



CSA M423.4:25 – TSC Update

Braking performance — Rubber-tired, self-propelled underground mining machines

Chairs: Cynthia Matikainen, Jason Flanagan

M424.3 :25, Technical Sub-Committee

First name	Last name	Company	Position
Cynthia	Matikainen	Ontario Ministry of Labour, Immigration, Training and Skills Development (MLITSD)	Chair
Jason	Flanagan	Caterpillar Inc	Vice Chair
Adrian	Gillies	Sandvik	
Andre	Touchette	MLITSD	
Benjamin	Newlon	J.H Fletcher & Co	
Blair	Baldwin	Baldwin Services Inc	
Bethany	Chiasson	Nova Scotia Department of Labour, Skills, and Immigration	
Brendan	Peacock	Komatsu	
Brent	Rubeli	CanmetMINING	
Cary	Ingram	WSCC	
Cheryl	Allen	Vale	
Craig	Allair	United Steelworkers	
Craig	Harris	Glencore	
David	Schmidt	Kovatera	
David	Rezansoff	Government of Saskatchewan	
David	Stewart	Glencore	
Gaurav	Mahajan	NRCan	
Joel	Thon	Nutrien	
John	Le	Natural Resources Canada-CanmetMINING	
Paul	Summers	Miller Technology Inc	
Raphael	Tiangco	Vale	
Richard	Riach	Epiroc	
Shawn	Sauve	Glencore	

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Braking performance — Rubber-tired, self-propelled underground mining machines

Background

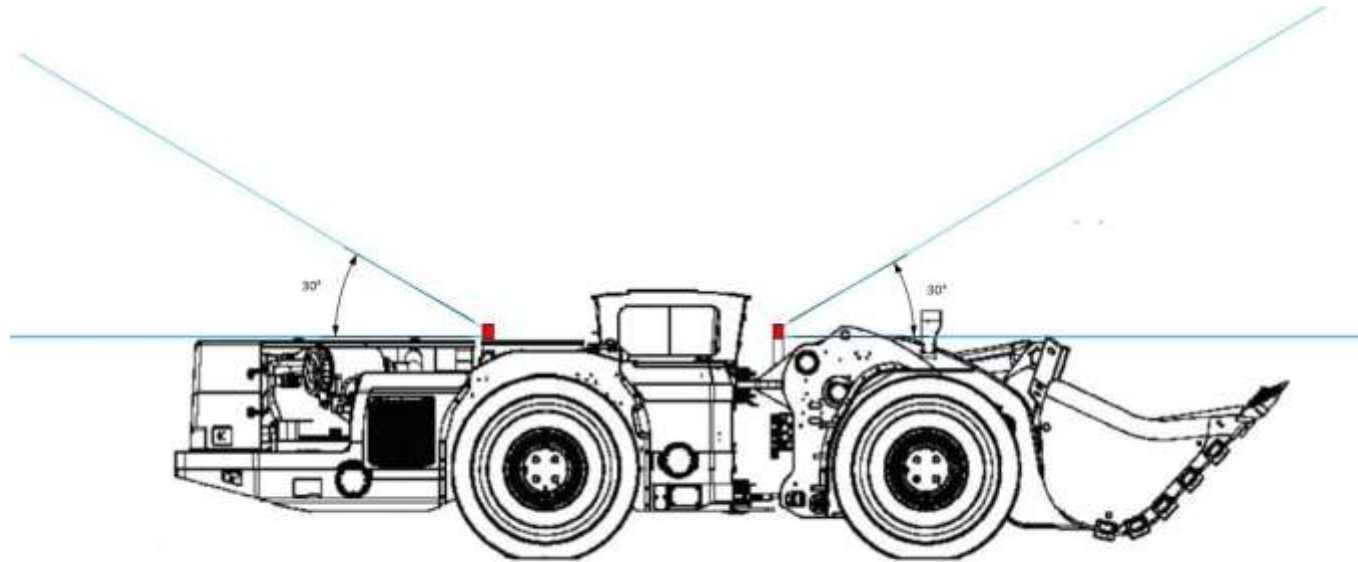
- Current test required on 20% grade
- International standards allow testing on level ground (ISO 19296)
- Surface mining machines allow testing on level ground (ISO 3450)



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Braking performance — Rubber-tired, self-propelled underground mining machines

- Current testing requires and operator to initiate braking
- Autonomous vehicles are in use in underground mines,
- no specific requirements for remote controlled or autonomous vehicles.



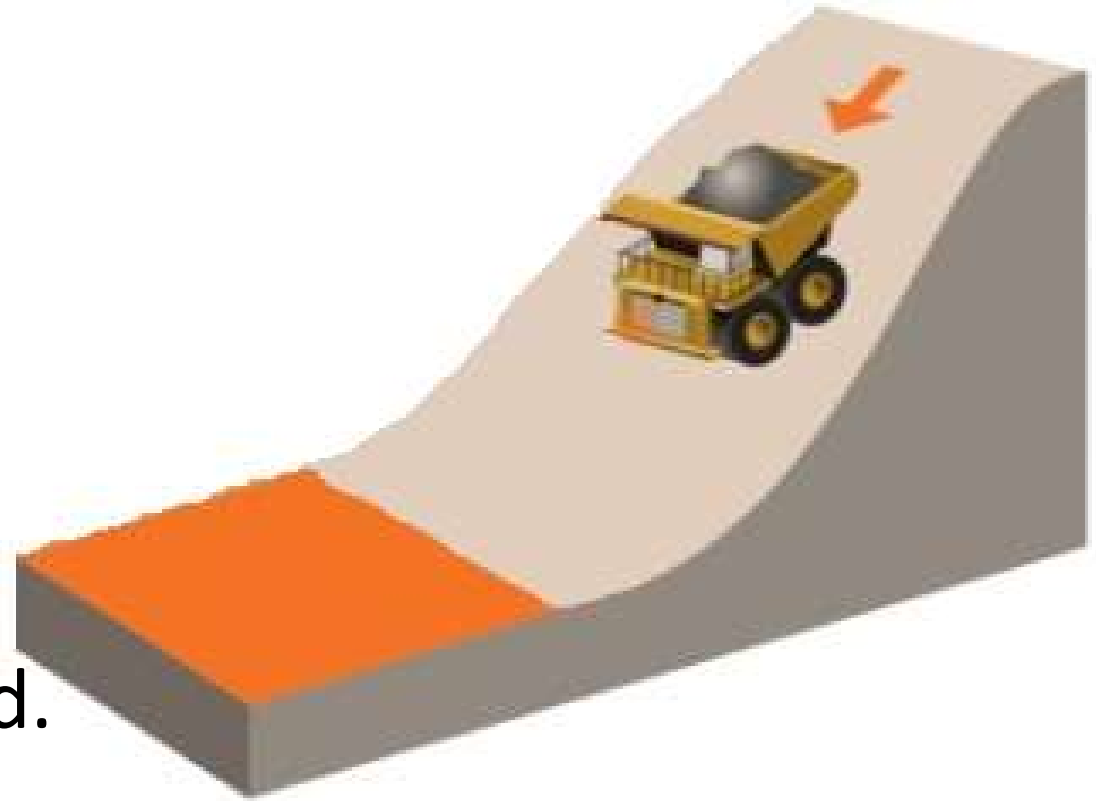
M424.3 :25 Objectives

Determine inclusion of:

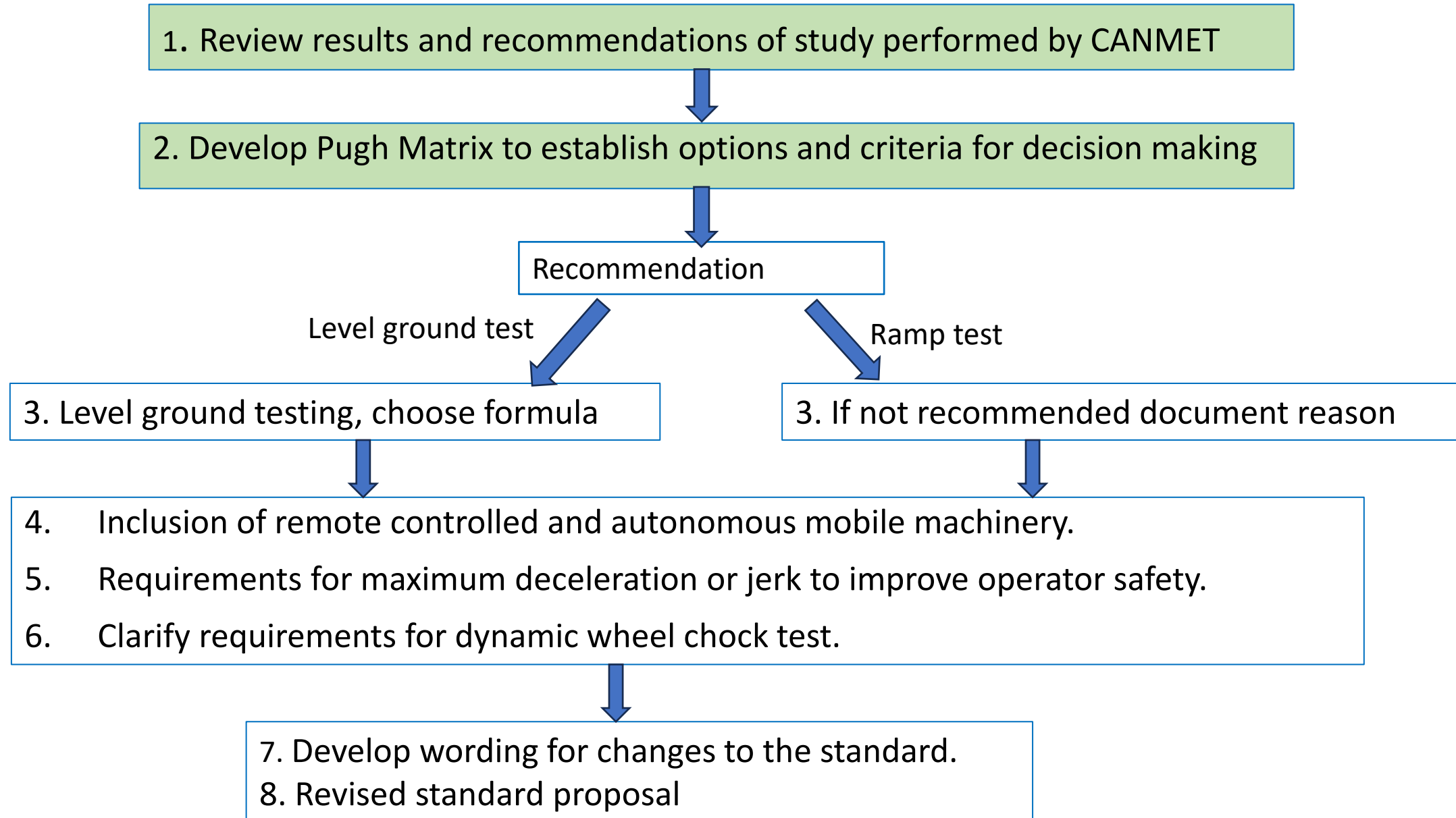
- Level ground performance testing
- Testing for remote controlled and autonomous mobile machinery.
- Requirements for maximum deceleration or jerk to improve operator safety.

As decided:

- Review and revise current standard.



M424.3 :25 Roadmap



M424.3 :25 Pugh Matrix analysis

Pugh Concept Selection Matrix

Key Criteria		Importance Rating	Datum Do Nothing	Option 1	Option 2	Do Nothing	
1	Criteria #1		s			0	
2	Criteria #2		s			0	
3	Criteria #3		s			0	
4	Criteria #4		s			0	
5	Criteria #5		s			0	
6	Criteria #6		s			0	
7	Criteria #7		s			0	
8	Criteria #8		s			0	
9	Criteria #9		s			0	
10	Criteria #10		s			0	
11	Criteria #11		s			0	
	Sum of double positives			0	0	0	0
	Sum of positives			0	0	0	0
	Sum of double negatives			0	0	0	0
	Sum of negatives			0	0	0	0
	Sum of neutrals			0	0	11	0
	Weighted sum of positives			0	0	0	0
	Weighted sum of negatives			0	0	0	0
	Total weighted sum			0	0	0	0

M424.3 :25 Pugh Matrix analysis

Proposed Options:

1. Status quo – all vehicles tested on a ramp
2. Level ground test equivalent for all vehicles (Formula – ISO 19296, SABS, MDG-39, ISO 3450)
3. Level ground test equivalent for specific vehicles (based on criteria such as mass, center of gravity, speed)

M424.3 :25 Pugh Matrix analysis

Key Criteria

1. Satisfy primary purpose of test, scope of the standard
2. Probability of failure to stop on ramp, braking system design, stopping distance outside of the allowable
3. Accuracy of simulation, simulation of real world, test on flat should be expected to simulate ramp results
4. Safety of operator and test facility
5. Cost
6. Availability of test facility
7. Maintenance of test facility, Need information on compaction/surface
8. Required test instrumentation and equipment, Measurement tape or accelerometers/Electronics

M424.3 :25 Pugh Matrix analysis

Key Criteria

9. Consideration of Stability, Observable?
10. Consideration for weight shift
11. Legislative compliance (Canada), Any conflict with other territories?
12. Incorporate brake mechanics, Type of brake systems - any adjustments?
13. Consistent with other standards, Is this harmonized to directives or legislation.
14. Ability to achieve test speed consistently, Consideration of maximum speed control reliability
15. Consideration for overspeed or runaway

M424.3 :25 Roadmap

1. Review results and recommendations of study performed by CANMET

2. Develop Pugh Matrix to establish options and criteria for decision making

Recommendation

Level ground test

Ramp test

3. Level ground testing, choose formula

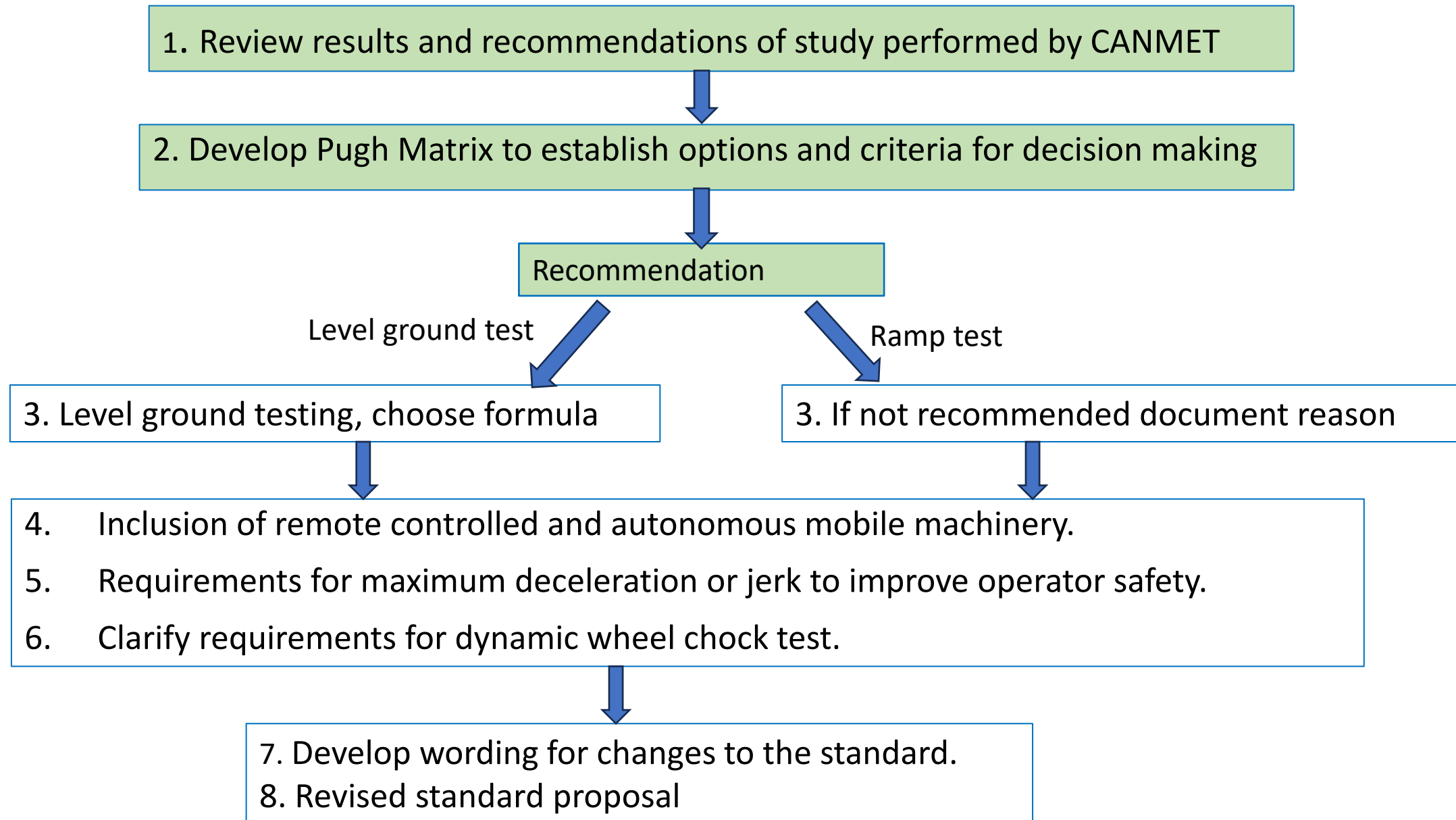
- ISO 19296 (ISO 3450)
- MDG-39 (Australia)
- SABS 1589-1

3. If not recommended document reason
Formula

- CSA M424.3

Formulas - response time and acceleration values vary

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M424.3 :25 Schedule

