COMMANDER DIRECTED
REPORT OF INVESTIGATION

PREPARED BY

(b)(6)

INVESTIGATING OFFICER

CONCERNING
USAFADS SONIC BOOM OVER
TUCSON, ARIZONA ON 13 APRIL 2012

11 MAY 2012
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APPOINTMENT AND TASKING LETTERS

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MEMORANDUM FOR [b/(6)]

FROM: USAFWC/CC

SUBJECT: Commander-Directed Investigation (CDI) of Sonic Boom

1. You are appointed to conduct a CDI into all aspects of the facts and circumstances surrounding a sonic boom that occurred while the United States Air Force Air Demonstration Squadron (Thunderbirds) was practicing on 13 Apr 12 over a populated area of Tucson, Arizona. Until completion of this duty and submission of an acceptable report this is your primary duty (no leave, temporary duty, or other duties), unless expressly discussed and permitted by me.

2. You are authorized to interview personnel, take sworn statements or testimony and examine and copy any and all relevant Air Force records, files, and correspondence germane to this investigation.

3. In conducting the CDI, follow the guidance in the Commander-Directed Investigation Guide. Prepare and submit to me a report of investigation in the format it describes. Submit the report to me by COB 11 May 12, unless I grant a written extension.

4. Prior to beginning your investigation, consult with [b/(6)] your designated legal advisor for purposes of this CDI. He may be reached at [b/(6)]

5. You may not release any information related to this investigation without my prior approval. This letter and the attached documents are marked FOR OFFICIAL USE ONLY and contain information that must be protected under the Privacy Act.

JAMES W. HYATT
Major General, USAF
Commander

Attachment:
Commander-Directed Investigation Guide
General Hyatt,

The 1D in the Thunderbirds sonic boom CDI, [b](6) is requesting an extension to the 11 May 12 report deadline specified in his appointment letter. Because the Thunderbirds were travelling this week he did not have an opportunity to conduct effective interviews. He would like until 18 May 12 to turn in his final report. General Buck supports the request. You may grant the request by responding to this message and it will be included in the file as documentation.

V/R

[[(b)[6]//SIGNED//]]

[[(b)[6]USAF Warfare Center]]

[[(b)[6]FOR OFFICIAL USE ONLY]]

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B1. Authority and Scope. Commanders have the inherent authority to conduct a Commander's Directed Investigation (CDI) to investigate matters under their command, unless preempted by higher authority. Pursuant to this authority, Major General James W. Hyatt, United States Air Force Warfare Center Commander, appointed [b](6) as the Investigating Officer (IO) on 26 April 2012, to conduct the Investigation into “all aspects of the facts and circumstances concerning the 13 April 2012 sonic boom that occurred while the United States Air Force Demonstration Squadron (Thunderbirds) were practicing over a populated area of Tucson, Arizona.” The CDI was conducted from 26 April to 11 May, 2012, at Nellis AFB, NV.

B1.1. No pre-investigative allegations were provided to the IO at the beginning of the investigation.


B2. Allegation(s). No formal allegations. The purpose of the investigation was to investigate all aspects of the facts and circumstances concerning the 13 April 2012, USAFADS sonic boom over Tucson, Arizona.

B2.1. Lacking predetermined allegations; this CDI was conducted, per the stated purpose contained within the SAF/IGQ CDI guide, to investigate the possibility of problems or concerns with 1) systemic or procedural processes, if any, and 2) individual conduct or responsibility, if any.

B3. Investigation Plan. To investigate the possibility of any problems with individual conduct/responsibility or procedural processes, the IO conducted interviews, reviewed tapes, inspected training records, and analyzed the operating procedures for the USAFADS.
BACKGROUND

Contents

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C1. Background. This investigation involved determining the facts, circumstances, and cause of a sonic boom that occurred on 13 April 2012 at 21:23Z, over a populated area of Tucson, AZ, approximately four miles north of Davis-Monthan AFB. The sonic boom was generated by [b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b][b]
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D1. Introduction. The investigative plan of the CDT was to confirm or deny the existence of any pilot error, aircraft anomaly, or compounding circumstances that may have caused or contributed to the sonic boom incident, while identifying any contributing systemic or procedural problems along the way.

D1.1. In the process of conducting this investigation, the IO discovered one primary finding that was directly related to the 13 April 2012 mishap.

D1.1.1. Pilot Error: The pilot became task saturated during the rejoin with [b] and failed to adequately crosscheck airspeed/Mach number and reduce power.

D2. Pilot Error.

D2.1. Finding. On 13 April 2012, [b] pilot became task saturated during the rejoin with [b] and failed to adequately crosscheck airspeed/Mach number and reduce power accordingly.

D2.2. Facts. On 13 April, the Thunderbirds were practicing at Davis Monthan AFB for the airshow on the approaching weekend. (Tab F-5) [b] was performing as [b] opposing solo. (Tab F-3) 31 minutes into the practice, at 21:22:18Z, [b] executes a High Bomb Burst Hit, which consists of a low pass across the airfield followed by a climb into the vertical, passing through the smoke of the four ship diamond bomb burst, then performing a series of aileron rolls up to approximately 14,000' AGL. (Tab F-5) At the top of the maneuver (21:22:43Z), [b] terminates the aileron rolls with his lift vector inadvertently away from the aileron roll shows line and pulls the nose back down to the horizon, with approximately 250 knots indicated airspeed (KIAS). (Tab F-5, Tab G-1) His follow-on maneuver is to rejoin with [b] who is currently arcing northeast behind the aileron roll show line, for the Reflection Pass. (Tab F-5) Because [b] is now pointed away from [b], he executes a slight nose low left hand turn in mil power. (Tab F-3) Due to a challenging look-down visual environment and [b] not being in the Link 16 network, [b] is unable to gain the visual and at 21:23:24Z, he directs [b] to turn on smoke to help gain the visual. (Tab F-3, Tab F-5, Tab G-1) At this time, [b] is at 377 KIAS and has descended slightly to 13,400' AGL. (Tab F-3, Tab G-1) [b] turns on smoke, and three seconds later, [b] calls “visual” on [b]. (Tab F-5, Tab G-1) [b] perceives he is in a tail chase on [b] due to the delay getting his aircraft turned around, and executes a 110 degree left slice at 3G, trailing off to 1.8G, to pull lead pursuit on [b]. (Tab F-1) This drops the nose of the aircraft to 28 degrees nose low, and within 10 seconds of calling visual, his jet has accelerated from 377 KIAS to 510 KIAS (.94Mach). (Tab F-5) [b] estimates that his power is still up at or near military power. (Tab F-5) At 21:23:43Z, his nose has gradually climbed back up to 23 degrees nose low and the aircraft has accelerated to Mach 1.0, 577 KIAS. (Tab G-1) The aircraft continues to accelerate to 1.02 Mach and 609 KIAS, until [b] recognizes his excess airspeed at 21:23:52Z, and reduces power, decelerating below Mach 1.0. (Tab F-3, Tab G-1) There is an audible “oh crap” in [b] intercom at the time he recognizes his mistake. (Tab G-1) When the aircraft decelerates below Mach 1.0, it is at 3600' AGL, 10 degrees nose low and heading 300 degrees, four miles north of Davis-Monthan AFB. (Tab G-1)

D2.3. Applicable Rules

D2.3.1. ACCI-11 USAFADSv3. ACCI-11 USAFADSv3 is the operational procedures for the Thunderbirds. It states in paragraph 6.9 that “The maximum speed during any aerial demonstration is .94M. Under certain conditions, parts of the F-16 begin to exceed 1.0M when the aircraft Mach indicator reads .95M.”
D2.3.2. AF11-202V3. AF11-202v3, para. 1.1.1. states that “the Pilot in Command (PIC) is responsible for, and is the final authority as to, the operation of the aircraft.” The AFI further states in para 1.2 and 1.2.1 that “The PIC will ensure compliance with this AFI and the following: MAJCOM guidance and MDS-specific instructions, manuals and supplements.”

D2.4. Analysis. Analysis of the facts and evidence indicate that there were several contributing factors which made the rejoin difficult. However, (b)(6) failed to maintain an adequate crosscheck during the rejoin.

D2.4. (b)(6) became task saturated during the rejoin with (b) and did not adequately crosscheck his airspeed/Mach number. He began the sliceback maneuver at .75M, and held the nose at or below 20 degrees nose low for 18 seconds with the throttle at or near military power. Due to the acceleration rates of a clean F-16, high power settings combined with nose low attitudes in excess of 10 degrees require frequent crosschecking of airspeed/Mach number to remain subsonic.

D2.5. Contributing Factors (CF)

D2.5.1. CF1: A break in habit patterns: Typically, will roll out from the Bomb Burst Hit in the direction of the aft show line. This puts in lead and well above The typical ensuing rejoin is nose low and moderately loaded with G forces, which helps scrub off or maintain speed. In addition, the steep rejoin cues the pilot to reduce his power setting. In this instance, rolled out away from the aft show line following the Bomb Burst Hit, requiring a 180 degree mil power turn. This put further out in front of resulting, in a slightly shallower and relatively unloaded pursuit curve. In addition, perceived that he was in a tail chase relative to . The shallower pursuit curve and tail chase picture did not produce cues to alert to reduce the power.

D2.5.2. CF2: Challenging visual conditions. While there were no significant obscurations to visibility, Tucson is a congested, urban area, which makes finding another aircraft in a look-down environment challenging due to the lack of consistent contrast between the aircraft and the surface. This complicated attaining the visual on Often, when trying to maintain sight of the lead aircraft in challenging visual environments, wingmen will padlock onto the lead aircraft until at a closer range when regaining the visual is assured which may prevent frequent crosschecking of flight parameters.

D2.5.3. CF3: Scripted profile leads to a reduced focus on contingencies. The Thunderbirds' show is highly scripted. The aircrew repetitively practice the show profile until it becomes second nature. Since the show is so scripted, less time is spent focusing on contingencies, so they may not be at the forefront of the aircrew's consideration. Aircrew may not key in on potential issues when minor deviations from the norm occur, such as a flatter, tail-chase pursuit curve during the rejoin. According to #6's testimony, that rejoin doesn't usually result in a high Mach condition, so he didn't think to crosscheck his airspeed.

D2.5.1. CF4: Pressure to maintain show timing. The Thunderbird show relies heavily on exact timing of all players to ensure proper sequencing of the diamond and solo.
maneuvers, and to ensure there is near constant presence at show center. Although [b](6) stated that he did not feel particularly pressured to expedite the rejoin, the delay caused by the roll out in the wrong direction compressed the timeline for the rejoin. In the IO's opinion, this pressure to stay on timeline may have caused [b] to subconsciously keep the power up to expedite the rejoin.

D2.6. Conclusion

D2.6.1. Several contributing factors combined to make the rejoin challenging, causing [b](6) to become task saturated and fail to crosscheck his airspeed/Mach number.
TESTIMONY

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F.1. Witness Testimony

STATEMENT OF SUSPECT/WITNESS/COMPLAINANT

PRIVACY ACT STATEMENT

PRINCIPAL PURPOSES: Used to record information and details of criminal activity which may require investigative action by commanders, supervisors, security police, MOSS special agents, etc., and to provide information to apprehend individuals within DoD organizations and ensure proper legal and administrative action is taken.
ROUTINE USES: Information may be disclosed to local, county, state and federal law enforcement agencies for investigation and possible criminal prosecution or civil court action. Information extracted from this form may be used in other related criminal and/or civil proceedings.
DISCLOSURE IS VOLUNTARY. SDV is used to positively identify the individual making the statement.

I. STATEMENT INFORMATION

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<th>DATE</th>
<th>LOCATION AND INSTALLATION</th>
<th>UNIT TAKING STATEMENT</th>
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<td>20120508</td>
<td>Nellis AFB, NV</td>
<td>CD/JO</td>
</tr>
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</table>

II. PERSONAL IDENTIFICATION (Print or Type)

<table>
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<tr>
<th>LOCAL ADDRESS</th>
<th>ZIP CODE</th>
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<tbody>
<tr>
<td>4445 Lynndale Ave, Nellis AFB, NV</td>
<td>89158</td>
</tr>
</tbody>
</table>

III. ACKNOWLEDGEMENT OF OFFENSES AND 5TH AMENDMENT/ARTICLE 31 RIGHTS ADVISEMENT (Suspect Only)

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PRIVACY ACT STATEMENT

PRINCIPAL PURPOSES: Used to record information and details of criminal activity which may require investigative action by commanders, supervisors, security police, MOSS special agents, etc., and to provide information to apprehend individuals within DoD organizations and ensure proper legal and administrative action is taken.
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DISCLOSURE IS VOLUNTARY. SDV is used to positively identify the individual making the statement.
## F.1. Witness Testimony

| Q1 | Was there anything notable for the site survey on Thursday, or the mission planning for Friday's mission? | A1 | No. |
| Q2 | Describe the sequence of events leading up to the sonic boom incident over Tucson on 13 April, 2012. | A2 | The maneuver was a 30-degree turn at Mach 1.02. During practice and the first six shows, it was not unusual to exceed Mach 1.0-1.03. However, on this particular day, the aircraft encountered an anomaly that resulted in a much flatter rejoin angle than normal (approximately 30 degrees nose low vs 60 degrees) and a relatively unloaded profile. I pulled lead to make the rejoin happen in time. My power setting was probably still in mill power during rejoin. There was no concern about making rejoin happen fast; we had plenty of time. I was late to retard the power during the rejoin. I looked at my airspeed in the HUD and was surprised to see 600 knots and 1.02 Mach. Going supersonic has never crossed my mind. It is not usually an issue during my profile. |
| Q3 | Did you inform of the suspected sonic boom? | A3 | I notified the chain of command and the on-scene leader of the potential threat. |
| Q4 | Who did you inform of the suspected sonic boom? | A4 | I notified the on-scene leader of the potential threat. |
| Q5 | What was the aircraft tail number and did you write up any codes for engine or throttle anomalies? | A5 | Aircraft 92-0048, no anomalies. |
| Q6 | How was the weather in the vicinity of the airfield? | A6 | High density altitude (around 30000 ft), clear, look down against the urban background was difficult. |
| Q7 | Did the Thunderbird Solo spinup/qualification program adequately prepare you to execute your profiles during the shows? | A7 | Absolutely. |
| Q8 | Was anything notable regarding the site survey on Thursday, or the mission planning for Friday's mission? | A8 | No. We did the site survey upon arrival at the airfield. I went to the gym that afternoon, and we went out to dinner that night. |
| Q9 | Any alcohol consumption that night? | A9 | Maybe one drink; plenty of sleep that night. |
| Q10 | Anything notable regarding health, wellness, or mental state around the time of the incident? | A10 | No. |
| Q11 | During practice and the first six shows, how often was 940K exceeded? | A11 | Rarely, if ever. |
| Q12 | During practice and the first six shows, how often was 940K exceeded? | A12 | Yes. |
| Q13 | Did you get the Link 16 network? | A13 | No. |
| Q14 | How do you think the maneuver and rejoin typically go? | A14 | I will recover in mill power toward the aft show line, get the nose to the horizon, and keep it in mill power until about 500 KIAS. Then I'll execute an aggressive sliceback with the power up. Also, excessive Mach & airspeed had never been an issue or cause of concern, so I was late to look at it. |
| Q15 | Why do you think you were unable to set the sun reference relative to the aft show line prior to pulling up for the bomb burst hit? | A15 | Something else caught my attention, possibly timing. It was a challenging day due to the winds. However, it is not critical to have a sun reference. For example, when we execute the show under an overcast, I don't have a sun reference. |
| Q16 | Do you have anything else you'd like to add? | A16 | At first, I did, but not anymore. I'm used to it. |
| Q17 | Do you have anything else you'd like to add? | A17 | No. |

### V. OATH/Signature

I hereby voluntarily and of my own free will make this statement without having been subjected to any coercion, unlawful influence, or unlawful procurement. I swear or affirm I have read this statement, written all pages and corrections, and it is true and correct to the best of my knowledge.

(signature)

Subscribed and sworn to before me, a person authorized by law to administer oaths, this [date of signature] day of [month] [year].

[Signature]

This statement was witnessed by [name of witness], who signed below.

[Signature]

Date: [date of witness interview]

[Signature]

V. Instructions for continuation pages

The blank bond paper (with laser option) at the top right of each page, print or type "Last name of individual making the statement," [date of statement], [name of individual], and "Page of [number of pages]." The individual must initial the top and bottom lines and sign their name at the bottom of each page.
F.2. Witness Testimony

STATEMENT OF SUSPECT/WITNESS/COMPLAINANT

SUSPECT

STATEMENT OF SUSPECT/WITNESS/COMPLAINANT

PRIVACY ACT STATEMENT

AUTHORITY: 10 U.S.C. 8013; 44 U.S.C. 3101; and EO 8337

PRINCIPAL PURPOSES: Used to record information and details of criminal activity which may require investigative action by commanders, supervisors, security police, AFOSI special agents, etc., and to provide information to appropriate individuals within DoD organizations who ensure proper legal and administrative action is taken.

ROUTINE USES: Information may be disclosed to local, county, state, and federal law enforcement/investigative authorities for investigation and possible criminal prosecution or civil court action. Information extracted from this form may be used in other related criminal and/or civil proceedings.

DISCLOSURE IS VOLUNTARY. SSN is used to positively identify the individual making the statement.

I, STATEMENT INFORMATION

DATE (YYYY/MM/DD) 20120508

TIME 0740

LOCATION AND INSTALLATION (Bldg/Room No) 1Bldg 98/CC office

UNIT TAKING STATEMENT CD/10

REPEAT (if known) ...

OFFENSE ...

COMPLAINANT ...

II. PERSONAL IDENTIFICATION (Print or Type)

NAME (Last, First, Middle Initial)

SSN ...

STATUS GRADE ...

LOCAL ADDRESS (Include Zip Code)

Nellis AFB, NV 89191

DATE AND PLACE OF BIRTH (if required) ...

TELEPHONE ...

ADDRESS OR HOME OF RECORD (Include Zip Code) ...

MILITARY ORGANIZATION/EMPLOYER ...

PERMANENT ADDRESS OR HOME OF RECORD (Include Zip Code) ...

USAFADS ...

SPONSOR IN OR AT ...

NAME ...

GRAD ...

ORGANIZATION ...

DUTY PHONE ...

TUTS ...

N/A ...

III. ACKNOWLEDGEMENT OF OFFENSES AND 6TH AMENDMENT/ARTICLE 31 RIGHTS ADVISEMENT (Suspect Only)

I have been advised that I am suspected of the following offenses:

ADVOSED BY ...

INDIVIDUAL IDENTIFIED HIMSELF-HERSelf AS A ...

SUSPECT ...

AND ADVISED ME THAT I HAVE THE FOLLOWING RIGHTS ACCORDING TO THE 6TH AMENDMENT OF THE U.S. CONSTITUTION/ARTICLE 31 OF THE UNIFORM CODE OF MILITARY JUSTICE.

I have the right to remain silent - that is, to say nothing at all.

Any statement I make, oral or written, may be used as evidence against me in a trial, or in other judicial, non-judicial, or administrative procedures.

I have the right to consult with a lawyer.

I have the right to have a lawyer present during this interview.

I may obtain a civilian lawyer of my own choice at no expense to the government.

I may request a lawyer any time during this interview.

If I decide to answer questions with or without a lawyer present, I may stop the questioning at any time.

MILITARY ONLY: If I want a military lawyer, one will be appointed for me free of charge.

CIVILIANS ONLY: If I cannot afford a lawyer and want one, one will be appointed for me by civilian authorities.

I have read my rights as listed above and I understand my rights. No promises, threats, or inducements of any kind have been made to me. No pressure or coercion has been used against me.

I make the following choice (Unmarked option will be deemed to have been given):

I do not want a lawyer. I will not answer any questions or make a statement of any kind under investigation.

I have read my rights and that my signature does not constitute an admission of guilt.

SUSPECT INITIALS ...

SUSPECT ...

I fully understand my rights and that my signature does not constitute an admission of guilt.

SUSPECT INITIALS ...

SIGNATURE OF SUSPECT ...

SIGNATURE OF WITNESS/INTERVIEWER ...

PREVIOUS EDITIONS ARE OBSOLETE.
F.2. Witness Testimony (b)(6)

SUMMARIZED TESTIMONY:
Q1) Describe the sequence of events leading up to the sonic boom incident on 13 April, 2012. A1) We conducted our site survey of Davis Monthan (DM) AFB on Thursday, 12 April when we arrived at the airfield. Our practice mission was on Friday, 13 April. Nothing notable for mission planning or ground operations.

Q2) Describe the incident. A2) During the last 5 minutes of the show, the diamond executed a high bomb burst, executed a "high bomb burst hit", which involves flying up the middle of the bomb burst after a delay, through the smoke, while executing continuous aileron rolls, up to 15,000' above ground level (AGL). After the maneuver, 46 is to rejoin 49. [b](b)46 executed a level 180 turn in mill power at approximately 250 knots while looking for 49 who is down around 1000' AGL. During the turn, the bingo fuel bug asserts, requiring a brief heads down time to reset it. 45 is not in the Link 16 network and is slightly behind the agh show line delaying the visual for 46. Also, the visibility was slightly reduced due to smog in the vicinity of the airfield at lower altitudes. I tasks for 46 to turn on smoke to facilitate the visual. I then picks up the visual on 46 and begins a 20-25 degrees nose low rejoin. I estimate that his power is still up near mil. He exceeds the Mach for approx 8 seconds, recognizes it and pulls the power back.

Q3) Anything notable during landing or the remainder of the mission? A3) No.

Q4) When were you notified of the incident? A4) Once on the ground, during debrief.

Q5) What was the aircraft tail number & if so, was anyone operating the aircraft? A5) Aircraft 92-908; no.

Q6) What was the weather like around the airfield at lower altitude? A6) Some smog at lower altitudes, with visibility slightly less than 10NM.

Q7) Describe the performance through the F-16 RTU transition, and the Thunderbird Solo upgrade program. A7) I attended the F-16 Replacement Training Unit (RTU) with 46. His performance during the first six shows of the 85 ride Thunderbird Solo checkout program was also above average. (b)(6) Performance during the first six shows of the mission were well above average.

Q8) Describe the flow often is .94M exceeded during practice/shows? A8) Approximate once every couple of shows.

Q9) Were there any trends in deviations above .94M? A9) We discuss how timing could be tighter. Timing deviations can result in other formation members having to push it up or slow down to compensate.

Q10) Why do you think the deviation occurred? A10) Timing was stretched due to rolling out away from for 45. When he had trouble gaining the visual, he became task saturated and was not reducing the power. His task prioritization was correct (i.e. deconflicting from 46) but his execution of the power reduction was not timely enough.

Q11) In your opinion, did any of (b) actions negatively impact performance during the rejoin? A11) No.

Q12) Is there anything else you would like to add? A12) I have complete confidence in 46's health, wellness, or mental state around the time of the incident.

V. OATH/SIGNATURE

"I hereby voluntarily and of my own free will make this statement without having been subjected to any coercion, unlawful influence, or unlawful inducement. I swear (or affirm) I have read this statement, initialed all pages and corrections, and it is true and correct to the best of my knowledge.

[Signature of Person Making Statement]

[Signature of Witness/Interviewer]

Subscribed and sworn to before me, a person authorized by law to administer oaths, this 10th day of May, 2012, (year).

[Signature of Person Administering Oath]

VI. INSTRUCTIONS FOR CONTINUATION PAGE(S)

Use plain bond paper (both sides optional) at the top right of each page, print or type "[Last name of individual making the Statement] on (Date)." At the bottom of each page, print or type "Page ___ of ___ Pages." The individual must initial the top and bottom entries and sign his/her name at the bottom of each page.
TAB G

EVIDENCE

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G.1. DVD with Thunderbird 6 HUD video from 13 April 2012
G.2. Weather printout from DM for 13 April 2012

Data from 2012/04/13

METAR KDMA 132355Z AUTO 22013G20KT 10SM CLR 25/M14 A2976 RMK AO2 SLP053 T02451137 19245 20207
56019 $=
METAR KDMA 132255Z AUTO 32007G16KT 10SM CLR 24/M14 A2978 RMK AO2 SLP059 T02401137 $=
METAR KDMA 132155Z AUTO 31011G20KT 10SM CLR 24/M12 A2980 RMK AO2 SLP062 T02391121 $="
TECHNICAL REVIEWS

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H.1.3. Tort Claims Spreadsheet ............................................................................................ H-5
H.1.1. Sonic Boom Plot. This plot is informational and shows the sonic boom footprint as estimated by NASA.
H.1.2. Letter from NASA engineer. This letter is informational and describes the projected overpressure based on the Mach number.

Here are the interim solutions for the Thunderbird sonic boom impact area for 04/13/2012 over Tucson based on the data that I have to date. These were generated using PCBoom6.6.6a.

- Assumptions

No balloon data was available during the flight time. NASA Dryden's meteorologist Ed Teets worked on getting weather data for this analysis. NASA Goddard atmospheric assimilation model data using satellite retrieved profiles and reanalyzed model initialization was used. The temperatures you provided were deemed too warm at high altitudes. I used the weather information in file TAZ21Z.att. This file contains altitudes in thousands of feet, along with temperatures in degrees Fahrenheit, wind speed to the east (called WINDX), and wind speed to the north (called WINDY). The second line of the file is the pressure in psf at 2464 ft MSL altitude.

The initial information of a constant dive angle of 30 degrees was not supported by the HUD video. The reduction in dive angle results in lower computed pressures on the ground and a larger footprint region.

I looked at the HUD video frame by frame. When the digital time changed to a new second I recorded time, KCAS, Mach, altitude, radar altitude, heading, and pitch angle. I also noted the location of the velocity vector on the ground image, and used GoogleEarth to find that latitude/longitude/elevation by matching the ground imagery. Starting at that ground altitude and going up at the negative of the pitch angle and the reciprocal of the aircraft heading until reaching the radar altitude shown by the HUD video gave the aircraft position. The locus of these points were close to the given ground track, and also gave a reasonable arcing trajectory as shown in the HUD video. Once I had a starting location, I used the true airspeed, heading, and flight path angle to project forward to the next second where a new speed, heading, and flight path angle were used.

Pneumatic airdata systems typically have accuracy problems near Mach 1 and also with pneumatic lag. Looking at the HUD video altitude (which is assumed to be mostly derived from airdata) and the radar altitude plus ground elevation gives nearly the same altitude at the beginning and end of the video, but has excursions of up to 900 ft difference during the supersonic portion and also during the rapid decrease in speed after the pilot realized he was too fast. A plot is attached. A static pressure error giving 900 ft of altitude error is equivalent to about 0.03 Mach error at these flight conditions. Therefore I performed four cases:

TH4 - using the Mach number as given in the HUD video as the truth.
TH5 - TH4 with the Mach number increased by 0.01, nothing else in the trajectory was modified.
TH6 - TH4 with the Mach number increased by 0.02, nothing else in the trajectory was modified.
TH7 - TH4 with the Mach number increased by 0.03, nothing else in the trajectory was modified.

If a more refined airdata calibration was available a more accurate sonic boom footprint could be generated, but these four cases should bound the possible sonic boom impact areas.

The output is given in the attached .km1 files which you should be able to view in GoogleEarth. The aircraft trajectory and ground track are shown, as well as the sonic boom footprint isopemps (hyperbolic or elliptic gray lines that are the locus of booms that originate at the same time on the aircraft), and colored pressure contours of various overpressures.

Normally well installed new window glass should not break until an overpressure of about 25 psf is experienced. Older glass that may be subject to stresses from the settling structure with building age may break at lower pressures. Windows that are near the ground experience a doubling effect of the boom. Windows near where two walls meet at an inside corner and the ground will experience four times the effect of the boom. The overpressures given are for flat open ground without the times two or four effects of walls. I did not take into account terrain for the boom footprint calculation as the ground was relatively flat and I didn't have the DTED data for this region handy.
For the various cases we have the following:

Case Max. Overpressure Calculated, psf
TH4 22
TH5 27
TH6 35
TH7 120

With increasing the aircraft Mach number the footprint becomes wider and starts further to the southeast. In all the footprints the highest overpressures occur on the leading edge of the footprint. If you were to run PCBoom with these cases you could interrogate specific locations for the time and overpressure time history of the booms.

I don't yet have the coordinates for the damage, but it appears from the plots given in Claims.PPTX the furthest north and west claims are well outside the probable sonic boom footprint area. Most of the others quite possibly experienced loud booms. The orientation of the window relative to the raypath of the shockwave, as well as its proximity to other reflecting surfaces can influence the susceptibility to boom damage.

I hope this information is useful to you. It was a interesting computational challenge on our part reconstructing the data without the full instrumentation suite we typically have for research flights. We are continuing researching sonic boom effects and also ways of reducing sonic booms to allow future civilian supersonic transportation that is acceptable to the public.

One item that may be of interest to your group is our work towards a sonic boom cockpit display. We hope to generate images much like these GoogleEarth plots and generate them realtime in the cockpit for the pilot. This will be an integral component of any civilian supersonic aircraft.

If the information is available, we could make good use of data such as locations of damage, the direction the window is facing, the size of the building, if the glass shards blew in or out of the building, etc. We have an active group investigating the effects of sonic booms on buildings, both homes and businesses.

Sincerely,

(b)(6)
H.1.3. Tort Claims Spreadsheet. Current Tort Claims provided by USAFWC/JA.

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TAB I

LEGAL REVIEW

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Legal Review.
MEMORANDUM FOR USAFWC/CC

FROM: USAFWC/JA

SUBJECT: Commander-Directed Investigation (CDI) of Thunderbirds Sonic Boom

(b)(5)
APPOINTING AUTHORITY APPROVAL AND ACTIONS

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J1. Appointing Authority Decision MFR
MEMORANDUM FOR RECORD

FROM: USAFWC/CC

SUBJECT: Commander-Directed Investigation (CDI) of 26 April 2012 Thunderbirds Sonic Boom

1. I have reviewed the CDI prepared by investigating officer (b)(6) (IO) and the legal review prepared by USAFWC/JA regarding the Thunderbirds Sonic Boom over Tucson, Arizona. I concur with the findings of the IO. The IO sufficiently demonstrated that the sonic boom was the direct result of (b)(6) pilot error as well as multiple factors (i.e., non-typical placement, urban backdrop, and highly-scripted routine) which contributed to this error.

2. Because the IO’s findings are substantiated, I approve of the CDI’s conclusions and recommendations.

JAMES W. HYATT
Major General, USAF
Commander
TAB K

ADMINISTRATIVE DOCUMENTS

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K-1. CDI Witness List. Two individuals were interviewed during this CDI. The subject, (b)(6), and the Commander and flight lead of the Thunderbird Team, (b)(6), (b)(6), (b)(6), (b)(6), (b)(6), (b)(6), (b)(6).
K2. Privacy Act Statements

FOR OFFICIAL USE ONLY

K-3
K2.1. Privacy Act Statement — (b)(6)

Attachment
PRIVACY ACT NOTICE

PRIVACY ACT STATEMENT

Policy
The Privacy Act statement is required to be read and acknowledged by each witness at the beginning of the interview process.

Authority
The ID is required to have each witness read this statement and document it in their Report of Investigation.

Principal purpose
Title 10, United States Code, Sections 8013, 8020, and Executive Order 9397. Information in the form of an inquiry or investigation to aid in determining facts and circumstances surrounding the allegations. The information is assembled in report format and presented to the Appointing authority as a basis for DoD or Air Force decision-making.

Routine uses
Routine uses include:

- Forwarded to federal, state, or military and local law enforcement agencies for law enforcement purposes.
- Used as a basis for summaries, briefings, or responses to members of Congress or other agencies in the Executive Branch of the Federal Government.
- Provided to Congress or other federal and state agencies when determined to be necessary.

Disclosure or non-disclosure
FOR MILITARY PERSONNEL: Disclosing your Social Security number is voluntary. Disclosing other personal information relating to your position responsibilities is mandatory and failure to do so may subject you to disciplinary action.

FOR DEPARTMENT OF THE AIR FORCE CIVILIANS: The Social Security number is voluntary. Disclosing other personal information in relation to your position responsibilities may subject you to adverse personnel action.

FOR ALL OTHER PERSONNEL: Disclosing your Social Security number and other personal information is voluntary. No adverse action can be taken against you for refusing to provide information about yourself.

(b)(6)

SIGNATURE

37
### PRIVACY ACT NOTICE

**Policy**
The Privacy Act statement is required to be read and acknowledged by each witness at the beginning of the interview process. The K3 is required to have each witness read this statement and document it in their Report of Investigation.

**Authority**
Title 10, United States Code, Sections 8013 and 8020, and Executive Order 9397.

**Principal purpose**
Information is collected during an inquiry or investigation to aid in determining facts and circumstances surrounding the allegations. The information is assembled in report format and presented to the Appointing authority as a basis for DoD or Air Force decision-making. The information may be used as evidence in judicial or administrative proceedings or for other official purposes within the DoD. Disclosure of Social Security number, if requested, is used to further identify the individual providing the testimony.

**Routine uses**
Routine uses include:
- Forwarded to federal, state, or military and local law enforcement agencies for law enforcement purposes.
- Used as a basis for summaries, briefings, or responses to members of Congress or other agencies in the Executive Branch of the Federal Government.
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**Disclosure or non-disclosure**

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**FOR ALL OTHER PERSONNEL:** Disclosing your Social Security number and other personal information is voluntary. No adverse action can be taken against you for refusing to provide information about yourself.

**Signature**

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K2.1. Privacy Act Statement — (b)(6)

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**FOR OFFICIAL USE ONLY**
M1. Conclusion. On 13 April, the Thunderbirds were practicing at Davis Montan AFB for the airshow on the approaching weekend. (b)(6) was performing as (b)(6) opposing solo. At 21:23:43Z, during a rejoin with (b)(6) his aircraft accelerated above Mach 1 in military power for approximately nine seconds. When the aircraft had decelerated back below Mach 1.0, it was at 3600' AGL, 10 degrees nose low and heading 300 degrees, four miles north of Davis Montan AFB. (Tab G-1) Contributing factors of a break in habits patterns, challenging visual conditions, and a tightly scripted, time compressed profile all contributed to (b)(6) becoming task saturated during the rejoin and failing to crosscheck airspeed and reduce power.