

DTI's Technical Report #29

Tests on the tightening of A490 bolts.

Introduction

The tests investigate the Turn-of-Nut and 'Coronet' Load indicator methods of tightening A490 bolts and compare the resulting tensions with the required minimum bolt tensions. Tightening was continued and note taken of the further rotation of the nut to produce bolt failure.

Summary

The 'Coronet' Load Indicator provides a more accurate register of A490 bolt tension than the Turn-of- Nut Method and leaves adequate safety margin between load at specified gap and ultimate.

Procedure

Twelve 3-3/4" x 7/8" A490 bolts were machined on the head and shank end to permit accurate measurement of overall length.

Specification requirements are:

Min. Bolt Tension 51.7 kips

Min. Ultimate Load 69.3 kips

Sample details:

Bolt Lot No. 7117/1

C.L.I. Lot No. 8004/5

(i) Turn-of-Nut Method

A bolt was set up in a solid steel bar rigidly fixed to a column. The assembly included flat round washers under the head and nut such that there was 1/4" of thread protruding from the nut. The overall length was measured and preliminary tightening carried out with spud wrench and a mark made across the nut and bolt shank end. The nut was then tightened half a turn relative to the bolt, and the overall length again measured.

The bolt was transferred to a load meter and tightened until the overall length recorded was the same as had been shown under a half turn in the solid steel bar. This method eliminated any inaccuracy that might have been introduced by the compression of the load meter capsule. The load meter reading was recorded.

To avoid damage to the load meter, the bolt was returned to the solid bar to continue the test to failure. After tightening to the loaded length previously obtained after half a turn, the further rotation of the nut to breaking point was observed.

The test was repeated on an additional five bolts.

Turn-of-Nut Method Results

Sample	Initial Length Inches	Length Under 1/4" turn Inches	Extension Inches	Load Meter Reading Kips	Further turn of nut to Failure
1	4.283	4.323	.040	61.6	3/4
2	4.260	4.294	.034	65.0	1/2
3	4.289	4.323	.034	66.4	1/2
4	4.264	4.309	.045	68.4	1/2
5	4.277	4.311	.034	66.0	1/2
6	4.281	4.322	.041	62.8	1/2

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(ii) 'Coronet' Load Indicator Method

A bolt was set up in the load meter with a Load Indicator under the head in place of a flat round washer and 3/16" of bolt protruding from the nut. The initial length was recorded and the bolt tightened until a 0.015" average gap was measured (See Cooper & Turner Leaflet 61/1A for measuring procedure) Note was taken of the load meter reading. After unloading, the overall length was checked to confirm that the 0.2% proof

stress had not been exceeded. The bolt was then transferred to the solid bar and tightened with a fresh load indicator under the head to the 0.015" average gap condition. Nut and bolt ends were marked and the further rotation of the nut to failure noted.

The test was repeated on an additional five bolts.

'Coronet' Load Indicator Method Results

Sample	Initial Length Inches	C.L.I. Average Gap x 1000 Inches	Load Meter Reading Kips	Length after Unloading Inches	Extension Inches
7	4.3514	15.5	15.0	4.3525	0.0011
8	4.3400	15.0	57.4	4.3430	0.0030
9	4.3235	15.5	58.8	4.3240	0.0005
10	4.3535	15.5	57.5	4.3545	0.0010
11	4.3590	15.5	58.3	4.3595	0.0005
12	4.3470	15.5	56.0	4.3475	0.0005

Reloading

Sample	C.L.I. Average Gap x 1000 Inches	Turns to obtain Average Gap*	Further turns to Failure
7	15.0	¾	1-1/4
8	15.2	¾	1-1/4
9	12.7	¾	1
10	15.1	¾	2
11	14.1	¾	1
12	12.5	¾	1-1/4

*This rotation of nut also includes the amount required to compress the C.L.I. protrusions.

Discussion of results

It has been shown that the Turn-of-Nut method on A490 bolts produces bolt tensions close to the minimum ultimate load.

The 'Coronet' Load Indicator can be depended upon to give a consistently safe proper tension in A490 bolts.

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