

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594



August 12, 2015

MATERIALS LABORATORY FACTUAL REPORT

Report No. 15-067

A. ACCIDENT INFORMATION

Place : Valhalla, New York
Date : February 3, 2015
Vehicle : Metro-North Train No. 659
NTSB No. : DCA15MR006
Investigator : Dana Sanzo O-RPH

B. COMPONENTS EXAMINED

Emergency window zip strips from accident rail car and other associated rail cars

C. DETAILS OF THE EXAMINATION

Eleven emergency window zip strips (both small single-handled zip strips and large two-handled zip strips) from several cars in the accident train consist were submitted to the Materials Laboratory for examination. An exemplar two-handled zip strip is shown in Figure 1 and an exemplar single-handled zip strip is shown in Figure 2. Nine zip strips had tears of various lengths and depths. The neoprene zip strips were submitted to determine the mode of tearing¹.

All of the tears originated where the emergency pull handles were attached to the zip strip. An exemplar of a full thickness tear is shown in Figure 3 and a partial thickness tear is shown in Figure 4. The aluminum pull handles were attached by wires molded into the zip strip. There was a designed narrowing of the zip strip thickness and molded cutouts in the area of the handles as shown in Figure 5. A complete damage description of each zip strip is found below.

- #4333 Left rear: Two-handled zip strip; Handle 1 was intact but had some thermal damage to the zip strip in this area. Handle 2 had a full thickness/full length tear (separation) on the left side of the handle and the right side had a partial thickness tear that was 0.40 inches in length.
- #4333 found outside train: Possibly a two-handled zip strip; one handle was missing. Remaining handle had a full thickness/full length tear on the left side and a partial thickness tear that was 0.50 inches in length. The separated end had thermal damage.

¹ The specifications for the window zip strip states that zip strip is made of neoprene (polychloroprene). This was confirmed using Fourier-transform infrared spectroscopy in the Materials Laboratory.

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- #4196 R1: Single-handled zip strip. Zip strip on left side of handle had a partial thickness tear that was 0.50 inches in length. Right side of handle had a partial thickness tear that was 0.50 inches in length.
 - #4196L L9: Two-handled zip strip; Handle 1 was intact on the left side of the handle and the right side had a partial thickness tear that was 0.50 inches in length. The zip strip in the area of Handle 2 was completely intact.
 - #4295 R1: Single-handled zip strip. Zip strip on left side of handle was intact. Right side of handle had a partial thickness tear that was 0.85 inches in length.
 - #4174 L9: Two handled zip strip. Handle 1 had a full thickness tear on the left and a partial thickness tear that was 0.39 inches in length on the right. Handle 2 had a partial thickness tear that was 0.54 inches in length and was intact on the right.
 - #4197 R1: Single-handled zip strip: Zip strip on left side of handle was intact. Right side of handle had a partial thickness tear that was 0.50 inches in length.
 - #4197 R6: Two-handled zip strip; Handle 1 was intact. Handle 2 had a partial thickness tear on the left that was 0.47 inches in length and a partial thickness tear on the right that was 0.38 inches in length.
 - #4197 L3: Zip strip complete intact and undamaged.
 - #4197 L8: Two-handled zip strip; Handle 1 was intact. Handle 2 had a partial thickness tear that was 0.50 inches in length on both sides of the handle.
 - #4175 L3: Zip strip was complete and undamaged.

The fracture features of the tears were visually examined using a 5x-50x stereo zoom microscope. The tear surface on all the damaged zip strips exhibited hackle or river lines that oriented in the direction of the tear and originated in the area of the handle attachment wires as shown in Figure 6. There were narrowing and shear patterns on the ends of the complete fractures as shown in Figure 7. These fracture patterns are consistent with overstress. None of the zip strips exhibited visible indicators of age or environmental-related degradation.

In addition, the zip strips appeared to have different lubricant residues present on the installation surface of the zip strip. Lubricant was used to aid in the installation of the window and window zip strip. The submitted zip strips were swabbed using a clean cotton swab. The residue swabs were examined using a Fourier Transform Infrared (FTIR) spectrometer with a diamond attenuated total reflectance (ATR) accessory in accordance to ASTM E1252-98 (American Society for Testing Materials E1252-98: *Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis*). The spectrometer was used to collect and process infrared wavelength absorbance spectra of each sample. These spectra were compared to the spectra of the three known lubricants used in the installation of the emergency windows (Silicone lubricant spray, Gojo® mineral oil based hand cleaner and Lubriplate® grease). The silicone lubricant had a unique spectral peak at $\sim 1250\text{ cm}^{-1}$. The GoJo® cleaner had a unique doublet pattern at $\sim 1570\text{-}1540\text{ cm}^{-1}$. The Lubriplate grease had a unique spectral peak at $\sim 1450\text{ cm}^{-1}$. The results are listed in the table below.

Car No. and Window	Residue identification
#4333 Left rear	Silicone lubricant
#4333 found outside train	Gojo® cleaner/silicone lubricant mixture
#4332 R1*	Gojo® cleaner
#4332 L8*	Gojo® cleaner/silicone lubricant mixture
#4196 R1	Gojo® cleaner
#4196 L9	Gojo® cleaner
#4295 R1	Gojo® cleaner/silicone lubricant mixture
#4174 L9	Gojo® cleaner
#4197 R1	Gojo® cleaner
#4197 R6	Gojo® cleaner
#4197 L3	Gojo® cleaner
#4197 L8	Gojo® cleaner
#4175 L3	Gojo® cleaner

*The lubricant samples were collected on-scene and the corresponding zip strips were not submitted to the laboratory for examination

Nancy B McAtee
Chemist



Figure 1. Overall photograph of two-handled (large) window zip strip from #4175 L3.



Figure 2. Overall photograph of single-handled (small) window zip strip from #4295 R1.



Figure 3. Photograph of full thickness (separation) tear (#4174 L9).



Figure 4. Photograph of partial thickness tear (#4196 R1).



Figure 5. Photograph of molded cutouts in handle area of zip strip.

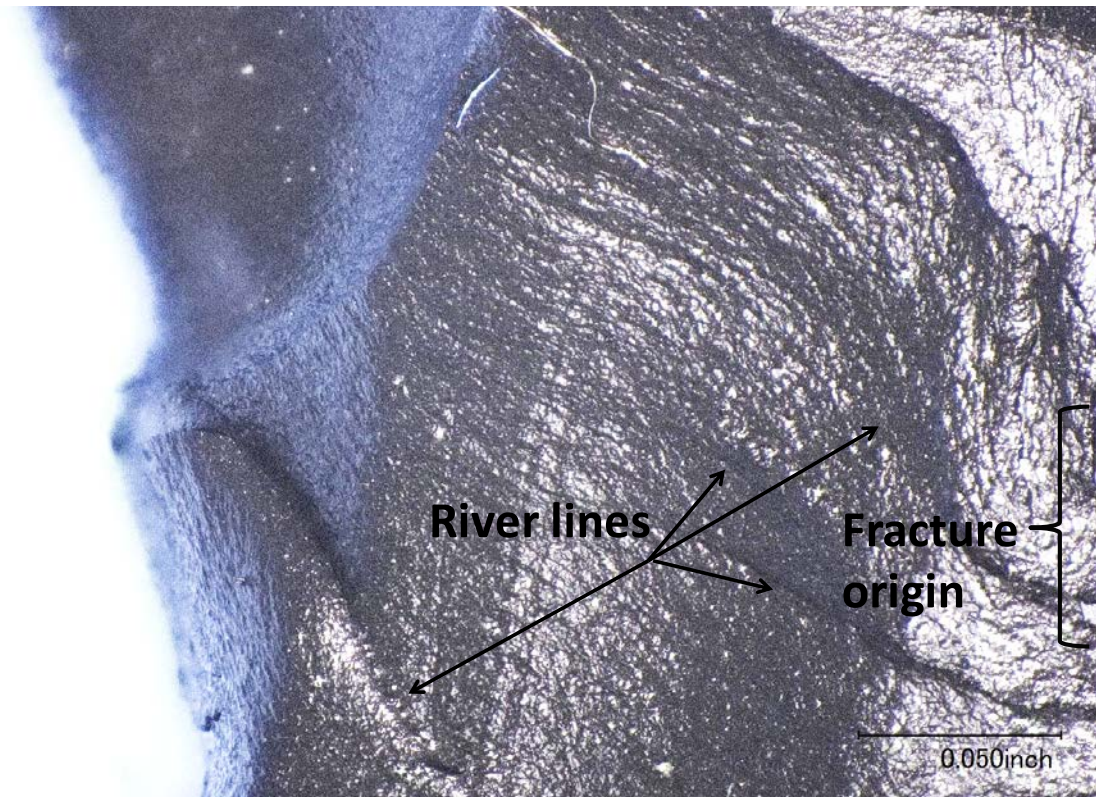


Figure 6. Close-up photograph of fracture/tear surface.



Figure 7. Close-up photograph of shear lip pattern.