



# NUTS & BOLTS

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## Our Philosophy

*New Hampshire Materials Laboratory has one goal—to help you solve your technical problems at a reasonable cost. Tests help, but are not always enough. Our team of dedicated and experienced professionals has both the skills and the backup facilities to serve in the following:*

- Failure Analysis
- Material Certification & Compliance
- New Product Testing
- Mechanical Properties
- Tensile and Compression Testing
- Heat Treat Problems and Verification
- Reverse Engineering
- Weld & Life Testing
- SEM & EDS

## Reviewing Our Past Issues...

Roughly—about every quarter—we publish an issue of Nuts & Bolts. Although we have been putting out this newsletter since 1995, there may be some of you who may have missed a topic of interest.

The following is a list of our past issues. If you see one of interest, please feel free to give us a call at: 800-334-5432 or e-mail us at lab@nhml.com.

Our list follows—from the oldest issue to the current date:

### A. Cutting Through Material Corrosion

The problem of metal corrosion is familiar to all of us that live in the Northeast. After a winter of snow and salt, who hasn't noticed a spot of rust starting? We've outlined some common types of metal corrosion, a little about their cause and some tips on addressing them.

### B. Gunk! A Cry For Help

Maybe it's crud, munge, or simply a slimy residue. If you haven't seen any lately you're lucky. Try looking in a pump strainer or fluid filter. Gunk takes time to develop. Catching it early can save thousands in product failures and production shut downs.

### C. Proper Application of Plastics

A Design Engineers checklist. Outlining a few characteristics of plastics, which must be considered in a plastic part. Thermal, Environmental, Electrical considerations as well as Mechanical Properties are discussed.

### D. Is your Solder Bath... All Wet?

Maintaining the right solder chemistry is required for proper electronic assembly and long product life. The discussion is of the "foreign" metals found in tin/lead solder baths and their impact on product quality.

### E. Tips On Welding Cast Iron

Proper in-house repair of cast iron parts can save you money and down time. Unlike welding low carbon steel, the welding of cast iron requires special training. We have highlighted some tips on welding cast iron.

### F. Insightful Failure Analysis

In a manufacturing world filled with TQM teams and ISO-9000 audits, Customers are demanding effective corrective actions. A scientific analysis of a failure can get to the root cause of the problem and, usually solve it for good.

### G. Know Your Steel & Heat Treatment

Selecting the wrong steel and heat treatment could result in premature part failure and an unhappy customer. Here are some examples where knowledge of what steel was used and how it was heat-treated is useful.

### H. Defective Welds

One element critical to a weld quality system is the final examination of the weld. Deficient welds can often be identified through visual inspection. The article identifies the various types of weld discrepancies and discusses some visual weld inspection methods.



## I. Scanning Electron Microscopes (SEM)

The SEM is a valuable in-house tool in both material and failure analysis. We discuss its operation and what it can do when coupled with EDAX prime energy dispersant analysis instrument.

## J. Electroless Nickel Plating

Electroless Nickel Plating is used to deposit nickel without the use of an electrical current. Since gaining commercial use in the 1950's, electroless nickel plating is used where excellent corrosion and wear resistant properties are needed.

## K. Hard Chromium Plating

Hard chromium plating is produced by Electro-deposition in a solution of chromic acid. Hard chromium plating has a wide range of applications where wear and a low coefficient of friction are considerations.

## L. Hot Isostatic Pressing

Although many of us have heard of "HIP", Hot Isostatic Pressing, few of us understand the many benefits of this material process as an element in manufacturing designs. The HIP process falls into three categories:

- Densification
- Powder Metallurgy
- Composites

In this paper we discuss the various techniques.

## M. FTIR Spectroscopy in the Material Laboratory

The spectrum of visible light has been observed in nature in the form of a rainbow. However, the visible region is only a small portion of the total electromagnetic spectrum. By use of a spectrograph, other parts of the invisible "rainbow" can be seen.

## N. Rusting by Stainless Steel

Contrary to popular belief, Stainless Steel is neither stain-free nor is it free from rust. Too often users are surprised to find rust deposits and corrosion in what was assumed to be a rust-free material. In many instances the presence of rust can lead to catastrophic failure of a part.

## O. Stainless Steel for Hardness and Corrosion Resistance

Picking the right stainless steel can be a challenge. We review some of the properties of this popular material. We examine relative hardness, corrosion resistance, rolling contact noise and strength along with failure mode.

## P. Verification of Materials in Old Structures

From time to time there is a need for a Laboratory's services in dealing with old structures. Too often, the structure's materials are not easily identifiable and need to be verified. Although prepared principally for Civil Engineers this will aid anyone in preparing test samples for our laboratory.

## Q. Polycarbonate Plastic

We discuss polycarbonate, a high performance amorphous engineering thermoplastic. It is a very strong plastic that is finding widespread use in industry.

## R. Martensite in Austenitic Stainless Steel Welds

Long needle-like clusters in the metal characterize martensite. When martensite is present in a weld, don't expect it to pass the bend test. The weld will not have the toughness and ductility we expect from stainless steel.

## S. Hardness Testing

In metalworking, hardness generally implies resistance to penetration. It may include resistance to scratching, abrasion or cutting. Hardness tests often supplement or can be substituted for tensile tests, since there is a good relationship between the tensile strength and the hardness of many metals.



## T. Hydrogen in Metals

If you are a user of metals that are strong but not very tough, or maybe you have had some parts break and are contemplating changing to a stronger alloy, then you need to know that hydrogen in the metal can bite you. If you take to heart the information in this Nuts & Bolts series maybe you won't be bitten.

## U. Some Special Papers

### 1. Aluminum Extension Ladders

Significant improvements in the ANSI and UL ladder codes have eliminated several common types of accidents. We review the problems we observe on ladders produced to the current codes and we list the failures which were formerly common.

### 2. Oil Burner Systems

Oil burner systems regularly malfunction leading to smoke damage claims. We discuss the components of two representative systems. Many components in the traditional hot-air furnace are common to the newer hot water condensing type furnaces. The components common to both types are discussed first, while components found only in condensing furnaces are discussed later.

### 3. Vehicle Fluids

Our Laboratory handles a variety of fluid analyses ranging from routine engine oil analysis for wear metals to identification of foreign fluids and solid contaminants in any of the vehicle fluids. We review the techniques employed in these analyses and some specific problems we have solved.

### 4. Coffee Maker Fires

Several times a year we examine the debris from domestic coffee makers which initiated fires. Included are models for both countertop and under cabinet installation. The problem seems to be spread among products from most of the manufacturers. In those fires where the room was closed off so the fire ran out of oxygen the temperatures often remain low enough so that we have had a useful amount of debris to examine.

### 5. Painting & Coating Systems

With the use of various chemical analytical techniques, we can identify paint and coating types such as epoxies, urethanes, acrylics and latexes. Causes of discoloration, contamination and degree of cure can also be studied. These analytical techniques and some common problems associated with coating system failures are discussed.

### 6. Burn Pattern in Vehicle Fires

The hottest spot in a vehicle fire is often different from

the point of origin. Determining the point of origin requires the interpretation of burn patterns, often progressing backwards from the hottest spot to the point of origin. Burn pattern interpretation requires both understanding of the underlying science and knowledge of vehicle materials, fuel and electrical systems. We review the science which underlies the interpretation of burn pattern in vehicles.

| Stainless Steels      |  |
|-----------------------|--|
| CHROMIUM TYPES        | Martensitic (hardenable)      Types: 403, 410, 414, 416, 416Se, 420, 431, 440A, 440B, 440C   |
|                       | Ferritic (non-hardenable)      Types: 405, 430, 430F, 430FSe, 442, 446   |
|                       | Austenitic (non-hardenable except by work-hardening) (strengthened by aging or precipitation hardening)      Types: 201, 202, 301, 302, 302B, 303, 303Se, 304, 304L, 305, 308, 309, 309S, 310, 310S, 314, 316, 316L, 317, 321, 347, 348<br>17-4CuMo, 17-10P and others |
| CHROMIUM NICKEL TYPES | Semi-Austenitic (precipitation hardening)      PH15-7Mo, 17-7PH and others   |
|                       | Martensitic (precipitation hardening)      17-4PH, 15-5PH and others   |

### 7. Leaks in Domestic Fuel Oil Tanks

Most leaks in domestic fuel storage tanks are caused by over pressure during delivery, corrosion, defective welds or defective steel. Buried tanks also experience coating failures, impact damage during installation and electrolytic corrosion. These factors can either work singly or in combination.

### 8. Weld Discrepancies

Revealing welding flaws through visual inspection. Quality in the welding process assures the product's structural life and safety. One element critical to a weld system is the final examination of the weld. Many fabricators have come to rely on scientific techniques such as radiography or ultrasonic inspection to confirm weld integrity. These high-tech methods have their place, but deficient welds can often be identified through visual inspection.

*To get any of the past issues of Nuts & Bolts or any of the special papers, let us know by dropping us a line, simply give us a call at 800-334-5432 or email us at lab@nhml.com.*

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