

# NATIONAL TRANSPORTATION SAFETY BOARD

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



January 18, 2008

MATERIALS LABORATORY FACTUAL REPORT

Report No. 08-006

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## A. ACCIDENT

Place : Minneapolis, Minnesota  
Date : August 1<sup>st</sup> 2007  
Vehicle : I-35W Bridge collapse  
NTSB No. : HWY07MH024  
Investigator : Gary Van Etten

## B. COMPONENTS EXAMINED

The components examined were parts from fractured rivets and bolts found on scene at the accident site of the I-35W bridge collapse in Minneapolis, Minnesota.

## C. DETAILS OF THE EXAMINATION

The examination of the bridge hardware consisted of dimensional measurements of the diameters and unthreaded shank lengths of pieces from the bolts and rivets collected on scene. The diameters and heights of the rivet heads were also measured. Additionally, hardness measurements were made on the bolt and rivet materials. For the rivets, the Rockwell hardness B scale was used and for the bolts the Rockwell hardness C scale was used. The measurements were taken on sections cut from the shanks of the hardware. A wet cutting abrasive saw was used to cut the sections. The sections were approximately three eighths on an inch thick. Five measurements were taken on the face of each sample and then averaged. The measurement points were located in such a way as to get an average hardness for the entire cross section of each sample. The results of the examination are contained in the following tables. Table 1 contains the measurements of the rivet diameters. Because of the roughness of the rivet shanks the minimum and maximum diameters that were recorded were averaged. Table 2 contains the results of the hardness measurements made on the sections taken from each of the rivets. Table 3 contains the results of the measurements taken on the sections from each of the bolts. In the tables there are designations A,B,C to help differentiate between multiple items found at the same locations

Rivet Diameter Measurements (inch)						
	Rivet Identification	MIN diameter	MAX diameter	AVG diameter	Head diameter	Head Height
A	Found @ L13 E	1.03	1.04	1.035	1.7	0.7
	Found @ U10' W	1.04	1.055	1.0475	1.8	0.8
	Found @ L8 E	1.044	1.051	1.0475	1.7	0.71
	Found @ U10' E (very corroded/deformed)	1.052	1.052	1.052	1.6	
B	Found @ L13 E	1.034	1.049	1.0415	1.6	0.85
A1	Found BTWN U11 / U12 W	1.022	1.035	1.0285	1.6	0.84
A2	Found BTWN U11 / U12 W	1.03	1.035	1.0325	1.5	0.86
B1	Found BTWN U11 / U12 W	1.027	1.043	1.035	1.5	0.84
B2	Found BTWN U11 / U12 W	1.034	1.038	1.036	1.6	0.86
C1	Found BTWN U11 / U12 W	1.012	1.016	1.014	1.5	0.87
C2	Found BTWN U11 / U12 W	1.01	1.016	1.013	1.5	0.86
	U1			1.08	1.7	0.74
	U2			1.06	1.8	0.79
	U3			1.08	1.8	0.78
	U4			1.07	1.6	0.7

**Table 1: Rivet diameter measurements.**

Rivet Hardness Measurements (HRB)							
	Rivet Identification	Test 1	Test 2	Test 3	Test 4	Test 5	AVG
	Found @ U10' E	101.4	99.1	100.7	97.6	98.1	99.38
	Found @ L8 E	99.7	99.2	100.1	100.2	99.9	99.82
A1	Found @ U11 / U12 W	94.6	94.5	94.4	94.3	95.5	94.66
A2	Found @ U11 / U12 W	97.4	95.8	96.3	96.9	97.6	96.8
	Found @ U10' W	104	103.1	100.6	98.4	103.7	101.96
B1	Found @ U11 / U12 W	98.6	99.2	98.8	99.4	99.6	99.12
B2	Found @ U11 / U12 W	91.8	93.5	91.6	93.3	91.7	92.38
C1	Found @ U11 / U12 W	92.6	90.9	92.8	92.8	93.9	92.6
C2	Found @ U11 / U12 W	90.9	91.6	90.6	90.1	89.8	90.6
A	Found @ L13 E	101	97.8	98.2	99.9	100	99.38
B	Found @ L13 E	95.9	94.3	94.7	95	95.5	95.08

**Table 2: Rivet hardness measurements.**

Bolt Hardness Measurements (HRC)								
Bolt Identification	Test 1	Test 2	Test 3	Test 4	Test 5	AVG	Diameter (in)	Shank length (in)
FT 10U3	23.5	19.7	23.2	25	22.8	22.84	0.86	~ 6.5
Found inside U8-U9W @ U9W FT top chord conn. Bolt	23.9	25.1	26.8	26	27	25.76	0.97	N/A
C1 Found inside top chord @ U9W	23.4	25.2	26.3	25.6	24.7	25.04	0.98	N/A
C2 Found inside top chord @ U9W	27.7	28.3	27.2	29	26.7	27.78	0.97	N/A
Found inside top chord @ U9E	26.4	22.8	28	28.2	26.3	26.34	0.98	N/A
FT 9' U6 NW Bolt	24.7	30.2	27.5	28.1	29.4	27.98	0.85	N/A
FT 10U4 SW Bolt	29.1	27.4	28.3	29.3	29.3	28.68	0.86	N/A
FT 11U8 NE Bolt	22.3	28.5	24.4	25	25.3	25.1	0.87	~ 4
A1 Found inside top chord @ U9W	28.9	23.4	27	26.4	29	26.94	0.98	N/A
A2 Found inside top chord @ U9W	27.9	27.8	25.7	27.5	26.9	27.16	1	N/A
B Found inside top chord @ U9W	25.3	28.4	29.1	26.7	29.3	27.76	0.97	N/A
Found inside member L7-L8E	22.5	19.1	21.3	21.3	20.6	20.96	1	N/A
FT U93 SE Bolt	25.3	24.2	28.3	25.9	26.7	26.08	0.88	N/A
FT 11' U3 SW Bolt	27.2	23	26.3	31.6	28.8	27.38	0.87	N/A
FT 10' U2 SW Bolt	21.9	19.5	24	29.1	21.9	23.28	0.86	N/A
FT 11' U9 SE Bolt	27.1	22.2	29.6	27.7	28.5	27.02	0.86	N/A
Found inside member U8-U9W @ U9W	26.6	26.5	27.2	27.1	27.1	26.9	0.98	N/A
Found @ L13E	19.6	17.8	20.1	18.5	19.2	19.04	1	N/A
FT 9' U10 NE Bolt	30	23.1	26.5	25.3	27	26.38	0.86	N/A

**Table 3: Bolt Hardness measurements.**

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Fire and Explosion Investigator