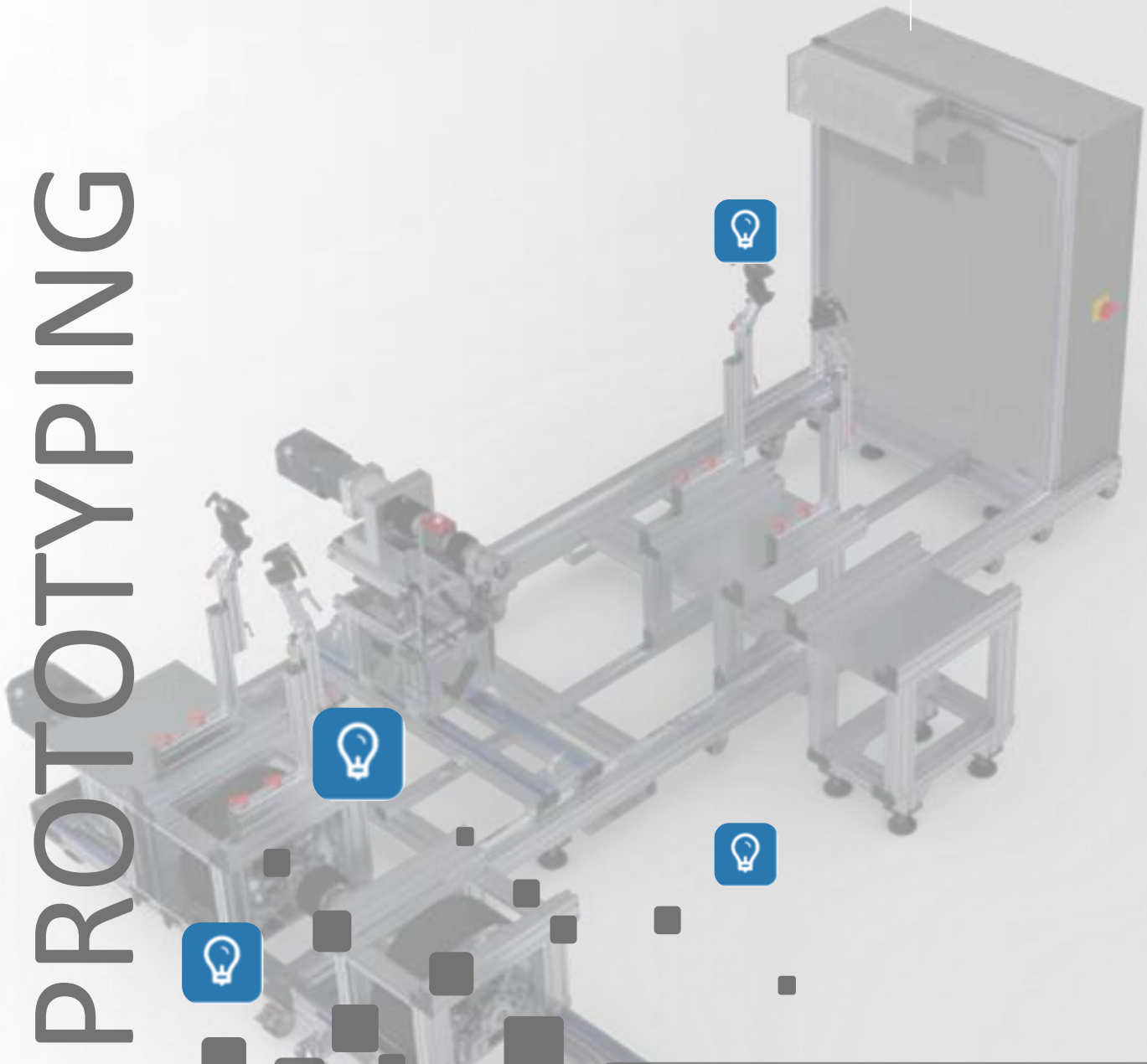


EMEC PROTOTYPING

01



Roller dynamometer for test and evaluation of electric bicycles

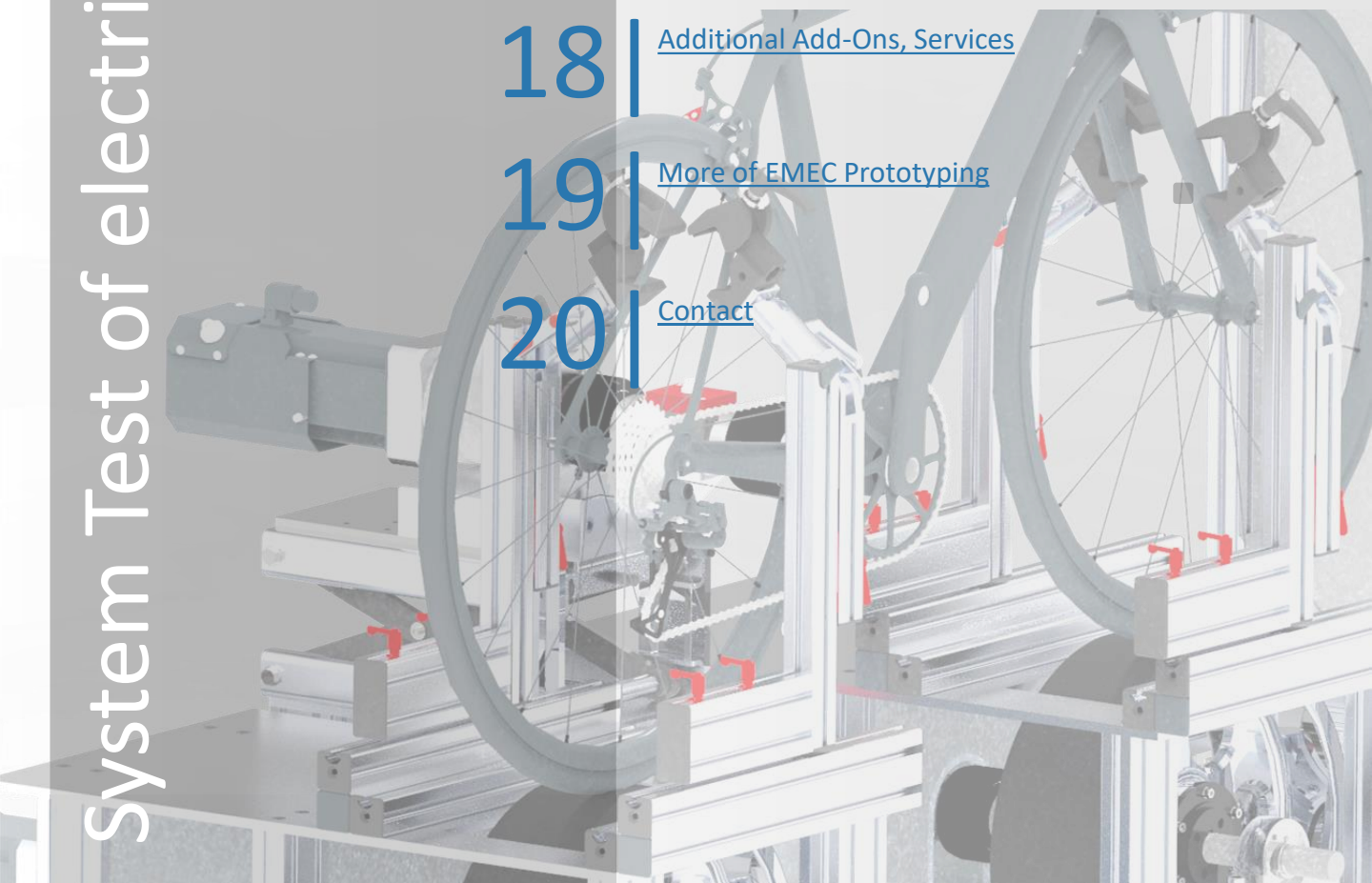
- DIN EN 15194
- Le1
- Dynamic
- Flexible
- Expandable



Content

System Test of electric Bicycles

- 03 | [Introduction](#)
- 04 | [Technical Design](#)
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Introduction



The most important indicators in the concept phase, the planning and development of electric bicycles are quality and safety. Due to the short development cycles, a high degree of flexibility in testing and verification is required. The system test is compact and built on industry standards. It allows you to perform a reliable and comprehensive review and analysis of your quality requirements and the applicable safety standards of e-bikes, pedelecs and S-pedelecs.

EMEC Prototyping offers you a highly dynamic, adaptive and scalable system test that grows with your needs along the value chain.

Range of Application

- Determining the Range/Efficiency Measurement
- Check of max. support performance to EPAC-Norm
- Determining of the power curve
- Investigation of overheating behavior under high load (driving uphill)
- Fatigue strength of all drive components before series start
- Test for quality assurance / Research & Development
- Implementation of dealer/customer feedback
- Verification & Assurance of safety standard **DIN EN 15194**

Deployment Scenarios

Full automated test cycles

Checking the safety standard of external assemblies

Laboratory and Development Tests



Boost Your Progress



Content

Technical Design



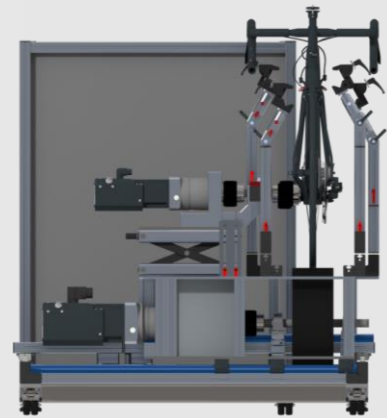
Hardware of the Basic configuration

The test bicycle is driven on the bottom bracket by one servomotor which is movable in X-Y-Z direction to connect every typical pedelec. The motor can apply either a sinusoidal or a constant, uniform torque. Thus, braking effects can be simulated by environmental influences such as slope or air friction. The rear wheel of the bike runs on a roll, which can be used in drive or brake mode. The brake unit is movable in X-Y direction and with loading rails to connect the brake unit with the front wheel support or the additional brake units in one direction / lane. The pedelec is attached with an ingenious system of clamps for quickly mounting. All test benches are with castors on the bottom of the frame and can move quickly.

View: side right



View: front

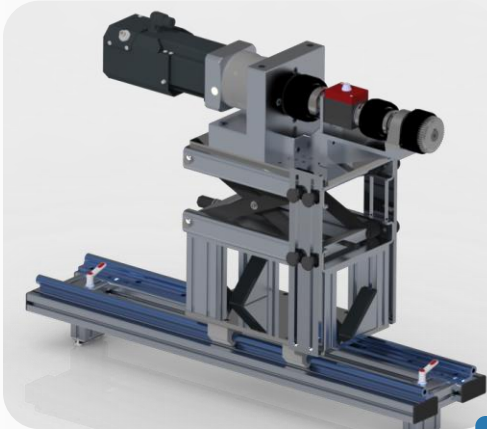


Size of Bicycle	Wheelbase:	700 – 1.700 mm
	Wheel size:	up to 29,5"
Dimensions of test bench (max.)	Height:	1.400 mm
	Lenght:	2.250 mm
	Width:	1.500 mm
Hardware being used	Frame:	item, Kamp & Kötter, igus and much more
	Control Cabinet:	Rittal, Siemens, Block, Phoenix and much more
	Servodrives:	Beckhoff or Fanuc
	Control:	Beckhoff
	Measurement:	ETH, Burster and much more



Technical Design

Drive Unit



Rated torque: 150 Nm
 Rated speed: 150 rpm
 Rated Power: 1300 W

Servodrive: Beckhoff or Fanuc

Movable in X-Y-Z direction
 Coupling with adapter for connecting the bottom bracket drive to the pedelec



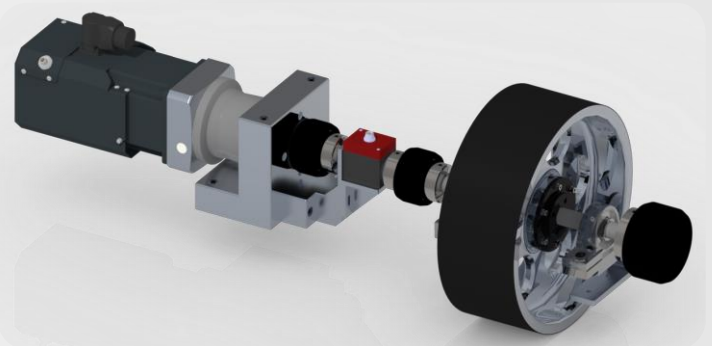
Brake Unit



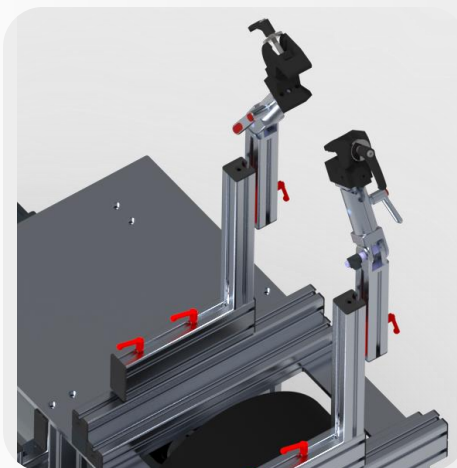
Rated torque: 150 Nm
 Max. velocity: 30 km/h
 Rated Power: 2400 W

Servodrive: Beckhoff or Fanuc
 Torque Sensor: ETH Messtechnik

- Roll with a diameter of 400 mm and a width of 150 mm
- Asphalt-like surface



Mounting System



- Two fixing arms per pedelec axle for optimal support
- Flexible, for all types of frame geometry
- Movable in X-Z direction and rotatable around X direction and the clamp is globally pivotable

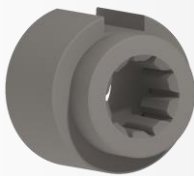
Technical Design



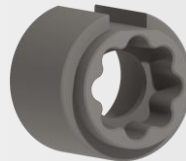
Bottom bracket adapter

- Bottom bracket adapter design of the insert according to the overview in the appendix
- Insert made of spark-eroded steel, precision-machined and surface-hardened
- Integration in system coupling hub for insert mounting
- Connection by press fit with spring groove
- Integrated extraction thread
- Delivery of matching puller
- Also applies to requested special designs and market launches
(Only one is included in the Basic Configuration)

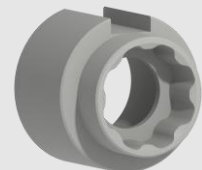
Available bottom bracket adapter



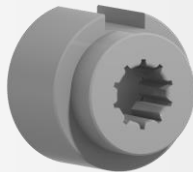
ISIS-Drive



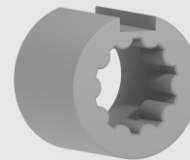
MAHLE M40 Sram



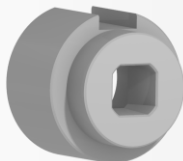
ROTOR eTORdrive 29 Fazura



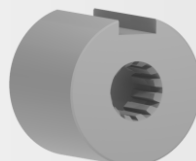
Bosch Gen 3



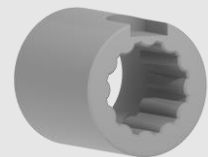
MAHLE M30 Specialized



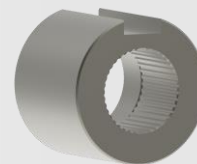
Square ISO 6695



FSA 12-tooth



Pinion



Hollowtech II

Technical Design

Sensorics

Mechanical Measurements

- Torque Sensor
- 1x Torque Sensor for the brake unit
 - Precision of 0,1 % of max. value
 - Resolution of 16 bit \pm 0,38 mV

- Speed Sensor
- 1x Speed sensor encoder per Servodrive
 - 2048 increments per rotation
 - Angle resolution of 0,175 °

Electrical Measurements

- Current Sensor
- 1x Current Sensor
 - Precision of 1 % of max. value (higher available)
 - Resolution of 0,1 A

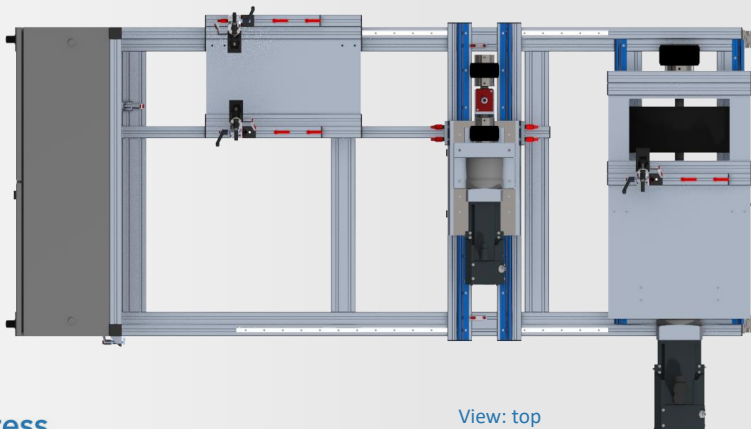
- Voltage Sensor
- 1x Speed sensor encoder per Servodrive
 - Precision of 1 % of max. value (higher available)
 - Resolution of 0,1 V

Temperature Measurement

- Temperature Sensor
- 4x Temperature Sensors
 - Type Pt1000
 - Type K

Safety

- Safety Sensor
- sensor input of safety PLC for the safety switch or fence
(Attention: The safety cell isn't part of the basic version!)



View: top

Software



Description **Laboratory and Development**

Requirement User-specific adjustment possibilities of all parameters like:

- Torque Driver
- Velocity Driver
- Power Brake unit
- Velocity Brake unit
- Headwind

Analysis - Storage of measured data in .csv-files
 - Loading stimulus .csv-file for predefined test profiles
 - Display of measurement values in user interface





User Interface

The screenshot displays the E-Mobility E-Bike Profstand user interface. The interface is organized into several functional areas:

- Header:** Features a logo placeholder "Space for your logo" and the EMEC logo with the tagline "Boost Your Progress".
- Control Panel:** Includes a digital timer showing 0:2:53 (h:min:s), a "Remaining Time" progress bar at 0%, and "Supply" status (Activated, Voltage: 20 - 50 V, 0.00 V).
- Temperatures:** Displays four temperature readouts: Temp 1: 25.00, Temp 2: 24.80, Temp 3: 25.00, and Temp 4: 25.20.
- State Indicators:** Shows "Emergency Stop" (green), "Light-barrier" (green), and "Motor enabled" (red).
- Target Velocity:** Offers "Const. Velo." (25 km/h) and "Dyn. Model" (45 km/h) options, along with a "Powered Axle" and "Velocity (km/h)" slider.
- Servomotor Teach-In:** Features a "Position (%)" slider from 0% to 100% and "Min Position Teach-In" / "Max Position Teach-In" buttons.
- Test Mode:** Set to "Direct" mode, with a "Stimulus File" path: C:\Testprofiles\test_prof.csv. Includes "Start" and "Stop" buttons.
- Road Parameters:**
 - Gravity:** Mass Driver (80.00), Mass Vehicle (20.00), Additional Mass (10.00), Inertia Wheel (0.000), Increase (%). (0 - 150), (0 - 150), (0 - 150), (0,001 - 0,1), (-40 - 40).
 - Drag:** Drag Coefficient (1.20), Air Density (1.20), Frontal Surface (0.50), Relative Wind (0.00). (0 - 2), (0,75 - 2), (0,2 - 2), (0 - 100).
 - Rolling Resistance:** Cwmatc (0.03), RRC (0.008), Perimeter Wheel (2222.00). (0 - 2), (0,002 - 0,02).
- Rider Parameters:** Target Power Motor (0.00), Torque Drive (15.00), Torque Modulation (0.00), Backpedal Torque (10.00), Backpedal. (0 - 280), (0 - 100), (0 - 0,5), (0 - 20).
- Force Calculation:** Gravitly Force (N) + Drag Force (N) + Rolling Force (N) = Running Resistance Force (N). 0.00 + 0.00 + 7.85 = 7.85.
- Plot:** A graph showing Torque (blue), Cadence (green), and Power (red) over time (0-110s). The y-axis ranges from -0.4 to 30.4.

Measured Quantities

Drive Torque	Resolution : 0,1 Nm	
Drive rotational speed	Resolution: 0,1 rpm	
Drive Power	[W]	
Brake force (rear wheel)	[N]	
Battery current	[A]	
Pedelec Voltage	[V]	
Pedelec Power Output	[W]	
Actual Pedelec Efficiency Drive Unit (calculated)	%	
Temperature	In °C, °F or K	
Pedelec Drive Torque	At rear wheel in the basic configuration. Calculated with input specification Instantaneous and r.m.s. value (selectable)	
System friction	Calculated with calibration routine, effective value	
Drive Total Distance	Remains saved after switching off the system, manually resettable	
Driven Tour Distance	Auto-reset at system reboot, or manually reset	
Flexibility	(Upon customer request, the measured variable or the resolution can be customised)	

Additional Add-Ons, Mechanical



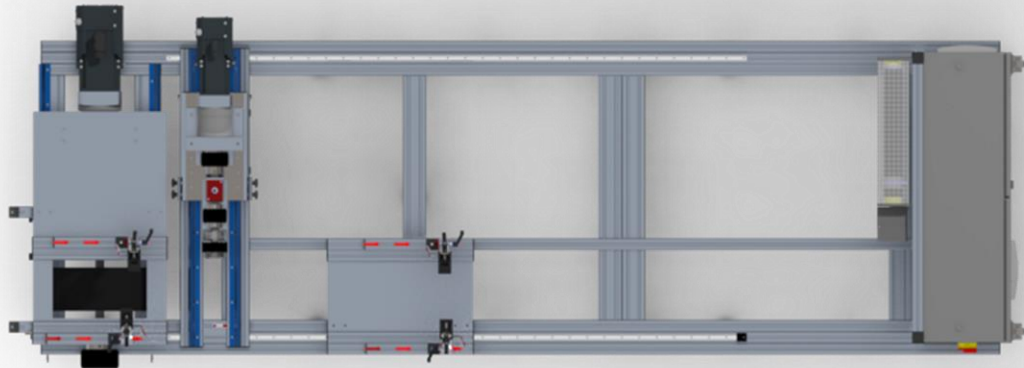
General Add-Ons

A.1 Extension for Cargo-Bikes

Wheelbase is adjustable up to 2.500 mm for Cargo-Bikes *

* or according to customer requirements

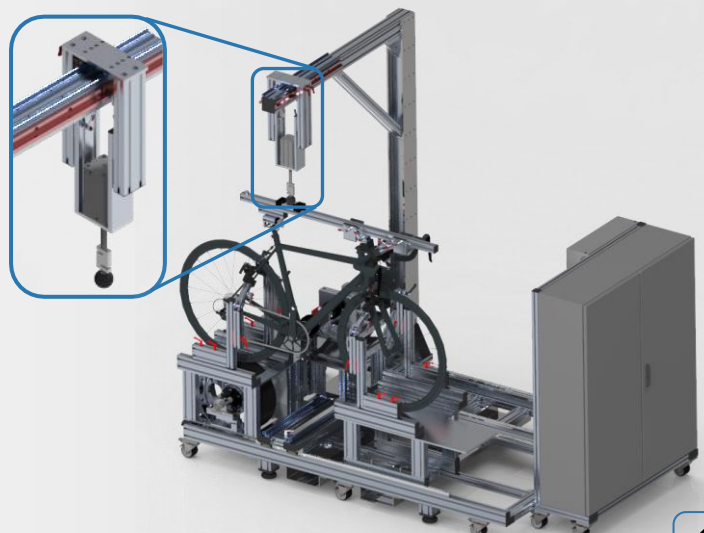
* Please check out your building conditions!



A.2 Actuator for Seat Weight

Integration of a controllable pneumatic cylinder from festo to generate the force on the seat post (useful for R200)

- Up to 1500 N
- Measurement by a force sensor from Burster
- Movable in X-Y-Z direction



Additional Add-Ons, Mechanical

General Add-Ons

- A.3** **Load Cells** Integration of Load cells in each brake unit to quickly and efficiently adjust loads on the bike
Useful for Brake Tests EN ISO 4210 and DIN 79010

- A.4** **Actuator for Braking Test** Integration of an electro-mechanically Brake force Actuator for Brake Test (dry) EN ISO 4210 and DIN 79010



Additional Add-Ons, Mechanical

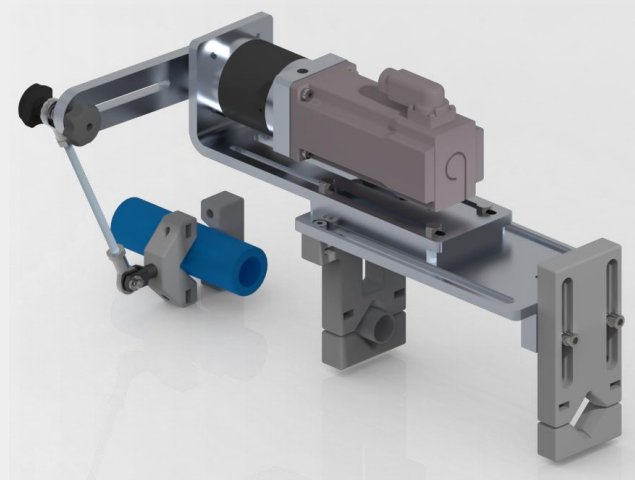
General Add-Ons

A.4.1 Water Pump System

Integration of a water pump, catch basin and nozzles for the Brake Test (wet) EN ISO 4210 and DIN 79010

A.5 Actuator for Accelerator Handle

Integration of an electro-mechanically actuator for automatic acceleration for vehicles with thumb pedal



A.6 S-Pedelec / WMTC

- Power Extension for the Brake Servo to 4500 Watt
- Speed Extension for Brake Wheel up to 50 km/h
- Speed controlled Fan
- Power measurement for battery charge measuring
- Software for WMTC functionality

Additional Add-Ons, Mechanical

General Add-Ons

A.7 Torque Measurement on Bottom Bracket Drive

Integration of a torque transducer on the bottom bracket drives (necessary for EN1594 and WMTC test)

- Max. torque: 150 Nm
- Resolution Resolution of 16 bit \pm 0,38 mV



A.8 Second Drive Unit One Lane

Integration of a second Drive Unit

Rated torque: 150 Nm
Rated speed: 150 rpm
Rated Power: 1300 W

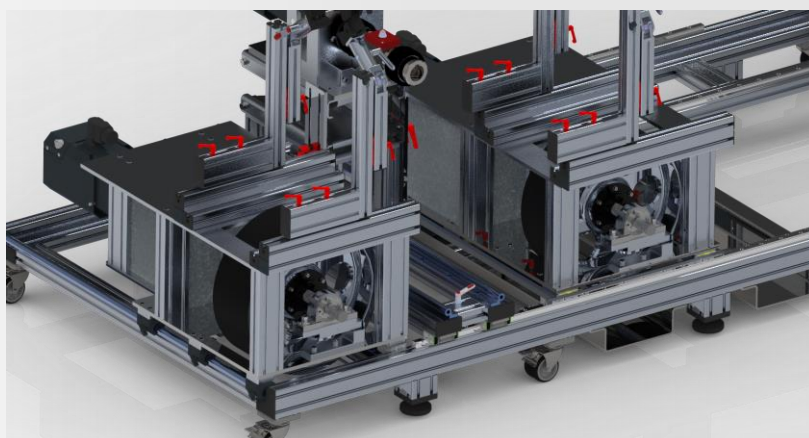
- Movable in X-Y-Z direction
- Coupling with adapter for connecting the bottom bracket drive to the pedelec

A.9 Second Brake Unit

Integration of a second Brake Unit

Rated torque: 150 Nm
Max. velocity: 30 km/h
Rated Power: 2400 W

- Roll with a diameter of 400 mm and a width of 150 mm
- Asphalt-like sureface



Additional Add-Ons, Mechanical

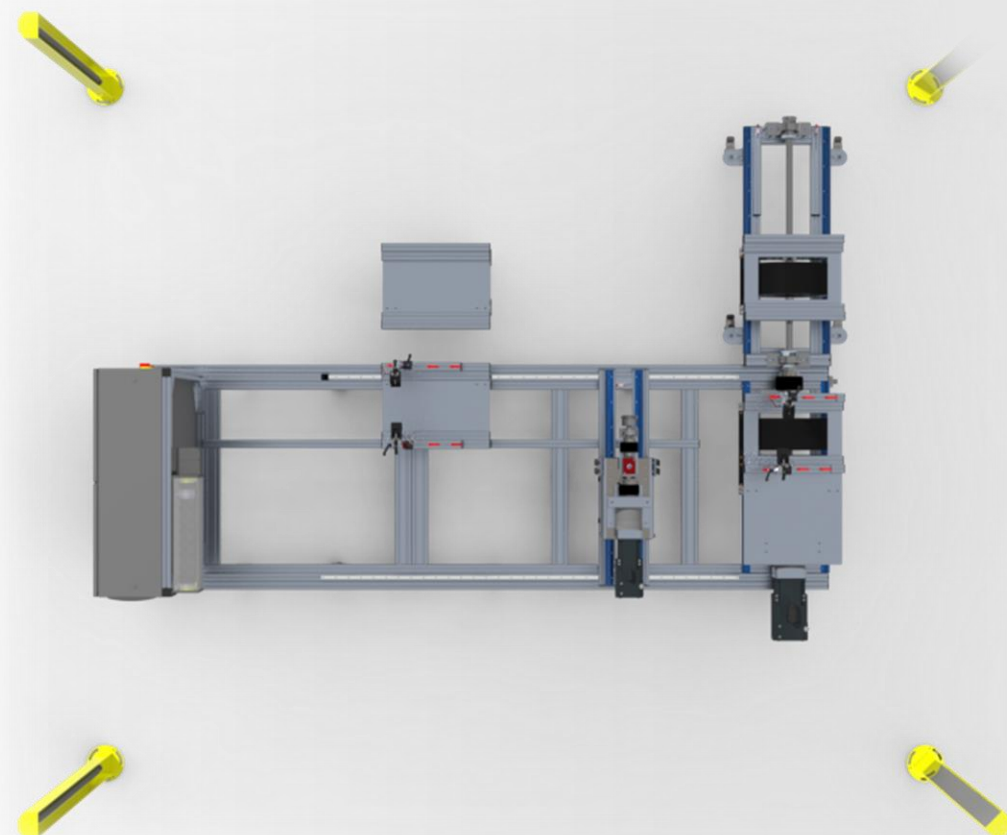
General Add-Ons

A.10 Universal Bottom Bracket Adapter

- Adapter for mounting on the pedal arm
- Fits all common bicycle types

A.11 Safety Equipment

- Light barrier
- Safety fence
- Railing
- Safety key switch



Additional Add-Ons, Mechanical

Two Lane Add-Ons

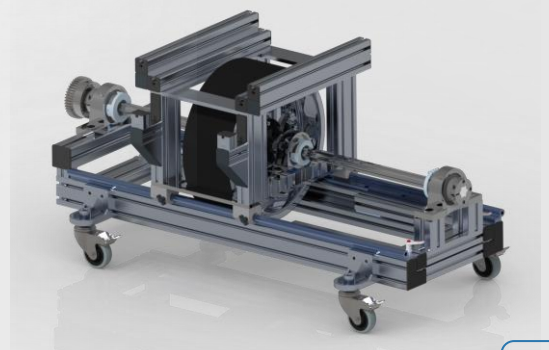
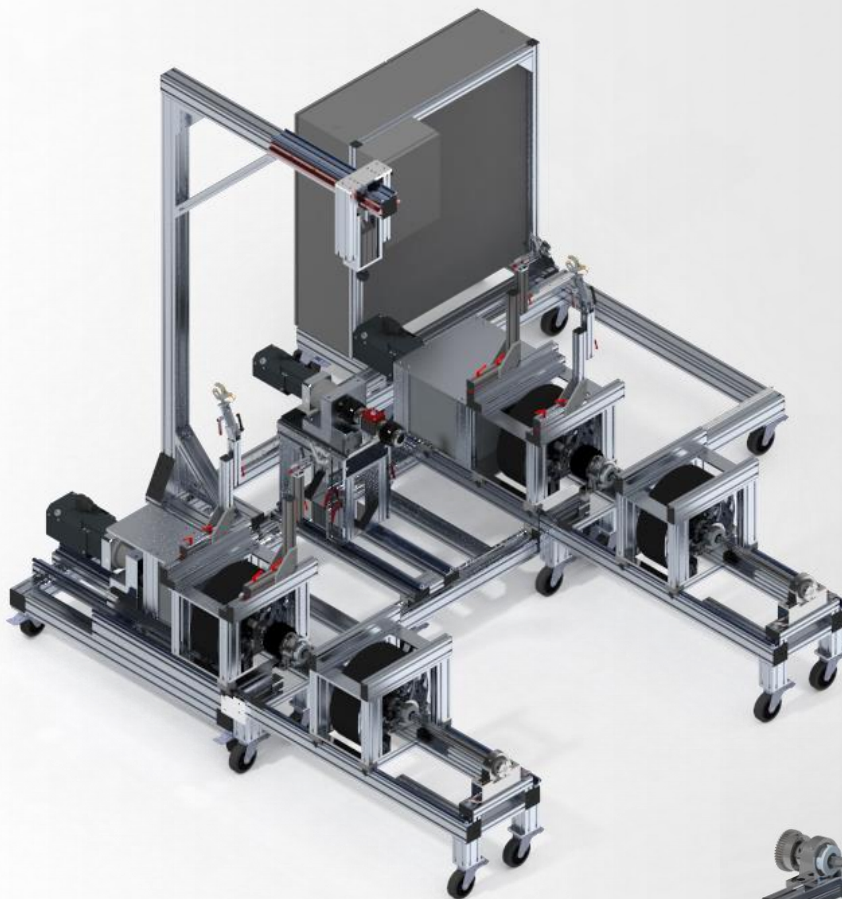
All add-ons for single lane test benches are also available for dual lane test benches!



B.1 Add-On Wheel Unit passiv

Integration of a second lane with a mobile wheel unit. The unit is connected to the test stand via a pair of couplings.

- Movable in X-Y direction
- Roll with a diameter of 400 mm and a width of 150 mm
- Asphalt-like sureface



Add-On Modul

Additional Add-Ons, Mechanical

Two Lane Add-Ons

All add-ons for single lane test benches are also available for dual lane test benches!

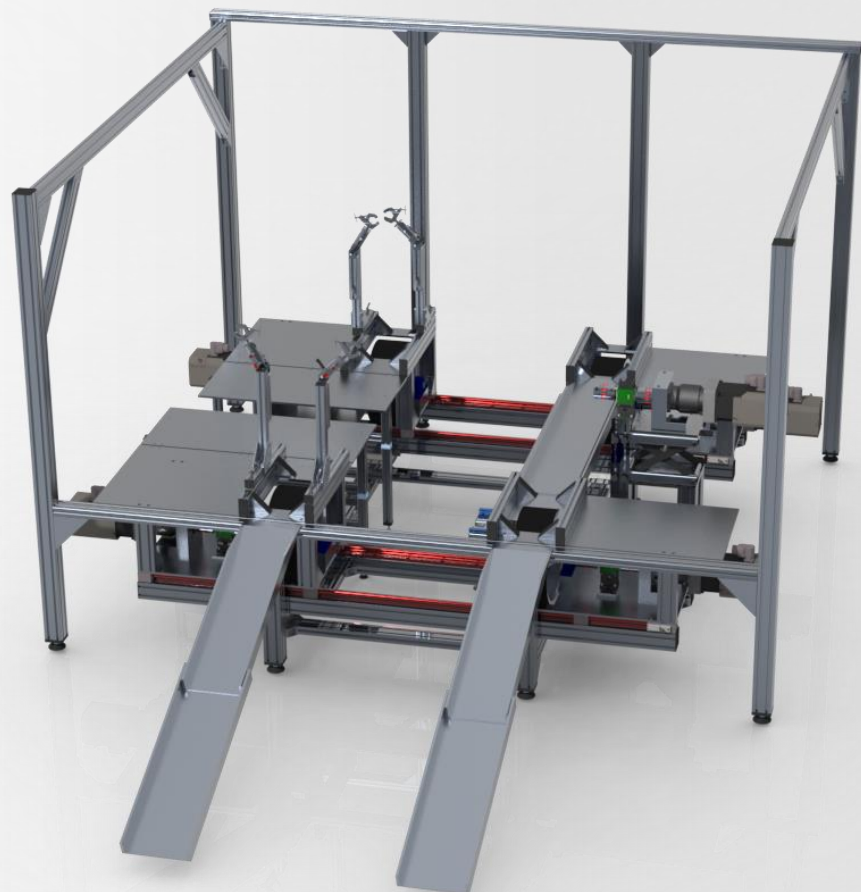


B.2 Second Brake Unit Lane active

Integration of a second lane with Brake Units to test 4-Wheel Vehicles of the class L1e





Rated torque: 150 Nm
Max. velocity: 30 km/h
Rated Power: 2400 W

- Roll with a diameter of 400 mm and a width of 150 mm
- Asphalt-like surface
- Movable in X-Y direction



Additional Add-Ons, Software

Software Add-Ons

- | | | | |
|-----|--------------------------|--|---|
| C.1 | User Interface | User interface can be customised according to the customer's requirements and corporate design. |  |
| C.2 | Automatic Operations | Automatic running with predefined tests according to DIN EN 15194
It's also possible to create automatic operations according to customer requirements. |  |
| C.3 | Automatic Protocol Creat | After running a predefined test according to DIN EN 15194 a protocol is created which includes all relevant measurements and diagrams |  |
| C.4 | CAN Communication | CAN interface for listen to CAN and send to CAN |  |
| C.5 | I/O's | Analogue and digital inputs and outputs that can be switched via the user interface | |

Additional Add-Ons, Service

Service Add-Ons

D.1 DAKS Calibration of the Measuremet Equipment

Calibration of the measurement technology according to the “Deutsche Akkreditierstelle” DakkS. All sensor types are possible.

- Torque sensor
- Current sensor
- Voltage sensor
- Temperature sensor
- Load cells



D.2 Service outside warranty

EMEC engineer is working on site

D.3 Support remote

EMEC engineer is working remote on the your test bench and help you to fix problems or makes customer-specific changes to the user interface or software.

More of EMEC Prototyping

Customer requests

If you have any other requests or suggestions to add to our portfolio, please do not hesitate to contact us. We can respond to most of our customers' wishes and solve your problems concerning pedelec test.

Updates



- Motor test rig for evaluation of the drive unit
- Components test bench for all tests of DIN EN 19154 and ISO 4210
- EoL test Battery test rig with charge/stop cycles monitoring
- CAN-Bus evaluation as HiL – test rig

Range of Services

- Test bench rental
- Test services in our test lab on our motor test rig and roller dynamometer or components test bench
- EMC-measurement of complete systems with our partner
- Drive benchmark test
- Real test drives for practical testing
- Environmental test systems
- Custom test setups



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