

# Gear Design

**PLEASE NOTE**—ASK THE EXPERT is intended—and will certainly remain so—to be a reader-driven platform where engineers, designers, specifiers, shop managers, machinists and more can ask a question that needs answering—complex or otherwise. But just to keep the line moving, so to speak, we occasionally ask our “Experts” to pose both an expert question—and answer—informed by the invaluable back-and-forth that occurs between client and, to cite a few examples, consultant, or job shop, or OEM...

Following is an experienced-based Q&A scenario regarding gear design, presented by **Dr. Alex Kapelevich**, principal, AK Gears:

## THE QUESTION

From a practical gear design point of view, can one find an acceptable “happy medium” design approach between specifying either conventional standard gears—and their inherent, modest performance characteristics regarding, for example, size, weight, load carrying capacity, noise and vibrations, etc.; or going with a non-standard (involute or non-involute), deeply optimized high-performance gear solutions—and their increased cost in development time, custom tooling, etc.?

The advantages of the conventional gears include availability of well-described methodology, gear design software, rating standards, off-shelf tooling, etc. They can be designed by an experienced mechanical engineer who might not be an expert in gearing. These are reasons why conventional standard gears should be considered as a first possible option of a gear drive design. If it is determined that conventional gearing cannot deliver the required gear drive performance, non-standard gear geometry options should be considered. Non-standard gears should be application-specific and optimized and designed by a gear expert familiar with specialized gear design optimization software. Non-standard gears require customized—and typically more expensive—tooling that will require extended time for design and fabrication. It is important to understand that any deviation from the standard tooth proportion requires such customized tooling. Gear drives that utilize non-standard optimized gears must pass comprehensive testing to confirm their suitability and conformance. It is for these reasons that it makes no sense to do “baby steps” in gear tooth geometry optimization, in that the result will be limited performance improvement offset by significant effort and expense. Non-standard gears should be *totally optimized* to achieve maximized gear drive performance. Only then will additional design, fabrication and testing efforts and expense be justified. In the end, it just might be that a “happy medium” cannot exist in the optimization of non-standard gears.

## THE QUESTION

High contact ratio (HCR) spur involute gears have long been considered an option for increasing gear drive load carrying capacity, and for reducing noise and vibration by sharing load between two and three pairs of contacting teeth. What’s more, this type of gear is addressed by most gear design and rating standards. Why don’t we see many—hardly any, in fact—applications of these promising, high-performance gears?

There are some cases of application of the high contact ratio (HCR) spur involute gears for high-performance gear drives, but they are usually considered to be non-standard gears. Unfortunately, “over-standardization” of a gear tooth geometry resulted in a “tunnel vision” that limits potential gear drive performance improvements that could be achieved by application of the HCR gears.

In addition to running AK Gears ([akgears.com](http://akgears.com)) **Dr. Alex Kapelevich** has produced or co-produced numerous technical articles. He is also the author of Direct Gear Design.