Velocity
Customer Newsletter for Industrial Systems

Bharat Bijlee

Customer Newsletter | Issue 10 | October 2021

Enabling Productivity, Precision and Energy Efficiency

75 years of experience

4 million motors

10,000 servo solutions

30,000 gearless machines for elevators

Editor's Note

Looking back at the evolution of the variable frequency drive (VFD), one sees a quantum transformation. The VFD first appeared in the 1950s and adopted various technologies, from current source inverter to voltage source inverter. Voltage source inverters began with analog six-step technology and then Pulse Width Modulation (PWM) with various control modes arrived to improve efficiency and reduce size.

Technology evolves every day, and today's VFDs with IGBT/ IPMs boast efficiency levels as high as 98.5%. Simultaneously, general purpose VFDs have become ubiquitous, low-cost, and almost generic, often falling outside Standards like those defined for motors. There are welcome moves now within industry to change this. It is also high time that VFDs are specified and evaluated based on technology and benefits rather than only initial cost.

VFDs that control permanent magnet (PM) servo motors are referred to as Servo Drives. These deliver high precision, fast dynamic response and fine positional accuracy, and usually deploy a feedback system (closed loop) using an encoder or resolver on the motor.

But encoder-based systems have disadvantages: they are more expensive, and vulnerability to harsh environments and long cable lengths can impair reliability. Our partners, KEB, have a unique solution that offers the best of both worlds.

Through an algorithm that precisely models the rotor, KEB's Sensorless Closed Loop (SCL) control technology provides precise torque and speed regulation without input from a feedback device. For many applications this offers performance close to closed-loop control but without using a resolver or encoder. World over, customers have benefited from SCL in applications like injection moulding machines, air compressors, high-speed spindles, textile machinery and others.

Bharat Bijlee's SynchroTorq® servo motors in the range 50 Nm to 145 Nm, along with KEB servo drives, are available for various applications in the plastics, metal, paper and textile sectors. The range will progressively be extended up to 280 Nm.

Last week we formally launched our range of SCL servo solutions using these motors and KEB drives. These SCL solutions perfectly suit many applications with high torque operation, notably extruders or injection moulders for the plastic industry; the motor identification model allows the SCL to provide very precise torque control.

You can read more about this in this issue of Velocity. Please give us your feedback and questions. We would be happy to explain and demonstrate the solution to you in detail. You can reach me at bhadresh.dani@bharatbijlee.com

Bhadresh Dani
VP - Drives & Automation

Case Study

4 Key Factors to Consider When Sizing Servo Motors

In the last issue, we examined advantages and application fits for SCL control, especially relevant for our new SCL servo range. We now bring you another informative case study on the challenges faced in sizing servo motors. Reproduced from the Technology Blog of our partners KEB Automation, this case study examines four key factors that are imperative to making a choice that will fit your application.

Written by Jeff Kardell of KEB America, the complete case study was originally published here:
https://www.kebamerica.com/blog/sizing-servo-motors-factors-to-consider/

The ability to size servo motors correctly is imperative for motion-controlled applications, and it can be much more involved than sizing AC induction motors. Acceleration, deceleration, and running torque must still be taken into account, but the servo's ability to dynamically control the load's speed and position is also important. During acceleration and deceleration, peak and nominal running torque measurements must be calculated to ensure that the servo motor does not overheat during use. In addition, inertia matching between the motor and load is necessary to ensure optimum response and system performance.

In this post, we will be examining these keys factors, as well as how KEB can provide a solution to your motion control needs. Four key servo selection factors I will be detailing are:

- Inertia matching
- Speed and torque profiles
- Speed-torque curves
- RMS torque

While there are other factors to keep in mind for your application, these four are most critical when accurately sizing servo motors.

Inertia Matching

Inertia matching refers to the system inertia. Specifically, the ratio between the inertia of the load and the motor. This formula definition is below:

$$\text{Inertia Ratio} = \frac{J_L}{J_M}$$

J_L = inertia of load reflected to motor
J_M = inertia of motor/rotor

The moment of inertia is a measurement of how difficult it is to change the rotating velocity of that object or system. The JM (inertia of motor/rotor) should be supplied by the motor manufacturer. KEB's servo motor data are found on the KEB Drive software, which is a program that aids in choosing motors and gearboxes. JL (load inertia) consists of all components in the system moved by the motor. This ratio between the motor and load is important when selecting servo motors, but the following must be considered:

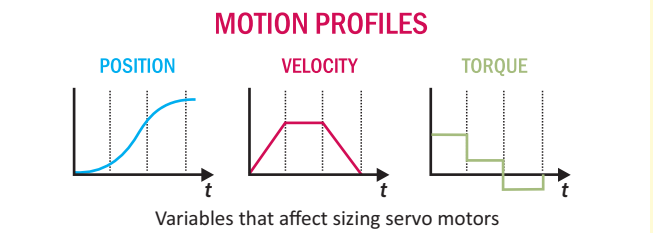
- Performance of the motor improves as the inertia ratio decreases
- Control loop tuning and machine performance improves as the inertia ratio decreases
- A motor with too low of an inertia ratio will be more expensive and have little to no performance improvement
- System inertia ratios should be designed for a max of 10:1 but are typically 5:1 for ideal performance

When choosing and calculating an inertia ratio, find the smallest motor that has the ability to provide the speed and torque necessary for your application. If you are finding it difficult to obtain a ratio that works, keep in mind that KEB has the ability to add additional motor inertia. Also consider that many motor manufacturers offer different servo series with different inertias. For example, there might be a product line with a "low inertia" and another with a "medium inertia".

Speed and Torque Profile

Speed and torque profiles are additional critical elements in choosing a servo motor. While the motors capability is described by the speed-torque curve (see below), the application requirements are best illustrated using the speed and torque profile. Depending on the application, there are different speed and torque requirements that the motor will need to meet.

Below is a graphical representation of a linear application with a servo motor. The speed profile is a graphical representation of acceleration, constant speed, and deceleration as the payload reaches its destination. As you can see by the torque profile, the maximum amounts of torque occur during acceleration. When the machine starts, the motor must overcome the mechanical friction while accelerating the load from rest. Once acceleration is complete, a nominal torque is output by the motor to maintain speed and overcome the friction. The decelerating point in the profile is still associated with high torque, but the friction also aids in stopping the load.



Variables that affect sizing servo motors

Case Study

It is important to ensure that the motor can produce the required maximum torque at the application speed. This ideally falls within the intermittent region of the motors speed-torque curve, so it is not oversized.

RMS Torque

RMS torque is the time-weighted average of the torque during a complete machine cycle (steady state). In order to size your motor correctly and prevent overheating, this RMS torque will need to fall within the continuous region of the speed-torque curve. For example, a servo motor with 4 N·m of RMS torque will experience the same heat rise if it produced 4 N·m of constant torque. Therefore, as long as 4 N·m is in the continuous region of your speed-torque profile, the motor will not overheat.

Speed-Torque Curves

Motor speed-torque curves are essential when selecting and sizing servos. In order to prevent the motor from overheating during use, ensure that the motor has the specific capabilities required for your application. These curves ensure that the required torques and speeds, whether continuous or intermittent, can be produced with the servo motor you choose. By examining the speed and torque profiles and computing the RMS torque, you can now look towards speed-torque curves of specific motors and see if they will fit your application.

Let us look at the image alongside to provide additional insight on speed-torque curves. This is an image from our KEB Drive software, which will be sure to help you when you are deciding if your servo motor is a valid choice for your application. This specific image is for our TA3S servo motor.

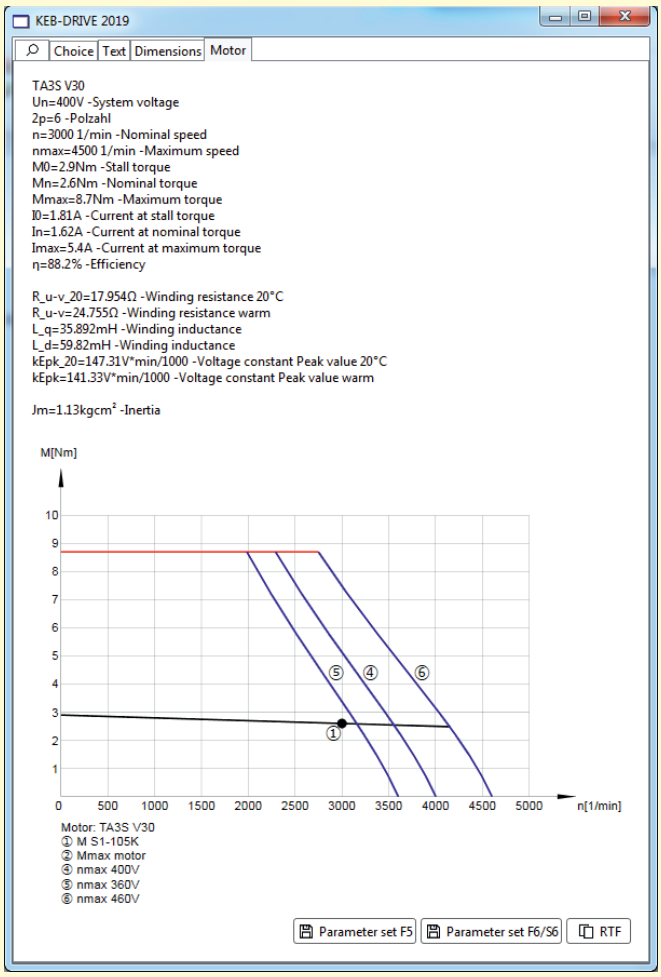
In the image, the blue lines represent the maximum speed/torque based on various input voltages. For this example, we will look at only one input voltage curve, 460 VAC (6). The region below the S1 line up until line 6 indicates the continuous running region. In this region, the servo motor is capable of running at the corresponding speed and torque values without overheating. Above the S1 line (1) lies the intermittent operation region. In this region, the servo motor can operate for a small amount of time based on the overall RMS torque of the system.

With the input voltage of 460 VAC, the TA3S can reach full peak torque (8.7 N·m) at speeds up to 2750 rpm. This is assuming no losses in the drive and that the full 460V is available. If the inverter were to have an input reactor on the input, there would be a slight voltage drop at the input to the drive, which would shift the blue curve to the left.

As the speed increases, the available torque starts to drop. If you determine application needs of 4 N·m of torque at 3500 rpm, using 460 VAC would allow you to reach this torque level on an intermittent basis. However, with a 400 VAC input, you would not have sufficient voltage to reach this speed and torque.

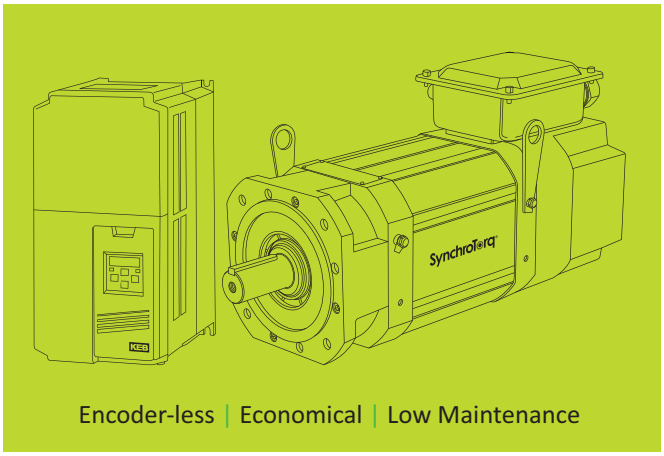
For continuous operation (rated torque), the required voltage difference is less, so we can reach higher speeds before we enter the field weakening range. With a 460 VAC input, we can achieve continuous rated torque (S1) out to about 4200 rpm.

An important point to remember when using speed-torque curves is to check the input voltage the motor will be operating at and ensure that the motor will run successfully in either the continuous or the intermittent regions.



KEB-Drive software includes servo torque/speed curves

New Servo Solution for Plastic IMM



Encoder-less | Economical | Low Maintenance

We are excited to bring you our newest offering, a compact 2000 RPM servo solution for Plastic Injection Moulding Machines. It combines KEB Drives and Sensorless Closed Loop (SCL) technology with our SynchroTorq® Servo Motors.

Bharat Bijlee's servo solutions with KEB drives for the plastics industry have a proven record of outstanding torque and speed control. They use resolver feedback for superior positioning accuracy in a highly dynamic operation. However, in some high torque applications like extruders and injection moulders, the costly and vulnerable feedback devices can be eliminated without compromising performance.

When economy is as important as reliability, KEB's Sensorless Closed Loop (SCL) technology becomes an ideal choice. Our new SCL servo solution using the SynchroTorq® servo motor range fulfils these twin objectives - along with precise torque control and dynamic response.

Going forward, we will progressively widen the available range of torque ratings.

To know more, download the catalogue or speak with our experts today!

Universal Motor Test Bench for comprehensive testing

Our new SCADA-based Universal Test Bench now enables us to thoroughly test motors for a multitude of load cycles and application conditions.

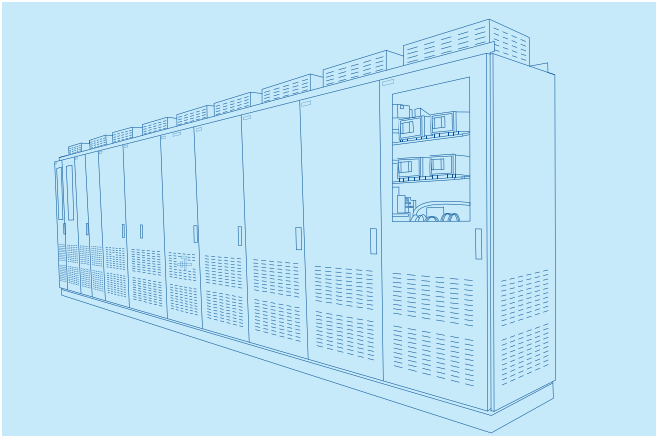
The fully automated and parameterised system can be configured to simulate loading patterns for any application (e.g. plastic IMM, elevator, or pick and place) by accurately programming the load cycle. This allows testing to replicate the harshest operating cycles before validating designs and releasing the product. This can reduce lengthy field trials and enables 'first time right' development. The system will also be used for type-testing not only new designs of special motors but of motor-driven solutions with drives. By simulating the customer's actual application cycle, we can also ensure that we offer an optimal product or solution.

Use of an Active Front End (AFE) system makes the test bench energy efficient; energy used for loading is regenerated back to mains, and only the energy corresponding to system losses like friction is drawn from the mains.

As test data is stored and readily retrievable from the system, reports can be generated on demand, and we will build up an invaluable library of digital application profiles.

An in-process enhancement is a "Zoom In" feature for data capture at 10 msec intervals. By positioning this window anywhere in the profile there is magnification of key parameters like current, torque etc. These micro-details, captured in the main controller, will aid deeper analysis of product behaviour.

The universal motor test bench ensures that we bring products of the highest quality standards to our customers.



Partner Spotlight

Ajay Grover
Proprietor
M/S Gurusabh Power
Delhi

Delhi-based Gurusabh Power was incorporated in 2002, however its proprietor Ajay Grover had been associated with the Motors industry since 1989. His strong business relationships with engineering OEMs and end-users in north India led to the inception of Gurusabh Power, with the vision to provide electrical solutions to customers.

Motors and gearboxes are the primary products Gurusabh deals in. They cater to various industry segments, including HVAC, surface grinders, food and packaging.

Bharat Bijlee's association with Gurusabh Power began in 2010. It led to the development of some key OEMs of brake and standard motors in the region. According to Ajay, "Bharat Bijlee's superior quality of products appealed to us and we decided to forge a business association. The continuous support they have provided us over the years has brought us to where we are today".

With its decade-long association with BB, Gurusabh Power continues in its quest to reach every segment in the region and strengthen the BB brand in the NR market. With support from BB, Gurusabh hopes to maintain its growth in the years to come.

B Shakthivel
Director
M/S Essen Indpro Pvt. Ltd.
Bangalore

Bangalore-based Essen Indpro Private Limited was incorporated in 1998, under the leadership of its Directors, B Shakthivel and K Nagi Reddy. It was founded with the objective of becoming a leading distributor for industrial automation products.

The company primarily focusses on HVAC, pollution controls, agitators, sewage treatment plants, blowers and OEMs. They supply various automation products in these industries, including Bharat Bijlee's servo motors and drives.

Their association with BB began in 1998, and according to Shakthivel the reason behind the success of this two-decade old partnership is the trust BB has earned in the market. In their long association, Shakthivel and his team have witnessed many changes in BB. In his words, "Bharat Bijlee is well-known in the industry for quality. The brand is also widely regarded in various industry sectors. They have a wide range of products, and ensure continued development and technology upgrade, thus maintaining their strong position in the market".

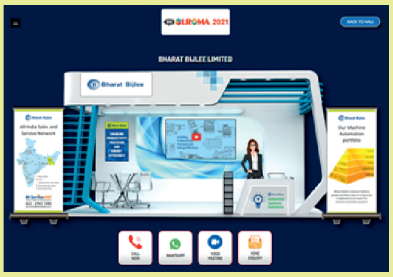
With BB's support, Essen Indpro aims to achieve a milestone turnover of Rs 10 crore soon.

BB in the News

Our motors are powering the Smog Towers launched by the GoI and Delhi Government to counter chronic air pollution in Delhi. The first tower at Connaught Place was inaugurated by Chief Minister Arvind Kejriwal on August 23rd 2021. A second tower will be installed at Anand Vihar.

We have supplied 84 nos. 22kW/6 pole IE2 motors for this prestigious project. The towers are fitted with axial fans of FläktGroup India Private Limited which are driven by BB motors.

Our MD, Nakul Mehta was interviewed in the Q3 2021 issue of Elevator World India magazine. On the occasion of our 75th year anniversary, Mr Mehta reflected on the company's journey, our contribution to the elevator industry and future plans. Do read the **full interview** on our LinkedIn page.



We were Platinum sponsors of the 10th edition of IEEMA's ELROMA Conference & Expo on Electrical Rotating Machines, Drives and Applications held from September 6th to 8th, 2021.

Our Motors, Drives & Automation and MTM divisions participated in the exhibition where they together showcased our range of products and services for Industrial Systems at our virtual booth. Please **view here** the animation we created on our Industrial Systems Solutions (ISS) portfolio and credentials for the expo. Our booth attracted hundreds of visitors and garnered great response.

At the conference, Salil Kumar - Sr. GM, Design, Motors, chaired a session on 'Advances in Materials & Manufacturing' and Amogh Gharat - Sr. GM, Engineering & Product Promotion, Drives & Automation, presented a paper titled 'IIoT solution for Injection Moulding Machine', which was very well-received by the attendees.

Sunil Mistry, VP - Motors, was interviewed by The Industry Outlook magazine for their special annual issue in the month of July focusing on the Electric Motor segment.

In the interview, Mr Mistry shared his views on the evolving market of electric motors, the need for energy efficiency, challenges in ensuring quality and achieving sustainability. To read the full interview **click here**.