



# National Technical Conference Recap: Metallurgy for the Non-Metallurgist

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In today's fast-changing world, changing materials requirements make materials knowledge essential for machinists to successfully deliver parts to spec.

Materials in our shops are certainly changing, and our ability to successfully produce parts while dealing with them is one of our greatest challenges. The PMPA's Technical Program Committee called on Myron Lee of Mueller Brass, John Collins of Stainless and Aluminum, Ray Schnell of Valbruna Stainless and me, Miles Free of PMPA, to review the fundamentals for the 130 attendees in this session.

## Brass

Myron Lee walked us through the standard ASTM test used to evaluate machinability, so we could understand how the machinability index we all rely on was developed and can be used. Understanding that the ASTM index takes into account rough and finish turning, as well as drilling, makes it universal in application.

Myron wanted us to understand three things:

1. Where and how free machining brass is made makes a difference in our shops. Properties come from both chemistry and crystal structure as a result of the manufacturing process.
2. On non-lead grades, the same principles apply, but the details of chemical make-up and micro-structure are different.
3. Depending on the properties desired, a manufacturer can optimize to achieve one aspect of the material, say machinability, over others. For example, when drilling small holes, a hard material with a large proportion of alpha phase delivers better results. For large holes, soft material exhibiting more alpha phase is perceived as better machining by operators. Forming applications also call for a soft material with a high proportion of copper to deliver best machining results.

## Aluminum

John Collins from Stainless and Aluminum presented a nice overview of aluminum, paying special attention to chip issues when changing grades. His slides showed the dramatic differences in chip volume when encountering different grades and tempers of aluminum. One focus of his talk was on machine process items that were under operator



control, such as choosing properly notched cams for stringy chip grades and the Garr AlumaStar three-flute drill for breaking up chips.

John's three takeaways included:

1. Lead and bismuth are viable additives in the materials for our shops, and they continue to be subject to change based on customer preference and developing regulations. The grades that we have are not as free cutting as we were used to cutting.
2. Pay attention to the yield strength and tensile strength on your materials.
3. There is a substantial price differential between cold-drawn and extruded aluminum and a substantial difference in processability. In order to minimize the processing difficulties, John recommends selecting only machine-grade billet, which has a specified amount of ferrite content to help the chip break.

## Stainless Steel

Ray Schnell from Valbruna Stainless led the next discussion regarding stainless steels, which are becoming more and more prevalent in our shops. Ray gave us a map of the stainless steel domain, helping us understand how more

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than 350 different stainless alloys fit into five categories and what each category meant to us as machinists. Austenitics, for example, give the best corrosion resistance and are virtually non-magnetic, except by cold working, which is also the only way to increase their hardness. Types 303, 304 and 316 are the most commonly encountered austenitic stainless steels in our precision machining shops.

Ferritic stainless steels are characterized by intermediate corrosion resistance, are magnetic and are hardenable only by cold work. Grades 409 and 430F are typical ferritic stainless steels.

Martensitic stainless steels, typically grades 410, 420F and 440C, have relatively low corrosion resistance, are magnetic, and achieve high hardness and strength through heat treatment. 440C is typically specified where high hardness (think 60 HRC) and some corrosion resistance is required.

The final group discussed was the precipitation hardenable grades, which were characterized as having low corrosion resistance, magnetic properties and are heat treatment hardenable. Ray says for best machinability, typically H 1150 M is the optimal treatment for our shops to process.

Ray's conclusion gave all in attendance a nice overview of the multiple types of stainless steel we see in our shops, how machinability can mean different things to different people and that efficiency is not always measured by the lowest cycle time. We are facing so many different options of materials, treatments, structures and processing options,

it is wise to reach out for help rather than struggle with production.

### Carbon and Alloy Steels

I reviewed how steel factors of chemistry, mechanical properties and our shops' processing can all impact the steels' machinability.

Chemistry factors discussed included the role of carbon on mechanical properties, role of sulfur on machinability, as well as that of lead. Understanding how phosphorous and nitrogen can help with chip separation and surface finish and the role silicon and aluminum play were also covered.

The benefits of cold drawing in regards to boosting mechanical properties were then discussed and the role of the yield strength to tensile strength ratio was explained for better understanding chipbreaking and machine power requirements.

Shop processes can also have a major impact on how the materials process, starting with the role of purchasing, to better limit material variability and improve machining performance in the shop. There were a number of heads nodding and conversations started when this factor was presented. A review of the process of work hardening, why we should work to eliminate tool dwells and the need to maintain sharp tools were the final takeaways. The use of a microscope to examine tools for wear patterns, built-up edge and other clues as to the voice of the process was presented as a best practice and concluded the prepared comments.

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## Four Steps to Gain Control of Inbound Shipping

routing instructions and sending them to all of your key vendors. This is where your 3PL partner will either impress or disappoint. A 3PL with inbound shipping experience will be able to help you create your inbound routing program with the following services:

- Identify and manage lists of key vendors.
- Create clear inbound routing instructions for each vendor.
- Draft and send routing instruction letters to each of your key vendors on your behalf.
- Monitor and report on vendor compliance.
- Consolidate your billing and report to you the savings you are receiving through the program.

Inbound shipping costs are a major expense item for many businesses, particularly when you leave the control up to each of your vendors. If approached correctly, an inbound shipping management program can be an easy way to reduce your overall transportation expenses.

Inbound shipping programs are often best managed through a third-party logistics provider. A good 3PL can help you analyze your purchase invoices for savings opportunities, develop routing instructions for your vendors, monitor compliance and audit and consolidate invoicing to ensure you're saving the most on inbound shipping.