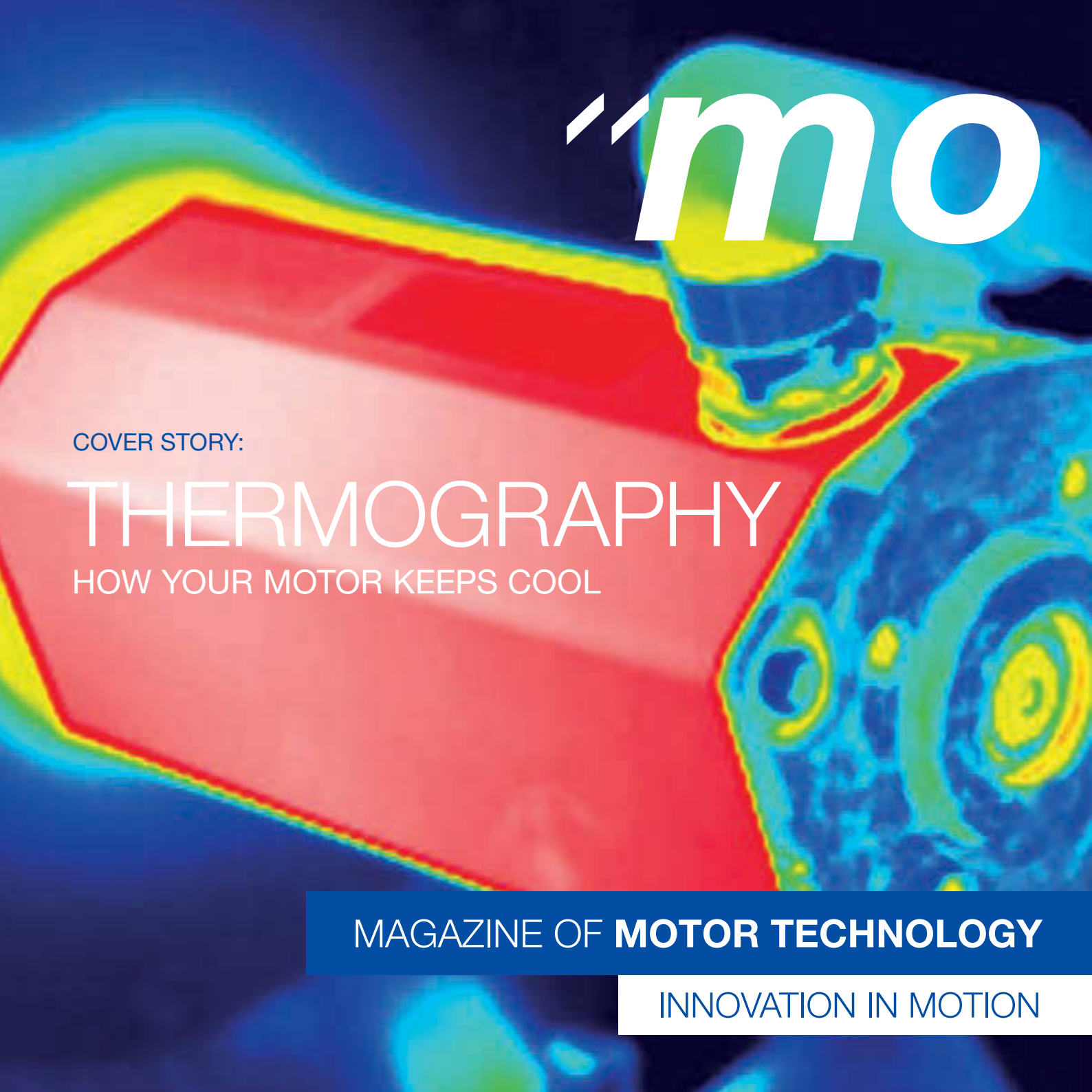

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COVER STORY:

THERMOGRAPHY

HOW YOUR MOTOR KEEPS COOL

MAGAZINE OF **MOTOR TECHNOLOGY**

INNOVATION IN MOTION

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EDITORIAL

INNOVATIONS INFORMATION, INTERESTING SUBJECTS

Dear Readers,

Most of us have experienced and shaped successful years of dynamic market growth, with all the positive and negative side effects. Scarcity and availability issues, allocations, terminations and resource bottlenecks have affected all of us, including Dunkermotoren.

Even more reason for me to be pleased that we can once again offer you considerably shorter delivery times for call-offs and deliveries within 5-10 days for items from our stock program, due to a comprehensive package of measures and massive investments in production capacities.

We also have not neglected the development of new products in this intensive phase. On the contrary, with this issue of the customer magazine we can present to you a real firework of innovative new products.

With the launch of our BG 66x75 dMove, we achieved more than integrating the latest generation of motor controllers into the high runner series. We further increased the peak output power to up to 700 W without change of the size. This is what makes the probably best-selling industrial DC servo motor with fully integrated motor electronics even more attractive for our customers.

In the field of linear direct drives, Dunkermotoren presents the SA 38, a highly dynamic and maintenance-free motor with a peak force of 3690 N and optional water cooling that is unrivalled on the market. For the 3-phase power package with nominal DC link voltage of 325 V or 560 V, parameter sets for all commercially available standard servo controllers can be provided.

With brushless DC motors of the BG 45 to BG 95 series, Dunkermotoren has been the market leader in the 20 - 1000 W power range for years. As part of a product partnership with Siemens, the motors are now also available in specific versions, compatible with the new servo drive system SIMATIC MICRO-DRIVE. The simple integration of the SIMATIC MICRO-DRIVE system into the SIMATIC world significantly shortens the engineering time. Integration into Siemens automation technology is now possible via the TIA portal, and simplifies commissioning and service.

You can look forward to these and many other interesting topics in the field of motor technology.

We hope you enjoy reading our customer magazine.

Yours sincerely,
Uwe Lorenz

Uwe Lorenz,
Managing Director

NEWS

NEW MAIN CATALOG

ORDER OUR MAIN CATALOG EASILY AND CONVENIENTLY NOW.

Either send a short mail with your contact details and the desired quantity to:
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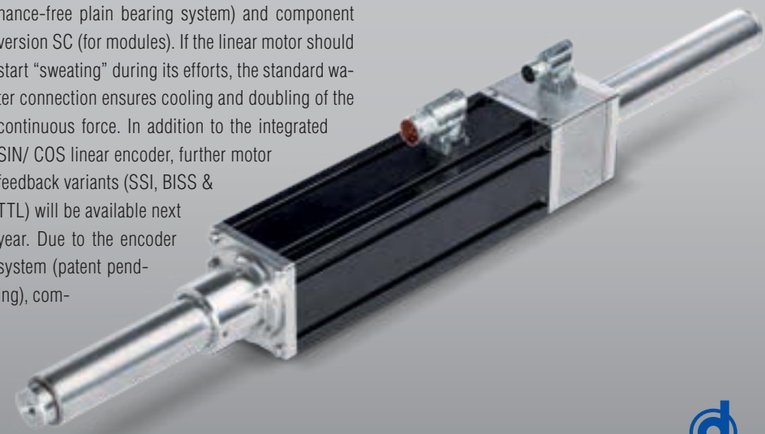
and we will deliver our catalog to your desired location free of charge.

COMPACT LINEAR MOTOR WITH DOUBLED PEAK FORCE

DUNKERMOTOREN WITH MODULAR LINEAR MOTOR CONCEPT ON THE MARKET.

With the SA/ SC 38 series, Dunkermotoren presents a completely new modular concept for tubular linear direct drives. The highly dynamic three-phase linear motors deliver up to 3690 N and accelerate at over 200 m/s². The modular design is currently available as an actuator version SA (with maintenance-free plain bearing system) and component version SC (for modules). If the linear motor should start “sweating” during its efforts, the standard water connection ensures cooling and doubling of the continuous force. In addition to the integrated SIN/ COS linear encoder, further motor feedback variants (SSI, BISS & TTL) will be available next year. Due to the encoder system (patent pending), commercially available servo controllers can position the compact linear motor quickly, precisely and reliably.

The main field of application of the SA/ SC 3806, 3810 or 3814 will be high-speed applications in the food and packaging industry. Since Dunkermotoren has been a system supplier in motor technology for decades, it will not remain just a solo motor. Pick & place modules, complete linear axes and a version designed for the food industry will follow soon to facilitate system integration at customer's site.



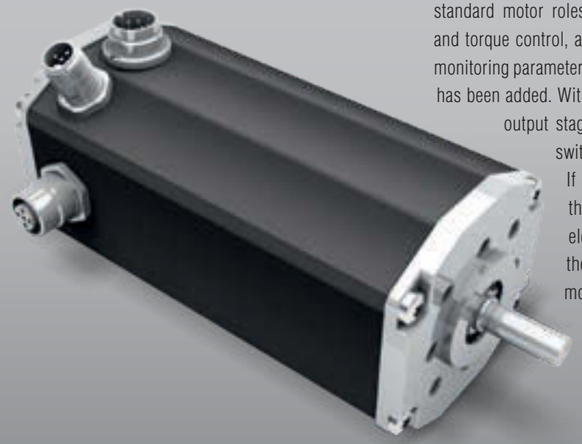
NEWS

BG 66 dMOVE – EVEN MORE POWER IN SIZE 65 MM

AT SOME POINT, THE LIMITS OF PHYSICS ARE REACHED. BUT IN THE MEANWHILE OUR MOTTO IS: OPTIMIZE AS LONG AS IT MAKES ECONOMIC SENSE!

With the BG 66x75 dMove, Dunkermotoren has significantly optimized the power density, i. e. the mechanical output power per installation space. At the same time, the BG 66x75 in this motor size breaks the sound barrier of over 300 W continuous output power for industrial motors for the first time since its introduction 20 years ago.

Like in many sporting disciplines, power is not the only criterion for success with electric motors.



It is the combination with intelligence that allows the power package to fulfil a multitude of tasks. In addition to simple speed and position control, the BG 66x75 dMove can be controlled via CANopen and freely definable digital inputs. In order to meet the demand for maximum flexibility in customer applications, these motors are freely programmable.

WITH „SAFETY“ THE RIGHT DECISION FOR NEW DRIVE TASKS

DRIVE CONTROLLERS FROM DUNKERMOTOREN WITH SAFE-TORQUE-OFF (STO) FUNCTIONALITY.

The external controller series BGE has been extended by another important feature. In addition to the standard motor roles such as positioning, speed and torque control, as well as numerous condition monitoring parameters, an important safety function has been added. With the STO function, the power output stage of the electronics is safely switched off via two channels. If one of the two signals lose the input level of 24 V DC, the electronics reliably switch off the transistors that control the motor phases. The electronics BGE 6060A STO is suitable for motors (brushless or brushed) in the power class of 200 to 1200 W. In addition to the CANopen and EtherCAT interfaces, the controller can also be operated as a stand-alone version.

Due to the voltage range of 10-60 V DC, the operational area of the BGE 6060A STO drive controller will be battery-powered, such as AGVs or industrial

applications. For drive applications with STO functionality, Dunkermotoren also offers the appropriate controller for outputs <200 W. In combination with a motor and attachment from the Dunkermotoren portfolio, we deliver a reliable and future-proof motor system with "safety".

NEWS

BLAZINGLY FAST TO THE OPTIMUM MOTOR SOLUTION

DUNKERMOTOREN INTRODUCES NEW ONLINE CONFIGURATOR.

For many decades, Dunkermotoren has been the undisputed market leader for complete system solutions of motor technology in the power range from 1 - 4000 W. The broad portfolio of DC and BLDC motors, integrated controls, gears, brakes, encoders and software allows more than 50 million available product combinations.

With the new online configurator, Dunkermotoren enables an easy and high-performance selection from more than 100.000 products of the preferred series. Optionally, a focused search to our more than 3.000 stock items is possible, which can be provided within a few days.

The configurator suggests suitable products and product combinations to the user for individually specified parameters. Possible search criteria include, for example, the required torque and speed, the available power supply, requirements for motor control and communication interfaces as well as the need for additional attachments such as brakes or IP protection covers. For experienced Dunkermotoren customers, direct input of the desired motor and gearbox series is also possible.

The configurator provides product specifications as well as drawings and 3D CAD models for the selected product online and as downloads. The customer also receives specifications and characteristic curves for the combination of motor and gearbox. As a result, manual calculation of the performance data resulting from gearbox reduction ratio and efficiency are no longer necessary. In addition, the risk of incorrect configurations is largely eliminated. Once a combination has been selected, an offer can be requested at any time with just one click.

Be efficient and configure your motor technology requirements for Dunkermotoren! The configurator is available at:
https://www.dunkermotoren.com/en/configuration/

NEWS

WITH THE E 310R, THE LEGITIMATE SUCCESSOR FOR THE E 300R HAS BEEN DETERMINED

THE NEW E 310R CONVINCES WITH ITS ROBUSTNESS AND IS PROTECTED AGAINST EXTERNAL INFLUENCES.

The dimensions are comparable to those of its predecessor, the E 300R. The E 310R functions are reliable, even in high temperature fluctuations and axial loads on the motor shaft.

The brake is currently extensively qualified, integrated into the motor and successfully tested. The E 310R is already available for sampling.

Preferably, this brake is combined with the BG 75 brushless DC motor. Further, the incremental encoder RE 30 and the absolute encoder AE 38 can be mounted easily.

The covered versions, used to achieve a high protection class, remain the same in terms of dimensions. So, no redesign is necessary.

THE PLG 22 – DUNKERMOTOREN'S SMALLEST GEARBOX IS A BIG HIT

WITH THE PLG 22, DUNKERMOTOREN IS LAUNCHING A POWERFUL 22 MM GEARBOX.

Not only in diameter, but also in torque, this gearbox optimally fits to the ironless BLDC motor BGA 22, which operates according to the axial flow principle.

In order to increase the robustness of the gearbox, it was designed of metal. The low noise level is outstanding. The PLG 22 can transmit a high torque of up to 3.5 Nm measured at the output shaft.

The planetary gearbox is manufactured using state-of-the-art, resource-conserving manufacturing techniques. Special assembly processes enable a hermetically sealed and smooth housing. This means that the gearboxes do not collect any dirt and are easy to clean. Both, the shaft and the housing are protected against corrosion, to further optimize the cleanliness.

Due to the small diameter, only small reduction ratios can be realized per stage. However, since the input speeds are relatively high in order to make optimum use of the motor, gearboxes with up to 5 stages are possible. In principle, total reductions of up to 4685:1 are possible. Dunkermotoren gearboxes are, normally, designed for speeds of up to 6.000 rpm, which is not sufficient for the BGA 22. With the PLG 22, the input speeds are set up to 10.000 rpm.

Such gearboxes are typically used in grippers for robotics, automatic electronic assembly machines, in professional camera systems as well as the two medical technology sectors of analysis and therapy.

NEWS

DUNKERMOTOREN WINS THE BEST OF INDUSTRY AWARD IN THE DRIVE TECHNOLOGY CATEGORY

NOW IT'S OFFICIAL - AFTER SEVERAL WEEKS OF VOTING, THE WINNER OF THE BEST OF INDUSTRY AWARD IN THE DRIVE TECHNOLOGY CATEGORY HAS BEEN ANNOUNCED.

The BG 95 dPro convinced the readers and the jury of the MM Maschinenmarkt. With 37.55%, the highly integrated servo motor wins ahead of the competitor's products.

Particularly noteworthy is that only companies that have already won an industry prize, made it onto the shortlist at an awards ceremony, or whose innovation has met great reader interest on the website of the machine market are nominated. With 31 nominees in 11 categories, various branches of industry were represented with their innovative and future-oriented products.

The trend towards ever higher integrated servo motors is unbroken. The BG 95 dPro sets a new standard and, at the same time, improves flexibility, functionality and operational reliability. As a result of the integrated controller, the BG 95 dPro is the first servo motor with a peak output of up to 3.900 W that does not require an external control unit at low voltages of up to 60 V. The motor offers CANopen and Industrial Ethernet communication interfaces in a minimum space. It can be programmed via language "C" like a PLC and performs tasks autonomously.

The representatives of Dunkermotoren accepted the award with great pleasure at a gala ceremony in the Vogel Convention Center in Würzburg.

NEWS

DUNKERMOTOREN PUBLISHES A HANDBOOK FOR SELECTION OF MOTORS FOR ENGINEERS, PRACTITIONERS AND STUDENTS

IN COOPERATION WITH THE RENOWNED MOTOR TECHNOLOGY EXPERT DR. JENS WEIDAUER, DUNKERMOTOREN HAS PUBLISHED A FREE HANDBOOK OF FORMULAS ON MOTOR TECHNOLOGY.

The extensive collection with illustrations and descriptions provides formulas, terms and explanations for calculations of motor systems. It is intended to serve users as a practical aid for motor dimensioning. The systematic structure of the handbook facilitates the introduction to the topic and makes that handbook a valuable tool for trainees, students as well as young and experienced professionals. The range of motor components and solutions covered satisfies the requirements of engineers who need to design, select or adapt electric motors to their specific applications in their daily work. For practitioners, the handbook for selection of motors contains calculated examples which serve as instructions for their own calculations and thus, facilitates the application of the formulas for real design tasks. Clearly arranged tables enable the selection of the appropriate motor and gearbox technology based on practical selection criteria.

The handbook was created by the specialist Dr. Jens Weidauer in cooperation with the product managers of Dunkermotoren GmbH. It comprises 96 pages and is available in German, English and Italian, in printed and digital form. You can download a PDF copy at
https://www.dunkermotoren.com/en/knowledge/publications/handbook-for-selection-of-motors/

Printed versions can be directly ordered at Dunkermotoren:
Sales.Dunkermotoren@ametek.com

10 YEARS OF HEDU APPRENTICESHIP COOPERATION

THE HEDU APPRENTICESHIP COOPERATION WITH THE NEIGHBORING COMPANY HECTRONIC, LATELY AWARDED THE IHK TRAINING PRIZE, IS ABOVE ALL, A BENEFIT FOR OUR TRAINEES.

They get the chance to complete their technical training in two well-equipped training workshops and acquire knowledge from specialists of two companies. Hectronic, which focuses on electronics, manufactures fuel and parking ticket vending machines. Thus, the general training covers two areas in the industry - mechanics (Dunkermotoren) and electronics. The apprentices are involved in the various training units in both companies.

In order to further clarify and strengthen the cooperation, the pilot project of the HeDu training days was started in 2009, held inside of the companies, where only these two companies were presented for the time being. Over the years, when the number of visitors continued to rise, the concept was changed and is now able to present oneself more broadly and in a new way.

For the 10th anniversary of the HeDu training days this year, the new concept was a great success. With a ceremonial act for invited guests from the enterprises and exhibitors, this was duly celebrated.

NEWS

Fact box: HeDu training days:
- 40 Exhibitors from industry, trade & commerce
- Approx. 700 participating students per year
- Since 2017: New venue in the city hall Bonndorf due to great attendance

Since a few years, the HeDu training days for pupils have been regarded as "the unique opportunity" in the region to get to know various companies, service institutions and secondary schools. In addition to the presentation of the individual professions, various workshops and company tours were offered so that the students could try out many things themselves.

Looking back, the concept developed over the last 10 years is a successful initiative, in line with today's requirements. However, Dunkermotoren and Hectronic will continue to invest energy and money in the former pilot project which has been turned into a unique offer today.

Author: Nina Zoller, Human Resources Manager, Apprenticeship

FACTS & FIGURES

1999
DUNKERMOTOREN'S FIRST SMART MOTOR COMES TO LIFE.

CURRENT DELIVERY TIMES FOR STOCK PROGRAM ORDERS UP TO FIVE PIECES – **10 WORKING DAYS.**

50 YEARS MOON LANDING:
DUNKERMOTOREN WAS THERE – GK22.

29% CAGR
SINCE 2016 (183 MIO.) UNTIL 2018 (236 MIO.).

3950 W – MAX. OUTPUT POWER
FOR MOTOR SIZE 95 MM.

IF ALL ELECTRIC MOTORS HAD THE EFFICIENCY OF DUNKERMOTOREN'S BLDC DRIVES
WE WOULD HAVE A YEARLY ENERGY SAVING IN THE GERMAN INDUSTRY AROUND 7.910.000.000 KWH
AND WE COULD REDUCE THE CO_2 EMISSIONS BY 4.524.000.000 KG.
(calculation / estimation by Dunkermotoren).

1.504
CONFIGURATIONS WITHIN THE FIRST 4 WEEKS WITH THE NEW ONLINE CONFIGURATOR.

2018
NUMBER OF USED GEARWHEELS: 7.717.833.

MOTOR DIMENSIONING

ENERGY-EFFICIENT AND COST-CONSCIOUS GEARBOX DESIGN

Why is it still possible that car gearboxes fail? They are designed for a certain mileage, say 150.000 km, but not to break under any circumstances. This saves costs and weight which, in turn, reduces fuel consumption. Thus, depending on the driving profile and style, gearbox failures can occur within a car's lifetime.

Why is reverse so noisy? The design, especially for low-cost vehicles, is made for a total driving distance of 200 km. The toothed parts are manufactured in a correspondingly minor but satisfactory quality - that's what you hear, by the way!

So why should gearboxes in motor technology be designed for eternity?

Would it not make more sense for servo applications to consider the expected service life and the load profile for the design?

If you then manage to optimize the cumulative efficiency, this will lead to sustainable and cost-conscious motor solutions.

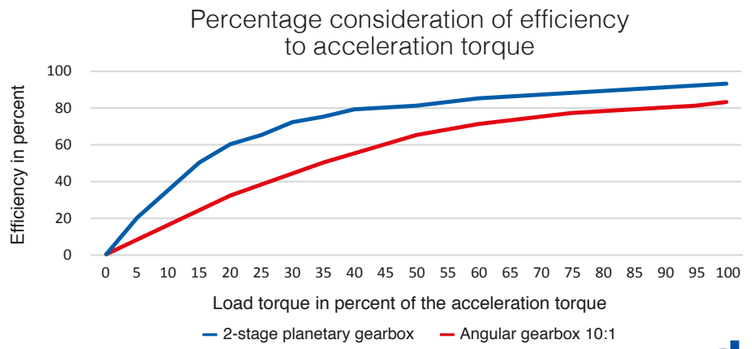
INSTALLATION CONDITIONS DETERMINE GEARBOX DESIGN

The gearbox design is, among other aspects, selected according to the installation conditions. Gearboxes with an axial output to the motor are more efficient and favorable regarding the transmittable torque than gearboxes with a right-angled output. If possible on side of design requirements, it is recommended to select gearboxes with an axial outlet for efficiency and economic reasons.

Why are angular gearboxes more expensive and less efficient? Angular gearboxes are usually lubricated with a liquid lubricant, which is also the reason why they are sealed. Losses occur as a result of the friction moments of the dynamic seals, i. e. the sealing lips of the radial shaft seals and, thus, of the rolling of the lubricant, the so-called churning losses. The increased current consumption of the driving motor is a measure of these losses.

This bad impression of the gearboxes in the cold state are relativized in real use. This consideration is particularly important when reaching the maximum operating temperature of the motor. At high temperatures, the sealing lips are very flexible and low-friction. The lubricant becomes low viscous, which also reduces friction.

Comparison of a 2-stage planetary gearbox with an angular gearbox:



MOTOR DIMENSIONING

It should be noted that these are cold specifications. In the warm state or even close to the maximum operating temperature, the angular gearbox is better than shown in the graph.

EFFICIENCY MAXIMIZATION

The lower the number of stages, the better the efficiency of a gearbox. This form of efficiency maximization leads to high ratios within a stage, which is at the expense of robustness and service life. How far this topic can be taken depends on the requirements of the application.

In a conservative design process, the nominal torque M_N of a gearbox is selected to be higher than the maximum load torque M_{Load} occurring in the application. This ensures a safe design, but also results ins oversizing and thus, in poor efficiency.

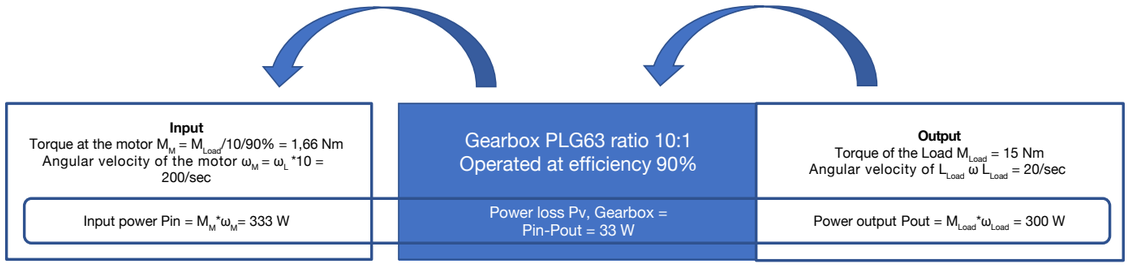
With an energy-efficient design, the acceleration torque M_{Acc} of a gearbox unit is selected to be higher than the maximum load torque M_{Load} occurring in the application. This design process leads to more compact motors and increases efficiency.

In order to prevent early failures due to malfunctions, the emergency stop torque ME-STOP$_{Gear}$ must be higher than the actual torque ME-STOP$_{Load}$ occurring in the emergency stop case. This avoids expensive repairs e. g. caused by emergency stop actuation.

THERMAL MANAGEMENT

For thermal testing, it must be adhered to performance limits, that are defined as the product of torque (M) and angular velocity (ω). With the single-stage PLG 63 of Dunkermotoren, the permissible average output power is 315 W and the short-term output power is 395 W. Since the load is not constant in most applications and pause times occur, the average output power must be calculated. This should not exceed the permissible average output power of the gearboxes.

The self-heating of the gearbox unit is determined by the losses in the gearbox. In a gearbox with an efficiency of 80%, the double heating occurs than in a gearbox with 90% efficiency. From a thermal point of view, the 80% efficiency gearbox is only half as good as the 90% efficiency gearbox.



Graphic of power throughput and power loss of a gearbox

MOTOR DIMENSIONING

▶ See graphic of power throughput and power loss of a gearbox.

When mounted on a motor, however, the heat generated from the motor is relatively high, so that even in gearboxes with good efficiency, the temperature is typically only about 10 K lower than that of the motor. If the gearbox is combined with a BG 65Sx55 and is working in intermittent operation, it will certainly be hotter than in combination with a BG 75x50. The heat dissipation through the connection to the machine also has a considerable influence on the temperatures occuring during operation. Direct mounting on a steel frame ensures better heat dissipation than if the drive is decoupled with vibration dampers for noise reasons.

Practical tip: *When qualifying the machine or device, check the temperature of the gearbox with a thermometer. If the temperature remains below 60°C, a resilient design can be assumed.*

Consideration of cumulative efficiency provides information on energy efficiency.

Knowing the different load cases of the application and their duration, as well as the load-dependent efficiency of the gearbox, is the basis to consider the energy efficiency. If the gearbox efficiency is assigned to the different load cases, the losses can be calculated.

Energy efficiency analysis using the simplified example of a door drive.

▶ See Comparison of angular gearboxes and 2-stage planetary gearboxes.

From this it can be concluded, that the planetary gearbox with 69.67% to 47.33% uses the supplied energy 47% better!

Practical tip: *If you dimension gearboxes correctly, you save resources and put a smile on the face of the accountant!*

Author: Stefan Tröndle,
Product Manager Brushed Motors and Gearboxes

	Speed up the door	Open the drive	Brakes before end position	Speed up door closing	Close the drive	Brakes before end position	**Cumulative efficiency**
Load in percent of acceleration torque	80	20	80	80	20	80	
Time [s]	1	4	1	1	4	1	
Angular gearbox efficiency	78,00%	32,00%	78,00%	78,00%	32,00%	78,00%	**47,33%**
2-staged planetary gearbox efficiency	89,00%	60,00%	89,00%	89,00%	60,00%	89,00%	**69,67%**

Comparison of angular gearboxes and 2-stage planetary gearboxes

MOTOR DIMENSIONING

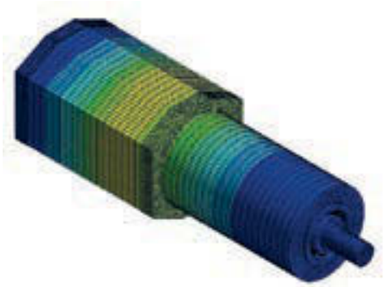
TEMPERATURE OBSERVATION OF GEARBOXES IN DRIVE SYSTEMS

The combination of a motor with a gearbox allows a significant increase in torque. As part of the drive unit, the gearbox must be matched to the motor. Not only the motor, but also the gearbox needs to fulfill the high requirements in terms of robustness, reliability and durability.

Each drive unit consisting of motor and gearbox is characterized by its torque and speed. These parameters can be used to define the conversion of the electrical input power into a mechanical output power. Similar to electric drives, there is a huge amount of mechanical motors. Choosing the suitable gearbox has a major impact on efficiency, cost and service life.

Especially the increased power density of permanent magnet synchronous machines requires a compact design and the transmission of high performance gearboxes. For this reason, planetary gearboxes are preferred. A planetary gearbox usually consists of a centrally mounted sun gear, a ring gear and several planetary gears that roll between the sun gear and the ring gear. Planetary gearboxes offer enormous advantages through the transmission of high torques, since the torque is distributed over several pinions. The function of the planetary gearbox is, therefore, to transmit or increase the torque. In addition, the planetary gearbox does not separate the power flow, and is characterized by a high degree of efficiency and a low-noise running level. In order to achieve high torques, it is recommended to divide it into several gearbox stages with different reduction ratios. The first gear stage is often designed with helical teeth for smooth running, whereas the second and third gear stages are generally straight teethed. The individual gear stages are, as a standard, fitted with three planetary gears. Due to the high load, the gear parts are made of steel. The planetary gearbox is suitable for continuous operation as well as intermittent and alternating operation in left and right rotation. The disadvantage of the compact design is a complex construction and the associated number of parts and susceptibility to loss. As the requirement for planetary gearboxes is to transmit forces and torques efficiently, the bearing arrangement is of particular importance. For applications with radial or axial forces, it must further be considered point- or surrounding loads. Planetary gearboxes for servo applications are usually self-supported and have the advantage to be combinable with different motors. The following drives are external bearing gearboxes. Here, the sun gear is mounted directly on the motor shaft and the additional bearing point on the drive flange is omitted.

Heat transfer and heat distribution can vary in a broad range, depending on the combination of electric motor and planetary gearbox. The heat distribution of a brushless DC motor BG 75x25 with a three-stage gearbox PLG 63 is designed as an example. In return, a single-stage gearbox, mounted on a long BG 75x75 motor, forms a different heat distribution.

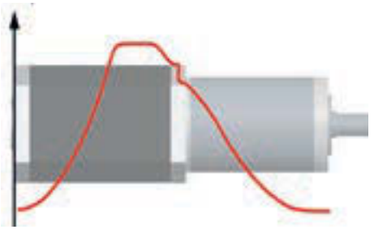


BG 75x25 and 3-stage PLG 63

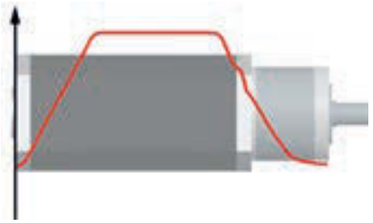
BG 75x75 and 1-stage PLG 63

The main heat source of the BG 75 motor is the winding, which is built into the housing. The electronics are in the rear part of the motor. In the gearbox, heat is generated mainly by friction. The heat transfer between motor, gearbox and environment can take place by means of three types: heat conduction, convection and heat radiation. Heat conduction is the mechanical coupling between motor and gearbox. Convection refers to the carrying of thermal energy in a flowing medium, such as oils and lubricants in the gearbox. If the solid body is supplied with energy in the form of heat, it always results in an increase of temperature. The body stores the heat supplied. Lubricating oils are the most important technical lubricants. By reducing friction, lubrication counteracts wear, additionally they inhibit noise development and ensure heat dissipation. The temperature difference due to heat transfer and heat conduction depends on the motor configuration. However, heat dissipation is independent of the medium. Each body emits heat to its environment. As the temperature increases, the intensity of the heat radiation also increases, with the maximum radiation coming from a black body.

The heat distribution along the length of the drive combination is shown below. The heat source is formed by the motor with a maximum temperature of 120°C. The heat distribution along the length of the motor combination is clearly visible. The output power can be increased with a BG 75x25 in combination with a three-stage PLG 63, as the heating can also be dissipated by the gearbox. If, on the other hand, a smaller gearbox is connected to a more powerful motor, the permissible output power must be reduced as the operating temperature of the gearbox exceeds 60°C at the nominal operating point. In the event of additional heating above the operating temperature, a decrease in service life must be expected.



BG 75x25 and 3-stage PLG 63



BG 75x75 and 1-stage PLG 63

Findings from lifetime tests of motors in combination with planetary gears show that torque and speed are not the only determining parameters. The size of the motor, the reduction ratio and the number of gear stages have a significant influence on the output power. The power loss of the gearbox is also decisive for the power consideration. The maximum heating of the gearbox is defined by the ambient temperature and the temperature inside the gearbox. Together with the heat dissipation of the planetary gearbox, the maximum permissible power dissipation results. Unrestricted operation of the motor solution at continuous torque and rated input speed is permissible if it is considered the maximum output power and heating.

Author: Dr. Bruno Basler I Head of R&D Predevelopment

MOTOR DIMENSIONING

CATALOG SPECIFICATIONS ARE ONE THING, GETTING THE MOST OUT OF THE MOTOR SOLUTION IS QUITE ANOTHER

The catalog data describe the motor in a balanced form, which tries to satisfy both, the physical conditions and the applications. In specific cases, however, it makes sense to move away from the catalog specifications during operation in order to better adapt the motor to the application. This article presents various optimization goals.

MINIMIZE NOISE:

Motors and gearboxes cause noise. This is caused by ball bearings, brush systems and gearboxes of a mechanical nature. Since inductances are switched during commutation, noise is also generated there. Noise is also generated by magnetic forces acting in the motor, such as latching force and remagnetization. Furthermore, the motor solution can also produce vibrations in the machine or device, which amplifies the noise and sometimes leads to surprising noise effects.

By lowering the operating voltage, the motor speed can be reduced, resulting in lower frequencies, which reduce the noise and make it more pleasant. *Figure 1* compares a GR 63x55 rated at 24 V with a GR 63x55 rated at 40 V. Both motors are operated at 24 V voltage. The GR 63x55 with 40 V runs at a significantly lower speed and is quieter in operation.

MINIMIZE CURRENT:

The guiding principle is: "Voltage is for free, electricity costs money."

The price of both, power supplies and controls, depends on the continuous and maximum current. By designing drives in a way where they require little power, the systems are cost-effective and compact. The compact design is based on small power supply units and small controllers as well as a reduced cable cross-section for the wiring.

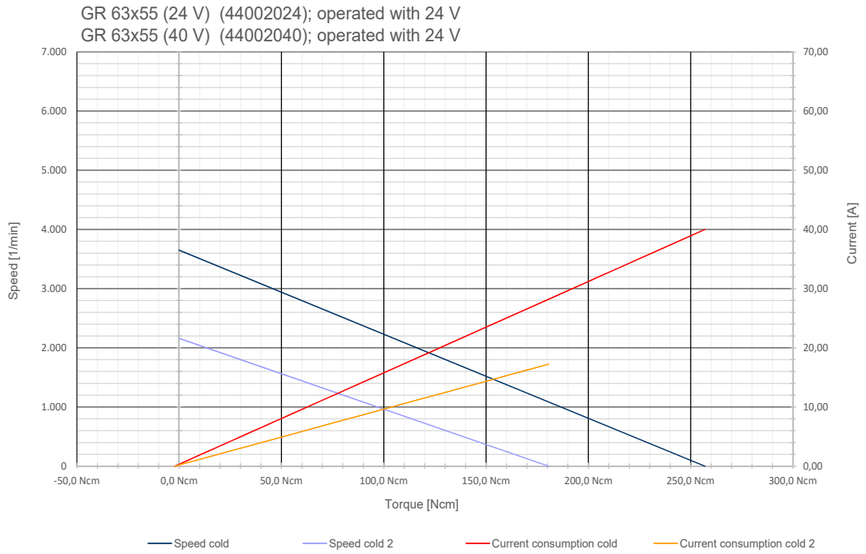


Figure 1

MOTOR DIMENSIONING

According to *figure 1*, the GR 63x55 designed for 40 V, delivers the same torque with significantly lower current. The prerequisite for this design is, of course, that the speed is still sufficient. If this is not the case, current minimization only works by increasing the operating voltage. *Figure 2* compares the GR 63x55 with 24 V rating, operated at 24 V, with a GR 63x55 with 40 V rating, operated at 40 V. The speeds are virtually the same, but the current is significantly reduced.

At this point I invite you to take a little trip into electromobility. Have you ever wondered why battery-powered vehicles don't simply use the 12 V voltage used for starter batteries? It would be obvious and above all safe, wouldn't it? Renowned manufacturers rely on direct voltages of 650 V, even up to 800 V. This minimizes currents, thus lowering costs, reducing weight and shortening charging times. The risk of high voltage is therefore accepted.

Practical tip: *If you want to save power when operating a BLDC motor in order to be able to use a controller with a lower rated current and thus lower costs, the 48 V winding, for example, offers an advantage over the 24 V winding. However, since the logic supply still requires 24 V, the controller should make this available. If this is not possible, a small DC/ DC converter for 24 V can be used.*

Practical tip: *If possible, make full use of the safety extra-low voltage up to 60 V for your application.*

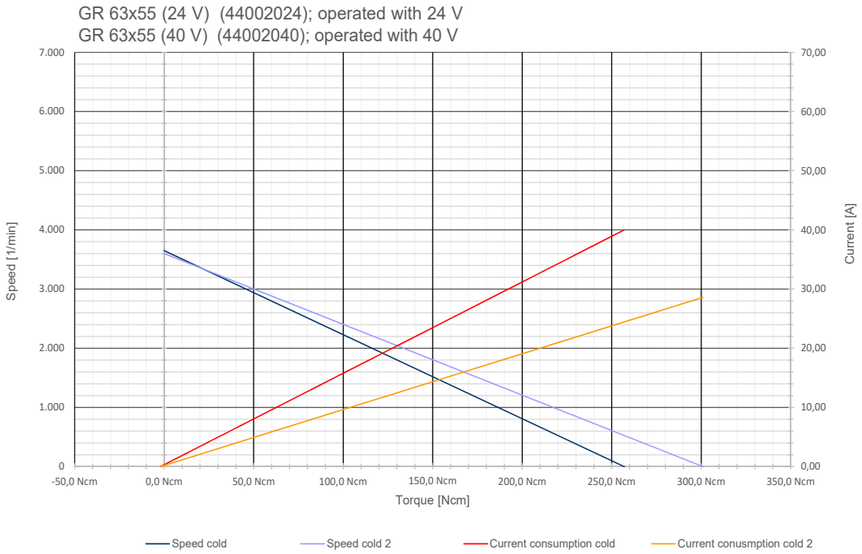


Figure 2

MAXIMIZE PERFORMANCE:

Motor solutions can be designed for maximum performance, especially when short-time operation is required. The power output is defined as product of the speed and the torque.

MOTOR DIMENSIONING

MOTOR DIMENSIONING

Figure 3 compares the GR 63x55 with 40 V rating operated at 40 V, with a GR 63x55 with 24 V rating operated at 40 V. This design allows considerably more power to be drawn from the same size and at the same cost.

It should be noted that an operation at torques above the nominal torque is just possible temporary, due to the risk of overheating. The demagnetizing current must not be exceeded.

The maximum power output is calculated from the product ½ starting torque times ½ idling speed. However, this maximum can rarely be used in practice, as deviating torques or speeds are required.

MAXIMIZE DYNAMICS:

In order to use motors as dynamically as possible, currents that are significantly higher than the rated current are required. The frequently cited GR 63x55 with 40 V rating has a rated current of 3 A. The maximum permissible current is an impressive 20 A. Theoretically, it is possible to retrieve approx. 7 times the current for a short time and thus 7 times the nominal torque of 210 Ncm. Usually, however, only the three- to fourfold is realized. If only a certain current is available, a clever design of the motor (see chapter "minimizing current") can still achieve high dynamics.

DISCUSSION:

For the described optimizations, limits such as maximum permissible speeds, maximum permissible current, thermal limits and service life restrictions, especially the lifetime of in particular the brushed motors (GR series) must be taken into account. Nevertheless, the approaches are worthwhile. This can improve machines and equipment and reduce costs.

If you want to push the limits, you should contact us as the manufacturer to make sure that the optimization works.

Author: Stefan Tröndle, Product Manager Brushed Motors and Gearboxes

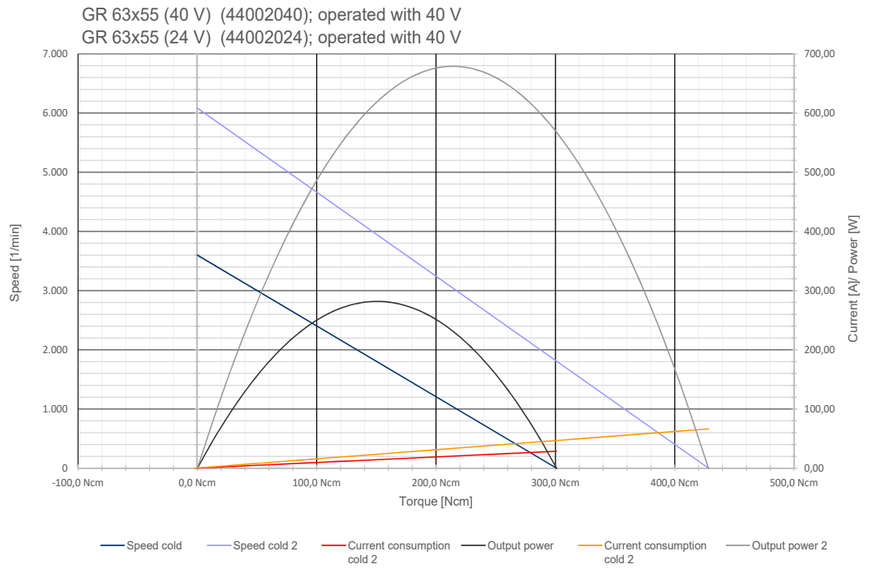


Figure 3

LOCATIONS

LOCATIONS

DUNKERMOTOREN CHINA – TAICANG

LOCATED SOUTH OF THE YANGTZE RIVER, IN JIANGSU PROVINCE, TAICANG IS A TOP 10 CITY IN CHINA.

Besides the location along the Yangtze river, the city is close to Shanghai with only 50 km distance to the Shanghai Hong Qiao airport, and 90 km to the Pu-Dong airport.

The city is renowned for its long history, rich culture and well-developed education system. With a history that spans more than 4.500 years, Taicang is nicknamed as the "Beautiful Golden City of the Southern Yangtze". Already during the Yuan and Ming dynasties Taicang was called "Port of the six kingdoms" when famous sailor Zheng He, started his 7 sea-going journeys from this harbor. Today, the port of Taicang belongs to the top 10 harbors of China.

As a city with many ecological resources, Taicang received numerous national awards including the most ecological city, the most hygienic city, the garden city, the excellent tourist city, the model city for environmental protection and the city with the most advanced public safety. Moreover, Taicang was voted "China's happiest city" for four consecutive years.

Shaxi, also called “Shatou”, is a town 10 km away from Taicang. The 1.300-year-old town offers a great number of waterside architectures, old streets and alleys, ancient bridges and former residences of celebrities. Shaxi is one of the most famous historic and cultural towns of China.

In 1993, the first German company started its business in Taicang. Since then more than 300 German enterprises have established themselves in Taicang. Thus, the city earned its recognition as the nation's first "Sino-German base for business cooperation" and the first "Sino-German demonstration zone for cooperation between Chinese and German SMEs".

The cooperation between Taicang and German partners mainly focuses on auto parts, precision machinery and other related industries. In the future, Taicang will further promote the construction of the China-Germany Industrial Cooperation and Innovation Pilot Zone to make Taicang a pilot and pioneer area for profound cooperation between the Chinese and German parties in politics, economy, culture and social management.

Author: Zhao Zhihua, Marketing, Dunkermotoren Taicang Co., Ltd.

INSIGHTS

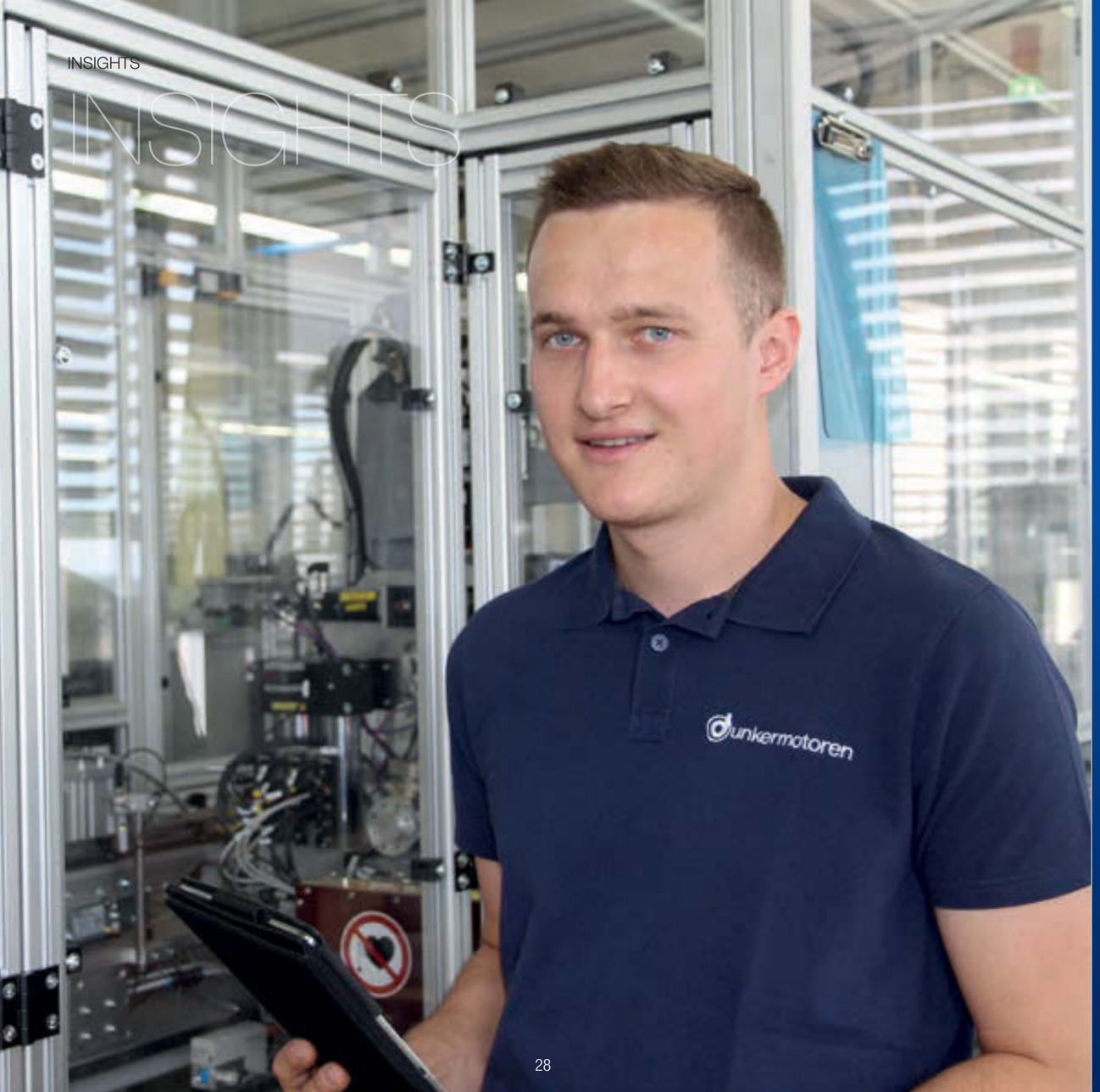
PREVENTIVE MAINTENANCE - DUNKERMOTOREN MAINTENANCE AS PART OF THE SMART FACTORY

IN TIMES OF DIGITALIZATION AND THE INTERNET OF THINGS, THE TOPIC OF “PREVENTIVE MAINTENANCE” IS BECOMING INCREASINGLY IMPORTANT.

It is not only the BG series of intelligent brushless DC motors that is used in smart factories and is already helping users with motor data that support the maintenance process. Dunkermotoren itself has optimized its own maintenance process down to the last detail by processing thousands of machine data. Since 2002, the headquarter in Bonndorf has been connected to the SAP software. The two sites, Subotica in Serbia and Taicang in China, followed immediately after the start of operations. The consistent integration of all plants enables a global view of all processes and workflows. All machines are stored in the system and are centrally controlled via a maintenance cockpit. Currently, 787 machines and building service systems are stored centrally. To make it easy for new employees finding their way around the company and the system, there is a QR code on each machine. This code refers to stored photos and data of the machine such as circuit diagrams, qualification plans, operating and maintenance instructions and the associated operating resources.

Each employee in the maintenance area is connected to the maintenance cockpit via a tablet. The data can thus be read directly via the bar code. Depending on the shift schedule, the machines can be assigned directly to a maintenance employee. This means that each maintenance employee can see the worklist for the relevant workday at a glance. A traffic light system makes it possible to categorize the scheduling of maintenance work or activities. This simplifies the prioritization of work. This system prevents the traffic light from being set to red - preventive maintenance is, therefore, already omnipresent in Dunkermotoren. Existing deadlines are met, and work is only carried out in the yellow area.

Comparable to a production order, the required work steps/ tasks are entered in a maintenance plan/ task list in the SAP-system. In addition, the administrative data contain information on the last maintenance, the performing technician, information on the specified maintenance cycle, scheduled date of next maintenance and the technician who’s going to do it. For each maintenance, a logbook is available in the maintenance cockpit, where all data and former maintenances are documented in a so-called ma-



INSIGHTS

chine history. Every maintenance technician always has access to the latest data from the SAP system via Wi-Fi connection of the tablets. After the completion of the maintenance/ repair work, the employee enters the working times and activities carried out via the tablet. Afterwards, the maintenance/ repair is completed via a confirmation in the system. If a quality control is required after a repair, a so-called "Check after Repair" is stored in the system. The maintenance employee starts a workflow with information on the repair, carried out via the "Check after Repair" button, which must be processed by the responsible quality employee and needs to be released afterwards. The production release is thus stored and documented in the SAP system.

The head of the maintenance department can monitor all maintenance processes in real time at any time via the cockpit. All systems to be maintained as well as the maintenance per employee are listed in the cockpit. It is also possible to react at short notice to employee failures, e. g. due to illness, and to postpone machine maintenance within the maintenance staff. The cockpit also provides various evaluations that can be restricted by type and period. For more detailed evaluations, the SAP reports can also be exported to Excel. Thus, became also possible to inform teams and managers about the current status. The use of the SAP-based maintenance cockpit has several advantages for Dunkermotoren. For example, the existing process was completely changed to active future planning in the sense of preventive maintenance. Maintenance can, as a result, be planned much better and allows larger expenditures to be carried out in foreseeable production gaps. The detailed documentation and evaluation makes it possible to predict the weaknesses so that downtimes can be eliminated.. Interdisciplinary teams (Industrial Engineering department) identify improvement measures. Controlling is possible by allocating the time and corresponding costs incurred. It is possible to retrieve the data of the plants and machines via an app on the smartphone. This enables a continuous flow of information.

But the use of the maintenance cockpit does not only offer enormous advantages for Dunkermotoren. Also for Dunkermotoren customers the use of the cockpit means that quality is assured and production downtimes due to unforeseeable breakdowns are avoided.

Author: Janina Dietsche, Public Relations

ENGINEERING

HOW YOUR MOTOR KEEPS COOL

Production is running at full speed. If the production lines continue working this way, they will set a new monthly record. The production manager can proudly inform the managing director, who can achieve the desired quarterly result. But suddenly: A downtime in the production line. Reason: The drive in the packaging system is overheated and needs to be replaced.

You can avoid this "horror scenario". Visualize the entire chain, from the origin of heat directly in the electric drive to the ambient air into which all the heat energy passes at the end. Every single step should be considered and, if necessary, improved.

LET'S START WITH THE THREE MAIN HEAT SOURCES:

- Electrical resistance:
  Current flows through the copper windings of a motor, solder joints and electronic components. The share of energy that is converted into heat depends on the motor current, circuit design and quality of the components.

- Eddy currents/ remagnetization losses:
  Electrical energy and rotational energy are converted into heat energy by constantly remagnetizing the motor sheet used or by eddy currents.

- Friction losses:
  Rolling ball bearings, gearboxes and lubricants that are moved convert kinetic energy into thermal energy.

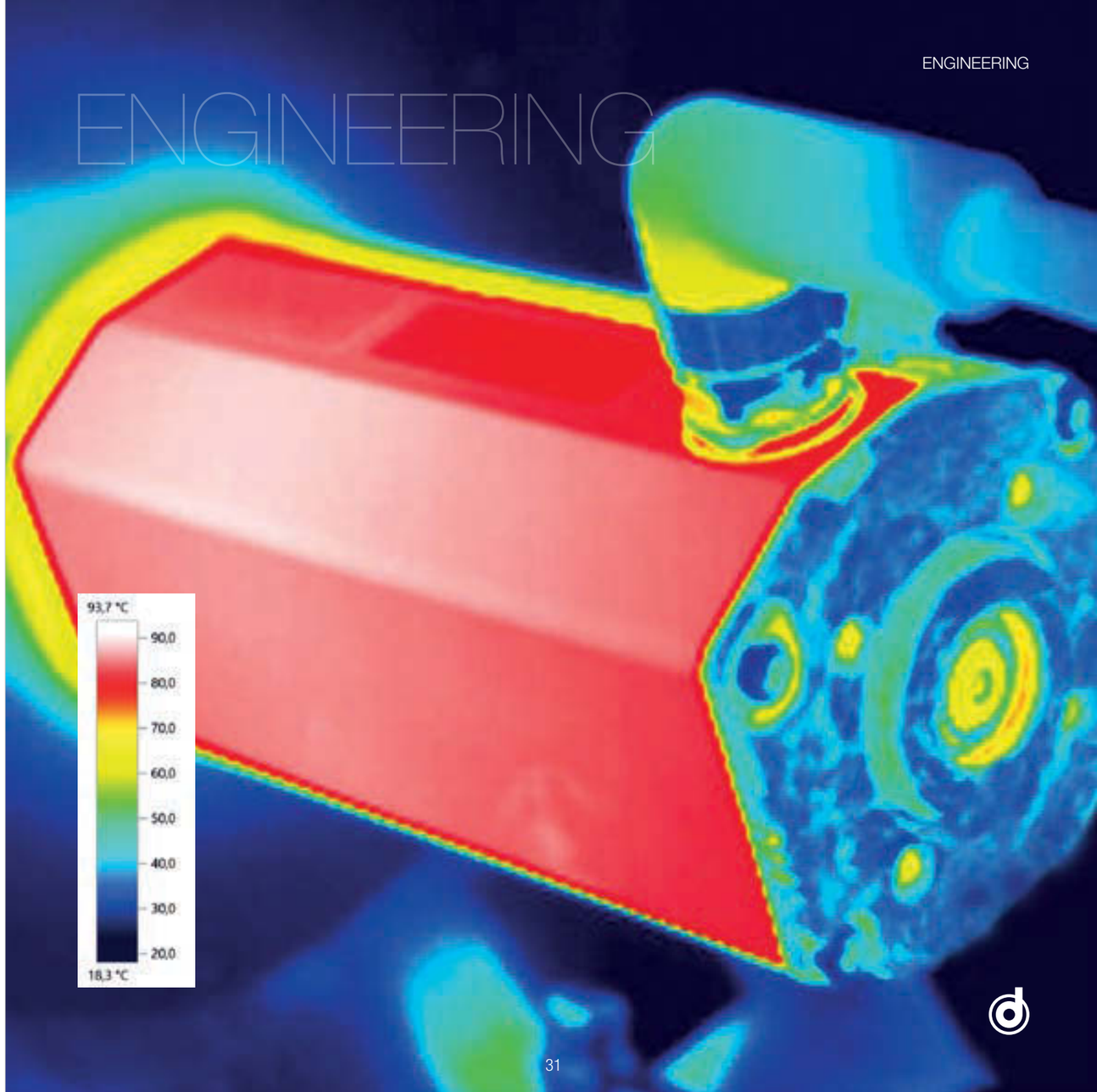
You could hardly argue that you as a user can hardly change the heat sources. Indeed, you have no influence on the gear materials used, the iron sheets or the electrical components used by the manufacturer. But exactly here at the heat source you have many possibilities to ensure that as little heat as possible is generated that would, otherwise, have later to be dissipated at great expense:

- Choose a motor with high efficiency and operate the motor at the point with the highest efficiency. The manufacturer will provide you with the relevant information. Motors operated with vector control have a particularly high degree of efficiency.

- Do not compare apples and oranges. Only if the specification values were recorded without an additional cooling plate (according to EN 60034) they are representative and comparable. Furthermore, carefully take a look on the gearboxes. Does the manufacturer specify the overall efficiency or only the theoretical gear efficiency? A 97% gear efficiency can quickly turn into an 80% overall efficiency and thus into a strong heat source.

- If in doubt, test your drive in the application under worst-case conditions. Smart motors have integrated temperature sensors whose values you can read out.

- Depending on the application, special high-temperature greases can be used in gearboxes that ensure less heat generation.



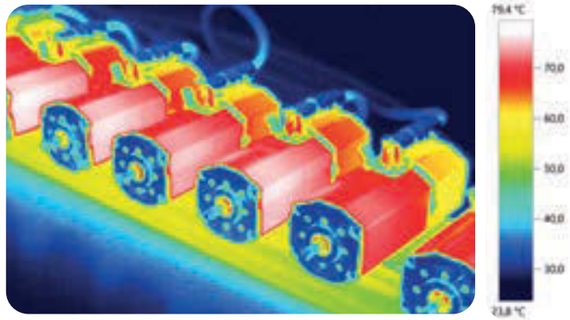
ENGINEERING

HOW YOUR MOTOR KEEPS COOL

Of course, the generation of heat cannot be avoided completely. This heat must now be released into the ambient air. Now you could spontaneously say: If the motor becomes too warm, I use a fan. Due to noise, costs and limited fan life, forced ventilation should only be an option if all other options fail. But there are plenty of options.

To illustrate the heat flow from the motor to the ambient air, you can compare heat with water. Water falls as continuous rain (constant supply of heat energy) to the sea (ambient air). If the water needs to pass almost impenetrable rock, it accumulates and flows off slowly. If the water, instead, flows through a wide riverbed, there is no barrier and it flows off smoothly
The impenetrable rock, in this case, represents substances with poor thermal conductivity. High-alloy steel conducts heat up to 10 times worse than aluminum alloys, which conduct heat up to 1.000 times better than many engineering plastics and almost 10.000 times better than air. The wide river bed symbolizes material with good thermal conductivity and a large cross-section.

In order to allow the heat to flow off well, make sure that the motor is attached to a large area of heat-conducting material. Even a small air gap of 100 µm would dissipate the heat as poorly as over approx. 1.000 mm aluminium. Good thermal bonding distributes the heat well in the application and has a large surface from which the heat is released into the ambient air.



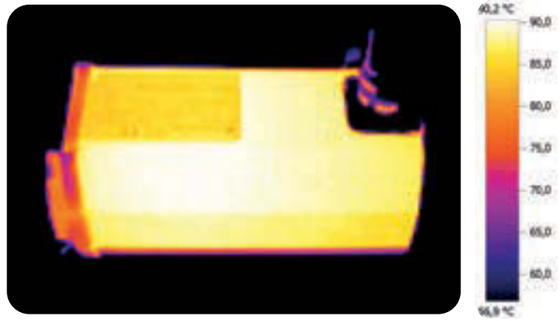
Avoid closed housings. Wherever possible, provide large ventilation slots in the machine or device. By natural convection, ambient air is sucked in at the bottom of the housing, absorbs the heat of the motor components, and releases the heat at the top to the ambient air. This, of course, only applies if there are ventilation slots with a correspondingly large cross-section.

Use decentralized motor technology with integrated electronics. Thus, the heat loss of the motor electronics is generated in a decentralized manner and is distributed in machines and not concentrated in a control cabinet. Compared to continuous rain: If a large amount of water rains on a spot, it drains off much slower than if it was distributed over many areas.

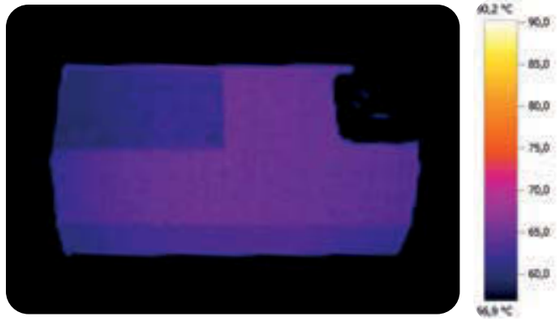
If you take all these points into account, your motor will keep cool. But what if the drives are unexpectedly overloaded, for example due to wear in the machine or incorrect operation? The motor solution must be prepared for these cases. Modern smart motors and drives work with algorithms that not only take into account the motor temperature, but also calculate in advance, based on the current load, how long the motor can continue to run until it overheats, and limit the output power beforehand.

You should therefore also check the status information, that can be read out cyclically via the bus interface of the motor. If the temperature or currents change significantly compared to the previous cycles, these can be an indicator of pending defects. Dunkermotoren has been manufacturing fully integrated smart motors for about 20 years and has extensive experience with sophisticated thermal design. This not only applies to the heat dissipation in the application, it also begins inside the motor. The optimized heat flow in the motor housing ensures an optimized heat transportation to the housing surface and that the temperature-critical components operate within the non-critical range.

The application consultancy provided by Dunkermotoren helps customers with the thermal design of the motors, to avoid overheating even under extreme conditions. After all, customers do not want to jeopardize the quarterly results, but rather work with reliable motors.



Drive thermally insulated



Flange directly connected

Author: Michael Burgert, Product Manager Brushless DC Motors

ENGINEERING

ENGINEERING

PERFORMANCE INCREASE WITH DC MOTORS

GR 80 WEARS THE DRESS OF A BLACK LEOPARD

The sun goes down over the savannah and the heat of the day gives way to bearable evening temperatures. Now it is time for the black leopard at the foot of Kilimanjaro to hunt. In order to get the best pieces, the terrain has to be changed. The way leads steeply up and in a 20-minute endurance run the slope is climbed. In order not to lose any time, he does this with twice his normal performance. His black fur helps him to radiate the warmth and not to overheat in spite of high performance. Arrived in the proximity of the loot, he now has got to feel himself cautiously ahead. As quietly as the leopard moves forward, so quietly purrs the brush apparatus of the noise-optimized GR 80. The velvety-soft running ball bearings establish contact with the fixed world. The electromagnetic radiation is not perceptible to the environment thanks to the integrated interference filter. This, coupled with the black coloring, makes the camouflage of the attacker perfect and the prey almost without chance.

The GR 80, which has been successfully placed on the market for years, will in future have a black housing. The black coating significantly improves heat dissipation and the surface's resistance to environmental influences.

In fact, the GR 80 can be operated for a long time at doubled or even higher moments. How can that be? The enormously high thermal time constant (Tth), which is 39 minutes for the GR 80x80, makes this possible. The GR 80 is therefore extremely overload resistant, which is further enhanced by the black coating. The heat radiation is improved in such a way that approx. 10% higher continuous torques can be called up. The high thermal overload capacity benefits the GR 80 in various applications. Imagine a sliding door at a subway station near the city center in a large city. At peak times, the sliding door has to open and close constantly.

The motor must provide maximum power, which is effectively (M_{eff}) far above what it provides in nominal power (M_N). With the simplified formula for calculating the effective value from the individual load sections, the moment with which the motor is thermally loaded can be determined.

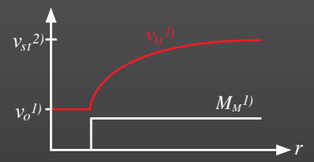
ENGINEERING

$$M_{eff} = \sqrt{\frac{M_{M1}^2 \cdot T_I + M_{MII}^2 \cdot T_{II} + M_{MIII}^2 \cdot T_{III} + \cdots}{T_I + T_{II} + T_{III} \cdots}}$$

To find out how long you can drive the $M_{eff} = 2 \cdot M_N$ you have to include the thermal time constant T_{th}.

Basically, the following applies: When the motor is loaded, its temperature rises with a time delay. The time delay is determined by the thermal time constant of the motor.

Excerpt from the formula collection of Dunkermotoren:



ϑ_o: Ambient temperature
ϑ_{st}: Stationary end temperature

Engine temperature $\vartheta_M = \vartheta_o + \vartheta_{ov} \left[1 - e^{-\frac{t}{T_{th}}}\right]$

After $t = 3 \cdot T_{th}$ the motor has reached 95% of its stationary overtemperature

ϑ_{ov}: Overtemperature
T_{th}: Thermal time constant of the motor

It can be downloaded for free at:
https://www.dunkermotoren.com/en/knowledge/publications/handbook-for-selection-of-motors/

In the example, the motor is started at a temperature corresponding to the environment with $\vartheta = 20°C$. How long can it now be operated with an effective load being twice the nominal torque? The calculation can be approximated as follows:

$$t_{max} = M_N / M_{eff} \cdot T_{th} \, (39 \; min) = 20 \; min.$$

The black power pack does not run out of breath even during this effort, and the great thing about it is that due to its low-noise design it does not attract unpleasant attention and retains its "camouflage".

The characteristic low-noise design of the GR series, in addition to its robust design and high reliability, is responsible for the fact that the GR 80 is increasingly being used in medical technology. In the meantime, more than 30% of the GR 80 produced goes into this market segment. It purrs effortlessly in applications such as patient couches (X-ray machines, CRT and MRT) as well as in rehabilitation machines. We see pumps in operating tables, massage rollers and actuators as further applications in the medical field.

Do not hesitate to use the GR 80 in your application using its overload capability. In this way, cost-effective compact motor solutions can be implemented.

Author: Stefan Tröndle, Product Manager Brushed Motors and Gearboxes

ENGINEERING

THE MOST IMPORTANT MINOR MATTER IN THE WORLD OF MOTOR TECHNOLOGY: ACCESSORIES

FROM TIME TO TIME IT IS IMPORTANT TO PUT THINGS OUT OF THEIR SHADOWY EXISTENCE INTO THE SPOTLIGHT TO GIVE THEM THE DESERVED IMPORTANCE.

Brake discs are one such example. In a car, the focus is usually on the engine, rims or the latest electronic gadgets, but not on the brake discs. But these are among the most important parts in the vehicle.

The situation is similar with the motor technology accessories for Dunkermotoren motors. It is indispensable for the function of a motor but rarely mentioned. All accessories for electric motors and complete motor solutions must meet at least the same requirements as the motors themselves, sometimes even higher.

For example, many customers need to be able to move a cable back and forth millions of times in a drag chain without even breaking a single wire. Since other customers may use the same cable outdoors, it must withstand environmental stresses such as extreme heat, cold, snow, ice and continuous rain throughout its service life.

Protective covers covering the rear ball bearing must be completely waterproof, space saving, corrosion resistant, very thin and easy to install. At the same time, they must fit so tightly that they do not lose their sealing effect even under the toughest conditions, such as in an agricultural machine. Here it is not enough to use a cover and a seal off the rack. Even with such a supposedly simple component, experience in design and testing is absolutely essential.

Customers of Dunkermotoren can also place high standards on completely different accessories: Starter kits for commissioning. Here, requirements for special environmental conditions are not likely to be met. Smooth operation is more important with these accessories, as they are required for service and commissioning. Every minute counts here. Delays cost money and nerves. Starter kits, usually consisting of a connection adapter to a commissioning computer with corresponding software, must therefore be easy to operate, function reliably and thus contribute to customers not having to deal with complex wiring and programming.

Dunkermotoren accessories are intensively qualified and undergo many practical tests until they can finally be included in the Dunkermotoren portfolio. In the complete catalog, on the last pages, they lead a shadowy existence, as if they didn't want to steal the show from the electric motors and gearboxes. In fact, these hidden heroes would deserve a place on the front page!

Author: Michael Burgert, Product Manager Brushless DC Motors

SEGMENT - AGRICULTURE

SMART & EFFICIENT - TREND-SETTING ELECTRIC MOTORS FOR AGRICULTURAL TECHNOLOGY

Dunkermotoren is the world market leader for BLDC motors with integrated electronics. For decades, the company has been known for its robust and intelligent electric motor solutions. According to this year's slogan at Agritechnica 2019 in Hanover, "Global Farming - Local Responsibility", Dunkermotoren is presenting efficient motor solutions for resource-saving agricultural applications.

Electric BLDC motors are more and more replacing hydraulic drives in agricultural plant and machinery. This development requires the use of smart electric motors with CANopen or Ethernet communication interfaces. Developments towards increasing networking, cloud-based platforms and decentralization of computing power are generating completely new possibilities for manufacturers of agricultural technology. With the data provided by the motor, an analysis can be performed which ends up in the possibility to execute tasks autonomously.

The BLDC motors with integrated electronics are therefore an essential part of SMART FARMING philosophy and enable resource-saving operation in agricultural applications. The heart of an intelligent brushless DC motor is the electronics. The controller is completely integrated into the motor, thus relieving or simplifying the customer's electronics. In addition to controlling the motor, the electronics can also perform tasks such as data monitoring. This enables precise evaluation of the movement. In addition, previously defined events can be monitored by the motor electronics, such as an increase in friction or wear. In this way, deviations are detected immediately, and preventative measures can be taken to avoid downtimes. Actual values in the field can thus be analyzed easily and conveniently. Due to the high-power density, comparatively small electric motors with a high degree of efficiency can be used, whose energy requirement is correspondingly low. This not only reduces fuel consumption, but also relieves the strain on the on-board power supply, which is in many cases exhausted.

Dunkermotoren developed the Motor Control Platform based on the modular approach, which enables

SEGMENT - AGRICULTURE

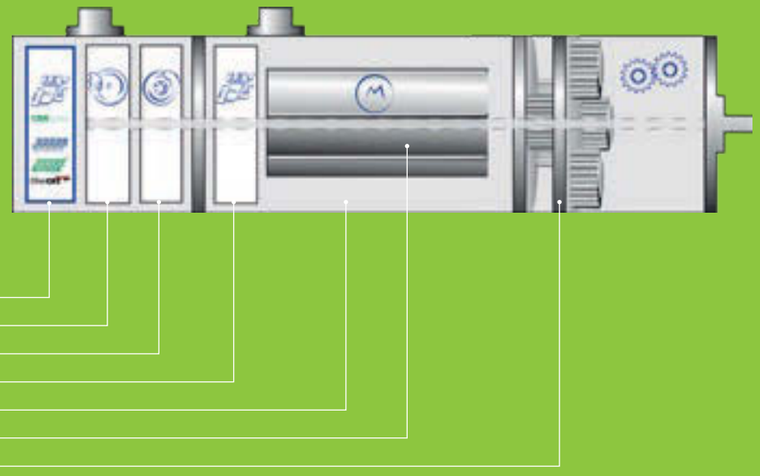
flexible configuration of the electronics according to functional requirements such as speed, positioning and current control operation. Control via CANopen or Industrial Ethernet interfaces is possible.

The integration of the electronics in the motor housing protects the electronics from environmental influences. Due to the robust design with a solid steel or aluminum housing and optional paint or coating, the entire drive unit can achieve a protection class up to IP69K. The integration of the electronics results in less cabling and enables simple plug & play commissioning.

With an output power of up to 3.900 W at a possible 12 V DC to 325 V DC supply voltage, Dunkermotoren motors cover a wide range of agricultural applications.

In addition to brushed and brushless DC motors, the product portfolio also includes linear motors, gearboxes, encoders and brakes, that allow endless combination options within the modular system. No matter if used in a seed drill, maize chopper, fertilizer spreader, stable or milking robot - Dunkermotoren enables flexible, robust and trend-setting solutions.

Authors:
Markus Fechtig & Jan Maurath,
both Key Account Manager Motive
Janina Dietsche I Public Relations



SEGMENT - AGRICULTURE

FARMING ROBOT

Motors for farming robotics do not only have to be robust and efficient but also reqire the highest possible degree of intelligence. Brushless motors from Dunkermotoren offer complete scalability which can also ideally be adapted to the highest customer requirements.

SMART FARMING – INTELLIGENT AND EFFICIENT

MILKING ROBOT

Electric motor solutions for milking robots require a high positioning accuracy as well as the control options through various bus systems according to customer requirements. Dunkermotoren offers with brushless DC motors with integrated electronics the necessary variety in a compact housing.

ROBUST DESIGN, ACCURACY AND VARIABILITY

- High protection class - up to IP 65/ 67
- Maintenance-free design
- Shock and vibration according to EN 61373:1999
- Low Total Cost of Ownership
- Available with integrated CANopen interface for BLDC motors
- Wide range of gearbox ratios

FORAGE HARVESTER

In the field of forage harvesters, motor solutions from Dunkermotoren have been used for many years. They meet the highest demands on robust design. In addition to a very high protection class, the motors can also withstand the highest stresses due to shock and vibration.

SEEDER

Seed is an expensive and scarce resource, which must be used as efficiently as possible. By using precision air seeders the seeds can be precisely stored and thus the yield optimized. Dunkermotoren has already recognized this trend a few years ago and supplies speed-controlled DC motors, which meet the high field requirements to 100%.

PRODUCTS

PROFINET NOW ALSO AVAILABLE FOR LOW-VOLTAGE DC MOTORS

DUNKERMOTOREN – AN INNOVATIVE MANUFACTURER OF MOTOR TECHNOLOGY.

The reliability of Dunkermotoren motor solutions in the various applications is known on the market. This is the reason why Siemens also became aware of the products of Dunkermotoren. For the latest development in the field of drive controllers - the SIMATIC MICRO-DRIVE - the company was looking for a complementary motor portfolio that could set standards in the low-voltage sector. This was found with the BG series of Dunkermotoren. In combination with the modular system that Dunkermotoren has pursued from the very beginning, the standard catalog offers a multitude of combination options. This establishes a whole universe of drive solutions in the low-voltage sector for the developer of machine tools, strapping systems and format adjustments. Combined with the possibility of adapting both, the mechanical and the electrical interface to specific projects, almost every demand can be matched.

SIMATIC MICRO-DRIVE – THE SMART SOLUTION FOR THE INDUSTRY

The special feature the SIMATIC MICRO-DRIVE now offers the user is the "Plug and Play" solution. This is possible since the start of the project by the mechanical, electrical and thermal design of the drive shaft and with the help of the TIA Selection Tool. The coordinated components of the motor and the SIMATIC MICRO-DRIVE controller, combined with a patented file transfer, the controller is automatically set to a pre-set state after connecting it to the motor. This all can be processed by the TIA portal with operator guidance. Cumbersome drive tuning and parameterization of the control loops are hence a thing of the past. Under normal drive load conditions, the drive train can be put into operation immediately without any problems. Of course, it is still possible to optimize the parameterization itself. However, this will no longer be necessary in 80% of applications.

PRODUCTS

PRODUCTS

SIMATIC MICRO-DRIVE – THE TECHNOLOGY BEHIND IT

The advantage of the SIMATIC MICRO-DRIVES for users is, for sure, the self-parameterization of the system. This is realized using modern electronic components. A special single-turn absolute encoder reads out the commutation point for the drive and works as a high-resolution encoder system together with the controller. A patented data transmission system provides commutation and parameter data from the drive when the unit is switched on. The drive informs the controller in detail which nominal data the motor has and which parameters the gearbox and an optional brake have, as well as boundary parameters which must not be exceeded by the drive. Thus, the entire drive unit is protected from inadvertent incorrect parameterization. This makes commissioning easier for the user. In the next step, a multiturn encoder is planned as an extension, which will be available in future.

Combined with the modular system, the SIMATIC MICRO-DRIVE, thus, offers a versatile application landscape for simple standard commissioning.

SIMATIC MICRO-DRIVE – THE SAFETY DRIVE

In addition to simple commissioning, this powerful drive concept also offers further features that are becoming more and more important in mechanical engineering. This drive solution shows its strengths in the area of "functional safety". Due to the modular design of the controller in conjunction with the powerful drive, this solution is a must-have for the safety-conscious engineer.

In addition to the PROFIsafe secure communication standard offered by the controller, the following safety functions can be implemented:

- STO: Safe Torque Off
- SS1: Safe Stop 1
- SLT: Safely Limited Torque
- SLS: Safely Limited Speed
- SBC: Safe Brake Control
- SSM: Safety Speed Monitor

All these functions meet the performance requirements of SIL2 according to IEC 61508-1, Performance Level PL d according to IEC ISO 13849-1 and Safety Category Cat.3 according to IEC ISO 13849-1.

PRODUCTS

SIMATIC MICRO-DRIVE – THE QUICKLY AVAILABLE UNIT

In addition to product reliability, a short time-to-market cycle is necessary today. In order to obtain quickly presentable results, it is essential to be able to put the first test samples directly into operation. This is exactly what the drive combinations with SIMATIC MICRO-DRIVE do. Both, the controller and the motor solutions of Dunkermotoren can be ordered for sampling in small quantities for initial trials. Via personal contact or the Dunkermotoren website, you can obtain quick and valid information about the product. In the Dunkershop, up to five drives in more than 80 combinations of different power ranges can be ordered. Larger quantities can be ordered on request. We aim to deliver the desired solution within three working weeks. Selected motor solutions even in one week. It is then up to the customer whether the catalog solution is used, or whether the motor solution needs to be optimized for the application. In any case, trouble-free cooperation with the SIMATIC MICRO-DRIVE controller from Siemens is guaranteed.

DUNKERMOTOREN – THE OPTIMAL PARTNER FOR DRIVE TECHNOLOGY

In order to be able to optimally select a drive for a certain application, it is necessary to carefully calculate the application requirements in advance. In combination with the TIA Selection Tool from Siemens, there are further options available in addition to the personal advice from Dunkermotoren.

You can make a basic preselection with the support of the "Sizer" within the TIA Selection Tool. Simply enter your known boundary parameters for the application and the design tool will help you with the pre-selection. You can see exactly whether your drive selection is close to the limiting point or has some reserve. With a personal consultation, you can further optimize the design of your drive combination and take joint measures to help you with assembly. Adapted connector solutions or mechanical connections are just as possible as optimized motor and/ or gearbox design. With access to the entire drive portfolio, you can define the drive unit for your application precisely.

Author:
Matthias Tidelski, Segment Sales Manager Building Automation

PRODUCTS

MAY THE "POWER" BE WITH YOU …

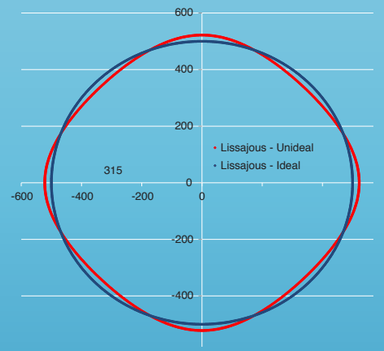
… could be the motto of the new SA 38 and SC 38 linear motor series from Dunkermotoren. In contrast to the similar saying ("May the force be with you") from Star Wars, this is a "real" product feature and not science fiction.

Due to the compact design of the linear motor, it only fits partially on the belt of a Jedi Knight and is rather suitable for use in high-performance machines. As in films, new ideas and solutions have to be created when the "normal" or standard version comes to its limits. In the blockbuster this is the invisible "force". With regard to the linear motor, it is new technical possibilities and feasibilities. Back to reality and performance of the new linear motor from Dunkermotoren.

How are linear movements implemented in devices and machines today?

Numerous linear applications, apart from simple point-to-point positioning which is the paradigm discipline of the pneumatic cylinder, are carried out by classical belt or spindle systems. The drive unit either consists of a stepper motor, a BLDC motor or a servo motor. This has been the state of the art for decades, but will it continue to be in the future? A direct linear motor of the ServoTube series has many technical advantages (integrated feedback system, maintenance-free plain bearings, high IP protection, low-noise movement, etc.), but ultimately cannot replace all conventional techniques. In which applications does the use of a linear motor make sense? This is quite easy to answer: In applications where belt or spindle applications reach their performance limits or where the advantages of both systems are required. On the one hand, the belt axes are highly dynamic, but not highly precise. The spindle axes, on the other hand, stand for high-precision positioning, but observe losses in the dynamic range. Thus, the application case of the direct drive is obvious: Fast and precise positioning with little or no maintenance. The SA 38 and SC 38 combine the disciplines of the sprinter (belt) and the weightlifter (spindle) in a single product.

The new 38 series with the three different overall lengths (3806, 3810 and 3814) differs technically from the previous version in almost all areas. Only the outer diameter of 38 mm of the thrust tube remained. All other parts of the engine have been completely revised. However, the successful engine concept of the actuator (SA 38xx with integrated plain bearing) and the component (SC 38xx) has been retained. Many customer requests have been collected over the last few years and have been incorporated into the new product. Greater power in a smaller space was one of the main requirements for a linear motor. A doubling of the peak force and continuous force, as well as almost identical outer dimensions are the result of the new development. This was achieved by adapting the housing, windings and magnetic characteristics. A larger number of magnets and higher quality magnets are the logical consequence. But this also changes the complete characteristics of the integrated SIN/ COS feedback system. The previous optimal sine and cosine and the resulting Lissajous circle (blue) are a thing of the past. The feedback signal changes to a rectangle with roundings (red).



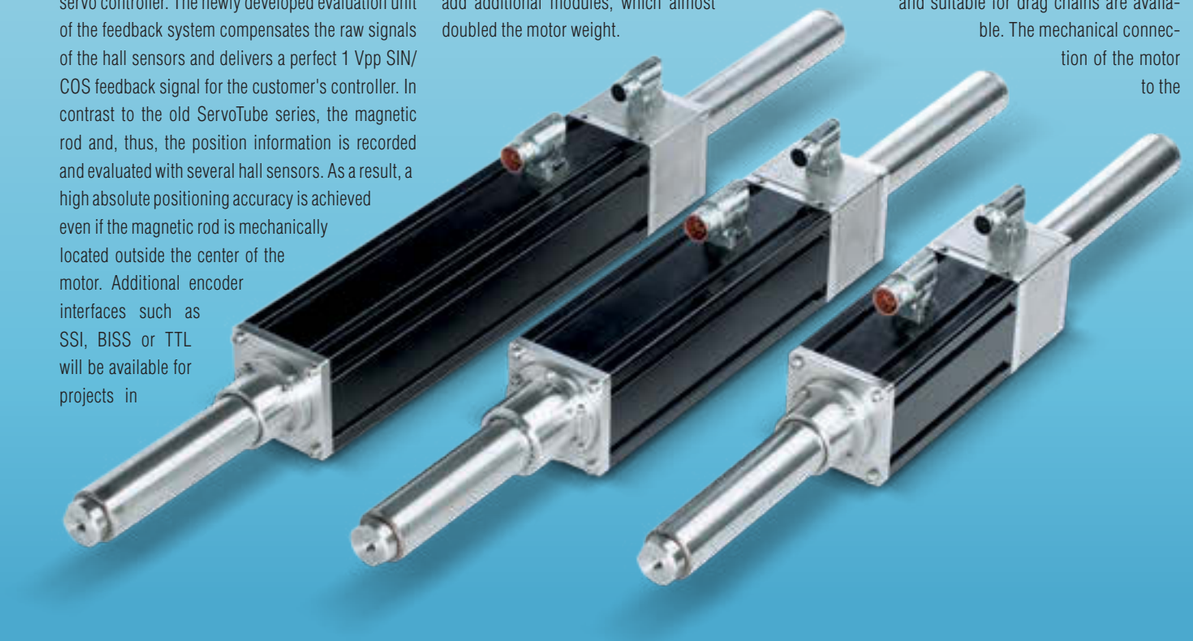
PRODUCTS

The feedback systems available on the market look similar. Special servo controllers and software logarithms are required to control a motor with this signal. But wouldn't it be advantageous for users to use their existing servo amplifier and simply adjust parameters? Does the user's controller concept have to be changed completely just because rotary servo motors are replaced by linear motors? Dunkermotoren's condition for the introduction of a linear series is to be able to operate it with a commercially available servo controller. The newly developed evaluation unit of the feedback system compensates the raw signals of the hall sensors and delivers a perfect 1 Vpp SIN/ COS feedback signal for the customer's controller. In contrast to the old ServoTube series, the magnetic rod and, thus, the position information is recorded and evaluated with several hall sensors. As a result, a high absolute positioning accuracy is achieved even if the magnetic rod is mechanically located outside the center of the motor. Additional encoder interfaces such as SSI, BISS or TTL will be available for projects in the future. Here, too, emphasis was placed on the modularity of the entire linear concept.

Should the motor ever start to "sweat", two cooling water connections are available on the engine. An additional heat sink is therefore no longer required, as the motor housing has internal cooling channels. In this compact design (80 mm x 80 mm), the new SA/ SC 38xx sets new standards for cooled linear motors. Until today, machine builders were forced to add additional modules, which almost doubled the motor weight.

Furthermore, the voltage range of the new series has been extended. The series can now also be operated with servo controllers which have connection voltages of 1x230 V AC, 3x400 V AC or 3x480 V AC.

The connection technology of the older linear series 25 and 38 with permanently attached cable has also been replaced by rotatable, industrially suitable angular connectors. For the motor phase and feedback connectors, connection cables of different lengths and suitable for drag chains are available. The mechanical connection of the motor to the machine takes place via the motor housing. The aluminium profile has slots on all sides for T-slot nuts. Last but not least, the maintenance-free plain bearing concept has been further improved over the years. The only component subject to wear on a SA 38 can now be easily replaced after thousands of kilometres of service.



With this new development and the technologies used in it, Dunkermotoren has succeeded in ensuring the bar-guided linear motor not only to be found in niche applications in the future, but will establish itself alongside the classic linear systems. In addition to the user requirements mentioned above, the design of the linear series has also been designed for modularity.

In contrast to the linear flatbed motor, the integration of a bar-guided linear motor into a machine is mechanically easier. Even if the magnetic rod is located outside the center of the motor, it retains its force constant due to the design.

Where will the new linear motor series be found in machines/ devices in the future? One of the main areas of application for the SA/ SC 3806, 3810 or 3814 will be high-speed applications in the food and packaging industries. Motor solutions used in the logistics sector are also reaching their technical limits due to the increasing online ordering behavior in the B2C sector.

Since Dunkermotoren has been a system supplier in motor technology for decades, it will not remain just a solo motor. Pick & place modules, complete linear axes and a version designed for the food industry will follow soon and facilitate system integration at the customer's site.

Finally, another parallel to the film can be made. In the end, it is usually the good ones that win - our linear motor will certainly bring good performance also to your machine.

Powerful, precise high-speed motor technology made in Germany!

Author: Matthias Utz, Product Manager Linear Systems

KEY-FACTS LINEAR MOTOR SA/ SC 38XX

Peak power:	3690 N
Continuous force (without water cooling):	308 N
Continuous force (with water cooling):	615 N
Maximum speed actuator:	6,3 m/s
Maximum speed component:	8,3 m/s
Hub Actuator:	450 mm
Max. Magnet bar length:	2000 mm
DC link voltage:	325 – 600 V DC
Protection class:	> IP 65
Integrated feedback system:	SIN/ COS 1Vss
Low noise	

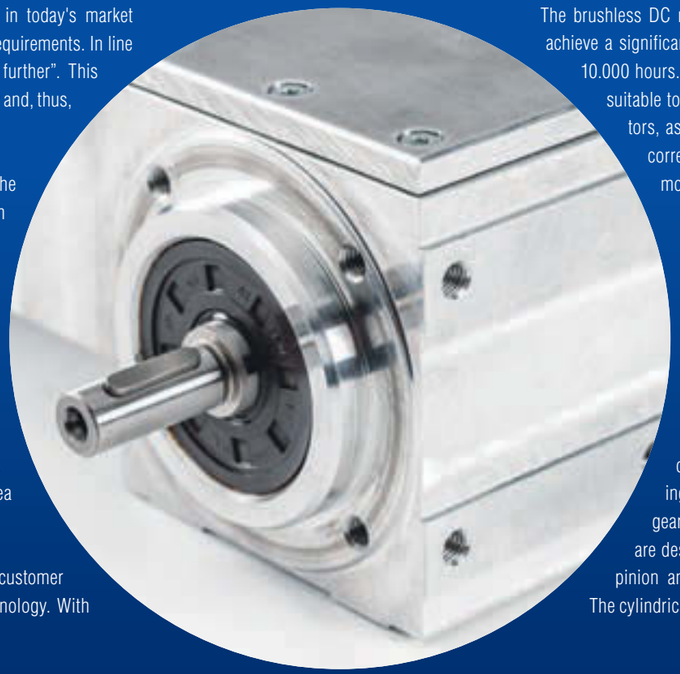
PRODUCTS

STG 65 – THE ANGULAR GEARBOX WITHOUT WEAR

Anyone who wants to survive in today's market needs to meet a wide range of requirements. In line with the motto "higher, faster, further". This also applies to motor technology and, thus, to Dunkermotoren.

In the field of motor technology, the goals which are in conflict with each other are: speed, torque, efficiency, service life and, of course, the price. A further important element of many industrial applications is motor solutions with intersecting axes, which in many cases facilitate mounting on machines and are also very space-saving. This is particularly true in the area of conveyor or door drives.

Dunkermotoren covers various customer areas in the field of motor technology. With brushed DC motors, customers are offered inexpensive and robust motors. The service life of these motors is limited by the brush technology. Most of these so-called GR motors are combined with the worm gearboxes developed in-house to form the overall drive.

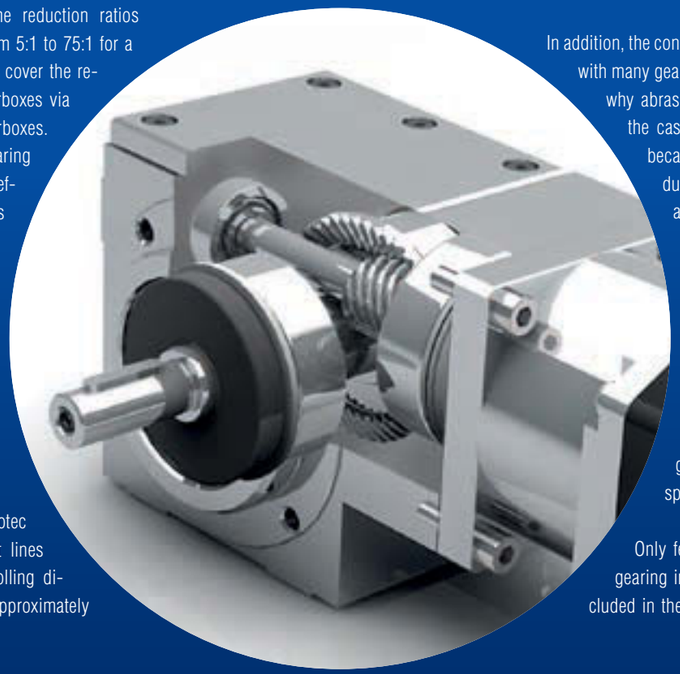


The brushless DC motors, known as BG motors, achieve a significantly longer service life of over 10.000 hours. The worm gearboxes are only suitable to a limited extent for these motors, as they are not designed for the corresponding service life of BG motors.

The ST gearbox with spirotec gearing is an angular gearbox developed for the long service life of BG motors. Further features of the spirotec gearbox are a high transmittable torque, a high robustness and a low-noise operation. The spirotec gearing is a special type of spiroid gearing in which the gearing parts are designed as a pairing of a helical pinion and a spiral-toothed ring gear. The cylindrical pinion allows free axial positioning, which is the basis for the greatly simplified assembly of the gear parts.

Compared to other angular gearboxes, the STG offers further advantages. The reduction ratios of the ST gearboxes range from 5:1 to 75:1 for a single-stage gearbox and thus cover the reduction range from bevel gearboxes via hypoid gearboxes to worm gearboxes. In addition, the spirotec gearing achieves a higher degree of efficiency than worm gearboxes with the same reduction ratio and similar installation space. The gearbox efficiency increases with decreasing reduction ratio and increasing speed up to total values of 90%. This is an outstanding value considering the installed radial shaft seals and bearings.

The special feature of the spirotec gearbox teeth are the contact lines running transversely to the rolling direction, which produce an approximately identical lubricating film thickness between pinion and ring gear during rolling. This makes it possible to install hardened steel pinions and ring gears without any risk of seizure. Worm gearboxes, in contrast, form much smaller lubricating films than spirotec gearboxes, i. e. they run, to a large extend, in the mixed friction area, which is a cause of wear.



In addition, the contact pattern must first be formed with many gearing systems. This is the reason why abrasion is unavoidable. This is not the case with the spirotec gear teeth, because the contact pattern is produced by the mathematically exact design. This means that the gearing is almost wear-free in the nominal load range and, as a consequence, has a particularly long service life. This also means that the spirotec gearbox can be lubricated for life without any problems. The great advantage is that the gearbox is maintenance-free despite its long service life.

Only few suppliers have this spirotec gearing in their portfolio, as it is not included in the numerous standards for gear-

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ing. The basis for the development of this gear type was a close cooperation with gear suppliers and several dissertations. Based on this information, the gearing was designed and both, suitable cutters for pinion and ring gear, as well as the necessary measurement and test specifications were created.

The elaborate development of this type of gearing has paid off, as the subsequent production of the gearing parts takes place on conventional gearing machines. Only slightly modified hob cutters are used instead of expensive cutter heads such as those used for bevel gears.

The spirotec gearbox is available in size 65. The STG 65 is the first Dunkermotoren gearbox to be equipped with oil lubrication.

At Dunkermotoren, gearboxes are tested for service life on specially developed test benches. In the test, they are operated permanently at nominal load and the required acceleration torque is also tested each time the motor is started. The gearboxes are tested in continuous operation S1 as well as in alternating intermittent operation S8.

Within the framework of the validation, which was completed in 2015, the end of life of the STG 65 had not yet been reached. At that time, the service life in the validation for the nominal operating point was 10.000 h. However, the continuation of these tests showed that the service life is much longer than expected. The tests were finally completed with a service life of more than 22.000 hours, whereby the gearboxes were still fully functional. The gear parts were evaluated after the dismantling of the tests and no wear was detectable. Only a minimal smoothing can be seen on the tooth flanks. The advantages of oil lubrication were compared in the STG 65 with grease lubrication in service life tests. In the tests with grease lubrication, significantly shorter service lives were achieved, whereby the lubricating effect of the grease failed completely, and the gear parts were worn out. The motor solution of a BG Motor and STG is therefore suitable for a particularly long service life in applications with intersecting axes.

Another positive aspect is the low heating of the gearbox. In rated operation, the temperatures are in the range of approx. 55°C, at an ambient temperature of 20°C. The latest test results show that the STG 65 can be subjected to even higher loads than previously specified. For this reason, further tests have been started, testing the gearboxes with an increased torque. However, the first interim evaluations of the gearboxes in the test show that even with these increased values, long service lives can be achieved.

It is interesting to note that the gearbox can also be purchased as a single product and not only in combination with Dunkermotoren motors. Due to the claw coupling used, it can be mounted on a wide variety of motors.

So far, the ST gearboxes are available with the following reduction ratios: i = 5:1, i = 10:1, i = 25:1. The gearboxes have a standard protection class of IP 54 and are shock and vibration resistant according to DIN EN 61373.

Authors: Benjamin Maier & Tim Kiefer, both R&D Department Gears

PRODUCTS

A MOTOR AS QUIET AND EFFICIENT AS A MOTOR CAN BE – THE BGA 22

Do you like to watch music videos, preferably from live concerts? Then it is easy for you to put yourselves into the following scenario. The concert recording is playing, the tension rises before the next piece, everything is quiet, only a buzzing breaks the silence and disturbs the listener sensitively!

What has happened? The motor driving the camera focusing wheel was picked up by a microphone close to the camera. That's annoying, but there is a solution - using the BGA 22 as a motor! Professional cameras require a lot of effort to ensure that the recordings are not disturbed by background noises. In practice, the camera focusing wheel is driven by the BGA 22, which is not locked in place and has prevailed over the concepts of other motor manufacturers. The smooth running of the BGA 22 can only be understood when you have experienced it.

With the advent of drones, cameras learned how to fly. Flying cameras are powered by accumulators. In order to keep them as small and light as possible, the motors are designed for a high power-to-weight ratio and good efficiency. The BGA 22 fully meets both requirements.

Other differentiating features of the BGA 22 include its very high overload capability and the resulting power density. Therefore, the spectrum of applications is huge. Other typical applications are for example:

- Grippers for robotics. Sensitive to powerful, everything is held securely, from sensitive material that has to be handled kids gloves to high-speed movements in which the component must not move.
- Automatic placement machines in the electronics industry in which electronics need to be swivelled and stacked.
- Gantries (portal robots for taking samples) run around the clock in the medical technology sector "Analysis". Durable, reliable motor technology is a must here.
- In the medical technology sector "Therapy" with hand-held devices.
- In the luxury segment to move doors and hangings.

All this is becoming possible by the impressive technical data of the BGA 22:

- Continuous torque (thermally decoupled) 20 mNm
- Continuous torque (thermally contacted) 30 mNm
- Short-term torque 80 mNm
- Power-to-weight ratio 308 mNm/ kg
- Efficiency up to 80%
- Speed range up to 16.000 rpm

Order a sample copy – on loan if you wish – and become an "ear witness"!

Author: Stefan Tröndle, Product Manager Brushed Motors and Gearboxes

FUTURE

SAVE THE DATE – FUTURE NOW! SMART, CONNECTED & EFFICIENT

For the first time, Dunkermotoren arranges a two-day symposium in June 2020, on the topic "Future now! Smart, connected & efficient". From 17th to 18th June 2020, the focus will be on forward-looking automation concepts, from industrial communication to edge and cloud computing to IIoT ecosystems, artificial intelligence and energy efficiency.

Venue: Öschberghof Donaueschingen

17TH & 18TH JUNE 2020
Öschberghof Donaueschingen

FUTURE NOW! SMART, CONNECTED & EFFICIENT.

The symposium
for technology strategists.

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NEW 2019
BG 65/66 dMove
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BG 65 dMove compared to BG 65 SI
OOOH! $$$
Cost-effective Servo Technology
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CANopen already in basis version

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