It Takes a Village to Raise Gears Transmissions

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The design and development of precision plastic gear transmissions — gears, shafts, bushings, bearings, and the housing — requires a significant, cooperative engineering effort.

The reason: Precision plastic gear transmission design takes an initial engineering effort that is greater than that required with metals to cope with greater changes in material properties and dimensions across the entire range of operating conditions.

This specialized, high technology area requires considerable expertise to develop, design, and produce precision plastic gear transmission components. The importance of designing plastic gears so the dimensional requirements match with the material and process capabilities cannot be over emphasized.

Proper plastic gear design — with the primary focus on getting the geometry of the gear pair right — requires an in-depth understanding of the broader relationship of materials, layout, shafting, bearings, and housings.

The success of plastic gear transmission design and development depends on a cooperative approach: a development team that is headed by a project engineer, a gear engineer, a plastics engineer, a resin supplier, a molder, a tool builder, a manufacturing engineer, a quality control engineer, and a purchaser.

The team’s role is to ensure all aspects of plastic gear design, manufacture, and operation are not overlooked throughout the development process so the final parts successfully work together within critical manufacturing tolerances and operating conditions. For example:

The gear engineer works with all members of the team to develop gear tooth geometry and assembly specifications that will produce gears that function satisfactorily under all operating conditions, across the entire range of manufacturing tolerances and environmental influences.

Plastics engineers help select the appropriate plastic for the application and environment, give basic plastic part design guidelines, and provide other data. They can assist in preliminary or detailed design, prototype testing, fabrication, and pre-production evaluations.

Material suppliers provide the plastics engineer with more detailed/specific data, design guidelines and material selection. They also provide services — from basic print reviews to sophisticated engineering analyses and training — that help customers better understand their materials and use them efficiently.

Tool builders and molders ensure that the parts can be fabricated precisely and cost-effectively. The molder, for instance, helps establish the appropriate process conditions that provide consistent, stable dimensions and optimal properties for the specific plastic.

Manufacturing engineers evaluate the overall design so that the transmission can be readily assembled. They determine, for example, whether or not assembly loads call for support tabs, and how to orient parts emerging from fabrication. Attending to such details improves the efficiency of the entire process.

This team is the foundation of a precision plastic gear transmission program. By working together at the early stages of design, the plastic gear transmission development team can evaluate all aspects of different solutions including performance, manufacturing, assembly, and total costs.

Their input can eliminate many production missteps as well as the extra cost and time lost in reworking a design that does not process well. It should be kept intact until the design effort is completed, so that the knowledge gained early in design is not lost later.

To cope with these engineering hurdles, the plastic gear transmission development team needs to follow a development cycle that starts from the broadest possible context. It should first evaluate the needs of the system, rather than those of individual parts or components.

Operating and performance requirements, materials selection, gear design, tool design, and molding processes are all important in the design and development of precision plastic gear transmissions.

Each aspect should be repeatedly evaluated as the gears and associated components evolve from concept to production

Today, polymer performance and processing techniques have advanced to a point

in which plastic gears can handle higher-torque applications, previously the domain of their metal counterparts.

The new design strategies are pushing the boundaries on plastic gear size — dimensional control for larger, multi-gated, injection-molded gears — structure and geometry, all of which will require a new team approach.

Some companies recognize the specialized nature of a precision plastic gear transmission program. They assemble a strong plastic gear and transmission development team to keep efforts on track in the face of a bewildering array of choices.

The team’s expertise can make the process more efficient by compressing the design cycle and avoiding timely, costly “re-dos”.

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