

Repair, Maintenance and Improvement of R & D Equipments

Er. Jai Chand

Senior Technical Officer & In-charge
Dept. of Instrument Maintenance
CSIR-National Botanical Research
Institute, Lucknow



REPAIR

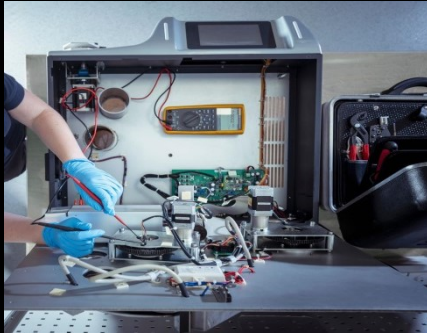


- Repair is a reactive measure taken to restore functionality after a breakdown or damage

Example :-

Fixing a broken component, replacing a damaged part, or restoring functionality after a failure.

Steps for General and R&D Equipment Repair



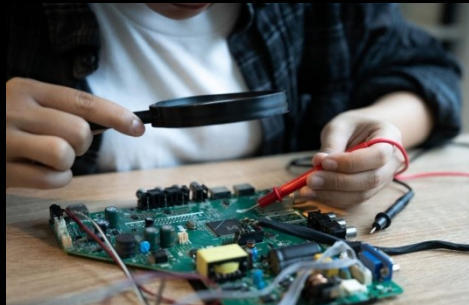
1. Issue identification



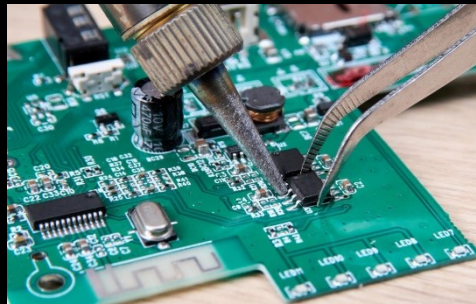
2. Safety precaution



3. Disassembly (if needed)



4. Inspection



5. Component Repair or Replacement



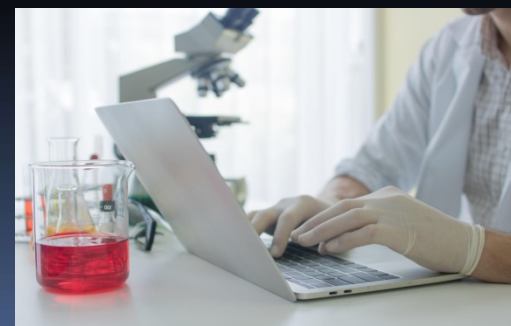
6. Assembly



7. Lubrication



8. Testing



9. Documentation

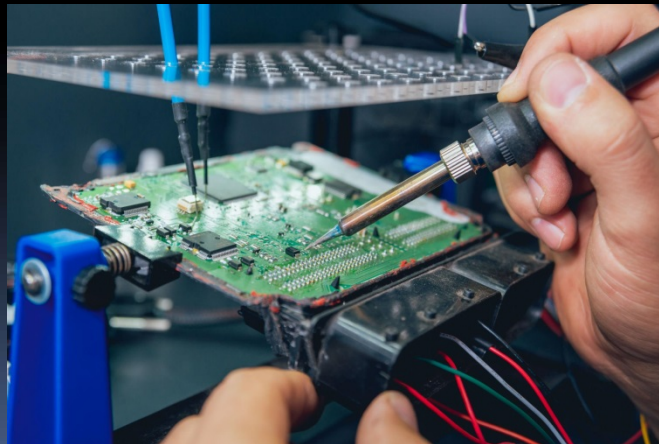
Specific Considerations for R&D Equipments



Calibration



Contamination



Specialized Repairs



Preventive Maintenance



MAINTENANCE

Maintenance is proactive, focusing on preventing failures and extending asset lifespan through

Examples:

Routine inspections, cleaning, lubrication, and replacement of worn-out parts.

LEVEL OF MAINTENANCE

FIRST – BY OPERATOR

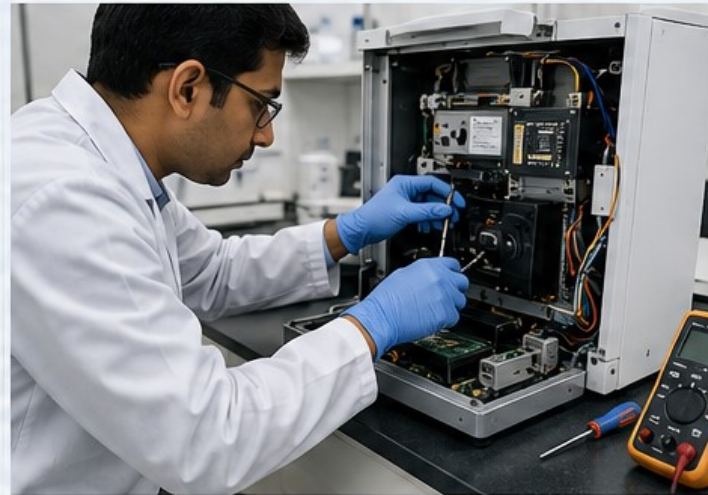


Routine inspection



Cleaning of equipment

SECOND – IN HOUSE STAFF



Detailed inspection & diagnostics



Adjustment, repair & part replacement



THIRD – BY PROFESSIONAL



Advanced diagnosis



Complex repair

01



OPTIMIZE UTILIZATION

- Ensure high availability and reliability of R&D instruments
- Maximize productivity and research output



05



EFFICIENT USE OF MAINTENANCE PERSONNEL

- Proper planning and scheduling of maintenance
- Optimal allocation of skilled personnel
- Improve efficiency and reduce response time



COST EFFECTIVENESS



- Reduce breakdown and downtime
- Lower repair costs planned maintenance
- Optimize spare parts and resource use

OBJECTIVES OF MAINTENANCE OF R&D INSTRUMENTS



PROLONGING THE LIFE OF EQUIPMENT



- Regular maintenance prevents premature wear and failure
- Extends the service life



TO MINIMIZE ACCIDENTS



- Regular inspection and repair of safety devices
- Ensure safe operation of instruments



1 ENSURING OPTIMUM OPERATIONAL EFFICIENCY

- Regular inspection, calibration and servicing of R&D instruments.
- Ensures accurate results, reliability and maximum performance.



2 MAINTAINING AN UP-TO-DATE OF EQUIPMENTS

- Keeping instruments updated with latest software, firmware and technology.
- Enhances functionality, compliance and life of equipment.



3 ANTICIPATING THE REQUIREMENT OF COMMONLY REQUIRED SPARES

- Identifying and maintaining essential spares inventory.
- Reduces downtime and ensures smooth operation.



SCOPES OF MAINTENANCE



4 BREAK DOWN MAINTENANCE IS PROMPT ENOUGH TO BE UN-INTERRUPTED

- Quick response to equipment breakdowns.
- Minimizes downtime and ensures continuous R&D activities.



5

ENSURING THE FACILITIES TO BE STAFF AND HAZARD FREE





MAINTENANCE



CORRECTIVE MAINTENANCE

Action taken after a failure to restore equipment to working condition.



BREAK-DOWN MAINTENANCE

Repair work carried out when equipment breaks down unexpectedly.



SCHEDULED MAINTENANCE

Planned maintenance activities performed at predetermined intervals to ensure reliability and performance.



PREVENTIVE MAINTENANCE

Routine inspections, cleaning, lubrication and replacement to prevent failures and extend equipment life.

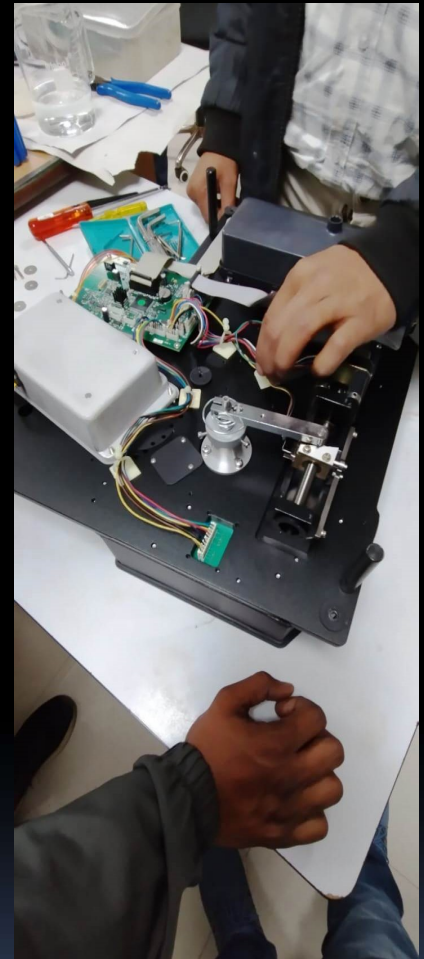


TURN AROUND MAINTENANCE

Comprehensive maintenance performed during planned shutdowns or turnaround periods to ensure reliable operation.



Inspection Maintenance



It is an activity to keep or maintain the equipment in proper condition before Failure

SCHEDULED MAINTENANCE

Scheduled maintenance, also known as preventive or planned maintenance, involves regularly scheduled inspections, repairs, and replacements to maintain equipment and systems in optimal condition.



This proactive approach aims to prevent breakdowns and reduce unplanned downtime by addressing potential issues before they escalate.



KEY BENEFITS



Prevents Breakdowns



Reduces Unplanned Downtime



Extends Equipment Life



Improves Reliability & Performance

MAINTENANCE SCHEDULE EXAMPLE

TASK	FREQUENCY	DETAILS	RESPONSIBLE
 Inspection	Every 500 Hours	Check all components, connections and safety devices	Operator
 Lubrication	Every 1000 Hours	Lubricate moving parts and bearings	Maintenance Technician
 Replacement	Every 6 Months	Replace filters, seals and worn-out parts	Maintenance Technician
 Calibration	Every 12 Months	Calibrate and verify instrument accuracy	Quality / Technical Team
		Overall system check	



SYSTEMS REQUIRE A



TIME

After a specific time (e.g., every 6 months)



HOURS OF OPERATION

After a certain number of hours the equipment has (e.g., every 500 / 1000 hours)



DISTANCE / USE

After a specific distance has been covered



PREVENTIVE MAINTENANCE

For R&D Instruments



It is defined as an art or method of carrying out maintenance on equipment to **prevent breakdown of the equipment** and **down time**.



It is a systematic **inspection, detection, correction and prevention** of **incipient failures** before they become actual or major failures.



ADVANTAGES



Minimizes unexpected breakdowns.



Reduces downtime and loss of productivity.



Lowers repair costs and extends equipment life.



DISADVANTAGES



Involves recurring cost of time and money.



Requires skilled and trained personnel.



Time consuming and may interrupt work.

TURN AROUND MAINTENANCE

PLANNED SHUT-DOWN. COMPLETE CARE. OPTIMAL PERFORMANCE.



DEFINITION

Turn Around Maintenance is a planned shut-down of a process or machine in order to perform repair and overhaul, testing and replacement of process equipment for effective operation.



PLANNED WELL

Turn Around Maintenance is planned one or more times a year to allow for adequate preparation and funding involved in carrying out the work.

OBJECTIVES / BENEFITS



Ensure safe and reliable operation



Restore equipment to optimum condition



Inspect, test and replace critical items

Improve

TYPICAL TURN AROUND PROCESS

1



2



3



4



5



PREDICTIVE MAINTENANCE

SMARTER INSIGHTS. TIMELY ACTION. MAXIMUM RELIABILITY.



DEFINITION

It is an activity to predict when equipment failure might happen and then perform maintenance to keep machines in operation.



HOW IT WORKS

It uses a process known as **condition monitoring** to check the status of equipment on a regular basis.



ADVANTAGES



Reduces unexpected breakdowns

Identifies potential failures early to prevent costly downtime.



Optimizes maintenance schedule

Maintenance is performed only when needed.



Lowers maintenance costs

Reduces unnecessary repairs and extends equipment life.



Improves safety

Minimizes risks of sudden equipment failure.



Increases productivity and reliability.

CONDITION MONITORING TECHNIQUES



VIBRATION MONITORING



THERMOGRAPHY



OIL ANALYSIS



ULTRASOUND



ANALYZE
PREDICT
ACT



DISADVANTAGES



High initial cost

Requires investment in equipment and skilled personnel.



Requires skilled personnel

Needs trained personnel to interpret data and make accurate decisions.



Data management

Large volume of data requires efficient integration and security measures.



Dependency on technology

Relies on sensors, communication networks, and data processing capabilities.

BREAKDOWN MAINTENANCE

REPAIR TODAY. RESTORE OPERATION.



UN
IM



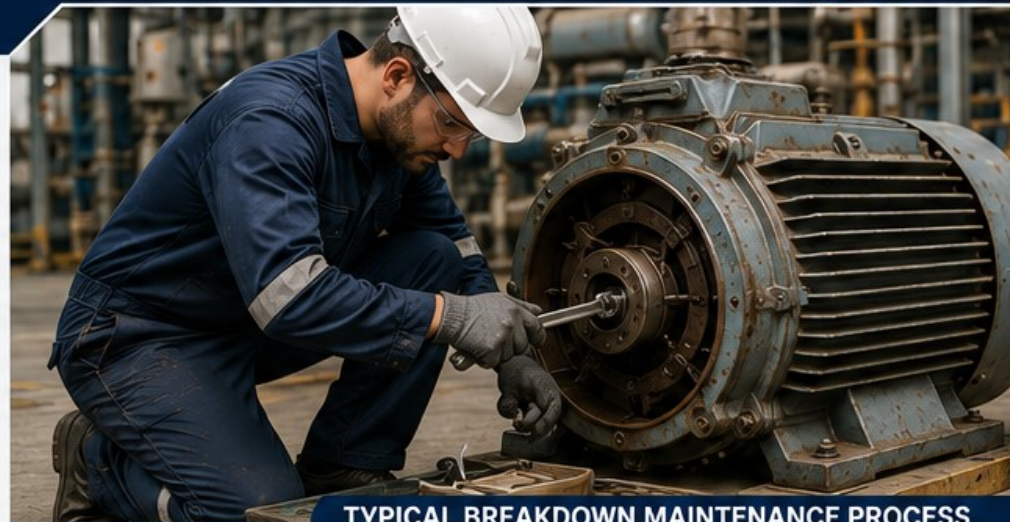
DEFINITION

It is defined as the repairs on replacement process carried out on a failed machine.



EXPLANATION

It is an activity usually carried out in order to bring the machine back to its functional state or working order.



TYPICAL BREAKDOWN MAINTENANCE PROCESS



FAILURE
OCCURS



PROBLEM
IDENTIFICATION



REPAIR /
REPLACEMENT



TESTING
INSPECTI



ADVANTAGES



No planned cost

No scheduled maintenance cost; expenses occur only when failure happens.



Immediate attention

Focuses resources only when there is an actual breakdown.



Simple to manage

Does not require planning, scheduling or detailed records.



DISADVANTAGES



High downtime

Leads to unexpected stoppages and loss of production.



Higher repair cost

Repairs and replacement are usually more expensive.



Risk of secondary damage

Breakdown can damage other parts or related equipment.



Safety & reliability issues

MASTER MAINTENANCE PLAN

PLAN SMART. MAINTAIN BETTER. ENSURE RELIABILITY.



This is maintenance organized and carried out comprehensively, effectively to a predetermined plan.

Preventive and **corrective** maintenance should be a part of master maintenance plan.



KEY ELEMENTS OF MASTER MAINTENANCE PLAN



Maintenance Policy



Maintenance Schedule



Job Procedures & Standards



Condition Monitoring



Performance Evaluation



Safety & Compliance

PREREQUISITES

1



Skill
Deployment of personnel activities

2



Regulatory
Provision of skills and technical knowledge

3



Establishment
Maintenance of spare parts

4



Establishment
Maintenance of records and compliance

5



Monitoring
Regular control and cost-effectiveness

6



Follow-up
Repair and ensure reliability

GENERAL EQUIPMENTS FOR R&D



Reliable Performance



Precision & Accuracy



Versatile Applications



Magnetic Stirrer



Rotavapour



Stirrer



Water Chiller



Hot plate



Microcentrifuge



Orbital shaker



Incubator shaker



Growth chamber



Water bath



Digester unit



Gel rocker



Microwave oven



Laminar air flow



Autoclave



SOPHISTICATED INSTRUMENTS

ADVANCED TECHNOLOGY. PRECISE ANALYSIS. RELIABLE RESULTS.

GC



Gas Chromatography for separation and analysis of volatile compounds.

AAS



Atomic Absorption Spectroscopy for trace metal analysis.

HPLC



High Performance Liquid Chromatography for separation, identification and quantification.

FLAME PHOTOMETER



For determination of alkali and alkaline earth metals in samples.

SPECTROPHOTOMETER



Measures the intensity of light for quantitative analysis.

GC-MS



Gas Chromatography - Mass Spectrometry for identification of complex compounds.

ICP-MS



Inductively Coupled Plasma - Mass Spectrometry for ultra-trace analysis of metals and elements.

LC-MS



Liquid Chromatography - Mass Spectrometry for sensitive and selective compound identification.

NMR



Nuclear Magnetic Resonance

TD-NMR



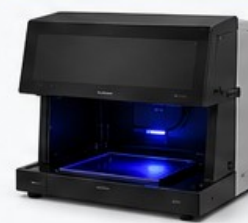
Time Domain NMR for

PCR



Polymerase Chain Reaction

GEL-DOC



Gel documentation and

XRD



X-Ray Diffraction for

TRAINING

Detailed training and instruction should be provided by a competent manufacturer's representative, particularly in the case of major equipment.



WELL
RELI



It is crucial that all operators are fully trained in the operation of the instruments including;

1

START-UP & SHUT-DOWN PROCEDURES



- Proper start-up steps for safe operation
- System checks
- Safe shut-down procedures



2

CLEANING & MAINTENANCE



- Routine cleaning procedures
- Preventive maintenance
- Extends equipment life and ensures accuracy

4

QC & CALIBRATION PROCEDURES



- Standard preparation
- Calibration steps
- Quality control checks
- Ensures data accuracy

5

TROUBLE SHOOTING



- Identify common issues
- Diagnose problems
- Corrective actions
- Minimizes downtime

BENEFITS OF PROPER TRAINING

- ✓ Improves instrument performance and reliability
- ✓ Ensures safety of operators and equipment
- ✓ Reduces errors and sample reanalysis
- ✓ Minimizes downtime and repair costs
- ✓ Ensures compliance with SOPs and regulations



EQUIPMENT INVENTORY RECORD



Maintain accurate records for effective management, tracking and maintenance of laboratory instruments.

RECORD THE FOLLOWING DETAILS:



INSTRUMENT TYPE, MODEL NUMBER, SERIAL NUMBER

Record complete details for unique identification.



LOCATION IN LABORATORY

Specify the room, section or bench location.



DATE OF PURCHASED

Record the date when the equipment was purchased.



MANUFACTURER AND VENDOR CONTACT INFORMATION

Include manufacturer name, vendor, phone, email and website.



WARRANTY

Record warranty type and coverage details.



NOTE ON EXPIRATION DATE

Track warranty or service contract expiration for timely renewal.



SPARE PARTS

List critical spare parts available.



BENEFITS OF MAINTAINING EQUIPMENT INVENTORY



Easy Tracking



Efficient Maintenance



Reduced Downtime



Cost Optimization



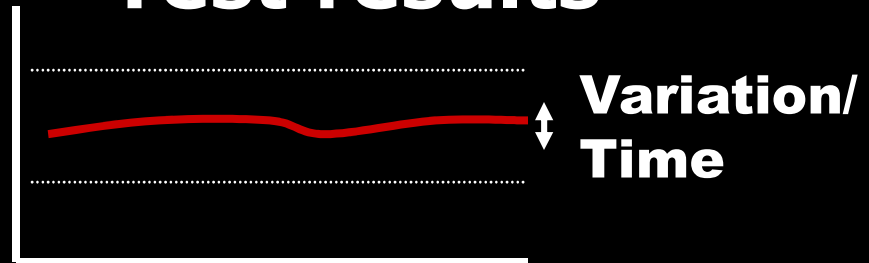
Com
R

Equipment Management Benefits



**High level
performance**

Test results



**Lengthens
lifespan**

**Lowers
repair costs**





SOME INSTRUMENT / EQUIPMENT PCBs

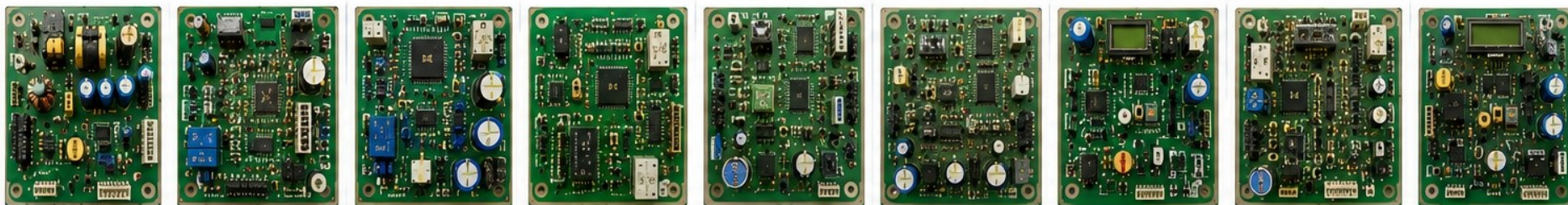
Some electronics / electrical , mechanical PCBs that are repaired / maintain by the instruments maintenance department Team Of **CSIR-NBRI Lucknow** and saved money for the institute.



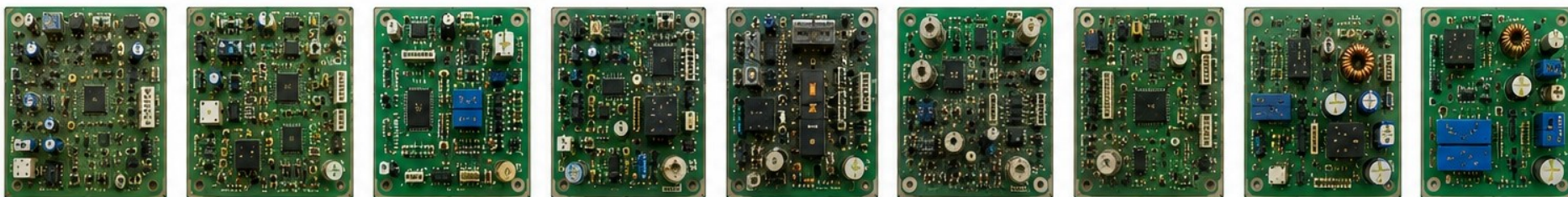
MAINTENANCE WITH IMPACT

In-house PCB repair and maintenance ensures equipment reliability and substantial cost savings for the Institute.

ELECTRONICS / ELECTRICAL PCBs



MECHANICAL / ELECTROMECHANICAL PCBs



OUR EXPERTISE

- PCB Level Diagnostics & Repair
- Component Level Repair / Replacement
- SMPS & Power Supply Repair
- Microcontroller Programming
- Functional Testing & Calibration
- Cost-effective Maintenance Solutions



SAVINGS TO THE INSTITUTE

- Reduced equipment downtime
- Avoided high AMC / repair costs
- Extended equipment life
- Improved reliability & performance
- Significant cost savings every year

BENEFITS



Quick
Turnaround
Time



Skilled &
Trained
Technical Team



Reliable &
Quality
Repairs



Support to
Research
Continuity



Strengthening
Self-Reliance



IN-HOUSE REPAIR. RELIABLE PERFORMANCE. REAL SAVINGS.

Committed to Excellence in Research Support

20/06/2026

Case Studies



Control Pannel of Covid Lab



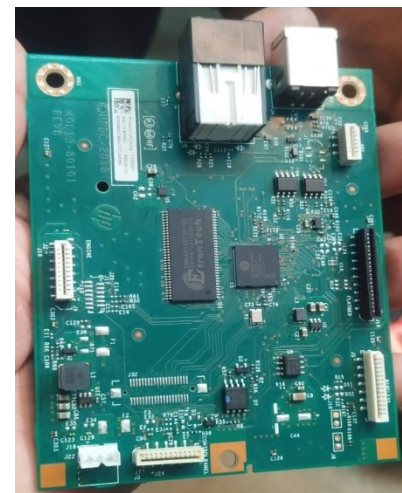
**Essential Oil
Fractionation Unit**



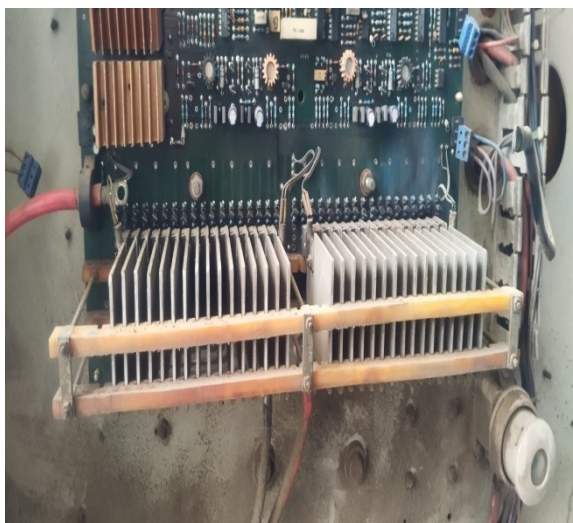
-20°C Fridge



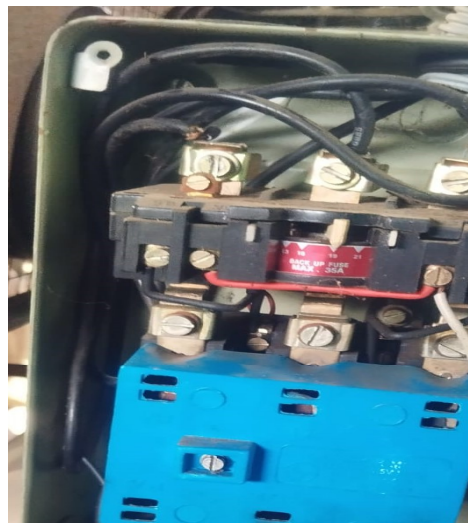
Vacuum Pump



**HP Printer
Main Logic Card**



UPS



**Starter of the Air
Generator**



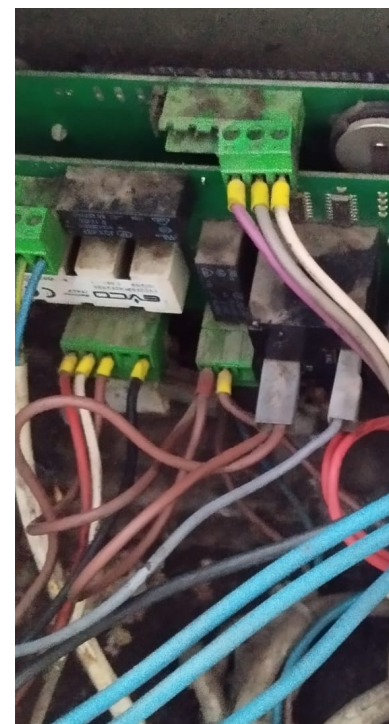
10 KVA UPS



**Incubator with
Shaker**



**Temperature
Controller of
Rheometer**



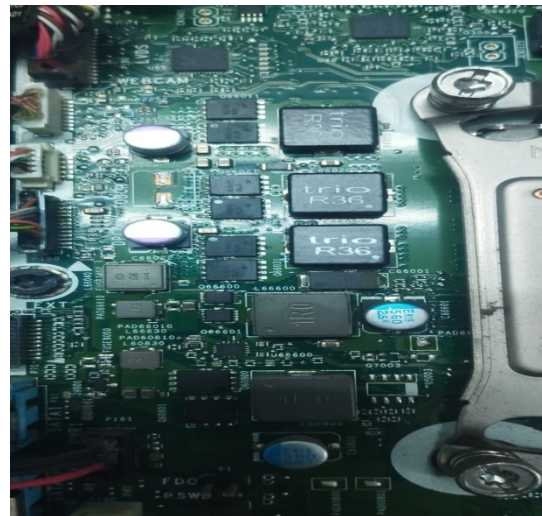
**Centrifuge
Machine Logic
Card**



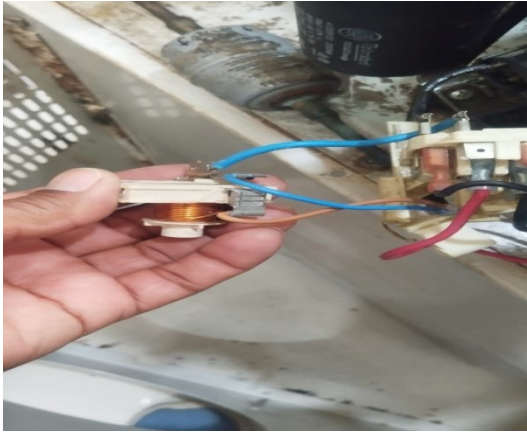
Autoclave



Power Supply of Inverter



Photocopy Machine Logic Card



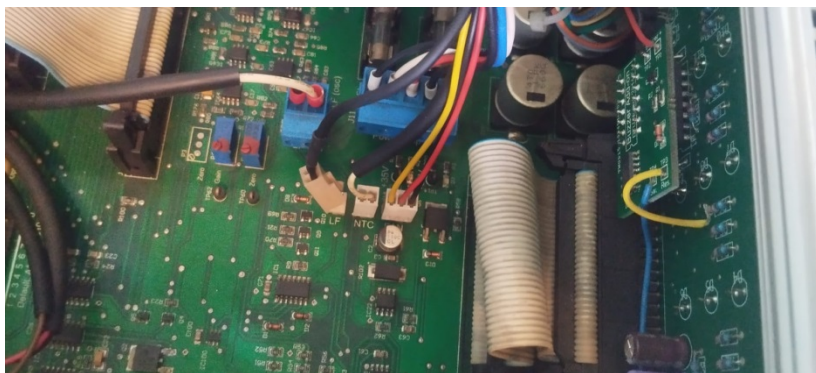
Relay Replacement of Fridge



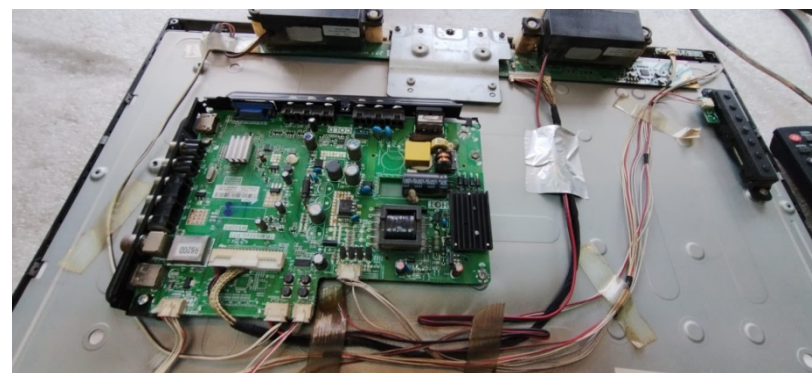
Power Supply of Vacuum Pump



Relay of -80°C Deep Freezer



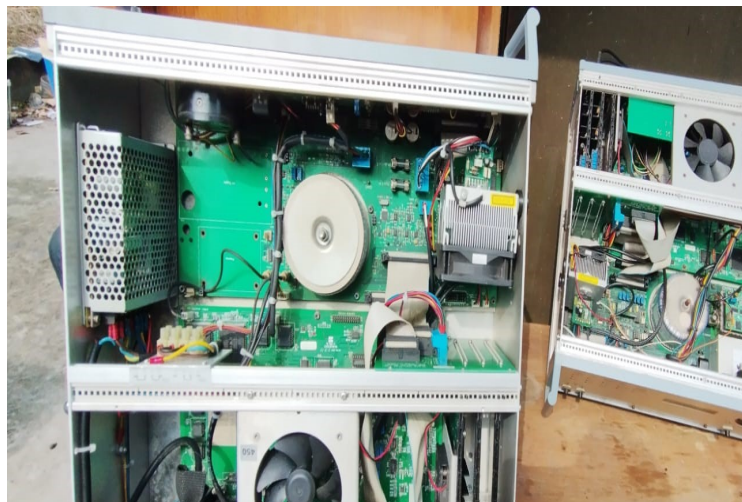
Instrument / Assay Back-up



Logic Card of Monitor



Incubator Cooling Relay



Function Generator

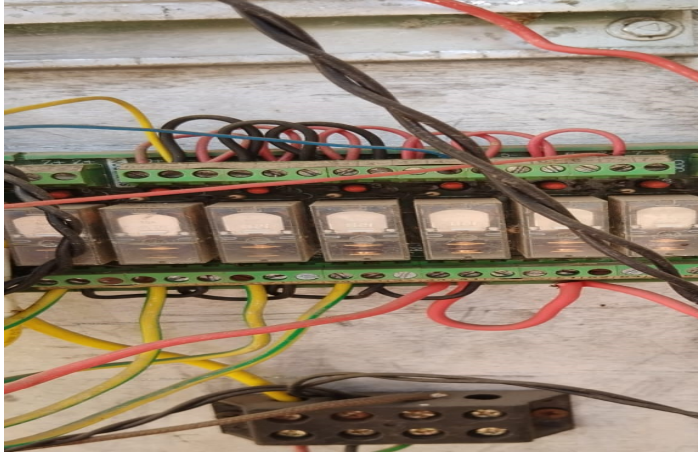


TD-NMR

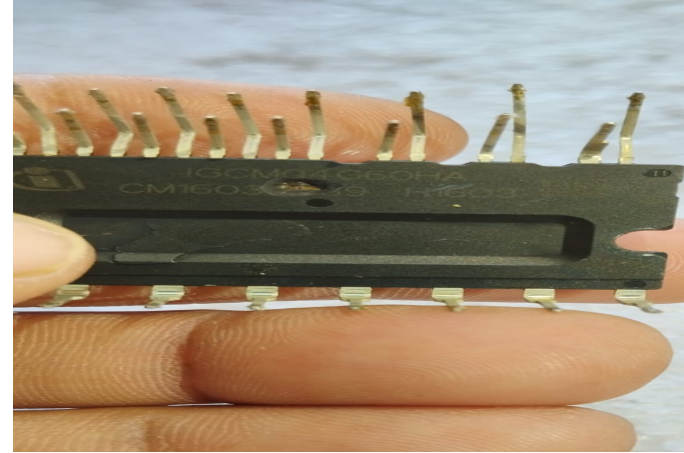


Controller PCB of 4°C Fridge

Sensor Relay PCB of Phase Facility



IGBT IC of Inverter Fridge



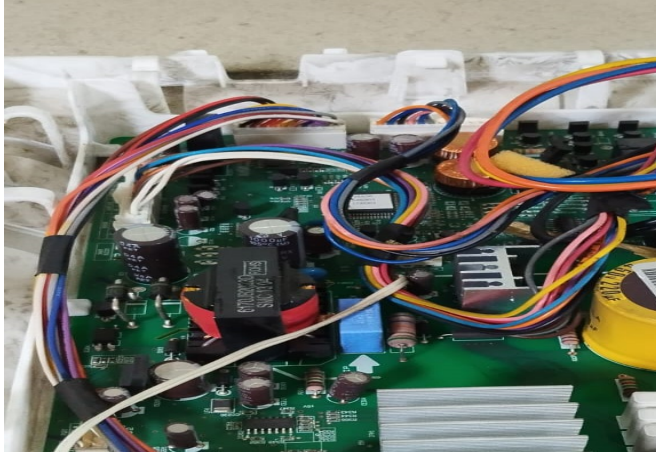
DC Motor Driver of Photocopy



Logic card of Pentium



Micro Centrifuge Power Supply



Incubator Shaker Display Repairing



Microwave Oven Controller



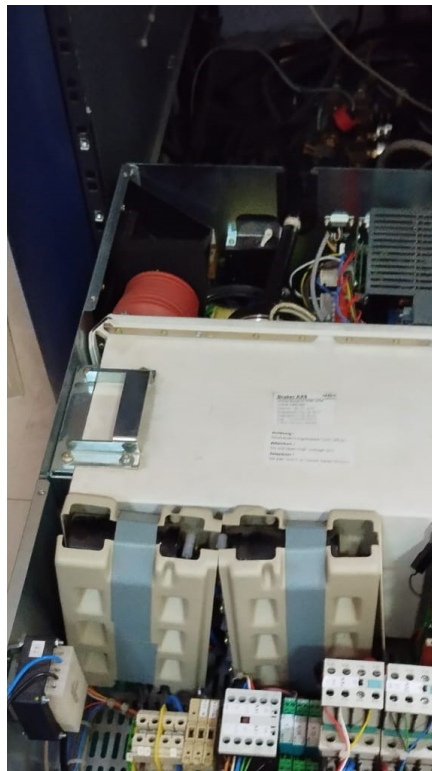
Centrifuge Starter



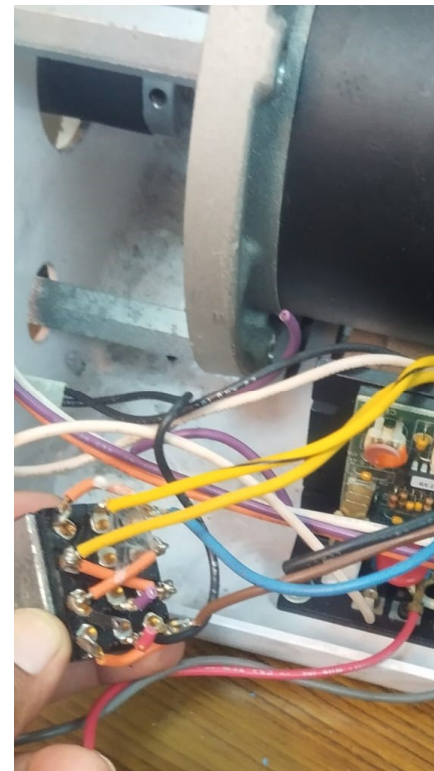
XRF High Voltage Generator



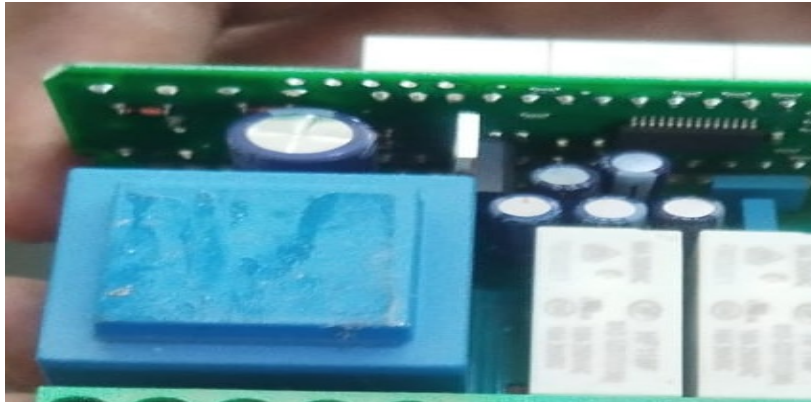
Internal Structure of Generator



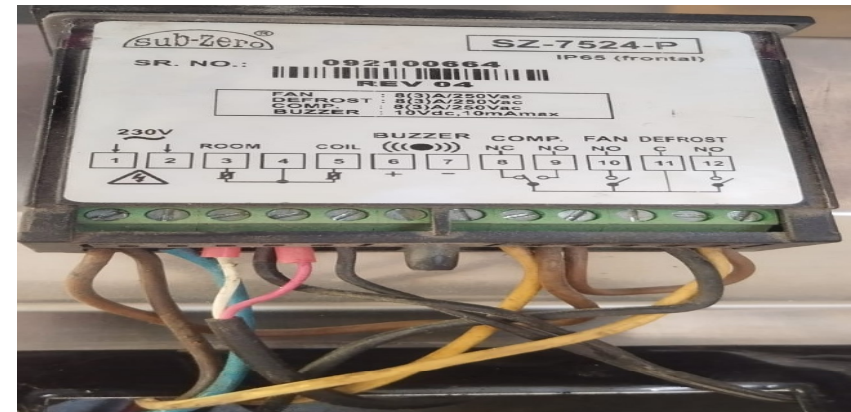
AAS Motor Supply



Internal Components of Temperature Controller



Circuit Diagram of Temperature Controller



Shaker With Internal Structure



Start Button Brake of Microwave Oven



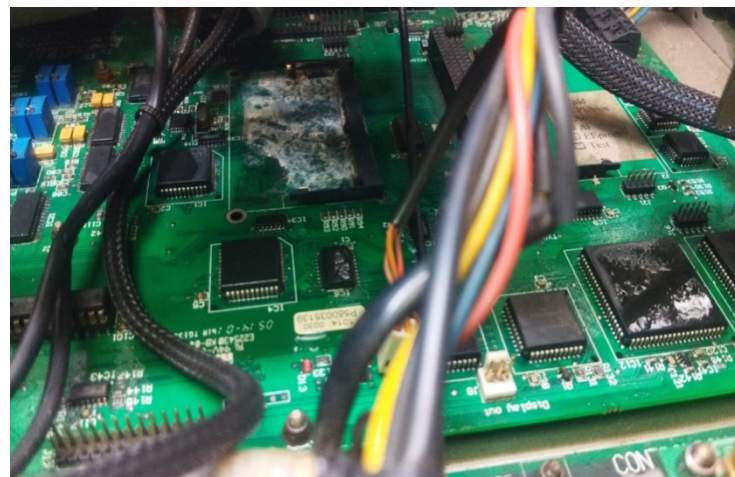
RAM Card



Analytical Weighing Balance



ICP-MS PCB board



MY TEAM





*Thank You For
Your Patience*

*Now we are open
for discussion.....*