DOCKET NO. **SA-510**
EXHIBIT NO. 13X-P

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C.

Boeing Memo and Letter on B-737 Lateral Stability

November 13, 1995
B-XK01-15420-ASI

Mr. Thomas Haueter, AS-10
National Transportation Safety Board
490 L'Enfant Plaza SW
Washington D.C. 20594

BOEING

Subject: Document Request- USAir 737-300 N513AU Accident Near Pittsburgh - September 8, 1994

Reference: a) Letter B-XK01-15418-ASI, November 10, 1995
b) Letter B-T02R-92-2100, September 14, 1992
c) Letter B-U01B-13419-C/G from John Purvis to John Clark, September 20, 1991

Dear Mr. Haueter:

The information contained in the reference (b) enclosure, *Rudder Induced Sideslip Control Capability,* has been clarified below. As previously discussed in reference (a), Boeing has no objection to release reference (b) to the public if done in conjunction with the contents of this letter excluding enclosure C. For proprietary reasons stated below, we do not authorize the release of enclosure C to the public.

LATERAL CONTROL REQUIREMENTS

The lateral control required to balance full rudder input was determined during steady sideslip testing on the Boeing 737-300 model during certification flight testing. During this testing it was demonstrated, that at low speeds, the lateral control system was not able to counter the rolling moment created by full rudder for flaps 1 and 5. That is, full wheel was required prior to full rudder input.

The summary from the "FLIGHT TEST CERTIFICATION REPORT", D6-37485 (enclosure C), SECTION C1.25.0004, that documented this information reads as follows:

> "Testing was conducted to demonstrate that the static lateral and directional stability characteristics of the Model 737-300 airplane are in compliance with Federal Aviation Regulations Part 25, Paragraphs 25.171 and 25.177.

> The data submitted with this report indicate that the Model 737-300 demonstrated positive static lateral and directional stability throughout the flight envelope, thus verifying compliance with the above regulations."

This report was approved by a representative of the Federal Aviation Administration on 30 November, 1984.

BOEING The recent testing conducted as part of the USAir flight 427 accident investigation has established that the lateral control system of the 737-300 does balance full rudder at the maneuvering speed recommended for flaps 1 operation. This data was flown near the weight and center of gravity of the accident aircraft.

It should be pointed out that most swept wing jet transport aircraft operating in the commercial fleet today have rudder control authority that will overpower the lateral control system as speed is decreased. The amount of rudder available is increased, by design, as airspeed decreases. This is to enable the pilot to control an engine out at takeoff speeds (the slower the speed, the more rudder required to balance the yawing moment due to the thrust asymmetry). As the amount of rudder increases, the amount of lateral control required to balance the rolling moment due to sideslip increases. At some speed, usually well above stall speed, the lateral control system is no longer able to counter the rolling moment generated by the available rudder. Most aircraft, however, do have a speed margin relative to their recommended maneuvering speed.

The speed margin of the 737-300 over it's recommended maneuvering speed is very similar relative to the other twin engine aircraft in the Boeing fleet at their minimum flaps down setting as shown in enclosure B. While data is not available at this time for non-Boeing aircraft in this category, there is no reason to believe other aircraft are much different.

For further information on this subject, please refer to reference (c).

Enclosure C forwarded to the NTSB with this correspondence is for the exclusive purpose of supporting investigative activities, is considered proprietary to The Boeing Company, and is being provided on a confidential basis. **We do not authorize dissemination of this material to the public.**

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If you have any questions, please contact me.

Very truly yours,

BOEING

FLIGHT TEST

John W. Purvis
Director, Air Safety Investigation
Org. B-XK01, Mail Stop 14-HM
Telex 32-9430, STA DIR PURVIS
[redacted]

Enclosures:
A. Letter B-T02R-92-2100, September 14, 1992
B. Boeing Chart, *Fleet Status Relative to Static Balance, Control of Full Rudder using Full Lateral Control,* November 2, 1995
C. Boeing Document D6-37485, FLIGHT TEST CERTIFICATION REPORT, *737-300 Static Lateral and Directional Stability,* December 3, 1984 (Boeing Proprietary)

Enclosure A to: B-XK01-15420-ASI

SEP 1 4 1992

B-T02R-92-2100

Department of Transportation
Federal Aviation Administration
Northwest Mountain Region
Seattle Aircraft Certification Office
Attention: Mr. Donald L. Riggin, Manager, ANM-100S
ANM-130S
1601 Lind Avenue SW
Renton, Washington 98055-4056

Subject: Lateral Control Capability
Model 737

Reference: Telecon K. W. Frey (FAA)/T. G. Heineman on September 4, 1992

Gentlemen:

Per the request of the reference telecon, enclosed please find a summary of the 737 lateral control capability analysis. We trust that this information satisfies your requirements.

The information being forwarded to the FAA by or with this correspondence is for the exclusive purpose of support of applications for or amendments to Type Certificates, is considered proprietary to The Boeing Company, and is being provided on a confidential basis.

Boeing does not authorize the FAA to retain any portion of these materials. They should be returned to Boeing immediately following use by the FAA, including any copies thereof which the FAA may make in the course of its review.

Very truly yours,

RENTON DIVISION

Original signed by

K.K. Usui
Manager, Airworthiness
Orgn B-T02R, Mail Stop 69-10

Enclosure

RUDDER INDUCED SIDESLIP CONTROL CAPABILITY

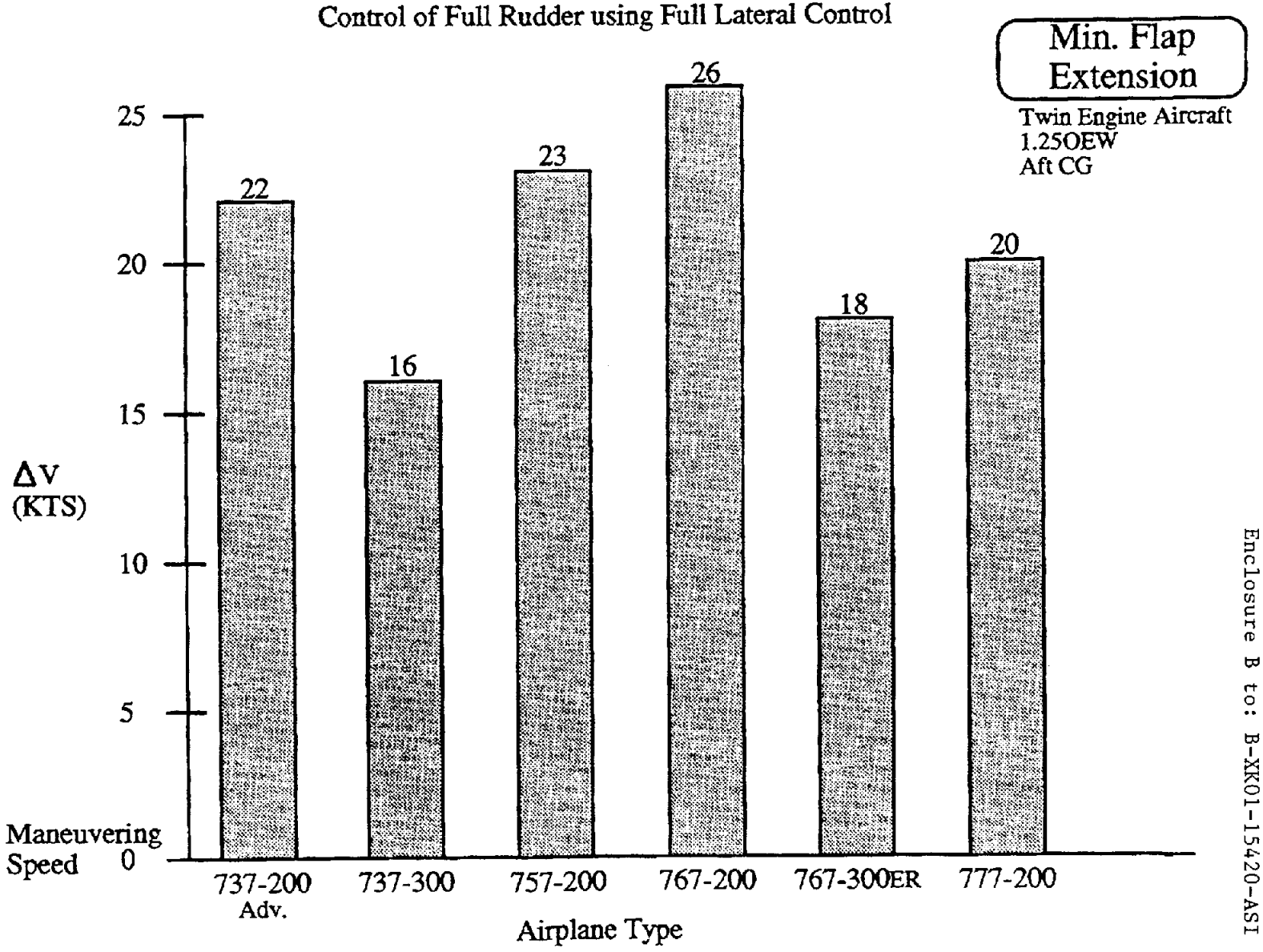
The 737 lateral control system capability exceeds the rolling moment due to a full rudder sideslip for all landing flaps at normal landing speeds (V_{REF} + additives) and for flaps up at all normal operational speeds. As previously discussed with the FAA and NTSB during the investigation of the 737-200 ADV accident at Colorado Springs, the rolling moment produced by a full rudder sideslip exceeds the capability of the lateral control system under the following conditions:

1) Flaps 1 to flaps 10 at the low speed end of their operational envelope.
2) Flaps up and flaps 15 if the aircraft is flown below normal operational speeds.

BOEING

Fleet Status Relative to Static Balance

Control of Full Rudder using Full Lateral Control



Enclosure B to: B-XK01-15420-ASI