



**SPECIAL PROVISIONS
FOR
HEAT STRAIGHTENING OF BRIDGE BEAMS**

**Polk County
IMN-235-2(687)0—0E-77**

**Effective Date
October 11, 2022**

THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

150936.01 DESCRIPTION.

This work is to permanently repair a damaged welded plate girder on the I-80 EB bridge over I-235, 0.2 miles East of W Jct. I-80 in Polk County. This bridge was damaged by an over height vehicle. The damaged beam shall be repaired by heat straightening to restore it to its original shape and alignment.

150936.02 EXPERIENCE REQUIREMENTS.

Prior to beginning work, submit to the Engineer documentation of 10 or more years of experience in the field of heat straightening major structural elements on highway or railroad bridges and a documented list of at least three bridge structures that have been successfully heat straightened.

150936.03 NOTIFICATION AND PRELIMINARY WORK.

- A.** Notify the Engineer 2 weeks prior to the starting date of heat straightening operations.
- B.** Prior to blast cleaning of structural steel, the Contractor and the Engineer shall inspect the damaged section for gouges, sharp dents, cracks or other impact caused defects and document any damage observed. If additional cracks are found other than those noted in the plans, the Iowa DOT's Bridges and Structures Bureau will be informed by the Engineer prior to the Contractor proceeding with the repair.
- C.** In accordance with the plans, blast clean the portions of the beam, that have been damaged and require heat straightening.

150936.04 REPAIR BEAM, HEAT STRAIGHTENING.

- A.** Jacks or "Come-Alongs" may be used to mechanically augment the heat straightening process.
 - a) The maximum magnitude of the jacking forces shall either be limited to 4 tons or per FHWA-IF-08-999 "Guide for Heat-Straightening of Damaged Steel Bridge Members":

- i) Jacking shall be limited so that the maximum bending moment in the heated zone shall be less than 50% of the plastic moment capacity of the member or major bending element. For local damage, the jacking force shall be limited to 50% of initial yield of the element.
 - ii) The jacking force shall be adjusted so that the sum of jacking-induced moments and estimated residual moments shall be less than 50% of the plastic moment capacity of the member. As an alternative to considering residual moments, the moment due to jacking forces can be limited to 25% of the plastic moment capacity of the member during the first two heating cycles. For additional heating cycles, the limit of 50% may again be used.
 - b) If maximum jacking forces above 4 tons are calculated, the calculations shall be signed and sealed by a Professional Engineer licensed in the State of Iowa and submitted to the Engineer for approval. A work plan and sketch showing the placement of the jacks and jack supports shall be included with the calculations submittal.
 - c) Jacks shall be placed so that forces are relieved as straightening occurs during cooling. Loading shall be judiciously applied to the beam during the straightening process. The jacking force shall not be adjusted during heating or before the temperature in the beam has cooled to 600°F or less. Adequately brace the adjacent beams at the jacking locations in order to prevent overloading due to applied lateral loads.
- B.** Heating shall be done using No. 8 or smaller torch tips on an oxygen-acetylene gas mixture. Vee line or spot heating patterns shall be conducted to bring the steel within the planned pattern to a temperature between 600°F and the limits shown below to produce deformations of the steel member conforming to the tolerances outlined on the plans and these special provisions. After the beam has been heat straightened, the heating pattern used shall be furnished to the Engineer for informational purposes. In no case shall the temperature exceed the limits defined below as determined with use of temperature indicating crayons, liquids or a bimetal thermometer. The temperature of the steel during heat straightening shall not exceed the following per FHWA-IF-08-999 "Guide for Heat-Straightening of Damaged Steel Bridge Members":
- (a) 1200°F for non-quenched and tempered Carbon Steels
 - (b) 1100°F for A514 and A709 (Grades 100 and 100W) quenched and tempered steels
 - (c) 1050°F for A709 grade 70W quenched and tempered steels
- C.** Provide the Engineer with temperature indicating crayons manufactured for all temperatures required to control the heating of the steel with visual observation, including but not limited to: 600°F (for compressed air cooling limit in Section E) and 1300°F, 1150°F or 1100°F (for the steel type heating limits of 1200°F, 1100°F and 1050°F shown respectively in Section B. above). Temperature verification during heat straightening may also be documented using infrared non-contact thermometers provided to the Engineer.
- D.** The temperature of the heated metal may be determined by the color of the steel adjacent to the tip of the torch by using temperature crayons to correlate the temperature of the heated metal to the color of the steel. In normal daylight conditions, 1200°F will be indicated by a satiny, silver color near the torch tip. After cooling, the area should be gray in color.
- E.** Only quenching with clean dry air will be permitted. Cooling with compressed air may be done only after the steel has cooled naturally to at least 600°F. Cooling shall be uniform throughout the heated area.
- F.** After the heat straightening has been completed, the Engineer will visually inspect the repaired beam. At the Engineer's discretion, nondestructive testing of the structural steel and weld may be performed if cracks are suspected. The Contracting Authority will do all testing.

150936.05 TOLERANCES.

The dimensions of heat-straightened structural members shall conform to the tolerances specified in the table below:

Tolerances for Heat Straightening Repair

Member Type	Tolerance ^{1,2}
Beam/Girder overall at impact point	1/2 inch over 20 ft
Local Web Deviations	d/100 but not less than 1/4 inch or more than 1/2 inch
Local Flange Deviations	b/100 but not less than 1/4 inch or more than 1/2 inch
¹ Units of member depth, d, and flange width, b, are inches ² Tolerances for curved or cambered members should account for the original shape of the member	

150936.06 PERFORMANCE.

If the alignment of the beam is not straightened to within the tolerances specified or if any portion of repaired beam or surrounding structure is damaged as a result of the heat straightening process or jacking procedure, replace or repair the portions of the beam as determined by the Bridges and Structures Bureau of the Iowa DOT. The cost of repair or replacement with a new section of beam, associated materials, and labor shall be borne by the Contractor at no cost to the Contracting Authority.

150936.07 METHOD OF MEASUREMENT & BASIS OF PAYMENT.

The Contractor shall be responsible for all costs associated with heat straightening to repair the bridge beams, including furnishing all labor, materials and equipment required to heat straighten all damaged portions of the beams to their original alignment as noted herein. This includes furnishing all jacks and temporary bracing needed in the heat straightening process.