

Vibration Test Machine and Operation Procedure

1. Scope

This SAE Recommended Practice provides procedures, and information to conduct vibration (impact) tests on lighting devices and their components as well as other safety equipment used on vehicles.

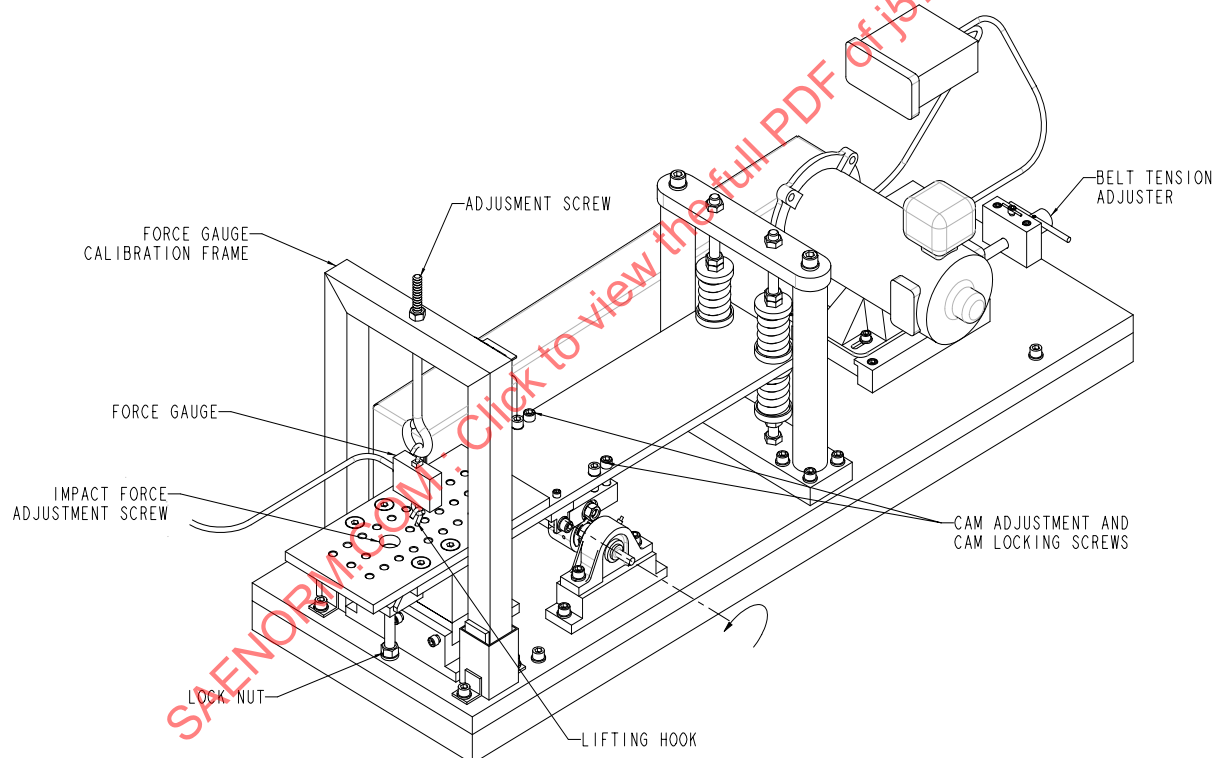


FIGURE 1—VIBRATION TEST MACHINE

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2005 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: custsvc@sae.org
http://www.sae.org

SAE WEB ADDRESS:

1.1 Rationale

The SAE Heavy Duty Lighting Committee established the SAE Vibration Task Force to incorporate improvements in the SAE J577 Vibration Machine. The goal was to make the test results repeatable from machine to machine and lab to lab without changing the nature of the test.

Members of the SAE Heavy Duty Lighting Committee and the SAE Lighting Committee were solicited for their input as to improvements made to their machines over time.

The drawings referenced in this document represent improvements suggested by committee members as well as those developed through testing.

1. Cam followers were added to reduce friction and prevent wear. This should extend the interval between calibrations.
2. The 4 springs that produce the $290\text{N} \pm 20\text{N}$ force were replaced with a single compression spring located at the front of the machine and mounted directly to the hammer. The compression spring will have a longer life cycle and is much easier to adjust and replace.
3. Cantilevered adjustment mechanisms were added to aid in fine tuning the 3.2 mm gap between the hammer and anvil.
4. Cam followers were added to engage a vertical Vee block to reduce side wobble.
5. A second cam was added to the machine to further stabilize the table. The cam design was changed so they are replaceable.
6. A programmable controller was added to control the rpm of the cams to $\pm \frac{1}{2}$ rpm. A "Hall Effect" sensor provides feedback from the cam shaft to the controller to control shaft rotation.
7. The "V" belt and pulleys were replaced with a timing belt and cogged pulleys. This will prevent slippage.
8. The $\frac{1}{4}$ horsepower motor was replaced with a $\frac{1}{3}$ horsepower DC motor.
9. The rear spring mounting frame was changed to a weldment with bolts on top for easy removal of the top bracket for spring replacement.
10. The rear springs have been detailed in their specifications to provide 1335 N force per spring when installed.
11. The hammers have been replaced with a solid block to reduce the force per square inch when striking the anvil which should result in less wear and longer calibration intervals.
12. A belt guard was added to improve safety.
13. The anvil was changed to a two-piece construction to make it easier to replace when necessary. The shape of the anvil is square, which allows for rotation without replacement.
14. A fixture mounting plate was added to the top plate to aid in fixture mounting and to prevent the need to disassemble the machine if a different fixture mounting is needed. Tapped holes are provided for a combination of fixture mountings. A threaded hole is provided for the accelerometer mounting and for the calibration of the tension test.
15. A calibration frame has been specified along with the appropriate force gage and connections. This should improve accuracy when calibrating the machine.
16. The location of the accelerometer has been standardized and will improve output measurements.

SAE J577 Reissued JUL2005

17. A study of accelerations using various weights that included the fixture mounting plate, the DUT, and the test fixture showed that when the sum of these weights are between 13.5 kg and 27.0 kg, the accelerations are not dampened. A survey of the SAE Heavy Duty Lighting Committee Members determined that 97% of all test fixtures plus the fixture mounting plate weigh less than 13.5 kg. This will require fixture designs that allow weights to be added or removed to meet the requirement. When larger devices are tested and a larger fixture mounting plate is required they should be kept within the 13.5 and 27.0 kg range
18. Zert fittings have been added to lubricate the cam followers mentioned in item number 1 and 3 above.
19. A detailed procedure has been added to the document for calibrating the machine.
20. The mounting base has been specified with a pressurized vibration isolation system so that all machines are mounted on bases with similar dampening characteristics.
21. A screw type mechanism was added for adjusting belt tension on the motor.
22. Three GO-NO-GO gages have been detailed in the document to aid in the calibration of the machine.
23. The cam design was studied and it was determined that when the hammer strikes the anvil the cam has rotated 14 degrees. The cam design from 1938 lifts the hammer after 225 degrees of rotation. The cam design used on the first round robin test lifted the hammer at 255 degrees. This required high accelerations to lift the hammer to 3.2 mm (.125 inch) or top dead center (TDC) on the cam. Tests showed that the high accelerations caused the hammer to travel higher than desired with the gap around 4.98 to 5.99 mm (.196 to .236 inch).
We also found that from the time the hammer first strikes the anvil (approximately 14 degrees cam rotation) until it is lifted at 255 degrees the hammer bounces on the anvil resulting in uncontrolled data points (around 4 g's). A new cam was designed to lift the hammer after 30 to 60 degrees rotation of the cam and making a smooth transition up to TDC. Tests revealed that the hammer/anvil gap did not exceed .125 inch and the data points were contained in a narrow band.
24. The SAE Heavy Duty Lighting Committee has conducted two round robin tests on 6 machines tooled by 5 different companies and has determined that the new machines, when properly calibrated, will greatly reduce variations from machine to machine. Benchmark data collected from machines in 1974 showed 1900% variation between peak to peak g values (over 200% if the lowest and highest values are thrown out). The following chart provides the results of the second round robin tests conducted by the SAE HDLC task force. There is approximately 31% variation in the data (20% if the lowest and highest values are thrown out).

FUNCTION	AVERAGE	Company A	Company B	Company C	Company D	Company E	Company F
X AXIS (g) side to side							
Average	2.329	2.735	1.625	7.13	2.352	4.666	-4.535
Y AXIS (g) front to back							
Average	1.309	2.655	-1.034	-2.598	4.259	-0.577	5.15
Z AXIS (g) vertical							
Average	7.196	7.783	8.164	6.446	7.578	6.226	6.98

When the improvements listed above are incorporated in the J577 vibration machine, following the detailed specifications along with proper calibration and fixturing, the test results from machine to machine will show a reduction in variations. Deviation from these specifications could affect repeatability of the test.

2. References

2.1 Related Publications

2.1.1 SAE PUBLICATIONS

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J575—Tests for Motor Vehicle Lighting Devices and Components

SAE J2139—Tests for Lighting Devices, Reflective Devices and Components Used on Vehicles
2032 mm or more in Overall Width

SAE 861957—Headlight Vibration Testing for Heavy Duty Trucks

SAE 840501—Automotive Component Vibration: A Practical Approach to Accelerated Vibration Durability
Testing

SAE 790747—Vibration Test for Motor Vehicle Lighting Devices and Components

2.1.2 FMVSS PUBLICATIONS

Available from the National Highway Traffic Safety Administration, 400 Seventh SW, Washington, DC
20024-0002.

FMVSS-108—Lamps Reflective Devices, And Associated Equipment (Available as 49 CFR 571.108)

2.1.3 OTHER PUBLICATIONS

U.S. Department of Agriculture General Technical Report FPL 22—An Assessment of the Common
Carrier Shipping Environment

3. Definitions

3.1 Anvil

The member located at the front of the machine on the lower base plate, that is struck by the hammer
when the top plate is falling.

3.2 Cam Follower

A mechanism that contains a roller(s) that comes in contact with the cam(s) surface and thereby reduces
the friction and wear on the cam by rotating rather than rubbing.

3.3 Hammer

The member located at the front of the machine on the upper plate, that strikes the anvil when the top
plate is falling.

3.4 Vibration Test Fixture

A fixture specifically designed to support the device under test in its designed operating position during the vibration test.

4. Lighting Identification Code

Not applicable.

5. Tests

5.1 Calibration Equipment and Instrumentation

Equipment listed is a guide for standardization only. Equivalent instrumentation equipment is available, however test results should be checked for accuracy

5.1.1 FORCE GAGE

5.1.1.1 Force/Torque Indicator with 50 x 0.02 kgf Capacity, 500 x 0.2 N, accuracy $\pm 0.2\%$ of full scale ± 1 digit.

5.1.1.2 Force Sensor with 50 x 0.02 kgf Capacity, accuracy $\pm 0.15\%$ of full scale ± 1 digit.

5.1.2 GO-NO-GO GAGES

5.1.2.1 Gages specified in Figures 2, 3, and 4 below should be used to set the machine up and for recalibration.

5.2 Vibration Test

This test evaluates the ability of a device to resist damage from vibration-induced (impact-induced) stresses.

5.3 Vibration Test Procedures

5.3.1 A sample of the device, mounted in the specified vibration test fixture shall be bolted to the anvil end of the table on the vibration test machine and vibrated at $12.5 \pm .17$ Hz (750 ± 10 cpm) through a vertical distance of $3.2 \text{ mm} \pm .25 \text{ mm}$. The table shall be spring mounted at one end and fitted with a steel hammer on the underside of the other end. The hammer shall contact the steel anvil once during each cycle at the completion of the fall. The impact force shall be $290 \text{ N} \pm 20 \text{ N}$.

6. Vibration Machine Requirements

6.1 The vibration system shall consist of a vibration machine and the mounting base.

6.2 The machine shall meet the specifications as outlined in drawing number 251942, which may be purchased from SAE Headquarters.

NOTE—Deviation from the specifications as listed could compromise the performance of the vibration test.

- 6.3** The mounting base for the machine shall meet the specifications as outlined in drawing number 230050, which may be purchased from SAE Headquarters.

7. Machine Set-Up and Calibration

The vibration isolator system on the mounting base should be pressurized to a minimum of 275.6 kPa.

7.1 Calibration and Instrumentation Sequence

- a. Vee block rollers
- b. Rear spring set-up
- c. Verify top plate is parallel to machine base plate.
- d. Adjust hammer and anvil gap
- e. Adjust top plate spring tension
- f. Program cycles per minute into the controller

7.2 Vee Block Roller Adjustment

- 7.2.1 Remove the fixture mounting plate mounted on top of the top plate to access the two mounting screws holding the vee block in place.
- 7.2.2 Place a 0.25 mm gage or shim stock between each roller and the vee block as shown in Figure 5. Position the vee block so that it makes contact with the shim stock on both rollers.
- 7.2.3 Tighten the two mounting bolts for the vee block and replace the fixture plate.
- 7.2.4 Remove the gages or shim stock(s).

7.3 Rear Spring Set-Up

- 7.3.1 The lifting cams should be rotated to their lowest point (not engaged). Rotate the cams counterclockwise, when viewed from the pulley side, until they touch the cam followers. The hammer and anvil must be touching.
- 7.3.2 Measure the height of the top plate from the machine's bottom plate using the "GO-NO-GO" gage shown in Figure 2. The measurement should be made at the front (both sides) to make sure it is at the proper height, then measure the rear of the top plate (both sides) to make sure they are at the same height. If the rear of the top plate is higher or lower than the front, adjust the rear springs until the gage fits both front and rear.
- 7.3.3 Use the "GO-NO-GO" gage per Figure 3 to gage the correct spring compression to obtain the force required. The gage should "go" over the spring keeper and interfere with the "NO-GO" portion of the gage. The spring force is determined by the spring rate to determine the amount of compression plus the wall thickness of the two spring keepers.

- 7.3.4 Recheck the height of the top plate using the “GO-NO-GO” gage from Figure 2 to make sure it is the same as the front (both sides).
- 7.3.5 Place a piece of manila folder between the hammer and anvil and run the machine for 60 seconds. Check the imprint on the manila paper to make sure the hammer and anvil are making contact over the entire surface. If they are not making even contact from side to side and front to back it is recommended that the hammer and anvil and holder assembly be surface ground. After grinding repeat the manila paper imprint test. Caution should be taken not to grind too much off the hammer and anvil so that the top plate is no longer level. It is recommended that no shims be used under the hammer or the anvil as this can cause dampening of the machine. Replace a worn anvil.

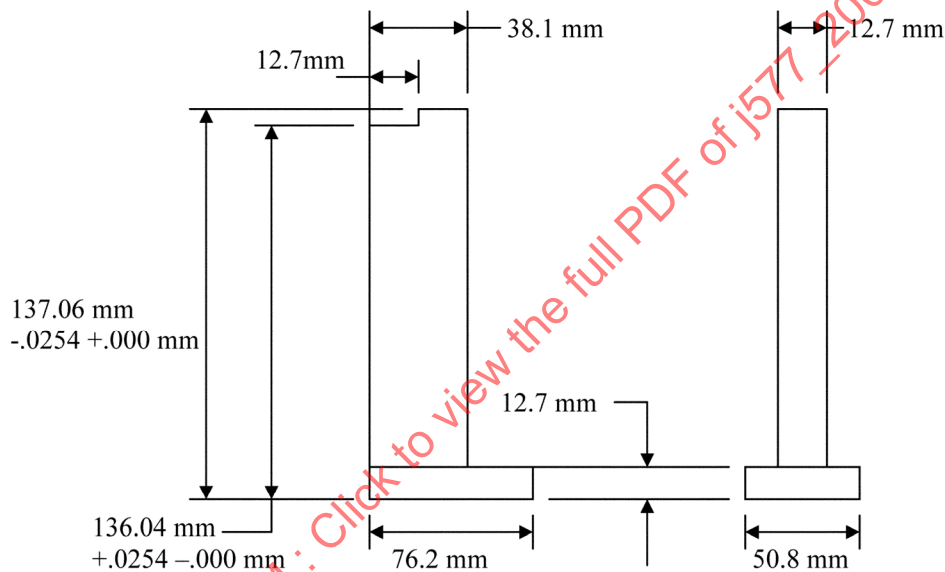


FIGURE 2—TOP PLATE GAGE

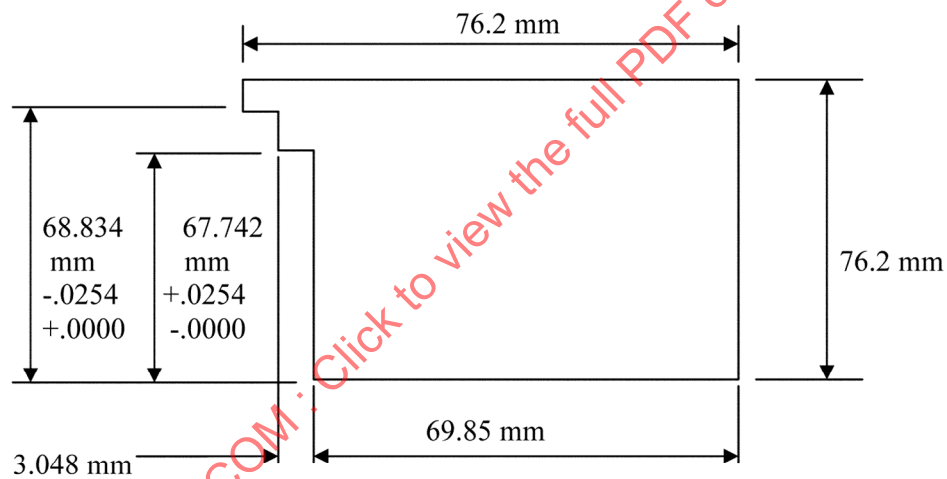
7.4 Calibration Procedure

7.4.1 CAM SET-UP

- 7.4.1.1 Care should be taken to assemble the cams on the machine correctly. When viewing the cams from the pulley side of the machine, the cams should rotate clockwise.
- 7.4.1.2 Manually rotate the cams to Top-Dead-Center (TDC). This will provide the largest gap between the hammer and anvil.
- 7.4.1.3 Check the gap using the “GO-NO-GO” gage in Figure 4. Adjust the cantilevered cam followers until the “GO” portion of the gage fits between the hammer and anvil.

7.4.2 SPRING FORCE CALIBRATION

- 7.4.2.1 Rotate the cam from TDC backwards until the highest point on the cam stops at the cam follower. This is the lowest point on the cam and the hammer should be touching the anvil.
- 7.4.2.2 Place the calibration frame in the receptacles as shown on the drawings referenced in 6.2. Install the lifting hook in the accelerometer-mounting hole in the fixture mounting plate directly over the center of the anvil.
- 7.4.2.3 Attach the force gage specified in 5.1.1 to the calibration frame and attach it to the hook installed in the accelerometer-mounting hole on the fixture plate. Tighten the screw on top of the calibration frame until the gap between the hammer and anvil fits the "GO-NO-GO" gage in Figure 4.
- 7.4.2.4 Adjust the socket head capscrew for the front compression spring through the hole in the fixture plate until the calibration gage has a reading between $290\text{ N} \pm 20\text{ N}$.



Recommended width of the gage is 25.4 mm.

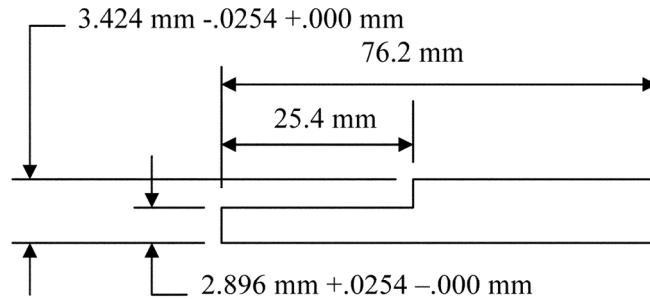
FIGURE 3—REAR SPRING GAGE

7.4.3 MACHINE CYCLE CALIBRATION

- 7.4.3.1 Set the controller at 750 cycles per minute.

8. Test Fixture Design

- 8.1 The combined weight of the fixture plate, the DUT, and the fixture shall be a minimum of 13.5 kg and a maximum of 27.0 kg.
- 8.2 The center of gravity of the fixture and the DUT should be centered as near as practicable over the anvil.



Recommended width of the gage is 25.4 mm.

FIGURE 4—GAP GAGE

9. Guidelines

9.1 Preventive Maintenance and Re-calibration

- 9.1.1 Calibration of the machine should be checked after 150 hours of tests or per the companies re-calibration schedule, which ever is less . Repair or replacement of worn machine components requires recalibration.
- 9.1.2 The machine should be inspected before and after each test to see if there is any wear appearing on the components and that all of the springs are functioning properly.
- 9.1.3 The machine should be lubricated on a quarterly basis or per the companies preventive maintenance schedule, which ever is less.

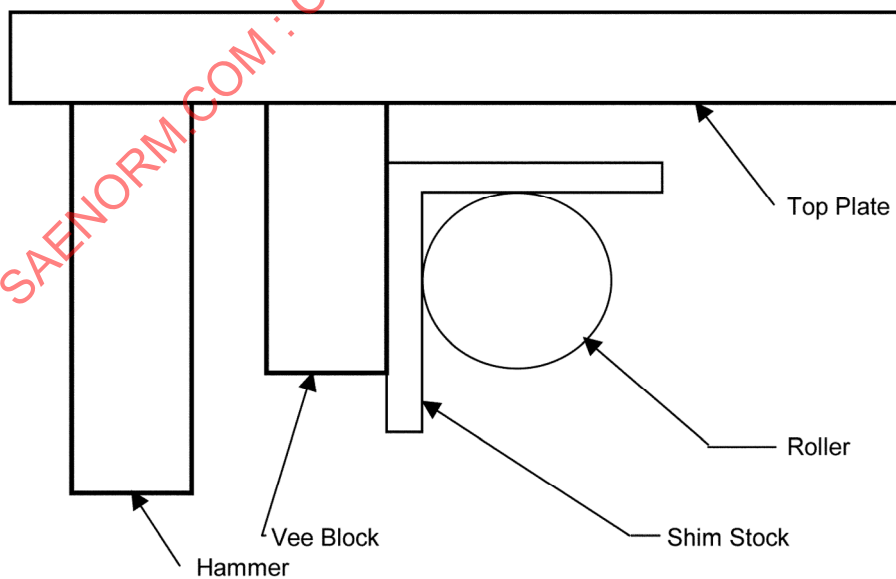
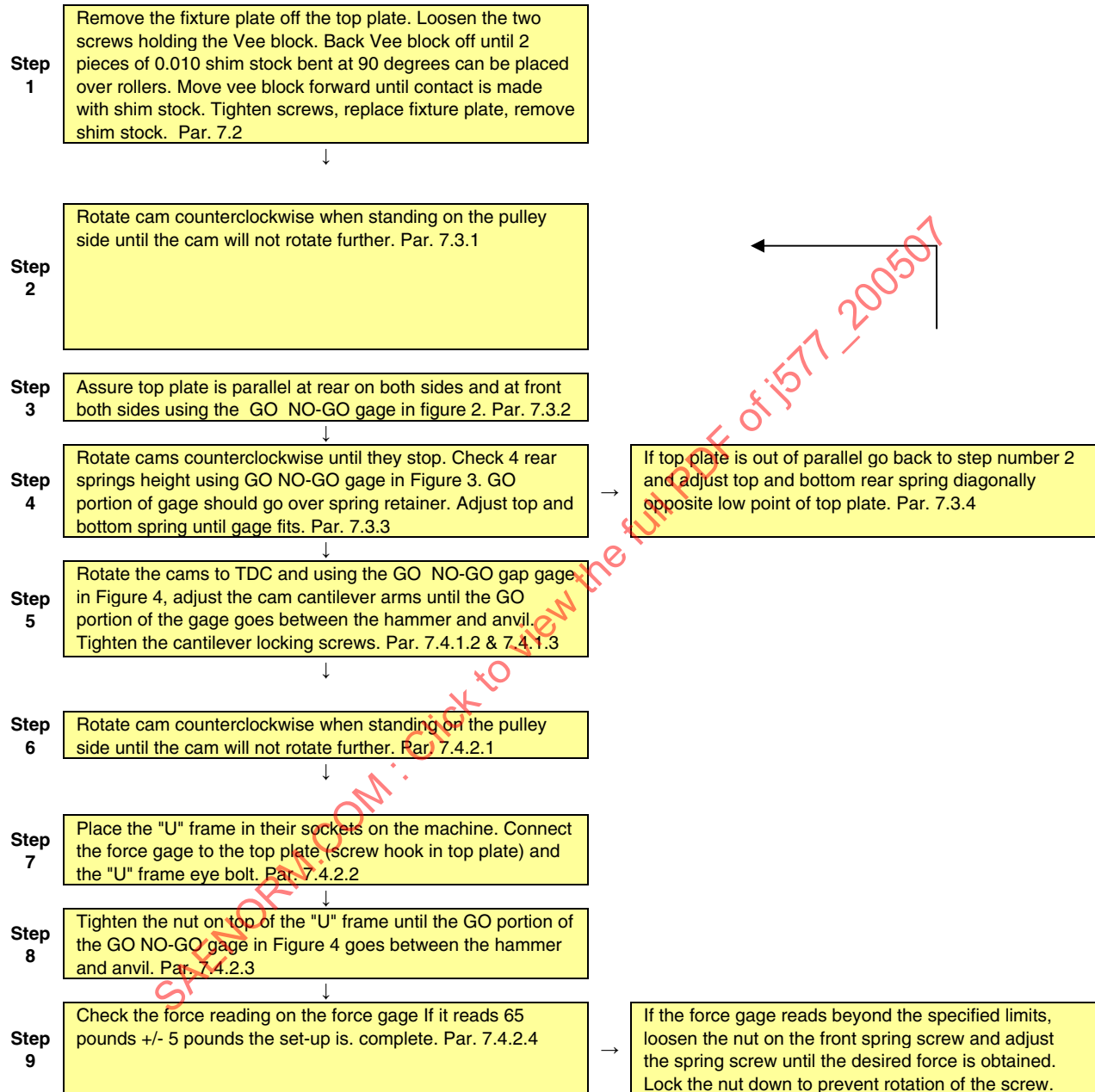


FIGURE 5—VEE BLOCK AND ROLLER SPACING ADJUSTMENT

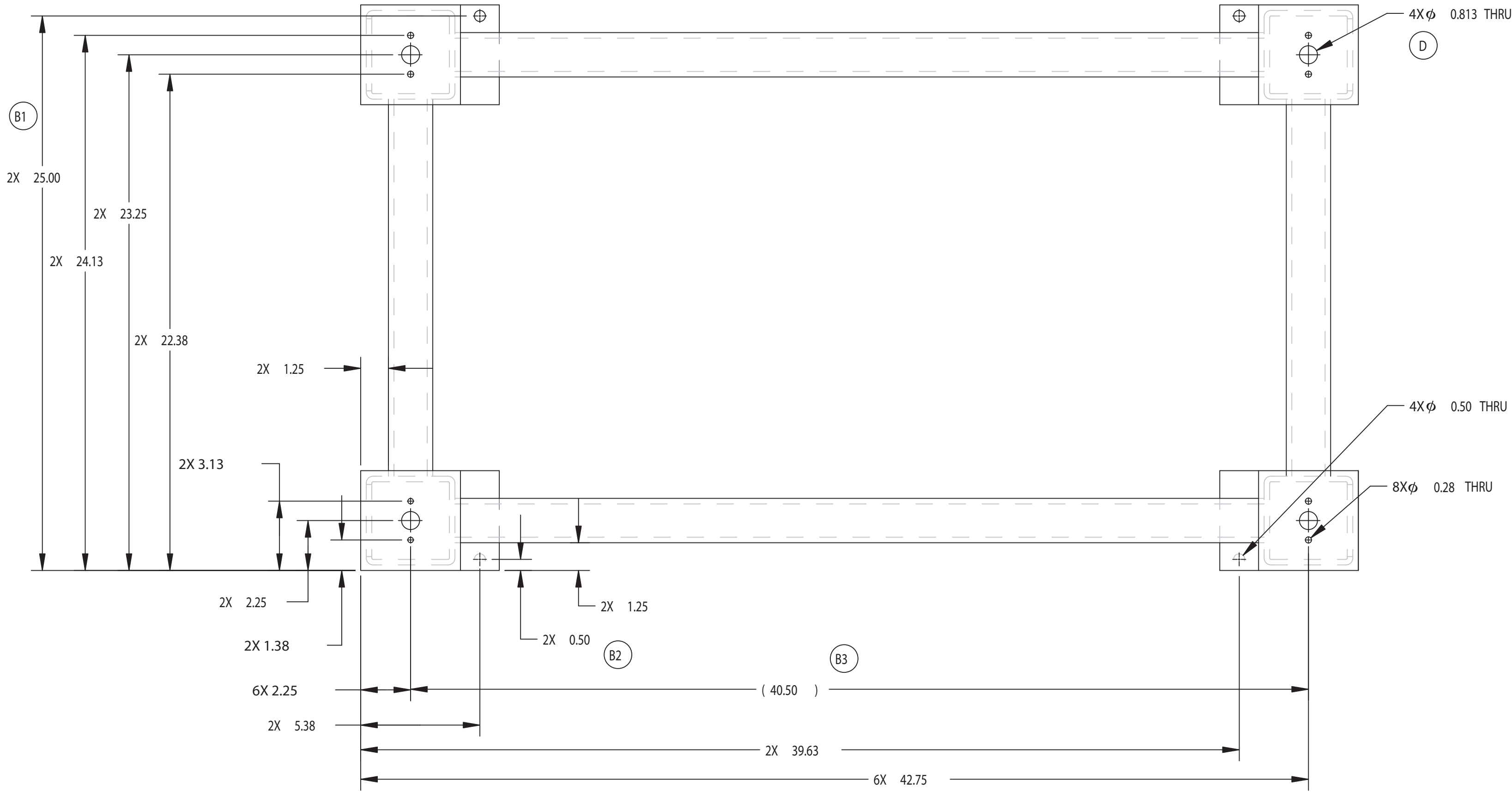
J577 VIBRATION MACHINE SET-UP FLOW CHART



SAE J577 Reissued JUL2005

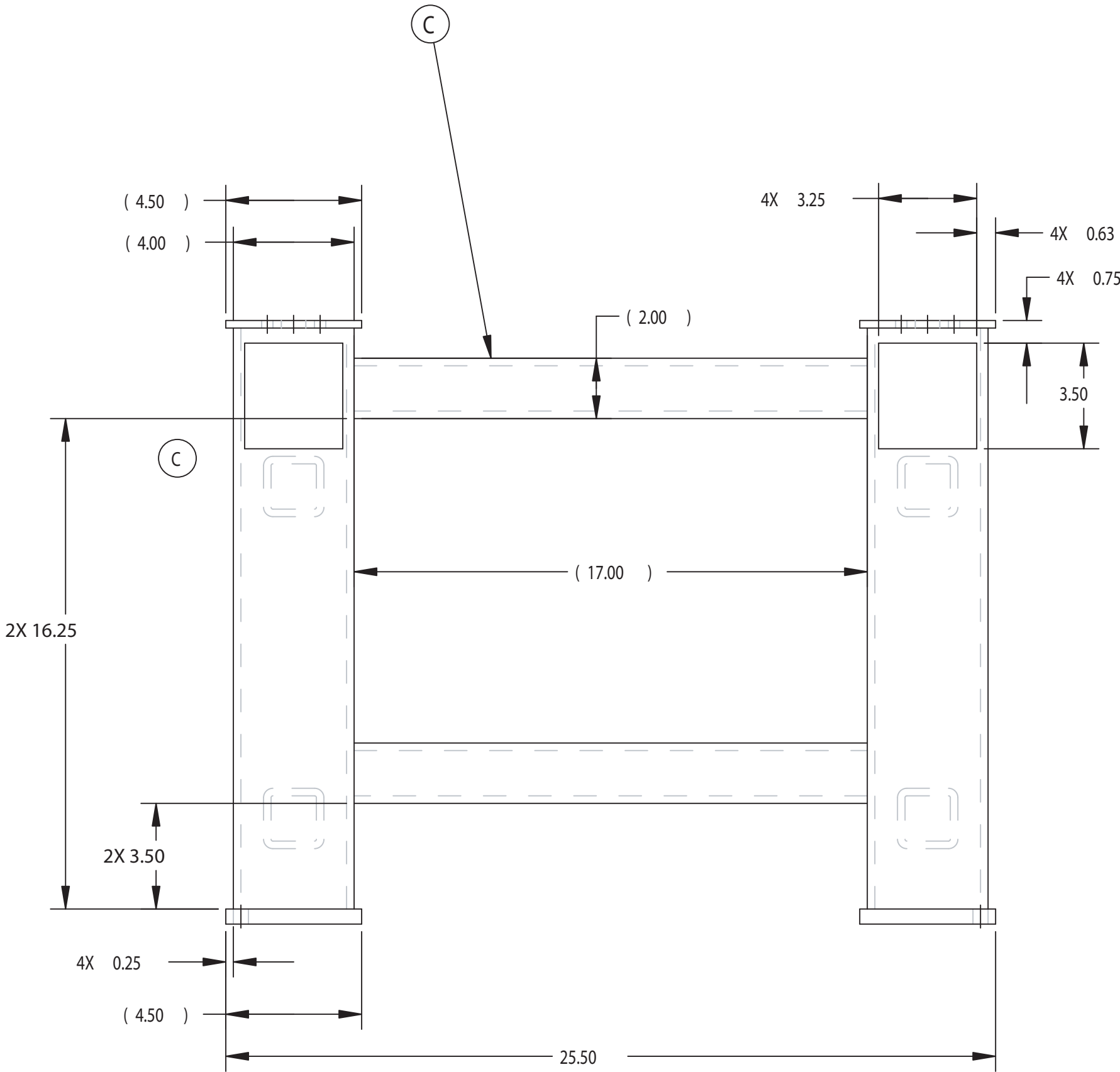
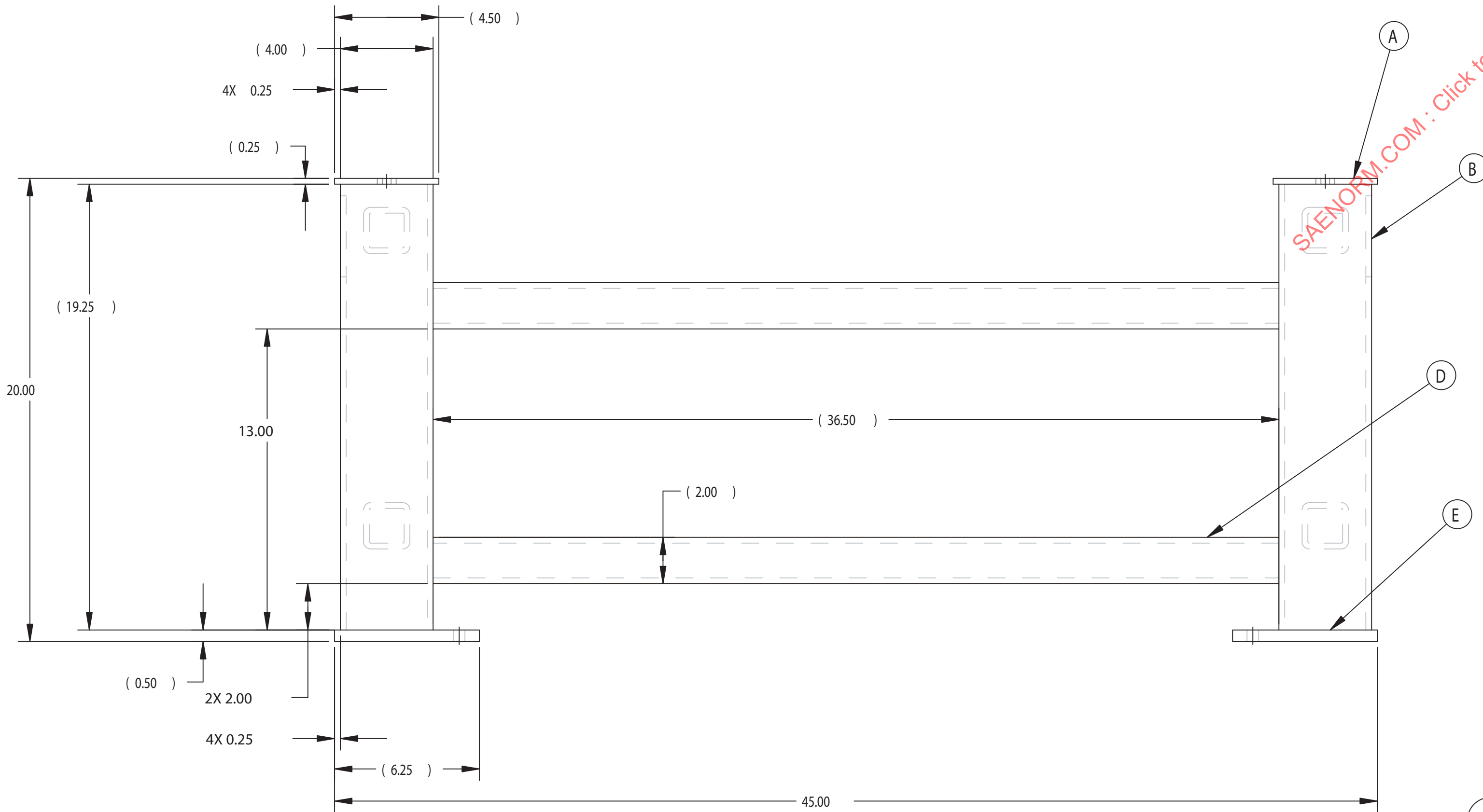
TABLE 1—MOUNTING BASE BILL OF MATERIAL

ITEM	ASY SHT	DTL SHT	QTY	MATERIAL	FINISH SIZE OR NAME
1	2		1	PUR	CARR LANE, SWING BOLT #CL-2-SB
2	2		4	PUR	FIRESTONE, AIRMOUNTS STYLE #16
3	2		1	PUR	McMASTER-CARR, DRAWER & DOOR PULLS #187A64
4	2		3	PUR	McMASTER-CARR, HEX THIN (JAM) NUT #91847A520
5	2		3	PUR	McMASTER-CARR, LARGE O.D. FLAT WASHER #91090A118
6	2		3	PUR & ALT	McMASTER-CARR, THREADED ROD #98847A033
7	3	5	1	WELDMENT	BASE WELDMENT ASEMBLY
8	3	6	1	WELDMENT	MOUNTING PLATE SUB-ASSEMBLY
9	3	7	2	STEEL TUBE	MOUNTING PLATE CROSSMEMBER
10	3	8	1	1018	WEIGHT RACK COVER
11	3	9	4	1018	WEIGHT
					23050-01



BILL OF MATERIAL
FINISHED SIZES GIVEN

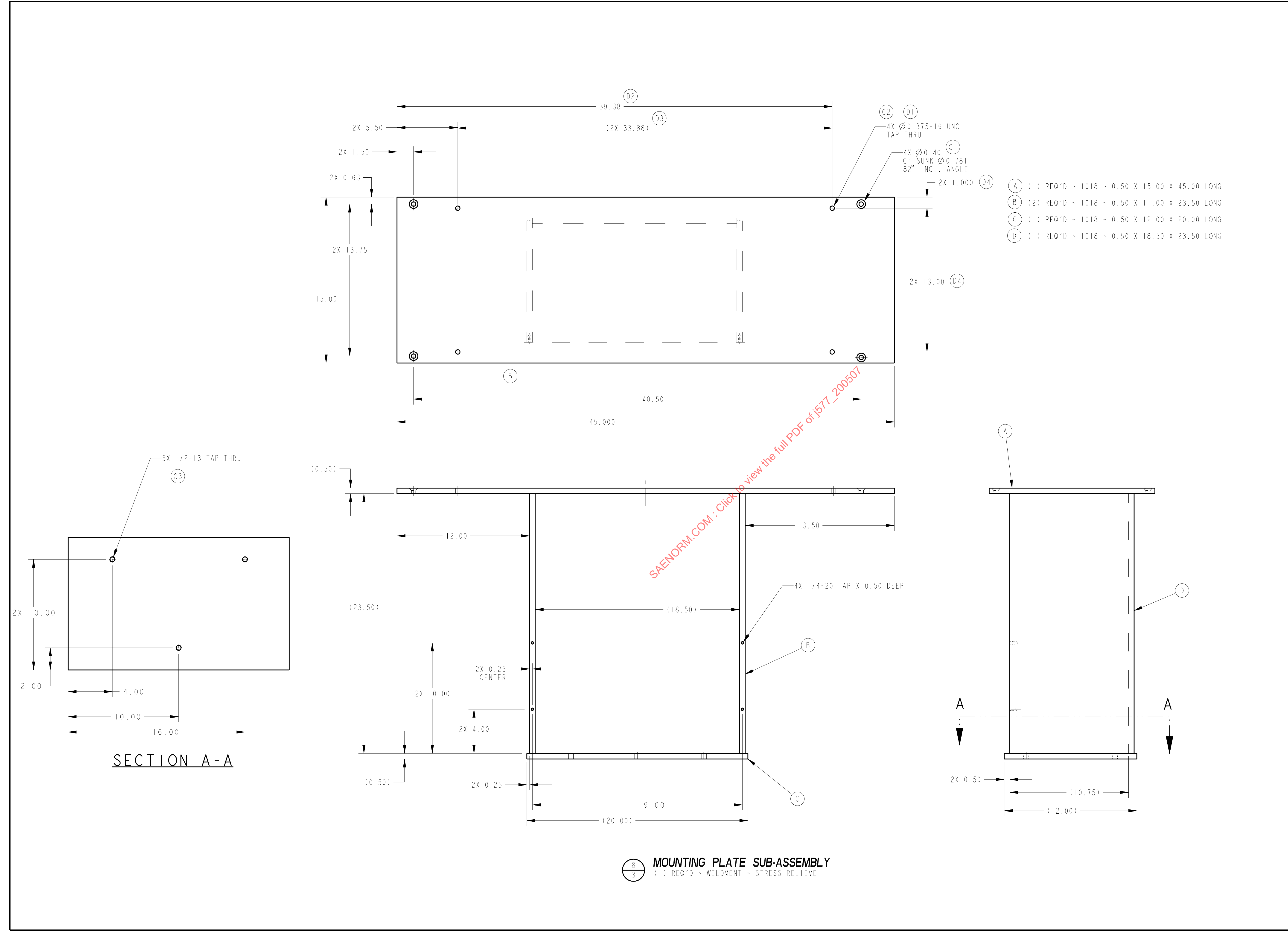
- (4) REQ'D ~ 1018 ~ 0.25 X 4.50 X 4.50 LONG
- (4) REQ'D ~ 1018 ~ 4" SQ.TUBING X 0.25 WALL X 19.25 LONG
- (4) REQ'D ~ 1018 ~ 2" SQ.TUBING X 0.125 WALL X 17.00 LONG
- (4) REQ'D ~ 1018 ~ 2" SQ.TUBING X 0.125 WALL X 37.50 LONG
- (4) REQ'D ~ 1018 ~ 0.50 X 4.50 X 6.25 LONG



7
3 BASE WELDMENT
(1) REQ'D ~ STRESS RELIEVE

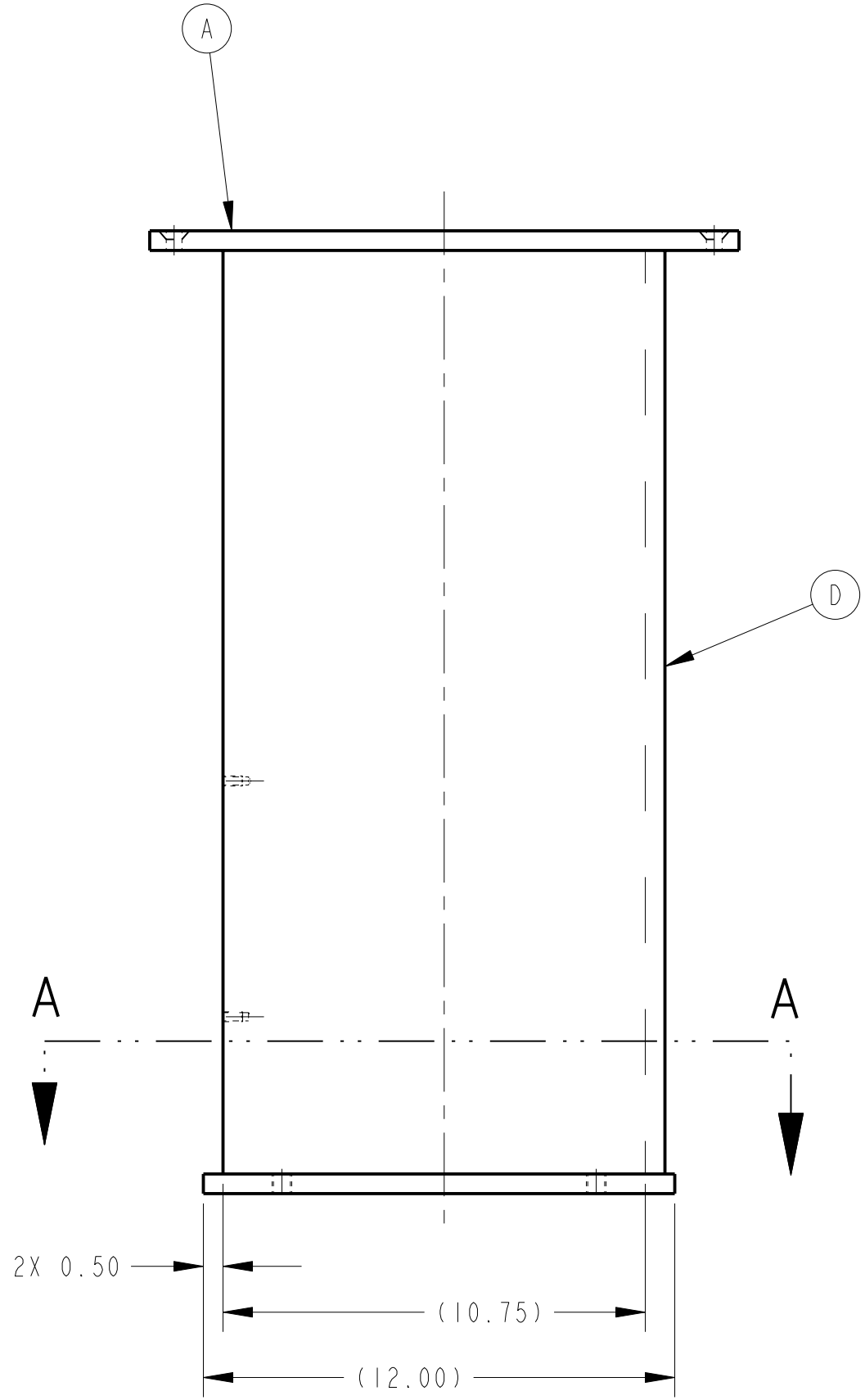
FIGURE 9—BASE WELDMENT

REV	DESCRIPTION	ENG APPL	ECN/ECO NO AND DATE
A	RELEASED		(230050) 11/13/01
MDN			
B1	25.00 WAS 23.25		230050
B2	0.50 WAS 2.25		
B3	ADDED (40.50) DIMENSION		02/11/02
MDN			
C	REMOVED TAPPED HOLE		230050
CDB			2/27/02
D	ADDED 4X ϕ 0.813 THRU		(230050) 07/09/02
MDN			



8 MOUNTING PLATE SUB-ASSEMBLY
3 (1) REQ'D ~ WELDMENT ~ STRESS RELIEVE

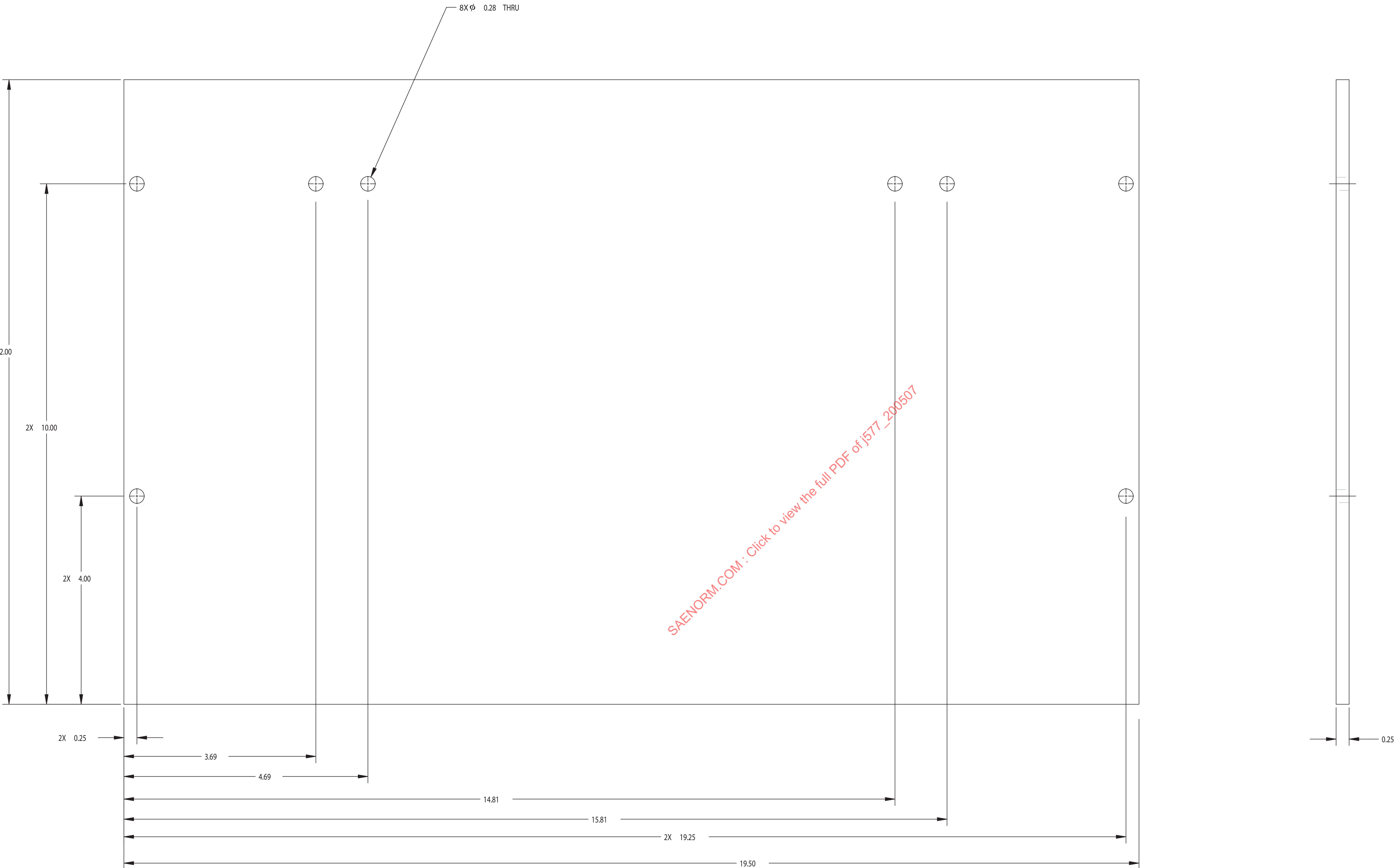
SAENORM.COM : Click to view the full PDF of j577_200507



REV	DESCRIPTION	ENG APP'L	ECN/ECO NO AND DATE
A	RELEASED		(230050) 1/13/01
B	MOVED TAPPED HOLE		230050 2/27/02
C1	ADDED C BORE		(230050)
C2	4X WAS 8X		
C3	MODIFIED TAP HOLE		
MON			07/09/02
D1	Ø 0.375-16 UNC WAS Ø 0.40		
D2	39.38 WAS 39.50		
D3	(2X 33.88) WAS (2X 34.00)		
D4	ADDED DIMENSIONS		
RF			01-10-07

TECHNICAL INFORMATION DISCLOSED HEREIN IS THE CONFIDENTIAL PROPERTY OF GROTE INDUSTRIES, INC. AND IS ISSUED IN CONFIDENCE FOR ENGINEERING INFORMATION ONLY. IT MAY NOT BE REPRODUCED OR USED IN ANY WAY WITHOUT EXPRESS WRITTEN LICENSE FROM GROTE INDUSTRIES, INC.			
GCC DENOTES GROTE CONTROL CHARACTERISTIC			
THIRD ANGLE PROJECTION			
DR. BY:	M. NOE	SCALE: 1/4	UNITS: IN
DATE:	06-Nov-01	DO NOT SCALE DRAWING	
MATERIAL NO.	N/A	CHECKED BY:	
MAT'L DESCRIPTION N/A			
TITLE MOUNTING BASE, J577 VIB. MACHINE			
Grote GROTE INDUSTRIES, LLC. MADISON, INDIANA U.S.A.			
SIZE	PART/DWG NO.	REV.	SHT #
D	230050-06	D	1 of 1
SYSTEM/REV. 3D DATA: no			

FIGURE 10—MOUNTING PLATE ASSEMBLY

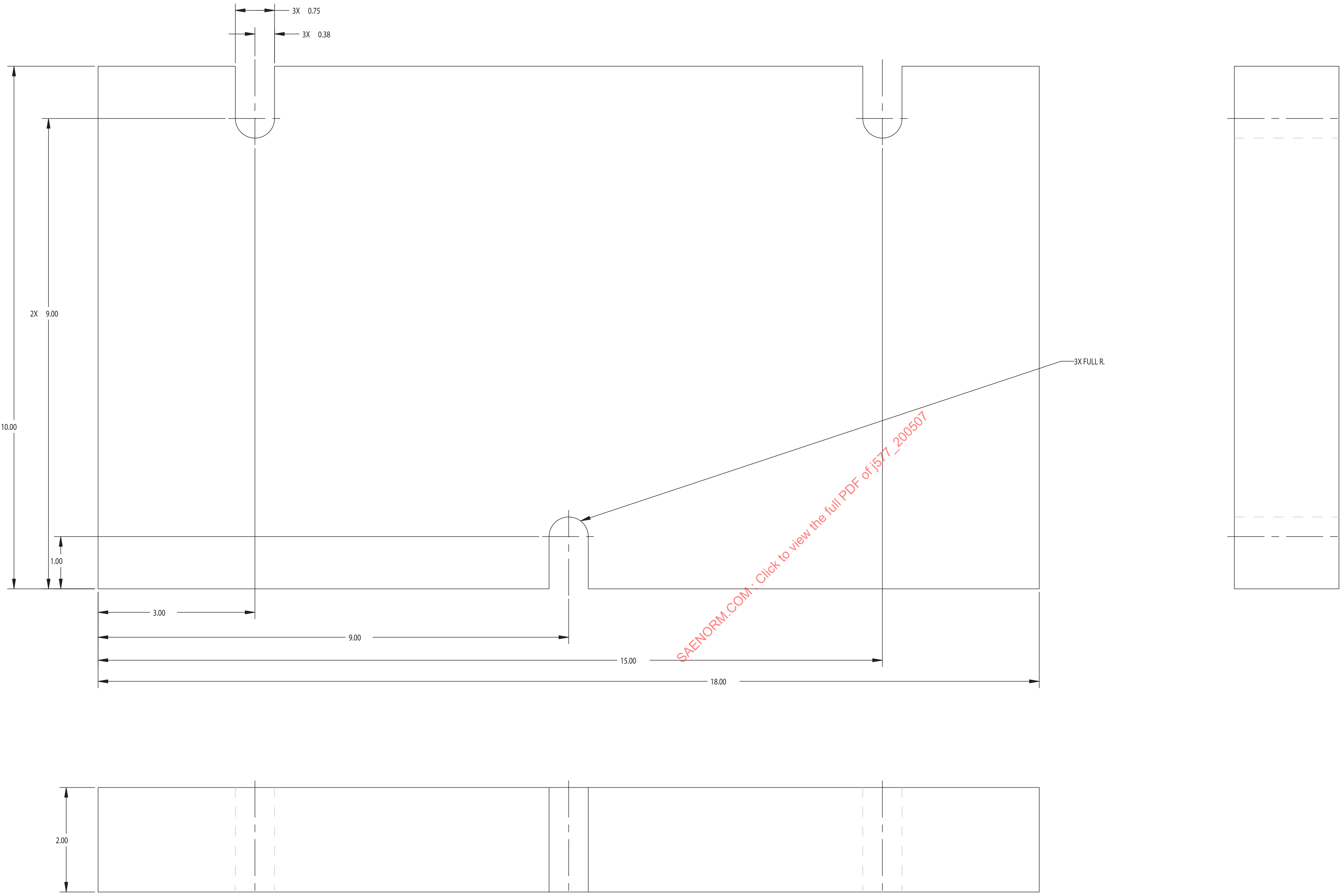


10
3

WEIGHT RACK COVER
(1) REQ'D ~ 1018

REV		DESCRIPTION	ENG APPL	ECN/ECO NO AND DATE
A	MDN	RELEASED		(230050) 11/13/01
TECHNICAL INFORMATION DISCLOSED HEREIN IS THE CONFIDENTIAL PROPERTY OF GROTE INDUSTRIES, INC. AND IS ISSUED IN CONFIDENCE FOR ENGINEERING INFORMATION ONLY. IT MAY NOT BE REPRODUCED OR USED IN ANY WAY WITHOUT EXPRESS WRITTEN LICENSE FROM GROTE INDUSTRIES, INC.				
GCC DENOTES GROTE CONTROL CHARACTERISTIC		THIRD ANGLE PROJECTION		
DR. BY:		M. NOE	SCALE:	FULL UNITS: IN
DATE:		07-Nov-01	DO NOT SCALE DRAWING	
MATERIAL NO.		N/A	CHECKED BY:	
MAT'L DESCRIPTION		N/A		
TITLE				
MOUNTING BASE, J577 VIB. MACHINE				
Grote GROTE INDUSTRIES, LLC. MADISON, INDIANA U.S.A.				
SIZE	PART/DWG NO.		REV.	SHT #
D	230050-08		A	1 of 1
SYSTEM REV: Proj E 2008			3D DATA: no	

FIGURE 12—WEIGHT RACK COVER



WEIGHT
(4) REQ'D ~ 1018

11
3

FIGURE 13—WEIGHT
- 19 -

REV		DESCRIPTION	ENG APPL	ECN/ECO NO AND DATE
A	MDN	RELEASED		(230050) 11/13/01
			</	

SAE J577 Reissued JUL2005

TABLE 2—J577 MACHINE BILL OF MATERIAL

BILL OF MATERIALS		
QTY	Part No.	Description
1	251942-01	Main Assembly
1	251942-02	Weldment Detail #2
1	251942-03	Weldment Detail #3
1	251942-04	Weldment Detail # 4
1	251942-05	Weldment Detail #5
4	251924-06	Weldment Detail #6
2	251942-07	Weldment Detail #8
1	251942-08	1.000 X 15.000 X 45.000 CRS
2	251942-09	1.670 DIA X 10.250 LG CRS
1	251942-12	1.250 SQ X 6.000 LG. # 4140 STL.
1	251942-13	1.250 X 1.500 X 6.000 LG. CRS
1	251942-14	0.750 X 1.000 X 4.125 LG. CRS
2	251942-15	FAFNIR PILLOW BLOCK #G1012KRRB, RAK 3/4
1	251942-16	0.500 X 6.000 X 26.625 LG. CRS
1	251942-17	0.750 X 2.000 X 11.000 CRS
1	251942-18	1.250 DIA X 13.375 LG. D2 58/62Rc STL.
1	251942-21	1.250 SQ. X 2.500 LG. #4140 STL.
1	251942-22	1.250 SQ. X 4.500 LG. CRS
2	251942-23	1.625 X 1.750 X 6.500 LG. CRS
1	251942-24	1.250 X 2.750 X 6.000 LG. D2 STL.
1	251942-25	1.000 X 2.875 X 11.875 LG. CRS
4	251942-26	Century Spring #11996
1	251942-27	Electric Motor, Baldor # CDP3320
1	251942-28	Bushed Gearbelt Pulley, Browning # 18LG075
1	251942-29	Bushed Gearbelt Pulley, Browning # 40LH075
1	251942-30	Timing Belt, Gates # 600L075
2	251942-31	Cam Follower, Roller Bearing Co. of America # S40L
2	251942-32	Cam follower # S32LW & Lube Fitting #36235 Roller Bearing Co. of America
4	251942-33	1.810 DIA X 0.344 LG. Tool STL
4	251942-34	1.810 DIA X 0.564 LG. Tool STL
1	251942-35	0.500 DIA X 2.250 X 4.000 LG CRS
2	251942-37	0.250 SQ. X 1.360 LG. Key
2	251942-38	E-Ring, McMaster Carr #98407A156
2	251942-40	1/8" Grease Zerk, McMaster Carr # 1095K11
2	251942-41	2.000 DIA X 1.500 LG Hardened D2 STL
1	251942-42	0.500 X 6.000 X 12.000 LG. CRS
2	251942-43	2.000 SQ. X 14 GA. Tubing X 3.000 LG
2	251942-44	1.500 SQ X 0.125 Wall Tubing X 18.000 LG.
1	251942-45	1.500 SQ X 0.125 Wall Tubing X 11.250 LG.
1	251942-46	12GA. X 17.605 X 40.908 LG. CRS

SAE J577 Reissued JUL2005

TABLE 2—J577 MACHINE BILL OF MATERIAL (CONTINUED)

BILL OF MATERIALS		
QTY	Part No.	Description
1	251942-47	Inline Force/Torque Indicator Mark -10, Model BGI, Series SSM100
2	251942-49	0.125 SQ. X 2.000 LG. Key
1	251942-50	Red Oak Quarter Sawn 1.625 X 15.000 X 45.000 LG.
3	251942-52	Hook, Purchased W/ P/N 251942-47
2	251942-53	0.125 X 1.000 X 1.000 Angle X 1.250 LG.
1	251942-54	2.250 X 2.188 X 7.500 LG. CRS
1	251942-56	1.250 X 4.500 X 6.000 LG. CRS
2	251942-61	1.250 SQ. X 8.000 LG. CRS
1	251942-62	Sub-Assembly
1	251942-63	1.000 X 2.000 X 3.000 LG. CRS
1	251942-65	Sub-Assembly
1	251942-66	Hinge, McMaster Carr # 16175A15
1	251942-67	0.750 X 1.000 X 4.125 LG. CRS
4	251942-68	0.125 X 1.000 X 1.000 Angle X 1.000 LG.
2	251942-69	1.250 DIA X 0.437 LG. Hardened Tool STL
1	251942-70	Sub-Assembly
1	251942-71	0.250 X 1.750 X 2.125 LG. CRS
1	251942-72	Honda ATV Valve Spring #14751-KCY-670
1	251942-73	Bushing, Browning # H 3/4
1	251942-74	Bushing, Browning # G 5/8
1	251942-75	Dart Tachometer #MDIOP
1	251942-76	Dart Pulse Generator # PU2E
2	251942-77	0.125 X 1.000 X 1.500 Angle X 1.000 LG.
2	251942-78	0.250 X 1.380 X 3.000 LG. CRS
1	251942-79	0.500 X 2.375 X 2.000 Angle X 1.500 LG.
1	251942-80	1.000 DIA X 1.500 LG. ROD
1	251942-81	0.250 DIA X 4.000 LG. ROD
1	251942-82	1/4-20UNC SHCS X 1.250 LG
1	251942-83	0.093 DIA X 1.250 LG. ROD

PREPARED BY THE SAE HEAVY DUTY LIGHTING STANDARDS COMMITTEE

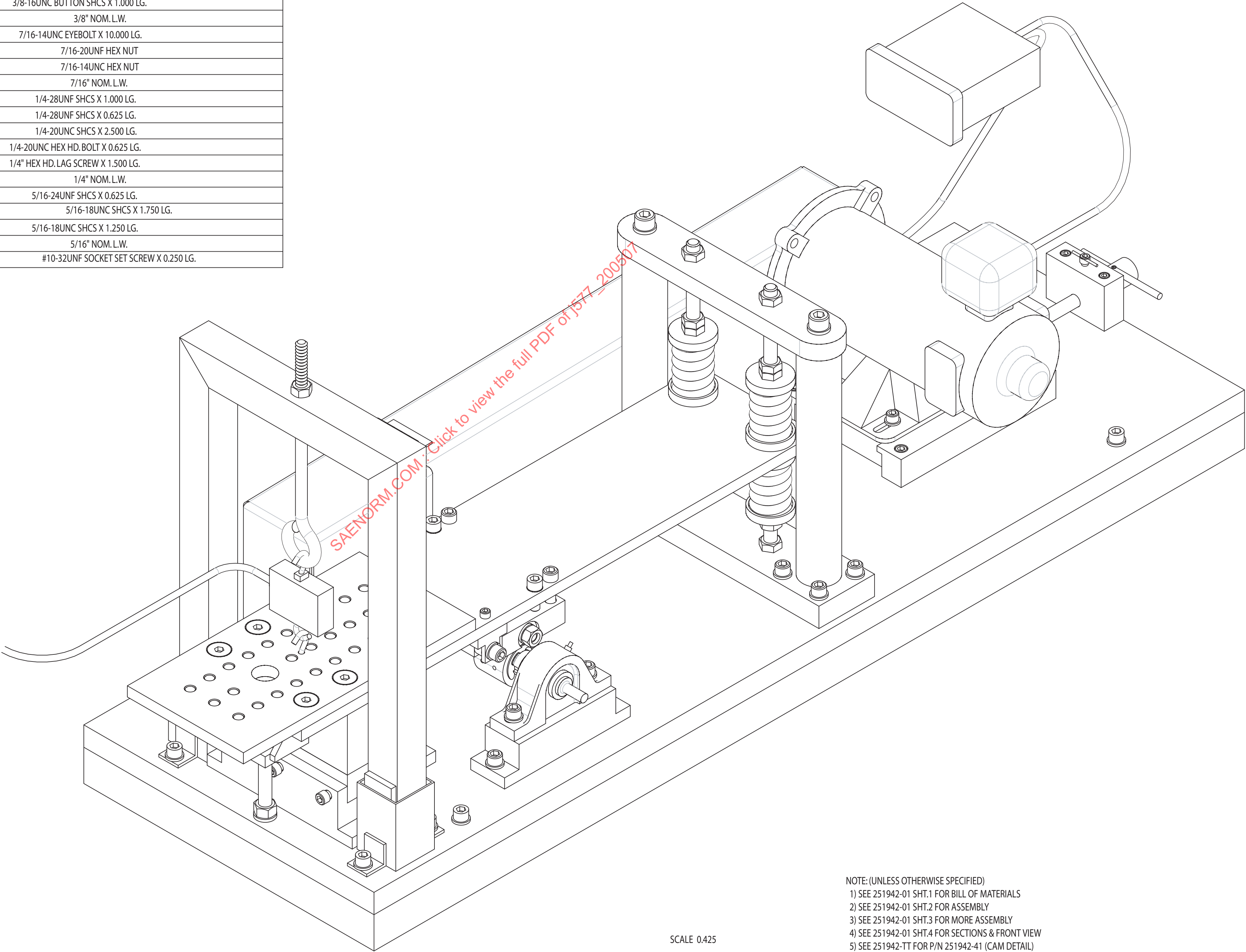
BILL OF MATERIAL			FASTENERS		
QTY.	PART NO.	DESCRIPTION	QTY.	PART NO.	DESCRIPTION
1	251942-01	MAIN ASSEMBLY	2		1/2-13UNC SHCS X 2.000 LG.
1	251942-02	WELDMENT DETAIL #2	1		1/2-13UNC SHCS X 5.500 LG.
1	251942-03	WELDMENT DETAIL #3	2		1/2-13UNC FLAT HD. SHCS X 1.250 LG.
1	251942-04	WELDMENT DETAIL #4	6		1/2-13UNC FLAT HD. SHCS X 1.000 LG.
1	251942-05	WELDMENT DETAIL #5	2		1/2-13UNC ALL-THD. X 12.500 LG.
4	251942-06	WELDMENT DETAIL #6	1		1/2-13UNC ALL-THD. X 9.250 LG.
2	251942-07	WELDMENT DETAIL #8	2		1/2-20UNF HEX NUT
1	251942-08	1.000 X 15.000 X 45.000 CRS	1		1/2-13UNC HEX NUT
2	251942-09	ϕ 1.670 X 10.250 LG. CRS	12		1/2-13UNC HEX JAM NUT
1	251942-12	1.250 SQ. X 6.000 LG. #4140 STL.	5		1/2" NOM. L.W.
1	251942-13	1.250 X 1.500 X 6.000 LG. CRS	8		3/8-16UNC SHCS X 2.000 LG.
1	251942-14	0.750 X 1.000 X 4.125 LG. CRS	12		3/8-16UNC SHCS X 1.500 LG.
2	251942-15	FAFNIR PILLOW BLOCK #G1012KRRB, RAK 3/4	2		3/8-16UNC SHCS X 1.250 LG.
1	251942-16	0.500 X 6.000 X 26.625 LG. CRS	2		3/8-16UNC SHCS X 1.875 LG.
1	251942-17	0.750 X 2.000 X 11.000 CRS	6		3/8-16UNC SHCS X 1.000 LG.
1	251942-18	ϕ 1.250 X 13.375 LG. D2 58/62Rc STL.	4		3/8-16UNC SHCS X "A" LG.
1	251942-21	1.250 SQ. X 2.500 LG. #4140 STL.	2		3/8-16UNC BUTTON SHCS X 1.000 LG.
1	251942-22	1.250 SQ. X 4.500 LG. CRS	30		3/8" NOM. L.W.
2	251942-23	1.625 X 1.750 X 6.500 LG. CRS	1		7/16-14UNC EYEBOLT X 10.000 LG.
1	251942-24	1.250 X 2.750 X 6.000 LG. D2 STL.	2		7/16-20UNF HEX NUT
1	251942-25	1.000 X 2.875 X 11.875 LG. CRS	1		7/16-14UNC HEX NUT
4	251942-26	CENTURY SPRING #11996	2		7/16" NOM. L.W.
1	251942-27	ELECTRIC MOTOR, BALDOR #CDP3320	2		1/4-28UNF SHCS X 1.000 LG.
1	251942-28	BUSHED GEARBELT PULLEY, BROWNING #18LG075	4		1/4-28UNF SHCS X 0.625 LG.
1	2519472-29	BUSHED GEARBELT PULLEY, BROWNING #40LH075	2		1/4-20UNC SHCS X 2.500 LG.
1	251942-30	TIMING BELT, GATES #600L075	4		1/4-20UNC HEX HD. BOLT X 0.625 LG.
2	251942-31	CAM FOLLOWER, ROLLER BEARING CO. OF AMERICA #540L	4		1/4" HEX HD. LAG SCREW X 1.500 LG.
2	251942-32	CAM FOLLOWER #532LW & LUB FITTING #36235 ROLLER BEARING CO. OF AMERICA	8		1/4" NOM. L.W.
4	251942-33	ϕ 1.810 X 0.344 LG. TOOL STL.	3		5/16-24UNF SHCS X 0.625 LG.
4	251942-34	ϕ 1.810 X 0.564 LG. TOOL STL.	4		5/16-18UNC SHCS X 1.750 LG.
1	251942-35	0.500 X 2.250 X 4.000 LG. CRS	4		5/16-18UNC SHCS X 1.250 LG.
2	251942-37	0.250 SQ. X 1.360 LG. KEY	9		5/16" NOM. L.W.
2	251942-38	E-RING, MCMASTER CARR #98407A156	4		#10-32UNF SOCKET SET SCREW X 0.250 LG.
2	251942-40	1/8" GREASE ZERK, MCMASTER CARR #1095K11			
2	251942-41	ϕ 2.000 X 1.500 LG. HARDENED D2 STL.			
1	251942-42	0.500 X 6.000 X 12.000 LG. CRS			
2	251942-43	2.000 SQ. X 14GA. TUBING X 3.000 LG.			
2	251942-44	1.500 SQ. X 0.125 WALL TUBING X 18.000 LG.			
1	251942-45	1.500 SQ. X 0.125 WALL TUBING X 11.250 LG.			
1	251942-46	12GA. X 17.605 X 40.908 LG. CRS			
1	251942-47	INLINE FORCE/TORQUE INDICATOR MARK-10, MODEL BGI, SERIES SSM100			
2	251942-49	0.125 SQ. X 2.000 LG. KEY			
1	251942-50	RED OAK QUARTER SAWN 1.625 X 15.000 X 45.000 LG.			
3	251942-52	HOOK, PURCHASED W/ P/N 251942-47			
2	251942-53	0.125 X 1.000 X 1.000 ANGLE X 1.250 LG.			
1	251942-54	2.250 X 2.188 X 7.500 LG. CRS			
1	251942-56	1.250 X 4.500 X 6.000 LG. CRS			
2	251942-61	1.250 SQ. X 8.000 LG. CRS			
1	251942-62	SUB-ASSEMBLY			
1	251942-63	1.000 X 2.000 X 3.000 LG. CRS			
1	251942-65	SUB-ASSEMBLY			
1	251942-66	HINGE, MCMASTER CARR #16175A15			
1	251942-67	0.750 X 1.000 X 4.125 LG. CRS			
4	251942-68	0.125 X 1.000 X 1.000 ANGLE X 1.000 LG.			
2	251942-69	ϕ 1.250 X 0.437 LG. HARDENED TOOL STL.			
1	251942-70	SUB-ASSEMBLY			
1	251942-71	0.250 X 1.750 X 2.125 LG. CRS			
1	251942-72	HONDA ATV VALVE SPRING #14751-KCY-670			
1	251942-73	BUSHING, BROWNING #H 3/4			
1	251942-74	BUSHING, BROWNING #G 5/8			
1	251942-75	DART TACHOMETER #MD10P			
1	251942-76	DART PULSE GENERATOR #PU2E			
2	251942-77	0.1250 X 1.000 X 1.500 ANGLE X 1.000 LG.			
2	251942-78	0.250 X 1.380 X 3.000 LG. CRS			
1	251942-79	0.500 X 2.375 X 2.000 ANGLE X 1.500 LG.			
1	251942-80	ϕ 1.000 X 1.500 LG. ROD			
1	251942-81	ϕ 0.250 X 4.000 LG. ROD			
1	251942-82	1/4-20UNC SHCS X 1.250 LG.			
1	251942-83	ϕ 0.093 X 1.250 LG. ROD			

F1

E1

E2

F2

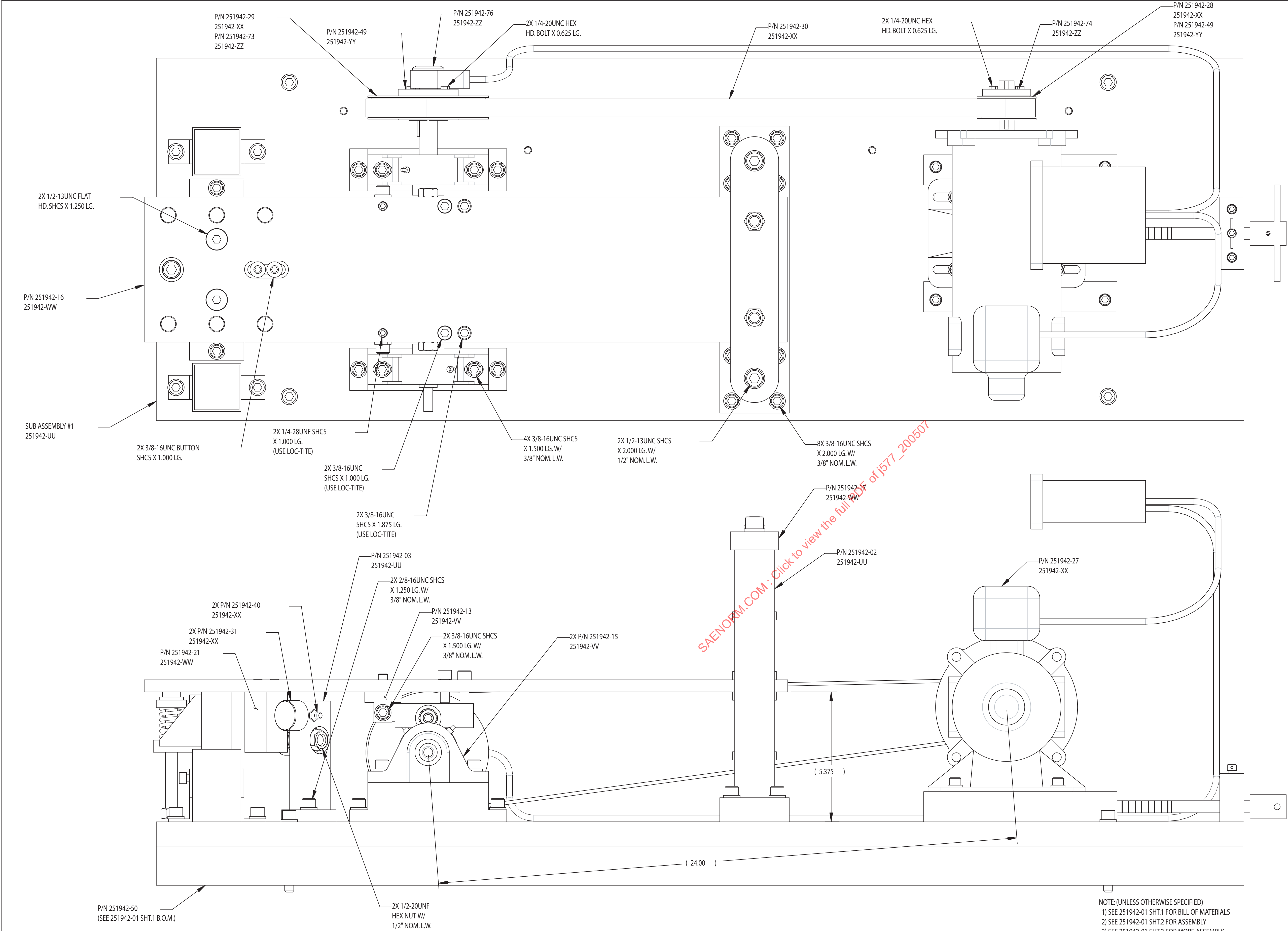


- NOTE: (UNLESS OTHERWISE SPECIFIED)
- 1) SEE 251942-01 SHT.1 FOR BILL OF MATERIALS
 - 2) SEE 251942-01 SHT.2 FOR ASSEMBLY
 - 3) SEE 251942-01 SHT.3 FOR MORE ASSEMBLY
 - 4) SEE 251942-01 SHT.4 FOR SECTIONS & FRONT VIEW
 - 5) SEE 251942-TT FOR P/N 251942-41 (CAM DETAIL)
 - 6) SEE 251942-UU FOR WELDMENTS & SUB-ASSEMBLY'S
 - 7) SEE 251942-VV FOR WELDMENTS, SUB-ASSEMBLY'S, & PARTS
 - 8) SEE 251942-WW FOR PARTS
 - 9) SEE 251942-XX FOR PARTS
 - 10) SEE 251942-YY FOR PARTS
 - 11) SEE 251942-ZZ FOR PARTS

REV	DESCRIPTION	ENG APPL	ECN/ECO NO AND DATE
B	REDRAWN & UPDATED ON PROJE		251942 07/10/03
C	P/N 251942-18 - 58/62Rc STL WAS 62/94Rc STL.		251942 11/14/03
D	P/N 251942-37 - 0.250 x 0.360 WAS 0.190 x 0.380		251942 12/11/03
E1 E2 CDB	DELETED P/N 251942-48 P/N 251942-49 QTY 2 WAS 1		251942 12/22/03
F1 F2 GDS	P/N 251942-32 - ADDED LUB FITTING P/N 251942-71 - 1.750 X 2.125 WAS 2.000 X 2.375		251942 05/27/04

TECHNICAL INFORMATION DISCLOSED HEREIN IS THE CONFIDENTIAL PROPERTY OF GROTE INDUSTRIES, INC. AND IS ISSUED IN CONFIDENCE FOR ENGINEERING INFORMATION ONLY. IT MAY NOT BE REPRODUCED OR USED IN ANY WAY WITHOUT EXPRESS WRITTEN LICENSE FROM GROTE INDUSTRIES, INC.			
GCC DENOTES GROTE CONTROL CHARACTERISTIC		 THIRD ANGLE PROJECTION	
DR. BY:	G.SMITH	SCALE:	1/2 UNITS: IN
DATE:	10-July-03	DO NOT SCALE DRAWING	
MATERIAL NO.	N/A	CHECKED BY:	
MAT'L DESCRIPTION			
N/A			
TITLE			
VIBRATION TEST STAND PER SAE J577 (BILL OF MATERIALS)			
		GROTE INDUSTRIES, LLC. MADISON, INDIANA U.S.A.	
SIZE	PART/DWG NO.	REV.	SHT #
D	251942-01	F	1 of 4
SYSTEM REV: Proj'E 2001		3D DATA: YES	

FIGURE 14—VIBRATION TEST MACHINE ASSEMBLY



P/N 251942-50
(SEE 251942-01 SHT.1 B.O.M.)

2X 1/2-20UNF
HEX NUT W/
1/2" NOM.L.W.

NOTE:(UNLESS OTHERWISE SPECIFIED)
1) SEE 251942-01 SHT.1 FOR BILL OF MATERIALS
2) SEE 251942-01 SHT.2 FOR ASSEMBLY
3) SEE 251942-01 SHT.3 FOR MORE ASSEMBLY
4) SEE 251942-01 SHT.4 FOR SECTIONS & FRONT VIEW
5) SEE 251942-TT FOR P/N 251942-41 (CAM DETAIL)
6) SEE 251942-UU FOR WELDMENTS & SUB-ASSEMBLY'S
7) SEE 251942-VV FOR WELDMENTS, SUB-ASSEMBLY'S, & PARTS
8) SEE 251942-WW FOR PARTS
9) SEE 251942-XX FOR PARTS
10) SEE 251942-YY FOR PARTS
11) SEE 251942-ZZ FOR PARTS

REV	DESCRIPTION	ENG APPL	ECN/ECONO AND DATE
B	REDRAWN & UPDATED ON PROJ.E		251942 07/10/03
C	P/N 251942-18 - 58/62Rc STL.WAS 62/94Rc STL.		251942 11/14/03
D	P/N 251942-37 -0.250 x 0.360 WAS 0.190 x 0.360		251942 12/11/03
E	SEE SHEET 1		251942 12/22/03
F	SEE SHEET 1		251942 05/27/04

TECHNICAL INFORMATION DISCLOSED HEREIN IS THE CONFIDENTIAL PROPERTY OF GROTE INDUSTRIES, INC. AND IS ISSUED IN CONFIDENCE FOR ENGINEERING INFORMATION ONLY. IT MAY NOT BE REPRODUCED OR USED IN ANY WAY WITHOUT EXPRESS WRITTEN LICENSE FROM GROTE INDUSTRIES, INC.

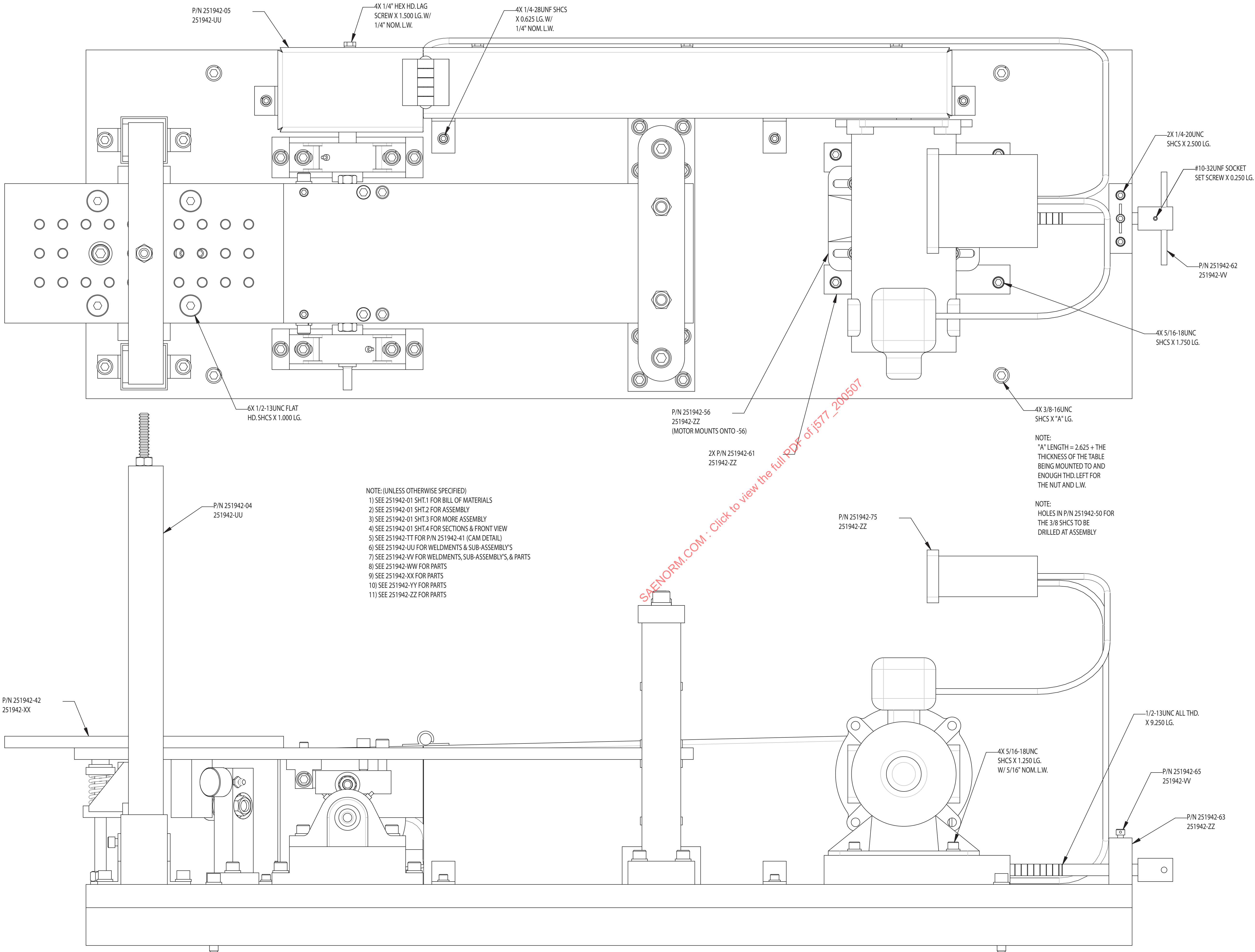
GCC

DENOTES GROTE CONTROL CHARACTERISTIC

THIRD ANGLE PROJECTION

DR. BY:	G.SMITH	SCALE:	1/2	UNITS:	IN
DATE:	11-July-03	DO NOT SCALE DRAWING			
MATERIAL NO.	N/A	CHECKED BY:			
MATERIAL DESCRIPTION N/A					
TITLE VIBRATION TEST STAND PER SAE JS77 (ASSEMBLY)					
Grote GROTE INDUSTRIES, LLC. MADISON, INDIANA U.S.A.					
SIZE	PART/DWG NO.	REV	SHT #		
D	251942-01	F	2 of 4		
SYSTEM/REV: Proj'E 2001					3D DATA: YES

FIGURE 15—VIBRATION MACHINE TOP AND SIDE VIEWS



REV	DESCRIPTION	ENG APPL	ECN/ECO NO AND DATE
B	REDRAWN & UPDATED ON PROE		251942 07/10/03
C	P/N 251942-18 - 58/62Rc STL WAS 62/94Rc STL		251942 11/14/03
D	P/N 251942-37 - 0.250 x 0.360 WAS 0.190 x 0.380		251942 12/11/03
E	SEE SHEET 1		251943 12/22/03
F	SEE SHEET 1		251942 05/27/04

TECHNICAL INFORMATION DISCLOSED HEREIN IS THE CONFIDENTIAL PROPERTY OF GROTE INDUSTRIES, INC. AND IS ISSUED IN CONFIDENCE FOR ENGINEERING INFORMATION ONLY. IT MAY NOT BE REPRODUCED OR USED IN ANY WAY WITHOUT EXPRESS WRITTEN LICENSE FROM GROTE INDUSTRIES, INC.

GCC

DENOTES GROTE CONTROL CHARACTERISTIC

THIRD ANGLE PROJECTION

DR. BY:

G.SMITH

SCALE:

1/2

UNITS:

IN

DATE:

11-July-03

DO NOT SCALE DRAWING

MATERIAL NO.

N/A

CHECKED BY:

MATL DESCRIPTION

N/A

TITLE

VIBRATION TEST STAND
PER SAE J577
(MORE ASSEMBLY)

GROTE INDUSTRIES, LLC
MADISON, INDIANA U.S.A.

SIZE

D

PART/DWG NO.

251942-01

REV:

F

SHT #

3 of 4

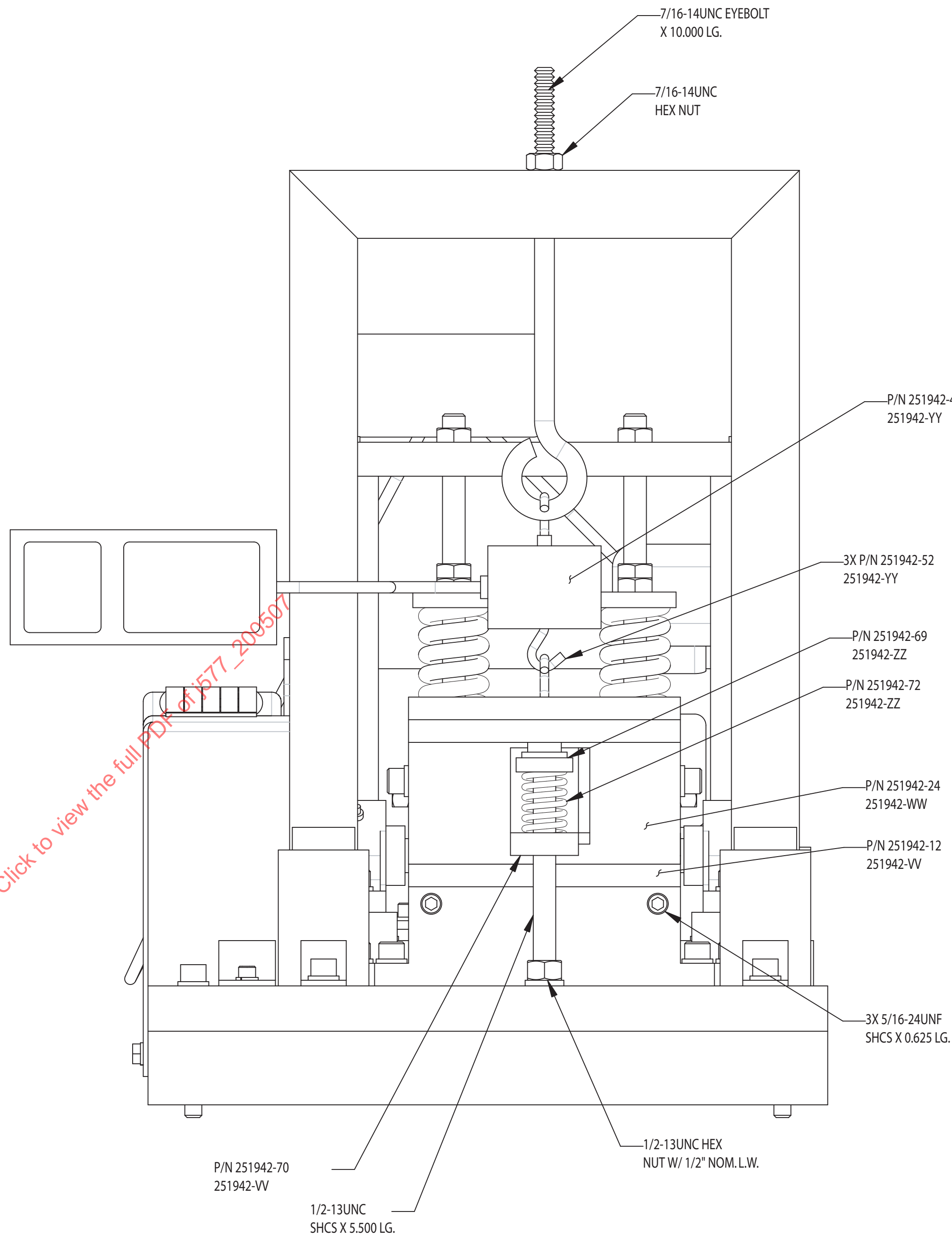
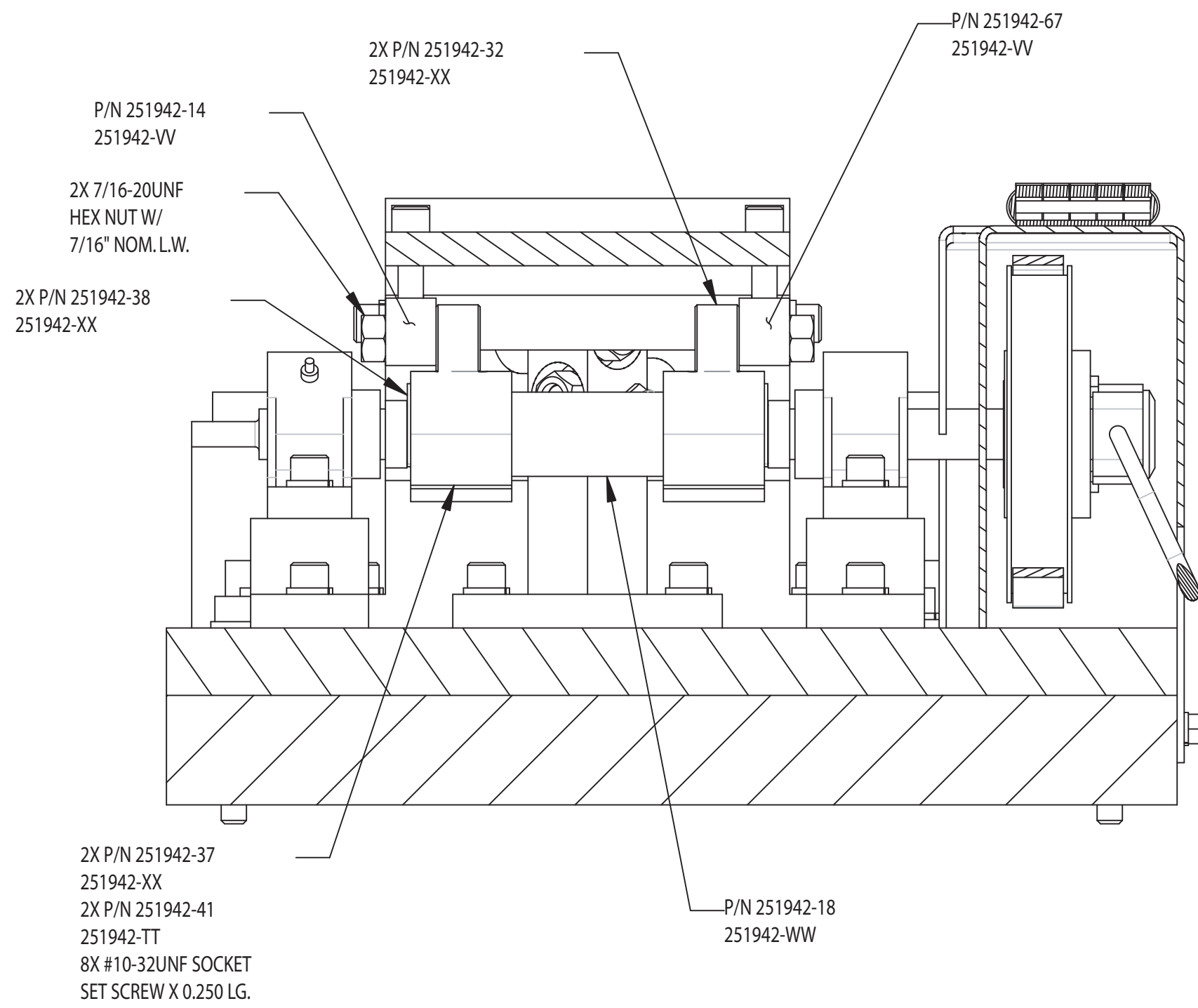
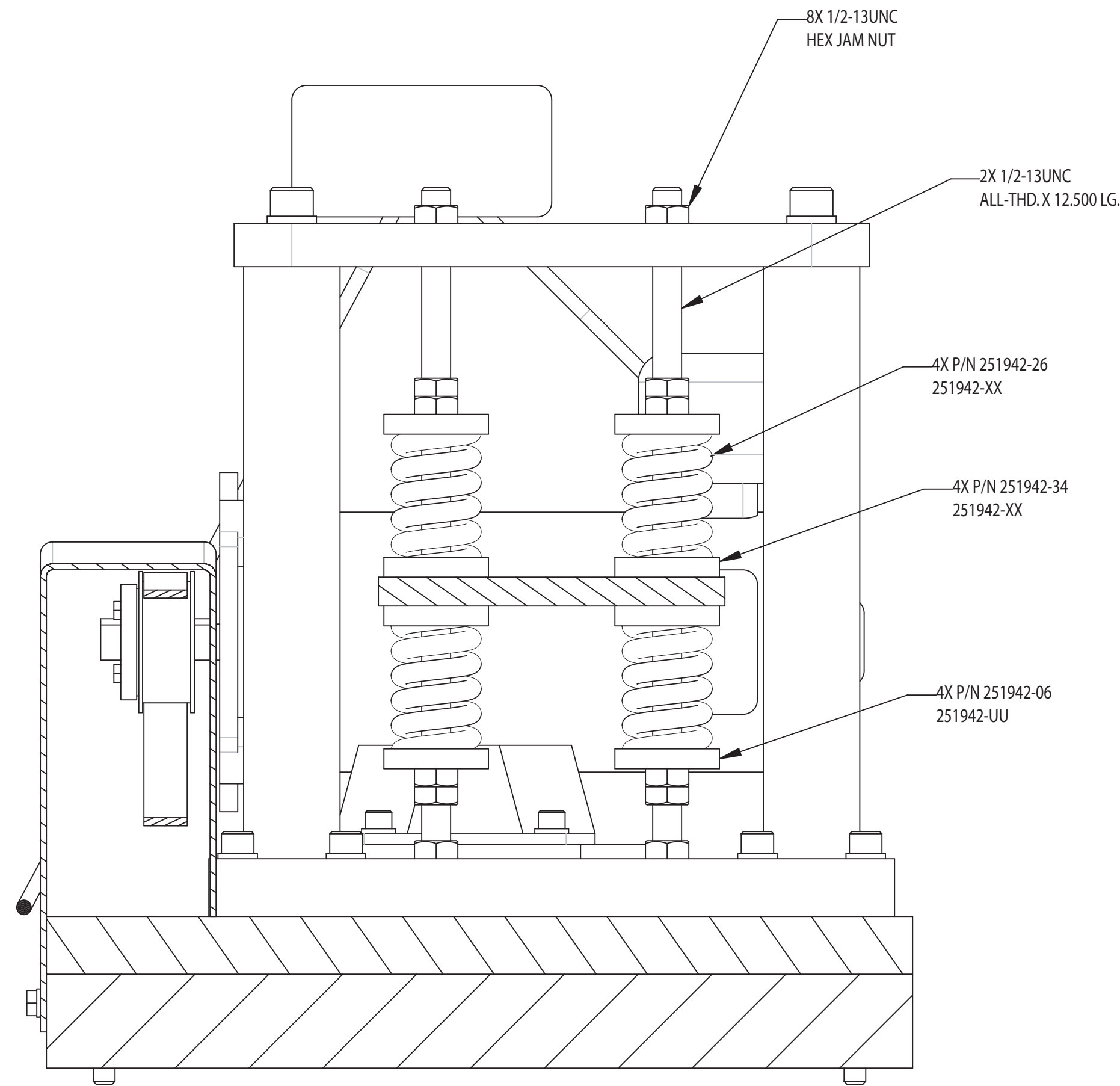
SYSTEM REV:

Rev'E 2001

3D DATA:

YES

FIGURE 16—VIBRATION MACHINE WITH CALIBRATION FRAME



- NOTE: (UNLESS OTHERWISE SPECIFIED)
- 1) SEE 251942-01 SHT.1 FOR BILL OF MATERIALS
 - 2) SEE 251942-01 SHT.2 FOR ASSEMBLY
 - 3) SEE 251942-01 SHT.3 FOR MORE ASSEMBLY
 - 4) SEE 251942-01 SHT.4 FOR SECTIONS & FRONT VIEW
 - 5) SEE 251942-TT FOR P/N 251942-41 (CAM DETAIL)
 - 6) SEE 251942-UU FOR WELDMENTS & SUB-ASSEMBLY'S
 - 7) SEE 251942-VV FOR WELDMENTS, SUB-ASSEMBLY'S, & PARTS
 - 8) SEE 251942-WW FOR PARTS
 - 9) SEE 251942-XX FOR PARTS
 - 10) SEE 251942-YY FOR PARTS
 - 11) SEE 251942-ZZ FOR PARTS

REV	DESCRIPTION	ENG APPL	ECN/ECO NO AND DATE
B	REDRAWN & UPDATED ON PROJE		251942 07/10/03
C	P/N 251942-18 - S8/63Rc STL WAS		251942 11/14/03
D	P/N 251942-37 - 0.250 x 0.360 WAS		251942 12/11/03
E	SEE SHEET 1		251943 12/22/03
F	SEE SHEET 1		251942 05/27/04

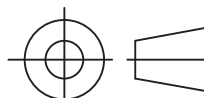
TECHNICAL INFORMATION DISCLOSED HEREIN IS THE CONFIDENTIAL PROPERTY OF GROTE INDUSTRIES, INC. AND IS ISSUED IN CONFIDENCE FOR ENGINEERING INFORMATION ONLY. IT MAY NOT BE REPRODUCED OR USED IN ANY WAY WITHOUT EXPRESS WRITTEN LICENSE FROM GROTE INDUSTRIES, INC.			
GCC DENOTES GROTE CONTROL CHARACTERISTIC		 THIRD ANGLE PROJECTION	
DR. BY:	G.SMITH	SCALE:	0.500 UNITS: IN
DATE:	11-July-03	DO NOT SCALE DRAWING	
MATERIAL NO.	CHECKED BY:		
MATL DESCRIPTION			
TITLE			
VIBRATION TEST STAND PER SAE J577 (SECTIONS & FRONT VIEW)			
		GROTE INDUSTRIES, LLC. MADISON, INDIANA U.S.A.	
SIZE	PART/OWG NO.	REV.	SHT #
D	251942-01	F	4 of 4
		SYSTEM REV: Proj/E 2001	3D DATA: YES

FIGURE 17—VIBRATION MACHINE CROSS SECTIONS