DTI's Technical Report #27

Independent Laboratory Tests on 'Coronet' Load Indicators and High Strength Bolts.

Messrs. Sandberg, the consulting inspecting and testing engineers of 40, Grosvenor Gardens, London, S.W.1., carried out a series of tests on 'Coronet' Load Indicators and High Strength Bolts. The tests were supervised by Mr. G.K. Wood, M.I. Mech.E., M.T. Loco. E. of Messrs. Sandberg, whose report as follow:

Introduction

The bolts, nuts and load indicator washers were selected at random from the warehouse of Cooper & Turner Ltd.., by our inspector and were submitted to us in sealed bags. It was requested that a series of loading tests be carried out on the load indicator washers and also a series of mechanical tests be carried out on the bolts.

The following materials were available:
27--3-3/4" long x 7/8" dia. Bolts with nuts representative of 4000 identical sized bolts. 3--5-1/2" long x 7/8" dia. Bolts with nuts representative of 2000 identical sized bolts. 54-load indicators for 7/8" dia. bolts representative of 7000 identical sized indicators. The twenty-seven bolts had been divided into three lots with three tests per lo tobe carried out. The fifty-four load indicator washers had been divided into three lots with a series of three test to be carried out on each lot. Thus six washers were available for each test with only the first one to be tested. However, if this one washer failed, the remaining five were to be tested.

Load Indicator Test Method of Testing

A North Bar Load Meter No. 2, supplied by Cooper & Turner Ltd., was used for the load test measurements. This was calibrated prior to and after testing, against our Universal Tensile Testing Machine (Grade A) and the readings obtained are tabulated below:

The method of testing was to place a bolt, fitted with a load indicator washer, through the Load Meter and to tighten a nut on the other side by means of a ratchet wrench. The gap between the washer and the underside of the bolt head was measured at the four positions by means of feeler gauges until an estimated average gap of 0.015" was reached. The Load Meter readings were taken and recorded against the gap between the load washer and the bolt head. In some cases the load was increased until the gap was reduced to nil.

Explanatory Notes

The hysteresis effect of the calibration of the Load Meter "Prior to Test" is caused by the sluggish operation of the hydraulic system after standing idle. This is largely mitigated by thorough exercising of the instrument before use, and is confined by the calibration figures taken:"After Test", which show an almost negotiable hysteresis effect, and confirm the degree of accuracy of the instrument. It will be noted that even after allowing for maximum hysteresis, all interpolated test loads fall within the specified load range for each Load Indicator.

North Bar Load Meter No. 2

Universal Tensile Machine (Load in Kips)	Prior to Test Ascending Load – Decending Load		After Test Ascending Load – Decending Load	
	(in Kips)	(in Kips)	(in Kips)	(in Kips)
11.2	10.3	11.9	10.07	11.04
22.4	21.2	23.6	22.0	22.06
33.6	32.0	35.3	33.2	34.0
44.8	42.8	46.6	44.5	45.1
56.0	53.8		55.5	

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Results 'Coronet' Load Indicators

Since these test were carried out, ASTM A325 had revised the minimum tension for 7/8" from 36.05 kips to 39.25 kips. 'Coronet' Load Indicators have been modified accordingly.

LOT NO. 1

Test #	Load Meter Reading	GAP				
		1	2	3	4	Average
1	37.0 kips	0.015"	0.017"	0.017"	0.012"	0.01525"
	38.2 kips	0.015"	0.018"	0.015"	0.010"	0.0145"
Interpolated load for gap of 0.015" = 37.6 kips						
2	39.2 kips	0.013"	0.017"	0.019"	0.017"	0.0165"
	40.6 kips	0.010"	0.013"	0.016"	0.015"	0.0135"
Interpolated load for gap of 0.015" = 39.5 kips						
3	39.2 kips	0.017"	0.014"	0.015"	0.018"	0.016"
	40.0 kips	0.016"	0.012"	0.013"	0.017"	0.0145"
Interpolated load for gap of 0.015" = 39.6 kips						
Nil gap 52.4 kips						

LOT NO. 2

Test #	Load Meter Reading	GAP				
		1	2	3	4	Average
1	39.0 kips	0.018"	0.011"	0.010"	0.018"	0.0125"
Nil gap 50.3 kips						
2	36.1 kips	0.015"	0.019"	0.023"	0.018"	0.01875"
	38.4 kips	0.010"	0.016"	0.018"	0.012"	0.014"
Interpolated load 0.015" gap = 39.4 kips						
3	39.1 kips	0.017"	0.017"	0.015"	0.015"	0.016"
	39.5 kips	0.016"	0.016"	0.014"	0.014"	0.015"
Load at 0.015" gap = 39.4 kips						

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Results 'Coronet' Load Indicators

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LOT NO. 3

Test #	Load Meter Reading	GAP				
		1	2	3	4	Average
1	38.0 kips	0.017"	0.017"	0.012"	0.017"	0.0145"
2	39.4 kips	0.016"	0.015"	0.015"	0.015"	0.01525"
	40.0 kips	0.016"	0.014"	0.015"	0.015"	0.015"
Load Indicator 0.015" gap = 40.0 kips						
3	38.6 kips	0.014"	0.016"	0.018"	0.016"	0.016"
	39.4 kips	0.011"	0.015"	0.016"	0.014"	0.014"
Interpolated load for gap of 0.015" = 39.0 kips						

Bolt Tests Proof load and ultimate load test were carried out on six bolts. The results obtained are tabulated below:

	Proof Load	Initial Length of Bolt	Length of Bolt After Test
Bolt #1	36.0 kips	5.843"	5.843"
Bolt #2	36.0 kips	5.845"	5.845"
Bolt #3	36.0 kips	5.840"	5.840"

	Ultimate Load	Position of Failure	
Bolt #4	67.0 kips	Failed in Threads	
Bolt #5	67.5 kips	Failed in Threads	
Bolt #6	68.4 kips	Failed in Threads	
B.S.3139	53.1 kips		

Elongation and reduction of area tests were carried out on three of the bolts.
The three specimens were prepared and tested in accordance with standard procedures.

	Elongation (percent)	Reduction of Area (percent)	
Specimen # 1	19.0	49.5	
Specimen # 2	17.8	51.8	
Specimen # 3	19.3	46.8	
A325	14 min.	35 min.	

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