

Comprehensive Engineering Guide to EN 81-20 and EN 81-50: The Definitive Standards for Modern Elevator Systems

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The landscape of vertical transportation underwent a paradigm shift with the introduction and mandatory adoption of the **UNI EN 81-20** and **UNI EN 81-50** standards. These regulations, which superseded the long-standing EN 81-1 and EN 81-2 frameworks, represent the most significant update to elevator safety and design in over two decades. Developed by the European Committee for Standardization (CEN), these standards were designed to harmonize international safety requirements, improve the safety of both passengers and maintenance personnel, and account for the rapid technological advancements in the lift industry.

The Theoretical Framework of the EN 81 Series

To understand the current regulatory environment, one must distinguish between the two primary pillars of the new standard. While they are often discussed in tandem, they serve distinct functions within the engineering and certification lifecycle of an elevator system.

EN 81-20: Construction and Installation Requirements

EN 81-20 defines the technical requirements for the construction and installation of passenger and goods-passenger lifts. It focuses on the physical attributes of the lift, the safety of users, and the ergonomics of the environment for technicians. This standard is applicable to both traction (electric) and hydraulic lifts, creating a unified set of rules that simplifies the design process for multidisciplinary engineering teams.

EN 81-50: Rules for Design, Calculation, and Examinations

Conversely, **EN 81-50** specifies the evaluation and testing protocols for lift components. It dictates how safety components—such as buffers, safety gears, and rupture valves—must be tested to verify their compliance with the safety requirements laid out in EN 81-20. This separation ensures that while the installation follows one set of rules, the individual mechanical and electrical sub-systems are vetted through a rigorous, standardized testing methodology.

Comparative Analysis: Legacy Standards vs. EN 81-20/50

The transition from EN 81-1/2 to EN 81-20/50 was not merely an incremental update; it introduced several high-impact changes across multiple technical domains. The following table highlights the critical shifts in regulatory requirements.

Feature / Area	Legacy Standard (EN 81-1/2)	Current Standard (EN 81-20/50)	Impact Level
Door Strength	Static test with minimal force requirements.	Must withstand 300N of force with max 15mm permanent deformation.	High (Safety)
Light Curtain	Mechanical safety edges were common.	Non-contact light curtains (3D protection) are mandatory.	High (Safety)
Pit Safety Space	Smaller refuge volumes allowed.	Increased refuge spaces for technicians (posture-specific).	Critical (Maintenance)
Lighting Levels	Minimal illuminance required (approx 50 lux in car).	Enhanced lighting: 100 lux in car; 50 lux in shaft/machine room.	Moderate (Usability)
Shaft Walls	General structural requirements.	Specific fire resistance and mechanical strength (1000N/300N).	High (Structural)

Technical Deep-Dive: Passenger Safety Enhancements

The primary objective of EN 81-20 is the mitigation of risk for passengers. This is achieved through several key engineering mandates that address the most common points of failure or injury in elevator operation.

Advanced Door Protection Systems

One of the most notable changes is the requirement for **non-contact protection systems**. Modern elevators must be equipped with a light curtain or similar electronic sensing device that covers the door opening from the floor level up to a height of 1,600 mm. This system prevents the doors from closing if an obstruction—such as a passenger's limb or a pet's leash—is detected. Furthermore, the standard mandates increased kinetic energy monitoring. If the doors are forced closed under a 'nudge' or emergency mode, the kinetic energy must be strictly limited to 4 Joules.

Enhanced Mechanical Strength of Doors and Walls

To prevent falls into the elevator shaft, EN 81-20 requires significantly higher mechanical strength for both landing and car doors. Doors must now withstand a force of 300N applied over a 5cm² area without significant permanent deformation. In more extreme cases, they must withstand 1000N of force without losing their structural integrity or functional safety. This is particularly relevant in high-traffic or public buildings where vandalism or accidental impact is a risk factor.

Car Lighting and Emergency Illumination

The standard mandates that the car interior must have a minimum light intensity of **100 lux**. In the event of a power failure, the emergency lighting must provide at least 5 lux for at least one hour. This ensures that passengers remain calm and can clearly see the alarm buttons or communication devices during an entrapment scenario.

Engineering Requirements for Maintenance and Inspection Safety

Safety for maintenance personnel (technicians and inspectors) is a cornerstone of the EN 81-20/50 framework. The

legislation recognizes that the elevator shaft and the car roof are high-risk environments.

Safety Spaces in the Headroom and Pit

The calculation of safety spaces (refuge spaces) has been completely redesigned. Technicians must be protected in the event of uncontrolled car movement. The standard defines specific volumes based on the technician's body posture: **standing, crouching, or lying down**. For instance, a crouching safety space must be at least 0.50m x 0.70m x 1.00m. These spaces must be clearly marked on the floor of the pit and the roof of the car with permanent signage.

Pit Access and Control Stations

To enter the pit, technicians must have access to a control station that allows them to take command of the lift. EN 81-20 specifies that this control station must be reachable from the safety space and must include a 'stop' button and an inspection operation switch. Additionally, an alarm device must be installed in the pit, connected to a 24/7 rescue service, ensuring that a technician who becomes trapped or injured can summon help immediately.

The Car Roof Balustrade

If the distance between the car roof and the shaft wall exceeds 0.30m, a balustrade (handrail) must be installed. The height of this balustrade is determined by the gap distance:

- If the gap is $\leq 0.30\text{m}$: No balustrade required (but recommended).
- If the gap is $> 0.30\text{m}$ and $\leq 0.50\text{m}$: Balustrade height must be at least 0.70m.
- If the gap is $> 0.50\text{m}$: Balustrade height must be at least 1.10m.

Structural Integrity of the Shaft and Machine Room

EN 81-20 imposes strict rules on the materials and construction of the lift well (shaft). These requirements are designed to prevent the spread of fire and ensure the shaft can withstand the immense mechanical loads generated by the elevator system.

Fire Resistance and Ventilation

The shaft must be constructed of materials that do not contribute to the spread of fire and do not emit toxic gases. Ventilation requirements have also been updated; while the specific amount of ventilation is often determined by local building codes, EN 81-20 mandates that the lift designer provide all necessary data (heat dissipation of the motor, etc.) to the building architect to ensure a safe thermal environment.

Mechanical Load Calculations

The shaft walls must be able to withstand a force of 1000N applied at any point. This is critical for preventing wall collapse under the tension of guide rails or the impact of the safety gear. Engineers must use the following simplified formula for estimating wall stress in standard installations, though complex FEA (Finite Element Analysis) is often required for high-speed systems:

$$\sigma \leq \frac{F_{total}}{A_{section}} \leq \frac{6V_7 F}{A_{section}}$$

Where F_{total} represents the sum of the car weight, rated load, and dynamic impact forces, k is a safety factor (typically 2.0 or higher), and $A_{section}$ is the cross-sectional area of the supporting structure.

The Role of EN 81-50 in Safety Component Verification

While EN 81-20 dictates *where* safety components go, **EN 81-50** dictates *how* they are proven to work. This

standard covers the type-testing of several critical components.

Verification of Buffers

Buffers (energy-dissipating or energy-accumulating) must be tested to ensure they can decelerate the car at a rate not exceeding 2.5g (standard gravity) when hitting the buffer at 115% of the rated speed. EN 81-50 provides the mathematical models for these drop tests, ensuring that the results are repeatable across different testing laboratories.

Safety Gear and Overload Detection

The safety gear, which physically grips the guide rails to stop the car in an overspeed event, must undergo rigorous testing. EN 81-50 requires tests for different rail surface conditions (oiled vs. dry) and different load configurations. Similarly, the overload detection system must be verified to prevent the car from starting if the load exceeds 110% of the rated capacity (or a minimum of 75kg).

Practical Implementation: Dimensions and Clearances

For architects and developers, the most tangible impact of EN 81-20/50 is the requirement for larger shaft dimensions. Because the safety spaces for technicians have increased, the "overhead" (the space above the top floor) and the "pit depth" (the space below the bottom floor) must often be deeper than in legacy buildings.

Minimum Dimensions Checklist

1. Clearance above the car: Ensure sufficient vertical space for the 1.1m balustrade and the standing technician safety volume.
2. Pit Depth: Account for the buffer height, the buffer stroke, and the crouching safety space.
3. Door Frame Clearances: Standardized door widths (usually 800mm or 900mm) must be accommodated within the structural opening of the shaft walls.
4. Machine Room Access: Doors to machine rooms must have a minimum height of 2.0m and a width of 0.6m, providing unobstructed access for heavy replacement components.

Addressing Common Operational Challenges

Despite the clarity of the EN 81-20/50 standards, implementation can face hurdles, particularly in modernization projects for existing buildings.

Retrofitting vs. New Installation

While EN 81-20/50 is mandatory for *new* installations, many countries apply parts of these standards to major modernizations. One common challenge is the **Reduced Headroom/Pit**. In older buildings where it is physically impossible to create the required safety volumes, engineers must implement alternative technical solutions, such as movable stops or electronic safety systems that create a "virtual" safety space, which must be approved by a notified body.

Electrical Interface and SIL Levels

The standards emphasize the reliability of the electrical safety chain. The use of Programmable Electronic Systems in Safety Related Applications (PESSRAL) is governed by **Safety Integrity Levels (SIL)**. Under EN 81-20, many safety functions now require a SIL 3 rating, ensuring that the probability of a dangerous failure is less than 1 in 10,000,000 per hour of operation.

The Future of Lift Standards

The EN 81-20 and EN 81-50 standards are not static. As the industry moves toward **Internet of Things (IoT)** integration, remote monitoring, and AI-driven predictive maintenance, the standards will continue to evolve. We are already seeing the integration of ISO standards (such as ISO 8100) aimed at creating a truly global set of lift regulations. However, the core principles established by EN 81-20—structural robustness, technician safety, and passenger protection—will remain the bedrock of elevator engineering for decades to come.

In conclusion, compliance with these standards is not merely a legal obligation but a commitment to excellence in engineering. By adhering to the rigorous design, calculation, and testing requirements of the EN 81 series, manufacturers and building owners ensure that the elevator remains one of the safest modes of transportation in the modern world. The meticulous attention to detail found in these regulations—from the lux levels of a car light to the impact resistance of a landing door—reflects an industry-wide dedication to zero-accident operation and technical reliability.

Baca Juga (Artikel Terkait)

- [The Comprehensive Guide to ASME A17.1 and Safety Standards for Elevators and Escalators](http://alghafgolden.com/asme-a17-1-elevator-escalator-safety-guide.pdf)

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Tags: #EN 81 20 #EN 81 50 #Elevator Safety #Lift Regulations #Technical Documentation #Building Compliance

