How to Approach Lift Doors Modernization and Refurbishment Projects

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Abstract. Millions of lifts are in use today in Europe. In many countries, more than half of the existing lifts are 25 years old or older. Few of them have been modernized to meet current safety and performance requirements. Nevertheless the aging of lifts can be made more effective, safer, more reliable and more comfortable through improvement and regular maintenance. EN 81-80 defines measures to be taken for existing elevators to bring them up to state-of-the-art standards. The objective is to reach, in existing lifts, the safety level prescribed in the EN 81 series of standards.

There are also special requirements for lift doors, which should be refurbished according to the characteristics described by the latest operational safety regulations, including fire and vandal resistance. A dedicated approach, as well as a rehabilitation plan and schedule for lift door modernization can be established using the regulations in EN 81-80. These can include specialized services for the analysis of risk levels in existing lifts and refurbishment needs, including on-site surveys, as well as different solutions according to the type of modernization required: complete product substitution, single component replacement or customized solutions.

1 INTRODUCTION

If we present a lift modernization project to an average lift passenger we will explain that the refurbishment's aim is to improve accessibility, reliability, efficiency, performance and comfort in existing systems, whilst simultaneously lowering maintenance activities and energy consumption.

From a sales and marketing point of view, this is a comprehensive description that already includes the full set of advantages for choosing to upgrade an existing lift. Anyway, something significant is missing: the focus on safety. This is clear to any industry expert who, when they start their analysis of how to approach refurbishment and modernization projects, looks to the most relevant safety norm for existing lifts: the EN 81-80 standard.

2 EN 81-80 SNEL [1,2]

The upgrading of the existing lifts in Europe, which are the oldest in the world, has been a top priority for the European lift industry for many years. The actual beginning of this can be considered to be the 1995 “10 recommendations to make existing lifts safe” document (see Fig.1) that was published by the European Commission in addition to the Lifts Directive 95/16/EC.

The recommendations had no legal force but they were the starting point considered by industry experts for the analysis and the identification of all the risks that an existing lift could pose. This process stood as the basis of the drawing up of the EN 81-80 standard in 2003.

1. Car doors to be fitted and a floor-level indicator to be fitted inside the car.
2. The car suspension cables to be inspected and possibly replaced.
3. The stop controls to be modified in order to achieve a high degree of precision in the stopping level of the car and a gradual deceleration.
4. Make the controls in both the cars and lift wells intelligible and usable by unaccompanied disabled persons.
5. Fit human- or animal-presence detectors to the automatic doors.
6. For lifts which travel faster than 0,6 m/s, fit a parachute system allowing them to decelerate smoothly when stopping.
7. Modify the alarm systems to establish a permanent link with a high-speed breakdown service.
8. Eliminate any asbestos in the braking systems, where this exists.
9. Fit a device preventing uncontrolled movements towards the top of the car.
10. Provide cars with emergency lighting that operates in the event of a main power supply failure. It must operate for long enough to enable the rescue services to intervene in a normal manner. The installation must also enable the alarm system provided for in item 7 to function.

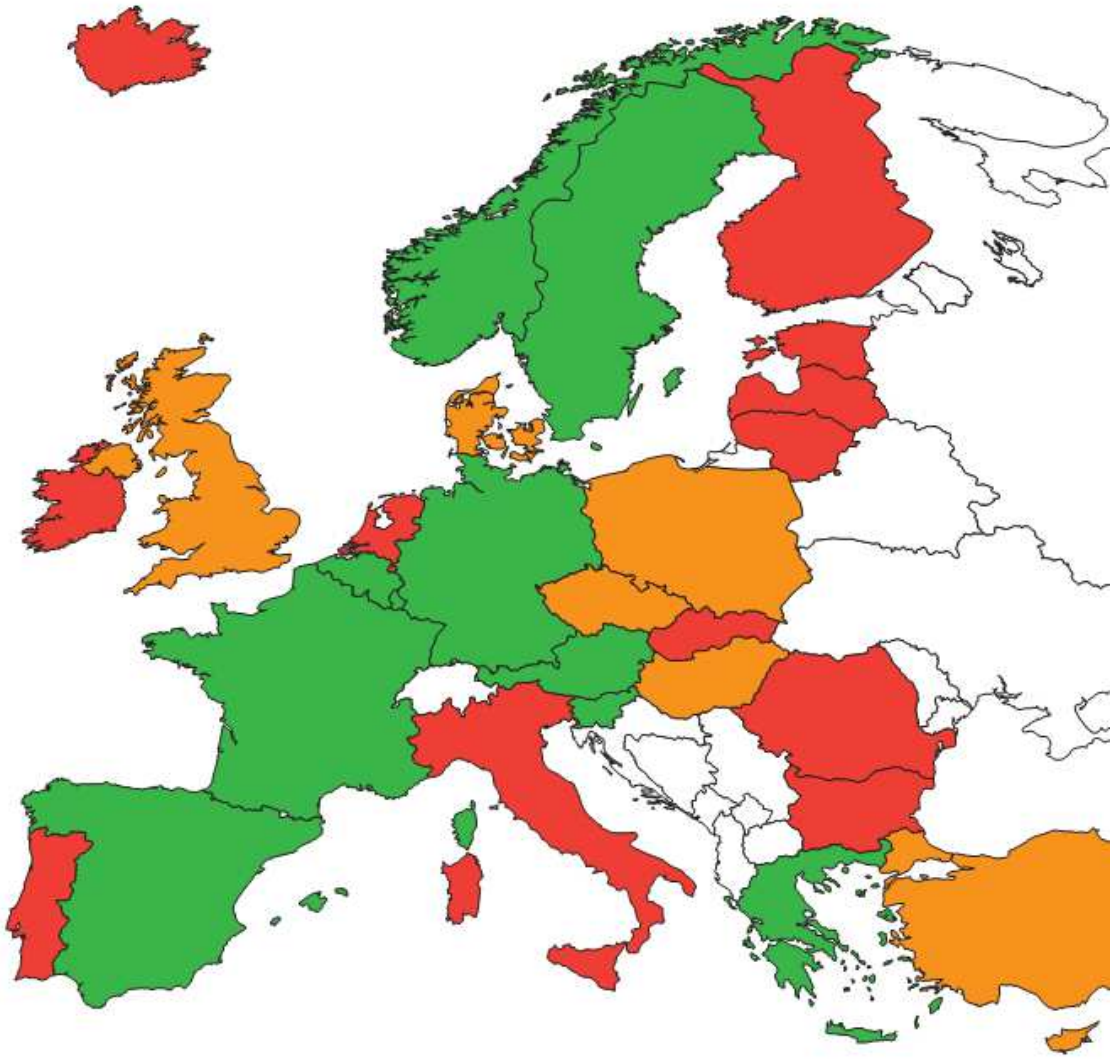
Figure 1: 10 recommendations to make existing lifts safe

Relevant indications related to lift door modernization, such as the need for car doors in any lift, or for adapting existing lifts to be usable by disabled persons, or for efficient detectors for preventing hits during the automatic door closing phase, were already present in the 10 recommendations. But it is only with the addition of EN 81-80 to the well-known European Standard for new lifts, EN 81 Part 1/2 in 2003, that the safety for existing lifts and their components became a crucial topic for the entire elevator industry.

The new standard, introduced by the European Committee of Standardization, was the result of a team composed of CEN safety experts from the lift industry, government authorities, third party inspection bodies, consumer organizations and insurance companies, and derived from the in-depth study of the 1995 “10 recommendations”.

From 2003 on, SNEL implementation has been different from country to country (applied through the national filtering method) since this European standard does not give directly binding requirements for improvement actions to be carried out on lifts. Such obligations are subject to national legislation.

So the implementation of EN 81-80 varies in content and scheduling for each country (see Fig.2), and is subject to local differences, for example, in the definition of risk levels, categorized as extreme, high, medium or low, which depend on previous country history of lift regulations and applied standards, accident statistics, specific product knowledge and social expectations.



GREEN: standard EN 81-80 has been implemented through a national law, including a defined position for the SNEL filtering

YELLOW: national legislation or guidelines in preparation

RED: a rather slow progress or nothing has been undertaken so far or no information received/available for the EN 81-80 implementation

Figure 2: SNEL survey table– source ELA

EN 81-80 can be seen as a technical guide that supports the progressive and selective improvement of the safety in existing lifts and it still remains the standard reference for refurbishment and modernization projects, even if the main lift norm EN 81-1/2 has being replaced by the new EN 81-20/50.

Starting from the analysis of international statistical data on accidents, specific risk assessments and the estimated life cycle of lifts, the EN 81-80 standard identifies and categorizes various hazards and hazardous situations that can be present in existing lifts, classifying them also by priority levels through the correlation between frequency and severity (high risks have to be addressed in the short term).

Table 1: EN 81-80 risk profile with priority levels

Frequency	Severity I	II	III	VI
	Number of hazardous situation			
A	Extreme	Extreme	High	Low
B	Extreme	High	High	Low
C	Extreme	High	Medium	
C-D	High	High	Medium	
D	High	Medium	Low	
D-E	Medium	Low		
E	Low	Low		
F				
Frequency (hazard cause level): A Frequent, B Probable, C Occasional, D Remote, E Improbable, F Impossible		**Severity** (hazard effect category): I Catastrophic, II Critical, III Marginal, IV Negligible		

Table 1: Correlation between hazard frequency and severity – source ELA

Furthermore, EN 81-80 provides a detailed checklist of more than 70 items for the safety audit of any existing lift and its components (which can be performed only by qualified technical experts) and gives a complete description of corrective actions to progressively improve lift safety and accessibility for both lift users and workers.

The safety checklist is one of the key tools to be used when starting a modernization project. It results in a clear picture of the status of the lift and groups all of the significant hazards, identified by the EN 81-80, by their position in the lift (well, machine and pulley rooms, landing doors and car doors, car, counterweight and balancing weight, suspension, compensation and over speed protection, guide rails, buffers and final limit switches, etc.). Furthermore this facilitates the risk analysis for component manufacturers and provides relevant suggestions for preparing a stepwise

upgrading, which can also be supported by preventive maintenance actions and repairs, for each specific lift component.

3 SAFETY REQUIREMENTS AND PROTECTIVE MEASURES FOR LIFT DOORS

EN 81-80 lists all the hazardous situations to be checked in any landing and car door of an existing lift, defining the priority level of intervention and the protective / risk reduction measures to be implemented. Hazardous situations are mostly linked to the ability of the doors, and of their safety components (door locks, door fixings, apron, protective devices), to act as reliable, safe and protective barriers with the main goal of preventing persons from falling into the well. Nonetheless specific actions are also required to upgrade existing components in order to make them compliant with other EN 81 standards and guarantee accessibility for disabled persons (EN 81-70), as well as resistance to vandalism (EN 81-71) and fire (EN 81-72).

Table 2: Hazardous situations for landing and car doors

Hazardous situation	Cause - Trigger	Incident / Effect	Priority level
Perforated landing and car doors	Person passes limbs through openings	Shearing and crushing of limbs, serious injuries	High
Inadequate design of landing door fixings	Person pushes the door, door collapses	Person falling into well, serious injury or death	
Inadequate glass in doors	Glass is broken by impact, person passes limbs through opening	Falling into well, shearing of limbs, serious injury or death	
No or inadequate protective devices on power operated doors	Person is passing the doors when door starts closing	Person is hit or jammed by the door, serious injury	
Unsafe locking device of landing door	Landing door closed but not properly locked, person opening the door	Person falling down the well, serious injury or death	
Unlocking of landing door possible without special tool	Person unlocks and opens a door	Person falls into the well, serious injury or death	
Well enclosure with perforated walls near door locks	Person is unlocking the landing door without a special tool, e.g. stick	Person falling into well, serious injury or death	
No automatic closing device on sliding doors	Door remains open after emergency unlocking or when car leaves the floor due to creeping	Person falls into the well, serious injury or death	
Inadequate length of car apron	Rescuing of trapped persons when car is stopped above landing	Falling down the well	
Car without doors	Goods in car hit sill or recesses on wall and tip; Person (child) enters gap between car sill and wall	User crushed, serious injury or death; Shearing and cutting of limbs, serious injury or death	
No or inadequate lighting on landings	Users entering or leaving the lift	Tripping and falling	Medium
Inadequate mechanical link between panels of	Mechanical link fails, one panel remains open	Shearing or falling of persons, fatal or serious	

landing doors		injuries	
Inadequate fire resistance of landing doors	Fire in front of landing door spreads into well and up to next floor	Person in upper floors killed by fire and smoke	
Car door moving when landing door is opened	Person entering the car before the car door is fully opened	Trapping and shearing of hands	
No or inadequate protection against dragging of fingers on sliding doors with glass	Person (child) touches glass and door start to move	Fingers are dragged into gap between door panel and frame	Low

Table 2: Hazardous situations, cause, effect, priority level for lift doors – source ELA

For all the items to be checked, the EN 81-80 defines the safety requirements that each part/component has to satisfy and suggests corrective actions to be implemented in order to fulfill these requirements. In many cases, the protective measures refer directly to specific paragraphs of the EN 81-1 and 2, quoting their references, prescriptions and measures. In others they are linked to specific norms or measures which are referred to directly in the EN 81-80 text.

For example, the SNEL suggests fitting landing doors according to the fire rating as required by national/local regulations, or to fit car and landing door protective devices according to EN 81-70. This would be so as to have them covering the opening over the distance between at least 25 mm and 1,800 mm above the car door sill (e.g. light curtain) and to prevent physical contact between the user and the leading edges of the closing door panels.

Table 3: Items to be checked and protective measures (EN 81-80)

Items to be checked	Protective measures
Strength of landing door fixing	Replace door fixings according to EN 81-1:1998, 7.2.3.1 and 7.4.2.1 or EN 81-2:1998, 7.2.3.1 and 7.4.2.1
Car door and landing door protective devices on a lift intended to be used by disabled persons	Fit a device according to EN 81-70:2003, 5.2.3 and 5.2.4
Non-accessibility of landing door locking devices from outside the well by unauthorized persons	a) Fit imperforate wall enclosure, or b) Fit protection around landing door locking device

Table 3: Examples of items to be checked and protective measures for lift doors – source EN 81-80

4 APPROACH TO COMPONENT MODERNIZATION

Even if each existing lift has its own specific characteristics (to be assessed individually) and each EU country has applied the EN 81-80 to a different extent, all the information included in the SNEL provides a precise, common framework that can guide companies and workers during modernization and refurbishment projects.

The starting point for any lift refurbishment project should always be the auditing of the existing lift on the jobsite by a qualified, competent technical expert, who should gather all the relevant information related to the audited components.

There are three main ways to approach the upgrading of a component in an existing lift:

- Complete refurbishment. This includes the replacement of the entire component and gives the advantage of upgrading it to a state-of-the-art model in terms of safety, reliability and performance. It has a higher cost compared to the other approaches.

- Partial refurbishment. This includes the replacement of only specific parts of a component in order to guarantee its compliance to specific requirements of the EN 81-80 standard. Usually partial refurbishment requires additional effort in product engineering and in the adaptation of the existing parts to the new ones.

- Refurbishment kit. As partial refurbishment it includes the replacement of specific parts alone, but in addition it can only be used for specific product lines of specific manufacturers. Costs are lower than for complete refurbishment and product engineering efforts are lower than for partial refurbishment.

The selection between the three types of approach is always guided by safety first but as soon as the compliance to EN 81-80 standard is satisfied, the main variables to be considered are costs and shaft configuration and accessibility.

5 APPROACH TO LIFT DOOR MODERNIZATION

Lift door modernization projects are even more critical because both the dynamic and static elements of the doors have to be analyzed, including installation characteristics, component integration (car-car door-landing door-shaft), shaft dimensions, finishes and materials.

Door manufacturers have developed specific refurbishment services that always start from the collection of data through to dedicated forms to fill in (see Fig.3). Dimensions, type of panels, position of door fixings, and skate and rollers are some of the key information to be collected.

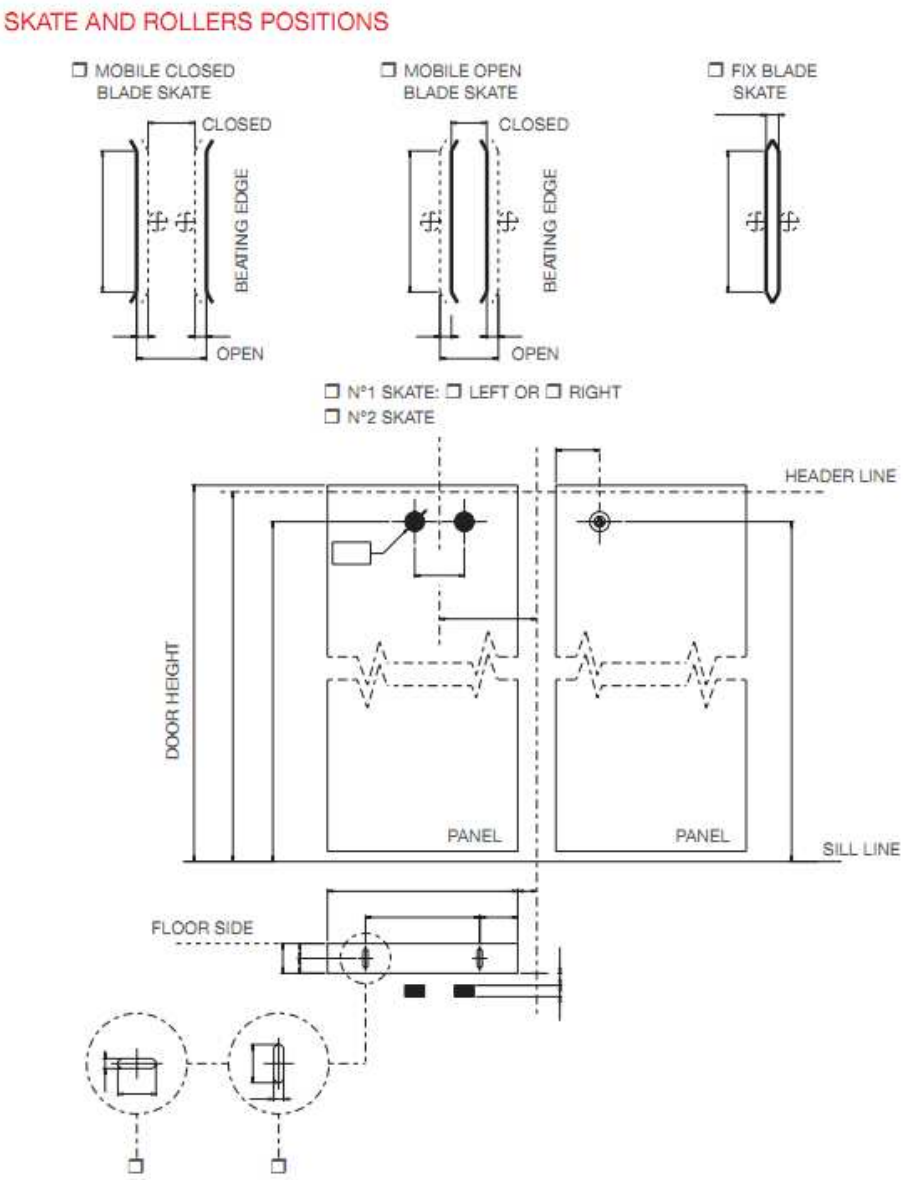


Figure 3: Lift door assessment – skate and roller positions – source Sematic

Seeing as every lift differs from one another, the collection of data (including jobsite pictures – see Fig.4) is needed in order to design a specific solution for each single refurbishment project. Taking into consideration the EN 81-80 prescriptions and the results of the assessment, door manufacturers are able to offer a wide range of solutions for the complete replacement of old lift doors (both manual and automatic), as well as of some of their key components (fixings, skates, operators, protective devices). The products offered in the modernization business are suitable for an extensive range of existing installations and can be customized according to the different destination markets and their characteristics, such as shaft dimensions or local regulations.

Figure 4: Jobsite survey pictures – source Sematic

For partial refurbishment and refurbishment through specific kits, additional services are provided after data collection, jobsite surveys and analysis. The solutions that door manufacturers can offer in terms of customized products have always to be verified through specific product engineering activities, including conversion of collected data into one-of-a-kind drawings (see Fig.5).

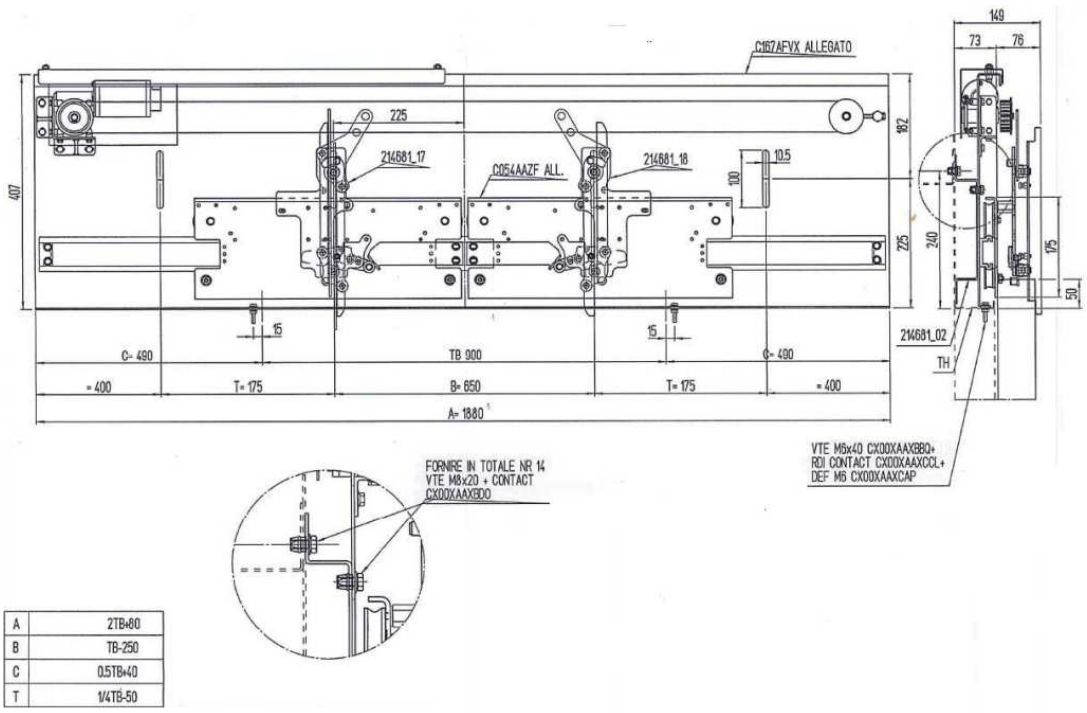


Figure 5: Product engineering – source Sematic

6 CONCLUSIONS

Lift doors are one of the most critical components for the safety and accessibility of any existing lift due to their complex integration with all the other lift components. Hazardous situations that, if not avoided, will result in death or serious injury are strictly linked with their malfunctioning or not updating to present-day standards. EN 81-80 offers all lift door manufacturers a well-defined path to follow during modernization projects, starting from lift assessment up to solution design and product definition. Safety and compliance to SNEL standards are always the guiding criteria of any lift door modernization and refurbishment project, even if technical and economic issues can direct the type of approach chosen.

REFERENCES

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BIOGRAPHICAL DETAILS

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Born in 1973, Giuseppe De Francesco holds a degree in Electronic Engineering from the Politecnico of Milan. Since 2002 he has worked in the Sematic Group, holding positions of increasing responsibility in the Engineering and R&D areas of the company. Nowadays he is responsible for all the product development activities of Sematic worldwide. Having a 13-year experience in the elevator industry, Mr. De Francesco has gained significant know-how and expertise in the development of innovative solutions for the design and manufacturing of automatic elevator doors, including glass and fire-resistant executions, in any application context: from high-rise to modernization.

Tommaso Sala

Born in 1979, Tommaso Sala holds a Master's degree in Public Relations and Communication from the IULM University of Milan. He has worked in the Sematic Group since 2009, holding positions of increasing responsibility in the Marketing and Communication areas of the company. Nowadays he is responsible for all the brand promotion activities of Sematic worldwide.