ETRTO®
European Tyre & Rim Technical Organisation

Informal document **GRBP-79-36**
79th GRBP, 6-9 February 2024
agenda item 7 (d)

New design C3 SRTTs Additional Explanations

update of GRBP-78-28e-Rev.1

New C3 SRTT Design – Snow performance

From GRBP-78-28e-Rev.1

Background - regulatory framework & reason for changing the current C3 SRTTs

Rib design of the tread pattern of current C3 SRTTs with limited snow performance capabilities
→ High performance variation depending on the track surface conditions during testing

- high performance variations in the evaluation of candidate tyres
- poor correlation between different test providers and/or proving grounds

Need to improve reproducibility of the Snow Grip test results (i.e., reduce the uncertainty of the test) while not deteriorating the Wet Grip reproducibility

New C3 SRTT Design – Snow performance

(*) additional data, missing in previous analysis, are considered

Analysis of Test Results – Conclusions (all valid results)*

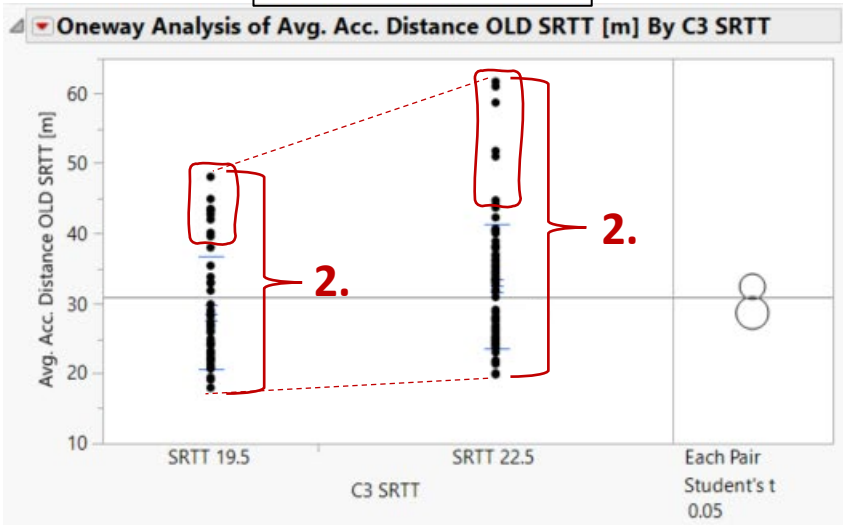
1. New SRTT 22.5 and 19.5 are equivalent in their performance
   → only one correlation factor

2. Very high variation of current SRTT could lead to very positive candidate performance

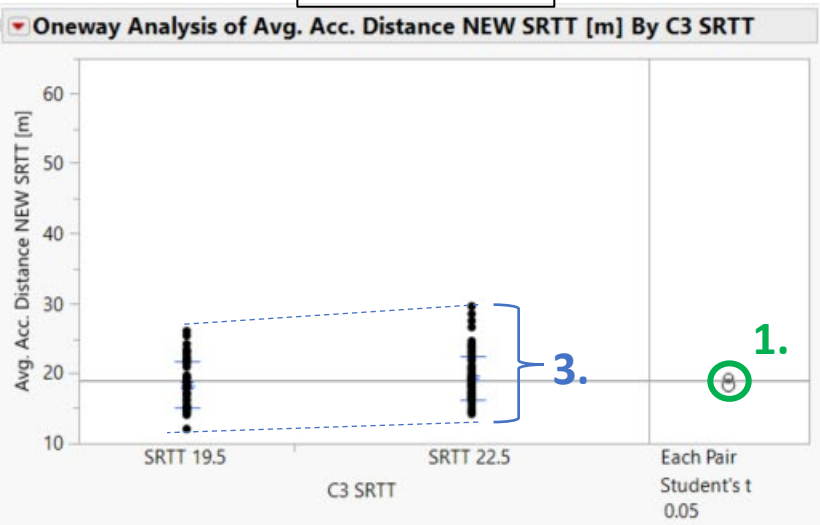
3. Performance variation of NEW SRTT is significantly reduced
   → good stability
   → high reproducibility
   → higher challenge to pass Threshold

4. Updated correlation factors:
   SRTT19.5 → 1.57 (instead of 1.53)
   SRTT22.5 → 1.68 (instead of 1.67)

Current SRTTs



New SRTTs



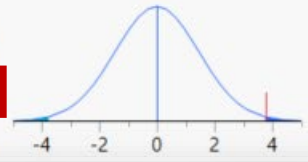
Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
SRTT 19.5	54	28.64	8.089	1.101	26.43	30.85
SRTT 22.5	88	32.4	8.904	0.949	30.51	34.29

t Test

SRTT 22.5-SRTT 19.5
Assuming unequal variances

Difference	3.759	t Ratio	2.587
Std Err Dif	1.453	DF	120.5
Upper CL Dif	6.637	Prob > |t|	0.011
Lower CL Dif	0.882	Prob > t	0.005
Confidence	0.95	Prob < t	0.995



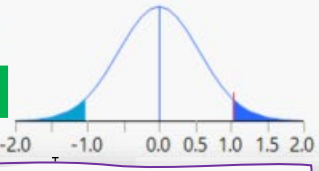
Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
SRTT 19.5	54	18.27	3.317	0.451	17.37	19.18
SRTT 22.5	88	19.29	3.143	0.335	18.63	19.96

t Test

SRTT 22.5-SRTT 19.5
Assuming unequal variances

Difference	1.023	t Ratio	1.82
Std Err Dif	0.562	DF	107.6
Upper CL Dif	2.137	Prob > |t|	0.072
Lower CL Dif	-0.09	Prob > t	0.036
Confidence	0.95	Prob < t	0.964



	Avg. Acc. OLD SRTT [m/s²]			Avg. Acc. Distance OLD SRTT [m]			Avg. Acc. NEW SRTT [m/s²]			Avg. Acc. Distance NEW SRTT [m]			C3 New SRTT SGI [%]		
C3 SRTT	Mean	Std Dev	CV	Mean	Std Dev	CV	Mean	Std Dev	CV	Mean	Std Dev	CV	Mean	Std Dev	CV
SRTT 19.5	0.76	0.21	28.40	28.64	8.09	28.24	1.14	0.19	17.06	18.27	3.32	18.15	157.11	30.12	19.17
SRTT 22.5	0.67	0.19	27.89	32.40	8.90	27.48	1.08	0.16	14.48	19.29	3.14	16.29	168.35	30.83	18.31

two-tailed test.

New C3 SRTT Design – Snow performance

Analysis of Test Results – Conclusions considering all valid results

- The NEW SRTT 19.5 and 22.5 are now equivalent with much higher performance stability

  → **Continuation of interchangeability of both NEW SRTT for candidate testing**

- Equivalence of NEW SRTT → **Same correlation factor needs to be applied due to interchangeability**

- Higher challenge to exceed threshold vs. the NEW SRTTs due to lower test variation of NEW SRTTs

  (strong reduced influence of test conditions on candidate snow index)

  → **No benefit expected when testing 19.5 and 17.5 candidates due to higher stability of the NEW SRTT**

New C3 SRTT Design – Snow performance

Summary

What is the background for implementation of new C3 SRTT design?

- **Too high variation of current SRTT leads to a poor reproducibility**

What is the reason for a unique correlation factor for both SRTT sizes?

- **Improved equivalence of both NEW SRTTs based on test result analysis**

Why is the final updated calculated factor 1.68 the right choice?

- **Covering all current candidate tyres which were tested vs. old SRTT 22.5**
  (a lower coefficient than 1.68 will lead to a global tightening)
- **Best fit for covering all local conditions including local market shares**
- **For candidates tested against SRTT19.5, it will be compensated by the reduced variability of test results because the stability of new SRTT will prevent very positive results due to SRTT poor performance only**

New C3 SRTT Design – wet grip performance

From GRBP-78-28e-Rev.1

Overview

- **3 years testing**
- **Different conditions (temp., track friction, vehicle)**
- **9 testing companies / locations**
- **More than 70 tests results**

DOT week code of the reference tyre	Candidate tyre	DOT week code (candidate)	Vehicle model	Axle configuration (1,2,3)	Rear Axle fitment: Single (2 tyres) or Dual (4 tyres)	Max mass associated with the load capacity index of the tyre Qr [kg]	Inflation pressure marked on the sidewall Pr [kPa]	Load per axle (Front) [kg]	Load per axle (Rear) [kg]	Inflation Pressure Pt (Front) [kPa]	Rim Size	Max mass associated with the load capacity index of the tyre Qr [kg]	Inflation pressure marked on the sidewall Pr [kPa]	Load per axle (Front) [kg]	Load per axle (Rear) [kg]	Inflation Pressure Pt (Front) [kPa]	Rim Size	Temperature wet surface (candidate)	Air Temperature (candidate)	Water depth (mm)	MTD	Track mu peak SRTT16''	BPN (for reference only)	Braking BFC reference (Ra)	braking BFC candidate (Ta)	CoV	WGI
0518	C3W new	0518	RENAULT 450DXI	1	Single	3750	900	6320	6356	720	22.5 x 9	3750	900	6320	6356	720	22.5 x 9	11	14	1.1	0.8		57	0.409	0.411	2.0%	**1.00**
0518	C3W new	0518	RENAULT 450DXI	1	Single	3750	900	6320	6356	720	22.5 x 9	3750	900	6320	6356	720	22.5 x 9	7	10	1.3	0.8		54	0.418	0.422	1.6%	**0.99**
0519	C3W new	0519	RENAULT 450DXI	1	Single	3750	900	6320	6356	720	22.5 x 9	3750	900	6320	6356	720	22.5 x 9	13	12	1.2	0.8		56	0.448	0.465	2.1%	**1.04**
0519	C3W new	0519	RENAULT 450DXI	1	Single	3750	900	6320	6356	720	22.5 x 9	3750	900	6320	6356	720	22.5 x 9	13	12	1.2	0.8		56	0.438	0.444	2.1%	**1.01**
0519	C3W new	0519	RENAULT 450DXI	1	Single	3750	900	6320	6356	720	22.5 x 9	3750	900	6320	6356	720	22.5 x 9	13	11	1.2	0.8		56	0.422	0.421	2.1%	**1.00**
0519	C3W new	0519	RENAULT 450DXI	1	Single	3750	900	6320	6356	720	22.5 x 9	3750	900	6320	6356	720	22.5 x 9	13	11	1.2	0.8		56	0.416	0.418	2.1%	**1.00**
0519	C3W new	0519	RENAULT 450DXI	1	Single	3750	900	6320	6356	720	22.5 x 9	3750	900	6320	6356	720	22.5 x 9	17	18	1.2	0.8		56	0.441	0.446	1.3%	**1.01**
0519	C3W new	0519	RENAULT 450DXI	1	Single	3750	900	6320	6356	720	22.5 x 9	3750	900	6320	6356	720	22.5 x 9	17	18	1.2	0.8		56	0.448	0.457	1.3%	**1.02**
0519	C3W new	0519	RENAULT 450DXI	1	Single	3750	900	6320	6356	720	22.5 x 9	3750	900	6320	6356	720	22.5 x 9	15	13	1.2	0.8		56	0.440	0.449	1.3%	**1.02**
0519	C3W new	0519	RENAULT 450DXI	1	Single	3750	900	6320	6356	720	22.5 x 9	3750	900	6320	6356	720	22.5 x 9	15	13	1.2	0.8		56	0.443	0.452	1.3%	**1.02**
0519	C3W new	0519	RENAULT 450DXI	1	Single	3750	900	6320	6356	720	22.5 x 9	3750	900	6320	6356	720	22.5 x 9	16	16	1.2	0.8		56	0.452	0.456	2.7%	**1.01**
0519	C3W new	0519	RENAULT 450DXI	1	Single	3750	900	6320	6356	720	22.5 x 9	3750	900	6320	6356	720	22.5 x 9	16	16	1.2	0.8		56	0.449	0.455	2.7%	**1.01**
0519	C3W new	0519	RENAULT 450DXI	1	Single	3750	900	6320	6356	720	22.5 x 9	3750	900	6320	6356	720	22.5 x 9	15	17	1.2	0.8		56	0.440	0.457	2.7%	**1.04**
0519	C3W new	0519	RENAULT 450DXI	1	Single	3750	900	6320	6356	720	22.5 x 9	3750	900	6320	6356	720	22.5 x 9	15	17	1.2	0.8		56	0.442	0.457	2.7%	**1.03**
5016	C3W new	3519	ACTROS 1851L	1	Single	3750	900	5800	5800	653	9.0x22.5	3750	900	5800	5800	653	9.0x22.5	5.2	6.4	1.5	0.93	0.85		0.448	0.473	0.9%	**1.06**
4218	C3W new	3519	ACTROS 1851L	1	Single	3750	900	5800	5800	653	9.0x22.5	3750	900	5800	5800	653	9.0x22.5	5.2	6.4	1.5	0.93	0.85		0.481	0.475	0.9%	**0.99**
5016	C3W new	3519	ACTROS 1851L	1	Single	3750	900	6720	6720	785	9.0x22.5	3750	900	6720	6720	785	9.0x22.5	6.1	6.1	1.5	0.93	0.85		0.450	0.472	0.5%	**1.05**
4218	C3W new	3519	ACTROS 1851L	1	Single	3750	900	6720	6720	785	9.0x22.5	3750	900	6720	6720	785	9.0x22.5	6.1	6.1	1.5	0.93	0.85		0.481	0.470	0.5%	**0.98**
0618	C3W new	3519	ACTROS 1851L	1	Single	3750	900	5800	5800	653	9.0x22.5	3750	900	5800	5800	653	9.0x22.5	10.2	7.0	1.5	0.93	0.85		0.502	0.514	1.6%	**1.02**
4218	C3W new	3519	ACTROS 1851L	1	Single	3750	900	5800	5800	653	9.0x22.5	3750	900	5800	5800	653	9.0x22.5	10.2	7.0	1.5	0.93	0.85		0.526	0.514	1.6%	**0.98**
0618	C3W new	3519	ACTROS 1851L	1	Single	3750	900	6720	6720	785	9.0x22.5	3750	900	6720	6720	785	9.0x22.5	10.3	11.8	1.5	0.93	0.85		0.478	0.507	0.8%	**1.06**
4218	C3W new	3519	ACTROS 1851L	1	Single	3750	900	6720	6720	785	9.0x22.5	3750	900	6720	6720	785	9.0x22.5	10.3	11.8	1.5	0.93	0.85		0.496	0.506	0.8%	**1.02**
0618	C3W new	3519	ACTROS 1851L	1	Single	3750	900	5800	5800	653	9.0x22.5	3750	900	5800	5800	653	9.0x22.5	16.1	22.3	1.5	0.93	0.85		0.467	0.484	0.7%	**1.03**
4218	C3W new	3519	ACTROS 1851L	1	Single	3750	900	5800	5800	653	9.0x22.5	3750	900	5800	5800	653	9.0x22.5	16.1	22.3	1.5	0.93	0.85		0.488	0.484	0.7%	**0.99**
0618	C3W new	3519	ACTROS 1854	1	Single	3750	900	5800	5800	653	9.0x22.5	3750	900	5800	5800	653	9.0x22.5	16.8	15.5	1.5	0.93	0.85		0.472	0.497	0.8%	**1.05**
4218	C3W new	3519	ACTROS 1854	1	Single	3750	900	5800	5800	653	9.0x22.5	3750	900	5800	5800	653	9.0x22.5	16.8	15.5	1.5	0.93	0.85		0.503	0.500	0.8%	**0.99**
4218	C3N new	3419	ATEGO 1330L	1	Single	2240	760	3300	3300	532	7.5x19.5	2240	825	3300	3300	532	6.75x19.5	5.6	6.7	1.5	0.93	0.85		0.452	0.494	1.1%	**1.09**
4816	C3N new	3419	ATEGO 1330L	1	Single	2240	760	4200	4200	701	7.5x19.5	2240	825	4200	4200	701	6.75x19.5	6.9	6.2	1.5	0.93	0.85		0.473	0.490	1.3%	**1.04**
4816	C3N new	3419	ATEGO 1330L	1	Single	2240	760	4200	4200	701	7.5x19.5	2240	825	4200	4200	701	6.75x19.5	8.2	8.2	1.5	0.93	0.85		0.473	0.495	0.9%	**1.05**
4816	C3N new	3419	ATEGO 1330L	1	Single	2240	760	4200	4200	701	7.5x19.5	2240	825	4200	4200	701	6.75x19.5	10.1	13.1	1.5	0.93	0.85		0.478	0.501	1.1%	**1.05**
4816	C3N new	3419	ATEGO 1330L	1	Single	2240	760	3300	3300	532	7.5x19.5	2240	825	3300	3300	532	6.75x19.5	19.0	18.8	1.5	0.93	0.85		0.412	0.443	2.5%	**1.07**
4816	C3N new	3419	ATEGO 1330L	1	Single	2240	760	4200	4200	701	7.5x19.5	2240	825	4200	4200	701	6.75x19.5	20.7	17.4	1.5	0.93	0.85		0.420	0.429	0.8%	**1.02**
3619	C3N new	3419	ATEGO 1330L	1	Single	2240	760	3300	3300	532	7.5x19.5	2240	825	3300	3300	578	7.5x19.5	21.6	26	1.5	1.00	0.84		0.382	0.382	1.8%	**1.00**
3619	C3N new	3419	ATEGO 1330L	1	Single	2240	760	4200	4200	701	7.5x19.5	2240	825	4200	4200	761	7.5x19.5	19.8	17.4	1.5	1.00	0.84		0.390	0.400	1.4%	**1.03**
4218	C3W new	3519	ATEGO 1330L	1	Single	3750	900	4480	4480	630	9.0x22.5	3750	900	4480	4480	630	9.0x22.5	19.8	24.3	1.5	0.93	0.85		0.443	0.449	0.7%	**1.01**
4218	C3N new	3419	ATEGO 1330L	1	Single	2240	760	4480	4480	760	6.75x19.5	2240	825	4480	4480	760	6.75x19.5	20.2	23.5	1.5	0.93	0.85		0.454	0.444	0.8%	**0.98**
4218	C3N old	4218	ATEGO 1330L	1	Single	3750	900	4480	4480	630	9.0x22.5	2240	760	4480	4480	760	6.75x19.5	19.1	21.8	1.5	0.93	0.85		0.442	0.456	0.6%	**1.03**
3519	C3N new	3419	ATEGO 1330L	1	Single	3750	900	4480	4480	630	9.0x22.5	2240	825	4480	4480	760	6.75x19.5	20.2	23.5	1.5	0.93	0.85		0.446	0.444	0.8%	**1.00**
3117	C3N new	3419	HINO-RANGER	1	Single	2240	760	2784	3162	532	19.5x6.75	2240	825	2784	3162	578	19.5x6.75	24.9	22.2	1.3	0.61	-	55	0.533	5.650	1.6%	**1.05**
4218	C3W new	3519	ISUZU-GIGA	1	Single	3750	900	5228	5334	630	22.5x9.00	3750	900	5228	5334	630	22.5x9.00	30.4	26.1	1.3	0.61	-	55	0.464	5.220	2.0%	**1.12**
3920	C3W new	3619	rcedes Actros 18.53, 1	1	Single	3750	900	4400	4400	630	9.00 x 22.5	3750	900	4400	4400	630	9.00 x 22.5	25.2	22.0	1.1		0.808	53.1	0.487	0.486	0.44%	**1.00**
3920	C3N old	4918	rcedes Actros 18.53, 1	1	Single	3750	900	4400	4400	630	9.00 x 22.5	2240	760	4400	4400	743	7.50 x 19.5	25.9	23.0	1.1		0.808	53.1	0.487	0.482	0.61%	**0.99**
3920	C3N new	3419	rcedes Actros 18.53, 1	1	Single	3750	900	4400	4400	630	9.00 x 22.5	2240	825	4400	4400	807	7.50 x 19.5	26.5	24.0	1.1		0.808	53.1	0.486	0.488	0.40%	**1.00**
3920	C3W new	3619	rcedes Actros 18.53, 1	1	Single	3750	900	4400	4400	630	9.00 x 22.5	3750	900	4400	4400	630	9.00 x 22.5	18.6	17.0	1.1		0.808	53.1	0.488	0.488	0.31%	**1.00**
3920	C3N new	3419	rcedes Actros 18.53, 1	1	Single	3750	900	4400	4400	630	9.00 x 22.5	2240	825	4400	4400	807	7.50 x 19.5	19.0	17.0	1.1		0.808	53.1	0.487	0.482	0.34%	**0.99**
3920	C3N old	4918	rcedes Actros 18.53, 1	1	Single	3750	900	4400	4400	630	9.00 x 22.5	2240	760	4400	4400	743	7.50 x 19.5	20.3	19.0	1.1		0.808	53.1	0.487	0.480	0.32%	**0.99**
3417	C3N new	3419	ATEGO 1229	1	Single	2240	TBC	3488	3283	600	7.5x19.5	2240	TBC	3488	3283	600	7.5x19.5	26.1	22.4	1.3	0.91	-	55	0.520	0.554	1.8%	**1.07**
4218	C3N new	3419	ATEGO 1229	1	Single	2240	TBC	3600	3640	640	7.5x19.5	2240	TBC	3600	3640	640	7.5x19.5	29.7	25	1.3	0.91	-	57	0.530	0.530	0.7%	**1.00**
3920	C3W new	3519	ACTROS1848	1	Single	3750	TBC	5714	5455	640	9.0x22.5	3750	TBC	5714	5455	640	9.0x22.5	31.7	23.8	1.3	0.91	-	55	0.570	0.574	1.3%	**1.00**
3920	C3W new	3519	ACTROS1848	1	Single	3750	TBC	5640	5600	630	9.0x22.6	3750	TBC	5640	5600	630	9.0x22.6	31.3	27.8	1.3	0.91	-	57	0.515	0.537	1.5%	**1.04**
5116	C3W new	3519	DB Arocs 1848	1	Single	3750	900	6420	5920	740/670	9.0x22.5	3750	900	6420	5920	740/670	9.0x22.5	16.0	15.2	0.8	0.90	0.76	51	0.409	0.440	1.7%	**1.08**
3417	C3N new	3419	DB Atego 1227	1	Single	2240	760	4200	3900	700/640	7.5x19.5	2240	760	4200	3900	700/640	7.5x19.5	29.9	19.4	0.8	0.90	0.76	51	0.404	0.426	1.6%	**1.05**

New C3 SRTT Design – wet grip performance

From GRBP-78-28e-Rev.1

	Method	CURRENT SRTT (Average BFC or mu-peak)			NEW DESIGNED SRTT (Average BFC or mu peak)			C3 New SRTT WGI (%)		
		Average	Stdev	CoV	Average	Stdev	CoV	**Average**	Stdev	CoV
SRTT19.5	**VEHICLE**	0.456	0.052	11.4%	0.473	0.058	12.1%	**1.04**	0.03	3.2%
	TRAILER	0.652	0.108	16.5%	0.662	0.111	16.7%	**1.02**	0.01	0.5%
SRTT22.5	**VEHICLE**	0.463	0.036	7.7%	0.473	0.036	7.7%	**1.02**	0.03	3.0%
	TRAILER	0.620	0.099	16.0%	0.625	0.081	12.9%	**1.01**	0.04	4.1%

Coefficient of variation of Current C3 SRTT and New Design C3 SRTTs (BFC or mu) are similar

→ **stability on wet is maintained**

Current and New SRTTs are not so distant in terms of wet performance: the available data show anyhow a slight improvement of new design SRTTs

→ **Proposed correlation factor was 1.04 for both 19.5 & 22.5, for both trailer and vehicle methods**

New C3 SRTT Design – wet grip performance

Interchangeability of the C3 SRTTs

- The choice of the C3 SRTT to be used for the Wet Grip index test is currently prescribed by regulation depending on the nominal section width of the Candidate tyre (Narrow and Wide families)

For C3 tyres	
Narrow Family **$S_{NOMINAL}$ < 285 mm**	Wide Family **$S_{NOMINAL}$ ≥ 285 mm**
SRTT 19.5	**SRTT 22.5**
$S_{NOMINAL}$ = Tyre nominal section width	

- In some cases, this approach has significant limitations:

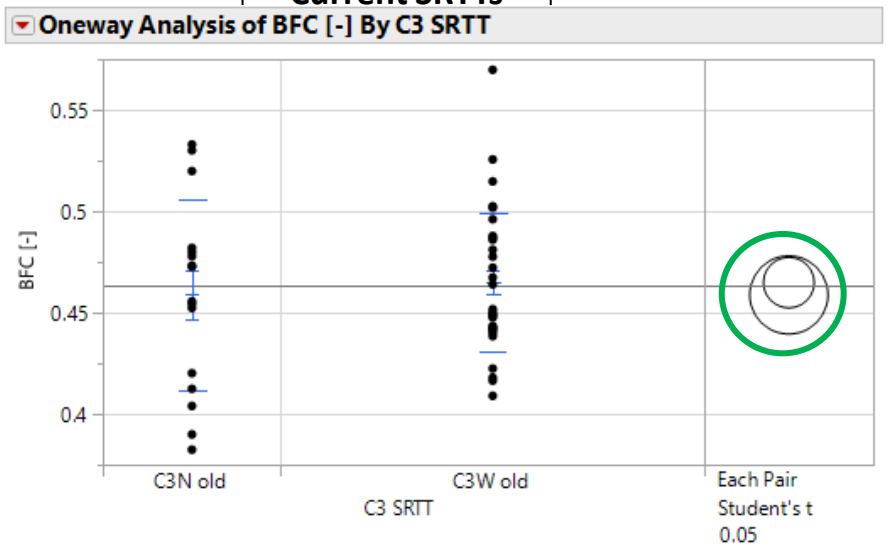
  Dimensional problems (Possibility to fit reference and candidate tyres on the same vehicle)

  Load problems (Difficulty in testing in the load conditions required by the regulation)

New C3 SRTT Design – wet grip performance

Interchangeability of the 2 C3 SRTTs – Vehicle method

Current SRTTs



Means and Std Deviations

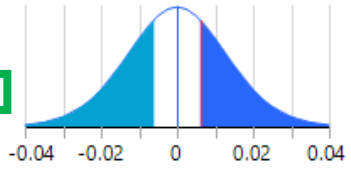
Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
C3N old	16	0.459	0.047	0.012	0.434	0.484
C3W old	38	0.465	0.034	0.006	0.454	0.476

t Test

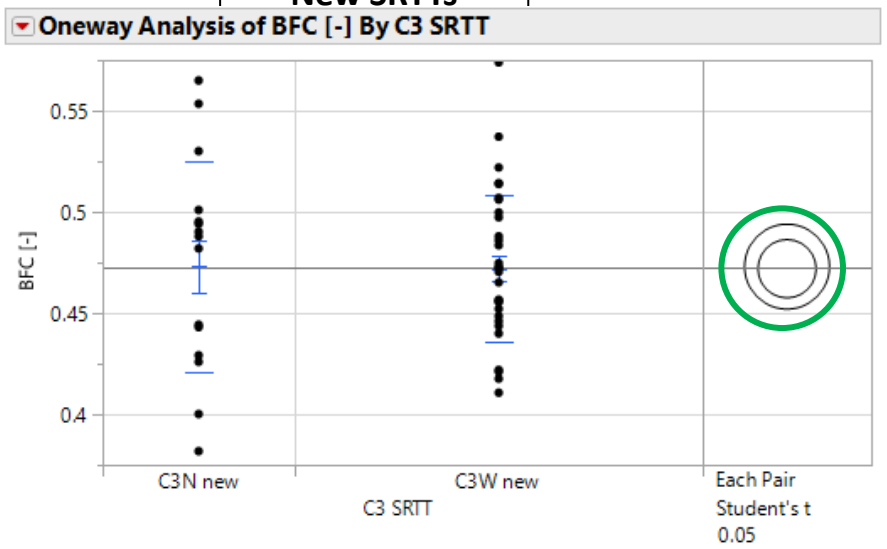
C3W old-C3N old

Assuming unequal variances

Difference	0.00610	t Ratio	0.467933
Std Err Dif	0.01304	DF	22.01704
Upper CL Dif	0.03314	Prob > |t|	0.6444
Lower CL Dif	-0.02094	Prob > t	0.3222
Confidence	0.95	Prob < t	0.6778



New SRTTs



Means and Std Deviations

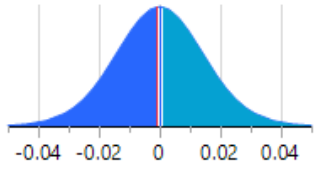
Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
C3N new	16	0.473	0.052	0.013	0.445	0.501
C3W new	34	0.472	0.036	0.006	0.459	0.485

t Test

C3W new-C3N new

Assuming unequal variances

Difference	-0.00105	t Ratio	-0.07274
Std Err Dif	0.01443	DF	22.0039
Upper CL Dif	0.02889	Prob > |t|	0.9427
Lower CL Dif	-0.03099	Prob > t	0.5287
Confidence	0.95	Prob < t	0.4713

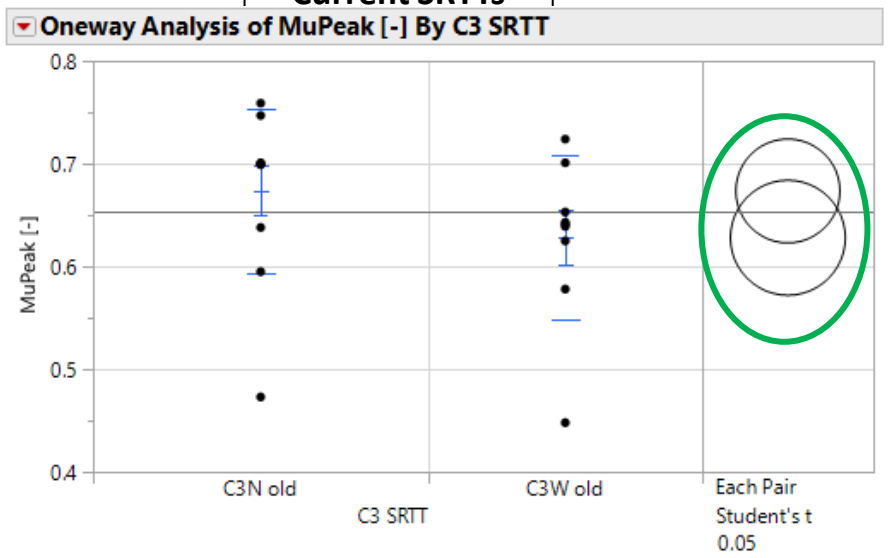


P-value > 0.05 ➔ **On average the difference between C3N & C3W (both Current & New) is not statistically significant.**

New C3 SRTT Design – wet grip performance

Interchangeability of the 2 C3 SRTTs – Trailer method

Current SRTTs



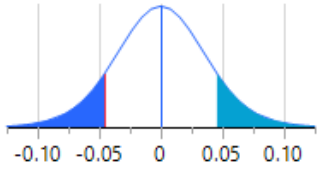
Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
C3N old	11	0.674	0.08	0.024	0.62	0.727
C3W old	9	0.628	0.08	0.027	0.567	0.689

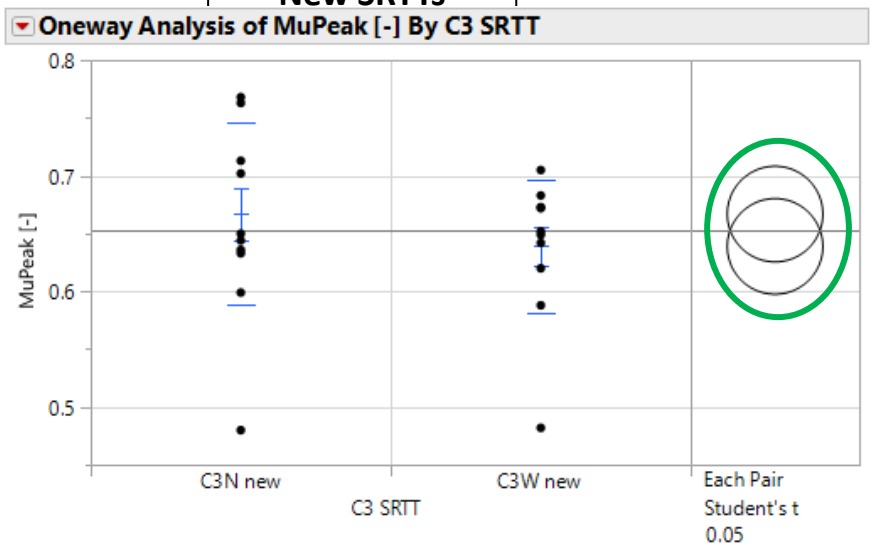
t Test

C3W old-C3N old
Assuming unequal variances

Difference	-0.04555	t Ratio	-1.26902
Std Err Dif	0.03589	DF	17.28472
Upper CL Dif	0.03008	Prob > |t|	0.2213
Lower CL Dif	-0.12117	Prob > t	0.8894
Confidence	0.95	Prob < t	0.1106



New SRTTs



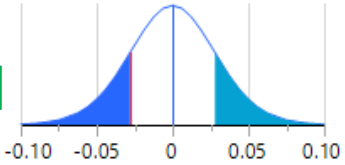
Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
C3N new	12	0.667	0.079	0.023	0.617	0.717
C3W new	12	0.639	0.058	0.017	0.602	0.676

t Test

C3W new-C3N new
Assuming unequal variances

Difference	-0.02800	t Ratio	-0.99126
Std Err Dif	0.02825	DF	20.14798
Upper CL Dif	0.03081	Prob > |t|	0.3333
Lower CL Dif	-0.08689	Prob > t	0.8333
Confidence	0.95	Prob < t	0.1667



P-value > 0.05 ➔ **On average the difference between C3N & C3W (both Current & New) is not statistically significant.**

New C3 SRTT Design – wet grip performance

Interchangeability of the 2 C3 SRTTs – Conclusions

- ETRTO proposes to adopt for the wet grip index test the same approach in force for Snow grip index test:

  - **Eliminating the unnecessary constrain of the SRTT selection** depending on the section width of the candidate tyre

  → Not anymore complexity in testing with benefits in logistics, vehicles' choice and setup

  → No change of reference tyre will be, in practice, applicable for most of the candidate tyres, while – only for the candidate tyres sizes which, as of today, are difficult to be tested - a direct comparison with the proper reference tyre will become possible

  - **making the two SRTTs 19.5 and 22.5 equivalent** for the WGI determination

  → ETRTO agree with GRBP-79-10, proposing a **unique correlation factor *f* = 1.02 for both trailer and vehicle methods** (average value of the 4 correlation factors, the difference falling within the standard deviation found during the test campaign)

  - **Same load range (60% – 100%) is applied also to the SRTT**, as already the case for the candidate tyre → Fair comparison between candidate and reference tyres

Wet Grip performance – track friction characterization

According to UN Reg. 117 & ISO 15222:2021, **the characterization and validation of tracks for C2/C3 WGI tests is currently performed using the C1 trailer method & the C1 SRTT16** $\mu_{peak,corr}$= [0.65, 0.90].

This provision is operationally complex and not effective

- **Requires to drive a C1 trailer fitting the C1 SRTT on C2/C3 tracks**
- **Does not allow a contextual check of the track during the test session**.

As anticipated by the informal document GRBP-78-28-Rev.1, ETRTO investigated the **possibility to characterize and validate the tracks using the same method (i.e., vehicle or trailer) and the same reference tyres (SRTT16C, SRTT19.5 or SRTT22.5) used in the evaluation of the candidate tyre,** using the same approach as C1 tyres wet grip index procedures.

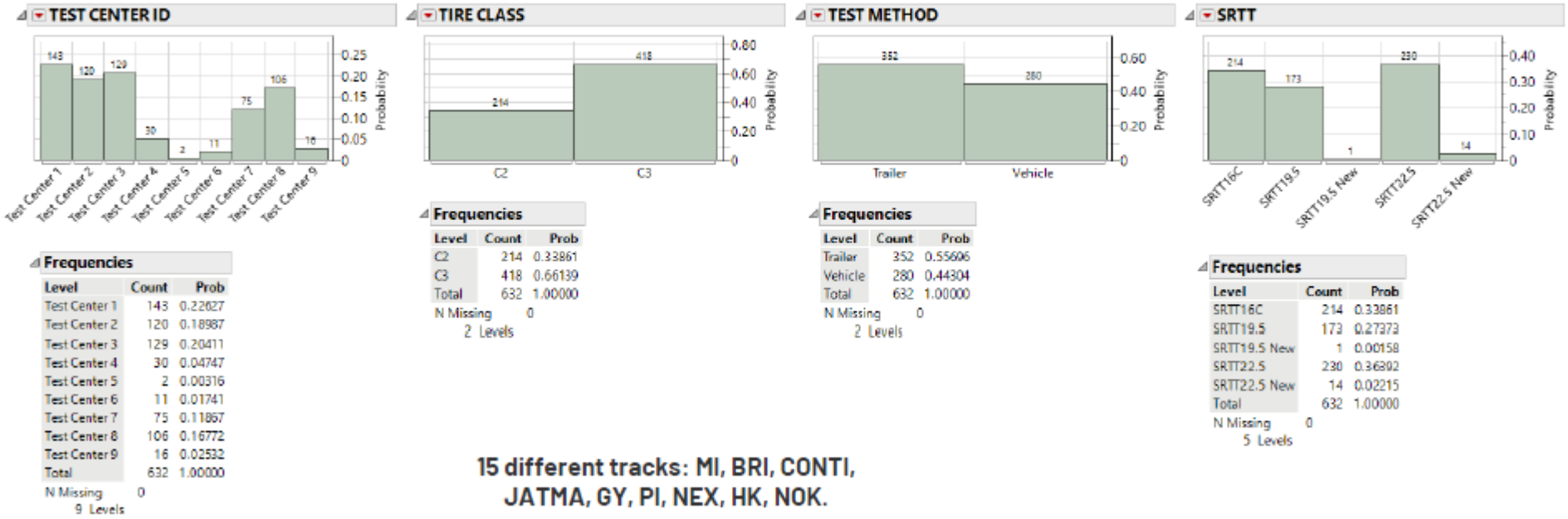
Wet Grip performance – track friction characterization

Data collection

1. Anonymous data collection of UN Reg. 117 compliant tracks, for SRTT C2/C3 (μ_{peak} & BFC) (historical data that were tested under R117.02 Suppl. 13 on compliant track surfaces)

2. Definition of ranges based on these data

Basics statistics of the collected dataset:



15 different tracks: MI, BRI, CONTI, JATMA, GY, PI, NEX, HK, NOK.

Wet Grip performance – track friction characterization

Data analysis and processing

- SRTT C2/C3 (μ_{peak} & BFC) anonymous data collection of tracks compliant to the latest version of UN R117 (since the Entry Into Force of the R117.02 Suppl. 13 (of 2021)).
- Being majority of data available for current C3 SRTTs, **ranges of current C3 SRTTs were defined first**
- Since not all data are normally distributed, **the min & max of the collected data of all test centers has been considered**, rounding to the nearest 0.01 digit.
- Given the equivalency of the 2 C3 SRTTs (C3N and C3W), the **largest range between the C3 SRTTs was applied**
- for Vehicle Method SRTT C3: **added a security margin of ± 10%** around the min-max range (up to ~ 10% difference could be observed on BFC SRTT (C3) during back-to back vehicle comparison test with all other test conditions almost identical)
- **Used correction factor of 1.02** to derive the ranges for the new C3 SRTTs
- For Vehicle C2 (BFC SRTT16C), not enough data points → **Average with same range as Trailer proposed** (i.e,. 0.526 ± 0.326 /2)

Wet Grip performance – track friction characterization

Proposal

			SRTT BFC or μ				
Tyre class	**Test method**	**SRTT**	**N**	**Mean**	**Min**	**Max**	**Range**
C2	Trailer	SRTT16C	209	0.595	0.44	0.766	0.326
	Vehicle	SRTT16C	5	0.526	0.495	0.564	0.069
C3	Trailer	SRTT19.5	52	0.594	0.511	0.665	0.154
		SRTT22.5	91	0.565	0.512	0.628	0.116
	Vehicle	SRTT19.5	121	0.472	0.4	0.534	0.134
		SRTT22.5	139	0.466	0.39	0.555	0.165

Tyre class	*SRTT*	*Trailer method μ_{peak} range*	*Vehicle method BFC range*
C2, C3	**SRTT16**	**0.65 – 0.90**	**-**
C2	**SRTT16C**	**0.44 – 0.77**	**0.36 – 0.69**
C3	**SRTT19.5 SRTT22.5**	**0.51 – 0.67**	**0.35 – 0.61**
C3	**SRTT19.5 siped SRTT22.5 siped**	**0.52 – 0.68**	**0.36 – 0.62**

$f = 1.02$

Wet Grip performance – track friction characterization

Test validation

It is proposed to **validate both the C2 and C3 track surface and the tests results of each test session using the same method and the same reference tyres used in the evaluation program itself**.

Paragraph 2.1.2.13, amend to read:

"2.1.2.13. Validation of results

For the reference tyre:

(a) If the coefficient of variation of the peak braking coefficient CV_{μ} of the reference tyre, which is calculated by the formula given in 4.2.8.2. of part (A) of this Annex, is higher than five per cent, discard all data and repeat the test for this reference tyre.

(b) **The average peak braking force coefficients ($\overline{\mu_{peak}}$, see paragraph 1.1.1.2.1. of this Annex) as calculated from the initial and from the final braking test of the reference tyre within a test cycle shall be within the range reported in the table in paragraph 1.1.1.**

If one or more of the above conditions is not met, the complete test cycle shall be performed again.

For the candidate tyres:

…"

"2.2.2.7.2. Validation of results

For the reference tyre:

(a) If the coefficient of variation of "AD" of any two consecutive groups of 3 runs of the reference tyre is higher than 3 per cent, discard all data and repeat the test for all tyres (the candidate tyres and the reference tyre). The coefficient of variation is calculated by the following relation:

$$\frac{\text{standard deviation}}{\text{average}} \times 100$$

(b) **The average braking force coefficients ($\overline{BFC}$, see paragraph 1.1.1.2.2. of this Annex) as calculated from the initial and from the final braking tests of the reference tyre within a test cycle shall be within the range reported in the table in paragraph 1.1.1.**

If one or more of the above conditions is not met, the complete test cycle shall be performed again.

For the candidate tyres:

ETRTO®
European Tyre & Rim
Technical Organisation

Thank You