

AD-A183 987

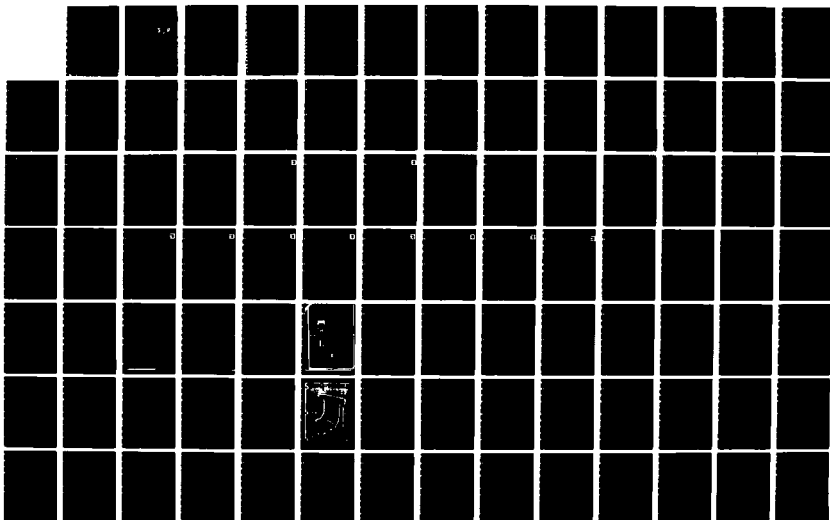
LIGHTWEIGHT TOWED HOWITZER DEMONSTRATOR PHASE 1 AND
 PARTIAL PHASE 2 VOLUM (U) FMC CORP MINNEAPOLIS MINN
 NORTHERN ORDNANCE DIV R RATHE ET AL APR 87
 FMC-E-3841-VOL-D1-PT-1 DAA21-86-C-8847

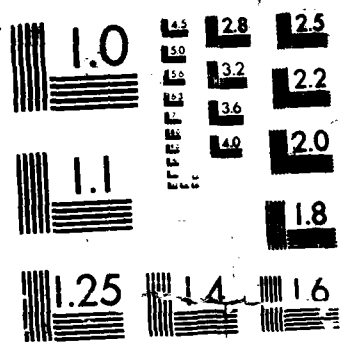
1/3

UNCLASSIFIED

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MICROCOPY RESOLUTION TEST CHART

(2)

DTIC FILE COPY

Lightweight Towed Howitzer Demonstrator

Final Report

Volume D1 - Part I

Structural Analysis
(Less Cradle and System)

DTIC
ELECT
SEP 03 1987
S
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April 1987

Contract Number DAAA21-86-C-0047

FMC CORPORATION
Northern Ordnance Division
4800 East River Road
Minneapolis, Minnesota 55421

DISTRIBUTION STATEMENT A

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AD-A183 987

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
	AD A183 987	
4. TITLE (and Subtitle) Final report for the Lightweight Towed Howitzer Demonstrator		5. TYPE OF REPORT & PERIOD COVERED Final: 20 December 1985 - 13 March 1987
		6. PERFORMING ORG. REPORT NUMBER E-3041
7. AUTHOR(s) Robert Rathe, FMC Program Manager Bart Anderson, FMC Project Manager		8. CONTRACT OR GRANT NUMBER(s) DAAA21-86-C-0047
9. PERFORMING ORGANIZATION NAME AND ADDRESS FMC CORPORATION, Northern Ordnance Division 4800 East River Road Minneapolis MN 55421		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Item 0001 LTHD Phase I and Partial Phase II
11. CONTROLLING OFFICE NAME AND ADDRESS AMCCOM AMSMC-PCW-A(D) Dover NJ 07801-5001		12. REPORT DATE April 1987
		13. NUMBER OF PAGES 4,856
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) AMCCOM AMSMC-FSA-F Dover NJ 07801-5001		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release, distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) Same as Block 16.		
18. SUPPLEMENTARY NOTES None		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) 55mm towed gun howitzer, advanced weapons, composite cradle, composite hydraulic actuators, composite trails, field artillery weapon, firing stability analysis, howitzers, hydraulic control valves with force feedback, hydraulic joystick control of gun direction, hydraulic inertial rammer, hydraulic opening breech, hydraulic primer autoloader, ~~lightweight towed howitzer demonstrator (LTHD)~~ load out of battery howitzer, mortar howitzer, recoil energy recovery, recoil mechanism, ~~using~~ metal matrix composites, titanium muzzle brake, titanium platform, titanium spade, titanium walking beams, thermal stability, towing stability analysis, unconventional weapons, ~~and weight reduction of artillery~~		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The LTHD (Lightweight Towed Howitzer Demonstrator) was to be a 9,000 lb equivalent to the M198, transportable via Blackhawk helicopter, with reduced emplacement time using fewer personnel. The FMC design achieved weight reduction via a mortar-like configuration, composites structure, and hydraulic actuators. Recovery of power from the recoil system, in turn, facilitated crew reduction via hydraulic emplacement, four-way joystick tube lay, and power ramming. FMC completed Concept Development (Ph I) and two-thirds of Detailed Design (Ph II) prior to funds running out. <i>REMARKS</i>		

DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Vol/Sec	Description
D1	Structural Analysis less Cradle and System
D1/050	Table of Contents
D1/060	Computer File Inventory
D1/100	Collars
D1/120	Equilibration Link Assembly
D1/130	Fire Control
D1/140	Gimbal
D1/150	Inner Breech Band
D1/160	Load Conditions
D1/170	Manifold Torque Anchors
D1/180	Muzzle Brake (titanium)
D1/190	Outer Breech Band
D1/200	Platform
D1/210	Rails
D1/220	Rail-to-Collar Clamp
D1/230	Slings and Tiedown Provisions
D1/240	Spade
D1/250	Speedshift Assembly
D1/270	Trail, Travel Locks, Firing Locks
D1/280	Trail Bulkhead
D1/290	Walking Beam Assembly
D1/300	Wheel Hubs

Accession For	
NTIS CRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	28



DESCRIPTION: COMPUTER FILE INVENTORY

STATUS: A complete listing of all computer programs and data files used in performing structural analysis is included in this section. Individual programs and files are described in the sections of this volume where appropriate.

Also included is a listing of all CAD files used for the LTHD. These files were also provided to ARDEC on tape with Cyber format.

AUTHOR: Dave Langerud, Larry Libhardt, Charles Ortloff, Jim Ries, Joe Fishbein. CAD drawing files are by the respective designer/drafters.

TO: D. Langerud

2

FROM: Jim Dillon

SYSTEM: VAX-8600 (VAX-11)

VOLUME NAME: A026T1

SUBJECT: VOLUNTARY FILE ARCHIVING

Save set VAC070011.FOR created on 10-12-1987 13:20:49.16

[MS0.LANGERUD_US.V SOLT 0.00P;1
[MS0.LANGERUD_US.V SOLT00STIP.00P;1
[MS0.LANGERUD_US.V SOLT00T-AY.00P;1

LTHDComputer Files4-3-87
Libhardt

Jim Rie has given me his Crodle
analysis diskette (IMAGES3D)
program. I will store.

YJZ

FMC Central Engineering Laboratories
Santa Clara

Interoffice

To L. Libhardt Date March 19, 1987

From C. R. Ortloff cc E. Thuse
A. Amberg
R. Kazares

Subject LIST OF COMPUTER FILES RELATED TO
THE LWHD, PHASE II PROJECT

In response to your request of 3/16/87, I am enclosing a list of computer files related to the LWHD system finite element models. Details are provided on the attachment.



C. R. Ortloff

<u>CEL FILE</u>	<u>SOFTWARE</u>	<u>DESCRIPTION</u>	<u>RESIDENCE</u>	<u>WHERE STORED</u>	<u>FILE SIZE (BLOCKS)</u>
TVEN72.F16 (DATA INPUT FILE)	ANSYS	TOTAL SYSTEM FE MODEL, 20° GIMBAL ROTATION, 72° CRADLE ELEVATION	CEL DISK DRAGON:: APPNECH1:	CEL 1205 COLEMAN AVE. SANTA CLARA, CA 95052	1773
TVEN72.F27;5	ANSYS	STRESS PASS FILE	"	"	1
TVEN725.F16	ANSYS	TOTAL SYSTEM FE MODEL, 20°, 72° CASE - LATEST MODIFICATIONS	" "	" "	1773
TVEN72.F16	ANSYS	TOTAL SYSTEM FE MODEL, 20°, 0° CASE	"	"	1757
TVEN72.F27	ANSYS	STRESS PASS FILE	"	"	1
ZERO.F16	ANSYS	TOTAL SYSTEM FE MODEL, 0°, 0° CASE	"	"	1837
ZERO.F27;5	ANSYS	STRESS PASS FILE	"	"	1
TVEN72.F23	ANSYS	DYNAMIC LOADS INPUT FILE, 20°, 72° CASE	"	"	1127
ZERO.F23	ANSYS	DYNAMIC LOADS INPUT FILE, 0°, 0° CASE	"	"	1120
TVEN.F23	ANSYS	DYNAMIC LOADS INPUT FILE, 0°, 20° CASE	"	"	1123

LTHD Structural Analysis FilesJim Ries Files

Libhardt
4-1-87

1. LTHD Walking Beam

WALKBM7.* (file)

IMAGES3D 1/87

Larry Libhardt has diskette

2. LTHD Cradle

 file

IMAGES3D

Jim Ries has diskette

TAPE TRANSFER AUTHORIZATION
INSTRUCTIONS/SIGNATURE FORM

As tape transfers are relatively infrequent, this form has been prepared to aid in the process.

Requestor: On ~~the reverse side of this form~~ a separate sheet, provide a complete list of the files to be transferred, their location, contents (by file), project name, classification, tape preparation instructions, preferred method of shipment, and name/address of recipient. By signing below, you certify that the description of the files is and will remain accurate until the files are transferred. The list must be in ink and cannot contain any corrections.

Signature: *John H. Dicks* Employee No. A-4297 Date: 4/18/87

Number of Files in List: 28

Project Leader (or requestor, if there is no project leader): By signing below, you certify that the recipient of the information has a valid "need-to-know" and the transfer will not, to the best of your knowledge, violate contractual agreements, compromise security, or violate corporate guidelines.

Signature: _____ Employee No. _____ Date: _____

Property Pass Signature: By signing below, you authorize the transfer of this information and verify that all information above has been provided. Do not sign if you do not wish to take responsibility for the described transfer. You must also attach a signed property pass as verification that you can authorize the transfer.

Signature: _____ Employee No. _____ Date: _____

Property Pass No: _____

Technical Computing: By signing below, you indicate solely that you have transferred the information to tape, per the tape preparation instructions. Following preparation of the Shipping Instruction Sheet (SIS); file copies of this sheet, the property pass, the SIS and supporting documents to be included in the Technical Computing Department file. This sheet and the property pass will be held by the Technical Computing Department until notification has been received from the Shipping Department that this shipment has been sent. A copy of this form will then be forward to the requestor, and the original property pass returned (along with a notation that the tape has been shipped) to the "Authorized By" property pass signature person.

Rejection Cause:

- () No file list or no description.
- () File count in request block does not match actual count.
- () Corrections have been made to file list.
- () Missing signatures, employee numbers, or dates.
- () Missing "tape preparation instructions".
- () No recipient/destination/address specified.
- () Missing files or files modified since start of request.
- () Other:

Signature: _____ Employee No. _____ Date: _____

SIS Preparator: _____ Employee No. _____ Date: _____

COMPUTER TAPE DATA TRANSFER SPECIFICATIONS

Date Transfer Tape Required: APRIL 24, 1987
Preferred Method of Shipment: REGISTERED / CERTIFIED MAIL
Recipient Name/Address: ROB NITZSCHE
BLOG #61 NORTH
ATTN: SMCAR - FSA - F
DOVER, NEW JERSEY
07801-5001
Current Machine Location: CYBER 830

Provide a complete list of the files to be transferred, their location (User I.D. Account Number), contents (by file), project name, and classification.

File Name	User ID Account	File Content	Project Name	Classification
SEE ATTACHED 14 SHEETS	M20E96	SEE ATTACHED 14 SHEETS	LIGHT WRIGHT TOWED HOWITZER DEMONSTRATOR (LTHD)	UNCLASSIFIED (ALL)

Technical Computing will write all tapes in the following format unless otherwise notified:

Nine Track, 1600 BPI, Unlabeled, ASCII, 80 Character Fixed Length Records

Binary tape transfers are not recommended except between identical systems.

Changes to Format Options:

FFFFFFFFFF
FFFFFFFFFF
FFFFFFFFFF

M	M	222	000	EEEE	333	666	888	55555	999	1								
MM	MM	2	2	0	0	E	3	3	6	8	8	5	9	9	11			
M	M	M	2	0	00	E		3	6	8	8	555	9	9	1			
M	M		2	0	0	0	EEEE		3	6666	888		5	9999	1			
M	M		2	00	0	E		3	6	6	8	8		5	9	1		
M	M		2	0	0	0	E	3	3	6	6	6	8	8	5	5	9	1
M	M	22222	000	EEEE	333	666	888		555	999	111							

L	III	SSSS	;;	1
L	I	S	;;	11
L	I	S		1
L	I	SSS	;;	1
L	I	S	;;	1
..	L	I	S	1
..	LLLLL	III	SSSS	; 111

By FILE NAME

File HSC000\$DJA0:[DECNET]M20E36_8591.LIS;1 (1966,8,0), last revised on 14-MAR-1987 09:21, is a 59 block sequential file owned by UIC [DECNET]. The records are variable length with implied (CR) carriage control. The longest record is 75 bytes.

Job M20E36_8591 (2023) queued to LNSYS on 24-MAR-1987 09:22 by user DECNET, UIC [DECNET], under account DECNET at priority 100, started on printer _VENUS\$TXM6: on 24-MAR-1987 09:22 from queue LNSYS.

FFFFFFFFFF
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FFFFFFFFFF

6-4

DATE 87/03/24. TIME 08.53.36. FAM=FMB USER=M20E96

DRAWING NAME	SHEET	TYPE	FILE
WHEELS	1	TAPE3	LTHD
AR FORK	1	TAPE3	LTHD
67	1	TAPE3	LTHD
5732	1	TAPE3	LTHD
5732	1	TAPE3	LTHD
5792	2	TAPE3	LTHD
5796	1	TAPE3	LTHD
5792	1	TAPE3	LTHD
5796	2	TAPE3	LTHD
5796	2	TAPE3	LTHD
5796	3	TAPE3	LTHD
5733	2	TAPE3	LTHD
5795	2	TAPE3	LTHD
5794	1	TAPE3	LTHD
5733	1	TAPE3	LTHD
5795	1	TAPE3	LTHD
5795	1	TAPE3	LTHD
5794	3	TAPE3	LTHD
5794	2	TAPE3	LTHD
5794	3	TAPE3	LTHD
5793	1	TAPE3	LTHD
5793	2	TAPE3	LTHD
5797	1	TAPE3	LTHD
5797	2	TAPE3	LTHD
5797	3	TAPE3	LTHD
WALKING BEAM	1	TAPE3	LTHD1
5741	1	TAPE3	LTHD1
5804	1	TAPE3	LTHD1
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5747	1	TAPE3	LTHD1
36	1	TAPE3	LTHD1
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FORK LAYOUT	1	TAPE3	LTHD1
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5809	1	TAPE3	LTHD1
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FRONT FORK	1	TAPE3	LTHD1
5826	1	TAPE3	LTHD1
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5822	1	TAPE3	LTHD1
5824	1	TAPE3	LTHD1
5730	1	TAPE3	LTHD1
5817	1	TAPE3	LTHD1
5819	1	TAPE3	LTHD1
5753	1	TAPE3	LTHD1
5825	1	TAPE3	LTHD1
5827	1	TAPE3	LTHD1
5803	1	TAPE3	LTHD1
5807	1	TAPE3	LTHD1
5829	1	TAPE3	LTHD1
JMP	1	TAPE3	LTHCLLR
CLAMPD	1	TAPE3	LTHCLLR
D CLAMP	1	TAPE3	LTHCLLR
C CLAMP	1	TAPE3	LTHCLLR

DATE 87/03/24.

TIME

08.53.36.

FAM-FMB

USER=M20E96

DRAWING NAME	SHEET	TYPE	FILE
D CLAMP	2	TAPE3	LTHCLLR
TRAIL ASSEMBLY	1	TAPE3	LTHDTRL
T-12585899/A TRAIL, LOWER FRONT, LH	1	TAPE3	LTHDTRL
12585899/A TRAIL, LOWER FRONT, LH	2	TAPE3	LTHDTRL
12585899/A TRAIL, LOWER FRONT, LH	3	TAPE3	LTHDTRL
T-12585897/A TRAIL, UPPER, LH	1	TAPE3	LTHDTRL
T-12586018/C LATTICE TUBE	1	TAPE3	LTHDTRL
T-12585899/A NOTES	1	TAPE3	LTHDTRL
FEB17 TRAIL ASSEMBLY	1	TAPE3	LTHDTRL
3 VIEWS OF T-12585898	1	TAPE3	LTHDTRL
2 VIEWS OF T-12585897	1	TAPE3	LTHDTRL
T-12585898/A LR LH	3	TAPE3	LTHDTRL
T-12585898/A LR LH	4	TAPE3	LTHDTRL
T-12585898/A LR LH	1	TAPE3	LTHDTRL
T-12585899/A TRAIL, LOWER FRONT, LH	5	TAPE3	LTHDTRL
T-12585899/A TRAIL, LOWER FRONT, LH	6	TAPE3	LTHDTRL
FEB18 TRAIL ASS'Y	1	TAPE3	LTHDTRL
T-12585898/A LR LH	2	TAPE3	LTHDTRL
LOWER FRONT OF TRAIL	1	TAPE3	LTHDTRL
T-12585765/B MUZZLE BRAKE CASTING	1	TAPE3	LTHMUZZL
T-12585765/B MUZZLE BRAKE CASTING	2	TAPE3	LTHMUZZL
T-12585765/B MUZZLE BRAKE CASTING	3	TAPE3	LTHMUZZL
T-12585766/B MUZZLE BRAKE (MACHINED)	2	TAPE3	LTHMUZZL
T-12585766/B MUZZLE BRAKE (MACHINED)	1	TAPE3	LTHMUZZL
T-12585963/B R RAIL, MACHINED, L.H.	1	TAPE3	LTHRAIL
T-12585963/B RAIL, MACHINED, LH	2	TAPE3	LTHRAIL
RAIL, RH	1	TAPE3	LTHRAIL
RAIL, RH	2	TAPE3	LTHRAIL
T-12585821/A SPADE	1	TAPE3	LTHSPAD
T 12585821/A SPADE	2	TAPE3	LTHSPAD
12585821/A SPADE	3	TAPE3	LTHSPAD
T-12585836/A SHOCK MOUNT GUIDE, REAR	1	TAPE3	LTHTRAY
T-12585876/A SHOCK MOUNT GUIDE, FRONT	1	TAPE3	LTHTRAY
T-12585875/A BRACKET, REAR SHOCK MOUNT	1	TAPE3	LTHTRAY
T-12585874/A SHOCK MOUNT, REAR	1	TAPE3	LTHTRAY
T-12585873/A SHOCK MOUNT, FRONT	1	TAPE3	LTHTRAY
T-12585872/A SHOCK MOUNT, SIDE BAR	1	TAPE3	LTHTRAY
T-12585942/A SHOCK, MAIN	1	TAPE3	LTHTRAY
T-12585877/A PROJ. STOP MOUNTING	1	TAPE3	LTHTRAY
T-12585878/A PROJ. STOP PAD	1	TAPE3	LTHTRAY
T-12585880/A CUSHION STOP PAD	1	TAPE3	LTHTRAY
T-12585867/A LOAD TRAY	2	TAPE3	LTLTRAY
T-12585840/A FRAME, TROLLEY	1	TAPE3	LTLTRAY
T-12585837/A PAD, BEARING	1	TAPE3	LTLTRAY
T-12585818/A SUPPORT (TOP PLATE/FRAME)	1	TAPE3	LTLTRAY
T-12585773/A PLATE, AFT	1	TAPE3	LTLTRAY
T-12585814/A STRUT, FOREWARD	1	TAPE3	LTLTRAY
T-12585883/A HOUSING	1	TAPE3	LTLTRAY
T-12585867/A LOAD TRAY	1	TAPE3	LTLTRAY
T-12585783/A ROD	1	TAPE3	LTLTRAY
T-12585833/A PLATE, TOP	1	TAPE3	LTLTRAY
T-12585885/A SUPPORT (SIDES)	1	TAPE3	LTLTRAY
T-12585815/A STRUT, REAR	1	TAPE3	LTLTRAY
T-12585940/A BAR, TRACK SUPPORT	1	TAPE3	LTLTRAY
T-12585930/A BAR, TRACK SUPPORT	1	TAPE3	LTLTRAY
T-12585869/A BASE SPRING, PROJ.	1	TAPE3	LTLTRAY
12585778/A SLEEVE	1	TAPE3	LTLTRAY
2585881/A RETAINER, PLATE	1	TAPE3	LTLTRAY
T-12585870/A BACKUP STRIP	1	TAPE3	LTLTRAY

9

DRAWING NAME

SHEET TYPE FILE

T-12585871/A	BRACKET, BACKSTOP MTG	1	TAPE3	LTLTRAY
T-12585737/A	BLOCK, CLEVIS	1	TAPE3	LTLTRAY
T-12585817/A	PIN, PIVOT(STRUT/CLEVIS)	1	TAPE3	LTLTRAY
T-12585884/A	PAD, BEARING	1	TAPE3	LTLTRAY
T-12585886/A	HEADED PIN	1	TAPE3	LTLTRAY
T-12585868/A	WEARSTRIP	1	TAPE3	LTLTRAY
T-12585861/A	PIN, PIVOT (1.937 LG)	1	TAPE3	LTLTRAY
T-12585890/A	WASHER, BUMPER	1	TAPE3	LTLTRAY
T-12585887/A	ROLLER	1	TAPE3	LTLTRAY
T-12585962/A	ROLLER(1.406 LG)	1	TAPE3	LTLTRAY
T-12585929/A	BAR, TRACK SUPPORT	1	TAPE3	LTLTRAY
T-12585808/A	SPACER(TRACK SUPPORT BAR)	1	TAPE3	LTLTRAY
T-12585981/A	SPACER	1	TAPE3	LTLTRAY
T-12585768/A	PLATE, FOREWARD	1	TAPE3	LTLTRAY
T-12585949/A	ORIFICE ROD, RECOIL	1	TAPE3	LWTOWED
T-12585949/A	ORIFICE ROD, RECOIL	2	TAPE3	LWTOWED
T-12585954/A	COLLAR, RECOIL	1	TAPE3	LWTOWED
T-12585955/A	NUT, RECOIL	2	TAPE3	LWTOWED
T-12585955/A	NUT, RECOIL	1	TAPE3	LWTOWED
T-12585782/B	CLAMP PLATE, RAIL	1	TAPE3	LWTOWED
T-12585951/A	END CAP, FRONT	2	TAPE3	LWTOWED
T-12585946/A	CYLINDER, C'RECOIL	1	TAPE3	LWTOWED
T-12585950/A	GUIDE ROD, C'RECOIL	1	TAPE3	LWTOWED
T-12585945/B	CYLINDER, RECOIL	1	TAPE3	LWTOWED
T-12585975/A	CYL. C'REC, ENRGY, RECOV	2	TAPE3	LWTOWED
T-12585975/A	CYL. C'REC, ENRGY, RECOV	1	TAPE3	LWTOWED
T-12585946/A	CYLINDER, C'RECOIL	2	TAPE3	LWTOWED
22		2	TAPE3	LWTOWED
T-12585951/A	END CAP, FRONT	1	TAPE3	LWTOWED
T-12585952/A	END CAP, REAR	1	TAPE3	LWTOWED
T-12585948/B	ROD, C'RECOIL	1	TAPE3	LWTOWED
T-12585945/B	CYLINDER, RECOIL	2	TAPE3	LWTOWED
T-12585953/B	WASHER, END CAP	1	TAPE3	LWTOWED
T-12585956/B	WAY BEARING	1	TAPE3	LWTOWED
T-12585960/B	SLIDE BUSHING, INSIDE	1	TAPE3	LWTOWED
T-12585961/B	SLIDE BUSHING, OUTSIDE	1	TAPE3	LWTOWED
T-12585959/B	TORQUE PIN, BOTTOM	1	TAPE3	LWTOWED
T-12585947/B	ROD, RECOIL	1	TAPE3	LWTOWED
T-12585957/B	WAY BEARING W/GROOVE	1	TAPE3	LWTOWED
5847		1	TAPE3	LTHD2
5834		1	TAPE3	LTHD2
5835		1	TAPE3	LTHD2
5770		1	TAPE3	LTHD2
5839		1	TAPE3	LTHD2
5838		1	TAPE3	LTHD2
BULKHEAD, LAYOUT		1	TAPE3	LTHD2
5846		1	TAPE3	LTHD2
5863		1	TAPE3	LTHD2
5847		2	TAPE3	LTHD2
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5862		1	TAPE3	LTHD4
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5888
5941
5982
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5992
5984
82
83
5879
12585710-460
12585710
LTHD
GIMBAL
GM
MODEL
3D
SIDE
5810
5810
5810
LTHD
MID MANIFOLD
CRADLE
LTHD
CRADLE
T-12585821/A SPADE
T-12585821/A SPADE
T-12585821/A SPADE
SPEED
MANDREL
LOADTRAY LAYOUT
LTHD
LOAD C130 W/ LTHD6
1 CRADLE MACH
SPEED
TRAIL ASSEMBLY
T
5831 CRADLE MACH
GIMBAL
5800
5800
PLATFORM
BREECH
OUTER BAND
SPADE
CRADLE
CRADLE DETAIL
MANDREL
PLATFORM
CRADLE/TRAIL INTERFACE
LTHD
LOADTRAY LAYOUT SLIDE
LOADTRAY LAYOUT
GIMBAL
SLIDE
LTHD
2
SPADE

1 TAPE3 LTHD4
1 TAPE3 LTHD4
1 TAPE3 LTHD4
1 TAPE3 LTHD4
1 TAPE3 LTHD4
1 TAPE3 LTHD4
1 TAPE3 LTHD4
1 TAPE3 LTHD4
1 TAPE3 LTHD4
1 TAPE3 HYDR
1 TAPE3 GIMBAL
6 TAPE3 GIMBAL
1 TAPE3 GIMBAL
1 TAPE3 GIMBAL
1 TAPE3 GIMBAL
1 TAPE3 GIMBAL
1 TAPE3 GIMBAL
2 TAPE3 GIMBAL
3 TAPE3 GIMBAL
8 TAPE3 LTH8703
1 TAPE3 LTH8703
8 TAPE3 LTH8703
7 TAPE3 LTH8702
10 TAPE3 LTH8702
1 TAPE3 LTH8702
2 TAPE3 LTH8702
3 TAPE3 LTH8702
2 TAPE3 LTH8702
1 TAPE3 LTH8701
7 TAPE3 LTH8701
7 TAPE3 LTH8701
10 TAPE3 LTH8701
1 TAPE3 LTH8701
2 TAPE3 LTH8701
1 TAPE3 LTH8701
5 TAPE3 LTH8701
2 TAPE3 LTH8701
1 TAPE3 LTH8701
1 TAPE3 LTH8701
2 TAPE3 LTH8701
10 TAPE3 LTH8701
1 TAPE3 LTH8612
1 TAPE3 LTH8612
1 TAPE3 LTH8612
6 TAPE3 LTH8612
1 TAPE3 LTH8612
1 TAPE3 LTH8612
6 TAPE3 LTH8612
10 TAPE3 LTH8612
6 TAPE3 LTH8612
4 TAPE3 LTH8612
5 TAPE3 LTH8612
2 TAPE3 LTH8612
6 TAPE3 LTH8612
7 TAPE3 LTH8612
2 TAPE3 LTH8612
7 TAPE3 LTH8612

12
13
14
15
16
17

DATE 87/03/24. TIME 08.53.36. FAM-FMB USER=M20E96

DRAWING NAME SHEET TYPE FILE
LOADTRAY LAYOUT 7 TAPE3 LTH8612

8

LTHD
AUTOPRIMMER

4 TAPE3 LTH8611
1 TAPE3 LTH8611

6-11

6-12

LTHD
LTHD
SPEEDSHIFT LAYOUT
LOADTRAY LAYOUT SLIDE
SPEEDSHIFT
T
AIL
WHEELS
CANNON
BREECH
SLIDE
PLATFORM FRAME
22
GIMBAL
LOADTRAY LAYOUT
GIMBAL
FIRING CHART
LTHD
MUZZLE BRAKE
LTHD NEW WHEELS
CANNON ASSY
BARREL & BREECH
FIRE CONTROL MEASUREMENT ERROR
DISPLACEMENT TIMELINE
LTHD
LOADING
LOAD C130
LTHD
LTHD
LTHD, HIDDEN CLAWS UP
SLIDE
EMPLACEMENT TIMELINE
LOAD C130 W/ LTHD6
AILS
GIMBAL
PLATFORM
FIRE CONTROL-MEASUREMENT-METHOD
TRAIL W/ COMPOSITE TOP & BOTTOM
TIME LINE FOR MAX RATE OF FIRE
LOADTRAY LAYOUT, TRAY AT 0 DEG.
SPADE
CLAWS
WHEEL UNIT
FIRE CONTROL
RECIL MECHANISM
SPEEDSHIFT TIMELINE
PAL
AUTOPRIMMER
LTHD, BOX SLIDES
HYD SCH LTHD
HYD SCH LTHD
CAM PLATE
MUZZLE BRAKE/ HITCH
CRADLE & TRAIL ASSY
DOLLY ASSY
CANNON ASSY

5 TAPE3 LTH8611
6 TAPE3 LTH8611
1 TAPE3 LTH8611
4 TAPE3 LTH8611
2 TAPE3 LTH8611
22 TAPE3 LTH8611
1 TAPE3 LTH8611
1 TAPE3 LTH8611
1 TAPE3 LTH8611
1 TAPE3 LTH8611
6 TAPE3 LTH8611
1 TAPE3 LTH8611
2 TAPE3 LTH8611
1 TAPE3 LTH8611
1 TAPE3 LTHD869
1 TAPE3 LTHD869
1 TAPE3 LTHD869
1 TAPE3 LTHD869
1 TAPE3 LTHD869
2 TAPE3 LTHD869
1 TAPE3 LTHD869
3 TAPE3 LTHD869
1 TAPE3 LTHD869
5 TAPE3 LTHD869
4 TAPE3 LTHD869
5 TAPE3 LTHD869
6 TAPE3 LTHD869
1 TAPE3 LTHD869
1 TAPE3 LTHD869
10 TAPE3 LTHD869
1 TAPE3 LTHD869
1 TAPE3 LTHD869
1 TAPE3 LTHD869
1 TAPE3 LTHD869
2 TAPE3 LTHD869
50 TAPE3 LTHD869
1 TAPE3 LTHD869
1 TAPE3 LTHD869
1 TAPE3 LTHD869
1 TAPE3 LTHD869
1 TAPE3 LTHD869
1 TAPE3 LTHD869
2 TAPE3 LTHD869
1 TAPE3 LTHD869
3 TAPE3 LTKENT1
3 TAPE3 LTKENT1
4 TAPE3 LTKENT1
1 TAPE3 LTKENT1
1 TAPE3 LTKENT1
1 TAPE3 LTKENT1
1 TAPE3 LTKENT1
1 TAPE3 LTKENT1

19

20

PAGE 5

DATE 87/03/24. TIME 08.53.36. FAM-FMB USER=M20E96

DRAWING NAME	SHEET	TYPE	FILE
SLIDE ASSY	1	TAPE3	LTKENT1
HYD SCH LTHD	5	TAPE3	LTKENT1
CANNON ASSY	5	TAPE3	LTKENT1

10

HYD SCH UPPER RH PORTION
HYD SCH LTHD

10 TAPE3 LTKENT1
6 TAPE3 LTKENT1

6-13

11

LTHD	4	TAPE3	LTKENT1
LAPES	3	TAPE3	LTKENT1
LTHD ASSY	2	TAPE3	LTKENT1
LTHD	5	TAPE3	LTKENT1
MUZZLE	10	TAPE3	LTKENT1
RECOIL FORCE VS STROKE	1	TAPE3	LTHDGRA
MINIMUM ALLOWABLE DECELERATING	1	TAPE3	LTHDGRA
CURRY	1	TAPE3	LTHDGRA
MASS MOMENT OF INERTIA	1	TAPE3	LTHDGRA
MUZZLE VELOCITY VS RANGE	1	TAPE3	LTHDGRA
CENTER OF GRAVITY VS STROKE	1	TAPE3	LTHDGRA
RECOIL	10	TAPE3	LTHDGRA
RECOILING MASS	1	TAPE3	LTHDGRA
CANNON ASSY	1	TAPE3	LTHDDWG
DOLLY ASSY	1	TAPE3	LTHDDWG
LTHD ASSY	2	TAPE3	LTHDDWG
PLATFORM ASSY	2	TAPE3	LTHDDWG
TRAIL ASSY, RH	2	TAPE3	LTHDDWG
GIMBAL ASSY	2	TAPE3	LTHDDWG
TRAIL ASSY, LH	2	TAPE3	LTHDDWG
22	2	TAPE3	LTHDDWG
GIMBAL DETAIL	2	TAPE3	LTHDDWG
PLATFORM, UPPER DETAIL	2	TAPE3	LTHDDWG
PLATFORM, LOWER DETAIL	2	TAPE3	LTHDDWG
CRADLE & TRAIL ASSY	2	TAPE3	LTHDDWG
CREW POSITIONS	10	TAPE3	LTHDDWG
BATTERY POSITION, 0 QE	10	TAPE3	LTHDDWG
LTHD AT 33.75 DEGREES	20	TAPE3	LTHDDWG
FORCES, LH TRAIL	20	TAPE3	LTHDDWG
SLIDE	1	TAPE3	LTHDDWG
SLIDE ASSY	1	TAPE3	LTHDDWG
FORCES, SLIDE	20	TAPE3	LTHDDWG
COUNTERRECOIL CYL	1	TAPE3	LTHDDWG
FORCES, UPPER PLATFORM	20	TAPE3	LTHDDWG
FORCES, LOWER PLATFORM	20	TAPE3	LTHDDWG
TASK ORDER SCHEDULE	10	TAPE3	LTHDDWG
HYD SYSTEM	2	TAPE3	LTHDDWG
RECOIL CYLINDER	1	TAPE3	LTHDDWG
MUZZLE BRAKE	1	TAPE3	LTHDDWG
LAPES	2	TAPE3	LTHKENT
LAPES	3	TAPE3	LTHKENT
LOAD	4	TAPE3	LTHKENT
MAP	1	TAPE3	LTHKENT
LTHD -18	1	TAPE3	LTHKENT
CANNON	1	TAPE3	LTHKENT
HYD SCH	1	TAPE3	LTHKENT
HYD SCH LTHD	2	TAPE3	LTHKENT
HYDSYS	1	TAPE3	LTHKENT
HYDSYS	2	TAPE3	LTHKENT
ELEV CYL	1	TAPE3	LTHKENT
HYDSYS	3	TAPE3	LTHKENT
LAYOUT, LAPES	1	TAPE3	LTHKENT
HOUSE	1	TAPE3	LTHKENT
HYD SCH LTHD	3	TAPE3	LTHKENT

DATE 87/03/24. TIME 08.53.36. FAM=FMB USER=M20E96

DRAWING NAME	SHEET	TYPE	FILE
LTHD LATTICE	10	TAPE3	LTHKENT
TIME TABLE	1	TAPE3	LTHKENT
MUZZEL BRAKE/HITCH	1	TAPE3	LTHKENT
CAM PLATE	1	TAPE3	LTHKENT
22	2	TAPE3	LTHKENT

BREECH
LTHD, BOX SLIDES

1 TAPE3 LTHKENT
3 TAPE3 LTHKENT

6-15

SPADE	1	TAPE3	LTHKENT	
SPADE	2	TAPE3	LTHKENT	
BARREL PROFILE	1	TAPE3	LTHKENT	
SPADE	3	TAPE3	LTHKENT	
LTHD, LOW ELEV CYL	2	TAPE3	LTHKENT	
C130	1	TAPE3	LTHKENT	
MUZZEL BRAKE /HITCH	2	TAPE3	LTHKENT	
BARREL ASSY	2	TAPE3	LTHKENT	
BREECH ASSY	5	TAPE3	LTHKENT	
SPADE HOLDING, SAND	10	TAPE3	LTGRAPH	24
SPADE HOLDING, LOAM	11	TAPE3	LTGRAPH	
SPADE HOLING, CLAY	12	TAPE3	LTGRAPH	
RECOIL FORCE VS STROKE	10	TAPE3	LTGRAPH	
COUNTERRECOIL CUSHION	10	TAPE3	LTGRAPH	
MUZZLE VELOCITY VS RANGE	10	TAPE3	LTGRAPH	
RECOILING MASS	10	TAPE3	LTGRAPH	
BATTERY POSITION, 0 QE	10	TAPE3	LTGRAPH	
LOAD C130	10	TAPE3	LTGRAPH	
FIGURE 4	5	TAPE3	LTGRAPH	
CANNON ASSY	4	TAPE3	LTGRAPH	
HYD SCH UPPER RH PORTION	5	TAPE3	LTGRAPH	
CREW POSITIONS	10	TAPE3	LTGRAPH	
FIGURE 3	10	TAPE3	LTGRAPH	
SLIDE	3	TAPE3	LTGRAPH	
SLIDE	1	TAPE3	LTHDDT	25
SLIDE	2	TAPE3	LTHDDT	
TRAIL	4	TAPE3	LTHDDT	
LTHD	1	TAPE3	LTHDDT	
SLIDE	6	TAPE3	LTHDDT	
DEMO	3	TAPE3	LTHDDT	
EMPLACEMENT TIMELINE	1	TAPE3	LTHDDT	
SPEEDSHIFT TIMELINE	1	TAPE3	LTHDDT	
ME LINE FOR MAX RATE OF FIRE	1	TAPE3	LTHDDT	
EMPLACEMENT TIMELINE	50	TAPE3	LTHDDT	
RAIL	1	TAPE3	LTHDDT	
BAND, INNER	1	TAPE3	LTHDJT	26
FBAND, OUTER	1	TAPE3	LTHDJT	
BAND, OUTER	2	TAPE3	LTHDJT	
BREECH7	1	TAPE3	LTHDJT	
CRANK	1	TAPE3	LTHDJT	
KEY	1	TAPE3	LTHDJT	
HOUSING	1	TAPE3	LTHDJT	
CLAMP	1	TAPE3	LTHDJT	
CLAMP2	1	TAPE3	LTHDJT	
CLAMPD	1	TAPE3	LTHDJT	
MID CRADLE MANIFOLD	1	TAPE3	LTHDJT	
CIRCLE	1	TAPE3	LTHDJL	27
LOADS ANALYSIS	1	TAPE3	LTHDJL	
FIRING LOADS	1	TAPE3	LOADS	28
LOADS ANALYSIS	1	TAPE3	LOADS	
WALKING BEAM	2	TAPE3	LOADS	
	1	TAPE3	LOADS	



ASSOCIATES, INC.

2-1
111 W. Evelyn Ave., Suite 301
Sunnyvale, California 94086
(408) 736-1636

March 20, 1987

Larry Libhardt
FMC Corporation
3989 Central Ave NE
Minneapolis, Minn 55421

Dear Larry,

Enclosed is the listing of the files which were on our RIDGE 32 computer as of 3/20/87. The binary results files were deleted in order to conserve disk space. We did save all of the input files and these have been transferred to a magnetic tape which we will keep in our tape library for at least 2 years. This information could be transmitted to you on a standard ascii tape or on a PC floppy if necessary. It was a pleasure working with you and if we can be of any assistance in the future please do not hesitate to call.

Best regards,

A handwritten signature in cursive script, reading "Mark C. Rodamaker".

Mark C. Rodamaker

IC0666	MARK	1508	FEB	26	18:08:36	1987	EPLOTS
0666	MARK	734384	MAR	2	20:52:45	1987	FILE16
0666	MARK	28521	DEC	11	13:44:00	1986	FPS.F33
100666	MARK	16604	DEC	11	13:46:32	1986	FPSBM
0666	MARK	63	DEC	7	16:12:30	1986	MAST
0666	ROOT	18638	DEC	7	14:25:33	1986	MOD1
TUG 5	MARK	30736	JAN	31	14:12:18	1987	MOD10
IC0666	MARK	30776	FEB	14	16:05:37	1987	MOD11
0666	MARK	29729	FEB	8	16:23:16	1987	MOD11TRAN
0666	MARK	30565	FEB	19	19:23:10	1987	MOD12
IC0666	MARK	30695	MAR	2	20:33:36	1987	MOD13
0666	ROOT	19374	NOV	25	13:50:54	1986	MOD2
0666	MARK	15445	DEC	2	12:08:05	1986	MOD3
100666	MARK	15793	DEC	5	11:12:14	1986	MOD4
100666	MARK	15688	DEC	7	14:29:43	1986	MOD5
0666	MARK	15530	DEC	7	16:45:17	1986	MOD5TRAN
IC0666	MARK	16779	DEC	15	13:42:12	1986	MOD6
IC0666	MARK	16656	DEC	16	13:08:42	1986	MOD6TRAN
0666	MARK	35335	JAN	13	13:03:21	1987	MOD7
0666	MARK	37396	JAN	14	19:58:32	1987	MOD8
100666	MARK	30638	FEB	2	17:46:45	1987	MOD9
IC0666	MARK	238	DEC	7	16:28:41	1986	MODAL
0666	MARK	215	DEC	8	08:49:23	1986	MODALPOST
100666	MARK	199	FEB	9	16:48:03	1987	P26
IC0666	MARK	170	MAR	3	10:57:36	1987	PLDISP
0666	MARK	695	FEB	26	19:17:39	1987	POST
0666	MARK	149	FEB	27	10:35:15	1987	POST.TEMP
IC0666	MARK	52	DEC	11	10:07:31	1986	STRESSPASS
0666	MARK	481	DEC	11	10:45:56	1986	STRESSPOST
0666	MARK	933	FEB	9	16:44:03	1987	TRANRST

LTHD Structural Analysis File Summary

Joe Fishbein
18 March 1987

All files listed below are for the IMAGES-3D Finite Element Program. Except where noted, all files were created under Version 1.3 of the program.

Each file consists of 18-31 sub-files (e.g. GUNRAIL.GEO, GUNRAIL.DIS, etc.) which are generated and used by IMAGES. The listing "filename.*" implies the entire group of sub-files.

All files are stored on labeled diskettes.

→ Larry Libhardt
has two boxes.

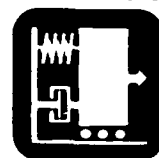
File	Disk Label	Description
CLAMPBAR.*	LTHDFEM2	Clamp bar for fastening collar to rail. 1/2 symmetric model of section "slice" under bolt tension loading.
COLLAR2.*	LTHDFEM2	(Version 1.1) Keyed section of original collar. 1/2 symmetric model of "slice" under recoil torque load. Two runs with sym./anti-sym. boundary conditions were run and combined. This geometry is obsolete.
GUNRAIL.*	LTHDFEM1	Cannon guide rail, with barrel and collars. Simple beam model to determine loading in rail from recoil torque at various barrel positions within manifolds.
IBBAND.*	LTHDFEM1	(Version 1.1) Inner breech band. Cross-section "slice" with loading from cannon recoil.
LTHDHUB.*	LTHDHUB1- LTHDHUB6 (6 disks)	Wheel hub. Half-symmetric plate model, with plate elements of various thicknesses for the different areas. Bump/skid and 4.5G Air Drop loadings.
LTHDHUBA.*	LTHDFEM3	Wheel hub. Simple beam model of hub under transport loadings listed above.
OBBAND.*	LTHDFEM1	Outer breech band. 1/4-symmetric model under cannon recoil, supported by cylinders at corners.
TESTRING.*	LTHDFEM4 LTHDFEM5	Speed shift plate -- initial test model. 1/2 symmetric model of uniform circular plate with central hole, supported at 3 equidistant points on outer radius and continuously loaded on inner radius.

LTHD Structural Analysis File Summary (continued)

File	Disk Label	Description
TESTRNG2.*	LTHDFEM6 LTHDFEM7 LTHDFEM8	Speed shift plate -- refined model. Same geometry as TESTRING, but with tapered plate for better stresses and a more detailed model.
TPMANFLD.*	LTHDFEM3	Middle manifold projection that engages torque pin. "Slice" model under triangular loading from recoil torque.
TRAILDIA.*	LTHDFEM3	Titanium diaphragm on trail, with loading from wheel actuator cylinders.

lthdfsum.doc

Subject DISK DOCUMENTATION	Analyst JMT	
	Project Number	
	EC. No.	Date 1-29-87



DISK LABEL: LTHDFEM1

FILENAME	DESCRIPTION	SIZE
OBBAND.*	IMAGES3D V1.3 MODEL OF LTHD OUTER BREECH BAND, 1/4 - SYMMETRIC MODEL. IMPACT LOAD FROM CANNON RECOIL.	192512
IBBAND.*	IMAGES3D V1.1 MODEL OF LTHD INNER BREECH BAND. CROSS-SECTION "SLICE", IMPACT LOAD FROM CANNON RECOIL	87040
GUNRAIL.*	IMAGES3D V1.3 MODEL OF LTHD CANNON GUIDE RAIL, WITH CANNON AND COLLAR "ARMS". TORQUE (RIFLING) ON CANNON, RESISTED BY MANIFOLDS (SUPPORTS) ALONG RAILS.	65536

DISK LABEL: LTHDFEM2

FILENAME	DESCRIPTION	SIZE
COLLAR2.*	IMAGES3D V1.1 MODEL OF LTHD BARREL COLLAR - 1/2 SYMMETRIC MODEL OF SECTION THROUGH KEYED AREA. 2 SYM/ASYM LOAD CASES. TORQUE LOAD FROM RIFLING. (GEOMETRY CHANGED ON FINAL DWG.)	235520
CLAMPBAR.*	IMAGES3D V1.3 MODEL OF LTHD CLAMP FOR FASTENING RAIL TO COLLAR. 1/2 SYM. MODEL OF "SLICE" - BOLT TENSION LOAD.	71680

DISK LABEL: LTHDFEM3

FILENAME	DESCRIPTION	SIZE
TRAILDIA.*	DIAPHRAGM FOR LTND TRAIL, LOADED BY WHEEL ACTUATOR CYLINDERS AND BASE LOADS FROM TRANSPORT	~~52248~~ 42784
TPMANFLD.*	MODEL OF MANIFOLD SECTION IN AREA OF TORQUE PINS, WITH TRIANGULAR LOAD FROM RIFLING TORQUE.	175104
LTHDHUBA.*	SIMPLE BEAM MODEL OF LTND WHEEL HUB UNDER TRANSPORT LOADS.	17445

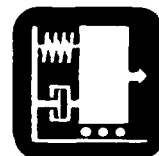
DISK LABEL: LTHDFEM4

FILENAME	DESCRIPTION	SIZE
TESTRING.*	TEST MODEL FOR LTND SPEED SHIFT - ANNULAR PLATE LOADED ALONG ID AND SUPPORTED AT 3 POINTS ON OD (DISK 1 OF 2)	267493

DISK LABEL: LTHDFEM5

FILENAME	DESCRIPTION	SIZE
TESTRING.*	(DISK 2 OF 2)	355900

Subject	Analyst	
	Project Number	
	EC. No.	Date



DISK LABEL: LTHDFEM6

FILENAME	DESCRIPTION	SIZE
TESTRNG2.*	SAME AS 'TESTRING', BUT TAPERED PLATE AND MORE DETAILED MODEL (1 OF 3)	276364

DISK LABEL: LTHDFEM7

FILENAME	DESCRIPTION	SIZE
TESTRNG2.*	(DISK 2 OF 3)	257046

DISK LABEL: LTHDFEM8

FILENAME	DESCRIPTION	SIZE
TESTRNG2.*	(DISK 3 OF 3)	220319

C:\IMAGES3D>ddir a:

Volume in drive A is LTHDFEM1
Directory of A:\

GUNRAIL	BLK	24	1-28-87	2:30p	3	IBBAND	DIO	15623	1-15-87	3:19p
GUNRAIL	BLS	14677	1-28-87	2:34p	3	IBBAND	DIA	1634	1-16-87	10:09p
GUNRAIL	DES	128	1-28-87	2:24p	3	IBBAND	DIS	15614	1-16-87	10:15p
GUNRAIL	DIA	352	1-28-87	2:30p	3	IBBAND	DOF	1176	1-16-87	10:10p
GUNRAIL	DIS	5816	1-28-87	2:31p	3	IBBAND	DSC	128	1-16-87	10:05p
GUNRAIL	DOF	444	1-28-87	2:30p	3	IBBAND	DUM	24	1-16-87	10:32p
GUNRAIL	DSC	102	1-28-87	2:24p	3	IBBAND	FEF	7	1-16-87	10:15p
GUNRAIL	DXX	70	1-28-87	2:23p	3	IBBAND	GEO	3840	1-16-87	10:05p
GUNRAIL	FEF	6	1-28-87	2:31p	3	IBBAND	IS	384	1-16-87	10:06p
GUNRAIL	GEO	2048	1-28-87	2:24p	3	IBBAND	K01	10406	1-16-87	10:12p
GUNRAIL	IS	260	1-28-87	2:26p	3	IBBAND	K02	6968	1-16-87	10:12p
GUNRAIL	K01	16872	1-28-87	2:30p	3	IBBAND	LOD	3072	1-15-87	3:09p
GUNRAIL	LOD	1202	1-28-87	2:28p	3	IBBAND	NRM	26	1-16-87	10:12p
GUNRAIL	NRM	25	1-28-87	2:30p	3	IBBAND	OVF	17	1-16-87	10:10p
GUNRAIL	OVF	7	1-28-87	2:30p	3	IBBAND	RAN	4096	1-16-87	10:09p
GUNRAIL	RAN	1944	1-28-87	2:29p	3	IBBAND	REA	2183	1-16-87	10:28p
GUNRAIL	REA	1491	1-28-87	2:34p	3	IBBAND	RNL	2537	1-16-87	10:15p
GUNRAIL	RNL	1696	1-28-87	2:31p	3	IBBAND	SEC	3456	1-16-87	10:05p
GUNRAIL	SEC	1725	1-28-87	2:24p	3	IBBAND	STA	128	1-15-87	3:09p
GUNRAIL	STA	11	1-28-87	2:28p	3	IBBAND	STL	128	1-15-87	3:09p
GUNRAIL	STL	70	1-28-87	2:28p	3	IBBAND	BLK	42	1-28-87	2:46p
GUNRAIL	SXX	1726	1-28-87	2:23p	3	IBBAND	DES	60	1-28-87	2:09p
IBBAND	BLK	42	1-16-87	10:10a	3	IBBAND	DIA	732	1-28-87	2:48p
IBBAND	DES	128	1-16-87	10:05a	3	IBBAND	DIS	10235	1-28-87	2:51p
MMMMMM Press any key to continue MMMMMM5										
IBBAND	DOF	786	1-28-87	2:46p	3	IBBAND	OVF	7	1-28-87	2:46p
IBBAND	DSC	70	1-28-87	2:09p	3	IBBAND	FLS	11130	1-28-87	2:56p
IBBAND	DXX	70	1-28-87	2:37p	3	IBBAND	RAN	2608	1-28-87	2:45p
IBBAND	FEF	6	1-28-87	2:51p	3	IBBAND	REA	1497	1-28-87	2:56p
IBBAND	GEO	2608	1-28-87	2:09p	3	IBBAND	RNL	1696	1-28-87	2:51p
IBBAND	IS	456	1-28-87	2:12p	3	IBBAND	SEC	2516	1-28-87	2:09p
IBBAND	K01	114266	1-28-87	2:48p	3	IBBAND	STA	11	1-28-87	2:09p
IBBAND	K02	23876	1-28-87	2:48p	3	IBBAND	STL	70	1-28-87	2:09p
IBBAND	LOD	2064	1-28-87	2:39p	3	IBBAND	SXX	2516	1-28-87	2:09p
IBBAND	NRM	25	1-28-87	2:48p	3					

67 File(s) 17408 bytes free

C:\IMAGES3D>

Volume in drive A is LTHDFEM2
Directory of A:\

CLAMPBAR BLK	42	1-30-87	8:45a	3	COLLAR2	DIO	16427	1-13-87	2:5
CLAMPBAR DES	60	1-30-87	8:28a	3	COLLAR2	DIA	1282	1-14-87	7:5
CLAMPBAR DIA	372	1-30-87	8:45a	3	COLLAR2	DIS	16424	1-14-87	8:0
CLAMPBAR DIS	15281	1-30-87	9:19a	3	COLLAR2	DOF	1236	1-14-87	7:5
CLAMPBAR DOF	1150	1-30-87	8:45a	3	COLLAR2	DSC	128	1-14-87	7:4
CLAMPBAR DSC	70	1-30-87	8:29a	3	COLLAR2	DUM	55	1-15-87	8:1
CLAMPBAR DXX	70	1-30-87	9:13a	3	COLLAR2	FEF	7	1-14-87	8:0
CLAMPBAR FEF	6	1-30-87	9:19a	3	COLLAR2	GEO	4096	1-14-87	7:4
CLAMPBAR GEO	3380	1-30-87	8:28a	3	COLLAR2	IS	512	1-14-87	7:4
CLAMPBAR IS	666	1-30-87	8:31a	3	COLLAR2	KO1	12696	1-14-87	7:5
CLAMPBAR KO1	14768	1-30-87	8:46a	3	COLLAR2	KO2	12762	1-14-87	7:5
CLAMPBAR KO2	7796	1-30-87	8:46a	3	COLLAR2	LOD	3200	1-14-87	7:5
CLAMPBAR LOD	2935	1-30-87	9:17a	3	COLLAR2	NRM	26	1-14-87	7:5
CLAMPBAR NRM	25	1-30-87	8:46a	3	COLLAR2	OVF	17	1-14-87	7:5
CLAMPBAR OVF	7	1-30-87	8:45a	3	COLLAR2	PLO	66521	1-13-87	3:1
CLAMPBAR RAN	3380	1-30-87	8:45a	3	COLLAR2	PLS	66581	1-14-87	8:1
CLAMPBAR RNL	1360	1-30-87	9:19a	3	COLLAR2	RAN	4096	1-14-87	7:5
CLAMPBAR SED	2889	1-30-87	8:28a	3	COLLAR2	REQ	2053	1-13-87	3:1
CLAMPBAR STA	11	1-30-87	9:17a	3	COLLAR2	REA	2053	1-14-87	8:1
CLAMPBAR STL	70	1-30-87	9:17a	3	COLLAR2	RNL	2369	1-14-87	8:0
CLAMPBAR SXX	2839	1-30-87	9:13a	3	COLLAR2	SED	3712	1-14-87	7:4
COLLAR2 BLK	42	1-14-87	7:57a	3	COLLAR2	STA	128	1-14-87	7:5
COLLAR2 DES	128	1-14-87	7:44a	3	COLLAR2	STL	128	1-14-87	7:5

46 File(s) 55296 bytes free

C:\IMAGESCD\

C:\images3d>ddir a:

Volume in drive A is LTHDFEM3
Directory of A:\

LTHDHUBA	BLK	24	2-25-87	1:56p
LTHDHUBA	DES	60	2-25-87	1:50p
LTHDHUBA	DIA	200	2-25-87	1:56p
LTHDHUBA	DIS	5405	2-25-87	1:58p
LTHDHUBA	DOF	212	2-25-87	1:56p
LTHDHUBA	DSC	114	2-25-87	1:50p
LTHDHUBA	FEF	12	2-25-87	1:58p
LTHDHUBA	GEO	1124	2-25-87	1:50p
LTHDHUBA	IS	127	2-25-87	1:51p
LTHDHUBA	K01	5872	2-25-87	1:56p
LTHDHUBA	LOD	1206	2-25-87	1:55p
LTHDHUBA	NRM	25	2-25-87	1:56p
LTHDHUBA	OVF	7	2-25-87	1:56p
LTHDHUBA	RAN	1124	2-25-87	1:56p
LTHDHUBA	RNL	688	2-25-87	1:58p
LTHDHUBA	SEQ	1102	2-25-87	1:50p
LTHDHUBA	STA	11	2-25-87	1:55p
LTHDHUBA	STL	132	2-25-87	1:55p
TPMANFLD	BLK	114	2-17-87	11:35a
TPMANFLD	DES	60	2-17-87	11:11a
TPMANFLD	DIA	888	2-17-87	11:35a
TPMANFLD	DIS	34697	2-17-87	11:43a
TPMANFLD	DOF	2614	2-17-87	11:35a
TPMANFLD	DSC	70	2-17-87	11:12a
Press any key to continue				
TRAILDIA	DSC	82	2-11-87	7:19a
TRAILDIA	DXX	70	2-11-87	7:14a
TRAILDIA	FEF	12	2-11-87	7:27a
TRAILDIA	GEO	1244	2-11-87	7:19a
TRAILDIA	IS	183	2-11-87	7:20a
TRAILDIA	K01	18002	2-11-87	7:26a
TRAILDIA	LOD	4224	2-11-87	7:24a
TRAILDIA	NRM	25	2-11-87	7:26a

63 File(s) 101376 bytes free

C:\images3d>

TPMANFLD	DXX	70	2-17-87	11:00a
TPMANFLD	FEF	6	2-17-87	11:43a
TPMANFLD	GEO	8996	2-17-87	11:11a
TPMANFLD	IS	1506	2-17-87	11:19a
TPMANFLD	K01	14882	2-17-87	11:38a
TPMANFLD	K02	14532	2-17-87	11:39a
TPMANFLD	K03	14646	2-17-87	11:39a
TPMANFLD	K04	14500	2-17-87	11:39a
TPMANFLD	K05	14508	2-17-87	11:39a
TPMANFLD	K06	3970	2-17-87	11:39a
TPMANFLD	LOD	6551	2-17-87	11:27a
TPMANFLD	NRM	25	2-17-87	11:39a
TPMANFLD	OVF	7	2-17-87	11:35a
TPMANFLD	RAN	8996	2-17-87	11:35a
TPMANFLD	RNL	184	2-17-87	11:43a
TPMANFLD	SEQ	8540	2-17-87	11:12a
TPMANFLD	STA	11	2-17-87	11:27a
TPMANFLD	STL	70	2-17-87	11:27a
TPMANFLD	SXX	7343	2-17-87	11:00a
TRAILDIA	BLK	24	2-11-87	7:25a
TRAILDIA	DES	60	2-11-87	7:19a
TRAILDIA	DIA	266	2-11-87	7:25a
TRAILDIA	DIS	7661	2-11-87	7:27a
TRAILDIA	DOF	310	2-11-87	7:25a
TRAILDIA	OVF	7	2-11-87	7:25a
TRAILDIA	RAN	1244	2-11-87	7:25a
TRAILDIA	RNL	2032	2-11-87	7:27a
TRAILDIA	SEQ	1090	2-11-87	7:19a
TRAILDIA	STA	11	2-11-87	7:24a
TRAILDIA	STL	318	2-11-87	7:24a
TRAILDIA	SXX	880	2-11-87	7:13a

LTHDFEM4

Directory of A:\

TESTRING DES	60	2-16-87	7:56a	3	TESTRING LOD	5834	2-16-87	8:05a
TESTRING DIA	2204	2-16-87	8:32a	3	TESTRING NRM	25	2-16-87	8:42a
TESTRING DSC	70	2-16-87	7:56a	3	TESTRING RAN	7044	2-16-87	8:31a
TESTRING GEO	7044	2-16-87	7:56a	3	TESTRING SEO	7921	2-16-87	7:56a
TESTRING IS	1338	2-16-87	8:02a	3	TESTRING STA	11	2-16-87	8:08a
TESTRING K01	110538	2-16-87	8:39a	3	TESTRING STL	70	2-16-87	8:05a
TESTRING K02	125334	2-16-87	8:40a	3				

13 File(s) 87040 bytes free

C:\images3d>ddir a:

Volume in drive A is LTHDFEM5

Directory of A:\

TESTRING BLK	96	2-16-87	8:33a	3	TESTRING K04	126390	2-16-87	8:41a
TESTRING DIS	30305	2-16-87	8:49a	3	TESTRING K05	66850	2-16-87	8:42a
TESTRING DOF	2320	2-16-87	8:33a	3	TESTRING OVF	7	2-16-87	8:34a
TESTRING FEF	6	2-16-87	8:49a	3	TESTRING RNL	3544	2-16-87	8:49a
TESTRING K03	126362	2-16-87	8:41a	3				

9 File(s) 0 bytes free

C:\images3d>

C:\images3d>ddir a:

Volume in drive A is LTHDFEM6
Directory of A:\

TESTRNG2 DES	60	3-11-87	9:07a	TESTRNG2 LOD	6404	3-05-87	11:11a
TESTRNG2 DIA	2428	3-11-87	9:51a	TESTRNG2 NRM	25	3-11-87	10:03a
TESTRNG2 DSC	70	3-11-87	9:08a	TESTRNG2 RAN	7792	3-11-87	9:51a
TESTRNG2 GEO	7792	3-11-87	9:07a	TESTRNG2 SEQ	9461	3-11-87	9:08a
TESTRNG2 IS	1471	3-11-87	9:14a	TESTRNG2 STA	11	3-05-87	11:11a
TESTRNG2 K01	113382	3-11-87	10:00a	TESTRNG2 STL	70	3-05-87	11:11a
TESTRNG2 K02	127682	3-11-87	10:01a				
13 File(s)				76800 bytes free			

C:\images3d>ddir a:

Volume in drive A is LTHDFEM7
Directory of A:\

TESTRNG2 K03	128316	3-11-87	10:01a	TESTRNG2 K04	128730	3-11-87	10:02a
2 File(s)				104448 bytes free			

C:\images3d>ddir a:

Volume in drive A is LTHDFEM8
Directory of A:\

TESTRNG2 BLK	114	3-11-87	9:53a	TESTRNG2 K05	128608	3-11-87	10:03a
TESTRNG2 DIS	31586	3-11-87	11:14a	TESTRNG2 K06	53566	3-11-87	10:03a
TESTRNG2 DOF	2552	3-11-87	9:53a	TESTRNG2 DVF	7	3-11-87	9:53a
TESTRNG2 DXX	70	3-11-87	8:49a	TESTRNG2 RNL	3880	3-11-87	11:14a
TESTRNG2 FEF	6	3-11-87	11:14a	TESTRNG2 SXX	9177	3-11-87	8:49a
10 File(s)				126976 bytes free			

C:\images3d>

\images3d>ddir a:

Volume in drive A is LTHDHUB1

Directory of A:\

LTHDHUB	BLK	222	2-25-87	8:57a	3	LTHDHUB	K01	91924	2-25-87	9:10a
LTHDHUB	DES	60	2-25-87	7:16a	3	LTHDHUB	LOD	17678	2-25-87	7:41a
LTHDHUB	DIA	3324	2-25-87	8:55a	3	LTHDHUB	NRM	25	2-25-87	9:17a
LTHDHUB	DIS	88115	2-25-87	9:47a	3	LTHDHUB	OVF	7	2-25-87	8:57a
LTHDHUB	DOF	3552	2-25-87	8:57a	3	LTHDHUB	RAN	11656	2-25-87	8:55a
LTHDHUB	DSC	70	2-25-87	7:16a	3	LTHDHUB	SEQ	14125	2-25-87	7:16a
LTHDHUB	DXX	70	2-25-87	7:12a	3	LTHDHUB	STA	11	2-25-87	7:42a
LTHDHUB	GEO	11656	2-25-87	7:16a	3	LTHDHUB	STL	132	2-25-87	7:42a
LTHDHUB	IS	2045	2-25-87	7:27a	3	LTHDHUB	SXX	13944	2-25-87	7:12a

18 File(s) 91136 bytes free

Volume in drive A is LTHDHUB2

Directory of A:\

LTHDHUB	K02	127006	2-25-87	9:10a	3	LTHDHUB	K03	125966	2-25-87	9:11a
---------	-----	--------	---------	-------	---	---------	-----	--------	---------	-------

2 File(s) 107520 bytes free

Volume in drive A is LTHDHUB3

Directory of A:\

LTHDHUB	K04	126876	2-25-87	9:12a	3	LTHDHUB	K05	126966	2-25-87	9:13a
---------	-----	--------	---------	-------	---	---------	-----	--------	---------	-------

2 File(s) 108544 bytes free

Volume in drive A is LTHDHUB4

Directory of A:\

LTHDHUB	K06	125894	2-25-87	9:13a	3	LTHDHUB	K07	126616	2-25-87	9:14a
---------	-----	--------	---------	-------	---	---------	-----	--------	---------	-------

2 File(s) 109568 bytes free

Volume in drive A is LTHDHUB5

Directory of A:\

LTHDHUB	K08	125666	2-25-87	9:15a	3	LTHDHUB	K09	126918	2-25-87	9:16a
---------	-----	--------	---------	-------	---	---------	-----	--------	---------	-------

2 File(s) 109568 bytes free

Volume in drive A is LTHDHUB6

Directory of A:\

LTHDHUB	FEF	12	2-25-87	9:47a	3	LTHDHUB	K12	32806	2-25-87	9:17a
LTHDHUB	K10	126942	2-25-87	9:16a	3	LTHDHUB	RNL	16480	2-25-87	9:47a
LTHDHUB	K11	123334	2-25-87	9:17a	3					

5 File(s) 59392 bytes free

C:\images3d>

PART NUMBERS: 12585781-001, -002, -003, -004, Collar Machining
12586036-001, Collar Forging

DESCRIPTION: COLLARS

STATUS:

Dimensions and tolerances for the collar machining (TDP, Dwgs. 12585781-001, -002, -003, -004, -005) and forging drawings (TDP, Dwg. 12586036-001) have been determined and are supported by extensive analysis. Analysis indicates that acceptable factors of safety are obtained for various worst-case conditions with Ti6AL4V used for the rear collar set and 6061 Al/20 v/o SiCp for the remaining collars. The collars have several worst-case load conditions which were analyzed separately: rifling torque, thermal stress, recoil thrust and barrel expansion. A complete summary of analysis results and the supporting calculations are found in the following pages of this section.

AUTHORS: Joe Fishbein, Joe Turek, Scott Dacko

COLLARS

=====

The collars attaching the rails to the barrel have several loading conditions, which were analyzed separately.

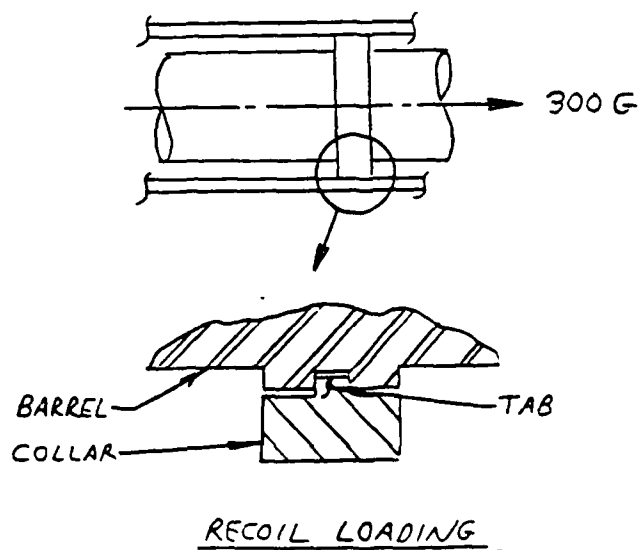
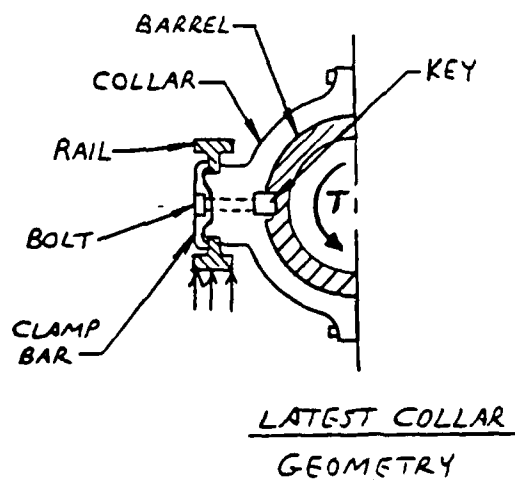
1) Rifling Torque -- This load is carried from the barrel to the manifolds through the collar ends in shear. Keys were used at the barrel/collar and collar/rail connections. A Finite Element model of a section through the collar end was made to evaluate these stresses. Since this analysis was performed, the collar end geometry has changed significantly. New analysis has not been performed, but the critical areas that were examined in the original geometry have been eliminated with the new geometry.

2) Thermal Stress -- The collars were analyzed for hoop stress due to thermal loads. The extreme condition is a 400-deg. F. barrel temperature, and a -25-deg. F. ambient temperature. Resulting stresses are 33,117 PSI for the AlSiC collars, and 58,104 PSI for the steel collar. This is an extremely conservative analysis, as it neglects the air space between the barrel and collars.

3) Recoil Thrust -- under firing conditions, the barrel will recoil with a maximum acceleration of 300 G. The inertia of the collar/rail assembly, weighing 368 lb., is resisted by internal tabs on the breech end collar that engage a slot on the barrel. Shear and bending stresses in these tabs are low (9,200 PSI and 14,490 PSI, respectively).

4) Barrel Expansion -- The steel collar and barrel were analyzed as concentric cylinders under 62,900 PSI internal pressure, similar to the analysis of the muzzle brake. Maximum hoop stress in the collar is 39,194 PSI (FS=3.06).

The AlSiC collars contact the barrel only at the keys. They were analyzed as a ring with forced outward displacements at opposite points. A simple FEM was used, and the resulting stresses were low (1,778 PSI tensile, 5,634 PSI bending).



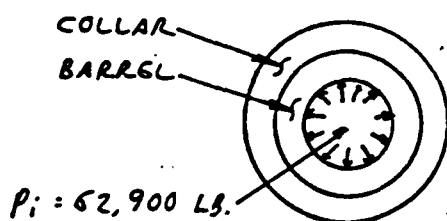
LTHD LOAD SUMMARY
GMAF 2/16/87 1 OF 1

SUMMARY OF LOADS USED IN ANALYSIS

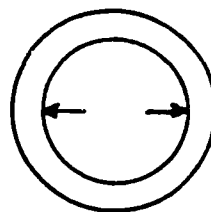
A. COLLARS

1. RIFLING TORQUE - 48,000 FT-LB.
2. THERMAL STRESS - INSIDE TEMPERATURE = +400°F
OUTSIDE " " = -25°F
3. RECOIL THRUST - 300 G ACCELERATION, RESISTED
BY WEIGHT OF COLLAR/RAIL
ASSEMBLY (358 LB.)
4. BARREL EXPANSION - BARREL INTERNAL PRESSURE = 62,900 LB.

STEEL COLLAR ANALYZED AS CONCENTRIC
CYLINDERS. AISI COLLARS ANALYZED AS
RING WITH POINT RADIAL LOADS AT
KEYS.



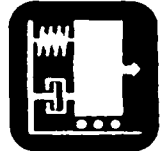
STEEL COLLAR



AISI COLLAR

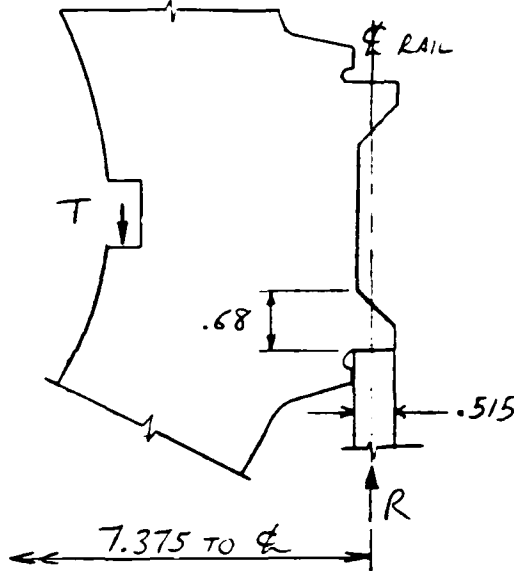
ANALYZED AS ENFORCED
DISPLACEMENT, WITH
 Δ DETERMINED BY
EXPANSION OF BARREL
ONLY.

Subject LTHD	Analyst <i>JMF</i>	
	Project Number	
	EC. No.	Date 2208-



RE-CHECK COLLARS

A. RIFLING TORQUE



$$T_{max} = 48,000 \text{ ft. lb}$$

$$R = \frac{(48,000)(12)}{2(7.375)} = 39051 \text{ lb}$$

$$\text{CONTACT AREA} = (4.00 \text{ in})(.515 \text{ in}) = 2.06 \text{ in}^2$$

$$\bar{\sigma}_{avg} = \frac{39051 \text{ lb}}{2.06 \text{ in}^2} = 18,957 \text{ psi}$$

MATERIAL	$\bar{\sigma}_y$ (ksi)	FS
4340 STEEL	120	6.33
TITANIUM	120	6.35
6061-AL/200% S.C.	60	3.17

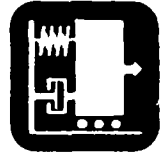
SHELL ACROSS PROTECTION

$$A = (.68)(4.00 \text{ in}) = 2.72 \text{ in}^2$$

$$\tau = \frac{39051 \text{ lb}}{2.72 \text{ in}^2} = 14360 \text{ psi} \rightarrow$$

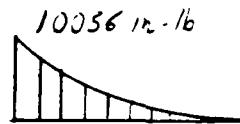
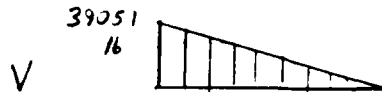
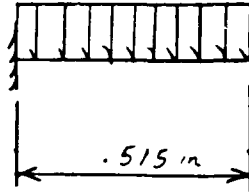
MAT'L	.5853 (ksi)	FS
4340	69.6	4.85
Ti	69.6	4.85
ALSiC	34.8	2.42

Subject LTHD	Analyst JMZ	
	Project Number	
	EC. No.	Date 2-20-87

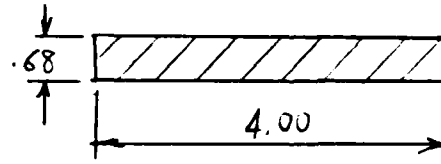


BENDING ON PROTECTION

$w = 75827 \text{ lb/in}$



SECTION

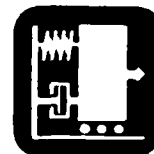


$A = 2.72 \text{ in}^2$
 $I = .1048 \text{ in}^4$
 $S = .3083 \text{ in}^3$

$\sigma_b = \frac{10056 \text{ in-lb}}{.3083 \text{ in}^3} = 32621 \text{ psi}$

MAT'L	σ_y	FS
4340	120	3.68
Ti	120	3.68
A/S.C	60	1.84

Subject LTHD	Analyst 207	
	Project Number	
	EC. No.	Date 2-20-87



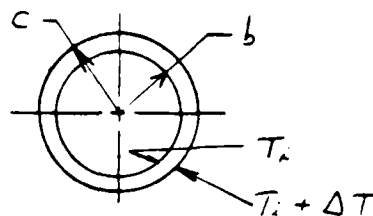
B. THERMAL STRESS (REF: DACK, 5th ed, p. 525)

MAXIMUM $\Delta T = -100^\circ F$ (PER S. DACKO, 2/2/87)

FOR 1st COIL

$b = 5.88$ in. A.S. W.

$c = 6.57$ in.



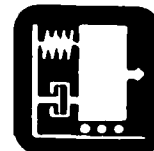
$$\text{OUTER } \sigma_T = \frac{\Delta T \alpha E}{2(1-\nu) \ln(c/b)} \left(1 - \frac{2b^2}{c^2 - b^2} \ln \frac{c}{b} \right)$$

$$\text{INNER } \sigma_T = \frac{-\Delta T \alpha E}{2(1-\nu) \ln(c/b)} \left(1 - \frac{2c^2}{c^2 - b^2} \ln \frac{c}{b} \right)$$

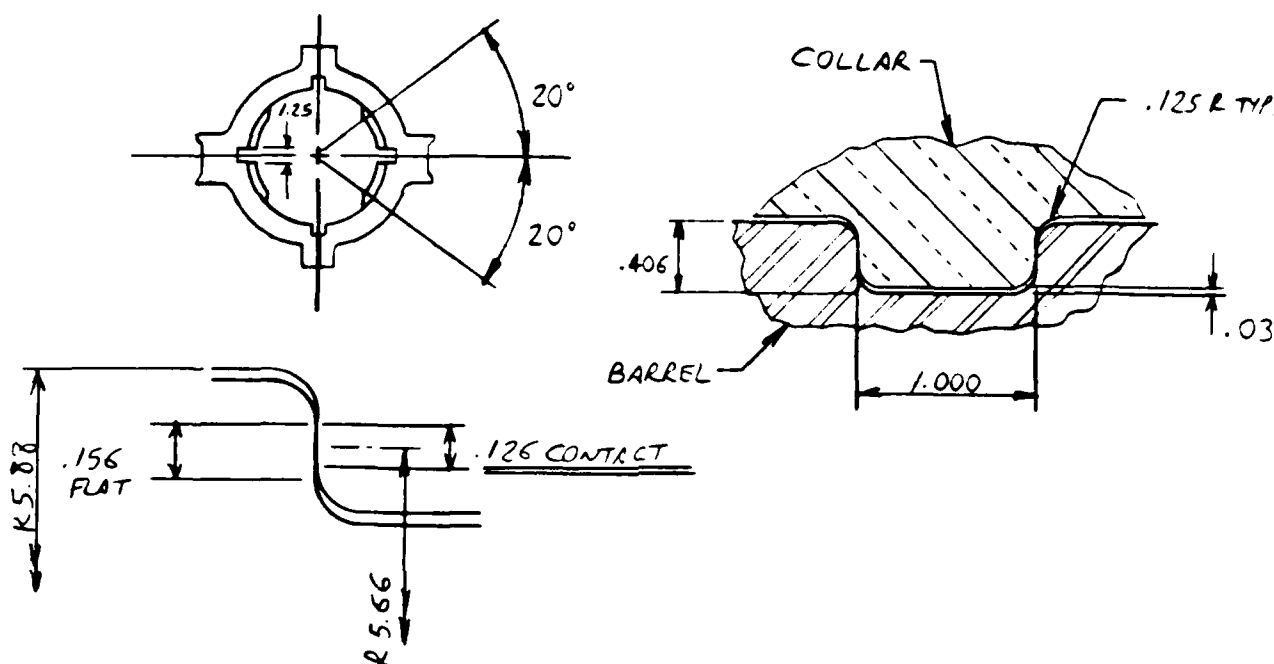
MAT'L	E	α	ν
4340 T&C	29×10^6 psi	$6.6 \times 10^{-6} / ^\circ F$	.3
TITANIUM	16×10^6 psi	$5.0 \times 10^{-6} / ^\circ F$	.31
ALSiC	15×10^6 psi	$9.0 \times 10^{-6} / ^\circ F$	.3

MAT'L	OUTER σ_T	INNER σ_T	FS
4340	-13152	-14190	8.46
Ti6Al4V	-5577	-6017	19.94
GOGIAl 20V/05 Cp	-9277	-10009	5.99

Subject LTHD	Analyst J177	
	Project Number	
	EC No	Date 2-23-77



C. RECOIL THRUST



$$LENGTH \text{ TAB} = 2\pi(5.66 \text{ in}) \left(\frac{80^\circ}{360^\circ} \right) - 2(1.25) = 5.4035 \text{ in}$$

$$CONTACT \text{ AREA} = (5.4035 \text{ in})(.126) = .681 \text{ in}^2$$

$$MAX. \text{ BARREL ACCELERATION} = 438 G \text{ (105\% PIMP)} - \text{PER S. DRCLD 2/25/87}$$

USE ORIGINAL WEIGHT (368 lb) FOR COLLAR/RAIL ASS'Y.

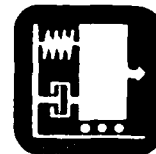
$$P_{max} = (368 \text{ lb})(438 G) = 161,184 \text{ lb}$$

$$\bar{T}_{brg} = \frac{161,184 \text{ lb}}{.681 \text{ in}^2} = 236,690 \text{ psi} \quad \underline{FS = 0.51}$$

CONSIDER MAKING TABS CONTINUOUS AROUND COLLAR

Sheet ___ Of ___

Subject LTHD	Analyst JTF	
	Project Number	
	EC No	Date 7-23-87



CONTINUOUS TABS

$$L = 2\pi(5.66 \text{ in}) - 2(1.25) - 2(.75) = 31.56 \text{ in}$$

$$A_c = (31.56)(.126) = 3.9769 \text{ in}^2$$

$$\bar{\sigma}_{brg} = \frac{161,184 \text{ lb}}{3.9769 \text{ in}^2} = 40,530 \text{ psi} \quad FS = 2.96$$

MINIMUM ANGLE FOR FS = 2.00

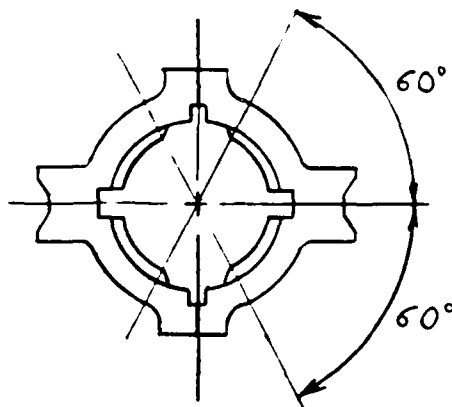
$$\bar{\sigma}_{brg} = \frac{120,000 \text{ psi}}{2} = 60,000 \text{ psi}$$

$$A_c = \frac{161,184 \text{ lb}}{60,000 \text{ psi}} = 2.6864 \text{ in}^2$$

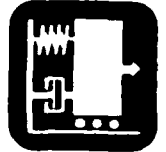
$$L = A_c / .126 \text{ in} = 21.32 \text{ in} = 2\pi(5.66)\alpha - 2(1.25)$$

$$\alpha = .6698 \Rightarrow 241^\circ$$

MINIMUM TAB ANGLE = $\pm 60^\circ$

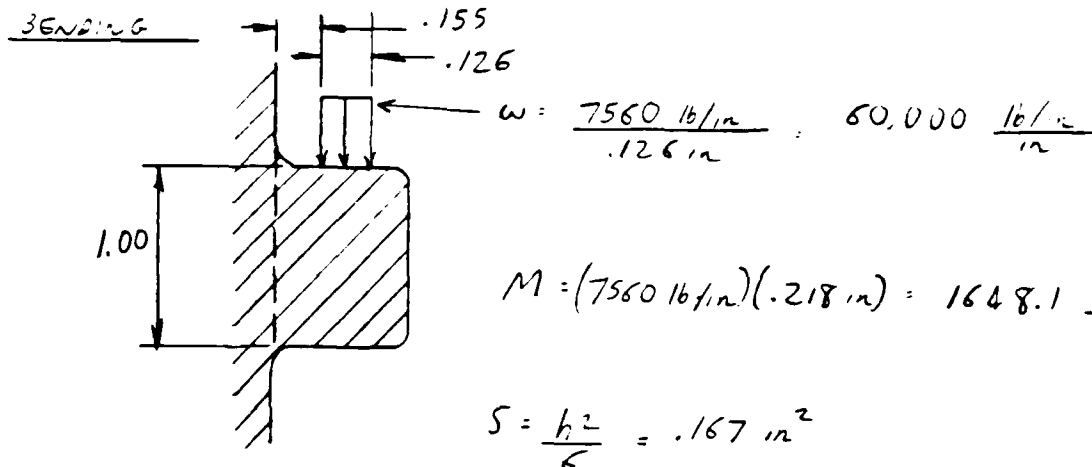


Subject LTHD	Analyst JMF	
	Project Number	
	EC No	Date 223 87



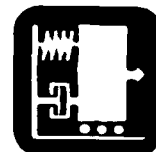
UNIT LOAD ON TAB : $\frac{161,184 \text{ lb}}{21.32 \text{ in}} = 7560 \text{ lb/in}$

SHCAR $\gamma = \frac{7560 \text{ lb/in}}{1.00 \text{ in}} = 7560 \text{ psi}$ $FS = \frac{(.58)(120000)}{7560} = 9.2$



$\sigma_b = M/S = 9888 \text{ psi}$ $FS = 12.14$

Subject LTHD	Analyst JMF	
	Project Number	
	EC No	Date 2 23 87



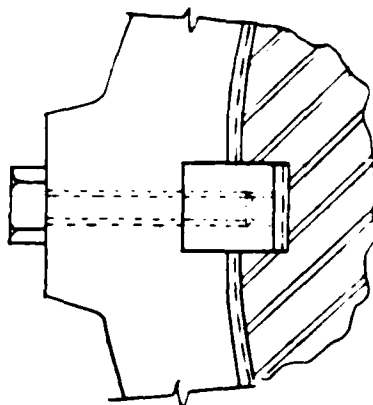
D. BARREL EXPANSION

BARREL EXPANSION ONLY: (REFER TO 32-1)

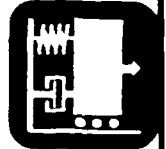
$$\begin{aligned} a &= 5.443 \\ b &= 3.050 \\ \mu &= 62,900 \text{ psi} \\ E &= 29 \times 10^6 \text{ psi} \end{aligned}$$

$$\Delta a = \frac{\mu}{E} \frac{2ab^2}{a^2 - b^2} = .0106 \text{ in}$$

THIS IS LESS THAN KEY CLEARANCE, SO COLLARS WILL SEE NO STRESS DUE TO BARREL EXPANSION



Subject LTHD	Analyst <i>QMF</i>	
	Project Number	
	EC. No.	Date 1-14-87

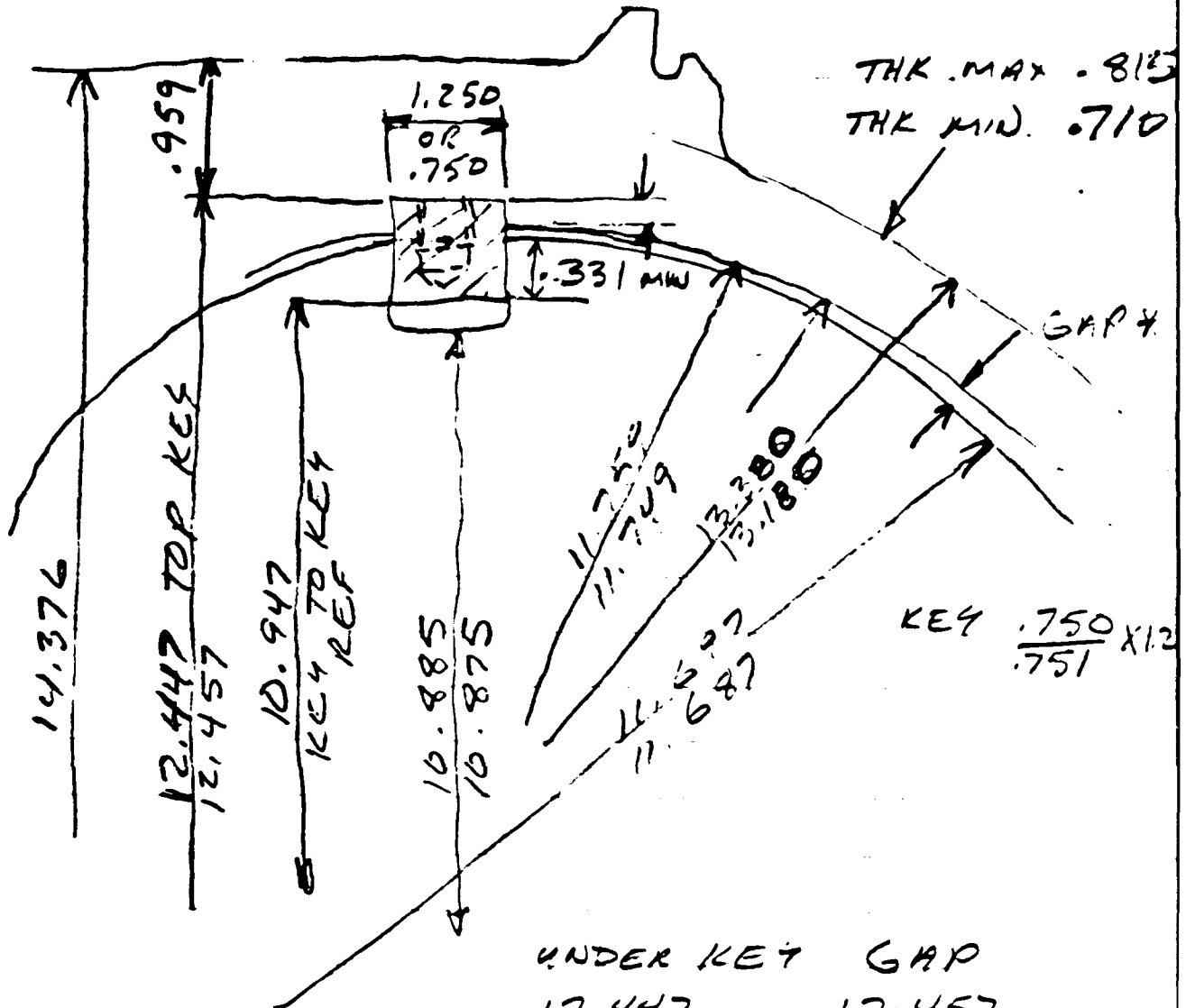


BARREL COLLAR "A" (CONTINUED)

LOADING	MAX. STRESS (PSI)	YIELDING FACTOR OF SAFETY
0) RIFLING TORQUE <u>ASSUMPTIONS:</u> - COLLAR "A" CARRIES ENTIRE TORQUE LOAD - KEYS TRANSFER ENTIRE LOAD BETWEEN COLLAR & RAIL - REACTION AT KEY SLOT AT CORNER ONLY MAXIMUM PRINCIPAL STRESS: A -55,870 B 25,480		

TIT A & TASC.

CLAMP Dim. 12



CENTER OF KEY
11.697

UNDER KEY GAP	
12.447	12.457
- 10.885	- 10.875
<u>1.562</u>	<u>1.582</u>
- 1.502	- 1.500
<u>.060</u>	<u>.082</u>
$\frac{.060}{2} = .030$	$\frac{.082}{2} = .041$
MIN	MAX

* GAP 11.749
- 11.697

.052 ÷ 2 = .026 MIN

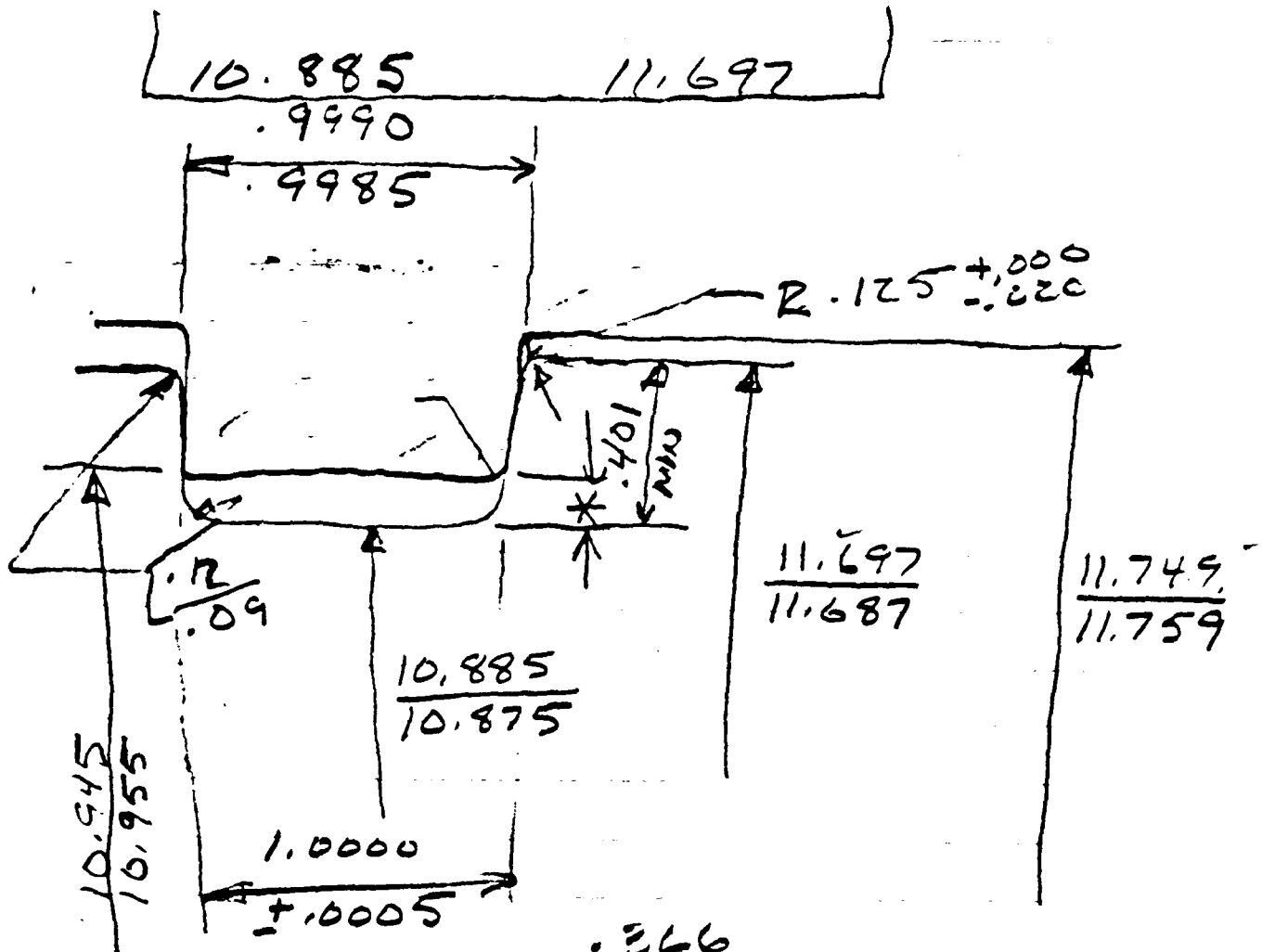
11.759
- 11.687

.072 ÷ 2 = .036 MAX

(A)

3/12/87
CO

13



$$\begin{array}{r} * 10.495 \\ - 10.875 \\ \hline .120 \end{array}$$

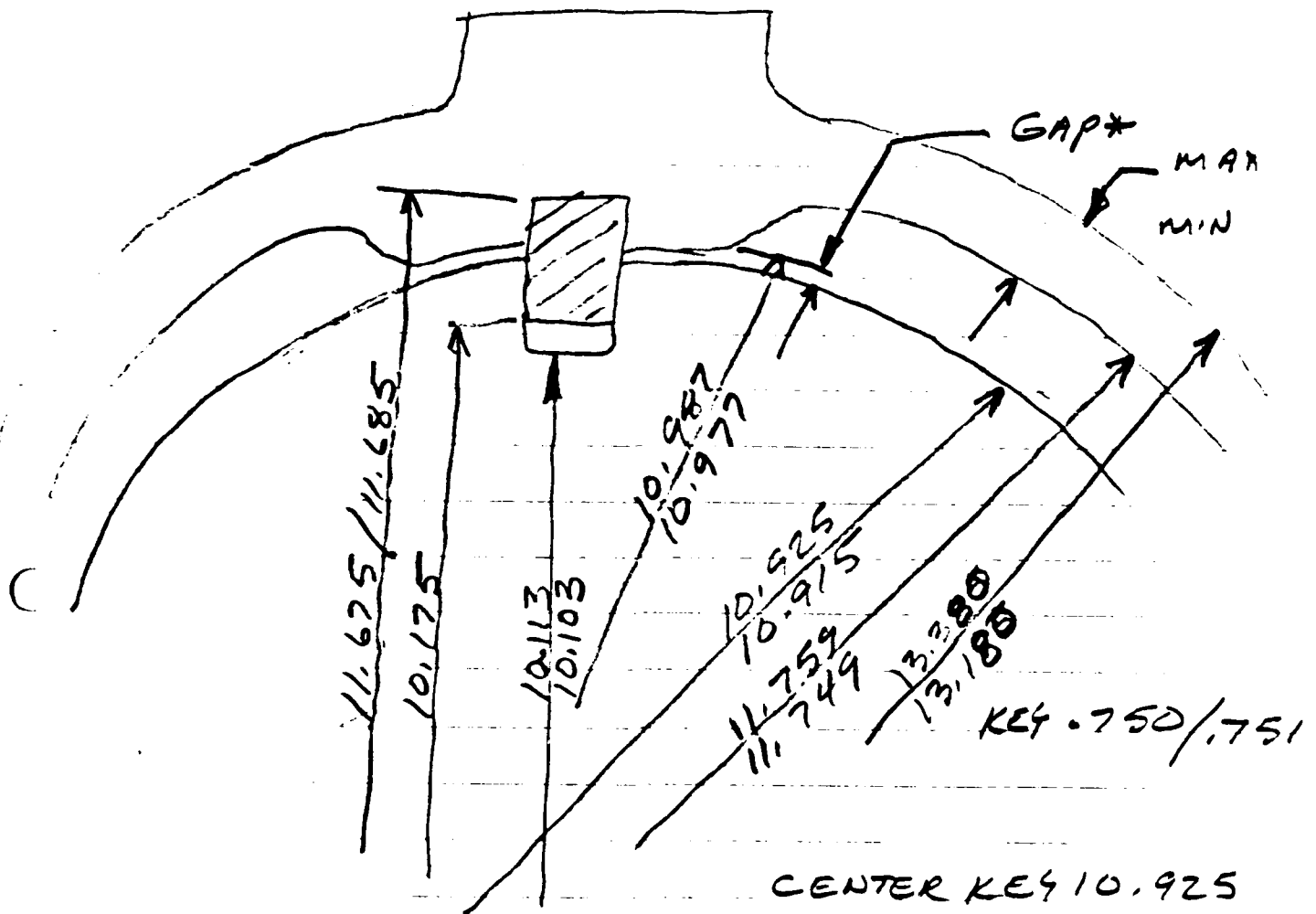
$$\begin{array}{r} 10.445 \\ 10.885 \\ \hline .060 \end{array}$$

MIN .9995
MAX 1.0005

GAP MAX .060
MIN .030 PER SIDE

C

14

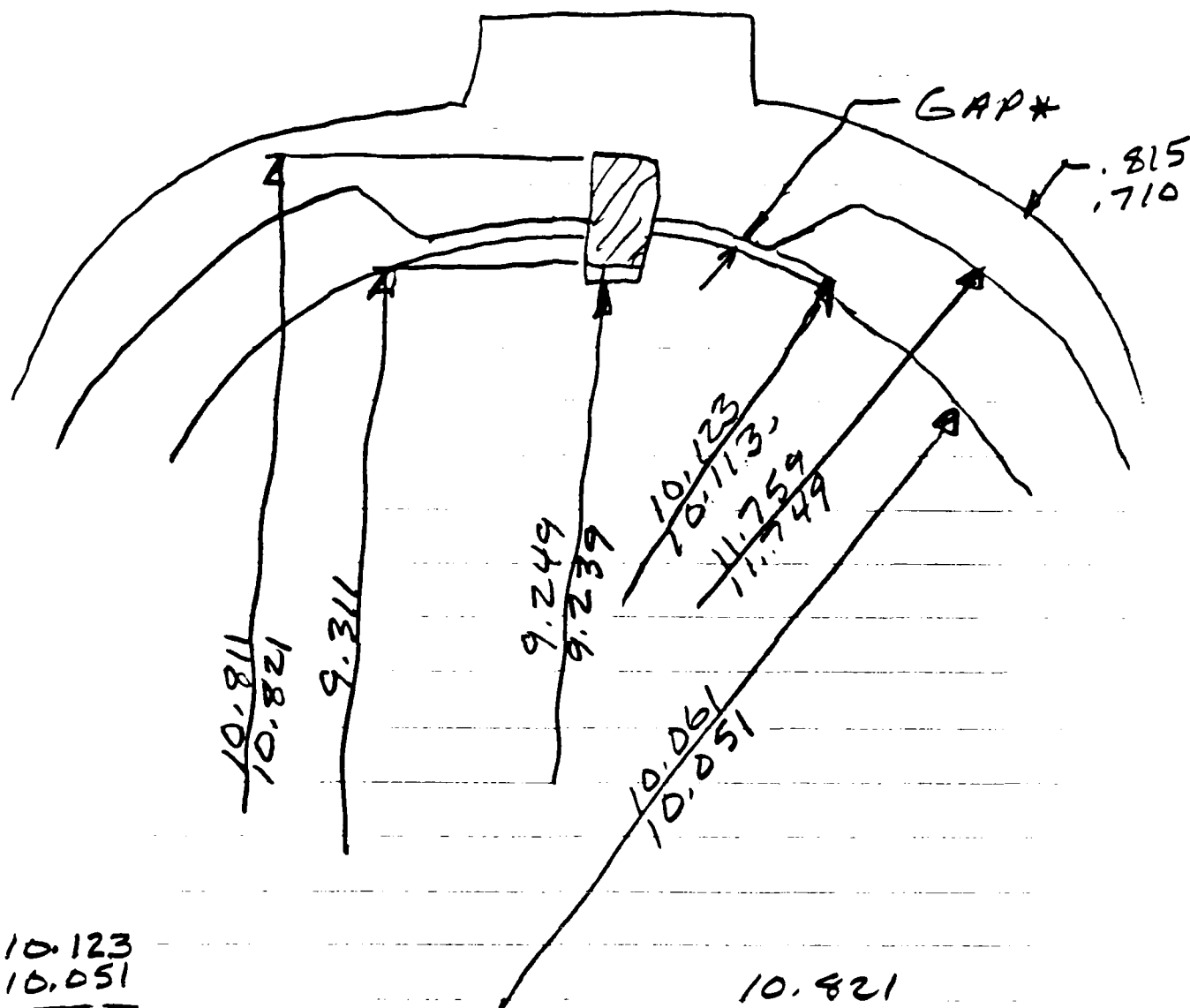


11.685	UNDER	11.675
10.103	KEY	- 10.113
1.582		1.562
- 1.500	GAP	- 1.502
		.060 ÷ 2 = MIN .030
.082 ÷ 2 = MAX .041		

* GAP 10.987	10.977
- 10.915	- 10.925
.072 ÷ 2 = .036 MAX	.052 ÷ 2 = .026

D

15



$$\begin{array}{r} 10.123 \\ 10.051 \\ \hline \end{array}$$

$$.072 \div 2 = .036 *$$

$$\begin{array}{r} 10.113 \\ 10.061 \\ \hline \end{array}$$

$$.052 \div 2 = .026 *$$

$$\begin{array}{r} 10.821 \\ - 9.239 \\ \hline \end{array}$$

$$\begin{array}{r} 1.582 \\ - 1.500 \\ \hline \end{array}$$

UNDER KEY

$$82 \div 2 = .041 \text{ MAX}$$

$$10.811$$

$$\begin{array}{r} - 9.249 \\ \hline \end{array}$$

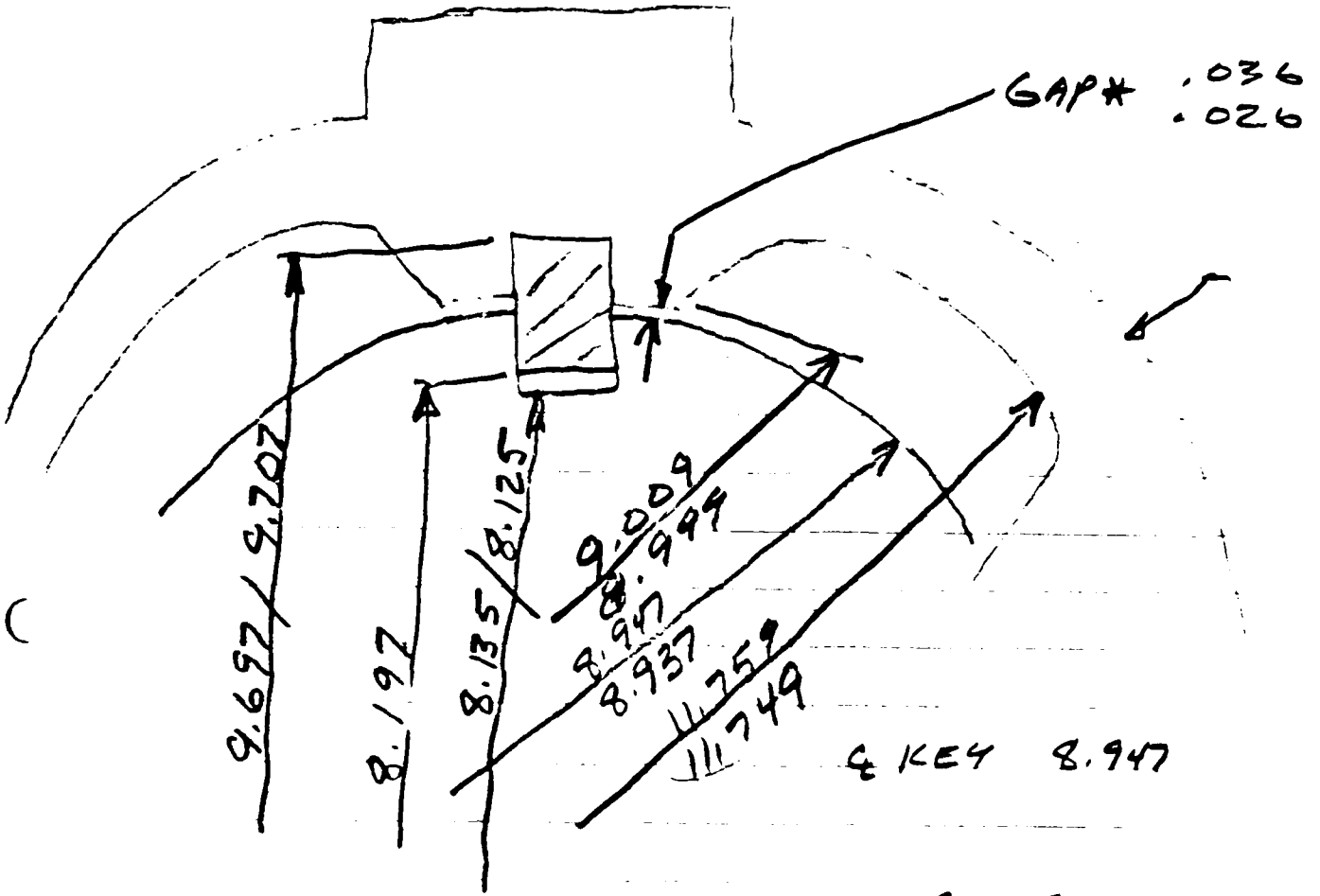
PER SIDE

$$\begin{array}{r} 1.562 \\ - 1.502 \\ \hline \end{array}$$

$$60 \div 2 = .030 \text{ MIN}$$

E

16



$$\begin{array}{r}
 9.707 \\
 8.125 \\
 \hline
 1.582 \\
 - 1.500 \\
 \hline
 .082 \div 2 = .041
 \end{array}$$

$$\begin{array}{r}
 9.697 \\
 - 8.135 \\
 \hline
 1.562 \\
 - 1.502 \\
 \hline
 .060 \div 2 = .030
 \end{array}$$

$$\begin{array}{r}
 9.009 \\
 - 8.937 \\
 \hline
 .072 \div 2 = .036
 \end{array}$$

$$\begin{array}{r}
 8.999 \\
 - 8.947 \\
 \hline
 .052 \div 2 = .026
 \end{array}$$

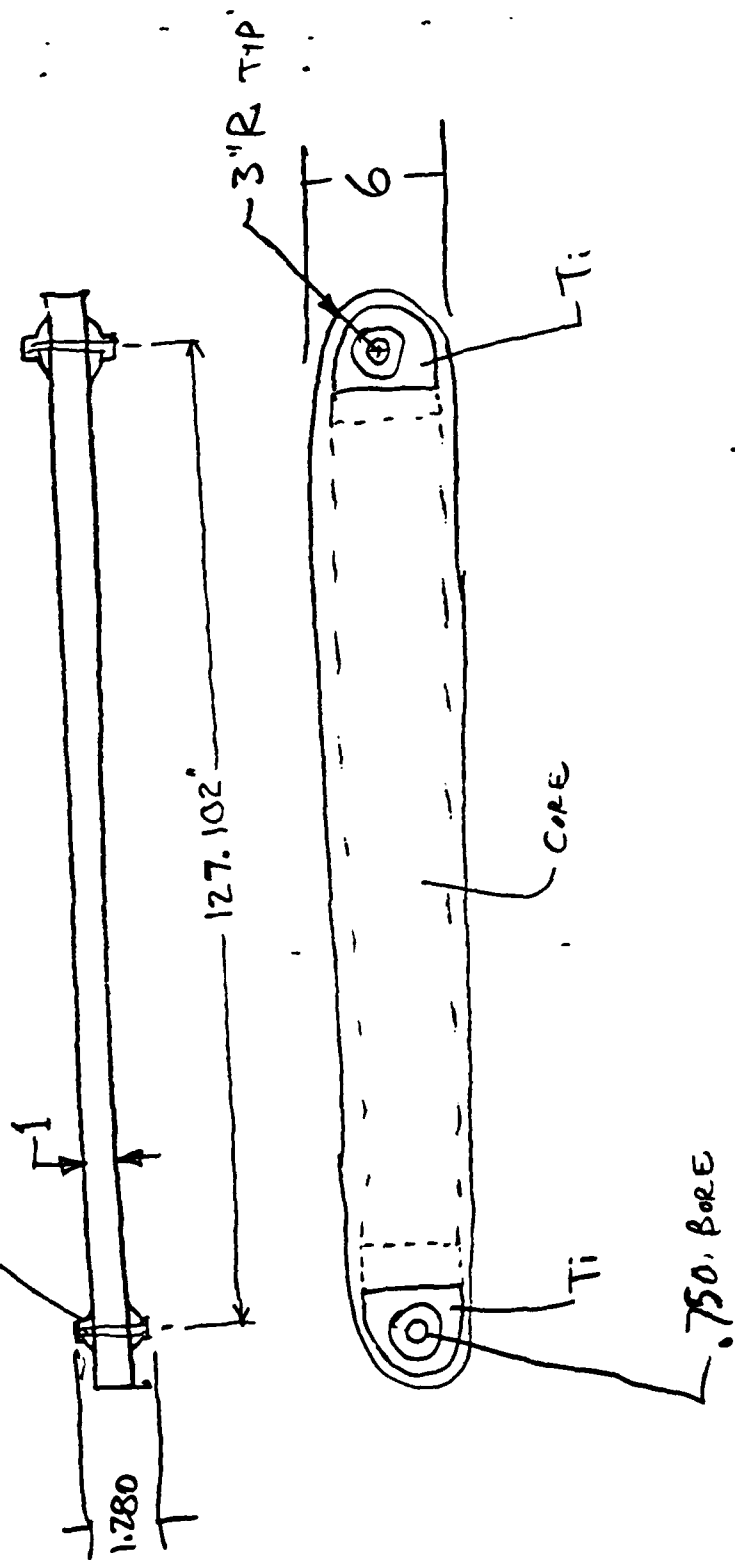
DESCRIPTION: EQUILIBRATION LINK ASSEMBLY

STATUS:

The equilibration link assembly was changed from a cable and pulley configuration to a rigid composite link configuration because of space problems caused by the large pulleys required for the cable. The sketches on the enclosed pages describe the current configuration.

AUTHOR: BART ANDERSON

FARNIR WSBS, ATC50Z (WT=.42)



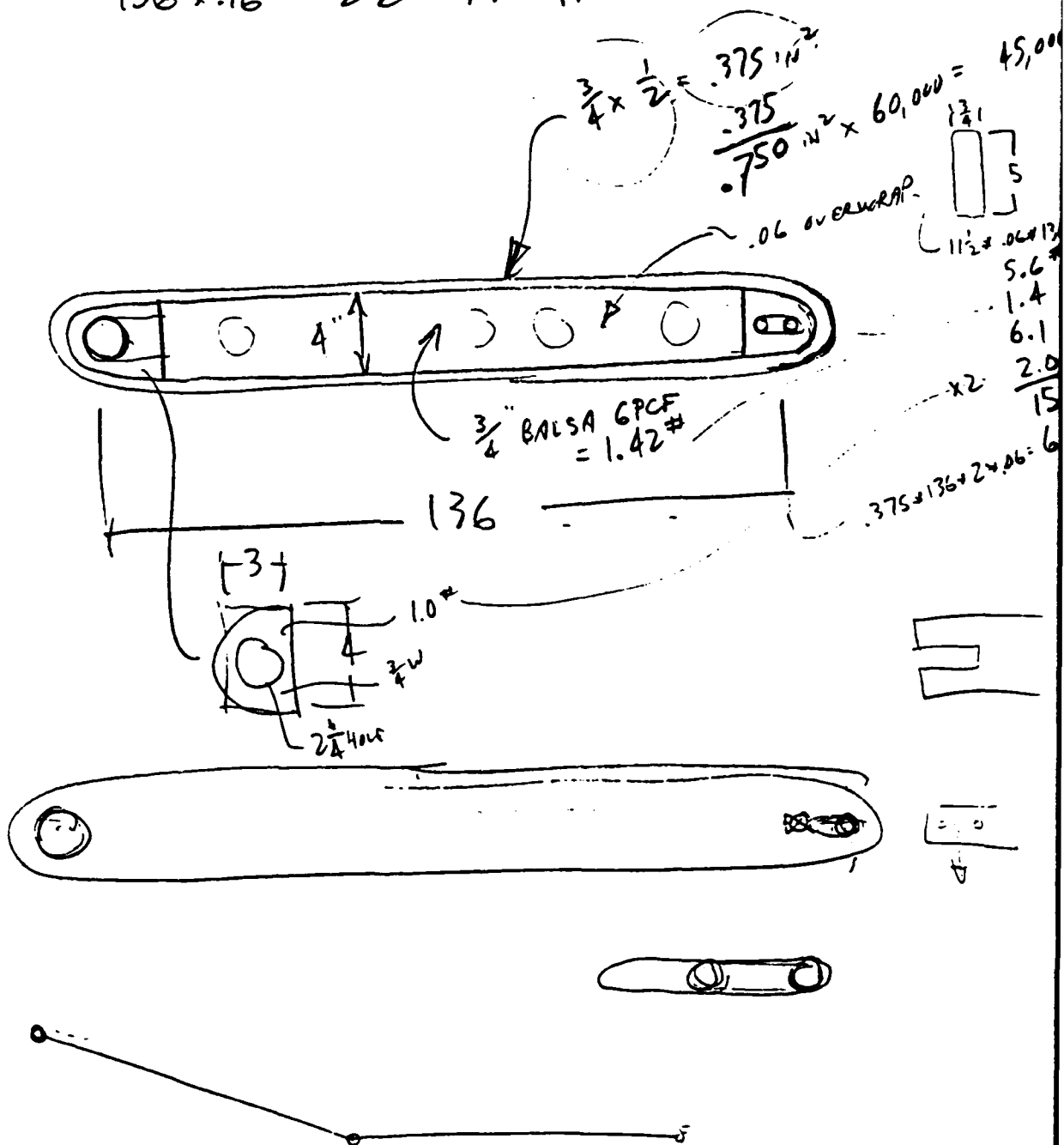
Est WT = 16 #

DESIGN LOAD IN TENSION = 50,000 LBS

$$50,000 \text{ PSI} = 1 \text{ IN}^2 \text{ FOR } 50,000 \text{ LBF}$$

$$136 \times .06 = 8\# \text{ CFE}$$

$$136 \times .16 = 22\# \text{ FOR T:}$$

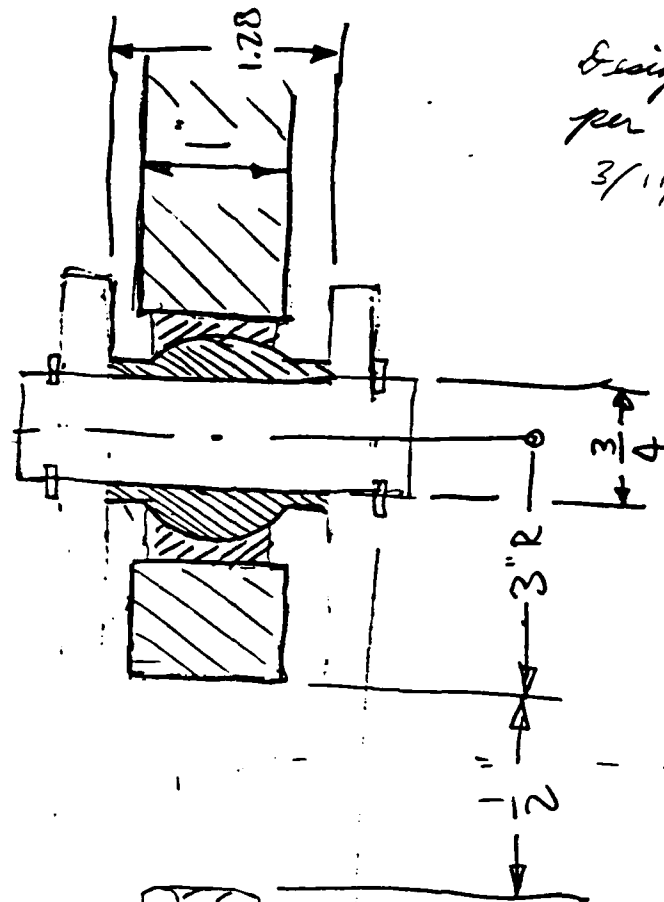
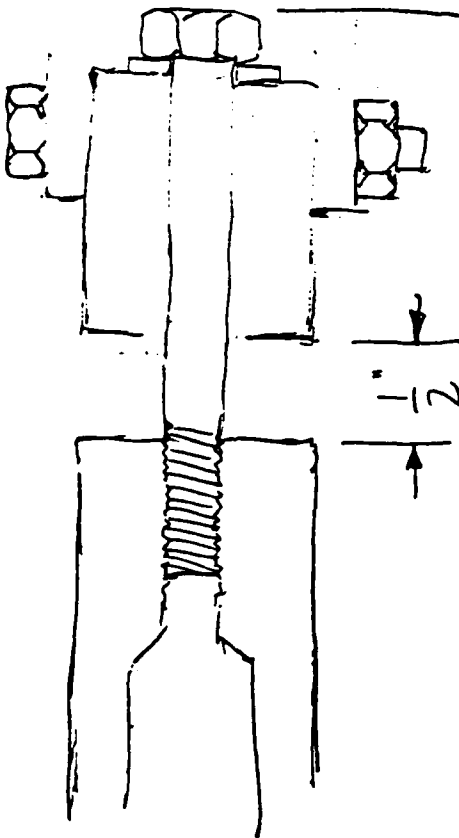


YORK (04-306)

FAFNR WSBS 24ATC50Z

$\frac{3}{4}$ Bore
WIDTH = 1.28

END OF EQUILIBRATION
ACTUATOR ROD



Design by York
per Burt a.
3/11/87

- Spherical type**
Operating temperature range - 85°F to +250°F
 (-53.9°C to 121°C)
Low wear
Material

Outer ring: 416 stainless steel Rc 28 min. AMS 5613
Inner ring: 440C stainless steel Rc 58 min. AMS 5630.
Liner: Nomex - Teflon fabric



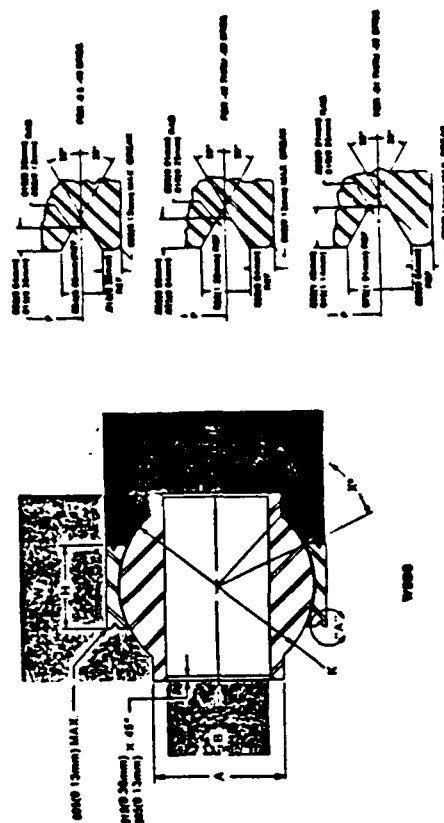
DIMENSIONS • TOLERANCES

[illegible]

FAFNIR

LOAD RATINGS

Seating Number	Outstanding Nodes	Lead Rating	Radial		Torsion		No Load		Weighted Average
			Limit	Rating	Limit	Rating	Reaction Torque	Def./in	
		Def./in	Def./in	Def./in	Def./in	Def./in	Def./in	Def./in	
W8888ATC312	3783 17000		3325 23800		640 1980		1-5 11-50	0.15 0.10	
W8888ATC24Z	4365 19300		5545 29000		550 2150		1-5 11-50	0.14 0.16	
W88816ATC32Z	4365 19300		5545 29000		550 2150		1-5 11-50	0.15 0.14	
W88812ATC32Z	7430 33500		17500 54000		1350 8000		1-5 11-50	0.17 0.27	
W88812ATC29-3Z	8635 30000		11180 50000		1250 5600		1-5 11-50	0.18 0.27	
W88816ATC32Z	8794 40000		14120 73500		2110 8300		1-5 11-50	0.11 0.20	
W88828ATC44Z	18086 85000		34880 173000		7500 33500		1-5 11-50	0.15 0.13	
W88816ATC39-3Z	24230 106000		43118 236000		12750 54000		1-5 11-50	0.16 0.24	
W88824ATC30F	22149 98000		40600 200000		10000 40000		1-5 11-50	0.18 0.19	
W88832ATC48Z	38040 180000		69100 360000		15000 11700		2-6 23-68	0.16 0.20	



PART NUMBER: 12585710-400, Fire Control and Optics

DESCRIPTION: FIRE CONTROL TRUNNION AND LINKAGE

Major components to be discussed include: actuator strut, side support struts, top support struts, bell crank, end caps, trunnion tube, torque beam and arm, X-brace and direct fire scope. Major areas of analysis include: design load determinations, linkage adjustability and alignment requirements. A summary of calculated design loads including damage tolerance loads is found in the following pages of this section.

Overview. A four-bar, parallelogram linkage design was developed to allow the QE at the cradle trunnion to be matched at a secondary, fire control trunnion. By maintaining a length delta between both sets of parallel links of less than .001 inch, alignment error between trunnions will not exceed 0.24 mils, as indicated in the Alignment Error vs. Quadrant Elevation graph in Figure D/130-1. Furthermore, to achieve the required alignment and allow easy assembly and maintainability, adjustability is designed into the actuator strut and bell crank.

Struts. All fire control struts are fiber-wrapped graphite epoxy with titanium end-pieces. Graphite-epoxy was chosen as a common strut material because of its very low coefficient of thermal expansion. This eliminates the introduction of alignment error due to temperature-induced changes in strut lengths. The actuator strut has pre-loaded Fafnir bearing rod ends threaded into the Ti end-pieces to provide strut length adjustability. Locking nuts hold the rod ends in place. The side and top support struts are similar in construction, the exception being that only the strut ends attaching to the gimbal use Fafnir bearings. The strut ends at the fire control trunnion house Kaydon bearings, which in turn house the fire control trunnion endcaps. The side support struts provide the mounting surfaces for the tube lay controls, which are mounted on the outer sides of these struts and approximately midway up.

Bell crank. Length adjustability is also required in this part to .001 inch from the fire control trunnion tube centerline to the point of actuator strut attachment. The layouts describe the adjustment method. Material is also GrEp to resist temperature-induced length changes.

End caps. Aluminum or Al/SiC end caps provide precision mounting surfaces for the pre-loaded Kaydon bearings housed in the top and side support struts. The end-caps are adhesively bonded to the trunnion tube at assembly with a tie-rod-like fixture that pushes and aligns the two end-caps on the trunnion tube. The adhesive is relied upon to prevent galvanic corrosion problems. The direct fire equipment mounts on the face of the right end cap and the indirect fire equipment mounts on the face of the left end cap. End cap hole patterns are identical to those found on the

M198 left and right trunnions. Although hole pattern dimensions are dimensioned as if the left and right end caps are mirror images, the dimensions are such that the end caps can be considered identical.

Trunnion tube. The trunnion tube is of fiberglass or fiber-wound graphite epoxy construction. The not-yet-finalized wall thickness is to be sized for the identified damage tolerant load conditions.

Torque beam and arm. Construction of both the torque beam and arm is similar to that of the other struts. The structure must be capable of transmitting the 2000 lb load from the indirect fire scope shock absorber to the gimbal.

X-brace. A X-brace configuration between the two top support struts is required to maintain sideways stability. Load cases determining the X-brace shape are primarily damage tolerant and not related to firing loads.

Direct-fire scope. A modified M198 direct fire or elbow telescope (TDP, Dwg. 12585970) is used with the LTHD. The current fire control trunnion height dictates that the look in-look out distance of this scope be a minimum of 6.125 inches. The current fire control trunnion distance from the gimbal suggests that the scope would be easier for the assistant gunner to use if the eye piece were angled 30 degrees further from the current 90-degree bend. For a further discussion, see the direct fire scope trade study presented in the trade study section of this report.

STATUS:

Layouts of the fire control trunnion and linkage design were created. The 1/12 scale layouts of this design that were provided to a model shop can be found in the TDP, Dwg. No. 12585710-400. Better sizing of some components is still required.

AUTHORS: Scott Dacko, Ron Larson, Bart Anderson

FIRE CONTROL ALIGNMENT ERROR VS Q.E. CHG IN ANGLE BETW TRUNNION & FC TRUNNION

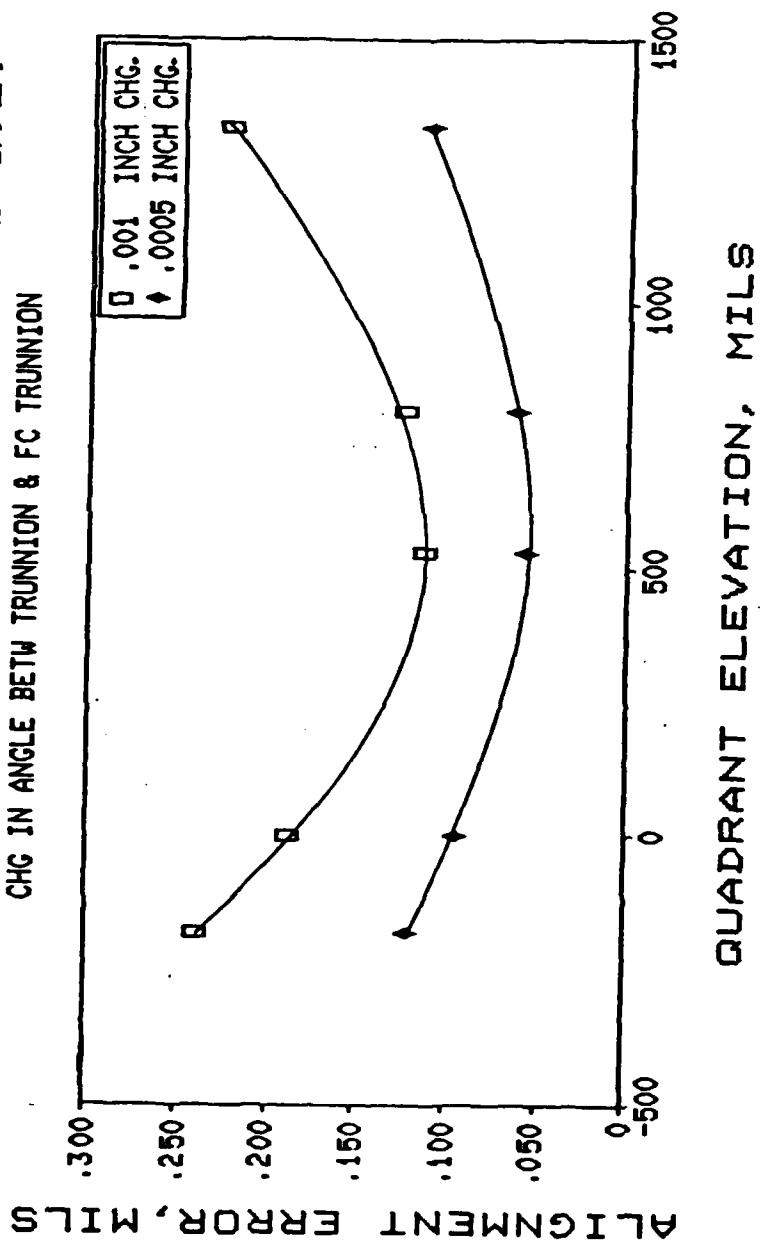


FIGURE D/130-1.

S. DACKO - 2/10/87

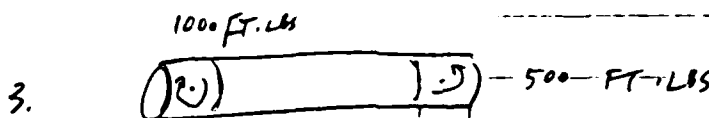
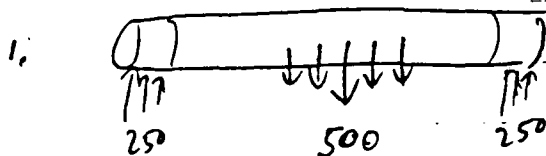
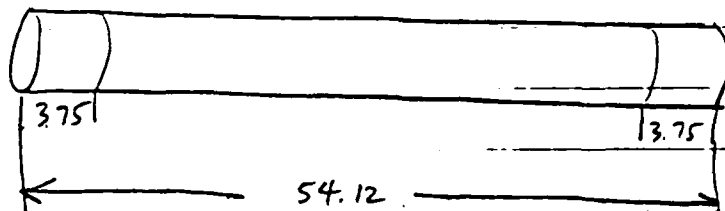
FIRE CONTROL LINKAGE

LOAD CASES :

1. 2 MEN HANGING ON MIDDLE OF TRUNNION TUBE, QUICKLY
2. 500 LB LOAD $\perp$ TO SIDE STRUTS & ACTUATOR STRUT +
TUT STRUT
3. 10 G RECOIL LOAD AT 0° QE + TRAV
4. 20 G "BOUNCE OFF ROCK" LOAD AT 0° QE + TRAV
5. 2 MEN PISHING SIDEWAYS ON TRUNNION TUBE, QUICKLY.
7. STATIC WT OF F.C. ACTING ON SYSTEM.

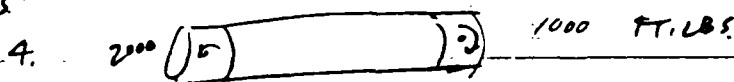
LOAD CASES - FIRE CONTROL COMPONENTS

TRUNNION TUBE - (CONSIDER FIBERGLASS FOR AL/SIC COMPLETIBILITY.)



TOP VIEW

ALL TORQUE
LOADS FOR
3 & 4 APPLIED
AT ENDS



TOP VIEW

3)

700 FT. LBS.

200 FT. LBS.

5.

(C)

(C)

↑ UP

(46's) or 5

or 5

7.

100 FT
LBS.

(C)

(C)

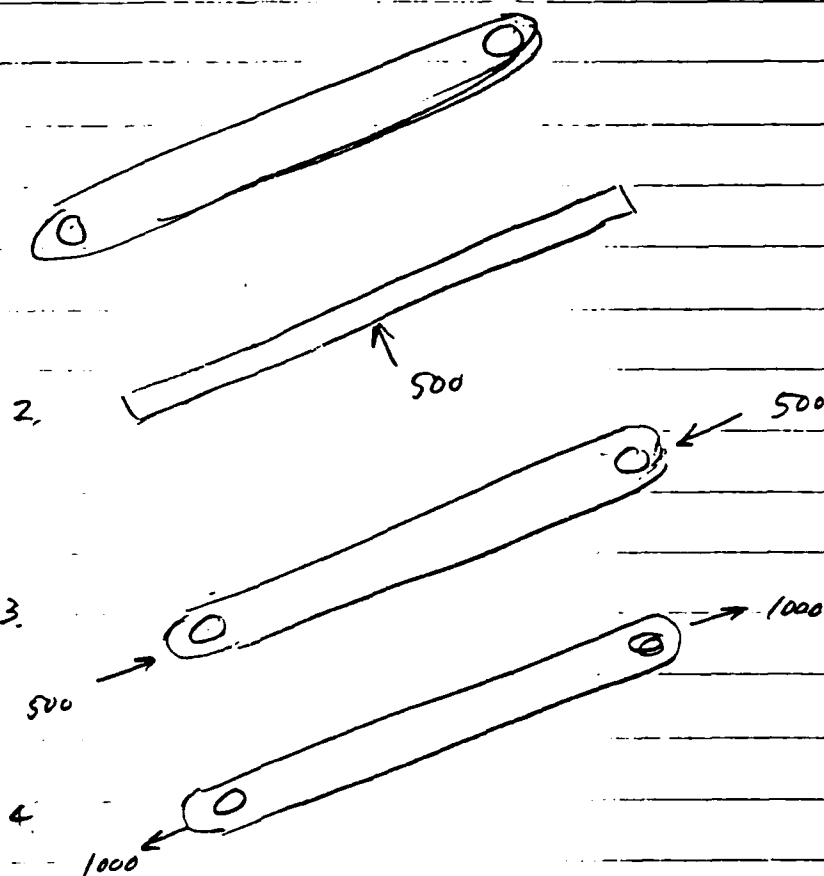
5

FT.
LBS.

↑ UP

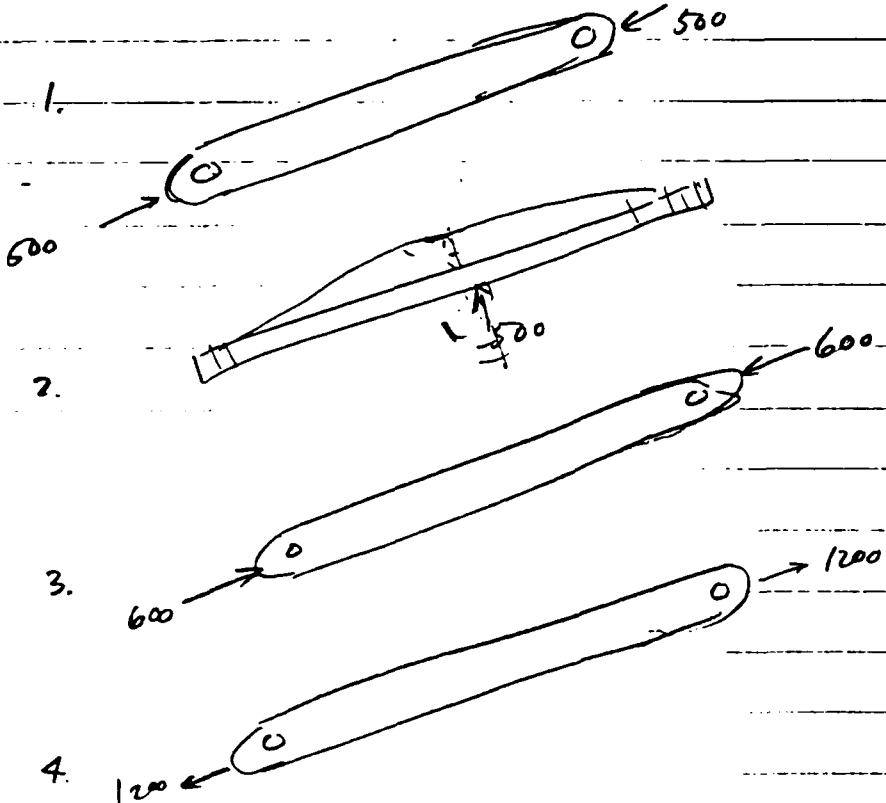
④

ACTUATOR STRUT.



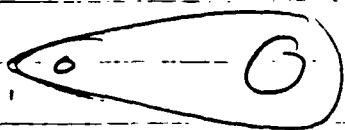
5

SME SUPPORT STRUT

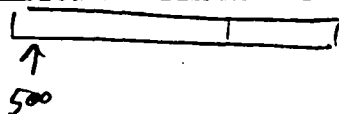


⑥

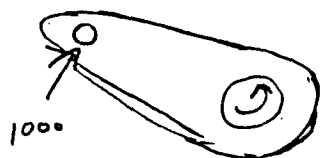
TOP SHORT STRUT



2.

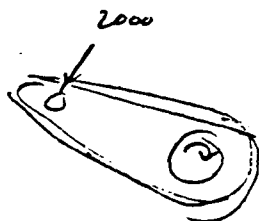


3



1000 FT. LBS

4.



2000 FT. LBS

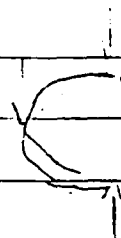
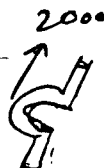
BOTTOM SHORT STRUT.



3.

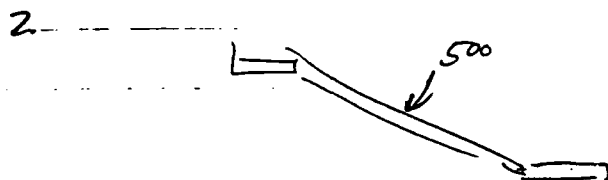
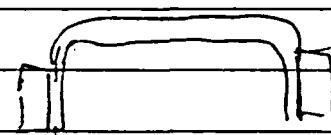
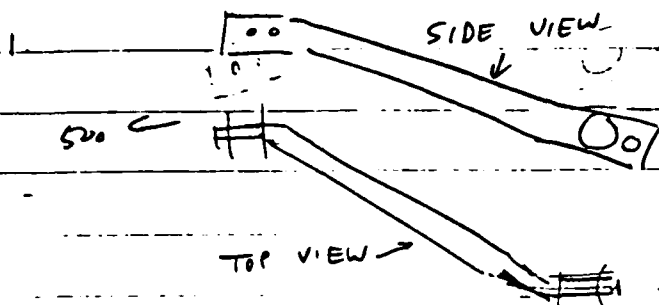


4.



⑦

CENTER SUPPORT STRUT



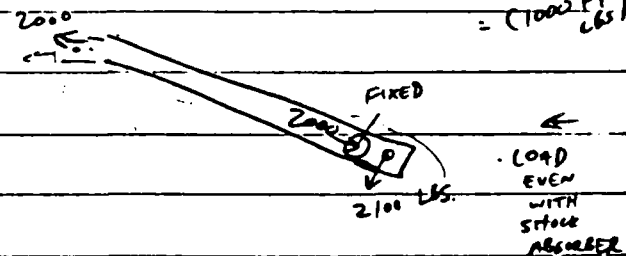
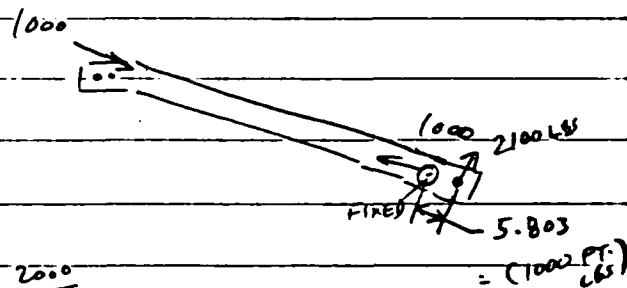
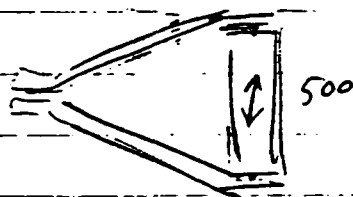
3.



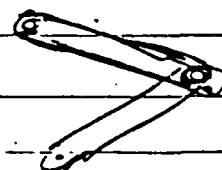
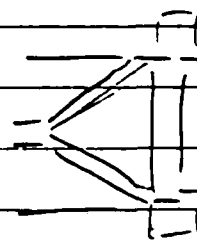
4.



5.



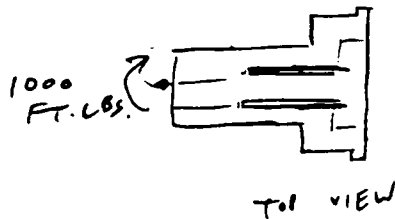
MUST BE MODELLED
AT POINT LOADS
TUBE PROVIDES
NO CROSS
SUPPORT.



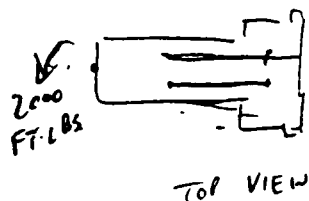
⑧

Al/SiC END CAPS.

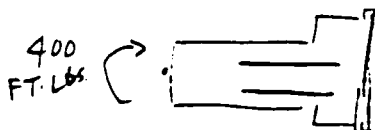
3.



4.

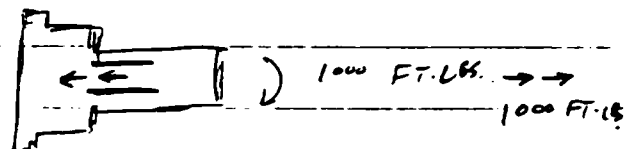
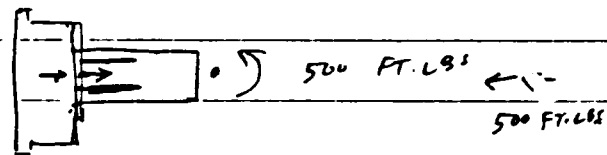


5.

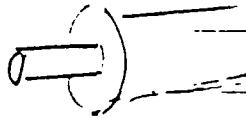
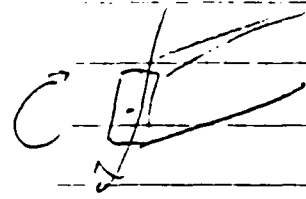
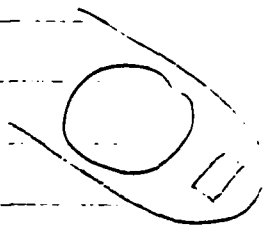
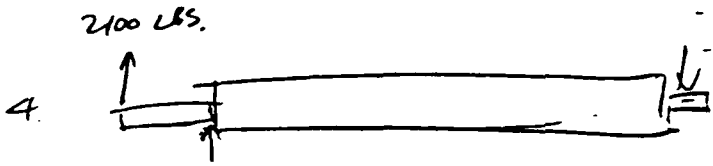
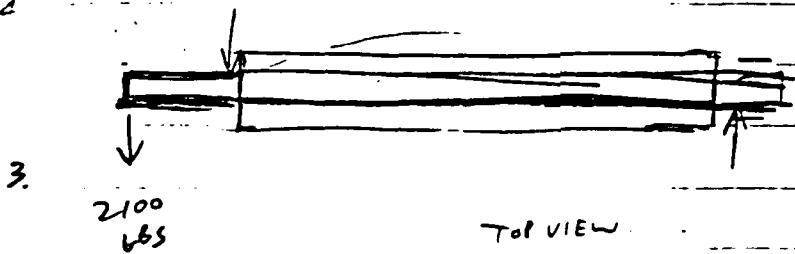
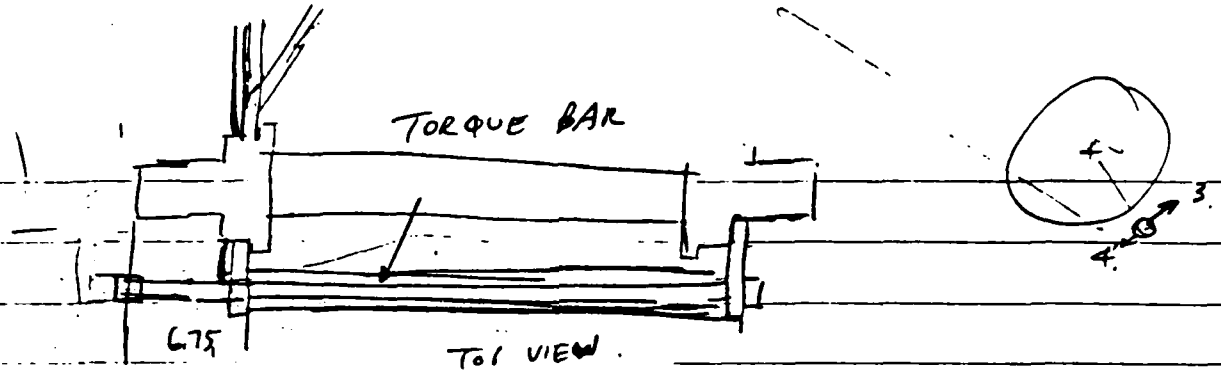


⊗ BARREL

7.



⑨



PART NUMBERS: 12585810, gimbal weldment,
12585811, gimbal machining

DESCRIPTION: GIMBAL

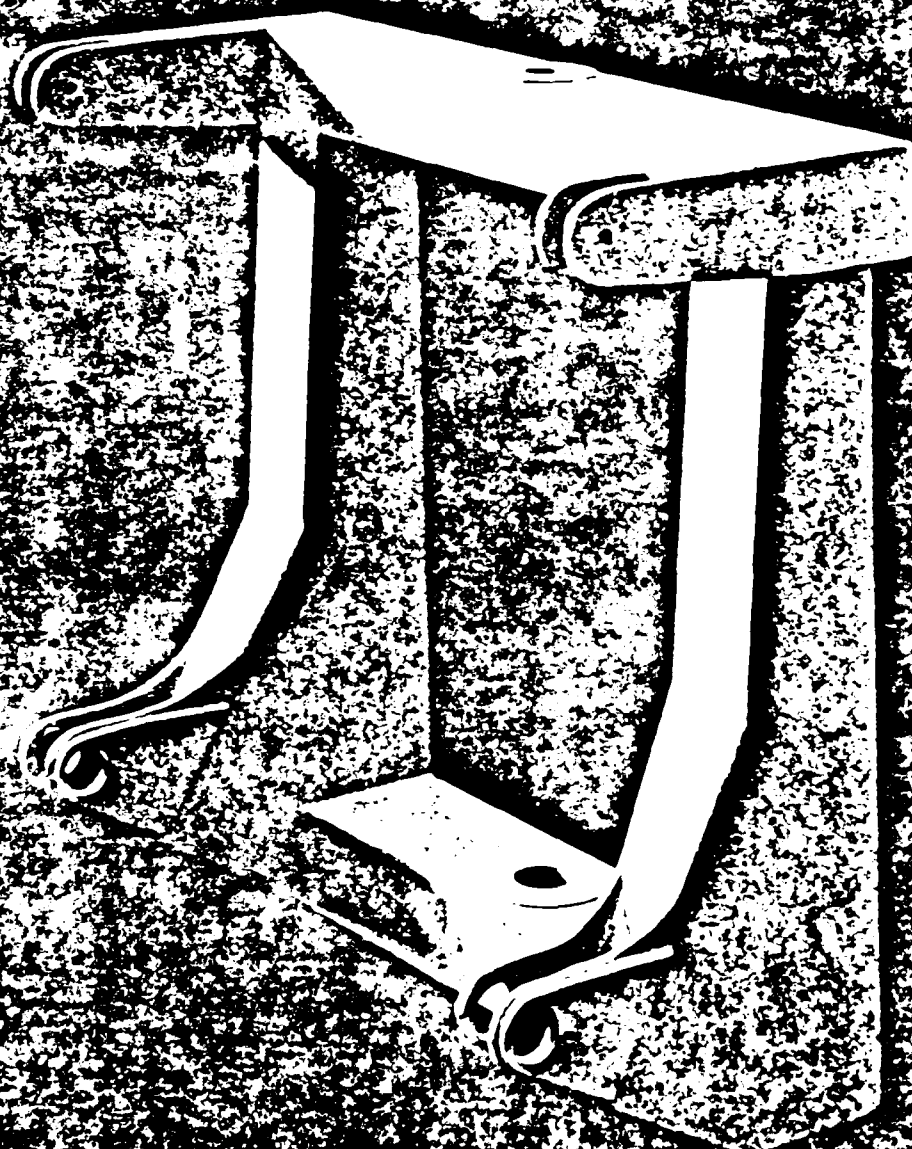
The gimbal is a machined titanium weldment whose weight is 244 lbs. Primary interfaces include: the upper and lower sections of the platform via Torrington bearings; the cradle at the trunnion; the equilibration rods at two locations; the elevation cylinder at one location and the traverse cylinder at one location. The complete fire control linkage also connects to the trunnion, but the reader is referred to Appendix Y for a discussion of these load cases.

STATUS:

All design and drawing requirements for the gimbal have been completed. Drawings for the gimbal can be found in the TDP.

Efforts to date have been to minimize the weight of the gimbal by generating an optimum configuration through the use of FEA models and hand calculation. Further weight reductions were envisioned by planned structural testing. A summary of loading conditions and design calculations can be found on the following pages of this section.

AUTHORS: Patty Yelich, Dave Langerud



N-69010
A-24-87

2-9-87

DSL

3

Western Ordnance Division
 Minneapolis

GIMBAL LOADS

CHARGE = 8S ; Recoil Force = 75 Kip

Rifling Torque = 26,000 Ft lb = 312 IN-KIP

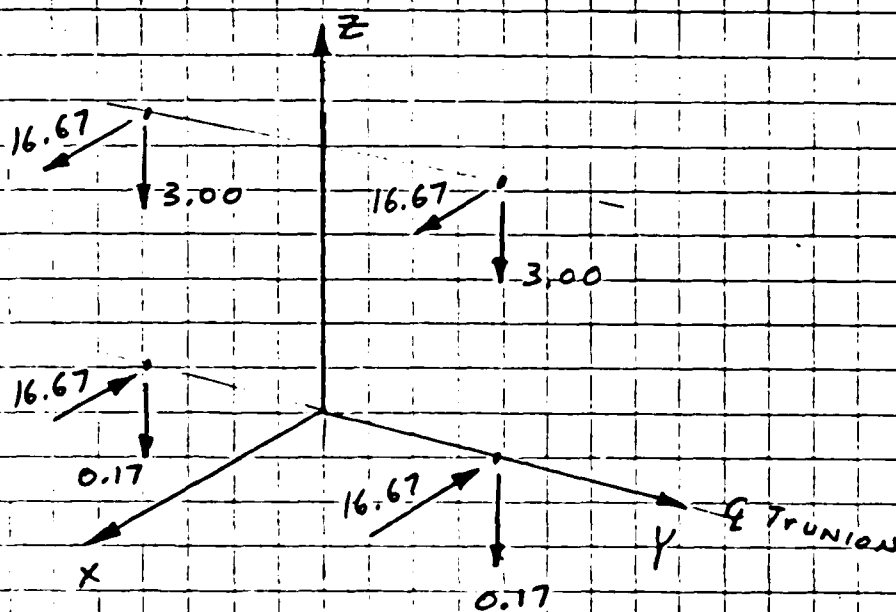
Per Feb 23 Letter from J. Ries & L. Libhardt

Recoil = $75 \times 1.2 = 90$ Kip

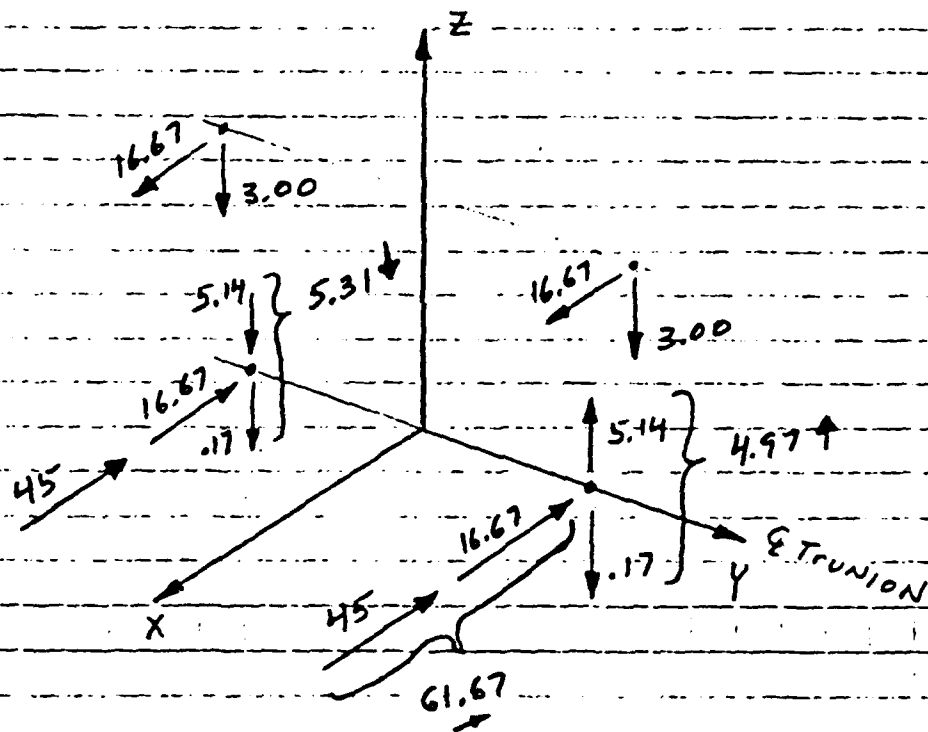
TORQUE = $312 \times .65 = 202.8$ in Kip

} Static Loads

1. ϕ° QE Static @ Battery

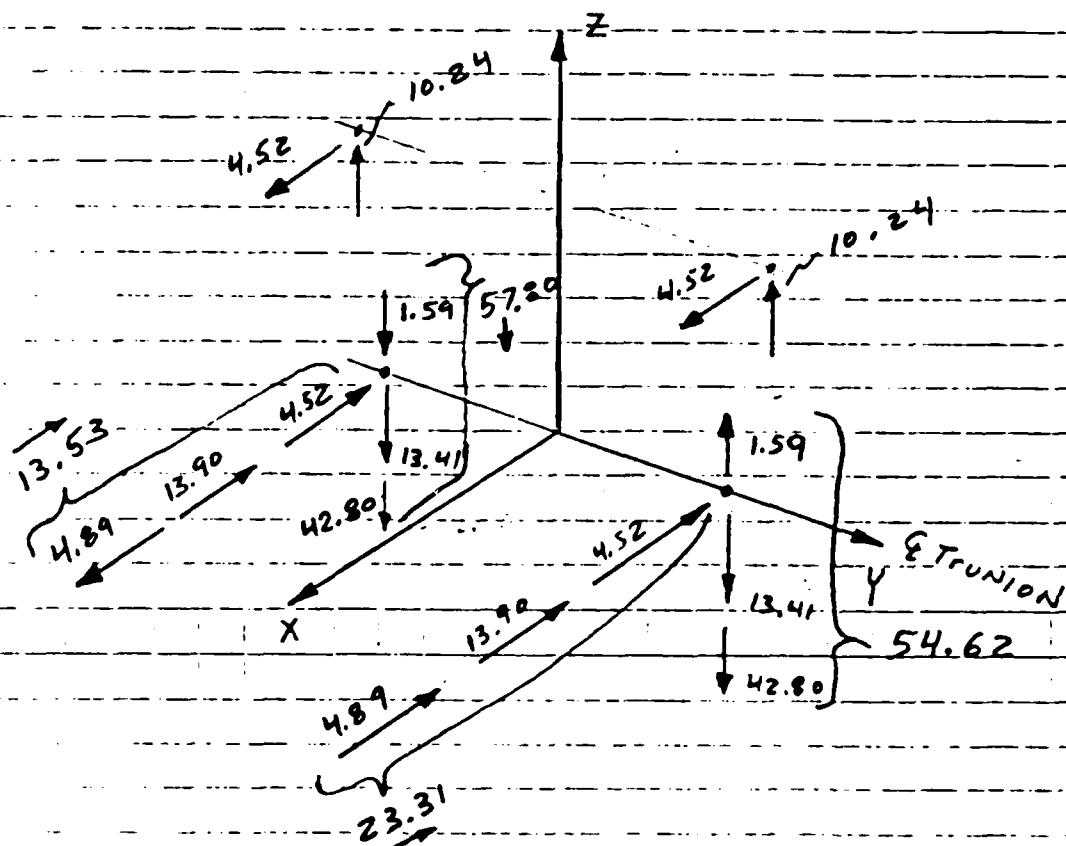


2. ϕ° QE Dead wt + Recoil + Torque



$$\frac{202.8}{39.44} = 5.14$$

3. 72° QE Dead Wt + Recoil + Torque



$$(90 \sin 72) / 2 = 42.80$$

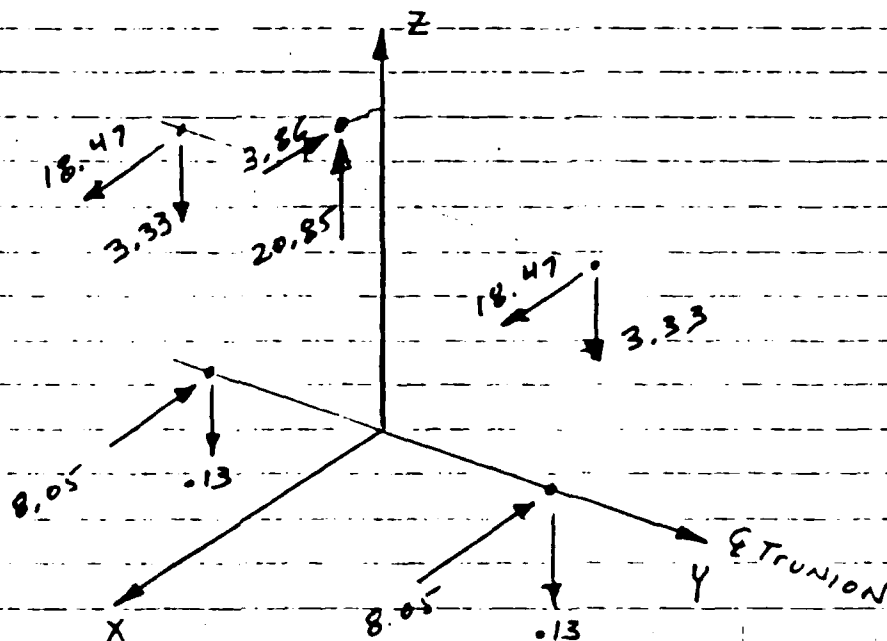
$$(90 \cos 72) / 2 = 13.90$$

$$(202.8 \sin 72) / 39.44 = 4.89$$

$$(202.8 \cos 72) / 39.44 = 1.59$$

2-9-87 6
OSL

4 ϕ OE @ LOAD & Depress

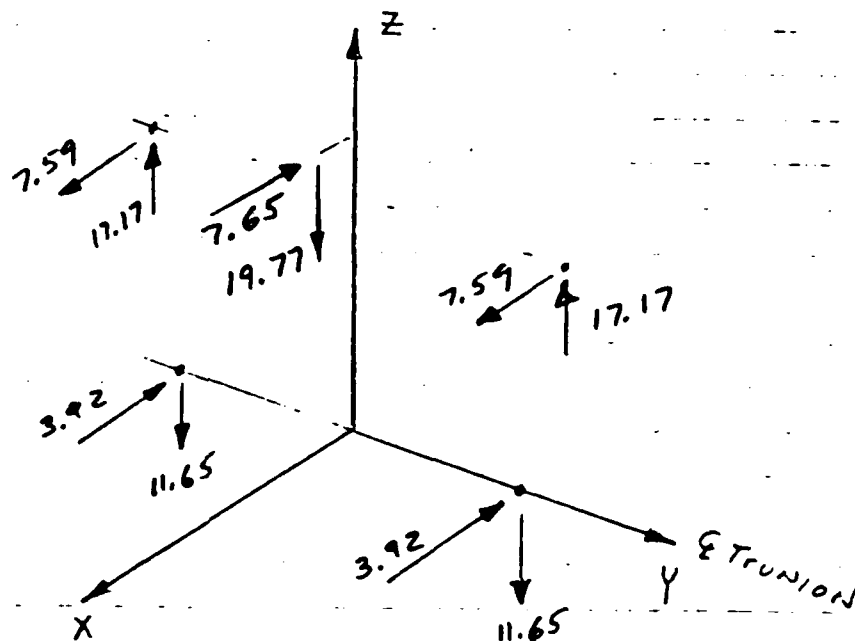


2-9-87

DSL

2-10-87

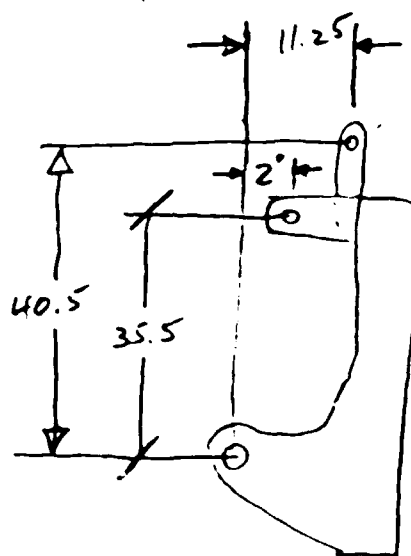
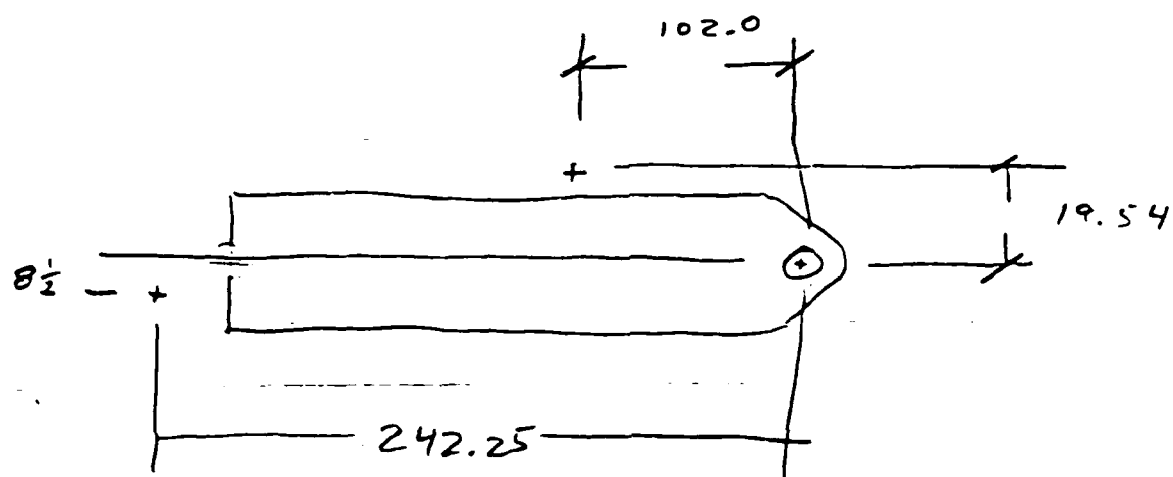
5) 72° OF @ LOAD, DEPRESS



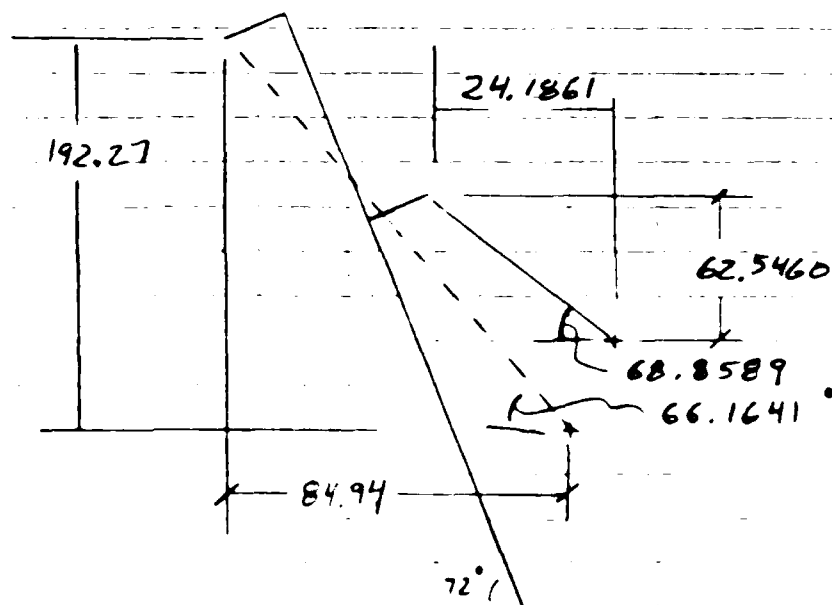
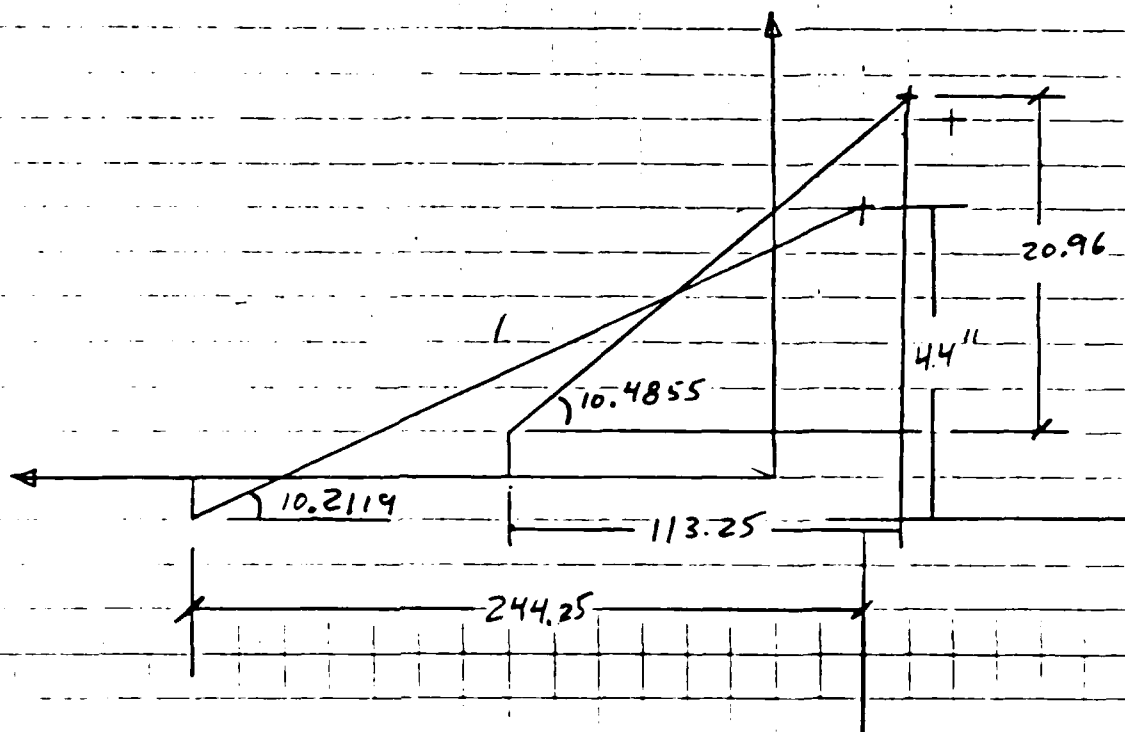
2-9-87

DSL

8



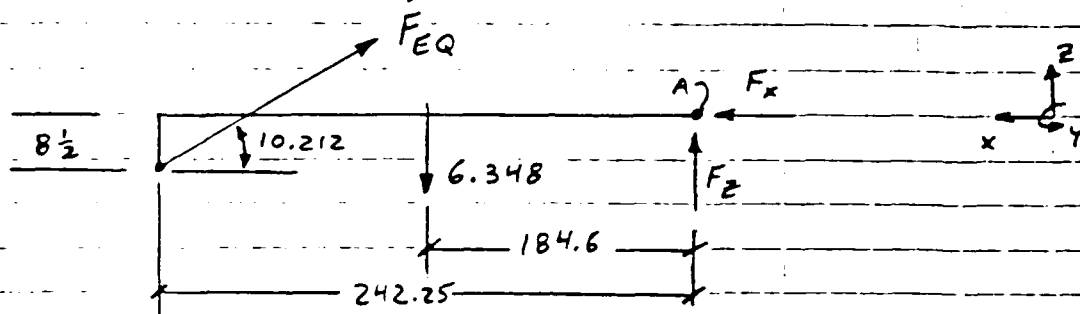
2-9-87
DSL
2-10-87



2-9-87

DSL

10

1' QE Static @ Battery

$$\sum M_Y^{\odot A} = 0; \quad 0 = -F_{EQ} (\sin 10.212) 242.25 + F_{EQ} (\cos 10.212) 8.5 + 6.348 (184.6)$$

$$F_{EQ} = 33.88 \text{ Kip} \quad (16.94 \text{ Kip/side})$$

$$\sum F_x = 0; \quad 0 = F_x - 33.88 \cos 10.212$$

$$F_x = 33.34 \text{ Kip} \quad (16.67 \text{ Kip/side})$$

$$\sum F_z = 0; \quad 0 = -6.348 + 33.88 \sin 10.212 + F_z$$

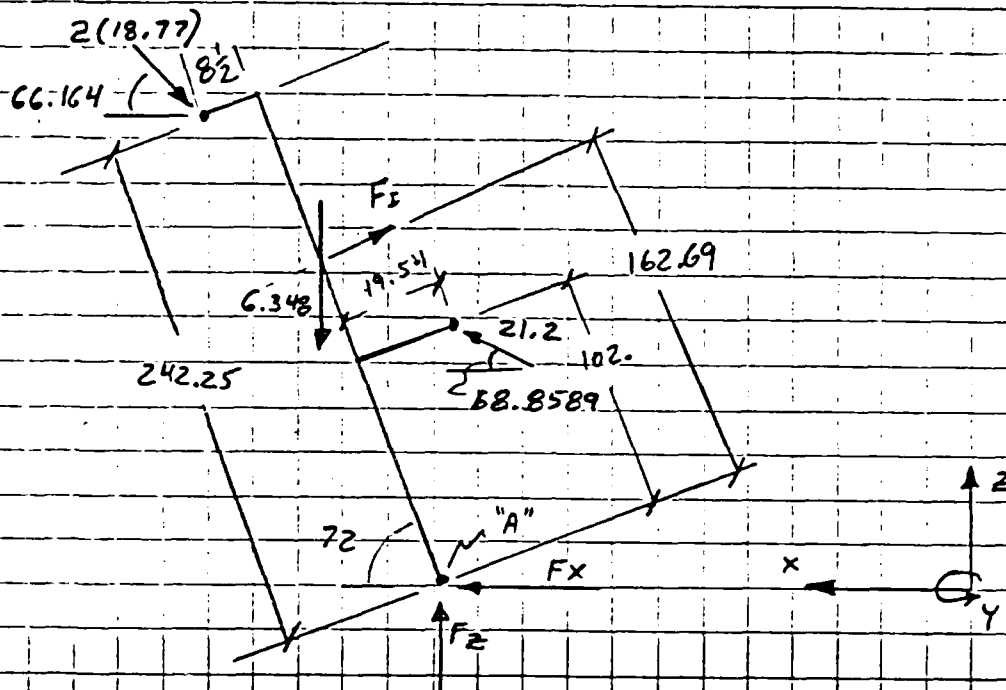
$$F_z = 0.34 \text{ Kip} \quad (0.17 \text{ Kip/side})$$

$$V = 16.94 \sin 10.212 = 3.003$$

$$H = 16.94 \cos 10.212 = 16.672$$

2-9-87
 DSL
 2-10-87

72° QE @ Load Depress



$$\begin{aligned}
 \sum M_y^A = 0; \quad 0 &= 2(18.77) \sin 66.164 [242.25 \cos 72 + 8.5 \sin 72] \\
 &\quad - 2(18.77) \cos 66.164 [242.25 \sin 72 - 8.5 \cos 72] \\
 &\quad + 6.348 (162.69) \cos 72 - 162.69 F_x \\
 &\quad + 21.2 \cos 68.8589 [102 \sin 72 + 19.54 \cos 72] \\
 &\quad - 21.2 \sin 68.8589 [102 \cos 72 - 19.54 \sin 72]
 \end{aligned}$$

$$F_x = 1.4997$$

$$\sum F_x = 0; \quad 0 = -2(18.77) \cos 66.164 - 1.4997 \sin 72 + 21.2 \cos 68.8589 + F_x$$

$$F_x = 8.9508$$

$$\sum F_z = 0; \quad 0 = -2(18.77) \sin 66.164 - 6.348 + 1.4997 \cos 72 + 21.2 \sin 68.8589 + F_z$$

$$F_z = 21.4495$$

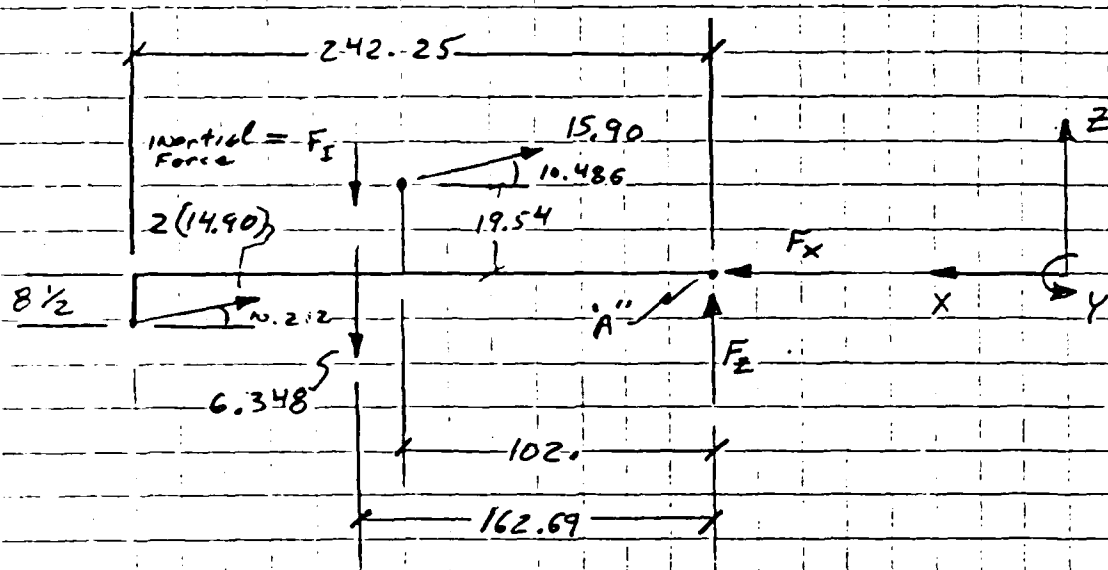
$$21.2 \sin 68.8589 = 19.7731$$

$$21.2 \cos 68.8589 = 7.6461$$

$$18.77 \sin 66.164 = 17.17$$

$$18.77 \cos 66.164 = 7.59$$

O'QE @ Load Elevate



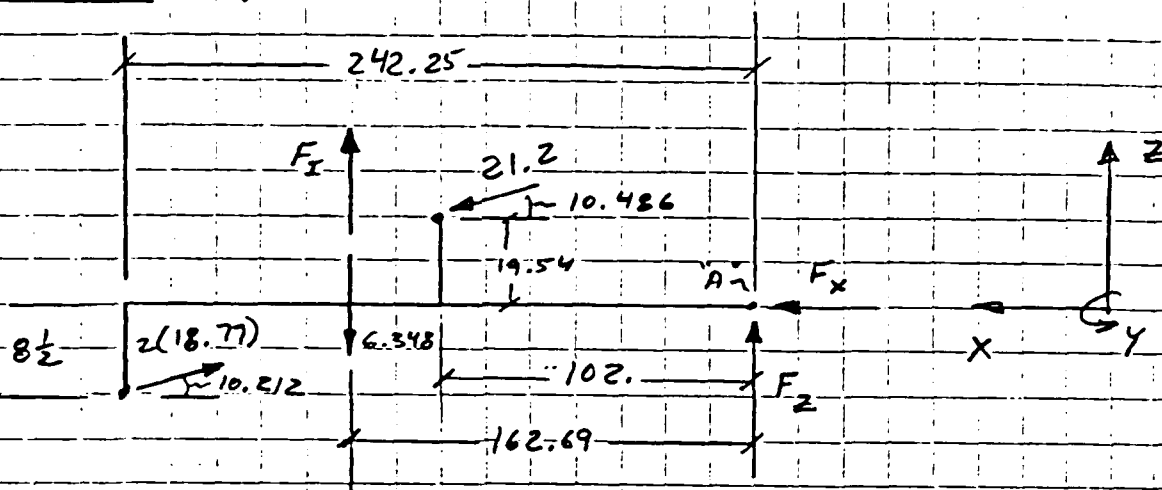
$$\sum M_y^A = 0; \quad 0 = 2(14.9)(\cos 10.212) 8.5 - 14.9(\sin 10.212) 242.25 (2)$$

$$+ 6.348 (162.69) + F_I (162.69) - 15.9(\sin 10.486) 102. - 15.9(\cos 10.486) 19.54$$

$$F_I = 3.6787$$

$$\sum F_x = 0; \quad F_x = 44.96$$

$$\sum F_z = 0; \quad 0 = 8.177 - 6.348 - 3.679 + F_z; \quad F_z = 1.85$$

Northern Ordnance Division
Minneapolis ϕ QE @ Load Depress

$$\begin{aligned} \sum M_y = 0; \quad \phi = & 8.5(2)(18.77) \cos 10.212 - 2(18.77)(242.25) \sin 10.212 \\ & + 6.348(162.69) - F_I(162.69) + 21.2(19.54) \cos 10.486 \\ & + 21.2(102) \sin 10.486 \end{aligned}$$

$$F_I = 3.2908$$

$$\sum F_x = 0; \quad 0 = -36.94 + 20.84 + F_x; \quad F_x = +16.10$$

$$\sum F_z = 0; \quad 0 = 6.656 + 3.2908 - 6.348 - 3.858$$

$$F_z = .260$$

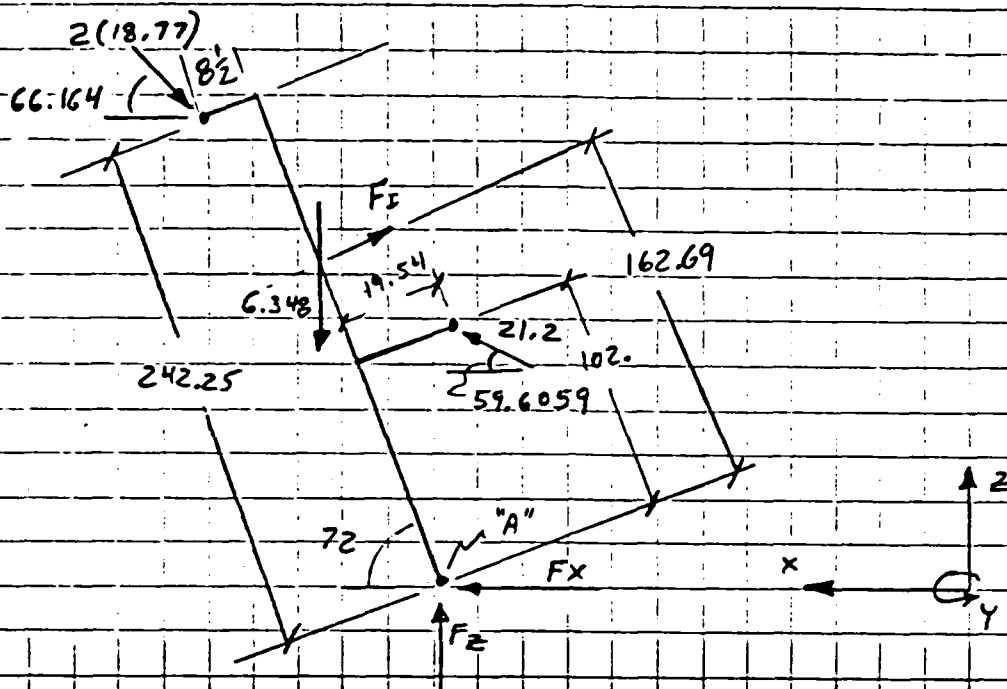
$$18.77 \sin 10.212 = 3.328$$

$$18.77 \cos 10.212 = 18.473$$

$$21.2 \sin 10.486 = 3.858$$

$$21.2 \cos 10.486 = 20.846$$

72° QE @ Load Depress



$$\begin{aligned} \sum M_y^{\text{@A}} = 0; \quad 0 = & 2(18.77) \sin 66.164 [242.25 \cos 72 + 8.5 \sin 72] \\ & - 2(18.77) \cos 66.164 [242.25 \sin 72 - 8.5 \cos 72] \\ & + 6.348 (162.69) \cos 72 - 162.69 F_x \\ & + 21.2 \cos 59.6059 [102 \sin 72 + 19.54 \cos 72] \\ & - 21.2 \sin 59.6059 [102 \cos 72 - 19.54 \sin 72] \end{aligned}$$

$$F_x = 3.568$$

$$\sum F_x = 0; \quad 0 = -2(18.77) \cos 66.164 - 3.568 \sin 72 + 21.2 \cos 59.6059 + F_x$$

$$F_x = 7.838$$

$$\sum F_z = 0; \quad 0 = -2(18.77) \sin 66.164 - 6.348 + 3.568 \cos 72 + 21.2 \sin 59.6059 + F_z$$

$$F_z = 21.30$$

$$21.2 \sin 59.606 = 18.29$$

$$21.2 \cos 59.606 = 10.73$$

$$18.77 \sin 66.164 = 17.17$$

$$18.77 \cos 66.164 = 7.59$$

Gimbal Top Beam Horizontal

V = 0, 0, 1

22½
Towers

CBor 16, 17, 18, 19

Grid	M ₁	M ₂	V ₁	V ₂	P	T	
16 A	—	—	2.4	17.0	—	-19.3	Dead at + Recoil 0 QE
B	-18.9	-132.					
17 A	104.2	-22.3	7.6	-11.6	6.6	8.7	
B	3.9	-188.					
18 A	-3.9	188.5					
B	-112.	103.	7.6	-6.0	-5.2	8.9	
19 A	-18.9	-132.	-2.4	-17.0	—	19.3	
B	—	—					
16 A	—	—					
B	-18.9	-132.	2.4	17.0	—	-19.3	
17 A	-3.8	-89.0	—				0 QE Dead at
B	-3.8	295.	—	14.5	.7	—	
18 A	-3.8	-295					
B	-3.8	-89.0	—	-14.5	.7	—	
19 A	-18.9	-132.	-2.4	-17.0	—	19.3	
B	—	—					
16 A	—	—					
B	108.8	-41.4	-14.0	5.3	—	-249.9	
17 A	98.	29.3	2.4	-20.5	4.9	7.9	Dead at + Recoil 72° PL
B	64.	-263.					
18 A	64.	-263.	2.4	-17.1			
B	30.	-20.					
19 A	108.6	-41.4	14.6	-5.3	—	249.9	
B	—	—					

$$I_1 = 16.75 \quad I_2 = 55.375$$

$$8\frac{1}{2} \times 4 \times \frac{1}{4}$$

$$Z_1 = 8.375 \quad Z_2 = 13.03$$

$$\underline{18 B} \quad \sigma = \frac{112}{8.375} + \frac{103}{13.03} + \frac{5.2}{6} = 13.37 + 7.90 + .9 = 22.14$$

$$\underline{17 B} \quad \sigma = \frac{3.8}{8.375} + \frac{295}{13.03} + \frac{1}{6} = .45 + 22.6 = 23.1$$

16/19

$$\tau_{xy} = \frac{249}{2(3.75)(8.25)(.25)} = 16.1 \text{ KSI}$$

System's Model $\approx 40 \text{ KSI}$

	A	I ₁	Z ₁	I ₂	Z ₂
4 × 8½ × ¼	6.0	16.75	8.375	55.4	13.03

$$175 \times 8.25 = 309$$

5 × 6 × ¼	5.25
-----------	------

5 × 5 × ¼	4.75	17.9	7.16	17.9	7.16
-----------	------	------	------	------	------

$$4.75(4.75) = 22.6$$

$$5 \times 5 \times \frac{1}{4}$$

18

$$I_1 = 16.75 \quad I_2 = 55.375$$

$$\frac{8\frac{1}{2} \times 4 \times \frac{1}{4}}$$

$$\bar{z}_1 = 8.375 \quad \bar{z}_2 = 13.03 \quad \bar{z}_1 = \bar{z}_2 = 7.16$$

$$\underline{18 B} \quad \sigma = \frac{112}{8.375} + \frac{103}{13.03} + \frac{5.2}{6} = 13.37 + 7.90 + .9 = \frac{22.14}{30.0}$$

$$\underline{17 B} \quad \sigma = \frac{3.8}{8.375} + \frac{295}{13.03} + \dots = .45 + 22.6 = \frac{23.1}{42.}$$

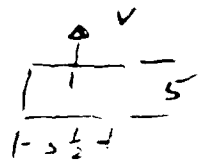
16/19

$$T_T = \frac{249}{2(3.75)(8.25)(.25)} = \frac{16.1 \text{ KSI}}{22.}$$

System's Model $\hat{=}$ 40 KSI

$\times 2 \hat{=}$ 80 KSI

Gimbal Columns CBor 11 & 12

 $V = -1, \phi, \phi$ 

EL, Grid	M ₁	M ₂	V ₁	V ₂	P	T	
11 A	-90.5	14.6	-2.6	.7	-2.4	-43.	
B	19.2	-15.1					
12 A	-90.5	14.6	-2.6	-7	2.4	-43	
B	19.3	15.1					
11 A	-203.	160.	-5.4	6.6	5.1	-110.	Ø ØE
B	28.	-123.					
12 A	-461.	131.	-11.	5.2	-10.	29.1	
B	10.6	-93.					
1 A	907.	222.	15.2	4.9	16.4	70.8	72 ØE
B	258.	108.					
12 A	744.	-131.	11.7	-1.2	11.6	21.6	
B	242.	-78.					

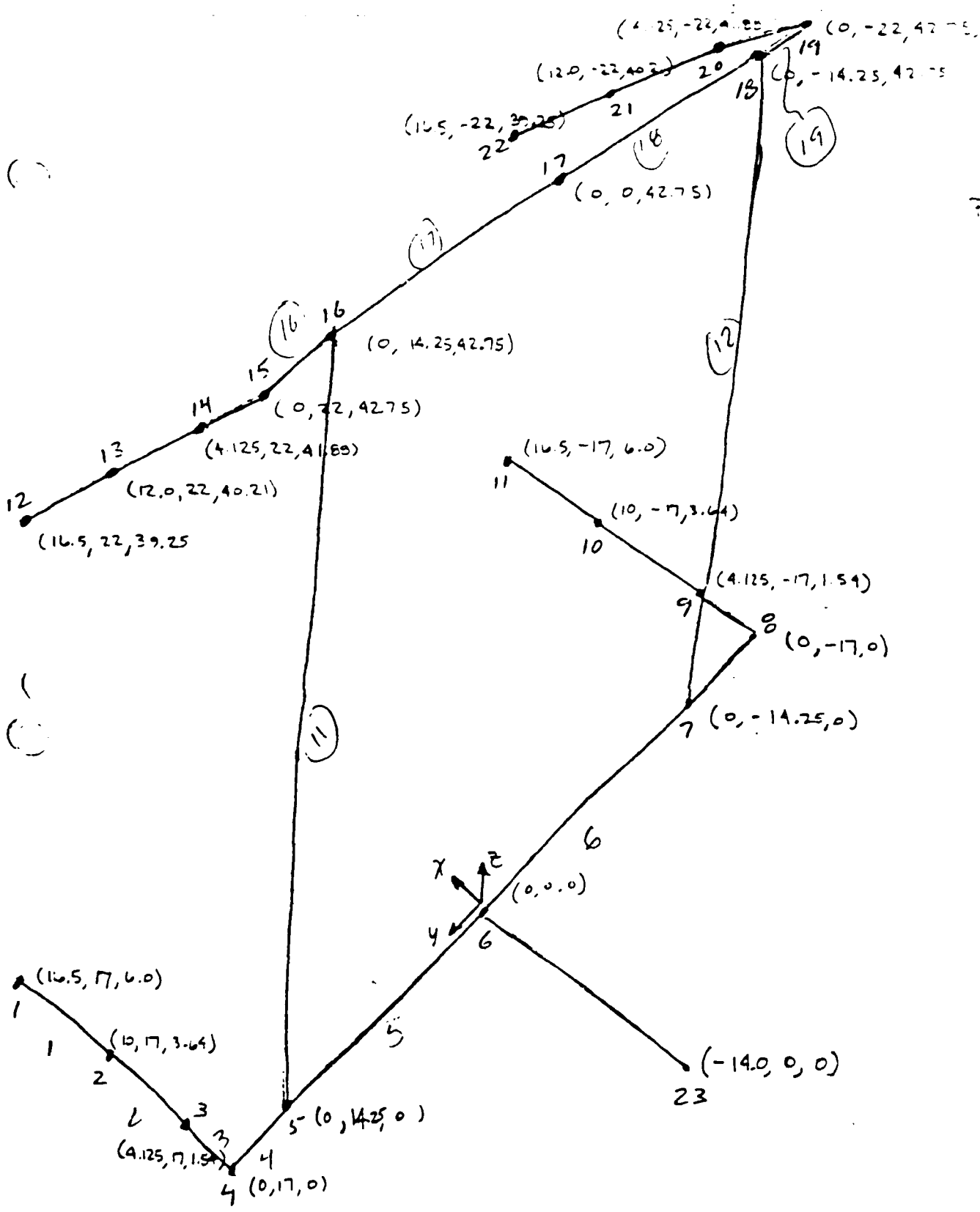
Top of Columns $I_1 = 19.32$ $Z_1 = 7.73$; $I_2 = 22.45$ $Z_2 = 8.16$
 $A = 5$

$$\sigma = \frac{258}{7.73} + \frac{123}{8.16} = 33.4 + 15 = 48$$

was $8\frac{1}{2} \times 5\frac{1}{2} \times \frac{1}{4}$

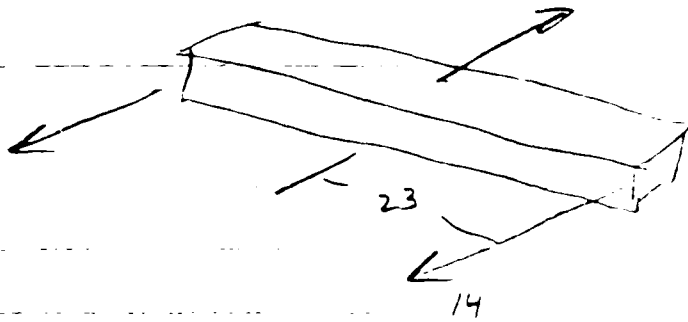
$$\sigma = \frac{258}{16.0} + \frac{123}{12.6} = 16.1 + 9.8 = 25.9$$

System was 20 KSE $\rightarrow$ 30

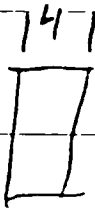
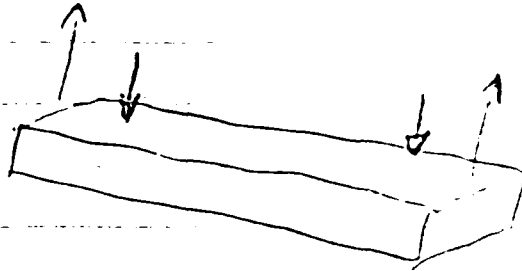


Gimbal Top Beam

21



M = 322

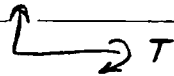


$8\frac{1}{2}$

$$I = 55.4$$

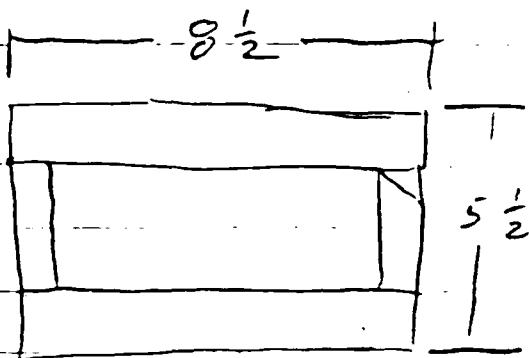
$$Z = 13$$

$$\sigma = 25$$



Gimbal Bottom Beam

$$\underline{\underline{A = 6.625}}$$



$$I = \frac{8.5(5.5)^3 - 8(4.75)^3}{12}$$

$$I = 46.40$$

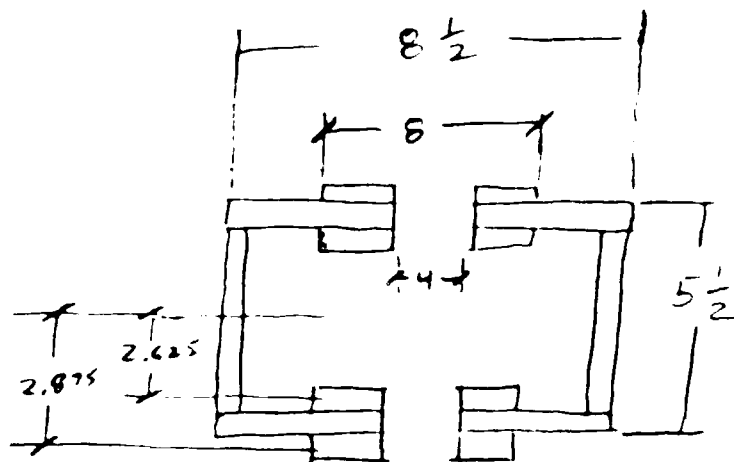
$$Z = 18.87$$

(2)

$$I = \frac{5.5(8.5)^3 - 4.75(8)^3}{12}$$

$$I = 78.81$$

$$Z = 18.54$$



$$A = 9.75$$

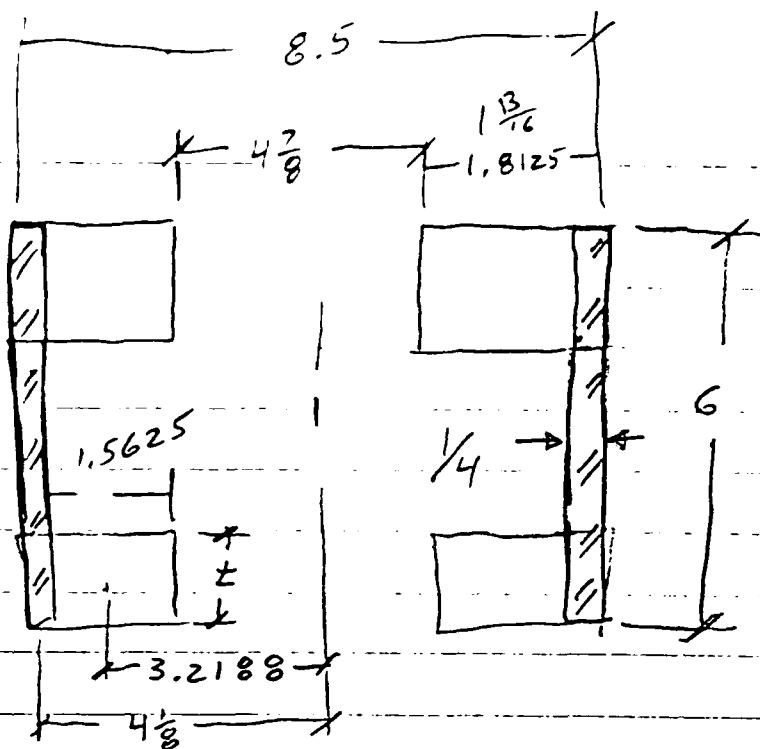
$$I = \frac{(8.5 - 4)(5.5)^3 - (8 - 4)(4.75)^3}{12} + \frac{8(4)(.25)^3}{12} + .25(8 - 4)(2)(2.625)^2 + .25(8 - 4)(2)(2.875)^2$$

$$I = 57.02 \quad Z = 19.01$$

$$I_2 = \frac{5.5(8.5)^3 - 4.75(8)^3 - .75(4)^3}{12} + \frac{4(.25)(8)^3 - 4(.25)(4)^3}{12}$$

$$I_2 = 112.14 \quad Z_2 = 26.39$$

$$A = 11.5938^{24}$$



$$I = \frac{.5(6)^3}{12} + 4(1.5625)(t)(3 - t/2)^2 + \frac{1.5625(t)^3}{12}$$

$$t = 1"$$

$$I = 9 + 39.06 + .13 = 48 ; Z = 16.06$$

$$t = 1 \frac{3}{8}$$

$$I = 9 + 45.9 + .34 = 55.24 ; Z =$$

$$I_2 = \frac{12(.25)^3}{12} + \frac{4(1.375)(1.5625)^3}{12} + 6(.25)(2)(4)^2$$

$$I_2 = 141.85 ; Z_2 =$$

AD-A183 987

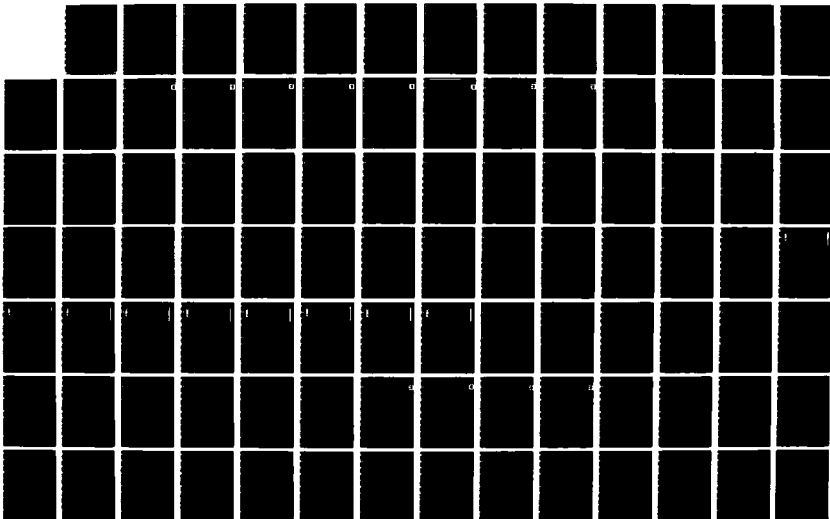
LIGHTWEIGHT TOWED HOWITZER DEMONSTRATOR PHASE 1 AND
PARTIAL PHASE 2 VOLUM (U) FMC CORP MINNEAPOLIS MINN
NORTHERN ORDNANCE DIV R RATHE ET AL APR 87
FMC-E-3841-VOL-D1-PT-1 DAA21-86-C-0047

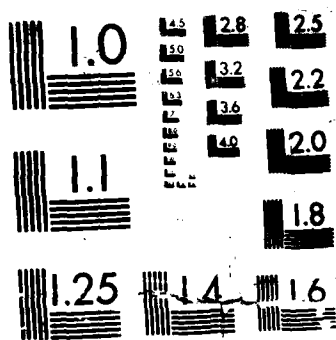
2/3

UNCLASSIFIED

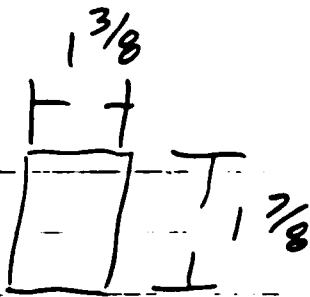
F/G 19/6

NL



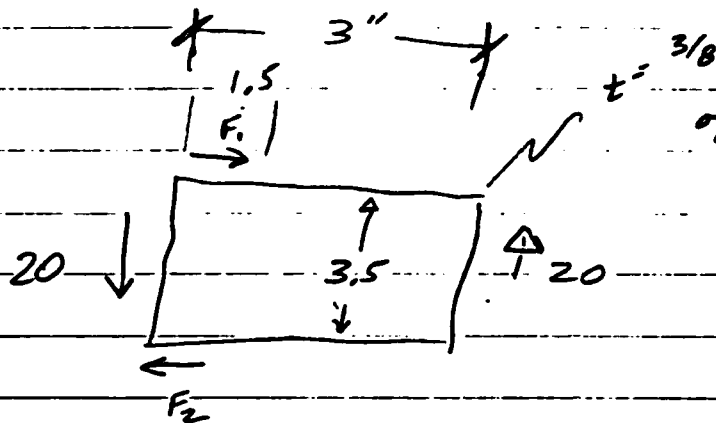


MICROCOPY RESOLUTION TEST CHART



$$I = \frac{1.375 (1.875)^3}{12} = .75$$

$$Z = .83$$



$$\tau = \frac{3}{2} \frac{20}{(.375)(4)} = 20 \text{ KSI}$$

$$20 \times 3 = F_1 (3.5)$$

$$F_1 = 17.14 \text{ Kip}$$

$$F_w = \frac{17.14}{1.5} = 11.4 \text{ Kip/in} \Rightarrow .22$$

$$F_A = 25.4$$

$$.375 \times .75 = .28$$

Use 1/4" Fillet

Ref Ror K



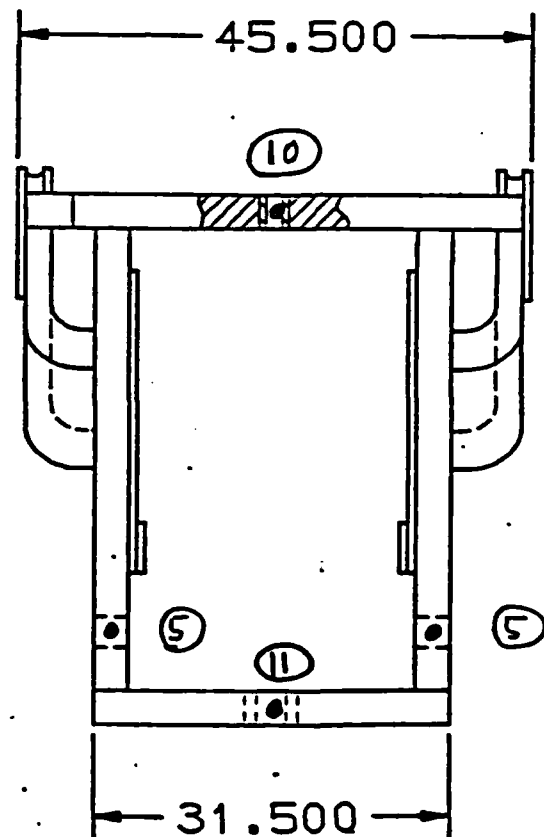
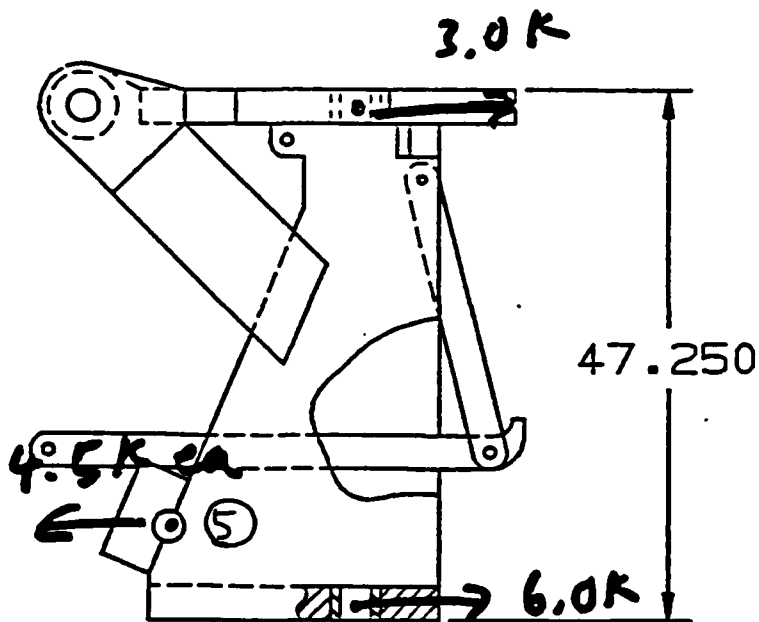
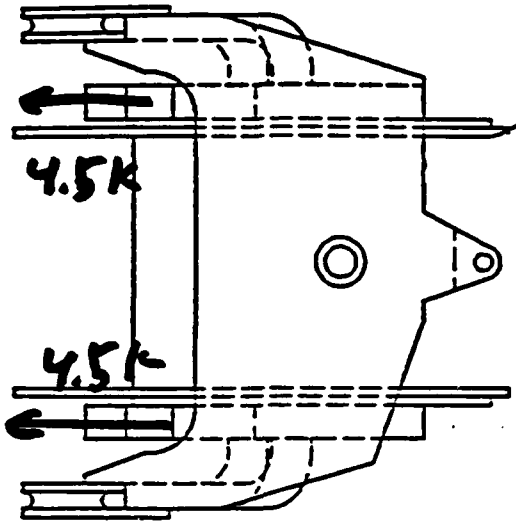
$$M = \frac{WR}{\pi} = \frac{17.14 (3.31)}{\pi} = 18.05$$

$$\sigma = \frac{M}{Z} = \frac{18.05}{.83} = 22 \text{ KSI}$$

GIMBAL ASSY

LOAD CONDITION#
18,000 # 10-11-86
Towing

26



SCALE: 1/16

(5)

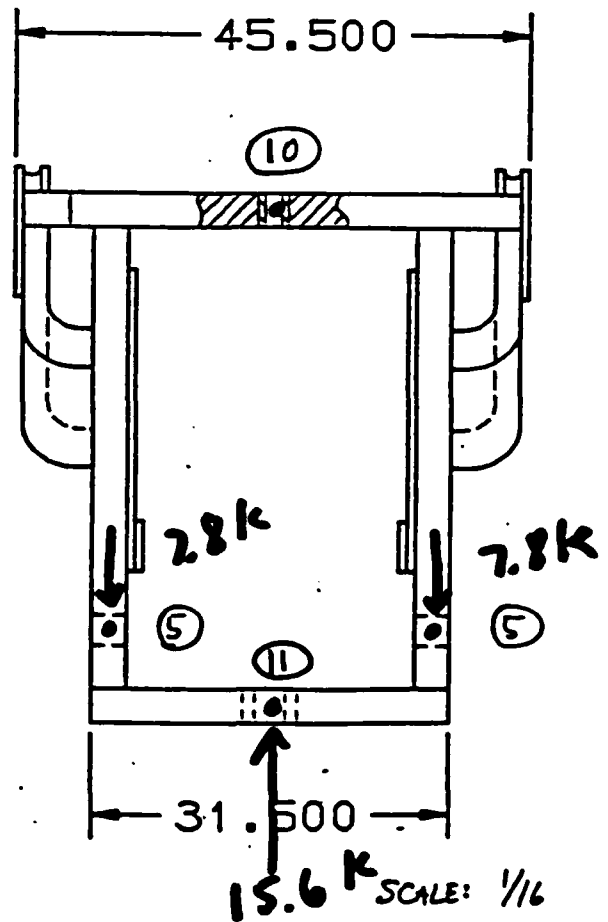
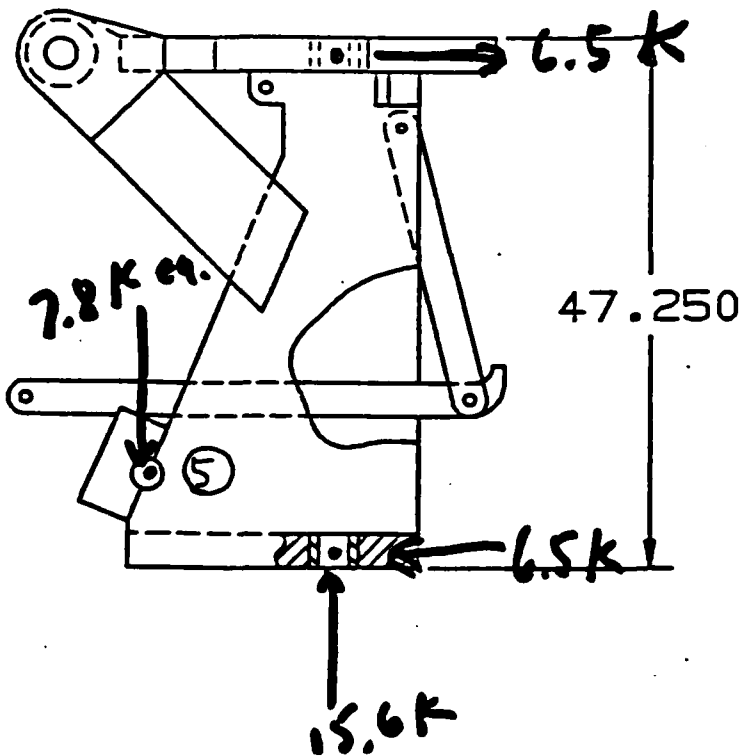
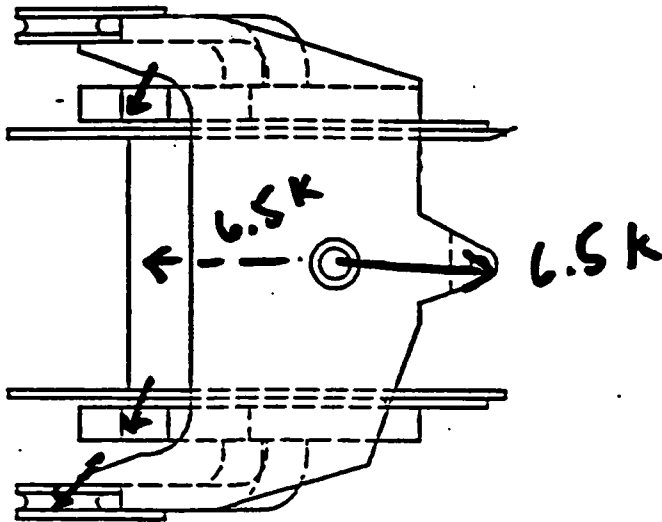
10-17-86

27

GIMBAL ASSY

LOAD CONDITION#

Aircraft
4.56 DMH



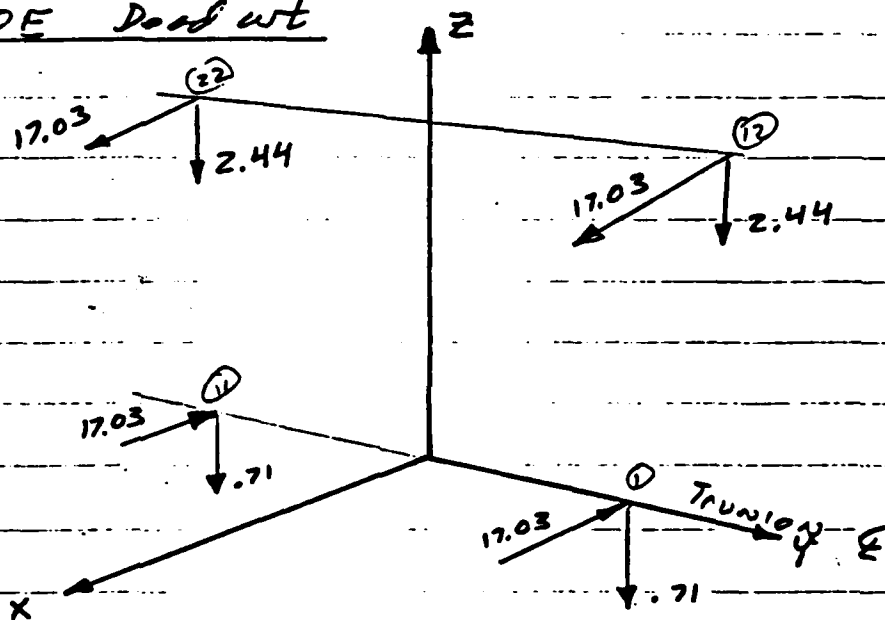
(5)

GIMBAL LOADS : UNITS; Kips, IN

Rifling Torque 42,500 ft lb = 510 in Kip

Static Loads Per SGD 9-20-86

Assume Recoil Force = 80 Kip

1. 0 Deg QE Dead wt

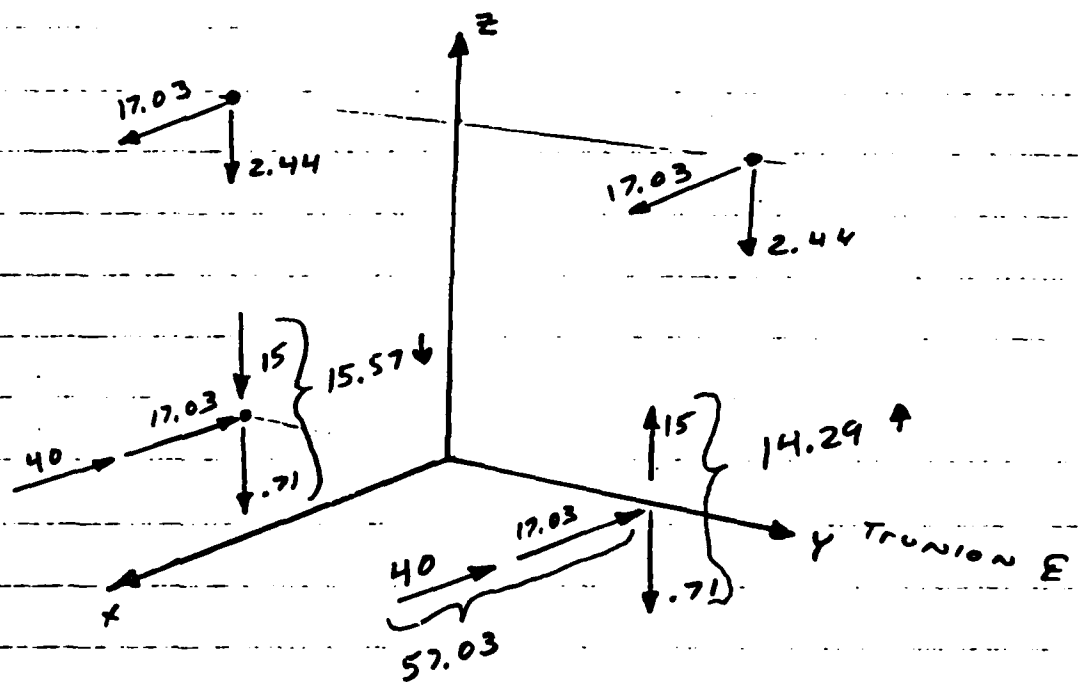
Same Loads Applied To THE Platform Frame

② 0 Deg ; 22 1/2 Deg Traverse

Travel Loads per Configuration 2 Frame

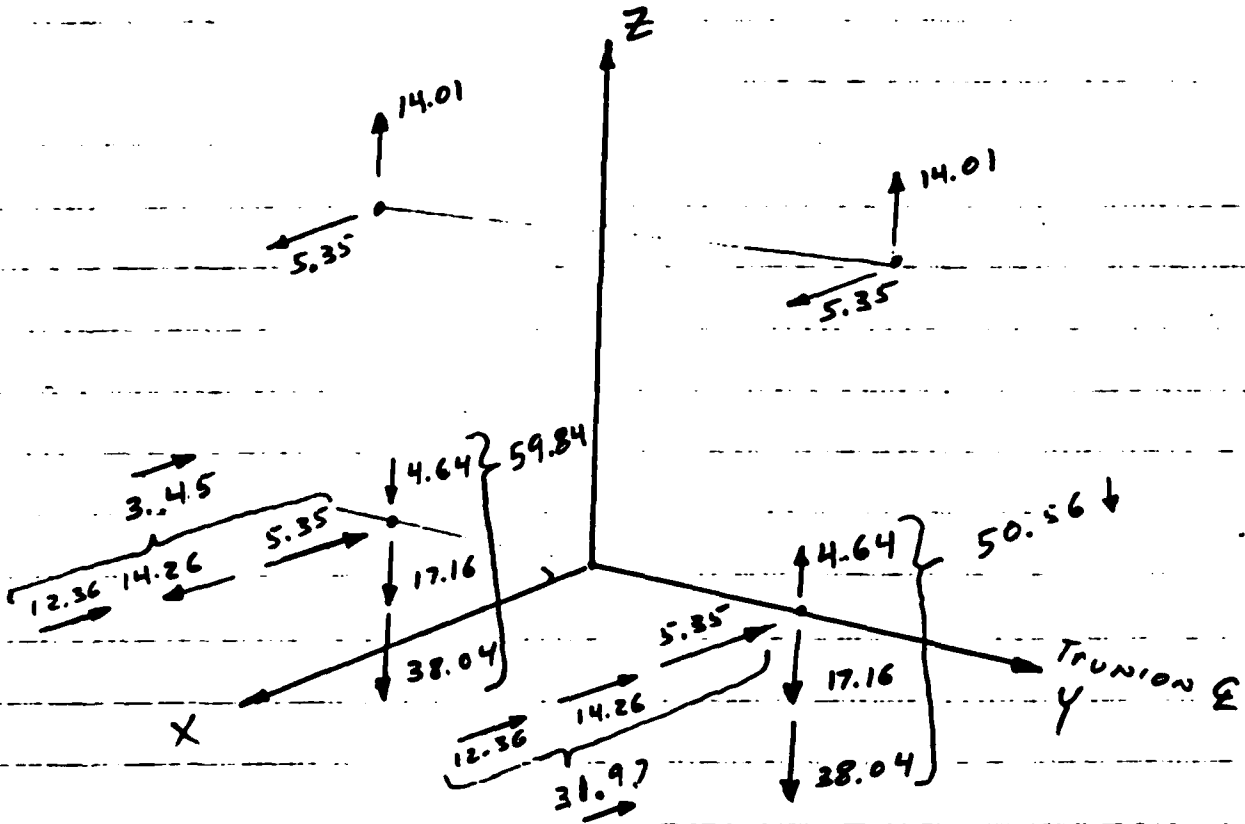
Dave B. Also Applied To THE Platform Frame

2. ϕ Deg QE, Dead wt + Recoil + Torque



$$\frac{510 \text{ in Kip}}{34''} = 15 \text{ Kip}$$

3. 72 Deg QE, Dead wt + Recoil + Torque

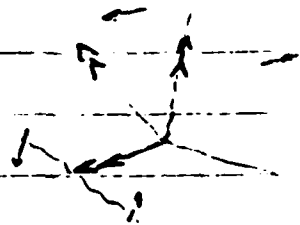


$$(80 \sin 72) / 2 = 38.04$$

$$(80 \cos 72) / 2 = 12.36$$

$$(510 \sin 72) / 34 = 14.26$$

$$(510 \cos 72) / 34 = 4.64$$



LOAD COND #1

31

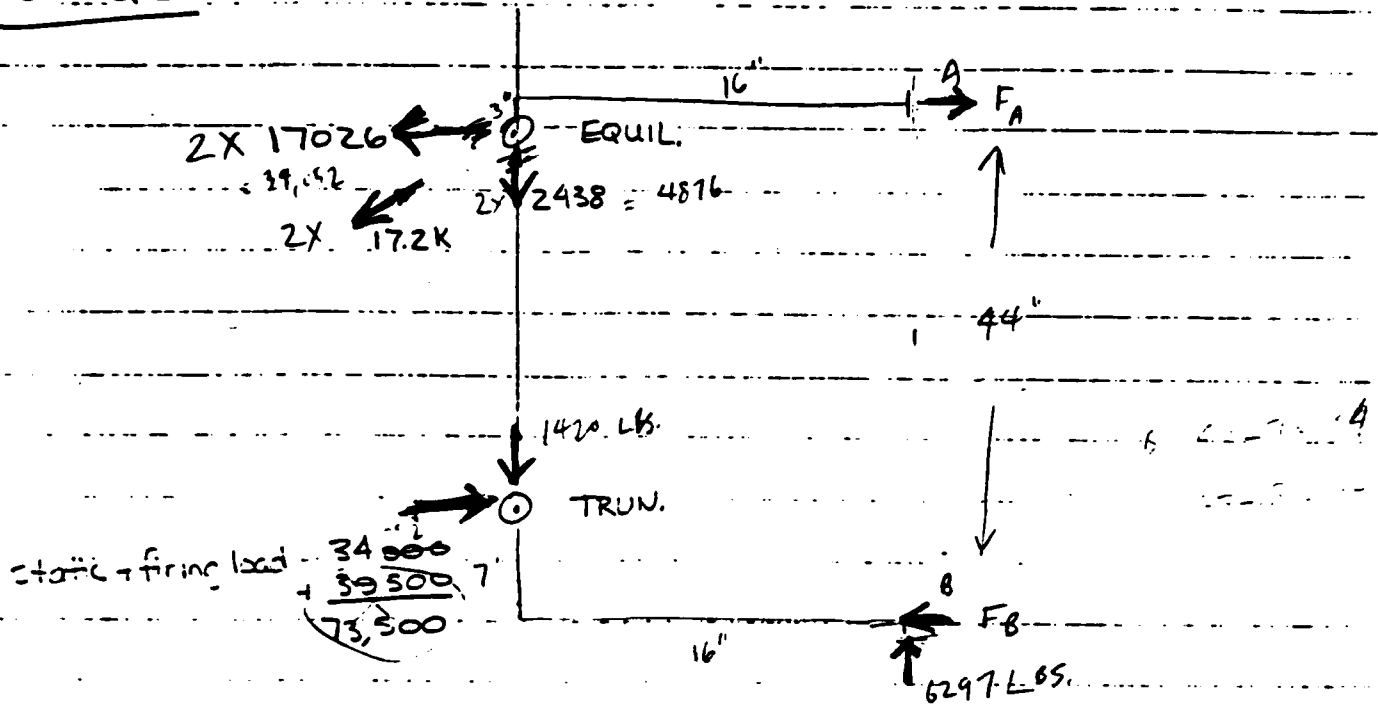
FIRE POS.

0° QE +

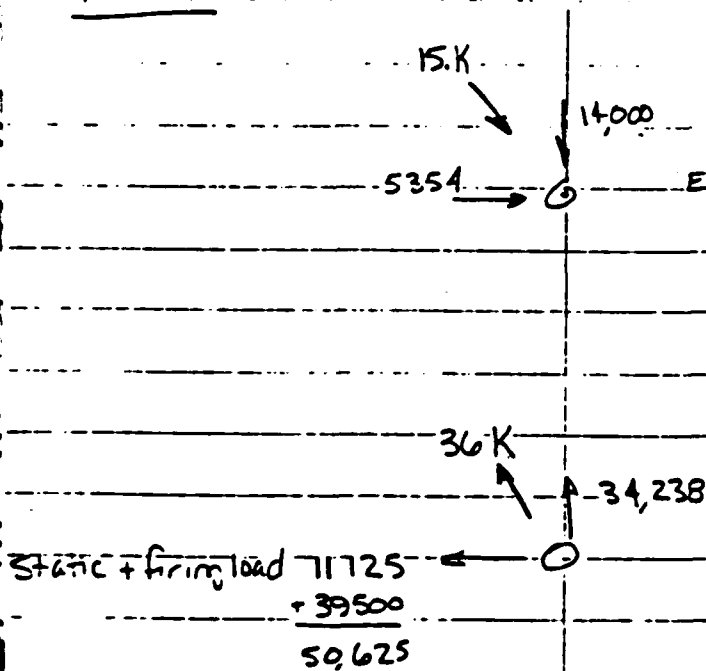
TRAX.

Loading on gimbal

0° QE



72° QE



ABOVE:

STATIC:

$$\sum M_A = 0 = F_B \cdot 44$$

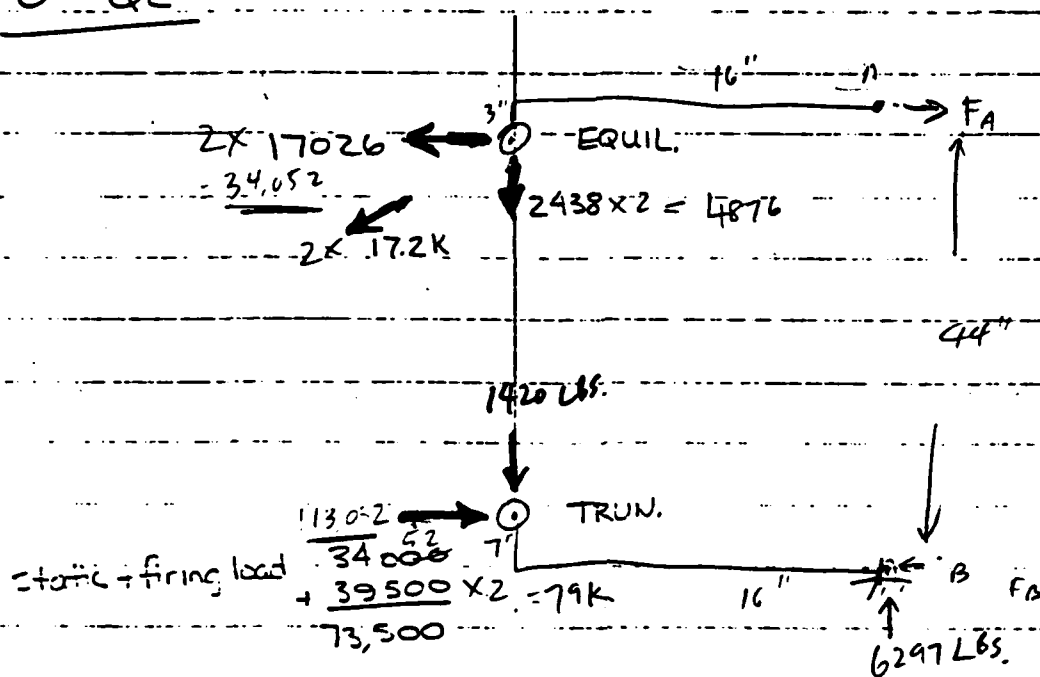
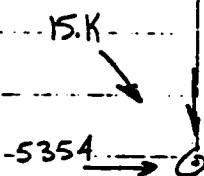
$$- 34,052 \cdot 37 - 1420 \cdot 16$$

$$+ 34,052 \cdot 3 - 4876 \cdot 16$$

$$F_A = F_B = 28,600 \text{ LBS}$$

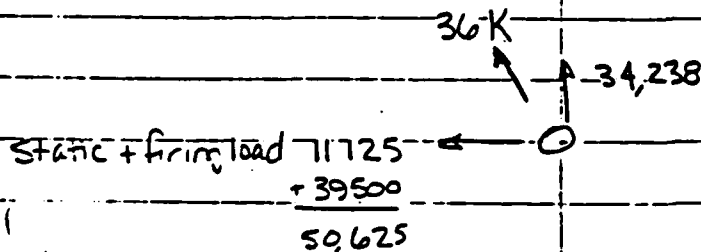
LOAD COND #5

Loading on gimbal

0° QE~~72° QE~~ABOVE:
DYNAMIC

$$\begin{aligned} \sum M_A = 0 &= F_B \cdot 44'' \\ &- 34,052 \cdot 37 - 1420 \cdot 16 \\ &+ 34,052 \cdot 3 - 4876 \cdot 16 \\ &- 79K \cdot 37 \end{aligned}$$

$$F_B = \underline{\underline{95,034 \text{ LBS.}}}$$



$$\begin{aligned} \sum M_B = 0 &= F_A \cdot 44 \\ &+ 113,052 \cdot 7 - 1420 \cdot 16 \\ &- 4876 \cdot 16 - 34,052 \cdot 41 \end{aligned}$$

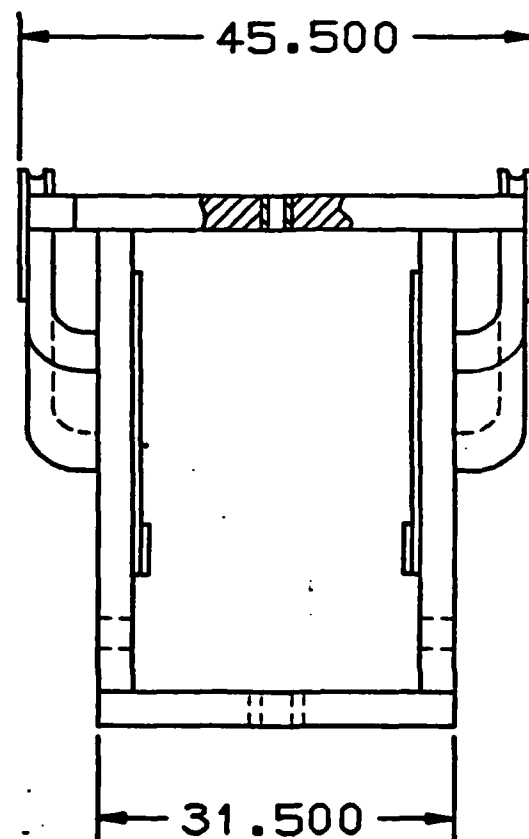
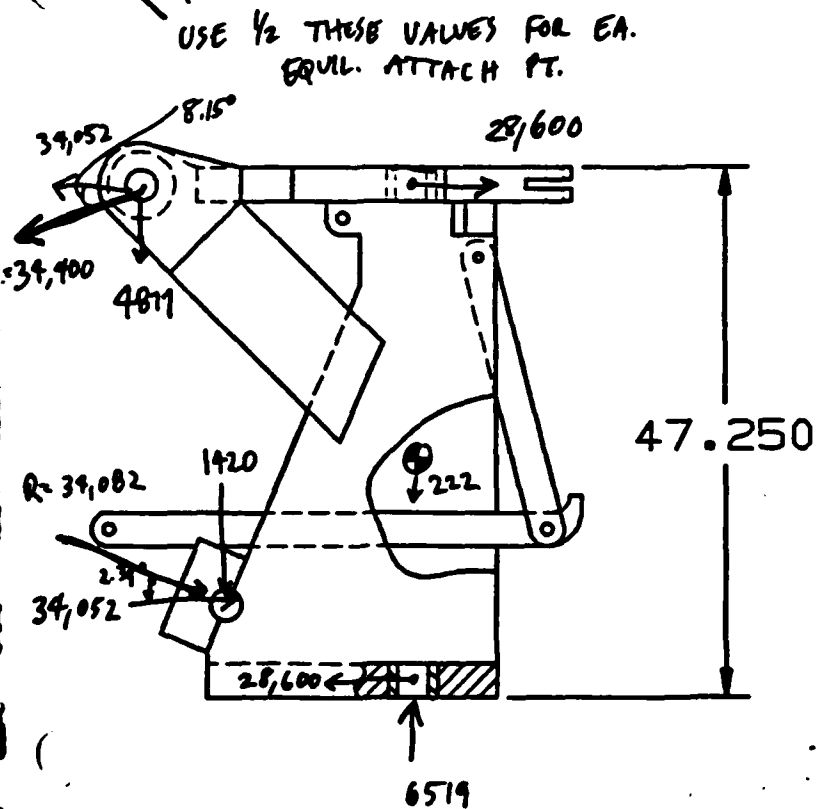
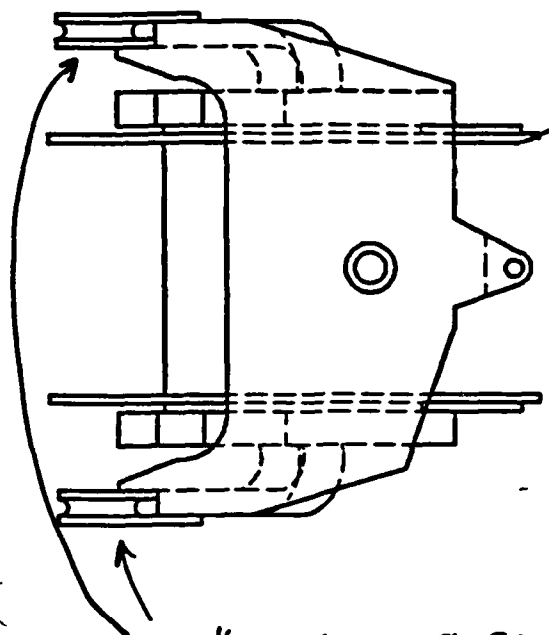
$$F_A = \underline{\underline{16,034}}$$

GIMBAL ASS'Y

LOAD CONDITION # 1 3

9/20/86

0° QE + TRAV.



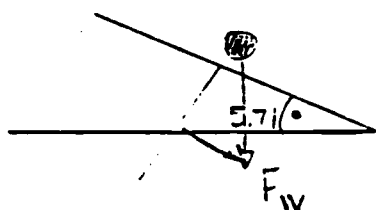
SCALE: 1/16

Forces the traverse cylinder sees
no S.F. included

34

From geometry, 22.5° traverse $\Rightarrow$ stroke = 11 in. P.Y. 11/6

Force to traverse barrel up 10% grade



$$T = R F_w \sin 5.71$$

$$T = 108 \text{ in-kip}$$

R = gimbal bearing is
(C.g.) =

$$\frac{161.7}{16.5}$$

$$= 178.2 \text{ in.}$$

1) hold (static)

Sum moments - gimbal pivot

$$\frac{108 \text{ in-kip}}{14'} = 7.7 \text{ kip}$$

$$F_w = 6077 \text{ lbs.}$$

2) accel.

assume moving $2 \frac{\text{deg}}{\text{sec}}$

$$\ddot{\theta} = .014$$

$$T = \frac{6077}{386} (178.2)^2 .014$$

$$= 7.0 \text{ kip}$$

$$\text{total} = 7.7 + 7.0 = \underline{14.7 \text{ kip}}$$

P.Y. 11/6

Force to resist rifling torque & 10% grade

rifling torque: 509 in-kip $\sin 72^\circ = 484$ in-kip

$$\frac{484}{14} = 34.6$$

rifling
static

$$34.6 \cos 10^\circ = 34.1 \text{ kip}$$

$$7.7 \text{ kip}$$

$$\text{total} = \underline{\underline{41.8 \text{ kip}}}$$

PART NUMBER: 12585788, Inner Breech Band

DESCRIPTION: INNER BREECH BAND

The breech band design consists of an inner breech band and an outer breech band. The two-piece design was developed to simplify disassembly of the tube and breech when the tube needs replacing after extended use or if other maintenance activities require disassembly.

STATUS:

A drawing of the inner breech band (TDP, Dwg. 12585788) was released and given to Benet for machining. The FEA model that was created to support the design can be found on the following pages of this section. With a load of 79,000 lb acting on the inner band, the factor of safety is 5.2 using 4340 steel for the band material. Two drawings of keys that interface with the inner breech band, breech key (TDP, Dwg. 12585966) and ring key (TDP, Dwg. 12585965) were also provided to Benet for machining.

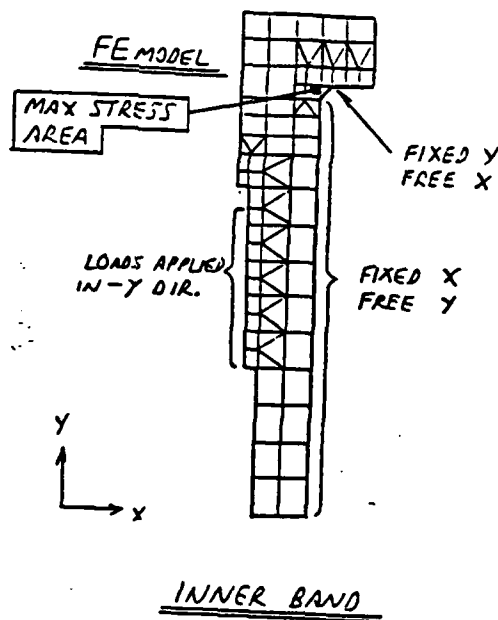
AUTHORS: Joe Turek, Joe Fishbein

INNER BREECH BAND

=====

The inner breech band was analyzed with a FEM of a cross-section. The inner radius of the flange is fixed vertically, and the outer part of the tube is free to translate vertically. Loads are applied where the threads engage the outer breech band.

The band is loaded by recoil of the gun at firing. Maximum load is 79,000 lb. The maximum resulting stress is 23,000 PSI, occurring at the corner between the tube and flange parts. For 4340 steel, with a yield strength of 120,000 PSI, the factor of safety (FS) is 5.2.

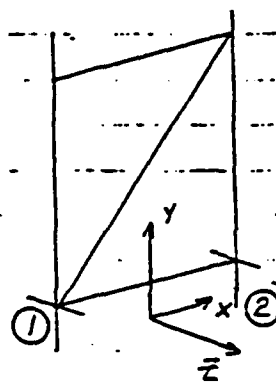


BREECH BANDS1. RECOIL THRUST - 79,000 LB.

NOTE: WHEN CHECKING STRESSES IN CYLINDER SOCKET OF OUTER BAND, IT WAS ASSUMED THAT ONE CYLINDER HAD FAILED, AND THRUST WAS CARRIED BY REMAINING THREE.

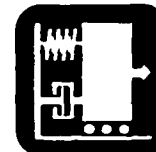
2. TRANSPORT - BUMP & SKID

FORCE	NODE 1	NODE 2
FX	-3700 lb	-3500 lb
FY	8600 lb	-16400 lb
FZ	3100 lb	-7600 lb
MX	0	0
MY	-9200 in.-lb	-1400 in.-lb
MZ	4900 in.-lb	26,200 in.-lb

3. TRANSPORT - 4.5G AIR DROP

FORCE	NODE 1	NODE 2
FX	-600 LB.	600 LB.
FY	-9800 LB.	-7700 LB.
FZ	100 LB.	-100 LB.
MX	0	0
MY	-22820 in.-LB.	20900 in.-lb
MZ	-27200 in.-lb.	23800 in.-lb

Subject LTHD	Analyst gmf	
	Project Number	
	EC. No.	Date 7-15-87



INNER BREACH BAND

LOADING: LOADING UNCERTAIN AT THIS TIME, SO APPLY
100,000 LB. AND SCALE RESULTS WHEN
ACTUAL LOADING IS KNOWN.

$$\text{CIRCUMFERENCE} = \pi(14.325 \text{ in}) = 45.00 \text{ in}$$

$$P = \frac{100,000 \text{ lb}}{45.00 \text{ in}} = 2222.06 \text{ lb/in}$$

FOR 0.1 in THICK "SLICE", TOTAL LOAD = 222.2 lb

DIVIDE AMONG 10 NODAL POINTS: 22.22 lb/POINT

MAX. TENSILE STRESS IN MODEL = 29,110 PSI IN ELEMENT 65

MAXIMUM RECOIL LOAD = 79,000 lb (PER J. DACKO, 1/19/87)

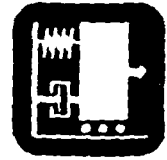
MAX STRESS IN BAND = 23,000 PSI

FOR 120 KSI MAT'L, FS = 5.2 AGAINST YIELDING

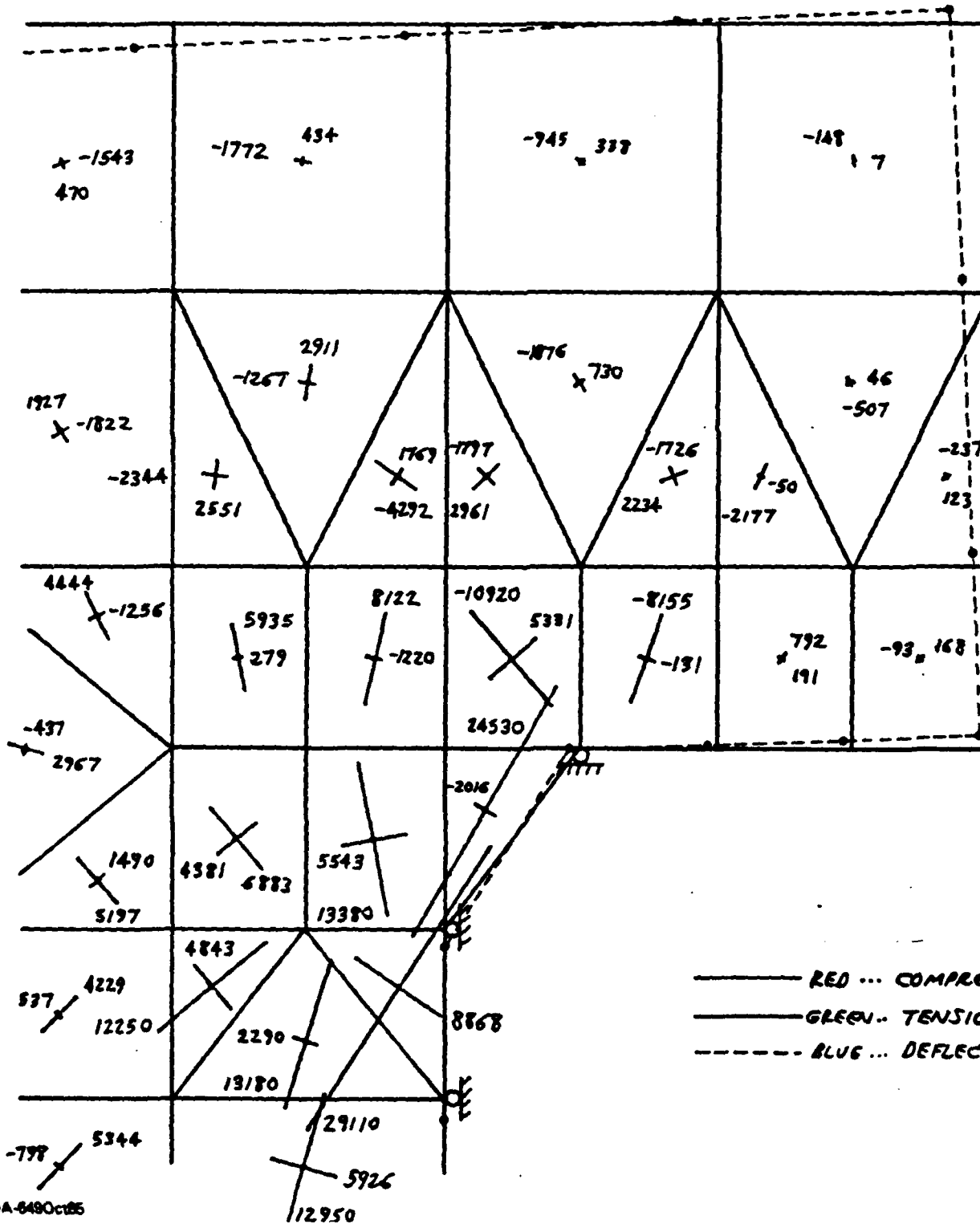
FMC Northern Ordnance Division
Minneapolis

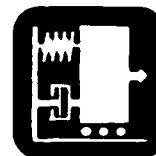
**APPLIED
MECHANICS**

Subject LTHD	Analyst Q177	
	Project Number	
	EC. No.	Date 1-16-87



INNER BREACH BAND - PRINCIPAL STRESSES





Subject LTHD	Analyst JMF	
	Project Number	
	EC. No.	Date 7-15-87

INNER BRACE BAND

LOADING: LOADING UNCERTAIN AT THIS TIME, SO APPLY
100,000 LB. AND SCALE RESULTS WHEN
ACTUAL LOADING IS KNOWN.

$$\text{CIRCUMFERENCE} = \pi(14.325 \text{ in}) = 45.00 \text{ in}$$

$$P = \frac{100,000 \text{ lb}}{45.00 \text{ in}} = 2222.06 \text{ lb/in}$$

FOR 0.1 in THICK "SLICE", TOTAL LOAD = 222.2 lb

DIVIDE AMONG 10 NODAL POINTS: 22.22 lb/POINT

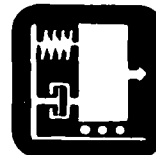
MAX. TENSILE STRESS IN MODEL = 29,110 PSI IN ELEMENT 65

MAXIMUM RECOIL LOAD = 79,000 lb (PER J. DACKO, 1/17/87)

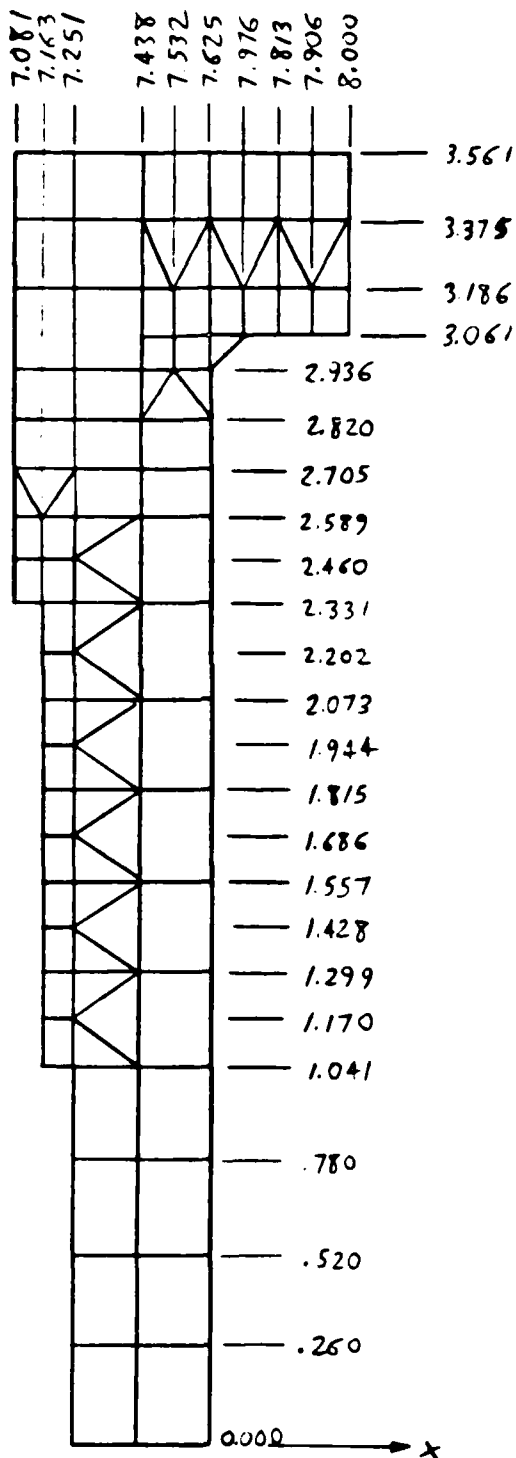
MAX STRESS IN BAND = 23,000 PSI

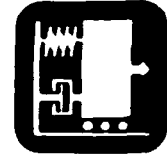
FOR 120 KSI MAT'L, FS = 5.2 AGAINST YIELDING

Subject LTHD	Analyst Q177	
	Project Number	
	EC. No.	Date 7-15-87



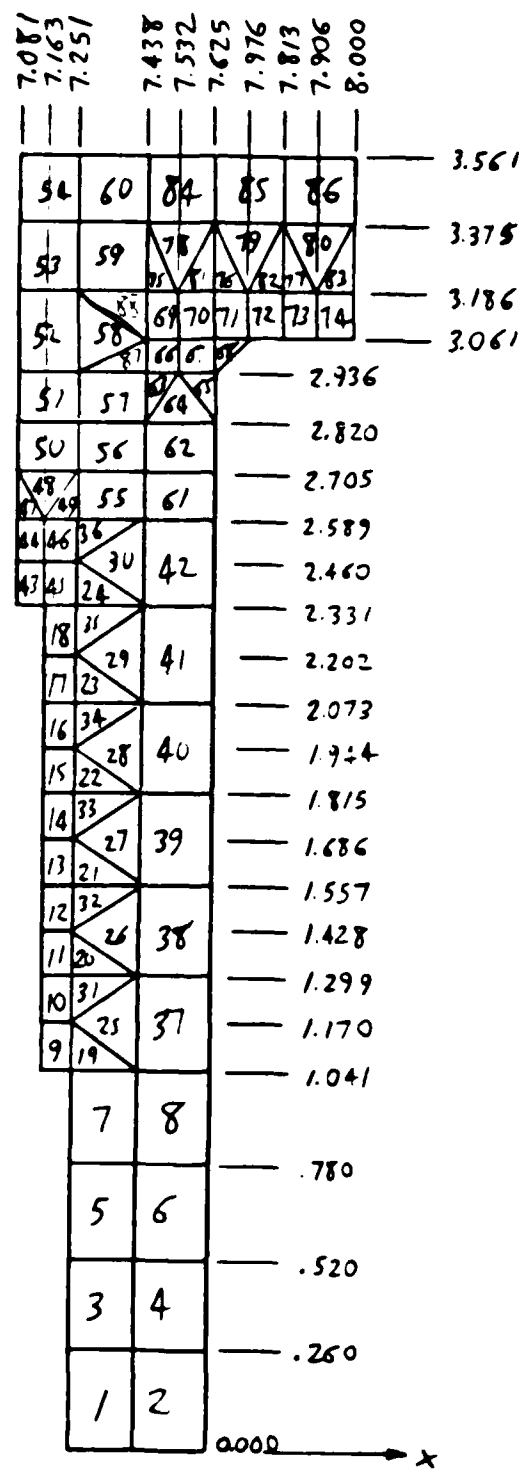
INNER BREACH
BAND



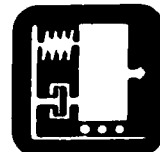


Subject LTHD	Analyst GMF	
	Project Number	
	EC. No.	Date 7-15-87

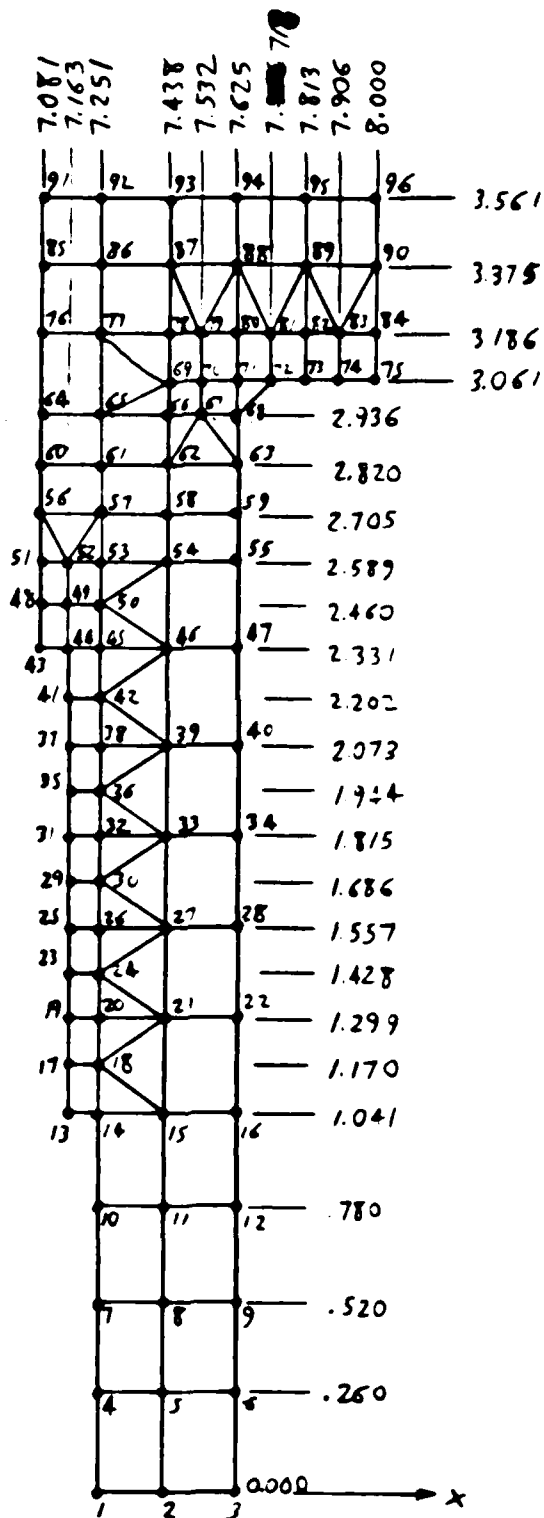
INNER BREACH
BAND



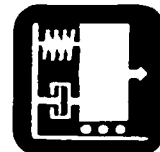
Subject LTHD	Analyst QMT	
	Project Number	
	EC. No.	Date 1-15-87



INNER BREACH
BAND

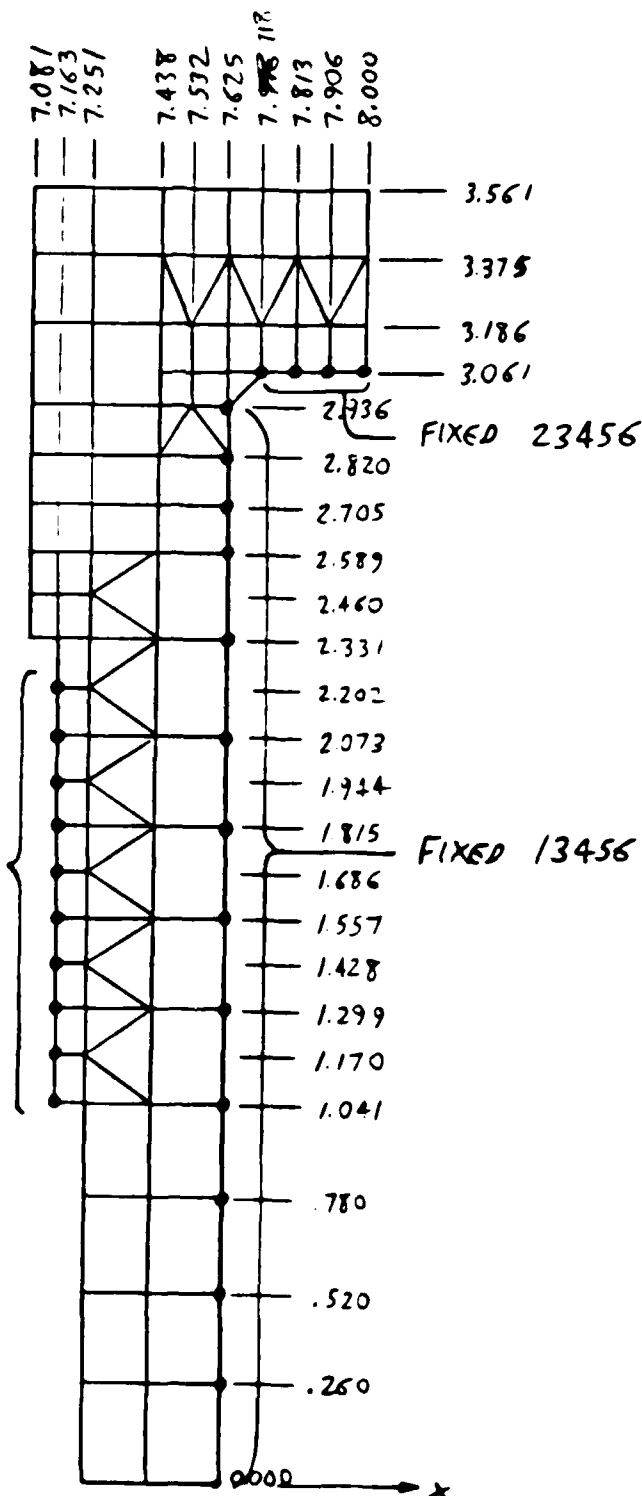


Subject LTHD	Analyst QMF	
	Project Number	
	EC. No.	Date 7-15-87

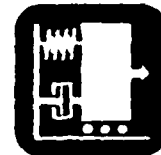


INNER BREACH
BAND

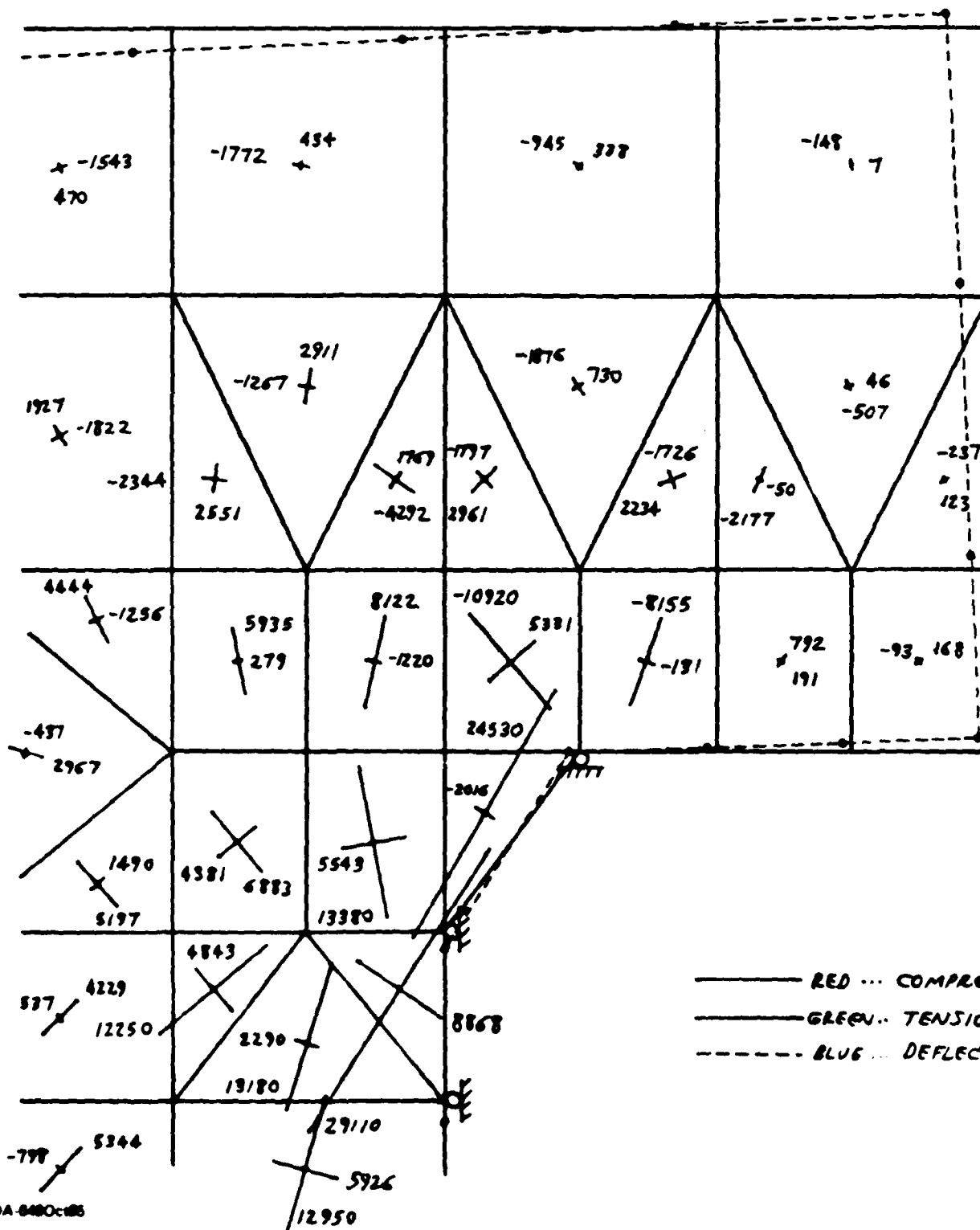
FORCES: 10 @ -22.22 lb
2 DIRECTION



Subject LT4D	Analyst J. H.	
	Project Number	
	EC. No.	Date 1-16-87



INNER BREACH BAND - PRINCIPAL STRESSES



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RENUMBER NODES Version 1.1 02/01/85

LTHD inner breach band under 100,000 lb. recoil

Node Renumbering Cross Reference List

Was	Is	Was	Is	Was	Is
1	1	2	2	3	5
4	4	5	3	6	6
7	8	8	7	9	9
10	11	11	10	12	12
13	19	14	14	15	13
16	15	17	20	18	16
19	22	20	21	21	17
22	18	23	26	24	23
25	28	26	27	27	24
28	25	29	32	30	29
31	34	32	33	33	30
34	31	35	38	36	35
37	40	38	39	39	36
40	37	41	44	42	41
43	51	44	46	45	45
46	42	47	43	48	52
49	50	50	47	51	58
52	54	53	53	54	48
55	49	56	59	57	56
58	55	59	57	60	63
61	61	62	60	63	62
64	67	65	65	66	64
67	66	68	68	69	70
70	69	71	73	72	74
73	82	74	90	75	95
76	72	77	71	78	76
79	75	80	77	81	81
82	83	83	91	84	96
85	79	86	78	87	80
88	84	89	89	90	93
91	86	92	85	93	87
94	88	95	92	96	94

Original Nodal Band 14
Final Nodal band 10

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PAGE 1

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ASSEMBLE STIFFNESS MATRIX Version 1.1 02/01/85

LTHD inner breach band under 100,000 lb. recoil

STIFFNESS ASSEMBLY SUMMARY

Number of Node Points.....	96
Number of Truss and Beam Elements.....	0
Number of Plate Elements.....	88
Number of Spring Elements.....	0
Number of Nodes with Restraints.....	15
Number of Blocks in the Matrix.....	2

BLOCK NUMBER 1

FORM Matrix
PACK Matrix
Size = 10240 Bytes
TRIANGULARIZE Matrix

BLOCK NUMBER 2

FORM Matrix
PACK Matrix
Size = 6856 Bytes
TRIANGULARIZE Matrix

Number of terms in the matrix.	2137
Largest column.....	20
Minimum Diagonal Stiffness =	.1098723D+07
Maximum Diagonal Stiffness =	.1023151D+08

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ASSEMBLE STIFFNESS MATRIX Version 1.1 02/01/85

LTHD inner breach band under 100,000 lb. recoil

CROSS REFERENCE LIST

Is Node Versus Internal Equation Number

Is Node	TRANSLATION			/	ROTATION		
	Eqn.	Eqn.	Eqn.		Eqn.	Eqn.	Eqn.
----	-----	-----	-----	/	-----	-----	-----
1	1	2					
2	3	4					
3	5	6					
4	7	8					
5		9					
6		10					
7	11	12					
8	13	14					
9		15					
10	16	17					
11	18	19					
12		20					
13	21	22					
14	23	24					
15		25					
16	26	27					
17	28	29					
18		30					
19	31	32					
20	33	34					
21	35	36					
22	37	38					
23	39	40					
24	41	42					
25		43					
26	44	45					
27	46	47					
28	48	49					
29	50	51					
30	52	53					
31		54					
32	55	56					
33	57	58					
34	59	60					
35	61	62					
36	63	64					
37		65					
38	66	67					
39	68	69					

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ASSEMBLE STIFFNESS MATRIX Version 1.1 02/01/85

LTHD inner breach band under 100,000 lb. recoil

Is	TRANSLATION			/	ROTATION		
Node	Eqn.	Eqn.	Eqn.	/	Eqn.	Eqn.	Eqn.
----	----	----	----	/	----	----	----
40	70	71					
41	72	73					
42	74	75					
43		76					
44	77	78					
45	79	80					
46	81	82					
47	83	84					
48	85	86					
49		87					
50	88	89					
51	90	91					
52	92	93					
53	94	95					
54	96	97					
55	98	99					
56	100	101					
57		102					
58	103	104					
59	105	106					
60	107	108					
61	109	110					
62		111					
63	112	113					
64	114	115					
65	116	117					
66	118	119					
67	120	121					
68		122					
69	123	124					
70	125	126					
71	127	128					
72	129	130					
73	131	132					
74	133						
75	134	135					
76	136	137					
77	138	139					
78	140	141					
79	142	143					

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ASSEMBLE STIFFNESS MATRIX Version 1.1 02/01/85

LTHD inner breach band under 100,000 lb. recoil

Is Node	TRANSLATION			/	ROTATION		
	Eqn.	Eqn.	Eqn.		Eqn.	Eqn.	Eqn.
80	144	145					
81	146	147					
82	148	149					
83	150	151					
84	152	153					
85	154	155					
86	156	157					
87	158	159					
88	160	161					
89	162	163					
90	164	165					
91	166	167					
92	168	169					
93	170	171					
94	172	173					
95	174	175					
96	176	177					

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SOLVE DISPLACEMENTS Version 1.1 02/01/85

LTHD inner breach band under 100,000 lb. recoil

L O A D C A S E 1

CONCENTRATED LOADS

Node	Fx	Fy	Fz	Mx	My	Mz
13	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
17	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
19	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
23	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
25	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
29	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
31	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
35	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
37	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
41	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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SOLVE DISPLACEMENTS Version 1.1 02/01/85

LTHD inner breach band under 100,000 lb. recoil

L O A D C A S E 1

APPLIED LOAD VECTOR

Node	Fx	Fy	Fz	Mx	My	Mz
13	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
17	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
19	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
23	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
25	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
29	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
31	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
35	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
37	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
41	.0000E+00	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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SOLVE DISPLACEMENTS Version 1.1 02/01/85

LTHD inner breach band under 100,000 lb. recoil

L O A D C A S E 1

DISPLACEMENTS

Node	T r a n s l a t i o n s			/	R o t a t i o n s		
	X	Y	Z		X	Y	Z
1	-.8766E-07	-.6928E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
2	-.6644E-07	-.6927E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
3	.0000E+00	-.6927E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
4	-.2354E-06	-.6926E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
5	-.2035E-06	-.6928E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
6	.0000E+00	-.6929E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
7	.3358E-07	-.6919E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
8	-.1914E-06	-.6927E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
9	.0000E+00	-.6938E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
10	.2977E-05	-.6903E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
11	.3046E-05	-.6938E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
12	.0000E+00	-.6920E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
13	.2186E-04	-.7328E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
14	.1276E-04	-.7006E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
15	.7211E-05	-.6881E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
16	.0000E+00	-.6865E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
17	.5889E-05	-.7173E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
18	.7359E-05	-.7018E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
19	.7251E-05	-.7104E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
20	.5583E-05	-.6983E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
21	.3003E-05	-.6818E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
22	.0000E+00	-.6756E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
23	.8165E-05	-.7029E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
24	.6615E-05	-.6916E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
25	.1021E-04	-.6938E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
26	.8154E-05	-.6826E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
27	.3830E-05	-.6671E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
28	.0000E+00	-.6616E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
29	.1240E-04	-.6825E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
30	.9899E-05	-.6717E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
31	.1501E-04	-.6692E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
32	.1210E-04	-.6586E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
33	.5902E-05	-.6439E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
34	.0000E+00	-.6388E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
35	.1792E-04	-.6538E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
36	.1463E-04	-.6436E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
37	.2163E-04	-.6361E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
38	.1763E-04	-.6263E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
39	.8865E-05	-.6115E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
40	.0000E+00	-.6073E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00

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SOLVE DISPLACEMENTS Version 1.1 02/01/85

LTHD inner breach band under 100,000 lb. recoil

L O A D C A S E 1

Node	T r a n s l a t i o n s			/	R o t a t i o n s		
	X	Y	Z		X	Y	Z
41	.2629E-04	-.6165E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
42	.2285E-04	-.6078E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
43	.3450E-04	-.5785E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
44	.3387E-04	-.5888E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
45	.2930E-04	-.5905E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
46	.1856E-04	-.5691E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
47	.0000E+00	-.5619E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
48	.4372E-04	-.5844E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
49	.4339E-04	-.5820E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
50	.4010E-04	-.5743E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
51	.3722E-04	-.5981E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
52	.4042E-04	-.5829E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
53	.3911E-04	-.5607E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
54	.2725E-04	-.5154E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
55	.0000E+00	-.4846E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
56	.2227E-04	-.6149E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
57	.2671E-04	-.5620E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
58	.2453E-04	-.4838E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
59	.0000E+00	-.4350E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
60	-.1493E-04	-.6436E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
61	-.3600E-05	-.5636E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
62	.3122E-05	-.4597E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
63	.0000E+00	-.3669E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
64	-.7481E-04	-.6764E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
65	-.6167E-04	-.5711E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
66	-.4672E-04	-.4390E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
67	-.2473E-04	-.3678E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
68	.0000E+00	-.2914E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
69	-.1558E-03	-.4288E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
70	-.1542E-03	-.3413E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
71	-.1671E-03	-.2196E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
72	-.1700E-03	.0000E+00	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
73	-.1688E-03	.4364E-04	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
74	-.1680E-03	.1466E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
75	-.1673E-03	.2443E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
76	-.2863E-03	-.7362E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
77	-.2821E-03	-.5773E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
78	-.2898E-03	-.4140E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
79	-.2997E-03	-.3076E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
80	-.3067E-03	-.1849E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
81	-.3054E-03	-.6626E-04	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00

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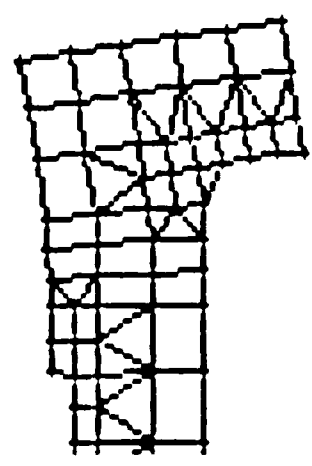
SOLVE DISPLACEMENTS Version 1.1 02/01/85

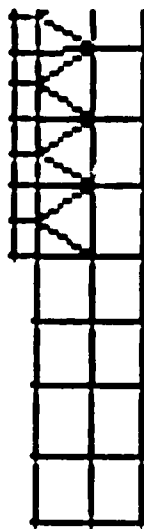
LTHD inner breach band under 100,000 lb. recoil

L O A D C A S E 1

Node	T r a n s l a t i o n s			/	R o t a t i o n s		
	X	Y	Z		X	Y	Z
82	-.2987E-03	.4954E-04	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
83	-.2983E-03	.1449E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
84	-.2988E-03	.2462E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
85	-.4868E-03	-.7545E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
86	-.4870E-03	-.5814E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
87	-.4948E-03	-.3933E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
88	-.5075E-03	-.1822E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
89	-.5061E-03	.3853E-04	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
90	-.5053E-03	.2466E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
91	-.6845E-03	-.7582E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
92	-.6869E-03	-.5811E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
93	-.6973E-03	-.3851E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
94	-.7081E-03	-.1790E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
95	-.7148E-03	.3509E-04	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
96	-.7149E-03	.2482E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00

MAX Δx





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SOLVE PLATE LOADS/STRESSES Version 1.1 02/01/85

LTHD inner breach band under 100,000 lb. recoil

Load Case 1:

PLATE LOADS AND/OR STRESSES

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
QUAD PLATE NO. 1							
Loads	1	-.1667E-13	.1790E-11	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	2	.1507E+00	-.1216E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	5	.7166E-02	-.8783E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	4	-.1578E+00	.2095E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.6070E+01	.6505E+01	-.8057E+01	.1435E+02	-.1772E+01	-45.8
QUAD PLATE NO. 2							
Loads	2	-.1507E+00	.1216E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	3	.2507E+00	-.7085E-11	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	6	.2427E+00	-.1390E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	5	-.3427E+00	.1740E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.1898E+02	-.6505E+01	-.5348E+01	.2005E+02	-.7582E+01	-11.4
QUAD PLATE NO. 3							
Loads	4	.1578E+00	-.2095E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	5	.2695E+00	-.5775E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	8	-.3304E+00	-.1659E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	7	-.9687E-01	.8036E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2344E+01	.4208E+02	-.2285E+02	.5174E+02	-.1200E+02	-67.1
QUAD PLATE NO. 4							
Loads	5	.6611E-01	.6479E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	6	.5420E+00	.1390E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	9	-.7425E-01	-.9845E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	8	-.5339E+00	.1976E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.1799E+02	-.4208E+02	-.3252E+02	.3222E+02	-.5632E+02	-23.6
QUAD PLATE NO. 5							
Loads	7	.9687E-01	-.8036E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	8	-.1820E+00	.2442E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	11	.1006E+00	-.1259E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	10	-.1546E-01	.6852E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.3131E+01	.2991E+02	.4551E+01	.3053E+02	-.3746E+01	62.3
QUAD PLATE NO. 6							
Loads	8	.1046E+01	-.4252E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	9	-.2766E+01	.9845E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	12	-.3222E+01	.1407E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	11	.4941E+01	-.1966E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2303E+03	-.2991E+02	.9197E+02	.5898E+01	-.2661E+02	68.7
QUAD PLATE NO. 7							
Loads	10	.1546E-01	-.6852E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	11	-.1058E+02	.8547E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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Version 1.1 02/01/85

LTHD inner breach band under 100,000 lb. recoil

Load Case 1:

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
Loads	15	-.3806E+01	.6195E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	14	.1437E+02	-.1406E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.5511E+03	-.4204E+03	.5648E+03	.8285E+02	-.1054E+04	48.3
QUAD PLATE NO. 8							
Loads	11	.5536E+01	-.6455E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	12	-.9119E+01	-.1407E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	16	-.8346E+01	.6407E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	15	.1193E+02	.1454E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.6692E+03	.4204E+03	.1916E+03	.4531E+03	-.7019E+03	80.3
QUAD PLATE NO. 9							
Loads	13	.8768E-12	-.2222E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	14	-.1848E+02	.1037E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	18	.7486E+01	.1672E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	17	.1100E+02	-.4875E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.8525E+03	.1346E+04	.2100E+04	.2618E+04	-.2124E+04	58.8
QUAD PLATE NO. 10							
Loads	17	-.1100E+02	-.1735E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	18	-.4267E+01	.6148E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	20	.8773E+01	.1623E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	19	.6491E+01	-.5030E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.3493E+03	.1272E+04	.1735E+04	.2606E+04	-.9841E+03	52.5
QUAD PLATE NO. 11							
Loads	19	-.6491E+01	-.1719E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	20	-.7315E+01	.3324E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	24	.6574E+01	.1691E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	23	.7232E+01	-.3049E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.5745E+02	.1576E+04	.1569E+04	.2528E+04	-.1010E+04	58.7
QUAD PLATE NO. 12							
Loads	23	-.7232E+01	-.1917E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	24	-.6635E+01	.1213E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	26	.6876E+01	.1911E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	25	.6991E+01	-.1157E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.1866E+02	.2041E+04	.1576E+04	.2902E+04	-.8426E+03	61.3
QUAD PLATE NO. 13							
Loads	25	-.6991E+01	-.2106E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	26	-.6717E+01	-.8500E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	30	.6672E+01	.2094E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	29	.7035E+01	.9689E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.3430E+01	.2490E+04	.1558E+04	.3239E+04	-.7519E+03	64.3
QUAD PLATE NO. 14							
Loads	29	-.7035E+01	-.2319E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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Version 1.1 02/01/85

LTHD inner breach band under 100,000 lb. recoil

Load Case 1:

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
Loads	30	-.6747E+01	-.2952E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	32	.6750E+01	.2316E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	31	.7033E+01	.2985E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.2088E+00	.2971E+04	.1566E+04	.3644E+04	-.6730E+03	66.7
QUAD PLATE NO. 15							
Loads	31	-.7033E+01	-.2520E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	32	-.6662E+01	-.4969E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	36	.6758E+01	.2504E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	35	.6937E+01	.5129E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.7382E+01	.3429E+04	.1556E+04	.4031E+04	-.5946E+03	68.9
QUAD PLATE NO. 16							
Loads	35	-.6937E+01	-.2735E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	36	-.6777E+01	-.7126E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	38	.6437E+01	.2723E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	37	.7278E+01	.7244E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2642E+02	.3918E+04	.1559E+04	.4459E+04	-.5679E+03	70.8
QUAD PLATE NO. 17							
Loads	37	-.7278E+01	-.2946E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	38	-.6816E+01	-.8436E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	42	.7678E+01	.2910E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	41	.6416E+01	.8803E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.6682E+02	.4307E+04	.1602E+04	.4844E+04	-.4702E+03	71.5
QUAD PLATE NO. 18							
Loads	41	-.6416E+01	-.3102E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	42	-.2816E+01	-.1405E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	45	.5609E+01	.2758E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	44	.3623E+01	.1749E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.2165E+03	.5122E+04	.1049E+04	.5337E+04	.1586E+01	78.4
TRIANGULAR PLATE NO. 19							
Loads	14	.4115E+01	.3684E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	15	-.6680E+01	.1769E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	18	.2565E+01	-.5453E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1036E+04	-.5832E+03	.2743E+03	-.4539E+03	-.1165E+04	64.8
TRIANGULAR PLATE NO. 20							
Loads	20	-.1035E+02	-.2107E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	21	.3513E+00	.6898E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	24	.9999E+01	.1417E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.5446E+02	.1515E+04	.1069E+04	.2080E+04	-.5101E+03	62.2
TRIANGULAR PLATE NO. 21							
Loads	26	-.1054E+02	-.3007E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	27	.4584E+00	.6957E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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Version 1.1 02/01/85

LTHD inner breach band under 100,000 lb. recoil

Load Case 1:

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
Loads	30	.1008E+02	.2311E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.7107E+02	.2472E+04	.1079E+04	.2885E+04	-.3423E+03	69.0
TRIANGULAR PLATE NO. 22							
Loads	32	-.1059E+02	-.3875E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	33	.3534E+00	.7062E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	36	.1024E+02	.3168E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.5479E+02	.3389E+04	.1095E+04	.3716E+04	-.2727E+03	73.4
TRIANGULAR PLATE NO. 23							
Loads	38	-.1167E+02	-.4716E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	39	-.7902E+00	.8596E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	42	.1246E+02	.3857E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1225E+03	.4125E+04	.1333E+04	.4508E+04	-.5060E+03	73.9
TRIANGULAR PLATE NO. 24							
Loads	45	-.1660E+02	-.4650E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	46	-.4068E+01	.1426E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	50	.2067E+02	.3224E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.6308E+03	.3448E+04	.2211E+04	.4417E+04	-.1599E+04	66.3
TRIANGULAR PLATE NO. 25							
Loads	18	.1945E+01	-.1057E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	15	-.8633E+01	-.9044E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	21	.6688E+01	.1147E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.6546E+03	.1166E+04	-.8889E+02	.1170E+04	-.6589E+03	-87.2
TRIANGULAR PLATE NO. 26							
Loads	24	-.2089E-01	-.1365E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	21	-.9884E+01	-.8686E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	27	.9905E+01	.2234E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.4532E+03	.2114E+04	-.3989E+03	.2174E+04	-.5138E+03	-81.4
TRIANGULAR PLATE NO. 27							
Loads	30	-.3033E-01	-.1366E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	27	-.9888E+01	-.1757E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	33	.9919E+01	.3123E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1471E+03	.2759E+04	-.8425E+03	.2986E+04	-.3737E+03	-74.9
TRIANGULAR PLATE NO. 28							
Loads	36	.4548E+00	-.1387E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	33	-.1028E+02	-.2698E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	39	.9826E+01	.4085E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.1405E+03	.3452E+04	-.1330E+04	.3920E+04	-.3276E+03	-70.6
TRIANGULAR PLATE NO. 29							
Loads	42	-.1775E+00	-.1885E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	39	-.1357E+02	-.3519E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	46	.1375E+02	.5404E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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Version 1.1 02/01/85

LTHD inner breach band under 100,000 lb. recoil

Load Case 1:

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
Stress	MEM	.1818E+03	.4603E+04	-.1705E+04	.5184E+04	-.3992E+03	-71.2
		TRIANGULAR PLATE NO. 30					
Loads	50	.1212E+02	-.2954E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	46	-.2747E+02	-.3906E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	54	.1535E+02	.6860E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.9206E+03	.5738E+04	-.2317E+04	.6465E+04	-.1648E+04	-72.6
		TRIANGULAR PLATE NO. 31					
Loads	18	-.7729E+01	-.6848E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	21	-.1164E+01	.5331E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	20	.8893E+01	.1516E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.8866E+03	-.3347E+03	.7202E+03	.1220E+04	-.6683E+03	24.9
		TRIANGULAR PLATE NO. 32					
Loads	24	-.9917E+01	-.1865E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	27	-.4660E+00	.6841E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	26	.1038E+02	.1180E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.1586E+04	.3364E+03	.1343E+04	.2442E+04	-.5198E+03	32.5
		TRIANGULAR PLATE NO. 33					
Loads	30	-.9979E+01	-.2744E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	33	-.5243E+00	.6884E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	32	.1050E+02	.2056E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.1889E+04	.9647E+03	.1789E+04	.3274E+04	-.4207E+03	37.8
		TRIANGULAR PLATE NO. 34					
Loads	36	-.1067E+02	-.3573E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	39	-.1377E+01	.7362E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	38	.1205E+02	.2837E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.2155E+04	.1453E+04	.2291E+04	.4122E+04	-.5141E+03	40.7
		TRIANGULAR PLATE NO. 35					
Loads	42	-.1715E+02	-.3477E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	46	-.3546E+01	.1183E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	45	.2069E+02	.2294E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.2541E+04	.6280E+03	.2646E+04	.4398E+04	-.1229E+04	35.1
		TRIANGULAR PLATE NO. 36					
Loads	50	-.2447E+02	-.2583E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	54	-.6517E+01	.1688E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	53	.3099E+02	.8954E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.2653E+04	-.9002E+03	.2693E+04	.4102E+04	-.2350E+04	28.3
		QUAD PLATE NO. 37					
Loads	15	.7188E+01	-.8515E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	16	-.9875E+01	-.6407E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	22	-.4382E+01	.1011E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	21	.7069E+01	.4808E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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LTHD inner breach band under 100,000 lb. recoil

Load Case 1:

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
Stress	MEM	-.5526E+03	.7980E+03	.1437E+03	.8131E+03	-.5677E+03	84.0
QUAD PLATE NO. 38							
Loads	21	-.3060E+01	-.1982E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	22	-.3786E+01	-.1011E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	28	.2508E+01	.1956E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	27	.4338E+01	.1038E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.4954E+02	.1601E+04	.3661E+03	.1679E+04	-.1271E+03	78.0
QUAD PLATE NO. 39							
Loads	27	-.4347E+01	-.2895E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	28	-.2358E+01	-.1956E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	34	.2966E+01	.2881E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	33	.3739E+01	.1970E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.2355E+02	.2594E+04	.3586E+03	.2643E+04	-.2553E+02	82.2
QUAD PLATE NO. 40							
Loads	33	-.3206E+01	-.3789E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	34	-.3162E+01	-.2881E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	40	.1230E+01	.3759E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	39	.5138E+01	.2911E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.7488E+02	.3567E+04	.3405E+03	.3599E+04	-.1064E+03	84.7
QUAD PLATE NO. 41							
Loads	39	.7767E+00	-.5073E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	40	-.1106E+02	-.3759E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	47	-.7241E+01	.5179E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	46	.1753E+02	.3654E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.7095E+03	.4723E+04	.5501E+03	.4778E+04	-.7646E+03	84.3
QUAD PLATE NO. 42							
Loads	46	.3803E+01	-.7760E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	47	-.2849E+02	-.5179E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	55	-.9600E+01	.8585E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	54	.3429E+02	.4354E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1476E+04	.6919E+04	.1320E+04	.7122E+04	-.1679E+04	81.3
QUAD PLATE NO. 43							
Loads	43	-.3468E-11	-.4824E-11	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	44	-.2251E+01	-.3544E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	49	.2302E+00	.3896E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	48	.2021E+01	-.3542E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1567E+03	.4322E+02	.2745E+03	.2354E+03	-.3489E+03	55.0
QUAD PLATE NO. 44							
Loads	48	-.2021E+01	.3542E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	49	-.4448E+01	.9782E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	52	.4701E+01	.3947E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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LTHD inner breach band under 100,000 lb. recoil

Load Case 1:

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress	Stress	Shear XZ	Shear YZ				
Stress	MEM	.1959E+02	-.1625E+04	.7889E+03	.3368E+03	-.1942E+04	21.9
QUAD PLATE NO. 45							
Loads	44	-.1372E+01	-.1714E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	45	-.9698E+01	-.4020E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	50	.2281E+01	.2025E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	49	.8788E+01	.9081E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.5749E+03	.2404E+04	.1258E+04	.2864E+04	-.1035E+04	69.9
QUAD PLATE NO. 46							
Loads	49	-.4571E+01	-.1459E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	50	-.1060E+02	.2881E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	53	.5976E+01	.1936E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	52	.9197E+01	-.7657E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.3586E+03	.1330E+04	.1724E+04	.2406E+04	-.1434E+04	58.0
TRIANGULAR PLATE NO. 47							
Loads	51	-.1768E+01	.1372E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	52	-.8219E+00	.3664E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	56	.2590E+01	-.1738E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1417E+03	-.4240E+04	.6318E+03	-.4652E+02	-.4335E+04	6.6
TRIANGULAR PLATE NO. 48							
Loads	56	.6776E+01	-.1794E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	52	-.1643E+02	.1300E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	57	.9656E+01	.4942E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2743E+04	.1512E+04	.2166E+03	.1523E+04	-.2754E+04	87.1
TRIANGULAR PLATE NO. 49							
Loads	52	.3356E+01	-.9401E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	53	-.1049E+02	.1157E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	57	.7132E+01	-.2169E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.5786E+03	-.4930E+03	.1621E+04	.1086E+04	-.2157E+04	45.8
QUAD PLATE NO. 50							
Loads	56	-.9366E+01	.3532E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	57	-.9100E+01	.2848E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	61	.1162E+02	-.1599E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	60	.6846E+01	-.4782E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.2191E+03	-.3753E+04	.1086E+04	.4967E+03	-.4031E+04	14.3
QUAD PLATE NO. 51							
Loads	60	-.6846E+01	.4782E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	61	-.1016E+00	.3460E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	65	.7442E+01	-.2986E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	64	-.4946E+00	-.5256E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.6328E+03	-.4848E+04	.4087E+03	.6631E+03	-.4879E+04	4.2

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LTHD inner breach band under 100,000 lb. recoil

Load Case 1:

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				

QUAD PLATE NO. 52							
Loads	64	.4946E+00	.5256E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	65	.1599E+02	.1073E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	77	-.6805E+01	-.3497E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	76	-.9681E+01	-.2831E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.3674E+03	-.3723E+04	-.9698E+03	.5857E+03	-.3941E+04	-12.7
QUAD PLATE NO. 53							
Loads	76	.9681E+01	.2831E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	77	.8570E+01	.1829E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	86	-.1208E+02	-.2212E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	85	-.6171E+01	-.8022E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1857E+03	-.1773E+04	-.1074E+04	.3557E+03	-.2314E+04	-26.8
QUAD PLATE NO. 54							
Loads	85	.6171E+01	.8022E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	86	.1161E+01	-.1788E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	92	-.7331E+01	-.6234E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	91	.1084E-10	-.3561E-11	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.3318E+03	-.3667E+03	-.4313E+03	.8238E+02	-.7809E+03	-43.8
QUAD PLATE NO. 55							
Loads	53	-.2647E+02	-.3989E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	54	-.2878E+02	-.3120E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	58	.2938E+02	.6548E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	57	.2588E+02	.5613E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.5167E+02	.3802E+04	.2955E+04	.5426E+04	-.1573E+04	61.2
QUAD PLATE NO. 56							
Loads	57	-.3356E+02	-.3687E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	58	-.2103E+02	-.2347E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	62	.3621E+02	.5705E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	61	.1838E+02	.3292E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.1320E+04	.3227E+04	.2919E+04	.5344E+04	-.7977E+03	54.0
QUAD PLATE NO. 57							
Loads	61	-.2990E+02	-.2191E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	62	-.4617E+01	-.2247E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	66	.3237E+02	.4389E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	65	.2152E+01	.4957E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.2392E+04	.2373E+04	.1846E+04	.4229E+04	.5368E+03	44.9
TRIANGULAR PLATE NO. 58							
Loads	65	-.4797E+01	.7059E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	69	.3134E+02	-.1454E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	77	-.2655E+02	.7479E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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LTHD inner breach band under 100,000 lb. recoil

Load Case 1:

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress	Stress	Shear XZ	Shear YZ				
Stress	MEM	.6653E+03	.1865E+04	-.1593E+04	.2967E+04	-.4369E+03	-55.3
QUAD PLATE NO. 59							
Loads	77	.2360E+02	.1177E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	78	.6582E+01	-.3058E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	87	-.2361E+02	.7849E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	86	-.6577E+01	.1874E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.9008E+03	.1006E+04	-.1614E+04	.1927E+04	-.1822E+04	-60.3
QUAD PLATE NO. 60							
Loads	86	.1750E+02	.5170E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	87	-.6031E+01	-.1006E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	93	-.1880E+02	-.1345E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	92	.7331E+01	.6234E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1335E+04	.2614E+03	-.6131E+03	.4698E+03	-.1543E+04	-71.2
QUAD PLATE NO. 61							
Loads	54	-.1434E+02	-.9781E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	55	-.2755E+02	-.8585E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	59	.1516E+02	.1118E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	58	.2674E+02	.7182E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1069E+04	.9821E+04	.2240E+04	.1026E+05	-.1511E+04	78.8
QUAD PLATE NO. 62							
Loads	58	-.3508E+02	-.1138E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	59	-.2447E+02	-.1118E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	63	.4145E+02	.1485E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	62	.1811E+02	.7720E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.1476E+04	.1207E+05	.3185E+04	.1295E+05	.5926E+03	74.5
TRIANGULAR PLATE NO. 63							
Loads	67	.5315E+02	.2118E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	66	-.3598E+02	.1609E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	62	-.1717E+02	-.3727E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.9164E+04	.7931E+04	.3652E+04	.1225E+05	.4843E+04	40.2
TRIANGULAR PLATE NO. 64							
Loads	62	-.3253E+02	-.7450E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	63	.4393E+01	-.4020E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	67	.2814E+02	.1147E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.3196E+04	.1227E+05	.3010E+04	.1318E+05	.2289E+04	73.2
TRIANGULAR PLATE NO. 65							
Loads	68	.1279E+03	.1614E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	67	-.8524E+02	-.5316E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	63	-.4262E+02	-.1083E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.1470E+05	.2328E+05	.9165E+04	.2911E+05	.8868E+04	57.5
QUAD PLATE NO. 66							
Loads	66	-.3450E+02	-.1697E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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Load Case 1:

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
Loads	67	.4603E+02	-.3825E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	70	.2134E+02	.2290E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	69	-.3288E+02	.3231E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.5390E+04	.5874E+04	-.1227E+04	.6883E+04	.4381E+04	-50.6
QUAD PLATE NO. 67							
Loads	67	-.4208E+02	-.4449E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	68	.5468E+02	-.7769E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	71	.1763E+02	.6076E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	70	-.3022E+02	.6141E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.5784E+04	.1314E+05	-.1354E+04	.1338E+05	.5543E+04	-79.9
TRIANGULAR PLATE NO. 68							
Loads	72	.2818E+02	.7143E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	71	.2497E+02	.1229E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	68	-.5315E+02	-.8373E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.4509E+04	.1801E+05	.1143E+05	.2453E+05	-.2016E+04	60.3
QUAD PLATE NO. 69							
Loads	69	-.1923E+01	-.1763E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	70	.1099E+02	-.3657E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	79	-.5376E+01	.2451E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	78	-.3689E+01	.2968E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.4489E+03	.5765E+04	-.9643E+03	.5935E+04	.2794E+03	-80.0
QUAD PLATE NO. 70							
Loads	70	-.2109E+01	-.4775E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	71	-.1592E+02	-.2387E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	80	.5929E+01	.4810E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	79	.1210E+02	.2352E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.7990E+03	.7701E+04	.1938E+04	.8122E+04	-.1220E+04	77.7
QUAD PLATE NO. 71							
Loads	71	-.2668E+02	-.4919E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	72	-.4789E+02	.8736E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	81	.2935E+02	.1287E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	80	.4522E+02	-.5104E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1484E+04	-.4104E+04	.8018E+04	.5331E+04	+.1092E+05	40.4
QUAD PLATE NO. 72							
Loads	72	.1971E+02	.6341E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	73	.3834E+01	.5918E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	82	-.1619E+02	-.3690E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	81	-.7357E+01	-.3243E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.9885E+03	-.7298E+04	-.2479E+04	-.1312E+03	-.8155E+04	-19.1
QUAD PLATE NO. 73							
Loads	73	-.3834E+01	-.5918E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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LTHD inner breach band under 100,000 lb. recoil

Load Case 1:

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
Loads	74	.1229E+01	.3228E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	83	.3545E+01	.3179E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	82	-.9392E+00	.2416E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.3818E+03	.6016E+03	.2801E+03	.7926E+03	.1908E+03	55.7
QUAD PLATE NO. 74							
Loads	74	-.1229E+01	-.3228E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	75	-.4012E-12	-.2740E-11	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	84	.5121E+00	.1634E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	83	.7164E+00	-.1311E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.4097E+02	.3434E+02	.1307E+03	.1684E+03	-.9309E+02	44.3
TRIANGULAR PLATE NO. 75							
Loads	78	.1907E+02	-.1677E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	79	-.2159E+02	.5064E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	87	.2518E+01	.1171E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2285E+04	.2492E+04	.5358E+03	.2551E+04	-.2344E+04	83.7
TRIANGULAR PLATE NO. 76							
Loads	80	-.1642E+02	-.2525E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	81	.5359E+01	.2248E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	88	.1106E+02	.2773E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.5671E+03	.5964E+03	.2379E+04	.2961E+04	-.1797E+04	45.2
TRIANGULAR PLATE NO. 77							
Loads	82	.7616E+01	.1599E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	83	-.3897E+01	-.7558E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	89	-.3719E+01	-.8437E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.4124E+03	-.1814E+04	-.7998E+03	-.4986E+02	-.2177E+04	-24.4
TRIANGULAR PLATE NO. 78							
Loads	88	-.7518E+01	.1975E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	87	.1409E+02	.6331E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	79	-.6571E+01	-.2608E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1145E+04	.2790E+04	.7028E+03	.2911E+04	-.1267E+04	80.2
TRIANGULAR PLATE NO. 79							
Loads	89	.4790E+01	.6505E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	88	.6575E+01	-.1645E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	81	-.1137E+02	.9946E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.8808E+02	-.1058E+04	.1209E+04	.7296E+03	-.1876E+04	34.1
TRIANGULAR PLATE NO. 80							
Loads	90	.6587E+00	-.4086E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	89	.9812E+00	-.3746E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	83	-.1640E+01	.4154E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1660E+02	-.4443E+03	.1754E+03	.4613E+02	-.5070E+03	19.7

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LTHD inner breach band under 100,000 lb. recoil

Load Case 1:

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				

TRIANGULAR PLATE NO. B1							
Loads	79	.2144E+02	-.2701E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	80	-.3473E+02	.2819E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	88	.1329E+02	-.1183E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2269E+04	-.2544E+03	.2858E+04	.1769E+04	-.4292E+04	54.7
TRIANGULAR PLATE NO. B2							
Loads	81	-.1598E+02	-.1287E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	82	.9514E+01	.1849E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	89	.6469E+01	-.5620E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.1691E+04	-.1183E+04	.1362E+04	.2234E+04	-.1726E+04	21.7
TRIANGULAR PLATE NO. B3							
Loads	83	.1276E+01	.1536E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	84	-.5121E+00	-.1634E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	90	-.7637E+00	.9822E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1350E+03	.2090E+02	-.1625E+03	.1232E+03	-.2373E+03	-57.8
QUAD PLATE NO. B4							
Loads	87	.1303E+02	-.8061E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	88	-.1978E+02	.1078E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	94	-.1204E+02	.5638E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	93	.1880E+02	.1345E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1711E+04	.3734E+03	.3611E+03	.4342E+03	-.1772E+04	80.4
QUAD PLATE NO. B5							
Loads	88	-.3628E+01	-.5969E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	89	-.8104E+01	.8877E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	95	-.3120E+00	.2730E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	94	.1204E+02	-.5638E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.4525E+03	-.1547E+03	.6241E+03	.3380E+03	-.9452E+03	51.7
QUAD PLATE NO. B6							
Loads	89	-.4170E+00	.2420E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	90	.1050E+00	.3104E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	96	.1271E-11	.7923E-11	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	95	.3120E+00	-.2730E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.5643E+01	-.1460E+03	.1669E+02	.7457E+01	-.1478E+03	6.2
TRIANGULAR PLATE NO. B7							
Loads	65	-.2079E+02	.1158E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	66	.3811E+02	-.4301E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	69	-.1733E+02	.3143E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	.3326E+04	.3361E+04	-.1853E+04	.5197E+04	.1490E+04	-45.3
TRIANGULAR PLATE NO. B8							
Loads	78	-.2197E+02	.1768E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	77	.1180E+01	.1389E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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Version 1.1 02/01/85

LTHD inner breach band under 100,000 lb. recoil

Load Case 1:

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
Loads	69	.2079E+02	-.3157E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1888E+03	.3377E+04	-.2223E+04	.4444E+04	-.1256E+04	-64.4

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===== I M A G E S 3 D =====
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SOLVE PLATE LOADS/STRESSES Version 1.1 02/01/85

LTHD inner breach band under 100,000 lb. recoil

Load Case 1:

MAXIMUM STRESS SUMMARY FOR PLATES
WITHIN SPECIFIED RANGE

Maximum (absolute) Stress = .2328E+05 at Plate 65

Plate	Sigma X	Sigma Y	Tau XY
65	.1470E+05	.2328E+05	.9165E+04

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PAGE 1

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SOLVE REACTIONS

Version 1.1 02/01/85

LTHD inner breach band under 100,000 lb. recoil

Load Case 1:

REACTIONS

Node	Fx	Fy	Fz	Mx	My	Mz
3	.2507E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
6	.7847E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
9	-.2840E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
12	-.1234E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
16	-.1822E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
22	-.8168E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
28	.1495E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
34	-.1958E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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COMBINE RESULTS Version 1.3 03/08/86

Combined Reactions

Load Combination Method

File switched to IBBAND.REA

Load Case 1

Factor 1

Node	Fx	Fy	Fz	Mx	My	Mz
3	2.507E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
6	7.847E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
9	-2.840E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
12	-1.234E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Combined Reactions

I*****								
: Node : Fx 3 Fy 3 Fz 3 Mx 3 My 3 Mz :								
L*****								
:	3	2.507E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00:
:	6	7.847E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00:
:	9	-2.840E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00:
:	12	-1.234E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00:
:	15	-1.822E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00:
:	22	-8.168E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00:
:	28	1.495E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00:
:	34	-1.958E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00:
:	40	-9.834E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00:
:	47	-3.573E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00:
:	55	-3.715E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00:
:	59	-9.309E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00:
:	63	3.222E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00:
:	68	1.294E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00:
:	72	0.000E+00	2.222E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00:
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DESCRIPTION: ENVIRONMENTS AND LOAD CONDITIONS

The following environments and load conditions were identified and evaluated:

1. Fire Position - Static
2. Fire Position - Dynamic
3. Speedshift
4. Helicopter Transport
5. Prime Mover (Truck) Transport
6. Aircraft Transport
7. Low-Velocity Parachute Deployment
8. LAFES Deployment
9. Rail Transport
10. Damage Tolerant Loading

Details include:

1. Fire Position - Static

Hand-calculations were performed to determine the cradle, platform, gimbal and trail loading due to an equilibrated barrel at both 0 and 72 degrees OE. Simple computer models were also used to determine worst-case trail loading at 22.5 degrees traverse and 0 degrees OE.

2. Fire Position - Dynamic

Two major dynamic loads were considered:

Recoil force. A value of 79,000 lbs for maximum recoil force was calculated by hand using recoil component weight, stroke length, projectile weight, projectile velocity at shot ejection. This value assumes using a FIMP charge.

Rifling torque. A value of 42,500 lb-sec was determined for the peak rifling torque. This also assumes the use of a FIMP charge.

This value, while used as working design, should have been used as limit design point. As a result the structural areas affected by this are oversized. The working design should be roughly 27,000 ft-lbs.

Both of these loads were used as inputs into the system which were ultimately transmitted through the major components and into the ground.

3. Speedshift

The major speedshift load is the 9000 lbs acting on the speedshift assembly and cradle. In addition, a damage tolerant

load for the trails was determined which accounted for the possibility of the trails hitting a tree, rock or other obstacle during the speedshift rotation.

4. Helicopter Transport

These loads were dictated by the LTHD having to meet the requirements of MIL-STD-209F, "Slings and Tiedown Provisions for Lifting and Tying Down Military Equipment." The loads are described in Section 4.8 of this report, Slings and Tiedown Provisions.

5. Prime Mover (Truck) Transport

Assumptions were made regarding the limitations of the LTHD during towing. A "bump and skid" load was determined to represent the load that, if exceeded, would cause a rollover.

6. Aircraft Transport

Documents on the air transport of military equipment were used to determine worst-case G-loading conditions.

7. Low-Velocity Parachute Deployment

G-loads from a document on this subject were used as inputs to the system to determine component load values.

8. LAFES Deployment

G-loads from documents on LAFESing were used as inputs to the system and major components.

9. Rail Transport

Documents on rail transport, rail car impact test requirements, and the MIL-STD on tiedowns were used to estimate G-loading values for this severe environment.

10. Damage Tolerant Loading

As appropriate, load magnitudes and their paths were determined which represented possible non-operating and accidentally-induced loads. These situations included side loading on the trails during speedshift and side loading on the fire control linkage and traction due to their exposed location.

STATUS:

Calculations of the load values for each of the environments

listed below can be found in the individual component sections. The "Book of Loads," found in the boxes of LTHD shutdown documents also contains this current information and old calculations as well.

AUTHORS: Scott Dacko, Larry Libhardt

LOAD COND'S 1,2,3,4

FMC

FMC LTHD NON-FIRING LOAD CONDITIONS

FIRE POSITION (EMPLACED)

LTHD STRUCTURE TO WITHSTAND WITHOUT PERMANENT DEFORMATION THE
STATIC LOADS FROM ITS INTERNAL COMPONENTS (E.G., EQUILIBRATORS)
AT ALL BARREL ORIENTATIONS INCLUDING:

0 DEG QE, 0 DEG TRAV
0 DEG QE, 22.5 DEG TRAV
72 DEG QE, 0 DEG TRAV
72 DEG QE, 22.5 DEG TRAV

CONSTRAINTS: FIRE (OR EMPLACED) POSITION.

SOURCE: LOAD CONDITION RESULTING FROM FMC LTHD DESIGN.

LTHD

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SD

LOAD COND: 5,6,7,8

FMC

FMC LTHD FIRING LOAD CONDITIONS

LTHD STRUCTURE TO WITHSTAND WITHOUT PERMANENT DEFORMATION A MAXIMUM RECOIL FORCE OF 79,000 LBS AND A MAXIMUM RIFLING TORQUE OF 42,416 FT-LBS.

LTHD STRUCTURE TO WITHSTAND THE DESIGNED RECOIL FORCE-TIME PROFILE HAVING A MAXIMUM RECOIL FORCE OF 62,000 LBS AND THE DESIGNED RIFLING TORQUE-TIME PROFILE HAVING A MAXIMUM RIFLING TORQUE OF 26,000 FT-LBS.

LOADS ARE APPLIED AT ALL BARREL ORIENTATIONS, INCLUDING:

0 DEG QE, 0 DEG TRAV
0 DEG QE, 22.5 DEG TRAV
72 DEG QE, 0 DEG TRAV
72 DEG QE, 22.5 DEG TRAV

CONSTRAINTS: FIRE POSITION, WITH TWO GROUND CONDITIONS:

HARD GROUND, SPADE HOLDS 100%
SOFT GROUND, SPADE HOLDS 68%, EACH CLAW HOLDS 16%

SOURCE: 79,000 LBS - FMC ESTIMATE OF 105% PIMP CONDITION.
42,416 FT-LBS - ARDEC ESTIMATE OF 105% PIMP CONDITION.
TIME-PROFILES - FMC ESTIMATE OF DYNAMIC CONDITIONS
RESULTING FROM FIRING HOT, ZONE 8S W/ XM795 PROJECTILE.

LTHD

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LOAD COND. 9 (TOWING)

FMC

PRIME MOVER (TRUCK) TRANSPORT

LTHD STRUCTURE TO WITHSTAND WITHOUT PERMANENT DEFORMATION AN 18,000 LB HORIZONTAL PULL AT THE LUNETTE CONCURRENT WITH THE FRONT WHEELS OF THE WALKING BEAMS HITTING ROAD OBSTACLES SUCH THAT THE REAR WHEELS START TO LIFT OFF THE GROUND.

LTHD STRUCTURE TO WITHSTAND WITHOUT PERMANENT DEFORMATION A 9,000 LB HORIZONTAL PULL AT THE LUNETTE COMBINED WITH A 0.8 G LATERAL LOAD AT THE WHEELS.

CONSTRAINTS: TOW POSITION. LUNETTE LOCKED TO PRIME MOVER PINTLE.

SOURCE: FMC ESTIMATES OF WORST-CASE TOWING CONDITIONS.

LTHD

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LOAD COND. 10

FMC

AIRCRAFT TRANSPORT

LTHD STRUCTURE TO WITHSTAND WITHOUT PERMANENT DEFORMATION 2 G'S IN THE UPWARD DIRECTION, 4.5 G'S IN THE DOWNWARD DIRECTION, 3 G'S IN THE FORWARD, 3 G'S IN REARWARD DIRECTIONS (AIR DROP), AND 1.5 G'S Laterally.

CONSTRAINTS: TOW POSITION. MINIMUM OF FOUR TIEDOWN PROVISIONS.

SOURCES: MIL-A-8421F, 25 OCTOBER 1974, "AIR TRANSPORTABILITY REQUIREMENTS, GENERAL SPECIFICATIONS FOR."

LTHD

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LOAD COND. 12 (LVPD)

FMC

LOW VELOCITY PARACHUTE DEPLOYMENT (HIGH ALTITUDE)

LTHD STRUCTURE TO WITHSTAND WITHOUT PERMANENT DEFORMATION
A LOAD OF 18.5 G'S IN THE DOWNWARD DIRECTION.

CONSTRAINTS: TOW POSITION WITH WHEELS RETRACTED. SUPPORTED AT
BOTTOM OF CRADLE, TRAILS AND PLATFORM WITH CRUSHABLE PALLET.

SOURCE: "AIR TRANSPORTABILITY CRITERIA FOR TRACKED COMBAT
VEHICLES," BY D. WILSON. FMC CORPORATION.

LTHD

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SD

SS

LOAD COND. 11

FMC

LAPES DEPLOYMENT

LTHD STRUCTURE TO WITHSTAND WITHOUT PERMANENT DEFORMATION:

- A. 6 G'S IN DOWNWARD DIRECTION AT REAR OF PALLET AT 15 DEGREES TO HORIZONTAL.
- B. FOLLOWED BY 20 G'S IN DOWNWARD DIRECTION AT FRONT OF PALLET WITH PALLET HORIZONTAL.

CONSTRAINTS: TOW POSITION WITH WHEELS RETRACTED. SUPPORTED AT BOTTOM OF CRADLE, BARREL, TRAILS, AND PLATFORM WITH COLLAPSABLE PALLET.

SOURCES: "AIR TRANSPORTABILITY CRITERIA FOR TRACKED COMBAT VEHICLES," BY D. WILSON. FMC CORPORATION. CONVERSATIONS WITH D. WILSON.

LTHD

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SD

FMC

RAIL TRANSPORT LOADS

LTHD STRUCTURE TO WITHSTAND WITHOUT PERMANENT DEFORMATION 15 G'S FORWARD AND BACKWARD.

LTHD STRUCTURE TO WITHSTAND WITHOUT PERMANENT DEFORMATION LOADS AT EACH TIEDOWN PROVISION EQUAL TO: 4.0 TIMES ITS PROPORTIONATE SHARE OF 9,000 IN THE FORWARD AND BACKWARD DIRECTIONS, 2.0 TIMES ITS PROPORTIONATE SHARE IN THE UPWARD DIRECTION AND 1.5 TIMES ITS PROPORTIONATE SHARE IN THE LATERAL DIRECTION. LOADS APPLIED STATICALLY AND INDEPENDENTLY AT SYSTEM C.G.

ULTIMATE STRENGTH OF LTHD TIEDOWN PROVISIONS AND STRUCTURAL FRAME TO BE NOT LESS THAN 1.5 TIMES THE YIELD STRENGTH.

CONSTRAINTS: TOW POSITION, WHEELS BLOCKED, MIN. OF FOUR TIEDOWN PROVISIONS. (ALTERNATIVE: WHEELS RAISED INTO TRAILS, 4+ TIEDOWNS.)

SOURCES: FMC ESTIMATE OF G-LOADING TO BE EXPERIENCED IN RAIL CAR IMPACT TEST. (MIL-STD-810D, 19 JULY 1983, METHOD 516.3, SHOCK, PROCEDURE VIII - RAIL IMPACT.)

MIL-STD-209F, 5 SEPTEMBER 1984, "SLINGING AND TIEDOWN PROVISIONS FOR LIFTING AND TYING DOWN MILITARY EQUIPMENT." CLASS II TIEDOWN PROVISIONS.

LTHD

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SD

LOAD COND. 14

FMC

HELICOPTER TRANSPORT

LTHD STRUCTURE TO WITHSTAND WITHOUT PERMANENT DEFORMATION A WORKING LOAD AT EACH SLINGING PROVISIONS EQUAL TO 3.2 TIMES ITS PROPORTIONATE SHARE OF 9,000 LBS. ULTIMATE STRENGTH OF LTHD STRUCTURE TO BE NOT LESS THAN 1.5 TIMES THE WORKING LOAD.

CONSTRAINTS: TOW POSITION, FOUR SLINGING PROVISIONS: TWO AT FORWARD MANIFOLD, TWO AT REAR PLATFORM. TRUE ANGLE OF SLING LEG MUST NOT EXCEED 45 DEGREES FROM VERTICAL. APEX TO BE ABOVE C.G. AND LESS THAN 24 FEET FROM GROUND.

SOURCE: MIL-STD-209F, 5 SEPTEMBER 1984, "SLINGING AND TIEDOWN PROVISIONS FOR LIFTING AND TYING DOWN MILITARY EQUIPMENT." CLASS I SLINGING PROVISIONS, TYPE II EQUIPMENT.

LTHD

29 OCTOBER 1986

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LOAD COND. 15

FMC

SPEEDSHIFT

LTHD STRUCTURE TO WITHSTAND WITHOUT PERMANENT DEFORMATION A 9,000 LB WEIGHT AT THE SPEEDSHIFT ASSEMBLY, ALONG WITH 500 LB HORIZONTAL FORCE INPUTS PERPENDICULAR TO THE LUNETTE, CLAWS AND PLATFORM.

CONSTRAINTS: SYSTEM WEIGHT ON SPEEDSHIFT ASSEMBLY, TRAILS SPREAD.

SOURCE: FMC ESTIMATE OF WORST-CASE LOADING CONDITION.

LTHD

29 OCTOBER 1985

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DESCRIPTION: MANIFOLD TORQUE ANCHORS

STATUS:

An FEA model was created to analyze the strength of the manifold torque anchor design. Results indicate that a factor of safety of 3.06 is obtained when an aluminum alloy with yield strength of 55,000 psi is used for the manifold material. The following pages of this section contain the details of this analysis.

AUTHOR: Joe Fishbein

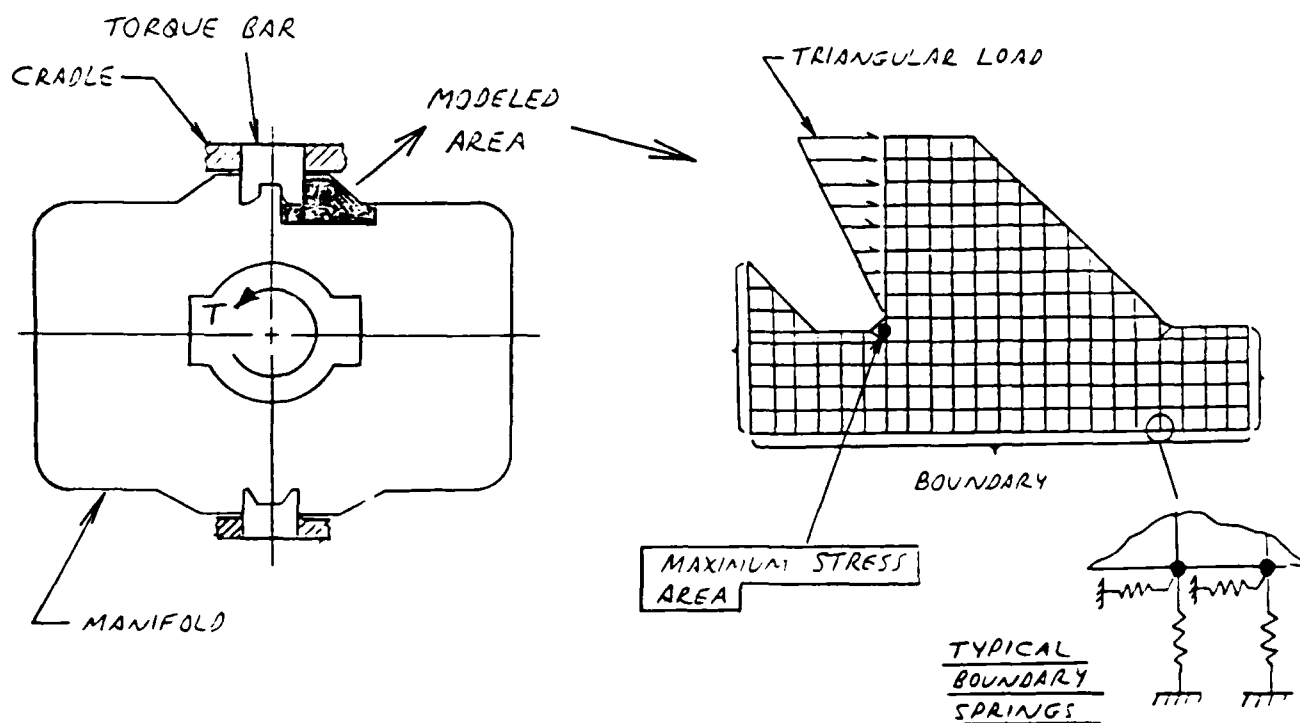
MANIFOLD

=====

The manifold, in addition to its other functions, transmits the rifling torque from the barrel/rail assembly to the cradle. This is accomplished with bars at the top and bottom, which engage projections on the manifold, and bear against the cradle openings.

This projection on the manifold was analyzed by modeling a cross section through this area. Since the loading on the bar is eccentric, a triangular load distribution on the manifold projection was assumed. The model is attached to the rest of the manifold by springs to ground in both directions at each node point on the boundary (The spring constant was estimated with a simple test model).

Maximum stresses occur in the corner at the base of the projection. Maximum stress is 18,000 PSI. Although the exact Aluminum alloy used for the manifold has not been selected yet, a yield strength of 55,000 PSI is required for other manifold loads, resulting in a FS of 3.06.



FE MODEL

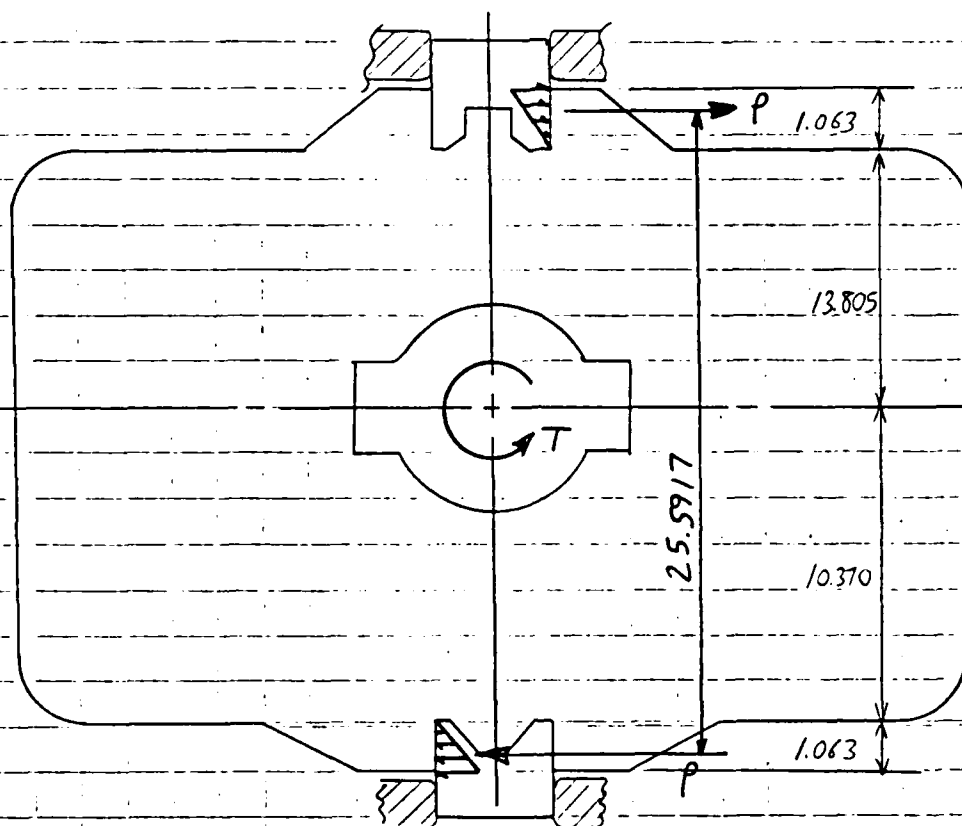
LTND 977 2/17/87

MANIFOLD TORQUE BARS

TORQUE LOAD - ASSUME TRIANGULAR DISTRIBUTION ON PINS -

$$T = 48,000 \text{ FT-LB. } (576,000 \text{ IN-LB.})$$

$$P = \frac{T}{L} = 22507 \text{ lb}$$



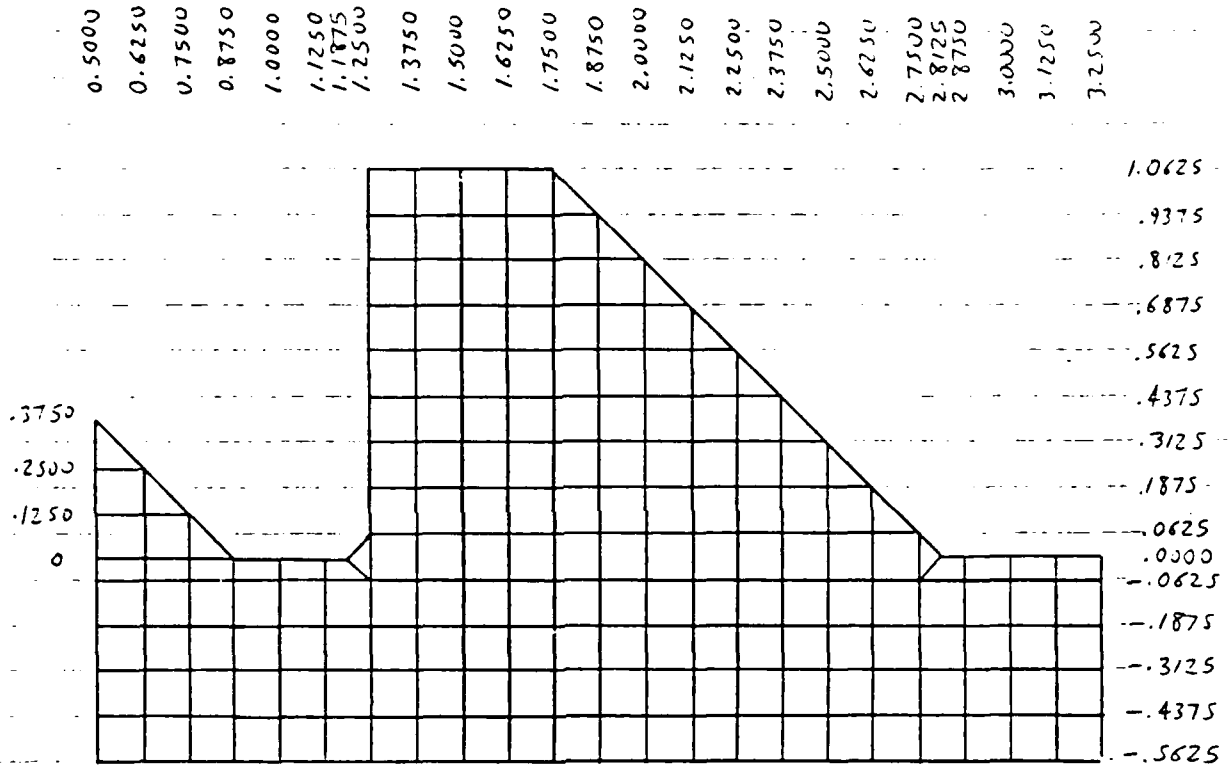
ASSUMING LOAD IS CARRIED ACROSS ENTIRE WIDTH (6.0 IN),

$$W = 3751.2 \text{ lb/in}$$

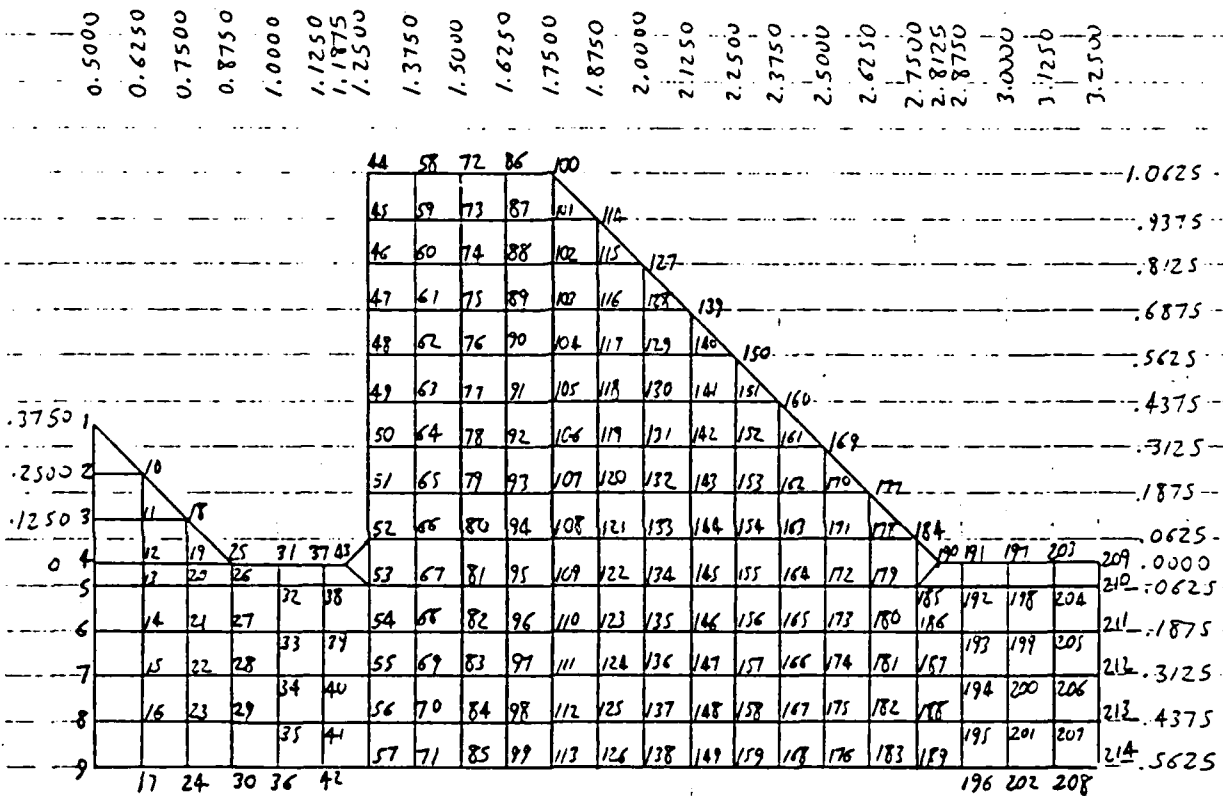
MOORE "SLICG" THICKNESS = 0.1 in

$$P \text{ ON MOORE} = 375.1 \text{ lb}$$

LTHD JMA 2/17/1



LTND
JNF 2-17-87



LTND
MFA 2/17/87

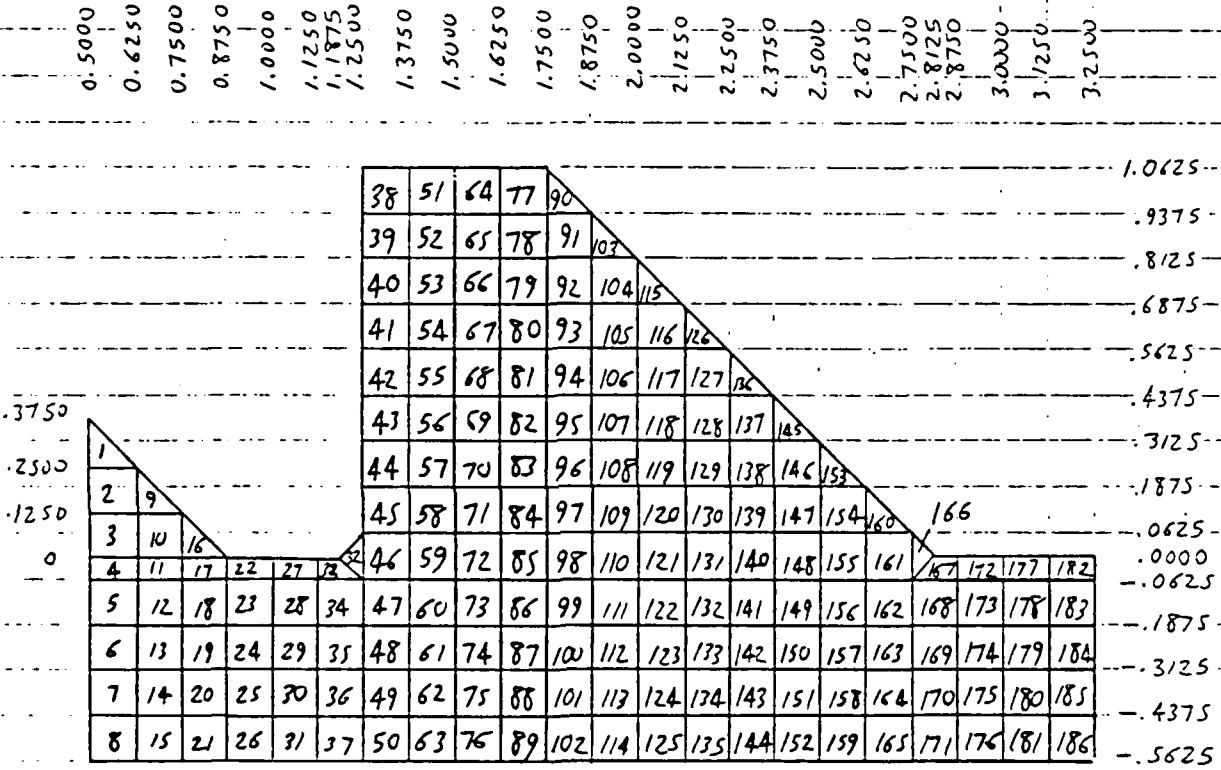
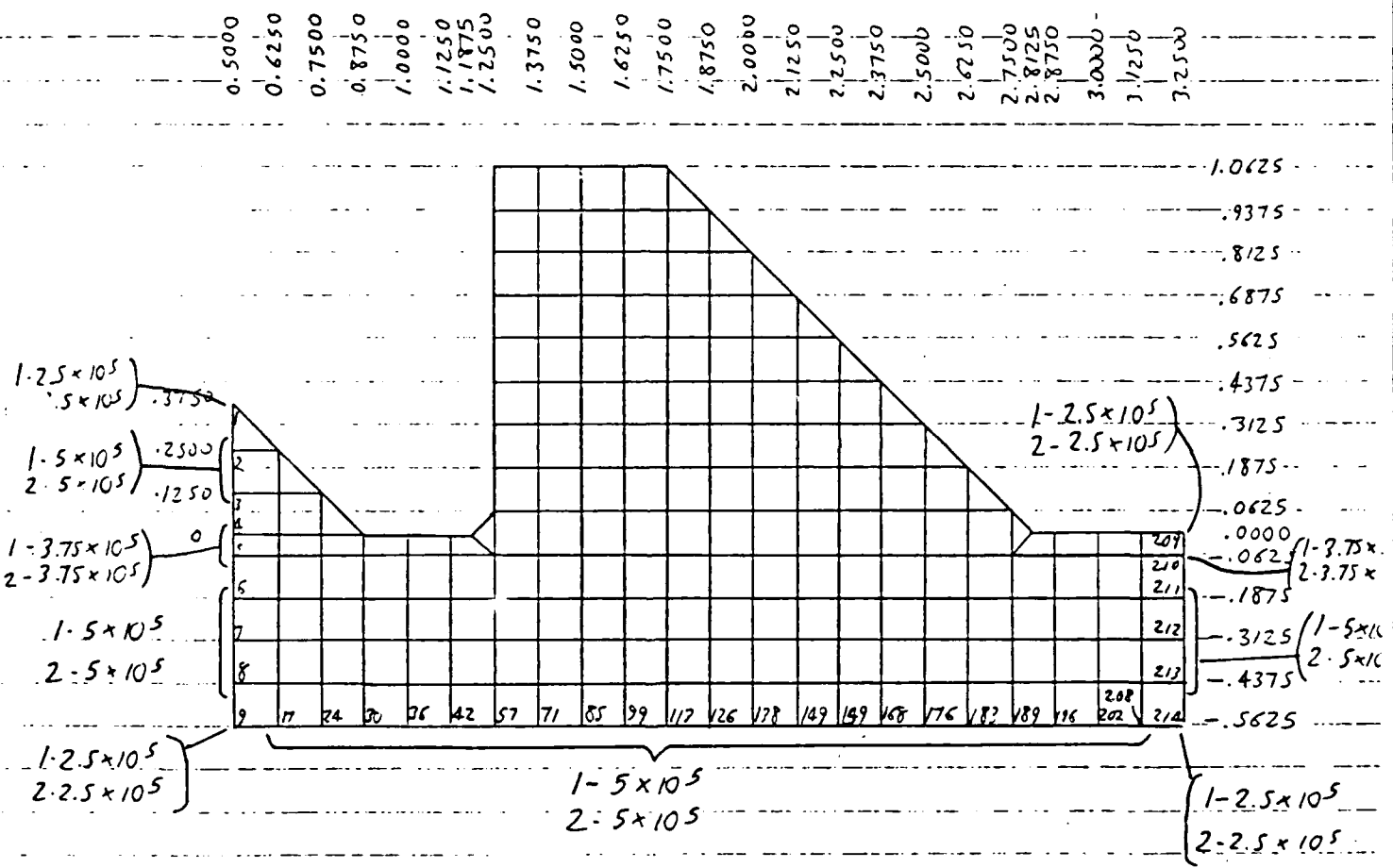


PLATE ELEMENTS

ENGINE Northern Ordnance Division
Winnipeg

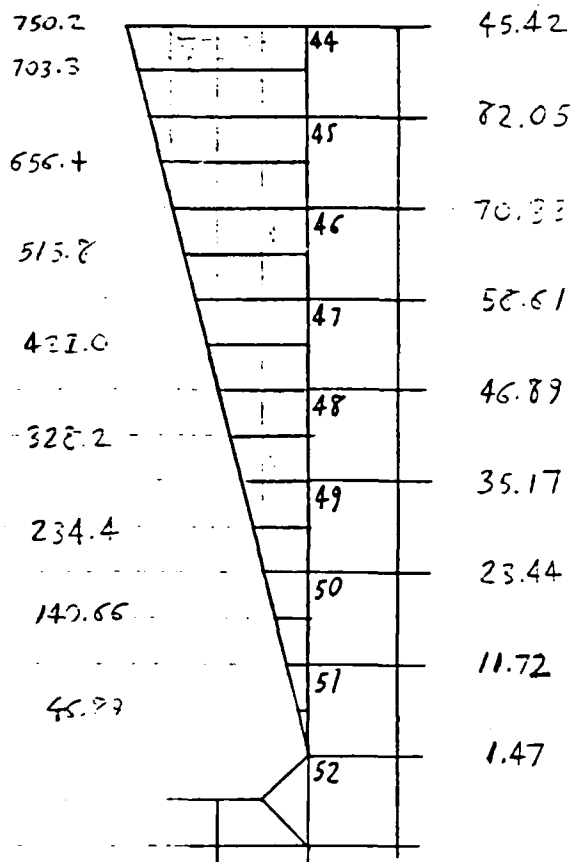
LTND
JMF 2/17/87



LTND
JMT 2/17/87

P_{NUCK}:

$w = 750.2 \text{ lb/in}$

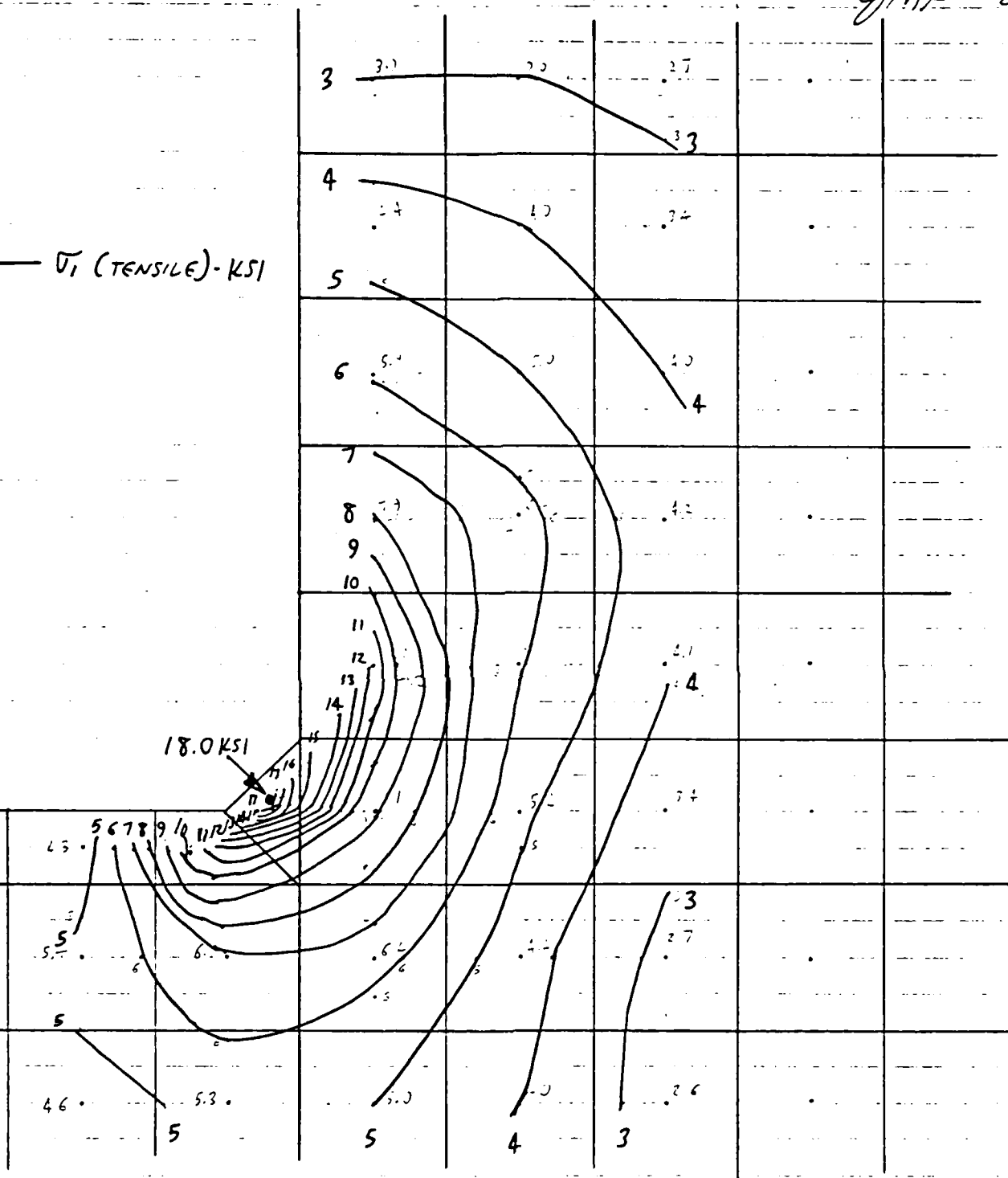


$\Sigma P_{NUCK} = 375.1 \text{ lb}$

$\bar{X} = .668 \text{ OF TOTAL LENGTH}$

LT/10
 G/MF 2/17/87

— σ_1 (TENSILE) - KSI

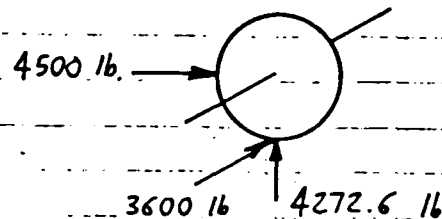


FOR ALUMINUM WITH $F_y = 40 \text{ KSI}$, FS = 2.2

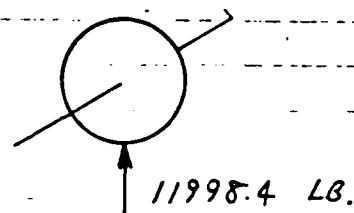
LTHD. LOAD SUMMARY
QNT 2/16/87 4 of 4

G. WHEEL HUB

1. BUMP & SKID



2. 4.5G AIR DROP



H. MANIFOLD TORQUE PINS

1. RECOIL TORQUE - 48,000 FT-LB.

PART NUMBERS: 12585766, Muzzle Brake machining,
12585765, Muzzle Brake casting

DESCRIPTION: MUZZLE BRAKE WITH INTEGRAL LUNETTE

The muzzle brake shape is identical to that of the M198 muzzle brake with the exception of a lunette addition. The material was changed to Ti6AL4V to provide a total after-machined weight of 181 lbs--a reduction of over 80 lbs from the current M198 muzzle brake.

STATUS:

Both casting and machining drawings for the FMC LTHD muzzle brake (TDF, Dwgs. 12585765, 12585766) are complete and ready to build from. FMC has worked closely with Titech to finalize all drawing notes and requirements for these drawings.

A preliminary investigation was performed to determine the extent of material corrosion caused by the high pressures and temperatures present as well as from particle impact on the muzzle brake baffles. No conclusive data was compiled, but all evidence suggested that titanium would survive the environment better than steel.

Additional analysis included the creation of an FEA model to determine the effect of temperature changes on stresses at the muzzle-tube interface. A comparison of a steel brake on a steel tube with a titanium brake on a steel tube was made and it was concluded that acceptable stress levels are obtained in the titanium muzzle brake. This thermal stress analysis is found on the following pages of this section.

AUTHORS: Joe Fishbein, Larry Libhardt, Suellen Halverson

2

=====

= SUMMARY OF LTHD ANALYSIS - J. Fishbein, 2/18/87 =

=====

1) MUZZLE BRAKE

The muzzle brake was analyzed for hoop stresses in the thread engagement region with the barrel. This was done for both internal pressure loading and differential temperature. A comparison was made between steel and titanium muzzle brakes.

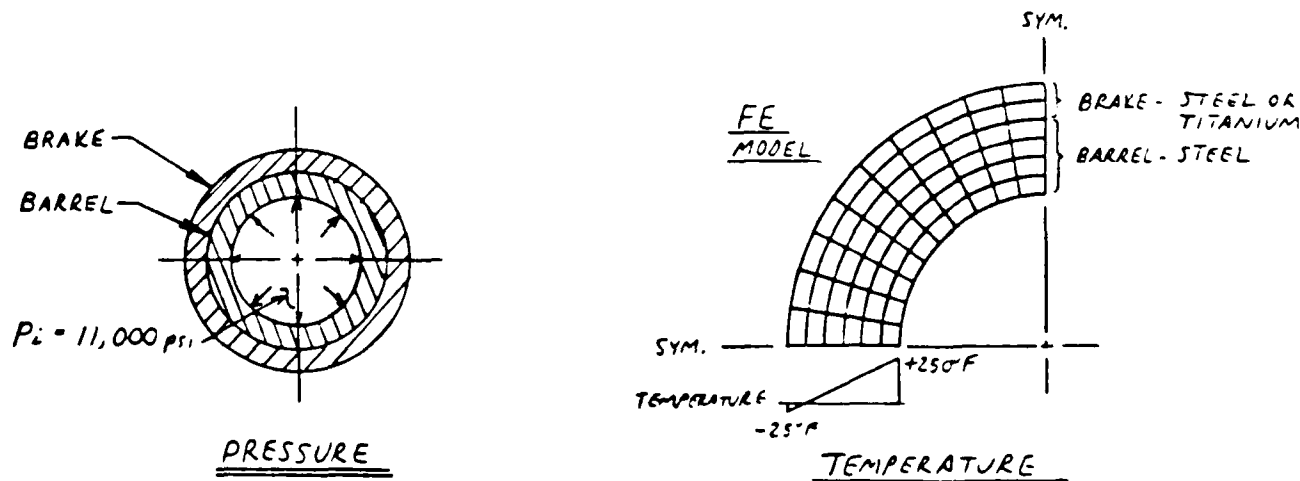
The pressure load case was analyzed by hand, using formulas in Roark (Table 32-1a,1c). The barrel is loaded with the 11,000-PSI internal pressure, and an unknown external pressure. The muzzle brake is loaded with the unknown internal pressure. By applying displacement compatibility (Change in barrel OD = change in brake ID), the unknown pressure may be determined, and thus the brake stresses. Below is a summary of results:

Item	Steel Brake	Titanium Brake
Pressure at Interface	2,483 PSI	1,569 PSI
Expansion at Interface	.0060 in.	.0069 in.
Hoop Stress in Brake	21,177 PSI	13,379 PSI

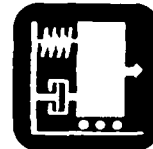
For the thermal stress analysis, a Finite Element Model of the cross-section of the barrel and brake was assembled. Six rows of elements were used through the thickness. Each row was loaded with a temperature, based on a linear gradient from +250-deg. F. (internal) to -25-deg. F. (external). A summary of the resulting stresses is given below:

Item	Steel Brake	Titanium Brake
Maximum Radial Stress-Barrel	-2,475 PSI	-2,052 PSI
Maximum Radial Stress-Brake	-1,515 PSI	-1,050 PSI
Maximum Hoop Stress-Barrel	-23,460 PSI	-20,795 PSI
Maximum Hoop Stress-Brake	20,620 PSI	13,770 PSI

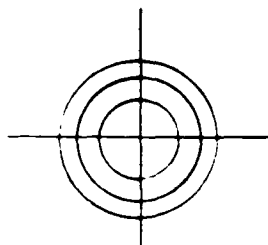
All stresses are well within the allowable for titanium (Yield stress = 120,000 PSI).



Subject LTHD	Analyst J. J. E.	
	Project Number	
	EC. No.	Date 1-10-61



MUZZLE BRAKE



$P_2 = 11,000 \text{ psi}$

BARREL ID = 6.100 in (b)
BARREL OD = 8.00 in (a)

BRAKE ID = 8.00 in (b)
BRAKE OD = 9.00 in (a)

Q = PRESSURE @ INTERFACE
 Δ = CHANGE OF RAD. @ "

(ROCKET, TYPE 32-12, 10)

BARREL $\Delta(r) = \frac{Q_2}{E} \left(\frac{a^2 b^2}{a^2 - b^2} \right) - \frac{Q_2}{E} \left(\frac{a^2 + b^2}{a^2 - b^2} - r^2 \right)$ (1)

BRAKE $\Delta(r) = \frac{Q_1}{E} \left(\frac{a^2 + b^2}{a^2 - b^2} + r^2 \right)$ (2)

A) STEEL BARREL TOGGLE BRAKE

$E = 29 \times 10^6 \text{ psi}$
 $\nu = 0.3$

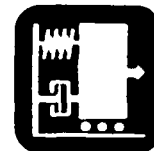
(1) $\Delta = .0084 - 9.5142 \times 10^{-7} Q$

(2) $\Delta = 2.4357 \times 10^{-6} Q$
 $Q = 410560 \Delta$

(1) $\Delta = .0084 - .3939 \Delta$

$\Delta = .0060$ (in)
 $Q = 2483 \text{ psi}$

Subject LTHD	Analyst JTF	
	Project Number	
	EC No	Date 1-12-57



TANGENTIAL STRESS - T_2

$$T_2 = \frac{Q b^2 (a^2 + r^2)}{r^2 (a^2 - b^2)} \quad \text{MAX @ } r = b$$

$$T_2 = \frac{Q (a^2 - b^2)}{(a^2 - b^2)} = \underline{\underline{21177 \text{ psi}}}$$

(C) STEEL BARREL TITANIUM BRAKE

$$E = 16 \times 10^6 \text{ psi}$$

$$\nu = .3$$

$$(1) \Delta = .0034 - 9.5742 \times 10^{-7} Q$$

$$(2) \Delta = 4.4147 \times 10^{-6} Q$$

$$Q = 226516 \Delta$$

$$\Delta = .0034 - .2173 \Delta$$

$$1.2173 \Delta = .0034$$

$$\Delta = .0028 \text{ in}$$

$$Q = 1567 \text{ psi}$$

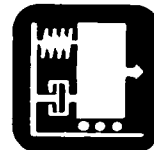
$$T_2 = \underline{\underline{13370 \text{ psi}}}$$

COMPARISON SUMMARY

	STEEL	TITANIUM
EXPAN @ INTERFACE	.0060 in	.0067 in
PRESSURE @ INTERFACE	2483 psi	1567 psi
100% STRESS IN BRAKE	21177 psi	13371 psi

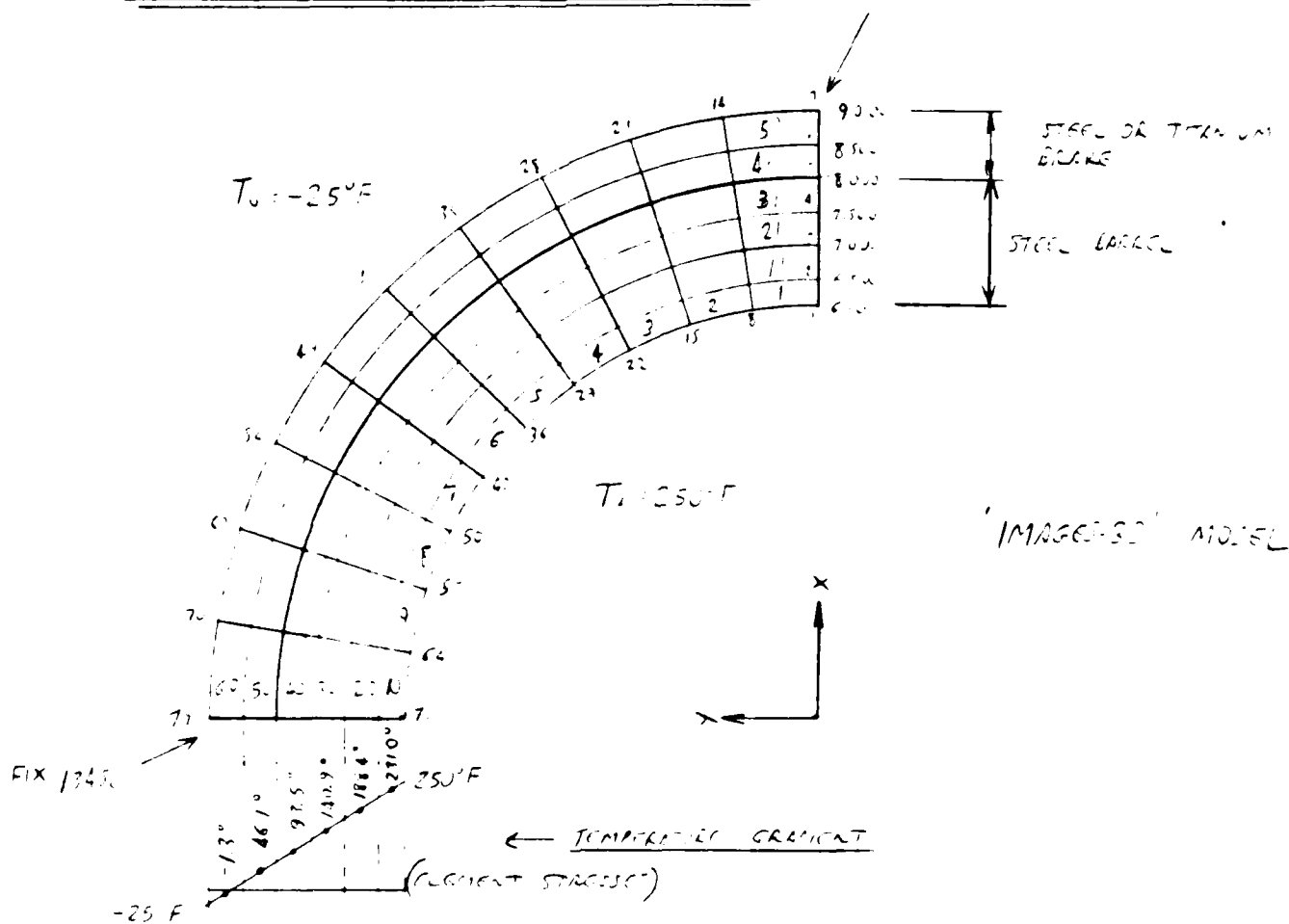
Sheet ___ Of ___

Subject LTHD	Analyst JWZ	
	Project Number	
	EC. No.	Date 1-12-77



MUZZLE BRAKE - THERMAL STRESS

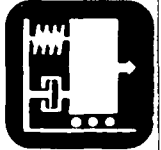
FIX 23456



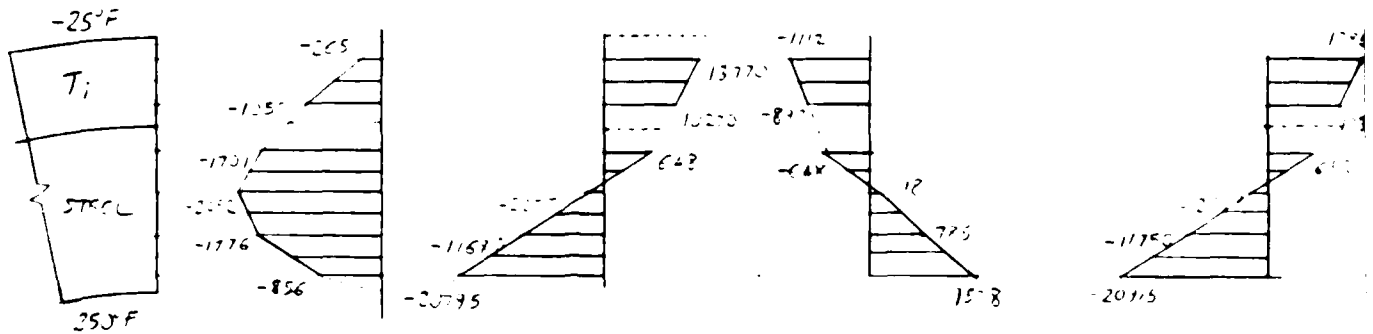
STEEL: $E = 30 \times 10^6$ psi
 $\nu = .283$
 $\alpha = 6.5 \times 10^{-6}$ in/in/°F
 $\nu = .3$

TITANIUM: $E = 17.3 \times 10^6$ psi
 $\nu = .160$
 $\alpha = 5.2 \times 10^{-6}$ in/in/°F
 $\nu = .3$

Subject LTHD	Analyst 917F	
	Project Number	
	EC No	Date 1/12/77



STEEL/Ti ASSEMBLY $T_{ref} = -25^{\circ}F$



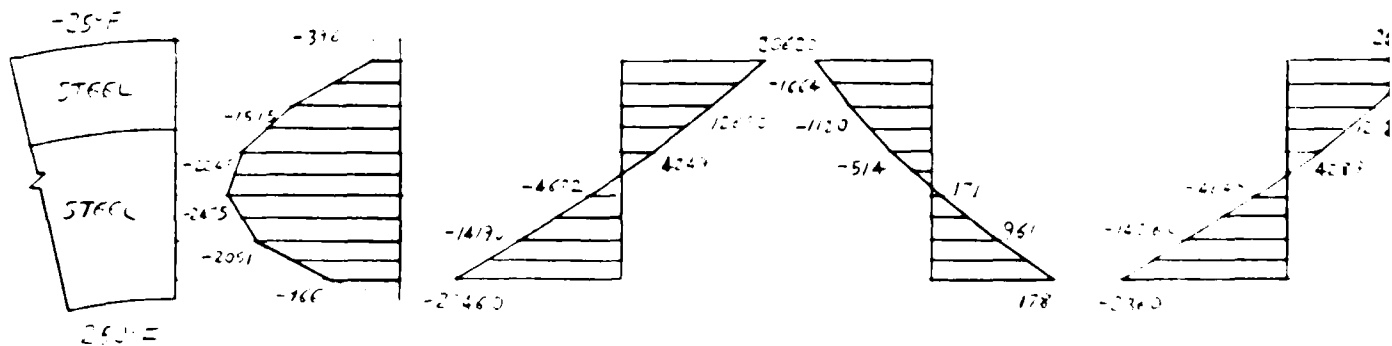
RADIAL
STRESS
(psi)

TANGENTIAL
STRESS
(psi)

SHEAR
STRESS
(psi)

MAX PRINCIPAL
STRESS
(psi)

STEEL/STEEL ASSEMBLY $T_{ref} = -25^{\circ}F$



LT4D MUZZLE BRAKE

- 1) STEEL BARREL, TITANIUM BRAKE
- 2) STEEL BARREL, STEEL BRAKE

THERMAL STRESS, $T_0 = -25^{\circ}\text{F}$

$T_i = 250^{\circ}\text{F}$

$T_{\text{REF}} = -25^{\circ}\text{F}$

IMAGES - 3D FEA

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RENUMBER NODES Version 1.1 02/01/85

LTHD muzzle brake thermal load - titanium

Node Renumbering Cross Reference List

Was	Is	Was	Is	Was	Is
---	---	---	---	---	---
1	1	2	2	3	3
4	4	5	5	6	6
7	7	8	8	9	9
10	10	11	11	12	12
13	13	14	14	15	15
16	16	17	17	18	18
19	19	20	20	21	21
22	22	23	23	24	24
25	25	26	26	27	27
28	28	29	29	30	30
31	31	32	32	33	33
34	34	35	35	36	36
37	37	38	38	39	39
40	40	41	41	42	42
43	43	44	44	45	45
46	46	47	47	48	48
49	49	50	50	51	51
52	52	53	53	54	54
55	55	56	56	57	57
58	58	59	59	60	60
61	61	62	62	63	63
64	64	65	65	66	66
67	67	68	68	69	69
70	70	71	71	72	72
73	73	74	74	75	75
76	76	77	77		

Original Nodal Band 9
Final Nodal band 9

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ASSEMBLE STIFFNESS MATRIX Version 1.1 02/01/85

LTHD muzzle brake thermal load - titanium

STIFFNESS ASSEMBLY SUMMARY

Number of Node Points.....	77
Number of Truss and Beam Elements.....	0
Number of Plate Elements.....	60
Number of Spring Elements.....	0
Number of Nodes with Restraints.....	14
Number of Blocks in the Matrix.....	2

BLOCK NUMBER 1

FORM Matrix
PACK Matrix
Size = 13864 Bytes
TRIANGULARIZE Matrix

BLOCK NUMBER 2

FORM Matrix
PACK Matrix
Size = 1816 Bytes
TRIANGULARIZE Matrix

Number of terms in the matrix.	2210
Largest column.....	18
Minimum Diagonal Stiffness =	.1336680D+08
Maximum Diagonal Stiffness =	.1006645D+09

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ASSEMBLE STIFFNESS MATRIX Version 1.1 02/01/85

LTHD muzzle brake thermal load - titanium

C R O S S R E F E R E N C E L I S T

Is Node Versus Internal Equation Number

Is Node	TRANSLATION			/	ROTATION		
	Eqn.	Eqn.	Eqn.		Eqn.	Eqn.	Eqn.
----	----	----	----	/	----	----	----
1	1						
2	2						
3	3						
4	4						
5	5						
6	6						
7	7						
8	8	9					
9	10	11					
10	12	13					
11	14	15					
12	16	17					
13	18	19					
14	20	21					
15	22	23					
16	24	25					
17	26	27					
18	28	29					
19	30	31					
20	32	33					
21	34	35					
22	36	37					
23	38	39					
24	40	41					
25	42	43					
26	44	45					
27	46	47					
28	48	49					
29	50	51					

30	52	53
31	54	55
32	56	57
33	58	59
34	60	61
35	62	63
36	64	65
37	66	67
38	68	69
39	70	71

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ASSEMBLE STIFFNESS MATRIX Version 1.1 02/01/85

LTHD muzzle brake thermal load - titanium

Is	TRANSLATION			/	ROTATION		
Node	Eqn.	Eqn.	Eqn.	/	Eqn.	Eqn.	Eqn.
----	----	----	----	/	----	----	----
40	72	73					
41	74	75					
42	76	77					
43	78	79					
44	80	81					
45	82	83					
46	84	85					
47	86	87					
48	88	89					
49	90	91					
50	92	93					
51	94	95					
52	96	97					
53	98	99					
54	100	101					
55	102	103					
56	104	105					
57	106	107					
58	108	109					
59	110	111					
60	112	113					
61	114	115					
62	116	117					
63	118	119					
64	120	121					
65	122	123					
66	124	125					
67	126	127					
68	128	129					
69	130	131					
70	132	133					
71		134					
72		135					
73		136					

74	137
75	138
76	139
77	140

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SOLVE DISPLACEMENTS Version 1.1 02/01/85

LTHD muzzle brake thermal load - titanium

L O A D C A S E 1

REFERENCE TEMPERATURE =-.2500E+02

PLATE TEMPERATURES

Plate	Temp	Plate	Temp	Plate	Temp	Plate	Temp
1	.2310E+03	2	.2310E+03	3	.2310E+03	4	.2310E+03
5	.2310E+03	6	.2310E+03	7	.2310E+03	8	.2310E+03
9	.2310E+03	10	.2310E+03	11	.1884E+03	12	.1884E+03
13	.1884E+03	14	.1884E+03	15	.1884E+03	16	.1884E+03
17	.1884E+03	18	.1884E+03	19	.1884E+03	20	.1884E+03
21	.1409E+03	22	.1409E+03	23	.1409E+03	24	.1409E+03
25	.1409E+03	26	.1409E+03	27	.1409E+03	28	.1409E+03
29	.1409E+03	30	.1409E+03	31	.9350E+02	32	.9350E+02
33	.9350E+02	34	.9350E+02	35	.9350E+02	36	.9350E+02
37	.9350E+02	38	.9350E+02	39	.9350E+02	40	.9350E+02
41	.4610E+02	42	.4610E+02	43	.4610E+02	44	.4610E+02
45	.4610E+02	46	.4610E+02	47	.4610E+02	48	.4610E+02
49	.4610E+02	50	.4610E+02	51	-.1300E+01	52	-.1300E+01
53	-.1300E+01	54	-.1300E+01	55	-.1300E+01	56	-.1300E+01
57	-.1300E+01	58	-.1300E+01	59	-.1300E+01	60	-.1300E+01

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SOLVE DISPLACEMENTS Version 1.1 02/01/85

LTHD muzzle brake thermal load - titanium

L O A D C A S E 1

APPLIED LOAD VECTOR

Node	Fx	Fy	Fz	Mx	My	Mz
1	-.3326E+05	-.1570E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
2	.5903E+04	-.2812E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
3	.7079E+04	-.2539E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
4	.7570E+04	-.1892E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
5	.1450E+05	-.9546E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
6	.4033E+04	-.2812E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
7	.2135E+04	-.6430E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
8	-.6569E+05	-.1040E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
9	.1166E+05	.1843E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
10	.1398E+05	.2218E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
11	.1495E+05	.2366E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
12	.2863E+05	.4537E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
13	.7967E+04	.1261E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
14	.4218E+04	.6683E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
15	-.6326E+05	-.2055E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
16	.1123E+05	.3648E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
17	.1347E+05	.4375E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
18	.1440E+05	.4678E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
19	.2757E+05	.8959E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
20	.7671E+04	.2492E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
21	.4061E+04	.1320E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
22	-.5926E+05	-.3020E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
23	.1052E+05	.5359E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
24	.1262E+05	.6425E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
25	.1349E+05	.6878E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
26	.2583E+05	.1316E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
27	.7187E+04	.3662E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
28	.3805E+04	.1939E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
29	-.5381E+05	-.3909E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
30	.9550E+04	.6938E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
31	.1145E+05	.8322E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
32	.1225E+05	.8899E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
33	.2345E+05	.1704E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
34	.6525E+04	.4741E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
35	.3455E+04	.2510E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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SOLVE DISPLACEMENTS Version 1.1 02/01/85

LTHD muzzle brake thermal load - titanium

L O A D C A S E 1

APPLIED LOAD VECTOR

Node	Fx	Fy	Fz	Mx	My	Mz
36	-.4703E+05	-.4703E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
37	.8347E+04	.8347E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
38	.1001E+05	.1001E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
39	.1071E+05	.1070E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
40	.2050E+05	.2050E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
41	.5703E+04	.5704E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
42	.3020E+04	.3020E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
43	-.3909E+05	-.5381E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
44	.6935E+04	.9553E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
45	.8328E+04	.1145E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
46	.8898E+04	.1225E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
47	.1704E+05	.2346E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
48	.4742E+04	.6525E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
49	.2510E+04	.3455E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
50	-.3020E+05	-.5926E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
51	.5360E+04	.1052E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
52	.6424E+04	.1262E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
53	.6876E+04	.1349E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
54	.1316E+05	.2583E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
55	.3661E+04	.7187E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
56	.1939E+04	.3805E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
57	-.2055E+05	-.6326E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
58	.3652E+04	.1123E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
59	.4372E+04	.1347E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
60	.4678E+04	.1440E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
61	.8959E+04	.2757E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
62	.2493E+04	.7671E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
63	.1320E+04	.4061E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
64	-.1040E+05	-.6569E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
65	.1847E+04	.1166E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
66	.2218E+04	.1398E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
67	.2363E+04	.1495E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
68	.4537E+04	.2863E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
69	.1262E+04	.7967E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
70	.6680E+03	.4218E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
71	-.1570E+05	-.3326E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
72	-.2812E+05	.5902E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
73	-.2539E+05	.7079E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
74	-.1891E+05	.7570E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
75	-.9546E+04	.1450E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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SOLVE DISPLACEMENTS Version 1.1 02/01/85

LTHD muzzle brake thermal load - titanium

L O A D C A S E 1

APPLIED LOAD VECTOR

Node	Fx	Fy	Fz	Mx	My	Mz
76	-.2812E+04	.4033E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
77	-.6430E+03	.2135E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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SOLVE DISPLACEMENTS Version 1.1 02/01/85

LTHD muzzle brake thermal load - titanium

L O A D C A S E 1

DISPLACEMENTS

Node	T r a n s l a t i o n s			/	R o t a t i o n s		
	X	Y	Z		X	Y	Z
1	.5773E-02	.0000E+00	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
2	.6525E-02	.0000E+00	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
3	.7261E-02	.0000E+00	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
4	.7784E-02	.0000E+00	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
5	.8111E-02	.0000E+00	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
6	.8174E-02	.0000E+00	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
7	.8106E-02	.0000E+00	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
8	.5702E-02	.9031E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
9	.6445E-02	.1021E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
10	.7171E-02	.1136E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
11	.7689E-02	.1218E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
12	.8012E-02	.1269E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
13	.8074E-02	.1279E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
14	.8006E-02	.1268E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
15	.5490E-02	.1784E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
16	.6206E-02	.2016E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
17	.6905E-02	.2244E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
18	.7403E-02	.2406E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
19	.7714E-02	.2507E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
20	.7774E-02	.2526E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
21	.7709E-02	.2505E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
22	.5144E-02	.2621E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
23	.5814E-02	.2962E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
24	.6469E-02	.3296E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
25	.6936E-02	.3534E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
26	.7227E-02	.3683E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
27	.7283E-02	.3711E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
28	.7222E-02	.3680E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
29	.4670E-02	.3393E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
30	.5279E-02	.3835E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
31	.5874E-02	.4268E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
32	.6298E-02	.4576E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
33	.6562E-02	.4768E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
34	.6613E-02	.4805E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
35	.6557E-02	.4764E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
36	.4082E-02	.4082E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
37	.4614E-02	.4614E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
38	.5134E-02	.5134E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
39	.5504E-02	.5504E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
40	.5736E-02	.5736E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00

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SOLVE DISPLACEMENTS Version 1.1 02/01/85

LTHD muzzle brake thermal load - titanium

L O A D C A S E 1

Node	T r a n s l a t i o n s			/	R o t a t i o n s		
	X	Y	Z		X	Y	Z
41	.5780E-02	.5780E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
42	.5731E-02	.5731E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
43	.3793E-02	.4670E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
44	.3835E-02	.5279E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
45	.4268E-02	.5874E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
46	.4576E-02	.6298E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
47	.4768E-02	.6562E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
48	.4805E-02	.6613E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
49	.4764E-02	.6557E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
50	.2621E-02	.5144E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
51	.2962E-02	.5814E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
52	.3296E-02	.6469E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
53	.3534E-02	.6936E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
54	.3682E-02	.7227E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
55	.3711E-02	.7283E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
56	.3680E-02	.7222E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
57	.1784E-02	.5490E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
58	.2016E-02	.6206E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
59	.2244E-02	.6905E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
60	.2406E-02	.7403E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
61	.2507E-02	.7714E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
62	.2526E-02	.7774E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
63	.2505E-02	.7709E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
64	.9031E-03	.5702E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
65	.1021E-02	.6445E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
66	.1136E-02	.7171E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
67	.1218E-02	.7689E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
68	.1269E-02	.8012E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
69	.1279E-02	.8074E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
70	.1268E-02	.8006E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
71	.0000E+00	.5773E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
72	.0000E+00	.6525E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
73	.0000E+00	.7260E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
74	.0000E+00	.7784E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00

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SOLVE PLATE LOADS/STRESSES Version 1.1 02/01/85

LTHD muzzle brake thermal load - titanium

PLATE LOADS AND/OR STRESSES

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
QUAD PLATE NO. 1							
Loads	1	.1826E+08	.4228E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	2	-.6539E+03	.4082E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	9	-.7409E+01	-.4134E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	8	.6614E+03	-.4176E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.8561E+03	-.2079E+05	.1578E+04	-.7319E+03	-.2091E+05	4.5
QUAD PLATE NO. 2							
Loads	8	-.6614E+03	.4176E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	9	-.1284E+04	.3929E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	16	.6394E+03	-.4084E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	15	.1306E+04	-.4021E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.8562E+03	-.2079E+05	.1578E+04	-.7319E+03	-.2091E+05	4.5
QUAD PLATE NO. 3							
Loads	15	-.1306E+04	.4021E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	16	-.1883E+04	.3680E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	23	.1270E+04	-.3534E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	22	.1919E+04	-.3767E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.8561E+03	-.2079E+05	.1579E+04	-.7319E+03	-.2091E+05	4.5
QUAD PLATE NO. 4							
Loads	22	-.1919E+04	.3767E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	23	-.2436E+04	.3340E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	30	.1870E+04	-.3687E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	29	.2485E+04	-.3420E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.8561E+03	-.2079E+05	.1578E+04	-.7319E+03	-.2091E+05	4.5
QUAD PLATE NO. 5							
Loads	29	-.2485E+04	.3420E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	30	-.2928E+04	.2918E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	37	.2424E+04	-.3349E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	36	.2989E+04	-.2989E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.8561E+03	-.2079E+05	.1578E+04	-.7319E+03	-.2091E+05	4.5
QUAD PLATE NO. 6							
Loads	36	-.2989E+04	.2989E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	37	-.3349E+04	.2424E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	44	.2918E+04	-.2928E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	43	.3420E+04	-.2485E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.8562E+03	-.2079E+05	.1579E+04	-.7319E+03	-.2091E+05	4.5
QUAD PLATE NO. 7							
Loads	43	-.3420E+04	.2485E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	44	-.3687E+04	.1870E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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Version 1.1 02/01/85

LTHD muzzle brake thermal load - titanium

Load Case: 1:

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Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
Loads	51	.3340E+04	-.2436E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	50	.3767E+04	-.1919E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.8561E+03	-.2079E+05	.1579E+04	-.7319E+03	-.2091E+05	4.5
QUAD PLATE NO. 8							
Loads	50	-.3767E+04	.1919E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	51	-.3934E+04	.1270E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	58	.3680E+04	-.1883E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	57	.4021E+04	-.1306E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.8561E+03	-.2079E+05	.1578E+04	-.7319E+03	-.2091E+05	4.5
QUAD PLATE NO. 9							
Loads	57	-.4021E+04	.1306E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	58	-.4064E+04	.6394E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	65	.3929E+04	-.1284E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	64	.4176E+04	-.6614E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.8561E+03	-.2079E+05	.1578E+04	-.7319E+03	-.2091E+05	4.5
QUAD PLATE NO. 10							
Loads	64	-.4176E+04	.6614E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	65	-.4134E+04	-.7401E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	72	.4082E+04	-.6540E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	71	.4228E+04	.8658E-09	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.8561E+03	-.2079E+05	.1579E+04	-.7319E+03	-.2091E+05	4.5
QUAD PLATE NO. 11							
Loads	2	.6539E+03	.3004E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	3	-.1113E+04	.2828E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	10	-.6568E+03	-.2967E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	9	.1116E+04	-.2865E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1776E+04	-.1168E+05	.7849E+03	-.1714E+04	-.1175E+05	4.5
QUAD PLATE NO. 12							
Loads	9	.1759E+03	.3070E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	10	-.1542E+04	.2619E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	17	-.1846E+03	-.3033E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	16	.1551E+04	-.2656E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1776E+04	-.1168E+05	.7849E+03	-.1714E+04	-.1175E+05	4.5
QUAD PLATE NO. 13							
Loads	16	-.3065E+03	.3060E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	17	-.1932E+04	.2345E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	24	.2921E+03	-.3025E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	23	.1947E+04	-.2380E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1776E+04	-.1168E+05	.7846E+03	-.1714E+04	-.1175E+05	4.5
QUAD PLATE NO. 14							
Loads	23	-.7814E+03	.2974E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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LTHD muzzle brake thermal load - titanium

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress	Stress	Shear XZ	Shear YZ				
Loads	24	-.2275E+04	.2014E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	31	.7617E+03	-.2942E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	30	.2295E+04	-.2046E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1776E+04	-.1168E+05	.7845E+03	-.1714E+04	-.1175E+05	4.5
QUAD PLATE NO. 15							
Loads	30	-.1237E+04	.2815E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	31	-.2563E+04	.1633E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	38	.1212E+04	-.2786E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	37	.2587E+04	-.1662E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1776E+04	-.1168E+05	.7846E+03	-.1714E+04	-.1175E+05	4.5
QUAD PLATE NO. 16							
Loads	37	-.1662E+04	.2587E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	38	-.2787E+04	.1213E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	45	.1634E+04	-.2563E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	44	.2815E+04	-.1237E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1776E+04	-.1168E+05	.7845E+03	-.1714E+04	-.1175E+05	4.5
QUAD PLATE NO. 17							
Loads	44	-.2046E+04	.2295E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	45	-.2942E+04	.7619E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	52	.2015E+04	-.2276E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	51	.2974E+04	-.7812E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1776E+04	-.1168E+05	.7844E+03	-.1714E+04	-.1175E+05	4.5
QUAD PLATE NO. 18							
Loads	51	-.2380E+04	.1946E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	52	-.3025E+04	.2923E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	59	.2346E+04	-.1932E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	58	.3059E+04	-.3064E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1776E+04	-.1168E+05	.7849E+03	-.1714E+04	-.1175E+05	4.5
QUAD PLATE NO. 19							
Loads	58	-.2655E+04	.1550E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	59	-.3033E+04	-.1847E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	66	.2619E+04	-.1542E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	65	.3070E+04	.1759E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1776E+04	-.1168E+05	.7847E+03	-.1714E+04	-.1175E+05	4.5
QUAD PLATE NO. 20							
Loads	65	-.2865E+04	.1116E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	66	-.2967E+04	-.6569E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	73	.2828E+04	-.1113E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	72	.3005E+04	.6540E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1776E+04	-.1168E+05	.7845E+03	-.1714E+04	-.1175E+05	4.5

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LTHD muzzle brake thermal load - titanium

Load Case: 1:

2.

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
QUAD PLATE NO. 21							
Loads	3	.1117E+04	.6274E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	4	-.1202E+04	.5010E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	11	-.1109E+04	-.6828E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	10	.1197E+04	-.4455E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2052E+04	-.2277E+04	.1781E+02	-.2051E+04	-.2279E+04	4.5
QUAD PLATE NO. 22							
Loads	10	.1001E+04	.7939E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	11	-.1265E+04	.3069E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	16	-.9861E+03	-.8479E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	17	.1252E+04	-.2529E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2052E+04	-.2278E+04	.1789E+02	-.2051E+04	-.2279E+04	4.5
QUAD PLATE NO. 23							
Loads	17	.8646E+03	.9406E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	18	-.1298E+04	.1052E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	25	-.8433E+03	-.9920E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	24	.1277E+04	-.5378E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2052E+04	-.2277E+04	.1787E+02	-.2051E+04	-.2279E+04	4.5
QUAD PLATE NO. 24							
Loads	24	.7068E+03	.1064E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	25	-.1298E+04	-.9933E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	32	-.6779E+03	-.1112E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	31	.1269E+04	.1465E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2052E+04	-.2277E+04	.1786E+02	-.2051E+04	-.2279E+04	4.5
QUAD PLATE NO. 25							
Loads	31	.5315E+03	.1162E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	32	-.1267E+04	-.3012E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	39	-.4956E+03	-.1204E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	38	.1231E+04	.3433E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2052E+04	-.2277E+04	.1769E+02	-.2051E+04	-.2279E+04	4.5
QUAD PLATE NO. 26							
Loads	38	.3434E+03	.1231E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	39	-.1204E+04	-.4955E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	46	-.3011E+03	-.1267E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	45	.1162E+04	.5316E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2052E+04	-.2277E+04	.1796E+02	-.2051E+04	-.2279E+04	4.5
QUAD PLATE NO. 27							
Loads	45	.1466E+03	.1269E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	46	-.1112E+04	-.6778E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	53	-.9937E+02	-.1298E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	52	.1065E+04	.7068E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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Version 1.1 02/01/85

LTHD muzzle brake thermal load - titanium

Load Case 1:

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress	Stress	Shear XZ	Shear YZ				
Stress	MEM	-.2052E+04	-.2277E+04	.1801E+02	-.2051E+04	-.2279E+04	4.5
QUAD PLATE NO. 28							
Loads	52	-.5379E+02	.1277E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	53	-.9919E+03	-.8434E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	60	.1052E+03	-.1298E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	59	.9405E+03	.8646E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2052E+04	-.2277E+04	.1763E+02	-.2051E+04	-.2279E+04	4.4
QUAD PLATE NO. 29							
Loads	59	-.2529E+03	.1252E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	60	-.8479E+03	-.9882E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	67	.3069E+03	-.1265E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	66	.7939E+03	.1001E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2052E+04	-.2278E+04	.1783E+02	-.2051E+04	-.2279E+04	4.5
QUAD PLATE NO. 30							
Loads	66	-.4457E+03	.1197E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	67	-.6827E+03	-.1109E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	74	.5008E+03	-.1202E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	73	.6275E+03	.1113E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2052E+04	-.2277E+04	.1785E+02	-.2051E+04	-.2279E+04	4.5
QUAD PLATE NO. 31							
Loads	4	.1202E+04	-.1596E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	5	-.9462E+03	-.1653E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	12	-.1193E+04	.1485E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	11	.9374E+03	.1764E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1701E+04	.6483E+04	-.6482E+03	.6534E+04	-.1752E+04	-85.5
QUAD PLATE NO. 32							
Loads	11	.1437E+04	-.1388E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	12	-.6759E+03	-.1781E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	19	-.1411E+04	.1280E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	18	.6498E+03	.1889E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1701E+04	.6483E+04	-.6481E+03	.6534E+04	-.1752E+04	-85.5
QUAD PLATE NO. 33							
Loads	18	.1636E+04	-.1146E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	19	-.3891E+03	-.1864E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	26	-.1593E+04	.1043E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	25	.3464E+03	.1967E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1701E+04	.6483E+04	-.6480E+03	.6534E+04	-.1752E+04	-85.5
QUAD PLATE NO. 34							
Loads	25	.1795E+04	-.8760E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	26	-.9250E+02	-.1902E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	33	-.1737E+04	.7811E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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LTHD muzzle brake thermal load - titanium

Load Case 1:

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Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
Stress	MEM	-.1701E+04	.6483E+04	-.6482E+03	.6534E+04	-.1752E+04	-85.5
QUAD PLATE NO. 35							
Loads	32	.1910E+04	-.5845E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	33	.2061E+03	-.1893E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	40	-.1838E+04	.4999E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	39	-.2783E+03	.1978E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1701E+04	.6483E+04	-.6480E+03	.6534E+04	-.1752E+04	-85.5
QUAD PLATE NO. 36							
Loads	39	.1978E+04	-.2784E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	40	.4998E+03	-.1838E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	47	-.1893E+04	.2061E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	46	-.5845E+03	.1910E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1701E+04	.6483E+04	-.6482E+03	.6534E+04	-.1752E+04	-85.5
QUAD PLATE NO. 37							
Loads	46	.1997E+04	.3439E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	47	.7812E+03	-.1737E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	54	-.1902E+04	-.9263E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	53	-.8763E+03	.1795E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1701E+04	.6483E+04	-.6482E+03	.6534E+04	-.1752E+04	-85.5
QUAD PLATE NO. 38							
Loads	53	.1968E+04	.3463E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	54	.1043E+04	-.1593E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	61	-.1864E+04	-.3890E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	60	-.1146E+04	.1636E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1701E+04	.6483E+04	-.6480E+03	.6534E+04	-.1752E+04	-85.5
QUAD PLATE NO. 39							
Loads	60	.1889E+04	.6499E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	61	.1280E+04	-.1411E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	68	-.1780E+04	-.6760E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	67	-.1388E+04	.1437E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1701E+04	.6483E+04	-.6482E+03	.6534E+04	-.1752E+04	-85.5
QUAD PLATE NO. 40							
Loads	67	.1764E+04	.9374E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	68	.1485E+04	-.1193E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	75	-.1653E+04	-.9462E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	74	-.1596E+04	.1202E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1701E+04	.6483E+04	-.6481E+03	.6534E+04	-.1752E+04	-85.5
QUAD PLATE NO. 41							
Loads	5	.9462E+03	-.2568E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	6	-.5418E+03	-.2572E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	13	-.9373E+03	.2456E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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LTHD muzzle brake thermal load - titanium

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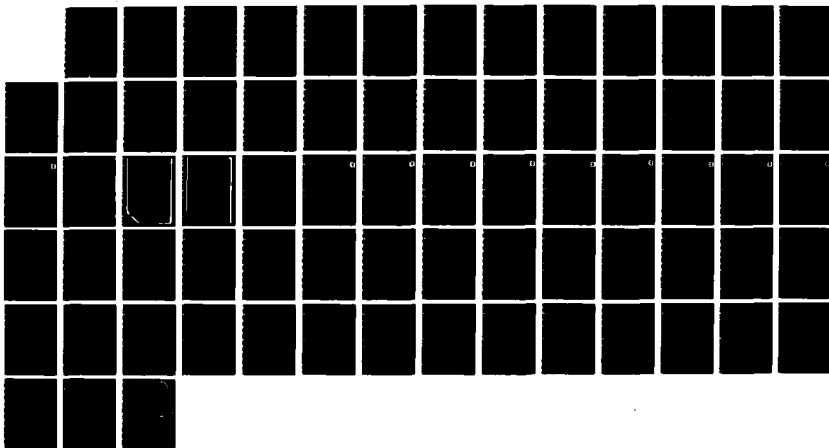
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Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
Stress	MEM	-.1050E+04	.1027E+05	-.8965E+03	.1034E+05	-.1121E+04	-85.5
QUAD PLATE NO. 42							
Loads	12	.1336E+04	-.2388E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	13	-.1327E+03	-.2625E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	20	-.1310E+04	.2279E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	19	.1065E+03	.2734E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1050E+04	.1027E+05	-.8966E+03	.1034E+05	-.1121E+04	-85.5
QUAD PLATE NO. 43							
Loads	19	.1693E+04	-.2149E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	20	.2797E+03	-.2613E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	27	-.1650E+04	.2046E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	26	-.3227E+03	.2717E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1050E+04	.1027E+05	-.8967E+03	.1034E+05	-.1121E+04	-85.5
QUAD PLATE NO. 44							
Loads	26	.2009E+04	-.1858E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	27	.6849E+03	-.2537E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	34	-.1950E+04	.1762E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	33	-.7436E+03	.2633E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1050E+04	.1027E+05	-.8966E+03	.1034E+05	-.1121E+04	-85.5
QUAD PLATE NO. 45							
Loads	33	.2274E+04	-.1521E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	34	.1074E+04	-.2399E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	41	-.2202E+04	.1435E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	40	-.1147E+04	.2485E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1050E+04	.1027E+05	-.8969E+03	.1034E+05	-.1121E+04	-85.5
QUAD PLATE NO. 46							
Loads	40	.2485E+04	-.1147E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	41	.1435E+04	-.2201E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	48	-.2399E+04	.1073E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	47	-.1521E+04	.2275E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1050E+04	.1027E+05	-.8965E+03	.1034E+05	-.1121E+04	-85.5
QUAD PLATE NO. 47							
Loads	47	.2633E+04	-.7437E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	48	.1762E+04	-.1950E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	55	-.2537E+04	.6850E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	54	-.1858E+04	.2009E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1050E+04	.1027E+05	-.8966E+03	.1034E+05	-.1121E+04	-85.5
QUAD PLATE NO. 48							
Loads	54	.2717E+04	-.3226E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	55	.2045E+04	-.1650E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	62	-.2613E+04	.2794E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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Version 1.1 02/01/85

LTHD muzzle brake thermal load - titanium

Load Case 1:

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress	Stress	Shear XZ	Shear YZ				
Stress	MEM	-.1050E+04	.1027E+05	-.8969E+03	.1034E+05	-.1121E+04	-85.5
QUAD PLATE NO. 49							
Loads	61	.2735E+04	.1063E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	62	.2278E+04	-.1310E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	69	-.2625E+04	-.1327E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	68	-.2388E+04	.1336E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1050E+04	.1027E+05	-.8965E+03	.1034E+05	-.1121E+04	-85.5
QUAD PLATE NO. 50							
Loads	68	.2684E+04	.5329E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	69	.2455E+04	-.9374E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	76	-.2572E+04	-.5416E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	75	-.2567E+04	.9462E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1050E+04	.1027E+05	-.8966E+03	.1034E+05	-.1121E+04	-85.5
QUAD PLATE NO. 51							
Loads	6	.5418E+03	-.3470E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	7	.3142E-09	-.3412E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	14	-.5338E+03	.3370E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	13	-.8024E+01	.3513E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2646E+03	.1377E+05	-.1112E+04	.1386E+05	-.3521E+03	-85.5
QUAD PLATE NO. 52							
Loads	13	.1078E+04	-.3344E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	14	.5338E+03	-.3370E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	21	-.1054E+04	.3244E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	20	-.5577E+03	.3469E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2647E+03	.1377E+05	-.1112E+04	.1386E+05	-.3522E+03	-85.5
QUAD PLATE NO. 53							
Loads	20	.1588E+04	-.3134E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	21	.1054E+04	-.3244E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	28	-.1549E+04	.3039E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	27	-.1093E+04	.3339E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2647E+03	.1377E+05	-.1111E+04	.1386E+05	-.3521E+03	-85.5
QUAD PLATE NO. 54							
Loads	27	.2059E+04	-.2847E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	28	.1549E+04	-.3039E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	35	-.2005E+04	.2760E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	34	-.1602E+04	.3127E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2647E+03	.1377E+05	-.1111E+04	.1386E+05	-.3522E+03	-85.5
QUAD PLATE NO. 55							
Loads	34	.2478E+04	-.2490E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	35	.2005E+04	-.2760E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	42	-.2413E+04	.2413E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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Version 1.1 02/01/85

LTHD muzzle brake thermal load - titanium

Load Case 1:

2

Loads Stress	Node Surf	Fx Sigma Shear	X XZ	Fy Sigma Shear	Y YZ	Fz Tau XY	Mx Sigma 1	My Sigma 2	Mz Angle
Stress	MEM	-.2647E+03		.1377E+05		-.1111E+04	.1386E+05	-.3521E+03	-85.5
QUAD PLATE NO. 56									
Loads	41	.2837E+04		-.2071E+04		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	42	.2413E+04		-.2413E+04		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	49	-.2760E+04		.2005E+04		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	48	-.2490E+04		.2478E+04		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2646E+03		.1377E+05		-.1111E+04	.1386E+05	-.3520E+03	-85.5
QUAD PLATE NO. 57									
Loads	48	.3126E+04		-.1602E+04		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	49	.2760E+04		-.2005E+04		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	56	-.3040E+04		.1549E+04		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	55	-.2846E+04		.2058E+04		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2647E+03		.1377E+05		-.1111E+04	.1386E+05	-.3521E+03	-85.5
QUAD PLATE NO. 58									
Loads	55	.3338E+04		-.1093E+04		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	56	.3040E+04		-.1549E+04		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	63	-.3245E+04		.1054E+04		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	62	-.3133E+04		.1588E+04		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2646E+03		.1377E+05		-.1111E+04	.1386E+05	-.3520E+03	-85.5
QUAD PLATE NO. 59									
Loads	62	.3468E+04		-.5573E+03		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	63	.3245E+04		-.1054E+04		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	70	-.3370E+04		.5337E+03		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	69	-.3343E+04		.1078E+04		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2646E+03		.1377E+05		-.1111E+04	.1386E+05	-.3521E+03	-85.5
QUAD PLATE NO. 60									
Loads	69	.3513E+04		-.7924E+01		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	70	.3370E+04		-.5337E+03		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	77	-.3412E+04		.1491E+08		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	76	-.3471E+04		.5416E+03		.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2646E+03		.1377E+05		-.1111E+04	.1386E+05	-.3521E+03	-85.5

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SOLVE PLATE LOADS/STRESSES Version 1.1 02/01/85

LTHD muzzle brake thermal load - titanium

MAXIMUM STRESS SUMMARY FOR PLATES
WITHIN SPECIFIED RANGE

Maximum (absolute) Stress = .2079E+05 at Plate 8

Plate	Sigma X	Sigma Y	Tau XY
8	-.8561E+03	-.2079E+05	.1578E+04

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SOLVE REACTIONS

Version 1.1 02/01/85

LTHD muzzle brake thermal load - titanium

REACTIONS

Node	Fx	Fy	Fz	Mx	My	Mz
1	.0000E+00	.4228E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
2	.0000E+00	.7086E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
3	.0000E+00	.3456E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
4	.0000E+00	-.1095E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
5	.0000E+00	-.4221E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
6	.0000E+00	-.6042E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
7	.0000E+00	-.3412E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
71	.4228E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
72	.7086E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
73	.3455E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
74	-.1095E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
75	-.4221					

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SOLVE DISPLACEMENTS Version 1.1 02/01/85

LTHD muzzle brake thermal load - steel

L O A D C A S E 1

REFERENCE TEMPERATURE =-.2500E+02

PLATE TEMPERATURES

Plate	Temp	Plate	Temp	Plate	Temp	Plate	Temp
1	.2310E+03	2	.2310E+03	3	.2310E+03	4	.2310E+03
5	.2310E+03	6	.2310E+03	7	.2310E+03	8	.2310E+03
9	.2310E+03	10	.2310E+03	11	.1884E+03	12	.1884E+03
13	.1884E+03	14	.1884E+03	15	.1884E+03	16	.1884E+03
17	.1884E+03	18	.1884E+03	19	.1884E+03	20	.1884E+03
21	.1409E+03	22	.1409E+03	23	.1409E+03	24	.1409E+03
25	.1409E+03	26	.1409E+03	27	.1409E+03	28	.1409E+03
29	.1409E+03	30	.1409E+03	31	.9350E+02	32	.9350E+02
33	.9350E+02	34	.9350E+02	35	.9350E+02	36	.9350E+02
37	.9350E+02	38	.9350E+02	39	.9350E+02	40	.9350E+02
41	.4610E+02	42	.4610E+02	43	.4610E+02	44	.4610E+02
45	.4610E+02	46	.4610E+02	47	.4610E+02	48	.4610E+02
49	.4610E+02	50	.4610E+02	51	-.1300E+01	52	-.1300E+01
53	-.1300E+01	54	-.1300E+01	55	-.1300E+01	56	-.1300E+01
57	-.1300E+01	58	-.1300E+01	59	-.1300E+01	60	-.1300E+01

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SOLVE DISPLACEMENTS Version 1.1 02/01/85

LTHD muzzle brake thermal load - steel

L O A D C A S E 1

APPLIED LOAD VECTOR

Node	Fx	Fy	Fz	Mx	My	Mz
1	-.3326E+05	-.1570E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
2	.5903E+04	-.2812E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
3	.7079E+04	-.2539E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
4	.7570E+04	-.1892E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
5	.8075E+04	-.1245E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
6	.8581E+04	-.5983E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
7	.4543E+04	-.1368E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
8	-.6569E+05	-.1040E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
9	.1166E+05	.1843E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
10	.1398E+05	.2218E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
11	.1495E+05	.2366E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
12	.1595E+05	.2529E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
13	.1695E+05	.2684E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
14	.8974E+04	.1422E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
15	-.6326E+05	-.2055E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
16	.1123E+05	.3648E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
17	.1347E+05	.4375E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
18	.1440E+05	.4678E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
19	.1536E+05	.4989E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
20	.1632E+05	.5304E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
21	.8641E+04	.2808E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
22	-.5926E+05	-.3020E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
23	.1052E+05	.5359E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
24	.1262E+05	.6425E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
25	.1349E+05	.6878E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
26	.1439E+05	.7332E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
27	.1529E+05	.7790E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
28	.8096E+04	.4125E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
29	-.5381E+05	-.3909E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
30	.9550E+04	.6938E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
31	.1145E+05	.8322E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
32	.1225E+05	.8699E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
33	.1307E+05	.9493E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
34	.1388E+05	.1009E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
35	.7351E+04	.5340E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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SOLVE DISPLACEMENTS Version 1.1 02/01/85

LTHD muzzle brake thermal load - steel

L O A D C A S E 1

APPLIED LOAD VECTOR

Node	Fx	Fy	Fz	Mx	My	Mz
36	-.4703E+05	-.4703E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
37	.8347E+04	.8347E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
38	.1001E+05	.1001E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
39	.1071E+05	.1070E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
40	.1142E+05	.1142E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
41	.1213E+05	.1214E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
42	.6425E+04	.6425E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
43	-.3909E+05	-.5381E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
44	.6935E+04	.9553E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
45	.8328E+04	.1145E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
46	.8898E+04	.1225E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
47	.9490E+04	.1307E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
48	.1009E+05	.1388E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
49	.5340E+04	.7351E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
50	-.3020E+05	-.5926E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
51	.5360E+04	.1052E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
52	.6424E+04	.1262E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
53	.6876E+04	.1349E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
54	.7334E+04	.1439E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
55	.7790E+04	.1529E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
56	.4125E+04	.8095E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
57	-.2055E+05	-.6326E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
58	.3652E+04	.1123E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
59	.4372E+04	.1347E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
60	.4678E+04	.1440E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
61	.4991E+04	.1536E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
62	.5303E+04	.1632E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
63	.2808E+04	.8641E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
64	-.1040E+05	-.6569E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
65	.1847E+04	.1166E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
66	.2218E+04	.1398E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
67	.2363E+04	.1495E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
68	.2527E+04	.1595E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
69	.2686E+04	.1695E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
70	.1421E+04	.8974E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
71	-.1570E+05	-.3326E+05	.0000E+00	.0000E+00	.0000E+00	.0000E+00
72	-.2812E+05	.5902E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
73	-.2539E+05	.7079E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
74	-.1891E+05	.7570E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
75	-.1245E+05	.8075E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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SOLVE DISPLACEMENTS Version 1.1 02/01/85

LTHD muzzle brake thermal load - steel

L O A D C A S E 1

APPLIED LOAD VECTOR

Node	Fx	Fy	Fz	Mx	My	Mz
76	-.5983E+04	.8581E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
77	-.1368E+04	.4543E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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SOLVE DISPLACEMENTS Version 1.1 02/01/85

LTHD muzzle brake thermal load - steel

L O A D C A S E 1

DISPLACEMENTS

Node	T r a n s l a t i o n s			/	R o t a t i o n s		
	X	Y	Z		X	Y	Z
1	.5191E-02	.0000E+00	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
2	.5953E-02	.0000E+00	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
3	.6697E-02	.0000E+00	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
4	.7226E-02	.0000E+00	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
5	.7556E-02	.0000E+00	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
6	.7697E-02	.0000E+00	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
7	.7659E-02	.0000E+00	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
8	.5127E-02	.8120E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
9	.5880E-02	.9313E-03	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
10	.6615E-02	.1048E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
11	.7137E-02	.1130E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
12	.7463E-02	.1182E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
13	.7602E-02	.1204E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
14	.7564E-02	.1198E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
15	.4937E-02	.1604E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
16	.5662E-02	.1840E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
17	.6369E-02	.2069E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
18	.6872E-02	.2233E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
19	.7186E-02	.2335E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
20	.7320E-02	.2378E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
21	.7284E-02	.2367E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
22	.4625E-02	.2357E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
23	.5304E-02	.2703E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
24	.5967E-02	.3040E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
25	.6439E-02	.3281E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
26	.6732E-02	.3430E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
27	.6858E-02	.3494E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
28	.6824E-02	.3477E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
29	.4200E-02	.3051E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
30	.4816E-02	.3499E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
31	.5418E-02	.3936E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
32	.5846E-02	.4247E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
33	.6113E-02	.4441E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
34	.6227E-02	.4524E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
35	.6196E-02	.4502E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
36	.3671E-02	.3671E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
37	.4209E-02	.4209E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
38	.4736E-02	.4736E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
39	.5110E-02	.5110E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
40	.5343E-02	.5343E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00

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SOLVE DISPLACEMENTS Version 1.1 02/01/85

LTHD muzzle brake thermal load - steel

L O A D C A S E 1

Node	T r a n s l a t i o n s			/	R o t a t i o n s		
	X	Y	Z		X	Y	Z
41	.5442E-02	.5442E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
42	.5415E-02	.5415E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
43	.3051E-02	.4200E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
44	.3499E-02	.4816E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
45	.3936E-02	.5418E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
46	.4247E-02	.5846E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
47	.4441E-02	.6113E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
48	.4524E-02	.6227E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
49	.4502E-02	.6196E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
50	.2357E-02	.4625E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
51	.2703E-02	.5304E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
52	.3040E-02	.5967E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
53	.3281E-02	.6438E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
54	.3430E-02	.6732E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
55	.3494E-02	.6858E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
56	.3477E-02	.6824E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
57	.1604E-02	.4937E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
58	.1840E-02	.5662E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
59	.2069E-02	.6369E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
60	.2233E-02	.6872E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
61	.2335E-02	.7186E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
62	.2378E-02	.7320E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
63	.2367E-02	.7284E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
64	.8121E-03	.5127E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
65	.9313E-03	.5880E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
66	.1048E-02	.6615E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
67	.1130E-02	.7137E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
68	.1182E-02	.7462E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
69	.1204E-02	.7602E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
70	.1198E-02	.7564E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
71	.0000E+00	.5191E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
72	.0000E+00	.5953E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
73	.0000E+00	.6697E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00
74	.0000E+00	.7226E-02	.0000E+00	/	.0000E+00	.0000E+00	.0000E+00

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SOLVE PLATE LOADS/STRESSES Version 1.1 02/01/85

LTHD muzzle brake thermal load - steel

PLATE LOADS AND/OR STRESSES

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
QUAD PLATE NO. 1							
Loads	1	.1346E-08	.4770E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	2	-.7379E+03	.4606E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	9	-.8359E+01	-.4664E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	8	.7462E+03	-.4712E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.9660E+03	-.2346E+05	.1781E+04	-.8258E+03	-.2360E+05	4.5
QUAD PLATE NO. 2							
Loads	8	-.7462E+03	.4712E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	9	-.1449E+04	.4433E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	16	.7214E+03	-.4608E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	15	.1474E+04	-.4537E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.9660E+03	-.2346E+05	.1781E+04	-.8259E+03	-.2360E+05	4.5
QUAD PLATE NO. 3							
Loads	15	-.1474E+04	.4537E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	16	-.2125E+04	.4152E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	23	.1433E+04	-.4439E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	22	.2166E+04	-.4250E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.9660E+03	-.2346E+05	.1781E+04	-.8258E+03	-.2360E+05	4.5
QUAD PLATE NO. 4							
Loads	22	-.2166E+04	.4250E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	23	-.2748E+04	.3769E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	30	.2110E+04	-.4160E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	29	.2804E+04	-.3859E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.9660E+03	-.2346E+05	.1781E+04	-.8258E+03	-.2360E+05	4.5
QUAD PLATE NO. 5							
Loads	29	-.2804E+04	.3859E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	30	-.3304E+04	.3292E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	37	.2735E+04	-.3778E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	36	.3373E+04	-.3373E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.9660E+03	-.2346E+05	.1781E+04	-.8258E+03	-.2360E+05	4.5
QUAD PLATE NO. 6							
Loads	36	-.3373E+04	.3373E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	37	-.3778E+04	.2735E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	44	.3292E+04	-.3304E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	43	.3859E+04	-.2804E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.9660E+03	-.2346E+05	.1781E+04	-.8259E+03	-.2360E+05	4.5
QUAD PLATE NO. 7							
Loads	43	-.3859E+04	.2804E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	44	-.4160E+04	.2110E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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Version 1.1 02/01/85

LTHD muzzlebrake thermal load - steel

Load Case 1:

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Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
Loads	51	.3769E+04	-.2748E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	50	.4250E+04	-.2166E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.9660E+03	-.2346E+05	.1781E+04	-.8258E+03	-.2360E+05	4.5
QUAD PLATE NO. 8							
Loads	50	-.4250E+04	.2166E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	51	-.4439E+04	.1433E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	58	.4152E+04	-.2125E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	57	.4537E+04	-.1474E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.9660E+03	-.2346E+05	.1781E+04	-.8258E+03	-.2360E+05	4.5
QUAD PLATE NO. 9							
Loads	57	-.4537E+04	.1474E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	58	-.4608E+04	.7214E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	65	.4433E+04	-.1449E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	64	.4711E+04	-.7462E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.9660E+03	-.2346E+05	.1781E+04	-.8258E+03	-.2360E+05	4.5
QUAD PLATE NO. 10							
Loads	64	-.4711E+04	.7462E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	65	-.4664E+04	-.8351E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	72	.4606E+04	-.7379E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	71	.4770E+04	-.1746E-09	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.9660E+03	-.2346E+05	.1781E+04	-.8258E+03	-.2360E+05	4.5
QUAD PLATE NO. 11							
Loads	2	.7379E+03	.3645E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	3	-.1295E+04	.3437E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	10	-.7417E+03	-.3597E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	9	.1299E+04	-.3485E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2051E+04	-.1419E+05	.9614E+03	-.1975E+04	-.1426E+05	4.5
QUAD PLATE NO. 12							
Loads	9	.1584E+03	.3716E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	10	-.1817E+04	.3192E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	17	-.1699E+03	-.3668E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	16	.1829E+04	-.3240E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2051E+04	-.1419E+05	.9614E+03	-.1975E+04	-.1426E+05	4.5
QUAD PLATE NO. 13							
Loads	16	-.4249E+03	.3696E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	17	-.2294E+04	.2868E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	24	.4060E+03	-.3650E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	23	.2313E+04	-.2914E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2051E+04	-.1419E+05	.9611E+03	-.1975E+04	-.1426E+05	4.5
QUAD PLATE NO. 14							
Loads	23	-.9978E+03	.3584E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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Version 1.1 02/01/85

LTHD muzzle brake thermal load - steel

Load Case 1:

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Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
Loads	24	-.2714E+04	.2474E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	31	.9720E+03	-.3542E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	30	.2740E+04	-.2516E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2051E+04	-.1419E+05	.9610E+03	-.1975E+04	-.1426E+05	4.5
QUAD PLATE NO. 15							
Loads	30	-.1546E+04	.3383E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	31	-.3068E+04	.2019E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	38	.1514E+04	-.3346E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	37	.3100E+04	-.2056E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2051E+04	-.1419E+05	.9611E+03	-.1975E+04	-.1426E+05	4.5
QUAD PLATE NO. 16							
Loads	37	-.2056E+04	.3100E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	38	-.3346E+04	.1514E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	45	.2019E+04	-.3068E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	44	.3383E+04	-.1546E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2051E+04	-.1419E+05	.9609E+03	-.1975E+04	-.1426E+05	4.5
QUAD PLATE NO. 17							
Loads	44	-.2516E+04	.2740E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	45	-.3542E+04	.9722E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	52	.2474E+04	-.2715E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	51	.3583E+04	-.9975E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2051E+04	-.1419E+05	.9608E+03	-.1975E+04	-.1426E+05	4.5
QUAD PLATE NO. 18							
Loads	51	-.2913E+04	.2312E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	52	-.3651E+04	.4062E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	59	.2868E+04	-.2294E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	58	.3695E+04	-.4247E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2051E+04	-.1419E+05	.9614E+03	-.1975E+04	-.1426E+05	4.5
QUAD PLATE NO. 19							
Loads	58	-.3239E+04	.1828E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	59	-.3669E+04	-.1700E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	66	.3192E+04	-.1817E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	65	.3717E+04	.1585E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2051E+04	-.1419E+05	.9612E+03	-.1975E+04	-.1426E+05	4.5
QUAD PLATE NO. 20							
Loads	65	-.3486E+04	.1299E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	66	-.3597E+04	-.7418E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	73	.3436E+04	-.1295E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	72	.3646E+04	.7379E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2051E+04	-.1419E+05	.9610E+03	-.1975E+04	-.1426E+05	4.5

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Version 1.1 02/01/85

LTHD muzzle brake thermal load - steel

Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
QUAD PLATE NO. 21							
Loads	3	.1295E+04	.1234E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	4	-.1477E+04	.1069E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	11	-.1291E+04	-.1287E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	10	.1473E+04	-.1017E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2475E+04	-.4632E+04	.1708E+03	-.2462E+04	-.4645E+04	4.5
QUAD PLATE NO. 22							
Loads	10	.1086E+04	.1422E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	11	-.1626E+04	.8249E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	18	-.1074E+04	-.1473E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	17	.1613E+04	-.7739E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2475E+04	-.4632E+04	.1708E+03	-.2462E+04	-.4646E+04	4.5
QUAD PLATE NO. 23							
Loads	17	.8503E+03	.1574E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	18	-.1735E+04	.5604E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	25	-.8303E+03	-.1623E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	24	.1715E+04	-.5120E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2475E+04	-.4632E+04	.1709E+03	-.2462E+04	-.4646E+04	4.5
QUAD PLATE NO. 24							
Loads	24	.5935E+03	.1688E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	25	-.1801E+04	.2819E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	32	-.5664E+03	-.1733E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	31	.1774E+04	-.2376E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2475E+04	-.4632E+04	.1708E+03	-.2462E+04	-.4646E+04	4.5
QUAD PLATE NO. 25							
Loads	31	.3221E+03	.1760E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	32	-.1823E+04	-.3373E+01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	39	-.2883E+03	-.1800E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	38	.1789E+04	.4286E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2475E+04	-.4632E+04	.1705E+03	-.2462E+04	-.4645E+04	4.5
QUAD PLATE NO. 26							
Loads	38	.4296E+02	.1789E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	39	-.1800E+04	-.2883E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	46	-.3209E+01	-.1823E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	45	.1760E+04	.3222E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2475E+04	-.4632E+04	.1709E+03	-.2462E+04	-.4646E+04	4.5
QUAD PLATE NO. 27							
Loads	45	-.2375E+03	.1774E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	46	-.1733E+04	-.5664E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	53	.2818E+03	-.1801E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	52	.1688E+04	.5936E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00

Load Case 1:

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Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress	Stress	Shear XZ	Shear YZ				
Stress	MEM	-.2475E+04	-.4632E+04	.1710E+03	-.2462E+04	-.4645E+04	4.5
QUAD PLATE NO. 28							
Loads	52	-.5120E+03	.1715E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	53	-.1623E+04	-.8304E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	60	.5604E+03	-.1735E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	59	.1574E+04	.8504E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2475E+04	-.4632E+04	.1705E+03	-.2462E+04	-.4645E+04	4.5
QUAD PLATE NO. 29							
Loads	59	-.7739E+03	.1613E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	60	-.1473E+04	-.1074E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	67	.8248E+03	-.1626E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	66	.1422E+04	.1086E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2475E+04	-.4632E+04	.1708E+03	-.2462E+04	-.4646E+04	4.5
QUAD PLATE NO. 30							
Loads	66	-.1017E+04	.1472E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	67	-.1287E+04	-.1291E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	74	.1069E+04	-.1477E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	73	.1235E+04	.1295E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2475E+04	-.4632E+04	.1709E+03	-.2462E+04	-.4645E+04	4.5
QUAD PLATE NO. 31							
Loads	4	.1477E+04	-.1015E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	5	-.1309E+04	-.1119E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	12	-.1468E+04	.9006E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	11	.1300E+04	.1234E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2245E+04	.4249E+04	-.5143E+03	.4289E+04	-.2286E+04	-85.5
QUAD PLATE NO. 32							
Loads	11	.1617E+04	-.7722E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	12	-.1117E+04	-.1310E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	19	-.1590E+04	.6600E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	18	.1091E+04	.1422E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2245E+04	.4249E+04	-.5141E+03	.4289E+04	-.2286E+04	-85.5
QUAD PLATE NO. 33							
Loads	18	.1718E+04	-.5095E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	19	-.8987E+03	-.1468E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	26	-.1674E+04	.4029E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	25	.8546E+03	.1575E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2245E+04	.4248E+04	-.5142E+03	.4289E+04	-.2286E+04	-85.5
QUAD PLATE NO. 34							
Loads	25	.1777E+04	-.2343E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	26	-.6577E+03	-.1591E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	33	-.1716E+04	.1361E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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Version 1.1 02/01/85

LTHD muzzle brake thermal load - steel

Load Case 1:

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Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress	Stress	Shear XZ	Shear YZ				
(Stress	MEM	-.2245E+04	.4249E+04	-.5146E+03	.4289E+04	-.2286E+04	-85.5
QUAD PLATE NO. 35							
Loads	32	.1792E+04	.4632E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	33	-.4010E+03	-.1675E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	40	-.1717E+04	-.1339E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	39	.3262E+03	.1762E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2245E+04	.4249E+04	-.5141E+03	.4289E+04	-.2286E+04	-85.5
QUAD PLATE NO. 36							
Loads	39	.1762E+04	.3261E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	40	-.1340E+03	-.1717E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	47	-.1674E+04	-.4010E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	46	.4634E+02	.1791E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2245E+04	.4249E+04	-.5143E+03	.4289E+04	-.2286E+04	-85.5
QUAD PLATE NO. 37							
Loads	46	.1690E+04	.5977E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	47	.1362E+03	-.1716E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	54	-.1591E+04	-.6580E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	53	-.2345E+03	.1777E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2245E+04	.4249E+04	-.5144E+03	.4289E+04	-.2286E+04	-85.5
QUAD PLATE NO. 38							
Loads	53	.1575E+04	.8545E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	54	.4028E+03	-.1674E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	61	-.1469E+04	-.8987E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	60	-.5095E+03	.1718E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2245E+04	.4249E+04	-.5141E+03	.4289E+04	-.2286E+04	-85.5
QUAD PLATE NO. 39							
Loads	60	.1422E+04	.1091E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	61	.6600E+03	-.1590E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	68	-.1310E+04	-.1117E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	67	-.7722E+03	.1617E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2245E+04	.4249E+04	-.5144E+03	.4289E+04	-.2286E+04	-85.5
QUAD PLATE NO. 40							
Loads	67	.1234E+04	.1300E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	68	.9007E+03	-.1468E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	75	-.1119E+04	-.1309E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	74	-.1016E+04	.1477E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.2245E+04	.4249E+04	-.5144E+03	.4289E+04	-.2286E+04	-85.5
QUAD PLATE NO. 41							
Loads	5	.1309E+04	-.3150E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	6	-.8115E+03	-.3169E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	13	-.1297E+04	.3004E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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LTHD muzzle brake thermal load - steel

Load Case 1:

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Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress	Stress	Shear XZ	Shear YZ				
(Stress	MEM	-.1515E+04	.1263E+05	-.1120E+04	.1272E+05	-.1604E+04	-85.5
QUAD PLATE NO. 42							
Loads	12	.1785E+04	-.2906E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	13	-.3053E+03	-.3257E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	20	-.1751E+04	.2764E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	19	.2710E+03	.3400E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1515E+04	.1263E+05	-.1120E+04	.1272E+05	-.1603E+04	-85.5
QUAD PLATE NO. 43							
Loads	19	.2218E+04	-.2592E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	20	.2079E+03	-.3265E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	27	-.2162E+04	.2456E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	26	-.2644E+03	.3401E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1515E+04	.1263E+05	-.1120E+04	.1272E+05	-.1603E+04	-85.5
QUAD PLATE NO. 44							
Loads	26	.2596E+04	-.2213E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	27	.7160E+03	-.3192E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	34	-.2519E+04	.2087E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	33	-.7927E+03	.3317E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1515E+04	.1263E+05	-.1120E+04	.1272E+05	-.1603E+04	-85.5
QUAD PLATE NO. 45							
Loads	33	.2910E+04	-.1779E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	34	.1207E+04	-.3041E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	41	-.2815E+04	.1667E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	40	-.1302E+04	.3153E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1515E+04	.1263E+05	-.1121E+04	.1272E+05	-.1603E+04	-85.5
QUAD PLATE NO. 46							
(Loads	40	.3153E+04	-.1302E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	41	.1667E+04	-.2815E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	48	-.3041E+04	.1207E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	47	-.1779E+04	.2910E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1516E+04	.1263E+05	-.1120E+04	.1272E+05	-.1604E+04	-85.5
QUAD PLATE NO. 47							
Loads	47	.3318E+04	-.7929E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	48	.2087E+04	-.2519E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	55	-.3192E+04	.7162E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	54	-.2213E+04	.2596E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1515E+04	.1263E+05	-.1120E+04	.1272E+05	-.1603E+04	-85.5
QUAD PLATE NO. 48							
Loads	54	.3401E+04	-.2641E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	55	.2456E+04	-.2162E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	62	-.3265E+04	.2077E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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LTHD muzzle brake thermal load - steel

Load Case 1:

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Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
(Stress	MEM	-.1515E+04	.1263E+05	-.1120E+04	.1272E+05	-.1604E+04	-85.5
QUAD PLATE NO. 49							
Loads	61	.3401E+04	.2709E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	62	.2763E+04	-.1751E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	69	-.3257E+04	-.3054E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	68	-.2907E+04	.1785E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1515E+04	.1263E+05	-.1120E+04	.1272E+05	-.1603E+04	-85.5
QUAD PLATE NO. 50							
Loads	68	.3316E+04	.7997E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	69	.3004E+04	-.1297E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	76	-.3170E+04	-.8112E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	75	-.3150E+04	.1309E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.1515E+04	.1263E+05	-.1120E+04	.1272E+05	-.1603E+04	-85.5
QUAD PLATE NO. 51							
Loads	6	.8115E+03	-.5198E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	7	-.2364E-08	-.5110E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	14	-.7994E+03	.5046E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	13	-.1209E+02	.5261E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.3962E+03	.2062E+05	-.1665E+04	.2075E+05	-.5273E+03	-85.5
QUAD PLATE NO. 52							
Loads	13	.1614E+04	-.5008E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	14	.7994E+03	-.5046E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	21	-.1579E+04	.4859E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	20	-.8351E+03	.5195E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.3965E+03	.2062E+05	-.1665E+04	.2075E+05	-.5275E+03	-85.5
QUAD PLATE NO. 53							
Loads	20	.2378E+04	-.4694E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	21	.1579E+04	-.4859E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	28	-.2319E+04	.4552E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	27	-.1638E+04	.5001E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.3963E+03	.2062E+05	-.1664E+04	.2075E+05	-.5273E+03	-85.5
QUAD PLATE NO. 54							
Loads	27	.3083E+04	-.4264E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	28	.2319E+04	-.4552E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	35	-.3003E+04	.4134E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	34	-.2399E+04	.4683E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.3966E+03	.2062E+05	-.1664E+04	.2075E+05	-.5275E+03	-85.5
QUAD PLATE NO. 55							
Loads	34	.3712E+04	-.3729E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	35	.3003E+04	-.4134E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	42	-.3613E+04	.3613E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00

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Version 1.1 02/01/85

LTHD muzzle brake thermal load - steel

Load Case 1:

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Loads	Node	Fx	Fy	Fz	Mx	My	Mz
Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
(Stress	MEM	-.3964E+03	.2062E+05	-.1664E+04	.2075E+05	-.5273E+03	-85.5
QUAD PLATE NO. 56							
Loads	41	.4249E+04	-.3102E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	42	.3613E+04	-.3613E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	49	-.4134E+04	.3003E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	48	-.3729E+04	.3712E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.3963E+03	.2062E+05	-.1665E+04	.2075E+05	-.5273E+03	-85.5
QUAD PLATE NO. 57							
Loads	48	.4682E+04	-.2399E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	49	.4134E+04	-.3003E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	56	-.4553E+04	.2320E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	55	-.4263E+04	.3083E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.3963E+03	.2062E+05	-.1664E+04	.2075E+05	-.5273E+03	-85.5
QUAD PLATE NO. 58							
Loads	55	.5000E+04	-.1637E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	56	.4553E+04	-.2320E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	63	-.4860E+04	.1579E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	62	-.4693E+04	.2378E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.3963E+03	.2062E+05	-.1664E+04	.2075E+05	-.5272E+03	-85.5
QUAD PLATE NO. 59							
Loads	62	.5194E+04	-.8347E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	63	.4860E+04	-.1579E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	70	-.5047E+04	.7993E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	69	-.5007E+04	.1614E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.3963E+03	.2062E+05	-.1664E+04	.2075E+05	-.5273E+03	-85.5
QUAD PLATE NO. 60							
(Loads	69	.5261E+04	-.1187E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	70	.5047E+04	-.7993E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	77	-.5110E+04	-.6903E-09	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Loads	76	-.5198E+04	.8112E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00
Stress	MEM	-.3963E+03	.2062E+05	-.1664E+04	.2075E+05	-.5273E+03	-85.5

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SOLVE PLATE LOADS/STRESSES Version 1.1 02/01/85

LTHD muzzle brake thermal load - steel

Load Case 1:

46

MAXIMUM STRESS SUMMARY FOR PLATES
WITHIN SPECIFIED RANGE

Maximum (absolute) Stress = .2346E+05 at Plate 1

Plate	Sigma X	Sigma Y	Tau XY
1	-.9660E+03	-.2346E+05	.1781E+04

1-12-1987
PAGE 1

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SOLVE REACTIONS

Version 1.1 02/01/85

LTHD muzzle brake thermal load - steel

47

Load Case 1:

REACTIONS

Node	Fx	Fy	Fz	Mx	My	Mz
1	.0000E+00	.4770E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
2	.0000E+00	.8251E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
3	.0000E+00	.4672E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
4	.0000E+00	.5339E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00
5	.0000E+00	-.4269E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
6	.0000E+00	-.8367E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
7	.0000E+00	-.5110E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00
71	.4770E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
72	.8251E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
73	.4671E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
74	.5309E+02	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
75	-.42					

PART NUMBER: 12585816, Outer Breech Band

DESCRIPTION: OUTER BREECH BAND

The breech band design consists of an inner breech band and an outer breech band. The two-piece design was developed to simplify disassembly of the tube and breech when the tube needs replacing after extended use or if other maintenance activities require disassembly.

STATUS:

Dimensions for the outer breech band (TDP, Dwg. 12585816) except for porting were determined and are supported by analysis. Dimensional tolerances have yet to be determined. A 1/4 symmetric FEA model was used to evaluate stresses. Model results indicate a factor of safety for bending stress of 1.88 when 6061-T62 Aluminum is used for the material. A summary of the stress analysis results and the supporting calculations are found on the following pages of this section.

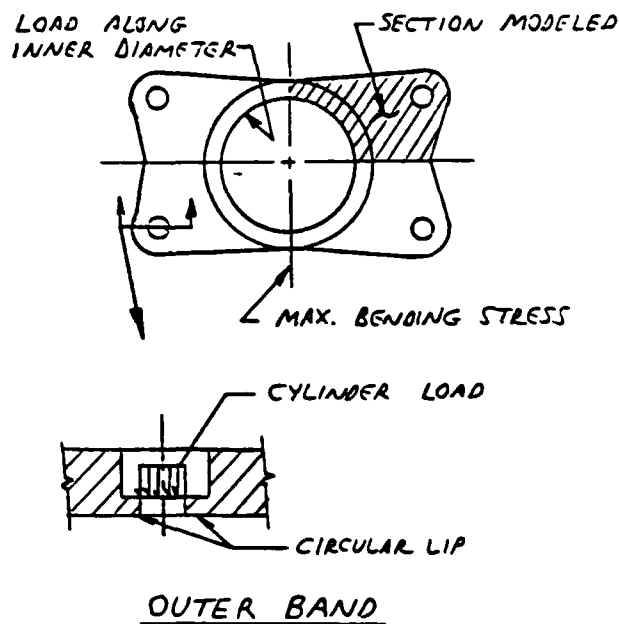
AUTHORS: Joe Turek, Joe Fishbein

OUTER BREECH BAND

A FEM was used to evaluate stresses in the outer breech band. A 1/4 symmetric model was used. The 79,000 lb. recoil thrust is applied to the inner radius of the band, and is supported at the recoil cylinder attachment points.

Maximum stresses occur as a result of bending at the center of the band. The actual section at this point differs slightly from the model; however, because the system is statically determinate, the moment is accurate. Based on the actual section, bending stress is 18,629 PSI. For the 6061-T62 Aluminum specified (Yield stress = 35,000 PSI), the factor of safety is 1.88. Specifying a material with a greater yield will increase the safety factor.

The circular lip inside the recoil cylinder attachment hole was also examined. It was assumed that one cylinder had failed, and the remaining three cylinders shared the load equally. The lip was analyzed as an annular plate, loaded on the inside radius and with a fixed outer edge. Maximum bending stress is 9,972 PSI, for a FS of 3.51.

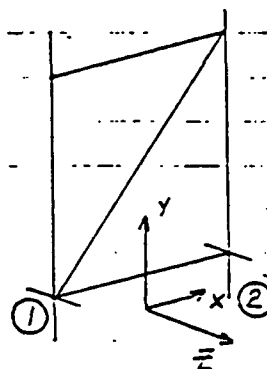


BRECH BANDS1. RECOIL THRUST - 79,000 LB.

NOTE: WHEN CHECKING STRESSES IN CYLINDER SOCKET OF OUTER BAND, IT WAS ASSUMED THAT ONE CYLINDER HAD FAILED, AND THRUST WAS CARRIED BY REMAINING THREE.

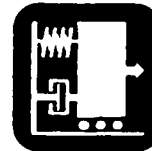
2. TRANSPORT - BUMP + SKID

FORCE	NODE 1	NODE 2
FX	-3700 lb	-3500 lb
FY	8600 lb	-16400 lb
FZ	3100 lb	-7600 lb
MX	0	0
MY	-9200 in.-lb	-1400 in.-lb
MZ	4900 in.-lb	26,200 in.-lb

3. TRANSPORT - 4.5G AIR DROP

FORCE	NODE 1	NODE 2
FX	-600 LB.	600 LB.
FY	-9800 LB.	-7700 LB.
FZ	100 LB.	-100 LB.
MX	0	0
MY	-22820 in.-LB.	20900 in.-lb
MZ	-27200 in.-lb.	23800 in.-lb

Subject LTHD	Analyst JM7	
	Project Number	
	EC. No.	Date 1-27-87



OUTER BREECH BAND

MAT'L : ALUMINUM 6061-T62 OR T651 PLATE

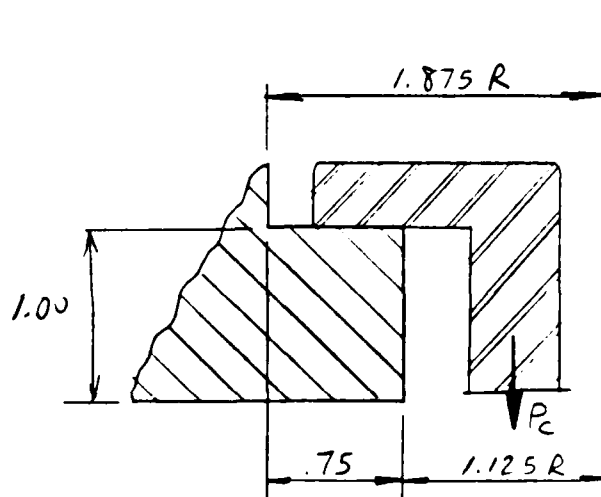
$$\begin{aligned} \tau_{TS} &= 40.0 \text{ KSI} & \nu &= .3 \\ \sigma_Y &= 35.0 \text{ KSI} \\ \rho &= .098 \text{ lb/in}^3 \\ E &= 10.0 \times 10^6 \text{ psi} \end{aligned}$$

LOADING - RECOIL THRUST - 79,000 lb
LOADS AT INNER RADII BY INNER BAND
RESISTED BY RECOIL CYLINDERS @ CORNERS

LOAD PER CYLINDER (ASSUMING FAILURE OF ONE CYLINDER)

$$P_C = \frac{79000 \text{ lb}}{3} = 26,333 \text{ lb}$$

a) INNER RING OF CYLINDER ROD SOCKET



sheet and plate/mechanical properties

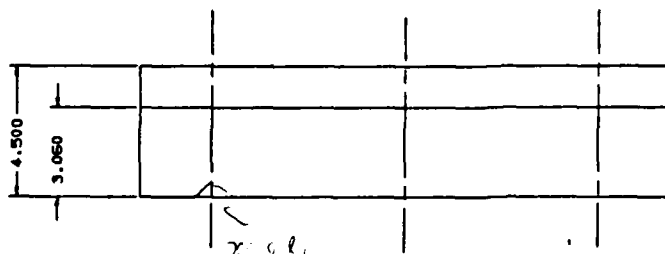
TABLE 7.2 Mechanical Property Limits—Heat-Treatable Alloys[Ⓢ] (continued)

ALLOY AND TEMPER	SPECIFIED THICKNESS [Ⓢ] IN.	TENSILE STRENGTH—ksi				ELONGATION PERCENT MIN IN 2 IN. OR 4D [Ⓢ]
		ULTIMATE		YIELD		
		min	max	min	max	

2219 (Continued)						
2219-T87 Flat sheet and plate	0.020–0.039	64.0	..	52.0	..	5
	0.040–0.249	64.0	..	52.0	..	6
	0.250–1.000	64.0	..	51.0	..	7
	1.001–2.000	64.0	..	51.0	..	6
	2.001–3.000	64.0	..	51.0	..	6
	3.001–4.000	62.0	..	50.0	..	4
	4.001–5.000	61.0	..	49.0	..	3
ALCLAD 2219 [Ⓢ]						
Alclad 2219-0	0.020–0.499	..	32.0	..	16.0	12
Sheet and plate	0.500–2.000	..	32.0 [Ⓢ]	..	16.0 [Ⓢ]	..
Alclad 2219-T31 [Ⓢ]	0.040–0.099	42.0	..	25.0	..	10
Flat sheet	0.100–0.249	44.0	..	26.0	..	10
Alclad 2219-T351 [Ⓢ] Plate	0.250–0.499	44.0	..	26.0	..	10
Alclad 2219-TT37 [Ⓢ]	0.040–0.099	45.0	..	34.0	..	6
Flat sheet and plate	0.100–0.249	47.0	..	35.0	..	6
	0.250–0.499	47.0	..	35.0	..	6
Alclad 2219-T62 [Ⓢ] [Ⓢ]	0.020–0.039	44.0	..	29.0	..	6
Sheet and plate	0.040–0.099	49.0	..	32.0	..	7
	0.100–0.249	51.0	..	34.0	..	7
	0.250–0.499	51.0	..	34.0	..	8
	0.500–1.000	54.0 [Ⓢ]	..	36.0 [Ⓢ]	..	8
	1.001–2.000	54.0 [Ⓢ]	..	36.0 [Ⓢ]	..	7
Alclad 2219-T81	0.020–0.039	49.0	..	37.0	..	6
Flat sheet	0.040–0.099	55.0	..	41.0	..	7
	0.100–0.249	58.0	..	43.0	..	7
Alclad 2219-T851 [Ⓢ] Plate	0.250–0.499	58.0	..	42.0	..	8
Alclad 2219-T87	0.040–0.099	57.0	..	46.0	..	6
Flat sheet and plate	0.100–0.249	60.0	..	48.0	..	6
	0.250–0.499	60.0	..	48.0	..	7
6061						
6061-0	0.006–0.007	..	22.0	..	12.0	10
Sheet and plate	0.008–0.009	..	22.0	..	12.0	12
	0.010–0.020	..	22.0	..	12.0	14
	0.021–0.128	..	22.0	..	12.0	16
	0.129–0.499	..	22.0	..	12.0	18
	0.500–1.000	..	22.0	..	..	18
	1.001–3.000	..	22.0	..	..	16
6061-T4	0.006–0.007	30.0	..	16.0	..	10
Sheet	0.008–0.009	30.0	..	16.0	..	12
	0.010–0.020	30.0	..	16.0	..	14
	0.021–0.249	30.0	..	16.0	..	16
6061-T451 [Ⓢ] [Ⓢ]	0.250–1.000	30.0	..	16.0	..	18
Plate	1.001–3.000	30.0	..	16.0	..	16
6061-T42 [Ⓢ] [Ⓢ]	0.006–0.007	30.0	..	14.0	..	10
Sheet and plate	0.008–0.009	30.0	..	14.0	..	12
	0.010–0.020	30.0	..	14.0	..	14
	0.021–0.249	30.0	..	14.0	..	16
	0.250–1.000	30.0	..	14.0	..	18
	1.001–3.000	30.0	..	14.0	..	16
6061-T6 and T62 [Ⓢ] [Ⓢ]	0.006–0.007	42.0	..	35.0	..	4
Sheet	0.008–0.009	42.0	..	35.0	..	6
	0.010–0.020	42.0	..	35.0	..	8
	0.021–0.249	42.0	..	35.0	..	10
6061-T62 [Ⓢ] [Ⓢ] and T651 [Ⓢ] Plate	0.250–0.499	42.0	..	35.0	..	10
	0.500–1.000	42.0	..	35.0	..	9
	1.001–2.000	42.0	..	35.0	..	8
	2.001–4.000	42.0	..	35.0	..	6
	4.001–6.000 [Ⓢ]	40.0	..	35.0	..	6

For all numbered footnotes, see page 118

2	1
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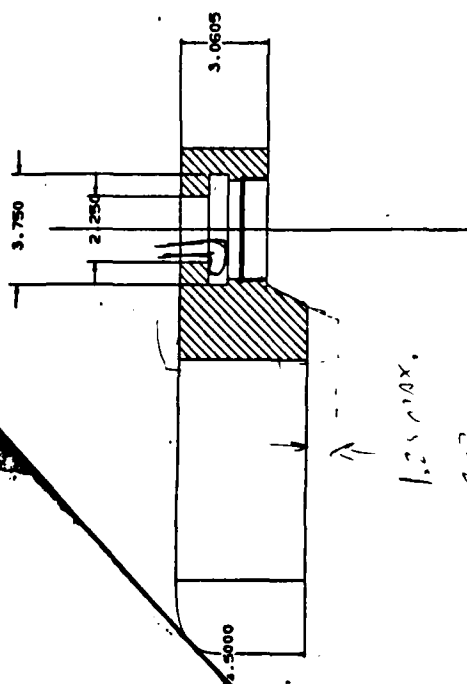


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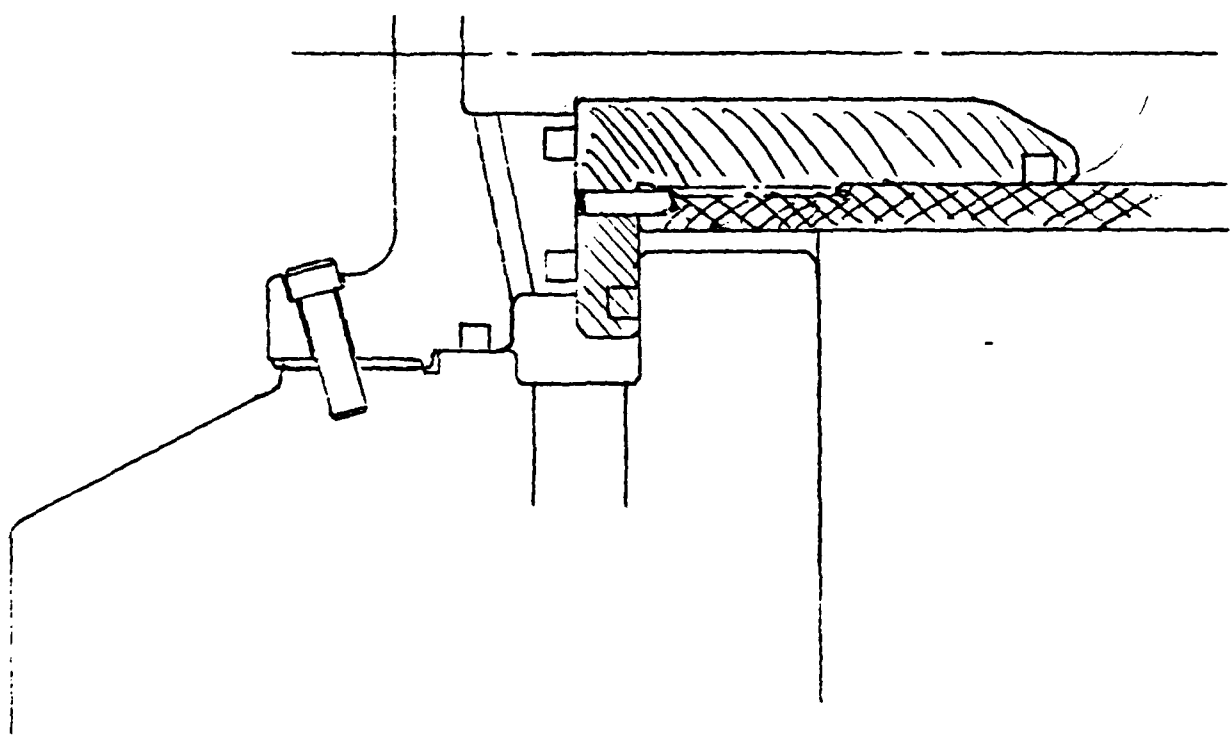
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10	YIELD STRENGTH	YIELD STRENGTH		YIELD STRENGTH	
15	TENSILE STRENGTH	TENSILE STRENGTH		TENSILE STRENGTH	
20	ELONGATION	ELONGATION		ELONGATION	
25	REDUCTION OF AREA	REDUCTION OF AREA		REDUCTION OF AREA	
30	IMPACT	IMPACT		IMPACT	
35	WELD	WELD		WELD	
40	OTHER	OTHER		OTHER	
APPROVAL		APPROVAL		APPROVAL	
DESIGNER		DESIGNER		DESIGNER	
CHECKER		CHECKER		CHECKER	
APPROVER		APPROVER		APPROVER	
DATE		DATE		DATE	
PROJECT		PROJECT		PROJECT	
SHEET NO.		SHEET NO.		SHEET NO.	
TOTAL SHEETS		TOTAL SHEETS		TOTAL SHEETS	
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CAO STATUS USER 07/01/10 12:02:02 GUN

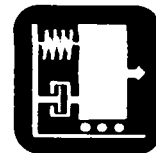
PRELIMINARY

[illegible]

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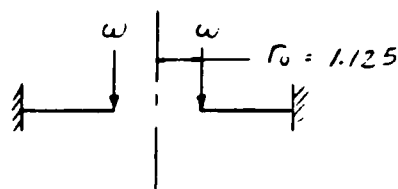


Subject LTHD	Analyst gnt	
	Project Number	
	EC. No.	Date 1-28-77



REF: ROARK, TBL. 24-1e

CONSERVATIVELY ASSUME POINT LOAD @ EDGE OF LIP:



$$a = 1.875$$

$$b = 1.125$$

$$W = \frac{26,333 \text{ lb}}{2\pi(r_0)} = 3725.4 \text{ lb/in} \quad (2)$$

$$D = \frac{Et^3}{12(1-\nu^2)} = 915751 \text{ in-lb} \quad (3)$$

$$C_1 = \frac{1+\nu}{2} \ln \frac{a}{b} + \frac{1-\nu}{4} \left(\frac{a}{b} - \frac{b}{a} \right) = .3859 \quad (4)$$

$$C_4 = \frac{1}{2} \left[(1+\nu) \frac{b}{a} + (1-\nu) \frac{a}{b} \right] = .9733 \quad (5)$$

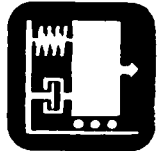
$$C_7 = \frac{1}{2} (1-\nu^2) \left(\frac{a}{b} - \frac{b}{a} \right) = .4853 \quad (6)$$

$$L_3 = \frac{r_0}{4a} \left[\left(\frac{r_0}{a} \right)^2 + 1 \right] \ln \frac{a}{r_0} + \left(\frac{r_0}{a} \right)^2 - 1 \quad (7)$$

$$L_6 = \frac{r_0}{4a} \left[\left(\frac{r_0}{a} \right)^2 - 1 + 2 \ln \frac{a}{r_0} \right] = .0572 \quad (8)$$

$$L_9 = \frac{r_0}{a} \left\{ \frac{1+\nu}{2} \ln \frac{a}{r_0} + \frac{1-\nu}{4} \left[1 - \left(\frac{r_0}{a} \right)^2 \right] \right\} = .2664 \quad (9)$$

Subject LTHD	Analyst JMT	
	Project Number	
	EC. No.	Date 1-27-77

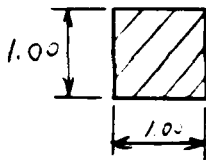


$$y_b = \frac{-w_2^3}{D} \left(\frac{C_1 L_6}{C_4} - L_3 \right) = -0.0004 \text{ in}$$

$$M_{r2} = -w_2 \left(L_9 - \frac{C_7 L_6}{C_4} \right) = \frac{1662 \text{ in-lb}}{\text{in}}$$

$$Q_2 = \frac{-w_2 L_2}{a} = 2235 \text{ lb/in}$$

"SECTION" OVER 1.00 in OF CIRCUMFERENCE



$$\begin{aligned} A &= 1.00 \text{ in}^2 \\ I &= .0833 \text{ in}^4 \\ S &= .1667 \text{ in}^3 \end{aligned}$$

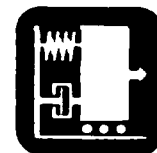
$$\sigma_b = \frac{1662 \text{ in-lb}}{.1667 \text{ in}^3} = 9972 \text{ psi}$$

$$FS = \frac{35000}{9972} = 3.51$$

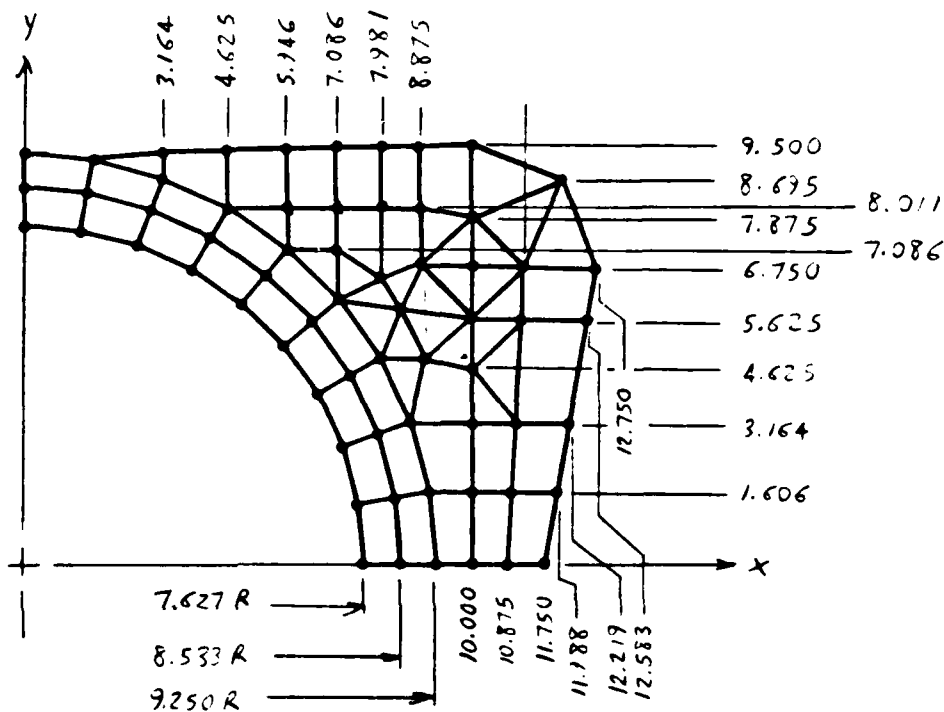
$$\tau = 2235 \text{ psi}$$

$$FS = \frac{(.58)(35000)}{2235} = 9.08$$

Subject LTHD	Analyst <i>giff</i>	
	Project Number	
	EC. No.	Date <i>1-28-57</i>



OUTER
BREECH
BAND

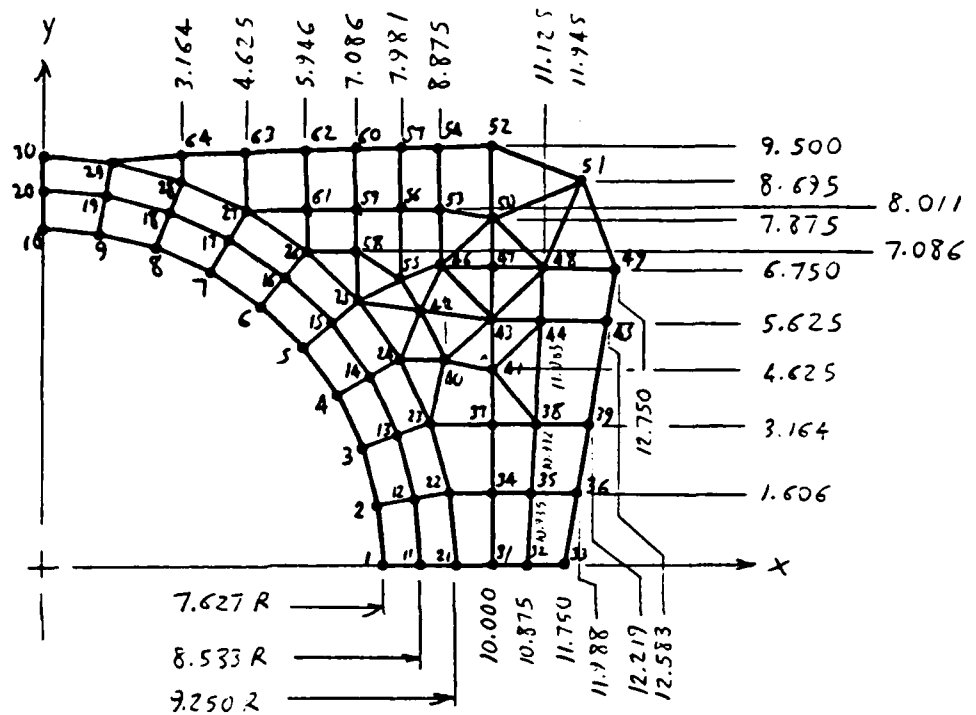


Subject <i>LTHD</i>	Analyst <i>J.177</i>	
	Project Number	
	EC. No.	Date <i>1-28-87</i>

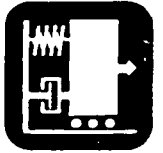


OUTER
BRECH
BAND

NODAL POINTS

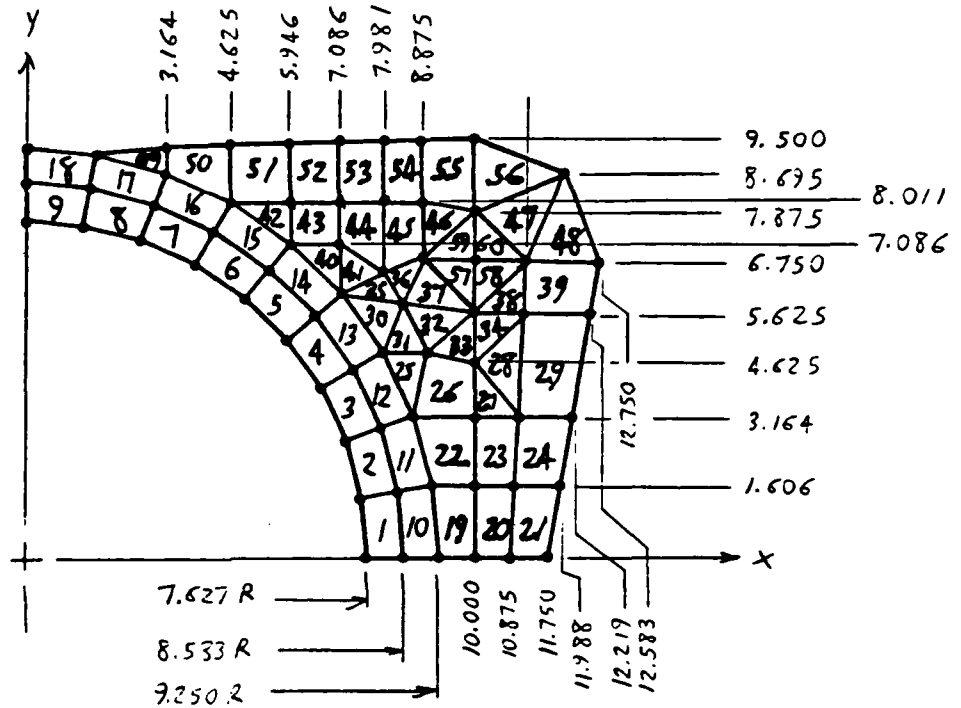


Subject <i>LTHD</i>	Analyst <i>JMT</i>	
	Project Number	
	EC. No.	Date <i>1-28-87</i>



OUTER
BRECH
BAND

ELEMENTS



4.500 THK MAT 1

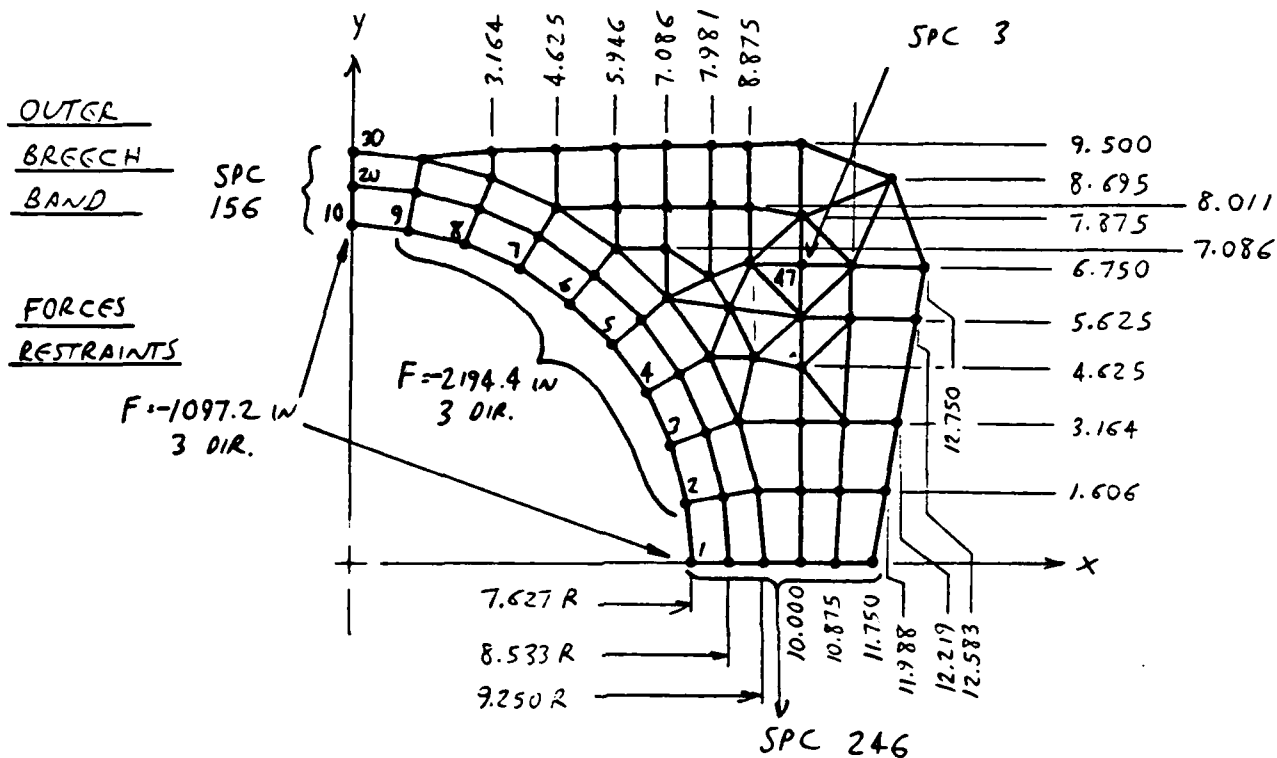
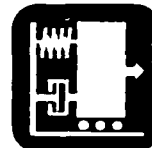
3.780 THK MAT 1

3.061 THK MAT 1

3.061 THK MAT 2

MAT ID	E	ρ	α	ν	
1	10.0×10^6	.098	—	.3	(6061-T6 Al)
2	30×10^6	.001	—	.3	(DUMMY MAT'L)

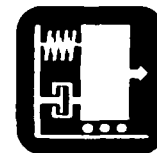
Subject LTHD	Analyst <i>gnt7</i>	
	Project Number	
	EC. No.	Date 1-28-87



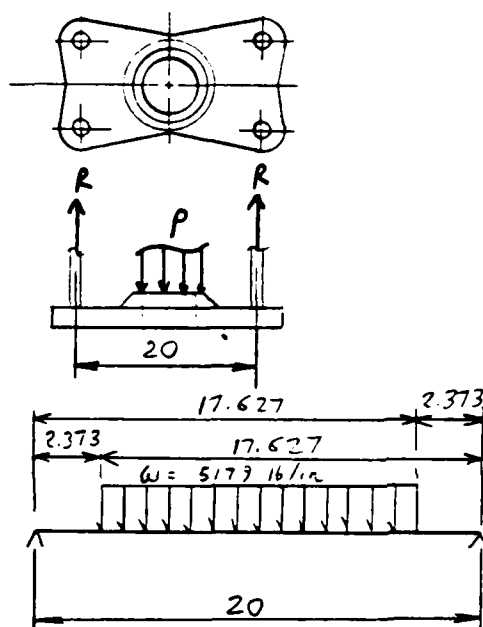
$$F = \frac{79000 \text{ lb}}{4} = 19750 \text{ lb}$$

$$\text{DIVIDED AMONG 9 NODES} = 2194.4 \text{ lb}$$

Subject LTHD	Analyst 977	
	Project Number	
	EC. No.	Date 1-21-87



APPROXIMATE BENDING STRESS

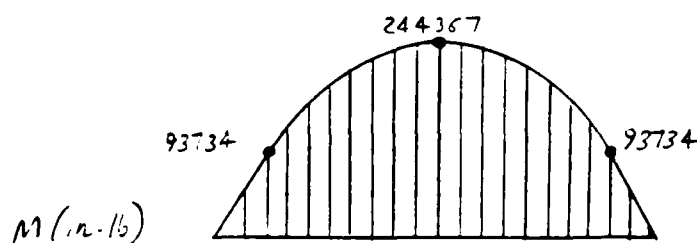
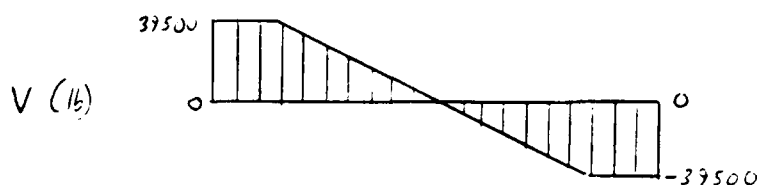


ID OF HOLE = 15.254 in

TOTAL THRU = 79,000 lb

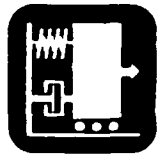
$w = 5179 \text{ lb/in}$

← CONSERVATIVE ASSUMPTION
OF LOAD DISTRIBUTION.
ACTUAL DISTRIBUTION IS:

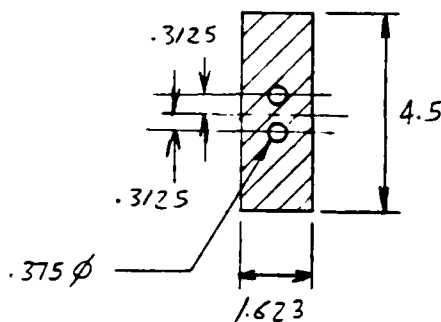


MAX. DEFLECTION (FROM FEA) = $-.0356 \text{ in}$

Subject LTHD	Analyst gnt	
	Project Number	
	EC. No.	Date 1-29-87



SECTION @ CENTER



$$A = (4.5)(1.623) - \frac{2\pi(.375)^2}{4} = 7.0826 \text{ in}^2$$

$$I = (1.623)(4.5)^3/12 - \frac{2\pi(.375)^4}{64} - \left(\frac{2\pi(.375)^2}{4}\right)(.3125)^2 = 12.3011 \text{ in}^4$$

$$S = I/2.25 = 5.467 \text{ in}^3 \quad (2)$$

$$\bar{T}_b = \frac{244367 \text{ in-lb}}{2(5.467 \text{ in}^3)} = 22349 \text{ psi}$$

$$\underline{FS = 1.57}$$

BENDING MOMENT FROM FEA:

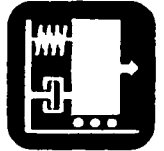
$$\Sigma M_y \text{ @ NOGS } 10,20 + 30 = 101850 \text{ in-lb}$$

$$\bar{T}_b = \frac{101850}{5.467} = 18629 \text{ psi}$$

$$\underline{FS = 1.88}$$

FOR $FS \geq 2.0$, USE MAT'L WITH $F_y = 45 \text{ KSI}$ OR GREATER

Subject LTHD	Analyst 2777	
	Project Number	
	EC. No.	Date 1-29-87



BEARING STRESS FROM INNER RING

$$\text{HOLE ID} = 15.254 \text{ in} + 2(.125 \text{ BEVEL}) = 15.504 \text{ in}$$

$$\text{RING OD} = 16.00 \text{ in}$$

$$\text{CONTACT AREA} = \frac{\pi[(16)^2 - (15.504)^2]}{4} = 12.273 \text{ in}^2$$

$$\bar{V}_{br} = \frac{79000 \text{ lb}}{12.273 \text{ in}^2} = 6437 \text{ psi} \quad FS = 5.44$$

SSSSSSSS	000000	11	333333	666666	555555555	000000		
SSSSSSSS	000000	11	333333	666666	555555555	000000		
SS	00	00	1111	33	33 66	55	00	00
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SS	00	00	11		33 66	555555	00	0000
SSSSSS	00	00	11	33	666666666	55	00	00 00
SSSSSS	00	00	11	33	666666666	55	00	00 00
SS	00	00	11		33 66	66	55	0000 00
SS	00	00	11		33 66	66	55	0000 00
SS	00	00	11	33	33 66	66 55	55	00 00
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SSSSSSSS	000000	111111	333333	666666	555555	000000		
SSSSSSSS	000000	111111	333333	666666	555555	000000		

FMC CORPORATION S/N:800484

Job Information	
Project	: LTHD
Client	: _____
Job Name	: Outer Breech Band
Remarks	: 1/4 symmetric model under recoil load
Engineer	: _____ J. Fishbein
Chk'd by	: _____
Appr'd by	: _____
Comments	: _____ _____

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Interactive Microcomputer Analysis & Graphics of Engineering Systems

IMAGES-3D Version 1.3 03/01/86

RUN ID=SD13650

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LTHD Outer Breech Band -- Recoil Load

MATERIAL PROPERTIES

Material No	Modulus of Elasticity	Weight Density	Coeff of Thermal Exp.	Poisson's Ratio	Shear Web Modulus
1	1.00000E+07	9.80000E-02	0.00000E+00	3.00E-01	0.00000E+00
2	3.00000E+07	1.00000E-03	0.00000E+00	3.00E-01	0.00000E+00

NODE COORDINATES

Node	X-Coord.	Y-Coord.	Z-Coord.
1	7.62700E+00	0.00000E+00	0.00000E+00
2	7.51113E+00	1.32441E+00	0.00000E+00
3	7.16704E+00	2.60859E+00	0.00000E+00
4	6.60518E+00	3.81350E+00	0.00000E+00
5	5.84262E+00	4.90254E+00	0.00000E+00
6	4.90254E+00	5.84262E+00	0.00000E+00
7	3.81350E+00	6.60518E+00	0.00000E+00
8	2.60859E+00	7.16704E+00	0.00000E+00
9	1.32441E+00	7.51113E+00	0.00000E+00
10	0.00000E+00	7.62700E+00	0.00000E+00
11	8.53300E+00	0.00000E+00	0.00000E+00
12	8.40337E+00	1.48174E+00	0.00000E+00
13	8.01840E+00	2.91846E+00	0.00000E+00
14	7.38980E+00	4.26650E+00	0.00000E+00
15	6.53666E+00	5.48491E+00	0.00000E+00
16	5.48491E+00	6.53666E+00	0.00000E+00
17	4.26650E+00	7.38980E+00	0.00000E+00
18	2.91846E+00	8.01840E+00	0.00000E+00
19	1.48174E+00	8.40337E+00	0.00000E+00
20	0.00000E+00	8.53300E+00	0.00000E+00
21	9.25000E+00	0.00000E+00	0.00000E+00
22	9.10947E+00	1.60625E+00	0.00000E+00
23	8.69216E+00	3.16369E+00	0.00000E+00
24	8.01073E+00	4.62500E+00	0.00000E+00
25	7.08591E+00	5.94579E+00	0.00000E+00
26	5.94579E+00	7.08591E+00	0.00000E+00
27	4.62500E+00	8.01074E+00	0.00000E+00

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LTHD Outer Breech Band -- Recoil Load

Node	X-Coord.	Y-Coord.	Z-Coord.
28	3.16369E+00	8.69216E+00	0.00000E+00
29	1.60625E+00	9.10947E+00	0.00000E+00
30	0.00000E+00	9.25000E+00	0.00000E+00
31	1.00000E+01	0.00000E+00	0.00000E+00
32	1.08750E+01	0.00000E+00	0.00000E+00
33	1.17500E+01	0.00000E+00	0.00000E+00
34	1.00000E+01	1.60600E+00	0.00000E+00
35	1.09350E+01	1.60600E+00	0.00000E+00
36	1.19880E+01	1.60600E+00	0.00000E+00
37	1.00000E+01	3.16400E+00	0.00000E+00
38	1.09920E+01	3.16400E+00	0.00000E+00
39	1.22190E+01	3.16400E+00	0.00000E+00
40	8.87500E+00	4.62500E+00	0.00000E+00
41	1.00000E+01	4.62500E+00	0.00000E+00
42	8.42800E+00	5.62500E+00	0.00000E+00
43	1.00000E+01	5.62500E+00	0.00000E+00
44	1.10830E+01	5.62500E+00	0.00000E+00
45	1.25830E+01	5.62500E+00	0.00000E+00
46	8.87500E+00	6.75000E+00	0.00000E+00
47	1.00000E+01	6.75000E+00	0.00000E+00
48	1.11250E+01	6.75000E+00	0.00000E+00
49	1.27500E+01	6.75000E+00	0.00000E+00
50	1.00000E+01	7.87500E+00	0.00000E+00
51	1.19450E+01	8.69500E+00	0.00000E+00
52	1.00000E+01	9.50000E+00	0.00000E+00
53	8.87500E+00	8.01100E+00	0.00000E+00
54	8.87500E+00	9.50000E+00	0.00000E+00
55	7.98100E+00	6.75000E+00	0.00000E+00
56	7.98100E+00	8.01100E+00	0.00000E+00
57	7.98100E+00	9.50000E+00	0.00000E+00
58	7.08600E+00	7.08600E+00	0.00000E+00
59	7.08600E+00	8.01100E+00	0.00000E+00
60	7.08600E+00	9.50000E+00	0.00000E+00
61	5.94600E+00	8.01100E+00	0.00000E+00
62	5.94600E+00	9.50000E+00	0.00000E+00
63	4.62500E+00	9.50000E+00	0.00000E+00
64	3.16400E+00	9.50000E+00	0.00000E+00

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CHECK GEOMETRY

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LTHD Outer Breech Band -- Recoil Load

PLATE ELEMENT CONNECTIVITY

	Plate No.	Nodes				Mat No.	Thickness	Area	Shear Web Thickness	Aspect Ratio	Plate Type
		I	J	K	L						
QUAD	1	1	11	12	2	1	4.500E+00	1.271E+00		6.408E-01	Mem+Bend
QUAD	2	2	12	13	3	1	4.500E+00	1.271E+00		6.408E-01	Mem+Bend
QUAD	3	3	13	14	4	1	4.500E+00	1.271E+00		6.408E-01	Mem+Bend
QUAD	4	4	14	15	5	1	4.500E+00	1.271E+00		6.408E-01	Mem+Bend
QUAD	5	5	15	16	6	1	4.500E+00	1.271E+00		6.408E-01	Mem+Bend
QUAD	6	6	16	17	7	1	4.500E+00	1.271E+00		6.408E-01	Mem+Bend
QUAD	7	7	17	18	8	1	4.500E+00	1.271E+00		6.408E-01	Mem+Bend
QUAD	8	8	18	19	9	1	4.500E+00	1.271E+00		6.408E-01	Mem+Bend
QUAD	9	9	19	20	10	1	4.500E+00	1.271E+00		6.408E-01	Mem+Bend
QUAD	10	11	21	22	12	1	3.780E+00	1.107E+00		4.609E-01	Mem+Bend
QUAD	11	12	22	23	13	1	3.780E+00	1.107E+00		4.609E-01	Mem+Bend
QUAD	12	13	23	24	14	1	3.780E+00	1.107E+00		4.609E-01	Mem+Bend
QUAD	13	14	24	25	15	1	3.780E+00	1.107E+00		4.609E-01	Mem+Bend
QUAD	14	15	25	26	16	1	3.780E+00	1.107E+00		4.609E-01	Mem+Bend
QUAD	15	16	26	27	17	1	3.780E+00	1.107E+00		4.609E-01	Mem+Bend
QUAD	16	17	27	28	18	1	3.780E+00	1.107E+00		4.609E-01	Mem+Bend
QUAD	17	18	28	29	19	1	3.780E+00	1.107E+00		4.609E-01	Mem+Bend
QUAD	18	19	29	30	20	1	3.780E+00	1.107E+00		4.609E-01	Mem+Bend
QUAD	19	21	31	34	22	1	3.061E+00	1.317E+00		5.102E-01	Mem+Bend
QUAD	20	31	32	35	24	1	3.061E+00	1.453E+00		5.634E-01	Mem+Bend
QUAD	21	32	33	36	35	1	3.061E+00	1.548E+00		5.977E-01	Mem+Bend
QUAD	22	22	34	37	23	1	3.061E+00	1.712E+00		6.994E-01	Mem+Bend
QUAD	23	34	35	38	37	1	3.061E+00	1.501E+00		6.183E-01	Mem+Bend
QUAD	24	35	36	39	38	1	3.061E+00	1.776E+00		7.286E-01	Mem+Bend
TRI	25	24	23	40		1	3.061E+00	6.315E-01		1.794E+00	Mem+Bend
QUAD	26	23	37	41	40	1	3.061E+00	1.777E+00		8.309E-01	Mem+Bend
TRI	27	37	38	41		1	3.061E+00	7.247E-01		6.429E-01	Mem+Bend
TRI	28	41	38	44		1	3.061E+00	1.287E+00		9.664E-01	Mem+Bend
QUAD	29	38	39	45	44	1	3.061E+00	3.356E+00		5.517E-01	Mem+Bend
TRI	30	25	24	42		1	3.061E+00	7.380E-01		1.710E+00	Mem+Bend
TRI	31	24	40	42		1	3.061E+00	4.321E-01		8.642E-01	Mem+Bend
TRI	32	42	40	43		1	3.061E+00	7.860E-01		7.616E-01	Mem+Bend
TRI	33	40	41	43		1	3.061E+00	5.625E-01		9.805E-01	Mem+Bend
TRI	34	41	44	43		1	3.061E+00	5.415E-01		2.000E+00	Mem+Bend
TRI	35	25	42	55		1	3.061E+00	6.832E-01		1.393E+00	Mem+Bend
TRI	36	55	42	46		1	3.061E+00	5.029E-01		1.383E+00	Mem+Bend
TRI	37	42	43	46		1	3.061E+00	8.842E-01		1.338E+00	Mem+Bend
TRI	38	43	44	48		1	3.061E+00	6.092E-01		8.546E-01	Mem+Bend
QUAD	39	44	45	49	48	1	3.061E+00	1.758E+00		1.383E+00	Mem+Bend
TRI	40	26	25	58		1	3.061E+00	6.500E-01		2.000E+00	Mem+Bend

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CHECK GEOMETRY

Version 1.3 03/01/86

LTHD Outer Breech Band -- Recoil Load

	Plate No.	Nodes				Mat No.	Thickness	Area	Shear Web Thickness	Aspect Ratio	Plate Type
		I	J	K	L						
TRI	41	25	55	58		1	3.061E+00	5.103E-01		1.394E+00	Mem+Bend
TRI	42	27	26	61		1	3.061E+00	6.110E-01		1.999E+00	Mem+Bend
QUAD	43	26	58	59	61	1	3.061E+00	1.055E+00		1.232E+00	Mem+Bend
QUAD	44	58	55	56	59	1	3.061E+00	9.782E-01		8.331E-01	Mem+Bend
QUAD	45	55	46	53	56	1	3.061E+00	1.127E+00		7.090E-01	Mem+Bend
TRI	46	46	50	53		1	3.061E+00	7.093E-01		1.774E+00	Mem+Bend
TRI	47	50	48	51		1	3.061E+00	1.555E+00		8.137E-01	Mem+Bend
TRI	48	48	49	51		1	3.061E+00	1.580E+00		8.355E-01	Mem+Bend
TRI	49	29	28	64		1	3.061E+00	6.291E-01		1.641E+00	Mem+Bend
QUAD	50	28	27	63	64	1	3.061E+00	1.678E+00		1.306E+00	Mem+Bend
QUAD	51	27	61	62	63	1	3.061E+00	1.967E+00		8.871E-01	Mem+Bend
QUAD	52	61	59	60	62	1	3.061E+00	1.697E+00		7.656E-01	Mem+Bend
QUAD	53	59	56	57	60	1	3.061E+00	1.333E+00		6.011E-01	Mem+Bend
QUAD	54	56	53	54	57	1	3.061E+00	1.331E+00		6.004E-01	Mem+Bend
QUAD	55	53	50	52	54	1	3.061E+00	1.752E+00		7.239E-01	Mem+Bend
TRI	56	50	51	52		1	3.061E+00	1.580E+00		1.356E+00	Mem+Bend
TRI	57	46	43	47		2	3.061E+00	6.328E-01		2.000E+00	Mem+Bend
TRI	58	43	48	47		2	3.061E+00	6.328E-01		2.000E+00	Mem+Bend
TRI	59	46	47	50		2	3.061E+00	6.328E-01		8.944E-01	Mem+Bend
TRI	60	47	48	50		2	3.061E+00	6.328E-01		8.944E-01	Mem+Bend

RESTRAINTS

Node No	Restraint Directions			
1	-	Y	-	RX - RZ
10	X	-	-	RY RZ
11	-	Y	-	RX - RZ
20	X	-	-	RY RZ
21	-	Y	-	RX - RZ
30	X	-	-	RY RZ
31	-	Y	-	RX - RZ
32	-	Y	-	RX - RZ
33	-	Y	-	RX - RZ
47	-	-	Z	- -

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RENUMBER NODES

Version 1.3 03/01/86

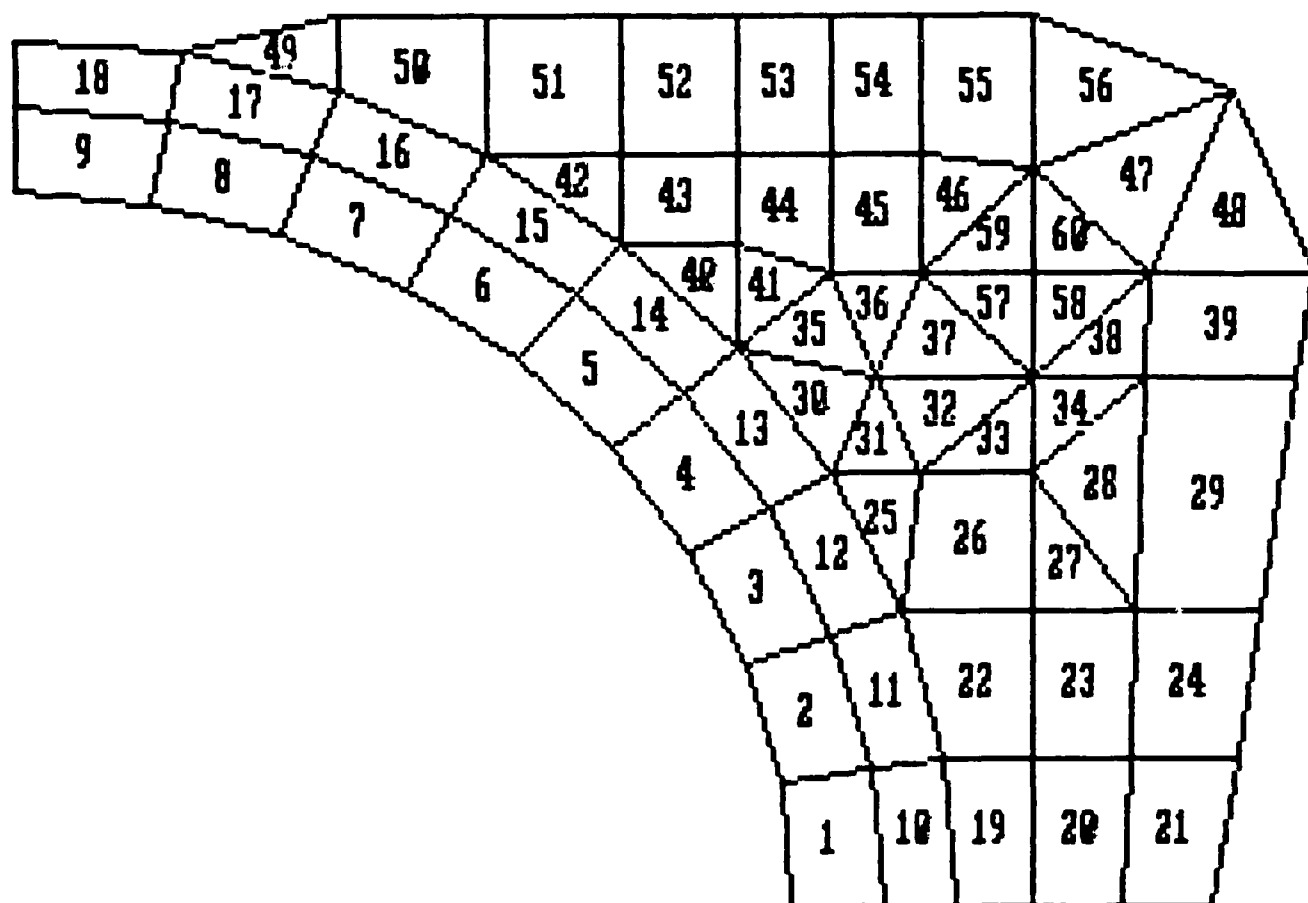
LTHD Outer Breech Band -- Recoil Load

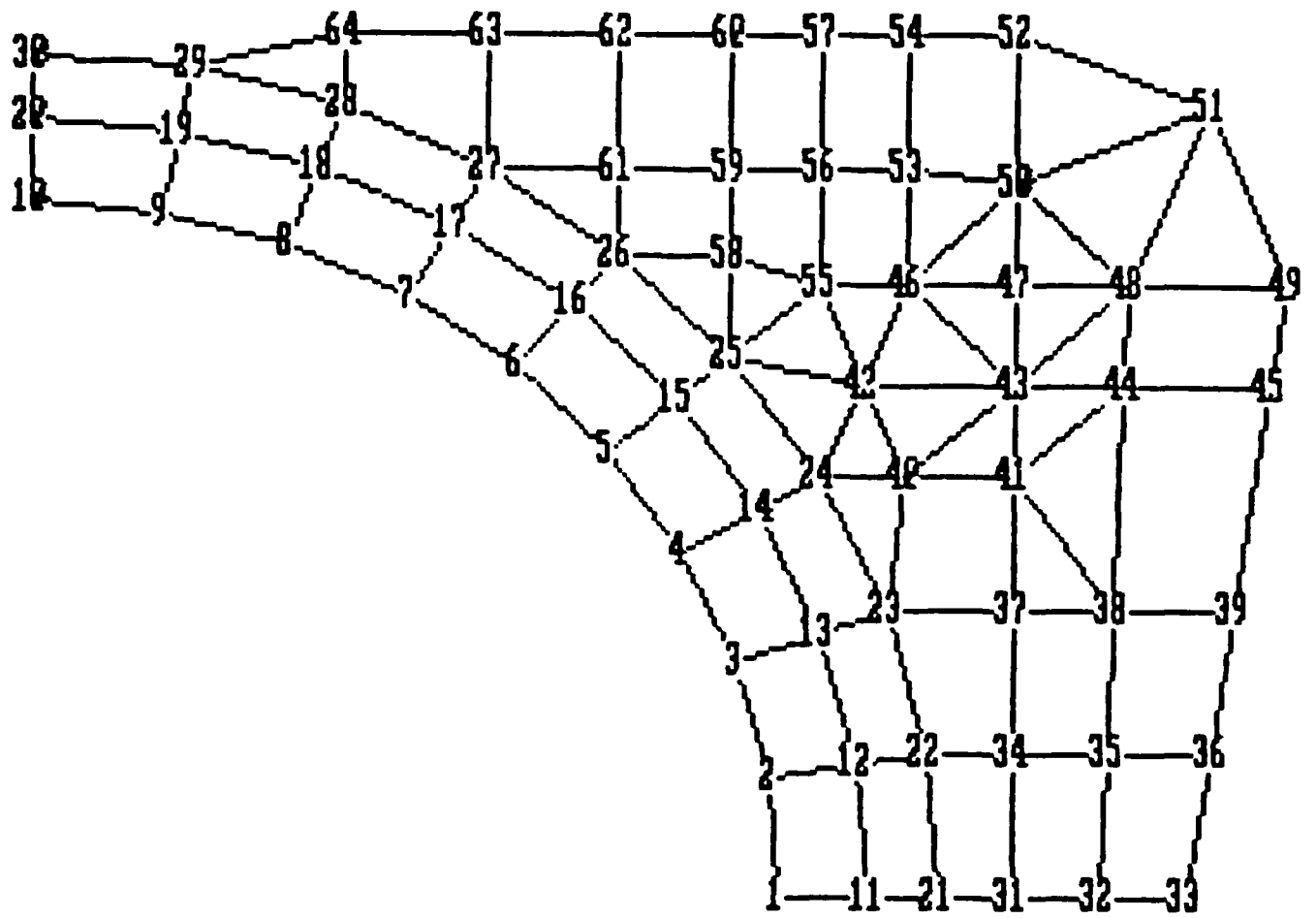
Node Renumbering Cross Reference List

Was	Is	Was	Is	Was	Is
1	22	2	23	3	24
4	25	5	32	6	41
7	50	8	58	9	61
10	64	11	13	12	14
13	15	14	21	15	31
16	39	17	48	18	55
19	60	20	63	21	7
22	8	23	12	24	20
25	30	26	38	27	47
28	54	29	59	30	62
31	2	32	1	33	5
34	4	35	3	36	6
37	10	38	9	39	11
40	19	41	16	42	29
43	26	44	17	45	18
46	33	47	34	48	27
49	28	50	35	51	36
52	44	53	42	54	45
55	37	56	43	57	51
58	40	59	46	60	52
61	49	62	53	63	56
64	57				

Original Nodal Band 38

Final Nodal band 12





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ASSEMBLE STIFFNESS MATRIX Version 1.3 03/01/86

LTHD Outer Breech Band -- Recoil Load

STIFFNESS ASSEMBLY SUMMARY

Number of Node Points.....	64
Number of Truss and Beam Elements.....	0
Number of Plate Elements.....	60
Number of Spring Elements.....	0
Number of Nodes with Restraints.....	10
Number of Blocks in the Matrix.....	2

BLOCK NUMBER 1

FORM Matrix
 FACT Matrix
 Size = 112504 Bytes
 TRIANGULARIZE Matrix

BLOCK NUMBER 2

FORM Matrix
 FACT Matrix
 Size = 20504 Bytes
 TRIANGULARIZE Matrix

Number of terms in the matrix.	17001
Largest column.....	69
Minimum Diagonal Stiffness =	.8153958D+03
Maximum Diagonal Stiffness =	.7044191D+10

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ASSEMBLE STIFFNESS MATRIX Version 1.3 03/01/86

LTHD Outer Breech Band -- Recoil Load

C R O S S R E F E R E N C E L I S T

Is Node Versus Internal Equation Number

Is Node	TRANSLATION			/	ROTATION		
	Eqn.	Eqn.	Eqn.		Eqn.	Eqn.	Eqn.
1	1		2		3		
2	4		5		6		
3	7	8	9		10	11	12
4	13	14	15		16	17	18
5	19		20		21		
6	22	23	24		25	26	27
7	28		29		30		
8	31	32	33		34	35	36
9	37	38	39		40	41	42
10	43	44	45		46	47	48
11	49	50	51		52	53	54
12	55	56	57		58	59	60
13	61		62		63		
14	64	65	66		67	68	69
15	70	71	72		73	74	75
16	76	77	78		79	80	81
17	82	83	84		85	86	87
18	88	89	90		91	92	93
19	94	95	96		97	98	99
20	100	101	102		103	104	105
21	106	107	108		109	110	111
22	112		113		114		
23	115	116	117		118	119	120
24	121	122	123		124	125	126
25	127	128	129		130	131	132
26	133	134	135		136	137	138
27	139	140	141		142	143	144
28	145	146	147		148	149	150
29	151	152	153		154	155	156
30	157	158	159		160	161	162
31	163	164	165		166	167	168
32	169	170	171		172	173	174
33	175	176	177		178	179	180
34	181	182			183	184	185
35	186	187	188		189	190	191
36	192	193	194		195	196	197
37	198	199	200		201	202	203
38	204	205	206		207	208	209
39	210	211	212		213	214	215

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ASSEMBLE STIFFNESS MATRIX Version 1.3 03/01/86

LTHD Outer Breech Band -- Recoil Load

Is Node	TRANSLATION			/	ROTATION		
	Eqn.	Eqn.	Eqn.		Eqn.	Eqn.	Eqn.
40	216	217	218	/	219	220	221
41	222	223	224	/	225	226	227
42	228	229	230	/	231	232	233
43	234	235	236	/	237	238	239
44	240	241	242	/	243	244	245
45	246	247	248	/	249	250	251
46	252	253	254	/	255	256	257
47	258	259	260	/	261	262	263
48	264	265	266	/	267	268	269
49	270	271	272	/	273	274	275
50	276	277	278	/	279	280	281
51	282	283	284	/	285	286	287
52	288	289	290	/	291	292	293
53	294	295	296	/	297	298	299
54	300	301	302	/	303	304	305
55	306	307	308	/	309	310	311
56	312	313	314	/	315	316	317
57	318	319	320	/	321	322	323
58	324	325	326	/	327	328	329
59	330	331	332	/	333	334	335
60	336	337	338	/	339	340	341
61	342	343	344	/	345	346	347
62		348	349	/	350		
63		351	352	/	353		
64		354	355	/	356		

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SOLVE DISPLACEMENTS Version 1.3 03/01/86

LTHD Outer Breech Band -- Recoil Load

L O A D C A S E 1

CONCENTRATED LOADS

Node	Fx	Fy	Fz	Mx	My	Mz
1	.0000E+00	.0000E+00	-.1097E+04	.0000E+00	.0000E+00	.0000E+00
2	.0000E+00	.0000E+00	-.2194E+04	.0000E+00	.0000E+00	.0000E+00
3	.0000E+00	.0000E+00	-.2194E+04	.0000E+00	.0000E+00	.0000E+00
4	.0000E+00	.0000E+00	-.2194E+04	.0000E+00	.0000E+00	.0000E+00
5	.0000E+00	.0000E+00	-.2194E+04	.0000E+00	.0000E+00	.0000E+00
6	.0000E+00	.0000E+00	-.2194E+04	.0000E+00	.0000E+00	.0000E+00
7	.0000E+00	.0000E+00	-.2194E+04	.0000E+00	.0000E+00	.0000E+00
8	.0000E+00	.0000E+00	-.2194E+04	.0000E+00	.0000E+00	.0000E+00
9	.0000E+00	.0000E+00	-.2194E+04	.0000E+00	.0000E+00	.0000E+00
10	.0000E+00	.0000E+00	-.1097E+04	.0000E+00	.0000E+00	.0000E+00

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SOLVE DISPLACEMENTS Version 1.3 03/01/86

LTHD Outer Breech Band -- Recoil Load

L O A D C A S E 1

APPLIED LOAD VECTOR

Node	Fx	Fy	Fz	Mx	My	Mz
1	.0000E+00	.0000E+00	-.1097E+04	.0000E+00	.0000E+00	.0000E+00
2	.0000E+00	.0000E+00	-.2194E+04	.0000E+00	.0000E+00	.0000E+00
3	.0000E+00	.0000E+00	-.2194E+04	.0000E+00	.0000E+00	.0000E+00
4	.0000E+00	.0000E+00	-.2194E+04	.0000E+00	.0000E+00	.0000E+00
5	.0000E+00	.0000E+00	-.2194E+04	.0000E+00	.0000E+00	.0000E+00
6	.0000E+00	.0000E+00	-.2194E+04	.0000E+00	.0000E+00	.0000E+00
7	.0000E+00	.0000E+00	-.2194E+04	.0000E+00	.0000E+00	.0000E+00
8	.0000E+00	.0000E+00	-.2194E+04	.0000E+00	.0000E+00	.0000E+00
9	.0000E+00	.0000E+00	-.2194E+04	.0000E+00	.0000E+00	.0000E+00
10	.0000E+00	.0000E+00	-.1097E+04	.0000E+00	.0000E+00	.0000E+00

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SOLVE DISPLACEMENTS

Version 1.3 03/01/86

LTHD Outer Breech Band -- Recoil Load

L O A D C A S E 1

DISPLACEMENTS

Node	T r a n s l a t i o n s			/	R o t a t i o n s		
	X	Y	Z		X	Y	Z
1	.0000E+00	.0000E+00	-.1635E-01	/	.0000E+00	-.5449E-02	.0000E+00
2	.0000E+00	.0000E+00	-.1676E-01	/	.3292E-03	-.5418E-02	.0000E+00
3	.0000E+00	.0000E+00	-.1801E-01	/	.6119E-03	-.5320E-02	.0000E+00
4	.0000E+00	.0000E+00	-.2008E-01	/	.8252E-03	-.5135E-02	.0000E+00
5	.0000E+00	.0000E+00	-.2290E-01	/	.9799E-03	-.4822E-02	.0000E+00
6	.0000E+00	.0000E+00	-.2622E-01	/	.1111E-02	-.4323E-02	.0000E+00
7	.0000E+00	.0000E+00	-.2965E-01	/	.1231E-02	-.3595E-02	.0000E+00
8	.0000E+00	.0000E+00	-.3268E-01	/	.1335E-02	-.2618E-02	.0000E+00
9	.0000E+00	.0000E+00	-.3479E-01	/	.1409E-02	-.1390E-02	.0000E+00
10	.0000E+00	.0000E+00	-.3555E-01	/	.1443E-02	.0000E+00	.0000E+00
11	.0000E+00	.0000E+00	-.1145E-01	/	.0000E+00	-.5393E-02	.0000E+00
12	.0000E+00	.0000E+00	-.1191E-01	/	.3186E-03	-.5371E-02	.0000E+00
13	.0000E+00	.0000E+00	-.1331E-01	/	.5790E-03	-.5300E-02	.0000E+00
14	.0000E+00	.0000E+00	-.1570E-01	/	.7525E-03	-.5157E-02	.0000E+00
15	.0000E+00	.0000E+00	-.1901E-01	/	.8532E-03	-.4889E-02	.0000E+00
16	.0000E+00	.0000E+00	-.2298E-01	/	.9325E-03	-.4428E-02	.0000E+00
17	.0000E+00	.0000E+00	-.2712E-01	/	.1012E-02	-.3720E-02	.0000E+00
18	.0000E+00	.0000E+00	-.3084E-01	/	.1086E-02	-.2737E-02	.0000E+00
19	.0000E+00	.0000E+00	-.3345E-01	/	.1129E-02	-.1462E-02	.0000E+00
20	.0000E+00	.0000E+00	-.3438E-01	/	.1164E-02	.0000E+00	.0000E+00
21	.0000E+00	.0000E+00	-.7595E-02	/	.0000E+00	-.5361E-02	.0000E+00
22	.0000E+00	.0000E+00	-.8085E-02	/	.3221E-03	-.5351E-02	.0000E+00
23	.0000E+00	.0000E+00	-.9598E-02	/	.5790E-03	-.5313E-02	.0000E+00
24	.0000E+00	.0000E+00	-.1221E-01	/	.7364E-03	-.5216E-02	.0000E+00
25	.0000E+00	.0000E+00	-.1592E-01	/	.8025E-03	-.4988E-02	.0000E+00
26	.0000E+00	.0000E+00	-.2043E-01	/	.8422E-03	-.4547E-02	.0000E+00
27	.0000E+00	.0000E+00	-.2519E-01	/	.8809E-03	-.3841E-02	.0000E+00
28	.0000E+00	.0000E+00	-.2948E-01	/	.9191E-03	-.2848E-02	.0000E+00
29	.0000E+00	.0000E+00	-.3255E-01	/	.9113E-03	-.1528E-02	.0000E+00
30	.0000E+00	.0000E+00	-.3363E-01	/	.9554E-03	.0000E+00	.0000E+00
31	.0000E+00	.0000E+00	-.3584E-02	/	.0000E+00	-.5336E-02	.0000E+00
32	.0000E+00	.0000E+00	.1071E-02	/	.0000E+00	-.5298E-02	.0000E+00
33	.0000E+00	.0000E+00	.5687E-02	/	.0000E+00	-.5246E-02	.0000E+00
34	.0000E+00	.0000E+00	-.3324E-02	/	.3202E-03	-.5340E-02	.0000E+00
35	.0000E+00	.0000E+00	.1658E-02	/	.3297E-03	-.5313E-02	.0000E+00
36	.0000E+00	.0000E+00	.7230E-02	/	.3499E-03	-.5264E-02	.0000E+00
37	.0000E+00	.0000E+00	-.2619E-02	/	.5799E-03	-.5349E-02	.0000E+00
38	.0000E+00	.0000E+00	.2682E-02	/	.5881E-03	-.5340E-02	.0000E+00
39	.0000E+00	.0000E+00	.9210E-02	/	.6101E-03	-.5301E-02	.0000E+00
40	.0000E+00	.0000E+00	-.7659E-02	/	.7360E-03	-.5316E-02	.0000E+00

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SOLVE DISPLACEMENTS

Version 1.3 03/01/86

LTHD Outer Breech Band -- Recoil Load

LOAD CASE 1

Node	T r a n s l a t i o n s			/	R o t a t i o n s		
	X	Y	Z		X	Y	Z
41	.0000E+00	.0000E+00	-.1647E-02	/	.7395E-03	-.5362E-02	.0000E+00
42	.0000E+00	.0000E+00	-.9266E-02	/	.7815E-03	-.5286E-02	.0000E+00
43	.0000E+00	.0000E+00	-.8761E-03	/	.7958E-03	-.5359E-02	.0000E+00
44	.0000E+00	.0000E+00	.4920E-02	/	.7915E-03	-.5342E-02	.0000E+00
45	.0000E+00	.0000E+00	.1292E-01	/	.7954E-03	-.5329E-02	.0000E+00
46	.0000E+00	.0000E+00	-.6021E-02	/	.7635E-03	-.5338E-02	.0000E+00
47	.0000E+00	.0000E+00	.0000E+00	/	.7601E-03	-.5359E-02	.0000E+00
48	.0000E+00	.0000E+00	.6021E-02	/	.7627E-03	-.5347E-02	.0000E+00
49	.0000E+00	.0000E+00	.1471E-01	/	.7840E-03	-.5343E-02	.0000E+00
50	.0000E+00	.0000E+00	.8248E-03	/	.7055E-03	-.5362E-02	.0000E+00
51	.0000E+00	.0000E+00	.1184E-01	/	.7111E-03	-.5375E-02	.0000E+00
52	.0000E+00	.0000E+00	.1931E-02	/	.6604E-03	-.5383E-02	.0000E+00
53	.0000E+00	.0000E+00	-.5092E-02	/	.7047E-03	-.5308E-02	.0000E+00
54	.0000E+00	.0000E+00	-.4090E-02	/	.6418E-03	-.5301E-02	.0000E+00
55	.0000E+00	.0000E+00	-.1073E-01	/	.7766E-03	-.5189E-02	.0000E+00
56	.0000E+00	.0000E+00	-.9779E-02	/	.7249E-03	-.5160E-02	.0000E+00
57	.0000E+00	.0000E+00	-.8768E-02	/	.6313E-03	-.5146E-02	.0000E+00
58	.0000E+00	.0000E+00	-.1501E-01	/	.7910E-03	-.4952E-02	.0000E+00
59	.0000E+00	.0000E+00	-.1430E-01	/	.7453E-03	-.4918E-02	.0000E+00
60	.0000E+00	.0000E+00	-.1327E-01	/	.6233E-03	-.4895E-02	.0000E+00
61	.0000E+00	.0000E+00	-.1967E-01	/	.7887E-03	-.4495E-02	.0000E+00
62	.0000E+00	.0000E+00	-.1861E-01	/	.6275E-03	-.4438E-02	.0000E+00
63	.0000E+00	.0000E+00	-.2403E-01	/	.6728E-03	-.3742E-02	.0000E+00
64	.0000E+00	.0000E+00	-.2882E-01	/	.7310E-03	-.2802E-02	.0000E+00

Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
QUAD PLATE NO. 1							
Stress	TOP	-.3262E+03	-.5241E+04	.4296E+03	-.2889E+03	-.5278E+04	5.0
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.3262E+03	.5241E+04	-.4296E+03	.5278E+04	.2889E+03	-85.0
QUAD PLATE NO. 2							
Stress	TOP	-.5182E+03	-.4611E+04	.5523E+03	-.4450E+03	-.4685E+04	7.6
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.5182E+03	.4611E+04	-.5523E+03	.4685E+04	.4450E+03	-82.4
QUAD PLATE NO. 3							
Stress	TOP	-.8790E+03	-.3940E+04	.1157E+04	-.4910E+03	-.4328E+04	18.5
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.8790E+03	.3940E+04	-.1157E+04	.4328E+04	.4910E+03	-71.5
QUAD PLATE NO. 4							
Stress	TOP	-.1251E+04	-.4208E+04	.2333E+04	.3273E+02	-.5492E+04	28.8
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.1251E+04	.4208E+04	-.2333E+04	.5492E+04	-.3273E+02	-61.2
QUAD PLATE NO. 5							
Stress	TOP	-.1506E+04	-.6271E+04	.3719E+04	.5279E+03	-.8305E+04	28.7
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.1506E+04	.6271E+04	-.3719E+04	.8305E+04	-.5279E+03	-61.3
QUAD PLATE NO. 6							
Stress	TOP	-.1513E+04	-.9762E+04	.4810E+04	.6986E+03	-.1197E+05	24.7
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.1513E+04	.9762E+04	-.4810E+04	.1197E+05	-.6986E+03	-65.3
QUAD PLATE NO. 7							
Stress	TOP	-.1283E+04	-.1411E+05	.5255E+04	.5945E+03	-.1599E+05	19.7
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.1283E+04	.1411E+05	-.5255E+04	.1599E+05	-.5945E+03	-70.3
QUAD PLATE NO. 8							

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LTHD Outer Breech Band -- Recoil Load

Load Case 1:

MAX. STRESS
IN MODEL

Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
Stress	TOP	-.8238E+03	-.1889E+05	.4831E+04	.3872E+03	-.2010E+05	14.1
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.8238E+03	.1889E+05	-.4831E+04	.2010E+05	-.3872E+03	-75.9
QUAD PLATE NO. 9							
Stress	TOP	-.3332E+03	-.2236E+05	.3089E+04	.9190E+02	.2278E+05	7.8
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.3332E+03	.2236E+05	-.3089E+04	.2278E+05	.9190E+02	-82.2
QUAD PLATE NO. 10							
Stress	TOP	-.5471E+03	-.4060E+04	.2117E+03	-.5344E+03	-.4073E+04	3.4
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.5471E+03	.4060E+04	-.2117E+03	.4073E+04	.5344E+03	-86.6
QUAD PLATE NO. 11							
Stress	TOP	-.9810E+03	-.3509E+04	.1270E+03	-.9747E+03	-.3515E+04	2.9
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.9810E+03	.3509E+04	-.1270E+03	.3515E+04	.9747E+03	-87.1
QUAD PLATE NO. 12							
Stress	TOP	-.1745E+04	-.2865E+04	.5176E+03	-.1542E+04	-.3067E+04	21.4
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.1745E+04	.2865E+04	-.5176E+03	.3067E+04	.1542E+04	-68.6
QUAD PLATE NO. 13							
Stress	TOP	-.2429E+04	-.2953E+04	.1535E+04	-.1134E+04	-.4248E+04	40.2
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.2429E+04	.2953E+04	-.1535E+04	.4248E+04	.1134E+04	-49.8
QUAD PLATE NO. 14							
Stress	TOP	-.2717E+04	-.4606E+04	.2797E+04	-.7089E+03	-.6613E+04	35.7
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.2717E+04	.4606E+04	-.2797E+04	.6613E+04	.7089E+03	-54.3
QUAD PLATE NO. 15							
Stress	TOP	-.2464E+04	-.7404E+04	.3814E+04	-.3903E+03	-.9478E+04	28.5
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.2464E+04	.7404E+04	-.3814E+04	.9478E+04	.3903E+03	-61.5
QUAD PLATE NO. 16							
Stress	TOP	-.1876E+04	-.1089E+05	.4281E+04	-.1669E+03	-.1260E+05	21.8
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.1876E+04	.1089E+05	-.4281E+04	.1260E+05	.1669E+03	-68.2
QUAD PLATE NO. 17							

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LTHD Outer Breech Band -- Recoil Load

Load Case 1:

Stress Surf	Sigma X Shear XZ	Sigma Y Shear YZ	Tau XY	Sigma 1	Sigma 2	Angle
Stress TOP	-.9420E+03	-.1482E+05	.4137E+04	.1973E+03	-.1596E+05	15.4
Stress MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress BOT	.9420E+03	.1482E+05	-.4137E+04	.1596E+05	-.1973E+03	-74.6
QUAD PLATE NO. 18						
Stress TOP	-.2109E+03	.1787E+05	.2520E+04	.1415E+03	-.1823E+05	8.0
Stress MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress BOT	.2109E+03	-.1787E+05	-.2520E+04	.1823E+05	-.1415E+03	-82.0
QUAD PLATE NO. 19						
Stress TOP	-.6491E+03	-.3254E+04	.2416E+02	-.6489E+03	-.3255E+04	.5
Stress MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress BOT	.6491E+03	.3254E+04	-.2416E+02	.3255E+04	.6489E+03	-89.5
QUAD PLATE NO. 20						
Stress TOP	-.4165E+03	-.3220E+04	-.6876E+02	-.4148E+03	-.3222E+04	-1.4
Stress MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress BOT	.4165E+03	.3220E+04	.6876E+02	.3222E+04	.4148E+03	88.6
QUAD PLATE NO. 21						
Stress TOP	-.1789E+03	-.3277E+04	-.1511E+03	-.1716E+03	-.3284E+04	-2.8
Stress MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress BOT	.1789E+03	.3277E+04	.1511E+03	.3284E+04	.1716E+03	87.2
QUAD PLATE NO. 22						
Stress TOP	-.1031E+04	-.2846E+04	.4795E+02	-.1029E+04	-.2847E+04	1.5
Stress MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress BOT	.1031E+04	.2846E+04	-.4795E+02	.2847E+04	.1029E+04	-88.5
QUAD PLATE NO. 23						
Stress TOP	-.5230E+03	-.2699E+04	-.1235E+03	-.5160E+03	-.2706E+04	-3.2
Stress MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress BOT	.5230E+03	.2699E+04	.1235E+03	.2706E+04	.5160E+03	86.8
QUAD PLATE NO. 24						
Stress TOP	-.1832E+03	-.2576E+04	-.2503E+03	-.1573E+03	-.2602E+04	-5.9
Stress MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress BOT	.1832E+03	.2576E+04	.2503E+03	.2602E+04	.1573E+03	84.1
TRIANGULAR PLATE NO. 25						
Stress TOP	-.2470E+04	-.2421E+04	-.8787E+02	-.2354E+04	-.2537E+04	-52.7
Stress MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress BOT	.2470E+04	.2421E+04	.8787E+02	.2537E+04	.2354E+04	37.3
QUAD PLATE NO. 26						

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LTHD Outer Breech Band -- Recoil Load

Load Case 1:

Stress	Surf	Sigma X	Sigma Y	Tau XY	Sigma 1	Sigma 2	Angle
Stress		Shear XZ	Shear YZ				
Stress	TOP	-.1112E+04	-.1990E+04	-.3177E+02	-.1111E+04	-.1991E+04	-2.1
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.1112E+04	.1990E+04	.3177E+02	.1991E+04	.1111E+04	87.9
TRIANGULAR PLATE NO. 27							
Stress	TOP	-.3948E+03	-.1791E+04	-.1020E+03	-.3874E+03	-.1798E+04	-4.2
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.3948E+03	.1791E+04	.1020E+03	.1798E+04	.3874E+03	85.8
TRIANGULAR PLATE NO. 28							
Stress	TOP	-.1072E+04	-.3176E+03	.5086E+03	-.6150E+02	-.1328E+04	63.3
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.1072E+04	.3176E+03	-.5086E+03	.1328E+04	.6150E+02	-26.7
DUAD PLATE NO. 29							
Stress	TOP	-.7437E+02	-.1218E+04	-.1025E+03	-.6525E+02	-.1227E+04	-5.1
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.7437E+02	.1218E+04	.1025E+03	.1227E+04	.6525E+02	84.9
TRIANGULAR PLATE NO. 30							
Stress	TOP	-.2685E+04	-.3099E+04	-.9932E+03	-.1878E+04	-.3907E+04	-39.1
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.2685E+04	.3099E+04	.9932E+03	.3907E+04	.1878E+04	50.9
TRIANGULAR PLATE NO. 31							
Stress	TOP	-.2184E+04	-.1349E+04	-.1268E+03	-.1331E+04	-.2203E+04	-81.5
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.2184E+04	.1349E+04	.1268E+03	.2203E+04	.1331E+04	8.5
TRIANGULAR PLATE NO. 32							
Stress	TOP	-.1062E+04	-.1035E+04	.1434E+02	-.1029E+04	-.1069E+04	67.1
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.1062E+04	.1035E+04	-.1434E+02	.1069E+04	.1029E+04	-22.9
TRIANGULAR PLATE NO. 33							
Stress	TOP	-.9700E+03	-.1153E+04	-.5460E+00	-.9700E+03	-.1153E+04	-1.2
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.9700E+03	.1153E+04	.5460E+00	.1153E+04	.9700E+03	89.6
TRIANGULAR PLATE NO. 34							
Stress	TOP	-.3674E+03	-.5182E+03	-.4201E+03	-.1595E+02	-.8696E+03	-39.9
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.3674E+03	.5182E+03	.4201E+03	.8696E+03	.1595E+02	50.1
TRIANGULAR PLATE NO. 35							


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LTHD Outer Breech Band -- Recoil Load

Load Case 1:

Stress	Surf	Sigma X Shear XZ	Sigma Y Shear YZ	Tau XY	Sigma 1	Sigma 2	Angle
Stress	TOP	-.3955E+04	-.8001E+03	-.9377E+03	-.5424E+03	-.4213E+04	-74.6
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.3955E+04	.8001E+03	.9377E+03	.4213E+04	.5424E+03	15.4
QUAD PLATE NO. 45							
Stress	TOP	-.2575E+04	-.1016E+03	.2477E+03	-.7704E+02	-.2600E+04	84.3
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.2575E+04	.1016E+03	-.2477E+03	.2600E+04	.7704E+02	-5.7
TRIANGULAR PLATE NO. 46							
Stress	TOP	.1895E+03	-.1551E+03	.5399E+03	.5840E+03	-.5495E+03	36.2
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	-.1895E+03	.1551E+03	-.5399E+03	.5495E+03	-.5840E+03	-53.8
TRIANGULAR PLATE NO. 47							
Stress	TOP	.5388E+03	.1740E+03	-.2053E+03	.6310E+03	.8174E+02	-24.2
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	-.5388E+03	-.1740E+03	.2053E+03	-.8174E+02	-.6310E+03	65.8
TRIANGULAR PLATE NO. 48							
Stress	TOP	.2047E+03	.5520E+03	-.1681E+03	.6201E+03	.1366E+03	-68.0
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	-.2047E+03	-.5520E+03	.1681E+03	-.1366E+03	-.6201E+03	22.0
TRIANGULAR PLATE NO. 49							
Stress	TOP	-.1232E+05	-.7887E+03	-.2554E+04	-.2484E+03	-.1286E+05	-78.1
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.1232E+05	.7887E+03	.2554E+04	.1286E+05	.2484E+03	11.9
QUAD PLATE NO. 50							
Stress	TOP	-.8897E+04	-.1469E+04	-.3177E+04	-.2956E+03	-.1007E+05	-69.7
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.8897E+04	.1469E+04	.3177E+04	.1007E+05	.2956E+03	20.3
QUAD PLATE NO. 51							
Stress	TOP	-.7965E+04	-.4923E+03	.6172E+03	-.4417E+03	-.8016E+04	85.3
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.7965E+04	.4923E+03	-.6172E+03	.8016E+04	.4417E+03	-4.7
QUAD PLATE NO. 52							
Stress	TOP	-.6015E+04	-.3492E+03	.2808E+03	-.3353E+03	-.6029E+04	87.2
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.6015E+04	.3492E+03	-.2808E+03	.3353E+03	.6029E+04	-2.8
QUAD PLATE NO. 53							

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LTHD Outer Breech Band -- Recoil Load

Load Case 1:

Stress	Surf	Sigma X Shear XZ	Sigma Y Shear YZ	Tau XY	Sigma 1	Sigma 2	Angle
Stress	TOP	-.4267E+04	-.1724E+03	.1144E+03	-.1692E+03	-.4271E+04	88.4
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.4267E+04	.1724E+03	-.1144E+03	.4271E+04	.1692E+03	-1.6
QUAD PLATE NO. 54							
Stress	TOP	-.2586E+04	.2821E+02	.7266E+02	.3023E+02	-.2588E+04	88.4
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.2586E+04	-.2821E+02	-.7266E+02	.2588E+04	-.3023E+02	-1.6
QUAD PLATE NO. 55							
Stress	TOP	-.8128E+03	.2452E+03	-.1989E+03	.2814E+03	-.8489E+03	-79.7
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.8128E+03	-.2452E+03	.1989E+03	.8489E+03	-.2814E+03	10.3
TRIANGULAR PLATE NO. 56							
Stress	TOP	.5106E+02	.5257E+03	.8835E+01	.5258E+03	.5089E+02	88.9
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	-.5106E+02	-.5257E+03	-.8835E+01	-.5089E+02	-.5258E+03	-1.1
TRIANGULAR PLATE NO. 57							
Stress	TOP	.3817E+03	.4883E+03	-.8872E+03	.1324E+04	-.4538E+03	-46.7
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	-.3817E+03	-.4883E+03	.8872E+03	.4538E+03	-.1324E+04	43.3
TRIANGULAR PLATE NO. 58							
Stress	TOP	.1347E+04	.1428E+04	.3744E+03	.1764E+04	.1011E+04	48.1
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	-.1347E+04	-.1428E+04	-.3744E+03	-.1011E+04	-.1764E+04	-41.9
TRIANGULAR PLATE NO. 59							
Stress	TOP	-.1983E+03	.2169E+04	.1423E+02	.2169E+04	-.1984E+03	89.7
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	.1983E+03	-.2169E+04	-.1423E+02	.1984E+03	-.2169E+04	-.3
TRIANGULAR PLATE NO. 60							
Stress	TOP	.1267E+04	.2608E+04	-.7965E+02	.2613E+04	.1262E+04	-86.6
Stress	MID	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0
Stress	BOT	-.1267E+04	-.2608E+04	.7965E+02	-.1262E+04	-.2613E+04	3.4

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SOLVE PLATE LOADS/STRESSES Version 1.3 03/01/86

LTHD Outer Breech Band -- Recoil Load

Load Case 1:

MAXIMUM STRESS SUMMARY FOR PLATES
WITHIN SPECIFIED RANGE 1- 60

Maximum (absolute) Stress = .2236E+05 at Plate 9

Plate	Sigma X	Sigma Y	Tau XY
9	-.3032E+03	-.2236E+05	.3089E+04

FMC CORPORATION S/N:800484

01-28-87

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SOLVE REACTIONS

Version 1.3 03/01/86

LTHD Outer Breech Band -- Recoil Load

Load Case 1:

REACTIONS

Node	Fx	Fy	Fz	Mx	My	Mz
1	.0000E+00	.0000E+00	.0000E+00	-.1040E+05	.0000E+00	.0000E+00
10	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.4008E+05	.0000E+00
11	.0000E+00	.0000E+00	.0000E+00	-.1105E+05	.0000E+00	.0000E+00
20	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.4926E+05	.0000E+00
21	.0000E+00	.0000E+00	.0000E+00	-.4687E+04	.0000E+00	.0000E+00
30	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.1251E+05	.0000E+00
31	.0000E+00	.0000E+00	.0000E+00	-.4040E+04	.0000E+00	.0000E+00
32	.0000E+00	.0000E+00	.0000E+00	-.4553E+04	.0000E+00	.0000E+00
33	.0000E+00	.0000E+00	.0000E+00	-.2921E+04	.0000E+00	.0000E+00
47	.0000E+00	.0000E+00	.1975E+05	.0000E+00	.0000E+00	.0000E+00

2/11/87

OUTER BAND

T = WALL THK 93

P = PRESS.

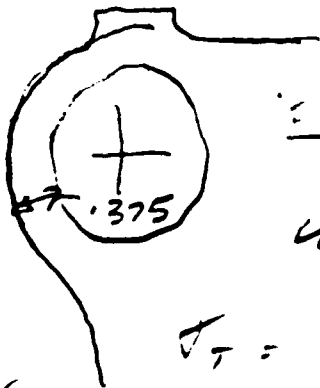
d_i = INSIDE DIA

USE MATL TEN. STRENGTH

$$\sigma_T = \frac{Pd_i}{2T}$$

LYL PRESS

$$= \frac{3000 \cdot 502}{2 \cdot 375} = 2000$$



$$\frac{3000 \cdot 3.75}{2 \cdot .375} = 15,000$$

4.4 TO 1

USING 6061 MATRIX 15 = 58,000 YIELD
66,000 TEN

$$\sigma_T = \frac{Pd_i}{2T} = \text{LONGITUDINAL STRESS}$$

USING 6061-T6 = 40,000
T651 45,000

PLATE

3 TO 1

2-20-87

SCOTT RAYMOND

MTRL FOR BAND	(OUTER BAND)		
	LONG	LTRANSVERSE	SHORT TRANSV
7075 TL	56	55	55
5 TO 6" THK	6%	3%	2%
7075 - T652	56	55	54
YIELD	16%	3%	1%
ELONG.			

L. TIME

IS CHECKING OUT MTRL.

BAND OUTER

45

ALCON

LACK FIELD

893-3800

7075 T651 PLATE

		MIN		MIN	
		4		T	EL
THK	5"	44 KSI		61 KSI	570
"	6"	40		59	5

FLATNESS $\pm .125$ LOG. & TRANSU IN 6'

(WILL SEND LETTER

12 WK L. TIME

STD MILL ✓

FOR A S. F. OF 2-1
45 KSI, REQUIRED.

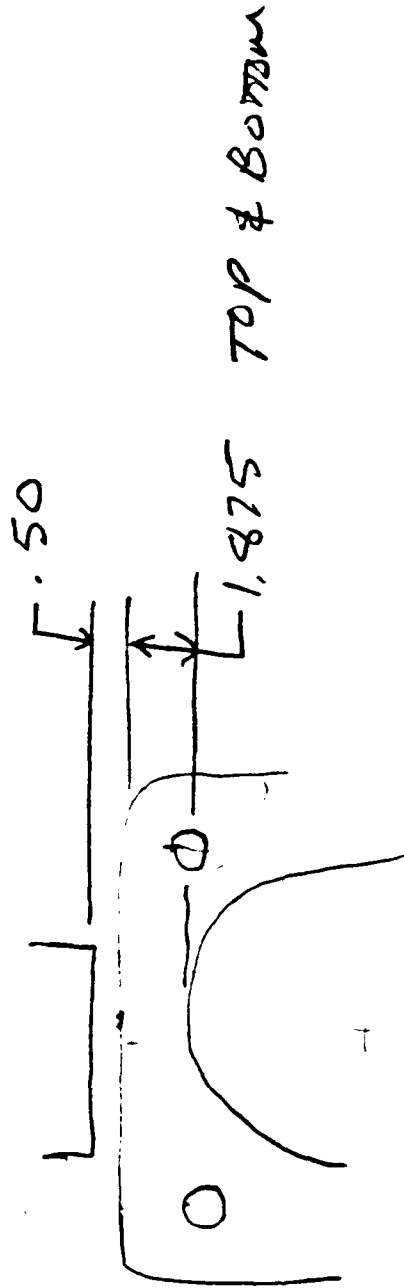
11/3/80

PLATE / BAND, OUTER

$$\begin{aligned} 1.875 \times 4.25 &= A = 7.968 \\ 1.625 \times 4.50 &= A = 7.3125 \\ 1.875 \times 4.50 &= A = \underline{8.4375} \end{aligned}$$

CLEARANCE BETWEEN TRACK & PLATE USING

$$1.875 = .50$$

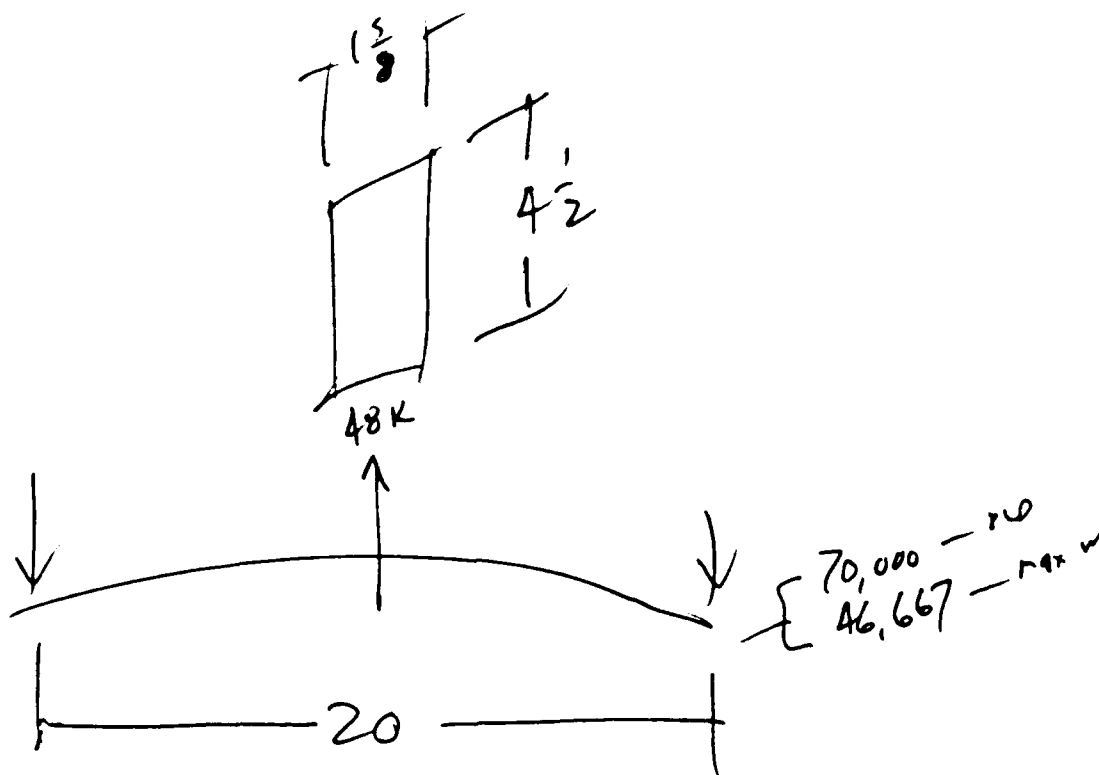


1.875
1.625
1.875

1.875

THK OF OUTER BAND PLATE BETWEEN CYL.

47



$$\frac{WL}{42} = \frac{48,000 \times 20}{4 \times Z} = 55,384 -$$

$$Z = \frac{bd^2}{6} = \frac{1.625 \times 16}{6} = 4.333$$

$$Z = \frac{1.625 \times 45}{6} = 43,760$$

7.5/25

END

10-87

DTIC