



'Spirit' of Persistent Pursuit to Technology

Explanations on the design datum of SMEC passenger elevators



上海三菱电梯有限公司
SHANGHAI MITSUBISHI ELEVATOR CO., LTD.

01
PART

More Reliable



More Durable

02
PART

03
PART

More Comfortable



More Environment-friendly

04
PART

Design Datum of Traction Brake

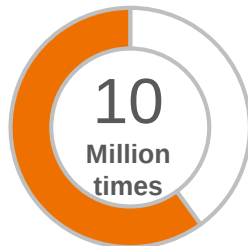
More Reliable

PART 01

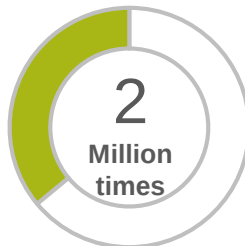
static test in testing condition



SMEC



Professional
brake
manufacturer



EN standard
requirements



Setting of traction brake static
test

$$\frac{15,000,000 \text{ times}}{365 \text{ days} * 24 \text{ hours} * 100 \text{ times/hour}} = 17 \text{ years}$$

This data is higher than data from all the existing elevators
(according to statistics from remote monitor system)

In the same measurement datum and working condition, calculated in light of 2,000,000 times required by EN standard, it needs to replace brake after 2 years (which means start once in less than 40 seconds, full load operation everyday in a full year)

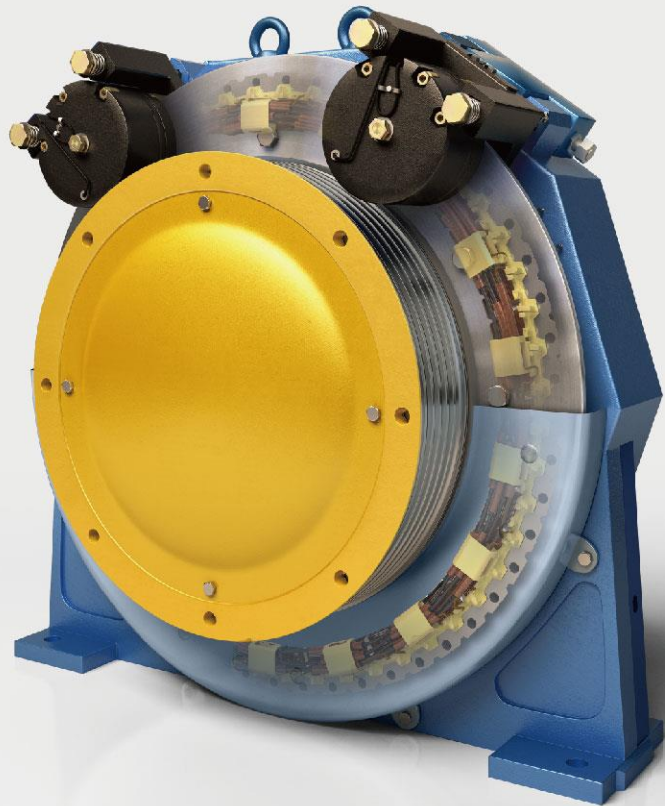
Design Datum of Traction Brake

More Reliable

PART 01

Benefits of this datum to passengers and owners

- ✓ Safety : Ensure the brake with tiny **little rate to have invalidation in long-term high duty operation**, and is unlikely to have car unexpected movement and overtravel;
 - ✓ Low cost : Decline client maintenance cost, **it is seldom to replace traction machine brake during the full lifetime in normal cases.**
- LEHY-H、LEHY-M-II and LEHY-III elevators use “Mute Brake Control Technology”, which can precisely control the brake action speed and torque in elevator deceleration process and speed is nearly “Zero”. Therefore riding comfort is improved with “Tranquiller and More Stable” feelings;



Allowed Voltage Fluctuation is **-15%~+10%**

(EN standard is $\pm 7\%$)

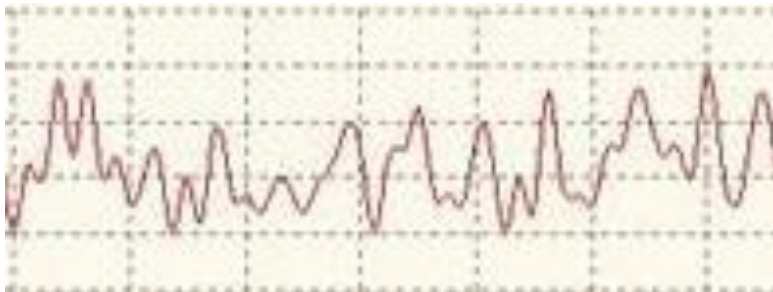
More Reliable | **PART 01**

Explanations on working condition corresponding to design datum

- ✓ Eg : Standard voltage requirements is three-phase AC 380V. And the elevator can run within the voltage scope **353.4V~406.6V** according to EN standard.
- ✓ And elevator form SMEC can run within voltage scope **323V~418V**
- ✓ It enhances countermeasure ability of elevator against extreme voltage fluctuation.



Eg : In rural area with unstable grid voltage, our elevators can still work normally.



Situations to have possible large voltage fluctuation

A. elevator adjustment powered by temporary power source on the site

B. Occasionally use elevator to deliver personnel and decorative material (with attendant), in case with temporary power on the site.

——although these kinds of method violates some laws and regulations, it does exist practically in some working site ;

C. Daily use in some areas with unstable grid voltage

- In case of temporary power on site, the voltage fluctuation is considerably large. It may have shutdown、 auto stop、 people entrapment or even damaging PCB during elevator adjustment or occasional use.
- In areas with unstable grid voltage, elevators will have frequent self-protective shutdown、 personnel entrapment and elevator faults due to voltage fluctuation.

Usage of Elevator EMC Performance

a) Immunity of EMC

- ✓ Elevator control system may be “disturbed” due to external electromagnetic interference during its operation.
- ✓ Typical interference source : speaker of large capacity, drone, mobile phone base station, high-speed railway, elevated power line, substation, thunder and etc..

In modern society, the interference from wireless network is greatly increased.
——EMC immunity performance is more and more important.

b) Emission of EMC Performance

- ✓ Elevator will also emit EMI signal, influencing normal operation of other equipment.



Elevator run in error, restart and re-level, or even elevator shutdown



Certificate of EMC Laboratory
The only qualified laboratory with complete qualification by German TUV Group in elevator industry.



Benefits of this datum to passengers and owners

- a. Immunity of EMC : Greatly decrease possibility of malfunction or shutdown due to other electromagnetic interference, ensuring elevator safe and stable operation;

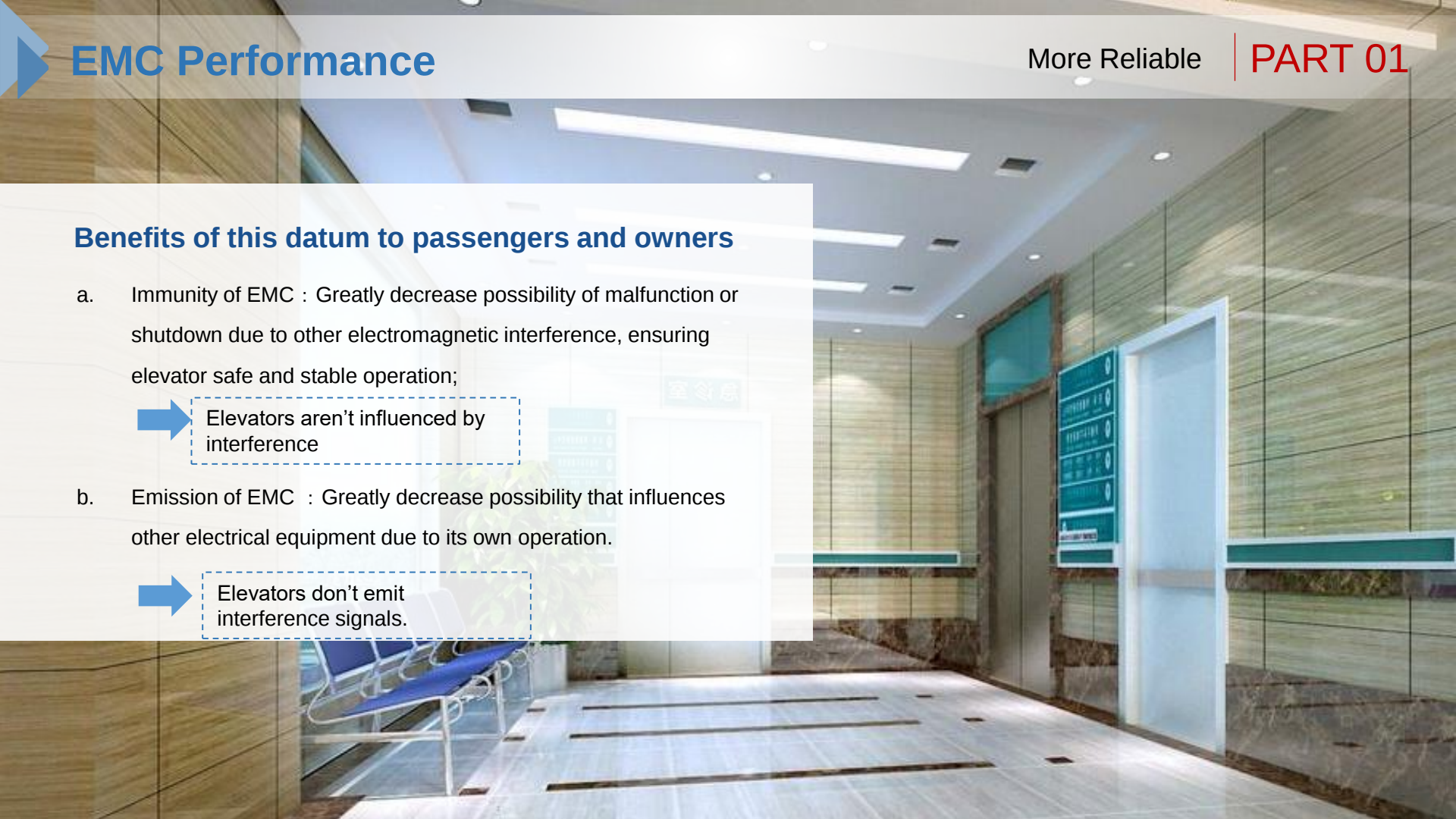


Elevators aren't influenced by interference

- b. Emission of EMC : Greatly decrease possibility that influences other electrical equipment due to its own operation.



Elevators don't emit interference signals.



Explanations on working condition corresponding to design datum

- ✓ Traction machine tolerance high volt will be $\pm 1500V$ (Frequency: $20kHz$ 、pulse rise time $100ns$) 12 hours
- ✓ Partial discharge (CSV) initial voltage is over $1050V$

Usage of traction machine insulation

- ✓ Traction machine is the "Heart "of an elevator, it is the elevator part to have careful protection.
- ✓ Without proper protection, occasional voltage impulse in ultra-high frequency will influence machine performance, or even directly damages traction machine, influencing use lifetime of the machine.

Benefits of this datum to passengers and owners

- ✓ Protect the machine withstanding voltage impulse in ultra-high frequency, and unlike to have damage.



The damage to traction machine will directly influence elevator safe operation, or even unable to use the elevator. Its resulting maintenance cost and elevator stop cost is really large.

- ✓ In extreme poor work condition (in design scope) , lifetime of traction machine will be unlikely reduced.



Testing Device of Partial Discharge

Explanations on working condition corresponding to design datum

- ✓ Even if luminous flux of LED only reaches 4% , it can still guarantee the normal use of photoelectric leveling switch.

Use of Photoelectric Leveling Switch

- ✓ Photoelectric leveling switch is installed at car top position. When the elevator runs to hall door, leveling switch approaches to shield board area, photoelectric switch can't receive infrared, the elevator will precisely stop at the entrance, ensuring the accuracy of leveling.



Photoelectric Leveling Switch

Benefits of this datum to passengers and owners

- ✓ For the hoistway in poor environment, the cleaning to photoelectric switch won't be done in normal maintenance. Instead, it will be done only in the intensive maintenance (normally with charge). (Intensive maintenance will be implemented only once a year at most even for the top real estate.)

—In these cases, In these cases, photoelectric leveling switch of SMEC can still work normally even luminous flux of LED only reaches 4%.



Ensure more precise leveling during elevator long-term operation, improve the feeling of elevator using.



dusty photoelectric leveling switch

Explanations on working condition corresponding to design datum

- ✓ PCB shall consecutively pass 10 severe environmental tests one by one as follows.

Test
Start

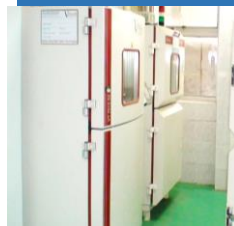
Temp. Variation
Test



Temp. & Hum.
Period Test



Constant Hum.
Test



Temp. Variation
Test (marginal.)



High Temp. &
Hum. Test
(marginal)



Test
End

Sand Test



Collision Test



Pulse Test



Vibration (Sinc)
Test



Temp. Variation
Test (limit)



Generally, one PCB is used only for one test in the industry. However, SMEC uses only one PCB to finish all of the test consecutively, and PCB shall function well during and after the entire test.

Use of PCB Test

- ✓ Case 1 : Applied cases for high temperature, humidity and dust test
- ✓ Case 2 : Applied cases for collision test



Picture of a random machine room

Benefits of this datum to passengers and owners

- ✓ Robust elevator “Brain” helps elevator to work stably in various kinds of severe conditions, improves the reliability of elevator.
- ✓ In high temp, high humidity or dusty conditions, significantly reduce probability of elevator fault, improve efficiency of later maintenance.



Bumpy Transportation

01

PART

More Reliable



More Durable

02

PART

03

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More Comfortable



More Environment-friendly

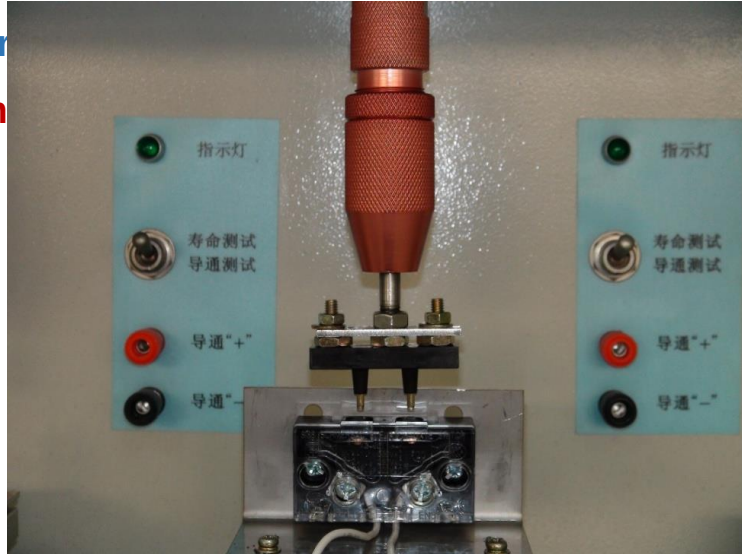
04

PART

- 1) Car door system runs normally for **13.5 millions of times**

- 2) Car door switch runs

nor
tim



car door switch lifetime
testing machine

Use of car door switch

After car door is closed, car door switch will detect position of car door. After car door is confirmed to be completely closed, send signal to main PCB board, which means "Door is completely closed, elevator is ready to run"



Door machine system
testing structure

Door System

Explanations on working condition corresponding to design datum

- ✓ Calculated on the basis of average door open & close 100 times/hour, designed lifetimes of car door system、car door switch are 15 years in idealistic cases.



Because : elevator starts or brakes once=car door opens and closes once

Therefore : The design datum of SMEC car door system、car door switch reliability is set in the same level as brakes!

Benefits of this datum to passengers and owners

- ✓ Durable door system ensures long-term stable operation, ensures the safety of elevator passengers, saves later elevator maintenance cost.

More Durable

PART 02



Door System

More Durable | **PART 02**

Hall door lock device acts normally for **3 millions of times**——in the situation with more than 7 times of rated current

Explanations on working condition corresponding to design datum

- ✓ Average probability of one single hall door switch is about “1/elevator floor numbers”. Nowadays, average number of elevator floors is way beyond 10. However, SMEC still set the hall door datum according to car door testing standard “1/5”. Therefore, hall door lock device can be used normally for 15 years upon the calculation 20 times/hour.

Testing standard for 1/5 is even stricter than the condition 100 times/hour for car doors.

Any error to one single hall door lock will disable the elevator.



Hall door lock device

Use of hall door lock device

- ✓ Hall door lock is one special door lock of mechanical linkage lock combined with electrical linkage contacts.
- ✓ When all of the mechanical locks of hall door lock are locked, electric contacts can be conductive , after that elevator can run;

Benefits of this datum to passengers and owner

- ✓ High reliability of elevator hall door lock ensures elevator won't be disabled or trap passengers.
- ✓ Long lifetime of hall door will reduce elevator maintenance cost.

Elevator Button (Operation Panel and Hall Button)

More Durable

PART 02

Explanations on working condition corresponding to design datum

- ✓ Tested on the basis of **25N** impacting force, it is able to use normally for **5 millions of times**, can be used for 20 years according to 685 presses/day.

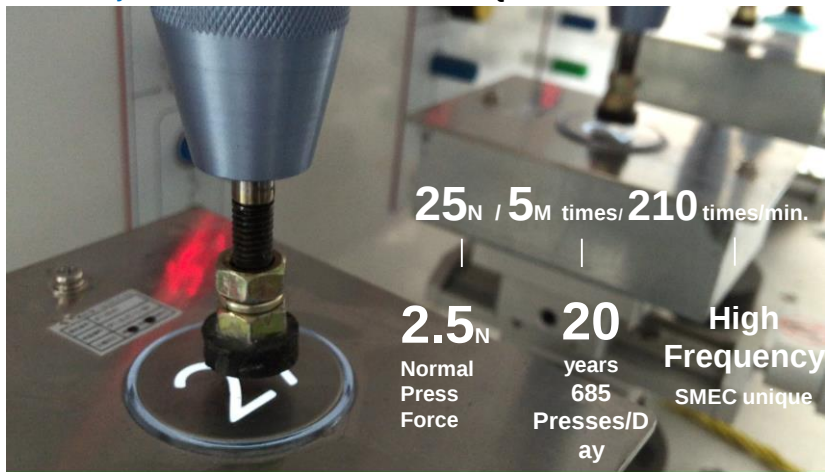
Normal press force is 2.5N, testing force is 10 times of it.

- ✓ Button can still be used after experiencing collision that

1kg iron ball falls from 0.5m height for triple times.

Durability Test

In accord with 《QSM-7.15-2014 Button Test Rules》

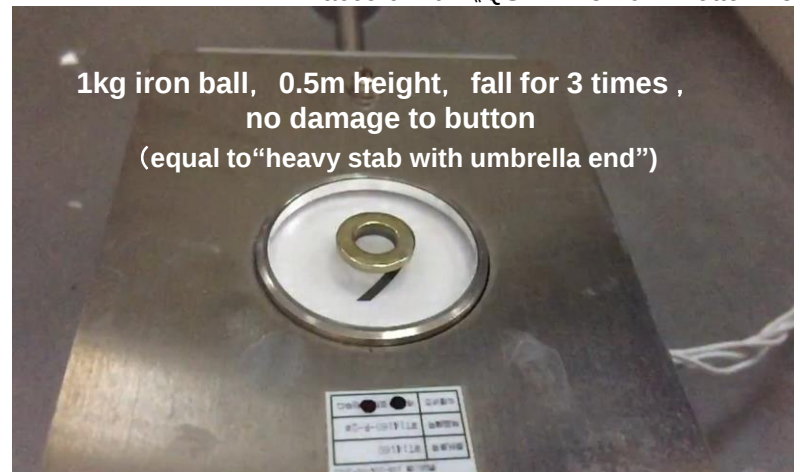


Use of button reliability

- ✓ Button is almost the only human-machine interface in elevator. The quality of the button will directly influence passenger's feelings.
- ✓ The damage to any button of the floors will influence the normal use of elevator by passengers and owners in related floor.

Shock-resistant test

In accord with 《QSM-7.15-2014 Button Test Rules》



Benefits of this datum to passengers and owners

- ✓ Basically button won't be stuck——button circle is fixed to faceplate, button cap moves;
- ✓ Reliability and durability of elevator button is strengthened ——it will have better resistant to brutal use such as “heavy stab with umbrella end” 、 “knock with handholding object when two hands are occupied by some objects; (especially heavy ones)
- ✓ Product quality with long lifetime ensures buttons are more robust and durable in the entire lifetime of elevator, and less damage probability reduces later operation cost!

Button circle fixed to faceplate

Button cap moves



metal cap
hooks plastic
base

character

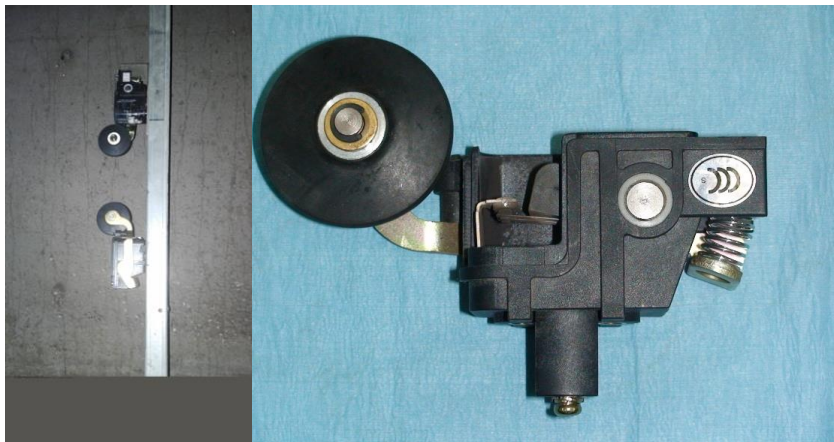
Stainless steel

Character
resin covers
stainless
steel

**Character
never falls
off**

Explanations on working condition corresponding to design datum Use of hoistway limit switch

- ✓ Estimated according to this standard, even if hoistway limit switch works 100 times/hour in average, it can be used normally for 17 years idealistically.



Hoistway limit switch

- ✓ Hoistway limit switches are mounted at both top and bottom ends. When car runs to top floor or bottom floor, it will trigger the switch to demand the elevator decelerate to stop.
- ✓ If hoistway limit switch fails, it would cause elevator runs to hoistway top&bottom ends without normal deceleration, and in extreme situations, over-travel hazard will occur.

Benefits of this datum to passengers and owners

- ✓ Ensure safety functionality of respective elevator parts can still be guaranteed after long-term operation. Ensure the elevator safe and reliable.
- ✓ Reduce later maintenance cost in the entire designed lifetime.

Hall Door Panel Reliability Test

More Durable

PART 02

Explanations on working condition corresponding to design datum

- Hall door panel、jamb made of stainless steel (stainless steel with different code used by SMEC)、painted or powder coating panels shall have no erosion for at least 240 hours in neutral salt spray test.
- 24 hours in neutral salt spray test equals to the erosion condition in natural condition for 1 year; 240 hours salt spray test by SMEC ensures all metal sheets of SMEC (including: car、car door、hall door、jamb、operation panel、hall call display faceplate and etc..) give a warrant in material aspect “No erosion in 10 years”



Salt spray testing box

Result of Neutral Salt Spray Test (Regular Door Panel)

Erosion



Hall Door Panel Reliability Test

More Durable

PART 02

Benefits of this datum to passengers and owners

- ✓ Ambient salt-spray concentration in sea view room、island tourist area is greatly larger than common area in the interior land. In these cases, "Strict Salt-Spray Test" is critical to elevators in these projects.
- ✓ Many "cost-efficient" new materials from many other companies can't meet the requirements that no erosion occurs in 10 years.



01

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More Comfortable



More Environment-friendly

04

PART

Max. door open & close noise **no more than 59dB (A)** More Comfortable | **PART 03**

(EN standard requires no more than 65dB (A))

Calculation formula of noise: $L_{dB} = 10 \lg \frac{P}{P_0}$

【Noise calculation : the logarithm to base 10, the decrease of one decibel equals to “Intensity P” of noise declines by 10 times.



In theory, the decrease of 6 dB of noise equals to the noise power declines by 6 orders of magnitude, gives passengers significantly different feelings.

Noise Magnitude:

40 — 60 dB : Normal、normal indoor conversation

60 — 70 dB : Loud、harmful to nerve



Max. door open & close noise **no more than 59dB (A)** More Comfortable | **PART 03**

Benefits of this datum to passengers and owners

- ✓ SMEC utilizes **VVVF speed-regulation technology**, combined with double closed-loop feedback control of speed and current, ensures elevator door open and close smoothly and peacefully.
- ✓ Besides noise of door open and close, when elevator comes to the top floor, **traction machine brake is also the main generator of the noise**—almost can't hear noise from the brake when you take SMEC elevator and door opens at the top floor.

Episode

“Mute Brake” (“Current Brake Control Technology”) of Mitsubishi will effectively control the action speed and torque of brake in all phases, improve the riding comfort as well as restrain traction machine brake sound to the minimum.



Start Comfort Index、Operation Comfort Index

More Comfortable

PART 03

(Acceleration jerk etc...)

Explanations on working condition corresponding to design datum

- ✓ Measured according to GB/T 24474-2009, the jerk during elevator operation shall be no more than 2.0m/s^3 ;
- ✓ Impulse and vibration shall be measured according to GB/T 24474-2009, the data of which is considerably small.

Use of start comfort index、operation comfort index

- ✓ Jerk and related comfort index do have practical influence on people's riding comfort——similar with lateral acceleration speed to car、train ;
- ✓ There is no definite assignment for related index in national standard, and they are the index of minority, most of the companies don't care about them. The ultimate pursuit to the product quality brings SMEC take these index into consideration, and take them into elevator design datum.

Benefits of this datum to passengers and owners

- ✓ What we see is the phenomenon such as "standing coin in SMEC elevator"、"operation as stable as stop condition". Behind these phenomenon, it is the strict self-demand towards these minor index such as "jerk" and the persistent pursuit to techniques motivates SMEC. Perfect product reliability evaluation system truly guarantees the reliable and reassuring



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Explanations on working condition corresponding to design datum

- ✓ Conform to GB 18583-2008 《Indoor decoration and refurbishing materials——Limit of harmful substances of adhesives 》
- ✓ Conform to GB 24409—2009 《Limit of harmful substances of automobile coatings》

Although unlike furniture and wall, elevator does use little adhesives and paint material, and the car room is considerably small.

SMEC , in the spirit of caring passengers and persistent pursuit to techniques, uses stricter limitation standard for harmful substances in indoor decoration and automobile industry.



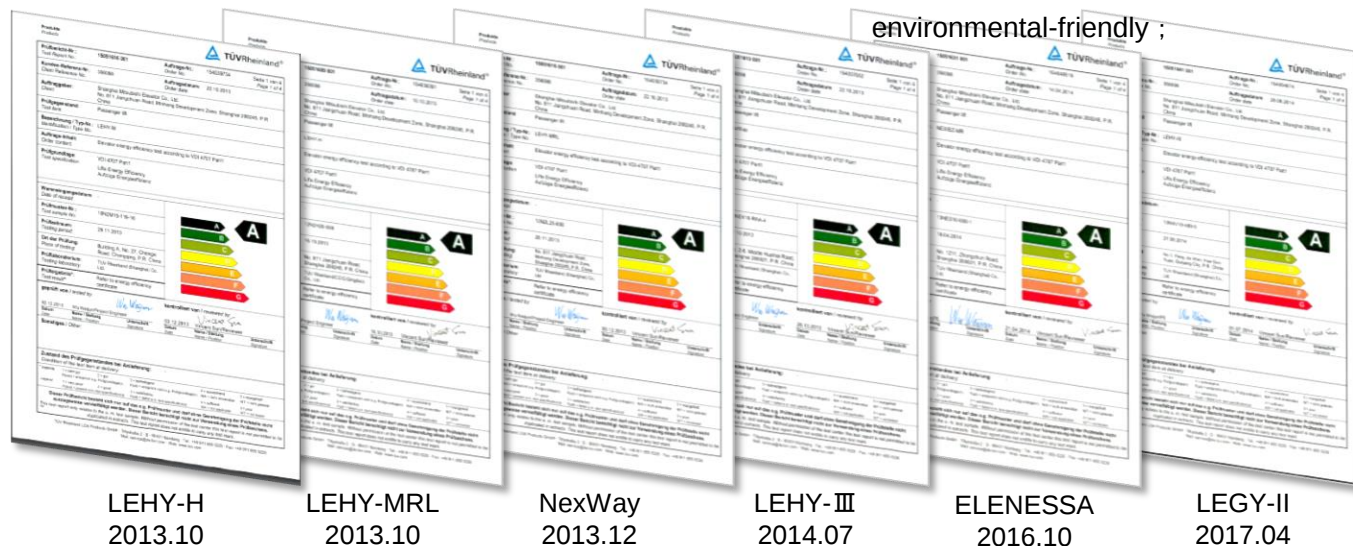
Benefits of this datum to passengers and owners

- ✓ Eradicate the harm to passengers from substances in car, like formaldehyde
- ✓ Decrease the pollution of harmful substances from the root.

Explanations on working condition corresponding to design datum Benefits of this datum to passengers and owners

- ✓ All of the main products on sale, including the low-end product, pass VDI4704 certificate of elevator energy efficiency, graded as A Class.

- ✓ For reducing client's cost during full lifetime of elevator, decrease daily elevator consumption cost in the building.
- ✓ Greatly reduce electricity consumption, which is more environmental-friendly ;





Although the price of SMEC is a little higher than elevators of other brand, our products have good quality、 low fault rate、 durable use, give passenger better riding feelings, lower cost for real estate, and higher transportation rate!

Compared to other elevators, we are confident and also capable of achieving our target and benchmark, which is“ lower comprehensive cost is elevator full lifetime, higher use value, and gaining more admiration for building developer and the brand, and being more perfect solution provider for vertical transportation in the building”

Shanghai Mitsubishi Elevator (SMEC)

With better product、 more perfect service,

In the spirit of customer-orientation, create greater value
for our customer, truly bring our passenger comfortable
and satisfied feelings that “**Joys in Up and Down Travel**”

