AVANTI
Established 1885

AVANTI SERVICE LIFT

User's, Installation and Maintenance Manual

Model Service Lift Pegasus

CE

CERTIFICATE

EC Type Examination

EC Directive 2006/42/EC, Article 12, Paragraph 3b

Machinery

Certificate Registration No.: 01/205/0823/12

Certification body for machinery NB 0035
of TÜV Rheinland Industrie Service GMBH
hereby certifies the company

AVANTI WIND SYSTEMS, S.L.

Pol. Ind. Centrovía – c/ Los Ángeles, nº88

E-50196 La Muela, Zaragoza

España

Conformity of the product

Vertical Platform Service Lift
Inside Wind Turbine Systems
Type: PEGASUS-250 kg

Technical data:

Ident. No: 20LP0001
Type of drive: Electric / Pinion-Rack
Max. Lifting height: 150 m
Máx. load capacity: 250 kg / 2 People
Máx. Lifting speed: 0,33 m/s

with the requirements defined in Annex I to Directive 2006/42/EC on machinery and amending Directive 95/16/EC of the European Parliament and the Council in May 2006 on the approximation of laws, regulations and administrative Member States relating to machinery.

Proof has been executed on the basis of an EC Type Examination, Report No.: AE.COL.00022-12 from 01.04.2012, and is valid subject to compliance with the requirements stated in this document.

This certificate is valid until 14.09.2017

Berlin, 14.09.2012

TÜVRheinland® 0035 Notified Body

Certification body
Notified under No. 0035
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Genau. Richtig.

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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.

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 Avanti service lift (“Product”) 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 be taken as authoritative.

* Avanti service lift (“Product”)

2. Explanation of symbols used in this manual

2.1 Symbols used in this manual

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	

2.2 Cautions

CAUTION!
Avoid injury – follow all instructions!

a) 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.

b) 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.

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

d) Access to cabin shall be done in pairs carrying reliable communication equipment and each user shall at all times wear PPE (safety helmet, full body harness, shock absorber, lanyard and slider).

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

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

DANGER!

g) Whenever installation, ascending, and/or descending involve a danger of falling, all personnel inside the danger area must wear personal protective equipment which will prevent them from falling by means of a safety system secured to the building.

h) Only pinions, ladder rack, motor groups, overload detections system or original control system may be used.

i) Electrical connection of the system must be made in accordance with EN 60204-1 which shall include necessary protection against indirect contacts according to the earthing system being used.

j) Prior to mounting all parts must be tested to ensure their completeness and full functionality.

k) Self-locking nuts must be used at all times and the following must always be observed:
a. The screw must extend from the nut by at least half of the thread diameter.
b. The nut may not be used once it has become possible to loosen by hand!

l) If any damage or faults are found during operation, or if circumstances arise jeopardizing safety:
a. Immediately interrupt the work in progress and notify the supervisor or employer!

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

n) All repairs to the motor group: gear box, centrifugal brake, motor brake and instead of supporting parts may be performed only be qualified fitters.

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

p) Use of non-original parts will render the manufacturer's warranty void and make the CE approval invalid. This particulary applies to the motor group.

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

r) 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.

s) Before using the lift an inspection by the authorised security organisation must be carried out.

t) The lift must be inspected at least once a year by an expert being trained by AVANTI. The Pegasus service lift is designed for a lifetime of 20 years with a operating frequency of approximately 12.5 h/year of 250 h during lift. In case of the operating frequency is higher, service and inspections are required and replacement of components might be necessary according to the replacement criteria stated on the maintenance manual.

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

v) Do not use the service lift in case of more than 18 m / s wind speed.

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

If the service lift is not in the platform, the routes of entry and exit to the turbine ensuring compliance with the preventive measures to avoid falls from the landings, must be insured by the wind turbine manufacturer.

3. Description

3.1 Purpose

The Service Lift described in this User's Manual serves the following purposes:
- Transportation of staff and material inside wind turbine systems.
- Transportation for mounting, inspection and repairs.
The service lift may be used to transport persons plus their tools and equipment to the most convenient height for performing work on the tower.

3.2 Scope

The system consists on a rack and pinion service lift guided along a metal ladder and the necessary accessories allowing the connection to the tower and providing the control and safety functions described in the manual. The accessories include: mast supports (ties to the tower brackets), rest platforms, mechanical stops, safe zone plates, control stations and other electrical equipment. It also includes the hardware necessary to make the connections, labels and warning signs.
The mast sections, their supports and related accessories may be assembled to the tower in the tower factory and supplied later on site for final installation. The cabin is supplied pre-assembled and may be supplied to the tower factory or on site directly. Final assembly, adjustment, installation and verification of the service lift shall be made on site.
The installation of the service lift shall only be made by the manufacturer or by a company trained and authorised by the manufacturer.
The system, as defined on this scope, is part of machinery falling under Annex IV, section 17 of the European Machinery directive and meets the essential health and safety requirements. A declaration of conformity of the complete system integrated in the wind tower can only be issued after the system has been fully incorporated. In case the necessary information for the evaluation is not supplied to Avanti, a declaration of incorporation shall be issued. The wind tower manufacturer is responsible for ensuring full compliance of the system once integrated in the tower in such case. To do so, the instructions and requirements stated in this manual shall be observed.

3.3 Exclusions

Please read Cautions section for limitations and exclusions of the service lift operation of the service lift.

The service lift must not be used outdoor or in potentially explosive atmospheres.

The equipment listed below is specifically out of the scope and is needed for the safe integration and use of the service lift. It shall be evaluated on the tower manufacturer's risk assessment on its integration study, designed and supplied as necessary:
- Fences to protect users from falling through the service lift hole at landings. They shall at least comply with EN 14122-3, have non slipping rails or steps facilitating access to the lift at landings and have no doors.
- Interlock systems for landing doors or hatches (when existing) preventing any movement of the lift if the door or hatch are not closed and locked.
- Emergency lighting along the tower and user portable light / helmet light as cabin uses perforated sheet to allow tower light inside.

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

3.4 Technical specifications

3.4.1 General specifications service lift

Service lift		
Cabin type		Bucket type, front fence (1.1 m) with double door
Service lift speed		19.4 m/min ± 10 % (50 Hz)
		17.4 m/min ± 10 % (60 Hz)
Working load limit / Nº persons (max)		250 Kg / 2 Persons
Travelling height		150 m
Operating temperature	Standard	-15ºC to +60ºC
	Low temperature	-25ºC to +40ºC
Survival temperature		-30ºC to +80ºC
Traction system type		Rack and pinion
Max. noise level		80 dB (A)
Power supply		3 kW, 16 A
		3 Phase 400V, 50Hz / 60Hz
IP protection		min. IP 54
Control voltage		24 VAC

Note: for special working conditions, check with the manufacturer

3.4.2 Traction system specifications

Traction system / Motor group	
Power	2 x 1.5 kW
Gear box ratio	1 : 15 (50 Hz)
	1 : 20 (60 Hz)
Rack / Pinion module	6
Centrifugal brake limiting speed	24 m/min
Dimensions	220 x 225 x 580 mm
Weight by motor group	30 Kg
Motor speed	1400 rpm (50 Hz) – 1680 rpm (60 Hz)
Nominal current	2 x 3 A
Start current	2 x 15 A

3.4.3 Cabin dimensions

Cabin	
Cabin weight	225 Kg
Outer dimensions (W x D x H)	1060 x 715 x 2540 mm
Inner dimensions (W x D x H)	990 x 525 (680) x 2200 mm
Door opening (full) (W x H)	980 x 1120 mm
Top hatch dimensions (W x D)	600 x 400 mm
Bottom hatch dimensions (W x D)	600 x 400 mm

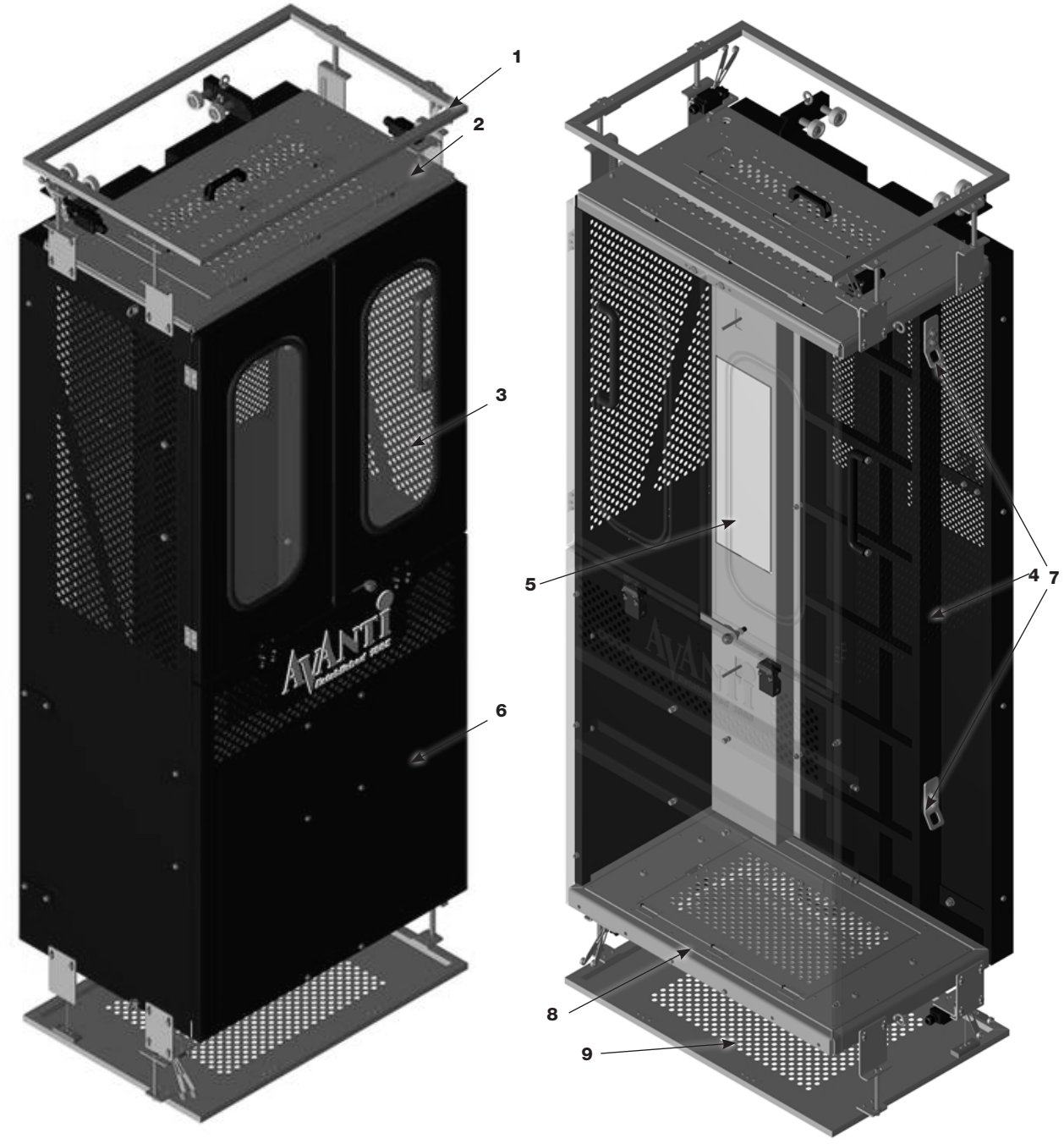
3.4.4 Power & control cable

Power & Control cable		
Type	Bottom platform to juction box	18 G 2.5
	Top platform to junction box	8 G 1.5
	Travelling cable	1 x 8 G 2.5 + 1 x 10 G 1.5
Travelling cable weight (approx.)		0.6 Kg/m

3.4.5 Mast sections

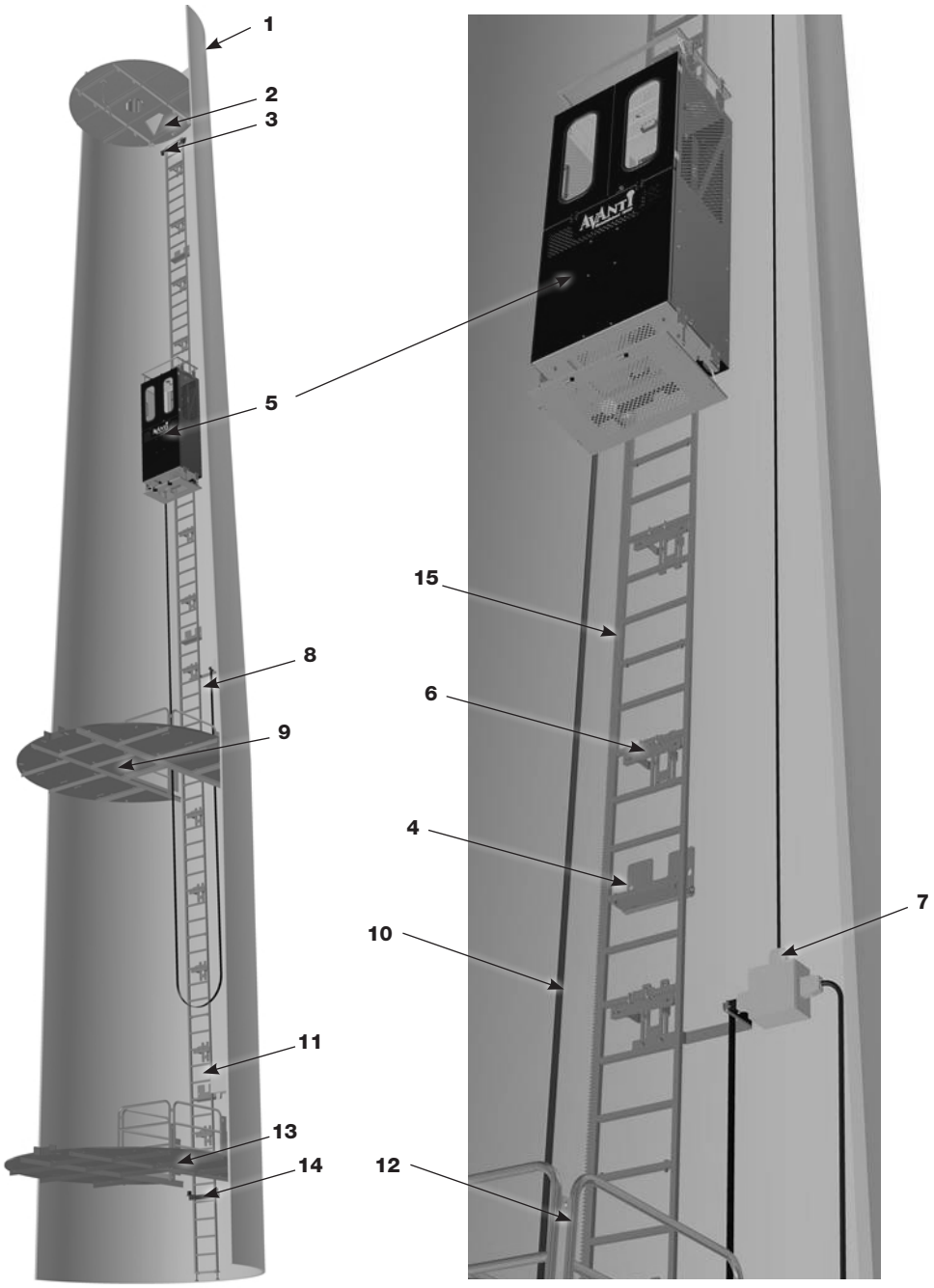
Ladder rack (Mast)	
Dimensions	530 x 30 x 1489 mm / 530 x 30 x 2978 mm
Weight (per piece)	15 Kg / 30 Kg
Attachment distance	1 per mast section, max. 3000 mm

3.5 Service lift overview



1. Top safety stop
2. Top hatch
3. Double door
4. Main frame
5. User control box
6. Fixed front
7. Anchor point for PPE
8. Bottom hatch
9. Bottom safety stop

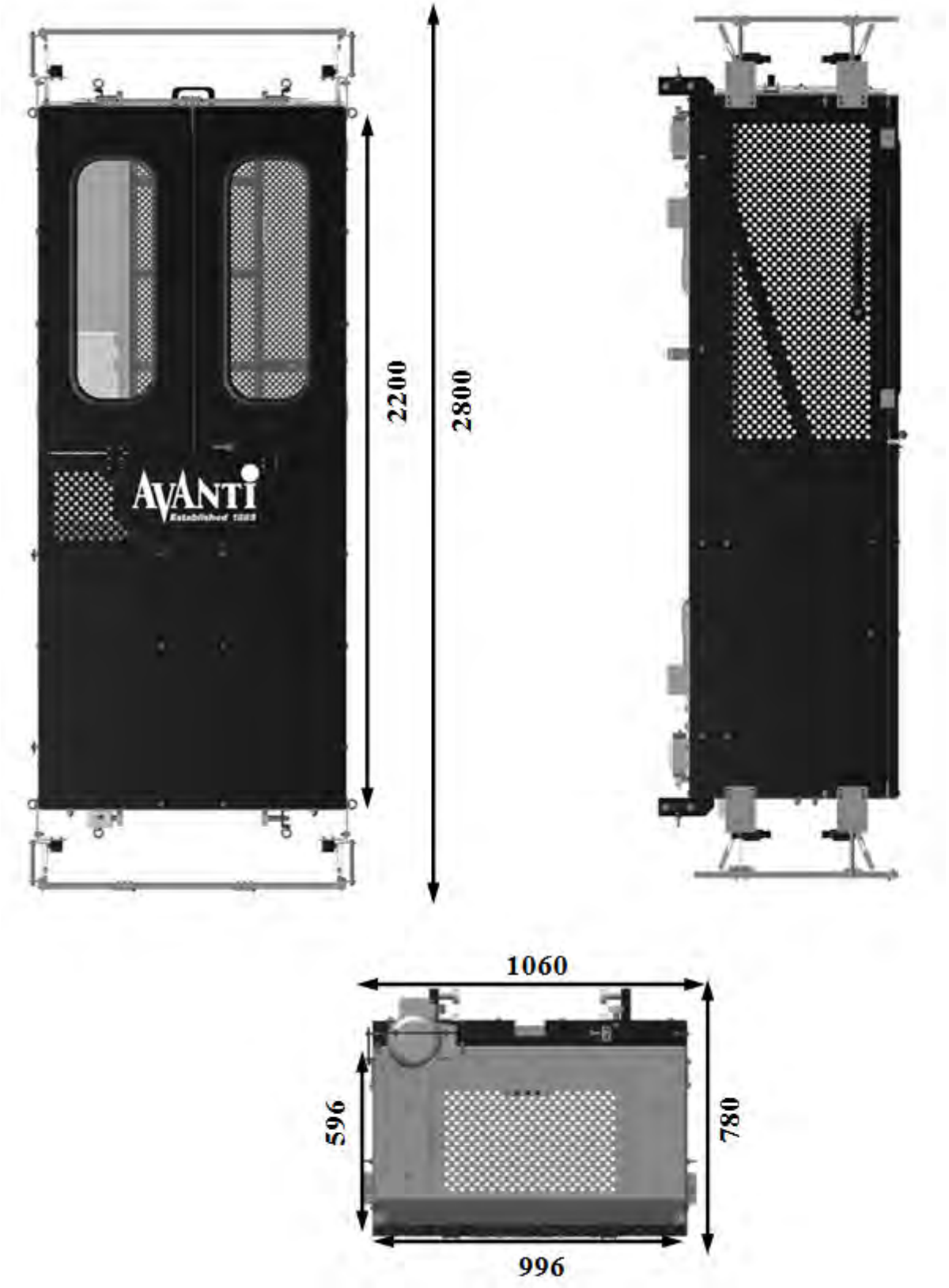
3.6 General arrangement of Pegasus lift inside a generic wind turbine tower



INTERMEDIATE ARM FOR ELECTRIC CABLE
This bracket is screwed to one of the anchorages of the installation at a suitable height to allow the proper reeving of the electrical cable.

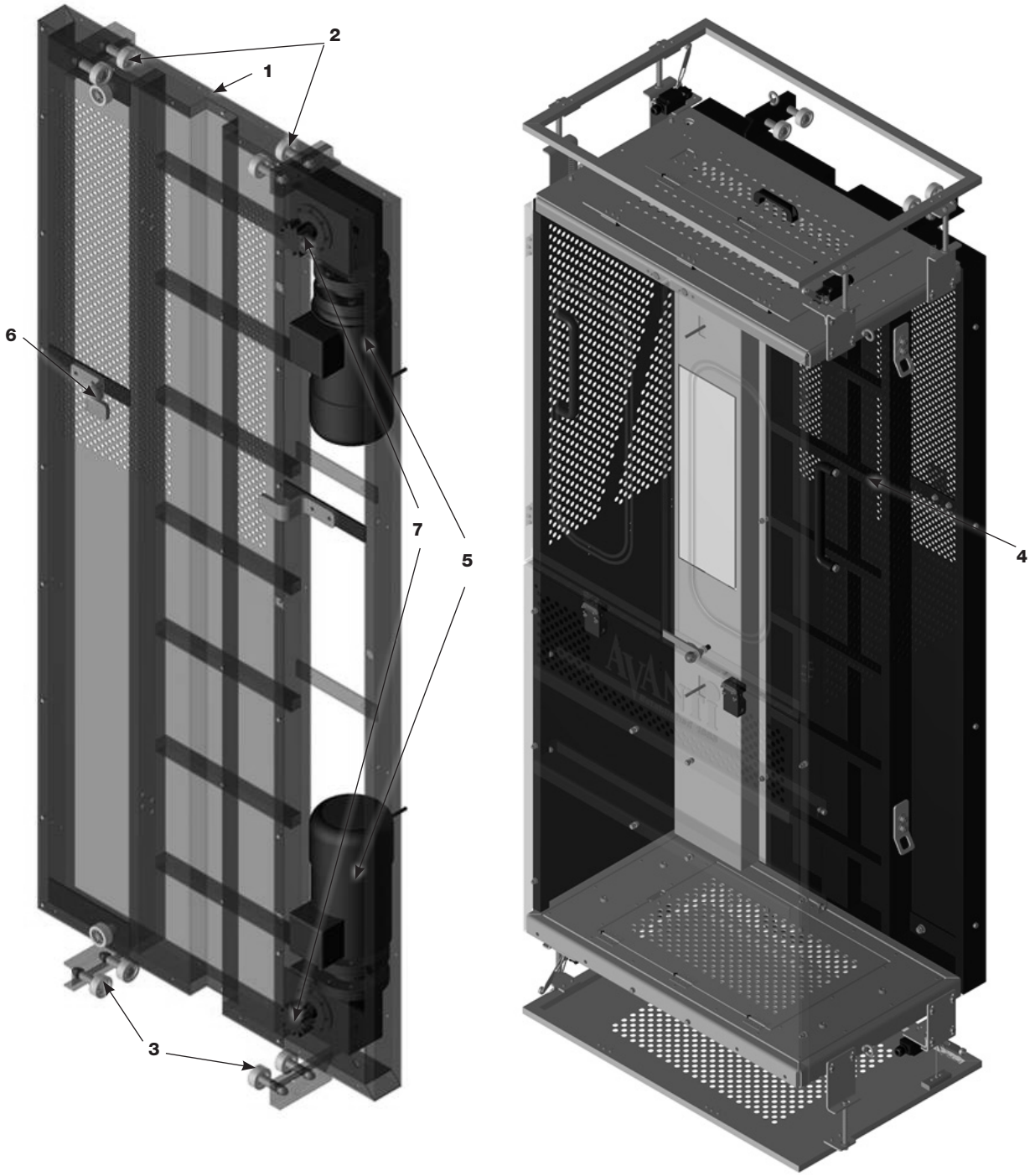
1. User control box in top platform
2. Top platform
3. Top mechanical stop
4. Rest platform
5. Pegasus service lift
6. Anchorages
7. Junction box
8. Intermediate arm for electric cable
9. Intermediate platform
10. Travelling cable
11. Bottom platform control box
12. Fence-railing
13. Bottom platform
14. Bottom mechanical stop
15. Ladder rack

3.7 Service lift dimensions



3.8 Main frame

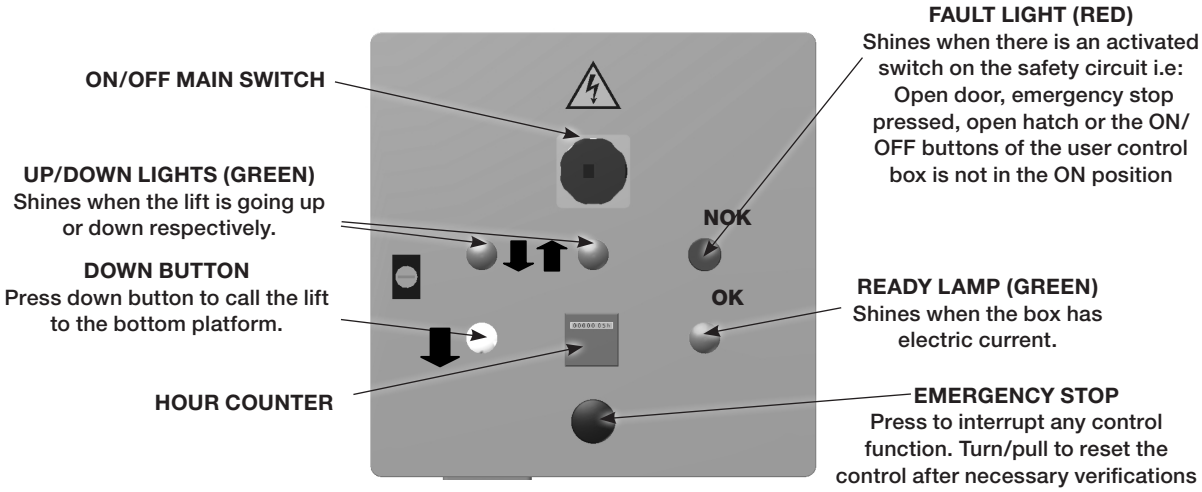
The main frame is a welded steel structure. The traction and guiding system are bolted to the main frame.



1. Main frame
2. Guiding rollers top
3. Guiding rollers bottom
4. Evacuation ladder
5. Traction system/ 2 Motor groups
6. Anti- derailment brackets
7. Pinions

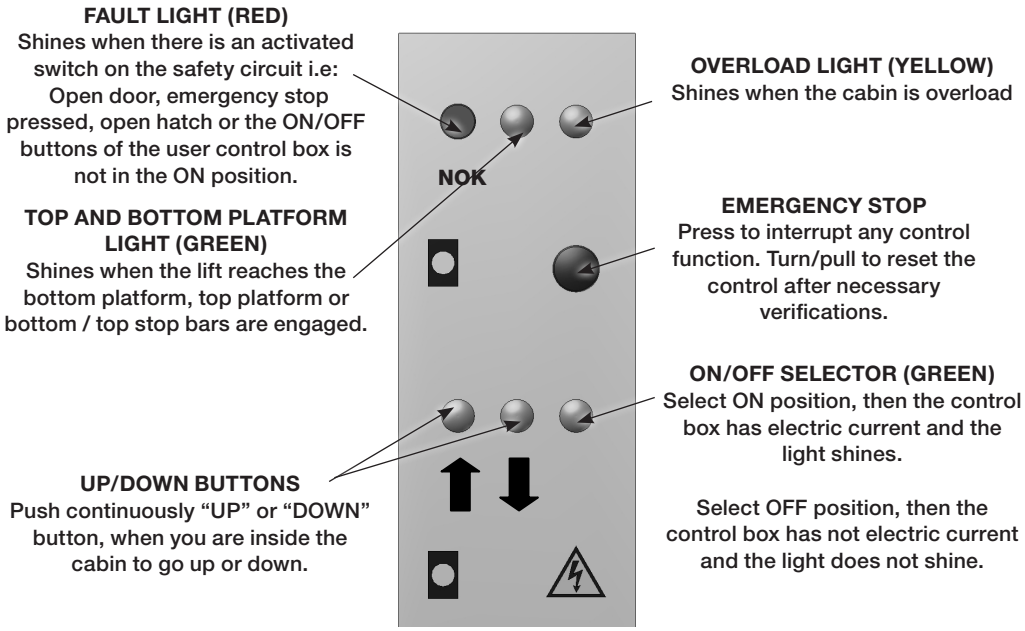
3.9 Controls

3.9.1 Bottom platform control box



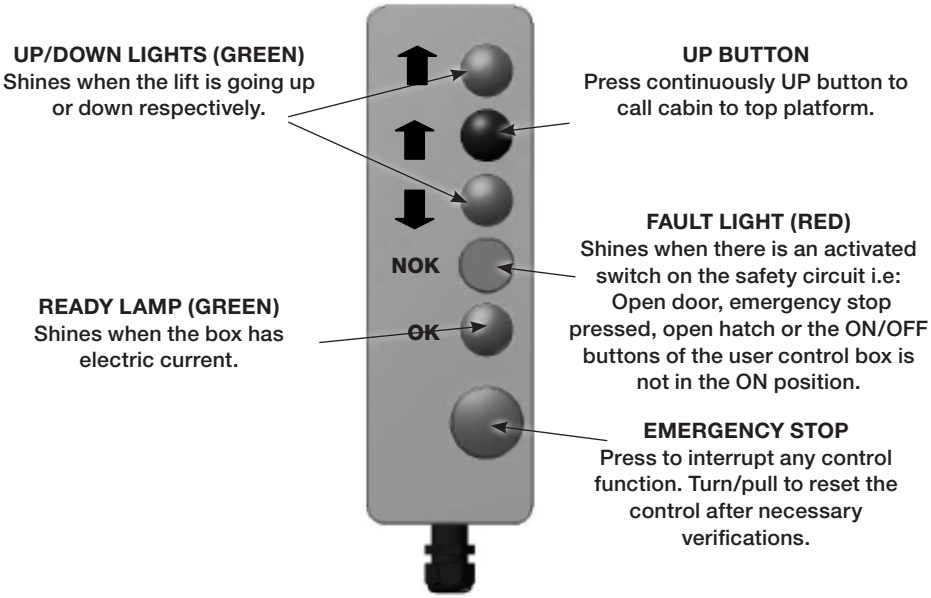
3.9.2 Cabin control box

IMPORTANT!
User control box inside the cabin has control priority over control boxes at platforms.

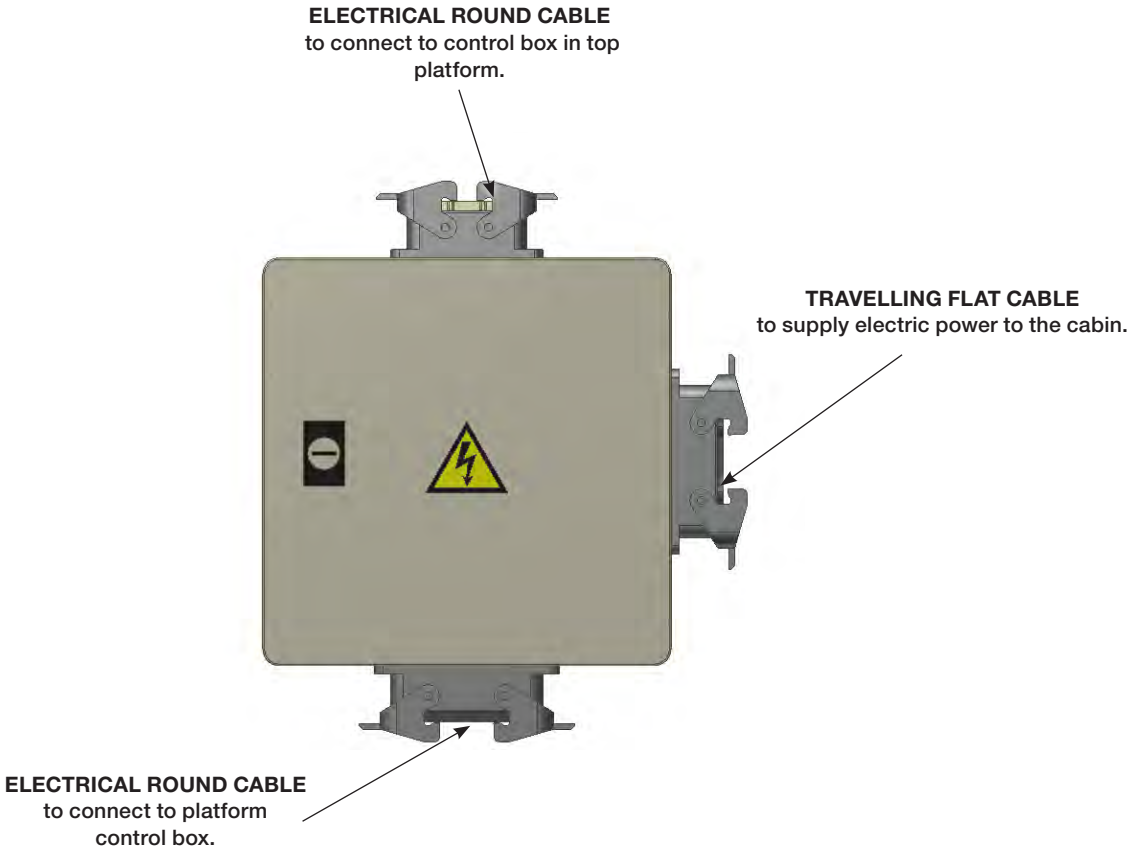


This button has priority over any UP/ DOWN BUTTON at the platforms.

3.9.3 Top platform control box



3.9.4 Mid tower junction box



3.10 Service lift doors

Main access to the cabin is done through the double door system installed in the front. The system consists of two folding doors that open outwards.

Each door has a door switch that monitors the closed function and stops or prevents any movement of the lift in case any of them is opened.

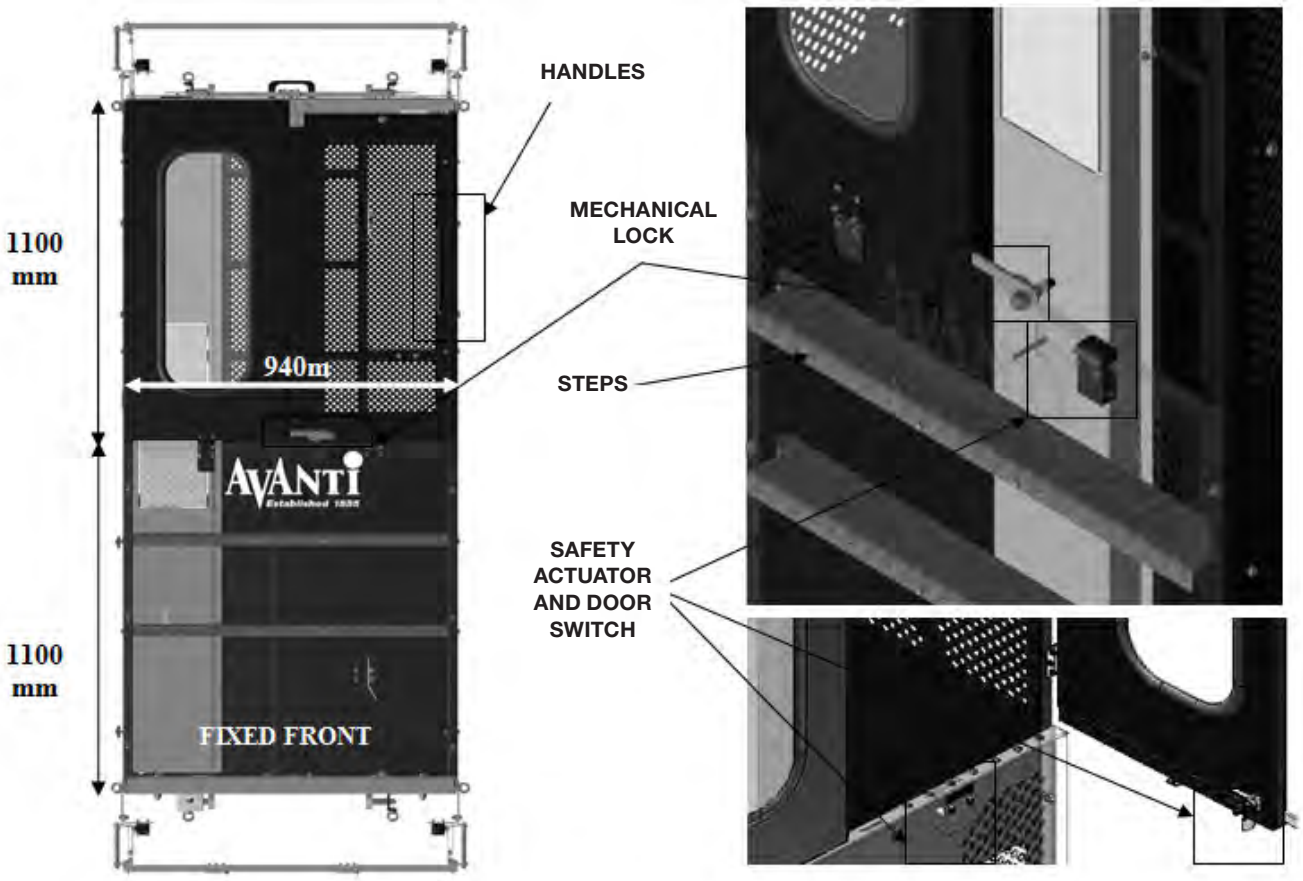
The doors can be opened at any time and the switch door automatically interrupts the control and the movement of the cabin.

A mechanical lock is also installed to lock the doors together to the fixed front.
To open the door: Slide the lock to the right and open the door.

To close the doors: Close the door and slide the lock to the left.
The doors can be opened in the same way from outside and inside the cabin. If the doors are not closed properly, the fault light shines.

The steps inside the cabin and the fence- railing of the tower have to be non-slipping surface to prevent the risk of falling.

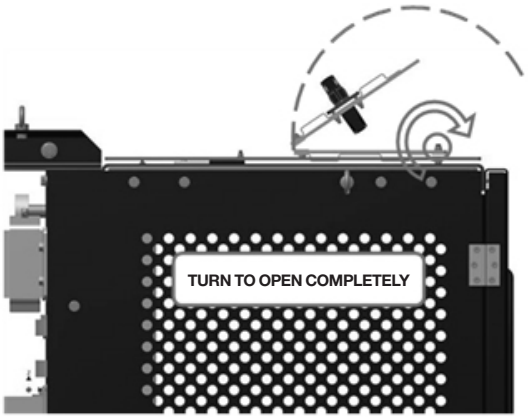
CAUTION!
When the door is open, user(s) MUST BE attached with the shock absorber to an anchor point.

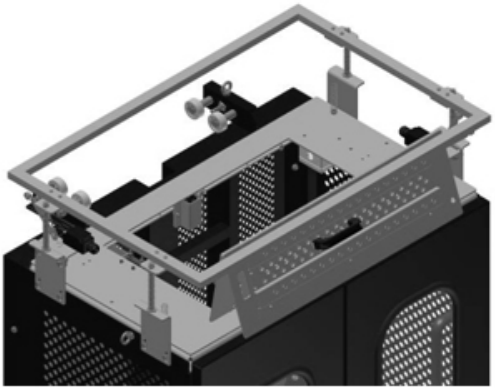


3.11 Top hatch

The service lift has a top hatch made of two sheets with hinges. This ensures that the hatch can be opened in 2 steps minimizing the necessary space over the service lift top to get it opened.

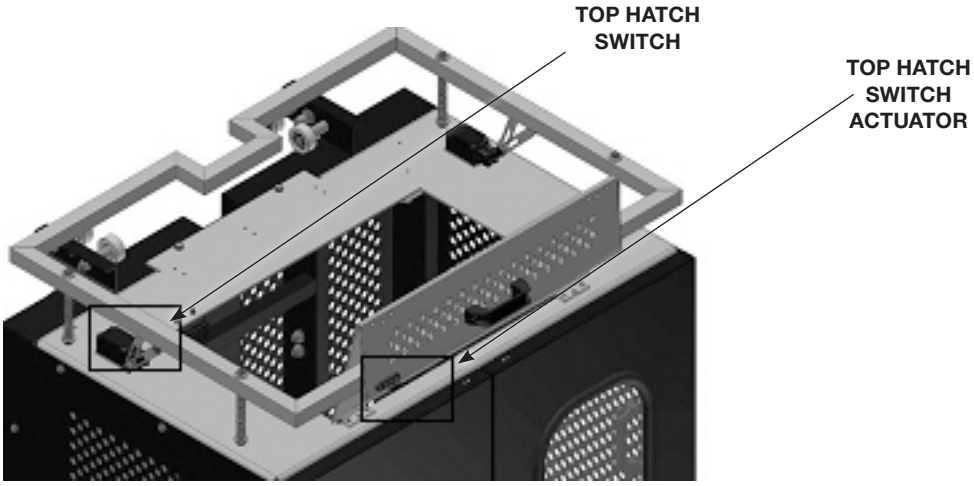
This hatch is used to evacuate the lift or access the top platform.



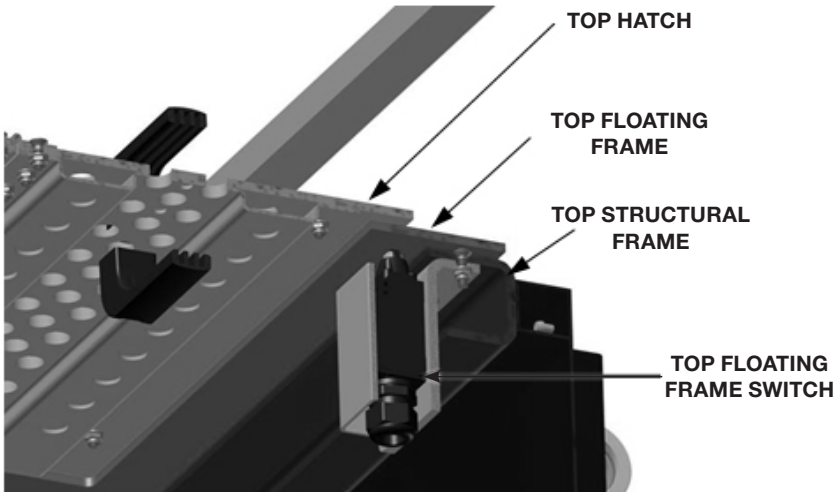


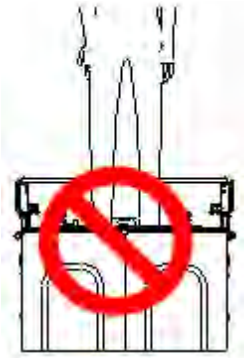
The dimensions of the hatch are 600 x 400 mm.

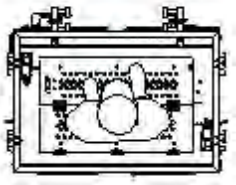
A switch with an independent actuator interrupts the control of any movement of the cabin if the hatch is open or not properly closed. In this case the fault light shines.



The Top hatch is mounted over a top floating frame. In case a person stands over the top floating frame, a switch will be triggered and any movement of the lift will be stopped. This will prevent misuse of the service lift like for example persons riding on top or overloading it.





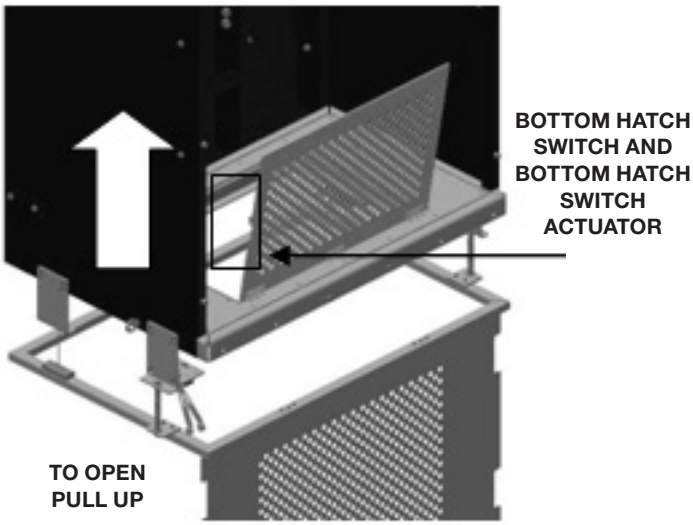


3.12 Bottom hatch

The service lift has a bottom hatch made of one sheet which is opened inwards the cabin. It can be used in case of evacuation. (SEE APPENDIX A)

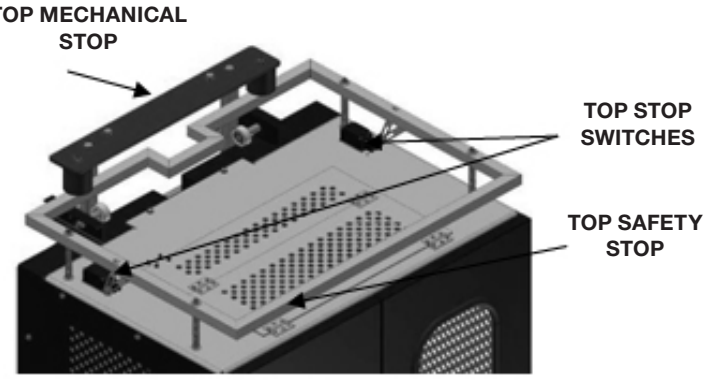
A switch ensures that the hatch is closed during operation. It interrupts the control of any movement of the cabin if the hatch is open or not closed properly. In this case the fault light shines.

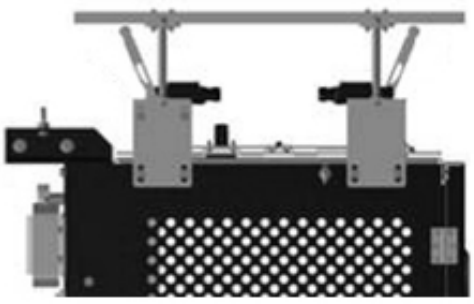
The dimensions of the hatch are 600 x 400 mm.



3.13 Top safety stop

The top safety stop will interrupt the up movement if:
1) Encounters an obstacle.
2) Reaches the top mechanical stop is installed on the top of the ladder.
Downward travel will be possible from any user control box, for instance to remove the obstacle after necessary verifications.



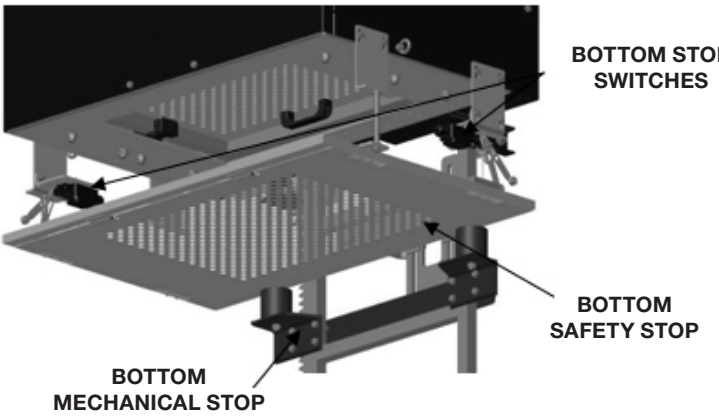


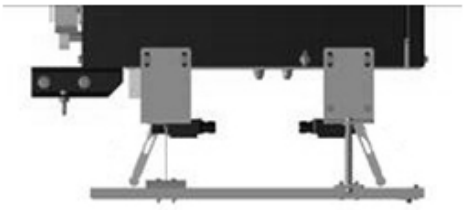
3.14 Bottom safety stop

The bottom safety stop will interrupt the up/ down movement if:

1) Encounters an obstacle.
2) Reaches the bottom mechanical stop installed on the bottom of the ladder.

Upward travel will be possible from any user control box, for instance to remove the obstacle after necessary verifications.





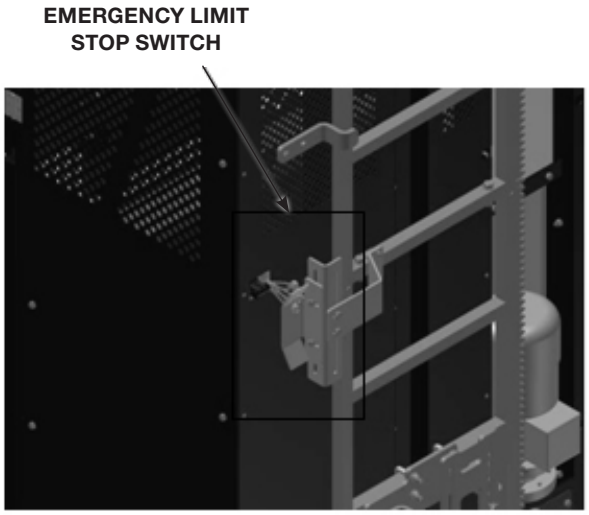
3.15 Emergency limit stop switch

Emergency limit stop switch interrupts the control if top stop limit switches fail.

To release the switch on the top plate: Perform manual descent some meters.

LOOK THROUGH THE PERFORATED FLOOR OF THE CABIN TO SEE IF ANYONE IS STANDING ON THE LADDER.

To release the switch on bottom plate: temporarily remove the switch lever and put the lever back afterwards and verify adjustment.

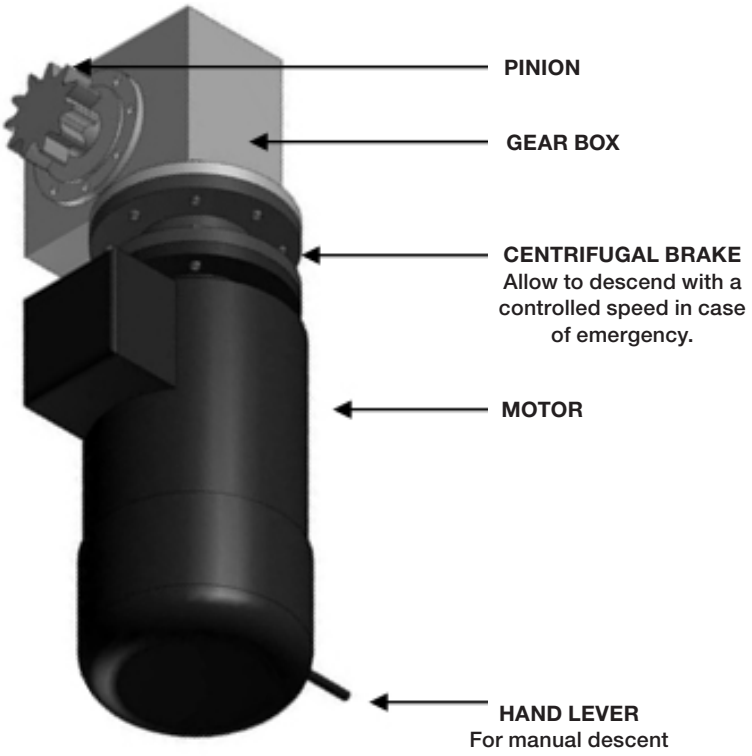


3.16 Top and bottom mechanical stops

Top and bottom mechanical stops including buffers are installed on top and bottom of the ladder to avoid derailment if the top stop/bottom stop and emergency limit stop switches fail.

3.17 Traction system

The traction system is rack and pinion type. The system has two motor groups working on the same rack. They are installed on the main frame of the cabin. Each motor groups has a centrifugal brake, gear box, pinion and a brake motor. Each motor brake includes a manual release lever allowing a manual descent in absence of electric current.

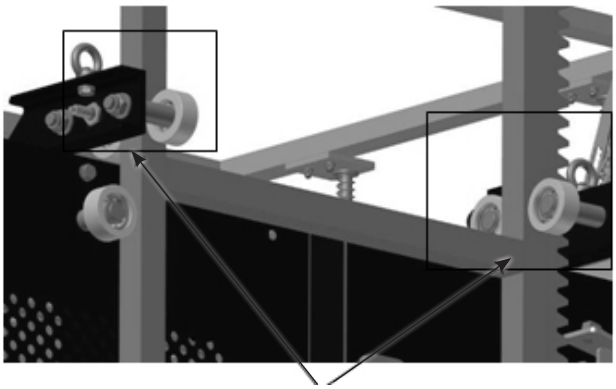


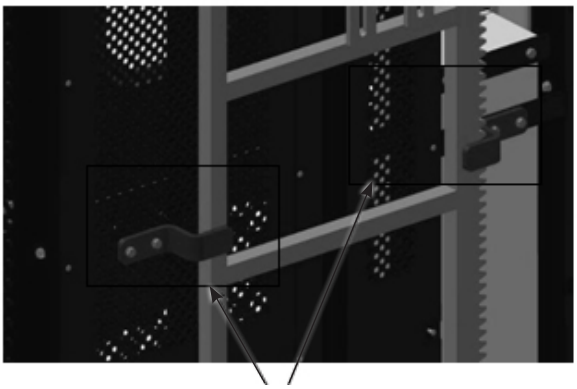
3.18 Guiding and anti-derailment system

The service lift has a guiding system based on rollers. The stiles of the ladder are the guides for the cabin.

There are ten rollers along the stiles of the ladder and an inductive sensor that detects the presence of the stile. If the stile is not detected (bigger distance than setting), the machine does not work. It avoids the derailment of the machine.

The cabin has two anti-derailment brackets preventing the derailment of the machine in case of failure of the rollers. This prevents the machine from going out of the ladder.


GUIDING ROLLER


ANTI- DERAILMENT BRACKETS

3.19 Overload detection system

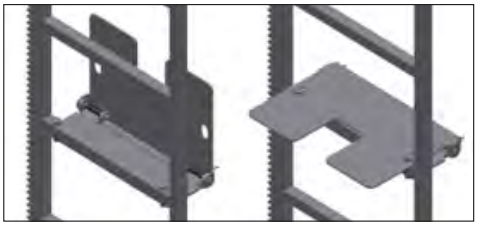
Electronic equipment is installed inside the user control box. The overload detection system prevents any movement of the lift in the event of an overload. In case of an overload, the overload light (yellow) shines. This system consists of a floating floor with four load cells. The load cells send the load signal to the electronic equipment. Remove the overload restriction reducing the load.

3.20 Manual descent system

Two motors groups allow manual release of the motor electromagnetic brake by means of hand levers. Once the motor brakes are released, the service lift travels down with a controlled speed limited by the centrifugal brake installed in the motor group.

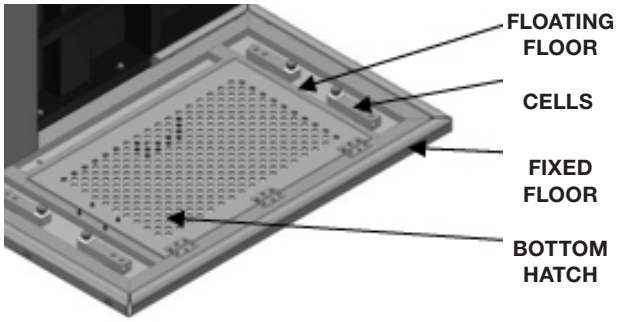
3.21 Rest platforms

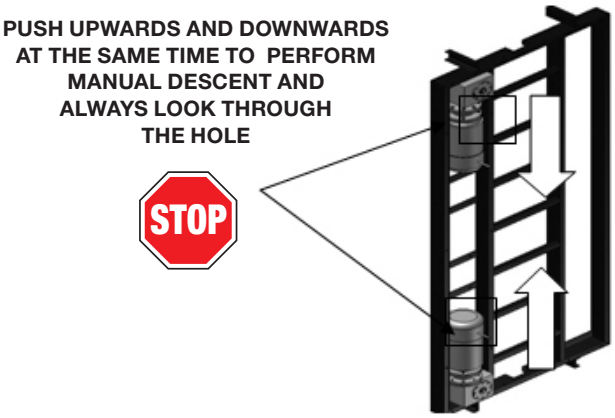
There must be a rest platform at least every 6 meters. The rest platforms are attached to the ladder on the ladder section connection.
Rest platforms are self folding using torsion springs so they do not interfere with the cabin movement when not used.



3.22 Anchor points for PPE

The service lift is equipped with two anchor points inside the cabin. In case of evacuation, the evacuation procedure must be observed. (SEE APPENDIX A)





3.23 Information signs and documents

The following documents, signs and labels are supplied with the lift and shall always be available.

Document	Position
Serial number plate	Cabin
Manual	Cabin
Quick guide	Cabin
Evacuation & rescue guide	Cabin & Bottom platform control box
Use of PPE label	Cabin
Work load / Nº persons label	Cabin
Warning risk of falling	Cabin
Warning risk of crushing	Cabin
Label emergency descend	Cabin
Wiring diagram	Bottom platform control box
Electric warning disconnection label	
Alignment labels on landings	Cabin and each landing

4. Lift Operation

4.1 Good use

Aspects to consider for a good use of the service lift:

A. No person on the ladder when the lift is in operation.
B. The fall protection system is properly installed.
C. The elevator is free of objects.
D. No objects are located on the top of the cabin.
E. When the door is open user(s) MUST BE attached with shock absorber to an anchor point.
F. Electrical system is properly insulated.
G. The manual, the evacuation procedure and quick guide must be accessible in the cabin.
H. Manual operation is done in case it is strictly necessary.
I. Before any maintenance operation check that the service lift is out of service.
J. To facilitate manual operation use walkie-talkies between operators.

Ladder and rest platforms must be used only for evacuation or when the service lift is out of service.

4.2 Prohibited uses

The following prohibitions shall be observed when using the service lift. The consequences of not following them are extremely hazardous to the physical integrity of the users.

It is prohibited to:

A. Use the service lift beyond its intended purpose.
B. Operate the lift without following the safety warnings and operating instructions.
C. Overload the service lift more than its rated load.
D. Try to repair machine components. Only personnel from AVANTI or competent persons certified by AVANTI are allowed to perform service on the machine.

4.3 Operation from inside the cabin

A. Turn the ON/OFF on the bottom platform control box to the ON position.
B. Open the door, climb the fence-railing and go inside the cabin and close the door.
C. Turn the ON/OFF buttons on the user control box to the ON position.
D. To go up or down, push and hold the UP or DOWN button as needed.

4.4 Operation from Bottom platform

The cabin can be called from bottom platform. It is necessary that the ON/OFF main control box is set to the ON position and the lift is ready to use, no fault light must be activated. To do so, push and hold the DOWN button as needed.

4.5 Operation from Top platform

The cabin can be called from the top platform.
It is necessary that the ON/OFF main control box is set to the ON position and the lift is ready to use, no fault light must be activated. To do so, push and hold the UP button as needed.

4.6 Landing alignment

The cabin can be landed at any platform totally aligned to permit safe egress and ingress. To do so:

A. Travel to desired platform (bottom, intermediates and top one).
B. Locate the cabin so that alignment label of inside the cabin overlaps alignment label of the platform.
C. Proceed to egress or ingress the cabin.

4.7 Enter and exit cabin

4.7.1 Double door

To enter the cabin:

- Open the door and attach the shock absorber to the cabin anchor point.
- Climb the fence-railing holding the handles.
- Climb down using the cabin steps.

To exit the cabin:

- Attach the shock absorber to the cabin anchor point and open the door.
- Climb up the cabin using the cabin and holding the handles.
- Climb down the fence-railing to the platform.

4.7.2 Top / Bottom hatch

To enter the cabin:

- Climb the ladder attached to the fall protection system or attach the shock absorber to the tower anchor.
- Open the hatch.
- Attach the shock absorber to the cabin anchor point.
- Release the fall protection device or shock absorber from the tower anchor point to enter the cabin.
- Climb inside the cabin holding the handles and the cabin main frame ladder as support.
- Close the hatch

To exit the cabin:

- Attach the shock absorber to the cabin anchor point.
- Open the hatch.
- Climb out of the cabin using the handles and the cabin main frame ladder as support.
- Attach to the fall protection system or attach the shock absorber to a tower anchor point.
- Release the shock absorber on the cabin anchor point.
- Close the hatch.

Wind turbine manufacturer ensures that access to the upper platform or nacelle can be done safely to avoid risk of falling.

The steps inside the cabin and the fence-railing of the tower have to be no- slip surface to prevent the risk of falling.

4.8 Emergency stop

Release the UP/DOWN buttons and the service lift should stop. If it does not, push the emergency stop, and all controls should be disabled.

Turn / pull the emergency stop button to reset the control.

4.9 Manual operation

In case of power failure or an operation fault, a controlled descent without power can be performed. To do so:

A. Remove the seals of the hand levers of the motor brake.

B. Check that there are no obstacles or person on the way.

C. Push upwards or downwards the two hand levers at the same time. The service lift will start travelling down.

D. To stop, simply loosen the hand lever.

Manual operation is done in case it is strictly necessary.

STOP

Always look through the perforated floor of the cabin to see if anyone is standing on the ladder.

STOP

Use walkie-talkie to report about the manual descent.

4.10 Rest platforms

If use of rest platforms is needed:

A. Climb up on the ladder to be one step above the rest platform.

B. With the safety of all your PPE, push down the rest platform with your foot.

C. Once platform is properly supported on the rung, stand over it with both feet.

D. The rest platform returns to its folded position once it is not in use.

Always wear all the PPE and attach the fall protection device in the fall protection rail system of the ladder.
User(s) in a rest platform MUST ALWAYS BE attached safely to the fall protection system.

Rest platforms must not be used unless necessary. For example if the service lift is out of service.

4.11 Service ladder

The service lift uses a ladder as support and guide. In case of failure of the lift, this ladder is used to evacuate people. (SEE APPENDIX A).

Service ladder may not be used, unless necessary. For example the service lift is out of service.

5. Out of Service

a) Securing the service lift:

Bring the service lift all the way down, until the bottom stop switch stops the cabin.

b) Turn off the main switch to prevent inadvertent operation of the lift:

Turn the main switch to the OFF position. Power supply is now interrupted. Mark the lift “OUT OF SERVICE” and padlock as necessary. Contact the service technician for repair.

6. Maintenance

Pegasus Service lift maintenance is required and necessary:

- To avoid premature wear
- To prolong the lifetime of the machine
- To maintain the level of safety which Pegasus was designed and manufactured to.

6.1 Maintenance planning

Time (Performance)	Component
Daily (Supervisor)	Cabin visual inspection
Safety circuit	Wires Electrical cable
Annually (Expert)	Electrical cable
Annually (Expert)	Gear box, centrifugal brake, motor brake, pinions, ladder rack
Annually	Torques assurance, overload

At the end of this manual there is a final installation check list (see APPENDIX B) and a maintenance form (SEE APPENDIX C).

6.2 Daily inspection by the supervisor

Operating area:
Ensure that there are no obstacles within the service lift's operating area which may obstruct the travel of the cabin or hit the cabin.
Ensure that the ladder rack is solidly and safely fixed.

Service lift visual inspection:
A. Check that the service lift components are mounted in accordance with the specifications and without any noticeable defects or missing components.

B. Check that the traction system (ladder rack & pinion) is not damaged or jammed.

C. Check that the guided system is not damaged or jammed.

D. Check that the two motor groups are in good conditions and not damaged.

Service lift functional inspection:
Check that the safeties are in place and working:

WARNING!
Before any maintenance operation check that the service lift is out of service.

ATTENTION!
Inspection may only be performed by AVANTI or competent person certified and authorised by AVANTI.

PLATFORM CONTROL BOX:
a) Main switch ON/OFF: Turn the ON/OFF electric isolator on the bottom platform control box to the OFF position. The green light shall be OFF. The service lift shall not run. Turn it ON; the green light shall be ON.
b) Emergency stop: The service lift shall not move UP/DOWN. Release the emergency stop and drive the lift UP approximately 1 meter.
c) Press UP/DOWN buttons on the control box. The lift should travel upwards or downwards.

CABIN CONTROL BOX:
a) ON/OFF button: Turn the ON/OFF button on the user control box to the OFF position. The green light shall be OFF. The service lift shall not run. Turn it ON; the green light shall be on.
The service lift shall run.
b) Emergency stop: Press the emergency stop button. The service lift shall not move UP/DOWN. Release the emergency stop and drive the lift UP approximately 1 meter.
c) Fault light: Open the door or press the emergency stop, the red fault light on the control box shall be on.
d) Top and bottom hatch: Open the hatch, the fault light in red shall be ON and the lift shall not move UP/DOWN.
e) Service lift door: Open the door, the fault light in red shall be ON and the lift shall not move UP/DOWN.
f) Drive the service lift down until the bottom safety stop hits the bottom mechanical stop. The lift shall stop.
g) Drive the service lift up until the top safety stop hits with the top mechanical stop.
h) Pull down the top hatch handle until the roof switch is activated, the fault light in red shall be ON and the lift shall not move.

WARNING!
If any faults occur during work,
- Stop working,
- If required secure the workplace and
- Rectify the fault!

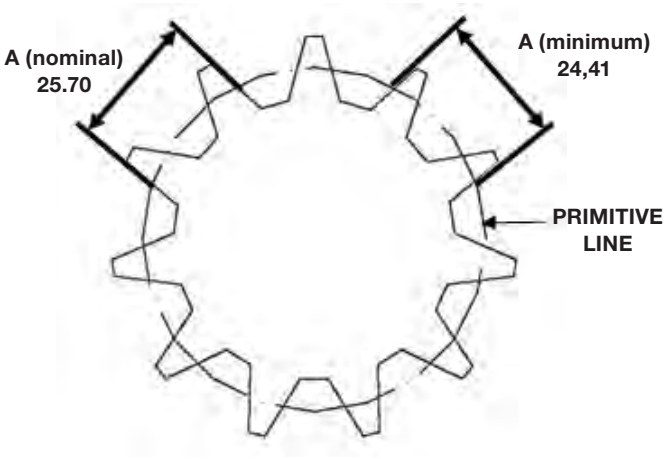
DANGER!
Make sure that nobody is exposed to danger below the service lift, for instance from falling parts.

6.3 Yearly inspection

6.3.1 Pinions

Check carefully that the pinions are free from deterioration, damage or abrasion.

Wear limit:
To evaluate the wear of the pinion, “A” dimension measured on the primitive line shall range between 24.41 and 25.7 mm (see figure)



Pinion replacement criteria is shown on table below:

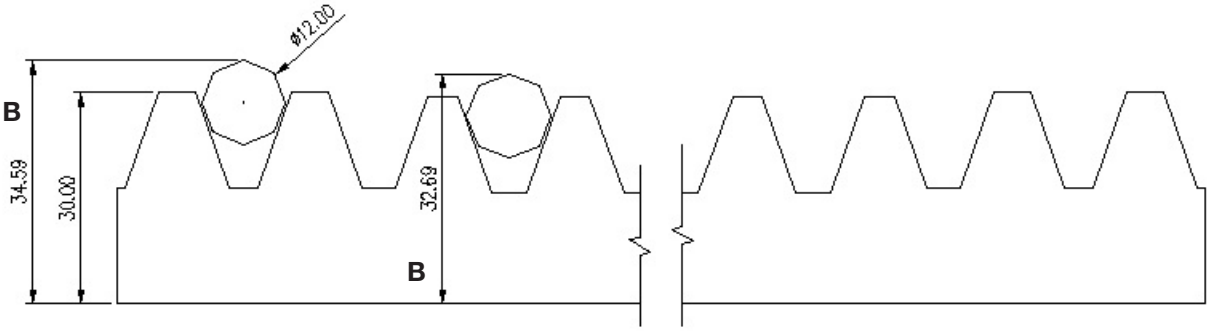
DIMENSIONS (mm)	NEW PINION (mm)	CHANGE PINION (mm)
A	25.70	< 24.41

6.3.2 Ladder rack

Check carefully that the rack is free from deterioration, damage or abrasion.

Check that the ladder mast has no cracks, dents or damages.

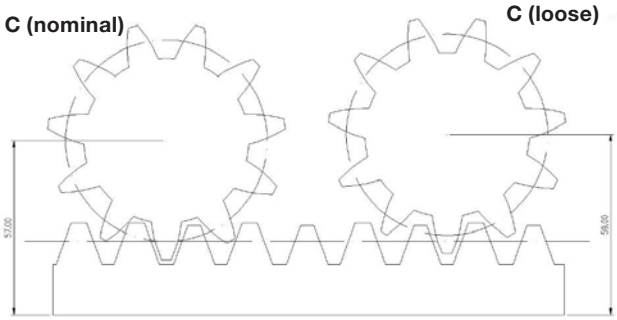
6.3.2.1 Wear limit:
Using a calibrated rod of Ø 12 and check that dimension control “B”, as shown in the picture, is between 32.69 and 34.59 mm. Measure the rack wear on each mast section.



Rack replacement criteria is shown on table below:

DIMENSIONS (mm)	NEW RACK (mm)	CHANGE RACK (mm)
B	34.59	< 32.69

6.3.2.2 Looseness limit:
To evaluate the looseness, check of control dimension “C” shall be between 57 and 59 mm.

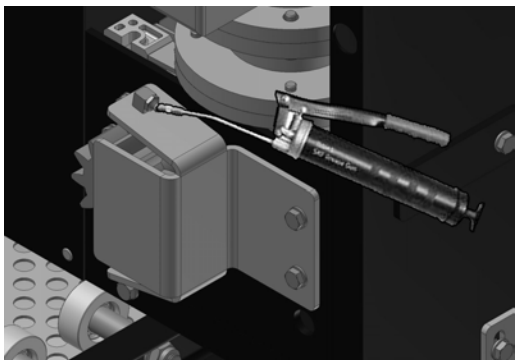


Rack replacement criteria is shown on table below:

DIMENSIONS (mm)	NEW RACK (mm)	CHANGE RACK (mm)
C	57	> 59

IMPORTANT!
Clean and lubricate the rack every time you replace a section of the ladder.

6.3.2.3 Lubricate the rack
Check status of old lubricant on rack and pinions. If maintenance required proceed as follows:
A. Locate lift at bottom platform and turn off power supply.
B. Clean old lubricant off the rack and pinions.
C. Use a grease gun and a zipper sleeve to lubricate low pinion through lubricating nipple.



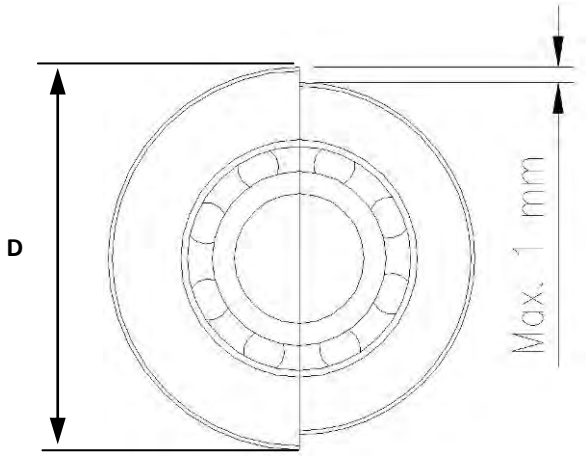
D. Turn on the power supply and enter the lift.
E. Remove female adaptor from grease gun and connect gun to lubricating hose.

F. Apply lubricant to top pinion from inside the cabin throughout ascend.
G. Repeat lubrication throughout descend.
H. If necessary clean excess of new lubricant off the rack.

IMPORTANT!
Clean and lubricate the rack every time you replace a section of the ladder.

If use is made more severe, it will be necessary to lubricate more often.

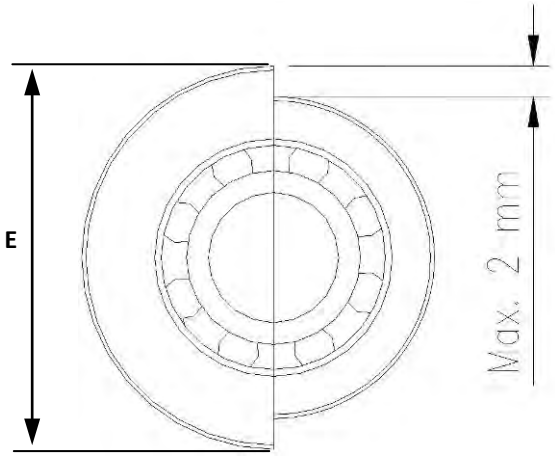
The type of grease can be KRAFFT KGP 2M or equivalent. For the low temperature use LUBEKRAFTT KMG or equivalent.



6.3.3 Counter Guiding roller

Check that the outer surface of the rollers is uniform and free from damage.
6.3.3.1 Looseness limit:
Wear of surface shall not be bigger than 1 mm.
Check on each roller guide that control dimension “D” is between 48 and 50 mm.

NEW COUNTER GUIDING ROLLER (mm)	CHANGE COUNTER GUIDING ROLLER (mm)
50	>48



6.3.5 Torques Assurance

Check tightening torques of all screw connections with approved and calibrated torque wrench in the following cases:

A. In tower factory, during assembly of ladder section to tower section.

B. On site, pre-commissioning, and in each yearly inspection.

See joints to be checked and appropriate tightening torques for each case in the list below:

Ladder:		TORQUE (N•m)	
JOINT	METRIC	ASSEMBLY IN TOWER FACTORY	ASSEMBLY ON SITE
Ladder sections	12	50	50
Ladder anchorages – Tower brackets	12	50	12
Ladder – Top mechanical stop	8	15	15
Ladder – Bottom mechanical stop	8	15	15

Traction system – Double Motor group:		TORQUE (N•m)	
JOINT	METRIC	ASSEMBLY IN TOWER FACTORY	ASSEMBLY ON SITE
Gear box – Centrifugal brake	8	15	15
Motor group – Main structure	8	15	15
Motor – Centrifugal brake	8	15	15

Cabin:		TORQUE (N•m)	
JOINT	METRIC	ASSEMBLY IN TOWER FACTORY	ASSEMBLY ON SITE
Fall protection anchor point – Cabin	12	50	50
Roller shafts – Main structure	12	50	50
Counter roller guide shafts – Main structure	12	50	50

IMPORTANT!
If the overload detection system fails, an expert must verify the system.

6.3.6 Overload, static and dynamic tests

A. Overload detection system test: check that the overload detection system works by applying a load of 125% of working load limit to the lift floor. The service lift shall not move UP and the overload light on the control box shall be on.
B. Static test: apply a load of 125% of working load limit to the lift floor. The service lift does shall not show any damage or cracks.
C. Dynamic test: apply a load of 110% of working load limit to the lift floor. The service lift shall be able to move UP.

6.3.7 Motor group

6.3.7.1 Gear box

Visually check for oil leaks. In case oil leaks are found, exchange the gasket on the gear box cover, and re-fill with oil as needed. Close the cover and ensure that the correct torque is applied.

6.3.7.2 Centrifugal brake

To check their operation, proceed as follows:
With cold centrifugal brake, perform a manual test in power descent on approximately 2 meters. The descent has to be done at maximum speed of 24 m/min. If the speed is more than 24 m/min, put the lift out of service and call service for replacement as the centrifugal brake means are not in good conditions.
Review lining and hubs. The lining of the centrifugal brake has a friction surface that is worn with use. When the thickness is reduced to half the original, linings and hubs should be replaced by new ones. This operation will be done only by qualified personnel according to centrifugal brake manufacturer instructions.

6.3.7.3 Motor brake

After checking the correct operation of centrifugal brakes, the motor brake operation must also be checked. To check the operation of the motor brakes, proceed as follows:
Load the service lift with a load of 1.1 times the nominal load. Release one of the two motor brakes by pulling its hand lever. While keeping the brake open, push the UP button and stop after 0,5 m. The cabin should stop and the brake must be able to hold the cabin. Repeat this operation 3 times.
Repeat the operation with the other motor brake.
If any of the two motor brakes fail to stop and hold the service lift in position, proceed as follows:
Measure the air gap. If the air gap is greater than specified by the manufacturer and the brake disc thickness is sufficient, readjust the air gap according to the motor brake manufacturer's specifications.
Check whether the brake discs and the springs have irregularities or damages. If any damages or broken parts are found, the motor brake must be replaced.

6.4 Ordering spare parts

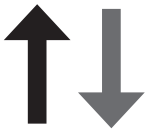
Only original parts must be used. Spare part list are available from AVANTI. Please indicate lift model when requesting a spare part list.

7. Repair in the event of breakdown

1. All tests and repairs to the electronic components should be performed by an **authorised electrician only!** The wiring diagram is placed in the traction hoist's power cabinet.

2. Repairs to the traction hoist, the safety gripping device and to the system's supporting components should be performed by **qualified fitters only!**

Breakdown	Cause	Solution
The service lift will **neither go up nor down!** 	**DANGER!** *Attempting to use the lift will jeopardize work safety*	
	A1 The fixed EMERGENCY STOP button has been activated.	Reset the button in question by pulling or turning it
	A2 TOP SWITCHES have been activated.	Carefully remove the obstacle.
	A3 Damaged rack/pinions	a) Check the damage. b) Evacuate the cabin.
	A4 The service lift is stuck on an obstacle.	a) Remove the obstacle. b) Test the operational safety of affected tower sections. Inform the supervisor.
	A5 Power failure a) Main switch is OFF b) Grid voltage interrupted c) Supply between grid connection and control interrupted	a) Turn the main switch ON b) Find the cause and wait for the power to return. c) Test and if necessary repair the supply cable, guide wires, fuses, and/or wiring from the control box
	A6 Two phases changed in the supply	Have an electrician switch the two phases in the plug.
	A7 TOP SWITCHES have been opened.	a) Check the service doors. b) Check the hatches.
	A8 Motor thermal protection	a) Rearm. b) If repeated, call AVANTI
	A9 ELECTROMAGNETIC BRAKES not open.	a) Check voltage to the electromagnetic brakes. b) Check the springs. c) Check the brake disc. d) Regulate the brake disc.
	A10 MAGNETIC THERMAL CONTROL.	a) Rearm. b) If repeated, call AVANTI.
	A11 CONTROL DIFFERENTIAL.	a) Rearm. b) If repeated, call AVANTI.
	A12 OVER VOLTAGE PROTECTION.	a) Rearm. b) If repeated, call AVANTI.
	A13 EMERGENCY LIMIT STOP SWITCH has been activated.	a) On top platform, manually take the lift down until the switch is released. b) On bottom platform, disassemble the bottom plate until the switch is released. c) Check the position of the plates. d) Check the top and bottom mechanical stop position.
	A14 OVERLOAD	a) Test and possibly reduce the load. b) If repeated, call to technical service.

Breakdown	Cause	Solution
Service lift goes down but not up 	**B1 The service lift is stuck on an obstacle.**	Carefully move the service lift downwards and remove the obstacle. Test the operational safety of the affected platform components. Inform the supervisor.
	B2 TOP SAFETY STOP has been activated	a) Check the springs b) Move the lift down until the top stop switches are released.
	B3 INDUCTIVE SENSOR has been activated	a) Check section ladders. b) Check the status LED:
Lift can go both up and down. 	**D1 Motor hums loudly**	Call AVANTI.
	If these steps do not identify the cause and rectify the fault: Consult a qualified electrician or contact the manufacturer.	

8.Transport and Storage

Depending on agreed transport and storage conditions with the customer, the following methods are standard ways for the transport:

A) Cabin

- Land transport: rear support over pallet, non stackable. Dimensions: 3000 x 800 x 1200 mm
- Sea transport: package using wooden box and plastic shrink on a pallet. Dimensions are 3000 x 800 x 1200 mm.

B) Installation accesories

The installation accessories other than mast sections (rest platforms, power cable, etc) are supplied on European pallet.

C) Mast sections

Mast sections are supplied on pallet. Dimensions: 1500 x 800 x 1000. If special transport and storage requirements are needed, customer must specify them to AVANTI prior to delivery.

9. Installation

9.1 Interface requirements

The following information is necessary for the correct integration of Pegasus service lift inside a wind turbine tower.

9.1.1 Height and angle

The Pegasus service lift can be installed on towers up to 150 m high, and with a maximum inclination angle to the tower axis of ±2° and of ±0,5° for every 3 m of ladder.

9.1.2 Lifetime and frequency of operation

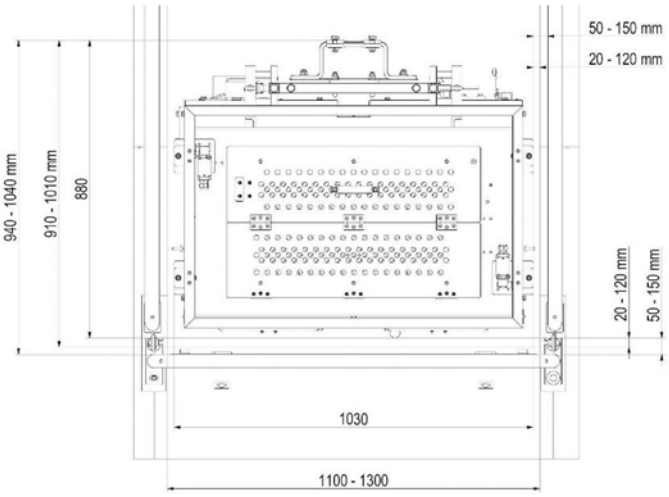
The Pegasus service lift is designed for a lifetime of 20 years with a time of operation of approximately 12.5 h/year of 250 h during lift. In case time of operation is more, service and inspections are required and replacement of components might be necessary according to the replacement criteria stated on the maintenance manual.

9.1.3 Lift holes at platforms and air gap to tower parts

The Pegasus service lift must have an air gap of at least 20 mm around it along the tower to avoid collision with tower components.

The wind tower manufacturer must verify this as part of the integration process not only in the static position but also considering possible movement of components inside the tower as a consequence of the tower sway. The components subjected to possible movement inside the tower may include, but are not limited to, dampers, wire ropes, cables, doors, hatches, etc..

The Pegasus service lift needs a gap of 500mm below the lowest landing area to accommodate the bottom buffers and power cable.



ATTENTION!

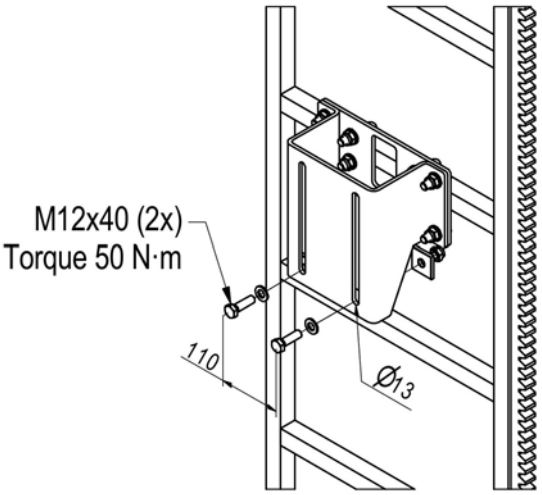
Competent inspection may only be performed by AVANTI or competent person certified by AVANTI.

9.1.4 Tower support brackets

The ladder rack is attached to the tower structure at a distance of max 3000 mm. The tower support brackets must be so designed that the ladder rack anchorages can be mounted.

The connection between the tower support brackets and the ladder rack anchorages is done with M12 bolts A2-70 tighten with a torque of 50 N•m in the tower factory but with a torque of 12 N•m on site once the tower has been erected and before the cabin is going up.

Reaction forces on connection bolts must be considered in the design of the tower brackets. This information may vary with the installation characteristics. Contact Avanti to get the information.



9.1.5 Wind turbine electrical supply requirements

Power Supply Type	3 Phase +PE + N
Voltage	400 V ± 5 %
Frequency	50 / 60 Hz
Fuses	16 A
Protection	Acc. To EN 60204 - 1

9.1.6 Other requirements

The wind turbine manufacturer must put in place any other means necessary to ensure the safe use of the Pegasus 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.

9.2 Cautions

Wear PPE for protection against falls if falling height is higher than 2 m.

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 elevator out of service and make the ladder accessible. Place a warning sign: SERVICE LIFT OUT OF SERVICE. DO NOT USE

Before starting the installation make sure that the elevator shaft is protected by fences.

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

9.3 Previous considerations

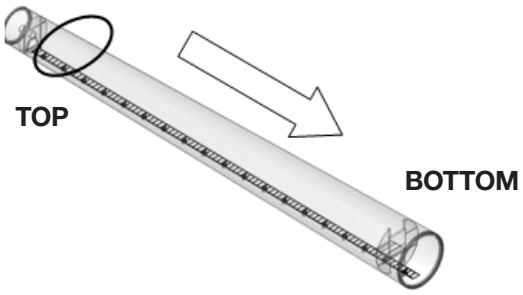
All installation process must be made according to the installation drawing supplied by AVANTI.

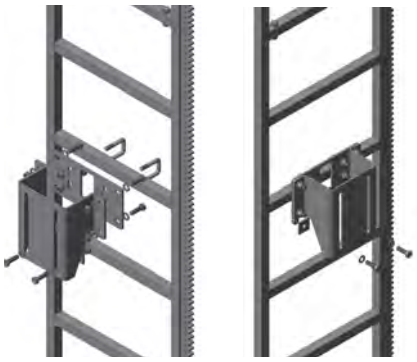
Before starting installation, check the instructions and drawings. Verify that all the needed components and necessary tools are available.

9.4 Assembly in tower factory

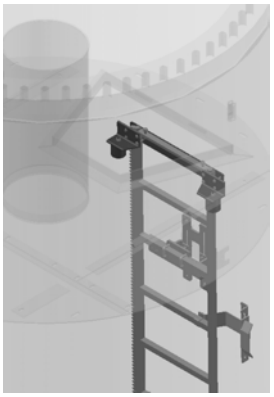
9.4.1 Top tower section

A. Install and adjust top ladder section in the top of the top tower section according to the installation drawing and shown on below figures. Continue installing the other ladder sections from top to bottom with all the screws and anchorages. Use 15 N.m torque for M8 and 50 N.m for M12.

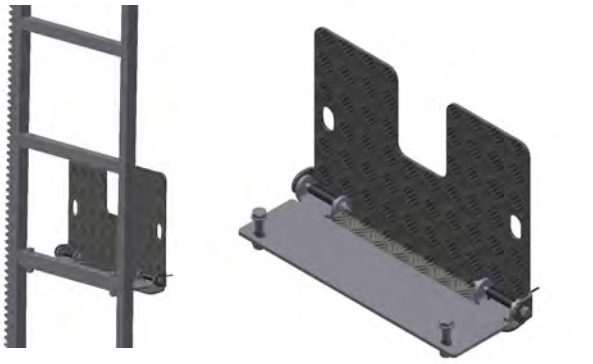




B. Install the top mechanical stops and top plate according to the installation drawing and shown on the figure below. Use 15 N.m torque for M8 and 50 N.m for M12.

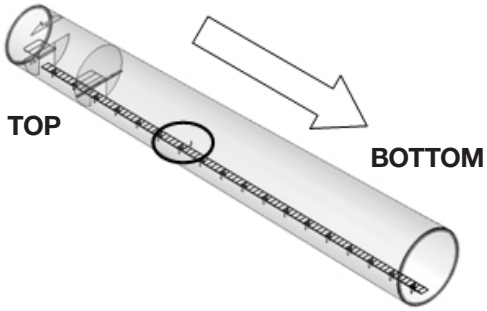


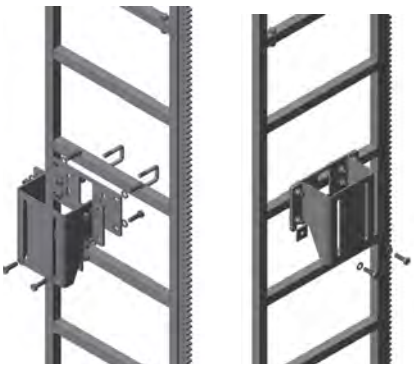
C. Install the rest platforms approximately every 9 m according to the installation drawing as shown on figure below:



9.4.2 Intermediate tower sections

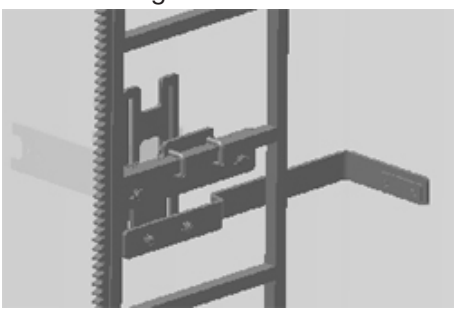
A. Install and adjust top ladder section in the top of the intermediate tower section. Continue installing the other ladder sections from top to bottom with all the screws and anchorages. Use 15 N.m torque for M8 and 50 N.m for M12.





B. Install the rest platforms approximately every 9 m according to the installation drawing as shown on figure below:

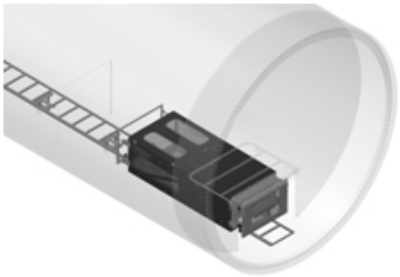
C. Install the electric cable arm support like shown on the figure below according to the installation drawing.



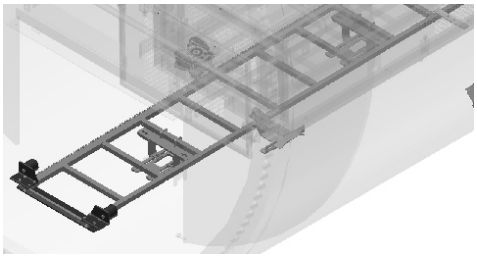
IMPORTANT!
Not necessary for all intermediate sections.

9.4.3 Bottom tower section

A. Follow same installation instructions as on points A and B for intermediate tower section.
B. Position the cabin inside the bottom tower section. See figures below:



C. Install the top mechanical stops and top plate according to the installation drawing and shown on the figure below.



IMPORTANT!
It is also possible to install the cabin and bottom mechanical stop on site.

9.5 Assembly on site

IMPORTANT!
Service lift can be used during installation.

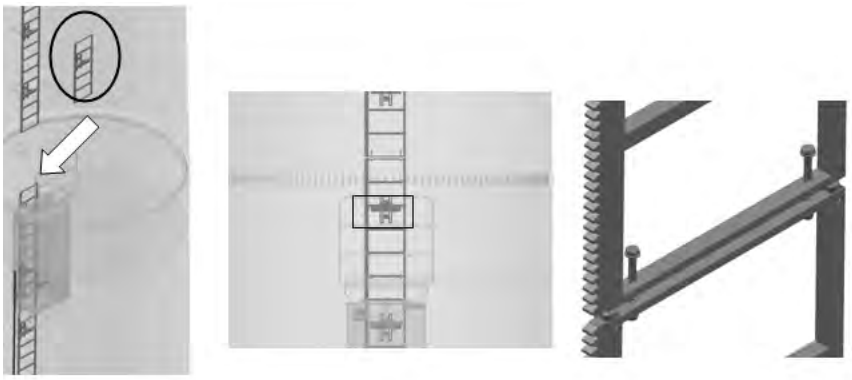
When the bottom section is erected:
A. Install the first ladder section according to the installation drawing and figure below. Adjust using the levelling screws.

B. Install the bottom platform control box and connect with all the cable connections with the electrical boxes.

C. Take the service lift up to the first tower flange. Install one ladder section to join the lower tower section with the intermediate tower section. There will be a gap. Place the connection bolts but do not tighten them. See figures below:

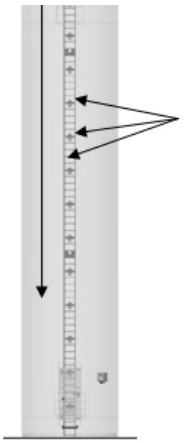
INTERMEDIATE TOWER SECTION

LOWER TOWER SECTION



D. Take the service lift down and loosen the anchorages screws to the tower of each ladder section.

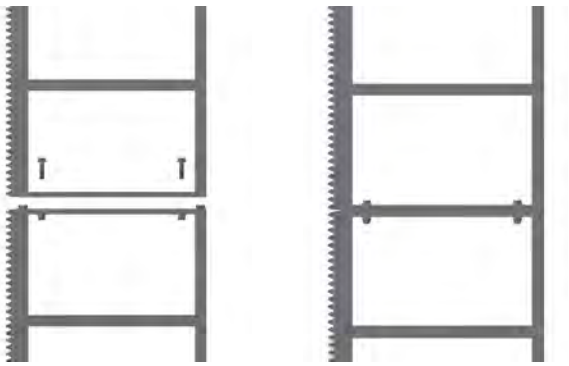
ATTENTION!
Loosen the screws above the lift.



LOOSEN ALL THE ANCHORAGES AND SCREWS

E. Turn the levelling screws of the first ladder section to push up the complete bottom tower section ladder until the gap at the flange connection joint is eliminated.
See the figures below:

TIGHTEN BOLTS

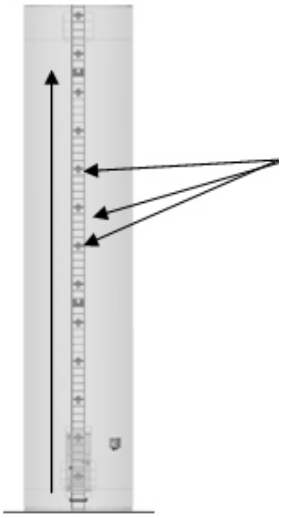


F. Go up with the service lift to the next tower section flange. Tighten all the ladder anchorage – ladder bracket screws M12 above the cabin with a torque of 12 N•m before the cabin is going up.

ATTENTION!
Tighten all the ladder anchorage - tower bracket screws above the lift with a torque of 12 N •m.

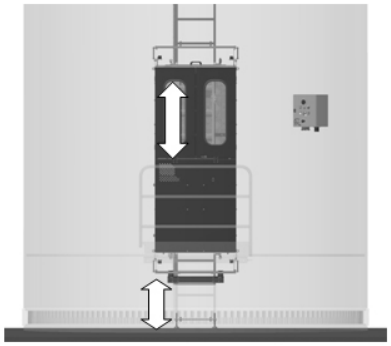
G. Repeat from C to F until all the tower sections are installed.

H. With the cabin on bottom platform adjust the bottom mechanical stop. It should be possible to open the doors just above the fence railing. The lift must stop before the cabin main structure hits the bottom mechanical stop.



9.6 Electric adjustment on site

A. Install the controls boxes according to the installation drawing.



B. Use cable strips to attach the fixed cable to the tower internal:

9.7 Alignment labels installation

A. Stick the alignment label inside the cabin next to the grid of holes at a height of 1,5 m from the floor of the cabin:

B. There is an alignment label for each platform of the tower. Stick label on ladder stile at a height of 1,5 m from each of the platforms.

10. Disassembling

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

Appendix A:
Safety measures when using AVANTI Pegasus lifts

In general: The Service Lift is only to be used by personnel who has received instructions about how to operate the Service Lift in all predictable situations. These instructions can only be given by a person with the proper knowledge e.g Avanti Trainer or Trainer approved by Avanti. The following precautions and procedures are to be followed during operation of Service Lift, and if the Service Lift stops and the manual emergency descend cannot be performed.

Operating the Service Lift and the ladder:
Anyone going in the Cabin must at all times wear PPE (Safety helmet, full body harness, Shock absorber, lanyard and slider/runner fitting the fall protection system on the ladder).

IMPORTANT!
User(s) in a rest platform MUST ALWAYS BE attached safely with fall protection device.

EVACUATION of personnel from the Lift/Cage is only necessary in very extreme situations. If necessary Avanti recommends the following procedures:

Evacuation through BOTTOM hatch:
1. User(s) attaches shock absorber to the bottom yellow anchor point. User(s) must be positioned to one side of the bottom hatch, in the same side as the bottom anchor point is. (See Fig. 1)

2. Pull up the bottom hatch and push down the bottom safety stop. (See Fig. 2)

3. User goes down through the bottom hatch. (See Fig. 3)

4. User attaches the fall protection device to the fall protection system on the ladder.

5. User releases his anchor point in the Cabin/ Cage and in the ladder.


Fig.1

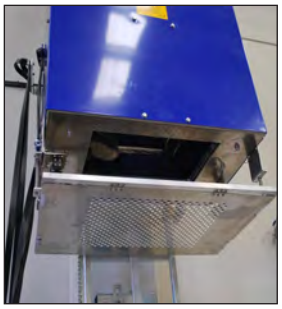


Fig.2


Fig.3


Fig.4


Fig.5

Evacuation through TOP hatch:
1. User(s) attaches shock absorber to the top yellow anchor point. User(s) must be positioned to one side of the bottom hatch, in the same side as the top anchor point is. (See Fig. 1)

2. Push up the top hatch and the top safety stop. (See Fig. 2)

3. User(s) goes up through the top hatch. (See Fig. 3)

4. User(s) attaches the fall protection device to the fall protection system on the ladder. (See Fig. 4)

5. User(s) releases his anchor point in the Cabin/ Cage and in the ladder. (See Fig. 5)


Fig.1


Fig.2


Fig.3


Fig.4


Fig.5

Lift rescue procedure:
How to act in case the person travelling in the cabin becomes unconscious.
1. There is a user outside the service lift.
2. User climbs up or down to the nearest control station.
3. User calls the lift.

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