



COMPARISON TESTING OF COMPRESSION STRENGTH

UNFILLED VS FILLED SELF-INDICATING DIRECT TENSION INDICATING WASHERS

This document is a summary of the results of comparison testing performed by Applied Bolting Technology Products, Inc of Ludlow, Vermont and MMA Laboratories of Newtown, Pennsylvania of the compression load strength properties of filled and unfilled Self-Indicating Direct Tension Indicating Washers (Also known as "SQUIRTERS")

DEFINITIONS:

DIRECT TENSION INDICATING WASHER – Load indicating washer that indicates bolt tension through the measured plastic deformation of protrusions stamped into the surface of the device.

SELF-INDICATING DIRECT TENSION INDICATING WASHER (SQUIRTER) – load indicating washer that indicates bolt tension through the measured plastic deformation of protrusions stamped into the surface of the device *and through the extrusion of pigmented compound around the outer diameter of the device.*

PROTRUSION CAVITIES – Voids under the stamped protrusions of direct tension indicating washers.

UNFILLED – That physical state whereby the protrusion cavities of the self-indicating direct tension indicating washer have not been filled with pigmented compound.

FILLED - That physical state whereby the protrusion cavities of the self-indicating direct tension indicating washer have been filled with pigmented compound.

PLAIN – That physical state whereby the self-indicating direct tension indicating washer has been heat treated but has not been coated with mechanical zinc or any other protective coating.

SCOPE:

Compression load testing per ASTM F959 – The governing specification for Direct Tension Indicating Washers was performed on unfilled and filled plain Self-Indicating Direct Tension Indicating Washers by both the Quality Assurance Laboratory of Applied Bolting Technology Products, Inc. and MMA Laboratories, Inc. This testing was performed to determine if the application of pigmented indicating compound to the protrusion cavities of these washers affected their compression load strength characteristics.

TESTING:**APPLIED BOLTING TECHNOLOGY PRODUCTS, INC.**

Compression load testing per ASTM F959 was performed by John A. Herr, Director – Quality Assurance on two – 27 piece samples of 7/8" A325 Plain Self-Indicating DTI washers from production Lot FC6: one sample in the unfilled condition and one sample in the filled condition.

MMA LABORATORIES, INC.

Compression load testing per ASTM F959 was performed by MMA Laboratories, Inc. on two – 15 piece samples of 7/8" A325 Plain Self-Indicating DTI washers from production Lot FC6: one sample in the unfilled condition and one sample in the filled condition.

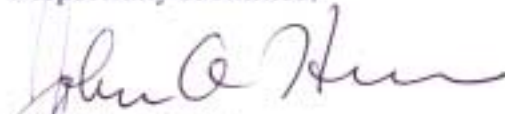
RESULTS:

Comparison between the compression load testing results of the unfilled and filled products showed no statistically significant variation (greater than two standard deviations) in the mean values of each test series performed by either MMA Laboratories, Inc. or Applied Bolting Technology Products, Inc

Furthermore, no statistically significant variation was evident when the test results of each laboratory was compared against the other.

Data and graphs follow.

Respectfully submitted,



JOHN A. HERR
Director – Quality Assurance
Applied Bolting Technology Products, Inc.

MMA LABS TEST #EANY-05-02-16631

TEST DATE - 5/9/00

VERIFICATION TESTING - LOT FC6
UNFILLED 7/8" A325 PLAIN FINISH
SELF-INDICATING DTIS

VERIFICATION TESTING - LOT FC6
FILLED 7/8" A325 PLAIN FINISH
SELF-INDICATING DTIS

45423
45130
45738
45000
46161
45613
45580
45271
44853
44728
45559
45206
44820
45672
45759

45483
44272
43333
46655
44370
46514
45086
45222
44198
45374
45005
44402
44761
45818
44001

MEAN 45368 LBS/F

STANDARD DEVIATION 410

MEAN 44966 LBS/F

STANDARD DEVIATION 921

COMPARISON OF THE TWO TESTING SERIES SHOWS THAT THERE IS LESS THAN TWO STANDARD DEVIATIONS DIFFERENCE BETWEEN THE MEANS, INDICATING THAT COMPRESSION FORCE CHARACTERISTICS BETWEEN THE UNFILLED AND FILLED PRODUCT STATES ARE RELATIVELY INDISTINGUISHABLE.

TESTING WAS PERFORMED PER ASTM F959-99A - ANNEX B MMA LABORATORIES
2 PHEASANT RUN
NEWTOWN, PA
18940

CUSTOMER:

APPLIED BOLTING TECHNOLOGY
P.O. BOX 255
101 MAIN STREET
LUDLOW, VT 05149
Attention: JOHN A. HERR

DATE: 05/09/2000

P.O. NO.: 0400

PART NUMBER: N/S

HEAT NUMBER: N/S

LOT NUMBER: FC6

SPECIFICATION: ASTM-F959-99a

MMA W.O. NO.: EANY-05-02-16631

CERTIFICATION OF TESTING
ALL TESTING PERFORMED IN A MERCURY-FREE ENVIRONMENT

* CORRECTED CERTIFICATION 05/12/00 *

DESC: 7/8" A325 PLAIN DTIS
SELF-INDICATING DIRECT TENSION INDICATING WASHER - ANNEX

LOAD INDICATING WASHER TEST
REQUIREMENTS: 39,000-47,000 LBS

UNFILLED		* FILLED *	
1)	45,423 LBS	1)	45,483 LBS
2)	45,130 LBS	2)	44,272 LBS
3)	45,738 LBS	3)	43,333 LBS
4)	45,000 LBS	4)	46,655 LBS
5)	46,161 LBS	5)	44,370 LBS
6)	45,613 LBS	6)	46,514 LBS
7)	45,580 LBS	7)	45,086 LBS
8)	45,271 LBS	8)	45,222 LBS
9)	44,853 LBS	9)	44,198 LBS
10)	44,728 LBS	10)	45,374 LBS
11)	45,559 LBS	11)	45,005 LBS
12)	45,206 LBS	12)	44,402 LBS
13)	44,820 LBS	13)	44,761 LBS
14)	45,672 LBS	14)	45,818 LBS
15)	45,759 LBS	15)	44,001 LBS

AFTER REVIEW OF THE TEST DATA, IT WAS DETERMINED THAT THE DATA FOR THE TWO* CONDITIONS SHOWED STATISTICALLY INDISTINGUISHABLE DIFFERENCES.
ALL DATA FELL WITH +/- TWO STANDARD DEVIATIONS

15 TESTS LISTED ON THIS CERTIFICATION HAVE BEEN PERFORMED IN ACCORDANCE WITH ASTM-F959-99a AND ALL TESTED SAMPLES DO CONFORM TO THE SPECIFICATION REQUIREMENTS.

Page 1 of 1

THE ANALYSIS REPORTED ON THIS CERTIFICATION HAS BEEN PERFORMED IN ACCORDANCE WITH STORK-MMA QUALITY MANUAL, 1st EDITION REV. 13 DATED MARCH 2000 AND RELATED PROCEDURES. THE SAMPLES TESTED OR INSPECTED ON THIS CERTIFICATION ARE CERTIFIED ONLY FOR THE TESTING PERFORMED.

RESPECTFULLY SUBMITTED,


RON COX

Manager, Technical Service

SUMMARY OF TESTING - APPLIED BOLTING TECHNOLOGY PRODUCTS, INC.

12 POND ST. LUDLOW, VT 05149

CERTIFICATION TESTING - LOT FC6
UNFILLED 7/8" A325 PLAIN FINISH
SELF-INDICATING DTIS
TEST DATE - 3/17/00

43380	44950
44520	43980
45760	44250
45280	45250
45170	45820
44640	44890
45410	44450
46110	44160
45830	45980
44940	43660
44520	44870
45960	45670
45740	44490
45670	

MEAN 45013 LBS/F

STANDARD DEVIATION 753

FOLLOW-UP TESTING - LOT FC6
FILLED 7/8" A325 PLAIN FINISH
SELF-INDICATING DTIS
TEST DATE - 4/28/00

45030	44890
43790	44310
44360	45060
44880	45350
44680	44280
44580	43940
44020	44600
44380	43990
43960	44890
44130	45310
45050	43340
44220	44580
45890	45000
43920	

MEAN 44534 LBS/F

STANDARD DEVIATION 573

COMPARISON OF THE TWO TESTING SERIES SHOWS THAT THERE IS LESS THAN TWO STANDARD DEVIATIONS DIFFERENCE BETWEEN THE MEANS, INDICATING THAT COMPRESSION FORCE CHARACTERISTICS BETWEEN THE UNFILLED AND FILLED PRODUCT STATES ARE RELATIVELY INDISTINGUISHABLE.

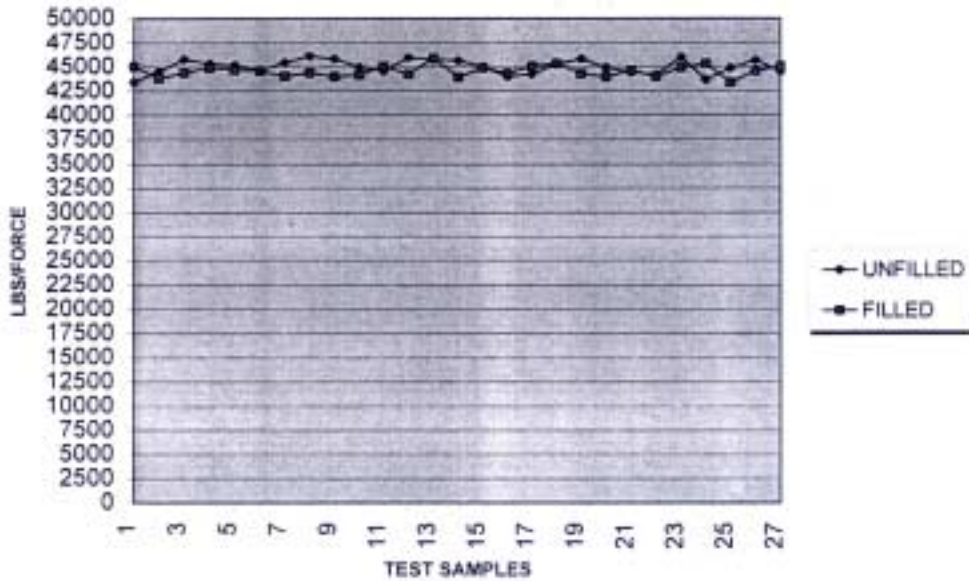
TESTING WAS PERFORMED PER ASTM F959-99A - ANNEX BY JOHN A. HERR, DIRECTOR - QUALITY ASSURANCE
APPLIED BOLTING TECHNOLOGY PRODUCTS, INC. USING A COMPRESSION FORCE TESTER CONFORMING TO ASTM F959
GAUGE NUMBER: G-026
CALIBRATION DATE: 03/00
NEXT DUE DATE: 06/00



NADCAP CERT NO: 0010
VALID THROUGH JULY 31, 2000

COMPARISON GRAPHS - FILLED VS UNFILLED SELF INDICATING DIRECT TENSION INDICATORS

TEST DATA - APPLIED BOLTING



TEST DATA - MMA LABS

