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INVESTIGATION FOR DETERMINING THE TORQUE-TENSION RELATIONSHIP OF SCREW THREADED FASTENERS USED ON AIRCRAFT

ABRAHAM B. ASCH

ASCH EQUIPMENT COMPANY

JULY 1957

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INVESTIGATION FOR DETERMINING THE TORQUE-TENSION RELATIONSHIP OF SCREW THREADED FASTENERS USED ON AIRCRAFT

ABRAHAM B. ASCH

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JULY 1957

SPECIAL PROJECTS BRANCH

AIRCRAFT LABORATORY

CONTRACT No. AF 33 (616)-2808

PROJECT No. 1318

TASK No. 13444

WRIGHT AIR DEVELOPMENT CENTER
AIR RESEARCH AND DEVELOPMENT COMMAND
UNITED STATES AIR FORCE
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

FOREWORD

This report, which describes the Torque-Tension Relationships of Screw Thread Fasteners for Aircraft, and the methods used to obtain these relationships, was prepared by Asch Equipment Company of Dayton, Ohio, Order No. P-1227.

This program was performed under Contract No. AF 33(616)-2808, Project No. 1318, Task No. 13444, for the Special Projects Branch WCLSJ-3 of the Aircraft Laboratory, Wright Air Development Center, Mr. A. B. Nutt, Branch Chief, Mr. J. W. Evans, Section Chief and Mr. F. A. Hannon, Project Engineer.

Work on this project was begun on January 28, 1955 and was completed June 21, 1957.

ABSTRACT

This report describes the work done and the results obtained during a program to determine the relationship between the torque required to tighten various types of aircraft bolts and screws and the tensile stress induced in the root area of these bolts and screws by this torque.

The torque-tension relationship was investigated for successive tightenings to high tensile stress levels from the head and nut, with and without lubrication.

The bolts upon which tests were performed were the MS-20,004 to MS-20,024 series (14 sizes), the AN-3C to AN-20C series (13 sizes), and the AN-509-3R to AN-509-916R series flat head screws (8 sizes).

For conditions of dry torquing the torque-tension relationship was found to be a function of many variables; among which were:

1. The type of metal, hardness and surface finish of the plates being bolted.
2. The amount of clearance in the hole drilled to accommodate the bolt.
3. The type of metal, hardness and plated or unplated condition of the bolts and nuts.
4. The geometry and surface finish of the head and nut bearing surfaces.
5. The number of successive tightenings.

Lubricated condition torquing produces average torque-tension relationships which do not vary appreciably over repeated torquings to the high tensile stress levels.

The above listed variables do not play as important a role in the case of lubricated torquing.

The increase in torque value for the dry condition for successive tightenings to the same stress level is due principally to two factors:

1. Galling of the head or nut seating surfaces.
2. Galling of the threads between the nut and bolt.

Preliminary tests indicate that #1 accounts for a considerably greater percentage of the increase in torque values than does thread galling, which suggests a method of partially lubricated torquing.

PUBLICATION REVIEW

The publication of this report does not constitute approval by the Air Force of the findings or conclusions herein. It is published only for the exchange and stimulation of ideas.

FOR THE COMMANDER:

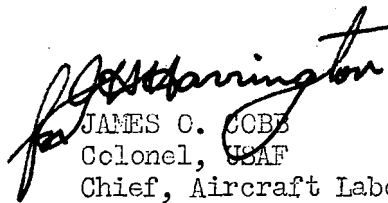

JAMES C. COBB
Colonel, USAF
Chief, Aircraft Laboratory

TABLE OF CONTENTS

<u>SECTION</u>		<u>PAGE</u>
I	Introduction	1
II	Specimens	2
III	Tests & Equipment	8
IV	Preliminary Testing	17
V	Test Procedures	21
VI	Test Results	24
VII	Conclusions	26
	Appendix I - Dimensional Details of Bolts Tested	31
	Appendix II - Hardness & Surface Finish Test Data	41
	Appendix III - Data Sheets of Torque-Tension Relationships	86
	Appendix IV - Graphs of Torque-Tension Relationships	126

LIST OF ILLUSTRATIONS

<u>FIGURE</u>	<u>PAGE</u>
1. Types of Bolts & Nuts Tested	7
2. Bolt Testing Machine	10
3. Strain Gage Compression Cells	11
4. Strain Gage Torsion Cells	12
5. Test Set Up - MS 20,004 to MS 20,024 Series Bolts .	13
6. Test Set Up for AN-509 Screws	14
7. Test Set Up for AN-20 to AN-20C Bolts	15
8. Hardened Steel Spacer Blocks	16
9. Examples of Test Specimen & Tool Failures	25

LIST OF TABLES

<u>TABLE</u>	<u>PAGE</u>
1. MS Bolts Tested	4
2. AN-509 Screws Tested	5
3. AN-3C Bolts Tested	6

SECTION I

I N T R O D U C T I O N

PURPOSE

The purpose of this contract is to determine the relationship between torque required to tighten various types of aircraft bolts and screws, and the tensile stress induced in the root area of these bolts and screws by this torque.

TEST CONDITIONS

The relationship was investigated for repeated torquings from the head, and from the nut, with and without lubrication. Hardness and surface finish tests were also made for comparison purposes.

BOLTS TESTED

All sizes in the MS-20,004 to MS-20,024 series, the AN-509-8R to AN-509-916R series and the AN-3C to AN-20C series were tested with suitable nuts. All nuts and bolts used were purchased in the open market with the exception of a limited number of nuts furnished by two aircraft manufacturers for comparison purposes.

TEST EQUIPMENT

The tests were performed on a special testing machine designed and built for the purpose, and capable of producing indications of torque and tension simultaneously.

Manuscript released by the author June, 1957 for publication as a WADC Technical Report.

SECTION II

S P E C I M E N S

BOLTS TESTED

Tests were performed on the following bolts and nuts:

<u>Sizes</u>	<u>Bolt</u>	<u>Nut</u>
14	MS-20,004 to MS-20,024	EB
6	MS-20,009 to MS-20,018	42 FW
8	AN-509-8R to AN-509-916R	AN-365
3	AN-509-8R to AN-509-416R	NMJ
9	AN-3C to AN-12C	AN-363-C
4	AN-14C to AN-20C	AN-310-C

Tables 1, 2 and 3, lists the sizes tested and the coded designations.

SPECIMEN IDENTIFI- CATION

The specimens used for the torque tension tests were identified by a code comprised of letters and digits indicating the following:

The first letter or letters designate the size of the bolt and the type as noted in Tables 1, 2 and 3.

The second digit indicates the specimen number. Five specimens were used for each condition of test.

The third letter is either H or N indicating whether the specimen was torqued from the head or from the nut.

When lubrication was used in testing the specimen, a fourth letter L was added to the code designation.

For example, the specimen E-3-N-L is the third specimen of the MS-20,008 bolt group and was torqued from the nut after the application of lubricant to the threads and to both the nut and head

seating surfaces.

During the course of the test program, several sizes of nuts which were supplied by Lockheed Aircraft Corporation and by Boeing Airplane Company were tested. These nuts were used with bolts F, G, H, I, J and K in the MS-20,009 to MS-20,018 series. These have been further identified in the "Test Data" sheets by the letter A for the nuts supplied by Lockheed and the letter B for the nuts supplied by Boeing. This letter appears before the specimen number.

Appendix I contains the dimensional details of the bolts and nuts used. Figure 1. shows the various types of specimens used.

TABLE 1
MS BOLTS TESTED

MS SERIES BOLTS
YIELD POINT - 140,000 LB/SQ. IN.

CODE No.	AN STANDARD No.	THREAD SIZE	ROOT AREA SQ. IN.	NUT No.
A	MS-20004-42	1/4-28 UNF-3A	0.0326	EB-048
B	MS-20005-50	5/16-24 UNF-3A	0.0524	EB-054
C	MS-20006-50	3/8-24 UNF-3A	0.0809	EB-064
D	MS-20007-50	7/16-20 UNF-3A	0.1090	EB-070
E	MS-20008-50	1/2-20 UNF-3A	0.1486	EB-080
F	MS-20009-50	9/16-18 UNF-3A	0.1888	EB-098 42FW-918
G	MS-20010-50	5/8-18 UNF-3A	0.2400	EB-103 42FW-1018
H	MS-20012-50	3/4-16 UNF-3A	0.3513	EB-126 42FW-1216
I	MS-20014-50	7/8-14 UNF-3A	0.4805	EB-144 42FW-1414
J	MS-20016-50	1-14 UNF-3A	0.6464	EB-164 42FW-1614
K	MS-20018-50	1 1/8-12 UNF-3A	0.8118	EB-182 42FW-1812
L	MS-20020-50	1 1/4-12 UNF-3A	1.0237	EB-202
M	MS-20022-52	1 3/8-12 UNF-3A	1.2602	EB-222
N	MS-20024-52	1 1/2-12 UNF-3A	1.5212	EB-242

COMMENTS:

NUTS - ELASTIC STOP NUT CORR - TYPE EB DOUBLE HEX. HIGH TENSILE

EXTERNAL WRENCHING NUTS

STANDARD PRESSED STEEL - 42FW HIGH TENSILE EXTERNAL WRENCHING

(2-EACH USED ON BOLTS - F, G, H, I, J, K)

TABLE 2
AN509 SCREWS TESTED

AN509 SERIES SCREWS
YIELD POINT - 130,000 ^{LB}/SQ. IN.

CODE No.	AN STANDARD No.	THREAD SIZE	ROOT AREA SQ. IN.	NUT No.
O	AN509-8R37	8-32 NC-3A	0.0120	AN365-832
P	AN509-10R37	10-32 NF-3A	0.0175	AN365-1032
Q	AN509-416R37	1/4-28 UNF-3A	0.0326	AN365-428
R	AN509-516R48	5/16-24 UNF-3A	0.0528	AN365-524
S	AN509-616R48	3/8-24 UNF-3A	0.0809	AN365-624
T	AN509-716R48	7/16-20 UNF-3A	0.1090	AN365-720
U	AN509-816R49	1/2-20 UNF-3A	0.1486	AN365-820
V	AN509-916R52	9/16-18 UNF-3A	0.1838	AN365-918
W	AN509-8R37	8-32 NC-3A	0.0120	NMJ-82
X	AN509-10R37	10-32 NF-3A	0.0175	NMJ-02
Y	AN509-416R37	1/4-28 UNF-3A	0.0326	NMJ-048
<u>COMMENTS:</u> "O THRU V" - STEEL NUTS - AN365 "W-X-Y" - ALUM. NUTS - NMJ-82, NMJ-02, NMJ-048 HIGH STRENGTH (ELASTIC STOP NUT CORP.)				

TABLE 3

AN-C BOLTS TESTED

AN SERIES BOLTS
YIELD POINT - 111,000 $\frac{\text{LB}}{\text{SQ. IN.}}$

CODE N ^o	AN STANDARD N ^o	THREAD SIZE	ROOT AREA SQ. IN.	NUT N ^o
A-A	AN 3C - 30	10-32 UNF-3A	0.0175	AN 363C-1032
B-B	AN 4C - 30	1/4-28 UNF - 3A	0.0326	AN 363C-428
C-C	AN 5C - 35	5/16-24 UNF - 3A	0.0524	AN 363C-524
D-D	AN 6C - 36	3/8-24 UNF - 3A	0.0809	AN 363C-624
E-E	AN 7C - 36	7/16-20 UNF - 3A	0.1090	AN 363C-720
F-F	AN 8C - 37	1/2-20 UNF - 3A	0.1486	AN 363C-820
G-G	AN 9C - 37	9/16-18 UNF-3A	0.1888	AN 363C-918
H-H	AN 10C - 37	5/8-18 UNF - 3A	0.2400	AN 363C-1018
I-I	AN 12C - 41	3/4-16 UNF - 3A	0.3513	AN 363C-1216
J-J	AN 14C - 42	7/8-14 UNF - 3A	0.4805	AN 310C-14
K-K	AN 16C - 42	1 - 14 UNF - 3A	0.6464	AN 310C-16
L-L	AN 18C - 44	1 1/8-12 UNF - 3A	0.8118	AN 310C-18
M-M	AN 20C - 45	1 1/4-12 UNF-3A	1.0237	AN 310C-20

COMMENTS:

NUTS - AN 363C - TO 3/4-16 SIZE
ABOVE 3/4-16 USED AN 310C

FIG. 1

TYPES OF BOLTS TESTED

MS20,000

AN509

AN-C

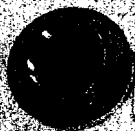


CADMIUM PLATED



STAINLESS STEEL

TYPES OF NUTS TESTED



42FW

AN365



AN363-C

SILVER PLATED

CADMIUM PLATED



EB



AN310-C

STAINLESS STEEL

NMJ-363-C
ALUMINUM

TYPES OF BOLTS & NUTS TESTED

SECTION III

TESTS AND EQUIPMENT

TORQUE- TENSION TESTS

In order to test the bolt torque-tension relationship, a special testing machine was designed and built. This testing machine incorporates a motorized drive for torquing the bolts. See Fig. 2.

Tension measurements were made by compressing calibrated strain gage load cells with the bolts. Four sizes of load cells were used for the complete range of bolt tension. Calibration of the compression cells was performed on a Tinius-Olsen Compression Tester, with a capacity of 200,000 lbs. Fig. 3 shows the compression cells.

Torsion measurements were made on calibrated torsion load cells. Four sizes were used for the complete range of torsion. Calibration of the torsion cells was performed on a Tinius-Olsen Torsion Tester, with a capacity of 60,000 in. lbs. Fig. 4 shows the torsion cells.

Bolt tension and torsion measurements were read directly from Asch Equipment Company self balancing type strain indicators. See Fig. 2.

The test set up for the different types of bolts are shown in Fig. 5, 6 and 7.

HARDNESS TESTS

Hardness tests were made on several specimens from each type and for each size of the bolts and nuts, and also on representative spacer blocks. These were made on a Rockwell Hardness Tester.

The spacer blocks were countersunk to allow clearance for the fillets under the heads of the MS-20,004 to MS-20,024 series bolts,

and the AN-3C to AN-20C series bolts, and also-for the flat heads of the AN-509-8R to AN-509-916R series screws. Contours are shown on the "Test Data" sheets in Appendix III. The spacer blocks used with the nuts were not countersunk. Spacer blocks are shown in Fig. 8.

SURFACE
FINISH
TESTS

Tests were also performed on the same specimens for finish of the seating surface of the heads and the nuts where they contact the spacer blocks, and also of the bearing surface of the spacer blocks. A Profilometer was used for these tests. Prior to making the tests, the Profilometer used was calibrated against known standards and found to be indicating 75% of the R.M.S. values. In the data sheets a correction factor of 1.33 was applied to the Profilometer readings.

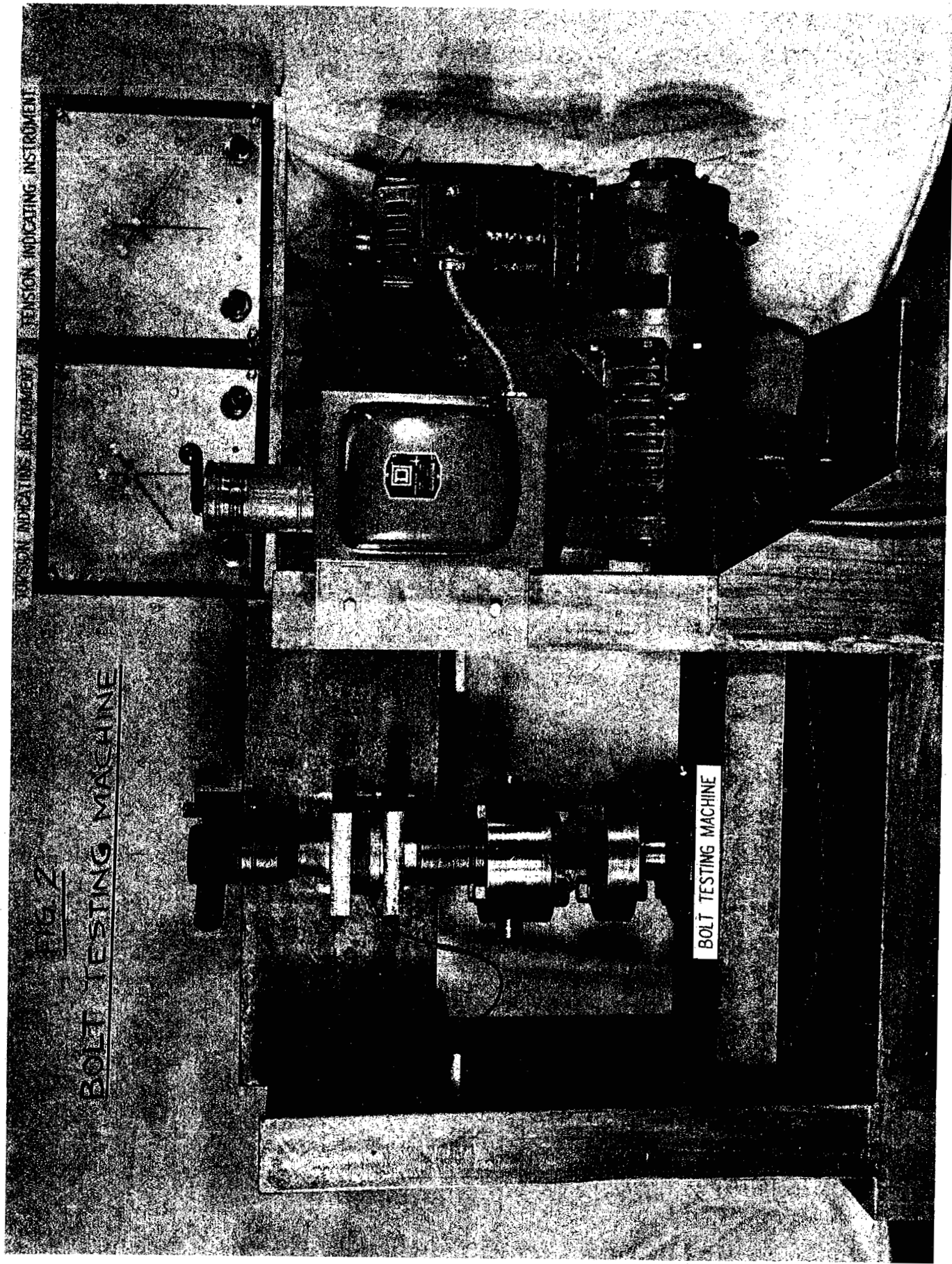
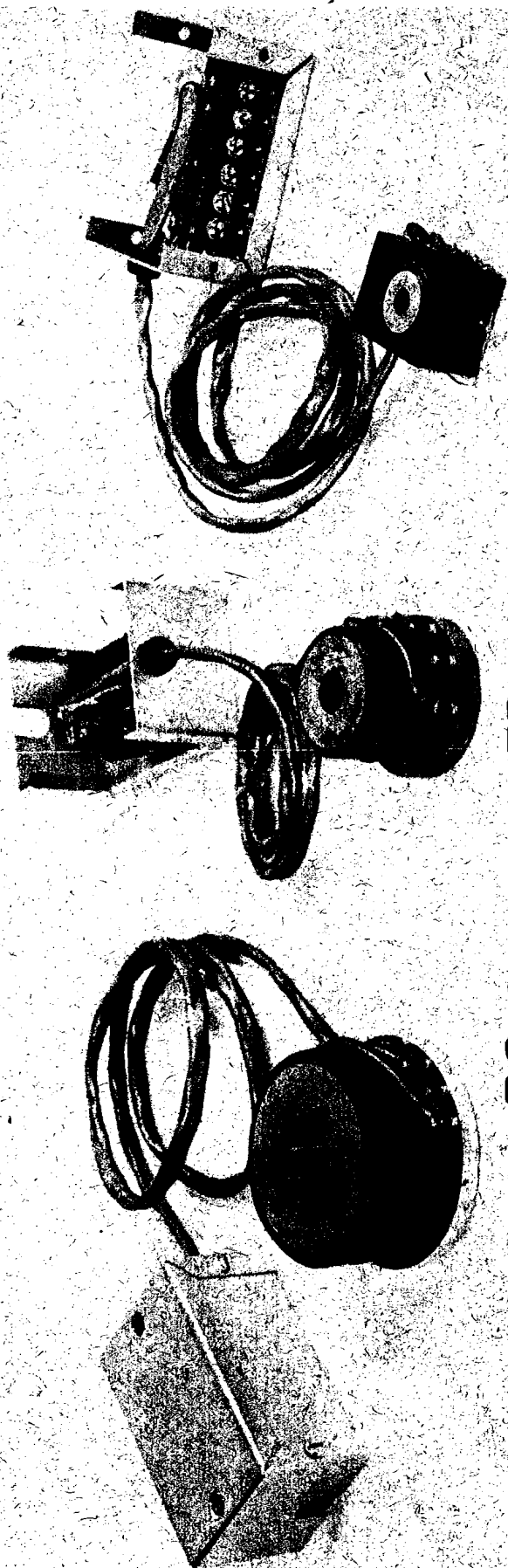


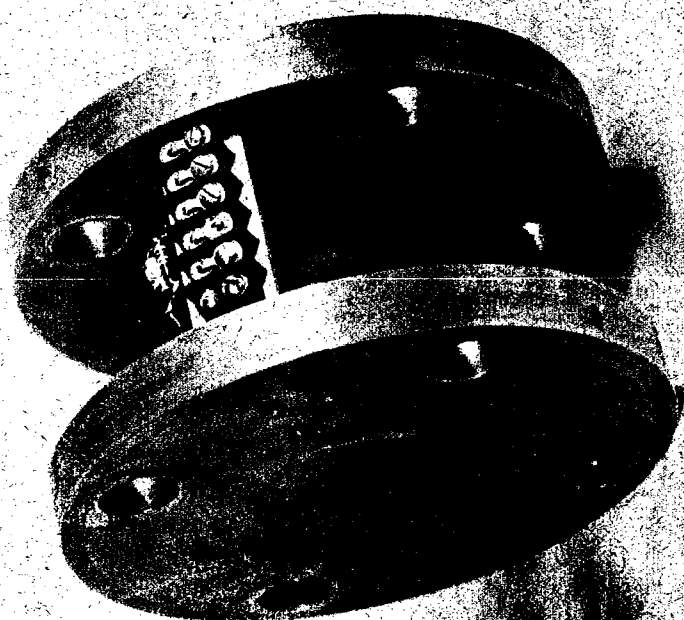
FIG. 2
BOLT TESTING MACHINE

FIG. 3

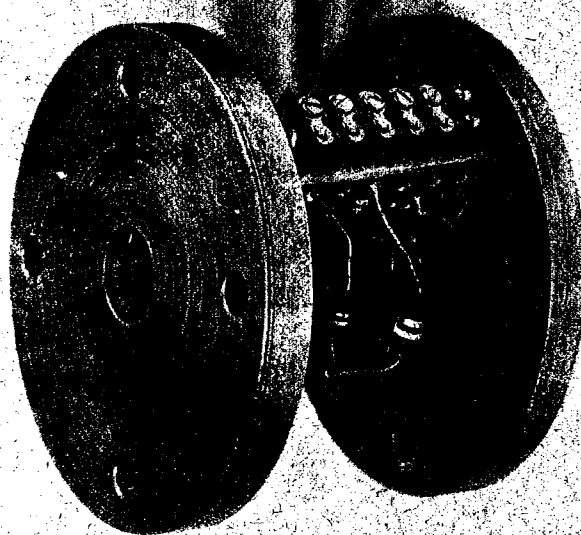


STRAIN GAGE COMPRESSION CELLS

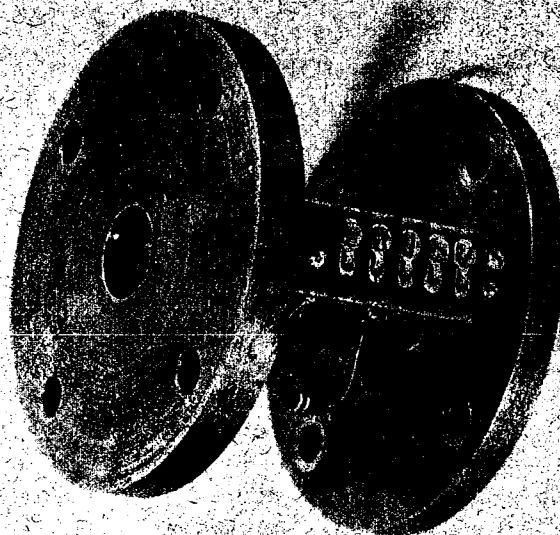
FIG. 4



6B



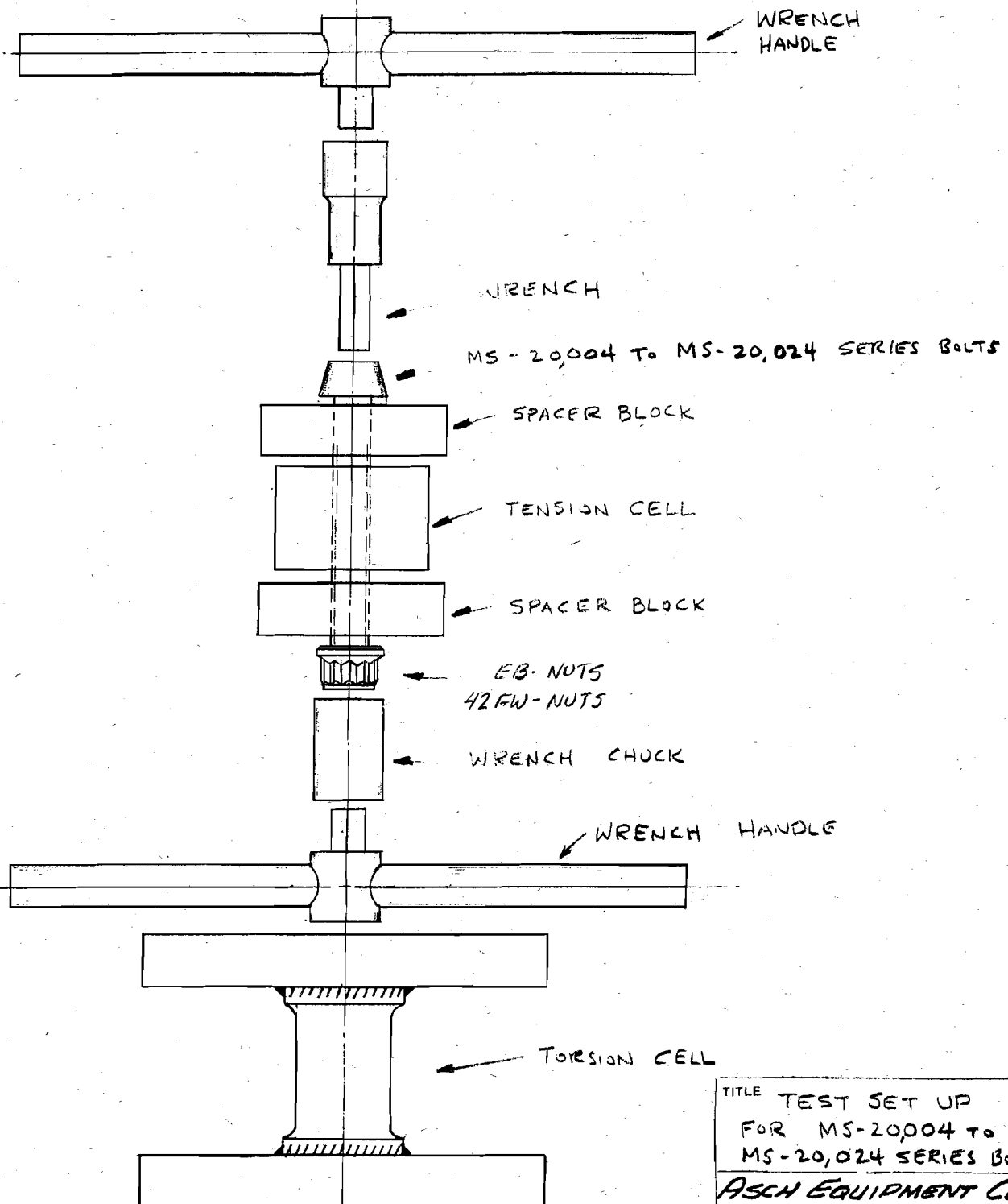
7B



7A

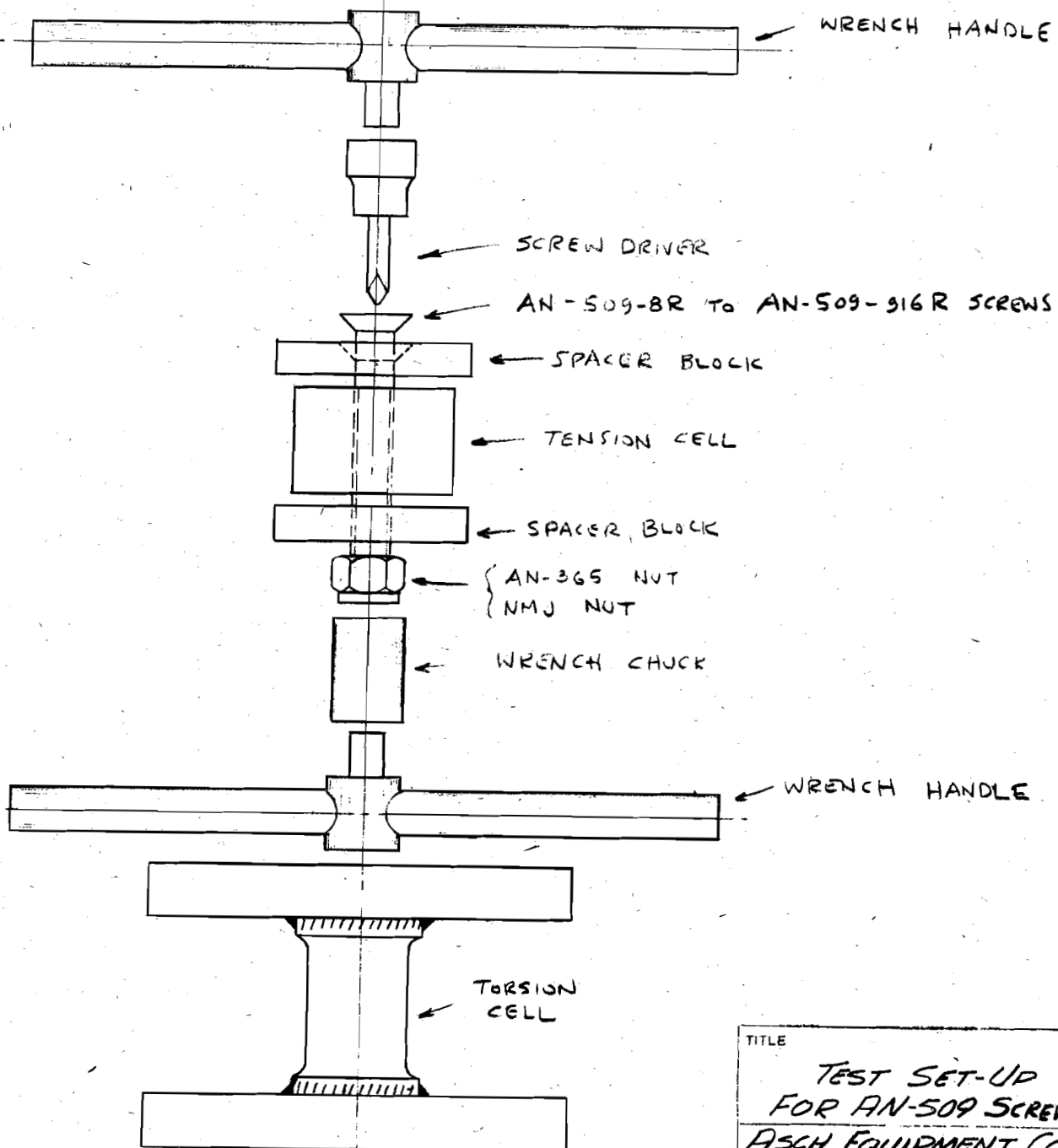
STRAIN GAGE TORSION CELLS

FIG. 5



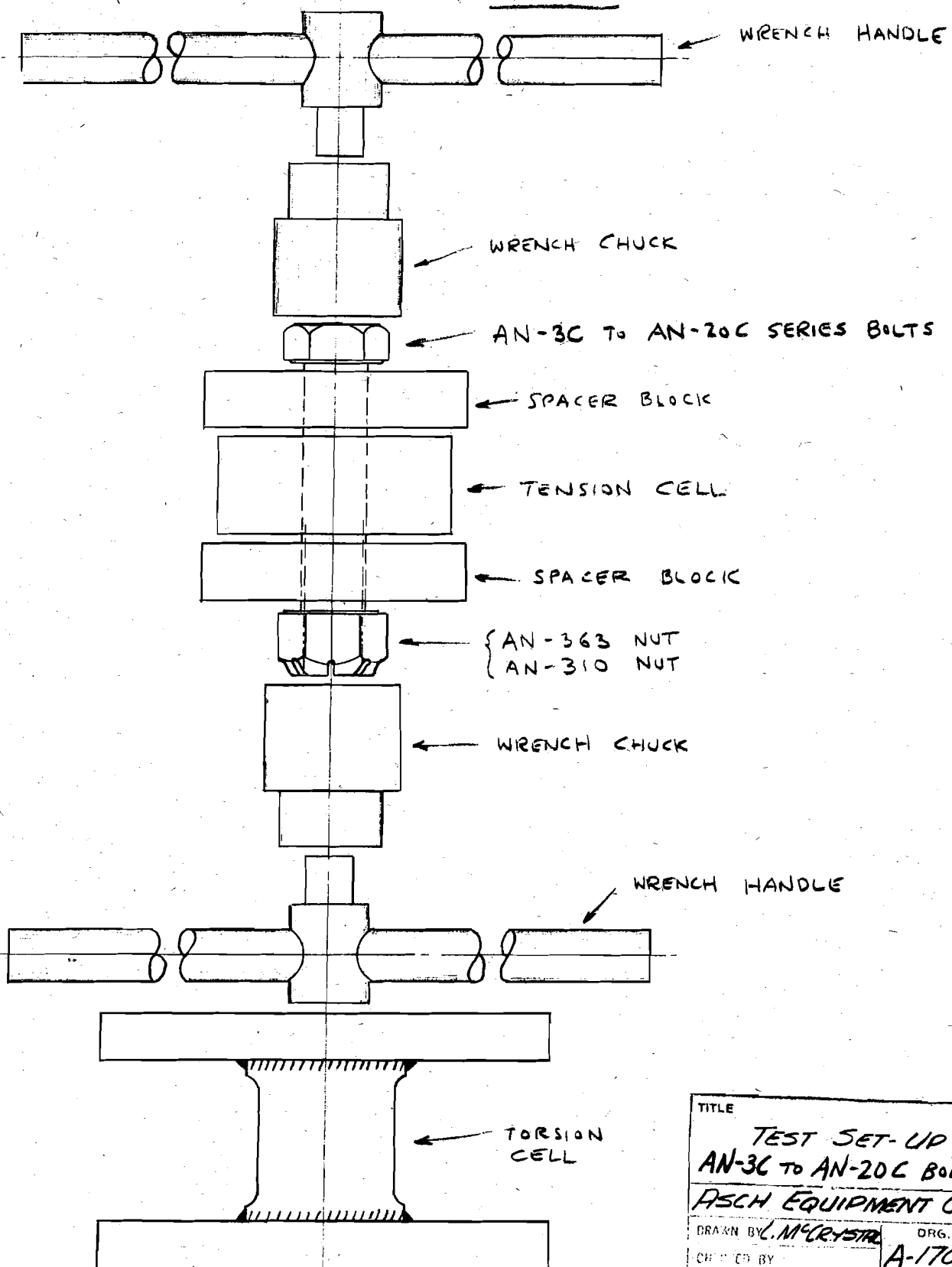
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ASCH EQUIPMENT CO.		
DRAWN BY L. M. CRYSTAL	ORG. NO.	
CHECKED BY	A-1706	
DATE 8/22/55	SCALE NONE	PART NO.

FIG. 6



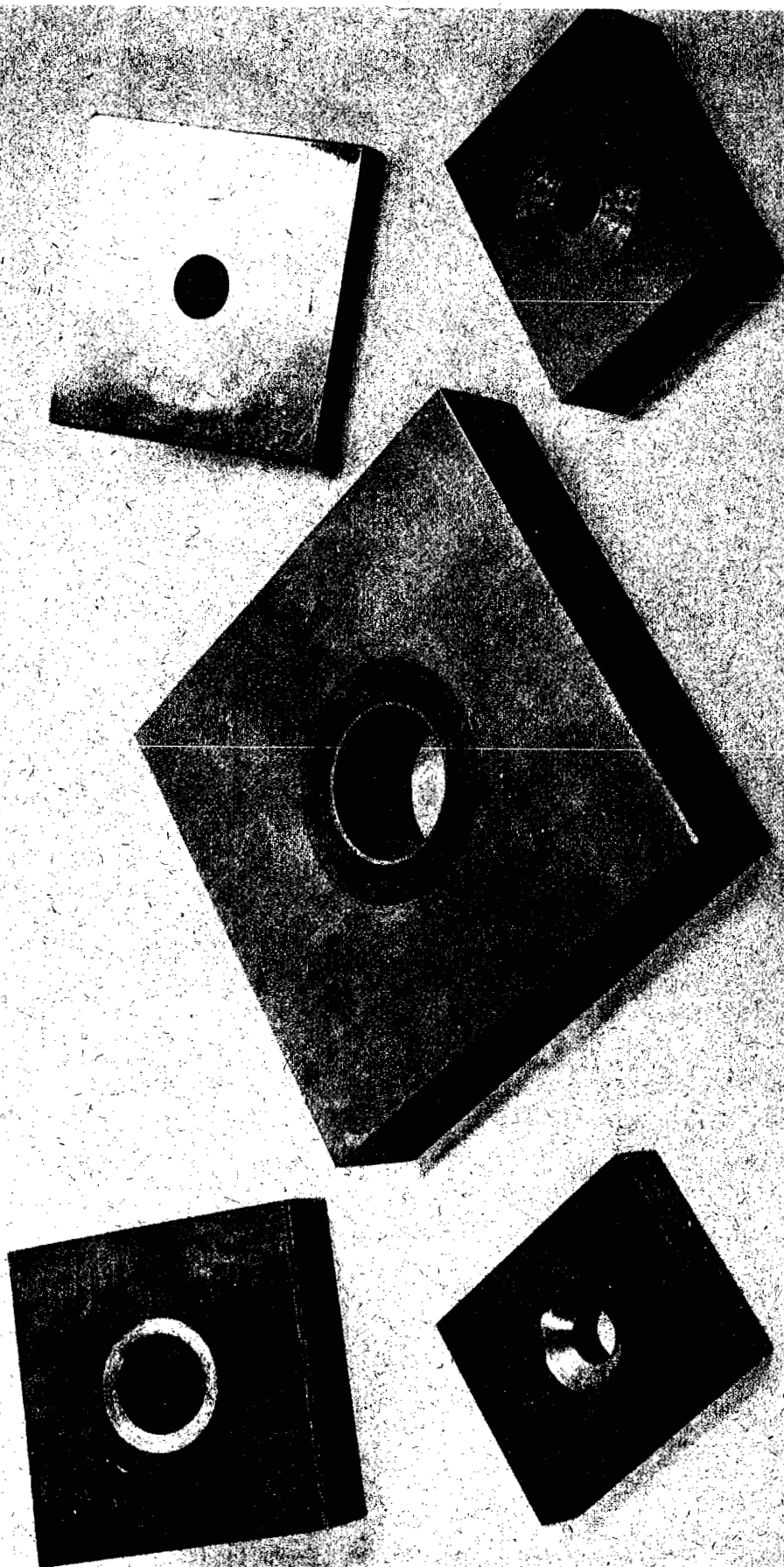
TITLE		
TEST SET-UP FOR AN-509 SCREWS		
ASCH EQUIPMENT CO.		
DRAWN BY	CHKD BY	DES. NO.
LINKRYSTAL		A-1708
DATE	SCALE	PART NO.
8-22-55	NONE	

FIG. 7



TITLE		
TEST SET-UP AN-3C TO AN-20C BOLTS		
PSCH EQUIPMENT CO.		
DRAWN BY	L. McCRYSTAL	DRG. NO.
CHECKED BY		A-1707
DATE	8-22-55	SCALE
	NONE	PART NO.

FIG. 8



HARDENED STEEL SPACER BLOCKS

SECTION IV

PRELIMINARY TESTING

TESTS OF TORQUING METHODS

Initial experimental tests were made using AN-4C-30, 1/4-28 UNF-3A stainless steel bolts and AN-363-C428 silver plated steel nuts.

In these tests the compression recording strain gage cell was sandwiched between cold rolled steel spacer blocks drilled to accommodate the 1/4" diameter AN bolts. Bolts were torqued in the dry condition from the nut.

Two methods of obtaining torque-tension data for multiple torquings of the individual bolt-nut combinations were investigated.

1. Torquing the bolts to a maximum tension value (less than that causing bolt yield) in six uniform steps, returning to zero tension and repeating the sequence five times.
2. Torquing the bolts from zero tension to the first of six uniform steps five times in succession and repeating for each higher tension point up to the maximum tension.

Torquing to each tension value five times before proceeding to the next, required greater values of torque at the higher tension loads than did the method of torquing the bolt from minimum to maximum tension five times in succession. The spread between individual torque values for the same bolt tension, however, was not as great using method #2.

It was decided that method #1 would be adopted for the test program for the reason that torquing by this method was more representative of actual field conditions than method #2.

It was observed that the torque required for the same tension in the bolt over repeated runs increased greatly due to galling

and scarring of the steel spacer blocks. Also, the initial run of each new bolt-nut combination increased over that of the previous combination as the surface of the spacer block became progressively rougher.

TESTING THE
EFFECT OF
WASHERS

In an effort to obtain more consistent results from bolt to bolt, hardened steel washers were inserted between the bearing surfaces of nut and bolt head and the steel spacer blocks. These washers, however, turned on the spacer block with the nut and caused the same galling conditions as did the nut turning directly on the spacer block.

Pinning the hardened washers to the spacer block proved unsatisfactory due to breakage of the brittle washers during the test runs.

TESTS TO
EVALUATE
HEAD & NUT
BEARING
FRICITION

In order to isolate the torque required to overcome thread friction from the torque required to overcome the friction of the nut and spacer block bearing surfaces, an AN-200-KP-4 ball bearing was mounted in the steel spacer block. The nut turned freely on the inner race of the ball bearing during these torque-tension tests. For this arrangement smaller torque values than previously observed were required to obtain the desired tension values in the bolts. After sixteen repeated dry torquing runs on the same bolt-nut combination the torque required to obtain the same tension in the bolt did not increase perceptibly. Thus for this bolt and nut combination the increase in thread friction due to repeated tightenings was negligible, indicating that the additional torque required for repeated tightenings, and successive bolts during previous tests was due principally to the worsening condition of the bearing surface of the steel spacer blocks, and nuts or heads.

TESTS
WITH
HARDENED
SPACER
BLOCKS

Since the surface condition of the cold rolled steel spacer blocks seemed to be the determining factor in the torque-tension relationship, and their reuse resulted in such wide fluctuations, it was decided to use SAE-01 tool steel blocks hardened to Rockwell C-60 for the test program. It was expected that in this way each new bolt would be subject to the same conditions as the previous one without necessitating the use of a new set of spacer blocks for each individual bolt-nut test specimen. Although the hardened blocks were a distinct improvement over the cold rolled steel blocks, it was found that even the hardened blocks were subject to galling and smearing of metal, and required sanding.

Experimental tests using hardened steel (Rockwell C-60) spacer blocks and the following bolts and nuts were made.

- BOLTS: (1) AN8C-37, 1/2-20 UNF-3A Stainless Steel Bolt.
(2) 1/2" Diameter Standard Cold Finished Steel Bolt.
- NUTS: (1) AN-363-C820, 1/2" Silver Plated Steel Nut.
(2) 1/2" Standard Cold Finished Steel Nut.

These tests involved successive dry torquings from the nut for the various combinations of the above bolts and nuts, and torquings with the nut bearing surfaces alone lubricated with oil; with the threads alone lubricated with oil, and with both the thread and nut bearing surfaces lubricated with oil.

As a result of these tests the following conclusions were reached:

1. The increase in the torque requirements for successive tightenings of the same bolt-nut combination is due to the following factors:
 - (a) Increased friction between bearing surfaces of nut and hardened steel spacer block due to galling.

- (b) Increased friction between threads of the nut and bolt due to galling.
2. Factor (a) above accounts for a much greater percentage of the increased torque required after successive tightenings for the combinations tested.
 3. A silver plated nut causes less galling of the hardened steel spacer block than does a standard steel nut. Silver plating acts like a lubricant in this respect.
 4. The increase in torque values over successive dry tightenings of the stainless steel bolt and silver plated nut due to thread friction is negligible for as many as six torquings.
 5. For the standard steel bolt used with the silver plated nut, or for the stainless steel bolt used with the standard steel nut the increase in torque values over successive dry tightenings is partially attributable to increased thread friction. That portion of the increased torque due to the increase in thread friction, however, is only about 10 to 20% of the total, the rest being due principally to the increased friction of the nut and spacer block bearing surfaces due to galling.

SECTION V

TEST PROCEDURES

TORQUE- TENSION TESTS

Torque-tension tests were performed in the following order:

1. Torqued from nut - Lubricated
2. Torqued from head - Lubricated
3. Torqued from nut - Dry
4. Torqued from head - Dry

Each bolt specimen was torqued through its full range for five successive torquings before the next specimen was tested. All tests were made at room temperature. Readings were made as torque was increased. No determination was made of the torque due to the self locking provisions in the nuts at zero tension load. No release torque readings were made.

Torque values were recorded on the test data sheets for six increasing stress levels, wherever possible. On the fifth torquing the stress was raised to the computed yield point where possible, and the torque noted. In many cases principally during dry torquing from the head, the bolt failed before the higher tensile stress levels could be reached.

LUBRICATED TORQUING

For the lubricated condition tests, thread compound, anti-seize, graphite petrolatum, Mil-T-5544 lubricant, which is a mixture of 50% graphite and 50% petrolatum, was applied to the threads and to the seating surfaces of the bolt heads and nuts prior to the initial torquing.

Lubrication was also applied during subsequent torquings due to loss of lubricant. The initial lubrication and subsequent lubrications

are noted in the "Test Data" sheets by an "L" placed before the torquing runs where they were applied.

For the MS-20,004 to MS-20,008 series bolts and the AN-3C to AN-8C series bolts, the seating surface of the spacer blocks had a ground finish at the start of the tests for each size bolt. No polishing or sanding was done on these surfaces during the lubricated torquing tests.

For the AN-509-8R to AN-509-816R series bolts, the finish was that left by the countersink tool at the start of the tests for each size bolt, and the surface was not processed in any way during the lubricated torquing tests.

For lubricated tests on the MS-20,009 to MS-20,024 bolts and for the AN-9C to AN-20C bolts, and for the AN-509-916R screws, the seating surfaces of the spacer blocks were sanded after the fifth torquing of each bolt as described under dry torquing.

DRY
TORQUING

After completing the lubricated tests on a bolt size, the blocks and the specimens were thoroughly cleaned with carbon tetrachloride before dry torquing was begun.

It was found that the pressure of the seating surfaces of the bolts and nuts during dry torquing, deposited an increasing amount of metal and plating on the seating surfaces of the spacer blocks.

For this reason the bearing surface of the blocks were sanded after the fifth torquing on each bolt. Thus tests on each new specimen was started on a newly sanded surface. For the MS-20,004 to MS-20,024 series and the AN-3C to AN-20C series bolt spacers, and for the spacers used with the nuts of the AN-509-8R to AN-509-916R series

screws this was done on a belt sander using a "100-X Grit Metallic Cloth" manufactured by Behr Manning of Troy, New York. For the AN-509-8R to AN-509-916R series bolt spacers used with the screw heads, this was done by hand sanding the countersunk area.

The "Test Data" sheets on finish show the Profilometer readings of these surfaces.

HARDNESS
TESTS

Hardness tests on the bolts were made by grinding a flat on the shank of the bolt. Tests on the nuts were made on the flats for hexagon nuts and on the seating surface for the EB and 42FW type nuts. Spacer blocks hardness tests were made on the seating surfaces.

SURFACE
FINISH
TESTS

Tests for surface finish were made on the spacer blocks in a direction across the cutting tool marks. In the case of the bolt and nut seating surface this was in a radial direction. For a few small sizes it was necessary to depart from the radial somewhat to clear the shank of the bolt.

SECTION VI

T E S T R E S U L T S

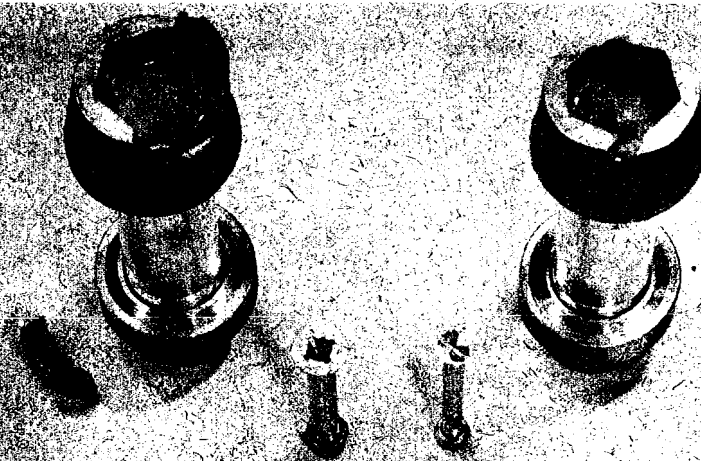
Appendix II contains the data on the hardness and surface finish of the bolt heads, the nuts, and the spacer blocks.

Appendix III contains the "Test Data" sheets showing the torque-tension test results obtained with the various bolts and nuts for the different test conditions.

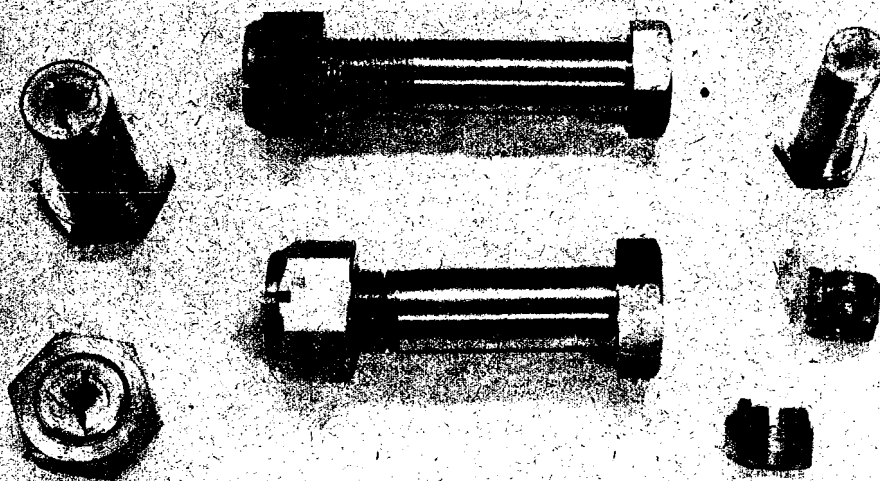
Appendix IV contains graphs of the relationship between the average torque and the tension for the various types and sizes of bolts, for the different conditions of test. Plot lines connect average points directly, without curve fitting. On Pages 166 to 175 are shown related families of curves for the various types of bolts tested.

FIG. 9

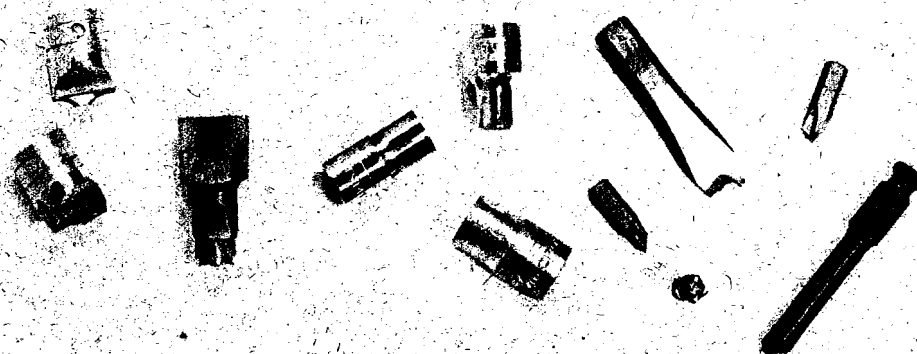
EXAMPLES
OF
TEST SPECIMEN
&
TOOL FAILURES



BOLT HEAD RECESS RUPTURE



BOLT FAILURE IN SHEAR AT ROOT DIAMETER



DRIVING TOOL FAILURES

SECTION VII
C O N C L U S I O N S

LUBRI
CATED
TORQUING

Lubricated condition torquing produces average torque-tension relationships which do not vary appreciably over repeated torquings to the high tensile stress levels.

The torque tension relationship varies with different lubricants. Specification Mil-T-5544 lubricant possesses outstanding anti-friction and anti-seize properties, and lower torque values were required to produce a given tension than other lubricants tried.

DRY
TORQUING

The torque required to produce a certain tension in the bolts increased with each successive dry torquing, due principally to the progressive deterioration of the bearing surfaces under the head or nut.

A study of the data sheets indicates that the socket heads on the MS-20,004 to MS-20,024 series bolts, and the Phillips, Frearson and screwdriver slots on the AN-509-8R to AN-509-916R series screws, do not develop the full tension capabilities of these bolts and screws under conditions of dry torquing. In most cases the higher tensile stresses were not reached due to rupture of the heads by torquing.

In the case of the AN-3C to AN-20C series bolts, this tendency to rupture the head was not evident, except in some isolated cases.

For the case of the AN-3C to AN-12C series bolts, the torque from the head was 50 to 100% greater than the torque from the silver plated nut, indicating the effectiveness of the plating.

TORQUE
VARIATIONS
AMONG
INDIVIDUAL
BOLTS

The torque tension relationship among individual bolts of the same size in a series, showed an average variation from the mean of about $\pm 18\%$ for both the dry and lubricated cases; with the exception of the dry torquing case for the MS-20,004 to MS-20,024 series bolts where the average variation was about 26%. These percentages were based on a 7% sample of all the results.

EFFECT OF
CLEARANCE
HOLES ON
SPACER
BLOCKS

It was observed that torque values obtained during the dry torquing tests were dependent to a noticeable extent on the size of the clearance holes drilled in the spacer blocks to accommodate a particular diameter bolt. As the diameter of the hole is enlarged, the torque required increases also; due to the reduced bearing surface area, which increases the friction, galling and seizing between bolt head or nut and the spacer block. See galling areas on blocks in Fig. 8.

The torque data obtained during this test program thus pertains to the bolting of hardened steel plates through holes, which have the specific clearances noted on the "Data Sheets". See Appendix III. The relationships for other sizes of clearance holes were not investigated.

BEARING
CONTACT
AREA OF
HEADS &
NUTS

Due to the fact that in most cases the bearing surfaces of both bolt heads and nuts are not formed flat and perpendicular to the bolt axis, the actual contact area is considerably different from that calculated from the dimensions shown on the specification sheets.

The heads of the AN-509-8R to AN-509-916R series flat head screws also do not fully contact the countersunk area of the spacer blocks. In most cases it is estimated that approximately 60% of the calculated bearing surface area was utilized.

EFFECT OF
PLATING

Silver or cadmium plating on a bolt or nut acts as an anti-seize with regard to lowering the required torque values for the dry con-

ditions. Silver plating appears to be superior to cadmium plating with regard to its anti-seize effect. Under lubricated torquing conditions the effect of the plating on the torque required is greatly reduced.

Values of torque for dry nut torquing of the AN type bolts employing silver plated nuts may vary from lot to lot and from manufacturer to manufacturer, as a function of pre-plating surface finish, thickness of plating deposited, and plating techniques.

EFFECT OF
DYED ALUM-
INUM NUTS

After plotting the data obtained from the AN-509-8R to AN-509-416R series screws with the NMJ aluminum nuts it was observed that for the case of dry torquing the curves did not follow the spread pattern obtained with the AN-365 silver plated steel nuts on the same size screws. Also the torque values were less. Compare graphs of bolts O, P and Q with W, X and Y.

These torque values were increased many fold when the blue dyed NMJ aluminum nuts were allowed to soak in carbon tetrachloride for about five minutes prior to testing. See graph of size X test bolt, Page 151.

The manufacturer of the blue dyed aluminum nuts later advised that these aluminum nuts were dyed blue for identification purposes only. During the process, the nuts are impregnated with a lubricant and are not subject to any subsequent bath or rinse that might tend to remove the lubricant.

The normal test procedure of wiping the nuts with carbon tetrachloride was not sufficient in this case to completely remove the lubricant and the results of the dry torquing test for bolts W, X and Y must be considered as having been modified by the manufacturers lubricant.

STAINLESS
STEEL
BOLTS &
NUTS

Tests on the AN-14C to AN-20C type bolts, of 7/8" diameter to 1 1/4" diameter were run with AN-310 type unplated stainless steel nuts. The friction on the stainless steel threads between bolt and nut caused seizure and consequent failure of the bolt in shear at the root area during dry torquings at values of tension from 40-60,000 psi. See examples of specimen failures shown in Fig. 9.

The higher torque values attributable to thread friction appears to be due to the galling and seizing action caused by the use of stainless steel for both the bolt and the nut. This severe galling effect at the threads was not evident when both metals were dissimilar or one or both were plated.

SOCKET
HEAD
RUPTURE

The recessed socket heads of the MS-20,004 to MS-20,024 type bolts ruptured before reaching the higher stress levels, when torquing from the head in the dry condition. Sizes between 1/2" diameter and 1 1/4" diameter ruptured out when torquing from the head in the dry condition at values of tension around 50,000 psi. With the 1 1/4" diameter and 1 1/2" diameter bolts under the same conditions, it was possible to torque to 70,000 psi. before rupture occurred.

Rupturing of the recessed head also occurred with the AN-509 flat head screws above 1/4" diameter, at values of 30,000 psi. or less. See Fig. 9.

DRIVE
TOOL
FAILURES

In many cases, particularly with the AN-509 screws the best drive tools commercially available ruptured before the bolts could be torqued to the yield point. Some of these broken tools are shown in Fig. 9.

CONCLU-
SION

The torque-tension relationships as determined during these tests, must be regarded as applying only for the particular conditions of these tests. It was found that the bearing surfaces of the objects bolted together exercised considerable influence on the results obtained. Thus for spacers of other materials, with other hardness and finish treatment, and with different clearance in the bolt holes, other torque-tension relationships would be expected. The variance affects of these conditions are greatly magnified for the case of dry torquing.

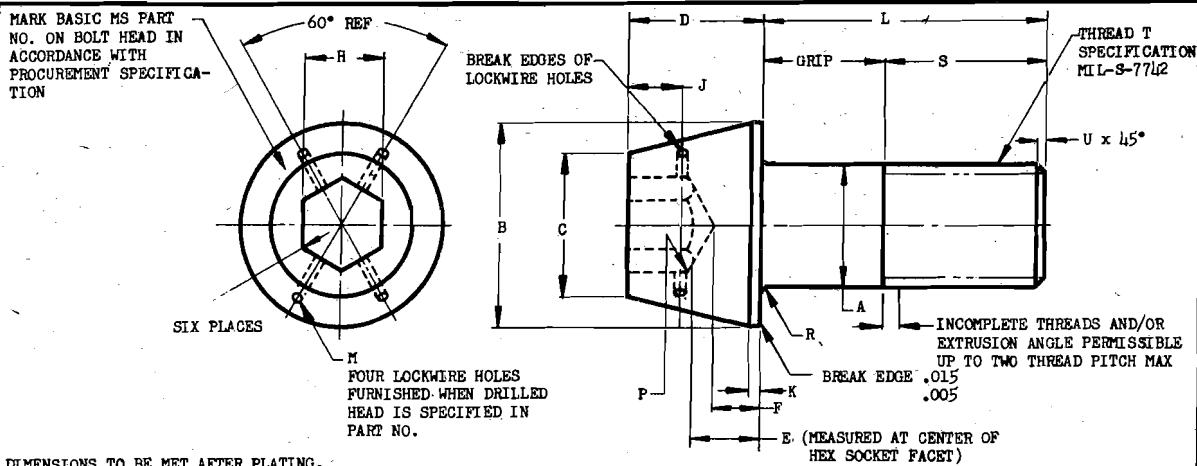
In view of the much greater repeatability of lubricated torquing relationships, it would appear that this method would be preferred for pre-stressing, subject to a possible reduction in locking and holding resistance of the nut due to the thread lubrication.

During the preliminary tests, it was noted that most of the scatter and increase during torquing conditions was due to the nut or the head bearing surface friction and seizure. In view of this, a torquing procedure might be considered in which the lubricant is applied only under the nut or head, whichever is used for torquing, without lubricating the threads. This method would improve consistency of results over the totally dry case, and at the same time maintain the full locking resistance of the thread.

APPENDIX I

DIMENSIONAL DETAILS OF BOLTS TESTED

NOTICE: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.



DIMENSIONS TO BE MET AFTER PLATING.

BASIC MS PART NO.	(a) THREAD T	(a) A DIA	(a) B DIA	(a) C DIA	D	E	F MIN	(a) H	J	K	M $\pm .005$ $-.000$ DIA	N MAX RAD	P RAD	R RAD	(b) S REF	U $\pm .016$	(a) CONCENTRICITY		
																	X	Y	Z
MS20004	1/4 -28UNF-3A	.2492 .2477	.438 .428	.342	.250	.112	.068	.1900 .1880	.078	.063	.037	.010	.020 .010	.041 .031	.500	.031	.005	.007	.0045
MS20005	5/16-24UNF-3A	.3117 .3102	.531 .521	.394	.312	.144	.094	.2210 .2190	.094	.063	.055	.010	.020 .010	.041 .031	.562	.047	.006	.008	.0045
MS20006	3/8 -24UNF-3A	.3742 .3727	.649 .639	.520	.375	.183	.116	.3150 .3130	.125	.063	.055	.011	.020 .010	.057 .047	.688	.047	.008	.010	.0045
MS20007	7/16-20UNF-3A	.4367 .4347	.750 .740	.534	.438	.208	.141	.3150 .3130	.156	.063	.055	.011	.020 .010	.057 .047	.812	.047	.009	.011	.006
MS20008	1/2 -20UNF-3A	.4991 .4971	.828 .818	.625	.500	.247	.169	.3785 .3755	.172	.063	.055	.011	.020 .010	.057 .047	.812	.047	.010	.012	.006
MS20009	9/16-18UNF-3A	.5616 .5596	.938 .928	.723	.562	.279	.190	.4410 .4380	.203	.094	.055	.011	.020 .010	.057 .047	.875	.062	.011	.014	.006
MS20010	5/8 -18UNF-3A	.6240 .6220	1.050 1.040	.826	.625	.317	.216	.5035 .5005	.234	.094	.055	.019	.020 .010	.073 .063	.938	.062	.012	.016	.006
MS20012	3/4 -16UNF-3A	.7488 .7468	1.230 1.220	.921	.750	.385	.273	.5660 .5630	.281	.094	.055	.022	.030 .015	.073 .063	1.062	.062	.015	.018	.006
MS20014	7/8 -14UNF-3A	.8737 .8707	1.438 1.428	1.083	.875	.450	.327	.6295 .6257	.344	.094	.055	.022	.030 .015	.073 .063	1.188	.078	.018	.022	.009
MS20016	1 -14 NF-3A	.9985 .9955	1.625 1.615	1.249	1.000	.527	.381	.7547 .7507	.391	.094	.055	.022	.030 .015	.073 .063	1.312	.078	.020	.025	.009
MS20018	1-1/8 -12UNF-3A	1.124 1.121	1.875 1.865	1.275	1.125	.589	.443	.7547 .7507	.453	.094	.055	.022	.030 .015	.073 .063	1.500	.094	.022	.026	.009
MS20020	1-1/4 -12UNF-3A	1.249 1.246	2.125 2.115	1.598	1.250	.667	.475	1.005 1.001	.500	.125	.055	.022	.030 .015	.089 .077	1.625	.094	.025	.032	.009
MS20022	1-3/8 -12UNF-3A	1.374 1.370	2.313 2.303	1.768	1.375	.746	.531	1.131 1.126	.547	.125	.055	.022	.030 .015	.089 .077	1.750	.094	.028	.035	.012
MS20024	1-1/2 -12UNF-3A	1.499 1.495	2.500 2.490	1.931	1.500	.823	.586	1.256 1.251	.594	.156	.055	.022	.030 .015	.089 .077	1.875	.094	.030	.039	.012

- (a) DIMENSIONS A, B, AND C SHALL BE CONCENTRIC TO EACH OTHER WITHIN VALUES SPECIFIED FOR X TOTAL INDICATOR READING. DIMENSIONS H AND C SHALL BE CONCENTRIC TO EACH OTHER WITHIN VALUES SPECIFIED FOR Y TOTAL INDICATOR READING. DIMENSIONS A AND THREAD PITCH DIAMETER SHALL BE CONCENTRIC TO EACH OTHER WITHIN VALUES SPECIFIED FOR Z TOTAL INDICATOR READING.
- (b) REFERENCE DIMENSIONS ARE FOR DESIGN PURPOSES ONLY AND ARE NOT AN INSPECTION REQUIREMENT.

MATERIAL: ALLOY STEEL. SEE PROCUREMENT SPECIFICATION.

FINISH: CADMIUM PLATE. SEE PROCUREMENT SPECIFICATION.

HEAT TREAT: SEE PROCUREMENT SPECIFICATION.

ADD H BEFORE DASH NO. FOR BOLT WITH DRILLED HEAD.

EXAMPLES OF PART NOS.: MS20004-8 = 1/4-28 BOLT, 1.000 INCH LONG, .500 INCH GRIP, UNDRILLED HEAD.
MS20004H8 = 1/4-28 BOLT, 1.000 INCH LONG, .500 INCH GRIP, DRILLED HEAD.
MS20004-9 = 1/4-28 BOLT, 1.062 INCH LONG, .562 INCH GRIP, UNDRILLED HEAD.
MS20004H9 = 1/4-28 BOLT, 1.062 INCH LONG, .562 INCH GRIP, DRILLED HEAD.

BOLTS SHALL BE FREE FROM ALL HANGING BURRS AND SLIVERS WHICH MIGHT BECOME DISLODGED UNDER USAGE. COUNTERSINKING OF DRILLED HOLES IS OPTIONAL.

DIMENSIONS IN INCHES. UNLESS OTHERWISE SPECIFIED, TOLERANCES: DECIMALS $\pm .010$, ANGLES $\pm 1^\circ$.

CUSTODIAN
Navy - BuAer

MILITARY STANDARD

**MS20004 THRU
MS20024**

PROCUREMENT SPECIFICATION
MIL-B-7838

BOLT - INTERNAL WRENCHING, 160,000 PSI

SHEET 1 OF 2

OTHER INTEREST: AIR FORCE

SUPERSEDES DRAWING NAS495

61 00170

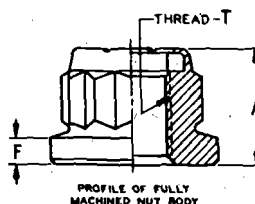
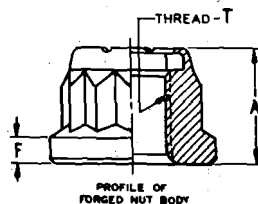
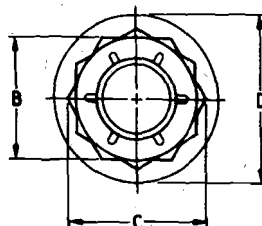
WADC TR 67-330

32

APPROVED 28 Jan 52 REVISED



ELASTIC STOP NUT CORPORATION OF AMERICA, UNION, NEW JERSEY.



ESNA PART NUMBER	THREAD T	A	B	C MIN	D +0.000 -0.010	F	ULTIMATE TENSILE STRENGTH LB MIN (SEE PERFORMANCE)	APPROX WEIGHT LB/100	AVAILABILITY
EB-048	1/4-28NF-3	.344	.377 .362	.409	.531	.090	7,132	1.00	*
EB-054	5/16-24NF-3	.406	.439 .424	.479	.593	.090	11,322	1.40	*
EB-064	3/8-24NF-3	.453	.503 .488	.551	.687	.099	16,876	2.00	*
EB-070	7/16-20NF-3	.516	.565 .550	.622	.781	.107	22,892	2.80	*
EB-080	1/2-20NF-3	.563	.628 .612	.692	.875	.118	30,555	3.50	*
EB-098	9/16-18NF-3	.625	.691 .675	.763	.968	.127	34,800	4.50	*
EB-108	5/8-18NF-3	.672	.785 .769	.870	1.062	.136	44,200	6.40	*
EB-126	3/4-16NF-3	.781	.943 .927	1.049	1.250	.185	64,700	11.00	*
EB-144	7/8-14NF-3	.953	1.067 1.050	1.188	1.438	.219	88,400	15.00	*
EB-164	1-14NF-3	.031 1.125	1.194 1.177	1.331	1.625	.328	119,000	25.00	*
EB-182	1 1/8-12NF-3	.031 1.296	1.382 1.365	1.543	1.875	.438	150,000	36.00	†
EB-202	1 1/4-12NF-3	.031 1.406	1.507 1.490	1.685	2.125	.500	189,000	50.00	†
EB-222	1 3/8-12NF-3	.031 1.531	1.633 1.616	1.830	2.313	.562	233,000	62.00	Δ
EB-242	1 1/2-12NF-3	.031 1.656	1.821 1.804	2.048	2.500	.656	281,400	85.00	Δ

CODE: PART NUMBER DESIGNATES DOUBLE HEX HIGH TENSILE NUT AS SPECIFIED IN TABULATION ABOVE.

EXAMPLE: EB-064 = DOUBLE HEX, HIGH TENSILE NUT, TYPE EB, 3/8-24 THREAD.

- ③ MATERIAL: STEEL - AISI 4130 (AMS 6370) OR EQUIVALENT, THREAD SIZES 1/4 THROUGH 1/2.
STEEL - AISI 3140 OR EQUIVALENT, THREAD SIZES 9/16 THROUGH 1.
STEEL - AISI 4340 (AMS 6415) OR EQUIVALENT, THREAD SIZES 1 1/8 AND LARGER.

FINISH: CADMIUM PLATE - FEDERAL SPEC QQ-P-416, TYPE 1, CLASS C.

- ③ LOCKING INSERT: RED NYLON - "ZYTEL" 101.

HARDNESS: ROCKWELL "C" 29-35. (SEE NOTE 1).

MAGNETIC PARTICLE INSPECTION: PARTS INDIVIDUALLY INSPECTED IN ACCORDANCE WITH MILITARY SPECIFICATION MIL-1-6868 AND DYED GREEN.

PERFORMANCE SPECIFICATION

NAS353
AS APPLICABLE

ESNA - STANDARD

NUT - DOUBLE HEX, HIGH TENSILE

EB

PAGE 1 OF 2



ELASTIC STOP NUT CORPORATION OF AMERICA, UNION, NEW JERSEY.

- ③ THREAD SQUARENESS: ESNA SPEC 405, GROUP 11, SIZES 1/4 THROUGH 1/2
ESNA SPEC 405, GROUP 1, SIZES 9/16 AND LARGER.

THREADS: MIL SPEC MIL-S-7742.

TOLERANCES: UNLESS OTHERWISE SPECIFIED: DECIMALS, ±.015

PERFORMANCE:

TORQUE: - NAS353 EXCEPT THAT THE ELEVATED TEMPERATURE TEST MAXIMUM IS 150°F.

AXIAL TENSILE STRENGTH - THE AXIAL TENSILE STRENGTH LISTED IN THE TABLE ON PAGE 1 OF 2 IS EQUIVALENT TO 180,000 PSI AT THE MINIMUM PITCH DIAMETER OF THE BOLT THREADS, FOR SIZES 1/4 THROUGH 1/2.

FOR SIZES 9/16 AND LARGER THE FIGURES LISTED ARE EQUIVALENT TO A MINIMUM OF 160,000 PSI AT THE MINIMUM PITCH DIAMETER OF THE BOLT THREADS.

APPROVAL STATUS: TYPE EB IS ACCEPTABLE FOR USE ON AIRCRAFT IN ACCORDANCE WITH BUREAU OF AERONAUTICS APPROVAL LETTERS 11472 AND 52353, DATED 15 FEB 49 AND 8 JUL 49, RESPECTIVELY, AND AIR MATERIEL COMMAND APPROVAL LETTER MCREX471 DATA 20 JAN 50.

APPLICATION: TYPE EB IS DESIGNED FOR HIGH TENSILE APPLICATIONS WHERE WEIGHT AND SPACE LIMITATIONS ARE MAJOR CONSIDERATIONS.

ESNA AVAILABILITY CODE:

- * - STANDARD PARTS NORMALLY CARRIED IN STOCK.
- † - STANDARD PARTS IN STOCK OR AVAILABLE WITHIN NORMAL DELIVERY SCHEDULES.
- Δ - STANDARD PARTS AVAILABLE WITHIN NORMAL DELIVERY SCHEDULES BUT FOR WHICH MINIMUM PRODUCTION RUN REQUIREMENTS ARE NECESSARY.
- NT - PARTS WHICH CAN BE MADE AVAILABLE IN PROTOTYPE QUANTITIES BUT PROCUREMENT IN VOLUME SHOULD ALLOW FOR PRODUCTION TOOLING.

NOTES: 1. WHEN MEASURING ROCKWELL HARDNESS OF TYPE EB NUTS, IT IS NECESSARY TO CUT OFF THE ENTIRE LOCKING DEVICE, GRIND THE TOP OF THE NUT SMOOTH AND PARALLEL TO THE NUT SEATING SURFACE AND REMOVE THE CADMIUM PLATING FROM THE SEATING SURFACE. THE HARDNESS READING IS THEN TO BE TAKEN ON THE TOP OF THE NUT.

2. WITH THE EXCEPTION OF THE FOLLOWING SIZES, 9/16, 5/8, 3/4, 7/8, 1 AND 1 1/8, WHICH WILL ALWAYS BE MANUFACTURED AS FORGINGS, EB NUTS WILL BE MANUFACTURED AS EITHER FORGINGS OR FULLY MACHINED PARTS. REGARDLESS OF MANUFACTURING METHOD THESE PARTS ARE INTERCHANGEABLE BOTH WITH RESPECT TO ENVELOPE DIMENSIONS AND PERFORMANCE. THEY WILL BE SHIPPED INTERCHANGEABLY, DEPENDENT ONLY UPON CURRENT AVAILABILITY, UNLESS INSTRUCTIONS TO THE CONTRARY ARE RECEIVED FROM THE CUSTOMER.

- ③ 3. REFER TO ESNA STANDARD DRAWING NA101 FOR A TWO-LUG HIGH TENSILE NUT DESIGN.

PERFORMANCE SPECIFICATION

NAS353
AS APPLICABLE

ESNA - STANDARD

NUT - DOUBLE HEX, HIGH TENSILE

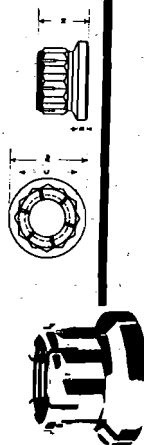
EB

PAGE 2 OF 2

ISSUED: 5 JAN 51 REVISED: ③ 30 DEC 53 ③ 12 NOV 54

ISSUED: 5 JAN 51 REVISED: ③ 30 DEC 53 ③ 12 NOV 54

FLEXLOC
"DESIGNED for 550° F."
AIRCRAFT TYPE
SIZES: 1/4" to 3/8"
EXTERNAL WRENCHING LOCKNUT
STYLE "A"
National Fine Thread Series



STYLE A

FLEXLOC External Wrenching Nuts are extra-performance locknuts. Like standard FLEXLOCs, they are one-piece, all-metal, incorporate the same efficient, self-locking principle. Developed primarily for airframe assembly, they can be used to advantage in many other critical applications. High-strength A.M.S. 6280 minimum alloy steel makes possible extreme tensiles with minimum weight. 12-point serrations for standard box or socket wrenches facilitate installation, even in close clearances.

External Wrenching Nuts are also snap nuts, lock securely anywhere on a bolt or stud without seating. Closely controlled torques provide positive locking without thread galling. Repeated re-use and high temperatures (550° F. and over) do not impair locking efficiency. Approved under latest NAS Specifications, also tentative approvals under new MIL Specifications.

STYLE 'A'
EXTERNAL WRENCHING NUT—1/4 TO 3/8 INCH
NATIONAL FINE THREAD (S.A.E.)
STEEL, PLATED

SIZE	PART NUMBER			DIMENSIONS					TENSILE VALUES		PACKING	
	Din.	Thrd. Per In.	CLAS. FIT	MATERIAL					FLEXLOC Part No.	N.A.S. Standard Part No.		
				A	H	C	B	MATERIAL				
1/4	28	3	3	42PW-428	.531	.344	.375	.090	5950	5700	100	10.
5/16	24	3	3	42PW-524	.593	.406	.437	.090	9610	9350	100	14.
3/8	24	3	3	42PW-624	.687	.453	.500	.099	14750	14500	100	20.
1/2	20	3	3	42PW-720	.781	.516	.563	.107	19800	19500	100	28.
3/4	20	3	3	42PW-820	.875	.563	.625	.133	27100	26700	100	36.
1	18	3	3	42PW-918	.968	.635	.687	.142	34500	34000	50	47.
1 1/8	18	3	3	42PW-1018	1.062	.672	.781	.151	43800	43300	50	65.

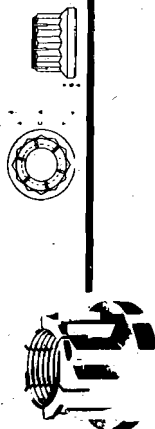
* These Parts are approved by both the Air Force and Bureau of Aeronautics for aircraft use.
* Present National Aircraft Standard

WHEN ORDERING—BE SURE TO SPECIFY QUANTITY • FLEXLOC PART NUMBER • THREAD SIZE

SPS

AIRCRAFT PRODUCTION DIVISION

EXTERNAL WRENCHING LOCKNUT
SIZES: 3/8" to 1 1/2"
AIRCRAFT TYPE
STYLE "B"
National Fine Thread Series "DESIGNED for 550° F."



STYLE B

Style "B" FLEXLOC External Wrenching Locknuts shown on this page differ slightly in appearance from Style "A," illustrated on the preceding page. Differences are due solely to the manufacturing processes involved and in no way affect performance or other characteristics of the locknut.

Both styles are approved for aircraft use under latest NAS specifications, and have tentative approval under the new MIL Specification.

STYLE 'B'
EXTERNAL WRENCHING NUT—3/8 TO 1 1/2 INCH
NATIONAL FINE THREAD (S.A.E.)
STEEL, PLATED

SIZE	CLASS FIT	FLEXLOC Part No. - Cust. Part No.	DIMENSIONS				MATERIAL	TENSILE VALUES		PACKING Qty. Per 1000 Parts	
			A	H	C	B		U.S. Standard Flexloc Part No.	Qty. Per 1000 Parts		
3/8	3	42PW-1216	1.250	.781	.937	.185	Steel - Minimum A.M.S. 5-9280	64100	63400	50	110.
1/2	3	42PW-1414	1.437	.953	1.062	.219		87600	86900	25	169.
3/4	3	42PW-1614	1.625	1.125	1.187	.266		117900	116900	25	266.
1	3	42PW-1812	1.875	1.296	1.375	.305		148100	146800	25	411.
1 1/8	3	42PW-2012	2.125	1.375	1.500	.320	193700	185400	25	515.	
1 1/4	3	42PW-2212	2.312	1.500	1.625	.350	237600	228300	25	660.	
1 1/2	3	42PW-2412	2.500	1.625	1.812	.375	286500	275400	25	844.	

* These Parts are approved by both the Air Force and Bureau of Aeronautics for aircraft use.
* Present National Aircraft Standard

WHEN ORDERING—BE SURE TO SPECIFY QUANTITY • FLEXLOC PART NUMBER • THREAD SIZE

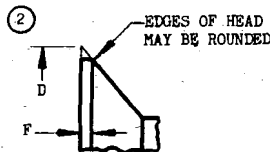
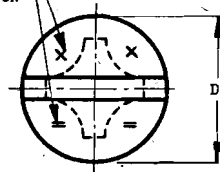
SPS

AIRCRAFT PRODUCTION DIVISION

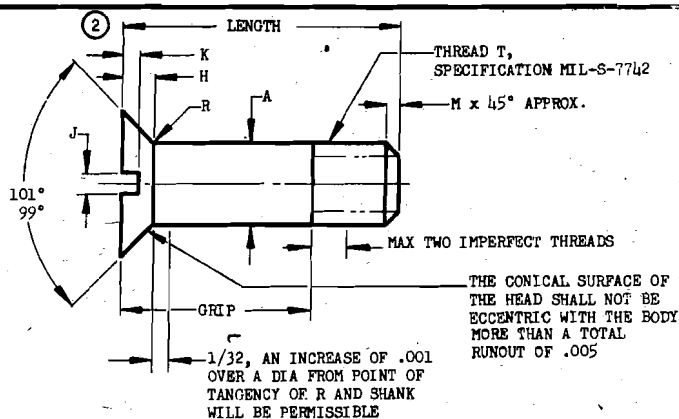
NOTE: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definite related Government procurement operation, the United States Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have furnished, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner endorsing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

NOTE: This drawing was approved by joint action of the Air Force and Navy Departments as the Air Force-Navy standard for this product. This drawing contains all dimensions and tolerances for the Air Force and Navy and is not to be used for the procurement of commercial supplies, or for use in new designs, until after the latest date of approval shown.

MARK STEEL SCREWS WITH "X", MARK BRONZE SCREWS WITH "=". ONLY ONE "X" OR "=" NEED BE VISIBLE AFTER SLOTTING, POSITION OPTIONAL

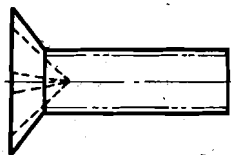
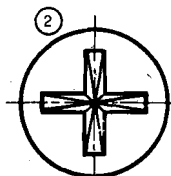


ENLARGED VIEW OF HEAD DIAMETER



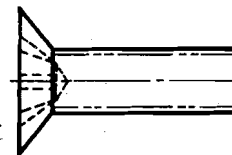
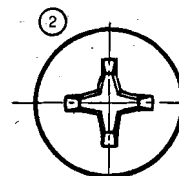
SLOTTED HEAD SCREW

THREAD T	A DIA		D DIA			F	(a) H REF	J		K		M	R RAD	
	MAX	MIN	MAX SHARP	MIN SHARP	ABSOLUTE MIN WITH MAX F			MAX	MIN	MAX	MIN		MAX	MIN
NO. 8-32 NC-3A	.1640	.1610	.332	.319	.283	.015	.068	.054	.045	.036	.027	.031	.015	.005
NO. 10-32 NF-3A	.1890	.1860	.385	.371	.327	.016	.080	.060	.050	.042	.031	.031	.015	.005
1/4 -28UNF-3A	.2490	.2460	.507	.491	.447	.018	.106	.075	.064	.055	.042	.031	.015	.005
5/16-24UNF-3A	.3115	.3085	.635	.617	.569	.020	.133	.084	.072	.069	.053	.047	.020	.010
3/8 -24UNF-3A	.3740	.3710	.762	.742	.686	.023	.159	.094	.081	.083	.064	.047	.020	.010
7/16-20UNF-3A	.4365	.4325	.890	.868	.805	.026	.186	.098	.082	.097	.077	.047	.020	.010
1/2 -20UNF-3A	.4990	.4950	1.017	.992	.919	.030	.213	.110	.094	.112	.088	.047	.020	.010
9/16-18UNF-3A	.5615	.5575	1.145	1.118	1.036	.034	.240	.122	.106	.127	.103	.047	.020	.010



RECESSED HEAD SCREW

THIS TYPE OF RECESS CONSISTS OF TWO INTERSECTING SLOTS WITH PARALLEL SIDES CONVERGING TO A SHARP APEX AT BOTTOM OF RECESS



RECESSED HEAD SCREW

THIS TYPE OF RECESS HAS A LARGE CENTER OPENING, TAPERED WINGS, AND BLUNT BOTTOM, WITH ALL EDGES RELIEVED OR ROUNDED

DIMENSIONING AND GAGING OF THE ABOVE TYPES OF RECESSES SHALL BE IN ACCORDANCE WITH THE 1950 SUPPLEMENT TO HANDBOOK H-28 SCREW THREADS FOR FEDERAL SERVICES 1944.

- (a) REFERENCE DIMENSIONS ARE FOR DESIGN PURPOSES ONLY AND ARE NOT AN INSPECTION REQUIREMENT.
- (b) TOLERANCE ON THE LENGTHS FOR NO. 8-32, NO. 10-32, 1/4-28, AND 3/8-24 SCREWS = +1/32, -1/64; FOR 5/16-24 AND 9/16-18 SCREWS = +3/64, -0; FOR 7/16-20 AND 1/2-20 SCREWS = +1/64, -1/32.
- (c) BRONZE SCREWS INACTIVE FOR DESIGN AFTER 31 JANUARY 1952.
- FOR DEFINITION AND APPLICATION OF DRAWING STATUS NOTES, SEE AIA BULLETIN NO. 337.
- MATERIAL: STEEL, ALUMINUM ALLOY, SEE PROCUREMENT SPECIFICATION; COMMERCIAL BRONZE, 85,000 PSI MINIMUM.
- HEAT TREAT: LOW ALLOY STEEL, 125,000 TO 145,000 PSI TENSILE STRENGTH, SPECIFICATION MIL-H-6875; ALUMINUM ALLOY, 62,000 PSI TENSILE STRENGTH (MIN), SPECIFICATION MIL-H-6088.
- FINISH: STEEL OR ALUMINUM ALLOY, SEE PROCUREMENT SPECIFICATION; BRONZE, CADMIUM PLATE, SPECIFICATION QQ-P-416, TYPE I, CLASS C. GRIP LENGTHS IN ADDITION TO THOSE TABULATED ARE AVAILABLE IN 1/8 INCH INCREMENTS BY THE USE OF SIGNIFICANT DASH NUMBERS.

PLAIN DASH NUMBERS INDICATE STEEL SCREWS.

- (c) ~~ADD B BEFORE FIRST DASH NUMBER FOR BARE BRONZE SCREWS. ADD P BEFORE FIRST DASH NUMBER FOR PLATED BRONZE SCREWS.~~
ADD C BEFORE FIRST DASH NUMBER FOR CORROSION RESISTANT STEEL SCREWS.
ADD DD BEFORE FIRST DASH NUMBER FOR ALUMINUM ALLOY SCREWS.
ADD R BETWEEN FIRST AND SECOND DASH NUMBER FOR RECESSED HEAD SCREWS.

EXAMPLES OF PART NOS.: AN509-10-12 = NO. 10 SLOTTED HEAD STEEL SCREW 25/32 INCH LONG.

- (c) ~~AN509P10-12 = NO. 10 SLOTTED HEAD PLATED BRONZE SCREW 25/32 INCH LONG.~~
~~AN509B10-12 = NO. 10 SLOTTED HEAD BARE BRONZE SCREW 25/32 INCH LONG.~~
AN509C10-12 = NO. 10 SLOTTED HEAD CORROSION RESISTANT STEEL SCREW 25/32 INCH LONG.
AN509DD10-12 = NO. 10 SLOTTED HEAD ALUMINUM ALLOY SCREW 25/32 INCH LONG.
AN509-10R12 = NO. 10 RECESSED HEAD STEEL SCREW 25/32 INCH LONG.

- SCREWS SHALL BE FREE OF ALL LOOSE OR HANGING BURRS OR SLIVERS WHICH MIGHT BECOME DISLODGED UNDER USAGE.

DIMENSIONS IN INCHES.

PROCUREMENT
SPECIFICATION

MIL-S-7839

AIR FORCE-NAVY AERONAUTICAL STANDARD

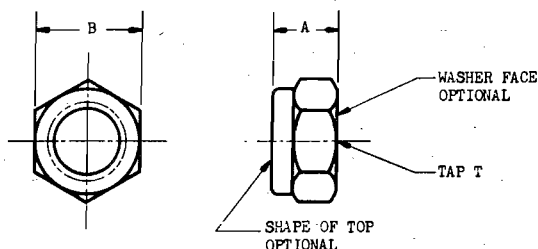
SCREW - MACHINE, FLAT HEAD, 100°, STRUCTURAL

AN509

SHEET 1 OF 3

APPROVED 21 May 45 REVISED 1 22 Jul 47 2 31 Jan 52

NOTE: This drawing was approved by joint action of the  and Navy Departments on the . Very standard for this problem. This drawing represents all successful standard drawings for the same problem and should be considered effective for the procurement of circumvented copies, or the use in new designs, not later than 6 months after the latest date of approval shown. It may be put into effect, however, at an earlier date after presentation.



FINE THREAD

DASH NUMBERS				(a)	B + .002 - .010
STEEL	① COPPER BASE ALLOY	AL ALLOY	TAP T		
440	B540	D640	NO. 4-18 NF-2	1.11	1.250
640	B540	D640	NO. 6-14 NF-2	1.12	1.312
836	B636	D936	NO. 8-36 NF-2	1.23	1.311
1032	B1032	D1032	NO. 10-32 NF-3	1.23	1.375
428	B428	D428	1/4 -28 NF-3	1.312	1.438
524	B524	D524	5/16-24 NF-3	1.34	1.500
624	B624	D624	3/8 -24 NF-3	1.453	1.563
720	B720	D720	7/16-20 NF-3	1.453	1.625
820	B820	D820	1/2 -20 NF-3	1.594	1.750
918	B918	D918	9/16-18 NF-3	1.688	1.875
1018	B1018	D1018	5/8 -18 NF-3	1.750	1.938
1216	B1216	D1216	3/4 -16 NF-3	1.875	1.063
1414	B1414	D1414	7/8 -14 NF-3	1.000	1.250
1614	B1614	D1614	1 -14 NF-3	1.125	1.438
1812	B1812	D1812	1-1/8 -12 NF-3	1.250	1.625
2012	B2012	D2012	1-1/4 -12 NF-3	1.438	1.813

COARSE THREAD

	B440	B440	D440	NO.	4-40 NC-2	.141	.250
632	B632	D632	NO.	6-32 NC-2	.172	.312	
832	B832	D832	NO.	8-32 NC-2	.234	.344	
1024	B1024	D1024	NO.	10-24 NC-3	.234	.378	
420	B420	D420	1/4	-20 NC-3	.312	.438	
518	B518	D518	5/16	-18 NC-3	.344	.500	
616	B616	D616	3/3	-16 NC-3	.453	.563	
714			7/16	-14 NC-3	.453	.625	
813	B813		1/2	-13 NC-3	.594	.750	
912	B912	D912	9/16	-12 NC-3	.688	.875	
1011	B1011	D1011	5/8	-11 NC-3	.750	.938	
1210	B1210	D1210	3/4	-10 NC-3	.875	1.063	
1409	B1409	D1409	7/8	-9 NC-3	1.000	1.250	
1608	B1608	D1608	1	-8 N-3	1.125	1.438	
1808	B1808	D1808	1-1/8	-8 N-3	1.250	1.625	
2008	B2008	D2008	1-1/4	-8 N-3	1.438	1.812	

- (1) (a) MINIMUM A NOT SPECIFIED. LIMITED ONLY BY STRENGTH REQUIREMENT OF SPECIFICATION.
- (1) (b) DASH NUMBERS 448 THRU 836 AND B640 THRU B836 AND D640 THRU D836 FOR FINE THREAD NUTS AND 1024 THRU 2008 AND B1024 THRU B2008 AND D1024 THRU D2008 FOR COARSE THREAD NUTS INACTIVE FOR DESIGN AFTER 14 APRIL, 1949.
- (1) FOR DEFINITION AND APPLICATION OF DRAWING STATUS NOTE SEE ANA BULLETIN NO. 337.
- (1) ADD A AFTER DASH NUMBER FOR NUTS HAVING NON-METALLIC INSERTS.
- (1) ADD C AFTER DASH NUMBER FOR NUTS FABRICATED ENTIRELY FROM METAL.
- (1) EXAMPLES OF PART NUMBERS: AN365-428 = 1/4-28 STEEL NUT, EITHER ALL METAL OR WITH NON-METALLIC INSERT.
AN365DL28 = 1/4-28 ALUMINUM ALLOY NUT, EITHER ALL METAL OR WITH NON-METALLIC INSERT.
AN365BL28A = 1/4-28 COPPER BASE ALLOY NUT WITH NON-METALLIC INSERT.
AN365-428C = 1/4-28 STEEL ALL METAL NUT.

DIMENSIONS IN INCHES.

FOR INSTALLATION INSTRUCTIONS SEE DRAWING AND10068.

PROCUREMENT SPECIFICATION

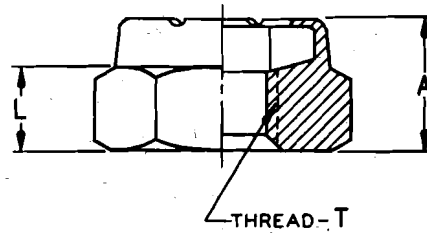
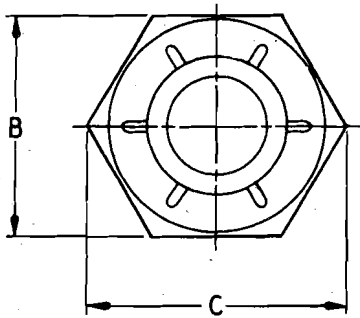
AN-N-5

AIR FORCE-NAVY AERONAUTICAL STANDARD

① NUT-SELF LOCKING, 250° F

AN365

APPROVED 21 Aug 43 REVISED 1 14 Apr 49



ESNA PART NUMBER	THREAD T	A	B	C MIN	L REF
MJ-40	4-40NC-3B	.143 $\pm .010$	.252 - .240	.275	.081
MJ-62	6-32NC-3B	.178 $\pm .010$	.314 - .302	.344	.103
MJ-82	8-32NC-3B	.266	.346 - .334	.378	.170
MJ-02	10-32NF-3	.266	.377 - .365	.413	.170
MJ-048	1/4-28NF-3	.345	.440 - .428	.488	.257

CODE: PART NUMBER AS LISTED IN THE TABULATION ABOVE DESIGNATES HIGH STRENGTH ALUMINUM ALLOY HEX NUT WITH FIBRE LOCKING INSERT.

PREFIX LETTER "N" TO PART NUMBER LISTED IN THE TABULATION ABOVE DESIGNATES HIGH STRENGTH ALUMINUM ALLOY HEX NUT WITH NYLON LOCKING INSERT.

EXAMPLE: MJ-02 = FIBRE LOCKING INSERT, HIGH STRENGTH ALUMINUM ALLOY HEX NUT, TYPE MJ, 10-32 THREAD.

NMJ-02 = NYLON LOCKING INSERT, HIGH STRENGTH ALUMINUM ALLOY HEX NUT, TYPE MJ, 10-32 THREAD.

- ① MATERIAL: ALUMINUM ALLOY, 2014-T6 (AMS4121).
ALUMINUM ALLOY, 2024-T4 (AMS4037) 1/4 SIZE ONLY.
- ① FINISH: ANODIZE, MIL SPEC MIL-A-8625(ASG) DYED BLUE AND LUBRICATED.
- ① LOCKING INSERT: RED FIBER
RED NYLON, "ZYTEL" 101.

THREAD SQUARENESS: ESNA SPEC 405, GROUP I.

THREADS: MIL SPEC MIL-S-7742.

TOLERANCES: UNLESS OTHERWISE SPECIFIED: DECIMALS, $\pm .015$

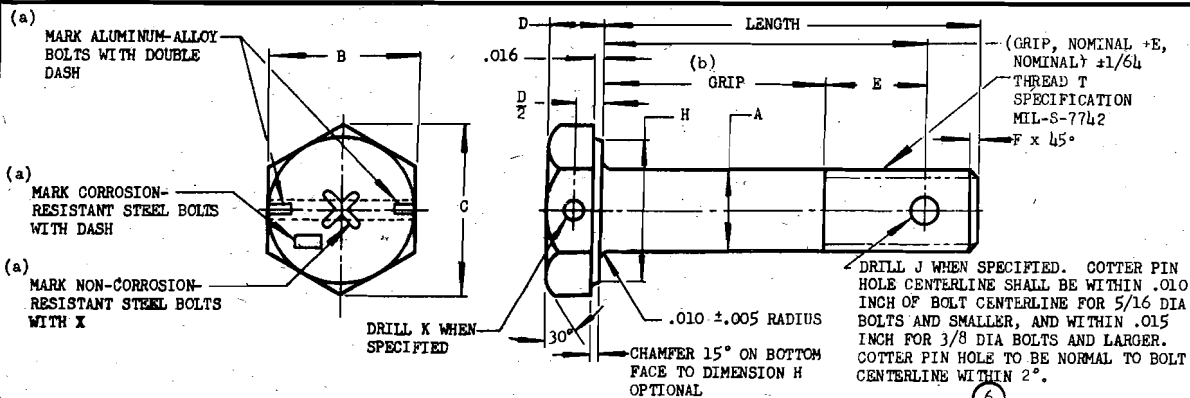
PERFORMANCE: ESNA SPEC 414.

APPROVAL STATUS: PENDING QUALIFICATION UNDER APPLICABLE MS STANDARD DRAWINGS BEING COORDINATED BY THE SERVICES AND INDUSTRY, APPROVAL FOR AIRCRAFT USE OF TYPE MJ NUTS AT STEEL LOADS MAY BE OBTAINED FROM EITHER THE BUREAU OF AERONAUTICS, FOR BUAER CONTRACTS, OR THE AIR MATERIEL COMMAND, FOR AIR FORCE CONTRACTS.

APPLICATION: TYPE MJ HIGH STRENGTH ALUMINUM ALLOY NUTS ARE DESIGNED TO BE USED IN PLACE OF STEEL NUTS ON 125,000 PSI STEEL SCREWS IN ORDER TO EFFECT AN APPRECIABLE WEIGHT SAVING.
(SEE NOTE 1).

ISSUED: 13 APR 54 REVISED: 5 JAN 56

PERFORMANCE SPECIFICATION	ESNA - STANDARD	MJ
ESNA SPEC 414	NUT - HEX, MACHINE SCREW, HIGH STRENGTH ALUMINUM ALLOY	PAGE 1 OF 2



BASIC AN PART NO.	THREAD T	A DIA		B		C REF	D		E REF	F		(c) H DIA	J DRILL DIA +.010 -.000	K DRILL DIA +.010 -.000
		MAX	MIN	MAX	MIN		MAX	MIN		MAX	MIN	MIN		
AN3	NO. 10-32 NF-3A	.189	.186	.377	.365	.430	.141	.109	17/64	.047	.015	.359	.070	.046
AN4	1/4 -28 UNF-3A	.249	.246	.440	.428	.510	.172	.140	5/16	.047	.015	.422	.076	.046
AN5	5/16-24 UNF-3A	.312	.309	.502	.490	.580	.204	.172	23/64	.063	.021	.484	.076	.070
AN6	3/8 -24 UNF-3A	.374	.371	.565	.553	.650	.235	.203	7/16	.063	.031	.547	.106	.070
AN7	7/16-20 UNF-3A	.437	.433	.627	.615	.720	.266	.234	31/64	.063	.031	.609	.106	.070
AN8	1/2 -20 UNF-3A	.499	.495	.752	.740	.870	.297	.265	39/64	.063	.031	.734	.106	.070
AN9	9/16-18 UNF-3A	.562	.558	.877	.865	1.010	.328	.296	21/32	.078	.046	.859	.141	.070
AN10	5/8 -18 UNF-3A	.624	.620	.940	.928	1.090	.360	.328	47/64	.078	.046	.922	.141	.070
AN12	3/4 -16 UNF-3A	.749	.744	1.066	1.053	1.230	.422	.390	7/8	.078	.046	1.047	.141	.070
AN11	7/8 -14 UNF-3A	.874	.869	1.253	1.240	1.440	.485	.453	63/64	.094	.062	1.234	.141	.070
AN16	1 -14 NF-3A	.999	.993	1.441	1.428	1.660	.547	.515	1-3/32	.094	.062	1.422	.141	.070
AN18	1-1/8 -12 UNF-3A	1.124	1.118	1.628	1.615	1.880	.610	.578	1-3/16	.110	.078	1.609	.141	.070
AN20	1-1/4 -12 UNF-3A	1.249	1.243	1.815	1.802	2.090	.672	.640	1-3/8	.110	.078	1.796	.141	.070

6 SEE SHEET 3 FOR NOTES (a) AND (b).

6 (c) THE DIAMETER OF THE WASHER FACE SHALL NOT EXCEED THE ACTUAL WIDTH ACROSS FLATS.

MATERIAL: NON-CORROSION-RESISTANT STEEL, CORROSION-RESISTANT STEEL OR ALUMINUM ALLOY. SEE PROCUREMENT SPECIFICATION.

FINISH: SEE PROCUREMENT SPECIFICATION.

ADD C BEFORE DASH NUMBER FOR CORROSION-RESISTANT STEEL BOLT.

ADD DD BEFORE DASH NUMBER FOR ALUMINUM-ALLOY BOLT.

ADD A AFTER DASH NUMBER FOR UNDRILLED BOLT. SEE ILLUSTRATION.

ADD H BEFORE DASH NUMBER FOR BOLT WITH DRILLED HEAD AND SHANK. SEE ILLUSTRATION.

ADD H BEFORE DASH NUMBER AND A AFTER DASH NUMBER FOR BOLT WITH DRILLED HEAD ONLY. SEE ILLUSTRATION.

EXAMPLES OF PART NUMBERS:

- AN6-10 = 3/8 NON-CORROSION-RESISTANT STEEL BOLT 1-5/64 LONG, 7/16 GRIP WITH DRILLED SHANK ONLY. SEE ILLUSTRATION.
- AN6C10 = 3/8 CORROSION-RESISTANT STEEL BOLT 1-5/64 LONG, 7/16 GRIP WITH DRILLED SHANK ONLY. SEE ILLUSTRATION.
- AN6DD10 = 3/8 ALUMINUM-ALLOY BOLT 1-5/64 LONG, 7/16 GRIP WITH DRILLED SHANK ONLY. SEE ILLUSTRATION.
- AN6DD10A = 3/8 ALUMINUM-ALLOY BOLT 1-5/64 LONG, 7/16 GRIP, UNDRILLED SHANK AND HEAD. SEE ILLUSTRATION.
- AN6DDH10 = 3/8 ALUMINUM-ALLOY BOLT 1-5/64 LONG, 7/16 GRIP WITH DRILLED HEAD AND SHANK. SEE ILLUSTRATION.
- AN6DDH10A = 3/8 ALUMINUM-ALLOY BOLT 1-5/64 LONG, 7/16 GRIP WITH DRILLED HEAD ONLY. SEE ILLUSTRATION.

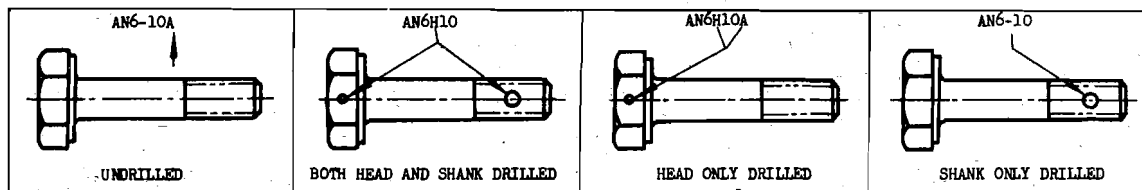


ILLUSTRATION OF DRILLED AND UNDRILLED BOLTS AND PART NUMBERS

6 BOLTS SHALL BE FREE FROM ALL HANGING BURRS AND SLIVERS WHICH MIGHT BECOME DISLODGED UNDER USAGE. COUNTERSINKING OF DRILLED HOLES IN HEAD IS MANDATORY. COUNTERSINKING OF DRILLED HOLES IN SHANK IS OPTIONAL.

DIMENSIONS IN INCHES. UNLESS OTHERWISE SPECIFIED, TOLERANCES: DECIMALS $\pm .010$, ANGLES $\pm 5^\circ$.

PROCUREMENT
SPECIFICATION

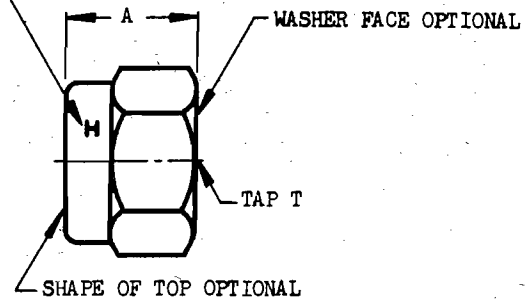
MIL-B-6812

AIR FORCE-NAVY AERONAUTICAL STANDARD

BOLT - MACHINE, AIRCRAFT

AN3 THRU AN20

SHEET 1 OF 4



DASH NUMBERS			TAP T	(a) [Ⓐ] ②	② [Ⓑ]
COR RES STEEL	STEEL	COPPER BASE ALLOY		+ .016	+ .002 - .010
C1032	1032	B1032	NO. 10-32 NF-3	.234	.375
C128	128	B128	1/4 -28 NF-3	.312	.438
C524	524	B524	5/16-24 NF-3	.344	.500
C624	624	B624	3/8 -24 NF-3	.453	.563
C720	720	B720	7/16-20 NF-3	.453	.625
C820	820	B820	1/2 -20 NF-3	.594	.750
C918	918	B918	9/16-18 NF-3	.688	.875
C1018	1018	B1018	5/8 -18 NF-3	.750	.938
C1216	1216	B1216	3/4 -16 NF-3	.875	1.063

b)	0632	632	B632	No. 6-32 NC-2	.172	.312
	0832	832	B832	No. 8-32 NC-2	.234	.344
	~~01024~~	~~1024~~	~~B1024~~	~~No. 10-24 NC-2~~	~~.234~~	~~.375~~
	~~0420~~	~~420~~	~~B420~~	~~1/4 -20 NC-3~~	~~.312~~	~~.438~~
	~~0518~~	~~518~~	~~B518~~	~~5/16-18 NC-3~~	~~.344~~	~~.500~~
	~~0616~~	~~616~~	~~B616~~	~~3/8 -16 NC-3~~	~~.453~~	~~.563~~
	~~0714~~	~~714~~	~~B714~~	~~7/16-14 NC-3~~	~~.453~~	~~.625~~
	~~0813~~	~~813~~	~~B813~~	~~1/2 -13 NC-3~~	~~.594~~	~~.750~~
	~~0913~~	~~913~~	~~B913~~	~~9/16-12 NC-3~~	~~.688~~	~~.875~~
	~~01011~~	~~1011~~	~~B1011~~	~~5/8 -11 NC-3~~	~~.750~~	~~.938~~
	~~01210~~	~~1210~~	~~B1210~~	~~3/4 -10 NC-3~~	~~.875~~	~~1.063~~

- (a) MINIMUM A NOT SPECIFIED. LIMITED ONLY BY STRENGTH REQUIREMENT OF SPECIFICATION.
- (b) DASH NOS. C1024 THRU C1210, 1024 THRU 1210, AND B1024 THRU B1210 FOR COARSE THREAD NUTS INACTIVE FOR DESIGN AFTER 14 APRIL 1949.

- ② FOR DEFINITION AND APPLICATION OF DRAWING STATUS NOTE SEE ANA BULLETIN NO. 337.

- ② EXAMPLES OF PART NUMBERS: AN363-428 = 1/4-28 STEEL NUT.

AN363B632 = NO. 6-32 COPPER BASE ALLOY NUT.

AN363C428 = 1/4-28 CORROSION RESISTING STEEL NUT.

- ② DIMENSIONS IN INCHES.

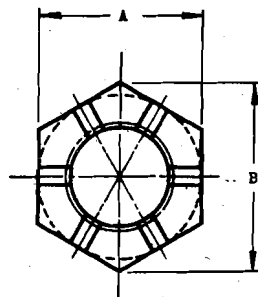
FOR INSTALLATION INSTRUCTIONS SEE DRAWING AND10068.

PROCUREMENT SPECIFICATION AN-N-10	AIR FORCE-NAVY AERONAUTICAL STANDARD ② NUT - SELF LOCKING, 550°F	AN363
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SUPERSEDES USAF DRAWING 363
3PD 813495

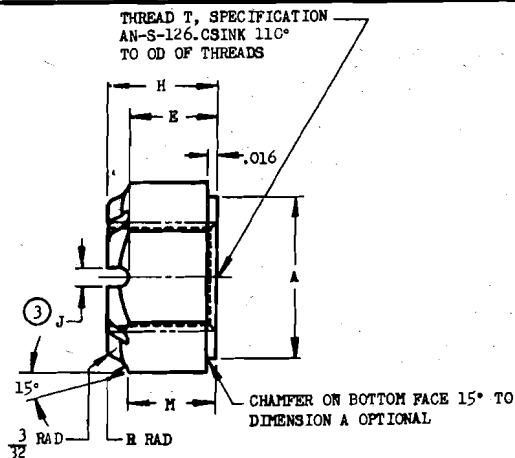
NOTE: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement, the United States Government assumes no responsibility, nor any obligation whatsoever; and the fact that the Government may have furnished, furnished, or is now supplying the said drawings, specifications, or other data is not to be regarded as an endorsement or approval in any manner favoring the holder or any person or persons, or conveying any right or permission to manufacture, use, or sell any product or process that may in any way be related thereto.

NOTE: This drawing was approved by joint action of the Army and Navy Departments as the standard drawing for the same product and shall be used for the production of such product. This drawing supersedes all other drawings for the same product and shall be used for the production of such product. It may be put into effect, however, at an earlier date after approval.



ROUND OR SQUARE BOTTOM
CASTELLATION OPTIONAL

③



AN PART NO.	THREAD T	ULTIMATE TENSILE STRENGTH MINIMUM, POUNDS		(a) A	B APPROX	③ E	H	J +1/32 -0	M	R
		STEEL	AL ALLOY							
AN310-3	NO. 10-32NF-3	2 210	1 100	.375 ^{+.002} _{-.010}	7/16	7/64	1/4	5/64	.110	3/32
AN310-4	1/4-28NF-3	4 080	2 030	.438 ^{+.002} _{-.010}	1/2	1/8	9/32	5/64	.125	3/32
AN310-5	5/16-24NF-3	6 500	3 220	.500 ^{+.002} _{-.010}	37/64	11/64	21/64	5/64	.172	3/32
AN310-6	3/8-24NF-3	10 100	5 020	.563 ^{+.002} _{-.010}	21/32	7/32	13/32	1/8	.218	3/32
AN310-7	7/16-20NF-3	13 600	6 750	.625 ^{+.002} _{-.011}	23/32	17/64	29/64	1/8	.265	3/32
AN310-8	1/2-20NF-3	18 500	9 180	.750 ^{+.002} _{-.012}	7/8	23/64	9/16	1/8	.359	1/8
AN310-9	9/16-18NF-3	23 600	11 700	.875 ^{+.002} _{-.012}	1- 1/64	25/64	39/64	5/32	.390	5/32
AN310-10	5/8-18NF-3	30 100	14 900	1.000 ^{+.002} _{-.014}	1- 5/32	15/32	23/32	5/32	.468	5/32
AN310-12	3/4-16NF-3	44 000	21 800	1.125 ^{+.002} _{-.016}	1-19/64	9/16	13/16	5/32	.562	3/16
AN310-14	7/8-14NF-3	60 000	29 800	1.313 ^{+.002} _{-.017}	1-33/64	21/32	29/32	5/32	.656	3/16
AN310-16	1-14NF-3	80 700	40 000	1.500 ^{+.002} _{-.019}	1-47/64	3/4	1	5/32	.750	3/16
AN310-18	1-1/8-12NF-3	101 800	50 500	1.688 ^{+.002} _{-.021}	1-61/64	13/16	1- 5/32	5/32	.844	1/4
AN310-20	1-1/4-12NF-3	130 200	64 400	1.875 ^{+.002} _{-.023}	2-11/64	7/8	1- 1/4	5/32	.938	1/4

(a) FOR AL ALLOY NUTS LARGER THAN -5 SIZE, TOLERANCES ON A MAY CONFORM TO APPLICABLE MATERIAL SPECIFICATIONS FOR BAR AND ROD.
MATERIAL: STEEL, AL ALLOY AND CORROSION RESISTING STEEL. SEE PROCUREMENT SPECIFICATION.

FINISH: SEE PROCUREMENT SPECIFICATION.

ADD D BEFORE DASH NUMBER FOR AL ALLOY NUTS.

ADD C BEFORE DASH NUMBER FOR CORROSION RESISTING STEEL NUTS.

EXAMPLES OF PART NOS.: AN310-5 = STEEL NUT, 5/16-24NF-3.
AN310D5 = AL ALLOY NUT, 5/16-24NF-3.
AN310C5 = CORROSION RESISTING STEEL NUT, 5/16-24NF-3.

③

REMOVE ALL BURRS.

DIMENSIONS IN INCHES. UNLESS OTHERWISE SPECIFIED, TOLERANCES: FRACTIONS $\pm 1/64$, DECIMALS $\pm .010$, ANGLES $\pm 1^\circ$

PROCUREMENT
SPECIFICATION

AN-N-2

AIR FORCE-NAVY AERONAUTICAL STANDARD

③

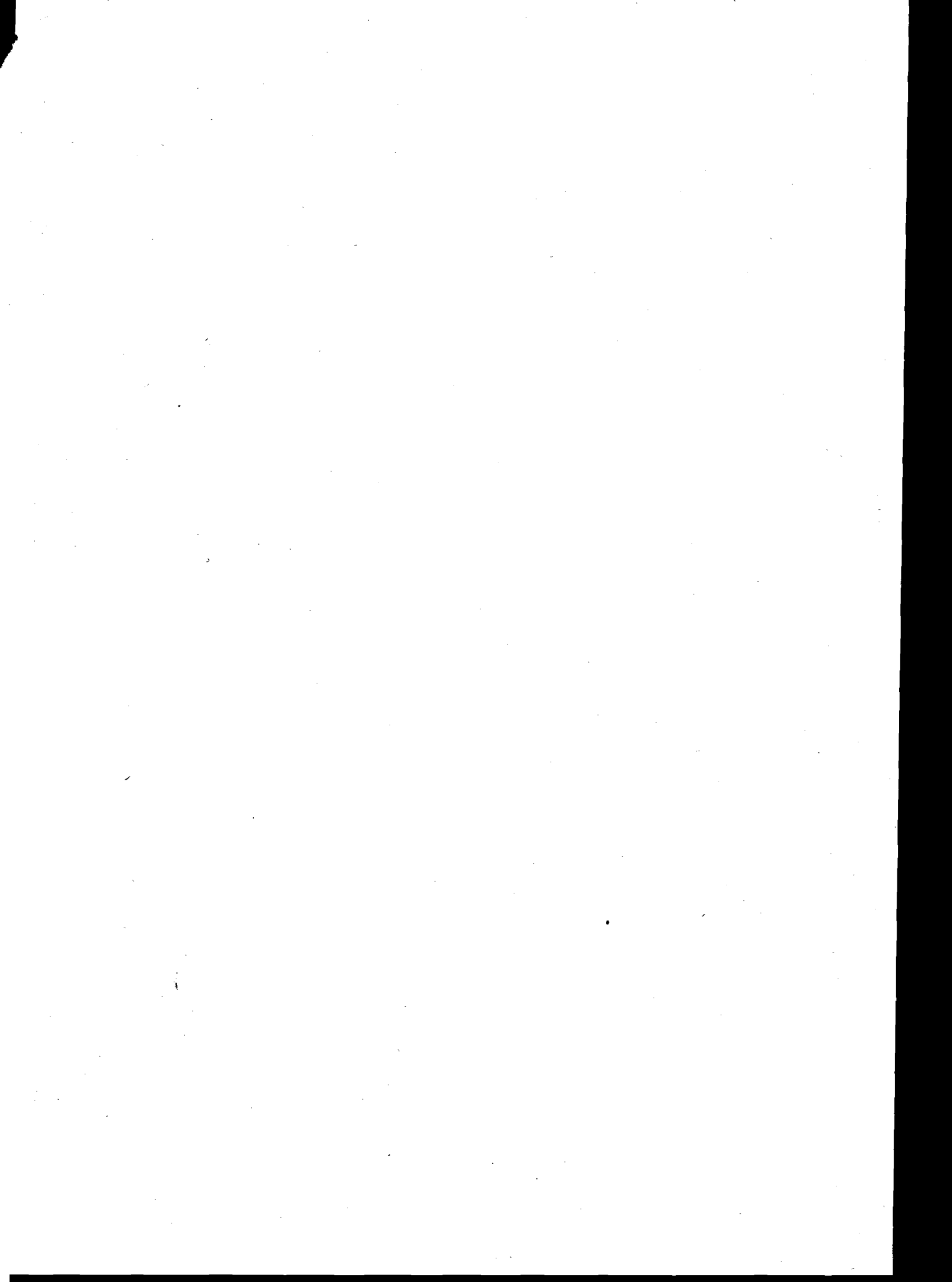
NUT-CASTELLATED, AIRFRAME

AN310

SUPERSEDES FORMER USAF AND NAVY
STANDARD ISSUES OF AN310

APPENDIX II

HARDNESS & SURFACE FINISH
TEST DATA





DATA SHEET

COMPARISON OF HARDNESS & SURFACE FINISH
OF NUTS SUPPLIED BY AIRCRAFT MANUFACTURERS
WITH " " " ASCH EQUIPMENT CO.

HARDNESS ROCKWELL "C"				BEARING SURFACE FINISH R.M.S.		
DIA. SIZE	EB NUTS ASCH EQUIP. CO.	42 FW BOEING AIRPLANE CO.	42 FW LOCKHEED AIRCRAFT CO.	EB NUTS ASCH EQUIP. CO.	42 FW BOEING AIRPLANE CO.	42 FW LOCKHEED AIRCRAFT CO.
1/4	10	35	—	18.6	34.3	—
5/16	25	36	—	24.6	57.6	—
3/8	13	33	—	21.7	70.4	—
7/16	11	29	29	25.7	66	24.3
1/2	27	33	—	26.3	74.6	—
9/16	20	33	34	26.2	79.8	32.1
5/8	30	30	28	27.3	79.8	39.0
3/4	21	31	31	25.9	53.2	32.3
7/8	31	—	28	19.7	—	25.3
1"	32	31	35	22.6	52.5	72.2
1 1/8	39	35	—	25.7	60.6	—

DATA SHEET

SURFACE FINISH SPACER BLOCKS

GROUND FINISH		SANDED FINISH		MACHINED C'SINK SURFACE	
SPACER	R.M.S.	SPACER	R.M.S.	SPACER	R.M.S.
37	10	9	24	16	85
	10		20		90
36	14	5	9	14	47
	11		15		50
35	5	1	19	12	NOT AVAILABLE
	5		12		
34	7	2B	14	10	50
	8		17		50
33	9	2Ac	13	12A	NOT AVAILABLE
	11		13		
32	13	1Bc	5	6	11
	9		7		16
31	10	1Ac	18	4	12
	10		18		20
30	6	1Ac	19	2	13
	7		17		20
29	5	2Ac	14	10A	70
	3		16		60
28	4	2Bc	16	8A	37
	5		16		28
TOTAL	162		302	2,4,6 & 8A 10,10A,14 & 16	(157) (502)
AVERAGE	8.1		15.1	SPEC. 2,4,6 & 8A 19.6	SPEC. 10,10A,14 & 16 62.8
⁽¹⁾ AVE. X 1.33	10.8		20.1	26.1	83.5

NOTE: (1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

1. NUTS FURNISHED BY BOEING AIRPLANE CO. FOR COMPARISON
2. MFG. BY STD. PRESSED STEEL CO.

BOEING

NUT N ^o .	SPEC.	HARDNESS - ROCKWELL "C"				SURFACE FINISH - RMS.			
		1 ST READING	2 ND READING	TOTAL	AVERAGE	1 ST READING	2 ND READING	AVERAGE	⁽¹⁾ AVE. x 1.33
42FW-9/8	1	28	34	62	33	47	50	60	79.8
	2	37	71	75		80			
	3	30	63	60		48			
42FW-10/8				196	30			60	79.8
	1	26	26	52		60	65		
	2	31	32	63		45	55		
42FW-12/6	3	33	29	62	31	65	70	40	53.2
			177						
	1	28	32	60		27	35		
42FW-16/4	2	30	28	58	31	48	52	39.5	52.5
	3	33	69	38		40			
			187						
42FW-18/2	1	28	33	61	35	32	35	45.6	60.6
	2	36	69	50		45			
	3	26	58	35		40			
			188	31			39.5	52.5	
	1	32	33		65	40			47
	2	36	33		69	37			48
	3	35	38	73	35	47	55	45.6	60.6
			207						

NOTE: (1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

1. NUTS FURNISHED BY LOCKHEED AIRCRAFT CORP. FOR COMPARISON.
2. MFG. BY STD. PRESSED STEEL CO.

LOCKHEED

NUT No.	SPEC.	HARDNESS - ROCKWELL "C"				SURFACE FINISH - RMS.			
		1 ST READING	2 ND READING	TOTAL	AVERAGE	1 ST READING	2 ND READING	AVERAGE	AVE. X 1.33
42FW-918	1	36	36	72			22	23	
	2	35	34	69			25	20	
	3	28	34	62			25	30	
				203	34			24.1	32.1
42FW-1018	1	25	28	53			23	30	
	2	31	32	63			30	25	
	3	26	28	54			32	36	
				170	28			29.3	39.0
42FW-1216	1	29	31	60			20	22	
	2	30	29	59			30	24	
	3	32	37	69			25	25	
				188	31			24.3	32.3
42FW-1414	1	31	27	58			20	22	
	2	24	24	48			23	19	
	3	30	30	60			15	15	
				166	28			19	25.3
42FW-1614	1	27	31	58			40	37	
	2	41	38	79			65	72	
	3	34	38	72			57	55	
				209	35			54.3	72.2

NOTE: (1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET HARDNESS & SURFACE FINISH

1. NUTS FURNISHED BY LOCKHEED AIRCRAFT CORP. & BOEING AIRPLANE CO. FOR COMPARISON.
2. MFG. BY STD. PRESSED STEEL CO.

NUT NO.	SPEC.	HARDNESS - ROCKWELL "C"				SURFACE FINISH - RMS.			
		1 ST READING	2 ND READING	TOTAL	AVERAGE	1 ST READING	2 ND READING	AVERAGE	(1) AVE. x 1.33
42FW-720 LOCKHEED	1	32	24	56		22	14		
	2	28	32	60		22	17		
	3	31	29	60		15	20		
				176	29			18.3	24.3
42FW-428 BOEING	1	33	33	66		21	23		
	2	37	38	75		22	32		
	3	36	34	70		30	27		
				211	35			25.8	34.3
42FW-524 BOEING	1	34	31	65		55	43		
	2	36	38	74		40	40		
	3	38	37	75		37	45		
				214	36			43.3	57.6
42FW-624 BOEING	1	34	32	66		55	52		
	2	33	29	62		70	65		
	3	34	34	68		40	35		
				196	33			52.9	70.4
42FW-720 BOEING	1	35	28	63		35	42		
	2	31	32	63		57	70		
	3	23	22	45		52	42		
				171	29			49.6	66
42FW-820 BOEING	1	33	35	68		35	40		
	2	32	28	60		70	67		
	3	35	32	67		60	65		
				195	33			56.1	74.6

NOTE: (1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE N^o: A

NUT N^o: EB-048

AN STD. N^o: MS 20004-42

SPACER N^o: (2)-1Bc

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	37	38	75	
	2	42	41	83	
	3	41	38	79	
				237	40
NUT	1	12	14	26	
	2	6	8	14	
	3	9	10	19	
				59	10
SPACER	1-Bc	65	65	130	65
SPACER	1-Bc	64	64	128	64

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1ST READING	2ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	8	14		
	2	7	13		
	3	8	7		
				9.5	12.6
NUT	1	11	14		
	2	13	15		
	3	17	14		
				14	18.6
SPACER	1-Bc	(1) AVERAGE R.M.S. 20.1 SEE PAGE			
SPACER	1-Bc	(1) AVERAGE R.M.S. 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

MS

SERIES BOLT

CODE N^o. B

NUT N^o. EB-054

AN STD. N^o. MS 20005-50

SPACER N^o. (2) - 2AC

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	42	44	86	
	2	22	22	44	
	3	39	39	78	
				208	35
NUT	1	20	26	46	
	2	26	26	52	
	3	27	26	53	
				151	25
SPACER	2-AC	65	65	130	65
SPACER	2-AC	64	65	129	65

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	AVERAGE	⁽¹⁾ AVE. X 1.33
BOLT	1	11	14		
	2	13	13		
	3	11	11		
				12.1	16.1
NUT	1	16	21		
	2	15	16		
	3	22	21		
				18.5	24.6
SPACER	2-AC	⁽¹⁾ AVERAGE R.M.S. 20.1 SEE PAGE			
SPACER	2-AC	⁽¹⁾ AVERAGE R.M.S. 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE N^o. C

NUT N^o. EB-064

AN STD. N^o. MS 20006-50

SPACER N^o. 2-Bc & 2-B

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	36	41	77	
	2	34	34	68	
	3	31	31	62	
				207	35
NUT	1	12	15	27	
	2	17	15	32	
	3	10	11	21	
				80	13
SPACER	2-Bc	64	65	129	65
SPACER	2-B	65	65	130	65

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	19	17		
	2	18	16		
	3	13	13		
				16	21.3
NUT	1	19	15		
	2	15	16		
	3	14	19		
				16.3	21.7
SPACER	2-Bc	(1) AVERAGE R.M.S. 20.1 SEE PAGE			
SPACER	2-B	(1) AVERAGE R.M.S. 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE N^o. D

NUT N^o. EB-070

AN STD. N^o. MS 20007-50

SPACER N^o. 2-Cc & 2-C

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	38	37	75	
	2	41	30	71	
	3	40	41	81	
				227	38
NUT	1	7	9	16	
	2	10	14	24	
	3	11	13	24	
				64	11
SPACER	2-C	63	64	127	64
SPACER	2-Cc	64	65	129	65

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	AVERAGE	Ave. x 133
BOLT	1	14	12		
	2	18	17		
	3	21	17		
				16.5	21.9
NUT	1	17	15		
	2	18	22		
	3	24	20		
				19.3	25.7
SPACER	2-C	(1) AVERAGE R.M.S. 20.1 SEE PAGE			
SPACER	2-Cc	(1) AVERAGE R.M.S. 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE N^o. E

NUT N^o. EB-080

AN STD. N^o. MS 20008-50

SPACER N^o. 2-Dc & 2-D

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	43	44	87	
	2	44	44	88	
	3	43	44	87	
				262	44
NUT	1	21	24	45	
	2	27	32	59	
	3	29	30	59	
				163	27
SPACER	2-Dc	64	64	128	64
SPACER	2-D	63	63	126	63

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	AVERAGE	A ⁽¹⁾ VE. x 1.33
BOLT	1	15	18		
	2	14	23		
	3	21	16		
				17.8	23.7
NUT	1	18	23		
	2	15	20		
	3	18	25		
				19.8	26.3
SPACER	2-Dc	(1) AVERAGE R.M.S. 20.1 SEE PAGE			
SPACER	2-D	(1) AVERAGE R.M.S. 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE N^o. F

NUT N^o. EB-098

AN STD. N^o. MS 20009-50

SPACER N^o. 17 & 18

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	36	35	71	
	2	42	41	83	
	3	37	39	76	
				230	38
NUT	1	18	21	39	
	2	31	30	61	
	3	8	10	18	
				118	20
SPACER	17	54	57	111	56
SPACER	18	54	61	115	58

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	(1) AVERAGE	(2) AVE. x 1.33
BOLT	1	16	16		
	2	13	20		
	3	19	22		
				17.5	23.3
NUT	1	19	16		
	2	26	26		
	3	15	16		
				19.7	26.2
SPACER	17	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	18	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE N^o: G

NUT N^o: EB-108

AN STD. N^o: MS 2000-50

SPACER N^o: 20 & 21

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	38	39	77	
	2	39	40	79	
	3	39	40	79	
				235	39
NUT	1	34	28	62	
	2	30	30	60	
	3	29	30	59	
				181	30
SPACER	20	57	55	112	56
SPACER	21	57	60	117	58.5

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	(1) AVERAGE	(2) AVE. X 1.33
BOLT	1	26	15		
	2	20	30		
	3	24	19		
				22.3	29.7
NUT	1	21	23		
	2	23	21		
	3	16	19		
				20.5	27.3
SPACER	20	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	21	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE N^o. H

NUT N^o. EB-126

AN STD. N^o. MS 200/2-50

SPACER N^o. 22 & 24

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	45	45	90	
	2	41	42	83	
	3	44	45	89	
				262	44
NUT	1	31	26	57	
	2	18	19	37	
	3	16	17	33	
				127	21
SPACER	22	61	57	118	59
SPACER	24	59	55	114	57

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	AVERAGE	(1) AVE. X 1.33
BOLT	1	12	12		
	2	11	13		
	3	15	14		
				12.8	17
NUT	1	22	25		
	2	17	16		
	3	16	21		
				19.5	25.9
SPACER	22	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	24	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE N^o. I

NUT N^o. EB-144

AN STD. N^o. MS 20014-50

SPACER N^o. 25 & 27

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	40	41	81	
	2	42	43	85	
	3	41	43	84	
				250	42
NUT	1	37	38	75	
	2	24	30	54	
	3	23	32	55	
				184	31
SPACER	25	60	59	119	60
SPACER	27	56	56	112	56

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1ST READING	2ND READING	AVERAGE	(1) AVE. X 1.33
BOLT	1	18	13		
	2	17	13		
	3	15	16		
				15.3	20.3
NUT	1	14	13		
	2	17	16		
	3	16	13		
				14.8	19.7
SPACER	25	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	27	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE N^o. J

NUT N^o. EB-164

AN STD. N^o. MS 200/6-50

SPACER N^o. 28 & 29

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	42	42	84	
	2	41	41	82	
	3	43	42	85	
				251	42
NUT	1	29	33	61	
	2	33	33	66	
	3	35	32	67	
				194	32
SPACER	28	67	67	134	67
SPACER	29	56	57	113	57

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	(1) AVERAGE	(2) AVE. x 1.33
BOLT	1	27	30		
	2	30	25		
	3	32	33		
				29.5	39.2
NUT	1	13	19		
	2	17	15		
	3	19	19		
				17	22.6
SPACER	28	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	29	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE N^o. K

NUT N^o. EB-182

AN STD. N^o. MS 20018-50

SPACER N^o. 30 & 31

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	42	44	86	
	2	42	43	85	
	3	43	43	86	
				257	43
NUT	1	39	40	79	
	2	38	39	77	
	3	39	38	77	
				233	39
SPACER	30	60	64	124	62
SPACER	31	54	58	112	56

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	(1) AVERAGE	(1) AVE. x 1.33
BOLT	1	16	9		
	2	14	14		
	3	14	17		
				16	21.3
NUT	1	21	20		
	2	15	21		
	3	22	17		
				19.3	25.7
SPACER	30	(1) AVERAGE R.M.S.-20.1 SEE PAGE			
SPACER	31	(1) AVERAGE R.M.S.-20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE N^o. L

NUT N^o. EB-202

AN STD. N^o. MS 20020-50

SPACER N^o. 32 & 33

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	44	44	88	
	2	44	40	84	
	3	40	43	83	
					43
NUT	1	30	33	63	
	2	34	34	68	
	3	27	29	56	
				187	31
SPACER	32	59	55	114	57
SPACER	33	59	59	118	59

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	AVERAGE	Ave. x 1.33
BOLT	1	9	11		
	2	9	8		
	3	6	6		
				8.2	10.9
NUT	1	48	50		
	2	42	45		
	3	45	45		
				45.8	60.9
SPACER	32	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	33	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE N^o. M

NUT N^o. EB-222

AN STD. N^o. MS 20022-50

SPACER N^o. 34 & 35

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	36	38	74	
	2	42	42	84	
	3	38	38	76	
				234	39
NUT	1	27	29	56	
	2	28	29	57	
	3	29	29	58	
				171	28.5
SPACER	34	60	63	123	62
SPACER	35	62	66	128	64

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	17	15		
	2	16	14		
	3	13	16		
				15.1	20.1
NUT	1	52	60		
	2	60	53		
	3	40	40		
				51	67.8
SPACER		(1) AVERAGE R.M.S. 20.1 SEE PAGE			
SPACER		(1) AVERAGE R.M.S. 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE N^o. N

NUT N^o. EB-242

AN STD. N^o. MS 20024-50

SPACER N^o. 36 & 37

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	38	39	77	
	2	40	40	80	
	3	39	41	80	
				237	39.5
NUT	1	28	24	52	
	2	29	31	60	
	3	29	31	60	
				172	28.6
SPACER	36	63	66	129	65
SPACER	37	58	61	119	60

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	AVERAGE	⁽¹⁾ AVE. x 1.33
BOLT	1	14	14		
	2	13	12		
	3	12	12		
				12.8	17
NUT	1	55	60		
	2	55	50		
	3	45	40		
				51	67.8
SPACER		⁽¹⁾ AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER		⁽¹⁾ AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE NO. 0

NUT NO. AN 365-832

AN STD. NO. AN 509-8R37

SPACER NO. 1 & 2

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM	SPEC. NO.	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	29	31	60	X
	2	35	32	67	
	3	29	29	58	
		X		185	31
NUT	1	37	22	59	X
	2	19	16	35	
	3	20	22	42	
		X		136	23
SPACER	1	59	59	118	59
SPACER	2	59	61	120	60

SURFACE FINISH (R.M.S.)

ITEM	SPEC. NO.	1ST READING	2ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	22	25	X	X
	2	57	60		
	3	45	38		
		X		41.1	54.7
NUT	1	11	14	X	X
	2	20	15		
	3	22	18		
		X		16.6	22.1
SPACER	1	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	2	(1) AVERAGE R.M.S. - 26.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE N^o. P

NUT N^o. AN 365-1032

AN STD. N^o. AN 509-10R37

SPACER N^o. 3 & 4

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	35	36	71	
	2	33	34	67	
	3	32	34	66	
				204	34
NUT	1	21	22	43	
	2	22	21	43	
	3	23	22	45	
				131	22
SPACER	3	63	63	126	63
SPACER	4	62	63	125	63

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	(1) AVERAGE	(1) AVE. X 1.33
BOLT	1	15	17		
	2	12	10		
	3	15	17		
				14.3	19
NUT	1	26	33		
	2	18	25		
	3	26	19		
				24.5	32.6
SPACER	3	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	4	(1) AVERAGE R.M.S. - 26.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE N^o. Q

NUT N^o. AN 365-428

AN STD. N^o. AN 509-416 R 37

SPACER N^o. 5 & 6

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	35	36	71	
	2	32	33	65	
	3	33	31	64	
				200	33
NUT	1	18	17	35	
	2	11	9	20	
	3	18	18	36	
				91	15
SPACER	5	63	63	126	63
SPACER	6	63	64	127	64

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	AVERAGE	Ave. x 1.33
BOLT	1	22	17		
	2	11	13		
	3	12	12		
				14.5	19.3
NUT	1	12	13		
	2	18	24		
	3	17	20		
				17.3	23
SPACER	5	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	6	(1) AVERAGE R.M.S. - 26.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE N^o R

NUT N^o AN 365-524

AN STD. N^o AN 509-516 R48

SPACER N^o 7 & 8

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	35	36	70	
	2	35	35	70	
	3				
				140	35
NUT	1	27	27	54	
	2	25	25	50	
	3				
				104	26
SPACER	7	64	64	128	64
SPACER	8	65	66	131	66

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	(1) AVERAGE	(2) AVE. X 1.33
BOLT	1	23	15		
	2	21	17		
	3				
				19	25.3
NUT	1	19	20		
	2	25	24		
	3				
				22	29.3
SPACER	7	(1) AVERAGE R.M.S.-20.1 SEE PAGE			
SPACER	8	(1) AVERAGE R.M.S.-26.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE N^o. 5

NUT N^o. AN 365-624

AN STD. N^o. AN 509-616 R 48

SPACER N^o. 9 & 10

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	29	29	58	
	2	29	31	60	
	3	30	31	61	
				179	30
NUT	1	14	18	32	
	2	20	24	44	
	3	22	24	46	
				122	20
SPACER	9	61	58	119	60
SPACER	10	66	66	132	66

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	AVERAGE	AVE. x 1.33
BOLT	1	18	21		
	2	36	21		
	3	25	20		
				23.5	31.3
NUT	1	28	25		
	2	25	30		
	3	27	26		
				26.8	35.6
SPACER	9	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	10	(1) AVERAGE R.M.S. - 83.5 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE N^o. 7

NUT N^o. AN 365-720

AN STD. N^o. AN 509-716 R 48

SPACER N^o. 11 & 12

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	30	28	58	
	2	29	29	58	
	3	29	30	59	
				175	29
NUT	1	26	29	55	
	2	28	31	59	
	3	28	26	54	
				168	28
SPACER	11	63	62	125	62.5
SPACER	12	62	63	125	62.5

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	AVERAGE	Ave. x 1.33
BOLT	1	22	32		
	2	45	48		
	3	60	43		
				41.7	55.5
NUT	1	23	28		
	2	25	28		
	3	22	17		
				23.8	31.7
SPACER	11	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	12	(1) AVERAGE R.M.S. - 26.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE N^o. U

NUT N^o. AN 365-820

AN STD. N^o. AN 509-816 R49

SPACER N^o. 13 & 14

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	32	36	68	
	2	36	37	73	
	3	36	38	74	
				215	36
NUT	1	19	21	40	
	2	19	21	40	
	3	17	20	37	
				117	20
SPACER	13	64	64	128	64
SPACER	14	64	66	130	65

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	(1) AVERAGE	(2) AVE. x 1.33
BOLT	1	22	19		
	2	22	21		
	3	27	22		
				22.1	29.4
NUT	1	16	20		
	2	20	20		
	3	22	24		
				20.3	27
SPACER	13	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	14	(1) AVERAGE R.M.S. - 26.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE N^o. V

NUT N^o. AN 365-918

AN STD. N^o. AN 509-916 R52

SPACER N^o. 15 & 16

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	33	35	68	
	2	32	35	67	
	3	32	35	67	
				202	34
NUT	1	15	16	31	
	2	19	20	39	
	3	17	16	33	
				103	17
SPACER	15	63	64	127	64
SPACER	16	46	51	97	49

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	(1) AVERAGE	(2) AVE. X 1.33
BOLT	1	38	32		
	2	37	33		
	3	27	30		
				32.8	43.6
NUT	1	22	25		
	2	28	37		
	3	27	23		
				27	35.9
SPACER	15	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	16	(1) AVERAGE R.M.S. - 83.5 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE N^o W

NUT N^o NMJ-82

AN STD. N^o AN 509 BR 37

SPACER N^o 162

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	21	29	50	
	2	32	34	66	
	3	31	33	64	
				180	30
NUT	1	7	7	14	
	2	9	9	18	
	3	8	5	13	
				45	8
SPACER	1	59	59	118	59
SPACER	2	59	61	120	60

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	AVERAGE	Ave. x 1.33
BOLT	1	41	30		
	2	40	40		
	3	30	32		
				35.5	47.2
NUT	1	4	3		
	2	5	5		
	3	4	4		
				4.2	5.6
SPACER	1	(1) AVERAGE R.M.S. 20.1 SEE PAGE			
SPACER	2	(1) AVERAGE R.M.S. 26.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE N^o: X

NUT N^o: NMT-02

AN STD. N^o: AN 509 10 R 37

SPACER N^o: 3 & 4

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	32	34	66	
	2	29	34	63	
	3				
				129	32
NUT	1	9	9	18	
	2	5	6	11	
	3				
				29	7
SPACER	3	63	63	126	63
SPACER	4	62	63	125	63

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	14	17		
	2	11	14		
	3				
				14	18.6
NUT	1	12	10		
	2	8	8		
	3				
				9.5	12.6
SPACER	3	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	4	(1) AVERAGE R.M.S. - 26.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE N^o. Y

NUT N^o. NMJ-048

AN STD. N^o. AN 509 4/16 R37

SPACER N^o. 5 & 6

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	34	35	69	
	2	34	34	68	
	3	33	33	66	
				203	34
NUT	1	10	9	19	
	2	11	10	21	
	3	9	9	18	
				58	10
SPACER	5	63	63	126	63
SPACER	6	63	64	127	64

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	(1) AVERAGE	(2) AVE. x 1.33
BOLT	1	12	10		
	2	11	14		
	3	16	18		
				13.5	18
NUT	1	10	8		
	2	7	9		
	3	10	9		
				8.8	11.7
SPACER	5	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	6	(1) AVERAGE R.M.S. - 26.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE N^o. A-A

NUT N^o. AN 363 C1032

AN STD. N^o. AN 3C-30

SPACER N^o. (2)-1AC

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	30	28	58	
	2	29	30	59	
	3	29	30	59	
				176	29
NUT	1	20	23	43	
	2	19	24	43	
	3	25	26	51	
				137	23
SPACER	1-AC	65	65	130	65
SPACER	1-AC	65	65	130	65

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	(1) AVERAGE	(1) AVE. x 1.33
BOLT	1	9	12		
	2	9	13		
	3	10	14		
				11.2	14.9
NUT	1	16	21		
	2	17	17		
	3	15	17		
				17.2	22.9
SPACER	1-AC	(1) AVERAGE R.M.S.-20.1 SEE PAGE			
SPACER	1-AC	(1) AVERAGE R.M.S.-20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE N^o. B-B

NUT N^o. AN363C-428

AN STD. N^o. AN 4C-30

SPACER N^o. (2) - 1Bc

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	34	35	69	
	2	32	35	67	
	3	35	35	70	
				206	34
NUT	1	30	28	58	
	2	27	26	53	
	3	26	26	52	
				163	27
SPACER	1-Bc	65	65	130	65
SPACER	1-Bc	64	64	128	64

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1ST READING	2ND READING	(1) AVERAGE	(2) AVE. x 1.33
BOLT	1	12	18		
	2	13	11		
	3	10	7		
				11.8	15.7
NUT	1	17	16		
	2	20	20		
	3	15	21		
				18.1	24.1
SPACER	1-Bc	(1) AVERAGE R.M.S.-20.1 SEE PAGE			
SPACER	1-Bc	(1) AVERAGE R.M.S.-20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE N^o. C-C

NUT N^o. AN 363C-524

AN STD. N^o. AN 5C-35

SPACER N^o. (2) - 2AC

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	36	37	73	
	2	34	33	67	
	3	33	32	65	
				205	34
NUT	1	32	32	64	
	2	29	28	57	
	3	31	31	62	
				183	31
SPACER	2-AC	65	65	130	65
SPACER	2-AC	64	65	130	65

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1ST READING	2ND READING	AVERAGE	AVE. x 1.33
BOLT	1	8	5		
	2	7	11		
	3	5	6		
				7	9.3
NUT	1	19	21		
	2	23	21		
	3	22	19		
				20.9	27.8
SPACER	2-AC	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	2-AC	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE N^o. D-D

NUT N^o. AN 363C-624

AN STD. N^o. AN 6C-36

SPACER N^o. 2BC & 2B

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	31	34	65	
	2	34	35	69	
	3	32	33	65	
				199	33
NUT	1	28	27	55	
	2	27	27	54	
	3	29	29	58	
				167	28
SPACER	2-BC	64	65	129	65
SPACER	2-B	65	65	130	65

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	(1) AVERAGE	(1) AVE. X 1.33
BOLT	1	21	24		
	2	24	25		
	3	18	20		
				22	29.3
NUT	1	15	20		
	2	22	25		
	3	18	16		
				19.3	25.7
SPACER	2-BC	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	2-B	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE N^o: E-E

NUT N^o: AN 363C-720

AN STD. N^o: AN 7C-36

SPACER N^o: 2 Cc & 2 C

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	34	35	69	
	2	35	36	71	
	3	34	35	69	
				209	35
NUT	1	28	28	56	
	2	25	26	51	
	3	28	27	55	
				162	27
SPACER	2-C	63	64	127	64
SPACER	2-Cc	64	65	129	65

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	(1) AVERAGE	(1) AVE. x 1.33
BOLT	1	35	45		
	2	19	14		
	3	13	16		
				23.6	31.4
NUT	1	9	11		
	2	20	17		
	3	14	16		
				14.5	19.3
SPACER	2-C	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	2-Cc	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE N^o: F-F

NUT N^o: AN 363C-820

AN STD. N^o: AN 8C-37

SPACER N^o: 2 Dc & 2 D

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	29	30	59	X
	2	31	32	63	
	3	31	31	62	
		X		184	31
NUT	1				X
	2				
	3	31	33	64	
		X		64	32
SPACER	2-Dc	64	64	128	64
SPACER	2-D	63	63	126	63

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	(1) AVERAGE	(2) AVE. x 1.33
BOLT	1	13	17	X	X
	2	12	13		
	3	16	16		
		X		14.5	19.3
NUT	1			X	X
	2				
	3	20	16		
		X		18	23.9
SPACER	2-Dc	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	2-D	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE N^o. G-G

NUT N^o. AN 363C-9/8

AN STD. N^o. AN 9C-37

SPACER N^o. 17 & 18

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	31	30	61	
	2	31	32	63	
	3	30	31	61	
				185	31
NUT	1	23	25	48	
	2	27	25	52	
	3	24	27	51	
				151	25
SPACER	17	54	57	111	56
SPACER	18	54	61	115	58

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	(1) AVERAGE	(1) AVE. x 1.33
BOLT	1	23	26		
	2	22	25		
	3	15	21		
				22	29.3
NUT	1	18	20		
	2	23	17		
	3	17	16		
				18.5	24.6
SPACER	17	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	18	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE N^o. H-H

NUT N^o. AN363C-1018

AN STD. N^o. AN 10C-37

SPACER N^o. 19 & 20

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	35	35	70	
	2	34	35	69	
	3	35	35	70	
				209	35
NUT	1	26	26	52	
	2	23	23	46	
	3	19	19	38	
				136	23
SPACER	19	62	61	123	62
SPACER	20	57	58	115	58

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	(1) AVERAGE	(2) AVE. X 1.33
BOLT	1	12	11		
	2	10	9		
	3	13	10		
				10.9	14.5
NUT	1	16	17		
	2	17	19		
	3	16	22		
				17.8	23.7
SPACER	19	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	20	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE N^o. I-I

NUT N^o. AN 363 C-1216

AN STD. N^o. AN 12C-41

SPACER N^o. 22 & 23

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	32	32	64	
	2	31	30	61	
	3	32	31	63	
				188	31
NUT	1	29	29	58	
	2	30	30	60	
	3	28	29	57	
				175	29
SPACER	22	61	57	118	59
SPACER	23	60	61	121	61

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	13	13		
	2	20	15		
	3	13	14		
				14.7	19.6
NUT	1	14	17		
	2	15	20		
	3	21	22		
				18.1	24.1
SPACER	22	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	23	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE N^o J-J

NUT N^o AN310C-14

AN STD. N^o AN 14 C-42

SPACER N^o 25 & 26

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	32	32	64	
	2	30	34	64	
	3	30	32	62	
				190	32
NUT	1	30	31	61	
	2	31	30	61	
	3	29	29	58	
				180	30
SPACER	25	60	59	119	60
SPACER	26	59	59	118	59

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	AVERAGE	Ave. x 1.33
BOLT	1	21	19		
	2	19	21		
	3	19	20		
				19.8	26.3
NUT	1	21	33		
	2	27	22		
	3	28	27		
				26.3	35
SPACER	25	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	26	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE N^o: K-K

NUT N^o: AN 310C-16

AN STD. N^o: AN 16C-42

SPACER N^o: 28 & 29

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	32	34	66	
	2	31	32	63	
	3	32	32	64	
				193	32
NUT	1	23	24	47	
	2	27	24	51	
	3	24	23	47	
				145	24
SPACER	28	67	67	134	67
SPACER	29	56	57	113	57

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	(1) AVERAGE	(2) AVE. x 1.33
BOLT	1	16	16		
	2	25	18		
	3	24	21		
				20	26.6
NUT	1	18	16		
	2	12	11		
	3	15	23		
				15.9	21.1
SPACER	28	(1) AVERAGE R.M.S.-20.1 SEE PAGE			
SPACER	29	(1) AVERAGE R.M.S.-20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE N^o: L-L

NUT N^o: AN 310C-18

AN STD. N^o: AN 18C-44

SPACER N^o: 30 & 31

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	30	30	60	
	2	28	31	59	
	3	32	32	64	
				183	31
NUT	1	20	22	42	
	2	24	21	45	
	3	19	19	38	
				125	21
SPACER	30	60	64	124	62
SPACER	31	54	58	112	56

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1ST READING	2ND READING	AVERAGE	(1) AVE. X 1.33
BOLT	1	10	12		
	2	10	10		
	3	11	21		
				12.3	16.4
NUT	1	16	11		
	2	15	14		
	3	17	13		
				14.3	19
SPACER	30	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	31	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

— DATA SHEET —

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE N^o: M-M

NUT N^o: AN 310C-20

AN STD. N^o: AN 20C-45

SPACER N^o: 32 & 33

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. N ^o	1 ST READING	2 ND READING	TOTAL	AVERAGE
BOLT	1	26	31	57	
	2	25	27	52	
	3	26	28	54	
				163	27
NUT	1	26	24	50	
	2	28	29	57	
	3	28	28	56	
				163	27
SPACER	32	59	55	114	57
SPACER	33	59	59	118	59

SURFACE FINISH (R.M.S.)

ITEM	SPEC. N ^o	1 ST READING	2 ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	17	12		
	2	14	14		
	3	15	13		
				14.2	18.9
NUT	1	14	23		
	2	47	32		
	3	40	32		
				31.3	41.6
SPACER	32	(1) AVERAGE R.M.S.-20.1 SEE PAGE			
SPACER	33	(1) AVERAGE R.M.S.-20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

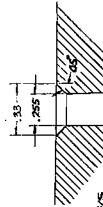
APPENDIX III

DATA SHEETS
of
TORQUE TENSION RELATIONSHIPS

DATE 16 APRIL 1956
 SIZE 1/4" - 20 UNF - 30
 SCREEN OR BOLT - MS 3000-4-42 MFD. BY AIRCRAFT BOLT CORP., EL MONTE, CAL.
 NUT - " " ELASTIC STOP NUT CORP., UNION, M.I.

TEST CELL - LV2
 TENSION - 7B
 COMPRESSION - 5A

TEST DATA
 CONTRACT NO. AF 33(616)2808
 1-1-1957

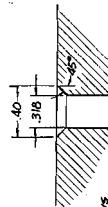


SIXTEEN SHAWINSHAW HEAD
 FILLET (CORNER) IN HARDWARE
 STEEL SPACING BLOCK
 (FOR ANAL. C - SCALE 60)

NOTE:
 FRACTIONS IN PARENTHESES
 DENOTE TENSILE STRESS CONCENTRATION

Non Lubricated		Torqued From Nut										Torqued From Head										Torqued From Nut										Torqued From Head										Torqued From Nut									
SHEET METAL		TENSILE STRESS (%/IN ²)										TENSILE STRESS (%/IN ²)										TENSILE STRESS (%/IN ²)										TENSILE STRESS (%/IN ²)										TENSILE STRESS (%/IN ²)									
THICKNESS INCHES 1/4 3/8 1/2 5/8 3/4 7/8 1 1 1/4 1 1/2 1 3/4 2 2 1/4 2 1/2 2 3/4 3 3 1/4 3 1/2 3 3/4 4 4 1/4 4 1/2 4 3/4 5 5 1/4 5 1/2 5 3/4 6 6 1/4 6 1/2 6 3/4 7 7 1/4 7 1/2 7 3/4 8 8 1/4 8 1/2 8 3/4 9 9 1/4 9 1/2 9 3/4 10 10 1/4 10 1/2 10 3/4 11 11 1/4 11 1/2 11 3/4 12 12 1/4 12 1/2 12 3/4 13 13 1/4 13 1/2 13 3/4 14 14 1/4 14 1/2 14 3/4 15 15 1/4 15 1/2 15 3/4 16 16 1/4 16 1/2 16 3/4 17 17 1/4 17 1/2 17 3/4 18 18 1/4 18 1/2 18 3/4 19 19 1/4 19 1/2 19 3/4 20 20 1/4 20 1/2 20 3/4 21 21 1/4 21 1/2 21 3/4 22 22 1/4 22 1/2 22 3/4 23 23 1/4 23 1/2 23 3/4 24 24 1/4 24 1/2 24 3/4 25 25 1/4 25 1/2 25 3/4 26 26 1/4 26 1/2 26 3/4 27 27 1/4 27 1/2 27 3/4 28 28 1/4 28 1/2 28 3/4 29 29 1/4 29 1/2 29 3/4 30 30 1/4 30 1/2 30 3/4 31 31 1/4 31 1/2 31 3/4 32 32 1/4 32 1/2 32 3/4 33 33 1/4 33 1/2 33 3/4 34 34 1/4 34 1/2 34 3/4 35 35 1/4 35 1/2 35 3/4 36 36 1/4 36 1/2 36 3/4 37 37 1/4 37 1/2 37 3/4 38 38 1/4 38 1/2 38 3/4 39 39 1/4 39 1/2 39 3/4 40 40 1/4 40 1/2 40 3/4 41 41 1/4 41 1/2 41 3/4 42 42 1/4 42 1/2 42 3/4 43 43 1/4 43 1/2 43 3/4 44 44 1/4 44 1/2 44 3/4 45 45 1/4 45 1/2 45 3/4 46 46 1/4 46 1/2 46 3/4 47 47 1/4 47 1/2 47 3/4 48 48 1/4 48 1/2 48 3/4 49 49 1/4 49 1/2 49 3/4 50 50 1/4 50 1/2 50 3/4 51 51 1/4 51 1/2 51 3/4 52 52 1/4 52 1/2 52 3/4 53 53 1/4 53 1/2 53 3/4 54 54 1/4 54 1/2 54 3/4 55 55 1/4 55 1/2 55 3/4 56 56 1/4 56 1/2 56 3/4 57 57 1/4 57 1/2 57 3/4 58 58 1/4 58 1/2 58 3/4 59 59 1/4 59 1/2 59 3/4 60 60 1/4 60 1/2 60 3/4 61 61 1/4 61 1/2 61 3/4 62 62 1/4 62 1/2 62 3/4 63 63 1/4 63 1/2 63 3/4 64 64 1/4 64 1/2 64 3/4 65 65 1/4 65 1/2 65 3/4 66 66 1/4 66 1/2 66 3/4 67 67 1/4 67 1/2 67 3/4 68 68 1/4 68 1/2 68 3/4 69 69 1/4 69 1/2 69 3/4 70 70 1/4 70 1/2 70 3/4 71 71 1/4 71 1/2 71 3/4 72 72 1/4 72 1/2 72 3/4 73 73 1/4 73 1/2 73 3/4 74 74 1/4 74 1/2 74 3/4 75 75 1/4 75 1/2 75 3/4 76 76 1/4 76 1/2 76 3/4 77 77 1/4 77 1/2 77 3/4 78 78 1/4 78 1/2 78 3/4 79 79 1/4 79 1/2 79 3/4 80 80 1/4 80 1/2 80 3/4 81 81 1/4 81 1/2 81 3/4 82 82 1/4 82 1/2 82 3/4 83 83 1/4 83 1/2 83 3/4 84 84 1/4 84 1/2 84 3/4 85 85 1/4 85 1/2 85 3/4 86 86 1/4 86 1/2 86 3/4 87 87 1/4 87 1/2 87 3/4 88 88 1/4 88 1/2 88 3/4 89 89 1/4 89 1/2 89 3/4 90 90 1/4 90 1/2 90 3/4 91 91 1/4 91 1/2 91 3/4 92 92 1/4 92 1/2 92 3/4 93 93 1/4 93 1/2 93 3/4 94 94 1/4 94 1/2 94 3/4 95 95 1/4 95 1/2 95 3/4 96 96 1/4 96 1/2 96 3/4 97 97 1/4 97 1/2 97 3/4 98 98 1/4 98 1/2 98 3/4 99 99 1/4 99 1/2 99 3/4 100 100 1/4 100 1/2 100 3/4 101 101 1/4 101 1/2 101 3/4 102 102 1/4 102 1/2 102 3/4 103 103 1/4 103 1/2 103 3/4 104 104 1/4 104 1/2 104 3/4 105 105 1/4 105 1/2 105 3/4 106 106 1/4 106 1/2 106 3/4 107 107 1/4 107 1/2 107 3/4 108 108 1/4 108 1/2 108 3/4 109 109 1/4 109 1/2 109 3/4 110 110 1/4 110 1/2 110 3/4 111 111 1/4 111 1/2 111 3/4 112 112 1/4 112 1/2 112 3/4 113 113 1/4 113 1/2 113 3/4 114 114 1/4 114 1/2 114 3/4 115 115 1/4 115 1/2 115 3/4 116 116 1/4 116 1/2 116 3/4 117 117 1/4 117 1/2 117 3/4 118 118 1/4 118 1/2 118 3/4 119 119 1/4 119 1/2 119 3/4 120 120 1/4 120 1/2 120 3/4 121 121 1/4 121 1/2 121 3/4 122 122 1/4 122 1/2 122 3/4 123 123 1/4 123 1/2 123 3/4 124 124 1/4 124 1/2 124 3/4 125 125 1/4 125 1/2 125 3/4 126 126 1/4 126 1/2 126 3/4 127 127 1/4 127 1/2 127 3/4 128 128 1/4 128 1/2 128 3/4 129 129 1/4 129 1/2 129 3/4 130 130 1/4 130 1/2 130 3/4 131 131 1/4 131 1/2 131 3/4 132 132 1/4 132 1/2 132 3/4 133 133 1/4 133 1/2 133 3/4 134 134 1/4 134 1/2 134 3/4 135 135 1/4 135 1/2 135 3/4 136 136 1/4 136 1/2 136 3/4 137 137 1/4 137 1/2 137 3/4 138 138 1/4 138 1/2 138 3/4 139 139 1/4 139 1/2 139 3/4 140 140 1/4 140 1/2 140 3/4 141 141 1/4 141 1/2 141 3/4 142 142 1/4 142 1/2 142 3/4 143 143 1/4 143 1/2 143 3/4 144 144 1/4 144 1/2 144 3/4 145 145 1/4 145 1/2 145 3/4 146 146 1/4 146 1/2 146 3/4 147 147 1/4 147 1/2 147 3/4 148 148 1/4 148 1/2 148 3/4 149 149 1/4 149 1/2 149 3/4 150 150 1/4 150 1/2 150 3/4 151 151 1/4 151 1/2 151 3/4 152 152 1/4 152 1/2 152 3/4 153 153 1/4 153 1/2 153 3/4 154 154 1/4 154 1/2 154 3/4 155 155 1/4 155 1/2 155 3/4 156 156 1/4 156 1/2 156 3/4 157 157 1/4 157 1/2 157 3/4 158 158 1/4 158 1/2 158 3/4 159 159 1/4 159 1/2 159 3/4 160 160 1/4 160 1/2 160 3/4 161 161 1/4 161 1/2 161 3/4 162 162 1/4 162 1/2 162 3/4 163 163 1/4 163 1/2 163 3/4 164 164 1/4 164 1/2 164 3/4 165 165 1/4 165 1/2 165 3/4 166 166 1/4 166 1/2 166 3/4 167 167 1/4 167 1/2 167 3/4 168 168 1/4 168 1/2 168 3/4 169 169 1/4 169 1/2 169 3/4 170 170 1/4 170 1/2 170 3/4 171 171 1/4 171 1/2 171 3/4 172 172 1/4 172 1/2 172 3/4 173 173 1/4 173 1/2 173 3/4 174 174 1/4 174 1/2 174 3/4 175 175 1/4 175 1/2 175 3/4 176 176 1/4 176 1/2 176 3/4 177 177 1/4 177 1/2 177 3/4 178 178 1/4 178 1/2 178 3/4 179 179 1/4 179 1/2 179 3/4 180 180 1/4 180 1/2 180 3/4 181 181 1/4 181 1/2 181 3/4 182 182 1/4 182 1/2 182 3/4 183 183 1/4 183 1/2 183 3/4 184 184 1/4 184 1/2 184 3/4 185 185 1/4 185 1/2 185 3/4 186 186 1/4 186 1/2 186 3/4 187 187 1/4 187 1/2 187 3/4 188 188 1/4 188 1/2 188 3/4 189 189 1/4 189 1/2 189 3/4 190 190 1/4 190 1/2 190 3/4 191 191 1/4 191 1/2 191 3/4 192 192 1/4 192 1/2 192 3/4 193 193 1/4 193 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336 1/2 336 3/4 337 337 1/4 337 1/2 337 3/4 338 338 1/4 338 1/2 338 3/4 339 339 1/4 339 1/2 339 3/4 340 340 1/4 340 1/2 340 3/4 341 341 1/4 341 1/2 341 3/4 342 342 1/4 342 1/2 342 3/4 343 343 1/4 343 1/2 343 3/4 344 344 1/4 344 1/2 344 3/4 345 345 1/4 345 1/2 345 3/4 346 346 1/4 346 1/2 346 3/4 347 347 1/4 347 1/2 347 3/4 348 348 1/4 348 1/2 348 3/4 349 349 1/4 349 1/2 349 3/4 350 350 1/4 350 1/2 350 3/4 351 351 1/4 351 1/2 351 3/4 352 352 1/4 352 1/2 352 3/4 353 353 1/4 353 1/2 353 3/4 354 354 1/4 354 1/2 354 3/4 355 355 1/4 355 1/2 355 3/4 356 356 1/4 356 1/2 356 3/4 357 357 1/4 357 1/2 357 3/4 358 358 1/4 358 1/2 358 3/4 359 359 1/4 359 1/2 359 3/4 360 360 1/4 360 1/2 360																																																			

SKETCH SHOWING HEAD
FILLET CLEARANCE IN HINGE
STEEL SPACING BLOCK

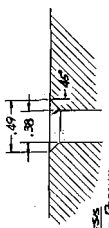
[illegible][illegible]

DATE: 4 April 1956
 SIZE: C 1/2-20 UNF-30
 SCREEN OR BOLT: MS 2000-50 NITD BY AIRCRAFT BOLT CORP., F. L. MONTGOMERY, CAL.
 NUT: "E" ELASTIC STOP NUT CORP., UNION, N. J.
 FB-064

TEST CELL: 140
 SECTION: 140
 COMPRESSION: 50

TEST DATA
 COURTESY OF AF 35 (16) 2000
 P-1271

SCREEN SHOWING HEAD
 JUST UNLOADED IN HARDWARE
 STEEL STOPPING BOLT
 (FORNELL C. SCALE 0.0)



NOTE:
 LOADS IN POUNDS
 ELASTIC STOP NUTS REMOVED

LUBRICATED	Torqued From Head										Torqued From Nut									
	TENSILE STRESS (#/in ²)										TENSILE STRESS (#/in ²)									
	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
Non Lubricated	1/4	85	215	335	475	600	745	885	1025	1165	1/4	85	215	335	475	600	745	885	1025	1165
	3/4	95	260	400	535	670	805	940	1075	1210	3/4	95	260	400	535	670	805	940	1075	1210
	1 1/4	105	275	415	550	685	820	955	1090	1225	1 1/4	105	275	415	550	685	820	955	1090	1225
	2 1/4	115	285	425	560	695	830	965	1100	1235	2 1/4	115	285	425	560	695	830	965	1100	1235
	3 1/4	125	295	435	570	705	840	975	1110	1245	3 1/4	125	295	435	570	705	840	975	1110	1245
2 Lip Torquing	1/4	130	300	440	575	710	845	980	1115	1250	1/4	130	300	440	575	710	845	980	1115	1250
	3/4	140	310	450	585	720	855	990	1125	1260	3/4	140	310	450	585	720	855	990	1125	1260
	1 1/4	150	320	460	595	730	865	1000	1135	1270	1 1/4	150	320	460	595	730	865	1000	1135	1270
	2 1/4	160	330	470	605	740	875	1010	1145	1280	2 1/4	160	330	470	605	740	875	1010	1145	1280
	3 1/4	170	340	480	615	750	885	1020	1155	1290	3 1/4	170	340	480	615	750	885	1020	1155	1290
5 Lip Torquing	1/4	175	345	485	620	755	890	1025	1160	1295	1/4	175	345	485	620	755	890	1025	1160	1295
	3/4	185	355	495	630	765	900	1035	1170	1305	3/4	185	355	495	630	765	900	1035	1170	1305
	1 1/4	195	365	505	640	775	910	1045	1180	1315	1 1/4	195	365	505	640	775	910	1045	1180	1315
	2 1/4	205	375	515	650	785	920	1055	1190	1325	2 1/4	205	375	515	650	785	920	1055	1190	1325
	3 1/4	215	385	525	660	795	930	1065	1200	1335	3 1/4	215	385	525	660	795	930	1065	1200	1335

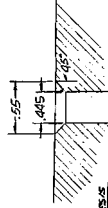
COMMENTS:
 1. DRY TORQUED BOLT 1/4" SPECIMEN SOCKET HEAD ENHANCED BY TORQUING TOOL BETWEEN 1/4" BOLT AND YIELD POINT AT 5" TORQUING.
 2. BOLTS 3/4" TO 5/8" WERE NOT TORQUED TO YIELD POINT TO AVOID RUPTURE OF SOCKET HEAD BY TORQUE WRENCH.
 3. ELONGATION OF BOLTS WAS MEASURED AT THE END OF THE 5" TORQUING AT EACH TORQUEING AND SUBSEQUENT LUBRICATION AND SUBSEQUENT TORQUING SURFACES.

DATE: 2 April 1966
 BY: D. H. 20 UNF-374
 SCREEN OR PLOT: MS 20-007-50, MFD
 NUT: E8-070

TEST CELL - NIP
 TENSION - TACTA
 COMPRESSION - 5B

TEST DATA
 COURTESY OF AF 30 (40) 2008
 P. 1271

SKETCH SHOWING HEAD
 BUT CLEARANCE IN HARDWARE
 STEEL SPRING BLOCK
 (ROCKWELL "C" SCALE 60)



NOTE:
 FEATURES IN PARENTHESES
 DENOTE TENSILE STRESS REMOVED

D		Non Lubricated										Lubricated									
		Torqued From Head					Torqued From Nut					Torqued From Head					Torqued From Nut				
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000	10000	50000	70000	90000	110000
Tensile Stress (ksi)		Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)					Tensile Stress (ksi)				
		10000	50000	70000	90000	110000	10000	50000	70000	90000	110										

Note:
Failures in FilletWelds
Due to Tensile Stress (Riveted)

OF EACH SPECIMEN FOR THE DAY CONDITIONS WERE BETWEEN 2100 & 2300 H-15

COMMENTS:

1. SOCKET HEADS OF BOLTS IN 2-IN NON-UNDERCUT TORQUE FROM HARD) RUPTURED BY THE TORQUING TOOL AT END OF 2ND TORQUING. TESTS HAD TO BE DISCONTINUED.
2. NON-UNDERCUT HAND TIGHTENED BOLTS BY THEIR 5/8 WERE REQUIRED TO VALUES LESS THAN THAT WHICH CAUSED FAILURE OF THE SOCKET-TYPE HEADS. CRITICAL VALUES OF THE MAXIMUM ALLOWABLE TORQUE FOR THE 5/8 WAS DETERMINED TO BE 10 FT-LB.
3. TWO 3/8 SOCKETS ONE STANDARD & ONE HEAVY DUTY, WERE CHECKED AT HIGH TORQUE VALUES REQUIRED TO TORQUE BOLT IN. THE 3/8 STANDARD SOCKET WAS DAMAGED BY THE TORQUING TOOL AND THE 3/8 HEAVY DUTY SOCKET WAS NOT DAMAGED BY THE TORQUING TOOL.

DATE 25 FEBRUARY 1957
 SIZE F 9/16-18 UNF-40
 SPECIMEN OR BOLT INS 20 009-50 Min. 8.16 inches Bar Gen. & Marine Co.
 NUT 1/2-13 UNF-40 Min. 1.18 inches Bar Gen. & Marine Co.
 1/2-13 UNF-40 Min. 1.18 inches Bar Gen. & Marine Co.
 1/2-13 UNF-40 Min. 1.18 inches Bar Gen. & Marine Co.

TEST CELL - A-9
 TORSION - 70
 COMPRESSION - 50

TEST DATA
 CONTRACT NO. AF 33(616)2805
 P-1272

SKETCH SHOWING HEAD
 FILET CHAMFER IN HORIZONTAL
 STEEL SHIMMING BLOCK
 (REPRESENTATIVE SCALE 60)



F	TORQUED FROM HEAD										TORQUED FROM NUT										LUBRICATED										TORQUED FROM NUT									
	TENSILE STRESS (psi)										TENSILE STRESS (psi)										TENSILE STRESS (psi)										TENSILE STRESS (psi)									
	10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000	100,000	10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000	100,000	10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000	100,000	10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000	100,000
NON LUBRICATED	10,000	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
	20,000	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00
	30,000	15.00	30.00	45.00	60.00	75.00	90.00	105.00	120.00	135.00	15.00	30.00	45.00	60.00	75.00	90.00	105.00	120.00	135.00	150.00	15.00	30.00	45.00	60.00	75.00	90.00	105.00	120.00	135.00	150.00	15.00	30.00	45.00	60.00	75.00	90.00	105.00	120.00	135.00	150.00
	40,000	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00
	50,000	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00	250.00	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00	250.00	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00	250.00
	60,000	30.00	60.00	90.00	120.00	150.00	180.00	210.00	240.00	270.00	30.00	60.00	90.00	120.00	150.00	180.00	210.00	240.00	270.00	300.00	30.00	60.00	90.00	120.00	150.00	180.00	210.00	240.00	270.00	300.00	30.00	60.00	90.00	120.00	150.00	180.00	210.00	240.00	270.00	300.00
	70,000	35.00	70.00	105.00	140.00	175.00	210.00	245.00	280.00	315.00	35.00	70.00	105.00	140.00	175.00	210.00	245.00	280.00	315.00	350.00	35.00	70.00	105.00	140.00	175.00	210.00	245.00	280.00	315.00	350.00	35.00	70.00	105.00	140.00	175.00	210.00	245.00	280.00	315.00	350.00
	80,000	40.00	80.00	120.00	160.00	200.00	240.00	280.00	320.00	360.00	40.00	80.00	120.00	160.00	200.00	240.00	280.00	320.00	360.00	400.00	40.00	80.00	120.00	160.00	200.00	240.00	280.00	320.00	360.00	400.00	40.00	80.00	120.00	160.00	200.00	240.00	280.00	320.00	360.00	400.00
	90,000	45.00	90.00	135.00	180.00	225.00	270.00	315.00	360.00	405.00	45.00	90.00	135.00	180.00	225.00	270.00	315.00	360.00	405.00	450.00	45.00	90.00	135.00	180.00	225.00	270.00	315.00	360.00	405.00	450.00	45.00	90.00	135.00	180.00	225.00	270.00	315.00	360.00	405.00	450.00
	100,000	50.00	100.00	150.00	200.00	250.00	300.00	350.00	400.00	450.00	50.00	100.00	150.00	200.00	250.00	300.00	350.00	400.00	450.00	500.00	50.00	100.00	150.00	200.00	250.00	300.00	350.00	400.00	450.00	500.00	50.00	100.00	150.00	200.00	250.00	300.00	350.00	400.00	450.00	500.00
	TEST DISCONTINUED																																							
LUBRICATED	10,000	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
	20,000	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00
	30,000	15.00	30.00	45.00	60.00	75.00	90.00	105.00	120.00	135.00	15.00	30.00	45.00	60.00	75.00	90.00	105.00	120.00	135.00	150.00	15.00	30.00	45.00	60.00	75.00	90.00	105.00	120.00	135.00	150.00	15.00	30.00	45.00	60.00	75.00	90.00	105.00	120.00	135.00	150.00
	40,000	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00
	50,000	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00	250.00	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00	250.00	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00	250.00
	60,000	30.00	60.00	90.00	120.00	150.00	180.00	210.00	240.00	270.00	30.00	60.00	90.00	120.00	150.00	180.00	210.00	240.00	270.00	300.00	30.00	60.00	90.00	120.00	150.00	180.00	210.00	240.00	270.00	300.00	30.00	60.00	90.00	120.00	150.00	180.00	210.00	240.00	270.00	300.00
	70,000	35.00	70.00	105.00	140.00	175.00	210.00	245.00	280.00	315.00	35.00	70.00	105.00	140.00	175.00	210.00	245.00	280.00	315.00	350.00	35.00	70.00	105.00	140.00	175.00	210.00	245.00	280.00	315.00	350.00	35.00	70.00	105.00	140.00	175.00	210.00	245.00	280.00	315.00	350.00
	80,000	40.00	80.00	120.00	160.00	200.00	240.00	280.00	320.00	360.00	40.00	80.00	120.00	160.00	200.00	240.00	280.00	320.00	360.00	400.00	40.00	80.00	120.00	160.00	200.00	240.00	280.00	320.00	360.00	400.00	40.00	80.00	120.00	160.00	200.00	240.00	280.00	320.00	360.00	400.00
	90,000	45.00	90.00	135.00	180.00	225.00	270.00	315.00	360.00	405.00	45.00	90.00	135.00	180.00	225.00	270.00	315.00	360.00	405.00	450.00	45.00	90.00	135.00	180.00	225.00	270.00	315.00	360.00	405.00	450.00	45.00	90.00	135.00	180.00	225.00	270.00	315.00	360.00	405.00	450.00
	100,000	50.00	100.00	150.00	200.00	250.00	300.00	350.00	400.00	450.00	50.00	100.00	150.00	200.00	250.00	300.00	350.00	400.00	450.00	500.00	50.00	100.00	150.00	200.00	250.00	300.00	350.00	400.00	450.00	500.00	50.00	100.00	150.00	200.00	250.00	300.00	350.00	400.00	450.00	500.00
	TEST DISCONTINUED																																							
5th Bearings	10,000	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
	20,000	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00
	30,000	15.00	30.00	45.00	60.00	75.00	90.00	105.00	120.00	135.00	15.00	30.00	45.00	60.00	75.00	90.00	105.00	120.00	135.00	150.00	15.00	30.00	45.00	60.00	75.00	90.00	105.00	120.00	135.00	150.00	15.00	30.00	45.00	60.00	75.00	90.00	105.00	120.00	135.00	150.00
	40,000	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00
	50,000	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00	250.00	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00	250.00	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00	250.00
	60,000	30.00	60.00	90.00	120.00	150.00	180.00	210.00	240.00	270.00	30.00	60.00	90.00	120.00	150.00	180.00	210.00	240.00	270.00	300.00	30.00	60.00	90.00	120.00	150.00	180.00	210.00	240.00	270.00	300.00	30.00	60.00	90.00	120.00	150.00	180.00	210.00	240.00	270.00	300.00
	70,000	35.00	70.00	105.00	140.00	175.00	210.00	245.00	280.00	315.00	35.00	70.00	105.00	140.00	175.00	210.00	245.00	280.00	315.00	350.00	35.00	70.00	105.00	140.00	175.00	210.00	245.00	280.00	315.00	350.00	35.00	70.00	105.00							

COMMENTS:

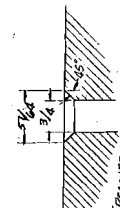
- 1) BOLTS TORQUED FROM THE HEAD IN THE DAY TORSION WERE TORQUED TO 100,000 PSI. CAPTURE OF THE BOLT HEAD SHEET PILE WRENCH AT VALUES OF TORQUE ABOVE 2000 IN-LB.
- 2) SLOWER BOLTS WERE CAPTURED BEFORE EACH RUN AND BOLT CAPTURED AND DISCONTINUED DUE TO SEIZING.
- 3) LIMIT OF LUBRICATED TIGHTENING IS INDICATED BY THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LOCATIONS OF NUT ON HEAD BEARING SURFACES.

DATE 13 FEBRUARY 1987
 SITE H. 10-10 UNF-34
 SPECIMEN OR BOLT MS 2002-50 WFO BY AIRCRAFT BOLT 1002 EL MONTE CAL.
 NUT 3/4" DIA. 1/2" THICK BY STEEL BOLT CO. STEAMFURNACE, PA.
 (NUT AND BOLT MARKED 13)

TEST CELL - NIP.
 REMOVAL - 68172
 COMPRESSION - 5C

TEST DATA
 CONTRACT NO. H. 31(60)2000
 P-1221

SKETCH SHOWING HEAD
 COMPRESSION IN HARDENED
 STEEL SHOWN BLACK
 (FOLLOWING IS SCALE 60)



NOTE:
 FLANGES IN DISCONTINUITY
 DETOUR THROUS STRESS REQUIRED

H	Torqued From Head				Torqued From Nut				Torqued From Head				Torqued From Nut			
	TENSILE STRESS (#/IN ²)				TENSILE STRESS (#/IN ²)				TENSILE STRESS (#/IN ²)				TENSILE STRESS (#/IN ²)			
Specimen No.	10,000	30,000	50,000	70,000	90,000	10,000	30,000	50,000	70,000	90,000	10,000	30,000	50,000	70,000	90,000	10,000
1H	1080	2540	3960	5480	6880	1120	1240	3100	4600	5960	1140	1400	1700	2100	2500	2900
2H	980	2500	4000			2H	880	2160	3840	5240	3H	300	760	1480	2380	3080
3H	620	1740	3040			4H	880	2580	3940	5100	5H	340	860	1400	2040	2740
4H	560	1260	2180			6H	1100	2600	3900	5200	7H	420	920	1580	2240	2880
5H	900	1000	3200			8H	500	1040	1760	2240	9H	480	900	1460	2060	2680
6H	738	2138	3238			10H	912	2316	3601	4771	11H	388	908	1532	2104	2676
7H	1038	2340	4100			12H	1340	3100	4600	5940	13H	388	908	1532	2104	2676
8H	560	1260	2180			14H	520	1240	1760	2240	15H	380	760	1400	2000	2600
9H	TEST DISCONTINUED					16H	1880	3940	5380	6600	17H	360	760	1400	2000	2600
10H	1500	3360	4700			18H	1400	3060	4600	5880	19H	340	760	1400	2000	2600
11H	1100	2200	3100			20H	1560	3200	4420	5460	21H	300	800	1400	2000	2600
12H	1160	2460	3680			22H	1540	3200	4420	5460	23H	300	800	1400	2000	2600
13H	1500	3360	4700			24H	1416	2912	4232	5332	25H	360	864	1440	2032	2672
14H	1800	3400	4700			26H	1716	3760	5180	6280	27H	360	864	1440	2032	2672
15H	1540	3440	4800			28H	1800	3760	5180	6280	29H	360	864	1440	2032	2672
16H	1240	2460	3680			30H	1560	3200	4420	5460	31H	360	864	1440	2032	2672
17H	1540	3440	4800			32H	1700	3700	5200	6400	33H	360	864	1440	2032	2672
18H	1240	2460	3680			34H	1600	3200	4700	6000	35H	360	864	1440	2032	2672
19H	1540	3440	4800			36H	1100	2300	3100	3600	37H	360	864	1440	2032	2672
20H	1240	2460	3680			38H	1596	3272	4672	5768	39H	360	864	1440	2032	2672
21H	1540	3440	4800			40H	1760	3760	5180	6280	41H	360	864	1440	2032	2672
22H	1240	2460	3680			42H	1100	2300	3100	3600	43H	360	864	1440	2032	2672
23H	1540	3440	4800			44H	1596	3272	4672	5768	45H	360	864	1440	2032	2672
24H	1240	2460	3680			46H	1760	3760	5180	6280	47H	360	864	1440	2032	2672
25H	1540	3440	4800			48H	1100	2300	3100	3600	49H	360	864	1440	2032	2672
26H	1240	2460	3680			50H	1596	3272	4672	5768	51H	360	864	1440	2032	2672
27H	1540	3440	4800			52H	1760	3760	5180	6280	53H	360	864	1440	2032	2672
28H	1240	2460	3680			54H	1100	2300	3100	3600	55H	360	864	1440	2032	2672
29H	1540	3440	4800			56H	1596	3272	4672	5768	57H	360	864	1440	2032	2672
30H	1240	2460	3680			58H	1760	3760	5180	6280	59H	360	864	1440	2032	2672
31H	1540	3440	4800			60H	1100	2300	3100	3600	61H	360	864	1440	2032	2672
32H	1240	2460	3680			62H	1596	3272	4672	5768	63H	360	864	1440	2032	2672
33H	1540	3440	4800			64H	1760	3760	5180	6280	65H	360	864	1440	2032	2672
34H	1240	2460	3680			66H	1100	2300	3100	3600	67H	360	864	1440	2032	2672
35H	1540	3440	4800			68H	1596	3272	4672	5768	69H	360	864	1440	2032	2672
36H	1240	2460	3680			70H	1760	3760	5180	6280	71H	360	864	1440	2032	2672
37H	1540	3440	4800			72H	1100	2300	3100	3600	73H	360	864	1440	2032	2672
38H	1240	2460	3680			74H	1596	3272	4672	5768	75H	360	864	1440	2032	2672
39H	1540	3440	4800			76H	1760	3760	5180	6280	77H	360	864	1440	2032	2672
40H	1240	2460	3680			78H	1100	2300	3100	3600	79H	360	864	1440	2032	2672
41H	1540	3440	4800			80H	1596	3272	4672	5768	81H	360	864	1440	2032	2672
42H	1240	2460	3680			82H	1760	3760	5180	6280	83H	360	864	1440	2032	2672
43H	1540	3440	4800			84H	1100	2300	3100	3600	85H	360	864	1440	2032	2672
44H	1240	2460	3680			86H	1596	3272	4672	5768	87H	360	864	1440	2032	2672
45H	1540	3440	4800			88H	1760	3760	5180	6280	89H	360	864	1440	2032	2672
46H	1240	2460	3680			90H	1100	2300	3100	3600	91H	360	864	1440	2032	2672
47H	1540	3440	4800			92H	1596	3272	4672	5768	93H	360	864	1440	2032	2672
48H	1240	2460	3680			94H	1760	3760	5180	6280	95H	360	864	1440	2032	2672
49H	1540	3440	4800			96H	1100	2300	3100	3600	97H	360	864	1440	2032	2672
50H	1240	2460	3680			98H	1596	3272	4672	5768	99H	360	864	1440	2032	2672
51H	1540	3440	4800			100H	1760	3760	5180	6280	101H	360	864	1440	2032	2672
52H	1240	2460	3680			102H	1100	2300	3100	3600	103H	360	864	1440	2032	2672
53H	1540	3440	4800			104H	1596	3272	4672	5768	105H	360	864	1440	2032	2672
54H	1240	2460	3680			106H	1760	3760	5180	6280	107H	360	864	1440	2032	2672
55H	1540	3440	4800			108H	1100	2300	3100	3600	109H	360	864	1440	2032	2672
56H	1240	2460	3680			110H	1596	3272	4672	5768	111H	360	864	1440	2032	2672
57H	1540	3440	4800			112H	1760	3760	5180	6280	113H	360	864	1440	2032	2672
58H	1240	2460	3680			114H	1100	2300	3100	3600	115H	360	864	1440	2032	2672
59H	1540	3440	4800			116H	1596	3272	4672	5768	117H	360	864	1440	2032	2672
60H	1240	2460	3680			118H	1760	3760	5180	6280	119H	360	864	1440	2032	2672
61H	1540	3440	4800			120H	1100	2300	3100	3600	121H	360	864	1440	2032	2672
62H	1240	2460	3680			122H	1596	3272	4672	5768	123H	360	864	1440	2032	2672
63H	1540	3440	4800			124H	1760	3760	5180	6280	125H	360	864	1440	2032	2672
64H	1240	2460	3680			126H	1100	2300	3100	3600	127H	360	864	1440	2032	2672
65H	1540	3440	4800			128H	1596	3272	4672	5768	129H	360	864	1440	2032	2672
66H	1240	2460	3680			130H	1760	3760	5180	6280	131H	360	864	1440	2032	2672
67H	1540	3440	4800			132H	1100	2300	3100	3600	133H	360	864	1440	2032	2672
68H	1240	2460	3680			134H	1596	3272	4672	5768	135H	360	864	1440	2032	2672
69H	1540	3440	4800			136H	1760	3760	5180	6280	137H	360	864	1440	2032	2672
70H	1240	2460	3680			138H	1100	2300	3100	3600	139H	360	864	1440	2032	2672
71H	1540	3440	4800			140H	1596	3272	4672	5768	141H	360	864	1440	2032	2672
72H	1240	2460	3680			142H	1760	3760	5180	6280	143H	360	864	1440	2032	2672
73H	1540	3440	4800			144H	1100	2300	3100	3600	145H	360	864	1440	2032	2672
74H	1240	2460	3680			146H	1596	3272	4672	5768	147H	360	864	1440	2032	2672
75H	1540	3440	4800			148H	1760	3760	5180	6280	149H	360	864	1440	2032	2672
76H	1240	2460	3680			150H	1100	2300	3100	3600	151H	360	864	1440	2032	2672
77H	1540	3440	4800			152H	1596	3272	4672	5768	153H	360	864	1440	2032	2672
78H	1240	2460	3680			154H	1760	3760	5180	6280	155H	360	864	1440	2032	2

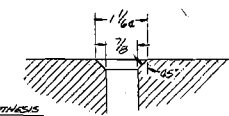
DATE 21 FEBRUARY 1957
 SIZE 1 7/8-18 UNF-5A
 SCREW OR BOLT MS 20014-50
 NUT 3-68-10A

TEST CELL - N°
 TORSION - 60
 COMPRESSION - 50

MFG. BY AIRCRAFT BOLT CORP., EL MONTE, CAL.
 MFG. BY EUSKE STOP NUT CORP., UNION, N.J.
 MFG. BY EUSKE UNF. OR STD. PRESSD STEEL CO., JERSEY CITY, N.J.
 (NUT FOR BOLT MARKED (A) FURNISHED BY LOCKHED AIRCRAFT CORP., BUEBANK, CAL.)

TEST DATA
 CONTRACT L# AF 33(616)2808
 P-127

NOTE:
 FIGURES IN PARENTHESES
 DENOTE TENSILE STRESS (PSI)



SKETCH SHOWING HEAD
 COUNTERSINK IN HARDENED
 STEEL SPRING BLOCK
 (ROCKWELL C-SCALE 60)

WADC TR 57-330

95

Torquing No.	NON LUBRICATED												LUBRICATED											
	Torqued From Head						Torqued From Nut						Torqued From Head						Torqued From Nut					
	TENSILE STRESS (*IN²)						TENSILE STRESS (*IN²)						TENSILE STRESS (*IN²)						TENSILE STRESS (*IN²)					
	10,000	30,000	50,000	70,000	90,000	110,000	10,000	30,000	50,000	70,000	90,000	110,000	10,000	30,000	50,000	70,000	90,000	110,000	10,000	30,000	50,000	70,000	90,000	110,000
Specimen No.	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)	TORQUE (IN-#)
1H	1560	4080	7000				1560	4920	7700	9900	11980	14060	1440	840	1440	2020	2820	3700	1440	900	1600	2300	3100	3900
2H	1500	4200					1260	2900	4580	6260	7900	9200	2440	980	1480	2000	2620	3200	2440	800	1460	2040	2700	3440
3H	1200	3180					1840	4920	7720	10000	12200	14180	3440	900	1380	1980	2700	3440	3440	700	1220	1780	2300	2980
(A)4H	1100	2700	5040				(A)4H	1220	2500	4200	5620	7300	(A)4H	600	1140	1700	2360	3040	(A)4H	400	940	1520	2200	2920
(A)5H	1280	3000	5400				(A)5H	720	1480	2400	3380	4500	(A)5H	560	1000	1600	2400	3400	(A)5H	400	940	1540	2340	3200
Ave	1324	3432	5712				Ave	1320	3344	5320	7032	8776	Ave	440	872	1520	2164	2712	Ave	364	856	1488	2144	2884
Max	1560	4080	7000				Max	1840	4920	7720	10000	12200	Max	600	1140	1700	2400	3400	Max	400	940	1640	2380	3480
Min	1160	2700	5040				Min	720	1480	2400	3380	4500	Min	340	840	1380	1980	2620	Min	280	700	1260	1780	2380
1H	2900	7800					1H	2640	6600	9400	11460	13540	1440	260	720	1260	1880	2500	1440	440	1100	1860	2600	3360
2H	2240	5060					2H	2000	4760	7200	9540	10400	2440	260	720	1300	1980	2740	2440	390	740	1400	2100	2800
3H	1860	4100					3H	3466	7600	10140	12360	14140	3440	300	800	1300	1980	2800	3440	240	680	1200	1800	2420
(A)4H	1600	3880	6200				(A)4H	2200	5000	6980	8760	10960	(A)4H	400	900	1500	2240	3180	(A)4H	320	880	1480	2220	3100
(A)5H	1700	4000	6600				(A)5H	2240	2780	4000	5300	6560	(A)5H	320	760	1400	2120	2840	(A)5H	300	800	1380	2040	2700
Ave	2092	4918	6400				Ave	2399	5360	7544	9784	11040	Ave	308	780	1332	2040	2832	Ave	320	840	1444	2152	2876
Max	2900	7800	6600				Max	3466	7600	10140	12360	14140	Max	400	900	1500	2240	3180	Max	440	1100	1860	2600	3360
Min	1600	3880	6200				Min	1340	2780	4000	5300	6560	Min	260	720	1260	1880	2600	Min	240	680	1200	1800	2440
1H	3160	8460					1H	2800	6800	9760	12140	14300	1440	220	720	1400	2100	2800	1440	300	1000	1760	2500	3200
2H	2440	6260					2H	3660	8240	11040	13060	14860	2440	240	800	1360	2060	2840	2440	280	800	1420	2160	2900
3H	2260	4760					3H	3400	7360	10240	12440	14160	3440	260	800	1300	2100	2800	3440	200	700	1400	2020	2640
(A)4H	1800	4320	6740				(A)4H	2640	6580	9060	10900	12740	(A)4H	380	900	1560	2200	2960	(A)4H	300	900	1540	2340	3020
(A)5H	1920	4540	7480				(A)5H	2200	4160	6040	7720	9640	(A)5H	320	800	1500	2200	2960	(A)5H	280	840	1500	2260	3020
Ave	2320	5668	7110				Ave	2940	6628	9228	11352	13140	Ave	284	804	1456	2132	2872	Ave	284	798	1504	2256	2992
Max	3160	8460	7480				Max	3660	8240	11040	13060	14860	Max	380	900	1560	2200	2960	Max	360	1000	1760	2580	3300
Min	1800	4320	6740				Min	2200	4160	6040	7720	9640	Min	240	720	1360	2060	2800	Min	200	700	1400	2020	2640
1H	3300	8320					1H	2840	6960	10000	12400	14600	1440	220	780	1460	2160	2880	1440	300	940	1600	2400	3180
2H	2680	6300					2H	3360	7440	10400	13120	15480	2440	260	780	1480	2320	3200	2440	280	800	1480	2220	3000
3H	2400	5200					3H	3400	7720	10040	12160	14040	3440	300	800	1480	2120	2840	3440	260	800	1580	2100	2700
(A)4H	2000	4660	7100				(A)4H	2060	7060	9600	11860	13400	(A)4H	400	1000	1620	2380	3120	(A)4H	380	940	1660	2440	3300
(A)5H	2200	5000	7940				(A)5H	2600	5500	7640	10000	12040	(A)5H	340	1000	1600	2200	2900	(A)5H	340	980	1820	2600	3480
Ave	2516	5896	7520				Ave	3052	6936	9536	11908	13912	Ave	304	832	1516	2236	2988	Ave	312	892	1608	2352	3128
Max	3300	8320	7940				Max	3400	7720	10040	12160	14040	Max	400	1000	1600	2380	3200	Max	380	980	1820	2600	3480
Min	2000	4660	7100				Min	2600	5500	7640	10000	12040	Min	320	780	1460	2120	2840	Min	260	800	1460	2100	2700
1H	3420	8400					1H	2900	7300	10460	13200	15500	1440	240	880	1600	2340	3000	1440	300	940	1600	2460	3300
2H	2660	6300					2H	3500	7600	10480	12780	14680	2440	240	800	1540	2300	3120	2440	280	800	1460	2120	2800
3H	2600	5600					3H	3700	7280	9900	12160	14020	3440	280	780	1500	2280	2800	3440	260	760	1460	2140	2740
(A)4H	2060	4860	7300				(A)4H	2640	6540	9540	11940	13860	(A)4H	400	1000	1740	2400	3200	(A)4H	400	1000	1780	2460	3260
(A)5H	2320	5200	8400				(A)5H	2680	5560	8200	10600	12600	(A)5H	360	900	1660	2380	3140	(A)5H	300	1000	1860	2660	3500
Ave	2688	6072	7850				Ave	3084	6856	9716	12136	14136	Ave	304	872	1608	2340	3052	Ave	308	900	1632	2438	3188
Max	3420	8400	8400				Max	3700	7600	10480	12780	14680	Max	400	1000	1740	2440	3200	Max	400	1000	1860	2760	3600
Min	2060	4860	7300				Min	2640	5560	8200	10600	12600	Min	340	780	1560	2320	3000	Min	260	760	1460	2120	2740

COMMENTS:

(1) BOLTS TORQUED FROM THE HEAD IN THE DRY CONDITION WERE TORQUED TO 30,000 OR 50,000 PSI ONLY TO PREVENT RUPTURE OF THE SOCKET AT MAX. WRENCH AT VALUES OF TORQUE ABOVE 8000 IN-#.
 (2) SOCKET SURFACES WERE SHAVED BEFORE EACH RUN FOR BOTH LUBRICATED AND DRY CONDITIONS DUE TO SANDING.
 (3) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.

Page 10

Sketch showing head
countersink in hardened
steel starting block
(Rockwell C" scale 60)

NOTE: FIGURES IN PARENTHESES
DENOTE TENSILE STRESS RATIO

LUBRICATED

WADC TR 57-330

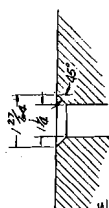
COMMENTS:

(1) BOLTS PROVIDED FROM THE FIELD IN THE LAST CONDITION WERE REMOVED TO 3000 PSI ONLY TO PREVENT RUPTURE OF THE SOCKET'S HICK WRENCH AT VALUES OF TORQUE ABOVE 15,000 14-18.

(2) SPACER BLOCKS WERE THREADED BEHIND EACH RUN AND WERE LUBRICATED AND DRY CONDITIONS DUE TO CORROSION.

(3) RUNS OF LUBRICATED TUBING ARE MARKED WITH "X" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.

STEEL SHAPING HEAD
COUNTERSINK IN HARDENED
STEEL SHAPING BLOCK
(ROCKWELL "C" SCALE 60)



WADC TR 57-330 98

- (3) RUNS OF LUBRICATED TORQUEINGS ARE MARKED WITH AN "L" AT THE BEGINNINGS OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF HOT OR HEAT BEARING SURFACES.
- (4) BUT 2H WAS REQUIRED TO 94000 Psi TO SEE IF FIVE TORQUEINGS. TO THIS VALUE COULD BE RUN WITHOUT HEAD RUNNERS. TORQUE VALUES OF 1H INDICATED THAT IT MIGHT BE ASSEMBLED.

SKETCH SHOWING HEAD
COUNTERSINK IN HARDWOOD
STEEL SPARKING BLOCK
(ROCKWELL "C" SCALE 60)

M	Non Lubricated										Lubricated									
	Torqued From Head					Torqued From Nut					Torqued From Head					Torqued From Nut				
	TENSILE STRESS (N/m ²)										TENSILE STRESS (N/m ²)									
Specimen No.	10,000	30,000	50,000	70,000	90,000	110,000	130,000	150,000	170,000	190,000	10,000	30,000	50,000	70,000	90,000	110,000	130,000	150,000	170,000	190,000
1H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
2H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
3H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
4H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
5H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
6H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
7H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
8H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
9H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
10H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
11H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
12H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
13H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
14H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
15H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
16H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
17H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
18H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
19H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
20H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
21H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
22H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
23H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
24H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
25H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
26H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
27H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
28H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
29H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
30H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
31H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
32H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
33H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
34H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
35H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
36H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
37H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
38H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
39H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
40H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
41H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
42H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
43H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
44H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
45H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
46H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
47H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
48H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
49H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,000	59,000
50H	6,000	11,400	17,000	23,000	29,000	35,000	41,000	47,000	53,00											

COMMENTS:

- (1) SAMPLE BARS WERE SANDPED BEFORE EACH RUN FOR BOTH LUBRICATED AND DRY CONDITIONS DUE TO SCORING.
- (2) RUNS OF LUBRICATED TESTS WERE INTERRUPTED AT AN n° AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF 400 OR HARD BEARING SURFACES.
- (3) HIGHER VALUES OF STRESS WERE ATTAINED UP TO THRUOUT VALUES OF 45000 INLB WITH BOOTS IN f° 3H.

PAGE 14

NUT EB-242 MFG. BY ELASTIC STRAP NUT CORP. UNION, N.Y.

COMPRESSION-5D

DET N° H
B. 1377



SKETCH SHOWING HEAD
COUNTERSINK IN HARDENED
STEEL SPACING BLOCK
(ROCKWELL "C" - SCALE 60)

100

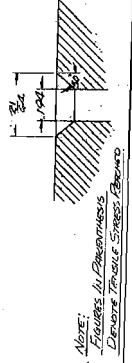
COMMENTS: (1) BOLTS TURNED FROM THE HEAD IN THE DRY CONDITIONS WERE DERIVED TO 50,000 PSI ONLY TO PREVENT RUPTURE OR BREAKAGE OF THE RECESSED HEAD SOCKET AND HEX. WRENCH AT VALUES OF TORQUE ABOVE 60,000 IN-LB. (2) SPARKER BOLDS WERE SAID BEFORE SUCH RUN IN BOTH LUBRICATED AND DRY CONDITIONS DUE TO STAIRWAYS. (3) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS ON NUT OR HEAD BEARING SURFACES. (4) CALCULATED YIELD POINT OF 150,000 PSI UNATTAINABLE DUE TO LIMITATIONS OF CALIBRATING DEVICES AND TENSION RECORDING INSTRUMENTS.

PAGE 14

DATE 9 JANUARY 1957
 SIZE 0 A-32 NF-39
 SCREW OR BOLT AN 800 BR-37 140 BY ARMO BAR & SCREW CO., STAMPAED GEAR (SCREW HEAD)
 NUT ELASTIC STOP NUT CORR. UNION, U.I.

TEST CELL - 142
 TENSION - 78
 COMPRESSION - 50
 TEST DATA
 CONTRACT NO. AF 33(66)2008
 P-1221

STEEL SHOWING HARD
 COUNTERSINK IN HARDENED
 STEEL SHOWING BLACK
 (ROUSELL T. SCALE 60)



		NON LUBRICATED										LUBRICATED									
Torquing N°	Torquing N°	Torqued From Head					Torqued From Nut					Torqued From Head					Torqued From Nut				
		TENSILE STRESS (%/in²)					TENSILE STRESS (%/in²)					TENSILE STRESS (%/in²)					TENSILE STRESS (%/in²)				
N°	N°	10000	30000	50000	70000	90000	10000	30000	50000	70000	90000	10000	30000	50000	70000	90000	10000	30000	50000	70000	90000
		TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)
1H	1H	5	14	22	31	43	50	11	6	12	19	24	32	40	46	52	11	6	12	19	24
2H	2H	5	14	22	31	43	50	2U	9	19	24	30	38	46	52	58	2U	9	19	24	30
3H	3H	5	14	22	31	43	50	2U	10	16	22	40	51	60	68	76	2U	10	16	22	40
4H	4H	5	14	22	31	43	50	4U	8	18	28	40	55	65	75	85	4U	8	18	28	40
5H	5H	6	13	18	27	39	49	5U	7	17	28	37	47	57	67	77	5U	7	17	28	37
6H	6H	7	16	23	33	45	57	6U	8	16	24	34	44	54	64	74	6U	8	16	24	34
7H	7H	7	16	23	33	45	57	6U	16	19	28	40	55	65	75	85	6U	16	19	28	40
8H	8H	7	16	23	33	45	57	6U	6	12	19	25	32	40	46	52	6U	6	12	19	25
9H	9H	9	22	34	45	52	60	1U	8	17	25	34	42	49	56	63	1U	8	17	25	34
10H	10H	12	25	36	48	55	65	2U	10	25	36	50	59	65	75	85	2U	10	25	36	50
11H	11H	15	28	40	51	60	70	3U	12	28	46	59	71	80	90	100	3U	12	28	46	59
12H	12H	15	28	40	51	60	70	4U	14	30	44	57	75	85	95	105	4U	14	30	44	57
13H	13H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
14H	14H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
15H	15H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
16H	16H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
17H	17H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
18H	18H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
19H	19H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
20H	20H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
21H	21H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
22H	22H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
23H	23H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
24H	24H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
25H	25H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
26H	26H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
27H	27H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
28H	28H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
29H	29H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
30H	30H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
31H	31H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
32H	32H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
33H	33H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
34H	34H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
35H	35H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
36H	36H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
37H	37H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
38H	38H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
39H	39H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
40H	40H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
41H	41H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
42H	42H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
43H	43H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
44H	44H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
45H	45H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
46H	46H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
47H	47H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
48H	48H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
49H	49H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
50H	50H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
51H	51H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
52H	52H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
53H	53H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
54H	54H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
55H	55H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
56H	56H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
57H	57H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
58H	58H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
59H	59H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
60H	60H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
61H	61H	19	27	35	46	54	64	5U	14	30	44	57	75	85	95	105	5U	14	30	44	57
62H	62H	19	27	35	46	54	64	5U													

STEEL SHOWING HARD
COUNTERSINK IN HARDENED
STEEL SPARKING BLOCK
ROCKWELL (C) SCALE 60)

[illegible]

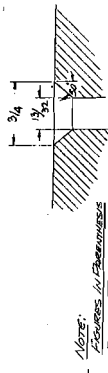
2

DATE 1 MAY 1956
 SIZE 5 3/8 - 24 UNF - 32
 SCREEN OR BOX - AN 500-618-843
 NUT - AN 965-624

TEST CELL - A-18
 TENSION - 74675
 COMPRESSION - 513

TEST DATA
 CONDUCTED BY AERO BOLT & SCREW CO. STAMFORD, CONN (PHILIP HEAD)
 CONDUCTED BY AERO BOLT & SCREW CO. STAMFORD, CONN (PHILIP HEAD)
 P-1277

STRETCH MARKING HEAD
 CENTERLINE IN HEAD
 STRETCH MARKING BLOCK
 (FOURTH LINE - SCREW GO)



Notes:
 STRETCH MARKING HEAD
 STRETCH MARKING BLOCK

S	Non Lubricated										Lubricated															
	Torqued From Head					Torqued From Nut					Torqued From Head					Torqued From Nut										
	TENSILE STRESS (#/in ²)					TENSILE STRESS (#/in ²)					TENSILE STRESS (#/in ²)					TENSILE STRESS (#/in ²)										
Directional Torsion A ¹	1000	2000	3000	4000	5000	1000	2000	3000	4000	5000	1000	2000	3000	4000	5000	1000	2000	3000	4000	5000	1000	2000	3000	4000	5000	
	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	TORQUE (in-lb)	
1H	100	215	455	610	455	610	455	610	455	610	1H	60	140	260	387	502	585				1H	60	140	260	387	502
2H	110	305	495	635	495	635	495	635	495	635	2H	83	210	300	394	512	634				2H	83	210	300	394	512
3H	95	260	425	560	425	560	425	560	425	560	3H	103	310	525	704	868	1103				3H	103	310	525	704	868
4H	100	285	480	615	480	615	480	615	480	615	4H	70	182	305	455	645	1103				4H	70	182	305	455	645
5H	90	230	400	535	400	535	400	535	400	535	5H	80	215	335	475	631	818				5H	80	215	335	475	631
6H	99	271	451	588	451	588	451	588	451	588	6H	103	310	525	704	868	1103				6H	103	310	525	704	868
7H	110	305	495	635	495	635	495	635	495	635	7H	103	310	525	704	868	1103				7H	103	310	525	704	868
8H	120	340	520	660	520	660	520	660	520	660	8H	120	340	520	660	802	1042				8H	120	340	520	660	802
9H	130	375	555	695	555	695	555	695	555	695	9H	140	365	580	760	947	1134				9H	140	365	580	760	947
10H	140	410	590	730	590	730	590	730	590	730	10H	140	365	580	760	947	1134				10H	140	365	580	760	947
11H	150	445	625	765	625	765	625	765	625	765	11H	150	445	625	765	982	1169				11H	150	445	625	765	982
12H	160	480	660	800	660	800	660	800	660	800	12H	160	480	660	800	1017	1204				12H	160	480	660	800	1017
13H	170	515	695	835	695	835	695	835	695	835	13H	170	515	695	835	1052	1239				13H	170	515	695	835	1052
14H	180	550	730	870	730	870	730	870	730	870	14H	180	550	730	870	1087	1274				14H	180	550	730	870	1087
15H	190	585	765	905	765	905	765	905	765	905	15H	190	585	765	905	1122	1309				15H	190	585	765	905	1122
16H	200	620	800	940	800	940	800	940	800	940	16H	200	620	800	940	1157	1344				16H	200	620	800	940	1157
17H	210	655	835	975	835	975	835	975	835	975	17H	210	655	835	975	1192	1379				17H	210	655	835	975	1192
18H	220	690	870	1010	870	1010	870	1010	870	1010	18H	220	690	870	1010	1227	1414				18H	220	690	870	1010	1227
19H	230	725	905	1045	905	1045	905	1045	905	1045	19H	230	725	905	1045	1262	1449				19H	230	725	905	1045	1262
20H	240	760	940	1080	940	1080	940	1080	940	1080	20H	240	760	940	1080	1297	1484				20H	240	760	940	1080	1297
21H	250	795	975	1115	975	1115	975	1115	975	1115	21H	250	795	975	1115	1332	1519				21H	250	795	975	1115	1332
22H	260	830	1010	1150	1010	1150	1010	1150	1010	1150	22H	260	830	1010	1150	1367	1554				22H	260	830	1010	1150	1367
23H	270	865	1045	1185	1045	1185	1045	1185	1045	1185	23H	270	865	1045	1185	1402	1589				23H	270	865	1045	1185	1402
24H	280	900	1080	1220	1080	1220	1080	1220	1080	1220	24H	280	900	1080	1220	1437	1624				24H	280	900	1080	1220	1437
25H	290	935	1115	1255	1115	1255	1115	1255	1115	1255	25H	290	935	1115	1255	1472	1659				25H	290	935	1115	1255	1472
26H	300	970	1150	1290	1150	1290	1150	1290	1150	1290	26H	300	970	1150	1290	1507	1694				26H	300	970	1150	1290	1507
27H	310	1005	1185	1325	1185	1325	1185	1325	1185	1325	27H	310	1005	1185	1325	1542	1729				27H	310	1005	1185	1325	1542
28H	320	1040	1220	1360	1220	1360	1220	1360	1220	1360	28H	320	1040	1220	1360	1577	1764				28H	320	1040	1220	1360	1577
29H	330	1075	1255	1395	1255	1395	1255	1395	1255	1395	29H	330	1075	1255	1395	1612	1799				29H	330	1075	1255	1395	1612
30H	340	1110	1290	1430	1290	1430	1290	1430	1290	1430	30H	340	1110	1290	1430	1647	1834				30H	340	1110	1290	1430	1647
31H	350	1145	1325	1465	1325	1465	1325	1465	1325	1465	31H	350	1145	1325	1465	1682	1869				31H	350	1145	1325	1465	1682
32H	360	1180	1360	1500	1360	1500	1360	1500	1360	1500	32H	360	1180	1360	1500	1717	1904				32H	360	1180	1360	1500	1717
33H	370	1215	1395	1535	1395	1535	1395	1535	1395	1535	33H	370	1215	1395	1535	1752	1929				33H	370	1215	1395	1535	1752
34H	380	1250	1430	1570	1430	1570	1430	1570	1430	1570	34H	380	1250	1430	1570	1787	1954				34H	380	1250	1430	1570	1787
35H	390	1285	1465	1605	1465	1605	1465	1605	1465	1605	35H	390	1285	1465	1605	1822	1979				35H	390	1285	1465	1605	1822
36H	400	1320	1500	1640	1500	1640	1500	1640	1500	1640	36H	400	1320	1500	1640	1857	2004				36H	400	1320	1500	1640	1857
37H	410	1355	1535	1675	1535	1675	1535	1675	1535	1675	37H	410	1355	1535	1675	1892	2029				37H	410	1355	1535	1675	1892
38H	420	1390	1570	1710	1570	1710	1570	1710	1570	1710	38H	420	1390	1570	1710	1927	2054				38H	420	1390	1570	1710	1927
39H	430	1425	1605	1745	1605	1745	1605	1745	1605	1745	39H	430	1425	1605	1745	1962	2079				39H	430	1425	1605	1745	1962
40H	440	1460	1640	1780	1640	1780	1640	1780	1640	1780	40H	440	1460	1640	1780	1997	2104				40H	440	1460	1640	1780	1997
41H	450	1495	1675	1815	1675	1815	1675	1815	1675	1815	41H	450	1495	1675	1815	2032	2129				41H	450	1495	1675	1815	2032
42H	460	1530	1710	1850	1710	1850	1710	1850	1710	1850	42H	460	1530	1710	1850	2067	2154				42H	460	1530	1710	1850	2067
43H	470	1565	1745	1885	1745	1885	1745	1885	1745	1885	43H	470	1565	1745	1885	2102	2179				43H	470	1565	1745	1885	2102
44H	480	1600	1780	1920	1780	1920	1780	1920	1780	1920	44H	480	1600	1780	1920	2137	2204				44H	480	1600	1780	1920	2137
45H	490	1635	1815	1955	1815	1955	1815	1955	1815	1955	45H	490	1635	1815	1955	2172	2229				45H	490	1635	1815	1955	2172
46H	500	1670	1850	1990	1850	1990	1850	1990	1850	1990	46H	500	1670	1850	1990	2207	2254				46H	500	1670	1850	1990	2207
47H	510	1705	1885	2030	1885	2030	1885	2030	1885	2030	47H	510	1705	1885	2030	2242	2289				47H	510	1705	1885	2030	2242
48H	520	1740	1920	2070	1920	2070	1920	2070	1920	2070	48H	520	1740	1920	2070	2277	2324				48H	520	1740	1920	2070	2277
49H	530	1775	1955	2110	1955	2110	1955	2110	1955	2110	49H	530	1775	1955	2110	2312	2359									

NOTE: FIGURES IN PARENTHESES

[illegible]

AW 365 - 918 MF

TOP NUT CORP. UNION

TOP NUT CORP., UNION, NEW JERSEY

EA 1727

FIGURES IN PARENTHESES

(Rockwell "C" Scale 60)

LUBRICATED	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)
TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)
TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)	TENSILE STRESS (*in*)
20,000	60,000	100,000	140,000	20,000	60,000	100,000	140,000	20,000	60,000	100,000	140,000	20,000	60,000	100,000	140,000
1st	355	1375	2260		195	600	900		195	600	900		195	600	900
2nd	425	1345	2175		250	625	1290		250	625	1290		250	625	1290
3rd					285	640	1140		285	640	1140		285	640	1140
4th					220	650	1265		220	650	1265		220	650	1265
5th					210	575	1145		210	575	1145		210	575	1145
6th					232	618	1145		232	618	1145		232	618	1145
7th					285	658	1290		285	658	1290		285	658	1290
8th					195	575	950		195	575	950		195	575	950
9th					190	475	885		190	475	885		190	475	885
10th					175	615	1175		175	615	1175		175	615	1175
11th					220	635	1195		220	635	1195		220	635	1195
12th					175	675	1275		175	675	1275		175	675	1275
13th					145	540	1050		145	540	1050		145	540	1050
14th					181	588	1116		181	588	1116		181	588	1116
15th					220	675	1275		220	675	1275		220	675	1275
16th					195	575	950		195	575	950		195	575	950
17th					205	525	1000		205	525	1000		205	525	1000
18th					170	720	1225		170	720	1225		170	720	1225
19th					300	815	1400		300	815	1400		300	815	1400
20th					175	675	1325		175	675	1325		175	675	1325
21st					110	525	1105		110	525	1105		110	525	1105
22nd					192	652	1211		192	652	1211		192	652	1211
23rd					205	612	1050		205	612	1050		205	612	1050
24th					170	525	1000		170	525	1000		170	525	1000
25th					205	550	1045		205	550	1045		205	550	1045
26th					215	730	1250		215	730	1250		215	730	1250
27th					240	760	1490		240	760	1490		240	760	1490
28th					165	715	1330		165	715	1330		165	715	1330
29th					135	590	1235		135	590	1235		135	590	1235
30th					192	575	1045		192	575	1045		192	575	1045
31st					125	550	1045		125	550	1045		125	550	1045
32nd					165	525	995		165	525	995		165	525	995
33rd					205	665	1220		205	665	1220		205	665	1220
34th					225	700	1400		225	700	1400		225	700	1400
35th					190	695	1260		190	695	1260		190	695	1260
36th					110	525	1035		110	525	1035		110	525	1035
37th					179	625	1185		179	625	1185		179	625	1185
38th					110	535	995		110	535	995		110	535	995
39th															
40th															
41st															
42nd															
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97th															
98th															
99th															
100th															

COMMENTS: IT WAS NECESSARY TO RECONVENE THE BURNING CHARGE CELL BEFORE CONTINUING WITH THE TESTS. THE VALUES OF TENSILE STRESS OBTAINED ON THIS LAST SWIFT WERE SUBJECTED TO THE NEW CALCULATED VALUES FOR THE ANISOTROPY σ_{22} BUTS AND PLOTTED ON THE GRAPH DATED 25 JAN 57. THE AMOUNT OF THE ANISOTROPY σ_{22} WAS SUBSEQUENTLY TWEAKED USING THE MEASURED STRAIN RATES ON DATA SHEET OF 20 JAN 57.

STARTEN SHOWING HEAD
COUNTERSINK IN HARDWARE
START STARTING BLOCK
(ROCKWELL "C" SCALE 60)

Comments:

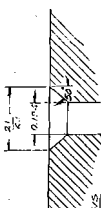
- (1) Values shown derived from GARCH
- (2) Due to short sample size, TEST DOSTA-TRADEN ANALYSIS USING COINTEGRATED VAR(1) MODEL WAS NOT ATTEMPTED.
- (3) DUE TO SLOW DIVERGED FROM GARCH
- (4) BREAKING UP VALUES INTO TWO GROUPS (BEFORE AND AFTER 1980) TO INDICATE ANY CHANGES IN THE BEHAVIOR OF THE DATA.
- (5) RUNS OF LOGNORMAL DISTRIBUTIONS ARE MARKED WITH "L". AT THE BEGINNING OF THE RUN TO INDICATE INITIAL COINTEGRATION AND SUBSEQUENTLY UNINTEGRATION IS NOT AS HIGHLY PROBABLE.
- (6) SHEET VALUES WERE SHOWN AFTER THE FIRST COINTEGRATION FOR ALL FOUR COINTEGRATION DUE TO SLOWLY DIVERGED FROM GARCH

THESE VALUES WERE NOT ATTEMPTED.

DATE: 10 JANUARY 1987
 SIZE: W-8-32MP 3A
 SPECIMEN OR BOLT: AN 505-GR37
 MTD. BY: HEDD BOLT & STEEL CO. STAMFORD, CONN. (NOT HEAD)
 MTD. BY: EAGLE STEEL CO. (HEAD)
 MTD. BY: EAGLE STEEL CO. (HEAD)
 MTD. BY: EAGLE STEEL CO. (HEAD)

TEST DATA
 CONTRACT NO. AF 33(6)2000
 C-REEL

STRETCH SENSING HEAD
 CENTERING IN HEAD
 STATE STRESSING BLOCK
 (FOURTH & SCALE 60)



NOTES:
 1. STRESSING IN PRESENTATION
 2. CENTER TENSILE STRESS (ROUND)

W	NON LUBRICATED										LUBRICATED									
	Torqued From Head					Torqued From Nut					Torqued From Head					Torqued From Nut				
	Torque (ft-lb)	Torque (in-lb)	Torque (ft-lb)	Torque (in-lb)	Torque (ft-lb)	Torque (ft-lb)	Torque (in-lb)	Torque (ft-lb)	Torque (in-lb)	Torque (ft-lb)	Torque (ft-lb)	Torque (in-lb)	Torque (ft-lb)	Torque (in-lb)	Torque (ft-lb)	Torque (ft-lb)	Torque (in-lb)	Torque (ft-lb)	Torque (in-lb)	Torque (ft-lb)
1H	5	9	15	21	28	10	15	22	31	42	10	15	22	31	42	10	15	22	31	42
2H	6	11	15	21	25	11	15	22	29	35	11	15	22	29	35	11	15	22	29	35
3H	5	11	18	24	32	11	15	25	37	42	11	15	25	37	42	11	15	25	37	42
4H	5	11	16	24	30	11	15	25	33	43	11	15	25	33	43	11	15	25	33	43
5H	5	12	17	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
6H	5	11	16	23	29	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
7H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
8H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
9H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
10H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
11H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
12H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
13H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
14H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
15H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
16H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
17H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
18H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
19H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
20H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
21H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
22H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
23H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
24H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
25H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
26H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
27H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
28H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
29H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
30H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
31H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
32H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
33H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
34H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
35H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
36H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
37H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
38H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
39H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
40H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
41H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
42H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
43H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
44H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
45H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
46H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
47H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
48H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
49H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
50H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
51H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
52H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
53H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
54H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
55H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
56H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
57H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
58H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
59H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43
60H	5	11	18	25	32	11	15	23	32	43	11	15	23	32	43	11	15	23	32	43

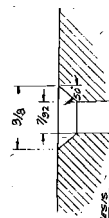
COMMENTS:
 (1) RUTING NOT CAUSED ON SURFACE OF BOLTS.
 (2) DUE TO REPAIRING OF THE SURFACE OF THE BOLTS.
 (3) DUE TO REPAIRING OF THE SURFACE OF THE BOLTS.
 (4) DUE TO REPAIRING OF THE SURFACE OF THE BOLTS.
 (5) DUE TO REPAIRING OF THE SURFACE OF THE BOLTS.

DATE 25 APRIL 1956
 SIZE X 10-32 NF 3A
 SCREW OR BOLT AN 509-10E37
 NUT NMJ -02 ALUMINUM

TEST CELL - A/S
 TORSION 7B
 COMPRESSION 5A

MFTD BY AERO BOLT & SCREW CO, STAMFORD, CONN. (PHILLIPS HEAD)
 CONTRACT 18 AF 35(64)2808
 P-1271

STARTING SAWING HEAD
 CONTINUOUS IN ALUMINUM
 START SAWING BLOCK
 (PHILLIPS HEAD - SCREW CO)



NOTE:
 FEATURES IN DIMENSIONS
 EXCEPT TENSILE STRESS GROUPED

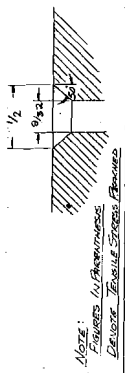
X	Non Lubricated										Lubricated																			
	Torqued From Head					Torqued From Nut					Torqued From Head					Torqued From Nut														
	TENSILE STRESS (psi)					TENSILE STRESS (psi)					TENSILE STRESS (psi)					TENSILE STRESS (psi)														
Screws Torquing Nuts	10000					30000					70000					100000					150000					200000				
	Torque (in-lb)	Torque (ft-lb)	Torque (in-lb)	Torque (ft-lb)	Torque (in-lb)	Torque (in-lb)	Torque (ft-lb)	Torque (in-lb)	Torque (ft-lb)	Torque (in-lb)	Torque (in-lb)	Torque (ft-lb)	Torque (in-lb)	Torque (ft-lb)	Torque (in-lb)	Torque (in-lb)	Torque (ft-lb)	Torque (in-lb)	Torque (ft-lb)	Torque (in-lb)	Torque (in-lb)	Torque (ft-lb)	Torque (in-lb)	Torque (ft-lb)						
1H	10	20	34	50	69	83	11	5	15	26	36	50	65	80	95	14L	3	9	17	25	34	40	48	57	68					
2H	10	20	34	50	69	83	2U	8	20	32	40	46	50	54	58	24L	1	9	19	24	32	38	45	53	63					
3H	6	21	36	59	93	111	3U	9	16	31	45	63	80	97	114	34L	1	11	16	20	24	26	34	41	49					
4H	4	16	32	49	69	71	4U	4	16	29	41	56	71	85	100	44L	1	13	24	33	45	50	58	68	80					
5H	6	19	36	51	71	88	5U	7	21	33	40	47	55	63	71	54L	1	7	15	21	29	36	43	51	60					
6H	7	19	34	51	74	88	6U	7	18	30	40	47	55	63	71	64L	1	9	18	25	34	40	48	56	66					
7H	10	21	36	59	93	111	7U	10	21	33	40	47	55	63	71	74L	1	14	24	33	45	50	58	68	80					
8H	10	21	36	59	93	111	8U	10	21	33	40	47	55	63	71	84L	1	14	24	33	45	50	58	68	80					
9H	10	21	36	59	93	111	9U	10	21	33	40	47	55	63	71	94L	1	14	24	33	45	50	58	68	80					
10H	10	21	36	59	93	111	10U	10	21	33	40	47	55	63	71	104L	1	14	24	33	45	50	58	68	80					
11H	10	21	36	59	93	111	11U	10	21	33	40	47	55	63	71	114L	1	14	24	33	45	50	58	68	80					
12H	10	21	36	59	93	111	12U	10	21	33	40	47	55	63	71	124L	1	14	24	33	45	50	58	68	80					
13H	10	21	36	59	93	111	13U	10	21	33	40	47	55	63	71	134L	1	14	24	33	45	50	58	68	80					
14H	10	21	36	59	93	111	14U	10	21	33	40	47	55	63	71	144L	1	14	24	33	45	50	58	68	80					
15H	10	21	36	59	93	111	15U	10	21	33	40	47	55	63	71	154L	1	14	24	33	45	50	58	68	80					
16H	10	21	36	59	93	111	16U	10	21	33	40	47	55	63	71	164L	1	14	24	33	45	50	58	68	80					
17H	10	21	36	59	93	111	17U	10	21	33	40	47	55	63	71	174L	1	14	24	33	45	50	58	68	80					
18H	10	21	36	59	93	111	18U	10	21	33	40	47	55	63	71	184L	1	14	24	33	45	50	58	68	80					
19H	10	21	36	59	93	111	19U	10	21	33	40	47	55	63	71	194L	1	14	24	33	45	50	58	68	80					
20H	10	21	36	59	93	111	20U	10	21	33	40	47	55	63	71	204L	1	14	24	33	45	50	58	68	80					
21H	10	21	36	59	93	111	21U	10	21	33	40	47	55	63	71	214L	1	14	24	33	45	50	58	68	80					
22H	10	21	36	59	93	111	22U	10	21	33	40	47	55	63	71	224L	1	14	24	33	45	50	58	68	80					
23H	10	21	36	59	93	111	23U	10	21	33	40	47	55	63	71	234L	1	14	24	33	45	50	58	68	80					
24H	10	21	36	59	93	111	24U	10	21	33	40	47	55	63	71	244L	1	14	24	33	45	50	58	68	80					
25H	10	21	36	59	93	111	25U	10	21	33	40	47	55	63	71	254L	1	14	24	33	45	50	58	68	80					
26H	10	21	36	59	93	111	26U	10	21	33	40	47	55	63	71	264L	1	14	24	33	45	50	58	68	80					
27H	10	21	36	59	93	111	27U	10	21	33	40	47	55	63	71	274L	1	14	24	33	45	50	58	68	80					
28H	10	21	36	59	93	111	28U	10	21	33	40	47	55	63	71	284L	1	14	24	33	45	50	58	68	80					
29H	10	21	36	59	93	111	29U	10	21	33	40	47	55	63	71	294L	1	14	24	33	45	50	58	68	80					
30H	10	21	36	59	93	111	30U	10	21	33	40	47	55	63	71	304L	1	14	24	33	45	50	58	68	80					
31H	10	21	36	59	93	111	31U	10	21	33	40	47	55	63	71	314L	1	14	24	33	45	50	58	68	80					
32H	10	21	36	59	93	111	32U	10	21	33	40	47	55	63	71	324L	1	14	24	33	45	50	58	68	80					
33H	10	21	36	59	93	111	33U	10	21	33	40	47	55	63	71	334L	1	14	24	33	45	50	58	68	80					
34H	10	21	36	59	93	111	34U	10	21	33	40	47	55	63	71	344L	1	14	24	33	45	50	58	68	80					
35H	10	21	36	59	93	111	35U	10	21	33	40	47	55	63	71	354L	1	14	24	33	45	50	58	68	80					
36H	10	21	36	59	93	111	36U	10	21	33	40	47	55	63	71	364L	1	14	24	33	45	50	58	68	80					
37H	10	21	36	59	93	111	37U	10	21	33	40	47	55	63	71	374L	1	14	24	33	45	50	58	68	80					
38H	10	21	36	59	93	111	38U	10	21	33	40	47	55	63	71	384L	1	14	24	33	45	50	58	68	80					
39H	10	21	36	59	93	111	39U	10	21	33	40	47	55	63	71	394L	1	14	24	33	45	50	58	68	80					
40H	10	21	36	59	93	111	40U	10	21	33	40	47	55	63	71	404L	1	14	24	33	45	50	58	68	80					
41H	10	21	36	59	93	111	41U	10	21	33	40	47	55	63	71	414L	1	14	24	33	45	50	58	68	80					
42H	10	21	36	59	93	111	42U	10	21	33	40	47	55	63	71	424L	1	14	24	33	45	50	58	68	80					
43H	10	21	36	59	93	111	43U	10	21	33	40	47	55	63	71	434L	1	14	24	33	45	50	58	68	80					
44H	10	21	36	59	93	111	44U	10	21	33	40	47	55	63	71	444L	1	14	24	33	45	50	58	68	80					
45H	10	21	36	59	93	111	45U	10	21	33	40	47	55	63	71	454L	1	14	24	33	45	50	58	68	80					
46H	10	21	36	59	93	111	46U	10	21	33	40	47	55	63	71	464L	1	14	24	33	45	50	58	68	80					
47H	10	21	36	59	93	111	47U	10	21	33	40	47	55	63	71	474L	1	14	24	33	45	50	58	68	80					
48H	10	21	36	59	93	111	48U	10	21	33	40	47	55	63	71	484L	1	14	24	33	45	50	58	68	80					
49H	10	21	36	59	93	111	49U	10	21	33	40	47	55	63	71	494L	1	14	24	33	45	50	58	68	80					
50H	10	21	36	59	93	111	50U	10	21	33	40	47	55	63	71	504L	1	14	24	33	45	50	58	68	80					
51H	10	21	36	59	93	111	51U	10	21	33	40	47	55	63	71	514L	1	14	24	33	45	50	58	68	80					
52H	10	21	36	59	93	111	52U	10	21	33	40	47	55	63	71	524L	1	14	24	33	45	50	58	68	80					
53H	10	21	36	59	93	111	53U	10	21	33	40	47	55	63	71	534L	1	14	24	33	45	50	58	68	80					
54H	10	21	36	59	93	111	54U	10	21	33	40	47	55	63	71	544L	1	14	24	33	45	50	58	68	80					
55H	10	21	36	59	93	111	55U	10	21	33	40	47	55	63	71	554L	1	14	24	33	45	50	58	68	80					
56H	10	21	36	59	93	111	56U	10	21	33	40	47	55	63	71	564L	1	14	24	33	45	50	58	68	80					
57H	10	21	36	59	93	111	57U	10	21	33	40	47	55	63	71	574L	1	14	24	33	45	50	58	68	80					
58H	10	21	36	59	93	111</																								

DATE 20 APRIL 1956
 SIZE Y 1/4 28UHF-3A
 SCREEN OR BELT - AN 509-A16R31 MPD BY AERO BOLT & SCREW CO., STAMFORD, CONN. (PHILLIPS HEAD)
 NUT - NUT-018 ALUM. " " ELASTIC STOP NUT CORP., UNION, N.J.

TEST CELL - NW
 TORSION - 78
 COMPRESSION - 5A

TEST DATA
 CONFIDENTIAL REPORT
 P-1221

STEEL SHIMMING AGENT
 COUNTERSINK IN HARDWARE
 STRENGTHENING BLOCK
 (FOLLOWING C. STONE GO)



		NON LUBRICATED										LUBRICATED									
		Torqued From Head					Torqued From Nut					Torqued From Head					Torqued From Nut				
Screw No.	Nut No.	TENSILE STRESS (psi)					TENSILE STRESS (psi)					TENSILE STRESS (psi)					TENSILE STRESS (psi)				
		1000	2000	3000	4000	5000	1000	2000	3000	4000	5000	1000	2000	3000	4000	5000	1000	2000	3000	4000	5000
1H	1H	15	48	71	107	165	210	11	17	33	56	86	116	142	144	142	144	142	144	142	144
2H	2H	16	40	65	98	135	175	21	17	40	69	100	135	167	244	10	28	43	55	68	87
3H	3H	16	40	67	95	135	156	31	15	39	65	100	127	142	344	10	24	40	55	76	95
4H	4H	12	39	66	97	131	170	41	15	39	75	108	137	144	444	14	26	42	60	78	97
5H	5H	15	41	65	95	137	172	51	14	37	63	103	133	146	544	16	42	66	72	84	89
6H	6H	15	40	64	94	134	172	61	14	38	65	103	133	146	644	16	42	66	72	84	89
7H	7H	15	40	64	94	134	172	71	14	38	65	103	133	146	744	16	42	66	72	84	89
8H	8H	15	40	64	94	134	172	81	14	38	65	103	133	146	844	16	42	66	72	84	89
9H	9H	15	40	64	94	134	172	91	14	38	65	103	133	146	944	16	42	66	72	84	89
10H	10H	15	40	64	94	134	172	101	14	38	65	103	133	146	1044	16	42	66	72	84	89
11H	11H	15	40	64	94	134	172	111	14	38	65	103	133	146	1144	16	42	66	72	84	89
12H	12H	15	40	64	94	134	172	121	14	38	65	103	133	146	1244	16	42	66	72	84	89
13H	13H	15	40	64	94	134	172	131	14	38	65	103	133	146	1344	16	42	66	72	84	89
14H	14H	15	40	64	94	134	172	141	14	38	65	103	133	146	1444	16	42	66	72	84	89
15H	15H	15	40	64	94	134	172	151	14	38	65	103	133	146	1544	16	42	66	72	84	89
16H	16H	15	40	64	94	134	172	161	14	38	65	103	133	146	1644	16	42	66	72	84	89
17H	17H	15	40	64	94	134	172	171	14	38	65	103	133	146	1744	16	42	66	72	84	89
18H	18H	15	40	64	94	134	172	181	14	38	65	103	133	146	1844	16	42	66	72	84	89
19H	19H	15	40	64	94	134	172	191	14	38	65	103	133	146	1944	16	42	66	72	84	89
20H	20H	15	40	64	94	134	172	201	14	38	65	103	133	146	2044	16	42	66	72	84	89
21H	21H	15	40	64	94	134	172	211	14	38	65	103	133	146	2144	16	42	66	72	84	89
22H	22H	15	40	64	94	134	172	221	14	38	65	103	133	146	2244	16	42	66	72	84	89
23H	23H	15	40	64	94	134	172	231	14	38	65	103	133	146	2344	16	42	66	72	84	89
24H	24H	15	40	64	94	134	172	241	14	38	65	103	133	146	2444	16	42	66	72	84	89
25H	25H	15	40	64	94	134	172	251	14	38	65	103	133	146	2544	16	42	66	72	84	89
26H	26H	15	40	64	94	134	172	261	14	38	65	103	133	146	2644	16	42	66	72	84	89
27H	27H	15	40	64	94	134	172	271	14	38	65	103	133	146	2744	16	42	66	72	84	89
28H	28H	15	40	64	94	134	172	281	14	38	65	103	133	146	2844	16	42	66	72	84	89
29H	29H	15	40	64	94	134	172	291	14	38	65	103	133	146	2944	16	42	66	72	84	89
30H	30H	15	40	64	94	134	172	301	14	38	65	103	133	146	3044	16	42	66	72	84	89
31H	31H	15	40	64	94	134	172	311	14	38	65	103	133	146	3144	16	42	66	72	84	89
32H	32H	15	40	64	94	134	172	321	14	38	65	103	133	146	3244	16	42	66	72	84	89
33H	33H	15	40	64	94	134	172	331	14	38	65	103	133	146	3344	16	42	66	72	84	89
34H	34H	15	40	64	94	134	172	341	14	38	65	103	133	146	3444	16	42	66	72	84	89
35H	35H	15	40	64	94	134	172	351	14	38	65	103	133	146	3544	16	42	66	72	84	89
36H	36H	15	40	64	94	134	172	361	14	38	65	103	133	146	3644	16	42	66	72	84	89
37H	37H	15	40	64	94	134	172	371	14	38	65	103	133	146	3744	16	42	66	72	84	89
38H	38H	15	40	64	94	134	172	381	14	38	65	103	133	146	3844	16	42	66	72	84	89
39H	39H	15	40	64	94	134	172	391	14	38	65	103	133	146	3944	16	42	66	72	84	89
40H	40H	15	40	64	94	134	172	401	14	38	65	103	133	146	4044	16	42	66	72	84	89
41H	41H	15	40	64	94	134	172	411	14	38	65	103	133	146	4144	16	42	66	72	84	89
42H	42H	15	40	64	94	134	172	421	14	38	65	103	133	146	4244	16	42	66	72	84	89
43H	43H	15	40	64	94	134	172	431	14	38	65	103	133	146	4344	16	42	66	72	84	89
44H	44H	15	40	64	94	134	172	441	14	38	65	103	133	146	4444	16	42	66	72	84	89
45H	45H	15	40	64	94	134	172	451	14	38	65	103	133	146	4544	16	42	66	72	84	89
46H	46H	15	40	64	94	134	172	461	14	38	65	103	133	146	4644	16	42	66	72	84	89
47H	47H	15	40	64	94	134	172	471	14	38	65	103	133	146	4744	16	42	66	72	84	89
48H	48H	15	40	64	94	134	172	481	14	38	65	103	133	146	4844	16	42	66	72	84	89
49H	49H	15	40	64	94	134	172	491	14	38	65	103	133	146	4944	16	42	66	72	84	89
50H	50H	15	40	64	94	134	172	501	14	38	65	103	133	146	5044	16	42	66	72	84	89
51H	51H	15	40	64	94	134	172	511	14	38	65	103	133	146	5144	16	42	66	72	84	89
52H	52H	15	40	64	94	134	172	521	14	38	65	103	133	146	5244	16	42	66	72	84	89
53H	53H	15	40	64	94	134	172	531	14	38	65	103	133	146	5344	16	42	66	72	84	89
54H	54H	15	40	64	94	134	172	541	14	38	65	103	133	146	5444	16	42	66	72	84	89
55H	55H	15	40	64	94	134	172	551	14	38	65	103	133	146	5544	16	42	66	72	84	89
56H	56H	15	40	64	94	134	172	561	14	38	65	103	133	146	5644	16	42	66	72	84	89
57H	57H	15	40	64	94	134	172	571	14	38	65	103	133	146	5744	16	42	66	72	84	89
58H	58H	15	40	64	94	134	172	581	14	38	65	103	133	146	5844	16	42	66	72	84	89
59H	59H	15	40	64	94	134	172	591	14	38	65	103	133	146	5944	16	42	66	72	84	89
60H	60H	15	40	64	94	134	172	601	14	38	65	103	133	146	6044	16	42	66	72	84	89
61H	61H	15	40	64	94	134	172	611	14	38	65	103	133	146	6144	16	42	66	72	84	89
62H	62H	15	40	64	94	134	172	621	14	38	65	103	133	146	6244	16	42	66	72	84	89
63H	63H	15	40	64	94	134	172	631	14	38	65	103	133	146	6344	16	42	66	72	84	89
64H	64H	15	40	64	94	134	172	641	14	38	65	103	133	146	6444	16	42	66	72	84	89
65H	65H	15	40	64	94	134	172	651	14	38	65	103	133	146	6544	16	42	66	72	84	89
66H	66H	15	40	64	94	134	172	661	14	38	65	103									

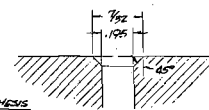
DATE 12 APRIL 1958
 SIZE A-A 10-32 NF 3A
 SCREW OR BOLT AN 3C-30
 NUT AN 363-C1032

TEST CELL - A-A
 TENSION - 7B
 COMPRESSION - 5A

MFD. BY AERO BOLT & SCREW CO., STAMFORD, CONN.
 FLEXLOC DIV. OF STANDARD PREST. STEEL CO., JENKINTOWN, PA.

TEST DATA
 CONTRACT NO. AF 33(616)2808
 P-1227

NOTE:
 FIGURES IN PARENTHESES
 DENOTE TENSILE STRESS REDUCED



SKETCH SHOWING HEAD
 FILLET CLEARANCE IN HARDENED
 STEEL SPRING BLOCK
 (ROCKWELL C SCALE 60)

WADC TR 57330

113

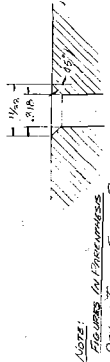
A-A		NON LUBRICATED														LUBRICATED																							
		TORQUED FROM HEAD							TORQUED FROM NUT							TORQUED FROM HEAD							TORQUED FROM NUT																
Torqueing No.	Specimen No.	TENSILE STRESS (*IN ²)							TENSILE STRESS (*IN ²)							Torqueing No.	Specimen No.	TENSILE STRESS (*IN ²)							TENSILE STRESS (*IN ²)														
		15,000	30,000	45,000	60,000	75,000	90,000	THEORETICAL YIELD STRESS 111,000	15,000	30,000	45,000	60,000	75,000	90,000	THEORETICAL YIELD STRESS 111,000			15,000	30,000	45,000	60,000	75,000	90,000	THEORETICAL YIELD STRESS 111,000	15,000	30,000	45,000	60,000	75,000	90,000	THEORETICAL YIELD STRESS 111,000								
		TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)			TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)	TORQUE (IN-LB)							
INITIAL TORQUEING	1H	1.2	4.0	6.6	10.1	13.0	17.3		1H	1.0	1.7	2.9	4.4	5.9	7.9		1H ^L	1.7	3.0	4.5	6.9	8.8		1H ^L	1.7	3.1	4.1	5.6	7.2		1H ^L	1.7	3.1	4.0	7.8	8.3			
	2H	1.8	2.7	5.1	8.0	12.0	17.5		2H	1.0	1.7	3.5	4.9	7.0	10.0		2H ^L	1.7	3.1	4.1	5.6	7.2		2H ^L	1.7	3.1	4.1	5.6	7.2		2H ^L	1.7	3.1	4.0	7.8	8.3			
	3H	1.5	3.4	5.9	9.2	13.4	19.0		3H	1.3	2.8	3.2	5.9	7.7	10.2		3H ^L	1.9	3.1	4.4	7.2	12.8		3H ^L	1.6	1.4	2.1	3.4	4.6	6.0		3H ^L	1.6	1.4	2.1	3.4	4.6	6.0	
	4H	1.5	3.6	5.5	8.0	11.4	18.7		4H	1.6	3.3	5.5	9.0	11.8	15.2 (11) (12) (13) (14) (15) (16) (17) (18) (19) (20) (21) (22) (23) (24) (25) (26) (27) (28) (29) (30) (31) (32) (33) (34) (35) (36) (37) (38) (39) (40) (41) (42) (43) (44) (45) (46) (47) (48) (49) (50) (51) (52) (53) (54) (55) (56) (57) (58) (59) (60) (61) (62) (63) (64) (65) (66) (67) (68) (69) (70) (71) (72) (73) (74) (75) (76) (77) (78) (79) (80) (81) (82) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97) (98) (99) (100) (101) (102) (103) (104) (105) (106) (107) (108) (109) (110) (111) (112) (113) (114) (115) (116) (117) (118) (119) (120) (121) (122) (123) (124) (125) (126) (127) (128) (129) (130) (131) (132) (133) (134) (135) (136) (137) (138) (139) (140) (141) (142) (143) (144) (145) (146) (147) (148) (149) (150) (151) (152) (153) (154) (155) (156) (157) (158) (159) (160) (161) (162) (163) (164) (165) (166) (167) (168) (169) (170) (171) (172) (173) (174) (175) (176) (177) (178) (179) (180) (181) 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COMMENTS:
 1. BOLT 4H YIELDED AND BROKE WHILE APPROACHING 6TH POINT OF FIRST TORQUEING. TEST ON BOLT 4H DISCONTINUED.
 2. BOLT 5H WAS NOT TORQUEING TO 6TH POINT (30,000 PSI) AT END OF FIRST TORQUEING TO PREVENT PRELIMINARY YIELDING PRIOR TO 5TH TORQUEING, BUT CONTINUED TO 6TH POINT ON SUBSEQUENT RUNS.
 3. BOLTS 3H-L AND 5H-L YIELDED BEFORE ATTAINING THEORETICAL YIELD VALUE OF 111,000 PSI AT END OF 5TH TORQUEING.
 4. HIGH VALUES OF TORQUE FOR FIRST TORQUEING OF BOLT 4H-L WAS BELIEVED TO BE CAUSED BY THREAD BURR. THIS RUN WAS NOT AVERAGE WITH OTHER BOLTS.
 5. RUNS OF LUBRICATED TORQUEING ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND, SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.

6. THE SPARKER BLOCKS WERE REMOVED AFTER THE 6TH TORQUEING FOR THE DRY CONDITIONS ONLY DUE TO SPARKING.

Page 113

DATE 10 APRIL 1956
 SIZE C-C, 5/8" x 24 UNF x 3A
 SCREEN OR BOLT AN 30-35 MILD BY AERO BOLT CO., STAMFORD CONN.
 LUT AN 30-35 " FLEXLOC DIV OF STANDARD PRESS STEEL CO., JENKINTOWN, PA.
 P-1221
 TEST DATA
 CONTRACT NO. AF 33(66)2008
 REPORT NO. AF 33(66)2008
 SKETCH SHOWING HEAD
 FILLET GRADUALLY IN HARDENED
 STEEL SPACING BLANK
 (REMARKS: SCALE 60)



C-C	NON LUBRICATED										LUBRICATED																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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Torsion No.	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	75,000	15,000	30,000	45,000	60,000	

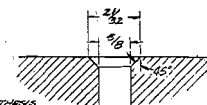
[illegible]

DATE 31 JANUARY '57
 SITE H. H. 1/8" 18 UNF 3/8
 SCREEN OR BOLT AN 10C 37 MFD. BY REED BOLT & SCREEN CO., STAMFORD, CONN.
 NUT AN 363 C 1018 MFD. BY FLETCHER DIV. OF STD. PRESSED STEEL CO., JENKINTOWN, PA.

TEST CELL - N°
 TENSION - G8672
 COMPRESSION - 5C

TEST DATA
 CONTRACT NO. AF 33(16)2008
 F-1227

NOTE:
 FIGURES IN PARENTHESES
 DENOTE TENSILE STRESS PER INCH



SKETCH SHOWING HEAD
 COUNTER-SINK IN HARDENED
 STATE, SHOWING BLOCK
 (ROCKWELL C-55 SCALE 60)

WADC TR 57-330

120

NON LUBRICATED												LUBRICATED																			
H-H		Torqued From Head						Torqued From Nut						H-H		Torqued From Head						Torqued From Nut									
		TENSILE STRESS (#/IN²)						TENSILE STRESS (#/IN²)								TENSILE STRESS (#/IN²)						TENSILE STRESS (#/IN²)									
		15,000	30,000	45,000	60,000	75,000	90,000	15,000	30,000	45,000	60,000	75,000	90,000	15,000	30,000	45,000	60,000	75,000	90,000	15,000	30,000	45,000	60,000	75,000	90,000						
		TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)	TORQUE (IN.-LBS.)						
1H		900	2080	3000	4320	6180	7260	1H <td>660</td> <td>1300</td> <td>1800</td> <td>2300</td> <td>2820</td> <td>3300</td> <td>1H/L</td> <td>5260</td> <td>460</td> <td>700</td> <td>1000</td> <td>1200</td> <td>1340</td> <td>1H/L</td> <td>3300</td> <td>500</td> <td>700</td> <td>900</td> <td>1160</td> <td>1360</td>	660	1300	1800	2300	2820	3300	1H/L	5260	460	700	1000	1200	1340	1H/L	3300	500	700	900	1160	1360			
2H		700	1880	3100	4600	6300	7440	2H <td>800</td> <td>1460</td> <td>2100</td> <td>2700</td> <td>3400</td> <td>4020</td> <td>2H/L</td> <td>260</td> <td>460</td> <td>660</td> <td>980</td> <td>1320</td> <td>1880</td> <td>2H/L</td> <td>340</td> <td>540</td> <td>720</td> <td>900</td> <td>1120</td> <td>1240</td>	800	1460	2100	2700	3400	4020	2H/L	260	460	660	980	1320	1880	2H/L	340	540	720	900	1120	1240			
3H		700	1840	3200	4600	6080	7040	3H <td>040</td> <td>1880</td> <td>2400</td> <td>3000</td> <td>3560</td> <td>4100</td> <td>3H/L</td> <td>280</td> <td>500</td> <td>760</td> <td>1020</td> <td>1320</td> <td>1700</td> <td>3H/L</td> <td>340</td> <td>560</td> <td>780</td> <td>980</td> <td>1180</td> <td>1360</td>	040	1880	2400	3000	3560	4100	3H/L	280	500	760	1020	1320	1700	3H/L	340	560	780	980	1180	1360			
4H		480	1600	2820	4080	5120	6180	4H <td>780</td> <td>1340</td> <td>1960</td> <td>2640</td> <td>3200</td> <td>3620</td> <td>4H/L</td> <td>380</td> <td>600</td> <td>900</td> <td>1200</td> <td>1500</td> <td>2000</td> <td>4H/L</td> <td>340</td> <td>580</td> <td>800</td> <td>1040</td> <td>1240</td> <td>1460</td>	780	1340	1960	2640	3200	3620	4H/L	380	600	900	1200	1500	2000	4H/L	340	580	800	1040	1240	1460			
5H		940	1880	2880	4220	5600	6960	5H <td>700</td> <td>1160</td> <td>1700</td> <td>2260</td> <td>2800</td> <td>3500</td> <td>5H/L</td> <td>260</td> <td>500</td> <td>760</td> <td>1060</td> <td>1400</td> <td>1800</td> <td>5H/L</td> <td>360</td> <td>700</td> <td>900</td> <td>1090</td> <td>1300</td> <td>1360</td>	700	1160	1700	2260	2800	3500	5H/L	260	500	760	1060	1400	1800	5H/L	360	700	900	1090	1300	1360			
Ave		744	1856	3000	4364	5856	6976	Ave <td>746</td> <td>1458</td> <td>1992</td> <td>2580</td> <td>3156</td> <td>3708</td> <td>Ave<td>288</td><td>504</td><td>756</td><td>1052</td><td>1348</td><td>1844</td><td>Ave<td>336</td><td>576</td><td>780</td><td>984</td><td>1196</td><td>1356</td></td></td>	746	1458	1992	2580	3156	3708	Ave <td>288</td> <td>504</td> <td>756</td> <td>1052</td> <td>1348</td> <td>1844</td> <td>Ave<td>336</td><td>576</td><td>780</td><td>984</td><td>1196</td><td>1356</td></td>	288	504	756	1052	1348	1844	Ave <td>336</td> <td>576</td> <td>780</td> <td>984</td> <td>1196</td> <td>1356</td>	336	576	780	984	1196	1356			
Max		740	2080	3200	4600	6300	7440	Max <td>1040</td> <td>1880</td> <td>2400</td> <td>3000</td> <td>3560</td> <td>4100</td> <td>Max<td>380</td><td>600</td><td>900</td><td>1200</td><td>1500</td><td>2000</td><td>Max<td>360</td><td>700</td><td>900</td><td>1080</td><td>1300</td><td>1460</td></td></td>	1040	1880	2400	3000	3560	4100	Max <td>380</td> <td>600</td> <td>900</td> <td>1200</td> <td>1500</td> <td>2000</td> <td>Max<td>360</td><td>700</td><td>900</td><td>1080</td><td>1300</td><td>1460</td></td>	380	600	900	1200	1500	2000	Max <td>360</td> <td>700</td> <td>900</td> <td>1080</td> <td>1300</td> <td>1460</td>	360	700	900	1080	1300	1460			
Min		480	1600	2820	4080	5120	6180	Min <td>660</td> <td>1160</td> <td>1700</td> <td>2260</td> <td>2800</td> <td>3300</td> <td>Min<td>260</td><td>460</td><td>660</td><td>980</td><td>1200</td><td>1700</td><td>Min<td>300</td><td>500</td><td>700</td><td>900</td><td>1120</td><td>1240</td></td></td>	660	1160	1700	2260	2800	3300	Min <td>260</td> <td>460</td> <td>660</td> <td>980</td> <td>1200</td> <td>1700</td> <td>Min<td>300</td><td>500</td><td>700</td><td>900</td><td>1120</td><td>1240</td></td>	260	460	660	980	1200	1700	Min <td>300</td> <td>500</td> <td>700</td> <td>900</td> <td>1120</td> <td>1240</td>	300	500	700	900	1120	1240			
1H		1440	2520	3440	4560	5660	6740	1H <td>800</td> <td>1300</td> <td>1820</td> <td>2460</td> <td>3100</td> <td>3600</td> <td>1H/L</td> <td>320</td> <td>580</td> <td>800</td> <td>1100</td> <td>1380</td> <td>1700</td> <td>1H/L</td> <td>240</td> <td>420</td> <td>620</td> <td>820</td> <td>1100</td> <td>1300</td>	800	1300	1820	2460	3100	3600	1H/L	320	580	800	1100	1380	1700	1H/L	240	420	620	820	1100	1300			
2H		1460	2680	3960	4780	5700	6500	2H <td>800</td> <td>1560</td> <td>2260</td> <td>2900</td> <td>3500</td> <td>4120</td> <td>2H/L</td> <td>320</td> <td>520</td> <td>800</td> <td>1040</td> <td>1380</td> <td>1760</td> <td>2H/L</td> <td>260</td> <td>460</td> <td>700</td> <td>980</td> <td>1160</td> <td>1440</td>	800	1560	2260	2900	3500	4120	2H/L	320	520	800	1040	1380	1760	2H/L	260	460	700	980	1160	1440			
3H		1220	2400	3540	4580	5600	6500	3H <td>1180</td> <td>1900</td> <td>2660</td> <td>3300</td> <td>3900</td> <td>4600</td> <td>3H/L</td> <td>320</td> <td>540</td> <td>780</td> <td>1000</td> <td>1280</td> <td>1600</td> <td>3H/L</td> <td>260</td> <td>440</td> <td>640</td> <td>860</td> <td>1100</td> <td>1360</td>	1180	1900	2660	3300	3900	4600	3H/L	320	540	780	1000	1280	1600	3H/L	260	440	640	860	1100	1360			
4H		1140	2300	3540	4740	5940	6980	4H <td>740</td> <td>1400</td> <td>2160</td> <td>2800</td> <td>3340</td> <td>3800</td> <td>4H/L</td> <td>460</td> <td>700</td> <td>900</td> <td>1200</td> <td>1500</td> <td>1880</td> <td>4H/L</td> <td>240</td> <td>440</td> <td>660</td> <td>900</td> <td>1180</td> <td>1400</td>	740	1400	2160	2800	3340	3800	4H/L	460	700	900	1200	1500	1880	4H/L	240	440	660	900	1180	1400			
5H		1460	2600	3740	4860	6000	7100	5H <td>700</td> <td>1380</td> <td>2000</td> <td>2600</td> <td>3020</td> <td>3440</td> <td>5H/L</td> <td>380</td> <td>600</td> <td>800</td> <td>1160</td> <td>1500</td> <td>1900</td> <td>5H/L</td> <td>260</td> <td>480</td> <td>700</td> <td>1000</td> <td>1240</td> <td>1500</td>	700	1380	2000	2600	3020	3440	5H/L	380	600	800	1160	1500	1900	5H/L	260	480	700	1000	1240	1500			
Ave		1344	2500	3644	4704	5772	6764	Ave <td>844</td> <td>1508</td> <td>2180</td> <td>2812</td> <td>3372</td> <td>3912</td> <td>Ave<td>360</td><td>588</td><td>816</td><td>1100</td><td>1408</td><td>1768</td><td>Ave<td>252</td><td>458</td><td>664</td><td>912</td><td>1156</td><td>1408</td></td></td>	844	1508	2180	2812	3372	3912	Ave <td>360</td> <td>588</td> <td>816</td> <td>1100</td> <td>1408</td> <td>1768</td> <td>Ave<td>252</td><td>458</td><td>664</td><td>912</td><td>1156</td><td>1408</td></td>	360	588	816	1100	1408	1768	Ave <td>252</td> <td>458</td> <td>664</td> <td>912</td> <td>1156</td> <td>1408</td>	252	458	664	912	1156	1408			
Max		1460	2680	3960	4860	6000	7100	Max <td>1180</td> <td>1900</td> <td>2660</td> <td>3300</td> <td>3900</td> <td>4600</td> <td>Max<td>460</td><td>700</td><td>900</td><td>1200</td><td>1500</td><td>1880</td><td>Max<td>260</td><td>480</td><td>700</td><td>1000</td><td>1240</td><td>1500</td></td></td>	1180	1900	2660	3300	3900	4600	Max <td>460</td> <td>700</td> <td>900</td> <td>1200</td> <td>1500</td> <td>1880</td> <td>Max<td>260</td><td>480</td><td>700</td><td>1000</td><td>1240</td><td>1500</td></td>	460	700	900	1200	1500	1880	Max <td>260</td> <td>480</td> <td>700</td> <td>1000</td> <td>1240</td> <td>1500</td>	260	480	700	1000	1240	1500			
Min		1140	2320	3440	4560	5600	6500	Min <td>700</td> <td>1300</td> <td>1820</td> <td>2460</td> <td>3020</td> <td>3440</td> <td>Min<td>320</td><td>520</td><td>780</td><td>1080</td><td>1280</td><td>1600</td><td>Min<td>240</td><td>420</td><td>620</td><td>820</td><td>1100</td><td>1300</td></td></td>	700	1300	1820	2460	3020	3440	Min <td>320</td> <td>520</td> <td>780</td> <td>1080</td> <td>1280</td> <td>1600</td> <td>Min<td>240</td><td>420</td><td>620</td><td>820</td><td>1100</td><td>1300</td></td>	320	520	780	1080	1280	1600	Min <td>240</td> <td>420</td> <td>620</td> <td>820</td> <td>1100</td> <td>1300</td>	240	420	620	820	1100	1300			
1H		1500	2700	3920	5060	6160	7140	1H <td>740</td> <td>1400</td> <td>2000</td> <td>2600</td> <td>3220</td> <td>3700</td> <td>1H/L</td> <td>360</td> <td>690</td> <td>900</td> <td>1120</td> <td>1360</td> <td>1660</td> <td>1H/L</td> <td>200</td> <td>400</td> <td>600</td> <td>880</td> <td>1140</td> <td>1420</td>	740	1400	2000	2600	3220	3700	1H/L	360	690	900	1120	1360	1660	1H/L	200	400	600	880	1140	1420			
2H		1200	2440	3600	4760	5640	6640	2H <td>940</td> <td>1780</td> <td>2420</td> <td>3220</td> <td>3860</td> <td>4480</td> <td>2H/L</td> <td>280</td> <td>480</td> <td>700</td> <td>940</td> <td>1260</td> <td>1520</td> <td>2H/L</td> <td>220</td> <td>420</td> <td>640</td> <td>900</td> <td>1120</td> <td>1380</td>	940	1780	2420	3220	3860	4480	2H/L	280	480	700	940	1260	1520	2H/L	220	420	640	900	1120	1380			
3H		1400	2540	3680	4840	6240	7200	3H <td>1300</td> <td>2200</td> <td>3020</td> <td>3860</td> <td>4520</td> <td>5140</td> <td>3H/L</td> <td>300</td> <td>560</td> <td>840</td> <td>1140</td> <td>1460</td> <td>1800</td> <td>3H/L</td> <td>200</td> <td>400</td> <td>640</td> <td>900</td> <td>1140</td> <td>1420</td>	1300	2200	3020	3860	4520	5140	3H/L	300	560	840	1140	1460	1800	3H/L	200	400	640	900	1140	1420			
4H		1300	2460	3820	5040	6100	6920	4H <td>800</td> <td>1560</td> <td>2240</td> <td>2960</td> <td>3560</td> <td>4100</td> <td>4H/L</td> <td>380</td> <td>640</td> <td>1000</td> <td>1300</td> <td>1640</td> <td>1940</td> <td>4H/L</td> <td>200</td> <td>400</td> <td>620</td> <td>860</td> <td>1100</td> <td>1380</td>	800	1560	2240	2960	3560	4100	4H/L	380	640	1000	1300	1640	1940	4H/L	200	400	620	860	1100	1380			
5H		1500	2700	3900	5140	6320	7160	5H <td>720</td> <td>1460</td> <td>2180</td> <td>3740</td> <td>3220</td> <td>3740</td> <td>5H/L</td> <td>440</td> <td>760</td> <td>1000</td> <td>1300</td> <td>1600</td> <td>1900</td> <td>5H/L</td> <td>240</td> <td>480</td> <td>700</td> <td>980</td> <td>1240</td> <td>1460</td>	720	1460	2180	3740	3220	3740	5H/L	440	760	1000	1300	1600	1900	5H/L	240	480	700	980	1240	1460			
Ave		1380	2568	3784	4968	6092	7012	Ave <td>900</td> <td>1620</td> <td>2372</td> <td>3276</td> <td>3676</td> <td>4232</td> <td>Ave<td>352</td><td>608</td><td>888</td><td>1160</td><td>1464</td><td>1744</td><td>Ave<td>212</td><td>420</td><td>640</td><td>904</td><td>1148</td><td>1412</td></td></td>	900	1620	2372	3276	3676	4232	Ave <td>352</td> <td>608</td> <td>888</td> <td>1160</td> <td>1464</td> <td>1744</td> <td>Ave<td>212</td><td>420</td><td>640</td><td>904</td><td>1148</td><td>1412</td></td>	352	608	888	1160	1464	1744	Ave <td>212</td> <td>420</td> <td>640</td> <td>904</td> <td>1148</td> <td>1412</td>	212	420	640	904	1148	1412			
Max		1500	2700	3920	5140	6320	7200	Max <td>1300</td> <td>2200</td> <td>3020</td> <td>3860</td> <td>4520</td> <td>5140</td> <td>Max<td>440</td><td>760</td><td>1000</td><td>1300</td><td>1640</td><td>1940</td><td>Max<td>240</td><td>480</td><td>700</td><td>980</td><td>1240</td><td>1460</td></td></td>	1300	2200	3020	3860	4520	5140	Max <td>440</td> <td>760</td> <td>1000</td> <td>1300</td> <td>1640</td> <td>1940</td> <td>Max<td>240</td><td>480</td><td>700</td><td>980</td><td>1240</td><td>1460</td></td>	440	760	1000	1300	1640	1940	Max <td>240</td> <td>480</td> <td>700</td> <td>980</td> <td>1240</td> <td>1460</td>	240	480	700	980	1240	1460			
Min		1200	2440	3600	4760	5640	6640	Min <td>720</td> <td>1400</td> <td>2000</td> <td>2600</td> <td>3220</td> <td>3700</td> <td>Min<td>280</td><td>480</td><td>700</td><td>940</td><td>1260</td><td>1520</td><td>Min<td>200</td><td>400</td><td>600</td><td>860</td><td>1100</td><td>1380</td></td></td>	720	1400	2000	2600	3220	3700	Min <td>280</td> <td>480</td> <td>700</td> <td>940</td> <td>1260</td> <td>1520</td> <td>Min<td>200</td><td>400</td><td>600</td><td>860</td><td>1100</td><td>1380</td></td>	280	480	700	940	1260	1520	Min <td>200</td> <td>400</td> <td>600</td> <td>860</td> <td>1100</td> <td>1380</td>	200	400	600	860	1100	1380			
1H		1400	2800	4100	5160	6260	7100	1H <td>740</td> <td>1400</td> <td>2140</td> <td>2880</td> <td>3620</td> <td>4260</td> <td>1H/L</td> <td>360</td> <td>540</td> <td>720</td> <td>1020</td> <td>1260</td> <td>1560</td> <td>1H/L</td> <td>200</td> <td>400</td> <td>600</td> <td>840</td> <td>1100</td> <td>1360</td>	740	1400	2140	2880	3620	4260	1H/L	360	540	720	1020	1260	1560	1H/L	200	400	600	840	1100	1360			
2H		1220	2420	3640	4580	5540	6420	2H <td>1000</td> <td>1980</td> <td>2800</td> <td>3540</td> <td>4200</td> <td>4900</td> <td>2H/L</td> <td>260</td> <td>480</td> <td>760</td> <td>1020</td> <td>1300</td> <td>1600</td> <td>2H/L</td> <td>240</td> <td>440</td> <td>660</td> <td>900</td> <td>1140</td> <td>1400</td>	1000	1980	2800	3540	4200	4900	2H/L	260	480	760	1020	1300	1600	2H/L	240	440	660	900	1140	1400			
3H		1400	2700	3960	5100	6240	7100	3H <td>1400</td> <td>2420</td> <td>3360</td> <td>4260</td> <td>5020</td> <td>5680</td> <td>3H/L</td> <td>300</td> <td>600</td> <td>840</td> <td>1100</td> <td>1360</td> <td>1640</td> <td>3H/L</td> <td>240</td> <td>420</td> <td>600</td> <td>860</td> <td>1100</td> <td>1360</td>	1400	2420	3360	4260	5020	5680	3H/L	300	600	840	1100	1360	1640	3H/L	240	420	600	860	1100	1360			
4H		1200	2700	3920	5200	6300	7100	4H <td>840</td> <td>1700</td> <td>2440</td> <td>3200</td> <td>3860</td> <td>4400</td> <td>4H/L</td> <td>400</td> <td>700</td> <td>900</td> <td>1200</td> <td>1500</td> <td>1800</td> <td>4H/L</td> <td>200</td> <td>400</td> <td>640</td> <td>900</td> <td>1160</td> <td>1440</td>	840	1700	2440	3200	3860	4400	4H/L	400	700	900	1200	1500	1800	4H/L	200	400	640	900	1160	1440			
5H		1400	2720	3860	5060	6040	7000	5H <td>860</td> <td>1600</td> <td>2300</td> <td>3000</td> <td>3620</td> <td>3900</td> <td>5H/L</td> <td>360</td> <td>660</td> <td>1000</td> <td>1300</td> <td>1660</td> <td>1960</td> <td>5H/L</td> <td>260</td> <td>500</td> <td>700</td> <td>980</td> <td>1200</td> <td>1500</td>	860	1600	2300	3000	3620	3900	5H/L	360	660	1000	1300	1660	1960	5H/L	260	500	700	980	1200	1500			
Ave		1324	2668	3896	5080	6076	6944	Ave <td>968</td> <td>1832</td> <td>2608</td> <td>3376</td> <td>4024</td> <td>4628</td> <td>Ave<td>336</td><td>596</td><td>844</td><td>1128</td><td>1416</td><td>1712</td><td>Ave<td>228</td><td>432</td><td>640</td><td>896</td><td>1120</td><td>1412</td></td></td>	968	1832	2608	3376	4024	4628	Ave <td>336</td> <td>596</td> <td>844</td> <td>1128</td> <td>1416</td> <td>1712</td> <td>Ave<td>228</td><td>432</td><td>640</td><td>896</td><td>1120</td><td>1412</td></td>	336	596	844	1128	1416	1712	Ave <td>228</td> <td>432</td> <td>640</td> <td>896</td> <td>1120</td> <td>1412</td>	228	432	640	896	1120	1412			
Max		1400	2800	4100	5200	6300	7100	Max <td>1400</td> <td>2420</td> <td>3360</td> <td>4260</td> <td>5020</td> <td>5680</td> <td>Max<td>400</td><td>700</td><td>1000</td><td>1300</td><td>1660</td><td>1960</td><td>Max<td>260</td><td>500</td><td>700</td><td>980</td><td>1200</td><td>1500</td></td></td>	1400	2420	3360	4260	5020	5680	Max <td>400</td> <td>700</td> <td>1000</td> <td>1300</td> <td>1660</td> <td>1960</td> <td>Max<td>260</td><td>500</td><td>700</td><td>980</td><td>1200</td><td>1500</td></td>	400	700	1000	1300	1660	1960	Max <td>260</td> <td>500</td> <td>700</td> <td>980</td> <td>1200</td> <td>1500</td>	260	500	700	980	1200	1500			
Min		1200	2420	3640	4580	5540	6420	Min <td>740</td> <td>1400</td> <td>2140</td> <td>2880</td> <td>3620</td> <td>4260</td> <td>Min<td>260</td><td>480</td><td>720</td><td>1020</td><td>1260</td><td>1560</td><td>Min<td>200</td><td>400</td><td>600</td><td>840</td><td>1100</td><td>1360</td></td></td>	740	1400	2140	2880	3620	4260	Min <td>260</td> <td>480</td> <td>720</td> <td>1020</td> <td>1260</td> <td>1560</td> <td>Min<td>200</td><td>400</td><td>600</td><td>840</td><td>1100</td><td>1360</td></td>	260	480	720	1020	1260	1560	Min <td>200</td> <td>400</td> <td>600</td> <td>840</td> <td>1100</td> <td>1360</td>	200	400	600	840	1100	1360			
1H		1600	2840	3980	5120	6120	8260	1H <td>800</td> <td>1600</td> <td>2320</td> <td>3000</td> <td>3740</td> <td>4360</td> <td>5400</td> <td>1H/L</td> <td>340</td> <td>560</td> <td>800</td> <td>1100</td> <td>1320</td> <td>1640</td> <td>2140</td> <td>1H/L</td> <td>200</td> <td>400</td> <td>600</td> <td>820</td> <td>1100</td> <td>1380</td> <td>1900</td>	800	1600	2320	3000	3740	4360	5400	1H/L	340	560	800	1100	1320	1640	2140	1H/L	200	400	600	820	1100	1380	1900
2H		1220	2680	3800	4800	5720	6840	2H <td>1040</td> <td>1900</td> <td>2780</td> <td>3560</td> <td>4280</td> <td>5100</td> <td>5900</td> <td>2H/L</td> <td>280</td> <td>500</td> <td>720</td> <td>940</td> <td>1240</td> <td>1500</td> <td>2000</td> <td>2H/L</td> <td>220</td> <td>460</td> <td>700</td> <td>1020</td> <td>1300</td> <td>1540</td> <td>1920</td>	1040	1900	2780	3560	4280	5100	5900	2H/L	280	500	720	940	1240	1500	2000	2H/L	220	460	700	1020	1300	1540	1920
3H		1480	2920	4140	5600	6560	7440	3H <td>1560</td> <td>2640</td> <td>3700</td> <td>4560</td> <td>5340</td> <td>6000</td> <td>6880</td> <td>3H/L</td> <td>340</td> <td>560</td> <td>840</td> <td>1100</td> <td>1380</td> <td>1660</td> <td>2220</td> <td>3H/L</td> <td>200</td> <td>400</td> <td>600</td> <td>860</td> <td>1140</td> <td>1460</td> <td>1860</td>	1560	2640	3700	4560	5340	6000	6880	3H/L	340	560	840	1100	1380	1660	2220	3H/L	200	400	600	860	1140	1460	1860
4H		1500	2760	4080	5400	6600	7340	4H <td>1000</td> <td>1740</td> <td>2600</td> <td>3340</td> <td>4000</td> <td>4600</td> <td>5580</td> <td>4H/L</td> <td>360</td> <td>620</td> <td>900</td> <td>1200</td> <td>1500</td> <td>1740</td> <td>2240</td> <td>4H/L</td> <td>200</td> <td>400</td> <td>620</td> <td>900</td> <td>1180</td> <td>1460</td> <td>1900</td>	1000	1740	2600	3340	4000	4600	5580	4H/L	360	620	900	1200	1500	1740	2240	4H/L	200	400	620	900	1180	1460	1900
5H		1400	2800	4000	5240	6080	7040	5H <td>860</td> <td>1600</td> <td>2360</td> <td>3000</td> <td>3580</td> <td>4160</td> <td>5080</td> <td>5H/L</td> <td>340</td> <td>600</td> <td>900</td> <td>1200</td> <td>1500</td> <td>1800</td> <td>2240</td> <td>5H/L</td> <td>240</td> <td>480</td> <td>700</td> <td>900</td> <td>1200</td> <td>1500</td> <td>2000</td>	860	1600	2360	3000	3580	4160	5080	5H/L	340	600	900	1200	1500	1800	2240	5H/L	240	480	700	900	1200	1500	2000
Ave		1440	2800	4000	5232	6116	7136	Ave <td>1052</td> <td>1896</td> <td>2752</td> <td>3492</td> <td>4188</td> <td>4844</td> <td>5768</td> <td>Ave<td>332</td><td>568</td><td>832</td><td>1108</td><td>1388</td><td>1668</td><td>2168</td><td>Ave<td>212</td><td>428</td><td>644</td><td>900</td><td>1184</td><td>1468</td><td>1916</td></td></td>	1052	1896	2752	3492	4188	4844	5768	Ave <td>332</td> <td>568</td> <td>832</td> <td>1108</td> <td>1388</td> <td>1668</td> <td>2168</td> <td>Ave<td>212</td><td>428</td><td>644</td><td>900</td><td>1184</td><td>1468</td><td>1916</td></td>	332	568	832	1108	1388	1668	2168	Ave <td>212</td> <td>428</td> <td>644</td> <td>900</td> <td>1184</td> <td>1468</td> <td>1916</td>	212	428	644	900	1184	1468	1916
Max		1600	2920	4140	5600	6600	7440	Max <td>1560</td> <td>2640</td> <td>3700</td> <td>4560</td> <td>5340</td> <td>6000</td> <td>6880</td> <td>Max<td>360</td><td>620</td><td>900</td><td>1200</td><td>1500</td><td>1800</td><td>2240</td><td>Max<td>240</td><td>480</td><td>700</td><td>1020</td><td>1300</td><td>1540</td><td>1900</td></td></td>	1560	2640	3700	4560	5340	6000	6880	Max <td>360</td> <td>620</td> <td>900</td> <td>1200</td> <td>1500</td> <td>1800</td> <td>2240</td> <td>Max<td>240</td><td>480</td><td>700</td><td>1020</td><td>1300</td><td>1540</td><td>1900</td></td>	360	620	900	1200	1500	1800	2240	Max <td>240</td> <td>480</td> <td>700</td> <td>1020</td> <td>1300</td> <td>1540</td> <td>1900</td>	240	480	700	1020	1300	1540	1900
Min		1220	2680	3800	4800	5720	6840	Min <td>700</td> <td>1600</td> <td>2320</td> <td>3000</td> <td>3580</td> <td>4160</td> <td>5080</td> <td>Min<td>280</td><td>500</td><td>720</td><td>940</td><td>1240</td><td>1500</td><td>2000</td><td>Min<td>200</td><td>400</td><td>600</td><td>820</td><td>1100</td><td>1380</td><td>1860</td></td></td>	700	1600	2320	3000	3580	4160	5080	Min <td>280</td> <td>500</td> <td>720</td> <td>940</td> <td>1240</td> <td>1500</td> <td>2000</td> <td>Min<td>200</td><td>400</td><td>600</td><td>820</td><td>1100</td><td>1380</td><td>1860</td></td>	280	500	720	940	1240	1500	2000	Min <td>200</td> <td>400</td> <td>600</td> <td>820</td> <td>1100</td> <td>1380</td> <td>1860</td>	200	400	600	820	1100	1380	1860

COMMENTS:

- THE SECOND THRU FIFTH SPECIMENS TORQUED FROM THE HEAD IN THE DRY CONDITION WERE RUN ON SANDER SPACER BLOCK WHICH BECAME PROGRESSIVELY MORE SANDER AND COULD NOT BE SANDER SMOOTH.
- SANDER BLOCKS WERE SANDER OFFER EACH SPECIMEN RUN FOR THE LUBRICATED CONDITION AS WELL AS DRY DIE TO SANDER.
- ENDS OF LUBRICATED TREADS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION & SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.

PAGE 1A

STEVEN SHOWING HERO
COUNTERSINK IN HARDWOOD
STEEL SPARKING BLOCK
(ROCKWELL "C" SCALE 60)

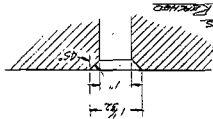
121

NEED BETTER SURFACES.

K-K		LUBRICATED		NON LUBRICATED	
Tensile Stress (%/in ²)		Tensile Stress (%/in ²)		Tensile Stress (%/in ²)	
Specimen No.	Load (lb)	Specimen No.	Load (lb)	Specimen No.	Load (lb)
1	15,000	1	15,000	1	15,000
2	30,000	2	30,000	2	30,000
3	45,000	3	45,000	3	45,000
4	60,000	4	60,000	4	60,000
5	75,000	5	75,000	5	75,000
6	90,000	6	90,000	6	90,000
7	105,000	7	105,000	7	105,000
8	120,000	8	120,000	8	120,000
9	135,000	9	135,000	9	135,000
10	150,000	10	150,000	10	150,000
11	165,000	11	165,000	11	165,000
12	180,000	12	180,000	12	180,000
13	195,000	13	195,000	13	195,000
14	210,000	14	210,000	14	210,000
15	225,000	15	225,000	15	225,000
16	240,000	16	240,000	16	240,000
17	255,000	17	255,000	17	255,000
18	270,000	18	270,000	18	270,000
19	285,000	19	285,000	19	285,000
20	300,000	20	300,000	20	300,000
21	315,000	21	315,000	21	315,000
22	330,000	22	330,000	22	330,000
23	345,000	23	345,000	23	345,000
24	360,000	24	360,000	24	360,000
25	375,000	25	375,000	25	375,000
26	390,000	26	390,000	26	390,000
27	405,000	27	405,000	27	405,000
28	420,000	28	420,000	28	420,000
29	435,000	29	435,000	29	435,000
30	450,000	30	450,000	30	450,000
31	465,000	31	465,000	31	465,000
32	480,000	32	480,000	32	480,000
33	495,000	33	495,000	33	495,000
34	510,000	34	510,000	34	510,000
35	525,000	35	525,000	35	525,000
36	540,000	36	540,000	36	540,000
37	555,000	37	555,000	37	555,000
38	570,000	38	570,000	38	570,000
39	585,000	39	585,000	39	585,000
40	600,000	40	600,000	40	600,000
41	615,000	41	615,000	41	615,000
42	630,000	42	630,000	42	630,000
43	645,000	43	645,000	43	645,000
44	660,000	44	660,000	44	660,000
45	675,000	45	675,000	45	675,000
46	690,000	46	690,000	46	690,000
47	705,000	47	705,000	47	705,000
48	720,000	48	720,000	48	720,000
49	735,000	49	735,000	49	735,000
50	750,000	50	750,000	50	750,000
51	765,000	51	765,000	51	765,000
52	780,000	52	780,000	52	780,000
53	795,000	53	795,000	53	795,000
54	810,000	54	810,000	54	810,000
55	825,000	55	825,000	55	825,000
56	840,000	56	840,000	56	840,000
57	855,000	57	855,000	57	855,000
58	870,000	58	870,000	58	870,000
59	885,000	59	885,000	59	885,000
60	900,000	60	900,000	60	900,000
61	915,000	61	915,000	61	915,000
62	930,000	62	930,000	62	930,000
63	945,000	63	945,000	63	945,000
64	960,000	64	960,000	64	960,000
65	975,000	65	975,000	65	975,000
66	990,000	66	990,000	66	990,000
67	1,005,000	67	1,005,000	67	1,005,000
68	1,020,000	68	1,020,000	68	1,020,000
69	1,035,000	69	1,035,000	69	1,035,000
70	1,050,000	70	1,050,000	70	1,050,000
71	1,065,000	71	1,065,000	71	1,065,000
72	1,080,000	72	1,080,000	72	1,080,000
73	1,095,000	73	1,095,000	73	1,095,000
74	1,110,000	74	1,110,000	74	1,110,000
75	1,125,000	75	1,125,000	75	1,125,000
76	1,140,000	76	1,140,000	76	1,140,000
77	1,155,000	77	1,155,000	77	1,155,000
78	1,170,000	78	1,170,000	78	1,170,000
79	1,185,000	79	1,185,000	79	1,185,000
80	1,200,000	80	1,200,000	80	1,200,000
81	1,215,000	81	1,215,000	81	1,215,000
82	1,230,000	82	1,230,000	82	1,230,000
83	1,245,000	83	1,245,000	83	1,245,000
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85	1,275,000	85	1,275,000	85	1,275,000
86	1,290,000	86	1,290,000	86	1,290,000
87	1,305,000	87	1,305,000	87	1,305,000
88	1,320,000	88	1,320,000	88	1,320,000
89	1,335,000	89	1,335,000	89	1,335,000
90	1,350,000	90	1,350,000	90	1,350,000
91	1,365,000	91	1,365,000	91	1,365,000
92	1,380,000	92	1,380,000	92	1,380,000
93	1,395,000	93	1,395,000	93	1,395,000
94	1,410,000	94	1,410,000	94	1,410,000
95	1,425,000	95	1,425,000	95	1,425,000
96	1,440,000	96	1,440,000	96	1,440,000
97	1,455,000	97	1,455,000	97	1,455,000
98	1,470,000	98	1,470,000	98	1,470,000
99	1,485,000	99	1,485,000	99	1,485,000
100	1,500,000	100	1,500,000	100	1,500,000

COMMENTS:

- (1) BOLTS REQUIRED UNDER DAY CONDITIONS WERE MEASURED TO 45,000 PSI TO PREVENT FAILURE OF THE BOLT ROOT AREA IN SHEAR DUE TO TENSILE STRESS.
- (2) STIFFER BOLTS - SEE SANDS BEFORE CATH ANV AND BATH WELDED TO DAY CONDITIONS DUE TO SCORING.
- (3) BOLTS MEASURED AFTER THE BOLT WAS REMOVED IN DAY CONDITIONS TO PREVENT FAILURE OF THE BOLT ROOT AREA IN SHEAR DUE TO TENSILE STRESS.
- (4) BOLTS REQUIRED UNDER DAY CONDITIONS WERE MEASURED TO 45,000 PSI TO PREVENT FAILURE OF THE BOLT ROOT AREA IN SHEAR DUE TO TENSILE STRESS.



STRESS SINKING MARK
COUNTERSINK IN HEAD
SLOT SINKING MARK
FOLLOWING (C) SCALE GO

TEST DATA
CONTRACT NO. W-39(6) 2808
NOTE: BOLTS IN HEADS
BOLTS IN HEADS

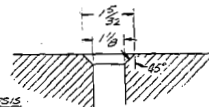
DATE: 19 MAR 57
SIZE: 1/4" DIA. X 3/4"
MATERIAL: 4140 STEEL
MFG. BY: FAYAT, INC. OF ST. LOUIS, MO.
MFG. BY: FAYAT, INC. OF ST. LOUIS, MO.

DATE 25 MAY 1951
 SIZE L-L 1/8-12 UNF-3A
 SCREEN OR BOLT AN 18C-38 MFD BY BERO BOLT & SCREEN CO., STAMFORD, CONN.
 NUT AN 312C 19 MFD BY FLEXLOC DIV OF STD. PRESS & STEEL CO., JOHNSTOWN, PA.

TEST SPEC - N°3
 TENSION - GAGE
 COMPRESSION - SD

TEST DATA
 CONTRACT N° AF 33(616)2808
 P-1227

NOTES:
 FIGURES IN PARENTHESES
 DENOTE TENSILE STRESS PER INCH



SKETCH SHOWING HARD
 COUNTERSINK IN HARDENED
 STEEL DRAWING BLOCK
 (FOLKELL C. SCHULZ '60)

WADC TR 57-330

124

TENSILE STRESS (%/IN²)	NON LUBRICATED												LUBRICATED											
	TORQUED FROM HEAD						TORQUED FROM NUT						TORQUED FROM HEAD						TORQUED FROM NUT					
	TENSILE STRESS (%/IN²)						TENSILE STRESS (%/IN²)						TENSILE STRESS (%/IN²)						TENSILE STRESS (%/IN²)					
	15,000	30,000	45,000	60,000	75,000	90,000	15,000	30,000	45,000	60,000	75,000	90,000	15,000	30,000	45,000	60,000	75,000	90,000	15,000	30,000	45,000	60,000	75,000	90,000
1/8 IN	3000	8500	16000	24600	31500	38000	4000	9400	16200	23400	30000	36000	11400	4200	7800	11200	15000	18200	10600	3800	7200	8600	11600	15400
3/16 IN	4000	12000	17000	25000	32000	39000	3800	9000	15000	23000	30000	36000	11400	4000	7400	11000	14400	17400	10000	3600	7000	8400	11200	15000
1/4 IN	5000	12000	21000	31000	38000	45000	3600	8600	16000	25000	32000	39000	11400	4000	6900	8000	10400	13600	9400	4800	7000	9400	12200	20400
5/16 IN	4000	11000	18000	26000	33000	40000	3200	7800	13200	20000	27000	34000	11400	4000	6800	9600	13000	17000	8000	3400	5600	8000	10800	16400
3/4 IN	5200	15000	25000	35000	42000	50000	4000	10000	17000	25000	32000	39000	11400	5000	8200	11200	15000	19000	1600	3400	5000	6800	9600	12400
Avg	4080	12400	19300	27000	34000	41000	3720	8800	15100	23400	30000	36000	11400	4120	7240	10120	13560	17560	1840	3800	6000	7400	10400	15200
Max	5400	13400	21600	31600	38000	45000	4400	10800	17600	25800	32800	39800	11400	5400	8300	11300	15200	19200	2400	4000	7200	9400	12400	20400
Min	3000	8600	16000	24600	31500	38000	3200	7800	13200	20000	27000	34000	11400	4000	6800	8000	10400	13600	1000	3400	5000	6800	9600	12400
1/8 IN	7000	14800	23300	31200	38000	45000	7100	13000	20000	26400	33000	40000	11400	4000	6000	8400	11200	14200	1800	3600	5000	6200	8200	12000
3/16 IN	8500	19000	21000	30000	37000	44000	7400	14400	21200	28800	36000	43000	11400	4200	7200	10000	12800	15800	1800	3400	5000	6200	8000	11000
1/4 IN	7200	15600	24200	33400	40000	47000	8000	15200	23200	31200	38000	45000	11400	4200	7200	10000	12800	15800	2200	3800	5400	6800	8800	11800
5/16 IN	1200	15000	23000	32000	39000	46000	6000	12000	18000	26000	33000	40000	11400	4200	6200	9000	11800	14800	1800	3800	5200	6600	8200	10400
3/4 IN	6500	18500	27200	36200	43000	50000	7000	13400	21000	28400	35000	42000	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
Avg	7120	14720	21760	31560	38400	45200	7120	13600	20800	28240	35200	42000	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
Max	7200	15600	24200	33400	40000	47000	8000	15200	23200	31200	38000	45000	11400	4200	7200	10000	12800	15800	2200	3800	5400	6800	8800	11800
Min	5700	14100	21000	30000	37000	44000	6000	12000	18000	26000	33000	40000	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
1/8 IN	7000	14800	23300	31200	38000	45000	7400	13000	20000	26400	33000	40000	11400	4000	6000	8400	11200	14200	1800	3600	5000	6200	8200	12000
3/16 IN	7000	16000	24000	32000	39000	46000	7400	14000	20600	27600	34600	41600	11400	4200	7000	9400	12000	15000	1600	3000	5200	7400	8000	11000
1/4 IN	7800	16400	24400	32500	39000	46000	8000	16000	23000	30000	37000	44000	11400	4200	7000	9400	12000	15000	2200	3800	5400	6800	8800	11800
5/16 IN	8000	17200	24800	32800	39000	46000	8000	16000	23000	30000	37000	44000	11400	4200	7000	9400	12000	15000	2200	3800	5400	6800	8800	11800
3/4 IN	8000	17200	24800	32800	39000	46000	8000	16000	23000	30000	37000	44000	11400	4200	7000	9400	12000	15000	2200	3800	5400	6800	8800	11800
Avg	7520	16320	24180	32880	39000	46000	7560	13960	21320	28480	35200	42000	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
Max	8000	17200	24800	32800	39000	46000	8000	16000	23000	30000	37000	44000	11400	4200	7000	9400	12000	15000	2200	3800	5400	6800	8800	11800
Min	7000	16000	24000	32000	39000	46000	6000	12000	18000	26000	33000	40000	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
1/8 IN	7200	14200	21200	28000	35000	42000	7200	12800	19800	26800	33800	40800	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
3/16 IN	7200	15900	23800	31400	38000	45000	7200	12800	19800	26800	33800	40800	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
1/4 IN	7200	15900	23800	31400	38000	45000	7200	12800	19800	26800	33800	40800	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
5/16 IN	7200	15900	23800	31400	38000	45000	7200	12800	19800	26800	33800	40800	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
3/4 IN	7200	15900	23800	31400	38000	45000	7200	12800	19800	26800	33800	40800	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
Avg	7200	15900	23800	31400	38000	45000	7200	12800	19800	26800	33800	40800	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
Max	7200	15900	23800	31400	38000	45000	7200	12800	19800	26800	33800	40800	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
Min	7200	15900	23800	31400	38000	45000	7200	12800	19800	26800	33800	40800	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
1/8 IN	5400	13400	26000	37000	48000	59000	5400	13400	26000	37000	48000	59000	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
3/16 IN	7000	15000	25000	35000	45000	55000	7000	15000	25000	35000	45000	55000	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
1/4 IN	7000	15000	25000	35000	45000	55000	7000	15000	25000	35000	45000	55000	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
5/16 IN	7000	15000	25000	35000	45000	55000	7000	15000	25000	35000	45000	55000	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
3/4 IN	7000	15000	25000	35000	45000	55000	7000	15000	25000	35000	45000	55000	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
Avg	7000	15000	25000	35000	45000	55000	7000	15000	25000	35000	45000	55000	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
Max	7000	15000	25000	35000	45000	55000	7000	15000	25000	35000	45000	55000	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400
Min	7000	15000	25000	35000	45000	55000	7000	15000	25000	35000	45000	55000	11400	4200	6200	8600	11400	14200	1800	3800	5200	6600	8200	10400

COMMENTS:
 (1) BOLTS TORQUED UNDER DRY CONDITIONS WERE TORQUED TO PREVENT FAILURE OF THE BOLT ROOT AREA IN SHEAR DUE TO TENSILE STRESS.
 (2) SPACER BLOCKS WERE HANDLED BEFORE EACH RUN TO BOLT WREATHS AND DRY CONDITIONS DUE TO SCRAPING.
 (3) BOLT DRIVEN FROM THE HEAD IN THE DRY CONDITION SHAPED OF THE BLOCK SUCH THAT THESE STARS COULD NOT BE REMOVED BY SANDING.
 (4) PULS OF LUBRICATED DRAWINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION OF NUT OR HEAD BEARING SURFACES.

PAGE 1A

APPENDIX IV

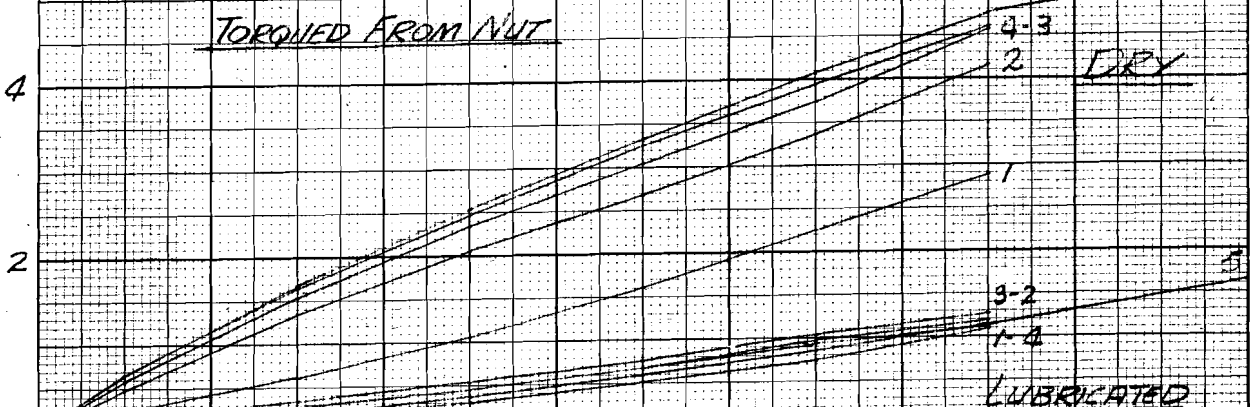
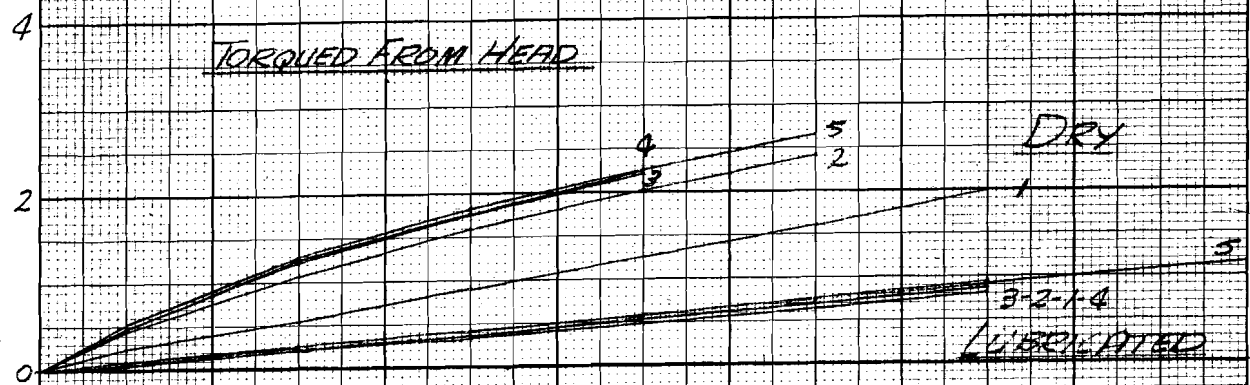
GRAPHS
of
TORQUE TENSION RELATIONSHIPS

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 NUT - EB-048

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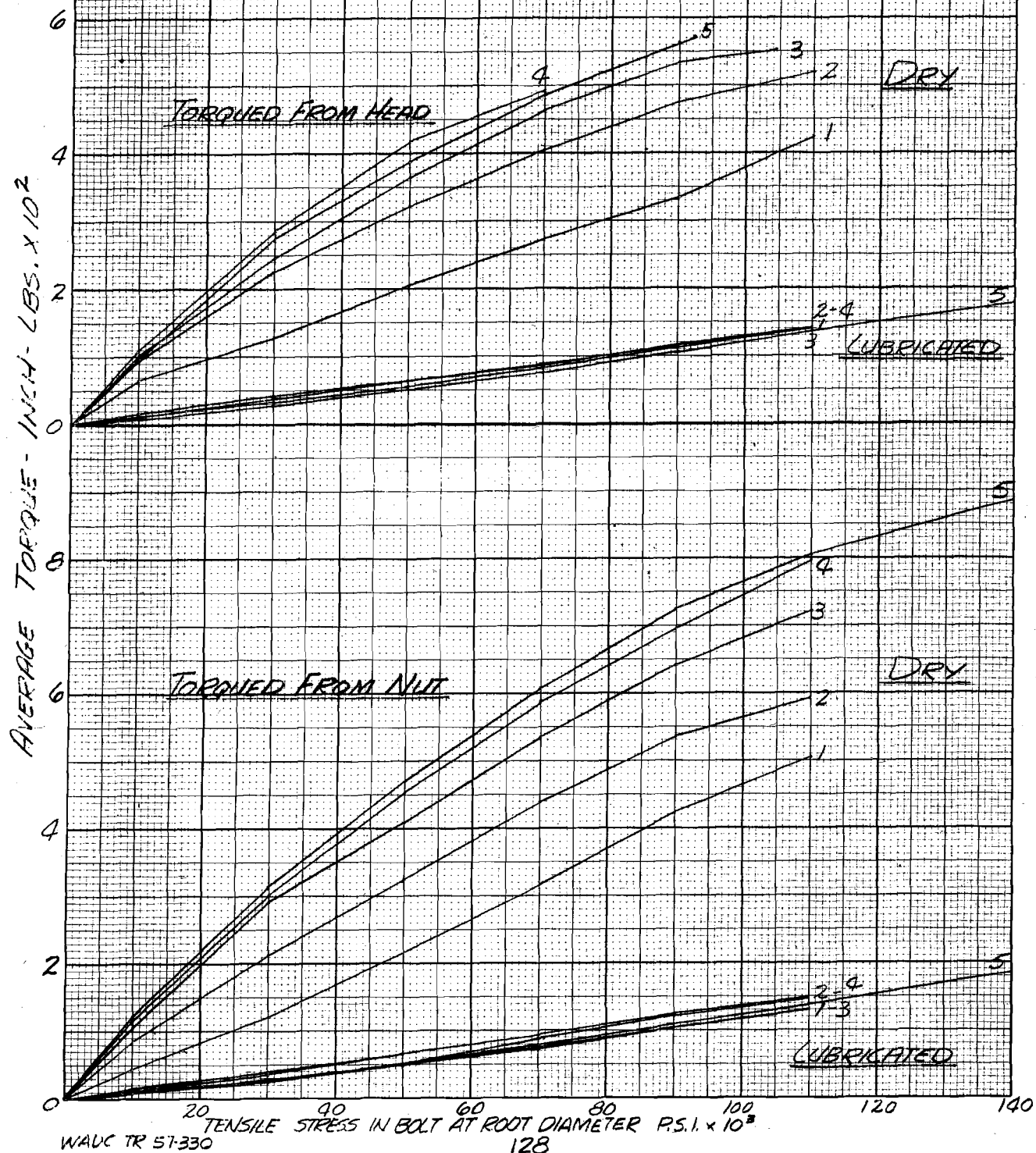
TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS

INVERTED TORQUE - INCH-LBS. $\times 10^2$



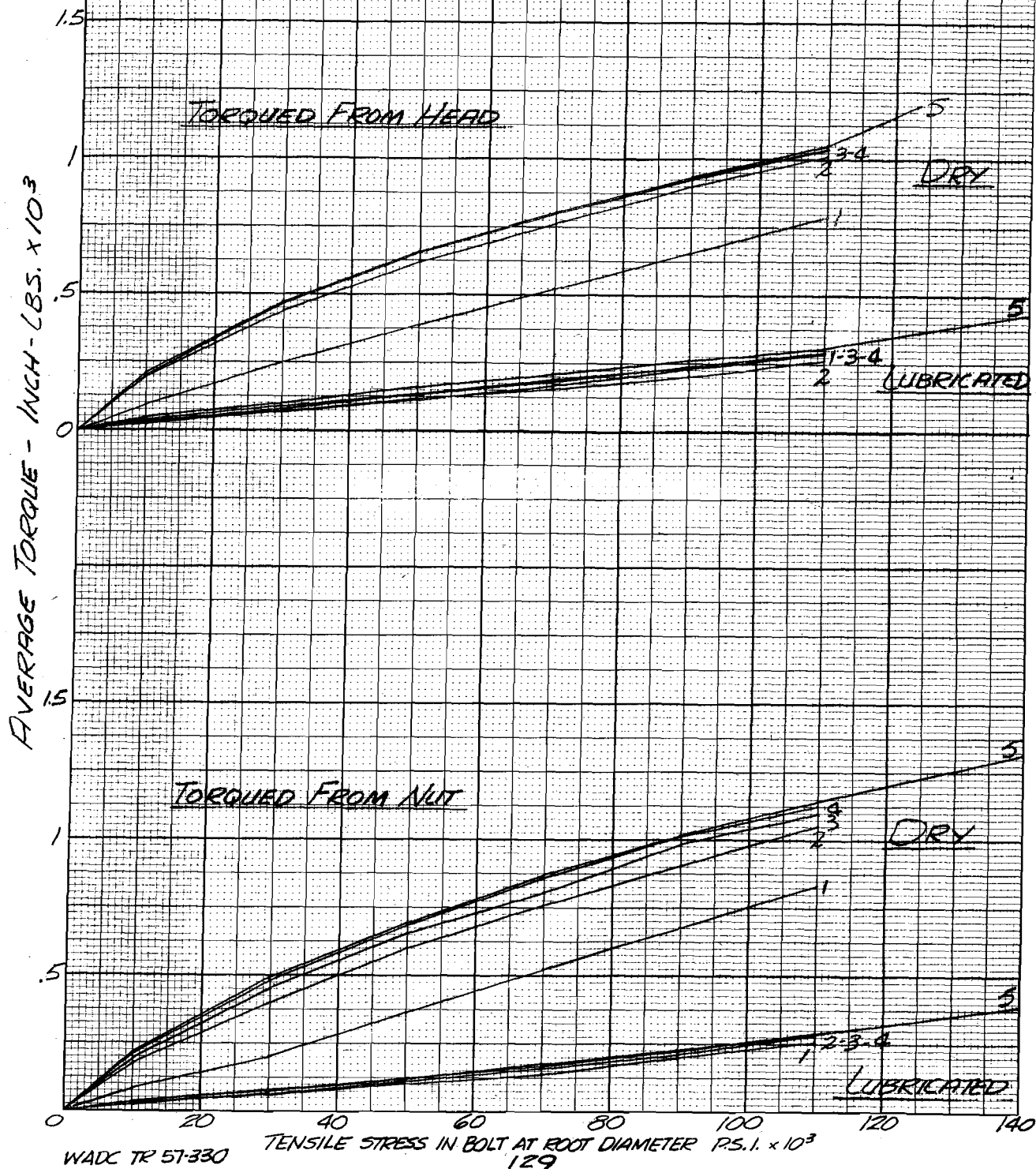
BOLT-M5 20005-50, 5/16-24UNF-3A "B" DATE- 4-10-56
 NUT- EB-054 DATA-PAGE-

TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS



BOLT - MS 20006-50, 3/8-24UNF-3A "C" DATE - 2-5-56
 NUT - EB-068 DATA - PAGE

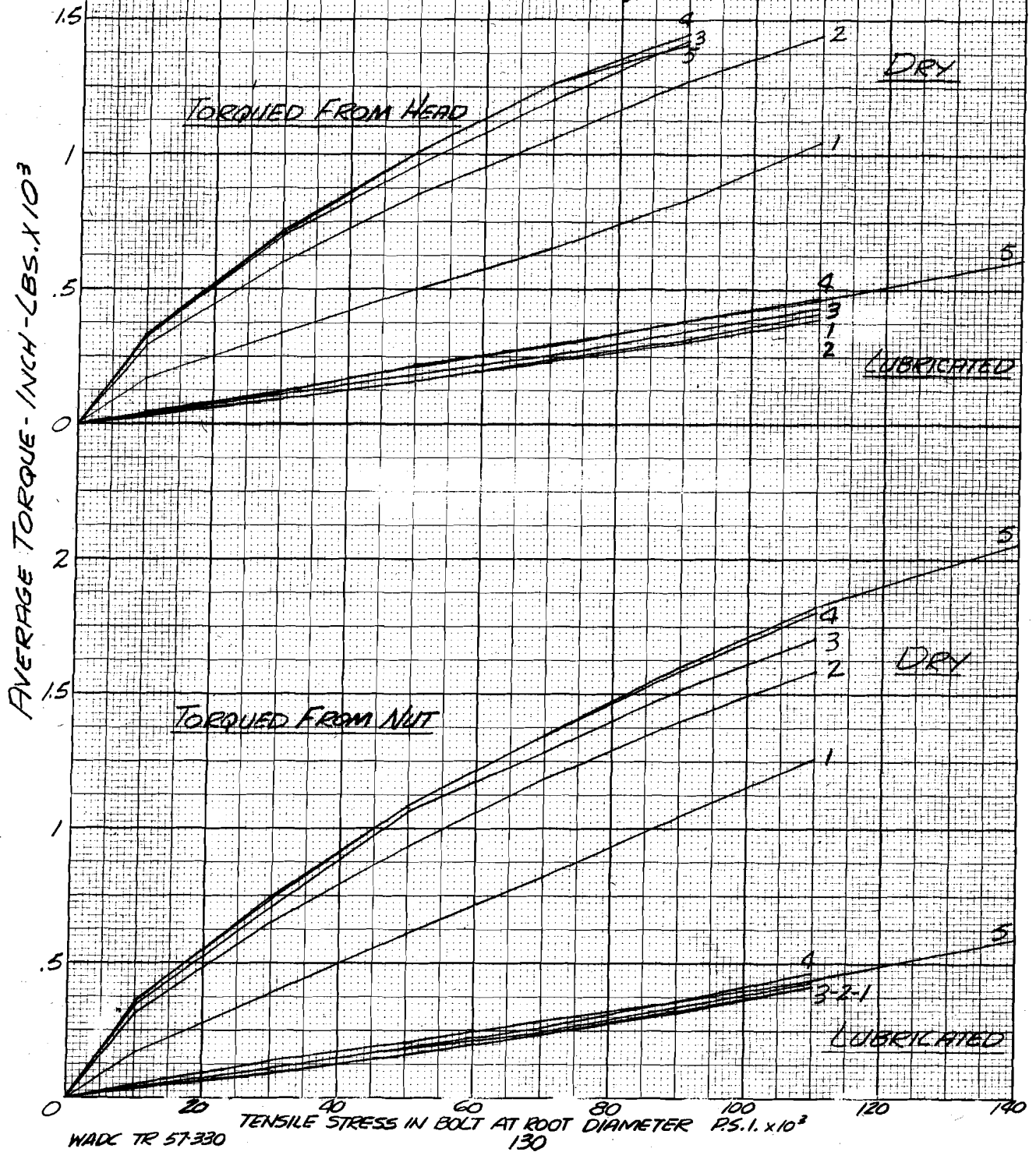
TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS



BOLT - MS 20007-50 , 7/16-20UNF-3A
NUT - EB-070

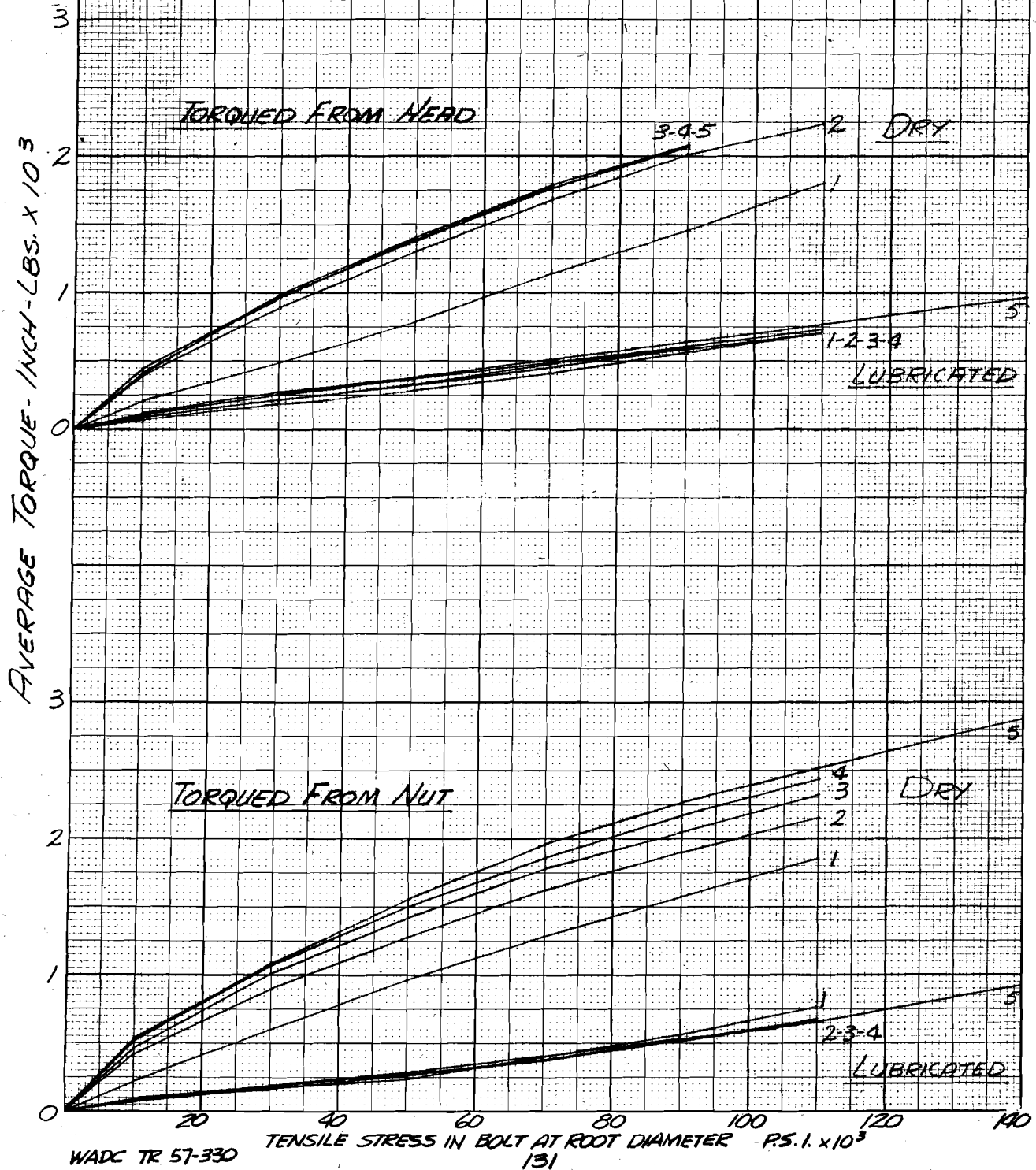
"D" DATE-4-3-56
DATA PAGE

TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS



BOLT- MS 20008-50, 1/2-20UNF-3A "E" DATE-3-30-56
NUT- EB-080 DATA PAGE

TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS

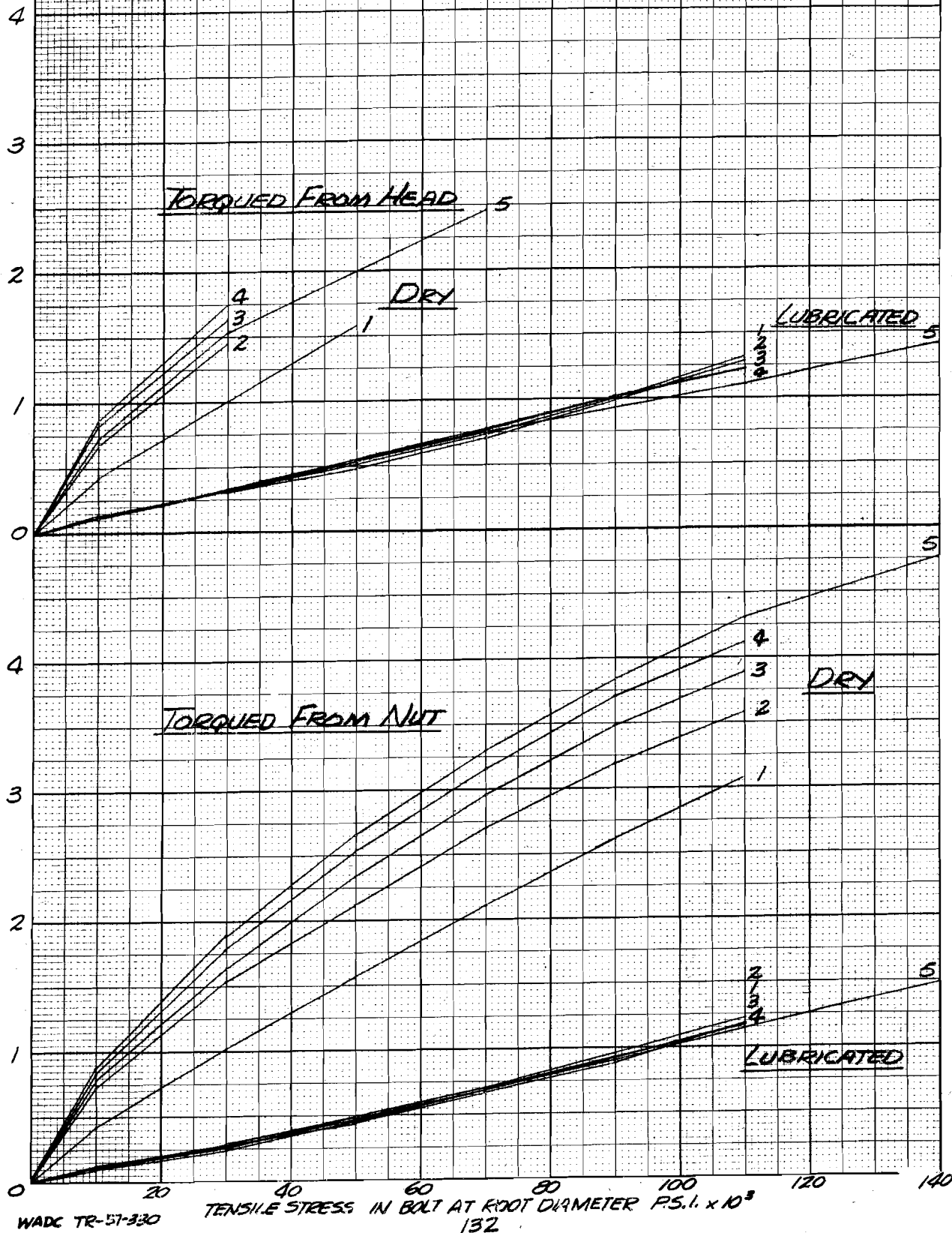


BOLT - MS 20009-50, 9/16-18 UNF-3A
 NUT - (3) EB-098, (2) 42 FW-918

"F" DATE - 2-27-57
 DATA PAGE -

TORQUE-TENSION RELATIONSHIP SUCCESSIVE TIGHTENINGS

AVERAGE TORQUE - INCH-LBS. $\times 10^3$

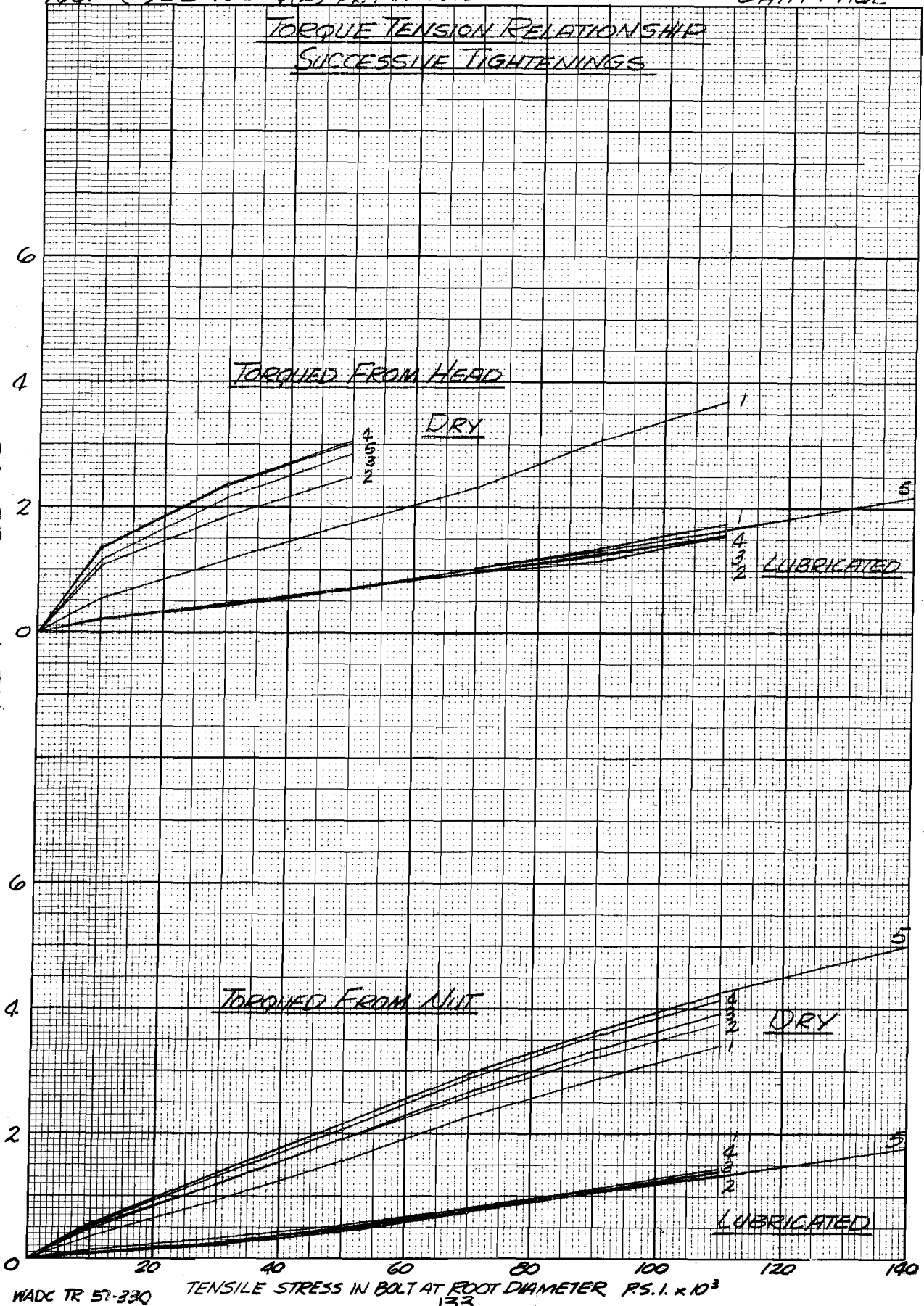


BOLT - MS-20010-50, 5/8-18 UNF-3A "G"
 NUT - (3) EB-108 & (2) 42 FIN-101B

DATE - 2-5-57
 DATA PAGE -

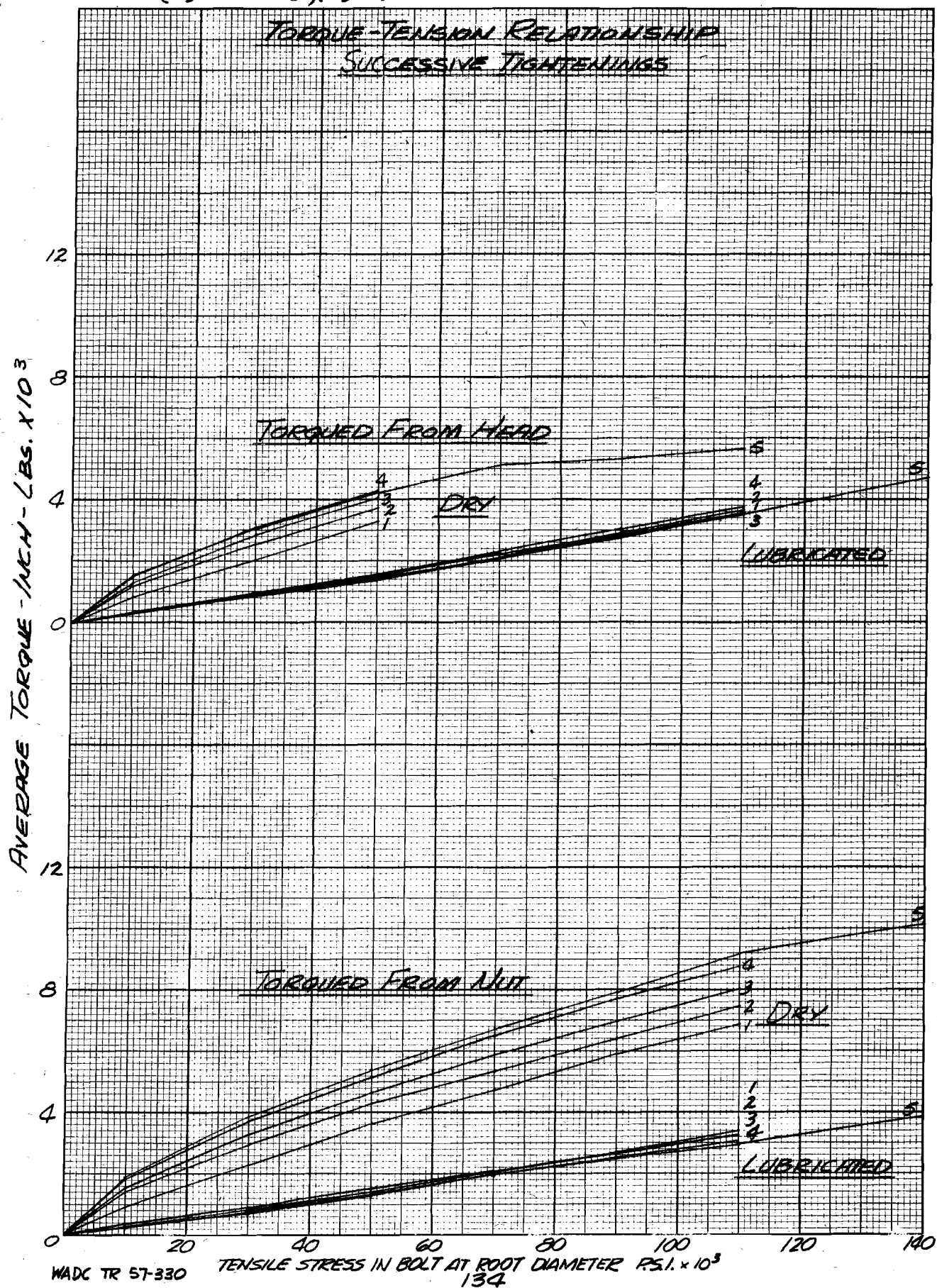
TORQUE TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS

AVERAGE TENSILE - INCH-LEBS. $\times 10^3$

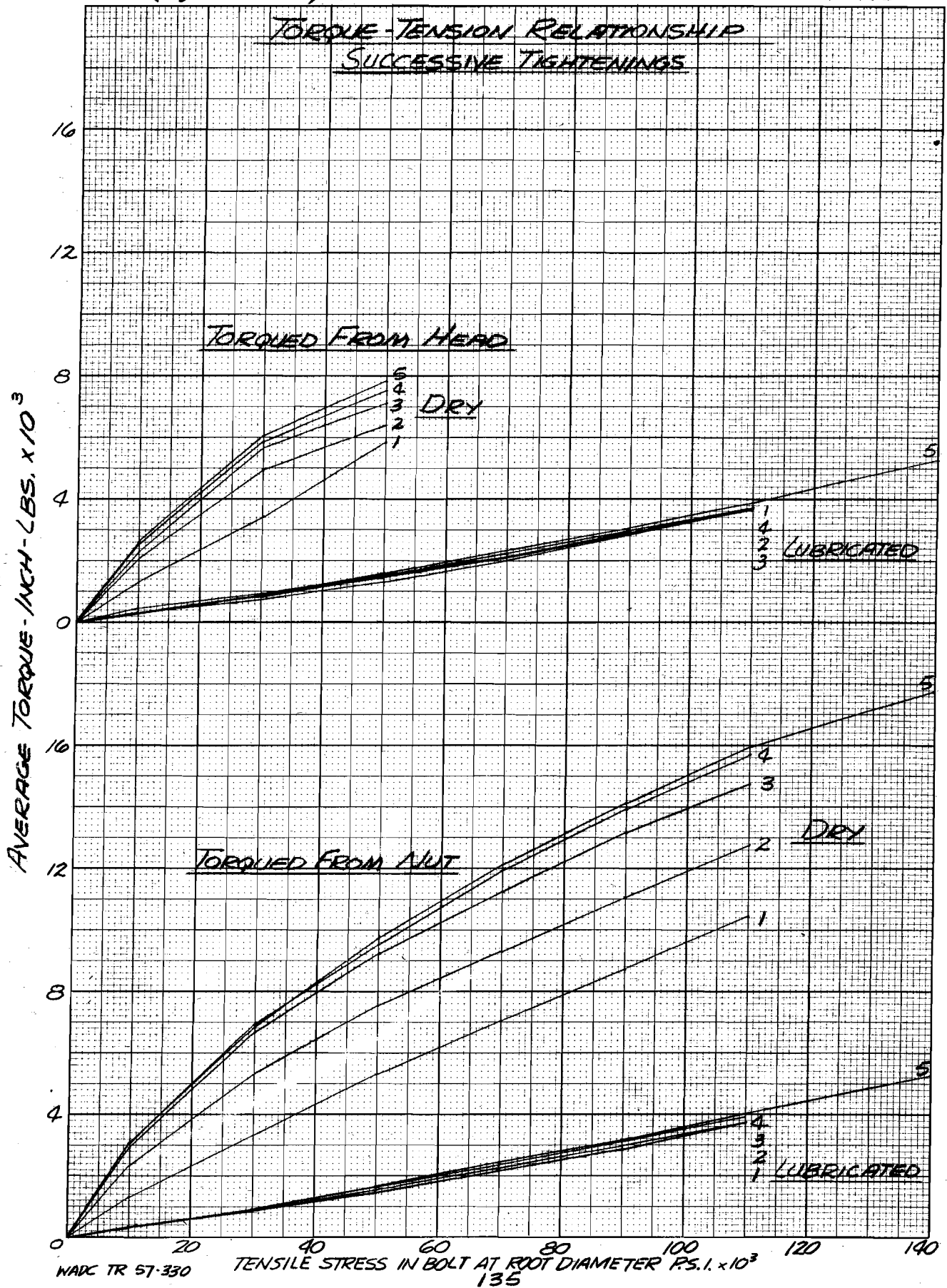


BOLT - MS 20012-50, 3/4-16 UNF-3A "H"
 NUT - (3) EB-126, (2) 42 FW-1216

DATE - 2-14-57
 DATA PAGE



"I" DATE-2-25-57
DATA PAGE.

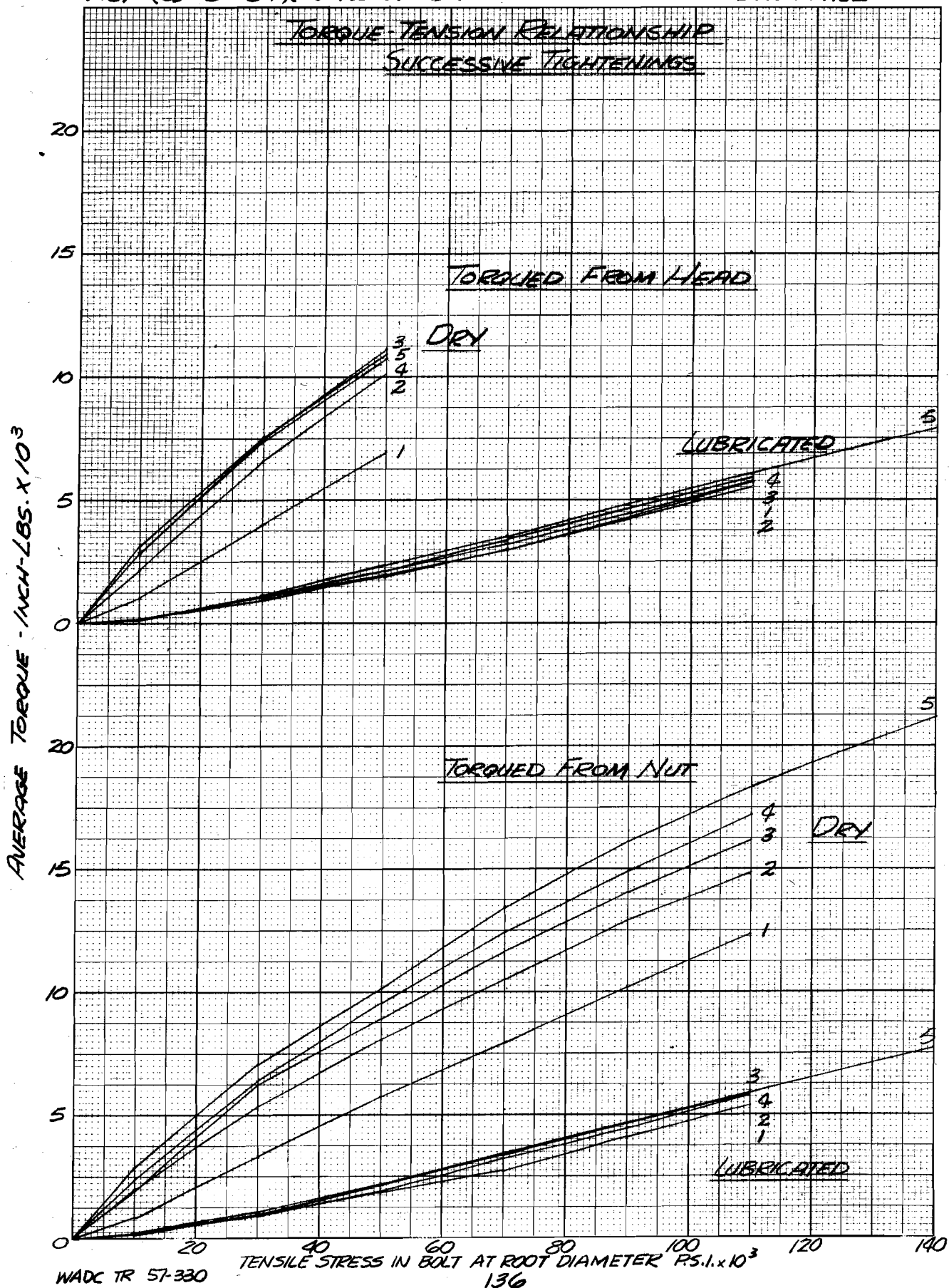


BOLT - MS 20016-50, 1-14 UNF-3A
NUT - (3) EB-164, (2) 42FW-16M

"J"

DATE - 3-18-57

DATA PAGE -

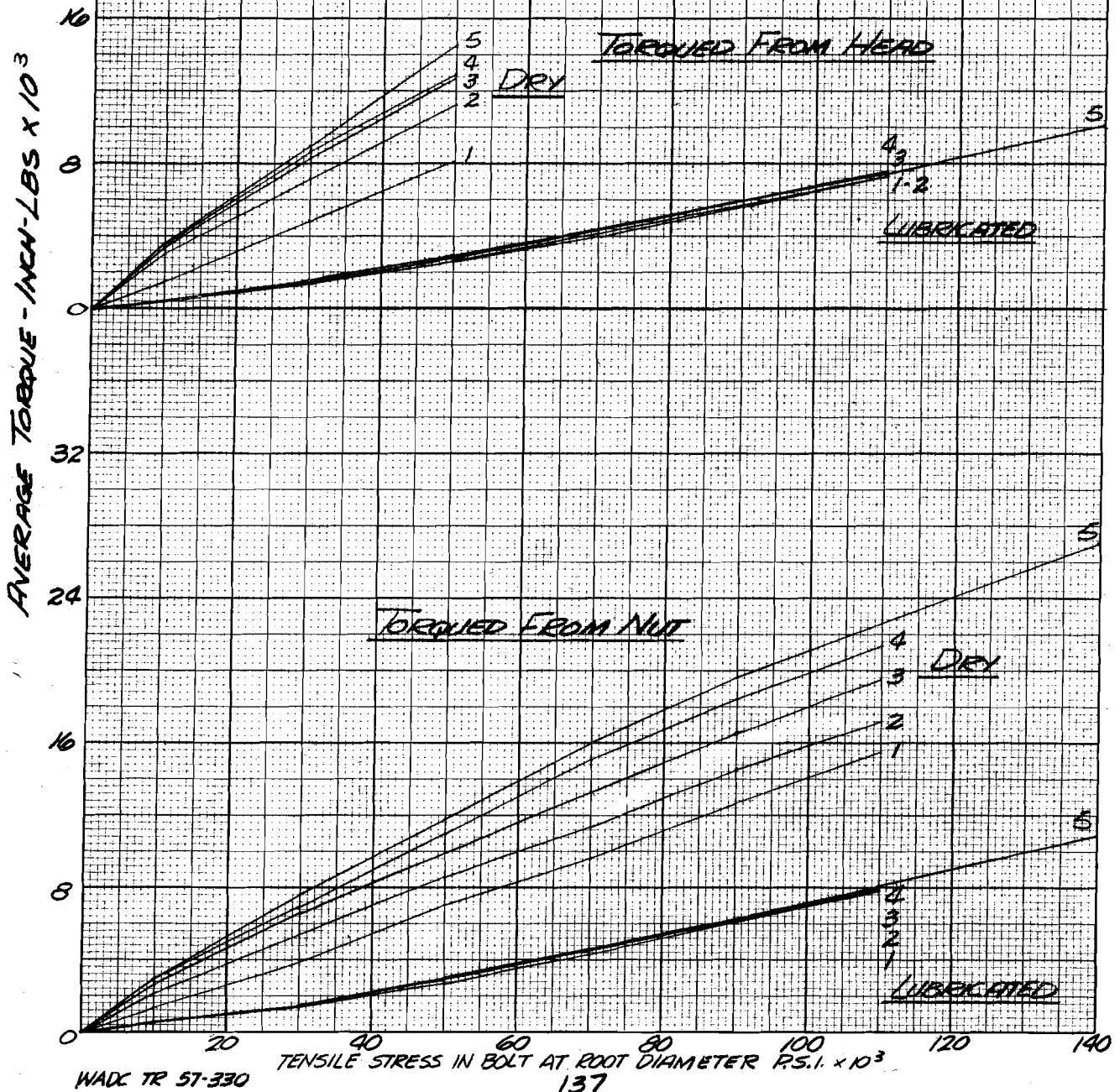


BOLT - MS20018-50, 1 1/8-12 UNF-3A
 NUT - (3) EB-182, (2) 42 FW-1812

"K"

DATE - 3-25-57
 DATA PAGE -

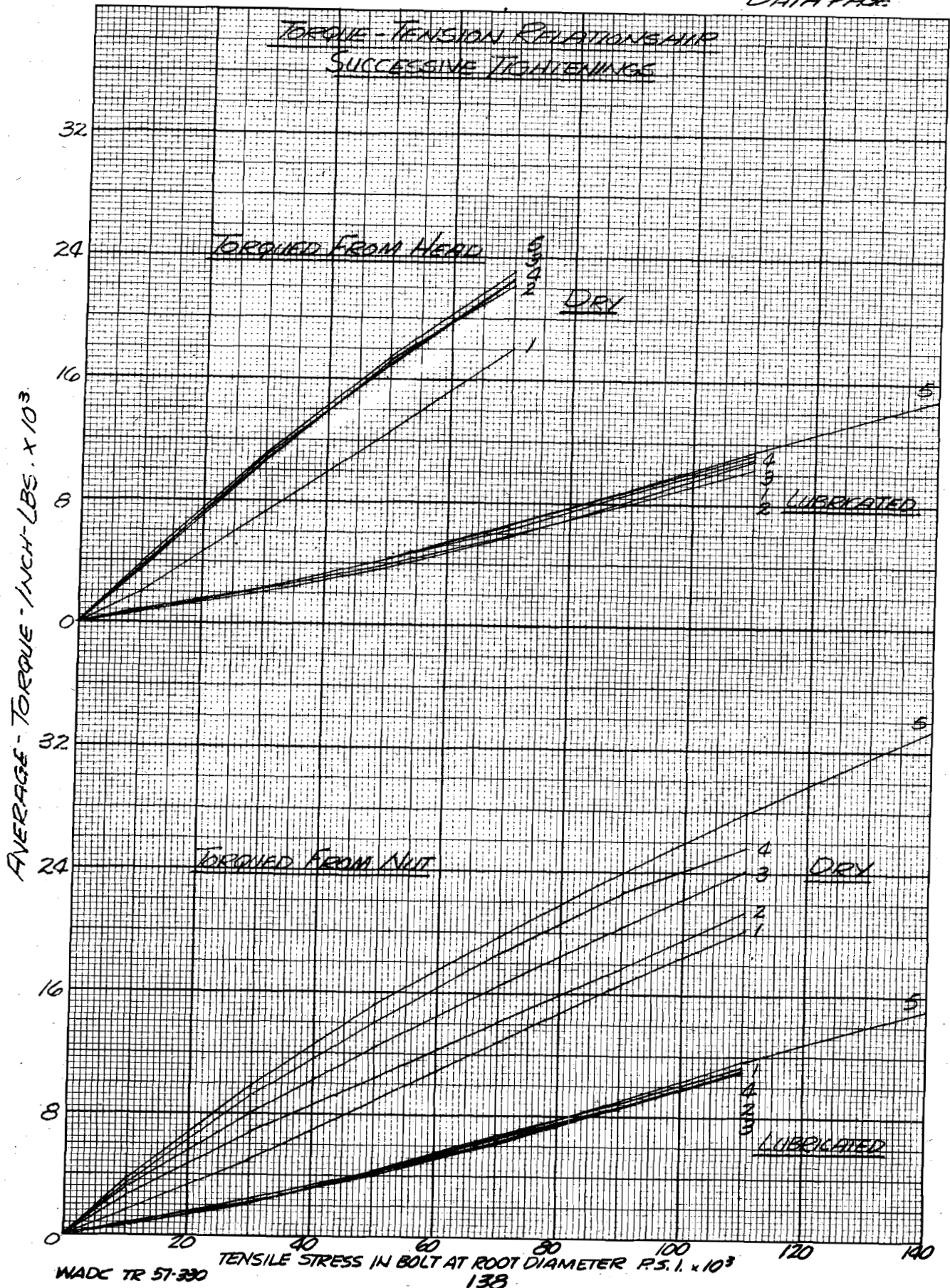
TORQUE - TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS



BOLT - MS 20020-50, 1/4-12 UNF-3A
 NUT - EB-202

"L"

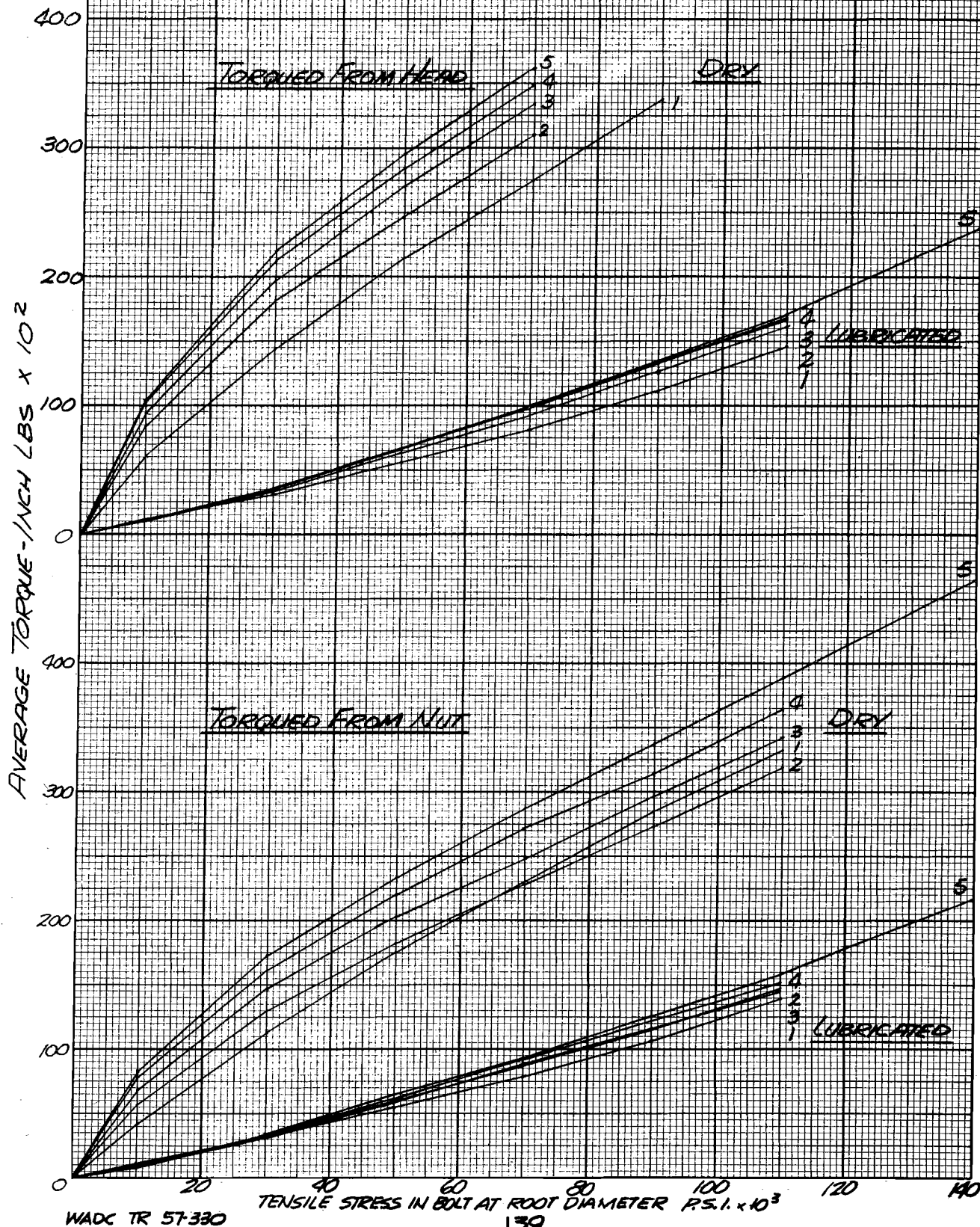
DATE - 4-5-57
 DATA PAGE

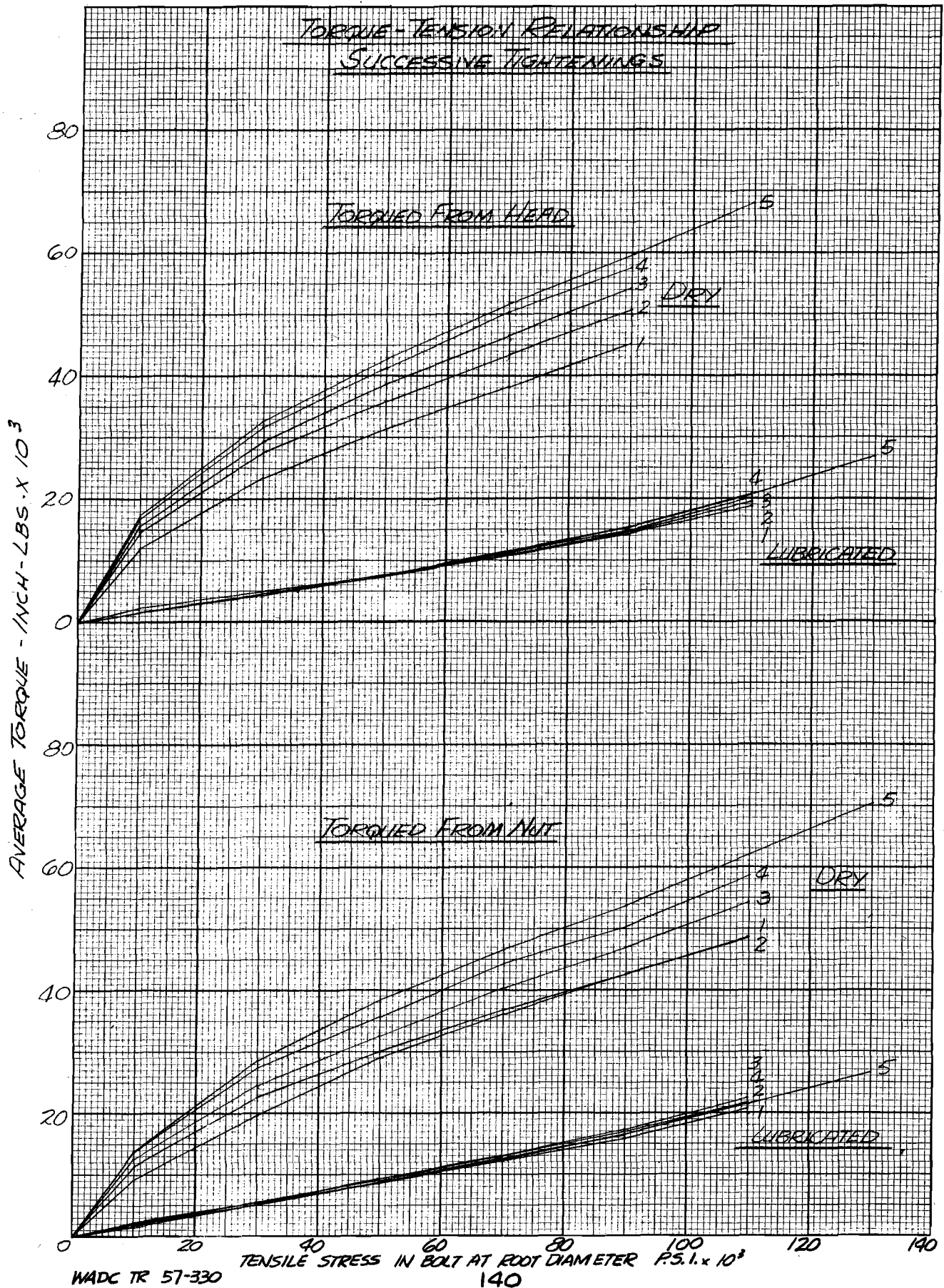


BOLT - MS 20022-52, 1 3/8-12 UNF-3A "M"
 NUT - EB-222

DATE - 4-12-57
 DATA PAGE -

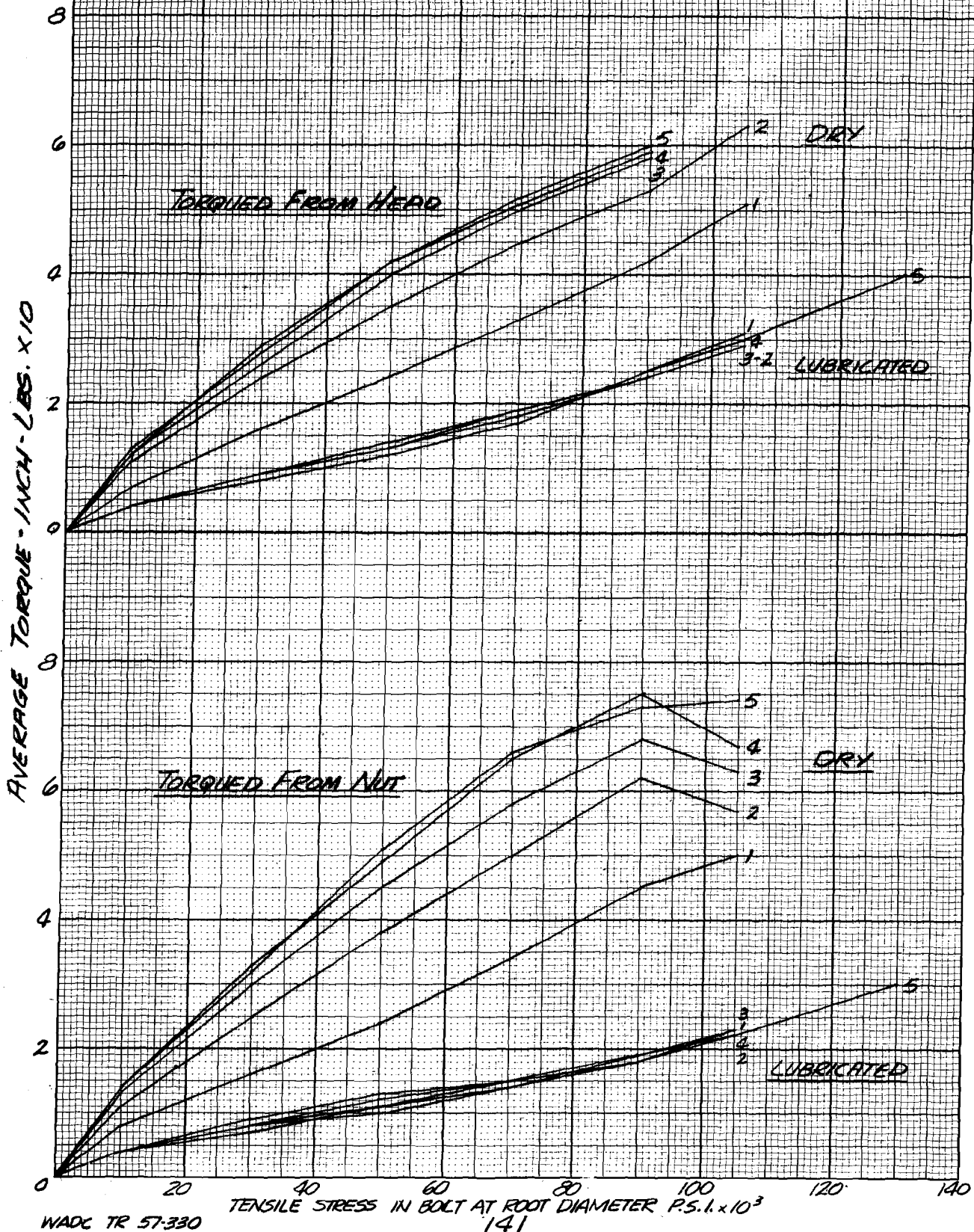
TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS





BOLT - AN 509 - 8R 37, 8-32 NF-3A "0" DATE - 1-15-57
 NUT - AN 365 - 832 DATA PAGE -

TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS



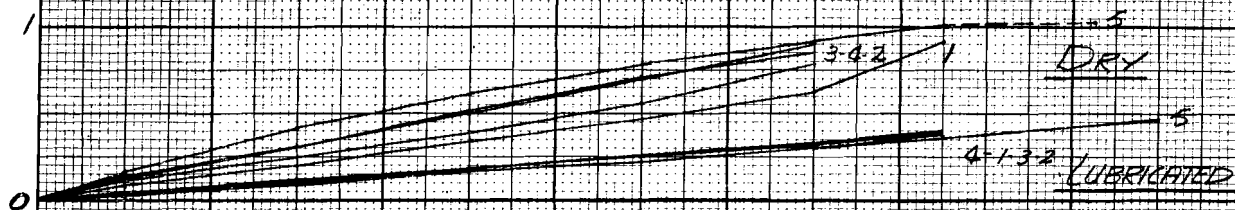
BOLT - AN 509-10R37, 10-32 NF-3A
NUT - AN 365-1032

"P" DATE - 4-30-56
DATA - PAGE

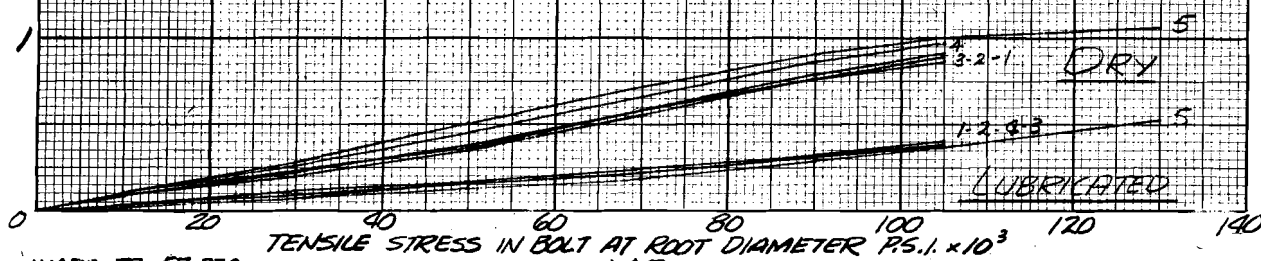
TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS

AVERAGE TORQUE - INCH - LBS. $\times 10^2$

TORQUED FROM HEAD



TORQUED FROM NUT



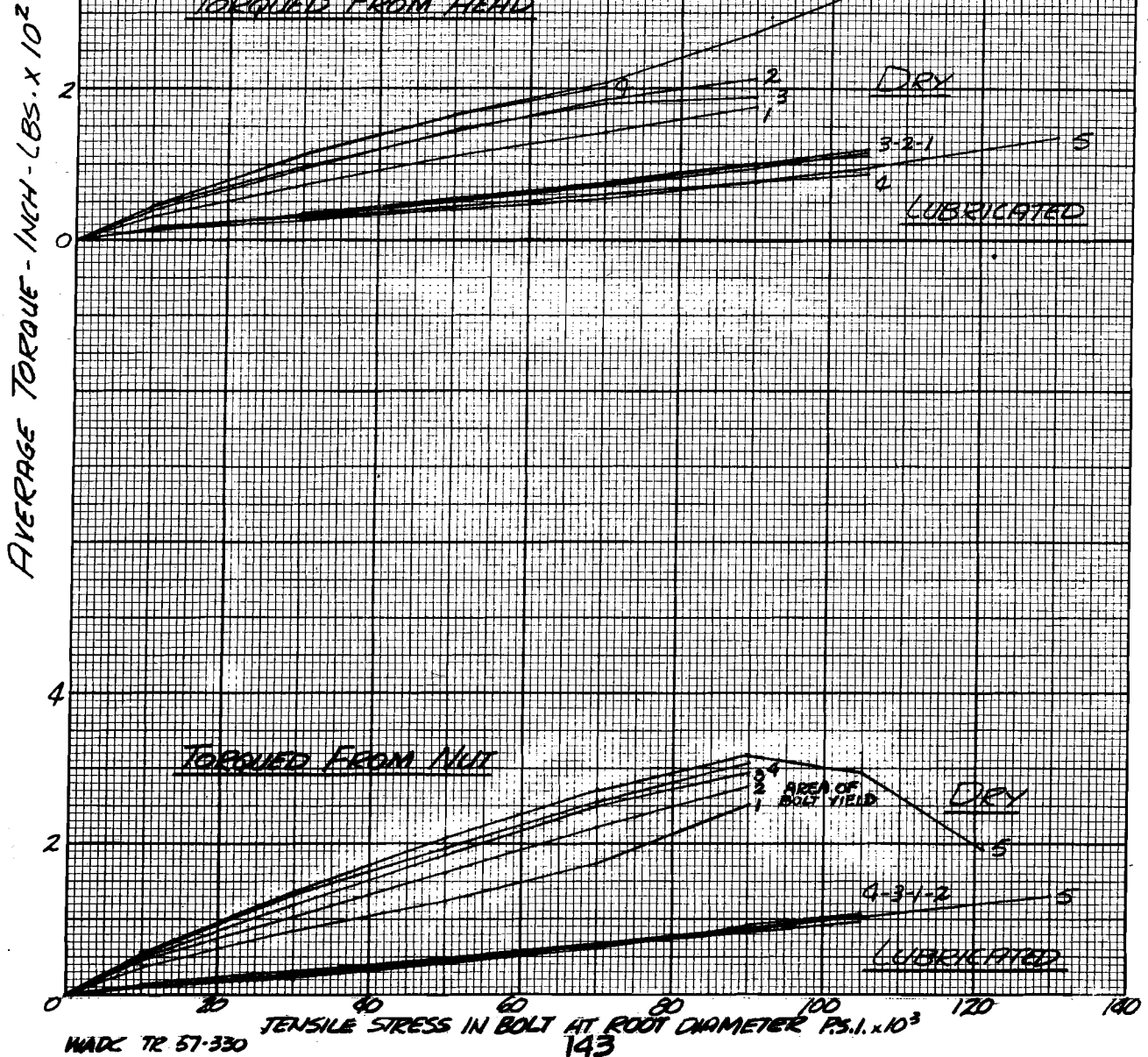
BOLT - AN 509-016 R37, 1/4-28 UNF-3A
NUT - AN 365-028

"Q"

DATE - 4.24.56

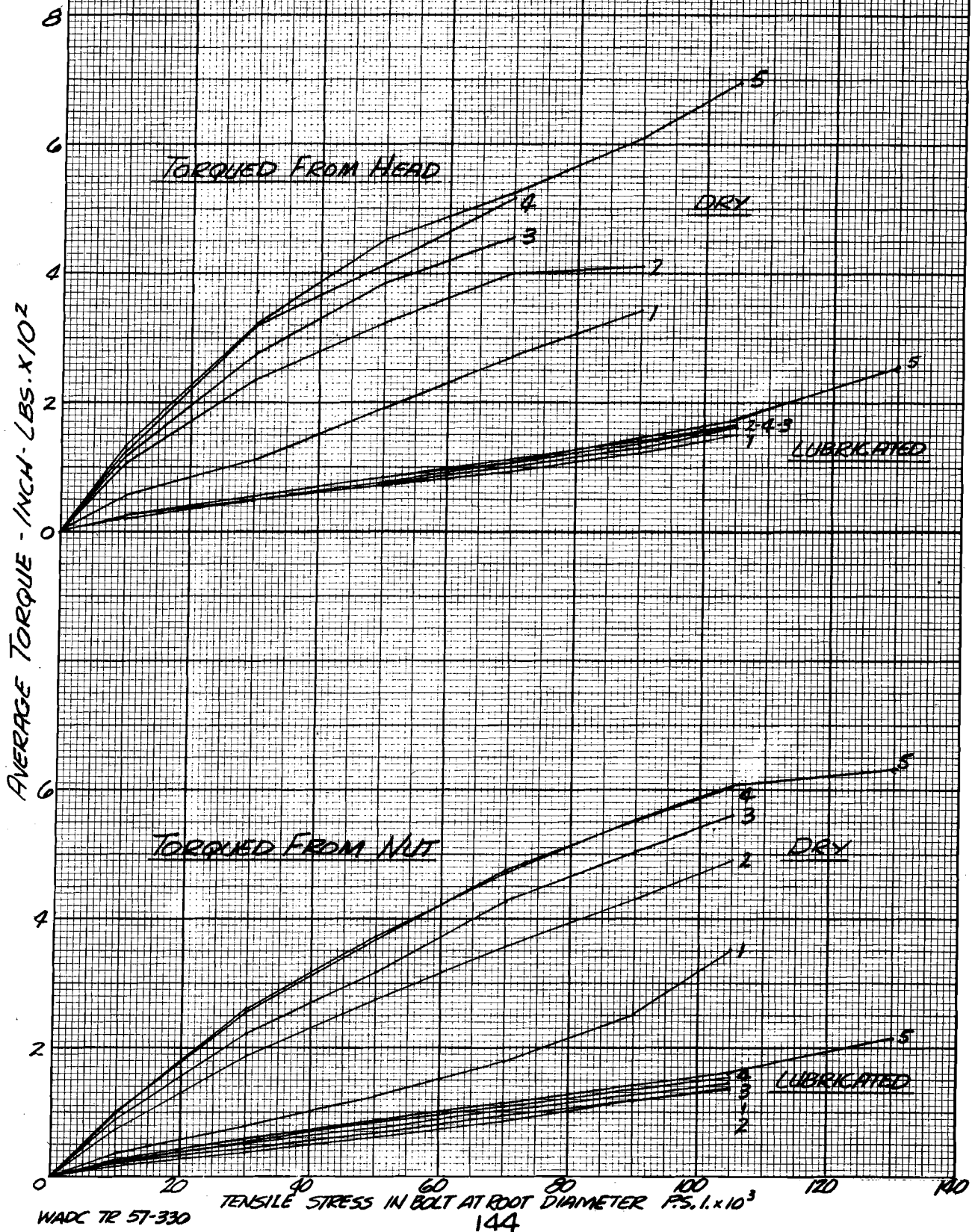
DATA - PAGE

TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS

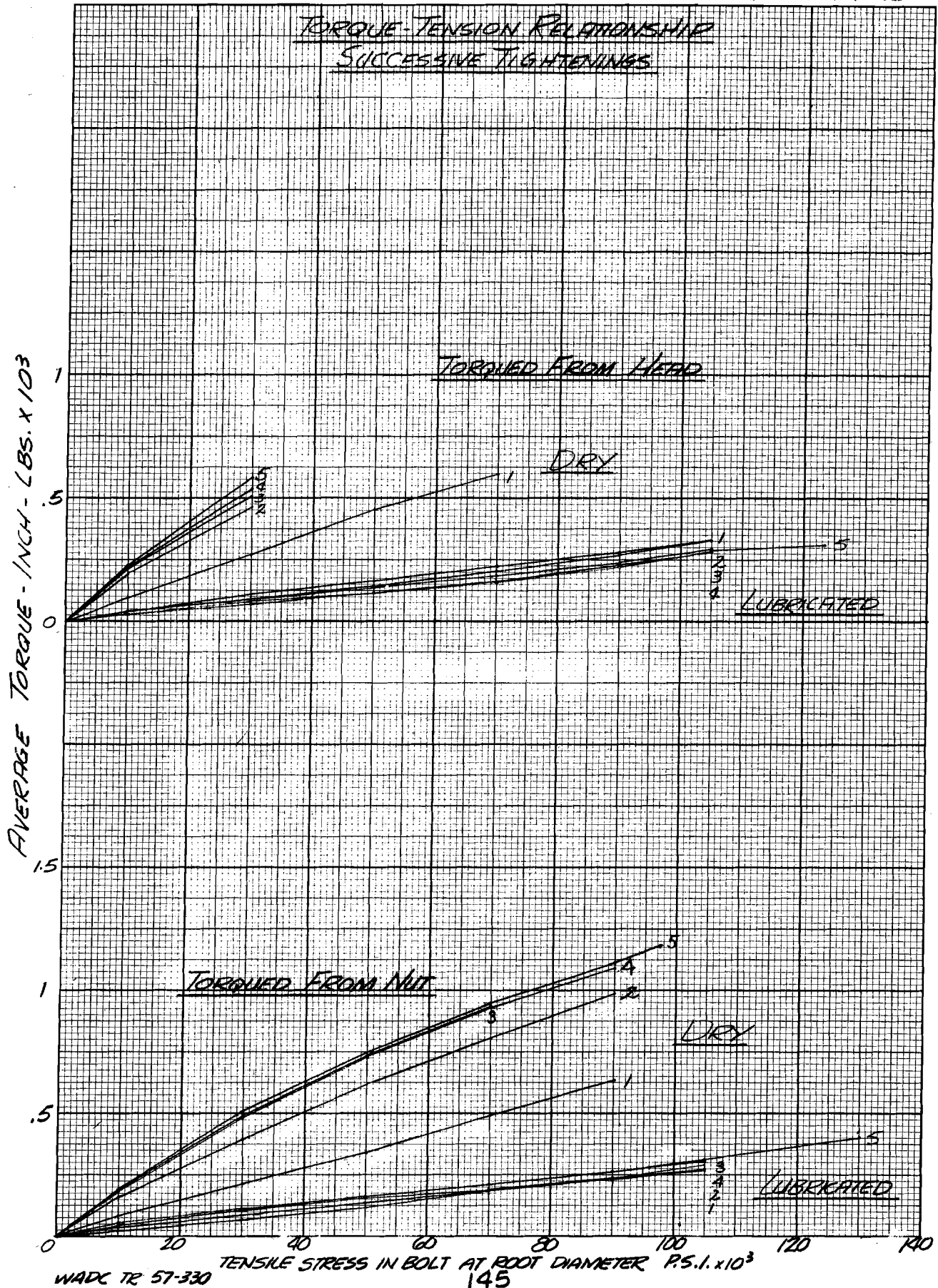


BOLT - AN 509-516 R 48, 5/16-24 UNF-3A "R" DATE - 1-16-57
 NUT - AN 365-524 DATA PAGE.

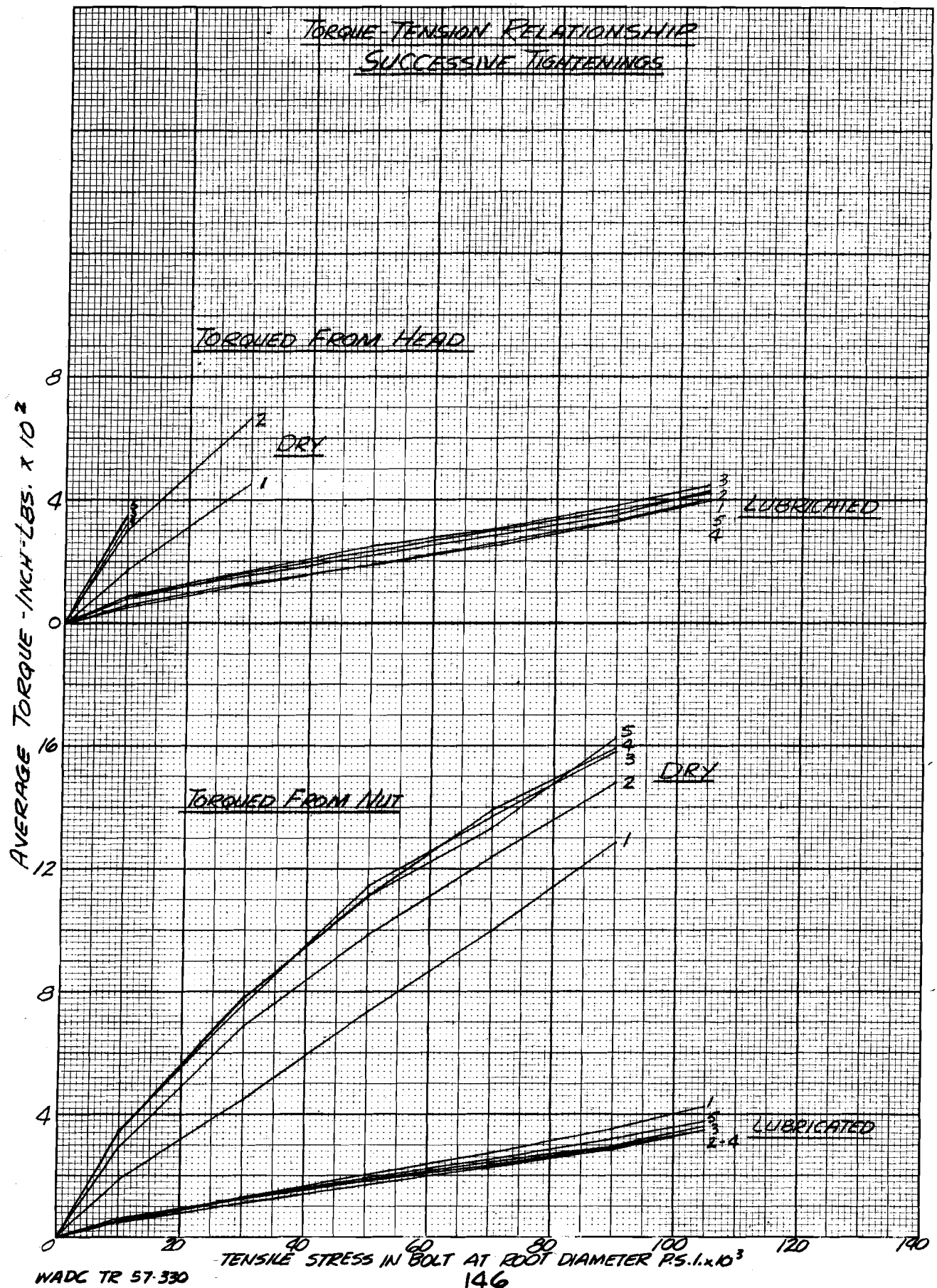
TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS



BOLT - AN 509-616 R48, 3/8-24 UNF-3A "S" DATE - 5-3-56
 NUT - AN 365-624 DATA PAGE -



TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS



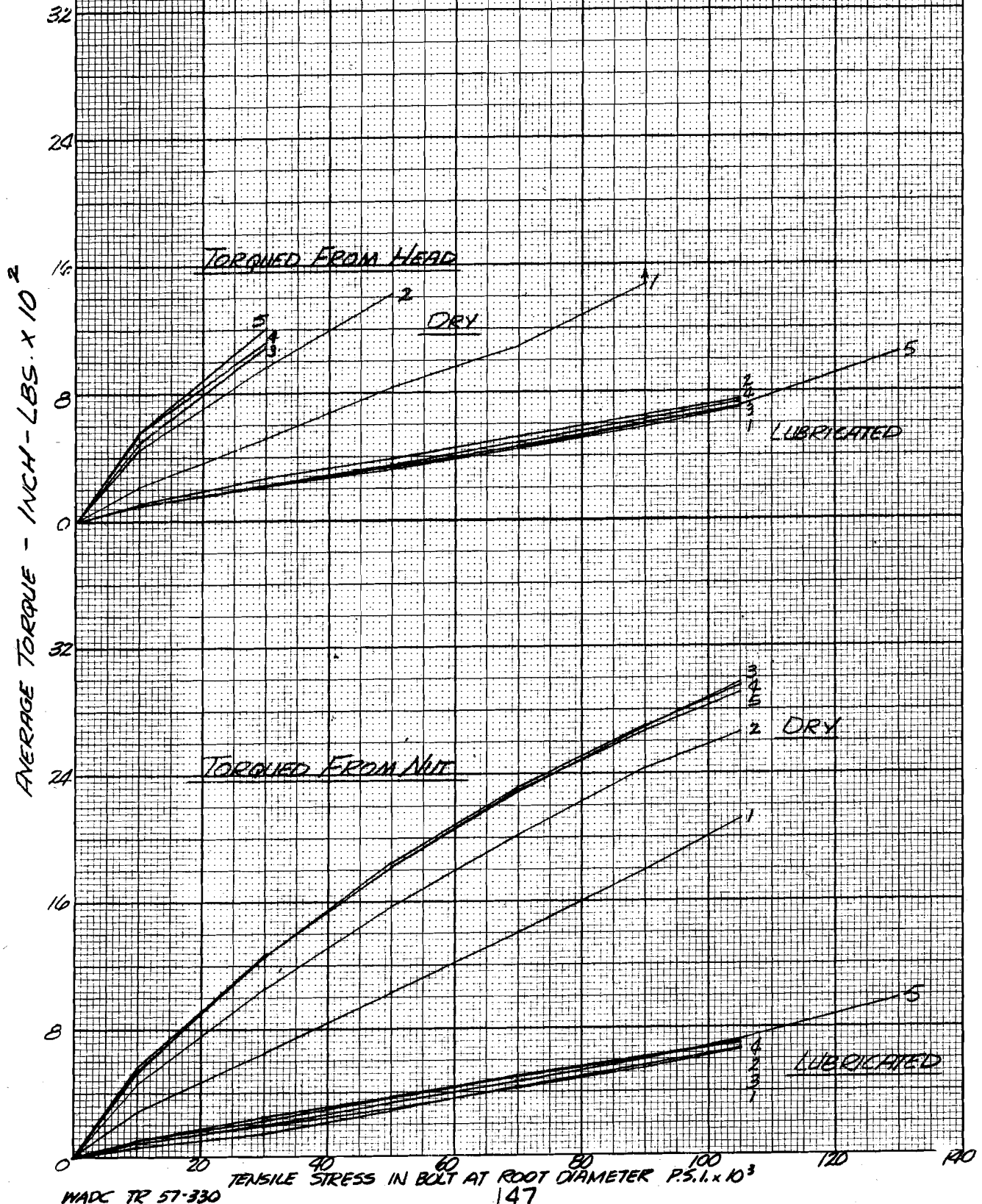
BOLT - AN 509-816 R49, 1/2-20 UNF-3A
 NUT - AN 365-820

"U"

DATE - 1-22-57

DATA PAGE -

TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS



TORQUE-TENSION RELATIONSHIP SUCCESSIVE TIGHTENINGS

DOTTED PORTIONS OF CURVES ARE EXTREPOLATED

NOTE - VALUES PLOTTED ARE FROM DATA SHEET - "V" DATED 1-24-57

TORQUED FROM HEAD
(AVERAGE OF 5 SPECIMENS AS LABELED)

1H-L THRU 5H-L

APPROX. PT. OF
 BOLT YIELD

LUBRICATED

AVERAGE TORQUE, INCH-LBS $\times 10^2$

TORQUED FROM NUT
(AVERAGE OF 2 SPECIMENS AS LABELED)

1N
 2N

DRY

LUBRICATED

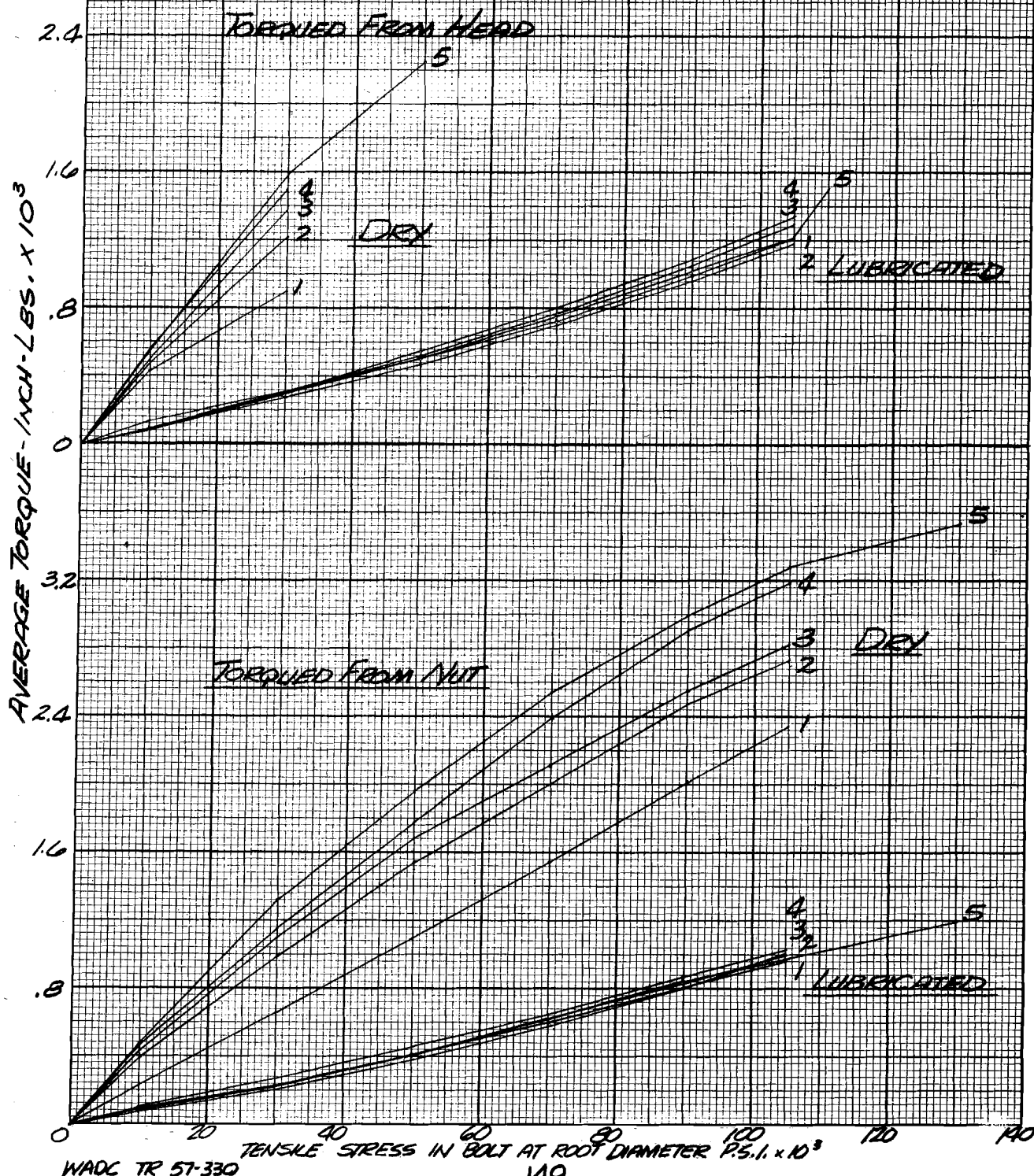
TENSILE STRESS IN BOLT AT ROOT DIAMETER $PSI. \times 10^3$

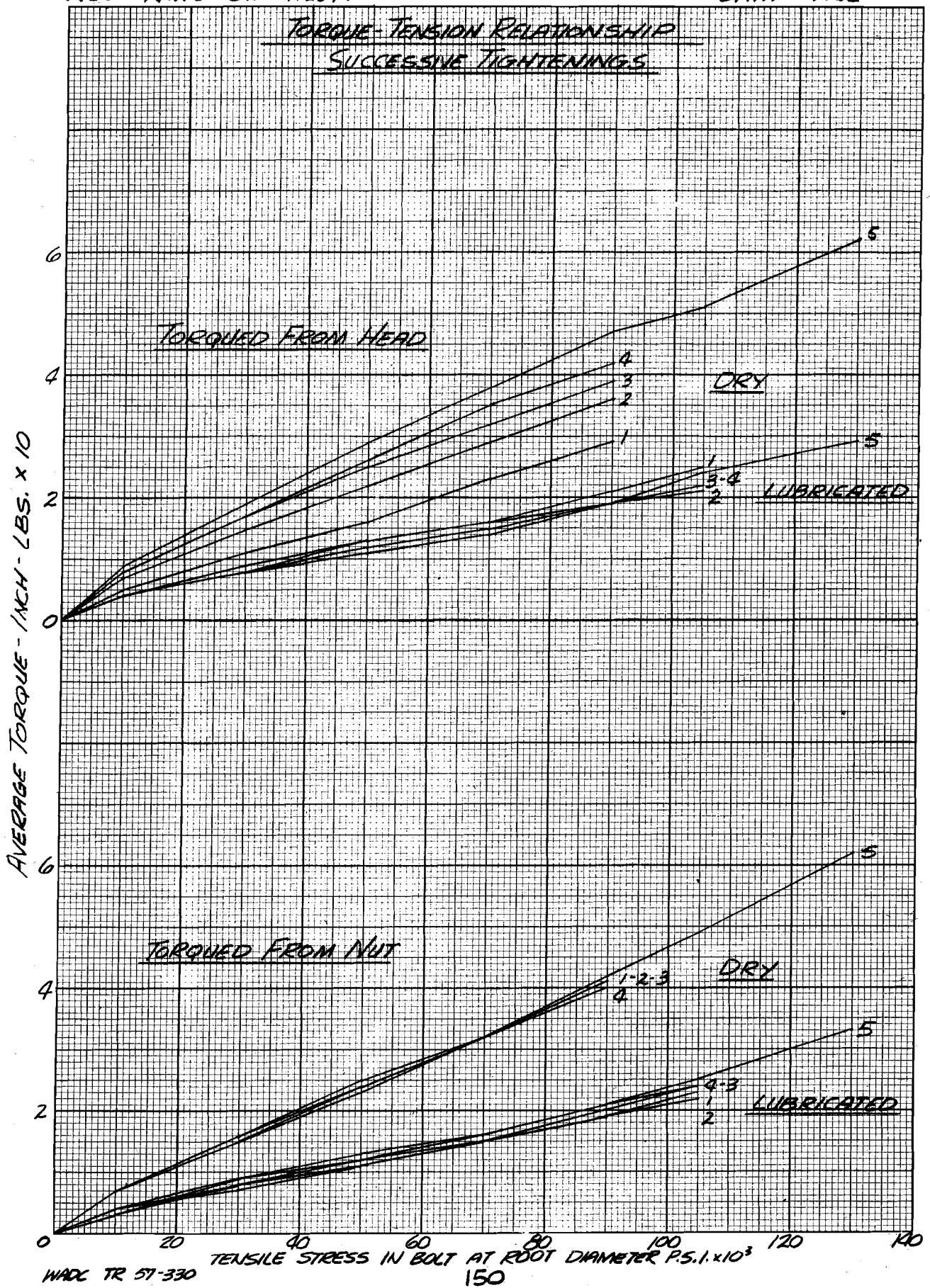
BOLT - AN 509-916 R 52, 9/16-18 UNF-3A "V"
 NUT - AN 365-918

DATE - 4-22-57
 DATA PAGE

TORQUE-TENSION RELATIONSHIP SUCCESSIVE TIGHTENINGS

NOTE: - VALUES PLOTTED ARE FROM DATA SHEET "V" DATED 4-19-57



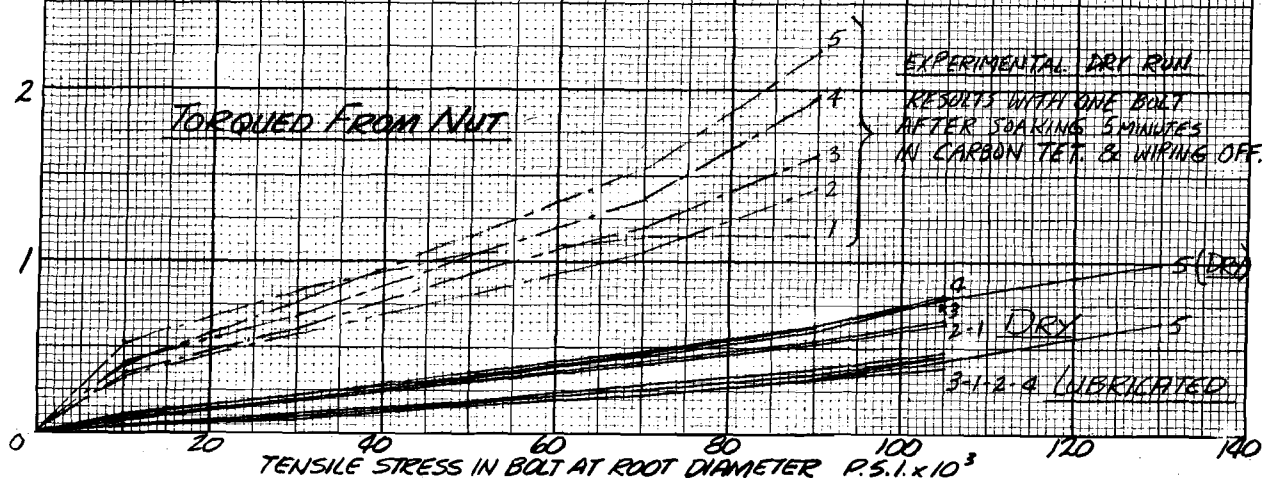
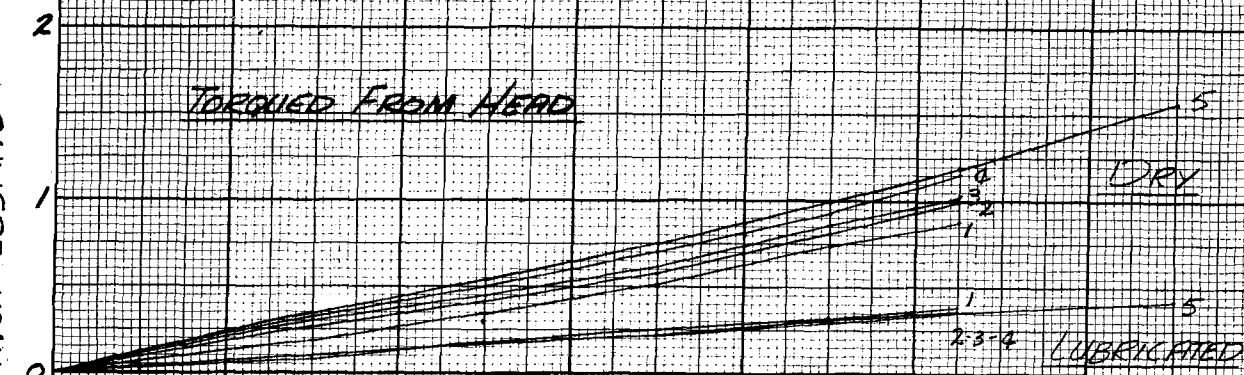


BOLT - AN 509-10R37, 10-32 NF-3A
 NUT - NMJ-02, ALUMINUM

"X" DATE - 4-27-56
 DATA - PAGE

TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS

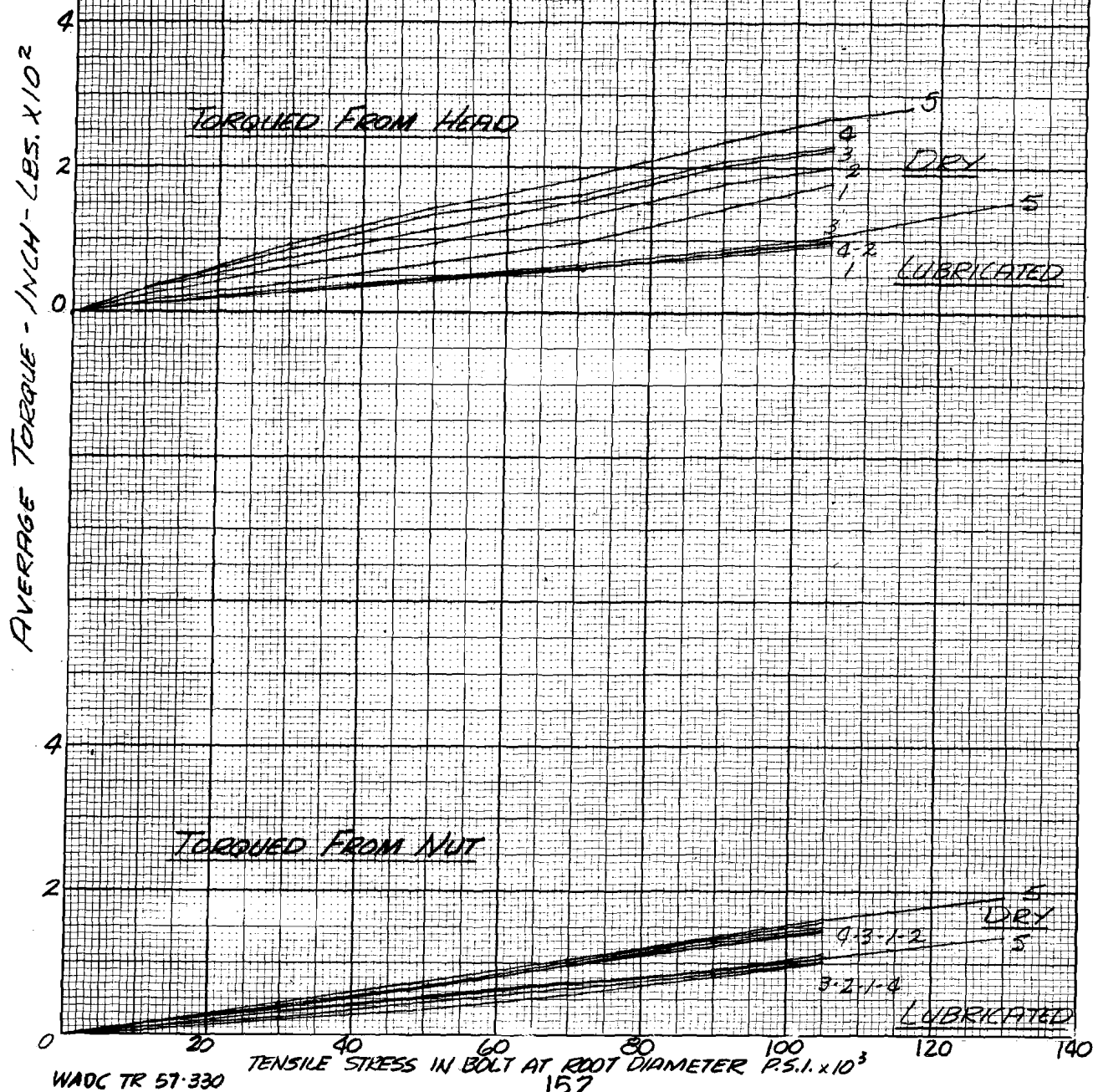
AVERAGE TORQUE - INCH-LBS. $\times 10^3$



BOLT - AN 509-416 R 37, 1/4-28 UNF-3A
 NUT - NMJ-048, ALUMINUM

"Y" DATE - 4-23-56
 DATA PAGE -

TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS

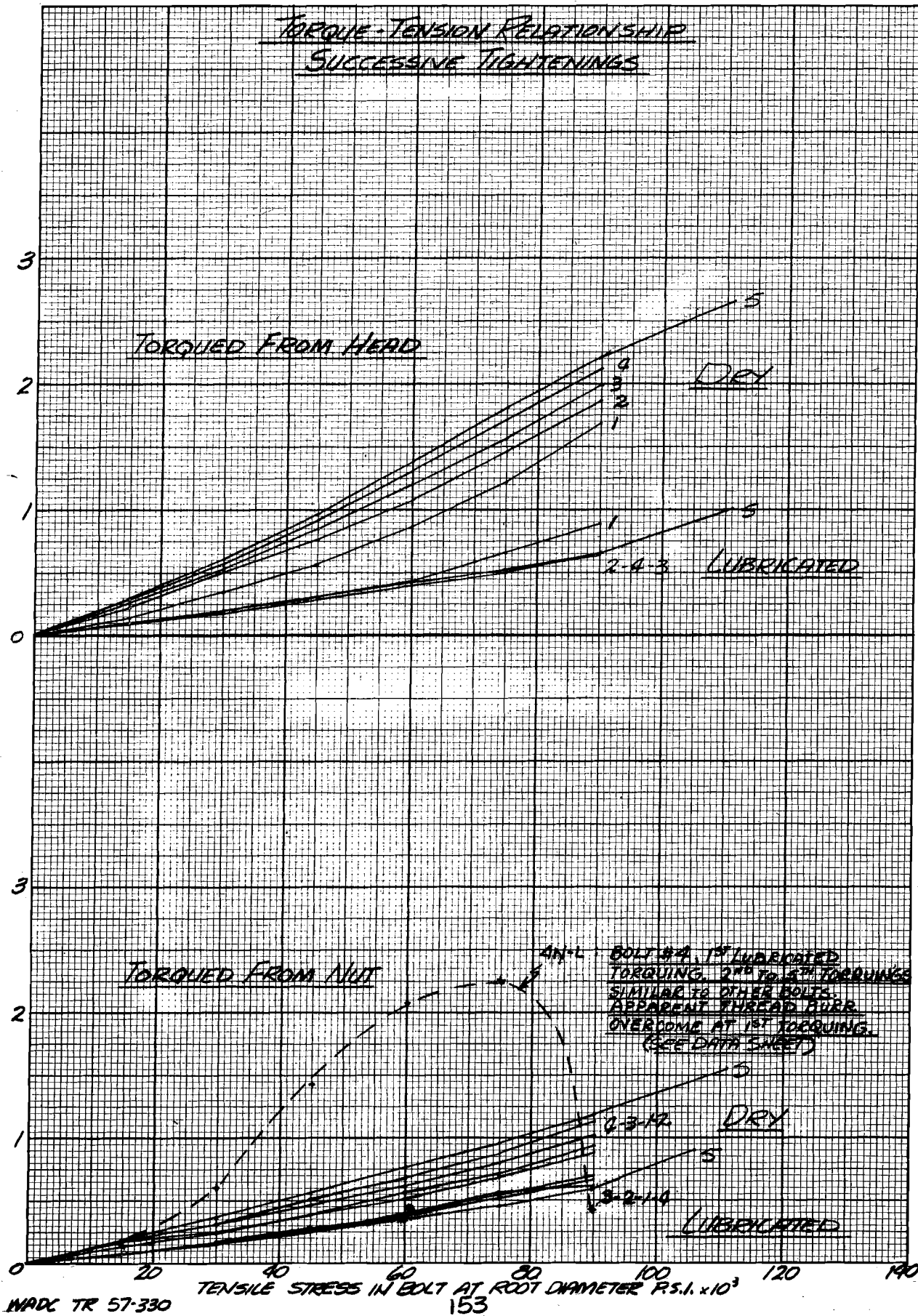


BOLT - AN 3C-30, 10-32 NF-3A
NUT - AN-363-C-1032

"A-A" DATE - 4-16-56
DATA - PAGE

AVERAGE TORQUE - INCH - LBS. $\times 10^2$

TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS



BOLT - AN 4C-30, 1/4-28UNF-3A
 NUT - AN 363-C-428

"B-B" DATE - 4-18-56
 DATA PAGE

TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS

AVERAGE TORQUE - INCH-LBS. $\times 10^2$

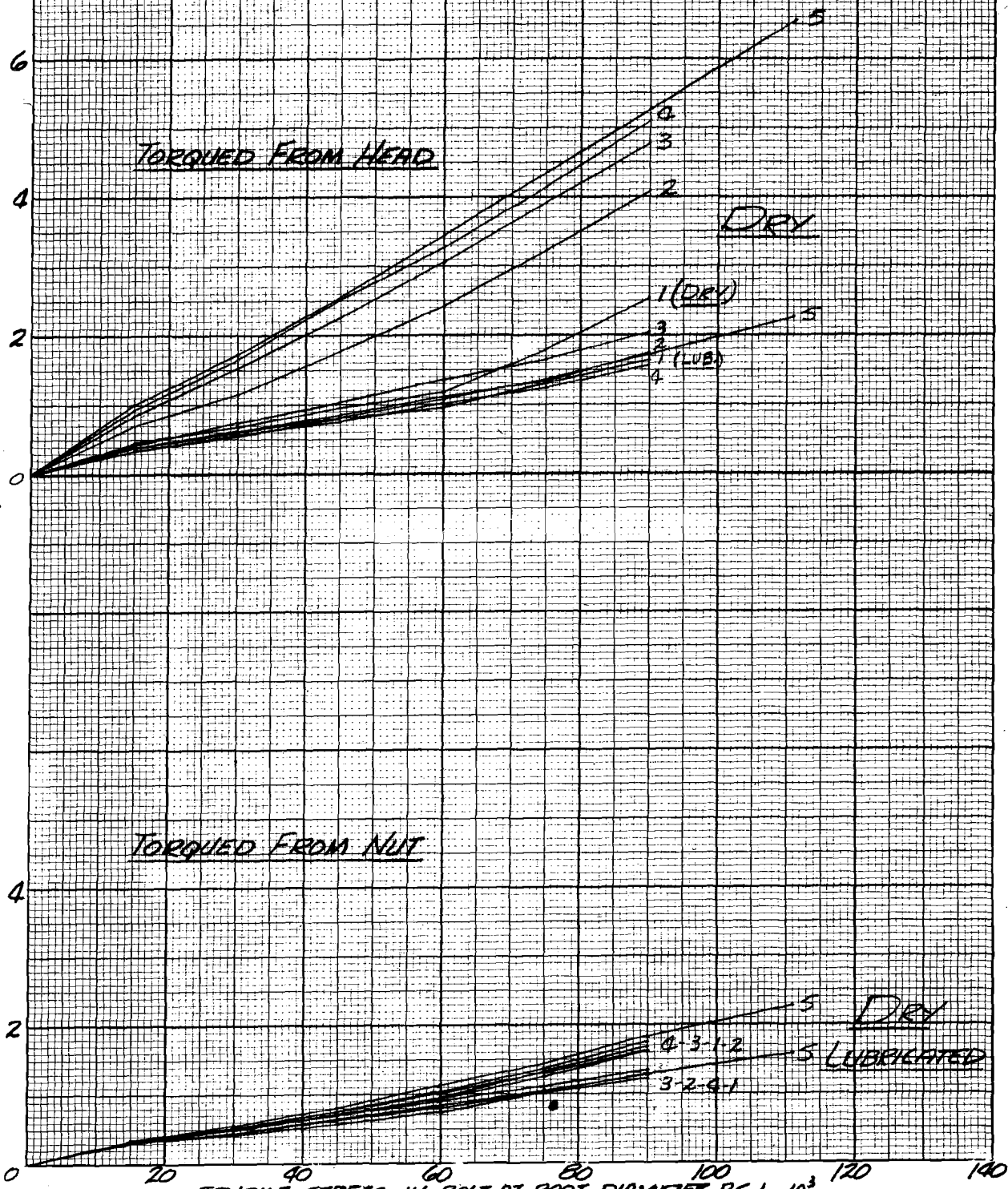
TORQUED FROM HEAD

DRY

TORQUED FROM NUT

DRY

LUBRICATED

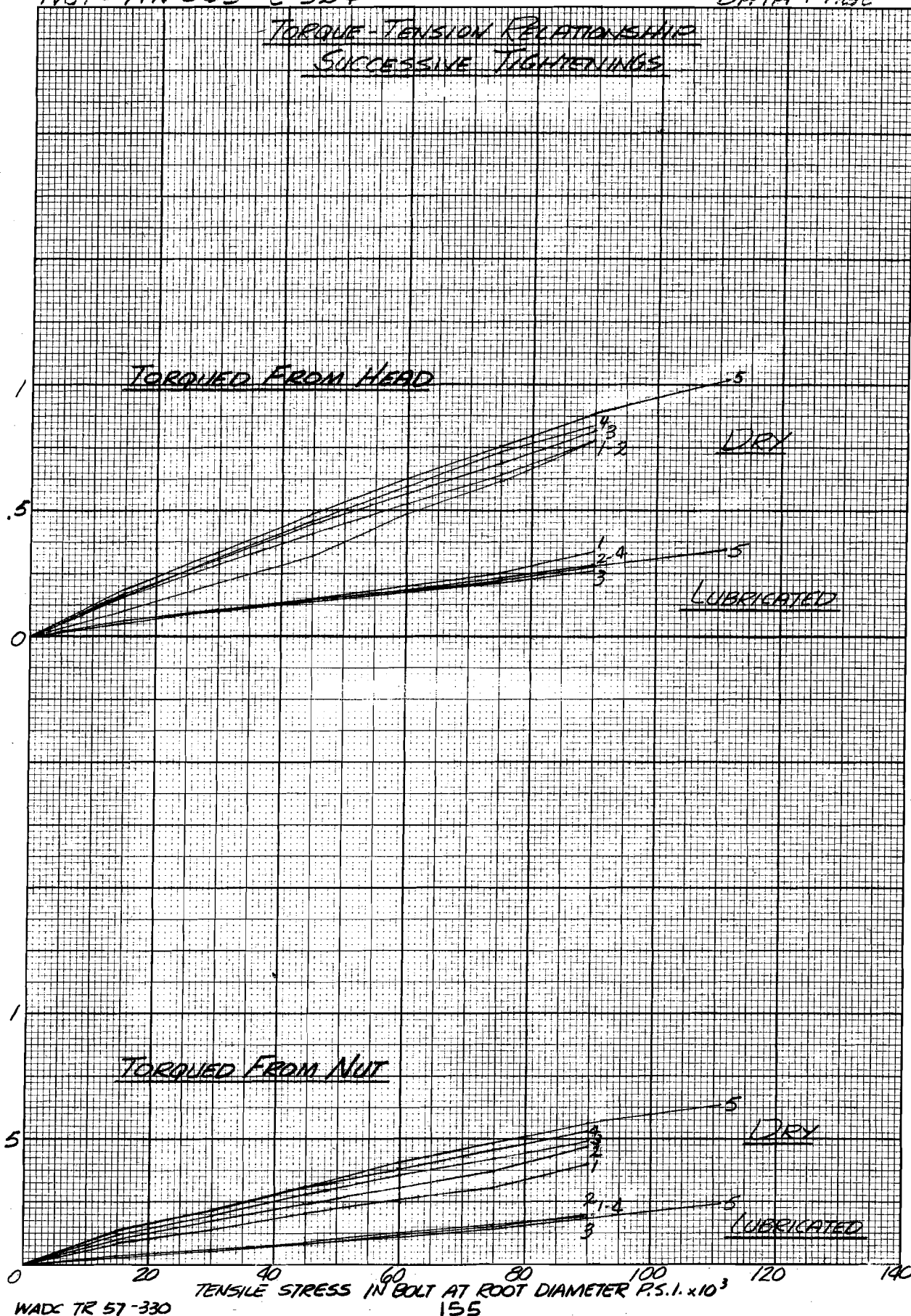


BOLT - AN 5C-35, 5/16-24 UNF-3A
 NUT - AN 363-C 524

"C-C" DATE - 4-11-56
 DATA PAGE -

TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS

AVERAGE TORQUE - INCH-LBS. $\times 10^3$



BOLT - AN 6 C-36 3/8-24 UNF-3A

"D-D" DATE - 3-27-56

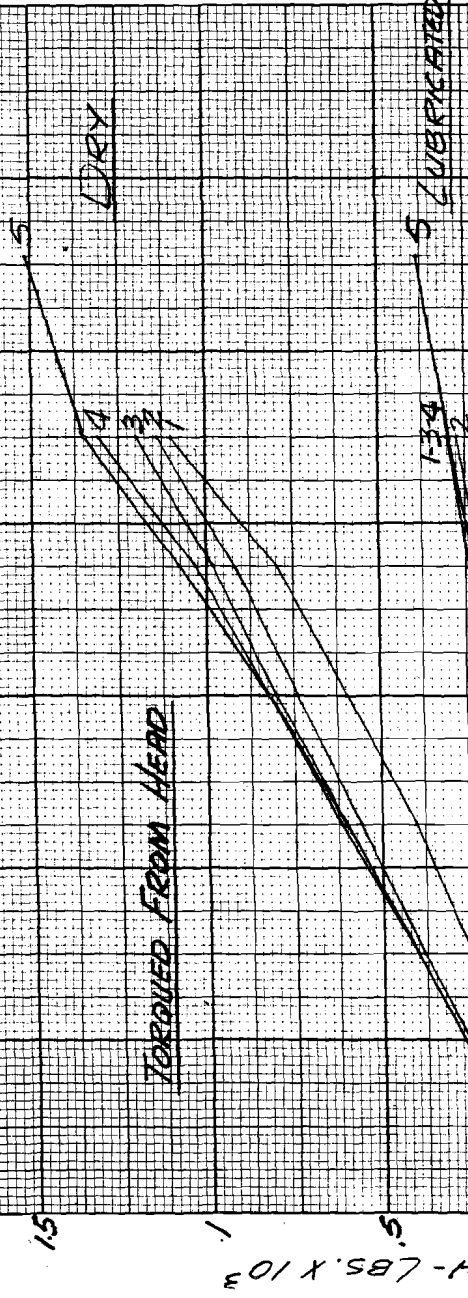
DATA PAGE

NUT - AN 363 C-624

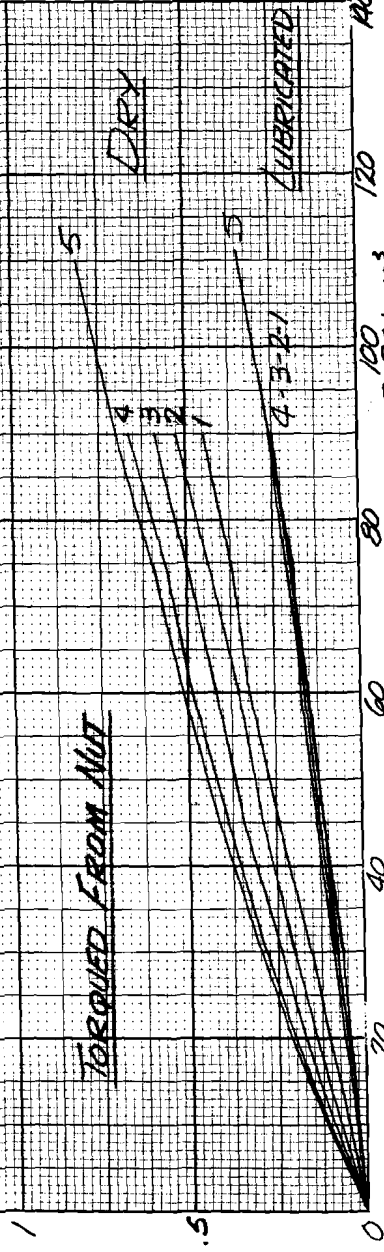
TORQUE-TENSION RELATIONSHIP

SUCCESSIVE TIGHTENINGS

TORQUED FROM HEAD



TORQUED FROM NUT



TENSILE STRESS IN BOLT AT ROOT DIAMETER PSI x 10³
156

BOLT-AN7C-36,
NUT-AN303C720

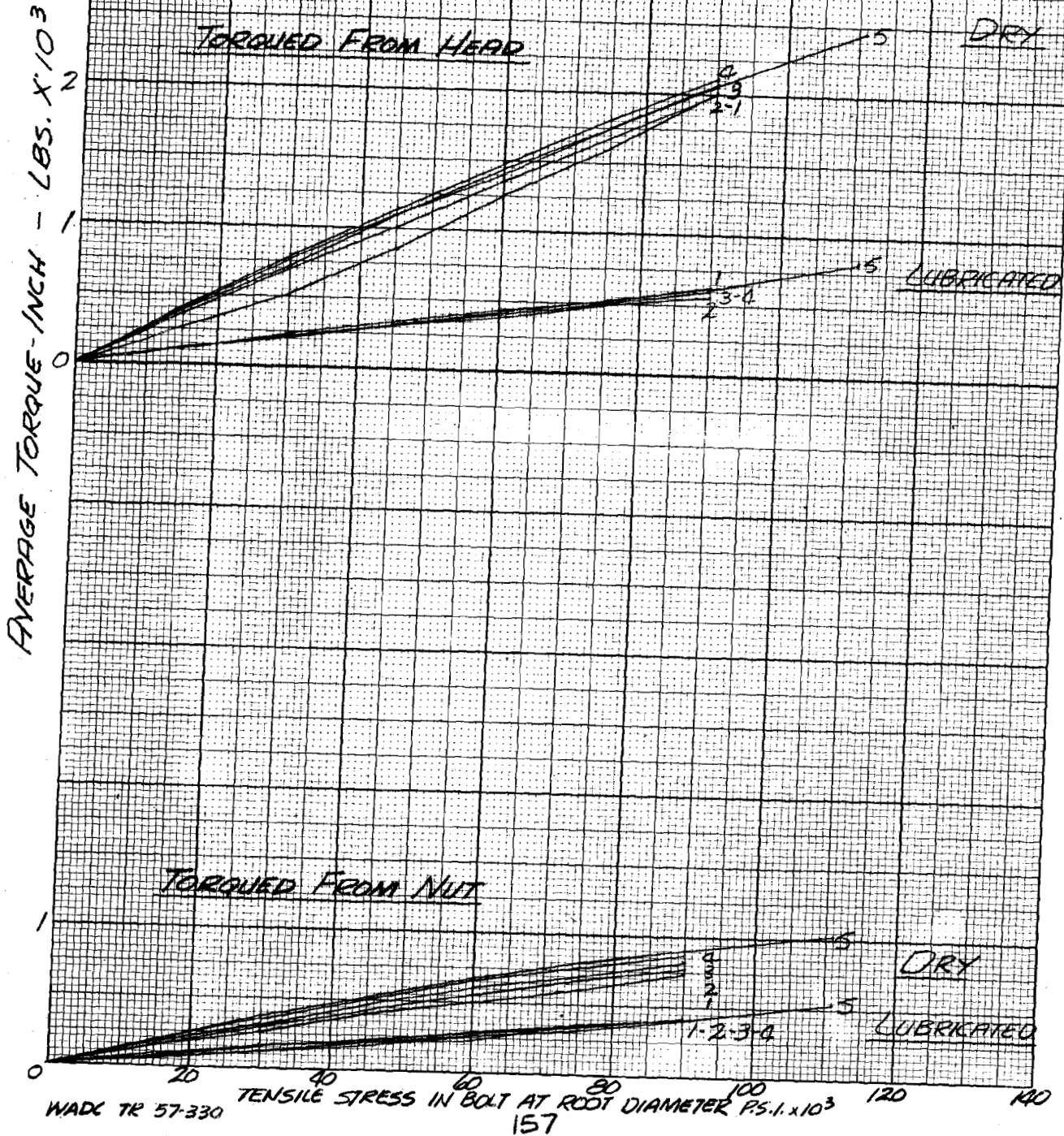
7/16-20UNF-3A

"E-E"

DATE- 3-23-56

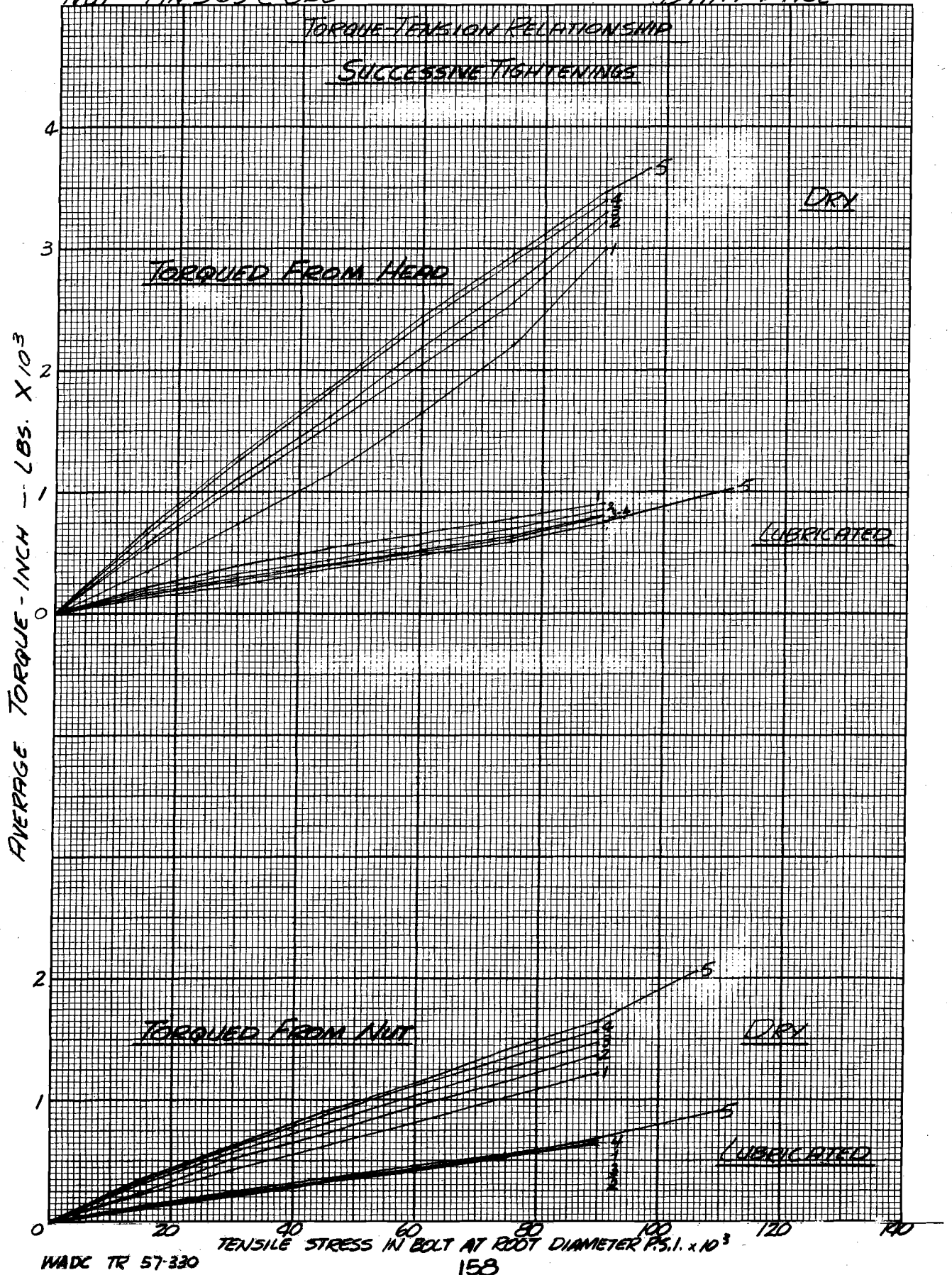
DATA-PAGE

TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS



BOLT - AN 8C-37, 1/2-20 UNF-3A
 NUT - AN 363 C 820

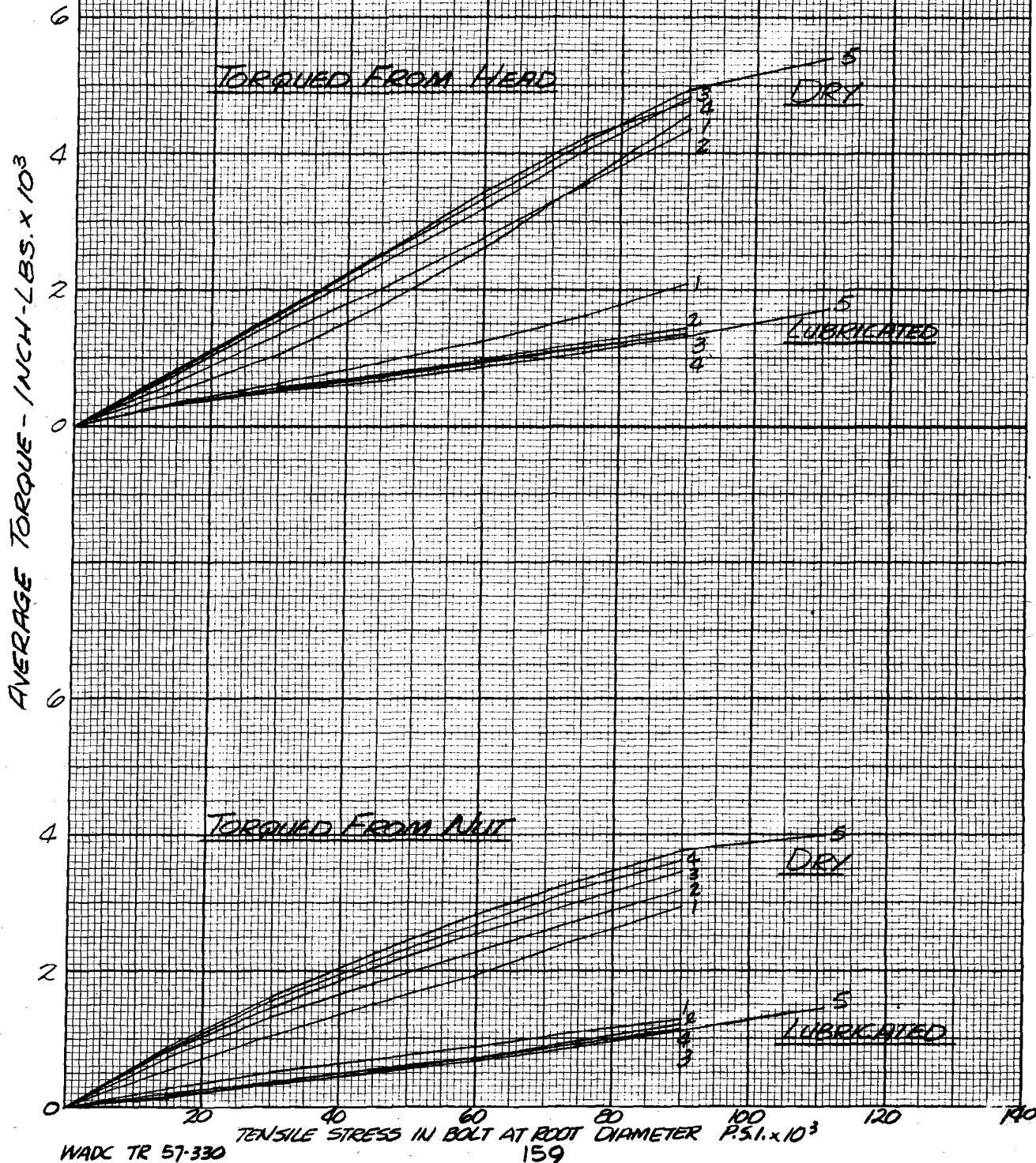
"F-F" DATE - 3-15-56
 DATA - PAGE



BOLT - AN 9C 37, 9/16-18 UNF-3A "G-G"
 NUT - AN 363-C 9/8

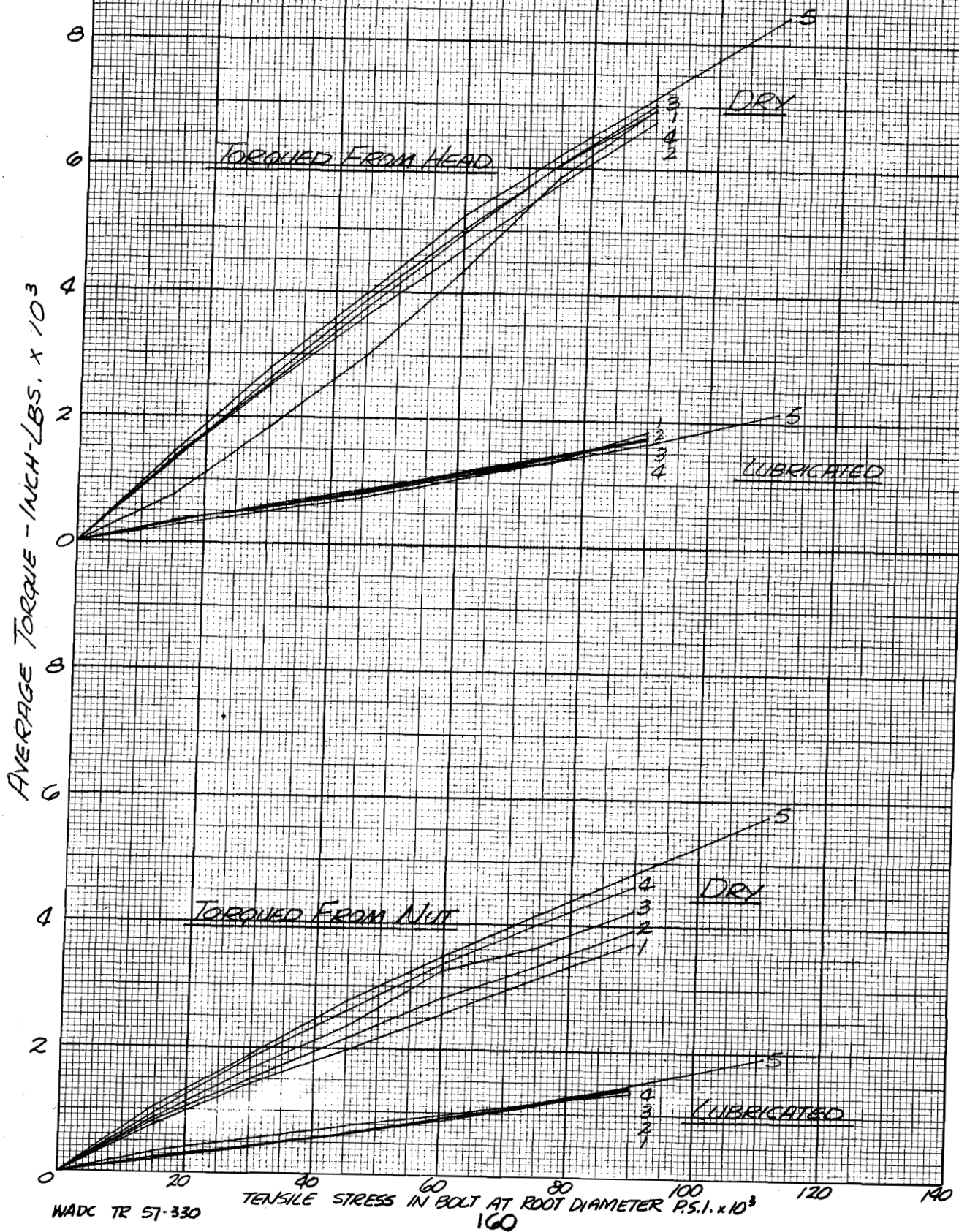
DATE - 1-30-57
 DATA PAGE -

TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS



BOLT - AN 10C-37 5/8-18 UNF-3A "H-H" DATE-2-1-57
 NUT - AN 363-C 1018 DATA PAGE-

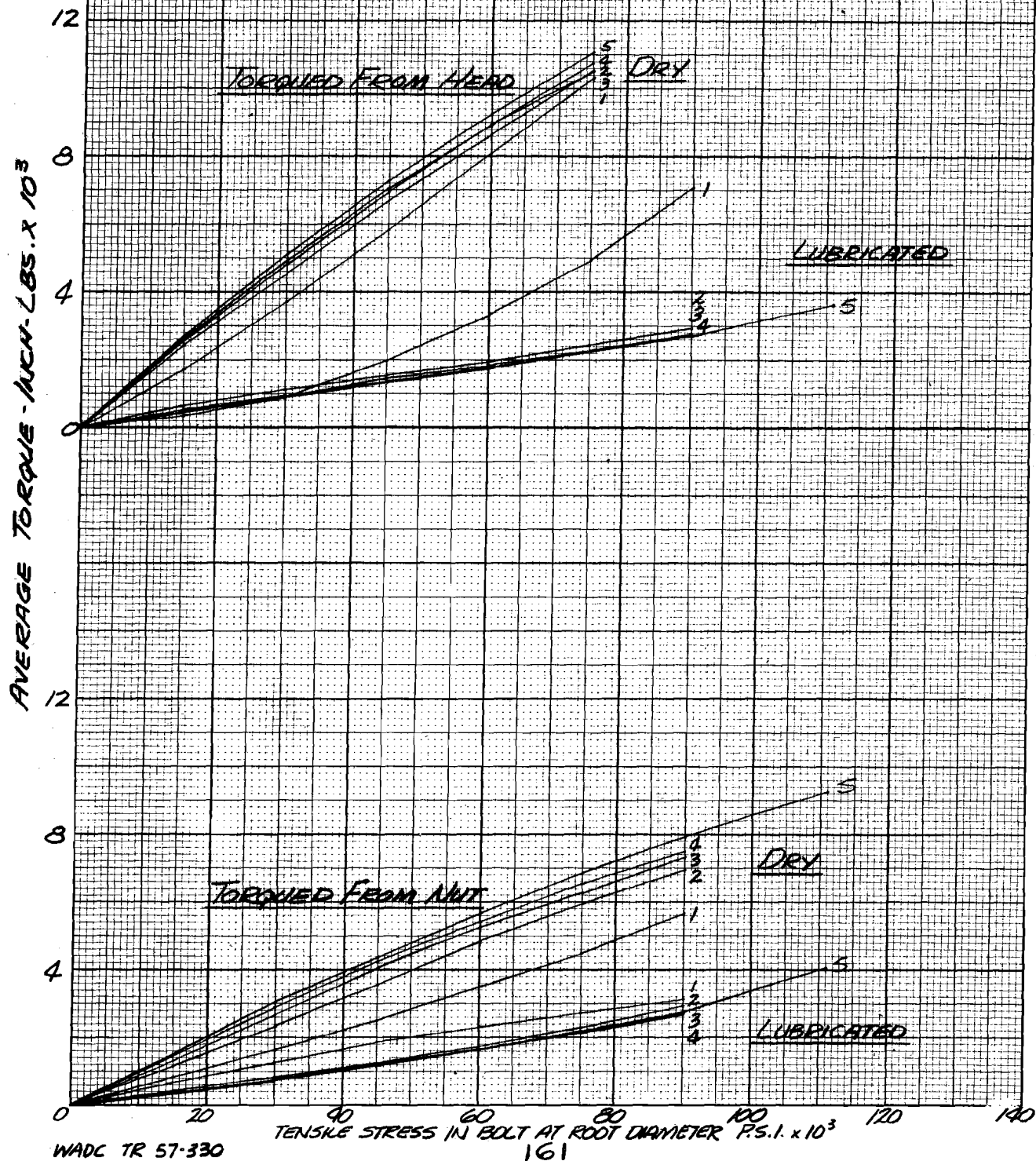
TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS



BOLT - AN 12C-41, 3/4"-16 UNF-3A "I-I"
 NUT - AN 363-C 1216

DATE - 2-13-57
 DATA PAGE -

TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS

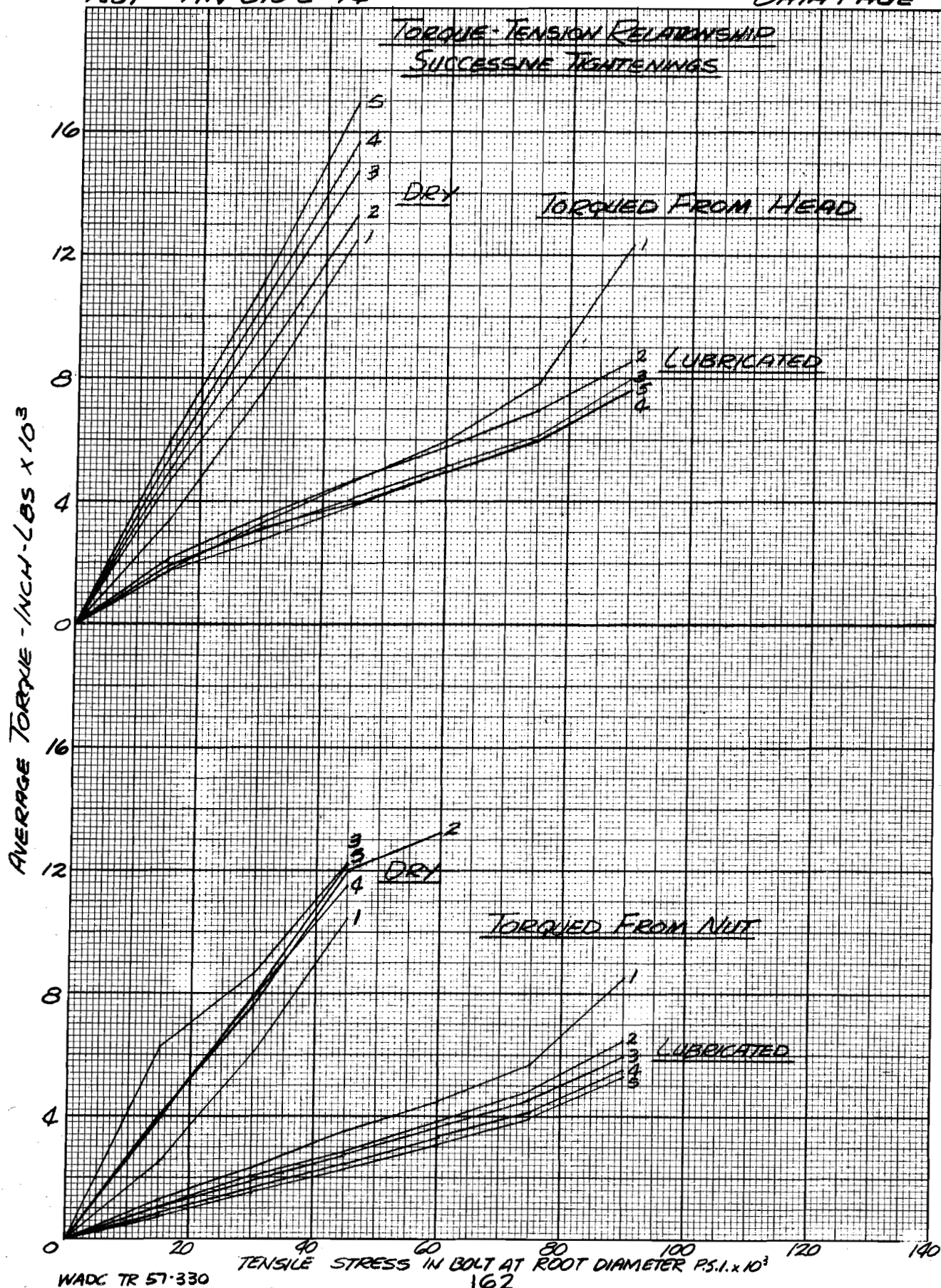


BOLT - AN 14C-42, 7/8-14-UNF-3A
 NUT - AN 310C-14

"J-J"

DATE - 2-19-57

DATA PAGE



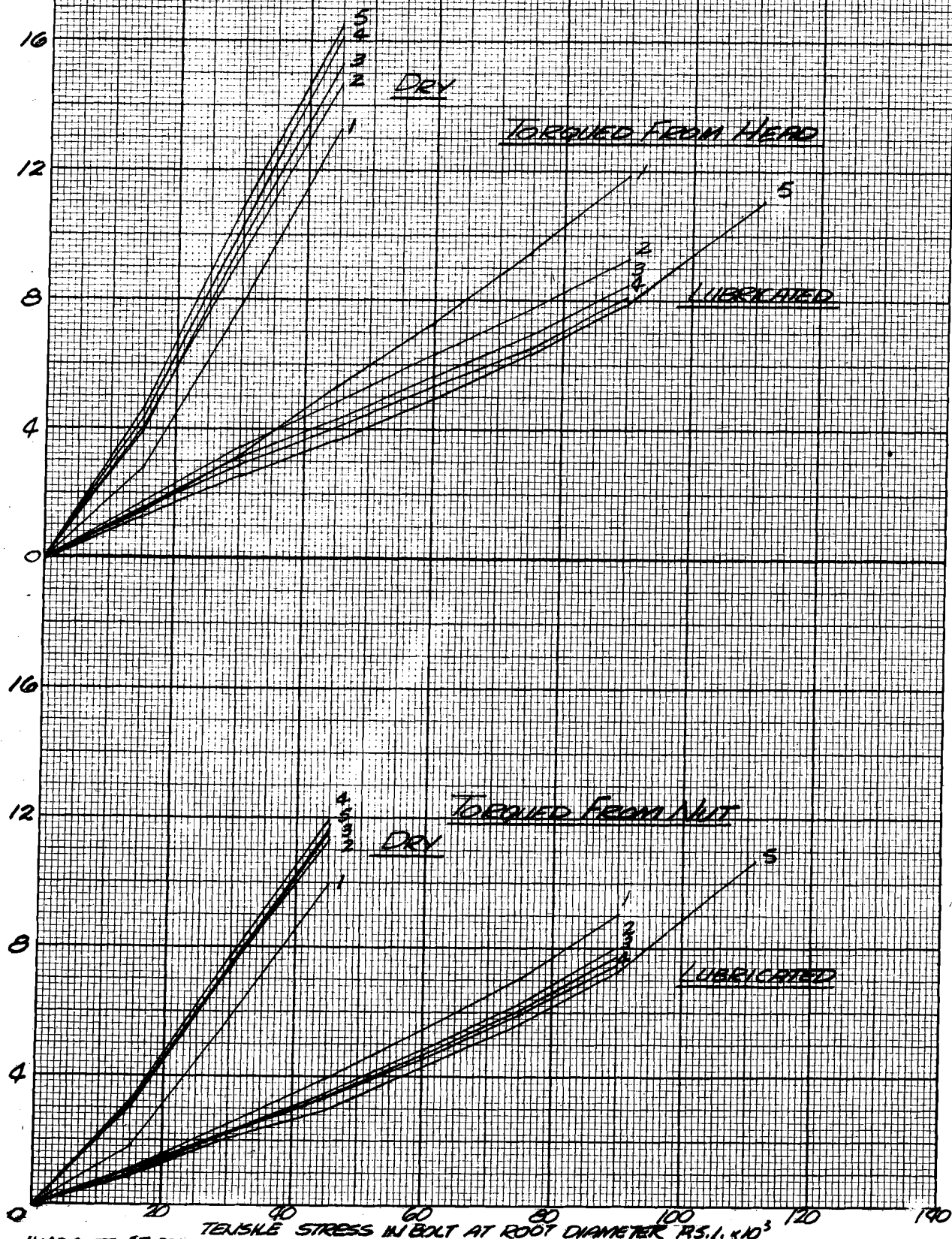
BOLT - AN 16 C-42, 1-14 NF-3A
 NUT - AN 310 C-16

"K-K"

DATE - 3-20-57
 DATA PAGE -

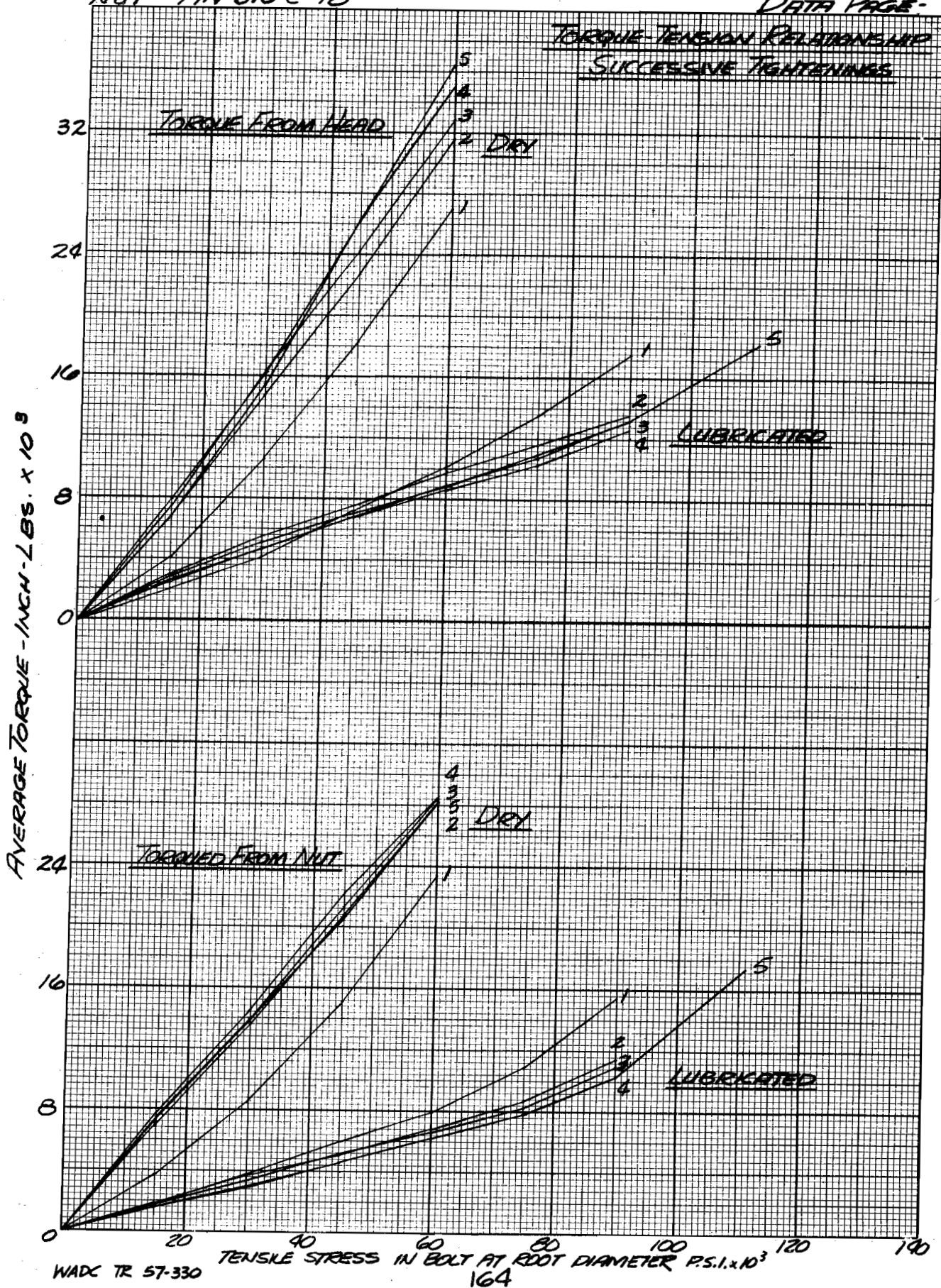
TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS

AVERAGE TORQUE - INCH-LEBS. $\times 10^3$



BOLT - AN 18C-44, 1 1/8-12 UNF-3A
 NUT - AN 310 C-18

"L-L" DATE - 3-27-57
 DATA PAGE -

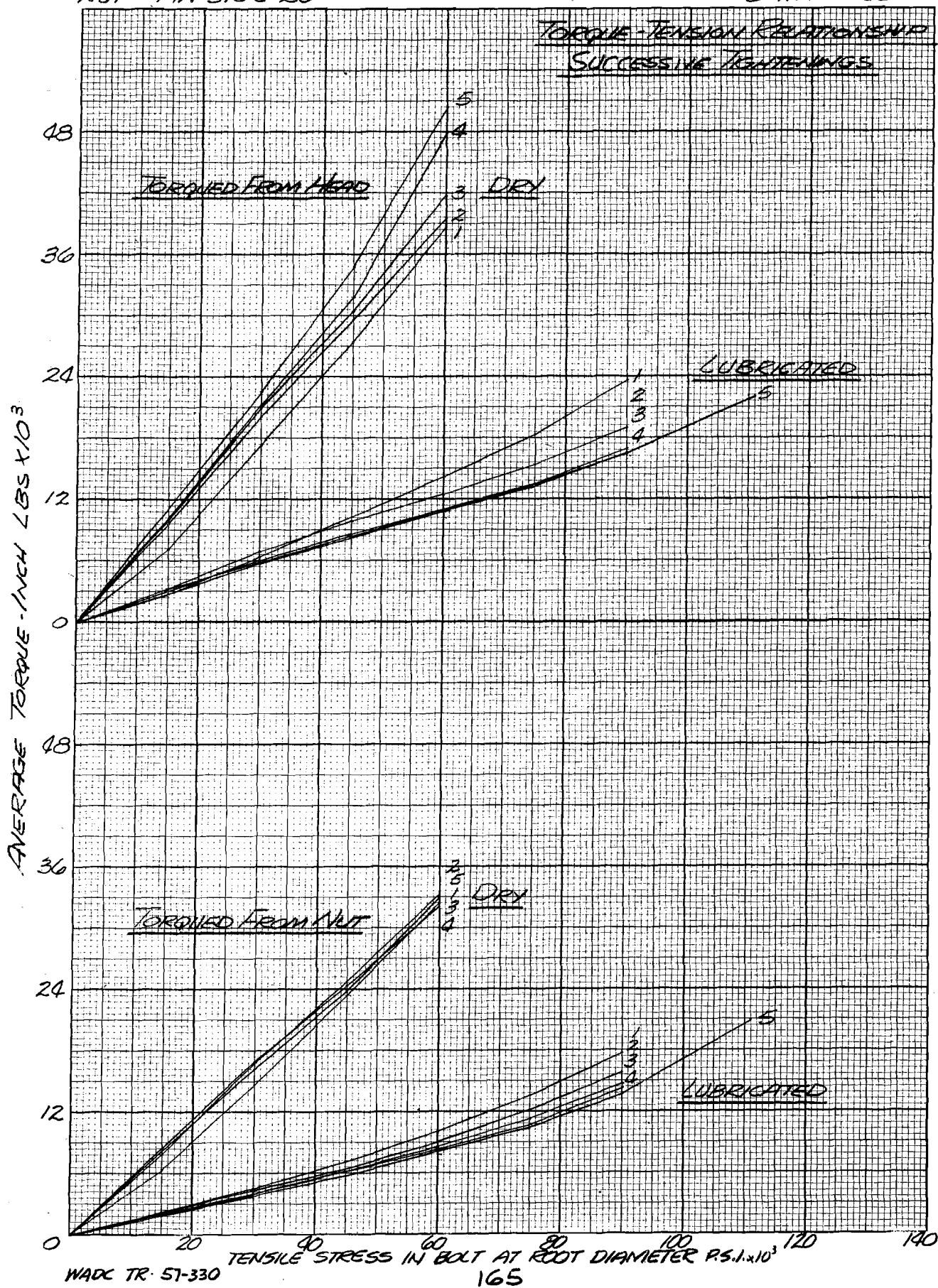


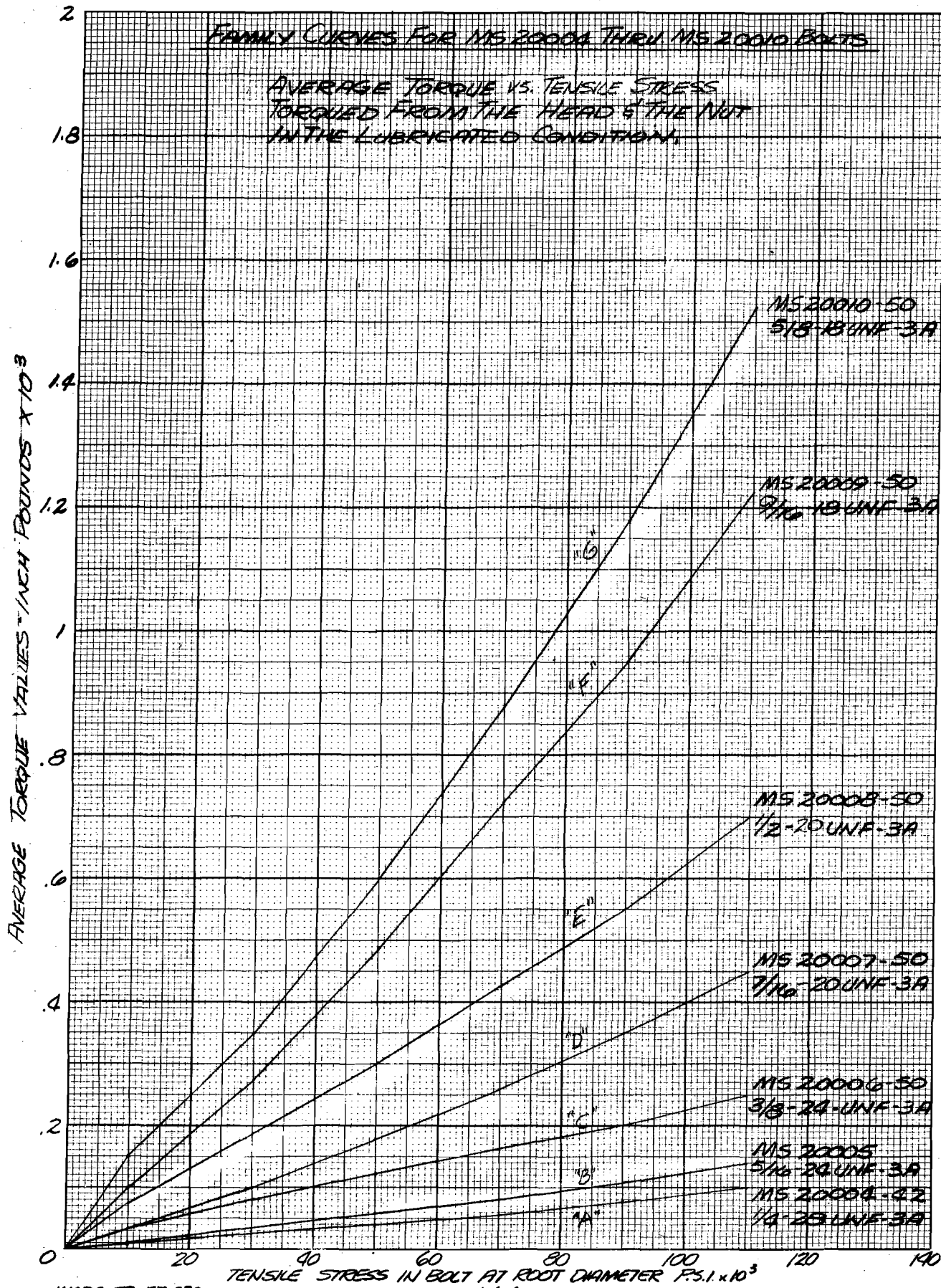
BOLT - AN 20C-45, 1 1/4-12 UNF 3A
NUT - AN 310C 20

"M-M"

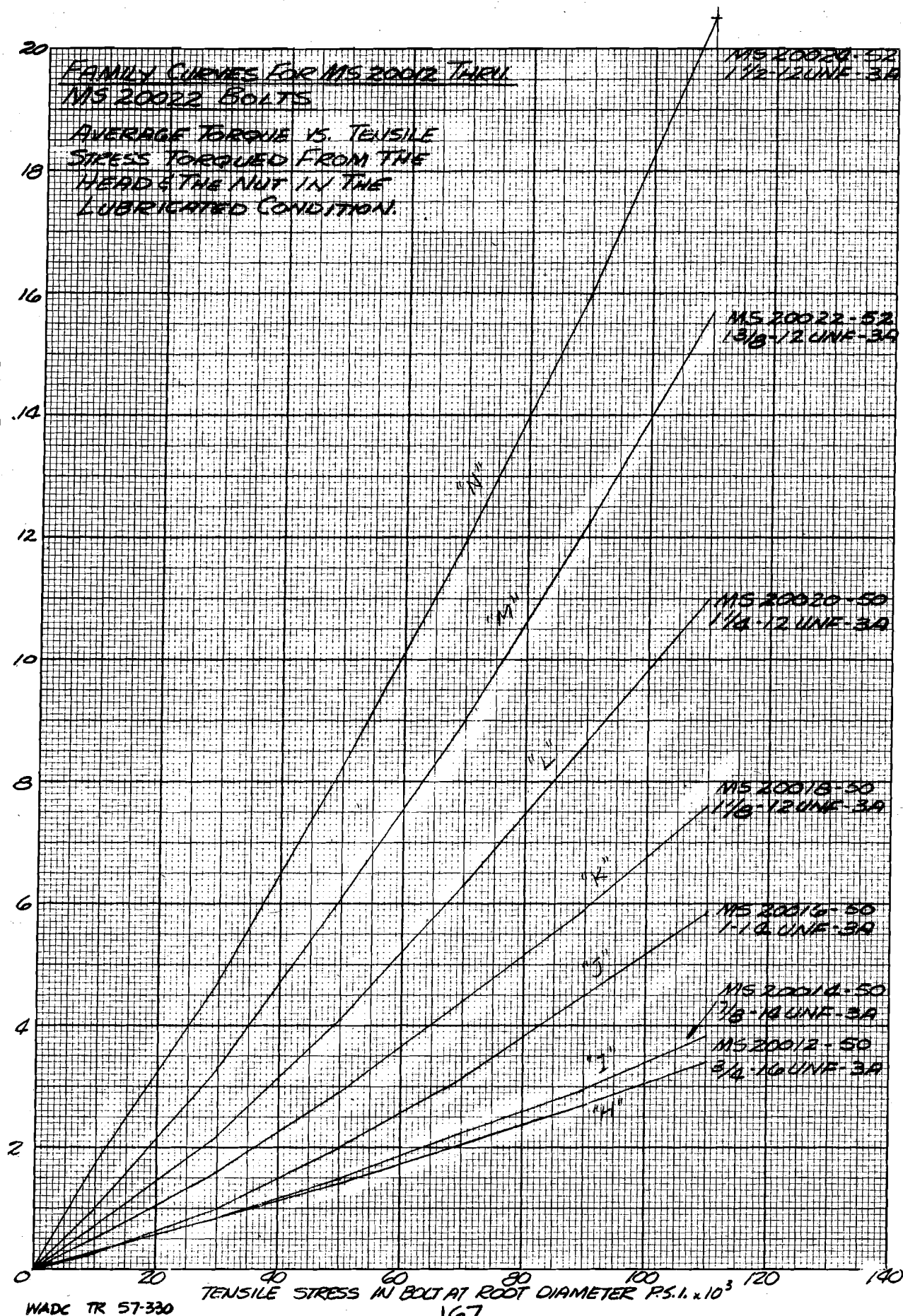
DATE - 4-9-57

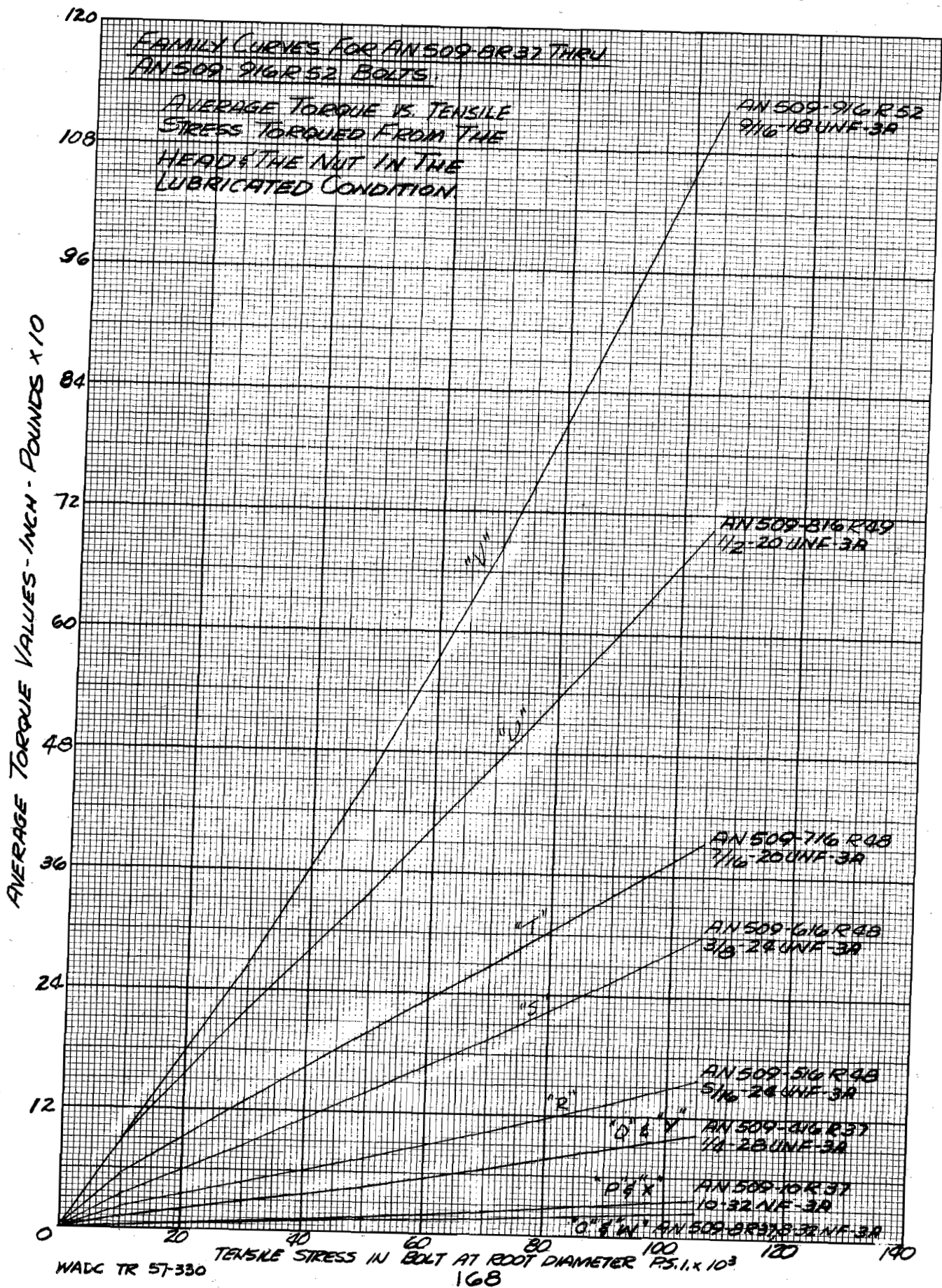
DATA PAGE

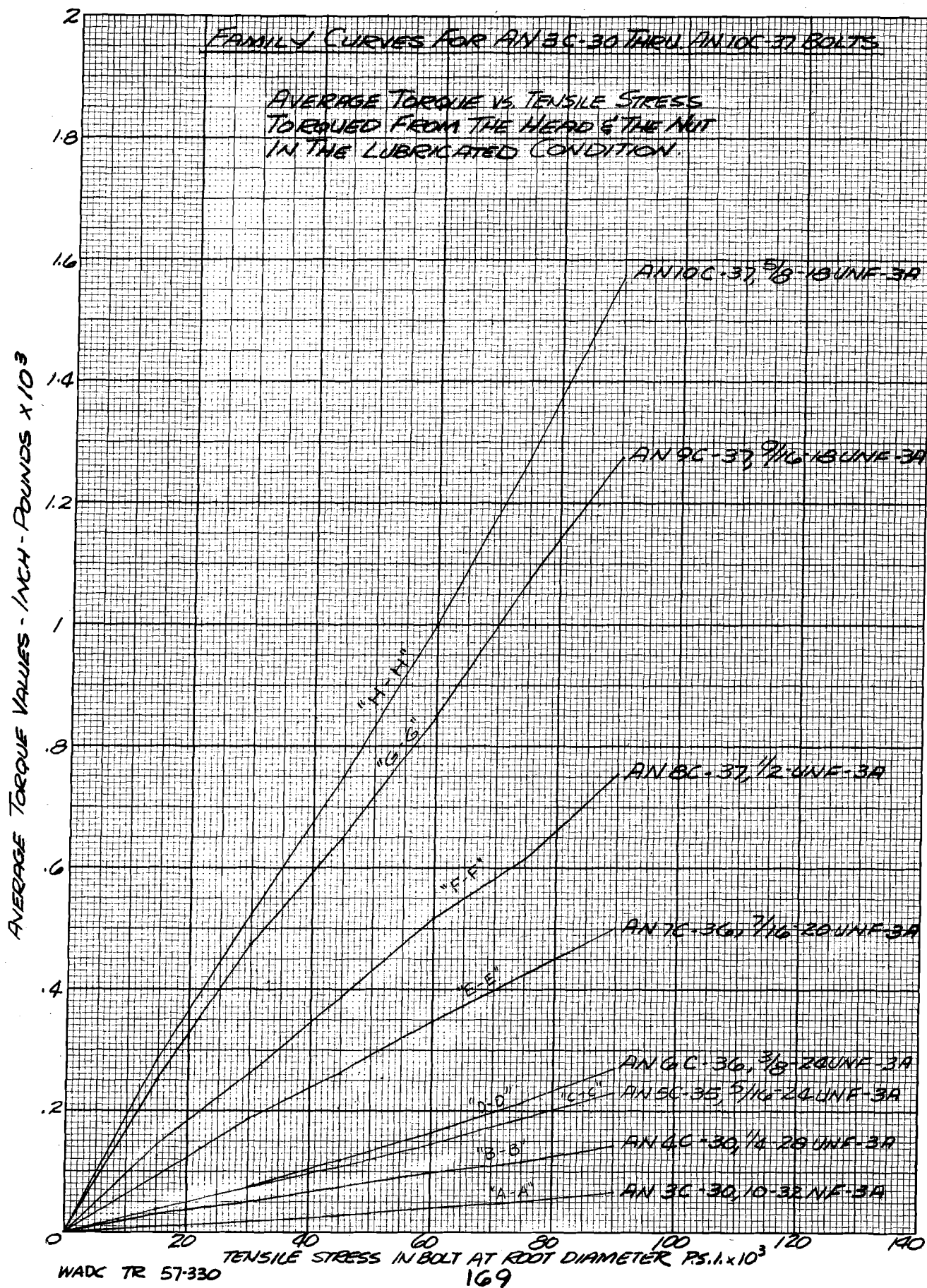


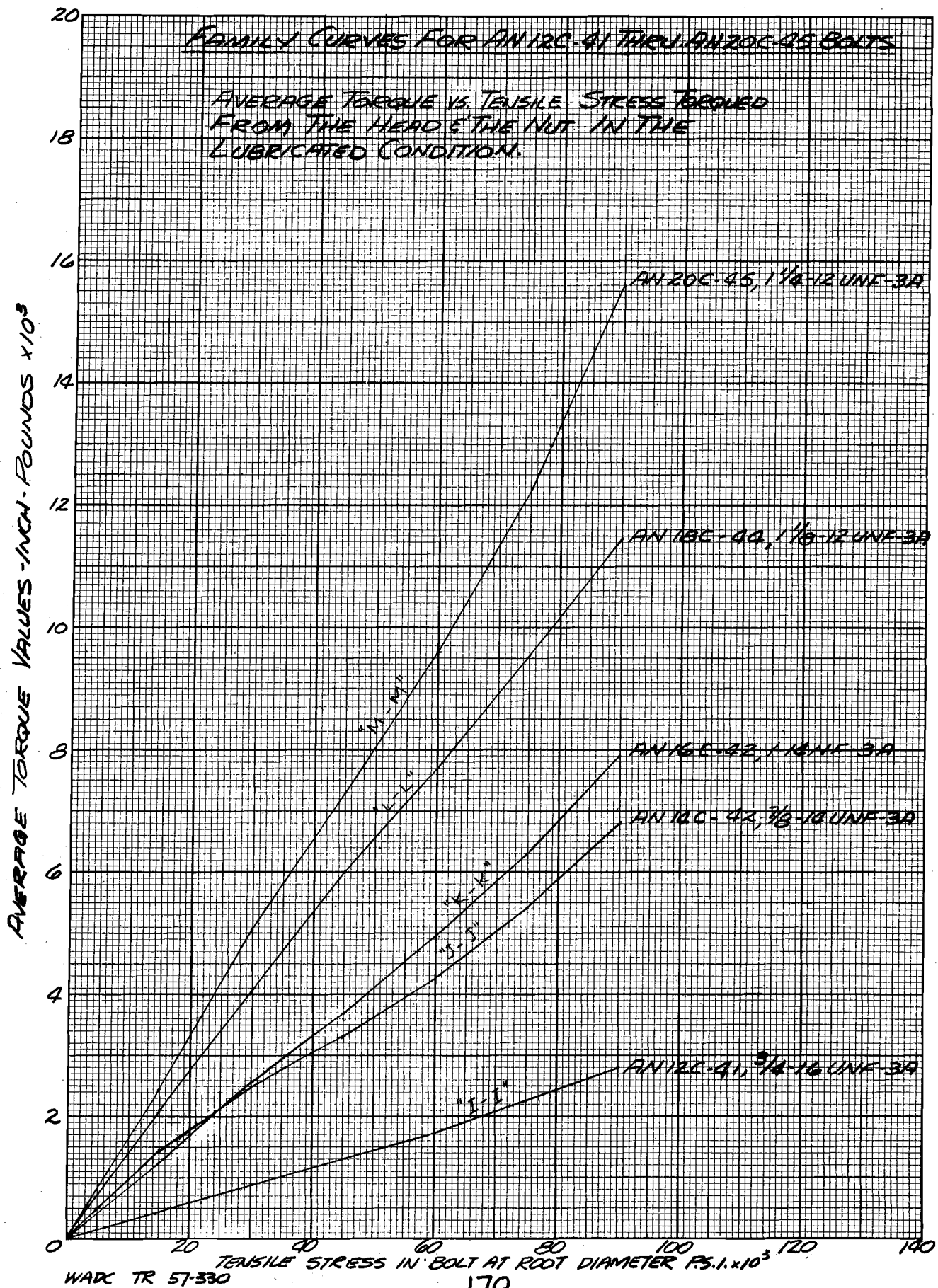


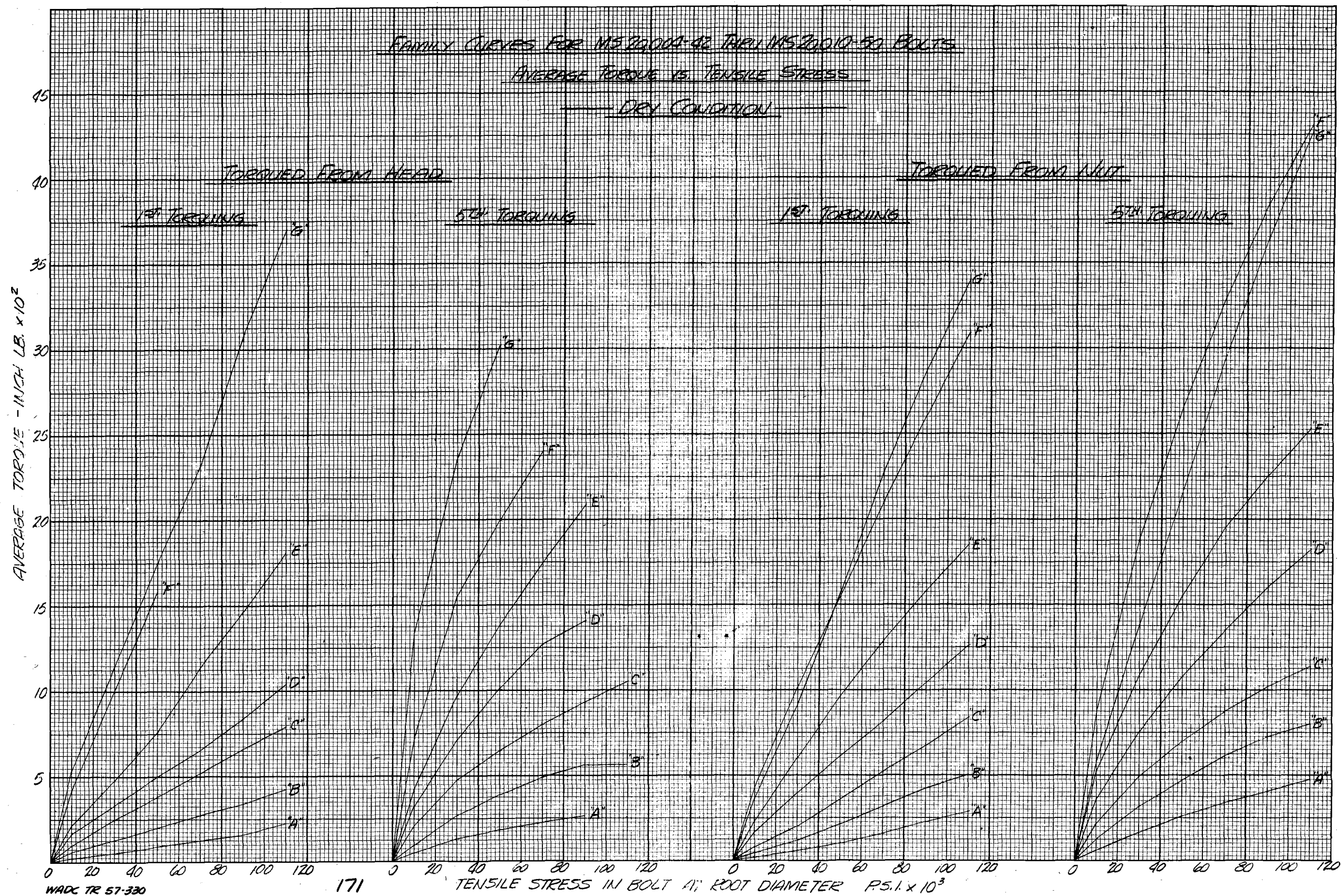
AVERAGE TORQUE VALUES - /INCH- POUNDS x 10³











FAMILY CURVES FOR MS 2002 50 TURN MS 20024 52 BOLTS

AVERAGE TORQUE VS. TENSILE STRESS

DRY CONDITION

TORQUED FROM HEAD

TORQUED FROM NUT

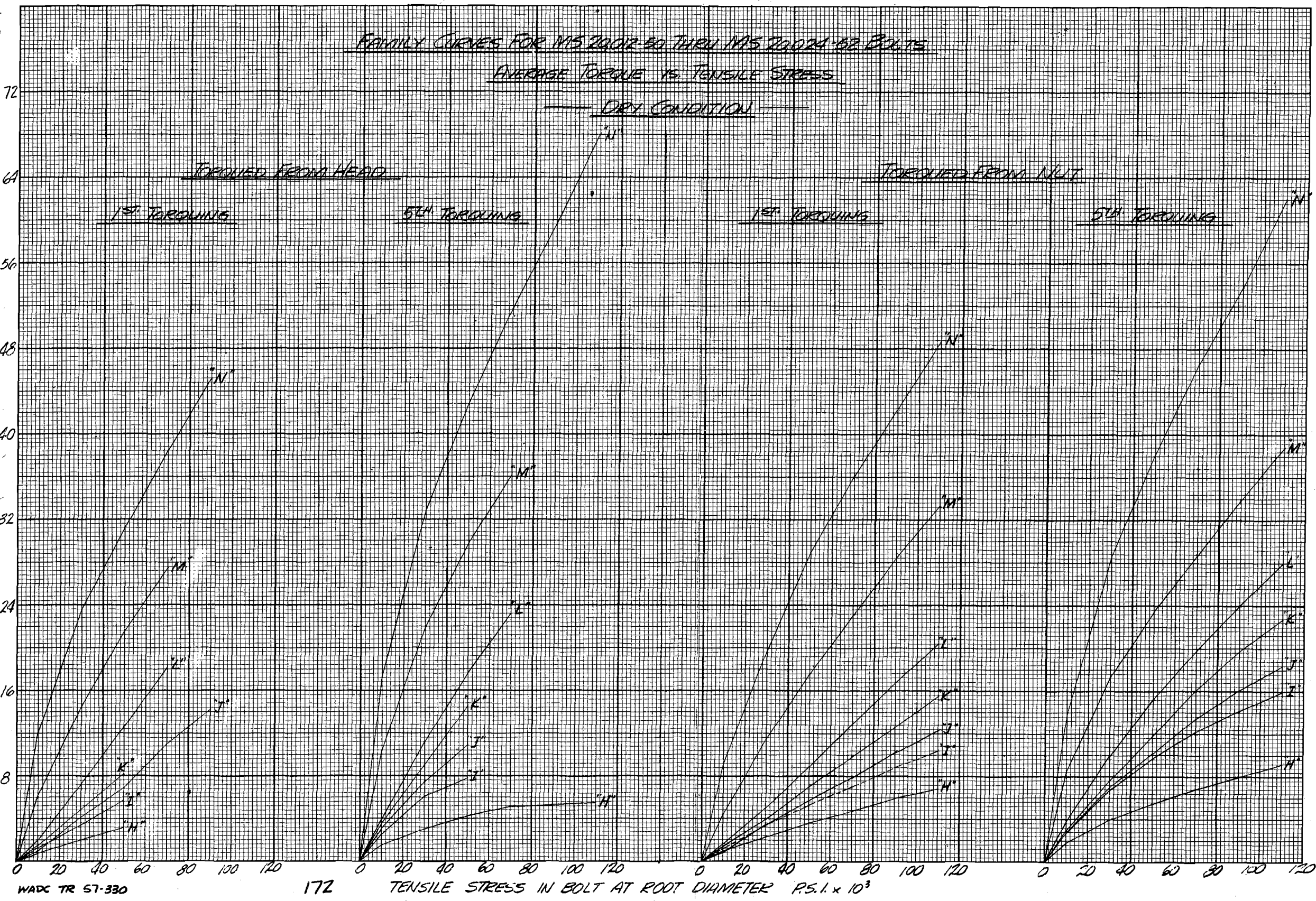
1ST TORQUING

5TH TORQUING

1ST TORQUING

5TH TORQUING

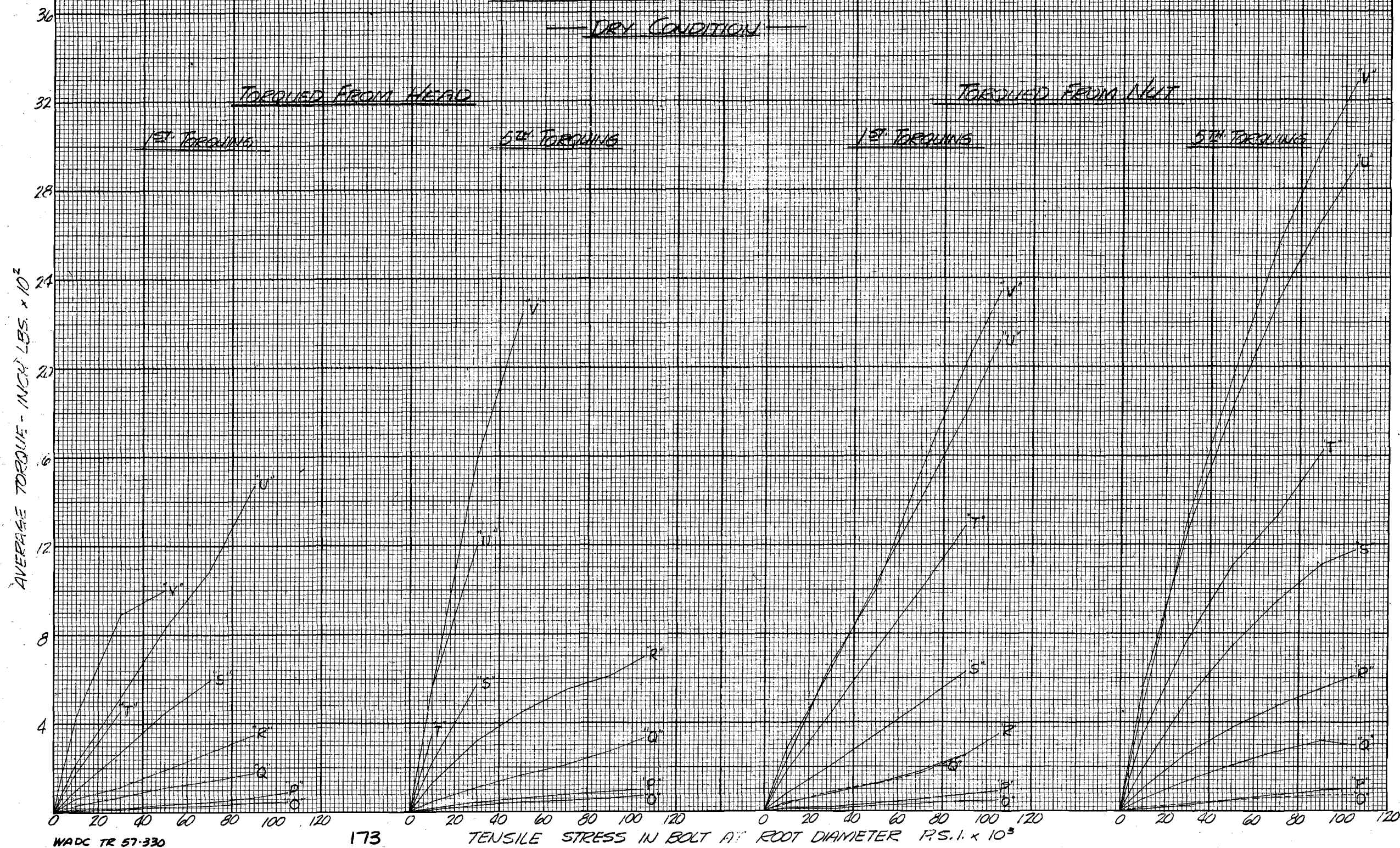
AVERAGE TORQUE - INCH LB. $\times 10^3$



FAMILY CURVES FOR AN509-8R37 THEN AN509-916R52 BOLTS

AVERAGE TORQUE VS. TENSILE STRESS

— DRY CONDITION —



FAMILY CURVES FOR AN3C-32 THRU AN10C-37 BOLTS

AVERAGE TORQUE VS. TENSILE STRESS

— DRY CONDITION —

TORQUED FROM HEAD

TORQUED FROM NUT

1/2" TORQUING

5/8" TORQUING

1/2" TORQUING

5/8" TORQUING

AVERAGE TORQUE - INCH LB. $\times 10^3$

80

70

60

50

40

30

20

10

0

174

TENSILE STRESS IN BOLT AT ROOT DIAMETER P.S.I. $\times 10^3$

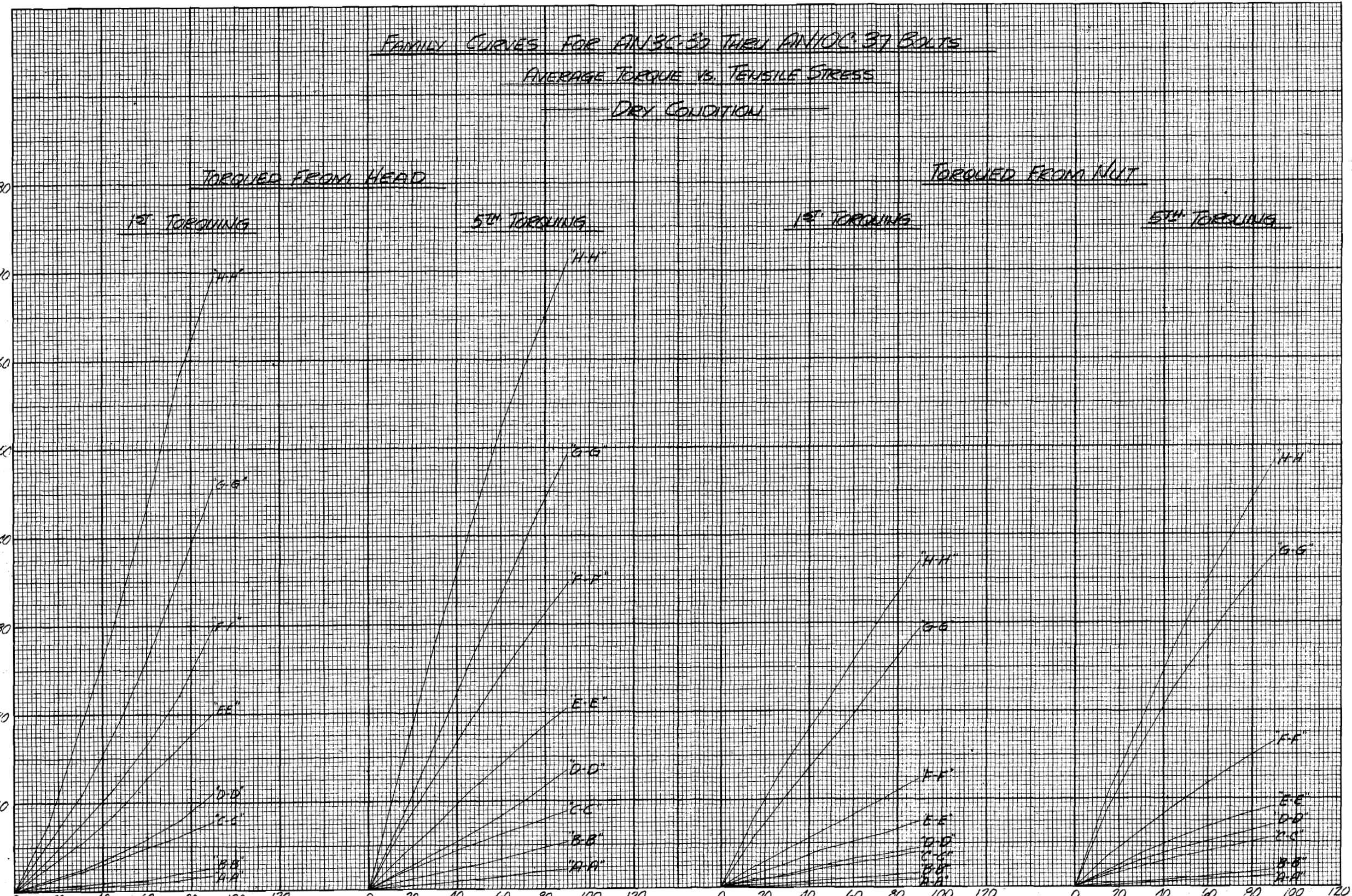
0 20 40 60 80 100 120

0 20 40 60 80 100 120

0 20 40 60 80 100 120

0 20 40 60 80 100 120

WADC TR 57-330



FAMILY CURVES FOR AN12C-41 THRU AN20C-45 BOLTS

AVERAGE TORQUE VS. TENSILE STRESS

— DRY CONDITION —

TORQUED FROM HEAD

TORQUED FROM NUT

1ST TORQUING

5TH TORQUING

1ST TORQUING

5TH TORQUING

