

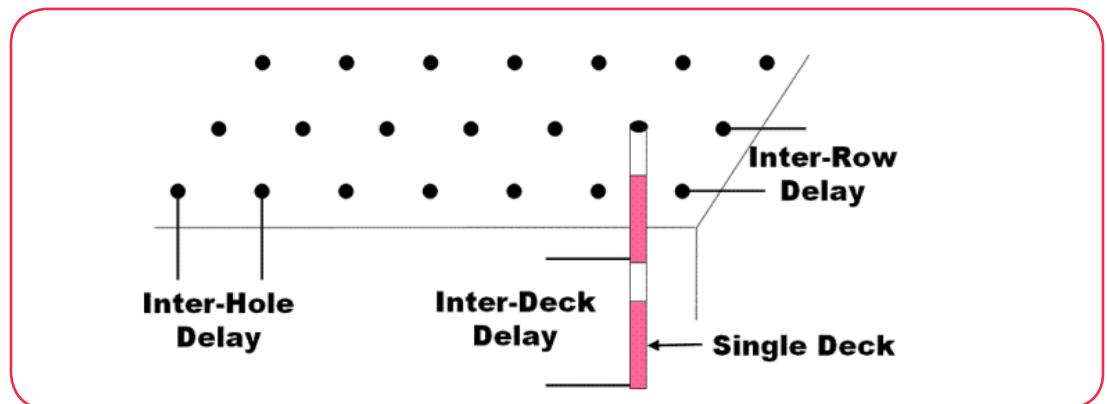
Signature Hole Analysis

Bob Turnbull, Product Manager

What is Signature Hole Analysis and why is it such a hot topic in the industry?

Signature Hole Analysis is a modeling technique used to help control blast induced vibrations. The process involves controlling the frequency content by adjusting delay times within a blast containing several explosive charges. The risk to adjacent structures is thereby mitigated. This method of simulating waveforms has been around for several years. Today, with the growing adoption rate of electronic initiation systems as a tool to control nuisance vibrations, the modeling techniques are becoming more popular.

InstanTEL has recently developed and launched a Signature Hole Analysis software tool. This tool will be included in the Blastware® Advanced Module software.



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Common terms that will be used throughout this article and in the Blastware software are:

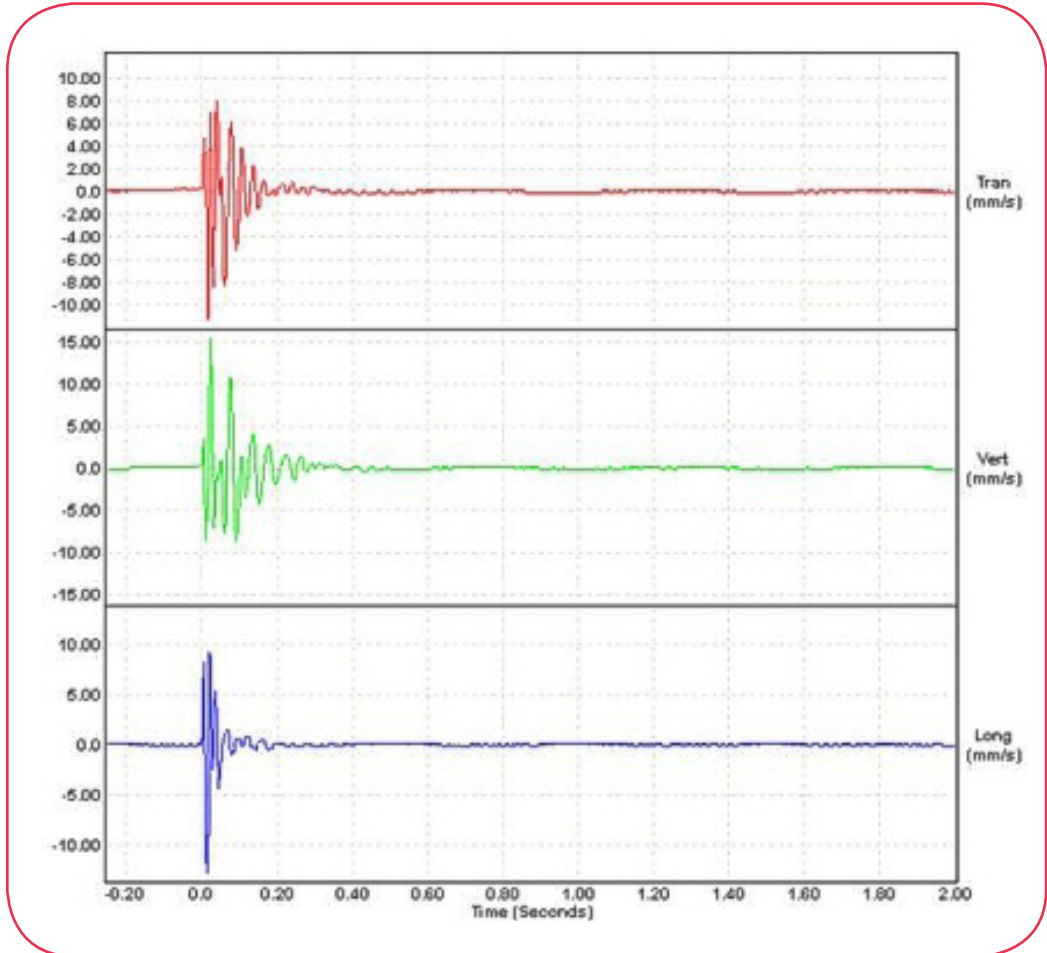
1. **Inter-Deck Delay** is the delay time between charges within one hole.
2. **Inter-Hole Delay** is the delay time between consecutive holes.
3. **Inter-Row Delay** is the delay between consecutive rows.
4. A **Signature Hole** can be a single hole with a single deck of explosives, a single hole with multiple decks for explosives, or a complete row of holes with or without multiple decks.
5. A **Signature Hole Waveform** is the vibration recorded from a Signature Hole.
6. A **Timeline File** is a data file that contains all of the time delays, relative to time zero (the actual initiation time) for the entire blast.

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The basic assumption used for Signature Hole Analysis is: The Signature Hole Waveform is representative of the vibration, both in frequency and amplitude, that all other charges or combination of charges will produce within a blast.

The seismograph can now be set up to record the Signature Hole Waveform. Depending on the distance and expected vibration level, the geophone must be installed and coupled properly.



Signature Hole Vibration Waveform

With the Signature Hole Waveform you can now simulate all the different blast timing delays you might want to use. The number of decks per hole, holes per row and the number of rows in the blast, as well as the desired range of delay times, are entered into the Timeline Generation tool.

In the example below, only one deck per hole is displayed, so inter-deck delay times are not required. The remaining values are 12 holes per row with inter-hole delays from 15 to 25 milliseconds, and seven rows in the blast with inter-row delays from 100 to 135 milliseconds. Associated to each of these delay ranges is an increment value. These values are the size of the steps in the delay range that the Blastware software will use to create the event simulations. This allows one to select a wider range of delays and increase the size of the steps to quickly narrow down the delay values that will produce the best simulation waveform.

Timeline Generation
(assumes a corner blast)

Number of Decks per Hole: 1

Inter-Deck Delay

Start: 0 msec, End: 0 msec, Increment: 1 msec

Number of Holes Per Row: 12

Inter-Hole Delay

Start: 15 msec, End: 25 msec, Increment: 5 msec

Number of Rows: 7

Inter-Row Delay

Start: 100 msec, End: 135 msec, Increment: 5 msec

Timeline Generation Tool

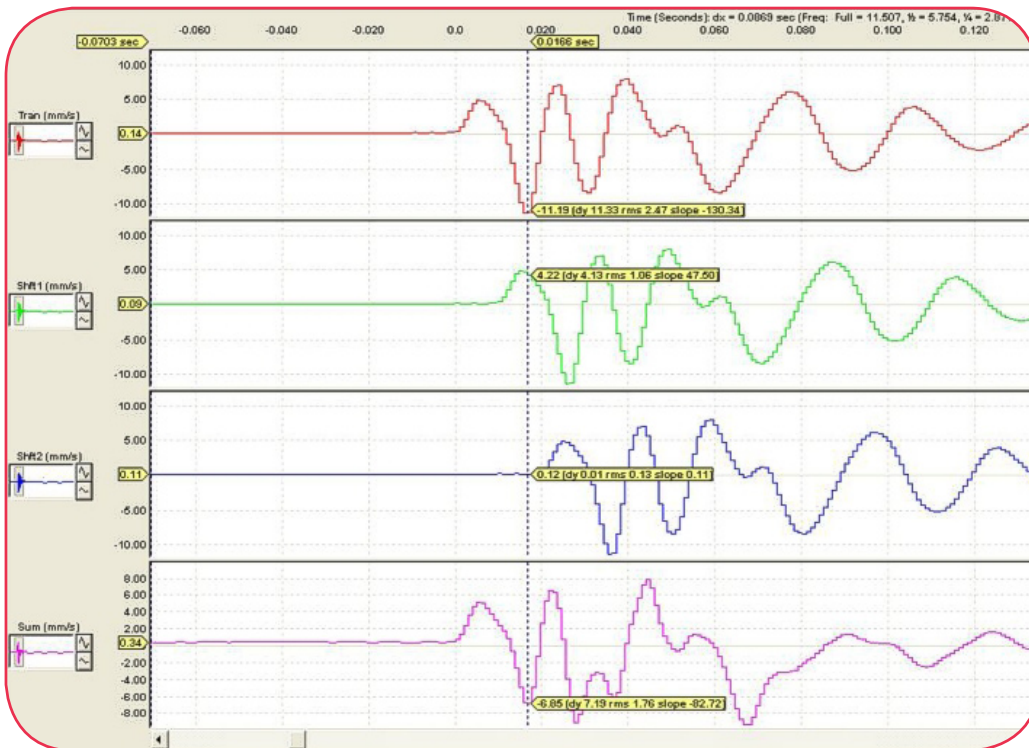
Charge Num	Row Num	Hole Num	Deck Num	Initiation Time (ms)	Travel Time (ms)	Arrival Time (ms)	Scale Factor
1	1	1	1	0	0	0	1.00
2	1	2	1	15	0	15	1.00
3	1	3	1	30	0	30	1.00
4	1	4	1	45	0	45	1.00
5	1	5	1	60	0	60	1.00
6	1	6	1	75	0	75	1.00
7	1	7	1	90	0	90	1.00
8	1	8	1	105	0	105	1.00
9	1	9	1	120	0	120	1.00
10	1	10	1	135	0	135	1.00
11	1	11	1	150	0	150	1.00
12	1	12	1	165	0	165	1.00
13	2	1	1	120	0	120	1.00
14	2	2	1	135	0	135	1.00
15	2	3	1	150	0	150	1.00
16	2	4	1	165	0	165	1.00
17	2	5	1	180	0	180	1.00
18	2	6	1	195	0	195	1.00
19	2	7	1	210	0	210	1.00
20	2	8	1	225	0	225	1.00
21	2	9	1	240	0	240	1.00
22	2	10	1	255	0	255	1.00
23	2	11	1	270	0	270	1.00
24	2	12	1	285	0	285	1.00
25	3	1	1	240	0	240	1.00
26	3	2	1	255	0	255	1.00
27	3	3	1	270	0	270	1.00
28	3	4	1	285	0	285	1.00
29	3	5	1	300	0	300	1.00

Sample Timeline File

Have a Project You Would Like to Nominate for an InstanTel Innovation Award?

Visit the InstanTel web site at www.instanTel.com for more information.

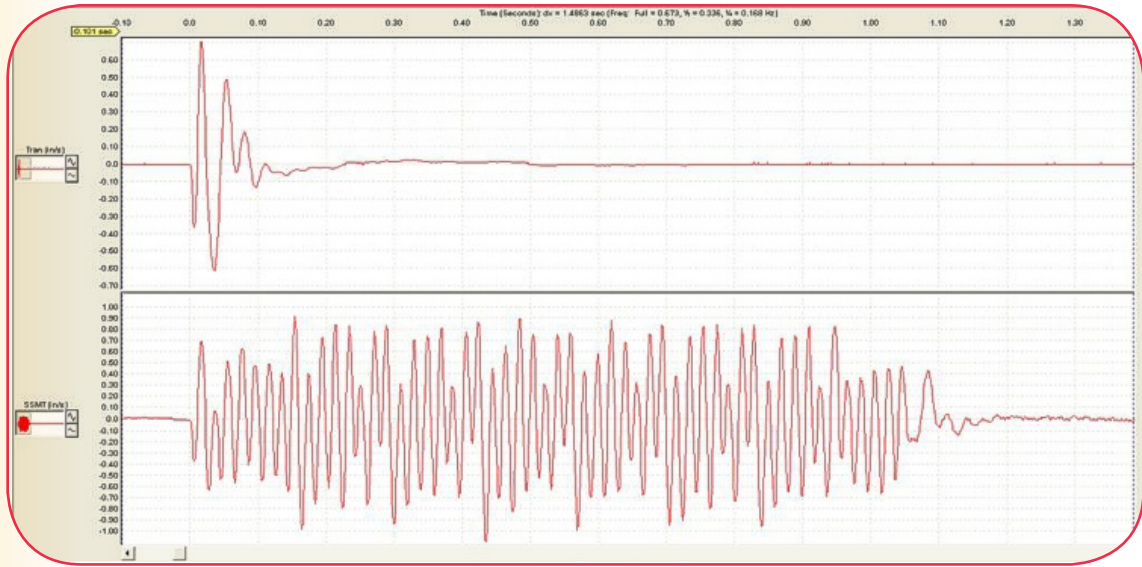
The basic concept to generate the simulation waveforms is to take each vibration channel, shift it in time for each of the blast delays and add it back to the original waveform to produce the final simulated waveform. This process is called the Superposition of Waveforms. The example below shows the "Tran" channel as the original waveform then shows it shifted by 10 milliseconds to produce "Shft1" and another 10 milliseconds to produce "Shft2". All of these waveforms are then added together to produce "Sum" at the bottom of the image.



Superposition of Waveforms

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The final result, after all the individual charge delays have been added, would produce a simulation waveform like the one below.



Final Simulation Waveform

Sorting Options			
	Operator	Value	Priority
PFV (mm/s)	Less Than	75	3
PVS (mm/s)	Less Than	80	4
Dominant FFT Frequency (Hz)	Greater Than	45	2
Upper to Lower Frequency Ratio	Greater Than	2	1
Frequency Ratio			
Upper (Hz)	21	to	80
Lower (Hz)	2	to	20
<input checked="" type="checkbox"/> Apply Sort Options			
Clear All			

The Signature Hole Analysis tools allow you to simulate a large number of charge delay times very quickly. All of the simulation waveforms and timeline files are conveniently saved in a user specified project directory for convenient reference and future use. To manually search through all of these simulations for the best result would be a very time consuming and tedious task. To simplify this process, InstanTel offers a wide variety of sort options to quickly and efficiently reduce the results down to a manageable number.

Blastware Simulation Waveform Sorting Options

Once the sort criterion has been applied to the complete list of waveform simulations, the remaining entries will be displayed in a tabular format. Refining the sort criteria and redisplaying the results only takes seconds. These results can be further sorted by simply clicking on any of the column titles to sort the displayed entries in an ascending or descending order.

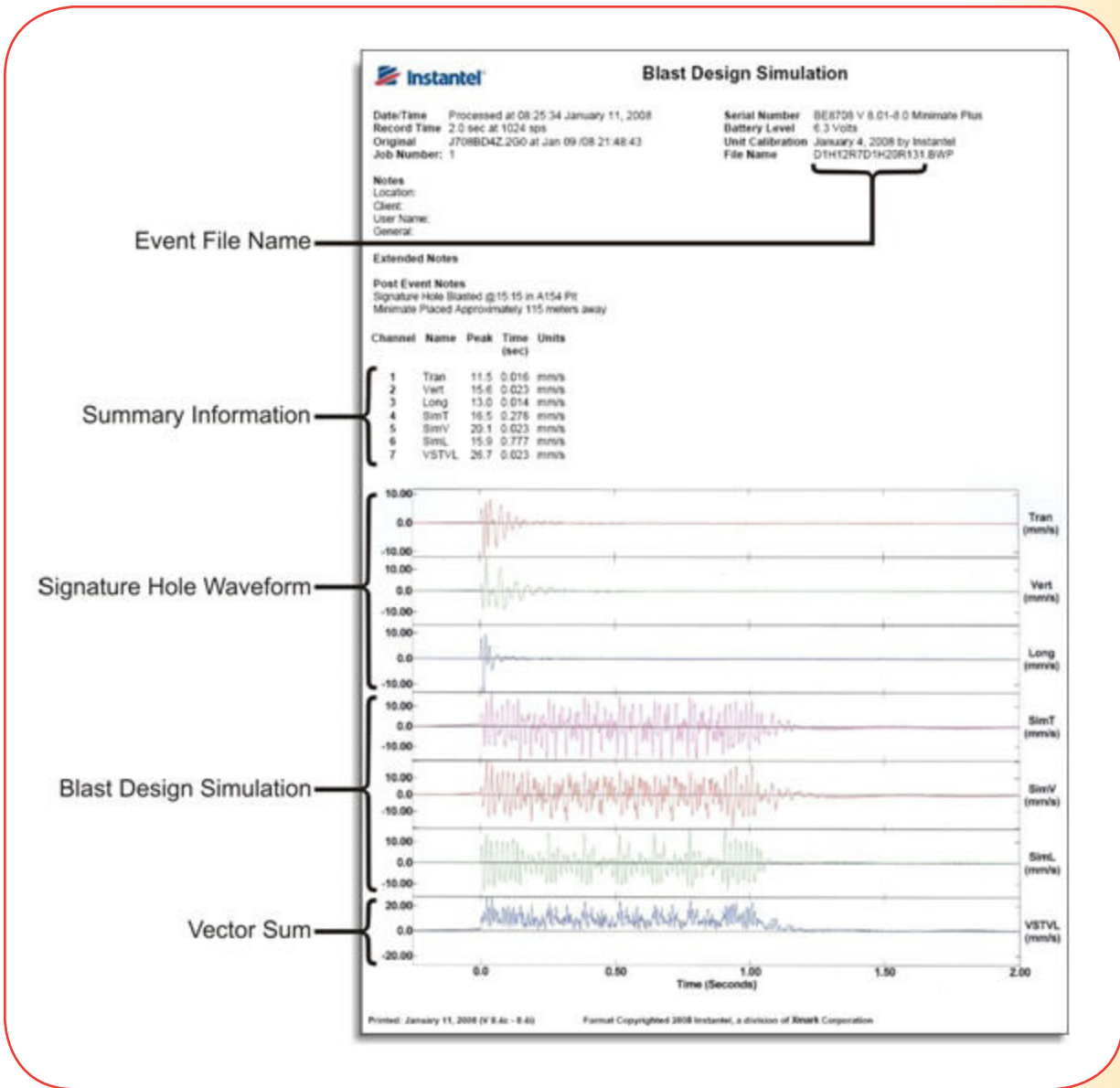
Filename (Double Click to view)	Blast Timing			Peak Particle Velocity				PVS	Dominant FFT Frequency				Upper/Lower Frequency Ratio			
	Deck Delay (msec)	Hole Delay (msec)	Row Delay (msec)	Trans (in/s)	Vert (in/s)	Long (in/s)	Peak (in/s)	Peak Vector Sum	Trans (Hz)	Vert (Hz)	Long (Hz)	Peak (Hz)	Trans	Vert	Long	Peak
	1H12R7D0H15R100.BWP	0	15	100	0.432	1.070	1.320	1.320	1.560	19.900	30.100	9.630	30.100	0.070	0.146	0.127
1H12R7D0H15R105.BWP	0	15	105	0.572	1.390	1.660	1.660	2.050	19.000	66.800	9.250	66.800	0.029	0.062	0.052	0.062
1H12R7D0H15R110.BWP	0	15	110	0.467	1.100	1.330	1.330	1.670	8.880	63.900	9.000	63.900	0.081	0.171	0.147	0.171
1H12R7D0H15R115.BWP	0	15	115	0.530	1.050	1.540	1.540	1.580	8.630	69.400	8.630	69.400	0.331	0.685	0.624	0.685
1H12R7D0H15R120.BWP	0	15	120	0.516	1.300	1.690	1.690	1.760	8.380	66.800	8.250	66.800	0.082	0.175	0.144	0.175
1H12R7D0H15R125.BWP	0	15	125	0.391	0.952	1.260	1.260	1.500	8.130	64.100	8.000	64.100	0.439	0.910	0.797	0.910
1H12R7D0H15R130.BWP	0	15	130	0.345	0.972	1.410	1.410	1.450	8.000	69.100	7.750	69.100	0.081	0.175	0.153	0.175
1H12R7D0H15R135.BWP	0	15	135	0.451	1.400	1.220	1.400	1.500	66.500	66.800	7.500	66.800	0.333	0.685	0.587	0.685
1H12R7D0H15R140.BWP	0	20	100	0.514	1.950	1.600	1.950	2.040	10.300	50.000	49.900	50.000	0.037	0.079	0.066	0.079
1H12R7D0H15R145.BWP	0	20	105	0.529	1.100	1.390	1.390	1.410	19.000	47.900	9.750	47.900	0.099	0.205	0.179	0.205
1H12R7D0H15R150.BWP	0	20	110	0.509	0.882	1.030	1.030	1.140	27.300	27.300	9.380	27.300	0.017	0.042	0.037	0.042
1H12R7D0H15R155.BWP	0	20	115	0.458	1.440	1.000	1.440	1.510	26.400	52.000	51.900	52.000	0.134	0.288	0.251	0.288
1H12R7D0H15R160.BWP	0	20	120	0.328	1.320	1.100	1.320	1.620	50.100	50.000	49.900	50.100	0.046	0.102	0.097	0.102

Signature Hole Analysis Table

Once you have selected the delay times that best suite your requirements, the simulated waveforms can be viewed to make sure the results look like what you would expect from the associated time delays.

In conclusion, the Signature Hole Analysis software tool may be used to help you optimize and improve your blast performance. This is a modeling tool that is intended to assist you in blast design; however, it is not intended to replace proper training and standard blasting practices and experience.

Please contact InstanTel for more information about the Signature Hole Analysis tool.



InstanTel Innovation Awards – Call For Nominations



For over twenty-five years, InstanTel has been honored by users who have trusted Blastmate® and Minimate® vibration monitors as their instrument of choice on ambitious and challenging projects. To recognize the outstanding vibration monitoring work that you do, InstanTel is calling for nominations for the 2009 “InstanTel Innovation Awards”.

To nominate your monitoring work from the past year on challenging projects that have shown creative and innovative solutions using InstanTel vibration monitors, go to www.instanTel.com. The purpose of the award is to celebrate ingenuity and innovation throughout the year. There is no due date for nominations and all nominations are reviewed by our Award Committee.

Innovation Award Winners receive:

- Recognition from Industry Announcements that are published in major trade publications worldwide
- A unique Crystal Innovation Globe
- Online promotion on the Innovation Awards page of the InstanTel Web site
- \$500 USD bonus to be used towards a celebratory event for your employees or customers!

Visit the InstanTel Innovation Awards page on www.instanTel.com to learn more about how you can nominate your innovative project and win!



InstanTel continues to offer InstaLink™, a web-based monitoring system which provides cost-effective remote monitoring allowing you to access data 24/7. InstaLink leverages

the Internet to automate the process of transferring vibration data directly from an InstanTel vibration monitor to secure, pass-word protected web site for viewing by approved stakeholders.

Q & A Corner

Customize InstanTEL Products to Your Preferred Interface Language

Q How do I change the language displayed on my **InstanTEL® Series III** monitor and within the **Blastware®** software?

A **InstanTEL® Series III** vibration monitors and **Blastware® Compliance Module** software support languages that use the 'Modern Latin' alphabet characters set, including English, French, Italian and Spanish.

The language files currently available for **Blastware Compliance Module** software can be downloaded from the **InstanTEL** website at www.instanTEL.com. Once you have downloaded your preferred language file, move it to the following directory: C:/Blastware8/System/Lang. For your language files to work they must be selected in both the software reports and monitor displays.

To program the language files for the software and monitor, follow these easy steps:

Blastware Reports:

- 1) Open the PC Reports Option dialog box found in the "Report Options" icon
- 2) Choose the "Language" dropdown menu and select your language preference.

Series III Monitors:

- 1) Click on the "Unit" menu and choose the "Reload Operating System" command.
- 2) Select your language file and click the "Reload Library Components Only" command to transfer the new language to the monitor.

If your desired language file is presently not available, you can upgrade to **InstanTEL® Blastware® Advance Module** software. The **Blastware Advance Module** allows you to create your own language file or modify any of the existing files to better suit your language requirements.

Upcoming Trade Shows

Learn More about InstanTEL Products at the Following Events Near You!



See the latest technology and **visit InstanTEL at Booth #1412** during the mining industry's premier worldwide event, **MINExpo International 2008**.

September 22-24, 2008
Las Vegas, Nevada, USA

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