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Testing. Advising. Assuring.

**London Trackwork Inc.
AY CHINA
Joint Bars Evaluation**

**Presented to:
London Trackwork Inc.
3-320 Ferndale Avenue
London, Ontario
N6C 5P7**

**Attn: Dave McLean
Sales Manager**

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Introduction

Per contractual agreement between Exova Pointe-Claire (Offer of Service number **PC15-391**) and **London Trackwork Inc. (PO 1305)**, one (1) pair of 132-136RE joint bars and one (1) pair of 115-119RE joint bars were provided to our lab by London Trackwork, for evaluation according to AREMA Section 3.4 "Specifications for Quenched Carbon-Steel Joint Bars, Micro alloyed Joint Bars, and Forged Compromise Joint Bars". A comparison of the results is also required with the CN specifications 12-11A for Splice Bars, Straight and Bent.

Scope

The following tests were performed on the supplied parts:

- A. Chemistry as per AREMA paragraph 3.4.3 and CN 12-11A paragraph 5
- B. Tensile as per AREMA paragraph 3.4.4 and CN 12-11A Amendment 1
- C. Bending Properties as per AREMA paragraph 3.4.5
- D. Dimensional as per AREMA paragraph 3.4.9 and CN TS-1202/TS-1203

Materials and Methods

- A. Chemical Composition: Determination of chemical properties was made using OES method. The chemistries were done on sample 70275 for the 115-119 type joint bar and sample 70276 for the 132-136 type joint bar.
- B. Tensile: Two (2) specimens were prepared from joint bars (sample 70275 for type 115-119 joint bar, and sample 70276 for type 132-136 joint bar) with dimensions as specified in AREMA figure 4-3-10, "Standard 2 Inch Gage Length Tension Specimen".
- C. Bend Test: Two (2) small specimen extracted from splice-bars (one for 115-119 type and one for 132-136 type) were bent cold through 90° around a pin 3 times the thickness of the specimen.
- D. Dimensional Evaluation: Measurements were performed on one (1) 115-119 type joint bar and on one (1) 132-136 type joint bar, using a measuring tape and ruler with 32_{NDS} divisions. Measurements were done at room temperature, in compliance with available dimensions taken from CN TS-1202 and TS-1203 and AREMA section 3.3 and 3.4.9 for permitted variations.

Test equipment and calibration

Test Group	Asset #	Description	Model #	Calibration method/ Start/End date ¹
A. Chemical Composition ²	N/A	N/A	N/A	N/A
B. Tensile	B14242	Instron 600DX Force serial # 197663 Position serial # 600DXQ3732 Strain serial # E83620	600DX	ISO 17025 2014-12-02/2015-12-02
C. Bend Test	B06225	SATEC Universal Testing Machine	60WHVL	ISO 17025 2014-12-03/2015-12-03

Table 1 - Test equipment list and calibration information

¹ If done in conformity to ISO 17025, all calibrations are made by an accredited outside firm and are active at time of testing. If this is the case, calibration date periods are recorded. All calibration documentation is available upon request.

² Chemistry tests are performed in our Burlington location.

Test Results

A. Chemical Composition: Samples are tested in accordance to ASTM D1976-12Mod and ASTM E1019-11 and as per AREMA paragraph 3.4.3.

Spec. Requirements		Results	
Splice Bar Identification		115-119	132-136
Exova sample #		70275	70276
Carbon - C	0.35% to 0.60% max	0.52%	0.55%
Manganese - Mn	1.20% Max.	0.67%	0.61%
Phosphorous – P	0.040 % max	0.031%	0.021%
Sulfur – S	0.050 % max	0.023%	0.018%

Table 2

B. Tensile:

Tensile minimum requirements			
Spec. Requirements		Results	
Splice Bar Identification		115-119	132-136
Exova sample #		70275	70276
Tensile Strength, psi	100,000	126,100	129,500
Yield Strength, psi	70,000	74,700	76,500
Elongation, %	12	17.2	15.2

Table 3

C. Bend Test:

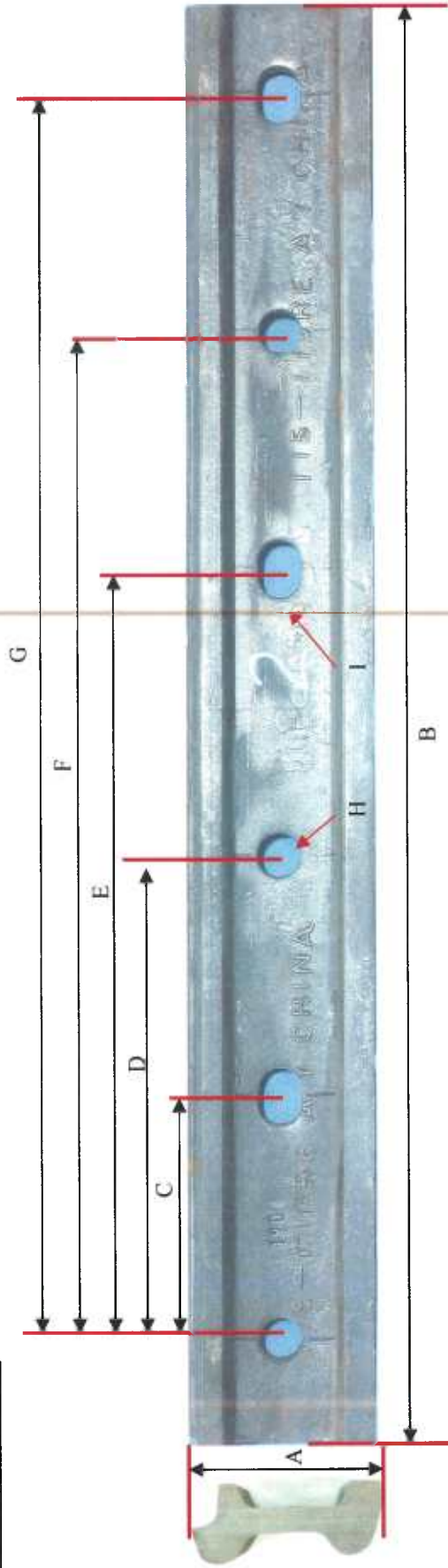
After bending the samples extracted from one (1) 115-119RE joint bar and one (1) 132-136RE joint bar, no crack was found on the outside of the bend.



Bend Test Setup and Results



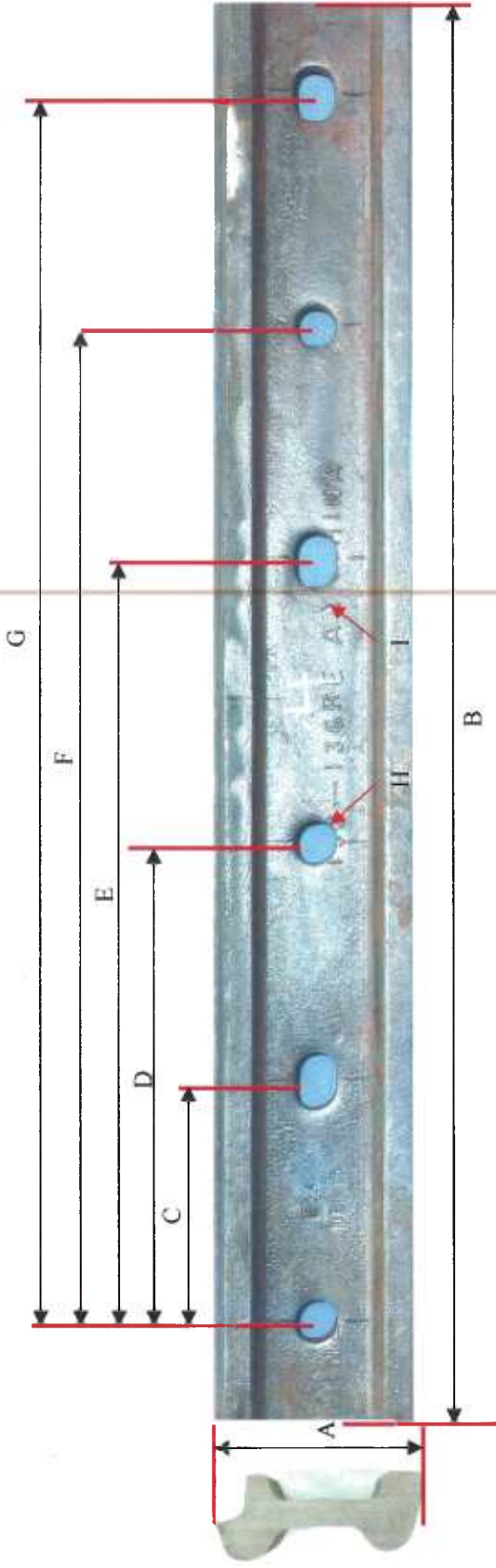
D. Dimensional Evaluation:



Dimensional in inch, on 115-119 Joint Bar

Position	Required		Measured	
	AREMA	CN	AREMA	CN
A	4.65	4.562	NA	4.63
B	36	± 1/8	± 1/8	35-15/16
C	6	± 1/16	± 1/32	6
D	12	± 1/16	± 1/32	12
E	19-1/8	± 1/16	± 1/32	19-1/8
F	25-1/8	± 1/16	± 1/32	25-1/8
G	31-1/8	± 1/16	± 1/32	31-1/8
H	1-1/16	± 1/8	± 1/32	1-1/16
I	1-13/32 x 1-1/16	1-13/32x1-1/8	± 1/32	1-13/32x1-1/16

Table 4



Dimensional in inch, on 132-136 Joint Bar

Position	Required		AREMA	CN	AREMA	CN	Measured	
	AREMA	CN					1	2
A	5.056	5	NA	+ 1/64 -0		4.98	4.98	
B	36	36	± 1/8	± 1/8		35-15/16	35-15/16	
C	6	6	± 1/16	± 1/32		6	6	
D	12	12	± 1/16	± 1/32		12	12	
E	19-1/8	19-1/8	± 1/16	± 1/32		19-1/8	19-1/8	
F	25-1/8	25-1/8	± 1/16	± 1/32		25-1/8	25-1/8	
G	31-1/8	31-1/8	± 1/16	± 1/32		31-1/8	31-1/8	
H	1-1/16	1-1/8	± 1/32	± 1/32		1-1/16	1-1/16	
I	1-13/32 x 1-1/16	1-13/32x1-1/8	± 1/32	± 1/32		1-13/32x1-1/16	1-13/32x1-1/16	

Table 5

Conclusion

Chemistry, bend test and visual examination were found to be acceptable on all the up-above tested samples, although ridges around the punched holes are not a good practice (see pictures below). All measurements were found to be acceptable except for the holes size regarding the CN tolerances.



Ridges around the holes can contain micro cracks that will eventually spread during the life of the joint bar.

End of Text

Written by:

Sylvain Léger, Project Leader
Railway technology/Mechanic

Approved by:

Robert Champagne, Manager
Railway technology/Fatigue/Special Projects

* * *

Aerospace/military samples shall be retained for 6 months, non-aerospace/non-military samples for 30 days from the date of issue of the report and then destroyed unless otherwise agreed to, in writing, by the client. The results relate only to the items tested. This report may not be reproduced except in full, without written approval of Exova, and that the recording of false, fictitious or fraudulent statements or entries on this document may be punished as a felony under federal law.

Appendix 1

Chemical Analysis and Tensile Test Certificate

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TEST CERTIFICATE

LONDON TRACKWORK INC.
 320 FERNDAL AVE. SUITE 3
 LONDON, Ontario
 N6C 5P7

Lab #: 30991
COA #: 32552
Issue #: 1
Date approved: 2015-08-26
Date printed: 2015-08-26

Material: Steel
Shape: NA
Condition: Not Applicable

Requested by **DAVE McLEAN**

Customer's ID: 2 joint bars: 115 and 132/136
Description: AREMA 2014 specification - Chapter 4 - Part 3
 Joint Bars

PO 1305
Material: Steel

CHEMICAL ANALYSIS										
		C	Mn	P	S					
Sample	Label	(%)	(%)	(%)	(%)					
70275	115 Joint bar	0.52	0.67	0.031	0.023					
70276	132/136 Joint bar	0.55	0.61	0.021	0.018					

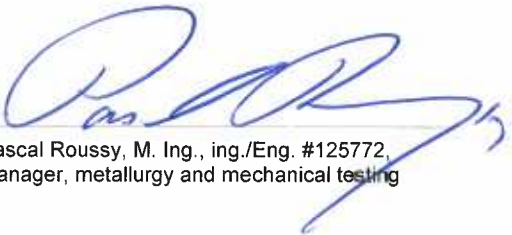
Test Method: OES: C, Mn, P, S

Analysis was subcontracted to Exova, Burlington, ON lab.

ROOM TEMPERATURE TENSILE TEST											
		Form	Diam	gage	GL	Yield	YS	UTS	Elong	RA	Fracture
Sample	Label		(in)	(prop)	(in)	(method)	(ksi)	(ksi)	(%)	(%)	(location)
70275	115 Joint bar	Round	0.500	4d	2.000	0.2% off.	74.7	126.1	17.2	34.7	center
70276	132/136 Joint bar	Round	0.500	4d	2.000	0.2% off.	76.5	129.5	15.2	34.7	center

Test Method: ASTM A370-14

Aerospace/military samples shall be retained for 6 months, other samples, see contract terms and conditions.
 The recording of false, fictitious or fraudulent statements or entries on this document may be punished as a felony under federal law.
 * Denotes the laboratory is accredited to the identified test method by ISO 17025 but not by NadCap.
 ** Denotes the laboratory is not accredited to the identified test method by ISO 17025 or NadCap.


 Pascal Roussy, M. Ing., ing./Eng. #125772,
 Manager, metallurgy and mechanical testing