Original instructions

AVANTI SERVICE LIFT

User's, Installation and Maintenance Manual

Model Service Lift OCTOPUS

CE

CERTIFICATE

EC Type Examination

EC-Directive 2006/42/EC, Article 12, Section 3b
Machinery

Number of registration: 01/205/0833/13

Certification body for machinery NB0035
at TÜV Rheinland Industrie Service GmbH
herewith confirms for the company

AVANTI WIND SYSTEMS A/S
Høgevej 19
DK- 3400 Hillerød
Denmark

the close conformity of the product

Service lift inside wind turbine systems

Technical data:

Service lift:	**Octopus**	
	L80	L95
- max. load capacity:	240 kg / 2 persons	
- traction hoist:	M508	
- fall arrest device:	ASL508	
- lifting speed:	18 m/min	
- protection fences:	1.10 m	
- fence Interlock system:	Trapped-key system	
- max. distance between brackets:	2240 mm	
- net weight:	180 kg	190 kg
- max. total travel height:	135 m	125 m
- dimensions of cabin (W x D x H):	800 x 1040 x 2680 mm	950 x 1040 x 2680 mm

Examination place: Zaragosa, Spain

with the requirements according to annex I of Directive 2006/42/EC about machinery and amending the Directive 95/16/EC of the European Parliament and the Council from May 2006 for adaptation of legal and administration regulations of the member countries regarding safety of machinery.

The verification was proved by EC-type approval test, Test-Report- No.: 13_021-1 from 2013-04-29 and is valid only duly considering the requirements mentioned in this document.

This certificate is valid until 2018-05-13

Certification body
Notified under No. 0035
certifier

Dipl.-Ing. Walter Ringhausen

Cologne, 2013-05-13

TÜVRheinland® 0035 Notified Body

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Contents

1. Limited Warranty

Avanti Wind Systems A/S warrants that commencing from the date of shipment to the Customer and continuing for a period of the longer of 365 days thereafter, or the period set forth in the standard AVANTI warranty, the Product[1)] described in this Manual will be free from defects in material and workmanship under normal use and service when installed and operated in accordance with the provisions of this Manual.

This warranty is made only to the original user of the Product. The sole and exclusive remedy and the entire liability of Avanti under this limited warranty, shall be, at the option of Avanti, a replacement of the Product (including incidental and freight charges paid by the Customer) with a similar new or reconditioned Product of equivalent value, or a refund of the purchase price if the Product is returned to Avanti, freight and insurance prepaid. The obligations of Avanti are expressly conditioned upon return of the Product in strict accordance with the return procedures of Avanti.

This warranty does not apply if the Product (i) has been altered without the authorization of Avanti or its authorized representative; (ii) has not been installed, operated, repaired, or maintained in accordance with this Manual or other instructions from Avanti; (iii) has been subjected to abuse, neglect, casualty, or negligence; (iv) has been furnished by Avanti to Customer without charge; or (v) has been sold on an “AS-IS” basis.
Except as specifically set forth in this Limited Warranty,

ALL EXPRESS OR IMPLIED CONDITIONS, REPRESENTATIONS AND WARRANTIES, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OR CONDITION OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, NON-INFRINGEMENT, SATISFACTORY QUALITY, COURSE OF DEALING, LAW, USAGE OR TRADE PRACTICE ARE HEREBY EXCLUDED TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW AND ARE EXPRESSLY DISCLAIMED BY AVANTI. IF, PURSUANT TO ANY APPLICABLE LAW, TO THE EXTENT AN IMPLIED WARRANTY CANNOT BE EXCLUDED AS PROVIDED IN THIS LIMITED WARRANTY, ANY IMPLIED WARRANTY IS LIMITED IN TIME TO THE SAME DURATION AS THE EXPRESS WARRANTY PERIOD SET FORTH ABOVE. BECAUSE SOME STATES DO NOT PERMIT LIMITATIONS ON THE DURATION OF IMPLIED WARRANTIES, THIS MAY NOT APPLY TO A GIVEN CUSTOMER. THIS LIMITED WARRANTY GIVES CUSTOMER SPECIFIC LEGAL RIGHTS, AND CUSTOMER MAY HAVE OTHER LEGAL RIGHTS UNDER APPLICABLE LAWS.

This disclaimer shall apply even if the express warranty fails of its essential purpose.

In any cases of dispute the English original shall

* Avanti service lift (“Product”)

2. Introduction

2.1 Observations

Only trained people may use this lift.
This manual must be available to staff at all times during installation, maintenance and operation.
Additional copies are available from the manufacturer upon request.
All measurements are indicative only and subject to change without notice.

The pictures and sketches in this manual may not reflect the product aesthetics, colours, arrangement precisely. This has no impact on the function or safety.

2.2 Symbols

Symbol	Signal word	Meaning	Possible injury if not observed
Safety instructions			
	**DANGER!**	IMMEDIATE or possibly imminent danger:	Death or severe injury!
	**DANGER!**	IMMEDIATE or possibly imminent danger of hazardous voltage:	Death or severe injury!
	**CAUTION!**	Potentially hazardous situation:	Light injury or material damage.
Additional instructions			
	**ATTENTION!**	Potentially dangerous situation:	Damage to equipment or workplace
	**IMPORTANT!**	Useful tips for optimum working procedure	None
Order			
		Reference to written specification/documentation	

2.3 Cautions

Installation and/or maintenance and/or operation of the service lift and its suspension may be performed only by qualified personnel, hired by the employer for the job at hand.

The personnel must be at least 18 years of age. The staff must be familiar with the relevant accident prevention instructions and must have received proper training in these.

Personnel are obliged to read and understand this User's Manual.

Personnel shall wear PPE (safety helmet, full body harness, shock absorber, lanyard and slider) at all times.

A copy of the User's Manual must be handed out to the personnel and must always be available for reference.

If more than one person is entrusted with one of the above tasks, the employer shall appoint a supervisor in charge of the operation.

Electrical connection of the system must be made in accordance with EN 60204-1.

Self-locking nuts must be used at all times. The screw must extend from the nut by at least half of the thread diameter. The nut may not be used once it has become possible to loosen by hand!

If any damage or faults are found during operation, or if circumstances arise which may jeopardize safety: immediately interrupt the work in progress and notify the supervisor or employer!

All tests/repairs of electrical installations may only be performed by qualified electricians.

All repairs to the traction, braking and supporting systems may only be performed by qualified installers.

If any supporting parts are repaired or replaced, the operational safety of the system must be tested and verified by an expert.

Only original fault-free parts may be used.

Use of non-original parts will render the manufacturer's warranty void and any type approval invalid.

No modification, extension or reconstruction of the service lift is allowed without the manufacturer's prior written consent.

No warranty is provided against damage resulting from reconstruction or modification of equipment or use of non-original parts which are not approved by the manufacturer.

Before using the lift an inspection by the authorized inspection organisation must be carried out.

Service lift must be inspected at least once a year by an expert trained by AVANTI. In case of high operating frequency or severe conditions of use, more frequent inspection is required.

Service lift is designed for a lifetime of 20 years with an operating frequency of approximately 12.5 h/year (250 h in total).

Service lift may not be used by persons who are under the influence of alcohol or drugs which may jeopardize working safety.

Service lift shall ONLY be used when the turbine is not generating power.

All wind farm site specific rules must be followed. Service lift shall not be used during inclement weather, including wind speeds over 18 m/s.

Avoid injury – follow all instructions!

The tower owner must verify the need for third party service lift inspections with the local authority and comply with the standards specified.

3. Description

3.1 Purpose

The service lift purpose is to transport persons plus their tools and equipment to the most convenient height for performing work in wind turbine generators (WTG).

Its use is limited to authorized personnel by AVANTI holding the relevant training certificates. The access to the WTG and consequently to the service lift is controlled and forbidden to public access.

The service lift is used primarily to transport technicians, their tools and spare parts from the bottom platform (or lowest accessible point) to the top platform (or highest accessible point). It is also used to access intermediate platforms where inspection and service of WTG connecting bolts and other equipment is made.

3.2 Scope

The Octopus service lift system consists of the following subsystems:

- Cabin.
- Traction and fall arrest systems.
- Guiding system.
- Control, safety and power systems (including an interlock system on platform fence doors).
- A rescue pendant control (only mandatory if rescue route of service lift can be somehow blocked).

Each of the subsystems listed above and their components are described in detail throughout the document.

The system fully complies with essential health and safety requirements of European Machinery directive.

There are two versions, L80 and L95, which differ in size. Additionally, there are two different configurations for working temperature ranges; in particular, there is a standard configuration and a low temperature configuration where traction system and main control box components are chosen specifically.

3.3 Exclusions

The service lift shall not be used outdoor or in potentially explosive atmospheres.
The service lift is not designed to carry a person on its top, unless service tool kit is installed.

The wind turbine manufacturer is responsible of integrating the service lift and ensuring compliance with the essential health and safety requirements as stated on the 2006/42/EC Machinery Directive and the applicable harmonized standards following the manufacturer recommendations.

This will require supply of interface components, including but not limited to:

- Ladder system.
- Brackets for ladder sections.
- Platform fences with doors.
- Power supply protection.

The wind turbine manufacturer shall also provide any additional relevant warning, instruction and / or training specific to the integration of the service lift necessary for its safe and correct installation.

Tower manufacturer's risk assessment shall include a service lift integration study.

3.4 Technical specifications

Service lift	
Main door type	Full sliding door
Main door interlock system	Guard locking
Service lift speed	18 m / min ± 20 %
Rated load	240kg
Max. nº persons	2 persons
Max. travelling height (L95)	125 m
Max. travelling height (L80)	135 m
Operating temp (normal version)	-15ºC to +60ºC
Survival temperature (normal version)	-25ºC to +80ºC
Operating temp (Low temp version)	-30ºC to +40ºC
Max. noise level	80 dB (A)

Traction hoist	
Model	M508
Rated load	500 kg
Centrifugal brake speed limiter	Yes
Unit weight	40 kg
Dimensions	266 x 300 x 61 mm
Vertical speed under operation	18 m / min ± 20 %
Power (50 Hz)	1.5 kW
Power (60 Hz)	1.8 kW
Rated current (400V / 690V, 50 Hz)	4.1 A / 2.3 A
Rated current (400 V / 480 V / 690 V, 60 Hz)	4.9 A / 4.1 A / 2.8 A
Start current (400V / 690V, 50 Hz)	13 A / 8.1 A
Start current (400V / 690V, 60 Hz)	15.5 A / 9.8 A
Traction hoist IP protection	IP 55

Fall arrest device	
Model	ASL508
Lifting capacity	500 kg
Max. wire rope speed	30 m / min
Unit weight	7 kg

Traction and safety wire ropes	
Diameter	8.4 mm 5 x 19
Min. breaking load limit	55 KN
Surface treatment	HDG
Weight	0.27 kg / m
Top beam fastenings	2 Ton shackles (C shape)

Cabin dimensions	
L95 Cabin weight	200 kg
L80 Cabin weight	192 kg
Distance from the rung center to the cabin outer edge	970 mm
Cabin width	950 mm for L95 800 mm for L80
Total height	2930 mm
Free standing height inside cabin	2100 mm
Door opening (full) (W x H)	500 x 2100 mm
Min. Emergency exit free pass dimen.	500 x 500 mm

Power supply		
Power supply type		3 Phase + PE + N
Power supply (50 Hz)	**Voltage**	400V / 690V ± 5 %
	Power	1.5 kW
	Rated current	4.1 A / 2.3 A
Power supply (60 Hz)	**Voltage**	400 V / 480 V / 690 V ± 5 %
	Power	1.8 kW
	Rated current	4.9 A / 4.1 A / 2.8 A
Control voltage		24 V (AC)
Fuse		16 A
Control boxes IP protection		IP 65

Travelling cable	
Nominal cross-section	5 G 1.5
Travelling cable type	Intended for use in WTG
Travelling cable weight (approx.)	0.18 kg / m
Travelling cable minimum breaking strength	1500 N
Socket type	To be agreed with customer

Ladder requirements [1)]	
Ladder width for Octopus L80	520 mm [1)]
Ladder width for Octopus L95	490 mm [1)]
Profile dimensions	74 x 25 mm
Max. distance between brackets	2240 mm
Maximum ladder angle with vertical	± 2°
Maximum angle variation	± 1°

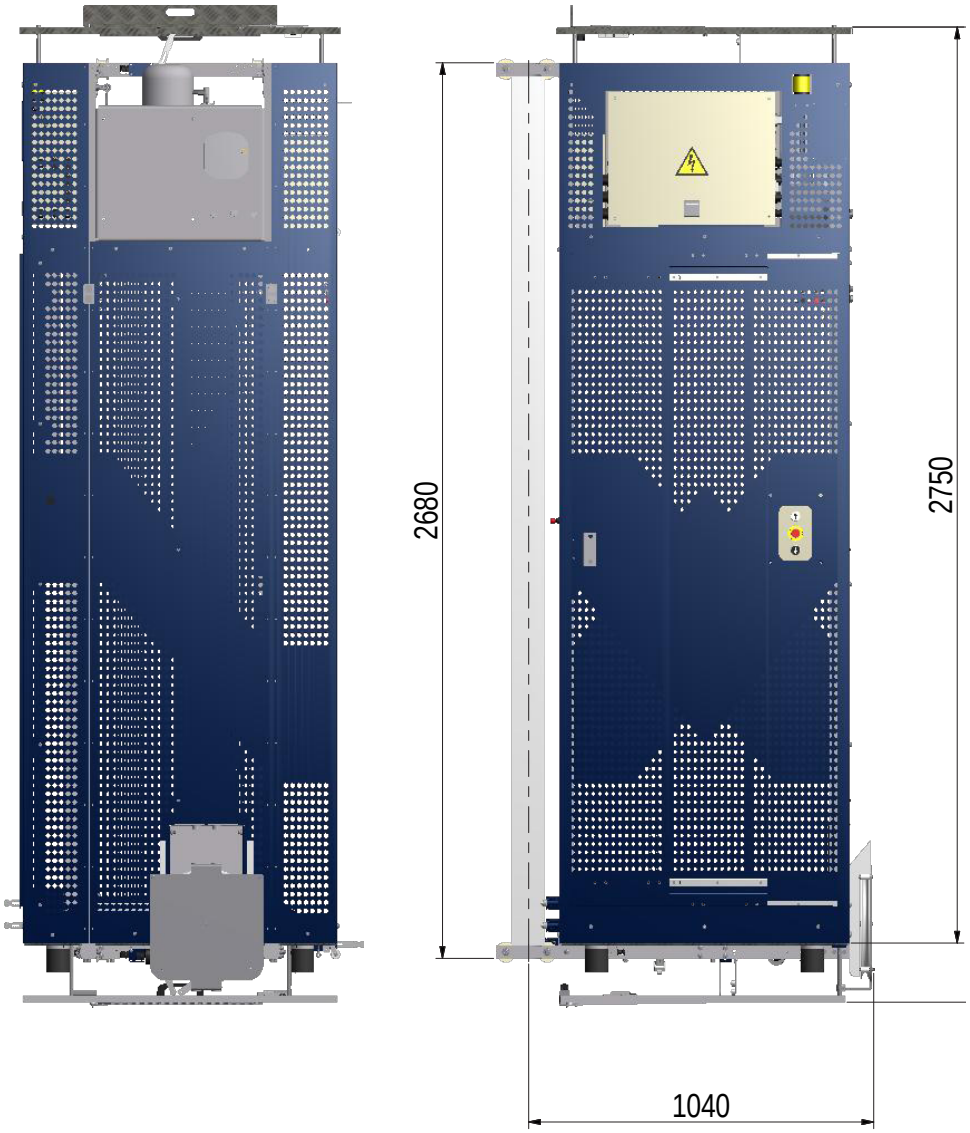
[1)] Other dimensions are possible upon request and design verification by AVANTI.

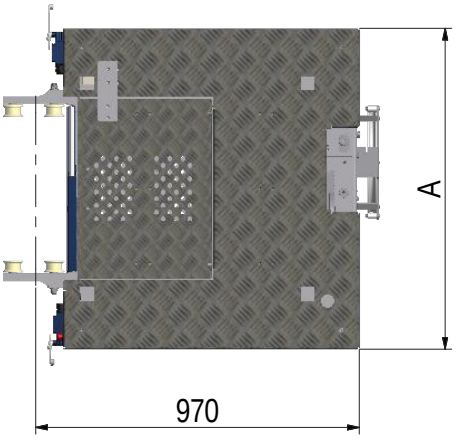
Service tool kit	
Service tool kit weight	<25 kg
Service lift rated load when service tool kit installed	215 kg

3.5 Dimensions

There are two standard sizes:

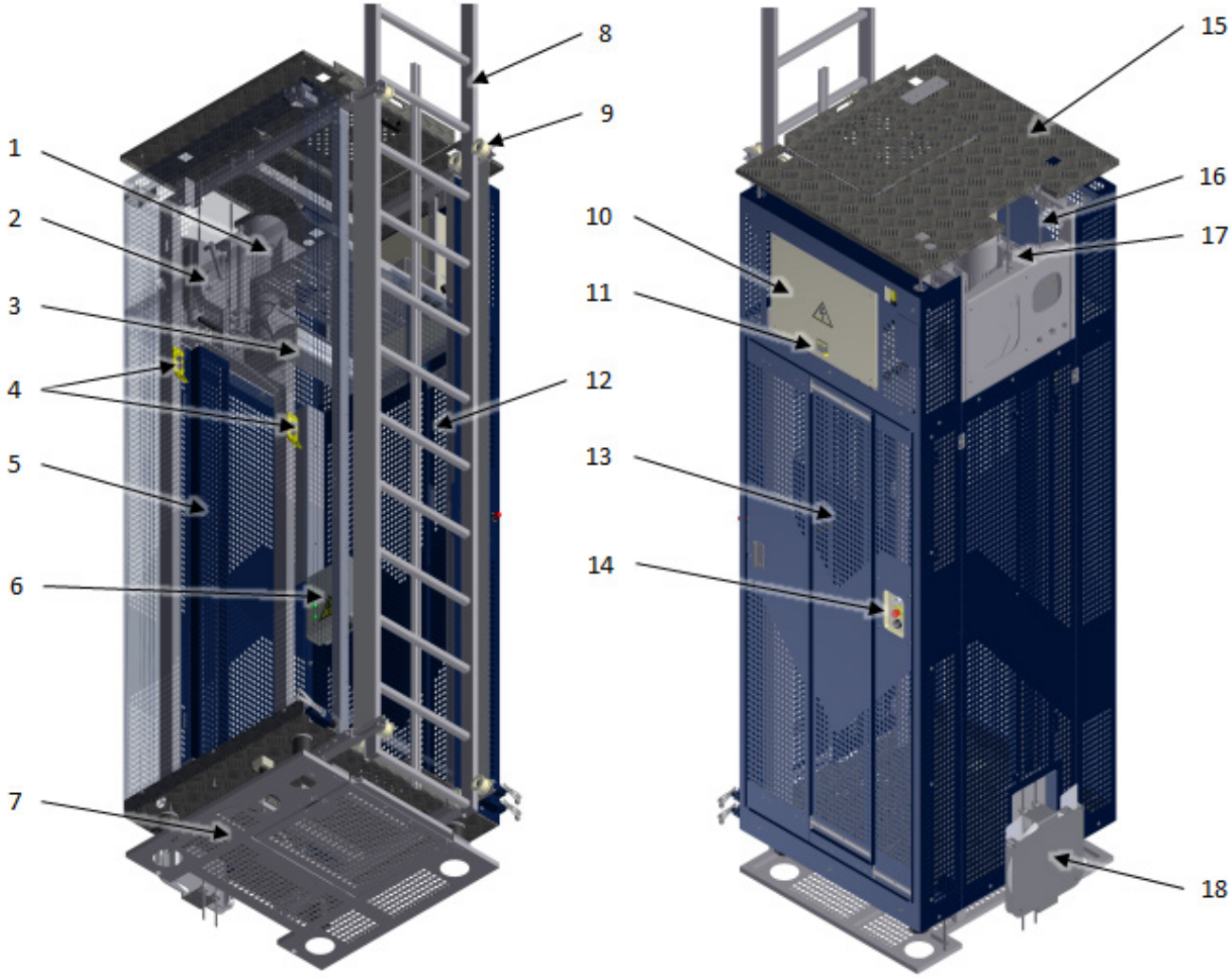
- L95, A = 950 mm
- L80, A = 800 mm





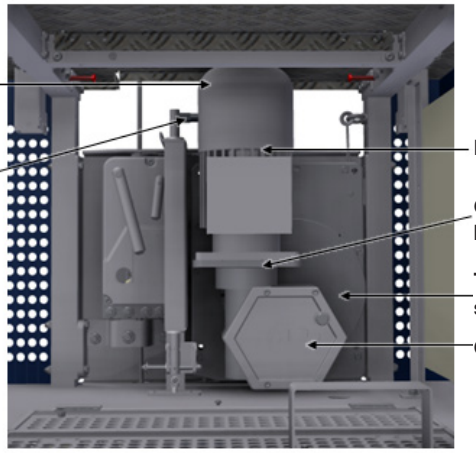
3.6 Components

3.6.1 Overview



1 Traction system
2 Fall arrest device
3 Cabin light
4 Anchor points
5 Maintenance cover
6 Cabin control box
7 Bottom obstruction device
8 Guide ladder
9 Guiding rollers
10 Main control box
11 Hour counter
12 Ladder access door
13 Full sliding door
14 External controls
15 Top obstruction device
16 Safety wire rope
17 Traction wire rope
18 Travelling cable pulley

3.6.2 Traction hoist



The service lift is powered up and down along the traction wire rope by means of an electrical powered hoist.

It features a motor, a gearbox and a traction system. The motor is equipped with a motor overheat limiter and an electromagnetic motor brake.

! *Reliability, endurance and safety of this hoist are only possible with the use of AVANTI approved wire ropes.*

It is largely maintenance free.

3.6.3 Fall arrest device

The service lift is provided with a fall arrest device which will be triggered in case of an overspeed condition. The speed of the safety wire rope passing through the device is continuously monitored, and the jaws automatically close in the event of sudden excessive speed.

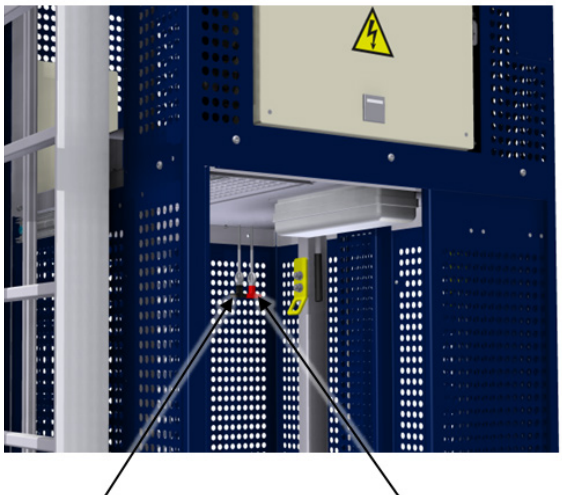
This device protects the service lift against traction wire rope breakages or traction system failures.

The fall arrest device can also be engaged manually in an emergency by pulling the red locking knob downwards.

To release the fall arrest device, pull the black unlocking knob downwards.

STOP *Tightness of safety wire rope must be frequently inspected to ensure full functionality of fall arrest device!*

It is largely maintenance free.

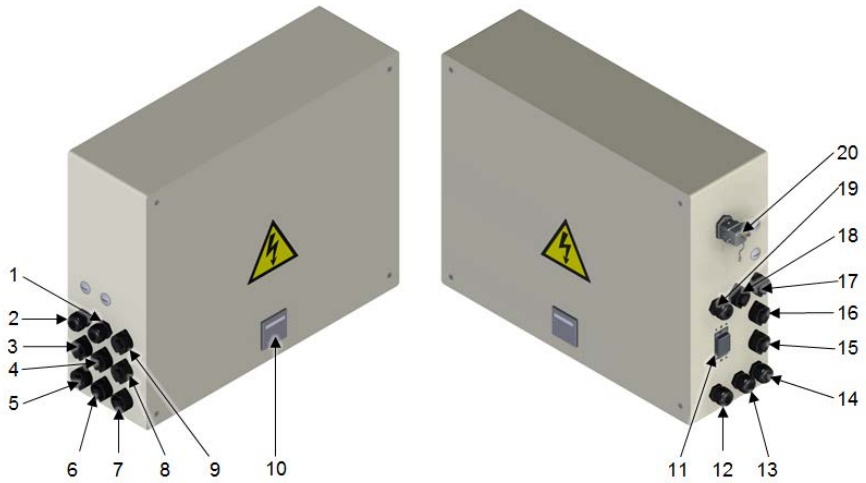


3.6.4 Guiding system

The service lift is safely guided along ladder stiles by means of guiding rollers.

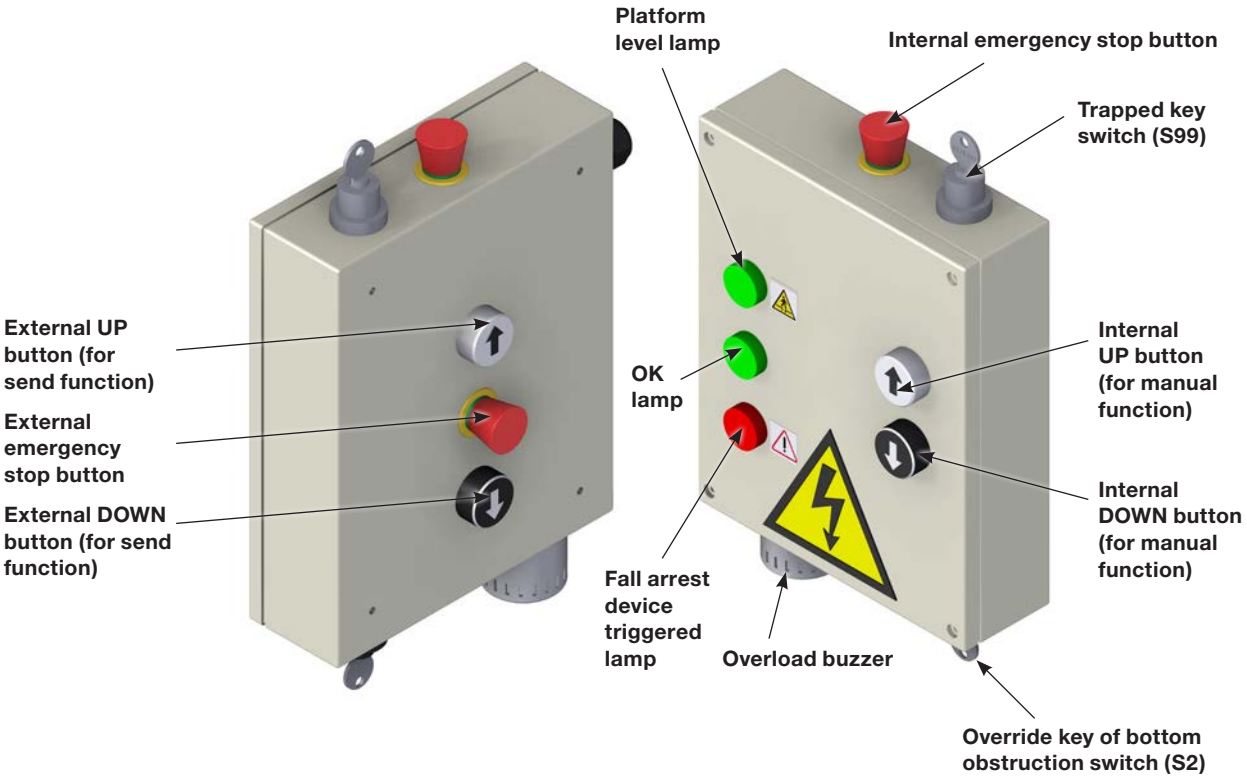
! *Ladder dimensions shall be compatible with guiding rollers.*

3.6.5 Main control box

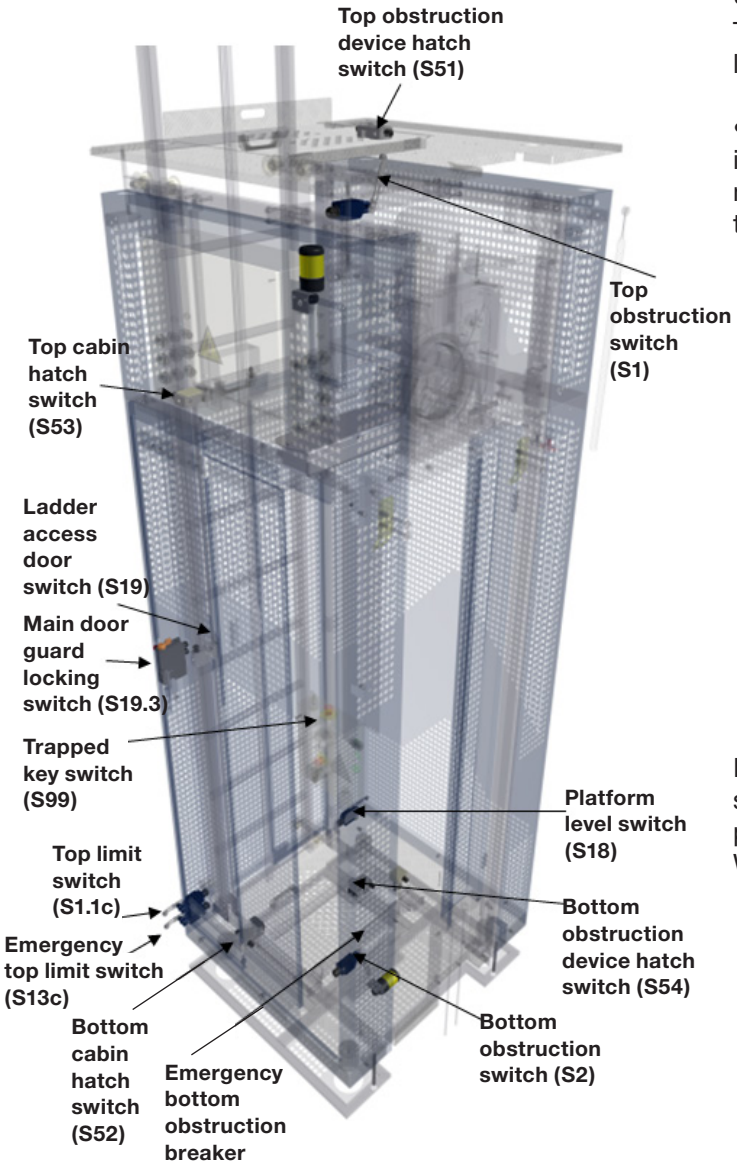


1 Rescue control attachment box socket
2 Top hatch switch (S53) socket
3 Top limit switch (S1.1c) socket
4 Emergency top limit switch (S13c) socket
5 Ladder access door switch (S19) socket
Main door guard locking switch (S19.3) & platform level switch (S18) socket
7 Bottom obstruction switch (S2) socket
8 Bottom hatches switches (S52 & S54) socket
9 Bottom warning light socket
10 Hour counter
11 Cabin control box socket
12 Power supply socket
13 Motor supply socket
14 Motor signals socket
15 Fall arrest device socket
16 Internal light socket
17 Top hatch switch (S51) socket
18 Top limit switch (S1) socket
19 Top warning light socket
20 Service control box socket

3.6.6 Cabin control box



3.6.7 Safety switches



3.6.8 Platform fences

They must conform to EN 14122, be 1,1 m high and be equipped with doors. These must be monitored with a trapped key system that permits fence door to be opened only when service lift is present.
Trapped key is attached to cabin by means of a wire rope, preventing loss of key.

In case service tool kit is provided, platform fences of intermediate and top platforms feature nonslip surfaces.

3.6.9 Main service lift door

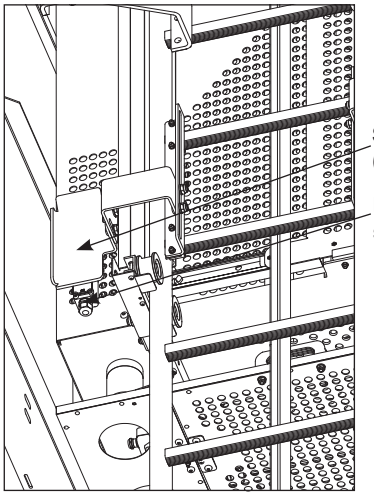
Main access to the cabin is done through the full sliding door installed on the front.

The full sliding door opening dimensions are 2100 x 500 mm.

It features a guard locking system that:

- Prevents service lift to travel if the door is open. This opening condition is monitored by the guard locking switch (S19.3).

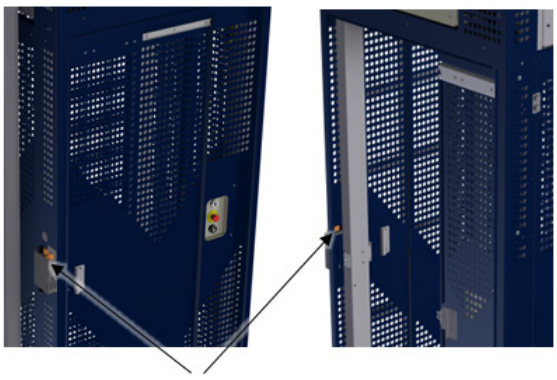
- Permits door to be opened only when service lift is levelled with a platform. This levelling condition is monitored by the platform level switch (S18) which is triggered by the safe zone plates.



It is possible to manually release guard locking system in order to open main door between platforms for maintenance tasks or installation of WTG parts.

External manual release of guard locking of L95

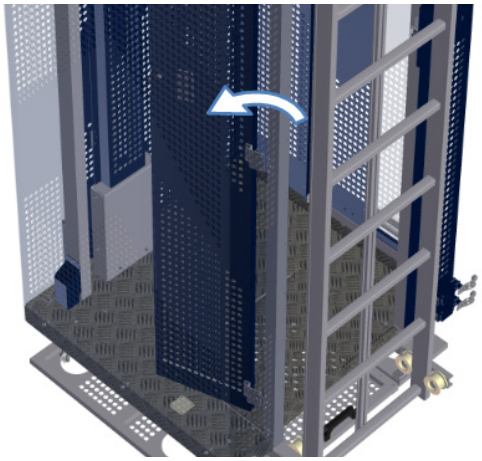
Internal manual release of guard locking of L95



Manual release of guard locking of L80 (accessible from outside and inside)

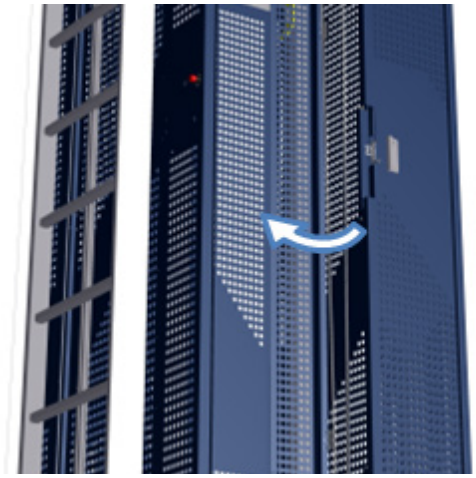
3.6.10 Ladder access door

Ladder access door consists of two hinged sheets that fold up when opened, thus optimizing space.
In case of evacuation, the ladder access door permits direct access to ladder and ladder rail.
A safety switch interrupts control when door is open.



3.6.11 Maintenance cover

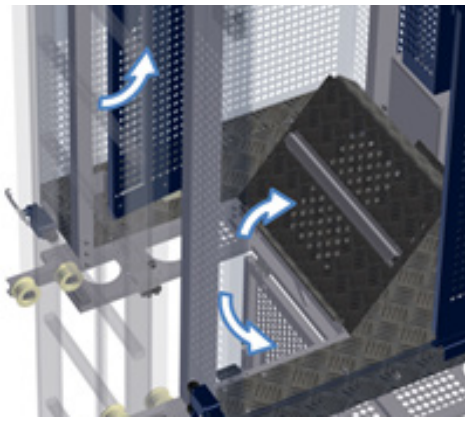
Maintenance cover allows safe and fast inspection of traction and safety wire ropes from inside the cabin while travelling.



3.6.12 Bottom hatches

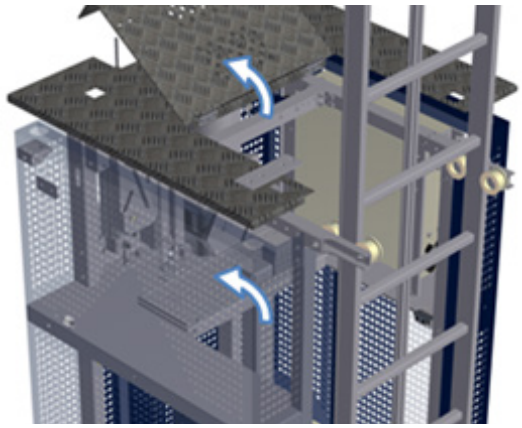
Bottom hatches can be opened from both sides, thus allowing egress and ingress from underneath.
Bottom cabin hatch opens inwards, and bottom obstruction device hatch opens outwards.
Each of them has a safety switch that interrupts control when hatch is opened.
Once top hatches and ladder access door are open, clear area is at least 500 x 500 mm, and ladder becomes totally accessible.

Direct evacuation to ladder is possible at any position along the WTG.



3.6.13 Top hatches

Top hatches can be opened from both sides, thus allowing egress and ingress from above.
Each of them has a safety switch that interrupts control when hatch is opened.
Top cabin hatch consists of two hinged sheets that fold up when opened, thus optimizing space.
Top obstruction device hatch opens outwards.
Once top hatches and ladder access door are open, clear area is at least 500 x 500 mm, and ladder becomes totally accessible.



3.6.14 Bottom obstruction device

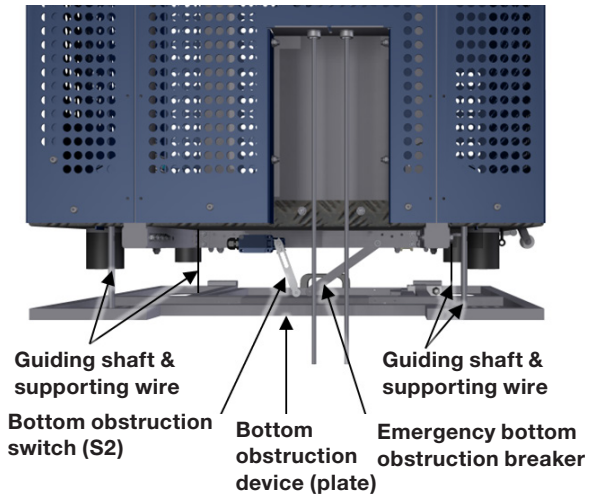
Bottom obstruction device interrupts descent if:

- It encounters an obstacle.
- It reaches the bottom platform.

Ascent will still be possible, for instance to remove the obstacle. In order to put the service lift on the ground, the contact plate functionality can be bypassed with the override bottom obstruction device switch located on the cabin control box. To do so, turn the override bottom obstruction switch key while pressing the down button.

Release the DOWN button as soon as the rubber bumpers hit the floor. Otherwise the service lift or the installation may get damaged.

An emergency bottom obstruction breaker permits the bottom obstruction device to be still operational during manual descent. Manual descent will be stopped if an obstacle is encountered.

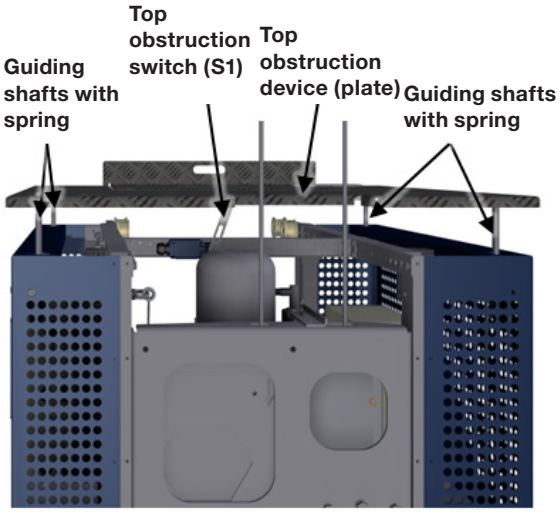


3.6.15 Top obstruction device

Top obstruction device interrupts ascent if it encounters an obstacle. Descent will still be possible, for instance to remove the obstacle.

When the top obstruction device switch (S1) is engaged, press the down button until it disengages.

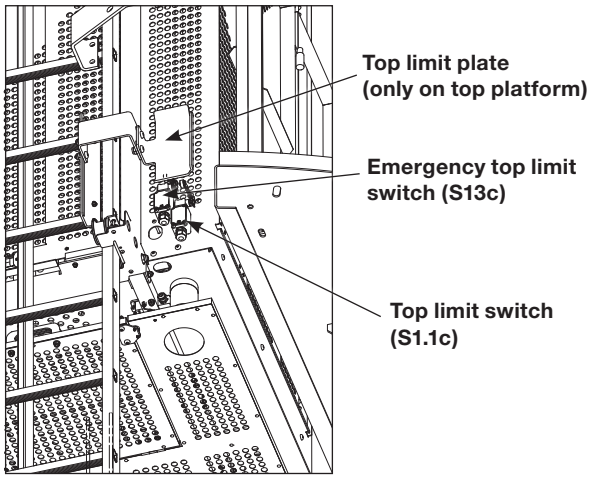
Do not use the service lift until the top obstruction device switch (S1) fault has been rectified.



3.6.16 Top limit switch

Top limit switch (S1.1c) interrupts ascent if it is triggered by the top plate.
Emergency top limit switch (S13c) is triggered in case the top limit switch fails to engage. It cuts off power supply, so only manual descent will be possible.

Top limit plate is mounted on the ladder.



3.6.17 Manual descent system

The service lift features a manual descent system that can be used in case of emergency.

To activate it, push the manual descent actuator upwards. The electromagnetic motor brake is released.
The service lift descends with a controlled speed limited by means of a centrifugal brake installed between the motor shaft and the gear box.

3.6.18 Overload limiter

An overload limiter is built into the traction hoist. In case of an overload, it will prevent any movement of the service lift (by interrupting control) and a buzzer will sound, until overload condition is eliminated.

STOP

Attempting to run an overloaded service lift is prohibited!

3.6.19 Internal light

The service lift is equipped with a light inside the cabin. When service lift is connected to power supply, this light illuminates at all times.

The internal light is battery packed in order to illuminate the inside of the cabin in case of a power failure. When fully charged, it will last at least for 30 minutes.

3.6.20 Warning lights

A set of warning lights is mounted on the top and on the bottom of the service lift. The flashes warn that the service lift is moving.

3.6.21 Anchor points

The service lift features two anchor points inside the cabin.

Each anchor point may only be used by one user simultaneously.

During operation personnel shall hook themselves up to the anchor points inside the cabin, in order to prevent falling risks. In case of need of evacuation, the evacuation procedure will be followed.

3.6.22 Rescue pendant control

Rescue pendant control is only mandatory if rescue route of service lift can be somehow blocked. A blocked rescue route is an event where:

- A person is unconscious inside the service lift, blocking the bottom hatch,
- the rescuer is below service lift, and
- the service lift is stopped halfway through a platform hole, blocking rescue route since platform has no extra hatch.

There shall be one rescue pendant control per WTG; and it shall be stored in the WTG bottom platform. A clearly visible sign shall indicate its exact location.

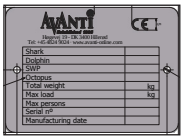
It features three buttons: UP, DOWN and emergency stop button. When necessary, pendant control is plugged to cabin bottom socket. It has a 4 m long cable that permits service lift to be powered up/down that same distance. When plugged, pendant control does not override any safety switch. If any of them is triggered, no running will be possible; including the obstruction device switches (S1 and S2). Therefore, there is no risk of moving service lift hitting rescuer. Pendant control overrides cabin control box, and service control box if installed.

3.6.23 Information signs and documents

The manual and quick guide are accessible from inside the cabin. The following documents, signs and labels are supplied with the service lift and shall always be available.

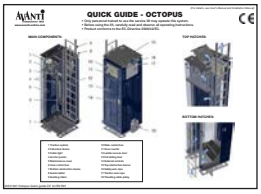
A rescue pendant control emergency sign shall be present at the bottom platform, clearly indicating storage location of rescue pendant control.

Location	Document
Cabin	Serial number plate
	Manual document inside blue bag
	Quick guide document
	Use of PPE label sign
	Working load limit / Nº persons label
	Manual descent label
	Fall arrest deactivation label
	Fall arrest activation label
	Main door guardlocking label
Main control box	Wiring diagram
	No standing on top prohibition label
	Electrical hazard warning label
Bottom platform	Rescue pendant control emergency sign



Serial number plate

Manual document



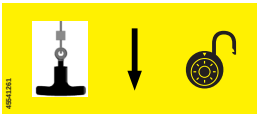
Quick guide document

Use of PPE label

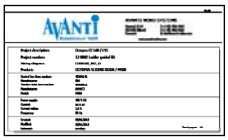
Working load limit / Nº persons label

Manual descent label

Main door guardlocking label



FAD de/activation labels



Wiring diagram

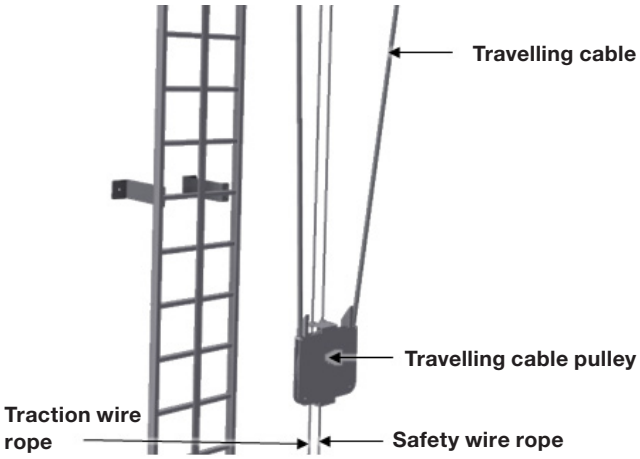
Electrical hazard warning label

No standing on top prohibition label

Rescue pendant control emergency sign

3.6.24 Travelling cable pulley

Travelling cable is connected from power supply socket over mid tower´s height platform to service lift socket and it is provided with a cable relief on each end. A travelling cable pulley is suspended on the cable and is guided along the traction and safety wire ropes.



The travelling cable pulley straightens the cable at all times.

4 Installation

4.1 WTG integration requirements

WTG component	General integration requirements	
Power supply	Power supply type	3 Phase + PE + N
	Voltage (50 Hz)	400 V / 690 V ± 5 %
	Voltage (60 Hz)	400 V / 480 V / 690 V ± 5 %
	Fuses	16 A
	Protection	Acc. To EN 60204 – 1
	Location of power supply connection for service lift	Over mid tower´s height
Platforms	Distance from rung center to platform outer edge for platforms over mid tower	1035 mm [1]
	Distance from rung center to platform outer edge for platforms below mid tower	1105 mm [1]
	Hole width for L95	1070 mm
	Hole width for L80	920 mm
	Minimum clearance around service lift	60 mm
Basement	Minimum height	600 mm [2]
Platform fences	Height	1.1 m
	Compliant to requirements of standard	EN 14122
	Fence door interlock system	Trapped key system
Safety ladder	Max. total travel height for L95	125 m (typical 140 m tower total height)
	Max. total travel height for L80	135 m (typical 150 m tower total height)
	Max. angle between ladder axis and vertical axis	± 2º [2]
	Max angle variance between ladder sections	± 1º [2]
	Max. distance between brackets	2240 mm [2]
	Forces capable to withstand by ladder brackets	Upon request to AVANTI
	Forces capable to withstand by ladder sections	Upon request to AVANTI
	Ladder width for Octopus L80	520 mm [2]
	Ladder width for Octopus L95	490 mm [2]
	Standard stile profile dimensions	74 x 25 mm [2]
	Rung dimensions	29 x 27 mm [2]
Top beam	Forces capable to withstand by top beam	Upon request to AVANTI
	Max. thickness of top beam for 2 Tn shackles (C shape)	20 mm
	Min. distance between top platform and top beam shackle holes	3000 mm [2]

[1] Depending of travel path, dimension may need to be larger in order to avoid collisions of travelling cable pulley with platforms.
[2] Other dimensions are possible upon request and design verification by AVANTI.

The WTG manufacturer shall put in place any other means necessary to ensure the safe use of the service lift according to AVANTI recommendations and its own risk assessment for the integration that shall include items which are not under AVANTI´s scope.

The Octopus service lift is designed for a lifetime of 20 years with a frequency of use of approximately 12.5 h / year or 250 h during life. In case frequency of use is higher, service, inspections and replacement of components might be more often, according to the replacement criteria stated in the maintenance instructions.

4.2 Service lift assembly

4.2.1 After transport

The service lift is transported in parts.
Once at destination, the service lift parts shall be assembled according to assembly drawing AD00067 for L95 and AD00068 for L80.

4.2.2 Before transport

Alternatively, the service lift can be transported already assembled.
Once at destination, the pre-assembled lift shall be extracted from the packaging by means of a crane and the lifting eye bolts.

4.3 Cautions

Prior to installation, ensure that:

- Building sections involved will be able to withstand the service lift loads.
- All parts are available and fully functional.
- Travel zone is protected by fences at each platform.
- Walking way surfaces are dry and not slippery.

The customer must define the maximum allowable wind speed ensuring safe installation.

During installation tasks, personnel shall:

- Wear at least the following PPE: fall arrest equipment if falling height is higher than 2 m, hand gloves, helmet, safety glasses, working gear.
- Use a hand winch attachable to the ladder when elevating heavy weights.
- Use a cable clamp or grip when lowering traction and safety wire ropes.
- Not work at different levels if tasks involve risk of falling objects.

Installation shall be performed by AVANTI or trained personnel by AVANTI. At the end of the workday security measures must be taken to put the service lift out of service and make the ladder accessible.

4.4 Service lift installation

The WTG manufacturer shall provide 3D drawings to ensure that installation of lift on ladder is possible.

4.4.1 After tower erection

The service lift is installed on to the ladder after tower erection.

1. Mount safe zone plates, top limit plate and rest platforms on ladder, according to installation drawing ID00112.
2. Fit the nuts and bolts to the shackles, and lock with cotter pins.
3. Mount traction and safety wire ropes (Ø8 mm) using the shackles supplied for the top beam at the top of the tower.
4. Follow instructions from chapter “4.5 Electrical connections on-site” onwards.

4.4.2 Before tower erection

Alternatively, the service lift can be installed on to the ladder before tower erection. With the tower section lying horizontally:

1. Mount safe zone plates, final limit activation plates and rest platforms on ladder, according to installation drawing ID00112.
2. Fit the nuts and bolts to the shackles, and lock with cotter pins.
3. Mount traction and safety wire ropes (Ø8 mm) using the shackles supplied for the top beam at the top of the tower.
4. Attach coiled wire ropes to top beam by means of cable strips to prevent them from moving during transport of tower section.
5. Position service lift on ladder at bottom platform, by means of a crane and the lifting eyes, and according to dimensions of installation drawing ID00112.
6. Mount fixing set for transport to prevent lift from moving during transport of tower section.
7. The tower sections shall be transported to the wind farm.
8. After tower erection takes place, follow instructions from chapter “4.5 Electrical connections on-site” onwards.

4.5 Electrical connections on site

Before making any connection, disconnect any power supply to the service lift and the fence interlock system; and verify with WTG responsible.

The electrical connection of the traction hoist must be made in accordance with EN 60204-1.

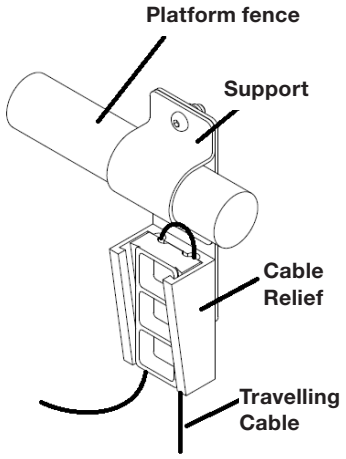
The power supply must be protected by a fuse and against indirect contacts according to local regulations.

Verify that the rated grid and motor voltages are identical.

Electrical system shall be properly insulated.

4.6 Travelling cable

1. Install power supply socket over mid tower´s height platform; and install a cable relief on the platform fence.



2. Feed travelling cable through the cable relief, without plugging it to power supply socket!
3. Uncoil the cable to the bottom platform.

The travelling cable must be evenly uncoiled to prevent looping.

4. Plug travelling cable outlet directly to service lift (provisional connection).
5. Plug travelling cable inlet to power supply socket over mid tower´s height.

4.7 Traction wire rope

1. Uncoil both wire ropes to the bottom of the WTG.

All wire ropes must be evenly uncoiled to prevent looping.

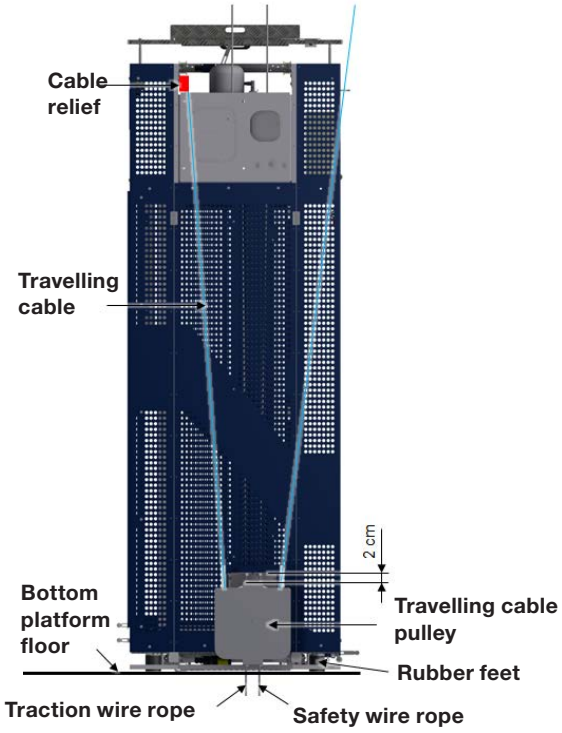
2. Check that traction and safety wire ropes are not crossed.
3. Feed the traction wire rope through the roof into the traction hoist inlet opening.
4. Push the UP button of cabin control box to continue feeding wire rope through until the hoist starts pulling.
5. Open maintenance cover and feed wire rope through guide bushing of service lift.
6. Feed through guide bushing of travelling cable pulley.
7. Feed through the platform hole (see ID00112 for hole´s position).
8. Attach an 11 kg counterweight to it at least 600 mm below the bottom platform.
9. Coil and fasten remaining wire rope with at least 3 cable ties.
10. Check that wire rope and counterweight are able to rotate freely.

4.8 Safety wire rope

1. Feed the safety wire rope through the roof into the fall arrest device inlet opening.
2. Pull the wire rope through while turning the fall arrest device release lever clockwise.
3. Open maintenance cover and feed wire rope through guide bushing of service lift.
4. Feed through guide bushing of travelling cable pulley.
5. Feed through the platform hole (see ID00112 for hole´s position).
6. Feed the wire rope through the compression spring.
7. Fasten cable ties to the compression spring, and adjust them to compress the spring.
8. Pre-tension the safety wire rope by hand as much as possible and fasten the wire lock.
9. Cut the cable ties that keep the spring compressed. The spring will apply a tension of approximately 40 kg to the safety wire rope.

4.9 Travelling cable pulley

1. Turn the override key of bottom obstruction device switch (S2).
2. Manually descend service lift until rubber feet reach bottom platform floor.
3. Unplug travelling cable inlet from power supply socket over mid tower´s height, leaving it attached with the cable relief.
4. Unplug travelling cable outlet from service lift socket.
5. Demount plug head from cable and adjust cable length by cutting off excess.
6. Feed cable through pulley until it is positioned 2 cm from service lift wire rope bushings.
7. Feed cable through cable relief, mount plug and plug it back to service lift.
8. Plug travelling cable inlet from power supply socket over mid tower´s height.



4.10 Safe zone plates and top limit plate

Adjust the final position of the safe zone plate on each platform, so that the service lift floor is levelled with the platform floor when it stops.
Adjust the final position of the top limit plate so that the service lift floor is levelled with the top platform floor when it stops.

4.11 Inspection before first use

A service lift inspector must carry out an inspection before first use following the Annual inspection procedure and filling in the Inspection checklist.

Inspection shall only be carried out by AVANTI, or an authorized person, following the Annual inspection procedure.

And filling in the Inspection checklist for future possible reference.

The WTG owner must ensure that the results of this inspection before first use are logged in the Operation log sheet.

4.12 Disassembling

In accordance with local authority regulations disassemble in reverse order and dispose.

5 Instructions for use

5.1 Prohibited uses

The consequences of not following below prohibitions are extremely hazardous to the physical integrity of the users.

When using the service lift it is prohibited to:

- Use the service lift beyond its intended purpose.
- Operate the service lift without following the safety warnings and operating instructions.
- Overload the service lift more than its rated load.
- Try to repair machine components. Only personnel from AVANTI or competent persons certified by AVANTI are allowed to perform service on the machine.
- To use the ladder while service lift is being used.
- To use the ladder, unless service lift is out of service, or in case of evacuation or rescue.
- To place objects on service lift roof.
- To descent on service lift roof.

5.2 Normal use

1. Connect power supply.
2. Open fence and service lift doors.
3. Enter cabin.
4. Close fence door.
5. Remove trapped key from fence.
6. Close service lift door.
7. Insert trapped key in cabin control box, and turn to ON position.
8. Press and hold UP or DOWN button to travel.
9. After use, disconnect power supply.

5.3 Send function

- Push external DOWN button of cabin control box to send the service lift to bottom platform.
- Push external UP button of cabin control box to send the service lift to top platform.

5.4 Enter and exit cabin through door

1. Hook up your shock absorber to an anchor point every time the service lift door is open.
2. Be aware of tripping risk if service lift floor is not perfectly aligned with platform floor.

5.5 Emergency stop button

1. Press the emergency stop button to interrupt any control function.
2. Pull to reset the control after necessary verifications.

5.6 Fall arrest device

1. Pull the red locking knob downwards to manually engage the fall arrest device in case of an emergency.
2. Pull the black unlocking knob downwards to release the fall arrest device.
3. If the fall arrest device cannot be released, ascend the service lift a few centimetres to remove the load on the safety wire rope.

When a fall is arrested, service lift is exposed to dynamic loads. Inspect and replace damaged wire ropes, wire rope fastenings fall arrest device and guiding system (including ladder).

5.7 Manual descent

Manual descent shall only be done in case it is strictly necessary.

To ensure a safe manual descent, personnel shall use walkie-talkies between them.

1. Verify that the fall arrest device is released.
2. In case it cannot be released, evacuate the service lift following the evacuation procedure.
3. Check that there are no obstacles or persons in the travel zone.
4. Take the manual descent actuator from its holder.
5. Push and hold the manual descent actuator upwards.
6. Position service lift at bottom platform.

5.8 Out of service

1. Secure service lift bringing it all the way down, until bottom normal switch is engaged.
2. Disconnect power supply to prevent inadvertent operation of the service lift.
3. Place a warning sign: SERVICE LIFT OUT OF SERVICE. DO NOT USE.
4. Padlock as necessary.
5. Contact technical service for repair.

6 Maintenance

6.1 Planning

In order to guarantee that the service lift is ready to be used, scheduled inspections shall be carried out.

Before any maintenance operation, check that the service lift is properly out of service.

Frequency	Performed by	Components
Daily	User	Travel zone
		Control and safety devices
Annually	Authorised person by AVANTI	Travel zone
		Control and safety devices
		Cabin
		Traction system
		Fall arrest system
		Overload limiter
		Traction and safety wire ropes
		Guiding system
		Electric system
		Information signs and documents
		Doors and hatches
		Cabin control box
		Safety switches
		Interlock system
		Platforms
		Overall
Every 250 h of use	AVANTI workshop	Traction hoist
		Fall arrest device

In case of a fault, do not use the service lift until it is solved. If required secure workplace.

6.2 Cautions

Before any maintenance task, ensure that walking way surfaces are dry and not slippery.

During maintenance tasks, personnel shall:

- Wear at least the following PPE: fall arrest equipment (when falling height is more than 2 m), hand gloves, helmet, safety glasses and working gear.
- Place cabin at bottom platform and disconnect power supply.
- Use an electricity measuring tool when performing inspection of electrical components.
- Use a hand winch attachable to the ladder when handling big/ heavy loads and shall be performed at least by 2 persons.
- Panel parts shall be removed to facilitate access to confined spaces.
- Guiding rollers shall be replaced one by one.
- Use a cable grip when replacing travelling cable.
- Keep cabin doors closed when using a 3-step ladder.
- Dismount hatch to access the engine room.
- Ensure that no one is working above them and secure ladder part against fall with two ropes when replacing a ladder section.

Only qualified technicians shall perform electrical installation tasks.

6.3 Daily inspection procedure

Inspect the travel zone, control and safety devices and control and safety devices of service tool kit, following the instructions of the Inspection checklist.

6.4 Annual inspection

6.4.1 Annual inspection procedure

Scheduled inspection is required every year. Although it may be required more frequently depending on frequency and conditions of use, and local regulations.

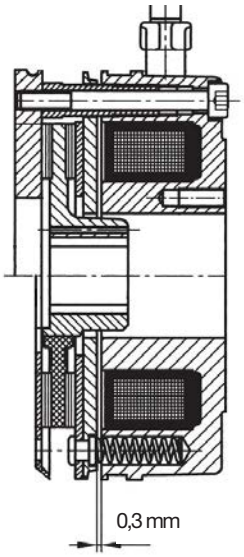
Annual inspection shall only be carried out by AVANTI, or an authorized person, following the Inspection checklist for future possible reference.

During the annual inspection all the components shall be checked to verify that they are mounted correctly, free of damage and that none are missing; in order to guarantee that the service lift can be used safely.

The WTG owner must ensure that the results of all annual and extraordinary inspections and tests are logged in the Operation log sheet.

6.4.2 Air gap between brake and disc

Check that air gap between brake and disc is 0.3 mm, using a thickness gauge.



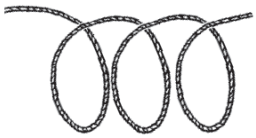
6.4.3 Common damages on wire ropes

Wire ropes shall be inspected as described in EN 12385-3 2004 + A1 2008, including, but not limited to, inspection of following common damages:

Kinks resulting from counterweight of traction wire rope not being able to rotate freely.

8 Wire strand breaks

Reduction of the Wire diameter



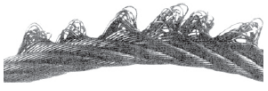
Wire strap/loop, which cannot be unwound

Loop knot forming when a wire loop is pulled tight

Bends resulting from inappropriate treatment (e.g. securing the load with the wire)

Damage resulting from crushing, squeezing, running over, etc.

Wire bags



Loop formation

6.4.4 Overload test

Load the service lift to 125% of its rated load. When an attempt is made to start the hoist, overload limiter should engage and prevent ascent, and the overload buzzer should sound.
In case overload limiter does not engage, follow procedure described in appendix of Regulation of overload limiter.

6.5 Spare parts

Only use original parts. Spare part lists are available from AVANTI upon request. Please, indicate service lift model.

6.6 Troubleshooting

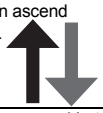
All tests and repairs to the electronic components shall be performed by authorized personnel only!

The wiring diagram is placed in the power cabinet.

Repairs to the traction hoist, the fall arrest device and to the system's supporting components shall be performed by qualified personnel only!

If these steps do not identify the cause and rectify the fault: consult a qualified authorized person or contact the manufacturer.

Breakdown	#	Cause	Specific cause	Solution
The service lift cannot ascend nor descend.  Attempting to use the lift will jeopardize work safety.	A1	An emergency stop button has been actuated.	-	Pull button to release it.
	A2	Wire rope loop in traction hoist.	Damaged or defective wire rope or wire rope outlet causes problems.	Stop work immediately. Ask supplier or manufacturer for help.
	A3	The fall arrest device is holding the service lift on the	Traction wire rope breakage. Traction hoist failure.	Evacuate service lift following procedure.
	A4	The service lift is stuck by an obstacle.	-	Carefully remove the obstacle. Test the operational safety of affected WTG and service lift components. Inform the supervisor.
				If obstacle cannot be removed: evacuate service lift. Test the operational safety of affected WTG and service lift components. Inform the supervisor.
	A5	Power failure.	Power supply is disconnected.	Connect power supply.
			Grid voltage interrupted.	Find the cause and wait for the power to return.
			Supply between grid connection and control interrupted.	Test, and repair or replace, connections, wiring and fuses.
			Slack rope sensor1) is engaged. 1)Note: Optional feature. Mandatory for AECO versions.	Test slack rope sensor´s functionality.
	A6	A safety switch is engaged.	Top limit switch (S13c) is activated.	Manually descend service lift until switch is released.
			Main door guard locking switch (S19.3) is activated.	Close door.
			Ladder access door switch (S19) is activated.	Close door.
			A top hatch switch (S51 & S53) is triggered.	Close hatches.
			A bottom hatch switch (S52 & S54) is triggered.	Close hatches.
			Manual descent switch is activated.	Adjust manual descent switch so that it is not involuntarily activated.
	A7	Overheating protection switch is activated.	A phase is missing.	Test, and repair or replace, connections, wiring and fuses.
			Motor is not cooling.	Clean the motor cover.
			Voltage too high/low.	Measure voltage and power consumption on the loaded motor. If voltage deviates from specifications, use cable with increased dimensions.
	A8	Electromagnetic motor brake does not release (no click sounds when UP or DOWN	Power supply failure. Braking coil or rectifier is defective. Braking rotor does not open.	Have an authorized person test, and repair or replace, the traction hoist.
	A9	The trapped key is not present or the trapped key switch is in the OFF position.	-	Insert the key and turn it to the ON position.
	A10	The guard locking switch is not functioning properly.	-	Test, and repair or replace, defective or damaged components.
		Slack rope is engaged.	-	Check the slack rope sensor1) connection/function. Replace if necessary. 1)Note: Optional feature. Mandatory for AECO version.
	A11	Overload buzzer sounds.	Service lift is overloaded!	Reduce load until buzzer stops.
	A12	Two phases are changed in the power supply.	Phase monitor relay interrupts control.	Have an authorized person switch the 2 phases in the plug.
	A13	Rescue pendant control is plugged.	It overrides cabin control box.	Use rescue pendant control in case of rescue event. Otherwise, unplug pendant control.

Breakdown	#	Cause	Specific cause	Solution
Service lift can descend but cannot ascend. 	B1	The service lift is stuck with an obstacle over it.	Top obstruction device is engaged.	Carefully move the service lift downwards and remove the obstacle. Test the operational safety of affected WTG and service lift components. Inform the supervisor.
	B2	Top final limit stop switch is activated.	Switch is defective.	Test, and repair or replace, top normal limit switch.
			Service lift has reached upwards travel limit.	-
	B3	A phase is missing.	-	Test fuses and power supply.
	B4	Fault in UP control circuit.	-	Test, and repair or replace, connections, wiring and relays.
Motor hums loudly or wire ropes squeak, but the service lift can ascend and descend. 	C	Wire ropes are dirty.  Further use of service lift may result in damage to the traction hoist.	-	Clean wire ropes. Test, and repair or replace, traction hoist at AVANTI.
Service lift can ascend but cannot descend. 	D1	The service lift is stuck with an obstacle below it.	Bottom obstruction device is engaged.	Carefully move the service lift upwards and remove the obstacle. Test the operational safety of affected WTG and service lift components. Inform the supervisor.
	D2	The fall arrest device is holding the service lift on the wire rope.	Traction hoist speed is too high.	Ascend service lift to free safety wire rope. Release fall arrest device by pulling black
			Triggering speed of fall arrest device is too low.	 A defective fall arrest device will threaten the safety of the service lift! Replace it immediately!
	D3	Fault in DOWN control circuit.	-	Manually descend service lift. Test, and repair or replace, connections, wiring and relays.
		The slack rope sensor is holding the service lift on the traction wire rope.	The device has engaged.	Ascend service lift to disengage the device.
			The device is not properly installed.	Have a competent technician adjust the device correctly.
			The device is defective.	Send device to AVANTI to test, repair or replace.
OK lamp does not illuminate although operation is normal. 	E	The OK lamp is defective.	-	Have an authorised person replace it.

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