Investigation of the December 30, 2014 incident at Ford Kansas City Assembly Plant, Claycomo, MO

U.S. Department of Labor
Occupational Safety and Health Administration
Directorate of Construction

March 2015

Report Prepared by
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Office of Engineering Services
Directorate of Construction

Report

A fatal incident occurred on December 30, 2014 at approximately 8:30 a.m. at the Ford Kansas City Assembly Plant (KCAP) in Claycomo, MO. The incident happened when the welds on a bracket holding a safety pin supporting the weight of a carriage suddenly failed, causing the carriage to slip off the pin and fall, pinning an employee who was working below the carriage.

KCAP produces trucks and other vehicles, and carriages are an essential part of the assembly line. To accommodate the next generation of F-150 trucks (Code P 552) which are wider than the previous models, the carriages had to be adjusted for a wider platform. This involved relocating the four safety pins holding the carriage at four corners. KCAP retained KCI, Inc., of Kansas City, MO to perform design and construction for the relocation of the pins. The new location of the safety pins required that new holes be created in the existing ¾" plates of the counterweight steel columns, and that a plate bracket be field welded to the columns. It was the weld on such a bracket that failed causing the incident.

The KCAP was closed for the 2014 Christmas recess which provided an opportune time to make the changes to the carriage before assembly would begin for the new year. The work began on December 23, 2014 with day and night shift crews. For the next four days, December 23-27, a number of activities were performed, e.g., removing existing decking components, existing column guide bars, de-skid fences, installing new decking components, etc. By the night shift on December 27, they were ready to cut/burn the holes in the plates attached to the steel column flanges to relocate the safety pins. First the hole was cut at the south west corner of the carriage during the night shift. The following day, the other three holes for the safety pin brackets were torched in the northwest, northeast and southeast columns. The bracket plates were also welded to the steel columns. The bracket plate at the southwest end corner was welded during the night shift on December 28. All four safety pins were placed and the carriage was placed on the pins. Work proceeded on December 29 with the pins supporting the weight of the carriage. During the following night shift, some adjustments were made by slotting the holes to finalize the location of the safety pins, see figures 1 to 3.

On the morning of the day shift on December 30, two nylon chokers were attached to the decking carriage at the northwest corner, and to the lower shaft with a 1½ ton come-along

positioned between the two chokers, see figure 4 and 5. It is believed that in addition to the dead load of the carriage, a force of 3,000 pounds was applied through the chokers to the safety pins. The carriage slipped from the safety pins and fell, pinning an employee. The slippage was caused by the failure of the welds of the bracket.

A structural engineer from the Directorate of Construction (DOC), OSHA National Office in Washington, D.C. visited the incident site on January 8, 2015, and examined the failure. The inspection revealed that there were multiple flaws in the installation of the bracket plate. The most notable flaw was the inferior quality of the welds due to an unacceptable weld profile and a lack of fusion, see figures 6 to 10. Moreover, the bottom of the plate was not even welded. The second flaw was the oversized hole made in the column plate which exacerbated the failure, see figures 11 and 12. If the hole had been only 1/16" larger than the diameter of the pin, the load could have been distributed to the ¾" column plate as well.

At the request of OSHA, KCAP retained an independent laboratory to examine the welds and provide a report (see Appendix). The report stated that the welds were inferior to the extent that they were not acceptable, and did not meet any applicable standards. DOC performed structural computations which indicated that even if the welds were done properly as per AWS standard, the dead load of the carriage with the additional force applied by the come-along would still have compromised the bracket. However, in the present case, because the welds were inferior and lacked fusion, and with a weld at the bottom of the plate completely missing, the dead load of the carriage with or without the additional force of the come along would have caused a failure of the bracket.

The following conclusions were made:

1. The failure occurred due to the inferior quality of the welds on the bracket plate welded to the column. The welds were found to be unacceptable by an independent laboratory, which examined the welds.
2. The hole in the column plate was made larger than required, thus excluding the possibility of distributing the load to the column flange plate.

3. The welds were performed by non-certified AWS welders. One of the welders who performed the weld that failed had limited experience in welding.
4. The Ford Kansas City Assembly Plant through its consultant failed to exercise due diligence by not ensuring that the work was performed as per industry standards.
5. There was a lack of supervision on the part of the consultant retained by the Ford Kansas City Assembly Plant as there was a window of approximately 48 hours during which the welds could have been examined. Even a cursory examination of the welds would have indicated the inferior quality of the welds.
6. If the welds had been properly performed in accordance with the applicable codes, this incident would not have occurred.

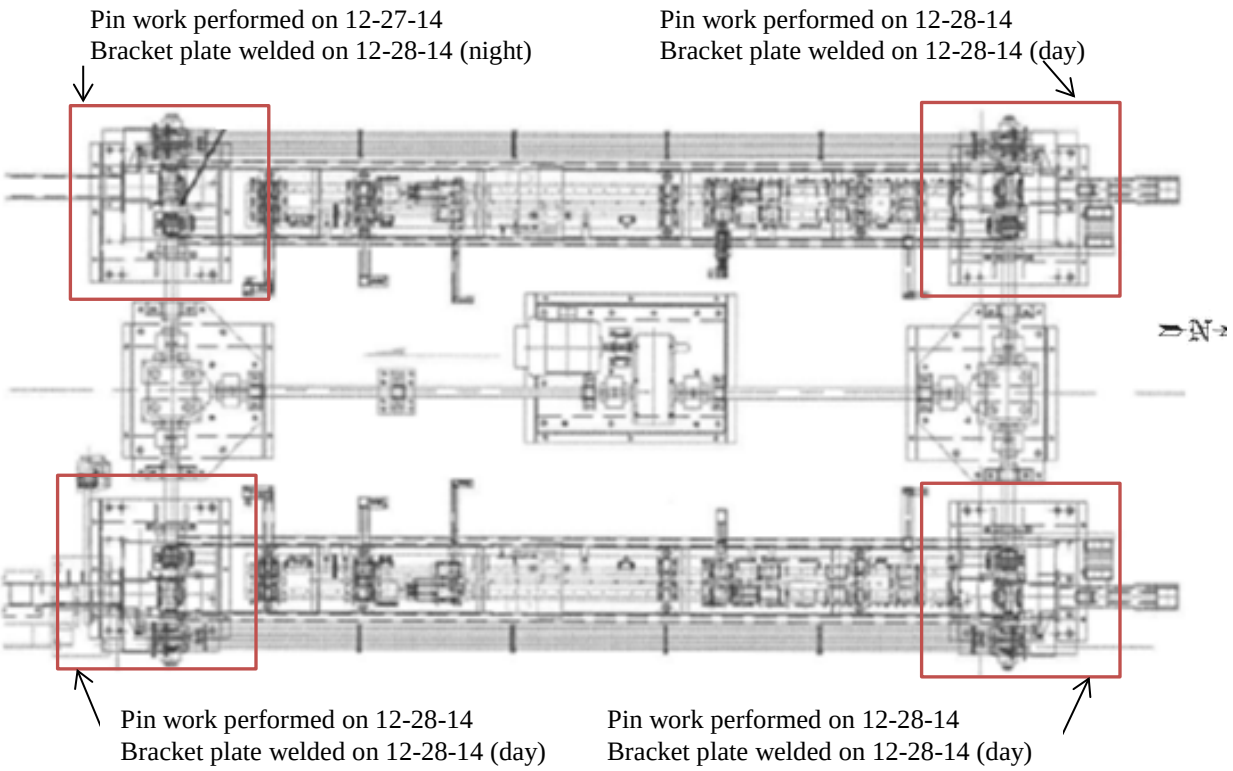

Fig. 1 – Decking Unit Plan

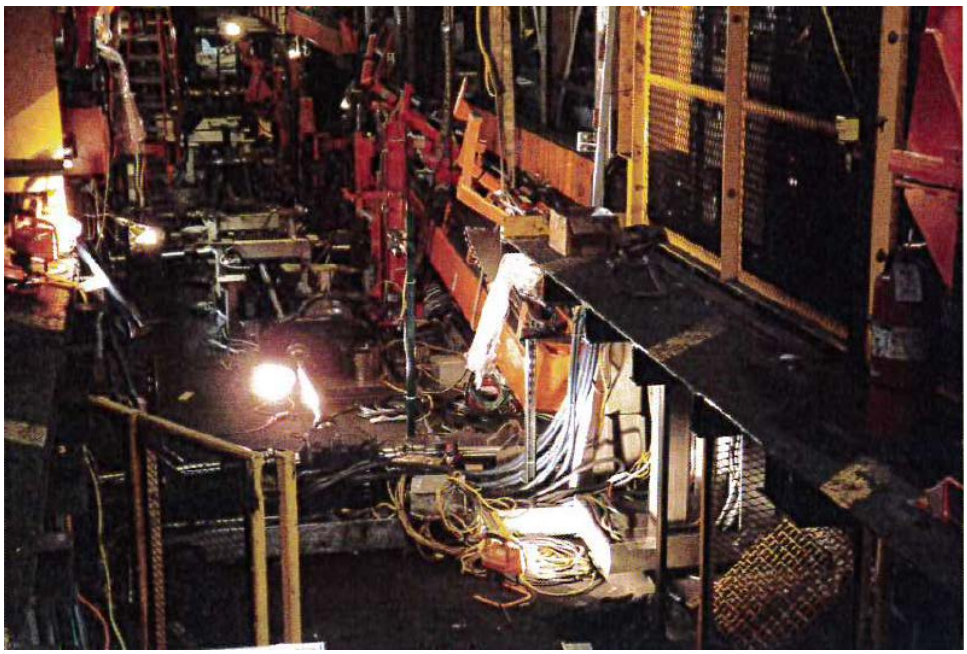

Fig. 2 – Overall view of pit area where workers were working

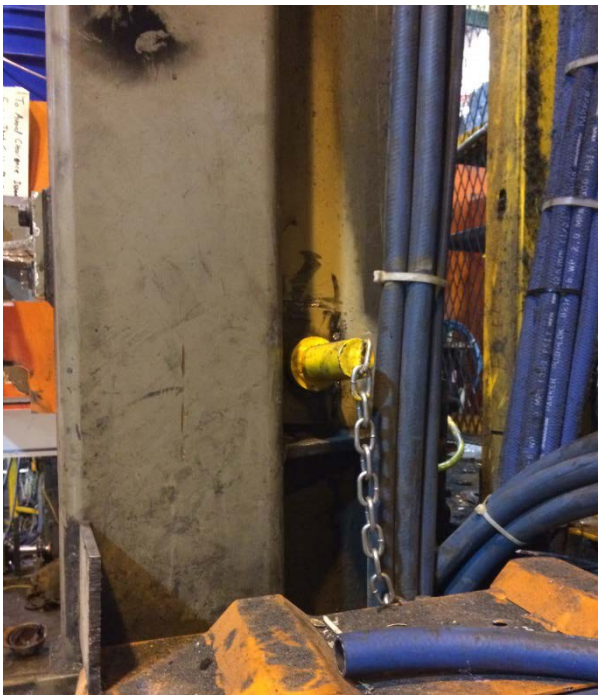

Fig. 3 – Safety pin and the column

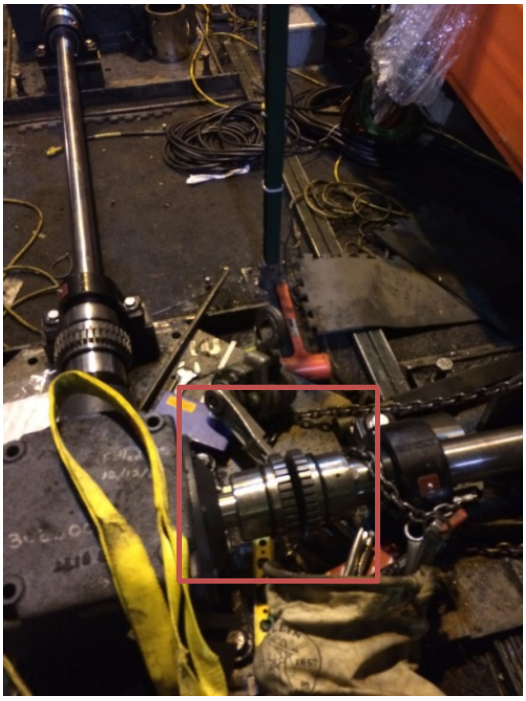

Fig. 4 – Coupling worker was aligning at the time of the incident

Fig. 5 – Attachment point for come-a-long

Fig. 6 – Safety pin and the bracket with the weld

Fig. 7 - Failed weld, bracket and safety pin

Fig. 8 – Safety pin

Fig. 9 - Failed weld and the bracket

Fig. 10 – Failed weld showing lack of fusion

Fig. 11 - Safety pin and the oversized hole

Fig 12 – Safety pin and the oversized hole

APPENDIX

(Weld Inspection Report)

Founded 1929 St. Louis Testing Laboratories INCORPORATED

2810 Clark Avenue • St. Louis, MO 63103-2574 • (314) 531-8080 • FAX (314) 531-8085

Chemical, Metallurgical, Mechanical, Nondestructive, Environmental Testing, Analyses and Field Service.

FORD MOTOR COMPANY
8121 N.E. 69th
Kansas City, MO 64119

January 8, 2015
Lab No. 15F-0033

Attention: Candace Glasgow

INSPECTION REPORT

SUBJECT:	Visual Inspection
PROCEDURE:	STL-VT-001, Rev. 3
CODE OR SPECIFICATION:	AWS D1.1-2010
TECHNICIAN:	D. Laroue, CWI #00120171
IDENTIFICATION:	NORTH CELL DECKING MACHINE WELD
INSPECTION DATE:	January 8, 2015
ACCEPTANCE CRITERIA:	AWS D1.1-2010, Cyclically loaded, nontubular connection

INSPECTION RESULTS:

See visual inspection results in the table on page 2 per AWS D1.1-2010, Table 6.1 acceptance criteria. The magnetic particle inspection results are presented in the table on page 3.

STATE OF MISSOURI
JAMES J. BRIEM
NUMBER E-17628
REGISTERED PROFESSIONAL ENGINEER

1/12/15

Authenticated By:

JKB/mrm

Juergen K. Bloch, Manager
Nondestructive Testing Department
St. Louis Testing Laboratories, Inc.

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January 8, 2015
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Attention: Candace Glasgow

AWS D1.1/D1.1M:2010 Table 6.1 Visual Inspection Acceptance Criteria (see 6.9)	
Discontinuity Category and Inspection Criteria	Cyclically Loaded nontubular Connections
(1) Crack Prohibition Any crack shall be unacceptable, regardless of size or location.	None Observed
(2) Weld/Base-Metal Complete fusion shall exist between adjacent layers of weld metal and between weld metal and base metal.	Unacceptable
(3) Crater Cross Section All craters shall be filled to provide the specified weld size, except for the ends of intermittent fillet welds outside of their effective length.	None Observed
(4) Weld Profiles Weld profiles shall be in conformance with 5.24.	Unacceptable
(5) Time of Inspection Visual inspection of welds in all steels may begin immediately after the completed welds have cooled to ambient temperature. Acceptance criteria for ASTM A 514, A 517, and A 709 Grade 100 and 100 W steels shall be based on visual inspection performed not less than 48 hours after completion of the weld.	N/A
(6) Undersized Welds The size of a fillet weld in any continuous weld may be less than the specified nominal size (L) without correction by the following amounts (U): L, specified nominal weld size, in [mm] → U, allowable decrease from L, in [mm] ≤ 3/16 [5] → ≤ 1/16 [2] 1/4 [6] → ≤ 3/32 [2.5] ≥ 5/16 [8] → ≤ 1/8 [3] In all cases, the undersize portion of the weld shall not excess 10% of the weld length. On web-to-flange welds on girders, underrun shall be prohibited at the ends for a length equal to twice the width of the flange.	None Observed
(7) Undercut (A) For material less than 1 in [25 mm] thick, undercut shall not exceed 1/32, in [1 mm], with the following exception: undercut shall not exceed 1/16 in [2 mm] for any accumulated length up to 2 in [50 mm] in any 12 in [300 mm]. For material equal to or greater than 1 in [25 mm] thick, undercut shall not exceed 1/16 in [2 mm] for any length of weld.	N/A
(B) In primary members, undercut shall be no more than 0.01 in [0.25 mm] deep when the weld is transverse to tensile stress under any design loading condition. Undercut shall be no more than 1/32 in [1 mm] deep for all other cases.	None Observed
(8) Porosity (A) CJP groove welds in butt joints transverse to the direction of computed tensile stress shall have no visible piping porosity. For all other groove welds and for fillet welds, the sum of the visible piping porosity 1/32 in [1 mm] or greater in diameter shall not exceed 3/8 in [10 mm] in any linear inch of weld and shall not exceed 3/4 in [20 mm] in any 12 in [300 mm] length of weld.	N/A
(B) The frequency of piping porosity in fillet welds shall not exceed one in each 4 in [100 mm] of weld length and the maximum diameter shall not exceed 3/32 in [2.5 mm]. Exception: for fillet welds connecting stiffeners to web, the sum of the diameters of piping porosity shall not exceed 3/8 in [10 mm] in any linear inch of weld and shall not exceed 3/4 in [20 mm] in any 12 in [300 mm] length of weld.	None Observed
(C) CJP groove welds in butt joints transverse to the direction of computed tensile stress shall have no piping porosity. For all other groove welds, the frequency of piping porosity shall not exceed one in 4 in [100 mm] of length and the maximum diameter shall not exceed 3/32 in [2.5 mm].	None Observed

Notes:

1. The connection was not welded on one of the 5" long sides or on the 3" long bottom area.
2. Welder certifications were not available for review.
3. It appeared that the subject welds had been made over paint.

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FORD MOTOR COMPANY
8121 N.E. 69th
Kansas City, MO 64119

January 8, 2015
Lab No. 15F-0033

Date of Inspection: 1/8/15

Attention: Candace Glasgow

MAGNETIC PARTICLE INSPECTION REPORT

Client: FORD MOTOR COMPANY	Report To: CANDACE GLASGO	Job Number:	Project: NORTH CELL DECKING MACHINE
Procedure: STL-MT-001-2006, Rev. 2	Code or Specification: AWS D1.1-2010		Acceptance Code: AWS D1.1-2010, Table 6.1, Cyclically loaded nontubular connection

Technique: ☑ Dry ☐ Wet ☑ Visible ☐ Fluor. ☐ Continuous ☐ Residual ☑ True Continuous

Equipment: ☑ Yoke ☐ Prods ☐ Stationary Unit ☐ Portable Unit ☐ Coil

Equipment Manufacturer: ☑ Parker Research ☐ Magnaflux ☐ Other

Magnetic Particle Manufacturer: ☐ Magnaflux ☑ Circle System ☐ Other

Equipment Model: ☑ B300 ☐ DA400 ☐ KH-09 ☐ P920 ☐ PL-8 ☐ H-700 ☐ Other

Equipment Serial Number: 7107

Current: ☑ AC ☐ DC ☐ HWAC

Magnetic Particles - Wet: ☐ 14A & Carrier II ☐ 14AM ☐ 9CM ☐ Other
Batch Number: N/A

Calibration Date: 1/19/15

Current Amperage(as applicable): 4

Material: ☑ Carbon Steel ☐ Other:

Yoke or Prod Spacing (as applicable): 4" – 6"

Magnetic Particles – Dry: ☐ Yellow ☐ Red ☐ Black ☑ Blue ☐ Gray ☐ Other
Batch Number: 14286

Thickness: 1/2"

Part Temperature: ☑ Ambient ☐ Other:

Strength of Field: ☑ Pie Gauge ☐ Other

Lighting Equipment Used: ☑ Yoke Light ☐ Black Light

Flashlight: ☐ Eveready ☐ Mag Lite ☐ Rayovac ☑ Mini Mag Lite ☐ Other:

Hat Light: ☐ Eveready ☐ Other

Lifting Power (if applicable by contract): ☑ 10 lbs. ☐ Other

Surface Condition: ☑ As Welded ☐ Ground ☐ Other

Demagnetizing Technique (if required): ☐ SB-1416(Demag. Unit) ☐ Cable Wrap ☐ Coil ☑ Yoke

Cleaning (if required): N/A

Marking Method: PHOTOGRAPHS

Item Identification	Accept	Reject	Remarks
NORTH CELL DECKING MACHINE			
Remaining weldment on catastrophic weld failure		X	Cold Lap & Lack of Fusion
			See photographs on pages 4 and 5.

Inspector: D. Laroue Level: II

JKB/mrm

Juergen K. Bloch, Manager
Nondestructive Testing Department
St. Louis Testing Laboratories, Inc.

MEMBER ACIL