

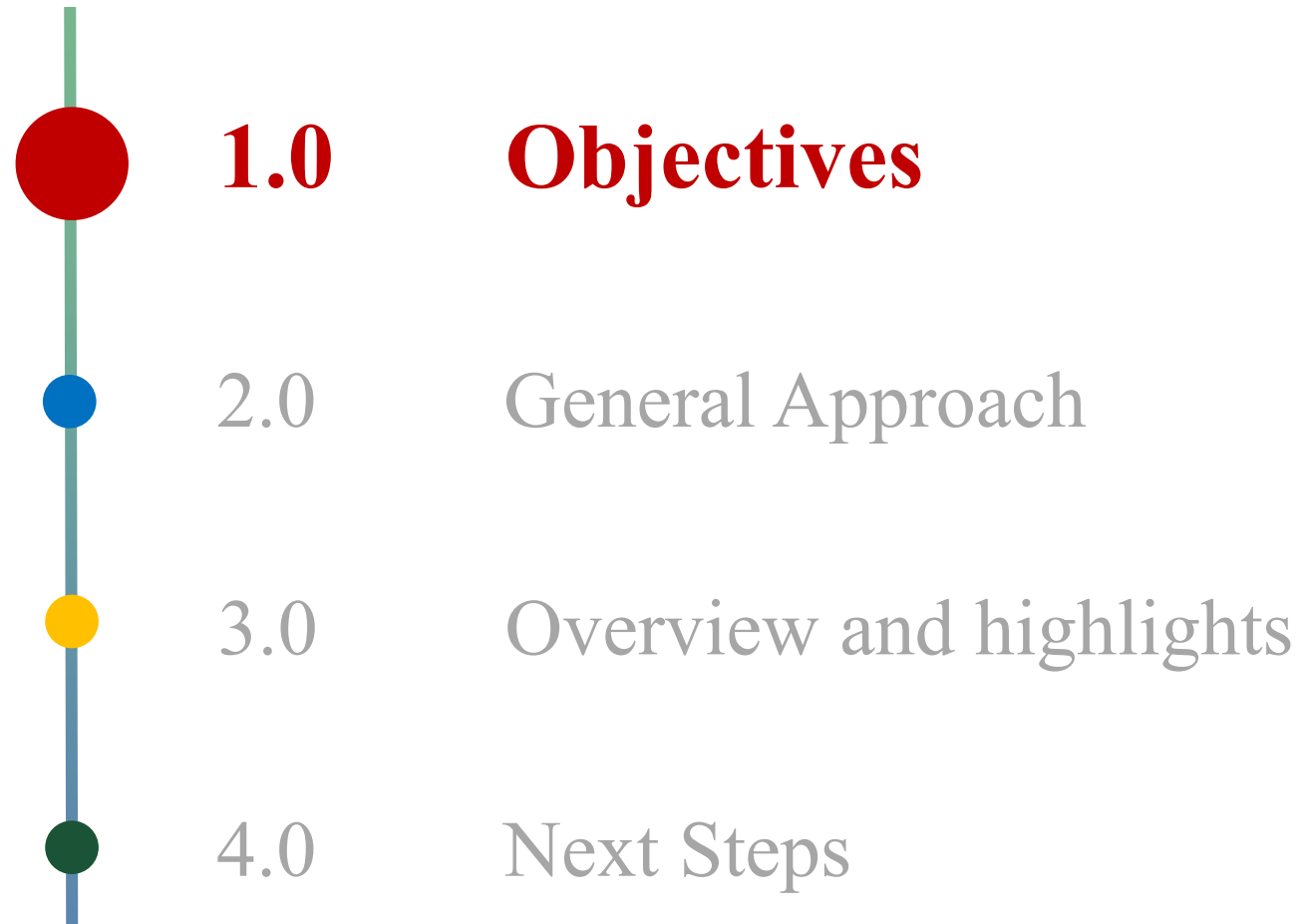
CSA M424.4:27 – Update

Self-propelled, electrically driven, non- rail-bound mobile machines for use in non-gassy underground mines

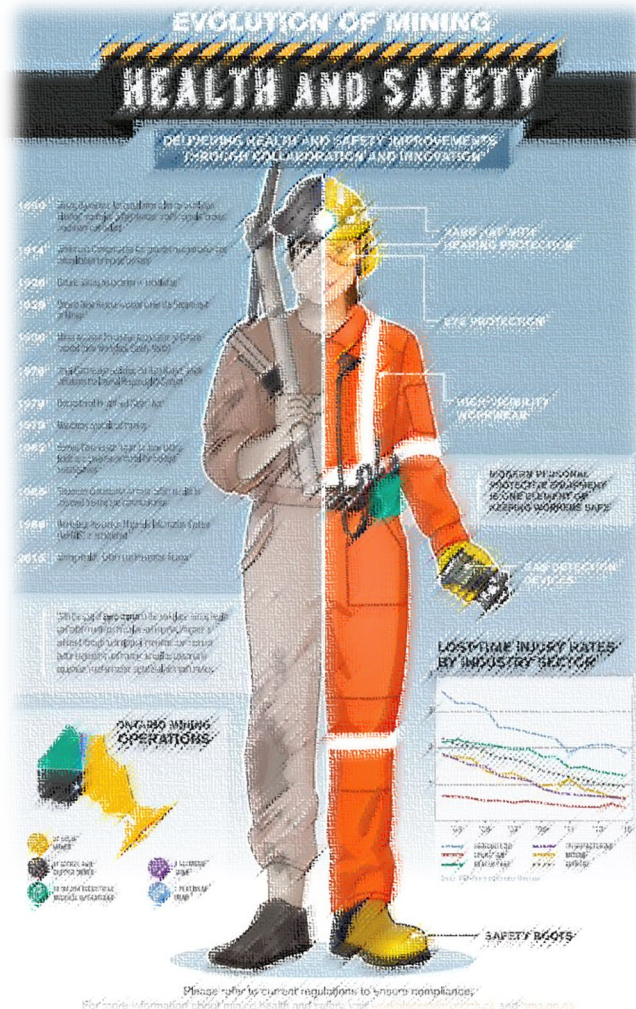
Nam (John) Le, P.Eng (CanmetMINING)
Cheryl Allen, P.Eng (Vale Base Metal)
William Hughes, P.Eng (Rokion)

October 7th, 2026

Presentation Overview



01. Objectives



- To address hazards and raise awareness related to battery-powered and diesel-electric powered machines in Canadian underground mines.
- To establish technical measures aimed at reducing or eliminating significant hazards during operation and maintenance.
- To provide guidance and reference materials to support OEMs and mine operators assessing the risks associated with these technologies.

Source: Workplace Safety North

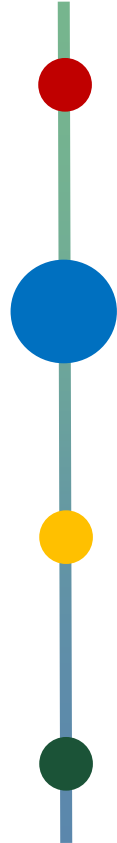
01. Objectives



Update M424.4:22 to develop M424.4:27

- Include requirements for battery handling, transportation, and storage
- Review, revise, and enhance all the clauses
- Relocate Section 6 (Hydrogen fuel cell–electric powered machine) to the new Standard M424.5:26

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2.0 General Approach

M424.4 TSC Membership					
No.	First Name	Last Name	Position	Group	Company
1	John	Le	Chair	Government	NRCan - CanmetMINING
2	Cheryl	Allen	Co-Chair	Mine Operation	Vale Base Metals
3	William	Hughes	Co-Chair	OEM	Prairie Machine
4	Vaishnavi	Somasundaram	Project Manager	Standard Organization	CSA
5	David	Rezanoff	WG Lead	Government	Labour
6	Blair	Baldwin	Member	Consultant	Baldwin Services
7	Brent	Rubeli	Member	Government	NRCan - CanmetMINING
8	Alexander	Lenz	Member	OEM	MacLean Engineering
9	Craig	Harris	Member	Mine Operation	Glencore
10	Brailyn	Johnsgaard	Member	Mine Operation	Nutrien
11	Andrew	Hubele	Member	OEM	Epiroc
12	Dave	Schmidt	Member	OEM	Kovatera
13	Jerry	Davis	Member	OEM	Komatsu
14	Joe	Benoit	Member	Mine Operation	Hudbay Minerals
15	Cornelius	Powell	Member	Mine Operation	Hudbay Minerals
16	Joel	Thon	Member	Mine Operation	Nutrien
17	Scott	Secord	Member	Government	Ontario Ministry of Labour
18	Shawn	Sauve	Member	Mine Operation	Glencore
19	Craig	Alair	Member	Mine Operation	Vale Canada
20	Gaurav	Mahajan	Member	Government	NRCan - CanmetMINING
21	Paul	Summers	Member	OEM	Miller Technology
22	Bryson	Cochrane	Member	Government	Ministry of Labour
23	Cynthia	Matikainen	Member	Government	Ontario Ministry of Labour
24	David	Lyon	Member	Consultant	Zero Nexus
25	Ian	Smith	Member	Consultant	Southwest Research Institute
26	Jason	Flanagan	Member	OEM	CAT
27	Fred	Pelletier	Member	Supplier	HJS
28	Michael	Bach	Member	Government	NRCan - CanmetMINING
29	Manish	Pal	Member	Government	NRCan - CanmetMINING
30	Syed	Sah	Member	Government	WSSC-NT/NU

TEAMWORK



IS

EVERYTHING

2.0 General Approach

Each working group will review, revise, and supplement the technical content, and provide the final version for the M424.4 Standard.

Working Group	Sections
WG1	Preface, (1) Scope, (2) Reference, (3) Definitions and Abbreviations
WG2	(4) General Requirements: BEV & hybrid, Risk assessment, Transport and storage batteries
WG3	(5) Battery electric-power machines
WG4	(6) Diesel-electric powered machines, Annex (Informative)

2.0 General Approach

Standards Procurement

No	M424.4:22 Clause	Reference Standard	Who has/buy	Workspace (July/25/2025)
91		ISO 16750-2		Yes
92		ISO 12405-4		Yes
93		ISO TS 5474-5		Yes
94		ISO PAS 5474-6		Yes
95		ISO 11452-1_2015		Yes
96		ISO 16750-3		Yes
97		Z107_56-94		Yes
98		ISO_IEC_DIS_80079-38(E)-_Annex_ZA		Yes
99		IEC 60034.1.2004		Yes
100		ISO 8528-5_2022		Yes
101		ISO 8528-1_18		
102		IEC 62282-2-100-2020		
103		IEC 60479-1_2018		
104		IEC 60034-1_2022		
105		ISO 8528-3_2020		
106		ISO 10263-3_2009	Vaishnavi	Yes
107		ISO 10570:2004	Vaishnavi	Yes
108		ISO 10968:2020	Vaishnavi	Yes
109		ISO 11112:1995	Vaishnavi	Yes
110		ISO 12509:2004	Vaishnavi	Yes
111		ISO 13031:2016	Vaishnavi	Yes
112		ISO 13857:2019	Vaishnavi	Yes
113		ISO 14401-1:2004	Vaishnavi	Yes
114		ISO 14401-2:2004	Vaishnavi	Yes
115		ISO 15817:2012	Vaishnavi	Yes
116		Z432		
117		Z462		
118		iec60695-1-20	Gaurav	Yes
119		iec60695-1-30	Gaurav	Yes
120		iec61427-1	Gaurav	Yes
121		iec61558-2-6	Gaurav	Yes
122		iec60947-5-1	Gaurav	Yes
123		iec62619[ed2.0.CMV]en	Gaurav	Yes
124		iec60034-2-1[ed3.0.RLV]en	Gaurav	Yes



International
Electrotechnical
Commission



International Organization of Standardization



Require over 124 Reference Standards

2.0 General Approach



Should we adopt ISO 14990-1:2016 (*Earth-moving machinery — Electrical safety of machines utilizing electric drives and related components and systems — General Requirements*) with Canadian deviations, or develop Canadian content with references to other Standards as needed?

Create Canadian Content
With reference to other
Standards

OR

Adopt ISO 14990-1:2016
With Canadian Deviation

Decision

Adopt ISO 14990-1:2016
With Canadian Deviation



2.0 General Approach

Review the adopted standard: ISO14990-1

Review every
clause

In scope?/Accept as
is/Accept with deviation

Post content

TSC
comment

Review at bi-
wk meeting

Motion to
accept/revise

Final content

ISO 14990-1	yes/no	M424.4 Equivalent Clauses	Comments
by controlling the flammability of surrounding parts, or by both measures. Component standards usually address these concerns, and they generally take precedence over the generic IEC 60695 standards.	Accept As Is yes		
	Accept with deviation		
7 Protection against thermal hazards Protection against thermal hazards should be according to ISO 20474-1. NOTE: Attention is directed to ISO 13732-1 and ISO 13732-2.	In Scope? yes	5.1.3 Thermal 5.1.3.1 Protection against thermal hazards Protection against thermal hazards shall meet the requirements of ISO 14990-1 Clause 7.	
	Accept As Is yes		
	Accept with deviation		
	In Scope? yes	5.1.3.2 Temperatures at the charge receptacle The charging receptacle shall be capable of withstanding continuous ambient temperature in the range of -30 °C to 50 °C. (See SAE J1772 Clause 4.7.3 f). Charging receptacle maximum external surface temperature should be as specified in UL 2251. Charging receptacle contact area temperature shall be monitored and charging shall be terminated when temperature exceeds 105 °C (see SAE J1772 Clause 6.5.21).	Review ISO 20474-1 if it contains the requirements in M424.4 5.1.3.2 then decide to keep M424 clause or not. * 14990-1, page #68. - IEC 62195-1: Plugs, socket outlet, conductive charging of BEV - IEC 61851-1: EV conductive charging system
	Accept As Is yes		
	Accept with deviation		
	In Scope? Yes	5.1.3.3 Battery cell thermal stability test The equipment manufacturer shall provide a product assurance letter to the mine operator to ensure that operating temperatures in the mine are well below the cell thermal stability temperature limit. The letter shall demonstrate compliance with one of the requirements listed below: a) SAE J2464 Clause 4.4.2; b) SAE J2464 Clause 4.4.3; or c) SAE J2464 Clause 4.4.4.	
	Accept As Is yes		
	Accept with deviation		
	In Scope? yes	5.1.5 Chemical In normal operation the BEV product and equipment shall not release any hazardous gases or effluents. See GTR 20.5.4.11	GTR 20.5.4.11 ensures the electric vehicle must alert occupants early if the battery exhibits conditions that could lead to a thermal safety hazard.
	Accept As Is		
	Accept with deviation		
	In Scope? yes	5.1.4 Mechanical Protection against mechanical hazards shall meet the requirements of ISO 3457 and ISO 20474-1. Note: Mining vehicles should meet on-road vehicle standards at a minimum and go beyond this rating for being safe and service-worthy in mine operations.	
	Accept As Is yes		
	Accept with deviation		
9 Protection against abnormal operation hazards 9.1 General	In Scope? yes	5.1.6 Abnormal operation	

M424.4 WG#3 _New Sub Groups _ Clauses _ September 2025 Shared.xlsx

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3.0 Overview and highlights

The new edition M424.4 was opened for public review from August 11 to October 5, 2026

➤ In the process of reviewing public comments

Draft Details

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- + CSA Preface
 - Canadian deviations
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- 2 Normative References
- + 3 Terms and definitions and abbreviated terms
 - 3.1 Electric shock protection-related terms and...
 - 3.2 Control-related terms and definitions
 - 3.3 Electrical infrastructure-related terms and...
 - 3.4 Risk-related terms and definitions
 - 3.5 Miscellaneous terms and definitions
 - + 3.6 Mobile machine and performance-related term...
 - 3.6.1 Battery Electric Mobile Machine (BEMM)
 - 3.6.2 Diesel-Electric Hybrid Mobile Machine
 - 3.6.3 Dynamic braking
 - 3.6.4 Grade
 - 3.6.5 Maximum power capacity
 - 3.6.6 Self-propelled electrically driven machin...
 - 3.7 Abbreviated terms
- + 4 General requirements
 - 4.1 General
- Figure 1
- + 7 Protection against thermal hazards
 - 7.1 Temperatures at the charge receptacle
 - 7.2 Battery cell thermal stability test
- + Protection against

Self-propelled, electrically driven, non-rail-bound mobile machines for use in non-gassy underground mines (New Edition)

Designation: CSA M424.4:27
Source: CSA
Contact: vaishnavi.somasundaram@csagroup.org
Review start date: Aug 6, 2026
Review end date: Oct 5, 2026
Categories: [Occupational Health and Safety](#)

[Read Draft](#)

[Alert a colleague](#)

Draft Scope/Description:

1 Scope

[Replace paragraph 1 with the following]

This Standard applies to new or unused wheeled or tyred, self-propelled, electrically driven, non-rail-bound mobile machines for use in non-gassy underground mines. It provides requirements for such machines and is intended to be used in conjunction with CSA M424.0, CSA M424.1, CSA M424.2, and CSA M424.3, each as applicable.

This Standard considers battery-electric as the base system configuration. Diesel-electric system is also considered as on-board sources of electrical energy supply and is addressed by this Standard with additional specific requirements. Additionally, other energy storage technologies are considered by this Standard for application as possible sources for electric propulsion.

[Replace paragraph 3 with the following]

This Standard addresses hazards relevant to the voltage range for underground mobile machines within its scope when the machinery is used as intended. It specifies appropriate technical measures for eliminating or reducing risks arising from significant hazards during commissioning, operation, and maintenance. The safety of operators, technicians, service and maintenance personnel, and bystanders is addressed in this Standard.

[Add following at the end]

In this Standard, "shall" is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the standard; "should" is used to express a recommendation or that which is advised but not required; and "may" is used to express an option or that which is permissible within the limits of the Standard.

Notes accompanying clauses do not include requirements or alternative requirements; the purpose of a note accompanying a clause is to separate from the text explanatory or informative material.

Notes to tables and figures are considered part of the table or figure and may be written as requirements.

You may comment on any section of this document by clicking the "Submit Comment" link at the bottom of the relevant section.

3.0 Overview and highlights

Overview of M424.4:27 in order with content samples

CSA Preface: *Any reference in ISO 14990-1 to earth-moving machinery (EMM) shall be interpreted as Battery electric mobile machine (BEMM)*

Canadian deviations: *The following deviations are intended to align with local occupational health and safety practices and to meet the requirements of Canadian workplace regulators.*

1. Scope:

* *Remove hydrogen fuel cell requirements*

2. Normative References

* *M424 series: M424.0, .2, .3 & other not included in ISO 14990-1*

3. Terms and definitions and abbreviated terms

* *Add terms not defined in ISO 14990-1: Battery electric mobile machine (BEMM), Diesel-Electric hybrid mobile machine, dynamic braking.*



3.0 Overview and highlights

Overview of M424.4:27 in order with content samples

4. General requirements

- * Vehicle operator should be alerted with audible and/or visible warning alarms....should not be allowed to persist uncorrected.*

- * Shall perform risk assessment*

5 & 6: *Requirements are covered in ISO 14990-1*

7. Protection against thermal hazards

- * Charge receptacle: -30°C to 50°C*

- * Battery thermal stability shall meet SAE J2464 or equivalent*

8. Protection against mechanical hazards

9 & 10: *Requirements are covered in ISO 14990-1*

11. Wiring

12. Electric motors and generators

- * Mining operator & supplier should discuss specific application and determine if different than ingress protection level in ISO 14990-1*



3.0 Overview and highlights

Overview of M424.4:27 in order with content samples

13. *Requirements are covered in ISO 14990-1*

14. Controls

** During dynamic braking, protections shall be provided to prevent overcharge and overvoltage.*

Provide means to reduce dynamic braking power being stored in battery as energy before a cell can become overcharged and potentially initiate a thermal runaway.

15. General: *Manuals and technical documentation*

16. Marking

** The machine shall have machine identification labels clearly identifying it as a battery electric and diesel –hybrid machines based on their internal design standards.*

** Label size: min. 100mm H, visible from 50 m*

** Material and colors: retro-reflective material, durable for mining environment conditions*

** Location: min. two locations*



Developed based on various sources



as per AS 5487

3.0 Overview and highlights

Overview of M424.4:27 in order with content samples

17. Tests

18. Diesel-electric power machines

- * *Requirements related to diesel engine are covered by CSA M424.2*

- * *Battery charging shall be unidirectional (charging only). Vehicle-to-grid (V2G) protocol shall not be utilized. To prevent the energy storage system from receiving power from the generator and charging inlet at the same time, the system shall be designed to prevent simultaneous charging and prevent back-feeding of power.*

Annex A (informative) List of significant hazards

Annex B (normative) TN system – protect against indirect contact

Annex C (informative) explanation of emergency operation functions

Annex D (informative) comparison of selected requirements of ISO 14990-1, UN ECE R100 & ISO 6469-3

Annex E (informative) additional information on battery electric powered machines

- * *E.1-8 from previous edition*

- * *E.9 Battery storage, handling & transportation dangerous goods*

- * *E.10 Machine identification*

3.0 Overview and highlights

Overview of M424.4:27 in order with content samples

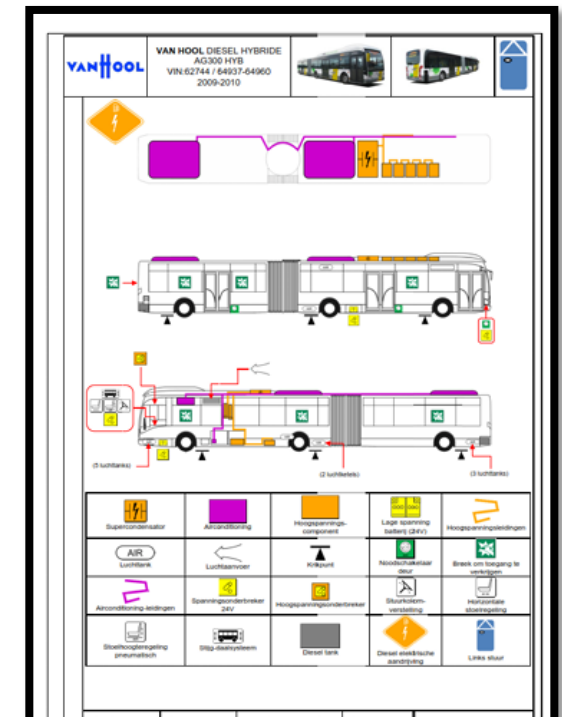
Annex E (informative) additional information on battery electric powered machines

* *E.9 Battery storage, handling & transportation of dangerous goods*

** *Recommendations: OEM provides the emergency response procedures for BEV in accordance with ISO 17840-3 template published end of 2018.*

1. Identification / recognition	Page ...
2. Immobilisation / stabilisation / lifting	Page ...
3. Disable direct hazards / safety regulations	Page ...
4. Access to the occupants	Page ...
5. Stored energy / liquids / gases / solids	Page ...
6. In case of fire	Page ...
7. In case of submersion	Page ...
8. Towing / transportation / storage	Page ...
9. Important additional information	Page ...
10. Explanation of pictograms used	Page ...

1. Identification / recognition	
	Electric bus with inductive charging
2. Immobilisation / stabilisation / lifting	
	Height control bus in driver cabin
	Seat height adjustment in driver cabin
	Use only these lifting points
3. Disable direct hazards / safety regulations	
	To emergency stop engine use CO ₂
	Shutdown high voltage possible at two places
4. Access to the occupants	
	Three door exits
	One roof exit
	Break these windows to obtain access



3.0 Overview and highlights

ISO 14990-1

** will be included as an attachment to M424.4:27*



Provided by the Standards Council of Canada for use in the development of standards by CSA

INTERNATIONAL
STANDARD

ISO
14990-1

First edition
2016-11-01

**Earth-moving machinery — Electrical
safety of machines utilizing electric
drives and related components and
systems —**

**Part 1:
General requirements**

*Engins de terrassement — Sécurité électrique des machines utilisant
des moteurs électriques et composants et systèmes connexes —
Partie 1: Exigences générales*



Reference number
ISO 14990-1:2016(E)

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4.0 Next steps

- Review and respond to published comments
- TC review and approval
- CSA editing & publication in 2027



THANK YOU.....



DO YOU HAVE ANY QUESTIONS ?

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