TECHNICAL CALCULATIONS

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Objednávka.: LKE 086-2025 – 1139001-VUT-01

Objednáváme u vás

Návrh elektromotoru

dle popisu příloha č.1

Pro projekt
FIRST! - LIQUID PROPULSION TECHNOLOGIES FOR FUTURE SPACE TRANSPORTATION: LAUNCHER AND IN-SPACE LIQUID PROPULSION ENGINE COMPONENTS DESIGN AND TECHNOLOGIES
ESA Contract No. 4000147874/25/FR/LCF

Fáze1:

- **concept for BLDC motor stator concept tailored to meet the pump requirements (torque, power, mass)**
- **prepare a conceptual rotor design considering the performance requirements (e.g., winding layout, core geometry, and material)**
- **selection of baseline BLDC motor concept based on engineering evaluations**
- **engineering Trade-offs incl. magnetic FE analysis**

Fáze 2:

- **BLDC motor stator detailed definition according to the pump requirements (torque, power, mass) incl. suitable materials selection**

- **detailed definition of rotor considering the required performance**
- **perform a loop of verification analyses against requirements (magnetic analysis)**

Platební plán
dle přílohy č.2

Fáze 1.
Cena: 13 363,40 EUR bez DPH předběžné datum odevzdání – 15.8.2025

Fáze 2.
Cena: 20 044,- EUR bez DPH předběžné datum odevzdání – 15.11.2025

Celková cena : 33 407,40 EUR bez DPH

Fakturace je možná po schválení předávacího protokolu panem xxx – xxx
Adresa pro doručení faktur - email : xxx
kopie xxx

Prosíme na faktuře uvádějte číslo objednávky a číslo projektu.
Všechny faktury mají splatnost 30 dní po doručení.

Místo, datum:

Jméno:

Místo, datum: Brno, 4. června, 2025

Jméno:

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Vysoké Učení Technické v Brně

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Brushless DC (BLDC) machines are derived directly from the classical DC machine by replacing the commutator and brushes with an electronic power supply. This minimizes mechanical wear and increases reliability of machine reliability, which is crucial for long-life durability.

The motor is often designed to have a trapezoidal back-EMF waveform, and the current waveforms are rectangular, with alternating polarity. The current polarity is switched in synchronism with the rotor position, by means of power semiconductors, which are also used to regulate the current. Fig. 1 shows a typical machine cross-section example. Permanent magnets, typically mounted on the rotor surface, are commonly used for excitation. Using magnets from rare-earth alloys enhances power density and reduces energy consumption.

Often, the stator winding of BLDC motors uses fractional pole winding to allow non-overlapping windings. This design helps reduce cogging torque, which can be a challenge in traditional distributed winding designs. The Cogging torque is caused by the interaction between the permanent magnets of the rotor and the stator slots, resulting in uneven rotation and undesirable vibrations.

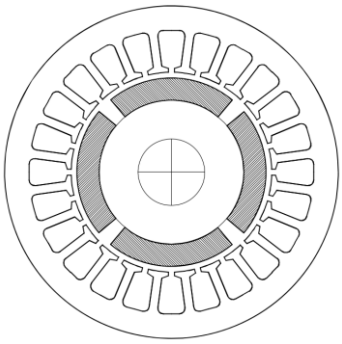

Figure 1 Design methodology of high-performance electrical machines. [1]

BLDC machines can be designed as radial configurations with either an inner or an outer rotor. Additionally, the axial flux variant is possible and popular in applications that require a combination of high power density and compact design.

For control of the BLDC motor, the controller has to determine the position of the rotor. There are two options; the first involves using position sensors, such as Hall sensors. The second method detects the position of the rotor, allowing sensorless design.

Sensorless designs reduce the complexity of the BLDC machine and lower its maintenance requirements. However, they may not be suitable for applications that require low-speed operation or high precision.

[1] Hendershot, J. R. Design of Brushless Permanent-Magnet Machines. Venice, Florida :Motor Design Books, 2010.

DPEEE FEEC BUT - budget proposal

Category	Unit	2025 Plan	TOTAL Plan
Personnel costs	EUR	26000,00	26000,00
Effort (person-month)	PM	6,50	6,50
Direct costs of subcontracting	EUR	0,00	0,00
Other direct costs - Other goods, works and services	EUR	0,00	0,00
Other direct costs - Travel and subsistence	EUR	0,00	0,00
Indirect costs	EUR	7407,40	7407,40
Percentage of indirect costs	%	28,49%	28,49%
Total costs	EUR	33407,40	33407,40
Reimbursement rate	%	100,00%	100,00%
Maximum Grant	EUR	33407,40	33407,40
Requested Grant	EUR	33407,40	33407,40
Cofinancing (own sources)	EUR	0,00	0,00