LA-UR- 09-06095

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Title:	PRAD0373: Equation of State Tin Shot Report
Author(s):	Alexander Saunders
Intended for:	Archiving, public release

Los Alamos
NATIONAL LABORATORY
EST. 1943

Form 836 (7/06)

Bainbridge, Joseph	188457	DE-3
Bitteker, Leo	111476	LANSCE-NS
Brooks, Bethany	188462	P-25
Campos, Eduardo	188791	P-25
Dominguez, Jose	169395	P-25
Espinoza, Camilo	092843	P-25
Fait, Jeremy	225839	P-25
Furlanetto, Michael	203247	P-23
Gray, George	098613	MST-8
Grim, Gary	188779	P-23
Hogan, Gary	089987	P-25
Hollander, Brian	172536	P-25
King, Nicholas	023852	P-23
Lewis, Douglas	152683	NSTEC
Lopez, Julian	176436	P-25
Lopez, Robert	086557	DE-3
Lovro, Luke	235719	P-25
Mariam, Fesseha	094970	P-25
Marr-Lyon, Mark	113973	DE-3
McNeil, Wendy	196665	HX-4
Meidinger, Alfred	182754	NSTEC
Merrill, Frank	105671	P-25
Morley, Deborah	085596	P-25
Morris, Christopher	081720	P-25
Murray, Matthew	083303	P-25
Nedrow, Paul	089364	P-23
Park, Nigel	200417	HX-DO
Rigg, Paulo	170311	DE-9
Rightley, Paul	118629	DE-3
Saunders, Alexander	133578	P-25
Schwartz, Cynthia	197376	P-25
Tainter, Amy	230139	P-25
Thompson, Neil	101120	P-25
Tupa, Dale	104583	P-25
Tybo, Joshua	182458	NSTEC
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Zellner, Michael	216107	DE-9

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- [ ] Composite of Every Frame of Dynamic

PRAD0373-Equation of State-Tin

Cast of Characters

Shot number: 373
Equation of State - Tin

Experimenter in Charge: Cynthia Schwartz
Principle Investigator: Cynthia Schwartz
High Explosives Person in Charge: Mark Marr-Lyon
Firing Site Leader: Robert Lopez
Secondary FSL: Joe Bainbridge
Laser Person in Charge: N/A
Camera Point of Contact: Paul Nedrow
Analysis Lead: Cynthia Schwartz
Safety Watch: Eduardo Campos
Data Acquisition System Point of Contact: Neil Thompson
Experimental Area Manager: Leo Bitteker

PRAD Core Team

Joe Bainbridge, Bethany Brooks, Eduardo Campos, Jose Domingez, Camilo Espinoza, Jeremy Fait, Gary Grim, Gary Hogan, Brian Hollander, Nicholas King, Kris Kwiatkowski, Douglas Lewis, Julian Lopez, Robert Lopez, Luke Lovro, Fesseha Mariam, Mark Marr-Lyon, Wendy McNeil, Alfred Meidinger, Frank Merrill, Deborah Morley, Christopher Morris, Matthew Murray, Paul Nedrow, Paul Rightley, Alexander Saunders, Cynthia Schwartz, Amy Tainter, Terry N. Thompson, Dale Tupa, Joshua Tybo, Aleksandra Vidisheva

Experiment Team

Cynthia Schwartz, Michael Furlanetto, George Gray, Nicholas King, Kris Kwiatkowski, Mark Marr-Lyon, Wendy McNeil, Frank Merrill, Christopher Morris, Nigel Park, Paulo Rigg, Alexander Saunders, Michael Zellner

Crystal Orientation-Dependence of Shock-Induced Phase Transitions

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When a compressed material changes phase it doesn't do so instantly. Instead it transitions through a mixed phase as it transforms to the end state phase for a given pressure, volume and temperature. Common phase diagrams show the phase boundaries as sharp lines when compression has been slowly applied and held for an infinite amount of time. When the compression is applied with high strain rate, however, the phase boundaries are no longer crisp as the kinetic effects of the crystal reorientation delay the transitions, resulting in regions of mixed phase. Molecular dynamics (MD) simulations recently have been used to examine the shock-induced transition in single crystal materials illustrating an orientation dependence of the transition stress, mechanisms, kinetics, and Hugoniot response.[1] For example, the [100] orientation of iron had a simulated transition stress higher than the experimentally determined polycrystalline value of 13 GPa by 2 Gpa.

In December, the proton radiography team performed an HE-driven experiment with tin, shocking the sample to a peak pressure with an unsupported Taylor shock wave. Below is an 18-frame time sequence of the shock moving through the tin target: decaying pressure is indicated by contrast reduction.

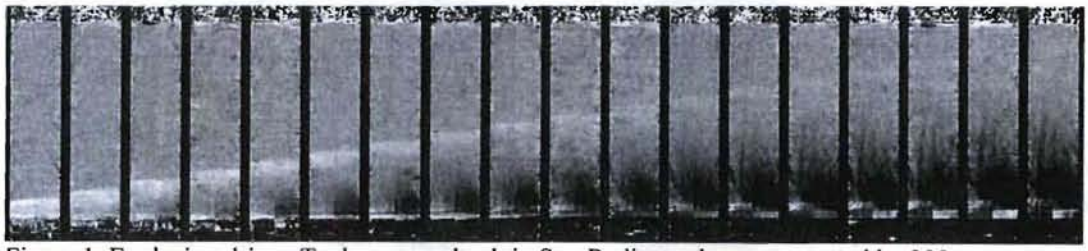


Figure 1. Explosive-driven Taylor wave shock in Sn. Radiographs are separated by 300 ns.

As the pressure decayed, we measured shock positions (velocities) and relative densities directly off the radiographs. For each radiograph, a point on the Hugoniot was measured, resulting in 18 data points on the Hugoniot from one experiment. Unfortunately, we did not drive the tin sample hard enough to successfully force a phase transition.

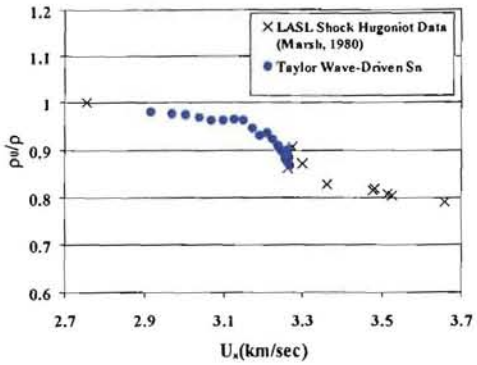
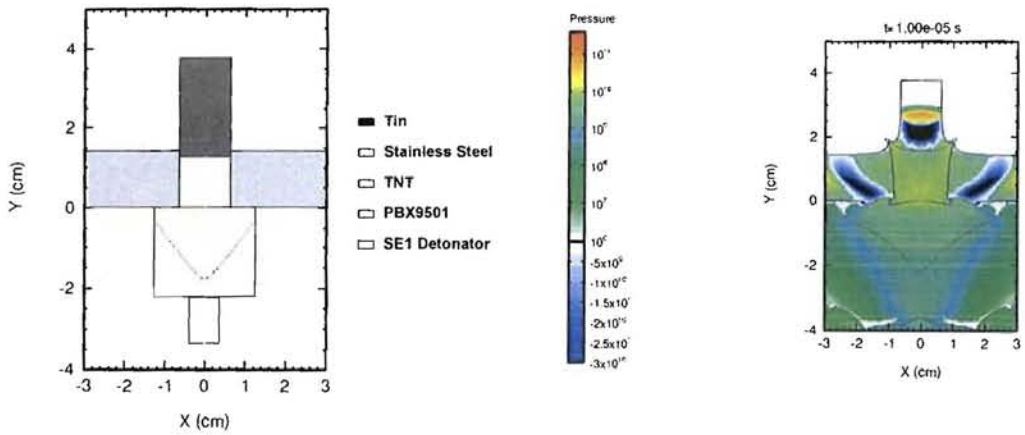


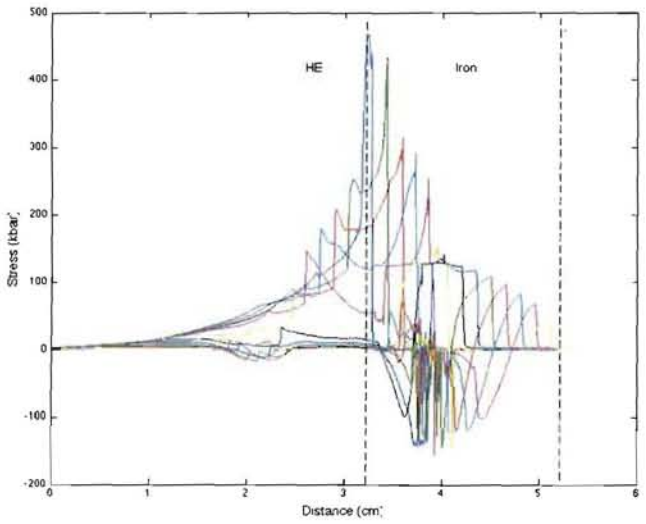
Figure 2. Each radiograph yields a shock position (velocity) and relative density measurement, plotting out points on the Hugoniot as the pressure decays

We propose a series of measurements using this newly developed technique on shock-loaded samples of different material composition and crystal orientations. Materials will include tin, iron, gallium, and zirconium. Through shock loading, we will dynamically compress polycrystalline samples as well as single crystals along different crystal planes. Since we are able to measure many points along the Hugoniot in one experiment, we will be able to determine Hugoniot response as a function of crystal structure and orientation by simply overlaying measured curves. Predicted transition stress differences are greater than 1%, which is greater than our achieved accuracy. We also intend to measure the length scale of the nucleating centers and volume fraction of mixed phase as a function of time for the targeted materials. We will use high accuracy bulk density measurements directly off the radiographs to determine the volume fraction of the two phases. Additionally, with quantitative relative density measurements, we will look for features in the region of the mixed phase, such as any ramping density change over time.

A preliminary shot design is pictured below. It consists of a 25mm plane-wave lens with a nearly 1.0 mm thick Stainless Steel ring and ¼ inch of PBX9501 booster. With this P-25 lens, the target sample is driven to high enough peak pressure (~400kbar) for all the target materials, Fe, Ga, Zr and Sn to completely transition phase. To optimize the radiography, the target samples will be 12.7mm (1/2inch) diameter and 25mm thick.



We have run CTH simulations with a tin target sample and looked at the pressure profile down the center of sample. The pressures are relatively constant around the center plane. This is important to measure the most accurate shock velocities and densities. For the iron sample, a CTH run with a P25 lens in direct contact with a 12mm diameter x 20mm thick iron cylinder and is profiled below. The α->ε phase transition is noticeable at approximately 3/4 cm into the iron target.

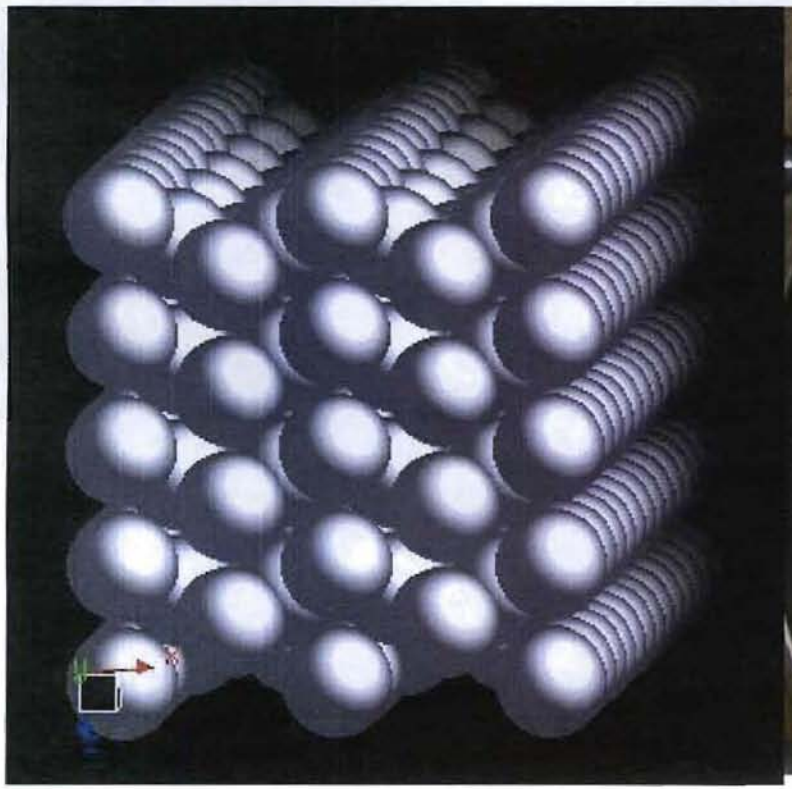


We are presently running more CTH simulations with various shot configurations with and without 9501 booster, with stacked boosters, and with the suite of target materials.

1. K. Kadau, T. C. Germann, P. S. Lomdahl, and B. L. Holian, "Atomistic simulations of shock-induced transformations and their orientation dependence in bcc Fe single crystals", Phys. Rev. B, **72**, 064120 (2005).

Crystal Orientation-Dependence of Shock-Induced Phase Transitions

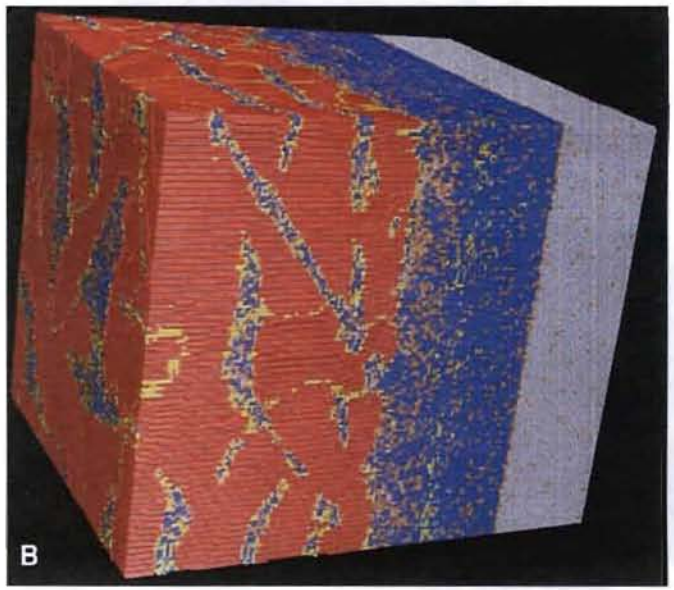
Cynthia L. Schwartz,
Los Alamos National Laboratory



Transition Stress, Mechanisms, Kinetics and Hugoniot response depend on crystal orientation

Polycrystalline Material

- Distribution of grain orientations
- Grain boundaries serve as heterogeneous nucleation sites
- Decreased transformation threshold
- Fast mechanism

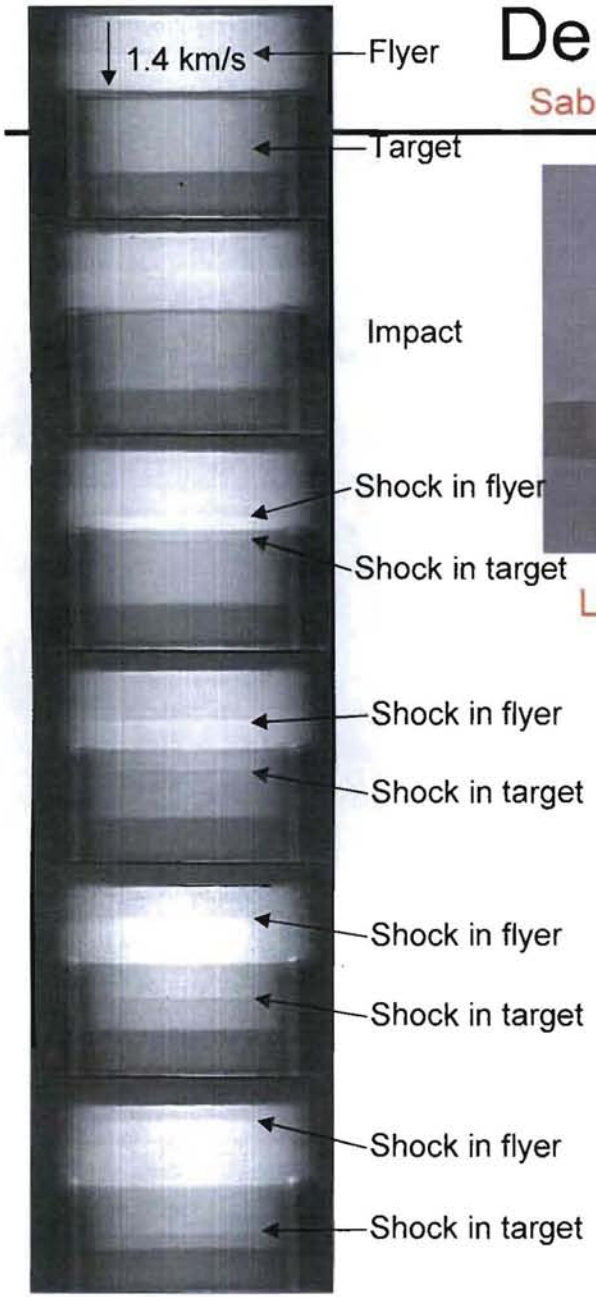


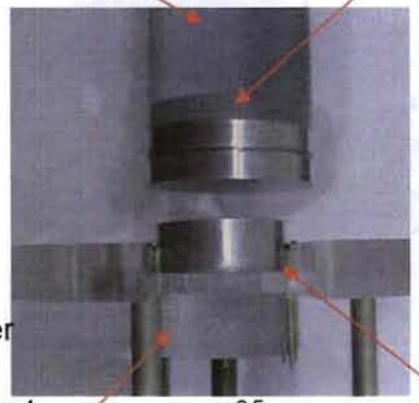
Single Crystal Material

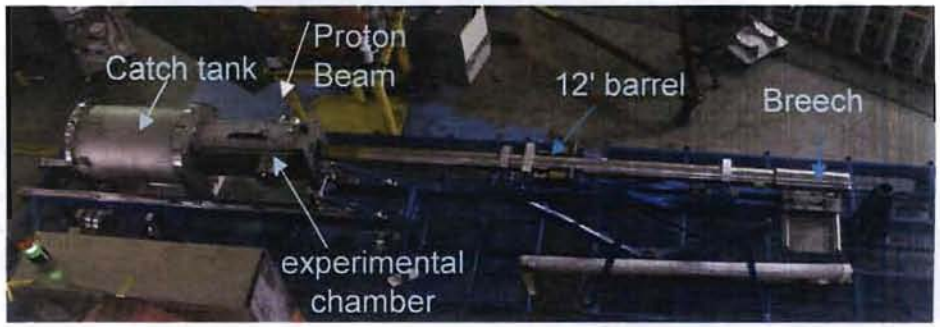
- Mulitmillion atom MD simulations for single crystal iron
- Homgeneous nucleation
- Slower mechanism
- Increased transformation threshold

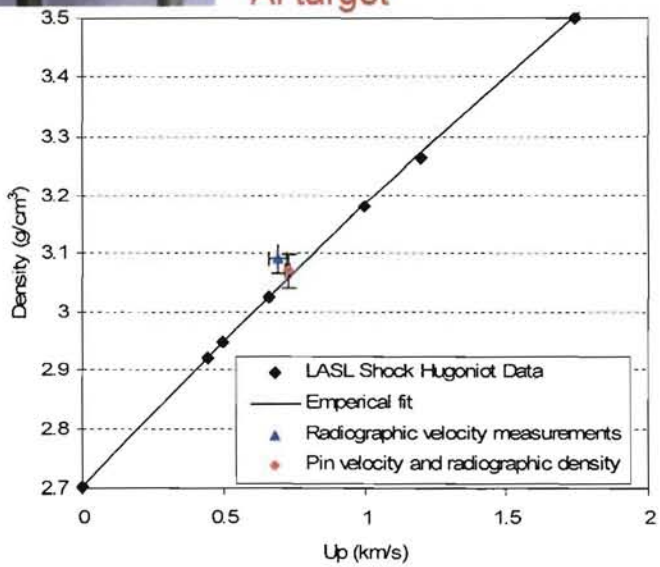
K. Kadau, T. C. Germann, P. S. Lomdahl, and B. L. Holian, *Science* **296**, 1681 2002.

Demonstration Powder Gun Experiment









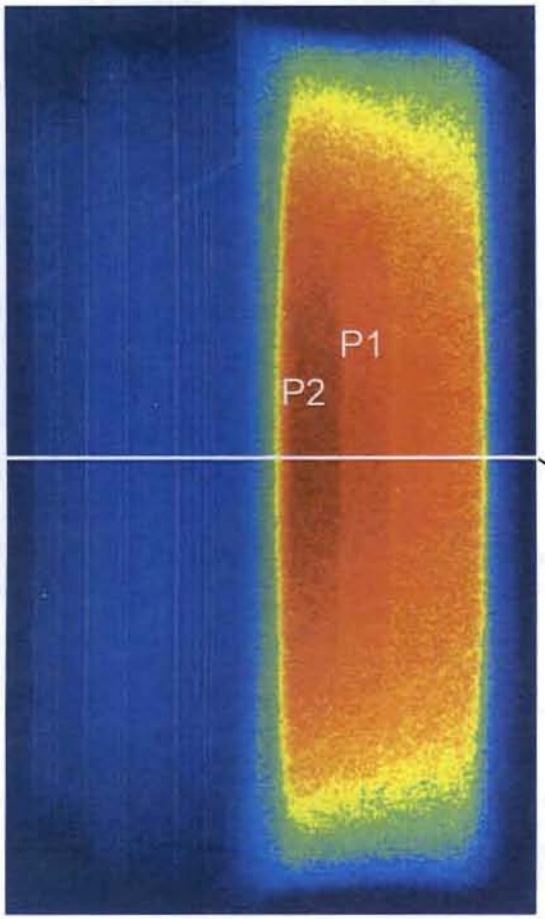
Two methods of measuring a point on shock Hugoniot per dynamic event:

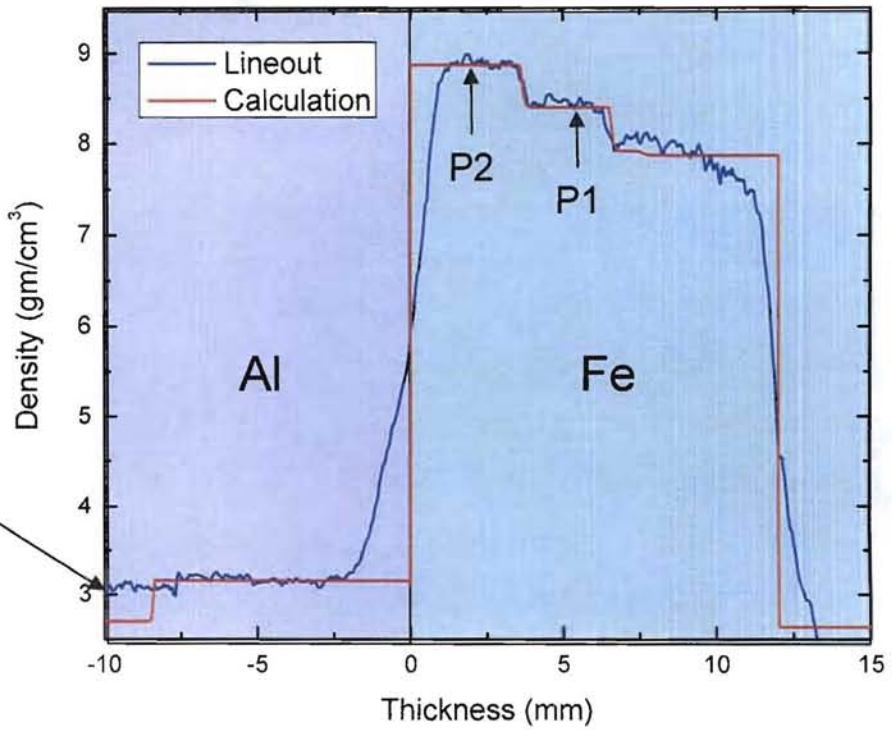
- Radiographic measurement of density behind shock front.
- Simultaneous measurement of particle and shock velocity

Invited Talk : Paulo Rigg, *Shock Compression of Condensed Matter*, 2007

Rigg, Schwartz, et al., *Phys. Rev. B*, Jun 08, vol. 77, iss. 22 220101

Powder Gun-Driven
Measured and Calculated Densities - Iron





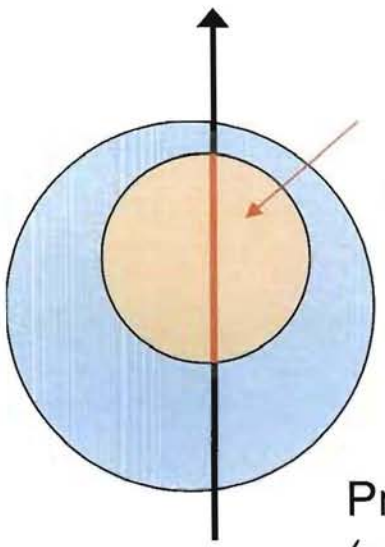
Schwartz, Rigg, et. al, IP Conference Proceedings (12 Dec. 2007) vol.955, no.1, p.1135-8

Fe Densities

State	Measured	Calculated*	Agreement
P1	8.346	8.342	<0.1%
P2	8.854	8.846	0.1%

*calculated values from 1-D Multi-Phase EOS for Fe model

Tomographic reconstruction and subtraction of overburden



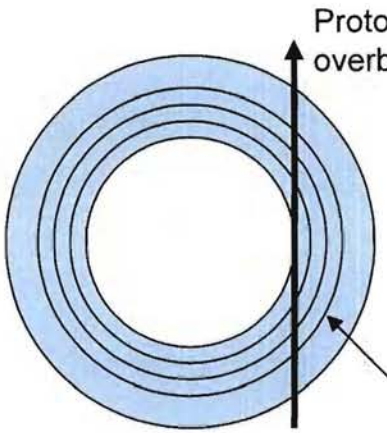
Experiment

Overburden

Proton path
(red is the good part;
We'd like to subtract the black)

Tomographic Reconstruction (Abel Inversion)

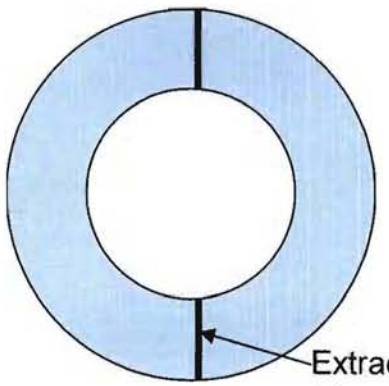
Converts line integrals to volume density map



Proton path thru overburden

Reconstructed density map

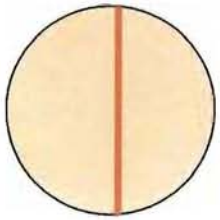
Projection: converts density map back to line integrals



Extracted and projected line integral thru overburden

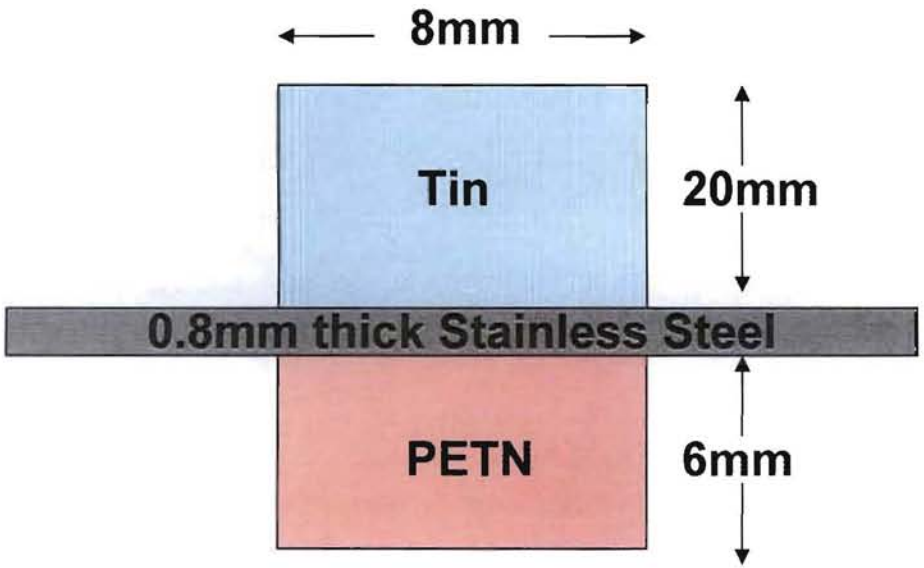
Subtraction

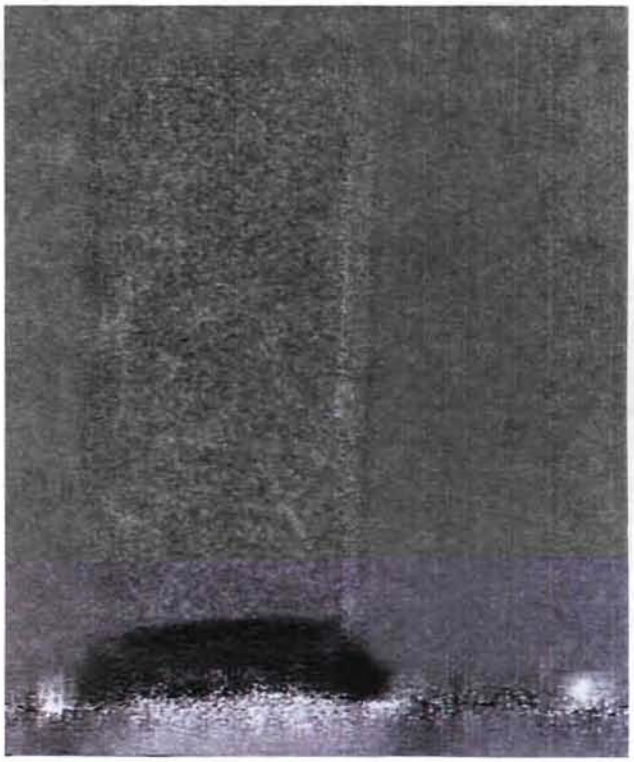
Leaves only the data we want



Taylor Wave-Driven Tin

- Explosive-driven "Taylor Wave" shock
- Multiple pressures, decaying over time
- Stainless steel membrane for future Pu shots

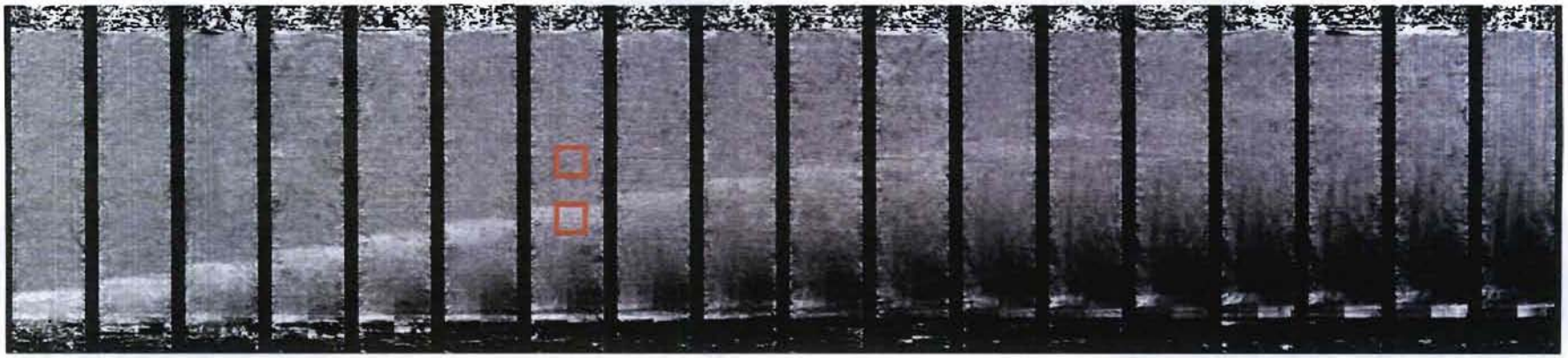




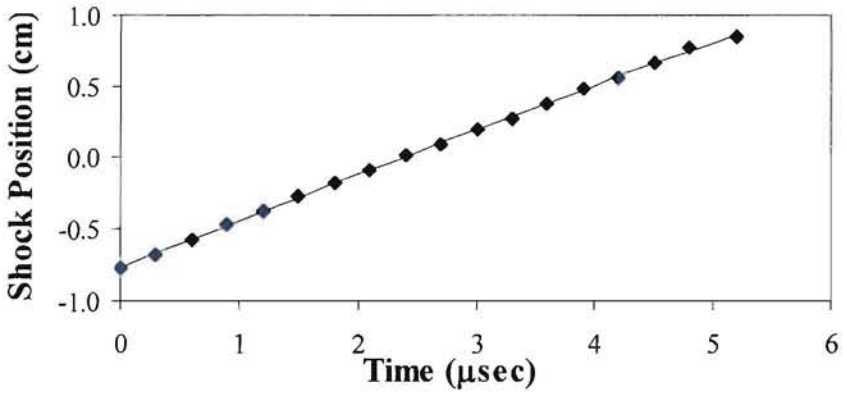
Dynamic / Static transmission radiographs

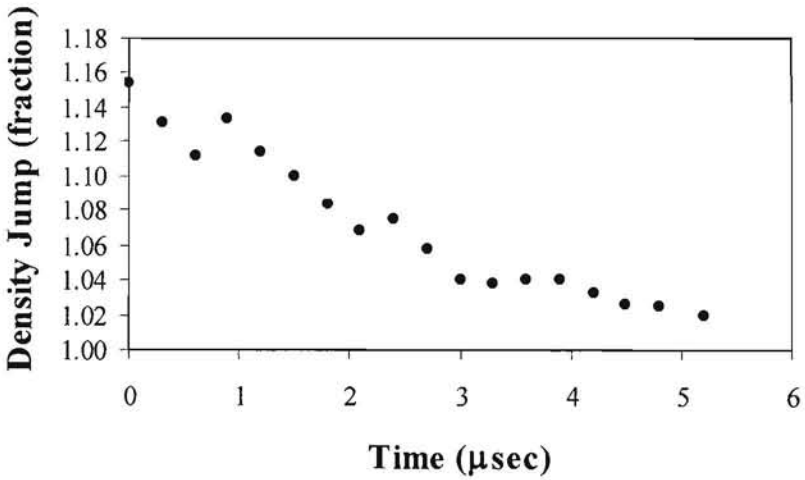
Rusty Gray provided "pristine" tin sample

Position and Density



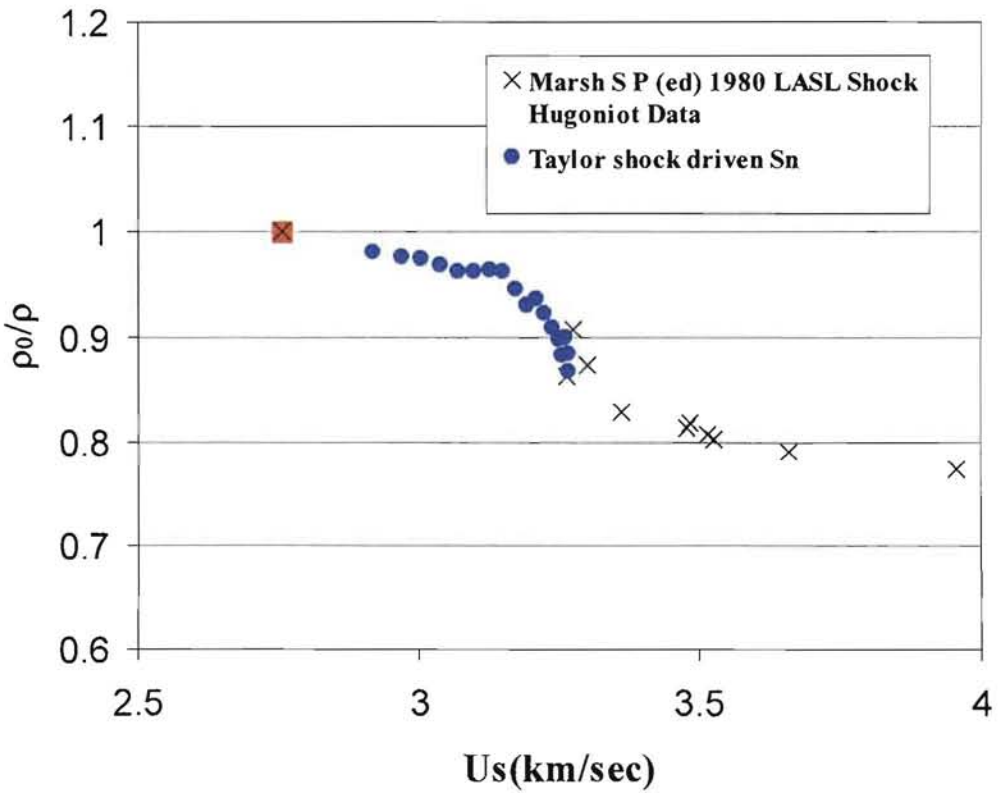
1.8μsec Time 6.9μsec





Single experiment, Multiple Measurements

- Single experiment measures many Hugoniot points
- Agreement with LASL Hugoniot data
- Hugoniot points measured from peak shock velocity down to nearly sound velocity



Technique Summary

- Measured points on the Hugoniot from peak shock velocity down to nearly sound wave velocities
- 19 images in single experiment equates to 19 points on the Hugoniot (we measured 18 points)
- Agreement between present measurement and known Hugoniot with less than 1% density and 0.3mm/μsec (1%) shock velocity statistical uncertainty

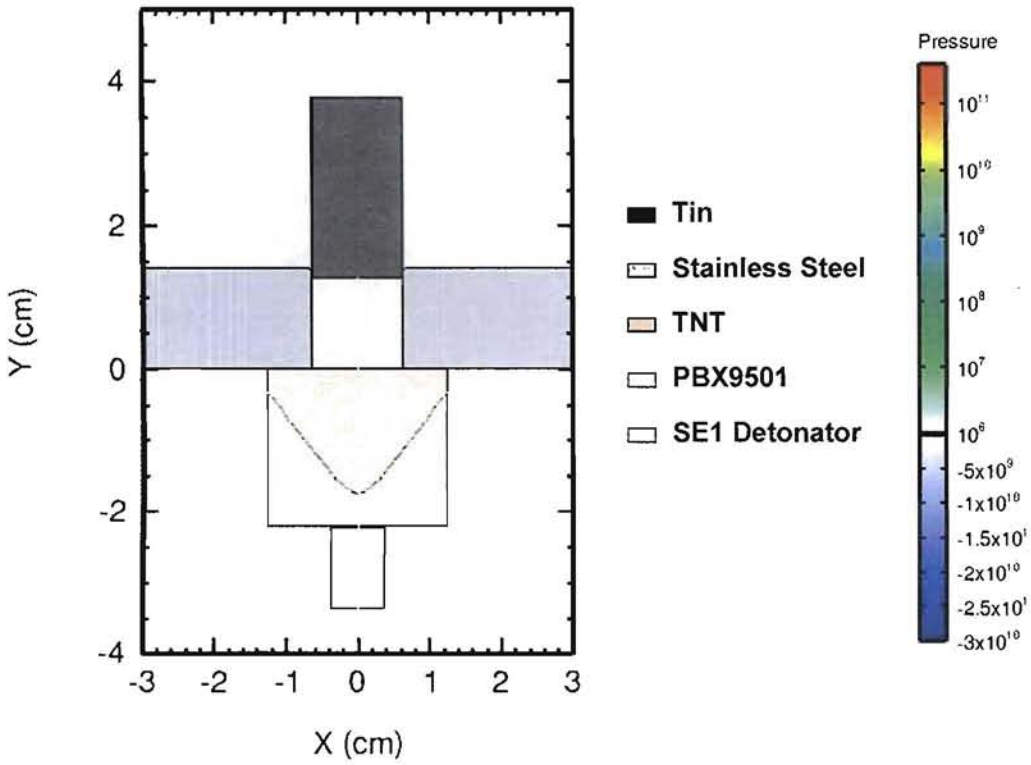
Technique Questions

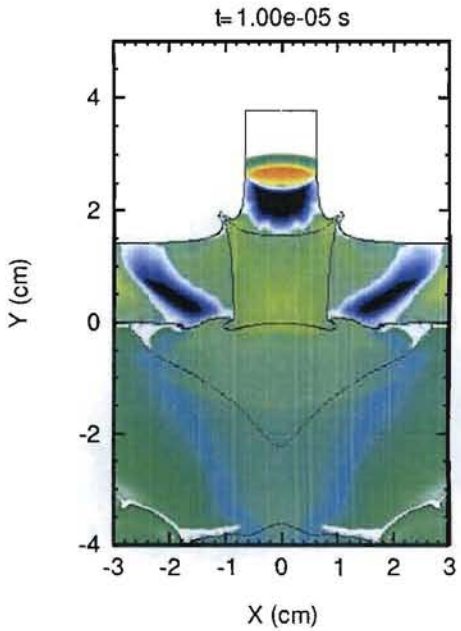
- Are we in equilibrium?
- How well does our tomographic reconstruction work?
- How flat is the pressure wave we are using to measure position?
- Is a polynomial approximation of position with time during a phase transition valid?

In 2 weeks….

- Determined we need proof of principle experiments with known materials such as Al, Cu
- To optimize radiography, samples are 12.7mm in diameter
- To optimize number of measured position, samples are 40mm in thickness (length)
- Redo Sn with different drive and no membrane to complete the β->γ phase transition

In 2 weeks….





Marr Marr-Lyon simulation using CTH of new drive on Tin target sample

Our Proposal

- Static experiment to verify our tomographic reconstruction analysis technique
- Use a Taylor Wave drive to acquire many points on the Hugoniot in single experiment
- Perform experiments with multiple crystal orientations in individual materials to understand the affect of crystal orientation on Hugoniot response
- Perform experiments on a range of materials
  - Fe : well studied; atomistic MD simulations to compare to; will use for benchmarking
  - Ga : used in nuclear weapons; EOS not known
  - Zr : used in shaped charges; multiple phase transitions and triple point
  - Sn : low strength; well studied

Shot Type	Number
Fe Poly	1
Fe [100]	1
Sn [100]	1
Sn [TBD]	1
Zr Poly	1
Zr [111]	1
Zr [100]	1
Ga Poly	1
Ga [111]	1
Ga [100]	1

Proposal Team

Cynthia Schwartz, PI (P-25),
Mike Furlanetto (P-23),
George (Rusty) Gray III (MST-8),
Nicholas King (P-23),
Kris Kwiatkowski (P-23),
Mark Marr-Lyon (DE-3),
Wendy McNeil (HX-4),
Frank Merrill (P-25)
Christopher Morris (P-25),
Nigel Park (AWE) (UK),
Paulo Rigg (DE-9),
Alexander Saunders (P-25),
Michael Zellner (DE-9)

LANSCE Approval Form
Explosives Operations in Area C

Starting Date of Activity: 20 July 2009
PRAD Proposal Number: 20081901
PRAD Shot Number: 373
HE Shot Plan Number: H3860 / LNSC-10627-DE3
Description: Phase Transition

Vessel Experiment:
VAA approved vessel: Yes
HE ≤ 10-lbs TNT-equivalent: Yes

Powder Gun Experiment:
Propellant ≤ 350-g Class 1.3: NA

Dynamic MAR Experiment:
Requirements of ASE 3.5.2 met: NA

Experiment Technical and Safety Review complete: Yes

PRAD EIC Authorization:

Signature Cynthia Schwartz Date: 20 July 2009

Print Cynthia Schwartz

DE-3 HE PIC Authorization:

Signature [signature] Date: 20 July 2009

Print Mark Marshall

LANSCE Area B/C AM Authorization:

Signature [signature] Date: 20 July 2009

Print Leo Bitteker

Shot Plan

WFO Shot Number:	LNSC-10625 · 10630 – DE3			**Release Date:**	7/10/09	K
Shot/Series Title:	PHASE TRANSITION		Originator's shot # (optional):		43858, 3859, 3860, 3861, 3862, 3863	
Estimated Number of shots:	UP TO SIX		Past shot reference (optional):			
Lead Experimenter(s):	WENDY VOGAN McNEIL		**Group:**	HX-4	**Phone:**	7-9038
Experiment Program Code/Cost Account:	3R050A / J1DP / 0000 /0000					
Firing Lead (s):	Robert Lopez Joe Bainbridge		**Group:**	DE-3	**Phone:**	7-0393 7-5495
Firing Site:	pRad		**Owning Group:**	DE-3	**Phone:**	5-4425

Max. Quantity HE per test:	< 50 g
Clearance Plan:	pRad
Desired Test Date(s):	Weeks of 13 and 20 Jul 09
IWD# and WPF# : Specify applicable document # (s) & expiration date(s) or note as NEW and in progress:	IWD: IWD-DE3-53-003-PJ00-0004 WPF: P DIVISION IS RESPONSIBLE FOR WASTE MANAGEMENT AT PRAD
Classified Shot: ☐ **YES** ☒ **NO**	If YES create classified shot addendum per classified document requirements
☐ After Hours Contingency Plan	Required for shots executed after normal working hours. (defined as 4:30 PM)

WFO Services Requested:

☐ RCT ☐ IH
☐ WMC ☐ Fire Department
☐ Heavy Equipment ☑ Fire Mitigation Review ☐ Other (Specify): _____
☐ Access Control ☐ Environmental

Brief Shot Description/Objectives: Attach sketches and drawings as necessary.
Shoot in the 6-foot 5-port vessel: SE-1 + P25 + ½" x ½" 9501 booster + metal target (metal = Al, Cu, Sn, Fe, or alloy).
The x3 magnifier will be used.
Up to 1/8" Al + 1/8" glass will be used.

High Explosive Operations Safety Officer (HE OSO): Shot Plan fire mitigation review. Provide comments as appropriate:
Shot screened out

C. M. Anderson — HE OSO approval for shot setup to proceed — Date: 7/10/09

Firing Site Leader (FSL): The FSL is the final authority on all operations of safety and procedure during firing site operatio
FSL ensures safety and technical aspects for executing the shots are complete.

FSL approval — Date

Classification Review: (**IF REQUIRED BY TSM LEAD EXPERIMENTER,** refer to K. Jones e-mail of 5/2/05)

☒ Unclassified	☐ Restricted Data	**Authorized Derivative Classifier:**
☐ Confidential	☐ Formerly Restricted Data	Signature: T. Turner
☐ Secret	☐ National Security Information	Name: T. TURNER — Date: 7/10/09
☐ Unclassified Controlled Nuclear Information (UCNI)		Title: GL
		Derived From:

Line Management (or Designee) Signature T. Turner **Date** 7/10/09

Firing Site Leader is responsible for keeping original record with Site records

From: "Paul Rightley" <pright@lanl.gov>
Subject: **VAA approval for H3860**
Date: July 19, 2009 8:57:43 PM MDT
To: vogan@lanl.gov, lbj@lanl.gov
Cc: mmarr@lanl.gov, dallman@lanl.gov, turner_thomas_p@lanl.gov
Reply-To: pright@lanl.gov

I approve firing shot H3860 in vessel 6-2-5-1 this week.

I have heard back that the steel ring involved in this shot remains intact and that the armor plate is not substantially damaged by the shot. Otherwise, there is no vessel damage. This approval is contingent upon a visual inspection of the interior of the vessel since an inspection has not yet occurred since the last shot. If there is more damage after this last RMI shot than after the first RMI shot, I need to know about it before firing H3860.

If you need to contact me, please call me at (505)500-4047 while I am on vacation.

Paul

Hi Paul,

We would like to fire up to six "phase transition" shots at pRad during the weeks of 13 and 20 July 2009: H3858 - H3863. These are the o[illegible]s that Cynthia and Mark and I have been working to design.

They consist of a P-25 plane wave lens [17 g PBX-9501 + 8 g TNT], initiated with an SE-1 detonator, driving a 1/2" diameter by 1/2" thick cylinder of PBX-9501 [3 g] (also see description of Shot 5 below), which drives a metal target. The first four shots have targets of either Al (Al-6061-T651), Sn (Rusty's Sn), Cu (OFHC) or Fe (Armco), and the targets are 0.492" diameter by 40mm thick. Shots 5 and 6 have targets of gold-silver alloy; the first target is 1" diameter and 0.25" thick, and the second target is 1cm diameter and 0.75" thick.

Shots 1 - 4 and 6: coupling the lens to the 9501 cylinder and the target is a steel ring of 3.5" diameter by 0.75" thick (~ 920 g). The ring is supported by nylon rods from a plastic holder plate which also seats the lens, and the plastic holder plate is screwed down to the lexan main 16" dia. mounting plate.
Shot 5 is a twin shot to H3837 to be fired at DARHT this fall, and has a slightly different drive: SE-1 + P-25 pwl [17 g PBX-9501 + 8 g TNT] + 1" dia. x 0.25" PBX-9501 [6 g] + 1" dia. x 0.25" alloy target. (There is no steel ring on Shot 5.)

The targets will be fired upward, and the usual amount of armor will be placed at the bottom of the vessel and in the top hat assembly. Shots 5 and 6 will be fired into a foam-filled tank (last used in Recovery/Capture shots) so that the targets will not be introduced to the vessel waste stream. (The post-shot targets will be returned to MST-6 for analysis.)

Proposed windows: 1/8" Al + 1/8" glass.

Thanks,
WVM

>X-Sieve: CMU Sieve 2.2
>Date: Tue, 7 Jul 2009 15:05:03 -0600 (MDT)
>Subject: Contained shot request
>From: "Mark Marr-Lyon" <mmarr@lanl.gov>
>To: pright@lanl.gov
>Cc: vogan@lanl.gov
>User-Agent: SquirrelMail/1.5.1
>X-NIE-2-MailScanner-Information: Please see
>http://network.lanl.gov/email/virus-scan.php
>X-NIE-2-MailScanner: Found to be clean
>X-NIE-2-MailScanner-From: mmarr@lanl.gov
>X-Spam-Status: No
>
>We would like to fire up to three RMI shots next week at pRad. They consist of a P-25 plane wave lens, initiated with an SE-1 detonator, driving a 1 3/4 inch diameter by 1 inch long cylinder of PBX-9501. Surrounding the explosives is a 1 3/4 inch ID delrin cylinder with
>approximately 1/2 inch thick walls. A smaller delrin cylinder fills the
>space between the P-25 and the outer delrin cylinder and holds the

Proton Radiography Experiment Safety and Security Review Checklist

PRAD shot number 369 Title Al Equation of state series

Review Date 7/13/09 Shot Date 7/13 ff

Review must be performed within two weeks of shot date.

Table 1: Requirements of the Accelerator Safety Envelope (ASE): Require USI to violate or modify

Table 2: Requirements of the Safety Analysis Document: Require USI to violate or modify

Table 3: Requirements of LANL Safety Documents: Require Hazard Analysis and Management Approval to violate or modify

Table 4: Requirements of LANL Security documents: Require Management Approval to violate or modify

Brief Unclassified Description of experiment, including sample material, form, and quantity:

He Taylor wave drive into metal samples: Al, Cu, Fe, Sn
Measure V_s and ρ/ρ_0 within metal.

Required Facility Configuration (e.g. magnifier vs. –I lens; powder gun vs. 6-foot vessel):

x3 Mag. 6' vessel
No other diagnostics

Required Beam parameters (e.g. standard PRAD; video mode):

Standard PRAD

All SMEs participating in review:

Table 1a: Requirements of Accelerator Safety Envelope (ASE):

Number	Question	Yes	No	Requirements if YES	SME Inits.
1	ASE section 3.1.1.5 "Line X/B/C Beam Delivery Mode" will NOT be satisfied?		X	Outside of Safety Envelope: USI to proceed	
2	Outer vessel NOT qualified to greater than 150% of HE load in this shot?		X	Outside of Safety Envelope: USI to proceed	
3	Outer vessel NOT qualified for this shot by Vessel Approving Authority?		X	Outside of Safety Envelope: USI to proceed	
4	Total HE load greater than 10.0 lbs TNT equivalent?		X	Outside of Safety Envelope: USI to proceed	
5	Total propellant load in powder gun greater than 350 g Class 1.3 propellant?		X	Outside of Safety Envelope: USI to proceed	
6	Total Material at Risk (MAR) of greater than 12.0 Plutonium-Equivalent Grams (PEG)?		X	Outside of Safety Envelope: USI to proceed	

Table 1b: Additional requirements of ASE if MAR >= 0.1 PEG

Number	Question	Yes	No	Requirements if YES	SME Inits.
1	Total MAR in target assembly greater than 11.0 PEG?		X	Outside of Safety Envelope: USI to proceed	
2	Any MAR in non-metallic form, including powders?		X	Outside of Safety Envelope: USI to proceed	
3	Total HE in target assembly greater than 30 g?		X	Outside of Safety Envelope: USI to proceed	

Table 2: Requirements of Safety Analysis Document (SAD):

Number	Question	Yes	No	Requirements if YES	SME Inits.
1	New experiment configuration not covered by SAD?		X	Outside of Safety Analysis: Hazard Analysis and USI to proceed	
2	Change to building design not consistent with SAD?		X	Outside of Safety Analysis: Hazard Analysis and USI to proceed	
3	Explosives or detonators NOT approved by Laboratory Explosives Review Committee?		X	Outside of Safety Analysis: Hazard Analysis and USI to proceed	
4	Firing circuits or firing circuit test equipment NOT approved by Explosives Instrument Review Committee?		X	Outside of Safety Analysis: Hazard Analysis and USI to proceed	
5	Flammable gases would result in greater than 50% of flammability limit if released into vessel and backfilled with air?		X	Outside of Safety Analysis: Hazard Analysis and USI to proceed	
6	Low voltage detonators on this shot?		X	Outside of Safety Analysis: Hazard Analysis and USI to proceed	
7	No containment for this shot?		X	Outside of Safety Analysis: Hazard Analysis and USI to proceed	
8	New hazards due to materials or equipment inside containment vessel?		X	Review for new hazards	

Table 3: Requirements of LANL Safety Documents

Number	Question	Yes	No	Requirements if YES	SME Inits.
1	Shot contains more than 100 lbs of DU?		X	Hazard analysis and management approval required	
2	Shot contains hazardous materials other than lead, silver, DU, or transuranics?		X	Hazard analysis, management approval, and waste profile required	
3	This shot contains lead, silver, or DU materials?		X	Hazard analysis, management approval, and waste profile required	
4	Lasers not covered by VISAR IWD required for this shot?		X	LSO Review required	
5	Pins NOT approved by EIRC required?		X	EIRC approval required	
6	Flammable gasses required in vessel?		X	Hazard analysis and management approval required	
7	Will some HE NOT be burned after dynamic event?		X	Hazard analysis and management approval required	
8	New chemicals required for this shot?		X	Hazard analysis required	
9	Internal pressure vessel?		X	Test pressure vessel to 110% for remote fill or 150% for manual fill	
10	Will hazardous waste be generated without an identified disposal path?		X	Submit waste profile to Waste Coordinator before experiment	
11	Unlisted or uninspected electrical equipment?		X	ESO review	
12	Will radioactive materials be produced that cannot be stored in radioactive materials cabinet in Area C?		X	RP-1 review required	
13	Any work not covered by P25-IWD-07-42 (PRAD IWD) and IWD-DE3-53-003-P100-0001 (HE IWD)?		X	Assess uncovered work and implement controls	

Table 4: Security Review

Number	Question	Yes	No	Requirements if YES	SME Inits.
1	Any special handling due to security concerns?		X	DC Review; Activity Security Plan	
2	Has experiment NOT been DC or SAFE-7 reviewed?	X	X	DC review	AS
3	Does experiment involve cleared or uncleared foreign nationals?		X	Escort and computer use requirements	
4	Does this shot require overnight classified supervision?		X	Arrange for overnight supervision	

Any new hazards or vulnerabilities not listed above?

No

Summarize requirements from tables above, including new training requirements:

DC Review by A. Saunders:
Not classified

Approval by Experiment Safety Review Committee

EIC _____ Date 7/13/09
Experimenter in Charge

HE PIC _____ Date 07.13.09
High Explosives Person in Charge

EAM _____ Date 13 July 2009
Experimental Area Manager

New review required if initial review is more than two weeks before activity:

Summary of Run 36795, 2:25:26 PM, Monday, July 20, 2009

Batch Protons

	Group 1	
	N	Integral
Trigger 1	25	1.00192E+11
Run 36795	25	1.00192E+11
Batch started at 36795	25	1.00192E+11

Total Protons

RUN	Time	N	Group 1
36795	14:25 07/20/09	25	1.00192E+11

Protons per Peak

Run	Scope	Channel	# Peaks	Sum V-S	Sum P	Peak	Time	Peak V-S	Peak P	Rel Error
36795	9	2	25	3.93065E-06	1.00192E+11					
						1	1.33721E-08	2.14706E-07	5.47285E+09	1.12812E-02
						2	2.50003E-04	1.73199E-07	4.41483E+09	1.23146E-02
						3	2.50399E-04	1.58423E-07	4.03819E+09	1.34632E-02
						4	2.50796E-04	1.51543E-07	3.86283E+09	1.37561E-02
						5	2.51192E-04	1.54474E-07	3.93755E+09	1.34951E-02
						6	2.51589E-04	1.62030E-07	4.13014E+09	1.31635E-02

7	2.51987 E-04	1.50251 E-07	3.82991E+ 09	1.38744 E-02
8	2.52384 E-04	1.48370 E-07	3.78194E+ 09	1.40503 E-02
9	2.52781 E-04	1.52469 E-07	3.88643E+ 09	1.33562 E-02
10	2.53179 E-04	1.61037 E-07	4.10482E+ 09	1.29451 E-02
11	2.53577 E-04	1.58720 E-07	4.04577E+ 09	1.28302 E-02
12	2.53974 E-04	1.53685 E-07	3.91743E+ 09	1.35644 E-02
13	2.54372 E-04	1.54217 E-07	3.93100E+ 09	1.35176 E-02
14	2.54768 E-04	1.52674 E-07	3.89166E+ 09	1.39701 E-02
15	2.55166 E-04	1.51274 E-07	3.85597E+ 09	1.34617 E-02
16	2.55564 E-04	1.56578 E-07	3.99117E+ 09	1.33138 E-02
17	2.55961 E-04	1.51698 E-07	3.86678E+ 09	1.34241 E-02
18	2.56359 E-04	1.52769 E-07	3.89408E+ 09	1.36457 E-02
19	2.56757 E-04	1.54193 E-07	3.93038E+ 09	1.35197 E-02
20	2.57154 E-04	1.49565 E-07	3.81240E+ 09	1.39381 E-02
21	2.57552 E-04	1.57743 E-07	4.02088E+ 09	1.32154 E-02
22	2.57949 E-04	1.50656 E-07	3.84023E+ 09	1.35169 E-02
23	2.58347 E-04	1.55940 E-07	3.97492E+ 09	1.33682 E-02
24	2.58744 E-04	1.45048 E-07	3.69726E+ 09	1.43721 E-02
25	2.59142 E-04	1.59390 E-07	4.06285E+ 09	1.33815 E-02

DG535 Timing

Run	DG Tag	A Delay	B Delay	C Delay	D Delay
36795	8	2.571200000000E-02	3.000000000000E-04	5.000000000000E-03	0.500000000000
36795	9	5.100000000000E-03	1.000000000000E-04	5.150000000000E-03	5.000000000000E-08
36795	10	4.000000000000E-05	4.500000000000E-05	5.000000000000E-05	6.000000000000E-08
36795	11	1.995120000000E-04	5.000000000000E-05	0.00000000000	0.00000000000
36795	13	2.500000000000E-02	5.000000000000E-07	0.00000000000	1.010000000000E-04
36795	14	5.000000000000E-12	1.300000000000E-05	5.000000000000E-12	5.000000000000E-12
36795	16	2.395950000000E-04	2.000000000000E-07	1.521500000000E-05	5.000000000000E-06
36795	23	9.100000000000E-06	3.000000000000E-04	6.750000000000E-07	1.000000000000E-06

Camera Walk/Timing File

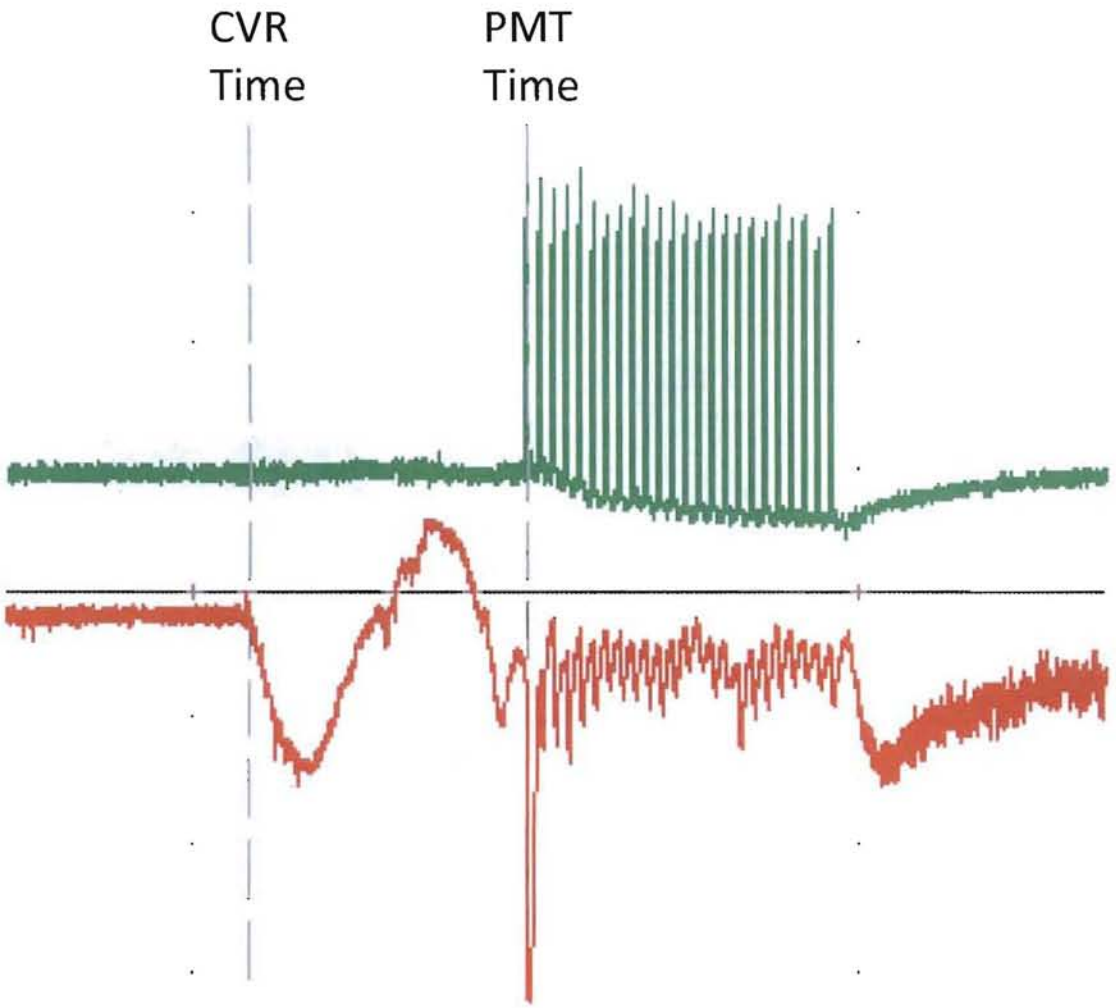
RUN	Time 1	Camera 1
36795	0.000	6.39608E-02,

Beam Line Status

Run	36795		
Time	7/20/2009 2:24:29 PM		
LCQM006V01	134579417	-364.028991699219	OK
LCQM006L06	1	OFF	OK
LCQM007V01	134579417	285.035003662109	OK
LCQM007L03	1	REV	OK
LCQM008V01	134579417	-952.286987304688	OK

LCQM008L03	1	OFF	OK
LCQL001P01	134579417	1760	OK
LCQL001V01	134579417	126.046997070313	OK
LCQL002I01	134579417	-2.59899997711182	OK
LCQL002P01	134579417	0	OK
LCQL002V01	134579417	-4.54099988937378	OK
LCQL003P01	134579417	1520	OK
LCQL003V01	134579417	1544.63793945313	OK
LCDF001E01	1	1219	OK
CCTM006D02	1	200	OK
CCTM006D03	1	625	OK
TBBC002D07	134579417	60	OK
TBBC002D06	134579417	9999	OK
TBMX001L01	134579417	NORM	OK
TBBC022D01	134579417	1500000	OK
TBBC022D02	134579417	1500000	OK
TBBC022D03	134579417	1500000	OK
TBBC022D04	134579417	1500000	OK
TBBC023D01	134579417	1500000	OK
TBBC023D02	134579417	1500000	OK
TBBC024D03	134579417	1500000	OK
TBBC023D04	134579417	1500000	OK
TBBC024D01	134579417	1500000	OK
TBBC024D02	134579417	1500000	OK
TBBC024D03	134579417	1500000	OK
TBBC024D04	134579417	1500000	OK
LCQM017I01	1	3.5	OK
LCQM020I01	1	63	OK
Perm Mg 2	0	79.92	OK
Perm Mg 3	0	112.746	OK
Perm Mg 4	0	135.644	OK
Energy Loss	0	15	OK
Energy Cal	0	0.0268	OK

PRAD0373 Proton Timing Measurement



Protons in
Integrating Current Toroid (ICT)

Detonator Charge Pulse (CVR)
+ Protons in Phototube (PMT)

prad373			cvr to db	db to foi	FOI Camera	DB to 1st camera (us)	CVR TO 1ST CAM	FC TIME REL TO	CVR to FOI
Sn EOS					H		8.3	300	9.90
	Camera	Daq Timing	seperation between pulses (ns)	CCPG pattern start	CCPG pattern stop	width	X=gone	Rel To CVR	REL to FOI
1	E	0	0	300000	300080	80		8.3	-1.60
2	H	400	400	300400	300480	80		8.7	-1.20
3	G1	400	0	300400	300480	80		8.7	-1.20
4	K	800	400	300800	300880	80		9.1	-0.80
5	F1	800	0	300800	300880	80		9.1	-0.80
6	N	1200	400	301200	301280	80		9.5	-0.40
7	G2	1200	0	301200	301280	80		9.5	-0.40
8	Q	1600	400	301600	301680	80		9.9	0.00
9	F2	1600	0	301600	301680	80		9.9	0.00
10	T	2000	400	302000	302080	80		10.3	0.40
11	G3	2000	0	302000	302080	80		10.3	0.40
12	X	2400	400	302400	302480	80		10.7	0.80
13	F3	2400	0	302400	302480	80		10.7	0.80
14	I	2800	400	302800	302880	80		11.1	1.20
15	G4	2800	0	302800	302880	80		11.1	1.20
16	L	3200	400	303200	303280	80		11.5	1.60
17	F4	3200	0	303200	303280	80		11.5	1.60
18	O	3600	400	303600	303680	80		11.9	2.00
19	G5	3600	0	303600	303680	80		11.9	2.00
20	R	4000	400	304000	304080	80	X=gone	12.3	2.40
21	F5	4000	0	304000	304080	80	X=gone	12.3	2.40
22	U	4400	400	304400	304480	80	X=gone	12.7	2.80
23	G6	4400	0	304400	304480	80	X=gone	12.7	2.80
24	Y	4800	400	304800	304880	80	X=gone	13.1	3.20
25	F6	4800	0	304800	304880	80	X=gone	13.1	3.20
26	J	5200	400	305200	305280	80	X=gone	13.5	3.60
27	G7	5200	0	305200	305280	80	X=gone	13.5	3.60
28	M	5600	400	305600	305680	80	X=gone	13.9	4.00
29	F7	5600	0	305600	305680	80	X=gone	13.9	4.00
30	P	6000	400	306000	306080	80	X=gone	14.3	4.40
31	G8	6000	0	306000	306080	80	X=gone	14.3	4.40
32	S	6400	400	306400	306480	80	X=gone	14.7	4.80
33	F8	6400	0	306400	306480	80	X=gone	14.7	4.80
34	V	6800	400	306800	306880	80	X=gone	15.1	5.20
35	G9	6800	0	306800	306880	80	X=gone	15.1	5.20
36	Z	7200	400	307200	307280	80	X=gone	15.5	5.60
37	A	7600	400	307600	307680	80	X=gone	15.9	6.00
38	B	8000	400	308000	308080	80	X=gone	16.3	6.40
39	C	8400	400	308400	308480	80	X=gone	16.7	6.80
40	D	8800	400	308800	308880	80	X=gone	17.1	7.20
41	F9	9200	400	309200	309280	80	X=gone	17.5	7.60

Count Down	
LR to First	8.3

Camera	Pulse No.
1	#N/A
2	#N/A
E	0
H	400
I	2800
J	5200
K	800
L	3200
M	5600
N	1200
O	3600
P	6000
Q	1600
R	4000
S	6400
T	2000
U	4400
V	6800
X	2400
Y	4800
Z	7200
A	7600
B	8000
C	8400
D	8800
F1	800
F2	1600
F3	2400
F4	3200
F5	4000
F6	4800
F7	5600
F8	6400
F9	9200
G1	400
G2	1200
G3	2000
G4	2800
G5	3600
G6	4400
G7	5200
G8	6000
G9	6800

K	0
H	0
N	0
E	0
F1	0
F2	0
F3	0
F4	0
G1	0
G2	0
G3	0
G4	0
G5	0
Q	0
T	0
X	0
I	0
L	0
O	0
D	X=gone
F9	X=gone
F5	X=gone
F6	X=gone
F7	X=gone
F8	X=gone
G6	X=gone
G7	X=gone
G8	X=gone
G9	X=gone
R	X=gone
S	X=gone
U	X=gone
V	X=gone
Y	X=gone
Z	X=gone
J	X=gone
A	X=gone
M	X=gone
B	X=gone
P	X=gone
C	X=gone

Proton Radiography

Science Based Stockpile Stewardship

● 43715 | 7/20/2009 9:08:30 AM | **EIC** | Edit

PRAD0373 - Equation of State - Tin

Beam Line Change

```
Beam Line Changed to EOS-370 & 373 & 374
Beam Line Title: EOS-370 & 373 & 374 - 07/14/2009 - 6 Foot [116]
Comment: EOS-370 & 373 & 374
Mode: Perm Mag X3
Vessel: 6 Foot
Collimator IL0: None
Collimator IL1: 10 mr Straight
Collimator IL2: None
Window IL0: 125 mil Al [125 mil G]
Window Object Up: N/A
Window Object Down: N/A
Window Up IL1: 125 mil Al [125 mil G]
Window Down IL1: 20 mil Kapton
Window IL2: 62.5 mil Al
Converter IL0: None
Converter IL1: 1.9 mm LSO, 2x3
Converter IL2: 2.2 mm Mosaic, LSO, black
Location: LANSCE, Line C, Cave
Key: 116
Date Created: 7/14/2009
```

Basic Filters	Content Filters
○ By Date ○ Last 10 ○ Today ○ This Week ○ This Month ◉ This Year ○ All	Date Range Start 8/31/2009 / 9/1/2009 End ☐ Name EIC ☑ Text Entry Beam Line * ☑ Activity No PRAD0373 - Equation of State - Tin ☐ Expt Family Miscellaneous ☐ Pic Type Other ☐ Run No ☐ Pic No

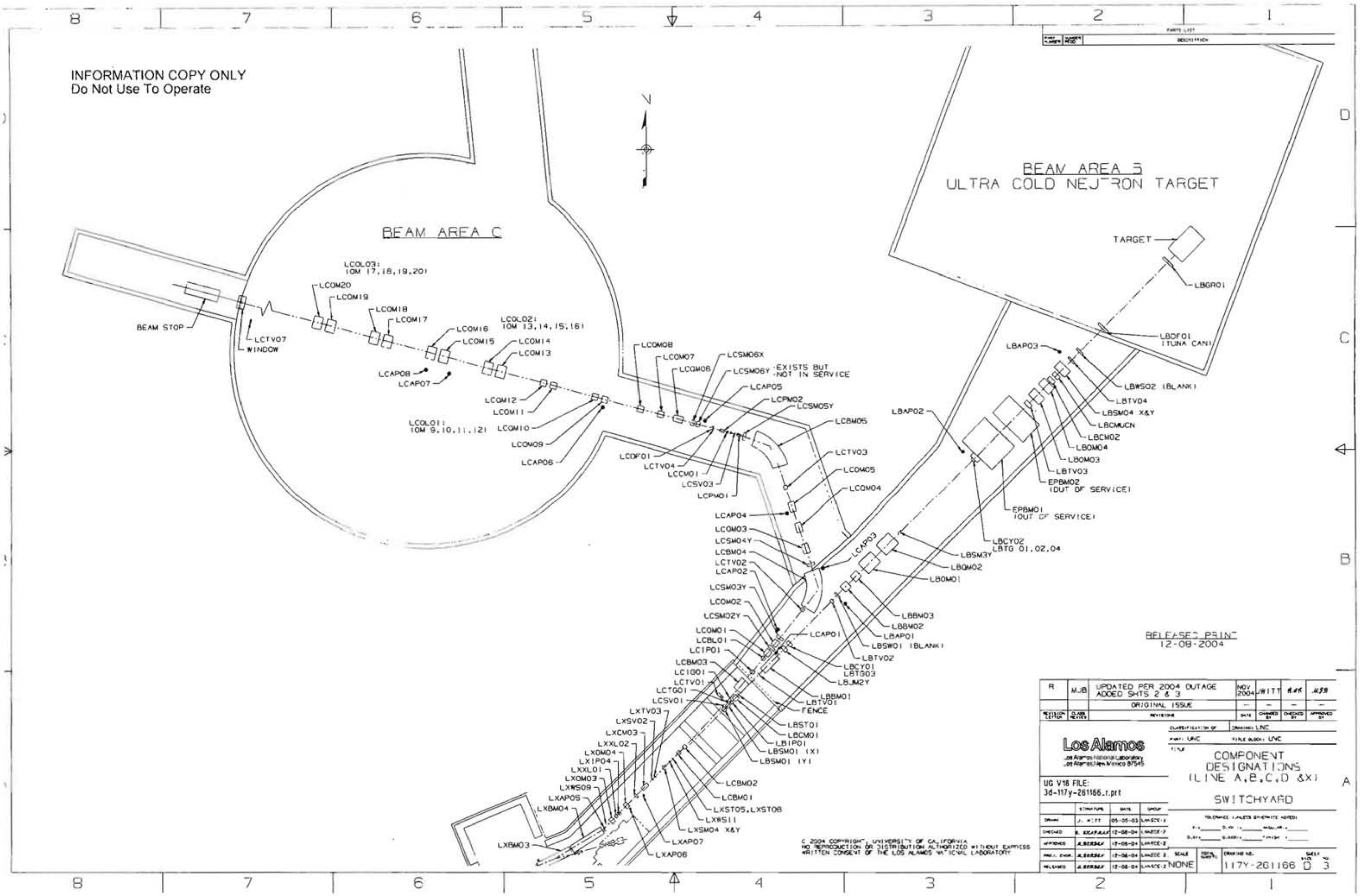
Check checkboxes to select content filters ("" , * , ? chars allowed).

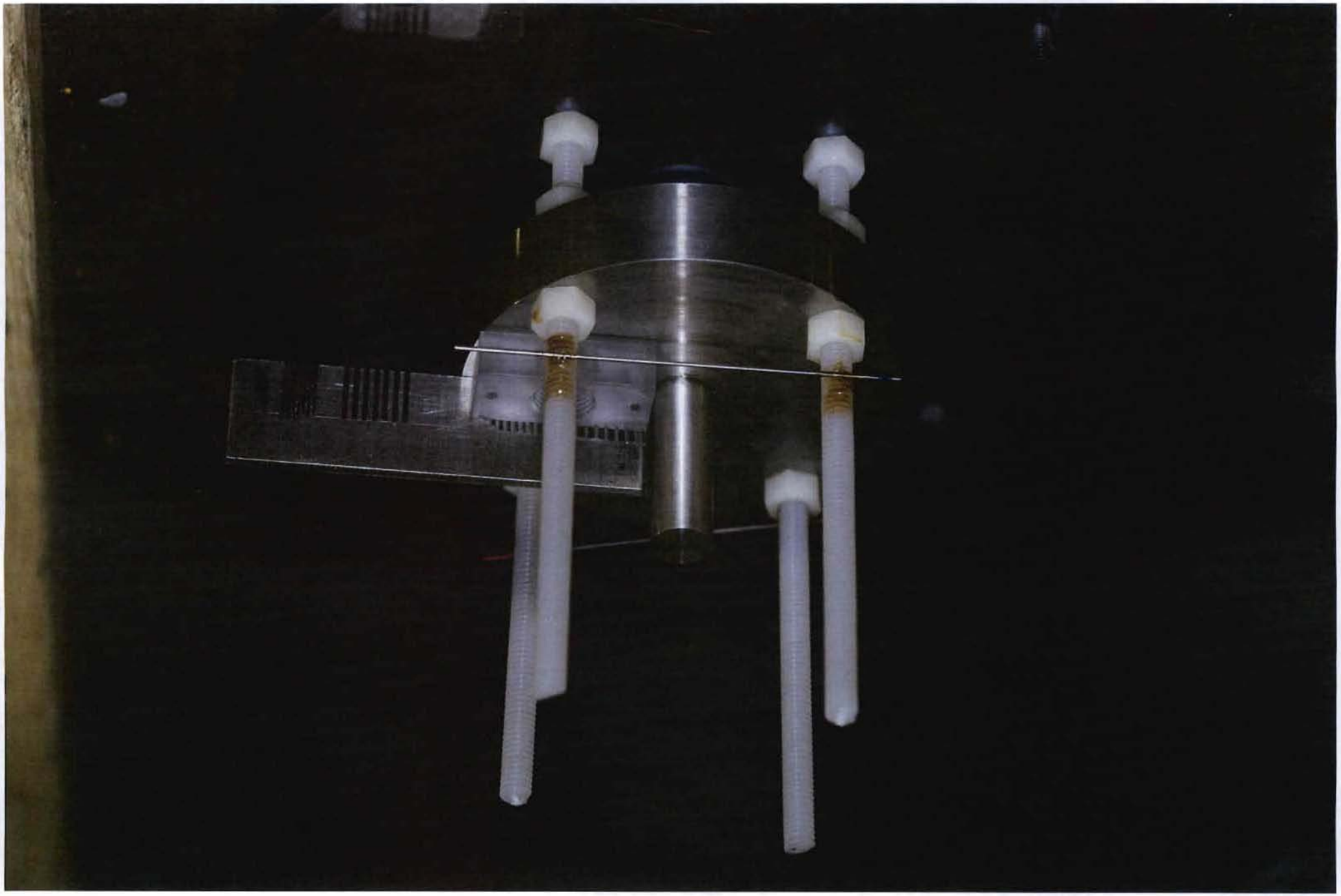
Refresh | Hide Filters | New Entry

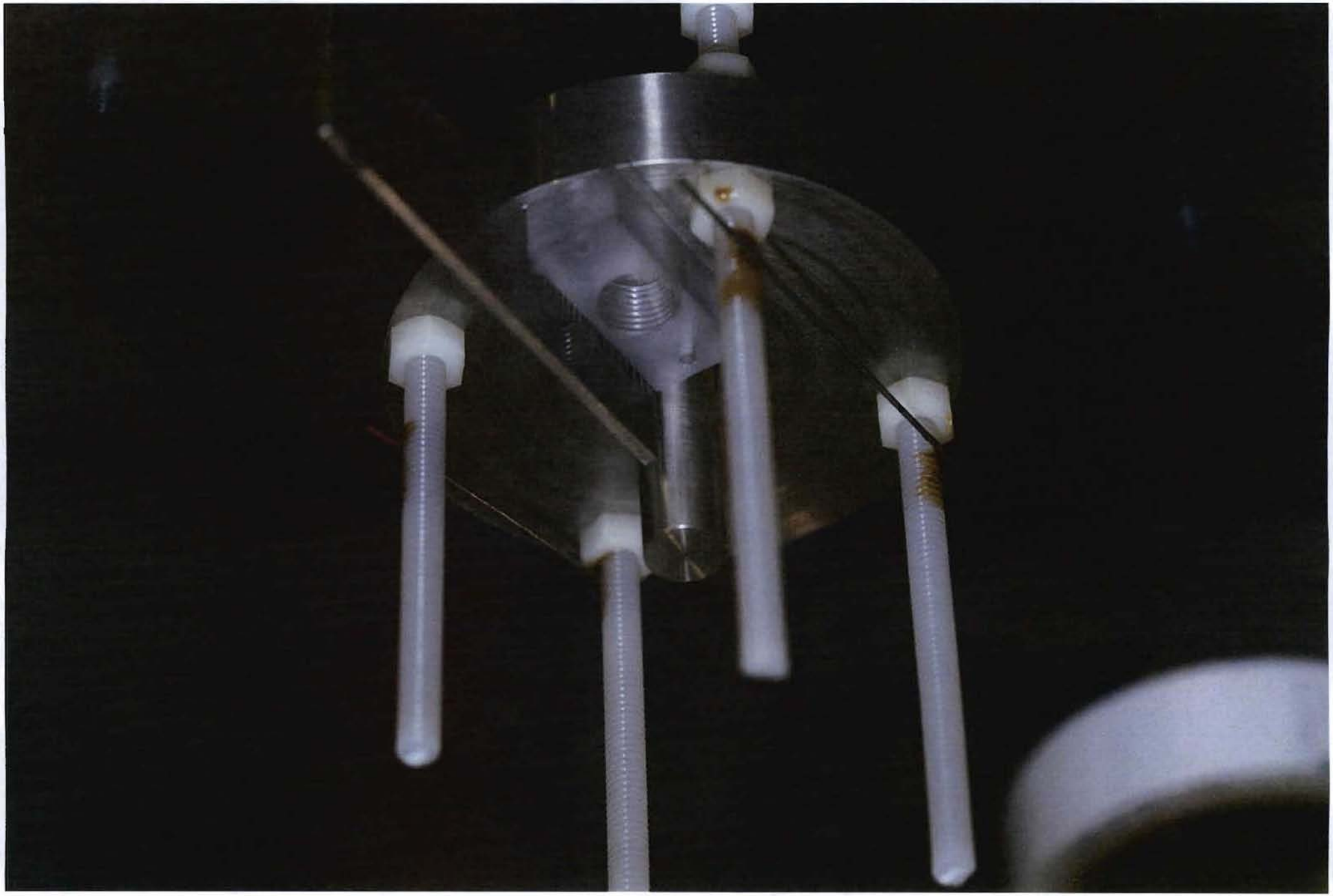
PRAD Home > Logbook Home

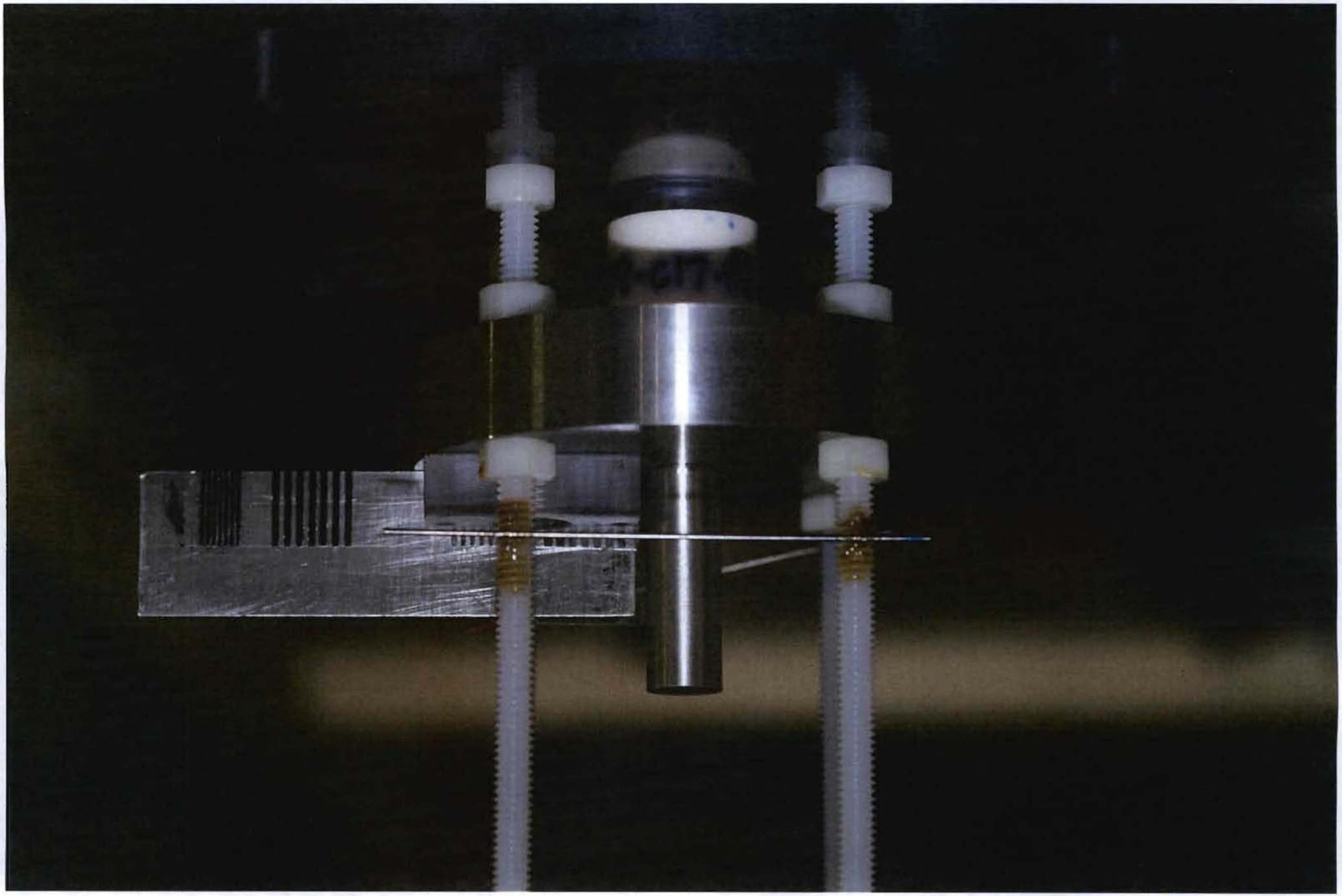
PRAD On-Line | Logbook | PRAD Off-Line | Run Status | Beam Status | Phone

INFORMATION COPY ONLY
Do Not Use To Operate









Proton Radiography
Science Based Stockpile Stewardship

43713 | 7/20/2009 8:06:50 AM | **EIC** | Edit PRAD0373 - Equation of State - Tin

Activity Change

Activity Changed to PRAD0373 [485]

43714 | 7/20/2009 8:06:50 AM | **EIC** | Edit PRAD0373 - Equation of State - Tin

Run: Picture: Type: HV Off

Picture Type Change

Picture Type changed to HV Off [13]

43715 | 7/20/2009 9:08:30 AM | **EIC** | Edit PRAD0373 - Equation of State - Tin

Beam Line Change

Beam Line Changed to EOS-370 & 373 & 373

Beam Line Title: EOS-370 & 373 & 373 - 07/14/2009 - 6 Foot [116]

Comment: EOS-370 & 373 & 373

Mode: Perm Mag X3

Vessel: 6 Foot

Collimator IL0: None

Collimator IL1: 10 mr Straight

Collimator IL2: None

Window IL0: 125 mil Al [125 mil G]

Window Object Up: N/A

Window Object Down: N/A

Window Up IL1: 125 mil Al [125 mil G]

Window Down IL1: 20 mil Kapton

Window IL2: 62.5 mil Al

Converter IL0: None

Converter IL1: 1.9 mm LSO, 2x3

Converter IL2: 2.2 mm Mosaic, LSO, black

Location: LANSCE, Line C, Cave

Key: 116

Date Created: 7/14/2009

43716 | 7/20/2009 9:08:50 AM | **DAQ On-line** |

Edit

PRAD0373 - Equation of State - Tin

Magnet Settings

Element	Value	Status
LCQM006V01	-364.032012939453	OK
LCQM006L06	OFF	OK
LCQM007V01	285.053009033203	OK
LCQM007L03	REV	OK
LCQM008V01	-952.27001953125	OK
LCQM008L03	OFF	OK
LCQL001P01	1760	OK
LCQL001V01	126.313003540039	OK
LCQL002I01	-2.4909999370575	OK
LCQL002P01	0	OK
LCQL002V01	-4.82800006866455	OK
LCQL003P01	1535	OK
LCQL003V01	1559.82495117188	OK
LCDF001E01	26	OK
CCTM006D02	200	OK
CCTM006D03	625	OK
TBBC002D07	60	OK
TBBC002D06	9999	OK
TBMX001L01	NORM	OK
TBBC022D01	1500000	OK
TBBC022D02	1500000	OK
TBBC022D03	1500000	OK
TBBC022D04	1500000	OK
TBBC023D01	1500000	OK
TBBC023D02	1500000	OK
TBBC024D03	1500000	OK
TBBC023D04	1500000	OK
TBBC024D01	1500000	OK
TBBC024D02	1500000	OK
TBBC024D03	1500000	OK
TBBC024D04	1500000	OK
LCQM017I01	4.5	OK
LCQM020I01	76	OK
Perm Mg 2	80.322	OK
Perm Mg 3	113.55	OK
Perm Mg 4	136.85	OK
Energy Loss	-12345	OK
Energy Cal	0.0268	OK

43717 | 7/20/2009 9:35:32 AM | **DAQ On-line** |

Edit

PRAD0373 - Equation of State - Tin

Run: Picture: 31575 Type: HV Off

Independent Picture

07/20 09:35 *Picture* **31575**, HV Off, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H,

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43718 | 7/20/2009 9:37:28 AM | **DAQ On-line** |
Edit

PRAD0373 - Equation of State - Tin

Run: Picture: 31576 Type: HV Off

Independent Picture

07/20 09:37 *Picture* **31576**, HV Off, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H,

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43719 | 7/20/2009 9:37:42 AM | **DAQ On-line** |
Edit

PRAD0373 - Equation of State - Tin

Run: 36777 Picture: 31577 Type: HV Off

Start Run

07/20 09:37	*Start Run* **36777**	PRAD 373, Tin EoS
07/20 09:37	*Arm*	
07/20 09:37	*Info*	**Manual Trigger** from PCPRAD307
07/20 09:37	*Trigger*	
07/20 09:38	*Picture* **31577**	HV Off, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, E, A, B, C, D, F
07/20 09:38	*End Run*	

43720 | 7/20/2009 9:38:54 AM | **DAQ On-line** |
Edit

PRAD0373 - Equation of State - Tin

Run: 36778 Picture: 31578 Type: HV Off

Start Run

07/20 09:38	*Start Run* **36778**	PRAD 373, Tin EoS
07/20 09:39	*Arm*	
07/20 09:39	*Info*	**Manual Trigger** from PCPRAD307
07/20 09:39	*Trigger*	
07/20 09:39	*Picture* **31578**	HV Off, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, E, A, B, C, D, F
07/20 09:40	*End Run*	

43724 | 7/20/2009 10:49:38 AM | **TNThompson** |
Edit

PRAD0373 - Equation of State - Tin

H.E.'s Here.

43725 | 7/20/2009 11:24:48 AM | **EIC** | Edit PRAD0373 - Equation of State - Tin

Camera Delays

PRAD Trigger Settings - PRAD 373, EoS for Tin

Walk Offset: 0

Camera	Delay	Total Delay	Width
E	0	248.43	0.3
A	7.6	256.08	0.3
B	8	256.46	0.3
C	8.4	256.86	0.3
D	8.8	257.26	0.3
F1	0.8	249.52	0.2
F2	1.6	250.32	0.21
F3	2.4	251.12	0.21
F4	3.2	251.92	0.21
F5	4	252.72	0.21
F6	4.8	253.52	0.21
F7	5.6	254.32	0.21
F8	6.4	255.12	0.21
F9	9.2	257.92	0.21
G1	0.4	249.12	0.2
G2	1.2	249.92	0.21
G3	2	250.72	0.21
G4	2.8	251.52	0.21
G5	3.6	252.32	0.21
G6	4.4	253.12	0.21
G7	5.2	253.92	0.21
G8	6	254.72	0.21
G9	6.8	255.52	0.21
H	0.4	249.09	0.2
I	2.8	251.49	0.2
J	5.2	253.89	0.2
K	0.8	249.5	0.2
L	3.2	251.9	0.2
M	5.6	254.3	0.2
N	1.2	249.91	0.2
O	3.6	252.31	0.2
P	6	254.71	0.2
Q	1.6	250.29	0.2
R	4	252.69	0.2
S	6.4	255.09	0.2
T	2	250.69	0.2

U	4.4	253.09	0.2
V	6.8	255.49	0.2
X	2.4	251.09	0.2
Y	4.8	253.49	0.2
Z	7.2	255.89	0.2

43737 | 7/20/2009 12:40:48 PM | **EIC** | Edit PRAD0373 - Equation of State - Tin

Run: Picture: Type: Dark Field

Picture Type Change

```
Picture Type changed to Dark Field [1]
```

43738 | 7/20/2009 12:45:25 PM | **DAQ On-line** | Edit PRAD0373 - Equation of State - Tin

Run: 36779 Picture: 0 Type: Dark Field

Start Run

```
07/20 12:45 Start Run 36779 PRAD 373, Tin EoS
07/20 12:45 Arm
07/20 12:45 Info            Manual Trigger from PCPRAD307
07/20 12:45 Trigger
07/20 12:46 End Run
```

43739 | 7/20/2009 12:46:55 PM | **DAQ On-line** | Edit PRAD0373 - Equation of State - Tin

Run: Picture: 31579 Type: Dark Field

Independent Picture

```
07/20 12:46 Picture 31579, Dark Field, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M
```

43740 | 7/20/2009 12:52:44 PM | **DAQ On-line** | Edit PRAD0373 - Equation of State - Tin

Run: Picture: 31580 Type: Dark Field

Independent Picture

```
07/20 12:52 Picture 31580, Dark Field, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M
```

43741 | 7/20/2009 12:54:20 PM | **DAQ On-line** | Edit PRAD0373 - Equation of State - Tin

Run: Picture: 31581 Type: Dark Field

Independent Picture

```
07/20 12:54 Picture 31581, Dark Field, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M
```

43742 | 7/20/2009 12:54:43 PM | **DAQ On-line** | PRAD0373 - Equation of State - Tin

Edit

Run: 36780 Picture: 31582 Type: Dark Field

Start Run

07/20 12:54	*Start Run* **36780**	PRAD 373, Tin EoS
07/20 12:54	*Arm*	
07/20 12:54	*Info*	**Manual Trigger** from PCPRAD307
07/20 12:54	*Trigger*	
07/20 12:55	*Picture* **31582**	Dark Field, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 12:55	*End Run*	

43743 | 7/20/2009 1:00:51 PM | **EIC** | Edit PRAD0373 - Equation of State - Tin

Run: Picture: Type: Focus

Picture Type Change

Picture Type changed to Focus [3]

43744 | 7/20/2009 1:01:09 PM | **DAQ On-line** | PRAD0373 - Equation of State - Tin

Edit

Run: 36781 Picture: 31583 Type: Focus

Start Run

07/20 13:01	*Start Run* **36781**	PRAD 373, Tin EoS
07/20 13:01	*Arm*	
07/20 13:01	*Trigger*	
07/20 13:01	Lens 1	1760
07/20 13:01	Lens 1	126.247
07/20 13:01	Lens 2	-2.57
07/20 13:01	Lens 2	0
07/20 13:01	Lens 2	-4.685
07/20 13:01	Lens 3	1535
07/20 13:01	Lens 3	1559.524
07/20 13:01	Diffuser	1219

07/20 13:01	Perm Mg 2	79.974
07/20 13:01	Perm Mg 3	112.853
07/20 13:01	Perm Mg 4	135.805
07/20 13:01	Energy Loss	13
07/20 13:01	Energy Cal	0.0268
07/20 13:02	*Picture* **31583**	Focus, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 13:02	*End Run*	

43745 | 7/20/2009 1:06:07 PM | **DAQ On-line** | PRAD0373 - Equation of State - Tin

Edit

Run: 36782 Picture: 31584 Type: Focus

Start Run

43746 | 7/20/2009 1:10:39 PM | **DAQ On-line** | PRAD0373 - Equation of State - Tin

Edit

Run: 36783 Picture: 31585 Type: Focus

Start Run

07/20 13:06	*Start Run* **36782**	
07/20 13:06	*Arm*	
07/20 13:06	*Trigger*	
07/20 13:06	Lens 1	1760
07/20 13:10	*Start Run* **36783**	PRAD 373, Tin EoS
07/20 13:06	Lens 1	126.262
07/20 13:10	*Arm*	
07/20 13:06	Lens 2	-2.65
07/20 13:10	*Trigger*	
07/20 13:06	Lens 2	0
07/20 13:06	Lens 1	1760
07/20 13:10	Lens 2	-4.663
07/20 13:06	Lens 1	126.228
07/20 13:10	Lens 3	1535
07/20 13:06	Lens 2	-2.64
07/20 13:10	Lens 3	1559.818
07/20 13:06	Lens 2	0
07/20 13:10	Diffuser	1219
07/20 13:06	Lens 2	-4.756
07/20 13:10	Perm Mg 2	79.84
07/20 13:06	Lens 3	1535
07/20 13:10	Perm Mg 3	112.585
07/20 13:06	Lens 3	1559.708
07/20 13:10	Perm Mg 4	135.403
07/20 13:06	Diffuser	1218
07/20 13:10	Energy Loss	18
07/20 13:06	Perm Mg 2	79.786
07/20 13:10	Energy Cal	0.0268
07/20 13:06	Perm Mg 3	112.478
07/20 13:10	*Picture* **31584**	Focus, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 13:06	Perm Mg 4	135.242
07/20 13:07	*End Run*	

07/20 13:10	Energy Loss	20
07/20 13:10	Energy Cal	0.0268
07/20 13:11	*Picture* **31585**	Focus, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 13:11	*End Run*	

43747 | 7/20/2009 1:18:03 PM | **DAQ On-line** |

Edit

PRAD0373 - Equation of State - Tin

Run: 36784 Picture: 31586 Type: Focus

Start Run

07/20 13:18	*Start Run* **36784**	PRAD 373, Tin EoS
07/20 13:18	*Arm*	
07/20 13:18	*Trigger*	
07/20 13:18	Lens 1	1760
07/20 13:18	Lens 1	126.177
07/20 13:18	Lens 2	-2.63
07/20 13:18	Lens 2	0
07/20 13:18	Lens 2	-4.547
07/20 13:18	Lens 3	1535
07/20 13:18	Lens 3	1559.875
07/20 13:18	Diffuser	1218
07/20 13:18	Perm Mg 2	80.027
07/20 13:18	Perm Mg 3	112.96
07/20 13:18	Perm Mg 4	135.966
07/20 13:18	Energy Loss	11
07/20 13:18	Energy Cal	0.0268
07/20 13:18	*Picture* **31586**	Focus, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 13:19	*End Run*	

43748 | 7/20/2009 1:22:14 PM | **DAQ On-line** |

Edit

PRAD0373 - Equation of State - Tin

Run: 36785 Picture: 31587 Type: Focus

Start Run

07/20 13:22	*Start Run* **36785**	PRAD 373, Tin EoS
07/20 13:22	*Arm*	
07/20 13:22	*Trigger*	
07/20 13:22	Lens 1	1760
07/20 13:22	Lens 1	126.154
07/20 13:22	Lens 2	-2.578
07/20 13:22	Lens 2	0
07/20 13:22	Lens 2	-4.834
07/20 13:22	Lens 3	1535
07/20 13:22	Lens 3	1559.711
07/20 13:22	Diffuser	1217
07/20 13:22	Perm Mg 2	79.92
07/20 13:22	Perm Mg 3	112.746
07/20 13:22	Perm Mg 4	135.644
07/20 13:22	Energy Loss	15
07/20 13:22	Energy Cal	0.0268
07/20 13:22	*Picture* **31587**	Focus, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 13:23	*End Run*	

43749 | 7/20/2009 1:27:53 PM | **DAQ On-line** | Edit PRAD0373 - Equation of State - Tin

Run: 36786 Picture: 0 Type: Focus

Start Run

07/20 13:27 *Start Run* **36786** PRAD 373, Tin EoS
07/20 13:28 *End Run*

43750 | 7/20/2009 1:42:05 PM | **EIC** | Edit PRAD0373 - Equation of State - Tin

Run: Picture: Type: Dark Field

Picture Type Change

Picture Type changed to Dark Field [1]

43751 | 7/20/2009 1:43:10 PM | **DAQ On-line** | PRAD0373 - Equation of State - Tin

Edit

Run: Picture: 31588 Type: Dark Field

Independent Picture

07/20 13:43 *Picture* **31588**, Dark Field, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M

43752 | 7/20/2009 1:43:59 PM | **DAQ On-line** | PRAD0373 - Equation of State - Tin

Edit

Run: Picture: 31589 Type: Dark Field

Independent Picture

07/20 13:43 *Picture* **31589**, Dark Field, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M

43753 | 7/20/2009 1:44:53 PM | **DAQ On-line** | PRAD0373 - Equation of State - Tin

Edit

Run: Picture: 31590 Type: Dark Field

Independent Picture

07/20 13:44 *Picture* **31590**, Dark Field, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M

43754 | 7/20/2009 1:45:45 PM | **DAQ On-line** | PRAD0373 - Equation of State - Tin

Edit

Run: Picture: 31591 Type: Dark Field

Independent Picture

07/20 13:45 *Picture* **31591**, Dark Field, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M

43755 | 7/20/2009 1:46:03 PM | **DAQ On-line** | PRAD0373 - Equation of State - Tin

Edit

Run: 36787 Picture: 31592 Type: Dark Field

Start Run

07/20 13:46	*Start Run* **36787**	PRAD 373, Tin EoS
07/20 13:46	*Arm*	
07/20 13:46	*Info*	**Manual Trigger** from PCPRAD307
07/20 13:46	*Trigger*	
07/20 13:46	*Picture* **31592**	Dark Field, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 13:47	*End Run*	

43756 | 7/20/2009 1:53:43 PM | **EIC** | Edit PRAD0373 - Equation of State - Tin

Run: Picture: Type: PreShot

Picture Type Change

```
Picture Type changed to PreShot [6]
```

43757 | 7/20/2009 1:57:19 PM | **DAQ On-line** | Edit PRAD0373 - Equation of State - Tin

Run: 36788 Picture: 31593 Type: PreShot

Start Run

07/20 13:57	*Start Run* **36788**	PRAD 373, Tin EoS
07/20 13:57	*Arm*	
07/20 13:58	*Trigger*	
07/20 13:58	MP Width	60
07/20 13:58	MP Countdown	9999
07/20 13:58	*Picture* **31593**	PreShot, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 13:59	*End Run*	

43758 | 7/20/2009 2:02:11 PM | **EIC** | Edit PRAD0373 - Equation of State - Tin

Run: Picture: Type: Timing Check

Picture Type Change

```
Picture Type changed to Timing Check [24]
```

43759 | 7/20/2009 2:08:44 PM | **DAQ On-line** | Edit PRAD0373 - Equation of State - Tin

Run: 36789 Picture: 31594 Type: Timing Check

Start Run

07/20 14:08	*Start Run* **36789**	PRAD 373, Tin EoS
07/20 14:09	*Arm*	
07/20 14:09	*Trigger*	
07/20 14:09	*Picture* **31594**	Timing Check, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 14:10	*End Run*	

43760 | 7/20/2009 2:12:11 PM | **EIC** | Edit PRAD0373 - Equation of State - Tin

Run: Picture: Type: PreShot

Picture Type Change

```
Picture Type changed to PreShot [6]
```

43761 | 7/20/2009 2:14:07 PM | **DAQ On-line** |

Edit

PRAD0373 - Equation of State - Tin

Run: 36790 Picture: 31595 Type: PreShot

Start Run

07/20 14:14	*Start Run* **36790**	PRAD 373, Tin EoS
07/20 14:14	*Arm*	
07/20 14:14	*Trigger*	
07/20 14:14	MP Width	60
07/20 14:14	MP Countdown	9999
07/20 14:14	*Picture* **31595**	PreShot, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 14:15	*End Run*	

43762 | 7/20/2009 2:15:44 PM | **DAQ On-line** |

Edit

PRAD0373 - Equation of State - Tin

Run: 36791 Picture: 31596 Type: PreShot

Start Run

07/20 14:15	*Start Run* **36791**	PRAD 373, Tin EoS
07/20 14:15	*Arm*	
07/20 14:16	*Trigger*	
07/20 14:16	MP Width	60
07/20 14:16	MP Countdown	9999
07/20 14:16	*Picture* **31596**	PreShot, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 14:16	*End Run*	

43763 | 7/20/2009 2:17:07 PM | **DAQ On-line** |

Edit

PRAD0373 - Equation of State - Tin

Run: 36792 Picture: 31597 Type: PreShot

Start Run

07/20 14:17	*Start Run* **36792**	PRAD 373, Tin EoS
07/20 14:17	*Arm*	
07/20 14:17	*Trigger*	
07/20 14:17	MP Width	60
07/20 14:17	MP Countdown	9999
07/20 14:17	*Picture* **31597**	PreShot, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 14:18	*End Run*	

43764 | 7/20/2009 2:18:31 PM | **ASaunders** |

Edit

PRAD0373 - Equation of State - Tin

prad373 Sn EOS		cvr to db H		db to foi H		FOI Camera 8.3	300	DB to 1st camera (9.90	
	Camera	Daq Timing		seperation between pulses (ns)			CCPG	pattern start	CC
1	E	0	0	300000	300080	80	8.3	-1.60	
2	H	400	400	300400	300480	80	8.7	-1.20	
3	G1	400	0	300400	300480	80	8.7	-1.20	
4	K	800	400	300800	300880	80	9.1	-0.80	
5	F1	800	0	300800	300880	80	9.1	-0.80	
6	N	1200	400	301200	301280	80	9.5	-0.40	
7	G2	1200	0	301200	301280	80	9.5	-0.40	
8	Q	1600	400	301600	301680	80	9.9	0.00	
9	F2	1600	0	301600	301680	80	9.9	0.00	
10	T	2000	400	302000	302080	80	10.3	0.40	
11	G3	2000	0	302000	302080	80	10.3	0.40	
12	X	2400	400	302400	302480	80	10.7	0.80	
13	F3	2400	0	302400	302480	80	10.7	0.80	
14	I	2800	400	302800	302880	80	11.1	1.20	
15	G4	2800	0	302800	302880	80	11.1	1.20	
16	L	3200	400	303200	303280	80	11.5	1.60	
17	F4	3200	0	303200	303280	80	11.5	1.60	
18	O	3600	400	303600	303680	80	11.9	2.00	
19	G5	3600	0	303600	303680	80	11.9	2.00	
20	R	4000	400	304000	304080	80	X=gone 12.3	2.40	
21	F5	4000	0	304000	304080	80	X=gone 12.3	2.40	
22	U	4400	400	304400	304480	80	X=gone 12.7	2.80	
23	G6	4400	0	304400	304480	80	X=gone 12.7	2.80	
24	Y	4800	400	304800	304880	80	X=gone 13.1	3.20	
25	F6	4800	0	304800	304880	80	X=gone 13.1	3.20	
26	J	5200	400	305200	305280	80	X=gone 13.5	3.60	
27	G7	5200	0	305200	305280	80	X=gone 13.5	3.60	
28	M	5600	400	305600	305680	80	X=gone 13.9	4.00	
29	F7	5600	0	305600	305680	80	X=gone 13.9	4.00	
30	P	6000	400	306000	306080	80	X=gone 14.3	4.40	
31	G8	6000	0	306000	306080	80	X=gone 14.3	4.40	
32	S	6400	400	306400	306480	80	X=gone 14.7	4.80	
33	F8	6400	0	306400	306480	80	X=gone 14.7	4.80	
34	V	6800	400	306800	306880	80	X=gone 15.1	5.20	
35	G9	6800	0	306800	306880	80	X=gone 15.1	5.20	
36	Z	7200	400	307200	307280	80	X=gone 15.5	5.60	
37	A	7600	400	307600	307680	80	X=gone 15.9	6.00	
38	B	8000	400	308000	308080	80	X=gone 16.3	6.40	
39	C	8400	400	308400	308480	80	X=gone 16.7	6.80	
40	D	8800	400	308800	308880	80	X=gone 17.1	7.20	

```
41      F9      9200    400     309200  309280  80      X=gone  17.5    7.60
```

File uploaded: ***Prad373.xls*** of type ***application/vnd.ms-excel***

Click to open uploaded file

43765 | 7/20/2009 2:18:44 PM | **DAQ On-line** | Edit

PRAD0373 - Equation of State - Tin

Run: 36793 Picture: 31598 Type: PreShot

Start Run

07/20 14:18	*Start Run* **36793**	PRAD 373, Tin EoS
07/20 14:18	*Arm*	
07/20 14:18	*Trigger*	
07/20 14:18	MP Width	60
07/20 14:18	MP Countdown	9999
07/20 14:19	*Picture* **31598**	PreShot, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 14:19	*End Run*	

43766 | 7/20/2009 2:20:06 PM | **DAQ On-line** | Edit

PRAD0373 - Equation of State - Tin

Run: 36794 Picture: 31599 Type: PreShot

Start Run

07/20 14:20	*Start Run* **36794**	PRAD 373, Tin EoS
07/20 14:20	*Arm*	
07/20 14:20	*Trigger*	
07/20 14:20	MP Width	60
07/20 14:20	MP Countdown	9999
07/20 14:20	*Picture* **31599**	PreShot, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 14:21	*End Run*	

43767 | 7/20/2009 2:23:01 PM | **EIC** | Edit

PRAD0373 - Equation of State - Tin

Run: Picture: Type: Dynamic

Picture Type Change

```
Picture Type changed to Dynamic [7]
```

43768 | 7/20/2009 2:23:59 PM | **DAQ On-line** | PRAD0373 - Equation of State - Tin

Edit

Run: 36795 Picture: 31600 Type: Dynamic

Start Run

07/20 14:23	*Start Run* **36795** PRAD 373, Tin EoS	
07/20 14:24	*Arm*	
07/20 14:24	*Trigger*	
07/20 14:24	Lens 1	1760
07/20 14:24	Lens 1	126.047
07/20 14:24	Lens 2	-2.599
07/20 14:24	Lens 2	0
07/20 14:24	Lens 2	-4.541
07/20 14:24	Lens 3	1520
07/20 14:24	Lens 3	1544.638
07/20 14:24	Diffuser	1219
07/20 14:24	H-GX Gate Delay	200
07/20 14:24	H-GX Gate Length	625
07/20 14:24	MP Width	60
07/20 14:24	MP Countdown	9999
07/20 14:24	Perm Mg 2	79.92
07/20 14:24	Perm Mg 3	112.746
07/20 14:24	Perm Mg 4	135.644
07/20 14:24	Energy Loss	15
07/20 14:24	Energy Cal	0.0268
07/20 14:24	Beam Line Title	EOS-370 & 373 & 373 - 07/14/2009 - 6 Foot [116]
07/20 14:24	Comment	EOS-370 & 373 & 373
07/20 14:24	Mode	Perm Mag X3
07/20 14:24	Vessel	6 Foot
07/20 14:24	Collimator IL0	None
07/20 14:24	Collimator IL1	10 mr Straight

07/20 14:24	Collimator IL2	None
07/20 14:24	Window IL0	125 mil Al [125 mil G]
07/20 14:24	Window Object Up	N/A
07/20 14:24	Window Object Down	N/A
07/20 14:24	Window Up IL1	125 mil Al [125 mil G]
07/20 14:24	Window Down IL1	20 mil Kapton
07/20 14:24	Window IL2	62.5 mil Al
07/20 14:24	Converter IL0	None
07/20 14:24	Converter IL1	1.9 mm LSO, 2x3
07/20 14:24	Converter IL2	2.2 mm Mosaic, LSO, black
07/20 14:24	Location	LANSCE, Line C, Cave
07/20 14:24	Key	116
07/20 14:24	Date Created	7/14/2009
07/20 14:24	*Picture* **31600**	Dynamic, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 14:25	*End Run*	

43769 | 7/20/2009 2:28:22 PM | **TNThompson** |

Edit

PRAD0373 - Equation of State - Tin

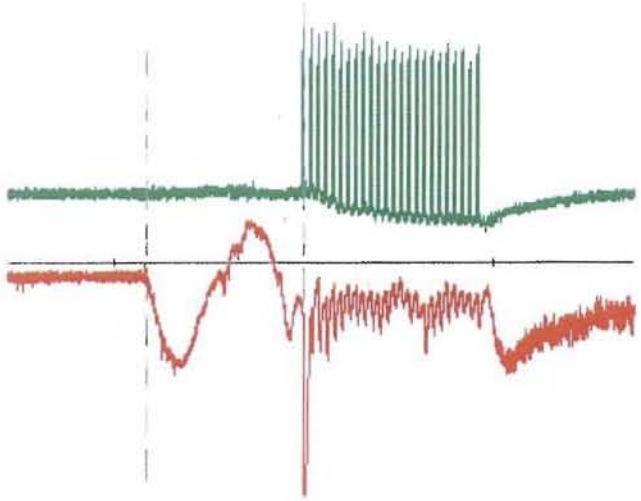
CVR to 1st Camera Timing:

Target: 8.300 uS
Actual: 8.284 uS

Markers: Scope 9, LeCroy LT584M

Time Markers

	1	2
1	0.0000E+00	-8.2841E-06
2	8.2841E-06	0.0000E+00
Value	2.4170E-04	2.4998E-04



File uploaded: ***P373.bmp*** of type ***image/bmp***

Click to open uploaded file

43770 | 7/20/2009 2:31:17 PM | **EIC** | Edit PRAD0373 - Equation of State - Tin

Run: Picture: Type: Small Fiducial

Picture Type Change

```
Picture Type changed to Small Fiducial [11]
```

43771 | 7/20/2009 2:31:27 PM | **DAQ On-line** | Edit PRAD0373 - Equation of State - Tin

Run: 36796 Picture: 31601 Type: Small Fiducial

Start Run

07/20 14:31	*Start Run* **36796**	PRAD 373, Tin EoS
07/20 14:31	*Arm*	
07/20 14:31	*Trigger*	
07/20 14:31	Lens 1	1760
07/20 14:31	Lens 1	126.042
07/20 14:31	Lens 2	-2.556
07/20 14:31	Lens 2	0
07/20 14:31	Lens 2	-4.358
07/20 14:31	Lens 3	1520
07/20 14:31	Lens 3	1544.506
07/20 14:31	Diffuser	1218

07/20 14:31	Perm Mg 2	80.134
07/20 14:31	Perm Mg 3	113.17
07/20 14:31	Perm Mg 4	136.29
07/20 14:31	Energy Loss	-12345
07/20 14:31	Energy Cal	0.0268
07/20 14:31	*Picture* **31601**	Small Fiducial, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 14:32	*End Run*	

43772 | 7/20/2009 2:34:18 PM | **DAQ On-line** |

Edit

PRAD0373 - Equation of State - Tin

Run: 36797 Picture: 31602 Type: Small Fiducial

Start Run

43773 | 7/20/2009 2:46:06 PM | **DAQ On-line** |

Edit

PRAD0373 - Equation of State - Tin

Run: 36798 Picture: 31603 Type: Small Fiducial

Start Run

07/20 14:34	*Start Run* **36797**	
07/20 14:34	*Arm*	
07/20 14:34	*Trigger*	
07/20 14:34	Lens 1	1760
07/20 14:34	*Start Run* **36798**	PRAD 373, Tin EoS
07/20 14:34	Lens 1	126.041
07/20 14:34	*Arm*	
07/20 14:34	Lens 2	-2.61
07/20 14:34	*Trigger*	
07/20 14:34	Lens 2	0
07/20 14:34	Lens 1	1760
07/20 14:34	Lens 2	-4.893
07/20 14:34	Lens 1	126.063
07/20 14:34	Lens 3	1520
07/20 14:34	Lens 2	-2.727
07/20 14:34	Lens 3	1544.827
07/20 14:34	Lens 2	0
07/20 14:34	Diffuser	1218
07/20 14:34	Lens 2	-4.573
07/20 14:34	Perm Mg 2	80.269
07/20 14:34	Lens 3	1520
07/20 14:34	Perm Mg 3	113.443
07/20 14:34	Lens 3	1544.505
07/20 14:34	Perm Mg 4	136.689
07/20 14:34	Diffuser	1220
07/20 14:34	Energy Loss	2
07/20 14:34	Perm Mg 2	80.054
07/20 14:34	Energy Cal	0.0268
07/20 14:34	Perm Mg 3	113.014
07/20 14:34	*Picture* **31602**	Small Fiducial, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 14:34	Perm Mg 4	136.046
07/20 14:35	*End Run*	

07/20 14:46	Energy Loss	10
07/20 14:46	Energy Cal	0.0268
07/20 14:46	*Picture* **31603**	Small Fiducial, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 14:47	*End Run*	

43774 | 7/20/2009 2:49:08 PM | **EIC** | Edit PRAD0373 - Equation of State - Tin

Run: Picture: Type: Beam

Picture Type Change

Picture Type changed to Beam [2]

43775 | 7/20/2009 2:49:14 PM | **DAQ On-line** | Edit PRAD0373 - Equation of State - Tin

Run: 36799 Picture: 31604 Type: Beam

Start Run

07/20 14:49	*Start Run* **36799**	PRAD 373, Tin EoS
07/20 14:49	*Arm*	
07/20 14:50	*Trigger*	
07/20 14:50	Diffuser	1216
07/20 14:50	MP Width	60
07/20 14:50	*Picture* **31604**	Beam, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 14:50	*End Run*	

43776 | 7/20/2009 2:51:04 PM | **DAQ On-line** | Edit PRAD0373 - Equation of State - Tin

Run: 36800 Picture: 31605 Type: Beam

Start Run

07/20 14:51	*Start Run* **36800**	PRAD 373, Tin EoS
07/20 14:51	*Arm*	
07/20 14:51	*Trigger*	
07/20 14:51	Diffuser	1218
07/20 14:51	MP Width	60

07/20 14:51	*Picture* **31605**	Beam, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 14:52	*End Run*	

43777 | 7/20/2009 2:52:19 PM | **DAQ On-line** |

Edit

PRAD0373 - Equation of State - Tin

Run: 36801 Picture: 31606 Type: Beam

Start Run

07/20 14:52	*Start Run* **36801**	PRAD 373, Tin EoS
07/20 14:52	*Arm*	
07/20 14:52	*Trigger*	
07/20 14:52	Diffuser	1219
07/20 14:52	MP Width	60
07/20 14:52	*Picture* **31606**	Beam, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 14:53	*End Run*	

43778 | 7/20/2009 2:53:36 PM | **DAQ On-line** |

Edit

PRAD0373 - Equation of State - Tin

Run: 36802 Picture: 31607 Type: Beam

Start Run

07/20 14:53	*Start Run* **36802**	PRAD 373, Tin EoS
07/20 14:53	*Arm*	
07/20 14:53	*Trigger*	
07/20 14:53	Diffuser	1218
07/20 14:53	MP Width	60
07/20 14:54	*Picture* **31607**	Beam, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 14:54	*End Run*	

43779 | 7/20/2009 2:54:49 PM | **DAQ On-line** |

Edit

PRAD0373 - Equation of State - Tin

Run: 36803 Picture: 31608 Type: Beam

Start Run

07/20 14:54	*Start Run* **36803**	PRAD 373, Tin EoS
07/20 14:54	*Arm*	
07/20 14:55	*Trigger*	
07/20 14:55	Diffuser	1219
07/20 14:55	MP Width	60
07/20 14:55	*Picture* **31608**	Beam, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 14:55	*End Run*	

43780 | 7/20/2009 2:56:35 PM | **TNThompson** | PRAD0373 - Equation of State - Tin

Edit

magnifier set to beam energy

43781 | 7/20/2009 2:57:05 PM | **DAQ On-line** | PRAD0373 - Equation of State - Tin

Edit

Run: 36804 Picture: 31609 Type: Beam

Start Run

07/20 14:57	*Start Run* **36804**	PRAD 373, Tin EoS
07/20 14:57	*Arm*	
07/20 14:57	*Trigger*	
07/20 14:57	Diffuser	1219
07/20 14:57	MP Width	60
07/20 14:57	*Picture* **31609**	Beam, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 14:58	*End Run*	

43782 | 7/20/2009 2:58:51 PM | **DAQ On-line** | PRAD0373 - Equation of State - Tin

Edit

Run: 36805 Picture: 31610 Type: Beam

Start Run

07/20 14:58	*Start Run* **36805**	PRAD 373, Tin EoS
07/20 14:59	*Arm*	
07/20 14:59	*Trigger*	

07/20 14:59	Diffuser	1218
07/20 14:59	MP Width	60
07/20 14:59	*Picture* **31610**	Beam, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 15:00	*End Run*	

43783 | 7/20/2009 3:00:11 PM | **DAQ On-line** |

Edit

PRAD0373 - Equation of State - Tin

Run: 36806 Picture: 31611 Type: Beam

Start Run

07/20 15:00	*Start Run* **36806**	PRAD 373, Tin EoS
07/20 15:00	*Arm*	
07/20 15:00	*Trigger*	
07/20 15:00	Diffuser	1219
07/20 15:00	MP Width	60
07/20 15:00	*Picture* **31611**	Beam, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 15:01	*End Run*	

43784 | 7/20/2009 3:01:34 PM | **DAQ On-line** |

Edit

PRAD0373 - Equation of State - Tin

Run: 36807 Picture: 31612 Type: Beam

Start Run

07/20 15:01	*Start Run* **36807**	PRAD 373, Tin EoS
07/20 15:01	*Arm*	
07/20 15:01	*Trigger*	
07/20 15:01	Diffuser	1218
07/20 15:01	MP Width	60
07/20 15:01	*Picture* **31612**	Beam, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 15:02	*End Run*	

43785 | 7/20/2009 3:02:52 PM | **DAQ On-line** |

Edit

PRAD0373 - Equation of State - Tin

Run: 36808 Picture: 31613 Type: Beam

Start Run

07/20 15:02	*Start Run* **36808**	PRAD 373, Tin EoS
07/20 15:02	*Arm*	
07/20 15:03	*Trigger*	
07/20 15:03	Diffuser	1218
07/20 15:03	MP Width	60
07/20 15:03	*Picture* **31613**	Beam, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 15:04	*End Run*	

43786 | 7/20/2009 3:05:22 PM | **EIC** | Edit PRAD0373 - Equation of State - Tin

Run: Picture: Type: Dark Field

Picture Type Change

Picture Type changed to Dark Field [1]

43787 | 7/20/2009 3:06:26 PM | **DAQ On-line** | Edit PRAD0373 - Equation of State - Tin

Run: Picture: 31614 Type: Dark Field

Independent Picture

07/20 15:06 *Picture* **31614**, Dark Field, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M

43788 | 7/20/2009 3:07:23 PM | **DAQ On-line** | Edit PRAD0373 - Equation of State - Tin

Run: Picture: 31615 Type: Dark Field

Independent Picture

07/20 15:07 *Picture* **31615**, Dark Field, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M

43789 | 7/20/2009 3:08:15 PM | **DAQ On-line** | Edit PRAD0373 - Equation of State - Tin

Run: Picture: 31616 Type: Dark Field

Independent Picture

07/20 15:08 *Picture* **31616**, Dark Field, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M

43790 | 7/20/2009 3:09:05 PM | **DAQ On-line** | Edit PRAD0373 - Equation of State - Tin

Run: Picture: 31617 Type: Dark Field

Independent Picture

07/20 15:09 *Picture* **31617**, Dark Field, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M

43791 | 7/20/2009 3:09:22 PM | **DAQ On-line** | PRAD0373 - Equation of State - Tin

Edit

Run: 36809 Picture: 31618 Type: Dark Field

Start Run

07/20 15:09	*Start Run* **36809**	PRAD 373, Tin EoS
07/20 15:09	*Arm*	
07/20 15:09	*Info*	**Manual Trigger** from PCPRAD307
07/20 15:09	*Trigger*	
07/20 15:10	*Picture* **31618**	Dark Field, Cameras X, Y, Z, T, U, V, Q, R, S, N, O, P, K, L, M, H, I, J, G, A, B, C, D, F, E
07/20 15:10	*End Run*	

Basic Filters	Content Filters
○ By Date ○ Last 10 ○ Today ○ This Week ○ This Month ○ This Year ◉ All	Date Range Start 7/29/2009 / 7/30/2009 End ☐ Name ASaunders ☐ Text Entry *trigger* ☑ Activity No PRAD0373 - Equation of State - Tin ☐ Expt Family Miscellaneous ☐ Pic Type Other ☐ Run No ☐ Pic No

Check checkboxes to select content filters ("" , * , ? chars allowed).

Refresh | Hide Filters | New Entry

PRAD Home > Logbook Home

PRAD On-Line | Logbook | PRAD Off-Line | Run Status | Beam Status | Phone

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Operational Guide and Safety Control Check List

The following is to be used as an operational guide and as a safety checklist to allow for recording of implementation of controls.
This document is to be completed by the Experimenter In Charge or his designee. This document will be retained for 2 years after completed.

Shot Name: Tin EOS ; PRAD # 373 ; HX # LNSC- 10627 ; Originator's # H3869
Dates of Shot: 7/20/2009 ; Experimenter in Charge (PRAD PIC): Cynthia Schwartz
HE PIC: Marr-Lyon ; Firing Leader: R. Lopez ; Secondary Operator: Bainbridge
Checklist & Safety Watch Campos ; Laser Diagnostics PIC N/A

Operational Guide	Safety Control Checklist	Initials	Date	Checked
Mark list for all N/A (Non/Applicable) items before EIC review. Classified shots; Call Richard Harford 5-0060 and Tim Olinger 5-6363 http://ptla.lanl.gov/cgi-bin/mailform/staff_form.htm	• EIC reviews & signs check list Cynthia Schwartz • PRAD safety/security review for this series within 2 weeks • Guards scheduled for night watching of classified shots	CLS EC NA	* 7/13	✓ ✓ NA
Rope stays up until after shot has been completed.	• Rope off truck access entrance, at north end of counting house - Label rope with "No Parking Fire Lane" sign	EC		✓
RWP = Radiation Work Permit – NOT expired Uranium, Pu, and other unusual materials/conditions	• RWP for dynamics – date is current & posted on shield door • RWP for extras (U/Pu) - date is current & posted on shield dr	NA NA		NA NA
1) HE Category (Orange Octagon) 2) Experimenter In Charge permission required for entry	• Signs - Line C tunnel entrance station (PACS) • Signs - Line C shield door – small door	EC		✓ ✓
Lightning Detector – Display NM. Full Zoom out - verify speaker volume	• Lightning computer speaker volume turned up & verified • LANSCE electric field mill displayed and indicating • Lightning Strike program displayed and updating	Broken Use EC	access	Broken control ✓
	• CCR notified – EIC for the HE shot	EC		✓
Gun shots do not normally have a "confined space". NOT for DU/Pu!	• Confined Space Permit 09-8037 ; effective 7/20-24/09	EC		✓
Respirators are required by the IWD.	• HE workers available with current confined space training • Respirators with canisters available – expiration date verified • Level II Anti-C clothing available (U/Pu) • (U/Pu) RCT available with respirator and canisters in date	EC EC NA NA		✓ ✓ NA NA
Experiment Design - HE = High Explosive (Less than or equal to 10 pounds of HE or 300 grams of black powder)	• Depleted Uranium less than 100 pounds • HE load within Authorization Basis <10 lb HE <300gr powder	NA EC		NA ✓
	• HE on LANSCE Approved List	EC		✓
Some experiments do not use detonators, like electrically heated Cook-Off	• Detonators on approved list, if required.	EC		✓
Some Powder gun shots require conductive surfaces for handling powder	• Conductive surfaces available if required by shot sheet or PIC	NA		NA
EIRC = Explosives Instrumentation Review Committee Power Supply, CDU, DCU, fiber optics trigger, etc.	• Firing Circuit & firing circuit test equipment, if used, have been reviewed by the EIRC for this specific use.	EC		✓
	• Corresponding Proof/Overpressure Tests Completed	EC		✓
Shot sheet specifies the approved HE load for this shot in this vessel/gun	• Vessel Approving Authority - Approval Received	EC		✓
LANSCE = Los Alamos Neutron Science Facility	• Notification to LANSCE Experimental Area C Manager	EC		✓
Tested within past 30 days.	• Emergency Lighting in Line C dome	EC	7/17	✓
Portable gantry - Each structural member is attached by a removable pin. Not usually required for gun shots.	• Ask HX-3 if a Critical Lift Form will be needed later • A-frame crane – Official Daily Check – qualified operator	NA EC		NA ✓

* item must be rechecked for multiple similar shots in series

Operational Guide	Safety Control Checklist	Initials	Date	Checked
Braided grounding strap connects ground block on dome wall south side east.	• Electrical bonding connection to dome wall ground plate • Vessel or gun target box • Crane • 6' vessel top door (sitting a top assembly stand) or gun barrel	EL EL EL —	 *	✓ ✓ ✓ —
Module 9 – select "Normal" & push reset. Place "S1 test" switch in "test" and run unit for 10 minutes. Place "test" switch back into "normal". Check automatic transfer valve is not pointing to empty bottle. If the stand-by tank is not open, the generator will fail when #1 empties.	• Backup generator enabled – Module 9 "Normal" and "Reset" • Backup generator tested (not usually required for gun shots) • Propane automatic selection valve – NOT RED • Both propane tank valves OPEN • Work-Stand light in dome hooked to generator and tested	EL EL EL EL EL	*	✓ ✓ ✓ ✓ ✓
CO = Carbon Monoxide – Zero ITX model after 15 minute warm-up. NOTE: Some CO monitors should not be ON when in their charger. NOTE: TV picture must be readable when dome lights are turned off. NOTE: The ITX models can be left on all day if no blower is installed.	• CO monitors – Two available and tested (includes zero reset) • Calibration memo current • One installed in dome with a TV picture in the counting house • Turn units off, including blowers, to preserve batteries	 EL	 	✓ ✓ ✓ ✓
Turn amplifier power on and select "phono" Amplifier can be turned off after test.	• Microphone is placed on vessel or gun catch tank and audio can be heard in counting house.	EL		✓
GFCI – Ground Fault Circuit Interrupter – Use circuit tester w/trip button Not usually required for gun shots. Power cords on floor can be electrical hazards during flooding caused by a cooling hose rupture. Check 208 V crane and laser cords also.	• GFCI receptacles for vessel tested within 30 days • Vessel drop light(s) hooked to GFCI • Vessel extension cord for impact wrench hooked to GFCI • No 120V or 208V power cord connections on floor	EL EL EL EL	7/17	✓ ✓ ✓ ✓
House air line drives a venturi pump in the vertical run of the PVC exhaust pipe to the LANSCE radioactive exhaust stack system	• Vacuum pump exhaust booster pump hooked up and working • Radiation Portal Monitor – Green status & bottles have gas	EL EL		✓ ✓
	• Laser setup check list started – if lasers will be used	NA		NA
Uranium and Plutonium – Vacuum system Pressure after the shot is supposed to be less than atmospheric. First filter layer is 2.0 microns. Second layer is 0.2 microns. Check valve prevents U dust going out into dome during venting. Venting must be done slowly so as to not ignite U dust. TV picture in counting house for vacuum gage.	• U/Pu – Calculated post shot pressure is below atmospheric • Filter pack between containment & vacuum sys – 0.2 micron • 2 psig check valve installed on vent valve • Flow restrictor installed in vent line • Remote reading of post shot pressure in counting house • Valves operate OK – containment isolation, vent, purge • Remote reading of primary container pressure in CCH	NA NA NA NA NA NA NA		NA NA NA NA NA NA NA
Uranium and Plutonium - Continuous Air Monitor	• CAM or Giraffe near vessel – Checked today by a RCT • Remote indication in counting house	NA NA		NA NA
Uranium and Plutonium – Contamination Control Areas	• Contamination area around vessel • Contamination area around HE assembly area • Contamination buffer area near portal monitor • Radioactive Materials Balance area (safe) posted correctly	NA NA NA NA		NA NA NA NA
Gas cooling/heating system could overpressure vacuum pumping system; so, a "conflat" blank is placed on a tee by the pressure gage. The LN2 dewar connections are easily confused – check the correctness.	• Gas filled, cooled, or heated shots • Zero pressure relief installed for upstream vacuum valve • LN2 dewar inlet & outlet connections double checked	 NA NA	 * *	 NA NA
Vacuum pump exhaust system to radioactive exhaust system – white PVC piping system – Big gray valves (usually without their red handles)	• Vacuum fore pump exhaust valve open – Upstream of vessel • Downstream of vessel • Second Lens system	 EL	 	✓ ✓ ✓
Both gage controllers in blue racks	• Vacuum gauge TV picture in CCH with separate illumination	EL		✓

Operational Guide	Safety Control Checklist	Initials	Date	Checked
Remove dust/gases falling out of front door	• Portable HEPA system rigged/tested under vessel front door	EC		✓
The type and thickness required is specified in the "Contained Shot Request Form" under "Shrapnel Protection". Windows must be checked for damage from previous shot every time, including checking the glass for cracks.	• Containment system beam windows • Glass thickness required = 1/8" inch; downStream 1/8" • Metal type = Al, thickness = 1/8"; dwnStr = 1/8" • Upstream checked for damage after previous shot and installed • Downstream checked for damage and installed	 EC EC	 * *	 ✓ ✓
Key & reset at IL0; Power ON = green LEDs on controllers in blue racks	• Dalek - Key IN, Reset, and power ON	EC	*	✓
Beam Line vacuum pump-out valve – The containment system isolation valves to the pumping stations. Tested from CCH. CCH = Line C Counting House TV picture requires separate illumination to be seen when the dome lights are out.	• Containment isolation vacuum valve actuator operation • Upstream of vessel • Downstream of vessel • TV pictures can be viewed in CCH • Illuminators available (flashlight or equivalent) • Vacuum valves OPEN	 EC EC EC EC GC	 * * *	 ✓ ✓ ✓ ✓ ✓
No bolts can be left out. Broken bolts must be reported to the HE PIC and EIC. Not required after the first shot in a series.	• Vessel/gun and containment pipes installed and checked for loose and missing bolts – every bolt installed and tight	EC		✓
Door check for is for the doors installed at this time, like beam line doors.	• Vessel/gun installed doors checked for loose/missing bolts	EC		✓
	• Beam Line Setup entered into DAQ program	EC		✓
Exclusion Threshold Temperature is the temperature above which the HE might be unstable; so, people are excluded. LANSCE requires all Lock Out Tag Outs to be entered into their log. Thermocouple Meter or DVM with temperature scale	• Cook-Offs: • Shutter illumination available • TV picture of laser blocking shutter in counting house • Four lock boxes & padlocks available • Laser shutter tested – Fails safe (closed) upon loss of power • Heater cables locked by FL in CCH and FL has the key(s) • Heated shot - Portable thermocouple meter available and tested	 NA NA NA NA NA NA	 * 	 NA NA NA NA NA NA
	• Exclusion Threshold Temperature = _____ • Temperature readout working in counting house	NA NA	* *	NA NA
CDU = Capacitive Discharge Unit	• Firing Leader in direct charge of HV connection box key and charging key for CDU Power Supply • Cook-Off laser shutter power locked off and FL has the key • Secondary operator has trigger key	EC NA EC	* * *	✓ NA ✓
For ribbon cables, to support "slappers", this test is performed off site.	• High Pot testing of vessel feed-throughs completed	EC	*	✓
DCO – Detonator Checking Ohmmeter	• DCO available, if needed – Charged up or charging	EC	*	✓
Signature in CCR (Central Control Room) for today's shot	• LANSCE Experimental Area C Manager Approval Received	EC	7/20	✓
Firing Site Access Control 7-6742	• Access Control - weather status – start a Weather Watch	NA		NA
	• HE starting transport to TA-53 at time = 1029	EC	*	✓
HE staff and P-25 have agreed that asking CCR to not open the line B tunnel door is sufficient control to prevent violation of the HE exclusion area. The EIC knows that the authorization basis requires firing leader approval before permitting line B entries. CCR line-by-line for Line B PACS = LBSS1L1 and/or 1L2 NTOF door – Exclusion Area – Red light ON and door Locked (pull on it)	• Notify CCR – "CCR, high explosives are being shipped to TA-53. Please do not allow entries into the line B and C tunnels without the permission of the Experimenter-In-Charge until after HE operations are completed." • Line B tunnel PACS secured • NTOF cave 202 key exclusion area secured	EC EC EC	*	✓ ✓ ✓
Orange Octagon with a "1" on it.	• Post large sign outside truck roll-up door – HE Category	EC	*	✓

Operational Guide	Safety Control Checklist	Initials	Date	Checked
Post 2 signs - HE Orange Octagon & EIC – **after** HE is on its way. HE octagon clips onto exclusion area box over top of keyed lock.	• EIC Sign for Line B tunnel - NTOF maze outside door • HE octagon – NTOF Exclusion area box	EL EL		✓ ✓
The experimenter in charge will notify CCR when the HE arrives on site.	• HE arrival time: 1050 • CCR Notified that the HE has arrived	 EL	 *	 ✓

******* **Move HE into Line C Dome** **********	**Move HE to Dome** * recheck all items for multiple shots			
			*	✓
Laminated Badge "I am guarding classified (SRD) High Explosives"	• Bomb Badge issued	NA		NA
LANL Meteorologist substitutes for broken lightning/field indications Moving the HE out of the delivery truck begins HE operations at TA-53	• Lightning/weather status - Access Control or Meteorologist • Notify Access Control that HE is being removed from truck	EL NA	* *	✓ NA
A custom terminator is placed on the end of the cable.	• CDU output detonator cable is terminated – not open ended	EL	*	✓
	• Pathway for HE movement cleared of obstructions and HE area is free of combustibles	EL	*	✓
	• HE moved into Line C dome inside D.O.T. container	EL	*	✓
Door cannot be re-opened until after shot fired or returned to DOT container – AC20 page 83 Explosives Operations at LANSCE	• Area C shield door closed and air pads deflated before opening HE shipping container	EL	*	✓
	• Firing Leader holds keys: • Dome access keys (PACS) • VISAR control box • PDV Laser key • Cook OFF laser control key OR laser ignition fiber lock box	 EL NA NA NA	 * * * *	 ✓ NA NA NA

HCP = Hazard Control Plan IWD = Integrated Work Document EIC = Experimenter In Charge VISAR – Laser system Velocity Interferometer System for Any Reflective surface **Uranium**, Beryllium, Lead, etc. all require additional training and may require a special IWD PIC = Person in Charge – must be consulted about work which comes under their responsibility before the work starts, as per the IWD. Only one briefing per day is required if all the days shots are discussed at the first briefing and if there are no significant changes from shot to shot. HE heated above its Exclusion Threshold Temperature may go off without warning.	• Pre-Job Briefing by EIC • Has anyone NOT read and signed the PRAD security plan? • ---- Dynamic RWP? • ---- Area C hazard overview? • ---- Dynamic IWD? ----------→ • ---- Special IWD and/or training (U, Be, Ca, Pb, etc.) • Does anyone NOT have current TA-53 site specific training? • Experimenter In Charge is ----------→ • No dome PACS entries after HE load, without EIC approval • HE PIC is ... • Firing-Leader is ... • Secondary firing leader is ----------→ • Ignition sources prohibited in dome – no lighters, no matches • Absolutely no entries after HE exceeds exclusion temperature • Safety Watch is ----------→ • Forklift operations are halted in the dome and truck entrance • Laser Diagnostics PIC is ----------→ • VISAR/LASER system status is ... • Laser Keys – Clarify the times when FL needs to hold keys • MSDS sheets available via counting house computers -------→ • Flammable gases in detectors, cameras, and vessel? • Are there any other issues? CWS • _____ • _____ • _____ • _____ • _____	------→ ------→ ------→	------→ ------→ ------→	___NA ___NA ✓ ✓ ___NA ✓ ✓ ✓ ✓ ✓ ✓ ✓ ___NA ✓ ✓ ___N/A ___NA ___NA _____ _____ _____ _____

******* Load HE into Vessel **********	**Loading HE** * recheck all items for multiple shots		*	
	• Crane - Critical Lift form completed	EL	*	✓
	• Laser setup check list completed	NA		NA
U/Pu containment system not opened until after venturi pump disconnect. No air flow through containment system for U/Pu.	• U/Pu – Vacuum system venturi disconnected before opening	NA	*	NA
	• CAM & CAM exhaust pump turned on and verified by a RCT	NA	*	NA
Cook-off laser ignition fiber locked after fiber is through the vessel door.	• Cook-off laser ignition fiber locked in box and FL has key	NA	*	NA
HE procedures limit the number of persons in the area to 5. Access Control or Meteorologist if local indications broken.	• Assign a door watch for HE exclusion area and to watch the lightning detector – reports to firing leader	EL	*	✓
No one is in the dome without the firing leader's approval.	• HE Exclusion Area established	EL	*	✓
Door watch asks each new person if they have ignition sources.	• HE team has NO ignition sources – no matches, no lighters	EL	*	✓
Team going in is in radio contact with a person outside.	• Radio Check – door watch to access control	NA	*	NA
	• Radio Check – entry team - door watch from inside shield door	EL	*	✓
epending on the meter, the DCU check is done before or after the vessel is secured. The detonator cable is protected from sparks.	• Detonator Checking Ohmmeter – check completed	EL	*	✓
	• Shorting cap on detonator cable connector	EL	*	✓
U/Pu - venturi pump air line was previously disconnected.	• U/Pu – Vacuum system venturi pump ReConnected	NA	*	NA
Blast containment system All bolts must be installed. No broken or missing bolts. All bolts must be re-checked for tightness after the system is under vacuum.	• Vacuum less than 25 torr and Vessel is secured (fully bolted steel doors) (25 torr = 25mm-Hg; = 25,000 microns)	EL	*	✓
	• Beam line bolts are all installed and tight (after vacuum)	EL	*	✓
	• Vessel door bolts are all installed and tight (after vacuum)	EL	*	✓
	• Gun breech – all holes plugged (pressure transducer)	NA	*	NA
Vessel and/or containment system leak too much for good pictures? 5 min DO NOT Exceed 25 Torr! HE exclusion area required for >25 torr!	• Leak check - Vessel pressure start ____ Finish ____ DO NOT Exceed 25 Torr! Time start ____ Finish ____		*	
Gas cooled/heated shots only – "zero pressure relief valve"	• Pop-off disk clamp ring OFF prior to gas cooling/heating shot	NA	*	NA
U/Pu - The inner chamber is the "Thermos" or other containment vessel holding Pu, U, Be, etc. The "Vessel" is the containment vessel attached to the beam line (6' or 4' vessel).	• 15 minute vacuum check < 1 Torr change – close blast valves	NA	*	NA
	• Inner chamber pressure start ____ finish ____	NA	*	NA
	• Vessel chamber pressure start ____ finish ____	NA	*	NA
Minimize radiation damage to CAM electronics during beam tuning.	• CAM **OFF**	NA	*	NA
Cook-offs - First testing of thermocouples and electric heaters. PACS must be secured for heater test. HX takes credit for PACS.	• Two thermocouples reading OK in counting house	NA	*	NA
	• Heater Cables still locked up in counting house	NA	*	NA
	• Laser blocking shutter CLOSED and laser ignition fiber locked	NA	*	NA
	• Cook Off heater test – Permission to hookup – HE PIC, EIC	NA	*	NA
	• HE exclusion area is established	NA	*	NA
	• Heater cables hooked up by FL in dome	NA	*	NA
	• Line C dome PACS secured	NA	*	NA
	• Permission to unlock & perform heater test – EIC, FL, HE PIC	NA	*	NA
	• Thermocouples tested by raising temperature 5 degrees	NA	*	NA
	• Heater cables locked by FL in CCH and FL has the key(s)	NA	*	NA
IL = Image location Thin vacuum windows have protective covers to guard against blowouts when the beam line is under vacuum.	• Remove vacuum window covers			
	• IL0 upstream		*	✓
	• IL1 downstream		*	✓
	• IL2 upstream and downstream	EL	*	✓

Go back inside vessel/target box with HE inside	**Vessel Re-entry** * recheck all items for multiple entries		*	
CDU may have been fired into a short to test timing signal synchronization	• Detonator high Voltage cables are **AGAIN** connected to grounding block on CDU power supply rack	____	*	____
	• Cook-off heaters locked off in CCH and the FL has the key(s)	NA	*	NA
	• EIC permission	____	*	____
	• Firing Leader & HE PIC permissions	____	*	____
	• Weather check with access control	____	*	____
	• HX-3 Radio checks with access control and entry team	____	*	____
	• FL has key(s) – CDU, laser(s), cook off keys (shutter&heaters)	____	*	____
	• Door & weather watch assigned	____	*	____
	• HE team has NO ignition sources – no matches, no lighters	____	*	____
	• HE Exclusion Area established	____	*	____
Inside dome	• U/Pu – Vacuum system venturi disconnected before opening	NA	*	NA
	• CAM & CAM exhaust pump turned on and verified by a RCT	NA	*	NA
	• Cooling/heating system shut off – if required by firing leader	**NA**	*	**NA**
	• Laser blocking shutter CLOSED and laser ignition fiber locked	NA	*	NA
	• Detonator cables disconnected from CDU & shorted	____	*	____
Exiting dome	• U/Pu – Vacuum system venturi Re-connected	NA	*	NA
	• Vacuum less than 25 torr and Vessel is secured (fully bolted steel doors) (25 torr = 25mm-Hg; = 25,000 microns)	____	*	____
	• Vessel door bolts are all installed and tight (after vacuum)	____		____
	• Gun breech – all holes plugged (pressure transducer)	NA	*	NA
	• Detonator Checking Ohmmeter – check completed	____	*	____
	• Shorting cap on detonator cable connector	____	*	____
	• Leak check - Vessel pressure start _____ finish _____	**NA**	*	**NA**
	• U/Pu - CAM OFF	NA	*	NA
	• 15min double vessel check < 1 Torr change – close valves	NA	*	NA
	• Inner chamber pressure start _____ finish _____	NA	*	NA
	• Vessel chamber pressure start _____ finish _____	**NA**	*	**NA**
	• Cooling/heating system turn ON if required		*	

Post Shot	After Firing		*	✓
	• CDU discharged - high Voltage meter indicates zero	EL	*	✓
Detonator high Voltage cables are **AGAIN** connected to grounding block on CDU power supply rack	• Detonator High Voltage cables connected to grounding block	EL	*	✓
	• Pin Power Supply OFF (in counting house)	NA	*	NA
	• CDU keys removed or cook-off laser blocking shutter closed	EL	*	✓
Beam line upstream of containment system. Unit 1 channel 6.	• Post shot beam line pressure = .1 e-3 torr	EL	*	✓
TV picture of CO monitor	• Line C - CO before initial re-entry = 0 ppm CO	EL	*	✓
Firing Leader determines the apparent shot status after evaluating the microphone audio, vacuum, and camera pictures.	• Apparent status • Successful • Partial (detonator fired) • Misfire (detonator did not fire)	EL	*	✓
Write "N/A" if there is no misfire.	• Misfire/partial-fire procedures started if shot not successful	NA	*	NA
24/7 numbers = PTLA scheduling 7-4438, shift commander 5-1279	• Notify PTLA of need /no need for overnight guards	NA		NA
Photon Doppler Velocimeter – Laser system in counting house	• PDV laser, if used – shutdown and key REMOVED	NA	*	NA
Shut down = Laser Power supply turned OFF and key removed.	• VISAR shut down, if applicable, and key(s) removed	NA	*	NA
Firing Site Access Control 7-6742	• Access Control notified – Shot status	EL	*	✓
	• Cook off locks removed	NA	*	NA
Line C dome radioactive exhaust must be ON before pumping. EIC console, Apps, right click, LXL, XAEF1L3 FLOW and 1L97 ON	• Area A radioactive exhaust stack fan is ON Do not rely upon Run Permit Ready - check line-by-line display	EL	*	✓
Uranium and Plutonium	• Inner container pressure _____ Torr	NA	*	NA
	• Vessel pressure _____ Torr	NA	*	NA
Read post shot pressure remotely. **NOTE: Three pump downs and two vents are a MUST for industrial health safety no matter how small the shot. After the first pump down to remove the HE products, two more air fills must be pumped out to ensure industrial safety.** **Uranium, Vanadium, etc.** need to cool before venting to reduce fire (**Uranium**) and/or slower oxidation (toxic **Vanadium** oxide).	• Upstream pressure .04 torr Close Upstream Pump Valve	EL	*	✓
	• Open Upstream blast valve - post shot pressure = 3.3	EL	*	✓
	• Open Upstream pump valve to begin pumping	EL	*	✓
	• Open Downstream blast & pump valves to help pumping	EL	*	✓
	• Pump down (1) to less than 5,000 microns (**5 torr**)	EL	*	✓
	• Fiducial plate beam picture to verify collimators are clear	EL	*	✓
	• Flammable materials (like U) - 30 minutes before venting	NA	*	NA
Normally, the first two vents are fast to blow out the collimators. For shots with potentially flammable post shot debris, like U, all venting is slow. **Venting is not required before an entry.**	• Vent 1 – Close Pump Valves & Open Atmosphere Vent valves	EL	*	✓
	• Pump down (2) to less than <5,000 microns (**5 torr**) --------→	EL	*	✓
	• Vent 2 – Close Pump Valves & Open Atmosphere Vent valves	EL	*	✓
	• Pump down (3) to less than <5,000 microns (**5 torr**)	EL	*	✓
	• Vent 3 – Slow – Close both pump valves	EL	*	✓
	• Open slow vent valve	EL	*	✓
The initial entry team should always be minimized.	• EIC and firing leader both agree that Line C can be entered	EL	*	✓
	• Notify CCR that the Line C dome CO is <25 ppm, before entry	EL	*	✓
	• Portable CO monitor in the hands of the entry team	EL	*	✓
Uranium and Plutonium	• Level II Anti-C on both the firing leader and RCT	NA	*	NA
	• Respirators for both	NA	*	NA
	• CAM reading OK	NA	*	NA

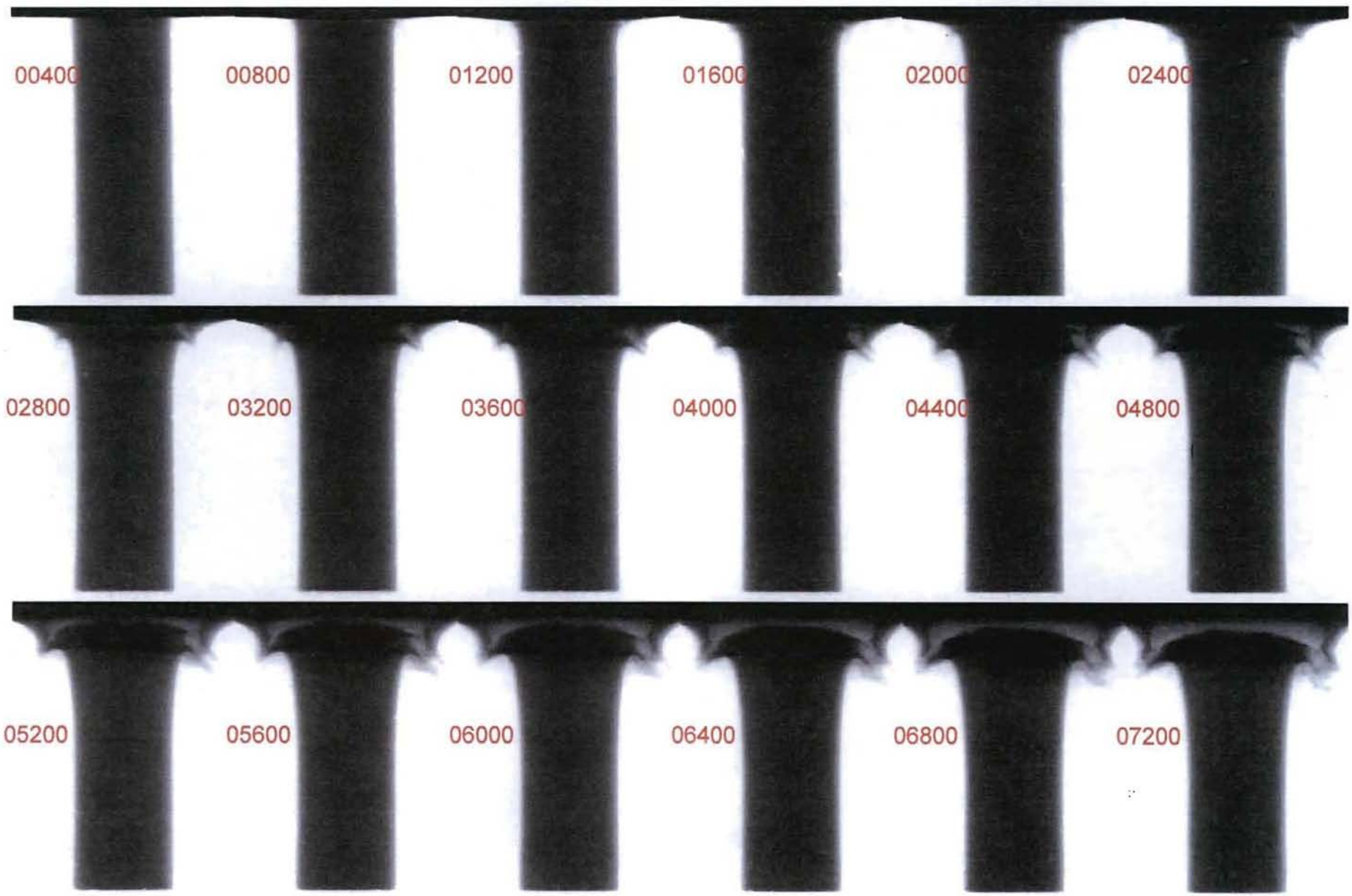
FINAL ENTRY before FINAL SWEEP	Final Entry * recheck all items for multiple shots		*	✓
Verify Pins signal path has been checked	• Pins operation verified	NA	*	NA
CDU may have been fired into a short to test timing signal synchronization	• Detonator high Voltage cables are **AGAIN** connected to grounding block on CDU power supply rack	EC	*	✓
	• Cook-off laser shutter power locked off by FL and FL has key	NA	*	NA
Radio operator stays outside the shield door	• Weather check with access control	NA	*	NA
Needed for initial re-entry	• CO monitor located outside the dome (second unit)	EC	*	✓
	• Vacuum gage unit 1 on channel 6	EC	*	✓
	• Vacuum gage unit 2 on channel 2	EC	*	✓
Carbon Monoxide detector – Call the line C counting house to verify picture of Co monitor before exiting dome.	• CO monitor in Line C dome turned ON with picture in CCH		*	✓
	• Illumination turned on for CO monitor		*	✓
	• Illumination turned on for vacuum Gauge		*	✓
	• Illumination turned on for vacuum Valve	EC	*	✓
Uranium and Plutonium U/Pu - Venturi pump air line was previously disconnected. CAM - Continuous Air Monitor	• U/Pu – Vacuum system venturi pump connected and working	NA	*	NA
	• CAM turned ON and working verified by a RCT	NA	*	NA
	• CAM exhaust pump turned ON	NA	*	NA
Usually for gun shots	• Turn on PIN power supply in Dome if required	N/A	*	NA
Post shot classified traces not visible to L-cleared RCT or operator	• Classified O-scopes are covered or displays disconnected	NA	*	NA
Amplifier power ON; select "phono".	• Microphone audio ON and in PHONO	EC	*	✓
Tap on vessel with metallic object.	• Microphone audio tested again	EC	*	✓
Note that the sign at the line B tunnel door is a long way away; so, this step is done in parallel with the final sweep with detonator hook-up. With UCN exclusion area, this is now the NTOF maze entrance door.	• Post sign "Special Re-Entry Procedure In Effect"			
	• Line C key bank	EC	*	✓
	• Line B tunnel entrance door (NTOF maze door)	EC	*	✓
FINAL SWEEP before Firing	**Final Sweep**		*	✓
	• EIC **AND** HE PIC give permission to hook-up shot for firing	EC	*	✓
	• Cook-off laser shutter power locked off by FL and FL has key	NA	*	NA
	• Heater cables locked by FL in CCH and FL has the key(s)	NA	*	NA
	• TV picture in counting house or control wires disconnected	NA	*	NA
HE operation - Team going in is in radio contact with a person outside. Lightning/ field level – local indication, Access Control, or Meteorologist	• Door/weather watch assigned	EC	*	✓
	• Weather/Lightning status OK	EC	*	✓
The detonator conductivity is usually checked again before hookup	• DCO meter	EC	*	✓
Team going in is in radio contact with a person outside	• Radio Check – door watch to access control	NA	*	NA
	• Radio Check – entry team - door watch from inside shield door	EC	*	✓
Health Physics Technician, Central Control Room Operator, Firing Leader, and Firing Team Members as needed by the Firing Leader.	• Detonator(s) connected to firing circuit or fiber to laser	EC	*	✓
	• DCO check completed	EC	*	✓
The gun catch tank and target chamber may have vacuum valves. Gas cavity fill is different from gas target fill valve – different shot types.	• Gas cavity fill valve OPEN	NA	*	NA
	• Target/shot gas fill, cooling, or heating valves CLOSED	NA	*	NA
	• Gun catch tank/target vac. valves – Both closed, if applicable	NA	*	NA
Lights are turned out for beam pictures.	• Lights OUT – dome	EC	*	✓
A containment system breach can release large quantities of CO.	• Notify CCR, " Line C Cave is ready for Firing. Special re-entry procedure is in effect due to possible carbon monoxide"	EC	*	✓

HE heated above its exclusion temperature may go off without warning.	• Cook offs - EIC and HE PIC and FL agree to start heating HE • Laser trigger OK • Laser blocking shutter enabled inside dome • Permission by EIC and FL to exceed exclusion temperature	NA NA NA NA	* * * *	NA NA NA NA
U/Pu - Room 53-3-S207, Motor Control Center T14G – HVA-1 and FE-1	• U/Pu - Lock fans OFF - Line C dome supply and exhaust fans	NA	*	NA
FIRING	**FIRING**		*	✓
Gun and vessel shots are fundamentally different when requesting beam	• LXP timing check – verify gate relationship to shot need	EC	*	✓
DG-535 on top of firing rack. Same one used for firing detonators.	• Cook-off laser - gate generator in external trigger mode	NA	*	NA
Powder gun projectile detection pin(s) are jumpered for pre-shot testing.	• Gun shots – Disconnect short from Beam Request Pin	NA	*	NA
Lights may have been turned on to watch something.	• Lights OUT – dome – again check	EC	*	✓
Some vessel shot have a gas cavity with two valves. The manual isolation valve is opened during final entry and the remotely operated valve is opened for the gas fill and then closed again before firing. Some vessel shots use timing pins powered from the counting house.	• Gas Fill valve OPEN • Gas fill pressure equalized • Gas fill valve CLOSED • PINS power supply ON, in counting house, if applicable	NA NA NA NA	* * * *	NA NA NA NA
	• VISAR ready, if applicable • PDV ready, if applicable	NA NA	* *	NA NA
Shift data taking mode from statics to dynamics. If in classified mode, camera computers are mode switched separately. If line X is lined up to the 1X or 2X beam stops, beam will not go to LC.	• DAQ in "Dynamic Mode" • Classified Camera computers in "Dynamic Mode" • CCR – "Is the line X beam lined up to send beam to line C?"	EC NA EC	* * *	✓ NA ✓
"Status" display from CCR is checked by EIC – right hand dash is green	• H- injector is ready and enabled to send beam – rt. green dash	EC	*	✓
Usually for cook offs.	• Movie Mode – Cameras in Movie Mode • Stand alone mode • 999 Frames • Acquire mode	NA NA NA NA	* * * *	NA NA NA NA
The radiation safety system MUST be secured for HX to fire. Absolutely no talking by anyone, except as required by the EIC	• PACS secured • Announcement – "Attention! Final firing sequence Absolutely NO unnecessary TALKING!"	EC EC	* *	✓ ✓
Beam Line vacuum pump-out valves – Valves from pumping station to beam pipe.	• Close beam line vacuum pump-out valve remotely – upstream • Close beam line vacuum pump-out valve remotely downstream	EC EC	* *	✓ ✓
CDU – Capacitive Discharge Unit – This energy storage box, located next to the HE, fires the detonator. DG-535 MUST be in external trigger mode before shutter is opened.	• EIC gives permission to charge CDU OR open laser blocking shutter AFTER gate trigger = external • CDU charged or laser shutter open	EC EC	* *	✓ ✓
	• CCR – "Is beam available?" If yes, "CCR, standby for firing!"	EC	*	✓
	• Cook offs – Start DAQ run WITHOUT arming cameras • Beam ON in continuous mode (like 2 or 3 Hz)	NA NA	* *	NA NA
	• EIC gives permission to Arm systems • Cameras ready • CDU trigger key enabled • PDV ready	EC	* * *	✓ ✓ ✓ NA
	• EIC called for beam or triggered laser at 1425 hours	EC	7/20	✓

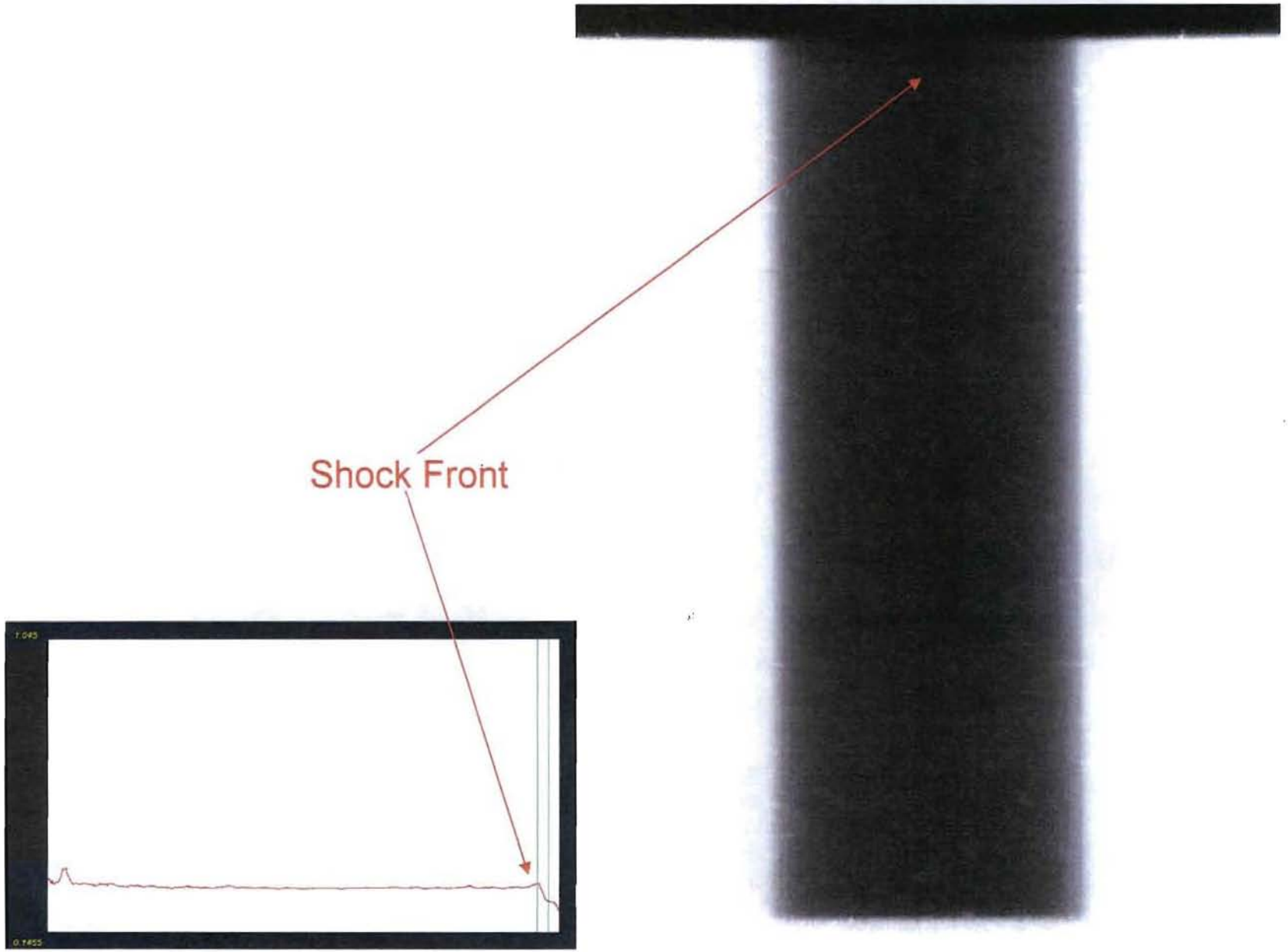
Until after the firing leader has checked for a breach, dome entries after a shot are a high explosives operation. Lightning/ field level – local indication, Access Control, or Meteorologist PPE includes tyvek suits, respirators, gloves, etc.	• Door/weather watch assigned for HE operations • Weather/Lightning status OK • Workers briefed on PPE requirements and waste segregation • Firing leader is controlling dome PACS keys • U/Pu – Reminder - disconnect venture pump before opening	EL EL EL EL NA	* * * * 	✓ ✓ ✓ ✓ NA
HE operation - Team going in is in radio contact with a person outside.	• Radio Check – door watch to access control • Radio Check – entry team - door watch from inside shield door	NA EL	* *	NA EL
Uranium and Plutonium	• Giraffe air monitor checked for contamination	NA	*	NA
	• Cook off laser key removed	NA	*	NA
	• Breach procedures implemented if a breach has occurred	NA	*	NA
The dome area is a HE exclusion area.	• Firing Leader releases Line C for additional access	EL	*	✓
The EIC makes this decision after the firing leader agrees	• Notify CCR that special re-entry procedures NOT in effect • If HE is still present - Notify CCR "Line C continues to be an HE exclusion area due to unburned HE. Please do not permit entries into the line B tunnel without EIC approval."	EL EL		✓ ✓
Classified shots only	• Bomb Badge returned	NA	*	NA
	• Sign removed – Special Re-Entry Procedure - Line C key bank	EL		✓
The dome area has been a HE exclusion area.	• Microphone – Turn OFF amplifier	EL	*	✓
	• Gas cooling/heating system disconnected from vessel	NA	*	NA
Upstream vacuum station bypass ensures vessel fresh air via venture. **Uranium and Plutonium** – No air flow through vessel! Hazardous materials exclusion areas are normally 10' in front of the vessel and bags on the windows. Samples must be sent out for analysis.	• Remind vessel clean up crew to open vacuum bypass valve • Venturi pump air line disconnected • Establish exclusion areas prior to opening vessel and pipes • Samples taken from vessel for analysis of contamination	EL NA NA NA	* * * *	✓ NA NA NA
	• CO Monitor in dome – Turn OFF	EL		✓
Prior to removing vacuum windows	• Beam Window covers installed at • IL0 upstream • IL1 downstream (after camera station removed)			
Plutonium – Put it back in the safe	• Container stored inside Radioactive Materials Balance Area	NA		NA

???? LAST SHOT of the day ????	• LAST SHOT of the day?			✓
	• TV Cameras and lights OFF • CO monitor & vacuum gauges at blue racks • Upstream valves • Downstream valves			
	• VISAR status signs = Green	NA		NA
The one in the dome usually stays in the dome with its charger in the blue rack. The other one charges on the bench west of the VISAR room.	• CO monitors in chargers	EL		✓
The EIC and Firing Leader must both agree.	• Notify CCR that HE operations are completed for this day	EL		✓
Locking out is preferable to log off.	• Lightning Detector Computers – Lock out	EL		✓
	• After HE operations are completed, remove signs • Large orange HE octagon – truck door • Small signs for HE and EIC • Line C Shield door • Line C access station (PACS) • Line B tunnel access (NTOF maze door) • Special Re-Entry - Line B tunnel access (NTOF maze door)	EL		✓
Run out of propane - starter cranks until battery dies or starter fails	• Disable generator – Module 9 in "STOP"	EL		✓
Uranium and Plutonium	• CAM turned OFF • Dome Fans unlocked	NA NA		NA NA
	• Remove parking lot rope to truck access for "Fire Lane"			
	• RWP – General RWP is current and posted	NA		NA
http://pwcnv02.lanl.gov/arakfram.htm?7:0 – Username/PW = APC/apc http://praddalek02/arakfram.htm?7:0 Dalek can also be turned off by cycling key switch in dome without Reset.	• HV to beam line data taking cameras – Turned Off • Dalek OFF – Look in the back of HS-R02 • No 120V or 208V power cord connections on floor	EL EL EL		✓ ✓ ✓
	• CCH doors locked			
Install vacuum window covers IL = Image location Thin vacuum windows have protective covers to guard against blowouts. CanNOT be required if additional beam operations are scheduled.	• IL0 (upstream side) • IL1 (downstream side) • IL2 (both sides)			
Master transfer key removed from transfer block and locked in PACS box	• Dome PACS keys locked in key bank	EL		✓

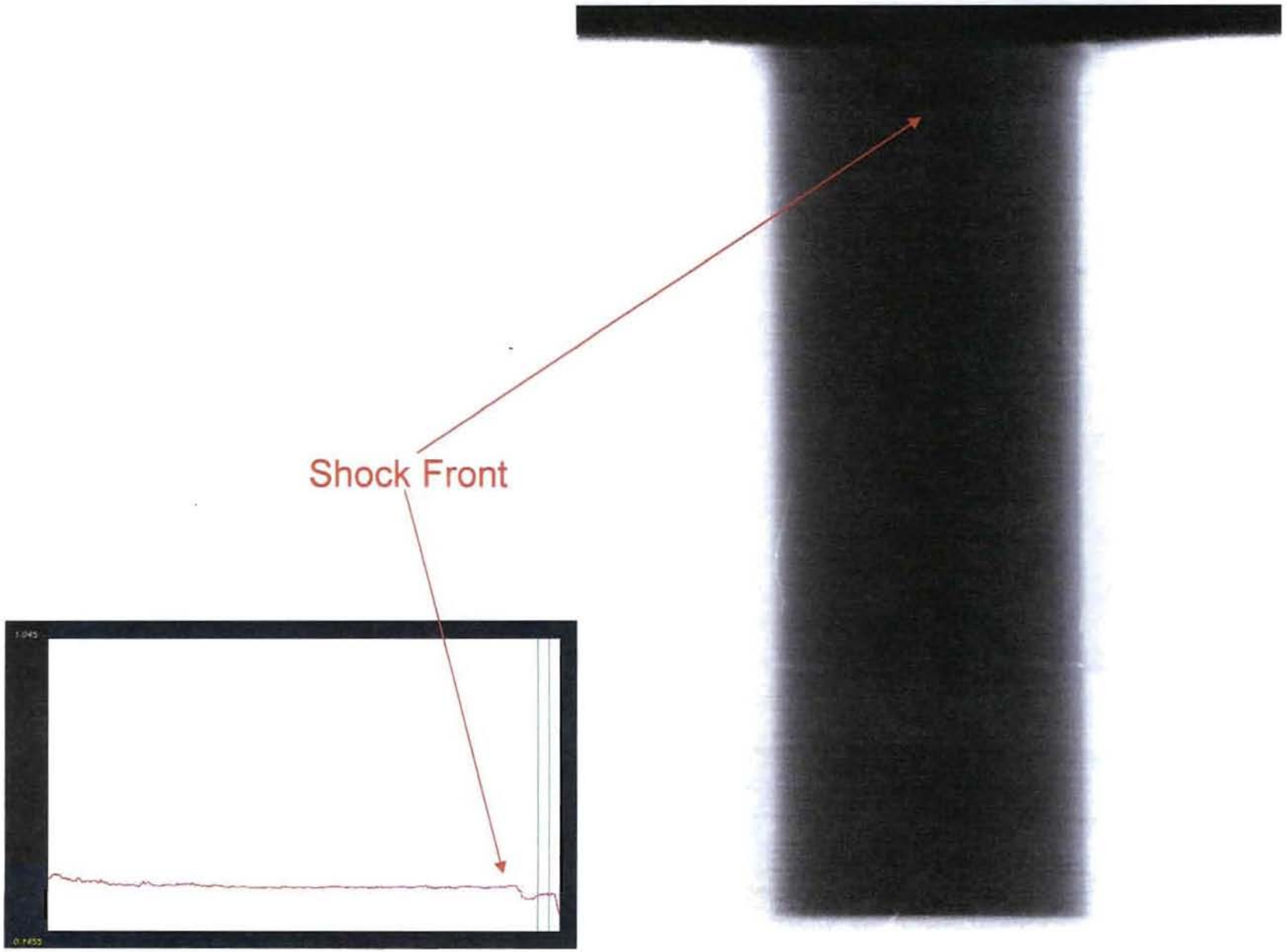
PRAD0373: Tin EOS Shot Composite



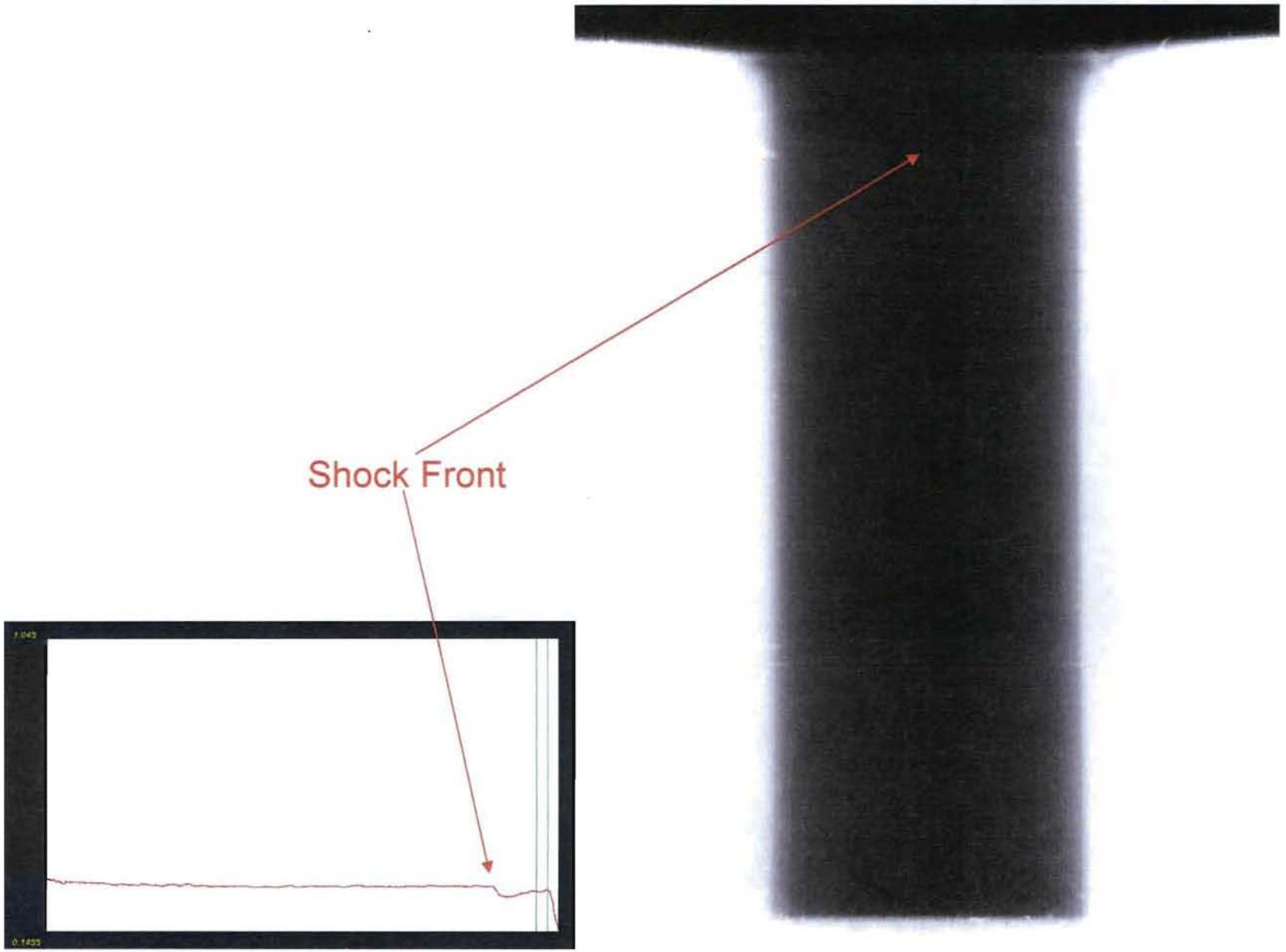
0400 PRAD0373: Tin EOS Shot H



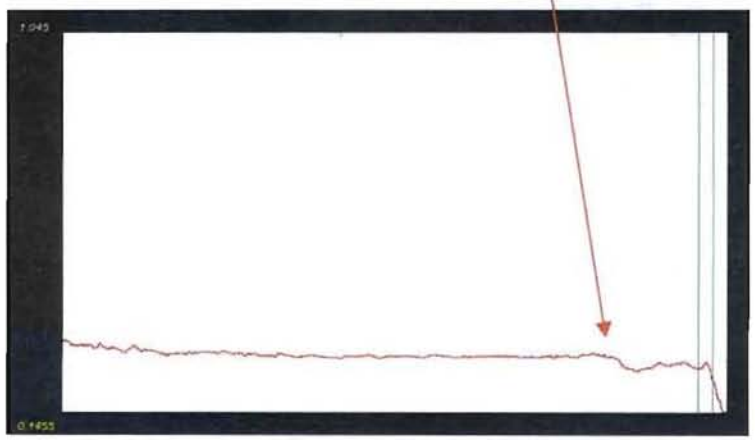
0800 PRAD0373: Tin EOS Shot K

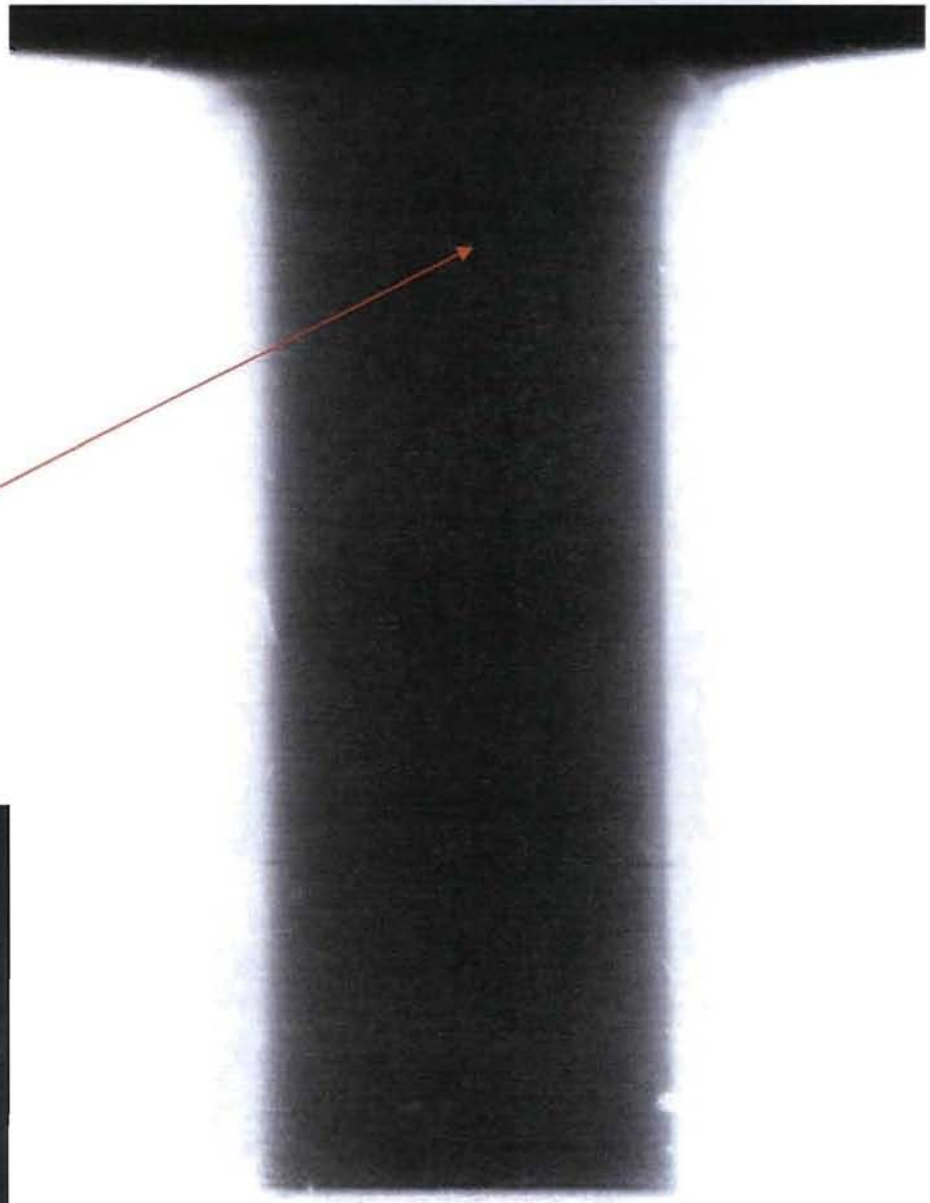


1200 PRAD0373: Tin EOS Shot N



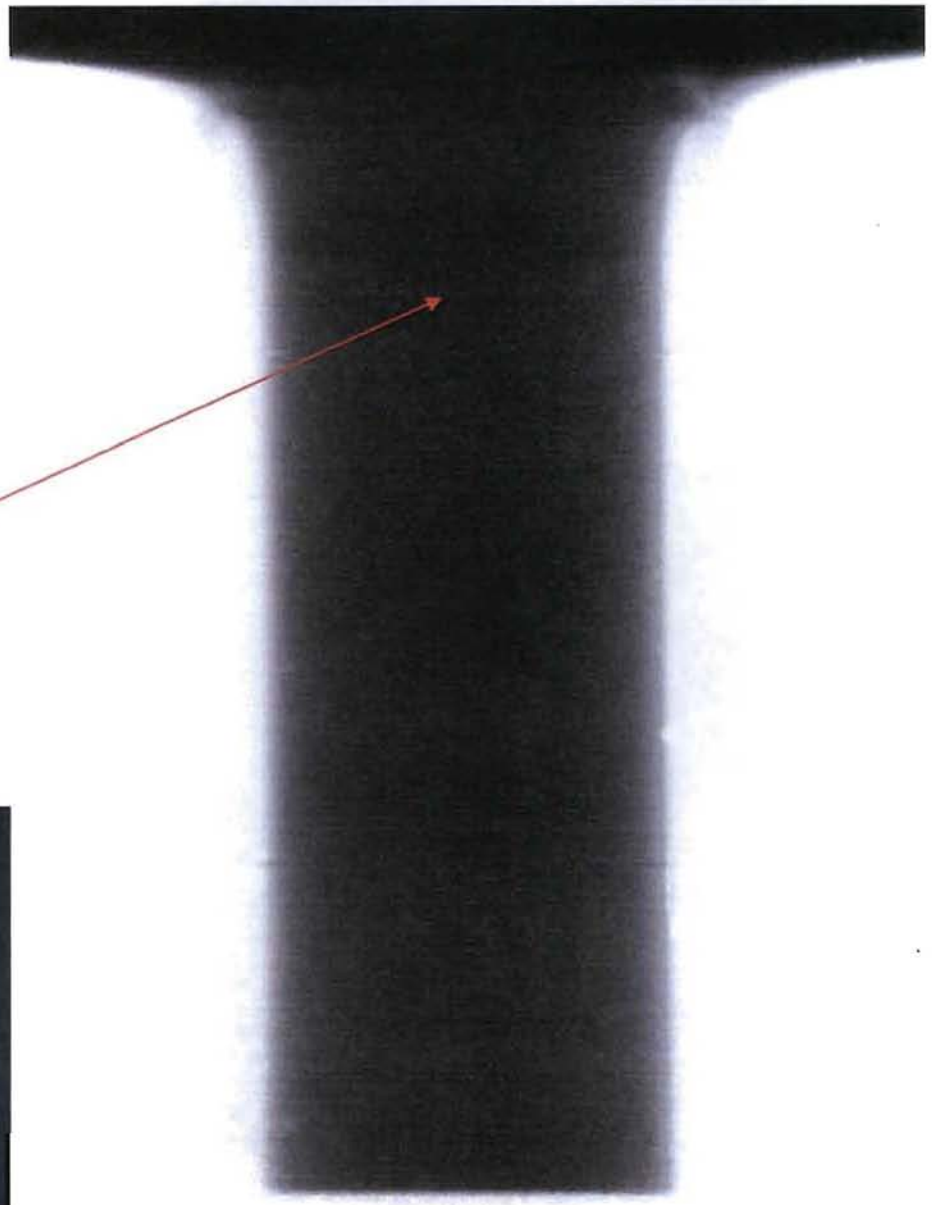
1600 PRAD0373: Tin EOS Shot Q



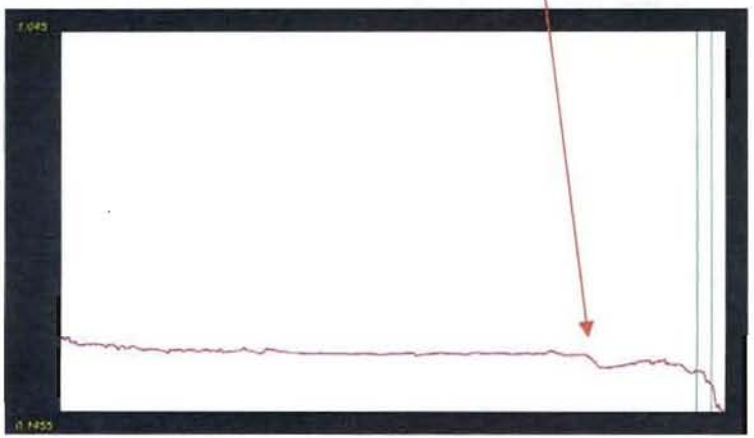


Shock Front

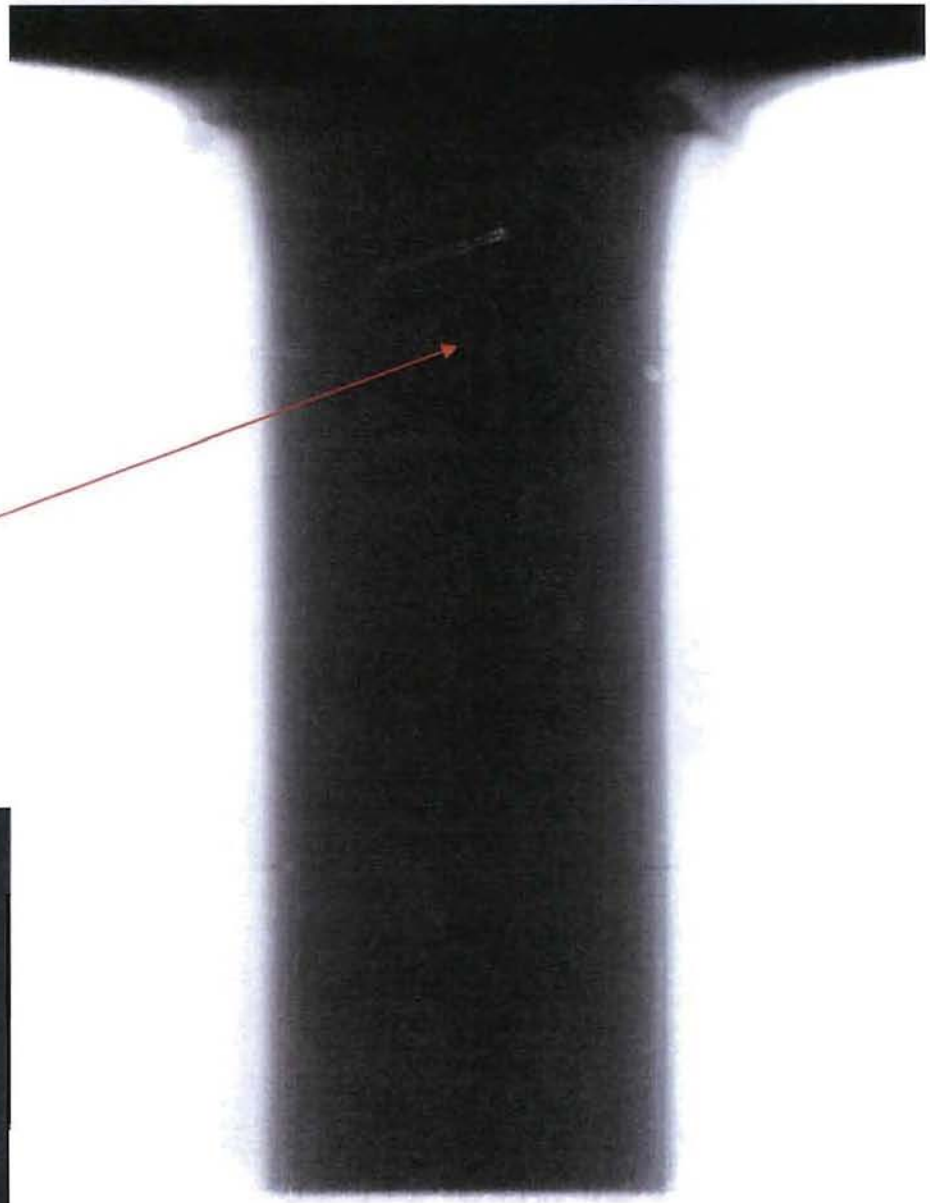
2000 PRAD0373: Tin EOS Shot T



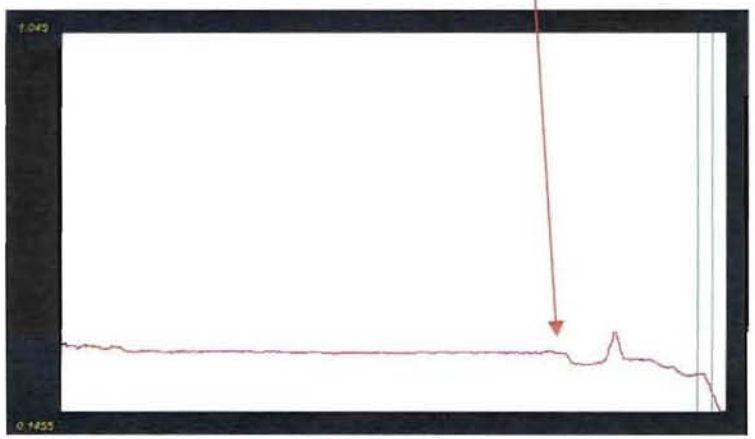
Shock Front



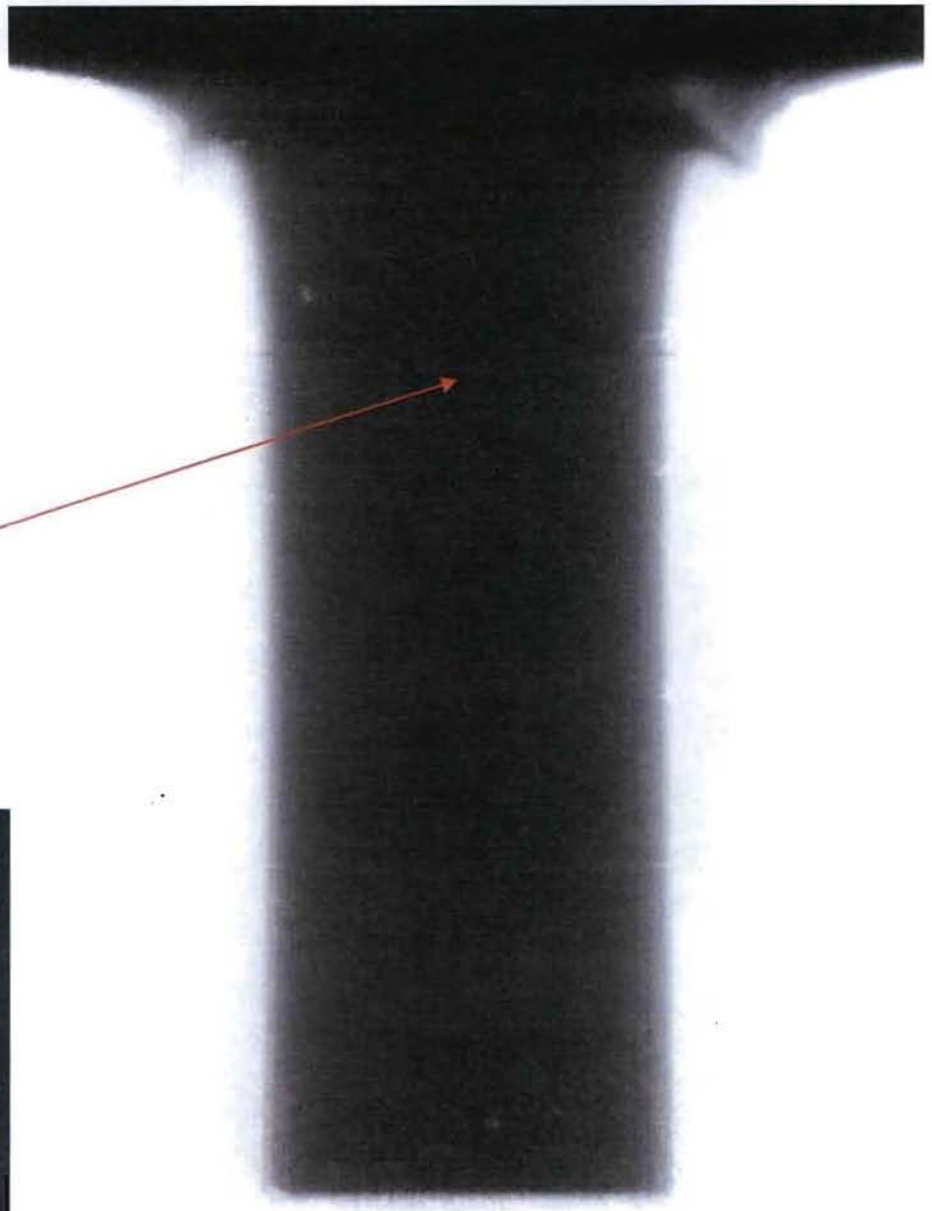
2400 PRAD0373: Tin EOS Shot X



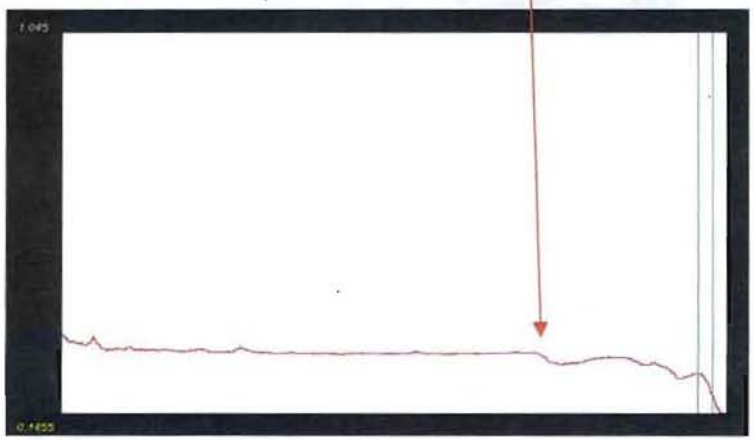
Shock Front



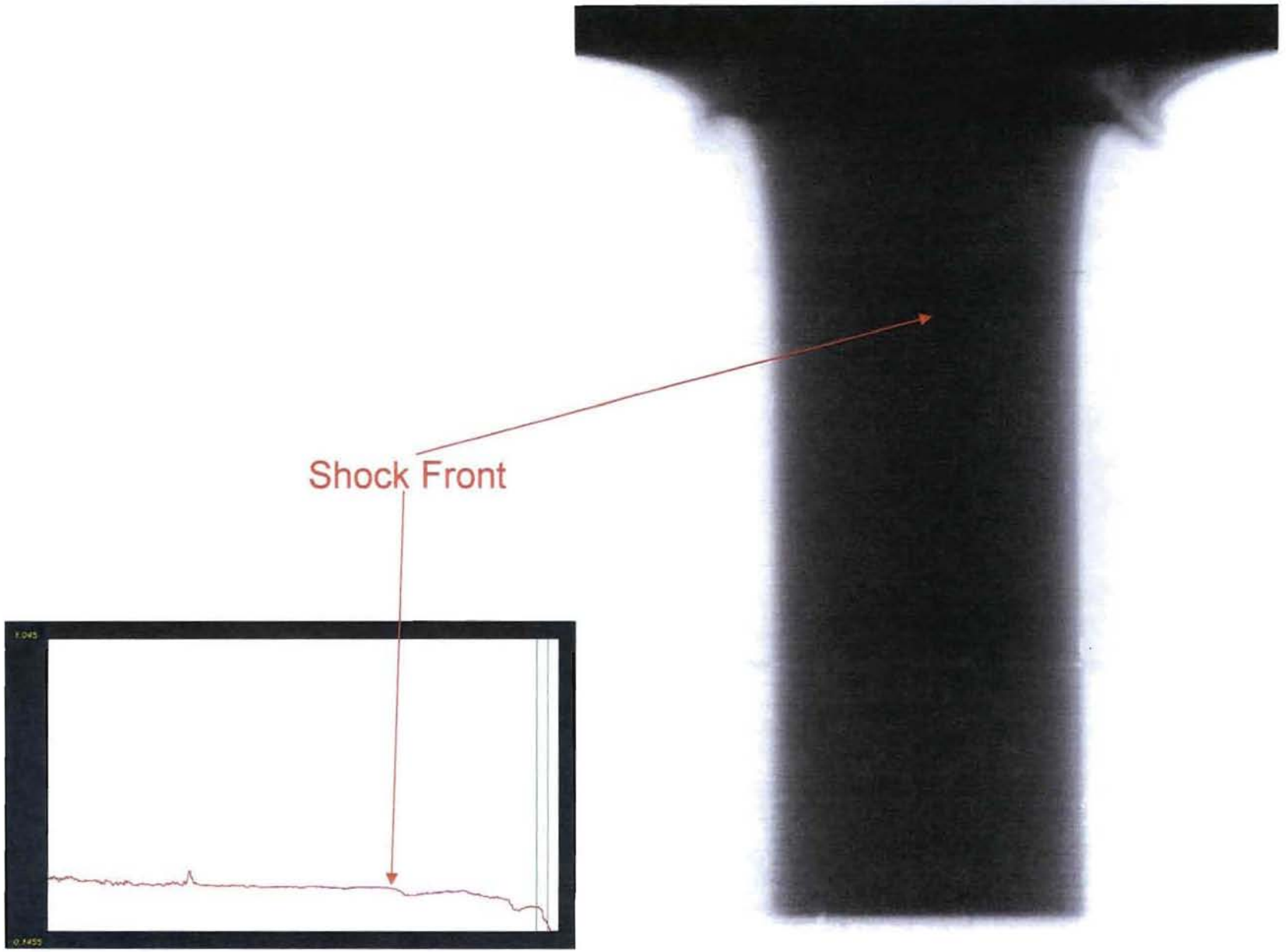
2800 PRAD0373: Tin EOS Shot I



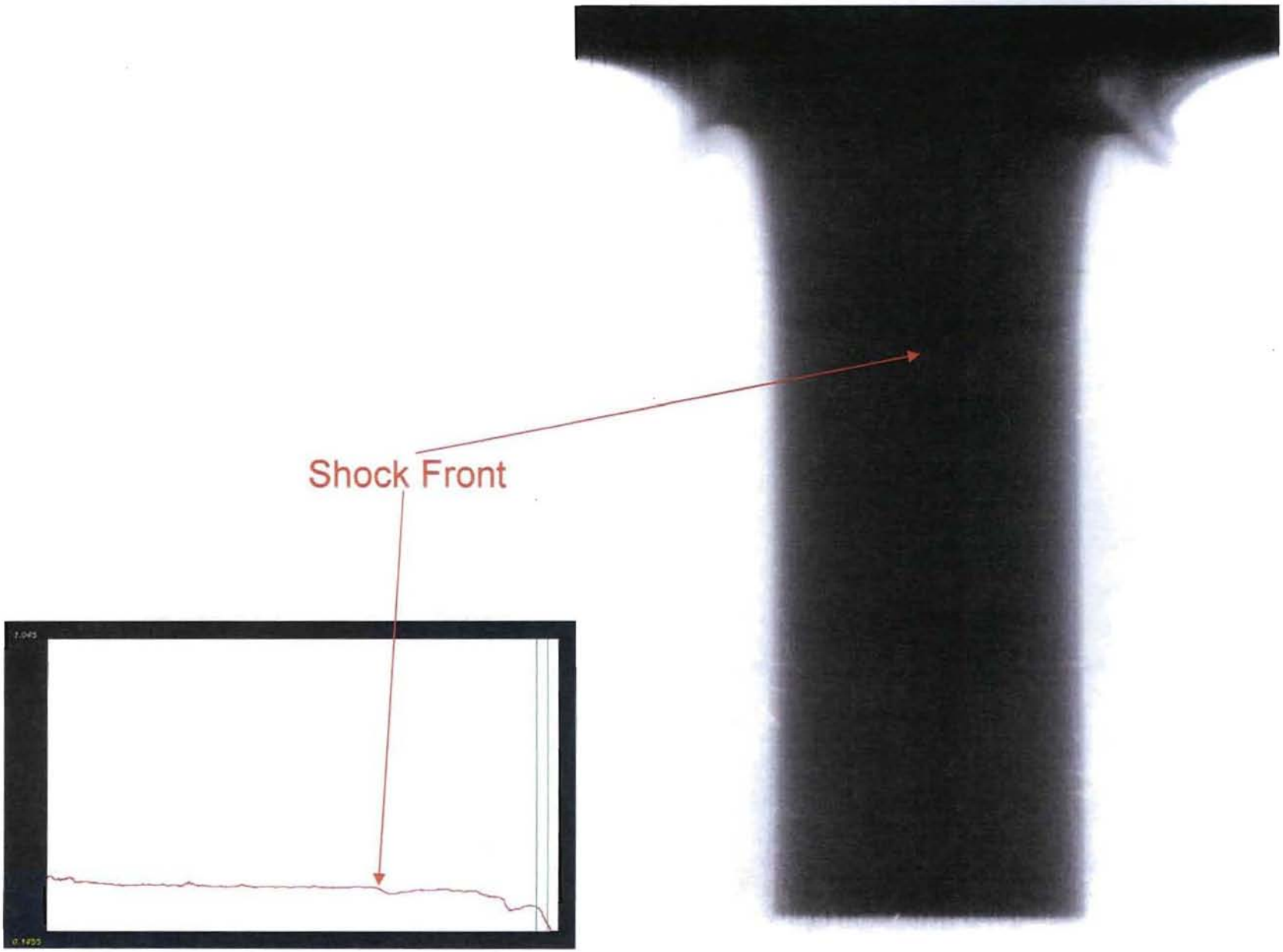
Shock Front



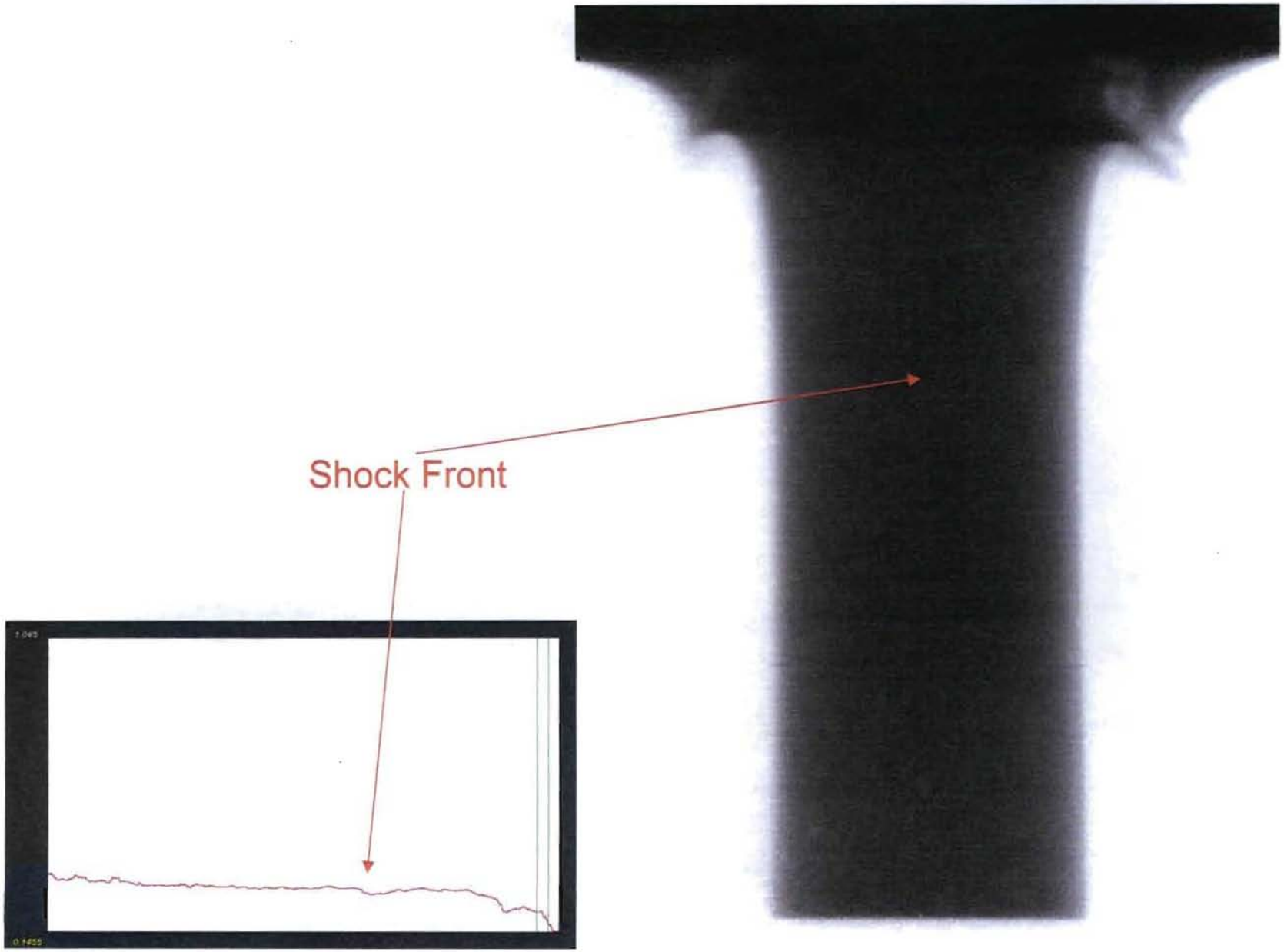
3200 PRAD0373: Tin EOS Shot L



3600 PRAD0373: Tin EOS Shot O

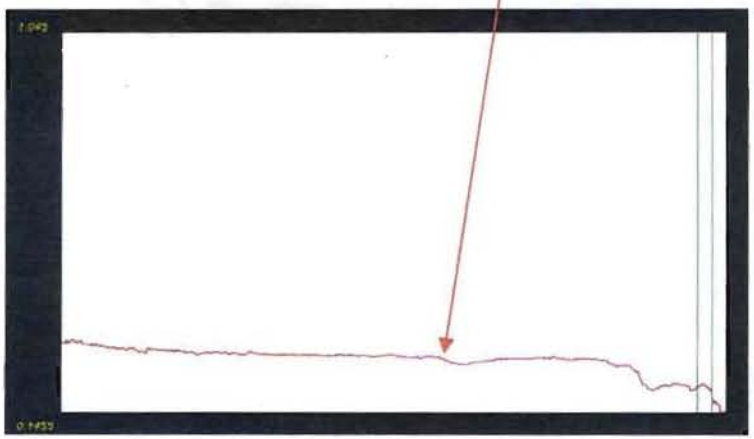


4000 PRAD0373: Tin EOS Shot R

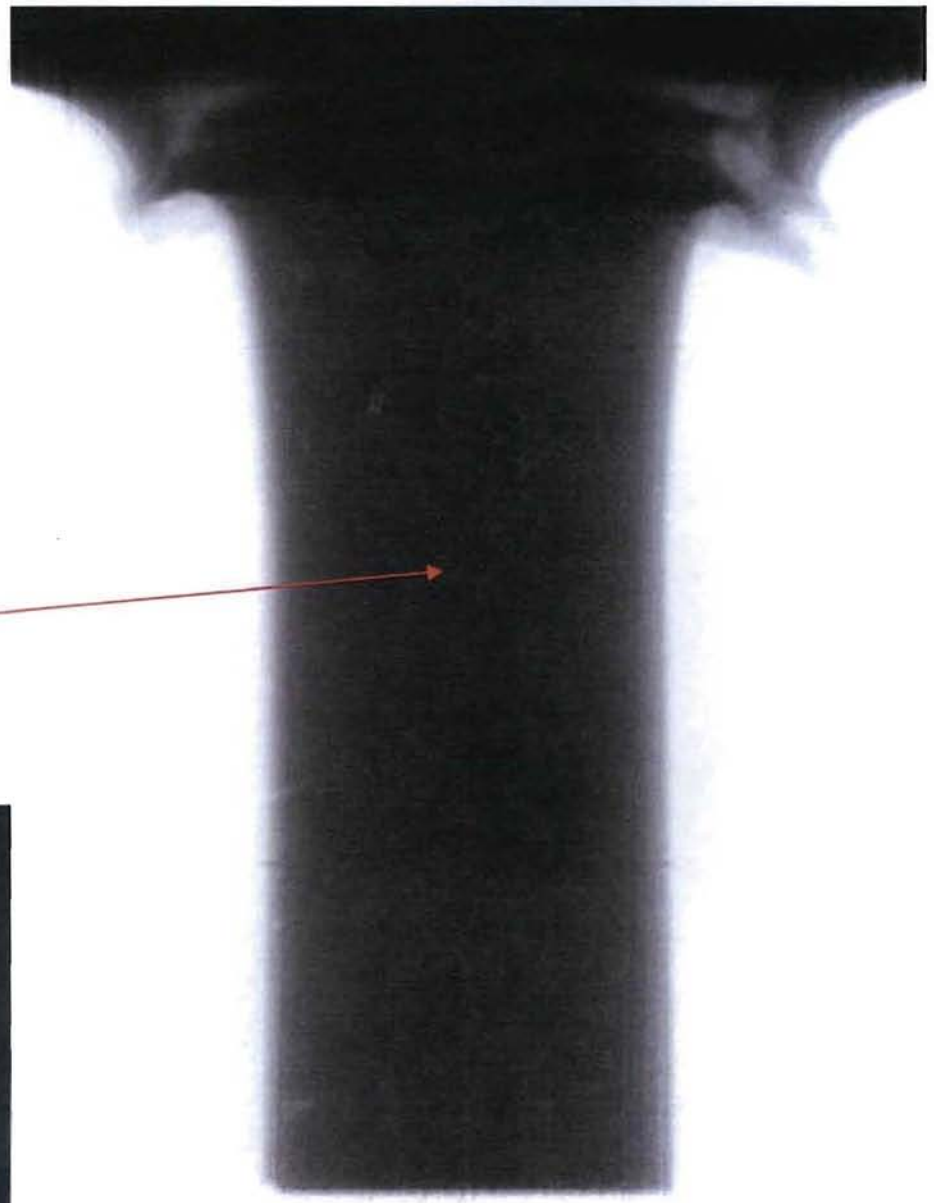


4400 PRAD0373: Tin EOS Shot U

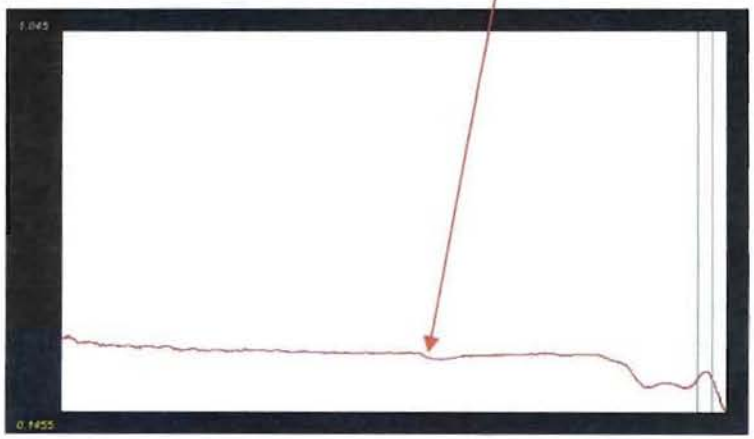
Shock Front



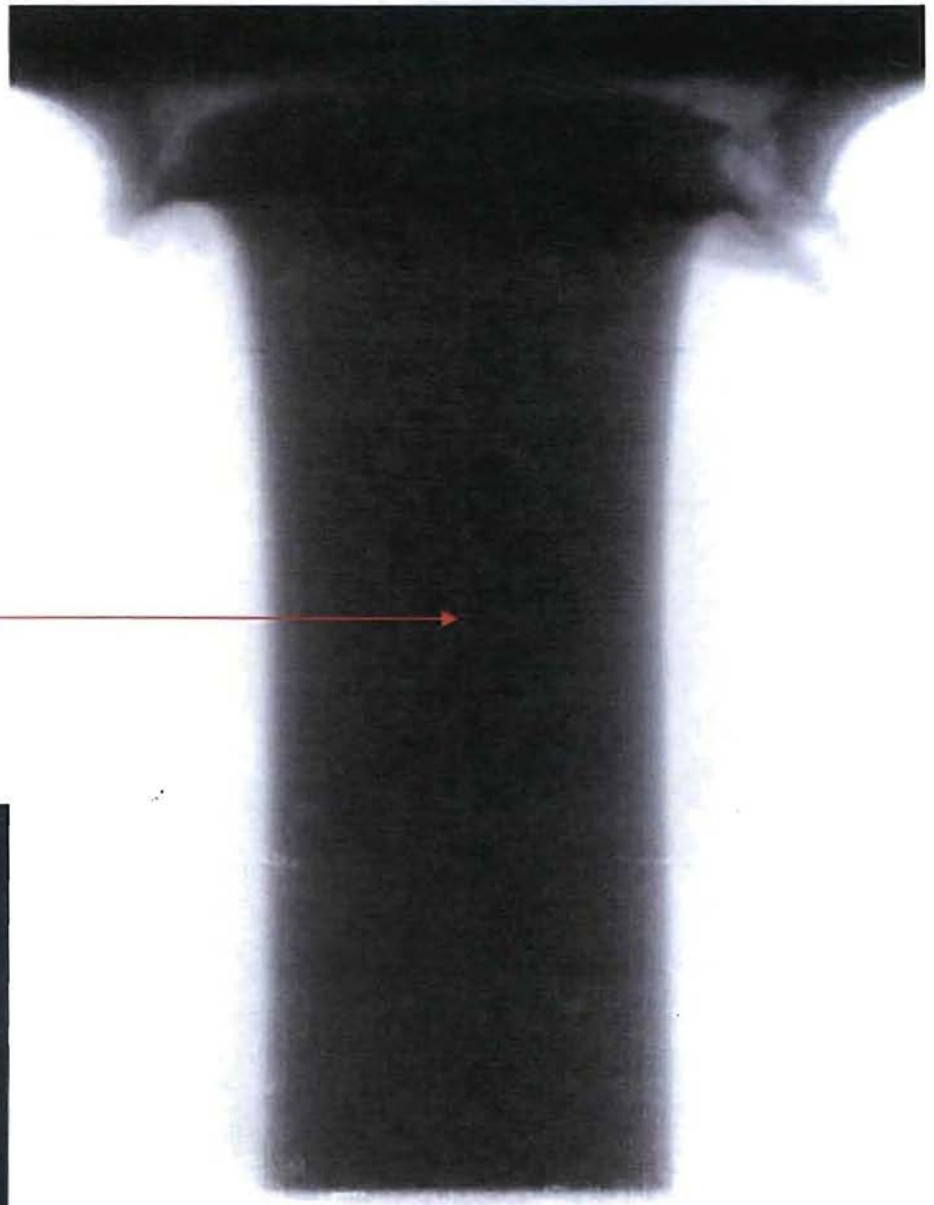
4800 PRAD0373: Tin EOS Shot Y



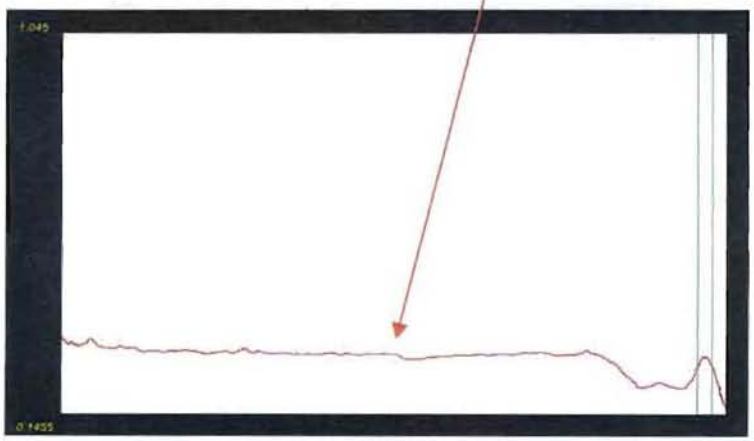
Shock Front



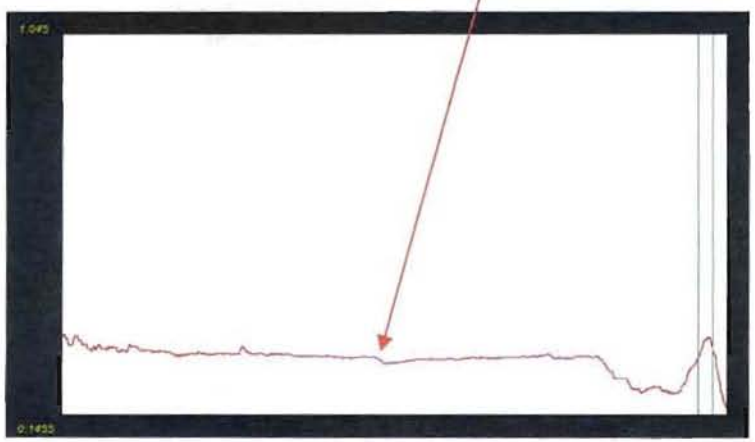
5200 PRAD0373: Tin EOS Shot J



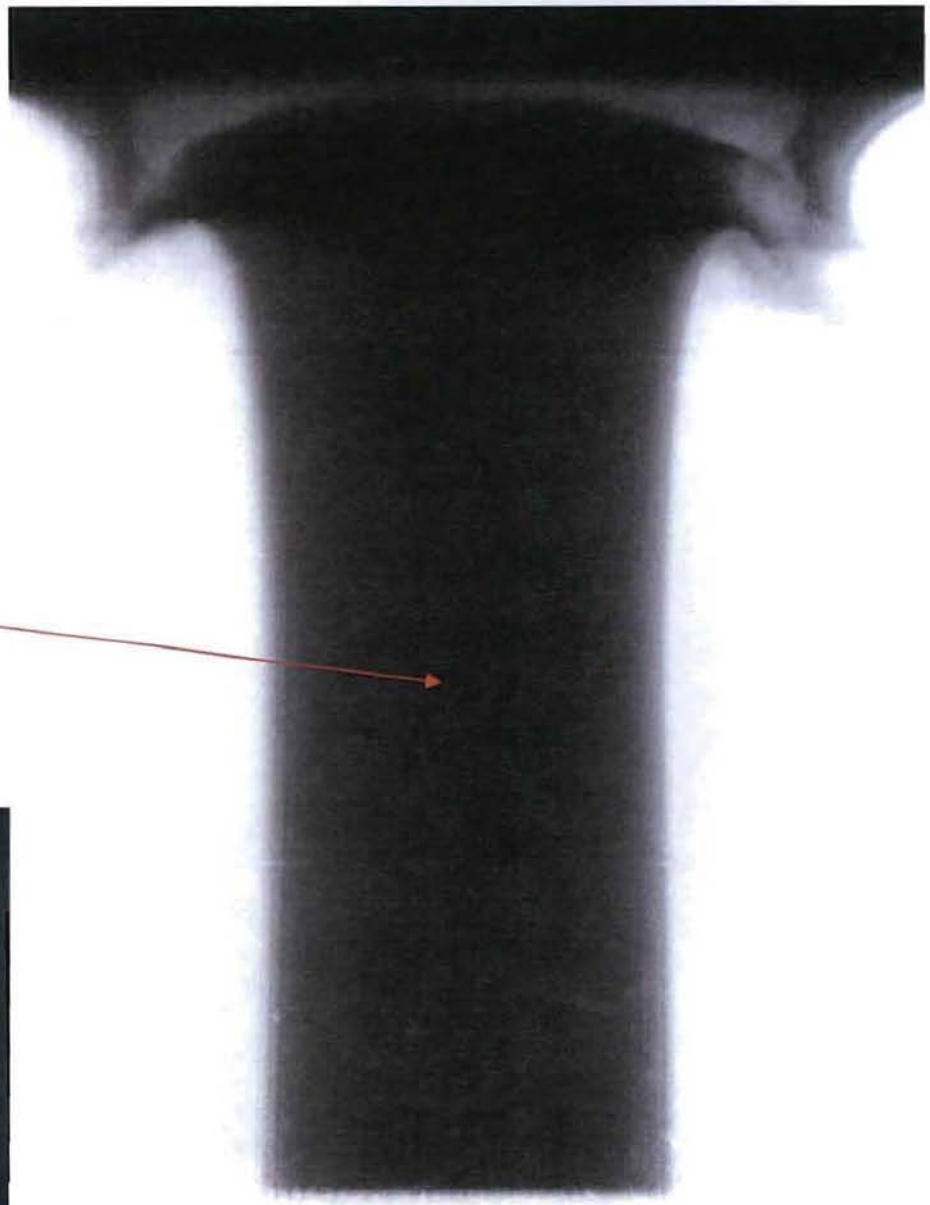
Shock Front



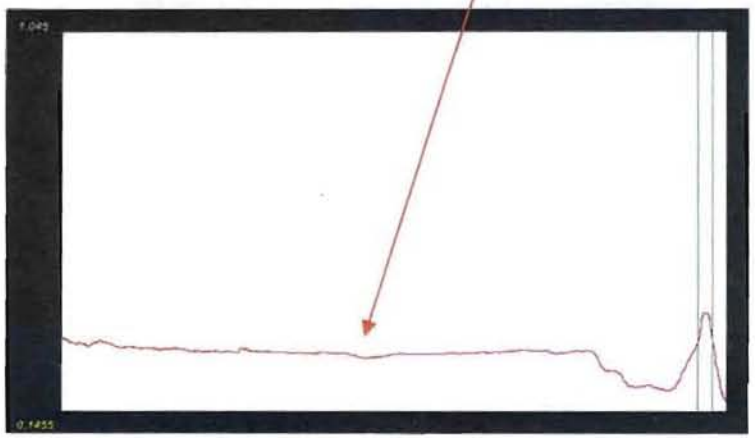
5600 PRAD0373: Tin EOS Shot M



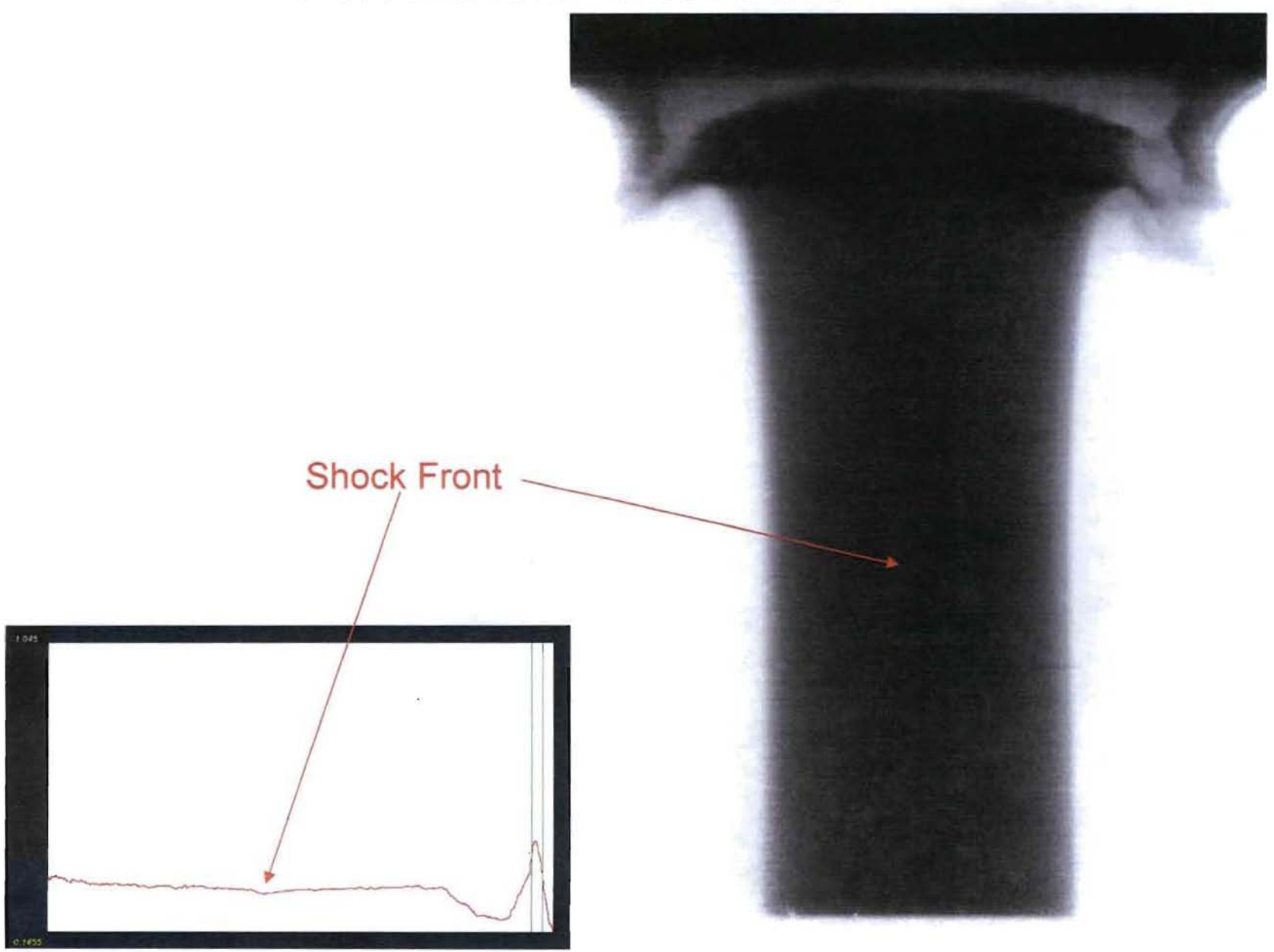
6000 PRAD0373: Tin EOS Shot P



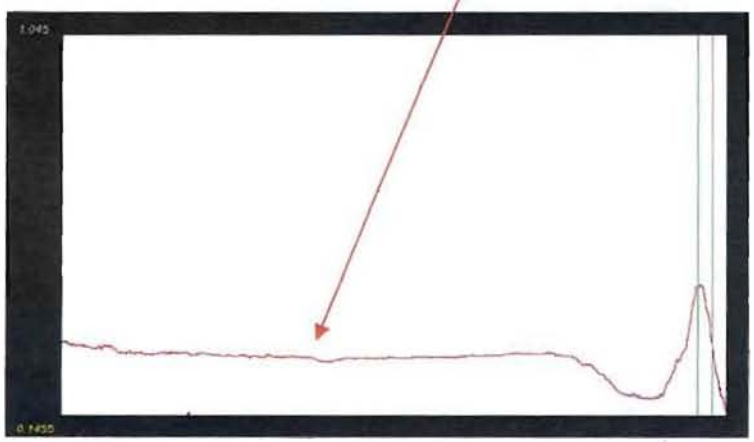
Shock Front



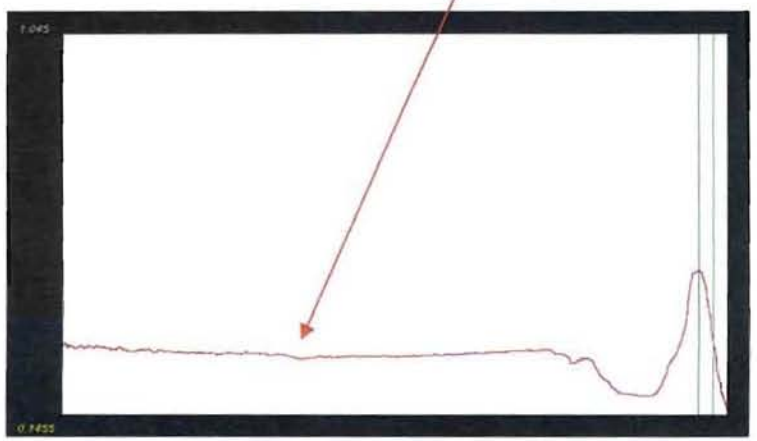
6400 PRAD0373: Tin EOS Shot S

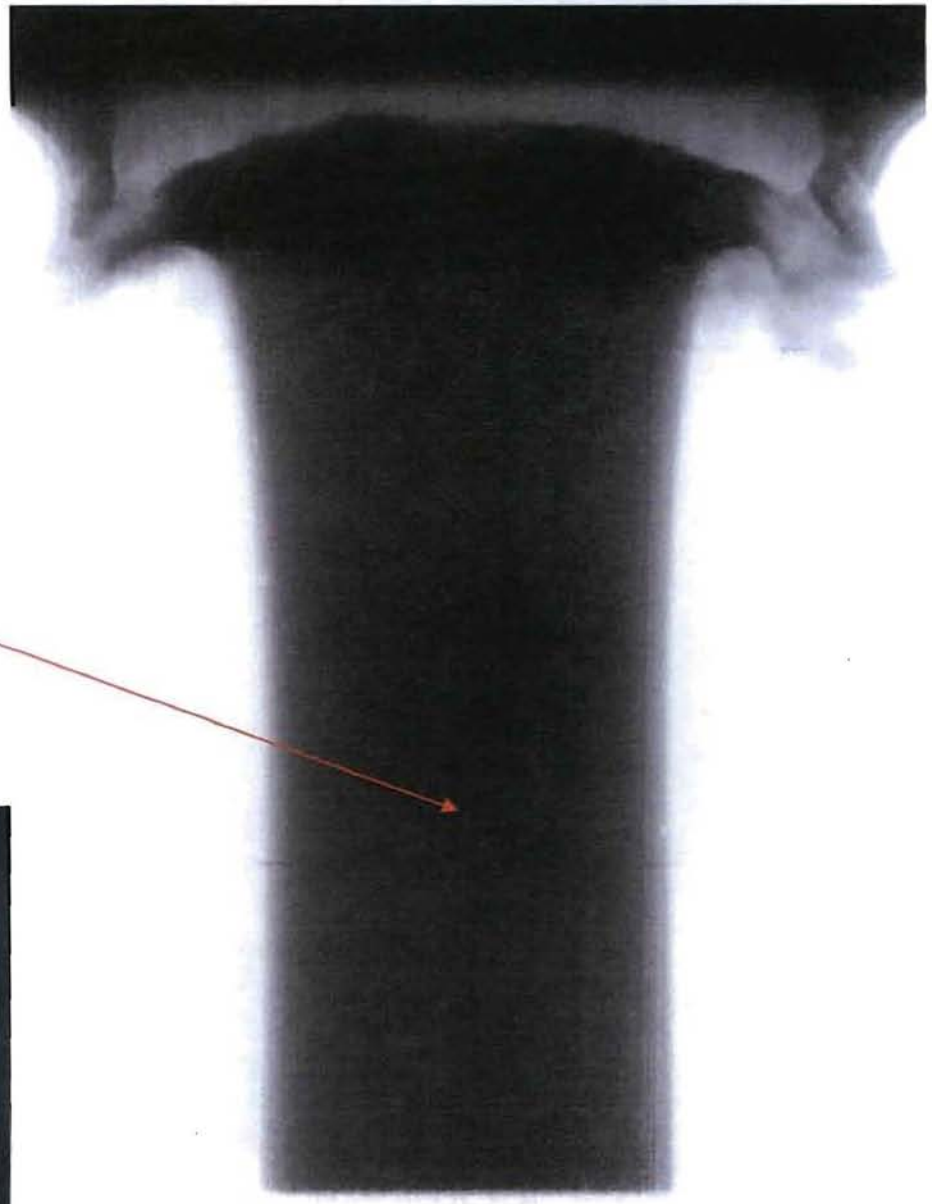


6800 PRAD0373: Tin EOS Shot V

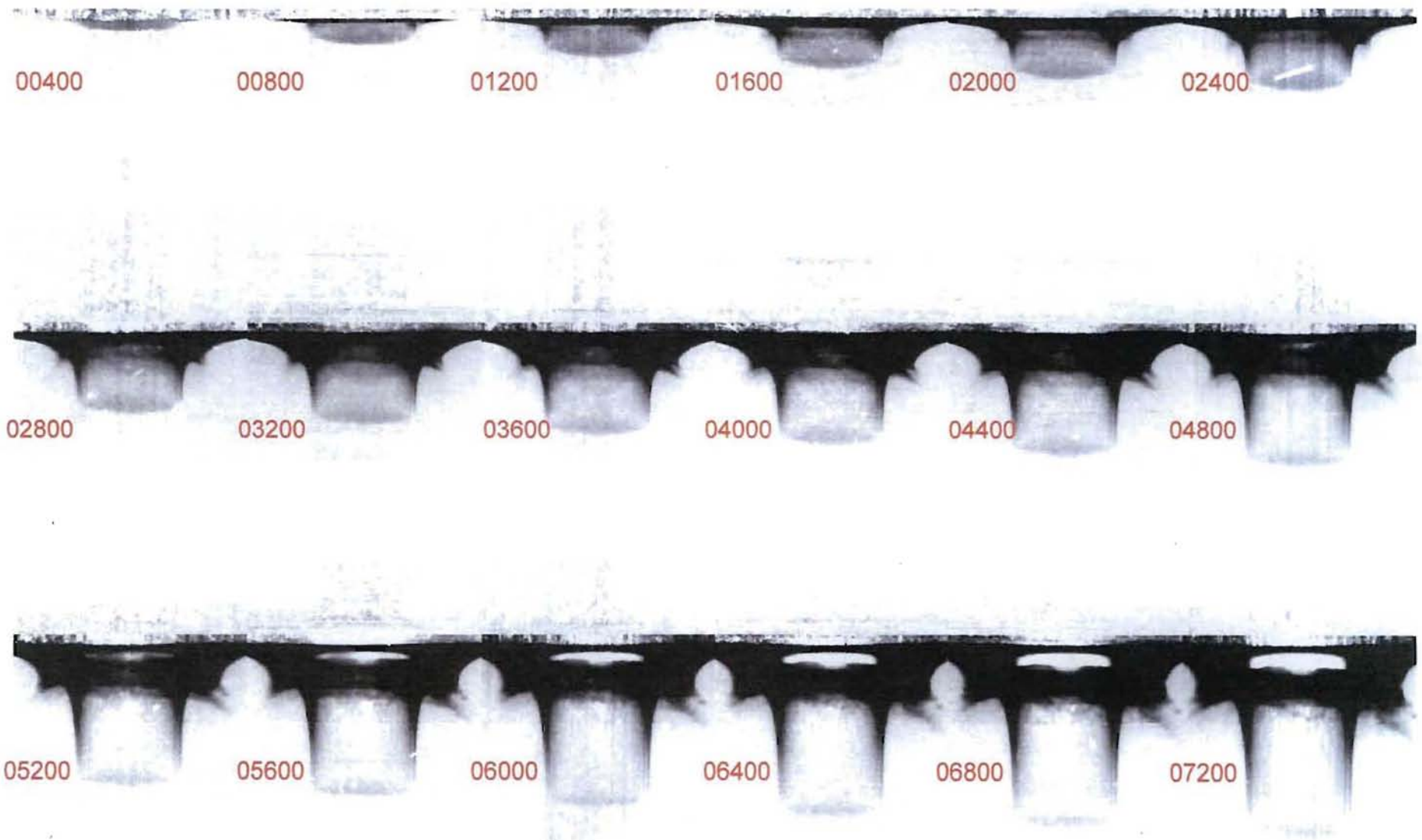


7200 PRAD0373: Tin EOS Shot Z

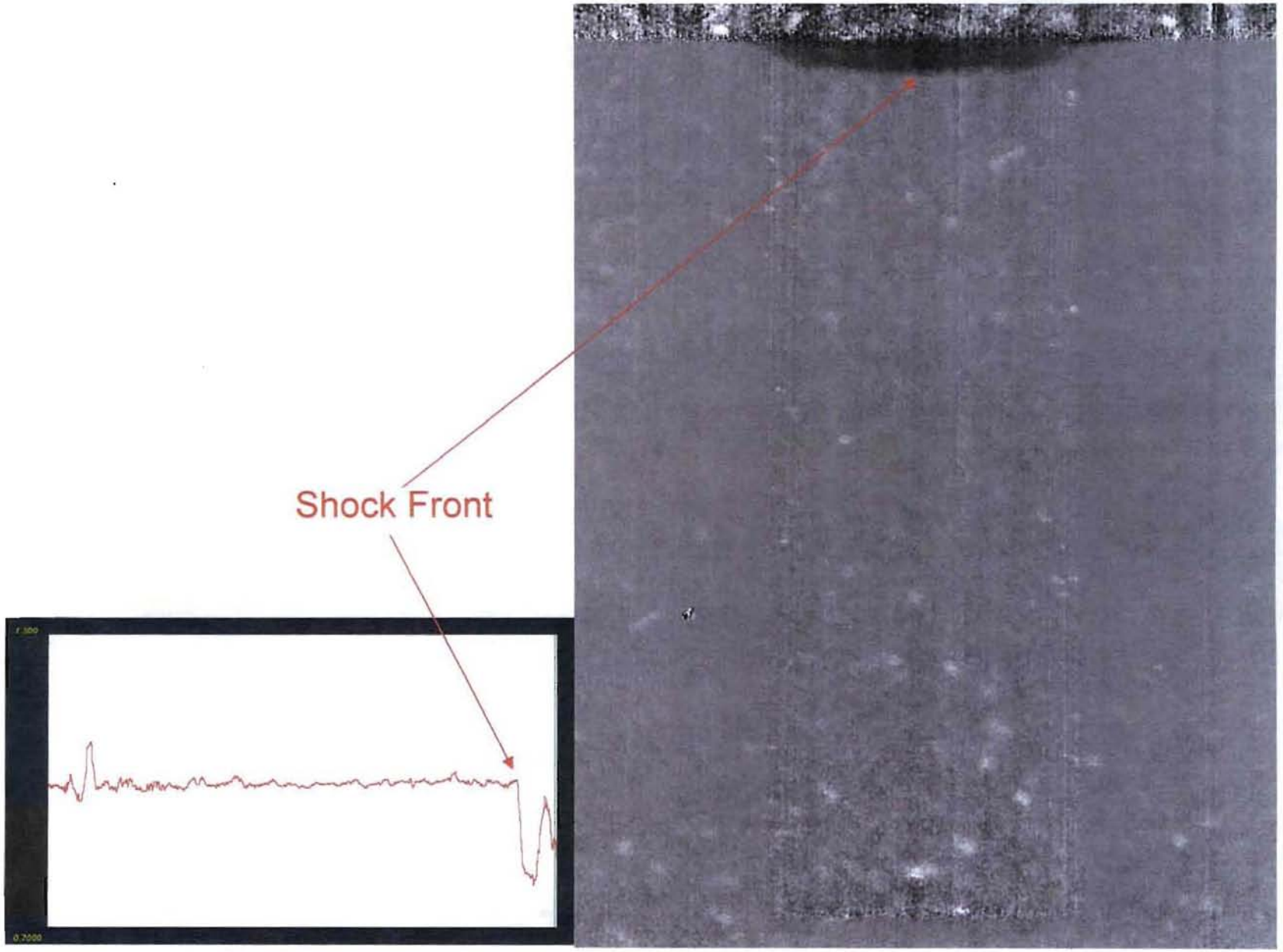




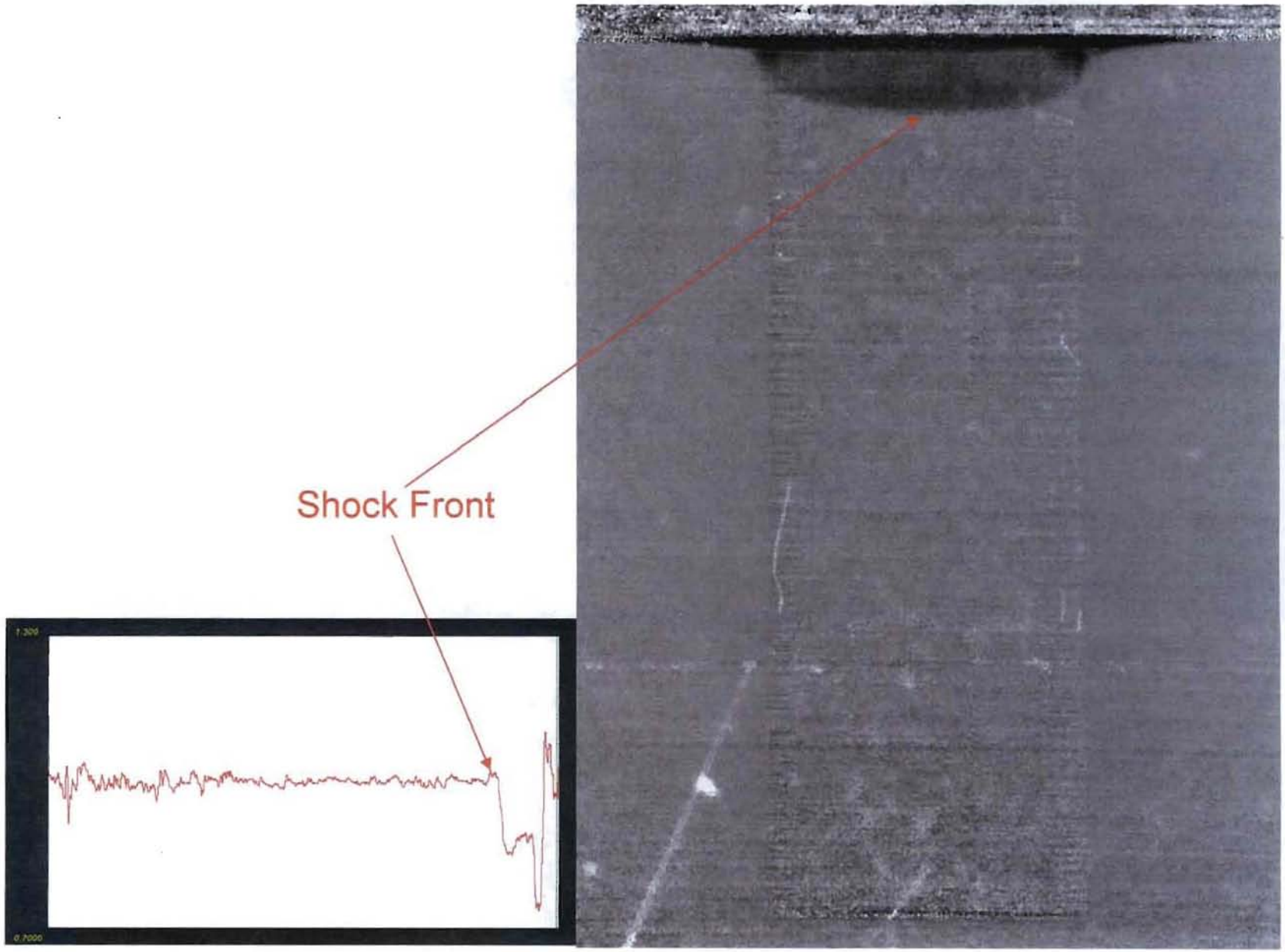
PRAD0373: Tin EOS Ratio Composite



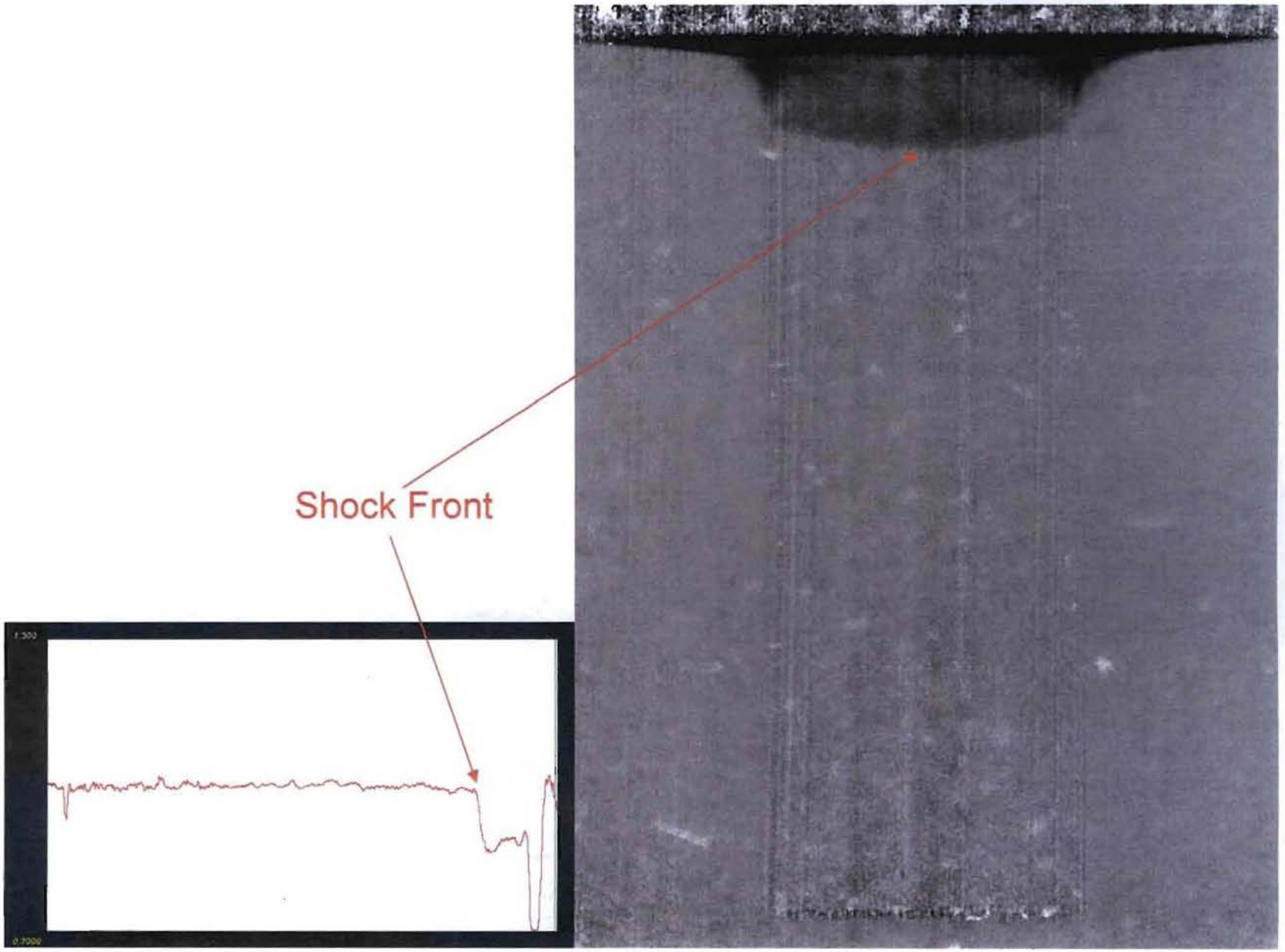
0400 PRAD0373 Ratio Composite H



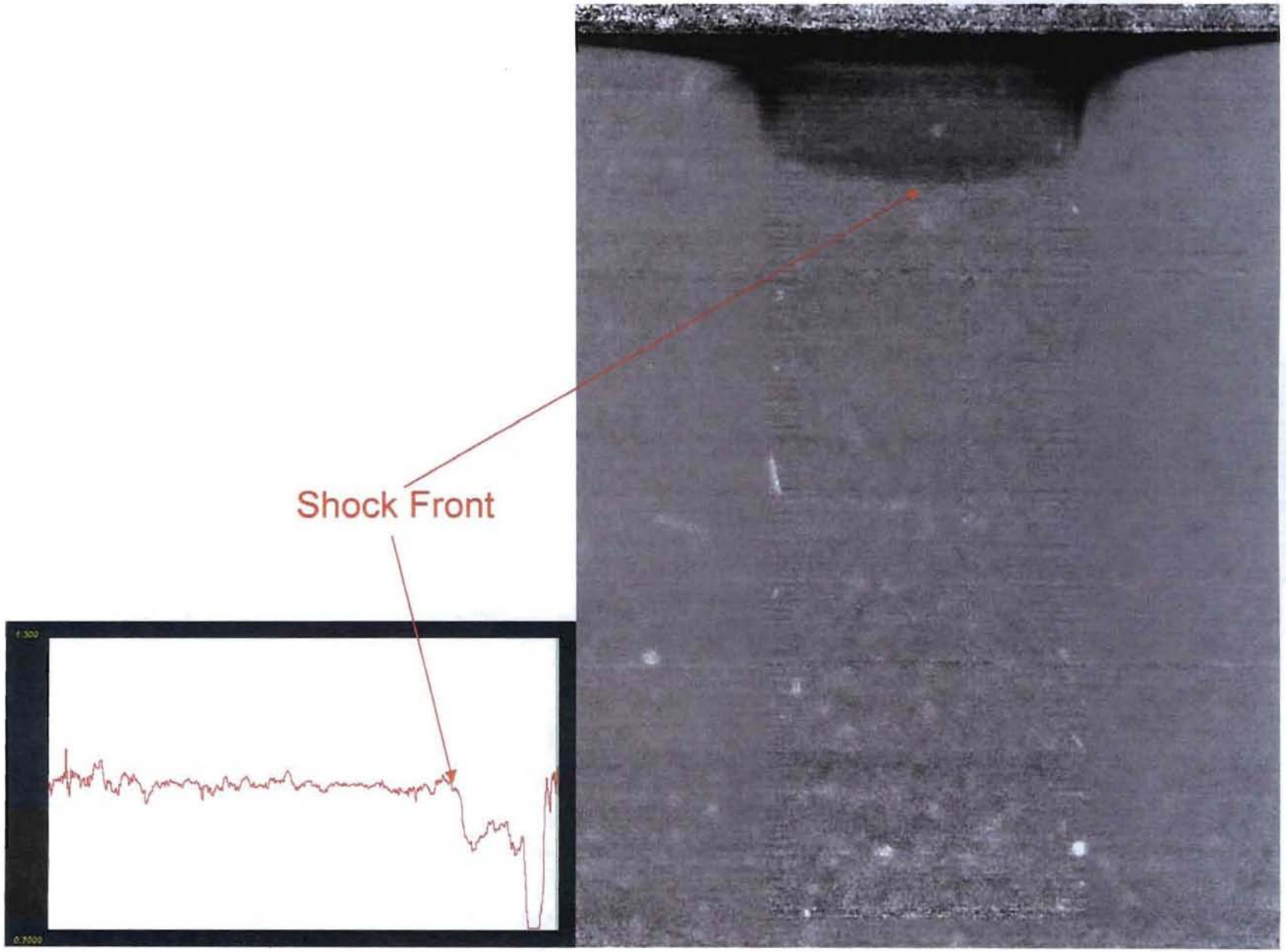
0800 PRAD0373 Ratio Composite K



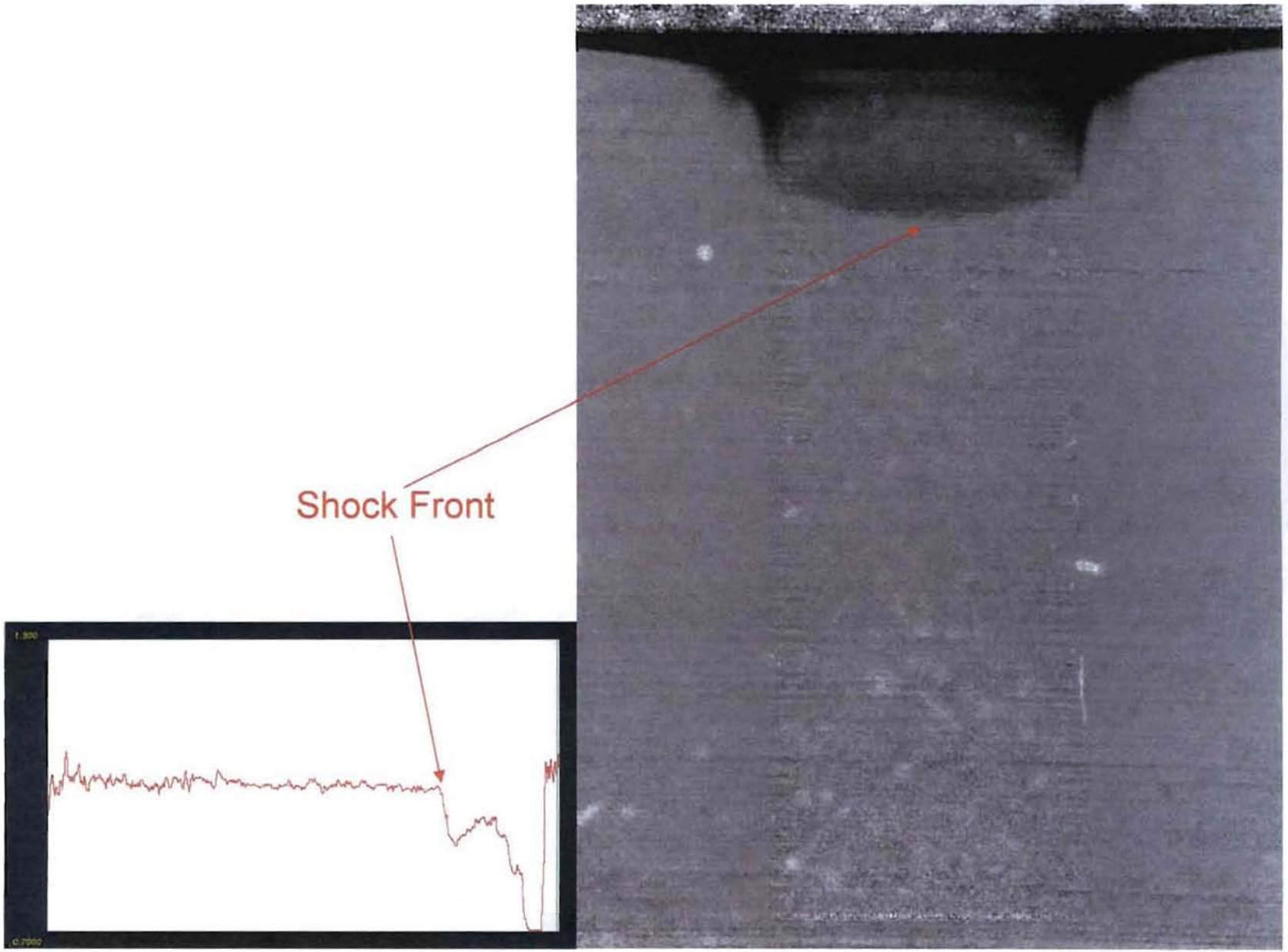
1200 PRAD0373 Ratio Composite N



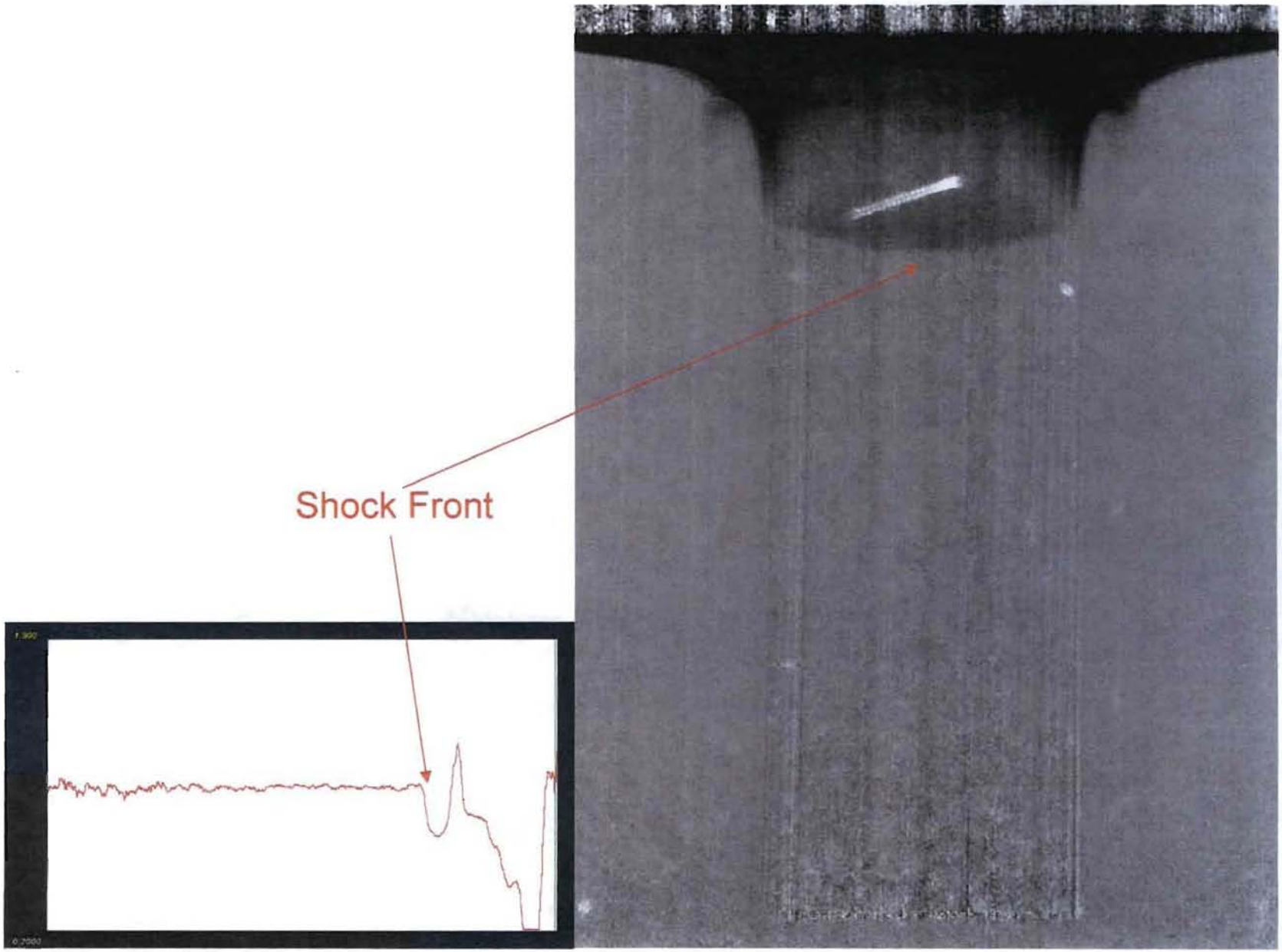
1600 PRAD0373 Ratio Composite Q



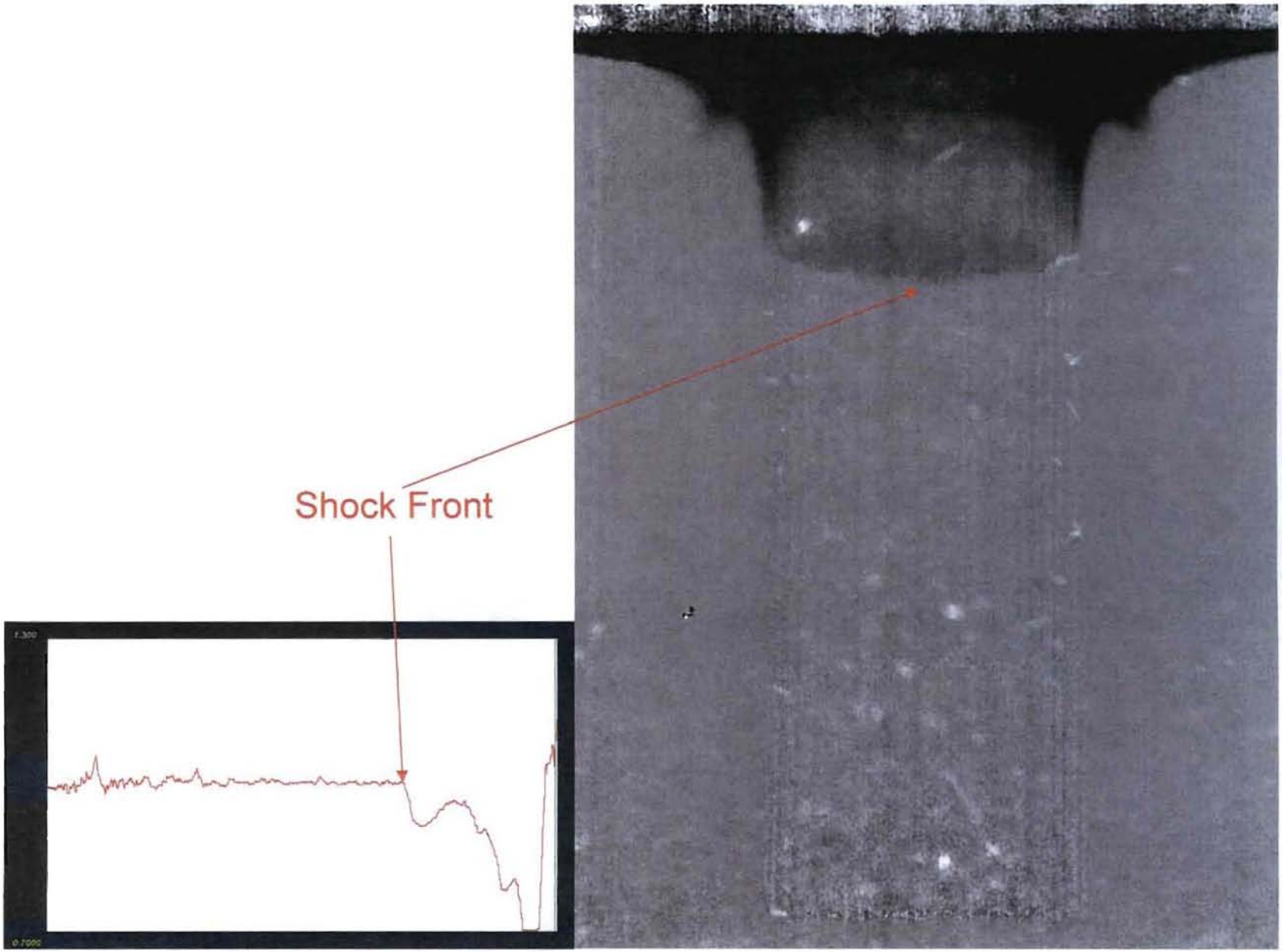
2000 PRAD0373 Ratio Composite T



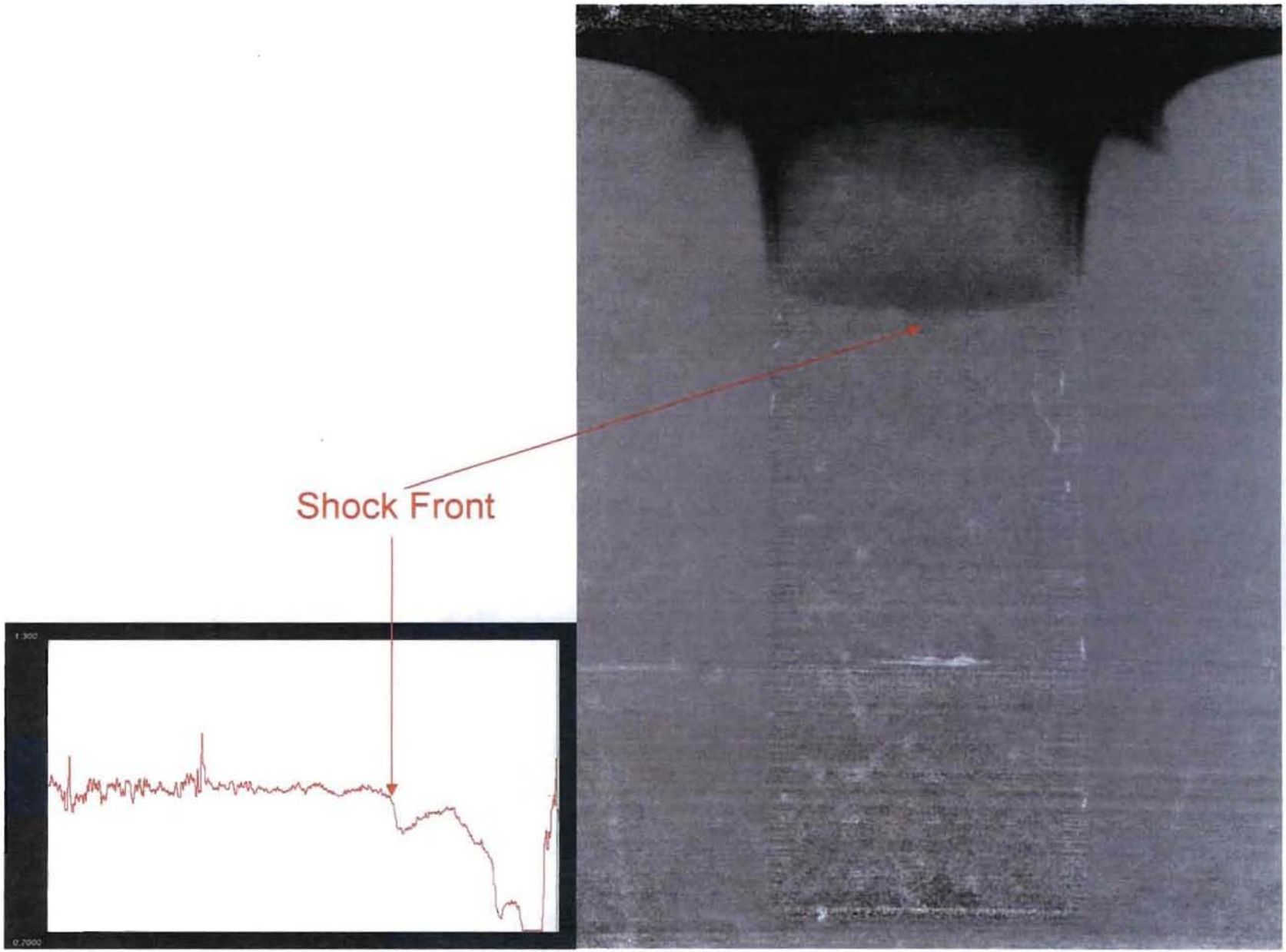
2400 PRAD0373 Ratio Composite X



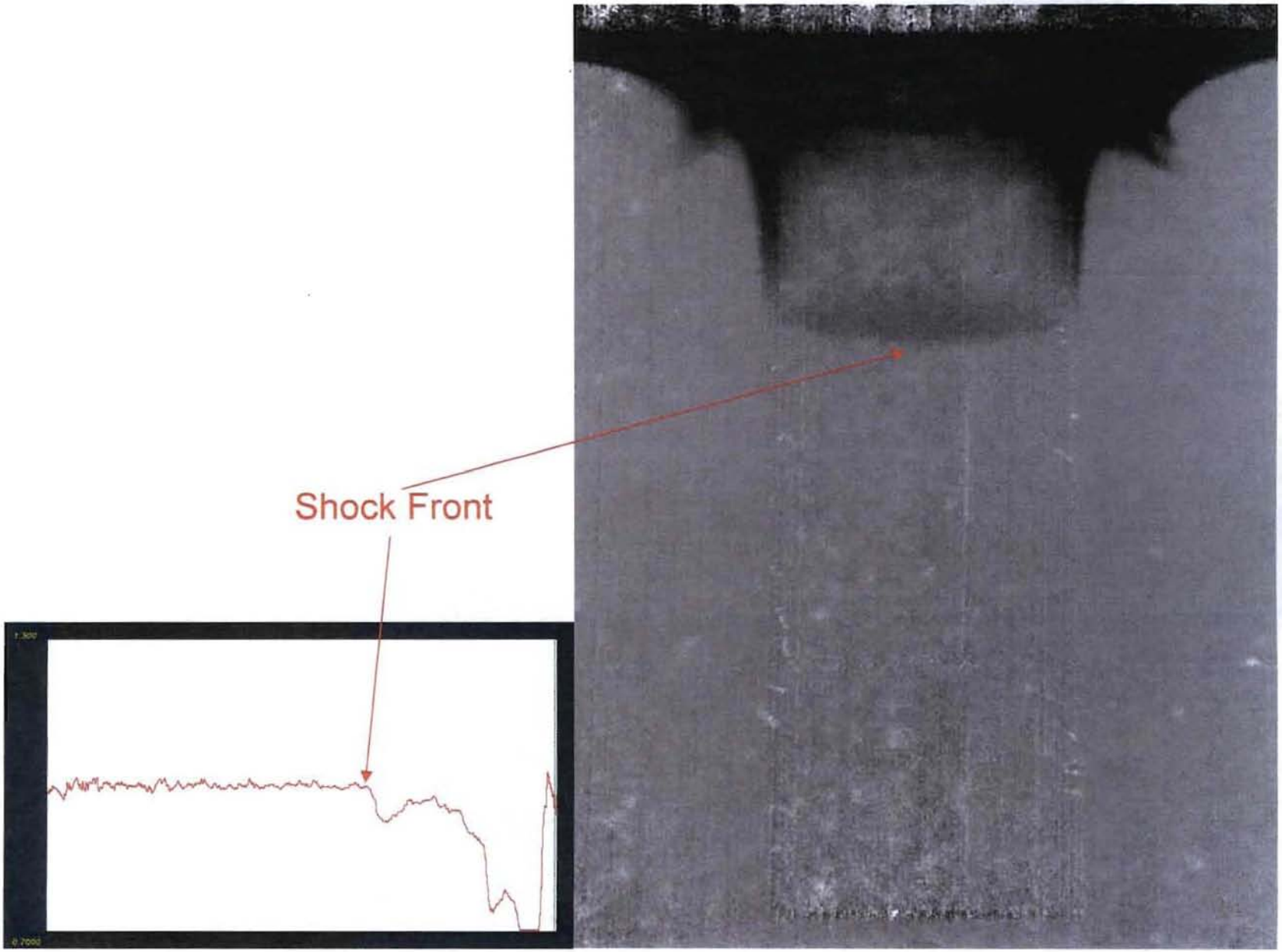
2800 PRAD0373 Ratio Composite I



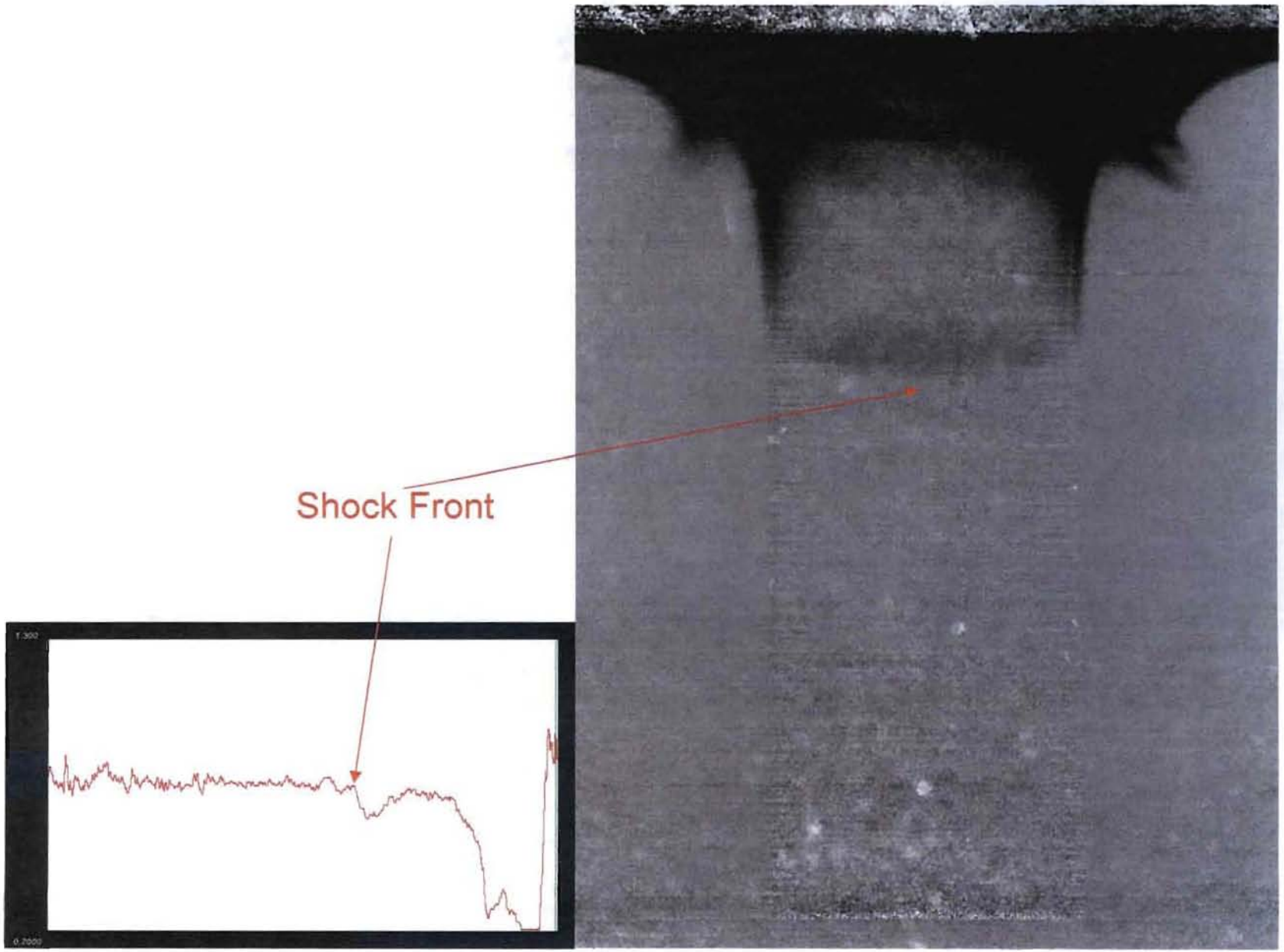
3200 PRAD0373 Ratio Composite L



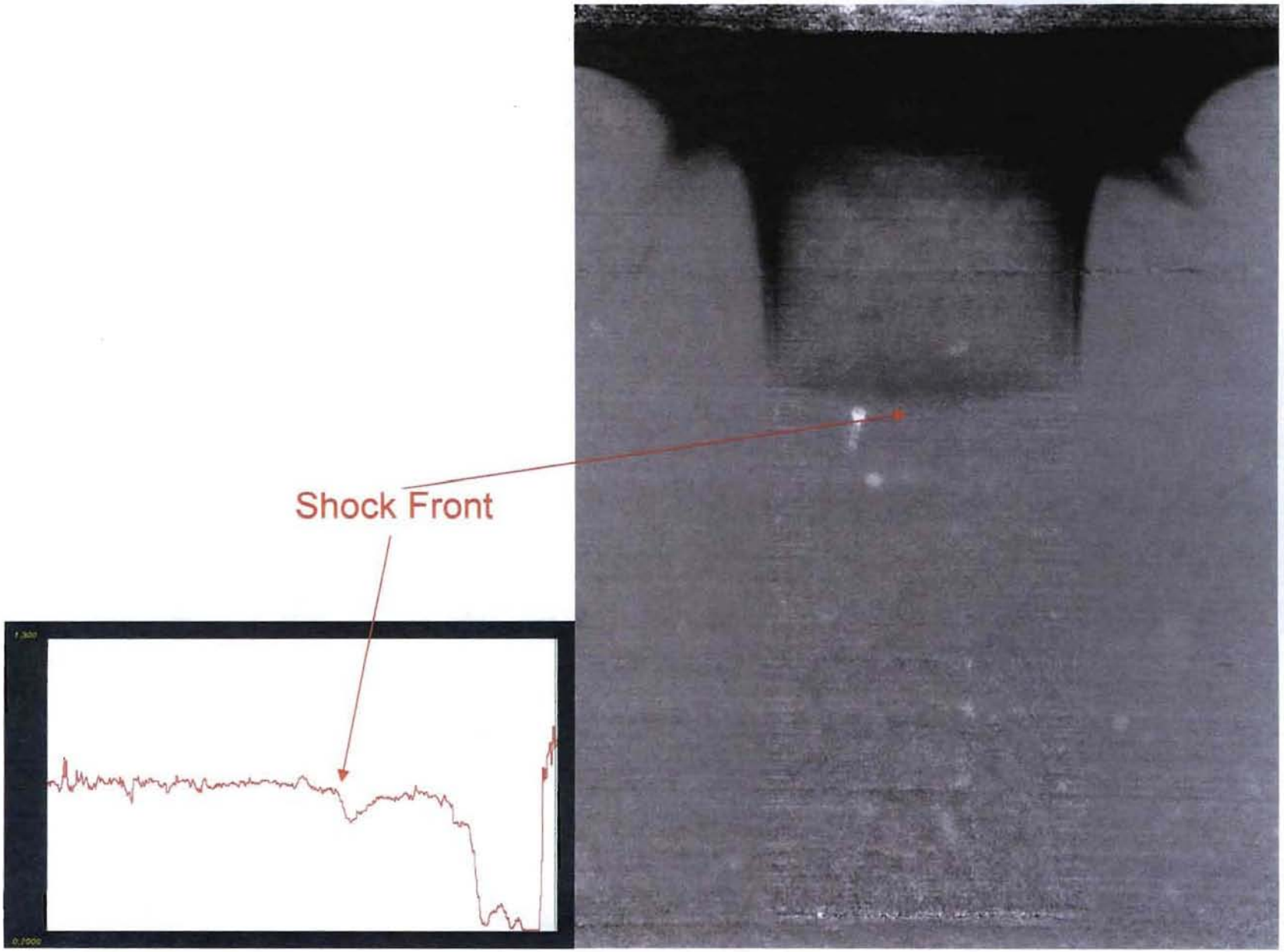
3600 PRAD0373 Ratio Composite O



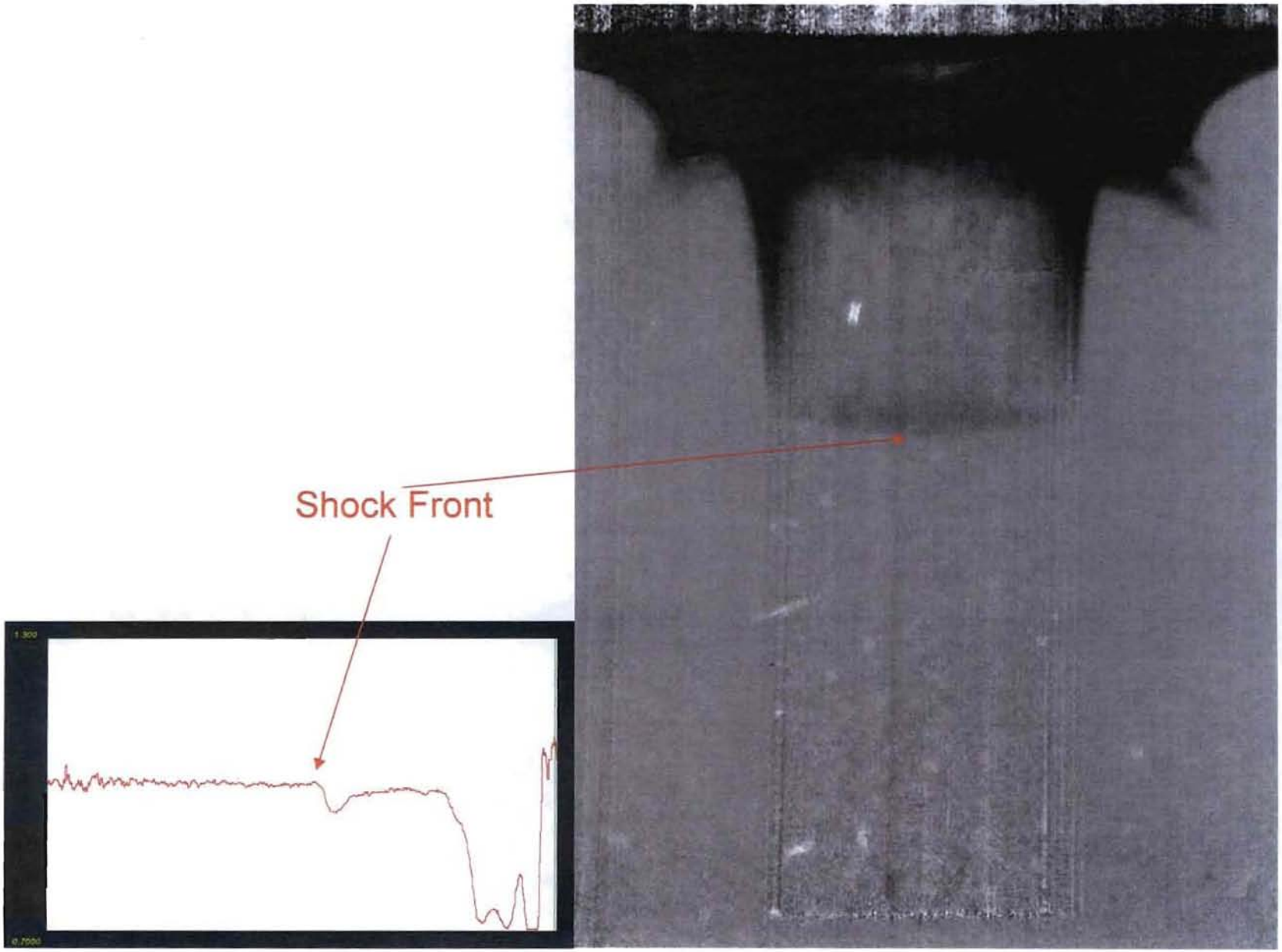
4000 PRAD0373 Ratio Composite R



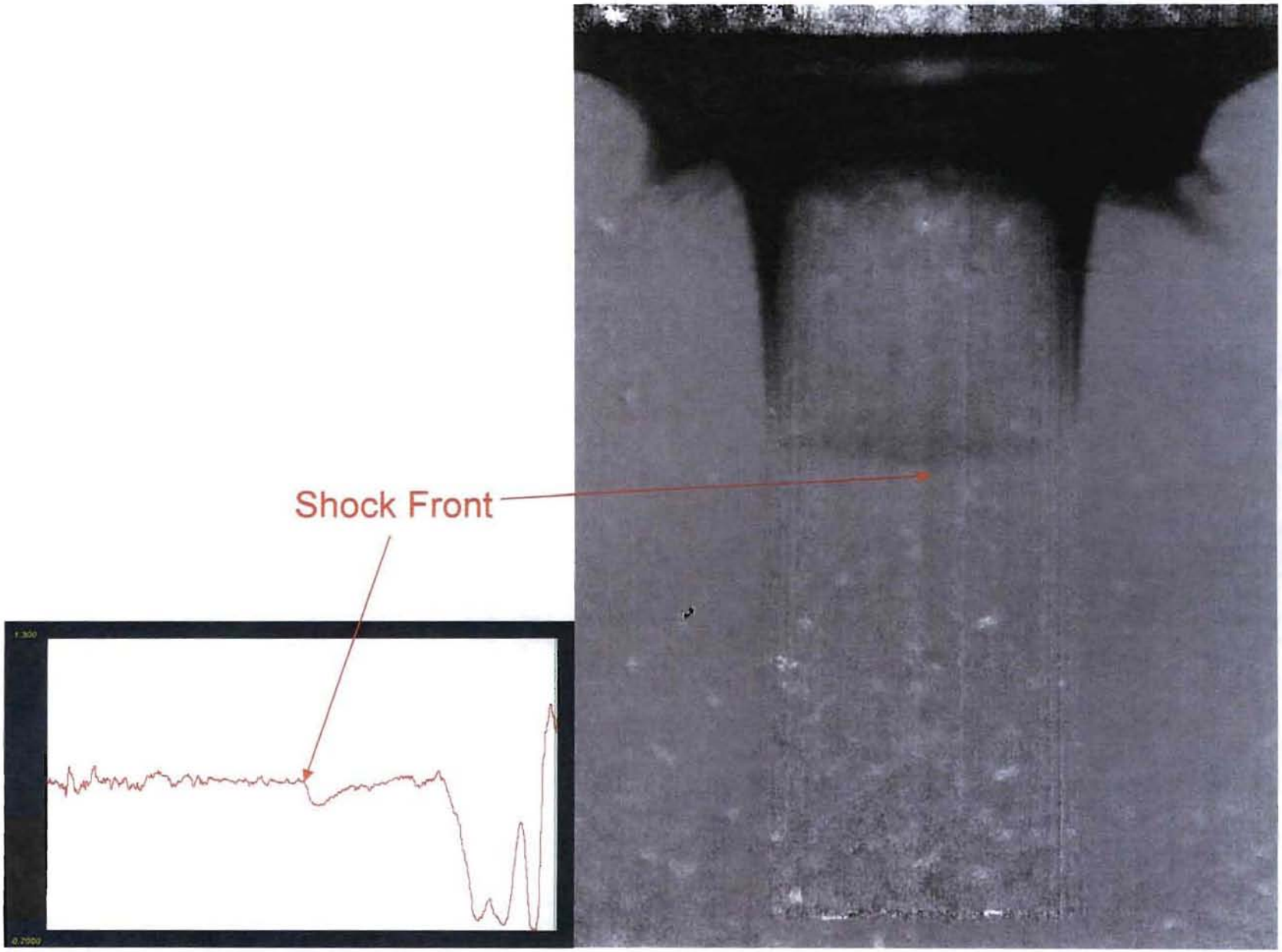
4400 PRAD0373 Ratio Composite U



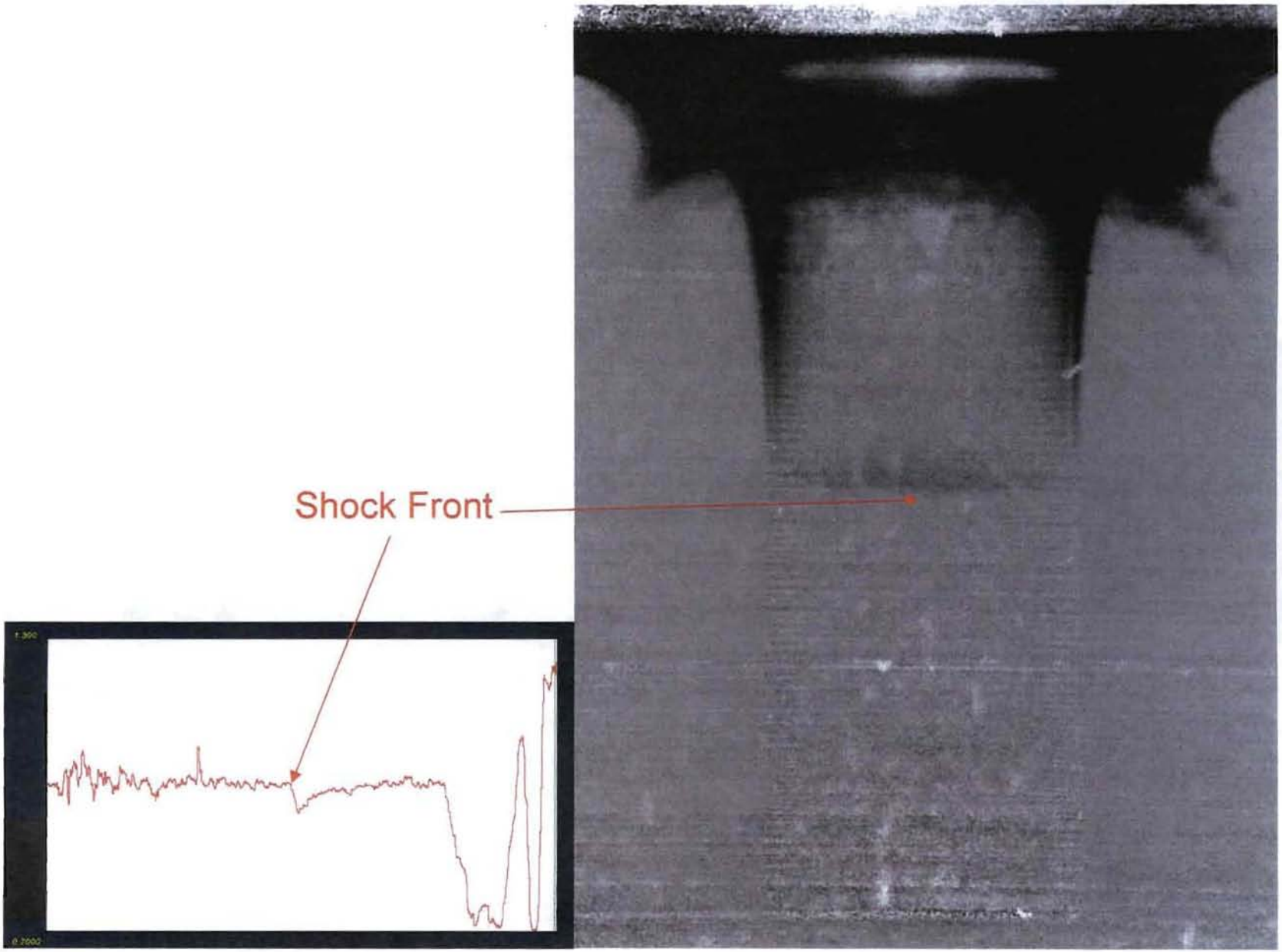
4800 PRAD0373 Ratio Composite Y



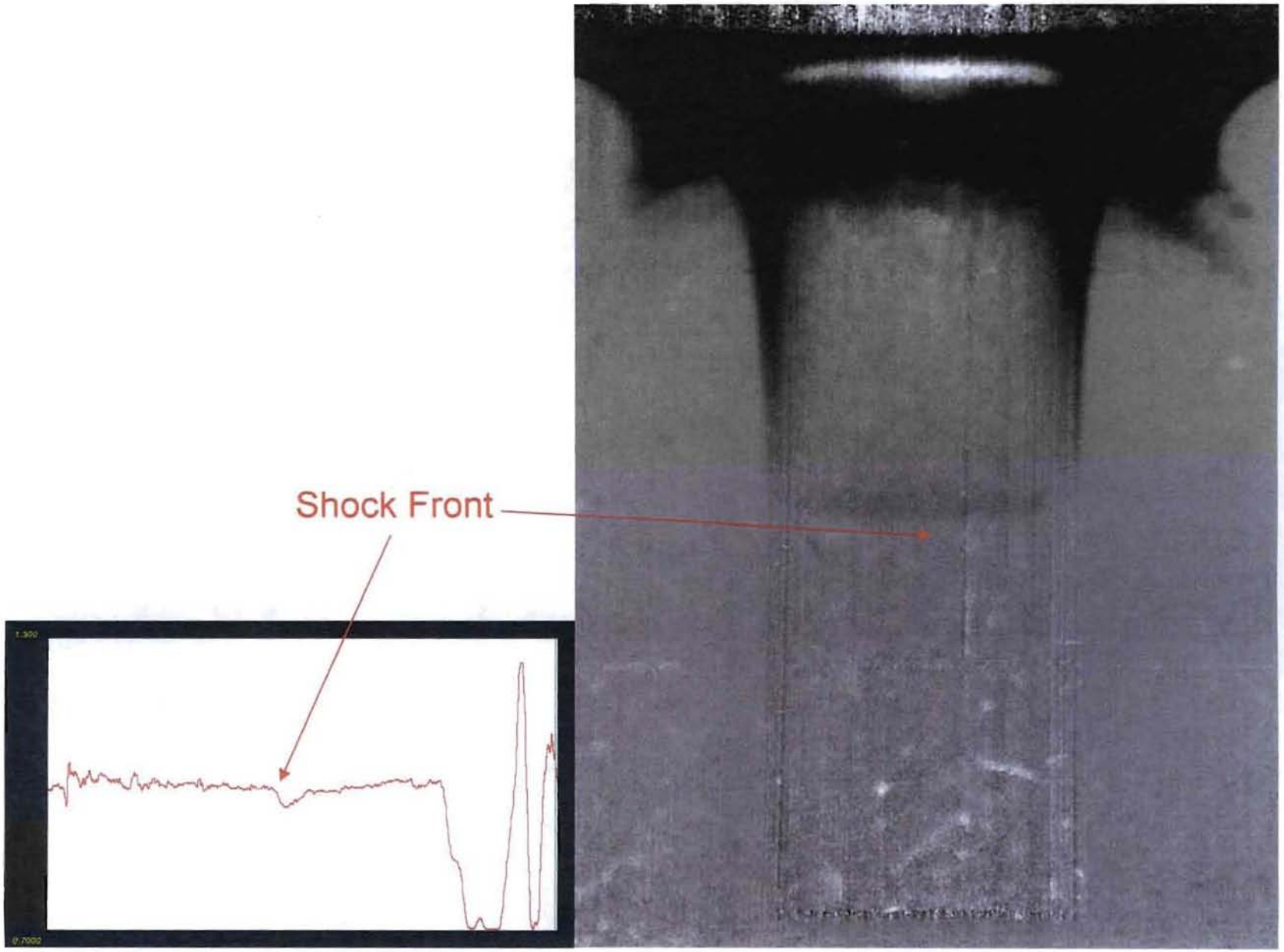
5200 PRAD0373 Ratio Composite J



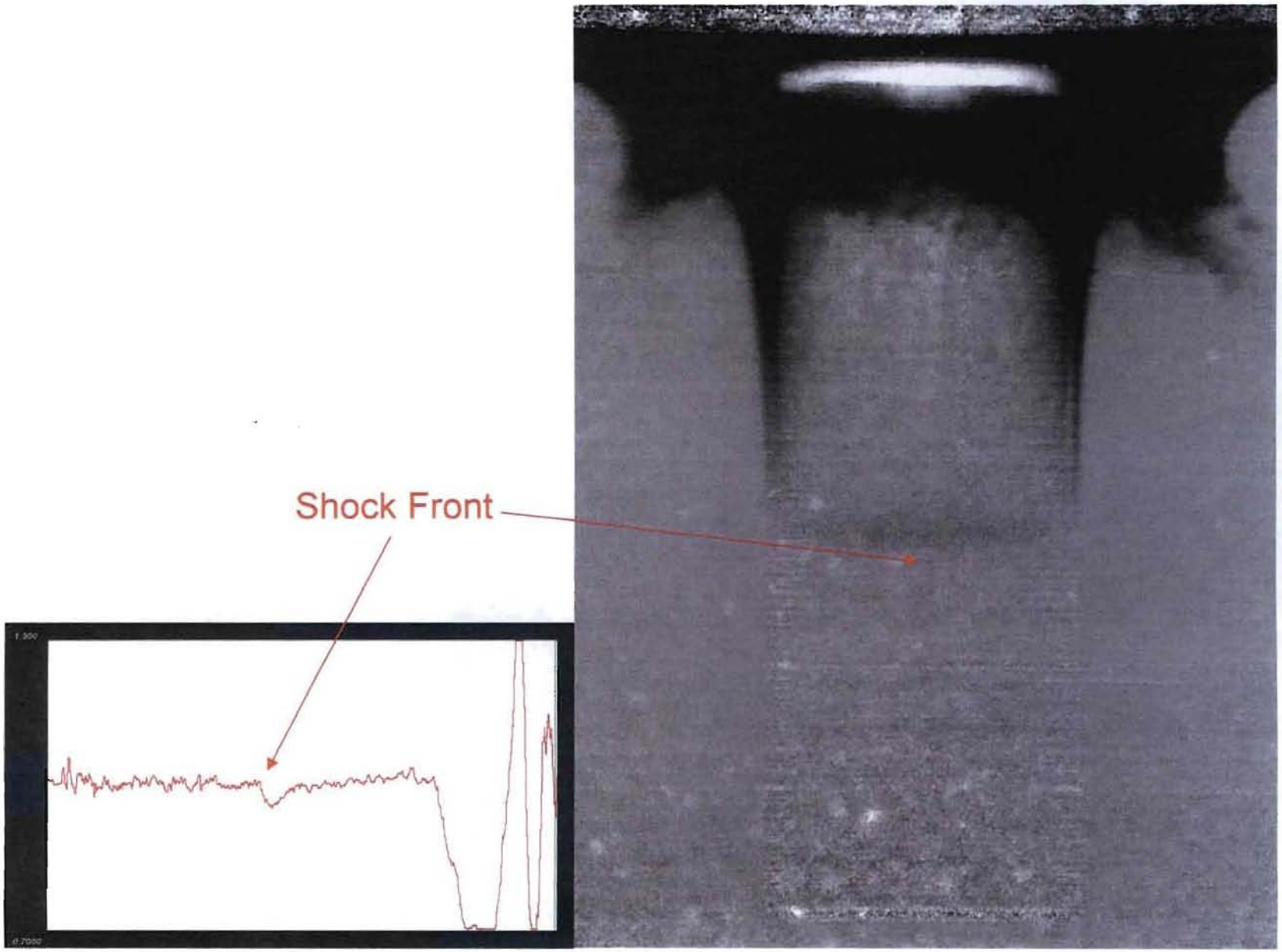
5600 PRAD0373 Ratio Composite M



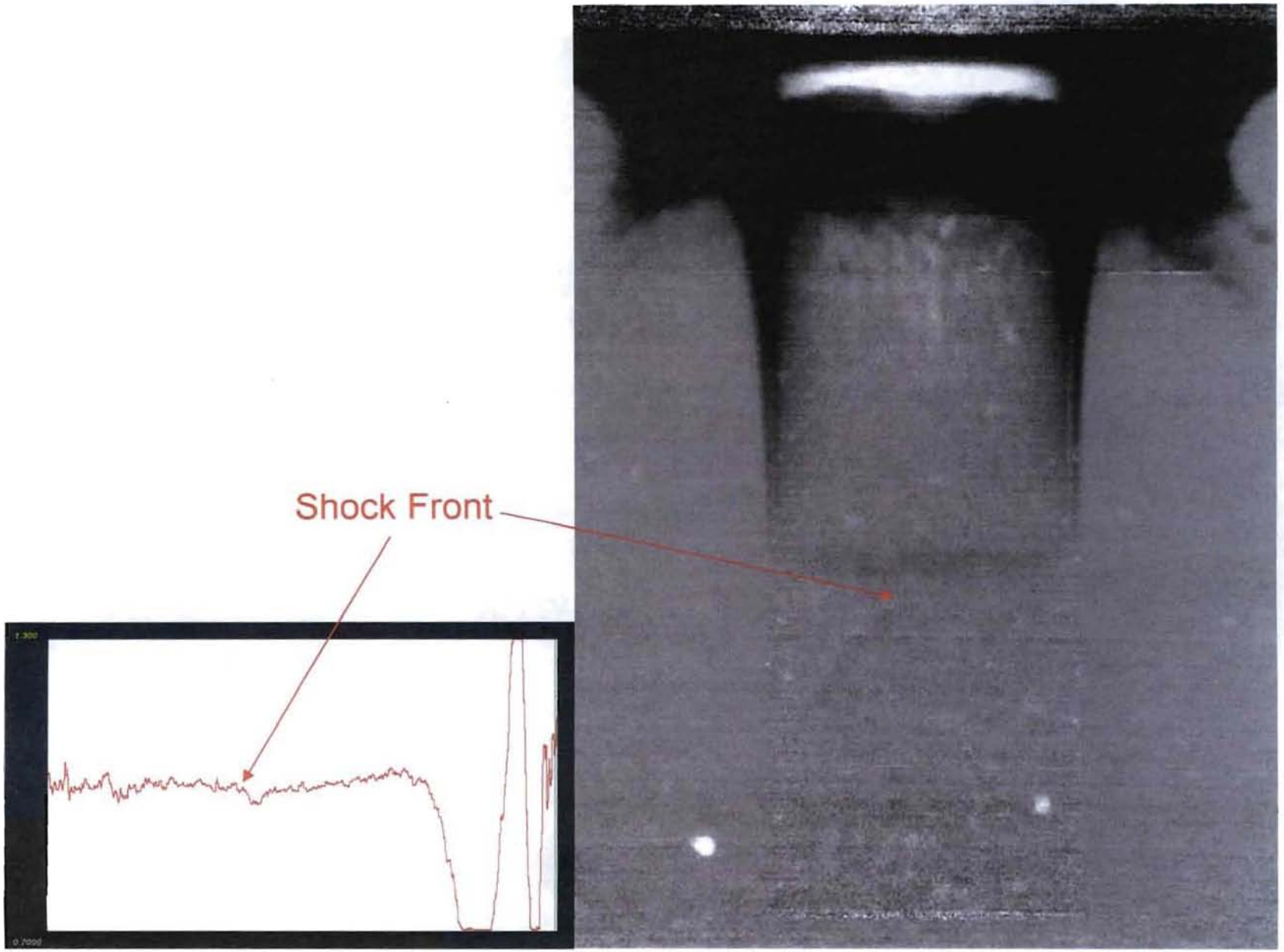
6000 PRAD0373 Ratio Composite P



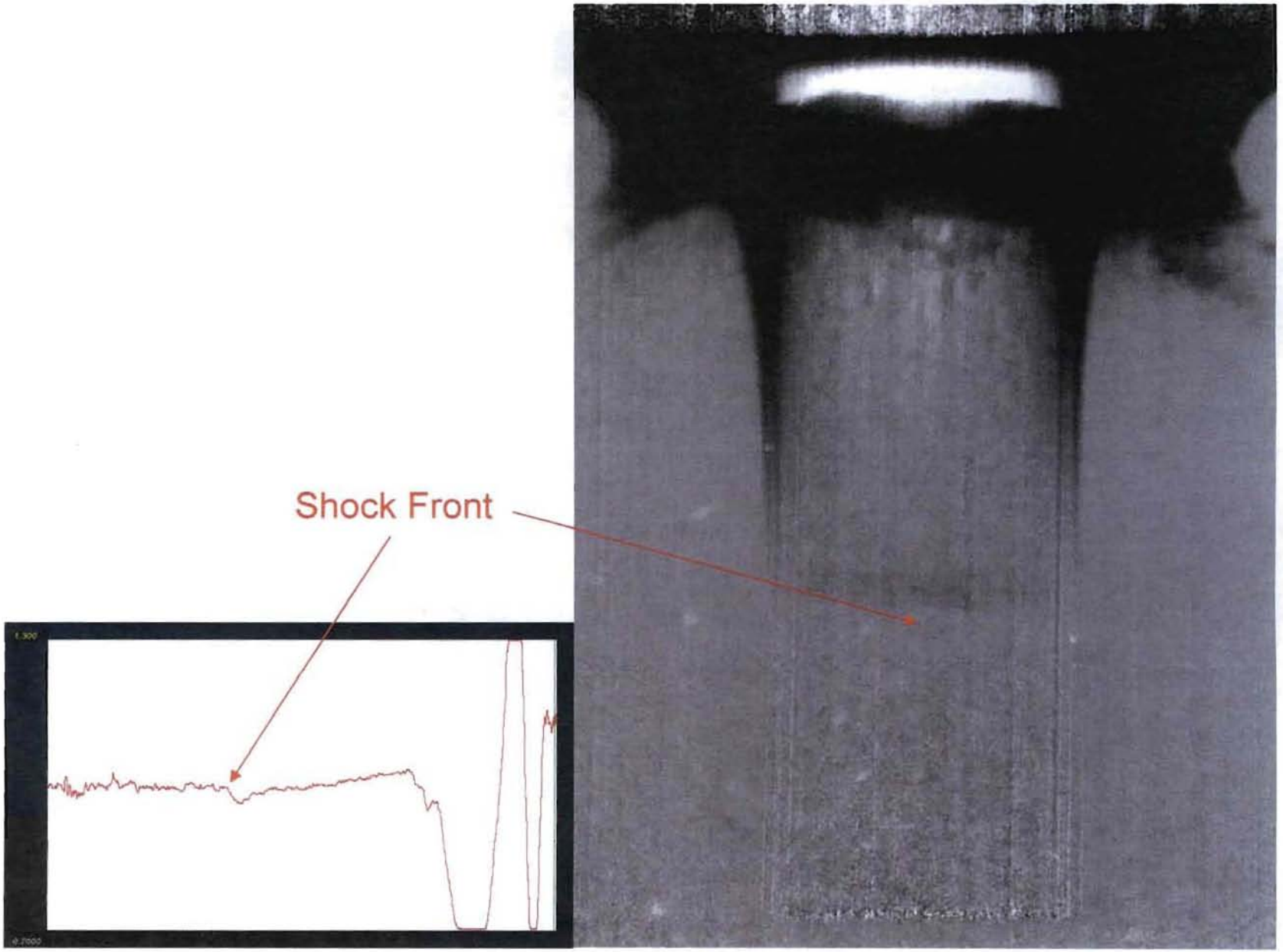
6400 PRAD0373 Ratio Composite S



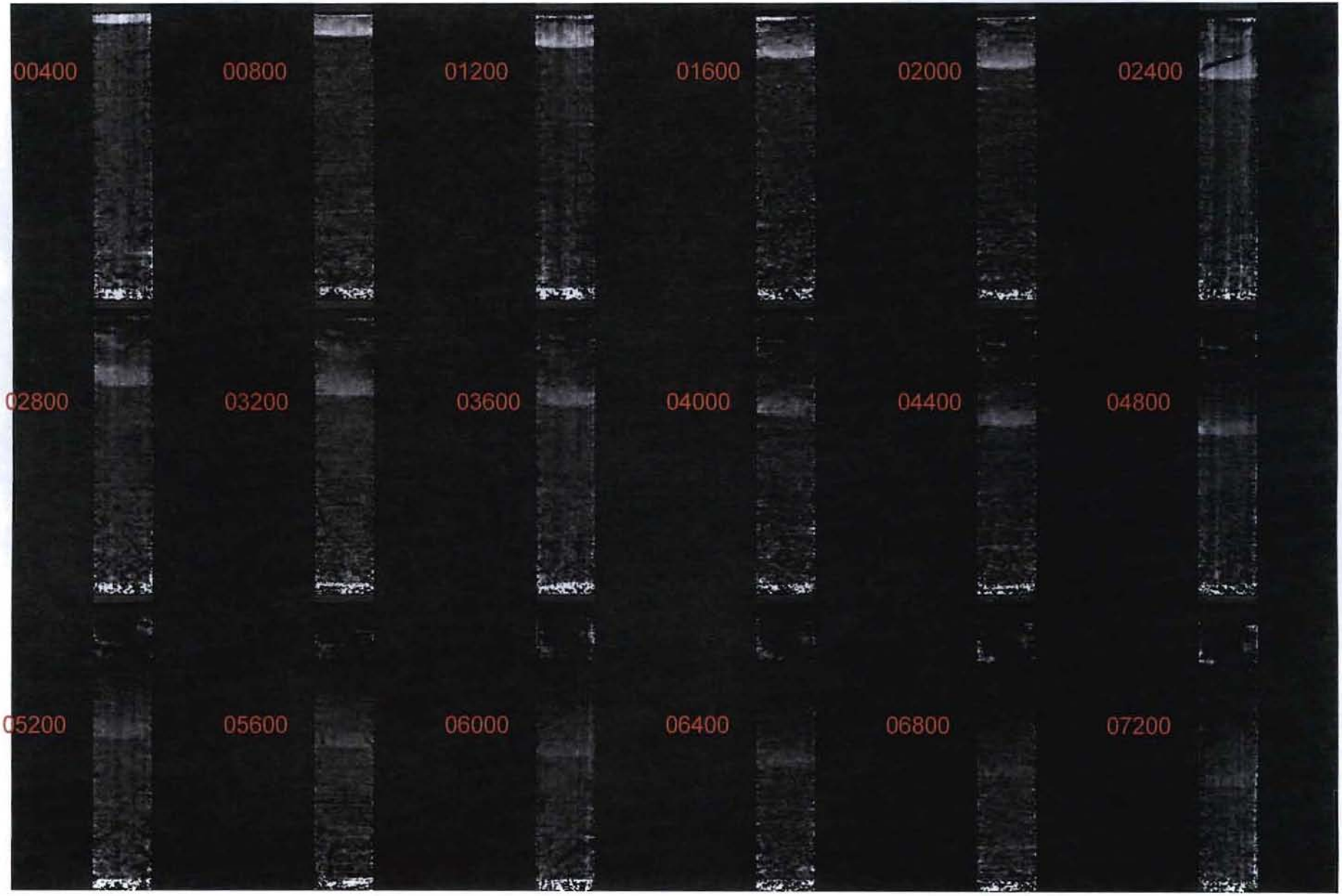
6800 PRAD0373 Ratio Composite V



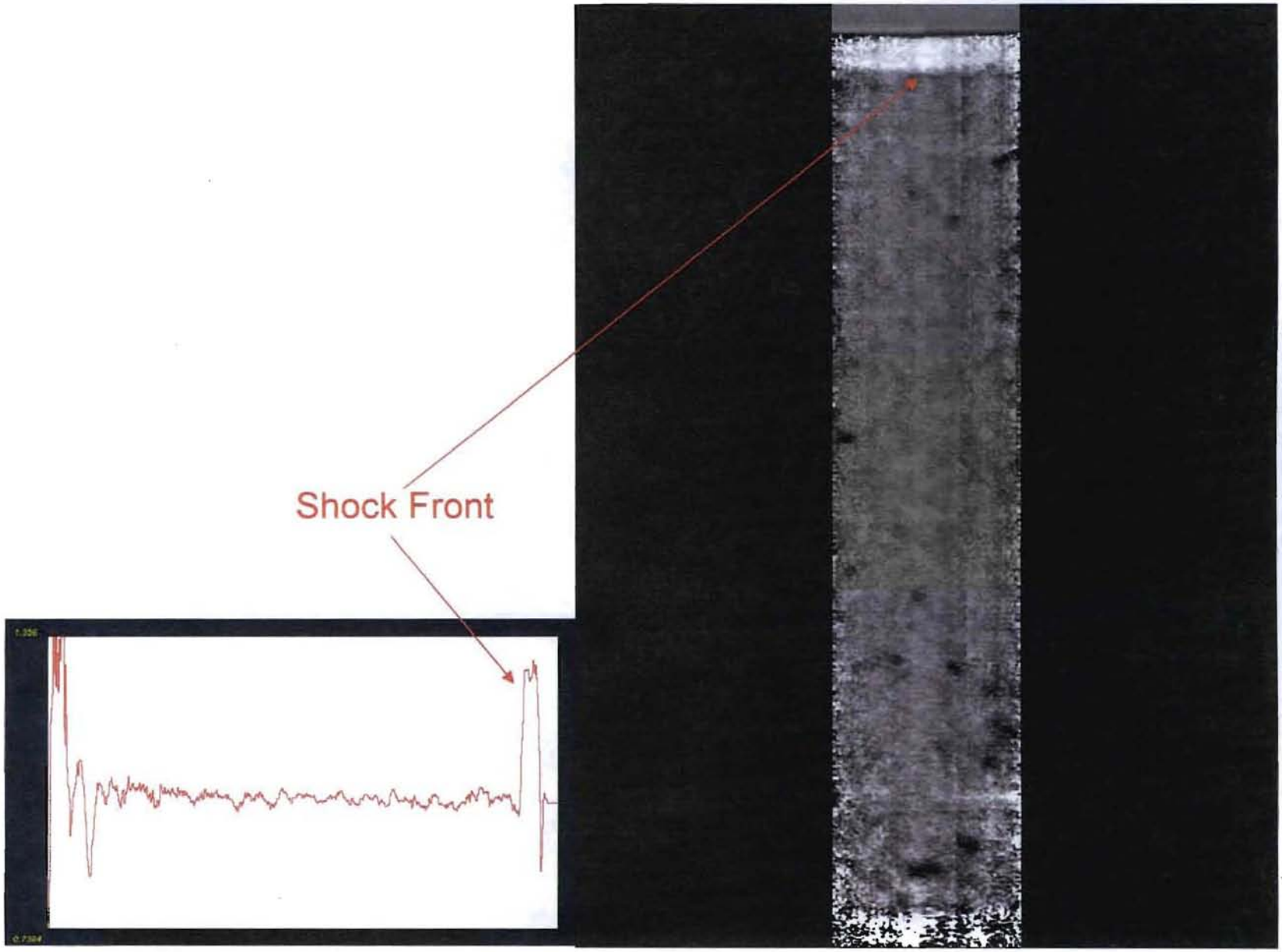
7200 PRAD0373 Ratio Composite Z



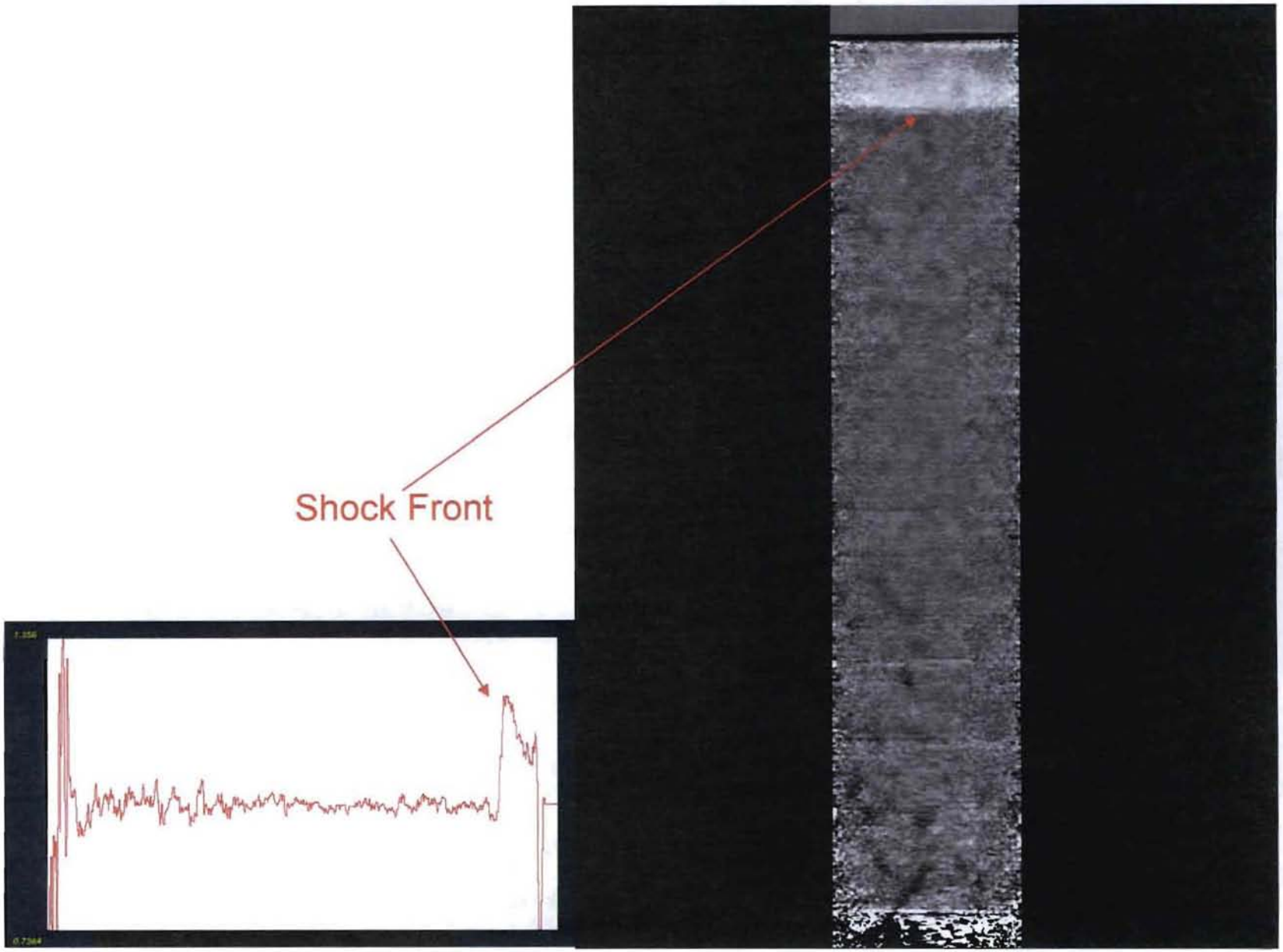
PRAD0373: Tin EOS Trimmed Areal EOS



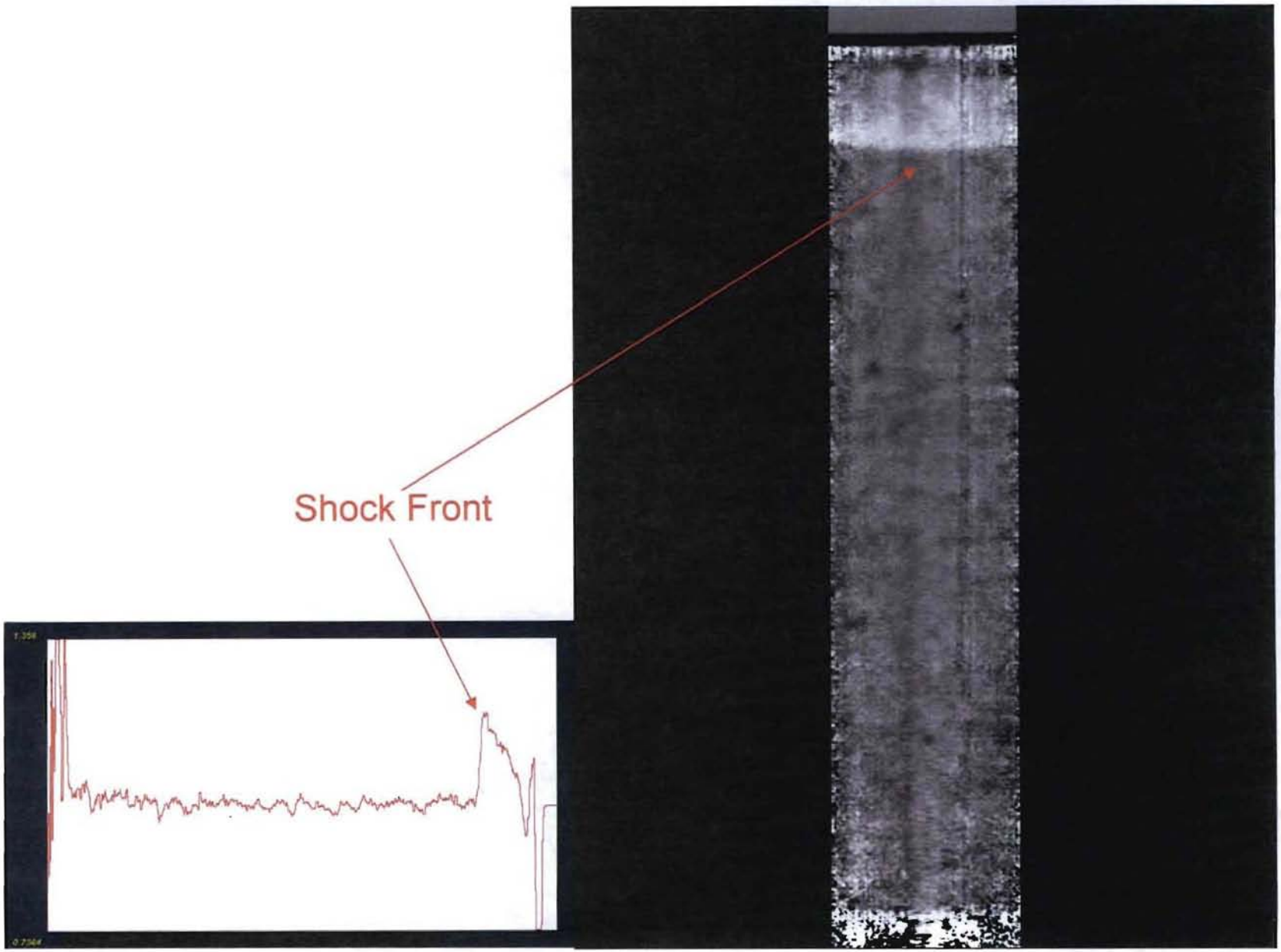
0400 PRAD0373 Trimmed Areal Ratio H



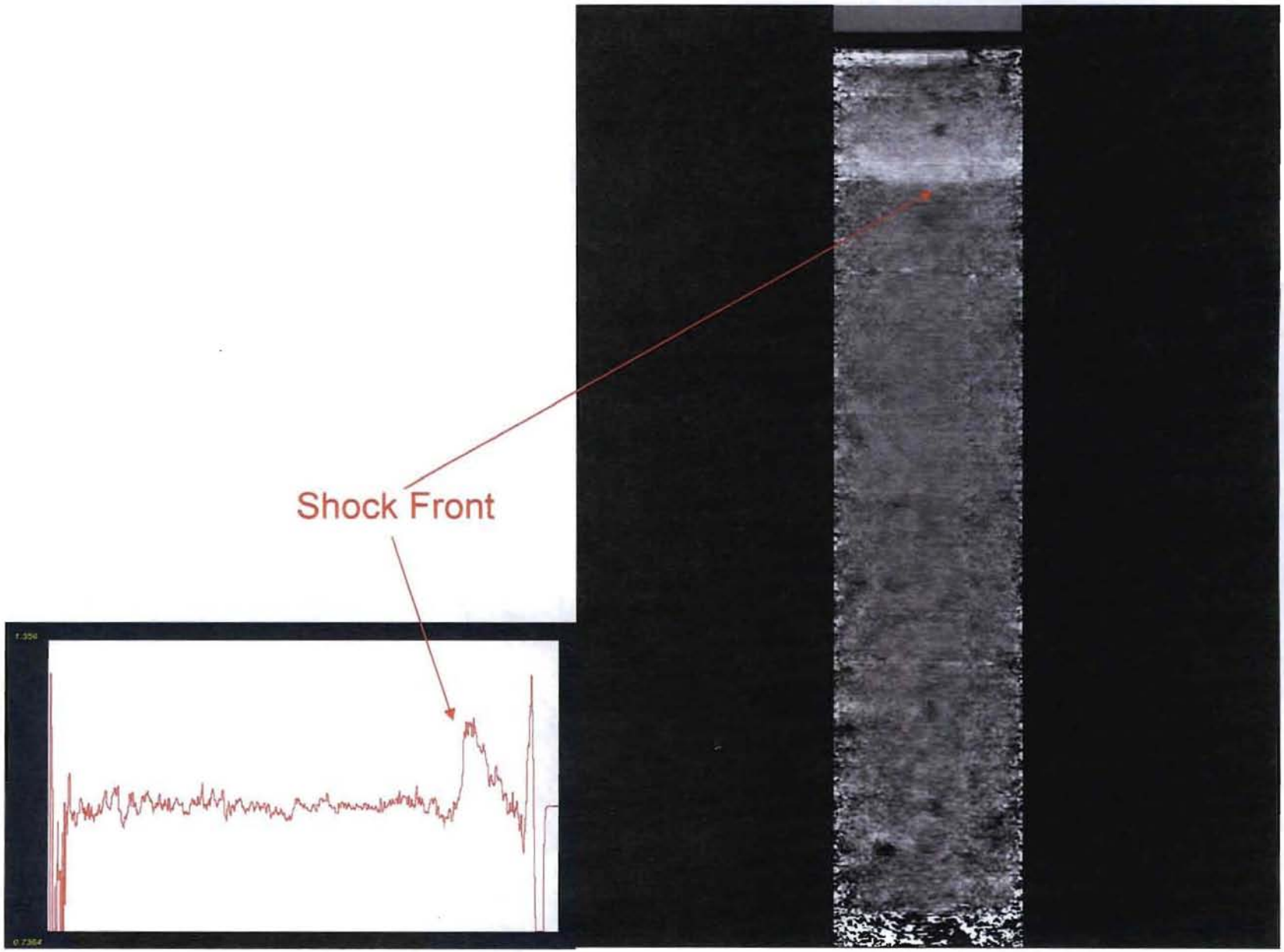
0800 PRAD0373 Trimmed Areal Ratio K



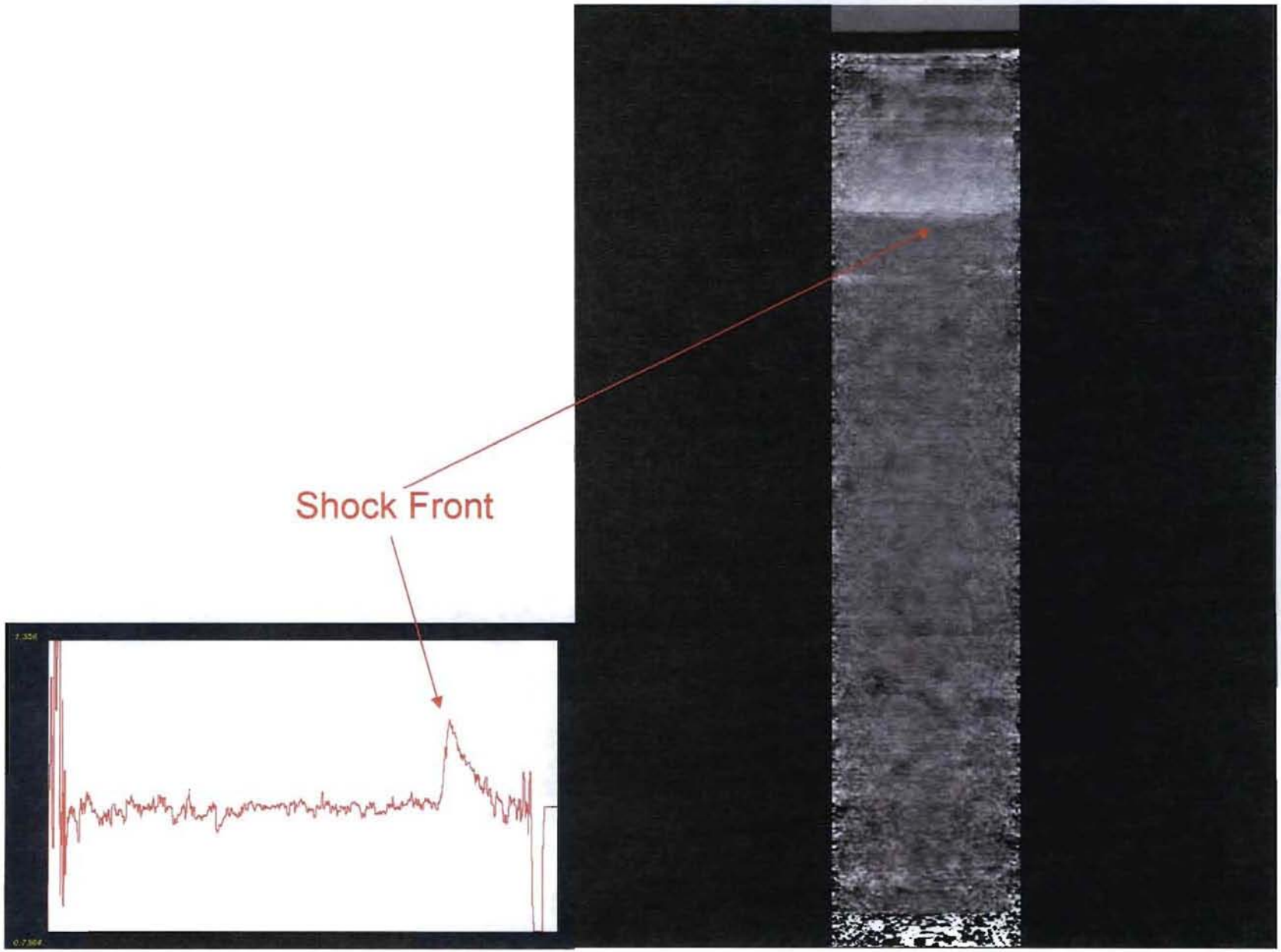
1200 PRAD0373 Trimmed Areal Ratio N



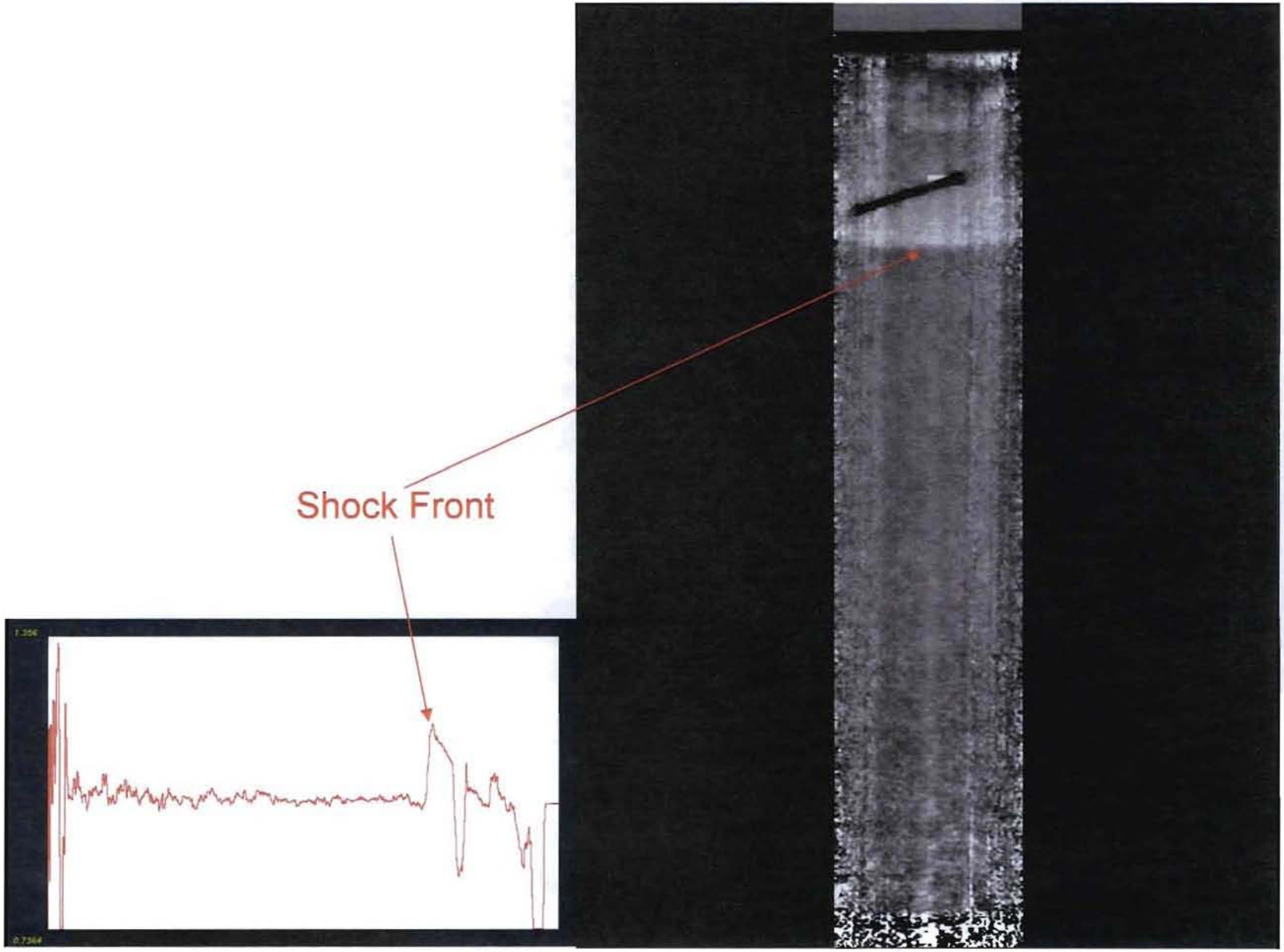
1600 PRAD0373 Trimmed Areal Ratio Q



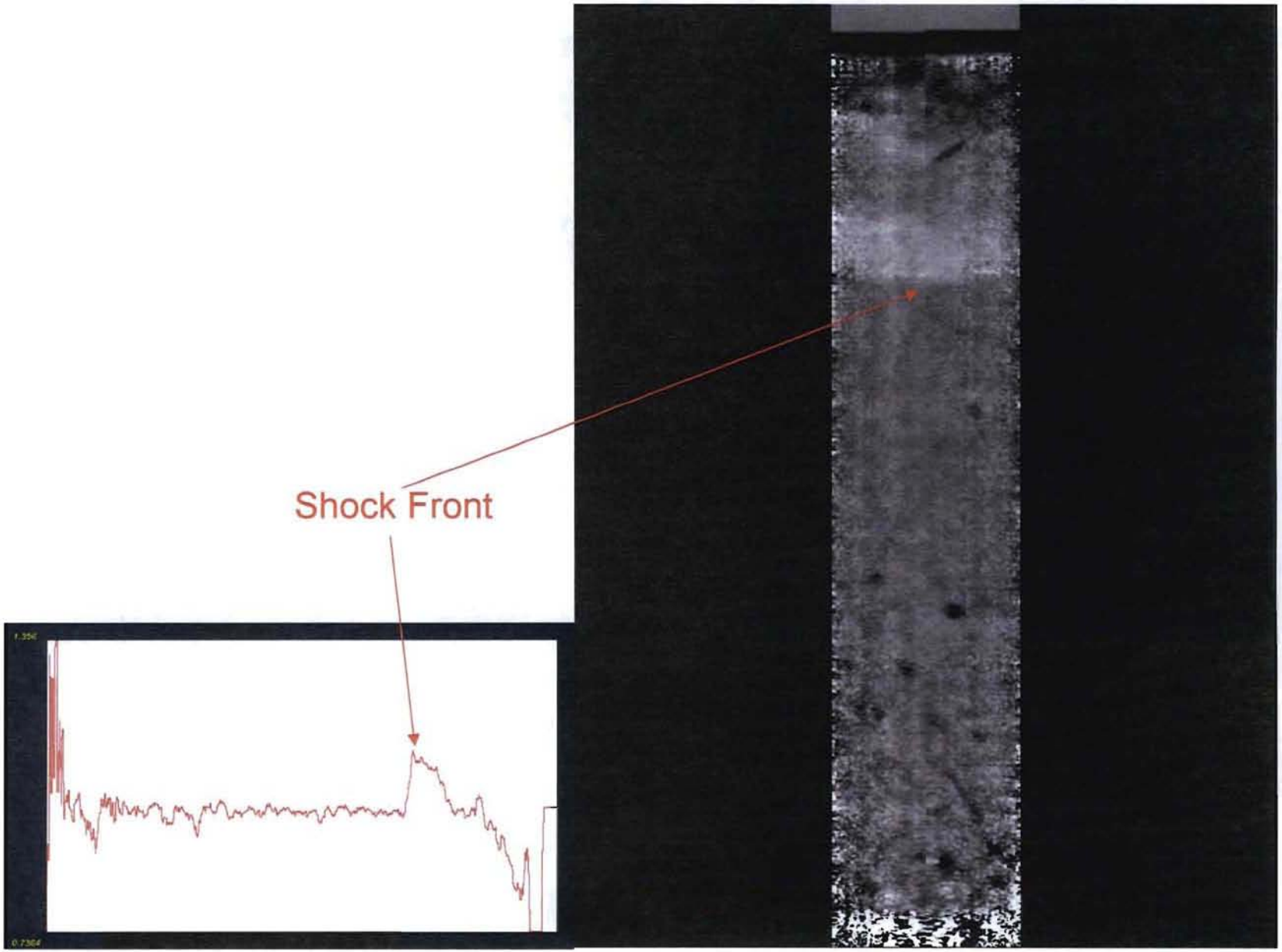
2000 PRAD0373 Trimmed Areal Ratio T



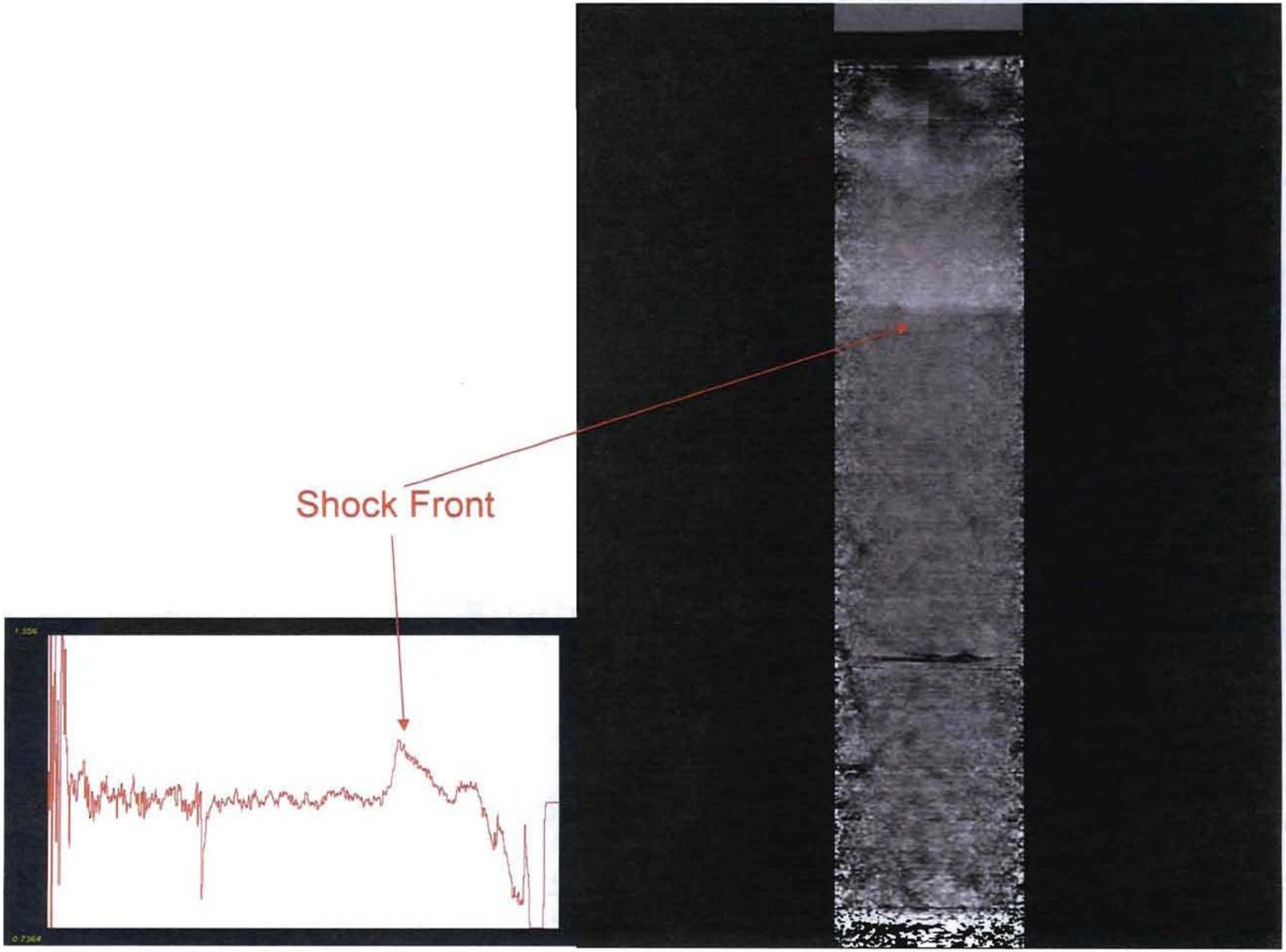
2400 PRAD0373 Trimmed Areal Ratio X



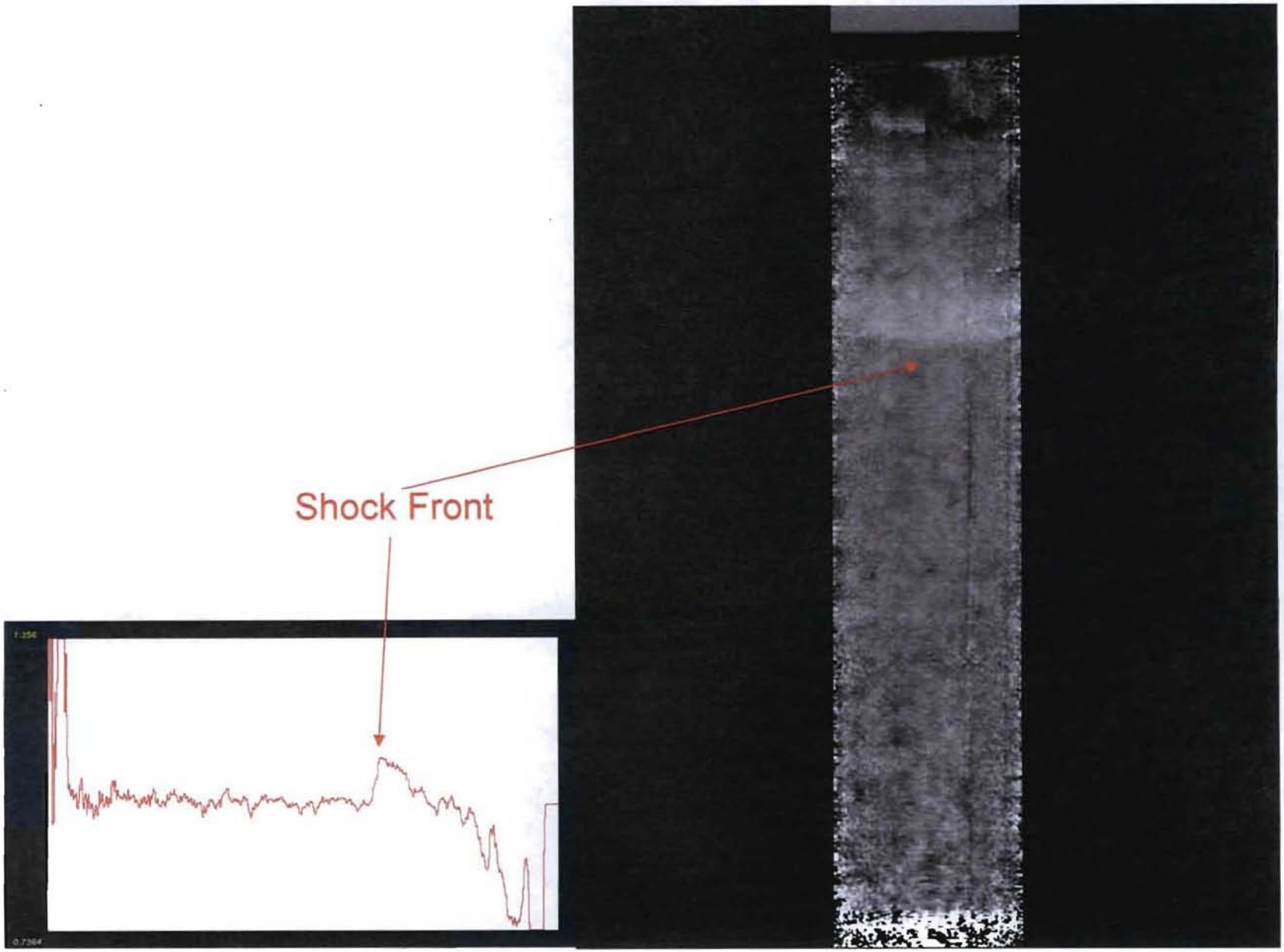
2800 PRAD0373 Trimmed Areal Ratio I



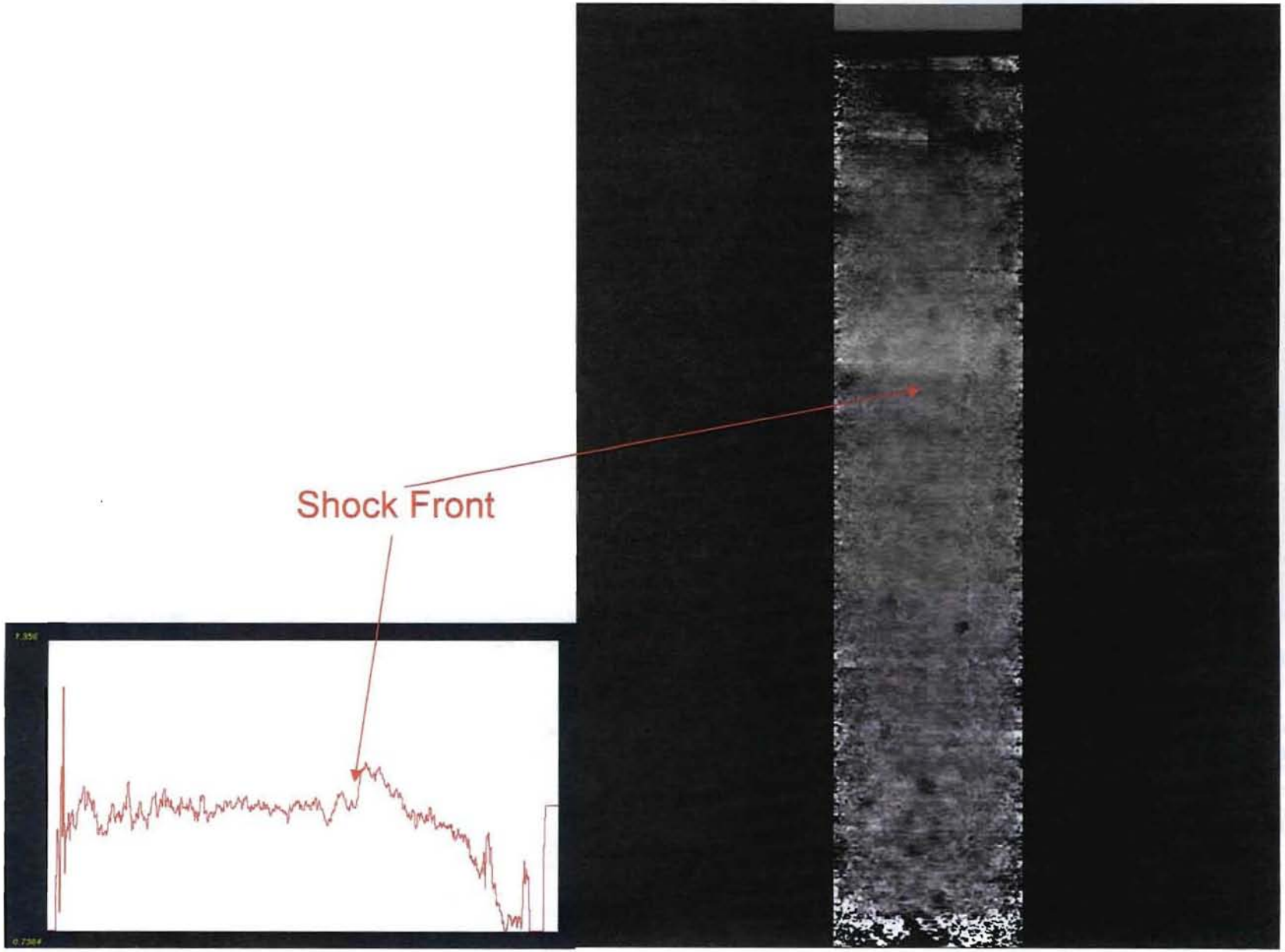
3200 PRAD0373 Trimmed Areal Ratio L



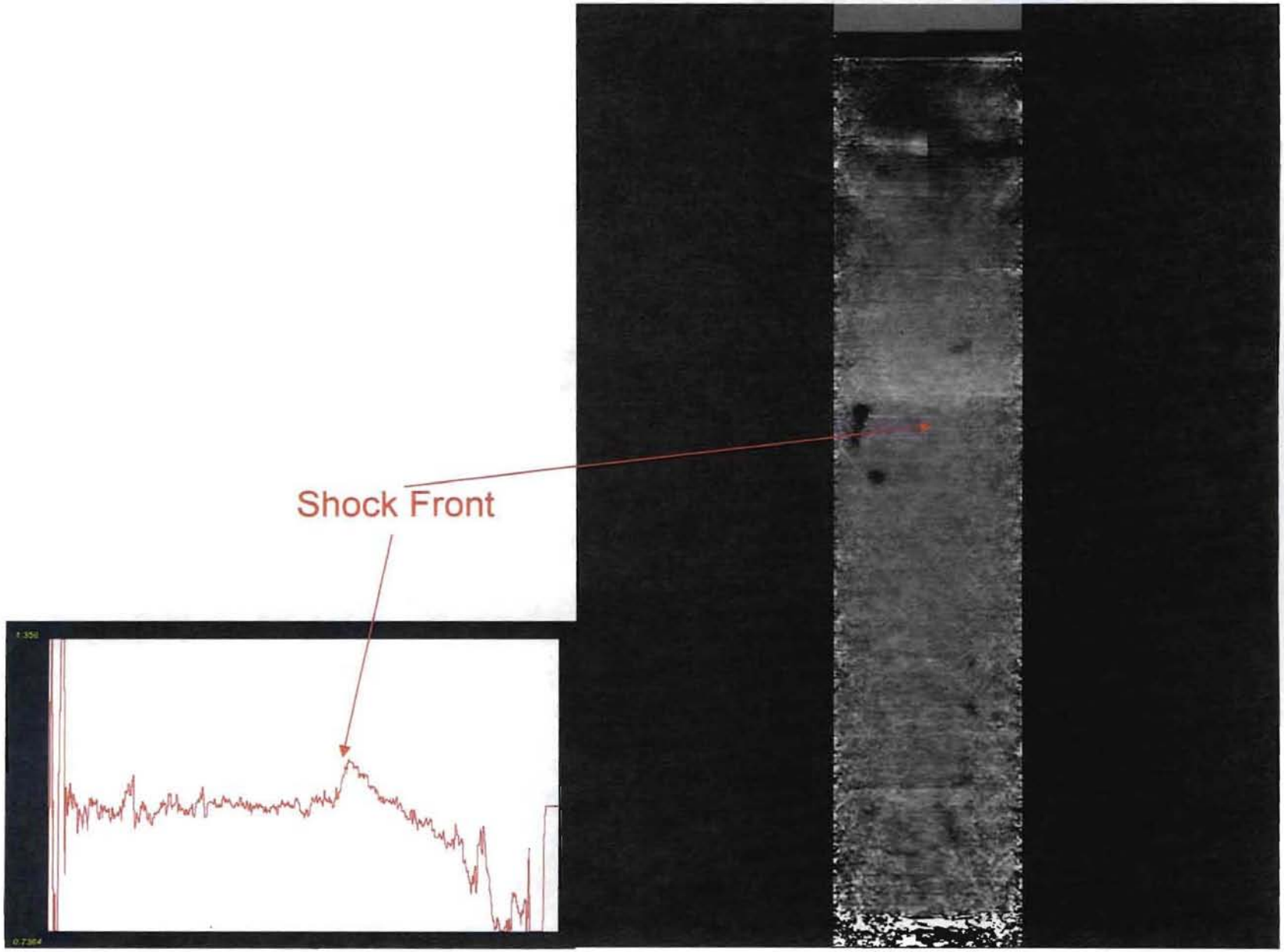
3600 PRAD0373 Trimmed Areal Ratio O



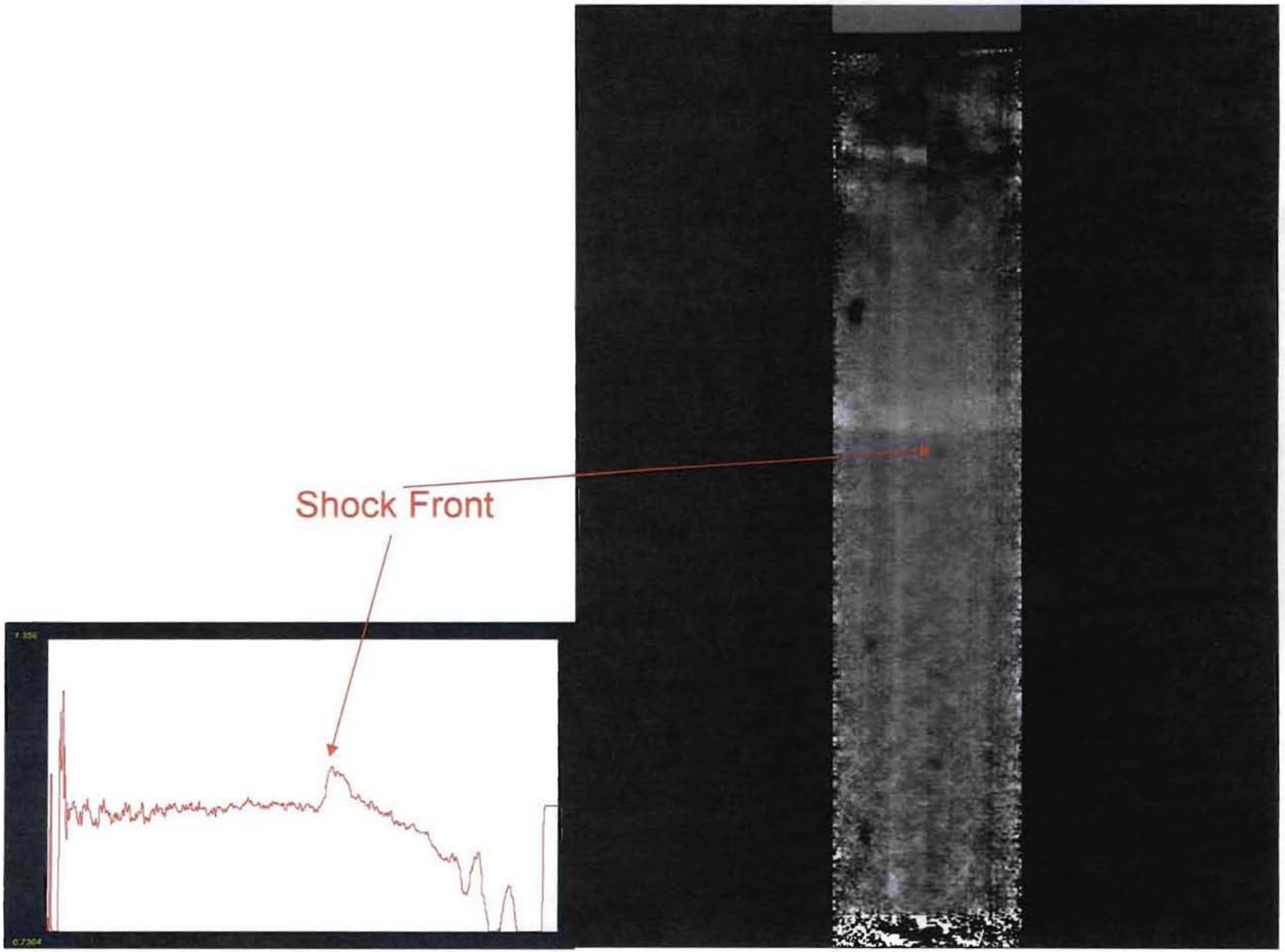
4000 PRAD0373 Trimmed Areal Ratio R



4400 PRAD0373 Trimmed Areal Ratio U



4800 PRAD0373 Trimmed Areal Ratio Y



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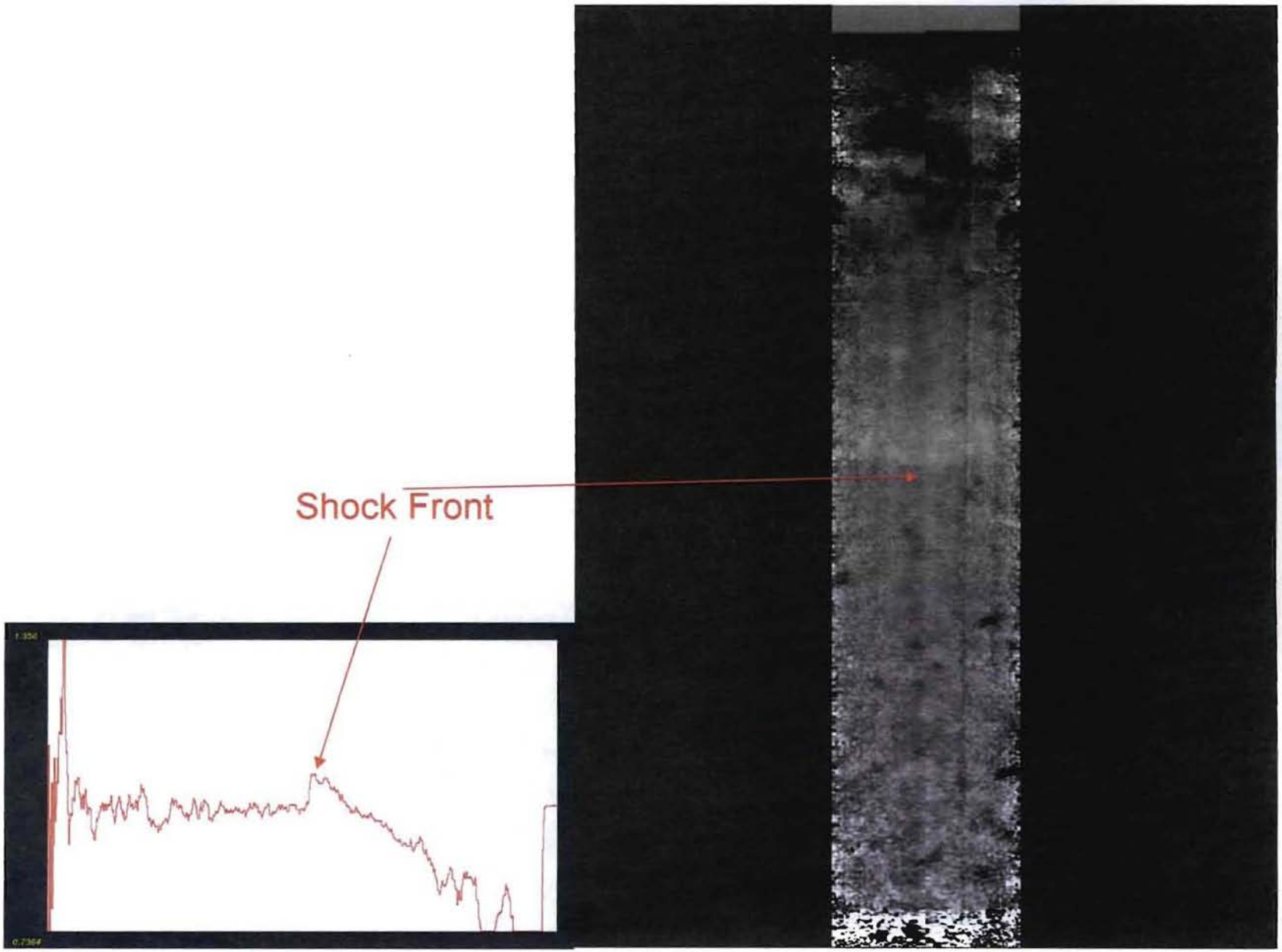
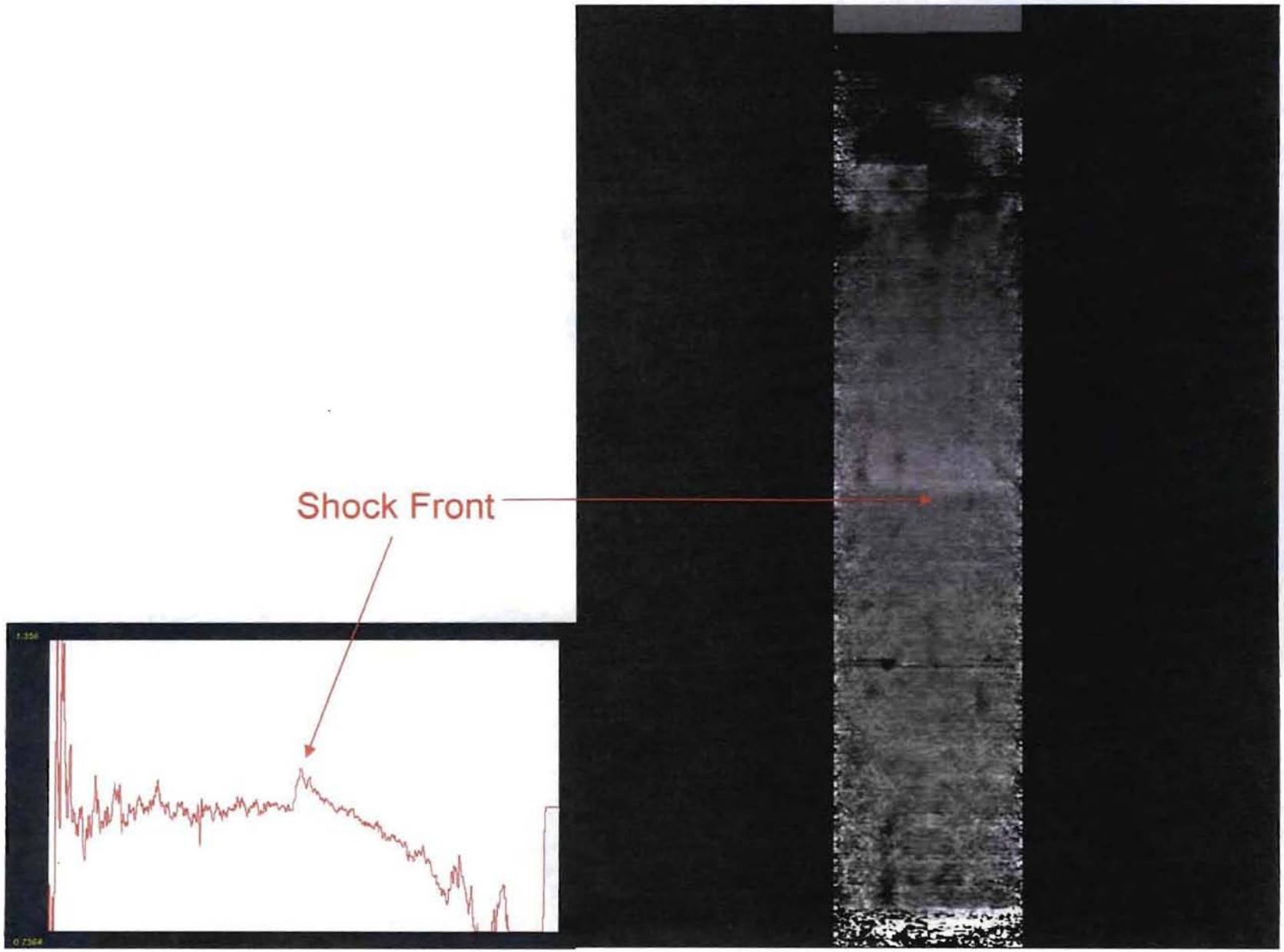


5600 PRAD0373 Trimmed Areal Ratio M



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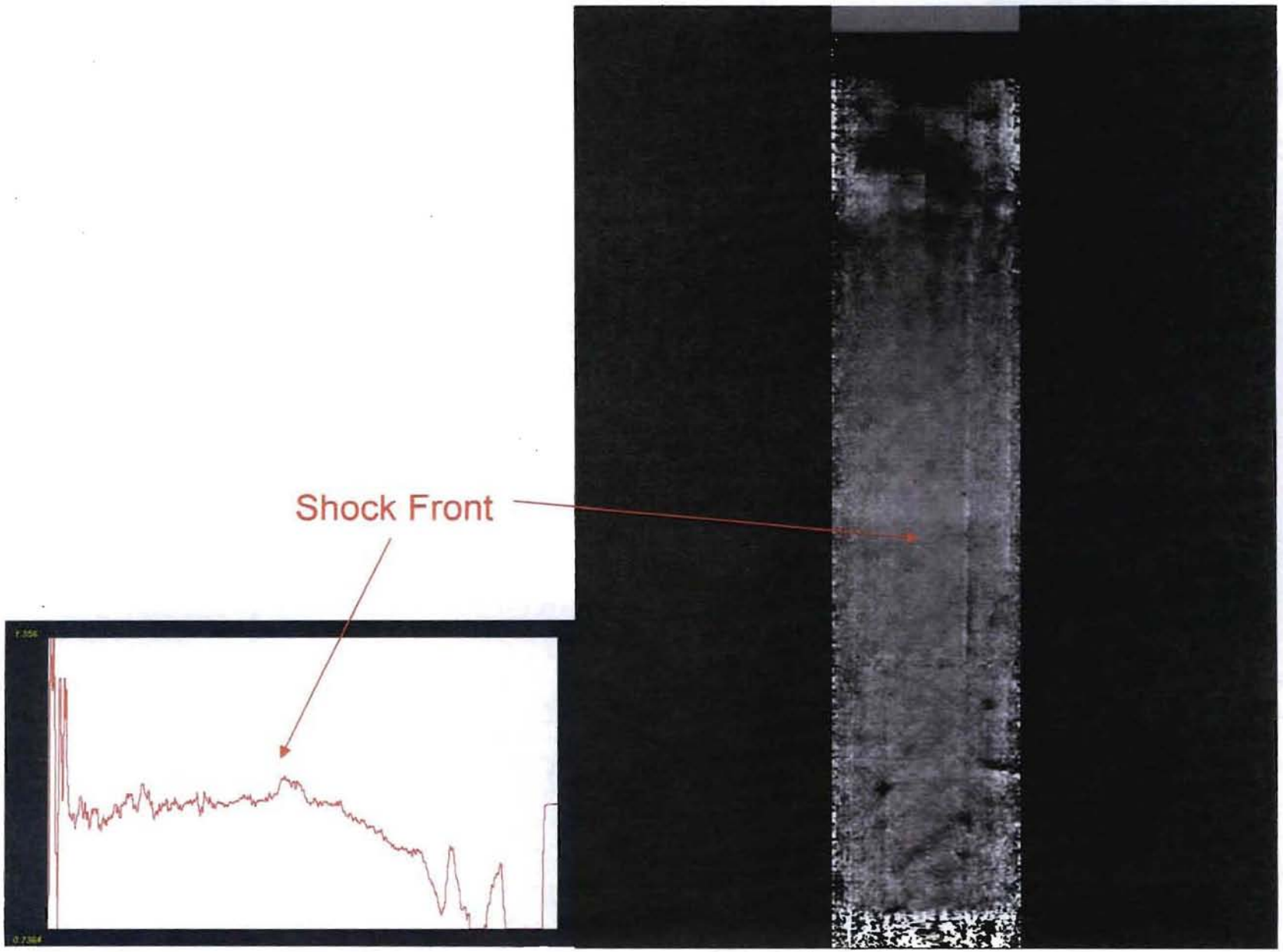

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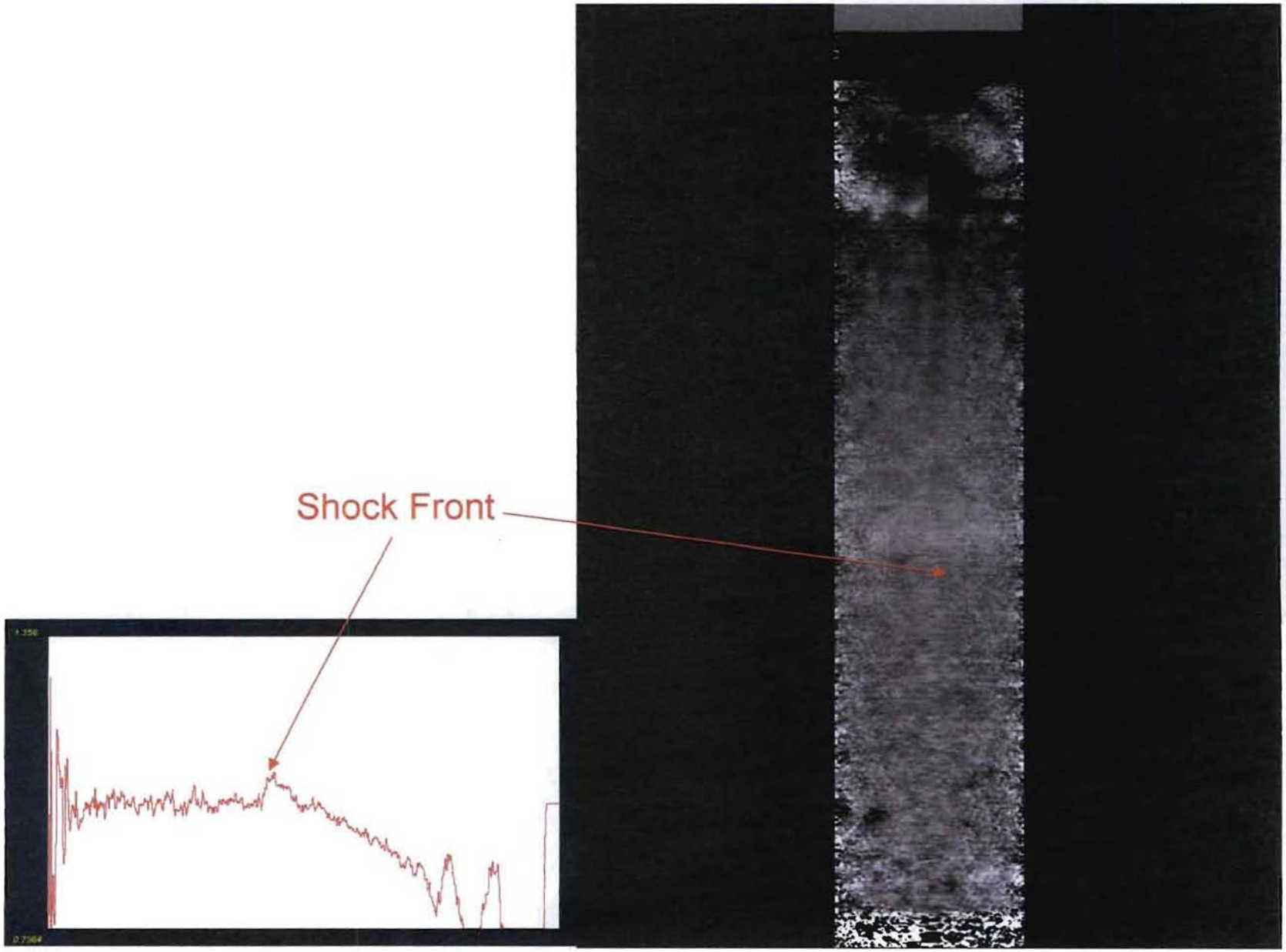
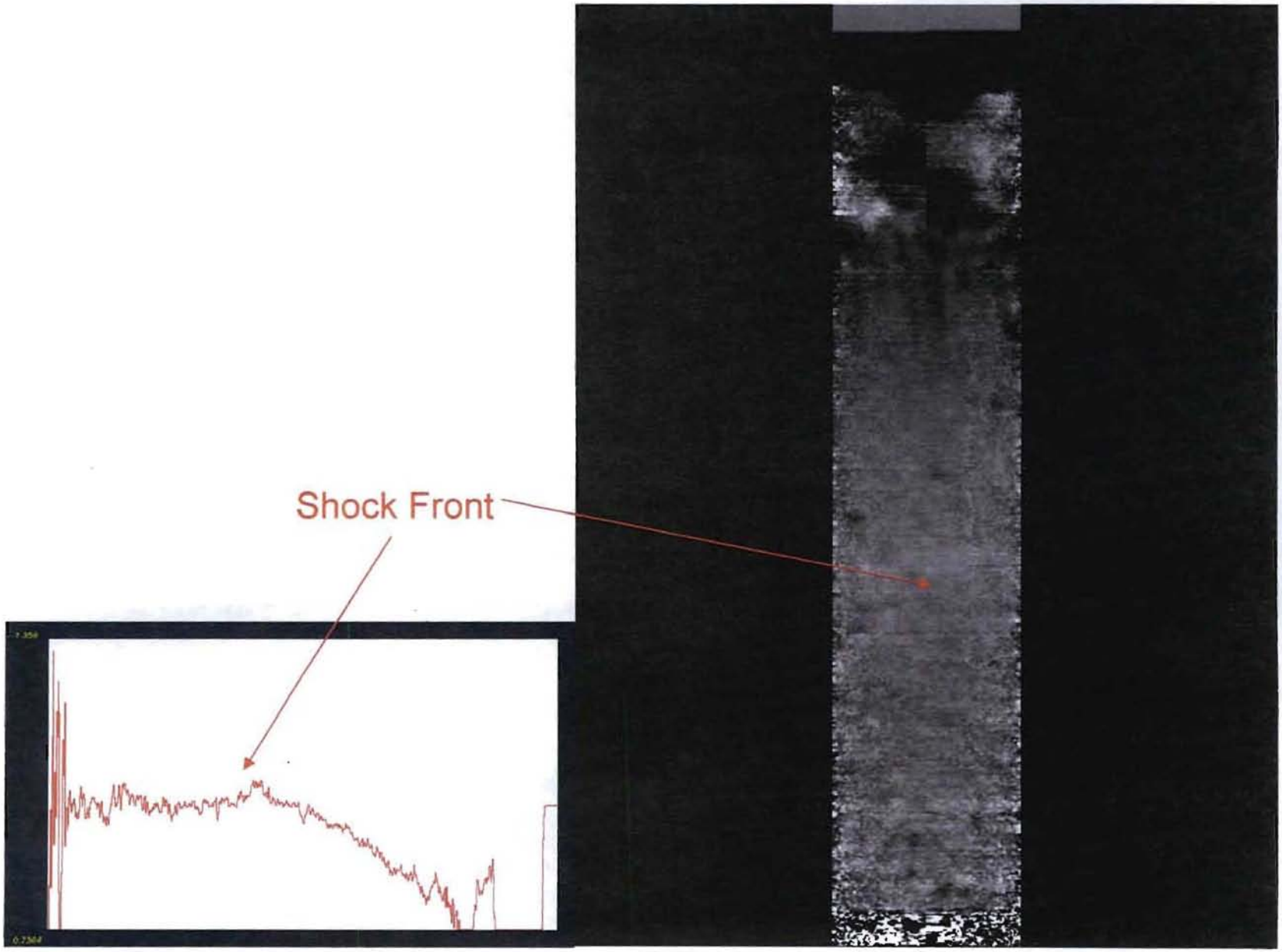


6800 PRAD0373 Trimmed Areal Ratio V



7200 PRAD0373 Trimmed Areal Ratio Z