

MA4-ID13 ID LONG MASTER THESIS PROJECT AALBORG UNIVERSITY JUNE 2012

FLUX

TOOL CARRIER CONCEPT



PRODUCT REPORT

FLUX

Introducing something new in outdoor maintenance

A collaboration between VPM Maskiner A/S, VPM Development ApS, and Aalborg University, developed by Søren Nørby and Malte Aarup Eriksen.



MODERN CITY KEEPING

Modern city maintenance of outdoor areas is a vital part of keeping a clean and healthy urban landscape. Machinery such as tool carriers are the mainstay of this daily duty.

Flux is a new tool carrier concept developed for VPM Maskiner A/S, a relatively new and small company in this business. VPM has a philosophy of focusing on the user experience, creating a comfortable place of work through their product offerings.

The Flux concept expands on this user centred approach, creating a workplace with many levels of comfort and overview. The Flux also introduces a new approach to propulsion, utilising a jet-turbine-powered hybrid system and an electric infrastructure to reduce emissions, both green house gasses and noise.

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FLUX

Exit &

John Hardy *ALG*



GETTING IN

As a tool carrier operator enters and exits the cabin many times during a day at work, this very action has been taken into consideration when designing the Flux. Unlike the competition, tool controls are integrated into the arm rests in the doors, allowing full ambidextrous entry.

As the floor and seat are relatively high, a convenient running board is located on the front wheels. This is complemented by handles on the A-pillars and a sturdy steering wheel, making the act of getting in and out of the machine an unhindered experience.





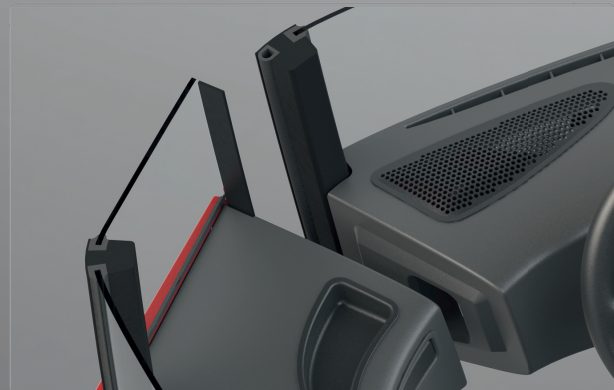
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A MACHINE AS WORKSPACE

When settling into the cabin and closing the door, another Flux innovation comes into play. A soft close system, as seen on high end cars, takes over the last bit of the closing action, providing a smooth and calm experience not found on any competitor.

The soft close module is located in the steering console and prevents excessive pressure that hurts the ears when needing to close a cabin door with force.



As people come in all shapes and sizes, the interior is made adjustable to accommodate. The air suspended seat and steering wheel provides wide adjustment travel to reach as many drivers as possible. This customisation is important when operating the vehicle for an entire day.

The flat floor in the cabin has provided space for storage compartments to include items that an operator likely has with him or her. This includes a mini-fridge for a lunch pack and a cup holder in the arm rest.



Along with a slot for documents and a cubbyhole for peripherals, a coat hanger is placed behind the seat so that a coat can be tucked safely away.

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Shown here are the interfaces used during operation. These include digital mirrors, brake and accelerator pedals, hand brake, indicator stalks, CANbus unit, and tool controls in the arm rest.

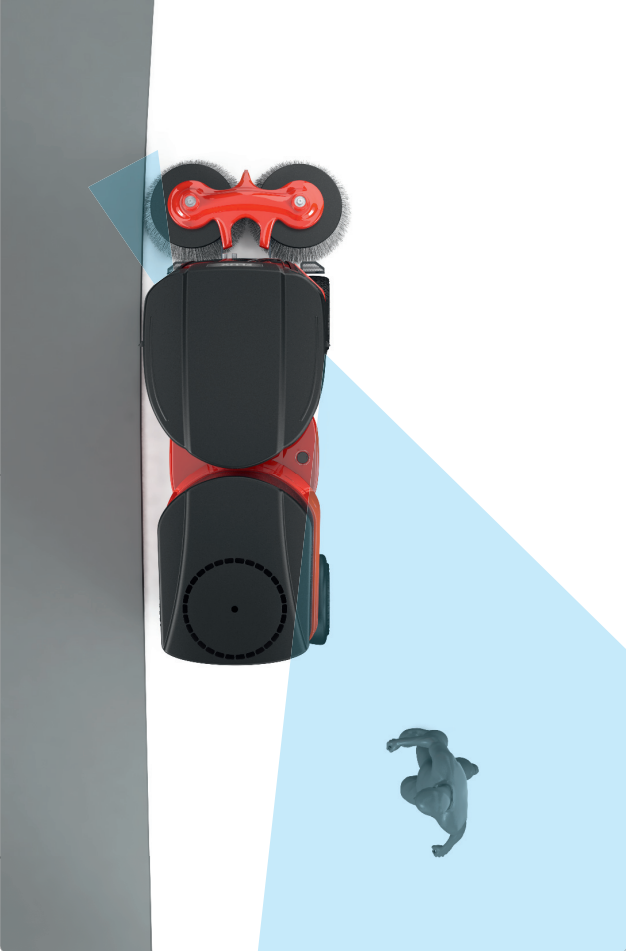
INTERFACING WITH OVERVIEW

The Flux has been designed with overview in mind. This applies both to the fields of view and the interfaces used in operation.

The pilot bridge that encompasses the operator can be laid out for both left and right hand tool control use. The steering wheel houses a stationary CANbus unit that functions as the brains of the machine, and conveys relevant readouts such as speed, tool speed, fuel levels, and diagnostic information.

The fields of view in Flux has also been carefully laid out to provide direct lines of sight where it is most needed - the front tools.





To complement the direct lines of sight, digital side view mirrors are implemented to provide a sleek, non-protruding exterior to avoid the vehicle getting stuck in tight situations.

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NEW STYLE MANOEUVRING

Flux brings about a new type of steering mechanism, double articulated steering (DAS) to replace the common single articulated steering (SAS) found on all other tool carriers.

This new type of steering enables best-in-class turning circle of just 1100 in diameter, along with individual control of the steering joints. This in turn enables steering on either the front or the rear

wheels, simulating SAS, and an interesting “crab” style steering.

Crab style steering allows operating close to ledges while shifting centre of gravity away, providing a much more sideways stable platform. This type of steering can also be used to distribute loads on delicate surfaces such as grass and tiles.



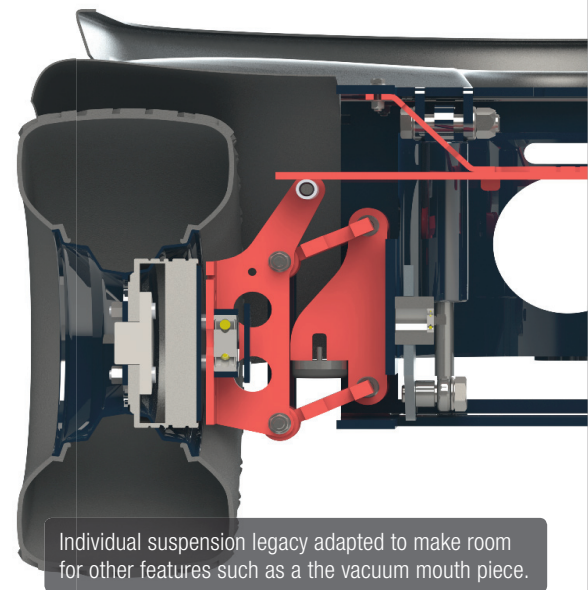


When moving to and from jobs at higher speeds, Flux only uses the front joint for steering, making for a much less jittery and car-like experience.

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Redesigned lift system, with rugged looks and optimised action.



Individual suspension legacy adapted to make room for other features such as a the vacuum mouth piece.

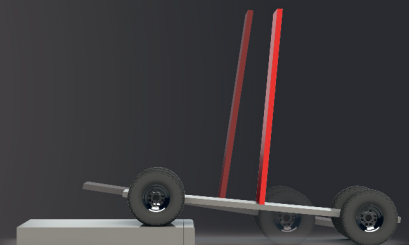
LOW SLUNG PLATFORM

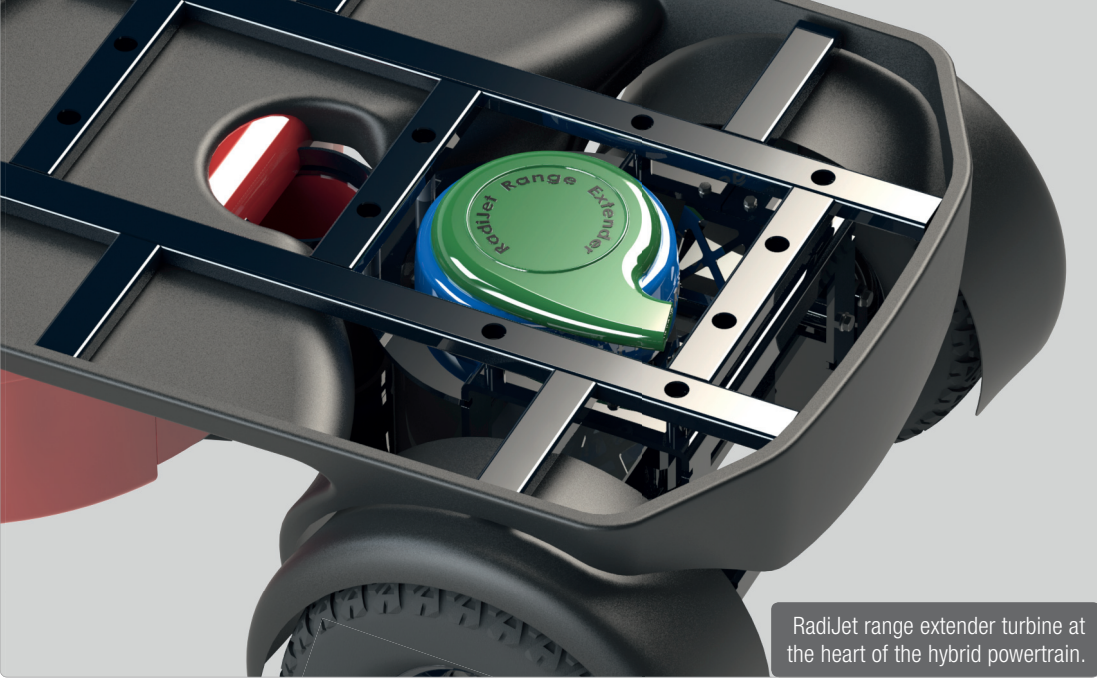
The DAS system and the hybrid powertrain are combined to produce a self contained platform with all propulsion systems on-board. The cabin and back box are built on top of this platform, and can be replaced with different future configurations.

The hybrid powertrain, capable of running on many fuel types, combines the best of an electric infrastructure with the ease of refuelling. This results in an efficient low-noise system with reduced emissions. Propulsion

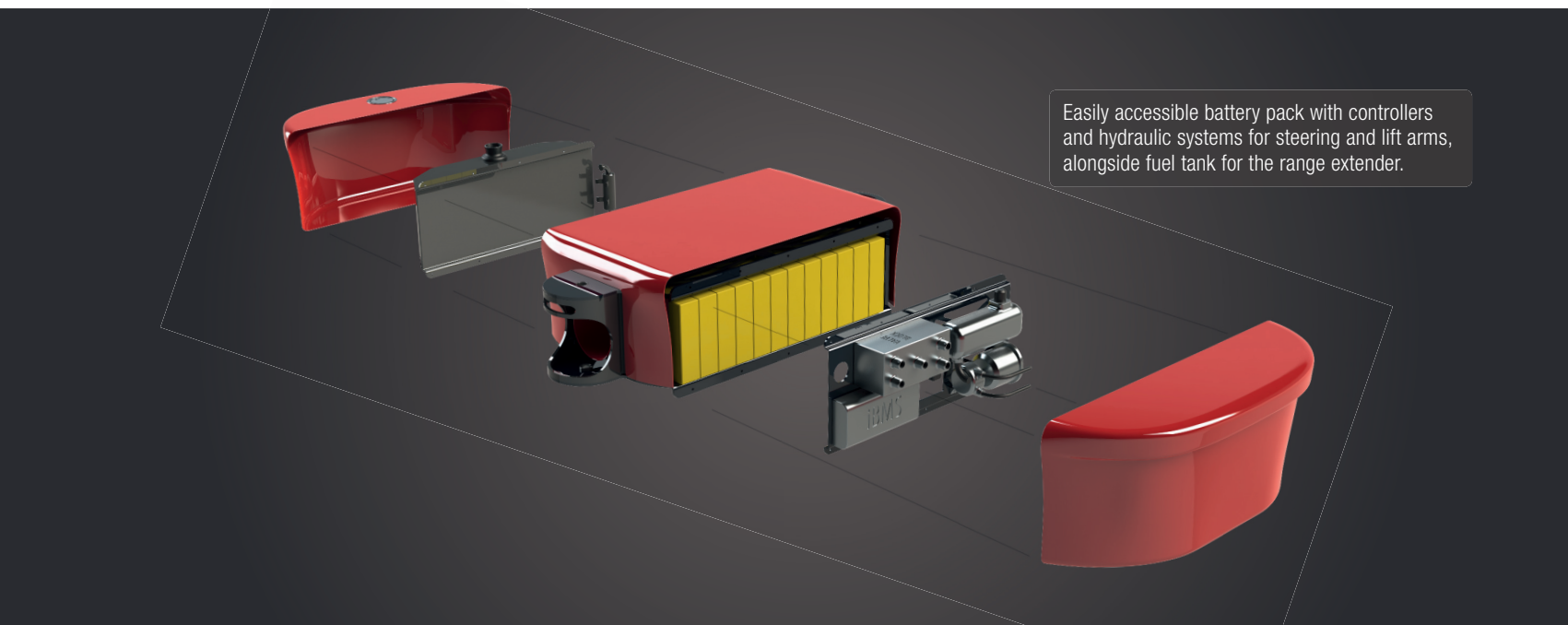
is provided by two electric motors on the rear wheels, geared to provide a total of 1200 Nm.

The platform enables a uniquely long wheelbase of 1940 mm, creating stability both when stationary and when moving over obstacles, negating the need for counter weights as employed on some competitors. The lift system is redesigned with updated aesthetics and action. It is positioned between the wheels to avoid scraping on e.g. kerbs.





RadiJet range extender turbine at the heart of the hybrid powertrain.



Easily accessible battery pack with controllers and hydraulic systems for steering and lift arms, alongside fuel tank for the range extender.





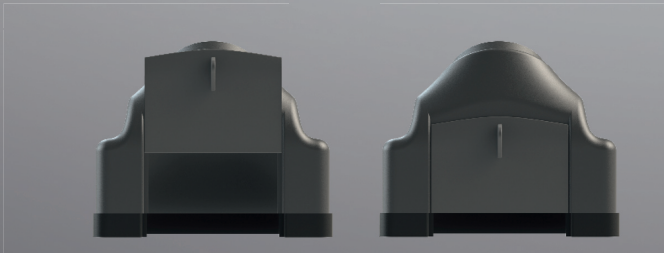
TOOL IMPLEMENTATION

Mounting tools onto the front of Flux is made easy with the clear line of sight provided by the lack of a traditional steering column.

Flux is introduced with a street sweeper attachment with a 750 litre vacuum box and a 300 litre water supply, almost doubling the capacity of the VPM 3400 to keep return runs to a minimum.

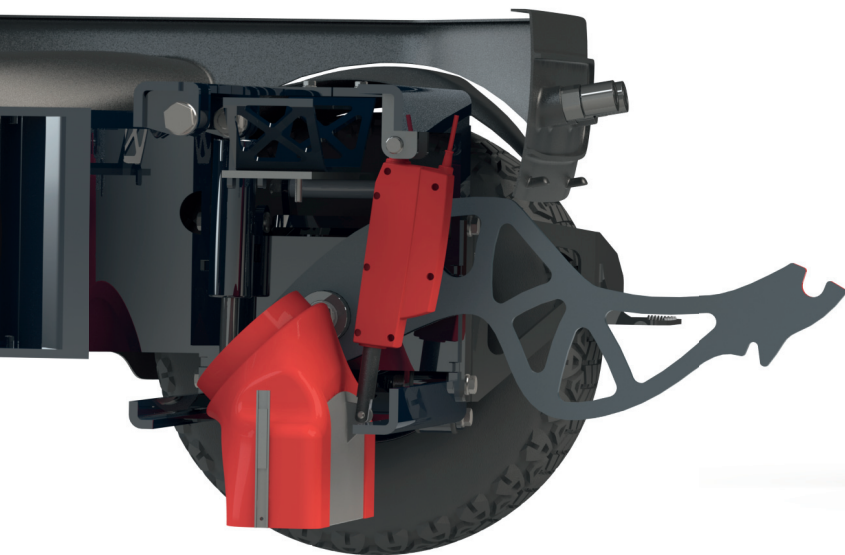
The platform incorporates a mouth piece in the front and an internally routed low-drag vacuum pipe to the back vacuum box.





As the mouth piece is incorporated into the front of the platform, the front sweeper tool is made much lighter, simpler, and easier to mount with no vacuum coupling to align. The mouth piece has an adjustable latch that enables Flux

to sweep up larger objects such as bottles, etc. The back vacuum box is raised in an unconventional way. A parallelogram action lifts the box up and over the container, making sure the dirt is off-loaded without any spills.



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PRODUCTION

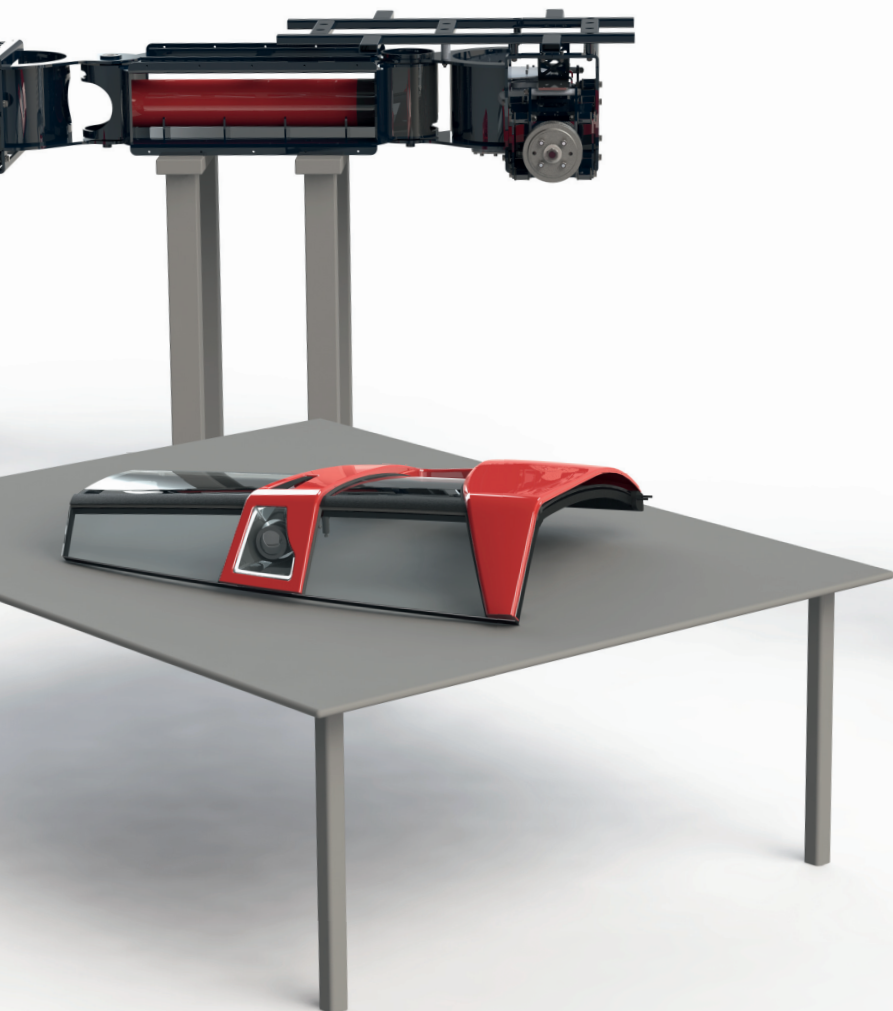
Flux builds upon classic boilermaker manufacturing processes combined with innovative production technologies allowing for small production runs. The chassis is constructed in typical laser-cut sheet metal, bent and welded together to withstand high loads in a simple and inexpensive fashion.

This is combined with lightweight plastics and aluminium components for the bodywork and cabin assembly. The coloured, high-gloss bodywork is made from thermoformed HIPS sheet plastic. Rotation moulding is used for large, low-gloss components such as the roof and lower bodywork. For interior components such as the pilot band, requiring a higher degree of surface finish, vacuum casting is employed, allowing for intricate detailing in low production runs.

The structural cage in the cabin is made from hard anodised, CNC bent, extruded 6082 aluminium for high strength and low weight.

These initiatives results in a kerb weight of just 700 kg, a quarter ton lighter than the VPM 3400.





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COLOURATION

As many municipalities and companies have their own distinctive signature and colour scheme, differently dyed sheet plastics can be used. Because the coloured bodywork is only comprised of thermoformed plastics, achieving a uniform custom colour is only a matter of choosing the right sheets; there are no painted parts that have to be matched.



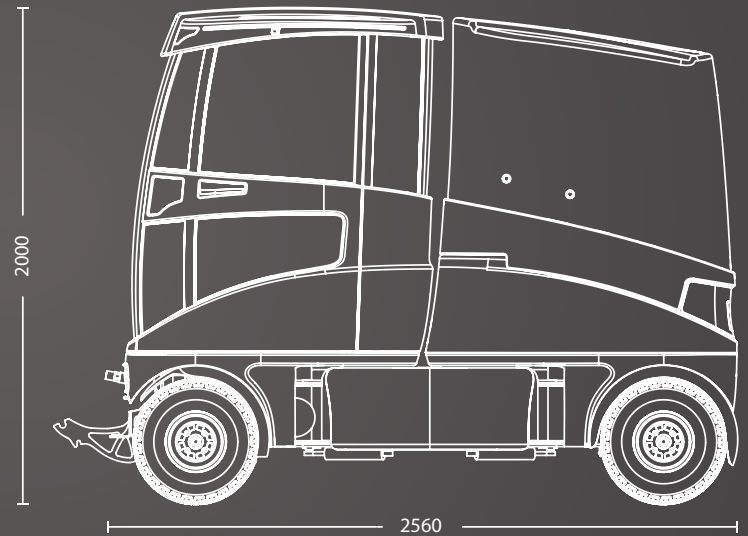
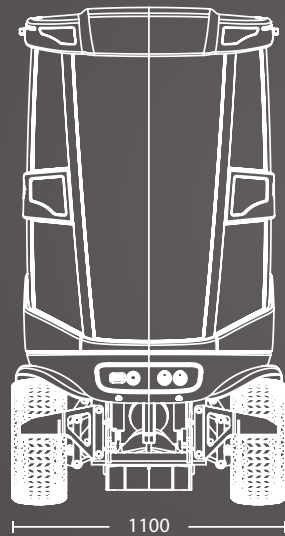
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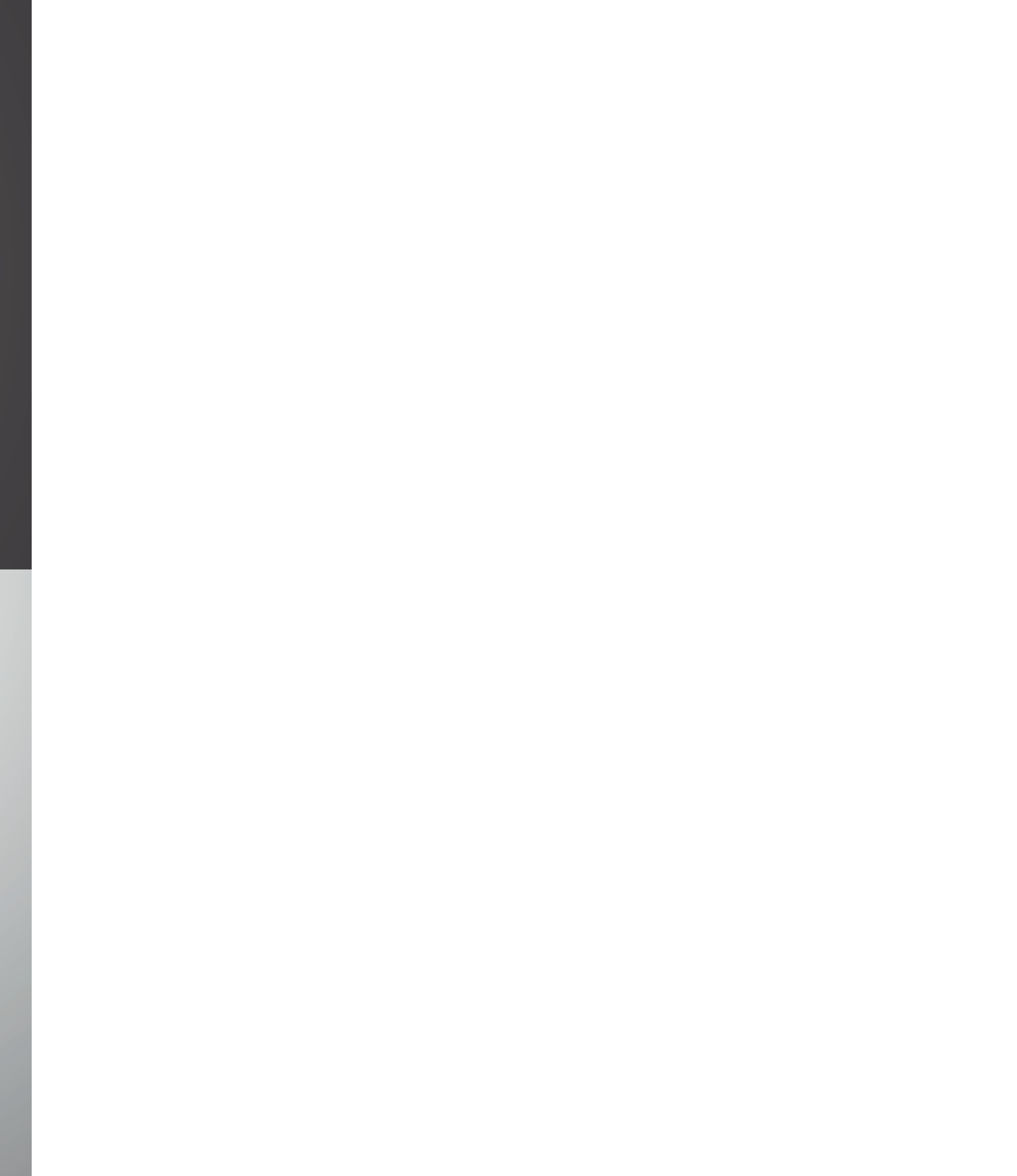
TECHNICAL SPECIFICATIONS

Kerb weight : 700 kg
Height: 2000 mm
Length: 2560 mm
Width: 1100 mm
Turning circle: 1100 mm
Wheelbase: 1940 mm
Platform height: 627 mm
Vacuum capacity: 750 litre
Water capacity: 300 litre
Vacuum pipe: 160 mm
Wheel size: 20 x 10"

Battery capacity: 7.2 kWh
Tank capacity: 22 litre
Run time on one tank: 8 hours

Jet turbine: 11 kW
Motors: Twin 8 kW
Gearing: 1:15
Moment: 1200Nm





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