

Electrification Works

**Self-propelled road-rail
vehicle with lifting platforms**



Description of the X6

UNAC-X6-ST-05-EN







TECHNICAL SPECIFICATIONS

SUMMARY

1.	Introduction	4
2.	General description of the X6	5
2.1.	Purpose of use of the vehicle.....	6
2.2.	Main data of the vehicle	7
3.	Technical characteristics of equipments	8
3.1.	All terrain mode	8
3.2.	Railway mode.....	10
3.3.	The platforms	12
3.4.	The hydraulic group.....	15
3.5.	Emergency	15
3.6.	The equipotential mast	16
4.	Working diagram and dimensions	17
4.1.	Working diagrams	17
4.2.	Main dimensions.....	19



1. INTRODUCTION

The Company UNAC has developed a reputation based on almost 70 years of experience of design and manufacture of machinery for civil works, railways, foresters or army.

Following the successful experience of its self-propelled trolley X3, sold in France and abroad at more than 25 units in only 4 years, UNAC has designed a new mobile rail-road lifting unit for high lifting capacity. While proposing a very compact rail-road system, with all terrain capabilities overcoming high slopes and obstacles, with an exclusive mechanical concept for a very easy and quick setting on track, the X6 enable to work in all safety at heights never reached by such sized mobile units. The X6 self-propelled trolley has been designed thanks to the strong experience of our customers, electrification contractors. Its characteristics and its performances have been elaborated in order to make possible to reach in a secure, ergonomic and as fast as possible a maximum of adjusting points corresponding to any supports, pendulum, cantilevers, poles which constitute the electrification network, including some extreme elements such as feeding cables or GSM-R telecommunication constituents or other track lightening systems.

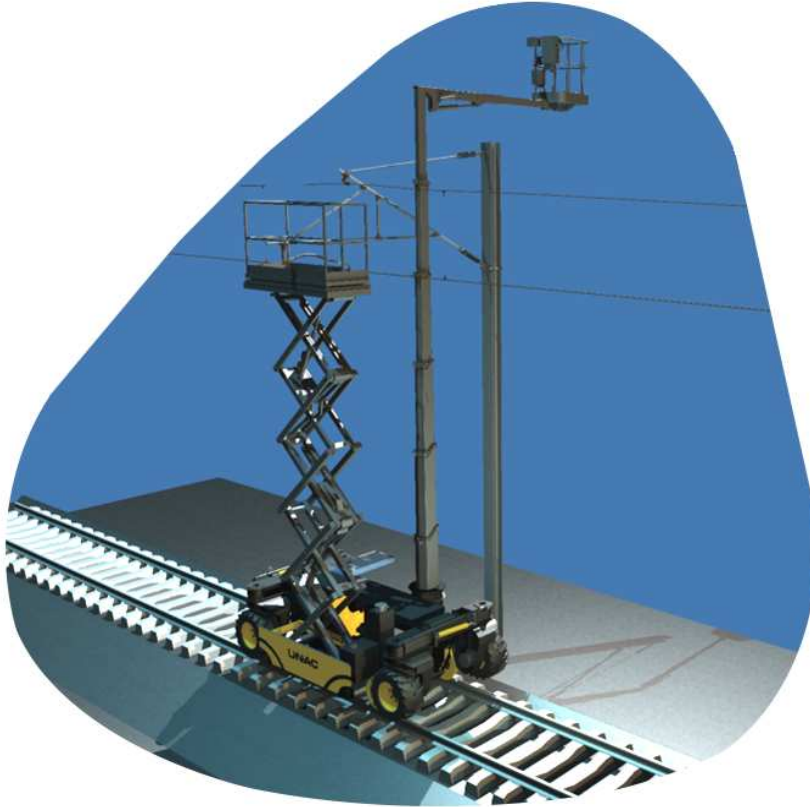
The study of this product has been directed with the greatest care, integrating the maximum of industrial manufacture notions and maintenance ease. All the design has been achieved thanks to integral 3D modelling made on last generation software, what has permitted to optimise each of the mechanical part for a strong and reliable design.

Designed to comply with the most demanding railway standards for safety, the system has also been defined in dialogue with CRAMIF, a state body specialized in working risk management contributing to the health state policy. The system notably complies with the following national and European standards for health and safety:

- Machine Directive 2006/42/CE
- NF EN 280 - Provisions for persons and good safety during use of mobile elevating platform for personnel, all types and all capacities
- NF F 58-051 - Personnel elevator on railway vehicles
- NF F 58-002 - Working accreditation for railway equipments
- NF F 60-100 - Railway rolling stock – Protection against electrical shocks – principles

In a constant intention to buck for high reliability and efficiency, main components, such as the fuel engine or the scissor platform, have been selected from the range of well-known manufacturer.

Such approach gives the maximum of guaranties for heavy-duty equipment with high reliability and low maintenance since the delivery of the first unit.



3D view of the machine set on track, platform and basket in working position

2. GENERAL DESCRIPTION OF THE X6

The self-propelled trolley X6 is made of a mechanically welded chassis integrating a permanent railway system with 4 driving wheels and having sufficient flexibility to accept track twists. The chassis receives a new and unseen **retractable all-terrain system** with 4 driving, steering and braking wheels. The engine is assembled on the chassis through silent-blocks. The control panel, scissor type lifting platform and the telescopic basket with its slew ring base are assembled onto the structure.

The main structure is made with box-section frames with high-strength and high-elastic limit steel.

A foldable telescopic pantograph is assembled to the chassis in order to come into sensitive contact with the contact wire for enabling the escape of residual currents to the hearth before working on the catenary.

During the setting on track, the vehicle is assisted and secured by a locking system integrating mechanical stops to make impossible to infringe the opposite track vehicle gauge.

2.1. Purpose of use of the vehicle

The X6 has been designed with main aim to make possible a very quick and secure intervention in all railway track points, in order to achieve the necessary works on the catenary network.

The system is made in order to be easily forwarded by the roads and then going as close as possible to the working site. The X6 shall be forwarded on heavy equipment transport trailer. All together, the trailer with the X6, are perfectly fit inside the road vehicle gauges, always remaining below the 4m height. This permits therefore to transport the equipment without constraint on any road network.



When coming to the site, the X6 can be unloaded. For that, the system is using its self-propelling hydrostatic drive.

For all travels, on track or on road, the vehicle is controlled directly from the remote radio-control.

Very equilibrated, the system shows a very good attack angle and easily overcomes the obstacles surrounding the railway tracks like the trenches, the embankments or the ballast. It thus accesses to the track by coming the closest as possible of the wished working point, which represents an actual optimized intervention in the time as there is no need to organize specific access or to waste time due to heavy logistic arrangements.

In the case of night works for instance, operators can start the works within the best time-limit, just 5 minutes after getting the green light from railway administration, and continue to work up the last possible minute since the system can be removed and set free the track very quickly (few minutes).

Likewise, if the electrification works need to pass from one track to the opposite one, just few minutes are requested to continue working on the other track, when other systems like track cars or heavy railway vehicles often need more than half-hour or an hour.

During the construction works of new lines or during maintenance of old lines, the trolley can be stored close to the tracks at the end of the day or the night and therefore make possible immediate work resumption the day or night after. Besides, it is also possible to other railway working units to



pass on the track, the system having the capability to go out and on the track very quickly.

Moreover, it is not requested to have dedicated driver. Each operator can on board, from the scissor platform or from the telescopic basket, take the control of the system. On travelling position, with all lifting elements down, the height of the floor is lower than 1m60 from top of the rail, which enables all operators to stay standing while travelling, as specified by the regulations for travels under live overhead line. Operators control on track travelling, at 5km/h maximum speed with working platforms not down, and up to 20km/h with platforms down.

The X6 trolley is therefore a very ergonomic tool as regards to the yard logistic. It is also for the achievement of the electrification works themselves. Indeed, its telescopic basket and its scissor lifting platform permits to operators to work together, face to face, always in an ideal and safe working position or in an independent way, each one working on different tasks. From the scissor lifting platform, two operators can achieve assembly and adjustment of drop wires and fastening to cantilever extremity. From the telescopic basket, the articulated telescopic arm with swivelling ring base permits to one operator to freely work on the cantilever set, behind the post, on the support cable, on the feeder cable and all around.

The machine therefore permits to become up to working position on track, in very fast conditions, optimizing then the site works. It results high efficiency while being in the most secure conditions and offering to operators ergonomics working conditions and therefore less wearying.

The characteristics of the self-propelled trolley are the followings:

2.2. Main data of the vehicle

- | | |
|---|--------------------------|
| • Dimensions, on road, all equipments set down (Lxlxh): | 4 950 x 2 530 x 3 350 mm |
| • Dimensions, on rail, all equipments set down (Lxlxh): | 4 600 x 2 835 x 3 060 mm |
| • Weight: | 9T |
| • Maximum railway speed (working / travelling): | 5 / 20 km/h |
| • Maximum road speed: | 2 speeds, 2,5 and 5 km/h |
| • Maximum passable slope in all-terrain mode: | 90 % |
| • Maximum railway slope: | 3,5 % |
| • Maximum railway cant: | 180 mm |
| • Rail gauge: | 1 435 mm |

3. TECHNICAL CHARACTERISTICS OF EQUIPMENTS



3D view of the vehicle on track, all-terrain wheels up

3.1. All terrain mode

The vehicle is set with low pressure tires. The tires have therefore a very good bearing capacity. High diameter wheels permit to give a high torque and a good driveability. The design of the X6 also includes one **oscillating axle** to guarantee actual all-terrain capacities.

The drive is made on hydrostatic mode. The 4 wheels are simultaneously driven by 4 hydraulic motors directly clutched on the wheels.

All wheels are hydrostatically brake. The vehicle also includes parking brake used at vehicle stop, made through the integrated disk brakes in the motor.

The operator controls the system from the remote control and chose 2 driving speeds, slow or fast. Both speed ranges are got thanks to two-position cylinder motor. The system includes a locked differential in order to avoid wheel spin during all-terrain travels. The drive is very

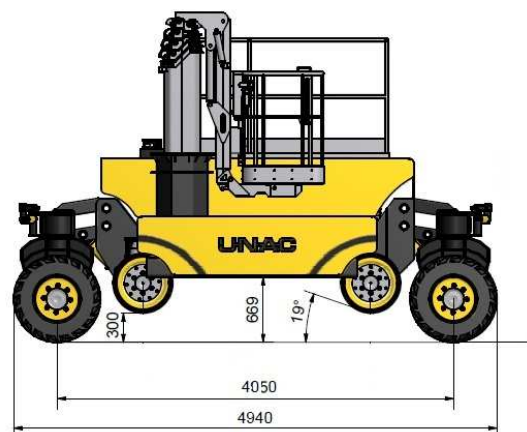


efficient and permits high easiness in overcoming of slopes. At low speed, the vehicle can make a start in high slope, in the ballast, even in the unfavourable case when wheel is against the rail.

Each of the wheels is steering. The steering of front and back wheels is independently controlled which allows crab and coordinate modes. Each wheel can turn 120° (from -30° to $+90^\circ$). The steering of the wheels is performed by hydraulic cylinder.

The all-terrain system is retractable. The operator controls separately the front and the rear of the vehicle from the remote radio-control. The lifting of the wheels is made through an articulated mechanical arrangement moved by 4 synchronized hydraulic cylinders. It is fully spread down when X6 is travelling under all-terrain mode. The wheel are positioned in middle spread when put on a truck trailer or totally up when travelling on railway tracks.

The tires being at the extremities of the vehicle, the system has an excellent approach angle and is therefore capable to access to the hardest sites.



Vehicle with all-terrain mode, all tires down

Technical characteristics of the all-terrain drive are the followings:

- Number of wheels (driving / steering): 4 / 4
- **Hydrostatic** drive: 2 speeds, with one hydraulic motor by wheel
- Hydraulic motors: Poclain, swept volume 1,5L and 3L
- All-terrain travelling speed, slow mode: from 0 to 2,5 km/h
- All-terrain travelling speed, fast mode: from 0 to 5 km/h
- Braking: hydrostatic and hydraulic parking brake
- Lifting of the wheels, front and rear: by hydraulic cylinders and safety valves
- Swivelling angle of the wheels: from -30° to $+95^\circ$
- Distance between wheels in all-terrain position: 4050 mm

- Tires: low pressure technology, with thread blocks
- Tire width, out of load: 425 mm
- Wheels diameter, out of load: 890 mm
- Maximum distance from the floor: 600 mm

Nota: The vehicle is not designed for using the platform on the tires.

3.2. Railway mode

The self-propelled trolley keeps totally inside the vehicle gauges, including the most demanding ones. Travelling on railway mode is achieved by 4 hardened steel wheels driven by hydraulic motor.

The setting on track is made easily thanks to the maximum control of the vehicle when in all-terrain mode. The operator uses the remote radio-control to control all motions of the vehicle. Once the system aligned above the track, the all-terrain wheels are lifted and the full trolley is laying on the track while lowering, one side by one side. Once completely lifted, the tires do not cross the track vehicle gauge, whatever their swivel angle.



The operator can take control of the vehicle on railway mode once he has connected the remote radio-control to the specific plug in the chosen dedicated place, in the telescopic basket or in the scissor lifting platform.

On the track, the X6 can travel at a maximum speed of 23 km/h when all platforms are in low position. Operators can then circulate under electrified catenary thanks to the low height of the platform floors, under 1,60m from top of the rail. As soon as a platform element is leaving the down position, the system can travel at a reduced maximum speed of 5 km/h.

The braking is achieved through the hydrostatic mode. By the way, the hydraulic motors of the rail wheels also ensure a parking and emergency brake. For this, there are equipped with positive action disk braking. Disk brakes are activated as soon as the motor is switched off or when emergency stop is engaged. During railway travels, the braking system is designed to stop the vehicle within required distances as mentioned in the NF F 58-002 French standard. Besides, an



accelerating and a decelerating ramp are preset into the PLC in order to manage the braking operation and thus, avoid any slipping between wheels and rails and maintain the system in the perfect balance. If necessary, those PLC parameters can be adjusted during the commissioning of the machine according to particular local requirements.

The railway system has the following characteristics:

- Wheels diameter: 595 mm
- Drive: hydrostatic type, one motor by wheel
- Brakes: hydrostatic, and with disks by absence of pressure* for parking or emergency
- Railway speed (working / travelling): from 0 to 5,0 km/h / 23,0 km/h
- System against encroachment of neighbouring vehicle gauge: with mechanical stop
- Maximum working and travelling cant: 180 mm
- Track gauge: 1 435 mm
- Maximum track gradient: 3,5 %

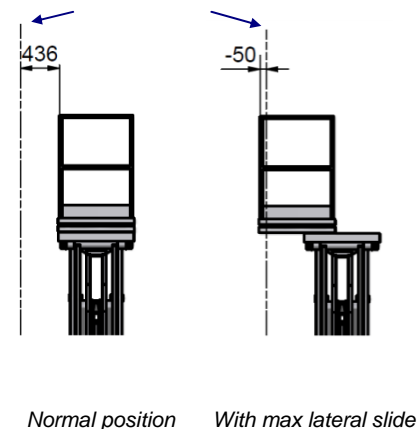
* The parking brake is within reach of the operator at its control post, in order to forbid any displacement of the vehicle while parked on a track of 40 ‰ gradient.

3.3. The platforms

The X6 chassis bears the scissor lifting platform, designed to receive 2 operators, and the telescopic lifting basket for 1 operator.

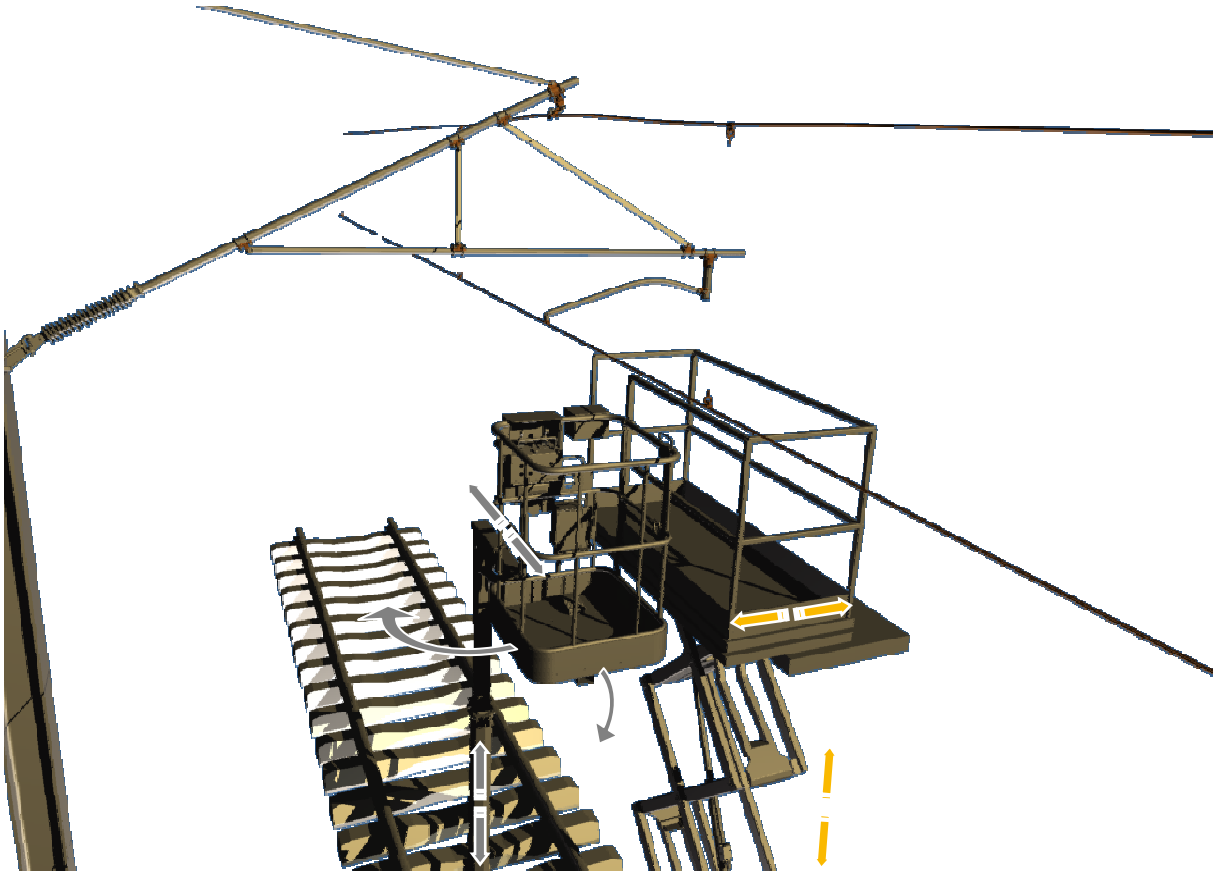
During the design of the lifting elements, UNAC highly put the emphasis on the **safety**, on the working **ergonomics** and on the high-performances lifting capacities. As a result, the scissor lifting platform is achieved by hydraulic cylinder equipped with safety valves. The platform is open permitting free movements of the operators in order to achieve independently or jointly their works.

The **scissor lifting platform** includes an exclusive design totally dedicated to overhead catenary system works. Indeed, in addition to receive tool baskets and hooks for on-board storing of necessary tools, equipments and components for the works, the entire platform is capable to slide laterally permitting then to operators to always be as close as possible of the catenary cables, whatever the stagger is.



Taking into account the lifting capacity of the scissor lifting platform, the longitudinal guardrails of the platform have been designed with a sliding opening with adjustable position along 500mm, permitting then the let the cantilever extremity pass through it. This 150mm opening is designed according the safety standards. This results in two main advantages: first, the operators can work higher than the overall catenary system and secondly to permit works simultaneously with the same machine, from the same platform, on 2 consecutive near cantilevers.

The **telescopic basket** permits to reach very high heights and also to go far on side of the track, in both cases going well beyond the post. It is made to bear one operator and have a mechanical closing system for entire safety. Thanks to its specific design including a pendular boom and swivelling baseframe, the telescopic basket permits to the operator to work within a very important volume, covering in total around 500m³, which corresponds to a 8m side length cube to give an idea. This working volume permits to the operator to cover a very big area and then avoid to use several types of machines on a same site, which would obstruct the track and would require a more complicate site organization. In those conditions, the operator always stays inside the basket and does not need to take risks like by standing on the guardrails as we can often see on the sites. He works either very independently at the post level or synchronized with the team of the scissor lifting platform, face to face with contact line in between, or higher on the support cable.



Visualisation of the possible motions of the lifters

Thus, each operator works at the required height for the working point, the most often at the bust height which generally is the most comfortable position for more working efficiency.

Working time and intervention time are therefore actually optimized. Indeed, each operator works freely and **simultaneously** on his tasks, individually or with his colleagues. It is resulting a **high working efficiency and ergonomics**, each operator being at an ideal, safe and **comfortable** position, always in activity, thus reducing to the maximum the idle times; people is then much efficient.

Individually accessible from the telescopic basket as well as from the scissor lifting platform, a control desk permits to the operator to manage the basket position as well as its lifting. The travelling of the self-propelled trolley is managed from the radiocontrol, once it is connected to one of the baskets.





The main characteristics of the lifting platforms are the followings:

- Number of baskets 2
- Maximum permitted number of operator on board: 3
- Maximum standing operator under electrified OCL: 3

- Scissor platform basket dimensions: 2000 x 800 mm
- Telescopic basket dimensions: 800 x 650 mm
- Max admissible load on the scissor lifting platform: 2 persons or 250 daN
- Max admissible load on the telescopic basket: 1 person or 180 daN

- Maximum scissor platform height, floor / rail: **8,20 m**
- Scissor platform height in low position , floor / rail: 1,55 m (lower than 1,60 m)
- Maximum telescopic basket height, floor / rail: **10,20 m**
- Telescopic basket height in low position , floor / rail: 1,30 m (lower than 1,60 m)

- Maximum lateral sliding extension of the scissor platform: 485 mm
- Maximum lateral outreach of the telescopic basket: **4,70 m from track centre**

- Movable opening of the scissor platform guardrail: 150 mm, movable along 500 mm

- Swivelling of the telescopic basket (in the horizontal plan) / track axle from -15° to 90°
inter-tracks / post side

- Swivelling of the telescopic basket (in the horizontal plane) / track axle from -15° to 90°
- Swivelling of the telescopic basket (in the vertical plane) / telescopic mast 90°
- Number of telescopic elements of the pendular arm: 1
- Number of scissor elements of the scissor platform: 6

- Standard accessories: lighting, 700 bar hydraulic plug
- Available electrical plug by basket 12V and 230V *
- Available controls for travelling speed, working mode: from one basket, at operator choice

* 230V plugs are mounted on the basket and shall be power supplied by an external power source, which can be stored on board on the chassis of the vehicle.

With the given admissible load, the lifting systems permits then to take on board the usual tooling of the catenary workers.



3.4. The hydraulic group

Le X6 est un véhicule hydrostatique. La fourniture de l'énergie hydraulique est assurée par le groupe moteur-pompes pour l'alimentation hydraulique de tous les équipements.

Les éléments constituant le groupe sont les suivants :

- Engine: Diesel, 4 cylinders
- Engine manufacturer and type: Caterpillar, type C2.2
- Power: 46 KW at 2 800 rev/min
- Fuel tank: 100 litres
- Hydraulic tank: 120 litres
- Hydraulic pumps: 2 for advance, 1 for the scissor and tires lifting and 1 for telescopic mast
- Control of the lifting elements movements: electro-hydraulic distributors
- Control of the all-terrain drive: radio-control, delivered with 2 batteries
- Hydraulic circuit: 250 litres
- Electrical control cabinet: with integrated touch-screen PLC
- Control and safety interlocking system: by PLC and relays
- Battery: 1x12V
- Emergency stops: 1 by basket, 1 on the radio-control, 1 on the chassis

In addition to the usual robustness inherent in Caterpillars engines, the X6 engine has been chosen in order to give a high effective power while maintaining reasonable noise level emissions and satisfying to the level III of antipollution European Union standards.

3.5. Emergency

Access to all mechanical, hydraulic or electrical parts can be made by simple opening of doors or panels.

In case of breakdown, the platforms can be lowered back and the system can easily be de-braked thanks to:

- One emergency system with electrical pump at disposal on the low chassis of the machine
- One manual emergency system actuated by handpump located on the chassis

Emergency stops are located on each basket and on the chassis.

3.6. The equipotential mast

The X6 is equipped with a pantograph for equipotential linking. It is set on at the beginning of the works in order to evacuate any residual energy from the overhead contact line.

The pantograph is made of one telescope at the end of which is assembled the bow. The pantograph base is articulated in order to be folded between the platforms. It makes thus an optimization of the size of the equipment.

The mast with telescopic deployment comes into sensitive contact with the contact line. The pantograph then applies a 7kg constant force on the catenary.

The lifting of the bow is guided by rollers mounted on bearings, in order to limit the play of the telescope and guaranty robustness of the telescope for long life time.

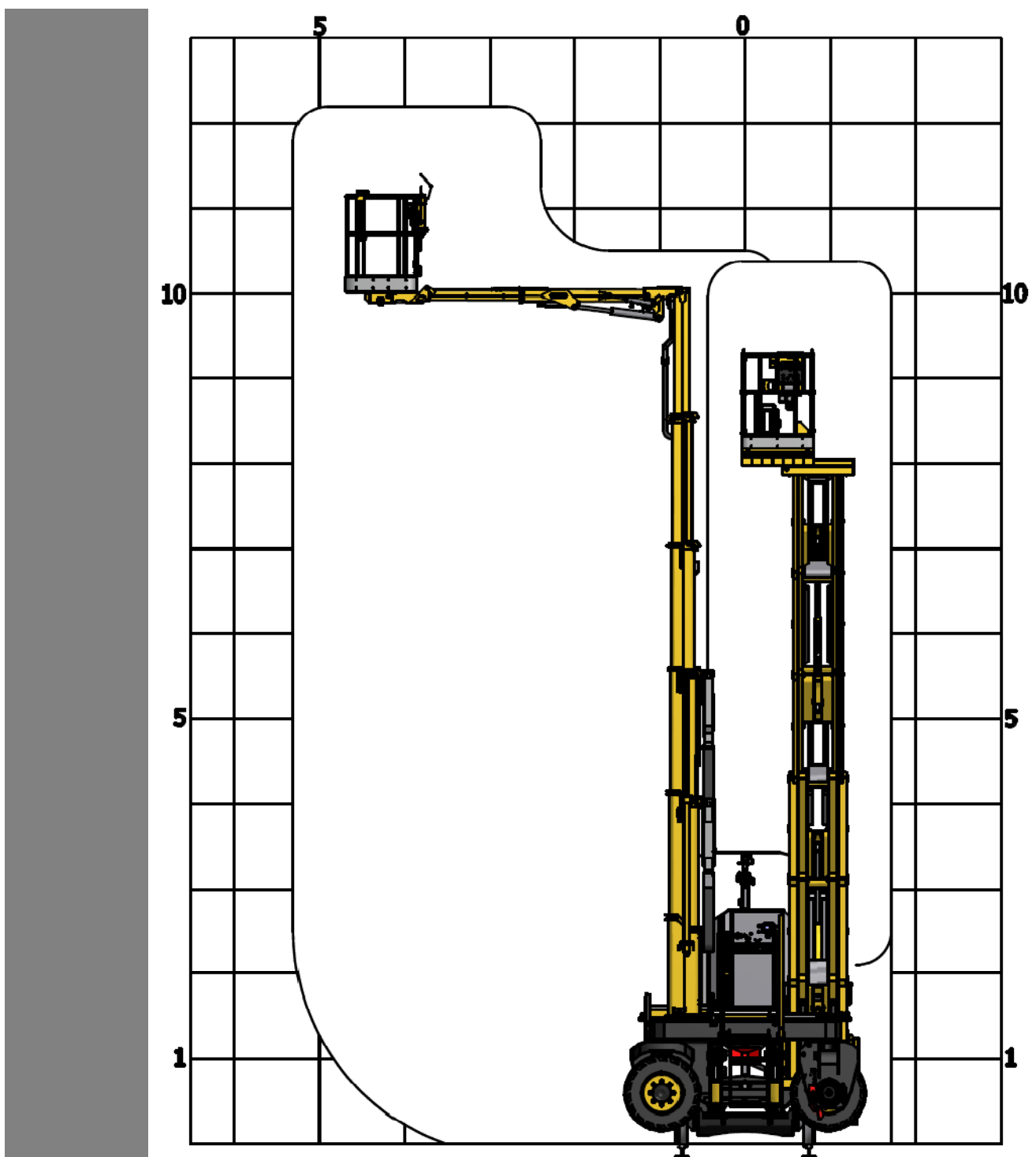
A 95 mm² equipotential cable is conveyed for the correct earthing.

The mast can also be used to control the catenary position. Indeed, a measuring rule is integrated into the pantograph and permits to read the catenary stagger thanks to the position graduated indication going from -400mm to +400mm. The **stagger** reading is therefore visually made, directly on the rule.

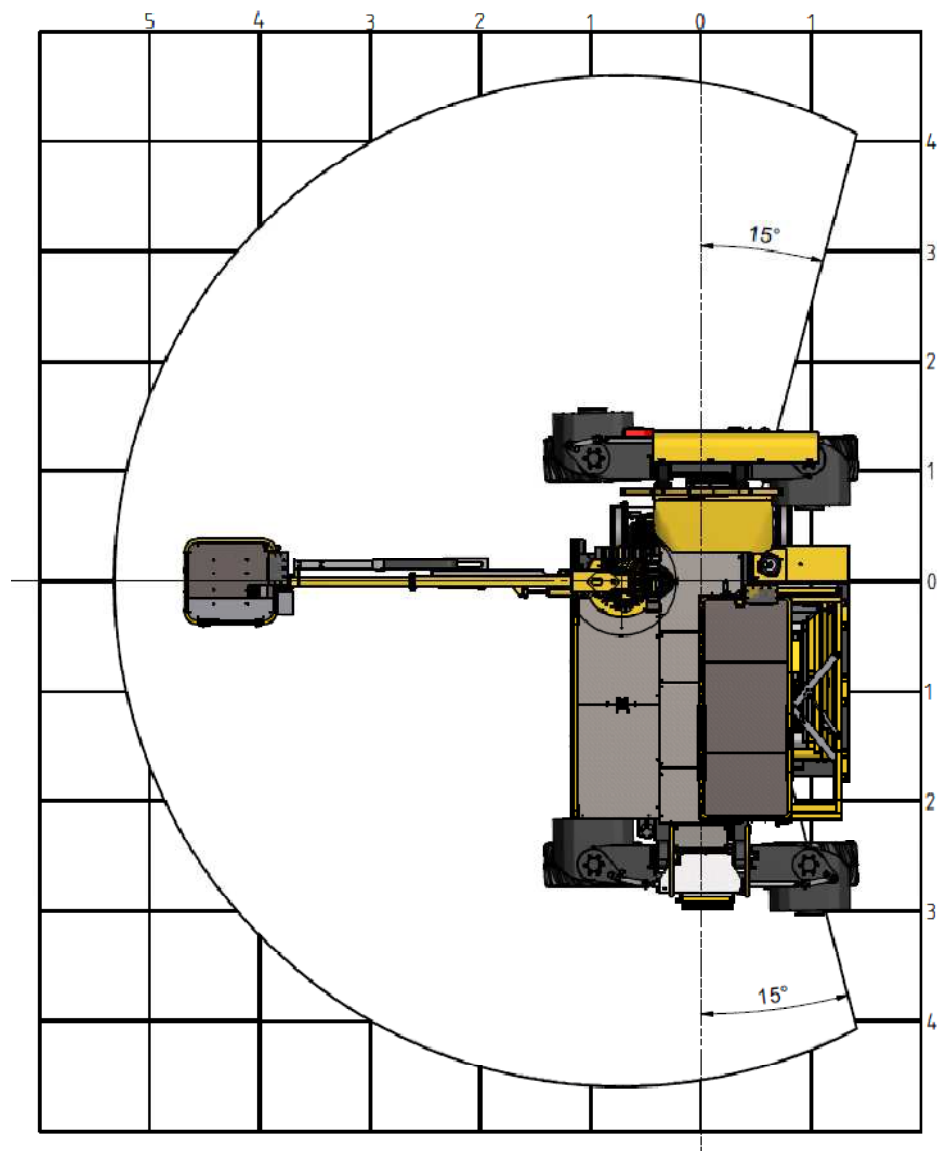
4. WORKING DIAGRAM AND DIMENSIONS

4.1. Working diagrams

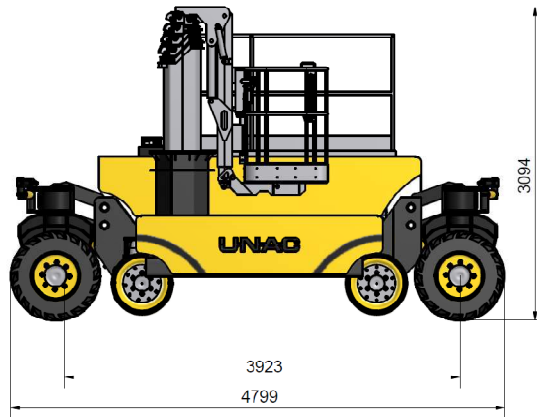
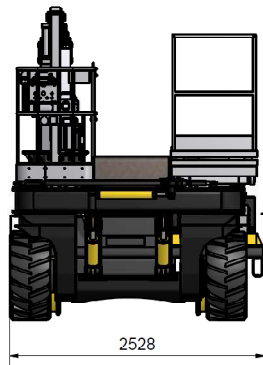
X6 working diagram – Telescopic basket and lifting platform – Side view



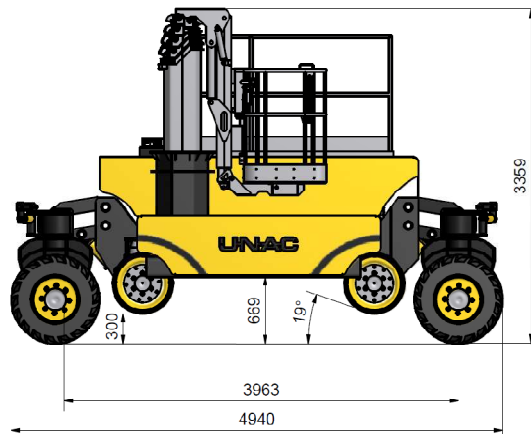
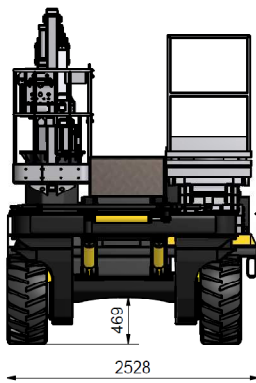
X6 working diagram – Telescopic basket – Top view



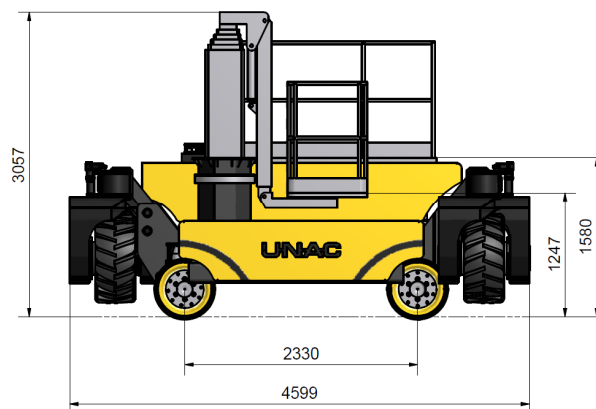
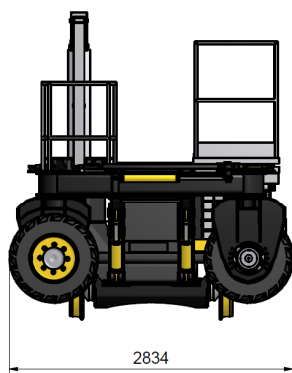
4.2. Main dimensions



on truck trailer



on road



on track

All functions, characteristics and other specifications of the product written in this document can be changed without prior notice.



TRENCHER



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ROAD-RAIL



SNOW REMOVAL



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