Expedient Military Load Classification (MLC) Analysis for STANAG 2021 ed. 6.5 Meeting Review.

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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Introduction

- Five different MLC procedures were analyzed:
  - Scale readings with MLC software.
  - Scale readings using STANAG factor.
  - Current expedient method using Data Plate information
  - Tire contact area with tire pressure (Gross Tire Area)
  - Tire contact area with tire pressure (Tire Tread Area)

- Data was collected from 5 common US Army vehicles.
  - CBT empty
  - M984A2 Wrecker
  - LMTV
  - MRAP MaxxPro
  - MRAP MaxxPro plus.

- Data was summarized and compared with additional information collected from all 287 military vehicles.

MLC Calculated from Scales and Software

- Data collected from scale in Fig.1 for each wheel.
- Applied in STANAG 2021 Reference software to determine the “True” MLC and create a control.

Table 1: Vehicle MLC’s calculated from software

Vehicle	Control MLC
CBT empty	17
Wrecker	24
LMTV	9
MRAP Maxx Pro	18
MRAP MaxxPro Plus	29

Figure 1: Scale Measurement

Control vs. MLC Calculated From Scales and STANAG Factor

- Data collected from scale in Fig.1 for each wheel.
- Applied the current STANAG factor of 1.15.

Table 2: Vehicle MLC's calculated from scales

Vehicle	Control MLC	Scaled MLC
CBT empty	17	21
Wrecker	24	31
LMTV	9	11
MRAP Maxx Pro	18	21
MRAP MaxxPro Plus	29	28

Control vs. Data Plate Method

- Data Plate Method
  - Gross vehicle weight from data plate (tons) x 1.15

Table 3: Comparison of Control and Data Plate Method MLC's

Vehicle	Control MLC	Data Plate MLC
CBT empty	17	38
Wrecker	24	55
LMTV	9	14
MRAP Maxx Pro	18	25
MRAP MaxxPro Plus	29	30

Control vs. Gross Tire Area

- Gross tire area Expedient Method:
  - Tire contact area was measured, shown in Fig 2.
  - Tire pressure was measured.
  - Wheel weights calculated:
    contact area (in^2) x tire pressure (psi).
  - Expedient method was applied:
    Calculated Weight (tons) x 1.15

Figure2: Tire Area Measurement

Table 4: Comparison of Control and Gross Tire Area MLC's

Vehicle	Control MLC	Gross Area MLC
CBT empty	17	49
Wrecker	24	76
LMTV	9	21
MRAP Maxx Pro	18	31
MRAP MaxxPro Plus	29	50

Control vs. Tire Tread Area

- Tire Tread Area Expedient Method:
  - Tread pattern was copied onto graph paper to estimate area.
  - Wheel weights calculated:
  - Contact area (in^2) x tire pressure (psi) x percent tire contact
  - Expedient method was applied: Calculated Weight (tons) x 1.15

Table 5: Comparison of Control and Tire Tread Area MLC's

Vehicle	Control MLC	Tire Tread Area MLC
CBT empty	17	23
Wrecker	24	36
LMTV	9	9
MRAP Maxx Pro	18	17
MRAP MaxxPro Plus	29	27

Factors of Safety (F.S.) for All Experimental Methods using 1.15

Table 6: F.S. for Calculated MLC's Using the STANAG 1.15 Factor

Vehicle	Control MLC	Scaled Method	Data Plate Method	Gross Tire Area	Tire Tread Area
CBT empty	1.0	1.22	2.23	2.89	1.36
Wrecker	1.0	1.27	2.28	3.18	1.50
LMTV	1.0	1.19	1.51	2.28	1.05
MRAP Maxx Pro	1.0	1.18	1.39	1.71	0.96
MRAP MaxxPro Plus	1.0	0.95	1.02	1.73	0.94
Ave F.S.	1.0	1.16	1.68	2.36	1.16

- Numbers Greater than 1 indicate an Over-estimation
- F.S. = Experimental MLC / Control MLC

Average Factor of Safety for 287 Wheeled Military Vehicles

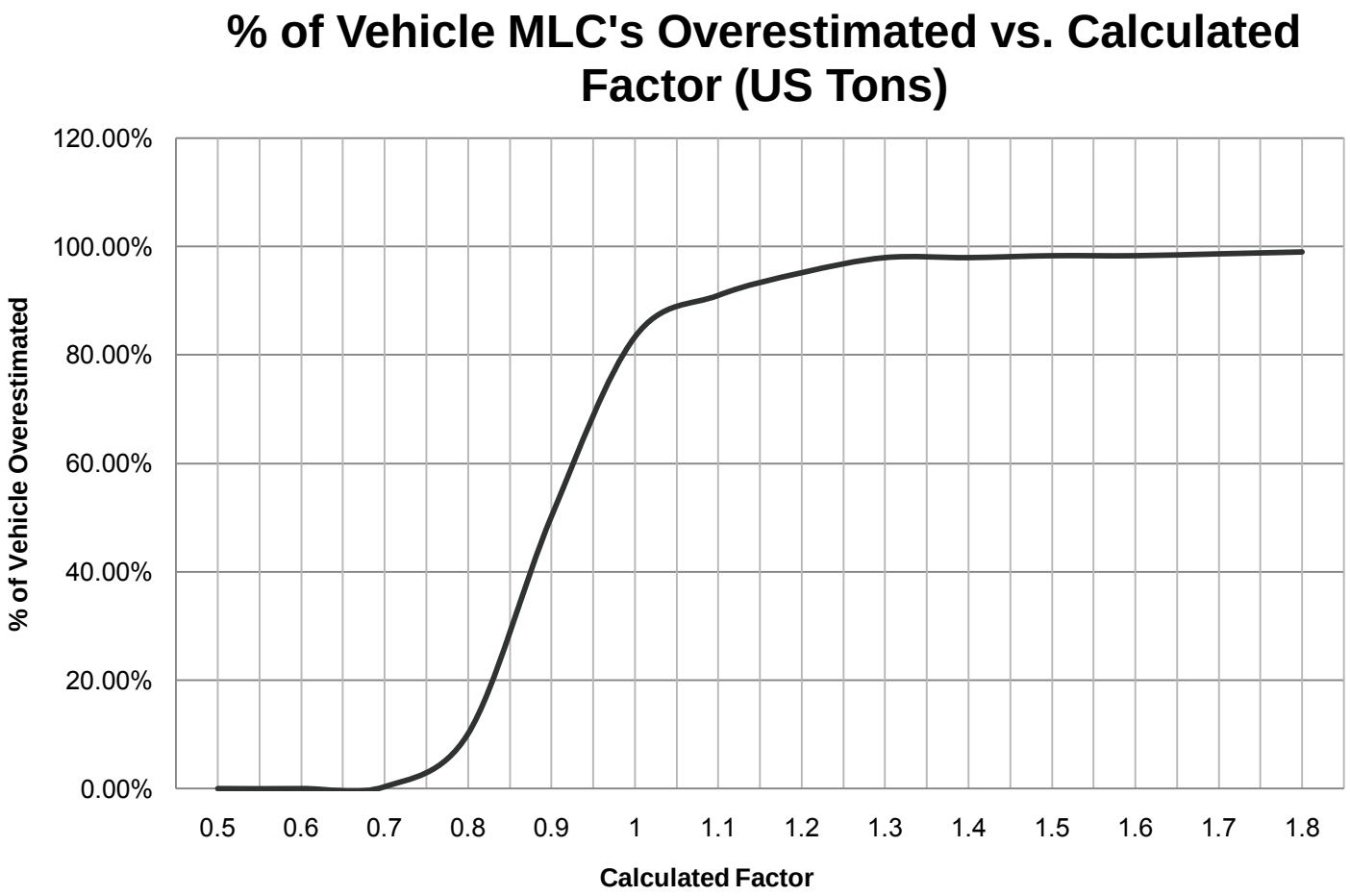
Model #	Software Calc MLC	Weight (tonnes)	Calculated Factor MLC/ mass (metric)	Weight (tons)	Calculated Factor MLC/ mass (US)	Calculations of MLC using Factors and comparing F.S. Metric MLC	F.S.	US Cust MLC	F.S.
M123 6x6 towing 6k water trailer	17	20.06	0.86	22.11	0.78	20	1.14	20	1.14
M123 6x6 towing 6k water trailer	38	43.81	0.87	48.29	0.79	43	1.12	43	1.13
M915 w/ XM 990 w XM21	17	20.07	0.86	22.12	0.78	20	1.14	20	1.14
M985	28	27.95	1.01	30.81	0.92	27	0.97	27	0.97
M978	25	25.32	0.98	27.91	0.89	25	1.00	25	1.00
Buffalo	30	25.40	1.17	28.00	1.07	25	0.83	25	0.84
Buffalo w/ Expedient Armor	38	30.84	1.24	34.00	1.12	30	0.79	30	0.79
Husky w/ Expedient Armor	10	9.98	0.96	11.00	0.87	10	1.03	10	1.03
JERRV w/ Expedient Armor	23	21.59	1.04	23.80	0.95	21	0.94	21	0.94
RG-31 MK5 w/ Expedient Armor	21	17.24	1.23	19.00	1.12	17	0.79	17	0.79
		Average	1.04	Average	0.94	Ave. F.S.:	1.00	Ave. F.S.:	1.00

	Factor	F.S
Original	1.25	1.27
Option	1.04	1.06
Proposed	1.08	1.1
	0.98	1

Factor	F.S
1.15	1.29
0.94	1.05
0.98	1.1
0.89	1

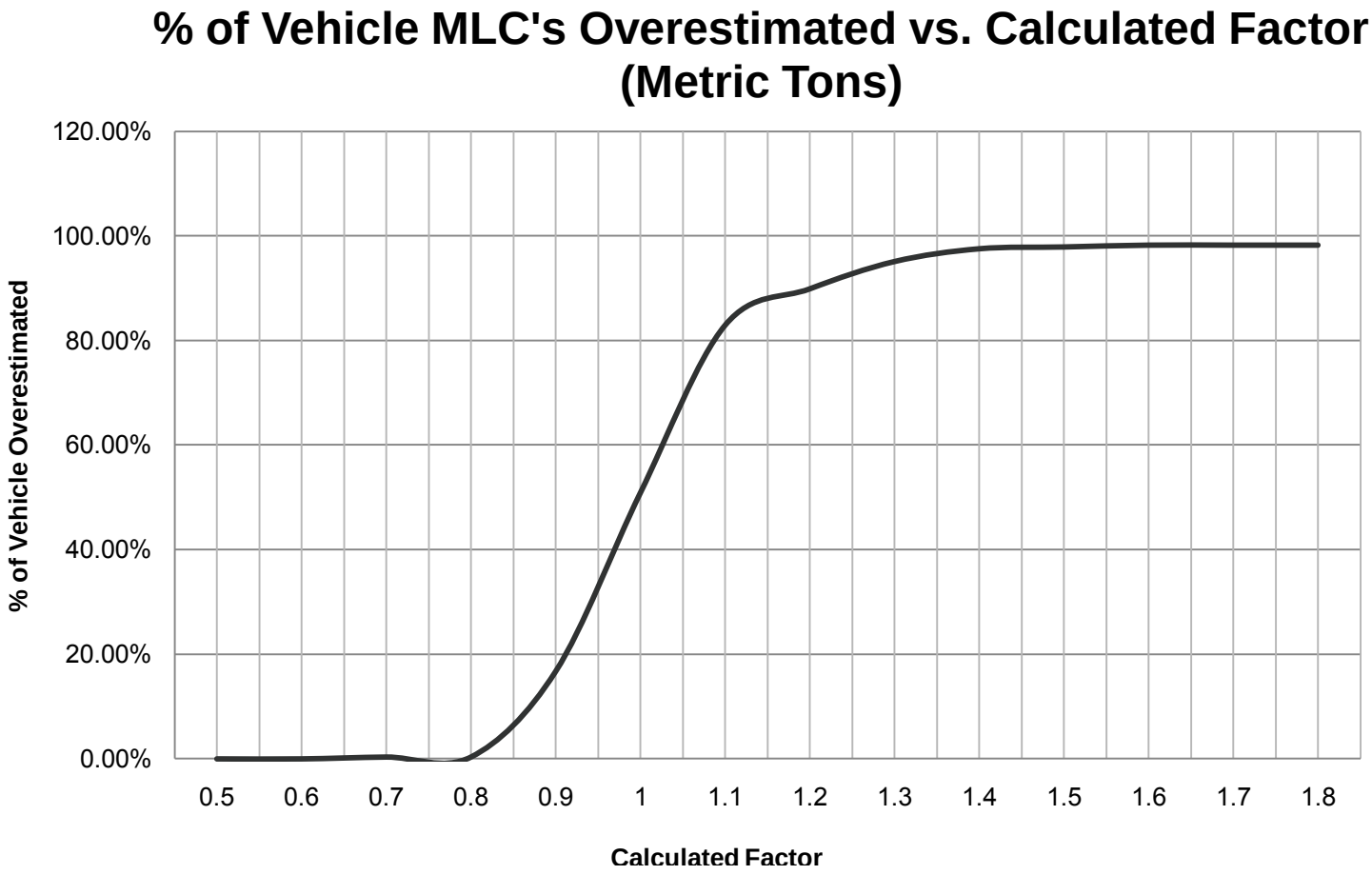
Factor Selection: 0.98 0.89

Data Comparison of 287 Wheeled Military Vehicles (US Tons)



- Factor of 0.98 overestimates 80% of wheeled military vehicles with an average safety factor of 1.1
- Current factor of 1.15 overestimates 92% of wheeled military vehicles with an average safety factor of 1.29

Data Comparison of all Military Vehicles (Metric Tons)



- Factor of 1.08 overestimates 80% of military vehicles with an average safety factor of 1.1
- Current factor of 1.25 overestimates 92% of military vehicles with an average safety factor of 1.27

MLCs for All Experimental Methods using 0.98

Table 7: MLCs Using the 0.98 Proposed Factor

Vehicle	Control MLC	Scaled Method MLC	Data Plate Method MLC	Gross Tire Area MLC	Tire Tread Area MLC
CBT empty	17	18	32	42	20
Wrecker	24	26	47	65	31
LMTV	9	9	12	17	8
MRAP Maxx Pro	18	18	21	26	15
MRAP MaxxPro Plus	29	24	25	43	23

F.S. for All Experimental Methods using 0.98

Table 8: F.S. for Calculated MLC's Using the 0.98 Proposed Factor

Vehicle	Control MLC	Scaled Method	Data Plate Method	Gross Tire Area	Tire Tread Area
CBT empty	1.0	1.04	1.9	2.46	1.16
Wrecker	1.0	1.08	1.94	2.71	1.27
LMTV	1.0	1.02	1.28	1.94	0.89
MRAP Maxx Pro	1.0	1.0	1.18	1.46	0.82
MRAP MaxxPro Plus	1.0	0.81	0.87	1.48	0.8
Ave F.S.	1.0	0.99	1.44	2.01	0.99

- Numbers Greater than 1 indicate an Over-estimation
- F.S. = Experimental MLC / Control MLC

Summary

- Current STANAG Factors (1.25 and 1.15) overestimate the MLCs for 92% of the US Army's laden wheeled vehicles
- Current STANAG Factors result in an average F.S. of 1.27 and 1.29 respectively for US Army's wheeled vehicles
- These F.S. are in addition to the bridge's design F.S. which is 1.33 for mobile bridges and higher for civilian fixed bridges
- Proposed Factors of 1.08 and 0.98 overestimate 80% of the US Army's laden wheeled vehicles
- Both proposed metric and short ton Factors (1.08 and 0.98 respectively) results in an average F.S. of 1.1 for US Army's wheeled vehicles
- The experimental data showed the method of collection provides an additional F.S. thus supporting the reduction of the current STANAG Factors