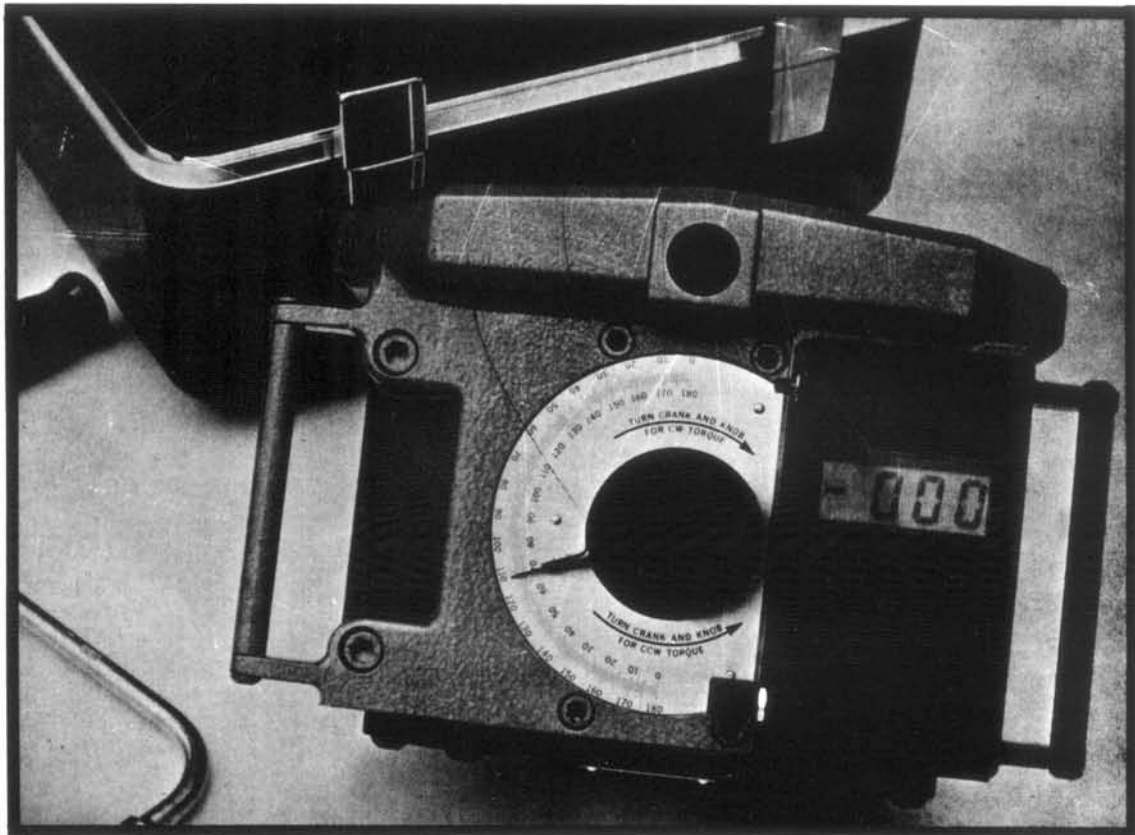


TECHNICAL MANUAL

ELECTRONIC TORQUE MULTIPLIERS

MODEL DPT-1200RWT [NSN 5120-00-169-2986]

MODEL DPT-1200R [NSN 5120-00-86]



CDI CONSOLIDATED DEVICES, INC.



19220 San Jose Avenue • City of Industry, California 91748 • Area Code (626) 965-0668 FAX (626) 810-2759

TECHNICAL MANUAL
OPERATION AND MAINTENANCE INSTRUCTIONS
for
ELECTRONIC TORQUE MULTIPLIERS
MODEL DPT-1200RWT [NSN 1200-00-169-2986]
MODEL DPT-1200R [NSN 5120-00-86]

Manufactured by:

CONSOLIDATED DEVICES, INC.

(SEE DPT-2500, NSN 5120-00-482-2543,

FOR 2500 FT-LB ELECTRONIC TORQUE MULTIPLIER)

UNITED STATES AND FOREIGN PATENTS PENDING

SECTION I

INTRODUCTION

1-1 GENERAL

This manual contains operating and maintenance instructions with a parts list for the Models DPT-1200R and DPT-1200RWT Electronic Torque Multipliers (NSN 5120-00-86 & 5120-00-169-2986) respectively. The CDI Multiplier (See Fig. 1) is designed and manufactured by Consolidated Devices, Inc., 19220 San Jose Avenue, P.O. Box 8830, City of Industry, California 91748, Telephone (818) 965-0668.

PURPOSE

The CDI Electronic Torque Multiplier allows the operator to apply high torque with little effort. Torque up to 1200 foot-pounds can be achieved by the Multiplier with an input of approximately 15 foot-pounds. This high-torque, low-input advantage is produced by a unique gear train providing a balanced output in either direction for as many full turns as necessary to reach the maximum output of 1200 foot-pounds.

1-3 SPECIFICATIONS FOR

Model DPT-1200R.....40 to 120 deg. F. Standard
Model DPT-1200RWT...-20 to 140 deg. F. Wide Temperature

Weight 20 pounds
Size (inches) 5-1/16 x 6-5/8 x 9-1/4
Input 3/8 inch (female square)
Output 3/8 inch (female square)
Torque Reaction Two 1/2" dia. pins on 3" centers
Range 0-1200 foot-pounds
Maximum Overload 1500 foot-pounds
Input Torque Approximately 15 foot-pounds
Gear Ratio 800 to 1
Output Accuracy(from 240 to 1200 ft.lbs +/- 2%
Resolution One (1) foot-pound
Calibration Frequent Use - Every 3 Months
IntervalsPeriodical Use - Every 6 Months
Battery 9-Volt
(Eveready 216 or NEDA 1604 or NI-CAD Rechargeable)
Wide Temperature Range.....-20 deg. F to +130 deg. F
Standard Temperature Range..+40 deg. F.to +120 deg. F



1-4 ITEMS FURNISHED

Each Electronic Torque Multiplier is supplied in a carrying case that serves as a storage container for the Multiplier when not in use. Also supplied is an input crank handle with 3/8" square drive and a 6-inch long, 3/4-inch square output drive.

1-5 SPECIAL TOOLS AND TEST EQUIPMENT

No special tools are required for maintenance of the Electronic Torque Multiplier. Calibration of the Multiplier can be accomplished with CDI-2000 or 3000PF Torque Testers and Tester Mount Adapter CDI 346-36, or per Technical Manual NAVAIR 17-20MU-09Q.

1-6 LIMITED WARRANTY

CDI Electronic Torque Multipliers are warranted for one (1) year from date of sale. If a Multiplier fails within the warranty period, and CDI is notified in writing, the unit will be repaired or replaced free of charge when returned to a CDI approved repair center. The customer is responsible for prepaying any transportation charges connected with service under this LIMITED WARRANTY. Contact CDI directly for location of approved repair centers.

This Limited Warranty is void if:

1. The Torque Multiplier has been damaged by accident, unreasonable use or neglect.
2. The purchaser or any other person, other than an authorized representative of CDI, has made any attempt to service or alter the unit prior to its delivery to a CDI representative in ways not specifically covered by this Technical Manual.

CDI shall not be liable for loss of product use or other incidental or consequential costs incurred by the purchaser or user of the Electronic Torque Multiplier, and all implied warranties are expressly excluded.

IMPORTANT NOTICE

CDI reserves the right to make changes in design or construction at any time without incurring any obligation in incorporating such changes in equipment previously sold. CDI cannot accept the responsibility for the results of using Torque Multipliers which have been abused, badly worn or not properly maintained as described in this Technical Manual.

1-7 DESCRIPTION

The Electronic Torque Multiplier utilizes a balanced worm gear train contained in a two-piece aluminum housing. A female input drive is located on the top front of the Multiplier with a female output drive through the center of the unit. Torque is measured by a reaction plate (torque sensing) fitted at the back of the Multiplier. The torque is displayed by a digital indicator mounted on the front. The battery powered indicator provides easy reading of torque from zero to 1200 foot-pounds in either direction with a resolution of one foot-pound.

NOTE: The sensitivity of the electronics is such that torque changes as small as 1/2 foot-pound can be read. Therefore, critical bolt relaxation is accurately detected. The reaction plate (torque sensing) is mounted on two pins in the rear of the housing and is itself fitted with two pins to mate with suitable adaptors, chosen for particular applications.

1-8 PROTRACTOR

For measurement of fastener rotation, a protractor and pointer assembly are provided on the front of the Multiplier. The pointer is attached to the drive shaft collar to provide a read-out in degrees of output rotation in either direction when the drive is turned. To measure rotation, set pointer to appropriate zero graduation before the torque is applied.

1-9 REACTION BAR AND ADAPTORS

The reaction bar is an adjustable, three piece unit that can be used to provide reaction torque up to 1200 foot-pounds in most applications. It is provided with two extensions. If a longer extension is required, use a tube or pipe of the required length.

When a reaction bar is used, make sure that the reaction pins of the Multiplier are properly seated and the shoulder bolts, which hold the reaction bar to the Multiplier, are properly fastened.

There are several versions of reaction adaptors available for different applications. Consult the factory for your specific needs.

1-10 MODELS

The Multiplier is available in two temperature ranges:

- o Model No. DPT-1200R.....+40 to +120 deg. F.
- o Model No. DPT-1200RWT.....-20 to +130 deg. F.

1-10 MODELS (Cont'd)

Both models are strong, durable and accurate. The ratchet permits fast alignment. For clockwise (CW) or right-hand (RH) torque (with counter-clockwise (CCW) ratcheting), turn the ratchet reversing ring on the face of the Multiplier in the clockwise (CW) direction. For counterclockwise (CCW) or left-hand (LH) torque (with clockwise (CW) ratcheting, turn the ring in the counterclockwise (CCW) direction. Selection between the standard and wide temperature models depends on the operating temperatures to be encountered under field conditions.

SECTION II

SAFETY PRECAUTIONS

2-1 SAFETY

Normal safety precautions must be taken in using the Electronic Torque Multiplier. Statements regarding personal safety and proper tool use are found throughout this Technical Manual.

2-2 DAMAGE TO EQUIPMENT

The output square drive supplied with the Electronic Torque Multiplier is designed to twist below torque levels that would damage the unit. NOTE: THE SQUARE DRIVE IS SUSCEPTIBLE TO FATIGUE. IT IS THEREFORE RECOMMENDED THAT THE SQUARE DRIVE BE REPLACED AFTER THE FOLLOWING NUMBER OF APPLICATIONS AT THE LISTED TORQUE LEVELS:

1200 foot-pounds	1000 applications (cycles)
900 foot-pounds	2000 applications (cycles)
600 foot-pounds	10,000 applications (cycles)
400 foot-pounds	
or less.....	Unlimited

As with any precision tool or instrument, care should be taken to stay within the design limits for torque values. Over-torquing beyond 1200 foot-pounds can result in serious damage to the gear train and/or the reaction plate (torque sensing). Potentially damaging side loading will be eliminated by use of the proper reaction adaptors.

NEVER USE AN IMPACT TOOL AS A POWER DRIVE. Powered nut runners may be used without damage provided caution is exercised to avoid overload.

Long periods of exposure to direct sunlight on the LCD (read-out window) will shorten the life of the LCD. When not in use, move Multiplier out of direct sunlight, or return Multiplier to carrying case and close the cover.

SECTION III

OPERATION

3-1 GENERAL

The Electronic Torque Multiplier applies torque through the mechanical coupling of a worm gear train. Force applied to the crank handle is transmitted through the gear train to the output drive. The reaction plate (torque sensing) is so mounted that when coupled to an adaptor, reaction forces are directed to the sensors, electronically converted to foot-pound units of measure and transmitted to the digital indicator on the face of the Multiplier.

3-2 RATCHETING (FOR DPT-1200R AND DPT-1200RWT)

Ratcheting models have six pawls--three for each direction of rotation to ensure even distribution of forces and proper self-centering of shaft.

The geometry of the pawls (Index No. 6 -- See pages 19 to 25 for Index Numbers) and their respective positions force the pawls into a self-lock engagement with the teeth of the gear hub (Index. No. 7).

The locking forces are directly proportional to torque to ensure a no-slip condition at any load.

To change the ratcheting direction, the pawls must first be unlocked to allow the full rotation of the reversing ring (Index No. 10).

The following procedure should be used under these conditions:

a) Unit not engaged with fastener.

Insert the 3/4 inch square output drive into the center female square. Hold the drive with one hand while turning the reversing ring with the other. Apply a slight twist to the drive to unlock the pawls in opposite direction of the ring's rotation. The ring will snap in place. The slot on the ring will line up with corresponding slot on shaft.

b) Unit engaged with fastener (reaction pins seated, drive engaged with socket).

Crank handle from load (if any) to no-load position. "000" should appear in window of read-out. Continue cranking while rotating the reversing ring. The continued cranking will unlock the pawls and the ring will freely snap into proper position - the slot on the ring will line up with the corresponding slot on shaft.



3-2 RATCHETING (FOR DPT-1200R AND DPT-1200RWT) - (Cont'd)

NOTE: Ratchet can only be reversed in no-load position and only when applying the procedures explained above.

The ratchet cannot be reversed if any load is exerted on the Multiplier. This feature is designed for added safety to prevent accidental release of load.

The Multiplier will deliver torque (in either direction) but will not ratchet with the ring not properly aligned. (For example, when the slots are not lined up).

3-3 OPERATION SEQUENCE

The following operation sequence is common to both models:

1. Before use, turn on power by pushing the ON/OFF Power Switch. A "000" should appear in the window of the digital display. If any value other than "000" appears, turn the Zero Adjust Knob until "000" is displayed. The Multiplier is now ready for use. (See Note on Page 8).
2. To operate, simply place socket and adaptor over fastener to be torqued. Insert square drive through the Multiplier and align with socket.
NOTE: IF THE RATCHET REVERSING RING IS TURNED IN WRONG DIRECTION THE UNIT WILL NOT TORQUE THE FASTENER. SIMPLY TURN THE RING IN OTHER DIRECTION. (SEE INSTRUCTIONS UNDER 3-2 ABOVE).
3. With the square drive and reaction pins seated, crank the input handle clockwise for right-hand torquing and counterclockwise for left-hand torquing. Clockwise and counterclockwise torque register in foot-pounds. A minus sign indicates counterclockwise direction. NOTE: THE OPERATOR MAY TORQUE FASTER THAN THE ELECTRONICS CAN RESPOND. TO CORRECT THIS TEMPORARY CONDITION, STOP CRANKING 20 - 40 FOOT-POUNDS BELOW DESIRED TORQUE. RELEASE THE CRANK MOMENTARILY AND ALLOW THE DIGITAL DISPLAY TO CATCH UP. CONTINUE CRANKING AT SLOWER SPEED AND SHORTER INCREMENTS. THE FINAL TORQUE READING WILL ONLY BE AT RATED ACCURACY WHEN THE FORCE ON THE CRANK IS COMPLETELY RELEASED. THE MULTIPLIER WILL NOT "UNWIND" WHEN CRANK IS RELEASED.
4. If fastener is over-torqued, back off the crank until display reads "000", reverse ratchet (see instructions under 3-2 above) and loosen the fastener. Reverse ratchet again and re-tighten the fastener to desired torque.

3-3 OPERATION SEQUENCE (Cont'd)

5. When the desired torque has been obtained, pause to check for fastener relaxation. The read-out will immediately show any loss of torque. Re-tighten, if necessary, until fastener no longer shows relaxation.
6. To remove the Multiplier, back-off on the crank until the display reads "000". The adaptor and socket can then be easily removed.
7. Turn off the power when not in use.

NOTE: In all cases in this Manual where "000" is mentioned for the display, either "000" or "-000" would be correct displays in the no-load condition.

SECTION IV MAINTENANCE

4-1 TROUBLESHOOTING

The Electronic Torque Multiplier is designed to provide maintenance-free, lifetime operation when properly used. Occasionally, production tools are misused or subjected to a condition which may cause damage requiring repair. Table 4-1 provides a list of the most common indications of trouble, the probable causes, and the suggested remedies.

TABLE 4-1 Troubleshooting Chart

<u>TROUBLE</u>	<u>PROBABLE CAUSE</u>	<u>REMEDY</u>
1. Excessive input force (more than 15 ft.-lbs) required to obtain maximum torque output (1200 ft.-lb.). Rough or erratic input crank.	Damaged or worn gears or bearings.	Replace faulty parts. See assembly-disassembly procedure below.
2. Ratchet mechanism won't turn.	Ratchet resetting ring improperly set.	Reset ring.
	Damaged spline pawls or springs due to overload.	Replace faulty parts. See assembly-disassembly procedure below.
3. Multiplier generates torque but there is no reading on indicator.	Battery exhausted.	Replace battery.
	Broken wire.	Replace faulty parts. See assembly-disassembly procedure below.
4. Multiplier won't produce torque.	Output gear teeth destroyed; usually due to abuse or applying excessive load.	Replace faulty parts. See assembly-disassembly procedure below.
	Ratchet improperly set.	Reset ratchet ring properly.
5. Improper output reading.	Multiplier out of calibration.	Recalibrate Multiplier.
	Battery exhausted.	Replace battery. (See Section 4-7)

4-1 TROUBLESHOOTING (Cont'd)

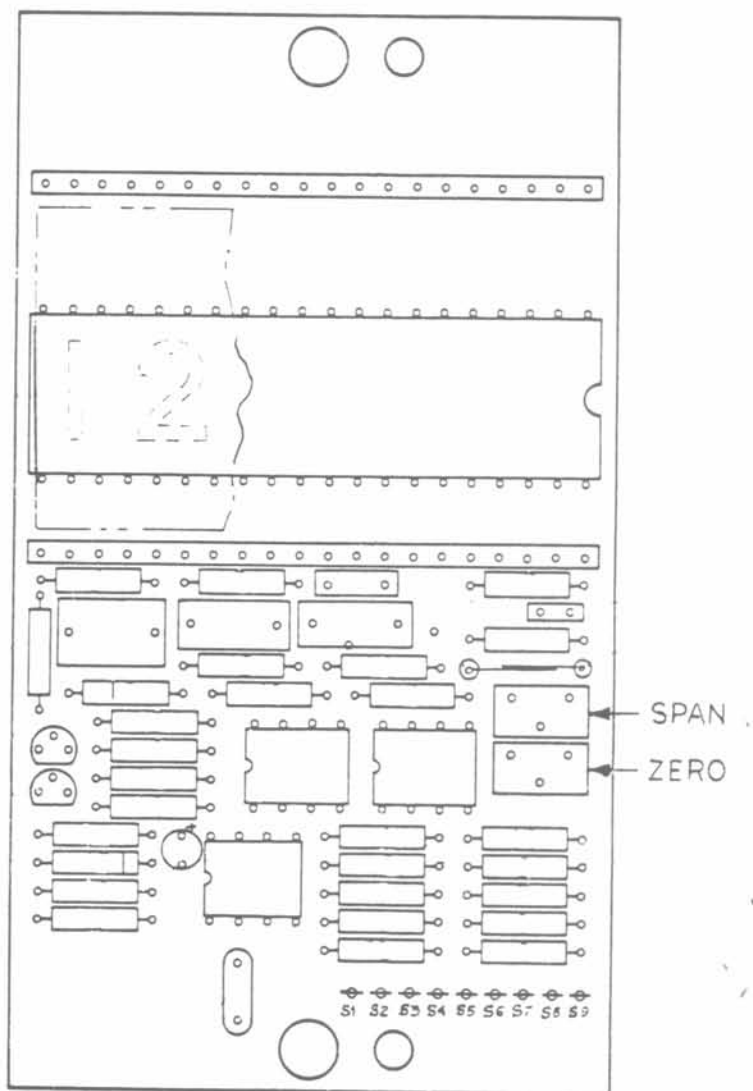
<u>TROUBLE</u>	<u>PROBABLE CAUSE</u>	<u>REMEDY</u>
6. Sudden drop of displayed torque.	Ratchet pawls not properly seated. Ratchet teeth destroyed due to excessive load.	Reset ratchet ring properly. Replace faulty parts. See assembly-disassembly procedure below.
7. Multiplier will not hold applied torque	Fastener is yielding or parts not fully seated.	Check for proper engagement. continue to apply torque until readings stabilize. If the fastener continues to yield, replace with higher strength fastener.
	3/4" square drive yielding.	Replace drive.

4-2 DISASSEMBLY PROCEDURE (Numbers in () refer to Index Nos. on pages 19-25)

NOTE: IF THE DISASSEMBLY OR ASSEMBLY PROCEDURE IS NOT CLEAR, CONSULT FACTORY PERSONNEL FOR ASSISTANCE. THE DISASSEMBLY AND ASSEMBLY OF THE UNIT MUST BE DONE BY A QUALIFIED TECHNICIAN USING THE PROPER EQUIPMENT. OTHERWISE, RETURN UNIT TO FACTORY FOR REPAIR.

If, due to trouble, it becomes necessary to replace any internal part, use the following procedure:

1. Set Multiplier down with read-out indicator facing up.
2. Remove electronic box (54).
3. Remove circuit board (57) and lay it aside, taking care not to pull on wiring harness.
4. Remove protractor pointer assembly (23).
5. Remove six end-plate screws to free input housing (14).
6. Remove top cover screws (29).
7. Remove top housing (16) slowly. Use extreme caution not to pull on wiring harness. Separate housings only as far as the wiring length allows.
8. If qualified repair person is available, disconnect the wires from the nine "S" terminals on the circuit board by carefully applying heat to the solder terminals. (See Figure 3, page 11).



Printed Circuit Board Components

Fig. 3

Black Wire - Battery to	S 1
Red Wire - Battery to Switch to	S 2
Blue Wire - Sensor Plate to	S 3
Green Wire - Sensor Plate to	S 4
Gray Wire - Sensor Plate to	S 5
Violet Wire - Sensor Plate to	S 6
Yellow Wire - Potentiometer (side pole) to . .	S 7
White Wire - Potentiometer (center pole) to . .	S 8
Orange Wire - Potentiometer (side pole) to . .	S 9

4-2 DISASSEMBLY PROCEDURE (Cont'd)

9. Examine all internal parts and replace any worn or damaged parts.

4-3 ASSEMBLY PROCEDURE

Clean all parts per 4-4 below before assembly.

1. Install "O" Rings (31).
2. Install bottom tapered bearing set (32).
3. Install ratchet assembly (RTA-1).
4. Install output wheel (1).
5. Install input worm gear (60) and assembly.
6. Install left input wheel (44) and right worm gear (41) and assembly. Rotate the input worm gear until the keyway of the worm gear shaft is facing straight up.
7. Install right input wheel (61) and right worm gear (41) and assembly. Keyway of the worm gear shaft (41) must also face straight up. When assembled, the output gear (1) may have to be lifted up slightly.
8. Apply lubricant (See 4-6).
9. You are now ready to close housing. Continue to exercise caution not to pull too hard on wiring harness or to pinch wiring when closing both halves of the housing.
10. Solder wires to nine "S" terminals (see description under Fig. 3) if they were disconnected. Slide the four wires from sensor beam through the hole provided in housing and assemble top and bottom housing (16 & 37).

4-4 CLEANING

Always clean the exterior of the Electronic Torque Multiplier after each use and prior to returning it to its carrying case.

If the Multiplier must be disassembled for maintenance, after establishing the malfunctioning mechanism, wash all parts in an appropriate solvent.

CAUTION: DO NOT WASH ELECTRONICS OR REACTION PLATE (TORQUE-SENSING) IN SOLVENT OR ANY OTHER LIQUID CLEANER.

4-4 CLEANING (Cont'd)

Clean corners, grooves and threads. After cleaning, dry all parts with a clean cloth.

Inspect to make sure all parts are free of dirt and corrosion.

4-5 INSPECTION

After cleaning, inspect all parts for obvious signs of damage. Spin bearings by hand and listen for noise that could indicate the presence of dirt or excessive wear. Replace any parts that cannot be properly serviced.

If it becomes necessary to disassemble the electronic package, remove the two screws (53). Lift off cover very carefully. Remove two screws (56) and printed circuit (PC) board (57) will be free of the Multiplier. It will, however, be attached to the Multiplier by the wiring harness. If it becomes necessary to remove the wiring from the PC board, refer to Figure 3 for reassembly. THIS WORK MUST BE DONE BY A QUALIFIED TECHNICIAN USING PROPER EQUIPMENT. OTHERWISE, SEND TO FACTORY FOR REPAIR.

4-6 LUBRICATION

NOTE: DO NOT APPLY ANY LUBRICANT TO REACTION PLATE (TORQUE-SENSING) OR ELECTRONICS.

After cleaning and inspection, and prior to reassembly, repack all bearings with grease (Mobilux EP#2, or equivalent). Apply a light coating of machine oil to internal parts except for electronics and reaction plate (torque-sensing). With the worm shafts and gears installed in rear section of the housing, apply a liberal coating of grease (Mobilux EP#2, or equivalent) to all internal parts prior to installing the bearing mount cover and reassembling the two sections of the housing.

4-7 BATTERY REPLACEMENT

If the battery output drops below 6.5 volts, the low battery indicator will immediately appear. The display will read "LO BAT". Battery must be replaced.

The low battery indicator should be monitored closely. Always use a fresh battery before attempting any repairs.

4-7 BATTERY REPLACEMENT (Cont'd)

To change the battery, remove the two screws from the cover (46) marked "Battery" (found on the right side of the Multiplier). Pull battery from housing, using care not to exert too much force on the wiring harness. Unclip dead battery and replace with a fresh, 9-volt battery. (See 1-3 for specifications).

SECTION V

CALIBRATION

5-1 CALIBRATION PRE-CHECK

The Electronic Torque Multiplier must be calibrated prior to use after overhaul or maintenance. The Multiplier should also be checked for calibration at regular six month intervals, or more frequently if required. (See Specs. 1-3).

Before calibrating the Torque Multiplier install a fresh battery and carefully check the working parts for signs of damage. If damage is noted, repair or replace defective parts as necessary.

The adjustments on the electronic indicator are limited to two (2) potentiometers - ZERO and SPAN (See Fig.3, Pg. 11). No adjustments should be made in the field. If an out-of-tolerance condition is noted in the field, the unit should be sent to a calibration facility equipped with a suitable torque tester and Calibration Standard NAVAIR 17-20MU-09Q or equivalent, certified to the required accuracy.

5-2 CALIBRATION PROCEDURE

1. Turn on the power and note the reading with no torque applied. If the reading is not "000", adjust the Zero potentiometer with the Zero Adjustment Knob until a reading of "000" count is achieved.
2. Mount the unit on the calibration stand, making sure that the drive and reaction pins are firmly engaged with the pins seated in the torque tester reaction slots. Use Navy Calibration Standard NAVAIR 17-20MU-09Q or equivalent.
3. Set the ratchet for clockwise torquing (if Model DPT-1200R is used). Apply 1200 foot-pounds torque in clockwise direction. Turn the crank back to a zero reading on the tester. Check the "000" display as the tester reaches exact zero. Adjust display zero if necessary. Remove the digital display box (54) after removing two screws (53). Torque the Multiplier to 800 foot-pounds while observing the tester readings. Stop torquing as tester indicates the exact torque. Set digital display to "800" (if necessary) by slightly turning SPAN screw. Repeat this procedure a few times if necessary. The moment the Multiplier and tester readings coincide within 0 - 5 foot-pounds, the Multiplier should be in calibration in both directions.

5-2 CALIBRATION PROCEDURE (Cont'd)

4. Reduce the torque to "000" and take a set of readings at 20, 25, 50, 75 and 100 percent of the range in the clockwise direction. Repeat in the counterclockwise direction. The readings must be within $\pm 2\%$ of the indicated value between 20 to 100 percent of full range. At this time observe the digital display readings and compare with those of the tester.
5. If the readings taken are not within the specified accuracy, repeat step 3 by adjusting the SPAN up or down as necessary. NOTE: IT SHOULD NEVER BE NECESSARY TO ADJUST THE INTERNAL ZERO ADJUSTMENT.
6. Check "000" display reading every time the Multiplier is at no load and adjust if necessary.
7. If the readings, taken as explained under step 4 above, are within tolerance, reduce torque to "000" or no load, turn off power and reassemble the digital display box.

NOTE: All Multipliers are certified and guaranteed to be within $\pm 2\%$ accuracy from 20% to 100% of full range. Multipliers with greater accuracy over a larger range are available on request. However, unless specially certified, no Multiplier is guaranteed for $\pm 2\%$ accuracy below 240 foot-pounds.

DPT 1200



CALIBRATED BY:

19220 San Jose Street
City of Industry, California 91748

Phone (818) 965-0668

S/N

INSPECTOR

DATE _____

Certificate of Accuracy

THIS CERTIFIES THAT THE SUBJECT DEVICE WAS CALIBRATED ON CERTIFIED TORQUE TESTING EQUIPMENT THAT HAS BEEN CALIBRATED WITH WEIGHTS AND MEASURES TRACEABLE TO AND COMPLYING WITH NATIONAL BUREAU OF STANDARDS (NBS) SPECIFICATIONS

TESTER USED

SPECIFIED ACCURACY FOR NSN

S/N

DATE CERTIFIED _____

± 2% FROM

To

FOOT-POUNDS

[illegible]

STANDARDS USED ARE TRACEABLE TO THE NATIONAL BUREAU OF STANDARDS THROUGH N.B.S. TEST NO.

SECTION VI**PREPARATION FOR RESHIPMENT OR STORAGE****6-1 HANDLING**

For reshipment or storage of the Electronic Torque Multiplier, clean and place in carrying case. Package the cased Multiplier in a suitable carton before shipping or placing in storage for lengthy periods. To prevent damage from moisture, it is advisable to wrap the carton in moisture-proof paper and add desecant packets to the carrying case.

When returning the Multiplier to Consolidated Devices, Inc., or an approved repair center, attach a tag indicating the trouble.

SECTION VII

PARTS LIST (Dimensions in Inches)

<u>INDEX NO.</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>NO. REQ'D</u>
1	395-41	Wheel, Output	1
2	395-16	Pawl Retainer	1
3	395-18	Spring, Pawl	6
6	395-17	Pawl	6
7	395-42	Gear Hub	1
10	395-23	Reversing Ring	1
11	395-54	Ring, Spirolox	1
12	10-142	Drive Screw	13
13	395-27	Nameplate	2
14	10-255-1	Button Hd. Soc. Cap Screw 1/4-20x3/4 (end plate)	12
15	395-20	End-Plate	1
16	395-1	Housing, Input	1
17	10-225-2	Button Hd. Soc. Cap Screw 10-32x5/8 (handle)	4
20	395-36	Handle (crank)	1
23	395-11	Ring, Pointer	2
24	395-32	Tip, Pointer	1
25	395-28	Drive (3/4 sq.)	1
26	10-105-6	Spring (3/4 drive)	1
27	395-26	Protractor	1
28	10-168-5	Socket Hd. Cap Screw 1/4-20x1-5/8	4
29	10-168-6	Socket Hd. Cap Screw 5/16-18 x 1-1/2	4
30	395-19	Handle, Housing	2

PARTS LIST (Cont'd)

<u>INDEX NO.</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>NO. REQ'D</u>
31	395-21-3	"O" Ring	2
32	395-4	Tapered Bearing Set	2
33	10-102-13	Dowel Pin (Housing)	2
34	10-128-5	Hex Soc. Fl. Hd. Screw 8-32 x 3/8 (cover sensor)	8
35	395-25	Cover (Torque Sensing)	1
36	395-66	Reaction Plate (Torque Sensing)	1
37	395-2	Housing, Output	1
38	395-8-1	Bushing	1
39	395-6	Ball Thrust Bearing	4
40	395-7	Radial Bearing	4
41	395-14	Worm, Output	2
42	395-22	Ring, Truarc	2
43	395-15	Key	2
44	395-13-1	Wheel, Input L.H.	1
45	10-126-6	Pan Hd. Mach. Screw 4-40 x 1/4 (battery cover)	2
46	395-30	Cover, Battery	1
47	81-6	Battery - 9-Volt	1
48	81-37	Battery Plug - 9-Volt	1
49	395-21-1	"O" Ring	1
50	395-53	Potentiometer	1
51	10-106-7	Ball (3/4 drive)	1
52	395-39	Window, Read-out Box	1
53	10-128-12	Hex Soc. Fl. Hd. Screw 8-32 x 7/8 (read-ot box)	2

PARTS LIST (Cont'd)

<u>INDEX NO.</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>NO. REQ.</u>
54	395-29	Box, Read-out	1
55	395-55	Switch, Pushbutton	1
56	10-110-1	Rd. Hd. Mach. Screw 4-40 x 1/4 lg. (PC Board)	2
57	395-45	PC Board/Components	1
58	395-10	Race, Thrust Bearing	4
59	395-9	Needle, Thrust Bearing	2
60	395-12	Worm, Input	1
61	395-13-2	Wheel, Input R.H.	1
63	395-46	Adapter, Navy	1
66	10-106-5	Ball (0.156 dia.)	1
67	10-105-3	Spring	1
68	10-101-25	Set Screw, Socket	1
87	TRB 1200	Reaction Bar Assembly (includes 69,70,71,72 (2))	1
69	395-76	Bar, Extension Reaction	1
70	395-72	Tube Extension	1
71	395-71	Plate and Bar Reaction Assembly	1
72	395-68	Shoulder Screw Assembly	2
73	395-73	Knob, Potentiometer	1
74	10-101-39	Soc. Set Screw 4-40 x 1/8	2
84	395-80	Spline Drive	1
85	10-102-12	Soc. Set Screw 10-32 x 5/16	1
86	395-8-2	Bushing	1

PARTS LIST (Cont'd)

<u>INDEX NO.</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>NO. REQ'D</u>
RTA-1 RATCHET ASSEMBLY CONSISTING OF:			
2	395-16	Retainer, Pawl	1
3	395-18	Spring, Pawl	6
6	395-17	Pawl	6
7	395-42	Gear Hub	1
10	395-23	Ring, Reversing	1
11	395-54	Ring, Spirolox	1
66	10-106-5	Ball (.156 dia)	1
67	10-105-3	Spring	1
68	10-101-25	Socket Set Screw 10-32 x 1/8	1
GRA-1 GEAR ASSEMBLY (6 GEARS) CONSISTING OF:			
60	395-12	Worm, Input	1
44	395-13-1	Wheel, Input	1
61	395-13-2	Wheel, Input	1
41	395-14	Worm, Output	2
1	395-41	Wheel, Output	2
43	395-15	Key	1
HDA-1 HOUSING ASSEMBLY CONSISTING OF:			
14	10-225-1	Button Hd. Soc. Cap Screw 1/4-20 x 3/4	12
15	395-20	End Plate	1
16	395-1	Housing, Input	1
17	10-225-2	Button Hd. Soc. Cap Screw 10-32 x 5/8	4
30	395-19	Handle, Housing	2
34	10-128-5	Hex Soc Fl. Hd. Screw 8-32 x 3/8	8
35	395-25	Cover, Reaction Plate Torque Sensing	1
37	395-2	Housing, Output	1
ELA-1 MEASURING DEVICE ASSEMBLY (DIG. READOUT ASSY.) CONSISTING OF:			
50	395-53	Potentiometer	1
53	10-128-12	Hex Soc. Fl. Hd Screw 8-32 x 7/8	2
54	395-29	Box, Readout	1
55	395-55	Switch, Pushbutton	1
56	10-110-1	Rd. Hd. Mach. Screw 4-40 x 1/4	2
57	395-45	P.C. Board	1
73	395-73	Knob. Potentiometer	1
74	10-101-39	Soc. Set Screw 4-40 x 1/8	2

PARTS LIST (Cont'd)

<u>INDEX NO.</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>NO. REQ'D</u>
RTA-1 RATCHET ASSEMBLY CONSISTING OF:			
84	395-80	Spline Drive	1
10	395-23	Ring, Reversing	1
85	10-101-2	Soc. Set Screw 10-32 x 5/16	1
TRB-1 ADJ. TORQUE REACTION BAR CONSISTING OF:			
69	395-76	Bar Extension, Reaction	1
70	395-72	Tube, Extension	1
71	395-71	Plate and Bar Reaction Assembly	1
72	395-68	Shoulder Screw Assembly	2
RPA-1 REACTION PLATE (TORQUE SENSING) ASSEMBLY			
36	395-66	Reaction Plate (Torque Sensing)	1
ADA-1 3/4" SQUARE DRIVE ASSEMBLY			
25	395-28	Drive (3/4 square)	1
26	10-105-6	Spring (3/4 drive)	1
51	10-106-7	Ball (3/4 drive)	1
CHA-1 CRANK HANDLE ASSEMBLY			
20	395-36	Handle (Crank)	1

