NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594

May 29, 2018

MATERIALS LABORATORY FACTUAL REPORT — Report No. 18-042

A. ACCIDENT INFORMATION

Place	:	Dupont, Washington
Date	:	December 18, 2017
Vehicle	:	Amtrak 501, Talgo articulated passenger train
NTSB No.	:	RRD18MR001
Investigator	:	Michael Hiller

B. COMPONENTS EXAMINED

Twelve web slings from Talgo articulated passenger trains

C. DETAILS OF THE EXAMINATION

The purpose of the laboratory testing was to measure the ultimate uniaxial tensile force to fracture the web slings. The web slings were manufactured by Spanset from CS-50 polyester with a rated tension breaking strength of 38,500 lbf. The slings have a design load rating of 5,512 pounds with a safety factor of 7. The slings were obtained from the accident train and an exemplar train from positions around tower supports at the upper side of the rolling assemblies (wheel sets) and from lower positions just above the wheels. In the sling identifications listed in Table 1, the “A”, “E”, “U”, and “L” indicate accident train, exemplar train, upper position, and lower position, respectively. Right and left positions are as viewed looking in the direction of travel at the time of the accident for the accident train, and the same viewing direction was used to denote right and left for the exemplar train.

The tension tests were conducted at Engineering Systems Inc., Omaha, Nebraska, on a Tinius Olsen 400,000 lbf hydraulic universal mechanical test frame. The web sling ends were affixed to the upper and lower crossheads using 2-inch diameter shafts/arbors. The rate of extension was 3.5 inch/minute. A 100 lbf to 200 lbf preload was applied to the sample web slings to straighten them out before recording the deflection between crossheads to web sling failure. Tests were conducted under standard conditions of 70 °F and 50 % relative humidity. The results of the tension tests are summarized in Table 1, and the detailed laboratory results are in Appendix 1.

Michael K. Budinski
Chief, Materials Laboratory Division

Table 1 Summary of web sling maximum tension breaking strengths

Web sling identification	Car number	Car side*	Vertical location	Maximum tension force to break (lbf)	Displacement at break (inch)
AL1	7423	Right	Lower	3,852	3.0
AL2	7554 to 7454	Left	Lower	12,800	3.7
AL3	7554 to 7454	Right	Lower	19,000	4.2
AU1	7102	Left	Tower	17,000	7.5
AU2	7420	Left	Tower	5,800	3.7
AU3	7420	Right	Tower	13,000	6.2
EL1	7302 to 7802	Left	Lower	9,700	3.5
EL2	7802 to 7552	Left	Lower	12,200	4.1
EL3	7802	Right	Lower	13,000	5.2
EU1	7302	Left	Tower	5,700	4.9
EU2	7802	Left	Tower	7,700	6.3
EU3	7802	Right	Tower	4,100	3.4

*Looking toward the direction of travel at the time of the accident for accident cars and a similar viewing direction for exemplar cars

Figure 1 Overall image of the AL1, AL2, and AL3 as-received web slings.

Figure 2 Overall image of the AU1, AU2, and AU3 as-received web slings.

Figure 3 Overall image of the EL1, EL2, and EL3 as-received web slings.

Figure 4 Overall image of the EU1, EU2, and EU3 as-received web slings.

Figure 5 Images after tension testing of web sling AL1 from car 7423, right side. Image (a) is a close view of the fracture region. Image (b) is an overall view of the fractured web sling.

Figure 6 Image of the AL1 web sling on the rolling assembly for car 7423, right side.

Figure 7 Images after tension testing of web sling AL2 from cars 7554 to 7454, left side. Image (a) is a close view of the fracture region. Image (b) is an overall view of the fractured web sling.

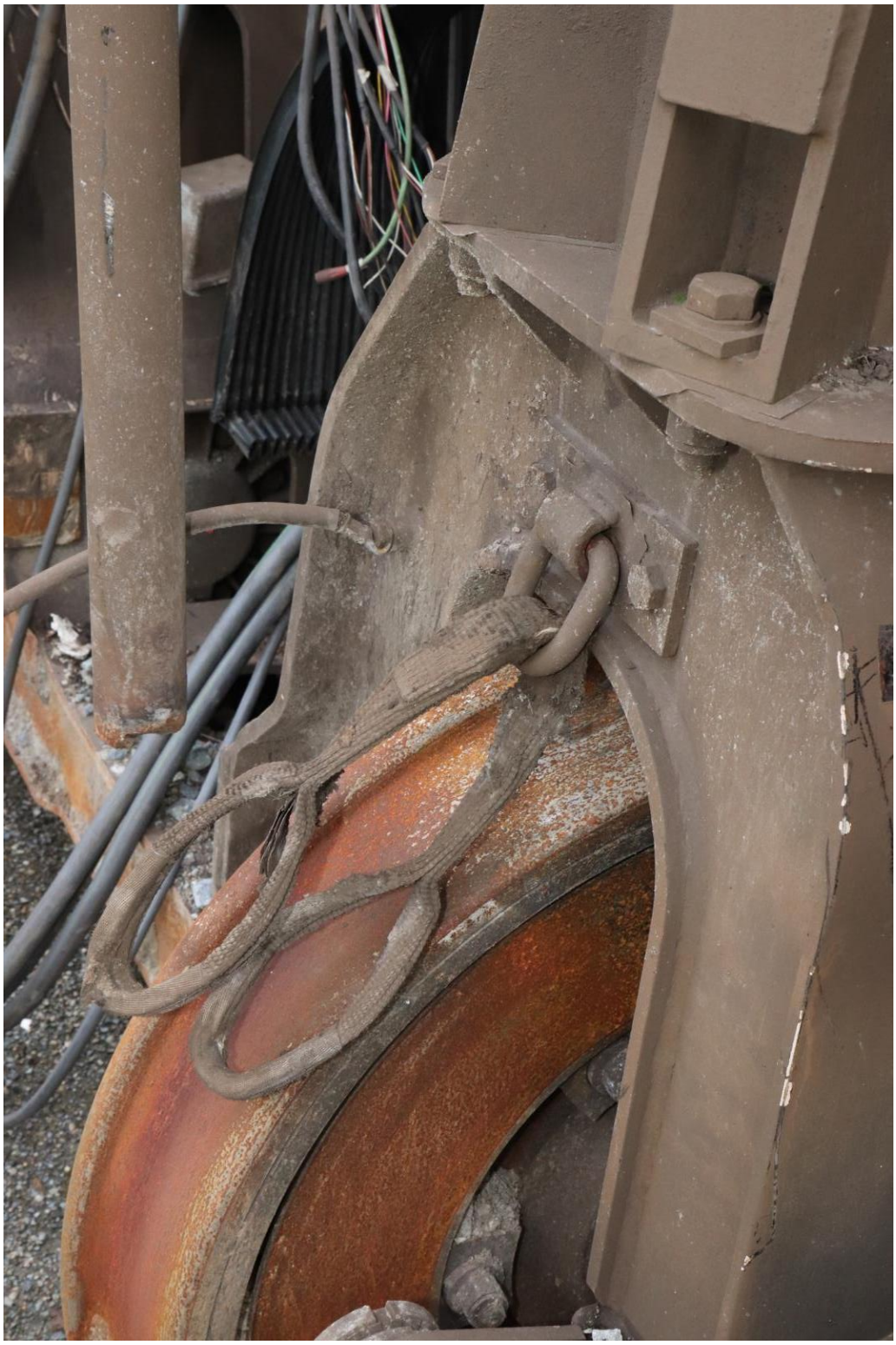

Figure 8 Image of web sling AL2 on the wheel assembly for car 7554, left side.

Figure 9 Images after tension testing of web sling AL3 from cars 7554 to 7454, right side. Image (a) is a close view of the fracture region. Image (b) is an overall view of the fractured web sling.

Figure 10 Image of web sling AL3 on car 7554, right side.

Figure 11 Images after tension testing of web sling AU1 from car 7102, left side. Image (a) is a close view of the fracture region. Image (b) is an overall view of the fractured web sling.

Figure 12 Image of web sling AU1 on car 7102, left side.

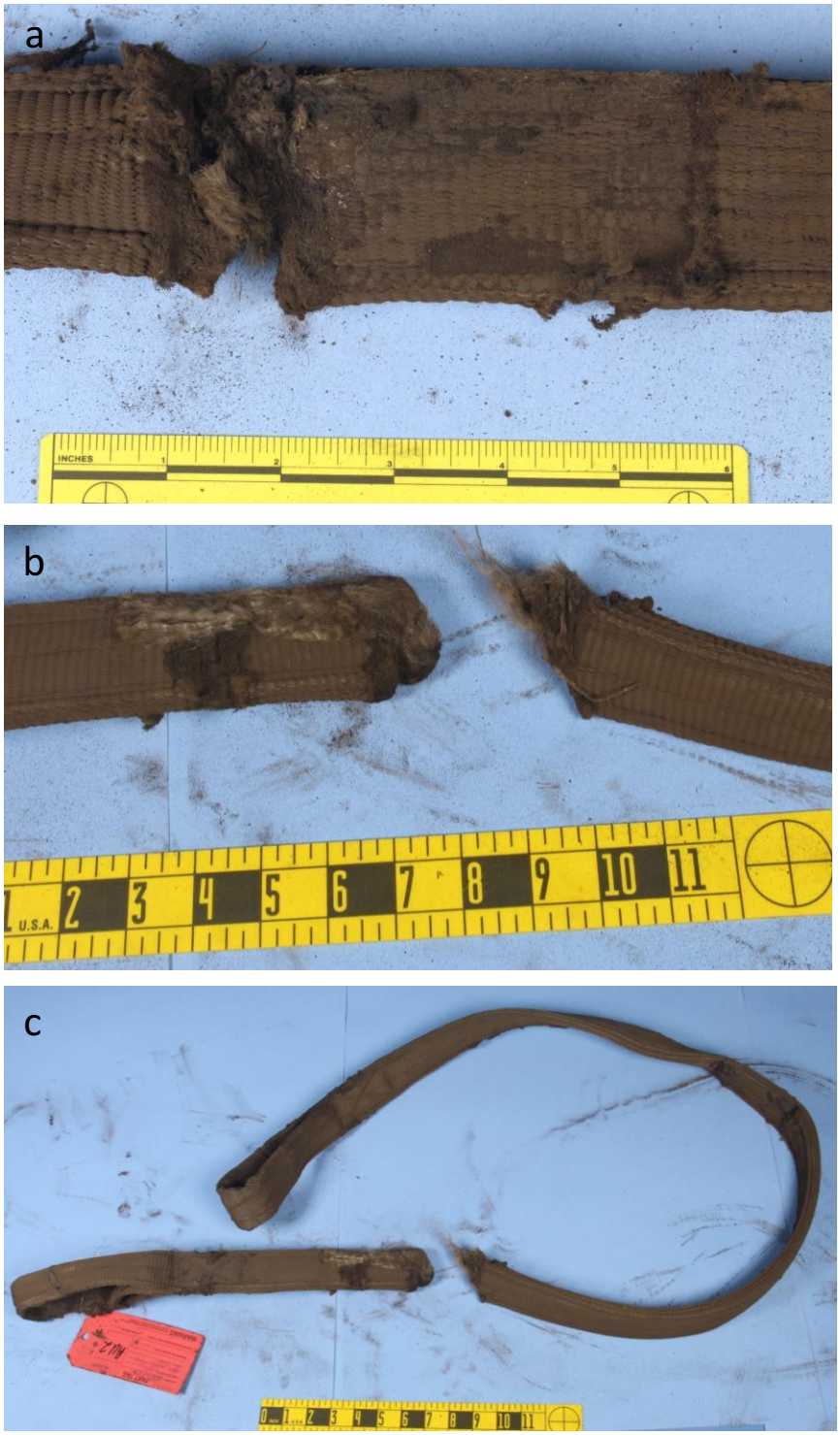

Figure 13 Images before and after tension testing of web sling AU2 from car 7420, left side. Image (a) is a worn area prior to tension testing. Image (b) is a close view of the fracture region. Image (c) is an overall view of the fractured web sling.

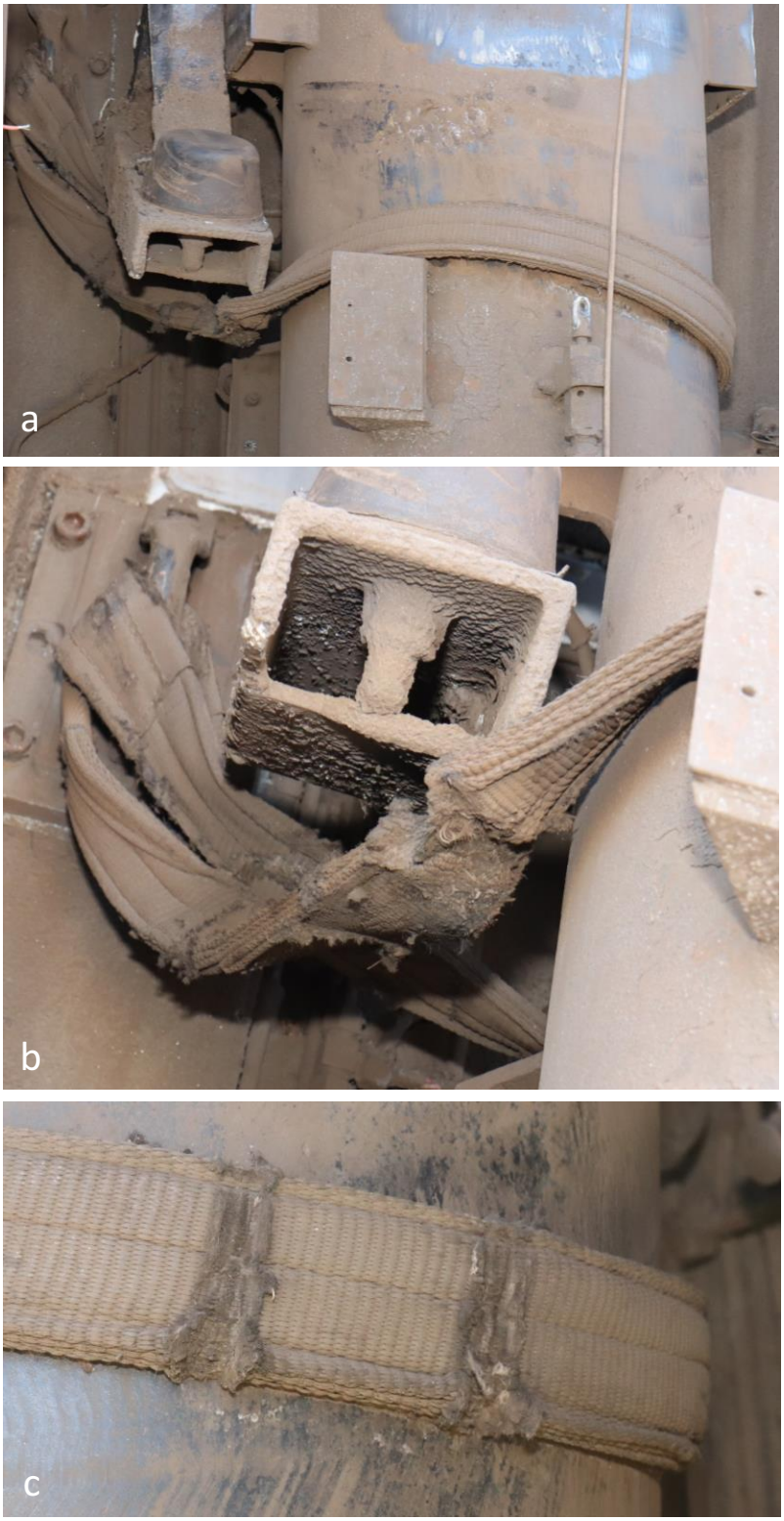

Figure 14 Image of web sling AU2 on car 7420, left side.

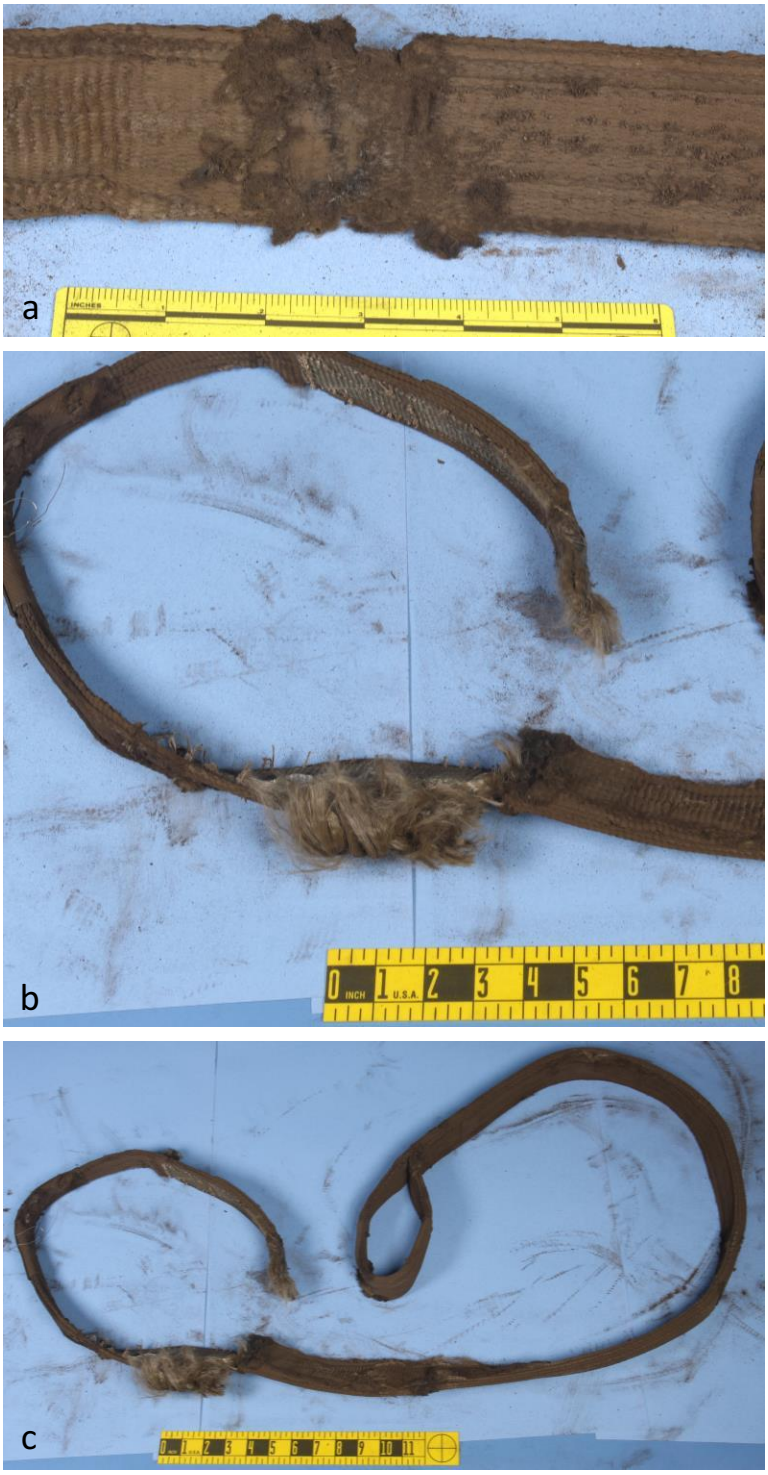

Figure 15 Images before and after tension testing of web sling AU3 from car 7420, right side. Image (a) is a worn area prior to tension testing. Image (b) is a close view of the fracture region. Image (c) is an overall view of the fractured web sling.

Figure 16 Image of web sling AU3 on car 7420, right side.

Figure 17 Image after tension testing of web sling EL1 from car 7302 to 7802, left side.

Figure 18 Images before and after tension testing of web sling EL2 from car 7802 to 7552, left side. Image (a) is a worn area prior to tension testing. Image (b) is a close view of the fracture region. Image (c) is an overall view of the fractured web sling.

Figure 19 Images before and after tension testing of web sling EL3 from car 7802, right side. Image (a) is a worn area prior to tension testing. Image (b) is a close view of the fracture region. Image (c) is an overall view of the fractured web sling.

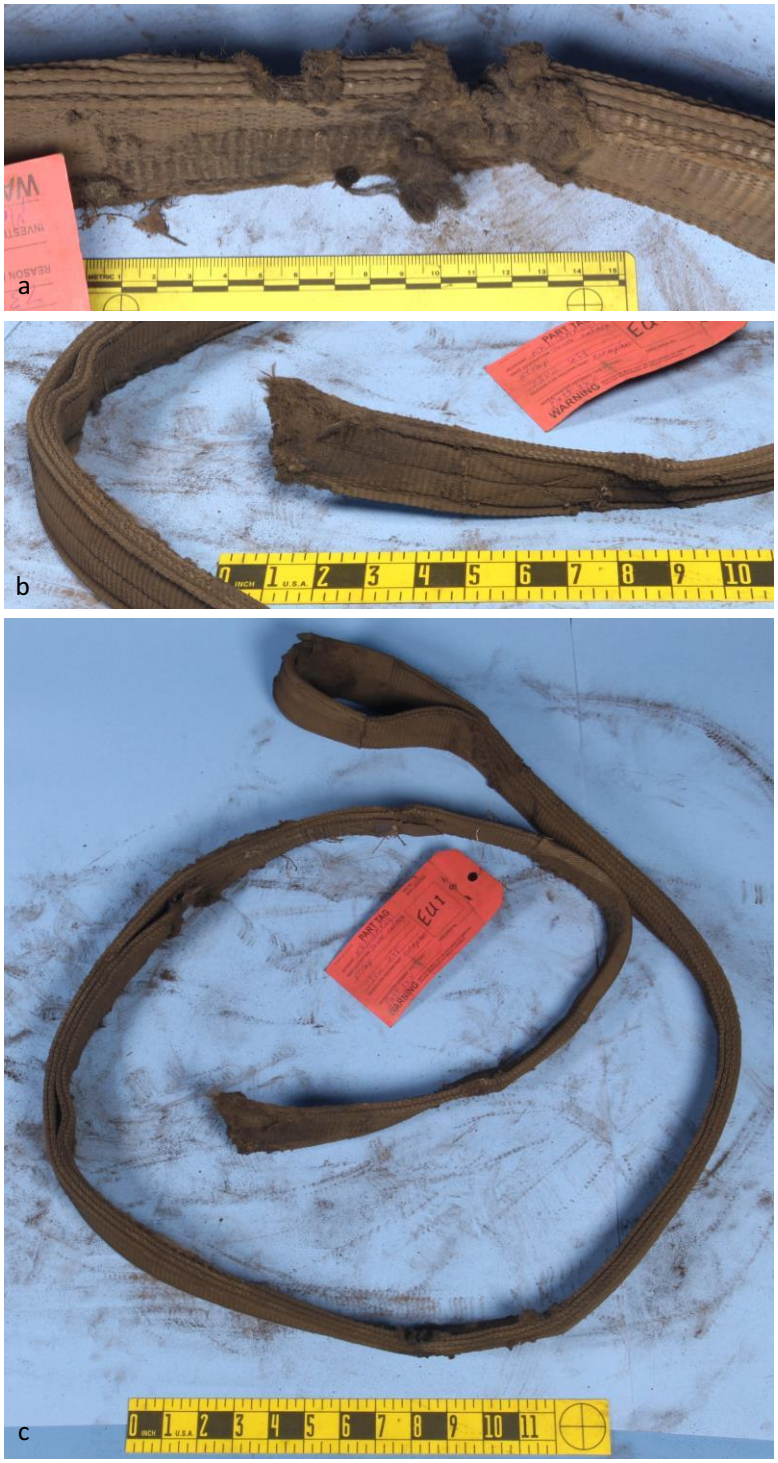

Figure 20 Images before and after tension testing of web sling EU1 from car 7302, left side. Image (a) is a worn area prior to tension testing. Image (b) is a close view of the fracture region. Image (c) is an overall view of the fractured web sling.

Figure 21 Images after tension testing of web sling EU2 from car 7802, left side. Image (a) is a close view of the fracture region. Image (b) is an overall view of the fractured web sling.

Figure 22 Images before and after tension testing of web sling EU3 from car 7802, right side. Image (a) is a worn area prior to tension testing. Image (b) is a close view of the fracture region. Image (c) is an overall view of the fractured web sling.

APPENDIX 1—Report from Engineering Systems Inc.

5697 North 13th Street
Omaha, NE 68110

May 18, 2018

Mr. Michael Budinski
National Transportation Safety Board (NTSB)
Office of Research and Engineering
Materials Laboratory Division
490 L'Enfant Plaza East, SW
Washington, DC 20594
michael.budinski@ntsb.gov

RE: Tension Testing of Lifting Straps
ESI File: 63323N

Dear Mr. Budinski:

As per your request, ESi has performed force-displacement tensile tests on the provided straps. Listed in Table 1 below are the maximum force and displacement for each strap tested. The values were obtained by choosing the average of the results from each of the graphs. In addition, we are providing you with the Excel™ spreadsheet data collected while testing for your use and records.

Table 1. Force Displacement Results for Supplied Straps

Strap	Force, lbs.	Displacement, in.
AL1	3,852	3.0
AL2	12,800	3.7
AL3	19,000	4.2
AU1	17,000	7.5
AU2	5,800	3.7
AU3	13,000	6.2
EL1	9,700	3.5
EL2	12,200	4.1
EL3	13,000	5.2
EU1	5,700	4.9
EU2	7,700	6.3
EU3	4,100	3.4

Phone: 402-881-4860 | Fax: 402-455-0736 | Toll Free: 866-596-3994

www.engsys.com

Test Arrangement

A general overview of the test setup is shown in Figures 1 and 2 below. The pins are 2-inch in diameter, ground AISI 4130 steel. The cross-head was set to traverse at 3.5-inches per minute, while force and displacement were recorded. Force is obtained from a pressure transducer, and displacement is measured using a string potentiometer attached to the cross-head. The 400-kip Tinius Olsen was calibrated 8-25-2017, which is performed annually.

Figure 1. Overall view of testing arrangement for six-foot long strap.

Figure 2. Overall view of short strap arrangement. Note pin located in bottom of cross-head. Identical arrangement on top. Orange strap secures cross-pin.

[redacted]
Hans C. Iwand
Principal & NE Office Manager
[redacted]
ESi