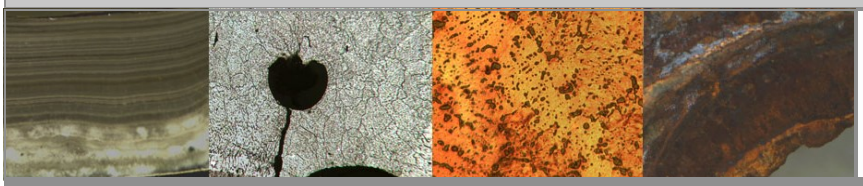
# NUTS & BOLTS



New Hampshire MATERIALS LABORATORY, INC.
*Your Problem Solving Partner*

**PROPER APPLICATION OF PLASTICS** **AUGUST 2013 SUPPLEMENT ISSUE**

## Welcome to New Hampshire Materials Laboratory

In today's society, we are surrounded by products, devices, and more made of plastics.

In this Nuts & Bolts, we discuss the Proper Application of Plastics and outline a few of the characteristics of plastics that should be considered during the design process.

Still have questions? Here is a link to another useful article published in a previous Nuts & Bolts:
*Polycarbonate High Performance*

Do you find yourself with a resign/plastic problem? We can help. To find out how we can be your "Problem Solving Partner" visit our website at *www.nhml.com*

Tim Kenney
Laboratory Director

# *A Design Engineer's Checklist: Proper Application of Plastic*

The following outlines a few characteristics of plastics which must be considered in the design or application of a plastic part. Discuss your design expectations and constraints with your material advisors. Consider there..

## Thermal Considerations:

- **Temperature Resistance & Heat Deflection Temperature:** High temperature exposure can result in changes in the mechanical strength or life of a plastic part. It accelerates plastic deterioration and may cause colors to shift.
- **Thermal Conductivity:** This is especially important for a device that is heat generating. Modern electronics often need a method of heat dissipation.
- **Coefficient of Thermal Expansion:** Dimensional changes may introduce unplanned stresses into the part which could result in part failure.

*To be continued on page 2* →

***A Design Engineer's Checklist: Proper Application of Plastics continue....***

## Environmental Considerations:

- **Operating Temperature:** Chemical resistance and mechanical strength can be affected by operating temperature. Operating temperatures (and time at those temperatures) must be assessed at the location of the part.
- **Internal & External Stress:** Residual (internal) stresses may be minimized by careful part design. Mechanical testing of the part may help to identify potential stress problems.
- **Chemical Exposure & Adjacent Materials:** Mechanical strength as well as appearance can be affected by chemical exposure. Reactions with organic chemicals are especially troublesome (See Did You Know..) Outgassing vapors or migrating chemicals can affect nearby parts. Review the chemical compatibility of nearby solids as well as liquids and lubricants.

## Mechanical Properties:

- Tensile and impact strength, as well as elastic moduli may be improved by the specification of fillers or fibrous reinforcements. For example, the base resin of PEEK plastic has a tensile strength of 13,000 psi. When reinforced with 40% short fibers, the tensile strength increases 27,000 psi. When long fibers are used, the tensile strength is increased to 32,000 psi.
- Some reinforcement fillers may affect the part's wear characteristics and flammability, as well as the tool choice and the ability to mold.
- Consider the structural requirements of the part. The affects of loading (long-term, short-term and impact) may drive your resin or filler choice.

## Electrical Considerations:

- Most plastics are excellent insulators; however their performance may vary with material thickness and temperature. Contact your material experts to confirm the expected performance of the material.
- International regulations are calling for the increased control of EMI (Electro Magnetic Interference). Carbon and metal fibers are often added in order to change the electrical conductivity of the plastic, thereby increasing the shielding affects. Another effective method of shielding is plating the part with a zinc or other metal coating.

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# Did You Know

“Organic liquids, such as cleaning fluids, detergents, gasoline, lubricants and sealants, may seriously reduce the mechanical properties of plastics,” reports Koksal Tonyali in an article from the **ASM Engineered Materials Handbook.*

The affects of organic materials on plastics can be numerous and diverse. The absorption of organic fluids into plastic assemblies can permanently disrupt the physical chemistry of the part. This disrupted physical structure can result in reduced part performance or personal hazards.

Visible symptoms of organic chemical attack can include swelling, cracking, embrittlement, crazing (a network of ultrafine cracks) and color shifts. The invisible changes, such as variations in tensile or impact strength or flexural modulus can result in catastrophic part failure.

Consideration of these chemical reactions during design, and verification testing once in production, are good safe-guards against unexpected part failure.

**Organic Chemical Related Failure by Koksal Tonyali in Engineering Plastics Volume 2 Engineered Materials Handbook, ASM International 1988*

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