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REPORT NO. C 27150

QUALIFICATION

RESULTS OF TEST EVALUATION OF McDONNELL DOUGLAS P/N 1F44595 REV. D (TTI P/N 050006) RAPID ASSEMBLY NUTS (ZIP NUTS), LOT NO. 3, SUBMITTED BY THREAD TECHNOLOGY, INC., STERLING, VIRGINIA

April 14, 1998

Thread Technology, Inc. P.O. No. 1759

(Ref: McDonnell Douglas P.O. No. 78990891
NASA Contract 15-10000)

by Harry S Brenner
Harry S. Brenner, P.E.
Director of Research

CERTIFIED Almay Research & Testing Corp., Los Angeles, CA

Defense Logistics Agency
Defense Contract Management Command

/s/ Tom Osborn 4/24/98
Tom Osborn
Quality Assurance Representative
DCMDW-GAODA

The Boeing Company
Space Systems Division

S 61608 I

/s/ Joseph M Campa II 4-24-98
Joseph M. Campa II
Quality Engineer
Procurement Quality Assurance

PACKING LIST NO.
PL 27150-1

ALMAY RESEARCH & TESTING CORPORATION

1415 Newton Street, Los Angeles, California 90021
Area Code 213, Phone 746-1555

SOLD TO
THE BOEING COMPANY
SPACE SYSTEMS DIVISION
5301 Bolsa Avenue
Huntington Beach, CA 92647

SHIPPED TO:
ATTN:
Mr. Paul Smudde
MS: H017-D605

CUST. ORDER NO.	SHIPPING DATE	SHIPPED VIA	INVOICE DATE	TERMS
Thread Technology 1759	5/7/98	Almay Delivery		1% 10 DAYS / NET 30

ITEM	ALMAY REPORT NO.	DESCRIPTION	UNIT PRICE	AMOUNT
1.	C 27150	One (1) copy, Almay Test Report, "Results of Test Evaluation of McDonnell Douglas P/N 1F44595, Rev. D (TTI P/N 050006) Rapid Assembly Nuts (Zip Nuts), Lot No. 3, Submitted by Thread Technology, Inc., Sterling, Virginia"		
2.		Twenty (20) each, Lot No. 3 Rapid Assembly Nuts (Zip Nuts) used in support of above test evaluation program, and authorized by Thread Technology, Inc. for direct return to The Boeing Company (19 nuts included in package; one test nut previously delivered to Mr. Paul Smudde)		

Received by _____

Date _____

ITEMIZED MEMORANDUM OF SHIPMENT

INTRODUCTION

Thread Technology, Inc., 22455 Davis Drive, Sterling, Virginia 20164 forwarded twenty (20) samples of a special design nut for test evaluation of performance properties. The nut was identified as a 'Rapid Assembly Nut' conforming to McDonnell Douglas Aerospace Spec. Control Dwg. 1F44595, Rev. D. The nut manufacturer, Thread Technology, identified the nut as the "Zip Nut", under TTI Part Number 050006. It was noted that "Zip Nuts" were intended for use in the construction and assembly of International Space Station.

The Purchase Order from Thread Technology, Inc. outlined the Acceptance/ Qualification Test Plan and Procedure for 1/2-20 UNJF-3B P/N 050006 and MDA 1F44595 in TTI Document No. 050016 dated 3/11/98. In addition,all tests were to be witnessed by Defense Contract Management Command, and by The Boeing Company formerly McDonnell Douglas Aerospace (MDA). The detailed test study program was witnessed by the following representatives at Almay:

Defense Logistics Agency
Defense Contract Management Command

Mr. Tom Osborn
Mr. Greg Wolfslau
Mr. Steve Vega

The Boeing Company
Space Systems Division

Mr. Joseph M. Campa II
Mr. Paul Smudde

The physical test program was initiated on March 11, 1998, and all tests completed on April 9, 1998. The "ZIP NUTS" included in this phase of the performance evaluation were identified as LOT No. 3. The test program was outlined to observe the Sequences and procedures referenced in TTI Document No. 050016, Rev. C.

DESCRIPTION

The 'Rapid Assembly Nut' design includes three threaded segments encased in an outer body housing. The threaded segments are positioned in place by means of two springs, which encircle the threaded segments. The unique nut design permits the nut to be engaged or forced over mating bolt threads to a seated condition. However, to remove the nut requires turning of the nut to disengage the fastener from the bolt threads.

The threaded elements were fabricated from 15-5PH CRES, while the two springs were fabricated from Type 302 CRES. The outer housing of the "ZIP NUT" was identified as being fabricated from A286 CRES. The nut size was .5000-20 UNJF-3B.

The "Zip Nuts" representing Lot No. 3 wereserialized by the Manufacturer, as noted in Table 1. On the recommendation of The Boeing Company engineering representative, assignment of specimen numbers for the various test sequences was made at random. The Test Flow and Specimen Identification numbers for this test program are shown in Figure 1. Care was exercised to maintain specimen identifications for the evaluation study.

The 'Rapid Assembly Nut', as received is shown in Figure 2. For information, TTI Drawing No. 050006, and MDA Spec. Control Drawing 1F44595, illustrating features of the nut design, are attached as an Appendix to this Report. Representative "Zip Nuts" with serial number identification on the top of the nuts are illustrated for information in Figure 3.

As a special condition for this test evaluation, the test bolts were required to have a minimum Hardness of Rc 36, and a minimum thread length of 0.800-inches. An extensive review of available bolts indicated a Boeing Standard, BAC B30LE Fabricated from A286 CRES, and treated to develop a tensile strength of 200 ksi. The test bolts, which were dry film lubed at the request of the Boeing Company, are also illustrated in Figure 2.

TABLE NO. 1

IDENTIFICATION OF RAPID ASSEMBLY NUTS (ZIP NUTS) RECEIVED FROM THREAD TECHNOLOGY, INC., FOR TEST EVALUATION STUDY

Specimen No.	TTI SERIAL NUMBER	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B) 1/	Lot Number	Test Procedure
1	3006	1F44595 Rev. C	050006	.5000-20	3	TTI Document 050016, Rev. C
2	3010	"	"	"	3	"
3	3013	"	"	"	3	"
4	3014	"	"	"	3	"
5	3016	"	"	"	3	"
6	3021	"	"	"	3	"
7	3023	"	"	"	3	"
8	3024	"	"	"	3	"
9	3026	"	"	"	3	"
10	3027	"	"	"	3	"
11	3029	"	"	"	3	"
12	3030	"	"	"	3	"
13	3031	"	"	"	3	"
14	3033	"	"	"	3	"
15	3034	"	"	"	3	"
16	3036	"	"	"	3	"
17	3039	"	"	"	3	"
18	3040	"	"	"	3	"
19	3041	"	"	"	3	"
20	3043	"	"	"	3	"

NOTES:

1/ "Zip-Nut" Rapid Nut Assembly with thread elements fabricated from 15-5PH CRES, and outer body fabricated from A286 CRES, conforming to Thread Technology, Inc. Drawing No. 050006, Rev. E.

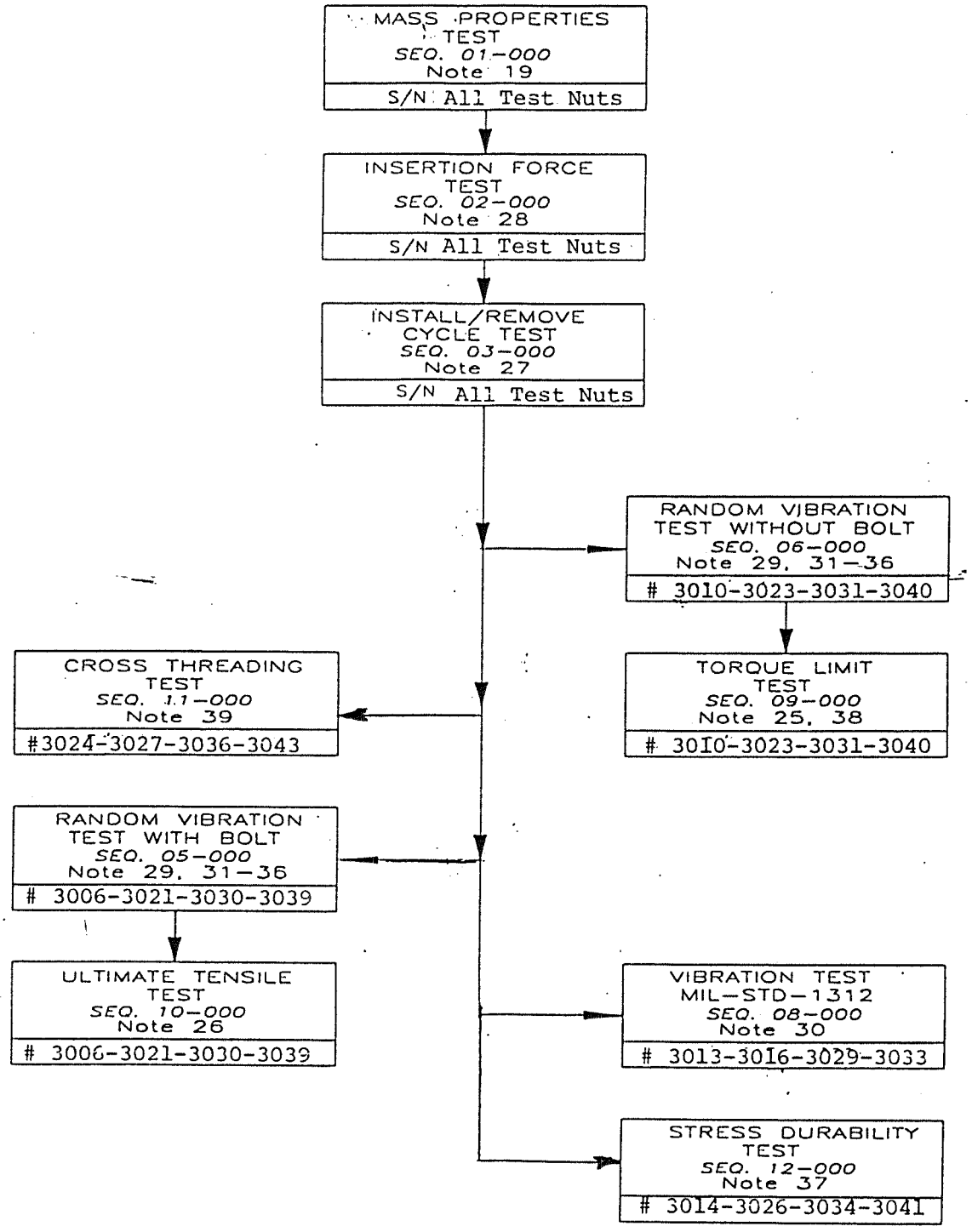


FIG. 1 (above).- Test Flow and Specimen identification for LOT No. 3 'ZIPNUTS' per TTI Document No. 050016, Rev. C

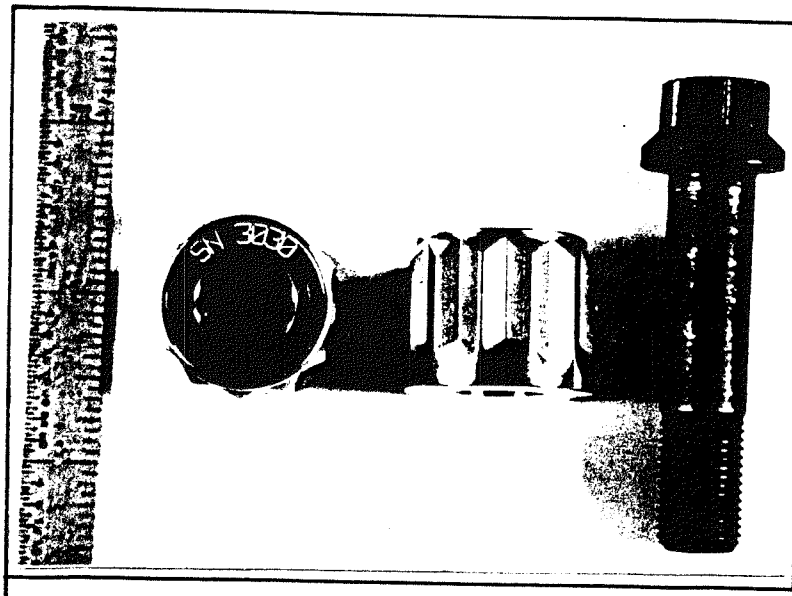


FIG. 2 (left).- Illustration of Rapid Assembly Nut (ZipNut) submitted by Thread Technology, Inc. Sterling, VA. Nut conformed to McDonnell Douglas dwg. 1F44595, and identified as TTI P/N 050006. Test bolt is Boeing P/N BAC B30LE A286 CRES, with dry film lube finish, specified for this test program. Test samples identified as Lot #3.

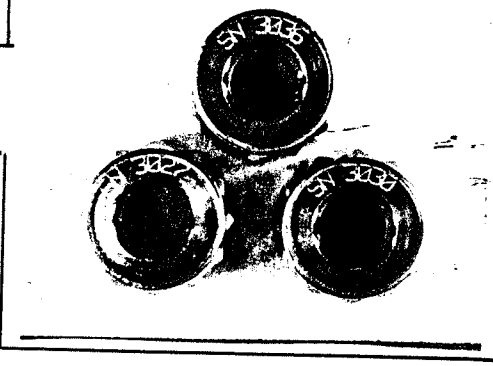


FIG. 3 (right).- Close-up view of serial number identification on top of nuts. Twenty nuts were included in evaluation study and all identified.

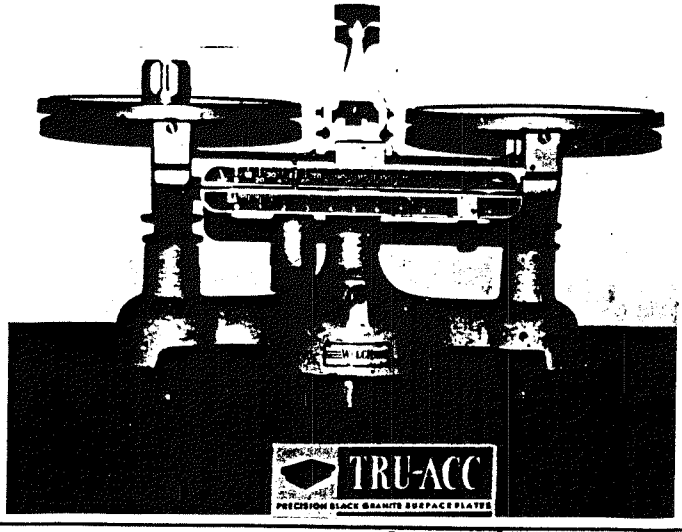
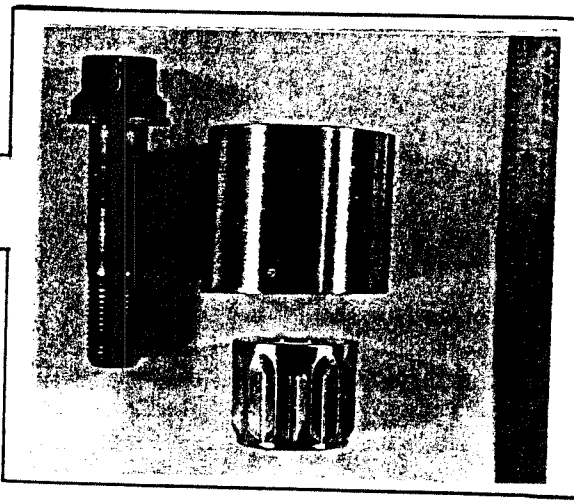


FIG. 4 (left).- View of W.M.Welch Scientific Scale used for mass property tests. ZipNuts were measured in grams and converted to weight in pounds. All nuts were within maximum weight limit.

FIG. 5 (right).- Special 2° face test bushing used for installation force tests.



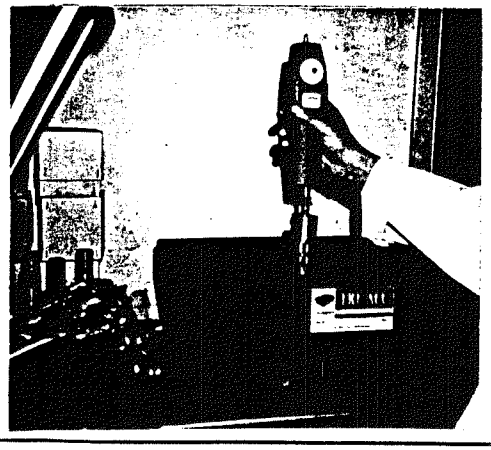


FIG. 6 (left).- Chatillon Model DPP10 (0-10 lb) Force Gage used for 2° insertion force tests. Gage accuracy was 0.1 lb. Twenty nuts from Lot #3 were tested, andwere within maximum limit of 5 lb.

TEST PROCEDURE

The test program on the MDA P/N 1F44595 (TTI P/N 050006) Rapid Assembly Nuts was outlined to observe the requirements and procedures referenced in TTI Document No. 050016. Particular attention was made of the sequence of tests to be conducted. All test equipment, fixtures, gages, etc. were in conformance with the requirements of the ALMAY "Quality System Manual (QSM)" dated 6/2/97, designed to satisfy requirements of MIL-Q-9858A and ISO 9003.

On receipt, the twenty (20) "Zip Nuts" were visually inspected for evidence of workmanship, and presence of identification serial numbers. All 20 nuts were then subjected Sequence 01-000 Mass Properties Test. Each nut was weighed using an W. M. Welch Scientific Scale, as illustrated in Figure 4. Nut weight was measured in grams, with an accuracy of 0.1 grams. The equivalent nut weight in pounds was determined and recorded for each serial number.

After completion of the Mass Property Test, the twenty "Zip Nuts" were subjected to the Insertion Force Test per Sequence 02-000 of TTI Document 050016, and MDA Spec. Control Dwg. 1F44595, Note 28. A special fixture with a though hole and one face machined at 2^{o} was used for this phase of the study, as illustrated in Figure 5. The "Zip Nut" under test was positioned on the 2^{o} face, and the mating BAC B30LE8U22 dry film lubed A286 CRES bolt was installed through the hole to engage the test nut. A chatillon Model DPP10 Force Gage was applied to the head of the bolt, as illustrated in Figure 6. The force required for full engagemnt with the "Zip Nut" was noted and recorded. The calibrated Force Gage was accurate to 0.1 lb. measurement.

The same twenty "Zip Nuts" subjected to Sequence Nos. 01-000 and 02-000 were then designated for the Installation/Removal Cycle Test noted in Sequence 03-000, and 1F44595, Note 27. A square alloy steel bushing was used for this phase of the evaluation, as illustrated in Figure 7. The BAC B30LE8U22 test bolt had a minimum thread length of 0.800-in. to assure full thread

engagement with the test "Zip Nut". The steel bushing with the bolt/nut was mounted in a special torque test fixture designed to prevent movement of the bushing under the torquing procedure. The bushing mounted in the torque fixture is shown for information in Figure 8. The test "Zip Nut" was then gradually torqued to 1200 in-lb. usin a SturtevantTorque Wrench, as shown in Figure 9. Each nut was torqued ten (10) times to 1200 in-lb. After each installation/ removal cycle, the nut was examined for evidence of deformation and/or fracture. All twenty test nuts were in functional and operable condition after completion of the 10-cycle torque schedule.

Two series of Random Vibration tests were then undertaken, under the supervision of Almay, The Boeing Company, and the Defense Contract Management Command. The tests were conducted at Consolidated Laboratories, Inc., 732 Arrow Grand Circle, Covina, California. Sequence No. 05-000 Random Vibration tests with mating bolts installed and torqued to 1125 in-lb. were conducted on Serial Nos. 3006, 3021, 3030, and 3039. Random Vibration tests without mating bolts were conducted on Serial Nos. 3010, 3023, 3031, and 3040 in accordance with Sequence No. 06-000 of TTI Document No. 050016. The random vibration tests were conducted in an MB Model C-50 Vibration Exciter as illustrated in Figure 10. Each group of four "Zip Nuts" was vibrated in 3-axis. On completion of the vibration test exposure, the nuts were examined for evidence of fracture and/or deformation. All nuts were in functional and operable condition. The results of the Random Vibration tests are presented in Consolidated Laboratories, Inc. Report No. 8746 attached as an Appendix to this Report.

Vibration tests inaccordance with Sequence No. 08-000 were conducted at Almay. The vibration tests were observed in accordance with MIL-STD-1312, Test 7. Four "Zip Nuts" were designated for this test and included Serial Nos. 3013, 3016, 3029, and 3033. The nuts were assembled in a vibration test fixture conforming to MIL-STD-1312, Test 7, as illustrated in Figure 11. Each nut was

used witha new Boeing BAC B30LE8U22 A286 CRES dry film lubed bolt and torqued to 1125 in-lb. The ends of the bolts, and the "Zip Nuts" were scribed to assist in detecting potential rotation and/or movement under the accelerated vibration test environment. The test fixture was mounted in a Sonntag SF-10-U Universal Fatigue Test machine operating at 1800 cpm, as illustrated in Figure 12. The double amplitude was adjusted to 0.450-in., as required by MIL-STD-1312, Test 7. The vibration tests were conducted for 30,000-cycles, with periodic inspection made at 10,000-cycle intervals to determine if rotation or movement had occurred. On completion of the accelerated vibration exposure, the "Zip Nuts" were removed and examined for evidence of deformation or fracture. The tests indicated no rotation or movement of any specimen after 30,000-cycles.

Torque Limit Tests were specified in Sequence No. 09-000, and required installation of the "Zip Nuts" and mating test bolts in a strain gaged load cell. A special full bridge strain gaged load cell was made for this project by Almay. Before using the load cell, it was first calibrated in a Satec Universal Tensile Test machine, as illustrated in Figure 13. The load cell was loaded in compression, and corresponding strain readings noted by means of a precision Reistance Bridge Indicator, also shown in Figure 13. Three calibration runs were performed, and the resulting load vs strain indications were plotted in a calibration curve. The calibration curve is illustrated in Figure 14.

Using the calibration curve, four "Zip Nuts" previously subjected to the Random Vibration tests without bolts, Serial Nos. 3010, 3023, 3031, and 3040 were utilized for the Torque Limit Tests. Each test nut was assembled with a Boeing BAC B30LE8U22 dry film coated bolt in the load cell, as illustrated in Figure 15. The nut under test was gradually tightened to 2000 in-lb torque. The action of tightening the fastener system introduced a compression, or preload in the fastener assembly, which was read out in strain by the Resistance Bridge Indicator. From the calibration curve, the resultant preload was determined.

The accuracy of the strain gaged load cell was one unit of measurement, or 48 lb. The "Zip Nut" was removed from the load cell and examined for evidence of deformation and/or failure which would interfere with proper application and removal of the "Zip Nut". All test nuts were capable of removal after the initial installation torque of 2000 in-lb, and were functional and operable. There was no indication of deformation in any of the test nuts.

Four "Zip Nuts" previously subjected to the Random Vibration tests with mating bolts were then used for Ultimate Tensile strength test in accordance with Sequence 10-000 of TTI Document No. 050016. The Serial numbers were: 3006, 3021, 3030, and 3039. For this test, Boeing BAC B30LE8U22 A286 CRES bolts with dry film lubricant were employed. The bolts were rated at 200 ksi minimum tensile strength and were considered strong enough to develop the full rated strength of the test "Zip Nuts". To permit assembly and torquing, the fasteners were installed in a compression-type tensile fixture as shown in Figure 16. Each test nut was tightened to 1125 in-lb, with care taken to assure full thread engagement of the bolt threads in the "Zip Nut". The test fixtures conformed to MIL-STD-1312, Test 8. The tensile strength tests were conducted in a Satec 400HV Universal Tensile Test Machine, as illustrated in Figure 17. Each nut-bolt combination was loaded to failure to develop the full rated strength of the fasteners. The failing load and nature of failure were noted and recorded.

Four "Zip Nuts" were subjected to the Cross-Threading Test outlined in Sequence 11-000 of TTI Document No. 050016. Serial numbers were: 3024, 3027, 3036, and 3043. An alloy steel bushing fixture with athrough hole was used, which was square on one end, and incorporated a 2° face on the opposite end. A special 6° wedge was positioned on the 2° face of the bushing presenting an effective face angle of 8°. The test bolt was installed through the bushing to engage the "Zip Nut" at 8°, as illustrated in Figure 18. The test bolt was capable of engaging the "Zip Nut" approximately half the depth of the nut threads.

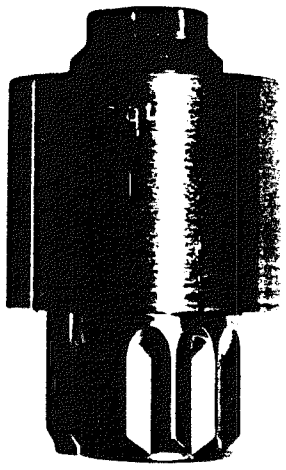


FIG. 7 (left).- View of square test bushing with with bolt engaged in ZipNut. Twenty nuts were each installed at 1200 in-lb for ten cycles. BAC B30LE8 bolt was selected for project to assure minimum thread length of 0.300-in. to provide proper thread engagement with ZipNut.

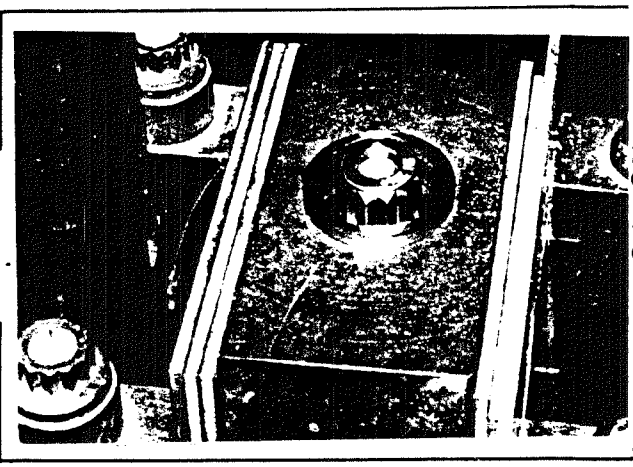


FIG. 8 (right).- Test bushing mounted in torque fixture to prevent misalignment or rotation during 10-cycle installation test.

FIG. 9 (left).- Sturtevant Torque Wrench used in developing 1200 in-lb installation torque. All ZipNuts satisfactorily passed 10-cycle installation test without failure.

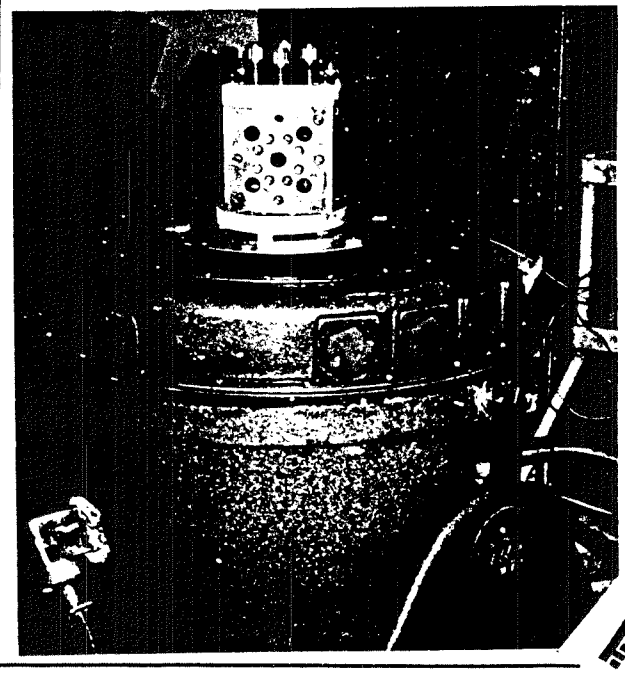


FIG. 10 (right).- MB Model C-50 Vibration Exciter used for random vibration tests conducted at Consolidated Laboratories, Inc., Covina, CA. Results of random vibration tests are noted in Consolidated Report No. 8746, included as an Appendix to this Report.

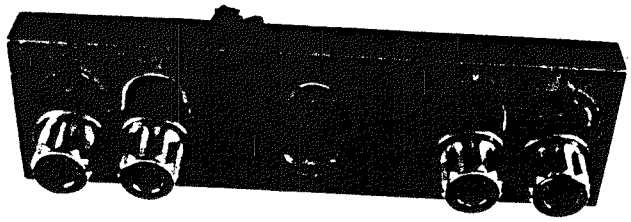


FIG. 11 (left).- ZipNuts installed in vibration test fixture conforming to MIL-STD-1312, Test 7. After installation torquing, nuts and mating bolts were scribed to detect possible rotation during accelerated vibration test.

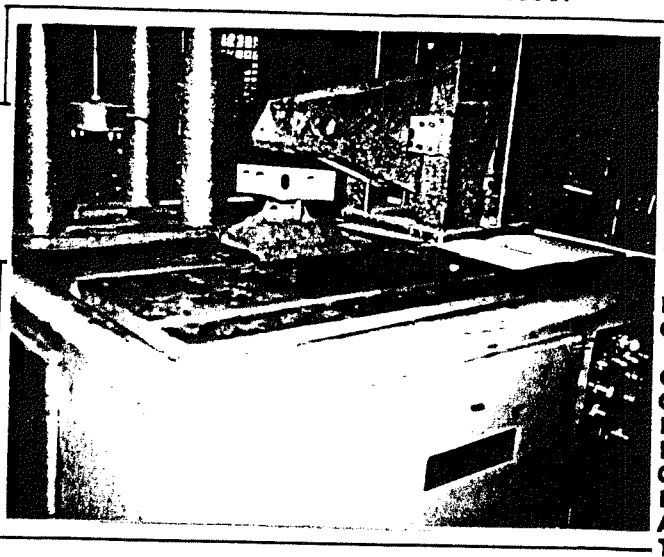


FIG. 12 (right).- View of Sonntag SF-10U Universal Fatigue Test Machine used for accelerated vibration test to 30,000-cycles. Test conducted at Almay.

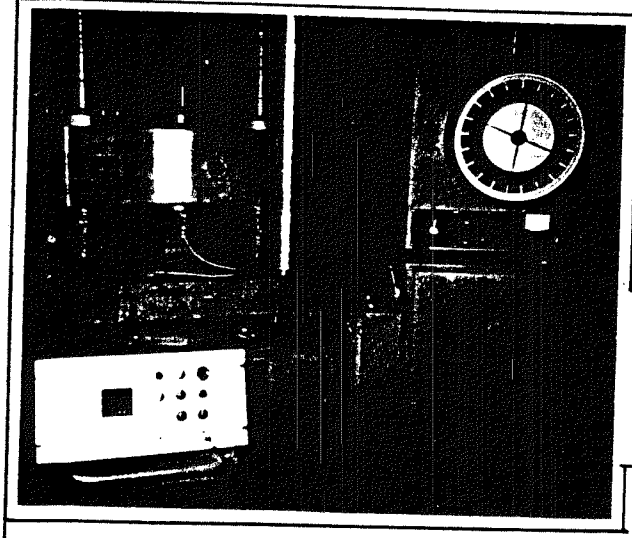


FIG. 13 (left).- Test set-up for strain gage load cell calibration in Satec Universal Tensile Test Machine. Calibration curve for load cell is shown in Figure 14.

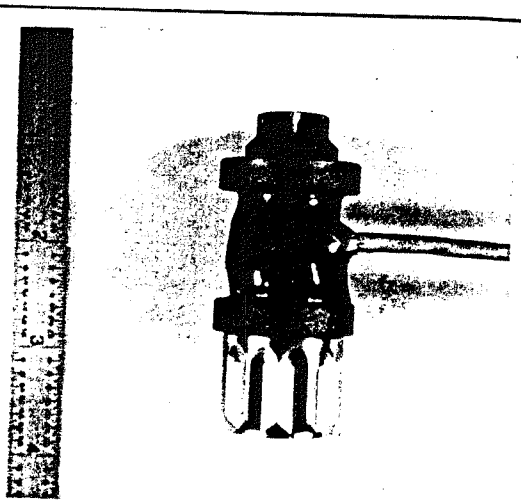


FIG. 15 (right).- Test set-up for torque limit test in load cell. Applied torque resulted in compression load measured by Resistance Bridge Indicator.

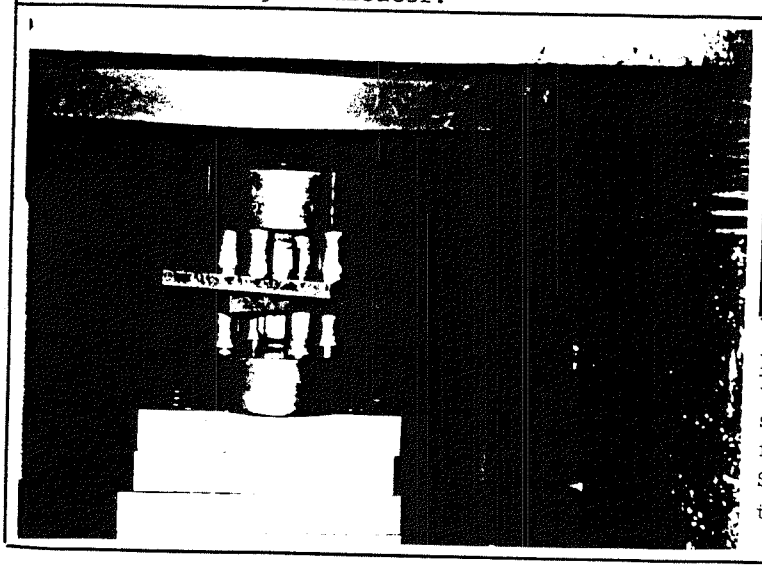


FIG. 16 (left).- Compression-type tensile fixture used for tensile strength tests of ZipNuts. Test fixture design conformed to MIL-STD-1312. Nuts were seated and torqued prior to tensile evaluation.

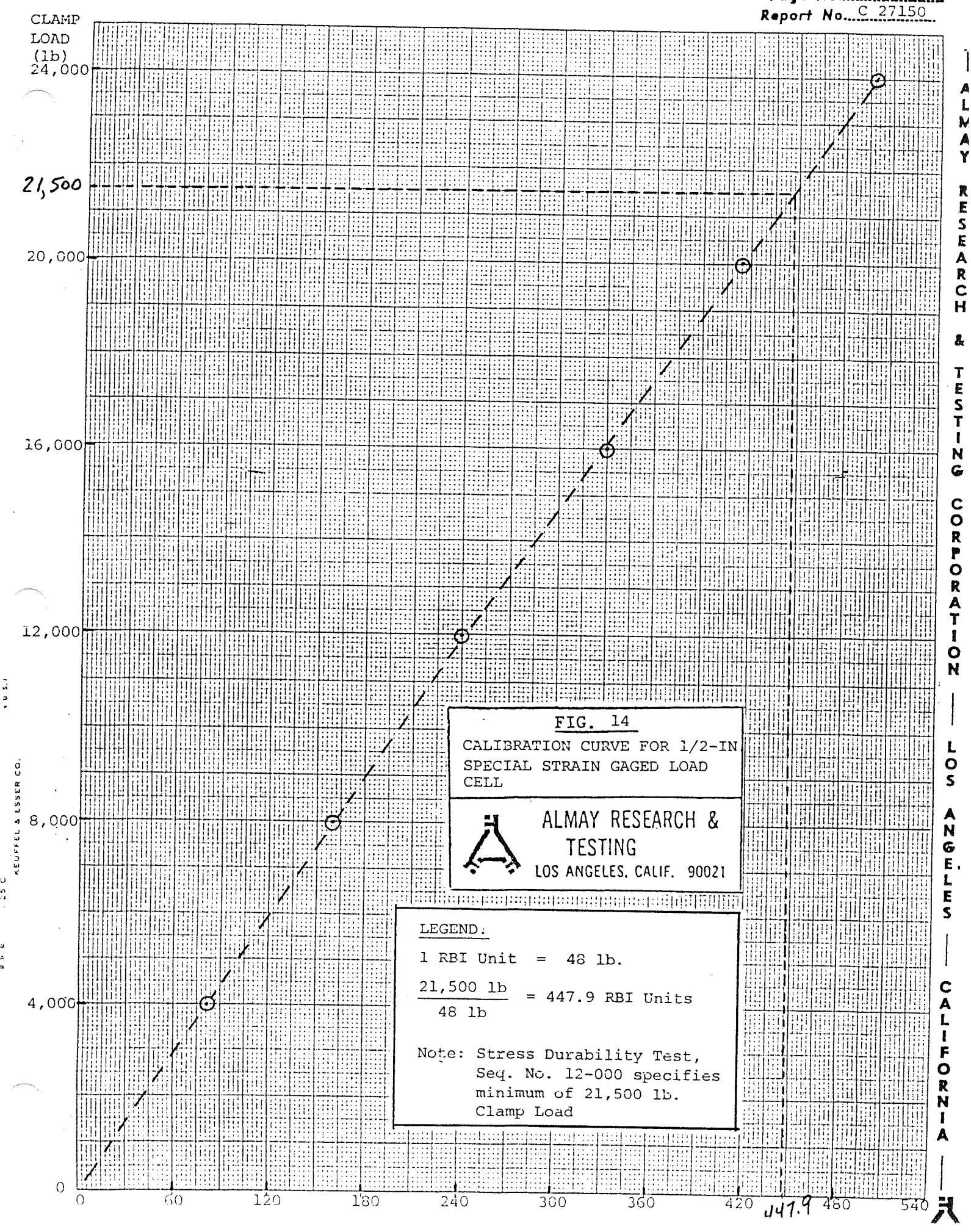


FIG. 14

CALIBRATION CURVE FOR 1/2-IN SPECIAL STRAIN GAGED LOAD CELL

ALMAY RESEARCH & TESTING
LOS ANGELES, CALIF. 90021

LEGEND:

1 RBI Unit = 48 lb.

$\frac{21,500 \text{ lb}}{48 \text{ lb}}$ = 447.9 RBI Units

Note: Stress Durability Test, Seq. No. 12-000 specifies minimum of 21,500 lb. Clamp Load

The 6° Wedge was then removed from the face of the bushing, and the mating bolt was then torqued to 840 in-lb from the bolt head end with the "Zip Nut" seated on the 2° face of the bushing. At the 2° face, full engagement was realized in the threads of the "Zip Nut". The nut under test was then removed and examined in the threaded areas for deformation and/or fracture. All test "Zip Nuts" satisfactorilly met the installation torque requirement from the Bolt head end. The test set-up is shown in Figure 19.

The final scheduled test of the "Zip Nuts" was the Stress Durability Test outlined in Sequence No. 12-000 of TTI Document No. 050016. Four nuts were tested including Serial Nos.3014, 3026, 3034, and 3041. The "Zip Nut" with the mating Boeing BAC B30LE8U22 A286 CRES dry film lubed bolt was installed in the calibrated strain gaged load cell as illustrated in Figure20. The load cell was hooked up to the Resistance Bridge Indicator, and the "Zip Nut" seated finger-tight. Torque was applied to the nut to develop a minimum axial clamp load of 21,500 lb. With the nut-bolt system under load, the fasteners were held for a minimum of 96-hours. Read-out of the induced axial clamp load was made by the Resistance Bridge Indicator as shown in Figure 21. After exposure, the "Zip Nuts" were removed, and examined for evidence of cracks or fracture. All test nuts exhibited no failures after completion of the Stress Durability tests at room temperature. The specimens were held under load for 118-hours, and were considered to have met the Stress Durability requirement.

Although the basic test program as outlined in TTI Document No. 050016 was completed, one additional test not previously specified was requested by the Cognizant Engineer, The Boeing Company, Space Systems Division. To determine the ultimate torque strength capability of The "Zip Nut" and mating BAC B30LE8U22 A286 CRES bolts, the four "Zip Nuts" used earlier for the Cross Threading Tests were installed in square alloy steel test bushing and torqued from the bolt head end to ultimate failure. Under the Cross-Threading tests, the fasteners had

previously been torqued from the bolt head to 840 in-lb. The additional torque tests to failure are noted as follows:

"ZIP NUT" Serial No.	Torque Ultimate (in-lb)
3024	2700
3027	3000
3036	2700 (started to yield at 2544)
3043	2700 (Bolt head strip)

TEST RESULTS

The results of the Weight (Mass Property) tests of the MDA P/N 1F44595 (TTI P/N 050006) Rapid Assembly Nuts for Lot No. 3 are presented in Table No. 2. The twenty "Zip Nuts" inspected all were within the maximum permissible weight of 0.16 lb. and are considered to have met this requirement.

The results of the 2^{o} Insertion Force Tests conducted on the twenty samples representing Lot. No. 3 are summarized in Table No. 3. The maximum permissible Insertion Force was noted at 5 lb., and all "Zip Nuts" conformed to this requirement.

The results of the 10-cycle installation/removal tests of the MDA P/N 1F44595 Rapid Nut Assemblies are noted in Table No. 4. The "Zip Nuts" installed at 1200 in-lb satisfactorily met the 10-cycle exposure without evidence of failure or fracture. All nuts were functional and operable for further testing under this program.

As noted earlier, the two sets of Random Vibration tests were conducted at Consolidated Laboratories, Inc. Their Report No. 8746 summarizing the results

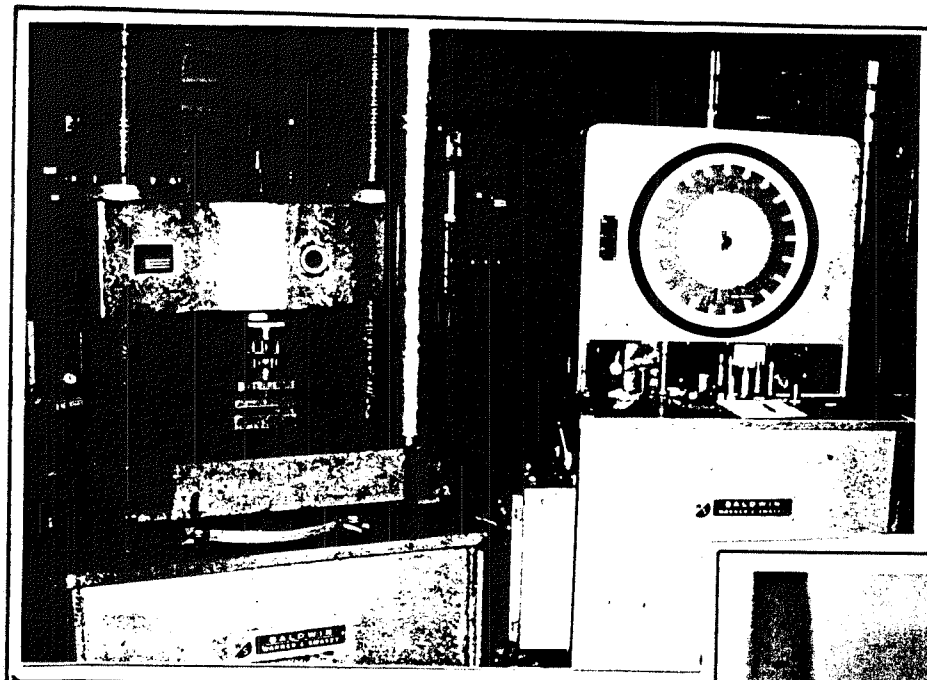


FIG. 17 (left).- View of Satec Universal Tensile Test Machine used in conducting tensile strength tests of ZipNuts. Note test fixture mounting in test machine. All test nuts were carried to failure to develop full rated strength of the fasteners.

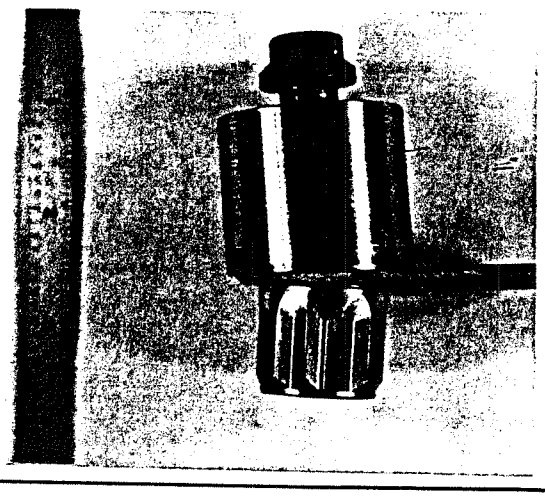


FIG. 18 (right).- Illustration of special cross threading test fixture. ZipNut was first installed at 8° to assure initial engagement. The 6° wedge was then removed to permit final torquing from bolt head at 2°.

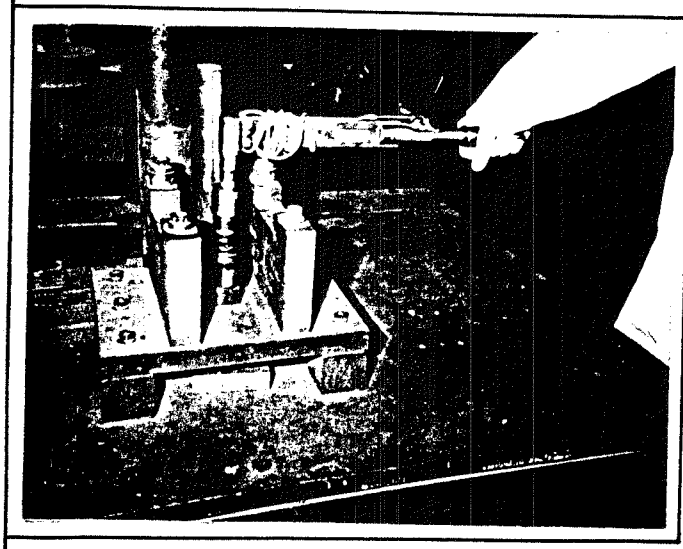


FIG. 19 (left).- Installation torquing at 840 in-lb from bolt head to complete cross threading test evaluation.

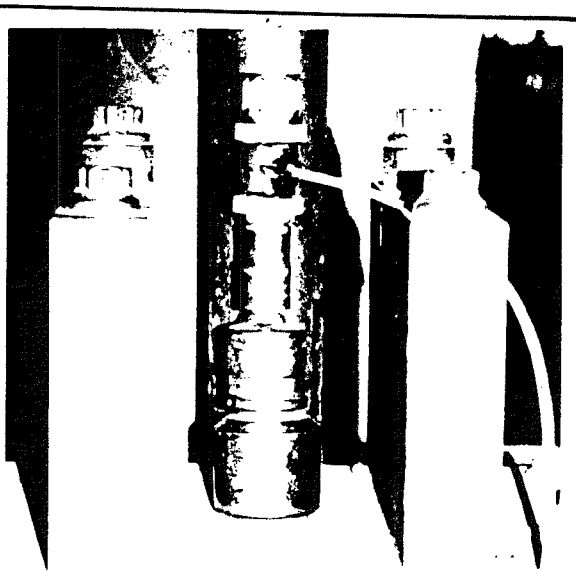


FIG. 20 (right).- ZipNut and mating bolt in strain gaged load cell for stress durability test. Nut was torqued to develop 21,500 lb. load, and held for 96-hours. Load cell calibration curve was used to confirm correct induced preload in fastener system.

of their tests is attached as an Appendix to this Report.

The results of the MIL-STD-1312, Test 7 Accelerated Vibration tests conducted at Almay are presented in Table No. 5. When subjected to a seating torque of 1125 in-lb., there was no evidence of rotation or loosening after 30,000-cycles. The test "Zip Nuts" were considered to conform to the vibration requirement without failure.

The four "Zip Nuts" subjected to the Torque Limit tests at 2000 in-lb indicated no evidence of deformation or failure. The test results are noted in Table No. 6. Test nuts and mating bolts after test evaluation are shown for information in Figure 22.

The results of the Ultimate Tensile Strength tests of the TTI P/N 050006 Zip Nuts are summarized in Table No. 7. The nuts had previously been subjected to Random Vibration testing with mating bolts. Minimum specified tensile strength was noted at 27,500 lb. By using the Boeing BAC B30LE8U22 A286 CRES bolts rated at 200 ksi, tensile strengths in excess of 37,000 lb. were developed. Test specimens after tensile strength evaluation are illustrated for information in Figure 23.

The results of the Cross-Threading tests conducted on the Lot No. 3 Rapid Nut Assemblies are presented in Table No. 8. All nuts were fully seated at 2° after initial engagement at 8°. No failures were observed in this pahse of the program.

The results of the Stress Durability tests conducted on the MDA P/N 1F44595, TTI P/N 050006 "Zip Nuts" are noted in Table No. 9. While the minimum requirement under load was for a minimum of 96-hours, the actual test exposure was 118-hours. No cracks or failures were observed after detailed examination. Test "Zip Nuts" and mating high strength bolts are illustrated for information in Figure 24 after completion of test exposure.

COMMENTS

Thread Technology, Inc. Document No. 050016 outlined an extensive series of tests intended to show capability to meet performance requirements referenced in MDA Spec. Control Drawing 1F44595 for P/N 050006 "Zip Nuts". The nuts incorporated .5000-20 UNJF-3B threads, and were designed for use in the construction and assembly of the International Space Station. The "Zip Nuts" tested under this project were identified as Lot No. 3.

Based on the comprehensive series of tests conducted, the "Zip Nuts" exhibited an ability to meet and/or exceed all rated requirements referenced in the Test Schedule. No cracks, deformation, or fractures were observed with any of the critical tests summarized in this Report.

Accordingly, it is considered that the P/N 050006 "Zip Nuts" representing Lot No. 3 do conform to the requirements of TTI Document 050016, and MDA Spec. Control Drawing 1F44595.

The above information is submitted for the information and use of Thread Technology, Inc.

X X X

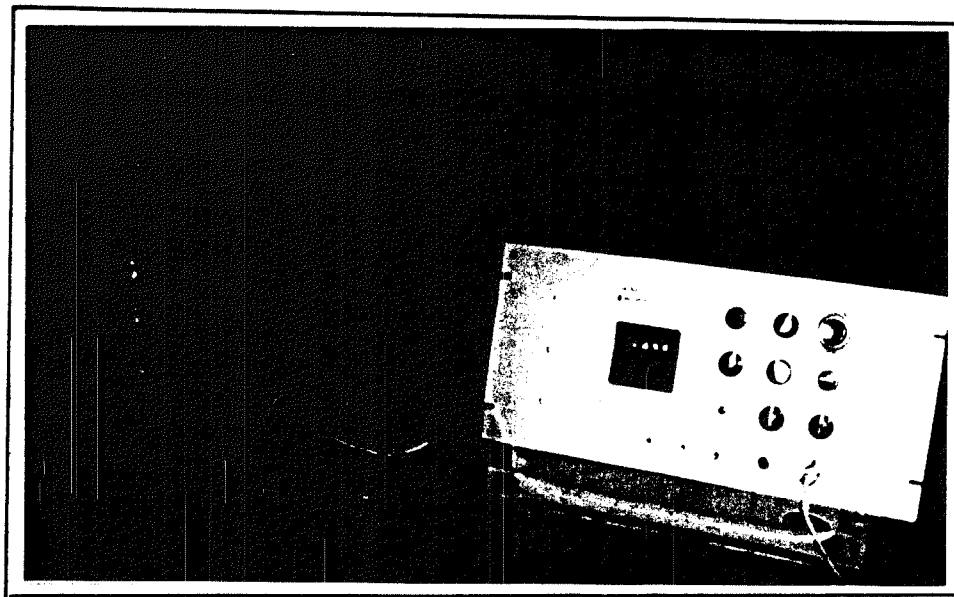
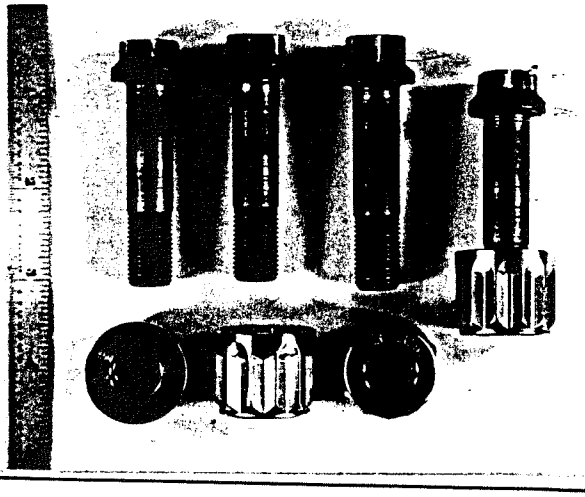


FIG. 21 (left).- Test set-up, showing Resistance Bridge Indicator read-out from load cell. Four ZipNuts were subjected to stress durability test.

FIG. 22 (right).- Test ZipNuts after exposure to torque limit test. Examination indicated all nuts were functional and operable. No failures were observed.



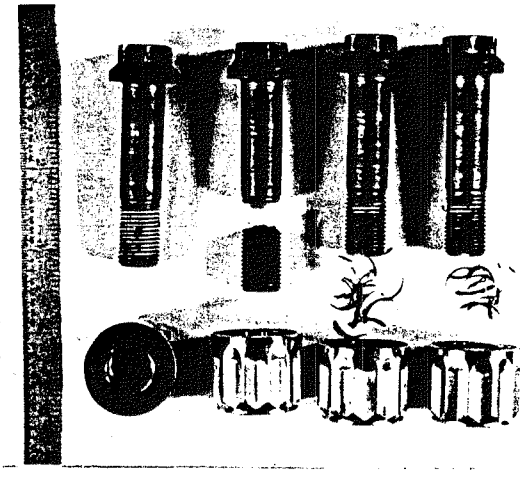


FIG. 23 (left).- Test specimens after tensile strength evaluation. All ZipNuts exceeded minimum tensile strength requirements, with 1 bolt fracture, and 3 nuts stripped threads.

FIG. 24 (right).- Four ZipNuts after 96-hour stress durability test. No failures were observed in either the test ZipNuts or mating bolts.

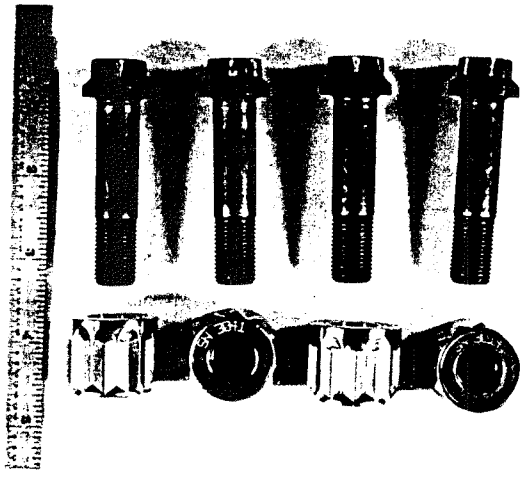


TABLE NO. 2.

RESULTS OF WEIGHT (MASS PROPERTY) TESTS OF
MDA P/N 1F44595 REV D (TTI P/N 050006) LOT #3
RAPID NUT ASSEMBLIES

Serial No.	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	Maximum Permissible Weight (lb) 2/	Actual Nut 4/ Weight (grams)	Equivalent Nut Weight (lb) 3/ 4/
3006	1F44595-1 Rev. D	050006	.5000-20	0.16	59.9	0.1321
3010	"	"	"	"	59.6	.1314
3013	"	"	"	"	59.0	.1300
3014	"	"	"	"	59.2	.1305
3016	"	"	"	"	59.1	.1303
3021	"	"	"	"	59.5	.1312
3023	"	"	"	"	59.6	.1314
3024	"	"	"	"	59.6	.1314
3026	"	"	"	"	58.8	.1296
3027	"	"	"	"	59.1	.1303
3029	"	"	"	"	60.0	.1323
3030	"	"	"	"	59.4	.1310
3031	"	"	"	"	59.5	.1312
3033	"	"	"	"	59.5	.1312
3034	"	"	"	"	59.6	.1314
3036	"	"	"	"	59.5	.1312
3039	"	"	"	"	59.4	.1310
3040	"	"	"	"	59.6	.1314
3041	"	"	"	"	59.5	.1312
3043	"	"	"	"	59.7	.1316

NOTES:

1/ "Zip-Nut" Rapid Nut Assembly with Thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Inc. Drawing No. 050006.

2/ Maximum Nut permissible weight per Note 19, MDA Spec. Control Drawing 1F44595.

3/ Test Nuts are within maximum weight limit, and conform to Note 19, Spec. Control Dwg. 1F445595.

4/ Mass Property tests conducted on March 12, 1998 in accordance with Sequence No. 01-000, TTI Document No. 050016, Rev. C dated 3/11/98. Test conducted using W.M.Welch Scientific Scale.

TABLE No. 3

RESULTS OF 2° INSERTION FORCE TESTS OF
MDA P/N 1F44595 REV D (TTI P/N 050006)
LOT #3 RAPID NUT ASSEMBLIES

Serial No.	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	Maximum Permissible Insertion Force (lb) 2/	2° TEST INSERTION FORCE (lb) 3/	COMMENTS
3006	1F44595-1 Rev. D	050006	.5000-20	5	2.8	Acceptable
3010	"	"	"	"	3.1	Acceptable
3013	"	"	"	"	4.1	Acceptable
3014	"	"	"	"	3.4	Acceptable
3016	"	"	"	"	2.9	Acceptable
3021	"	"	"	"	4.5	Acceptable
3023	"	"	"	"	3.6	Acceptable
3024	"	"	"	"	3.9	Acceptable
3026	"	"	"	"	2.7	Acceptable
3027	"	"	"	"	2.9	Acceptable
3029	"	"	"	"	2.6	Acceptable
3030	"	"	"	"	2.7	Acceptable
3031	"	"	"	"	2.8	Acceptable
3033	"	"	"	"	2.7	Acceptable
3034	"	"	"	"	3.7	Acceptable
3036	"	"	"	"	2.8	Acceptable
3039	"	"	"	"	3.0	Acceptable
3040	"	"	"	"	2.8	Acceptable
3041	"	"	"	"	2.5	Acceptable
3043	"	"	"	"	3.2	Acceptable

NOTES:

1/ "Zip-Nut" Rapid Nut Assembly with Thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Inc. Drawing Co. 050006.

2/ Maximum insertion force at engagement angle of 2° maximum per Note 28, MDA Spec. Control Dwg 1F445595, Rev. D.

3/ Tests conducted installing P/N BAC B30LE8U22 dry film coated bolts thru steel bushing into P/N 1F445595-1 Rapid Nut assembly seated against 2° face. Installation force measured using Chatillon Model DPP10 (0-10lb) Force Gage.

4/ Insertion Force Tests conducted on March 12, 1998 in accordance with sequence No. 02-000, TTI Document No. 050016, Rev. C dated 3/11/98.

TABLE No. 4

RESULTS OF 10-CYCLE INSTALLATION/REMOVAL TESTS OF MDA P/N 1F44595 (TTI P/N 050006) LOT #3 RAPID NUT ASSEMBLIES

Serial No. 2/	McDonnell Douglas Aerospace Part No. 1/	Nominal Thread Size	SEATED INSTALLATION TORQUE (in-lb) 3/										COMMENTS
			Cycle #1	Cycle #2	Cycle #3	Cycle #4	Cycle #5	Cycle #6	Cycle #7	Cycle #8	Cycle #9	Cycle #10	
3006	1F44595-1 Rev. D (TTI 050006)	.5000-20	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
3010	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
3013	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
3014	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
3016	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
3021	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
3023	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
3024	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
3026	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
3027	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
3029	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failrue
3030	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
3031	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
3033	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
3034	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
3036	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
3039	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
3040	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
3041	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
3043	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure

NOTES:

1/ "Zip Nut" Rapid Nut Assembly with thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Drawing 050006.

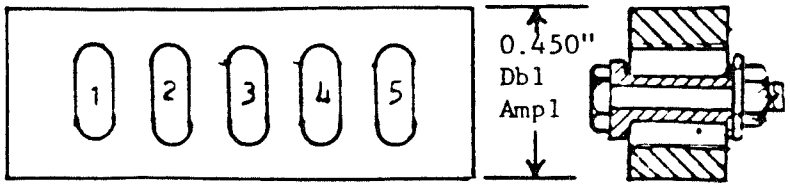
2/ Serial number identification as noted by Thread Technology, Inc.

3/ Installation - removal torque tests conducted using P/N BAC B30LE8U22 dry film coated bolts thru square steel bushing (1.388" height). Zip Nuts torqued with Sturtevant 0-1200 in-lb Torque Wrench each cycle.

4/ Installation/Removal tests conducted on March 13 and 16, 1998 in accordance with Sequence No. 03-000, TTI Document No. 050016, Rev C dtd 3/11/98.

TABLE 5.

RESULTS OF MIL-STD-1312 ACCELERATED VIBRATION TESTS OF MDA P/N 1F44595 (TTI P/N 050006) LOT #3 RAPID NUT ASSEMBLIES



TYPICAL MIL-STD-1312 VIBRATION FIXTURE

Specimen No.	TEST PART NUMBER 1/	Mating Test 2/ Fastener	Assembly Torque 3/ (in-lb)	Test Amplitude 4/	Vibration Frequency (cpm) 4/	NUMBER OF TEST CYCLES	OBSERVED ROTATION
3013	1F44595-1 Rev D (TTI 050006)	B30LE8U22	1125	0.450	1800	10,000 20,000 30,000	No Rotation No Rotation No Rotation
3016	1F44595-1 Rev D (TTI 050006)	B30LE8U22	1125	.450	1800	10,000 20,000 30,000	No Rotation No Rotation No Rotation
3029	1F44595-1 Rev D (TTI 050006)	B30LE8U22	1125	.450	1800	10,000 20,000 30,000	No Rotation No Rotation No Rotation
3033	1F44595-1 Rev D (TTI 050006)	B30LE8U22	1125	.450	1800	10,000 20,000 30,000	No Rotation No Rotation No Rotation

NOTES:

1/ "Zip Nut" Rapid Nut Assembly with thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Drawing 050006.

2/ Test bolt was Boeing BAC B30LE8U22 dry film coated A286 CRES.

3/ Test nuts installed in vibration fixture per MIL-STD-1312, Test 7. Seating torque per Sequence No. 08-000, TTI Document No. 050016.

4/ Vibration tests conducted in Sonntag SF-10-U fatigue machine per test procedure of MIL-STD-1312, Test 7, on March 16, 1998.

5/ Maximum permissible rotation noted at 30° per Sequence 08-005. Test nuts conform to requirement without failure.

TABLE NO. 6

RESULTS OF TORQUE LIMIT TESTS OF MDA P/N 1F44595
(TTI P/N 050006) LOT #3 RAPID NUT ASSEMBLIES

Serial No. 3/	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	Mating Test Bolt 2/	Installation Torque (in-lb) 3/	Induced Tensile Clamp Load (lb) 3/ 4/
3010	1F44595-1 Rev. D	050006	.5000-20	B30LE8U22	2,000	23,808
3023	"	"	"	"	2,000	22,800
3031	"	"	"	"	2,000	24,912
3040	"	"	"	"	2,000	26,688

NOTES:

1/ "Zip-Nut" Rapid Nut Assembly with thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Inc. Drawing No. 050006.

2/ Test bolt was Boeing BAC B30LE8U22 dry film coated A286 CRES, rated at 200 KSI minimum tensile.

3/ Torque limit tests conducted on "Zip Nuts" previously subjected to random vibration tests without bolts (ref: Sequence 06-000). Torque limit test per Sequence 09-000, TTI Document No. 050016, Rev. C dated 3/11/98. Each "Zip Nut" installed in calibrated strain gaged load cell, and torqued to 2,000 in-lb. Induced tensile clamp load observed and recorded. Tests conducted on April 1, 1998.

4/ Examination of "Zip Nuts" after disassembly indicated no evidence of deformation or failure. All nuts functional and operable.

TABLE No. 7

RESULTS OF ULTIMATE TENSILE STRENGTH TEST
OF MDA P/N 1F44595, REV. D (TTI P/N 050006)
LOT #3 RAPID NUT ASSEMBLIES

Specimen No. 2/	NUT PART NUMBER 1/	Nominal Thread Size	AXIAL TENSILE STRENGTH (lbs)		Type Failure 4/	Test Temp. °F
			Spec. Reqt. 3/	Test Nut 4/		
3006	1F44595-1 Rev. D (TTI 050006)	.5000-20	27,500	38,600	Bolt Threads Break	Room
3021	"	"	"	39,100	Nut & Bolt Threads Strip	"
3030	"	"	"	37,700	Nut & Bolt Threads Strip	"
3039	"	"	"	37,000	Nut & Bolt Threads Strip	"

NOTES:

1/ "Zip-Nut" Rapid Nut Assembly with Thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Inc. Drawing No. 050006.

2/ Test Nuts previously subjected to random vibration test with mating bolts per Schedule 05-000, TTI Document 050016, Rev. C.

3/ Minimum axial tensile load requirement per Note 28, MDA Spec. Control Dwg. 1F44595.

4/ Test nuts tested with Boeing BAC B30LE8 A286 CRES Bolts. Each nut torqued to 1140 in-lb (95 ft-lb) prior to Tensile Test. Test conducted on 3/25/98 in Satec 400 HV Universal Tensile Machine.

TABLE NO. 8

RESULTS OF CROSS-THREADING TESTS OF MDA P/N 1F44595 (TTI P/N 050006) LOT #3 RAPID NUT ASSEMBLIES

Serial No.	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	8° Installation 2/	2° Installation Torque (in-lb) 3/	COMMENTS 3/
3024	1F44595-1 Rev. D	050006	.5000-20	Nut engaged	840	No failure
3027	"	"	"	Nut engaged	840	No failure
3036	"	"	"	Mut engaged	840	No failure
3043	"	"	"	Nut engaged	840	No failure

NOTES:

1/ "Zip Nut" Rapid Nut Assembly with thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Inc. Drawing No. 050006.

2/ Cross-Threading test conducted in accordance with Sequence 11-000, TTI Document No. 050016, Rev. C dated 3/11/98. Boeing BAC B30LE8U22 dry film coated A286 CRES test bolt inserted in bushing fixture into "Zip Nut" seated at 8°. Test bolt successfully engaged nut approximately half-way into the nut.

3/ Special 6° wedge removed from bushing fixture leaving "Zip Nut" seated against 2° face of bushing. Installation torque applied from the bolt head until "Zip Nut" fully seated at 2°. After nut removal, examination indicated no evidence of deformation and/or fracture. Test nuts fully operable and functional on completion of test schedule. Tests conducted on April 9, 1998.

TABLE NO. 9

RESULTS OF STRESS DURABILITY TESTS OF MDA P/N 1F44595
(TTI P/N 050006) LOT #3 RAPID NUT ASSEMBLIES

Serial No.	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	Installation Torque (in-lb) 2/	Induced Tensile Clamp Load (lb) 2/	No. of Hours at Load 3/	COMMENTS 3/ 4/
3014	1F44595-1 Rev. D	050006	.5000-20	1,800	21,648	118	No failure
3026	"	"	"	1,800	21,552	118	No failure
3034	"	"	"	2,100	21,984	118	No failure
3041	"	"	"	1,920	21,312	118	No failure

NOTES:

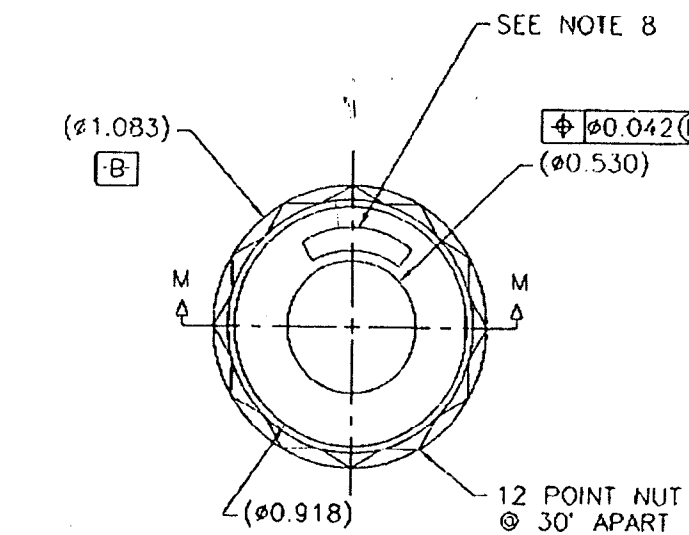
1/ "Zip Nut" Rapid Nut Assembly with thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Inc. Drawing No. 050006.

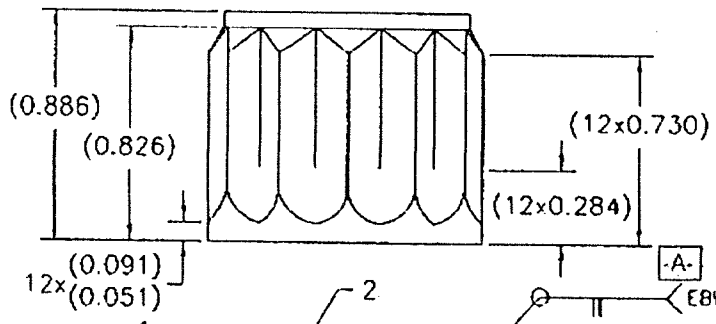
2/ Stress Durability test conducted in accordance with Sequence 12-000, TTI Document No. 050016, Rev. C dated 3/11/98. "Zip Nut" installed on BAC B30LE8U22 dry film coated A286 CRES bolt (200 KSI min. uts) in strain gaged load cell. Nut torqued to develop minimum tensile clamp load of 21,500 ± 250 lb.

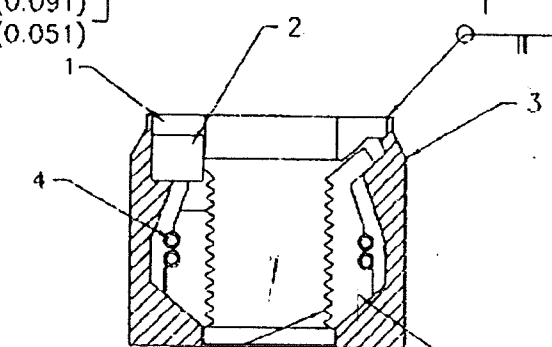
3/ Minimum exposure under load for stress durability test noted at 96-hours. Stress durability tests started on April 1, 1998, and disassembled on April 6, 1998.

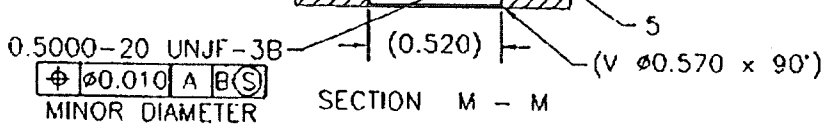
4/ Examination of "Zip Nuts" after stress durability exposure indicated no evidence of cracks or failure of the nuts. Test nuts were functional and operable on completion of test exposure.

REV	REVISION DESCRIPTION	DATE	APPD
C	MDA DWG NO.CORR WAS 1F44595 TO NOTE 1 TO 3 . REPLACED NOTE 4. ADD NOTE 7 ECN 96-0190 EC 10/15/96	10/15/96	EC
D	CORRECTION IN NOTE 3 OF MDA P/N REPHRASE NOTE 5 FOR CLARITY ECN 96-0195 EC 11/6/96	11/6/97	EC
E	ADDED NOTE 8 TO SHOW SERIALIZE S/N PER CUSTOMER PO78990891. DEL MDA DWG REV LEV. ECN 98-0259 EC 1/21/98	1/21/98	









NOTES:

1. UNLESS OTHERWISE SPECIFIED MDA DWG NO. 1F44595 SHALL BE FURNISHED TOGETHER WITH THIS DRAWING.
2. SPECIFICATION REQUIREMENTS SUCH AS; MATERIAL, MFG. PROCESSES, TESTING, AND OTHERS SHALL BE PER MDA DRAWING 1F44595.
3. EBW PENETRATION SHALL BE 0.035 TO 0.045 IN. INSPECTED PER AMS 2681, MDA 1F44595 NOTE 21.
4. MAINTAIN CLEAN STP0416-01. REF. MDA 1F44595 NOTE 15.
5. ALL DIMENSIONS WITH ( ) ARE FOR REFERENCE ONLY.
6. * MDA - McDONNELL DOUGLAS AEROSPACE
7. IDENTIFY PART NUMBER AND LOT NUMBER PER MIL-STD-130, AND MDA 1F44595 NOTE 5.
8. UNIT TO BE SERIALIZE IN CONSECUTIVE ORDER. EXAMPLE: S/N 0001.

ITEM	QTY	PART NO./DESCRIPTION
5	1	050018 15-5PH SST THD SEGMENTS
4	2	050005 302 SST GARTER SPRING
3	1	050003 A286 SST OUTER BODY
2	3	050004 303 SST KEY
1	1	050002 A286 SST TOP CAP

Thread Technology, Inc.
22455 DAVIS DRIVE
STERLING, VA 20164
PHONE (703) 404-1400

ENGINEER	CHECKED BY	DRAWN BY	DATE
ECABAHUG		ECABAHUG	3/15/96

PART NAME: 1/2-20UNJF-3B MDA* ZIPNUT

CAD FILENAME: 050006 | DRAWING # 050006 | REVISION E

NOTES:

1. IDENTIFICATION OF THE SUGGESTED SOURCE(S) OF SUPPLY HEREON IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY AS A SOURCE OF SUPPLY FOR THE ITEM DESCRIBED ON THE DRAWING.
2. INTERPRET DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1982.
3. (flag) OPTIONAL: IDENTIFY WITH MANUFACTURER'S TRADEMARK OR SYMBOL IN ACCORDANCE WITH MIL-STD-130.
4. PREPRODUCTION SAMPLES SHALL BE TESTED BY MDA PRIOR TO REGULAR PRODUCTION TO DEMONSTRATE THE ADEQUACY AND SUITABILITY OF THE CONTRACTOR'S PROCESSES AND PROCEDURES. ADDITIONALLY, A PREPRODUCTION SAMPLE SHALL BE REQUIRED WHEN A CONTRACT IS AWARDED TO A NEW SOURCE THAT HAS NOT PREVIOUSLY SUPPLIED THE NUTS ON A PRODUCTION BASIS.
5. IDENTIFY PART NUMBER AND LOT NUMBER PER MIL-STD-130 ON TAG OR CONTAINER.
6. EDGE RADII SHALL BE .015-.030 UNLESS OTHERWISE NOTED.
7. ALL MACHINED SURFACE ROUGHNESS 125 MICROINCHES PER ANSI B46.1-1985. FOR FEATURES DIMENSIONED ON THE DRAWING.
8. (flag) THREAD FORM PER MIL-S-8879.
9. (flag) APPLY EVERLUBE 620C TO SURFACE INDICATED. APPLICATION OF LUBRICANT SHALL BE PER THE REQUIREMENTS OF MIL-L-46010, TYPE I.
10. (flag) BURNISH SOLID FILM LUBRICANTS USING A CLEAN DRY CLOTH OR NYLON BRISTLE BRUSH APPLYING LIGHT PRESSURE TO REMOVE LOOSE PARTICLES.
11. PASSIVATE ALL CORROSION RESISTANT STEEL PER QQ-P-35.
12. (flag) MAGNETIC PARTICLE INSPECT PER MIL-STD-1949. ACCEPTANCE CRITERIA PER STP0504-0202.
13. (flag) PENETRANT INSPECT PER MIL-STD-6866, TYPE I, SENSITIVITY LEVEL 2. ACCEPTANCE CRITERIA PER STP0504-0102.
14. CLEAN PER SN-C-0005C, VISIBLY CLEAN LEVEL STANDARD.
15. MAINTAIN CLEAN PER STP0416-01.
16. NUTS ARE ACCEPTABLE ONLY WHEN PACKAGED AND SEALED BY THE ORIGINAL MANUFACTURER.
17. (DELETED)
18. (flag) THREADED SEGMENTS SHALL BE FABRICATED, INSPECTED, AND ASSEMBLED AS A SERIALIZED MATCH SET.
19. THE WEIGHT OF THE NUT SHALL NOT EXCEED .16 POUNDS.
20. (DELETED)
21. (flag) WELD AND INSPECT PER AMS2681.
22. THE ASSEMBLY SHALL INCLUDE TWO SPRINGS ELEMENTS, EITHER SPRING ELEMENT, INDEPENDENT OF THE OTHER, SHALL MAINTAIN THE FUNCTIONALITY OF THE NUT ASSEMBLY AS SPECIFIED HEREIN.
23. (flag) THE ENTERING END OF THE NUT THREADS AND THE THREADS AT THE TOP OF THE NUT ASSEMBLY SHALL BE COUNTERSUNK .05 X .05
24. THE NUT SHALL FUNCTION TO THE REQUIREMENTS HEREON IN A VACUUM ENVIRONMENT WITHIN A TEMPERATURE RANGE OF -120 DEGREES F THROUGH +180 DEGREES F.
25. THE NUT SHALL WITHSTAND TORQUES UP TO 2,000 POUND-INCHES FOR ACHIEVING AXIAL PRELOADING OF THE BOLT.
26. THE NUT SHALL HAVE A MINIMUM AXIAL STRENGTH OF 27,500 POUNDS. THE NUT SHALL BE ASSEMBLED TO THE BOLT AND TORQUED TO 1,125 ±200 POUND-INCH. AXIAL STRENGTH SHALL BE TESTED IN ACCORDANCE WITH MIL-STD-1312, TEST 8. THE BOLTS USED FOR THE TEST SHALL HAVE A MINIMUM ROCKWELL HARDNESS OF RC = 36 AND HAVE ROLLED THREADS PER MIL-S-8879, CLASS 3A.
27. THE NUT SHALL BE CAPABLE OF 10 LOADED INSTALLATION AND REMOVAL CYCLES WITHOUT DAMAGE TO EITHER THE NUT OR THE BOLT. ONE LOAD CYCLE IS DEFINED AS ASSEMBLING THE NUT AND BOLT, AND APPLYING 1,200 ±200 POUND-INCHES TORQUE. WITH THE EXCEPTION OF MINOR WEAR MARKS, AS DEFINED IN NOTE 28, NO DISTORTION, SCRATCHES, GALLING OR SEIZING OF THE NUT AND BOLT THREADS SHALL OCCUR.
28. (flag) THE FORCE REQUIRED TO PUSH A BOLT THROUGH THE NUT DURING ASSEMBLY SHALL NOT EXCEED 5 POUNDS AT ANY TIME. THE INSERTION FORCE REQUIREMENT SHALL BE MET AT ANGLES OF INSERTION UP TO 2 DEGREES OFF AXIS. MINOR WEAR MARKS, INCLUDING SCRATCHES, IN NOTED AREA ARE PERMISSABLE. THE DEPTH OF WEAR SHALL NOT PASS THROUGH THE PITCH DIAMETER ON THE LOAD BEARING SIDE OF THE THREADS. EXCEPT FOR THE FIRST TWO FULL THREADS, THE DEPTH OF WEAR SHALL NOT PASS THROUGH THE PITCH DIAMETER ON THE NON-LOAD BEARING SIDE OF THREADS.
29. THE VENDOR SHALL DEMONSTRATE BY TEST, THE NUT IS FULLY FUNCTIONAL AS SPECIFIED IN NOTES 25 THROUGH 27, AND 37 THROUGH 39 AFTER EXPOSURE TO THE FOLLOWING RANDOM VIBRATIONS APPLIED ALONG EACH OF 3 MUTUALLY PERPENDICULAR AXES BOTH WITH AND WITHOUT A BOLT ENGAGED.

FREQUENCY (HZ)	QUALIFICATION LEVEL
20	.04 GXG/HZ
20-50	+9.8 DB/OCTAVE
50-400	.8 GXG/HZ
400-2000	-6.3 DB/OCTAVE
2000	.028 GXG/HZ

OVERALL LEVEL : 23.1 G RMS (GRMS)
DURATION : 510 SECONDS/AXIS
THREE MUTUALLY PERPENDICULAR AXES

30. THE NUTS SHALL BE ASSEMBLED TO BOLTS AND TORQUED TO 1,125 POUND-INCH IN ACCORDANCE WITH FIGURE 1 OF MIL-STD-1312, TEST 7. PRIOR TO VIBRATING, THE NUTS SHALL BE REMOVED AND REINSTALLED 10 TIMES PER NOTE 27. THE NUT AND BOLT ASSEMBLY SHALL BE VIBRATED AT 30,000 CYCLES ON A STAND IN ACCORDANCE WITH MIL-STD-1312, TEST 7. THE NUT SHALL MAINTAIN SUFFICIENT PRELOAD SUCH THAT IT CANNOT BE REMOVED WITH THE FINGERS AND SHALL NOT HAVE ROTATED MORE THAN 10 DEGREES IN EITHER DIRECTION.
31. VIBRATION TEST TOLERANCES: THE TEST DURATION TOLERANCE SHALL BE ±1% OR 3 SECONDS, WHICHEVER IS GREATER. THE OVERALL GRMS TEST LEVEL TOLERANCE SHALL BE ±10%.
32. ACCELERATION SPECTRAL DENSITY TOLERANCE SHALL BE ±2.0 dB WHEN MEASURED WITH 10 HZ OR NARROWER BANDPASS RESOLUTION FROM 20 TO 2000 HZ WITH THE MEAN VALUE OF THE VARIATIONS REMAINING APPROXIMATELY EQUAL TO THE NOMINAL VALUE. +4 dB AND -3 dB FOR QUALIFICATION (+3 dB AND -4 dB FOR ACCEPTANCE) IS PERMITTED FOR ANY NARROW BAND SPECTRAL EXCESS (SPIKES) WHOSE BANDWIDTH IS LESS THAN 10 HZ OR LESS THAN 10% OF THE GEOMETRIC MEAN FREQUENCY WHERE THE SPIKE OCCURS, WHICHEVER IS GREATER.
33. DATA RECORDING: AS A MINIMUM, THE DATA SHALL BE RECORDED ON MAGNETIC INSTRUMENTATION TAPE DURING ALL TEST RUNS. THE TAPE RECORDER SHALL BE IN THE RECORD MODE WHENEVER THE TEST SPECIMEN IS MOUNTED AND THE POWER AMPLIFIER IS ON. THE RECORDED SIGNAL SHALL BE AN ACCURATE REPRESENTATION OF THE ACCELEROMETER SIGNAL WITHIN 12% FROM 10 -3000 HZ WHEN PLAYED BACK ON THE SAME RECORDER. ACCELEROMETER DATA SHALL BE CAPTURED ON A DIRECT DIGITAL ANALYZER IF ONE IS AVAILABLE.
34. THE FREQUENCY RESPONSE OF THE ACCELEROMETER CHANNEL(S) SHALL BE FLAT (±1 dB) FROM 10-3000 HZ. PRIOR TO THE INITIATION OF EACH TEST RUN, THE ACCELEROMETER CHANNEL(S) SHALL BE CALIBRATED USING THE CALIBRATED SIGNAL IN THE CHARGE AMPLIFIERS OR AN APPROPRIATE G-RANGE SIGNAL. THE CALIBRATION SIGNAL SHALL BE ANNOTATED IN TERMS OF G(O-P). AN AC CALIBRATION SIGNAL SHALL BE USED.
35. RANDOM VIBRATION DATA REDUCTION: DATA SHALL BE ANALYZED TO PROVIDE ACCELERATION SPECTRAL DENSITY CURVES SHOWING G²/HZ VERSUS FREQUENCY. THE RMS LEVEL SHALL BE NOTED ON EACH PLOT. WHEN ADDITIONAL DATA REDUCTIONS ARE DONE, THE PLOT RESOLUTION SHALL MATCH THE CONTROL RESOLUTION AS CLOSELY AS POSSIBLE. ANALYZED SAMPLES SHALL CONTAIN AT LEAST 120 DEGREES OF FREEDOM.
36. AN INDEPENDENT END-TO-END CHECK SHALL BE PERFORMED WITH THE CONTROL ACCELEROMETER(S) AND ALL IN-LINE RESPONSE ACCELEROMETERS BEFORE THE START OF THE DYNAMIC TEST PROGRAM. AN INDEPENDENT REDUNDANT ACCELEROMETER, OR AN OVERANGE ACCELEROMETER, OR A WEDGE CHECK IS ACCEPTABLE.
37. STRESS DURABILITY: THE NUT SHALL BE TORQUED TO ACHIEVE AN AXIAL LOAD OF 21,500 POUNDS. AFTER 96 HOURS OF CONTINUOUS LOAD THE NUT SHALL BE REMOVED AND INSPECTED UNDER 10X MAGNIFICATION FOR CRACKS OR OTHER DISCONTINUITIES.
38. THE NUT SHALL PRODUCE A CONSISTANT WRENCH TORQUE VERSUS BOLT PRELOAD WHEN USING A BOLT WITH MINIMUM HARDNESS OF Rc:36 AND THREADED PER MIL-S-8879, CLASS 3A. THE PRELOAD SHALL BE WITHIN +/- 20% FOR A CONSTANT INPUT TORQUE SETTING.
39. CROSS THREADING SHALL NOT OCCUR WHEN THE BOLT IS INSERTED AT ANGLES UP TO 8 DEGREES OFF AXIS.
40. PRODUCTION ACCEPTANCE CRITERIA: 100% OF PRODUCTION UNITS SHALL CONFORM WITH NOTES 2 THROUGH 23. IN ADDITION, 100% OF PRODUCTION UNITS SHALL BE SUBJECTED TO TEST FOR VERIFICATION OF REQUIREMENTS DEFINED IN NOTE 28.
41. DESTRUCTIVE PRODUCTION ACCEPTANCE CRITERIA: 4% OR A MINIMUM OF 4 PRODUCTION UNITS PER LOT SHALL BE SUBJECTED TO EACH TEST FOR VERIFICATION OF REQUIREMENTS DEFINED IN NOTES 25, 26, 27, 37, 38 AND 39. PRIOR TO TEST, HALF OF THE TEST UNITS SHALL BE SUBJECT TO THE VIBRATION ENVIRONMENTS PER NOTES 29 AND 31 THROUGH 36 WITH A BOLT ENGAGED, AND HALF WITHOUT A BOLT ENGAGED. SINCE THESE TESTS MAY BE NON-DESTRUCTIVE, PERFORMING MULTIPLE TESTS ON THE SAME UNIT IS AT THE DISCRETION OF THE SUPPLIER.
42. VERIFICATION OF NOTE 24 MAY BE BY ANALYSIS. MDA MECHANICAL DESIGN APPROVAL OF ANALYSIS REQUIRED.

SUGGESTED SOURCES OF SUPPLY			MDA CONTROL NUMBER
VENDOR	CAGE CODE	VENDOR PART NO	
THREAD TECHNOLOGY INC. 14514-H LEE RD. CHANTILLY, VA 22021	076C7	050006	1F44595-1
AVIBANK 210 SOUTH VICTORY BLVD BURBANK, CA 91503	84256	56944-1	

ENGRG REF: LAST DATUM LETTER USED: B
ENGRG REF: LAST VIEW/SECTION LETTER USED: A

THIRD ANGLE PROJECTION

CONTRACT NO. NAS15-10000
02-12-20
03-04-01
McDONNELL DOUGLAS
NUT, RAPID ASSEMBLY
SPEC CONTROL DWG
SIZE E | CAGE CODE 18355 | DRAWING NO. 1F44595
SHEET 1 OF 2
1F44595-1

CM1 NO.: 1F44595d-010202.prt
LAYOUT NO.: none

Consolidated Laboratories, Inc.
732 Arrow Grand Circle
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(626) 915-8991
FAX (626) 966-3156

April 10, 1998

TEST REPORT

Almay Research & Testing Corporation
1415 Newton Street
Los Angeles, California 90021

Subject: Vibration Test on Eight (8) Specimens of P/N 1F44595 (TTI P/N 050006), Rapid Assembly Nut, S/N's 3006, 3010, 3021, 3023, 3030, 3031, 3039 and 3040

This will certify that the units above were subjected to the Vibration Test of the referenced documents in this Laboratory in the manner and with results as described below:

1. **REFERENCES**

1.1 Purchase Order No. 988 dated 3/11/98 from Almay Research & Testing Corporation.

1.2 Thread Technology, Inc. Document No. 050016, Rev. C, dated 3/11/98: Acceptance/Qualification Test Plan and Procedure For ½-20UNJF-3B ZipNut P/N 050006 and MDA 1F44595.

1.3 McDonnell Douglas Drawing No. 1F44595, Rev. D: Nut, Rapid Assembly.

2. **PURPOSE** -- The purpose of this test program was to subject the units to the Vibration Test of Reference 1.2, Paragraphs 05-000 & 06-000 and Reference 1.3, Notes 29 & 31 - 36. Four of the units (S/N's 3006, 3021, 3030 & 3039) were to be assembled onto the mating bolt, torqued to 1,125 ± 200 in-lb and monitored for rotation during the test. The remaining four units were to be held in place with ⅜" (non-mating) bolts. The units were to be examined for physical damage and returned to Almay after completion of the test program.

3. **SUMMARY** -- The units were subjected to the Vibration Test as required. The procedures and results of the test are shown on the laboratory instruction/ data sheet which is reproduced as Page 3 of this report. S/N's 3006, 3021, 3030 & 3039 exhibited no rotation in excess of 30°. Examination of the units after completion of testing disclosed no visible evidence of damage or deterioration as a result of the test conditions. The units were considered to have passed the Acceptance Random Vibration Test as conducted in this Laboratory and were returned to Almay for disposition.

Test By: **L. L. Frye**	Concurred:
Report By: **D. D. Huff**	DCMAO Quality Assurance Representative

Prepared By: _____
Dale D. Huff, Test Engineer

REGISTERED PROFESSIONAL ENGINEER
PHILIP MICHAEL HARTY
NO. 19959
Exp. 9-30-00
MECHANICAL
STATE OF CALIFORNIA

Approved By: _____
P. M. Harty, P. E., Laboratory Director

Consolidated Laboratories, Inc.
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TEST REPORT

4. **TEST EQUIPMENT** -- The following items of test equipment, maintained within the current applicable calibration period, were used to conduct the tests:

-Accelerometer: Endevco Model 2246M4, S/N HB91, ID/N 2106-24, 13.64 pC/g, ±5.6%. Calib. due 6-1-98, 6 mos. Used with Endevco Model 2721B, S/N CJ82, ID/N 2104-1, charge amplifier. Calib. due 5-12-98, 6 mos. Used to monitor and control vibration input levels.

-Torqometer: Snap-On Model TE100L, ID/N 304, 0 to 100 foot-pounds, torque meter. Calib. due 8-8-98, 12 mos.

-Vibration Exciter: MB Model C-50, S/N 168, ID/N 2005, with MB Model T451-B power amplifier, S/N 119, ID/N 2008, rated at 5000 force pounds. Used with Hewlett-Packard Model 5427A, S/N 282, ID/N 2006, vibration control system. Calib. due 5-5-98, 6 mos.

HP

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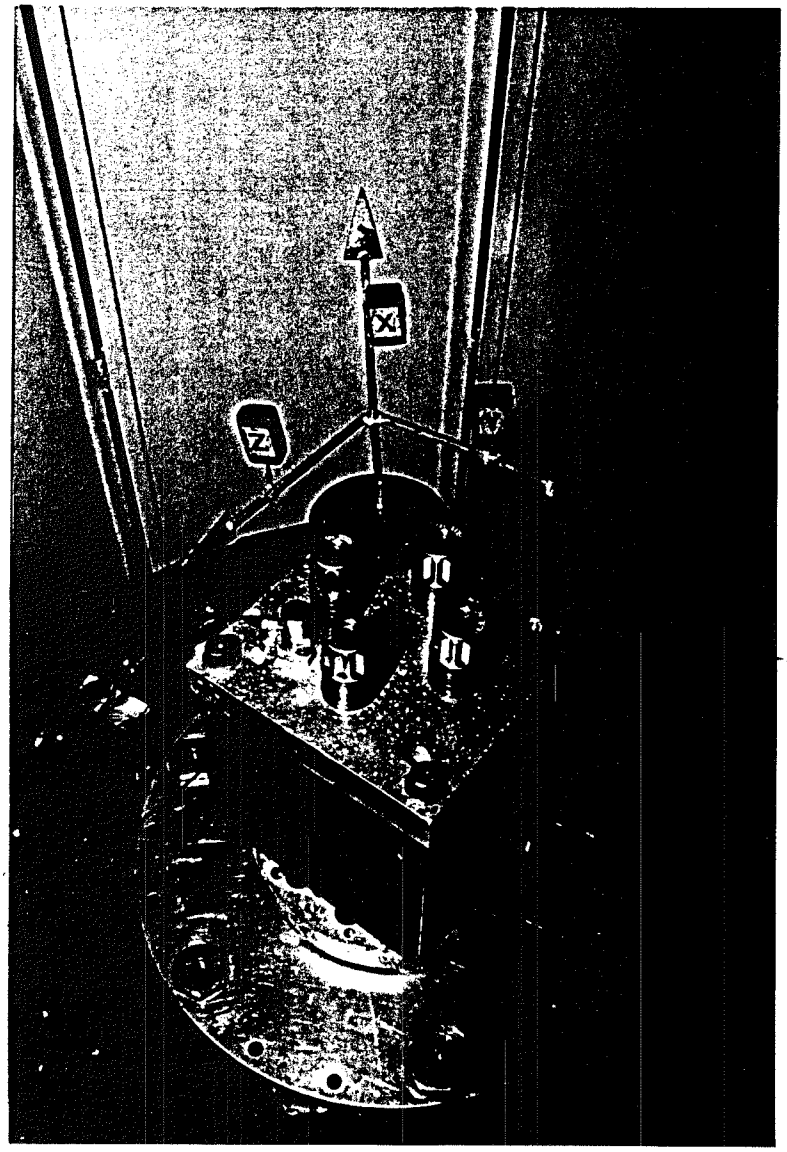
TEST REPORT

VIBRATION TEST SETUP

(X Axis; S/N's 3006, 3021, 3030 & 3039)



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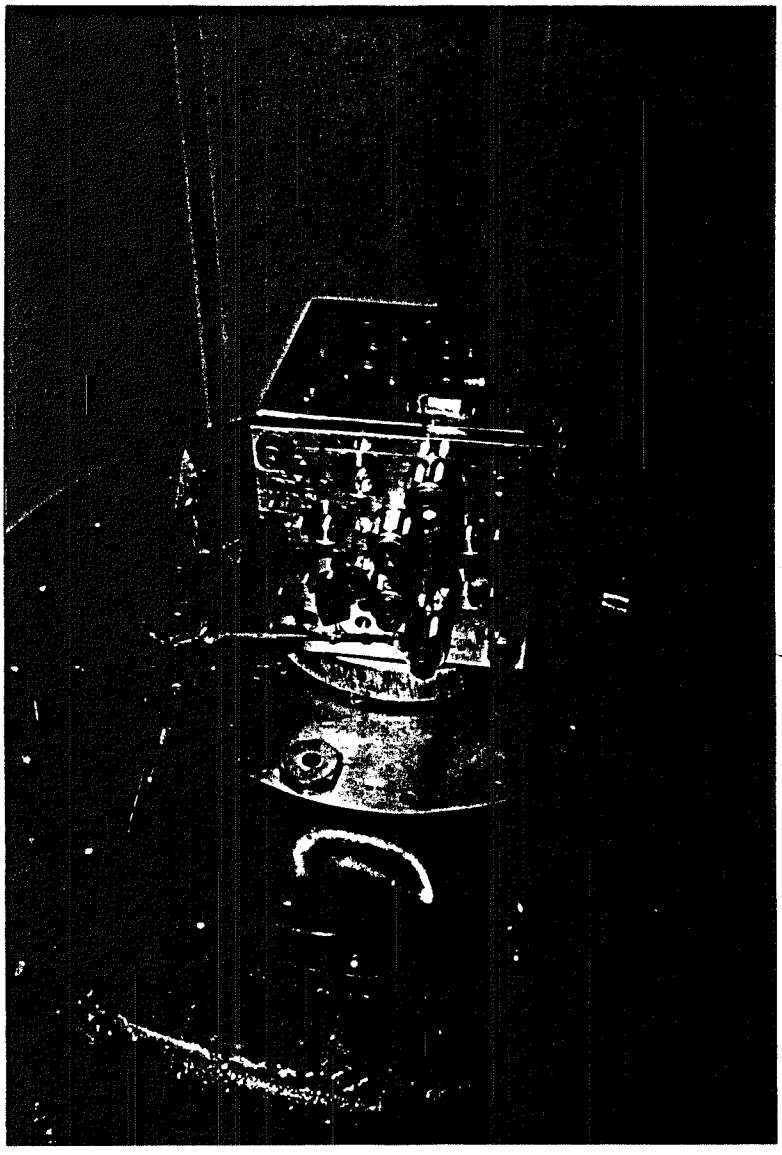
TEST REPORT

VIBRATION TEST SETUP

(Y Axis; S/N's 3010, 3023, 3031 & 3040)



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LAB DATA SHEET

Part No. 1F44595 S/N 3006, 3010, 3021, 3023, 3030, 3031, 3039 & 3040 Sample 1 - 8 Job 8746
Description Rapid Assembly Nut Co. Almay
Page 1.0

TEST: VIBRATION		Start	Cptd
To Spec: 050016, Rev. C, Paras. 05-000 & 06-000; Dwg. No. 1F44595, Rev. D, Notes 29 & 31 - 36	Date	MAR 23 1998	MAR 23 1998
	Test By		
	Photo	✓	

Photo Req'd YES

CLI 15 CLI 5 INSP

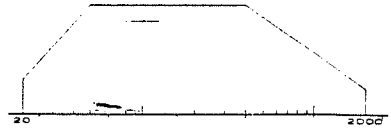
1. Axis Identification:

   X -- Parallel to the axis of bolt insertion through the nut.
   Y -- At random radially to the body of the nut.
   Z -- Mutually perpendicular to the X and Y Axes.

2. Assemble four of the nuts (S/N's 3006, 3021, 3030 & 3039) onto the mating bolt through an appropriate fixture plate until seated against the washers and tighten finger tight. Gradually tighten to 1,125 ± 200 in-lb and then mark the units in order to observe rotation as a result of the vibration. Secure the fixture plate to a vibration cube. Mount the composite assembly on the head of the vibration exciter, with the axis under test being changed by changing the orientation of the fixture plate on the cube. Mount a control accelerometer on the fixture plate adjacent to the mounting interface of the units. As a minimum, the accelerometer signal shall be recorded on magnetic instrumentation tape during all test runs.

3. Subject the units to the following levels of random vibration.

Hz	PSD, g^2/Hz	Slope, dB/Oct
20	0.04	----
50	0.80	+9.8
400	0.80	----
2000	0.028	-6.3



Tolerances
20 - 2000 Hz; ±2 dB
Overall: 23.1 g_{rms} ± 10%

On each axis, equalize and vibrate the unit for 510 ± 5.1 seconds at the full level listed above. Make a computer print-out of the control equalization for each axis of vibration. Check off O.K. completion below:

X Axis ✓ Y Axis ✓ Z Axis ✓

Any visible evidence of physical damage? NO

Any rotation in excess of 30°? NO CLI 15 CLI 5 INSP

4. Assemble the other four nuts (S/N's 3010, 3023, 3031 & 3040) to an appropriate fixture plate using 3/8 inch bolts. Secure the fixture plate to the vibration cube on the head of the vibration exciter, as stated in Step 2, above, and repeat the procedures of Step 3, above. Check off O.K. completion below:

X Axis ✓ Y Axis ✓ Z Axis ✓

Any visible evidence of physical damage? NO CLI 15 CLI 5 INSP

H P DDH

5. List test equipment used on the Test Equipment List, attached.

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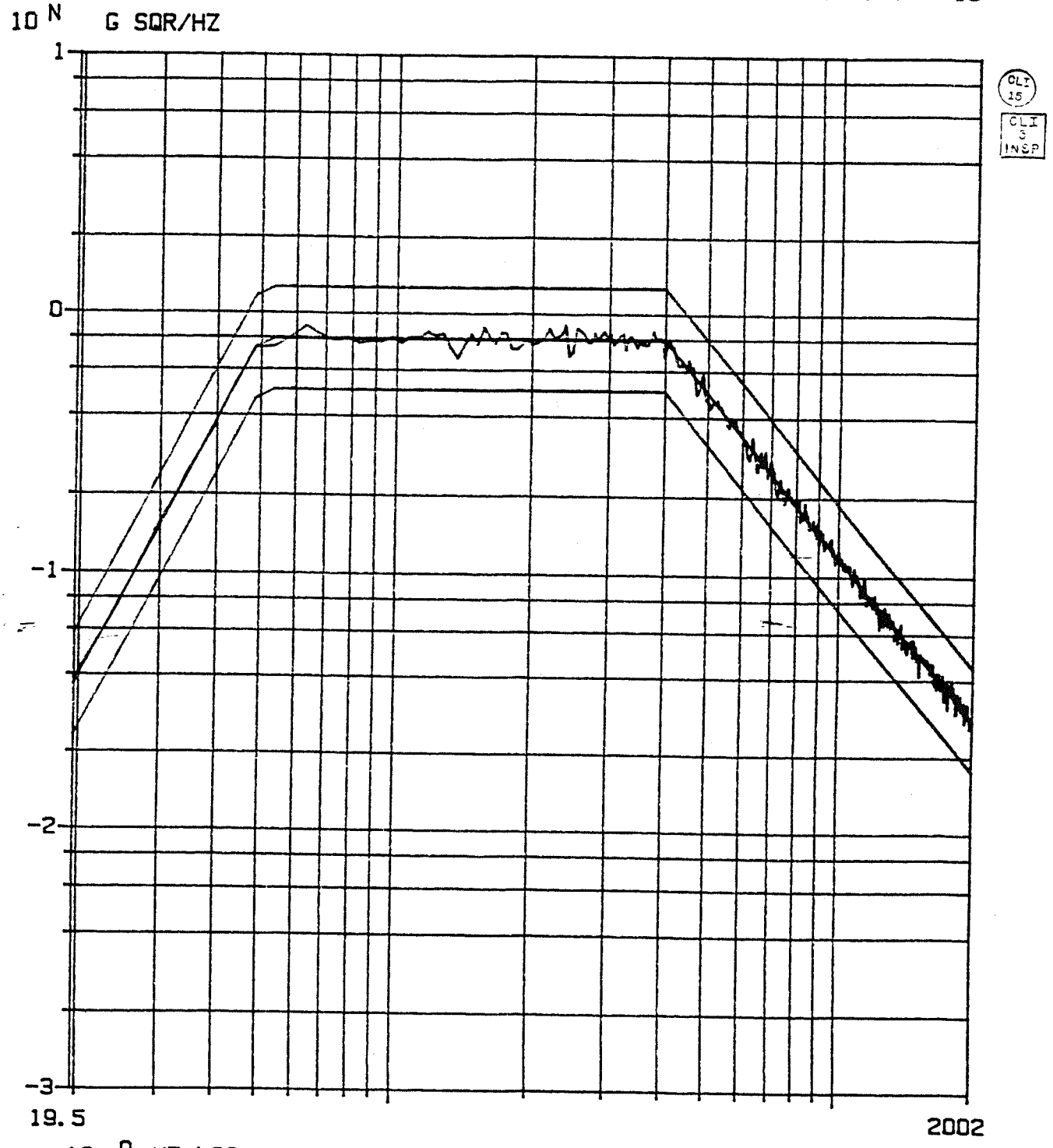
TEST REPORT

MAR 2 3 1998

P/N 1F44595 S/N 3006, 3021, 3030, 3039 RANDOM VIBRATION X AXIS

POST TEST ELAPSED TIME = 511 SECS AT .00 DB

RMS LEVEL = 22.99 G'S DELTA F = 4.883 DOF= 304 AWF= 10



CLI 15

CLI G INSP

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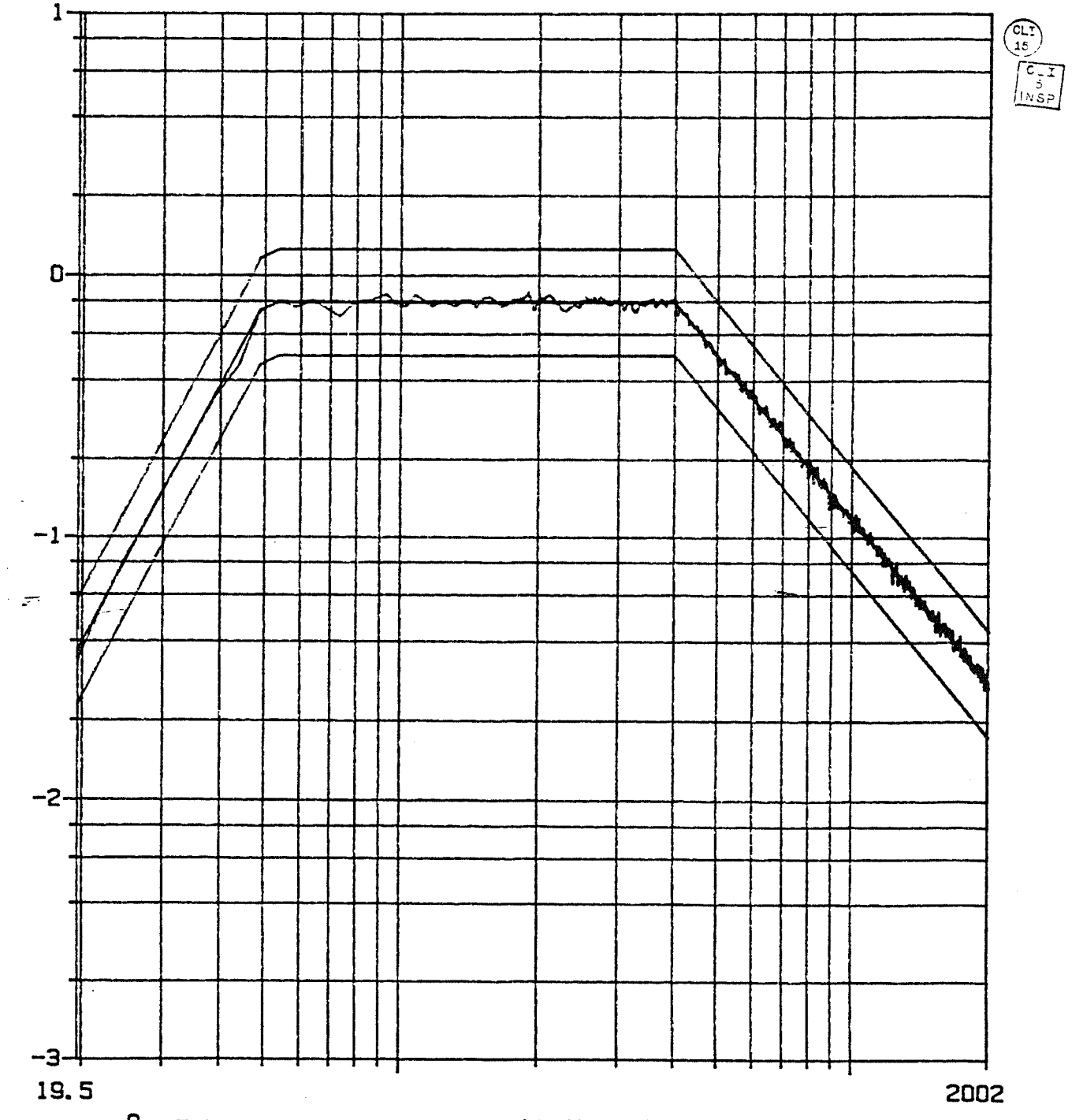
TEST REPORT

MAR 2 3 1999

P/N 1F44595 S/N 3006, 3021, 3030, 3039 RANDOM VIBRATION Y AXIS
POST TEST ELAPSED TIME = 511 SECS AT .00 DB
RMS LEVEL = 23.03 G'S DELTA F = 4.883 DOF= 304 AWF= 10
10 N G SQR/HZ



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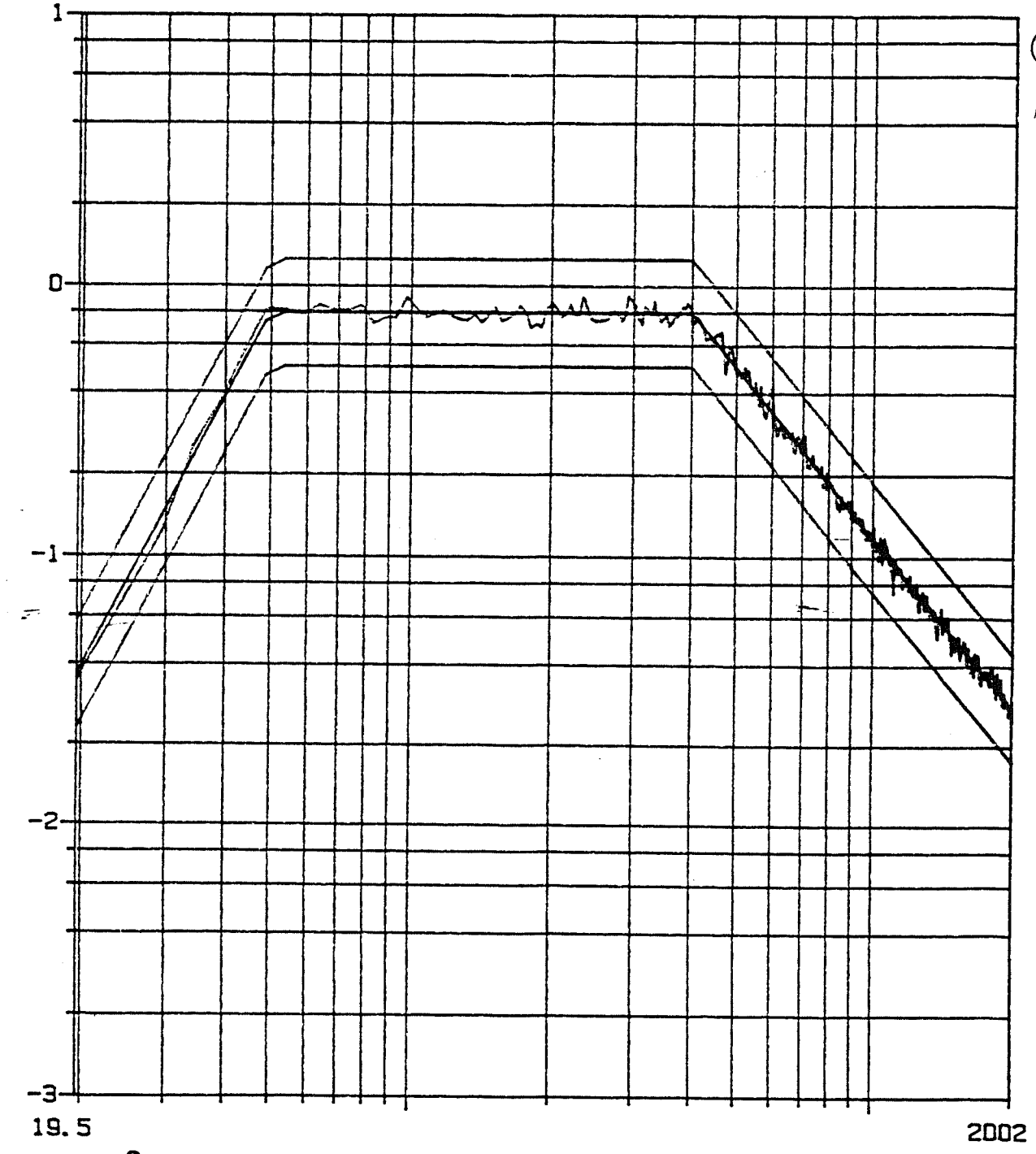
TEST REPORT

MAR 2 3 [illegible]

P/N 1F44595 S/N 3006, 3021, 3030, 3039 RANDOM VIBRATION Z AXIS
POST TEST ELAPSED TIME = 511 SECS AT .00 DB
RMS LEVEL = 23.06 G'S DELTA F = 4.883 DOF= 304 AWF= 10
10 N G SQR/HZ



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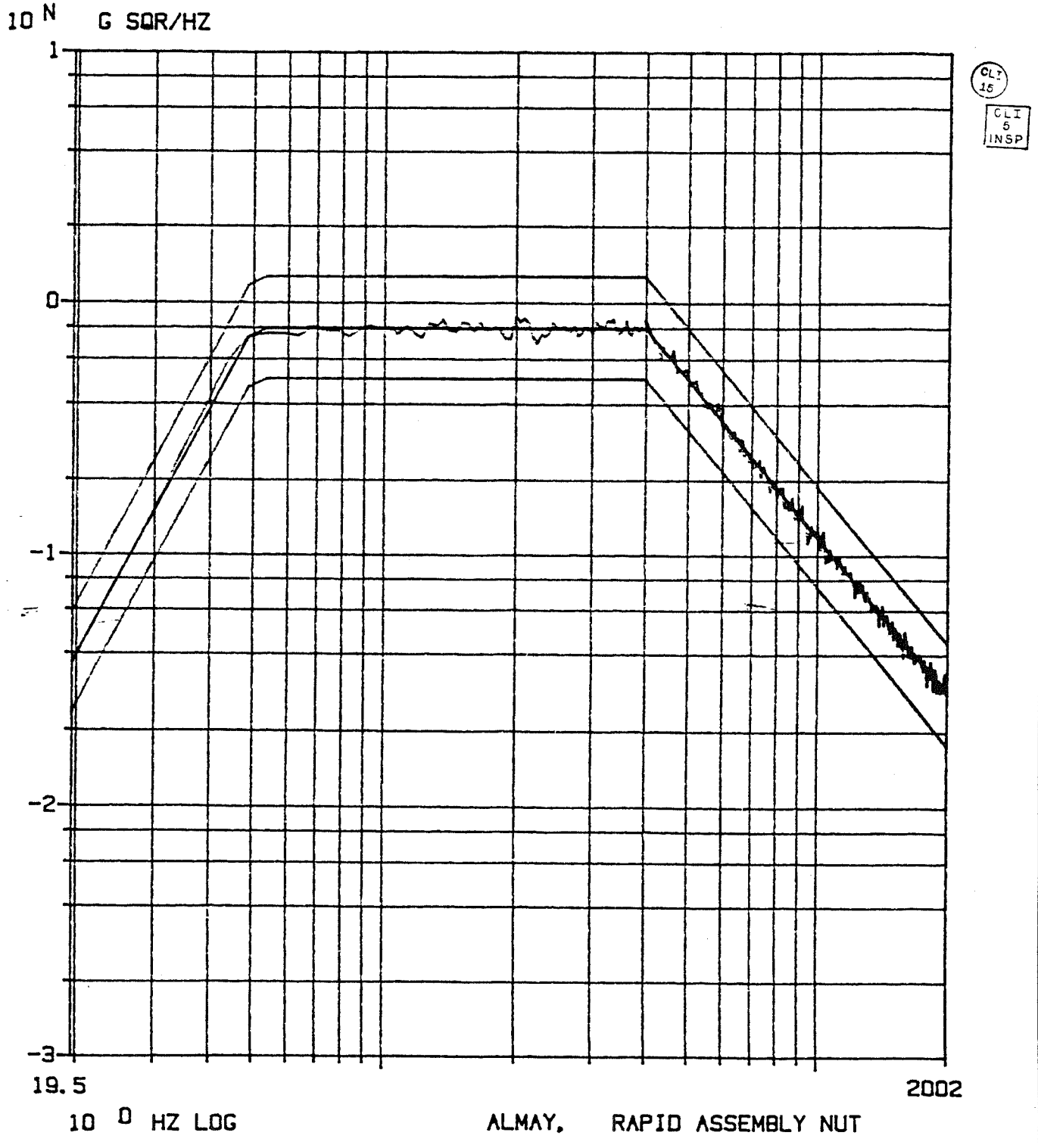
TEST REPORT

MAR 2 3 1999

P/N 1F44595 S/N 3010, 3023, 3031, 3040 RANDOM VIBRATION X AXIS
POST TEST ELAPSED TIME = 511 SECS AT .00 DB
RMS LEVEL = 23.03 G'S DELTA F = 4.883 DOF= 304 AWF= 10



CLI 15

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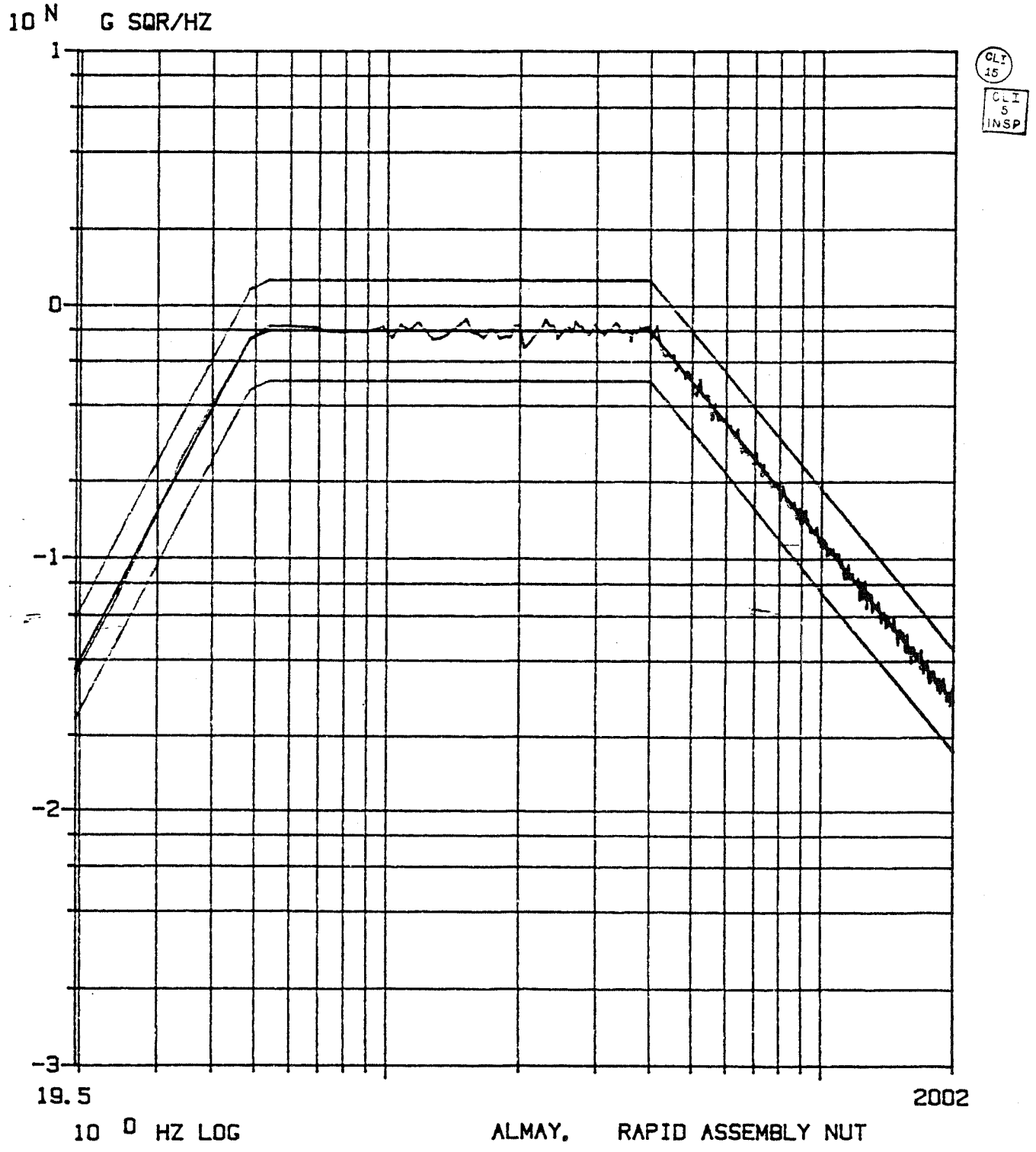
TEST REPORT

MAR 2 3 1999

P/N 1F44595 S/N 3010, 3023, 3031, 3040 RANDOM VIBRATION Y AXIS
POST TEST ELAPSED TIME = 511 SECS AT .00 DB
RMS LEVEL = 23.06 G'S DELTA F = 4.883 DOF= 304 AWF= 10



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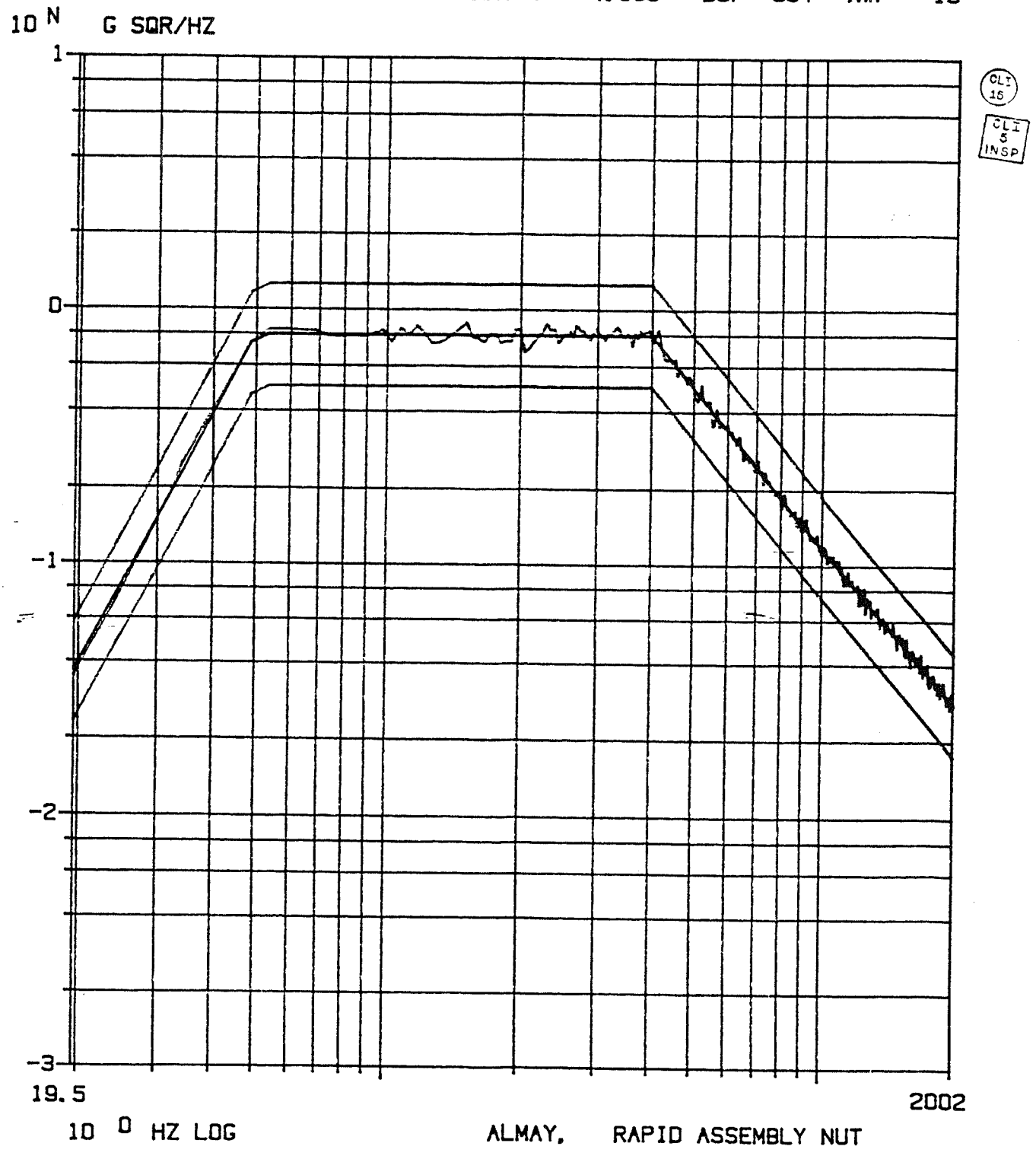
TEST REPORT

MAR 2 3 1998

P/N 1F44595 S/N 3010, 3023, 3031, 3040 RANDOM VIBRATION Z AXIS
POST TEST ELAPSED TIME = 511 SECS AT .00 DB
RMS LEVEL = 23.06 G'S DELTA F = 4.883 DOF= 304 AWF= 10



CLI 16

CLI 5 INSP

REPORT NO. C 27150-1

RESULTS OF PRODUCTION ACCEPTANCE TEST
EVALUATION OF McDONNELL DOUGLAS
P/N 1F44595, REV. E (TTI P/N 050006)
RAPID ASSEMBLY NUTS (ZIP NUTS), LOT NO. 4,
SUBMITTED BY THREAD TECHNOLOGY, INC.,
STERLING, VIRGINIA

June 3, 1998
(Corrected June 9, 1998 for S/N 4059)

S 61608 1 6-10-98

Thread Technology, Inc. P.O. No. 1759 T.O.

(Ref: McDonnell Douglas P.O. No. 78990891
NASA Contract 15-10000)

VERIFIED CORRECTIONS 6/12/98

by _____
Harry S. Brenner, P.E.
Director of Research

Defense Logistics Agency
Defense Contract Management Command

/s/ _____
Tom Osborn
Quality Assurance Representative
DCMDW-GAODA

The Boeing Company
Space Systems Division

/s/ _____
Joseph M. Campa II
Quality Engineer
Procurement Quality
Assurance

S 61608 1

PACKING LIST NO.

PL 27150-1A

ALMAY RESEARCH & TESTING CORPORATION

1415 Newton Street, Los Angeles, California 90021
Area Code 213, Phone 746-1555

SOLD TO THE BOEING COMPANY
SPACE SYSTEMS DIVISION
5301 Bolsa Avenue
Huntington Beach, CA 92647

SHIPPED TO:
ATTN:
Mr. Paul Smudde
MS: H017-D605

CUST. ORDER NO.	SHIPPING DATE	SHIPPED VIA	INVOICE DATE	TERMS
Thread Technology 1759	6/8/98	Almay Delivery		1% 10 DAYS / NET 30

ITEM	ALMAY REPORT NO.	DESCRIPTION	UNIT PRICE	AMOUNT
1.	C 27150-1	One (1) copy, Almay Test Report, "Results of Production Acceptance Test Evaluation of McDonnell Douglas P/N 1F44595, Rev. E (TTI P/N 050006) Rapid Assembly Nuts (Zip Nuts), Lot No. 4, Submitted by Thread Technology, Inc., Sterling, Virginia"		
2.		Twenty (20) each, Lot No. 4 Rapid Assembly Nuts (Zip Nuts) and mating test bolts, used in support of above production acceptance test program, and authorized by Thread Technology, Inc. for direct return to The Boeing Company		
		Received by_____		
		Date_____		

ITEMIZED MEMORANDUM OF SHIPMENT

INTRODUCTION

Thread Technology, Inc., 22455 Davis Drive, Sterling, Virginia 20164 forwarded twenty (20) samples of a special design nut for production acceptance test evaluation of performance properties. The nut was identified as a 'Rapid Assembly Nut' conforming to McDonnell Douglas Aerospace Spec. Control Drawing 1F44595, Rev. E. The nut manufacturer, Thread Technology, identified the nut as the "ZIP NUT", under TTI Part Number 050006. It was noted that the "Zip Nuts" were intended for use in the construction and assembly of the International Space Station.

The applicable Purchase Order from Thread Technology, Inc. outlined the Acceptance Test Plan in TTI Document No. 050016 dated 3/11/98 for the MDA 1F44595-1 (TTI P/N 050006) "Zip Nuts". In addition, all tests were to be witnessed by the Defense Contract Management Command, and by The Boeing Company (formerly McDonnell Douglas Aerospace (MDA)). The comprehensive test program was was witnessed and monitored by the following representatives at Almay:

Defense Logistics Agency
Defense Contract Management Command

Mr. Tom Osborn

The Boeing Company
Space Systems Division

Mr. Joseph M. Campa II

The physical test program was initiated on May 20, 1998, and all tests completed on June 2, 1998. The "ZIP NUTS" included in this phase of the performance test evaluation were identified as production LOT No. 4. The test program was outlined to observe the Sequences and test procedures referenced in TTI Document No. 050016, Rev. C. All test equipment, fixtures, gages, etc. used in support of the evaluation testing were in current calibration conforming to the requirements of the ALMAY "Quality System Manual (QSM)" dated 6/2/97, designed to satisfy requirements of MIL-Q-9858A and ISO 9003.

TEST PROCEDURE

Almay Test Report No. C 27150 dated April 14, 1998 covered the detailed 'qualification' tests conducted on LOT NO. 3 P/N 1F44595-1 (TTI P/N 050006) "ZIP NUTS". The report included photographs of the test parts, test equipment used, typical fixturing and test set-ups, specimens after test evaluation, etc. Also, all test procedures were detailed in compliance with the requirements and objectives of the TTI Document No. 050016. The production acceptance tests of LOT NO. 4 covered by this report utilized the same test equipment, fixturing, and gages as noted in C 27150. In addition, the test procedures described in Report C 27150 were observed and followed in conducting these tests on LOT NO. 4. Accordingly, by reference, Almay Report No. C 27150 is made a part of this production acceptance report.

The "ZIP NUTS" representing production Lot No. 4 were serialized by Thread Technology, Inc., and are identified in Table 1. On the recommendation of The Boeing Company engineering representative, assignment of specimen numbers for the various test sequences was made at random. The Test Flow and applicable Specimen Identification numbers for this test program are shown in Figure 1. Care was exercised to maintain specimen identifications for the complete evaluation test program.

As a special condition for this test project, the test bolts were required to have a minimum hardness of Rc 36, and a minimum thread length of 0.800-inches. For the evaluation of LOT NO. 3, Boeing Standard BAC B30LE Series Bolts were employed, which were fabricated from A286 CRES having a minimum tensile strength of 200 ksi. For this particular project, Boeing Standard BAC B30US series bolts were utilized as also meeting the required thread length. The bolts were fabricated from Inconel 718 CRES, and developed a minimum tensile strength of 220 ksi. All test bolts were treated to provide a dry film lubricant finish, which was requested by The Boeing Company.

TABLE NO. 1.

IDENTIFICATION OF RAPID ASSEMBLY NUTS (ZIP NUTS)
RECEIVED FROM THREAD TECHNOLOGY, INC. FOR PRODUCTION
ACCEPTANCE TEST EVALUATION

Specimen No. 2/	TTI SERIAL NUMBER	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size 1/ (UNJF-3B)	Lot Number	Test Procedure
1	4001	1F44595-1 Rev. E	050006	.5000-20	4	TTI Document 050016, Rev. C
2	4002	"	"	"	4	"
3	4004	"	"	"	4	"
4	4009	"	"	"	4	"
5	4015	"	"	"	4	"
6	4017	"	"	"	4	"
7	4029	"	"	"	4	"
8	4032	"	"	"	4	"
9	4038	"	"	"	4	"
10	4048	"	"	"	4	"
11	4050	"	"	"	4	"
12	4060	"	"	"	4	"
13	4064	"	"	"	4	"
14	4065	"	"	"	4	"
~~15~~	~~4069~~	"	"	"	4	"
16	4072	"	"	"	4	"
17	4075	"	"	"	4	"
18	4081	"	"	"	4	"
19	4083	"	"	"	4	"
20	4086	"	"	"	4	"
15	4059	"	"	"	4	"

NOTES:

1/ "Zip-Nut" Rapid Assembly Nut with thread elements fabricated from 15-5PH CRES, and outer body fabricated from A286 CRES, conforming to Thread Technology, Inc. Drawing No. 050006, Rev. E.

2/ Specimen No. 15 erroneously identified as "S/N 4069". Correct S/N is "4059", per TTI confirmation.

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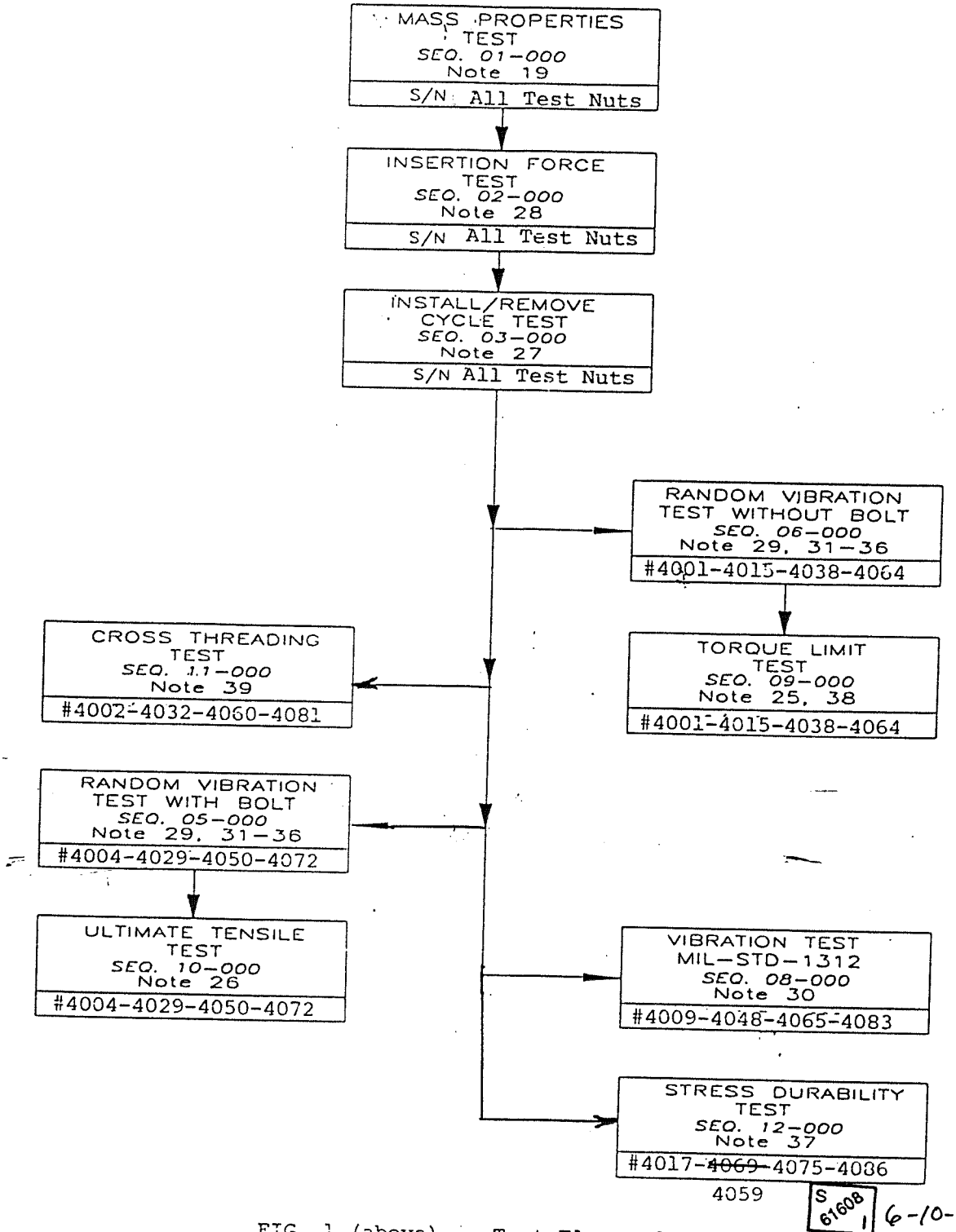

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FIG. 1 (above).- Test Flow and Specimen identification for Lot No. 4 'ZIPNUTS' per TTI Document No. 050016, Rev. C

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All tests outlined in Thread Technology, Inc. Document No. 050016 were conducted at Almay, with the exception of the random Vibration tests. The two series of Random Vibration tests were performed at Consolidated Laboratories, Inc., under the supervision of Almay, The Boeing Company, and the Defense Contract Management Command. The results of the Random Vibration tests are presented in Consolidated Laboratories, Inc. Report No. 8914 dated May 29, 1998, and is attached as an Appendix to this Report.

TEST RESULTS

The results of the various tests conducted on the MDA P/N 1F44595-1 (TTI P/N 050006) Rapid Assembly Nuts for LOT NO. 4 are summarized in the following Tables:

Table No. 2 - Results of Weight (Mass Property) Tests

Table No. 3 - Results of 2^{o} Insertion Force Tests

Table No. 4 - Results of 10-Cycle Installation/Removal Tests

Table No. 5 - Results of MIL-STD-1312 Accelerated Vibration Tests

Table No. 6 - Results of Torque Limit Tests

Table No. 7 - Results of Ultimate Tensile Strength Tests

Table No. 8 - Results of Cross-Threading Tests

Table No. 9 - Results of Stress Durability Tests

Random Vibration Tests - Consolidated Report No. 8914

COMMENTS

The results of the comprehensive tests conducted on the MDA P/N 1F44595-1 (TTI P/N 050006) Rapid Assembly Nuts indicate that all test nuts representing Lot No. 4 exhibit an ability to meet and/or exceed all rated performance requirements referenced in MDA Spec. Control Drawing 1F44595, and

TTI Document 050016. No cracks, deformation, or fractures were observed with any of the critical tests noted in this report.

Of particular interest in evaluating the performance of LOT NO. 4 is the difference in bolt strength level, as compared with the tests conducted on LOT NO. 3. For Lot No. 3, BAC B30LE8 Series bolts were employed, rated at 200 ksi, and fabricated from A286 CRES. For Lot No. 4, BAC B30US8 Series bolts were used, rated at 220 ksi, and fabricated from INCO 718 CRES. Higher ultimate tensile strength properties were developed with the BAC B30US8 series bolts, with the "ZIP NUTS" developing the full rated strength of the bolts by breaking the bolts in the threads (Table No. 7). Similarly, higher Induced Tensile Clamp Loads were observed in the Torque Limit tests (Table No. 6). It is possible that the lubricity of the dry film lube coating may have influenced the Clamp Load values. However, it is an indication that the Lot No. 4 "Zip Nuts" have the capability of matching the performance of 220 ksi INCO 718 CRES bolts.

The above information is submitted for the information and use of Thread Technology, Inc.

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TABLE NO. 2.

RESULTS OF WEIGHT (MASS PROPERTY) TESTS OF
MDA P/N 1F44595, REV. E (TTI P/N 050006) LOT #4
RAPID NUT ASSEMBLIES

Almay Serial No. 5/	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	Maximum Permissible Weight (lb) 2/	Actual Nut Weight (grams) 4/	Equivalent Nut Weight (lb) 3/ 4/
4001	1F44595-1 Rev. E	050006	.5000-20	0.16	59.1	0.1303
4002	"	"	"	"	59.2	.1305
4004	"	"	"	"	59.1	.1303
4009	"	"	"	"	59.4	.1310
4015	"	"	"	"	59.5	.1312
4017	"	"	"	"	58.9	.1299
4029	"	"	"	"	58.9	.1299
4032	"	"	"	"	59.4	.1310
4038	"	"	"	"	59.2	.1305
4048	"	"	"	"	59.0	.1300
4050	"	"	"	"	58.1	.1281
4060	"	"	"	"	59.1	.1303
4064	"	"	"	"	59.2	.1305
4065	"	"	"	"	59.5	.1312
~~4069~~	~~"~~	~~"~~	~~"~~	~~"~~	~~59.1~~	~~.1303~~
4072	"	"	"	"	59.5	.1312
4075	"	"	"	"	58.8	.1296
4081	"	"	"	"	59.1	.1303
4083	"	"	"	"	59.5	.1312
4086	"	"	"	"	59.0	.1300
4059	"	"	"	"	59.1	.1303

NOTES:

1/ "Zip Nut" Rapid Nut Assembly with thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES, conforming to Thread Technology Inc. Drawing No. 050006.

2/ Maximum Nut permissible weight per Note 19, MDA Spec. Control Drawing 1F44595, Rev. E.

3/ Test nuts are within maximum weight limit, and conform to Note 19, Spec. Control Dwg. 1F44595.

4/ Mass Property tests conducted on May 20, 1998 in accordance with Sequence No. 01-000, TTI Document No. 050016, Rev. C dated 3/11/98. Tests conducted using W.M.Welch Scientific Scale.

5/ Serial No. '4069' should be Serial No. '4059', per TTI correction.

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TABLE No. 3

RESULTS OF 2° INSERTION FORCE TESTS OF
MDA P/N 1F44595 REV E (TTI P/N 050006)
LOT #4 RAPID NUT ASSEMBLIES

Almay Serial No. 5/	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	Maximum Permissible Insertion Force (lb) 2/	2° TEST INSERTION FORCE (lb) 3/	COMMENTS
4001	1F44595-1 Rev. E	050006	.500-20	5	4.8	Acceptable
4002	"	"	"	"	3.8	Acceptable
4004	"	"	"	"	4.0	Acceptable
4009	"	"	"	"	4.4	Acceptable
4015	"	"	"	"	3.9	Acceptable
4017	"	"	"	"	3.5	Acceptable
4029	"	"	"	"	4.2	Acceptable
4032	"	"	"	"	4.3	Acceptable
4038	"	"	"	"	3.8	Acceptable
4048	"	"	"	"	4.1	Acceptable
4050	"	"	"	"	4.3	Acceptable
4060	"	"	"	"	4.2	Acceptable
4064	"	"	"	"	3.8	Acceptable
4065	"	"	"	"	3.7	Acceptable
~~4069~~	"	"	"	"	~~3.6~~	~~Acceptable~~
4072	"	"	"	"	4.9	Acceptable
4075	"	"	"	"	4.1	Acceptable
4081	"	"	"	"	3.9	Acceptable
4083	"	"	"	"	4.2	Acceptable
4086	"	"	"	"	~~3.7~~	Acceptable
4059	"	"	"	"	3.6	Acceptable

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NOTES:

1/ "Zip-Nut" Rapid Nut Assembly with Thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Inc. Drawing. Co. 050006.

2/ Maximum insertion force at engagement angle of 2° maximum per Note 28, MDA Spec. Control Dwg. 1F44595, Rev. E.

3/ Tests conducted installing P/N BAS B30US8U22 dry film coated bolts thru steel bushing into P/N 1F44595-1 Rapid Nut assembly seated against 2° face. Installation force measured using Chatillon Model DPP10 (0-10lb) Force Gage.

4/ Insertion Force Tests conducted on May 21, 1998 in accordance with Sequence No. 02-000, TTI Document No. 050016, Rev. C dated 3/11/98.

5/ Serial No. '4069' should be Serial No. '4059', per TTI correction.

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TABLE No. 4

RESULTS OF 10-CYCLE INSTALLATION/REMOVAL TESTS OF MDA P/N 1F44595-1 (TTI P/N 050006), LOT #4 RAPID NUT ASSEMBLIES

Serial No. 2/ 5/	McDonnell Douglas Aerospace Part No 1/	Nominal Thread Size UNJF-3B	SEATED INSTALLATION TORQUE (in-lb) 3/										COMMENTS
			Cycle #1	Cycle #2	Cycle #3	Cycle #4	Cycle #5	Cycle #6	Cycle #7	Cycle #8	Cycle #9	Cycle #10	
	1F44595-1 Rev. E												
4001	(TTI 050006)	.5000-20	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
4002	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
4004	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
4009	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
4015	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
4017	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
4029	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
4032	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
4038	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
4048	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
4050	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
4060	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
4064	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
4065	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
~~4069~~ 4059	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
4072	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
4075	S 61608 I "	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
4081	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
4083	6-10-98 "	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
4086	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure

NOTES:

1/ "Zip Nut" Rapid Nut Assembly with thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Drawing 050006.

2/ Serial number identification as noted by Thread Technology, Inc.

3/ Installation - removal torque tests conducted using P/N BAC B30US8U22 dry film coated bolts thru square steel bushing (1.388" height). Zip Nuts torqued with Sturtevant 0-1200 in-lb Torque Wrench each cycle.

4/ Installation/Removal tests conducted on May 21, 1998 in accordance with Sequence No. 03-000, TTI Document No. 050016, Rev C dtd 3/11/98.

5/ Serial No. '4069' should be Serial No. '4059', per TTI correction.

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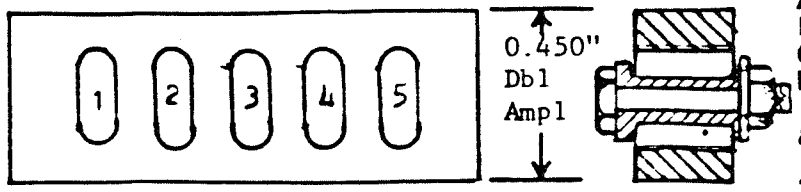
TABLE 5

RESULTS OF MIL-STD-1312 ACCELERATED VIBRATION TESTS OF MDA P/N 1F44595 (TTI P/N 050006) LOT #4 RAPID NUT ASSEMBLIES



TYPICAL MIL-STD-1312 VIBRATION FIXTURE

Specimen No.	TEST PART NUMBER 1/	Mating Test Fastener 2/	Assembly Torque 3/ (in-lb)	Test Amplitude 4/	Vibration Frequency (cpm) 4/	NUMBER OF TEST CYCLES	OBSERVED ROTATION
4009	1F44595-1 Rev E (TTI 050006)	B30US8U22	1125	0.450	1800	10,000	No Rotation
						20,000	No Rotation
						30,000	No Rotation
4048	1F44595-1 Rev E (TTI 050006)	B30US8U22	1125	.450	1800	10,000	No Rotation
						20,000	No Rotation
						30,000	No Rotation
4065	1F44595-1 Rev E (TTI 050006)	B30US8U22	1125	.450	1800	10,000	No Rotation
						20,000	No Rotation
						30,000	No Rotation
4083	1F44595-1 Rev E (TTI 050006)	B30US8U22	1125	.450	1800	10,000	No Rotation
						20,000	No Rotation
						30,000	No Rotation

NOTES:

1/ "Zip Nut" Rapid Nut Assembly with thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Drawing 050006.

2/ Test bolt was Boeing BAC B30US8U22 dry film coated INCO 718 CRES.

3/ Test nuts installed in vibration fixture per MIL-STD-1312, Test 7. Seating torque per Sequence No. 08-000, TTI Document No. 050016.

4/ Vibration tests conducted in Sonntag SF-10-U fatigue machine per test procedure of MIL-STD-1312, Test 7, on May 28, 1998.

5/ Maximum permissible rotation noted at 30° per Sequence 08-005. Test nuts conform to requirement without failure.

TABLE NO. 6

RESULTS OF TORQUE LIMIT TESTS OF MDA P/N 1F44595-1
(TTI P/N 050006) LOT #4 RAPID NUT ASSEMBLIES

Serial No. 3/	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	Mating Test Bolt 2/	Installation Torque (in-lb) 3/	Induced Tensile Clamp Load (lb) 3/ 4/
4001	1F44595-1 Rev. E	050006	.5000-20	B30US8U22	2,000	31,104
4015	"	"	"	"	2,000	34,224
4038	"	"	"	"	2,000	29,952
4064	"	"	"	"	2,000	33,216

NOTES:

1/ "Zip-Nut" Rapid Nut Assembly with thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Inc. Drawing.No. 050006.

2/ Test bolt was Boeing BAC B30US8U22 dry film coated INCO 718 CRES, rated at 220 KSI minimum tensile.

3/ Torque limit tests conducted on "Zip Nuts" previously subjected to random vibration tests without bolts (ref: Sequence 06-000). Torque limit test per Sequence 09-000, TTI Document No. 050016, Rev. C dated 3/11/98. Each "Zip Nut" installed in calibrated strain gaged load cell, and torqued to 2,000 in-lb. Induced tensile clamp load observed and recorded. Tests conducted on June 2, 1998.

4/ Examination of "Zip Nuts" after disassembly indicated no evidence of deformation or failure. All nuts functional and operable.

TABLE No. 7

RESULTS OF ULTIMATE TENSILE STRENGTH TESTS
OF MDA P/N 1F44595, REV. E (TTI P/N 050006)
LOT #4 RAPID NUT ASSEMBLIES

Specimen No. 2/	NUT PART NUMBER 1/	Nominal Thread Size	AXIAL TENSILE STRENGTH (lbs)		Type Failure 4/	Test Temp. °F
			Spec. Reqt. 3/	Test Nut 4/		
4004	1F44595-1 REV. E (TTI 050006)	.5000-20	27,500	45,500	Bolt Threads Break	Room
4029	"	"	"	45,500	Bolt Threads Break	"
4050	"	"	"	42,800	Bolt Threads Break	"
4072	"	"	"	41,000	Bolt Threads Break	"

NOTES:

1/ "Zip-Nut" Rapid Nut Assembly with Thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Inc. Drawing. No. 050006.

2/ Test Nuts previously subjected to random vibration test with mating bolts per Schedule 05-000, TTI Document 050016, Rev. C.

3/ Minimum axial tensile load requirement per Note 28, MDA Spec. Control Dwg. 1F44595.

4/ Test nuts tested with Boeing BAC B30US8 INCO 718 CRES Bolts. Each nut torqued to 1140 in-lb (95 ft-lb) prior to Tensile Test. Test conducted on May 28, 1998 in Satec 400 HV Universal Tensile Machine.

TABLE NO. 8

RESULTS OF CROSS-THREADING TESTS OF MDA P/N 1F44595-1 (TTI P/N 050006) LOT #4 RAPID NUT ASSEMBLIES

Serial No.	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	8° Installation 2/	2° Installation Torque (in-lb) 3/	COMMENTS 3/
4002	1F44595-1 Rev. E	050006	.5000-20	Nut engaged	840	No Failure
4032	"	"	"	Nut engaged	840	No Failure
4060	"	"	"	Nut engaged	840	No Failure
4081	"	"	"	Nut engaged	840	No Failure

NOTES:

1/ "Zip Nut" Rapid Nut Assembly with thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Inc. Drawing No. 050006.

2/ Cross-Threading test conducted in accordance with Sequence 11-000, TTI Document No. 050016, Rev. C dated 3/11/98. Boeing BAC B30US8U22 dry film coated INCO 718 CRES test bolt inserted in bushing fixture into "Zip Nut" seated at 8°. Test bolt successfully engaged nut approximately half-way into the nut.

3/ Special 6° wedge removed from bushing fixture leaving "Zip Nut" seated against 2° face of bushing. Installation torque applied from the bolt head until "Zip Nut" fully seated at 2°. After nut removal, examination indicated no evidence of deformation and/or fracture. Test nuts fully operable and functional on completion of test schedule. Tests conducted on June 2, 1998.

TABLE NO. 9

RESULTS OF STRESS DURABILITY TESTS OF MDA P/N 1F44595-1
(TTI P/N 050006) LOT #4 RAPID NUT ASSEMBLIES

Serial No. 5/	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	Installation Torque (in-lb) 2/	Induced Tensile Clamp Load (lb) 2/	No. of Hours at Load 3/	COMMENTS 3/ 4/
4017	1F44595-1 Rev. E	050006	.5000-20	1,920	21,984	96	No Failure
~~4069~~ 4059	"	"	"	1,800	21,840	96	No Failure
4075	"	"	"	1,800	21,504	96	No Failure
4086	"	"	"	1,800	21,888	96	No Failure

NOTES:

1/ "Zip-Nut" Rapid Nut Assembly with thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Inc. Drawing No. 050006.

2/ Stress Durability test conducted in accordance with Sequence 12-000, TTI Document No. 050016, Rev. C dated 3/11/98. "Zip Nut" installed on BAC B30US8U22 dry film coated INCO 718 CRES Bolt (220 KSI min. uts) in strain gaged load cell. Nut torqued to develop minimum tensile clamp load of 21,500 + 250 lb.

3/ Minimum exposure under load for stress durability test noted at 96-hours. Stress durability tests started on May 28, 1998, and disassembled on June 1, 1998.

4/ Examination of "Zip Nuts" after stress durability exposure indicated no evidence of cracks or failure of the nuts. Test nuts were functional and operable on completion of test exposure.

5/ Serial No. '4069' should be Serial No. '4059', per TTI correction.

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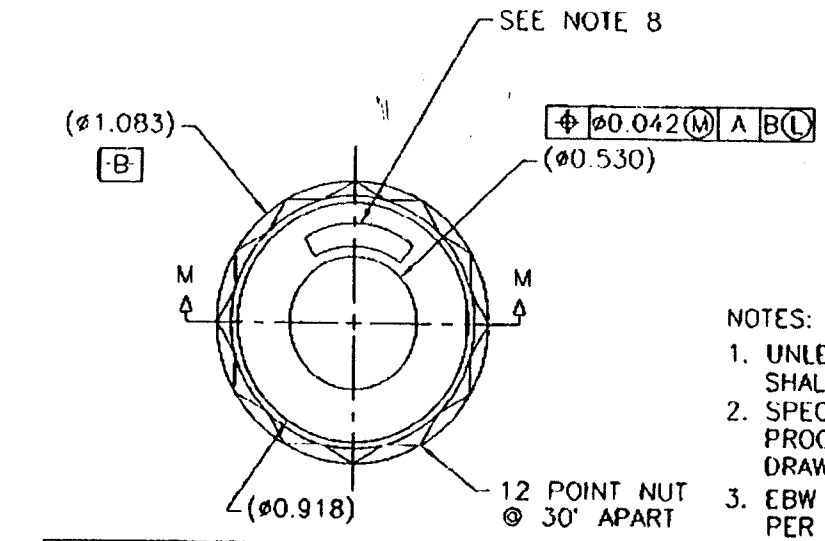
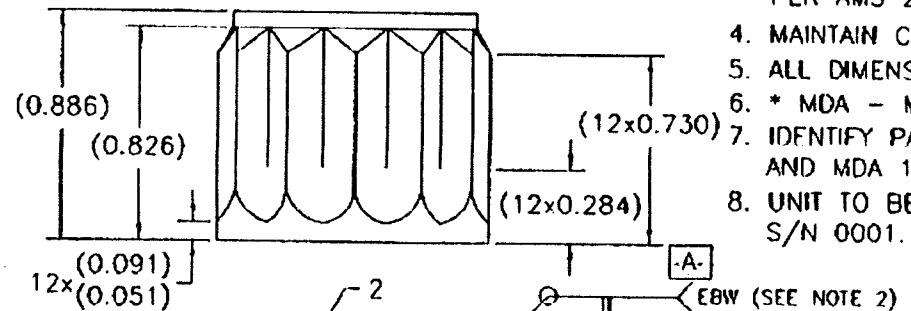
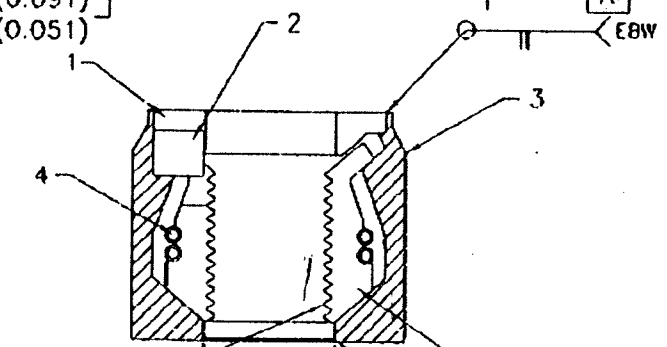
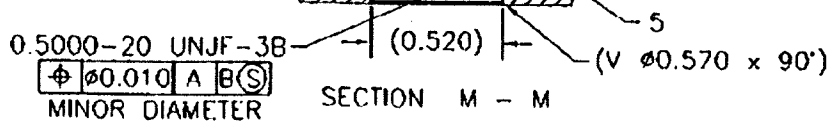
REV	REVISION DESCRIPTION	DATE	APPD
C	MDA DWG NO.CORR WAS IF44595 TO NOTE 1 TO 3., REPLACED NOTE 4. ADD NOTE 7 ECN 96-0190 EC 10/15/96	10/15/96	EC
D	CORRECTION IN NOTE 3 OF MDA P/N REPHRASE NOTE 5 FOR CLARITY ECN 96-0195 EC 11/6/96	11/6/97	EC
E	ADDED NOTE 8 TO SHOW SERIALIZE S/N PER CUSTOMER PO78990891, DEI MDA DWG REV LEV. ECN 98-0259 EC 1/21/98	1/21/98	









NOTES:

1. UNLESS OTHERWISE SPECIFIED MDA DWG NO. 1F44595 SHALL BE FURNISHED TOGETHER WITH THIS DRAWING.
2. SPECIFICATION REQUIREMENTS SUCH AS; MATERIAL, MFG. PROCESSES, TESTING, AND OTHERS SHALL BE PER MDA DRAWING 1F44595.
3. EBW PENETRATION SHALL BE 0.035 TO 0.045 IN. INSPECTED PER AMS 2681, MDA 1F44595 NOTE 21.
4. MAINTAIN CLEAN STP0416-01. REF. MDA 1F44595 NOTE 15.
5. ALL DIMENSIONS WITH ( ) ARE FOR REFERENCE ONLY.
6. * MDA - McDONNELL DOUGLAS AEROSPACE
7. IDENTIFY PART NUMBER AND LOT NUMBER PER MIL-STD-130, AND MDA 1F44595 NOTE 5.
8. UNIT TO BE SERIALIZE IN CONSECUTIVE ORDER. EXAMPLE: S/N 0001.

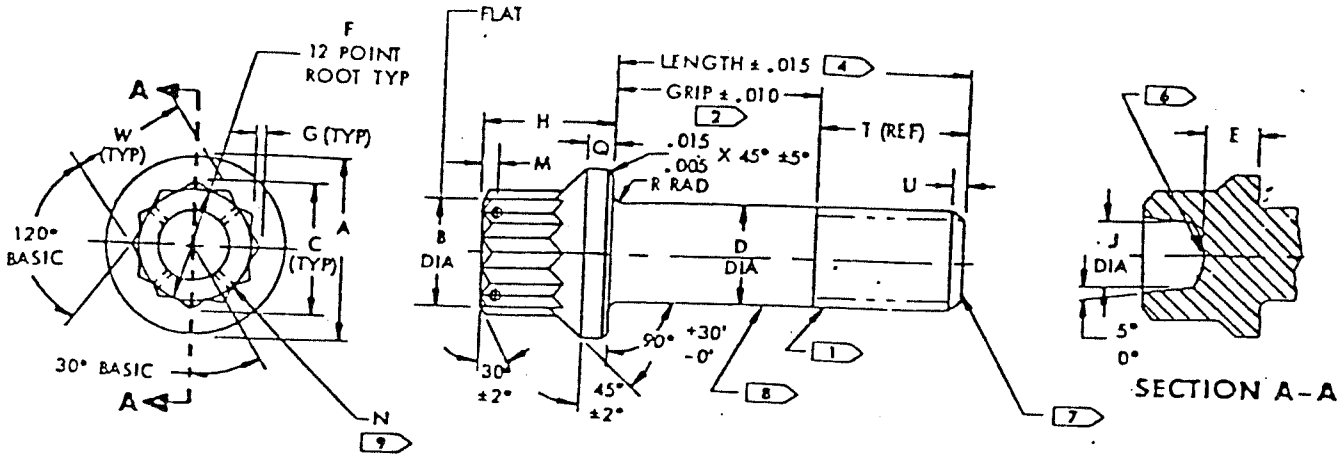
ITEM	QTY	PART NO./DESCRIPTION
5	1	050018 15-5PH SST THD SEGMENTS
4	2	050005 302 SST GARTER SPRING
3	1	050003 A286 SST OUTER BODY
2	3	050004 303 SST KEY
1	1	050002 A286 SST TOP CAP

Thread Technology, Inc.
22455 DAVIS DRIVE
STERLING, VA 20164
PHONE (703) 404-1400

ENGINEER	CHECKED BY	DRAWN BY	DATE
ECABAHUG		ECABAHUG	3/15/96

PART NAME: 1/2-20UNJF-3B MDA*ZIPNUT

CAD FILENAME: 050006 | DRAWING # 050006 | REVISION E



DIMENSIONS IN INCHES UNLESS OTHERWISE NOTED.

TABLE I 10

BOEING STANDARD NUMBER BACB30US 5	NOMINAL THREAD SIZE UNJF-3A	A DIA ±.005	B DIA +.000 -.015	C		D DIA		E	F	G	H	J DIA +.010 -.030	M
				MAX	MIN	MAX	MIN	MIN	MAX	MIN	±.010		±.010
3	.1900-32	.364	.250	.290	.277	.1895	.1885	.092	.262	.013	.214	.125	.062
4	.2500-28	.470	.312	.361	.347	.2495	.2485	.135	.326	.017	.254	.180	.062
5	.3125-24	.580	.375	.434	.418	.3120	.3110	.162	.392	.021	.319	.215	.070
6	.3750-24	.644	.437	.507	.490	.3745	.3735	.197	.458	.026	.388	.260	.070
7	.4375-20	.745	.500	.580	.561	.4370	.4360	.228	.524	.030	.435	.320	.070
8	.5000-20	.823	.562	.651	.637	.4995	.4985	.254	.588	.034	.504	.380	.094
9	.5625-18	.933	.625	.724	.703	.5615	.5605	.287	.654	.038	.557	.440	.094
10	.6250-18	1.045	.687	.797	.775	.6240	.6230	.327	.720	.042	.618	.500	.094
12	.7500-16	1.225	.812	.940	.917	.7490	.7480	.380	.849	.052	.711	.570	.094
14	.8750-14	1.433	.937	1.085	1.059	.8740	.8730	.438	.980	.060	.808	.650	.125
16	1.0000-12	1.620	1.062	1.229	1.200	.9990	.9980	.493	1.110	.068	.923	.740	.125
18	1.1250-12	1.870	1.250	1.446	1.414	1.1240	1.1225	.556	1.306	.081	1.051	.840	.125
20	1.2500-12	2.120	1.312	1.517	1.484	1.2490	1.2475	.636	1.371	.085	1.155	.950	.125

* OVERSIZE, SEE BOOK 16 OF D-590

(A)

1	REV A	2	REV A	3	---	4	*	5	*	6	*

LIST OF ACTIVE SHEETS

DATE 13 NOV 80 REV (A) 17 MAR 81

FSCM NO 81205

BAC B30US SH 1 OF 6

BOLT, 12 POINT HEAD, 220 KSI MIN TENSILE, 125 KSI MIN SHEAR, INCONEL 718

BAC B30US SH 1 OF 6

PAGE 80.1.6.167.1

Consolidated Laboratories, Inc.
732 Arrow Grand Circle
Covina, California 91722
(626) 915-8991
FAX (626) 966-3156

May 29, 1998

TEST REPORT

Almay Research & Testing Corporation
1415 Newton Street
Los Angeles, California 90021

Subject: Vibration Test on Eight (8) Specimens of P/N 1F44595 (TTI P/N 050006), Rapid Assembly Nut, S/N's 4001, 4004, 4015, 4029, 4038, 4050, 4064 and 4072

This will certify that the units above were subjected to the Vibration Test of the referenced documents in this Laboratory in the manner and with results as described below:

1. **REFERENCES**

1.1 Purchase Order No. 988A dated 5/22/98 from Almay Research & Testing Corporation.

1.2 Thread Technology, Inc. Document No. 050016, Rev. C, dated 3/11/98: Acceptance/Qualification Test Plan and Procedure For ¼-20UNJF-3B ZipNut P/N 050006 and MDA 1F44595.

1.3 McDonnell Douglas Drawing No. 1F44595, Rev. D: Nut, Rapid Assembly.

2. **PURPOSE** -- The purpose of this test program was to subject the units to the Vibration Test of Reference 1.2, Paragraphs 05-000 & 06-000 and Reference 1.3, Notes 29 & 31 - 36. Four of the units (S/N's 4004, 4029, 4050 & 4072) were to be assembled onto the mating bolt, torqued to 1,125 ± 200 in-lb and monitored for rotation during the test. The remaining four units were to be held in place with ⅜" (non-mating) bolts. The units were to be examined for physical damage and returned to Almay after completion of the test program.

3. **SUMMARY** -- The units were subjected to the Vibration Test as required. The procedures and results of the test are shown on the laboratory instruction/data sheet which is reproduced as Page 3 of this report. S/N's 4004, 4029, 4050 & 4072 exhibited no rotation in excess of 30°. Examination of the units after completion of testing disclosed no visible evidence of damage or deterioration as a result of the test conditions. The units were considered to have passed the Acceptance Random Vibration Test as conducted in this Laboratory and were returned to Almay for disposition.

Test By: **L. L. Frye**	Concurred:
Report By: **D. D. Huff**	DCMAO Quality Assurance Representative

S 61608 I Joe Campa 6-4-98

Prepared By: _____
Dale D. Huff, Test Engineer

REGISTERED PROFESSIONAL ENGINEER
PHILIP MICHAEL HARTY
NO. 19959
Exp. 9-30-00
MECHANICAL
STATE OF CALIFORNIA

Approved By: _____
P. M. Harty, P. E., Laboratory Director

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TEST REPORT

4. **TEST EQUIPMENT** -- The following items of test equipment, maintained within the current applicable calibration period, were used to conduct the test:

-Accelerometer: Endevco Model 2246M4, S/N HB91, ID/N 2106-24, 13.64 pC/g, ±5.6%. Calib. due 6-1-98, 6 mos. Used with Endevco Model 2721B, S/N CJ82, ID/N 2104-1, charge amplifier. Calib. due 6-12-98, 6 mos. Used to monitor and control vibration input levels.

-Torqometer: Snap-On Model TE100L, ID/N 304, 0 to 100 foot-pounds, torque meter. Calib. due 8-8-98, 12 mos.

-Vibration Exciter: MB Model C-50, S/N 168, ID/N 2005, with MB Model T451-B power amplifier, S/N 119, ID/N 2008, rated at 5000 force pounds. Used with Hewlett-Packard Model 5427A, S/N 282, ID/N 2006, vibration control system. Calib. due 11-5-98, 6 mos.

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Consolidated Laboratories, Inc.
732 Arrow Grand Circle
Covina, California 91722
(626) 915-8991

LAB DATA SHEET

Part No. 1F44595 S/N See Below Sample 1 - 8 Job 8914
Description Rapid Assembly Nut Co. Almay
S/N's 4004, 4029, 4050, 4072, 4001, 4015, 4038 & 4064. Page 1.0

TEST: VIBRATION		Start	Cptd
To Spec:	Date	MAY 27 1998	MAY 27 1998
050016, Rev. C, Paras. 05-000 & 06-000;	Test By	L. Tinge	L. Tinge
Dwg. No. 1F44595, Rev. E, Notes 29 & 31 - 36	Photo	✓	

Photo Req'd YES

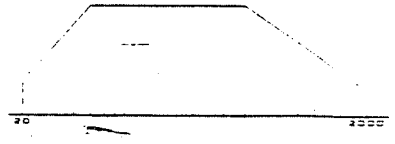
1. Axis Identification:

   X -- Parallel to the axis of bolt insertion through the nut.
   Y -- At random radially to the body of the nut.
   Z -- Mutually perpendicular to the X and Y Axes.

2. Assemble four of the nuts onto the mating bolt through an appropriate fixture plate until seated against the washers and tighten finger tight. Gradually tighten to 1,125 ± 200 in-lb and then mark the units in order to observe rotation as a result of the vibration. Secure the fixture plate to a vibration cube. Mount the composite assembly on the head of the vibration exciter, with the axis under test being changed by changing the orientation of the fixture plate on the cube. Mount a control accelerometer on the fixture plate adjacent to the mounting interface of the units. As a minimum, the accelerometer signal shall be recorded during all test runs.

3. Subject the units to the following levels of random vibration.

Hz	PSD, g^2/Hz	Slope, dB/Oct
20	0.04	----
50	0.80	+9.8
400	0.80	----
2000	0.028	-6.3



Tolerances
20 - 2000 Hz; ±2 dB
Overall: 23.1 g_{rms} ± 10%

On each axis, equalize and vibrate the unit for 510 ± 5.1 seconds at the full level listed above. Make a computer print-out of the control equalization for each axis of vibration. Check off O.K. completion below:

X Axis ✓ Y Axis ✓ Z Axis ✓

Any visible evidence of physical damage? NO

Any rotation in excess of 30°? NO

4. Assemble the other four nuts to an appropriate fixture plate using 3/8 inch bolts. Secure the fixture plate to the vibration cube on the head of the vibration exciter, as stated in Step 2, above, and repeat the procedures of Step 3, above. Check off O.K. completion below:

X Axis ✓ Y Axis ✓ Z Axis ✓

Any visible evidence of physical damage? NO

5. List test equipment used on the Test Equipment List, attached.

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TEST REPORT

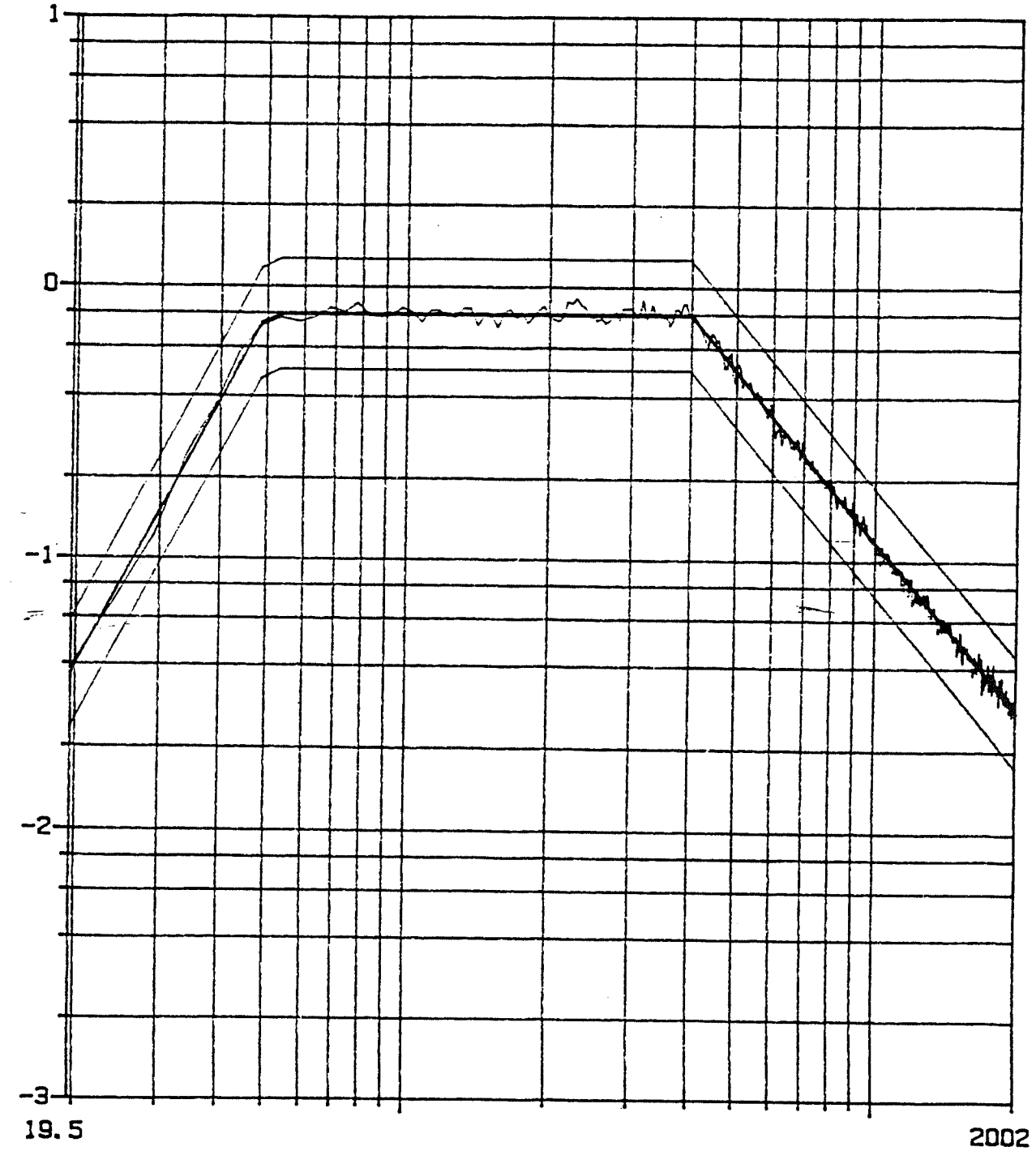
MAY 27 1998

P/N 1F44595 S/N 4004, 4029, 4050, 4072 RANDOM VIBRATION X AXIS

POST TEST ELAPSED TIME = 511 SECS AT .00 DB

RMS LEVEL = 23.14 G'S DELTA F = 4.883 DOF= 304 AWF= 10

10 N G SQR/HZ



CLI 15

CLI S INSP

ALMAY, RAPID ASSEMBLY NUT

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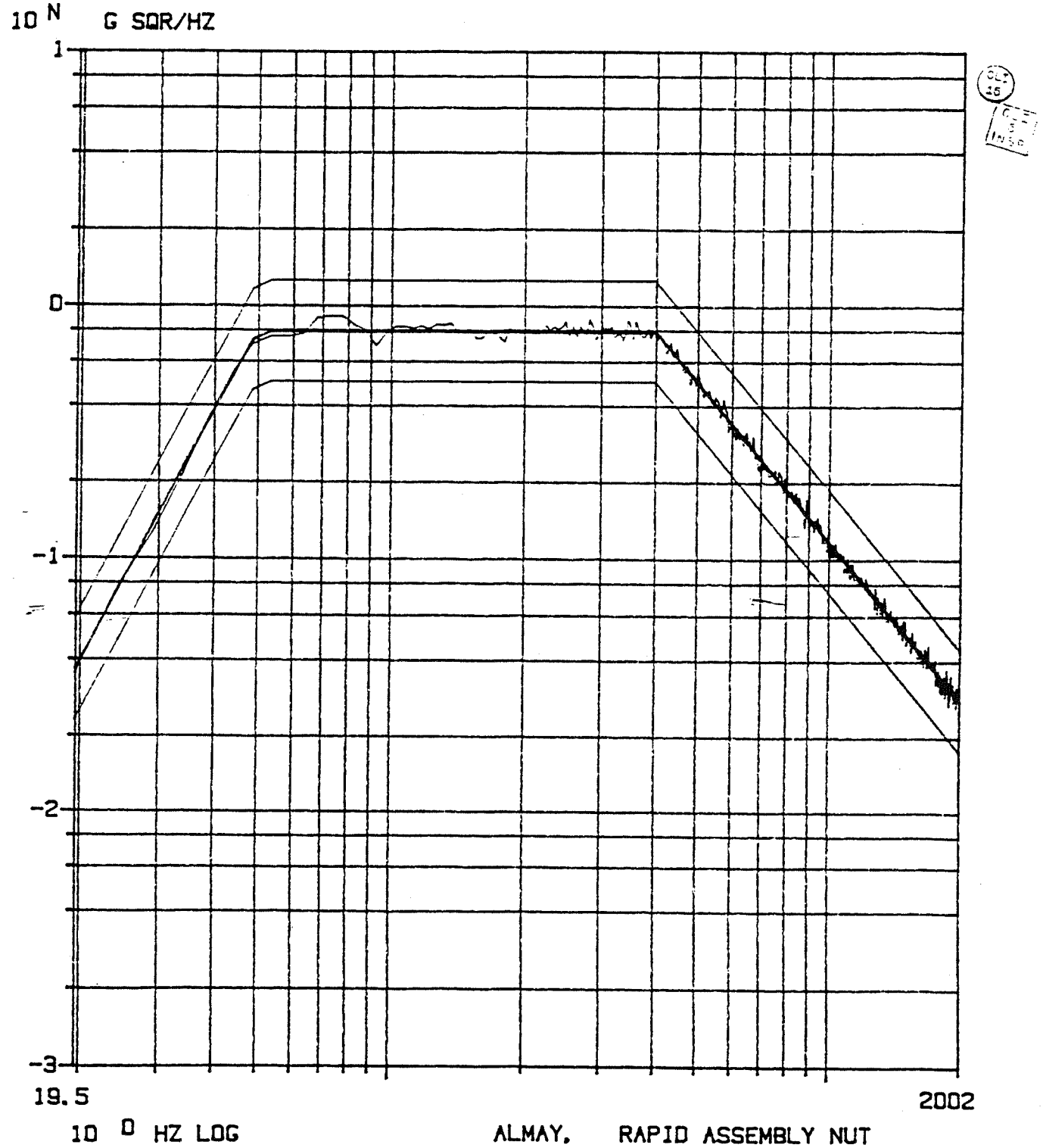
Covina, California 91722
(626) 915-8991

REPORT NO. 8914

TEST REPORT

MAY 27 1998

P/N 1F44595 S/N 4004, 4029, 4050, 4072 RANDOM VIBRATION Y AXIS
POST TEST ELAPSED TIME = 511 SECS AT .00 DB
RMS LEVEL = 23.09 G'S DELTA F = 4.883 DOF= 304 AWF= 10



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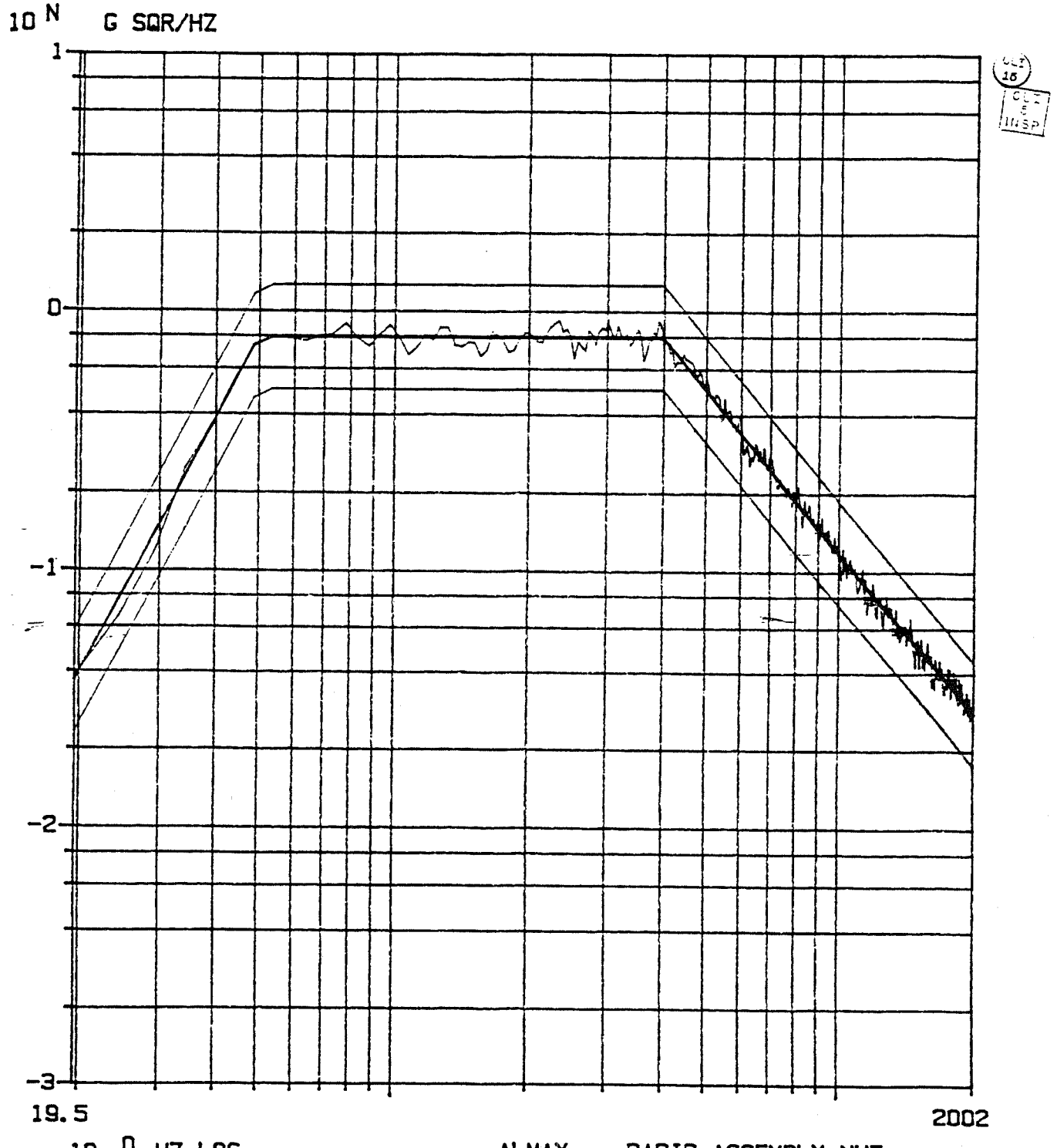
TEST REPORT

MAY 27 1998

P/N 1F44595 S/N 4004, 4029, 4050, 4072 RANDOM VIBRATION Z AXIS
POST TEST ELAPSED TIME = 512 SECS AT .00 DB
RMS LEVEL = 23.08 G'S DELTA F = 4.883 DOF= 304 AWF= 10



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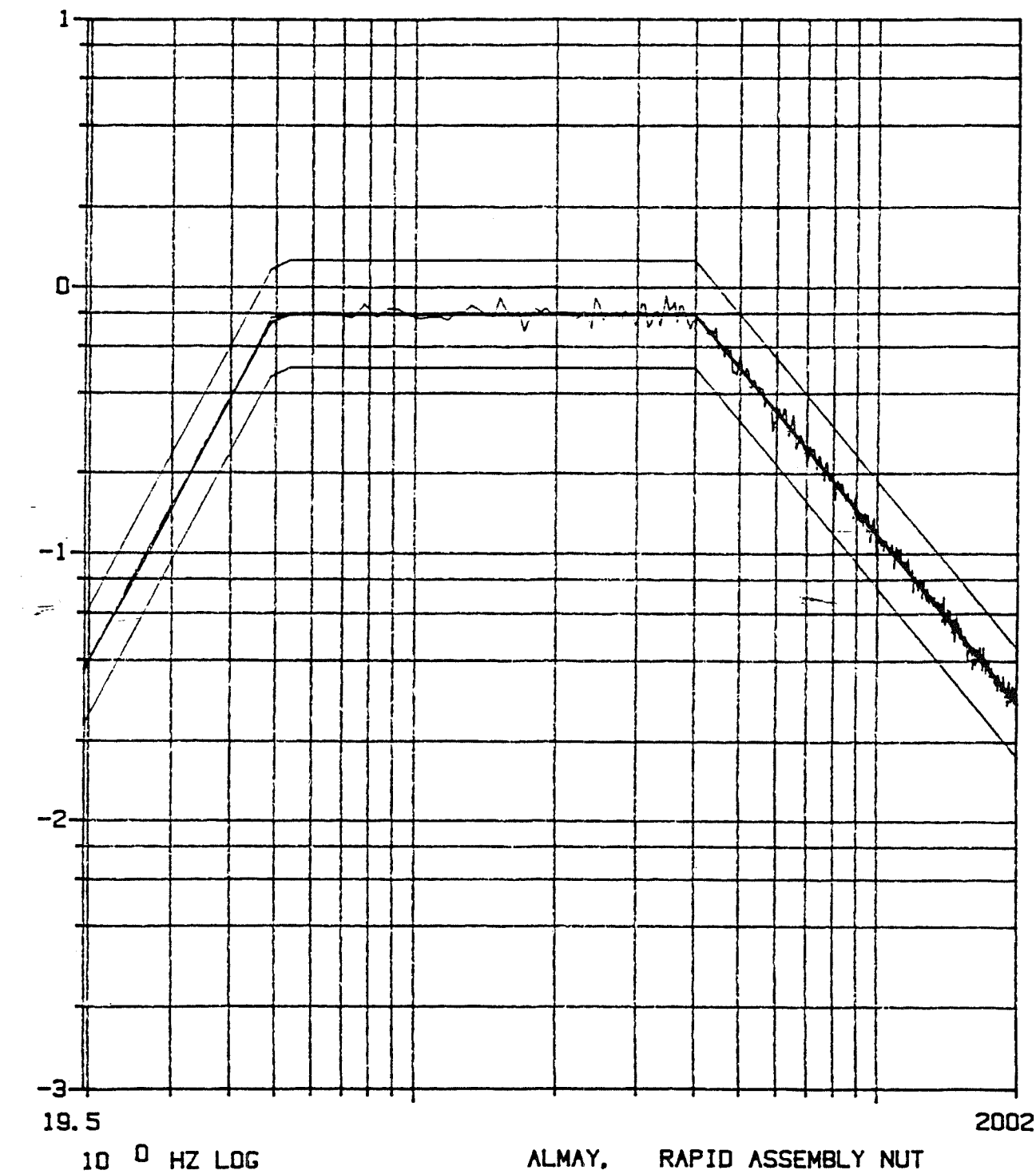
REPORT NO. 8914

PAGE 7

TEST REPORT

MAY 27 1998

P/N 1F44595 S/N 4001, 4015, 4038, 4064 RANDOM VIBRATION X AXIS
POST TEST ELAPSED TIME = 511 SECS AT .00 DB
RMS LEVEL = 23.07 G'S DELTA F = 4.883 DOF= 304 AWF= 10



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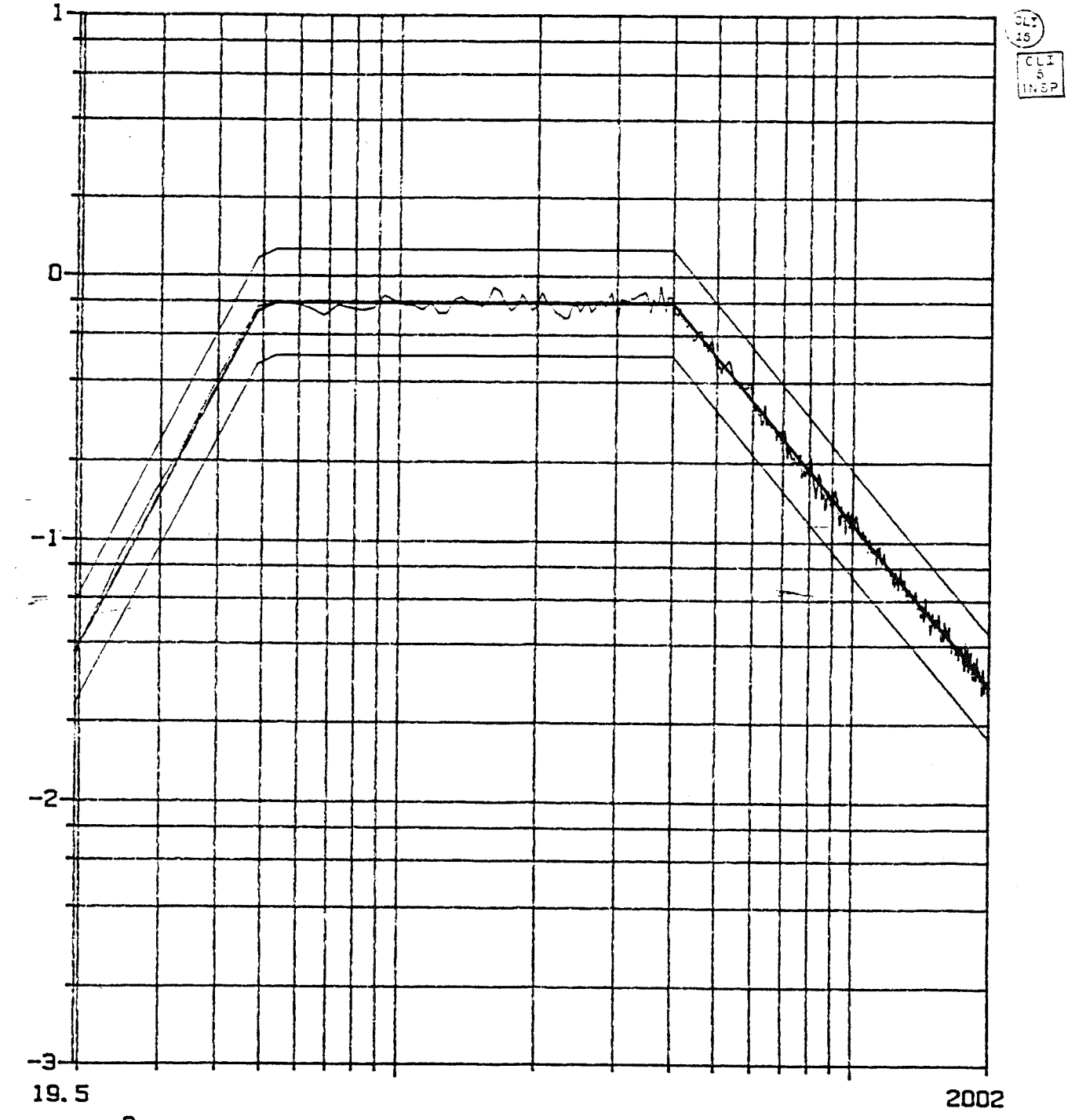
TEST REPORT

MAY 27 1998

P/N 1F44595 S/N 4001, 4015, 4038, 4064 RANDOM VIBRATION Y AXIS
POST TEST ELAPSED TIME = 511 SECS AT .00 DB
RMS LEVEL = 22.98 G'S DELTA F = 4.883 DOF= 304 AWF= 10
10 N G SQR/HZ



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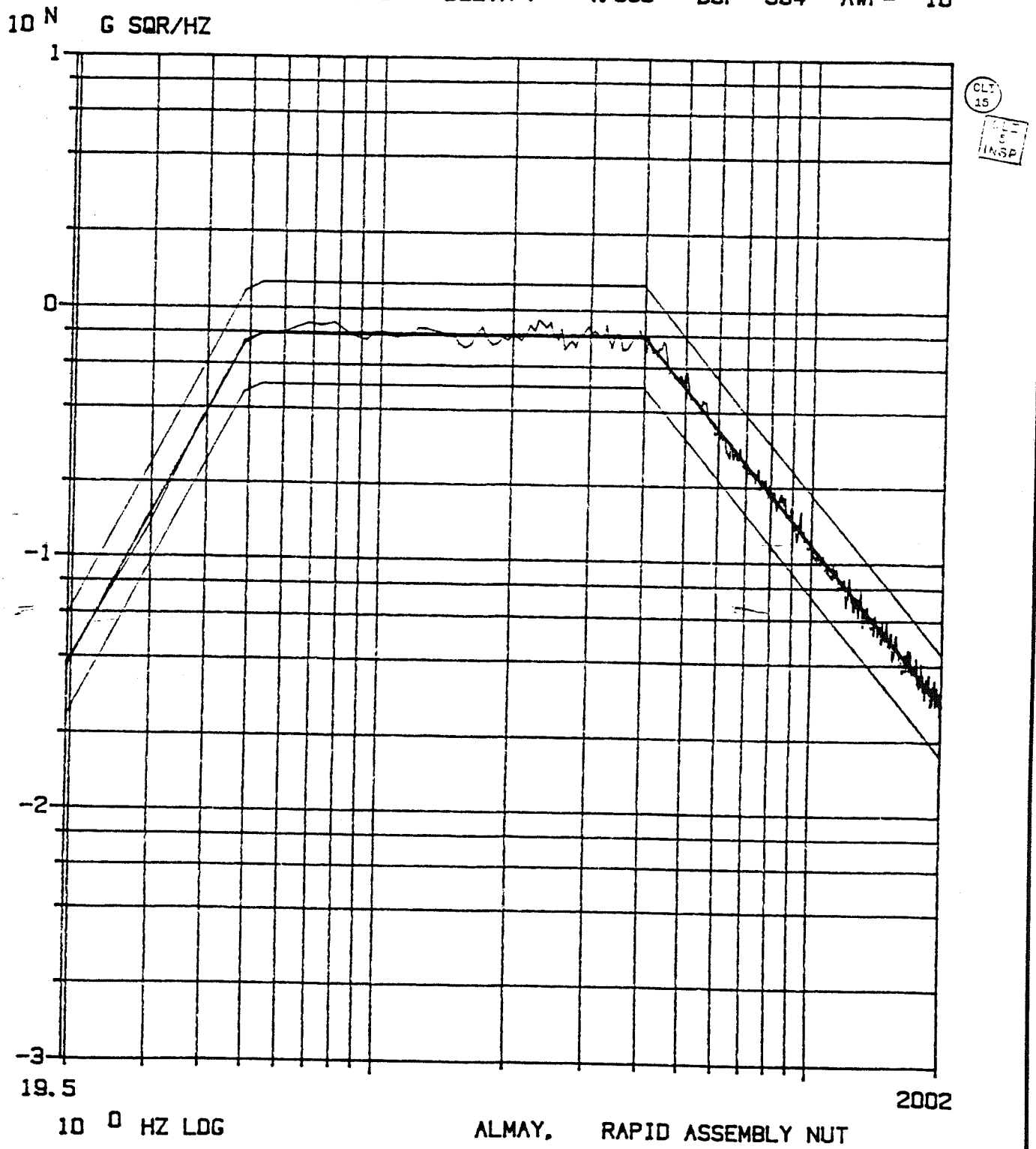
TEST REPORT

MAY 27 1998

P/N 1F44595 S/N 4001, 4015, 4038, 4064 RANDOM VIBRATION Z AXIS
POST TEST ELAPSED TIME = 511 SECS AT .00 DB
RMS LEVEL = 23.10 G'S DELTA F = 4.883 DOF= 304 AWF= 10



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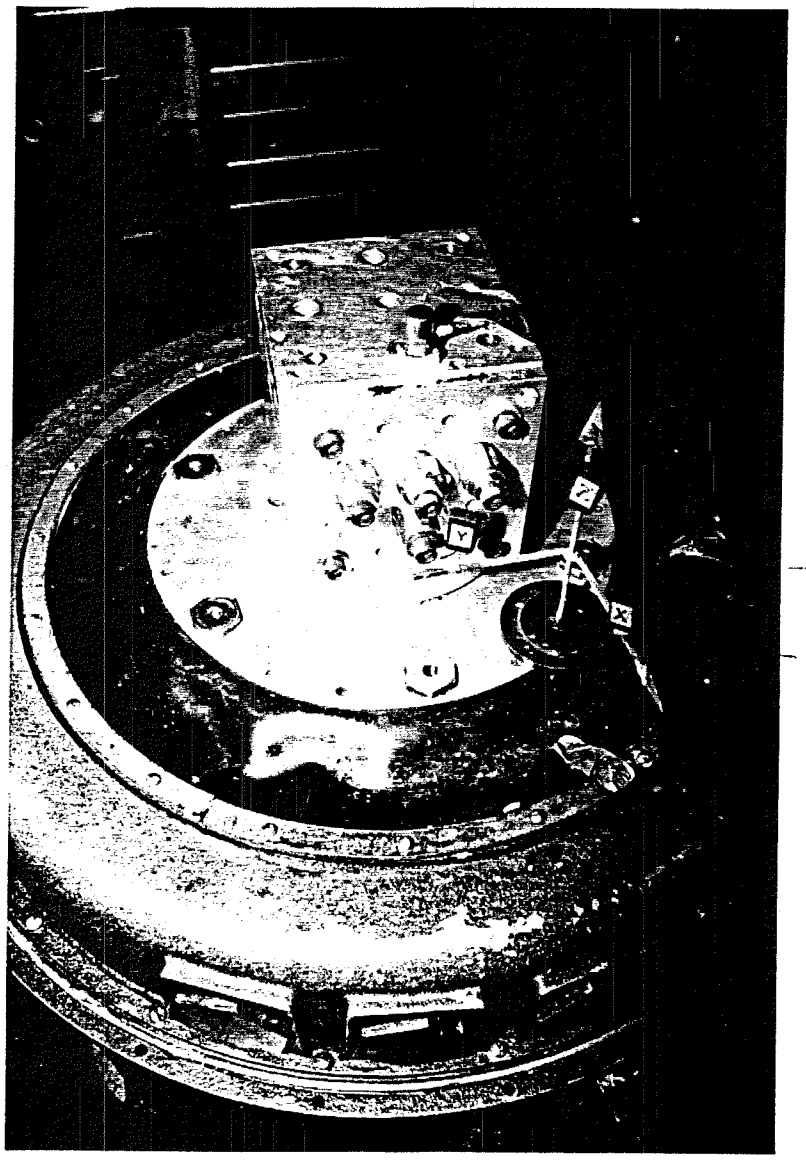
TEST REPORT

VIBRATION TEST SETUP

(Z Axis; S/N's 4001, 4015, 4038 & 4064)



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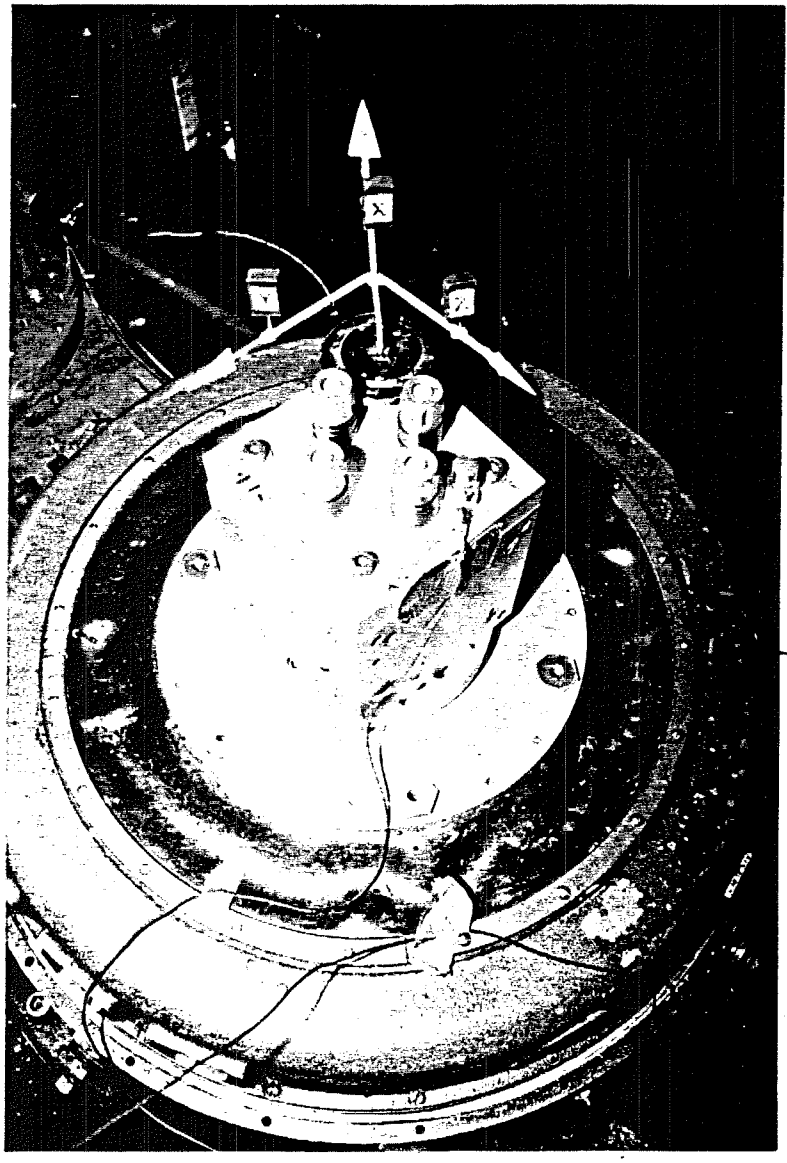
TEST REPORT

VIBRATION TEST SETUP

(X Axis; S/N's 4004, 4029, 4050 & 4072)



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REPORT NO. C 27150-2

RESULTS OF PRODUCTION ACCEPTANCE TEST
EVALUATION OF McDONNELL DOUGLAS
P/N 1F44595, REV. E (TTI P/N 050006)
RAPID ASSEMBLY NUTS ('ZIP NUTS') LOT NO. 5,
SUBMITTED BY THREAD TECHNOLOGY, INC.,
STERLING, VIRGINIA

July 29, 1998

Thread Technology, Inc. P.O. No. 1810

(Ref: McDonnell Douglas P.O. No. 78990891
& NASA Contract 15-10000)

by Harry S. Brenner
Harry S. Brenner, P.E.
Director of Research

CERTIFIED Almay Research & Testing Corp., Los Angeles

Defense Logistics Agency
Defense Contract Management Command

/s/ Tom Osborn 8/3/98
Tom Osborn
Quality Assurance Representative
DCMDW-GAODA

The Boeing Company
Space Systems Division

/s/ Joseph M Campa II
Joseph M. Campa II
Quality Engineer
Procurement Quality
Assurance

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56 7-31-98

INTRODUCTION

Thread Technology, Inc., 22560 Glenn Drive, Suite 114, Sterling, Virginia 20164, submitted twenty (20) samples of a special design nut for production acceptance test evaluation of performance properties. The nut was identified as a 'Rapid Assembly Nut' conforming to McDonnell Douglas Aerospace Spec. Control Drawing 1F44595, Rev. E. Thread Technology identified the nut as the "ZIP NUT", under TTI Part Number 050006. It was noted that the "ZIP NUTS" were intended for use in the construction and assembly of the International Space Station. (Reference: McDonnell Douglas P.O. 78990891 and NASA Contract 15-10000).

The applicable Purchase Order from Thread Technology, Inc. outlined the Acceptance Test Plan in TTI Document No. 050016, Rev. C, dated 3/11/98 for the MDA 1F44595-1 (TTI P/N 050006) "Zip Nuts". In addition, all tests were to be witnessed by the Defense Contract Management Command (representing NASA), and by The Boeing Company (formerly McDonnell Douglas Aerospace (MDA)). The comprehensive test program was witnessed and monitored by the Following Representatives at Almay:

Defense Logistics Agency
Defense Contract Management Command
Mr. Tom Osborn

The Boeing Company
Space Systems Division
Mr. Joseph M. Campa II

After coordination with the designated quality representatives, the physical test program was initiated on July 16, 1998, and all tests completed on July 28, 1998. The "ZIP NUTS" included in this phase of the performance test evaluation were identified as Production LOT No. 5. The test program was outlined to observe the sequences and test procedures referenced in TTI Document No. 050016, Rev. C. All test equipment, fixtures, gages, etc. used in support of the evaluation testing were in current calibration conforming to the requirements of

the ALMAY "Quality System Manual (QSM)" dated 6/2/97, designed to satisfy and meet requirements of Spec. MIL-Q-9858A, and ISO 9003.

TEST PROCEDURE

Almay Test Report No. C 27150 dated April 14, 1998, initially covered the detailed 'qualification' series of tests conducted on LOT No. 3 "ZIP NUTS" P/N 1F44595-1 (TTI P/N 050006). The report included photographs of the test parts as received, test equipment used, typical fixturing and test set-ups, specimens after test evaluation, etc. Also, all test procedures were detailed in compliance with the requirements and objectives of TTI Document No. 050016. The current production acceptance tests of LOT NO. 5 covered by this report utilized the same test equipment, fixturing, and gages noted in Report C 27150. In addition, the test procedures described in Report C 27150 were observed and followed in conducting the current tests on LOT NO. 5. Accordingly, by refernce, Almay Report No. C 27150 is made a part of this production acceptance report.

The "ZIP NUTS" representing production LOT NO. 5 were serialized by Thread Technology, Inc., and are identified in Table 1. On the recommendation of The Boeing Company engineering representative, assignment of specimen numbers for the various test sequences was made at random. The Test Flow and applicable Specimen Identification numbers for this program are shown in Figure 1. Specific care was exercised to maintain specimen identification during all phases of the evaluation test program.

As a special condition for this test project, the test bolts were required to have a minimum hardness of Rc 36, and a minimum thread length of 0.800-inches. As noted previously, for the evaluation of LOT NO. 3, Boeing Standard BAC B30LE Series Bolts were employed, which were fabricated from A286 CRES, having a minimum tensile strength of 200 ksi. For the test of LOT NO. 4, and for this particular evaluation of LOT NO. 5, Boeing Standard BAC B30US Series Bolts

TABLE NO. 1.

IDENTIFICATION OF RAPID ASSEMBLY NUTS (ZIP NUTS)
RECEIVED FROM THREAD TECHNOLOGY, INC. FOR PRODUCTION
ACCEPTANCE TEST EVALUATION

Specimen No.	TTI SERIAL NUMBER	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size 1/ (UNJF-3B)	Lot Number	Test Procedure
1	5007	1F44595-1 Rev. E	050006	.5000-20	5	TTI Document 050016, Rev. C
2	5024	"	"	"	5	"
3	5047	"	"	"	5	"
4	5049	"	"	"	5	"
5	5057	"	"	"	5	"
6	5061	"	"	"	5	"
7	5067	"	"	"	5	"
8	5080	"	"	"	5	"
9	5085	"	"	"	5	"
10	5092	"	"	"	5	"
11	5095	"	"	"	5	"
12	5108	"	"	"	5	"
13	5113	"	"	"	5	"
14	5116	"	"	"	5	"
15	5120	"	"	"	5	"
16	5127	"	"	"	5	"
17	5137	"	"	"	5	"
18	5148	"	"	"	5	"
19	5157	"	"	"	5	"
20	5173	"	"	"	5	"

NOTES:

1/ "Zip-Nut" Rapid Assembly Nut with thread elements fabricated from 15-5PH CRES, and outer body fabricated from A286 CRES, Conforming to Thread Technology, Inc. Drawing No. 050006 Rev. E.

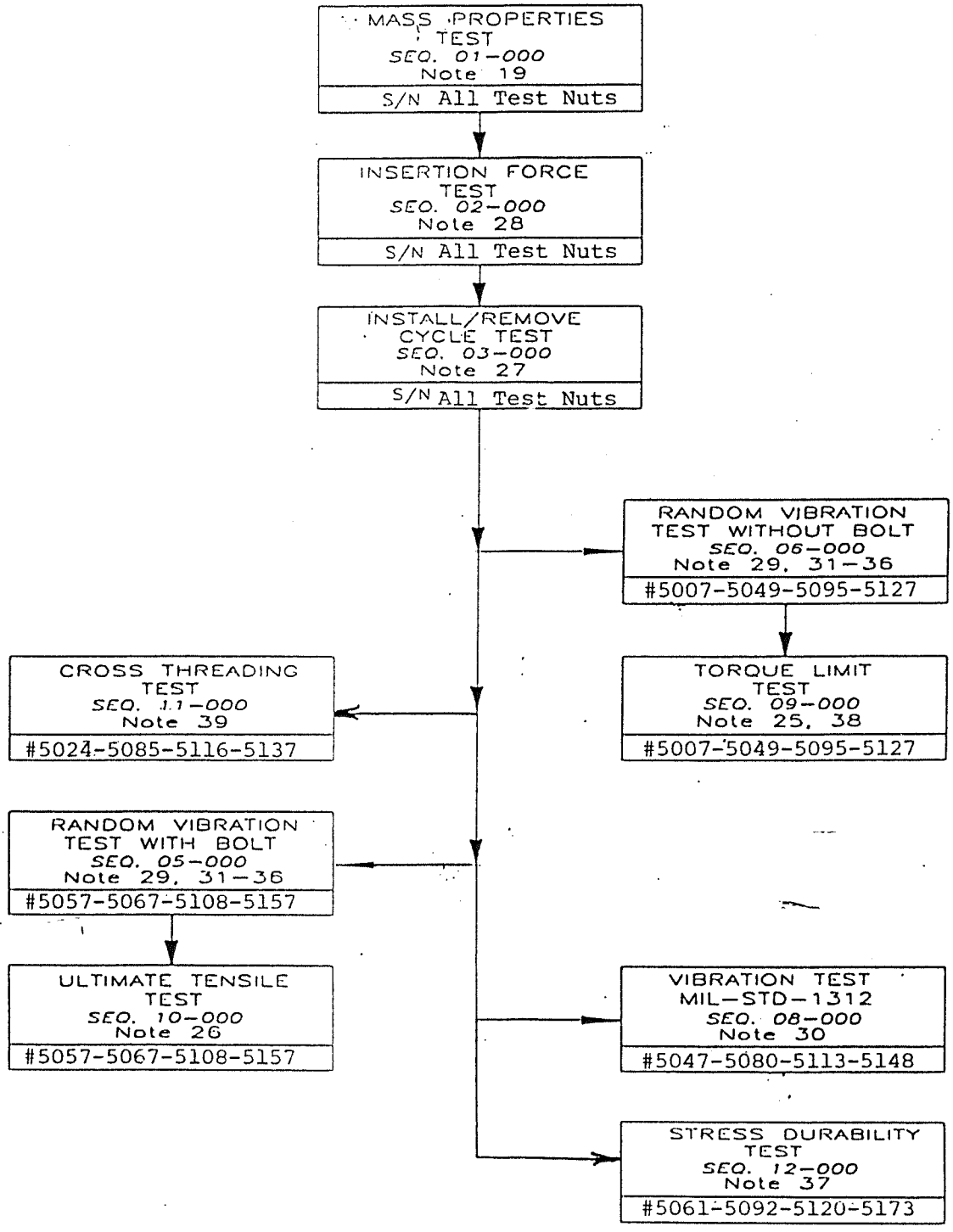

FIG. 1 (above).- Test Flow Chart and Specimen identification for LOT NO. 5 'ZIP NUTS' per TTI Document No. 050016, Rev. C

were utilized as also meeting the required thread length. The bolts were fabricated from Inconel 718 CRES, and developed a minimum tensile strength of 220 ksi. Prior to use, all test bolts were treated to provide a dry film lubricant finish per MIL-L-46010E, which was requested by The Boeing Company.

All tests outlined in Thread Technology, Inc. Document No. 050016, Rev. C were conducted at Almay, with the exception of the Random Vibration tests. The two series of Random Vibration tests were performed at Consolidatyd Laboratories Inc., under the supervision of Almay, The Boeing Company, and the Defense Contract Management Command. The results of the Random Vibration tests are presented in Consolidated Laboratories, Inc. Report No. 9067 dated July 25, 1998, and is attached as an Appendix to this Report.

TEST RESULTS

The results of the various tests conducted on the MDA P/N 1F44595-1 (TTI P/N 050006) Rapid Assembly Nuts for LOT NO. 5 are summarized in the following Tables:

Table No. 2 - Results of Weight (Mass Property) Tests

Table No. 3 - Results of 2° Insertion Force Tests

Table No. 4 - Results of 10-cycle Installation/Removal Tests

Table No. 5 - Results of MIL-STD-1312 Accelerated Vibration Tests

Table No. 6 - Results of Torque Limit Tests

Table No. 7 - Results of Ultimate Tensile Strength Tests

Table No. 8 - Results of Cross-Threading Tests

Table No. 9 - Results of Stress Durability Tests

Random Vibration Tests - Consolidated Report No. 9067

COMMENTS

The results of the comprehensive tests conducted on the MDA P/N 1F44595-1 (TTI P/N 050006) Rapid Assembly Nuts indicate that all test nuts representing LOT NO. 5 exhibit an ability to meet and/or exceed all rated performance requirements referenced in MDA Spec. Control Drawing 1F44595, and TTI Document No. 050016. No cracks, deformation, or fractures were observed with any of the critical tests noted in this Report.

As noted in Almay Report No. C 27150-1 covering the performance results of LOT NO. 4 Rapid Assembly Nuts, Boeing BAC B30US8 Series Inconel 718 CRES bolts were used in testing the "ZIP NUTS" from both Lot Nos. 4 and 5. The bolts were rated at 220 ksi, whereas the earlier tests of Lot No. 3 were evaluated using Boeing BAC B30LE8 Series bolts rated at 200 ksi and fabricated from A286 CRES. The result of using the higher strength bolts was the ability to develop higher ultimate tensile strengths, and higher induced tensile clamp loads in the Torque Limit tests.

The thread elements of the "ZIP NUTS" were furnished with dry film lubricant per Spec. MIL-L-46010E, Type I. The lubricity of the nut/bolt combination appeared to be lower for LOT NO. 5, than for previous Lots tested. This effect was particularly noticeable for the Stress Durability Tests (Table 9) where installation torque was lower to achieve objective design clamp load. Also, for the Torque Limit Tests (Table 6), at the specified installation torque of 2000 in-lb, it appeared that the INCO 718 CRES bolts were beginning to yield in the threads.

The LOT NO. 5 test fasteners are being forwarded directly to The Boeing Company for information and examination.

The above information and data is accordingly submitted for the use of Thread Technology, Inc.

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TABLE NO. 2.

RESULTS OF WEIGHT (MASS PROPERTY) TEST OF
MDA P/N 1F44595, REV. E (TTI P/N 050006) LOT #5
RAPID NUT ASSEMBLIES

Serial No.	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	Maximum Permissible Weight (lb) 2/	Actual Nut Weight 4/ (grams)	Equivalent Nut Weight (lb) 3/ 4/
5007	1F44595-1 Rev. E	050006	.5000-20	0.16	59.2	0.1305
5024	"	"	"	"	59.2	.1305
5047	"	"	"	"	58.9	.1299
5049	"	"	"	"	59.0	.1300
5057	"	"	"	"	59.1	.1303
5061	"	"	"	"	59.0	.1300
5067	"	"	"	"	59.4	.1310
5080	"	"	"	"	58.9	.1299
5085	"	"	"	"	59.2	.1305
5092	"	"	"	"	58.8	.1296
5095	"	"	"	"	59.2	.1305
5108	"	"	"	"	59.1	.1303
5113	"	"	"	"	59.0	.1300
5116	"	"	"	"	59.2	.1305
5120	"	"	"	"	59.0	.1300
5127	"	"	"	"	58.9	.1299
5137	"	"	"	"	59.0	.1300
5148	"	"	"	"	59.1	.1303
5157	"	"	"	"	59.2	.1305
5173	"	"	"	"	59.1	.1303

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NOTES:

1/ "ZIP NUT" Rapid Nut Assmbly with thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES, conforming to Thread Technology Inc. Drawing No. 050006.

2/ Maximum Nut permissible weight per Note 19, MDA Spec. Control Drawing 1F44595, Rev, E.

3/ Test nuts are within maximum weight limit, and conform to Note 19, Spec. Control Dwg. 1F44595.

4/ Mass Property test conducted on July 16, 1998 in accordance with Sequence No. 01-000, TTI Document No. 050016, Rev. C dated 3/11/98. Test conducted using W.M Welch Scientific Scale.

TABLE No. 3

RESULTS OF 2° INSERTION FORCE TEST OF
MDA P/N 1F44595 REV E (TTI P/N 050006)
LOT #5 RAPID NUT ASSEMBLIES

Serial No.	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	Maximum Permissible Insertion Force (lb) 2/	2° TEST INSERTION FORCE (lb) 3/	COMMENTS
5007	1F44595-1 Rev. E	050006	.5000-20	5	3.4	Acceptable
5024	"	"	"	"	3.8	Acceptable
5047	"	"	"	"	3.5	Acceptable
5049	"	"	"	"	3.1	Acceptable
5057	"	"	"	"	2.8	Acceptable
5061	"	"	"	"	3.0	Acceptable
5067	"	"	"	"	3.2	Acceptable
5080	"	"	"	"	3.6	Acceptable
5085	"	"	"	"	2.9	Acceptable
5092	"	"	"	"	3.0	Acceptable
5095	"	"	"	"	3.1	Acceptable
5108	"	"	"	"	2.8	Acceptable
5113	"	"	"	"	2.9	Acceptable
5116	"	"	"	"	3.3	Acceptable
5120	"	"	"	"	2.8	Acceptable
5127	"	"	"	"	3.1	Acceptable
5137	"	"	"	"	2.8	Acceptable
5148	"	"	"	"	3.4	Acceptable
5157	"	"	"	"	3.1	Acceptable
5173	"	"	"	"	3.5	Acceptable

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NOTES:

1/ "ZIP-NUT" Rapid Nut Assembly with Thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Inc. Drawing. Co. 050006.

2/ Maximum insertion force at engagement angle of 2° maximum per Note 28, MDA Spec. Control Dwg. 1F44595, Rev. E.

3/ Test conducted installing P/N BAC B30US8U22 dry film coated bolts thru steel bushing into P/N 1F44595-1 Rapid Nut assembly seated against 2° face. Installation force measured using Chatillon Model DPP10 (0-10lb) Force Gage.

4/ Insertion Force Tests conducted on July 16, 1998 in accordance with Sequence No. 02-000, TTI Document No. 050016, Rev. C dated 3/11/98.

TABLE No. 4

RESULTS OF 10-CYCLE INSTALLATION/REMOVAL TESTS OF MDA P/N 1F44595-1 (TTI P/N 050006) LOT #5 RAPID NUT ASSEMBLIES

Serial No. 2/	McDonnell Douglas Aerospace Part No.1/	Nominal Thread Size UNJF-3B	SEATED INSTALLATION TORQUE (in-lb) 3/										COMMENTS
			Cycle #1	Cycle #2	Cycle #3	Cycle #4	Cycle #5	Cycle #6	Cycle #7	Cycle #8	Cycle #9	Cycle #10	
	1F44595-1 Rev. E												
5007	(TTI 050006)	.5000-20	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
5024	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
5047	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
5049	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
5057	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
5061	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
5067	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
5080	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
5085	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
5092	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
5095	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
5108	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
5113	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
5116	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
5120	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
5127	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
5137	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
5148	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
5157	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
5173	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure

NOTES:

1/ "Zip Nut" Rapid Nut Assembly with thread element fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Drawing 050006.

2/ Serial number identification as noted by Thread Technology, Inc.

3/ Installation - removal torque tests conducted using P/N BAC B30US8U22 dry film coated bolts thru square steel bushing (1.388" height). Zip nuts torqued with Sturtevant 0-1200 in-lbs Torque Wrench each cycle.

4/ Installation/Removal tests conducted on July 16, 1998 in accordance with Sequence No. 03-000, TTI Document No. 050016, Rev C dated 3/11/98.

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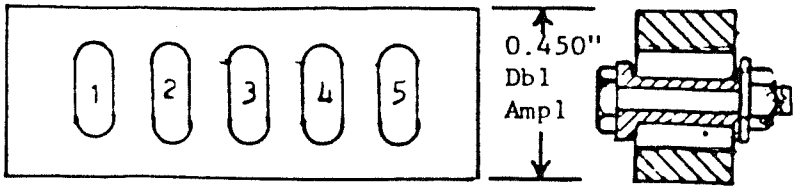
TABLE 5

RESULTS OF MIL-STD-1312 ACCELERATED VIBRATION TEST OF MDA P/N 1 F44595 (TTI P/N 050006) LOT # 5 RAPID NUT ASSEMBLIES



TYPICAL MIL-STD-1312 VIBRATION FIXTURE

Specimen No.	TEST PART NUMBER 1/	Mating Test 2/ Fastener	Assembly Torque 3/ (in-lb)	Test Amplitude 4/	Vibration Frequency (cpm) 4/	NUMBER OF TEST CYCLES	OBSERVED ROTATION
5047	1F44595-1 Rev E (TTI 050006)	B30US8U22	1125	0.450	1800	10,000 20,000 30,000	No Rotation No Rotation No Rotation
5080	1F44595-1 Rev E (TTI 050006)	B30US8U22	1125	.450	1800	10,000 20,000 30,000	No Rotation No Rotation No Rotation
5113	1F44595-1 Rev E (TTI 050006)	B30US8U22	1125	.450	1800	10,000 20,000 30,000	No Rotation No Rotation No Rotation
5148	1F44595-1 Rev E (TTI 050006)	B30US8U22	1125	.450	1800	10,000 20,000 30,000	No Rotation No Rotation No Rotation

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NOTES:

1/ "Zip Nut" Rapid Nut Assembly with thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Drawing 050006.

2/ Test bolt was Boeing BAC B30US8U22 dry film coated INCO 718 CRES.

3/ Test nuts installed in vibration fixture per MIL-STD-1312, Test 7. Seating torque per sequence No. 08-000, TTI Document No. 050016.

4/ Vibration test conducted in Sonntag SF-10-U fatigue machine per test procedure of MIL-STD-1312, Test 7, on July 23, 1998.

5/ Maximum permissible rotation noted at 30° per Sequence 08-005. Test nuts conform to requirement without failure.

TABLE NO. 6

RESULTS OF TORQUE LIMIT TEST OF MDA P/N 1F44595-1
(TTI P/N 050006) LOT # 5 RAPID NUT ASSEMBLIES

Serial No. 3/	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	Mating Test Bolt 2/	Installation Torque (in-lb) 3/	Induced Tensile Clamp Load (lb) 3/ 4/
5007	1F44595-1 Rev. E	050006	.5000-20	B30US8U22	2,000	31,200
5049	"	"	"	"	2,000	28,176
5095	"	"	"	"	2,000	31,728
5127	"	"	"	"	2,000	30,384

NOTES:

1/ "ZIP-NUT" Rapid Nut Assembly with thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Inc. Drawing No. 050006.

2/ Test bolt was Boeing BAC B30US8U22 dry film coated INCO 718 CRES, rated at 220 KSI minimum tensile.

3/ Torque limit test conducted on "ZIP NUT" perviously subjected to random vibration tests without bolts (ref:Sequence 06-000). Torque limit test per Sequence 09-000, TTI Document No. 050016, Rev. C dated 3/11/98. Each "ZIP NUT" installed in calibrated strain gaged load cell, and torqued to 2,000 in lb. Induced tensile clamp load observed and recored. Test conducted on July 27, 1998.

4/ Examination of "ZIP NUT" after disassembly indecated no evidence of deformantion of failure. All nuts functional and operable. Test bolts exhbited evidence of slight yielding noticeable in bolt Threads.
Test bolts did not fracture.

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Table No. 7

RESULTS OF ULTIMATE TENSILE STRENGTH TESTS
OF MDA P/N 1F44595, REV. E (TTI P/N 050006)
LOT #5 RAPID NUT ASSEMBLIES

Specimen No. 2/	NUT PART NUMBER 1/	Nominal Thread Size	AXIAL TENSILE STRENGTH (lbs) Spec. Reqt. 3/	AXIAL TENSILE STRENGTH (lbs) Test Nut 4/	Type Failure 4/	Test Temp. °F
5057	1F44595-1 REV. E (TTI 050006)	.5000-20	27,500	41,000	Bolt Threads Break	Room
5067	"	"	"	47,000	Bolt Threads Break	"
5108	"	"	"	43,600	Nut Threads Strip	"
5157	"	"	"	45,900	Bolt Threads Break	"

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NOTES:

1/ "Zip Nut" Rapid Nut Assembly with Thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Inc. Drawing No. 050006.

2/ Test nuts previously subjected to random vibration test with mating bolts per Schedule 05-000, TTI Document 050016, Rev. C.

3/ Minimum axial tensile load requirement per Note 28, MDA Spec. Control Dwg. 1F44595.

4/ Test nuts tested with Boeing BAC B30US8 INCO 718 CRES Bolts. Each nut torqued to 1,125 in-lb prior to Tensile Test. Test conducetd on July 27, 1998 in Satec 400 HV Universal Tensile Machine.

TABLE NO. 8

RESULTS OF CROSS-THREADING TESTS OF MDA P/N 1F44595-1 (TTI P/N 050006) LOT # 5 RAPID NUT ASSEMBLIES

Serial No.	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	8° Installation 2/	2° Installation Torque (in-lb) 3/	COMMENTS 3/
5024	1F44595-1 Rev. E	050006	.5000-20	Nut engaged	840	No Failure
5085	"	"	"	Nut engaged	840	No Failure
5116	"	"	"	Nut engaged	840	No Failure
5137	"	"	"	Nut engaged	840	No Failure

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NOTES:

1/ "ZIP NUT" Rapid Nut Assembly with thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Inc. Drawing No. 050006.

2/ Cross-Threading test conducted in accordance with Sequence 11-000, TTI Document No. 050016, Rev. C dated 3/11/98. Boeing BAC B30US8U22 dry film coated INCO 718 CRES test bolt inserted in bushing fixture into "ZIP NUT" seated at 8°. Test bolt successfully engaged nut approximately half-way into the nut.

3/ Special 6° wedge removed from bushing fixture leaving "ZIP NUT" seated against 2° face of bushing. Installation torque applied from the bolt head until "ZIP NUT" fully seated at 2°. After nut removal, examination indicated no evidence of deformation and/or fracture. Test nuts fully operable and fuctional on completion of test schedule. Test conducted on July 28, 1998.

TABLE NO. 9

RESULTS OF STRESS DURABILITY TESTS OF MDA P/N 1F44595-1 (TTI P/N 050006) LOT # 5 RAPID NUT ASSEMBLIES

Serial No.	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	Installation Torque (in-lb) 2/	Induced Tensile Clamp Load (lb) 2/	No. of Hours at Load 3/	COMMENTS 3/ 4/
5061	1F44595-1 Rev. E	050006	.5000-20	1,200	21,648	96	No Failure
5092	"	"	"	1,500	22,992	96	No Failure
5120	"	"	"	1,500	22,512	96	No Failure
5173	"	"	"	1,500	23,232	96	No Failure

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NOTES:

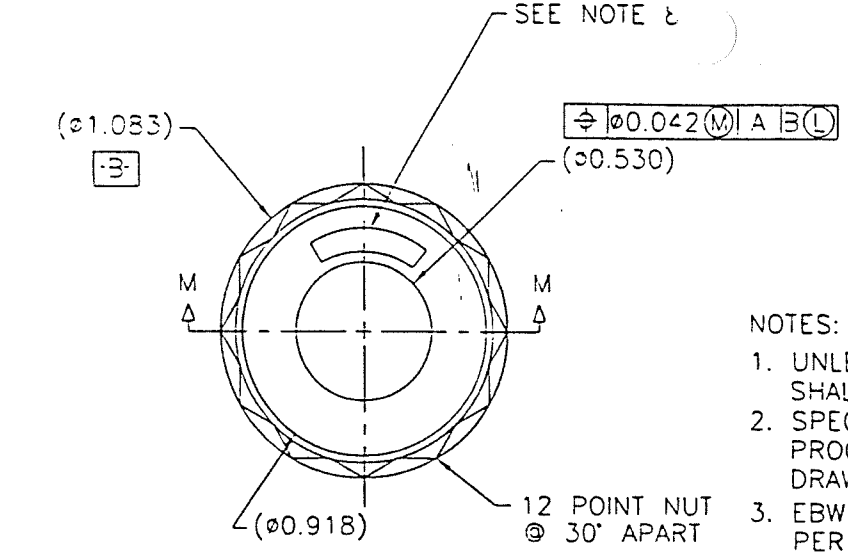
1/ "ZIP-NUT" Rapid Nut Assembly with thread elements fabricated from 15-5PH CRES and outer body fabricated from CRES conforming to Thread-Technology Inc. Drawing No. 050006.

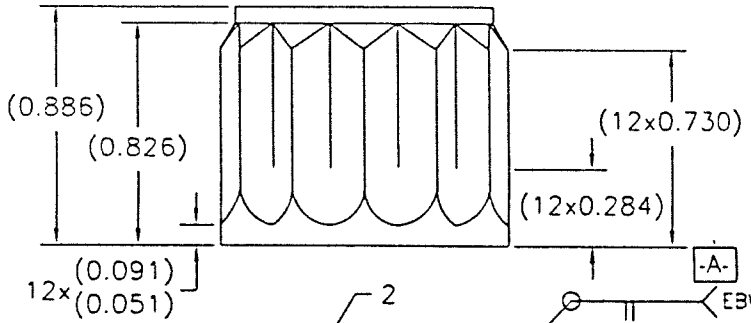
2/ Stress Durability test conducted in accordance with Sequence 12-000, TTI Document No. 050016, Rev. C dated 3/11/98. "ZIP NUT" installed on BAC B30US8u22 dry film coated INCO 718 CRES Bolt (220 KSI min. UTS) in strain gaged load cell. Nut torqied to develop minimum tensile clamp load of 21,5000 + 250 lb.

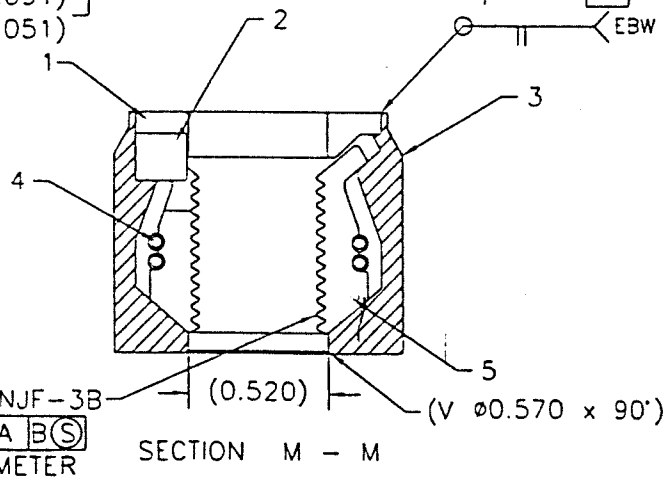
3/ Minimum sxposure under load for stress durability test noted at 96-hours Stress durability tests started on July 23, 1998, and disassembled on July 27, 1998.

4/ Examination of "Zip NUT" after stress durabilty exposure indicated no evidence of crack of failure of the nuts. Test nuts were functional and operable on completion of test exposure.

REV	REVISION DESCRIPTION		APPD
C	MDA DWG NO.CORR WAS IF44595 TO NOTE 1 TO 3 . REPLACED NOTE 4. ADD NOTE 7 ECN 96-0190 EC 10/15/96	10/15/96	EC
D	CORRECTION IN NOTE 3 OF MDA P/N REPHRASE NOTE 5 FOR CLARITY ECN 96-0195 EC 11/5/96	11/5/97	EC
E	ADDED NOTE 8 TO SHOW SERIALIZE S/N PER CUSTOMER PO78990891. DEL MDA DWG REV LEV. ECN 98-0259 EC 1/21/98	1/21/98	







NOTES:

1. UNLESS OTHERWISE SPECIFIED MDA DWG NO. 1F44595 SHALL BE FURNISHED TOGETHER WITH THIS DRAWING.
2. SPECIFICATION REQUIREMENTS SUCH AS; MATERIAL, MFG. PROCESSES, TESTING, AND OTHERS SHALL BE PER MDA DRAWING 1F44595.
3. EBW PENETRATION SHALL BE 0.035 TO 0.045 IN. INSPECTED PER AMS 2681, MDA 1F44595 NOTE 21.
4. MAINTAIN CLEAN STP0416-01. REF. MDA 1F44595 NOTE 15.
5. ALL DIMENSIONS WITH ( ) ARE FOR REFERENCE ONLY.
6. * MDA - McDONNELL DOUGLAS AEROSPACE
7. IDENTIFY PART NUMBER AND LOT NUMBER PER MIL-STD-130, AND MDA 1F44595 NOTE 5.
8. UNIT TO BE SERIALIZE IN CONSECUTIVE ORDER. EXAMPLE: S/N 0001.

ITEM	QTY	PART NO./DESCRIPTION
5	1	050018 15-5PH SST THD SEGMENTS
4	2	050005 302 SST GARTER SPRING
3	1	050003 A286 SST OUTER BODY
2	3	050004 303 SST KEY
1	1	050002 A286 SST TOP CAP

Thread Technology, Inc.
22455 DAVIS DRIVE
STERLING, VA 20164
PHONE (703) 404-1400

ENGINEER	CHECKED BY	DRAWN BY	DATE
ECABAHUG		ECABAHUG	3/15/96

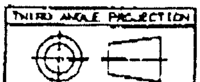
PART NAME: 1/2-20UNJF-3B MDA* ZIPNUT

CAD FILENAME: 050006 | DRAWING # 050006 | REVISION: E

NOTES:

1. IDENTIFICATION OF THE SUGGESTED SOURCE(S) OF SUPPLY HEREON IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY AS A SOURCE OF SUPPLY FOR THE ITEM DESCRIBED ON THE DRAWING.
2. INTERPRET DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1982.
3. △ OPTIONAL: IDENTIFY WITH MANUFACTURER'S TRADEMARK OR SYMBOL IN ACCORDANCE WITH MIL-STD-130.
4. PREPRODUCTION SAMPLES SHALL BE TESTED BY MDA PRIOR TO REGULAR PRODUCTION TO DEMONSTRATE THE ADEQUACY AND SUITABILITY OF THE CONTRACTOR'S PROCESSES AND PROCEDURES. ADDITIONALLY, A PREPRODUCTION SAMPLE SHALL BE REQUIRED WHEN A CONTRACT IS AWARDED TO A NEW SOURCE THAT HAS NOT PREVIOUSLY SUPPLIED THE NUTS ON A PRODUCTION BASIS.
5. IDENTIFY PART NUMBER AND LOT NUMBER PER MIL-STD-130 ON TAG OR CONTAINER.
6. EDGE RADII SHALL BE .015-.030 UNLESS OTHERWISE NOTED.
7. ALL MACHINED SURFACE ROUGHNESS 125 MICROINCHES PER ANSI B46.1-1985, FOR FEATURES DIMENSIONED ON THE DRAWING.
8. △ THREAD FORM PER MIL-S-8879.
9. △ APPLY EVERLUBE 620C TO SURFACE INDICATED. APPLICATION OF LUBRICANT SHALL BE PER THE REQUIREMENTS OF MIL-L-46010, TYPE I.
10. △ BURNISH SOLID FILM LUBRICANTS USING A CLEAN DRY CLOTH OR NYLON BRISTLE BRUSH APPLYING LIGHT PRESSURE TO REMOVE LOOSE PARTICLES.
11. PASSIVATE ALL CORROSION RESISTANT STEEL PER QQ-P-35.
12. △ MAGNETIC PARTICLE INSPECT PER MIL-STD-1949. ACCEPTANCE CRITERIA PER STP0504-0202.
13. △ PENETRANT INSPECT PER MIL-STD-6866, TYPE I, SENSITIVITY LEVEL 2, ACCEPTANCE CRITERIA PER STP0504-0102.
14. CLEAN PER SN-C-0005C, VISIBLY CLEAN LEVEL STANDARD.
15. MAINTAIN CLEAN PER STP0416-01.
16. NUTS ARE ACCEPTABLE ONLY WHEN PACKAGED AND SEALED BY THE ORIGINAL MANUFACTURER.
17. (DELETED)
18. △ THREADED SEGMENTS SHALL BE FABRICATED, INSPECTED, AND ASSEMBLED AS A SERIALIZED MATCH SET.
19. THE WEIGHT OF THE NUT SHALL NOT EXCEED .18 POUNDS.
20. (DELETED)
21. △ WELD AND INSPECT PER AMS2681.
22. THE ASSEMBLY SHALL INCLUDE TWO SPRINGS ELEMENTS. EITHER SPRING ELEMENT, INDEPENDENT OF THE OTHER, SHALL MAINTAIN THE FUNCTIONALITY OF THE NUT ASSEMBLY AS SPECIFIED HEREIN.
23. △ THE ENTERING END OF THE NUT THREADS AND THE THREADS AT THE TOP OF THE NUT ASSEMBLY SHALL BE COUNTERSUNK .05 X .05
24. THE NUT SHALL FUNCTION TO THE REQUIREMENTS HEREON IN A VACUUM ENVIRONMENT WITHIN A TEMPERATURE RANGE OF -120 DEGREES F THROUGH +180 DEGREES F.
25. THE NUT SHALL WITHSTAND TORQUES UP TO 2,000 POUND-INCHES FOR ACHIEVING AXIAL PRELOADING OF THE BOLT.
26. THE NUT SHALL HAVE A MINIMUM AXIAL STRENGTH OF 27,500 POUNDS. THE NUT SHALL BE ASSEMBLED TO THE BOLT AND TORQUED TO 1,125 ±200 POUND-INCH. AXIAL STRENGTH SHALL BE TESTED IN ACCORDANCE WITH MIL-STD-1312, TEST 8. THE BOLTS USED FOR THE TEST SHALL HAVE A MINIMUM ROCKWELL HARDNESS OF RC = 36 AND HAVE ROLLED THREADS PER MIL-S-8879, CLASS 3A.
27. THE NUT SHALL BE CAPABLE OF 10 LOADED INSTALLATION AND REMOVAL CYCLES WITHOUT DAMAGE TO EITHER THE NUT OR THE BOLT. ONE LOAD CYCLE IS DEFINED AS ASSEMBLING THE NUT AND BOLT, AND APPLYING 1,200 ±200 POUND-INCHES TORQUE. WITH THE EXCEPTION OF MINOR WEAR MARKS, AS DEFINED IN NOTE 28, NO DISTORTION, SCRATCHES, GALLING OR SEIZING OF THE NUT AND BOLT THREADS SHALL OCCUR.
28. △ THE FORCE REQUIRED TO PUSH A BOLT THROUGH THE NUT DURING ASSEMBLY SHALL NOT EXCEED 5 POUNDS AT ANY TIME. THE INSERTION FORCE REQUIREMENT SHALL BE MET AT ANGLES OF INSERTION UP TO 2 DEGREES OFF AXIS. MINOR WEAR MARKS, INCLUDING SCRATCHES, IN NOTED AREA ARE PERMISSABLE. THE DEPTH OF WEAR SHALL NOT PASS THROUGH THE PITCH DIAMETER ON THE LOAD BEARING SIDE OF THE THREADS. EXCEPT FOR THE FIRST TWO FULL THREADS, THE DEPTH OF WEAR SHALL NOT PASS THROUGH THE PITCH DIAMETER ON THE NON-LOAD BEARING SIDE OF THREADS.

THIRD ANGLE PROJECTION



CONTRACT NO.	NAS15-10000
DATE	92-12-20
	93-04-01
TITLE	NUT, RAPID ASSEMBLY
	SPEC CONTROL DWG
SIZE	E
CAGE CODE	18355
DRAWING NO.	1F44595

USED ON: 1F44595-1

McDONNELL DOUGLAS

ENGRG REF: LAST DATUM LETTER USED: B

ENGRG REF: LAST VIEW/SECTION LETTER USED: A

1F44595 F1

CMI NO.: 1F44595a-010202.ort
LAYOUT NO.: none

29. THE VENDOR SHALL DEMONSTRATE BY TEST, THE NUT IS FULLY FUNCTIONAL AS SPECIFIED IN NOTES 25 THROUGH 27, AND 37 THROUGH 39 AFTER EXPOSURE TO THE FOLLOWING RANDOM VIBRATIONS APPLIED ALONG EACH OF 3 MUTUALLY PERPENDICULAR AXES BOTH WITH AND WITHOUT A BOLT ENGAGED.

FREQUENCY (HZ)	QUALIFICATION LEVEL
20	.04 G²/HZ
20-50	+8.8 DB/OCTAVE
50-400	.8 G²/HZ
400-2000	-6.3 DB/OCTAVE
2000	.028 G²/HZ

OVERALL LEVEL = 23.1 G RMS (GRMS)
DURATION = 510 SECONDS/AXIS
THREE MUTUALLY PERPENDICULAR AXES

30. THE NUTS SHALL BE ASSEMBLED TO BOLTS AND TORQUED TO 1.125 POUND-INCH IN ACCORDANCE WITH FIGURE 1 OF MIL-STD-1312, TEST 7. PRIOR TO VIBRATING, THE NUTS SHALL BE REMOVED AND REINSTALLED 10 TIMES PER NOTE 23. THE NUT AND BOLT ASSEMBLY SHALL BE VIBRATED AT 30,000 CYCLES ON A STAND IN ACCORDANCE WITH MIL-STD-1312, TEST 7. THE NUT SHALL MAINTAIN SUFFICIENT PRELOAD SUCH THAT IT CANNOT BE REMOVED WITH THE FINGERS AND SHALL NOT HAVE ROTATED MORE THAN 10 DEGREES IN EITHER DIRECTION.

31. VIBRATION TEST TOLERANCES: THE TEST DURATION TOLERANCE SHALL BE ±1% OR 3 SECONDS, WHICHEVER IS GREATER. THE OVERALL GRMS TEST LEVEL TOLERANCE SHALL BE ±10%.

32. ACCELERATION SPECTRAL DENSITY TOLERANCE SHALL BE ±2.0 dB WHEN MEASURED WITH 10 HZ OR NARROWER BANDPASS RESOLUTION FROM 20 TO 2000 HZ WITH THE MEAN VALUE OF THE VARIATIONS REMAINING APPROXIMATELY EQUAL TO THE NOMINAL VALUE. +4 dB AND -3 dB FOR QUALIFICATION (+3 dB AND +4 dB FOR ACCEPTANCE) IS PERMITTED FOR ANY NARROW BAND SPECTRAL EXCESS (SPIKES) WHOSE BANDWIDTH IS LESS THAN 10 HZ OR LESS THAN 10% OF THE GEOMETRIC MEAN FREQUENCY WHERE THE SPIKE OCCURS, WHICHEVER IS GREATER.

33. DATA RECORDING: AS A MINIMUM, THE DATA SHALL BE RECORDED ON MAGNETIC INSTRUMENTATION TAPE DURING ALL TEST RUNS. THE TAPE RECORDER SHALL BE IN THE RECORD MODE WHENEVER THE TEST SPECIMEN IS MOUNTED AND THE POWER AMPLIFIER IS ON. THE RECORDED SIGNAL SHALL BE AN ACCURATE REPRESENTATION OF THE ACCELEROMETER SIGNAL WITHIN 12% FROM 10 -2000 HZ WHEN PLAYED BACK ON THE SAME RECORDER. ACCELEROMETER DATA SHALL BE CAPTURED ON A DIRECT DIGITAL ANALYZER IF ONE IS AVAILABLE.

34. THE FREQUENCY RESPONSE OF THE ACCELEROMETER CHANNEL(S) SHALL BE FLAT (±1 dB) FROM 10-3000 HZ. PRIOR TO THE INITIATION OF EACH TEST RUN, THE ACCELEROMETER CHANNEL(S) SHALL BE CALIBRATED USING THE CALIBRATED SIGNAL IN THE CHARGE AMPLIFIERS OR AN APPROPRIATE G-RANGE SIGNAL. THE CALIBRATION SIGNAL SHALL BE ANNOTATED IN TERMS OF G(O-P). AN AC CALIBRATION SIGNAL SHALL BE USED.

35. RANDOM VIBRATION DATA REDUCTION: DATA SHALL BE ANALYZED TO PROVIDE ACCELERATION SPECTRAL DENSITY CURVES SHOWING G^2/HZ VERSUS FREQUENCY. THE RMS LEVEL SHALL BE NOTED ON EACH PLOT. WHEN ADDITIONAL DATA REDUCTIONS ARE DONE, THE PLOT RESOLUTION SHALL MATCH THE CONTROL RESOLUTION AS CLOSELY AS POSSIBLE. ANALYZED SAMPLES SHALL CONTAIN AT LEAST 120 DEGREES OF FREEDOM.

36. AN INDEPENDENT END-TO-END CHECK SHALL BE PERFORMED WITH THE CONTROL ACCELEROMETER(S) AND ALL IN-LINE RESPONSE ACCELEROMETERS BEFORE THE START OF THE DYNAMIC TEST PROGRAM. AN INDEPENDENT REDUNDANT ACCELEROMETER, OR AN OVERRANGE ACCELEROMETER, OR A WEDGE CHECK IS ACCEPTABLE.

37. STRESS DURABILITY: THE NUT SHALL BE TORQUED TO ACHIEVE AN AXIAL LOAD OF 21,500 POUNDS. AFTER 60 HOURS OF CONTINUOUS LOAD THE NUT SHALL BE REMOVED AND INSPECTED UNDER 10X MAGNIFICATION FOR CRACKS OR OTHER DISCONTINUITIES.

38. THE NUT SHALL PRODUCE A CONSISTANT WRENCH TORQUE VERSUS BOLT PRELOAD WHEN USING A BOLT WITH MINIMUM HARDNESS OF Rc=36 AND THREADED PER MIL-S-8879, CLASS 3A. THE PRELOAD SHALL BE WITHIN +/- 20% FOR A CONSTANT INPUT TORQUE SETTING.

39. CROSS THREADING SHALL NOT OCCUR WHEN THE BOLT IS INSERTED AT ANGLES UP TO 8 DEGREES OFF AXIS.

40. PRODUCTION ACCEPTANCE CRITERIA: 100% OF PRODUCTION UNITS SHALL CONFORM WITH NOTES 2 THROUGH 23. IN ADDITION, 100% OF PRODUCTION UNITS SHALL BE SUBJECTED TO TEST FOR VERIFICATION OF REQUIREMENTS DEFINED IN NOTE 28.

41. DESTRUCTIVE PRODUCTION ACCEPTANCE CRITERIA: 2% OR A MINIMUM OF 4 PRODUCTION UNITS PER LOT SHALL BE SUBJECTED TO EACH TEST FOR VERIFICATION OF REQUIREMENTS DEFINED IN NOTES 25, 26, 27, 37, 38 AND 39. PRIOR TO TEST, HALF OF THE TEST UNITS SHALL BE SUBJECT TO THE VIBRATION ENVIRONMENTS PER NOTES 29 AND 31 THROUGH 36 WITH A BOLT ENGAGED, AND HALF WITHOUT A BOLT ENGAGED. SINCE THESE TESTS MAY BE NON-DESTRUCTIVE, PERFORMING MULTIPLE TESTS ON THE SAME UNIT IS AT THE DISCRETION OF THE SUPPLIER.

42. VERIFICATION OF NOTE 24 MAY BE BY ANALYSIS. MDA MECHANICAL DESIGN APPROVAL OF ANALYSIS REQUIRED.

SUGGESTED SOURCES OF SUPPLY			MDA CONTROL NUMBER
VENDOR	CAGE CODE	VENDOR PART NO	
THREAD TECHNOLOGY INC. 14514-H LEE RD. CHANTILLY, VA 22021	07607	050006	1F44595-1
AVIBANK 210 SOUTH VICTORY BLVD BURBANK, CA 91503	84256	56944-1	

NOTES:

1. IDEN AS A ITEM
2. INTE
3. OPTI MIL-
4. PREP THE ADDI TO A
5. IDEN
6. EDGE
7. ALL DIME
8. THRE
9. APPL THE F
10. BURN APPLY
11. PASS
12. MAGNE
13. PENET
14. CLEAN
15. MAINT
16. NUTS
17. (DELE
18. THREA MATCH
19. THE M
20. (DELE
21. WELD
22. THE A OF THE
23. THE EN SHALL
24. THE NU A TEMP
25. THE NU OF THE
26. THE NU BOLT A MIL-ST RC = 3
27. THE NU NUT OR POUND SCRATC
28. THE FO TIME. MINOR PASS T FULL T SIDE O

ENGRG REF: LAST DAT
ENGRG REF: LAST VIE

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Consolidated Laboratories, Inc.
732 Arrow Grand Circle
Covina, California 91722
(626) 915-8991
FAX (626) 966-3156

July 25, 1998

TEST REPORT

Almay Research & Testing Corporation
1415 Newton Street
Los Angeles, California 90021

Subject: Vibration Test on Eight (8) Specimens of P/N 1F44595 (TTI P/N 050006), Rapid Assembly Nut, S/N's 5007, 5049, 5057, 5067, 5095, 5108, 5127 and 5157

This will certify that the units above were subjected to the Vibration Test of the referenced documents in this Laboratory in the manner and with results as described below:

1. **REFERENCES**

1.1 Purchase Order No. 893 dated 7/13/98 from Almay Research & Testing Corporation.

1.2 Thread Technology, Inc. Document No. 050016, Rev. C, dated 3/11/98: Acceptance/Qualification Test Plan and Procedure For ½-20UNJF-3B ZipNut P/N 050006 and MDA 1F44595.

1.3 McDonnell Douglas Drawing No. 1F44595, Rev. D: Nut, Rapid Assembly.

2. **PURPOSE** -- The purpose of this test program was to subject the units to the Vibration Test of Reference 1.2, Paragraphs 05-000 & 06-000 and Reference 1.3, Notes 29 & 31 - 36. Four of the units (S/N's 5057, 5067, 5108 & 5157) were to be assembled onto the mating bolt, torqued to 1,125 ± 200 in-lb (93.75 ± 16 ft-lb) and monitored for rotation during the test. The remaining four units were to be held in place with ⅜" (non-mating) bolts. The units were to be examined for physical damage and returned to Almay for disposition after completion of the test program.

3. **SUMMARY** -- The units were subjected to the Vibration Test as required. The procedures and results of the test are shown on the laboratory instruction/data sheet, test log and plots which are reproduced as subsequent pages of this report. S/N's 5057, 5067, 5108 & 5157 exhibited no rotation in excess of 30°. Examination of the units after completion of testing disclosed no visible evidence of damage or deterioration as a result of the test conditions. The units were considered to have passed the Acceptance Random Vibration Test as conducted in this Laboratory and were returned to Almay for disposition after completion of the test program.

Test By: L. L. Frye	Concurred:
Report By: D. D. Huff	DCMAO Quality Assurance Representative

SI 56 Joe Campa 7-31-98

Prepared By: _____
Dale D. Huff, Test Engineer

REGISTERED PROFESSIONAL ENGINEER
PHILIP MICHAEL HARTY
NO. 19959
Exp. 9-30-00
MECHANICAL
STATE OF CALIFORNIA

Approved By: _____
P. M. Harty, P. E., Laboratory Director

H P

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TEST REPORT

4. TEST EQUIPMENT -- The following items of test equipment, maintained within the current applicable calibration period, were used to conduct the test:

-Accelerometer: Endevco Model 2215, S/N 1536, ID/N 2106-61, 27.80 pC/g, ±1.4%. Calib. due 9-1-98, 6 mos. Used with Endevco Model 2721B, S/N CY05, ID/N 2104-4, charge amplifier. Calib. due 12-16-98, 6 mos. Used to monitor and control vibration input levels.

-Torqometer: Snap-On Model TE100L, ID/N 304, 0 to 100 foot-pounds, torque meter. Calib. due 8-8-98, 12 mos.

-Vibration Exciter: MB Model C-50, S/N 168, ID/N 2005, with MB Model T451-B power amplifier, S/N 119, ID/N 2008, rated at 5000 force pounds. Used with Hewlett-Packard Model 5427A, S/N 282, ID/N 2006, vibration control system. Calib. due 11-5-98, 6 mos.

HP

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LAB DATA SHEET

Part No. 1F44595 S/N See Below Sample 1 - 8 Job 9067
Description Rapid Assembly Nut Co. Almay
Page 1.0

TEST: VIBRATION
To Spec:
050016, Rev. C, Paras. 05-000 & 06-000;
Dwg. No. 1F44595, Rev. E, Notes 29 & 31 - 36
Photo Req'd YES

	Start	Cptd
Date	JUL 24 1998	JUL 24 1998
Test By	[signature]	[signature]
Photo	✓	

CLT 15 INSP — CLT 5 INSP

1. Axis Identification:

   X -- Parallel to the axis of bolt insertion through the nut.
   Y -- At random radially to the body of the nut.
   Z -- Mutually perpendicular to the X and Y Axes.

2. Assemble four of the nuts onto the mating bolt through an appropriate fixture plate until seated against the washers and tighten finger tight. Gradually tighten to 1,125 ± 200 in-lb and then mark the units in order to observe rotation as a result of the vibration. Secure the fixture plate to a vibration cube. Mount the composite assembly on the head of the vibration exciter, with the axis under test being changed by changing the orientation of the fixture plate on the cube. Mount a control accelerometer on the fixture plate adjacent to the mounting interface of the units. As a minimum, the accelerometer signal shall be recorded during all test runs.

3. Subject the units to the following levels of random vibration.

Hz	PSD, g^2/Hz	Slope, dB/Oct
20	0.04	----
50	0.80	+9.8
400	0.80	----
2000	0.028	-6.3

Tolerances
20 - 2000 Hz; ±2 dB
Overall: 23.1 g_{rms} ± 10%

On each axis, equalize and vibrate the unit for 510 ± 5.1 seconds at the full level listed above. Make a computer print-out of the control equalization for each axis of vibration. Check off O.K. completion below:

X Axis ✓ Y Axis ✓ Z Axis ✓

Any visible evidence of physical damage? NO

Any rotation in excess of 30°? NO

4. Assemble the other four nuts to an appropriate fixture plate using 3/8 inch bolts. Secure the fixture plate to the vibration cube on the head of the vibration exciter, as stated in Step 2, above, and repeat the procedures of Step 3, above. Check off O.K. completion below:

X Axis ✓ Y Axis ✓ Z Axis ✓

Any visible evidence of physical damage? NO (CLT 15) (CLT 5 INSP)

H P

5. List test equipment used on the Test Equipment List, attached.

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TEST REPORT

Type of Test Random Vibration Job Number 9067
Specification Customer ALMAY
Specimen Description RAPID ASSEMBLY NUT
Sample Qty. 8 Part Number 1F44595 Serial Number SEE BELOW

Frequency (Hz)		Level			Duration
From	To	dB/Oct	g^2/Hz	Overall (g_{rms})	
20	—		0.04		510 SEC/AXIS
20	50	+9.8			
50	400		0.80		
400	2000	−6.3			
—	2000		0.028	23.1	

Tolerances: 20–2000 HZ AT ±2.0 DB

NOTES:

Date	Time	Axis	Comments
7-24-98	09:30		START SETUP.
			S/N - 5157, 5108, 5057, 5067
			TORQUED TO MATING BOLTS AT
			94 'LBS. (EA)
	10:52	Y	START RANDOM VIB.
	11:00	Y	END, NO ROTATION NOTED.
	11:11	Z	START RANDOM VIB.
	11:19	Z	END,
	11:35	X	START RANDOM VIB.
	11:43	X	END.
			MEASURE TORQUE REQUIRED TO LOOSEN.
			5157 = 80'LB 5057 = 70'LB 5108 = 72'LB 5067 = 79'LB

Inspector ______________ Technician L. [signature]

CLI 15 CLI 5 INSP

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REPORT NO. 9067

TEST REPORT

Type of Test RANDOM VIBRATION Job Number 9067
Specification _____ Customer ALMAY
Specimen Description RAPID ASSEMBLY NUT.
Sample Qty. 8 Part Number 1F44595 Serial Number SEE BELOW

Vibration/Shock Test Log:

Date	Time	Axis	Comments
7-24-98	13:20	X	START RANDOM VIB, S/N-5007,
			5049, 5095, 5127 (GROUP#2)
	13:28	X	END.
	13:39	Y	START RANDOM VIB, GROUP#2
	13:47	Y	END.
	13:54	Z	START RANDOM VIB, GROUP #2
	14:02	Z	END.
			NO ANOMALIES NOTED.
			ALL 8-NUTS + 4 BOLTS RETURNED
			TO ALMAY WITH CUSTOMER (HARRY)

Inspector _____ Technician L. Fye

CLT 15 CLT 5 INSP

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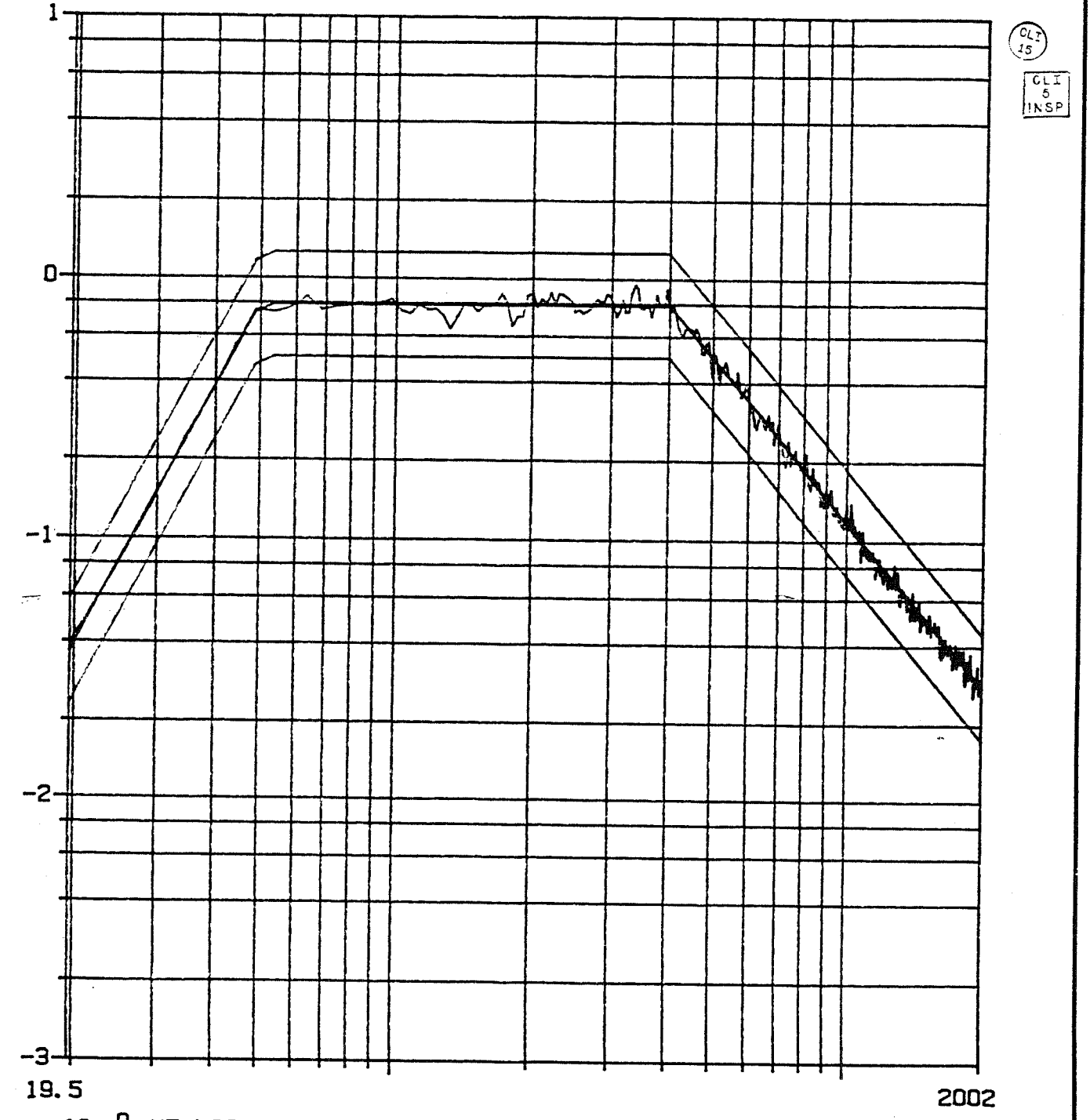
TEST REPORT

JUL 24 1998

P/N 1F44595 S/N 5157, 5108, 5057, 5067 RANDOM VIBRATION X AXIS
POST TEST ELAPSED TIME = 511 SECS AT .00 DB
RMS LEVEL = 23.03 G'S DELTA F = 4.883 DOF= 304 AWF= 10
10 N G SQR/HZ



GLI 15

GLI 5 INSP

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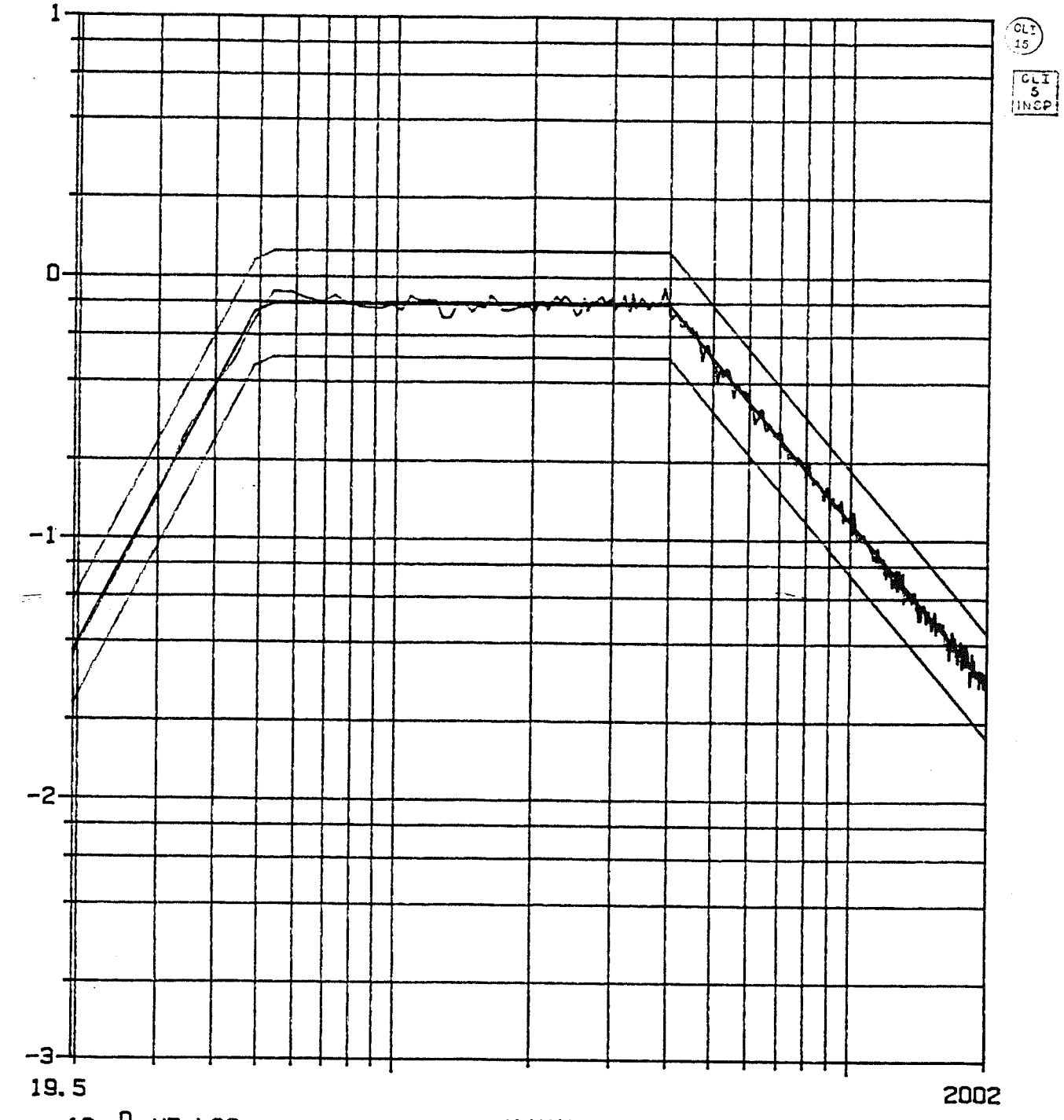
(626) 915-8991

TEST REPORT

JUL 24 1998

P/N 1F44595 S/N 5157, 5108, 5057, 5067 RANDOM VIBRATION Y AXIS
POST TEST ELAPSED TIME = 511 SECS AT .00 DB
RMS LEVEL = 23.04 G'S DELTA F = 4.883 DOF= 304 AWF= 10
10 N G SQR/HZ



CLI 15

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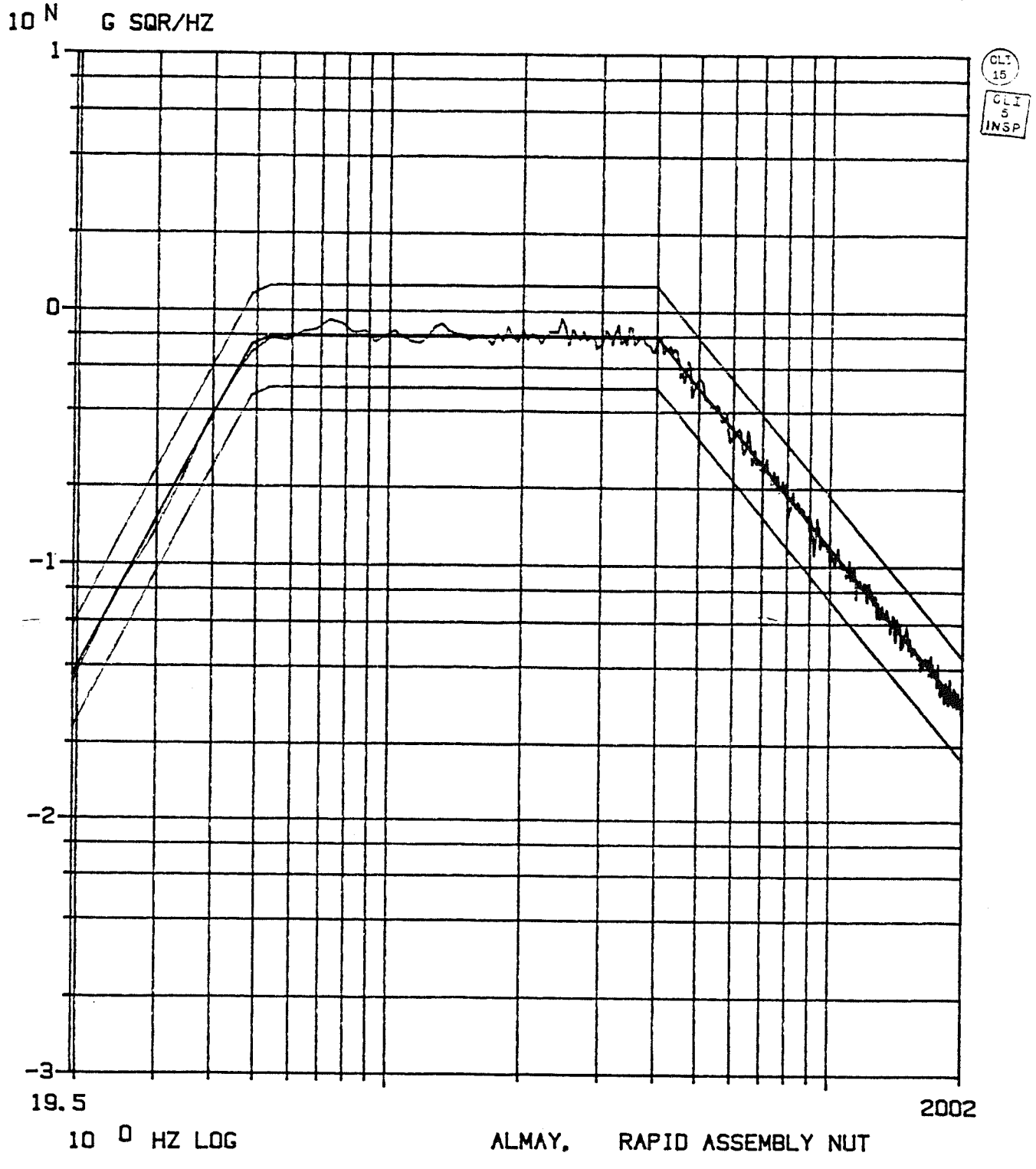
TEST REPORT

JUL 24 1998

P/N 1F44595 S/N 5157, 5108, 5057, 5067 RANDOM VIBRATION Z AXIS
POST TEST ELAPSED TIME = 511 SECS AT .00 DB
RMS LEVEL = 23.13 G'S DELTA F = 4.883 DOF= 304 AWF= 10



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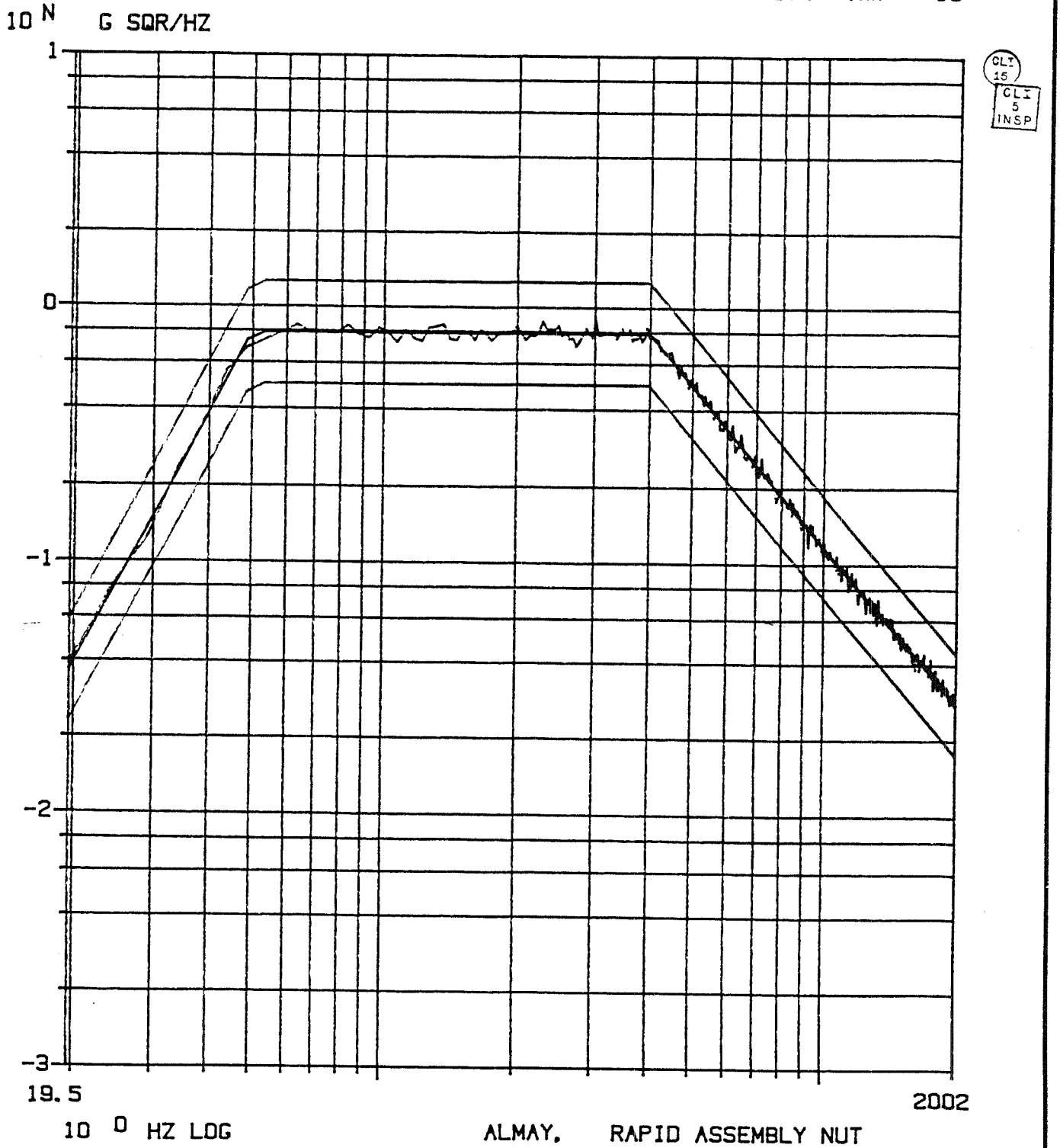
TEST REPORT

JUL 24 1998

P/N 1F44595 S/N 5007, 5049, 5095, 5127 RANDOM VIBRATION X AXIS
POST TEST ELAPSED TIME = 511 SECS AT .00 DB
RMS LEVEL = 23.03 G'S DELTA F = 4.883 DOF= 304 AWF= 10



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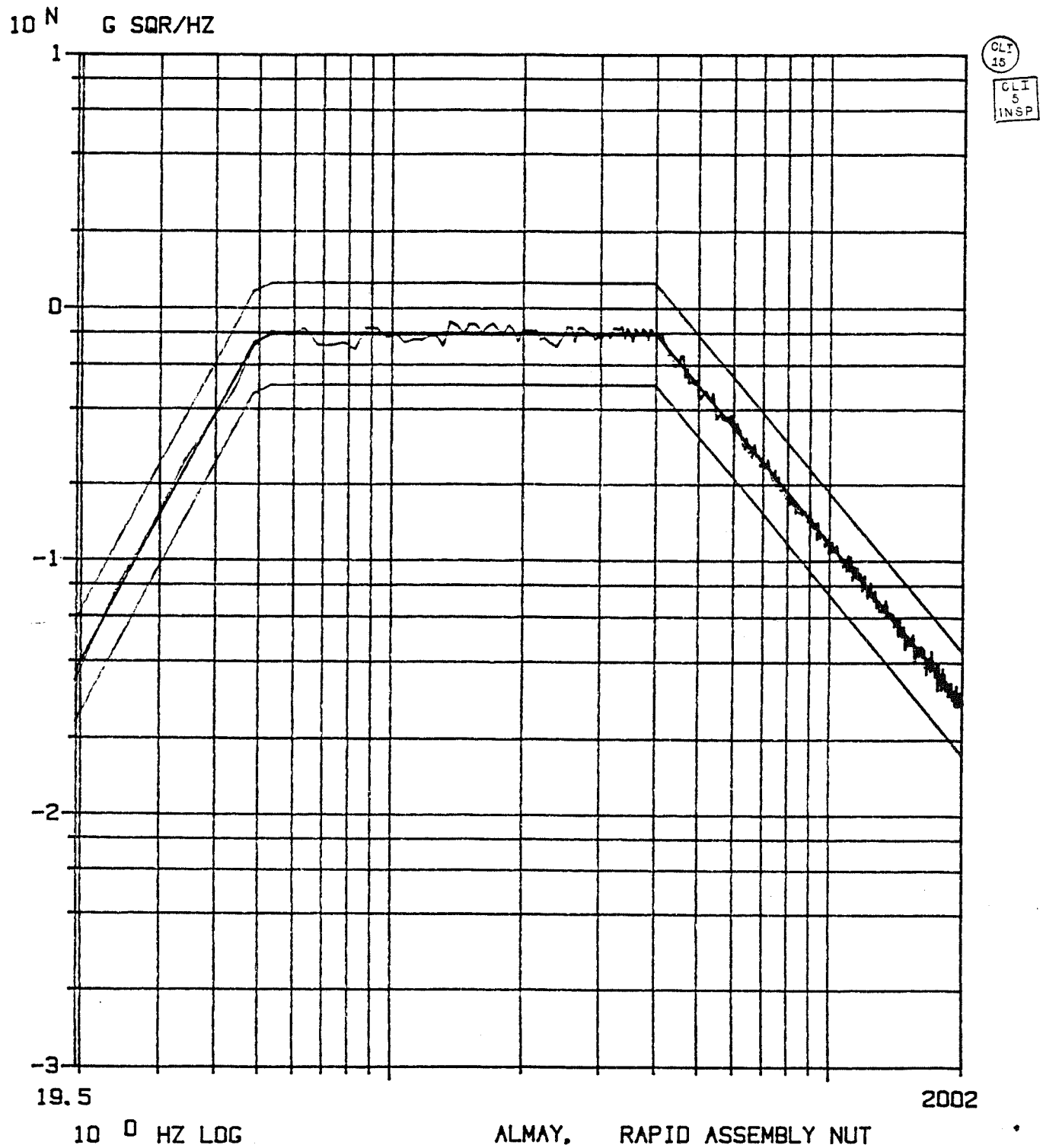
TEST REPORT

JUL 24 1998

P/N 1F44595 S/N 5007, 5049, 5095, 5127 RANDOM VIBRATION Y AXIS

POST TEST ELAPSED TIME = 511 SECS AT .00 DB

RMS LEVEL = 23.03 G'S DELTA F = 4.883 DOF= 304 AWF= 10



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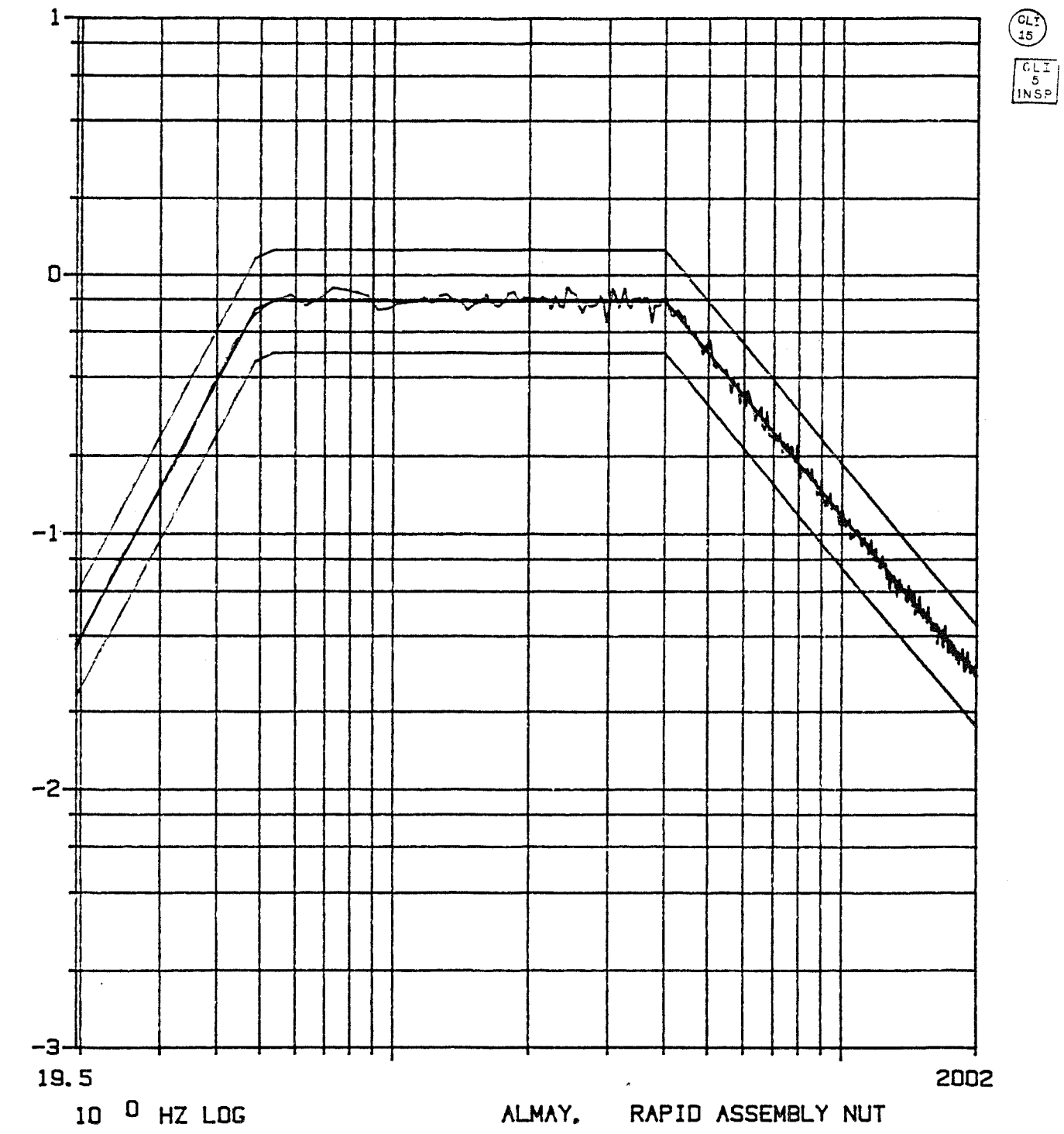
TEST REPORT

JUL 24 1998

P/N 1F44595 S/N 5007, 5049, 5095, 5127 RANDOM VIBRATION Z AXIS
POST TEST ELAPSED TIME = 511 SECS AT .00 DB
RMS LEVEL = 23.07 G'S DELTA F = 4.883 DOF= 304 AWF= 10



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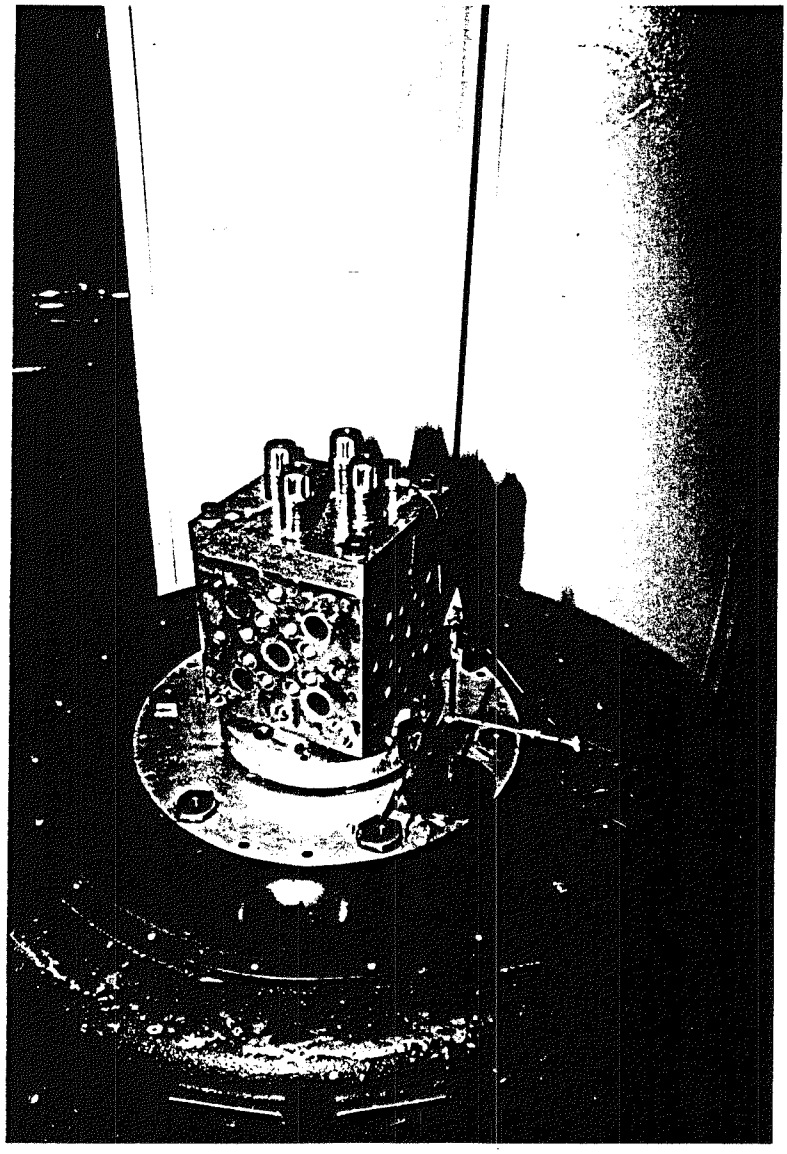
TEST REPORT

VIBRATION TEST SETUP

(X Axis; S/N's 5057, 5067, 5108 & 5157)



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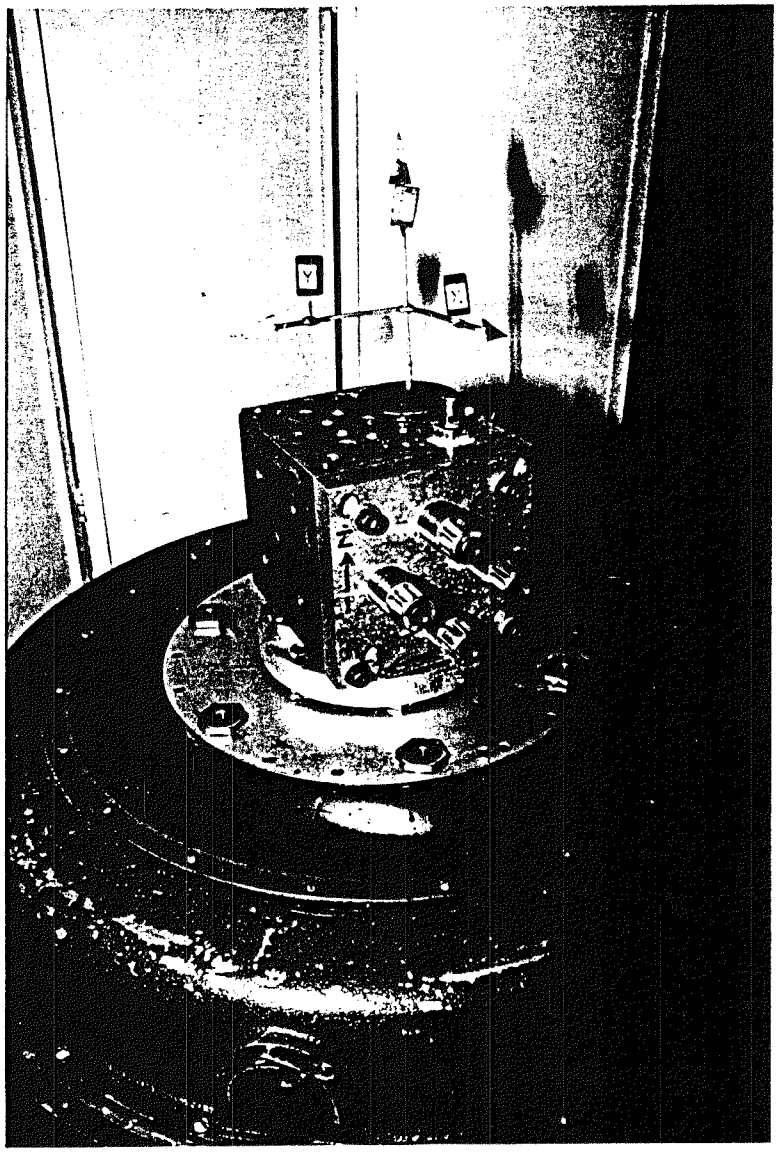
TEST REPORT

VIBRATION TEST SETUP

(Z Axis; S/N's 5057, 5067, 5108 & 5157)



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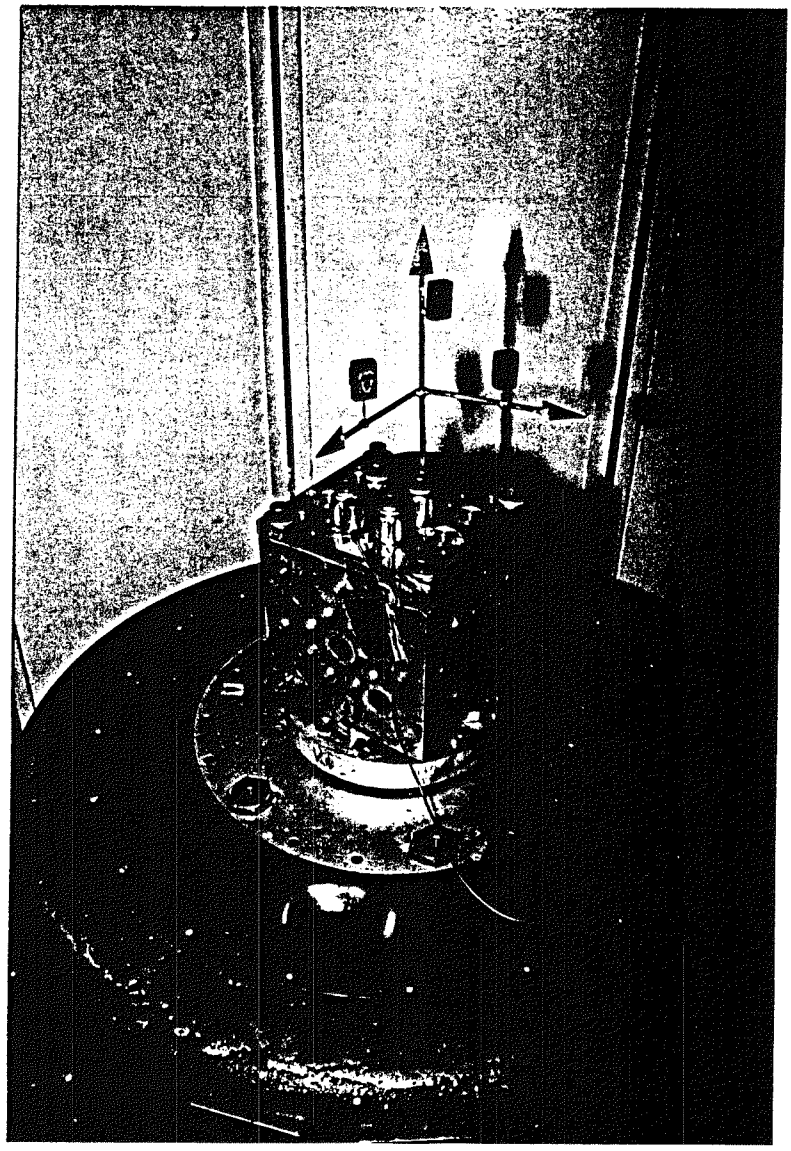
TEST REPORT

VIBRATION TEST SETUP

(X Axis; S/N's 5007, 5049, 5095 & 5127)



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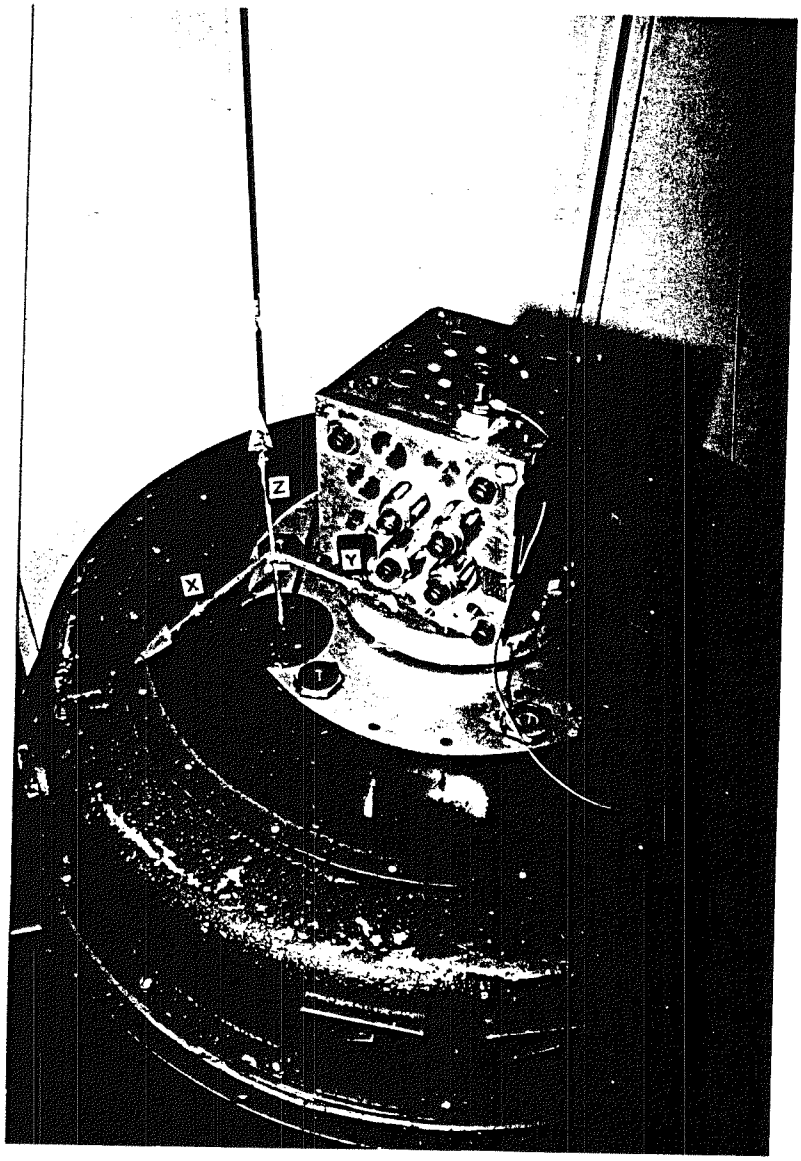
TEST REPORT

VIBRATION TEST SETUP

(Z Axis; S/N's 5007, 5049, 5095 & 5127)



REPORT NO. C 27150-3

RESULTS OF PRODUCTION ACCEPTANCE TEST
EVALUATION OF McDONNELL DOUGLAS
P/N 1F44595, REV. E (TTI P/N 050006)
RAPID ASSEMBLY NUTS ('ZIP NUTS') LOT NO. 6,
SUBMITTED BY THREAD TECHNOLOGY, INC.,
STERLING, VIRGINIA

October 1, 1998

Thread Technology, Inc. P.O. No. 1826

(Ref: McDonnell Douglas P.O. No. 927402
& NASA Contract 15-10000)

by Harry S. Brenner
Harry S. Brenner, P.E.
Director of Research

ALMAY RESEARCH & TESTING CORPORATION | LOS ANGELES | CALIFORNIA

Defense Logistics Agency
Defense Contract Management Command

/s/ Tom Osborn 10/6/98
Tom Osborn
Quality Assurance Representative
DCMDW-GAODA

The Boeing Company
Space Systems Division

/s/ Joseph M Campa II
Joseph M. Campa II
Quality Engineer
Procurement Quality Assurance
10-05-98

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INTRODUCTION

Thread Technology, Inc., 22560 Glenn Drive, Suite 114, Sterling, Virginia 20164, submitted twenty-five (25) samples of a special design nut for production acceptance test evaluation of performance properties. The nut was identified as a 'Rapid Assembly Nut' conforming to McDonnell Douglas Aerospace Spec. Control Drawing 1F44595, Rev. E. Thread Technology identified the nut as the "ZIP NUT", conforming to TTI Part Number 050006. It was noted that the "ZIP NUTS" were intended for use in the construction and assembly of the International Space Station. (Reference: McDonnell Douglas P.O. #927402 and NASA Contract 15-10000).

The applicable Purchase Order from Thread Technology, Inc. outlined the Acceptance Test Plan in TTI Document No. 050016, Rev. D, dated 8/18/98 for the MDA 1F44595-1 (TTI P/N 050006) "Zip Nuts". In addition, all tests were to be witnessed by the Defense Contract Management Command (representing NASA), and by The Boeing Company (formerly McDonnell Douglas Aerospace (MDA)). The comprehensive and detailed test program was witnessed and monitored by the following representatives at Almay:

Defense Logistics Agency
Defense Contract Management Command
Mr. Tom Osborn, Quality Assurance Representative

and

The Boeing Company
Space Systems Division
Mr. Joseph M. Campa II, Quality Engineer

After coordination with the designated quality representatives, the physical test program was initiated on September 10, 1998, and all tests completed on October 1, 1998. The "ZIP NUTS" included in this phase of the performance test evaluation were identified as PRODUCTION LOT NO. 6. The test program was outlined to observe the sequences and test procedures referenced in TTI Document No. 050016, Rev. D, dated 8/18/98. All test equipment, fixtures, gages, etc. used in support of the evaluation testing were in current calibration conforming to the requirements of the ALMAY "Quality System Manual (QSM)" dated 6/2/97, designed to

satisfy and meet requirements of Spec. MIL-Q-9858A, and ISO 9003.

TEST PROCEDURE

Almay Test Report No. C 27150 dated April 14, 1998, initially covered the detailed 'qualification' series of tests conducted on LOT NO. 3 "ZIP NUTS" P/N lF44595-1 (TTI P/N 050006). The report included photographs of the test parts as received, test equipment used, typical fixturing and test set-ups, specimens after test evaluation, etc. Also, all test procedures were detailed in compliance with the requirements and objectives of TTI Document No. 050016. The current production acceptance tests of LOT NO. 6 covered by this report utilized the same test equipment, fixturing, and gages noted in Report No. C 27150. In addition, the test procedures described in Report C 27150 were observed and followed in conducting the current tests on LOT NO. 6. The only change was the test sample size of twenty-five (25) nuts for LOT NO. 6, whereas the earlier tests of the "ZIP NUTS" were limited to a sample size of twenty (20) units. Accordingly, by reference, Almay Report No. C 27150 is made a part of this production acceptance report.

The "ZIP NUTS" representing production LOT NO. 6 were serialized by Thread Technology, Inc., and are identified in Table 1. On the recommendation of The Boeing Company engineering representative, assignment of specimen numbers for the various test sequences was made at random. The Test Flow and applicable Specimen Identification numbers for this prwgram are noted in Figure 1. Specific care was exercised to maintain specimen identification during all phases of the evaluation test program.

As a special condition for this test project, the test bolts were required to have a minimum hardness of Rc 36, and a minimum thread length of 0.800-inches. As noted previcusly, for the evaluation of LOT NO. 3, Boeing Standard BAC B30LE Series Bolts were employed, which were fabricated from A286 CRES, having a minimum tensile strength of 200 ksi. For the test of LOT NO. 6, as well

TABLE NO. 1.

IDENTIFICATION OF RAPID ASSEMBLY NUTS (ZIP NUTS)
RECEIVED FROM THREAD TECHNOLOGY, INC. FOR PRODUCTION
ACCEPTANCE TEST EVALUATION

Specimen No.	TTI SERIAL NUMBER	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size 1/ (UNJF-3B)	Lot Number	Test Procedure
1	6001	1F44595-1 REV. E	050006	.5000-20	6	TTI Document 050016, REV. D
2	6006	"	"	"	6	"
3	6010	"	"	"	6	"
4	6039	"	"	"	6	"
5	6045	"	"	"	6	"
6	6064	"	"	"	6	"
7	6068	"	"	"	6	"
8	6075	"	"	"	6	"
9	6096	"	"	"	6	"
10	6105	"	"	"	6	"
11	6113	"	"	"	6	"
12	6130	"	"	"	6	"
13	6137	"	"	"	6	"
14	6155	"	"	"	6	"
15	6159	"	"	"	6	"
16	6162	"	"	"	6	"
17	6190	"	"	"	6	"
18	6197	"	"	"	6	"
19	6201	"	"	"	6	"
20	6208	"	"	"	6	"
21	6218	"	"	"	6	"
22	6241	"	"	"	6	"
23	6246	"	"	"	6	"
24	6265	"	"	"	6	"
25	6270	"	"	"	6	"

NOTES:

1/ "ZIP NUT" Rapid Assembly Nut with thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES, Conforming to Thread Technology Inc. Drawing No. 050006 Rev. E.

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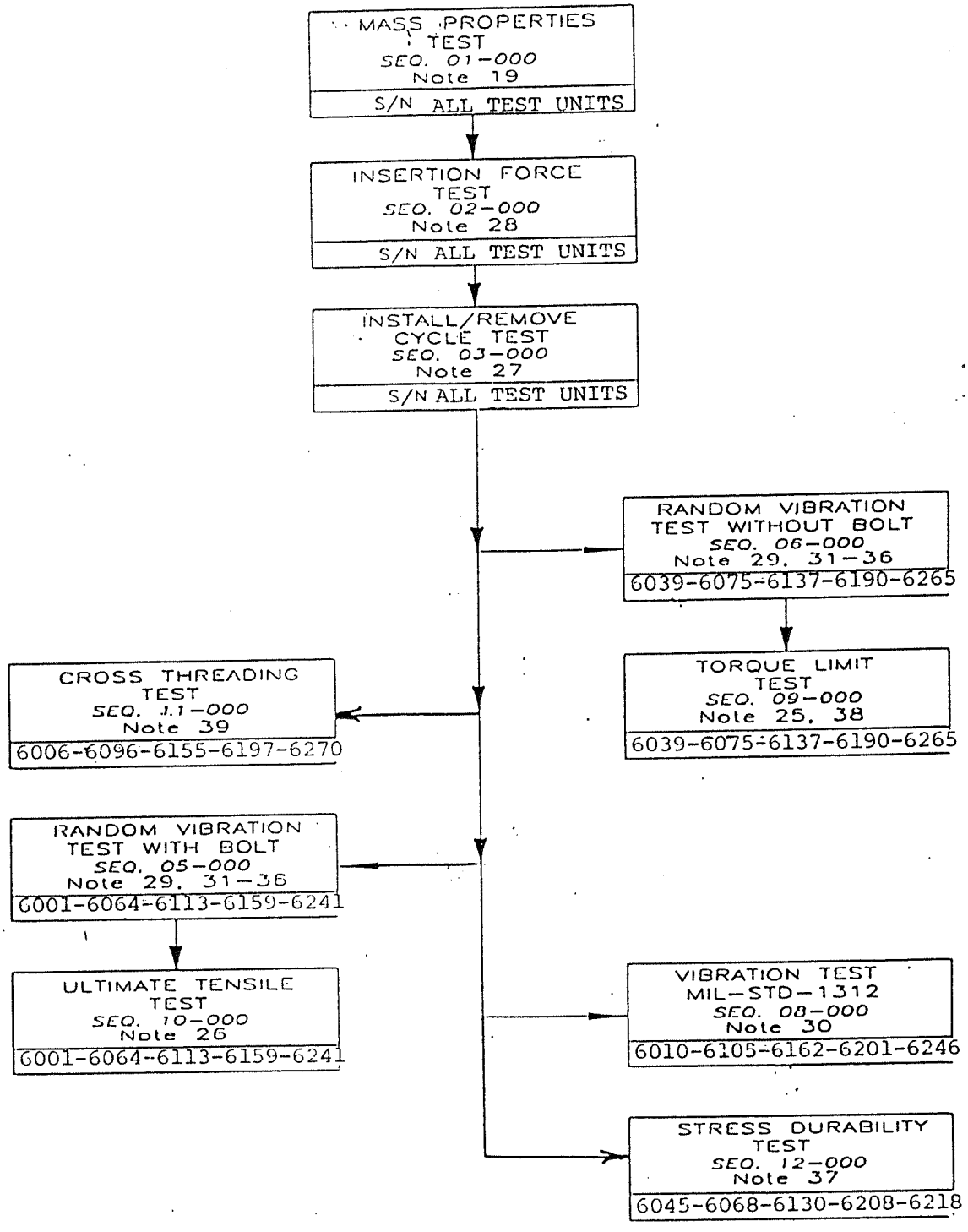

FIG. 1 (above).- Test Flow Chart and Specimen identification for LOT NO. 6 'ZIP NUTS' per TTI Document No. 050016, Rev. D.

as for LOT NOS. 4 and 5, Boeing Standard BAC B30US Series Bolts were utilized as also meeting the required thread length. The bolts were fabricated from Inconel 718 CRES, and developed a minimum tensile strength of 220 ksi. Prior to use, all test bolts were treated to peovide a dry film lubricant finish per MIL-L-46010E, which was requested by The Boeing Company.

All tests outlined for the "ZIP NUTS" in Thread Technology, Inc. Document No. 050016, Rev. D were conducted at Almay, with the exception of the Random Vibration tests. The two series of Random Vibration tests were performed at Consolidated Laboratories, Inc., under the supervision of Almay, The Boeing Company, and the Defense Contract Management Command. The results of the Random Vibration tests are presented in Consolidated Laboratories, Inc. Report No. 9218 dated September 24, 1998, and is attached as an Appendix to this Report.

TEST RESULTS

The results of the various tests conducted on the MDA P/N 1F44595-1 (TTI P/N 050006) Rapid Assembly Nuts for LOT NO. 6 are summarized in the following Tables:

Table No. 2 - Results of Weight (Mass Property) Tests

Table No. 3 - Results of 2° Insertion Force Tests

Table No. 4 - Results of 10-Cycle Installation/Removal Tests

Table No. 5 - Results of MIL-STD-1312 Accelerated Vibration Tests

Table No. 6 - Results of Torque Limit Tests

Table No. 7 - Results of Ultimate Tensile Strength Tests

Table No. 8 - Results of Cross-Threading Tests

Table No. 9 - Results of Stress Durability Tests

Random Vibration Tests - Consolidated Report No. 9218.

COMMENTS

The results of the comprehensive series of tests conducted on the MDA P/N 1F44595-1 (TTI P/N 050006) Rapid Assembly Nuts indicated that all test nuts representing LOT NO. 6 exhibited an ability to meet and/or exceed all rated performance requirements referenced in MDA Spec. Control Drawing 1F44595, and TTI Document No. 050016. No cracks, deformation, or fractures were observed with any of the critical tests noted in this Report.

As noted in Almay Report No. C 27150-1 covering the performance results of LOT NO. 4 Rapid Assembly Nuts, Boeing BAC B30US Series Inconel 718 CRES bolts were used in testing the "ZIP NUTS", and also for LOT NO. 5. The bolts were rated at 220 ksi, whereas the earlier tests of LOT NO. 3 were evaluated using Boeing BAC B30LE Series Bolts rated at 200 ksi, and fabricated from A286 CRES. The result of using the higher strength bolts for LOT NO. 6 was the ability to develop higher ultimate tensile strengths, and higher induced tensile clamp loads in the Torque Limit tests. The ability to exceed minimum requirements would appear to indicate an adequate margin of safety for design application.

The LOT NO. 6 fasteners used in the test program are being forwarded directly to The Boeing Company for information and examination.

The above information and data are accordingly submitted for the use of Thread Technology, Inc.

X X X

TABLE NO. 2.

RESULTS OF WEIGHT (MASS PROPERTY) TESTS OF
MDA P/N 1F44595 REV. E (TTI P/N 050006) LOT #6
RAPID NUT ASSEMBLIES

SI 56 10-05-98

Almay Serial No.	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	Maximum Permissible Weight (lb) 2/	Actual Nut Weight 4/ (grams)	Equivalent Nut Weight (lb) 3/ 4/
6001	1F44595-1 Rev. E	050006	.5000-20	0.16	59.0	0.1300
6006	"	"	"	"	58.9	.1299
6010	"	"	"	"	58.9	.1299
6039	"	"	"	"	58.1	.1281
6045	"	"	"	"	59.2	.1305
6064	"	"	"	"	58.8	.1296
6068	"	"	"	"	59.3	.1307
6075	"	"	"	"	58.7	.1294
6096	"	"	"	"	59.1	.1303
6105	"	"	"	"	58.5	.1290
6113	"	"	"	"	58.5	.1290
6130	"	"	"	"	59.0	.1300
6137	"	"	"	"	58.7	.1294
6155	"	"	"	"	59.1	.1303
6159	"	"	"	"	58.9	.1299
6162	"	"	"	"	59.1	.1303
6190	"	"	"	"	58.7	.1294
6197	"	"	"	"	58.8	.1296
6201	"	"	"	"	58.5	.1290
6208	"	"	"	"	58.5	.1290
6218	"	"	"	"	59.2	.1305
6241	"	"	"	"	58.9	.1299
6246	"	"	"	"	58.7	.1294
6265	"	"	"	"	59.0	.1300
6270	"	"	"	"	58.8	.1296

NOTES:

1/ "ZIP NUT" Rapid Nut Assembly with thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES, conforming to Thread Technology Inc. Drawing No. 050006.

2/ Maximum Nut permissible weight per Note 19, MDA Spec. Control Drawing 1F44595, Rev. E.

3/ Test nuts are within maximum weight limit, and conform to Note 19, Spec. Control Dwg. 1F44595.

4/ Mass Property test conducted on September 10, 1998 in accordance with Sequence No. 01-000, TTI Document No. 050016, Rev. D dated 8/18/98. Test conducted using W.M Welch Scientific Scale.

TABLE No. 3

RESULTS OF 2° INSERTION FORCE TEST OF
MDA P/N 1F44595 REV E (TTI P/N 050006)
LOT # 6 RAPID NUT ASSEMBLIES

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Serial No.	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	Maximum Permissible Insertion Force (lb) 2/	2° TEST INSERTION FORCE (lb) 3/	COMMENTS
6001	1F44595-1 Rev. E	050006	.5000-20	5	4.0	Acceptable
6006	"	"	"	"	3.7	Acceptable
6010	"	"	"	"	3.4	Acceptable
6039	"	"	"	"	3.5	Acceptable
6045	"	"	"	"	3.3	Acceptable
6064	"	"	"	"	3.6	Acceptable
6068	"	"	"	"	3.6	Acceptable
6075	"	"	"	"	3.4	Acceptable
6096	"	"	"	"	3.3	Acceptable
6105	"	"	"	"	3.7	Acceptable
6113	"	"	"	"	3.5	Acceptable
6130	"	"	"	"	4.1	Acceptable
6137	"	"	"	"	3.4	Acceptable
6155	"	"	"	"	3.5	Acceptable
6159	"	"	"	"	3.9	Acceptable
6162	"	"	"	"	3.3	Acceptable
6190	"	"	"	"	3.1	Acceptable
6197	"	"	"	"	3.3	Acceptable
6201	"	"	"	"	3.6	Acceptable
6208	"	"	"	"	3.8	Acceptable
6218	"	"	"	"	3.7	Acceptable
6241	"	"	"	"	3.4	Acceptable
6246	"	"	"	"	3.5	Acceptable
6265	"	"	"	"	3.3	Acceptable
6270	"	"	"	"	3.5	Acceptable

NOTES:

1/ "ZIP-NUT" Rapid Nut Assembly with Thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Inc. Drawing. Co. 050006.

2/ Maximum insertion force at engagement angle of 2° maximum per Note 28, MDA Spec. Control Dwg. 1F44595, Rev. E.

3/ Test conducted installing P/N BAC B30US8U22 dry film coated bolts thru steel bushing into P/N 1F44595-1 Rapid Nut Assembly seated against 2° face. Installation force measured using Chatillon Model DPP10 (0-10lb) Force Gage.

4/ Insertion Force Tests conducted on September 10, 1998 in accordance with Sequence No. 02-000, TTI Document No. 050016, Rev. D dated 8/18/98.

Table No. 4

RESULTS OF 10-Cycle INSTALLATION TESTS OF MDA P/N 1F44595-1
(TTI P/N 050006) LOT # 6 RAPID NUT ASSEMBLIES

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Almay Serial No. 2/	McDonnell Douglas Aerospace Part No. 1/	Nominal Thread Size UNJF-3B	SEATED INSTALLATION TORQUE (in-lb) 3/										COMMENTS
			Cycle #1	Cycle #2	Cycle #3	Cycle #4	Cycle #5	Cycle #6	Cycle #7	Cycle #8	Cycle #9	Cycle #10	
	1F44595-1 Rev. E												
6001	(TTI 050006)	.5000-20	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6006	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6010	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6039	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6045	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6064	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6068	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6075	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6096	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6105	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6113	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6130	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6137	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6155	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6159	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6162	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6190	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6197	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6201	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure

NOTES:

1/ "ZIP NUT" Rapid Nut Assembly with thread element fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Tchnology Drawing 050006.

2/ Serial number identification as noted by Thread Technology, Inc.

3/ Installation - removal torque tests conducted using P/N BAC B30US8U22 dry film coated bolts thru square steel bushing (1.388" height). Zip nuts torqed with Sturtevant 0-1200 in-lbs Torque Wrench each cycle.

4/ Installation/Removal tests conducted on Sept. 10, 1998 in accordance with Sequence No. 03-000, TTI Document No. 050016, Rev D Dated 8/18/98.

Tab No. 4 (continued)

RESULTS OF 10-CYCLE INSTALLATION/REMOVAL TESTS OF MDA P/N 1F44595-1 (TTI P/N 050006) LOT #6 RAPID NUT ASSEMBLIES

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Almay Serial No. 2/	McDonnell Douglas Aerospace Part No. 1/	Nominal Thread Size UNJF-3B	SEATED INSTALLATION TORQUE (in-lb) 3/										COMMENTS
			Cycle #1	Cycle #2	Cycle #3	Cycle #4	Cycle #5	Cycle #6	Cycle #7	Cycle #8	Cycle #9	Cycle #10	
	1F44595-1 Rev. E												
6208	(TTI 050006)	.5000-20	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6218	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6241	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6246	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6265	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure
6270	"	"	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	No Failure

NOTES:

1/ "ZIP NUT" Rapid Nut Assembly with thread element fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Drawing 050006.

2/ Serial number identification as noted by Thread Technology, Inc.

3/ Installation - removal torque tests conducted using P/N BAC B30US8U22 dry film coated bolts thru each cycle.

4/ Installation/Removal tests conducted on Sept. 10, 1998 in accordance with Sequence No. 03-000, TTI Document No. 050016 Rev. D dated 8/18/98.

TABLE 5

RESULTS OF MIL-STD-1312 ACCELERATED VIBRATION TEST OF MDA P/N 1F44595 (TTI P/N 050006) LOT # 6 RAPID NUT ASSEMBLIES

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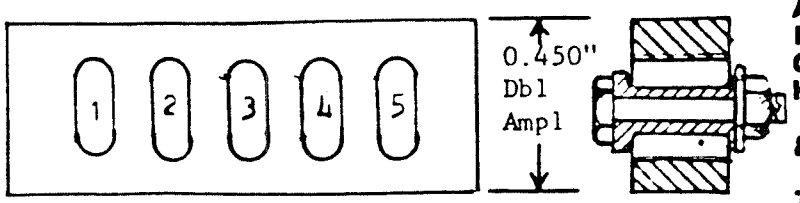

TYPICAL MIL-STD-1312 VIBRATION FIXTURE

Specimen No.	TEST PART NUMBER 1/	Mating Test Fastener 2/	Assembly Torque (in-lb) 3/	Test Amplitude 4/	Vibration Frequency (cpm)	NUMBER OF TEST CYCLES	OBSERVED ROTATION
6010	1F44595-1 REV. E (TTI 050006)	B30US8U22	1125	0.450	1800	10,000 20,000 30,000	No Rotation No Rotation No Rotation
6105	1F44595-1 REV. E (TTI 050006)	B30US8U22	1125	.450	1800	10,000 20,000 30,000	No Rotation No Rotation No Rotation
6162	1F44595-1 REV. E (TTI 050006)	B30US8U22	1125	.450	1800	10,000 20,000 30,000	No Rotation No Rotation No Rotation
6201	1F44595-1 REV. E (TTI 050006)	B30US8U22	1125	.450	1800	10,000 20,000 30,000	No Rotation No Rotation No Rotation
6246	1F44595-1 REV. E (TTI 050006)	B30US8U22	1125	.450	1800	10,000 20,000 30,000	No Rotation No Rotation No Rotaion

NOTES:

1/ "ZIP NUT" Rapid Nut Assembly with Thread element fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Drwaing 050006.

2/ Test bolt was Boeing BAC B30US8U22 dry film coated INCO 718 CRES.

3/ Test nuts installed in vibration fixture per MIL-STD-1312, Test 7. Seating torque per sequence No. 08-000, TTI Document No. 050016, REV D.

4/ Vibration test conducted in Sonntag SF-10-U fatigue machine per test procedure of MIL-STD-1312, Test 7, on September 19,1998.

5/ Maximum premissible rotation noted at 30° per Sequence 08-005. Test nuts conform to requirement without failure.

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TABLE NO. 6

RESULTS OF TORQUE LIMIT TEST OF MDA P/N 1F44595-1
(TTI P/N 050006) LOT # 6 RAPID NUT ASSEMBLIES

Serial No. 3/	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	Mating Test Bolt 2/	Installation Torque (in-lb) 3/	Induced Tensile Clamp Load (lb) 3/ 4/
6039	1F44595-1 Rev. E	050006	.5000-20	B30US8U22	2,040	32,930
6075	"	"	"	"	2,040	28,224
6137	"	"	"	"	2,040	32,448
6190	"	"	"	"	2,040	31,824
6265	"	"	"	"	2,040	32,592

NOTES:

1/ "ZIP NUT" Rapid Nut Assembly with Thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Inc. Drawing No. 050006.

2/ Test bolt was Boeing BAC B30US8U22 dry dry film coated INCO 718 CRES, rated at 220 KSI minimum tensile.

3/ Torque limit test conducted on "ZIP NUT" perviously subjected to random vibration tests without bolts (refSequence 06-000). Torque limit test per Sequence 09-000, TTI Document No. 050016, Rev. D dated 8/18/98. Each "ZIP NUT" installed in calibrated strain gaged load cell, and torqued to 2,000 in lb. Induced tensile clamp load observed and recored. Test conducted on October 1, 1998.

4/ Examination of "ZIP NUT" after disassembly indicated no evidence of deformation of failure. All nuts functional and operable. Test bolts did not fracture.

Table No. 7

RESULTS OF ULTIMATE TENSILE STRENGTH TESTS
OF MDA P/N 1F44595, REV. E (TTI P/N 050006)
LOT # 6 RAPID NUT ASSEMBLIES

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Specimen No. 2/	NUT PART NUMBER 1/	Nominal Thread Size	AXIAL TENSILE STRENGTH (lbs)		Type Failure 4/	Test Temp. °F
			Spec. Reqt. 3/	Test Nut 4/		
6001	1F44595-1 REV. E (TTI 050006)	.5000-20	27,500	42,200	Bolt Treads Break	Room
6064	"	"	"	42,100	Bolt Threads Break	"
6113	"	"	"	42,900	Bolt Threads Strip	"
6159	"	"	"	42,700	Bolt Threads Break	"
6241	"	"	"	42,300	Bolt Threads Break	"

NOTES:

1/ "ZIP Nut" Rapid Nut Assembly with Thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology INC. Drawing NO 050006.

2/ Test nuts previously subjected to random vibration test with mating bolts per Schedule 05-000, TTI Document 050016, REV. D.

3/ Minimum axial tensile load requirement per Note 28, MDA Spec. Control Dwg. 1F44595.

4/ Test nuts tested with Boeing BAC B30US8 INCO 718 CRES Bolts. Each nut torqued to 1,125 in-lb prior to Tensile Test. Test conducted on September 25, 1998 in Satec 400 HV Universal Tensile Machine.

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TABLE NO. 8

RESULTS OF CROSS-THREADING TEST OF MDA P/N 1F44595-1 (TTI P/N 050006) LOT # 6 RAPID NUT ASSEMBLIES

Serial No.	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	8° Installation 2/	2° Installation Torque (in-lb) 3/	COMMENTS 3/
6006	1F44595-1 Rev. E	050006	.5000-20	Nut engaged	840	No Failure
6096	"	"	"	Nut engaged	840	No Failure
6155	"	"	"	Nut engaged	840	No Failure
6197	"	"	"	Nut engaged	840	No Failure
6270	"	"	"	Nut engaged	840	No Failure

NOTES:

1/ "ZIP NUT" Rapid Nut Assembly with Thread elements fabricated from 15-5PH CRES and outer body fabricated from A286 CRES conforming to Thread Technology Inc. Drawing No. 050006.

2/ Cross-Threading test conducted in accordance with Sequence 11-000, TTI Document No. 050016, Rev. D dated 8/18/98. Boeing BAC B30US8U22 dry film coated INCO 718 CRES test bolt inserted in bushing fixture into "ZIP NUT" seated at 8°. Test bolt successfully engaged nut approximately half-way into the nut.

3/ Special 6° wedge removed from bushing fixture leaving "ZIP NUT" seated against 2° face of bushing. Installation torque applied from the bolt head until "ZIP NUT" fully seated at 2°. After nut removal, examination indicated no evidence of deformation and/or fracture. Test nuts fully operable and fuctional on completion of test schedule. Test conducted on September 28, 1998.

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TABLE NO. 9

RESULTS OF STRESS DURABILITY TESTS OF MDA P/N 1F44595-1 (TTI P/N 050006) LOT # 6 RAPID NUT ASSEMBLIES

Serial No.	McDonnell Douglas Aerospace Part No. 1/	Thread Technology Part No. 1/	Nominal Thread Size (UNJF-3B)	Installation Torque (in-lb) 2/	Induced Tensile Clamp Load (lb) 2/	No. of Hours at Load 3/	COMMENTS 3/ 4/
6045	1F44595-1 Rev. E	050006	.5000-20	1,500	22,416	96	No Failure
6068	"	"	"	1,500	22,272	96	No Failure
6130	"	"	"	1,500	21,840	96	No Failure
6208	"	"	"	1,500	22,080	96	No Failure
6218	"	"	"	1,680	22,512	96	No Failure

NOTES:

1/ "ZIP NUT" Rapid Nut Assembly with Thread elements fabricated from 15-5PH CRES and outer body fabricated from CRES conforming to Thread Technology Inc. Drawing No. 050006.

2/ Stress Durability test conducted in accordance with Sequence 12-000, TTI Document No. 050016, Rev. D dated 8/18/98. "ZIP NUT" installed on BAC B30US8U22 dry film coated INCO 718 CRES Bolt (220 KSI min. UTS) in strain gaged load cell. Nut torqued to develop minimum tensile clamp load of 21,5000 + 250 lb.

3/ Minimum exposure under load for stress durability test noted at 96-hours Stress durability test started on September 25, 1998 and disassembled on September 29, 1998.

4/ Examination of "ZIP NUT" after stress durabilty exposure indicated no evidence of crack of failure of the nuts. Test nuts were functional and operable on completion of test exposure.

Consolidated Laboratories, Inc.
732 Arrow Grand Circle
Covina, California 91722
(626) 915-8991
FAX (626) 966-3156

September 24, 1998

TEST REPORT

Almay Research & Testing Corporation
1415 Newton Street
Los Angeles, California 90021

Subject: Vibration Test on Ten (10) Specimens of P/N 1F44595 (TTI P/N 050006), Rapid Assembly Nut, S/N's 6001, 6039, 6064, 6075, 6113, 6137, 6159, 6190, 6241 and 6265

This will certify that the units above were subjected to the Vibration Test of the referenced documents in this Laboratory in the manner and with results as described below:

1. **REFERENCES**

1.1 Purchase Order No. 989 dated 9/4/98 from Almay Research & Testing Corporation.

1.2 Thread Technology, Inc. Document No. 050016, Rev. D, dated 8/18/98: Acceptance/Qualification Test Plan and Procedure For ½-20UNJF-3B ZipNut P/N 050006 and MDA 1F44595.

1.3 McDonnell Douglas Drawing No. 1F44595: Nut, Rapid Assembly.

2. **PURPOSE** -- The purpose of this test program was to subject the units to the Vibration Test of Reference 1.2, Paragraphs 05-000 & 06-000 and Reference 1.3, Notes 29 & 31 - 36. Five of the units (S/N's 6001, 6064, 6113, 6159 & 6241) were to be assembled onto the mating bolt, torqued to 1,125 ± 200 in-lb (93.75 ± 16 ft-lb) and monitored for rotation during the test. The remaining five units (S/N's 6039, 6075, 6137, 6190 & 6265) were to be held in place with ⅜" (non-mating) bolts. The units were to be examined for physical damage and returned to Almay for disposition after completion of the test program.

3. **SUMMARY** -- The units were subjected to the Vibration Test as required. The procedures and results of the test are shown on the laboratory instruction/data sheet, test log and plots which are reproduced as subsequent pages of this report. S/N's 6001, 6064, 6113, 6159 & 6241 exhibited no rotation in excess of 30°. Examination of the units after completion of testing disclosed no visible evidence of damage or deterioration as a result of the test conditions. The units were considered to have passed the Acceptance Random Vibration Test as conducted in this Laboratory and were returned to Almay for disposition after completion of the test program.

Test By: **L. L. Frye**	Concurred: DCMAO Quality Assurance Representative
Report By: **D. D. Huff**	

Prepared By: Dale D. Huff, Test Engineer

REGISTERED PROFESSIONAL ENGINEER
PHILIP MICHAEL HARTY
NO. 19959
Exp. 9-30-00
MECHANICAL
STATE OF CALIFORNIA

Approved By: P. M. Harty, P. E., Laboratory Director

Consolidated Laboratories, Inc.
732 Arrow Grand Circle
Covina, California 91722
(626) 915-8991
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TEST REPORT

4. **TEST EQUIPMENT** -- The following items of test equipment, maintained within the current applicable calibration period, were used to conduct the test:

-Accelerometer: Endevco Model 2233E, S/N AF51, ID/N 2106-54, 58.0 pC/g, ±2.6%. Calib. due 12-1-98, 6 mos. Used with Endevco Model 2721B, S/N CY05, ID/N 2104-4, charge amplifier. Calib. due 11-1-98, 6 mos. Used to monitor and control vibration input levels.

-Torqometer: Snap-On Model TE100L, ID/N 304, 0 to 100 foot-pounds, torque meter. Calib. due 8-11-99, 12 mos.

-Vibration Exciter: MB Model C-50, S/N 168, ID/N 2005, with MB Model T451-B power amplifier, S/N 119, ID/N 2008, rated at 5000 force pounds. Used with Hewlett-Packard Model 5427A, S/N 282, ID/N 2006, vibration control system. Calib. due 11-5-98, 6 mos.

H
P

Consolidated Laboratories, Inc.
732 Arrow Grand Circle
Covina, California 91722
(626) 915-8991

LAB DATA SHEET

Part No. 1F44595 S/N _____ Sample 1 - 10 Job 9218
Description Rapid Assembly Nut Co. Almay
Page 1.0

TEST: VIBRATION		Start	Cptd
To Spec:	Date	SEP 18 1998	SEP 18 1998
050016, Rev. D, Paras. 05-000 & 06-000;	Test By		
Dwg. No. 1F44595, Rev. E, Notes 29 & 31 - 36	Photo	✓	

Photo Req'd YES

CLI 15 CLI 5 INSP

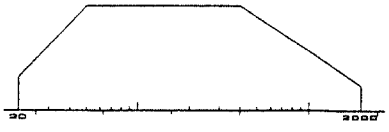
1. Axis Identification:

   X -- Parallel to the axis of bolt insertion through the nut.
   Y -- At random radially to the body of the nut.
   Z -- Mutually perpendicular to the X and Y Axes.

2. Assemble the first half of the nuts onto the mating bolt through an appropriate fixture plate until seated against the washers and tighten finger tight. Gradually tighten to 1,125 ± 200 in-lb and then mark the units in order to observe rotation as a result of the vibration. Secure the fixture plate to a vibration cube. Mount the composite assembly on the head of the vibration exciter, with the axis under test being changed by changing the orientation of the fixture plate on the cube. Mount a control accelerometer on the fixture plate adjacent to the mounting interface of the units. **As a minimum, the accelerometer signal shall be recorded during all test runs.**

3. Subject the units to the following levels of random vibration.

Hz	PSD, g^2/Hz	Slope, dB/Oct
20	0.04	----
50	0.80	+9.8
400	0.80	----
2000	0.028	-6.3



Tolerances
20 - 2000 Hz; ±2 dB
Overall: 23.1 g_{rms} ± 10%

On each axis, equalize and vibrate the unit for 510 ± 5.1 seconds at the full level listed above. Make a computer print-out of the control equalization for each axis of vibration. Check off O.K. completion below:

X Axis ✓ Y Axis ✓ Z Axis ✓

Any visible evidence of physical damage? NO

Any rotation in excess of 30°? NO CLI 15

4. Assemble the other half of the nuts to an appropriate fixture plate using 3/8 inch bolts. Secure the fixture plate to the vibration cube on the head of the vibration exciter, as stated in Step 2, above, and repeat the procedures of Step 3, above. Check off O.K. completion below:

X Axis ✓ Y Axis ✓ Z Axis ✓

Any visible evidence of physical damage? NO CLI 15 CLI 5 INSP

HP

5. List test equipment used on the Test Equipment List, attached.

732 Arrow Grand Circle
Covina, California 91722
(818) 915-8991

REPORT NO. 9218

PAGE 4

TEST REPORT

Type of Test Random Vibration Job Number 9218
Specification _____ Customer ALMAX
Specimen Description _____
Sample Qty. 10 Part Number _____ Serial Number _____

Frequency (Hz)		Level			Duration
From	To	dB/Oct	g^2/Hz	Overall (g_{rms})	
SEE	DATA	SHEET.			

Tolerances:

NOTES:

Date	Time	Axis	Comments
9-18-98	10:00		START SETUP, TORQUE NUTS TO 10 LBS.
	11:25	Z	START RANDOM VIB, S/N- 6064, 6113,
			6241 WITH BOLTS
	11:33	Z	END
	11:44	Y	START RANDOM VIB, S/N-6064, 6113,
			6241 WITH BOLTS.
	11:52	Y	END
	12:08	X	START RANDOM VIB, S/N-6064, 6113,
			6241 WITH BOLTS
	12:16	X	END.
			RECORD BREAKAWAY TORQUE: N/A
			↓

Inspector _____ Technician L. Fuge

CLI 15 CLI 5 INSP

732 ArrowGrand Circle
Covina, California 91722
(818) 915-8991

REPORT NO. 9218

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TEST REPORT

Type of Test VIBRATION Job Number 9218
Specification Customer ALMAY
Specimen Description
Sample Qty. 10 Part Number Serial Number

Vibration/Shock Test Log:

Date	Time	Axis	Comments
9-18-98			S/N FT. LBs.
			6241 = 9.1 FT. LB's
			6064 = 10 FT. LB's.
			6113 = 9.5 FT. LBs.
			TORQUED S/N 6001, 6159 TO
			BOLTS AT 10. FT. LBS.
	1317	X	START RANDOM VIB, S/N-6001,
			6159 WITH ~~BOLT~~ MATING BOLTS.
	1325	X	END.
	1338	Y	START RANDOM VIB., S/N-6001,
			6159 WITH BOLTS.
	13:46	Y	END.
	13:53	Z	START RANDOM VIB, S/N-6001,
			6159 WITH BOLTS.
	14:01	Z	END.
			RECORDED BREAKAWAY TORQUE:
			S/N-6001 = 11.2' LBs.
			S/N-6159 = 10.5' LBs.
	~~14:17~~		MOUNTED S/N: 6190, 6265, 6039,
			6075, 6137 WITH 3/8" BOLTS
			THROUGH UNITS; 3/8" BOLTS ~~BOLTED~~
			SCREWED INTO FIXTURE.
	14:17	Z	START RANDOM VIB.
	14:25	Z	END.
			↓

Inspector

Technician [signature] CLT 16 CLZ 3 INSP

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REPORT NO. 9218

TEST REPORT

Type of Test VIBRATION Job Number 9218
Specification _____ Customer ALMAY
Specimen Description _____
Sample Qty. 10 Part Number _____ Serial Number _____

Vibration/Shock Test Log:

Date	Time	Axis	Comments
9-18-98	14:30	Y	START RANDOM VIB, S/N - 6190,
			6265, 6039, 6075, 6137
	14:38	Y	END.
	14:47	X	START RANDOM VIB, " " "
	14:55	X	END.
			NO ANOMALIES NOTED. CLI 15 CLI 5 INSP

Inspector _____ Technician L. Tripp CLI 15 CLI 5 INSP

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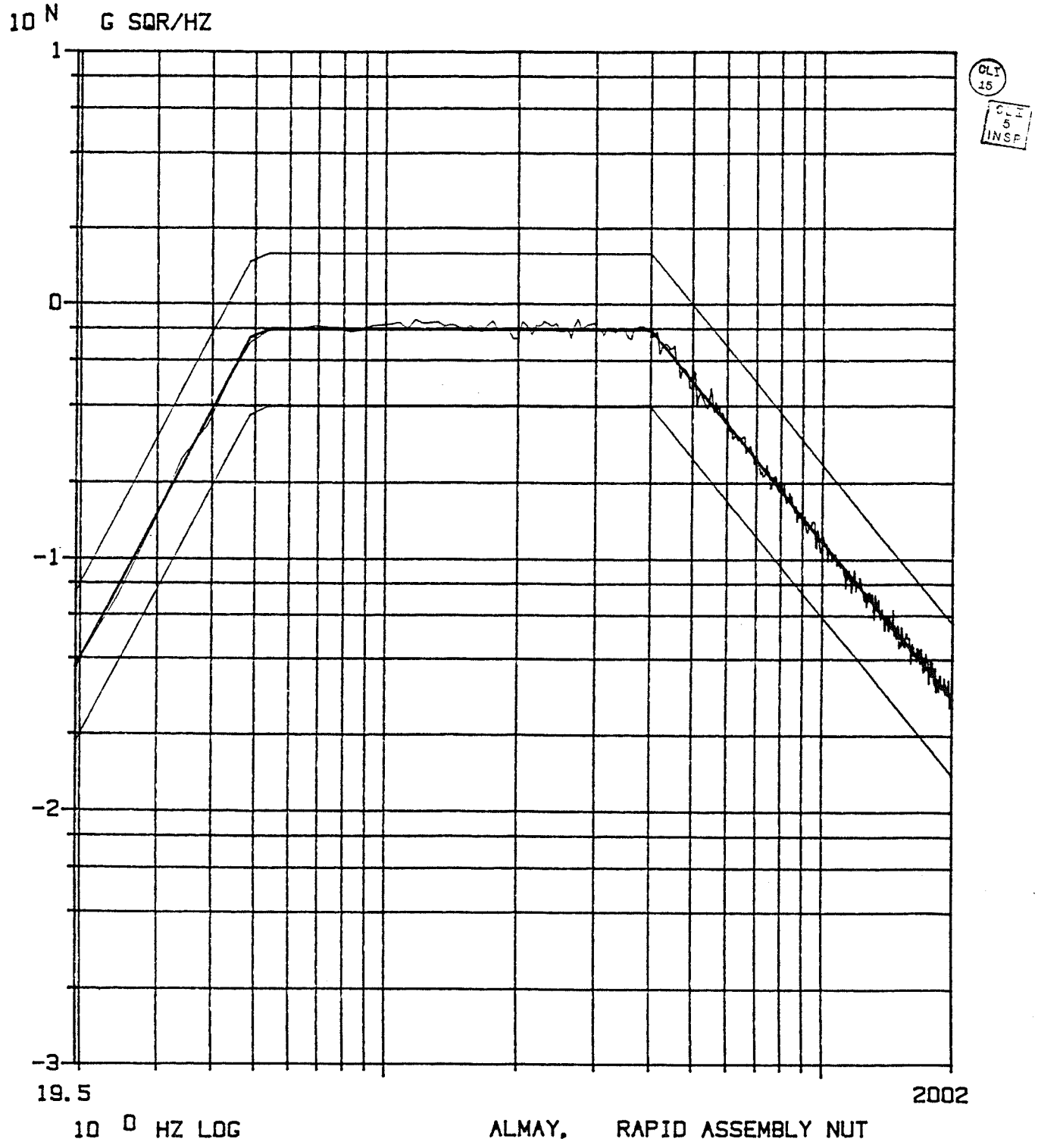
TEST REPORT

SEP 18 1998

P/N 1F44595 S/N 6064, 6113, 6241 WITH BOLTS RANDOM VIB. X AXIS
POST TEST ELAPSED TIME = 512 SECS AT .00 DB
RMS LEVEL = 23.11 G'S DELTA F = 4.883 DOF= 304 AWF= 10



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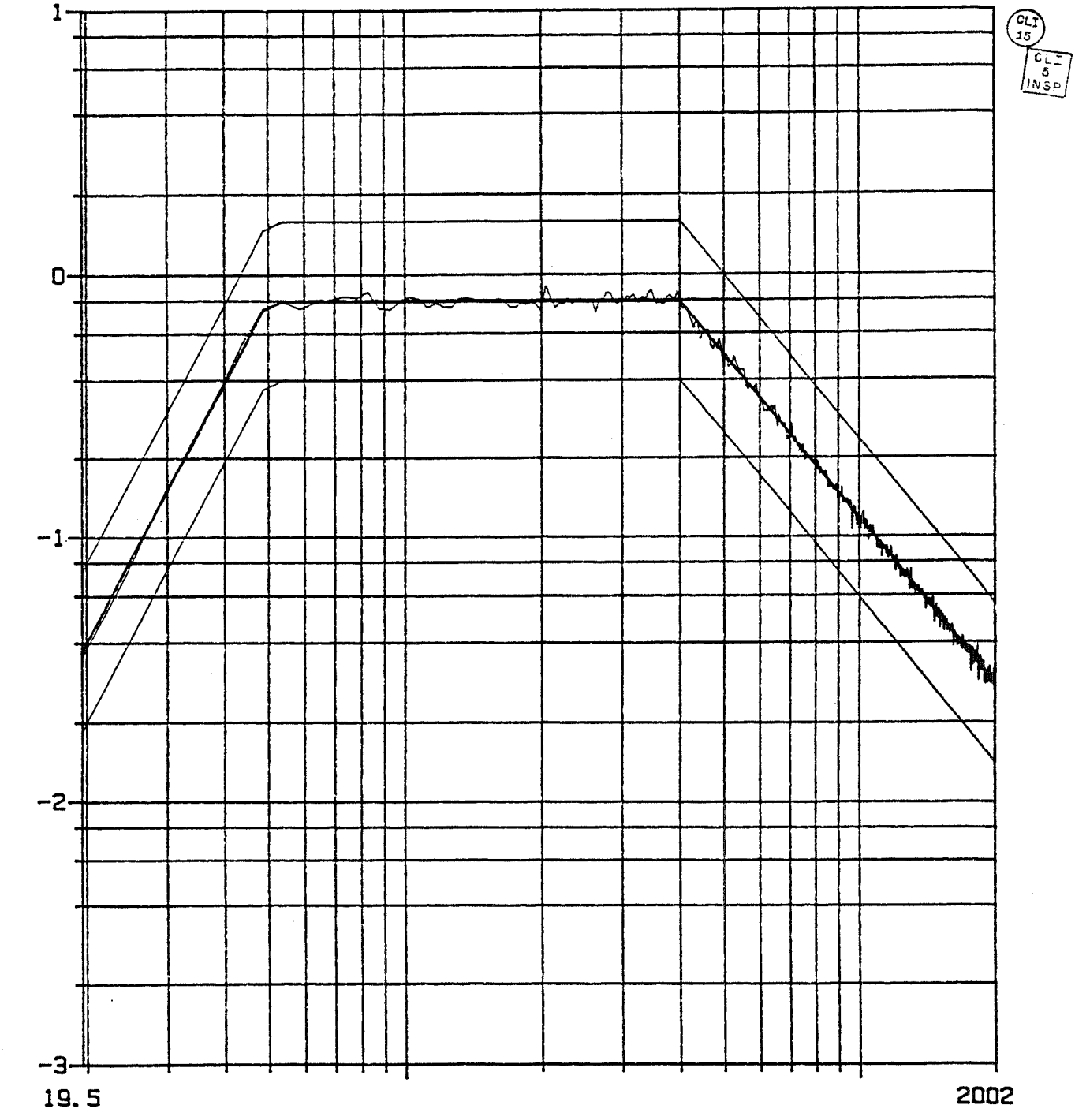
TEST REPORT

SEP 18 1998

P/N 1F44595 S/N 6064, 6113, 6241 WITH BOLTS RANDOM VIB. Y AXIS
POST TEST ELAPSED TIME = 512 SECS AT .00 DB
RMS LEVEL = 22.99 G'S DELTA F = 4.883 DOF= 304 AWF= 10



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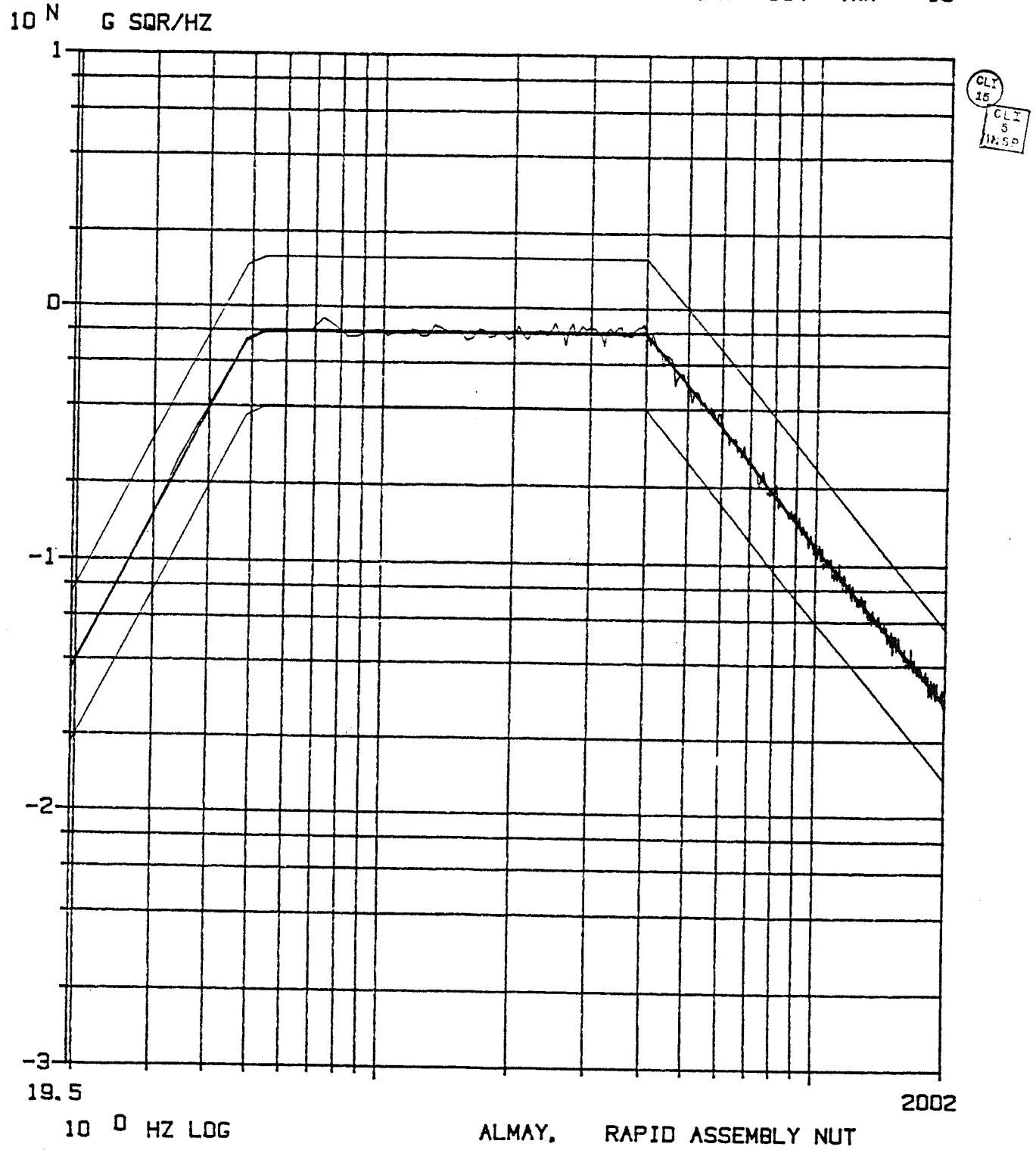
TEST REPORT

SEP 18 1998

P/N 1F44595 S/N 6064, 6113, 6241 WITH BOLTS RANDOM VIB. Z AXIS
POST TEST ELAPSED TIME = 512 SECS AT .00 DB
RMS LEVEL = 23.08 G'S DELTA F = 4.883 DOF= 304 AWF= 10



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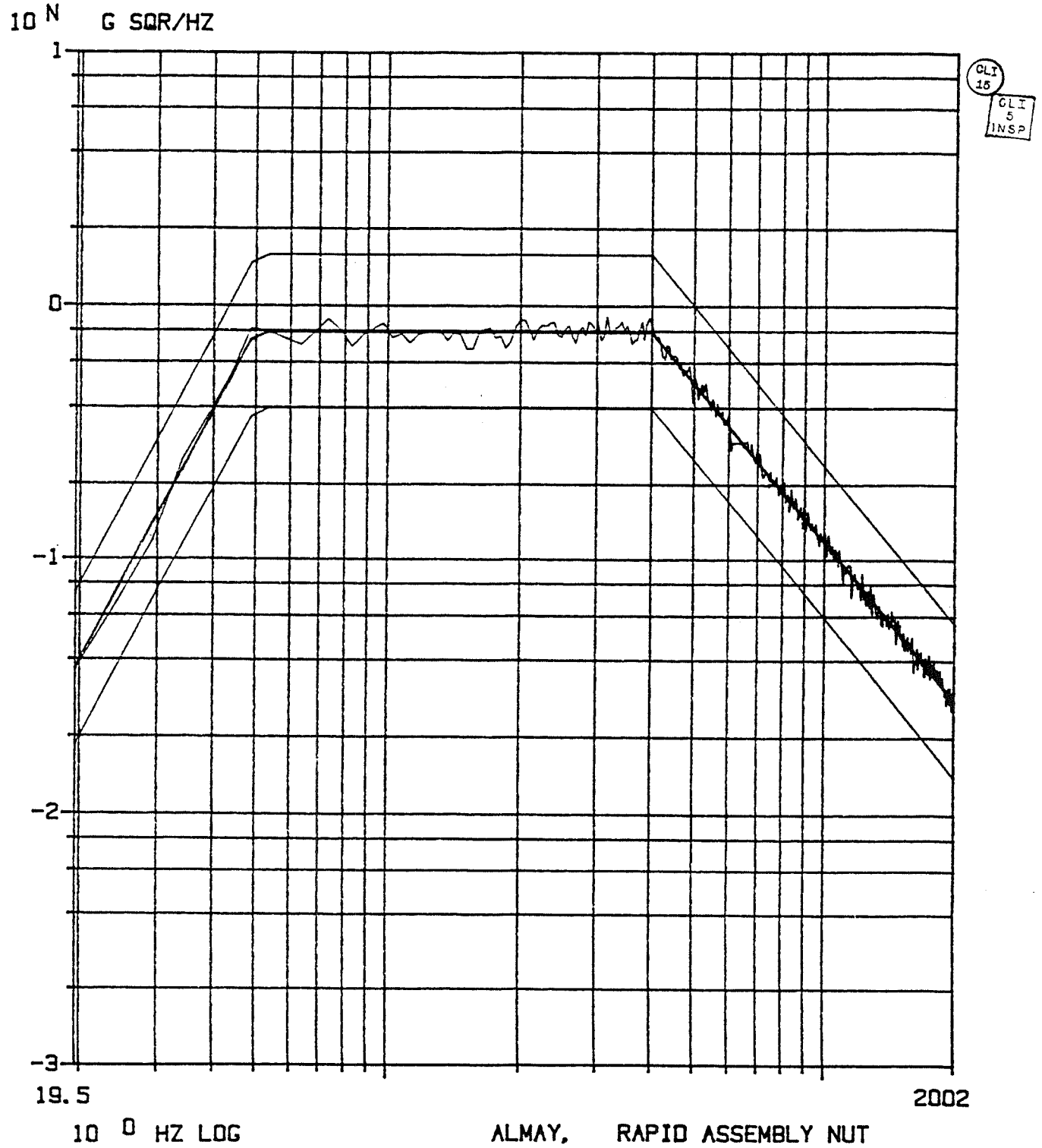
TEST REPORT

SEP 18 1998

P/N 1F44595 S/N 6001, 6159 WITH BOLTS RANDOM VIBRATION X AXIS
POST TEST ELAPSED TIME = 512 SECS AT .00 DB
RMS LEVEL = 23.03 G'S DELTA F = 4.883 DOF= 304 AWF= 10



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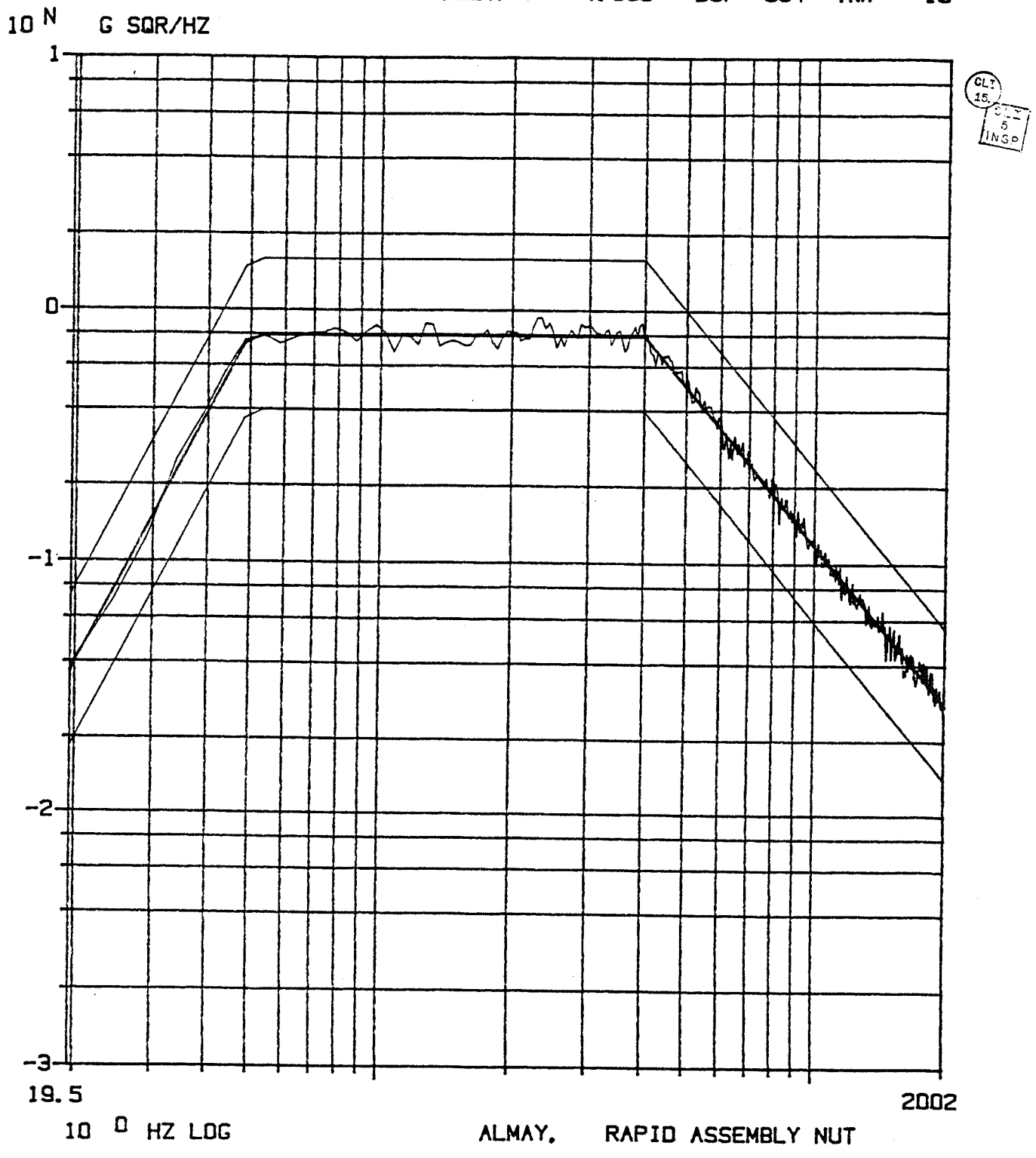
TEST REPORT

SEP 18 1998

P/N 1F44595 S/N 6001,6159 WITH BOLTS RANDOM VIBRATION Y AXIS
POST TEST ELAPSED TIME = 512 SECS AT .00 DB
RMS LEVEL = 23.15 G'S DELTA F = 4.883 DOF= 304 AWF= 10



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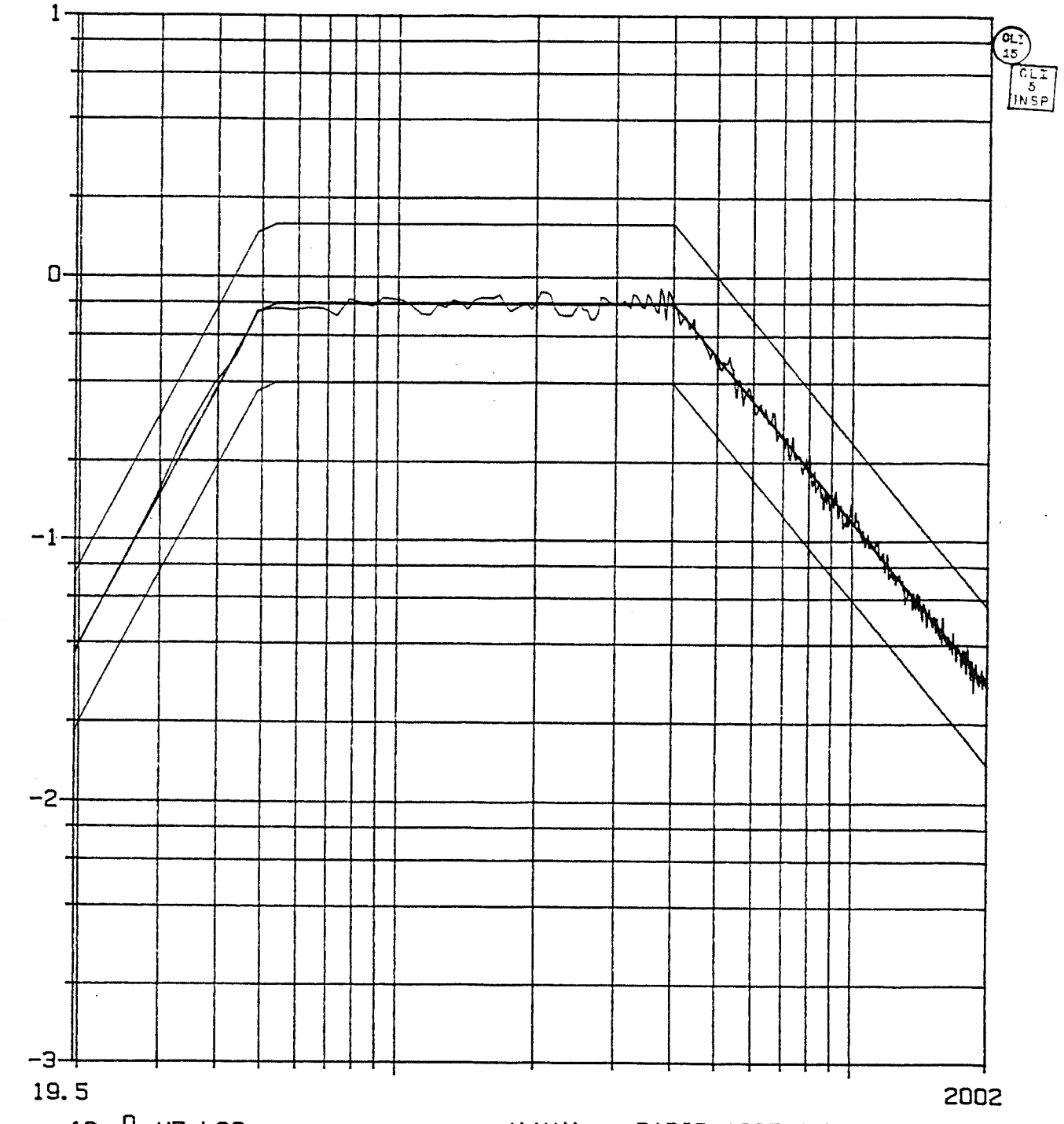
TEST REPORT

SEP 18 1998

P/N 1F44595 S/N 6001,6159 WITH BOLTS RANDOM VIBRATION Z AXIS
POST TEST ELAPSED TIME = 513 SECS AT .00 DB
RMS LEVEL = 23.00 G'S DELTA F = 4.883 DOF= 304 AWF= 10
10 N G SQR/HZ



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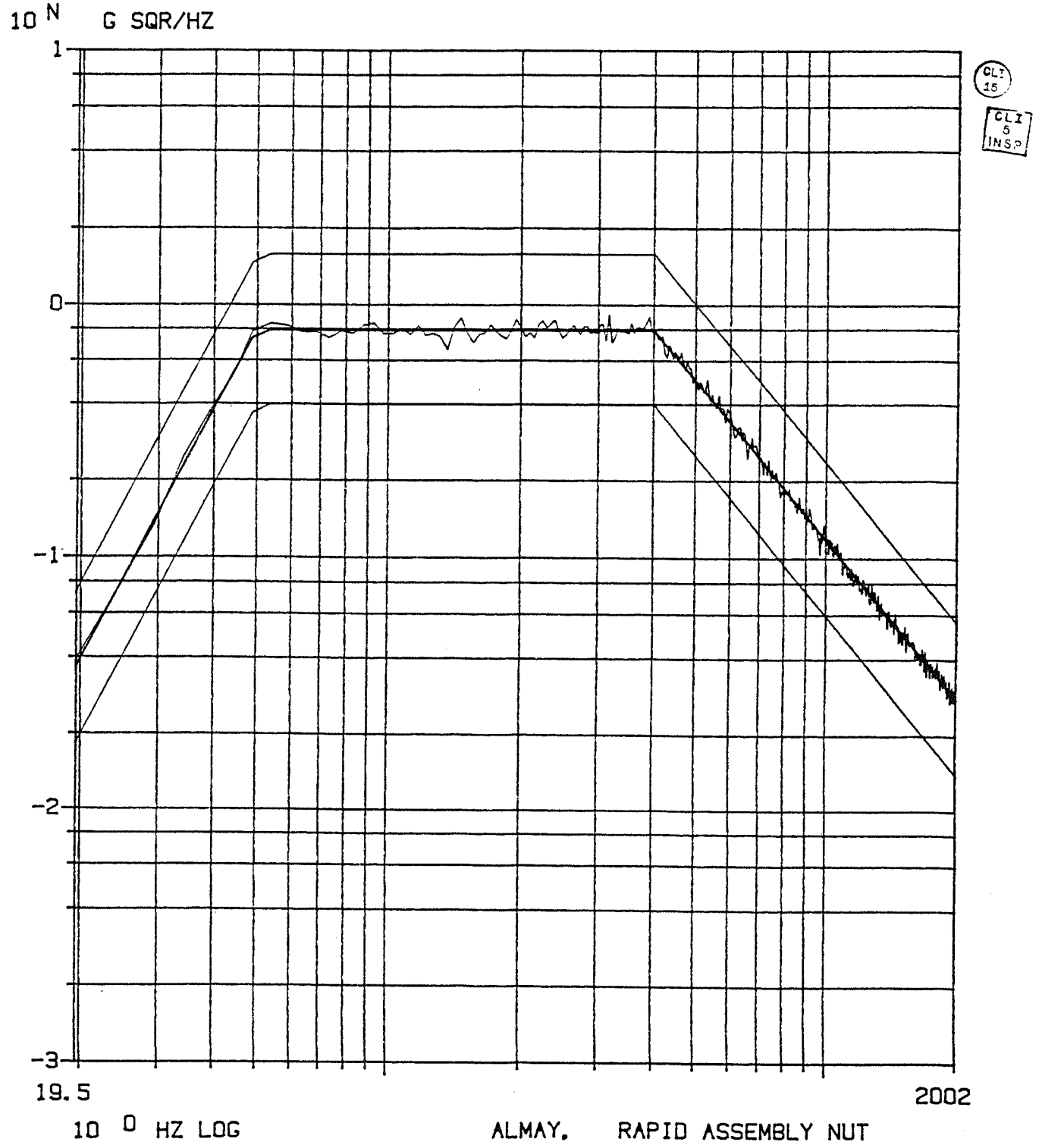
TEST REPORT

SEP 18 1998

P/N 1F44595 S/N 6190, 6265, 6039, 6075, 6137 RANDOM VIB. X AXIS
POST TEST ELAPSED TIME = 513 SECS AT .00 DB
RMS LEVEL = 23.04 G'S DELTA F = 4.883 DOF= 304 AWF= 10



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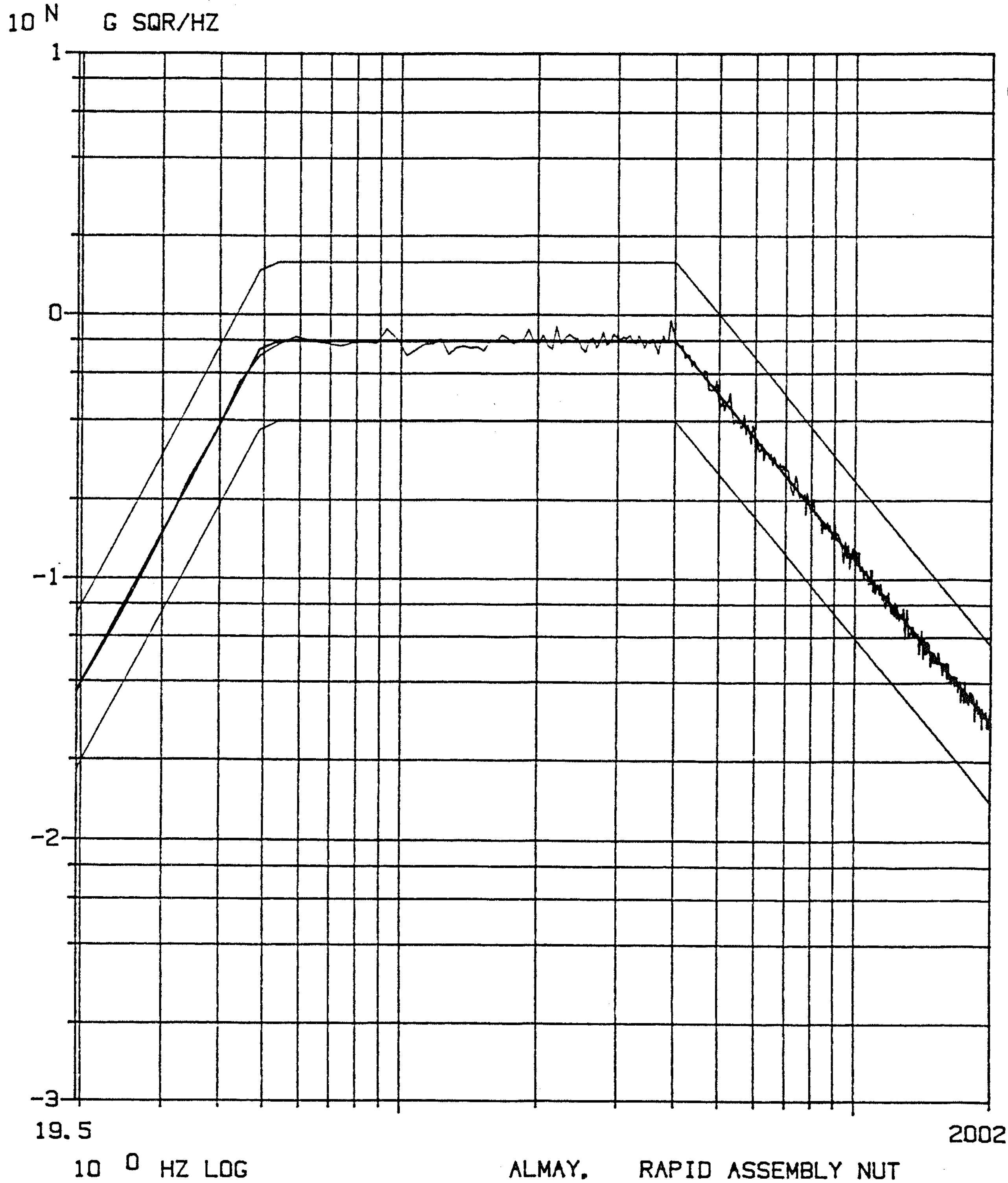
TEST REPORT

SEP 18 1998

P/N 1F44595 S/N 6190, 6265, 6039, 6075, 6137 RANDOM VIB. Y AXIS

POST TEST ELAPSED TIME = 512 SECS AT .00 DB

RMS LEVEL = 23.02 G'S DELTA F = 4.883 DOF= 304 AWF= 10



ALMAY. RAPID ASSEMBLY NUT

CLI 15

CLI 5 INSP

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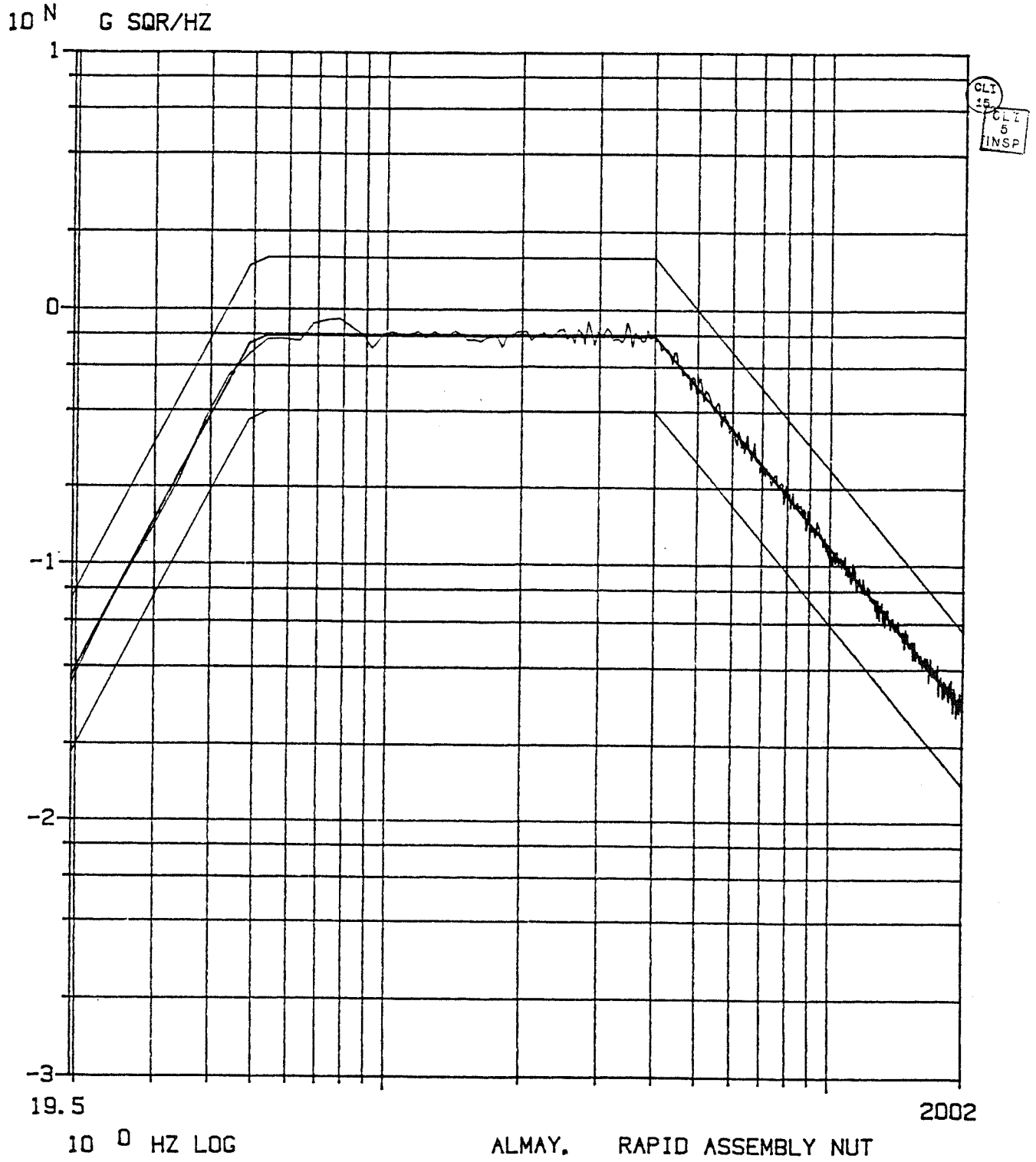
TEST REPORT

SEP 18 1998

P/N 1F44595 S/N 6190, 6265, 6039, 6075, 6137 RANDOM VIB. Z AXIS
POST TEST ELAPSED TIME = 512 SECS AT .00 DB
RMS LEVEL = 23.07 G'S DELTA F = 4.883 DOF= 304 AWF= 10



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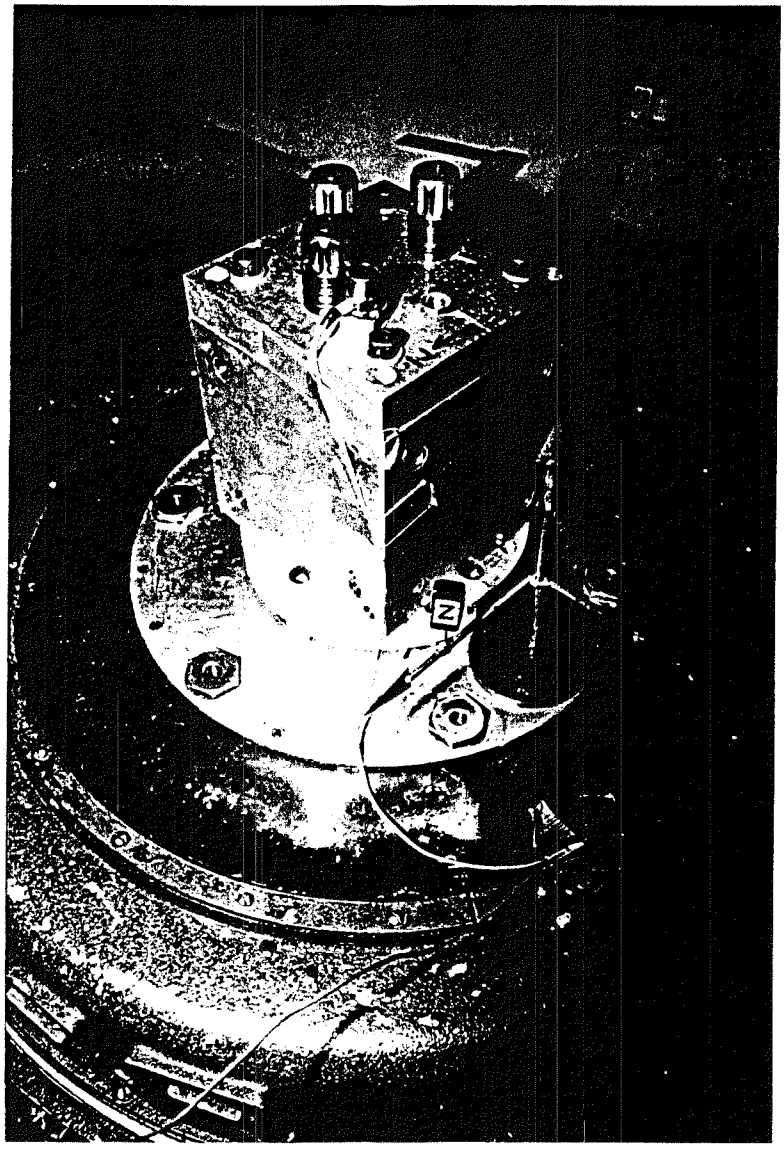
TEST REPORT

VIBRATION TEST SETUP

(X Axis; S/N's 6064, 6113 & 6241)



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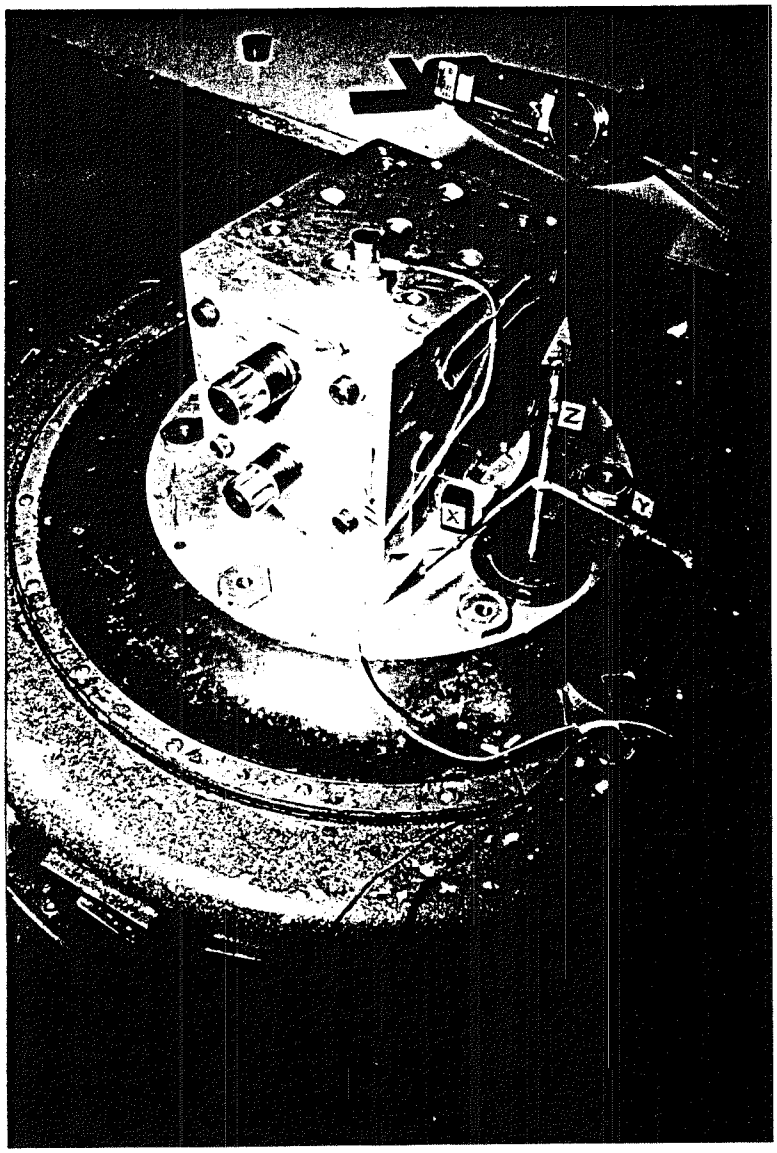
TEST REPORT

VIBRATION TEST SETUP

(Z Axis; S/N's 6001 & 6159)



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TEST REPORT

VIBRATION TEST SETUP

(Z Axis; S/N's 6039, 6075, 6137, 6190 & 6265)