# EDAXinsight

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INSIDE




EDS NEWS

## WDS Joins the Team!

With the introduction of TEAM™ WDS, EDAX has merged its Wavelength Dispersive Spectrometry (WDS) product line into the highly successful TEAM™ Analysis System. The TEAM™ platform improves ease of use and workflow, while streamlining all three microanalysis techniques - Energy Dispersive Spectroscopy (EDS), Electron Backscatter Diffraction (EBSD) and WDS - into one common user interface.

WDS has distinct advantages over EDS in both energy resolution and detection limits. With energy resolution around 10 eV compared to the EDS best of 121 eV, WDS is able to resolve peak overlaps that present a problem in EDS analysis. Additionally, with detection limits better by an order of magnitude, WDS is able to perform trace analysis that cannot be done with EDS.

The analytical advantages of WDS have always been offset by the downside of WDS - historically, it has been a much more difficult technique to optimize than EDS. Spectrometer setup, crystal selection and system optimization were much more involved and time consuming than with EDS analysis. With the launch of TEAM™ WDS, EDAX has brought the automated set up, ease of use and analytical intelligence of the TEAM™ platform to WDS analysis, opening up the analytical power of WDS to all analysts.

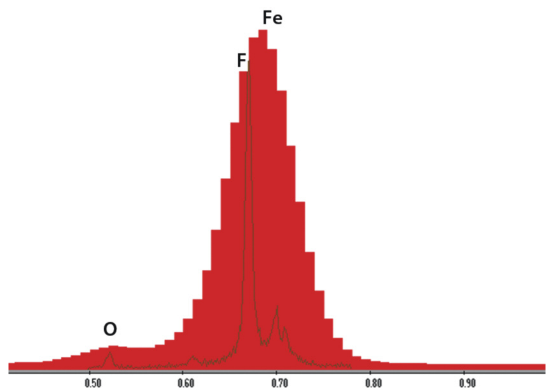


*Figure 1. EDS spectrum in red and WDS spectrum in outline show clearly that WDS offers much better energy resolution and peak deconvolution than EDS.*

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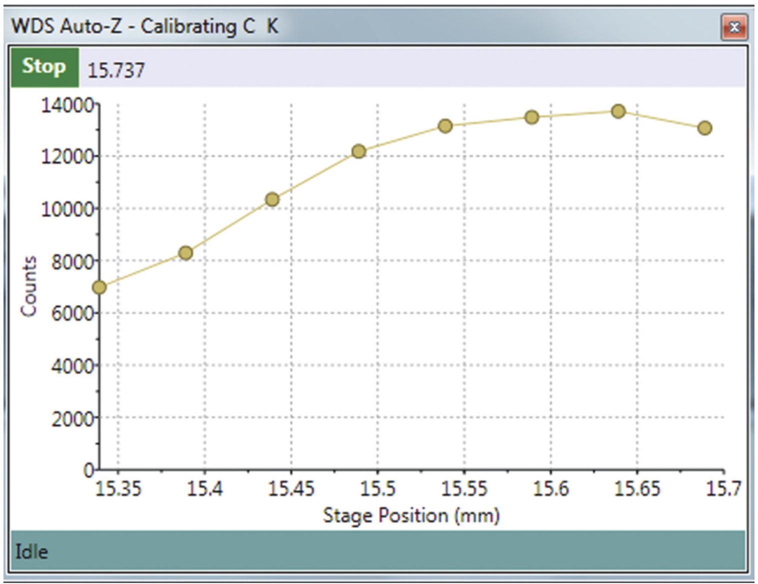


*Figure 2. Smart Focus routine optimizes sample height by moving the stage in fine increments until the maximum sweet spot (15.63 mm) is reached.*

The key to improving the usability of WDS is EDAX's introduction of Smart Focus, a fully automated focusing routine that provides complete microscope optimization for WDS analysis. This Smart feature optimizes the stage position relative to the WDS optic, guaranteeing the highest intensity for each element.

By ensuring the highest quality data is collected on the first iteration, Smart Focus brings a new level of speed and ease of use to WDS analysis. With Smart Focus, the user is able to solve an EDS peak overlap in three clicks of the mouse without going through the process of focusing the optic.

TEAM™ WDS is completely integrated with TEAM™ EDS, allowing the user to transition seamlessly between the techniques as required by the sample. After collecting an EDS spectrum, the user can simply highlight the area or peak of concern on the EDS results, and TEAM™ WDS will perform a spectral acquisition over that energy range, displaying the two spectra side by side for comparison.

For samples with known overlaps or where trace analysis is predetermined, the TEAM™ Analysis System is also able to collect EDS and WDS simultaneously, maximizing productivity for the user and providing a highly efficient workflow.

The TEAM™ Analysis System pairs TEAM™ WDS software with a parallel beam WDS spectrometer. The EDAX spectrometer design can be mounted on most EDS ports on a scanning electron microscope (SEM), allowing the user greater freedom in system configuration compared to alternative WDS systems. Additionally, the EDAX spectrometer excels in a wide range of operating conditions from low currents for beam sensitive materials to high currents more typical of WDS analysis.

The launch of the TEAM™ WDS Analysis System brings all three microanalysis techniques - EDS, EBSD and WDS - into one common, easy to use interface and creates the industry's most comprehensive analytical system. The TEAM™ Analysis System provides EDAX's users with maximum insight in minimal time to solve their materials characterization challenges.

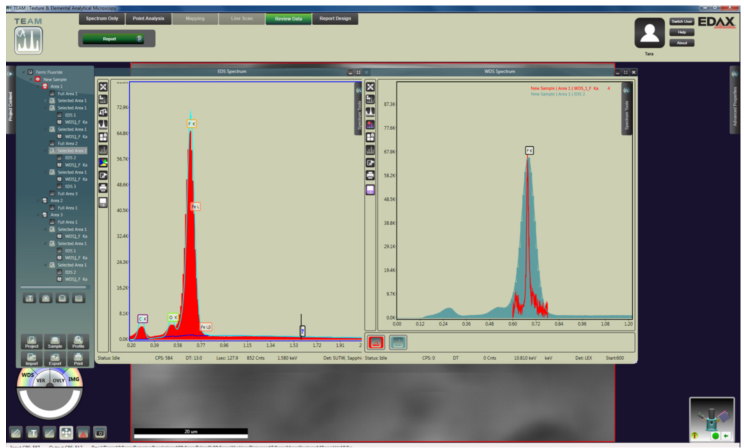


*Figure 3. Side by side display of EDS and WDS spectra from an integrated acquisition.*

# TEAM™ WDS Element Scan Simplifies Peak Separation and Trace Element Detection Analyses

**Element Scan**

WDS optimization using the Element Scan routines allows the user to tailor data collection specifically to a particular goal: fine peak separation or trace element detection. The microanalysis data required to solve each of these goals differs and, in the past, an advanced level of knowledge was required to set up the WDS in order to capture the relevant data. Now, using the TEAM™ WDS software, these parameters are set automatically once the user identifies the element and energy line of interest and clicks on the analysis goal.

| *If your goal is* | *What you need is* | *TEAM™ software provides* |
|---|---|---|
| PEAK SEPARATION | Best resolution | Element Scan with Better Resolution setting |
| TRACE ELEMENT DETECTION | Highest intensity | Element Scan with Higher Intensity setting |

**EDS / WDS Comparison**

A sample analysis is required of a fluorinated surface layer on an iron part. Unfortunately, the energy of Fe L lines are very close to the energy of the F K X-rays which produces an overlap situation, Figure 1. The use of a high resolution X-ray spectrometer like WDS is needed to resolve the F K and the Fe L lines.

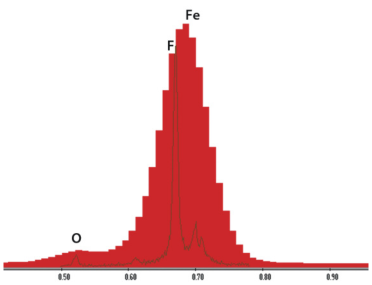


*Figure 1. Overlay of WDS spectrum in outline over the broad EDS overlapping peaks in red.*

The diffractors in WDS collect X-rays over a range of energies. Depending upon the diffractors mounted in the WDS spectrometer, small energy ranges exist at the edges of these ranges where two or more potential diffractors can be used to collect X-rays. The selection process for the "best" diffractor can seem complicated, but is usually delineated into Peak Separation and Trace Element Detection acquisitions.

**Peak Separation and Trace Element Detection**

For a Peak Separation task, the diffractor that provides the best spectral resolution is preferred; whereas, for a Trace Element Detection task a diffractor with the highest sensitivity (intensity) is preferred. If multiple diffractors are an option, the one with the larger d-spacing is preferred for trace analysis while the one with the smaller d-spacing is preferred for peak separation.

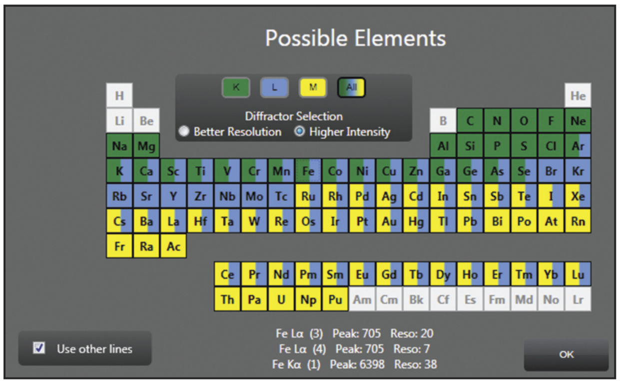


*Figure 2. Element selection screen with options for Fe selected.*

As seen at the bottom of the Element Selection screen shown in Figure 2, the analyst has selected to analyze the sample for Fe and has a choice of two diffractors (D3 and D4) for the L line, and one (D1) for the K line. If the goal of the analysis is peak separation and the L line is chosen, the TEAM™ WDS software will automatically choose the D4 diffractor, which will give results with the best resolution. If the goal is trace element detection, the D3 diffractor will be used, giving the highest intensity.

The WDS Elemental scans for each of these diffractors is shown in Figure 3 using the same vertical scaling. The intensity of the D3 diffractor is significantly higher than that of the D4 diffractor. This observation is not so important for the high F K peak but is significant in identifying the much lower intensity Fe L lines. However, the spectral resolution using this diffractor does not fully separate the F K, Fe La1 and Fe Lb1 peaks. Use of the D4 diffractor more clearly separates each of these peaks, especially the Fe La1 and Fe Lb1 peaks, for visual identification but at a reduced intensity.

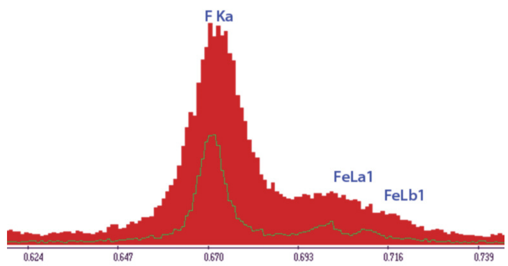


*Figure 3. Comparison of the WDS analysis results obtained using D3 (red) and D4 (outline) crystals.*

**Conclusion**

As advances in microanalytical hardware technology improve performance, precise software optimization becomes increasingly more important. The Element Scan routines within the TEAM™ WDS software guarantee the best data collection possible, allowing all users to achieve the highest level of insight into their material.

# TEAM™ Trident Helps Engineer Better Wear Materials

Tungsten Carbide (WC) is a ceramic material used in many industrial applications and is well known for its abrasion resistance and ability to withstand high temperatures. One standard application is for cutting tools, where the WC is typically cemented together with a binder material, usually metal such as Cobalt (Co). The metal forms a ductile matrix phase which counters the brittle nature of the WC grains, raising the toughness and durability of the tool.

Engineers can control the properties of the cutting tool by varying the WC grain size and the binder content in the matrix, enabling them to maximize tool performance and lifetime for specific application needs. For example, smaller WC grains produce a harder final product, increasing wear resistance and decreasing erosion, but also decreasing strength and toughness. By contrast, if the product is to operate in thermal extremes, engineers will design tools with larger WC grains for increased resistance to thermal shock. In terms of the binder material, higher levels of Co will lead to an increase in crack resistance, but decrease abrasive wear resistance.

Table 1 shows some examples of application requirements correlated to microstructure trait and characterization method. In each case, advanced characterization of the cemented carbide is required to design and control the production of the cutting tool for optimized results. To fully understand the microstructure and the resulting properties, engineers rely on chemical (Energy Dispersive Spectroscopy (EDS) and Wavelength Dispersive Spectrometry (WDS)) and structural (Electron Backscatter Diffraction (EBSD)) analysis.

| Application Requirement | Chemical/Structural Need | Characterization Tool |
|---|---|---|
| High Abrasion Resistance | Small WC Grains | EBSD |
| Thermal Shock Resistance | Higher Binder content; characterization of the binder and additives | WDS |
| High Compression Resistance | Co and C Content & Distribution | EDS/Phase Mapping |

*Table 1. WC application requirements correlated to microstructure trait and characterization method.*

### High Abrasion Resistance - Grain Size Analysis (EBSD)

EBSD is an ideal characterization tool for measuring the grain size of crystalline materials, particularly when the WC grain size approaches the resolution limits of optical microscopy. By indexing the orientation of grains on the sample surface, engineers are able to measure not only grain orientation but also size, shape and distribution and to determine materials phases.

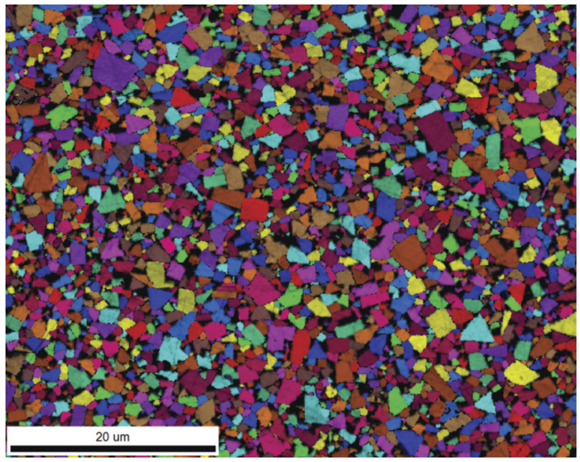


*Figure 1a. EBSD grain map showing grain structures in a WC material where individual grains highlight size and morphology.*

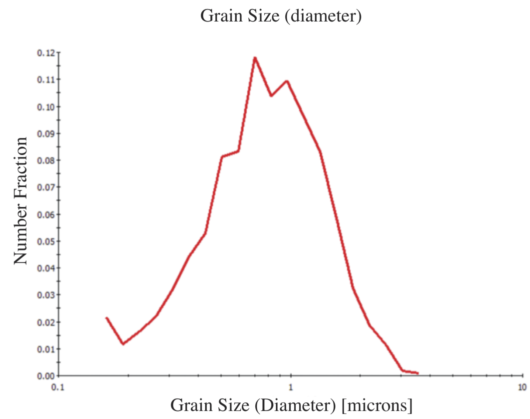


*Figure 1b. Corresponding grain size distribution resulting from the map in figure 1a.*

Figure 1a is an EBSD grain map showing grain structures in a WC material where individual grains are randomly colored to highlight size and morphology. Figure 1b is the corresponding grain size distribution resulting from the map in Figure 1a. The average grain size in this case is 880 nm.

### High Compression Resistance – Co and C distribution (EDS/Phase Mapping)

For tools operating in a high compression application, lifetime is strongly affected by the amount of Co and C in the matrix and by the distribution of these elements.

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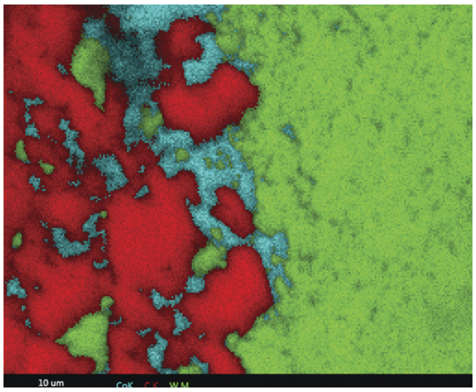


*Figure 2a. Elemental map of W (green), Co (blue) and C (red).*

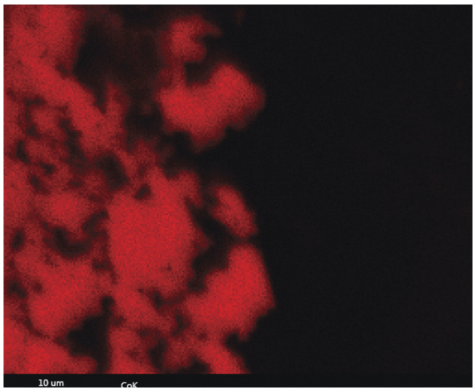


*Figure 2b. Standard C elemental map.*

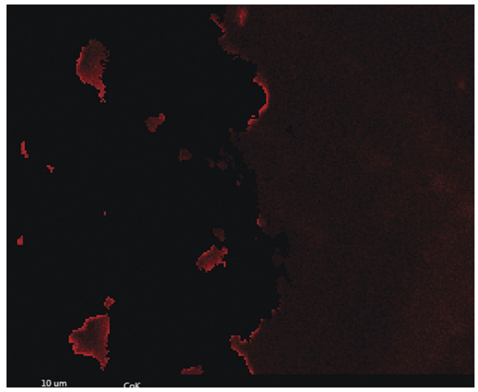


*Figure 2c. Map of C from WC phase only.*

EDS elemental mapping is sufficient to examine the distribution of Co in the microstructure, as shown in figure 2a, but C is much more difficult because of its association with W in WC and its existence as elemental C (see Figure 2b). Standard elemental mapping cannot distinguish between C in different phases. EDAX's Smart Phase Mapping has the unique ability to be able to look at C distribution as it relates to each phase; whereas, competitive systems provide only overall distribution. Engineers gain invaluable insight from this accurate depiction of the microstructure.

**Thermal Shock Resistance – Binder concentration and additives (WDS)**

The thermal shock properties of WC tools are controlled by the varying percentage of the binder phase and with specific binder additives to modify transport properties of the final composition. While EDS is often sufficient to analyze the amount of binder present, the additives are often present in minute amounts, requiring the trace analysis capabilities of WDS. Figure 3 shows two WDS spectra from a binder phase, one with trace Fe additive and one without. The increased sensitivity of WDS, paired with the resolution necessary to resolve crowded low energy X-ray lines, allows engineers to make very small changes to binder composition and design the thermal properties of the tool to match the application.

**Conclusion**

EDAX's TEAM™ Trident combines the power of EDS, EBSD and WDS into a smart, easy to use platform and creates the most comprehensive analysis system on the market. With complete integration and optimum workflow, TEAM™ Trident is the ultimate tool to solve the most difficult characterization problems, and allows engineers to design a better tool.

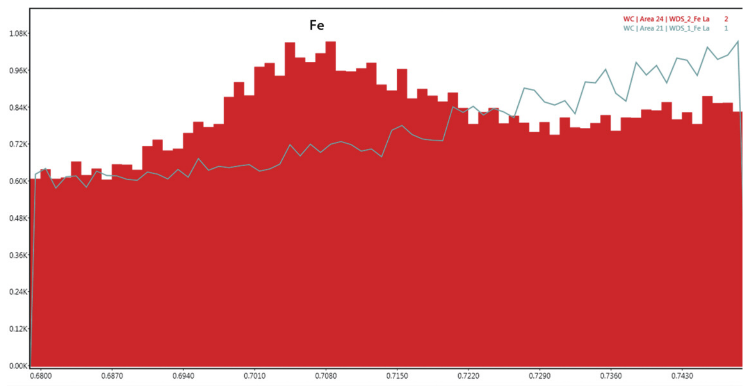


*Figure 3. WDS spectra from two different regions of the binder phase.*

EVENTS AND TRAINING

# Worldwide Events

| | |
|---|---|
| **July 7-11** | |
| Integrated Computational Materials Engineering | Salt Lake City, UT |
| **August 4-8** | |
| Microscopy & Microanalysis 2013 | Indianapolis, IN |
| **August 11-16** | |
| International Materials Research Congress | Cancun, Mexico |
| **August 25-30** | |
| MC Regensburg | Regensburg, Germany |
| **September 3-6** | |
| EMAG 2013 | York, UK |
| **September 18-20** | |
| Materialographie | Friedrichshafen, Germany |
| **October 27-31** | |
| MS&T 2013 | Montreal, Quebec, Canada |
| **November 5-6** | |
| ISTFA | San Jose, CA |

Please visit www.edax.com for a complete list of our tradeshows.

# 2013 Worldwide Training

To help our present and potential customers obtain the most from their equipment and to increase their expertise in EDS microanalysis, WDS microanalysis, EBSD/OIM™ , and Micro-XRF systems, we organize a number of Operator Courses at the EDAX facilities in North America; Tilburg, NL; Wiesbaden, Germany; Japan, and China.

## EUROPE

**EDS Microanalysis**

| | |
|---|---|
| September 12-13, 2013 | Tilburg |
| November 7-8, 2013 | Tilburg |
| **TEAM™ EDS** | |
| September 24-26, 2013 | Tilburg |
| November 11-13, 2013 | Wiesbaden |
| **Genesis** | |
| November 19-21, 2013 | Tilburg |

**EBSD**

| | |
|---|---|
| September 9-11, 2013 | Tilburg |
| November 4-6, 2013 | Tilburg |
| November 13-15, 2013 | Wiesbaden |

**TEAM™ EDS & EBSD (Pegasus)**

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|---|---|
| November 11-15, 2013 | Wiesbaden |

**WDS LEXS**

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|---|---|
| October 8-9, 2013 | Tilburg |

**Orbis: Course & Workshop Presented in English**

| | |
|---|---|
| October 29-30, 2013 | Wiesbaden |

## JAPAN

**EDS Microanalysis**

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|---|---|
| **Genesis** | |
| October 10-11, 2013 | Tokyo |
| November 14-15, 2013 | Osaka |
| **TEAM™ EDS** | |
| July 11-12, 2013 | Osaka |

## CHINA

**EDS Microanalysis**

| | |
|---|---|
| **TEAM™ EDS** | |
| September 24-26, 2013 | Shanghai |
| October 10, 2013 | Xi'an |
| December 3-5, 2013 | Shanghai |

**EBSD OIM™ Academy**

| | |
|---|---|
| October 15-17, 2013 | Shanghai |

## NORTH AMERICA

**EDS Microanalysis**

| | |
|---|---|
| **TEAM™ EDS** | |
| July 16-18, 2013 | Draper, UT |
| September 17-19, 2013 | Mahwah, NJ |

**EBSD OIM™ Academy**

| | |
|---|---|
| November 12-14, 2013 | Mahwah, NJ |

**Micro-XRF**

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| October 1-3, 2013 | Mahwah, NJ |

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AMETEK® MATERIALS ANALYSIS DIVISION

EMPLOYEE SPOTLIGHT

# Tobias Lorenz

Tobias joined EDAX in November 2007 as Field Service Engineer for Germany, Austria and Switzerland. He is located in the south of Germany near Stuttgart.

Prior to EDAX, Tobias worked as a Field Service Engineer for the Holzmann Service Group servicing domestic appliances for the United States Army in southern Germany from 1998-2002. In this job, he improved his knowledge of the English language and learned a lot about American culture. From 2001-2007, Tobias worked as a Sales and Service Engineer for an Italian company, Etipack Labeling Systems in Germany. Previously, he attended vocational school where he trained as an electromechanical technician.

Tobias and his partner, Tatjana, have lived in Waiblingen near Stuttgart for the past three years. In his spare time, Tobias enjoys hiking and spending time with his family, friends and dog, Vito.


# Kim Meyer

Kim joined EDAX in February 1986 in the purchasing department as a Purchasing Clerk. She has been with EDAX in the Mahwah, NJ facility for over 27 years. Today, as a Senior Planner/Buyer, Kim is responsible for the planning and purchasing of materials for the manufacturing floor to meet customers' delivery requirements. She works closely with the engineering department on various team projects and supports the service department when parts are needed for customers. Kim enjoys working with suppliers and building partnerships that will benefit both EDAX and the supplier. She is also an ISO Internal Auditor for the EDAX organization.

Kim attended the County College of Morris where she earned an associate's degree in Psychology. She then went onto Montclair State University and also attended Dutchess BOCES for additional training in electronics.

Kim currently lives in Wappingers Falls, NY with her husband Keith and her two children, Deanna (21) and Brandon (16). Outside of EDAX, she has been involved with her local school district as PTA Council President and was a parent representative on several school committees. In her spare time, Kim enjoys playing tennis, running/walking, reading biographies and attending her kids' various sports activities. She loves the hot weather and usually heads to the beach every summer for vacation.

CUSTOMER NEWS

# Freudenberg-NOK Sealing Technologies Plymouth, Michigan

Freudenberg-NOK Sealing Technologies is a leading producer of advanced sealing technologies and rubber products for a variety of performance applications, including: aerospace, agriculture, appliance, automotive, construction, diesel engine, energy, food and beverage, heavy industry and pharmaceuticals. Founded in 1989, Freudenberg-NOK is headquartered in Plymouth, Michigan with 22 facilities throughout North America. The company also performs product analysis and reverse engineering on samples sent from the United States, Canada, Mexico and South America.

One of the challenges currently facing Freudenberg-NOK is detecting silane-based adhesives on a matrix of rubber filled with silicon-based minerals. The details of this complex process are important because much of the company's work deals with adhesion analysis.

To help solve this issue, Freudenberg-NOK purchased an EDAX Octane Silicon Drift Detector (SDD). One of the company's busiest instruments, the Octane SDD, along with the TEAM™ EDS Analysis System, allows the lab chemists to quickly and effectively analyze materials. They use the data to complement information obtained from the company's Fourier Transform Infrared Spectrometers, which provide information concerning chemical structure.

"EDAX is the analysis system we are most familiar with," stated Fred Fraser, Analytical Lab Manager. "We have had good experiences with the company and the equipment works very well. One other important consideration is the organization's ability to address technical questions. EDAX has done this in a prompt and professional manner."


*Chemist Ryan Fleming uses an EDAX Octane Silicon Drift Detector in Freudenberg-NOK Sealing Technologies' Analytical Laboratory.*

**EDAX Inc.**
**91 McKee Drive**
**Mahwah, NJ 07430**
**Phone (201) 529-4880**
**E-mail: info.edax@ametek.com**
**www.edax.com**

**Art and Layout**
Jonathan McMenamin

**Contributing Writers**
Sue Arnell
Patrick Camus
Mike Coy
Tara Nylese

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