The safest and most efficient pushback system. Pushback aircraft electrically.
Every minute of waiting for a pushback tug is expensive. British Airways reduces the pushback delay at London Heathrow T5 by up to 70%. Fever delays mean less costs and less emissions.

Only specialized and authorized staff is permitted to push back aircraft with a conventional pushback tug. Mototoks can be operated by everyone of the ground handling staff without the need of a driving license.

Our concept is to equip every third boarding bridge with a Mototok to ensure fast and direct access to a pushback tug. Exactly when it’s needed – without delays.
Dimensions of a conventional tow tractor with or without a towing bar

Dimensions of a Mototok
The view outside a standard pushback tug.

Normally minimum 2 Persons are required for pushing back an aircraft with a conventional tug: A wing-walker and a specially trained and authorized pushback operator.

With Mototok only one person is able to maneuver the aircraft – far away from the engines and with a huge circumferential view around the aircraft.
Due to wireless remote control the operator can stand far away from the turbines and the machine. He has a complete and circumferential view all around the aircraft during the whole pushback process.

This is our concept:
The Mototok principle – Circumferential all around view
SPACER 8600.
Pushback Operations made easy.

- Full electric drive
- Wireless remotely controlled
- Only one person needed
- One-click-loading system
- No driving license required
- 2 hours operational Training
- Reduce delays
- One Mototok for 1-5 Boarding bridges
- Compact design
- Recharging time: about 3 hours
- 30 to 50 pushbacks with one charge
- Very low maintenance costs
- Green Energy: No fuel costs
- I-OPS: Oversteer Protection

Video: www.bit.ly/mototok-pb
Very low maintenance costs
Compared to conventional drives, an electric drive has significantly fewer moving components. Therefore the maintenance costs are much lower compared to a conventional tractor.
All important electrical and hydraulic components are located in a single compartment – making maintenance considerably easier.

No fuel costs
The costs for maintenance, repair and energy are less than 0.90 € for a pushback – based on 986 pushes per month or approximately 33 per day.

Green energy – less emissions
Reduction in CO₂ emissions
Reduction in NOₓ emissions
Reduction in ultra-fine particulate emission
Reduction in heavy vehicle movements

ADVANTAGE 1:
Enormous savings on operational and maintenance costs.
ADVANTAGE 2: Enormous savings on staff and personal costs thanks to safe one-man-operation.

Only one man needed for operation
Thanks to the remote control, the operator has an excellent all-round view: the operator is his own wing-walker. This avoids possible communication problems between the additional wing-walker, which is no longer necessary, and the operator. Additionally, the operator is always connected to the pilot via the headset. The communication paths on the airfield during the pushback are reduced to a minimum.

Convenient, quick and easy
By tapping a button on the remote, the loading process of the nose gear will start automatically. This is a process of about 10-15 seconds – ready for take-off.

No driving license required
Any ground crew member can push back the aircraft. A short introduction and a operational training of about 2-3 hours is sufficient. This gives you more flexibility in personnel resource planning. In addition, you do not have to wait for a conventional tug driver with a driving licence. This explains the significant decrease in delays due to waiting times for the conventional pushback tug.
ADVANTAGE 3: Pushback ready anytime!

One Mototok Pushback Tug for three Boarding Bridges

Use a Mototok for up to three boarding bridges to get a fast and direct access to a pushback tug. The Mototok is always in place and available when you need it. Since no official driving licence is required, any trained ground staff member can carry out the pushback.

Exactly when it’s needed – without delays.

Yesterday’s world of London Heathrow Airport: 12 hour heatmap of TBL 280 movements

Today’s world of London Heathrow Airport T5: Heatmap of Mototok movements

MORE THAN 110,000 PUSHBACKS DONE
STATUS 05/2019
TORQUE LIMIT REACHED
COUNTERSTEERING
ADVANTAGE 4: Oversteering was yesterday.

Equipped with I-OPS – the intelligent oversteering protection system

The Mototok’s I-OPS prevents an oversteer incident through intelligent torque measurement and automatic counter-steering. When the measured torque reaches a critical value of the set torque limit, counter-steering is performed immediately. The torques occurring at the nose wheel are saved in a log file and can be read out and evaluated by authorized personnel at any time.

No more flight delays due to broken shear pins or oversteer occurrences

The occurrence of an oversteering normally means an immediate standstill of the aircraft until the cause of the occurrence has been clarified. A conventional tow tractor – regardless of whether it is towbarless or not – cannot prevent oversteering, it can only indicate it.

Mototok takes a completely new approach: Equipped with our I-OPS – the Intelligent Oversteer Protection System – oversteering is virtually impossible. The system actively intervenes in the controls as soon as a critical value of the torque at the nose gear is measured or exceeded.
Advantages for the Ground Handling Company

- Enormous cost reduction:
  - staff
  - operational cost (fuel)
  - maintenance cost (parts, downtime)
- Staff planning becomes more easy and flexible
- Training costs for new staff members are low
- Reduced complexity of workforce planning: Equipment and personnel are always available – just in time.

Advantages for the Airline

- Safe one-man-operations – more and more airlines will agree
- No change of the Pushback procedure from the view of a pilot
- No delays anymore: The tug and the driver are always available
- Less kerosene consumption because there is no waiting time for a conventional pushback tug

Advantages for the Airport

- 100% green operation – no hybrid, no diesel.
- Reduces the emission of carbon dioxide (CO₂), both from the towing vehicle and from the aircraft’s turbines, while waiting for the pushback
- More safety through total overview of the operator
- No more flight delays by waiting for an conventional tug – the equipment and personnel are always available – just in time
Also for use in harsh conditions.

In bad weather conditions the Mototok remains safe and ready for action. Rain, snow and ice – no problem.
The de-icing of the aircraft can also be done with the help of a Mototok.
MOTOTOK IN DETAIL
The Mototok Principle – How it works.
Engaging and Disengaging the Nose Wheel

The engaging procedure can be started automatically by pressing just one button on the remote control:

1. Drive the Mototok with the hydraulic door open and the platform lowered to the nose wheel of the aircraft until the nose wheel touches the sliding table. Then press the start button on the remote control.

2. The hydraulic door closes ...

3. ... and clamps the nose wheel with a specified pressure.

4. The platform lifts up and raises the nose wheel

5. The securing paddles lower down automatically and clamp the nose gear gently and safely – ready for moving the aircraft. The whole procedure takes only 10-15 seconds.

Website: www.bit.ly/mototok-easy
The Mototok central processing unit: Mototok is digital!

Mototok comes with a central processing unit (CPU) for features and adjustments relating to:
- Towing and braking forces
- Oversteering protection and counter steering
- Voice announcements
- Unit diagnostics
- Log files
- User access

The CPU can connect to any mobile device (smartphone, tablet or laptop) via Bluetooth, WLAN or USB and a standard Internet browser (such as Microsoft Edge, Apple Safari, Google Chrome or Mozilla Firefox). Once connected to the system, you can manage many types of Mototok settings.

In addition, remote maintenance allows Mototok technicians to assist you with settings and maintenance.

Authorization to use the Mototok

The fastest way to login is to use an RFCI card and an appropriate card reader on the machine. Depending on the authorization level, the user can move the Mototok, check or adjust the settings or read out the log files.
Everything in sight – from everywhere.

Always receive information about the condition and the battery status, the location and activities of each Mototok in your fleet.
Safety first: I-OPS – Intelligent Oversteering Protection System

Achieve more safety in your daily operations: Our Intelligent Oversteer Protection System (I-OPS) with automatic counter-steering function is our latest contribution to preventing damage to the nose gear during shunting and pushback operation – the only one worldwide!

Equipped with several sensors that measure the forces and torques on the nose gear, Motokok’s counter-steering algorithm starts when the torque reaches a set limit. This prevents damage to the sensitive nose gear.

**The difference to conventional oversteering protection systems**

The occurrence of an oversteering normally means an immediate standstill of the aircraft until the cause of the occurrence has been clarified. A conventional tow tractor – regardless of whether it is towbarless or not – cannot prevent oversteering, it can only indicate it. Mototok takes a completely new approach: Equipped with our I-OPS – the Intelligent Oversteer Protection System – oversteering is virtually impossible.

**How this works**

The Mototok’s I-OPS prevents an oversteer incident through intelligent torque measurement and automatic counter-steering. When the measured torque reaches a critical value of the set torque limit, counter-steering is performed immediately. The torques occurring at the nose wheel are saved in a log file and can be read out and evaluated by authorized personnel at any time.

**Intuitive and easy handling**

- Information for operators over the display of the Mototok and over electronic speech synthesis with the wireless headset (optional)
- Information for technicians over Mototok App with Laptop or tablet

![Diagram of nose wheel rotating force and torque measuring point](image-url)

- Driving Direction (pushing)
- Maximum allowed steering.
- If the torque falls below 70% of the permissible value again, the counter steering is reduced.
Automatic Counter Steering

I-OPS takes action actively and not only with a simple alarm – when it is too late.

The forces and torques acting on the nose gear are measured by weighing cells. Mototok’s Intelligent Oversteer Protection System (I-OPS) prevents too high torques and initiates a counter steer action whilst either pulling or pushing the aircraft.
For a quick transport to another location at the airport.

With the help of the towing adapter, the Mototok can be towed over a long distance of the airport. The drive wheels are raised and thus do not hinder the towing process.

Video: www.bit.ly/motok-tow
Our innovative aircraft tractors, which are designed for a long service life, are optimally equipped for daily hard use, as they consist of high-quality materials and hand-picked components according to the best technical findings. Our products are able to withstand the toughest conditions under wind and salt water. Thanks to the selection of the best materials, only limited maintenance is required.

Our production process meets and applies to all the necessary requirements and conditions required in mechanical and electrical engineering.

<table>
<thead>
<tr>
<th>2006/42/EC</th>
<th>Machinery Directive (MD)</th>
</tr>
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<tbody>
<tr>
<td>2014/35/EU</td>
<td>Low Voltage Directive (LVD)</td>
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<tr>
<td>2014/30/EU</td>
<td>Electromagnetic Compatibility Directive (EMC)</td>
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<tr>
<td>EN 1915-1</td>
<td>Aircraft ground support equipment General requirements Part 1: Basic safety requirements</td>
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<tr>
<td>EN 1915-2</td>
<td>Aircraft ground support equipment General requirements Part 2: Stability and strength requirements, calculation and test methods</td>
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<tr>
<td>EN 12312-7</td>
<td>Aircraft ground support equipment Part 7: Aircraft movement equipment</td>
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<tr>
<td>EN ISO 12100</td>
<td>Safety of machinery General principles for design Riskassessment and risk reduction</td>
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<tr>
<td>EN 1175-1</td>
<td>Safety of industrial trucks Electrical requirements Part 1: General requirements for battery powered trucks</td>
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<tr>
<td>EN ISO 4413</td>
<td>Hydraulic fluid power General rules and safety requirements for systems and their components</td>
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<tr>
<td>EN ISO 13849-1</td>
<td>Safety of machinery Safety-related parts of control systems Part 1: General principles for design</td>
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<tr>
<td>EN 60204-1</td>
<td>Safety of machinery – Electrical equipment of machines Part 1: General requirements</td>
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**Technical Data**

<table>
<thead>
<tr>
<th>Mototok</th>
<th>SPACER 8600 MA PB</th>
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<tbody>
<tr>
<td><strong>Use for</strong></td>
<td>double nosewheel</td>
</tr>
<tr>
<td>Maximum towing capacity ¹</td>
<td>95 t</td>
</tr>
<tr>
<td></td>
<td>209439 lbs</td>
</tr>
<tr>
<td>Maximum nosewheel weight capacity</td>
<td>10000 kg</td>
</tr>
<tr>
<td></td>
<td>22046 lbs</td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td></td>
</tr>
<tr>
<td>(without antenna, grips on the surface)</td>
<td>width</td>
</tr>
<tr>
<td></td>
<td>2610 mm</td>
</tr>
<tr>
<td></td>
<td>102.76 inch</td>
</tr>
<tr>
<td></td>
<td>3305 mm</td>
</tr>
<tr>
<td></td>
<td>130.12 inch</td>
</tr>
<tr>
<td></td>
<td>553 mm</td>
</tr>
<tr>
<td></td>
<td>21.77 inch</td>
</tr>
<tr>
<td>Ground clearance</td>
<td>81 mm</td>
</tr>
<tr>
<td></td>
<td>3.19 inch</td>
</tr>
<tr>
<td>Max width of the Nosewheel</td>
<td>851 mm</td>
</tr>
<tr>
<td></td>
<td>33.50 inch</td>
</tr>
<tr>
<td>Nosewheel diameter</td>
<td>450 – 1200 mm</td>
</tr>
<tr>
<td></td>
<td>1772 – 4724 inch</td>
</tr>
<tr>
<td>Unladen weight</td>
<td>5400 kg</td>
</tr>
<tr>
<td></td>
<td>11905 lbs</td>
</tr>
<tr>
<td>Time to load/fix aircraft</td>
<td>10 sec</td>
</tr>
<tr>
<td>Speed</td>
<td>5.4 km/h</td>
</tr>
<tr>
<td></td>
<td>1.5 m/sec</td>
</tr>
<tr>
<td></td>
<td>3.36 mph</td>
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<table>
<thead>
<tr>
<th>Batteries (maintenance-free, deep cycle gel batteries)</th>
<th>Armour Plate 300 Ah with electrolyte recirculation</th>
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</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>80 V</td>
</tr>
<tr>
<td>Recharging time</td>
<td>3 h</td>
</tr>
<tr>
<td>Range (depending on workload, distance to push/move, engines of the aircraft on/off)</td>
<td>3-4 days of hangar operations up to 30 pushbacks</td>
</tr>
<tr>
<td>Possible terrain</td>
<td>Concrete, stone</td>
</tr>
<tr>
<td>Tyres</td>
<td>Puncture-proof tyres</td>
</tr>
</tbody>
</table>

**Three Way Braking system:**
1. Recuperation (recharging the batteries), 2. deceleration by reversing direction, 3. electromagnetic disc brake

**Optional Equipment**
- Radio remote control (with safety features, waterproof, certification of conformity), worldwide safety approval, including airports, TÜV certified
- Fully hands free hydraulic door inclusive
- Hydraulic nosewheel securing ² inclusive
- Driving light (LED, 10,000 hour operating life, very high beam range) inclusive
- Yellow flashlights on both sides of the machine inclusive
- Safety beeper inclusive
- Automatic controls by ground markings (AGV functionality) available

¹ The stated towing capacity is valid for towing on normal ground conditions without any incline.
² This prevents the nosewheel from rising and slipping out of position. The securing device is hydraulically lowered onto the nosewheel and securely locked at the push of a button.

Mistakes and technical alterations reserved / Date 01.2019
**Dimensions**

**Aircraft tires**
- wheel diameter: 450–1200 mm (17.72”–47.24”)
- width: max. 851 mm (33.5”)

All dimensions without antenna, handgrips, etc. Subject to change without prior notice.
Mototok – the company.

- Founded 2003 by Kersten Eckert and Thilo Wiers-Keiser
- Worldwide distribution since 2008 with over 850 machines in use worldwide
- Distribution partners and subsidiaries in USA, China and Singapore
- Developing and manufacturing tugs for Airports · FBOs · MROs · Aircraft manufacturers · Airlines · Offshore · Military and other forces

Video: www.bit.ly/mototok-portfolio
Mototok.
Electrify your Ground Handling.