

Ascending car overspeed Protection and Unintended Car Movement Protection

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KEYWORDS:

- Elevator Safety
- Ascending Car Overspeed
- Speed Governors
- Emergency Braking System
- Vertical Transportation Engineering
- EN 81-20/50, ASME A17.1/CSA B44, IS 17900 Part 1 & 2
- ACOP and UCMP

Abstract

Safety in vertical transportation systems, particularly elevators, is governed by stringent international and national standards aimed at mitigating critical hazards such as Ascending Car Overspeed (ACOP) and Unintended Car Movement (UCMP). These conditions pose significant risks to passenger safety and equipment integrity if not effectively controlled.

This paper presents a comparative analysis of safety requirements for ACOP and UCMP, as specified in **IS 17900 Part 1 & 2 (India)**, **EN 81-20/50 (Europe)**, and **ASME A17.1/CSA B44 (North America)**.

IS 17900 Part 1:2022 outlines general requirements for elevator design and installation, mandating the inclusion of ACOP and UCMP protection systems capable of detecting abnormal movement conditions and responding with corrective actions. **Part 2** supplements this with detailed specifications for the design, testing, and certification of these safety mechanisms. ACOP systems detect excessive upward car speed and trigger emergency braking, while UCMP systems prevent or stop unintended movements away from landings—especially when doors are open.

Similarly, **EN 81-20/50** and **ASME A17.1/CSA B44** require the integration of overspeed governors, monitored braking systems, and redundant safety components designed to respond reliably under fault conditions. Overspeed events typically defined as speeds

exceeding 115% to 125% of the rated value can result from traction drive failures, brake malfunctions, or control system errors. Modern safety architectures incorporate real-time speed monitoring through sensors or mechanical governors, enabling rapid motor deactivation and brake engagement upon detecting hazardous conditions.

The study highlights both the commonalities and regional differences among the standards in terms of detection thresholds, performance criteria, and validation protocols. It emphasizes the value of harmonizing global safety practices while accommodating local operating environments and regulatory frameworks.

Ultimately, the paper concludes that the effective deployment of ACOP and UCMP system bolstered by ongoing technological innovation and international standardization efforts is essential to enhancing the safety, reliability, and resilience of today's vertical transportation systems

Introduction

In the evolving landscape of vertical transportation, the demand for faster, more efficient, and safer elevator systems has intensified. Elevators have become critical infrastructure in modern buildings, particularly in high-rise residential, commercial, and institutional spaces. With increased usage and system complexity, ensuring passenger safety has emerged as a non-negotiable priority. Among the various safety risks associated with elevator operation, two critical scenarios—**Ascending Car Overspeed (ACOP)** and **Unintended Car Movement (UCMP)**—require particular attention due to their potential to cause severe injury, equipment damage, or even fatalities.

Ascending Car Overspeed refers to a condition where the elevator car moves upward beyond a predefined speed threshold—typically between 115% and 125% of the rated speed—due to drive system malfunctions, control system failures, or braking issues. If not promptly detected and mitigated, this situation can result in the car colliding with the overhead structure or activating emergency stops that can injure passengers.

Unintended Car Movement, on the other hand, involves elevator car displacement from a landing position without a corresponding command—especially when the doors are open. This condition typically arises from brake slippage, control errors, or drive torque leakage, posing serious hazards to boarding or disembarking passengers.

To address these risks, global standards bodies have introduced stringent requirements for detection, control, and mitigation of ACOP and UCMP conditions. Standards such as **IS 17900 (India)**, **EN 81-20/50 (Europe)**, and **ASME A17.1/CSA B44 (North America)** prescribe the implementation of mechanical and electronic safety systems—ranging from overspeed governors and monitored brakes to fail-safe controllers and emergency stopping devices.

This paper presents a comparative review of the ACOP and UCMP safety requirements across these three major standard frameworks. It highlights the convergence of international best practices, key differences in performance expectations, and the implications for manufacturers, system integrators, and safety regulators. By analyzing the design, testing, and certification guidelines, the study aims to provide a comprehensive understanding of how current safety technologies and regulatory protocols can be harmonized to improve elevator system reliability and user protection.

Table 1: Comparison of ACOP and UCMP – Definitions and Key Characteristics		
Feature	ACOP (Ascending Car Overspeed Protection)	UCMP (Unintended Car Movement Protection)
Primary Risk	Upward movement beyond safe speed	Movement from landing with doors open
Common Causes	Drive control failure, traction slip, motor runaway	Brake slip, control logic error, residual torque
Detection Mechanism	Overspeed governor, encoder-based sensors	Position sensors, brake monitoring, door interlock systems
Typical Activation Threshold	115%–125% of rated speed	Any movement when doors are open and no movement command is issued
Required Safety Action	Emergency brake engagement, motor cutoff	Break re-engagement, movement interruption
Regulatory Mandate	Required in EN 81-20/50, IS 17900, ASME A17.1	Required in all major safety codes
Impact of Failure	Collision with overhead, passenger injury	Entrapment, shear hazard, passenger fall

ASCENDING CAR OVERSPEED

1. What is Ascending Car Overspeed?

In normal operation, elevators have a maximum rated speed (for example, 1.75 m/s or 3.5 m/s, depending on the system). If the elevator car, while moving upward, exceeds a

certain percentage above this rated speed (commonly around 115%-125% of rated speed depending on code requirements), it triggers what's called an ascending car overspeed condition.

2. Why Can This Happen?

Possible causes include:

- Malfunctioning drive system (traction motor issue)
- Control system fault (incorrect speed reference)
- Counterweight imbalance
- Brake failure while moving upward
- Drive inverter issue (overvoltage or runaway motor)

3. How is it Detected?

Elevators are equipped with:

- Bidirectional Speed governors or speed sensors that continuously monitor the elevator's travel speed.
- If upward speed exceeds the allowed threshold, an overspeed detection signal is triggered.

Figure one displays a flow chart in simple action of detection and braking of car in unfortunate event of ACOP.

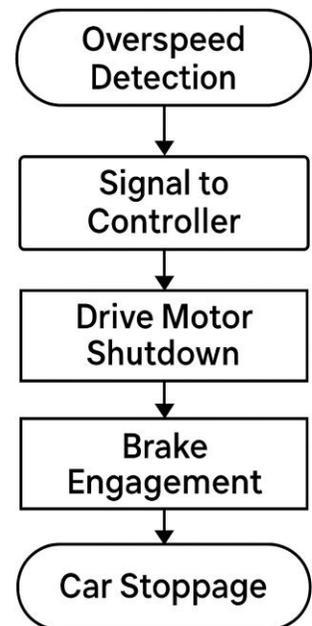


Figure 1

4. What Happens After the detection of an Overspeed Event?

When ascending car overspeed is detected:

I. Overspeed Detection

- The elevator continuously monitors car speed using speed sensors or an overspeed governor (OSG).
- If the elevator car moves upward faster than its permissible limit (typically 115%–125% of rated speed), the system flags it as an overspeed condition.

II. Emergency Signal Activation

- Once overspeed is detected, an emergency signal is immediately sent to the elevator controller.
- This triggers a pre-programmed emergency sequence to protect passengers and the system.

III. Drive Motor Shutdown

- The controller cuts power to the traction motor to stop driving the elevator further.
- In regenerative drives, energy is dissipated or fed back to the grid to reduce speed.

IV. Brake Engagement

- The main elevator brakes (typically spring-applied and electrically released) are instantly applied.
- These brakes clamp onto the motor or sheave, helping stop and hold the car in place.

V. Safety Gear (if applicable) Activation

- In some systems, especially those compliant with EN 81-20/50, mechanical safety gear may be triggered via the overspeed governor.
- This safety gear clamps the guide rails, physically stopping the car from moving further.

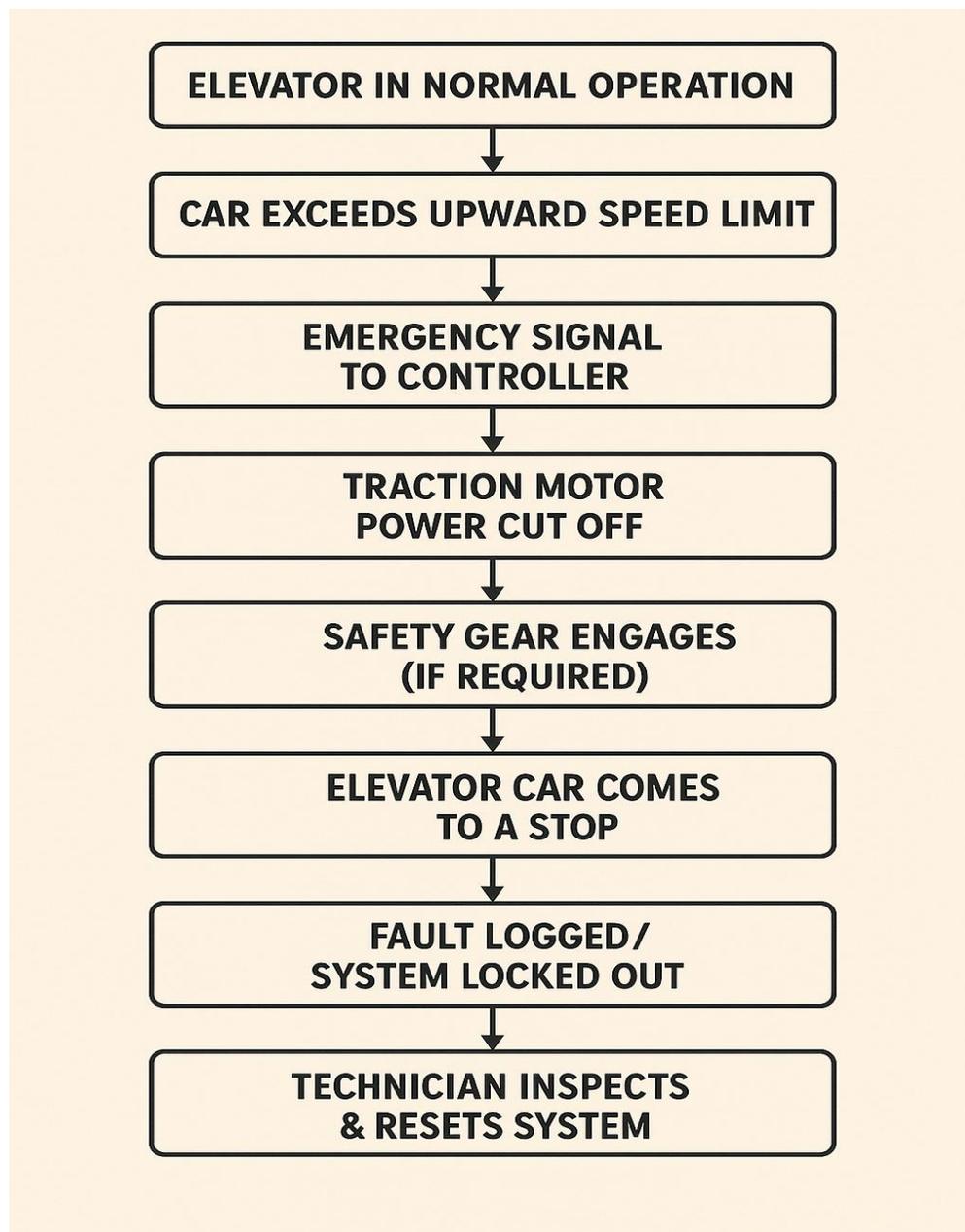
VI. System Lockout

- The elevator system is locked out to prevent further operation until a qualified technician inspects and resets it.
- An error or fault code is displayed on the controller interface or car panel.

VII. Maintenance & Inspection

- A technician will check:
 - The cause of overspeed (e.g., drive failure, brake malfunction)
 - The condition of the brakes and overspeed governor
 - Any passenger reports or event logs.

Figure 2 Shows the Process Flow Chart After the detection of an Overspeed Event



5. Safety Codes Reference

Most of this is governed by international standards like:

- **ASME A17.1 / CSA B44** (in North America)
- **EN 81-20/50** (in Europe)
- **IS 17900 Part 1 :2022**
which specify detection mechanisms, thresholds, and safety responses.

6. System Lockout

- The elevator system is locked out to prevent further operation until a qualified technician inspects and resets it.
- An error or fault code is displayed on the controller interface or car panel.

7. Maintenance & Inspection

A technician will check:

- The cause of overspeed (e.g., drive failure, brake malfunction).
- The condition of the brakes and overspeed governor.
- Any passenger reports or event logs.
- Then the technician will reset the elevator to normal operation.

ASCENDING CAR OVERSPEED PROTECTION

1. LSG01 High-Speed Progressive Safety Gear

- **Description:** The LSG01 is a high-speed progressive safety gear designed for passenger lifts. It is activated when the elevator car exceeds its rated speed, clamping onto the guide rails to bring the car to a controlled stop. This gear is suitable for elevators with speeds up to 2.5 m/s.
- **Features:**
 - Progressive braking mechanism for smooth deceleration.
 - Compatible with various elevator models.
 - Ensures passenger safety during overspeed conditions.
- **More Information:** LSG01 High-Speed Progressive Elevator Safety Gear

2. VG Rope Brake by Atwell

- **Description:** The VG Rope Brake is a versatile unit that can function as a single or bi-directional brake. It operates on the lift ropes and is designed to prevent uncontrolled movement or overspeed in both upward and downward directions.

- **Features:**
 - Electromechanical design ensures fail-safe operation.
 - It can be mounted in various positions around the traction sheave.
 - Complies with EN81-1:1998 clause 9.10 for overspeed protection.
 - **More Information:** VG Rope Brake – Lift Material Australia
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3. ACOP Rope Gripper with Protech UCMP Protection

- **Description:** The ACOP Rope Gripper is an ascending car overspeed protective device equipped with the Protech UCMP (Unintended Car Movement Protection) system. It grips the elevator ropes to halt the car during overspeed or unintended movement scenarios.
- **Features:**
 - CE certified for safety compliance.
 - Suitable for elevators with speeds exceeding 3.5 m/s.
 - Provides both overspeed and unintended movement protection.

These devices are integral to elevator safety systems, ensuring that in the event of an ascending overspeed condition, the elevator car is brought to a safe stop, protecting passengers and equipment alike.

Unintended Car Movement

Unintended Car Movement refers to a hazardous condition where the elevator car moves away from the landing (floor level) without any active call or door closure command, while the doors are still open. This poses a serious risk to passengers boarding or exiting the car.

1. Why Does It Happen?

Unintended movement can occur due to:

- **Brake failure or slippage**
- **Control system errors**
- **Drive inverter issues**
- **Loss of traction holding torque**
- **External forces (e.g., strong wind or seismic vibrations)**

2. Detection Mechanism

Elevators are equipped with **Unintended Car Movement Protection (UCMP) systems** as mandated by standards like:

- **EN 81-20/50 (Europe)**

- **ASME A17.1 / CSA B44 (North America)**
- **IS 17900 Part 1 & 2 (India)**

These systems include:

- **Position sensors** to detect any movement when the elevator should be stationary.
- **Brake monitoring devices** to confirm brake engagement.

3. What Happens During a UCMP Event?

If unintended movement is detected:

- I. The **UCMP system activates**.
- II. The **drive is immediately shut down**.
- III. **Electromechanical brakes** are applied.
- IV. Some systems include a **UCMP brake (rope gripper or rail clamp)** to further secure the car.
- V. The elevator is brought to a halt and locked out for inspection.

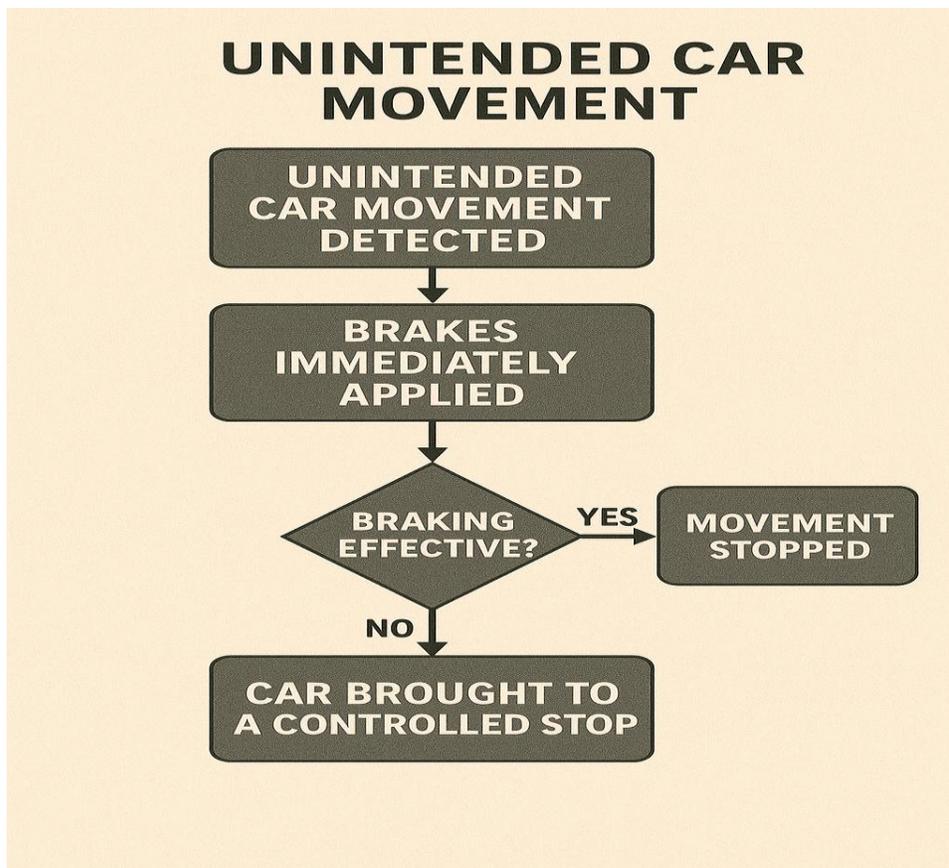


Figure 3 shows UCMP action flow chart

4. Safety Standards & Compliance

- **ASME A17.1 / CSA B44: 2.19.2** — requires elevators to prevent unintended movement with doors open.
- **EN 81-20: Clause 5.6.7.6.1** — mandates UCMP protection.
- **IS 17900** also incorporates these provisions based on international harmonization.

Unintended Car Movement Protection

UCMP devices are specialized safety components designed to **prevent or stop elevator car movement** when the doors are open, and **no command** has been given. They are activated **automatically** upon detection of unintended motion.

Core Components of a UCMP System

Based on industry standards and common architecture, a UCMP system includes:

1. **Detection Subsystem**
 - Sensors to detect any elevator movement while doors are open or unlocked
 - Can detect even slight motion or lack of brake holding torque
2. **Braking / Clamping Subsystem**
 - Rope gripper (rope brake) or rail clamp engages to physically halt the elevator
 - Acts independently of the main brake to provide redundancy
3. **Self-Diagnosis Subsystem**
 - Monitors device health, brake wear, electrical status, and system readiness
 - Sends fault notifications if a subsystem fails

Types of UCMP Devices

1. Rope Gripper (Rope Brake)

- **Function:** Clamps the hoisting ropes tightly to prevent the car from moving.
- **Installation:** Mounted near the traction sheave or machine bedplate.
- **Operation:** Spring-applied, electrically released; activates in less than 100 m/s.
- **Example Brands:** Warner, Otis RB Series, Witter PFB.

2. Rail Clamp / Safety Gear (UCMP-capable)

- **Function:** Grips the guide rails (like traditional safety gear) to stop the car.
- **Use Case:** Often integrated with emergency stop systems.
- **Works With:** Mechanical actuation or solenoid-based release.
- **Standards:** Compliant with EN 81-20 Clause 5.6.7.6 and A17.1 Clause 2.19.

3. Electromechanical Brake Monitoring Systems

- **Function:** Continuously check if the brake is correctly applied when the car is stationary at a landing.
- **Action:** Sends fault if the brake slips or partially releases.
- **Works Alongside:** Main brake and secondary UCMP devices.

4. Drive-Based Holding Torque Monitoring

- **Function:** Detects loss of torque from the motor when at floor level.
- **Failsafe Behavior:** Triggers UCMP brake and disables inverter output.

Summary Table:

Component	Description
Rope Gripper / Brake	Clamps rope to prevent unintended motion when doors open
Rail Clamp / Gear	Optional rail-based clamping gear for redundancy or mechanical stop
Control Board	Electronic detection and brake actuation interface
Self-Diagnostic Module	Monitors health, reports fault, supports periodic testing

Typical UCMP Activation Sequence

- I. Car stops at landing.
- II. Brake is released, but doors still open.
- III. If unintended motion is detected:
 - **Brake re-applies**
 - **UCMP rope brake or rail clamp engages**
 - **Drive cuts off power**
- IV. System locks out until inspection/reset.

Regulatory Standards

Region	Standard Reference
India	IS 17900 Part 1 & 2
Europe	EN 81-20/50 – Clause 5.6.7.6
North America	ASME A17.1 / CSA B44 – 2.19.2

Conclusion

The safety of elevator systems is paramount in ensuring the reliability and trustworthiness of modern vertical transportation, especially in high-density urban environments. This study explored two critical elevator safety mechanisms—**Ascending Car Overspeed Protection (ACOP)** and **Unintended Car Movement Protection (UCMP)**—which safeguard passengers and equipment from potentially catastrophic motion anomalies.

ACOP systems are designed to detect and respond to upward motion beyond a predefined safe threshold. They leverage speed sensors, overspeed governors, and high-speed braking systems to halt the elevator car before it can collide with overhead structures. On the other hand, UCMP systems monitor car position and braking performance at floor level, intervening if any movement is detected while the doors are open and no command has been given. These systems use rope grippers, rail clamps, and electronic monitoring subsystems to ensure immediate corrective action.

The comparison of international standards—**IS 17900 (India)**, **EN 81-20/50 (Europe)**, and **ASME A17.1/CSA B44 (North America)**—demonstrates a high degree of convergence in safety philosophy, though there are regional variations in technical implementation and compliance requirements. All three emphasize real-time monitoring, redundancy, and rapid braking response as fundamental to safety assurance.

As elevator technology evolves, incorporating AI-based diagnostics, predictive maintenance, and smart controllers, the role of ACOP and UCMP systems will become even more critical. Future developments may include integrated multi-sensor fusion systems, IoT-enabled brake analytics, and machine learning algorithms that predict faults before they occur.

In conclusion, effective implementation and regular maintenance of ACOP and UCMP systems—backed by adherence to harmonized global standards—are essential to minimizing operational hazards and advancing overall safety, reliability, and public confidence in vertical transportation systems.

References

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- EN 81-20/50 – Clause 5.6.7.6
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Biographical Details



Viren Gajera is a Sr. RND Engineer and technical researcher at **Tectronics Techworld Pvt. Ltd., India**, specializing in elevator Traction Machine Design technology. With a strong background in **electromechanical systems**.

Viren holds a degree in Electrical Engineering and has over **2 years of industry experience** in the design, testing, and implementation of elevator Traction machines and safety mechanisms including **overspeed protection**. His work emphasizes the importance of regulatory harmonization and practical field deployment of Traction Machines and safety devices in both urban and industrial elevator applications.

At Tectronics Techworld, he leads cross-functional teams focused on R&D, safety audits, and certification support, with a vision to advance smart, reliable, and fail-safe lift systems for modern infrastructure.