BS EN ISO 25745-3:2015

BSI Standards Publication

Energy performance of lifts, escalators and moving walks

Part 3: Energy calculation and classification of escalators and moving walks

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National foreword

This British Standard is the UK implementation of EN ISO 25745-3:2015.

The UK participation in its preparation was entrusted to Technical Committee MHE/4, Lifts, hoists and escalators.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Foreword

This document (EN ISO 25745-3:2015) has been prepared by Technical Committee ISO/TC 178 "Lifts, escalators and moving walks" in collaboration with Technical Committee CEN/TC 10 "Lifts, escalators and moving walks" the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2015, and conflicting national standards shall be withdrawn at the latest by October 2015.

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Endorsement notice

The text of ISO 25745-3:2015 has been approved by CEN as EN ISO 25745-3:2015 without any modification.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 178, *Lifts, escalators and moving walks*.

ISO 25745 consists of the following parts, under the general title *Energy performance of lifts, escalators and moving walks:*

— *Part 1: Energy measurement and verification*

— *Part 2: Energy calculation and classification for lifts (elevators)*

— *Part 3: Energy calculation and classification for escalators and moving walks*

Introduction

This International Standard has been prepared in response to the rapidly increasing need to ensure and to support the efficient and effective use of energy. This International Standard provides

a) a method to estimate energy consumption of escalators and moving walks on a daily and an annual basis for escalators and moving walks,

b) a method for energy classification of new, existing, or modernized escalators and moving walks,

c) guidelines for reducing energy consumption that can be used to support building and environmental and energy classification systems.

This International Standard is intended to be a reference for the following parties:

— building developers/owners to evaluate the energy consumption of escalators and moving walks;

— building owners and service companies when modernising installations including reduction of energy consumption;

— the installers and maintenance providers of escalators and moving walks;

— consultants and architects involved in specification of escalators and moving walks;

— inspecting authorities and other third parties providing energy classification services.

The total energy consumption over the entire life cycle of escalators and moving walks consists of the energy to manufacture, install, operate, and dispose of the lifts. However, for the purpose of this International Standard, only operating energy (running and standby) performance is considered.

In the preparation of this International Standard, Technical Committee ISO/TC 178/ WG 10 has initiated extensive research, which included the measuring and modelling of over 300 typical escalator and moving walk installations. The results of this research have been used to provide the numerical values shown in Table 3 and Table A.3.

This International Standard is suitable for national/regional jurisdictional energy performance purposes.

Energy performance of lifts, escalators and moving walks —

Part 3: Energy calculation and classification of escalators and moving walks

1 Scope

This part of ISO 25745 specifies

a) generic tools for estimating energy consumption of escalators and moving walks, and

b) a consistent method for energy performance classification of existing, modernized, or new escalators and moving walks.

This part of ISO 25745 considers the energy performance during the operational portion of the life cycle of escalators and moving walks. It does not cover energy consumption and classification of the ancillary equipment, such as the following:

a) lighting with the exception of comb plate lighting, step gap lighting, and traffic light;

NOTE 1 Comb plate lighting, step gap lighting, and traffic light are considered essential for the operation of the equipment and are therefore not defined as ancillary equipment.

b) cooling and heating and machine room ventilation;

c) alarm devices and emergency battery supplies equipment, etc.;

d) environmental conditions;

e) consumption through the power sockets.

NOTE 2 There can be other electrical loads not associated with the escalator or moving walk, which shall not be included.

This part of ISO 25745 considers all escalators and inclined moving walks up to a rise of 8 m and horizontal moving walks with a length up to 60 m.

NOTE This represents about 85 % of worldwide installed units.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 25745-1, *Energy performance of lifts, escalators and moving walks — Part 1: Energy measurement and verification*

3 Terms, definitions and symbols

For the purposes of this document, the following terms, definitions and symbols (see Table 1) apply.

3.1 Terms and definitions

3.1.1
ancillary energy
energy used by the ancillary equipment

3.1.2
ancillary equipment
equipment such as lighting, fans, heating, alarm devices, emergency battery supplies, etc.

3.1.3
auto start condition
condition when escalator/moving walk is stationary and powered up and ready to start initiated by passenger detection

3.1.4
energy
power consumed over time

3.1.5
load condition
condition when escalator/moving walk is running with one or more passengers

3.1.6
no load condition
condition when escalator/moving walk is running at nominal speed without passengers

3.1.7
nominal speed of escalator/moving walk
speed in the direction of the moving steps, pallets, or the belt, when operating the equipment under no load condition (i.e. without persons), stated by the manufacturer as that for which the escalator or moving walk has been designed

3.1.8
power-off condition
power supply to the unit is turned off by the main switch, e.g. during the night

3.1.9
running-in period
required time to get mechanical components to best performance

3.1.10
slow speed condition
condition when escalator/moving walk is running at reduced speed without passengers

3.1.11
standby condition
condition when the escalator/moving walk is stationary and powered on and can be started by authorized personnel

3.2 Symbols (in alphabetical order)

Table 1 — Symbols and abbreviations

Symbol	Term	Definition	Unit	Assumptions
A		Length depending part of handrail drag force normalized to horizontal	N/m	
B		The constant part of handrail drag force normalized to horizontal	N	

Table 1 *(continued)*

Symbol	Term	Definition	Unit	Assumptions
C		Constant part of step band reversal drag force	kN	
CF	Correction factor	Correction factor for efficiency η applied to units in downward direction	-	Number of users/N day ≤ 10 000 or non-regenerative drive technology: CF = 0 N/day > 10 000: CF = 0,5
D		Pitch length of step or pallet	m	Default value = 0,405
$E_{ancillary}$	Energy	Total energy consumption of ancillary system	kWh	
$E_{auto\ start}$	Energy	Energy consumption in auto start condition	kWh	
E_{load}	Energy	Energy consumption due to the transport of passengers	kWh	Negative for down running; Positive for up running
E_{main}	Energy	Total energy consumption of unit w/o ancillary energy	kWh	
$E_{no\ load}$	Energy	Energy consumption under no load condition	kWh	
$E_{slow\ speed}$	Energy	Energy consumption in slow speed condition	kWh	
$E_{standby}$	Energy	Energy consumption in standby condition	kWh	
E_{total}	Energy	Total energy consumption of unit incl. Ancillary energy	kWh	
H	Rise	Vertical distance between the upper and lower finished floor levels	m	
L	Length	Distance between the comb intersection lines	m	
m	Weight of passenger	Average weight of passenger	kg	75 kg/person
m_{chain}	Mass	Mass of chain band per meter	kg/m	
$m_{SB/PB}$	Mass	Mass of a step/pallet	kg	
N	Number of passengers	Number of transported persons in observation period	-	
$P_{no\_load\_control}$	Power	Total reference power consumption to operate no load condition	kW	
$P_{no\_load\_handrail}$	Power	Total reference power consumption of a handrail system in no load condition	kW	
$P_{no\_load\_ref}$	Power	Total reference power consumption in no load condition	kW	
$P_{no\_load\_spec}$	Power	Total calculated or measured power consumption of the specified unit in no load condition	kW	
$P_{standby}$	Power	Total reference power consumption to operate in standby condition	kW	

Table 1 *(continued)*

Symbol	Term	Definition	Unit	Assumptions
$P_{no\_load\_step/pallet}$	Power	Total reference power consumption of a step/pallet system in no load condition	kW	
$t_{ancillary}$	Time	Time period of activated ancillary system	h	
$t_{auto\ start}$	Time	Time period of auto start condition in observation period		
$t_{nominal\ speed}$	Time	Time period under nominal speed in observation period	h	
$t_{power\ off}$	Time	Time period in power off condition in observation period	h	
$t_{slow\ speed}$	Time	Time period of slow speed condition in observation period	h	
$t_{standby}$	Time	Time period of standby condition in observation period	h	
t_{total}	Time	Time period of the energy consumption in observation period	h	
$α$	Angle of inclination	Maximum angle to the horizontal in which the steps, the pallets, or the belt move	degree	
$η$	Efficiency	Efficiency due to load conditions	—	Average value due to different load conditions
$η_{no\ load}$	Efficiency	Efficiency under no load conditions	—	
$μ$	Friction coefficient	Friction coefficient due to load conditions	—	Average value due to different load conditions
$μ_{SB/PB}$	Friction coefficient	Friction coefficient of step/pallet band	—	Average value due to different load conditions
v	Speed	Nominal speed of escalator or moving walk	m/s	

4 Estimation of energy consumption

The measured or calculated power consumption is used for determining the energy consumption. Energy consumption is power consumption multiplied with a defined time period.

Calculation methods to estimate energy consumption of escalators and moving walks are given in Annex A. Formulas are provided for a situation where a more complete or appropriate method is not available. Energy consumption estimated by the formulae is based on average factors. Energy calculations using these methods are only estimations and can differ from real energy consumption, which is mainly affected by traffic topology, technology, and load factors.

NOTE There can be a deviation between a calculated value and a measured value in a specific installation. This can be due to assumptions made. Where the difference is greater than 20 %, an investigation should be carried out.

Two methods for estimation of energy consumption are provided:

— calculation method based on default values for planning purposes;

— calculation method based on power measurement.

The scope and contents of reporting of the results are shown in Annex A.

All information according to Table A.3 and Table A.4 shall be reported. Additional information about applied technologies is recommended.

5 Energy performance classification

5.1 General

This section specifies a methodology for the energy performance classification of an escalator or moving walk.

The energy performance classification is obtained by executing the following steps:

a) Normalizing the calculated or measured power consumption of a single unit:

- — calculation of the reference power consumption (5.2);
- — calculation or measurement of the power consumption of the specified unit (5.3);
- — calculation of the energy performance ratio (5.4).

b) Normalizing of operation mode power consumption of a single unit:

- — calculation of the reference operation mode performance ratio (5.5).

c) Consideration of ancillary power performance:

- — consideration according to 5.6 item c).

The classification methodology applies to in-service escalators and moving walks whether the values are measured on an installation or provided by the manufacturer. It can also be used to re-classify an installation after modernisation.

5.2 Classification of the reference power consumption

The result of this calculation $P_{no\_load\_ref}$ is the power consumption of a unit running in no load condition as a total of

- — power consumption of the handrail system,
- — power consumption of the step band system, and
- — power consumption of the control system (reference value according to Table 2).

$$P_{no\_load\_ref} = P_{no\_load\_handrail} + P_{no\_load\_step/pallet} + P_{no\_load\_control} \quad (1)$$

The values for handrail and step band system are calculated using the following Formulae (2) and (3):

$$P_{no\_load\_handrail} = \frac{2 \times \cos(\alpha) \times (A \times \frac{H}{\tan(\alpha)} + B) \times v}{1000 \times \eta_{no\_load}} [kW] \quad (2)$$

NOTE 1 In case of flat moving walk, $H/\tan\alpha = L$ (length of the moving walk).

$$P_{no\_load\_step/pallet} = \frac{\left[\left(2 \times (\frac{m_{SB/PB}}{D} + 2 \times m_{chain}) \times \frac{9{,}81[m/s^2]}{1000} \times \mu_{SB/PB} \times \frac{H}{\tan(\alpha)} + C\right) \times v\right]}{\eta_{no\_load}} [kW] \quad (3)$$

NOTE 2 In case of flat moving walk, $H/\tan\alpha = L$ (length of the moving walk).

To obtain the reference power consumption, the calculation shall be executed with the reference values according to Table 2. For determined configurations, the application of the formulae above and the reference values below results in values given in Table A.2.

Table 2 — Reference values

	Escalator v **< 0,65 m/s** **all inclinations**	**Escalator** v **≥ 0,65 m/s**[a] **all inclinations**	**Inclined moving walk** α > 3° to 12°	**Horizontal moving walk** α = 0° to 3°	**Unit**
A	9	5	4	5	N/m
B	400	400	400	300	N
C	0,1	0,1	0,1	0,1	kN
D	0,405	0,405	0,405	0,405	m
$\eta_{\text{no load}}$	0,3	0,25	0,34	0,4	—
$\mu_{\text{SB/PB}}$	0,05	0,05	0,05	0,05	—
$m_{\text{SB/PB}}$	14	14	14	14	Kg
m_{chain}	5,5	7	5,5	5,5	kg/m
$P_{\text{no\_load\_control}}$	0,4	0,4	0,4	0,4	kW

[a] Escalators with speed ≥0,65 m/s and 0,75 m/s as normally used in public transport applications.

5.3 Calculation or measurement of the power consumption of the specified unit

For the calculation of the power consumption of the specified unit, the calculation model according to 5.2 can be used. In this case, reference values of Table 2 are replaced by specific values for the specified unit.

Any other equivalent calculation method can be applied.

Alternatively, in case of existing units, the power consumption can be determined by measurement according to ISO 25745-1. The following additional conditions shall exist to those specified in ISO 25745-1:

The measurement shall be taken

— after the completion of a running-in period of 1 000 h,

— after at least 30 min of continuous running (i.e. once the machine temperature is stabilized), and

— at an ambient temperature between 10 °C and 30 °C.

Direction indication, step gap lighting, and comb plate lighting (if any) shall be included in the calculation and/or measurement.

The result of the calculation or the measurement is defined as $P_{\text{no\_load\_spec}}$.

5.4 Calculation of the energy performance ratio

The energy performance ratio is determined by relating the specific power consumption (see 5.3) and the reference power consumption (see 5.2).

The energy performance ratio is $P_{\text{no\_load\_spec}}/P_{\text{no\_load\_ref}}$ [%].

5.5 Calculation of the reference operation mode performance ratio

For the calculation of the reference operation mode performance ratio, a reference usage profile according to Table 3 is used.

Table 3 — Reference usage profile

Operation mode	**Power off**	**Slow speed**	**Auto start**	**Continuous operation**
Specification of the unit	According to Annex A, Table A.3			
	Reference usage profile			
t_{total}	24 h	24 h	24 h	24 h
$t_{nominal\ speed}$	12 h	10 h	10 h	12 h
$t_{standby}$	0 h	12 h	12 h	12 h
$t_{power\ off}$	12 h	—	—	—
$t_{slow\ speed}$	—	2 h	—	—
$t_{auto\ start}$	—	—	2 h	—
Energy consumption[a]	30,1 kWh/d	30,0 kWh/d	28,1 kWh/d	32,5 kWh/d
Operation mode performance ratio	93 %	92 %	86 %	100 %

NOTE The combination of slow speed mode and auto start mode leads to another user profile and is not considered.

[a] Without energy consumption due to transport of the passengers (E_{load}).

The operation mode performance ratio varies in dependence of the usage profile and it does NOT affect the energy performance ratio. For the classification of the operation mode performance ratio, only the reference in Table 3 is used.

For usage profiles other than the reference usage profiles, the calculation according to Table A.3 can be applied.

5.6 Energy performance classification

The energy performance classification is derived by applying the following indicators:

a) Energy performance class indicator

This classification indicator describes the impact of both the efficiency of active parts and the friction of passive escalator/moving walk components or systems. The classification indicator is in the range of A+++ to E where A+++ is the best performance. The reference power consumption according to Table A.2 is energy performance class D at 100 %.

The classification is obtained by applying Table 4.

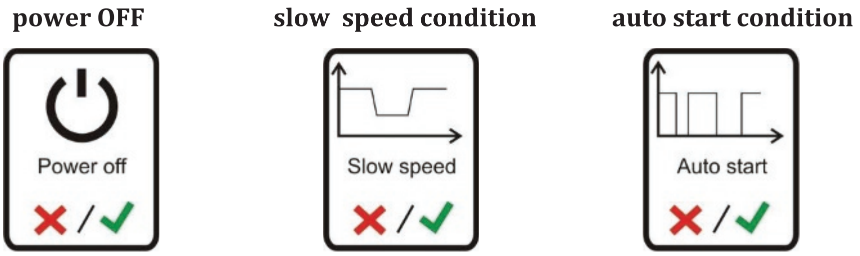
Table 4 — Energy performance class indicator

Energy performance ratio	≤55%	≤60%	≤65%	≤70%	≤80%	≤90%	≤100%	>100%
Energy performance class indicator	A+++	A++	A+	A	B	C	D	E

b) Operation mode indicator

Each mode capability is indicated by a logo.

This classification indicator (logo) describes the capability of the unit to operate in one or more of the following operation modes.



In case of capability, the logo is check marked ✓ or crossed ✗.

c) Ancillary energy performance indicator

No indicator for the escalator/moving walk is defined.

Measurement of power consumption of any ancillary equipment is not considered for the energy classification.

6 Reporting

6.1 Documentation of the energy assessment

The results of the energy assessment shall be documented and shall include the following:

a) the technical specification of the unit according the manufacturers data sheet;

b) the calculated or measured power consumption under no load condition;

c) the energy performance class indicator;

d) the operation mode performance indicator(s) marked X or ✓ depending on available optional operation modes of the unit.

6.2 Example

As an example for the reporting, the following unit is used: an escalator with 4,5 m rise, 30° inclination, and a nominal speed of v = 0,5 m/s. The specific calculated power consumption is 1 780 W.

The unit is Class B because 1 780 W/2 505 W = 71 % of the reference value according to Table A.2.

The unit includes auto start and slow speed capability.

An example of energy assessment report figures is given below:

— rise: 4,5 m

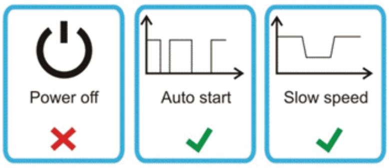
— inclination: 30°

— nominal speed: 0,5 m/s

a) Power consumption under no load condition: 1,78 kW

b) Energy performance class indicator: B

c) Operation mode performance indicators:



Annex A
(informative)

Calculation of energy consumption

A.1 General

A.1.1 Preliminary notes

The formulae below have been developed for escalators and moving walks for any kind of application.

A.1.2 Default values

Default values are given in order to allow energy consumption estimations for planning purposes. The default values are average, generic values based on manufacturers indications which were validated by ISO/TC 178/WG 5. They can vary depending on product application and specification.

A value for the average number of passengers per day (N) shall be provided or can be obtained from Table A.1.

NOTE In this part of ISO 25745, the time period for calculation is 1 d. Any other time period can be applied.

Table A.1 — Typical usage and locations and energy consumption of units

Passengers/day (N)	Typical locations
<3 000	Shops, museums, libraries, leisure facilities, stadium
up to 10 000	Department stores, shopping centres, regional airports, regional railway stations
up to 20 000	Major airports, major railway stations, major underground railways
>20 000	Larger major airports, larger major railway stations, capital city underground railways
Energy consumption (kW)	**Typical default values (as used in Table A.3)**
P_{standby}	0,2 kW
$P_{\text{auto start}}$	0,3 kW
$P_{\text{no load}}$	According to Table A.2.
$P_{\text{slow speed}}$	$P_{\text{no load}} \times 0,5$

A.2 Calculation method based on estimated values for planning purposes

For planning purposes, the total energy consumption of an escalator or moving walk shall be determined by the following formulae:

$$E_{total} = E_{main} + E_{ancillary} \quad (A.1)$$

where

E_{total} is the total energy consumption of unit including ancillary energy;

E_{main} is the total energy consumption of unit without ancillary energy;

$E_{ancillary}$ is the total energy consumption of ancillary equipment.

$$Emain = Estandby + Eauto\ start + Eslow\ speed + Eno\ load + Eload \quad (A.2)$$

where

$E_{standby}$ is the escalator energy consumption in standby condition which is equal to 0,2 kW × time period of standby condition in observation period;

NOTE 1 0,2 kW is a default value for power in standby condition. It is 50 % of $E_{no\ load\ control}$ as brakes, contactors, and other equipment are not activated.

$E_{auto\ start}$ is the escalator energy consumption in auto start condition which is equal to 0,3 kW × time period of auto start condition in observation period;

NOTE 2 0,3 kW is a default value for power in auto start condition. It is 75 % of $E_{no\ load\ control}$ as brakes, contactors, and other equipment are not activated but direction indicators are on.

$E_{no\ load\ control}$ is the escalator controller energy consumption in no load condition which is equal to $P_{no\_load\_control}$ (see Table 2) × respective time period;

$E_{slow\ speed}$ is the escalator energy consumption in slow speed condition which is equal to $P_{no\ load}/2$ (Table A.2) × time period of slow speed condition in observation period;

$E_{no\ load}$ is the escalator energy consumption in no load condition which is equal to $P_{no\ load}$ (Table A.2) × time period of no load condition in observation period;

E_{load} is the escalator energy consumption due to the transport of passengers according to Table A1 and Table A3.

Table A.2 — Reference power in no load condition according to 5.2

Rise *H*	**Escalator (α = 30°)**	
m	*v* = 0,5 m/s	*v* = 0,65 m/s
3,0	2 243 W	3 222 W
4,5	2 505 W	3 602 W
6,0	2 766 W	3 983 W
8,0	3 114 W	4 490 W
Rise *H*	**Inclined moving walk (α = 12°)**	
m	*v* = 0,5 m/s	*v* = 0,65 m/s
3,0	2 788 W	—
4,5	3 333 W	—
6,0	3 878 W	—
Length *L*	**Horizontal moving walk (α = 0°)**	
m	*v* = 0,5 m/s	*v* = 0,65 m/s
30	3 326 W	4 204 W
45	4 352 W	5 538 W
60	5 378 W	6 871 W
NOTE 1 For intermediate rises or lengths or inclinations or any other speeds, the reference formulae and reference values of Table A.1 shall be applied.		
NOTE 2 The power consumption above includes $P_{no\_load\_control}$.		

Table A.3 — Calculation method to estimate escalator and moving walk energy consumption for planning purposes

General data	**Parameter**	**Example**	**Unit**
Building address		sample building	
Product category (escalator/ moving walk)		escalator	
Unit application (commercial, public transport)		commercial	
Rise	*H*	4,5	m
Length	*L*	not applicable	m
Angle of inclination	*α*	30	degree
Average number of passengers in observation period	*N*	8 000	pers./d
Average weight of passengers	*m*	75	kg
Direction of travel (up, down, horizontal)		up	
Step width	*W*	1 000	mm
Nominal speed	*v*	0,5	m/s
Nominal motor power	*P*	7,5	kW

Periods of operation			
Observation period (day, week, month, year)		1	d
Time period of energy consumption	t_{Total}	24	h
Time period of standby on condition	$t_{standby}$	12	h
Time period of auto start condition	$t_{auto\ start}$	0	h
Time period under nominal speed	$t_{nominal\ speed}$	10	h
Time period of slow speed condition	$t_{slow\ speed}$	2	h

Escalator energy consumption in standby condition				
$E_{standby}$	$E_{standby} = P_{standby} \times t_{standby}$	P s t a n d b y acc. to Table A.1 = 0,2	0,2 × 12 = 2,4	kWh

Escalator energy consumption in auto start condition				
$E_{auto\ start}$	$E_{auto\ start} = P_{auto\ start} \times t_{auto\ start}$	P a u t o _ s t a r t acc. to Table A.1. = 0,3	0,3 × 0 = 0	kWh

Escalator energy consumption under no load condition				
$E_{no\ load}$	$E_{no\ load} = P_{no\ load} \times t_{nominal\ speed}$	P n o _ l o a d acc. to Table A.2	2,505 × 10 = 25,1	kWh

Escalator energy consumption at slow speed condition				
$E_{slow\ speed}$	$E_{slow\ speed} = P_{slow\ speed} \times t_{slow\ speed}$	P s l o w s p e e d acc. to Table A.1.	1,250 × 2 = 2,5	kWh

Escalator energy consumption due to the transport of passengers				
E_{load}	escalator or inclined moving walk in up direction: $E_{load} = N \times m \times g \times H \times 1/(3\,600\,000 \times \eta) \times (1 + \mu/\mathrm{tg}\,\alpha)$	default η = 0,75 default μ = 0,05	(8 000 × 75 × 9,81 × 4,5) × 1/(3 600 000 × 0,75) × (1 + 0,05/0,577) = 10,7	kWh
	escalator or inclined moving walk in down direction: $E_{load} = N \times m \times g \times H \times \eta \times \mathrm{CF}/(3\,600\,000) \times (-1 + \mu/\mathrm{tg}\,\alpha)$	Correction factor *CF* acc. to 3.2	(8 000 × 75 × 9,81 × 4,5 × 0,75 × 0) × 1/(3 600 000) × (−1 + 0,05/0,577) = 0	
	horizontal moving walk (alpha = 0): $E_{load} = N \times m \times g \times L \times \mu/(3\,600\,000 \times \eta)$			

Main energy consumption of unit without ancillary energy			
E_{main}	Up direction: $E_{main} = E_{standby} + E_{auto\ start} + E_{slow\ speed} + E_{no\ load} + E_{load}$	2,4 + 0 + 25,1 + 2,5 + 10,7 = 40,7	kWh
E_{main}	Down direction: $E_{main} = E_{standby} + E_{auto\ start} + E_{slow\ speed} + E_{no\ load} + E_{load}$ ($E_{load} < 0$)	2,4 + 0 + 25,1 + 2,5 – 0 = 30,0	kWh

NOTE 1 Ancillary equipment energy consumption is project specific and needs to be calculated on a case-to-case base.

A.3 Calculation method based on measured values

The power is measured in the following conditions:

— $P_{standby}$ (power in standby condition);

— $P_{auto\ start}$ (power in auto start condition);

— $P_{slow\ speed}$ (power in slow speed condition);

— $P_{no\ load}$ (power in no load condition);

— $P_{ancillary}$ (power of ancillary equipment);

$E_{main} = E_{standby} + E_{auto\ start} + E_{slow\ speed} + E_{no\ load} + E_{load}$

$E_{total} = E_{main} + E_{ancillary}$

where

$E_{standby} = P_{standby} \times t_{standby}$

$E_{auto\ start} = P_{auto\ start} \times t_{auto\ start}$

$E_{slow\ speed} = P_{slow\ speed} \times t_{slow\ speed}$

$E_{no\ load} = P_{no\ load} \times t_{nominal\ speed}$

$E_{load} = N \times m \times g \times H \times 1/(3\,600\,000 \times \eta) \times (1+ \mu/\tan \alpha)$

(for α > 0° in up direction for escalators and inclined moving walks)

$E_{load} = N \times m \times g \times H \times \eta \times CF/(3\,600\,000) \times (-1 + \mu/\tan \alpha)$

(for α > 0° in down direction for escalators and inclined moving walks)

$E_{load} = N \times m \times g \times L \times \mu/(3\,600\,000 \times \eta)$

(for α = 0 in both directions for horizontal moving walks)

$E_{ancillary} = P_{ancillary} \times t_{ancillary}$

Table A.4 — Calculation method based on power measurement to verify escalator and moving walk energy consumption

General data (example)	Parameter	Example	Unit
Building address		sample building	
Product category (escalator/moving walk)		escalator	
Initial measurement/verification check		initial measurement	
Serial number		sample number	
Product brand and type		sample type	
Date of manufacturing		ddmmyyyy	
Unit location (indoor, semi-outdoor, outdoor)		indoor	
Unit application (commercial, public transport)		commercial	
Rise	H	4,5	m
Length	L	not applicable	m
Angle of inclination	alpha, α	30	degree
Average number of passengers in observation period	N	8 000	1./d
Average weight of passengers	m	75	kg
Direction of travel (up, down, horizontal)		up	
Step width	W	1 000	mm
Nominal speed	v	0,5	m/s
Nominal motor power	P	7,5	kW

Periods of operation (example)			
Observation period (day, week, month, year)		1	d
Time period of energy consumption	t_{Total}	24	h
Time period of standby condition	t_{standby}	12	h
Time period of auto start condition	$t_{\text{auto start}}$	0	h
Time period under nominal speed	$t_{\text{nominal speed}}$	10	h
Time period of slow speed condition	$t_{\text{slow speed}}$	2	h
Time period of activated ancillary equipment	$t_{\text{ancillary}}$	12	h

Condition of measurement (example)			
Date, time		ddmmyyy:hh:mm	
Name of responsible person for measurements		John Q. Public	
Measuring equipment (brand, type, serial number, settings)		sample type	
Ambient temperature	T	20	°C
Date of last maintenance		ddmmyyyy	
Observations			

Measured data (example)			
Power in standby condition	$P_{standby}$	0,15	kW
Power in auto start condition	$P_{auto\ start}$	0,28	kW
Power in slow speed condition	$P_{slow\ speed}$	0,80	kW
Power in no load condition	$P_{no\ load}$	1,80	kW
Power of ancillary equipment	$P_{ancillary}$	0,30	kW
Other observations			

Escalator energy consumption in power on condition			
$E_{standby}$	$E_{standby}$ = measured power × $t_{standby}$	Measured power 0,15 × 12 = 1,8	kWh

Escalator energy consumption in auto start condition			
$E_{auto\ start}$	$E_{auto\ start}$ = measured power × $t_{auto\ start}$	Measured power 0,28 × 0 = 0	kWh

Escalator energy consumption under no load condition			
$E_{no\ load}$	$E_{no\ load}$ = measured power × $t_{nominal\ speed}$	Measured power 1,8 × 10 = 18,0	kWh

Escalator energy consumption at slow speed condition			
$E_{slow\ speed}$	$E_{slow\ speed}$ = measured power × $t_{slow\ speed}$	Measured power 0,8 × 2 = 1,6	kWh

Escalator energy consumption due to the transport of passengers				
E_{load}	Escalator or inclined moving walk in up direction: $E_{load} = N \times m \times g \times H \times 1/(3\,600\,000 \times \eta) \times (1 + \mu/\text{tg}\,\alpha)$	default η = 0,75 default μ = 0,05	(8 000 × 75 × 9,81 × 4,5) × 1/(3 600 000 × 0,75) × (1 + 0,05/0,577) = 10,7	kWh
	Escalator or inclined moving walk in down direction: $E_{load} = N \times m \times g \times H \times \eta \times CF \times 1/(3\,600\,000) \times (-1 + \mu/\text{tg}\,\alpha)$	Correction factor *CF* acc. to 3.2	(8 000 × 75 × 9,81 × 4,5 × 0,75 × 0) × 1/(3 600 000) × (−1 + 0,05/0,577) = 0	kWh
	Horizontal moving walk (alpha = 0) $E_{load} = N \times m \times g \times L \times \mu/(3\,600\,000 \times \eta)$			

Escalator energy consumption of ancillary equipment			
$E_{ancillary}$	$E_{ancillary}$ = measured power × $t_{ancillary}$	0,3 × 12 = 3,6	kWh

Main energy consumption of unit without ancillary energy			
E_{main}	Up direction: $E_{main} = E_{standby} + E_{auto\ start} + E_{slow\ speed} + E_{no\ load} + E_{load}$	1,8 + 0 + 18,0 + 1,6 + 10,7 = 32,1	kWh
E_{main}	Down direction: $E_{main} = E_{standby} + E_{auto\ start} + E_{slow\ speed} + E_{no\ load} + E_{load}$ ($E_{load} < 0$)	1,8 + 0 + 18,0 + 1,6 − 0 = 21,4	kWh

Total energy consumption of unit with ancillary energy			
E_{total}	Up direction: $E_{total} = E_{main} + E_{ancillary}$	32,1 + 3,6 = 35,7	kWh
E_{total}	Down direction: $E_{total} = E_{main} + E_{ancillary}$	21,4 + 3,6 = 25,0	kWh

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