

# Technical Article



## Avoiding Common Pitfalls When Selecting & Integrating Linear Modules

Fully integrated linear modules provide a versatile and cost-effective solution for many linear transport requirements and applications. Whether for Cartesian robots, pick and place or linear motion and transport systems in or between machines, complete, pre-engineered linear modules are an essential and very effective component of many of today's high-speed automation and material handling systems. These Tech Tips can help you avoid some of the common technical and operational pitfalls that can occur when selecting and integrating linear modules.

- 1. Make sure not to oversize or undersize linear modules based on technical characteristics, such as load and speeds.**

The most common mistake made when specifying pre-engineered linear modules is not sizing them correctly for long-term use. Too often, purchasers will determine the standard speed or load capacity of the system they are building, then select a module whose maximum speed or load is that same number. This leads to undersizing the module, which impacts performance in a number of ways.

Undersizing can lead to multiple modes of failure. For example, a bearing failure, or pitting and brinelling of the ball bearings and raceways, which can increase friction and heat, leading to increased wear on the bearing; the more material that's removed from the bearing, the more that material gets stuck in the bearing return, causing failure. And if the linear module is undersized for the load it's carrying, that can also void a manufacturer's warranty.

The alternative to undersizing is oversizing – selecting a module that has much more carrying or speed capacity than your application requires. While this can be safer, it's a more costly solution than is actually needed. By working with linear module suppliers who provide high-quality, easy-to-use sizing software, you can be certain that the linear module you select will be sized to precisely fit your application.

## **2. Avoid over-specifying performance criteria.**

Searching for and selecting linear modules based on overly precise performance criteria can lead to selecting linear modules that are more expensive and complex to work with than is absolutely necessary. For example, some linear modules are available in both steel housings and aluminum extrusion housings for the guide into the drive system. The steel housing is much more rigid, but also has higher costs; if the load the module is carrying isn't high enough to cause deflection during the motion sequence, then an aluminum housing may be the right solution.

There are a number of mechanical drive elements used in linear modules, including linear motors and rack and pinion. The two most widely used mechanical drives are belt drives and ball screw drives. Ball screw drives work best for applications that require a high degree of end-point accuracy and repeatability, as well as carrying or moving loads vertically. For example, Bosch Rexroth's MKK Linear Ball Screw modules provide end-point accuracy as tight as 52 microns, and repeatability of 5.2 microns as a standard, but higher if needed.

But if the particular motion requirements in a machine or system such as a Cartesian robot does not require that kind of end-point accuracy,

belt-driven linear modules can provide a fully functional solution that is more cost-effective. The Bosch Rexroth MKR Belt Driven module features a high-performance toothed belt for high drive torques, long travel lengths and high rigidity. The MKR module is available in multiple lengths, including a standard 12 meters length package as well as longer options. Its end point accuracy is 500 microns, which can satisfy many applications.

## **3. Make sure the linear modules incorporate features that make mounting and integrating the module into larger machines efficient and cost-effective.**

Linear modules are typically integrated into larger machines or combined into systems such as pick-and-place machines or Cartesian robots. One item that can be overlooked when selecting linear modules is how the modules will be connected and mounted. Depending on the supplier, there may be limitations: Some modules can only be mounted by the base of the extrusion; if the location where the module is to be installed doesn't allow for that, additional mounting brackets and other hardware may need to be purchased or machined from scratch, increasing costs and adding time to machine integration.

So, it's important to investigate how a linear module can be mounted and discover what kind of mounting options a linear module supplier offers in its product lines. In addition, it's helpful to investigate whether the linear modules include features to help quickly and accurately align modules for a tight fit into machine spaces. Look for suppliers that offer standardized, positive-locking connection elements and centering technology engineered to ensure that all components are perfectly aligned and accurately connected right away, making it unnecessary to build expensive, custom-designed constructions.

For example, the Bosch Rexroth linear technology portfolio features an extensive range of connecting elements – brackets, adapter plates, clamping fixtures, sliding blocks, T-nuts, positive locking centering rings, etc. – designed to simplify installation and integration.

**4. CAD models are critical to engineering linear systems into complete machines, so make sure CAD models are included in the package.**

Not all linear module suppliers will include complete CAD models as part of the package when you purchase products. While that may save initial cost of goods, it's almost always necessary to create CAD models in order to properly engineer and configure the final system and provide the necessary direction to integrate the linear technology. If the CAD model isn't included, the OEM or end-user engineering staff will need to get one of their engineers to take the catalogue specifications and create their own CAD model. And since many companies are paring back the size of their engineering staffs to control costs, or they are focusing their mechanical and electrical engineers on core machine design, this is an additional task that can slow down work or interfere with established timelines. Most top linear module manufacturers include CAD models as standard elements of the digital documentation supplied with the module, but it pays to make certain.

**5. Select linear modules that have been fully tested to ensure proper mounting and alignment.**

Poor or incorrect mounting and alignment practices will degrade product and system performance, with linear module components, such as bearings and belt drives, wearing out faster than expected and leading to unscheduled downtime. Linear module suppliers that have engineered their products with centering technology, such as centering holes and slots for connectivity, help to ensure that all components are tightly aligned and level as part of the installation process.

It's also important to determine what level of performance testing a linear supplier conducts on their products. Some suppliers assemble and deliver customers' modules without testing, so customers don't discover that it will not work as specified until it's installed in the machine. The best practice is to perform a runoff test with torque measurement which verifies that when the linear module is manufactured, it meets all catalogue specifications.

**6. Make sure the linear module design includes proper lubrication plumbing and access points.**

Linear technology is motion technology – so linear modules require regular lubrication with lubricants specified by the supplier. A very common pitfall end-users face with linear modules is that they are installed into production machines in ways that the lubrication ports cannot be accessed – leading to premature failures.

To avoid this pitfall, machine designers need to understand where the lubrication ports are located and design the way the modules are installed so that those ports are easily accessible for routine lubrication. To make sure this happens, it's important to investigate where the lubrication ports are positioned on the module. The best linear module suppliers have multiple lubrication ports to make it easier to integrate the module into the machine design.

It is also extremely important that end-users follow the manufacturers' guidelines for the type of lubrication used. This is typically a very specific type of lubricant – for example, for linear ball bearings, an NLGI lithium soap grease with no solid particles must be used. Linear module suppliers know that in some cases end-users will use a lubricant, with carbonate or other solid particles, that is used in other parts of the machine but can cause wear and premature failure for linear module bearings.

**7. Parameterization and commissioning of the motion controller and drives needs to correctly align with the performance characteristics of the selected linear module.**

The motion controller and drives parameters need to have correct safe torque limits and end-of-stroke limits programmed to ensure that the linear module doesn't overshoot its limits and crash or operate with excessive end-point vibration. The best way to ensure that this doesn't happen is to make certain that electrical engineers and mechanical engineers on a project clearly understand and communicate all the parameters that have been established for the performance of each linear module.

---


## Author:

**Justin Lackey**  
**Product Manager – Systems**  
**Bosch Rexroth Corp.**  
**Charlotte, NC**

©2019 Bosch Rexroth Corporation  
Subject to change without notice.  
ALL RIGHTS RESERVED

Bosch Rexroth Corporation  
14001 South Lakes Drive  
Charlotte, NC 28273  
[www.boschrexroth-us.com](http://www.boschrexroth-us.com)

 [www.facebook.com/BoschRexrothUS](http://www.facebook.com/BoschRexrothUS)

 [twitter.com/BoschRexrothUS](https://twitter.com/BoschRexrothUS)

 [www.youtube.com/BoschRexrothUS](http://www.youtube.com/BoschRexrothUS)

**rexroth**  
A Bosch Company