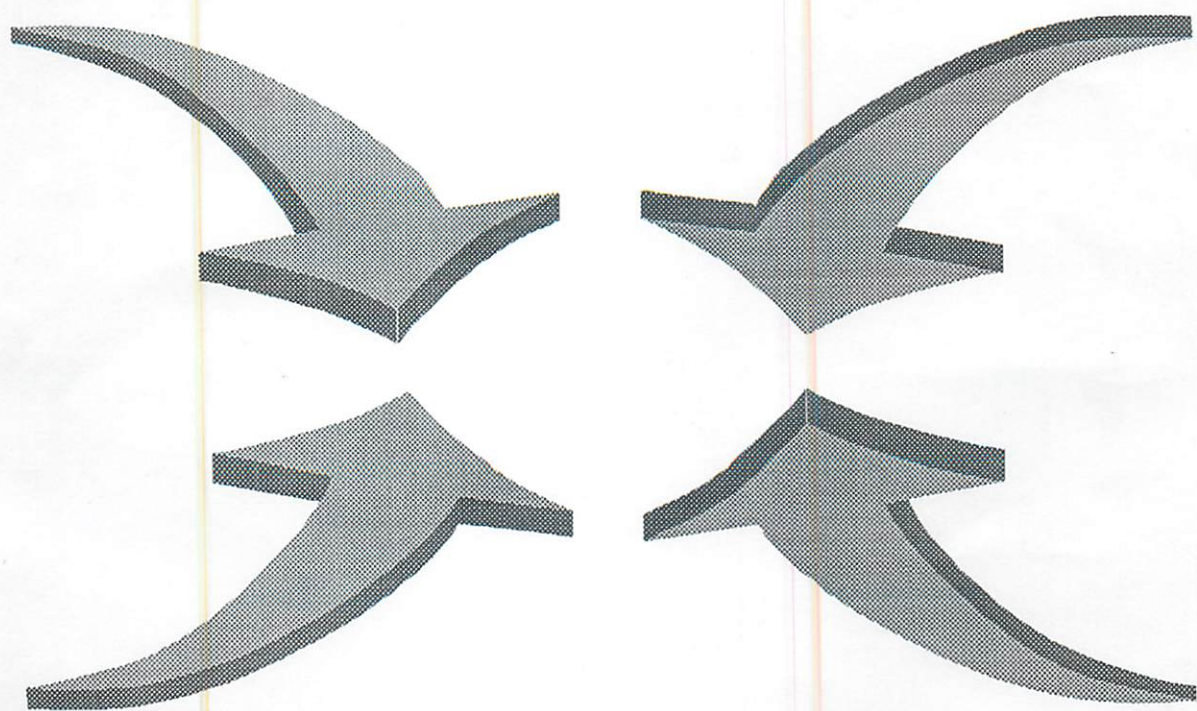


# **Ledco Industrial Series HS-25**

## **“Thoroughbred” Highspeed Laminator**

### **Troubleshooting Guide**



# LEDCO HS-25 "THOROUGHbred" INDUSTRIAL SERIES

## LAMINATOR PROBLEM DIAGNOSTIC CHARTS

Problem	Possible Cause	Repair Procedure	Procedure Number	Skill Level
Laminator will not heat up, top and/or bottom heat on/off switches do not illuminate when engaged.	No power.	Check power cord.	1	*
		Check master power switch position.	2	*
	Heat system fuse(s) blown.	Check heat system fuses. (locations "X", "Y", and "T" in wiring diagram)	3	*
		Replace heat system fuse(s).	3	*
		Check for wires that are disconnected, broken or shorting out.	4	*
Top or bottom heat control does not illuminate with heat switch engaged.	Master power switch failure.	Check master power switch.	5	**
		Replace master power switch.	5	***
	Heat switch failure.	Check for wires that are disconnected, broken or shorting out.	4	*
		Check heat switch.	6	**
		Replace heat switch.	6	**
Top or bottom heat shoe does not heat up with heat switch engaged and controls illuminated.	Heat control failure.	Check for wires that are disconnected, broken or shorting out.	4	*
		Check heat control.	7	**
		Replace heat control.	7	**
	Heat control temperature set too low.	Raise temperature to proper setting for respective films.		*
	Emergency stop switch(s) engaged.	Check E-stop switch position.		*
	Emergency stop switch failure.	Check E-stop switch(s).	8	**
		Replace E-stop switch(s)	8	**
	Heater fuse(s) blown.	Check heater fuses. (locations "X" and "Y" in wiring diagram)	3	*
		Replace heater fuse(s).	3	*

Skill Level Index: \* Basic, End-User \*\* Intermediate or Dealer \*\*\* Advanced or Servicing Dealer/Technician



# LEDCO HS-25 "THOROUGHbred" INDUSTRIAL SERIES

## LAMINATOR PROBLEM DIAGNOSTIC CHARTS

Problem	Possible Cause	Repair Procedure	Procedure Number	Skill Level
Top or bottom heat shoe does not heat up with heat switch engaged and controls illuminated.	Thermocouple (heat sensor) failure.	Check for wires that are disconnected, broken or shorting out.	4	*
		Check thermocouple.	10	**
		Replace thermocouple.	10	**
	Heat relay failure.	Check for wires that are disconnected, broken or shorting out.	3	*
		Check heat relay(s)	11	**
		Replace heat relay(s)	11	**
	Cartridge heater failure.	Check for wires that are disconnected, broken or shorting out	3	*
		Check cartridge heater.	9	**
		Replace cartridge heater.	9	**
Heat control(s) upper display shows "□ □ □"	Thermocouple wires disconnected or loose.	Check thermocouple wires, plugs and receptacles.	10	*
	Thermocouple failure.	Replace thermocouple.	10	**
Laminator heat cannot be controlled.	Thermocouple failure.	Check thermocouple wires, plugs and receptacles.	10	*
		Replace thermocouple.	10	**
	Heat relay failure.	Check heat relay(s).	11	**
		Replace heat relay(s).	11	**
Laminating rollers do not operate.	No power.	Check power cord.	1	*
		Check master power switch position	2	*
		Check emergency stop switch(s) position.	8	*
		Check drive on/off switch position	12	*
		Check forward/reverse switch position	13	*
		Check speed control potentiometer (knob & dial) position.	14	*

Skill Level Index: \* Basic,End-User \*\* Intermediate or Dealer \*\*\* Advanced or Servicing Dealer/Technician

# LEDCO HS-25 "THOROUGHbred" INDUSTRIAL SERIES LAMINATOR PROBLEM DIAGNOSTIC CHARTS

Problem	Possible Cause	Repair Procedure	Procedure Number	Skill Level
Laminating rollers do not operate.	Drive motor control 8 amp fuse(s) blown.	Check motor control 8 amp fuse(s).	15	*
		Replace 8 amp fuse(s).	15	*
	Emergency stop switch failure.	Check E-stop switch(s).	8	**
		Replace E-stop switch(s).	8	**
	Drive switch failure.	Check drive switch.	12	*
		Replace drive switch.	12	**
	Forward/reverse selector switch failure.	Check forward/reverse selector switch.	13	**
		Replace forward/reverse selector switch.	13	**
	Drive motor control board failure.	Check drive motor control board.	16	**
		Replace drive motor control board.	16	**
	Speed dial potentiometer failure.	Check speed dial potentiometer.	14	**
		Replace speed dial potentiometer.	14	**
	Drive motor failure.	Check drive motor.	17	**
		Replace drive motor.	17	***
No reverse drive	Drivetrain mechanical failure.	Check drive chains.	18	*
		Check drive sprockets.	19	*
		Replace drive motor.	17	***
	Forward/reverse selector switch failure.	Replace selector switch.	13	**
	Drivetrain failure.	Check drive chain.	18	*
		Check drive sprockets.	19	*
	Film "wrap-around".	Clear minor "wrap-around".	20	*
		Clear "wrap-around" of front laminating rolls.	21	*
		Clear "wrap-around" of rear laminating rolls.	22	**

Skill Level Index: \* Basic, End-User \*\* Intermediate or Dealer \*\*\* Advanced or Servicing Dealer/Technician

# LEDCO HS-25 "THOROUGHbred" INDUSTRIAL SERIES

## LAMINATOR PROBLEM DIAGNOSTIC CHARTS

Problem	Possible Cause	Repair Procedure	Procedure Number	Skill Level
Laminating rollers operate intermittently, sometimes with a clunking, skipping or grinding noise.		Clear "wrap-around" by removing and cleaning or replacing rolls.	23	***
	Drive motor gear failure.	Replace drive motor.	17	***
Cooling fans do not operate.	No power.	Check power cord, and main power switch position	1	*
	Fan switch failure.	Check fan switch.	24	**
		Replace fan switch.	24	**
	Fan motor failure.	Check cooling fans.	25	**
		Replace fan motor(s).	26	***
The lamination has wrinkles.	Item being laminated has been folded, rolled, bent or wrinkled.	Smooth item on feed table as it is being laminated.		
	Laminating two pieces of unequal thickness side by side.	Only laminate items of the same thickness side by side.		
	Thicker material causes wrinkles on each side.	This is normal. Trim off material with wrinkles.		
	Inadequate supply roll tension.	Add tension to take wrinkles out of film before it gets past the heat shoes.		
		Check supply roll gripper rods.	27	*
		Check supply roll hex adaptor spring pin position.	28	*
	Improper rubber roll pressure.	Check rubber roll dwell line.	29	*
		Adjust rubber rolls.	30	**
		Replace rubber rolls.	23	***
The film does not adhere to the document.	Thicker documents absorb the heat.	Run at a higher temperature not to exceed 340 degrees.		
	Thin (1.5 mil) films lose heat from heat shoe to the roller nip.	Run at higher temperature increase speed slightly.		
	Thicker media, such as mounting boards, not absorbing enough heat.	Reduce speed.		

Skill Level Index: \* Basic,End-User \*\* Intermediate or Dealer \*\*\* Advanced or Servicing Dealer/Technician



# LEDCO HS-25 "THOROUGHbred" INDUSTRIAL SERIES

## LAMINATOR PROBLEM DIAGNOSTIC CHARTS

Problem	Possible Cause	Repair Procedure	Procedure Number	Skill Level
The lamination has wrinkles.	Film between heat shoe and nip cool while idle.	Run a few inches of film before inserting sheets to be laminated.		
	Inkjet print still wet.	Let inkjet prints dry at least 2 hours.		
	Incompatible Inkjet print media and inks.	Test samples before laminating many pieces.		
Lamination has a repeating crescent shaped wrinkle or pocket (usually from the center out).	Leading edge of document contacting top or bottom web of film before the nip.	Make sure the document remains flat when feeding it into the nip.		
	Excessive laminating roll pressure.	Check rubber roll dwell line.	29	**
		Adjust rubber rolls.	30	
	Worn rollers.	Check rubber roll dwell line.	29	*
		Adjust rubber rolls.	30	**
		Replace rubber rolls.	23	**
Lamination has wavy, rippling, almost "boat wake" like appearance.	Excessive heat.	Reduce heat.		
	Inadequate chill roll contact.	Increase chill roll contact angle.		
		Check chill roll mechanism components.	31	**
		Replace chill roll mechanism component(s).	31	**
	Laminating too slow causing prolonged heat exposure of document at the nip.	Increase laminating speed.		
Film shrinks as it passes over heat shoe.	Excessive supply roll tension.	Reduce supply roll tension.		
	Excessive heat.	Reduce heat.		
Laminated item has "oily" spot near the leading edge.	Excess adhesive is created when machine left hot and idles for a few minutes.	Run a few inches of film before inserting sheets to be laminated.		

Skill Level Index: \* Basic,End-User \*\* Intermediate or Dealer \*\*\* Advanced or Servicing Dealer/Technician

# LEDCO HS-25 "THOROUGHbred" INDUSTRIAL SERIES LAMINATOR PROBLEM DIAGNOSTIC CHARTS

Problem	Possible Cause	Repair Procedure	Procedure Number	Skill Level
Milky, hazy line appears after initial warm-up.	Rollers not evenly heated.	When warming up the machine, keep the rollers open and moving slowly.		
The machine squeals when laminating	Dirty heat shoes.	Clean heat shoes.		
	Excessive heat.	Reduce heat.		
	Excessive supply roll tension.	Reduce supply roll tension.		
	Coating on film.	Try different type or different brand of film.		
Laminated item has pitted, irregular surface.	Adhesive build-up or dirt on rollers.	Clean the rollers.		
	Cuts or other damage to the rubber rollers.	Replace rubber rolls.	23	***
General haziness or cloudiness in film after lamination.	Not enough heat.	Increase the temperature.		
Bubbles in the center of the web and/or film not sticking to center.	Excessive laminating roll pressure.	Adjust rubber rolls.	30	**
	Worn rollers.	Check rubber roll dwell line.	29	*
		Adjust rubber rolls.	30	**
		Replace rubber rolls.	23	***
Slitters not penetrating film web.	Slitter blades not engaged.	Engage slitter blades.		*
	Slitter blades dull.	Replace slitter blades.	32	*
	Slitter assembly component failure.	Check slitter assembly components.	33	*
		Adjust/replace slitter assembly component(s).	34	**
Slitter head (knife holder and blade assembly) drifts during operation.	Slitter head internal threads worn excessively or stripped.	Replace slitter head.	34	*
	Slitter adjustment (threaded) rod(s) excessively worn or damaged.	Replace adjustment rod(s).	34	**
Slitter head difficult to adjust side to side.	Slitter adjustment (threaded) rod(s) excessively worn or damaged.	Replace adjustment rod(s).	34	**

Skill Level Index: \* Basic,End-User \*\* Intermediate or Dealer \*\*\* Advanced or Servicing Dealer/Technician



## LEDCO HS-25 "THOROUGHbred" INDUSTRIAL SERIES LAMINATOR PROBLEM DIAGNOSTIC CHARTS

Problem	Possible Cause	Repair Procedure	Procedure Number	Skill Level
Slit edges of web have scalloped, frayed or wavy appearance.	Slitter blades dull.	Replace slitter blades.	32	*
	Web not sufficiently cooled before slitting.	Be sure to run cooling fans.		*
		Be sure to sufficiently engage chill rolls.		**
	Pull rollers excessively worn or out of adjustment.	Adjust rubber rolls.	30	**
		Replace rubber rolls.	23	***

Skill Level Index: \* Basic,End-User \*\* Intermediate or Dealer \*\*\* Advanced or Servicing Dealer/Technician



## LEDCO HD25 INDUSTRIAL SERIES LAMINATOR REPAIR PROCEDURES

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### Replace thermocouple(s).

To replace thermocouple(s), you must first remove the respective heat shoe assembly from the machine as described in Section 8 above.

- a. Place heat shoe assembly(s) on a level work surface. Be careful not to scratch teflon coating.
  - b. Carefully slit the outermost layer of heat shrink tubing that encases the heater wires, ground wire, and the thermocouple wires. Separate the respective sets of wires.
  - c. Locate the small hole on the back side of the heat shoe in which the wire ring end of the thermocouple resides. Note the length of aluminum channel that retains the t-couple wire in the back side of the shoe.
  - d. Using a phillips head screwdriver, loosen and remove the 8-32 x 1/4" round head phillips screw that secures the wire ring end to the interior of the shoe, gently tap out the aluminum retaining channel with a hammering device and small punch, and remove the failed thermocouple.
  - e. Replace with new, reassemble in exact reverse order, and rewire exactly as shown in wiring diagram.
- 

### 11. Check heat relay(s).

- a. Disconnect power cord.
- b. Open left side housing door as described in 3 above.
- c. Locate and identify heat system relays(locations "B" and "D" in wiring diagram) and respective wiring.
- d. Visually check for any wires that are disconnected, broken, or shorting out. Reconnect or replace wires exactly as shown in wiring diagram.

\*\*\*WARNING\*\*\*WARNING\*\*\*WARNING\*\*\*WARNING\*\*\*

EXTREME CAUTION MUST BE USED WHEN TESTING ANY MACHINERY  
WHERE LIVE VOLTAGE(ESPECIALLY 220) IS PRESENT. ONLY A QUALIFIED  
SERVICE TECH OR ELECTRICIAN SHOULD PERFORM SUCH TESTS.

- e. Plug the machine in and turn on the master power switch.
- f. Turn on either top or bottom heat switch. The corresponding heat relays should make an audible clicking sound and you should see the small reset tabs on the side of the relays retract. If this is not happening, chances are the relay(s) is faulty.
- g. To thoroughly check the relay with a multimeter, start by setting your meter at volts AC and put one probe on terminal 1 and the other probe on terminal 0 of the relay. With the heat switch engaged there should be a reading of approximately 220 volts at these terminals(provided the circuitry in line before it is functioning properly).
- h. With the proper 220 volts coming into the relay, check for proper 220 volts coming out of the relay that powers the heaters by placing one probe on terminal 4 and the other probe on terminal 6 of the relay(the heater wire lead terminals). Again(with the machine plugged in, master power switch on) engage the heat switch. The relay should then engage and show 220 volts out of these terminals. If not, for certain the relay is faulty and should be replaced(Part#PRR231).

### Replace heat relay(s).

- a. Follow steps a,b,c as detailed above.
- b. Disconnect all wire leads to relay making careful notes of their location(use wiring diagram for reference).
- c. Using a small straight blade screwdriver, gently pry apart the snap fit brackets that secure the relays to the base of the housing.
- d. Remove faulty relay, replace with new, reassemble in exact reverse order, and rewire exactly as shown in schematic.

NOTE: Diagnostic, repair, and replacement procedures are exactly the same for top and bottom heat relays

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## LEDCO HD25 INDUSTRIAL SERIES LAMINATOR REPAIR PROCEDURES

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### 12. Check drive on/off switch position.

- a. Switch should be in the up, or "I", position (the switch should illuminate green when engaged).

#### Check drive switch.

- a. **Disconnect power cord.**
- b. Remove left side housing cover to access electrical components and wiring within as described in 3 above.
- c. Locate and identify the motor drive on/off switch (location "Q" in the wiring diagram). Visually check for any wires that are disconnected, broken, or shorting out. Reconnect or replace wires exactly as shown in wiring diagram.
- d. Using a multimeter set to check continuity, place your probes on terminals 5 and 6 of the heat switch (the two outermost terminals, one is silver, one is slanted gold).
- e. With the switch engaged there should be a positive continuity reading, if not the switch is faulty and should be replaced (Part # PRS310).

#### Replace drive switch.

- a. **Disconnect power cord.**
  - b. To replace switch, carefully remove the wires and connectors from the back of the switch making careful note of their locations as to reconnect them correctly later.
  - c. Firmly depress the small tabs at the sides of the switch and pull the switch out of the front of the housing.
  - d. Replace with new, reassemble in exact reverse order and rewire as shown in wiring schematic.
- 

### 13. Check forward/reverse switch position.

- a. The three position forward/reverse switch should be in the Forward, or up, position.

#### Check forward/reverse switch.

- a. **Disconnect power cord.**
- b. Remove left side housing cover to access electrical components and wiring within as described in 3 above.
- c. Locate and identify the forward/reverse switch (location "M" in the wiring diagram), and respective wire terminals and leads. Visually check for any wires that are disconnected, broken, or shorting out. Reconnect or replace wires exactly as shown in wiring diagram.
- d. Using a multimeter set to check continuity and looking at the back of the switch, place one probe on the left center terminal and the other probe on the lower left terminal at the back of the forward/reverse switch. Flip the switch up to the "forward" position. You should get continuity at these checkpoints.
- e. Consequently, with the switch still in the "forward" position, place a probe on the center right terminal and the other on the lower right terminal, you should have continuity here as well.
- f. Next, place a probe on the left center terminal and the other on the upper left terminal. Flip the switch down to the "reverse" position. You should get continuity at these checkpoints.
- g. Consequently, with the switch still in the "reverse" position, place a probe on the center right terminal and the other on the upper right terminal, you should have continuity here as well.
- h. If there is not continuity reading at any of these checkpoints, the switch has most likely failed and should be replaced (Part # PRS 312).

#### Replace forward/reverse selector switch.

- a. **Disconnect power cord.**
  - b. Remove left side housing cover to access electrical components and wiring within as described in 3 above.
  - c. Locate and identify the forward/reverse switch (location "M" in the wiring diagram), and respective wire leads and connectors. Follow the wire leads to their respective quick connectors and disconnect them there. Make careful note of the pairings and location of the wires as to reconnect them correctly later.
  - d. Firmly depress the small plastic tabs on the body of the switch and push the switch forward through the front of the housing.
  - e. Replace with new, reassemble in exact reverse order and rewire exactly as shown in wiring diagram. Rewire exactly as shown in schematic.
-



# LEDCO HD25 INDUSTRIAL SERIES LAMINATOR REPAIR PROCEDURES

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## 14. Check speed control potentiometer(knob and dial) position.

- a. Speed control must be set past 0 on the dial to engage motor drive.

### Check speed dial potentiometer.

- a. **Disconnect power cord.**
- b. Remove left side housing cover to access electrical components and wiring within as described in 3 above.
- c. Locate and identify speed dial potentiometer (location "L" in wiring diagram) and respective yellow, orange, and gray wire leads.
- d. Locate and identify the motor control board (location "Q" in the wiring diagram), and respective wire terminals and leads. Note the gray, yellow, and orange wires that come from the speed dial potentiometer and connect to terminals S1, S2, and S3 respectively on the motor control board.
- e. Disconnect the yellow wire and the orange wire of the speed dial from their respective terminals (S2 and S3) on the motor control board and place your multimeter probes in the quick-connect ends of these wires. Set the multimeter to read ohms resistance.
- f. With the pot set at zero (all the way counter clockwise), you should get a resistance reading of approximately 10.00 k ohms, gradually decreasing in resistance as you increase the speed dial (turning clockwise) to wide open.
- g. At wide open you should get a resistance reading of approximately 00.0 ohms.  
If the meter shows open or closed circuit, or if there is resistance but it does not change when rotating the potentiometer, the potentiometer is bad and should be replaced (ref Part# PRM218A).

### To replace speed dial potentiometer.

- a. **Follow steps "a" thru "e" as detailed above.**
- b. Disconnect the gray, yellow and orange wires of the potentiometer from their respective terminals on the motor control board.
- c. Using a small straight blade screwdriver, loosen the small screw that secures the speed dial knob to the shaft of the potentiometer and remove the knob.
- d. Using a small adjustable wrench, loosen and remove the retaining nut that secures the potentiometer to the face of the housing.
- e. Remove failed potentiometer and wires, replace with new, pre-wired potentiometer. Reassemble in exact reverse order and rewire exactly as shown in the schematic.

---

## 15. Check motor control 8 amp fuse(s).

- a. **Disconnect power cord.**
- b. Remove left side housing cover to access electrical components and wiring within as described in 3 above. Locate and identify the drive system 8 amp fuses (locations "V" and "W" in wiring diagram). Visually check for any wires that are disconnected, broken, or shorting out. Reconnect or replace wires exactly as shown in wiring diagram.
- c. Visually inspect the fuse. If a fuse appears discolored and/or the element inside is broken, it has most likely failed and should be replaced with the exact same amperage fuse.
- d. If after initial inspection you are still unsure of the status of the fuse, you can use a multimeter to check its continuity. If the fuse shows no continuity, it has failed and should be replaced with the exact same amperage fuse.

### Replace motor control 8 amp fuse(s).

- a. Gently extract the old fuse from the fuse holder(standard) and install new one.

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## 16. Check drive motor control board.

- a. **Disconnect power cord.**
- b. Remove left side housing cover to access electrical components and wiring within as described in 3 above.
- c. Locate and identify the motor control board (location "S" in the wiring diagram), and respective wire terminals and leads. Visually check for any wires that are disconnected, broken, or shorting out. Re-connect or replace wires exactly as shown in wiring diagram.
- d. Plug the machine in and turn on the master power switch.



# LEDCO HD25 INDUSTRIAL SERIES LAMINATOR REPAIR PROCEDURES

**\*\*\*WARNING\*\*\*WARNING\*\*\*WARNING\*\*\*WARNING\*\*\***

**EXTREME CAUTION MUST BE USED WHEN TESTING ANY MACHINERY WHERE LIVE VOLTAGE (ESPECIALLY 220) IS PRESENT. ONLY A QUALIFIED SERVICE TECH OR ELECTRICIAN SHOULD PERFORM SUCH TESTS.**

- e. With your multimeter set to read Volts DC, place one probe on terminal A1 and the other probe on terminal A2 of the motor control board.
- f. Engage the motor drive on/off switch. With the speed dial potentiometer at lowest (counter-clockwise) setting, you should have 0 volts on the meter. As you turn the speed dial potentiometer slowly clockwise, you should get a gradual increase in voltage.
- g. With the speed dial potentiometer at highest (clockwise) setting, you should get between 180 to 186 volts on the meter.
- h. If no voltage is present, the motor control is faulty and should be replaced (Part# PRM 218A).
- i. If the prescribed range of voltage is present and there is still no motor drive, the drive motor may be faulty.

**Replace motor control board.**

- a. Follow steps 1,2,3 as detailed above.
- b. Disconnect all wire leads to the board making careful notes of their location (use wiring diagram for reference).
- c. Using a phillips head screwdriver, loosen and remove the 4, 8-32 truss head phillips screws that secure the motor control board to the side panel.
- d. Remove failed board, replace with new. Reassemble in exact reverse order and rewire exactly as shown in schematic.

**Check drive motor.**

- a. Disconnect power cord.
- b. Remove left side housing cover to access electrical components and wiring within as described in 3 above.
- c. Locate and identify the forward/reverse switch (location "M" in the wiring diagram), and respective wire terminals and leads. Visually check for any wires that are disconnected, broken or shorting out. Pay particular attention to the two center leads and wires that are connected to the red and black motor wire leads at their white plastic cap connectors. Reconnect or replace wires exactly as shown in wiring diagram.

**\*\*\* WARNING\*\*\*WARNING\*\*\*WARNING\*\*\*WARNING\*\*\***

**EXTREME CAUTION MUST BE USED WHEN TESTING ANY MACHINERY WHERE LIVE VOLTAGE (ESPECIALLY 220) IS PRESENT. ONLY A QUALIFIED SERVICE TECH OR ELECTRICIAN SHOULD PERFORM SUCH TESTS.**

- d. Plug in the machine, turn on the master power switch.
- e. With your multimeter set to read Volts DC, place one probe on the right, center terminal and the other probe on the left, center terminal of the forward/reverse switch.
- f. With the forward/reverse switch set to forward and the speed potentiometer set at 0, engage the motor drive on/off switch.
- g. With the potentiometer set at 0, there should be a voltage reading of near 0. As you rotate the speed dial clockwise, the voltage will gradually increase to the maximum of 180 volts. If the prescribed range of voltage is present and there is still no motor drive, the drive motor has failed and should be replaced (Part#PRM 2000).

# LEDCO HD25 INDUSTRIAL SERIES LAMINATOR REPAIR PROCEDURES

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## Replace drive motor.

- a. **Disconnect power cord.**
- b. Remove left side housing cover to access electrical components and wiring within as described in 3 above.
- c. Locate and identify the forward/reverse switch (location "M" in the wiring diagram), and respective wire leads and connectors. Follow the two center terminal wire leads to their respective quick connectors to the red and black motor wire leads and disconnect them there making note of their positions for correct reconnection later.
- d. Remove right side housing cover to access drive chain, sprockets, and respective shafts within as described previously in section 9.
- e. On the right side, using a 5/32 and a 3/16 allen wrench, loosen and remove both inside and outside idler blocks and idler sprockets. This will allow you to slip the chains off the motor sprockets.
- f. With the chains removed from the motor, use a 1/8" allen wrench to remove the inner and outer motor sprockets. The sprockets have woodruff keys so don't lose them.
- g. Once you've removed the sprockets from the motor shaft, use a 5/32 allen wrench to loosen and remove the four 1/4 28 button head allen bolts that secure the drive motor to the side panel. Support the motor from underneath as you carefully remove it from the machine.
- h. Replace with new drive motor (Part# PRM 2000) reassemble in exact reverse order paying particular attention to sprocket placement and chain tension (again use the chain and sprocket routing diagram at the back of this guide as reference). Rewire the motor exactly as shown in schematic.

**NOTE:** When re-installing drive motor sprockets, make sure they are in line with the other respective sprockets, parallel to the side panel. Also, make final chain tension adjustments with the rubber rolls in the closed and locked position, with an allowance of 3/16" to 1/4" play in the drive chains.

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## 18. Check drive chains.

- a. **Disconnect power cord.**
  - b. Remove right side housing cover to access drive chain, sprockets, and respective shafts within as described previously in section 9.
  - c. Visually inspect the upper and lower drive chains. Use the chain and sprocket routing diagram at the back of this guide for reference.
  - d. If a connecting link is missing or damaged, replace the connecting link (Part# PRC 084).
  - e. If a drive chain is damaged, replace with proper length drive chain (Part # PRC083.1). You can remove and install chains using the procedures described in "17" above or totally disconnect chains at their connecting links and reconnecting new chain in similar fashion.
- 

## 19. Check drive sprockets.

- a. **Disconnect power cord.**
  - b. Remove right side housing cover to access drive chain, sprockets, and respective shafts within as described previously in section 9.
  - c. Visually inspect the drive sprockets as well as the idler sprockets. Use the chain and sprocket routing diagram at the back of this guide for reference.
- If a sprocket is not tight on its shaft:**
- a. Check drive sprockets to be sure they have the small, half moon shaped woodruff key in place. If the key is missing or damaged, replace with new (Part# M161KEY for the motor sprockets, Part# PRX347 all other sprockets).
  - b. With the woodruff key properly in place, align the sprocket and drive chain 1 and 3/4" from the side panel for the outer, lower chain. Align the inner, upper chain and respective sprockets 1" from the side panel.
  - c. Tighten drive sprockets to their respective shafts with a 1/8" allen wrench.
  - d. Tighten any loose idler sprocket mounting, shoulder bolts using a 3/16" allen wrench.
- If a sprocket is broken or excessively worn, it must be replaced:**
- a. Remove the chain at the connecting link.
  - b. Remove the sprocket (and respective woodruff keys) and replace with new.
  - c. Align and reassemble in exact reverse order. Refer to previous section for alignment and tension adjustments.
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## LEDCO HD25 INDUSTRIAL SERIES LAMINATOR REPAIR PROCEDURES

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### 20. Clear minor "wrap-around".

- a. Visually check all four rolls for any film "wrap-around" or foreign objects.
- b. Carefully remove foreign objects.
- c. If a "wrap-around" occurs while the laminator is cold, open the rolls, reverse the direction of the rubber rolls, permitting the laminator to release the film from the rolls.
- d. If a "wrap-around" occurs while the laminator is hot:

**WARNING: Be very careful not to touch the heat shoes when the machine is hot.**

- (1.) Leave the heat on so that the adhesive does not harden.
  - (2.) Remove the feed tray.
  - (3.) Cut the film on the top and bottom, just in front of the idler bars.
  - (4.) Loosen the film from the heat shoes and grip the two loose ends, holding them together.
  - (5.) Open the rolls
  - (6.) Turn the selector switch to the reverse position and slowly allow the laminator to back out the film that is wrapped around the rolls. Pull the film off the roller.
- 

### 21. Clear "wrap-around" of front laminating rolls.

- a. Swing away top heat shoe to gain greater access to top front rubber roller.
- b. Remove feed tray.
- c. Open the rolls.
- d. Create a loose end of film and use reverse to unwind "wrap-around". There is enough room behind the laminating rolls to grasp a loose end of film as well if need be.

**NOTE:** It may be necessary to remove the chain and sprockets from the drive side to allow unrestricted rotation of the rolls. See sections 9, 17 and 19 above for procedures.

\*\*\* It is very important to thoroughly clean the rolls and heat shoes of any accumulated adhesive as a result of a wrap around to lessen the chance of it happening again in the future\*\*\*

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### 22. Clear "wrap-around" of rear laminating rolls.

- a. Open the rolls.
- b. Create a free end of film and manually pull film off rollers.
- c. To gain greater access to the rear pull rollers, take a phillips head screwdriver and remove the four small phillips head screws that secure the rear roller anti-wrap shield to its mounting brackets. Gently, but firmly, lift up and away the anti-wrap shield from the rear rolls to fully expose them for ease of maintenance.

**NOTE:** It may be necessary to remove the chain and sprockets from the drive side to allow unrestricted rotation of the rolls. See sections 9, 17 and 19 above for procedures.

\*\*\* It is very important to thoroughly clean the rolls and heat shoes of any accumulated adhesive as a result of a wrap around to lessen the chance of it happening again in the future\*\*\*

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### 23. Clear "wrap-around" by removing and cleaning or replacing rolls.

To remove the rubber rollers:

- a. **Disconnect power cord.**
- b. Open the front laminating rollers then put the rear pull rollers in the down, but not locked, position.
- c. Remove both right and left side housing covers as described previously.

**To remove front/laminating rolls:**

- a. On the right side, using a 5/32 and a 3/16 allen wrench, loosen and remove both inside and outside idler blocks and idler sprockets.
- b. Using a 1/8" allen wrench, loosen the set screws that secure the top and bottom front laminating roll sprockets to their respective shafts. Remove the sprockets (note the sprockets are keyed, don't lose the keys or you'll be pissed when you can't find them later).



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- c. On the left side, using a 3/16 allen wrench, loosen and remove the black stop collars from the top and bottom laminating rolls. Remove any and all spacer rings making careful note of their positions for proper reassembly later.
- d. On the right side, using a 1/4" allen wrench, loosen and remove the large shoulder bolts that hold the cam follower mounting plate to the side panel, follower plate and follower. On the left side, use a 1/8" allen wrench to remove the 1/2" stop collar and washer from cam shaft, then remove the left side cam follower mounting plate and follower the same as right side.
- e. Temporarily attach the bottom laminating roller to the top using cable ties (or something similar) around journal ends on both sides of rolls.
- f. Use a 3/32" allen wrench to remove the right side cam, then pull out cam shaft from left side of machine while supporting the bottom idler assembly from the front of the machine (Note: middle idler is directly supported by the cam shaft, be careful when removing the bottom idler assembly from machine).
- g. While bottom roll is still suspended, use a phillips head screwdriver to remove the pan head screws visible just below the the rubber roll bearings in both sides of the bottom heat shoe brackets.
- h. Remove cable ties connecting bottom roll to top rubber roll letting journals of bottom roll rest on the edge of the large keyholes in side panels.
- i. Remove remaining two screws from both sides of bottom heat shoe brackets, remove oilite flange bearings, roller bearings, and thin spacer rings from both journals.
- j. Remove the bottom laminating roller by lifting up and sliding out thru the large "keyholes" in the side panels.
- k. Now have someone support the top laminating roller while you gently tap the right and left side rubber roll journal, sealed roller bearings from their location in the respective side panels. They can only move outward. Make careful note of all bushings and spacers on the journals and their positions, *before* you lose them, for proper reassembly later.
- l. You can now gently lower the roll and slide it out thru the key holes.
- m. If the "wrap-around" prevents the roll from fitting through the opening, some of the film must be removed **being very careful not to damage the rolls.**
- n. After the rolls are removed, remove any remaining film and clean the rolls thoroughly.
- o. If rolls are damaged, they must be replaced (Part# ID25-040.4).

Reassemble in exact reverse order of disassembly. Use the chain and sprocket routing diagrams at the back of this guide as a reference.

### To remove rear/pull rolls:

- a. On the right side, using a 5/32 and a 3/16 allen wrench, loosen and remove both inside and outside idler blocks and idler sprockets.
- b. To gain access to the rear pull rollers, take a phillips head screwdriver and remove the four small phillips head screws that secure the rear roller anti-wrap shield to its mounting brackets. Gently but firmly lift up and away the anti-wrap shield from the rear rolls to fully expose them for ease of maintenance.
- c. Using a 1/8" allen wrench, loosen the set screws that secure the top and bottom rear/pull roll sprockets to their respective shafts. Remove the sprockets (remember the sprockets are keyed, so don't lose the keys because this whole procedure is a big enough cluster as it is).
- d. On the left side, using a 1/8 allen wrench, loosen and remove the chrome 1/2" stop collars from the top and bottom pull rolls. Remove any and all spacer rings making careful note of their positions for proper reassembly later.
- e. Carefully slide the right and left connecting plate assemblies off their respective cams and rubber roll journal ends. There is no need to loosen the pressure springs to perform this task.
- f. You can now lift the top rear/pull roll up and out of the machine through the keyholes in the side panels. Make careful note of the brass bushings on the journal ends of the roll for proper reassembly later.
- g. Gently tap out the bottom roll journal sealed bearings the same as you did for the front rolls. Slide them off the ends of the roll.
- h. You can now slide the bottom pull roll up and out of the keyholes in the side panel. Again make careful note of any and all spacer rings and/or bushings on the ends of the rolls for proper reassembly later.
- i. If the "wrap-around" prevents the roll from fitting through the opening, some of the film must be removed **being very careful not to damage the rolls.**
- j. After the rolls are removed, remove any remaining film and clean the rolls thoroughly.
- k. If rolls are damaged, they must be replaced (Part # H500-040.4).

Reassemble in exact reverse order of disassembly. Use the chain and sprocket routing diagrams at the back of this guide as a reference.

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**\*\*\*** In the unlikely event of a film wrap around on the chill rolls:

- a. **Disconnect power cord.**
- b. Carefully trim the web of film directly in front of and behind the chill rolls. Be careful not to nick the rolls.
- c. Turn the chill rolls to the perpendicular, open position.
- d. Grasp a free end of the laminate and manually pull it off and out of the chill rolls.
- e. If the laminate has melted to the chill rolls (unlikely) or some dummy has cut or otherwise heinously damaged the rolls (likely), it may be necessary to remove and replace the chill rolls. Please refer to Section 31 of this guide to proceed.

**Check fan switch.**

- a. **Disconnect power cord.**
- b. Remove left side housing cover to access electrical components and wiring within as described in 3 above.
- c. Locate and identify the fan switch and wire leads (location "N" in wiring diagram).
- d. Using a multimeter set to check continuity, place the probes on the outermost terminals of the switch (terminals 5 and 6 on the back of the switch).
- e. There should be continuity at these checkpoints when engaging the switch. Disengaging the switch should break continuity.
- f. If this check yields negative results, the switch has failed and should be replaced (Part# PRS 310).
- g. If the switch has continuity, but does not light up under power, check the 20 amp neutral fuse (location "T" in wiring diagram) and replace it if the fuse has blown (part # PRF 138).

**To replace fan switch:**

- a. **Disconnect power cord.**
- b. Remove left side housing cover to access electrical components and wiring within as described in 3 above.
- c. Locate fan switch and respective wire leads (location "N" in wiring diagram).
- d. Carefully disconnect the wire leads from the back of the switch making note of their locations for proper reconnection later.
- e. Remove the switch from the back of the housing by gently but firmly depressing the small retaining tabs at the top and bottom edges of the switch and pull the switch out of the face of the housing.
- f. Replace with new, reassemble in exact reverse order and rewire exactly as shown in wiring diagram.

**5. Check cooling fan motor(s).**

- a. **Disconnect power cord.**
- b. Remove left side housing cover to access electrical components and wiring within as described in 3 above.
- c. Locate the fan motors (upper fan motors location "R" in diagram, lower fan motor location "S" in diagram, and the chill roll fan motor that for some strange reason hasn't been denoted in the wiring diagram) and their respective wire leads.
- d. Visually check for any wires that are disconnected, broken, or shorting out. Reconnect or replace wires exactly as shown in wiring diagram.
- e. As the three fan motor groups are all wired into the same twist lock receptacle, it should be fairly easy to determine if an individual fan motor has failed, or if it's the receptacle or plug that's hosed.

**\*\*\*WARNING\*\*\*WARNING\*\*\*WARNING\*\*\*WARNING\*\*\***

**EXTREME CAUTION MUST BE USED WHEN TESTING ANY MACHINERY WHERE LIVE VOLTAGE (ESPECIALLY 220) IS PRESENT. ONLY A QUALIFIED SERVICE TECH OR ELECTRICIAN SHOULD PERFORM SUCH TESTS.**

# LEDCO HD25 INDUSTRIAL SERIES LAMINATOR REPAIR PROCEDURES

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- f. Note where the upper fan assembly plugs into its receptacle on the left side panel. To the inside of this receptacle is where you can test for proper voltage coming into the receptacle. However if any of the fan motors are working in any of the three fan assembly groups, there is proper voltage present and a voltage check is unnecessary.
  - g. If you absolutely feel the need to check the voltage at the receptacle, you can do so by using a multimeter set to volts AC, and placing the probes on the upper and lower terminals of the receptacle (black and white wire leads respectively). **Use extreme caution when checking for 220 volts, See above.**
  - h. With the machine plugged in, the main power switch on, and the fan switch engaged, you should get a reading of approximately 220 volts AC. If a fan does not function with proper voltage present, it has failed and should be replaced (Part # PRF 111 for the upper and lower assembly fans and HS30 185.4 for the larger, chill roll fan).
- 

## 26. Replace fan motor.

- a. **Disconnect power cord.**
- b. Remove left side housing cover to access electrical components and wiring within as described in 3 above.
- c. Locate the fan motors (upper fan motors location "R" in diagram, lower fan motors location "S" in diagram, and the chill roll fan motor that for some strange reason hasn't been denoted in the wiring diagram) and their respective wire leads.
- d. Once you have determined which fan motor has failed, proceed as follows.....

### ***For Chill Roll Fan Motor:***

- a. Disconnect the fan motor wire leads from their respective terminals at the back of the fan motor receptacle (near location "S" in wiring diagram) using a small straight blade screwdriver. Make careful note of all wire locations for correct rewiring later.
- b. Using a phillips head screwdriver, loosen and remove the two 1/4-20 trusshead screws that secures the two stand-offs, mounting bracket, and fan motor to the left side panel. Carefully remove the assembly from the machine.
- c. Loosen and remove the two 10-32 button head allen screws that secure the fan motor to the mounting brackets. Disconnect the two wire leads from the fan motor and save them for rewiring later.
- d. Replace with new fan motor, reassemble in exact reverse order and rewire exactly as shown in wiring diagram (part # HS30 185.4).

### ***For Upper Assembly Fan Motors:***

- a. Unplug the upper fan assembly twist lock plug from its receptacle in the left side panel. Carefully lift the three fans and their mounting brackets up and out of the machine and place them on a level working surface.
- b. Determine which fan motor needs replacing and locate and identify its individual respective wire leads. Visually check for any wires that are disconnected, broken, or shorting out. Reconnect or replace wires exactly as shown in wiring diagram. In the event of damaged wires and/or connectors, it is advisable to replace the entire wiring harness for the upper fan assembly.
- c. Using a phillips head screwdriver and a small adjustable wrench, loosen and remove the small hex nut that secures the ground wire ring terminal to the fan chassis. Then carefully pull the two quick connects from their small terminals next to the ground wire.
- d. Replace with new fan motor, reassemble in exact reverse order and rewire exactly as shown in wiring diagram (part # PRF 111).

### ***For Lower Assembly Fan Motors:***

- a. Determine which fan motor needs replacing and from underneath the machine, locate and identify its individual respective wire leads and connectors. Visually check for any wires that are disconnected, broken, or shorting out. Reconnect or replace wires exactly as shown in the wiring diagram.
  - b. Using a phillips head screwdriver and a small adjustable wrench, loosen and remove the small hex nut that secures the ground wire ring terminal to the fan chassis. Then carefully pull the two quick connects from their small terminals next to the ground wire.
  - c. Again using a small phillips head screwdriver, loosen and remove the 4 truss head allen screws that secure the fan motor finger guard and the fan motor itself to the top of the top motor cover. Be careful not to let the detached fan motor fall to the floor or on your foot.
  - d. Replace with new fan motor, reassemble in exact reverse order and rewire exactly as shown in wiring diagram (part # PRF 111).
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## 9. Check supply roll gripper rods.

- a. Check to see if the three supply roll gripper rods that run the width of the supply rolls are not bent, damaged, or overly loose.
  - b. If damaged or missing, replace it (Part# H500-021.4).
  - c. Occasionally the cardboard cores of the laminating films run slightly larger than 3" resulting in the roll of film slipping on the supply roll, not getting enough tension and resulting in wrinkles in the finished lamination. To alleviate this, try wrapping some masking tape around intermittent sections of the gripper rods (thereby slightly increasing the overall gripping diameter). Also heat shrink tubing can be used in the same fashion.
- 

## 10. Check supply roll hex adaptor spring pin.

- a. The supply roll hex adaptor, located to the inside of the tension knob and spring, is held in place on just one end of each respective supply roll by a split drive pin. This pin is located inside a small, milled slot.
  - b. This pin should never be all the way to the right or left of the inside of this slot as you will have no remaining range of tension adjustment from one side to the other.
  - c. The best technique for initial supply roll tension setting is to loosen the tension knobs so they are just touching the tension springs, making note to keep the hex adaptor drive pin fairly centered in its' slot, then three to four hand turns of tension on one side then the same amount of turns on the other side.
  - d. If the hex adaptor spring pin is sheared or missing, it will have to be replaced (drive the remainder of the sheared pin out with a center punch and replace with new 1/8 x 3/4" split drive pin).
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## 11. Check rubber roll dwell line.

- a. Create a "dwell line". The "dwell line" is the imprint the front laminating rolls leave in the web of a threaded and heated laminating machine after being stationary for 90 seconds.
  - b. Thread the laminator with a good quality film.
  - c. Warm up the laminator.
  - d. After the laminator is warm, run a short length of film and stop the drive motor for at least 90 seconds.
  - e. Advance the film 12 to 15 inches and look at the impression the laminating rollers left on the film.
  - f. This impression, "dwell line", should be two parallel lines running the full width of the film measuring approximately 1/4" to 5/16" in width.
    - (1.) If the dwell line is very narrow, the rubber roll pressure may not be great enough to grip and pull the film taut, resulting in wrinkles in the web that can't be corrected with supply roll tension.
    - (2.) If the dwell line is over 3/8" wide, there may be too much pressure resulting in shifting of the film towards the path of least resistance, adding wrinkling in the area with less pressure.
    - (3.) If the dwell line is narrow on one side and much wider on the other, the roll pressure is not adjusted correctly, contributing to wrinkling problems.
    - (4.) If the dwell line has an hour glass appearance (wide on both ends and much narrower in the middle), there is either too much pressure on both ends or the rubber rolls could be worn excessively.
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## 12. Adjust rubber rolls.

### To adjust front laminating rolls:

- a. Disconnect power cord.
- b. Open both right and left side housing as described in 3 above.
- c. Locate the front laminating rolls, their journal ends, and pressure related components thereof.
- d. Locate the brass cam follower plates, mounting plates, springs and 5/16 18 x 1" pressure set screws therein.
- e. With the rolls engaged, loosen (turn counter clockwise) the pressure set screws so they are flush with the bottom edge of the brass cam follower plate.
- g. Using your 5/32 allen wrench, turn the pressure set screws clockwise 5 half turns into the body of the brass cam follower plate.
- h. Repeat this procedure for both the right and left sides to return the pressure settings to factory specs.

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## To adjust rear pull rolls:

- a. **Disconnect power cord.**
  - b. Open both right and left side housing as described in 3 above.
  - c. Locate the rear pull rolls, their journal ends, connecting plates, pressure springs and bolts thereof.
  - d. Using a 3/16 allen wrench, loosen the cap head pressure bolts that run thru the pressure springs so they are just barely touching the top of the springs with the bottom shoulder of the bolts.
  - e. Now turn the bolts 3 full turns clockwise to return them to factory specs.
- 

## 31. Check chill roll mechanism components.

- a. **Disconnect power cord.**
- b. Open both right and left side housing as described in 3 above.
- c. Locate chill rolls and related mechanism components.
- d. First examine the large black chill roll handle and make sure that it is held secure to the chill roll rotational shaft via the 10-32 x 3/8" set screw located in the hub of the handle. Use a 1/8" allen wrench to tighten the set screw into the small milled spot face in the shaft.
- e. Next examine the sprockets and chain on both sides of the chill roll assembly. Make sure the set screws in the sprockets are tight to their respective shafts. If a sprocket has broken or missing teeth or shows signs of excessive wear, it should be replaced (part # PRS 357).  
*NOTE: The sprockets are timed from side to side, be sure they are aligned properly when secured in place on their respective shaft ends.*
- f. Check the chains for excessive wear and/or broken or missing links. Replace as needed (part # PRC 083 for chain, PRC 084 for connecting link).

## Replace chill roll mechanism component(s).

- a. **Disconnect power cord.**
  - b. Open both right and left side housing as described in 3 above.
  - c. Locate chill rolls and related mechanism components.
  - d. On the left side of the machine use a phillips head screwdriver to remove the two 8-32x1/2" truss head phillips screws that secure the fan mounting bracket to the respective standoffs. Carefully lower the fan down and to the side.
  - e. Remove the chain by disconnecting it at the master link.
  - f. Using a 9/64" allen wrench, loosen and remove the 8-32x1/2" cap head bolts that secure the three small roller bearings (part #'s PRB140 and insert # PRS230) to the side panel. These bearings secure chill roll actuator disk (part # ID25 192.4) to the side panel. Respective parts are identical on both sides.
  - g. By carefully removing the actuator disk and dowel pins from the chill roll and needle bearings assembly, you can now slide the chill rolls (part # ID25 145.4 and needle bearings [PRB 073]) out of left side of the machine for replacement of the rolls and/or other components.
  - h. Reassemble all components in exact reverse order.
- 

## 32. Replace slitter blades.

- a. **Disconnect power cord.**
  - b. Locate slitter heads and blade assemblies. Visually inspect for excessive wear or damage.
  - c. Replace blades by loosening the thumb screws that secure the slitter blade to the slitter head.
  - d. Remove the old blade and rotate it if the second cutting edge is still good. If not, replace the blade with new (Part# PRB031). Reassemble in exact reverse order.
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## 33. Check slitter assembly components.

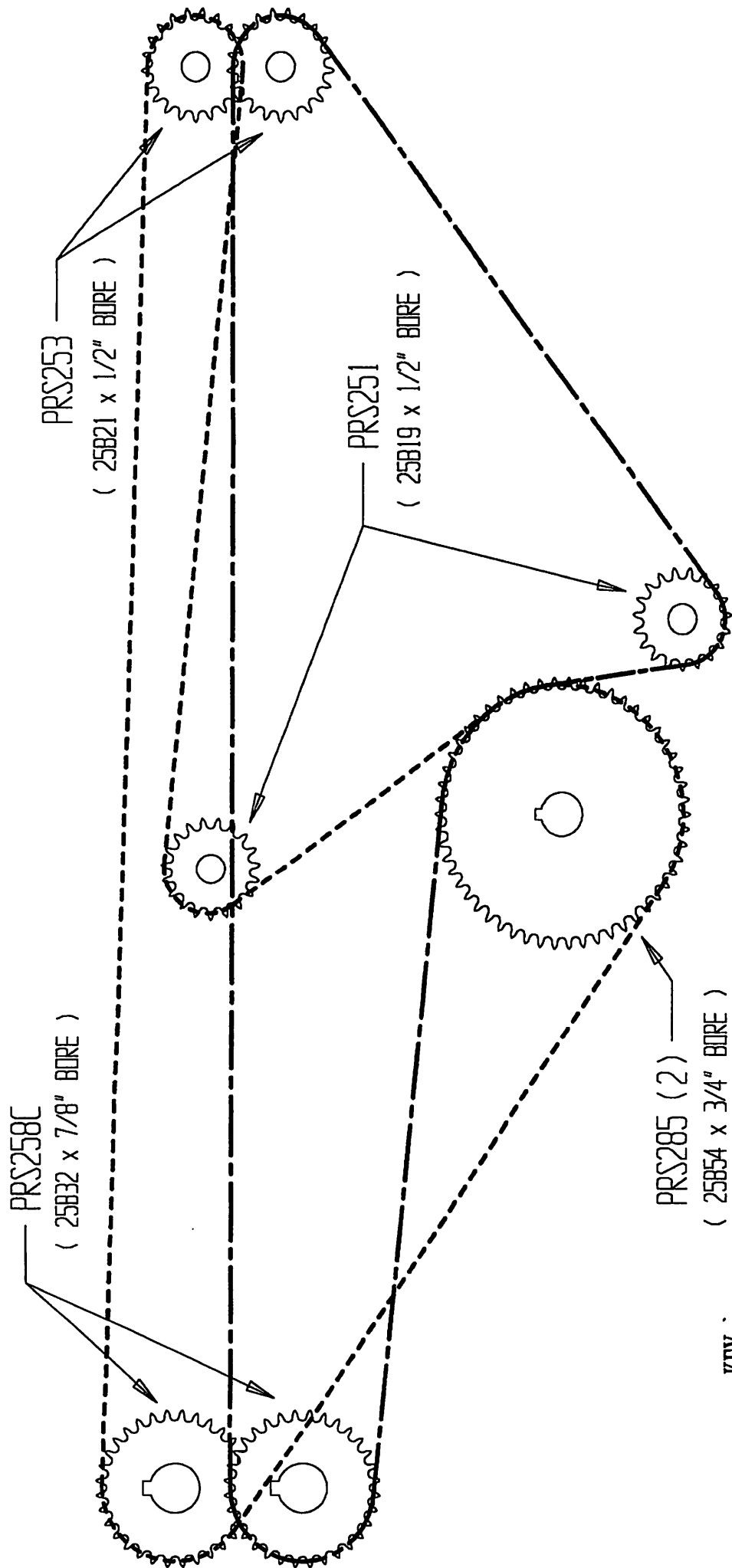
- a. **Disconnect power cord.**
  - b. Open both right and left side housings as described in 3 above.
  - c. On the left side housing inspect the slitter control cable, making sure it is not broken, loose, or kinked.
  - d. Check the cable actuating disk and standoff to make sure they are not broken or loose.
  - e. Inspect the actuating shaft (the 1/2" diameter shaft that runs the width of the machine and is engaged up and down by the cable, actuating disk and standoff) to make sure they're not broken or loose.
  - f. Inspect the slitter adjustment (threaded) rods for excessive wear or damage, as well as the slitter head internal threaded insert.
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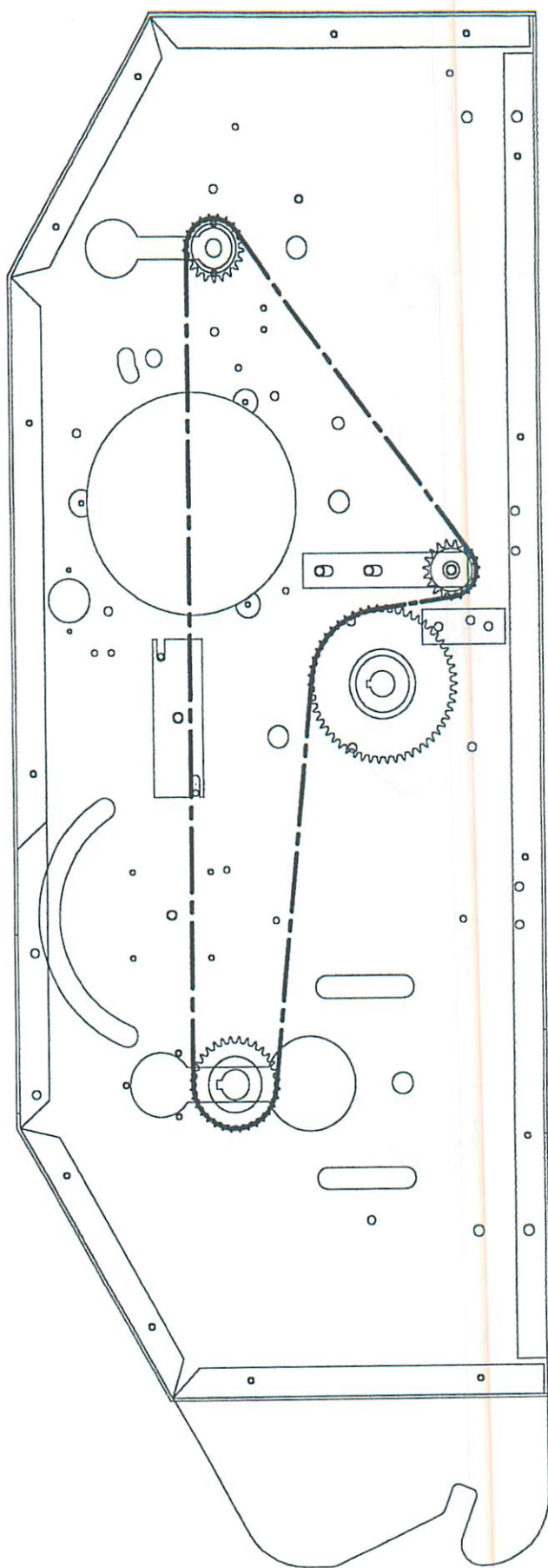
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- . Adjust/replace slitter assembly component(s).
  - a. Disconnect power cord.
  - b. Open both right and left side housings as described in 3 above.
  - c. The slitter control cable (part# PRC 089) is secured to the inside of the left housing by a thin, 1/2" hex nut. Use a small adjustable wrench to tighten.
  - d. The cable runs thru the slitter cable clamp (part #'s H380 182.4 & 183.4) and is secured there by two cap head allen bolts. Use a 5/32 allen wrench to tighten.
  - e. The cable is secured to the actuating disk (part# ID25 074.4) by the threaded standoff (part # PRS359) and cap head screw. Use a 7/64" allen wrench and small adjustable wrench when adjusting or removing these parts.
  - f. The slitter actuating disks are in turn secured to the actuating shaft (part# ID25 73.4) by 10-32 button head allen screws. Use a 1/8" allen wrench to loosen when adjusting or replacing the actuating disks.
  - g. The black plastic handwheels (part # PRK190) that you had to remove to get to the insides of the machine are held in place with 10-32 x 3/16" set screws. Adjust or replace using a 3/32" allen wrench.
  - h. The threaded slitter adjustment rods run thru the actuating disks thru the side panels and are joined in the center using a 1/4 x 1 1/2" dowel pin as a pivot. The adjustment rods are secured to the side panels by 1/2" stop collars. Loosen and/or remove these stop collars with a 1/8" allen wrench.
  - i. You can now remove and replace the slitter knife holders and nuts (part #'s ID25 186.4 and ID25 188.4 respectively) by pulling gently outward to disconnect the center pin and turn the respective adjustment rods counter clockwise till the slitter knife holders are screwed off the inside ends of the adjustment shafts.
  - j. As described in "f" above, loosen and remove the actuating shaft to facilitate the unobstructed removal and replacement of the slitter knife holders and related components.
  - k. Remove and replace respective components as needed and reassemble in exact reverse order.

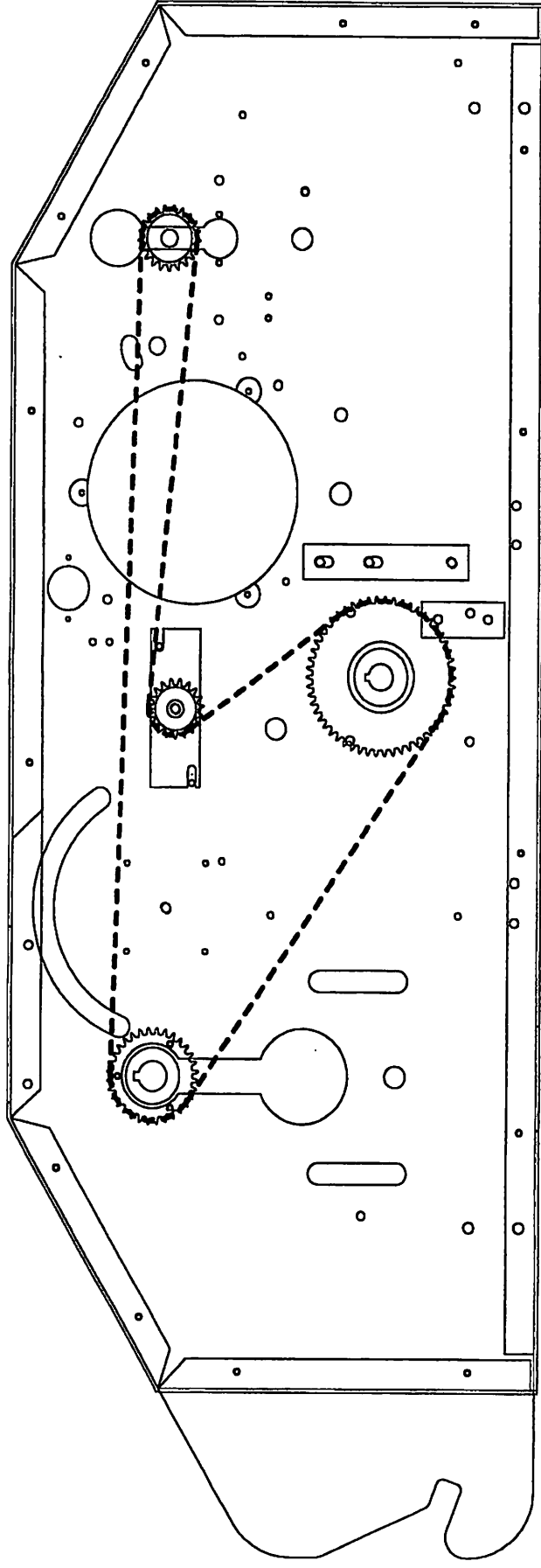


# HS25 CHAIN ROUTING





HS25 OUTSIDE ( BOTTOM ) CHAIN ROUTING



HS25 INSIDE ( TOP ) CHAIN ROUTING