

## Application Note: Extreme Customization, well-maintained tooling, and accuracy

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The marketplace has many vendors that offer motion control products for those in need of rotary or linear movement solutions. Not all vendors that supply these products have the same objectives or the same quality concerns over the lifespan of a product line. An OEM small-batch manufacturing customer came to Nippon Pulse because their current supplier was producing motors that had a very high failure rate for their application. The supplier’s motors had worked fine for previous generations of their system, but the new generation required an accuracy from the motor that 50 percent of the delivered motors could not meet. The motor was spec’d to have sufficient resolution for the application, but was unable to deliver the accuracy. When the supplier was approached by the customer, they offered no effective solution to meet the customers’ needs and requirements. This customer contacted us and requested a sample to evaluate, which – when tested – was well within their resolution and accuracy requirements. In order for our motor to fit into their application, it needed to be customized from our standard configuration. Nippon Pulse customizes motors for and supports both large and small-batch customers.

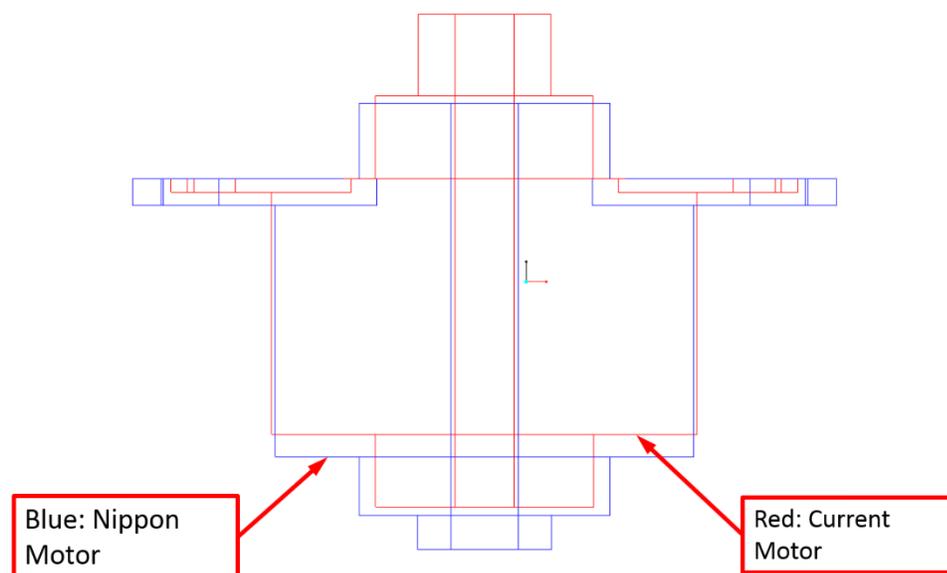
There were seven major modifications required for our standard motor to fit within the product and the manufacturing process. Changes to the motor included the redesigning of the mounting flange, moving the lead wire exit location, and development of a specialized lead screw thread pitch. Nippon Pulse factory engineers worked directly with the customer’s engineers to design the required changes. During this process, the customer conducted tests and found that the accuracy and precision of the customized motor was improved over the already high values of our standard motor.

Motor	Step Error (Accuracy) $\mu\text{m}$	Cyclic Error (Precision) $\mu\text{m}$
Competitor linear stepper	8	48
Standard NPM linear stepper	2.9	3
Customized NPM linear	1.40 (52% reduction)	2 (33% reduction)

This example of our customization demonstrates a couple of noteworthy concepts, specifically for consumers of stepper motor products and for motor products in general. First is quality. Quality can be discerned by the magnitude of part tolerance, with a lower tolerance indicating lower quality. While a production component may start out with a high tolerance and quality at the beginning of a production run, this decreases as time and the quantity of parts made

increases. If the process isn't monitored and corrective action taken to address the source of the change, the degradation of part quality will continue. This is, in part, due to wear associated with the tooling in the manufacturing process. As each part is produced, the tooling will wear some. No matter how well-designed or how hard the tooling material, the wear occurs and erodes part tolerance. Since tooling has a definitive capital cost for its creation, a greater profit can be realized by not replacing the tooling, though extending the lifetime of the tooling will cause part tolerance will become steadily worse. Nippon Pulse prides itself on the quality of their motors and replaces tooling at specified intervals so that motor tolerance maintains its high tolerance. This can, at times, show up as a cost difference between our motors and those of our competitors. A cheap motor is a cheap motor.

The second item to note in this example is that Nippon Pulse is able to design and manufacture a motor to fulfill OEM needs, as long as it doesn't violate the laws of physics. With this customer, we essentially redesigned our motor to solve a very important problem that was the result of a lower quality motor from another manufacturer. The other manufacturer was unable to offer solutions to the customer. Nippon Pulse hasn't changed ownership since its founding in 1953, and the design documentation process is meticulously done as a component of the corporate culture. If we build you a motor today, we will be able to support and modify that motor years from now to fit your needs. As a corollary to this, Nippon Pulse is capable of designing and manufacturing motors for small batch purchases, as in the case of this customer who only purchases a couple of thousand motors each year. Nippon Pulse is able to support customers' small and large quantity motor production with our attendant production tooling and design knowledge.



**Shape modifications from our standard motor (blue line drawing) to fit the shape of application's current motor (red line drawing).**