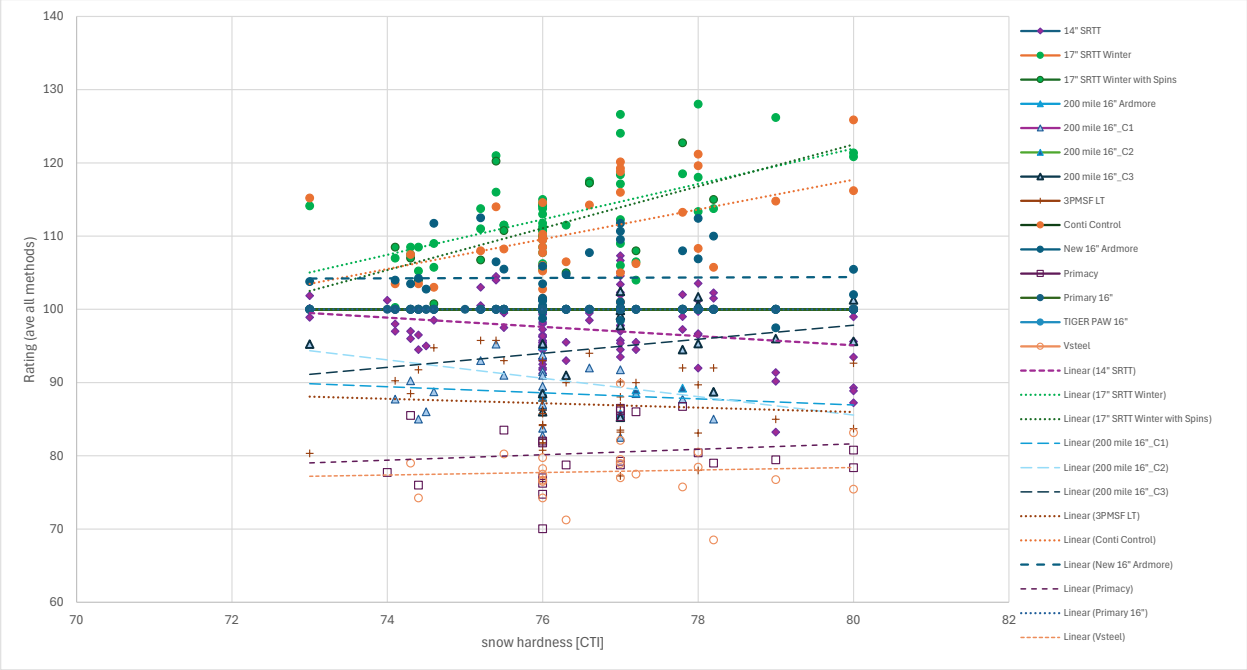


Figure 24 - Study 1 average rating vs snow hardness (different weighting of different vendors for different tires included)

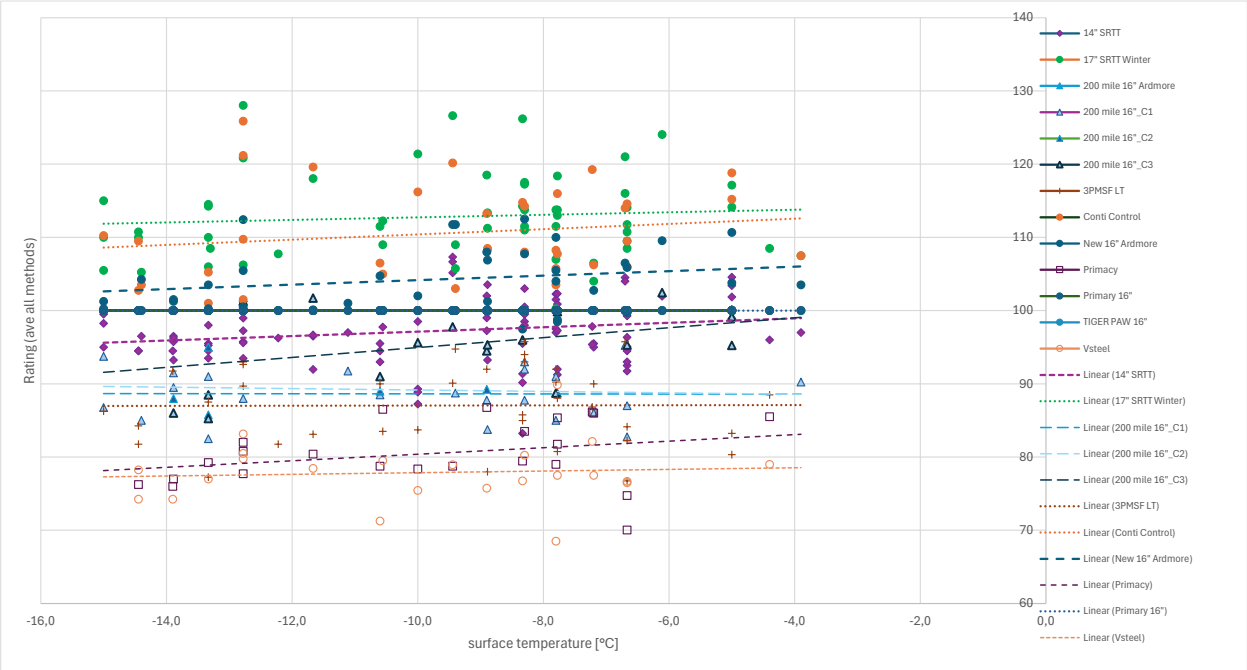


Figure 25 - - Study 1 average rating vs snow surface temperature (different weighting of different vendors for different tires included)

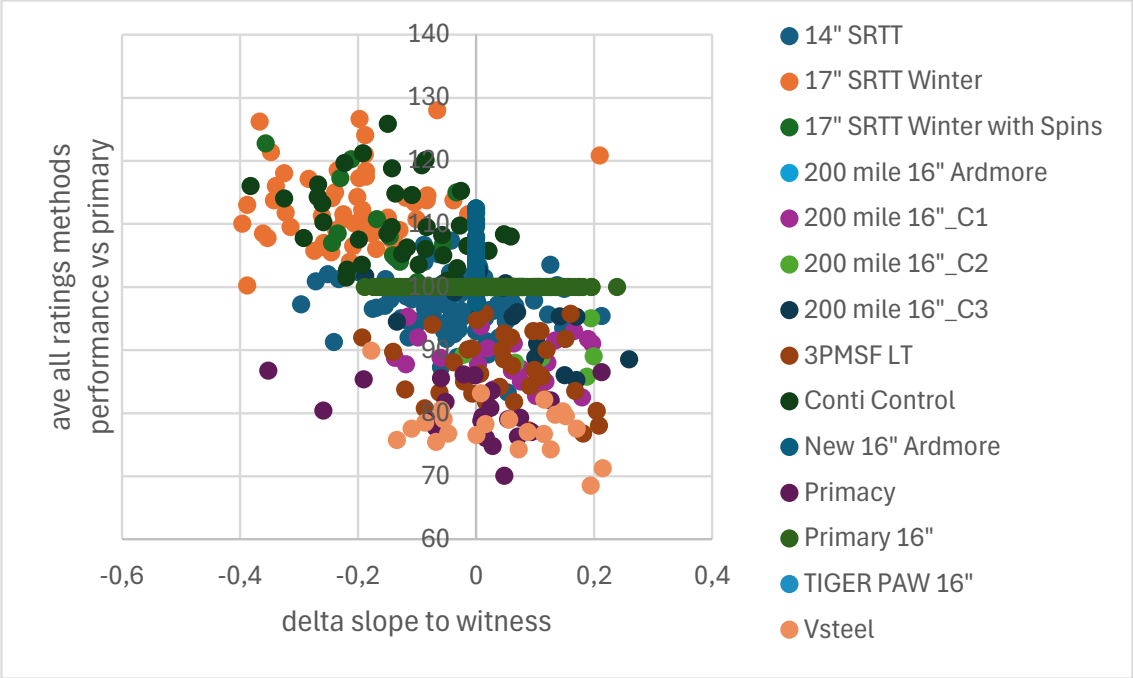
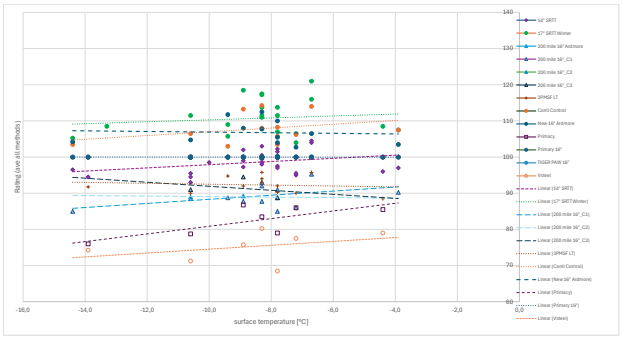
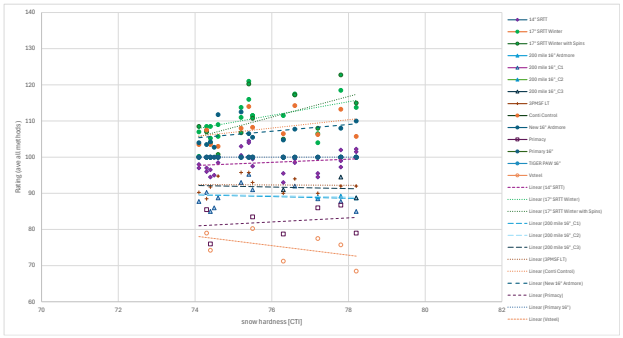


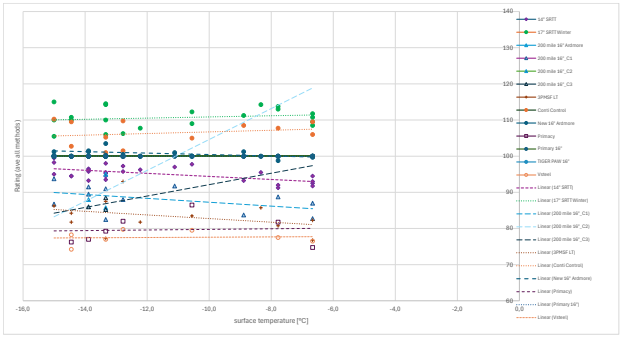
Figure 26 - average rating of tire variants vs delta slope (= slope witness - slope candidate) in μ slip curves (different weighting of different vendors for different tires included)

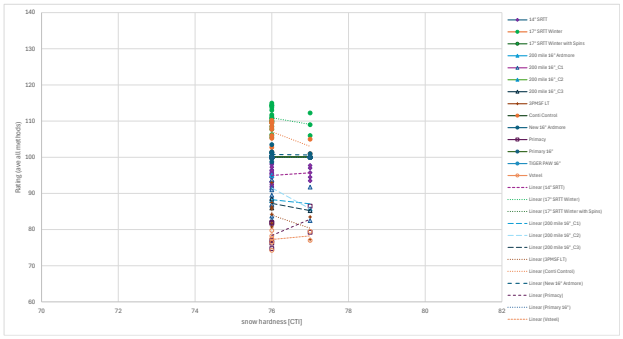
Location A only



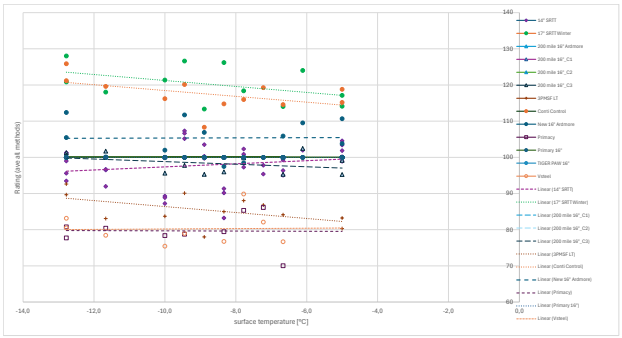


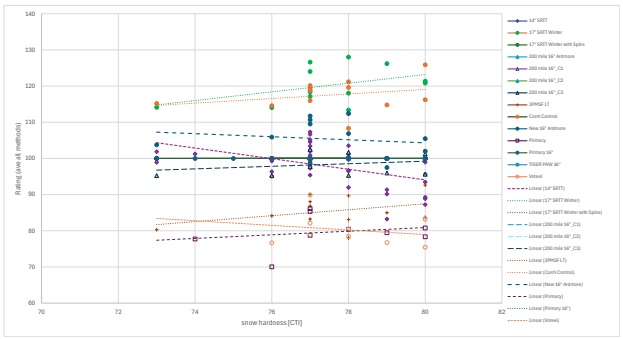
Location B only



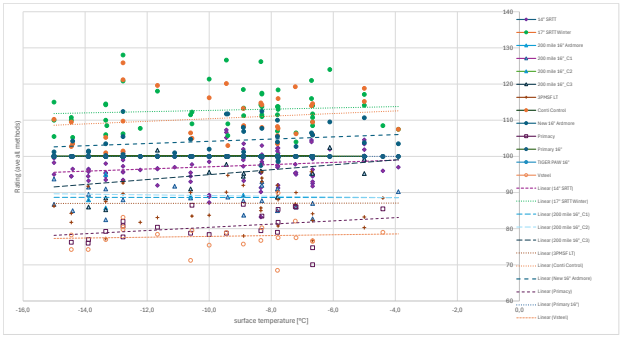


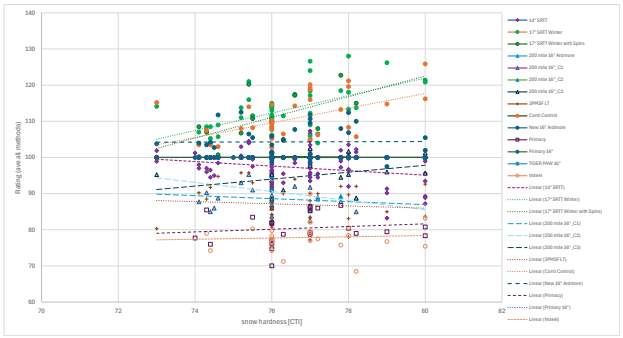
Location C only



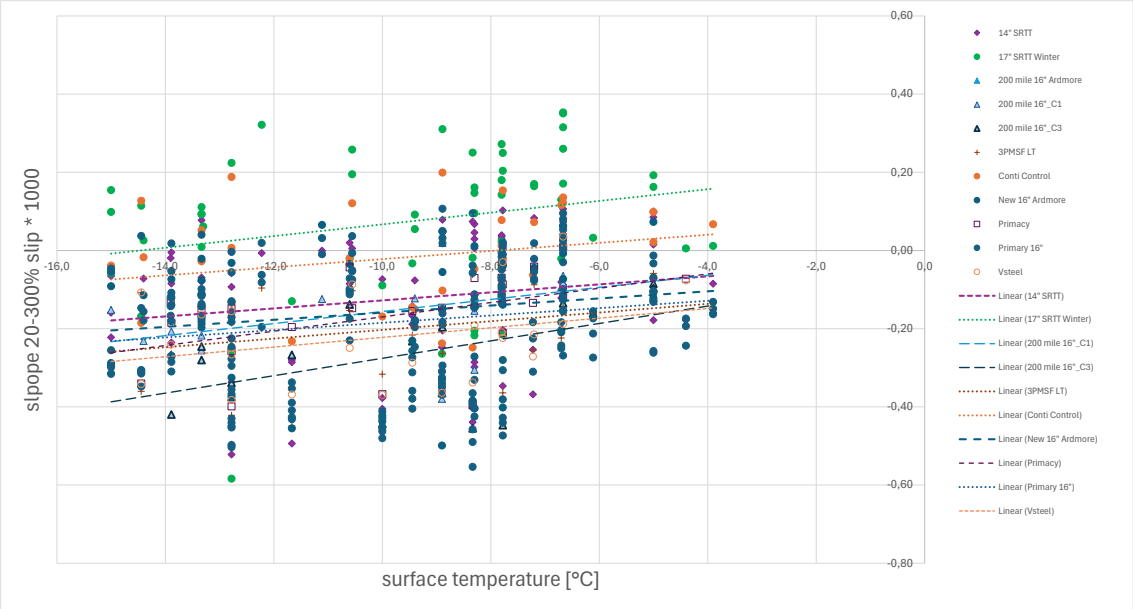


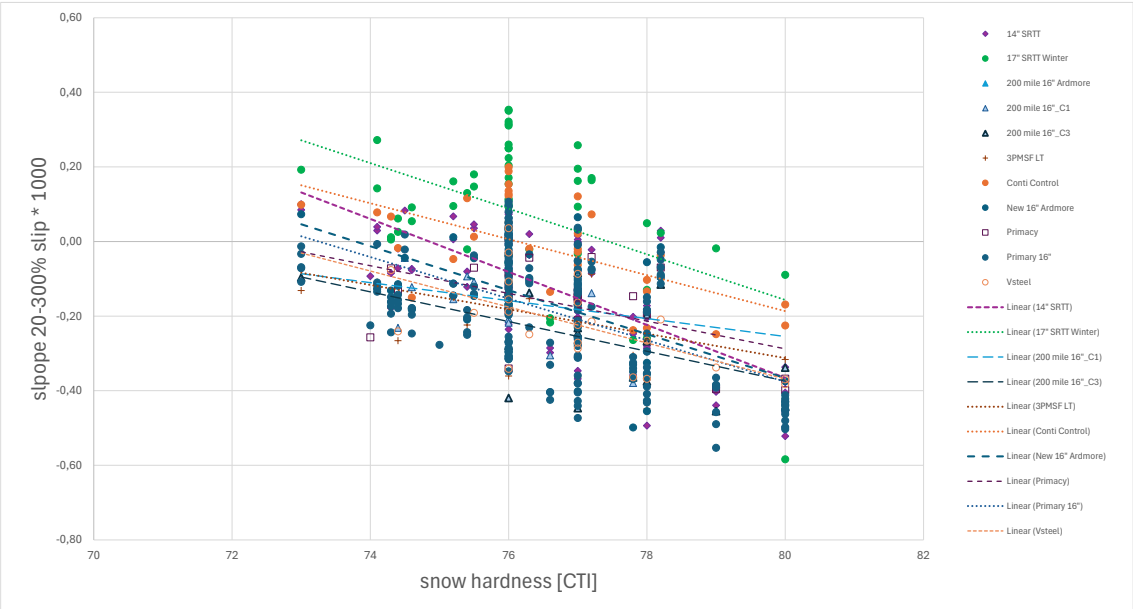
All locations

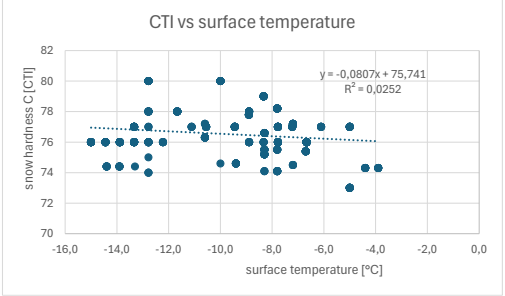




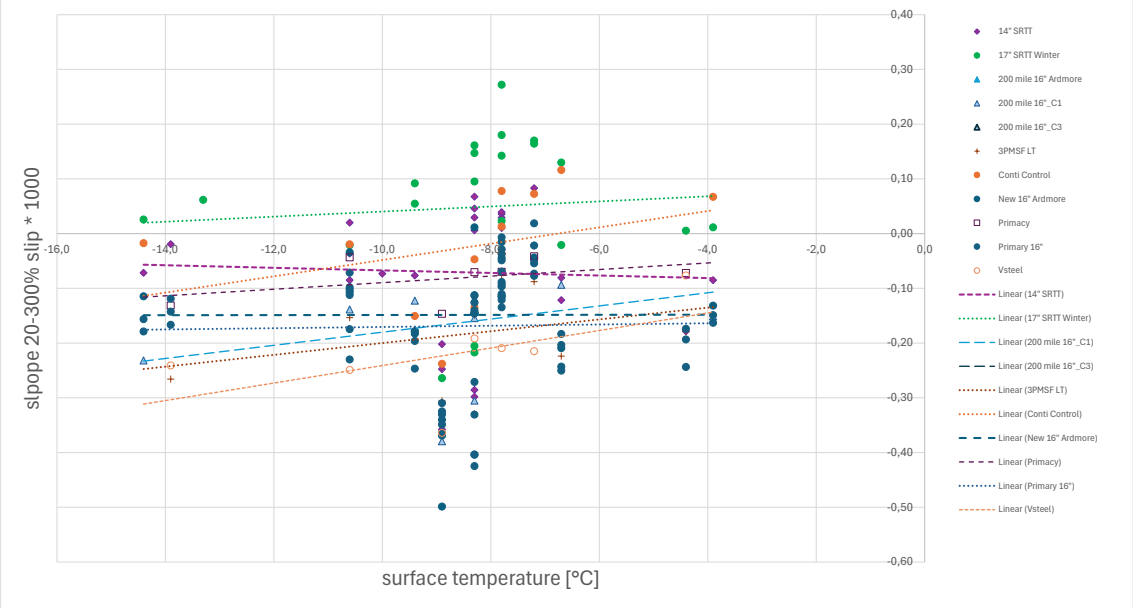
All locations – Study 1, slope of μ slip curves - only tires with more than 18 repetitions in sum for all locations based on table 2.

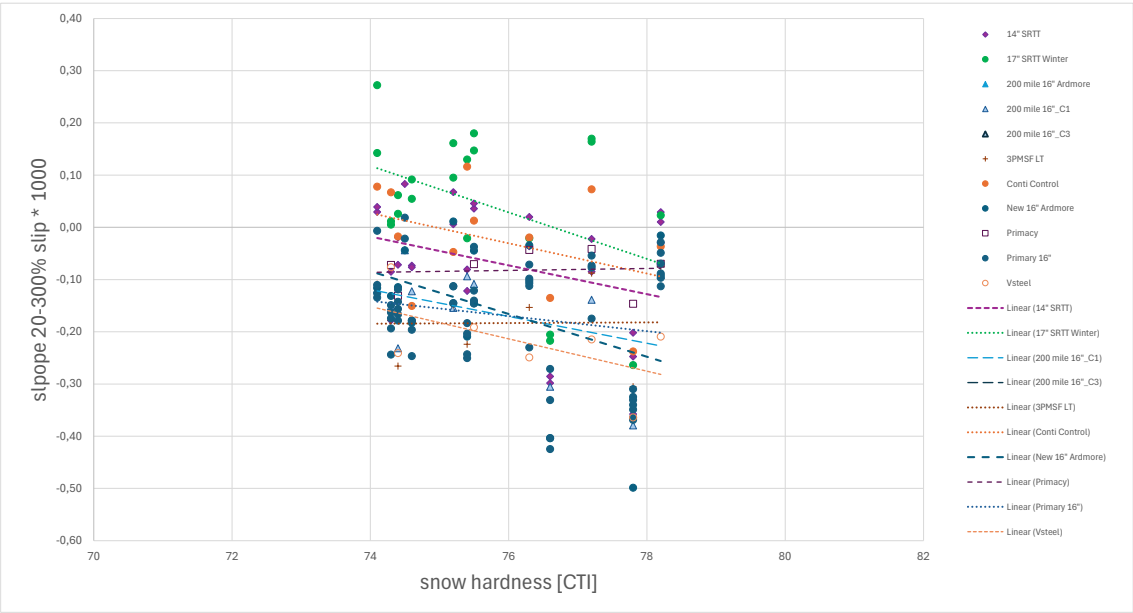


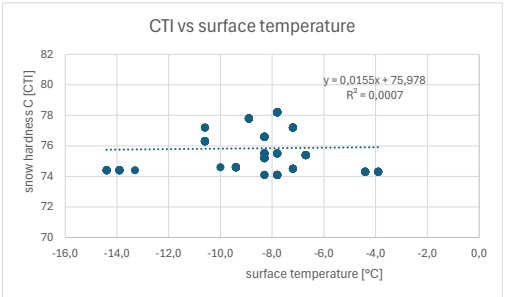




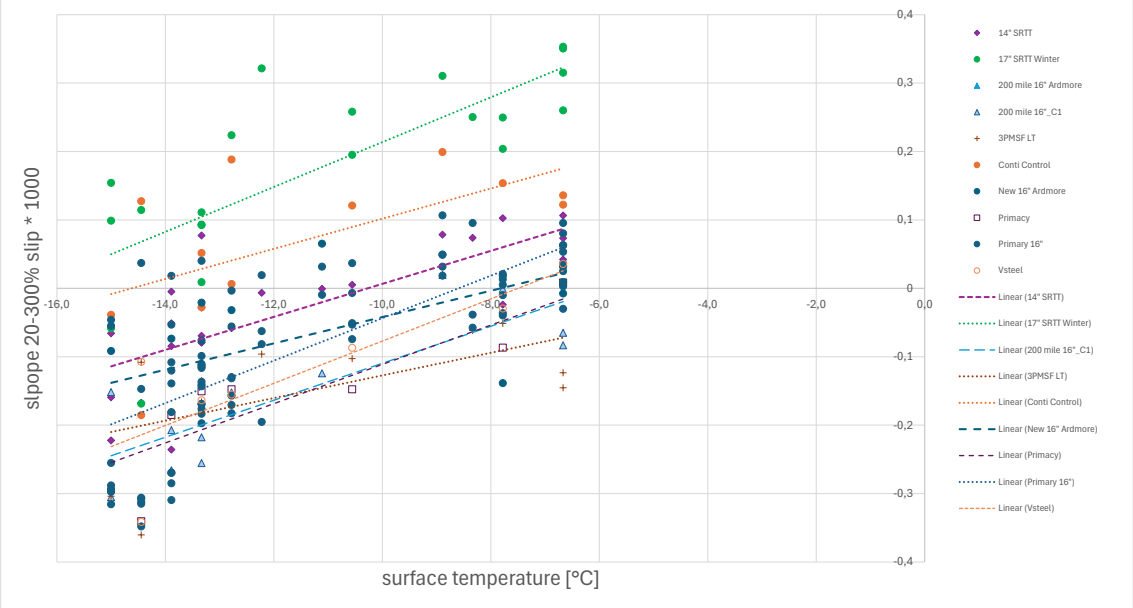
Location A – Study 1, only tires with more than 7 repetitions

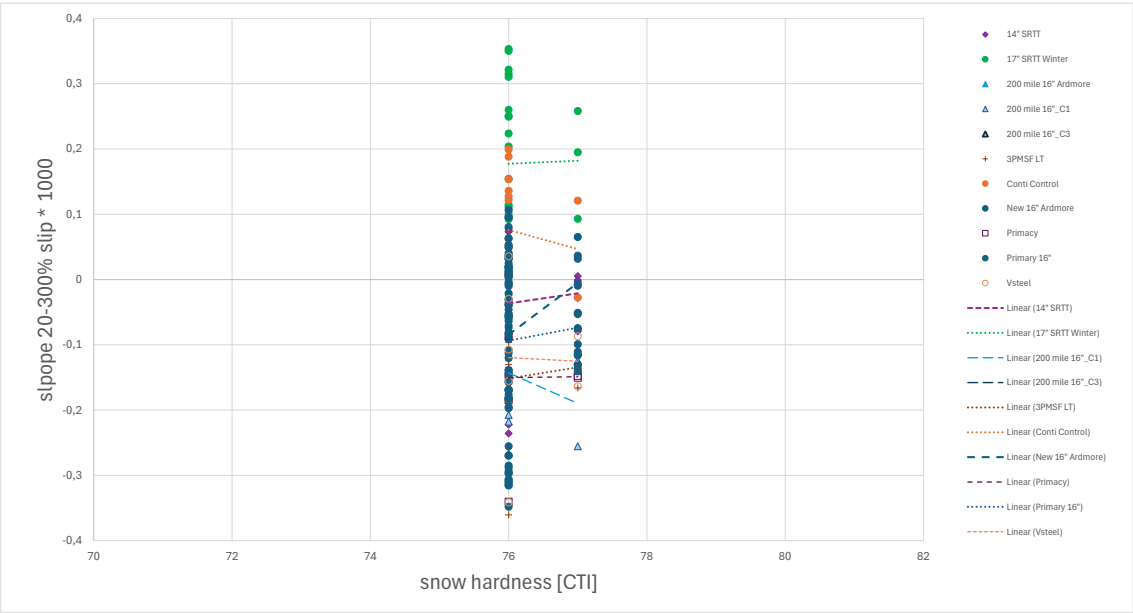


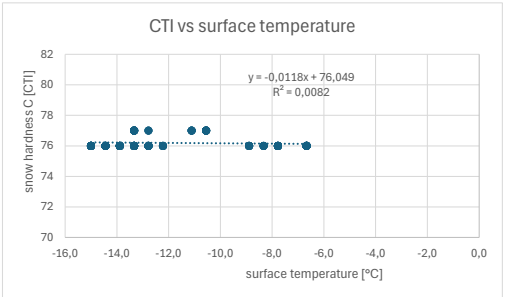




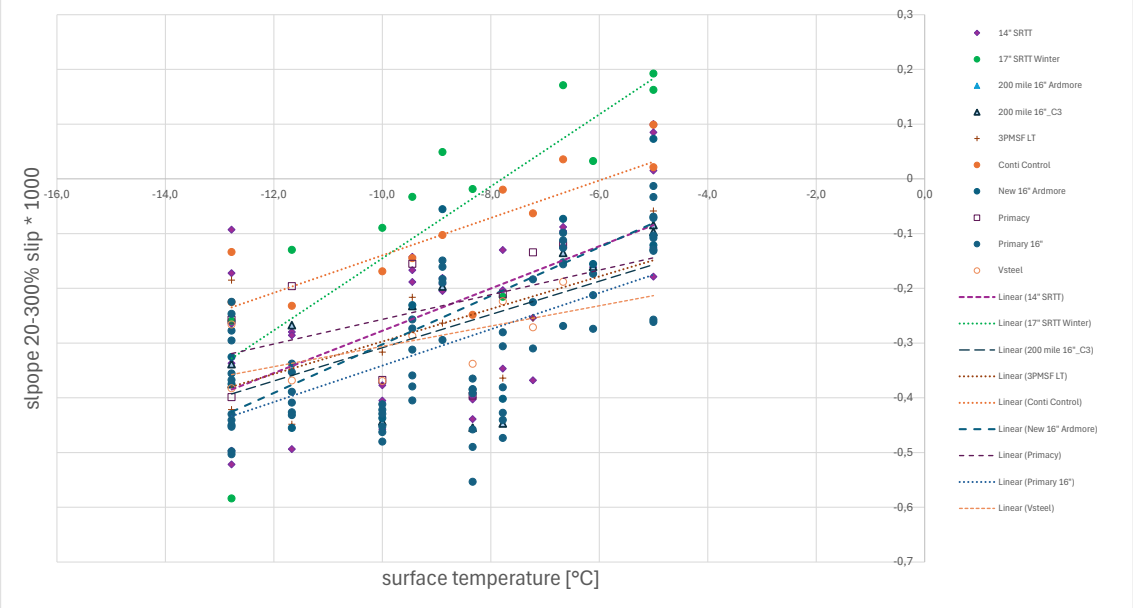
Location B – Study 1, only tires with more than 7 repetitions

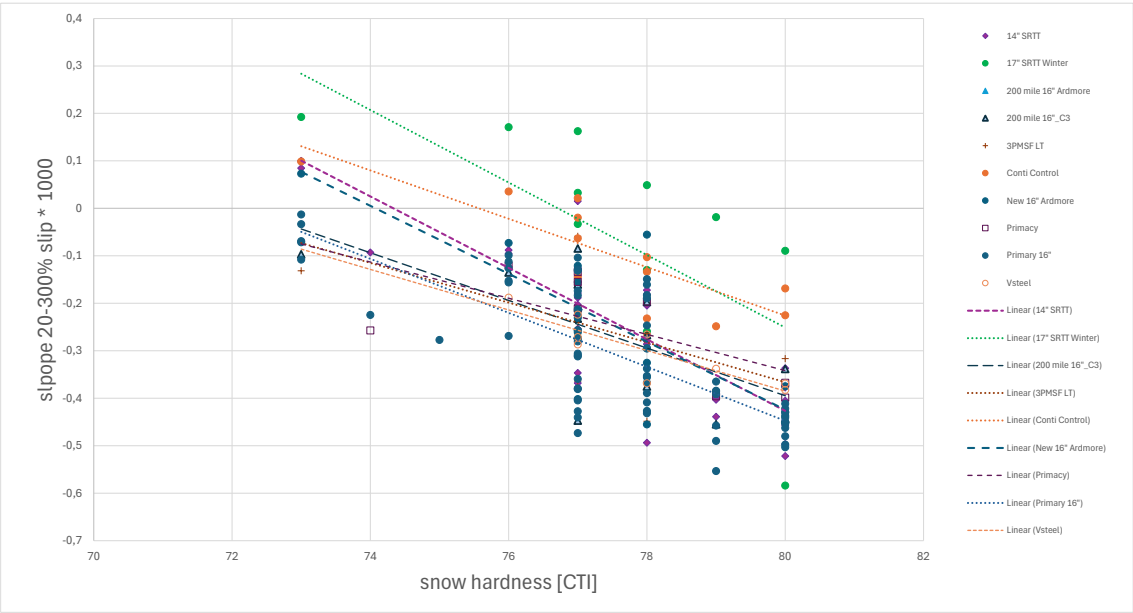


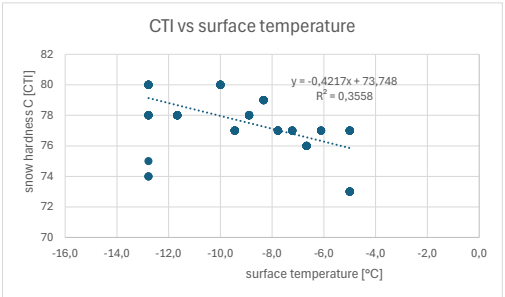




Location C – Study 1, only tires with more than 7 repetitions







Appendix 4: 2025 Best Practice for ASTM F1805-20:

This is only considered best practice since it must conform to F1805-20. The best practice has restored reproducibility of F1805 to historic levels and had been improved based on studies from the 2023 season. Other studies in 2024 further refine the best practice. A 2025 test plan is designed to further study the 16" SRTT and a possible replacement SRTT, the F3675 SRTT, with a planned update to F1805 in 2025.

Specify Range of Relative Performance vs New 16" SRTT

Definitions:

witness SRTT, n - a witness F2493 SRTT is considered "new" when less than 18 months old and less than 25 spins have been performed in each direction on the SRTT. The tire wheel assembly shall only be installed and used at the test site to prevent the tread surface being altered from the condition when it was manufactured.

primary SRTT, *n* - a single F2493 SRTT tire used as a reference to generate candidate tire ratings.

Procedure:

1. Pre-conditioning of the primary SRTT prior to rating candidate tires: Pre-conditioning must include 50 spins in the rotational direction of use while on medium compaction snow. Additional pre-conditioning is likely necessary to ensure the SRTT snow grip level is 1.000 or below. Pre-conditioning may include on-the-road conditioning of up to 322 km (200 miles) or additional spins on the snow.
2. Initial Validation - primary SRTT performance is below the upper thresholds:
    a. $Adj. Coefficient\ (witness\ SRTTx) = Coefficient\ (witness\ SRTTx) * F$
        i. For witness SRTT first test run (includes spin 5) in either direction F=1.0
        ii. For witness SRTT second test run (includes spin 20) in either direction F=0.98
    b. Test Tire Matrix (either option below is acceptable):
        i. Primary SRTT – witness SRTTa – Candidate tire (optional) - Primary SRTT
            1. $Relative\ Performance\ Rating\ 1\ witness = \frac{Coefficient\ (primary\ SRTT\ Avg.)}{Adj.\ Coefficient\ (\ witness\ SRTTa)}$
        ii. Primary SRTT – witness SRTTa – witness SRTTb - Primary SRTT

1. $$Relative\ Performance\ Rating\ 2\ witnesses = \frac{Coefficient\ (primary\ SRTT\ Avg.)}{((Adj.\ Coefficient\ (witness\ SRTTa) + Adj.\ Coefficient\ (witness\ SRTTb))/2)}$$

   c. If using 2 different witness SRTTs for relative performance ratings, then the ratings must be equal or below 1.000 before using the primary SRTT for candidate tire ratings
      i. Alternatively, two values of "Relative Performance Rating 1 witness" can be averaged together if different witness SRTTs were used for the two ratings
   d. If using 1 witness SRTT for relative performance ratings, then the relative performance must be below 0.980 before using the primary SRTT for candidate tire ratings
   e. Once the primary SRTT is validated as below the upper threshold, the SRTT can be used for rating candidate tires until it is below the lower threshold (even if the relative performance is measured to be above 1.000 during the 200 spin interval witness checks)

3. Periodic Validation - primary SRTT performance is above the lower threshold:
   a. Test Tire Matrix: Primary SRTT – witness SRTT – Candidate tire (optional) - Primary SRTT
   b. $$Relative\ Performance\ Rating = \frac{Coefficient\ (primary\ SRTT\ Avg.)}{Adj.\ Coefficient\ (witness\ SRTT)}$$
   c. The relative performance of the primary SRTT must be checked once per day and every 200 spins unless any of the following situations exist: The frequency may be extended to 250 spins to avoid interrupting a test matrix; The frequency may be extended to once per day and every 300 spins if the relative performance of the primary SRTT is greater than 0.95 on the previous check.
   d. The primary SRTT should no longer be used for rating candidate tires once the relative performance is measured to be less than 0.936. Results prior to the measurement below 0.936 are acceptable even if the primary SRTT performance was potentially less than 0.936 for some tests within the spin interval.

4. Daily Surface Rating Monitor using 17" winter SRTT (ASTM F3675)
   a. When testing on medium pack snow, ratings from the ASTM F3675 tire vs a 16" primary SRTT are recommended to monitor that the test method produces consistent results relative to historical values on each test day.
   b. Test Tire Matrix: Primary SRTT – witness SRTT – ASTM F3675 - Primary SRTT
   c. The ASTM F3675 should be less than 2 years old based on the week/year manufacture date molded into the tire sidewall.
   d. The tire wheel assembly should only be installed and used at the test site to prevent the tread surface being altered from the condition when it was manufactured.
   e. The ASTM F3675 should be replaced before reaching 1,250 spins.

Data Reporting

- The relative performances of the primary SRTT vs witness SRTT should be reported for each test
- F3675 rating vs. a 16" primary SRTT from the same day and surface a candidate tire was tested
- Spin count of candidate tire, 17" SRTT and 16" SRTT at the time of test
- Break-in procedure for SRTT and each candidate tire (if known); ie. Check box Y/N/Unknown, OR more details: spins, distance/surface

Appendix 5: Data tables

Most of the data used for this report can be found in the ASTM F09 committee site using the links below:

https://www.astm.org/membership-participation/technical-committees/committee-f09

- 2025_11_06 Study 1 Evaluations
- 2025_11_06 Study 1 Worksheets Pivot Analysis Date Chart
- 2025_11_06 ASTM Study 3 tables
- 2025_11_06 Study 4 evaluations

The screenshot below shows the additional information available on the ASTM F09 committee site in 2026.

Additional Information

- F09 Fact Sheet
- IMPORTANT E1136 SRTT PHASE-OUT INFO (NOV 2018)
- F2493-18 Updates
- Technical Report: SRTT Transition for ASTM F1805
- ASTM International Statement on ASTM F1805-20 Standard Reference Test Tire (SRTT) Usage
- SRTT International Order Form
- F1805-20 Best Practice 2026 DOT update
- 2025_11_06 Study 1 Evaluations
- 2025_11_06 Study 1 Worksheets Pivot Analysis Date Chart
- 2025_11_06 ASTM Study 3 tables
- 2025_11_06 Study 4 evaluations