

# FINISHINGWORLD

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## The Brightest Ideas...

Over the past couple of decades, manufacturing has shifted in perception—and, sometimes, reality—from an 'old world' of chugging machinery and almost coal miner-dirty professionals slaving dangerously away in cold (or hot), dimly lit factories, to a 'new world' of manufacturing professionalism.

## New Career of Choice

Once upon a time, industrial manufacturing was not considered the career of choice for growing numbers of students, making it increasingly difficult for companies to attract the top talent needed to spur growth and development.

But, that's all changing. Tremendous advancements in technology, automation, and quality—along with the need for highly skilled engineers and designers—have begun to enhance industry's image, turning it once again into a highly desirable and well-paying career choice for up and coming talent.

## Bright Design Challenge

That brings us to a very special student competition closely related to finishing: one that challenges students to think beyond traditional design and develop next-generation engineering solutions incorporating a variety of surface finishing solutions.

The Bright Design Challenge, sponsored by the National Association for Surface Finishing in conjunction with key industry participants, is once again under way in Detroit.

Over an intensive 12-week period, student participants have been challenged to develop new design and engineering concepts to be used by the famous Indian Motorcycle brand. In California, a separate challenge will take place later in the year.

## It's Working

The emphasis on motivating students toward highly skilled industrial careers is increasing throughout most sectors of U.S. industry today and it's starting to produce the desired results. To that end, the NASF, its members and the educational institutions involved are leading the charge for surface finishing.

As NASF states on its web site, "The future of surface finishing depends on the innovative ideas of our youth."

For a full report on The Bright Design Challenge, turn to page 24.

— Mike Botta, Editorial Director  
— Mark Devlin, Editor-at-Large

## COVER STORY

### Technically Revisited: Eliminating Tin Whiskers

By Mark Devlin

*Two years ago this month in IEN/Finishing World, we interviewed Don Walsh, Director of Operations at the Uyemura Tech Center in Southington, CT. One of the interview topics was the problem of 'tin whiskers.' Here's what Walsh said back then about tin whiskers...*

"There's been a phenomenon in which metals—it can also happen with silver, which was discovered during WWII—can grow, and 'whiskers' is a good definition. A 'root' comes from the metal and, if that root touches another part that's conducting electricity, it causes a short. It's a serious problem. It's cost us satellites in the past; it's caused big problems."

According to NASA, the first reports of tin whiskers date back to the 1940s and 1950s. The space agency states that whiskers can 'grow' from only a handful of metals; the most common is tin. The phenomenon can also occur with some tin alloys, zinc, cadmium, iridium, antimony, and silver.

So, why does a little, metal whisker—which can grow up to 10 mm in length (a bit more than 3/8-in.)—matter? Short circuiting is one problem, as a single whisker can bridge two circuits. Whiskers carrying less than tens of mA can be permanent, while those pushing beyond tens of mA can be intermittent. Either way, the resulting damage is typically permanent.

## Problems Not Isolated

The problem of whiskers isn't related just to space applications such as ICs on satellites. They also occur, for example, in potentiometers and relays, and on IC leads. A failed relay doesn't typically cause a potentially catastrophic situation unless, of course, it's used in a nuclear power plant.

Such failures have actually been reported. Military-related problems have also been reported, such as in missiles and systems, radar equipment, and aircraft.

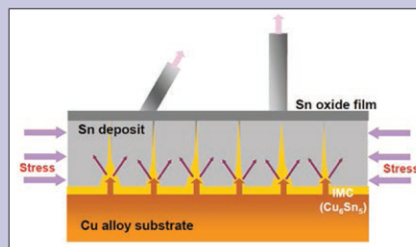
According to the FDA, the electrical resistance of a typical tin whisker is 50 ohms. Tin whiskers can be a life-threatening problem in medical devices such as pacemakers. More than theoretical, such tin whisker problems have already resulted in recalls. Here's more from the FDA...

*The growth of tin whiskers is not directly related to the surrounding medium. Whiskers will grow in sealed components, under high vacuum, and in low or high humidity. Temperature has some effect on the rate of growth, and the thickness of tin deposits affects whisker density. An obvious factor affecting whisker growth is pressure. High-compression pressure from bolts or screws will always produce whiskers in tin deposits.*

## Are Whiskers and Dendrites the Same Thing?

No, they're not. Each exhibits different characteristics. Says NASA... A 'Whisker' generally has the shape of a very thin, single filament or hair-like protrusion that emerges outward (z-axis) from a surface. 'Dendrites,' on the other hand, form in fern-like or snowflake-like patterns growing along a surface (x-y plane) rather than outward from it.

While NASA and the FDA seem a bit unclear even today about specific causes and solutions, a Uyemura technical paper, called 'The Elimination of Whiskers from Electroplated Tin,' includes discussion of...



Here's how a whisker forms

Continued on page 26

## Esma: Automated System for Passivation of Stainless Steel



The Esma E992 automated ultrasonic system is suited for batch passivation processing of stainless steel parts. The system has been redesigned with added functionality and more features, including self-neutralization technology of rinse water.

The E992 is closed and covered using a process that transfers liquids into and out of the central process unit, essentially automation without moving parts. Advanced models feature data storage technology for recording process data such as cycle times and temperatures. Esma Inc.: 800-276-2466; 708-331-1855

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## Rosler: Space-Saving RMO Machines are Flexible and Mobile

A new line of RMO mobile trough machines, operating at 3,600 rpm, provide high grinding power. The space-saving machines are available with 7- or 8-in. tub widths, and are suited for processing small, intricate parts. They are specifically designed for flexibility and process integration.

The process channel can be separated by a series of polyurethane coated dividers to process different parts at the same time while ensuring batch integrity.

Built-in wheels allow RMO machines to be easily moved around the shop and placed next to machining centers without the need for major material handling operations. RMO machines also feature sound abatement enclosures to encapsulate the process chamber and significantly reduce noise levels. Rosler Metal Finishing USA, LLC: 269-441-3000



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## HIGHLIGHTS

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## NEWS BRIEFS

## Mitutoyo Appoints Three New VPs

Aurora, IL – Mitutoyo America Corp. appointed three new vice presidents: Matt Dye now serves as VP of Measuring Instrument Sales; Michael Creney was named VP of Measuring Instrument Sales Support; and Douglas Adkins takes the post of VP of Distributed Products. The changes were effective in late 2012, according to Shigeyuki Sasaki, Mitutoyo president.

## Products, Services

The company provides measurement and inspection products. Machines, sensors, systems and services include coordinate measuring machines, vision, form and finish measuring machines, as well as precision tools and instruments, and metrology data management software. Mitutoyo's metrology centers and support operations provide application,

calibration, service, repair and educational programs. [www.mitutoyo.com](http://www.mitutoyo.com)

## OMAX Announces Major Headquarters Expansion

Kent, WA – OMAX Corp. is adding a new 22,000-sq-ft building here, extending the company's training, R&D, and engineering capabilities.

The company said the move is in response to "significant growth" evidenced over the past several years. In a recent report, *Inc.* magazine named OMAX to its list of fastest-growing private companies in America for achieving



21 percent business growth between 2008 and 2011.

John Cheung, CEO, attributed the growth in part to the 2009 launch of its MAXIEM JetCutting Center series, which makes abrasive waterjet technology more accessible, and to improved technology aimed at meeting the diverse and changing needs of manufacturers.

## Largest Expansion

The building expansion, new dedicated training space and lab area will help distributors, end-users, and sales representatives gain a high level of understanding and retention of abrasive waterjet technology, according to the company. It also will provide support for existing technologies and fast development of new machines and accessories.

Upon completion, the OMAX campus in Kent will encompass 130,000 sq ft of space across three buildings. The move marks the largest expansion of the Kent site since it opened in 1999. [www.omax.com](http://www.omax.com)

## Technically Revisited

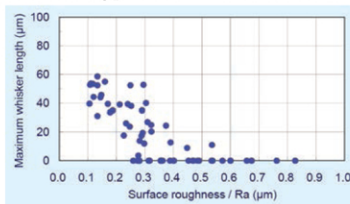
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...different paths to stress and whisker formation. (See illustration at bottom of page.)

Uyemura has determined that crystal structure has a direct impact on tin whisker formation, and that modifying that structure is capable of preventing whisker formation by dissipating and delocalizing the stress that causes whiskers. (Even press-fit connectors can create such stress.)

## Necessary Roughness

Uyemura has determined that, in many applications involving the morphology of a copper substrate prior to plating, controlling surface roughness with chemical etching can greatly reduce whisker problems. (In terms of common finishing processes, this would be done between



etching and pre-dipping.)

As shown in the above illustration, maximum whisker length (along with whisker density) decreased dramatically as surface roughness increased.

## The Solder Side

While controlled roughness is one way to avert or reduce the problem of tin whiskers, one should also look at the soldering side of the equation.

Uyemura states...

On the solder side the transition has moved forward and solutions have been implemented, like the SAC family of LF solders for paste reflow and tin-copper for HASL (hot air solder leveling). The industry is constantly making progress adapting its materials and processes to the higher reflow temperature profile for these LF solders. Today there is a much better understanding of the types of solder joints that are formed; their reliability and the type of intermetallic compound (IMC) formed.

Complementing their unique knowledge and experience with tin whisker reduction and elimination, Uyemura also offers a variety of product solutions such as Miralloy, Niphos, Auruna 526, Auruna 8100, and Platinode.

See References below for considerably more technical and detailed information.

## References

Finishing World, Interview with Don Walsh, Uyemura Tech Center

<http://www.ien.com/finishingworld/article/qa-unique-uyemura/163062>

NASA (Background)

<http://npp.nasa.gov/whisker/background/index.htm>

NASA (Whisker Failures)

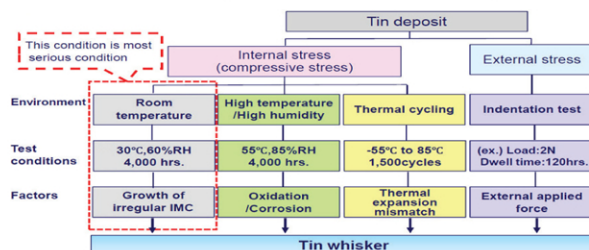
<http://npp.nasa.gov/whisker/failures/index.htm#power>

FDA (Tin Whiskers Problems, Causes, and Solutions) <http://www.fda.gov/ICECI/Inspections/Inspection-Guides/InspectionTechnicalGuides/ucm072921.htm>

Uyemura (The Elimination of Whiskers from Electroplated Tin), PDF, 11 pages, illustrated <http://www.uyemura.com/pdfs/elimination-of-whiskers-from-electroplated-tin.pdf>

Uyemura (IPC Symposium on Tin Whiskers, Study of Tin Whisker Inhibiting Systems...), PDF, 38 presentation slides, illustrated <http://www.uyemura.com/images/library/tin-whisker-ipc-symposium.pdf>

Uyemura ('22,000-Hour Solution' to Tin Whiskers Formation), web page with specific products <http://www.uyemura.com/electrolytic-processes.htm>



Four paths to tin whisker formation

# LEGENDARY

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