

**ENTE**C  
**ENGINEERING TECHNOLOGY, INC.**

**Installation and Maintenance Manual**

**Filament Winding Machine**

**Model PW6H-5S-80-2A**

**Serial No. EN010378**

**WARNING**

Operation or service of the equipment described in this document can be hazardous. Only personnel qualified to operate or service the equipment should do so. The information contained in this document is for use of qualified personnel only.

# Safety Summary

This general safety information is for both operating and service personnel. Specific information will be found throughout the manual where applicable, but may not be listed in this summary.

In this manual WARNING statements identify conditions or practices that could result in personal injury or loss of life. CAUTION statements identify conditions or practices that could result in damage to the equipment.

## WARNING

**Operating personnel should have a thorough understanding of this equipment's capabilities and of the motions of the machine parts before attempting to operate the equipment.**

- **NEVER stand or place any portion of your body in the path of any moving part of this equipment with the power on!! If there is an equipment failure, the equipment could move quickly and violently in any direction.**
- **DO NOT operate or service this equipment if it is not grounded.**
- **DO NOT operate this equipment in an explosive atmosphere, unless it is specifically certified for such operation.**
- **DO NOT operate this equipment with covers or protective panels removed.**
- **DO NOT service this equipment unless another person capable of rendering first aid is present.**
- **DO NOT touch exposed connections while servicing when power is on. High voltages exist at many points in this equipment. Disconnect power before removing covers or protective panels, and when replacing components.**

# Notice

The information contained in this document is subject to change without notice.

ENGINEERING TECHNOLOGY, INC. makes no warranty of any kind with regard to this document, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. ENGINEERING TECHNOLOGY, INC. shall not be liable for errors contained herein, nor for incidental or consequential damages in connection with the furnishing, performance or use of this document.

This document contains proprietary information which is protected by copyright. All rights are reserved. No part of this document may be reproduced in any form whatsoever without the prior written consent of ENGINEERING TECHNOLOGY, INC.

**Copyright © 1996 by ENGINEERING TECHNOLOGY, INC.**

**HyperChain™, FiberGrafIX™, WiMaX™ & EnTec™ are trademarks of Engineering Technology, Inc.**

# Warranty

ENGINEERING TECHNOLOGY, INC. warrants that its products are free from defects in material and workmanship for a period of **one year** from the date of shipment. ENGINEERING TECHNOLOGY, INC. will, at its option, repair or replace the product if ENGINEERING TECHNOLOGY, INC. determines it is defective within the warranty period. ENGINEERING TECHNOLOGY, INC. reserves the right to request the return of the product, freight prepaid, to an ENGINEERING TECHNOLOGY, INC. service center for repair.

ENGINEERING TECHNOLOGY, INC. is not obligated to furnish service under this warranty if service has been attempted or done by other than authorized ENGINEERING TECHNOLOGY, INC. representatives or if the product has been damaged by improper use or abuse, or by connection to incompatible equipment.

Equipment or parts manufactured by others but furnished by ENGINEERING TECHNOLOGY, INC. will be repaired or replaced only to the extent of the original manufacturer's guarantee.

ENGINEERING TECHNOLOGY, INC. makes no warranty of any kind regarding the use or reliability of software furnished with its products.

The foregoing obligations are in lieu of all other obligations and liabilities, including negligence and all warranties either expressed or implied. There is no implied warranty of merchantability or of fitness for a particular purpose.

ENGINEERING TECHNOLOGY, INC. is not liable for any special or consequential damages.

# Table of Contents

## 1 - General Information

Drawings . . . . .	.1 - 1
Machine Specifications . . . . .	.1 - 2
Basic Control Schematic . . . . .	.1 - 3
Physical Description . . . . .	.1 - 4
Machine Frame . . . . .	.1 - 4
Operator's Control Panel . . . . .	.1 - 4
Power Supply . . . . .	.1 - 4
Basic Functions . . . . .	.1 - 4
Axis #1— Spindle Rotation . . . . .	.1 - 4
Axis #2— Horizontal Carriage . . . . .	.1 - 5
Radial Carriage . . . . .	.1 - 5
Cut-Off Mechanism . . . . .	.1 - 5
Figure 1-1: Basic Axes of Motion . . . . .	.1 - 6

## 2 - Handling, Installation and Setup

Handling . . . . .	.2 - 1
Installation . . . . .	.2 - 1
General Inspection . . . . .	.2 - 1
Machine Leveling . . . . .	.2 - 1
Power Connection . . . . .	.2 - 2
Start-Up Procedure . . . . .	.2 - 2

## 3 - Mechanical Maintenance

General Cleanliness . . . . .	.3 - 1
Control Panel . . . . .	.3 - 1
Miscellaneous . . . . .	.3 - 1
Lubrication . . . . .	.3 - 2
Worm Gear Boxes . . . . .	.3 - 2
Spindle Bearings . . . . .	.3 - 2
Horizontal Carriage Cam Followers . . . . .	.3 - 2
Horizontal Carriage Linear Bearings and Shafting . . . . .	.3 - 2
Summary . . . . .	.3 - 3
Table 3-1: Lubrication Table . . . . .	.3 - 3
Adjustments . . . . .	.3 - 3
Carriage Chain . . . . .	.3 - 4
Trouble Shooting . . . . .	.3 - 5
SPINDLE . . . . .	.3 - 5
Problem: Spindle does not rotate or tracking error is diagnosed by computer on 3axis #1. . . . .	.3 - 5
HORIZONTAL CARRIAGE . . . . .	.3 - 5
Problem: Horizontal carriage motion not uniform and smooth. . . . .	.3 - 5

*Table of Contents*

---

Problem: Horizontal carriage does not move or tracking error is diagnosed by  
computer for axis #2. . . . . 3 - 5

**A - Appendix A – Recommended Spare Parts**

---

Headstock Assembly 500-X-297-4 . . . . . A - 1  
Bed Assembly 500-X-269-5 . . . . . A - 1  
Horizontal Carriage Assembly 500-X-281-3 . . . . . A - 1  
Cut-Off Assembly 500-X-268-6 . . . . . A - 1  
Headstock Multi-Spindle Assembly 500-X-305-6 . . . . . A - 1  
Pre-Preg Delivery Assembly 500-X-294-6 . . . . . A - 1  
Tailstock Tension Assembly 500-X-289-7 . . . . . A - 2  
Resin Bath Assembly 005-X-205-18 . . . . . A - 2  
Tensioner Assembly 006-X-022-2,-3 . . . . . A - 2  
Tensioner Compensator Assembly 006-X-081-1,-2 . . . . . A - 2  
Electrical Schematic 300-X-059 . . . . . A - 2  
Tension Schematic 306-X-059 . . . . . A - 3

# 1. General Information

This manual is presented for the use of the personnel owning or operating an EnTec™ PW Series computer controlled filament winding machine. It contains the machine specifications, an introduction and mechanical maintenance instructions. The subject machine is a horizontal filament winding machine with the capability of handling parts up to the capacities outlined in the machine specifications. In addition to this manual, the owner-operator should have available an operation (HyperChain™) manual, a programming (Fiber-Grafix™) manual, and a set of EnTec assembly drawings covering all the assemblies and sub-assemblies of the subject machine. The operator should also have a thorough understanding of the operation of the equipment as the result of instruction from EnTec personnel or qualified owner personnel.

## 1.1. Drawings

### Model PW6H-5S-80-2A

### Serial No. EN010378

<b>I.</b>	<b>Top Assembly</b>	<b>.500-XX-317-3</b>
A.	Bed Assembly	.500-X-269-5
B.	Headstock Assembly	.500-X-297-4
C.	Headstock Multi-Spindle Assembly	.500-X-305-6
	1. Cut-Off Assembly, H.S.	.500-X-268-6
D.	Tailstock Assembly	.500-X-293-1
E.	Tailstock Tension Assembly	.500-X-289-7
F.	Horizontal Carriage Assembly	.500-X-281-3
G.	Wet Delivery System Assembly	.500-X-294-5
H.	Pre-Preg Delivery Assembly	.500-X-294-6
I.	Pneumatic Schematic	.500-X-288-6
J.	Resin Bath Assembly	.005-X-205-18
K.	Creel Assembly	.006-X-046-7
	1. Tensioner Assembly	.006-X-022-2,-3
	2. Tensioner Compensator	.006-X-081-1,-2
	3. Redirect Roller	.074-PX-076-11
<b>II.</b>	<b>Electrical Schematic &amp; Wiring Diagram</b>	<b>.300-X-059</b>
A.	EN250 HC Board	.300-X-009
B.	Tension Schematic	.306-X-059
C.	PWMTC Tension Board	.052-XA-190

## 1.2. Machine Specifications

---

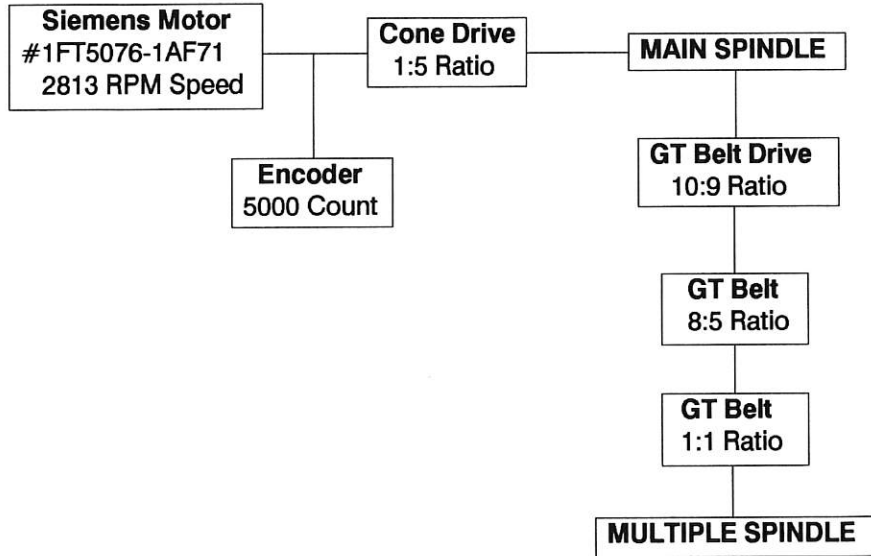
**Model PW6H-5S-80-2A**  
**Serial No. EN010378**

Weight Capacity	20 lbs.
Diameter Capacity	6 inches
Length Capacity	.80 inches
Machine Size	.14 ft. lg. x 6 ft. wide x 8 ft. high
Multiple Spindle Speed	1000 RPM
Carriage Pull Total (Maximum)	100 lbs. (effective roving tension)
Carriage Speed (Maximum)	4 feet/second
Cross Carriage Adjustment	2 inches
Winding Angles	5 to 90 degrees
Winding accuracy at 6 inch diameter (excluding roving and delivery error)	
Helical	.Std. deviation 0.010 inches
Circumferential	.Std. deviation 0.010 inches
Electrical Power	380VYAC, 3 Phase, 10 KVA, 60 Hz, 15A
Air Service	80 psi min., 2 S.C.F.M.
Minimum Service Wire Size	#8 AWG
Tailstock Tension (lb) = Area (in <sup>2</sup> ) X Supply Pressure (psi) = 2.7 X Supply Pressure (psi)	

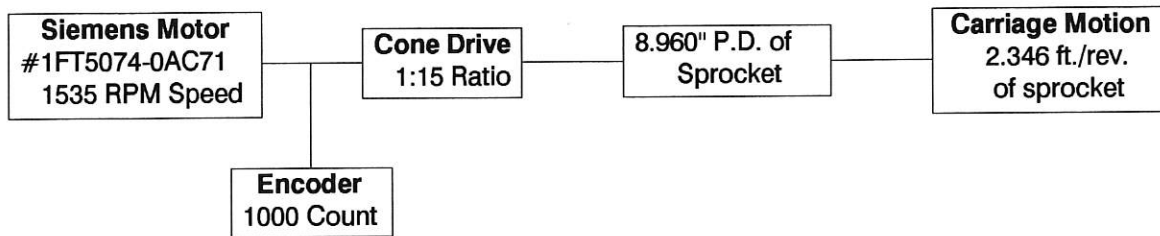


### 1.3. Basic Control Schematic

#### SPINDLE Multi-Spindle 1000 RPM Top Speed



#### HORIZONTAL CARRIAGE 4 ft./sec. Top Speed



## 1.4. Physical Description

---

### 1.4.1. Machine Frame

The top assembly (see Drawing Table for drawing number) shows the location of each of the major sub-assemblies. The basic frame is a steel fabrication and includes a headstock and bed. The horizontal carriage is a steel fabrication also.

### 1.4.2. Operator's Control Panel

The machine is operated from a control panel located on the headstock. The relay control panel and the motor controllers are mounted in the headstock, as is the computer hardware.

### 1.4.3. Power Supply

The spindle of the machine is driven by a brushless DC electric motor. The speed of the motor is regulated by a solid state controller. The carriage speed is controlled by the computer generated error signal. The motor, controller, and amplifier sizes are listed in the specifications.

## 1.5. Basic Functions

---

The filament winding operation requires simultaneous control of at least two axes of motion. It is necessary to control these axes accurately to lay down a band of filaments in a predetermined geometric pattern. The basic motions of the machine are indicated in Figure 1 – 1. These motions are defined as:

Axis #1 – Spindle Rotation

Axis #2 – Carriage Linear Travel

### 1.5.1. Axis #1 – Spindle Rotation

The spindles are rotated by a brushless DC motor-controller set through a gear reducer and belt drives. The spindles are solid steel shafts with a socket to match the customer part.

The speed of the drive motor is controlled by the overall machine speed joystick located on the control panel in conjunction with the computer servo system. The spindle can be operated manually with the spindle **JOG** button.

### **1.5.2. Axis #2 – Horizontal Carriage**

The horizontal carriage drive consists of a brushless DC motor and gear reducer mounted on the bed. The output is a steel chain sprocket driving a chain connected to the carriage. The carriage assembly rides on cam rollers running on a steel way and on ball bushings running on a ball shaft.

The speed of the carriage is controlled by the machine speed and the program in the computer. The length of carriage stroke and carriage dwell are determined by the algorithm for winding.

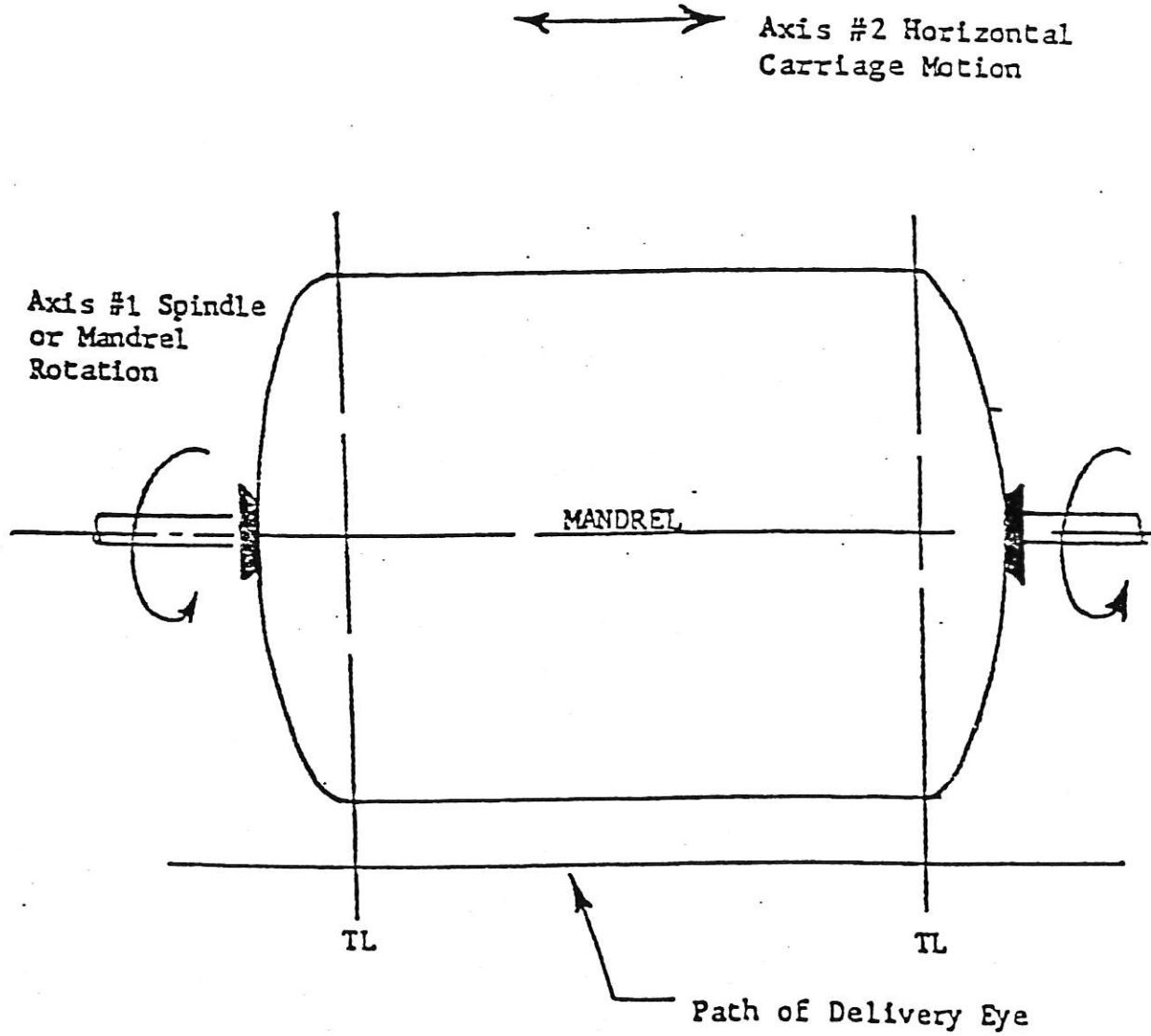
### **1.5.3. Radial Carriage**

The radial carriage is manually adjustable to properly locate the delivery point.

### **1.5.4. Cut-Off Mechanism**

On the multiple spindle arrangement there is a cut-off mechanism for each spindle. This mechanism is a carriage with (5) cutters mounted on it. The cutters are mounted on ball shafts. The carriage is driven by (2) air cylinders. The cylinder in-stroke velocity can be controlled by the speed control on each cylinder. When a blade becomes dull it can be changed by removing the screws holding it in place while the cutting carriage is extended. The blade can be turned around to give an additional cutting surface.

Figure 1-1: Basic Axes of Motion



## **2. Handling, Installation and Setup**

---

### **2.1. Handling**

---

Lifting eyes are provided on each end of the machine. The lift load on these eyes should be vertical, not at an angle. If two overhead cranes are not available, one end of the machine can be put on rollers and the other end lifted and pushed or pulled.

#### **WARNING:**

**WHEN LIFTING, USE THE LIFTING EYES. IF A FORKLIFT IS USED UNDER THE MACHINE, THERE IS A DANGER OF TIPPING THE MACHINE OVER BACKWARDS.**

### **2.2. Installation**

---

When the machine is first installed, several precautions should be taken to ensure proper operation.

#### **2.2.1. General Inspection**

The machine should be inspected for any evidence of physical damage. A claim should be filed with the transit company for any shipping damage evident.

#### **2.2.2. Machine Leveling**

The machine should be supported by a floor of sufficient strength and stiffness for a light machine tool of equivalent size.

Installation should be done using a level to align and level the machine. Leveling screws are provided at the headstock and tailstock end.

Procedure in aligning the machine:

1. Adjust leveling screws in the headstock frame so that all screws support the weight of the machine and the headstock is level in both directions.

2. Using a level along the bed ways, adjust the leveling screws in the tailstock end to level the bed in the longitudinal direction. Make sure that the leveling screws on the bed are both touching the floor to take the weight of the machine. Due to the stiffness of the machine bed, it is not necessary to align the ways vertically. This relationship was held during the manufacture of the machine to maintain a correct alignment between the bed and the headstock.

### **2.2.3. Power Connection**

The electrical power connection must be as listed in the machine specifications at the front of the manual.

## **2.3. Start-Up Procedure**

---

Before attempting to operate the EnTec filament winding machine, the operator should be familiar with the contents of the manuals. Special precautions must be taken when starting this machine to verify proper operation of control systems. This should be done before attempting to run the machine. These precautions are discussed in the operation manual.

Once connected to the specified power source, the power should be turned on and all controls should be checked for proper operation as outlined in the operation manual.

### **CAUTION:**

**INITIAL START UP MUST BE PERFORMED IN THE PROPER ORDER AS OUTLINED. IF THIS PRECAUTION IS NOT TAKEN, INJURY TO THE OPERATOR OR DAMAGE TO THE MACHINE MAY RESULT.**

## **3. Mechanical Maintenance**

---

### **3.1. General Cleanliness**

---

The fundamental aspect for maintenance of a filament winding machine is cleanliness. Proper cleaning and protection of the machine from accumulated glass and resin will avoid many problems.

Application of a release agent to areas subject to resin contamination will ease the cleaning process substantially. Glass fibers should be kept from entangling moving parts such as shafts and support rollers.

Paint used on EnTec machines is a modified epoxy and is resistant to common solvents such as ketones generally used for cleanup.

#### **3.1.1. Control Panel**

The machine control panel should be cleaned thoroughly after each period of usage. It is suggested that a sheet of clear or translucent polyethylene, or similar material, be fastened at the top of the machine so that it will hang down over the front of the control panel to protect the controls from resin during the winding operations. This clear sheet will allow the operator to select and operate the numerous buttons on the control panel without contaminating the controls. Holes may be cut through the sheet for the operation of knobs that are often used. The painted portion of the control panel may be cleaned with any good solvent. Care should be exercised in the cleaning of plastic knobs, pushbuttons and meter faces since the solvents may attack the plastics.

#### **3.1.2. Miscellaneous**

All of the unpainted metal parts on the machine, including the spindle, chuck and tailstock spindle should receive regular and routine maintenance. Clean the metal using a strong solvent and follow with an application of a heavy clean grease. Very satisfactory operation can be obtained using the white colored silicone greases. The grease should be removed as required to carry away any accumulated fibers.

It is imperative that the *Thomson* bearings and shafting and the way used on the horizontal carriage be kept clean at all times. This support mechanism is precision aligned and must be properly maintained. It should be cleaned and lightly oiled to prevent corrosion.

## **3.2. Lubrication**

---

### **3.2.1. Worm Gear Boxes**

The worm gear speed reducers used in the spindle drive and the carriage drive are lubricated by the splash method and require that the oil level be strictly maintained. The oil level should be inspected **at least once monthly**, and should always be examined with the unit stopped.

Oil should be changed after the first two weeks of operation. Thereafter, it should be changed every 2500 hours of operation or every 6 months, whichever occurs first.

Draining should be done after the speed reducers have been operating and the oil is fully warmed up and impurities thoroughly agitated. The drain plug should be removed promptly after the reducer is stopped so that foreign matter does not settle out. **Never** operate the reducer when there is no oil in the housing.

Refill with AGMA #8 compound (see Lubrication Table).

### **3.2.2. Spindle Bearings**

The main spindle shaft is supported by ball bearings. They are prelubricated with grease and must be periodically relubricated to obtain full bearing fatigue life. Relubricate bearings with lithium base grease every 6 to 12 months.

### **3.2.3. Horizontal Carriage Cam Followers**

Inspect the precision shafting on a daily basis to determine need for cleaning and lubrication. This is necessary because of contamination by glass fibers, resins, and/or strong solvents. The cam followers will probably require lubrication at 30 day intervals. Grease fittings are provided on each bearing. It is recommended that the bearings be greased with a lithium base grease.

### **3.2.4. Horizontal Carriage Linear Bearings and Shafting**

The linear bearings and shafting used to support the horizontal carriage must be kept clean at all times. A coat of light oil, SAE 10W, non-detergent should be applied after each cleaning to provide protection from corrosion and to provide lubrication.



### 3.2.5. Summary

All other bearings used in the machine are permanently lubricated and sealed and should not require attention for the life of the bearing. These include:

- 1) multiple spindle bearings
- 2) multiple spindle drive bearings
- 3) motor bearings.

A summary of lubrication requirements is found in Table 3-1.

**Table 3–1: Lubrication Table**

<u>Component</u>	<u>Location</u>	<u>Number</u>	<u>Lubricant</u>	<u>Check &amp; Clean Frequency</u>	<u>Change Or Purge Frequency</u>
Cam Rollers	Horizontal Carr.	6	Lithium base grease	Daily	Monthly
Linear Shafting	Horizontal Carr.	1	SAE 10 wt. non-detergent oil	Monthly	Every 90 days
Gearboxes (Cone Drive)	Headstock & Bed	1	AGMA #8 Compound (See Cone Drive Lubrication List)	Monthly	Every 6 months or 2500 hours
Ball Bearings	Headstock	2	Lithium base grease		Every 6 - 12 months
Ball Shaft Pillow Blocks	Horizontal Carr.	2	Lithium base grease	Monthly	Every 90 days
Carriage Chain	Bed	1	SAE 10 wt. non-detergent oil	Daily	Weekly

### 3.3. Adjustments

---

Very few mechanical adjustments are required on this machine. Proper adjustment of the drive belts was made when the machine was assembled. Changes normally should only be required when it is necessary to compensate for wear or after the installation of new components. These adjustments should be made by qualified personnel.

### **3.3.1. Carriage Chain**

The carriage chain can be tightened (as wear or stretching occurs) in the following manner: Loosen the four bolts holding the sprocket support bracket in position. The chain can then be tightened by turning the tension bolt into its support block. Loosening this bolt will allow the chain to be removed.

## 3.4. Trouble Shooting

---

The following section is for use of personnel doing mechanical maintenance on an EnTec™ series PWHC machine. The information contained herein is not intended to supersede diagnostic information contained in the HyperChain™ Operation Manual. This material is to be used when it is suspected that mechanical problems exist.

### 3.4.1. SPINDLE

#### 3.4.1.1 **Problem: Spindle does not rotate or tracking error is diagnosed by computer on axis #1.**

*Possible Causes and Solutions:*

1. Drive belts loose or broken. Replace or tighten as required.
2. Motor-to-encoder coupling loose or bad. Replace or tighten as required.
3. Bad motor or controller. Refer to pertinent manufacturer's literature for diagnosis and solution.
4. Bad encoder. Replace as required.

### 3.4.2. HORIZONTAL CARRIAGE

#### 3.4.2.1 **Problem: Horizontal carriage motion not uniform and smooth.**

*Possible Causes and Solutions:*

1. Dirt and contaminates on ways. Clean and lubricate as required.
2. Chain loose or dirty. Clean and adjust as required.

#### 3.4.2.2 **Problem: Horizontal carriage does not move or tracking error is diagnosed by computer for axis #2.**

*Possible Causes and Solutions:*

1. Motor-to-encoder coupling loose or bad. Replace or tighten as required.

*Mechanical Maintenance*

---

2. Bad motor or controller. Refer to pertinent manufacturer's literature for diagnosis and solution.
3. Bad encoder. Replace as required.

## **A. Appendix A – Recommended Spare Parts**

---

### **Quantity**

### **Description**

#### **Headstock Assembly 500-X-297-4**

4*	McGill Camrol #CFH-1/2-SB
1*	EnTec Coupling Center #64-P-001-19
2*	EnTec Coupling Spacer #64-P-001-18

#### **Bed Assembly 500-X-269-5**

4*	McGill Camrol #CFH-1/2-SB
1*	EnTec Coupling Center #64-P-001-19
2*	EnTec Coupling Spacer #64-P-001-18

#### **Horizontal Carriage Assembly 500-X-281-3**

6	McGill Camrol #CFH-1-1/2-SB
1	Micro Switch #LSF3K
4	Seal for Thomson Block #SPB-32-OPN

#### **Cut-Off Assembly 500-X-268-6**

100	McMaster-Carr Utility Knife Blades #38755A18
-----	--

#### **Headstock Multi-Spindle Assembly 500-X-305-6**

1	Gates Belt #8M-2400-12
1	Gates Belt #8M-720-21
1	Gates Belt #8M-640-12

#### **Wet Delivery System Assembly 500-X-294-5**

20	Lambertville Ceramic Eyes #244 with 10-24 NC x 2" Shank
----	---

#### **Pre-Preg Delivery Assembly 500-X-294-6**

2	NTN Bearing #R6ZZ
---	-------------------

**Quantity****Description****Tailstock Tension Assembly 500-X-289-7**

5	Parker O-Ring (See Drawing)
10	Parker Parbaks Ring (See Drawing)

**Resin Bath Assembly 005-X-205-18**

2	Fafnir Ball Bearing #S5K
1	Vollrath Stainless Steel Pan #74264

**Tensioner Assembly 006-X-022-2,-3**

1	Placid Industries Brake #B35, Solid Shaft, 24 V
---	---

**Tensioner Compensator Assembly 006-X-081-1,-2**

1	Bourns Potentiometer 2K, 7/8 Dia., #6538S-1-202
---	---

**Electrical Schematic 300-X-059**

1	EnTec EN250HC Open Loop Control Board
1	CH D5PR3A 120V AC 3PDT Relay
1	CTX 1451CLR Part #XA1451-N21 VGA Monitor 14"
3	Gould TRS15 600V 15A Time Delay Fuse
3	Gould FNM5 240V 5A Time Delay Fuse
1	Gould FNM10 240V 10A Time Delay Fuse
1	Heidenhain ROD 426B 5000 Count Encoder
1	Heidenhain ROD 426B 1000 Count Encoder
1	IC&S PC-DI048 48 Digital I/O Board
1	Industrial QM30850TRA 850MB IDE Hard Drive
1	Industrial FD-505 Dual Floppy Drive
1	Industrial SB4862PV/66 486 66MHz w/Video CPU
2	Industrial TMS-10036-60 4MEG 60NS SIMM
1	International IHBB15-1.5 +/-12V 1.5A Power Supply
1	International IHBS-3/0VP 5V 3A Power Supply
1	Micro 2TL1-3 DPDT Toggle Switch
1	Opto22 OAC5
1	Opto22 IAC5 AC Input
1	Opto22 OAC5A5 (NC) AC Output N.C.
1	Opto22 ODC5 DC Output
1	Opto22 IDC5 DC Input
1	P & B KHAU-17A16-120V Relay
1	QTronics KT-30M Serial Keyboard w/mouse

<u>Quantity</u>	<u>Description</u>
1	Siemens 6SN1123-1AA00-0AA0 7.5/15A Power Section
1	Siemens 6SN1123-1AA00-0BA0 12.5/25A Power Section
1	Siemens 6SN1118-0AA11-0AA0 Controller Board
1	Siemens 6SN1119-0AA01-0AA0 Parameter Board
1	Siemens 6SN1145-1AA00-0AA0 10kW I/R Module
3	Siemens 3NA3812 32A/500V Fuse
1	TECH 80 5638 3 Axis Servo Controller
2	Telemecanique ZA2-BZ101 N.O. Contact Block
2	Telemecanique ZA2-BZ102 N.C. Contact Block
1	Telemecanique XD2-PA22 Joystick
1	Telemecanique LCI-D2510-G6-120V Contactor

### **Tension Schematic 306-X-059**

1	EnTec PWMTC Tension Board 52-XA-190
2	Gould FNM5 240V/5A/TD Fuse
1	Lambda LST-39-133 5V/13A +/-12V/4A,1A
1	Lambda LSS-38-24 24V/4.5A
1	ProLog 7831-01 Main CPU
1	ProLog 7402-02 Analog In
1	ProLog 7508 I/O Board
1	Ultra Link #101 Analog Out

This list does not include common hardware items such as fasteners. It is assumed that maintenance personnel have access to such items.

\* These items located on more than one assembly.