

# Computer Sports Medicine, Inc., (CSMi)

## NORM™ TESTING AND REHABILITATION SYSTEM

### PARTS & SERVICE MANUAL

for

CYBEX NORM™ Manufactured from 1995 to 2003  
CSMi NORM™ Manufactured from 2003 to Present

This manual covers the original CYBEX NORM manufactured by CYBEX International, NY 1995 - 1997 CYBEX Medical, a Division of Henley Healthcare, TX from 1998 to 2003. The only changes made to this manual from the original manual are references to company contact information.

CSMi acquired the CYBEX NORM product line in 2003. CSMi manufactures and markets the CYBEX NORM as the HUMAC NORM. For service and parts for a CYBEX NORM updated with HUMAC or a new HUMAC NORM see the HUMAC NORM Service & Parts Manual.

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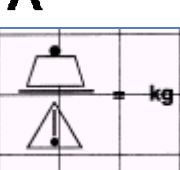



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## IMPORTANT INFORMATION





### Qualified Personnel Notice

**WARNING:** The NORM System contains no user serviceable parts. Installation, Assembly and Repair of the NORM Testing & Rehabilitation System should only be performed by qualified service personnel.

### Labels

Symbol	IEC Publication	Description
	417-5032	Alternating Current
	417-5019	Protective earth (ground)
	417-5017	Earth (ground)
	348	Attention, consult accompanying documents
	417-5008	Off (power: disconnection from the mains)
	417 - 5009	Stand-by
	417-5007	On (power: connection of the mains)
	417-5265	“Off” (only for a part of equipment)
	417-5264	“On” (only for a part of equipment)
	417-...878-02-02	Type B applied part
	60601-2-38	Weight Limits on support parts
	878-5110	Emergency Switch
	ISO 7000-1641	Operator should optionally refer to the accompany documents for additional advice.
	60878	Operator must refer to the accompany documents for additional advice.

## IMPORTANT INFORMATION

Symbol	IEC Publication	Description
		WEES directive
		Temperature Limits
		Humidity Limits
		Pressure Limits

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### SECTION 1. OVERVIEW

#### OVERVIEW

This CSMi NORM Testing and Rehabilitation System Service and Parts manual has been designed as a reference tool and troubleshooting guide for both service technicians and owners of the CSMi NORM system. Specific part number and assembly information for the major mechanical and electronic subsystems are provided.

The manual assumes that an initial installation of the CSMi NORM System has already taken place. If it has not, refer to the CSMi NORM Testing and Rehabilitation System Assembly and Installation Manual for detailed information on the initial assembly and check-out procedures.

For detailed information on patient setup procedures and software usage refer to the CSMi NORM Testing and Rehabilitation System User's Guide.

### MANUAL STRUCTURE

The chapters are divided into functional areas. The manual begins with a discussion of power and power-related topics and continues to electrical and mechanical part maintenance. At the back of this manual are a series of exploded view drawings and the list of replacement parts. A brief listing of each chapter follows.

#### SECTION 1. OVERVIEW

This chapter provides a general description of the CSMi NORM Testing and Rehabilitation System's major components and identifies specific maintenance areas covered in this manual.

#### SECTION 2. FIELD SERVICE BULLETINS

This chapter is reserved for Field Service bulletins. The bulletins are published whenever a service procedure has been updated.

#### SECTION 3. POWER

This chapter describes the power flow through the NORM System. Refer to this chapter for information on the Isolation Transformer, Servo Amp, to locate cables and to trace the power distribution.

#### SECTION 4. FUSES

This chapter locates the NORM System fuses and provides instructions on their replacement.

#### SECTION 5. JUMPERS

This chapter describes various jumper locations, their functions, and normal and optional settings.

#### SECTION 6. CABLES

This chapter describes the cables used in the NORM system and identifies the signal names and pin connections from cable to cable.

#### SECTION 7. ELECTRONICS MODULE

This chapter describes the computer components and devices that support the NORM System.

#### SECTION 8. DYNAMOMETER

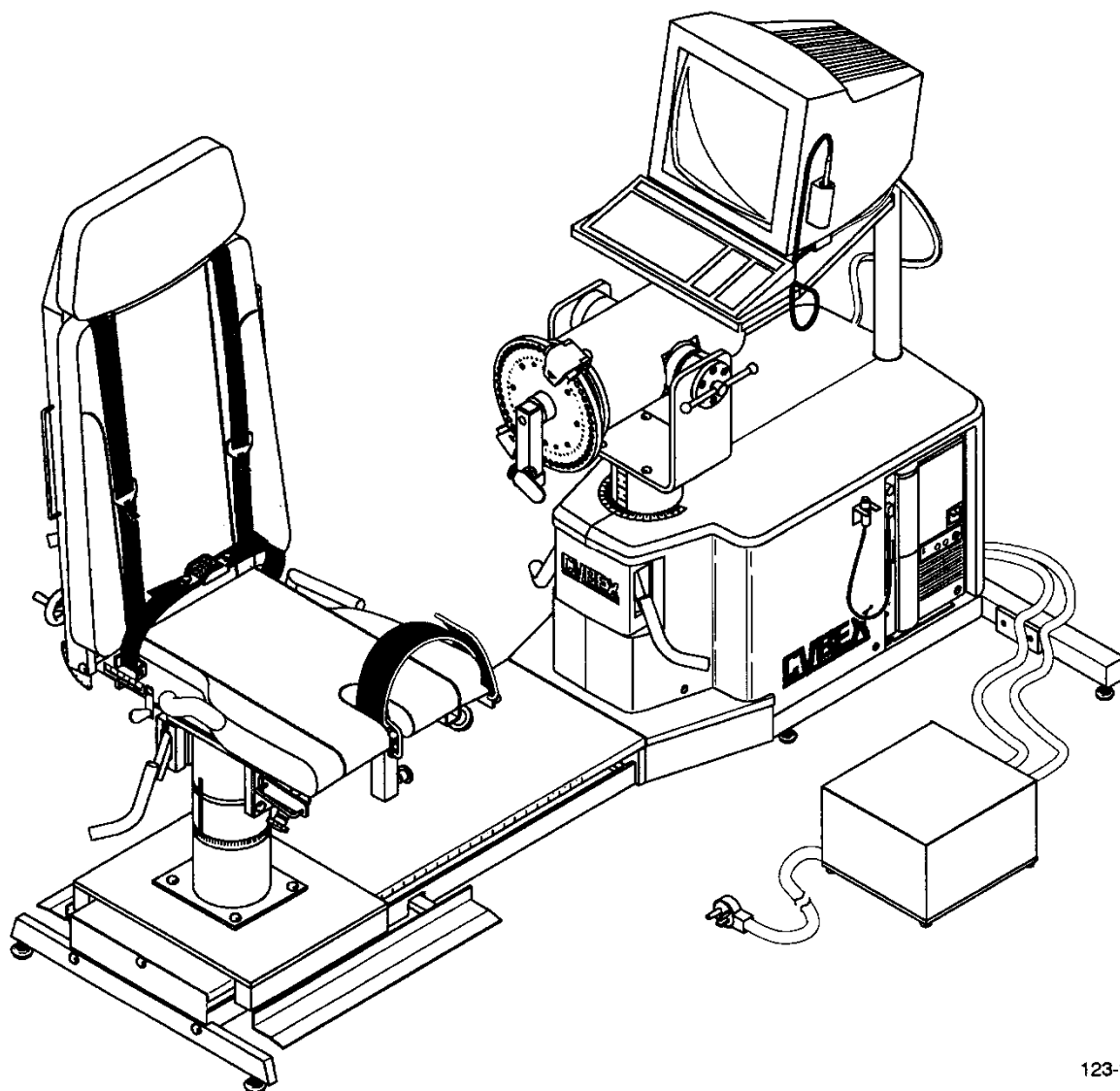
This chapter describes the procedures to remove the Dynamometer, its subassemblies, and the NDCB for testing and replacement. NDCB and Torque Board test point locations are also included in this chapter.

#### SECTION 9. PATIENT POSITIONING MODULE

This chapter describes corrective maintenance procedures for the Patient Positioning Module.

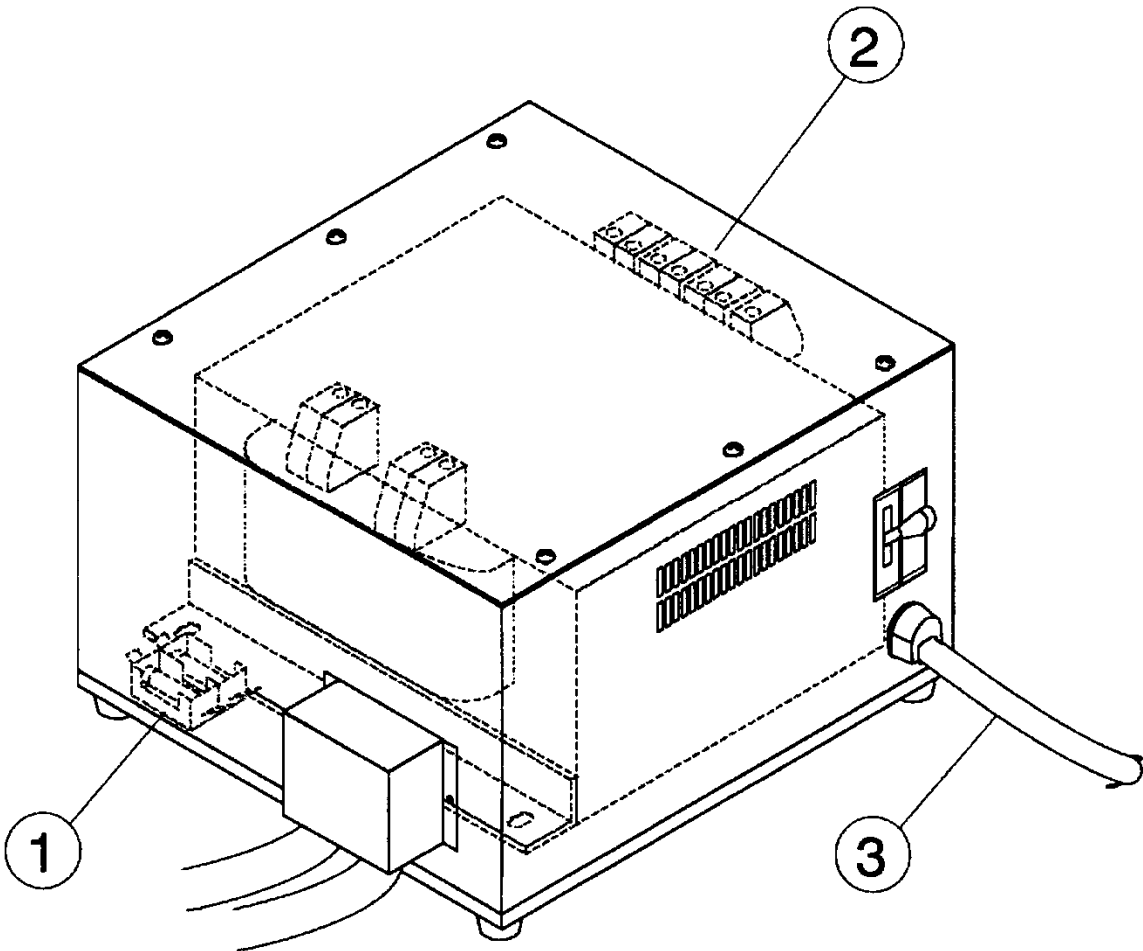
#### SECTION 10. REPLACEMENT PARTS

This chapter provides exploded view drawings and a list of replacement parts. Use these detailed diagrams, part numbers, and descriptions when requesting replacement parts.



123-1

Figure 1-1 NORM System



114-1F

Figure 1-2 Isolation Transformer Maintenance Directory



### ISOLATION TRANSFORMER MAINTENANCE

*Refer to Chapter 4 for:*

1. Isolation Transformer Fuse Removal / Replacement

*Refer to Chapter 5 for:*

2. Isolation Transformer Jumper Settings

*Refer to Chapter 6 for:*

3. Isolation Transformer Cable Diagrams

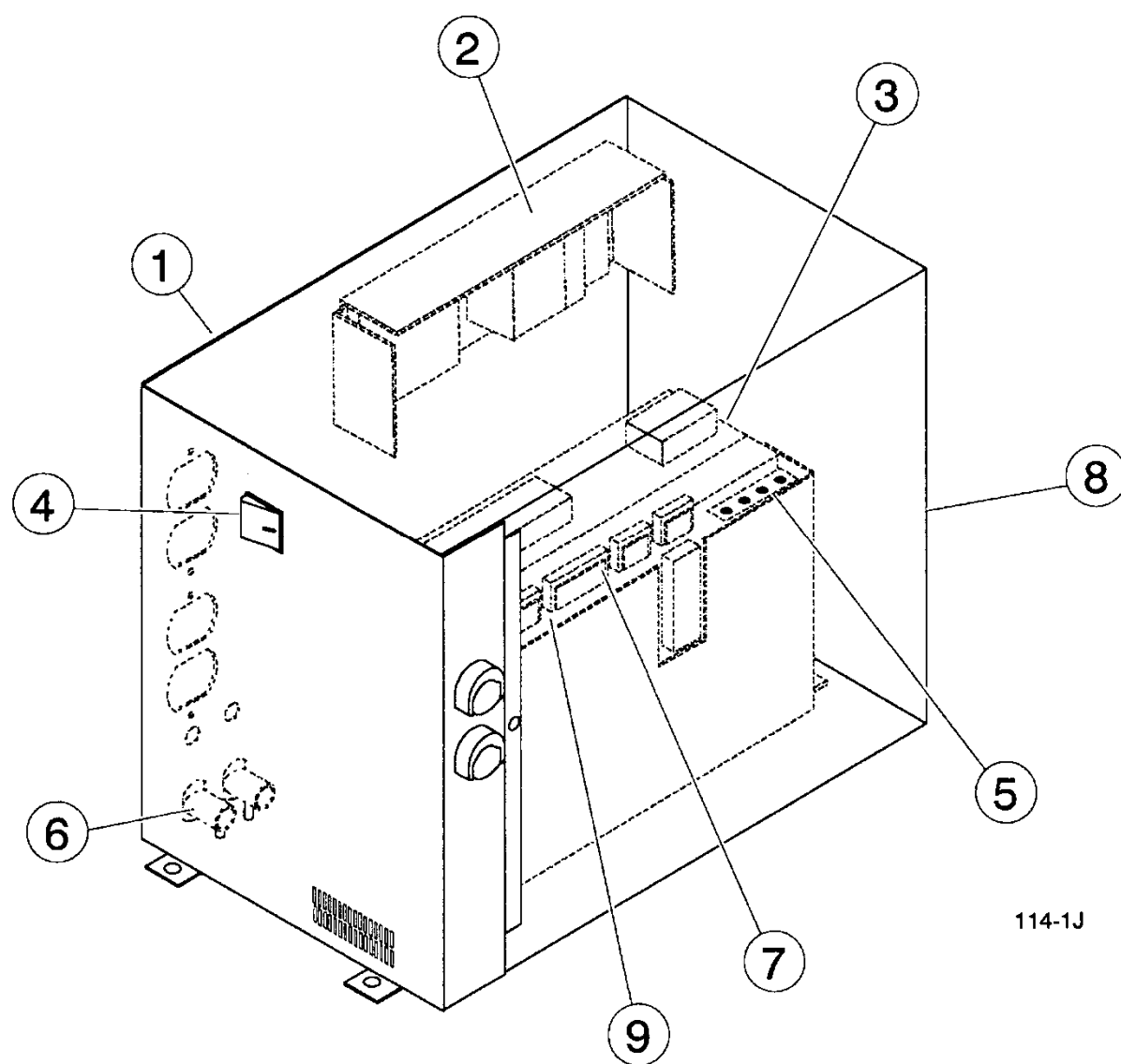


Figure 1-3 Servo Amp Box Maintenance Directory

### SERVO AMP BOX MAINTENANCE

*Refer to Chapter 3 for:*

1. Servo Amp Box Removal / Replacement
2. Servo Amp Power Supply Removal / Replacement
3. Servo Amp Removal / Replacement
4. Servo Amp Box (NORM System) Power On / Off
5. Servo Amp Box Controls and Indicators

*Refer to Chapter 4 for:*

6. Servo Amp Box Fuse Removal / Replacement

*Refer to Chapter 5 for:*

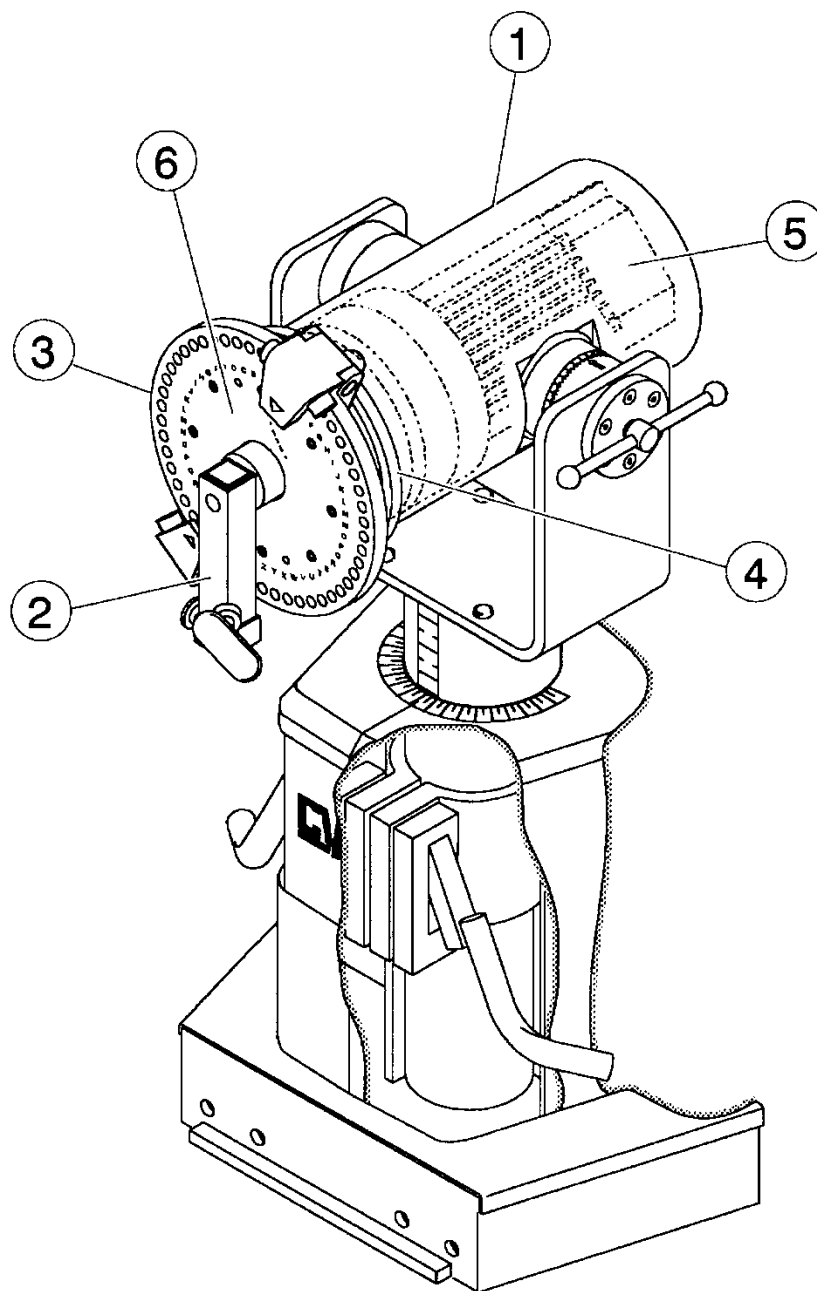
7. Servo Amp Box Jumper Settings

*Refer to Chapter 6 for:*

8. Servo Amp Box Cable Diagrams

*Refer to Chapter 8 for:*

9. Servo Amp Test Point Locations



114-1E

Figure 1-4 Dynamometer Maintenance Directory

### DYNAMOMETER MAINTENANCE

*Refer to Chapter 6 for:*

1. Dynamometer Cable Diagrams

*Refer to Chapter 8 for:*

2. Input Arm Adapter Removal /  
Replacement
3. ROM Ring and ROM Stops Removal  
/ Replacement
4. EMI Can, EMI Shield, Torque Board,  
Mounting Plate, and Stator Board  
Removal / Replacement
5. Motor Removal / Replacement
6. Torque Board Test Point Locations

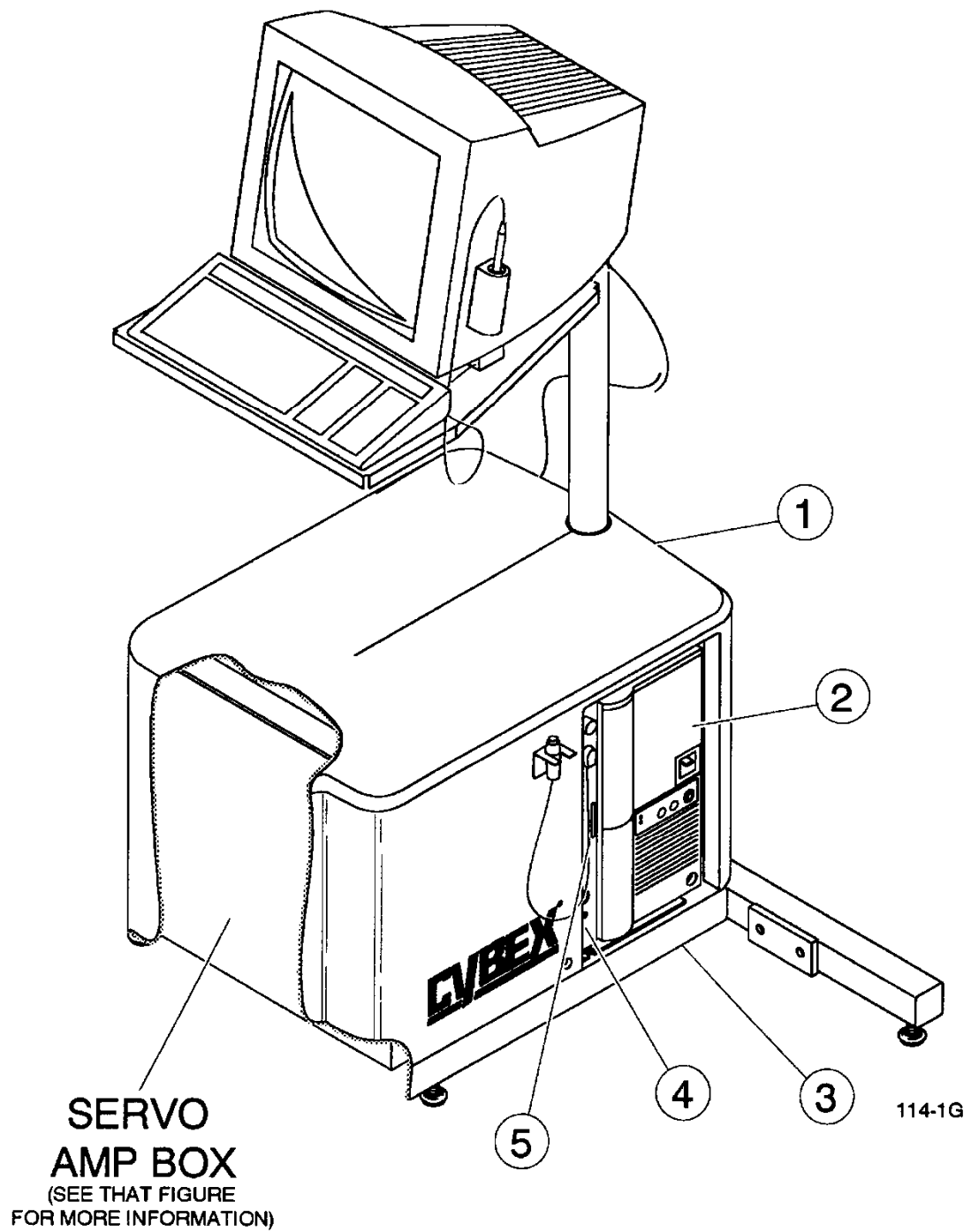


Figure 1-5 Electronics Module and NDCB Maintenance Directory

### **ELECTRONICS MODULE MAINTENANCE**

*Refer to Chapter 5 for:*

1. Computer and Peripherals Jumper Settings

*Refer to Chapter 7 for:*

2. Computer and Peripherals Controls and Indicators
3. Computer and Peripherals Descriptions

*Refer to Chapter 8 for:*

4. NDCB Manual Mode Board, Auxiliary Interface Board, and NDCB Board Removal / Replacement
5. NDCB Test Point Locations

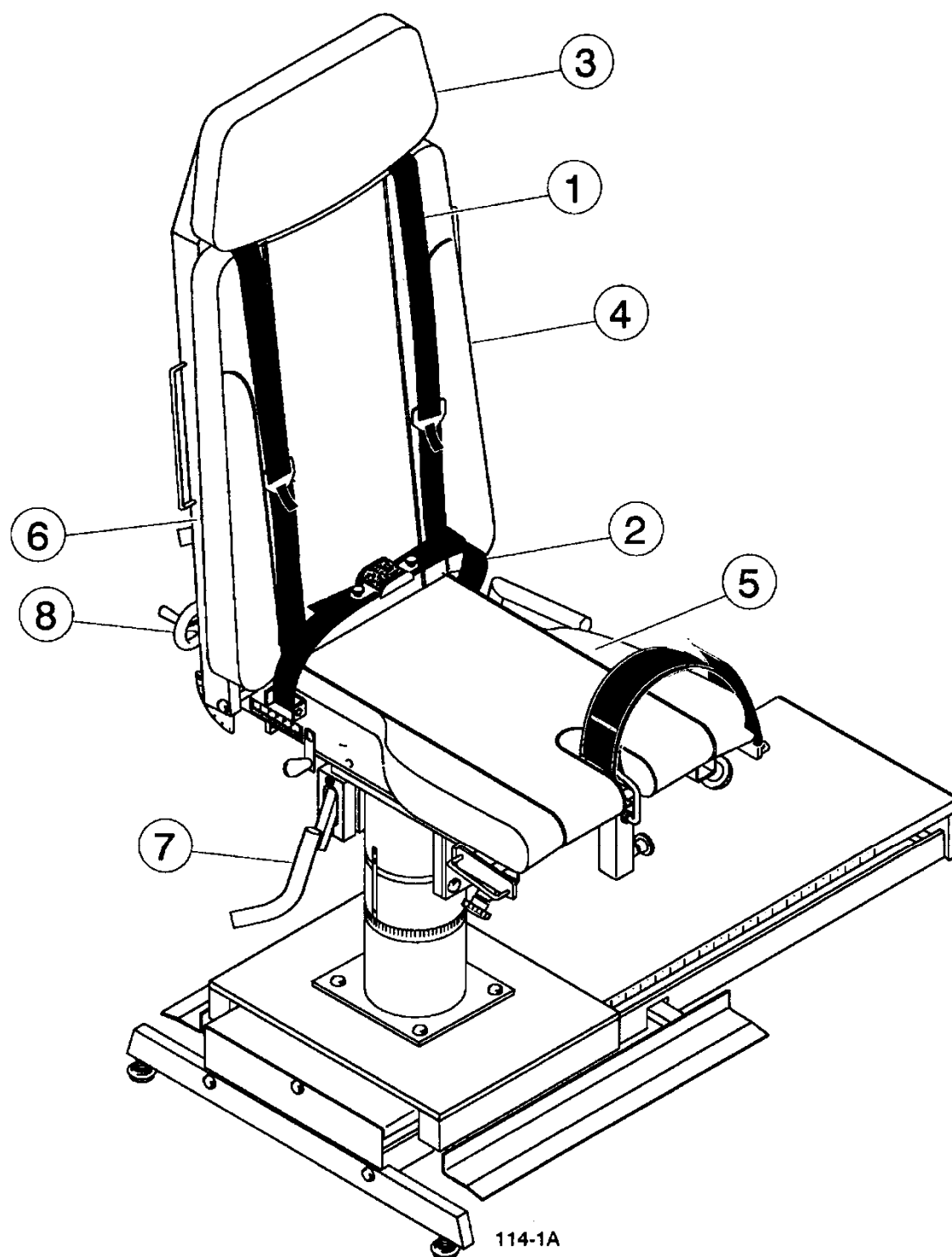


Figure 1-6 Patient Positioning Module Maintenance Directory



### **PATIENT POSITIONING MODULE MAINTENANCE**

*Refer to Chapter 9 for:*

1. Shoulder Belt Removal  
/Replacement
2. Pelvic Belt Removal / Replacement
3. Head Rest Cushion Removal /  
Replacement
4. Seat Back Cushion Removal /  
Replacement
5. Lower Seat Cushion Removal /  
Replacement
6. Gas Spring Removal / Replacement
7. Chair Seat Rotation Tilt Lock Handle  
Adjustment
8. Chair Back Translation Wheel  
Adjustment



NOTES:

### **SECTION 2. FIELD SERVICE BULLETINS**

#### **FIELD SERVICE BULLETINS**

Periodically, Field Service Bulletins (FSBs) containing product updates and revisions to the instructions within CSMi service manuals will be issued. This section of the NORM Service and Parts manual is reserved for use by field service technicians as a place for the FSBs. (Other users will receive updates by formal technical manual change.) An index of bulletins, when issued, should be used to verify the completeness of this section. If any FSBs are found to be missing, please notify CSMi Customer Service.

NOTES:



### SECTION 3. POWER

#### POWER

This chapter describes the power distribution of the NORM system. The chapter traces power inputs to the major assemblies and describes the general flow and interaction of affected circuitry.

The chapter assumes the NORM system is installed and has been configured to reflect its site-specific power requirements. For instructions to perform initial power measurements and equipment configurations, refer to the Assembly and Installation manual. For instructions to power up (or power down) the system, refer to turn-on/shutdown procedures in this chapter.

## POWER DISTRIBUTION

The recommended power source for the NORM system is a dedicated 200V-240V ac, 20 amp outlet. The input voltage supplied by the facility is conducted through a hospital-grade receptacle and cabled to the NORM Isolation Transformer. The Isolation Transformer is

configurable to accept one of five input voltages, as described below. Once configured, it supplies the correct operating voltages to other system equipment and effectively isolates them from potentially dangerous voltage conditions.

NOMINAL VOLTAGE	ACCEPTABLE RANGE	PRIMARY TAPS
<b>200 VAC 50/60HZ</b>	184/216 VOLTS	0/200
<b>208 VAC 50/60HZ (FACTORY)</b>	191 / 224 VOLTS	0/208
<b>220 VAC 50/60HZ</b>	202 / 238 VOLTS	0/220
<b>230 VAC 50/60HZ</b>	212/248 VOLTS	0/230
<b>240 VAC 50/60HZ</b>	221 / 259 VOLTS	0/240

The secondary taps at the output side of the Isolation Transformer supply both 230V ac and 115V ac power to the Servo Amp Box. These output taps are non-adjustable. When the NORM system is configured with an Uninterruptible Power Supply (UPS), the 115V ac input line from the Isolation Transformer is cabled to the UPS directly rather than to the Servo Amp Box (see Figure 3-1). Equipments eligible for UPS protection - the Computer,

Monitor, and Printer - plug into any one of the 115V outlets located on the Servo Amp Box connector panel. When equipment cabling to the Servo Amp Box is completed, the UPS ENABLE switch on the UPS back panel is positioned to on. This switch remains enabled at all times, allowing the UPS to filter ac power to the equipments it supports, reduce signal noise, and suppress electrical surges and sags.

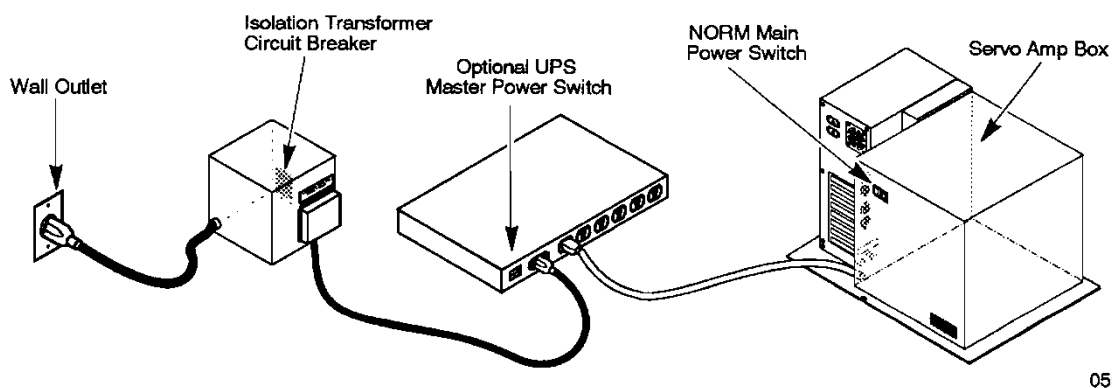


Figure 3-1 AC Cabling with Optional UPS

Inside the Servo Amp Box are the servo amp, the power supply, and associated components and cables, which generate and carry the +5V logic and dc power signals that other external assemblies require to function correctly. These

other assemblies, such as the Dynamometer and the New Dynamometer Control Board (NDCB), acquire the signals to drive the motor and encoder (in the Dynamometer assembly) and to

initiate processor functions (on the NDCB). See Figure 3-2.

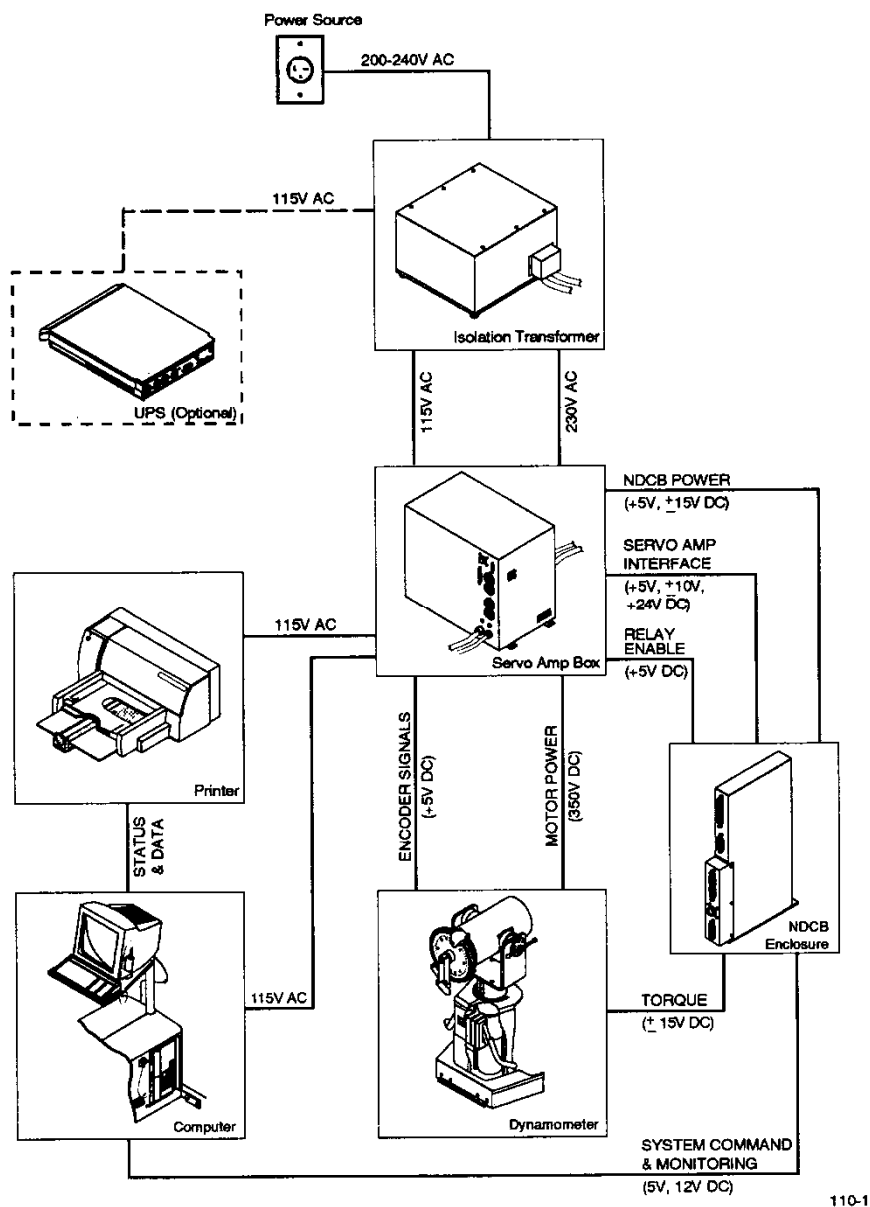


Figure 3-2 Power Distribution Simplified Block Diagram

The Main Power Switch for the NORM system is located on the Servo Amp Box (see Figure 3-1, above). When the switch is turned on, logic circuitry within the Dynamometer and NDCB responds in the following ways. The NDCB will command the Dynamometer to provide information on the amount of resistance

(torque) detected at the motor shaft, and the position of the input adapter arm and its direction. This data is collected by the NDCB, which monitors these values to ensure the NORM system can operate safely. If faults are identified, the NDCB directs the Servo Amp to shut down power to the Dynamometer motor.

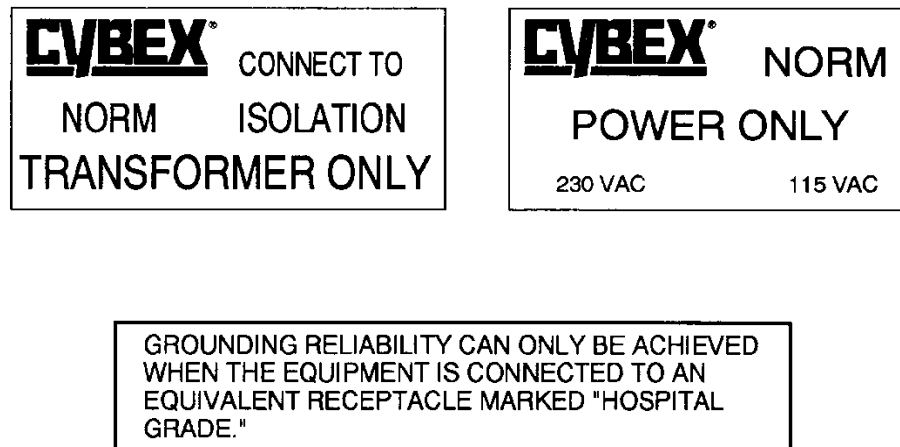
Once the torque signal is received by the NDCB, it is evaluated by the firmware as a way of ensuring a "torque baseline "is established correctly. (When the system is running, the NDCB will monitor Dynamometer torque, position, and speed data continuously.) The torque signal received by the NDCB is analog, so the NDCB digitizes the signal and sends it to the Computer. After processing the torque signal, the Computer returns speed commands to the NDCB for display and data reporting. From that point, the NDCB maintains real-time control of the Dynamometer motor and the Servo Amp.

Data on the input arm's range of motion (ROM) is passed from the Dynamometer encoder to the NDCB via the Servo Amp. In this way, exceeded limits in range of motion will cause the Servo

Amp to remove power to the Dynamometer, inhibiting further movement of the input arm.

## ISOLATION TRANSFORMER FUNCTION AND DESCRIPTION

The Isolation Transformer was designed to conform to stringent UL specifications and to provide the utmost safety to personnel using the NORM system. The Isolation Transformer is enclosed within a shock-mounted cover assembly and uses an external bracket to cover its output receptacles. Several labels are affixed internally and on outside panels of the Isolation Transformer. These labels provide specific information of two types. First, there are labels that emphasize the location of power connections on the Isolation Transformer enclosure. See Figure 3-3.



121-1


Figure 3-3 Power Connection Labels




Second, there are labels that describe the electrical characteristics of the system (rating and ground labels). See Figure 3-4.

The Isolation Transformer enclosure is equipped with a circuit breaker that can be used to apply and remove power to the transformer. When the NORM system is configured with an optional UPS, this switch should remain on. Powering down the system in these configurations is done at the Main Power Switch, located on the Servo Amp Box.

Figure 3-5 describes the wiring inside the Isolation Transformer enclosure. When the transformer has been configured to function at its normal operating setting, a number of a current-limiting features will protect and isolate the loads supported by the Isolation Transformer. Both power lines from the transformer's output taps pass through fuses before connecting to their associated receptacles. The 115V output is regulated by a 5 amp fuse; the 230V output by a 20 amp fuse. On the input side of the transformer, the taps connect to a circuit breaker, which provides additional voltage protection.

<b>CYBEX</b> <sup>®</sup>	CLASS 1 MODEL: NORM	CE	
MADE IN U.S.A.			
VOLTAGE	200/208/220/230/240	VAC	
PHASE	SINGLE		
FREQUENCY	50	HZ	
CONTINUOUS R.M.S. LOAD	0.8/0.4	KVA/PF	
MAXIMUM SHORT-TIME LOAD	6.0/0.6	KVA/PF	
SHORT-TIME LOAD DURATION	2	SECS	

<b>CYBEX</b> <sup>®</sup>	CLASS 1 MODEL: NORM		
MADE IN U.S.A.			
VOLTAGE	200/208/220/230/240	VAC	
PHASE	SINGLE		
FREQUENCY	50	HZ	
CONTINUOUS R.M.S. LOAD	0.8/0.4	KVA/PF	
MAXIMUM SHORT-TIME LOAD	6.0/0.6	KVA/PF	
SHORT-TIME LOAD DURATION	2	SECS	

### Rating Labels

20 AMP, 250 VAC	5 AMP, 250 VAC
3AB SLO-BLO	3AG SLO-BLO
WARNING: FOR CONTINUED PROTECTION AGAINST RISK OF FIRE, REPLACE ONLY WITH SAME TYPE & RATING OF FUSE	
PIN 770M157 REV. A	



Protective Grounds

5 AMP, 250 VAC	5 AMP, 250 VAC
3AG SLO-BLO	3AB SLO-BLO
WARNING: FOR CONTINUED PROTECTION AGAINST RISK OF FIRE, REPLACE ONLY WITH SAME TYPE & RATING OF FUSE	



Functional Grounds

### Fuse Rating Labels

### Ground Labels

121-2

Figure 3-4 Equipment Rating, Fuse Rating, and Ground Labels

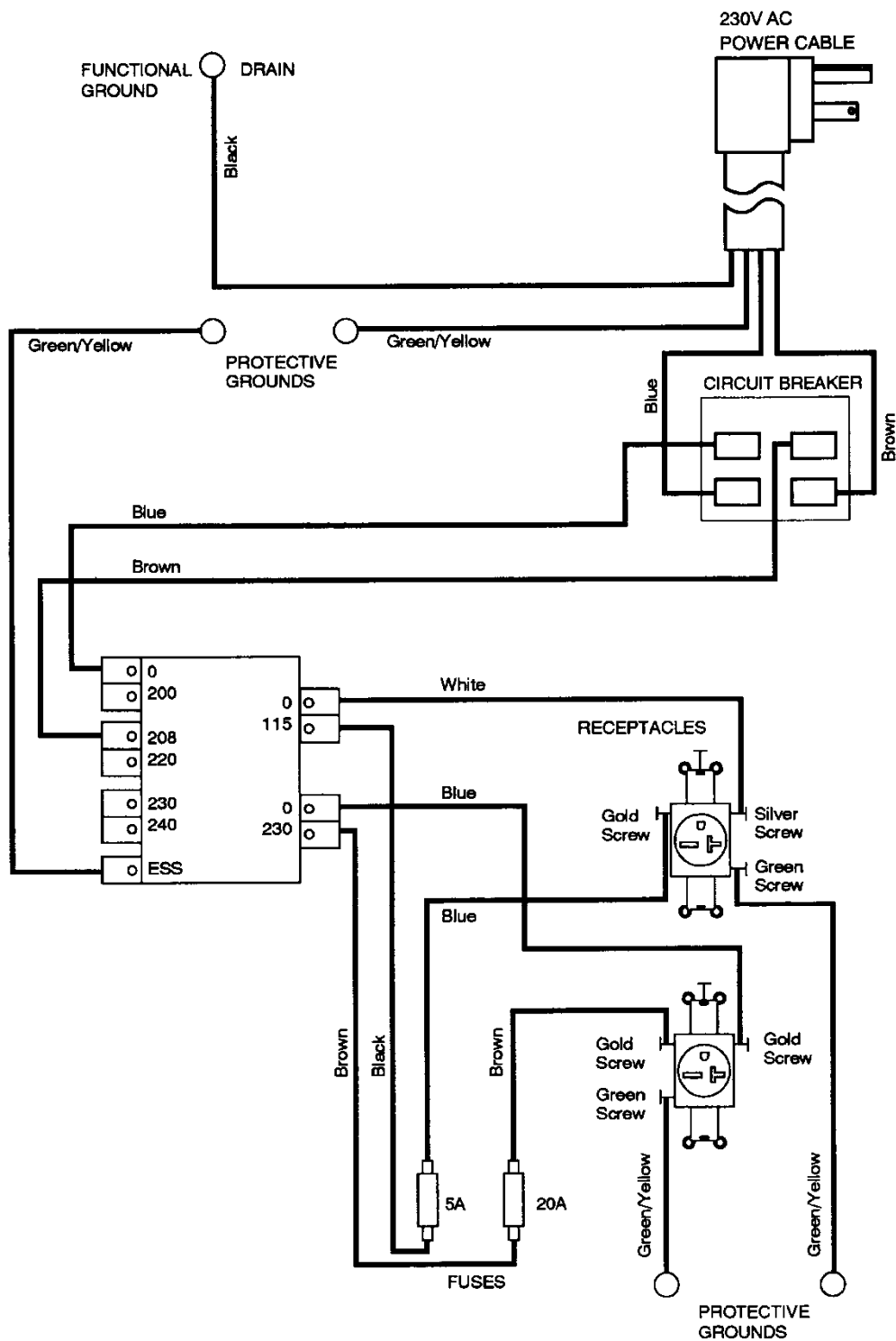


Figure 3-5 Isolation Transformer Internal Wiring.

## SERVO AMP BOX FUNCTION AND DESCRIPTION

The Servo Amp Box consists of several assemblies that collectively supply the logic and power circuitry of the Dynamometer Motor and Encoder and the NDCB. The primary modules comprising the Servo Amp Box include the Servo Amp itself (sometimes referred to as the drive module or DM) and the Power Supply module.

Control and power for the Dynamometer motor and encoder is provided by the Servo Amp. Control circuitry on the Servo Amp logic board utilizes a 16 bit microprocessor to provide a high performance yet simple user interface. All setup and tuning is performed via a battery-backed-up RAM chip (Personality Module). The Personality Module (PM) plugs into an IC socket (U12) on the logic board and is customized to CSMi specifications. There are no physical

adjustments on the logic board as all parameters are set by the PM.

When the NORM Main Power switch on the Servo Amp Box is enabled, 120V is applied to input terminals 1 and 2 on the Power Supply Module. The power supply responds by providing +5V and +/- 15V DC logic signals that turn on the NDCB front panel indicators and the diagnostic LEDs (light-emitting diodes) on the Servo Amp logic board. The fact that the Servo Amp LEDs illuminate on start-up should not be assumed to mean the Servo Amp is receiving its proper 230V from the Servo Amp Box relay.

As shown in the chart below, there are two Personality Module configurations available for the CSMi NORM System and one for the CSMi 6000 System.

SERVO AMP MODEL	SYSTEM	CONCENTRIC TORQUE LIMIT	ECCENTRIC TORQUE LIMIT
<b>DM-30</b>	NORM System	500 ft lbs	300 ft lbs
<b>DM-30</b>	CYBEX 6000	500 ft lbs	300 ft lbs
<b>DM-75</b>	NORM System	500 ft lbs	500 ft lbs

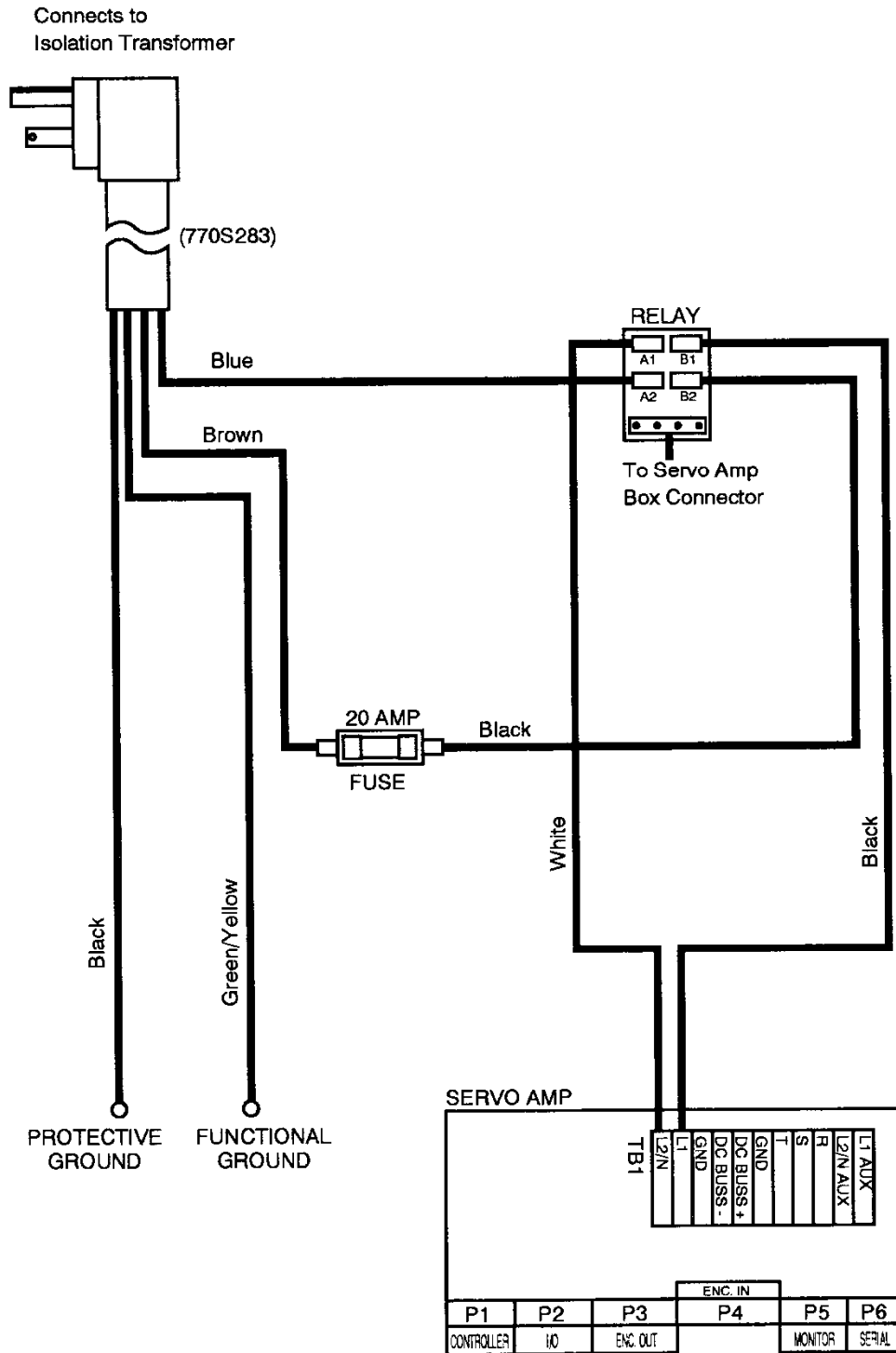
The important difference between the two Servo Amp models is their ability to enable different eccentric torque limits, either 300 or 500 ft-lbs. The 500 ft-lb eccentric torque limit is a customer option, and when selected, the NORM System is furnished with the DM-75 model. The DM-30 model is supplied as standard.

Figures 3-6 and 3-7 describe the 230V and 115V wiring inside the Servo Amplifier Box. When power is applied to the Servo Amp, current from the 230V AC power cable energizes a relay mounted inside the Servo Amp Box connector panel. The NDCB latches the normally-opened contacts of this relay: closing them during normal power-on operations and opening them

during fault or non-power conditions. A 20 amp fuse provides quick-disconnect Servo Amp protection when necessary, but is also rated SLO-BLO to accommodate the brief current inrush associated with power initialization.

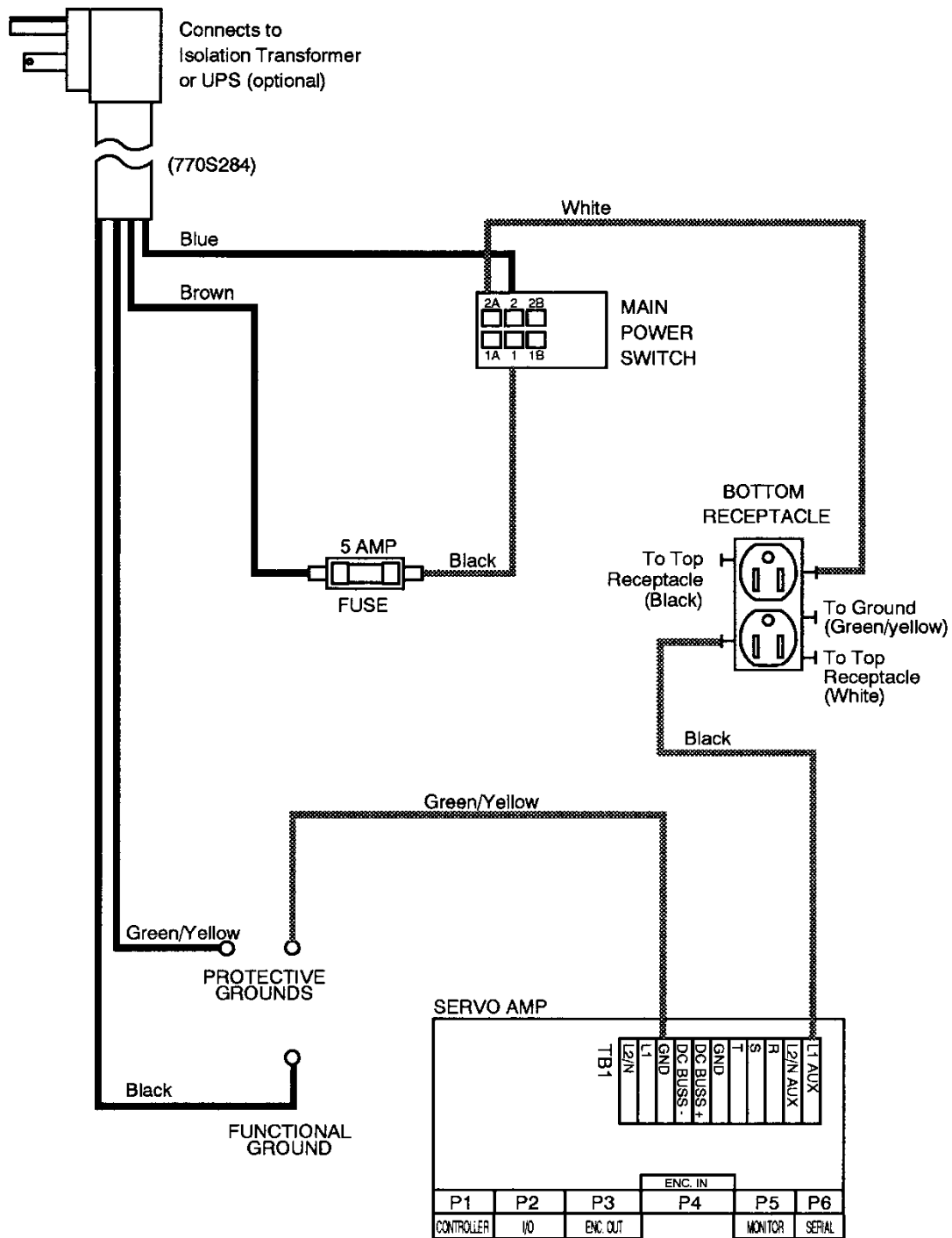
Current from the 115V AC power cable is drawn across two terminals (1 and 2) of a DPST (double-pole single-throw) rocker-type switch (Main Power Switch). Two other switch terminals (1a and 2a) conduct 120V (Figure 3-8) to the power supply. The contacts of the DPST switch work in unison: they are either both off or both on. Positioning the switch removes or applies power to the Servo Amp and all the 115V devices it supports. If a power surge occurs, sufficient to

blow the 5 amp fuse that connects 115V power to the switch, the Servo Amp and its supported equipments are removed immediately from the conducting path.



034-1e

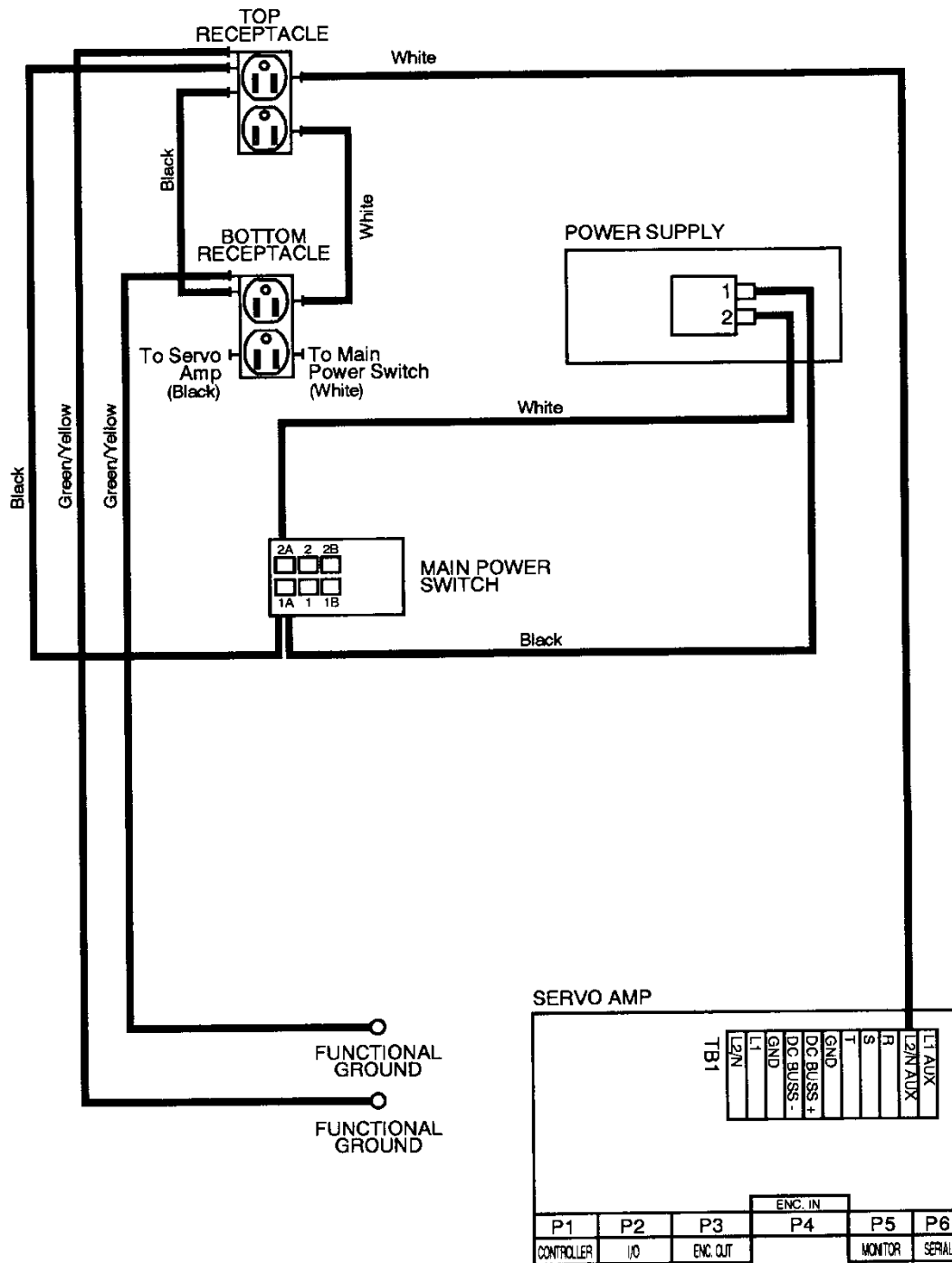
Figure 3-6 Wiring Diagram for 230V AC Power Cable.



NOTE: Gray lines are part of 120V harness wiring

034-1b

Figure 3-7 Wiring Diagram for 115V AC Power Cable



034-1

Figure 3-8 Wiring Diagram for 120V AC Cable



## SERVO AMP BOX CONTROLS AND INDICATORS

The Servo Amp logic board includes a bank of diagnostic LEDs that report on its status and the status of the other equipments it monitors (motor and encoder). Although these indicators

are concealed during patient testing operation (by the Servo Amp Box cover and the NORM panel enclosures), they can be useful during troubleshooting efforts when those covers are removed. The listing below describes some typical LED responses during fault conditions.

LED	COLOR	STATUS	DESCRIPTION
<b>1</b>	GRN	OFF	No internal dc voltage present.
		ON	Internal dc voltage present. During power-down, LED should turn off within 1 second. If LED remains on, internal shunt regulator is not functioning. Replace Servo Amp.
<b>2,3,4</b>	RED	OFF	During power-up and reset the LEDs should turn on for 1 second. If they remain on, there is a logic board CPU fault.
<b>2</b>	RED	ON	Overvoltage or heatsink overtemperature or logic power supply undervoltage
<b>3</b>	RED	ON	Excessive average current or short circuit overcurrent faults
<b>4</b>	RED	ON	Motor Overspeed fault
<b>2,3</b>	RED	ON	Encoder fault
<b>3,4</b>	RED	ON	Motor Overtemperature fault
<b>2,4</b>	RED	ON	Power-up diagnostic fault or watchdog timeout (CPU OK)

## NORM SYSTEM TURN-ON

For NORM systems not configured with an Uninterruptible Power Supply (UPS), perform this procedure (beginning with step 2) after all replacement parts have been installed and all cabinet and system enclosures are in place. For NORM systems configured with an UPS, perform this procedure (beginning with step 1) and then replace NORM system enclosures.

1. UPS Option Only. Ensure UPS ENABLE switch is in the ON position. Ensure 115V cable from Servo Amp Box is connected to UPS Master Outlet. Ensure 115V cable from Isolation Transformer is connected to UPS Power Inlet.
2. Ensure all equipment cables have been connected.
3. Turn Computer front panel ON-OFF switch to ON position.
4. Connect Isolation Transformer 220V power cable to its 20 amp wall outlet.
5. Place Isolation Transformer circuit breaker to ON (up) position.
6. Turn NORM system Main Power Switch on Servo Amp Box to ON position.
7. Verify the following normal, turn-on indications, shown on the following page.
8. Refer to NORM User's Guide manual to enter the NORM application.

EQUIPMENT	INDICATOR TYPE	RESPONSE
<b>Computer</b>	Front Panel LEDs	All indicators flash momentarily; POWER and TURBO indicators remain steady
<b>NDCB</b>	Front Panel LEDs	All indicators flash momentarily; PC 5V, +5V, -15V, +15V, and PC 12V indicators remain steady
<b>Monitor</b>	Dual-Color LED	Illuminates and remains steady green
<b>Color Printer (Optional)</b>	Front Panel LEDs	Both indicators flash momentarily; POWER remains steady. RESUME turns off
<b>Dot Matrix Printer (Optional)</b>		

## NORM SYSTEM SHUTDOWN

Perform this procedure before installing replacement parts and prior to removing any cabinet and system enclosures.

1. Refer to NORM User's Guide manual to exit the NORM application.
2. Turn NORM system Main Power Switch on Servo Amp Box to OFF position.
3. Disconnect Isolation Transformer 230V power cable from its 20 amp wall outlet.
4. Place Isolation Transformer circuit breaker to OFF (down) position.

## SERVO AMP BOX REMOVE AND REPLACE PROCEDURES

(PART NUMBER 7700W481)

### Tools Required

- ☐ Screwdriver (phillips-blade, 1/4-inch)
- ☐ Screwdriver (small, flat-blade)
- ☐ Wrench (3/8-inch socket-type)
- ☐ Ty-Wraps

### Servo Amp Power Supply Removal Procedure

1. Perform NORM System Shutdown procedure.

### Accessing Servo Amp Box

2. Remove NORM Cover Panels (right and left side enclosure panels and pedestal

clamp cover) using a phillips-blade screwdriver to untighten and remove 10 (1/4—inch) pan head screws. (Left side enclosure panel is tethered to NORM unit by cables encased in plastic tubing. Without straining cable tubing, move panel aside to allow sufficient access to Servo Amp Box.)

3. Once NORM panel covers are removed, locate Servo Amp Box.

### Removing Servo Amp Box Cover

4. Using phillips-blade screwdriver, untighten and remove seven (1/4-inch) pan head screws securing Servo Amp Box cover to enclosure. Remove cover.
5. Locate Servo Amp Power Supply, mounted on standoffs, on Servo Amp Box connector panel.

### Removing Servo Amp Box Power Supply

6. Disconnect 2-pin mate-and-lock connector that connects Power Supply block to Main Power switch.
7. Disconnect 6-pin mate-and-lock connector that connects Power Supply circuit boards to Servo Amp Box connector.
8. Cut ty-wrap securing 2-pin mate-and-lock connector to Power Supply bracket.

9. Using phillips-blade screwdriver, untighten and remove four (1/4-inch) pan head screws and lockwashers securing Power Supply to standoffs. Remove Power Supply.

### **Servo Amp Power Supply Replacement Procedure**

1. Mount replacement Power Supply to standoffs using phillips-blade screwdriver to tighten four (1/4-inch) pan head screws and lockwashers.
2. Use new ty-wrap to secure 2-pin mate-and-lock connector to Power Supply bracket.
3. Reconnect 2-pin and 6-pin mate-and-lock connectors to their mating connectors.
4. If no other repairs are required inside Servo Amp Box, secure cover to enclosure using phillips-blade screwdriver to tighten seven (1/4-inch) pan head screws.
5. If no other repairs are required inside Servo Amp Box area of the NORM system, secure cover panels using phillips-blade screwdriver to tighten 10 (1/4-inch) pan head screws.
6. Perform NORM Turn-on procedure.

### **Servo Amp Removal Procedure**

1. Perform NORM Shutdown procedure.

### **Accessing Servo Amp**

2. Perform Accessing Servo Amp Box procedure.
3. Perform Removing Servo Amp Box Cover procedure.

### **Removing Servo Amp**

4. Locate wire bundle from Servo Amp Box connector to Servo Amp interface

connectors. Carefully remove each plug from its connector (P1 thru P6).

5. Locate terminal board TB 1 on Servo Amp. Slide protective strip off of terminal board posts. Note each wire connection, keeping ty-wrapped wires together. Remove wires from terminal board.
6. Using nut driver or ratchet with attachment, untighten and remove two hex nuts and lockwashers securing wire bundles from terminal board and interface connector to right-angled metal bracket (bus bar).
7. Using nut driver or ratchet with attachment, untighten and remove three hex nuts, flatwashers, and lockwashers securing Servo Amp to Servo Amp Box enclosure. (For NORM systems configured with DM-75, remove four nuts and attaching hardware.)
8. Remove Servo Amp from Servo Amp Box and place it on a stable platform.

### **Servo Amp Replacement Procedure**

1. Mount replacement Servo Amp to Servo Amp Box enclosure using nut driver or ratchet with attachment, tighten three hex nuts, flatwashers, and lockwashers. (For NORM systems configured with DM-75, tighten four nuts and attaching hardware.)
2. Using nut driver or ratchet with attachment, secure wire bundles from terminal board and interface connector to right-angled metal bracket (bus bar) by tightening two hex nuts and lockwashers.
3. Attach wires to terminal board TB 1 on Servo Amp, referring to wire locations noted previously. Verify correct wire

placement, using the information provided in the chart on the next page. After verifying wire locations, slide

protective strip over terminal board posts.

Terminal Board Post	Wire Color	Description
<b>R</b>	Red	Three phase motor power
<b>S</b>	White	
<b>T</b>	Black	
<b>GND</b>	Green/Yellow	Protective Ground for motor
<b>DC Bus+</b>	–	Not Connected
<b>DC Bus-</b>	–	Not Connected
<b>L1</b>	Black	To Relay B2 Terminal
<b>L2/N</b>	White	To Relay A2 Terminal
<b>L3</b>	–	Not Connected
<b>GND</b>	Green/Yellow	Protective Ground to chassis
<b>L1 AUX</b>	Black	To Bottom Duplex Outlet
<b>L2/N AUX</b>	White	To Top Duplex Outlet

- Carefully reattach each plug to its mating connector (P1 thru P6).
- If no other repairs are required inside Servo Amp Box, secure cover to enclosure using phillips–blade screwdriver to tighten seven (1/4–inch) pan head screws.
- If no other repairs are required inside Servo Amp Box area of the NORM system, secure cover panels using phillips–blade screwdriver to tighten 10 (1/4–inch) pan head screws.
- Perform NORM System Power Turn–on procedure.

NOTES:



### SECTION 4. FUSES

#### FUSES

This chapter describes the location of replaceable fuses in the NORM system. Specific information is provided on the kind of fuse, its replaceability, procedures to remove and replace the fuse if it has blown, and part number information.

## FUSE TYPES

Fuses provide current protection to critical loads within the NORM system. Fuses used in the system are cartridge fuses that are either field-replaceable or are factory-soldered in place. They are characterized as time-lag or SLO-BLO fuses.

SLO-BLO fuses are tolerant of small, intermittent changes in current. When current sufficient to blow the fuse is detected, or if the fuse is subjected to prolonged overloads, the fuse elements break, producing visible signs that the fuse has blown. Visual inspection of the fuse is sufficient to determine its condition.

Normally, fuses blow because of current overloads or circuit faults. This is, however, not always the case. An environment of excessive heat will adversely affect the condition of the fuse, as will poor connections between the fuseholder and its contacting circuits. In other situations transient signal surges can cause fuses to blow even though the load circuits are functioning normally. Should a new fuse blow, the problem exists in the circuit itself, and associated equipment, or the power source.

## FUSE LOCATIONS

Refer to the table below and the illustrations that follow for fuse information and location.

FUSE LOCATION	VALUE	TYPE	PART NUMBER
<b>Isolation Transformer</b>	5 amps at 250V	SLO-BLO	EF290003
<b>(Output Taps)</b>	20 amps at 250V	SLO-BLO	EF000021

FUSE LOCATION	VALUE	TYPE	PART NUMBER
<b>Servo Amp Box</b>	5 amps at 250V	SLO-BLO	EF290003
<b>(Connector Panel)</b>	20 amps at 250V	SLO-BLO	EF000021

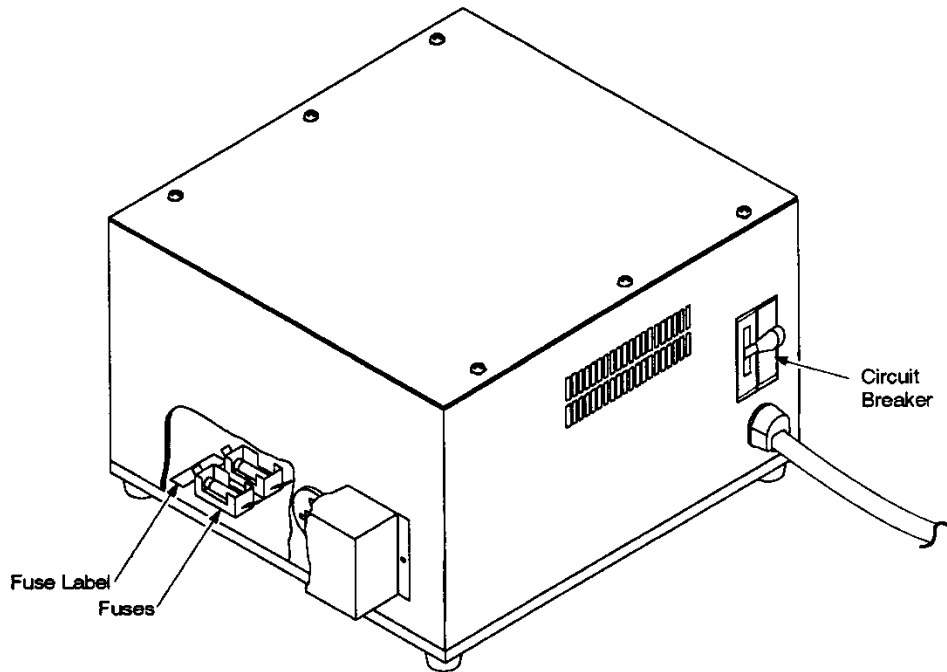
Other fuses located in commercial assemblies supplied are not field-replaceable (below).

FUSE LOCATION	VALUE	TYPE	PART NUMBER
<b>Servo Amp Box (Servo Amp Logic Board)</b>	4 amps at 125V	SLO-BLO	F1
<b>Servo Amp Box (Power Supply)</b>	2.5 amps at 250V	SLO-BLO	F1, 3 F4, 6

If a bad fuse is suspected in any of these equipments, the entire assembly is replaced.

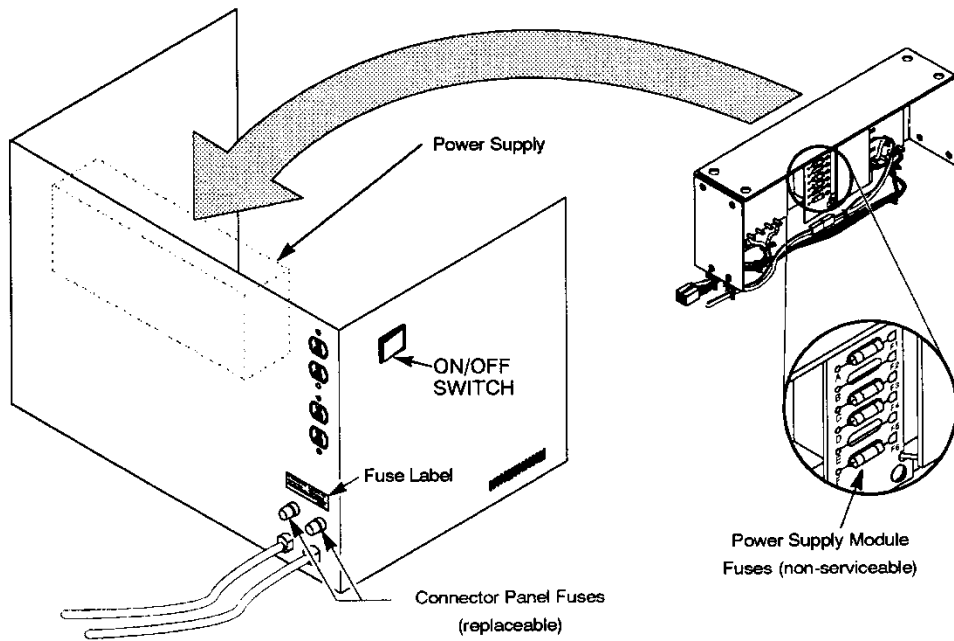
## FUSE REPLACEMENT

When removing bad fuses, their replacements must have the same voltage and current capacity and the same "blowing" characteristic (SLO BLO). Prior to performing fuse replacement, the equipment where the fuse is located must be de-energized; typically, this will require removing power to the NORM itself. (Refer to Section 3 Power for the NORM system shutdown procedure.) Power should be checked carefully after replacing the fuse since a faulty circuit may have induced the fuse to blow. Servo Amp power can be tested at various locations: at the receptacles (115V), at the Power Supply input terminals (120V), and at Terminal Board 1 (230V ac in, 350V dc out).



110-1

Figure 4-1 Isolation Transformer Fuse Locations



038-1

Figure 4-2 Servo Amp Box Fuse Locations



## **ISOLATION TRANSFORMER FUSE REMOVAL AND REPLACEMENT PROCEDURE**

(PART NUMBERS EF000021 AND EF290003)

### **Tools and Material Required**

- ☐ Screwdriver (phillips-blade, 1/4-inch)
- ☐ Replacement Fuses

### **Isolation Transformer Fuse Removal**

1. Perform NORM System Power Shutdown procedure.
2. Using screwdriver, remove 12 pan head screws (Figure 4–1) and washers that secure the Isolation Transformer enclosure cover to housing.
3. Locate fuseholders on base assembly, next to 115V and 230V receptacles.
4. Remove either fuse first and inspect it visually. Remove only one fuse at a time. Check the condition of the cartridge for signs of damage.
5. If fuse is in good condition, return it to fuseholder and perform steps 2, 3, and 4 of Isolation Transformer Fuse Replacement procedure.
6. If fuse has blown, perform Isolation Transformer Fuse Replacement procedure.

### **Isolation Transformer Fuse Replacement**

1. Check replacement fuse to ensure its voltage rating, current capacity, and blowing characteristic (SLO BLO) match the fuse removed. Insert replacement fuse into fuseholder.
2. Ensure that wire jumpers connecting fuse to receptacle and transformer output tap have not been disconnected. Check that connections are tight.

3. Replace Isolation Transformer enclosure cover to housing and secure it with 12 pan head screws and lockwashers.
4. Perform NORM System Power Turn-on procedure.

## **SERVO AMP FUSE REMOVAL AND REPLACEMENT PROCEDURE**

(PART NUMBERS EF000021 AND EF290003)

### **Tools and Material Required**

- ☐ Screwdriver (phillips-blade, 1/4-inch)
- ☐ Replacement Fuses
- ☐ Screwdriver (flat-blade)

### **Servo Amp Fuse Removal**

1. Perform NORM System Power Shutdown procedure.
2. Remove NORM cover panels (right and left side enclosure panels and pedestal clamp cover) using a phillips-blade screwdriver to untighten and remove 10 (1/4-inch) pan head screws. (Left side enclosure panel is tethered to NORM unit by cables encased in plastic tubing. Without straining tubing, move panel aside to access to fuseholders near base of Servo Amp Box connector panel.)
3. Locate fuseholders (Figure 4–2) positioned below four 115V ac receptacles on Servo Amp connector panel.
4. Using flat-blade screwdriver, turn fuseholder clockwise and removing it from connector panel. Remove only one fuseholder at a time. Remove fuse from fuseholder. Check the condition of the cartridge for signs of damage.
5. If fuse is in good condition, return it to fuseholder and perform steps 2 and 3 of Servo Amp Fuse Replacement procedure. Insert fuseholder into connector panel.

and turn it counterclockwise to lock into position.

6. If fuse has blown, perform Servo Amp Fuse Replacement procedure.

### **Servo Amp Fuse Replacement**

1. Check replacement fuse to ensure its voltage rating, current capacity, and blowing characteristic (SLO BLO) match

the fuse removed. Insert replacement fuse into fuseholder.

2. Insert fuseholder into connector panel and turn it counterclockwise to lock into position.
3. Perform procedure to NORM System Power Turn-on procedure.

*Notes:*



### SECTION 5. JUMPERS

#### JUMPERS

This chapter describes the location and settings for jumpers used in the NORM system. All jumpers are factory-set to reflect the normal operating configuration. Some jumpers have been soldered in place and cannot be repositioned. Adjustments to jumpers that can be changed should only be attempted by qualified personnel having a clear understanding of how jumper settings affect system functions.

## JUMPER LOCATIONS

Jumpers are typically short wires used to apply or divert current in a variety of electrical applications. In the NORM system, jumpers are used primarily for three reasons. First, to set the correct operating voltage in the Isolation Transformer. Second, to connect with protective devices (such as relays and circuit breakers) to isolate potentially dangerous currents and voltages before they damage equipment. Third, to access the alternate functions and expanded features built into the design of some circuit boards.

### Isolation Transformer Jumpers

The jumper that configures the Isolation Transformer at the correct operating voltage is factory set at 208V at the input side of the transformer. This jumper is repositioned only during the initial set-up of the NORM system. (Refer to the Assembly and Installation manual for configuration procedures.) All other transformer connections remain the same.

Other jumpers in the Isolation Transformer enclosure divert (or shunt) current to circuit protective devices. These are described in the following table.

LOCATION	JUMPER AT TRANSFORMER TAP	CONNECTED TO	PART NUMBER
<b>ISOLATION TRANSFORMER ENCLOSURE (Transformer)</b>	115V (Output Tap)	5 Amp Fuse	7700S514-2
	220V (Output Tap)	20 Amp Fuse	7700S514-3
	ESS (Input Tap)	Ground	7700S514-4
	0V (Input Tap)	Circuit Breaker	7700S514-5
	208V (Input Tap)*	Circuit Breaker	7700S514-6

\* Factory setting is 208V.

### Servo Amp Box Jumpers

Listed in the table on the next page are the location and settings for circuit board and terminal board jumpers in the Servo Amp Box.

When referring to the following table, see Figure 5-1 for module and connector locations.

LOCATION	CONNECTOR NUMBER	JUMPER POSITIONED ACROSS PINS	SETTINGS SELECTABLE
<b>SERVO AMP BOX (Logic Board)</b> * = STOCK setting for NORM or 6000	P9	* 1-2 (Factory-setting) Soldered Jumper	Personality Module (PM) variables are stored in RAM or EPROM
		2-3	PM variables are stored in EEPROM
	P10	* 1-2 (Factory setting)	PM variables cannot be altered (write-protected)
		2-3	New PM variables can be entered (write-enabled)
	P11	1-2	Configures Drive Module (DM) serial port (P6) for RS-422 interface input signal

LOCATION	CONNECTOR NUMBER	JUMPER POSITIONED ACROSS PINS	SETTINGS SELECTABLE
		* 2–3 (Factory setting)	Configures DM serial port P6 for RS–232 interface input signal
	P12	* 1–2	Configures DM serial port P6 for RS–422 interface output signal
		2–3 (Factory setting)	Configures DM serial port P6 for RS–232 interface output signal
	P13	* 1–2 (Factory setting)	Configures DM serial port P6 for RS–232 interface output signal
		2–3	Configures DM serial port P6 for RS–422 interface output signal
	P14	1–2	Motor overtemperature condition is not monitored by thermal switch
		* 2–3 (Factory setting)*	Motor overtemperature condition is monitored by thermal switch
<b>SERVO AMP BOX (Terminal Board)</b>	TB2	* 1–2 (Factory setting)	Internal shunt resistor is used
		1–3	Optional external shunt resistor is used

\* Operating the motor with pins 2–3 shorted together will inhibit thermal protection.

The following jumpers are used in conjunction with relays to provide equipment protection from overvoltage, undervoltage, and excessive

current conditions. The wiring diagram for the 230V ac power cable in Section 3 Powershows the wiring connections listed below.

LOCATION	JUMPER AT RELAY CONTACT	CONNECTED TO	PART NUMBER
<b>SERVO AMP BOX (Relay)</b>	A1	Servo Amp TB1 (L2/N)	7700S507-1
	B1	Servo Amp TB1 (L1)	7700S507-3
	B2	20 Amp Fuse	7700S507-2

The following jumpers are located in the commercial circuit boards supplied with the NORM system. Except (possibly) in the case of

the modem, no changes are needed to reset factory–defined positions.

LOCATION	JUMPER SETTINGS	JUMPER DESCRIPTION	FACTORY SETTING
<b>SERVO AMP BOX (Relay)</b>	A1	Servo Amp TB1 (L2/N)	7700S507-1
	B1	Servo Amp TB1 (L1)	7700S507-3
	B2	20 Amp Fuse	7700S507-2
<b>LIGHT PEN CIRCUIT BOARD</b>	AUTO	Selects the IRQ level the light pen circuit board will use when light pen	AUTO

LOCATION	JUMPER SETTINGS	JUMPER DESCRIPTION	FACTORY SETTING
		software drivers are loaded (IRQ 5, Base Address 210H for NORM)	
	2, 3, 4, 5, 7	Standard PC and PC/XT models	
	10, 11, 12, 15	PC/AT, 386, 486, Pentium and some PS/2 models	
<b>MODEM</b>	E1 and E3	Sets COM Port 1	COM 1
	E3	Sets COM Port 2	
	E1	Sets COM Port 3 (NORM setting)	
	Open	Sets COM Port 4	
	E7	Selects IRQ 2	IRQ 4
	E4	Selects IRQ 3	
	E5	Selects IRQ 4 (NORM setting)	
	E6	Selects IRQ 5	
<b>SYSTEM BOARD (486 Processor)</b>	W1	BIOS Operation	2–3
	W2	Video Monitor Display	1–2
	W3, W4	Printer Port IRQ	Open
	W5	CMOS Reset	1–2
	W6	SMI Configuration	2–3
	W7	Local Bus IDE	1–2
	W8	Printer Port IRQ	1–2
	W10	CPU Clock	Set by software
	W11, W12, W18, W19, W20, W21, W22, W23, W24, W25, W26, W27, W28	CPU Type	Set by software
	W33	Secondary IDE Controller	–
	W16, W19	Reserved	–

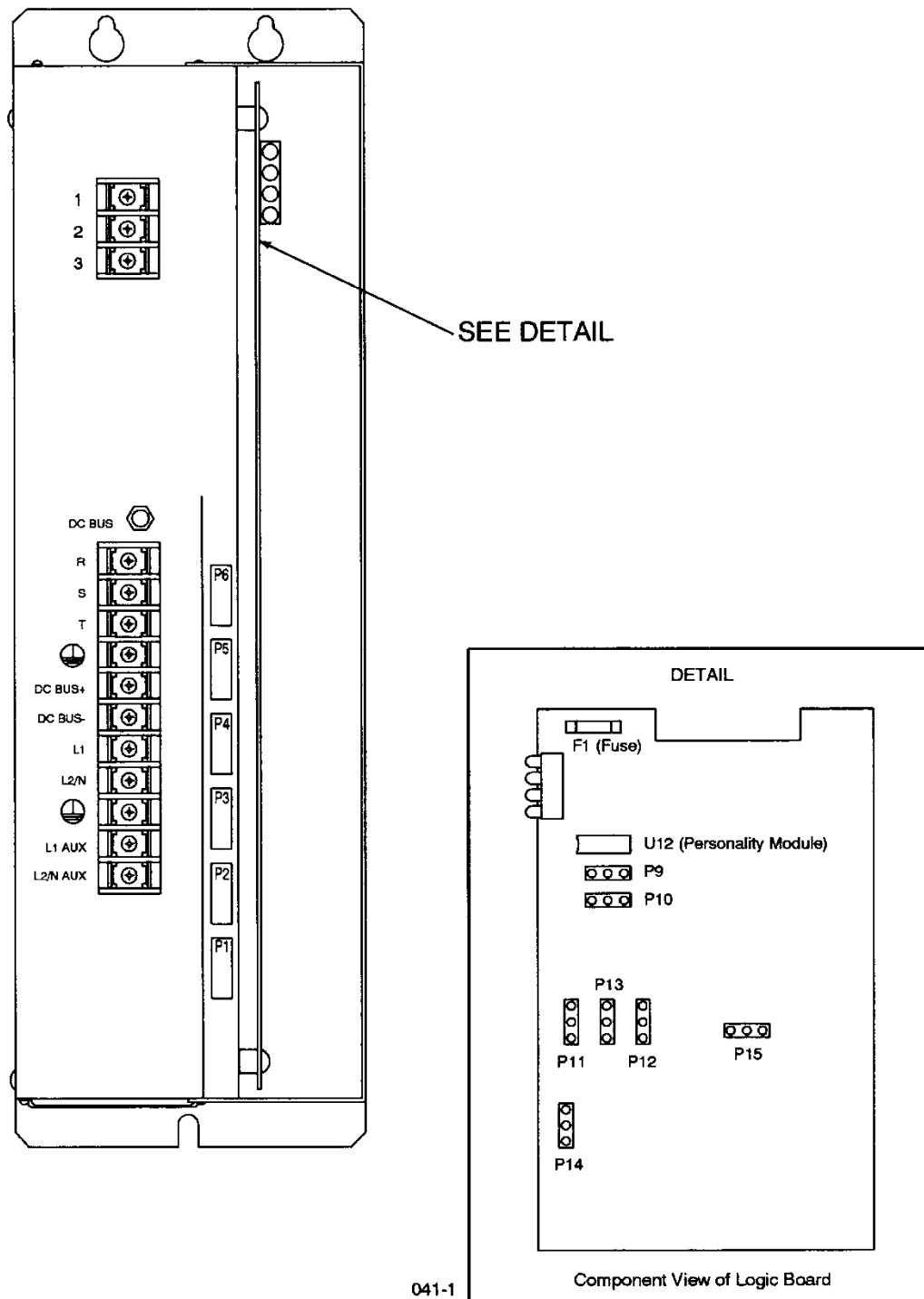


Figure 5-1 Servo Amp Logic Board Jumper Locations



NOTES:



## **SECTION 6.        CABLES**

### **CABLES**

This chapter describes the cables internal to the Servo Amp Box and the Dynamometer, and the external cables that link these and other primary NORM equipments (Isolation Transformer, New Dynamometer Control Board, and Computer). For general information on cables supplied with various computer peripherals (light pen, modem, printer, and monitor), refer to Chapter 7 Electronics Module of this manual.

Cable 7700S273, Torque Signal Cable, connects P1 to Dynamometer and P2 to J6 of NDCB.

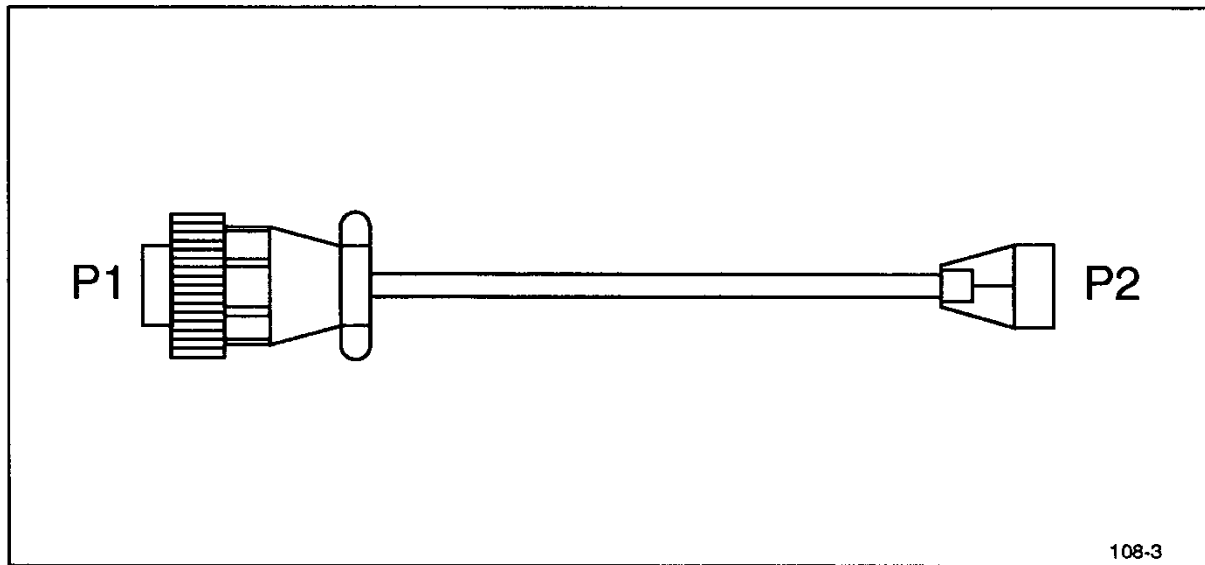


Figure 6-1 Torque Signal Cable

The following list supplies pin-to-pin information.

FROM	TO	COLOR	SIGNAL	FROM	TO	COLOR	SIGNAL
P1-A	P2-1	Red	TORQERR				
P1-B	P2-2	Black	-15VDC				
P1-C	P2-3	White	+15VDC				
P1-D	P2-4	Black	PWRCOM				
P1-E	P2-5	Green	TORQUE				
P1-F	P2-6	Black	TORQCOM				

Cable 7700S274, External Power Supply Cable, connects P1 to J5 (bottom section) of NDCB and P2 to Servo Amp Box connector.

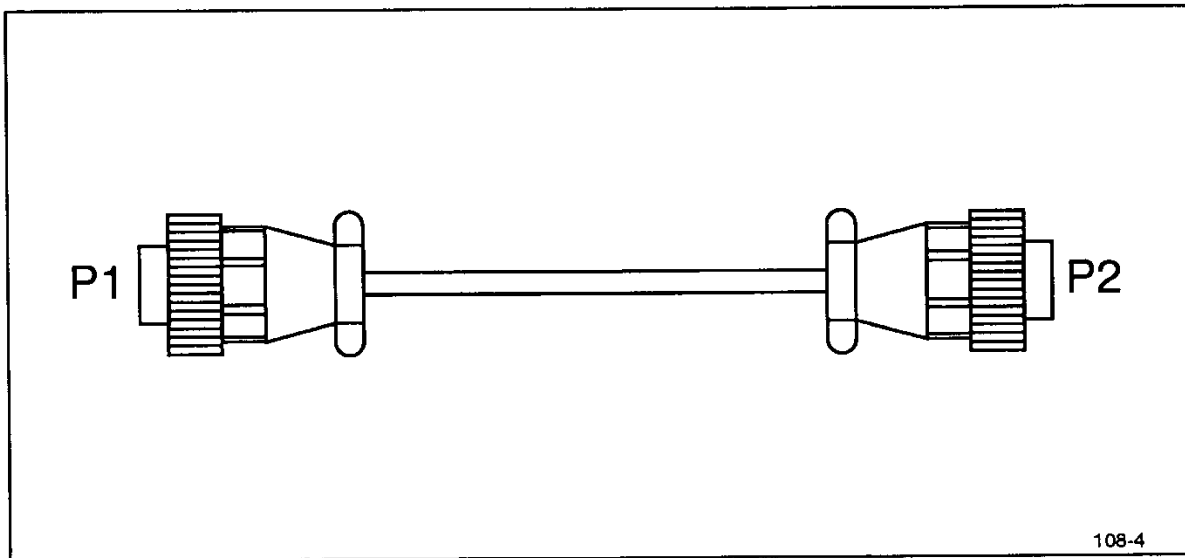


Figure 6-2 External Power Supply Cable

The following list supplies pin-to-pin information.

FROM	TO	COLOR	SIGNAL	FROM	TO	COLOR	SIGNAL
P1-A	P2-A	Black	+15VDC				
P1-B	P2-B	Red	-15VDC				
P1-C	P2-C	White	AGND				
P1-D	P2-D	Green	DGND				
P1-E	P2-E	Orange	+5VDC				

Cable 7700S275, External Relay Cable, connects P1 to J5 (top section) of NDCB and P2 to Servo Amp Box connector.

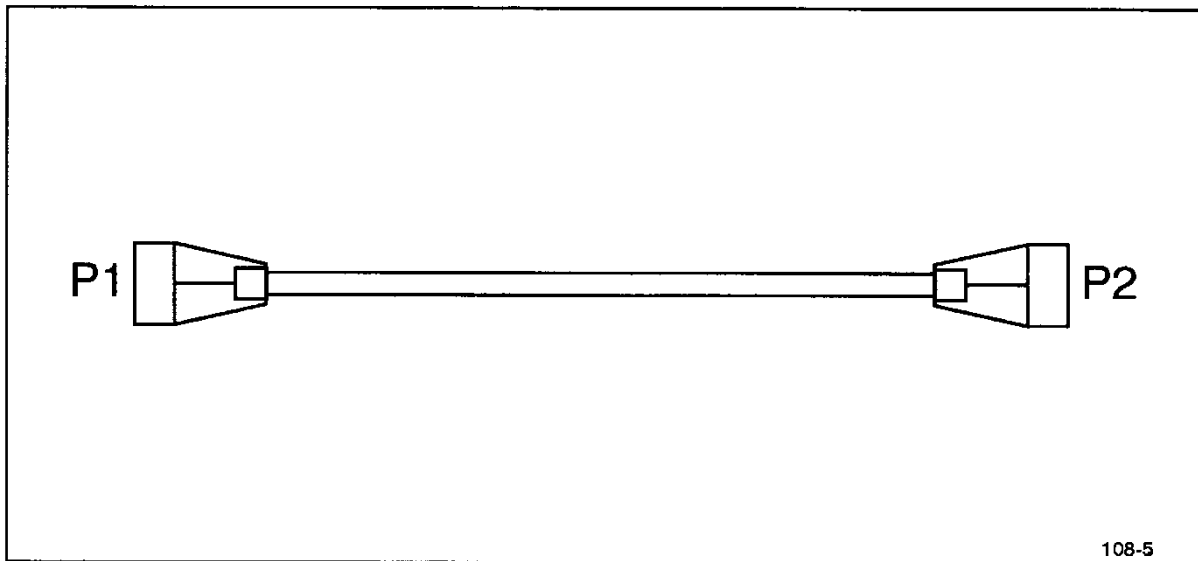


Figure 6-3 External Relay Cable

The following list supplies pin-to-pin information.

FROM	TO	COLOR	SIGNAL	FROM	TO	COLOR	SIGNAL
P1-1	P2-1	Black	SSR2-				
P1-2	P2-2	Red	SSR2+				
P1-3	P2-3	Black	SSR1-				
P1-4	P2-4	White	SSR1 +				

Cable 7700S276, External Servo/NDCB Cable, connects P1 to Servo Amp Box connector and P2 to J4 of NDCB

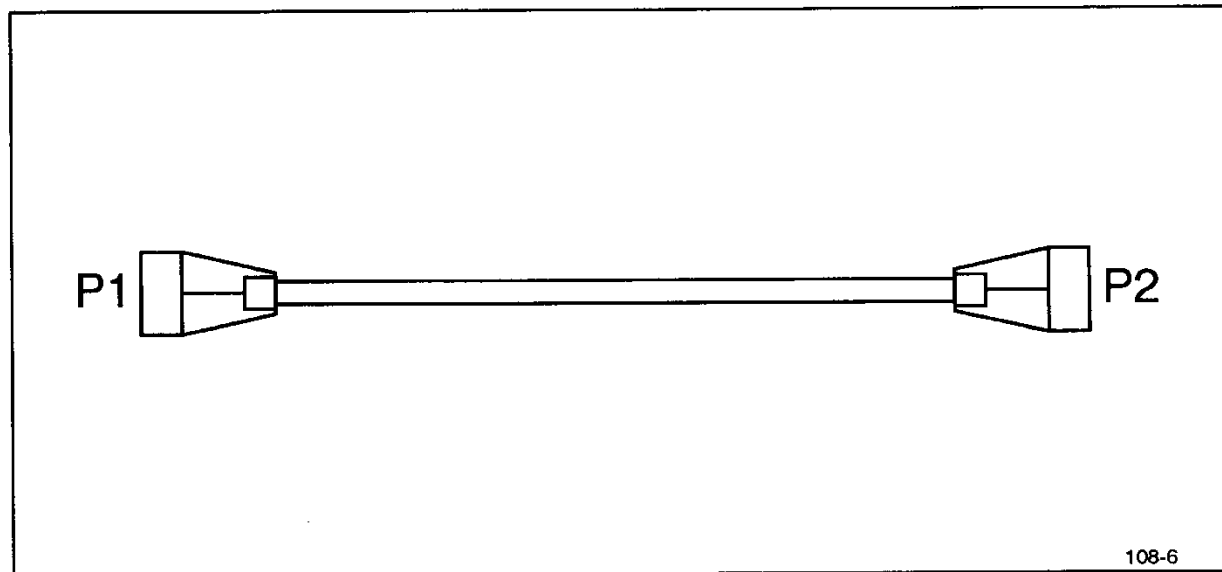


Figure 6-4 External Servo / NDCB Cable

The following list supplies pin-to-pin information.

FROM	TO	COLOR	SIGNAL	FROM	TO	COLOR	SIGNAL
P1-1	P2-1	Red	PHSA+	P1-16	P2-16	Blue	RAC+
P1-2	P2-2	Black	PHSA-	P1-17	P2-17	Red	FAC+
P1-3	P2-3	Brown	-	P1-18	P2-18	Black	OUT-
P1-4	P2-4	Red	-	P1-19	P2-19	Red	+24VDCOM
P1-5	P2-5	Gray	RESET+	P1-20	P2-20	Black	ENABL-
P1-6	P2-6	Yellow	OUT+	P1-21	P2-21	Black	SSO-
P1-7	P2-7	Green	ENABL+	P1-22	P2-22	White	VCS+
P1-8	P2-8	Blue	SSO+	P1-23	P2-23	Red	SERIALCO
P1-9	P2-9	Black	VCS-	P1-24	P2-24	Black	MONCOM
P1-10	P2-10	White	XMT-	P1-25	P2-25	Orange	MONITOR
P1-11	P2-11	Yellow	RCV-				
P1-12	P2-12	Green	MCO				
P1-13	P2-13	Red	MVO				
P1-14	P2-14	Brown	PHSB+				
P1-15	P2-15	Black	PHSB-				

Cable 7700S277, Servo Box Power Supply Cable, connects P1 to Servo Amp Box connector and P2 to wire bundle from Power Supply.

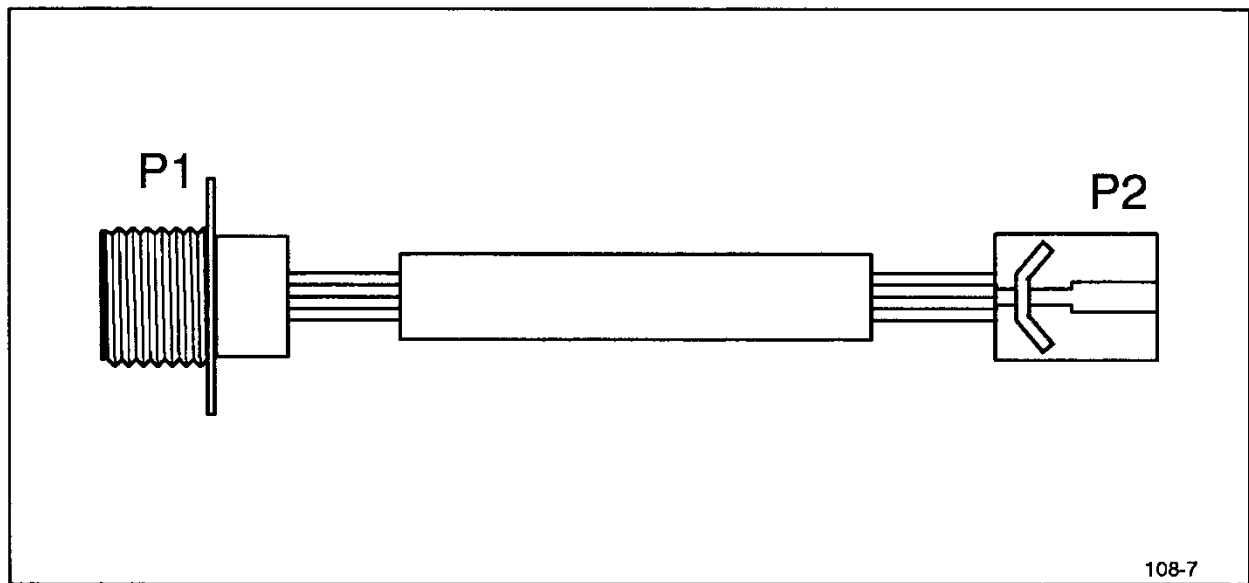


Figure 6-5 Servo Box Power Supply Cable

The following list supplies pin-to-pin wiring information.

FROM	TO	COLOR	SIGNAL	FROM	TO	COLOR	SIGNAL
P1-A	P2-5	Orange	+15VDC				
P1-B	P2-4	Violet	-15VDC				
P1-C	P2-3	Gray	AGND				
P1-D	P2-2	Black	GND				
P1-E	P2-1	Red	+5VDC				

Cable 7700S278, Servo Box Relay Cable, connects P1 to Servo Amp Box connector and P2 to Servo Amp Relay.

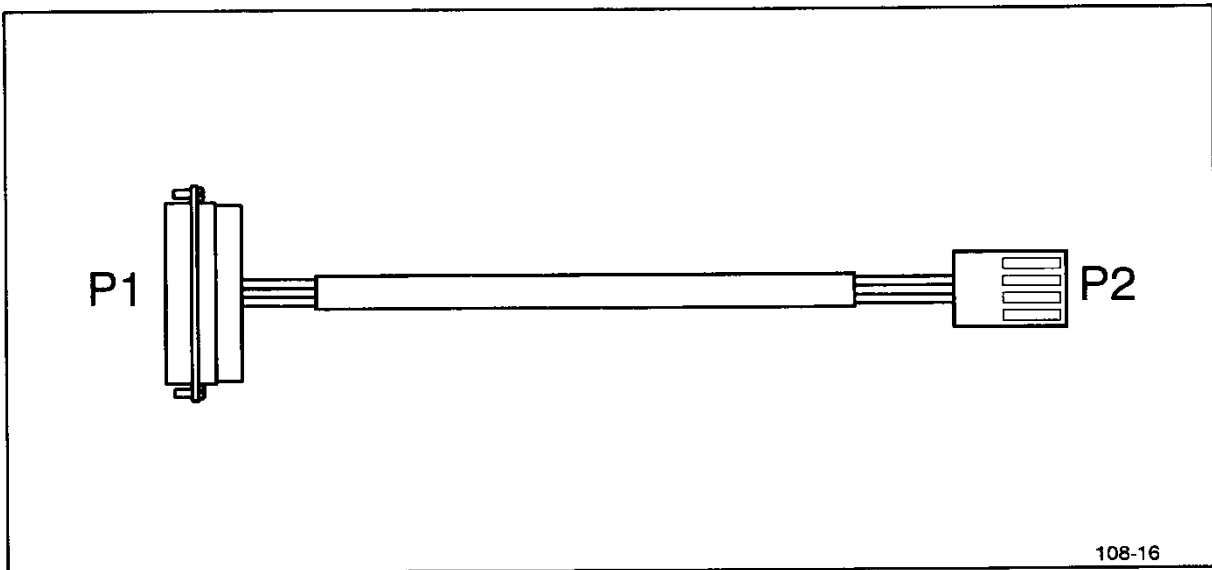


Figure 6-6 Servo Box Relay Cable

The following list supplies pin-to-pin wiring information.

FROM	TO	COLOR	SIGNAL	FROM	TO	COLOR	SIGNAL
P1-1	P2-4	Black	SSR2-				
P1-2	P2-3	Red	SSR2+				
P1-3	P2-2	Black	SSR1-				
P1-4	P2-1	Red	SSR1 +				



Cable 7700S279, Internal Servo Amp Cable, connects P1 to Servo Amp Box connector, and P2, P3, P4, P5, and P6 to Servo Amp Drive Module interface connectors.

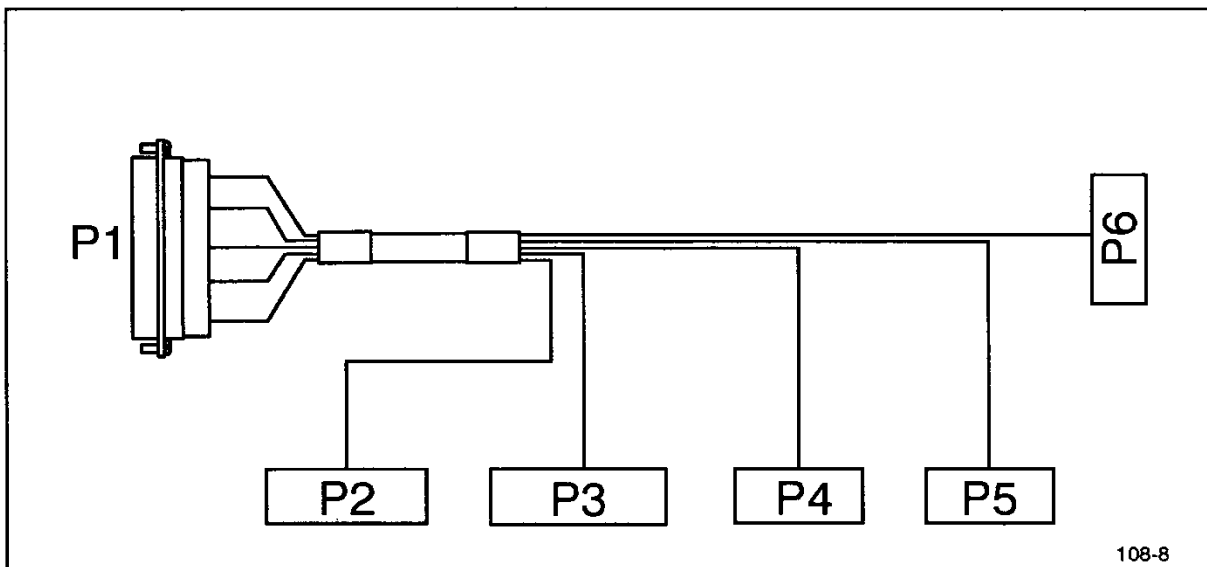


Figure 6-7 Internal Servo Amp Cable

The following list supplies pin-to-pin wiring information.

FROM	TO	COLOR	SIGNAL	FROM	TO	COLOR	SIGNAL
P1-1	P4-1	Red	PHSA+	P1-16	P3-3	Blue	RAC+
P1-2	P4-2	Black	PHSA-	P1-17	P3-1	Red	FAC+
P1-3	-	Brown	-	P1-18	P3-9	Black	OUT-
P1-4	-	Red	-	P1-19	P2-5	Red	+24VDCOM
P1-5	P3-5	Gray	RESET+	P1-20	P2-2	Black	ENABL-
P1-6	P3-8	Yellow	OUT+	P1-21	P2-7	Black	SSO-
P1-7	P2-1	Green	ENABL+	P1-22	P2-4	White	VCS+
P1-8	P2-6	Blue	SSO+	P1-23	P6-3	Red	SERIALCOM
P1-9	P2-3	Black	VCS-	P1-24	P5-5	Black	MONCOM
P1-10	P6-1	White	XMT-	P1-25	P5-3	Orange	MONITOR
P1-11	P6-5	Yellow	RCV-				
P1-12	P5-1	Green	MCO				
P1-13	P5-2	Red	MVO				
P1-14	P4-3	Brown	PHSB+				
P1-15	P4-4	Black	PHSB-				

Cable 7700S280, Motor Power Cable, connects P1 to Dynamometer and pigtail leads to Servo Amp Drive Module TB1.

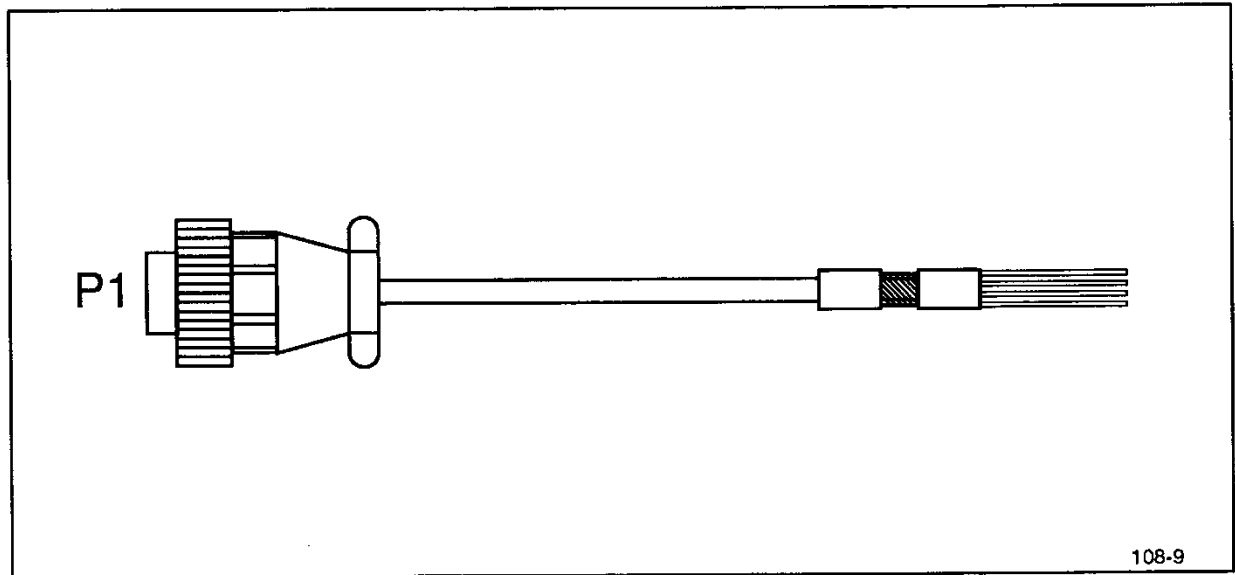


Figure 6-8 Motor Power Cable

The following list supplies the pin-to-wire lead information.

FROM	TO	COLOR	SIGNAL	FROM	TO	COLOR	SIGNAL
P1-A	-	Red	R				
P1-B	-	Brown	S				
P1-C	-	Orange	T				
P1-D	-	Black	GND				

Cable 7700S281, Motor Encoder Signal Cable, connects P1 to Dynamometer and P2 to Servo Amp Drive Module interface connector.

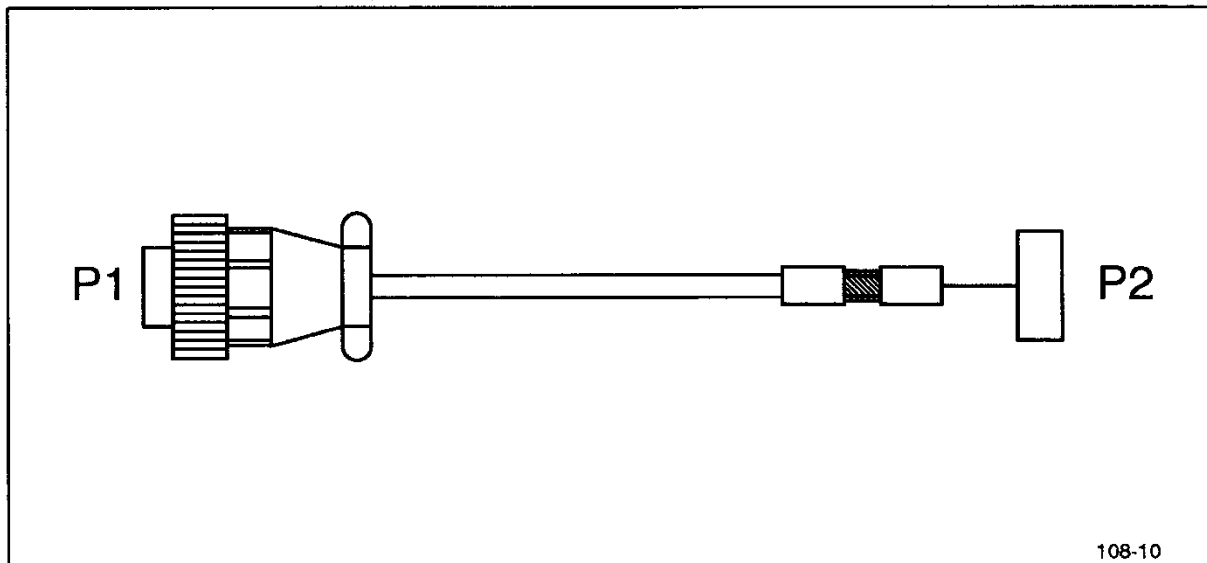


Figure 6-9 Motor Encoder Signal Cable

The following list supplies pin-to-pin wiring information.

FROM	TO	COLOR	SIGNAL	FROM	TO	COLOR	SIGNAL
P1-A	P2-3	Green	A	P1-S	P2-14	Black	THERM
P1-B	P2-4	Black	A'	P1-T	-	-	-
P1-C	P2-5	Blue	B				
P1-D	P2-6	Black	B'				
P1-E	P2-7	Yellow	I				
P1-F	P2-8	Black	I'				
P1-G	P2-10	Black	ENCGND				
P1-H	P2-9	Brown	ABS				
P1-J	P2-11	White	-				
P1-K	P2-1	Red	+5VDC				
P1-L	P2-2	Black	COM				
P1-M	P2-12	Black	-				
P1-N	-	-	-				
P1-P	-	-	-				
P1-R	P2-13	Orange	THERM				

Cable 7700S282, Stator Board Cable, connects wire leads to Stator Board circuit board and P1 to Dynamometer.

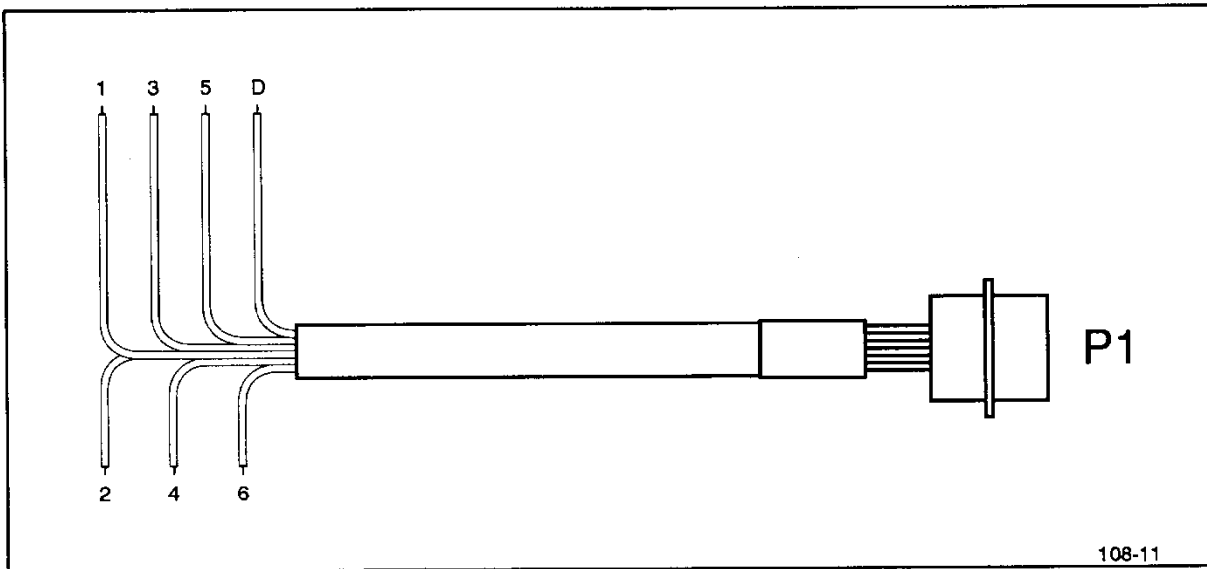


Figure 6-10 Stator Board Cable

The following list supplies wire lead and pin information.

FROM	TO	COLOR	SIGNAL	FROM	TO	COLOR	SIGNAL
P1-A	2	Red	TORQERR				
P1-B	3	Black	-15VDC				
P1-C	1	Green	+15VDC				
P1-D	5	Black	PWRCOM				
P1-E	4	White	TORQUE				
P1-F	6	Black	TORQCOM				
P1-G	D	Drain	DRAIN				

Cable 7700S283, 230V AC Power Cord Cable, connects 230V ac power from facility receptacle to Isolation Transformer and from Isolation Transformer to Servo Amp Box.

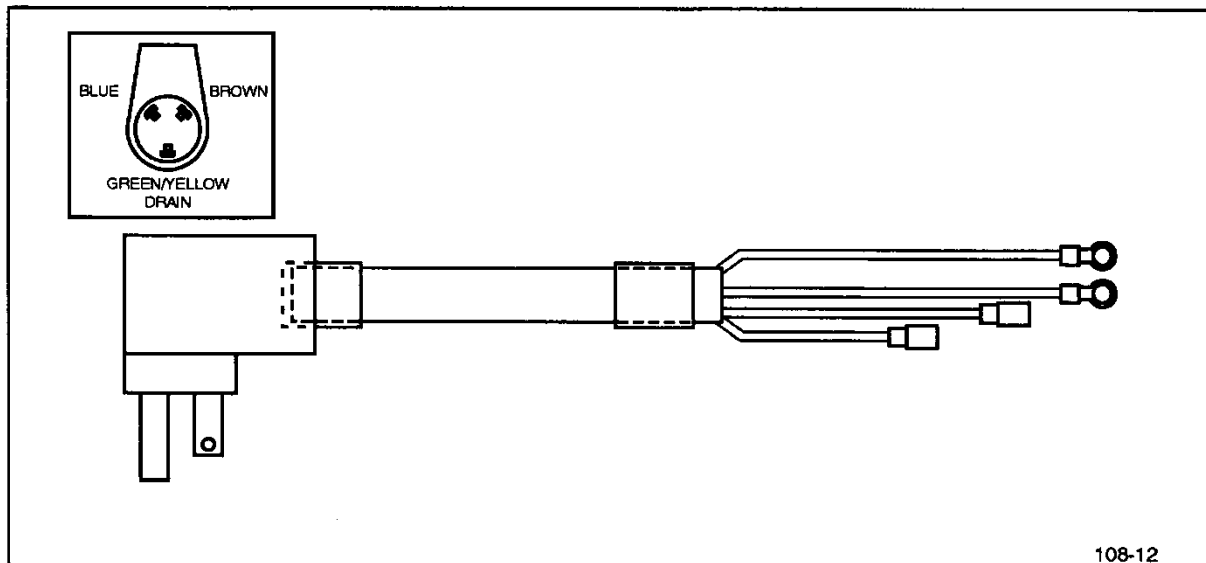


Figure 6-11 230V AC Power Cord Cable

The following list supplies plug-to-terminal information.

FROM	TO	COLOR	SIGNAL	FROM	TO	COLOR	SIGNAL
Plug	Terminal	Green/ Yellow	GROUND				
Plug	Terminal	Black	DRAIN				
Plug	Terminal	Blue	NEUTRAL				
Plug	Terminal	Brown	HOT				

Cable 7700S284, 115V AC Power Cord Cable, connects 115V ac power from Isolation Transformer to Servo Amp Box.

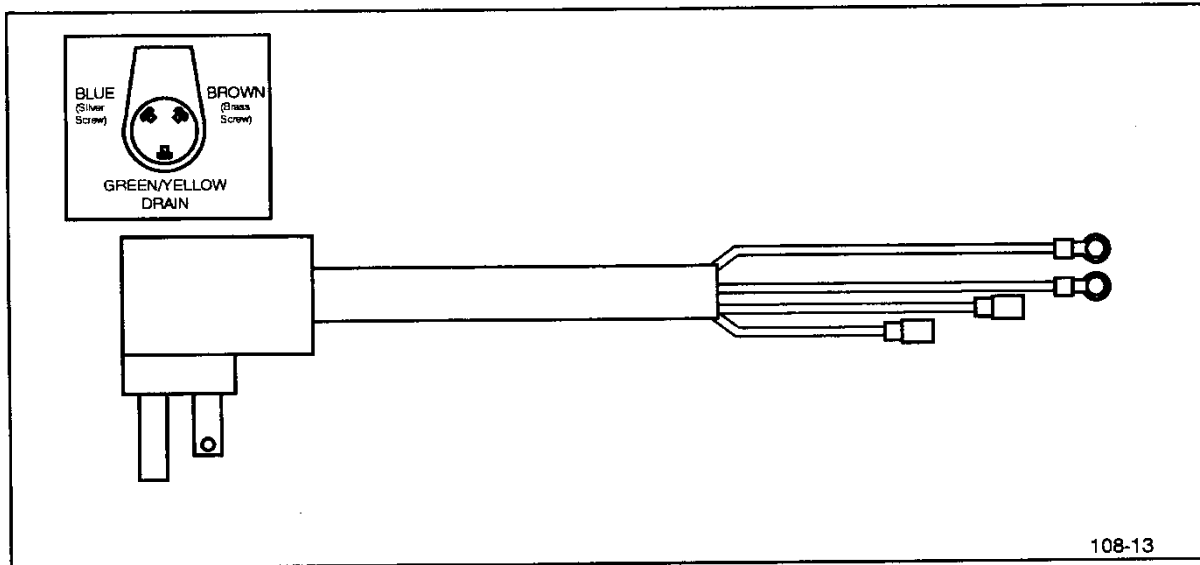


Figure 6-12 115V AC Power Cord Cable

The following list supplies plug-to-terminal information.

FROM	TO	COLOR	SIGNAL	FROM	TO	COLOR	SIGNAL
Plug	Terminal	Green/ Yellow	GROUND				
Plug	Terminal	Black	DRAIN				
Plug	Terminal	Blue	NEUTRAL				
Plug	Terminal	Brown	HOT				

Cable 7700S512, 120V AC Cable Harness, conducts 120V ac inside the Servo Amp Box

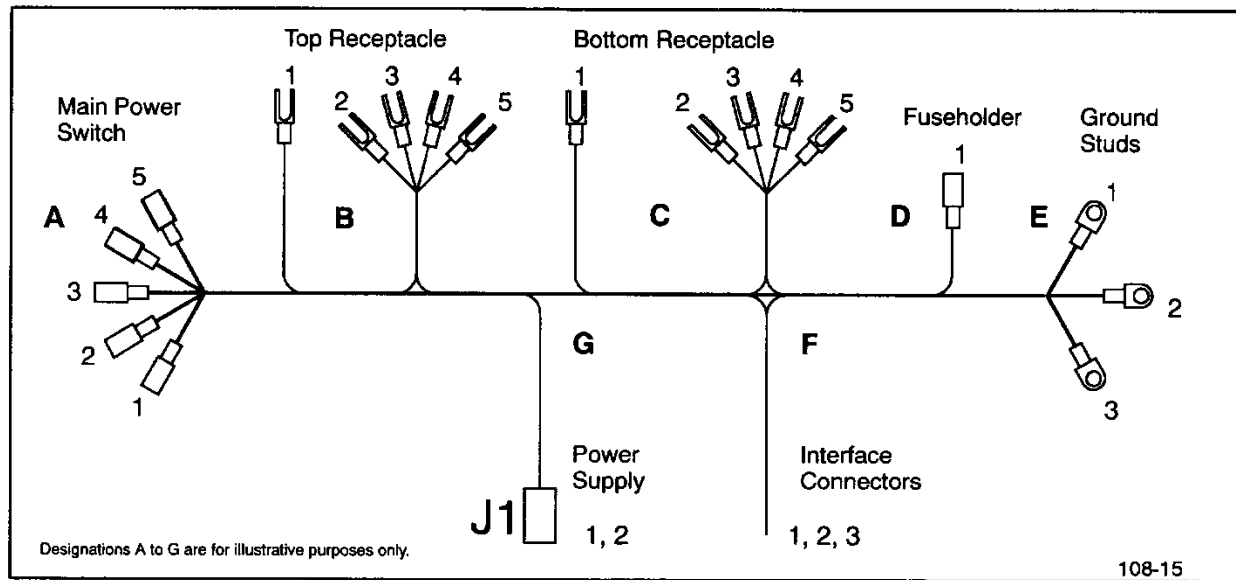


Figure 6-13 120V AC Cable Harness

The following list supplies the wire lead-to-terminal information.

FROM	TO	COLOR	SIGNAL	FROM	TO	COLOR	SIGNAL
A-1	G-1	White	NEUTRAL	C-5	B-3	White	NEUTRAL
A-2	G-2	Black	HOT	D-1	A-3	Black	HOT
A-3	D-1	Black	HOT	E-1	F-1	Green/ Yellow	GROUND
A-4	B-2	Black	HOT	E-2	C-1	Green/ Yellow	GROUND
A-5	C-2	White	NEUTRAL	E-3	B-1	Green/ Yellow	GROUND
B-1	E-3	Green/ Yellow	GROUND	F-1	E-1	Green/ Yellow	GROUND
B-2	A-4	Black	HOT	F-2	C-4	Black	HOT
B-3	C-5	White	NEUTRAL	F-3	B-4	White	NEUTRAL
B-4	F-3	White	NEUTRAL	G-1	A-1	White	NEUTRAL
B-5	C-3	Black	NEUTRAL	G-2	A-2	Black	HOT
C-1	E-2	Green/ Yellow	GROUND				
C-2	A-5	White	NEUTRAL				
C-3	B-5	Black	HOT				
C-4	F-2	Black	HOT				

Cable 7700S513, NDCB/AT Cable, connects P1 to J1 of NDCB and P2 to J2 of ATIC circuit board.

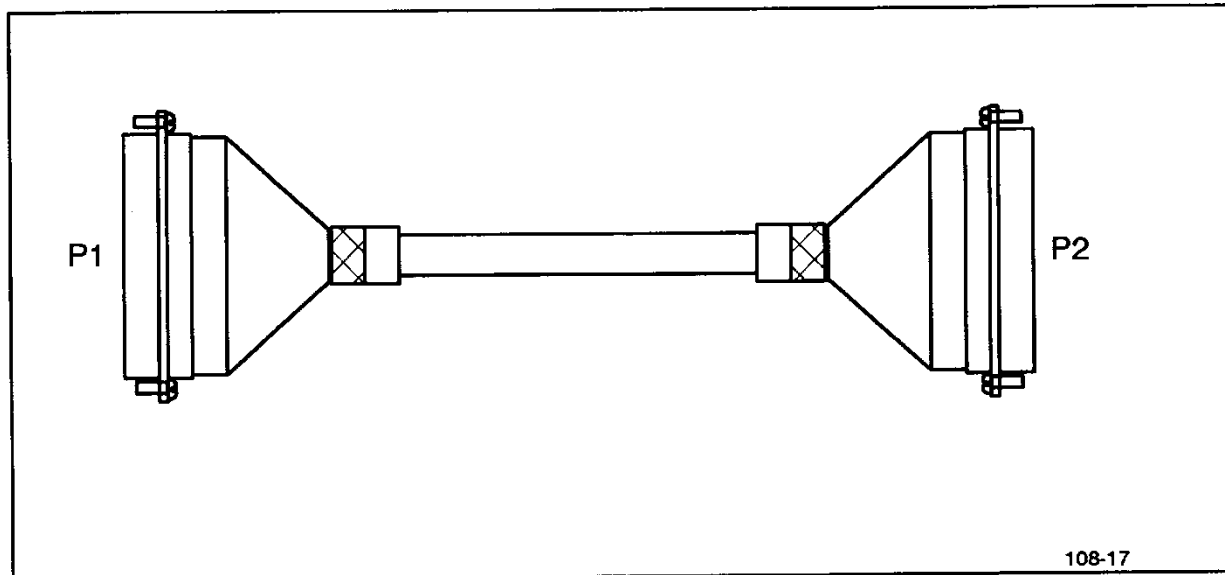


Figure 6-14 NDCB/AT Cable

The following list supplies pin-to-pin wiring information.

PAIR	FROM	TO	COLOR	SIGNAL	PAIR	FROM	TO	COLOR	SIGNAL
1	P1-1	P2-1	Red	BDCBSYC	9	P1-9	P2-9	Green	DCB5
	P1-22	P2-22	Black	GROUND		P1-30	P2-30	Red	GROUND
2	P1-2	P2-2	White	ATSYNCR	10	P1-10	P2-10	Blue	DCB6
	P1-23	P2-23	Black	GROUND		P1-31	P2-31	Red	GROUND
3	P1-3	P2-3	Green	RESETDCB	11	P1-11	P2-11	Yellow	DCB7
	P1-24	P2-24	Black	GROUND		P1-32	P2-32	Red	GROUND
4	P1-4	P2-4	Blue	DCBO	12	P1-12	P2-12	Brown	DCB8
	P1-25	P2-25	Black	GROUND		P1-33	P2-33	Red	GROUND
5	P1-5	P2-5	Yellow	DCB1	13	P1-13	P2-13	Orange	DCB9
	P1-26	P2-26	Black	GROUND		P1-34	P2-34	Red	GROUND
6	P1-6	P2-6	Brown	DCB2	14	P1-14	P2-14	White	DCB10
	P1-27	P2-27	Black	GROUND		P1-35	P2-35	Green	GROUND
7	P1-7	P2-7	Orange	DCB3	15	P1-15	P2-15	Blue	DCB11
	P1-28	P2-28	Black	GROUND		P1-36	P2-36	Green	GROUND
8	P1-8	P2-8	White	DCB4	16	P1-16	P2-16	Yellow	DCB12
	P1-29	P2-29	Red	GROUND		P1-37	P2-37	Green	GROUND



Cable 7700S692, Position Auxiliary Interface Cable, is supplied with NORM systems configured to support KINESTIM™ devices. The cable connects J1 to NDCB front panel and J2 to Auxiliary Interface Board.

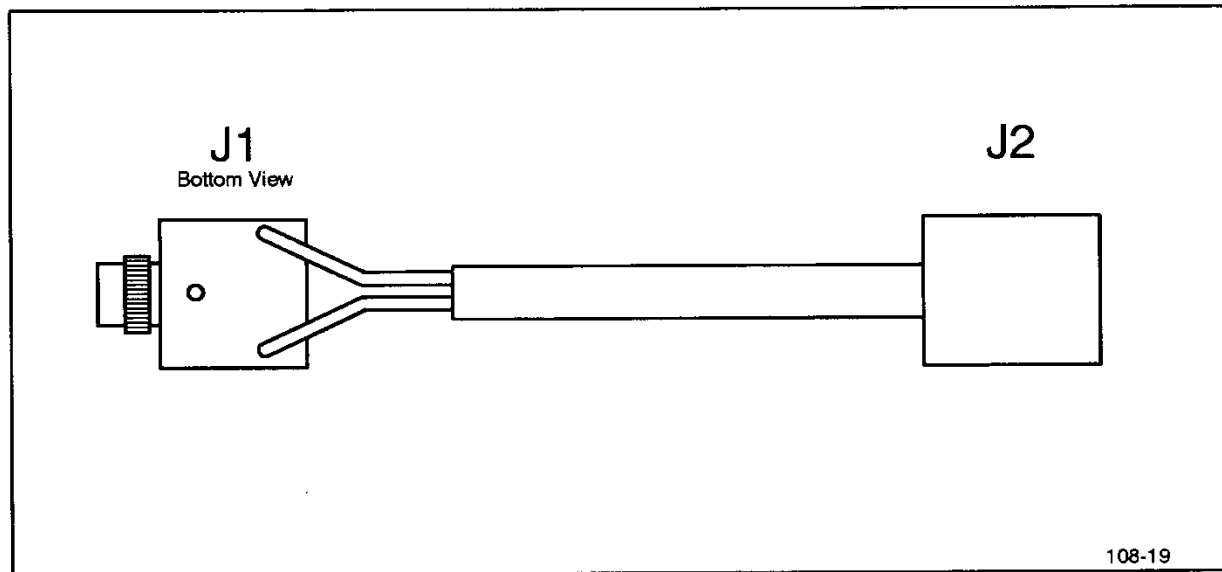


Figure 6-15 Position Auxiliary Interface Cable

The following list supplies pin-to-pin wiring information.

FROM J1	TO J2	COLOR	SIGNAL	FROM	TO	COLOR	SIGNAL
Tip	2	Red	POSITION				
Ring	1	Black	GROUND				
Sleeve	NC	-	SLEEVE				

Cable 7700S693, Torque Auxiliary Interface Cable, is an option supplied with NORM systems configured to support KINESTIM™ devices. The cable connects J1 to Auxiliary Interface Board and J2 to NDCB front panel.

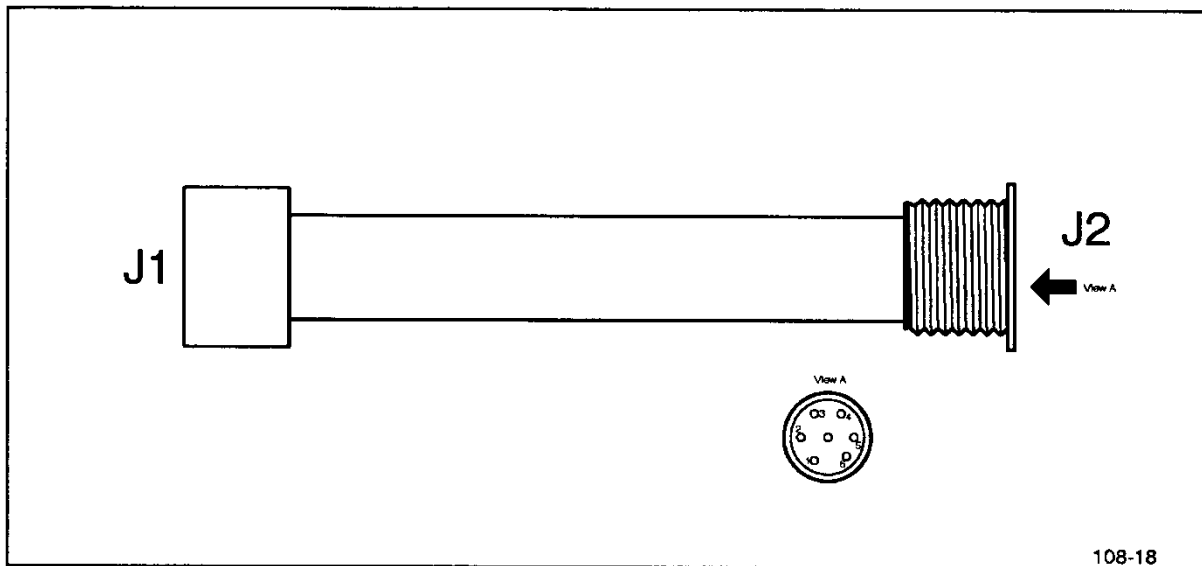


Figure 6-16 Torque Auxiliary Interface Cable

The following list supplies pin-to-pin wiring information.

FROM	TO	COLOR	SIGNAL	FROM	TO	COLOR	SIGNAL
J1-1	J2-6	Brown	TORQUE				
J1-2	NC	-	-				
J1-3	J2-5	Red	DIRECTION				
J1-4	J2-3	Black	AGND				
J1-5	J2-7	Gray	VELOCITY				

### SECTION 7. ELECTRONICS MODULE

#### ELECTRONICS MODULE

This chapter describes the equipments and devices that support the computer functions of the NORM system. These items are commercial-off-the-shelf (COTS) products that have been purchased by CSMi and integrated into the

NORM design and function. Additional information about the hardware described in this chapter may be found in the technical and user documentation provided by the manufacturer and shipped with the NORM system.

### COMPUTER

The computer currently used in the NORM system is powered either by an IBM-compatible 486 DX2 processor operating at 66 MHz or a Pentium™ processor operating at 133 or 166 MHz. The 486 system is configured with 8M random access memory (RAM), expandable to 128M with the installation of 72-pin SIMM (Single In-line Memory Module) integrated circuits. The Pentium system operates with 16M RAM and can be upgraded also to 128M (133 MHz system) or 256M (166 MHz system) with additional SIMMs. In both 486 and Pentium configurations, control and monitoring functions are supplied by the system board's Read Only Memory (ROM) Basic Input/Output System (BIOS). The system board used by the Pentium enlists several advanced features not available with 486 processors. Significant among these capabilities are: (a) Plug and Play support for new peripheral installations, (b) EDO (Extended Data Output) memory support for accelerated DRAM (Dynamic Random Access Memory) and Synchronous DRAM (166 MHz system) performance, and (c) PCI (Peripheral Component Interconnect) bus support, discussed in the following paragraph.

The design of the Pentium processor allows it to communicate with other PCI-compatible devices using 32-bit or 64-bit formats. Using the PCI bus enables the Pentium processor to optimize its bit transfer rates and to be forward-compatible with future hardware changes. In comparison, the 486 processor is VL (VESA Local) Bus-compatible and uses a VL-Bus adapter card for NORM applications. The VL bus employs a 32-bit format and operates at a speed dictated by the 486 processor.

### System Board

The 486-processor system board (Figure 7-1) supports all 486 processors and the Pentium OverDrive™ version. The Pentium-processor configuration supports Pentium, Cyrix™, and AMD™ processors. Both 486 and Pentium configurations employ auto-detect and auto-configuration features for CPU upgrades and memory expansions. Like the New Dynamometer Control Board (NDCB), the system board uses Flash EPROMs to retain its programmed data and to permit in-circuit updates.

The system board is configured to activate the 486- and Pentium-processor's internal memory cache and the system board's own external cache. By activating this feature, system BIOS and video BIOS are copied into RAM ("shadowed"), increasing the speed at which the computer can access data and perform multi-tasking functions. The system board supports 16K of internal (also called Level 1) write-back cache in the Pentium configuration, and either 8K or 16K of internal write-through/write-back cache in the 486-processor configuration (depending on the type of 486 processor installed). Additional external cache memory (Level 2, write-back or write-through) may be installed using the SRAM (Static Random Access Memory) sockets on the system board. With the appropriate jumper and configuration changes, the 133 MHz Pentium processor can use a pipelined burst cache, instead of external memory, to improve access times. For the 166 MHz processor, Level 2 pipelined burst cache is soldered on the system board.

To check configurations established by the system board, or to reset them, configuration screens are accessible after the computer's boot

process by pressing <CTRL> <ALT> <ESC> at the "C:\\" prompt. Typically, these screens are used after installing new hardware, but they can be useful in reconciling hardware conflicts. (The number of accessible screens will vary with the system board: the configurations set by the 486–processor system board are supplied on two configuration screens; those set by the Pentium–processor system board are displayed on four primary screens and several submenus).

A brief description of the configuration screens available with the 486–processor system board follows.

The first screen, the Main Screen, displays system time and date, settings for floppy and hard drives, settings for the video card, and microprocessor type, speed, and memory settings.

The second screen, the Extended Screen, displays additional system and video selections, including I/O port assignments, controller card speeds, password setup, and other system–performance options.

A brief description of the configuration screens and submenus available with the Pentium–processor system board follows.

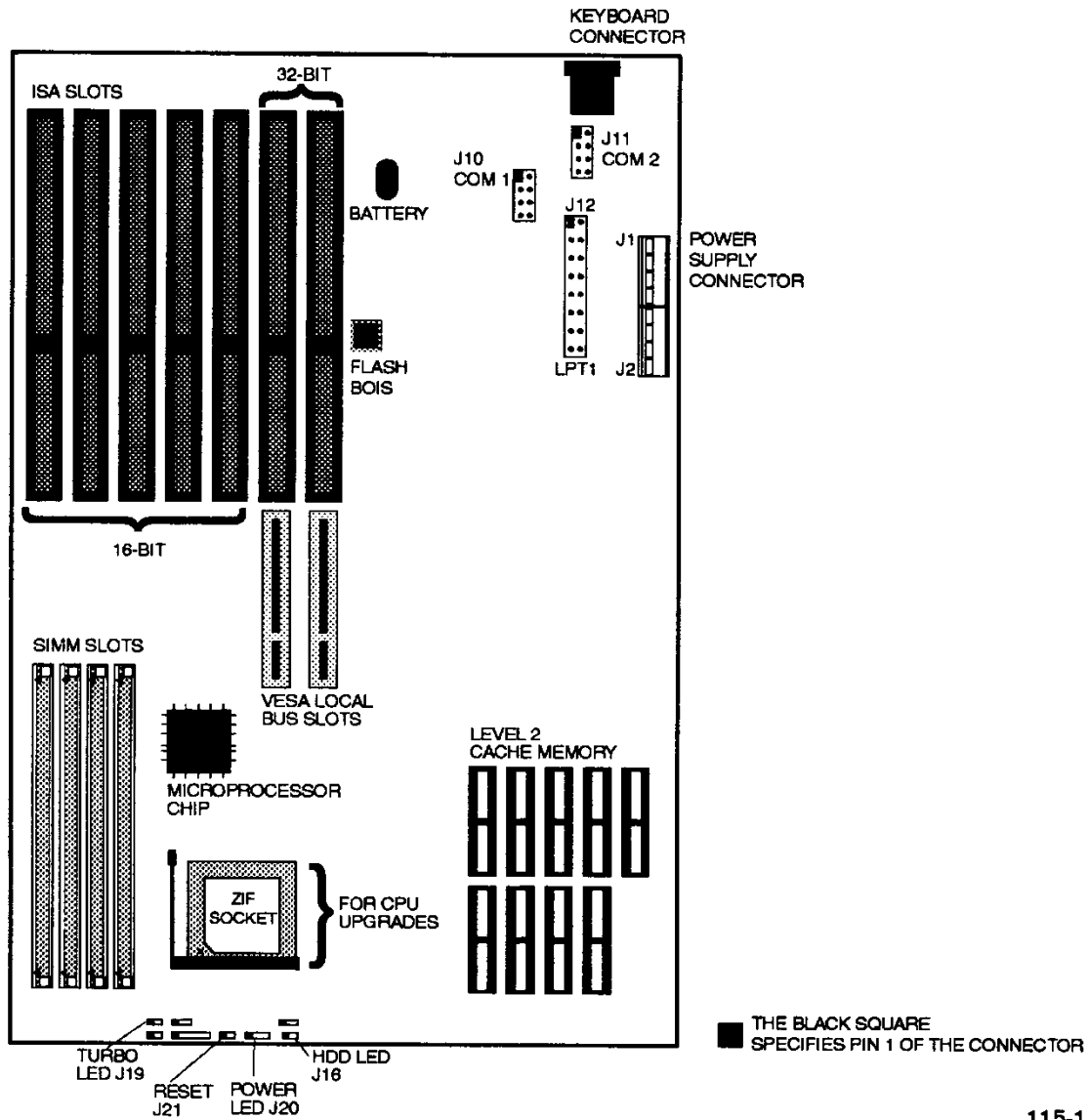
The Main Screen is used to set the time and date, to set the floppy drive types, to configure the hard disks, and to configure the video. The Boot Options Submenu, available at the Main Screen, can be used to set various options during the

system boot sequence (for example, which drives the system will check for a boot disk). The Advanced Screen and its Integrated Peripherals Submenu enable operating system options and several I/O–related settings. The Security Screen and its Supervisor Password Submenu allow two passwords, with varying system access, to be registered. The supervisor password permits complete system access, while the user password is limited to system only, not setup, permission. The Power Screen controls the power management functions of the system, enabling a standby timer to power down the display or spin down the hard drive. (Support for hard disk drive spin–down is not available on all systems.) The timer will restore the system to its normal operating state when certain external events occur; for example, a keyboard stroke or mouse movement. These events can be modified at the Power Screen.

The system board serves as the connection point for various peripherals and computer chassis connections. The connectors for two high–speed serial ports (COM 1 and COM 2) and one bi–directional parallel port (LPT 1) are located here, as are the power supply, optional tape drive, and keyboard connectors. The system board for the Pentium processor includes support for additional hard disk and floppy drives and for enhanced parallel port performance. The connectors for front panel LEDs and hard–key pushbutton switches are also located on the system board and are described below.

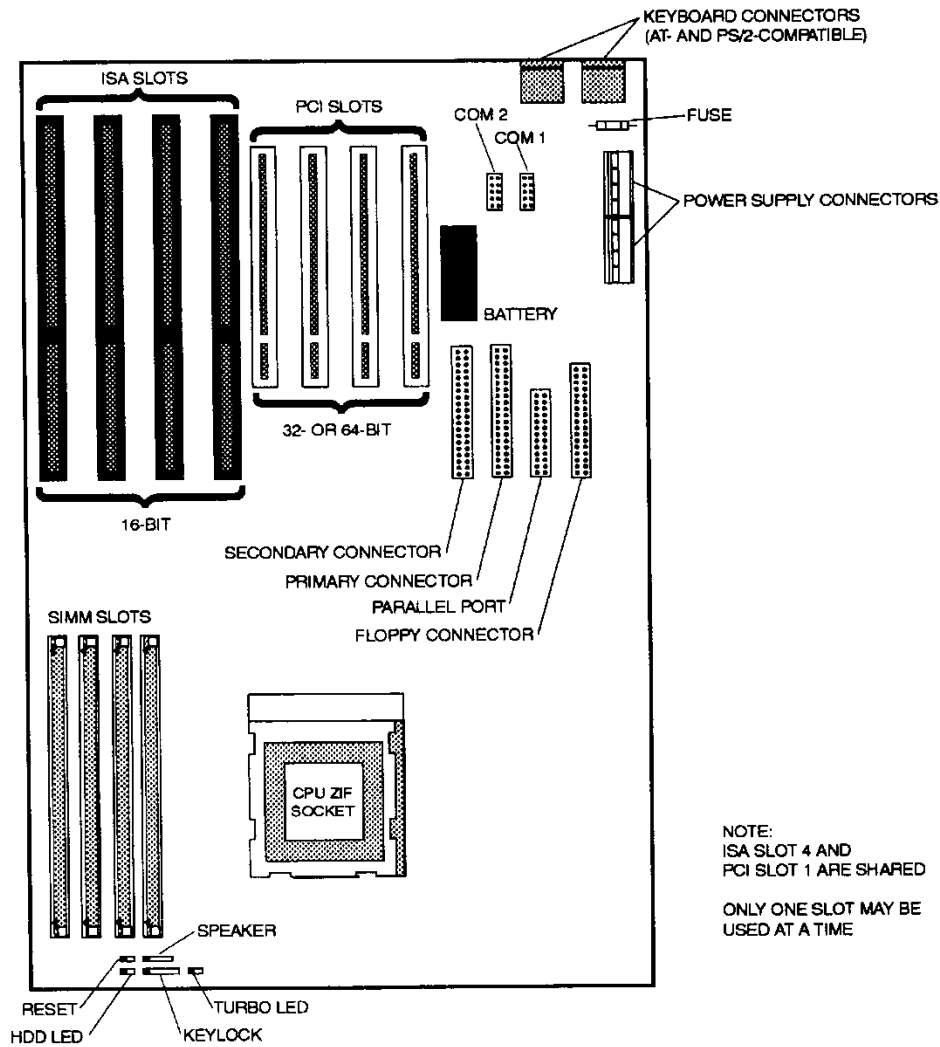
<b>COMPUTER FRONT PANEL CONTROL/ INDICATOR</b>	<b>INDICATION</b>	<b>486 DX2-66 PROCESSOR SYSTEM BOARD CONNECTOR</b>	<b>PENTIUM PROCESSOR SYSTEM BOARD CONNECTOR</b>	<b>DESCRIPTION</b>
POWER LED	Green	J20	J35	Illuminates and remains steady when computer is receiving power
TURBO LED	Orange	J19	J39	Illuminates and remains steady during computer operation because the microprocessor is accessing cacheable memory
HDD (Hard Disk Drive) LED	Yellow	J16	J34	Illuminates and flashes when computer is accessing information on its hard disk drive
RESET pushbutton	None	J21	J32	When pressed, computer reboots
TURBO pushbutton (See NOTE)	None	J18	None	Not used in NORM application

NOTE: Indicator not present on computer front panel in Pentium system board configuration.



115-1

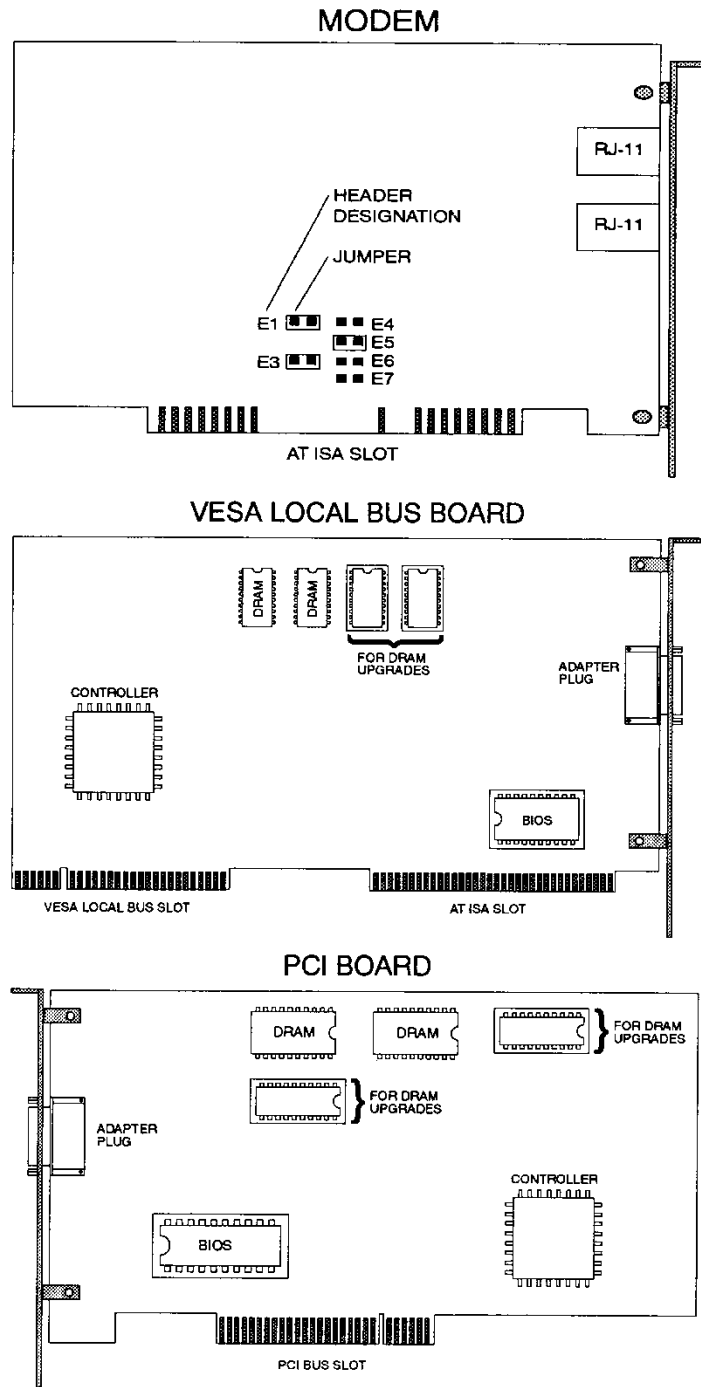
Figure 7-1 Typical System Board for Pentium Processor



136-1

Figure 7-2 Typical System Board for Pentium Processor





116-1

Figure 7-3 Typical Modem and Video Adapter Boards

### Modem

The modem (Figure 7-3) provides the essential hardware link between the computer and the telephone network. The modem installed in the NORM system operates on all standard dial-up lines and is capable of communicating at either 28,800 bits per second (bps) (133 MHz system) or 56,000 bps (166 MHz system). For NORM applications the modem is used to access isokinetic database information using NORMA™ software from CSMi in cooperation with Worldwide Data Management (WDM) Company.

The modem supplied with the NORM system is IBM-compatible and is installed in one of the six ISA (Industry Standard Architecture) slots in the system board. The modem requires one available logical communications port (COM 1 (default) or COM 3 for NORM) and an addressable IRQ line (IRQ 4 for NORM). COM port selections and IRQ settings are made by placing jumpers at the appropriate headers (E1 and E3 for COM 1, E1 for COM 3, and E5 for IRQ 4).

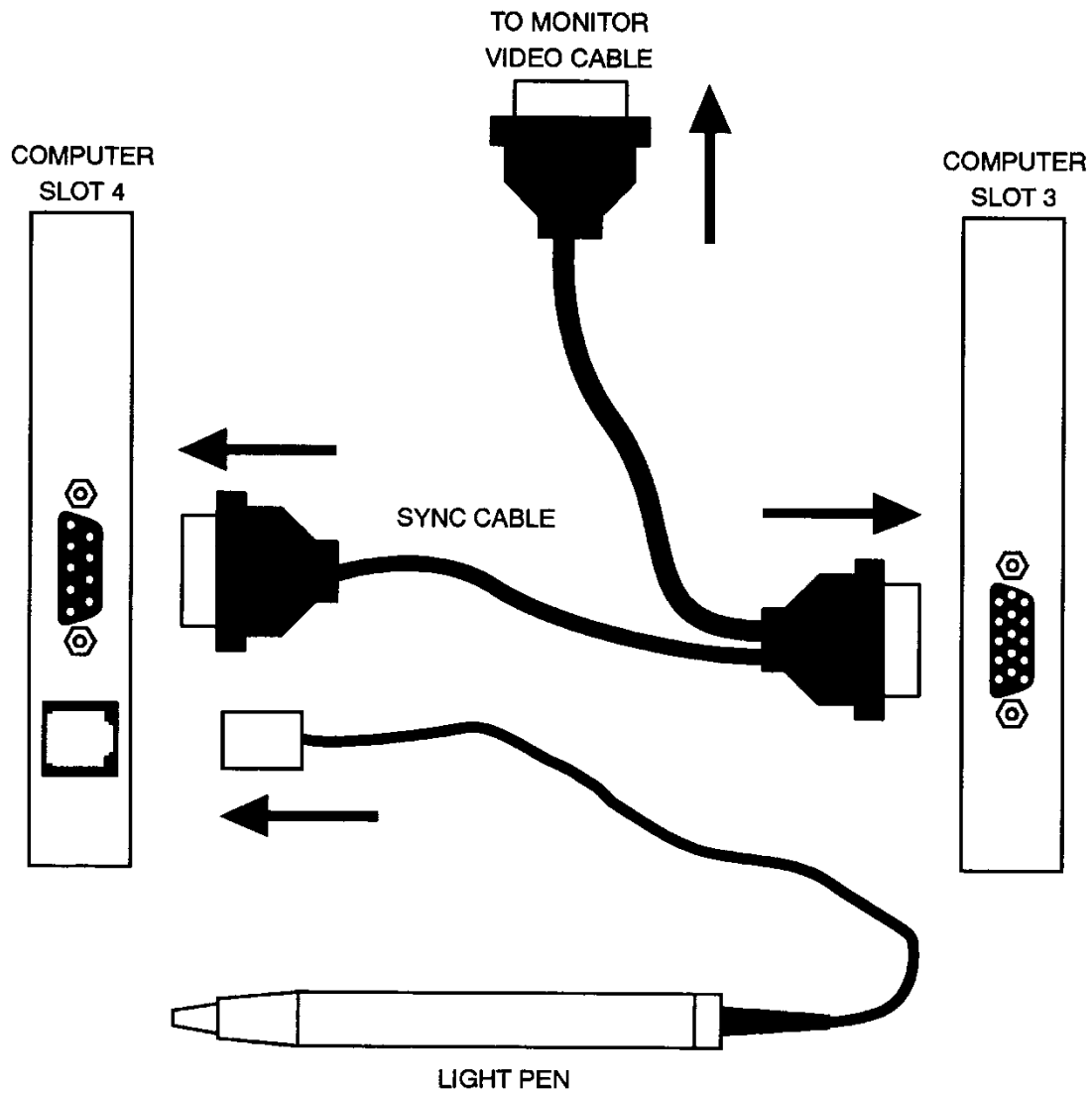
The modem has two modular telephone connectors (RJ-11 jacks) which connect to the RJ-11 jack of a telephone service outlet or to a telephone. The modem's RJ-11 jacks can be used interchangeably.

### Video Adapter Board

Video adapter boards enhance the graphics interface by supporting true color palettes,

SVGA-compatible display resolutions, and high-speed image transfer rates available with the current range of color monitors. Two types of video boards are available with the NORM system: (a) the VL bus adapter, which uses the 486-powered system board and provides 32-bit support, and (b) the PCI adapter, which uses the Pentium-powered system board and provides 64-bit support. Figure 7-3 describes each adapter.

Both the VL (VESA Local) and the PCI (Peripheral Component Interconnect) adapter boards provide accelerated graphics performance and true-color imaging using 1 MB of on-board Dynamic Random Access Memory (DRAM), expandable to 2 MB (133 MHz system), or 2 MB of RAM upgradable to 4 MB (166 MHz system). In addition, the PCI board utilizes the accelerated display drivers designed for Microsoft Windows and other GUI (Graphical User Interface) environments. The VL board seats into one of the system board's 32-bit VESA Local Bus expansion slots; the PCI board seats into one of the 32-bit PCI slots. Both video adapter boards have one edge-mounted 15-pin connector which mates with one of the sync cable's 15-pin plugs. Both boards require no jumpers or switches to set, and the utility software and display drivers they require to run are down-loaded from disks supplied with the boards.



117-1

Figure 7-4 Light Pen Device and Cable Connections

### Light Pen

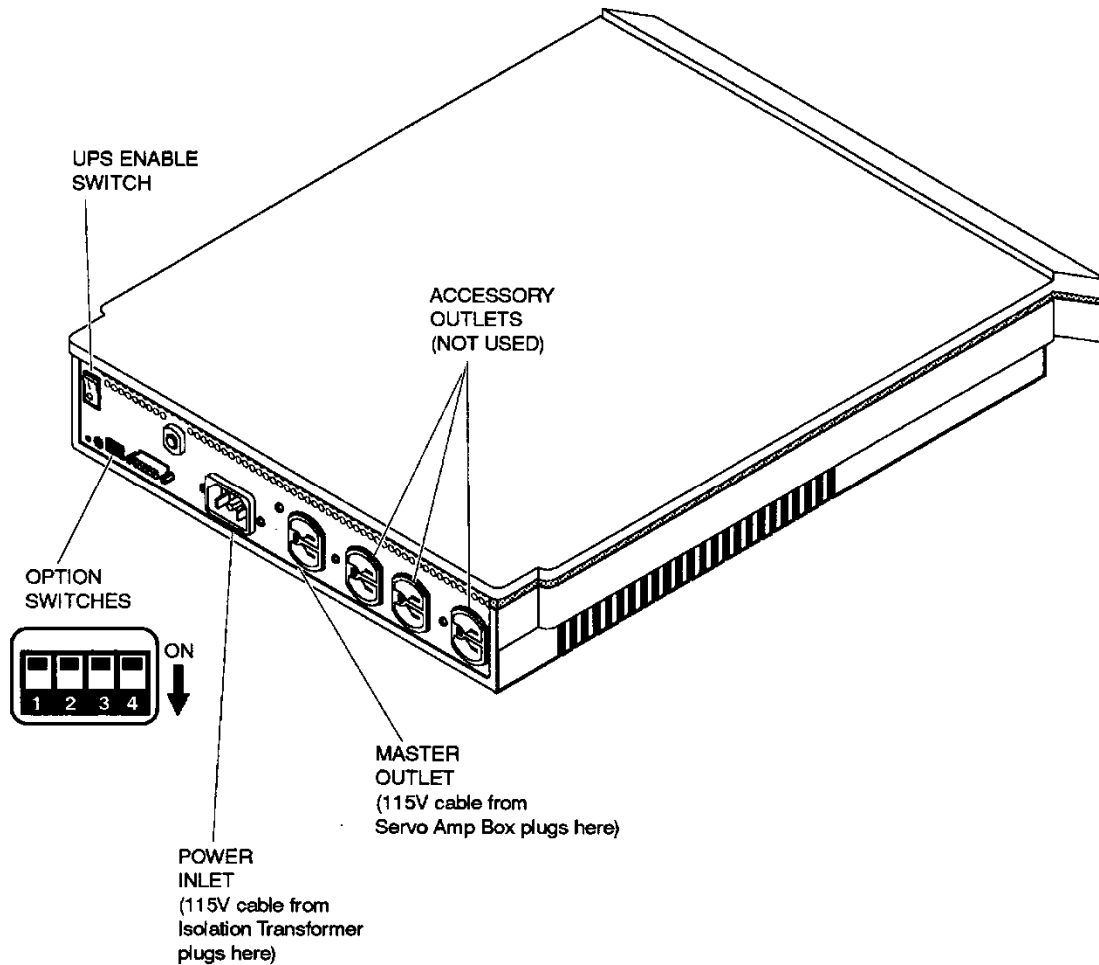
The light pen (Figure 7-4) is used in the NORM system as a point-and-click peripheral. It provides the same functions of a mouse device, but requires less work space and is easier to use. Light pen functions are controlled by the light pen board and software drivers. The light pen board is installed in one of the ISA slots on the system board and uses two edge-mounted connectors for light pen and video cable connections.

The light pen board uses one of twelve I/O addresses to communicate with the NORM computer. In the NORM System, 210H is the base address, which is also the factory default setting. This address was enabled by making the following switch settings on the light pen board.

SWITCH S1	1	2	3	4
SETTING	OFF	ON	ON	ON

An external sync cable (Y-shaped) supplies the interface between the light pen board, the system video board, and monitor video cable. The sync cable plugs into a 9-pin connector at the computer light pen board, and two 15-pin connectors at the video cable and the computer video board.





## **OPTION SWITCH SETTINGS:**

### **1. UPS SENSITIVITY**

Set to ON if installation site has unusually high or distorted line voltage.

### **2. OUTPUT/TRANSFER VOLTAGES**

Set to ON for 115V, OFF for 120V (N/A on 100V units).

### **3. AUDIBLE ALARM DELAY**

Set to ON to prevent alarm from sounding during brief power disturbances.

### **4. DEFEAT AUTO TURN ON**

Set to ON to turn UPS on whenever the ENABLE switch is on.

118-1

Figure 7-5 Uninterruptible Power Supply.

### UNINTERRUPTIBLE POWER SUPPLY

The uninterruptible power supply (UPS) (Figure 7-5) is designed to provide reliable ac power to computer loads with a minimum of signal noise, optimal surge suppression, and rapid response in the event of severe voltage sag or failure. The UPS is line-interactive: it continuously monitors utility power to compensate for minor voltage fluctuations and prepares its circuitry to supply battery backup if major outages occur. When utility line voltage fails, the UPS transfers all loads to battery power, typically within 2 milliseconds. The output voltage from the UPS during a utility failure is a low-distortion waveform, allowing a clean return to on-line operations when utility power is restored.

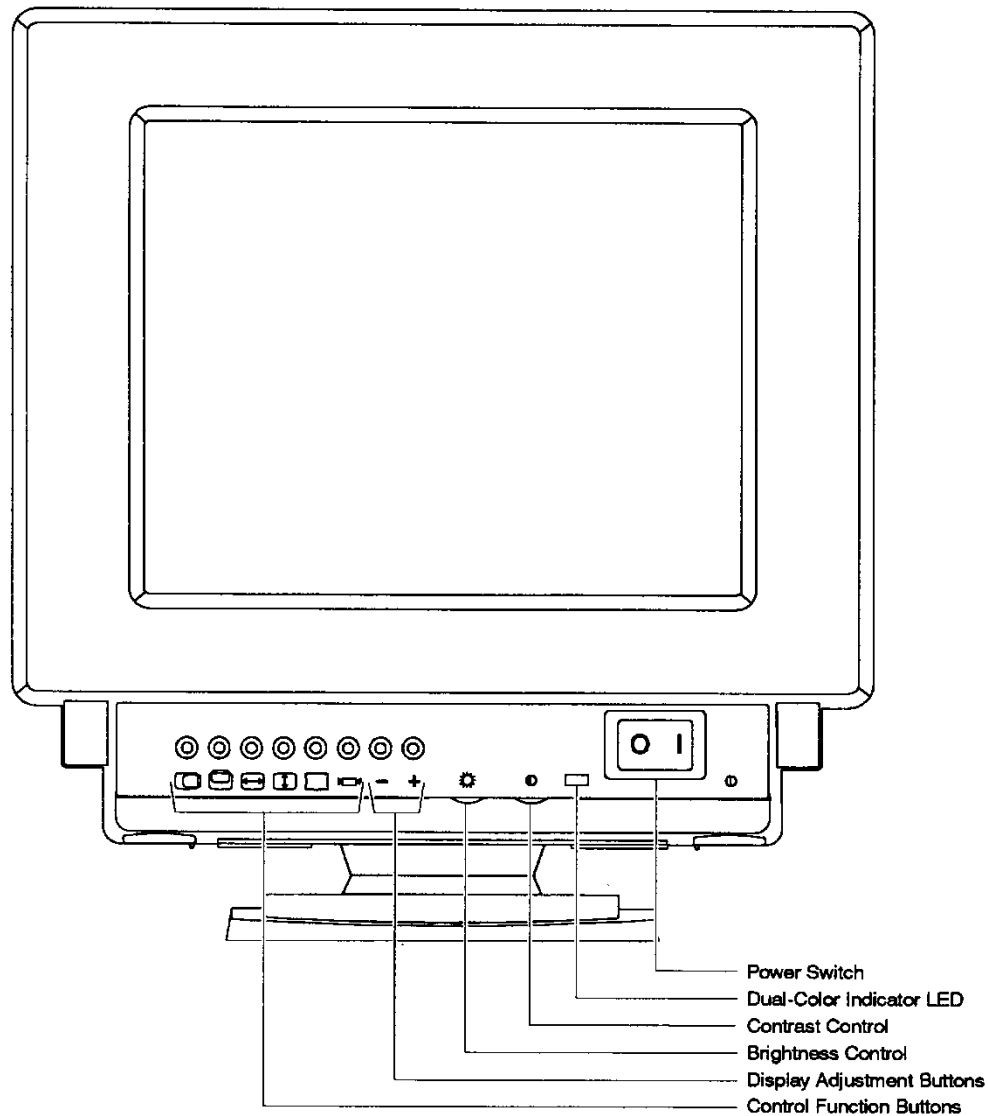
At startup the UPS performs a brief self test to determine its capacity to support computer loads on battery power. During this test the UPS operates the loads from its battery source for a few seconds and then returns to line power. If the battery charge level is low, the UPS will immediately return all loads to line power and will emit a sequence of short beeps for one minute. The UPS will continue to emit short beeps once every five hours until a successful battery test is completed.

Other audible alarms may occur during UPS operation. When the loads supported by the UPS exceed its rated capacity, the UPS emits a loud, sustained tone. If the overload occurs while the UPS is operating on line power, the alarm continues until the overload condition is corrected. If the overload occurs while the UPS is operating on battery power, the alarm continues until the UPS ENABLE switch on the back panel is turned off.

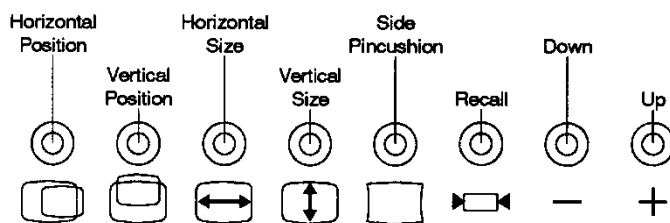
While the UPS is operating on battery power, it emits four short beeps every 30 seconds until it reaches its low-battery threshold. After this point, the UPS beeps steadily to indicate less than 2 minutes of battery power remains. The 2-minute low-battery warning interval is a default setting and may be changed by repositioning one of the UPS option switches.

When supplied with the NORM system, the UPS is located inside an enclosure that includes the Servo Amp Box, the connector section of the Computer, and much of the cabling between the Servo Amp Box and the Computer connectors. The design reflects the need to secure this critical protection device and to minimize the trip hazard caused by the many equipment interface cables.

## FRONT VIEW



## CONTROL PANEL



119-1

Figure 7-6 Computer Monitor





### MONITOR

The typical monitor (Figure 7-6) supplied with the NORM system is a 15-inch flat-screen color monitor providing resolutions up to 1024 (dots horizontal) × 768 (lines vertical) at 0.28 dot pitch. The monitor's power supply can accept 100–240 ac voltages, making the equipment compatible with utility services worldwide. In terms of image quality, the monitor supports an unlimited number of colors at screen refresh rates that provide stable, flicker-free displays.

When power is applied to the monitor, its dual-color LED indicator illuminates green. If the operator adjusts the screen display by selecting one of the six Control Function switches on the

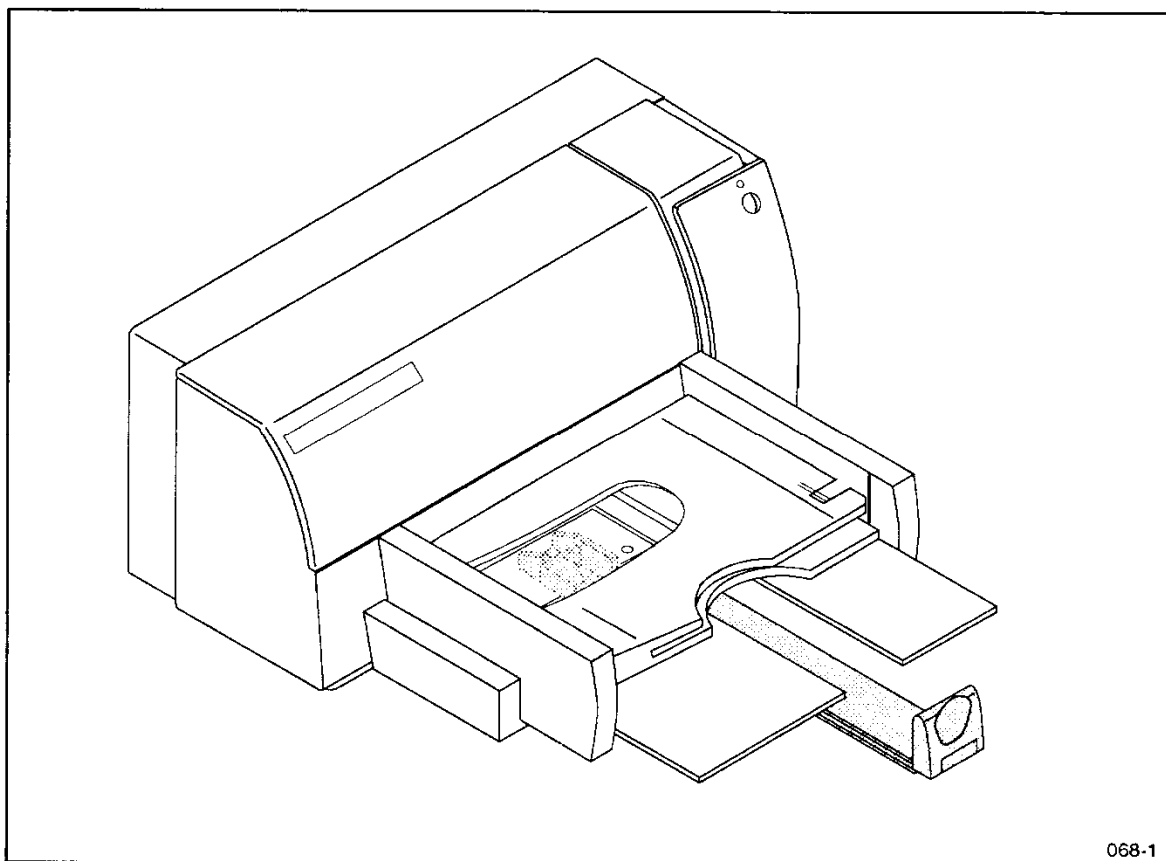
front panel, the indicator changes to orange. Five of the buttons adjust horizontal size and position, vertical size and position, and vertical shape (called SIDE PINCUSHION). The sixth button, RECALL, returns adjusted functions to their factory settings. After one of the screen adjustment switches is enabled, the Display Adjustment buttons (also accessible from the front panel) are used to increase (UP) or decrease (DOWN) the value of the selected function. After memorizing the new setting, the monitor will turn the LED indicator green, typically 3 to 4 seconds after the adjustment is made.

### PRINTER

The printer available with the NORM system is a thermal inkjet printer capable of black and color printing on a wide number of paper media sizes and weights. The printer is compatible with Windows- and DOS-based software programs and includes support for Windows-based TrueType™ fonts. Depending on the type of paper media used for printing and the type of print mode selected, the printer provides graphic resolutions of 600 x 600 dpi (dots per inch) for black print and 600 x 300 dpi for black and color. The amount of time required to output a page also varies by print mode (and other factors as well), with maximum resolution color products needing the longest time to compose.

The printer software automatically establishes color printing as the default value and selects the AUTOMATIC button at the ColorSmart dialog box. This feature applies drop-on-demand color matching while the page is printing. In some instances a non-color draft product is preferable to one in color, for faster time-to-print speeds and reduced color cartridge usage. A grayscale option is available, which uses gray tones to approximate color contrasts and to provide a good sample of how the color product will print. For grayscale printing, the PRINT IN GRAYSCALE option is selected at the ColorSmart dialog box.

The printer uses a power module (available in several input voltages) and a parallel printer cable. The power module connects to one of the Servo Amp 115V receptacles, and the printer cable connects to slot 2 of the Computer.



068-1

Figure 7-7 Color Printer

## TAPE DRIVE

The back-up tape drive (Figure 7-8) is installed internally in a 3.5-inch drive bay in the computer chassis. The tape drive (in the 133 MHz system) can store up to 400 MB of data on a single tape (uncompressed) or 800 MB on a single tape (using a software-defined data-compression option). (In the 166 MHz system, the back-up capability is 1600 MB (normal) and 3200 MB with data compression.) The speed at which the drive transfers data to tape depends on the floppy disk controller (residing on the system board in the 133 MHz system) or a separate controller card (used in the 166 MHz system).

At the back of the tape drive are two connectors (data and power) and one jumper. (The jumper

is reset only if the floppy disk controller does not recognize the tape drive and "hard selects" it.) Cables from the data and power connectors terminate on the system board. At the front of the tape drive is a single LED which illuminates when tape operations are in process. The tape should be ejected only when the LED is extinguished.

Files can be backed up immediately (on demand) or automatically (according to a pre-determined schedule). In either case, the backup software will display the necessary steps and optional settings to perform tape operations. To perform scheduled back-ups, the computer must be powered on and Windows must be running.

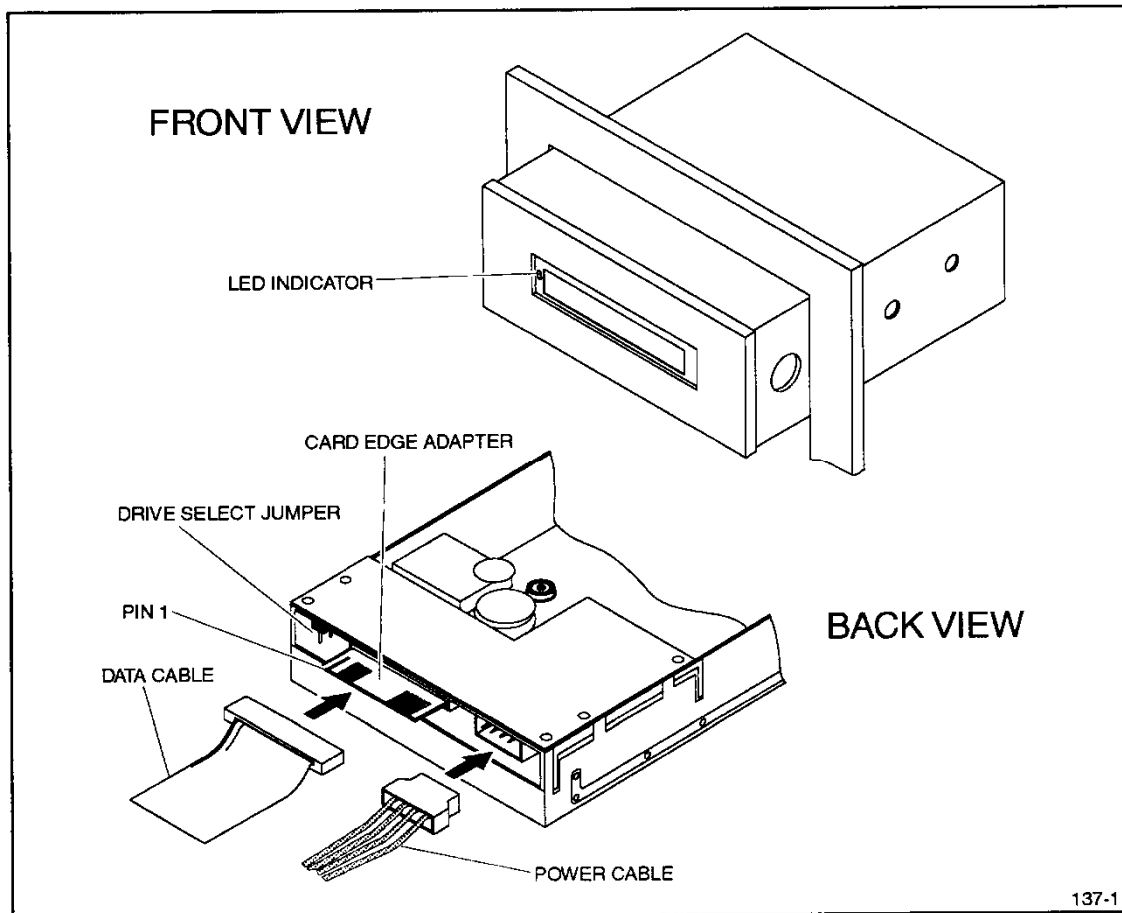


Figure 7-8 Tape Drive

*NOTES:*



### **SECTION 8.        DYNAMOMETER DYNAMOMETER**

This chapter describes the general functions of the Dynamometer, the primary parts and sub-assemblies that support its operation, some basic troubleshooting guidance, and procedures to remove and replace failed units.

This chapter assumes the initial set-up of the Dynamometer has been accomplished. For instructions on initial Dynamometer set-up procedures, refer to the Assembly and Installation manual. For instructions on how to adjust the Dynamometer's position, to set Range of Motion (ROM) stops, or to use input adapters, refer to the User's Guide manual. For information on preparing the Dynamometer as part of the patient set-up procedure, refer to the Quick Start manual.

## DYNAMOMETER FUNCTION

The Dynamometer is the focal point for the physical actions performed on and tested by the NORM system. The Dynamometer's primary function is to measure the torque produced by a patient during testing and to respond with appropriate resistance. How the Dynamometer responds, meaning how much resistance it applies in response to the torque produced by a patient's movement, depends on test parameters established by the clinician. Typically, there are four test parameters that define the Dynamometer's operation:

- Operating Mode
- Action Type

- Operating Speed
- Range of Motion (ROM) stop settings.

Specific information on these parameters and how they are set before a testing or rehabilitation session may be found in the User's Guide manual.

The test parameters that define the Dynamometer's response to a patient's activity are entered by the clinician at the Dynamometer Control Window. This is the first window displayed at the computer monitor after the NORM System Application is entered. See Figure 8-1.

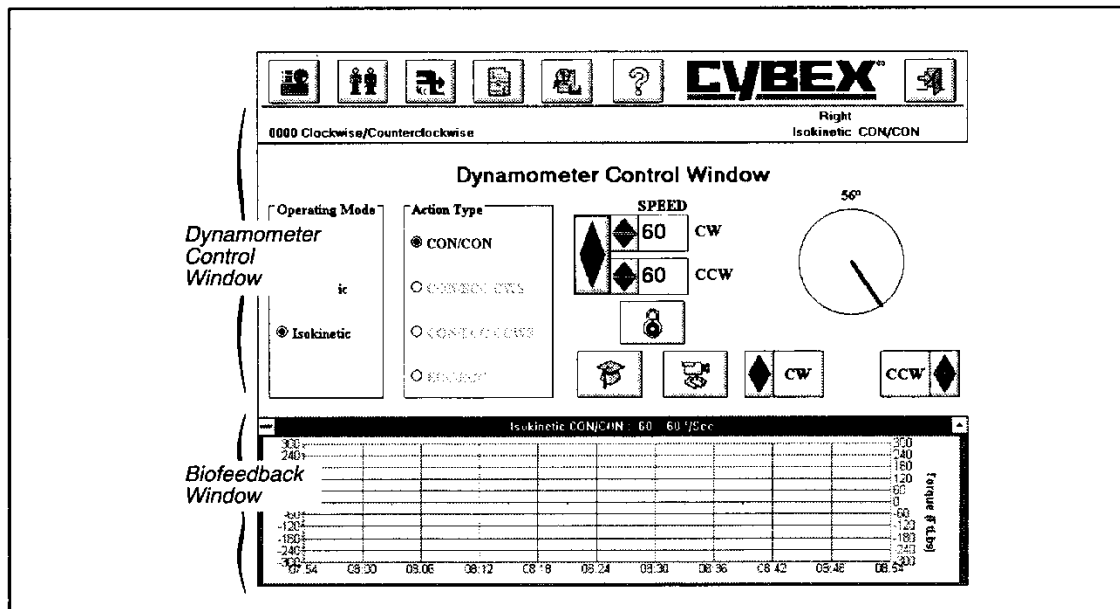


Figure 8-1 Dynamometer Control Window

The parameters entered at the monitor are accessed by the ATIC (Advanced Technology Input Card) in the Computer. The ATIC forms the communication bridge between the Computer (which receives the working range and limits on how the Dynamometer should operate) and the New Dynamometer Control Board (NDCB)

(which uses that data to control how the Dynamometer will operate).

The ATIC plugs into the Computer's system board and receives +5V and +/-12V dc power to enable its microcircuit functions. The ATIC's J3 connector acquires critical Dynamometer data



by tapping COM 2, one of the Computer's serial interface ports. The ATIC processes this data and transmits it to the NDCB.

The serial communication between the ATIC and the NDCB occurs bi-directionally, using an RS-232 interface. This communication allows the ATIC to receive filtered torque data from the NDCB. It also allows the ATIC to transmit the parameter data the NDCB needs to control the Dynamometer. The NDCB controls the Dynamometer by monitoring and reacting to the following factors:

- a. the position of the Dynamometer's input arm
- b. the direction and speed it travels
- c. its range of motion
- d. how much torque is produced as it moves.

The following paragraphs discuss each of these factors.

The position of the Dynamometer input arm is determined by the rotation of the Dynamometer encoder and the Dynamometer input arm. The encoder rotates four times for each rotation of the Dynamometer input arm, producing output pulses that can be used to measure input arm position and direction. To determine the position of the input arm, an index pulse (I) is read by the firmware every 45 degrees of input arm rotation. If the actual position of the input arm varies by more than 1/2 degree from its relative (calibrated) position, the encoder may be faulting and the NDCB will command the Servo Amp to remove power from the Dynamometer motor.

To determine the direction in which the Dynamometer input arm is travelling (clockwise or counter-clockwise), encoder phase outputs

(A and B) are read by the firmware after each complete phase cycle. Direction is determined by reading the state of phase A while phase B is falling. If phase A is low while phase B is falling, the encoder is rotating clockwise. If phase A is high while phase B is falling, the encoder is rotating counter-clockwise.

To determine the speed at which the Dynamometer input arm travels, the Speed Control digital-to-analog converter (DAC) on the NDCB is addressed by the on-board microprocessor. The converter produces bipolar outputs (VCS+ and VCS-) that vary in the +10V to -10V range and are applied to the Servo Amp. The value of these outputs determines the Dynamometer's motor speed: +10V sets the motor at maximum clockwise speed, 0V at zero speed, and -10V at maximum counter-clockwise speed. The maximum speed in either direction is 500 Dynamometer arm degrees per second.

To determine the range of motion (ROM) of the Dynamometer input arm, two separate sets of data are collected. These data correspond to the two kinds of stops, software and mechanical, that limit the arc described by the Dynamometer input arm as it moves. The stops provide an important, redundant safety feature: ensuring that the movement of the tested limb never exceeds the range determined initially by the application software and revised subsequently (if necessary) by the clinician. Position of the software stops is part of the parameter information transmitted serially from the ATIC to the NDCB. This data is also displayed graphically, in degrees, at the Dynamometer Control Window. The color and letter of each selected ROM stop are shown exactly on the screen.

To determine the amount of torque produced as the Dynamometer input arm travels, the analog

torque signal from the Dynamometer is processed and digitized. Torque data is acquired and filtered by the NDCB's Digital Signal Processor (DSP), which uses the Torque Signal analog-to-digital converter (ADC) to accomplish the digital conversion. The DSP then sends the converted data over parallel I/O lines to the microprocessor. This transfer occurs bi-directionally: as filtered digital data is available

for the microprocessor to access, new torque data becomes available for the DSP to process. The DSP's filtering (damping) value and the ADC's sampling rate are both determined by the microprocessor. The maximum amount of torque produced by the Dynamometer input arm, moving concentrically in either direction, is 500 foot-pounds.

### DYNAMOMETER ASSEMBLY DESCRIPTION

The Dynamometer includes several primary parts and subassemblies, as shown in Figure 8–2. Each item is described briefly in the following paragraphs, beginning at the top of the Dynamometer assembly (the ROM ring) and concluding at the bottom (the Dynamometer housing).

#### Range of Motion Ring

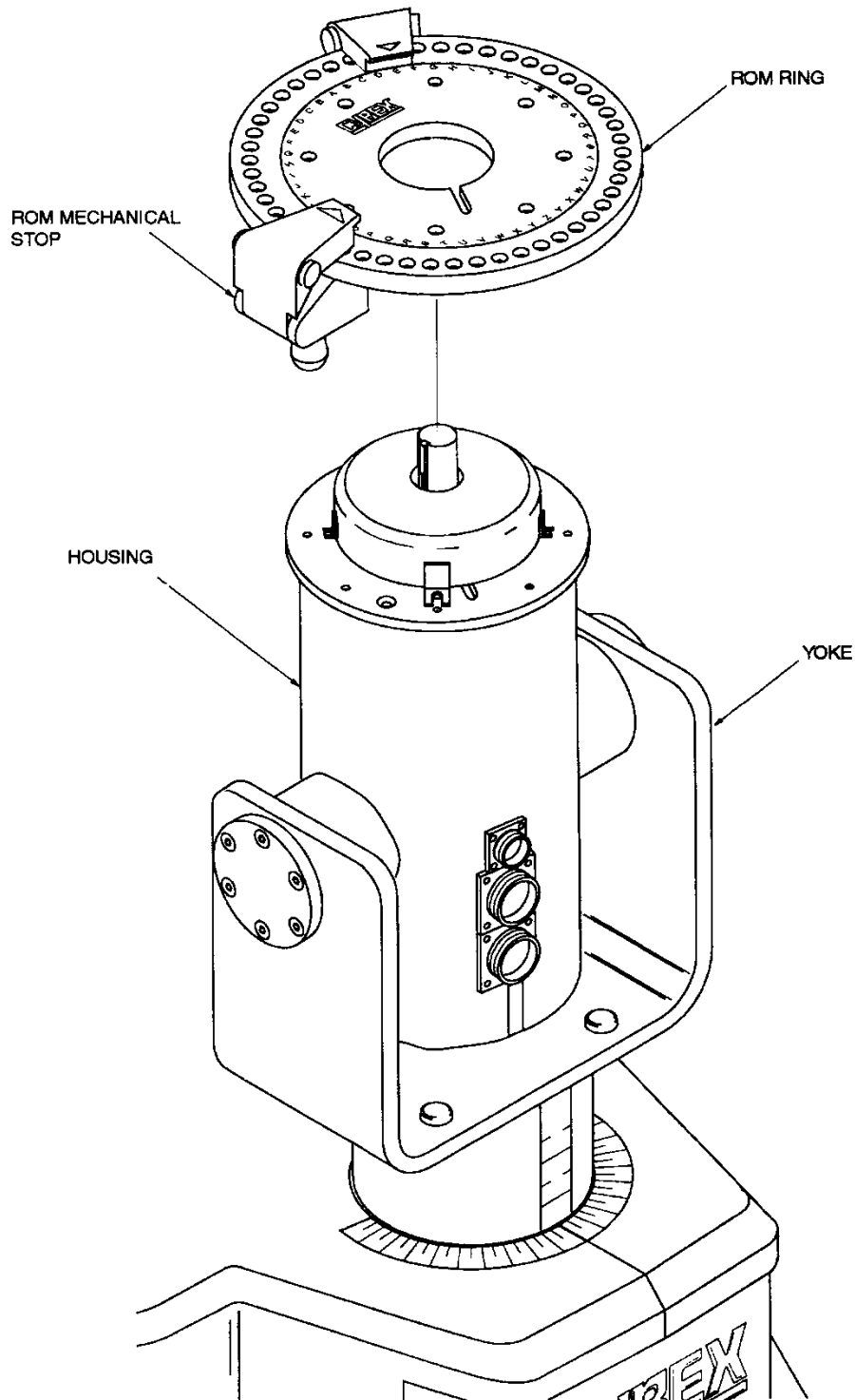
The Range of Motion (ROM) Ring (Figure 8–2) is seated under the input arm adapter and aligns with it via a slotted keyway. The ring is drilled with 50 ROM positions, lettered A to Z (white) and B to Y (teal), corresponding to left limb (white) or right limb (teal) settings. Mechanical ROM positions are selected when each stop clamp engages a ring hole and secures it by locking the pin of the clamp's release knob into position.

#### Dynamometer Module Subassembly

The Dynamometer Module Subassembly (Figure 8–3) is accessible when the ROM Ring Subassembly is removed. The Dynamometer Module Subassembly contains the following replaceable parts, discussed separately below.

- a. Torque Board
- b. Stator Board
- c. Mounting Plate
- d. Motor.

Parts in this subassembly perform two critical tasks. The first task (accomplished by the Torque Board and Stator Board) requires sensing the torque at the input arm shaft, amplifying the values, and transmitting torque data to the NDCB. The second task (accomplished by the Motor and its encoder element) requires tracking the movement of the input arm and applying the power provided by the Servo Amp to meet that movement with the appropriate resistance.



044-2

Figure 8-2 Dynamometer Assembly

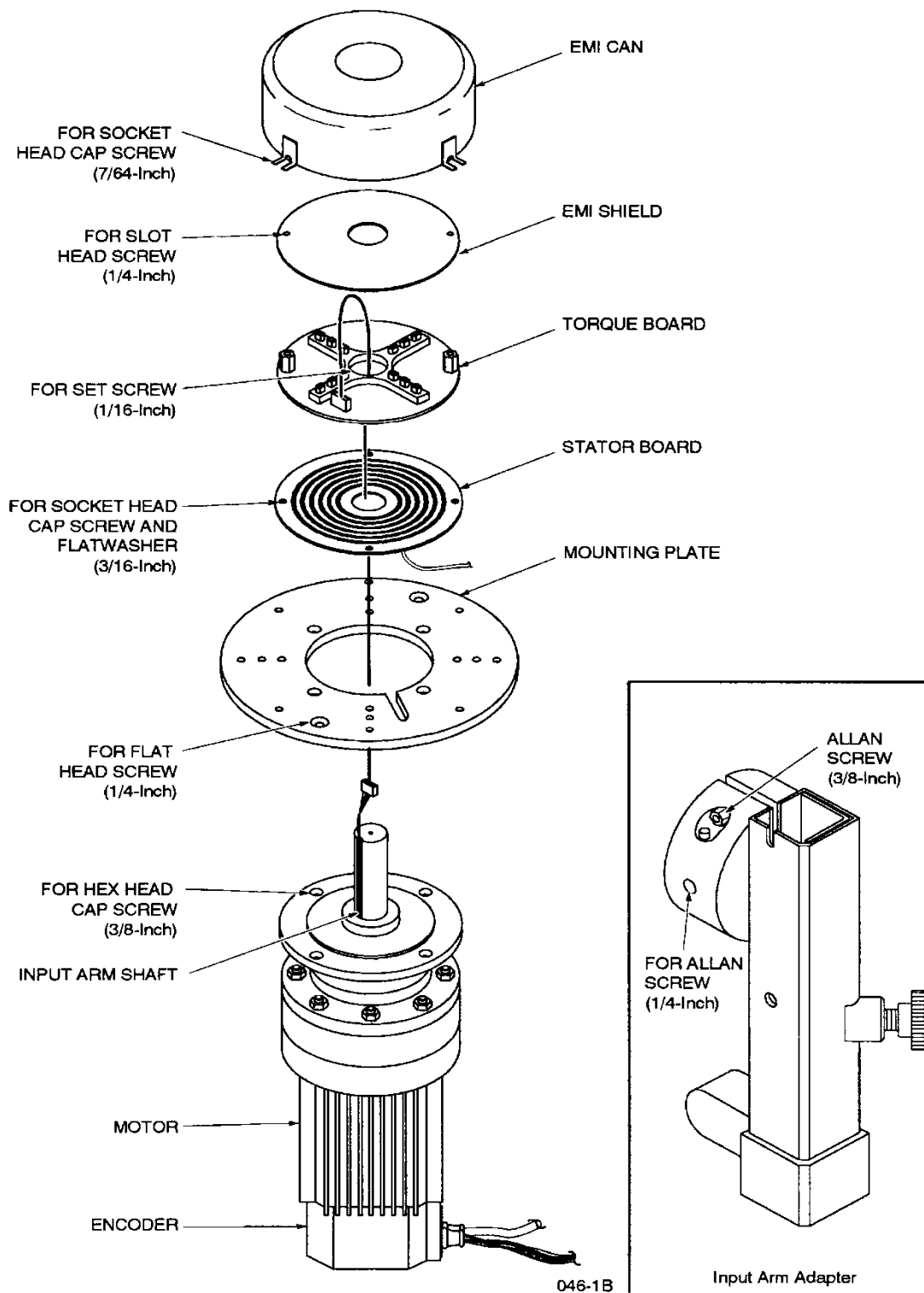


Figure 8-3 Dynamometer Module Subassembly

**Torque Board:** Supplies the required 10V dc to excite the four strain gages bonded around the Dynamometer input shaft. These gages (connected electrically as a Wheatstone–Bridge circuit) measure the changes in torque as the input arm moves and output two 5V returns to the Torque Board. The voltage is positive when the input arm is moving clockwise; negative when the arm is moving counter–clockwise. The returns from the bridge circuit are amplified and buffered on the Torque Board and output as +/- 10V torque signals to the Stator Board.

**Stator Board:** Supplies the Torque Board with +/- 15V dc power from the NDCB. Brushes on the Torque Board ride along the Stator Board, providing continuous electrical contact during input arm rotation.

**Mounting Plate:** Provides a stable platform for the Dynamometer Module Subassembly by securing it to the Dynamometer housing.

**Motor:** Receives 350V dc, 3–phase power from Servo Amp. The Motor includes an internally mounted encoder that sends Dynamometer input arm speed, range of motion, and position and direction data to the NDCB.

### Dynamometer Housing

The housing for the Dynamometer Module Subassembly is cylindrically shaped and is notched along one side to provide an exit point for the torque signal cable (terminating at NDCB) and the motor power and motor encoder signal cables (terminating at Servo Amp Box). The housing is positioned in a U–shaped yoke and can be tilted in 5 degree increments by operating a lever on the side of the Dynamometer.

## DYNAMOMETER ASSEMBLY REMOVE AND REPLACE PROCEDURES

(PART NUMBER 7700A153)

### Tools Required

- ☐ Screwdriver (phillips–blade)
- ☐ Screwdriver (flat–blade, 1/4–inch)
- ☐ Wrenches (allen (3/8–inch, 1/4–inch, 3/16–inch, 7/64–inch, 1/16–inch))
- ☐ Gap–Setting Tool (0.365 thickness)
- ☐ Loctite
- ☐ Torque Wrenches (Calibrations of 100 ft–lbs, 50–ft–lbs, 30 ft–lbs, and 96 in–lbs)
- ☐ Input Adapter
- ☐ Wrench (crescent–head, 3/8–inch)

### Dynamometer Assembly Removal

1. Perform NORM System Shutdown procedure.

### Removing Input Arm Adapter

2. Locate the screw recessed on both sides of input arm adapter collar. This screw is torqued to 100 ft–lbs and will require additional leverage to untighten it. Using one of the NORM input adapters (for example, the Knee/Hip Adapter), position (3/8–inch) allen wrench in screw slot and place adapter over wrench. Carefully untighten screw approximately three–quarters of one turn.
3. Locate Woodruff–Key screw at center of input arm collar. This screw is torqued to 50 ft–lbs and can be untightened without additional leverage. Using (1/4–inch) allen wrench, untighten screw several turns (6 or 7) until key releases input shaft. Remove input arm adapter by "walking" it off of input shaft.

### Removing Range-of-Motion (ROM) Ring and Stops

4. Before removing ROM Ring, ensure mechanical stops are locked in place.

5. Using allen wrench, untighten and remove eight (1/4-inch) socket head cap screws securing ROM Ring to Mounting Plate. Remove ROM Ring with mechanical stops attached.
6. If no other Dynamometer subassemblies require removal, perform Dynamometer Assembly Replacement procedure.

### ***Removing EMI Can, EMI Shield, and Torque Board***

7. Using allen wrench, untighten and remove four (7/64-inch) socket head cap screws securing EMI can to mounting plate. Remove EMI can.
8. Using flat-blade screwdriver, untighten and remove two (1/4-inch) pan head screws securing EMI shield to torque board standoffs. Remove EMI shield.
9. Using allen wrench, untighten two (1/16-inch) set screws securing torque board to input arm shaft. Carefully remove torque cable 5-pin connector from J1. Remove torque board.
10. If no other Dynamometer subassemblies require removal, perform Dynamometer Assembly Replacement procedure.

### ***Removing Stator Board and Mounting Plate***

11. Using allen wrench, untighten and remove four (3/16-inch) socket head cap screws and flatwashers securing stator board to mounting plate standoffs.
12. Using crescent wrench, untighten and remove four (3/8-inch) hex head cap screws, lockwashers, and flatwashers securing motor to mounting plate. These screws are torqued to 30 ft-lbs and can be removed without additional leverage. Remove stator board and mounting plate.

13. If no other Dynamometer subassemblies require removal, perform Dynamometer Assembly Replacement procedure.

### ***Removing Motor***

14. Locate small door near base of Dynamometer housing assembly, below barrel connectors. Using small flat-blade screwdriver, untighten and remove four (1/4-inch) pan head screws. Remove door.
15. Loosen cables attached at barrel connectors. Using allen wrench, untighten and remove four (3/32-inch) socket head cap screws for each connector plate. Remove connector plates.
16. Tilt Dynamometer 90 degrees (horizontal position) to access plate at bottom of Dynamometer housing. Using allen wrench, untighten and remove four (1/4-inch) socket head cap screws. Remove plate.
17. Tilt Dynamometer back 90 degrees (vertical) position. Use allen wrench to untighten and remove two (1/4-inch) flat head screws securing motor mounting plate to housing assembly.
18. Lift motor carefully from housing assembly and place it on stable platform.
19. Perform Dynamometer Assembly Replacement procedure.

### ***Dynamometer Assembly Replacement***

1. If either the stator board or the mounting plate were removed, they must be re-installed before proceeding with this procedure. Perform steps 2 through 4 to reinstall stator board and mounting plate; otherwise, proceed to step 5.

### *Replacing Mounting Plate and Stator Board*

2. Place mounting plate and stator board over motor, routing stator board cable through mounting plate notch and aligning mounting plate and motor screw holes.
3. Using crescent wrench and Loctite, tighten four (3/8-inch) hex head cap screws, lockwashers, and flatwashers securing mounting plate to motor. Use torque wrench to torque screws to 30 ft-lbs.
4. Using allen wrench and Loctite, tighten four (3/16-inch) socket head cap screws and flatwashers securing stator board to mounting plate standoffs.

### *Replacing Motor*

5. Ensure Dynamometer is in its upright (vertical) position. Lift motor carefully and place it in housing assembly, aligning motor's mounting plate holes with holes on housing assembly. Ensure three cables (one from stator board and two from motor) are facing notched (connector) side of housing assembly.
6. Using allen wrench and Loctite, tighten two (1/4-inch) flat head screws securing mounting plate to housing. Using torque wrench, torque these screws to 96 in-lbs.
7. Carefully guide cables (stator board cable first) through slot at base of housing. Mount connectors to housing using allen wrench and Loctite to tighten four (3/32-inch) socket head cap screws for each connector plate.
8. Tilt Dynamometer 90 degrees (horizontal position). Using allen wrench, tighten four (1/4-inch) screws that secure bottom plate to housing.

9. Using small flat-blade screwdriver, tighten four (1/4-inch) pan head screws that secure small door (below barrel connectors) to housing.
10. Tilt Dynamometer 90 degrees (vertical position) and attach cables to barrel connectors, matching pin configurations and keyways correctly.

### *Replacing Torque Board, EMI Shield, and EMI Can*

11. Place torque board over input arm shaft, guiding torque cable to connect with J1 connector on torque board. (Do not mistake 5-pin test connector TC 1 for 5-pin contacts of J1.)
12. Using allen wrench, partly tighten two (1/16-inch) set screws securing torque board to input arm shaft. Use gap-setting tool to ensure the distance between the stator board and torque board is exactly 0.365 inches. When gap distance is correct, completely tighten set screws.
13. Using flat-blade screwdriver, tighten two (1/4-inch) pan head screws securing EMI shield to torque board standoffs.
14. Using allen wrench, tighten four (7/64-inch) socket head cap screws securing EMI can to mounting plate.

### *Replacing Range-of-Motion (ROM) Ring and Stops*

15. Before replacing ROM Ring, ensure mechanical stops are locked in place.
16. Using allen wrench and Loctite, tighten eight (1/4-inch) socket head cap screws securing ROM ring to mounting plate.



### *Replacing Input Arm Adapter*

17. Guide input arm adapter over input shaft, aligning Woodruff key on adapter with slot on shaft. Using torque wrench, torque screw to 50 ft-lbs.
18. Locate the screw recessed on both sides of input arm adapter collar. Using torque wrench, torque screw to 100 ft-lbs.
19. Perform NORM System Turn-on procedure.

### NEW DYNAMOMETER CONTROL BOARD FUNCTION

The NDCB maintains real-time control of the Dynamometer motor and Servo Amp and acquires real-time data on Dynamometer input arm position, direction and speed, range of motion, and torque. In this capacity the NDCB supplies the necessary control to ensure patient testing is accomplished safely and effectively. The NDCB may prevent the start of patient testing or may interrupt the testing session for any of the conditions described below.

- a. patient-initiated (patient depresses NDCB Comfort Switch)
- b. clinician-initiated (clinician aborts test at Computer Dynamometer Control Window)
- c. power-related (power missing or low at NDCB, Servo Amp, or Computer)
- d. speed-related (velocity exceeded at Dynamometer input arm)
- e. processor-initiated (watchdog timer or bus error at NDCB)
- f. ROM-related (software stops at Computer and mechanical stops at Dynamometer not in place or not in correct position)
- g. motor-related (excessive current or heat at Dynamometer motor)
- h. encoder-related (position data missing on Dynamometer input arm)
- i. torque-related (excessive torque detected at Dynamometer input arm).

The NDCB controls power to the Dynamometer motor by energizing/de-energizing the solid-state relay inside the Servo Amp Box.

### NDCB ENCLOSURE DESCRIPTION

The New Dynamometer Control Board Enclosure is located between the Computer and the Servo Amp Box. The enclosure includes several circuit board assemblies, as shown in Figure 8–4. Each item is described briefly in the following paragraphs.

#### NDCB Circuit Board Assembly

The NDCB circuit board assembly contains the logic devices and peripheral chips to capture and process critical Dynamometer information and send it over connecting cables to other NORM system equipments. The signals sent by the NDCB include speed commands to the Servo Amp, and speed, torque, position and direction, and range of motion data to the ATIC. All on-board data processing and filtering, timing and interrupt routines, and communication protocol are microprocessor-controlled. The microprocessor program itself resides on non-volatile memory chips (EPROMs) which retain their instruction set even when power is removed from the board. Also resident on the board are flash EPROMs which can be reprogrammed in circuit for field updates.

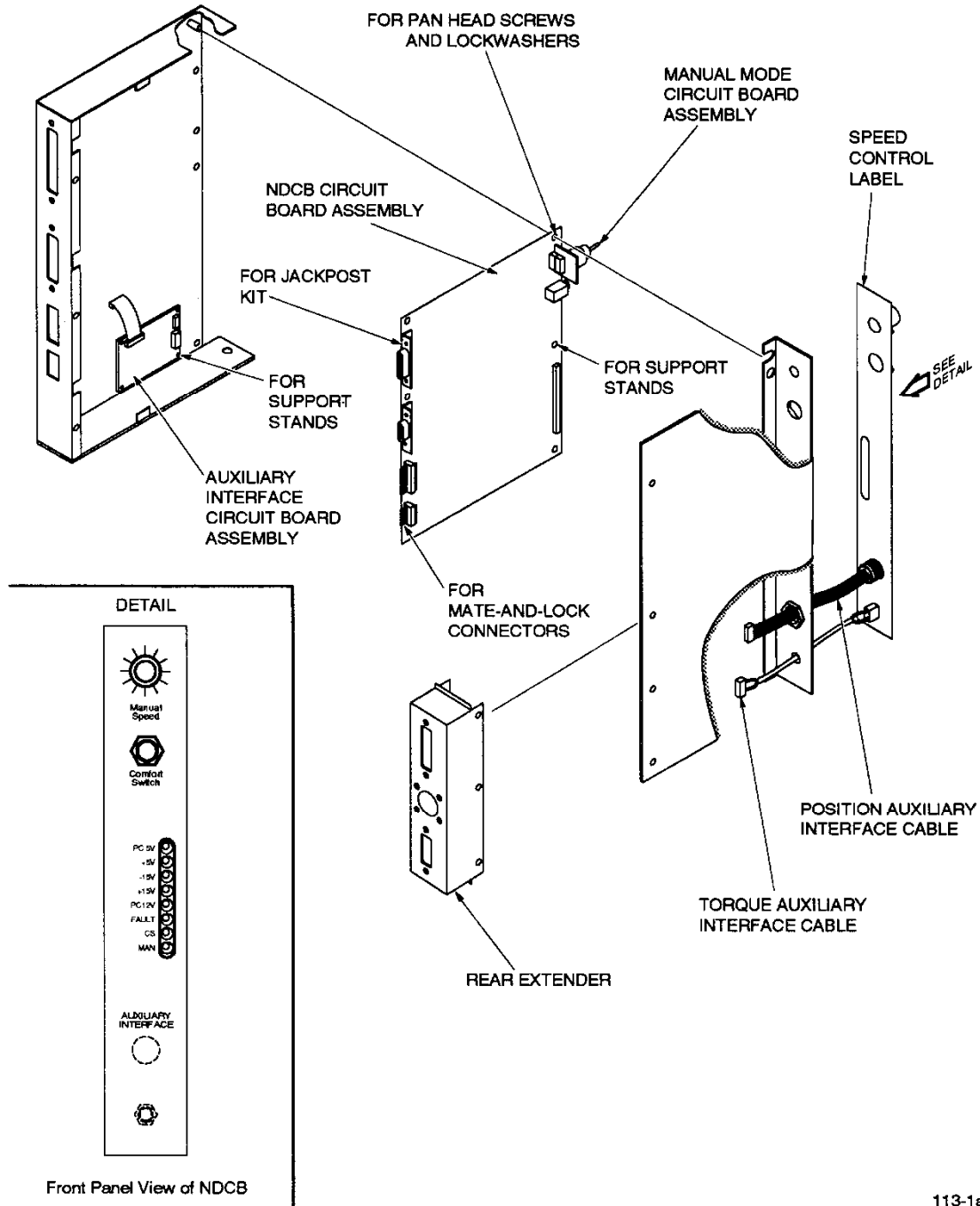
#### Auxiliary Interface Circuit Board Assembly

The Auxiliary Interface circuit board assembly provides the means by which torque, speed, and direction data from the NORM system can be used by the CSMi Kinestim™ Electrostimulation Device. The Kinestim provides electrical stimulation to modulate muscle pain, reduce joint swelling, and augment muscle strength following injury or surgery. The Kinestim uses the NORM signal outputs to stimulate a muscle at a specific torque level or at a certain point in the patient's range of motion. Both parameters are established by the clinician.

## Manual Mode Circuit Board Assembly

The Manual Mode circuit board assembly allows the NORM system to operate in non-powered mode, without inputs from the NDCB or the computer. In this mode the speed of the Dynamometer is controlled by setting the front

panel Manual Mode switch to one of the available speed positions (from 0 to 300, in 30 degree increments). The absence of computer/NDCB monitoring in this mode limits its application for NORM testing.



113-1a

Figure 8-4 New Dynamometer Control Board Enclosure



## NDCB CONTROLS AND INDICATORS

The NDCB contains several front panel controls and indicators (Figure 8–4) that provide the following visual feedback and tactile adjustments:

- a. Manual control (MANUAL SPEED switch) and patient control (COMFORT SWITCH) of the Dynamometer arm

- b. Status LEDs for power inputs to the NDCB, NDCB faults, and status of Comfort and Manual Speed switches
- c. Connector outlet (AUXILIARY INTERFACE) for cabling to Kinestim Electro–stimulation Device.

Each of these control/indicator devices is described in the following table.

CONTROL/INDICATOR	POSITION/SETTING	FUNCTION
MANUAL SPEED switch	PC	When positioned, Dynamometer arm rotates at speed entered into Computer.
	0–300 degrees per second (30 degree increments)	When positioned, Dynamometer arm rotates at speed selected.
COMFORT SWITCH	(Press to enable)	When pressed, Comfort Switch inhibits rotation of the Dynamometer input arm.
NDCB Status LEDs	PC 5V	Lights green when 5V signal from Computer is present. Unlit when input is missing.
	+5V	Lights green when +5V signal from Servo Amp power supply is present. Unlit when input is missing.
	–15V	Lights green when –15V signal from Servo Amp power supply is present. Unlit when input is missing.
	PC 12V	Lights green when 12V signal from Computer is present. Unlit when input is missing.
	FAULT	Lights red if hardware fault has occurred. Unlit when NDCB status is normal.
	COMMON SW	Lights red when Comfort Switch is depressed; otherwise unlit.
	MANUAL MODE	Lights yellow when Manual Mode switch is positioned to any numeric value (0–300). Unlit when switch is set to PC position.
AUXILIARY INTERFACE connector	(Connect cable for interface)	When connected, Dynamometer torque, position,

## DYNAMOMETER

CONTROL/INDICATOR	POSITION/SETTING	FUNCTION
		and direction data is transmitted to Kinestim device.

## NDCB ENCLOSURE ASSEMBLY REMOVE AND REPLACE PROCEDURES

(PART NUMBER 7700S755)

### Tools Required

- ☐ Screwdriver (phillips-blade, 1/4–inch)
- ☐ Screwdriver (flat-blade)
- ☐ Wrenches (socket-head (3/8–inch), hex head, allen (0.05–inch))
- ☐ Pliers (needle–nose)
- ☐ Hex Nut Driver

### NDCB Enclosure Assembly Removal

1. Perform NORM System Shutdown procedure.
2. Remove comfort switch connection from NDCB front panel.

### Accessing and Removing Enclosure

3. Remove NORM cover panels (right and left side enclosure panels and pedestal clamp cover) using a phillips-blade screwdriver to untighten and remove 10 (1/4–inch) pan head screws. (Left side enclosure panel is tethered to NORM unit by cables encased in plastic tubing. Without straining cable tubing, move panel aside to allow sufficient access to cables at rear of NDCB enclosure.)

4. Remove the cables listed in the table below from the NDCB enclosure. Use small flat-blade screwdriver to remove D–connectors. Loosen and remove circular connector by hand.
5. At front of NDCB enclosure. use socket wrench or ratchet with attachment to un-tighten and remove one (3/8–inch) hex head securing NDCB enclosure to frame assembly. Slide enclosure out and remove it.

### Removing Front Housing

6. Using allen wrench, untighten (0.05–inch) screw securing speed instrument knob to switch shaft. Remove knob and attaching hardware.
7. Using hex nut driver, untighten and remove fastener and lockwasher securing comfort switch to front panel.
8. KINESTIM™ Option Only. Using nut driver, untighten and remove hex nut securing phone jack to front panel.
9. Using phillips screwdriver, remove four pan head screws with lockwashers located at back edge of housing. (Removing the three screws grouped together will free half of NDCB rear extender.)

NDCB CONNECTOR NUMBER	CABLE DESCRIPTION AND PART NUMBER	NDCB CONNECTOR DESCRIPTION
J1	NDCB/AT Communication (7700S513)	62–pin D–connector (50 pins used)
J4	External Servo/NDCB (7700S276)	25–pin D–connector (female)
J5 (top section)	External Relay (7700S275)	9–pin D–connector (4 pins used)
J5 (bottom section)	External Power Supply (7700S274)	5–pin circular connector (5 pins used)
J6	Torque Signal (7700S273)	15–pin D–connector (6 pins used)

10. Turn enclosure over to access its opposite side. Using phillips screwdriver, remove six pan head screws with lockwashers securing front housing to rear housing. Slip rear extender away from housing. Remove front housing.

### ***Removing Manual Mode Circuit Board***

11. Locate manual mode circuit board on connector J2 of NDCB circuit board.
12. Holding manual mode circuit board by its edges, carefully remove it from connector.
13. If no other NDCB assemblies require removal, perform NDCB Enclosure Assembly Replacement procedure.

### ***Removing Auxiliary Interface Circuit Board***

14. KINESTIM™ Option Only. Locate auxiliary interface circuit board adjacent to NDCB circuit board and connected to it by ribbon cable (connector J1 on auxiliary interface circuit board).
15. KINESTIM™ Option Only. Remove ribbon cable from NDCB circuit board (connector J7).
16. KINESTIM™ Option Only. Using nut driver, untighten and remove hex nut and lockwasher securing auxiliary interface position cable to front panel.
17. KINESTIM™ Option Only. Holding auxiliary interface circuit board by its edges, carefully remove it from four support stands.
18. KINESTIM™ Option Only. If no other NDCB assemblies require removal, perform NDCB Enclosure Assembly Replacement procedure.

### ***Removing NDCB Circuit Board***

19. Ensure all external cables have been removed from NDCB Assembly. Using needle-nose pliers, remove jackpost kit

(two hex standoffs and fasteners) securing J1 and J4 D-connectors to panel.

20. Remove two mate-and-lock connectors from J5 and J6 of NDCB.
21. Using phillips screwdriver, untighten and remove four pan head screws and lockwashers securing NDCB circuit board to rear housing.
22. Holding NDCB circuit board by its edges, carefully remove it from two support stands.
23. Perform NDCB Enclosure Assembly Replacement procedure.

### ***NDCB Enclosure Assembly Replacement***

#### ***Replacing NDCB Circuit Board***

1. Holding NDCB circuit board by its edges, carefully replace it on two support stands.
2. Using phillips screwdriver, tighten four pan head screws and lockwashers securing NDCB circuit board to rear housing.
3. Using needle-nose pliers, tighten jackpost kit (two hex standoffs and fasteners) securing J1 and J4 D-connectors to panel.

#### ***Replacing Auxiliary Interface Circuit Board***

4. KINESTIM™ Option Only. Holding auxiliary interface circuit board by its edges, carefully replace it on four support stands.
5. KINESTIM™ Option Only. Using nut driver, tighten and hex nut and lockwasher securing auxiliary interface position cable to front panel.
6. KINESTIM™ Option Only. Reconnect ribbon cable from NDCB circuit board (connector J7) to auxiliary interface circuit board (connector J1).



## Replacing Manual Mode Circuit Board

7. Holding manual mode circuit board by its edges, carefully reconnect it to connector J2 of NDCB circuit board.

## Replacing Front Housing

8. Using phillips screwdriver, tighten ten pan head screws with lockwashers securing front housing to rear housing and rear extender to front and rear housing.
9. KINESTIM™ Option Only. Using nut driver, tighten hex nut securing phone jack to front panel.
10. Using hex nut driver, tighten fastener and lockwasher securing comfort switch to front panel.
11. Using allen wrench, tighten (0.05–inch) screw securing speed instrument knob to switch shaft. Re-attach knob and attaching hardware.

## Replacing Enclosure

12. At front of NDCB enclosure. use socket wrench or ratchet with attachment to tighten (3/8–inch) hex head securing NDCB enclosure to frame assembly. Slide enclosure into frame assembly.
13. Reconnect the cables listed below from the NDCB enclosure. Use small flat-blade screwdriver to tighten D-connectors. Tighten circular connector by hand.
14. Re-attach NORM cover panels (right and left side enclosure panels and pedestal clamp cover) using a phillips-blade screwdriver to tighten 10 (1/4–inch) pan head screws.
15. Reconnect comfort switch to NDCB front panel.
16. Perform NORM System Turn-on procedure.

NDCB CONNECTOR NUMBER	CABLE DESCRIPTION AND PART NUMBER	NDCB CONNECTOR DESCRIPTION
J1	NDCB / AT Communication (7700S513)	62–pin D–connector (50 pins used)
J4	External Servo / NDCB (7700S276)	25–pin D–connector (female)
J5 (top section)	External Relay (7700S275)	9–pin D–connector (4 pins used)
J5 (bottom section)	External Power Supply (7700S274)	5–pin circular connector (5 pins used)
J6	Torque Signal (7700S273)	15–pin D–connector (6 pins used)

## TORQUE MEASUREMENT

Torque is the amount of rotation produced when force is applied about an axis of rotation. In the NORM system, torque is measured at the center of rotation, which is the shaft of the Dynamometer input arm. Torque is measured

instantaneously by NORM, at every half-degree in the range of motion.

For troubleshooting purposes, the torque signal can be measured at several locations (listed below). To measure the torque signal, a digital multimeter is required to test the signal pin

relative to a ground point. When probed, the torque signal should read between 0V and +/- 10V.

The measured torque signal reflects nominally 1 volt per 50 foot-pounds, to a maximum of 10 volts per 500 foot-pounds. The signal will read positive when the input arm is moving clockwise, negative when the arm is moving counter-clockwise. If the torque signal is present and reading correctly when measured, but the

Dynamometer input arm does not move, either the Servo Amp or the NDCB may be faulty.

Torque can also be measured at the NDCB front panel connector, where the cabling point between the NORM and the Kinestim device is located. The input requirements of the Kinestim require that the torque signal be rectified, which is done on the Auxiliary Interface circuit board, and then cabled to the NDCB. For this reason, the torque signal measured at the NDCB front panel connector always reads in the positive range.

SIGNAL NAME	MEASURED AT	CONNECTOR
TORQUE	NDCB	J6 Pin 5
TORQCOM (GROUND)	NDCB	J6 Pin 6
TORQUE	Torque Board	TC1 Pin 1
TORQUE (GROUND)	Torque Board	TC1 Pin 3

## ENCODER PHASE MEASUREMENT

For troubleshooting purposes, the encoder signal can be measured at several locations (listed below). There are several symptoms that suggest the encoder is not operating correctly or that the encoder signals are not reaching the equipments that require them. If the Servo Amp appears to be functioning correctly (all diagnostic LEDs reading normally), but input arm

movement does not track at the Computer monitor, encoder signals between the Servo Amp and the NDCB may be missing. This is a safety issue for the NORM system and in response to it the power to drive the Dynamometer will be removed immediately. The presence of encoder signals should be verified at the NDCB and the Servo Amp. Using a digital multimeter, the encoder signals should read between 0V and 5V when probed.

SIGNAL NAME	MEASURED AT	CONNECTOR
PHASE A	NDCB	U26 Pins 6, 7
PHASE B	NDCB	U26 Pins 1, 2
PHSA+, PHSA–	NDCB	J4 Pins 1, 2
PHSB+, PHSB–	NDCB	J4 Pins 14, 15
A+, A–	Servo amp	P3 Pins 1, 2
B+, B–	Servo amp	P3 Pins 3, 4

## SPEED CONTROL MEASUREMENT

For troubleshooting purposes, the speed signal can be measured at several locations (listed below). The speed signal is called Speed Control Voltage (SCV) on the NDCB (the board itself) and

is read as the Velocity Control Signal (VCS) at the connector. Using a digital multimeter, the speed signal should measure between 0V and 5V when probed.

SIGNAL NAME	MEASURED AT	CONNECTOR
SCV	NDCB	U49 Pin 1
AGND (GROUND)	NDCB	U49 Pin 2
VCS+, VCS–	NDCB	J4 Pins 9, 22

### CONTROL SIGNAL MEASUREMENT

For troubleshooting purposes, circuit board control signals can be measured at several

locations (listed below). Using a digital multimeter, the voltage signals should read the appropriate value when probed.

SIGNAL NAME	MEASURED AT	CONNECTOR
+15V	Torque Board	Brushes BR3, 6
-15V	Torque Board	Brushes BR2, 5
(GROUND)	Torque Board	Brushes BR1 , 4
+15V	NDCB	TPD1
-15V	NDCB	TPD2
+5V	NDCB	TPD3
12V AT	NDCB	TPD4
(GROUND)	NDCB	TP1

### **SECTION 9.       PATIENT POSITIONING MODULE**

#### **PATIENT POSITIONING MODULE**

This chapter describes the procedures to remove and replace worn or failed items on the Patient Positioning Module. Additional information on this module, also referred to as the Reclining Chair, may be found in the User's Guide. Users needing information on typical chair adjustments, or on fastening seat belts and pads, should refer to that manual.

### PATIENT POSITIONING MODULE REMOVE AND REPLACE PROCEDURES

(PART NUMBER 7700A002)

#### Tools Required

- ☐ Screwdrivers (phillips-blade, flat-blade)
- ☐ Wrenches (socket-type, 1/2-inch, 7/16-inch, 3/8-inch)
- ☐ Wrench (crescent-type, 5/8-inch)
- ☐ Wrench (allen, 1/16-inch)

**Note:** When performing maintenance on the Patient Positioning Module, always ensure the chair is secure by locking the handles of the Chair Back and the Chair Seat in their downward position. For procedures that require chair adjustments to access attaching hardware, exercise care to prevent injury or damage to equipment. All adjustments, regardless of complexity, should be performed without clients on the equipment.

#### Shoulder Belt Removal

(P/N 7700S528)

1. Perform NORM System Shutdown procedure.
2. At back of chair, use phillips-blade screwdriver to remove four (1/4 inch) screws located along the upper section of the back cover. When removing the last screw, support the cushion and remove it from the chair.
3. Locate four "christmas tree" fasteners located in a single line just below where the screws in Step 1 were removed. Working from inside the back cover, in the gap between the seat back frame and the flexible cover, use a flat-blade screwdriver to release the fasteners.

**Note:** Fasteners may deform slightly when removed. This will in no way affect the performance of the equipment.

4. Using socket-type and allen wrenches, remove cap screw (3/8-inch) and attaching hardware from each belt bracket. Remove shoulder belt.

#### Shoulder Belt Replacement

1. Slide new shoulder belt onto cap screw and position screw back into bracket. Tighten screw using socket-type and allen wrenches.
2. Using "christmas tree" fasteners removed previously, work them back into position by pressing on them from outside the back cover.
3. Place the head rest cushion in its proper position and support it while re-tightening screws. Use phillips-blade screwdriver to secure the four screws.
4. If no other maintenance is needed, perform NORM System Turn-on procedure.

#### Pelvic Belt Removal

(P/N 7700S528)

1. Perform NORM System Shutdown procedure.
2. Locate the pelvic belt brackets on both sides of the chair. Using two crescent-type wrenches, remove the hex head bolt and nut (5/8-inch) securing each belt to its bracket.
3. Unfasten the pelvic and shoulder belts (if they are buckled together) and remove the pelvic belts.



### Pelvic Belt Replacement

1. Slide pelvic belt onto the bolt and secure both to the bracket using two crescent wrenches to tighten the hex head nut (5/8-inch).
2. Fasten the pelvic and shoulder belt buckles.
3. If no other maintenance is needed, perform NORM System Turn-on procedure.

### Head Rest Cushion Removal

(P/N 7700S451)

1. Perform NORM System Shutdown procedure.
2. At back of chair, use phillips-blade screwdriver to remove four (1/4 inch) screws located along the upper section of the back cover. When removing the last screw, support the cushion and remove it from the chair.

### Head Rest Cushion Replacement

1. Support new head rest cushion in its proper position and use phillips-blade screwdriver to secure the four (1/4—inch) screws.
2. If no other maintenance is needed, perform NORM System Turn-on procedure.

### Seat Back Cushion Removal

(P/N 7700S452)

1. Perform NORM System Shutdown procedure.

### Removing Head Rest Cushion

2. At back of chair, use phillips-blade screwdriver to remove four (1/4 inch) screws located along the upper section of the back cover. When removing the

last screw, support the cushion and remove it from the chair.

3. Locate four "Christmas tree" fasteners located in a single line just below where the screws in Step 1 were removed. Working from inside the back cover, in the gap between the seat back frame and the flexible cover, use a flat-blade screwdriver to release the fasteners.

**Note:** Fasteners may deform slightly when removed. This will in no way affect the performance of the equipment.

4. Turn translation crank wheel counterclockwise (CCW) to move the chair-back forward. Looking inside the gap between the cushion and the seat back frame, locate three screws on each side of the cushion.

### Removing Seat Back Cushion

5. Using ratchet with 7/16-inch attachment, remove the bottom and middle sets of screws and lockwashers first.
6. Using ratchet with 7/16-inch attachment, remove the upper set of screws and lock-washers. When removing upper screws, apply finger pressure to clear cushion away from the frame it attaches to.
7. Slide cushion away from the chair and remove it.

### Seat Back Cushion Replacement

#### Replacing Seat Back Cushion

1. Slide new seat cushion into position. Using ratchet with 7/16-inch attachment, re-tighten upper, middle, and lower sets of screws, in that order.



2. Using "christmas tree" fasteners removed previously, work them back into position by pressing on them from outside the back cover.

### Replacing Head Rest Cushion

3. Support head rest cushion in its proper position and use phillips-blade screwdriver to secure the four (1/4-inch) screws.
4. If no other maintenance is needed, perform NORM System Turn-on procedure.

### Lower Seat Cushion Removal

(P/N 7700S450)

1. Perform NORM System Shutdown procedure.
2. Release chair from its secured position by moving both tilt lock handles upwards, one at a time, and supporting chair-back after re-positioning second tilt handle.
3. Refer to tilt scale and adjust seat-back recline angle to 30 degree setting. Re-secure the chair in this position by moving both tilt handles downwards.
4. Refer to the fore / aft scale and adjust chair position by pulling up on the fore / aft lever and moving the seat backward to position 30 on the scale. Push lever down to lock chair in position.
5. Using socket-type wrench with extension, remove two hex head cap screws (7/16-inch) and attaching hardware that secure the cushion to the chair frame.
6. Refer to the fore / aft scale and adjust chair position by pulling up on the fore /aft lever and moving the seat forward to position 0 on the scale. Push lever down to lock chair in position.
7. Adjust the chair seat angle by pulling up on the lever located at the front of the chair. Raising the seat to its up (angled) position will allow access to the two

screws that must be removed in the next step.

8. Using socket-type wrench with extension, remove two hex head cap screws (7/16-inch) and attaching hardware that secure the cushion to the chair frame.
9. Lift cushion away from the chair and remove it.

### Lower Seat Cushion Replacement

1. Slide new seat cushion into position.
2. Move chair seat forward to position 0 on the fore / aft scale and adjust seat angle so it is in the up position. Use socket-type wrench with extension to tighten two hex head cap screws (7/16-inch) and attaching hardware that secure the cushion to the frame.
3. Lower the seat to its down (flat) position and move the chair seat backward to position 30 on the fore / aft scale. Use socket-type wrench with extension to tighten two hex head cap screws (7/16-inch) and attaching hardware that secure the cushion to the frame.
4. Adjust seat-back recline angle to any setting desired. Re-secure the chair in this position by moving both tilt handles downwards.
5. If no other maintenance is needed, perform NORM System Turn-on procedure.

### Gas Spring Removal

(P/N EZ000771)

**Note:** Symptoms of gas spring failure are little or no resistance when adjusting the recline angle of the chair. To ensure continued safe and reliable use, always replace gas springs in pairs.

1. Perform NORM System Shutdown procedure.
2. Adjust seat-back to its fully-extended upright position. The tilt scale will read

90 with the seat-back in this position. Secure the chair by moving both tilt handles downwards.

3. Remove either gas spring first, but remove only one at a time, as follows.
4. Using box wrench or socket-type wrench with (1/2-inch) attachment, remove hex cap nut at top section of gas spring.
5. Using needle-nose pliers, remove the retaining clip from the top section of the spring.
6. At the bottom section of the spring, use a needle-nose pliers to remove the retaining clip there. Tap the spring away from the ball stud and remove the gas spring.
7. Install a replacement, using the procedure below, before removing the second gas spring.

### Gas Spring Replacement

1. Slide new gas spring into position, installing bottom section first by guiding it over the ball stud.
2. Using box wrench or socket-type wrench with (1/2-inch) attachment, tighten hex cap nut at top section of gas spring.
3. Attach retaining clips to top and bottom sections of the gas spring.
4. Remove the second gas spring and replace it as described in the preceding steps. If both gas springs have been replaced, and no other maintenance is needed, perform NORM System Turn-on procedure.

## PATIENT POSITIONING MODULE

### ADJUSTMENT PROCEDURES

**Note:** During normal usage, some mechanical parts of the reclining chair may require minor adjustment. Procedures for those adjustments are described below.

### Chair Seat Rotation Tilt Lock Handle Adjustment

**Note:** Minimal or no resistance during rotation are indications that the tilt lock handle requires adjustment. The lock handles that control chair rotation are located below the lower seat cushion and are mounted to the pedestal.

1. Adjust chair to its fully-extended upright position (the tilt scale reads 90) and secure it by setting both chair back tilt handles in the down position.
2. Secure the chair from rotating by setting one of the two lock handles in the down position. Leave the other handle in the up position to check top and bottom hex head cap screws.
3. Using socket-type wrench with (3/8-inch) attachment, check the screw tightness on the lock handle. If loose, tighten the screw approximately 1/16 of a turn.
4. Repeat Steps B and C for the second lock handle.

### Chair Back Translation Wheel Adjustment

**Note:** Excessive back-and-forth play in the seat back of the chair is an indication that the translation wheel requires adjustment. The wheel is located at the back of the chair.

1. Rotate the wheel clockwise (CW) to move the seat-back to its straight vertical position.
2. On the collar of the wheel locate two (1/16-inch) allen screws. Using an allen wrench, loosen both screws slightly.
3. Move the wheel forward (towards the seat back) approximately 1/16 of a turn. Re-tighten allen screws.

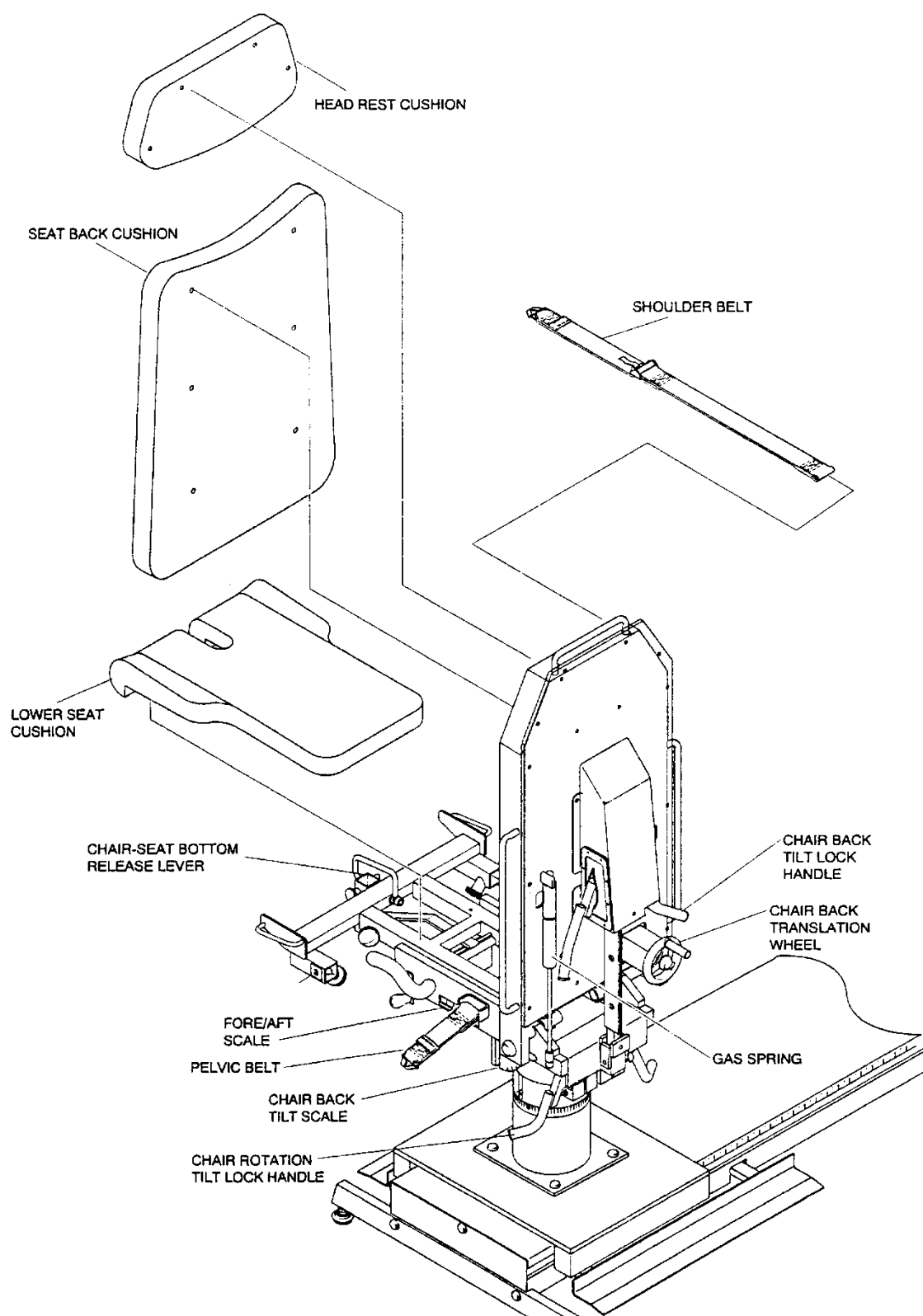


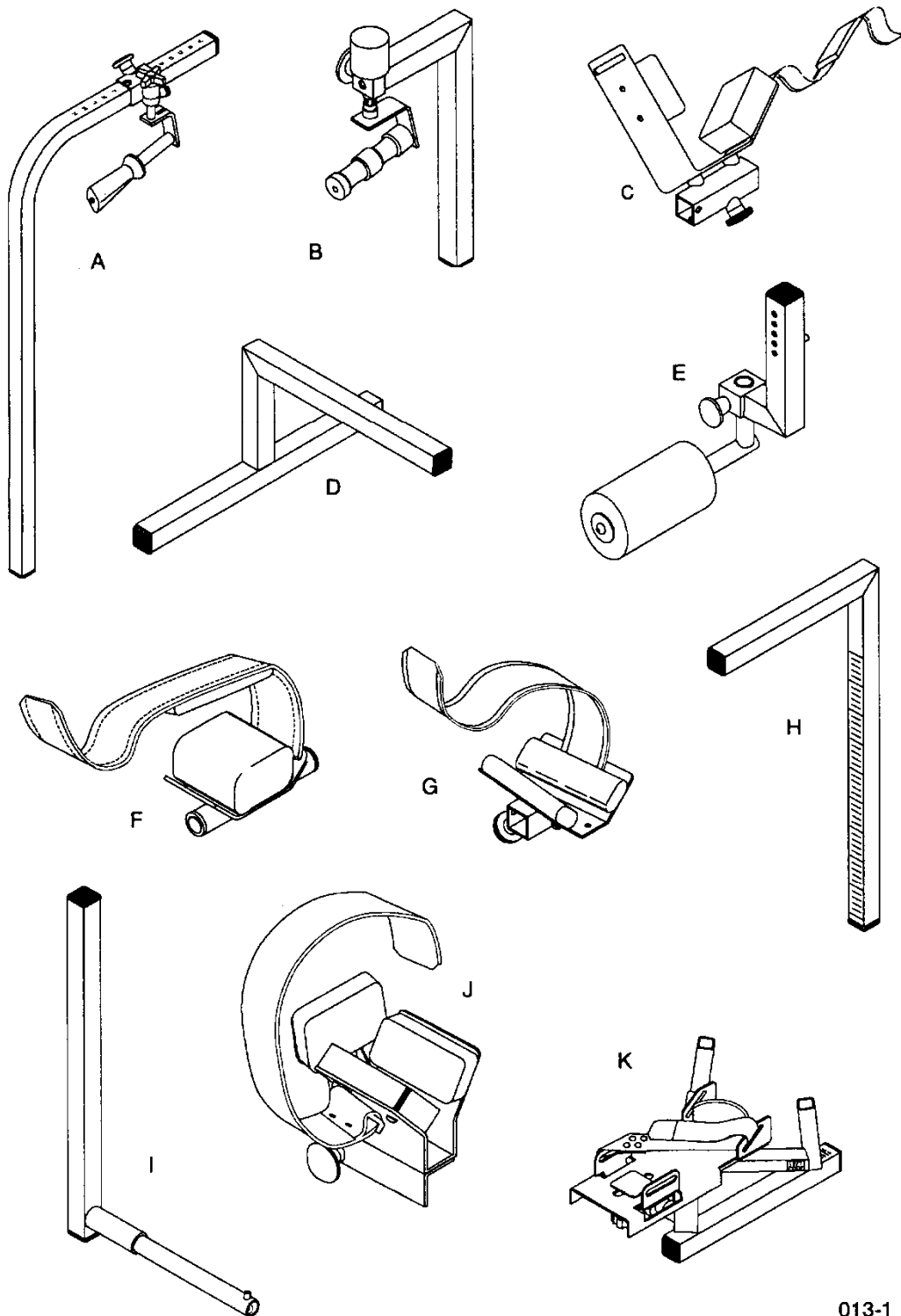
Figure 9-1 Patient Positioning Module

### **SECTION 10.      REPLACEMENT PARTS**

#### **REPLACEMENT PARTS**

This chapter describes the input adapters and accessories available with the NORM system. The input adapters are the various attachments used to exercise and test specific limbs and joints. Accessories include, for example, documentation and software delivered with the NORM system, consumable parts like printer ink cartridges, and other equipments like the cart used to store the input adapters.

The information supplied in this chapter is intended to supplement the adapter part description and part number information in Appendix D of the User's Guide manual. The information in this chapter provides a greater level of detail but does not obsolete the part descriptions in the User's Guide. Those descriptions can continue to be used when general information about the adapters is needed.



013-1

Figure 10-1 NORM System Adapters

### NORM SYSTEM ADAPTERS

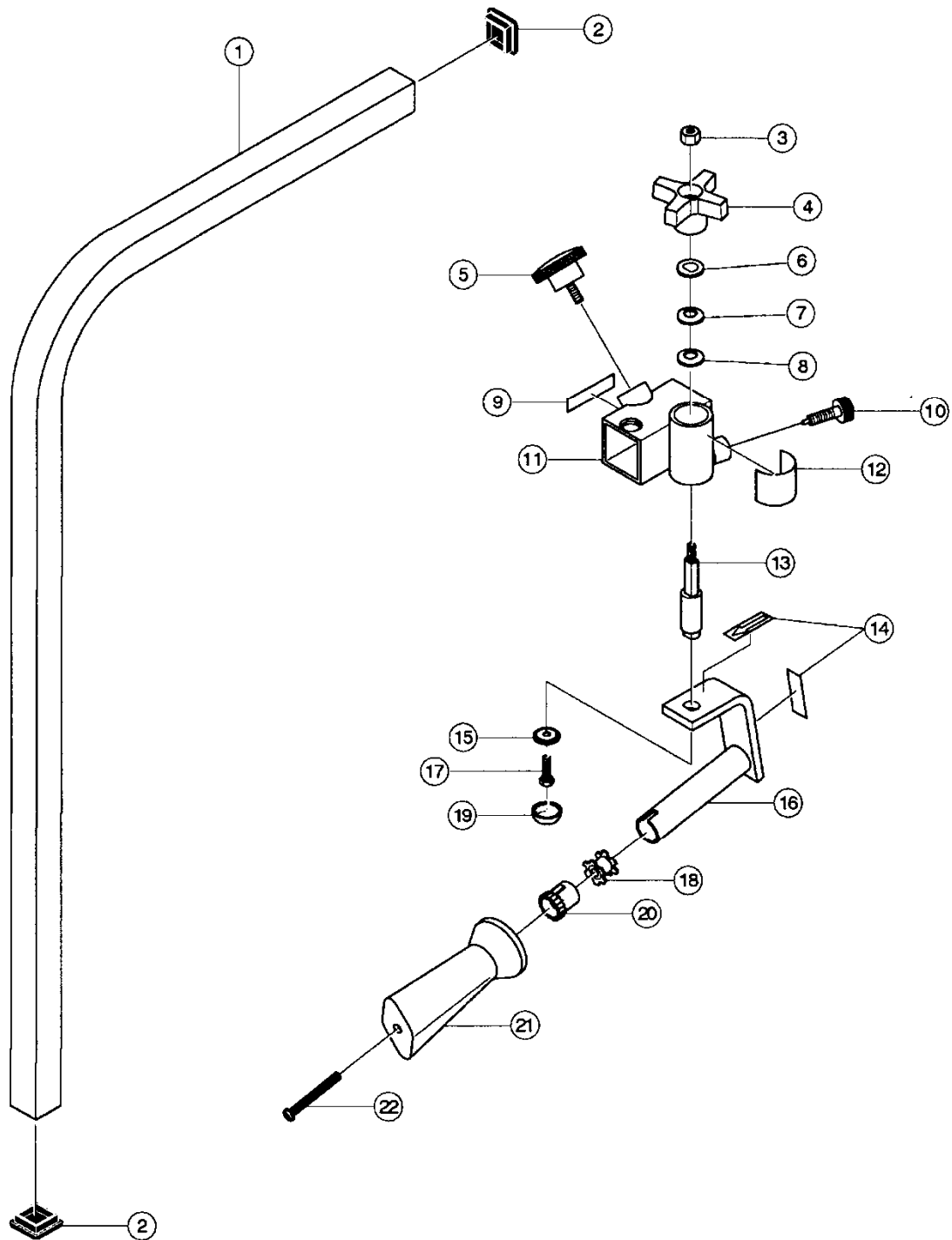
The figure on the facing page describes the input adapters packaged with the NORM system. Adapter accessories, such as the Stabilization

Utility Strap and the Coated Counter Weight, and other replaceable items, such as the lumbar and support cushions, are described later in this chapter. These items are also supplied with the NORM system.

ITEM	DESCRIPTION	PART NUMBER
A.	Elbow/Shoulder Adapter Assembly	7700S780
B.	Wrist/Shoulder Adapter Assembly	7700S960
C.	Thigh Stabilization Adapter Assembly	7700A870
D.	Foot Rest Assembly	7700S845
E.	Contralateral Limb Stabilizer	7700A240
F.	Shin Pad Adapter	7700A804
G.	Forearm Stabilization Adapter	7700A850
H.	Stabilizer Tube Assembly	7700S865
I.	Knee/Hip Adapter Assembly	7700A814
J.	Elbow Support Subassembly	7700S915
K.	Ankle Adapter Assembly	7700S886

NOTE: The Ankle Adapter Assembly includes the Ankle Arm Assembly. Previously, the Ankle Arm Assembly was supplied as a separate part with its own part number (770S885).



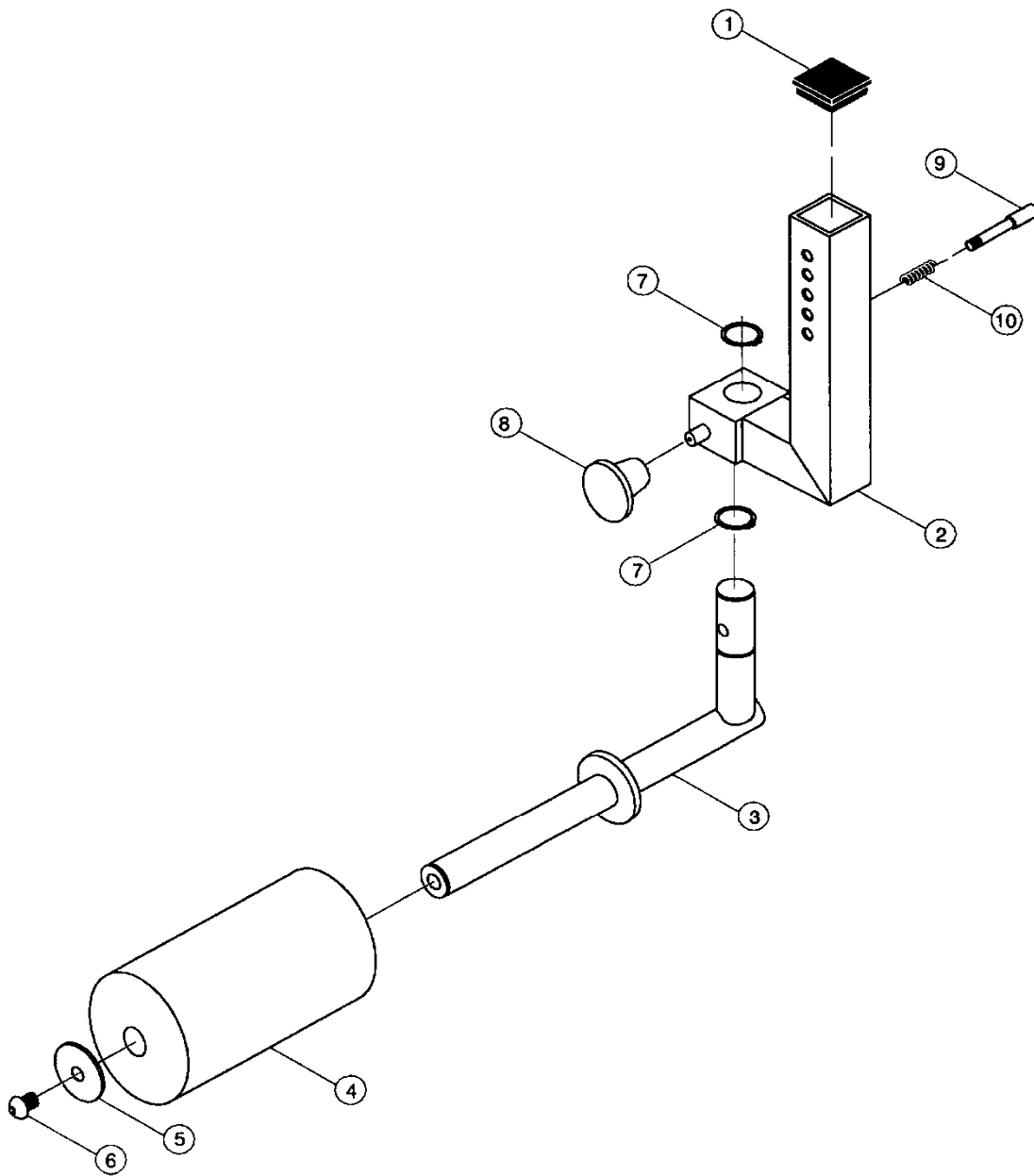


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Figure 10-2 Elbow and Shoulder Adapter (P/N7700S780)

### Replaceable Parts

REF. NO.	PART NO.	QTY	DESCRIPTION
1.	7700M977	1	Bent Tube, Elbow/Shoulder
2.	PP300013	2	Insert Guide, 1-1/4 Sq. x 16 GA.
3.	HN626300	1	Nut, Hex Nylox, 1/4-28 UNF-2B
4.	PP460771	1	Knob, with 3/8-24 Brass Insert
5.	PP460004	1	5/16-18 Black Knob Assembly
6.	HS390770	1	D-Washer, 3/8 ID x 3/4 OD x .09 Thick
7.	HS387705	7	Washer, Belleville, 1/2 x .035
8.	HS387604	1	Thrust Washer, .5 ID x .937 OD x .092 Thick
9.	730CM011	1	Label, "Right Ext/Flx"
10.	HF709420	1	Plunger, Hand Retractable, 3/8-16
11.	7700C975	1	Sliding Tube Weldment
12.	730CM024	1	Label, Shoulder Adapter
13.	7700C783	1	Handle Weldment
14.	730CM018	2	Label, Arrow Indicator (Dark Background)
15.	HS010003	1	Washer Screw Cap 1/4
16.	7700C783	1	Handle Weldment
17.	HC621212	1	Screw, Hex Head Cap, 1/4-20 UNC x 1/2
18.	HF449060	1	Insert, 7/8 x 1/4-20, Too Star
19.	PP080005	1	Screw Cap, Black
20.	P660003	1	Crutch Handle Plug
21.	PP410004	1	Orthoease Handgrip Gray Type B
22.	HM620228	1	Slotted Binding HD, 1/4-20 x 2-1/4

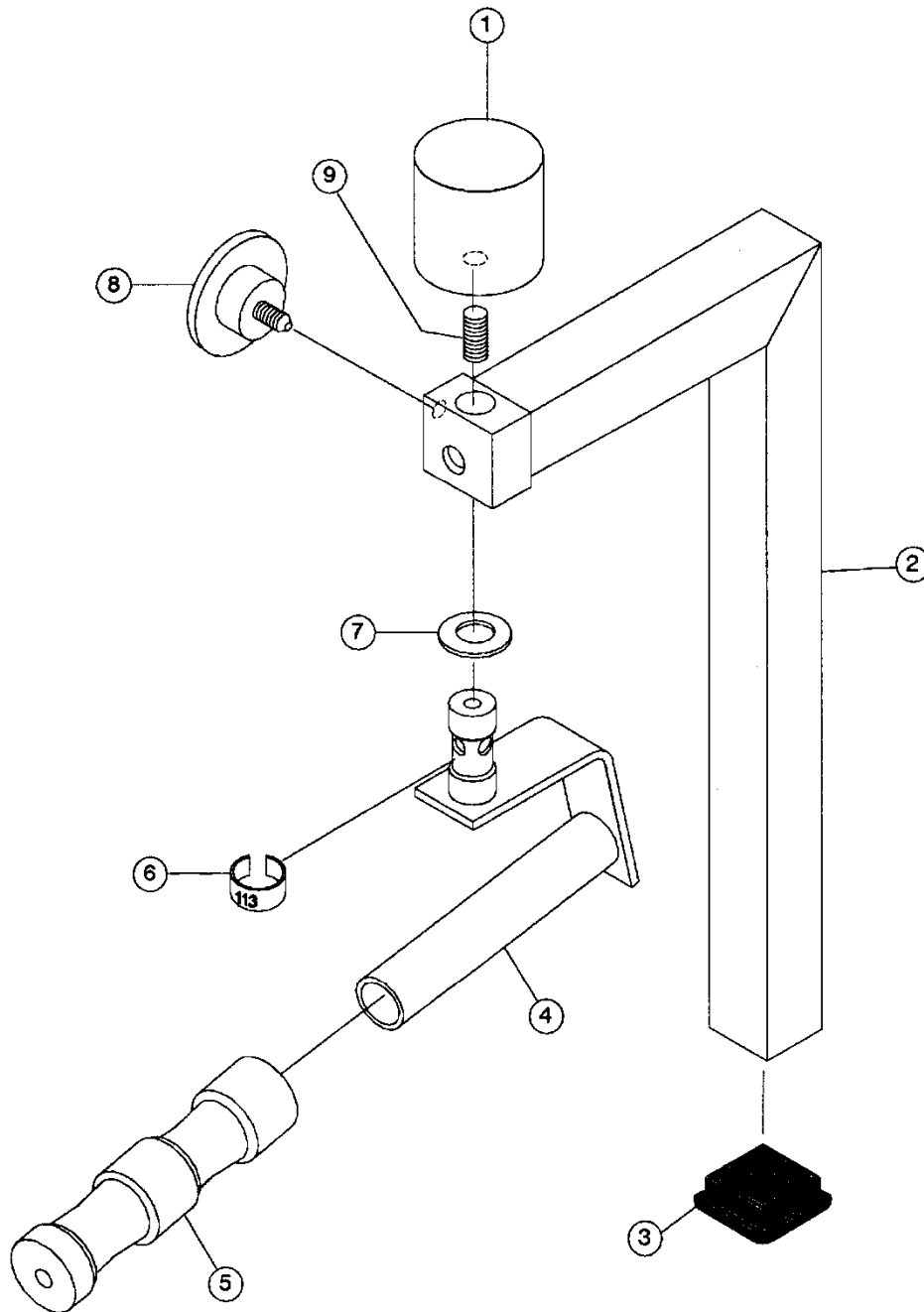


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Figure 10-3 Contralateral Limb Stabilizer (P/N 7700A240)

### Replaceable Parts

REF. NO.	PART NO.	QTY	DESCRIPTION
1.	PP300013	2	Insert Glide, 1-1/4"
2.	7700W459	1	Contralateral Stabilization Bar
3.	7700C455	1	Roller Bracket
4.	PP400013	1	Roller Pad, Self Filming, 3-1/4
5.	3400C468-1	1	Flat Washer, Black
6.	HC700412	1	Button HD Cap Screw, 3/8-16 x 1/2
7.	BR030042	2	Snap Ring, External, 7/8
8.	PP450201	1	Plastic Knob
9.	7700M463	1	Pull Pin
10.	BS071367	1	Spring, Compression

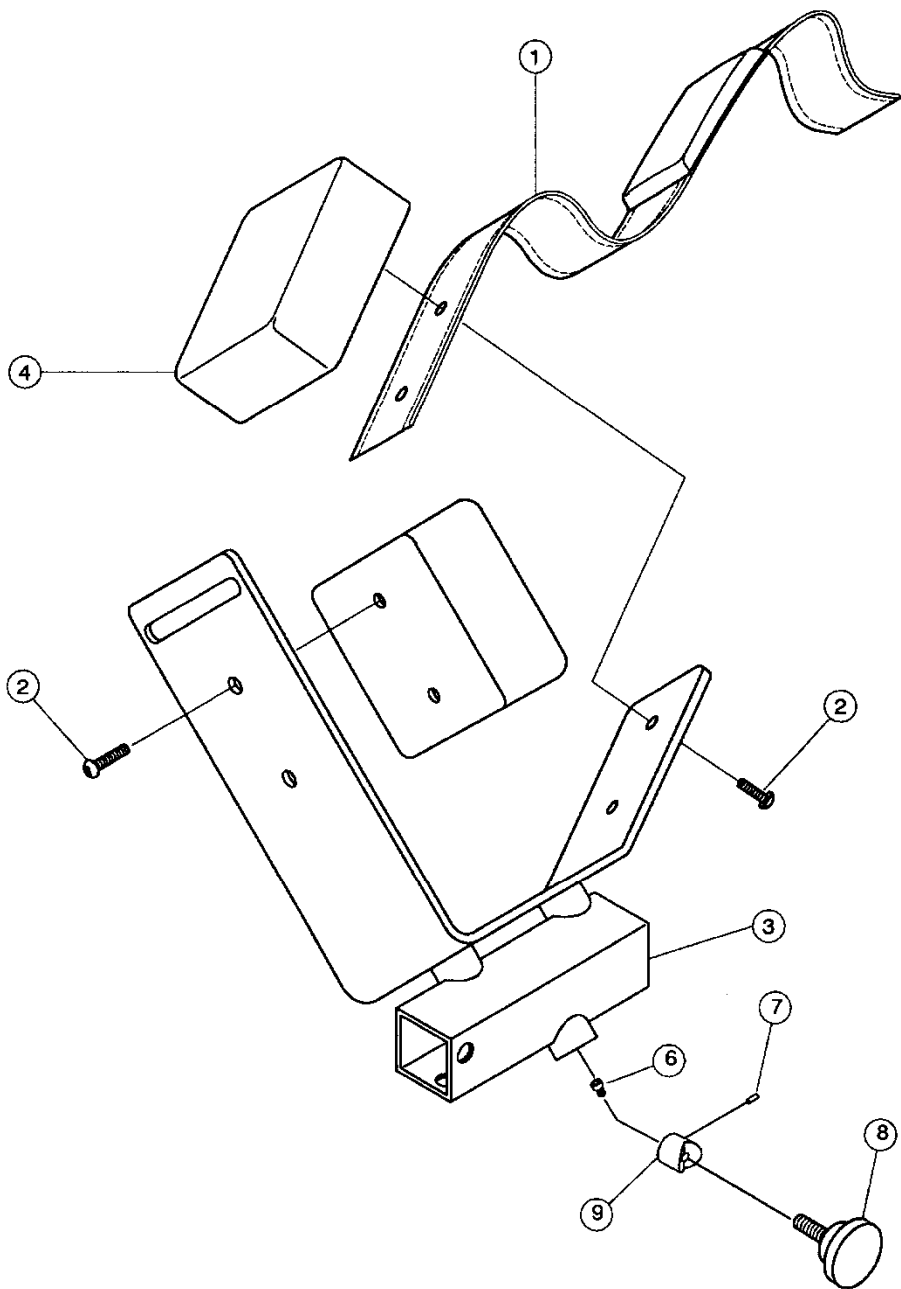


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Figure 10-4 Wrist and Shoulder Adapter Assembly (P/N 7700S960)

### Replaceable Parts

REF. NO.	PART NO.	QTY	DESCRIPTION
1.	7320C121-1	1	Counter Weight, Black
2.	7700W961	1	Wrist/Shoulder Adapter Weldment
3.	PP300013	1	Insert Glide 1-1/4 Sq. x 16GA.
4.	7700C965	1	Handle Weldment, Wrist/Shoulder
5.	PP400201	1	Hand Grip (Fly)
6.	770CM969	1	Label, Wrist/Shoulder Position
7.	FB030100	1	Thrust Washer, .750 ID x 1.25 OD x .06 Thick
8.	PP460774	1	Knob, with 5/16-18 x 3/4" Stud
9.	7320M122	1	Stud



012-1E

Figure 10-5 Thigh Stabilization Adapter Assembly (P/N 7300S950)

### Replaceable Parts

REF. NO.	PART NO.	QTY	DESCRIPTION
1.	7700U805	1	Shin Pad Belt
2.	HC620417	4	Screw, Socket Button Head, 1/4–20 x 1"
3.	7700C872	1	Thigh Plate/Side Weldment
4.	PP460004	1	Knob, 5/16–18, Black
5.	7700S802	2	Cushion
6.	HC532807	1	Screw, Socket Head Cap 6–31 x 1/4, Nylok
7.	HP246708	1	Roll Pin, 3/32 x 1/4
8.	PP460004	1	Knob, 5/16–18, Black
9.	AA033904	1	V–Pusher



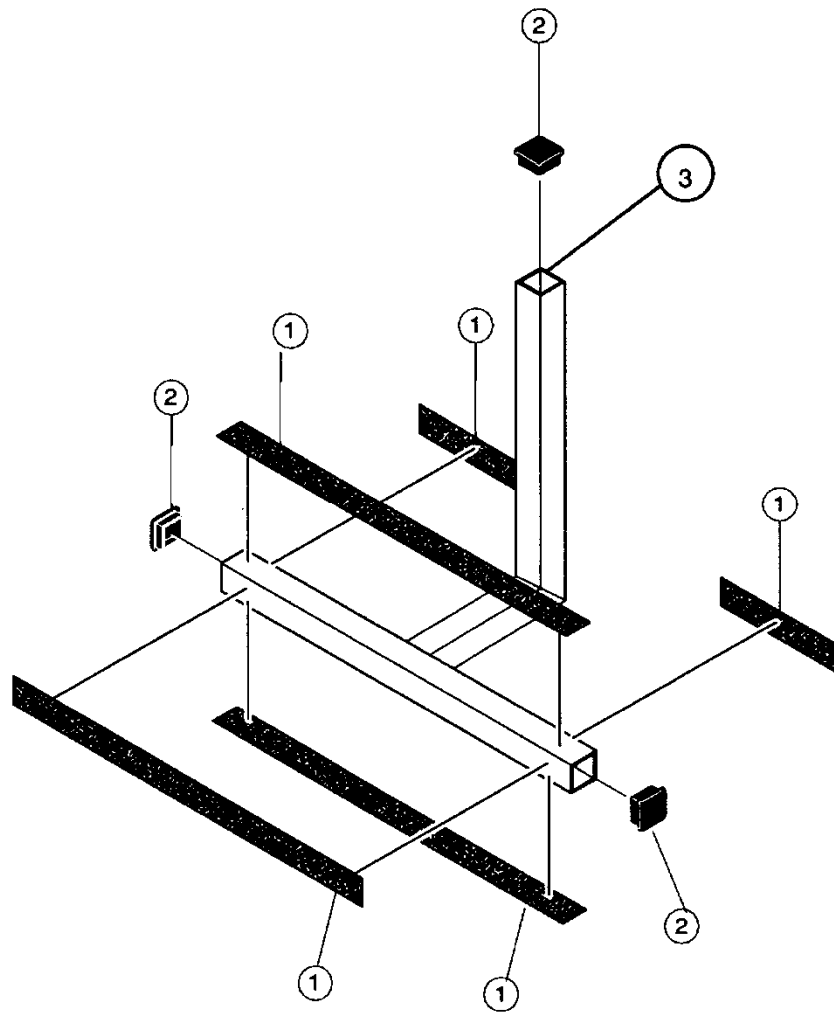
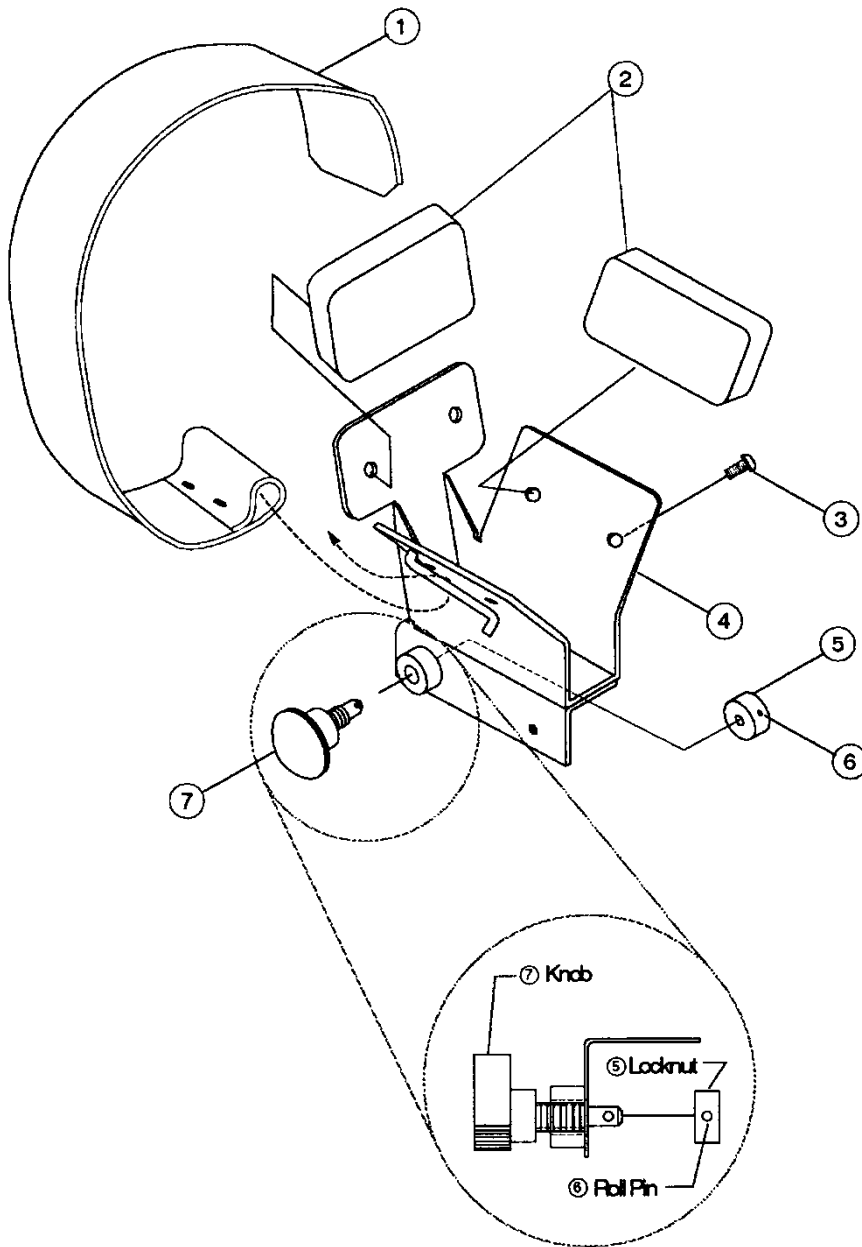


Figure 10-6 Foot Rest Assembly (P/N 7700S845)

### Replaceable Parts

REF. NO.	PART NO.	QTY	DESCRIPTION
1.		1	Non-Skid Foot Treads
2.	PP300013	3	Insert Glide, 1-1/4" Sq. x 16 GA.
3.	7700W840	1	Welded Foot Rest

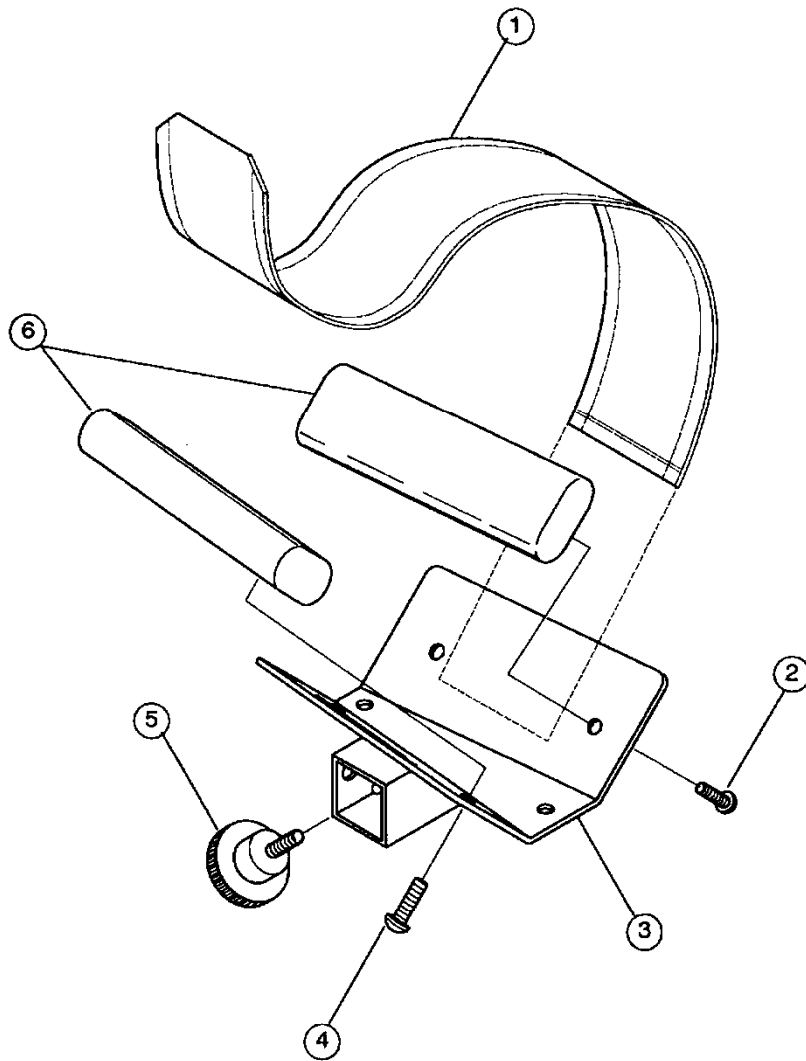


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Figure 10-7 Elbow Support Subassembly (P/N 7700S915)

### Replaceable Parts

REF. NO.	PART NO.	QTY	DESCRIPTION
1.	1810S189	1	Shoulder Rotation Belt Subassembly
2.	2500S001	3	Cushions
3.	HC620412	6	Screw, Hex Socket Button Head, 1/4–20 x 1/2
4.	7700C912	1	Elbow Stabilization Weldment
5.	7300P142	1	Locknut
6.	HP266723	1	Roll Pin, 1/8 Dia. x 5/8 Long
7.	PP460030	1	Knob, 3/8–16 Stud, L.H. Thread

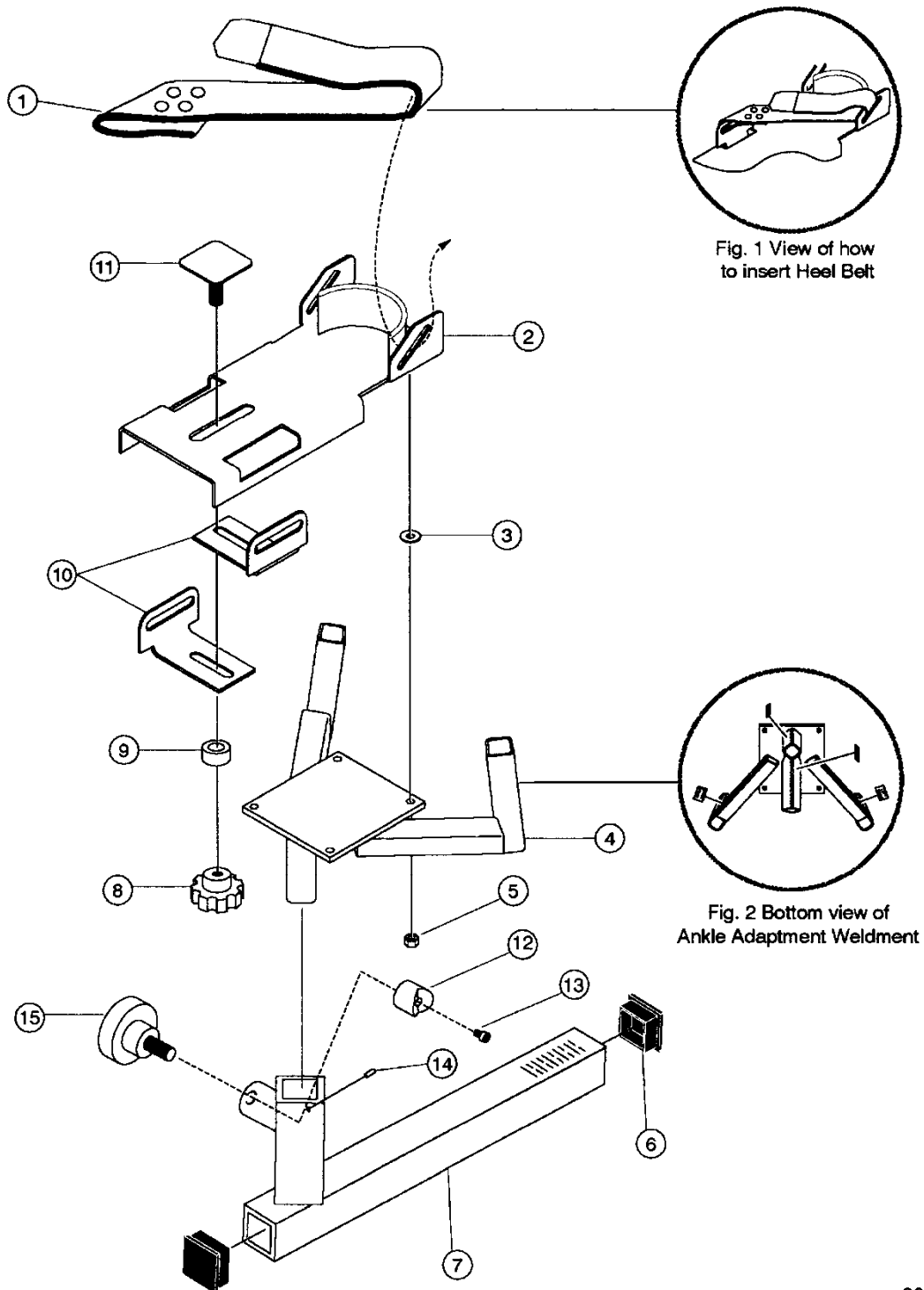


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Figure 10-8 Forearm Stabilization Adapter (P/N 7700A850)

### Replaceable Parts

REF. NO.	PART NO.	QTY	DESCRIPTION
1.	UB410001	1	Forearm Stabilization Belt
2.	HC620417	4	Screw, Socket Button Head, 1/4–20 x 1
3.	7700C852	1	Forearm Slide Weldment
4.	HC620417	4	Screw, Socket Button Head, 1/4–20 x 1
5.	PP460004	1	Knob, 5/16–18, Black
6.	2500S001	2	Forearm Cushions



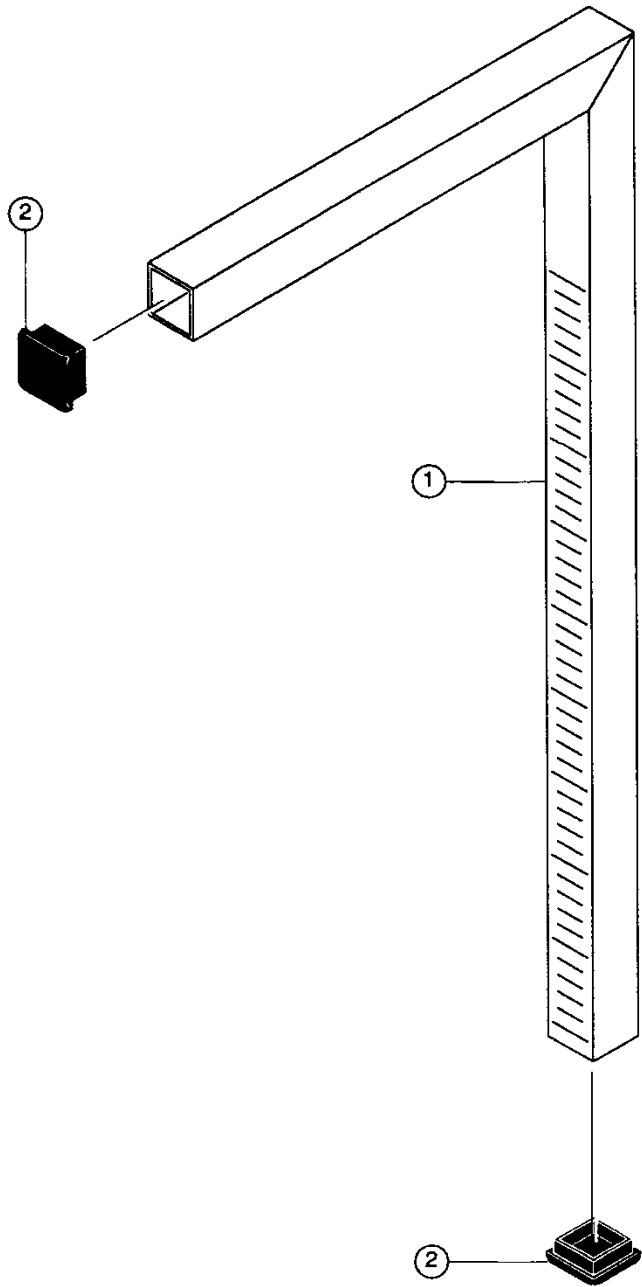
005-1E

Figure 10-9 Ankle Adapter Assembly (P/N 7700S886)

**Replaceable Parts**

<b>REF. NO.</b>	<b>PART NO.</b>	<b>QTY</b>	<b>DESCRIPTION</b>
1.	7300S978	2	Heel Belt Assembly
2.	7700C884	1	Ankle Plate Weldment
3.	HS307600	4	Flatwasher, 1/4 (5/8 OD x 9/32 ID x .062 Thick)
4.	7700W836	1	Ankle Adapter Weldment
5.	HN625200	4	Nut, .25–20 Ounce–3B Elastic Strip
6.	PP300013	2	Insert Glide, 1–1/4 Sq. x 16 Ga.
7.	7700W881	1	Ankle Arm Weldment
8.	PP460010	1	Locking Knob
9.	7300M035	1	Knob Spacer
10.	7700C831	2	Slide Support, Ankle Adapter
11.	7300C038–1	1	Threaded Stud Weldment, Black
12.	AA033904	1	V–Pusher
13.	HC532807	1	Screw, Socket Head 6–31 x 1/4, Nylok
14.	HP246708	1	Roll Pin, 3/32 x 1/4
15.	PP460008	1	Locking Knob





010-1E

Figure 10-10 Stabilizer Tube Adapter (P/N 7700S865)

## REPLACEMENT PARTS

---

### Replaceable Parts

REF. NO.	PART NO.	QTY	DESCRIPTION
1.	7700W860	1	Stabilizer Tube Weldment
2.	PP300013	2	Insert Glide, 1-1/4" Sq. x 16 Ga.

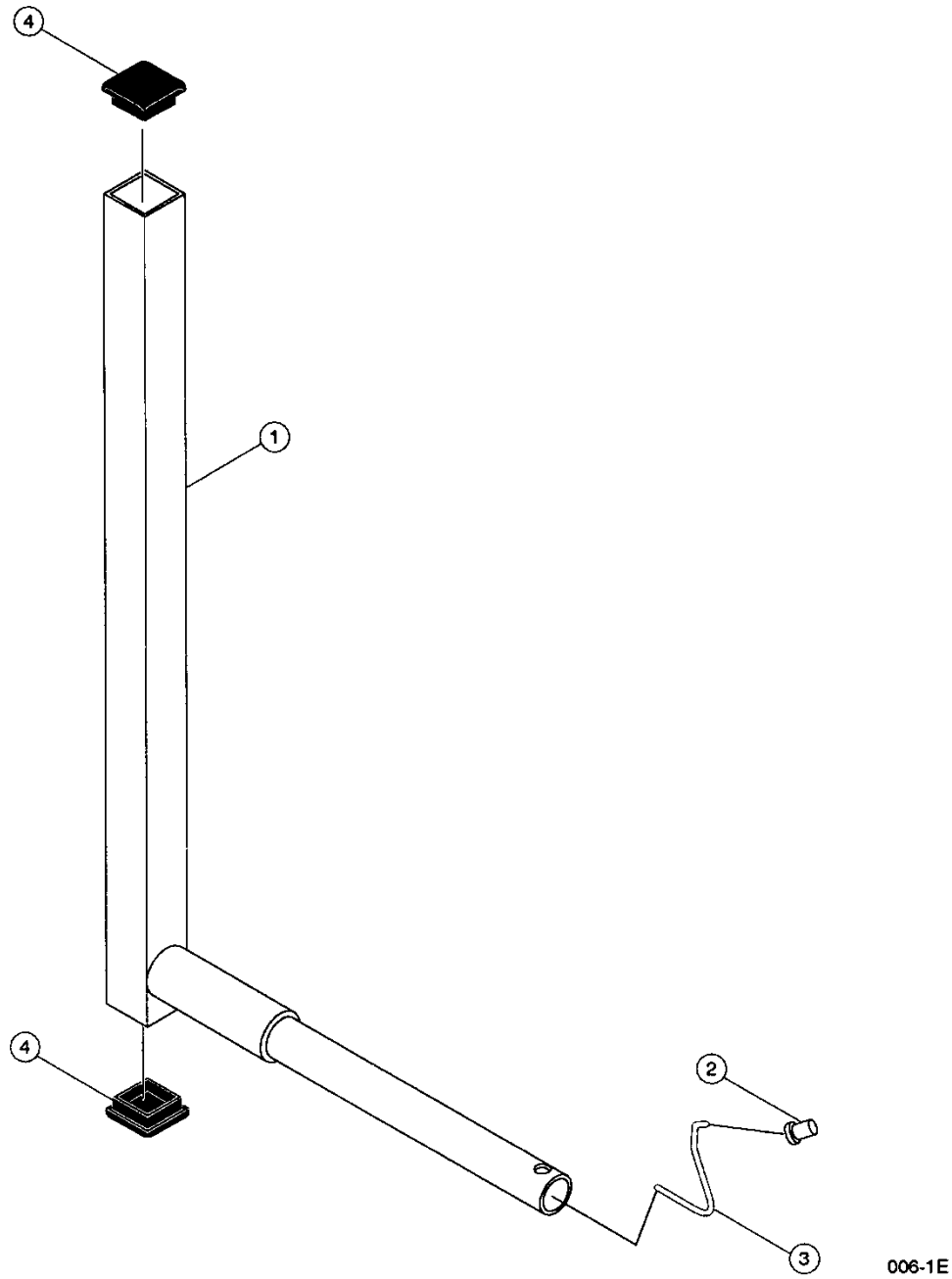
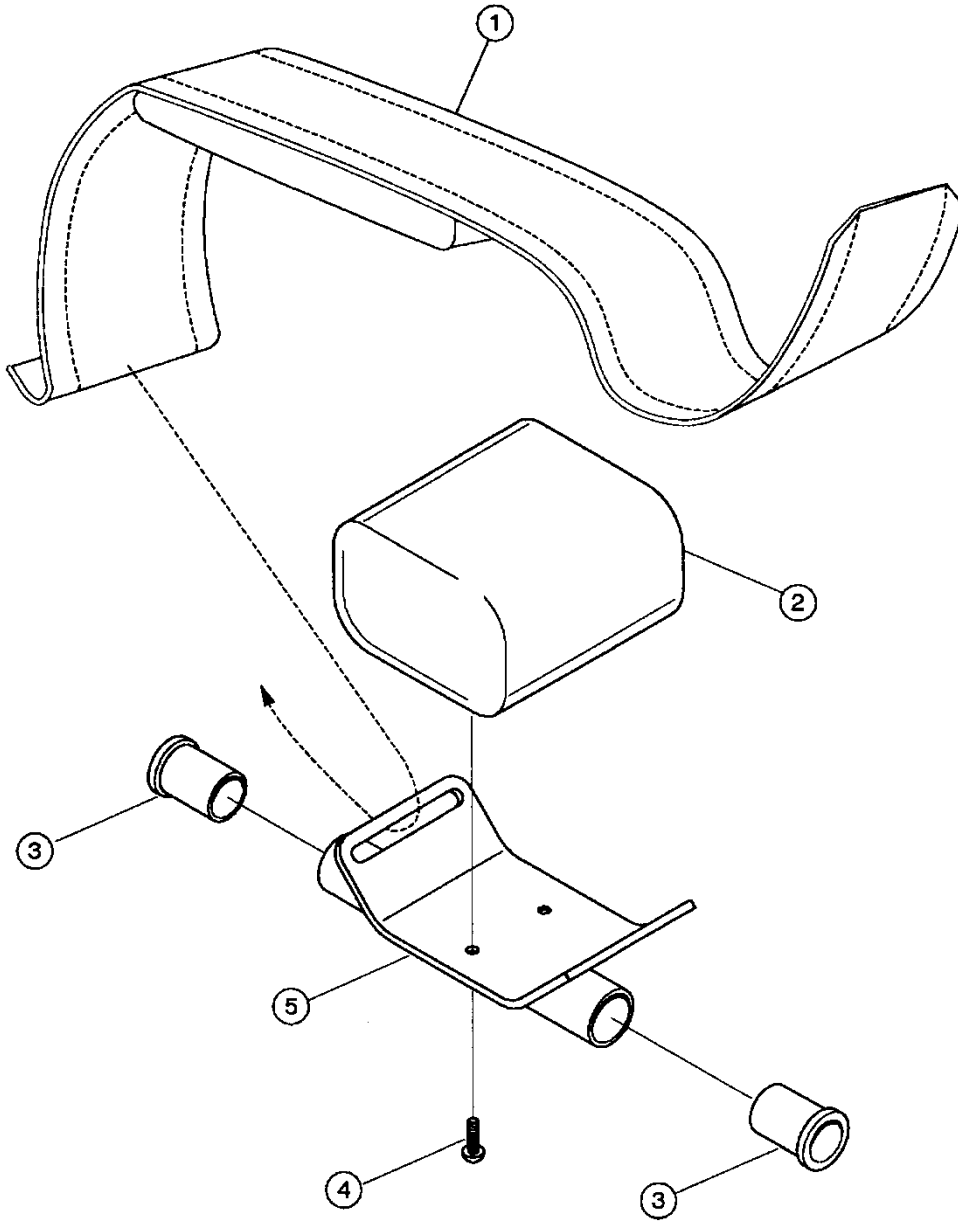


Figure 10-11 Knee and Hip Adapter (P/N 7700A814)

### Replaceable Parts

REF. NO.	PART NO.	QTY	DESCRIPTION
1.	7700W813	1	Knee/Hip Adapter Weldment
2.	AP030006	1	Push Button
3.	BS070017	1	Spring – Wire, .062 Dia
4.	PP300013	2	Insert Glide, 1–1/4 Sq. x 16 Ga.

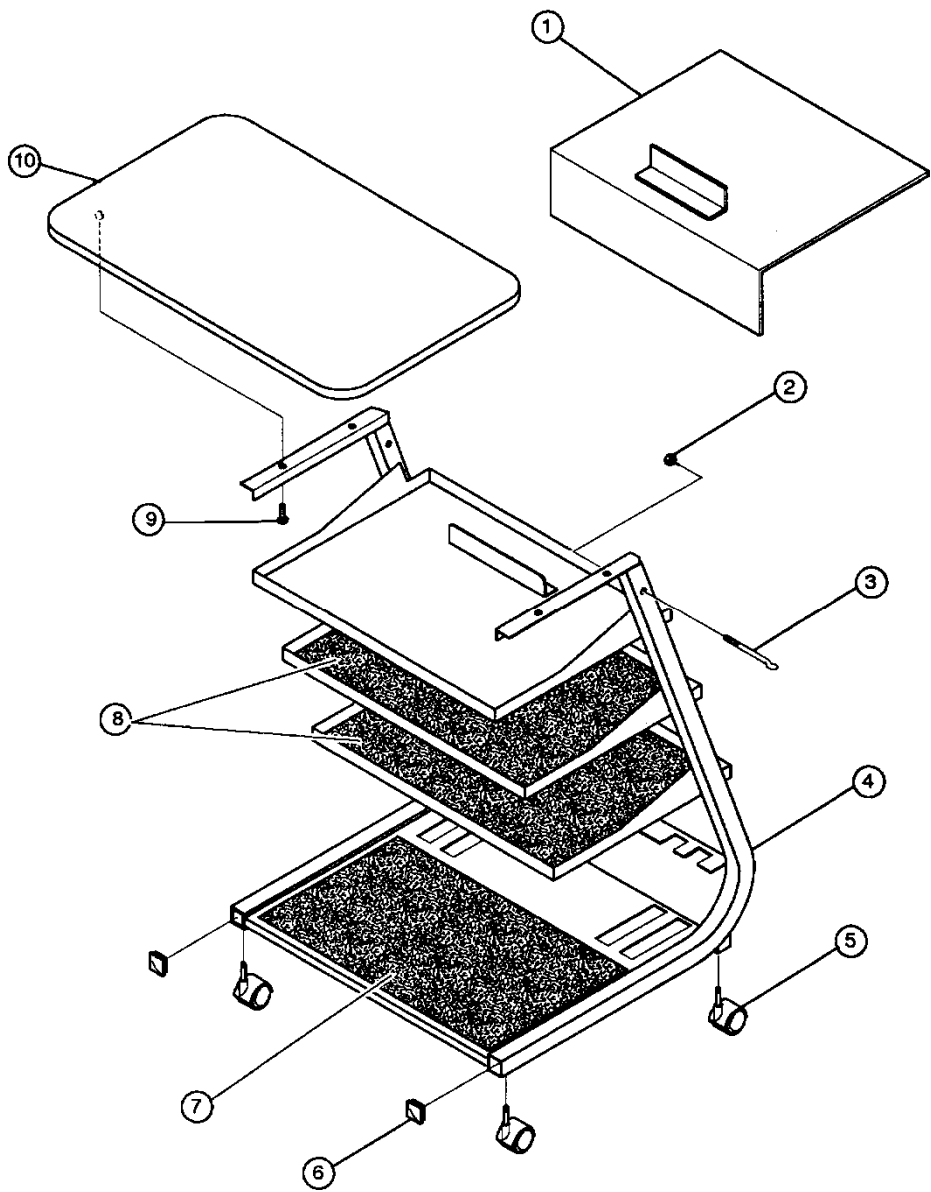


008-1E

Figure 10-12 Shin Pad Adapter (P/N 7700A804)

### Replaceable Parts

REF. NO.	PART NO.	QTY	DESCRIPTION
1.	7300U805	1	Shin Pad Belt
2.	7700S802	1	Shin Pad
3.	AD120000	2	Pad Tube Cushion
4.	HC620417	2	Screw, Socket Button Head, 1/4–20 x 1"
5.	7700C801	1	Shin Pad Retainer Weldment



014-1E

Figure 10-13 Accessory Cart (P/N 7700F090)

**Replaceable Parts**

<b>REF. NO.</b>	<b>PART NO.</b>	<b>QTY</b>	<b>DESCRIPTION</b>
1.	7300C078	1	Paper Basket
2.	HN5825200	2	Elastic Stop Nut #10
3.	7300P099	2	Hangar Bars
4.	7700F090	1	Cart
5.	WB04001	4	Caster w/Brakes, 5/16–18 Stem
6.	PP300003	2	End Cap, 1–1.4 Sq, 14Ga.
7.	7300M082	2	Weight Shelf Mat
8.	7300M081	1	Accessory Shelf Mat
9.	HM582214–2	4	Pan L Screw, 10/32 x 5/8 (Gray)
10.	730PE090	1	Table Top



**NORM ACCESSORIES**

7700U525	Stabilization Utility Strap
7320C121	Coated Counter Weight
7700S456	Support Cushion
7700S516	Lumbar Cushion

**CONSUMMABLE PARTS**

DB020502	Box of 10, 3 1/2" DS HD Diskettes
DC010009	Mini Data Cartridge Tape
DC030001	3 1/2" Drive Cleaning Kit
DR020009	HP Printer Cartridge, Color
DR020008	HP Printer Cartridge, Black

**DOCUMENTATION**

7700D4000	NORM Assembly and Installation
7700D0001	NORM Quick Start Manual
7700D0000	NORM User's Guide

**SOFTWARE**

770SW-DEU	Software Platform – German
770SW-DUT	Software Platform – Dutch
770SW-ENG	Software Platform – English
770SW-ENG/MET	Software Platform – English/Metric
770SW-ESP	Software Platform – Spanish
770SW-ESP/ENG	Software Platform – Spanish/English
770SW-FRE	Software Platform – French
770SW-ITA	Software Platform – Italian
770SW-JPN	Software Platform – Japanese
770SW-NOR	Software Platform – Norwegian
770SW-SWE	Software Platform – Swedish
770SW076	Software, DOS, 3–1/2" Media
770SW077	Software, Windows, 3–1/2" Media

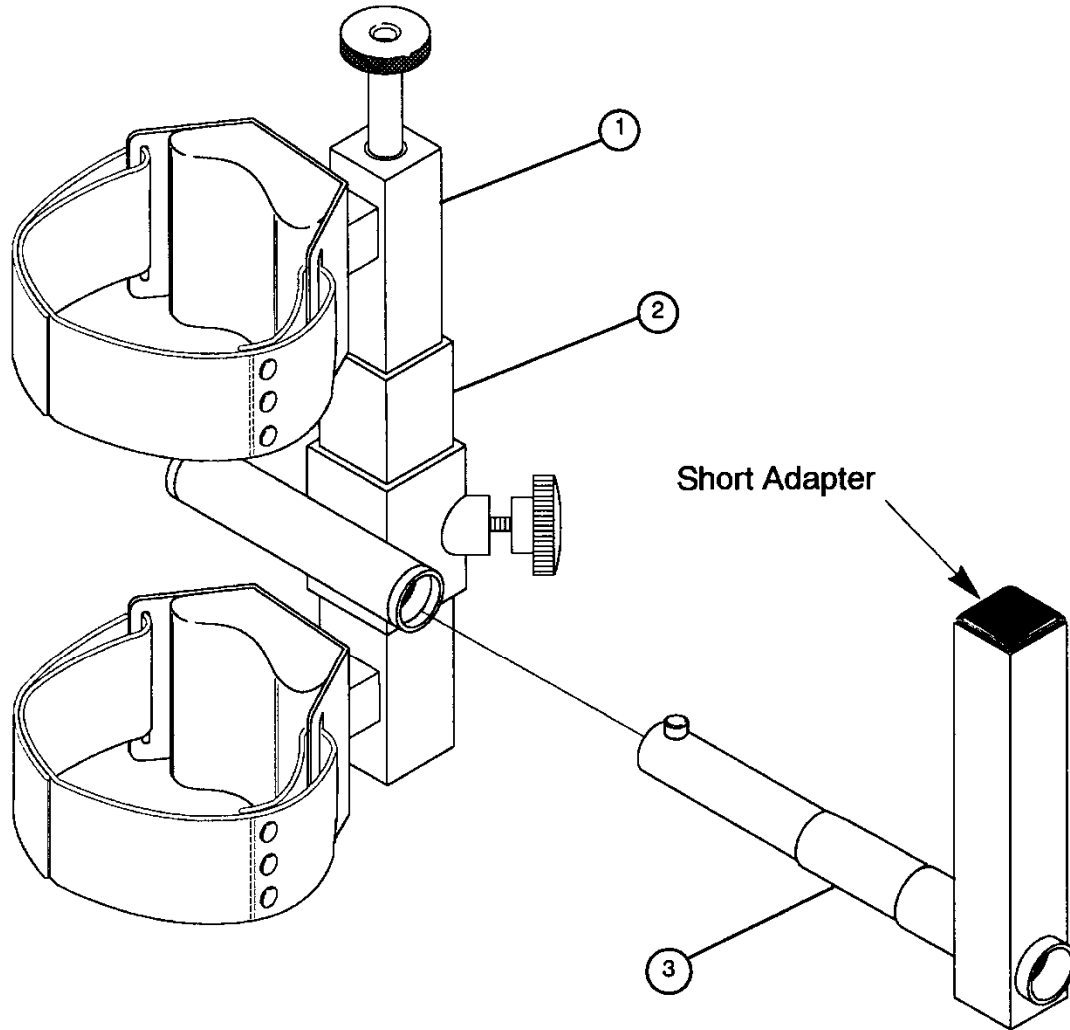
### HARDWARE

EN040030	Computer
EN380016	Monitor
EN770001	Light Pen
EK390010	Keyboard
EN490060	Printer

### OPTIONS

EP500005	Uninterruptible Power Supply
7700S758	High Torque Servo Amp DM-75
7700S755	KINESTIM Auxiliary Interface
2600F770	Johnson Anti-Shear Accessory
7310A001	TEF Modular Component (TMC)

The Johnson Anti-Shear Accessory



022-1

Figure 10-14 The Johnson Anti-Shear Accessory

### Replaceable Parts

ITEM	DESCRIPTION	PART NUMBER
1.	Accessory	2600F770
2.	Pivot Arm	2600C004
3.	Sleeve	7700M890

Worksim Adapters and Accessories

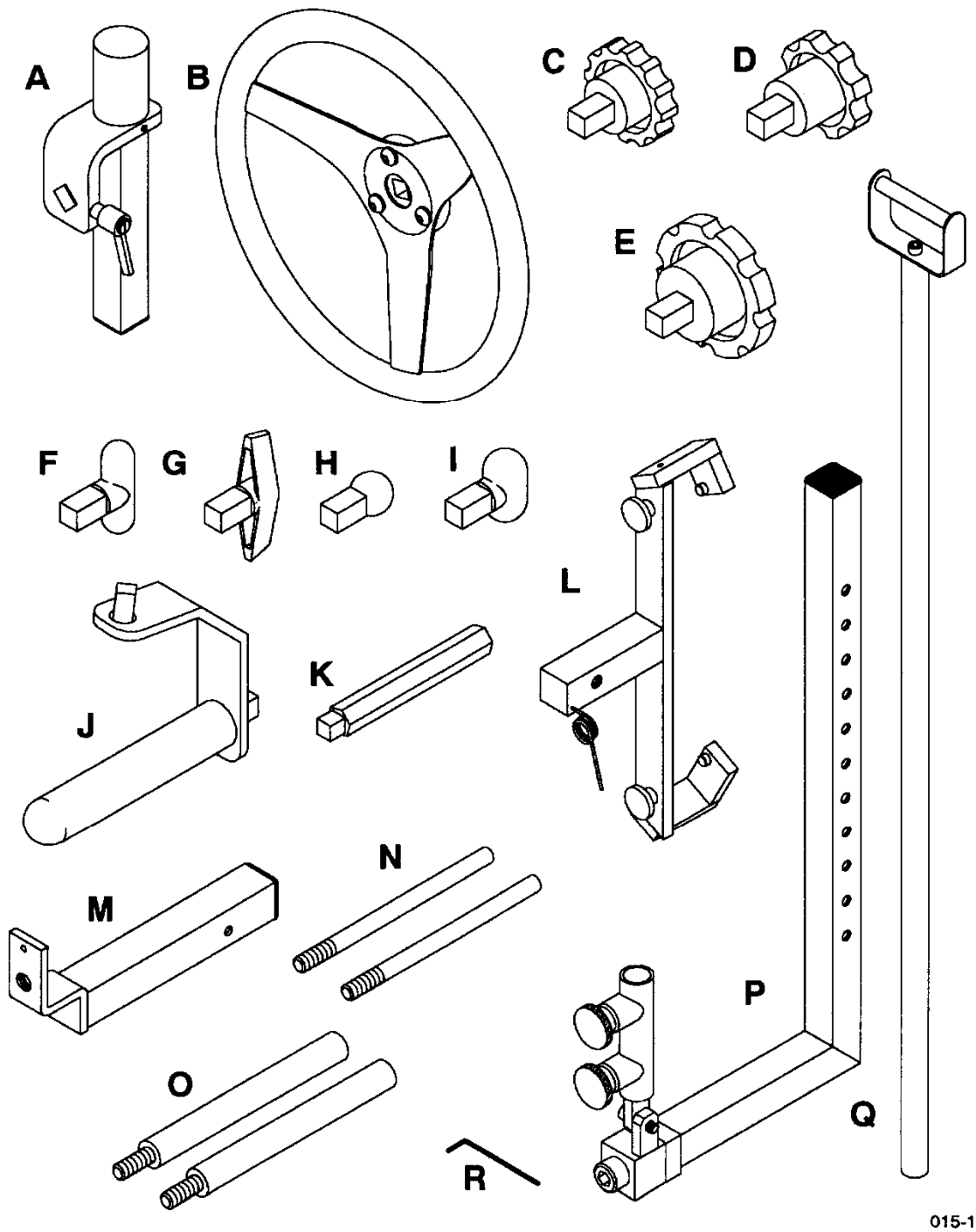
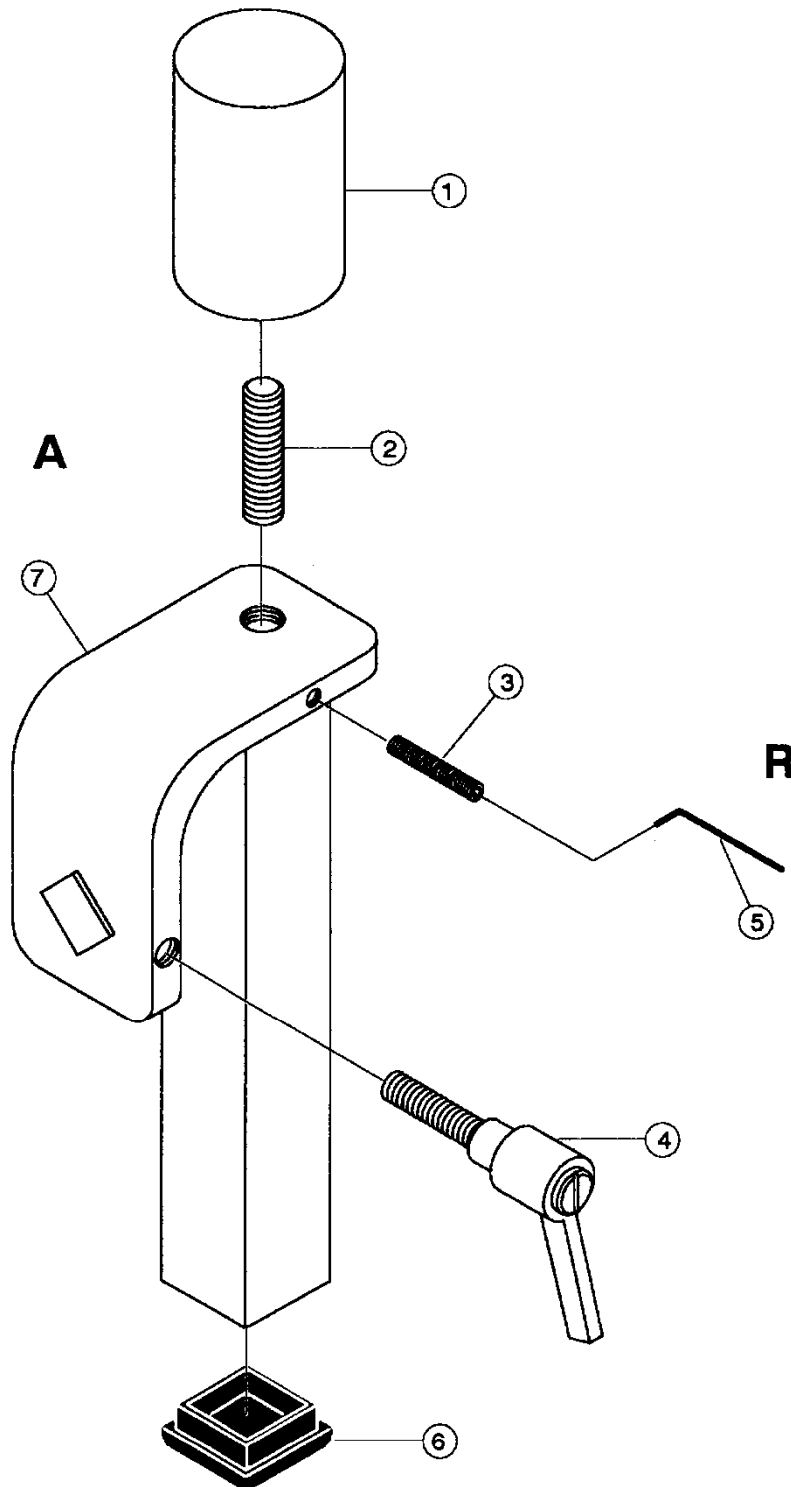


Figure 10-15 Work Simulation Adapters and Accessories

**ADAPTER AND ACCESSORY LISTING**

<b>ADAPTER</b>	<b>DESCRIPTION</b>	<b>PART NUMBER</b>
<b>A</b>	Universal WorkSim Adapter	7720A100
<b>B</b>	Steering Wheel/Valve Adapter	7720A400
<b>C</b>	Small Fluted Knob Adapter	7320A600
<b>D</b>	Small Fluted Knob w/Large Offset	7320A610
<b>E</b>	Large Fluted Knob	7320A640
<b>F</b>	Small T-Handle	7320A660
<b>G</b>	Large T-Handle	7320A670
<b>H</b>	Spherical Knob	7320A620
<b>I</b>	Oval Knob	7320S650
<b>J</b>	Multi-Grip / Screwdriver Adapter	7720A630
<b>K</b>	Universal Tool Adapter	7320P201
<b>L</b>	Stationary Gripper Arm	7720A300
<b>M</b>	Gripping Device	7720A300
<b>N</b>	1/2" Diameter Handle (2 pieces)	7720C302
<b>O</b>	3/4" Diameter Handle (2 pieces)	7720C301
<b>P</b>	Push / Pull Input Arm	7720A500
<b>Q</b>	Simulation Handle	7720A500
<b>R</b>	1/8" Wrench	BK030125

Universal Worksim Arm



020-5A

Figure 10-16 Universal WorkSim Arm

### REPLACEABLE PARTS

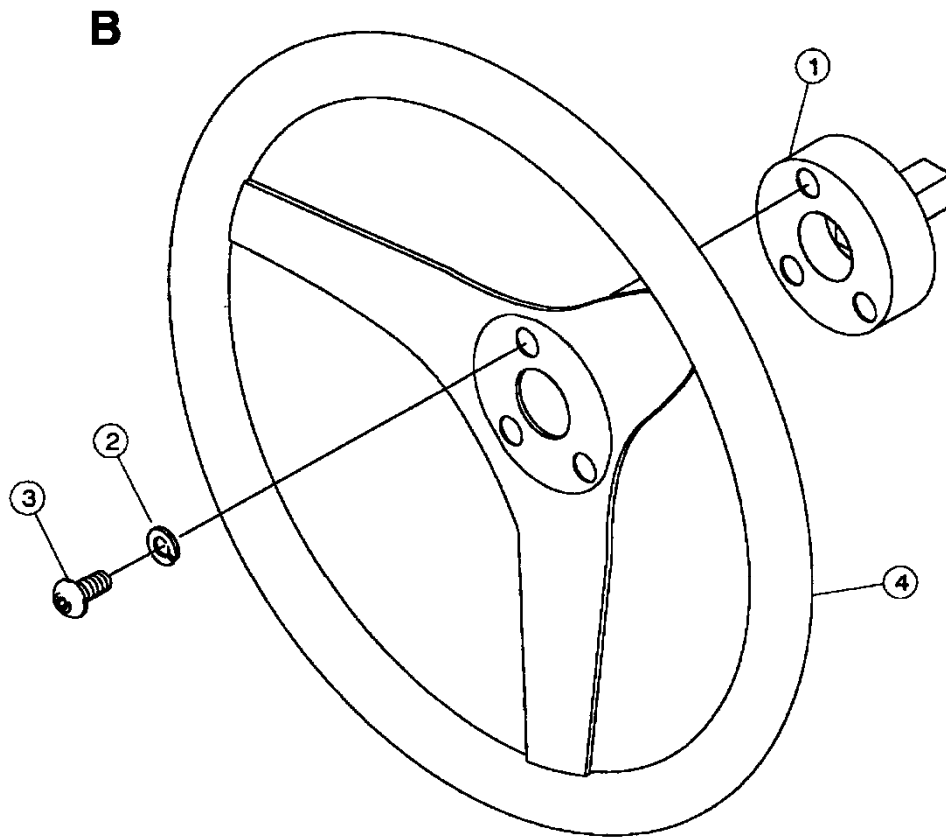
REF. NO.	PART NO.	QTY	DESCRIPTION
A	7720C110		Universal WorkSim Arm Assembly
1.	7720C121-1	1	Counter Weight
2.	7720M122	1	Stud, 3/8 – 16 x 1-1/2
3.	HY622917	1	Socket Head Screw, 1/4–20x1
4.	BH030019	1	Adjustable Handle
5.	BK030125	1	Allen Wrench, 1/8
6.	PP300013	1	Insert Glide, 1-1/4" sq. x 16 ga.
7.	7720C110	1	Universal WorkSim Weldment

### ADAPTER USAGE

The Universal WorkSim Arm is used in DAP 201 through DAP 211 Pattern Set-ups.



Steering Wheel / Valve Adapter



025-1A

Figure 10-17 Steering Wheel / Valve Adapter

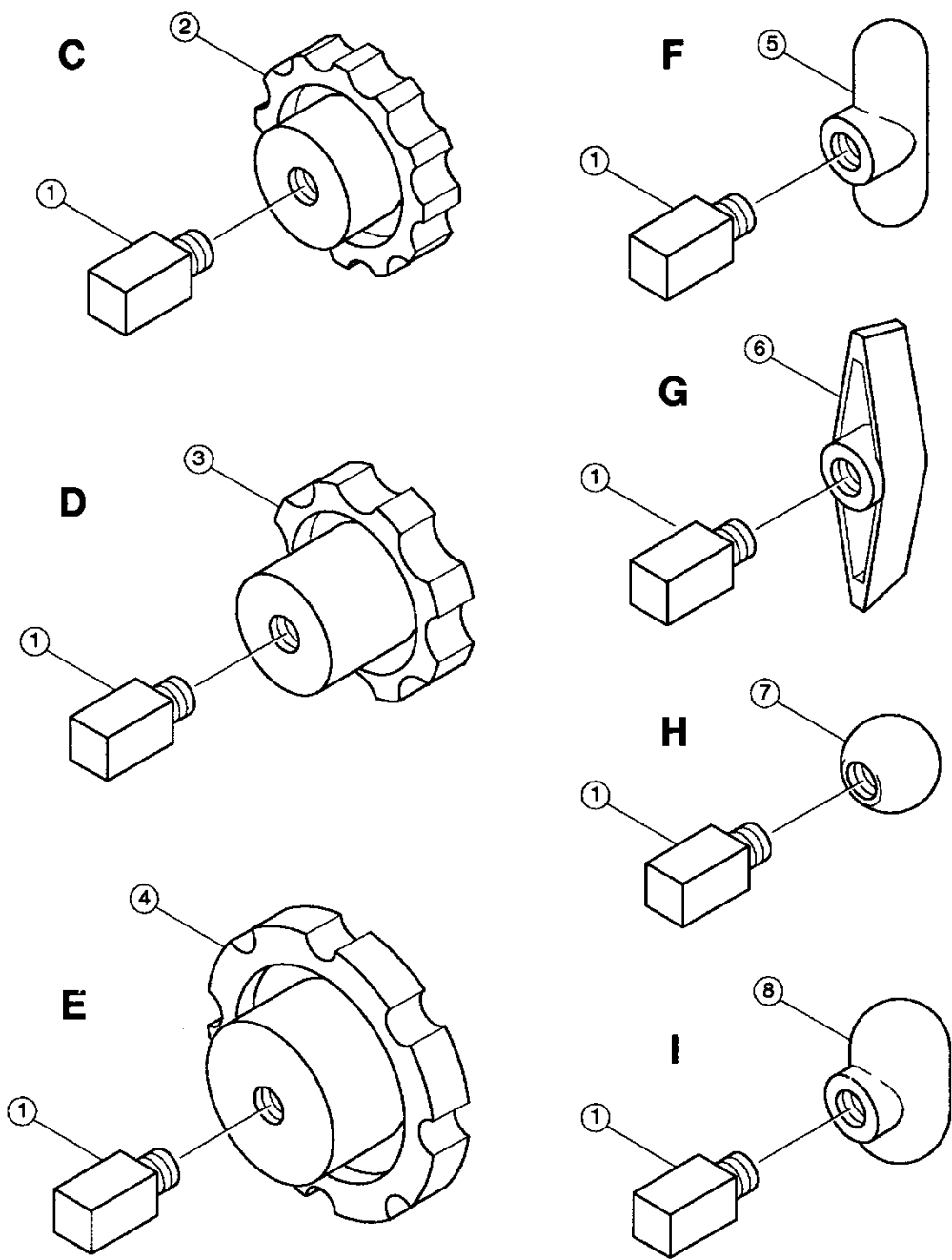
### REPLACEABLE PARTS

REF. NO.	PART NO.	QTY	DESCRIPTION
B	7720A400		Steering Wheel / Valve Assembly
1.	7720P408	1	Steering Wheel / Valve Weldment
2.	HS308300	3	Lockwasher, 1/4
3.	HC620412	3	Butt. Hd. Cap Screw, 1/4x-20x1/2
4.	732WW412	1	Steering Wheel / Valve Adapter

### ADAPTER USAGE

The Steering Wheel / Valve adapter is used in DAP 201 Pattern Set-Up with the Universal WorkSim Arm.

Handles and Knobs



016-1E

Figure 10-18 Handles and Knobs

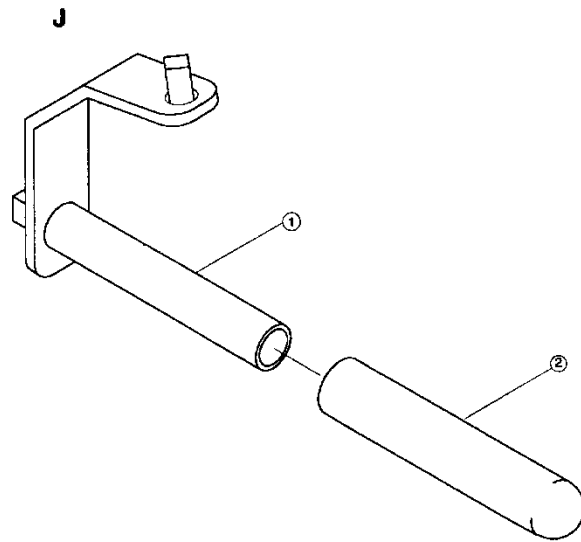
### REPLACEABLE PARTS

REF. NO.	PART NO.	QTY	DESCRIPTION
C	7320A600		Small Fluted Knob Assembly
1.	7320P601	1	Threaded Knob Adapter, 3/8–16
2.	732PP602	1	Small Fluted Knob
D	7320A610		Small Fluted Knob with Offset
1.	7320P601	1	Threaded Knob Adapter, 3/8–16
3.	PP450005	1	Small Fluted Knob with Offset
E	7320A640		Large Fluted Knob assembly
1.	7320P601	1	Threaded Knob Adapter, 3/8–16
4.	732PP641	1	Large Fluted Knob
F	7320A660		Small "T" Handle assembly
1.	7320P601	1	Threaded Knob Adapter, 3/8–16
5.	732PP661	1	Small "T"–Handle
G	7320A670		Large "T" Handle assembly
1.	7320P601	1	Threaded Knob Adapter, 3/8–16
6.	732P671	1	Large "T"–Handle
H	7320A620		Spherical Knob assembly
1.	7320P601	1	Threaded Knob Adapter, 3/8–16
7.	732PP621	1	Spherical Knob
I	7320A650		Oval Knob assembly
1.	7320P601	1	Threaded Knob Adapter, 3/8–16
8.	732PP651	1	Oval Knob

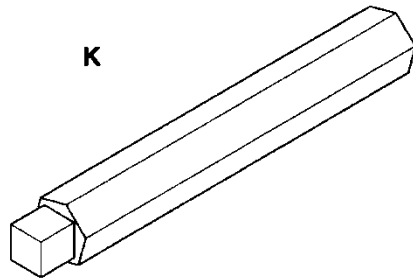
### ADAPTER USAGE

Handles and Knobs are used in DAP 202 through 208 Pattern Set–Ups with the Universal WorkSim Arm.

Multi-Grip / Screwdriver Adapter Multi-Grip / Screwdriver and Universal  
Tool Adapters



017-1E



021-1A

Figure 10-19 Multi-Grip / Screwdriver and Universal Tool Adapters

### REPLACEABLE PARTS

REF. NO.	PART NO.	QTY	DESCRIPTION
J	7720A630		Multi-Grip / Screwdriver assembly
1.	7720631	1	Multi-Grip Screwdriver Weldment
2.	732PP634	1	Rubber Hand Grip

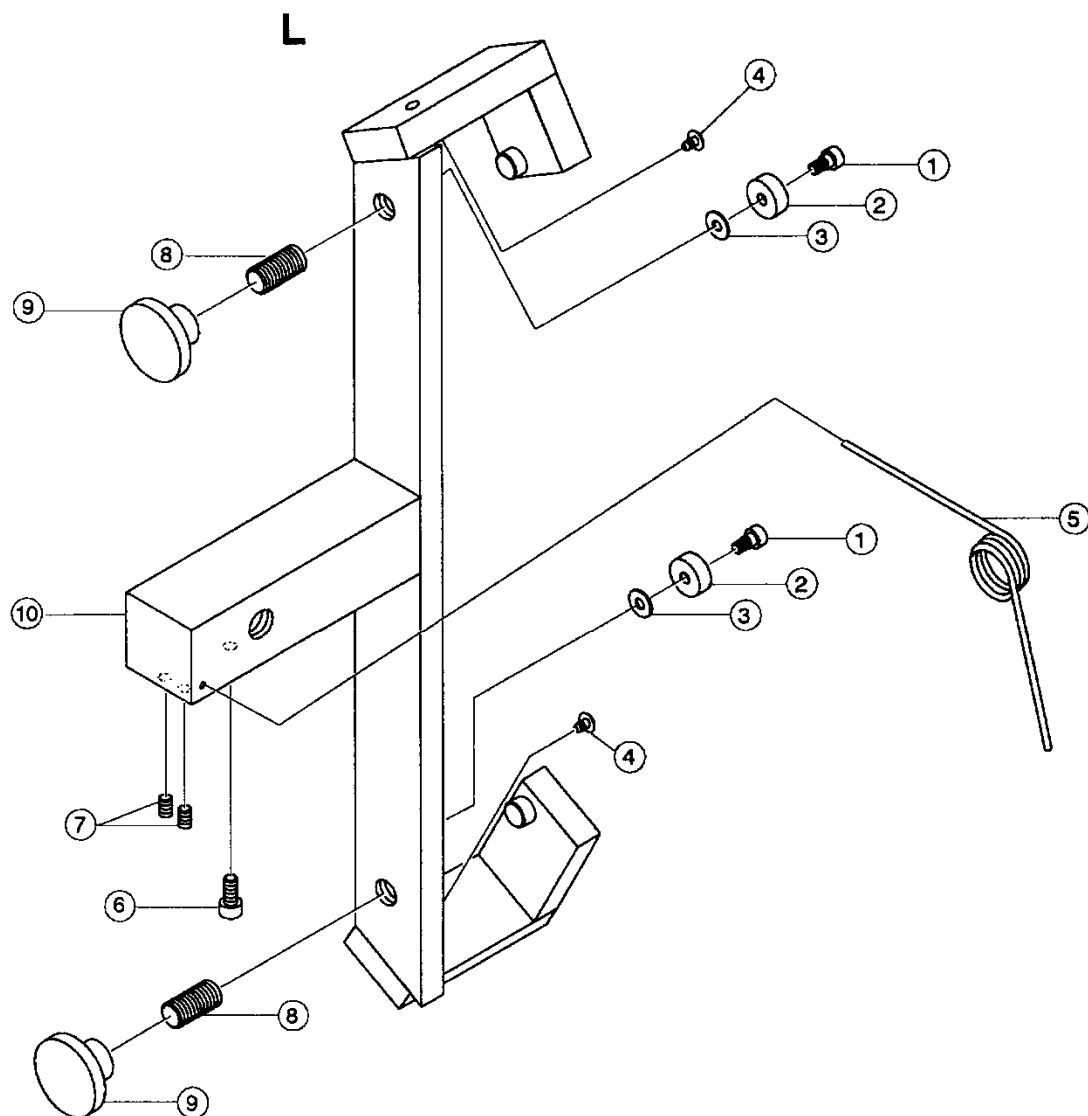
### ADAPTER USAGE

The Multi-Grip / Screwdriver adapter is used in DAP 209 and DAP 210 Pattern Set-Ups with the Universal WorkSim Arm.

### REPLACEABLE PARTS

REF. NO.	PART NO.	QTY	DESCRIPTION
K	7320P201	1	Universal Tool Adapter

## Stationary Gripper Arm



020-1E

### Figure 10-20 Stationary Gripper Arm

### REPLACEABLE PARTS

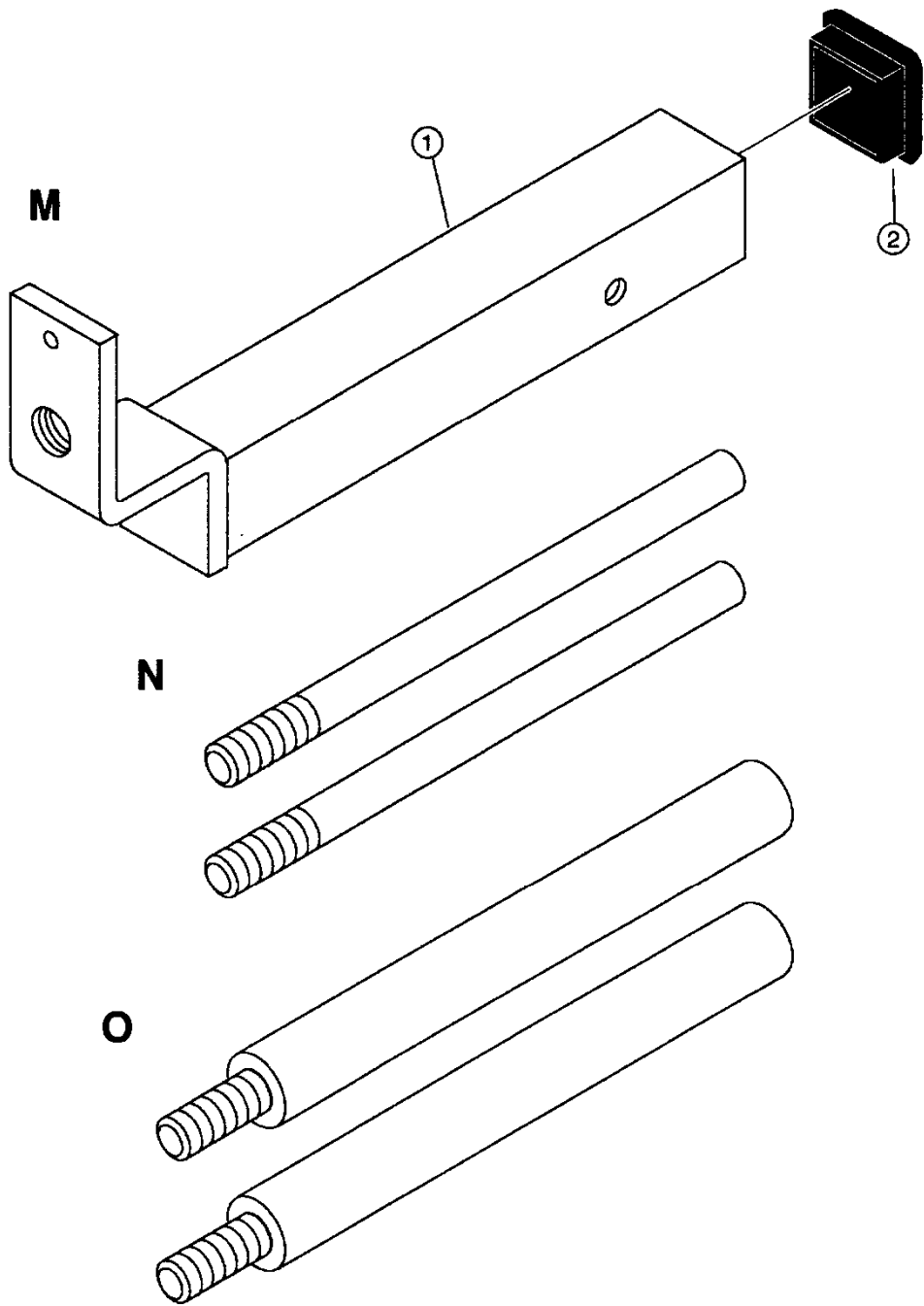
REF. NO.	PART NO.	QTY	DESCRIPTION
L	7720A300		Stationary Gripper Arm assembly
1.	HD583307	2	Slotted Shoulder Screw #10–32x14
2.	7320M305	2	R.O.M. Face Clamp
3.	HS107702	2	Flat Washer, 1/4"
4.	PP060010	2	Stem Bumper, 7/16" Dia.
5.	BS071732	1	Torsion Spring
6.	HC582810	1	Socket Head Cap Screw, #10–32x3/8
7.	HY581408	2	Set Screw, #10–32x1/4
8.	7320M307	2	Machined Stud
9.	PP460019	2	Clamp Knob
10.	7720C316	1	Gripper Weldment

### ADAPTER USAGE

The Stationary Gripper Arm along with the Gripping Device is used in DAP 212 Pattern Set-Up.



Gripping Device and Handles



021-1

Figure 10-21 Gripping Device and Handles

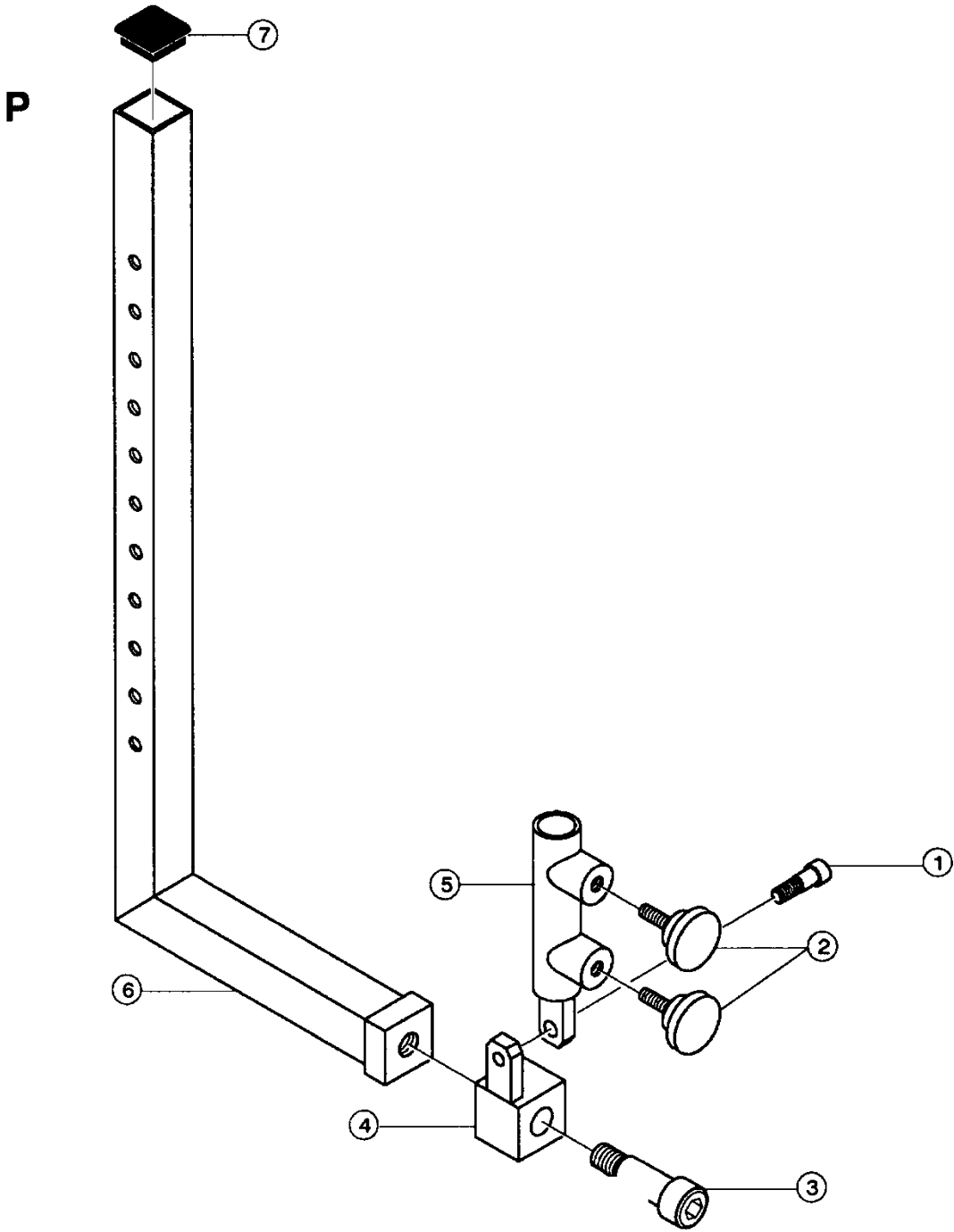
### REPLACEABLE PARTS

REF. NO.	PART NO.	QTY	DESCRIPTION
M	7720W320	1	Gripping Device Assembly
1.	7720W320	1	Gripping Device
2.	PP300013	1	Insert Glide, 1–1/4" sq. x 16 ga.
N	7320C302	1 pair	Handles, 1/2" Diameter
O	7320C301	1 pair	Handles, 3/4" Diameter

### ADAPTER USAGE

The Gripping Device and Handles are used in DAP 212 Pattern Set–Up.

Push / Pull Input Arm



018-1E

Figure 10-22 Push / Pull Input Arm

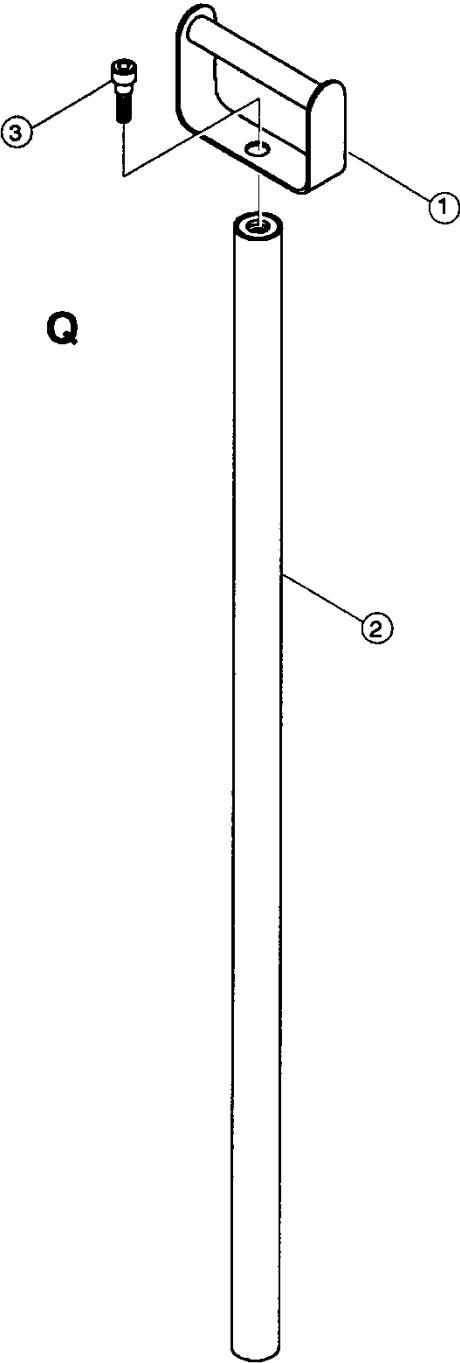
### REPLACEABLE PARTS

REF. NO.	PART NO.	QTY	DESCRIPTION
P	7720A500		Push / Pull Input Arm assembly
1.	HD383312	1	Shoulder Bolt, 3/8–16 x 1–1/16
2.	PP460012	2	Locking Knob w/Shaft
3.	HD753322	1	Shoulder Bolt, 5/8–11 x 1–3/8
4.	7720C510	1	C/Swivel Hub Weldment
5.	7720C515	1	Input Arm Receiving Tube Weldment
6.	7720W505	1	Input Tube Weldment
7.	PP300013	1	Insert Glide, 1–1/4" sq. x 16 ga.

### ADAPTER UAGE

The Push / Pull Input Arm along with the Simulation Handle is used in DAP 213 Pattern Set–Up.

Simulation Handle



019-1E

Figure 10-23 Simulation Handle

### REPLACEABLE PARTS

REF. NO.	PART NO.	QTY	DESCRIPTION
Q	7720A500		Simulation Handle Assembly
1.	7720C520	1	Simulation Handle Adapter
2.	7720C525	1	Simulation Handle Weldment
3.	HD383312	1	Shoulder Bolt, 3/8–16 x 11/16

### ADAPTER USAGE

The Simulation Handle along with the Push / Pull Input Arm is used in DAP 213 Pattern Set–Up.

TEF Modular Component - P/N 731A001

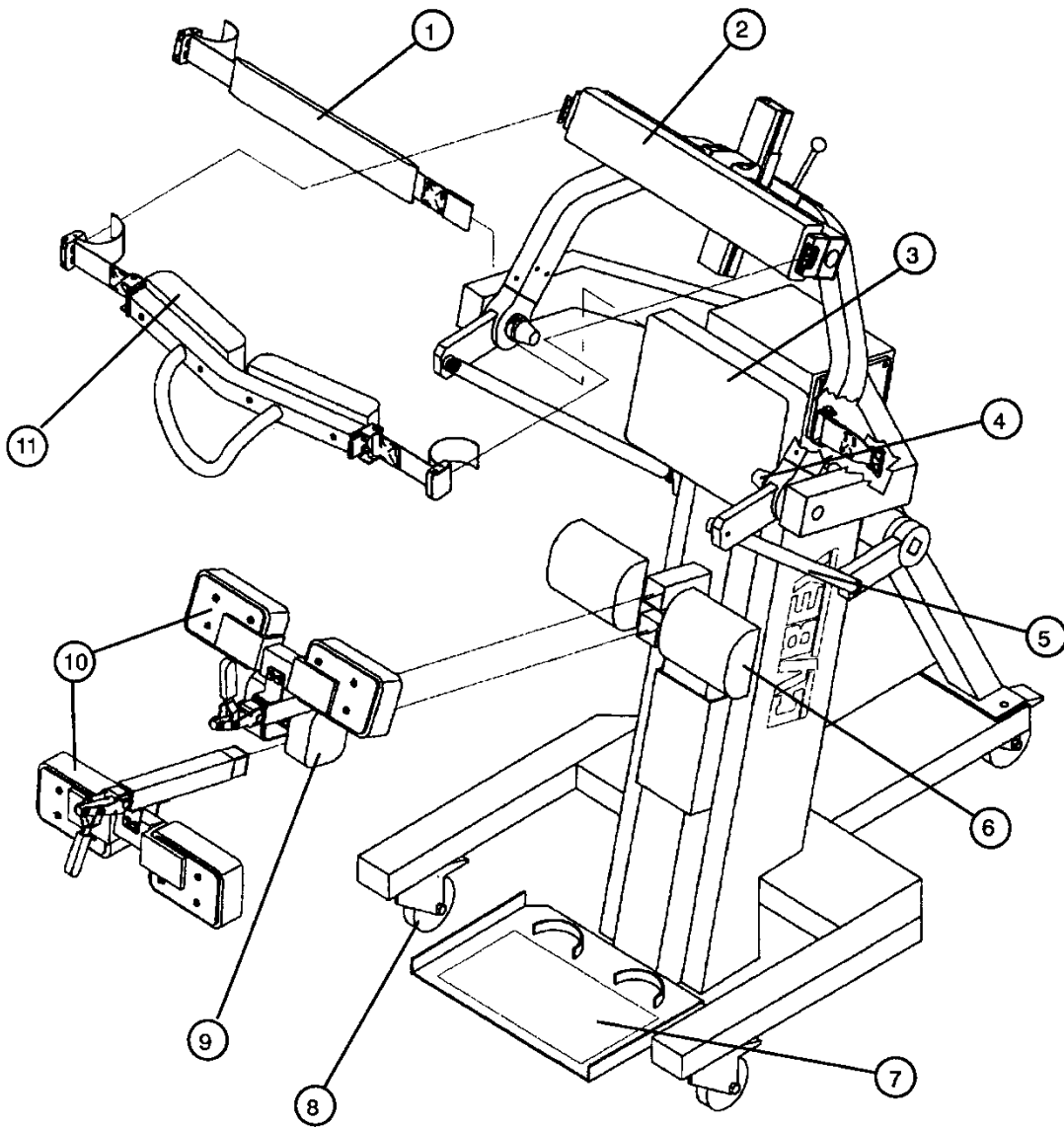


Figure 10-24 TEF Modular Component

### TEF Modular Component

The TEF Modular Component is designed to test and rehabilitate the trunk musculature involved in daily lifting, carrying, and reaching, as well as posture and movement. Upon docking with the NORM System, the TEF Modular Component becomes an integral part of the CSMi Testing and Rehabilitation System.

TEF Modular Components produced prior to 1997 were equipped with an internal isolation Replaceable Parts

transformer. Starting in 1997, the isolation transformer is externally mounted. (The pre-1997 build is shown on the facing page.)

The upholstery color numbers for the TEF Modular Component are the same as for the NORM System. Refer to those part numbers (provided in Appendix E) when ordering upholstery replacements.

REF. NO.	PART NO.	QTY	DESCRIPTION
1.	3400U216-XX	1	Pelvic Belt Pad
2.	7310S699-XX	1	Scapular Pad
3.	1750U110-XX	1	Back Cushion
4.	PR069473	2	Bumper, 1-1/2 inch
5.	731C502	2	Tie Rod
6.	1750U081-XX	2	Poplietal Pad
7.	1750M148	1	Safety Walk
8.	WB021500	3	Wheel Caster
9.	175U059-XX	2	Knee Cushion
10.	1750U067-XX	4	Thigh / Tibial Cushion
11.	3400U216-XX	2	Chest Pad



NOTES:



### APPENDIX A      SYSTEM DIAGNOSTICS

#### SYSTEM DIAGNOSTICS

This chapter describes the system tools available for troubleshooting on the NORM System. Two different support areas are accessible: System Diagnostic Tools, which can be accessed through Windows, and Firmware Interface Tools (FWINTF), which are accessible through DOS.

Both sets of tools were designed for use by qualified technicians who have been trained specifically in this area of the NORM system. To a large extent, the information in this chapter reflects instructional documentation provided to technicians during that training.

After the system tools section, the symptom reporting system for NORM is described. This section supplies the steps and fault codes needed to report and resolve mechanical, electrical, or operational-type equipment symptoms. It is intended for customer service representatives and CSMi field and in-house technicians.

## STATUS WORDS

Status Words are an invaluable diagnostic aid as they are used by the system to report error conditions. Status Words are written in hexadecimal (base 16) notation. Each 32-bit Status Word contains eight, 4 bit hexadecimal digits. Each digit is assigned a value in the range 0–9 or A–F such as: C1000803.

### How Hex Digit Values are Assigned

The individual bits within the 4 bit hexadecimal digit are represented by the values 1, 2, 4 and 8 with 1 being the rightmost or least significant bit (LSB) and 8 being the leftmost or most significant bit (MSB):

(MSB)				(LSB)
x	x	x	x	(4 bits, 0 or 1)
8	4	2	1	(value when bit=1)

If more than one of the four bits is 1, their values are added to produce the hex digit.

*Example:*

9 represents a bit pattern of **1001**

8	4	2	1	(value when bit=1)
1	0	0	1	Bit pattern
(8 + 1 = 9)				

If the bit pattern values add up to a number greater than 9 (decimal) the letters A–F are used. A=10 (decimal), B=11 (decimal), ..... , F=15 (decimal). **F** represents all bits set to 1 for bit pattern 1111 (since 8+4+2+1=15 decimal).

### Reading a Status Word

Status Word bits are numbered from bit 0 to bit 31. Of the 8 hexadecimal digits within the Status Word, the leftmost digit (most significant) contains bits 28 to 31 while the rightmost digit (least significant) contains bits 0 to 3.

Each bit in the 32-bit Status Word represents an error condition. When the bit is set (value set to 1) the error condition has occurred, otherwise the bit is cleared (0).

*If all 4 Status Words contain all 0's, no errors are reported.*

To determine which bits are set in a Status Word, expand the 8 hexadecimal digits to their bit patterns (for 32 bits) and count the bit numbers.

*Example:*

Consider the Status Word: C1000803.

The equivalent bit pattern is:

C	1	0	0	0	8	0	3
1100	0001	0000	0000	0000	1000	0000	0011
Bits 28–31				Bits 0–3			

Here, six bits are set (their value set to 1): Bits 0, 1, 11, 24, 30 and 31.

### Hex Digit to Bit Pattern Conversion Chart

Hex Digit	=	Bit Pattern	Hex Digit	=	Bit Pattern
0	=	0000	8	=	1000
1	=	0001	9	=	1001
2	=	0010	A	=	1010
3	=	0011	B	=	1011
4	=	0100	C	=	1100
5	=	0101	D	=	1101
6	=	0110	E	=	1110
7	=	0111	F	=	1111

A description of each bit in the four system diagnostic Status Words (Word 0 through Word

3) can be found in the charts on the following pages.

## FIRST STATUS WORD — (WORD 0)

<b>31</b> 68K EEPROM Checksum Error	<b>30</b> 68K Boot PROM Checksum Error	<b>29</b>	<b>28</b> RAM Diagnostic Error
<b>27</b> GP Timer Diagnostic Error	<b>26</b> DUART Diagnostic Error	<b>25</b> 82C54 Diagnostic Error	<b>24</b> Servo ADC Monitor Error
<b>23</b> 68K Watchdog Time-out	<b>22</b> Address Error	<b>21</b> Bus Error	<b>20</b> Absolute Position Error
<b>19</b> Speed Calibration Error	<b>18</b> Baseline Adjustment Error	<b>17</b> No DUART Channel A Interrupt	<b>16</b> Encoder Queue Full
<b>15</b> DSP Not Responding	<b>14</b> DSP NAK'd 68K Command	<b>13</b> Bad Parity in DSP Response	<b>12</b> DSP's Delay Queue Full
<b>11</b> DSP Version Incompatible	<b>10</b> IRQ5 Packet Time-out	<b>9</b> DSP Reprogramming Error	<b>8</b> DSP Reprogramming In Progress
<b>7</b> Channel A DAUART Received Break	<b>6</b> Channel A DUART Framing Error	<b>5</b>	<b>4</b> Channel A DUART Overrun Error
<b>3</b>	<b>2</b>	<b>1</b> Channel A DUART Output Error	<b>0</b>
0 = 0000	4= 0100	8= 1000	C= 1100
1 = 0001	5= 0101	9= 1001	D= 1101
2 = 0010	6= 0110	A= 1010	E= 1110
3 = 0011	7= 0111	B= 1011	F= 1111

## SECOND STATUS WORD — (WORD 1)

<b>31</b> Amp Interface Error	<b>30</b> Servo Amp Command Time-out	<b>29</b> AT SYNC Change IPO	<b>28</b> Boot Stalled Before Firmware was Read
<b>27</b> DSP EEPROM Checksum Error	<b>26</b> DSP Boot Prom Checksum Error	<b>25</b> DSP Detect its Delay Queue Full	<b>24</b> DSP Output Queue Full
<b>23</b> No DUART Channel B Interrupt	<b>22</b> Channel B Output Error	<b>21</b> Channel B Receive Break	<b>20</b> Channel B Framing Error
<b>19</b> Amp Input Buffer Full	<b>18</b> Channel B Overrun Error	<b>17</b> AT Command Time-out	<b>16</b> Servo Amp Overcurrent
<b>15</b> Privilege Violation	<b>14</b> Zero Divide	<b>13</b> Spurious Interrupt	<b>12</b> HW/SW Encoder CNT Mismatch
<b>11</b>	<b>10</b>	<b>9</b> Illegal Instruction	<b>8</b>
<b>7</b> Software FIFO Full	<b>6</b> Unassigned User Vector Interrupt	<b>5</b> Unexpected Interrupt	<b>4</b>
<b>3</b>	<b>2</b> Absolute Position Verif. Req.	<b>1</b>	<b>0</b> NDCB STACK Overflow
0 = 0000	4 = 0100	8 = 1000	C = 1100
1 = 0001	5 = 0101	9 = 1001	D = 1101
2 = 0010	6 = 0110	A = 1010	E = 1110
3 = 0011	7 = 0111	B = 1011	F = 1111

THIRD STATUS WORD — (WORD 2)

31	30	29	28
27	26	25	24
	QUICK STOP Activated	Hardware Safety System Activated	Safety Switch Pressed
23	22	21	20
	Missing Motor Encoder (@ DCB Chk P3 @ Servo)	Motor Velocity Over Software Limit	
19	18	17	16
		Servo Amp Faulted	
15	14	13	12
ADC Chnl 3 ± 15V Supply Error	ADC Chnl 4 + 15V Supply Error	ADC Chnl 5 +5V Supply Error	ADC Chnl 6 VPP{+12V} Error
11	10	9	8
System Mode 0 = Computer 1 = Manual	Torque Error Signal Failure	NMI (IRQ7) Error With No Latched Bit Set	Real-Time BIT Set Without Real-Time Error
7	6	5	4
3	2	1	0
0= 0000	4= 0100	8= 1000	C= 1100
1 = 0001	5= 0101	9= 1001	D= 1101
2= 0010	6= 0110	A= 1010	E= 1110
3= 0011	7= 0111	B= 1011	F= 1111

## FOURTH STATUS WORD — (WORD 3)

<b>31</b> Comfort Swich Latch Not Set IRQ1	<b>30</b>	<b>29</b>	<b>28</b> Test Fixture Firmware Enabled
<b>27</b>	<b>26</b>	<b>25</b> Dyna Arm Outside ROM	<b>24</b> DAC Saturation Error
<b>23</b> AT Power Failure	<b>22</b>	<b>21</b>	<b>20</b>
<b>19</b> Amp Not Ready	<b>18</b>	<b>17</b>	<b>16</b>
<b>15</b>	<b>14</b>	<b>13</b>	<b>12</b>
<b>11</b>	<b>10</b>	<b>9</b>	<b>8</b>
<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>
<b>3</b>	<b>2</b>	<b>1</b> Generated Non-recoverable Fault to AT IRQ10	<b>0</b> Generated Non-critical Fault to AT IRQ10
0= 0000	4= 0100	8= 1000	C= 1100
1 = 0001	5= 0101	9= 1001	D= 1101
2= 0010	6= 0110	A= 1010	E= 1110
3= 0011	7= 0111	B= 1011	F= 1111



The four columns of information on the following pages make up the symptom reporting system for the NORM Extremity Testing Device. The consistent use of this system will provide CSMi with useful and timely information needed to effectively take corrective action in the event of a field failure.

The reporting system is to be used at all levels of reporting:

In-House Customer Service Representatives

Field Service Technicians, and

In-House Service Technicians.

The symptom reporting system is set up in a hierarchical structure:

Level I	The first column contains upper assemblies.
Level II	The second column contains sub-assemblies.
Level III	The third column contains detailed parts of the sub assemblies.
Level IV	The fourth column contains symptoms that can be applied to a combination of columns one through three.

*Refer to the examples on the next pages for the proper construction of a symptom reporting code.*

## FIELD SERVICE REPRESENTATIVES (F + 8 digit code)

### EXAMPLE #1:

If a field technician finds the cam for the y-translation, which is in the chair, to be worn, the code would be as follows:

**F**, for field service technician, **01** for chair (from column I), **01** for y-translation (from column II), **01** for cam (from column III), and **24** for worn (from column IV). See Example code page below.

The F + 8 digit code would then look like, **F01010124**

I	II	III	IV
01 CHAIR	00 NO DESCRIPTION	00 NO DESCRIPTION	01 CHIPPED/SCRATCHED
	01 Y-TRANSLATION	01 CAM	02 LEAKING
		02 CAM STOP	03 GRINDING/SCRAPING
		03 CAMSHAFT	04 SQUEAKING/CLICKING
		04 C/LEVER	05 SLIPPING
		05 FRONT/REAR BUMPER	06 LOOSE/EXCESSIVE PLAY/LOOSENS
		06 GUIDE WHEEL BUSHING	07 STUCK/BINDING
		07 GUIDE WHEELS	08 HOLE WRONG, MISSING, OPENED
		08 HARDWARE	09 STRIPPED
		09 KNOB	10 TORN
		10 LABEL, FORE/AFT POS.	11 WRONG COLOR
		11 LONG RACK	12 BENT
		12 PIVOT RACK W/	13 UNEVEN
		13 PIVOT RACK W/ BUSHING	14 RUSTING/OXIDIZING
		14 POINTERS	15 CANNOT BE THREADED OR TIGHTENED
		15 SPRING	16 INTERFERENCE / NO CLEARANCE
		16 V-RAIL	17 VIBRATING
	02 7-DEGREE ADJ	00 NO DESCRIPTION	18 MISALIGNED
		01 LEVER	19 TENSION LOSS
		02 SHAFT	20 MISSING HARDWARE
		03 SPRING	21 BROKEN TEETH / WORN TEETH
		04 PRESSED PIN	22 SHARP EDGES
			23 ROUGH OPERATION
			24 WORN
			25 CONNECTOR FAILURE (ELEC.)

### EXAMPLE #2:

If there is a problem with either an assembly or subassembly, and not a detailed part, that upper assembly can be listed followed by a "no description" in the following column. For example:

If a problem is found with the Torque Board Printed Circuit Board, which is in the Dynamometer, the code would be as follows:

**F** for field service technician, **04** for dynamometer (column I), **07** for PCB Torque Board Assy, (column II), **00** for no description (column III), since the problem is with the entire board (suspected), and **32** for electrical component burned out (column IV).

The code would then look like, **F04070032**

### IN-HOUSE REPRESENTATIVES (I or R + 8 to 12 digit code)

#### *EXAMPLE #3:*

If a Printed Circuit Board was shipped to CSMi and repaired, the symptom code would contain more detailed information. For example:

If the NDCB Printed Circuit Board was repaired at CSMi, and the problem was found to be a wrong component on the printed circuit board (say capacitor number 126), the code would be as follows:

I for in-house service technicians, **07** for computer/electronic (column I), **04** for NDCB box (column II), **01** for NDCB PCB Assy (column III) **33** for electrical component wrong (column IV), and last, **C126** for the reference designation of the bad capacitor.

*The I + 12 digit code would then look like,  
107040133C126*

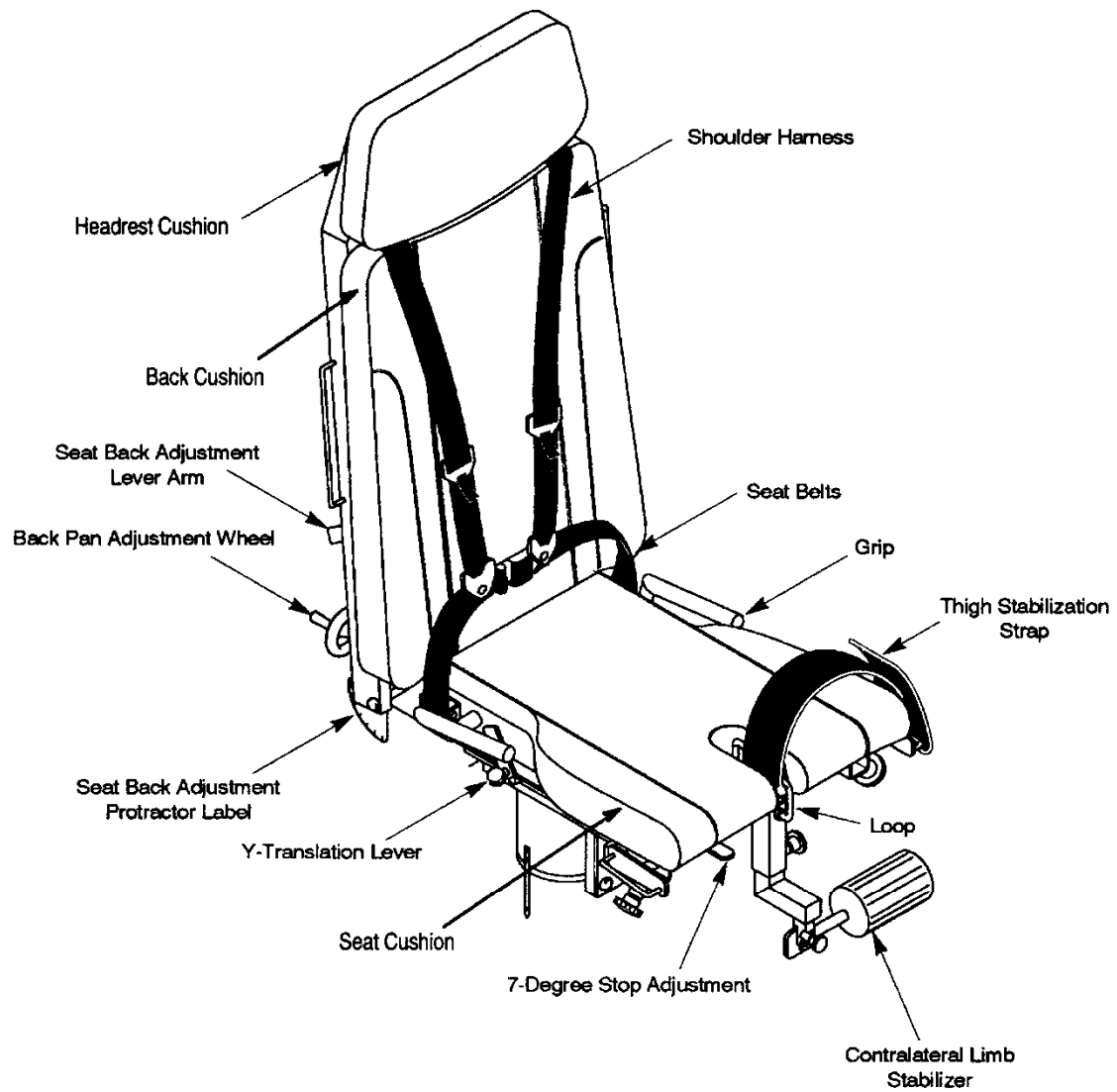
#### *EXAMPLE #4:*

Mechanical assemblies can also be carried through the columns using "no description" if the symptom applies to them. For example:

If an in-house customer service representative receives a call and the complaint is that a dynamometer is vibrating, the code would be as follows:

**R** for in-house representative, **04** for dynamometer, **00** for no description in column two since a more detailed assembly is not showing the symptom, **00** for no description again since a detailed part is not showing the symptom, **17** for vibrating.

The R + 8 digit code would then look like,  
**R04000017**

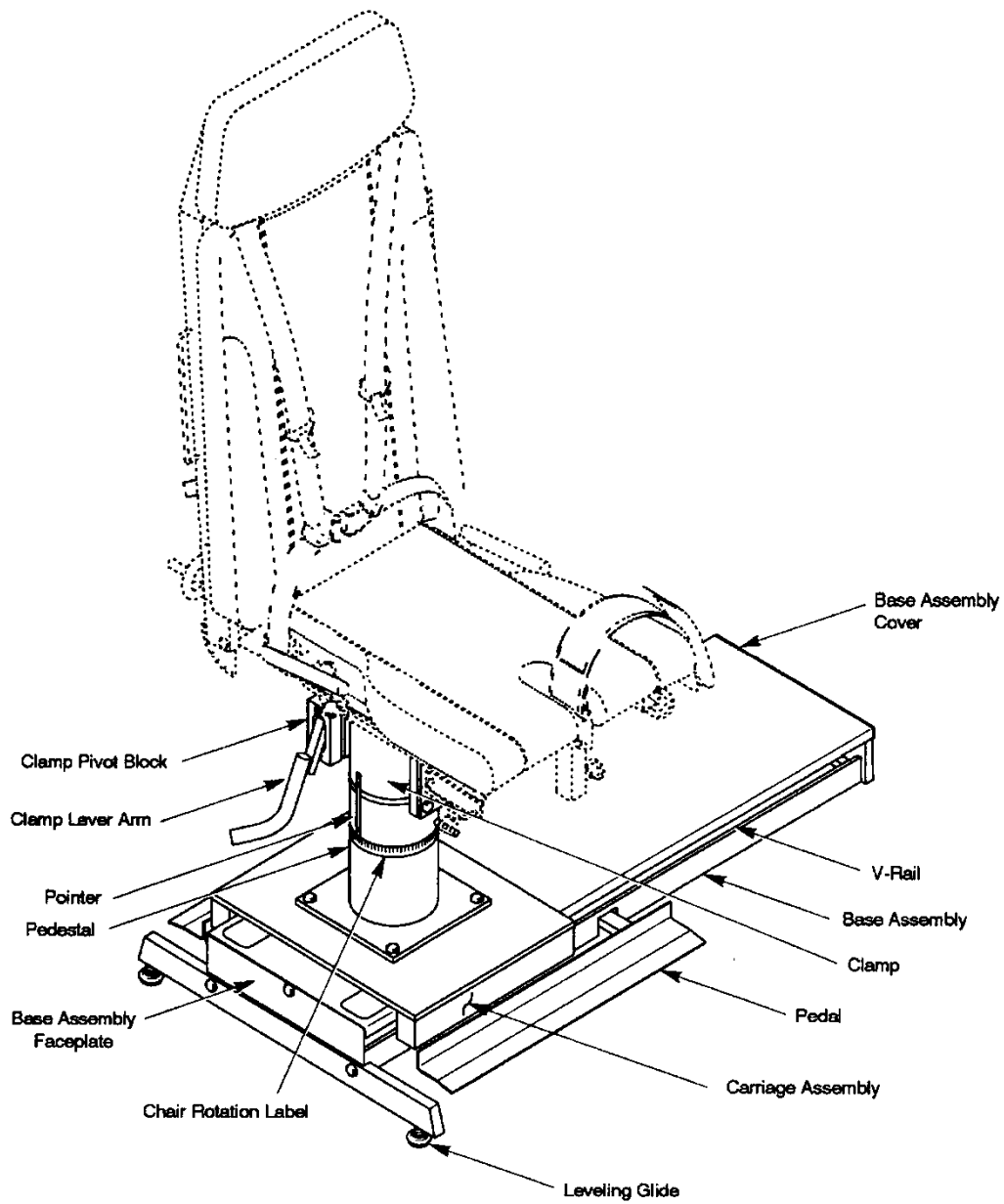


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Figure 10-25 Chair Assembly

I		II		III		IV	
01	CHAIR.....	00	NO DESCRIPTION	00	NO DESCRIPTION	01	CHIPPED/SCRATCHED
		01	Y-TRANSLATION	00	NO DESCRIPTION	02	LEAKING
				01	CAM	03	GRINDING/SCRAPING
				02	CAM STOP	04	SQUEAKING/CLICKING
				03	CAMSHAFT	05	SLIPPING
				04	COATED LEVER	06	LOOSE/EXCESSIVE PLAY/LOOSENS
				05	FRONT/REAR BUMPER	07	STUCK/BINDING
				06	GUIDE WHEEL BUSHING	08	HOLE WRONG, MISSING, OPENED
				07	GUIDE WHEELS	09	STRIPPED
				08	HARDWARE	10	TORN
				09	KNOB	11	WRONG COLOR
				10	LABEL, FORE/AFT POS	12	BENT
				11	LONG RACK	13	UNEVEN
				12	PIVOT RACK ASSY	14	RUSTING/OXIDIZING
				13	PIVOT RACK BUSHING	15	CANNOT BE THREADED OR TIGHTENED
				14	POINTERS	16	INTERFERENCE / NO CLEARANCE
				15	SPRING	17	VIBRATING
				16	V-RAIL	18	MISALIGNED
		02	7-DEGREE ADJUST	00	NO DESCRIPTION	19	TENSION LOSS
				01	LEVER	20	MISSING HARDWARE
				02	SHAFT	21	BROKEN TEETH / WORN TEETH
				03	SPRING	22	SHARP EDGES
				04	PRESSED PIN	23	ROUGH OPERATION
		03	SEAT BACK ADJUST	00	NO DESCRIPTION	24	WORN
				01	BOTTOM PIVOT BLOCK	25	CONNECTOR FAILURE (ELEC.)
				02	CLIPS	26	BAD CRIMP (ELEC.)
				03	PLASTIC BLOCKS	27	CABLE FAILURE (ELEC.)
				04	DOWEL PIN	28	DIRTY
				05	ECCENTRIC CAM	29	FALLS OFF/FALLING OFF
				06	GAS SPRING	30	SMOKING
				07	HARDWARE	31	BROKEN/CRACKED
				08	LEVER ARM	32	ELECTRICAL PCB/COMPONENT BURNED OUT
				09	LOWER RACK	33	ELECTRICAL COMPONENT WRONG
				10	PIVOT BLOCK OR SHAFT	34	MECHANICAL FAILURE OF ELEC. COMPONENT
				11	PLUNGER	35	SOFTWARE ERROR/FAILURE
				12	POINTER BRACKET	36	LOCKS UP (SFTWR)
				13	POINTER LABEL	37	SHOWING CRITICAL ERRORS (SFTWR)
				14	PROTRACTOR LABEL	38	UNABLE TO RELOAD/REPROGRAM (SFTWR)
				15	SPRING	39	MISSING
				16	UPPER PIVOT POINT	40	SETUP/CONFIGURATION
				17	UPPER RACK		
		04	BACK PAN ADJUST	00	NO DESCRIPTION		
				01	ACME SHAFT		
				02	BLOCKS		
				03	COLLAR		
				04	HARDWARE		
				05	POINTER		
				06	SCALE LABEL		
				07	WHEEL		
		05	CONTRALATERAL	00	NO DESCRIPTION		
				01	HARDWARE		
				02	PAD		
				03	PULL PIN		

06	SEAT BELTS/STRAPS .....	04	W/CONT. STAB. BAR
		00	NO DESCRIPTION
		01	HARDWARE
		02	SEAT BELT
		03	SEAT BELT MTG BRACKET
		04	SHLDR HARNESS
		05	SHLDR HRNESS MTG BRKT
		06	STABIL UTILITY STRP
		07	THIGH STABIL STRP OR LOOP
		00	NO DESCRIPTION
07	CUSHIONS/GRIPS .....	01	SUPPORT CUSHION
		02	LUMBAR CUSHION OR COVER
		03	BACK CUSHION
		04	HAND GRIP
		05	HEADRST CUSHION
		06	SEAT CUSHION



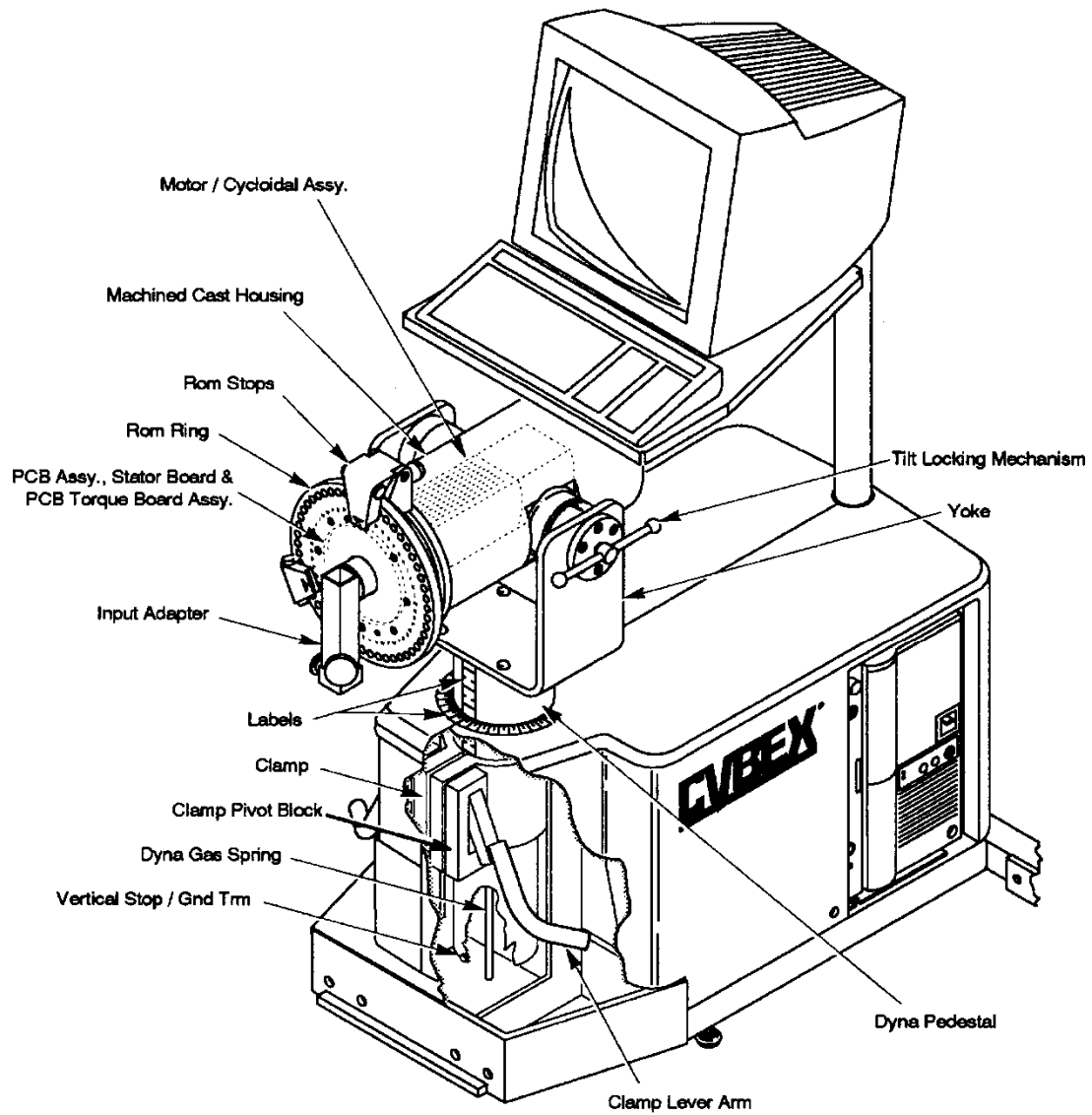
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Figure 10-26 Chair Pedestal and Monorail Assembly

# SYSTEM DIAGNOSTICS

I		II		III		IV	
02	CHAIR PEDESTAL .....	00	NO DESCRIPTION	00	NO DESCRIPTION	01	CHIPPED/SCRATCHED
		01	PEDESTAL	00	NO DESCRIPTION	02	LEAKING
				01	BEARING BIG	03	GRINDING/SCRAPING
				02	BEARING SML	04	SQUEAKING/CLICKING
				03	COTTER PIN	05	SLIPPING
				04	LABEL, CHAIR ROTATION	06	LOOSE/EXCESSIVE PLAY/LOOSENS
				05	POINTER	07	STUCK/BINDING
				06	HARDWARE	08	HOLE WRONG, MISSING, OPENED
		02	CLAMP	00	NO DESCRIPTION	09	STRIPPED
				01	ECCENTRIC CAM	10	TORN
				02	HARDWARE	11	WRONG COLOR
				03	LEVER ARM	12	BENT
				04	PIVOT BLOCK	13	UNEVEN
				05	PIVOT PIN	14	RUSTING/OXIDIZING
				06	PIVOT PIN COVER	15	CANNOT BE THREADED OR TIGHTENED
				07	SPRING	16	INTERFERENCE / NO CLEARANCE
03	MONORAIL .....	00	NO DESCRIPTION	00	NO DESCRIPTION	17	VIBRATING
		01	CARRIAGE ASSEMBLY	00	NO DESCRIPTION	18	MISALIGNED
				01	COATING	19	TENSION LOSS
				02	LABEL, POINTER	20	MISSING HARDWARE
				03	SHORT RACK SEGMENT	21	BROKEN TEETH / WORN TEETH
				04	V-ROLLERS	22	SHARP EDGES
				05	HARDWARE	23	ROUGH OPERATION
		02	BASE ASSEMBLY	00	NO DESCRIPTION	24	WORN
				01	COATING	25	CONNECTOR FAILURE (ELEC.)
				02	COVER	26	BAD CRIMP (ELEC.)
				03	FACEPLATE	27	CABLE FAILURE (ELEC.)
				04	LABELS	28	DIRTY
				05	LEVELING GLIDES	29	FALLS OFF/FALLING OFF
				06	LONG RACK SEGMENT	30	SMOKING
				07	PEDALS	31	BROKEN/CRACKED
				08	SAFETY WALK	32	ELECTRICAL PCB/COMPONENT BURNED OUT
				09	SPRINGS	33	ELECTRICAL COMPONENT WRONG
				10	V-RAIL	34	MECHANICAL FAILURE OF ELEC. COMPONENT
				11	HARDWARE	35	SOFTWARE ERROR/FAILURE
						36	LOCKS UP (SFTWR)
						37	SHOWING CRITICAL ERRORS (SFTWR)
						38	UNABLE TO RELOAD/REPROGRAM (SFTWR)
						39	MISSING
						40	SETUP/CONFIGURATION





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Figure 10-27 Dynamometer Assembly, Yoke, and Pedestal

I		II		III		IV	
04	DYNA .....	00	NO DESCRIPTION .....	00	NO DESCRIPTION	01	CHIPPED/SCRATCHED
		01	MOTOR/CYCLOIDALASSY .....	00	NO DESCRIPTION	02	LEAKING
				01	HARDWARE	03	GRINDING/SCRAPING
		02	MACHINED CAST HOUSING .....	00	NO DESCRIPTION	04	SQUEAKING/CLICKING
				01	COATING	05	SLIPPING
				02	ENDPLATE	06	LOOSE/EXCESSIVE PLAY/LOOSENS
		03	ROM STOPS .....	00	NO DESCRIPTION	07	STUCK/BINDING
				01	ANTIFRICTION TAPE (3)	08	HOLE WRONG, MISSING, OPENED
				02	KNOB	09	STRIPPED
				03	PLUNGER	10	TORN
				04	PULL-PIN	11	WRONG COLOR
				05	ROM STOP POINTER	12	BENT
				06	RUBBER BUMPER	13	UNEVEN
				07	SPRING PLUNGER	14	RUSTING/OXIDIZING
				08	SPRING PULL-PIN	15	CANNOT BE THREADED OR TIGHTENED
		04	INPUT ADAPTER .....	00	NO DESCRIPTION	16	INTERFERENCE / NO CLEARANCE
				01	DOWEL PIN	17	VIBRATING
				02	HARDWARE	18	MISALIGNED
				03	KNOB	19	TENSION LOSS
				04	P/V BRACKET ASSY	20	MISSING HARDWARE
				05	SPRING	21	BROKEN TEETH / WORN TEETH
				06	PULL PIN	22	SHARP EDGES
		05	ROM RING .....	00	NO DESCRIPTION	23	ROUGH OPERATION
				01	ROM RING LABEL	24	WORN
		06	PCB ASSY, STATOR BOARD .....	00	NO DESCRIPTION	25	CONNECTOR FAILURE (ELEC.)
				01	CABLE STATOR BOARD	26	BAD CRIMP (ELEC.)
				02	CONDUCTIVE RINGS	27	CABLE FAILURE (ELEC.)
		07	PCB ASSY, TORQUE BOARD .....	00	NO DESCRIPTION	28	DIRTY
				01	BRUSH PLUNGER ASSY	29	FALLS OFF/FALLING OFF
				02	STRAIN GAUGE WIRE/CONN	30	SMOKING
05	YOKE .....	00	NO DESCRIPTION .....	00	NO DESCRIPTION	31	BROKEN/CRACKED
		01	TILT LOCKING MECH .....	00	NO DESCRIPTION	32	ELECTRICAL PCB/COMPONENT BURNED OUT
				01	ARROW INDICATOR LABEL	33	ELECTRICAL COMPONENT WRONG
				02	BALL KNOB	34	MECHANICAL FAILURE OF ELEC. COMPONENT
				03	BRONZE BEARING	35	SOFTWARE ERROR/FAILURE
				04	BUSHING HOUSING	36	LOCKS UP (SFTWR)
				05	COTTER PIN	37	SHOWING CRITICAL ERRORS (SFTWR)
				06	HANDLE	38	UNABLE TO RELOAD/REPROGRAM (SFTWR)
				07	HANDLE HUB	39	MISSING
				08	HARDWARE	40	SETUP/CONFIGURATION
				09	PIVOT, SHERICAL BEARING		
				10	PROTRACTOR SCALE		
				11	SLEEVE, TORSION SPRING		
				12	SPHERICAL BEARING		
				13	THRUST BEARING		
				14	TILT LOCK ACME NUT		
				15	TLT LCK FLOTING FACE GEAR		
				16	TLT LCK RMVBLE FACE GEAR		
				17	TORSION SPRING		
				18	W/ TILT LOCK LEAD SCREW		
06	DYNA PEDESTAL .....	00	NO DESCRIPTION .....	00	NO DESCRIPTION		
		01	CLAMP .....	00	NO DESCRIPTION		

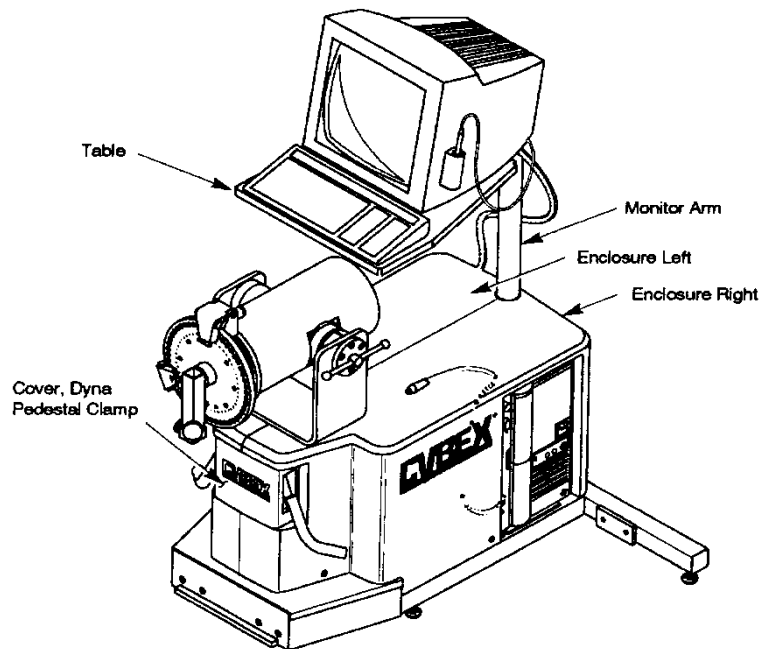
		01	ECCENTRIC CAM
		02	GAP BTWN EARS OF CLAMP
		03	HARDWARE
		04	LEVER ARM
		05	PIVOT BLOCK
		06	PIVOT PIN
		07	PIVOT PIN COVER
		08	SPRING
02	LABELS.....	00	NO DESCRIPTION
		01	LABEL, DYNAPED HEIGHT
		02	LABEL, DYNA ROT. LT. (ON PLASIC)
		03	LABEL, DYNA ROT. RT. (ON PLASIC)
03	DYNA GAS SPRING .....	00	NO DESCRIPTION
04	VERTICAL STOP / GND TRM .....	00	NO DESCRIPTION



### Figure 10-28 Electronics Frame Assembly

# SYSTEM DIAGNOSTICS

I	II	III	IV
07 COMPUTER/ELECTRONICS.....	01 COMPUTER	00 NO DESCRIPTION	01 CHIPPED/SCRATCHED
		00 NO DESCRIPTION	01 CHIPPED/SCRATCHED
		01 KEYBOARD	02 LEAKING
		02 MONITOR	03 GRINDING/SCRAPING
		03 AT INTERFACE BOARD	04 SQUEAKING/CLICKING
		04 LIGHT PEN	05 SLIPPING
		05 LIGHT PEN BOARD	06 LOOSE/EXCESSIVE PLAY/LOOSENS
		06 VIDEO CARD	07 STUCK/BINDING
		07 HARD DISK DRIVE	08 HOLE WRONG, MISSING, OPENED
		08 FLOPPY DISK DRIVE	09 STRIPPED
		09 TAPE BACKUP DRIVE	10 TORN
		10 MODEM	11 WRONG COLOR
	02 TRANSFORMER	00 NO DESCRIPTION	12 BENT
		01 FUSE, 5A SECONDARY	13 UNEVEN
		02 FUSE, 20A, PRIMARY	14 RUSTING/OXIDIZING
		03 FLISF 20A SECONDARY	15 CANNOT BE THREADED OR TIGHTENED
		04 ISOLATION TRANSFORMER	16 INTERFERENCE / NO CLEARANCE
		05 LABEL, 770 ONLY	17 VIBRATING
		06 LABEL, POWER	18 MISALIGNED
	03 SERVO AMP BOX	00 NO DESCRIPTION	19 TENSION LOSS
		01 POWER SUPPLY S/A	20 MISSING HARDWARE
		02 CABLE ASSY, PWR SUPPLY	21 BROKEN TEETH / WORN TEETH
		03 AC HARNESS, PWR SUPPLY	22 SHARP EDGES
		04 SERVO AMP. (DM 30)	23 ROUGH OPERATION
		05 SERVO AMP. (DM75)	24 WORN
		06 LABEL, AC POWER	25 CONNECTOR FAILURE (ELEC )
		07 SOLID STATE RELAY	26 BAD CRIMP (ELEC.)
		08 POWER SWITCH	27 CABLE FAILURE (ELEC.)
	04 NDCB ENCLOSURE	00 NO DESCRIPTION	28 DIRTY
		01 PCB ASSY.NDCB	29 FALLS OFF/FALLING OFF
		02 PCB ASSY, MANUAL SPEED	30 SMOKING
		03 MANUAL SPEED, KNOB	31 BROKEN/CRACKED
		04 PANEL LABEL	32 ELECTRICAL PCB/COMPONENT BURNED OU"
		05 PCB ASSY, AUX. INTRFCE	33 ELECTRICAL COMPONENT WRONG
	05 UPS	00 NO DESCRIPTION	34 MECHANICAL FAILURE OF ELEC. COMPONENT
	06 CABLES & CONNECTORS	01 CABLE ASSY, MTR. PWR. SK	35 SOFTWARE ERROR/FAILURE
		02 CABLE ASSY, TORQUE SIG.	36 LOCKS UP (SFTWR)
		03 MTR PWR SIG CONN, DYNA	37 SHOWING CRITICAL ERRORS (SFTWR)
		04 TRQ SIG CONN, DYNA	38 UNABLE TO RELOAD/REPROGRAM (SFTWR)
		05 GROUND WIRE, MON ARM	39 MISSING
		06 AT INTERFACE JUMPER (Inside Computer)	40 SETUP/CONFIGURATION
		07 PCB ASSY AT INTRFCE (Inside Computer)	
		08 POWER CABLE, MONITOR	
		09 SIGNAL CABLE, MONITOR	
		10 WIRE, KEYBOARD	
		11 120 VAC HARNESS, SERVO AMP (Inside Servo Amp Box)	
		12 JUMPER CABLE ASSY, SERVO AMP (Inside Servo Amp Box)	
		13 CABLE, AC POWER 115VAC	
		14 CABLE, AC POWER 230VAC	
		15 CABLE, COMFORT SWITCH	
		16 CABLE ASY, NDCB PWR SUP	
		17 CABLE ASY, NDCB TO SERV	
		18 CABLE, NDCB/ATCOMM.	
		19 CABLE, AUX. INT. TORQUE	
		20 CABLE, AUX INT. POSMON	
		21 CABLE, AC POWER, TRANSFORMER BOX	
		22 COMPUTER CABLE, PC AC POWER	



REFER TO NEXT PAGE FOR ADAPTER DESCRIPTIONS

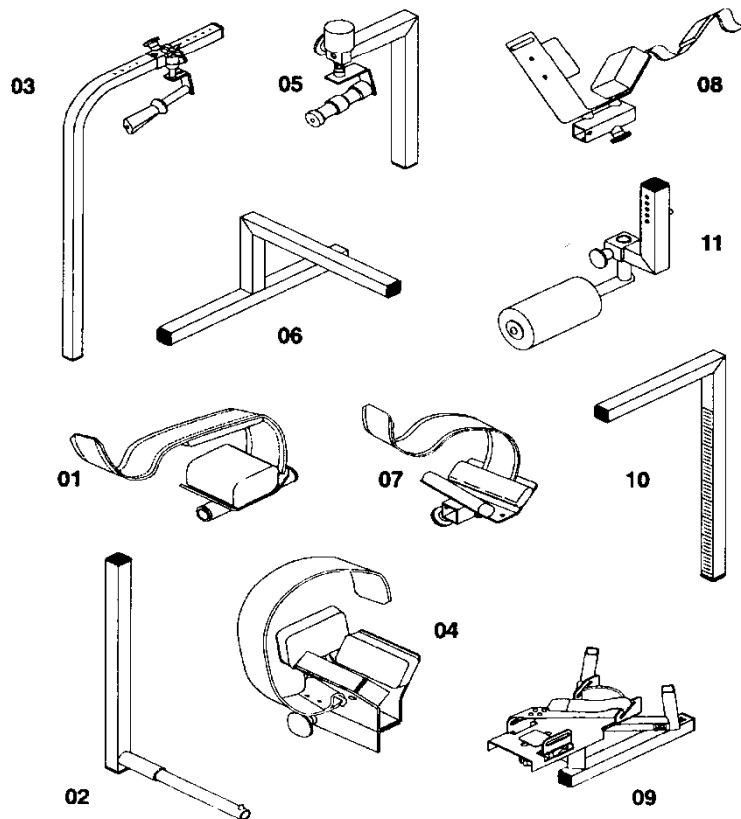


Figure 10-29 Monitor Arm, Plastics, and Adapters

I		II		III		IV	
08	MONITOR ARM & PLASTICS	00	MONITORARM.....	00	NO DESCRIPTION	01	CHIPPED/SCRATCHED
				01	TABLE	02	LEAKING
				02	TABLE SWIVEL MECHANISM	03	GRINDING/SCRAPING
				03	ARM ROTATION BUSHING	04	SQUEAKING/CLICKING
		02	PLASTICS .....	04	ROM STOP	05	SLIPPING
				00	NO DESCRIPTION	06	LOOSE/EXCESSIVE PLAY/LOOSENS
				01	COVER, DYNAPED. CLAMP	07	STUCK/BINDING
				02	ENCLOSURE, RIGHT	08	HOLE WRONG, MISSING, OPENED
				03	ENCLOSURE, LEFT	09	STRIPPED
				04	SEATBACKABS	10	TORN
				05	PLASTIC FASTENERS	11	WRONG COLOR
				06	TINNERMAN FASTENERS	12	BENT
09	ADAPTERS .....	01	SHIN PAD ADAPTER.....	13	UNEVEN	14	RUSTING/OXIDIZING
				01	CUSHION	15	CANNOT BE THREADED OR TIGHTENED
				02	HARDWARE	16	INTERFERENCE / NO CLEARANCE
		02	KNEE/HIP ADPT ASSY.....	00	NO DESCRIPTION	17	VIBRATING
				01	HARDWARE	18	MISALIGNED
		03	ELBOW/SHLDER ADPT ASSY	00	NO DESCRIPTION	19	TENSION LOSS
				01	HANDLE	20	MISSING HARDWARE
				02	HARDWARE	21	BROKEN TEETH / WORN TEETH
				03	LABEL	22	SHARP EDGES
				04	KNOB	23	ROUGH OPERATION
		04	ELBOW SUPPORT S/A .....	00	NO DESCRIPTION	24	WORN
				01	CUSHION	25	CONNECTOR FAILURE (ELEC.)
				02	HARDWARE	26	BAD CRIMP (ELEC.)
		05	WRIST/SHLDER ADPT ASSY .....	00	NO DESCRIPTION	27	CABLE FAILURE (ELEC.)
				01	HANDLE	28	DIRTY
				02	HARDWARE	29	FALLS OFF/FALLING OFF
				03	LABEL	30	SMOKING
				04	KNOB	31	BROKEN/CRACKED
		06	W/FOOTRESTADPTER.....	00	NO DESCRIPTION	32	ELECTRICAL PCB/COMPONENT BURNED OUT
		07	FOREARM STABILIZER .....	00	NO DESCRIPTION	33	ELECTRICAL COMPONENT WRONG
				01	CUSHION	34	MECHANICAL FAILURE OF ELEC. COMPONENT
				02	HARDWARE	35	SOFTWARE ERROR/FAILURE
		08	THIGH STABILIZER .....	00	NO DESCRIPTION	36	LOCKS UP (SFTWR)
				01	CUSHION	37	SHOWING CRITICAL ERRORS (SFTWR)
				02	HARDWARE	38	UNABLE TO RELOAD/REPROGRAM (SFTWR)
		09	ANKLE ADAPTER .....	00	NO DESCRIPTION	39	MISSING
				01	STRAP	40	SETUP/CONFIGURATION
				02	HARDWARE		
				03	KNOB		
		10	STABILIZER TUBE .....	00	NO DESCRIPTION		
		11	CONTRLATRLIMB STBL.....	00	NO DESCRIPTION		

I		II		III		IV	
10	SOFTWARE .....	00	NO DESCRIPTION .....	00	NO DESCRIPTION	01	CHIPPED/SCRATCHED
		01	DYNA CONTROL WINDOW .....	00	NO DESCRIPTION	02	LEAKING
				01	OPERATING MODE	03	GRINDING/SCRAPING
				02	ACTION TYPE	04	SQUEAKING/CLICKING
				03	SPEED	05	SLIPPING
				04	LOCK	06	LOOSE/EXCESSIVE PLAY/LOOSENS
				05	DISPLAY	07	STUCK/BINDING
				04	DIRECTION	08	HOLE WRONG, MISSING, OPENED
		02	PATIENT SELECTION .....	00	NO DESCRIPTION	09	STRIPPED
				01	EXTENDED PATIENT INFO.	10	TORN
				02	CREATE NEW PATIENT	11	WRONG COLOR
				03	PATIENT REPORT SPEC.	12	BENT
		03	PATTERN SELECTION .....	00	NO DESCRIPTION	13	UNEVEN
				01	PATIENT SETUP	14	RUSTING/OXIDIZING
				02	SET AZ	15	CANNOT BE THREADED OR TIGHTENED
				03	SET ROM	16	INTERFERENCE / NO CLEARANCE
		04	AUTOMATED PROTOCOLS .....	00	NO DESCRIPTION	17	VIBRATING
				01	SET CONFIGURATION	18	MISALIGNED
				02	RUN PROTOCOL	19	TENSION LOSS
		05	DATASTORAGE .....	00	NO DESCRIPTION	20	MISSING HARDWARE
				01	SET REVIEW	21	BROKEN TEETH / WORN TEETH
				02	SAVE DATA	22	SHARP EDGES
				03	GENERATE REPORT	23	ROUGH OPERATION
		06	HELP .....	00	NO DESCRIPTION	24	WORN
		07	SYSTEM TOOLS .....	00	NO DESCRIPTION	25	CONNECTOR FAILURE (ELEC.)
				01	CALIBRATION	26	BAD CRIMP (ELEC.)
				02	SYSTEM CONFIG.	27	CABLE FAILURE (ELEC.)
				03	SYSTEM BACKUP	28	DIRTY
				04	DATABASE MAINT.	29	FALLS OFF/FALLING OFF
				05	PATIENT MANAGEMENT	30	SMOKING
				06	ERROR MANAGEMENT	31	BROKEN/CRACKED
				07	SYSTEM DIAGNOSTICS	32	ELECTRICAL PCB/COMPONENT BURNED OUT
		08	POSITION CALIBRATION .....	00	NO DESCRIPTION	33	ELECTRICAL COMPONENT WRONG
		09	NORMA .....	00	NO DESCRIPTION	34	MECHANICAL FAILURE OF ELEC. COMPONENT
						35	SOFTWARE ERROR/FAILURE
						36	LOCKS UP (SFTWR)
						37	SHOWING CRITICAL ERRORS (SFTWR)
						38	UNABLE TO RELOAD/REPROGRAM (SFTWR)
						39	MISSING
						38	SETUP/CONFIGURATION



### **APPENDIX B      INTERNATIONAL CONSIDERATIONS**

#### **INTERNATIONAL CONSIDERATIONS**

This chapter outlines the areas that the distributor will need to change or verify on the NORM series systems prior to installation.

### PRIMARY INPUT VOLTAGE

The line voltage at every installation is to be measured to determine the nominal voltage and noted, along with the time of day for CSMi records. It is recommended that the distributor consult with the local electrical utility to ensure that the measured nominal voltage agrees with the utilities nominal voltage for that area.

All units are wired for a primary input voltage of 208 VAC.

Refer to the chart below to determine what primary transformer taps should be connected

for your area. As an example, if the nominal voltage for an area is 220 VAC, connect the wire to the 220 transformer tap. Do not change the wire connection to the 0 tap.

#### NOTE:

1. *The transformer outputs are non-selectable at 115 VAC and 230 VAC. The secondary (output) side of the transformer should **not** be changed at any time.*
2. *Input current requirements: Independent 20 AMP line.*

INPUT (PRIMARY) TRANSFORMER TAPS							
NOMINAL LINE VOLTAGE	VOLTAGE RANGE	0	200	208	220	230	240
200 VAC	184-216 VAC	✓	✓				
208 VAC	191 -224 VAC	✓		✓			
220 VAC	202-238 VAC	✓			✓		
230 VAC	212-248 VAC	✓				✓	
240 VAC	221 -259 VAC	✓					✓

#### NOTES:

1. Isolation transformer outputs are non-selectable at 115 VAC and 230 VAC.
2. Consult with local utility to ensure proper nominal line voltage.

### LINE CORD PLUG END

It is the distributors responsibility to remove the right angle plug shipped with 6000 systems. A new plug end compatible with the customers facilities is to be installed by the distributor.

***NOTE:*** All ground wires internal to the NORM are now green with a yellow trace to meet European standards.

## REPLACEMENT PARTS

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Notes:

### APPENDIX C      TERMS AND ABBREVIATIONS

#### TERMS

**ACCESS TIME** The difference between the time data is requested and the time that it is made available. In other words, the time interval between a request of data from a memory location or Input/Output device until that data is valid. Access times are usually expressed in nanoseconds.

**ADDRESS** A coded representation of the origin or destination of data.

**AMBIENT TEMPERATURE** The temperature of a medium surrounding an object.

**AWG (AMERICAN WIRE GAUGE)** A standard system for designating wire diameter.

**BAUD** Data transmission rate equal to the number of signal events per second; typically the number of bits transmitted per second; used to quantify the communications data transfer speed of a device.

**BIT (BINARY DIGIT)** The contraction of "binary digit," the smallest unit of information in a binary system. A bit represents the choice between a one or zero condition.

**BOARD** A printed circuit board (or "card"). Acid etched boards with circuit patterns are usually placed inside the computer to expand its capability.

**BOOT** To initialize (a computer for example).

**BPS (BITS PER SECOND)** Unit of data transmission rate.

**BUFFER** A temporary data storage area used when it is necessary to verify or gather data prior to processing; a circuit placed between other

circuits to prevent electrical interactions or provide additional power or drive capability.

**BUS** A group of parallel conductors which bridge the same connection point on all devices connected to the bus. This forms a path over which information is transmitted from any of several sources to any of several destinations. Typical buses in a microcomputer are the data and address buses. These are used whenever multiple devices need access to the same signal or information.

**BYTE** A group of binary bits considered as a unit or word; typically, 8 bits equal 1 byte.

**CABLE** A group of individually insulated conductors in twisted or parallel configuration under a common sheath.

**COAXIAL CABLE** A cable consisting of two cylindrical conductors with a common axis, separated by a dielectric.

**COM 1 (COM 2)** The primary (or secondary) communications port on an IBM PC. The connection is always serial.

**COMPATIBLE** The term used in conjunction with word or data processing equipment which signifies the ability of the equipment to be used together.

**CONFIGURATION** A reference to a variety of word or data processing equipment (i.e. CRTs, CPUs, Magnetic Media Storage, and Printers) linked together to form a system or network.

**CONNECTOR** A device used to physically and electrically join two or more conductors.

**CPI** Characters per inch.

**CPU (CENTRAL PROCESSING UNIT)** Portion of a computer which directs the sequence of operations and initiates the proper commands to the computer for execution.

**DIP (DUAL IN-LINE PACKAGE)** An electronic component package characterized by two rows of external connecting pins which are inserted into the holes of the printed circuit board.

**DIRECT MEMORY ACCESS** Allows peripherals (hard disk etc.) to access computer memory, bypassing the microprocessor.

**DISK DRIVE** A machine which writes data on, and reads data from a diskette storage surface. The type (brand) of diskette drive, not the computer being used, determines the type of diskette to use.

**DISK OPERATING SYSTEM (DOS)** A program that instructs the central processing unit (CPU) in the transfer of data to and from disks.

**DISSIPATION** The loss of electrical energy as heat.

**DOWNLOAD** The transferring of information (such as a program or data file) from a central computer to another computer or a printer.

**DPI Dots per inch.** Measurement of density on dot matrix printers. Image clarity increases as DPI increases.

**DRAIN WIRE** The uninsulated wire in intimate contact with a shield to provide for easier termination of such a shield to a ground point in a cable .

**ELECTROMAGNETIC INTERFERENCE (EMI)** Magnetic fields which induce potentially detrimental voltages in electrical circuits.

**ELECTROMAGNETIC** The combined electric and magnetic fields associated with movements of electrons through conductors.

**ELECTROMOTIVE FORCE (e.m.f.)** Pressure or voltage. The force which causes current to flow in a circuit.

**ELECTROSTATIC** Pertaining to static electricity or electricity at rest. A constant intensity electric charge.

**ENCODER PHASES** The output of an optical encoder consists of two lines with pulse trains 90 degrees out of phase with each other. These two lines are called encoder phases(1 and 2 or A and B).

**EPROM (ERASABLE PROGRAMMABLE READ ONLY MEMORY)** A read only memory I.C. capable of being erased by using intense ultraviolet light and then reprogrammed. This reprogrammability is a distinct advantage in a prototype system where the program is not yet fixed or in equipment requiring periodic updating of a program. When power to the device is removed, memory contents are not lost.

**FIRMWARE** A computer program or software stored permanently in PROM or ROM or semipermanently in EPROM.

**FLASH MEMORY** An electrically erasable and programmable read-only memory device (ROM). It is similar to conventional EEPROM devices, except that the entire device is erased at once. Programming is still done on a byte-to-byte basis. When power to the device is removed, memory contents are not lost.

**FONT** A type style; the shape or style of printed characters.

**FREQUENCY** The number of cycles per second of an AC signal.

**GAUGE** A term used to denote the physical size of a wire.

**GROUND** A conducting connection between an electrical circuit and the earth or other large conducting body to serve as an earth thus making a complete electrical circuit.

**HARD DISK** A term usually associated with Winchester-type disk drive subsystems. Any magnetic disk media that is rigid as opposed to flexible.

**HARNESS** An arrangement of wires and cables, usually with many breakouts, which have been tied together or pulled into a rubber or plastic sheath, used to interconnect electric circuits.

**HEADER** Connector, usually found on a printed circuit board which contains pin or socket contacts.

**HERTZ (Hz)** A measure of frequency or bandwidth. The same as cycles per second.

**HEXADECIMAL NUMBER SYSTEM** The number system with the base of sixteen. In hexadecimal, the first nine digits are 0-9 and the last six digits are represented by the letters A-F.

**INDEX PULSE** A special encoder output line, separate from the two phase lines, used to indicate absolute positions. An index pulse output usually only a few times per encoder revolution. It helps to detect an error in counting encoder phase pulses.

**INDEPENDENT AC LINE** An independent circuit is one which no other electrical device shares. This circuit must have the hot, neutral, and ground leads run directly to the main distribution panel.

**INSULATION** A material having high resistance to the flow of electric current.

**INTERCONNECTING CABLE** The wiring between modules, between units, or the larger portions of a system.

**INTERFACE** A circuit that links one device with another and allows them to communicate.

**INTERRUPTS** A means of pausing a program in order to accomplish other programming functions and then resume the original program at the point it was interrupted. Interrupts allow external events to supersede the normal software flow.

**ISA (INDUSTRY STANDARD ARCHITECTURE)** Defines the pin designations for the expansion buss connectors in the PC/XT, PC/AT computers.

**ISOKINETICS** A form of dynamic resistance exercise in which the speed is controlled and the resistance is perfectly accommodating to the force produced at every point in the range of motion. This results in the safest, most tolerable and efficient means of dynamically loading a muscle.

**ISOMETRIC** Constant zero velocity so the resistance varies to match the force applied.

**JUMPER** A device which completes an electrical circuit, may be a wire shunt of other device.

**JUMPER CABLE** A short flat cable interconnecting two wiring boards or devices.

**LEAKAGE** The small amount of current that flows in a semiconductor device when in the OFF state.

**LED (LIGHT EMITTING DIODE)** A semiconductor light source that emits visible light or invisible infrared radiation.

**LIGHT PEN** A light-sensitive stylus used for forming graphics by touching coordinates on the screen or by drawing on the screen.

**LOAD** The process of inputting the necessary data into the computer memory for a program to operate correctly.

**LOGIC** Digital circuitry, usually TTL or CMOS, which stores or translates electrical states.

**LPT1** A personal computer's port(s) or outlets for connecting a printer. The connection is always parallel.

**MEMORY** The component of a computer designed to store information. There are two types of memories used within a computer, commonly referred to as RAM and ROM.

**RAM (RANDOM-ACCESS MEMORY)** The memory which is accessible to the operator. The operator has the ability to change or customize the information stored in the RAM.

**ROM (READ-ONLY MEMORY)** Usually inaccessible to the operator. Memory implanted within the computer at the factory and necessary for the computer to function. Usually cannot be changed.

**MENU** A listing, that appears on the CRT, of the different options within the computer program that the user can select.

**MICROPROCESSOR** A semiconductor circuit containing the central processing unit functions; includes arithmetic, logic, control, memory and I/O functions.

**MODEM (MODULATOR/DEMODULATOR)** A device which takes a computer's digital impulse and converts it into a signal to be sent over transmission lines (usually telephone lines). It

also decodes the signal back to a digital impulse for acceptance in the computer.

**NOISE** Any unwanted signal superimposed upon a useful signal which tends to obscure the information contents.

**NONVOLATILE MEMORY** Memory which is protected and retains its information in the absence of power making the information available when power is restored. Battery backed memory is considered nonvolatile.

**OPTICAL ENCODER** A device used to measure angular position and velocity. It operates by interrupting a light beam with every specified fraction of a degree of rotation. This produces output pulses which indicate the number of degrees of rotation and direction.

**PHASE** The relationship between two signal waves with respect to time, normally expressed in degrees, where 180 degrees is a lead or lag by 1/2 cycle.

**PIXEL** Picture Element. The smallest unit of a video screen image. The individual dot from which characters or pictures are formed.

**PORT** A channel (outlet) that connects the computer to outside sources. May be parallel or serial.

**PROM (PROGRAMMABLE READ ONLY MEMORY)** Nonvolatile memory chip that allows a program to reside permanently in a piece of hardware.

**RESISTANCE** The opposition to electron flow in a circuit or component. It is measured in ohms.

**RIBBON CABLE** A flat cable of individually insulated conductors lying parallel and held together by means of adhesive or woven textile yarn.



**SCV** Speed Control Voltage, an analog signal (Between -10V and +10V) sent to the servo amplifier. The value of the SCV determines the selected motor speed and direction. For example, -10V = maximum counterclockwise speed. +10V = maximum clockwise speed and 0V = 0 speed.

**SERIAL INTERFACE** A device which processes information one bit at a time from the computer to a printer or other peripheral units.

**SHIELD** In cables, a metallic layer placed around a conductor or group of conductors to prevent electrostatic interference between the enclosed wires and external fields.

**SIGNAL** A current used to convey information, either digital, analog, audio or video.

**SLOT** An outlet (port) or place in the central processing unit of a personal computer provided for the attachment or insertion of an add-on-board (integrated circuit board).

**STRAIN GAGE** A transducer that measures strain by measuring the change in electrical resistance of a small filament of wire bonded to the structure under strain.

**STREAMER/STREAMING TAPES** Small tape drive, usually using cassette media, for backing up and storing data from fixed-media disks.

**SYSTEM CLOCK** Is an electrical pulse used to synchronize all computer boards and/or logic circuits connected to the system bus.

**TORQUE** Rotational force, measure in units of foot-pounds (ft-lbs). One ft-lb equals one pound of force applied at a radius of one foot from the axis of rotation.

**WHEATSTONE BRIDGE** Four equal value electrical resistors arranged in such a way that when energized, a small change in any one of the resistors produces a maximum change of voltage.

### ABBREVIATIONS

**A** Amps., A.C. or D.C.

**A/D** Analog to Digital (converter)

**AC** Alternating Current

**CAL** or **CALIB** Calibration

**CCW** Counterclockwise

**CH** or **CHAN** Channel

**CLK** Clock

**CMOS** Complementary Metal Oxide Semiconductor

**CRT** Cathode Ray Tube

**CU.** Cubic

**CW** Clockwise

**DC** Direct Current

**DB** Decibel

**DCB** Dynamometer Control printed circuit Board

**DIP** Dual In-line Package

**DMA** Direct Memory Access

**DVM** Digital Volt Meter

**GA** Wire Gauge

**GND** Ground Signal

**HDD** Hard Disk Drive

**HEX** Hexadecimal

**HZ** Hertz

**I/O** Input/Output

**IND** Indicator

**ISO** Isometric

**LBS.** Pounds

Notes:

### APPENDIX D      EXPLODED VIEW DIAGRAMS

#### EXPLODED VIEW DIAGRAMS

This chapter illustrates the physical construction of the NORM system and provides part number and part description information.

NOTES:



Item	Description	Part No.
1	SCREW, SOCKET HD CAP, 5/16-18 X 1/2"	HC662812
2	FACEPLATE	7700C218
3	EDGE GUARD, NEOPRENE	PR245504
4	BUMPER, 7/8" OD	PR060771
5	HEX HD CAP SCREW, 1/2-13 x 1-3/4"	HC781226-1
6	LOCKWASHER, SPLIT, 33/64" ID x 7/8" OD	HS388300
7	BUSHING, V-WHEEL	7700M170
8	GUIDE WHEEL SAE 52100 SHIELDED	VW120770
9	THRUST WASHER, .5 ID x .937 OD x .030	HS387603
10	SCREW, 1/4-20 X 1/2 SOCKET HEAD CAP	HC622812
11	LOCKWASHER, 1/4"	HS308300
12	POINTER, SEAT TRANSLATION	7700C277
13	UPPER BED PEDESTAL WELDMNT	7700C370
14	SCREW CAP, BLACK 1/2"	PP080005
15	SCREW CAP, WASHER 1/2"	HS010001
16	CLAMP BRACKET, BED	7700C390
17	SPHERICAL WASHER SET	HS387706
18	HARD COAT ANODIZED PEDESTAL CLAMP	7700P200
19	ROLLER BEARING CUP, 4.7822" OD	FB030021
20	ROLLER BEARING CONE, 3.0625" BORE	FB030020
21	WHEEL PLATE	7700C221
22	FLATWASHER 1/4" FLAT	HS307600
23	HEX HD CAP SCREW, 1/4-20 x 3/4"	HC621215
24	MODIFIED RACK	7700M235
25	SOCKET HD SH. SCREW, 3/8" D x 2-3/4" LG	HD663332
26	BEARING, FLANGED	FB050065
27	PIVOT BRACKET WELDMNT	7700C222
28	SPRING	BS070367
29	PIVOT RACK WELDMNT	7700C223
30	FLATWASHER (1/4) 1/2" OD x .281" ID x .062"	HS307601
31	ELASTIC LOCKNUT, 5/1 6-1 8	HN665201
32	CAM STOP	7700C231
33	SCREW, HEX HD, 5/16-1 8X1"	HC661215
34	LOCKWASHER, SPLIT, 5/16	HS328300
35	FLATWASHER, 5/16	HS327600
36	SCREW, SOCKET HD CAP, 10-32 x 1/2"	HM582812
37	FLATWASHER, #10	HS107702
38	SCREW CAP WASHER	HS010003
39	THRUST WASHER, .51" ID x .937" OD x .09" THK	HS387604
40	CAM SHAFT	7700M229
41	SCREW, SOCKET HD CAP, 8-32 x 3/4"	HC542815
42	CAM, Y-TRANSLATION	7700M232
43	KNOB, PULL, BLACK	PP450770
44	LEVER, Y-TRANSLATION	7700C233
45	SCREW, FLAT SOCKET HD, 1/4-20 x 5/8"	HM620914
46	MAIN FRAME WELDMNT	7700C400
47	WASHER, SPECIAL	166HS098
48	BRACKET, PELVIC BELT, BLACK	7310C067-1
49	SCREW, BUTTON HD CAP, 3/8-16 x 3/4"	HC700415-1
50	V-RAIL (RIGHT HAND)	7700M239-1
51	V-RAIL (LEFT HAND)	7700M392-2
52	SET SCREW, 1/4-20X1/4"	HY622908
53	HEX JAM NUT, 3/8-24	HN714400
54	POINTER BRACKET WELDMNT	7700C424
55	FLATWASHER, 3/8"	HS347703
56	LABEL, POINTER SCALE, LEFT	7700M540
57	LABEL, POINTER SCALE, RIGHT	7700M541
58	COATED CLAMP BLOCK	7700C213
59	BEARING PLATE	7700M214
60	DOWELPIN, 3/8"DIAx2"LG	HP346626
61	SHAFT RETAINER PLATE	7700C569
62	SCREW, 8-32 X 3/8" LOW SOC HD. CAP	HC543410
63	SCREW, SOCKET SET, 1/2-13 X 3/8" LG.	HM781610
64	SPRING, COMPRESSION, .325" D X 1.5" LG.	BS070772
65	POINTER, BED PED. ROTATION	7700C206
66	DOWEL PIN, 1/4" DIA x 1-1/4" LG	HP306620
67	CLAMP ROLLER	7700M215
68	BUSHING, 1" ID x 1-3/8" OD x 3/4" LG	FB050202
69	COATED RIGHT CLAMP LEVER WELDMNT	7700C209
70	PLUG, CAP, STEEL, 7/8" DIA.	BG030200
71	COATED LEFT CLAMP LEVER WELDMNT	7700C210
72	SCREW, HEX HEAD CAP, 3/8-24 x 6-1/2" LG	HC701259
73	POINTER LABEL	730CM020
74	SCREW, LOW SOCKET HD CAP, 10-24 x 3/8"	HC572811
75	LABEL, BED PEDESTAL ROTATION	7700M397
76	LOWER BED PEDESTAL WELDMNT	7700C380
77	BEARING, T.R.B. CUP (L44610)	FB030771
78	BEARING, T.R.B. CONE (L44649)	FB030772
79	FLATWASHER, 3/4" ID x 1-1/2" OD x 1/8" THK	HS137622
80	HEX NUT, SLOTTED, 3/4-16	HN904000
81	COTTER PIN, 1/8" DIA x 1-1/2" LG	HP652200
82	CARRIAGE WELDMNT	7700C300
	FLATWASHER, 1/2"	HS387600

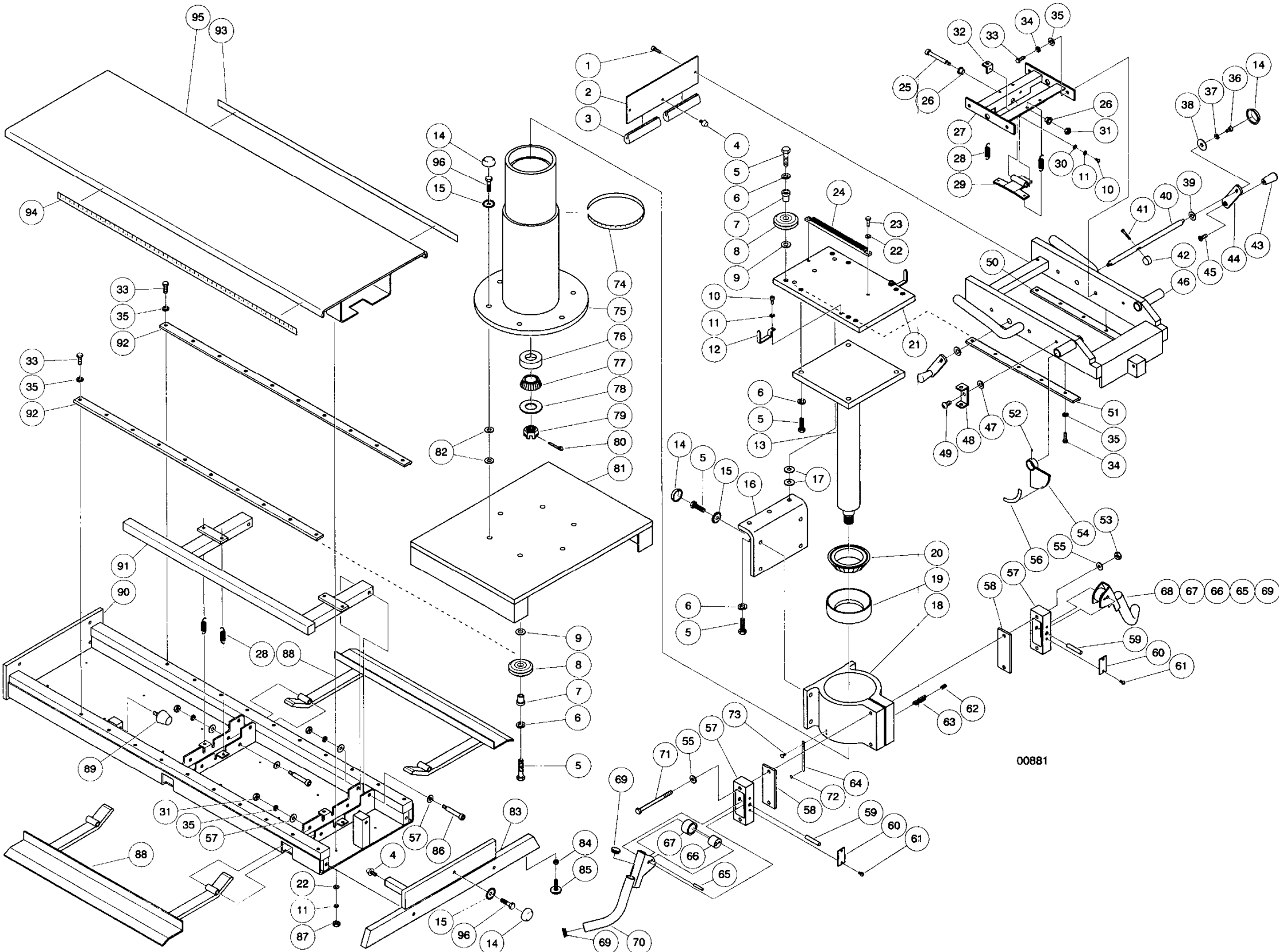
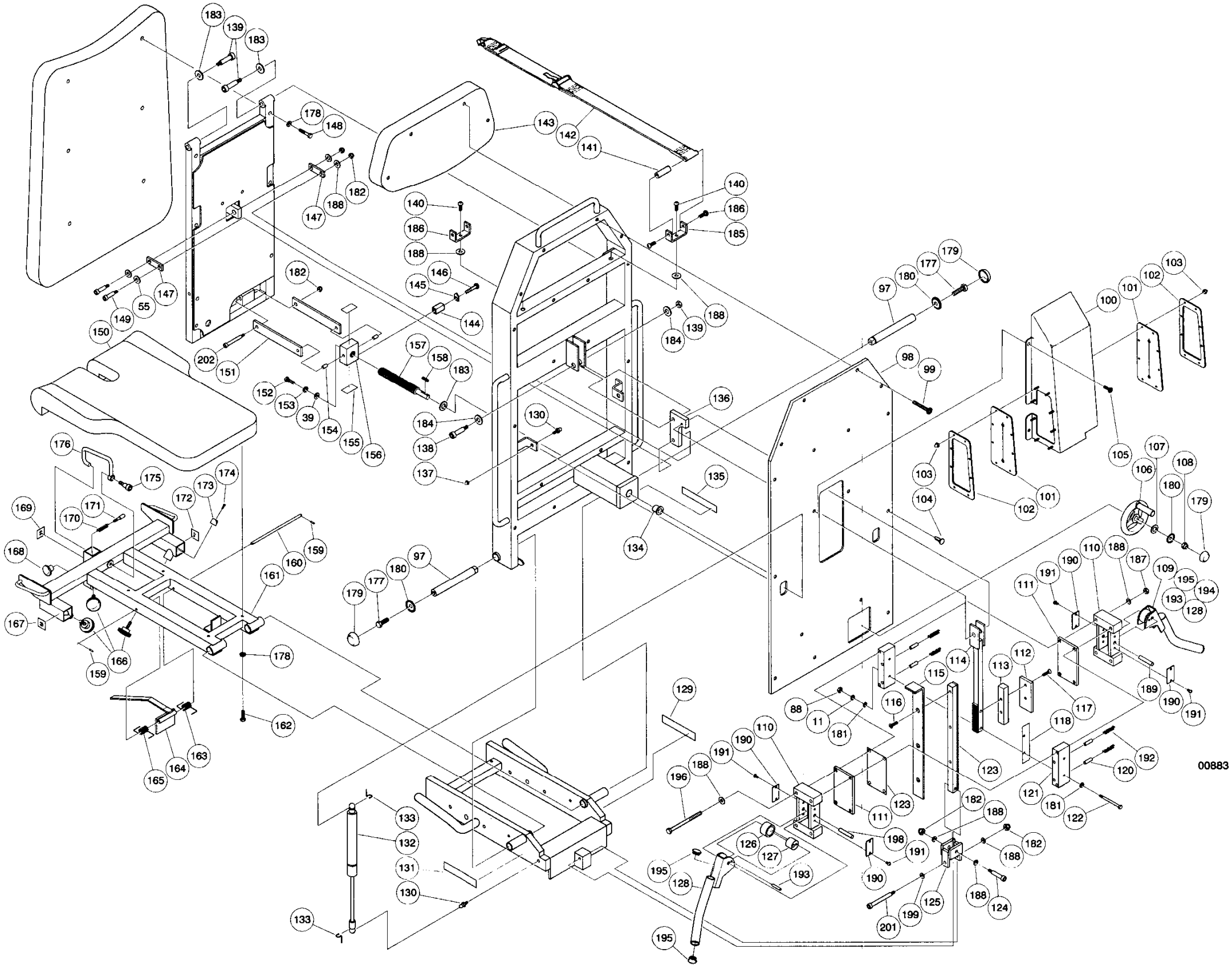


Figure 10-30 Patient Positioning Module Exploded View (Sheet 1)

83	FACEPLATE, CARRIAGE	7700C355
84	HEX JAM NUT	HN784400
85	LEVELING GLIDE, 1/2-13	HG780029
86	SCREW, SHLDR, 3/8" DIA x 2" L, 5/16-18	PR060771
87	HEX NUT, 1/4-20	HD343326
88	PEDAL WELDMENT	HN624100
89	BUMPER.VIBRATION MOUNT	7700C340
90	BASEPLATE WELDMENT	PR069473
91	LARGE RACK WELDMENT	7700C360
92	V-RAIL TRACK, 37" W/10 HOLES	7700C330
93	LABEL, CARRIAGE TRANSLATION RIGHT	MT350000
L 94	LABEL, CARRIAGE TRANSLATION LEFT	770CM307-2
95	COVER WELDMENT, V-RAIL	770CM307-1
96	SCREW, HEX HD, 1/2-13X1-1/4"	7700C350

Item	Description	Part No.
97	PIVOT SHAFT, BACK FRAME	7700M436
98	BACK COVER	7700M440
99	PAN L SCREW, 1/4-20X23/4"	HM621832
100	COVER, BACK LOCKING MECHANISM	7700C575
101	WIPER, SEAT BACK HANDLE	7700M562
102	WIPER, FRAME	7700M561
103	ACORN NUT, 6-32	HN534700
104	PLASTIC CHRISTMAS TREE	PP260000
105	SCREW, PAN-L, 8-32 X 3/4, BLACK	HM541815-2
106	HANDLE, REVOLVING HANDLE /WHEEL	BH080002-1
107	WASHER, SHIM	HS381500
108	HEX LOCKNUT, 1/2-20	HN795200
109	RT CLAMP LEVER WELDMENT, SEAT BACK	7700C596
110	CLAMP BRACKET, SEAT BACK	7700C570
111	BEARING PLATE, SEAT BACK	7700C565
112	SUPPORT PLATE, SEAT BACK RACK	7700C584
113	SUPPORT BLOCK, SEAT BACK RACK	7700C583
114	UPPER RACK WELDMENT	7700C580
115	PUSH PLATE, SEAT BACK RACK	7700C577
116	SCREW, FLAT HEAD SOCKET CAP	HC580914
117	SCREW, 1/4-20 X 1-1/4" FLAT HEAD SOCKET	HM620920
118	SHIM, RACK, SEAT BACK	7700M568
119	LOWER RACK, SEAT BACK	7700C576
120	SPRING PLUNGER, BACK LOCKING	7700M585
121	GUIDE BLOCK, RACK	7700M567
122	SCREW, 1/4-20 X 3-1/4 HEX HEAD CAP	HC621236
123	ANTI-FRICTION PLATE, SEAT BACK	7700M598
124	SCREW, SHOULDER, 3/8" D X 1 -1	HD343322
125	RACK UNIVERSAL COUPLING WELDMENT	7700C590
126	BUSHING, 1" ID X 1-3/8" OD X 3/4" LG	FB050202
127	CLAMP ROLLER, SEAT BACK	7700M566
128	LEFT CLAMP LEVER WELDMENT, SEAT BACK	7700C597
129	POINTER SCALE, RIGHT	7700CM541
130	BALL STUD	HP706612
131	POINTER SCALE, LEFT	7700CM540
132	GAS SPRING	EZ000771
133	RETAINING CLIP	BB030022
134	BEARING, FLANGED	FB050038
135	LABEL, SEAT TRANSLATION SCALE, RH	7700M761
136	MAIN LINK, BACK PAN	7700C491
137	HEX CAP NUT, 5/1 6-18	HN664700
138	SCREW, SHOULDER, 1/2 DIA. x 1-1/2", 3/8-16	HD703322
139	HEXNUT, 3/8-16	HN704000
140	SCREW, BUTTON HD CAP, 3/8-16 x 1", BLACK	HC700417-1
141	SPACER, SEAT HARNESS	7700M528
142	LAP BELT SHOULDER HARNESS	7700S528
143	HEADREST CUSHION	7700S451-XX
144	POINTER SPACER	HP007110
145	POINTER	2900C176
146	SCREW	HC543417
147	LINK, BACK PAN SWING	7700C497
148	SCREW, HEX HD, 1/4-20 x 1-3/4"	HC621224
149	SCREW, SHOULDER, 3/8" X 1-1/4" LG, 5/16-18	HD343320
150	SEAT CUSHION	7700S450-XX
151	LINK, SCREW JACK SWING	7700C495
152	SCREW, SOCKET SET, 1/4-20 x 1/4"	HC701216
153	LOCKWASHER, SPLIT, 3/8"	HS348300
154	DOWEL PIN, 3/8" DIA. x 5/8"	HP346614
155	ANTI-FRICTION LABEL, ACME NUT	7700M498
156	NUT, THREADED, ACME, 3/4-6	7700M494
157	ACME SCREW, 3/4-6	7700M496
158	KEY, 1/8" x 1/8" x 1-1/4"	BK030020
159	ROLL PIN, 1/8" DIA. x 5/8"	HP266723
160	PIVOT ROD	7700M461
161	SEAT PAN FRAME WELDMENT	7700C405
162	SCREW, 1/4-20 X 2-1/4" HEX HEAD CAP	HC621228
163	SPRING, CUSTOM LEFT HAND COIL	BS070727
164	7 DEGREE STOP	7700C465
165	SPRING, CUSTOM RIGHT HAND COIL	BS070728
166	KNOB, LOCKING, 3/8-24 x 3/4"	PP460008
167	LABEL, RECEIVING TUBE #3	181CM303
168	KNOB, PULL	PP450201
169	LABEL, RECEIVING TUBE #2	181CM302
170	SPRING	BS070007
171	PULL PIN	2450M052
172	LABEL, RECEIVING TUBE #1	181CM301
173	V-PUSHER	AA033904
174	SCREW, SOCKET HD CAP, NYLON, 6-32 x 3/8"	HC533410
175	SCREW, SHOULDER, 1/2" DIA. x 1/2" LG, 3/8-16	HD383312
176	BELT LOOP WELDMENT, MIDDLE	7700C485
177	HEX HD CAP SCREW, 1/2-13 x 1-3/4"	HC781226-1
178	LOCKWASHER, 1/4"	HS308300
179	SCREW CAP, BLACK	PP080005
180	SCREW CAP, WASHER 1/2"	HS010001
181	FLATWASHER 1/4" FLAT	HS307600
182	ELASTIC LOCKNUT, 5/16-18	HN665201
183	THRUST WASHER, .51" ID x .937" OD x .09" THK	HS387604
184	WASHER, SPECIAL	166HS098
185	BRACKET, PELVIC BELT, BLACK	7310C067-1
186	SCREW, BUTTON HD CAP, 3/8-16 x 3/4"	HC700415-1
187	HEX JAM NUT, 3/8-24	HN714400
188	FLATWASHER, 3/8"	HS347703
189	DOWEL PIN, 3/8" DIA x 2" LG	HP346626
190	SHAFT RETAINER PLATE	7700C569
191	SCREW, 8-32 X 3/8" LOW SOC HD. CAP	HC543410
192	SPRING, COMPRESSION, .325" D X 1.5 LG	BS070772



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Figure 10-31 Patient Positioning Module Exploded View (Sheet 2)



193	DOWEL PIN, 1/4" DIA x 1-1/4" LG	HP306620			
194	BUSHING, 1" ID x 1-3/8" OD x 3/4" LG	FB050202			
195	PLUG, CAP. STEEL, 7/8" DIA.	BG030200	199	FLATWASHER, 3/4" OD	HS347703
196	SCREW, HEX HEAD CAP, 3/8-24 x 6-1/2" LG	HC701259	200	HEXNUT, 1/4-20	HN624100
197	HEXNUT, 1/4-20	HN624100	201	SCREW, SOC HEAD, 3/8" X 1-1/2"	HD343322
198	DOWEL PIN, 3/8" DIA X 2" LG	HP346626	202	SCREW, SHOULDER, 3/8" X 2-1/4"L, 5/16-18	HD663328

Item	Description	Part No.
1	COVER, ISOLATION TRANSFORMER-CE	7700C347
2	SCREW, PAN HEAD W/LOCKWASHER 6-32 X 1/4"	HM532508
3	LABEL, AC POWER/SERIAL NUMBER (INT.)	770CM388
4	CIRCUIT BREAKER	EF000022
5	STRAIN RELIEF, STRAIGHT	EL770008
6	LABEL, AC POWER, ISOLATION TRANSFORMER	770CM954
7	SCREW, PAN HEAD W/LOCKWASHER 6-32 X 1/4"	HM532508
8	SCREW, PAN HEAD W/LOCKWASHER 6-32 X 1/4"	HM532508
9	BRACKET, ISOLATION TRANSFORMER - CE	770C191
10	BASE, ISOLATION TRANSFORMER - CE	7700C348
11	BUMPER, 7/8" OD WITH 8-32 X 1/4" STUD	PR060771
12	FUSEHOLDER, .25 QUICK DISCONNECT	EF000770
13	FUSEHOLDER, .25 QUICK DISCONNECT	EF000770
14	FUSE 5A @ 250V, SLO-BLO, 3AG	EF290003
15	BASE, ISOLATION TRANSFORMER - CE	7700C348
16	GROMMET, SHOCK MOUNT	PP260008
17	FLATWASHER, 1/4"	HS307601
18	ISOLATION TRANSFORMER	ET000770
19	FLATWASHER, 1/4"	HS307601
20	HEX NUT, 1/4"-20	HN625200
21	WASHER, EXTERNAL TOOTH LOCK, 1/4"	HS308302
22	RECEPTACLE, AC SOCKET, 115 VAC, 20 AMPS	ES130007
23	FUSE 5A @ 250V SLO-BLO	EF00021
24	SCREW, PAN HEAD, 8/32" X 1/2"	HM542512
25	SCREW, PAN HEAD, 8/32 X 1/2"	HM542512
26	AC RECEPTACLE, 250 VAC, 20 AMPS	ES130770
27	DRIVE MODULE DM-30, CE (NON-CE)	730EM835 (7700S752)
	DRIVE MODULE DM-75, CE (NON-CE)	770EM937 (7700S758)
28	HEX NUT, 10-32	HN584100
29	FLATWASHER, #10	HS107601
30	LOCKWASHER, EXTERNAL TOOTH, #10	HS308302
31	SOLID STATE RELAY	EE770000
32	SCREW, PAN HEAD PHILLIPS (SEMS) #6 X 1/2"	HM532512
33	BRACKET, MOTOR CABLE TERMINATION	7700M259
34	POWER SUPPLY	EP470770
35	SCREW, PAN HEAD PHILLIPS W/LOCKWASHER, #6 X 1/4"	HM532508
36	SERVO AMP COVER	7700W490
37	UNINTERRUPTIBLE POWER SUPPLY	EP500005
38	HEX NUT, 6-32 KEPS	HN534300
39	RECEPTACLE (DUPLEX)	ES130034
40	RECEPTACLE (DUPLEX)	ES130034
41	WHIZ-L, 1/4-20X5/8	HM621114
42	STRAIN RELIEF, .430" D, STRAIGHT THRU	EL270001
43	STRAIN RELIEF, STRAIGHT, .660" OD	EL130034
44	SWITCH, DPST	ES000770
45	STRAIN RELIEF, .430" D, STRAIGHT THRU	EL270001
46	FUSEHOLDER	EF00017
47	FUSE 20A @ 250V, SLO-BLO	EF000021
48	STRAIN RELIEF, .430" D, STRAIGHT THRU	EL270001
49	FUSEHOLDER	EF00017
50	FUSE 5A @ 250V, SLO-BLO	EF290003
51	SCREW, PAN HEAD, 6-32 X 3/8"	HM532410
52	JACKPOST KIT	EZ420002
53	JACKPOST KIT	EZ420002
54	SCREW, SOCKET HEAD CAP, 4-40 X 3/8"	HC522810
55	LOCKNUT, ELASTIC, 4-40	HN525200
56	LOCKNUT, ELASTIC, 4-40	HN525200
57	LOCKNUT, ELASTIC, 4-40	HN525200
58	LOCKNUT, ELASTIC, 4-40	HN525200
59	HOUSING, NDCB REAR-CE	7700M167
60	JACKPOST KIT	EZ4230002
61	JACKPOST KIT	EZ4230002
62	JACKPOST KIT	EZ4230002
63	JACKPOST KIT	EZ4230002
64	CIRCUIT BOARD SUPPORT	HP713770
65	SCREW, PAN HEAD PHILLIPS W/LOCKWASHER, #6 X 1/4'	HM532508
66	SELF CLINCHING STANDOFF	HP537109
67	WHIZ-L, 1/4-20X5/8"	HM621114
68	SCREW, PAN HEAD PHILLIPS W/LOCKWASHER, #6 X 1/4'	HM532508
69	MANUAL MODE PCB ASSEMBLY	7700S635
70	HOUSING, NDCB FRONT-CE	7700S163
71	INSTRUMENT KNOB	PP470007
72	LABEL, SPEED CONTROL	770CM629
73	SELF CLINCHING NUT, 6-32	HN534901
74	SELF CLINCHING NUT, 6-32	HN534901
75	SELF CLINCHING NUT, 6-32	HN534901
76	SCREW, PAN HEAD PHILLIPS W/LOCKWASHER, #6X1/4'	HM532508
77	JACKPOST KIT	EZ4230002
78	JACKPOST KIT	EZ4230002
79	SCREW, SOCKET HEAD CAP, 4-40 X 3/8"	HC522810
80	JACKPOST KIT	EZ4230002
81	JACKPOST KIT	EZ4230002

82	JACKPOST KIT	EZ4230002
83	SELF CLINCHING NUT, 6-32	HN534901
84	NDCB, REAR EXTENDER	7700M169
85	NDCB, PCB ASSEMBLY	7700S628
86	SCREW WITH WASHER, 6-32 X 1/4"	HM532508
87	AUXILIARY INTERFACE PCB ASSEMBLY	7700S690

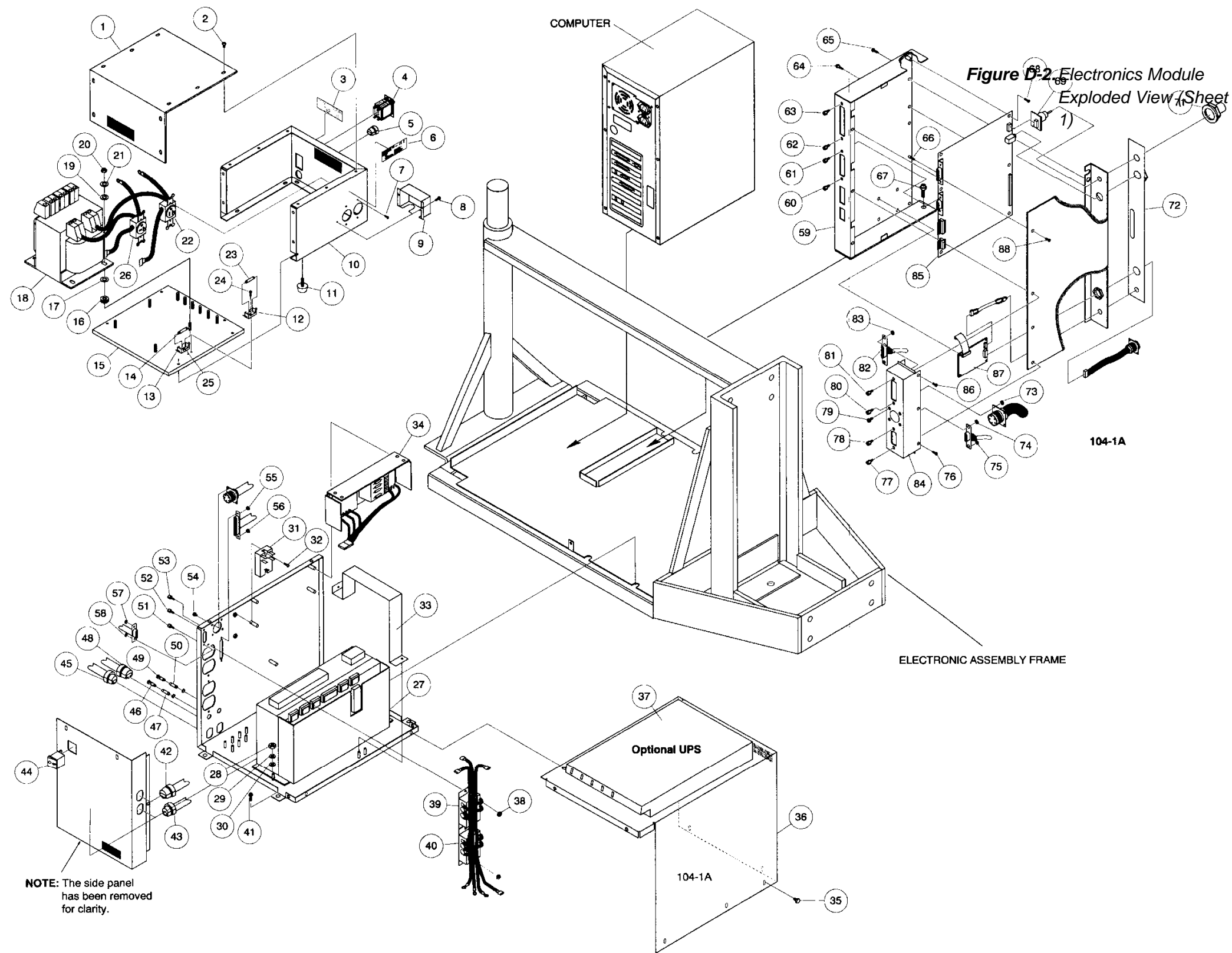


Figure 10-32 Electronics Module Exploded View (Sheet 1)

Item	Description	Part No.
88	LIGHT PEN	EN770001
89	KEYBOARD	EK390010
90	LABEL, ROM RING	7700M108
91	INPUT ADAPTER ASSEMBLY	7700A828
92	SCREW, SOCKET HEAD CAP, 1/4-20 X 3"	HC622834-1
93	MACHINED ROM RING	7700P105
94	ROM STOP SUBASSEMBLY	7700S101
95	ROM STOP SUBASSEMBLY	7700S101
96	EMI CAN	7700W338
97	EMI SHIELD	7700M141
98	TORQUE BOARD	7700S123
99	SCREW, SOCKET HEAD CAP, 6-32 X 3/8"	HC532810
100	LOCKWASHER, #6 SPLIT	HS068301
101	STATORPCB ASSEMBLY	7700S262
102	DYNAMOMETER INTERFACE PLATE	7700C253
103	STANDOFF, HEX MALE/FEMALE 6-32 X 3/8" STEEL	HP537110
104	SCREW, FLAT HEAD, SOCKET, 1/4-20 X 3/4"	HC620915
105	WOODRUFF KEY	REFERENC E
106	DYNAMOMETER MODULE SUBASSEMBLY	7700S135
107	BEARING SPHERIAL, 1" BORE	FB030012
108	DYNA HOUSING	7700C252
109	BEARING, THRUST	FB050053
110	TILT LOCK LEAD SCREW	7700W131
111	BEARING, THRUST	FB050053
112	LABEL, ARROW INDICATOR	7700M138
113	LABEL, PROTRACTOR SCALE	7700M139
114	TILT LOCK ACME NUT	7300M244
115	SCREW, FLAT HEAD, SOCKET, 8-32 X 1/2"	HM540912
116	TILT LOCK FLOATING FACE GEAR	7300P245
117	TILT LOCK REMOVABLE FACE GEAR	7300P246
118	SCREW, SOCKET HEAD CAP, 4-40 X 3/8"	HC532810
119	SCREW, SOCKET HEAD CAP, 4-40 X 3/8"	HC532810
120	SCREW, SOCKET HEAD CAP, 4-40 X 3/8"	HC532810
121	END PLATE	7700C256
122	SCREW, BUTTON HEAD SOCKET, 1/4-20 X 1/2"	HC620412
123	SCREW, SHOULDER, 3/16" DIA X 1/8" LG, 8-32"	HD543306
124	UNIVERSAL MOUNTING STRAP	PC149640
125	PIVOT, SPHERICAL BEARING	7700C134
126	HOUSING, BUSHING	7700C133
127	SCREW, FLAT HEAD SOCKET, 5/16-18 X 1-1/2"	HC600922-1
128	BALL KNOB, 1" DIA	PP460024
129	ROLL PIN, 3/16" DIA X 3/4" LG	HP286715
130	HANDLE HUB	7300P254
131	HANDLE	7300P255
132	BALL KNOB, 1" DIA	PP460024
133	BENT YOKE	7700C130
134	THRUST WASHER, .5" ID X .937" OD X .092"	HS387604
135	DYNAMOMETER PEDESTAL	7700W150
136	UNIVERSAL MOUNTING STRAP, 1-1/2"	PC149640
137	SCREW, SHOULDER, 3/16" DIA X 1/8" LG, 8/32"	HD543306
138	HEX JAM NUT, 3/8-24	HN714400
139	FLATWASHER, 3/8"	HS347703
140	RIGHT LEVER SUBASSEMBLY	REFERENC E
141	COATED CLAMP BLOCK	7700C213
142	SCREW, LOW SOCKET HEAD CAP, 8-32 X 3/8"	HC543410
143	BEARING PLATE	7700M214
144	DOWEL PIN, 3/8" DIA X 2" LG	HP346626
145	SHAFT RETAINER PLATE	7700C569
146	GAS SPRING	EZ000770
147	SCREW, SOCKET SET, 1/2"-13 X 3/8" LG	HM781610
148	SPRING, COMPRESSION, .325" D X 1.5" LG	BS070772
149	HARD COAT ANODIZED PEDESTAL CLAMP	7700P200
150	FLATWASHER, 3/8"	HS347703
151	COATED CLAMP BLOCK	7700C213
152	BEARING PLATE	7700M214
153	SHAFT RETAINER PLATE	7700C569
154	SCREW, LOW SOCKET HEAD CAP, 8/32" X 3/8"	HC543410
155	DOWEL PIN, 3/8" DIA X 2" LG	HP346626
156	CLAMP ROLLER	7700M215
157	DOWEL PIN, 1/4" DIA X 1-1/4" LG	HP306620
158	COATED LEFT CLAMP LEVER WELDMENT	7700C210
159	PLUG, CAP, STEEL, 7/8" DIA	BG030200
160	PLUG, CAP, STEEL, 7/8" DIA	BG030200
161	BUSHING, 1" ID X 1-3/8" OD X 3/4" LG	FB050202
162	SCREW, HEX HEAD CAP, 3/8-24 X 6-1/2" LG	HC701259
163	SLEEVE, TORSION SPRING	7700M254
164	TORSION SPRING	BS000770-2
165	TINNERMAN FASTENER, #8, J-TYPE	HF080007
166	COVER PLATE	7700C602
167	TINNERMAN FASTENER, #8, J-TYPE	HF080007
168	FLATWASHER, 1/2" OD X 7/32" ID X 3/64" THK	HS107601
169	LOCKWASHER, 10 SPLIT	HS108302
170	SCREW, SOCKET HEAD CAP, #10-24 X 1/2"	HC5782812
171	COVER, PEDESTAL CLAMP	7700E697
172	LABEL, DYNA PED, ROTATION LT	7700M154-1
173	SCREW, PAN-L, 8-32X3/4"	HM541815-1
174	ENCLOSURE, LEFT SIDE	7700E699
175	SCREW, PAN-L, 8-32X3/4"	HM541815-1
176	MONITOR ARM	7700C660
177	MONITOR TABLE WELDMENT	7700C670
178	VELCRO PADS	7700M609
179	MONITOR	EN380016
180	ENCLOSURE, RIGHT SIDE	7700E698
181	LABEL, DYNA PED ROTATION RT	7700M154-2

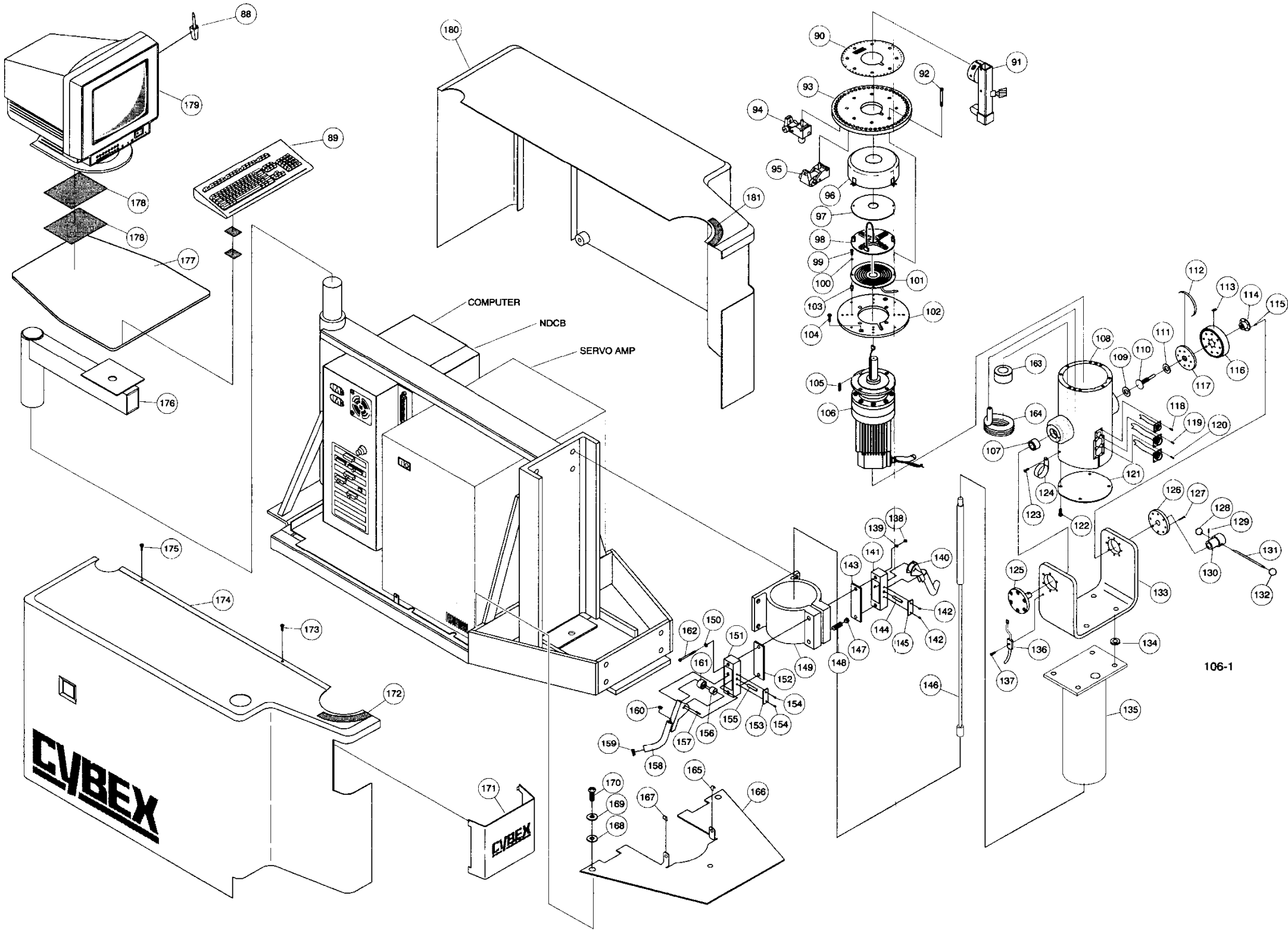


Figure 10-33 Electronics Module Exploded View (Sheet 2)

### APPENDIX E CARE AND MAINTENANCE

#### CARE AND MAINTENANCE

The CSMi NORM Testing and Rehabilitation system has been designed to require a minimum of periodic maintenance. This section of the Service & Parts manual outlines recommended care of the NORM system.

### CARE AND MAINTENANCE

**Monitor:** Apply a household window cleaner to a soft cloth to clean the monitor screen.

**Caution:** Do not use Benzene, thinner, or any volatile substance to clean the unit as they may leave a permanent mark. Never leave the unit in contact with rubber or vinyl for an extended period.

**Printer:** Clean cover and access panel with mild detergent and lint free cloth. Clean window with a soft lint free cloth moistened with commercial glass cleaner. The paper feed path should be cleaned when changing a ribbon cartridge or if there is a build up of dust, ink deposits or paper deposits.

**Tape Drive:** The head should be cleaned after two (2) hours of use with a new cartridge, and every eight (8) hours of operation thereafter.

- The recommended cleaning procedure is to use the Perfect Data QIC-II Drive Head Cleaning Kit (P/N 102791-21 for the large tape cartridges and P/N 104415-1 for the mini tape cartridges) according to the manufacturer's instructions.

**Note:** Never clean the tape drive using isopropyl alcohol as it will leave a residue on the head.

**Keyboard:** Use a cloth dampened with household glass cleaner.

**Computer:** No cleaning recommended.

**Floppy Drive:** Clean every 12 months. Use a commercially available drive cleaning kit according to the manufacturer's instructions.

**Upholstery:** Clean with a mild household cleaner applied to a cloth.

### USER REPLACEABLE PARTS

#### Upholstery Color Part Numbers

When ordering upholstered items, it is necessary to indicate the number of the upholstery color in addition to the part number of the desired cushion. This is done by adding the "dash number" of the desired color to the part number of the cushion. For instance, the seat bottom cushion (P/N 7700S450) in Dusty Rose (dash number -04) would be 7700S450-04.

#### Standard Colors:

ROSEWOOD	-16
JADE	-17

#### Special Colors:

OYSTER.....	-00
BLACK.....	-01
ROYAL BLUE .....	-02
RED.....	-03
DUSTY ROSE .....	-04
TURQUOISE.....	-05
REGATTA BLUE.....	-06
CHAMPAGNE.....	-07
BURGUNDY .....	-08
NAVY .....	-09
ALABASTER.....	-10
GROTTO .....	-11
CHARCOAL .....	-12

### SERVICE & WARRANTY POLICY

Our goal is to help you obtain optimum performance and the longest possible operation life from your CSMi equipment. Whenever possible, we offer updates or modifications to provide older equipment with the features of our most current products. It is therefore in our best interest, as well as yours, to keep every CSMi system well serviced.

The following pages describe the various service programs either provided automatically with equipment purchase or offered on an elective basis. The optional programs described in this brochure may not be necessary for every situation, but are provided for those customers whose equipment applications demand specific insurance against "down time."

For additional information or to establish a starting date for an optional program, please contact your regional Sales Representative or contact the CSMi ([www.csmisolutions.com](http://www.csmisolutions.com))

### FREIGHT AND INSIDE DELIVERY

Testing and Rehabilitation Systems and their adjunct rehabilitation products are shipped disassembled and packaged so that the boxes will fit through a minimum doorway of 36". Prior arrangements should be made for sufficient space to receive the equipment. The equipment will be moved by the carrier to a predetermined location.

To ensure efficient equipment installation, please have your facility ready prior to delivery and have the trucker place the equipment in the EXACT location where it will be used. We will not leave your equipment at the curb or on the loading dock unless you advise us to do so!

The only exception to the nominal flat rate charges listed are inside deliveries requiring

equipment to be carried more than 100 feet from the closest point accessible by a commercial tractor-trailer or those requiring the use of a hoist or other special equipment. Prior to shipment, please advise CSMi of any unusual distances or obstacles in your facility so that we can minimize costs by assuring that proper manpower and equipment are made available. It is important to be sure not to place your systems near saunas, whirlpools or other high humidity environments.

### ELECTRICAL REQUIREMENTS

Certain CSMi Products require specific electrical consideration. Please consult your CSMi Representative for further information.

### EQUIPMENT RELOCATION PRIOR TO ASSEMBLY

In order to ensure that your equipment installation proceeds smoothly, please have your facility ready prior to accepting delivery and have the trucker place the equipment in the exact location where it will be used. In the unlikely event that equipment relocation is necessary prior to installation, please let us know so that we can help you find relocation assistance at minimal cost to you.

### EQUIPMENT RELOCATION AFTER ASSEMBLY

Should there be a future need to have the equipment dismantled and reassembled for moving purposes, services will be billed at normal Customer Service rates. These charges are for the dismantling and re-assembly of the equipment only. Moving the equipment is the responsibility of the facility. Contact CSMi Customer Service for details.



### EXPERT INSTALLATION

To insure proper operation, CSMi requires that the NORM Testing and Rehabilitation System be installed and assembled by our expert Field Service Technicians. The installation fee listed includes unpacking, set-up, and a complete system check-out to verify that the unit is ready for trouble-free operation. (Note: In some cases, a Travel Zone Charge may apply.)

Each visit by a CSMi Trained Technician for the purpose of uncrating and installing equipment is subject to a Travel Zone Charge. The charge applicable to your geographical location may be obtained from your CSMi Sales Representative or from CSMi Customer Service. A Minimum installation will be made for each visit.

### EXPORT INFORMATION

For information on shipment of CSMi products to countries outside of the United States, please contact your local CSMi Distributor or contact the CSMi ([www.csmisolutions.com](http://www.csmisolutions.com))

### THE CSMi SERVICE POLICY

This statement of Service Policy is not a warranty and in no way alters the terms, conditions, or requirements of the warranty. The Service Policy represents only our current procedures for handling service requirements during and after the warranty period. Although we do not have sales and service representatives in every location, we can and will provide excellent warranty and continued maintenance service. Please call CSMi Customer Service if you have any questions.

#### 1. Shipping Cost Policy:

If a service requirement arises during warranty on any CSMi product which requires the return for repair or replacement of that product or any of its components, parts, or accessories, it is the current policy of CSMi to pay directly or

reimburse our customer for all shipping costs connected with the repair or replacement in excess of five dollars (\$5.00). The only requirements for obtaining this extra service are that a Return Authorization Number be obtained from the CSMi Customer Service Department and that any return shipments are made only by the method or carrier instructed by Customer Service.

This policy does not include total cost of air freight shipments requested by the customer. These will be paid or reimbursed on a pro-rated basis (difference between motor and air freight cost is the responsibility of the customer). This also does not include shipment outside the United States.

#### 2. Return and Replacement Policy:

If a need for service arises during the warranty period on any CSMi product which requires the replacement of a defective component, part, or accessory, it is the current policy of CSMi to expedite service by immediately shipping and invoicing for the appropriate replacement. This invoice is then credited in full on receipt of the authorized return by CSMi. Invoicing and return for credit may be waived in some cases when cost of handling exceeds value of item.

To obtain credit, any returned component, part, or accessory must be packed carefully to avoid damage in transit and must be clearly marked with Return Authorization Number obtained from CSMi Customer Service.

#### 3. Repair Policy:

A Return Authorization Number is required on any return for repair or credit. For non-warranty repairs, a written purchase order is required to cover material, labor and shipping costs. Repairs paid for by customers are warranted for 90 days from date of repair. Subsequent parts failure

unrelated to the repair are not warranted and therefore chargeable.

#### **4. Response Time Policy:**

It is the policy of CSMi to respond to customer requests for technical service by dispatching service personnel and/or by ship-

ping necessary components, parts, or accessories normally within two business days in major metro areas and three days in rural areas from date of request.

### **5. Standard Service Rates:**

For service rates for out-of-warranty repairs, consult the Services Price List.

Minimum Service charge is the minimum one-hour charge plus appropriate zone travel charge.

### **Standard Warranties**

Every CSMi product is warranted against defects in materials and workmanship. Warranty periods vary among products.

It is the policy of CSMi to provide (with no charges for parts, labor or transportation) appropriate warranty repair or replacement of any defective component, part or accessory within ten business days from the date a problem is reported.

### **6. Standard Business Hours:**

Inside Telephone Technical Support is available from Monday - Friday 8 a.m. to 6 p.m. Eastern Time Zone toll-free at 1-800-892-2732.

On-Site Technical Service is available Monday - Friday 8 a.m. - 5 p.m. in your respective time zone.

## **PREVENTIVE MAINTENANCE AGREEMENTS**

Preventive maintenance is the key to the efficient, long-term operation of any mechanical device. Frequent inspection for damage or wear, checking for proper tightness of bolts and other hardware, cleaning, lubrication, and calibration are activities that should be performed on a regularly scheduled basis. For those customers who do not have the time to dedicate to the maintenance and calibration of their CSMi

Testing Systems, and prefer to have a trained technician handle it for them, CSMi offers a comprehensive Maintenance Agreement.

The CSMi Preventative Maintenance Agreement Program provides continuous maintenance on your CSMi NORM Testing and Rehabilitation System. As a participant, you will receive two or four regularly scheduled visits (see price scheduling attached) by a Qualified CSMi Service Technician to help you keep your system operating efficiently.

This program will qualify you for a 20% discount on parts used for on-site repairs during the term of this agreement.

Owners of more than one system per location will receive a 5% maintenance discount for each additional system.\* Required maintenance visits made outside the normal working hours will be subject to an additional charge (see Services Price List).

This maintenance program will provide the following services. During each visit, a qualified technician will:

- Meet with you to discuss any problems involving your testing and rehabilitation equipment.
- Inspect complete system(s) and prepare a list of any items in need of repair or replacement.
- Secure all stabilization and component hardware.
- Check all wear points and lubricate as required.
- At your request, we will replace parts at a 20% discount in order to complete repairs.
- Perform a complete system calibration.

To participate in the program, send your purchase order or check to CSMi.

We will schedule your service calls and contact you at least five business days in advance of each visit to make a convenient appointment. If you have any questions, please contact us at our toll-free number 1-800-645-5392.

*\* Cannot be combined with other discounts.*

### SERVICE CONTRACT

Our Service Contract is a definite plus for customers with equipment in high-usage environments. This optional 12-month Service Contract offers total protection against equipment failure not resulting from abuse, neglect or other exclusionary factors listed under the terms of the Service Contract.

#### 1. Contract Period/ Twelve Months

During the contract period, CSMi will perform one scheduled, multi-point examination of the system.

#### 2. Service Contract Coverage

The service contract includes all parts, labor\* and travel necessary to repair the system throughout the contract period. In addition, CSMi will offer any software upgrades or enhancements at a 50% discount off the prevailing price list.

#### 3. To Qualify

A Service Contract can be purchased under the following conditions:

Along with a new equipment order;

For Systems that have been covered under any combination of:

The original warranty, or;

A maintenance agreement currently active or that has expired within the last six months. (In this case, a Service Contract can begin at any time without undergoing a site inspection.)

Systems must be in good working order to begin a Service Contract. All systems that an owner wishes to be covered by a Service Contract will receive a 20% discount on all parts required to restore them to good working order.

Systems that have not been covered under A or B above within the past six months will require a site inspection and may require repairs. The cost of inspection, parts needed and travel charges will be charged to the owner.

#### 4. Party Covered

The Service Contract is extended to the original purchaser of the contract.

*\* Labor during normal business hours Monday through Friday 8am to 5pm.*

#### 5. Extent of Service Coverage

This contract is effective for all CSMi products as listed in services pricing schedule with the exception of the EDI 320 and CSMi CMS. It does not cover any product, component, part or accessory which CSMi determines to be defective due to abuse or neglect. In addition, the contract will be voided if the equipment has been modified, altered, or contains components, parts, software (except for CSMi approved IBM/AT compatible commercially available personal computing programs) or other accessory products that are not part of the CSMi product line.

#### 6. Parts Not Covered

All wear items and consumable goods. See CSMi Warranty Policy.

#### 7. Cancellation

A \$50 administrative fee will be charged if a Service Contract is canceled within 30 days of entry of order. Any refunds for service not performed will be prorated on the number of

service calls completed at regular time and material rate.

### 8. Other Discounts Offered

A Maintenance Agreement purchased with a Service Contract on the same system will receive a 20% discount on the Maintenance Agreement. Cannot be combined with other discounts.

Owners of more than one system per location will receive a 5% discount on each additional contract. Cannot be combined with other discounts.

*Systems that are used in mobile environments, or that are relocated by other than CSMi carriers and technicians, require special warranty and service coverage which is available at extra cost depending on individual circumstances. Warranty is voided if system is moved from place of original installation without approval of the CSMi Customer Service Department.*

### NON-CONTRACTUAL SERVICES

#### TRAVEL CHARGES

A call by one or more CSMi Trained Field Service Technicians for the purpose of providing non-warranty or installation service is subject to a Travel Zone Charge which is based upon the geographic location of the customer site. This fee is only charged once per visit, regardless of the number of procedures or quantity of equipment involved.

For the Travel Zone Charge that applies to your facility, contact your local CSMi Representative or CSMi Customer Service.

#### CLINICAL EDUCATION AND TRAINING

Initial training includes on-site education and hands-on in-service programs by a CSMi Clinical Education Specialist.

All of the Clinical Education Specialists are licensed or registered Physical Therapists. The clinical training will provide a foundation for safe, effective testing and rehabilitation. Testing Clinical Packages include in-service time based on the number of units in the package. Single units require one day. Additional clinical training is available. Consult Price List for charges.

#### CSMi WARRANTY POLICY

This and every quality-engineered and manufactured CSMi product is warranted to be free from defects in materials and workmanship. CSMi offers this written warranty to the original consumer / purchaser which is intended to fully comply with federal legislation\* relating to the contents and terminology of warranties subject to the following conditions and qualifications:

#### DURATION OF THE WARRANTY:

##### A. ISOKINETIC TESTING AND REHABILITATION SYSTEMS

CSMi Isokinetic Testing and Rehabilitation Systems are warranted to the original consumer/purchaser for a period of one year from the date of shipment or from the date of installation (if performed by an authorized Technician) with the following exceptions:

90 Days:

- Upholstery & Handlebar Grips
- Straps & Consumables

##### B SOFTWARE

CSMi warrants all proprietary and licensed software which is offered as an integral part of CSMi Systems.

\*Magnuson-Moss Warranty Act of 1975

### EXTENT OF WARRANTY COVERAGE

CSMi retains the right to elect repair or replacement of improperly functioning equipment free of charge within the warranty period. Replacements or repairs will not extend the warranty period. CSMi reserves the right to replace the failed component with a new or equivalent component. Replaced components become the property of CSMi. If the product must be returned to the factory, all transportation costs must be prepaid by the consumer/purchaser. (See Service Policy statement.)

This warranty is effective for CSMi products listed above. It does not however, cover any product, component, part or accessory which CSMi determines to be defective due to abuse, neglect or lack of maintenance as outlined in the CSMi Service and Parts Manuals. In addition, the warranty will be voided if the equipment has been modified, altered or contains components, parts, software (except for CSMi approved IBM®/AT-compatible commercially available personal computing programs, which may or may not be warranted by the software manufacturer) or other accessory products that are not part of the CSMi product line.

If a defect or damage involves a component, part or accessory that is already in service and can reasonably be replaced or serviced by the consumer/purchaser, CSMi will be responsible only for providing, at no charge, a suitable replacement and instructions for the consumer/purchaser.

If damage is caused by the transport carrier, the customer must notify CSMi Customer Service and a claim should be filed by the customer directly with the carrier at the time of delivery or by CSMi Customer Service on the customer's behalf. CSMi will provide a suitable replacement

component, part or accessory and instructions for replacement or service by the consumer/purchaser, but will not assume purchase or shipping costs for the replacement.

### PROCEDURE TO FOLLOW IN ORDER TO OBTAIN WARRANTY PERFORMANCE:

Contact the CSMi Customer Service Department by e-mail for instructions and/or a Return Authorization Number:  
info@csmisolutions.com.

### WARRANTY DISCLAIMERS AND ADDITIONAL INFORMATION

There are no additional warranties, either expressed or implied, arising out of the sale of this product other than those contained herein except an implied warranty of fitness for the purpose intended for a period of one year or as noted below. This warranty extends only to the repair or replacement of the product and does not afford additional coverage with respect to any incidental or consequential damages arising from the use or non-use of this product. CSMi is not responsible for any lost data or interrupted system operation.

Systems that are used in a mobile environment, or that are relocated by other than CSMi carriers and technicians, require special warranty and service coverage which is available at extra cost depending on individual circumstances. Warranty is voided if system is moved from place of original installation without approval of the CSMi Customer Service Department.

Some states do not allow the exclusion or limitation of incidental or consequential damages and/or limitation on how long an implied warranty lasts, so the above limitations or exclusions may not apply to you. This



warranty gives you specific legal rights and you may also have other rights which may vary from state to state. This warranty gives you specific legal rights and you may also have other rights which may vary from state to state.