Calling All Engineers: Beyond Form, Fit and Function for Formulated Products

BY LEE PETERMAN

Like most engineers, I learned about rules of interchangeability back in school. These rules help companies decide whether a product change should require a new item number or simply a revision of the same item number. The standard “form, fit and function” (F/F/F) definition has served the needs of discrete manufacturers well for a long time.

While I’ve personally used the standard F/F/F rule of interchangeability successfully in several discrete industries, the standard rule does not satisfy all the needs of formulated products such as chemicals, pharmaceuticals, foods and beverages. For these industries, new rules must be defined that include regulatory requirements, nutritional information, and even customer experience, in order to better manage product changes and control revision and new item number decisions. Let’s take a look at why.

But First, What is Interchangeability?

Returning to engineering school for a minute, a part is often considered interchangeable with another when the form, fit and function are identical:

- **Form** – The unique and relevant physical characteristics (shape, size, mass) that characterize a part for a particular use
- **Fit** – The ability of a part to physically mate with, interconnect to, or become integrated with another part
- **Function** – The action that a part is expected to perform in fulfilling its purpose

According to the traditional F/F/F rule, a part is interchangeable with another part when:

a) The relevant functional and physical properties are equivalent in performance, reliability and maintainability, AND

b) The part can be used without requiring special procedures (such as selecting for fit or performance) and without altering the part itself or any other part

Why the Difference for Formulated Products?

In the past, companies in formulated product industries typically captured and managed hard copy specifications manually with an army of people and offices full of filing cabinets. Many of these companies are now adopting and expanding their use of product lifecycle management (PLM) systems to manage product information, capture efficiency improvements and provide the traceability necessary in today’s regulatory environment. In order to get the most benefit from these systems, new definitions for rules of interchangeability must be considered.
For formulated products, the standard F/F/F rule is not sufficient to decide interchangeability. Let’s use a bottle of household cleaner as an example to develop some rules on this type of product. Let’s assume we have made some minor formulation changes to the old cleaner.

First let’s try the F/F/F rules.

- **Form** – The form is liquid and maybe has a particular color, through addition of a dye. It is likely that a fragrance is used to impart a unique scent to the cleaner. So, if a change results in the cleaner remaining a liquid, still looks pale yellow and smells like pine, that passes the “form” part of the rule.
- **Fit** – The “fit” of our cleaner really hasn’t changed as it still “fits” into the dispensing bottle.
- **Function** – The “function” rule is a quite important one for our changed cleaner; it must clean, disinfect and perform other functions to the same level as the previous cleaner. Let’s assume that it cleans just as well as the previous cleaner.

This is a good example of where the definition of “fit” within the F/F/F rule must be extended. Our cleaner is very tightly regulated from both safety and environmental perspectives. So, the new cleaner must also “fit” within the same existing environmental and regulatory classifications as the old cleaner. The change in our cleaner is not permitted to have a different regulatory classification (usually defined by the Material Safety Data Sheet or MSDS). So, if the MSDS does not change, is it interchangeable with the earlier cleaner?

That brings about a series of questions that begin to snowball quickly: *What about trace chemicals (byproducts coming in with raw materials) that are not part of the general makeup of the raw material? What if these change slightly? Is this formula still interchangeable with the earlier formula? What if this trace chemical is prohibited from use in certain countries? If that is the case, then it certainly would not be interchangeable with the old formula. Uh oh…*

**Rules of Interchangeability: A Formula for Success**

Obviously there are gaps between the traditional rules of interchangeability and the needs of a formulated products company. So how far should formulated products companies go to measure and track interchangeability? Many formulated products companies take the easy route – they assign new item numbers for even minor and insignificant changes in formulations. This provides the regulatory scrutiny required to ensure compliance and product safety.

But with new item numbers come significant cost penalties. Each new item number requires a redo of all item checks and approvals (including product registrations), and requires changes to product labels, catalogs, and other customer-facing materials. The retailers or distributors themselves may not like it either, as they may have to make adjustments for the new item codes in their purchasing systems. When added up across thousands of products, the cost impact of item number proliferation is tremendous. We’re talking millions of dollars.
Don’t worry though; engineering school didn’t completely fail us on this one. The best way to avoid many of these costs is to develop new and expanded rules of interchangeability and put processes and systems in place to ensure compliance with these rules.

As these rules are often specific to companies and products, it is impossible to define a generic set. As a start, consider the following in addition to form, fit and function:

- Regulatory/transportation/safety classifications (MSDS, etc.)
- Customer experience
- Specifications/properties of the item of a significant nature
- Others specific to needs of the company and industry

There are likely to be other rules specific to companies and industries that should be included. Only a detailed knowledge of the company and its business environment can help define these rules.

Happily, the benefits are worth the effort. Formulated product companies can avoid the excess complexity associated with item number proliferation, reducing the overall cost of managing the product portfolio and improving performance. Your engineering professor would be proud.