Machine Room-less Lifts

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ABSTRACT

In most European countries as well as outside Europe the importance of lifts without machine room is steadily increasing. Compared to hydraulic lifts an even higher market share has been achieved by this type of lift in some parts of Europe. Therefore the preparation of an amendment A2 of EN 81-1/2 was started to specify requirements for lifts without machine room. The report gives a general summary of the current status of the standardisation work in Europe and demonstrates on an existing system how the requirements can be met.

1. INTRODUCTION

Lifts without machine room are the greatest innovation the lift industry has been faced with in the past few decades. The Interlift fair in Augsburg in October 1999 was mainly dominated by components and overall systems of this lift type. The variety of technical solutions shows the wealth of ideas of the engineers of the lift industry but also the importance this lift is expected to gain in the future. The lift without machine room is offered by most lift companies nowadays at least as part of their standard lift range.

The increasing importance of these lifts was one of the major reasons for the responsible standardization committeess in Europe to deal with this technology. The European standardization organization CEN already started in 1997 a new standardization project for electric and hydraulic passenger and goods passenger lifts without machine room. The drafts of these amendments have been worked out meanwhile and submitted to public enquiry. The following article details the main contents of these draft standards and gives a general idea how these requirements can be met. A lift which is already available on the market serves as an example how these requirements can be realized in practice.

2. DRAFT STANDARD FOR LIFTS WITHOUT MACHINE ROOM

Mainly existing chapter 6 of EN 81-1/2 covering the requirements for machine and pulley rooms is reviewed in draft standards prEN 81-1/A2 and prEN 81-2/A2 for lifts without machine room. The heading of this chapter is renamed in „machinery and pulley spaces". The pulley spaces will not be dealt with below since the relevant chapters for pulleys were only subject to editoral changes. The definitions „machinery" and „machinery spaces", which have not been used in EN 81-1/2 had to be re-defined.

Machinery: equipment traditionally placed in the machine room: cabinet(s) for control and drive system, lift machine, main switches and means for emergency operations

Machinery space: space(s) inside or outside of the well where the machinery as a whole or in parts is placed

Chapter 6 of the draft standard is subdivided into 3 possible spaces for arranging the machinery: machine room, machinery inside the well and machinery outside the well. For arrangements of the lift machine and the control inside or outside the well the spaces illustrated in ***Figure 1*** and ***Figure 2*** are considered.

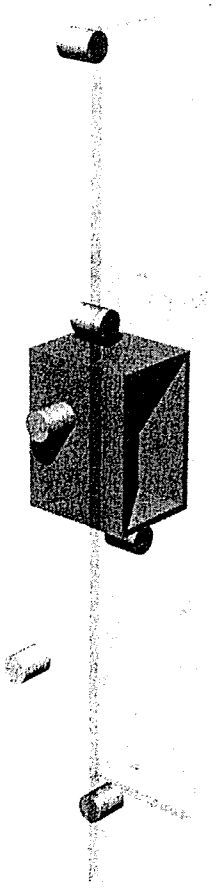

Figure 1: Possible arrangements of the lift machine

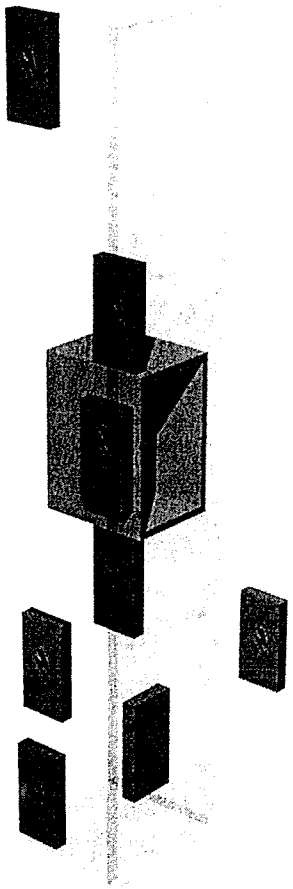

Figure 2: Possible arrangements of the control

All machinery spaces are subject to the same basic requirements regarding accessibility, lighting, ventilation, protection against environmental influences and strength which apply to machine rooms. Note that in particular the requirement of access to machinery spaces, which shall be easy to use in complete safety in all circumstances causes problems regarding arrangement of machinery in the well. If, for example, the machinery is placed in the pit and access is possible by bottom-most landing door this access can be blocked by the car. To ensure easy access in complete safety equipment shall be provided for moving the car away from this landing even in the case of power failure or breakdown.

For safety requirements in connection with machinery spaces the arrangement of the working areas from which the necessary maintenance and inspection work on different parts of the

machinery are carried out is of particular importance. ***Figure 3*** illustrates the possible ways of arranging the working areas which have been dealt with in this draft standards.

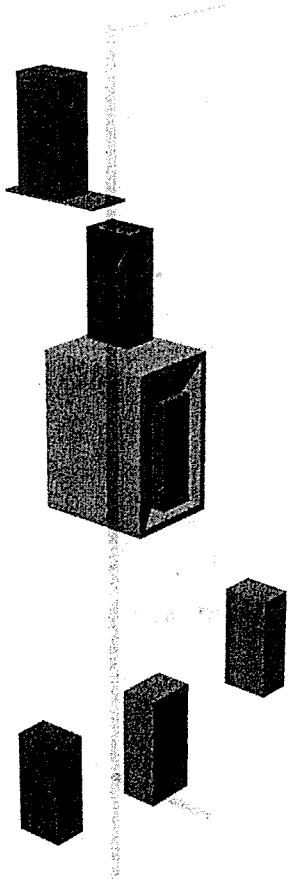

Figure 3: Possible arrangements of working areas

All working areas are subjected to the same requirements on dimensions as for working areas in the machine room:

- clear height of 2 m
- clear horizontal area of 0.50 m x 0.60 m, in front of control panels depth of 0.70 m

Machinery inside the well

For machinery inside the well requirements for working areas in the car, on the car rooof, on a platform inside the well, in the pit and outside the well are defined. If the working areas are inside the well any necessary devices for emergency operation and for dynamic tests (such as brake tests, traction tests, safety gear tests, buffer tests or tests of ascending car overspeed protection means) shall be generally arranged in such a way that they can be operated from outside the well. The most important requirements for the different arrangements of the working areas are specified below.

Working areas in the car or on the car roof

Any uncontrolled and unexpected car movement resulting from maintenance or inspection in the car or on the car roof that can be dangerous to persons carrying out maintenance or inspection work shall be prevented by a mechanical device. When the device is in the active position, monitoring by means of an electric safety device which prevents any car movements is necessary. When the car is blocked by this device it shall be possible to leave the working area easily and safely.

This requirement for leaving the working area cannot be fulfiled without additional means if the machinery is arranged in the headroom, work is carried out on the car roof and the car is blocked by means of the mechanical device. Leaving the car roof in this position through the top-most landing door is no longer possible with normal headroom heights. In this case additional means, e.g. trap door in car roof and ladder which is accessible from the car roof is necessary for leaving the working area easily and safely.

Working areas in the pit

If the maintenance or inspection work in the pit requires movement of the car, or is likely to result in uncontrolled and unexpected car movement a mechanical device shall be provided which stops the car in a position in which a free distance of at least 2 m between the floor of the working area and the lowest parts of the car is available. The mechanical stop shall be buffered. It can be operated manually or automatically.

The electrical system has to be realized in a way that the opening of any door providing access to the pit shall neutralize all electrical controls. The mechanical device has to be monitored in its active and inactice position. If the device is in its active position the lift can be moved by means of the inspection control on the car and, if available, by means of an additional inspection control in the pit. Return of the lift to normal service shall only be made by operation of a reset device placed outside of the well and inaccessible to unauthorized persons.

If the car being in its bottom-most position hits the mechanical device it shall be possible to leave the pit easily and safely. The minimum distance between car toeguard and sill of bottom-most landing door necessary for leaving the pit should be specified more in detail in this requirement.

Working areas on a platform

The working area can be realized on a platform which is either permanently installed or retractable if it is in the travel path of the car or the counterweight. If the maintenance platform is located in the travel path of the car or counterweight maintenance or inspection work shall only be carried out if the car is either stopped by a mechanical device or the travel path of the car is limited by movable stops. Movable stops shall retard the car either above the platform leaving a clear height of 2 m or below the platform before the car comes in contact with the platform.

The platform shall be able to support at any position the mass of two persons and additional heavy equipment, if necessary. It shall be provided with a balustrade which complies with the requirements for the balustrade on the car roof. If the platform is retractable it shall be

provided with a manually or electrically operated device for putting into or removing from the working position from outside the well. An electric safety device shall be provided for checking the retracted position of the platform. It shall also be possible to leave the working area on the platform easily and safely.

The movable stops shall be provided with buffers and their final positions shall be checked by an electric safety device. If the platform is retracted car movements shall only be possible if the movable stops are in the active position. The movable stops shall only be operable from outside the well or from the platform. If the stops are in the active position an additional final limit switch shall operate before the car or counterweight comes into contact with the movable stops.

Working areas outside the well

Maintenance and inspection can also be carried out from outside the well through a door/ trap. When the door/trap is open, protection means shall be provided to prevent the access of unauthorized persons into dangerous areas. Passage ways shall not be obstructed by these protection means. The doors or traps shall have sufficient dimensions to carry out the required work. On the other hand they shall be as small as possible to avoid falling into the well.

Machinery outside the well

If the machinery is placed outside the well the equipment shall be located inside a cabinet, which consists of imperforate walls, floor, roof and door and is also suitably ventilated and properly lit (including the working area) if the door is open. Protection means shall be provided, as described above, for protecting the working areas which are always placed outside the well for this type of arrangement.

Devices for emergency and tests

If the working areas are inside the well the necessary devices for emergency and tests shall be in a panel suitable for carrying out from outside of the well all emergency operations and any necessary dynamic tests of the lift. These devices shall be inaccessible to unauthorised persons. The panel shall include all emergency operation devices which are also required in a machine room and an intercom system to the car, if required. Furthermore the panel shall have equipment which enables dynamic tests to be carried out.

The panel shall be provided with an opening for direct observation of the lift machine or it shall be provided with display devices which inform about the direction of movement, the reaching of an unlocking zone and the speed of the lift. Furthermore the panel shall be provided with a lighting as well as a main switch provided that the control is inside the well and not accessible from outside. The requirements for the dimensions of working areas have also to be complied with in front of the panel.

Apart from the modifications in chapter 6 additional midifications of chapters 12 to 16 as well as annexes A, C, D and ZA were necessary. However, these modifications were only subject to editorial changes. Only the main switch had to be technically modified. For lifts without machine room the main switch shall be located in the cabinet for control or at the emergency and test panel, when the cabinet for control is mounted in the well. If the main switch is not

easily accessible from the cabinet for control, then the cabinet shall be provided with an isolating switch.

The mentioned requirements both apply to electric and hydraulic lifts. Realization of these requirements raises some questions to be answered in the course of the future development of this amendments. The draft standards prEN 81-1/A2 and prEN 81-2/A2 shall be submitted to public enquiry approximately in the middle of 2000. Provided that further proceeding goes off smoothly formal vote can be expected by end of 2001 and publication by end of 2002.

3. EXAMPLE OF A LIFT WITHOUT MACHINE ROOM

The lift without machine room described below is instrumental in illustrating how the requirements described in the section above can be fulfilled. This lift has been offered for sale under the brand name „EVOLUTION" by Thyssen Aufzüge since early 1998. The lift complies with the European Lift Directive. EVOLUTION was one of the first type tested lifts which was certified in accordance with this directive. EVOLUTION was also exhibited at Interlift '99.

The machinery of the Evolution is completely located inside the well. The lift machine is arranged in a machine base frame directly below the well ceiling (***Figure 4***). The lift machine, consisting of a gearless synchronous motor with traction sheave and disc brake, is almost maintenance-free. The necessary visual checks can be carried out from the working area on the car roof. Since these work cannot cause uncontrolled movements of the car a mechanical device for stopping the lift is not necessary.

The control is mounted on the side wall of the well in the area of the top-most landing directly adjacent to the landing door. The front of the control cabinet has a covering with a flexible hinge at the bottom side, which can be folded down and used as working platform (***Figure 5***). Easy and safe access to the platform from the open top-most landing door is possible as soon as the platform has been folded down from outside the well. The landing door can also be used for leaving the working area at any time.

All maintenance work on the control can be carried out from the working platform and the machine can be observed at a short distance. Since observation of the lift in operation is very helpful, in particular for trouble-shooting purposes, the travel path of the counterweight is limited by a movable stop (***Figure 6***), so that the car running in up direction cannot collide with the working platform. This means that normal lift operation is possible for all landings except the topmost landing.

The movable stop is lowered together with the working platform. The working platform and the movable stop are creating a temporary machine room within the well which complies with almost all requirements for normal machine rooms. When the maintenance people carry out maintenance work they stay in a closed space which is inaccessible to unauthorized persons. As a consequence additional safety measures are not necessary.

In addition to the machinery in the well there is a panel with the necessary euqipment for emergency operations and dynamic tests (***Figure 7***) beside the topmost landing door. This panel consists of the brake release lever, the main switch, the switch for well lighting, the switch and buttons for emergency electrical operation, the key –operated switch for moving the platform and the movable stop, the emergency lighting as well as additional elements. The

panel is provided with a door which can only be opened with a special key by authorized persons.

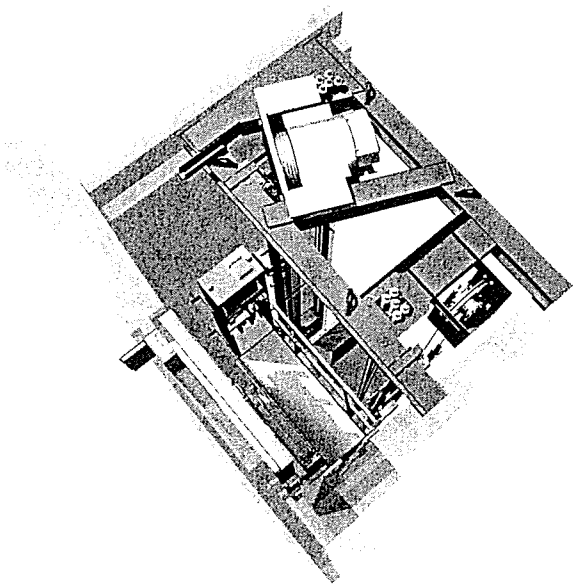

Figure 4: Arrangement of lift machine in headroom

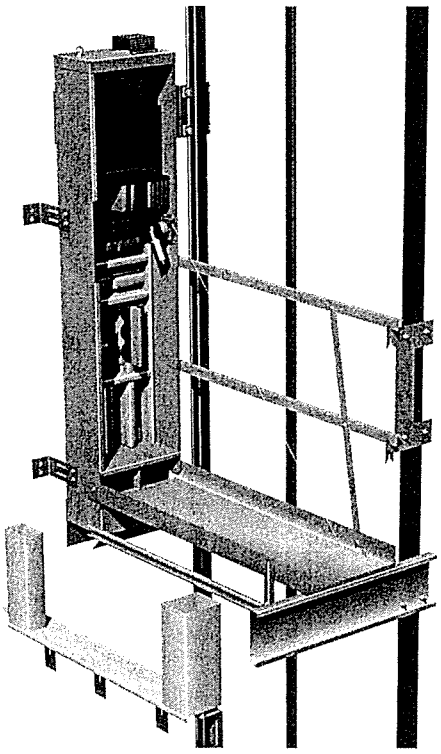

Figure 5: Arrangement of control and platform in well

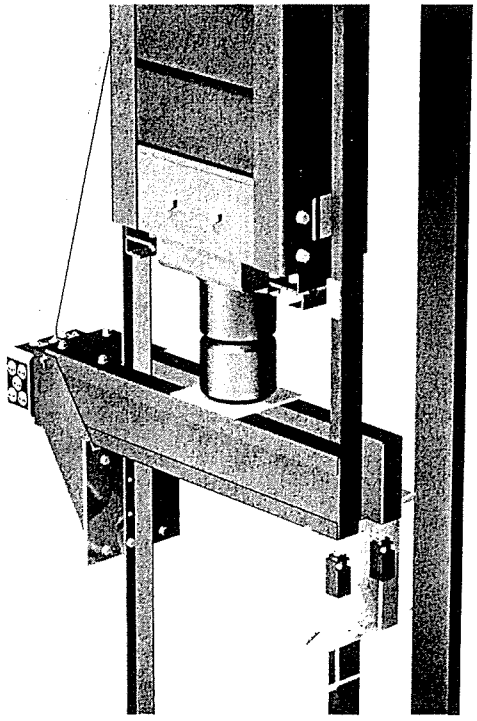

Figure 6: Movable stop below counterweight

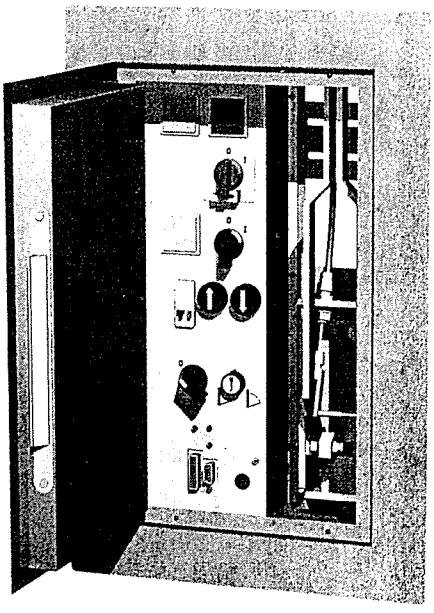

Figure 7: Panel for emergency and test devices

4. CONCLUSIONS

The lift companies realized that lifts without machine room do not only have structural advantages for the building but also offer state-of-the-art safety and comfort. Nowadays almost any lift company can offer a lift without machine room. In the future this lift type will dominate the market and dramatically reduce the currently strong market share of hydraulic lifts.

Since this lift type is not covered by the current lift standards time-consuming and expensive approval procedures are necessary for proving that the safety level is equivalent. This is why use of this technology is mainly restricted to standard lifts currently. Consequently the amendments for lifts without machine room are urgently needed to extend use of this innovation to a wider range of lifts.

5. BIOGRAPHICAL DETAILS

Dr. Gerhard Schiffner studied mechanical engineering at Stuttgart University and passed his masters degree in 1981. Dr. Schiffner then worked as research assistant at the Institute of Mechanical Handling Technology and received his doctorate in the field of wire rope research from Stuttgart University. He joined Thyssen Aufzüge group in 1986 and was responsible for various tasks in the R&D and Product Coordination departments. Currently Dr. Schiffner is responsible for Codes & Standards. He is a member of several ISO and CEN code committees.