

AE-GROUP NEARLY 100 YEARS E-DRIVES

HQ AE-GROUP IN WAALWIJK, THE NETHERLANDS

R&D & Volume Production of Electrical Drives Systems
Innovators, Production, System Creators & Maintenance of Electric Drives

NEARLY 100 YEARS ELECTRIC DRIVE EXPERIENCE

Electric Drives From deep-sea to the sky



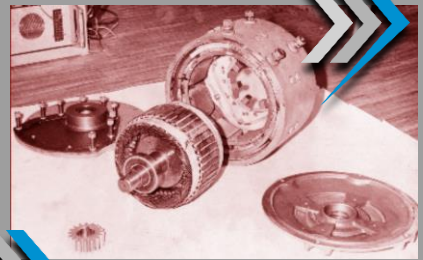
NEARLY 100 YEARS ELECTRIC DRIVE EXPERIENCE



NEARLY 100 YEARS ELECTRIC DRIVE EXPERIENCE



1st gen electric motors



Established in Sprang-Capelle

Shoe industry automation

1938

1950

Original Equipment Manufacturer for Electric Motors

2nd gen electric machines



E-motor Optimizations & Improvements

1000+ production with machine shop

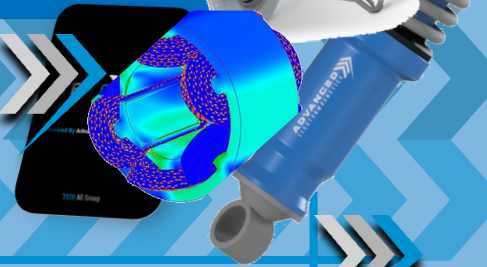
1985

3rd gen electric machines and drives



OEM System Projects

Dedicated Power Electronics, Drive & Control Software



High performance & e-racing

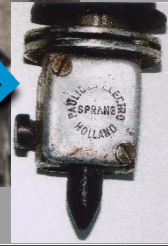
2008

Custom AEPP + Power Electronics

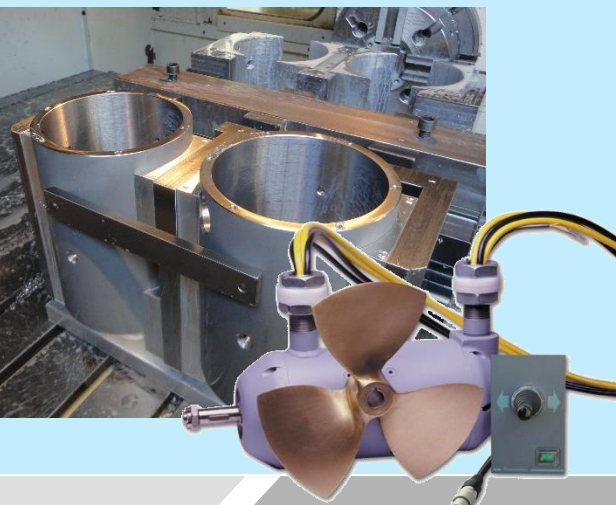
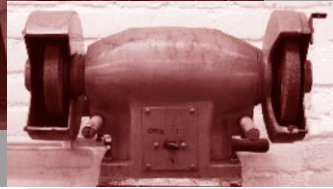
2018

2024

100,000+ production at AE-India



1968 Fiat





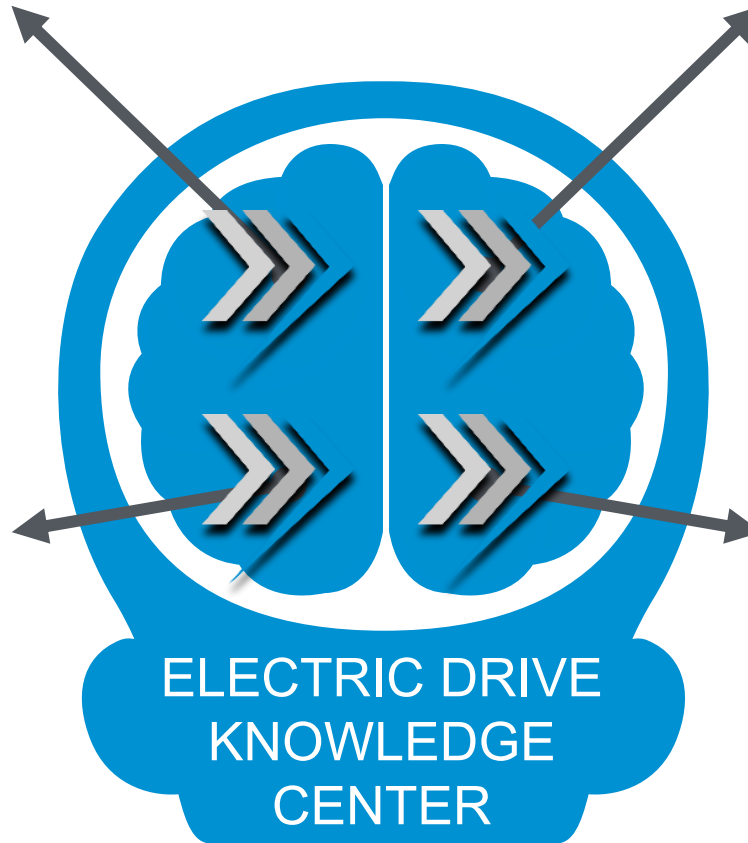
APPLICATION ORIENTED SOLUTIONS

E-Drive manufacturing service

NL Production & System Experience
Medium Volume Czech Republic
High Volume Motor AE-India
Integrated Motor/Electronics
RIM-Thruster and Direct-Drive Motors

E-drive Consultancy

Design Electrical Machine & Drives
In-House Prototyping Facilities
Low Frequency Electromagnetics
Don't Walk Away From Challenge



E-Drive Test Benches

Static to Dynamic Analysis
NL Roadworthy E-Certification
Up to 300,000rpm
AE - Graphical User Interface
Fully Custom-Tailored Solutions

E-Drive Analysis Software

Siemens Partner in Benelux
In-House Analysis Tools
Speed, Magnet & Star-CCM
Application Oriented Analysis



AE-GROUP RESEARCH AND DEVELOPMENT HQ WAALWIJK

AE-GROUP R&D CENTER AND MEDICAL PRODUCTION



AE NL: ELECTRIC DRIVE KNOWLEDGE CENTER, 5000 PCS/YEAR



Founder - 1938

Nearly 100 years
electric drives
experience



In-house design &
manufacturing &
prototyping



Consulting &
technical
support



Facilities for
research &
development



Qualified
operators for
measurements

SUPPLIER OF PROTOTYPES TO HIGH VOLUMES



Electric System Consultancy



We seek the best solutions with state-of-the-art technologies

"Off-the-shelf"



Get to the market quickly with first-class qualified products

Design and Manufacturing



Focus on reliability, quality and continuous improvements

Leverage: High Tech Prototypes by AE from the Netherlands



"THERE IS NOTHING NEW
UNDER THE SUN",
ECCLESIASTES

**R&D Center, Low volume
HQ Waalwijk Holland**

"GOD USED BEAUTIFUL MATHEMATICS
IN CREATING THE WORLD",
PAUL DIRAC

**Medium volume
Czech Republic**

"LEARNING NEVER EXHAUSTS
THE MIND",
LEONARDO DA VINCI

**Medical e-drives,
Raleigh, USA**

"LIFE IS ABOUT LEARNING. IF
YOU STOP LEARNING, YOU DIE",
TOM CLANCY

**Consultancy, Racing
Nottingham UK**

**AE-India, High volume
Ahmadabad Office &
Kukarwada Factory, India**

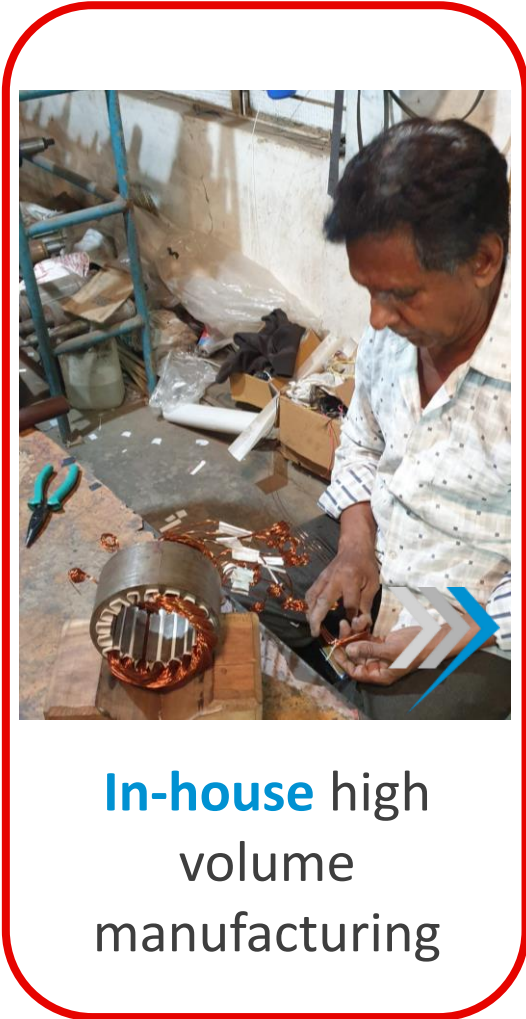
"THE JOURNEY OF A THOUSAND MILES
BEGINS WITH ONE STEP",
LEO TZU

EDUCATION IS THE
POWERFUL WEAPON WHICH YOU CAN
USE TO CHANGE THE WORLD",
NELSON MANDELA

AE-INDIA HIGH VOLUME MANUFACTURING COLLEAGUES



55+ years of experience with electric pumps



In-house high volume manufacturing



Manufacturing & purchase **support**

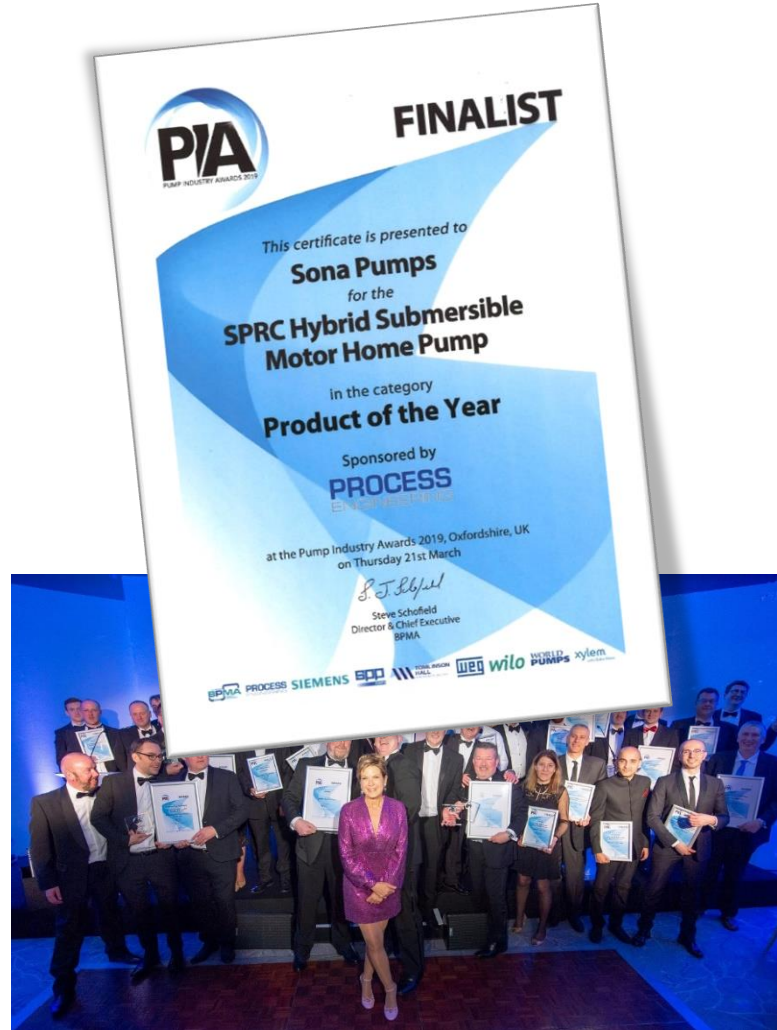


Facilities for High Volume production



Quality insurance by automated measurements

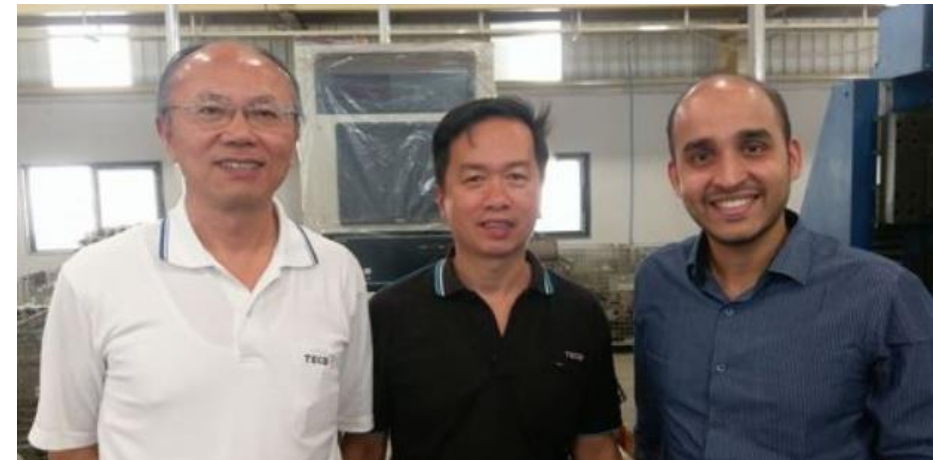
AE-INDIA PRODUCED GOODS AND ACTIVITIES



PIA Pump Supplier Award, 2019

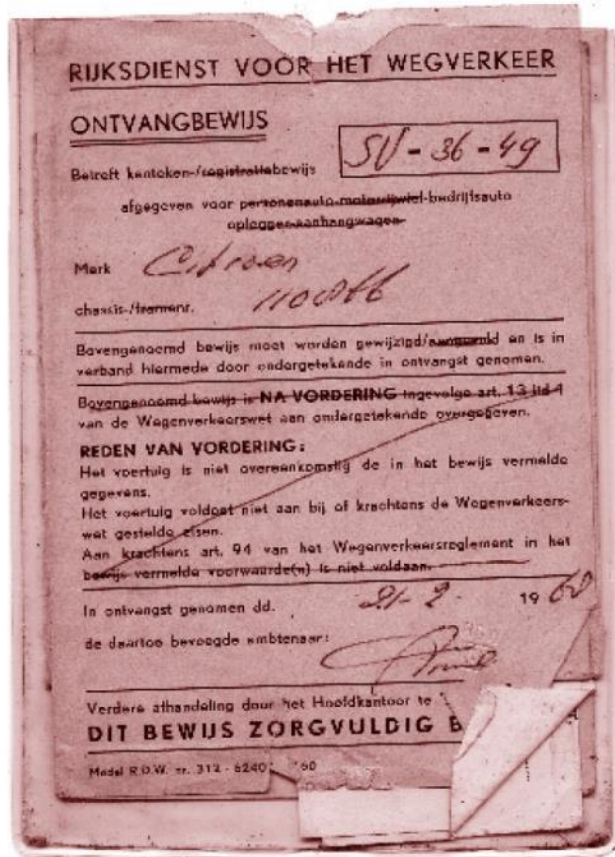


Pump Dealer Network meeting in Kukarwada

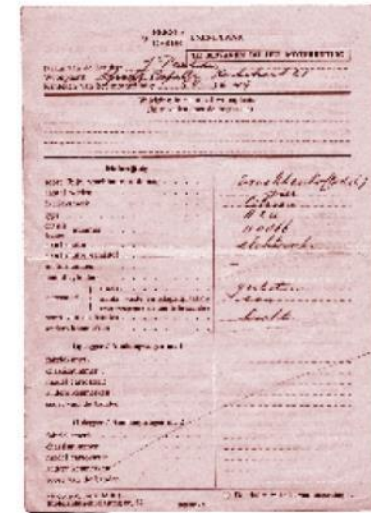
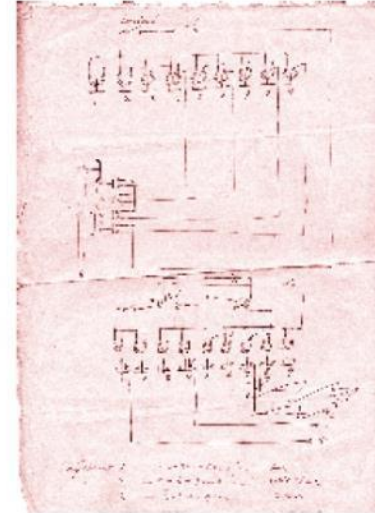


Visit of Teco Electric & Machinery, Taiwan

NEARLY 100 YEARS EXPERIENCE => ELECTRIC VEHICLE



1968



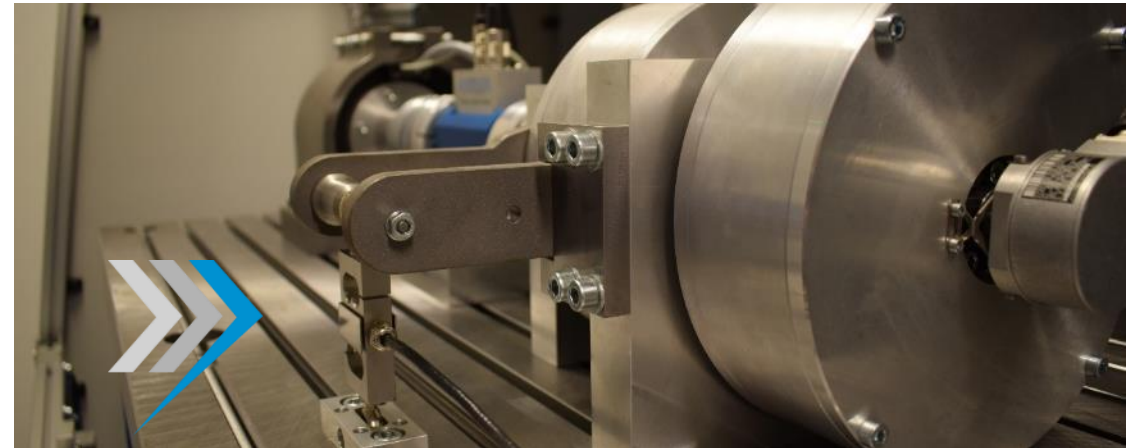
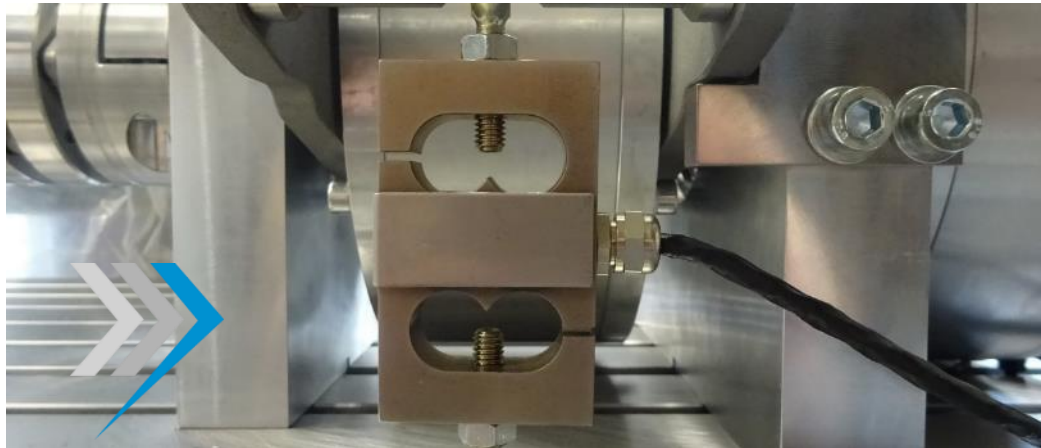
Elektrische auto

Op dit moment is er een steeds grotere commerciële vraag naar zuinige hybride voertuigen (b.v. Toyota Prius, Honda Civic, etc.), maar al in de zeventiger jaren reed er in Sprang-Capelle een omgebouwde Citroën met een 48VDC motor. Hierin waren vier vrachtwagen accu's ingebouwd welke allemaal in parallel (12VDC), serie-parallel (24VDC) of in serie (48VDC) geschakeld konden worden d.m.v. start relais. Deze werden ingeschakeld door een driestanden gaspedaal. Ook de versnellingsbak was nog aanwezig, daardoor er vooraf gekozen kon worden hoe snel men wilde rijden (max 70km/uur) al kostte dat dan wel actieradius.

Op dit moment is er een steeds grotere commerciële vraag naar zuinige hybride voertuigen (b.v. Toyota Prius, Honda Civic, etc.), maar al in de zeventiger jaren reed er in Sprang-Capelle een omgebouwde Citroën met een 48VDC motor. Hierin waren vier vrachtwagen accu's ingebouwd welke allemaal in parallel (12VDC), serie-parallel (24VDC) of in serie (48VDC) geschakeld konden worden d.m.v. start relais. Deze werden ingeschakeld door een driestanden gaspedaal. Ook de versnellingsbak was nog aanwezig, daardoor er vooraf gekozen kon worden hoe snel men wilde rijden (max 70km/uur) al kostte dat dan wel actieradius.

BUILD AND TESTED TO CUSTOMER SPECIFICATIONS

- Takes on any challenge!
 - A. Technical consultancy
 - B. Rapid prototyping: components to complete systems
 - C. Detailed electromagnetic system analysis
 - D. Advanced physics modeling



BATTERY ELECTRIC VEHICLE AUTONOMOUS AGRICULTURE



Modern Greenhouses are fully
automated factories
Powered by AE Group powertrains

RELIABLE SUPPLY PARTNER FOR INDUSTRIAL APPLICATIONS



50+ years electric motor supplier



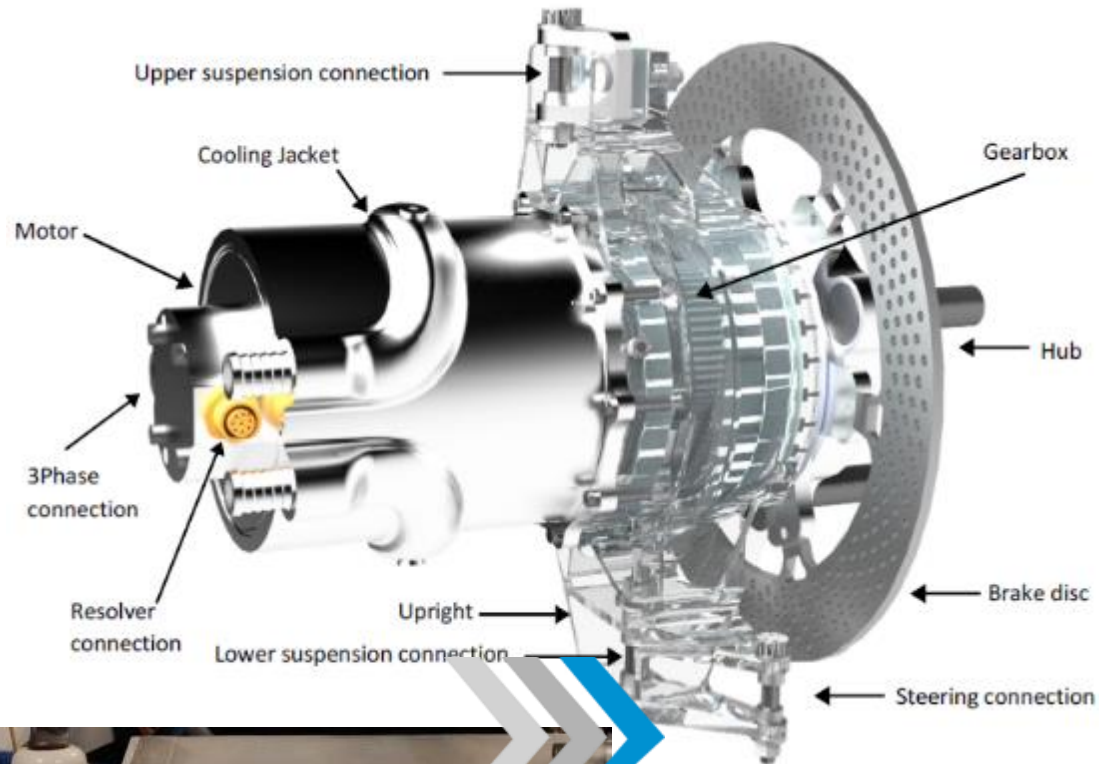
250,000+ units delivered

POWERED BY AE USING 4X NEAR-WHEEL LIGHT WEIGHT MOTORS

- Motor supplier for sixth consecutive year
 - A. Winners in various competition criteria
 - B. 120 kW of power, 4x 400 Nm of torque
 - C. Already used from 2014 to 2021
 - D. 10kW/kg and 10Nm/kg

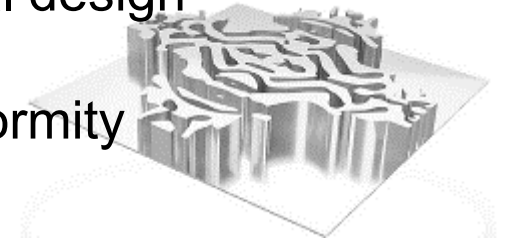


EXTREME COOLING CONCEPTS ARE BEING DEVELOPED BY AE



Optimal heat sink design through state of the art generative thermal design software

- High temperature uniformity
- High heat transfer
- Low mass
- Heat distribution control
- Can also be develop for air-cooling



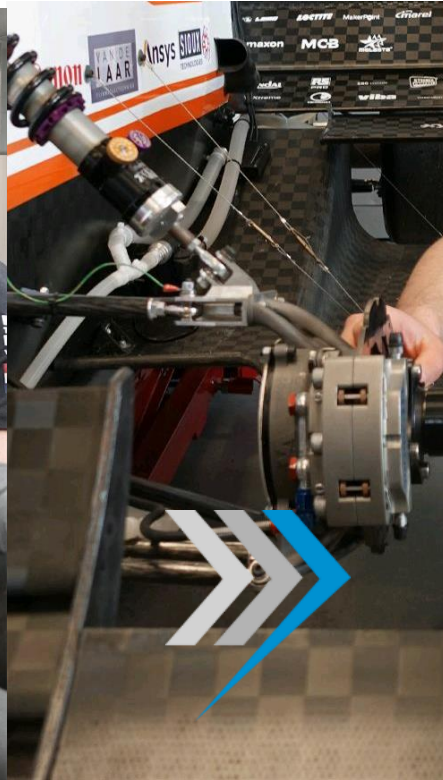
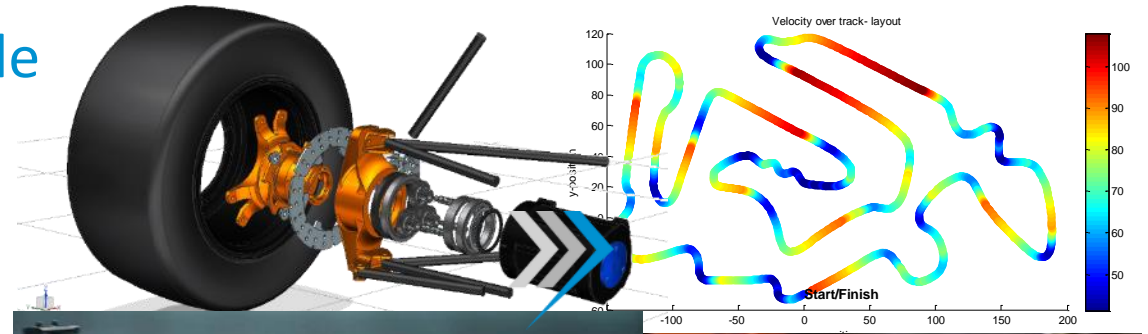
ULTRA PERFORMANCE RACING MOTORS AND INVERTERS



- Custom-tailored motor design race example

A. $P_{nom} > 10\text{kW}$ ($> 3.5\text{kW/kg}$; $> 3\text{Nm/kg}$)

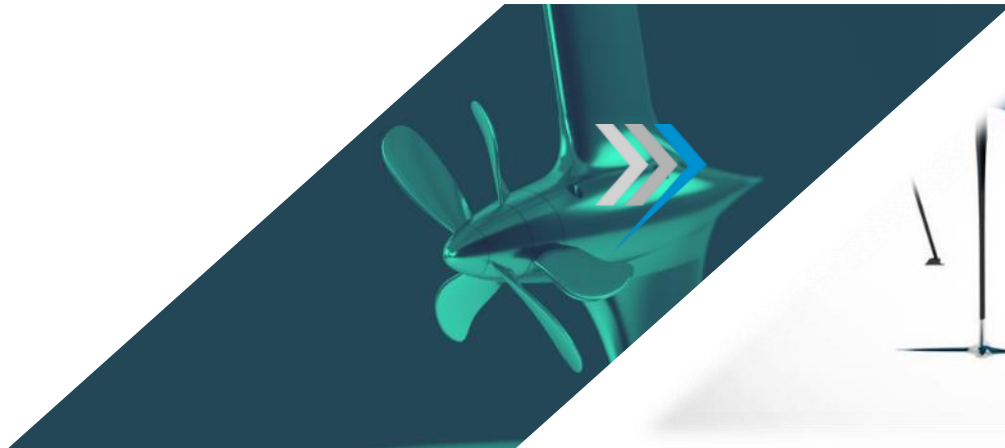
B. $P_{max} > 30\text{kW}$ ($> 10\text{kW/kg}$; $> 10\text{Nm/kg}$)



INTEGRATED NACELLE MOTOR AND ON-BOARD ELECTRONICS

1. Electric motor and power electronics supplier

- A. Motor powered by the sun
- B. High power, minimal volume
- C. Direct-drive propeller
- D. Goal is >40km/hr over water

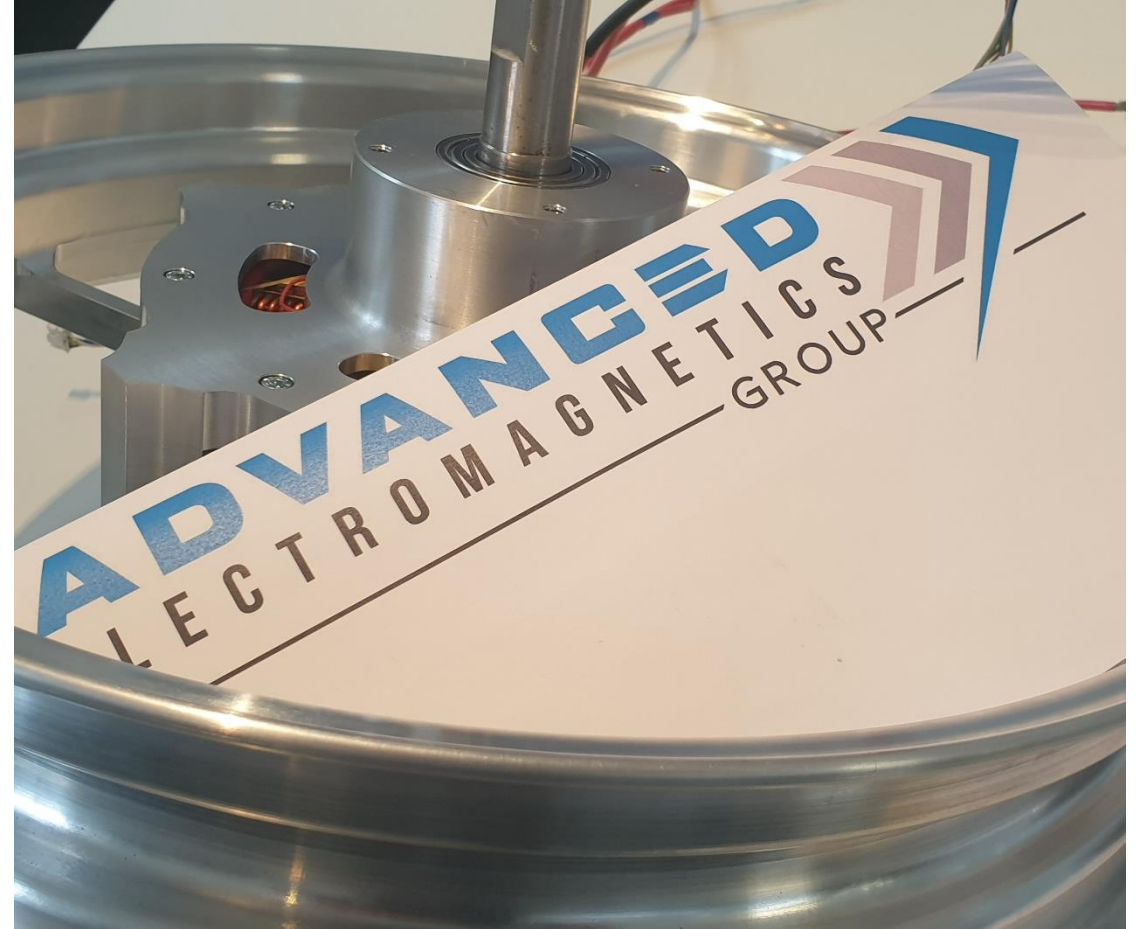


EXTREME EFFICIENCY ELECTRIC MOTOR AND ELECTRONICS

- Extreme energy reduction
 - A. Aim 1W per 1kg person weight
 - B. Fuel cell powered
 - C. Direct-drive in-wheel low speed motors
 - D. Efficiency >98%



REGENERATIVE BIKE HUB DRIVE MOTOR AND INVERTER



Super high-efficient Regenerative Hub Motor Design and Realization

EXTREME EFFICIENCY DOUBLE AIRGAP ELECTRIC MOTOR

- Driving on solar power
 - A. New team for 2020-2021
 - B. Super light weight design
 - C. Extremely optimized/integrated design
 - D. Efficiency >98%



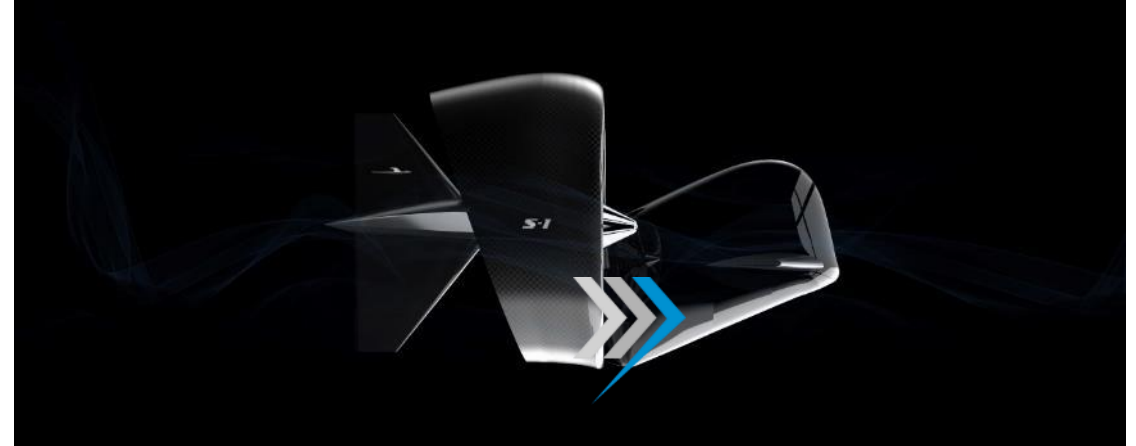
DIRECT DRIVE RIM REGENERATIVE HUB MOTOR



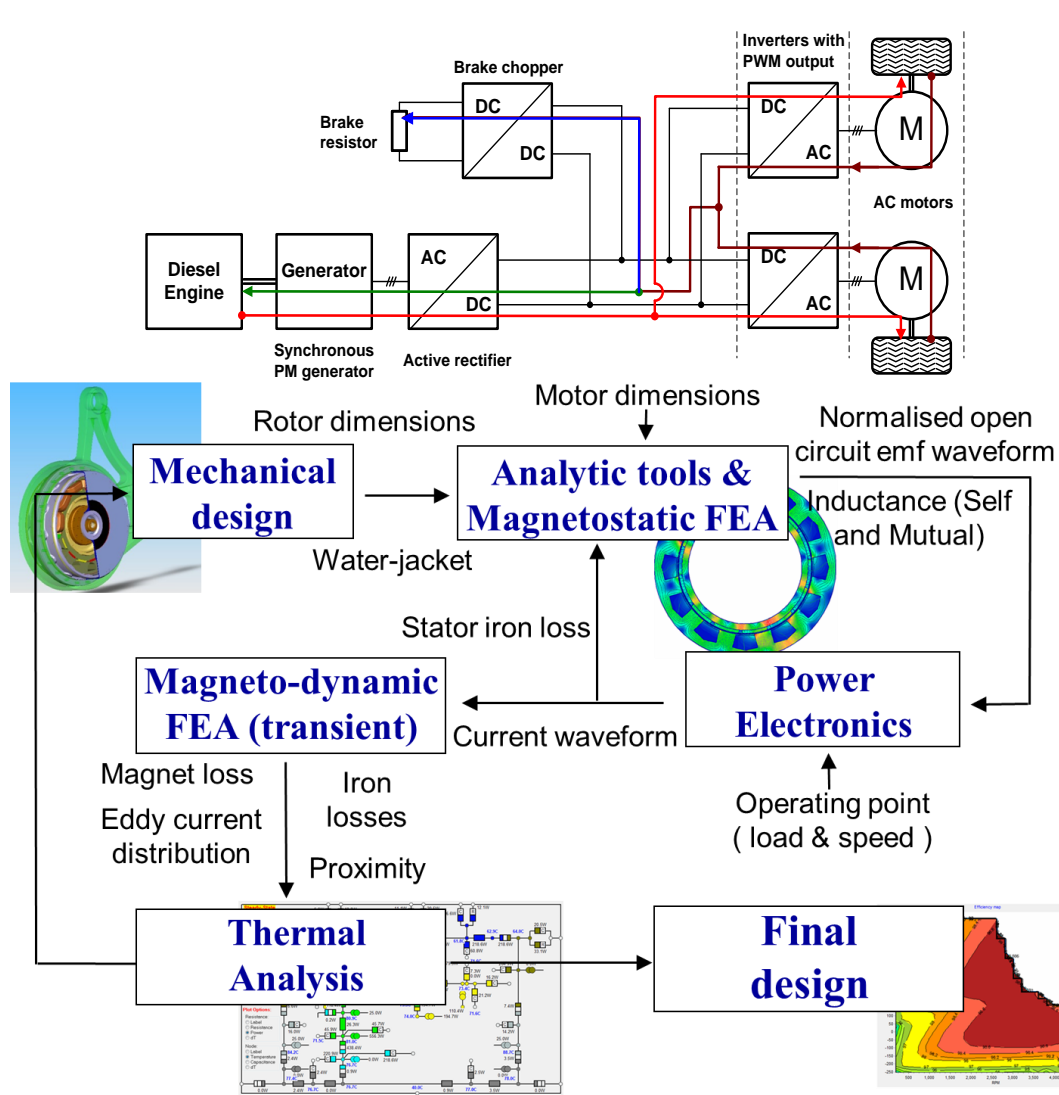
Super high-efficient Regenerative Hub Motor Design and Realization

AIR COOLED AIRCRAFT / DRONE MOTOR AND ELECTRONICS

- Sparking the electric autonomous future in three dimensions
 - A. Winners of the first two stages of the Boeing GoFly competition
 - B. Took untethered flight in Q1 2020
 - C. Ultimate motor/electronics design



SYSTEM AND DETAILED IN-WHEEL SIMULATION TO VEHICLE



Stress Analysis

Displacement Magnitude mm

- 0.153569
- 0.1525768
- 0.1475842
- 0.1445919
- 0.1415995
- 0.1396071
- 0.1355148
- 0.1326224
- 0.12963
- 0.1266377
- 0.1236453

Load Case: 1 of 1
Maximum Value: 0.153569 mm
Minimum Value: 0.123645 mm
1 < Design Scenario 1 >

W/kg

- 24.9456
- 22.4511
- 19.9565
- 17.4619
- 14.9674

(x,y)=(314.088,-252.054)(r,th)=(402.719,321.253)

Iron loss

High speed rotor

Failures

Thermal analysis

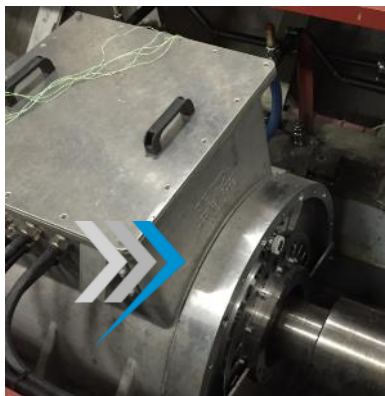
Density Plot: Temperature (K)

- 3.973e+002 : >4.004e+002
- 3.942e+002 : 3.973e+002
- 3.911e+002 : 3.942e+002
- 3.879e+002 : 3.911e+002
- 3.848e+002 : 3.879e+002
- 3.817e+002 : 3.848e+002
- 3.786e+002 : 3.817e+002
- 3.755e+002 : 3.786e+002
- 3.724e+002 : 3.755e+002
- 3.693e+002 : 3.724e+002
- 3.662e+002 : 3.693e+002
- 3.631e+002 : 3.662e+002
- 3.600e+002 : 3.631e+002
- 3.569e+002 : 3.600e+002
- 3.538e+002 : 3.569e+002
- 3.507e+002 : 3.538e+002
- 3.476e+002 : 3.507e+002
- 3.444e+002 : 3.476e+002
- 3.413e+002 : 3.444e+002
- <3.382e+002 : 3.413e+002

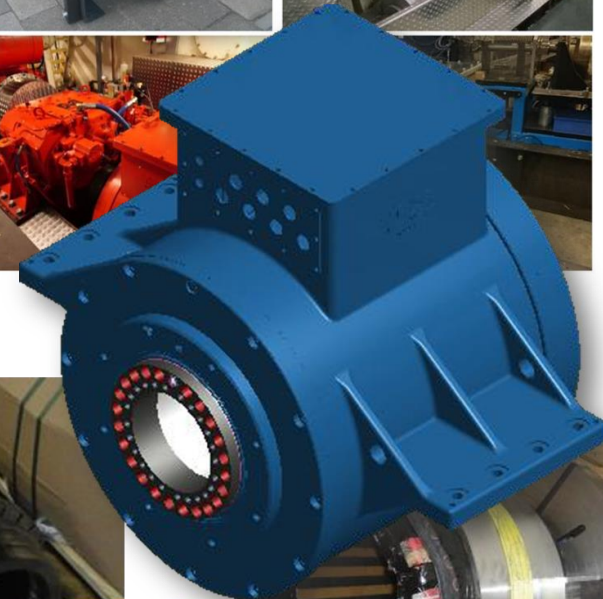
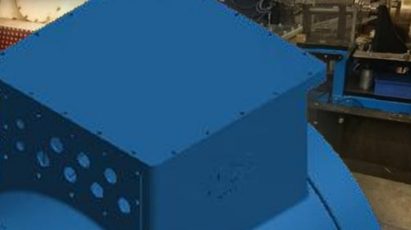
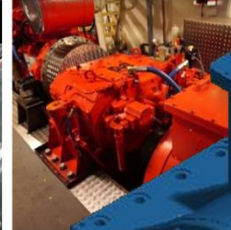
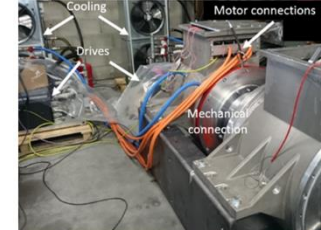
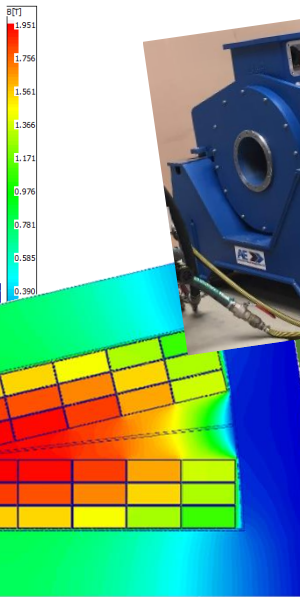
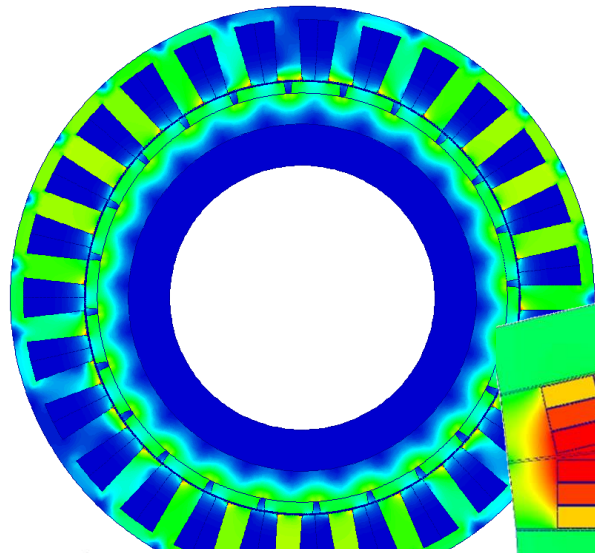
MARINE PROPULSION SYSTEMS > 100,000 OPERATIONAL HOURS

Custom-tailored motor design

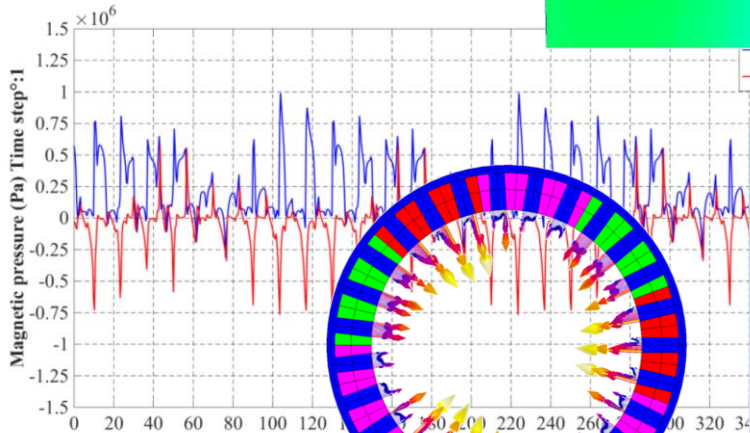
- Direct drive motors for hybrid propulsion
- Full electric or hybrid modes
- Power rating: up to 500kW
- Maximum continuous: up to 20,000 Nm
- Motor cooling system – water jacket
- Also used as micro-grid generators



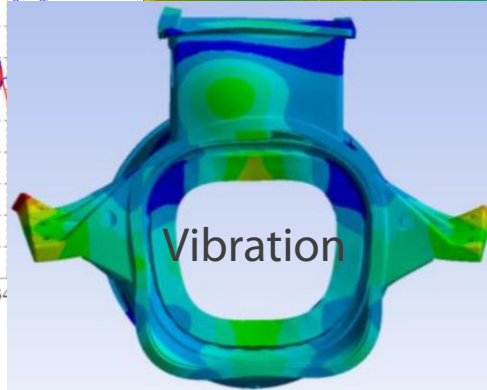
ELECTROMAGNETIC NOISE VIBRATION HARSHNESS REALIZATION



Noise Visualization



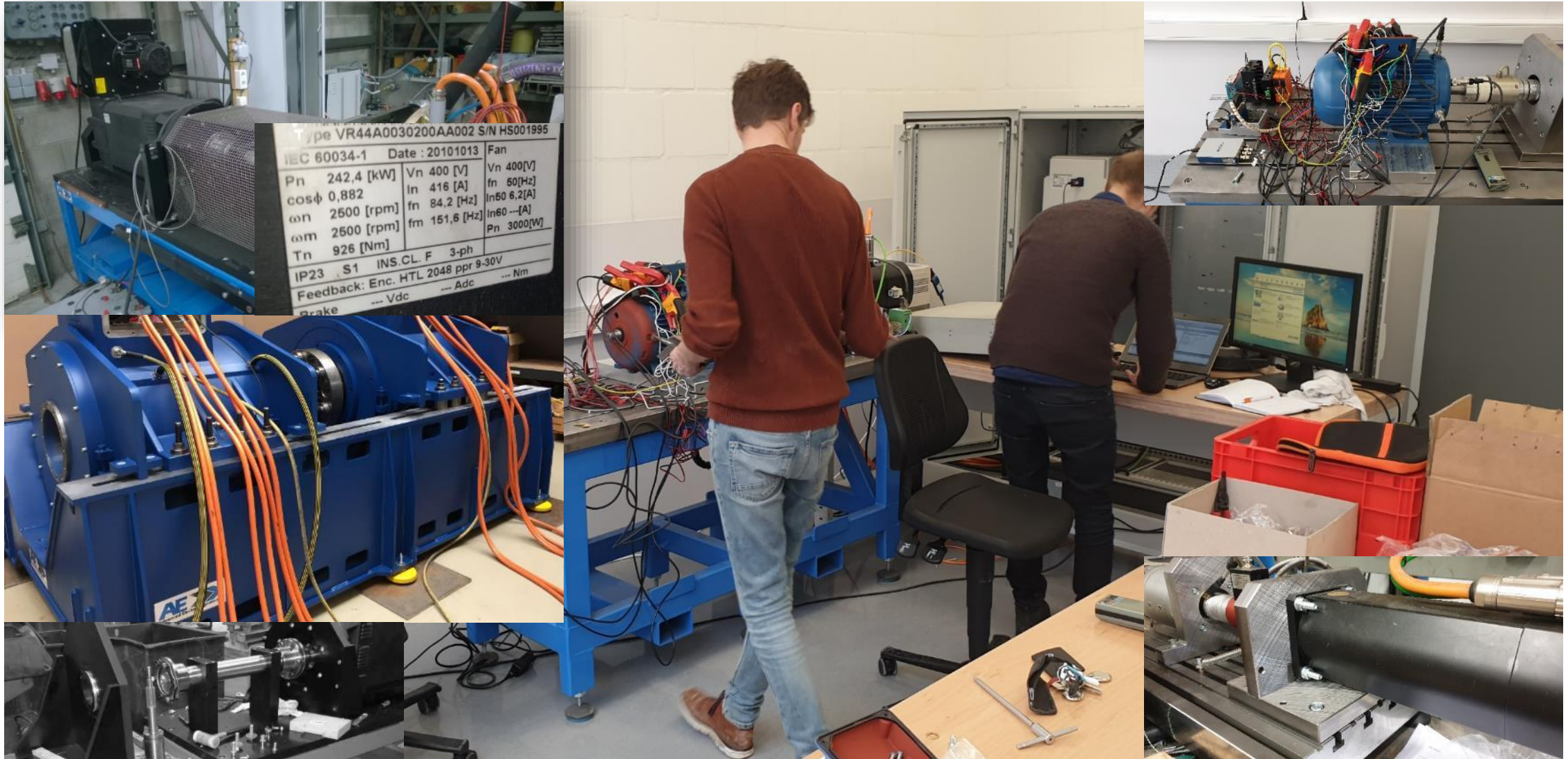
Magnetic Pressure



Vibration



REGENERATIVE BRAKE TEST BENCHES PRESENT AT HQ WAALWIJK



ADVANCED RACING BIKE ELECTRIC MOTOR PART OF CHASSIS



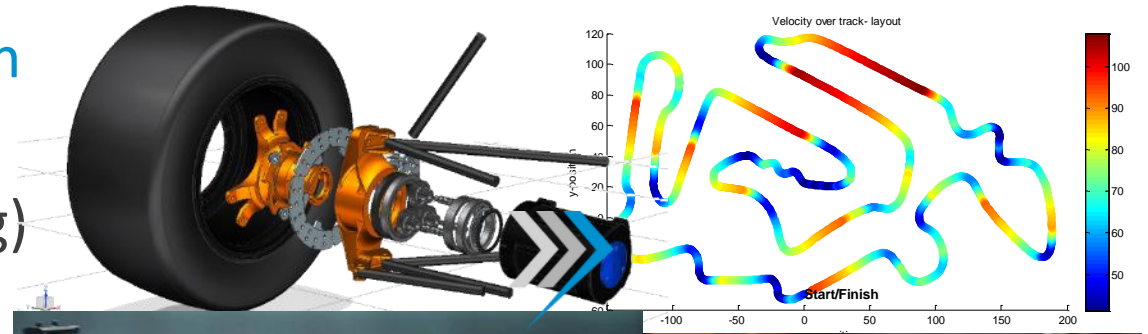
Racing season has started again (>300 km/hr)

FROM ELECTRIC RACING TO SILENT MILITARY DRIVES

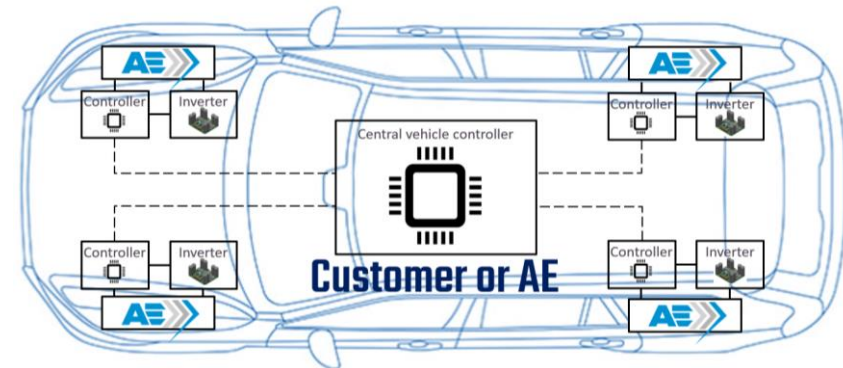


- Custom-tailored design for race application

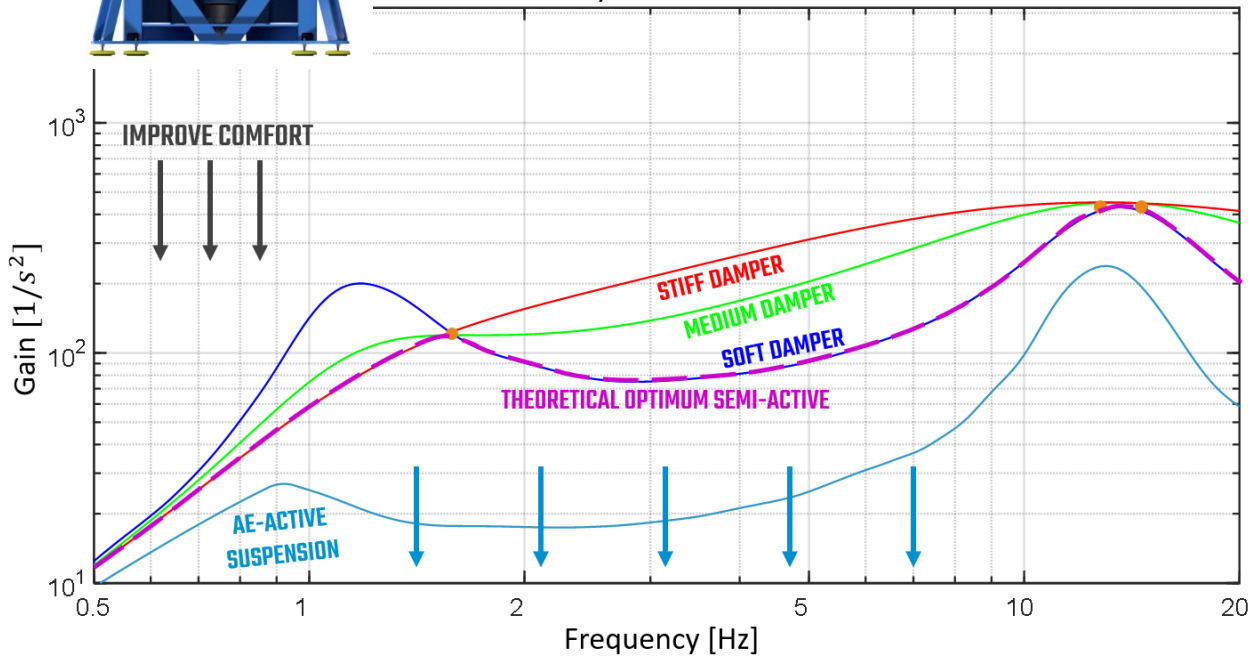
- A. $P_{nom, density}$ >5kW/kg; >3Nm/kg)
- B. $P_{max, density}$ >30kW/kg; >30Nm/kg)



FULLY ACTIVE ELECTROMAGNETIC SUSPENSION SYSTEM



Body Acceleration



AEROSPACE WITH HELI-DRIVE, PROPULSION AND PITCH



- Custom-tailored electric drive and motors of all sizes
 - A. Not to be disclosed from drones to propulsion



ENERGY RESEARCH WITH WAVE, WIND, BATTERY AND SOLAR

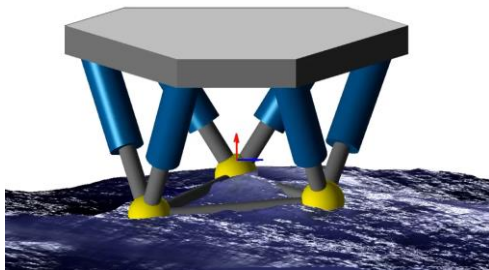


- Sustainability is our future! AE-Group involved from generation to storage



AE-WAVEHEXAPOD

1. AE-WaveHexapod is a multi-facetted scale-up company that uniquely will harvest, for the first time, renewable energy from the three-dimensional (3D) movement of sea waves.
2. The technology that AE-WaveHexapod markets is
 - A. a sea-worthy robot in close cooperation with ABB Robotics,
 - B. an energy connection between submersible and a wind-turbine (also usable for floating solar),
 - C. knowledge of design for classification, finances, legislation, energy laws, and contracts with customers
 - D. a unique wave-harvesting AE-WaveHexapod system.



MOBILE AEPP POWERTRAIN CONTROL DURING ENGINEERING

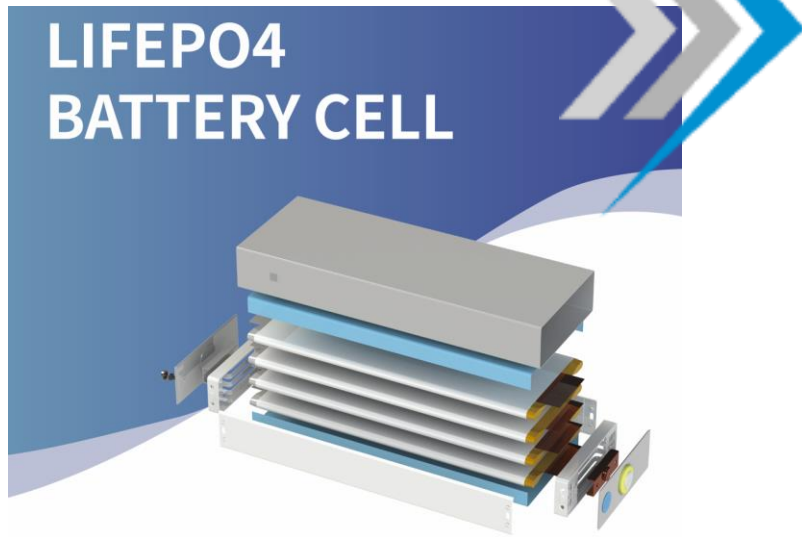
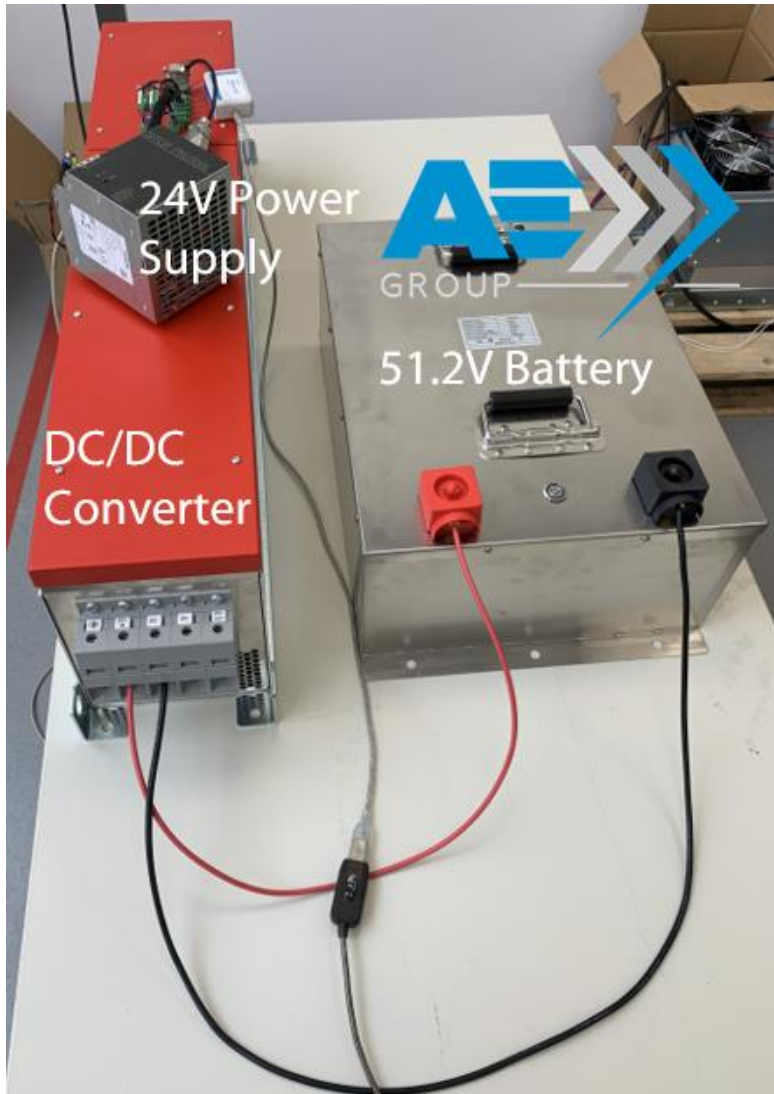


AEPP & AE-INVERTER

BATTERY SIMULATION AND PACK DESIGN FOR HIGH PERFORMANCE



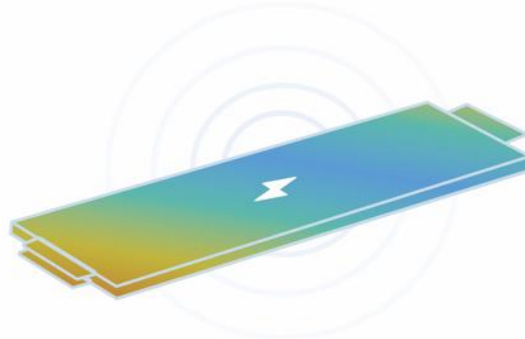
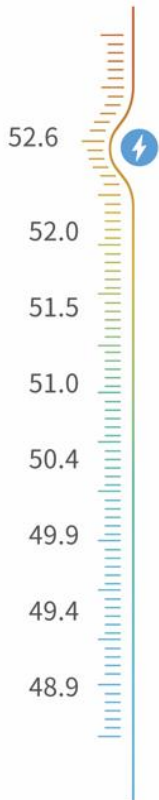
HYBRID BATTERY SIMULATION AND PACK DESIGN



HYBRID BATTERY SIMULATION AND PACK DESIGN

YJT52145405(280Ah)Large Cooling Area

Temperature (°C)



After discharging for 3600s

The highest temperature point is
52.6 °C

The temperature difference is
4.2 °C

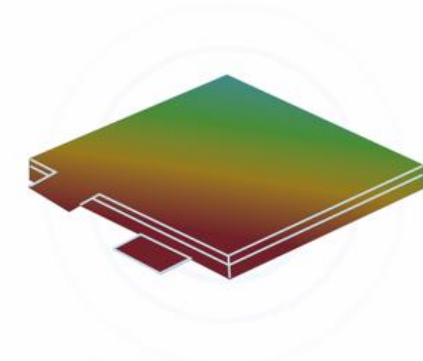
Big lug, low resistance, less burrs to puncture the separator that lead to short-current.

- Very suitable for stackable structure.
- High space use rate for ESS and E-ship.



71173207(280Ah)Small Cooling Area

Temperature (°C)



After discharging for 3600s

The highest temperature point is
57.7 °C

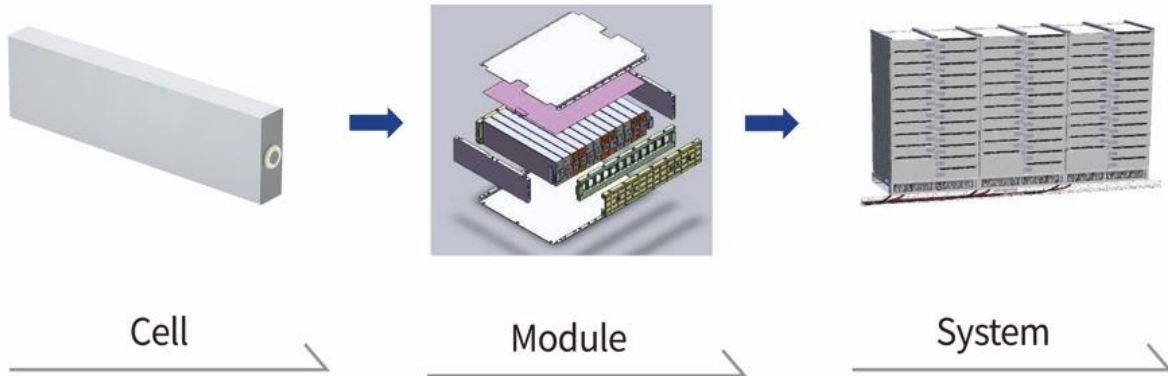
The temperature difference is
10.95 °C

Small lug, high resistance, more burrs to puncture the separator

- Very suitable for one layer structure. (EV chassis)
- low space use rate for ESS and E-ship.



HYBRID BATTERY SIMULATION AND PACK DESIGN



Product application scenes



Application

- Cruise Ships
- Yachts
- Painting Boats
- Official Boats
- Electric Boats
- Sightseeing Boats
- Traffic Law Enforcement Boats
- Cleaning Boats, Blue Algae Boats, Etc



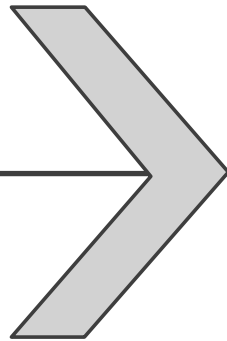
COOPERATION WITH AE >>

THREE LEVEL APPROACH KNOWLEDGE CENTER PARTNER



- Specifications -

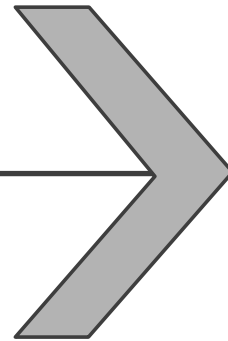
Special request are mutually agreed



Specifications with customer at system level

- Manufacturing -

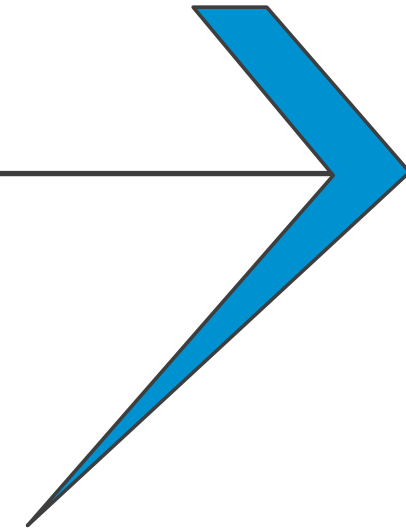
High quality products assembly



Summarizes in detail e-drive component requirements

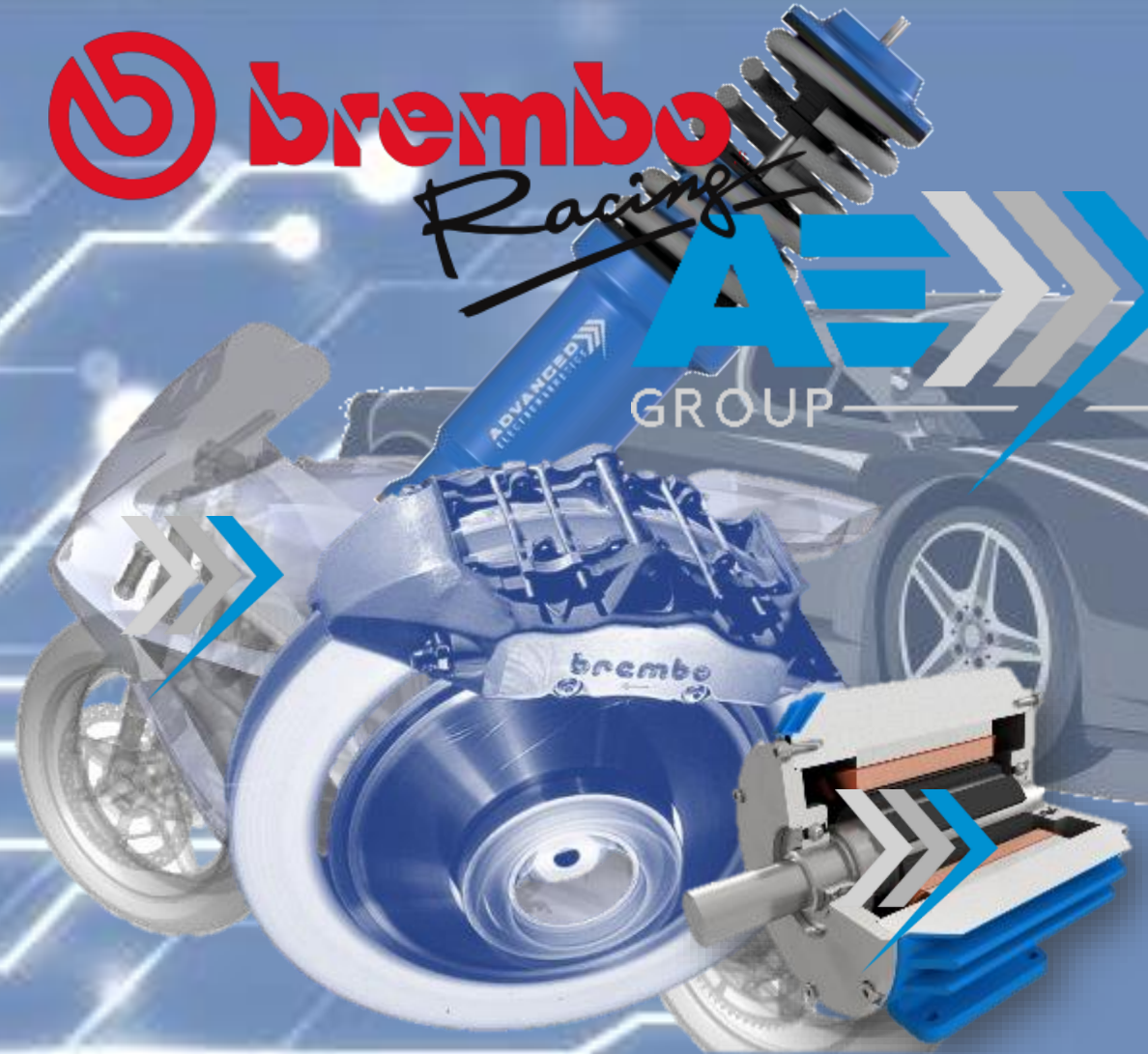
- FAT -

Before delivery to customer

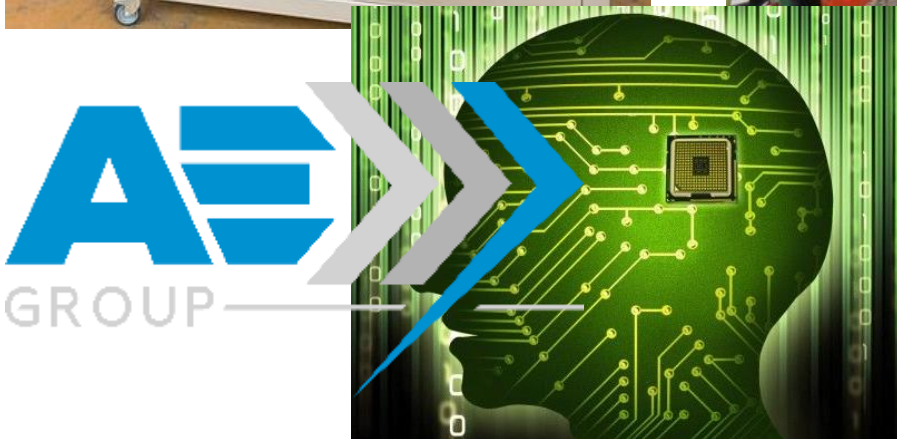


Factory Acceptance Test at AE will ensure product quality

COOPERATION FOR AUTOMOTIVE AND RACING APPLICATIONS



SAMOTICS <=> AE – SCHEDULED EQUIPMENT MANAGEMENT



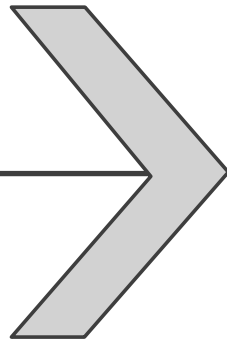
Efficiëntere
pompbewaking met
automatische
patroonherkenning



KNOWLEDGE CENTER FROM R&D TO PRODUCTION

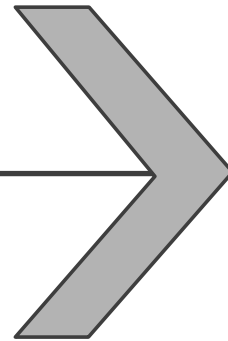
- R&D -

Detailed Material Analysis



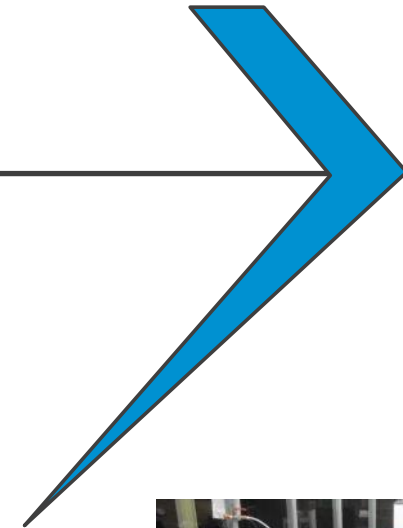
- Production -

High volume Experience



- Testing -

Complete Product Testing





>> Motion By Innovation



धन्यवाद, આભાર, Thank You, Danke, Bedankt, Merci



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