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| C75 Components Lapping Procedure |
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##

# Purpose and Scope

The purpose of this procedure is to provide a safe and repeatable way to lap components connected to the cavity flanges within specification.

SCOPE: This procedure applies to the following C75 components for indium seal surface preparation:

* HOM Elbows
* Inner Adapter
* Dogleg FPC’s
* Waveguide Extensions
* Warm Window Assembly
* HOM Loads

SAFETY:

Individuals must keep safety as the first priority in the process; before beginning any job, the user must be trained and assure they have the correct PPE for the individual job. Maintaining the level of safety and secure nature of the work area is paramount. Assure personal safety by using caution in movement and taking necessary steps to avoid unnecessary personnel in the immediate area.

Refer to the work-center OSP for specifics.

# References

[C50 Component Lapping Procedure](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-19180/C50%20COMPONENT%20LAPPING%20PROCEDURE-2converted-3.docx)

[Lapping Room OSP SRF-20-83803-OSP](https://mis.jlab.org/mis/apps/mis_forms/operational_safety_procedure_form.cfm?entry_id=83803)

# Terms and Definitions

# Process Details

## PREPARATION

1. Required PPE:
	1. Safety glasses
	2. Appropriate gloves compatible with solvents or cleaners
	3. Leather gloves
	4. Steel toe safety shoes
2. Ensure all flanges are free of indium before lapping.

## HOM ELBOW

### HOM ELBOW: Setup (Using the Lapmaster 36 Machine)

**NOTE**: To prevent damage to components and lapping machine, a thin layer of lapping slurry must **always** be present between the lap plate and the components/ conditioning rings.

1. Fill the slurry tank with:
	1. 1 liter of lapping vehicle concentrate
	2. 15 liters of cold tap water
	3. 2 Kg of #360 or finer grade aluminum oxide abrasive powder.
2. Turn on the slurry pump and let it run for three (3) minutes to allow the abrasive to blend with the lapping vehicle and create a slurry. Ensure the slurry drain tank is empty and in place under the drain.
3. Wipe the lap plate with a clean cloth saturated with lapping vehicle to remove dust and dirt. Apply a small amount of abrasive slurry to the lap plate.
4. Using proper lifting techniques place the conditioning rings on the lap plate and slide them into the yoke assemblies until they rest against the roller yoke bearings.
5. If necessary, loosen the plastic roller yoke knobs and slide the yokes in or out to position two of the conditioning rings in the neutral position; that is, position the ring so that the same amount of the ring extends out over both the inside and outside diameters of the plate.
	1. The ID of the ring is nearly the same as the width of the lap plate land.
	2. The third conditioning ring should be positioned approximately 1/8” inboard from the neutral position.
6. Ensure the yoke arm rollers contact the conditioning rings just above the serrations. Adjust yoke arm height if necessary.
7. Turn on the machine and rotate the lap plate.
8. Observe that the slurry compound flows down the track wires and onto the lap plate.
9. Adjust the white plastic collars on the slurry feed tube to a flow rate of about 2 drips per second.
10. Stop the machine when the slurry has coated the entire lap plate surface.

### HOM ELBOW: Lapping

1. Place the appropriate plastic work holding discs (carriers) inside each conditioning ring.
	1. For each carrier, adjust the four carrier suspension rods until there is a 1/8” gap between the lap plate and the carrier.
2. Lap the straight end first.
3. Rinse the elbows in warm water and dry with compressed air to remove any loose particles.
4. Protect the flange that will not be lapped with vinyl tape.
5. Place two (2) elbows in the carrier and insert tooling wedge to the mating surfaces.



1. Retain the wedge in place with an O-ring using a figure eight cross over loop.
2. Adjust the wedge up or down between the two flanges to ensure that the flanges to be lapped are flat on the lapping table.
3. Repeat for additional elbows if applicable.
	1. Up to six elbows can be lapped in this configuration at a time (two elbows per conditioning ring).
4. Start the machine and set the timer for 30 minutes.
5. Periodically monitor the slurry distribution to the lap plate.
	1. The lap plate should be evenly coated with a thin layer of lapping slurry and have a dark grey appearance.
6. When a uniform finish has been achieved the component should be thoroughly rinsed and dried.
	1. If not, continue running the machine for 30 minute intervals until the flange has a uniform finish.
7. After lapping the straight end, wipe clean the lapped flange and protect with vinyl tape.
8. Attach the masked surface to the Adjustable Angle Assembly with two screws in opposite corners.
9. Place the adjustment screw onto the Sacrificial Plate.
	1. Adjust the screw so that the flange to be lapped is “flat” on the lap plate.



* 1. Repeat this step for additional elbows if applicable.
	2. Up to three elbows can be lapped in this configuration at a time (one elbow per conditioning ring).
1. Start the machine and set the timer for 30 minutes.
2. Periodically monitor the slurry distribution to the lap plate.
	1. The lap plate should be evenly coated with a thin layer of lapping slurry and have a dark grey appearance.
3. When a uniform finish has been achieved continue to the next step.
4. If not, continue running the machine for 30 minute intervals until the flange has a uniform finish.
5. Thoroughly rinse and dry the elbow and install protective covers on the flanges.
6. Clean components using the ultrasonic cleaner located in the lapping room.
7. Fill ultrasonic tank with ~1% Liquinox (7 gallons of water and 7 ounces of Liquinox).
	1. Carefully load components into ultrasonic making sure to protect flanges from damage.
8. Turn ultrasonic tank on and run for 15 minutes.
9. Drain ultrasonic tank and rinse components parts and let dry before taking components to be inspected.
10. Take component to the QA lab for surface finish evaluation.

## INNER ADAPTER & HOM ELBOWS

### INNER ADAPTER & HOM ELBOWS: Setup (Manual Method)

**NOTE:** Use aluminum oxide abrasive paper only.

1. Assess the condition of the flange to determine which grade of lapping paper to use.
	1. If the flange is free of scratches and pitting, start with 80 micron paper.
2. Grasp the component firmly and start to wet sand the flange on the marble lapping table while keeping the flange flat on the sanding surface.
	1. Do not allow the flange to skip or vibrate while sanding.
	2. Alternate the orientation of the flange occasionally to prevent grooves from forming.
	3. Be sure to rinse the abrasive paper often with water and replace as necessary.
3. Rinse and inspect the flange to check on your progress.
4. Continue sanding until the entire surface has a uniform appearance.
5. Periodically check the flange surface for flatness with a straight edge.

### HOM ELBOW

1. Continue sanding until the entire surface has been contacted by the sandpaper.

### INNER ADAPTER

1. Continue sanding until the surface contacted by the paper extends at least .5 “radially inside the outer diameter.
2. Change to 60µm aluminum oxide abrasive paper and repeat steps 4.3.1 above.
3. Change to 40µm aluminum oxide (transparent with blue lettering) abrasive paper and repeat steps 4.3.1 above.

### INNER ADAPTER & HOM ELBOWS: Final Lapping

**NOTE**: This step must be performed by hand.

1. Attach adhesive backed 40µm aluminum oxide (translucent blue) abrasive paper to the lapping plate but do not rotate it.
2. Use water to keep the lapping surface wet and to prevent loading the abrasive paper with niobium.
3. Wet sand the flange using a circular motion on the marble lapping table, while keeping the flange flat on the sanding surface.
	1. Do not allow the flange to skip or vibrate while sanding.
	2. Alternate the orientation of the flange occasionally to prevent grooves from forming.
	3. Be sure to rinse the abrasive paper often with water and replace as necessary.
4. Rinse and inspect the flange to check on your progress.
5. Continue sanding until the entire surface has a uniform appearance.
6. When a uniform finish has been achieved the component should be thoroughly cleaned and dried. Install protective covers on flanges.
7. Take component to the QA lab for surface finish evaluation.

## DOGLEG FPC

### DOGLEG FPC: Setup (Using the Lapmaster 36 Machine)

**NOTES**:

* Use extreme care when handling doglegs with ceramic windows – the widows are very fragile. The ceramic windows have a sputtered coating that may become damaged, use extreme caution.
* To prevent damage to components and lapping machine, a thin layer of lapping slurry must **always** be present between the lap plate and the components/ conditioning rings.
1. Fill the slurry tank with:
	1. 1 liter of lapping vehicle concentrate
	2. 15 liters of cold tap water
	3. 2 Kg of #360 or finer grade aluminum oxide abrasive powder
2. Turn on the slurry pump and let it run for three (3) minutes to allow the abrasive to blend with the lapping vehicle and create a slurry.
	1. Ensure the slurry drain tank is empty and in place under the drain.
3. Wipe the lap plate with a clean cloth saturated with lapping vehicle to remove dust and dirt.
4. Apply a small amount of abrasive slurry to the lap plate.
5. Using proper lifting techniques place the conditioning rings on the lap plate and slide them into the yoke assemblies until they rest against the roller yoke bearings.
	1. If necessary, loosen the plastic roller yoke knobs and slide the yokes in or out to position two of the conditioning rings in the neutral position; that is, position the ring so that the same amount of the ring extends out over both the inside and outside diameters of the plate.
	2. The ID of the ring is nearly the same as the width of the lap plate land.
	3. The third conditioning ring should be positioned approximately 1/8” inboard from the neutral position.
6. Ensure the yoke arm rollers contact the conditioning rings just above the serrations.
	1. Adjust yoke arm height if necessary.
7. Turn on the machine and rotate the lap plate.
	1. Observe that the slurry compound flows down the track wires and onto the lap plate. Adjust the white plastic collars on the slurry feed tube to a flow rate of about 2 drips per second.
	2. Stop the machine when the slurry has coated the entire lap plate surface.

### DOGLEG FPC: Small Flange lapping

**NOTE**: The small flange must be lapped first.

1. Place the appropriate plastic work holding discs (carriers) inside each conditioning ring.
	1. For each carrier, adjust the four carrier suspension rods until there is a 1/8” gap between the lap plate and the carrier.
	2. The flange that will be lapped must lay completely flat on the lap plate.
2. Place two (2) FPC’s in the carrier with the small flange facing the lap plate.
3. Repeat this step for additional FPC’s if applicable.
4. Protect the large flange with vinyl tape.
5. Loosely attach an aluminum stabilizer plate to the large flange of the FPC’s with screws.
	1. DO NOT fully tighten the screws!
6. The bridge must slide freely across the flanges to allow the component to follow the lap plate surface but not tip over.
	1. Up to six FPC’s can be lapped in this configuration at a time.
7. Start the machine and set the timer for 30 minutes.
	1. Make sure there is an adequate supply of slurry being applied to the lap plate as it rotates.
8. Continue running the machine for 30 minute intervals until the flange has a uniform finish.

### DOGLEG FPC: Large Flange lapping

1. Place the appropriate plastic work holding discs (carriers) inside each conditioning ring.
	1. For each carrier, adjust the four carrier suspension rods until there is a 1/8” gap between the lap plate and the carrier.
	2. The flange that will be lapped must lay completely flat on the lap plate.
2. Place two (2) FPC’s in the carrier with the large flange facing the lap plate.
3. Repeat this step for additional FPC’s if applicable.
	1. Up to six FPC’s can be lapped in this configuration at a time.
4. Start the machine and set the timer for 30 minutes.
	1. Make sure there is an adequate supply of slurry being applied to the lap plate as it rotates.
5. Continue running the machine for 30 minute intervals until the flange has a uniform finish.
6. Thoroughly rinse and dry the component and install protective covers on the flanges.
7. Take component to the QA lab for surface finish evaluation if applicable.

### DOGLEG FPC: Setup (Manual Method)

**NOTES**:

* Use aluminum oxide abrasive paper only.
* Use extreme care when handling doglegs with ceramic windows – the widows are very fragile. The ceramic windows have a sputtered coating that may become damaged, use extreme caution.

### DOGLEG FPC: Small Flange:

**NOTE**: The small flange must be lapped first.

1. Prevent excessive water and residual lapping slurry from entering the waveguide.
	1. Block off the waveguide opening at the small flange as needed with clean rags/wipers.
2. Carefully clamp the large flange with protective cover to the table with a c-clamp.
3. Assess the condition of the flange to determine which grade of lapping paper to use.
	1. If the flange is flat (± .002”) and free of scratches and pitting, start with 80 micron paper.
	2. If the flange is not flat, or is scratched, pitted, or has grooves from machining, start with 120 grit paper.
4. Attach appropriate adhesive backed abrasive paper to the marble lapping table.
5. Sand the small flange evenly in multiple directions to achieve a smooth flat surface.
	1. Use water to keep the lapping surface wet and to prevent loading the abrasive paper with niobium.
	2. Do not allow residual lapping slurry to enter the waveguide.
	3. Periodically check the flange surface for flatness with a straight edge.
	4. Continue sanding until the entire surface has been contacted by the sandpaper.
6. Gradually work your way down, where applicable, as follows:
	1. 120 grit
	2. 180 grit
	3. 100 micron
	4. 80 micron
	5. 60 micron
	6. 40 micron (transparent with blue lettering).
7. Repeat step 4-5 with the appropriate grade of lapping paper through 40 micron (transparent with blue lettering).
	1. If rough lapping the flanges, finish with 80 micron and go to step 4.5.2.8.
	2. If final lapping the flanges, finish with 40 micron and continue to the 4.5.2 Final Lapping.

### DOGLEG FPC: Small Flange Final lapping:

**NOTE**: This step must be performed by hand.

1. Attach adhesive backed 40µm aluminum oxide (translucent blue) abrasive paper to sanding block.
2. Use water to keep the lapping surface wet and to prevent loading the abrasive paper with niobium.
3. Wet sand the flange using small circular motions while keeping the sanding block flat on the cavity flange.
4. Alternate the orientation of the flange occasionally to prevent uneven material removal.
5. Be sure to rinse the abrasive paper often with water and replace as necessary.
6. Rinse and inspect the flange to check on your progress.
7. Continue sanding until the entire surface has a uniform appearance.
8. When a uniform finish has been achieved carefully remove the rags/wipers from inside the waveguide.
9. Thoroughly rinse the entire dogleg inside and out.
10. Dry the small flange with compressed air and install protective cover.
11. Proceed to lap the large flange if applicable.

### DOGLEG FPC: Large Flange lapping

1. Assess the condition of the flange to determine which grade of lapping paper to use.
	1. If the flange is flat (± .002”) and free of scratches and pitting, start with 80 micron paper.
	2. If the flange is not flat, or is scratched, pitted, or has grooves from machining, start with 120 grit paper.
2. Attach the lapping paper to the marble lapping table
	1. Use the micro/water solution to keep the lapping surface wet and to prevent loading the abrasive paper with niobium.
3. Grasp the component firmly and continue to wet sand the flange on the lapping plate while keeping the flange flat on the sanding surface.
	1. Do not allow the flange to skip or vibrate while sanding. Alternate the orientation of the flange occasionally to prevent grooves from forming.
	2. Be sure to rinse the abrasive paper often with water and replace as necessary.
4. Rinse and inspect the flange to check on your progress.
5. Continue sanding until the entire surface has a uniform appearance.
6. Gradually work your way down, where applicable, as follows:
	1. 120 grit
	2. 180 grit
	3. 100 micron
	4. 80 micron
	5. 60 micron
	6. 40 micron (transparent with blue lettering).
7. Repeat step 3-7 with the appropriate grade of lapping paper through 40 micron (transparent with blue lettering).
	1. If rough lapping the flanges, finish with 80 micron and go to step 4.5.4.6.
	2. If final lapping the flanges, finish with 40 micron and continue with step 4.5.4.

### DOGLEG FPC: Large Flange Final Lapping

**NOTE**: This step must be performed by hand.

1. Attach lapping paper to the lapping plate but do not rotate it.
2. Use water to keep the lapping surface wet, this prevents loading the abrasive paper with niobium.
3. Wet sand the flange using a circular motion on the marble lapping table while keeping the flange flat on the sanding surface.
	1. Do not allow the flange to skip or vibrate while sanding.
	2. Alternate the orientation of the flange occasionally to prevent grooves from forming.
	3. Be sure to rinse the abrasive paper often with water and replace as necessary.
4. Rinse and inspect the flange to check on your progress.
5. Continue sanding until the entire surface has a uniform appearance.
	1. Make sure that the lapping has not contacted the eyelet.
	2. If it does the component must be leak tested after lapping is complete.
6. When a uniform finish has been achieved, thoroughly rinse the entire dogleg inside and out.
7. Dry the component with compressed air and install protective covers.
8. Take component to the QA lab for surface finish evaluation.

## WAVEGUIDE EXTENSION

### WAVEGUIDE EXTENSION: Setup

**NOTES**:

* + Use care when handling the waveguide extension – the flexible bellows can very easily become wrinkled or distorted.
* To prevent damage to components and lapping machine, a thin layer of lapping slurry must *always* be present between the lap plate and the components/ conditioning rings.
1. Fill the slurry tank with:
	1. 1 liter of lapping vehicle concentrate
	2. 15 liters of cold tap water
	3. 2 Kg of #320 or finer grade aluminum oxide abrasive powder.
2. Turn on the slurry pump and let it run for three (3) minutes to allow the abrasive to blend with the lapping vehicle and create a slurry.
	1. Ensure the slurry drain tank is empty and in place under the drain.
3. Wipe the lap plate with a clean cloth saturated with lapping vehicle to remove dust and dirt.
4. Apply a small amount of abrasive slurry to the lap plate.
5. Using proper lifting techniques place the conditioning rings on the lap plate and slide them into the yoke assemblies until they rest against the roller yoke bearings.
6. If necessary, loosen the plastic roller yoke knobs and slide the yokes in or out to position two of the conditioning rings in the neutral position; that is, position the ring so that the same amount of the ring extends out over both the inside and outside diameters of the plate.
	1. The ID of the ring is nearly the same as the width of the lap plate land.
	2. The third conditioning ring should be positioned approximately 1/8” inboard from the neutral position.
7. Ensure the yoke arm rollers contact the conditioning rings just above the serrations.
	1. Adjust yoke arm height if necessary.
8. Turn on the machine and rotate the lap plate.
	1. Observe that the slurry compound flows down the track wires and onto the lap plate.
	2. Adjust the white plastic collars on the slurry feed tube to a flow rate of about 2 drips per second.
	3. Stop the machine when the slurry has coated the entire lap plate surface.

### WAVEGUIDE EXTENSION: Flange Lapping

1. Place the appropriate plastic work holding discs (carriers) inside each conditioning ring.
	1. For each carrier, adjust the four carrier suspension rods until there is a 1/8” gap between the lap plate and the carrier.
2. Protect the inside of the component from excess dirt and grit by installing foam or clean wipers inside the waveguide of the flange to be lapped.
	1. The flange that will be lapped must lay completely flat on the lap plate.
3. Place two (2) Waveguide Extensions in the carrier with the thin flange facing the lap plate.
	1. Repeat this step for additional Waveguide Extensions if applicable.
4. Protect the thick flange with vinyl tape.
5. Loosely attach an aluminum stabilizer plate to the thick flange of the Waveguide Extensions with screws.
	1. DO NOT fully tighten the screws!
	2. The bridge must slide freely across the flanges to allow the component to follow the lap plate surface but not tip over.
	3. Up to six Waveguide Extensions can be lapped in this configuration at a time.
6. Start the machine and set the timer for 60 minutes and set the rotation at 40 Hz.
	1. Make sure there is an adequate supply of slurry being applied to the lap plate as it rotates.
7. Continue running the machine for 30 minute intervals until the flange has a uniform finish.
	1. Repeat this step for the large flange of the Wave guide extension.
8. Thoroughly rinse and dry the component and install protective covers on the flanges.

## WARM WINDOW

### WARM WINDOW: Setup

 **NOTES**:

* + Use care when handling the warm window assembly
* To prevent damage to components and lapping machine, a thin layer of lapping slurry must **always** be present between the lap plate and the components/ conditioning rings.
1. Fill the slurry tank with:
	1. 1 liter of lapping vehicle concentrate
	2. 15 liters of cold tap water
	3. 2 Kg of #320 or finer grade aluminum oxide abrasive powder.
2. Turn on the slurry pump and let it run for three (3) minutes to allow the abrasive to blend with the lapping vehicle and create a slurry.
	1. Ensure the slurry drain tank is empty and in place under the drain.
3. Wipe the lap plate with a clean cloth saturated with lapping vehicle to remove dust and dirt.
4. Apply a small amount of abrasive slurry to the lap plate.
5. Using proper lifting techniques place the conditioning rings on the lap plate and slide them into the yoke assemblies until they rest against the roller yoke bearings.
	1. If necessary, loosen the plastic roller yoke knobs and slide the yokes in or out to position two of the conditioning rings in the neutral position; that is, position the ring so that the same amount of the ring extends out over both the inside and outside diameters of the plate.
	2. The ID of the ring is nearly the same as the width of the lap plate land.
	3. The third conditioning ring should be positioned approximately 1/8” inboard from the neutral position.
6. Ensure the yoke arm rollers contact the conditioning rings just above the serrations.
	1. Adjust yoke arm height if necessary.
7. Turn on the machine and rotate the lap plate.
	1. Observe that the slurry compound flows down the track wires and onto the lap plate.
	2. Adjust the white plastic collars on the slurry feed tube to a flow rate of about 2 drips per second.
	3. Stop the machine when the slurry has coated the entire lap plate surface.

### WARM WINDOW: Flange Lapping

1. Place the appropriate plastic work holding discs (carriers) inside of a conditioning ring.
	1. Adjust the four carrier suspension rods until there is a 1/8” gap between the lap plate and the carrier.
2. Protect the inside of the component from excess dirt and grit by installing foam or clean wipers inside the waveguide of the flange to be lapped.
	1. The flange that will be lapped must lay completely flat on the lap plate.
3. Place two (2) Warm windows in the carrier with the small flange facing the lap plate.
4. Protect the large flange with vinyl tape.
	1. Only 2 Warm window can be lapped in this configuration at a time.
5. Start the machine and set the timer for 60 minutes and set the rotation at 40 Hz.
	1. Make sure there is an adequate supply of slurry being applied to the lap plate as it rotates.
6. Continue running the machine for 30 minute intervals until the flange has a uniform finish.
7. Repeat this step for the large flange of the Warm Window.
8. Thoroughly rinse and dry the component and install protective covers on the flanges.

## HOM LOAD

**NOTE**: HOM loads repair work will be done by the Jefferson Lab machine shop if the surface finish and/or flatness need to be corrected. Machined HOM loads may not meet surface finish and/or flatness tolerances after the machining process. The project manager will determine if HOM load can be used if it is not within tolerance

# **Revision History**

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# **Approvals**

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