

THROUGH-HOLE COPPER PLATING USING THE LPKF CONTAC S4

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1 Purpose

This SOP describes the standard workflow for through-hole copper plating of a **double-sided or multi-layer printed circuit board (PCB)** using the LPKF Contac S4. It also describes optional chemical tin plating after copper plating.

The procedure covers:

- Preparing and mounting the drilled PCB
- Selecting the appropriate Contac S4 process profile
- Cleaning, conditioning, activation, and active cleaning
- Reverse-pulse copper plating
- Optional tin plating
- Normal shutdown and selected operator-level special tasks

2 Scope

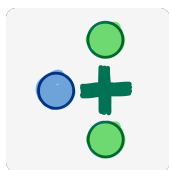
This SOP is intended for trained users in the Rodgers RLE Laboratory processing prototype circuit boards for research use.

The Contac S4 may be used to plate drilled holes with a minimum diameter of approximately 0.2 mm and a maximum hole aspect ratio of 1:8, provided the PCB and chemistry are otherwise compatible with the system. The maximum PCB size is 200 mm × 300 mm.

This SOP does not replace the chemical safety data sheets or the complete LPKF operating instructions. It does not cover filling new chemical baths, replacing spent chemistry, repair, electrical service, or other maintenance reserved for Rodgers Lab staff or LPKF service personnel. Please see Rodgers Lab staff for advice beyond this SOP.

3 Required Materials and Equipment

- LPKF Contac S4 with correctly filled and serviceable process tanks



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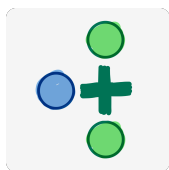
- Drilled double-sided or multilayer PCB
- Contac S4 PCB holder
- Spray bottle filled with de-ionized water
- Sink or approved rinse station
- Clean tap water or de-ionized water, as directed by Rodgers Lab staff
- Soft cleaning brush
- Non-woven polishing pad, when tin plating
- Warm-air dryer or hair dryer
- Oil-free compressed air, if used for drying or clearing holes
- Teflon or glass-fiber stirring rod, as appropriate
- Approved chemical-waste containers

4 Required PPE

Wear the following whenever operating the Contac S4 or handling a PCB that has entered a chemical bath:

- Splash goggles
- Chemical-resistant gloves selected according to the applicable safety data sheet
- Closed work clothing or laboratory coat
- Closed-toe shoes

Use heat-resistant gloves if handling components that may be hot. Replace gloves immediately if torn, contaminated internally, or otherwise compromised.



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5 Safety

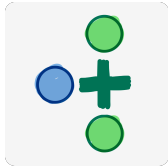
- Only trained personnel may operate the Contac S4.
- Read the safety data sheets for all process chemicals before beginning work.
- Operate the system only in the approved, well-ventilated location.
- Avoid all skin and eye contact with process chemistry and do not inhale fumes.
- Do not eat or drink in the work area.
- Do not reach into or grasp the motorized frame while it is moving.
- Keep all tanks covered whenever they are not actively in use.
- Prevent cross-contamination between tanks, particularly Tank 3, the activation bath.
- Never add water to Tank 3 to compensate for evaporation. See Rodgers Lab staff.
- Do not discharge process chemistry or copper-bearing rinse water into a drain unless the approved treatment and disposal procedure specifically permits it.
- Clean spilled liquid according to the applicable safety data sheet and notify Rodgers Lab staff immediately.

If liquid reaches an electrical component, switch off and disconnect the system. Do not restart it. Notify Rodgers Lab staff.

Tank 1 operates at approximately 60 °C. Avoid contact with the heated liquid. The electrical contact between the PCB holder and Tank 5 may also become hot if the holder is loose or the contact surface is dirty.

6 Process Overview

The standard copper-plating sequence is:



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Prepare PCB → Tank 1: Clean → Tank 2: Condition → Tank 3: Activate → Tank 4: Active Clean → Tank 5: Copper Plate

Optional tin plating uses a separate profile and includes surface preparation in Tank 4 followed by tin deposition in Tank 6.

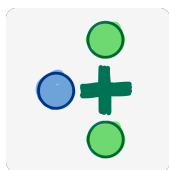
The touchscreen prompts the operator through the selected profile. Follow the sequence in this SOP while also observing any active touchscreen instructions.

7 Pre-Use Inspection and Setup

Before switching on the system, verify:

- Room temperature is between 20 and 25 °C.
- Tank 1 is filled to the proper level.
- All tank covers are in place and correctly seated.
- No foreign material or visible contamination is present in the tanks.
- Copper sulfate crystals at the rim of Tank 5 or on its anodes have been returned carefully to the copper-plating solution.
- The PCB holder and its Tank 5 electrical contact surfaces are clean.
- A spray bottle filled with de-ionized water is beside the system.
- The rinse station, cleaning brush, warm-air dryer, and waste containers are ready.
- The drilled PCB is clean, structurally complete, and compatible with the selected process.

Do not proceed if a bath appears contaminated, depleted, incorrectly filled, or otherwise abnormal. Notify Rodgers Lab staff.



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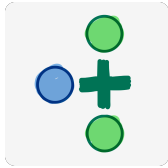
8 Starting the System and Selecting a Profile

8.1 Switch On the Contac S4

1. Move the main switch on the right side of the system to **I**.
2. Press and hold the On/Off button for at least two seconds.
3. Follow the instructions on the touchscreen.
4. Allow Tank 1 to heat. Do not begin the Tank 1 cleaning step until the display reaches 60 °C.



Figure 1: Main switch in the On position.



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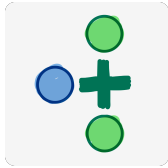


Figure 2: Contac S4 On/Off button.

8.2 Select the Process Profile

1. Open the touchscreen main menu.
2. Select **Profiles**.
3. Select the profile appropriate for the PCB and desired process.
4. For the standard through-hole copper-plating sequence in this SOP, select **Copper Plating Profile** unless Rodgers Lab staff has provided a validated custom profile.
5. Confirm that the selected profile is displayed in the process view before continuing.

Profile dimensions are used to calculate the copper-plating current. Do not use a custom profile for a board size substantially different from the dimensions stored in that profile.



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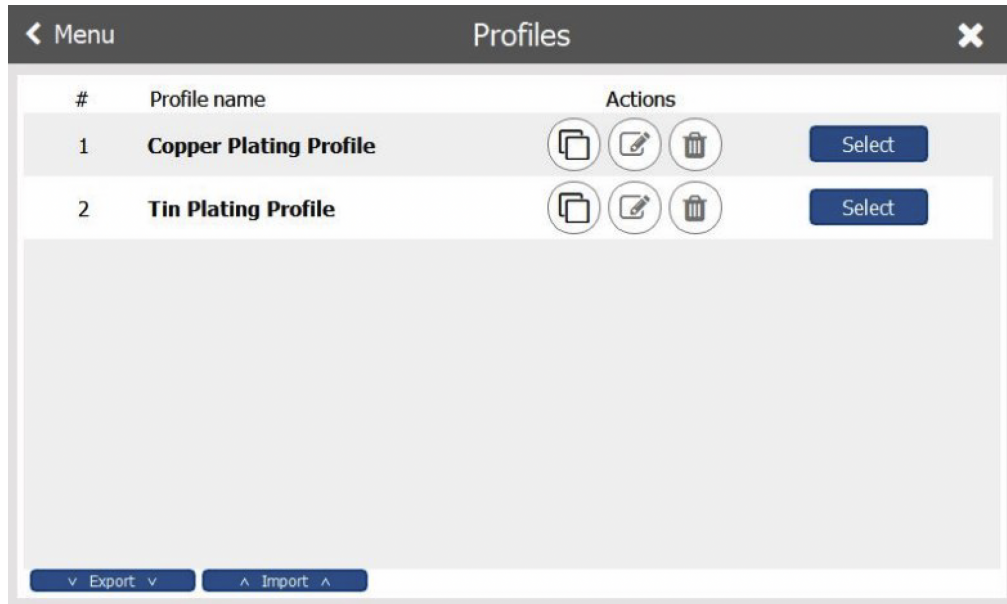
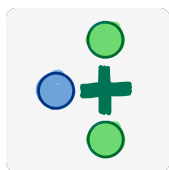


Figure 3: Selecting the appropriate process profile.

9 Preparing and Mounting the PCB

1. Loosen the two side screws on the PCB holder sufficiently to insert the PCB.
2. Center the PCB in the holder.
3. Tighten the side screws until the PCB is held securely. Do not overtighten or damage the board.
4. Rinse the PCB for at least 30 seconds with clean water.
5. Inspect the drilled holes for chips, burrs, or trapped debris. Clean as needed before beginning the chemical sequence.

Contamination on the inside clamping surfaces of the PCB holder can impair copper plating. Clean these surfaces with a coarse sponge and water when necessary.



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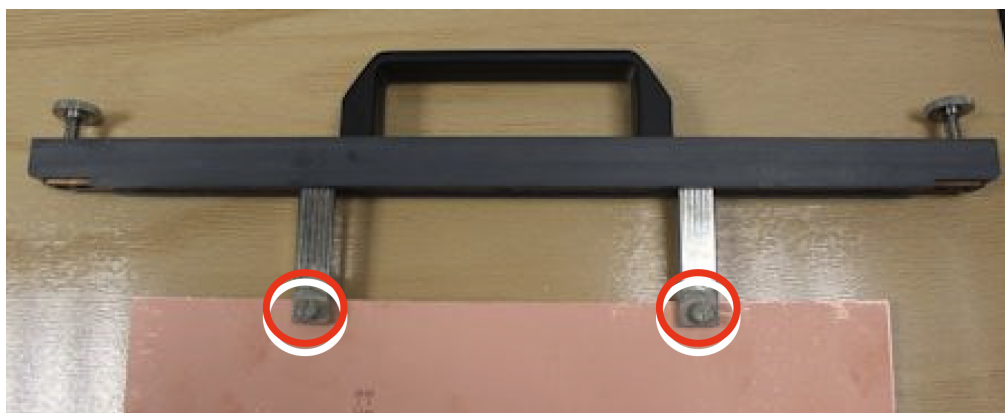
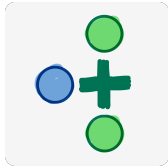


Figure 4: PCB-holder side screws.



Figure 5: Rinse the mounted PCB for at least 30 seconds before processing.



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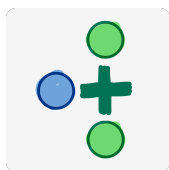
10 Copper-Plating Procedure

For each tank, remove the cover only immediately before use and place it in the provided cover-holder slot. Replace the cover as soon as the PCB is removed.

When installing the holder, ensure that the pins at the edge of the tank enter the openings in the PCB holder. Tighten the knurled screws by hand before starting the step.

10.1 Tank 1: Cleaning

1. Wait until Tank 1 reaches 60 °C.
2. Remove the Tank 1 cover and place it in the cover-holder slot.
3. Insert the mounted PCB into Tank 1. Confirm that the tank pins engage the holder openings.
4. Lift the front edge of the PCB holder approximately 3 cm and knock it gently down against the frame 8–10 times. This dislodges air bubbles from the drilled holes.
5. Set the holder down on the pins again, and hand-tighten both knurled screws.
6. Start the displayed Tank 1 step and allow the programmed time to finish.
7. Loosen the knurled screws and remove the PCB holder.
8. Replace the Tank 1 cover.
9. Rinse the PCB for at least 30 seconds with water.



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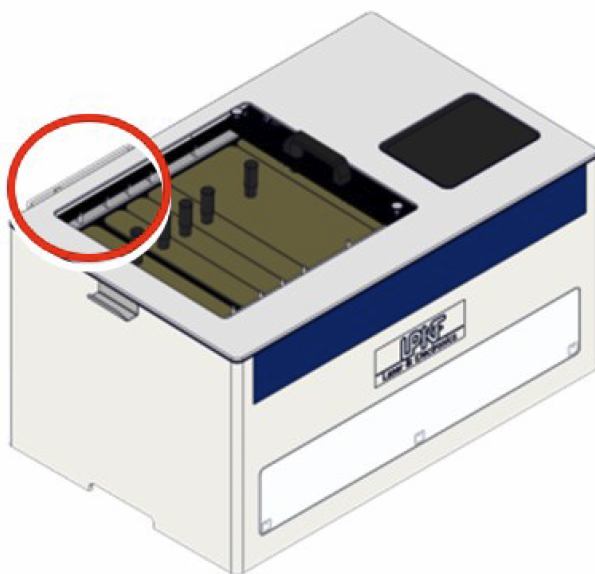
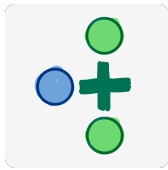


Figure 6: Place each tank cover in the provided holder slot while the tank is in use.



Figure 7: Correct engagement of the tank pin and PCB-holder opening.



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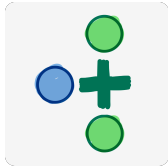
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Figure 8: Lift and knock the PCB holder 8–10 times to remove air bubbles from drilled holes.

10.2 Tank 2: Conditioning

1. Remove the Tank 2 cover and place it in the holder slot.
2. Insert the PCB holder and confirm correct engagement with the tank pins.
3. Hand-tighten the knurled screws.
4. Start the Tank 2 step and allow the programmed time to finish.
5. Loosen the knurled screws and remove the PCB holder.
6. Replace the Tank 2 cover.
7. Proceed directly to activation. Do not introduce an unprompted rinse between Tanks 2 and 3.



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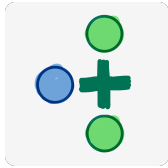
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10.3 Tank 3: Activation

Tank 3 is especially sensitive to contamination. Keep it covered except during the activation step. Never place a tool, rod, brush, glove, or wet PCB holder into Tank 3 unless it is part of the approved process and is free of incompatible contamination.

1. Remove the Tank 3 cover and place it in the holder slot.
2. Insert the PCB holder and confirm correct engagement with the tank pins.
3. Hand-tighten the knurled screws.
4. Start the Tank 3 step and allow the programmed time to finish.
5. Loosen the knurled screws and remove the PCB holder.
6. Rinse the PCB for at least 30 seconds with water.
7. Replace the Tank 3 cover immediately.
8. If the material has a removable protective copper foil and the touchscreen directs its removal, remove the foil at this point and refasten the PCB securely in the holder.



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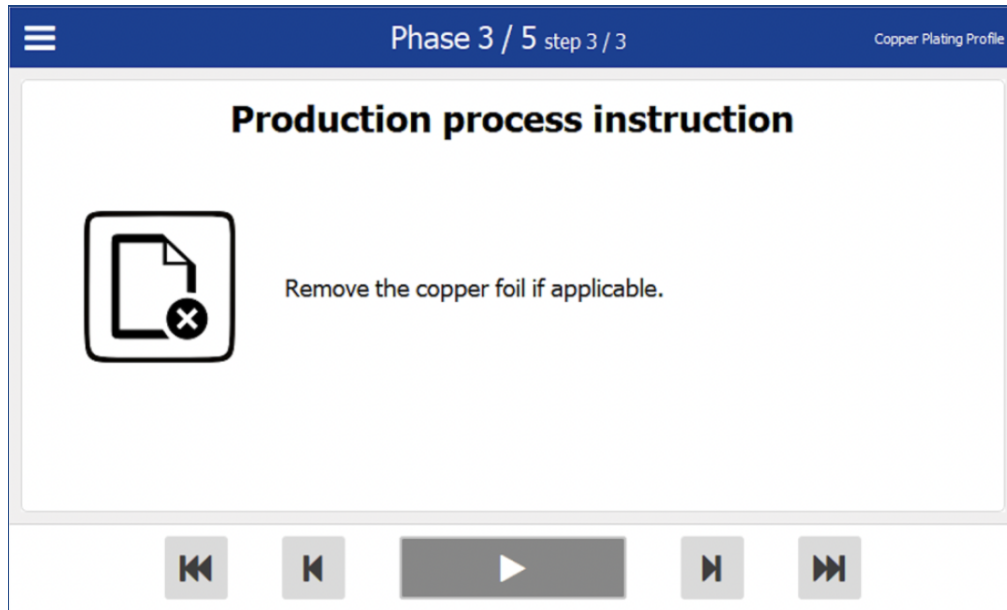
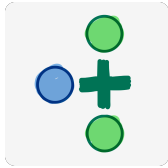


Figure 9: Remove protective copper foil only when applicable and when directed by the process.

10.4 Tank 4: Active Cleaning

1. Remove the Tank 4 cover and place it in the holder slot.
2. Insert the PCB holder and confirm correct engagement with the tank pins.
3. Lift the front edge of the holder approximately 3 cm and knock it gently against the frame 8–10 times to remove air bubbles from the holes.
4. Set the holder down and hand-tighten the knurled screws.
5. Start the Tank 4 step and allow the programmed time to finish.
6. Loosen the knurled screws and remove the PCB holder.
7. Replace the Tank 4 cover.
8. Rinse the PCB for at least 30 seconds.



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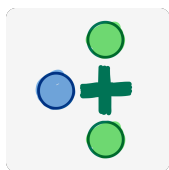
9. Use a soft cleaning brush during rinsing if needed to remove residual active-cleaning solution.

One fill of Tank 4 is rated for no more than approximately fifteen standard 305 mm × 230 mm double-sided PCBs. Smaller boards may consume less bath capacity, but users must follow the bath-life tracking procedure established by Rodgers Lab staff.

10.5 Tank 5: Copper Plating

Before inserting the PCB, verify that the electrical contact surfaces are clean. Loose knurled screws or dirty contacts can cause excessive heating and poor plating.

1. Remove the Tank 5 cover and place it in the holder slot.
2. Insert the PCB holder and confirm correct engagement with the tank pins.
3. Lift the front edge of the holder approximately 3 cm and knock it gently against the frame 8–10 times to remove trapped air.
4. Set the holder down and tighten both knurled screws securely.
5. Start the copper-plating step **immediately** after immersion. Excessive delay can affect the PCB and process result.
6. Verify that the displayed current and process duration are reasonable for the selected profile.
7. Allow the process to run until the midpoint pause or completion.



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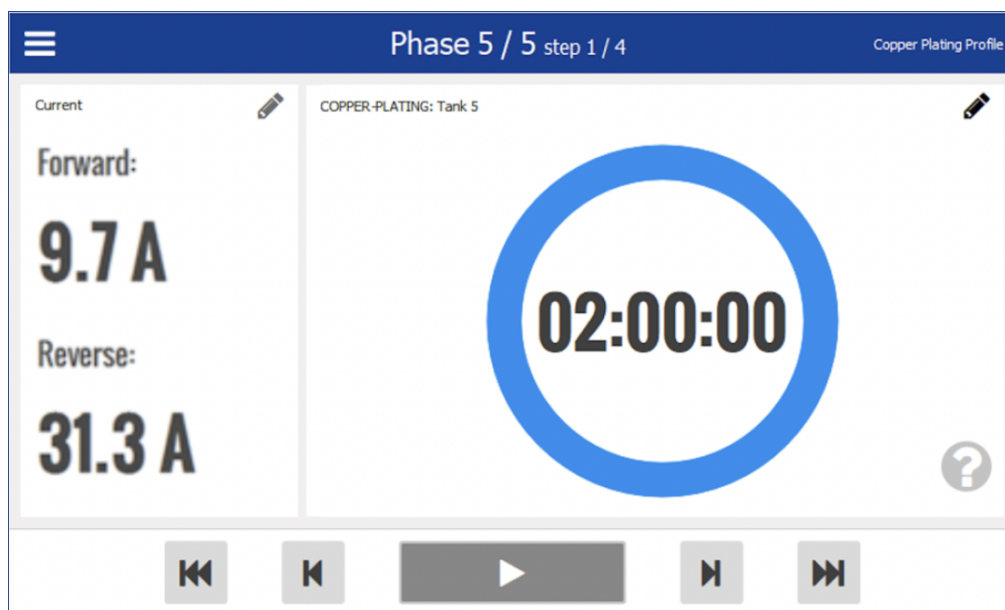
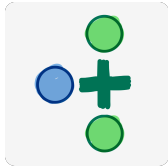


Figure 10: Tank 5 process duration and plating current.

10.6 Turning the PCB at the Midpoint Pause

When **Pause** is enabled in the profile, the Contac S4 pauses halfway through copper plating and sounds an alert. Turning the PCB improves plating uniformity.

1. Loosen the knurled screws and remove the PCB holder from Tank 5.
2. Rotate the PCB holder 180 degrees.
3. Reinsert the holder into Tank 5.
4. Confirm correct engagement with the tank pins.
5. Tighten the knurled screws securely.
6. Resume the process from the touchscreen.



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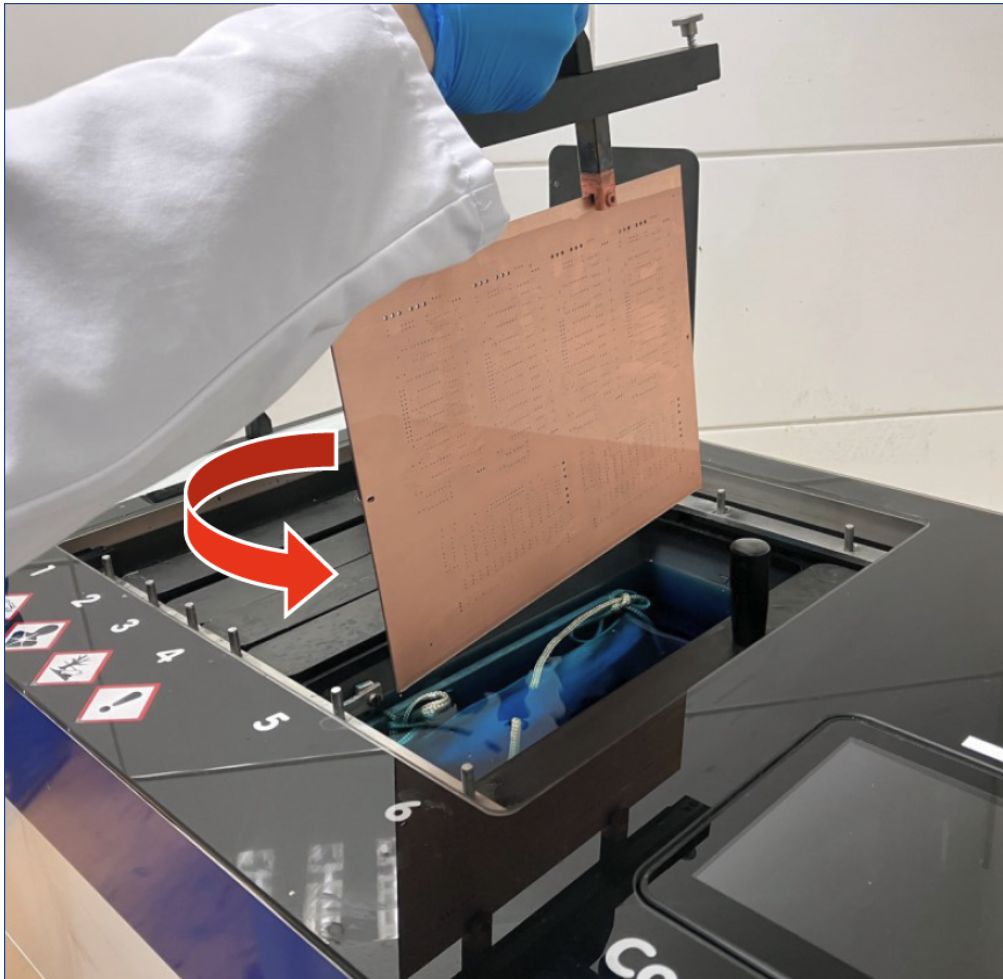
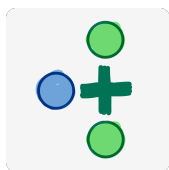


Figure 11: Rotate the PCB 180 degrees at the midpoint pause when enabled in the profile.

10.7 Completing Copper Plating

1. When the programmed time has elapsed, loosen the knurled screws and remove the PCB holder.
2. Hold the PCB above Tank 5 and allow excess plating solution to drip back into the tank.



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3. Using the provided spray bottle, lightly spray both sides of the PCB with de-ionized water while holding it above Tank 5. Allow the liquid to drip into the tank.
4. Replace the Tank 5 cover.
5. Rinse the PCB for at least 30 seconds with water.
6. Dry the PCB as quickly as possible with warm air to minimize oxidation of the fresh copper.
7. Inspect the PCB before further processing.

Only the small, controlled amount of de-ionized water applied above Tank 5 as described may be used to compensate for evaporation. Do not add other liquids or unmeasured water to the bath.

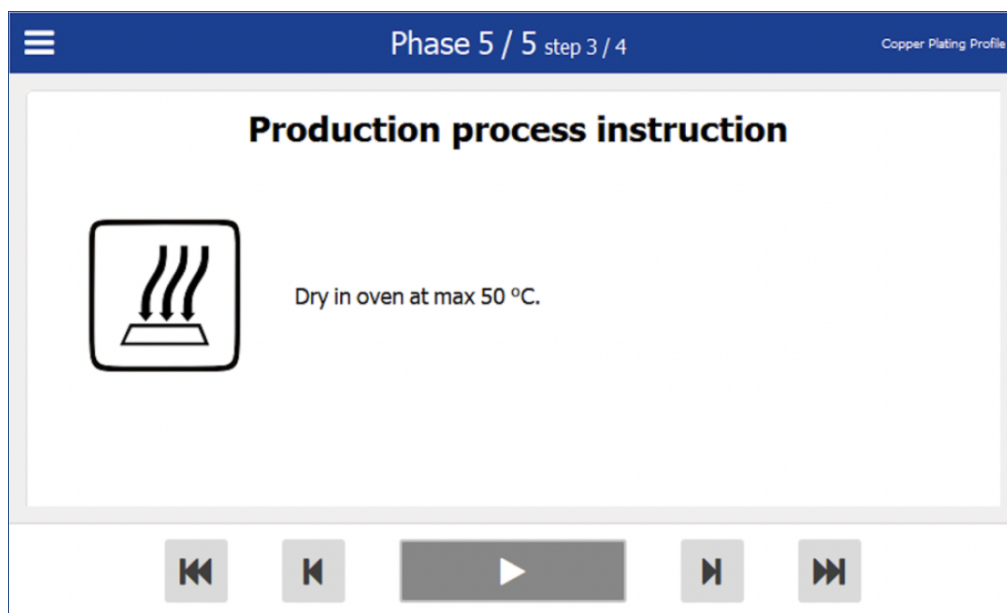
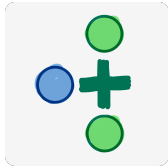


Figure 12: Dry freshly copper-plated PCBs promptly with warm air.

11 Copper-Plating Inspection

Inspect the PCB under good lighting and magnification where appropriate.



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Check:

- Copper appears continuous through representative drilled holes.
- No obvious unplated areas, blisters, peeling, or burned contact regions are present.
- Both PCB faces show reasonably uniform deposition.
- No large crystals, loose residue, or contamination remain on the board.
- The board is dry before storage or subsequent milling.

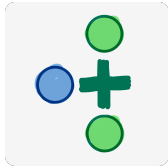
For process qualification or critical work, verify plated-hole continuity and copper thickness using the measurement method specified by Rodgers Lab staff. Do not change plating current, time, reverse-pulse settings, or the stored plating rate without authorization.

12 Optional Tin Plating

Tin plating is optional. It protects copper against corrosion and can improve solderability. The manual permits tin plating of unprocessed PCBs, through-plated but unmilled PCBs, and PCBs that have been milled and through-plated.

12.1 Prepare the PCB for Tin Plating

1. Select the **Tin Plating Profile**.
2. Secure the PCB in the holder.
3. Rinse the PCB for at least 30 seconds with water.
4. Gently brush and polish the copper with a clean non-woven pad or approved PCB brushing machine.
5. Clean the drilled holes as well, removing chips and burrs without damaging the plated copper.



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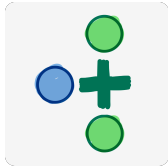
12.2 Tank 4: Pre-Tin Active Cleaning

1. Remove the Tank 4 cover and place it in the holder slot.
2. Insert the PCB holder and confirm correct engagement with the tank pins.
3. Lift the front edge approximately 3 cm and knock the holder gently against the frame 8–10 times.
4. Hand-tighten the knurled screws.
5. Start the Tank 4 step and allow the programmed time to finish.
6. Remove the PCB holder and replace the Tank 4 cover.
7. Rinse the PCB for at least 30 seconds with water.

12.3 Tank 6: Tin Plating

1. Remove the Tank 6 cover and place it in the holder slot.
2. Stir the Tank 6 chemistry gently with the dedicated glass-fiber rod to prevent sedimentation. Do not use a rod assigned to another tank.
3. Insert the PCB holder and confirm correct engagement with the tank pins.
4. Hand-tighten the knurled screws.
5. Start the Tank 6 step and allow the programmed time to finish.
6. Remove the PCB holder and replace the Tank 6 cover.
7. Rinse the PCB for at least 30 seconds with warm water.
8. Dry the PCB promptly with warm air.
9. Remove the PCB from the holder.

The standard 30-minute profile is intended to produce a maximum tin thickness of approximately 1 μm . Extending the process should not be assumed to produce a proportionally thicker layer.



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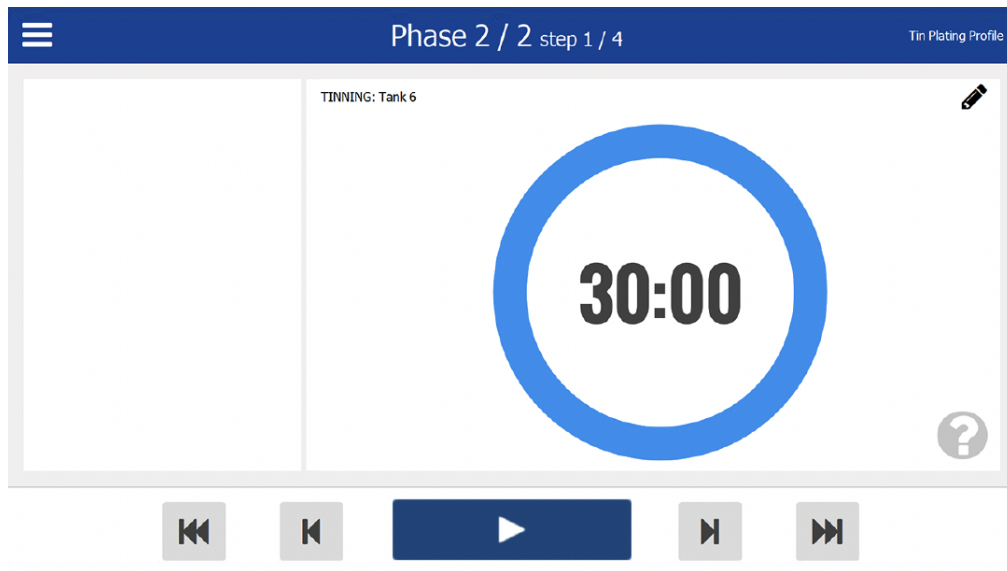
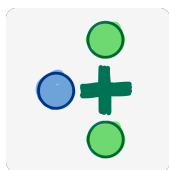


Figure 13: Tank 6 tin-plating process time.



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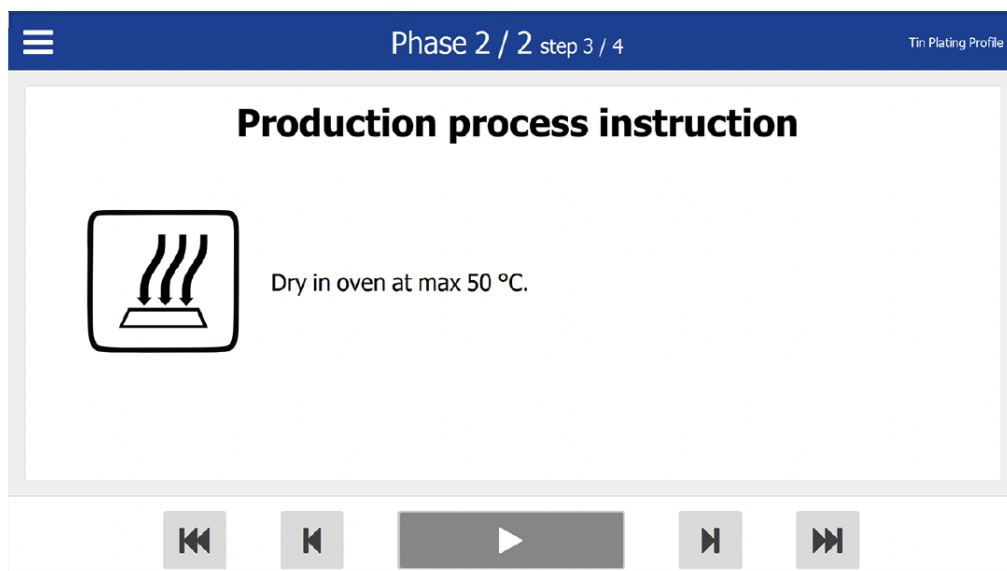


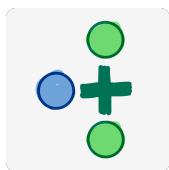
Figure 14: Dry the tin-plated PCB promptly with warm air.

13 Shutdown

1. Confirm that no PCB or PCB holder remains in any tank.
2. Confirm that every tank cover is installed.
3. Open the touchscreen main menu.
4. Select **Shutdown**.
5. Confirm by selecting **YES**.
6. Verify that the touchscreen turns off and Tank 1 is no longer heating.

The alternate shutdown method in the LPKF manual is to hold the On/Off button for at least three seconds and then swipe downward across the touchscreen. Use the menu method whenever practical.

Do not use the rear main switch as the normal software-shutdown control.



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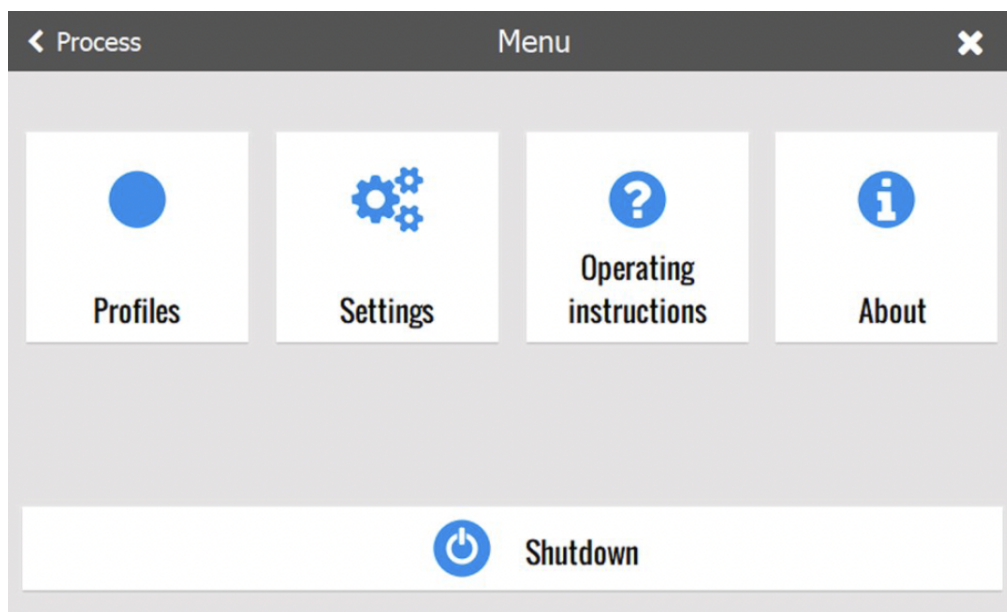
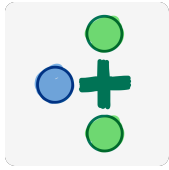


Figure 15: Use the touchscreen Shutdown command after processing.

14 Cleanup and Documentation

1. Rinse and clean the PCB holder without contaminating the process tanks.
2. Dry the PCB holder and return it to its storage location.
3. Wipe external drips and splashes using the chemical-specific cleanup procedure.
4. Confirm that all tank covers are closed.
5. Clean and return dedicated rods, brushes, spray bottles, and other accessories to their assigned locations.
6. Dispose of contaminated wipes, rinse water, and spent chemistry through the approved waste stream.
7. Wash hands thoroughly after removing gloves.



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Record the following in the lab log:

- User name and date
- Project or PCB identifier
- PCB dimensions and approximate processed area
- Selected profile
- Copper-plating time and any midpoint rotation
- Whether tin plating was performed
- Pass/fail result and observed defects
- Any abnormal bath appearance, alarms, spills, or process interruptions

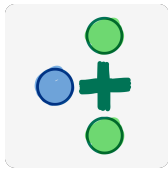
15 Operator-Level Special Tasks

The following tasks are included in Chapter 6 of the LPKF manual but should be performed only with authorization from Rodgers Lab staff.

15.1 Creating or Editing Profiles

A new profile may be created by copying an existing profile and entering:

- A unique profile name
- PCB height and width
- Cleaning time and temperature
- Conditioning time
- Activation time
- Active-cleaning time



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- Copper-plating time and target thickness
- Tin-plating time and target thickness
- Reverse Pulse Plating, air injection, and midpoint-pause settings

The entered PCB dimensions are used to calculate plating current. Use a profile only for the dimensions for which it was created.

Default profiles cannot be edited. Create a new profile rather than attempting to alter a default profile.

Profiles **Profile** ✕

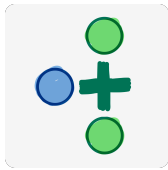
Create new profile: Copper Plating Profile_copy

↕ height (mm): 304.8 ↔ width (mm): 228.6

CLEANING:	Tank 1	t [min]	<u>7</u>	T [°C]	<u>60</u>
CONDITIONING:	Tank 2	t [min]	<u>1</u>		
ACTIVATION:	Tank 3	t [min]	<u>7</u>		
ACTIVE-CLEANING:	Tank 4	t [min]	<u>4</u>		
COPPER-PLATING:	Tank 5	t [min]	<u>120</u>	→ [16.8 µm]	RPP ☒ Air ☒ Pause ☒
TIN-PLATING:	Tank 6	t [min]	<u>/</u>	→ [0 µm]	

Cancel Save

Figure 16: Create a validated custom profile by copying an existing profile.



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Process	Tank	t [min]	T [°C]	Thickness [μm]	RPP	Air	Pause
CLEANING:	Tank 1	7	60				
CONDITIONING:	Tank 2	1					
ACTIVATION:	Tank 3	7					
ACTIVE-CLEANING:	Tank 4	4					
COPPER-PLATING:	Tank 5	120		16.8	☒	☒	☒
TIN-PLATING:	Tank 6	/		0			

Figure 17: Editing the parameters of a user-created profile.

15.2 Copper-Plating Rate

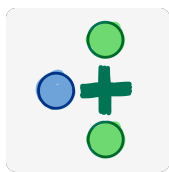
The average plating rate stored in the software is used to calculate the displayed copper thickness. The manufacturer's default is only a starting value and may not match the actual chemistry, PCB geometry, bath age, or operating conditions.

Only Rodgers Lab staff may change the stored average plating rate. Any change should be based on measured plated thickness from a controlled test coupon or other approved verification method.

15.3 Cleaning Tank 3

Cleaning Tank 3 requires draining and handling activation chemistry and therefore is not a normal user task. It must be performed by Rodgers Lab staff using the approved chemical-waste procedure.

The LPKF sequence includes:



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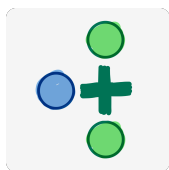
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- Draining the activation bath into a suitable chemical-waste container
- Water rinsing
- Optional conditioning with LPKF Cleaner for 5–10 minutes
- Scrubbing with water and common dish soap
- Repeated draining and rinsing
- A final rinse with distilled or de-ionized water
- Air drying with the cover open until no moisture remains

Tank 3 must be cleaned thoroughly when changing from an active-carbon chemistry to the palladium chemistry. The firmware and chemical selection may also require updating. Do not perform this conversion without Rodgers Lab staff and the current LPKF instructions.



Figure 18: Final de-ionized-water rinse during authorized cleaning of Tank 3.



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15.4 Vacuum Table Preparation

When an optional vacuum table is used:

1. Connect the extraction hose from the approved extraction system to the vacuum table.
2. Install a clean non-woven mat when needed.
3. Verify airflow and secure support before placing a PCB on the table.

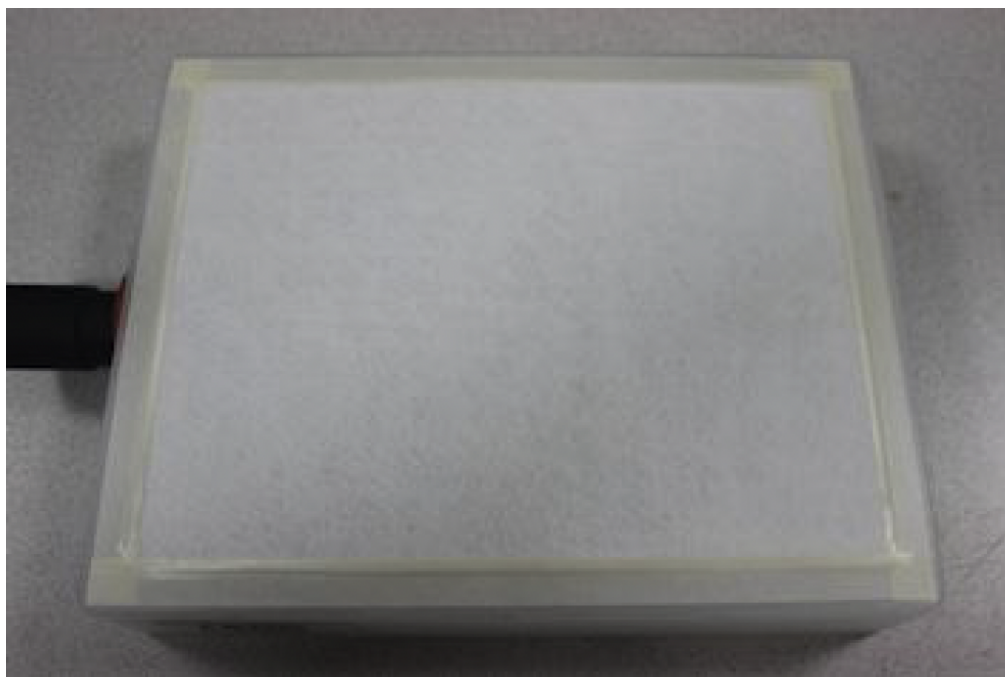
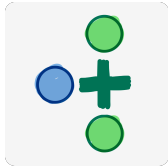


Figure 19: Optional vacuum table prepared with a clean non-woven mat.

16 Troubleshooting



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Issue	Corrective Action
Tank 1 does not reach 60 °C	Stop and notify Rodgers Lab staff. Verify fill-level messages and do not bypass the temperature requirement.
Uneven or missing copper in holes	Check for trapped air, incomplete cleaning, incorrect profile dimensions, poor holder contact, or exhausted chemistry. Do not re-run without reviewing the process with lab staff.
Holder contact becomes hot	Stop the process if safe to do so. Check that the knurled screws are tight and contact surfaces are clean. Notify lab staff if heating persists.
Activation bath appears contaminated	Cover Tank 3 immediately and stop. Do not attempt to correct the bath or add water. Notify lab staff.
Fresh copper darkens after plating	Improve rinsing and dry the PCB immediately with warm air.
Tin layer is uneven	Confirm surface preparation, Tank 4 cleaning, Tank 6 stirring, complete immersion, and bath condition.
Process interrupted or touchscreen alarm occurs	Follow the displayed safe-state instructions and notify Rodgers Lab staff before restarting or repeating chemistry steps.

17 References

1. LPKF Laser & Electronics SE. *Contac S4 Operating Instructions*, Order code 10057789, Version 5.0, June 19, 2025. Chapter 6, “Operating the system.”

18 Revision History

Rev	Date	Description
A	July 22, 2026	Initial Rodgers Lab SOP draft based on Chapter 6 of the LPKF Contac S4 operating instructions.