APPLIED MATERIALS®

Applied Endura® 2 Mechanical Defect Reduction

BKM

July 2004 Revision 001

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1 How to Use This Document

This document is intended to be an aid in defect troubleshooting and defect performance improvement activities on the CPI, ENDURA2-based products, and was developed with the Copper Barrier Seed product application as the focus. Several portions of this document may be relevant for other Endura configurations and applications (Endura CL, XP, etc). The document is intended for use with the following configuration:

- Endura2 mainframe
- XP robots
- 5.3 FI
- HT SWLLs
- PCXTe clean chamber
- PVD chambers with SLTESC pedestals

The document can be used under two scenarios: as a mechanical defect excursion troubleshooting guide, and as a comprehensive, system level, mechanical defect improvement guide. The troubleshooting section is a subset of the overall mechanical defect improvement guide.

This document uses the following philiosophy:

- Defect isolation and identification: Multiple wafer passes through problematic paths to ensure capture of intermittent defect modes and defect cluster generation; Equipment used: SP1-TBI
- Defect classification: Defect review undertaken with SEM-EDX analysis and high resolution photographs to identify possible contributors;
  Equipment used: SEMVision G2, digital photographs
- Root cause attribution: Isolation of defect contributor through iterative partitioning; once a repeatable signal is captured, components are subject to failure analysis
- Elimination of defect source: This may require redesign of components, tuning of processes, procedural changes, and additional quality requirements. Once corrected, the partitioning test that captured the defect mode is rerun in order to validate the fix

Adherence to this methodology will greatly reduce the overall time spent on defect reduction, and should ensure a higher level of confidence in root cause elimination of the defect sources.

The troubleshooting section references the partitioning and isolation test tables to aid in identifying and isolating the path/component/process that is causing the defects. After the cause is isolated, the hardware component and module checklists are used to determine the next course of action: component issues or setup and configuration issues.

This document is most effective when used online to facilitate the use of the internal and external links.

2 Methodology and Guidelines

The objective of this procedure is to identify the source of defects and to isolate the root cause. Do the following:

1. Generate the .tff defect map file from the SPI for the pre and post measurements.
2. Use the ttf2excel and Defect Data Analysis (DDA) programs to generate a wafer contact area map. The programs reside on the CPI-GPS website under Defect Reduction.
3. Submit the wafer for EDX analysis.
4. Extract the exact handling path of the wafer on which the excursion occurred from wafer histories.
5. Rerun the *EXACT* path of the wafer with the excursion multiple times (for mechs, using the same wafer multiple times is acceptable) to ensure that the issue is repeatable within a certain number of repetitions.
    a. If a cluster of particles is observed on the wafer contact area map that corresponds to particular components, proceed with isolation tests for those components. Use the "Cluster with Wafer Contact" table to isolate the particle source.
    b. If a cluster of particles is observed on the wafer contact area map that does not correspond to a particular component, use the "Cluster without Contact" table to isolate the particle source.
    c. If no noticeable defect pattern exists, depending on the path of the defect excursion, refer to the "Module Partitions" table to determine which path number is to be isolated. If unclear, either start at Path I and work upwards to islate the prablematic path, or drill downwards to identify when the defects go away, thereby isolating the problem area.
6. If the source can be identified by repeatedly generating the defects using the tests in the "Component Isolation" table, perform the necessary maintenance (change hardware component, adjust calibration/setup, thoroughly clean, PM, etc.) and recovery. After recovery is complete, repeat the test that isolated the defect source to verify that the issue has been resolved.
7. Rerun the *EXACT* path of the wafer which experienced the original excursion (step 4) to confirm resolution of the excursion.
8. Document the excursion, troubleshooting, SEM-EDX analysis, wafer contact area maps, corrective action taken, verification data, and other relevant information for future reference.

The following tables are included in this section:

Table 2-1. Module Partitions

PATH	CONTROL LIMIT (AVG > 0.16mm)	PARTITION DESCRIPTION	UNIQUE COMPONENTS EXERCISED	# WAFERS
I	2.5	FOUP-FI-SWLL-BUFFER-SWLL-FI-FOUP	FI-FOUP, FI mini-environment, FI-ALIGNER-FI-SWLL(IN), SWLL PUMP, SWLL VENT, SWLL SV, BUFFER-SWLL(in), SWLL INDEXER, BUFFER-SWLL(out), FI-SWLL(out)	4
II	4	FOUP-FI-SWLL-BUFFER-A-TRANSFER-B(Cool)-BUFFER-SWLL-FI-FOUP	A SV's, A LIFTER, A HOOP, BUFFER-A, TRANSFER-A, TRANSFER-B, B SV's, B LIFTER, B HOOP, B RECIPE(fill, pump), BUFFER-B	4
III	5	FOUP-FI-SWLL-BUFFER-DEGAS-BUFFER-A-TRANSFER-B(Cool)-BUFFER-SWLL-FI-FOUP	DEGAS SV, BUFFER-DEGAS, DEGAS LIFTER, DEGAS HOOP, DEGAS RECIPE(fill, pump, cryo sv)	4
IV	6	FOUP-FI-SWLL-BUFFER-CLEAN-BUFFER-A-TRANSFER-B(Cool)-BUFFER-SWLL-FI-FOUP	CLEAN SV, BUFFER-CLEAN, CLEAN LIFTER's, CLEAN HOOP/PINS, CLEAN RECIPE(mfc+gas, esc, throttle valve)	4
V	6	FOUP-FI-SWLL-BUFFER-A-TRANSFER-BARRIER-TRANSFER-B(Cool)-BUFFER-SWLL-FI-FOUP	BARRIER SV, TRANSFER-BARRIER, BARRIER LIFTER's, BARRIER HOOP/PINS, BARRIER RECIPE(mfc+gas, esc)	2
VI	6	FOUP-FI-SWLL-BUFFER-A-TRANSFER-SEED-TRANSFER-B(Cool)-BUFFER-SWLL-FI-FOUP	SEED SV, TRANSFER-SEED, SEED LIFTER's, SEED HOOP/PINS, SEED RECIPE(mfc+gas, esc)	2
VII	18	FOUP-FI-SWLL-BUFFER-DEGAS-BUFFER-CLEAN-BUFFER-A-TRANSFER-BARRIER-TRANSFER-SEED-TRANSFER-B(Cool)-BUFFER-SWLL-FI-FOUP	FULL MECHANICAL SEQUENCE	2
VIII	25	FOUP-FI-SWLL-BUFFER-DEGAS-BUFFER-CLEAN-BUFFER-A-TRANSFER-BARRIER-TRANSFER-SEED-TRANSFER-B(Cool)-BUFFER-SWLL-FI-FOUP	FULL PROCESS DEPOSITION SEQUENCE	2

Table 2-2. Sample Sequence Description

Lot name	Path	Description																
LL1	I	FI	LLA	BP	LLA	FI												
LL2	I	FI	LLA	BA	LLA	FI												
LL3	I	FI	LLB	BP	LLB	FI												
LL4	I	FI	LLB	BA	LLB	FI												
AB1	II	FI	LLA/B	BP	A	XP	B	BP	LLA/B	FI								
AB2	II	FI	LLA/B	BA	A	XP	B	BA	LLA/B	FI								
AB3	II	FI	LLA/B	BP	A	XA	B	BP	LLA/B	FI								
AB4	II	FI	LLA/B	BA	A	XA	B	BA	LLA/B	FI								
Degas1a	III	FI	LLA/B	BP	E	BP	A	XP	B	BP	LLA/B	FI						
Degas1b	III	FI	LLA/B	BA	E	BA	A	XA	B	BA	LLA/B	FI						
Clean1a	IV	FI	LLA/B	BP	C	BP	A	XP	B	BP	LLA/B	FI						
Clean1b	IV	FI	LLA/B	BA	C	BA	A	XA	B	BA	LLA/B	FI						
PVD1a	V or VI	FI	LLA/B	BP	A	XP	ch1	XP	B	BP	LLA/B	FI						
PVD1b	V or VI	FI	LLA/B	BA	A	XA	ch1	XA	B	BA	LLA/B	FI						
Full mech	VII	FI	LLA/B	BP/BA	E	BP/BA	C	BP/BA	A	XP/XA	PVD	XP/XA	PVD	XP/XA	B	BP/BA	LLA/B	FI
Full stack	VIII	FI	LLA/B	BP/BA	E	BP/BA	C	BP/BA	A	XP/XA	PVD	XP/XA	PVD	XP/XA	B	BP/BA	LLA/B	FI
Witness		in FOUP																

Sample sequence description of module partition wafers for single Degas, Clean and PVD chambers

LLA – Loadlock A

LLA/B – Loadlock A and B

BP – Buffer robot, primary blade

BA – Buffer robot, auxilliary blade

XP – Transfer robot, primary blade

XA – Transfer robot, auxilliary blade

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Table 2-3. Component Isolation Tests

TEST #	PARTITION PATH	SPECIFIC PATH OR COMPONENT BEING TESTED	TEST DESCRIPTION	WAFER	Potential EDX signals	Potential issues	Approx. time to perform*
VISUAL CHECKS	I	FI handoffs	Visual check of FI robot handoffs to FOUP SLOT2			handoffs	
	I	FI handoffs	Visual check of FI robot handoffs to FOUP SLOT18			handoffs	
	I	FI handoffs	Visual check of FI robot handoffs to ALIGNER			handoffs	
	I	FI handoffs	Visual check of FI robot handoffs to SWLL(in); observe thru FI without removing SWLL lid			handoffs	
	I	FI handoffs	Visual check of FI robot handoffs to SWLL(out); observe thru FI without removing SWLL lid			handoffs	
	I	SWLL lid	Verify all SWLL lid screws are in place and tight under vacuum		Al	lid to SWLL body abrasion	
	I	SWLL indexer	Verify smooth translation of indexer			SWLL vibration, abrasion	<15 min
	I	SWLL door	Verify smooth open/close motion of door			door-SWLL body abrasion, misalignment, atmosphere calibration, poppet valve setup	
	I	BUFFER[prim]-SWLL	FOUP-FI-[SWLL(2)-BUFFER(PRIM)-SWLL(1)]X10-FI-FOUP		Al, Mg, Ni, substrate, SST	overall check of FI-to-buffer path	<30 min
	I	BUFFER[aux]-SWLL	FOUP-FI-[SWLL(2)-BUFFER(AUX)-SWLL(1)]X10-FI-FOUP		Al, Mg, Ni, substrate, SST	overall check of FI-to-buffer path	

Table 2-3. Component Isolation Tests (Continued)

TEST #	PARTITION PATH	SPECIFIC PATH OR COMPONENT BEING TESTED	TEST DESCRIPTION	WAFER	Potential EDX signals	Potential issues	Approx. time to perform*
1.1a	I	FI-SWLL PATH	[FOUP-FI-ALIGN-SWLL(1)-FOUP]X10		Al, substrate, O-ring	FI handoffs, SWLL door, SWLL fins, SWLL indexer	<15 min
1.1b	I	FI-SWLL PATH	[FOUP-FI-ALIGN-SWLL(2)-FOUP]X10		Al, substrate, O-ring	FI handoffs, SWLL door, SWLL fins, SWLL indexer	
1.2.1	I	FI DOOR	[FI DOOR OPEN/CLOSE]X20	1) foup-fi-align-swll(1)slotdelta 2) foup-fi-align-fi infront of swll	Al, substrate, O-ring	door is misaligned, O-ring wear, scraping against SWLL body	<10 min
1.2.2	I	FI-FOUP	[FOUP-FI]X10		substrate	bad handoffs	<5 min
1.2.3	I	FI BLADE	FOUP-[FI-ALIGNER]X10-FOUP		peek material, substrate	pad wear, plunger force	<5 min
1.2.6	I	FI Environment	FOUP-FI-[ALIGN]5mins-FI-FOUP			incorrect laminar flow, dirty, robot track	<10 min
1.2a	I	FI-SWLL(out)	FOUP-FI-ALIGN-[FI-SWLL(2)]X10-FOUP		Al, substrate	fin wear, handoffs, indexer, hoop misalignment	<10 min
1.2b	I	FI-SWLL(in)	FOUP-FI-ALIGN-[FI-SWLL(1)]X10-FOUP		Al, substrate	fin wear, handoffs, indexer, hoop misalignment	
1.3.1	I	SWLL SLIT VALVE	[SWLL SLIT VALVE-OPEN/CLOSE]X20	1) foup-fi-align-swll(2)-buffer(prim) in front of swll 2) foup-fi-align-swll(2)slot base	Al, O-ring, substrate	faceplate abrasion, loose fasteners, misalignment	<10 min

Table 2-3. Component Isolation Tests (Continued)

TEST #	PARTITION PATH	SPECIFIC PATH OR COMPONENT BEING TESTED	TEST DESCRIPTION	WAFER	Potential EDX signals	Potential issues	Approx. time to perform*
1.3.2.1	I	BUFFER (PRIM) WRIST BEARING	FOUP-FI-SWLL(2)-[BUFFER(PRIM) extend-retract into ChA w/ slit valve open, chA lifter in release position]x20-SWLL(1)-FI-FOUP		SST-half wfr cluster	lubrication degradation, bearing loading	<20 min
1.3.2.1	I	BUFFER (AUX) WRIST BEARING	FOUP-FI-SWLL(2)-[BUFFER(AUX) extend-retract into ChA w/ slit valve open, chA lifter in release position]x20-SWLL(1)-FI-FOUP		SST-half wfr cluster	lubrication degradation, bearing loading	
1.3.2.2	I	BUFFER CHAMBER	CYCLE PURGE(10T-500T)X5			wafer debris	<20 min
1.3a	I	BUFFER[prim]-SWLL(2)	FOUP-FI-[SWLL(2)-BUFFER(PRIM)]X10-FI-FOUP			fin wear, handoffs, indexer, hoop misalignment	<15 min
1.3b	I	BUFFER[AUX]-SWLL(2)	FOUP-FI-[SWLL(2)-BUFFER(AUX)]X10-FI-FOUP			fin wear, handoffs, indexer, hoop misalignment	
1.4.1	I	SWLL INDEXER	FOUP-FI-SWLL(2)-[slotdelta(2)-slotbase(1)]x20-FI-FOUP		SST, Al, substrate	misalignment, clamp blocks	<15 min
1.4.2	I	SWLL PUMP/ VENT	[SWLL PUMP-VENT]x20	1) foup-fi-align-swll(1) 2) foup-fi-align-swll(2)	SST, Al, substrate, Ni	diffuser, lid, vent gas, debris trapped in chamber	<30 min
1.4a	I	BUFFER[prim]-SWLL(1)	FOUP-FI-[SWLL(1)-BUFFER(PRIM)]X10-FI-FOUP			fin wear, handoffs, indexer, hoop misalignment	<15 min
1.4b	I	BUFFER[AUX]-SWLL(1)	FOUP-FI-[SWLL(1)-BUFFER(AUX)]X10-FI-FOUP			fin wear, handoffs, indexer, hoop misalignment	

Table 2-3. Component Isolation Tests (Continued)

TEST #	PARTITION PATH	SPECIFIC PATH OR COMPONENT BEING TESTED	TEST DESCRIPTION	WAFER	Potential EDX signals	Potential issues	Approx. time to perform*
VISUAL CHECKS	II	BUFFER HANDOFFS	VISUAL CHECK OF BUFFER PRIM & AUX BLADE HANDOFFS INTO CHA & CHB		Al, Mg, Ni, substrate, SST	handoffs	
	II	TRANSFER HANDOFFS	VISUAL CHECK OF TRANSFER PRIM & AUX BLADE HANDOFFS INTO CHA & CHB		Al, Mg, Ni, substrate, SST	handoffs	
	II	LIFT SPEEDS	VERIFY CHA & CHB LIFT SPEEDS			handoffs, wafer sliding	<15 min
	II	FILL RATES	VERIFY CHA & CHB FILL RATES			wafer sliding	<10 min
2.1.1	II	A BUFFER SLIT VALVE	[A BUFFER SLIT VALVE-OPEN/CLOSE]X20	1) foup-fi-swl(2)-buffer(prim)-A(release) 2) foup-fi-swl(2)-buffer(prim) in front of A	Al, O-ring, substrate	faceplate abrasion, loose fastners, misalignment	<15 min
2.1.2	II	A LIFTER	FOUP-FI-SWLL(2)-BUFFER(PRIM)-[A lift/release]X10-BUFFER(PRIM)-SWLL(1)-FI-FOUP		SST, substrate	misalignment, binding, speed	<15 min
2.1a	II	BUFFER(PRIM)-A	FOUP-FI-SWLL(2)-[BUFFER(PRIM)-A]X10-SWLL(1)-FI-FOUP		Al, Mg, Ni, substrate, SST	handoffs	<30 min
2.1b	II	BUFFER(AUX)-A	FOUP-FI-SWLL(2)-[BUFFER(AUX)-A]X10-SWLL(1)-FI-FOUP		Al, Mg, Ni, substrate, SST	handoffs	

Table 2-3. Component Isolation Tests (Continued)

TEST #	PARTITION PATH	SPECIFIC PATH OR COMPONENT BEING TESTED	TEST DESCRIPTION	WAFER	Potential EDX signals	Potential issues	Approx. time to perform*
2.2.1	II	A transfer SLIT VALVE	[A transfer SLIT VALVE-OPEN/CLOSE]X20	1) foup-fi-swl(2)-BUFFER(prim)-A-TRANSFER(PRIM) in front of A 2) foup-fi-swl(2)-BUFFER(prim)-A(release)	Al, O-ring, substrate	faceplate abrasion, loose fastners, misalignment	<15 min
2.2.2	II	TRANSFER (PRIM) WRIST BEARING	FOUP-FI-SWLL(2)-BUFFER(PRIM)-A-[TRANSFER(PRIM) extend-retract into ChA w/ slit valve open, chA lifter in release position]x20-BUFFER(PRIM)-SWLL(1)-FI-FOUP		SST-half wfr cluster	lubrication degradation, bearing loading	<20 min
2.2.3	II	TRANSFER (AUX) WRIST BEARING	FOUP-FI-SWLL(2)-BUFFER(PRIM)-A-[TRANSFER(AUX) extend-retract into ChA w/ slit valve open, chA lifter in release position]x20-BUFFER(PRIM)-SWLL(1)-FI-FOUP		SST-half wfr cluster	lubrication degradation, bearing loading	
2.2.4	II	TRANSFER CHAMBER	CYCLE PURGE(10T-500T)X5			wafer debris	<20 min

Table 2-3. Component Isolation Tests (Continued)							
TEST #	**PARTITION PATH**	**SPECIFIC PATH OR COMPONENT BEING TESTED**	**TEST DESCRIPTION**	**WAFER**	**Potential EDX signals**	**Potential issues**	**Approx. time to perform***
2.2a	II	TRANSFER(PRIM)-A	FOUP-FI-SWLL(2)-BUFFER(prim)-[A-TRANSFER(PRIM)]X10-BUFFER(prim)-SWLL(1)-FI-FOUP		Al, Mg, Ni, substrate, SST	handoffs	<30 min
2.2b	II	TRANSFER(AUX)-A	FOUP-FI-SWLL(2)-BUFFER(prim)-[A-TRANSFER(AUX)]X10-BUFFER(prim)-SWLL(1)-FI-FOUP		Al, Mg, Ni, substrate, SST	handoffs	
2.3.1	II	B BUFFER SLIT VALVE	[B buffer SLIT VALVE-OPEN/CLOSE]X20	1) foup-fi-swl(2)-buffer(prim)-B(release) 2) foup-fi-swl(2)-buffer(prim) in front of B	Al, O-ring, substrate	faceplate abrasion, loose fastners, misalignment	<15 min
2.3.2	II	B LIFTER	FOUP-FI-SWLL(2)-BUFFER(PRIM)-[B lift/release]X10-BUFFER(PRIM)-SWLL(1)-FI-FOUP		SST, substrate	misalignment, binding, speed	<15 min
2.3a	II	BUFFER(PRIM)-B	FOUP-FI-SWLL(2)-[BUFFER(PRIM)-B]X10-SWLL(1)-FI-FOUP		Al, Mg, Ni, substrate, SST	handoffs	<30 min
2.3b	II	BUFFER(AUX)-B	FOUP-FI-SWLL(2)-[BUFFER(AUX)-B]X10-SWLL(1)-FI-FOUP		Al, Mg, Ni, substrate, SST	handoffs	

Table 2-3. Component Isolation Tests (Continued)

TEST #	PARTITION PATH	SPECIFIC PATH OR COMPONENT BEING TESTED	TEST DESCRIPTION	WAFER	Potential EDX signals	Potential issues	Approx. time to perform*
2.4.1	II	B transfer SLIT VALVE	[B transfer SLIT VALVE-OPEN/CLOSE]X20	1) foup-fi-swl(2)-buffer(prim)-B-transfer(prim) in front of B 2) foup-fi-swl(2)-transfer(prim)-B(release)	Al, O-ring, substrate	faceplate abrasion, loose fastners, misalignment	<15 min
2.4a	II	TRANSFER(PRIM)-B	FOUP-FI-SWLL(2)-BUFFER(PRIM)-[B-transfer(PRIM)X10]-SWLL(1)-FI-FOUP		Al, Mg, Ni, substrate, SST	handoffs	<30 min
2.4b	II	TRANSFER(AUX)-B	FOUP-FI-SWLL(2)-BUFFER(PRIM)-[B-transfer(AUX)X10]-SWLL(1)-FI-FOUP		Al, Mg, Ni, substrate, SST	handoffs	
2.5	II	B RECIPE	FOUP-FI-SWLL(IN)-BUFFER(PRIM)-A-TRANSFER(PRIM)-[B COOL RECIPE in rel]X5-BUFFER(PRIM)-SWLL(1)-FI-FOUP		substrate, SST	wafer sliding, cool gas delivery	<20 min
2.5.1	II	B FILL/PUMP	FOUP-FI-SWLL(2)-BUFFER(PRIM)-B(RELEASE)-[FILL TO 2T/PUMP]X5-BUFFER(PRIM)-SWLL(1)-FI-FOUP			flow rate, filter, valve, gas purity	<10 min

Table 2-3. Component Isolation Tests (Continued)

TEST #	PARTITION PATH	SPECIFIC PATH OR COMPONENT BEING TESTED	TEST DESCRIPTION	WAFER	Potential EDX signals	Potential issues	Approx. time to perform*
VISUAL CHECKS	III	DEGAS CONFIG CHECK	VERIFY BKM CHAMBER CONFIGS			fill & pump parameters; chamber should be pumped with wafer in release position	
	III	DEGAS RECIPE CHECK	VERIFY BKM SETTINGS, INCLUDING HEADER				
	III	DEGAS FILL RATE	VERIFY DEGAS FILL RATE			wafer sliding, gas delivery defects	< 5 min
	III	DEGAS LIFT SPEEDS	VERIFY DEGAS LIFT SPEED			handoffs, wafer sliding	< 5 min
3.1	III	BUFFER(PRIM)-DEGAS	FOUP-FI-SWLL(2)-[BUFFER(PRIM)-DEGAS]X10-SWLL(1)-FI-FOUP			handoffs, slit valve, lifter	<10 min
3.1.1	III	DEGAS SLIT VALVE	[SLIT VALVE OPEN/ CLOSE]X20	1) fi-swll(2)-buffer(prim)-degas(release) 2) fi-swll(2)-buffer(prim) in front of degas	Al, O-ring, substrate	faceplate abrasion, loose fastners, misalignment	<15 min
3.1.2	III	DEGAS LIFTER	FOUP-FI-SWLL(2)-BUFFER(PRIM)-[DEGAS LIFT/RELEASE]X20-BUFFER(PRIM)-SWLL(1)-FI-FOUP		SST, substrate	hoop-pedestal-robot blade misalignment, lifter speeds, pedestal level & surface	<15 min

Table 2-3. Component Isolation Tests (Continued)

TEST #	PARTITION PATH	SPECIFIC PATH OR COMPONENT BEING TESTED	TEST DESCRIPTION	WAFER	Potential EDX signals	Potential issues	Approx. time to perform*
3.1.3	III	DEGAS CHAMBER	CYCLE PURGE(10T-500T)X5			wafer debris	<20 min
3.2	III	BUFFER(AUX)-DEGAS	FOUP-FI-SWLL(2)-[BUFFER(AUX)-DEGAS]X10-SWLL(1)-FI-FOUP			handoffs, slit valve, lifter	<10 min
3.3	III	DEGAS RECIPE	FOUP-FI-SWLL(2)-BUFFER(PRIM)-[DEGAS RECIPE IN RELEASE ONLY]X5-BUFFER(PRIM)-SWLL(1)-FI-FOUP			gas delivery, pump-vent, wafer movement, cryo slit valve	<20 min
3.3.1	III	DEGAS FILL/ PUMP	FOUP-FI-SWLL(2)-BUFFER(PRIM)-DEGAS(RELEASE)-[FILL TO 7T/PUMP]X5-BUFFER(PRIM)-SWLL(1)-FI-FOUP			flow rate, filter, valve, gas purity	<10 min
3.3.2	III	DEGAS CRYO SLIT VALVE	FOUP-FI-SWLL(2)-BUFFER(PRIM)-DEGAS(RELEASE)-[CRYO SLIT VALVE OPEN/ CLOSE]X10-BUFFER(PRIM)-SWLL(1)-FI-FOUP		Al, substrate, SST, o-ring	wafer debris, actuator assembly, faceplate wear, misalignment	<10 min

Table 2-3. Component Isolation Tests (Continued)

TEST #	PARTITION PATH	SPECIFIC PATH OR COMPONENT BEING TESTED	TEST DESCRIPTION	WAFER	Potential EDX signals	Potential issues	Approx. time to perform*
VISUAL CHECKS	IV	PRE-CLEAN CONFIG CHECK	VERIFY BKM CHAMBER CONFIGS			pump config, esc parameters, power supply calibration	
	IV	PRE-CLEAN RECIPE CHECK	VERIFY BKM SETTINGS, INCLUDING HEADER			chucking parameters, bsg flows, power levels, ignitions	
4.1	IV	BUFFER(PRIM)-PRE-CLEAN	FOUP-FI-SWLL(2)-[BUFFER(PRIM)-PRE-CLEAN]X10-SWLL(1)-FI-FOUP			handoffs, slit valve, lifter, pedestal	<10 min
4.1.1	IV	PRE-CLEAN SLIT VALVE	[SLIT VALVE OPEN/ CLOSE]X20	1) fi-swll(2)-buffer(prim)-PRE-CLEAN(release) 2) fi-swll(2)-buffer(prim) in front of PRE-CLEAN	Al, O-ring, substrate	faceplate abrasion, loose fastners, misalignment	<15 min
4.1.2	IV	PRE-CLEAN LIFTER	FOUP-FI-SWLL(2)-BUFFER(PRIM)-[PRE-CLEAN LIFT/PROCESS-open sv, extend blade, release-lift, extract blade, close sv]X10-BUFFER(PRIM)-SWLL(1)-FI-FOUP			hoop-pedestal-robot blade misalignment, lifter speeds, pedestal level & surface	<30 min

Table 2-3. Component Isolation Tests (Continued)

TEST #	PARTITION PATH	SPECIFIC PATH OR COMPONENT BEING TESTED	TEST DESCRIPTION	WAFER	Potential EDX signals	Potential issues	Approx. time to perform*
4.1.3	IV	CLEAN LIFTER(s)	FOUP-FI-SWLL(2)-BUFFER(PRIM)-[CLEAN LIFT/PROCESS-open sv, extend blade, release-lift, extract blade, close sv]X10-BUFFER(PRIM)-SWLL(1)-FI-FOUP			hoop-pedestal-robot blade misalignment, lifter speeds, pedestal level & surface	<30 min
4.1.4	IV	CLEAN CHAMBER	CYCLE PURGE(10T-500T)X5			wafer debris	<20 min
4.1.5	IV	PRE-CLEAN ESC	2 CONSECUTIVE BSP MAPS WITH MECH RECIPE, USING THE IDENTICAL PATHS FROM AND TO THE FOUP			esc parameters, wafer type, esc chucking force, dechucking	<1 hour
4.2	IV	BUFFER(AUX)-PRE-CLEAN	FOUP-FI-SWLL(2)-[BUFFER(AUX)-PRE-CLEAN]X10-SWLL(1)-FI-FOUP			handoffs, slit valve, lifter, pedestal	<10 min
4.3	IV	PRE-CLEAN RECIPE	FOUP-FI-SWLL(2)-BUFFER(PRIM)-[PRE-CLEAN RECIPE IN RELEASE ONLY]X5-BUFFER(PRIM)-SWLL(1)-FI-FOUP			esc parameters, gas flows, throttle valve, pumping	<20 min
4.3.1	IV	PRE-CLEAN THROTTLE					
4.3.2	IV	PRE-CLEAN GASES	FOUP-FI-SWLL(2)-BUFFER(PRIM)-PRE-CLEAN(RELEASE)-[TURN ON PARTICULAR GAS MFC TO HIGHEST FLOW FOR 3S]X10-BUFFER(PRIM)-SWLL(1)-FI-FOUP			gas flows, gas bursts, leaky valves/ mfc	<30 min

Table 2-3. Component Isolation Tests (Continued)

TEST #	PARTITION PATH	SPECIFIC PATH OR COMPONENT BEING TESTED	TEST DESCRIPTION	WAFER	Potential EDX signals	Potential issues	Approx. time to perform*
VISUAL CHECKS	V	PVD CONFIG CHECK	VERIFY BKM CHAMBER CONFIGS				
	V	PVD RECIPE CHECK	VERIFY BKM SETTINGS, INCLUDING HEADER				
	V	PVD LIFTER CHECKS	VERIFY BKM SETTINGS, CHECK FOR LIFTER BINDING, RUBBING, NOISE ETC				
5.1	V	TRANSFER(PRIM)-PVD	FOUP-FI-SWLL(2)-BUFFER(PRIM)-A-[TRANSFER(PRIM)-PVD]X10-A-BUFFER(PRIM)-SWLL(1)-FI-FOUP			handoffs, slit valve, lifter, pedestal, cover ring, dep ring	<10 min
5.1.1	V	PVD SLIT VALVE	[SLIT VALVE OPEN/ CLOSE]X20	1) fi-swll(2)-buffer(prim)-a-transfer(prim)-PVD(release) 1) fi-swll(2)-buffer(prim)-a-transfer(prim) in front of PVD	Al, O-ring, substrate	faceplate abrasion, loose fastners, misalignment	<15 min

Table 2-3. Component Isolation Tests (Continued)

TEST #	PARTITION PATH	SPECIFIC PATH OR COMPONENT BEING TESTED	TEST DESCRIPTION	WAFER	Potential EDX signals	Potential issues	Approx. time to perform*
5.1.2	V	PVD LIFTER(s)	FOUP-FI-SWLL(2)-BUFFER(PRIM)-A-TRANSFER(PRIM)-[PVD LIFT/PROCESS-open sv, extend blade, release-lift, extract blade, close sv]X10-TRANSFER(PRIM)-A-BUFFER(PRIM)-SWLL(1)-FI-FOUP			hoop-pedestal-robot blade misalignment, lifter speeds, pedestal level & surface	<30 min
5.1.4	V	PVD CHAMBER	CYCLE PURGE(10T-500T)X5			wafer debris	<20 min
5.1.5	V	PVD ESC	2 CONSECUTIVE BSP MAPS WITH MECH RECIPE, USING THE IDENTICAL PATHS FROM AND TO THE FOUP			esc parameters, wafer type, esc chucking force, dechucking	<1 hour
5.2	V	TRANSFER(AUX)-PVD	FOUP-FI-SWLL(2)-BUFFER(PRIM)-A-[TRANSFER(AUX)-PVD]X10-A-BUFFER(PRIM)-SWLL(1)-FI-FOUP			handoffs, slit valve, lifter, pedestal, cover ring, dep ring	<10 min
5.3	V	PVD RECIPE	FOUP-FI-SWLL(2)-BUFFER(PRIM)-A-TRANSFER(PRIM)-[PVD RECIPE IN RELEASE ONLY]X5-TRANSFER(PRIM)-A-BUFFER(PRIM)-SWLL(1)-FI-FOUP			esc parameters, gas flows, gate valve, pumping	<20 min

Table 2-3. Component Isolation Tests (Continued)

TEST #	PARTITION PATH	SPECIFIC PATH OR COMPONENT BEING TESTED	TEST DESCRIPTION	WAFER	Potential EDX signals	Potential issues	Approx. time to perform*
5.3.1	V	PVD GASES	FOUP-FI-SWLL(2)-BUFFER(PRIM)-A-TRANSFER(PRIM)-PVD(RELEASE)-[TURN ON PARTICULAR GAS MFC TO HIGHEST FLOW FOR 3S]X10-TRANSFER(PRIM)-A-BUFFER(PRIM)-SWLL(1)-FI-FOUP			gas flows, gas bursts, leaky valves/ mfc	<30 min
5.3.2	V	PVD CRYO GATE VALVE	FOUP-FI-SWLL(2)-BUFFER(PRIM)-A-TRANSFER(PRIM)-PVD(RELEASE)-[CRYO GATE VALVE OPEN/ CLOSE]X10-TRANSFER(PRIM)-A-BUFFER(PRIM)-SWLL(1)-FI-FOUP			wafer debris, contamination from cryo	<10 min

Table 2-4. Particle Clusters with Contact

Component	Geometric arrangement of defects	Isolation Test(s)	Potential EDX signal
SWLL fins	cluster around SWLL fin edge (SWLL fin wear, especially at fin edge)	1.2a,b; 1.4a,b	Al, substrate
FI blade	cluster around fangs or plunger	1.2.2,3	peek material, substrate
Buffer blade	cluster confined to fang edge or wrist edge	2.1a,b	Al-Mg, substrate, Ni
Transfer blade	cluster confined to fang edge or wrist edge	2.2a,b	Al-Mg, substrate, Ni
Degas lift fingers	cluster corresponding to 1 or 2 finger edges	3.1, 3.2, 3.1.2	SST-Fe, Cr, Ni; substrate
Pass-thru lift fingers	cluster corresponding to 1 or 2 finger edges	2.1a,b; 2.2a,b; 2.1.2	SST-Fe, Cr, Ni; substrate
Cool lift fingers	cluster corresponding to 1 or 2 finger edges	2.3a,b; 2.4a,b; 2.3.2	SST-Fe, Cr, Ni; substrate

Table 2-5. Particle Clusters without Contact

Component	Geometric arrangement of defects	Isolation Test	Potential EDX signal
slit valves	1/2 wafer distribution	1.3.1, 2.1.1, 2.2.1, 2.3.1, 2.4.1, 3.1.1, 4.1.1, 5.1.1	Al, substrate, C, Ca
wrist bearing	1/2 wafer distribution	1.3.2.1, 2.2.2	SST - Fe, Cr, Ni
diffuser	cluster confined to diffuser area	1.4.2	SST - Fe, Cr, Ni; substrate, Ni

Table 2-6. Calibration Tools

The following is a list of critical calibration tools required to ensure precise setup of components known to impact defect performance. It is essential that these tools and their associated procedures are used when performing initial setup and subsequent preventative and corrective maintenance.

Module	Part #	Description
Robot	0270-01156	CAL TOOL, HEATER-TO-ROBOT, 300MM ESC
Robot	0270-02076	TOOL ZERO POSTION ENDURA XP 300MM
Robot	0270-76245	FIXTURE, CALIBRATION ALIGNMENT PIN 300MM
Preclean	0270-02202	FIXTURE ADAPTER ALIGNMENT 300MM PC
Cool/Degas	0270-02768	TOOL CALIBRATION COOLDOWN / DEGAS 300MM
Chamber	0270-70043	CENTER ALIGNMENT PERP JIG, REV
Chamber	0270-76244	TOOL, CENTERING-CH CALIBRATION MDP 300MM
Chamber	0270-00755	FIXTURE, ROBOT ALIGNMENT 300MM ENDURA
SWLL	0270-02907	SWLL/ ROBOT CALIBRATION WAFER 300MM HT SWLL
LCF	0020-13048	SPINDLE, CALIBRATION WAFER
LCF	0021-76749	TOOL,OTF CALIBRATION WAFER
FI	0270-02299	WAFER, 300MM ROBOT PIN CALIBRATION, 300MM 5.3FI
FI	0270-02300	WAFER, 302MM ROBOT PIN CALIBRATION, 300MM 5.3FI
FI	0270-02456	PIN, 300MM ROBOT CALIBRATION, 300MM 5.3FI

Table 2-7. Checklists (1 of 6)

Item/Task	Frequency	Parts Required	Tools Required	Procedures
FI Checklist				
FI handoffs	Quarterly	-	0270-02299 0270-02300	5.3 FI Manual, 5.2
Home loadports	Weekly	-	-	-
Home robots	Weekly	-	-	-
FI door inspection & wipedown	Quarterly	IPA Wipes	-	-
ADO door latch Inspection	Quarterly	-	-	-

Table 2-7. Checklists (2 of 6)

Item/Task	Frequency	Parts Required	Tools Required	Procedures
SWLL Checklist				
Robot Handoff Verification	Quarterly	-	0270-70043 0270-00755	0260-06571
Indexer lubrication	None		-	-
Fin inspection	Monthly	-	-	-
Vent time verification	Quarterly	-	-	0250-28012
Rough time verification	Quarterly	-	-	0260-07520
Basic vacuum and wipedown	Monthly	IPA Wipes	-	-
Thorough vacuum and wipedown (remove hoop)	Quarterly	IPA Wipes	-	-
Replace diffuser	Quarterly	Diffuser: 4020-00050 VCR Gaskets (x2): 3320-01165	-	Maint Manual, 3.5.3.1
Check door O-ring	Quarterly	-	-	Maint Manual, 3.5.3
Replace door o-ring	Annual	3700-01379	-	Maint Manual, 4.17.1
Slit valve inspection & replacement	Semi-annual	0040-81424, IPA Wipes	0021-70091	Maint Manual, 3.6.1 and 4.11
Base pressure check	Daily	-	-	Maint Manual, 3.2.1
Rate-of-Rise Check	Weekly	-	-	Maint Manual, 4.13
Lamp replacement	Annual	1010-01116 (14 per SWLL)	0190-14994: Degas sling	Maint Manual, 4.16

Table 2-7. Checklists (3 of 6)

Item/Task	Frequency	Parts Required	Tools Required	Procedures
Buffer & Transfer Checklist				
XP Robot hub bearing replacement	Bi-annual	0242-29963	0270-02115: Ring lift fixture	Maint manual, 4.20
Robot wrist assembly replacement	Annual	0010-17402 or 0010-17403	-	Maint manual, 4.20.10
Robot blade replacement	Annual	0021-22627	-	-
Robot blade inspection and wipedown	Monthly	IPA Wipes	-	-
Robot zero position verification	Monthly	-	0270-02076	0260-07536
Home robots	Weekly	-	-	-
Chamber vacuum and wipedown	Monthly	IPA Wipes	-	-
LCF calibration	Upon Opening the Chamber	-	0020-13408 0021-76749	0260-07537
Lid o-ring replacement	As needed	3700-01091	-	Maint Manual, 2.3.6
Cryo regen	Monthly	-	-	-
Mainframe facilities gas in-line filters	Annual	4020-01145	-	-

Table 2-7. Checklists (4 of 6)

Item/Task	Frequency	Parts Required	Tools Required	Procedures
Degas Checklist				
Robot Handoff Verification	Quarterly	-	0270-02768	0260-06571
Lifter lubrication	None		-	-
Pedestal inspection & wipedown	Monthly	IPA Wipes	-	-
Fill rate verification	Quarterly	-	-	0260-07872
Lift speed verification	Quarterly	-	-	0250-28765
Slit valve inspection & replacement	Semi-annual	0040-81424, IPA Wipes	0021-70091	Maint Manual, 3.6.1 and 4.11
Basic vacuum and wipedown	Monthly	IPA Wipes	-	-
Thorough vacuum and wipedown (remove hoop)	Quarterly	IPA Wipes	-	-
Cryo regen	Monthly	-	-	-
Lid O-ring check / replacement	Annual	3700-01091	-	-

Table 2-7. Checklists (5 of 6)

Item/Task	Frequency	Parts Required	Tools Required	Procedures
A & B Checklist				
Buffer Robot Handoff Verification	Quarterly	-	0270-02768	0260-06571
Transfer Robot Handoff Verification	Quarterly	-	0270-02768	0260-06571
Lifter lubrication	None		-	-
Pedestal inspection & wipedown	Monthly	IPA Wipes	-	-
Fill rate verification	Quarterly	-	-	0260-07872
Lift speed verification	Quarterly	-	-	0250-28765
Slit valve inspection & replacement	Semi-annual	0040-81424, IPA Wipes	0021-70091	Maint Manual, 3.6.1 and 4.11
Basic vacuum and wipedown	Monthly	IPA Wipes	-	-
Thorough vacuum and wipedown (remove hoop)	Quarterly	IPA Wipes	-	-

Table 2-7. Checklists (6 of 6)

Item/Task	Frequency	Parts Required	Tools Required	Procedures
PVD / Clean Checklist				
Robot Handoff Verification	Quarterly	-	0270-70043 0270-00755	0260-06571
Lifter lubrication	None		-	-
Pedestal inspection & wipedown	Monthly	IPA Wipes	-	-
Cryo regen	Monthly	-	-	-
Pendulum valve maintenance (if applicable)	Annual	0242-22856	-	PC XTe Manual, 6.14
Lifter travel verification	Quarterly	-	-	-
Slit valve inspection & replacement	Semi-annual	0040-81425, IPA Wipes	0021-70090	Maint Manual, 3.6.1 and 4.11
Basic vacuum and wipedown	Monthly	IPA Wipes	-	-
Pedestal levelness verification	Upon change of hardware	-	-	-
Wafer lift levelness verification	Upon change of hardware	-	-	-
Shutter handoff verification	Upon change of disk	-	Alignment pin	0260-08351
Home lifters	Weekly	-	-	-
Home shutter	Weekly	-	-	-

3 Troubleshooting Flowcharts

The following flowcharts are meant to serve as a guideline for defect excursion troubleshooting. The average number of adders in the decision boxes for the different paths and tests are based on the requirements of less than 12 adders for an entire tool pass. Modify this limit based on individual system requirements.

All wafer adder maps should be examined for every test. The preserce of any particle concentrations should override the numebr of adders and efforts must be made to understand and eliminate the clusters.

The flowcharts are broken down to deal with five distict wafer paths through the system:

- Path I SWLL – buffer
- Path II Buffer – transfer – cooldown
- Path III Degas
- Path IV Clean
- Path V PVD

Paths I and II must be verified prior to troubleshooting any of the other paths in depth.

The numbers in the isolation test boxes of the flowchart refer to the Component Isolation Tests table.

Use the bookmarks menu of Acrobat Reader to navigate to each of the component isolation tables for the different paths.

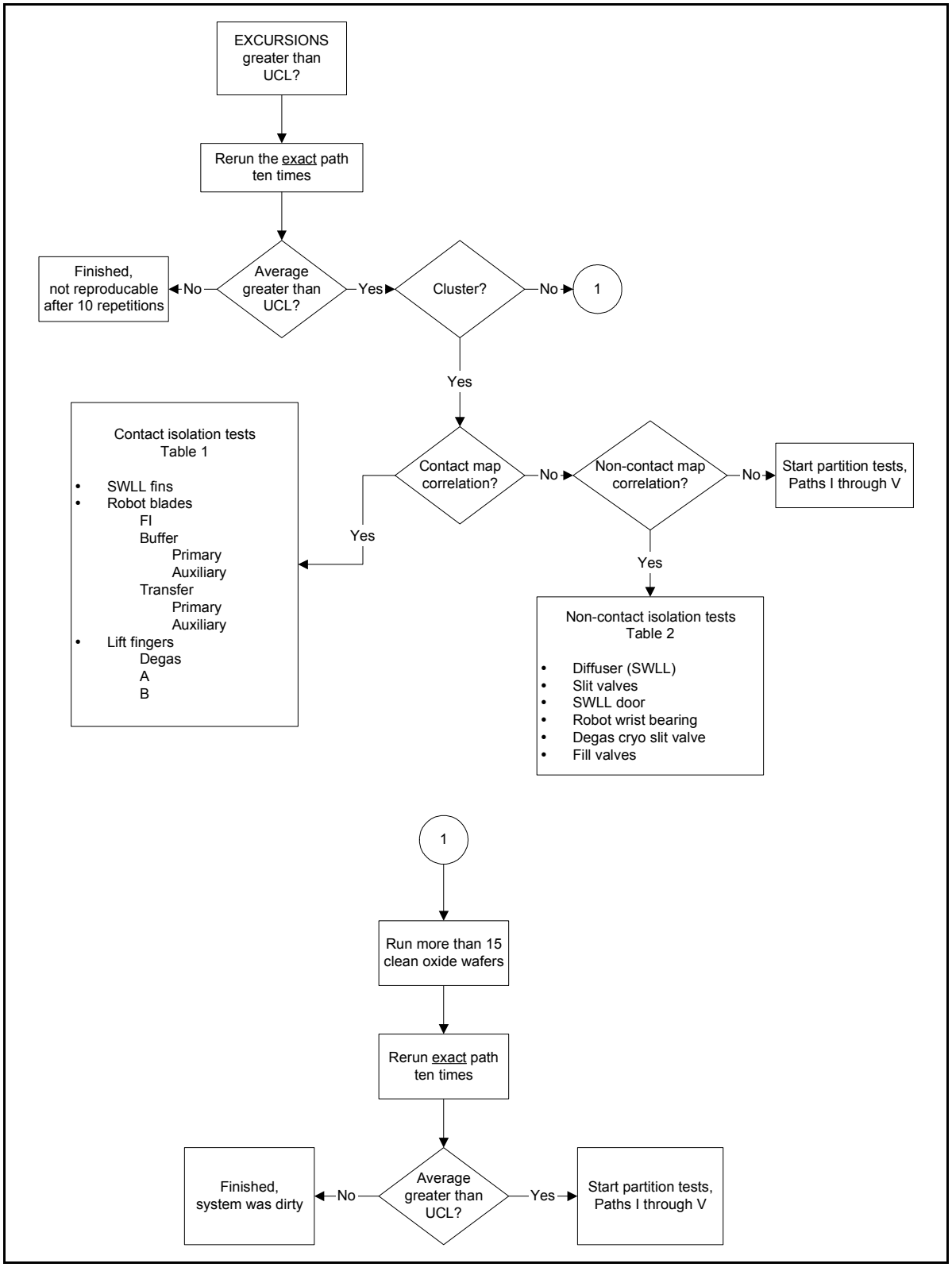

Figure 3-1. Troubleshooting Flowchart – Excursions

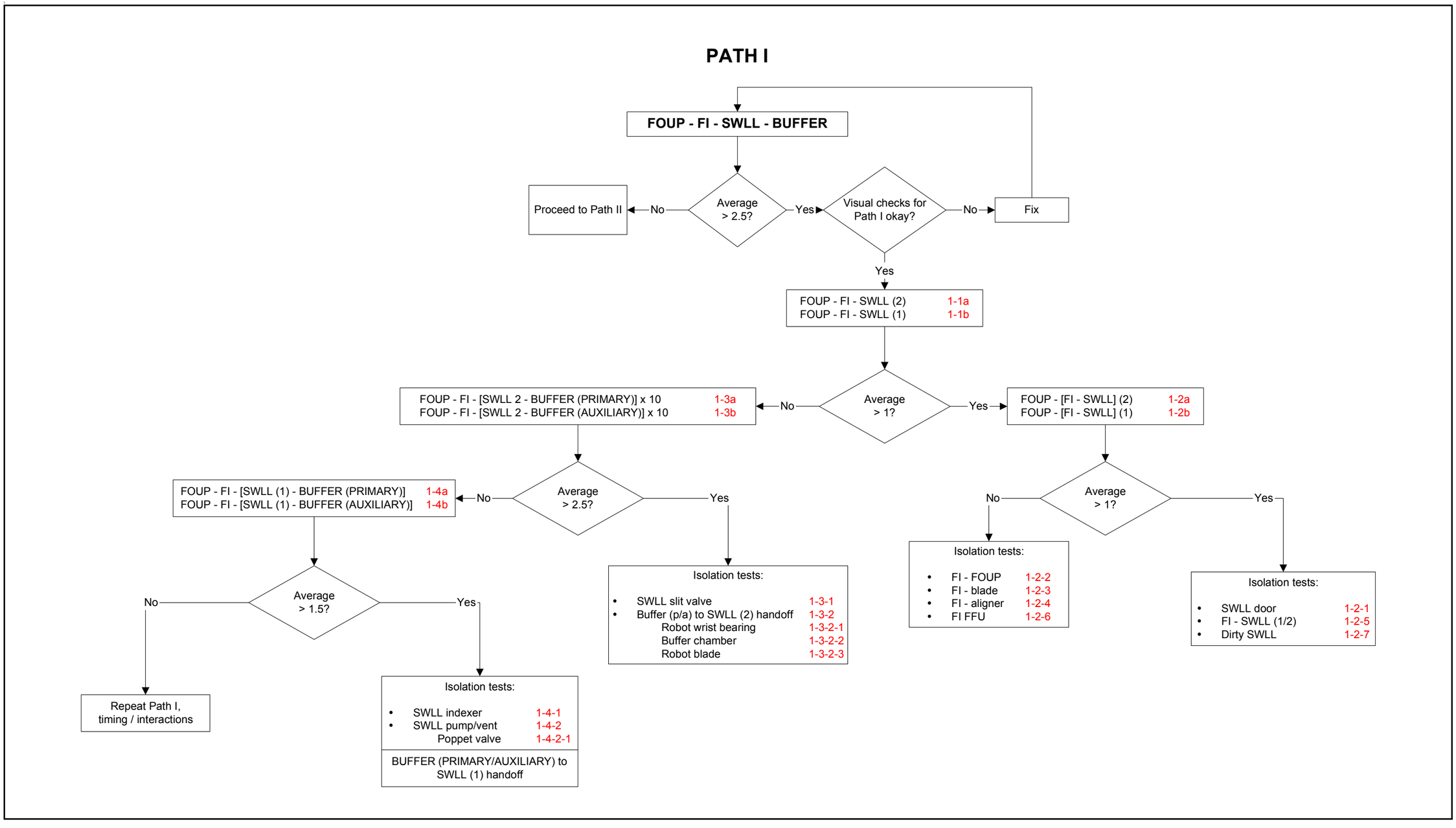

Figure 3-2. Troubleshooting Flowchart – Path I

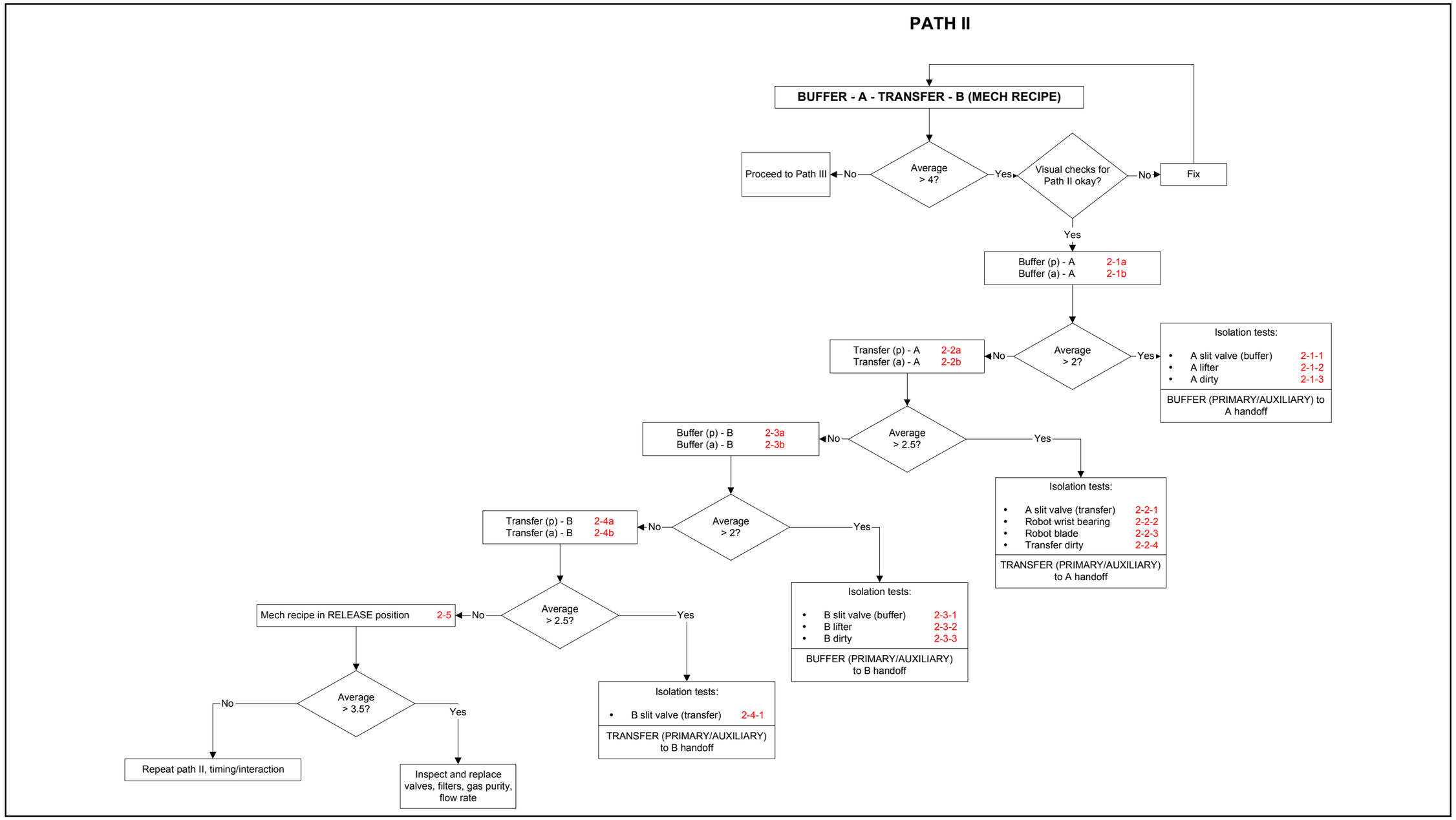

Figure 3-3. Troubleshooting Flowchart – Path II

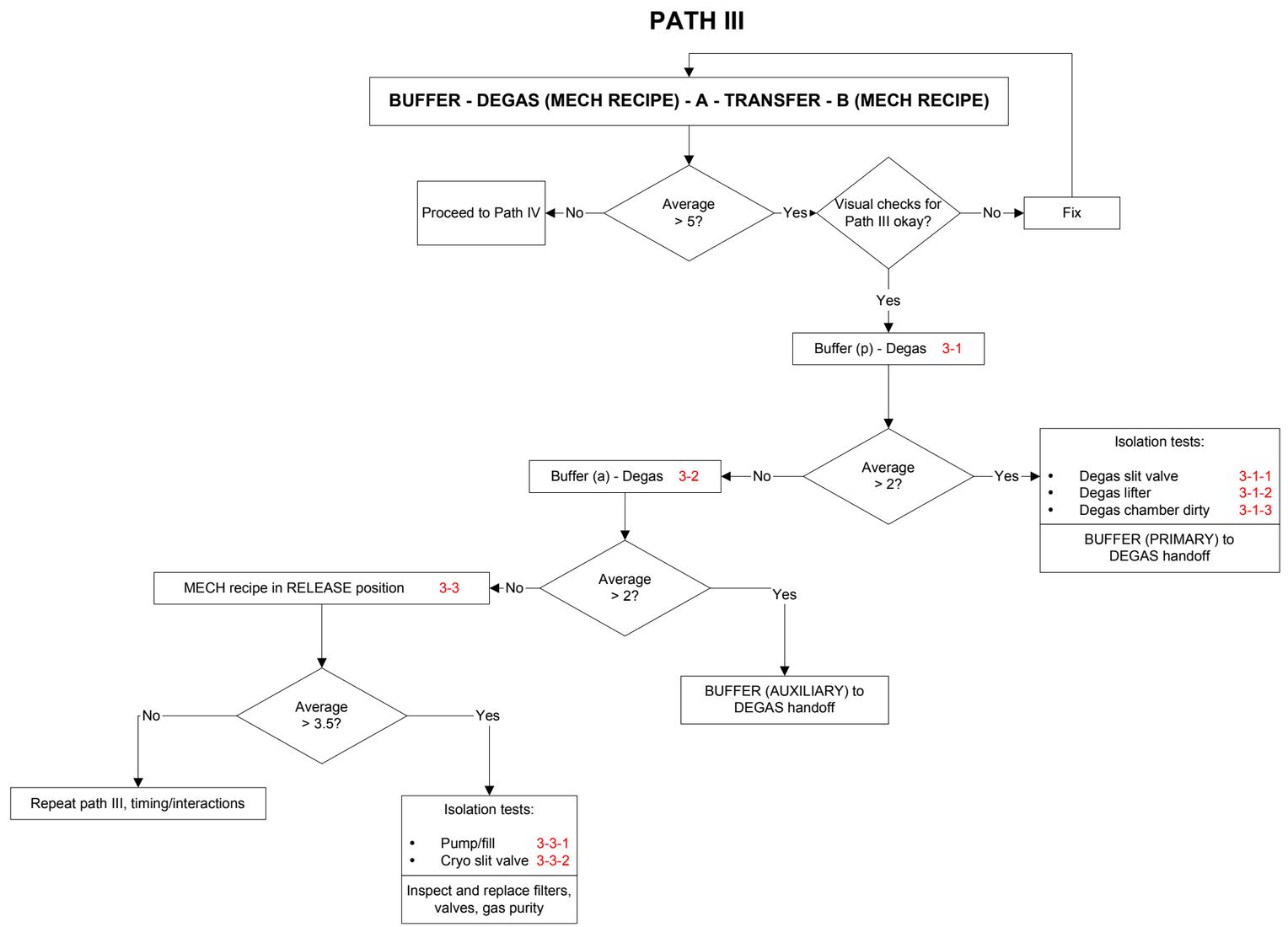

Figure 3-4. Troubleshooting Flowchart – Path III

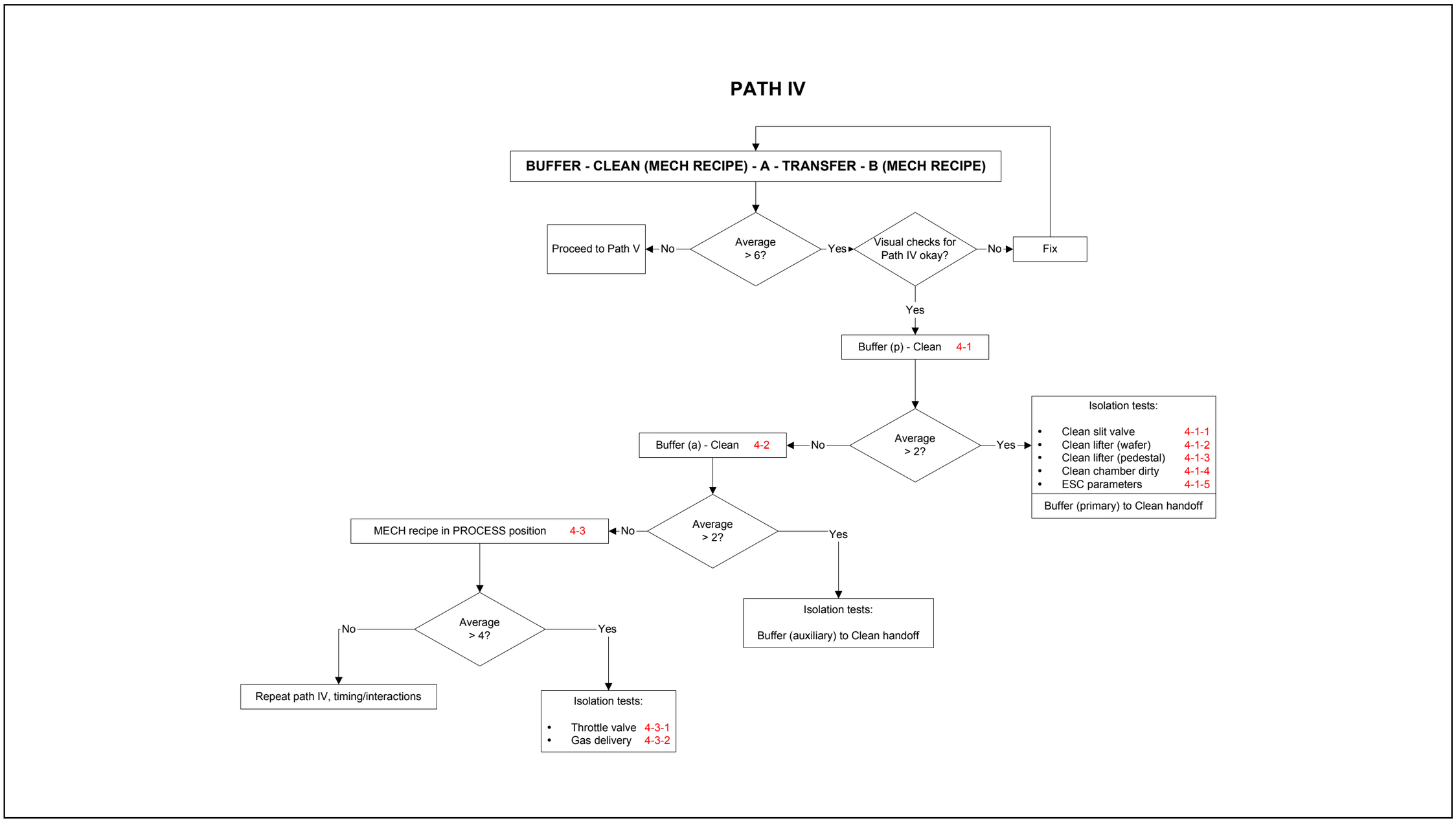

Figure 3-5. Troubleshooting Flowchart – Path IV

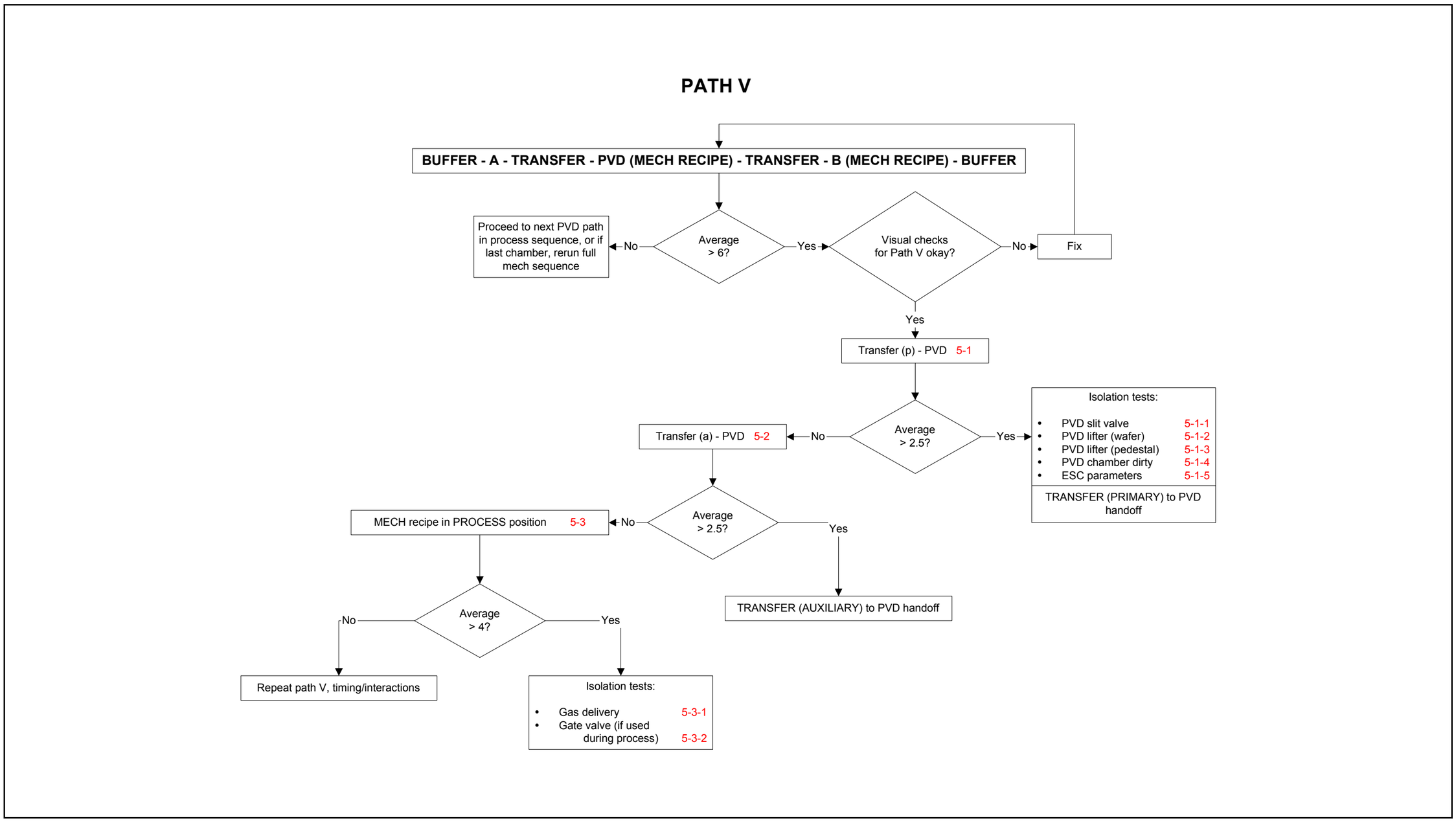

Figure 3-6. Troubleshooting Flowchart – Path V

4 Maps of Wafer Contact Points

This section contains maps of contact points that were generated using the *Defect Data Analyzer* program found on the CPI-GPS website, under the Defect Reduction heading. For these maps to accurately reflect the contact points of various components referenced with respect to the wafer notch, the wafer must be oriented so that the wafer notch is centered directly opposite a transfer-side chamber slit valve. The maps do not show contact areas for any pedestals.

- Figure 4-1 displays the contact points for the FI-SWLL-Buffer-Degas-Clean-A-Transfer-PVD (SLTESC)-B-Buffer-SWLL-FI path
- Figure 4-2 displays the contact points for buffer and transfer robots, and Ch A and Ch B lift fingers (A-B loop)
- Figure 4-3 displays the contact points for the FI and SWLL

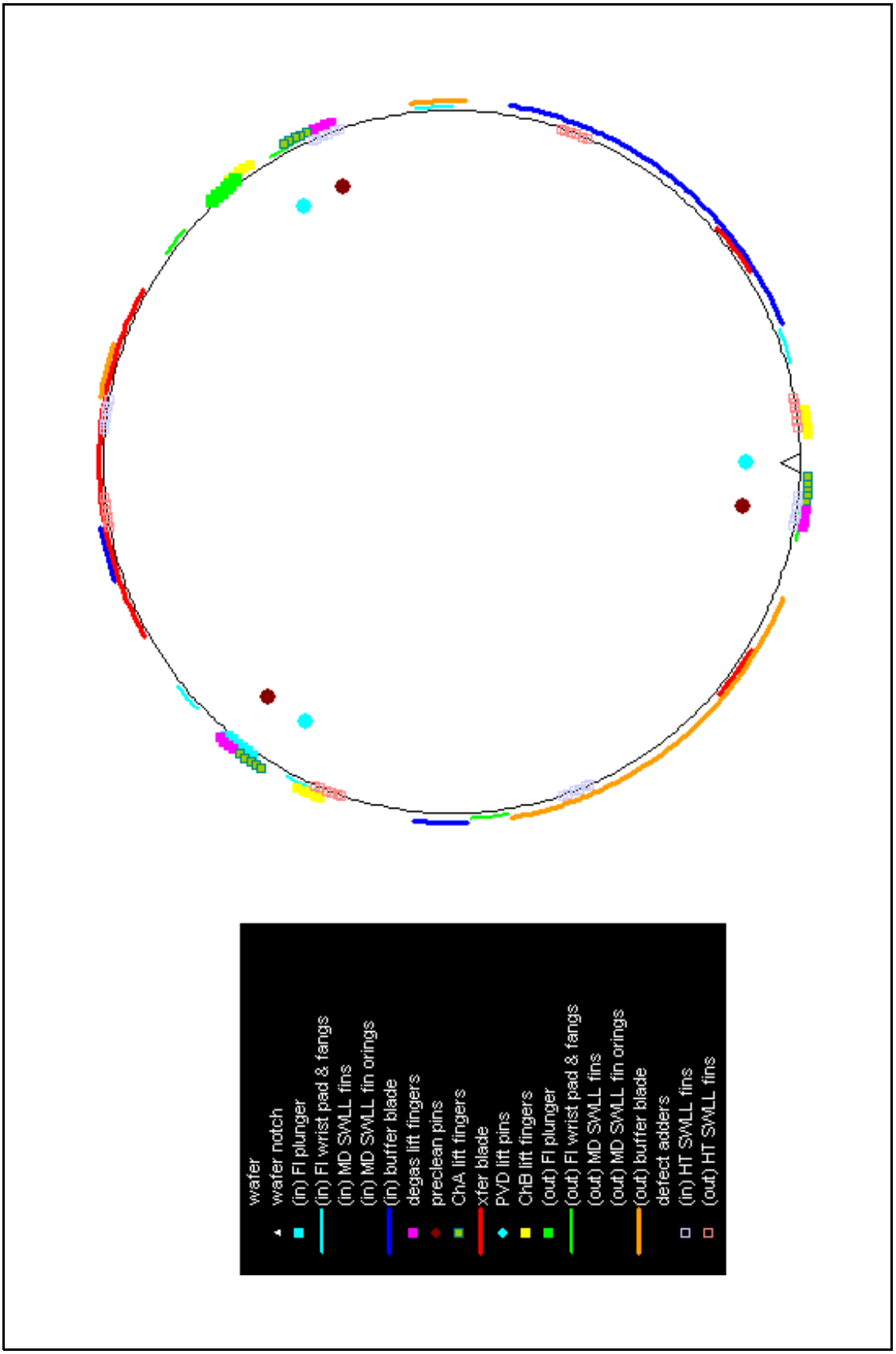

Figure 4-1. All Contact Points for CuBS System with ESC Pedestals

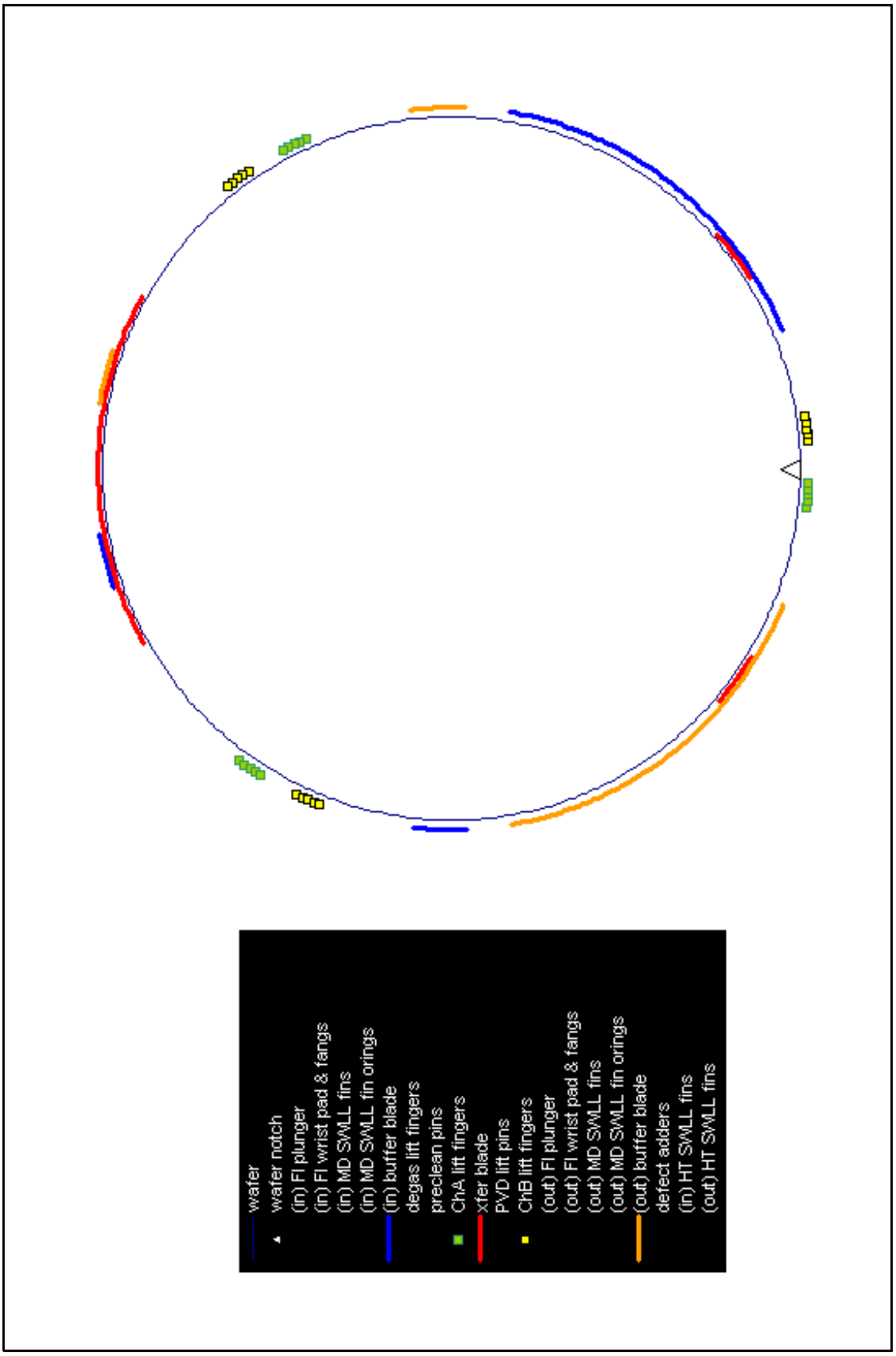

Figure 4-2. Contact Points for Robots and Ch A and B Lift Fingers (A-B loop)

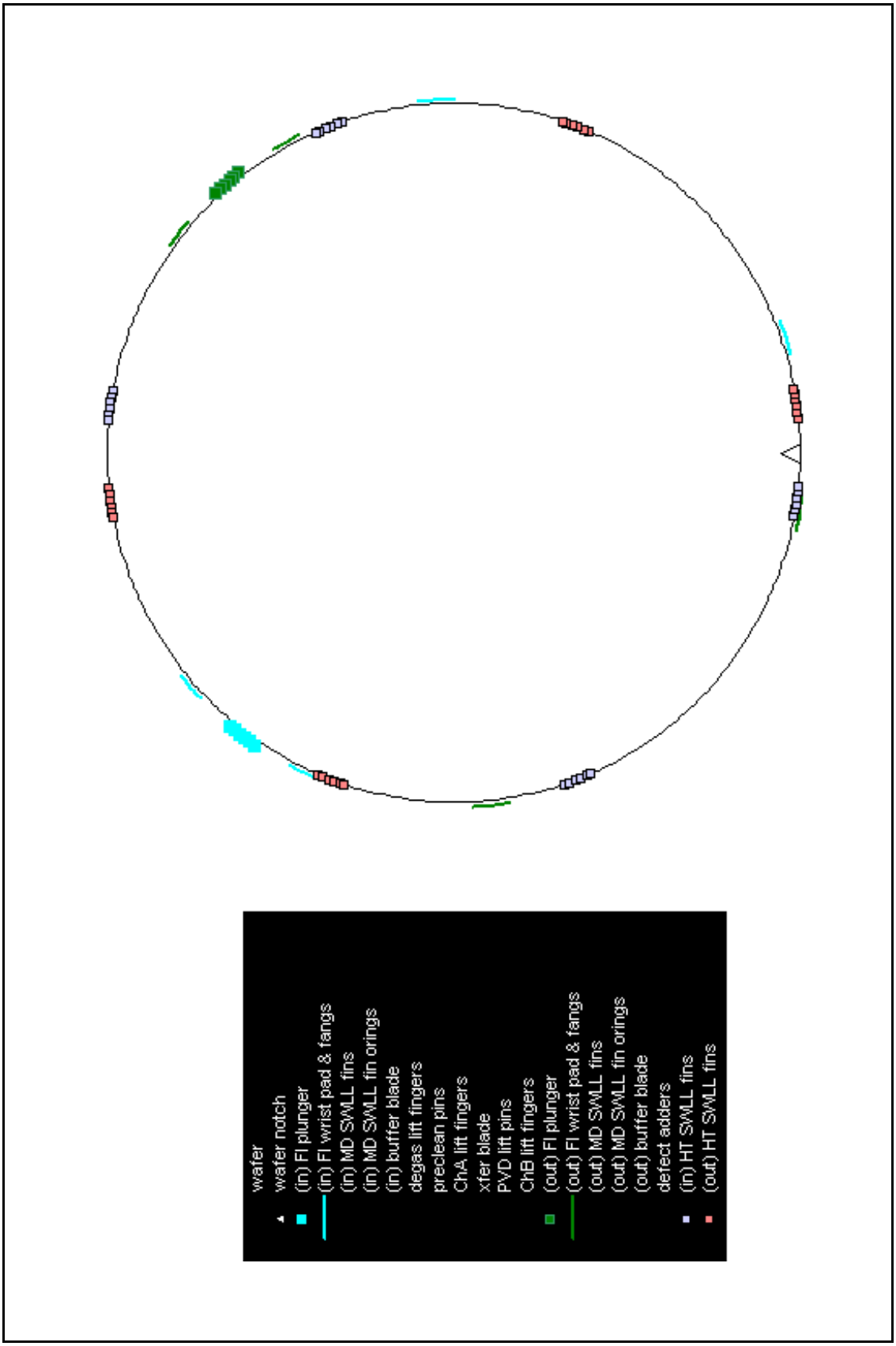

Figure 4-3. Contact Points for FI and SWLL

5 Broken Wafer Recovery

Do the following to recover from a broken wafer situation:

1. Ensure that all potential affected chambers are isolated from the non-affected chambers. All slit valves must be closed and not leaking because of wafer debris. If there is a leak up between chambers, both chambers must be vented and cleaned.
2. Follow all safety procedures to vent and open all affected chambers.
3. Take digital pictures of the wafer remains in all affected chambers.
4. Recover as many large pieces of the wafer as possbile and attempt to reconstruct the wafer. If there are large sections still missing, open up other chambers through which the wafer had passed. *IT IS CRITICAL TO REMOVE ALL PIECES OF THE WAFER*. Take digital pictures of the reconstructed wafer to aid in root cause identification. Also, copy the event logs and fault logs.
5. Remove process kit components and other components that may get in the way of vacuuming and wiping down the chamber. In the case of the SWLL and A/B, it may be necessary to remove the lift hoops to allow for adequate cleaning.
6. After vacuuming and wet cleaning with IPA saturated wipes, use high pressure N_2 to blow out the chamber. Pay special attention to those areas which are in tight corners, or recessed features. Extend the bellows assembly to its maximum and blow out the bellows. Cycle the bellows up and down several times and blow out again.

   The SWLL bellows are shrouded, making it extremely difficult to clean. It is recommended to change the bellows assembly upon a wafer break in the SWLL. At the least, the assembly must be removed, cleaned thoroughly outside the chamber, and reinstalled.
7. Open the chamber slit valve and vacuum and wipe down the faceplate and chamber insert thoroughly. Check both surfaces for signs of wear, and replace if any wear is noted.
8. Vacuum and wet clean again.
9. Prior to reinstalling the process kits or hoops, cycle purge the chamber 20 times with the bellows extended.
10. Vacuum and wet clean again.
11. Install the process kits and hoops, recalibrate wafer handoffs if the hoops were removed, and continue with the chamber recovery procedure.

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