NCVET
कौशल गुणवत्ता प्रगति

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कौशल भारत-कुशल भारत

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GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

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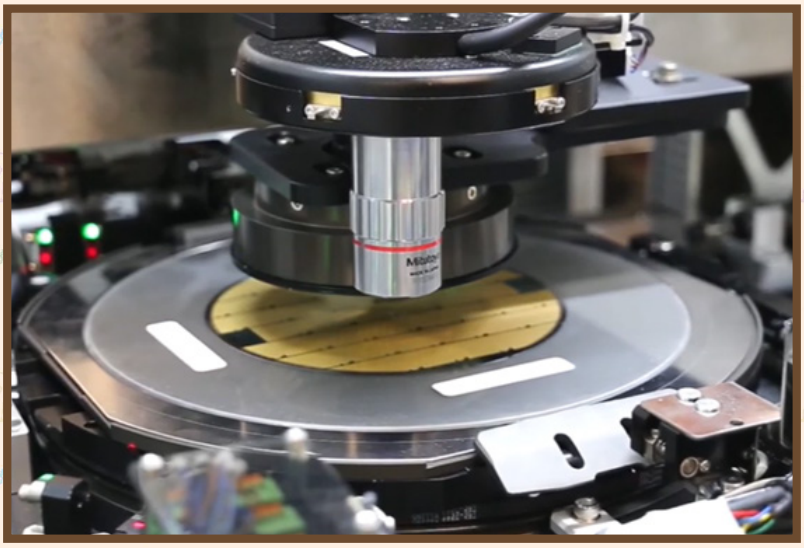
Facilitator Guide



Sector
Telecom

Sub-Sector
Semiconductor-Manufacturing & Packaging

Occupation
Semiconductor – M&P

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Assembly Process Technician - Wafer Testing

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> Skilling is building a better India. If we have to move India towards development then Skill Development should be our mission.

Shri Narendra Modi
Prime Minister of India

Acknowledgements

Telecom Sector Skill Council would like to express its gratitude to all the individuals and institutions who contributed in different ways towards the preparation of this "Participant Handbook". Without their contribution it could not have been completed. Special thanks are extended to those who collaborated in the preparation of its different modules. Sincere appreciation is also extended to all who provided peer review for these modules.

The preparation of this handbook would not have been possible without the Telecom Industry's support. Industry feedback has been extremely encouraging from inception to conclusion and it is with their input that we have tried to bridge the skill gaps existing today in the industry.

This participant handbook is dedicated to the aspiring youth who desire to achieve special skills which will be a lifelong asset for their future endeavours.

About this book

The facilitator guide (FG) for Assembly Process Technician - Wafer Testing is primarily designed to facilitate skill development and training of people, who want to become professional Assembly Process Technician - Wafer Testing in various organizations. The facilitator guide is aligned to the Qualification Pack (QP) and the National Occupational Standards (NOS) as drafted by the Sector Skill Council (TSSC) and ratified by National Skill Development Corporation (NSDC).

It includes the following National Occupational Standards (NOSs)-

1. TEL/N7201: Assemble Wafer Test Equipment
2. TEL/N7202: Perform Wafer Test Procedures
3. TEL/N7203: Analyze Wafer Test Data
4. TEL/N7204: Maintain Wafer Test Equipment
5. DGT/VSQ/N0102: Employability Skills (60 Hours)

Post this training, participants will be able to operate wafer testing equipment, execute testing procedures, and document results. They will identify defects, collaborate with engineering on corrective actions, and maintain high standards of quality and precision in wafer testing for telecom applications. We hope this Participant Handbook will provide sound learning support to our young friends to build an attractive career in the telecom industry.

Symbols Used

Ask


Explain


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1. Role and Responsibilities of Assembly Process Technician - Wafer Testing

Unit 1.1: Fundamentals of Telecom Networks and the Indian Telecom Market
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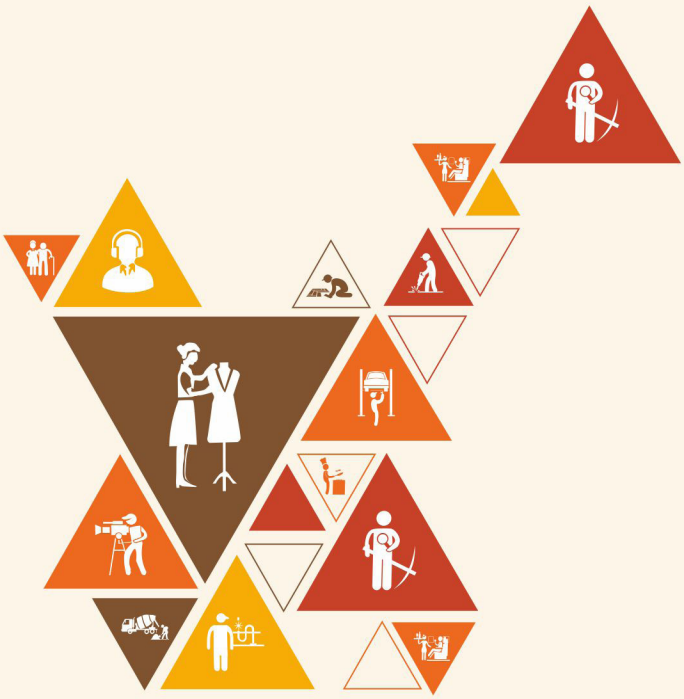


TEL/N7201

Key Learning Outcomes

At the end of this module, the participant will be able to:

1. Discuss the basics of telecom networks, including different network types (wired, wireless) used in telecom infrastructure
2. Discuss the potential of the Indian telecom market over the next decade.
3. Explore the basics of semiconductors, their role in telecom devices, and the concept of wafer fabrication.
4. Discuss the significance of wafer testing in ensuring the quality and functionality of telecom equipment.
5. Discuss the importance of adhering to industry standards and regulations in telecom wafer testing.
6. List the safety precautions to be taken while working in a cleanroom environment.
7. Discuss the importance of using personal protective equipment (PPE) and demonstrate proper use.
8. Explain the essential role of Assembly Process Technicians in wafer testing for the telecom industry
9. Identify professional skills required for career advancement in wafer testing

Unit 1.1: Fundamentals of Telecom Networks and the Indian Telecom Market

Unit Objectives

At the end of this unit, the participants will be able to:

1. Understand the basics of telecom networks, including wired and wireless types.
2. Explain the components and infrastructure of telecom networks.
3. Analyze the potential growth of the Indian telecom market over the next decade.
4. Identify opportunities for skill development in the evolving telecom industry.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the fundamentals of telecom networks, their components, and infrastructure. We will analyze the future growth potential of the Indian telecom market and explore skill development opportunities to adapt to the evolving industry. This unit equips learners with essential knowledge to navigate the dynamic telecom sector effectively.

Ask

Ask the participants the following questions:

- What are the key differences between wired and wireless telecom networks, and how do they influence communication?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Understand the basics of telecom networks, including wired and wireless types

- **Wired Telecom Networks**

  Wired telecom networks use physical cables, such as fiber optics, coaxial cables, or twisted pairs, to transmit data. Fiber optic cables are the most advanced, offering ultra-fast speeds and high bandwidth. Wired networks provide stable and reliable connections, making them ideal for fixed locations like offices and homes. These networks are less prone to interference and are widely used for internet and telecommunication services.

- **Wireless Telecom Networks**

  Wireless telecom networks use electromagnetic waves to transmit data without the need for physical cables. These include cellular networks (like 4G and 5G), Wi-Fi, and satellite systems. Wireless networks enable mobility, allowing users to stay connected on the go. They are crucial for widespread coverage in rural and remote areas where laying cables might not be feasible. Wireless systems support mobile communication, IoT devices, and global connectivity.

Explain the components and infrastructure of telecom networks

Telecom networks consist of core components like routers, switches, and transmission towers. Infrastructure includes base stations, optical fiber cables, and data centers that ensure connectivity and data processing. Together, these components support seamless communication across local and global networks.

Analyze the potential growth of the Indian telecom market over the next decade

The Indian telecom market is poised for significant growth, driven by increasing smartphone penetration, the expansion of 5G, and rising internet users. Innovations in technology and government initiatives, like Digital India, will further boost the sector, creating opportunities for investments and advancements in communication.

Identify opportunities for skill development in the evolving telecom industry

- **Network Engineering and Management:** With the expansion of telecom infrastructure, there is a growing demand for professionals skilled in designing, managing, and maintaining advanced networks, including 5G and fiber optics.
- **Cybersecurity Expertise:** The increasing reliance on telecom networks for critical operations makes cybersecurity a priority. Professionals trained in securing networks and preventing data breaches are highly sought after.
- **Data Analytics and AI Integration:** As telecom companies gather vast amounts of data, expertise in data analytics and artificial intelligence helps optimize operations, enhance customer experience, and predict market trends.
- **IoT and Smart Technology Applications:** The integration of IoT in telecom opens opportunities for developing and managing interconnected devices, smart homes, and industrial automation systems.
- **Cloud Computing and Virtualization:** Skills in cloud-based services and network virtualization are essential for enabling scalable and efficient telecom solutions.
- **Customer Relationshi Management (CRM):** With customer-centric services gaining importance, professionals skilled in CRM tools and customer engagement strategies play a vital role in improving service quality and satisfaction.

Say

Let us participate in an activity to explore the unit a little more.

Activity

- Arrange the class in a semi-circle/circle.
- Each of us will tell the class their name, hometown, hobbies and special quality about themselves, starting with the 1st letter of their name. I will start with mine.
- Say your name aloud and start playing the game with your name.
- Say, “Now, each of one you shall continue with the game with your names till the last person in the circle/ semi-circle participates”.
- Listen to and watch the trainees while they play the game.
- Ask questions and clarify if you are unable to understand or hear a trainee.

Activity	Duration	Resources used
Ice Breaker	60 minutes	Pen, Notebook, etc.

Remember to:

- Discourage any queries related to one’s financial status, gender orientation or religious bias during the game.
- Try recognising each trainee by their name because it is not recommended for a trainer to ask the name of a trainee during every interaction

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Encourage active participation and ensure every group member contributes during discussions.
- Provide guidance on using scenario cards effectively, emphasizing creative and realistic solutions.
- Foster a collaborative atmosphere by highlighting the importance of diverse perspectives in addressing skill development challenges.

Unit 1.2: Basics of Semiconductors and Wafer Fabrication

Unit Objectives

At the end of this unit, the participants will be able to:

1. Define semiconductors and explain their role in telecom devices.
2. Understand the process of wafer fabrication and its significance.
3. Describe the relationship between semiconductors and telecom advancements.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the importance of semiconductors in the telecom industry, explore the process of wafer fabrication, and analyze how semiconductors contribute to advancements in telecom technologies. This knowledge provides insight into the role of microelectronics in shaping modern communication systems and their impact on technological growth

Ask

Ask the participants the following questions:

- What are semiconductors, and why are they critical to the functioning of telecom devices?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Define Semiconductors and Explain Their Role in Telecom Devices

Semiconductors are materials whose electrical conductivity lies between that of conductors and insulators. This unique property makes them ideal for controlling electrical currents in a precise manner. Silicon and germanium are common examples of semiconductors. Their ability to switch and amplify electrical signals underpins the functioning of electronic devices.

In telecom devices, semiconductors play a pivotal role by forming the basis of critical components like transistors, diodes, and integrated circuits. These components enable efficient signal processing and data transmission, making semiconductors indispensable for technologies such as mobile phones, satellites, and internet networks. Their versatility supports advancements in communication systems, enhancing connectivity and performance.

Understand the Process of Wafer Fabrication and Its Significance

Wafer fabrication is the process of creating semiconductor wafers, which serve as the base for microelectronic circuits. It involves intricate steps like doping, etching, and deposition. This process ensures precision and quality, enabling the production of reliable and efficient telecom components. Its significance lies in driving innovation and meeting the demands for faster and more compact communication devices.

Describe the Relationship Between Semiconductors and Telecom Advancements

Semiconductors are pivotal in advancing telecom technologies. They enable the development of faster processors, efficient network systems, and high-speed data transmission. Innovations like 5G, IoT, and satellite communication rely heavily on semiconductor technology to provide the speed, connectivity, and performance required in modern communication systems.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Exploring Semiconductor Applications in Telecom Devices

Group Size: 4-6 participants

Materials: Whiteboard or flipchart, markers, sticky notes (different colors), application cards (described below)

Activity Duration: 60 minutes

Instructions

Setup and Objective Introduction (10 minutes):

- Divide participants into groups of 4-6.
- Explain the objectives: to understand and explore the applications of semiconductors in various telecom devices.
- Briefly review the role of semiconductors, including key components like transistors, diodes, and integrated circuits, in telecom technologies.

Scenario-Based Exploration (20 minutes):

- Distribute application cards to each group. Each card describes a telecom device or scenario involving semiconductors (e.g., mobile phones, satellites, 5G networks).
- Groups will discuss the following prompts:
  - How do semiconductors enable the operation of the described device or system?
  - What specific semiconductor components are used in the application?
  - How do advancements in semiconductor technology impact the device's performance and features?

Group Presentations (20 minutes):

- Each group presents their findings, focusing on the semiconductor components involved and their critical role in the device's operation.
- Encourage questions and discussions from other groups to promote peer learning.

Debrief and Takeaways (10 minutes):

- Facilitate a class discussion on the activity. Key points to consider:
  - What were the common semiconductor components identified across applications?
  - How do semiconductor advancements drive innovation in telecom technologies?
  - What opportunities for skill development exist in the field of semiconductors?

Scenario Cards (Examples)

Scenario 1: A telecom company is rolling out 5G services, relying on semiconductor-based components like microchips and transceivers to enhance speed and connectivity. Discuss how advancements in semiconductors are enabling the deployment of reliable and efficient 5G networks. Explore how semiconductor technology helps address challenges such as network scalability and low latency in 5G systems.

Scenario 2: A satellite communication system depends on semiconductors for high-frequency signal processing and reliable data transmission under harsh space conditions. Identify the critical semiconductor technologies that improve satellite communication performance and resilience. Analyze how miniaturization of semiconductor devices impacts the efficiency and design of satellite systems.

Scenario 3: The latest smartphone features advanced processors and energy-efficient components powered by semiconductors, enabling faster performance and longer battery life. Discuss the significance of semiconductor-based processors in powering features like AI and high-resolution cameras. Examine how innovations in semiconductor manufacturing are driving advancements in smartphone design and functionality.

Activity	Duration	Resources used
Exploring Semiconductor Applications in Telecom Devices	60 minutes	Whiteboard or flipchart, markers, sticky notes (different colors), application cards (described below), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Encourage active participation by assigning roles within each group, such as discussion leader, note-taker, and presenter.
- Provide examples of semiconductor components (e.g., silicon transistors, microchips) and their uses in telecom devices to help participants connect theory with practice.
- Ensure the debrief includes real-world applications of semiconductors to highlight their relevance and importance in modern telecom systems.

Unit 1.3: Wafer Testing and Quality Assurance

Unit Objectives

At the end of this unit, the participants will be able to:

1. Explain the importance of wafer testing in telecom device quality and functionality.
2. Identify methods and processes involved in wafer testing.
3. Understand the role of industry standards and regulations in ensuring quality.
4. Recognize how testing contributes to reliable telecom equipment.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the importance of wafer testing in ensuring the quality and reliability of telecom devices. We will explore the processes involved in testing, the role of industry standards in maintaining quality, and how testing contributes to the functionality of telecom equipment. By understanding these aspects, learners will gain insight into the critical role of testing in the telecom industry.

Ask

Ask the participants the following questions:

- What is the primary purpose of wafer testing in the telecom device manufacturing process?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Explain the importance of wafer testing in telecom device quality and functionality

Wafer testing ensures that the semiconductor chips used in telecom devices meet quality standards and function as intended. It helps detect defects early in the manufacturing process, preventing faulty components from being integrated into devices. This process is vital for maintaining the reliability and efficiency of telecom equipment.

Identify methods and processes involved in wafer testing

- **Probing Individual Chips:** Wafer testing starts with probing individual chips on the wafer using specialized equipment. This step checks the electrical properties of each chip to ensure that they function as expected. The probe contacts the chip's electrical pads, testing parameters like voltage, current, and resistance.
- **Automated Testing:** Automated testing systems are commonly used to test large numbers of wafers quickly and efficiently. These systems perform a series of predefined tests on each chip to detect faults or performance issues. They improve the speed, accuracy, and scalability of the testing process.
- **Parameter Analysis:** Parameter analysis involves testing key characteristics of the chips, such as signal integrity, power consumption, and frequency response. This helps identify potential problems that could affect the chip's performance in telecom devices. The results are compared with design specifications to ensure compliance.
- **Burn-In Testing:** Burn-in testing subjects chips to high temperatures and voltages to simulate extended use and identify early failures. This process helps to weed out defective chips before they are used in telecom devices, improving the reliability of the final product.
- **Optical Inspection:** Optical inspection is a non-destructive process used to detect physical defects in the wafer, such as cracks, scratches, or misalignment. Advanced imaging techniques capture high-resolution images of the wafer surface to ensure the integrity of the chips.
- **Functional Testing:** Functional testing involves checking whether the chip operates in its intended manner under realistic conditions. This could include simulating a network environment to test a telecom chip's communication capabilities and ensuring it meets all functional specifications.
- **Electrical Testing:** Electrical testing is performed to evaluate the functionality of the semiconductor material and its electrical circuits. This includes measuring the response of the chip under various electrical conditions, ensuring that it can handle power fluctuations or changes in electrical signals without failure.

Understand the role of industry standards and regulations in ensuring quality

Industry standards and regulations provide a framework for consistent quality in telecom devices. Adhering to these guidelines ensures compatibility, safety, and reliability across various telecom components and systems. Compliance with these standards fosters consumer trust and enhances market competitiveness.

Recognize how testing contributes to reliable telecom equipment

Comprehensive wafer testing plays a key role in ensuring telecom equipment functions smoothly under various conditions. By identifying and eliminating defective chips, manufacturers can deliver products that meet performance expectations and reduce the likelihood of system failures.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Simulating a Wafer Testing Scenario with a Focus on Quality Assurance and Process Efficiency

Group Size: 4-6 participants

Materials:

- Whiteboard or flipchart
- Markers
- Sticky notes (different colors)
- Scenario cards (described below)

Activity Duration: 60 minutes

Instructions:

- Divide participants into groups and explain the objectives of the activity.
- Briefly review the wafer testing process, its importance in ensuring the quality of telecom devices, and industry standards that help maintain high levels of functionality and reliability.
- Distribute scenario cards (one per group). Each card will describe a hypothetical situation related to wafer testing in telecom device production.
- The scenario will introduce a challenge that requires the group to consider various aspects of wafer testing, such as testing methodologies, quality control, efficiency, and adherence to industry standards.
- **Group Discussion and Planning (20 minutes):**
  - Each group should discuss the scenario using the following prompts:
    - What phase of wafer testing is being impacted by this situation?
    - How might the situation affect the overall quality of the telecom devices?
    - What steps or methodologies can be implemented to address this challenge while ensuring efficiency and maintaining industry standards?
  - As a team, propose solutions or actions to address the challenge, keeping in mind the importance of both testing accuracy and production timelines.
- **Group Presentations (20 minutes):**
  - Each group will present their scenario, analysis, and proposed solutions to the rest of the class.
  - Encourage questions and discussions from other groups to explore multiple perspectives on addressing wafer testing challenges.
- **Debriefing and Key Takeaways (20 minutes):**
  - Facilitate a class discussion to debrief on the activity.
  - Key points to consider:
    - What different approaches were taken by each group to address the scenario?
    - How did the groups balance efficiency with quality control during wafer testing?
    - What did participants learn about wafer testing methodologies and the importance of adhering to industry standards?

Scenario Cards (Examples):

Scenario 1: During the wafer testing process, you notice that several chips are failing the functional tests due to minor manufacturing defects. These defects are not visible but affect the device's performance. How would you address the issue of defective chips in terms of quality control, testing accuracy, and process adjustments to prevent future issues?

Scenario 2: A batch of wafers has passed all electrical tests, but upon further examination, some chips show inconsistent results under high stress conditions. What additional testing would you implement to identify potential long-term issues and ensure the quality and reliability of the chips for telecom devices?

Scenario 3: The wafer testing team is falling behind schedule due to inefficient test setups and manual testing processes. How would you streamline the testing process to improve efficiency while maintaining testing accuracy and adhering to industry standards for quality assurance?

Activity	Duration	Resources used
Simulating a Wafer Testing Scenario with a Focus on Quality Assurance and Process Efficiency	60 minutes	Whiteboard or flipchart, Markers, Sticky notes (different colors), Scenario cards (described below), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Remind participants that the activity is meant to simulate real-world challenges, and they should think critically about both the technical aspects of wafer testing and its impact on device performance.
- Stress the importance of teamwork and communication when addressing challenges, as these factors are critical in a high-stakes, quality-driven environment like telecom device production.
- Encourage groups to come up with realistic and actionable solutions that can be implemented in a production setting, considering resource constraints and operational workflows.

Unit 1.4: Safety in Cleanroom Environments and PPE Usage

Unit Objectives

At the end of this unit, the participants will be able to:

1. Understand the concept of cleanroom environments and their role in wafer testing.
2. List essential safety precautions to follow in cleanroom settings.
3. Identify the importance of Personal Protective Equipment (PPE) in ensuring worker safety.
4. Demonstrate the correct methods of wearing and handling PPE.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss cleanroom environments and their crucial role in wafer testing. Cleanrooms are controlled environments designed to minimize contamination, ensuring the precision and reliability of semiconductor testing. We will explore the importance of safety precautions, personal protective equipment (PPE), and correct handling techniques to protect both workers and the quality of the testing process.

Ask

Ask the participants the following questions:

- Why are cleanroom environments essential in the wafer testing process?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Understand the concept of cleanroom environments and their role in wafer testing

Cleanroom environments are controlled spaces with low levels of particulates, such as dust, airborne microbes, and chemical vapors. These environments are crucial in semiconductor manufacturing and wafer testing because even minute contamination can affect the performance of the chips being tested. Cleanrooms maintain strict temperature, humidity, and particle count standards to ensure the integrity and accuracy of the testing processes

List essential safety precautions to follow in cleanroom settings

- **Wear Appropriate PPE:** Workers must wear designated cleanroom attire, including gowns, gloves, masks, and shoe covers, to protect both the environment and their safety.
- **Adhere to Hygiene Protocols:** Thorough hand washing and sanitization are necessary before entering and after handling equipment to prevent contamination.
- **Follow Entry/Exit Procedures:** Strict protocols must be followed for entering and exiting cleanrooms, including passing through air showers and changing into cleanroom clothing to minimize contamination.
- **Avoid Personal Items and Minimize Movements:** Personal items like jewelry and makeup should be left outside, and excessive movement or talking should be minimized to reduce the risk of contaminating the environment.
- **Sterilize Equipment and Tools:** All tools and equipment must be sterilized before use to avoid introducing contaminants into the cleanroom.
- **Regular Cleaning and Monitoring:** Cleanroom surfaces and equipment should be cleaned regularly, and air quality, along with humidity, must be carefully monitored to maintain the controlled environment.

Identify the importance of Personal Protective Equipment (PPE) in ensuring worker safety

PPE is crucial in a cleanroom to protect both the workers and the environment. It helps prevent contamination of sensitive equipment and devices during wafer testing. Additionally, PPE safeguards workers from exposure to hazardous chemicals, electrical components, and other potential risks present in the cleanroom. Proper PPE, including gloves, gowns, face masks, and shoe covers, is vital to maintaining a sterile, safe, and compliant working environment.

Demonstrate the correct methods of wearing and handling PPE

The proper use of PPE involves wearing the equipment in a specific order to ensure both safety and contamination control. Workers should first sanitize their hands, then don shoe covers, face masks, gloves, and full-body protective suits, making sure to cover every part of their body. Handling PPE with care is essential to avoid contamination. PPE should be removed in a designated area, ensuring that it doesn't come into contact with cleanroom surfaces, and discarded or sanitized according to safety protocols.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Understanding Cleanroom Safety and Procedures in Wafer Testing

Group Size: 4-6 participants

Materials:

- Whiteboard or flipchart
- Markers
- Sticky notes (different colors)
- Scenario cards (described below)

Activity Duration: 60 minutes

Introduction:

Begin by introducing the topic of cleanroom safety, wafer testing, and the importance of maintaining a sterile environment. Briefly explain the protocols and PPE requirements in cleanroom settings.

Distribute Scenario Cards:

Provide each group with a scenario card. The cards will describe hypothetical situations that can occur in a cleanroom during wafer testing. These scenarios will require the group to think about the safety procedures, hygiene protocols, and PPE requirements involved in the situation.

Group Discussion and Planning (20 minutes):

Each group should discuss the scenario and address the following points:

- What stage of the wafer testing process is affected by the scenario?
- How should the group ensure the cleanroom environment is maintained?
- What safety precautions must be followed, and what PPE is required in the scenario?
- What is the most effective way to communicate these protocols to the team?

  As a team, propose solutions or actions to address the challenge.

Group Presentations (20 minutes):

Each group presents their scenario, the challenges they identified, and the solutions they proposed to the class. After the presentation, encourage open discussion, questions, and suggestions from other groups.

Debriefing and Key Takeaways (20 minutes):

After all the presentations, lead a class-wide discussion to review key points and takeaways. Focus on:

- The different approaches groups took to address cleanroom safety challenges.
- How safety, hygiene, and proper use of PPE are critical in wafer testing.
- The importance of clear communication within the team when handling safety protocols.

Scenario Cards (Examples):

Scenario 1: During a wafer testing procedure, a technician notices a small amount of contamination in the cleanroom. The contamination doesn't pose an immediate hazard but could affect the integrity of the testing process. How would you address the contamination while ensuring that the testing continues smoothly and the cleanroom remains safe?

Scenario 2: One of the team members forgets to wear their gloves before entering the cleanroom. The person realizes their mistake halfway through the testing process. How would you handle this situation to ensure the safety of the testing environment and minimize the risk of contamination?

Scenario 3: The cleanroom is undergoing maintenance and there's a temporary increase in humidity, which could potentially affect the testing results. How would you manage this situation to maintain the integrity of the testing environment and ensure the workers' safety?

Activity	Duration	Resources used
Understanding Cleanroom Safety and Procedures in Wafer Testing	60 minutes	Whiteboard or flipchart, Markers, Sticky notes (different colors), Scenario cards (described below), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Emphasize that adhering to strict safety protocols is crucial for maintaining the cleanliness of the environment and ensuring the quality of wafer testing. Ensure participants understand the relationship between the environment, PPE, and safety.
- Foster open communication between group members when discussing solutions. Encourage participants to ask questions and challenge each other's ideas to enhance critical thinking.
- Connect the scenarios to real-world situations, explaining how adherence to these protocols ensures safety and high-quality results in the semiconductor industry.

Unit 1.5: Role of Assembly Process Technicians and Career Development

Unit Objectives

At the end of this unit, the participants will be able to:

1. Define the responsibilities of Assembly Process Technicians in wafer testing.
2. Understand their role in maintaining quality standards in telecom equipment.
3. Identify essential professional skills for career advancement in the field.
4. Develop a plan for upskilling and exploring growth opportunities.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the roles and responsibilities of Assembly Process Technicians in wafer testing, including how they contribute to maintaining quality standards in telecom equipment. We will also explore the essential skills required for career advancement and how to plan for upskilling and growth within the field.

Ask

Ask the participants the following questions:

- What are the key responsibilities of an Assembly Process Technician in wafer testing, and how do they contribute to ensuring quality in telecom equipment?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Responsibilities of Assembly Process Technicians in Wafer Testing:

Assembly Process Technicians play a crucial role in ensuring the proper assembly of semiconductor wafers during the testing phase. Their responsibilities include

- **Assembling semiconductor wafers:** Technicians ensure the proper assembly of delicate semiconductor components during testing.

- **Testing functionality:** They test each unit's performance to ensure it meets design specifications and functions correctly.
- **Identifying defects:** Technicians detect and address any defects or malfunctions in the assembly process.
- **Troubleshooting assembly issues:** They identify and resolve problems that may arise during the assembly process.
- **Ensuring quality standards:** Technicians verify that components meet required specifications before proceeding to the next production phase.

Role in Maintaining Quality Standards in Telecom Equipment:

Assembly Process Technicians maintain high-quality standards by ensuring that all assembly processes meet industry regulations and specifications. They perform regular inspections to ensure that each piece of equipment is fully functional and free from defects. Additionally, they follow quality control procedures, document test results, and work closely with other departments to ensure telecom equipment meets the necessary performance criteria.

Essential Professional Skills for Career Advancement in the Field:

To advance in the field, Assembly Process Technicians should develop strong technical skills such as proficiency in wafer testing, familiarity with automated testing systems, and knowledge of advanced assembly techniques. Problem-solving, attention to detail, and the ability to work in a team are also essential. Communication skills and an understanding of industry standards will help technicians collaborate with other departments and stay updated on industry trends.

Developing a Plan for Upskilling and Exploring Growth Opportunities:

Technicians can develop a plan for upskilling by taking courses in advanced assembly techniques, robotics, and automation. Certifications in quality control or process management will help them stand out in the field. Networking with industry professionals, attending workshops, and staying informed about new technologies will also provide growth opportunities. Technicians should seek roles that allow them to expand their skills and gain experience in higher-level tasks.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Addressing Challenges in Cleanroom Wafer Testing with a Focus on Safety and Efficiency

Group Size: 4-6 participants

Materials: Whiteboard or flipchart, Markers, Sticky notes (different colors), Scenario cards (described below)

Activity Duration: 60 minutes

Instructions:

1. Divide participants into groups and explain the activity objectives.

2. Briefly review cleanroom environments, wafer testing processes, safety protocols, and the role of assembly process technicians.
3. Distribute the scenario cards (one per group). Each card will describe a hypothetical challenge related to wafer testing in cleanroom environments. The scenario should require the group to consider aspects of the process, employee safety, and efficiency in handling wafer testing tasks.

Group Discussion and Planning (20 minutes):

Each group should discuss the scenario using the following prompts:

- What part of the wafer testing process is impacted by the scenario?
- How might this scenario affect employee morale and engagement?
- What safety protocols must be followed when addressing this scenario?
- What strategies can you implement to improve safety and productivity simultaneously?

Group Presentations (20 minutes):

Each group will present their scenario, analysis, and proposed solutions to the rest of the class. Encourage questions and discussions from other groups.

Debriefing and Key Takeaways (20 minutes):

Facilitate a class discussion to debrief on the activity. Key points to consider:

- What were the different approaches taken by each group to address the scenario?
- How did employee engagement and safety considerations influence the group's decisions?
- What are the best practices for handling wafer testing in cleanroom environments while maintaining high safety standards?

Scenario Cards (Examples):

Scenario 1: During a wafer testing procedure, a technician notices an unexpected temperature fluctuation in the cleanroom. This could affect the accuracy of test results. How would you handle this issue, ensuring that both the testing process and employee safety are not compromised?

Scenario 2: A technician is tasked with replacing a malfunctioning testing device in the cleanroom. However, the device is bulky, and there's a risk of contamination during the replacement process. How would you address this task while following safety protocols and maintaining testing efficiency?

Scenario 3: A new team member is joining the wafer testing team in the cleanroom. They are unfamiliar with the strict protocols for handling sensitive wafers. How would you train the new member to ensure they understand the safety measures and work efficiently without compromising quality?

Activity	Duration	Resources used
Addressing Challenges in Cleanroom Wafer Testing with a Focus on Safety and Efficiency	60 minutes	Whiteboard or flipchart, Markers, Sticky notes (different colors), Scenario cards (described below), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Ensure every group member contributes to the discussion and provides input on potential solutions.
- Encourage groups to come up with actionable solutions that balance safety, efficiency, and quality.
- Reinforce the importance of following established safety measures and industry standards, especially in cleanroom settings, throughout the activity.

Exercise

Multiple Choice Questions (MCQs)

1. Which of the following network types is most commonly used for long-distance communication in telecom infrastructure?

   a) Wired networks

   b) Wireless networks

   c) Hybrid networks

   d) Bluetooth networks

   Answer: a) Wired Networks

2. What is the primary role of semiconductors in telecom devices?

   a) To generate electrical signals

   b) To act as an insulator in devices

   c) To facilitate data transmission and processing

   d) To store data for devices

   Answer: c) To facilitate data transmission and processing

3. Which of the following is the most critical safety precaution when working in a cleanroom environment for wafer testing?

   a) Wearing casual clothing

   b) Ensuring minimal contact with tools

   c) Wearing proper personal protective equipment (PPE)

   d) Ignoring cleanliness procedures

   Answer: c) Wearing proper personal protective equipment (PPE)

4. Why is adhering to industry standards and regulations important in telecom wafer testing?

   a) To ensure the equipment is aesthetically pleasing

   b) To meet the quality and functionality expectations for telecom equipment

   c) To avoid legal penalties

   d) To reduce production costs

   Answer: b) To meet the quality and functionality expectations for telecom equipment

Fill in the blanks

1. In telecom infrastructure, _____ networks are mainly used for mobile communication, offering flexibility and broad coverage.

   Answer: wireless

2. The process of _____ involves testing the electrical characteristics and functionality of semiconductor wafers to ensure their quality.

   Answer: wafer testing

3. Industry standards and _____ ensure that telecom devices are reliable, safe, and compatible with existing technologies.

   Answer: regulations

4. To protect workers in cleanroom environments, proper _____ is essential, including gloves, masks, and specialized suits.

   Answer: personal protective equipment (PPE)

Match the Following

Column A	Column B
1. Wafer fabrication	a) Ensuring proper functioning of telecom devices
2. Indian telecom market potential	b) Use of semiconductors in telecom devices
3. Wafer testing	c) Growth in telecom demand over the next decade
4. Personal protective equipment	d) Protection for workers in a cleanroom environment

Answers: 1 - b, 2 - c, 3 - a, 4 - d

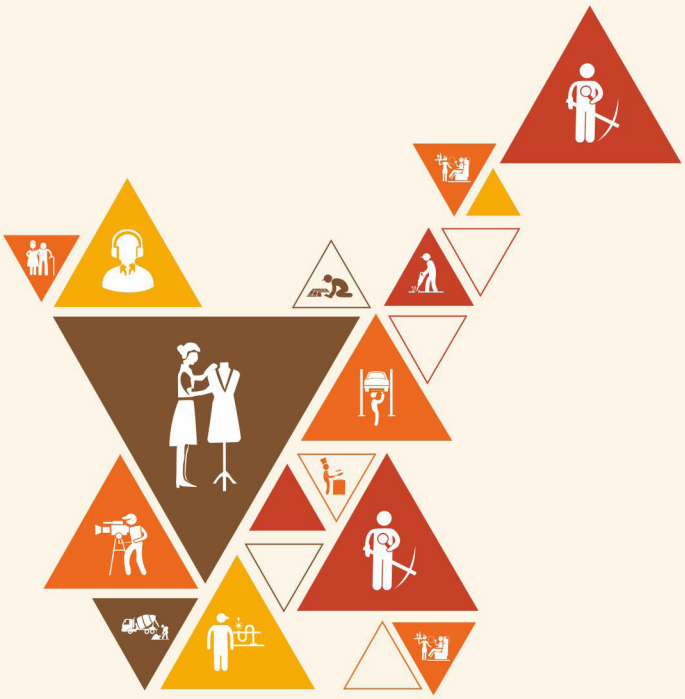
Match the following

Column A	Column B
1. Cleanroom environment	a) Ensures quality control in telecom devices
2. Assembly Process Technicians	b) Maintains employee safety and hygiene in production
3. Telecom network types	c) Both wired and wireless networks
4. Industry standards and regulations	d) Semiconductor testing and handling of devices

Answers: 1 - b, 2 - d, 3 - c, 4 - a

2. Prepare Test Environment

Unit 2.1: Understanding SOPs and Essential Tools for Telecom Wafer Testing
Unit 2.2: Environmental Factors and Test Equipment Specifications
Unit 2.3: Wafer Test Equipment and Accessories
Unit 2.4: Calibration and Documentation in Wafer Testing
Unit 2.5: ESD Control and Safe Handling of Telecom Wafers
Unit 2.6: Visual Inspection and Labelling of Telecom Wafers



Key Learning Outcomes

At the end of this module, the participant will be able to:

1. Discuss SOPs to identify the specific SOP document applicable to testing a particular type of telecom wafer.
2. Create a complete list of all necessary materials and tools required for testing the specific telecom wafers.
3. Identify key environmental factors (e.g., temperature, humidity) that can affect the performance of wafer test equipment, including their specific acceptable ranges
4. Explain test program specifications and use them to configure equipment for accurate telecom wafer testing.
5. Identify and differentiate between different types of wafer test equipment commonly used for telecom applications.
6. Explain the basic principles of operation for the specific type of wafer test equipment used in telecom wafer testing.
7. Describe the functions and proper use of various test equipment accessories (e.g., test heads, probes) specific to telecom wafer testing.
8. Describe the significance of regular calibration for maintaining the accuracy of wafer test equipment used in telecom applications.
9. Identify different types of calibration procedures used for various test parameters in telecom wafer testing.
10. Explain why calibration results and other records need to be documented for traceability in telecom wafer testing.
11. Describe the principles of electrostatic discharge (ESD) control and its potential consequences for telecom wafers.
12. Demonstrate gathering all necessary materials and tools for testing specific telecom wafers following the SOPs identified in theory.
13. Utilize thermometers and hygrometers to monitor the test environment conditions (temperature, humidity) according to SOPs.
14. Demonstrate installing test accessories onto the designated ports or fixtures on the test equipment, ensuring proper connection and secure positioning for optimal test performance.
15. Perform necessary adjustments or report the issue for maintenance personnel to address it.
16. Demonstrate proper handling techniques using ESD-safe tools (e.g., grounded tweezers) to safely load telecom wafers into the test equipment following designated loading patterns and SOPs.
17. Implement established electrostatic discharge (ESD) control procedures during the loading process.
18. Visually inspect the wafers for any physical damage or defects that might affect testing.
19. Describe the established protocols for labelling telecom wafers with clear identification information to ensure proper tracking during testing.
20. Identify the importance of designated loading patterns for specific test equipment models used in telecom wafer testing.
21. Describe various visual inspection techniques used to identify potential defects on telecom wafers that might affect testing.

Unit 2.1: Understanding SOPs and Essential Tools for Telecom Wafer Testing

Unit Objectives

At the end of this unit, the participants will be able to:

1. Identify and understand the Standard Operating Procedures (SOPs) applicable to telecom wafer testing.
2. Create a comprehensive list of materials and tools required for telecom wafer testing.
3. Recognize the importance of adhering to SOPs for accurate testing outcomes.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the role of Standard Operating Procedures (SOPs) in telecom wafer testing, the essential materials and tools required for the process, and the significance of strict adherence to SOPs for achieving accurate testing outcomes. Learners will gain insights into optimizing processes and ensuring compliance with industry standards.

Ask

Ask the participants the following questions:

- Why is it important to follow Standard Operating Procedures (SOPs) during telecom wafer testing?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Identify and understand the Standard Operating Procedures (SOPs) applicable to telecom wafer testing

SOPs are detailed instructions that outline consistent methods for conducting wafer testing in telecom. These procedures ensure accuracy, repeatability, and compliance with industry standards. Understanding SOPs allows technicians to minimize errors, optimize the testing process, and maintain the quality of telecom devices.

Comprehensive List of Materials and Tools for Telecom Wafer Testing

- **Testing Equipment:** This includes automated test systems and manual testing devices designed to evaluate the electrical properties and functionality of wafers.
- **Probes:** High-precision probes are essential for establishing contact with wafer circuits during testing. These tools must be clean and calibrated for accurate measurements.
- **Calibration Tools:** Instruments like multimeters, oscilloscopes, and signal generators are used to ensure that testing equipment is functioning correctly and providing reliable data.
- **Cleaning Materials:** Specialized cleaning agents, lint-free wipes, and air blowers are needed to maintain a contamination-free environment and ensure the accuracy of test results.
- **Software Systems:** Testing software is required for data collection, analysis, and reporting. It helps automate the testing process and ensures consistency in outcomes.
- **Wafer Handling Tools:** Tools such as tweezers, vacuum wands, and wafer carriers ensure safe and damage-free handling of delicate wafers.
- **Protective Gear:** Personal Protective Equipment (PPE), including gloves, masks, and cleanroom suits, helps maintain cleanliness and protect wafers from contamination.
- **Documentation and Reference Materials:** Manuals, checklists, and Standard Operating Procedures (SOPs) provide essential guidelines for the testing process.

By having these materials and tools readily available and in proper working condition, technicians can ensure smooth operations, accurate testing, and adherence to quality standards.

Recognize the importance of adhering to SOPs for accurate testing outcomes

Adhering to Standard Operating Procedures (SOPs) is fundamental for achieving reliable and consistent outcomes in telecom wafer testing. These procedures provide a structured approach that ensures all testing activities are performed correctly, minimizing errors and detecting defects efficiently. SOP compliance helps maintain the quality and calibration of testing equipment, reduces variability in processes, and upholds safety standards in the workplace. By following SOPs, organizations can ensure that their products consistently meet industry regulations and customer expectations, building trust and credibility in the market.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Developing an SOP Implementation Plan for Telecom Wafer Testing

Group Size: 4-6 participants

Materials:

- Whiteboard or flipchart
- Markers
- Sticky notes (different colors)
- Scenario cards (one for each group)

Activity Duration: 60 minutes

Instructions:

1. Divide participants into groups and explain the activity objectives.
2. Briefly review the significance of Standard Operating Procedures (SOPs), tools, and materials in telecom wafer testing. Highlight the importance of adherence to SOPs for quality outcomes.
3. Distribute scenario cards to each group. Each card presents a challenge or situation that requires the team to plan or revise SOP implementation strategies.

Group Discussion and Planning (20 minutes):

- Groups will analyze their scenario and answer the following prompts:
  - What specific steps of the SOP are impacted by this challenge?
  - What materials and tools are essential to address the issue?
  - How can the team ensure strict adherence to SOPs during the process?
  - What actions can be taken to avoid similar issues in the future?

Group Presentations (20 minutes):

- Each group will present their scenario, analysis, and proposed SOP implementation plan.
- Encourage questions and feedback from other groups.

Debriefing and Key Takeaways (20 minutes):

- Facilitate a discussion to summarize the activity. Key points:
  - What were the common strategies across groups?
  - How did the scenarios highlight the importance of materials and tools?
  - What insights were gained regarding the role of SOPs in telecom wafer testing?

Scenario Cards (Examples):

Scenario 1: During wafer testing, a malfunction in a critical testing tool leads to inconsistent results. How would you revise the SOP to address tool maintenance and calibration?

Scenario 2: A technician fails to follow an essential step in the SOP, resulting in defective wafers. How would you incorporate additional checks to prevent procedural errors?

Scenario 3: A sudden shortage of cleaning materials causes delays in testing. How would you plan to avoid future disruptions while ensuring compliance with SOPs?

Activity	Duration	Resources used
Developing an SOP Implementation Plan for Telecom Wafer Testing	60 minutes	Whiteboard or flipchart, Markers, Sticky notes (different colors), Scenario cards (one for each group), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Encourage active participation and ensure all group members contribute to the discussion.
- Provide guidance during the group discussions to clarify any doubts about SOPs or their importance.
- Summarize the key learnings after each group presentation to reinforce the relevance of SOPs in telecom wafer testing.

Unit 2.2: Environmental Factors and Test Equipment Specifications

Unit Objectives

At the end of this unit, the participants will be able to:

1. Identify key environmental factors such as temperature and humidity and their acceptable ranges for wafer testing.
2. Utilize tools like thermometers and hygrometers to monitor environmental conditions.
3. Understand test program specifications and use them to configure telecom wafer testing equipment.
4. Differentiate between types of wafer test equipment used in telecom applications.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the environmental factors critical to wafer testing, including temperature and humidity, and the tools used to monitor these parameters. We will also explore the importance of test program specifications in configuring equipment and the different types of testing tools utilized in telecom applications. These insights will help ensure precise and efficient wafer testing processes.

Ask

Ask the participants the following questions:

- Why is it important to maintain specific temperature and humidity ranges during wafer testing?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Key environmental factors for wafer testing:

Environmental factors like temperature and humidity play a critical role in ensuring the accuracy of wafer testing.

- **Temperature:** Maintaining an optimal temperature is essential during wafer testing to ensure accurate results and protect sensitive components. The ideal temperature range is typically between 20°C and 25°C, as fluctuations outside this range can negatively impact testing processes. High temperatures can cause overheating, leading to equipment malfunctions or material degradation, while low temperatures may result in condensation, potentially damaging the wafer or testing equipment. Stability in temperature helps to ensure the integrity and consistency of testing outcomes.
- **Humidity:** Controlling humidity is equally important to prevent moisture-related damage during wafer testing. The recommended humidity range is generally between 30% and 50%, ensuring a safe and efficient testing environment. High humidity levels can lead to condensation and corrosion of equipment, compromising test accuracy and product quality. On the other hand, low humidity can generate static electricity, which is hazardous for handling sensitive semiconductor components. Proper humidity control ensures operational reliability and prevents environmental factors from affecting testing processes.

Utilize tools like thermometers and hygrometers to monitor environmental conditions

Accurate environmental monitoring is critical in wafer testing to maintain the reliability of results. Digital thermometers and hygrometers are essential tools used to measure temperature and humidity, respectively. These instruments help technicians ensure that environmental parameters stay within the recommended ranges, safeguarding both the wafers and the equipment from potential damage caused by unfavorable conditions.

Understand test program specifications and use them to configure telecom wafer testing equipment

Test program specifications are essential guidelines that outline the required parameters for conducting wafer tests. These include details such as voltage levels, frequency, time limits, and other testing conditions. By following these specifications, technicians can accurately configure testing equipment, ensuring compliance with industry standards and achieving consistent, high-quality results.

Differentiate between types of wafer test equipment used in telecom applications

- **Parametric Testers:** These are used to measure the electrical characteristics of the wafer, such as voltage, current, resistance, and capacitance. They ensure that the semiconductor devices on the wafer meet the required electrical performance.
- **Probe Stations:** These are used to test individual chips on a wafer by providing physical access to the pads on the semiconductor for electrical testing. Probe stations allow technicians to test and diagnose specific areas of a wafer for defects or malfunctions.
- **Automated Test Systems (ATS):** These systems are designed for high-throughput testing and automation. They integrate various testing functions and can test multiple wafers or chips simultaneously, improving efficiency and consistency in testing.

Each type of equipment is tailored to specific testing needs, helping technicians select the right tool based on the test parameters and the scale of testing required in telecom applications.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Simulating Telecom Wafer Testing Scenarios with a Focus on Environmental Factors, SOPs, and Safety

Group Size: 4-6 participants

Materials: Whiteboard or flipchart, Markers, Sticky notes (different colors), Scenario cards (described below)

Activity Duration: 60 minutes

Instructions:

1. Divide participants into groups and explain the objectives of the activity. Briefly review the importance of maintaining environmental conditions, understanding SOPs, and adhering to safety protocols in telecom wafer testing.
2. Distribute scenario cards to each group. Each card presents a challenge related to wafer testing, environmental factors, safety, and the adherence to SOPs.
3. Ask groups to discuss the scenario, consider the impact on the testing process, and propose solutions or actions to ensure that testing is performed accurately and safely while following the required protocols.

Group Discussion and Planning (20 minutes):

Each group should address the scenario by discussing:

- What environmental factors are involved in the testing process and how do they affect the outcome?
- What SOPs should be followed to ensure the testing process is accurate?
- What safety precautions should be taken in response to the situation?
- Propose solutions or actions to overcome the challenges while keeping safety, accuracy, and compliance with SOPs a priority.

Group Presentations (20 minutes):

- Each group presents their scenario analysis and proposed solutions to the rest of the class.
- Encourage questions and feedback from other groups to foster a collaborative learning environment.

Debriefing and Key Takeaways (20 minutes):

Facilitate a discussion to summarize key takeaways from the activity. Some points to consider:

- How did each group approach the scenario and what challenges did they face?
- How did environmental factors and safety protocols influence their decisions?
- What lessons can be applied to actual telecom wafer testing situations?

Scenario Cards (Examples):

Scenario 1: During a telecom wafer test, the temperature and humidity levels are slightly outside the ideal range, but the test is about to begin. How would you ensure that the testing process continues safely and accurately? What SOPs need to be followed?

Scenario 2: You notice that some team members are unfamiliar with the new testing equipment. How would you address this knowledge gap while maintaining safety standards and ensuring that testing is not delayed?

Scenario 3: A technician accidentally mishandles a sensitive wafer during testing. The wafer is not damaged, but the technician is concerned about safety protocols. How do you handle this situation to maintain safety and compliance with SOPs?

Activity	Duration	Resources used
Simulating Telecom Wafer Testing Scenarios with a Focus on Environmental Factors, SOPs, and Safety	60 minutes	Whiteboard or flipchart, Markers, Sticky notes (different colors), Scenario cards (described below), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Emphasize that the main objective is to balance environmental conditions, SOPs, and safety while addressing the challenges presented. Encourage participants to focus on problem-solving.
- Remind the groups to consider safety at every stage of their decision-making process. Safety should never be compromised, even if it means halting or adjusting the testing procedure.
- Encourage participants to share ideas, insights, and experiences related to telecom wafer testing to enrich the learning process. Highlight how different perspectives can lead to comprehensive solutions.

Unit 2.3: Wafer Test Equipment and Accessories

Unit Objectives

At the end of this unit, the participants will be able to:

1. Identify key environmental factors such as temperature and humidity and their acceptable ranges for wafer testing.
2. Utilize tools like thermometers and hygrometers to monitor environmental conditions.
3. Understand test program specifications and use them to configure telecom wafer testing equipment.
4. Differentiate between types of wafer test equipment used in telecom applications.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the essential principles of wafer testing, focusing on the operation of test equipment, the use of accessories such as probes and test heads, and the procedures for securing these accessories for accurate results. We will also cover the importance of proper adjustments and maintenance to ensure the equipment functions optimally.

Ask

Ask the participants the following questions:

- What are the main accessories involved in wafer testing, and how do they contribute to accurate testing results?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Basic Principles of Operation of Wafer Test Equipment

Wafer test equipment is designed to evaluate the electrical properties and functionality of semiconductor wafers. These machines utilize various testing techniques, such as parametric testing, functional testing, and optical inspection, to ensure that wafers meet the required specifications. The equipment typically consists of a probe station, a test head, and a controller system. Probes make electrical contact with the wafer, while the test head applies signals and measures responses. The controller system manages the test process and records results for analysis.

Functions and Proper Use of Test Accessories:

Test accessories like test heads and probes play crucial roles in wafer testing. The test head is responsible for transmitting electrical signals to the wafer, and the probes create a physical connection to individual wafer pads. Probes must be carefully selected for the correct type of wafer and the test being performed. Proper handling and alignment of these accessories are essential to avoid damage to both the wafer and the equipment. Incorrect use can lead to inaccurate results or faulty testing.

Demonstrating the Process of Installing Test Accessories:

Proper installation of test accessories is critical for accurate testing. First, ensure the test head is securely mounted and properly aligned with the wafer to avoid misalignment during testing. The probes must be positioned to make clean and stable contact with the wafer pads. They should be calibrated before use to ensure the correct electrical measurements are taken. The test head and probes must be connected to the equipment and verified for proper signal flow and functionality before beginning the test process.

Performing Necessary Adjustments or Reporting Equipment Issues for Maintenance:

Wafer test equipment may require periodic adjustments for optimal performance. This can include recalibrating the probes, adjusting the test head pressure, or ensuring that the environmental conditions are within acceptable ranges. Any issues, such as faulty probes, misaligned test heads, or malfunctioning components, should be reported immediately. It's crucial to follow maintenance protocols to prevent disruptions in testing and to maintain equipment longevity and accuracy.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Simulating a Telecom Wafer Testing Scenario with a Focus on Equipment Setup, Safety, and Team Collaboration

Group Size: 4-6 participants

Materials:

- Whiteboard or flipchart
- Markers
- Sticky notes (different colors)
- Scenario cards (described below)

Activity Duration: 60 minutes

Instructions:

1. Divide the participants into groups of 4-6 members.
2. Explain the activity objectives: The goal is to simulate a telecom wafer testing scenario, focusing on proper equipment setup, safety protocols, and team collaboration.
3. Briefly review the basics of wafer testing equipment, the importance of following SOPs, and safety protocols in a cleanroom environment.

4. Distribute one scenario card to each group. Each card will describe a hypothetical situation in telecom wafer testing. The scenario should introduce a challenge that requires the group to think about equipment setup, safety, and team dynamics.
5. Group Discussion and Planning (20 minutes):
    - Each group will discuss their scenario using the following prompts:
        - What type of equipment is involved, and how should it be configured for the test?
        - What safety measures must be taken before beginning the test?
        - How should the team communicate and collaborate during this process to ensure smooth operation?
        - What potential issues could arise during the wafer testing, and how should they be addressed?
6. Group Presentations (20 minutes):
    - Each group will present their scenario, analysis, and proposed solutions to the rest of the class. Encourage other groups to ask questions and engage in discussions.
7. Debriefing and Key Takeaways (20 minutes):
    - Facilitate a class discussion to reflect on the activity.
    - Key points to discuss:
        - How did the groups approach the different aspects of wafer testing equipment and safety?
        - What were the solutions proposed to address potential challenges in the testing process?
        - How did the group collaboration impact the outcome of the scenario?

Scenario Cards (Examples):

Scenario 1: During a routine wafer test, a technician notices that the test head is not aligning properly with the wafer pads. The test might be compromised if not resolved. How would you resolve this issue while maintaining equipment safety and adhering to the standard operating procedures (SOPs)?

Scenario 2: While configuring the wafer testing equipment, the system suddenly shuts down due to a power surge. This disrupts the testing process. How would you handle this situation, considering the importance of minimizing downtime and ensuring safety protocols are followed during equipment restoration?

Scenario 3: You are conducting a wafer test in a cleanroom, and one of the probes gets contaminated. How would you handle the contamination while ensuring that the test is not compromised, and how would you maintain proper team communication in this scenario?

Activity	Duration	Resources used
Simulating a Telecom Wafer Testing Scenario with a Focus on Equipment Setup, Safety, and Team Collaboration	60 minutes	Whiteboard or flipchart, Markers, Sticky notes (different colors), Scenario cards (described below), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Stress the importance of teamwork when resolving technical issues and safety concerns. Each group member should contribute ideas and share their perspective during the discussion.
- Reinforce the significance of safety protocols in wafer testing, particularly in cleanroom environments. Safety should always come before speed or convenience.
- Help participants understand how these scenarios could occur in real telecom wafer testing situations. Encourage them to think critically about how equipment malfunctions or environmental issues could affect the testing process and the team's productivity.

Unit 2.4: Calibration and Documentation in Wafer Testing

Unit Objectives

At the end of this unit, the participants will be able to:

1. Describe the significance of regular calibration in maintaining equipment accuracy.
2. Identify various types of calibration procedures used in telecom wafer testing.
3. Explain the importance of documenting calibration results for traceability and quality assurance.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the importance of calibration in telecom wafer testing. Calibration ensures that testing equipment operates with precision, providing reliable results. We will explore the types of calibration procedures used, their role in maintaining accuracy, and the necessity of documenting calibration outcomes for traceability and quality assurance. Understanding these concepts is essential for ensuring optimal performance and adherence to industry standards.

Ask

Ask the participants the following questions:

- Why is it important to regularly calibrate testing equipment in telecom wafer testing?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Describe the significance of regular calibration in maintaining equipment accuracy

Regular calibration of testing equipment is critical for ensuring that instruments produce accurate and reliable results. Over time, equipment may drift from its original settings due to factors like wear and tear, environmental conditions, or component aging. Without proper calibration, test results can become unreliable, leading to incorrect measurements, faulty testing, and potentially compromised product quality. Routine calibration helps maintain equipment within the specified tolerances, ensuring high-quality outcomes and consistent testing results.

Identify various types of calibration procedures used in telecom wafer testing

There are several calibration procedures used in telecom wafer testing, each designed for specific instruments or testing requirements. Common procedures include voltage and current calibration for electrical test equipment, impedance calibration for measuring resistance, and time or frequency calibration for devices that measure signal timing or frequency. Calibration may involve using known standards or reference materials to adjust the equipment, ensuring its measurements are within an acceptable range. These procedures are performed to confirm that the equipment is functioning properly and can deliver accurate data.

Explain the importance of documenting calibration results for traceability and quality assurance

Documenting calibration results is essential for maintaining traceability and ensuring quality assurance in telecom wafer testing. Calibration records provide a detailed history of when and how equipment was calibrated, ensuring compliance with industry standards and regulatory requirements. This documentation helps in verifying the accuracy of the equipment over time and can be used to track any trends or issues that arise. It also serves as proof that proper maintenance and calibration procedures were followed, which is crucial for audits and ensuring consistent test results.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Simulating Telecom Wafer Testing with a Focus on Equipment Accuracy and Calibration

Group Size: 4-6 participants

Materials: Whiteboard or flipchart, Markers, Sticky notes (different colors), Scenario cards

Activity Duration: 60 minutes

Instructions:

Divide participants into groups. Explain the activity objectives: to simulate a scenario involving telecom wafer testing, focusing on equipment calibration and maintenance, and how these affect test results and product quality.

Briefly review the wafer testing process, the significance of calibration, and the role of proper equipment maintenance in ensuring accurate test outcomes.

Distribute scenario cards. Each card will describe a hypothetical situation in telecom wafer testing. The scenario introduces a challenge that requires the group to consider the testing equipment, calibration procedures, and how they affect the testing process.

Group Discussion and Planning (20 minutes):

Each group should discuss the scenario using the following prompts:

1. What is the testing equipment involved in this scenario?
2. How might the scenario affect the accuracy of test results?
3. What calibration or maintenance procedures should be considered in response to this situation?

4. Propose actions or solutions to ensure the accuracy and reliability of the test results while considering equipment calibration.

Group Presentations (20 minutes):

Each group presents their scenario, analysis, and proposed solutions to the class. Encourage questions and discussions from other groups, focusing on how calibration and maintenance are critical to accurate testing.

Debriefing and Key Takeaways (20 minutes):

Facilitate a class discussion to debrief the activity. Key points to consider:

1. What were the different approaches taken by each group to address the scenario?
2. How did calibration and maintenance influence the group's solutions?
3. What key lessons were learned regarding the importance of equipment calibration, maintenance, and accurate testing in telecom wafer applications?

Scenario Cards (Examples):

Scenario 1: During a routine calibration of a parametric tester, the device fails to meet the specified accuracy range. How would you troubleshoot the issue and ensure the test equipment is calibrated correctly before continuing testing? What steps would you take to maintain the quality of the test results?

Scenario 2: A wafer test has been producing inconsistent results across multiple tests. The issue appears to stem from the probe station, which has not been calibrated in several months. How would you address this issue, and what maintenance or calibration procedures would you recommend?

Scenario 3: You are conducting a telecom wafer test, but the temperature and humidity levels in the testing environment are fluctuating. How would you adjust the test equipment settings to account for these environmental changes, and how would you ensure that testing remains accurate and reliable?

Activity	Duration	Resources used
Simulating Telecom Wafer Testing with a Focus on Equipment Accuracy and Calibration	60 minutes	Whiteboard or flipchart, Markers, Sticky notes (different colors), Scenario cards, etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Guide groups to understand how critical it is to have equipment calibrated regularly to ensure accurate results. Encourage participants to recognize the link between proper calibration and product quality.
- When discussing the scenarios, challenge the participants to think about the root causes of the problem and how to resolve it systematically, whether it's related to equipment failure or calibration issues.
- Share examples from telecom wafer testing where improper calibration or maintenance led to faulty results. This helps participants understand the practical implications of neglecting calibration and maintenance procedures.

Unit 2.5: ESD Control and Safe Handling of Telecom Wafers

Unit Objectives

At the end of this unit, the participants will be able to:

1. Understand the principles of Electrostatic Discharge (ESD) control and its consequences on wafers.
2. Demonstrate proper handling techniques using ESD-safe tools such as grounded tweezers.
3. Implement ESD control procedures during wafer loading and testing processes.
4. Identify the importance of loading patterns specific to test equipment models.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the importance of Electrostatic Discharge (ESD) control in wafer testing, including the handling techniques and procedures required to prevent damage to wafers. We will also explore the role of proper loading patterns specific to test equipment models to ensure optimal testing conditions and results.

Ask

Ask the participants the following questions:

- How can Electrostatic Discharge (ESD) affect the results of wafer testing, and what steps can be taken to prevent it?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Electrostatic Discharge (ESD) Control and Its Consequences on Wafers

Electrostatic Discharge (ESD) is the sudden transfer of electrical energy between two objects with different electrical potentials. In the context of wafer testing, ESD can have severe consequences. Wafers contain highly sensitive components that can be damaged by even a small discharge. This damage can lead to functional failures, defects, or degraded performance, which compromises the quality and reliability of the tested wafers. To prevent such damage, strict ESD control measures, such as grounding personnel, tools, and equipment, are essential throughout the testing process.

Proper Handling Techniques Using ESD-Safe Tools

To minimize the risk of ESD damage during wafer testing, it is essential to use ESD-safe tools like grounded tweezers. These tools are designed to dissipate any built-up static charge before it comes into contact with the sensitive components. When handling wafers, technicians must avoid direct contact with bare hands, as human bodies are significant conductors of static electricity. Proper grounding of tools and work surfaces ensures the safety of the testing process.

Implementing ESD Control Procedures during Wafer Loading and Testing

Implementing ESD control procedures during wafer loading and testing is critical to maintaining the accuracy and quality of the tests. This involves ensuring that all surfaces, tools, and personnel are properly grounded before beginning the wafer handling process. ESD mats, wrist straps, and anti-static clothing are commonly used to create a controlled environment. Additionally, handling the wafer in an ESD-protected environment and avoiding sudden movements that could generate static charge is essential for safe testing.

Importance of Loading Patterns Specific to Test Equipment Models

Loading patterns refer to the specific arrangement of wafers in test equipment. Each test equipment model may require different loading patterns to ensure proper contact with probes, prevent damage, and optimize test accuracy. Correct loading patterns minimize the risk of mechanical stress and ensure uniform results across all wafers. Understanding the required loading pattern for each specific model is critical for maintaining the integrity of the wafers and achieving reliable test results.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Wafer Testing Process Simulation with a Focus on ESD Control and Equipment Calibration

Group Size: 4-6 participants

Materials:

- Whiteboard or flipchart
- Markers
- Sticky notes (different colors)
- Scenario cards (described below)

Activity Duration: 60 minutes

Instructions:

1. **Divide Participants into Groups:** Briefly explain the activity objectives and the importance of Electrostatic Discharge (ESD) control, equipment calibration, and proper handling techniques in wafer testing.
2. **Review Key Concepts:** Provide a short review of ESD control procedures, wafer testing processes, and equipment calibration principles.

3. **Distribute Scenario Cards:** Each group will receive a scenario card that describes a potential situation that could arise during wafer testing, focusing on ESD control, handling techniques, or equipment calibration.
4. **Group Discussion and Planning (20 minutes):** Each group should discuss the scenario using the following prompts:
    - How does the scenario impact the wafer testing process or equipment calibration?
    - What potential ESD-related issues could arise in this scenario, and how would they be prevented?
    - How would you ensure that all safety and handling protocols are followed?
    - What calibration steps need to be taken to address the situation, and how do these affect equipment performance?
    - Propose a solution that addresses both safety and equipment functionality while ensuring proper handling techniques.
5. **Group Presentations (20 minutes):** Each group will present their scenario, analysis, and proposed solutions to the rest of the class. Encourage questions and discussions from other groups.
6. **Debriefing and Key Takeaways (20 minutes):** Facilitate a class discussion to debrief on the activity. Key points to consider:
    - How did each group approach the challenges presented in their scenario?
    - How did the team address ESD control and equipment calibration?
    - What key lessons can be learned from this activity to improve wafer testing procedures and safety protocols?

Scenario Cards (Examples):

Scenario 1: During a wafer test, a technician accidentally discharges static electricity near the wafer. The test equipment fails to capture accurate data due to ESD interference. How would you address this issue, ensuring proper ESD control and that the equipment is recalibrated for accurate testing?

Scenario 2: The wafer testing system experiences calibration drift after several tests. The accuracy of test results is compromised. How would you handle recalibration, considering safety protocols and minimizing downtime during the process?

Scenario 3: You notice that the test probes are not making secure contact with the wafer pads, causing inconsistent test results. How would you implement proper handling techniques and ensure that all necessary ESD-safe tools are used to prevent damage to the wafers and equipment?

Activity	Duration	Resources used
Wafer Testing Process Simulation with a Focus on ESD Control and Equipment Calibration	60 minutes	Whiteboard or flipchart, Markers, Sticky notes (different colors), Scenario cards (described below), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Encourage each group to work collaboratively and consider all aspects of the scenario, including technical, safety, and ESD-related concerns.
- While discussing the scenarios, allow participants to interact with mock equipment or tools (if available) to demonstrate handling techniques and calibration steps.
- Relate the scenarios to real-world wafer testing situations and emphasize the importance of both safety and technical precision.

Unit 2.6: Visual Inspection and Labelling of Telecom Wafers

Unit Objectives

At the end of this unit, the participants will be able to:

1. Describe various visual inspection techniques to identify physical defects on wafers.
2. Perform visual inspections to detect potential damage that might affect testing.
3. Explain protocols for labelling telecom wafers for proper identification and tracking.
4. Understand the significance of tracking and labelling in ensuring test process accuracy.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the importance of visual inspections, labeling, and tracking protocols in the wafer testing process. We will explore how these practices help detect physical defects, maintain accuracy in testing, and ensure proper identification of each telecom wafer through its testing lifecycle.

Ask

Ask the participants the following questions:

- Why is visual inspection crucial in identifying defects in telecom wafers before they undergo testing?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Visual Inspection Techniques to Identify Physical Defects on Wafers

Visual inspection plays a crucial role in detecting physical defects on wafers that can impact the performance of telecom devices. Common inspection techniques include

- **Microscopic Inspection:** Using high-powered microscopes to closely examine the surface of the wafer helps detect fine defects like micro-cracks, scratches, and contamination that are not visible to the naked eye.

- **Surface Inspection for Contamination:** Looking for foreign particles or contaminants, such as dust, oils, or fingerprints, that could affect the performance of the wafer or interfere with testing.
- **Crack and Scratch Detection:** Inspecting the wafer for visible cracks, scratches, or other surface irregularities that can result from mishandling or mechanical stress during processing.
- **Alignment Check:** Verifying the alignment of the wafer's bonding pads and other essential features to ensure they are in proper position for subsequent testing.
- **Visual Color Coding or Surface Reflection Check:** Using color contrast or changes in surface reflection to detect areas that may indicate damage, contamination, or irregularities on the wafer.
- **Edge Inspection:** Examining the wafer's edges for chips, cracks, or other imperfections that could lead to test failures or cause damage to the testing equipment.

These techniques are crucial for ensuring that the wafer is in optimal condition before beginning the testing process, preventing potential errors or inaccurate results.

Performing Visual Inspections to Detect Potential Damage

Performing visual inspections involves a careful examination of the wafer under magnification to identify any visible damage such as chips, scratches, or contamination that could affect the accuracy of test results. It is essential to inspect both the front and back sides of the wafer, as defects may appear in both areas. This step helps ensure that any damage, whether from handling, transport, or previous processes, is recognized before proceeding to testing.

Protocols for Labelling Telecom Wafers for Proper Identification and Tracking

Labeling is an essential step in the telecom wafer testing process for ensuring traceability and preventing mix-ups. Protocols for labeling include

- **Clear and Non-Damaging Marking:** Use markers or tags that do not damage the wafer's surface. The labeling method should be gentle to avoid introducing any additional defects.
- **Critical Information:** Labels must include essential data such as the wafer ID, production lot number, test status (e.g., pass/fail), and the date the testing was conducted. This information is crucial for accurate tracking and troubleshooting.
- **Consistency in Labeling:** Apply the same format and standards across all wafers to ensure consistency in tracking and identification. This reduces the risk of errors during the testing and analysis stages.
- **Placement of Labels:** Ensure that labels are placed in easily accessible areas that do not interfere with the wafer's functionality or testing equipment. The location should allow quick identification without compromising wafer handling.
- **Traceability:** Labels should enable traceability throughout the wafer's lifecycle, allowing for easy reference during quality control, rework, or testing stages.

Significance of Tracking and Labelling in Ensuring Test Process Accuracy

Tracking and labeling telecom wafers ensure that each wafer is tested according to the correct specifications and in the proper sequence. Proper identification helps prevent errors such as testing the wrong wafer, misreporting results, or losing track of which wafers have passed or failed specific tests. Effective tracking systems contribute to maintaining test integrity, ensuring that data collected is associated with the correct product, and improving overall quality assurance.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Simulating a Telecom Wafer Testing Scenario with a Focus on ESD Control, Safety, and Employee Engagement

Group Size: 4-6 participants

Materials: Whiteboard or flipchart, Markers, Sticky notes (different colors), Scenario cards (de-scribed below)

Activity Duration: 60 minutes

Instructions:

Introduction (10 minutes):

Divide participants into groups. Briefly review the key principles of Electrostatic Dis-charge (ESD) control, safety protocols, and employee engagement in telecom wafer test-ing. Explain the activity objectives, emphasizing the importance of ESD-safe tools, proper handling techniques, and the need for effective communication and team engagement during the testing process.

Scenario Cards:

Distribute scenario cards (one per group). Each card will describe a hypothetical situation that could arise during telecom wafer testing. The scenario should introduce challenges that require the group to consider the impact on wafer testing, ESD safety, and team mo-rale.

Group Discussion and Planning (20 minutes):

Each group will discuss their assigned scenario using the following prompts:

1. What ESD control measures are impacted by this scenario?
2. How might the scenario affect the testing accuracy, safety, and employee morale?
3. What actions can be taken to prevent damage and ensure the safety of both equipment and employees?
4. How can the team maintain high levels of employee engagement while ensuring strict safety measures are followed?

Group Presentations (20 minutes):

Each group will present their scenario, analysis, and proposed solutions to the rest of the class. Encourage questions and open discussions from other groups to explore different perspectives.

Debriefing and Key Takeaways (20 minutes):

Facilitate a class discussion to debrief on the activity. Key points to consider:

1. What different approaches did the groups take to address the scenario?
2. How did employee engagement and safety considerations influence the group's deci-sions?
3. What are some key learnings about ESD control, testing protocols, and safety measures in telecom wafer testing?

Scenario Cards (Examples):

Scenario 1: A technician notices that some wafers have been mishandled during the testing process, leading to possible electrostatic damage. How would you address this situation and ensure ESD safety protocols are reinforced without compromising team morale?

Scenario 2: During wafer loading, an unexpected ESD incident causes minor damage to several wafers. How would you respond to this situation to minimize further risks, while maintaining effective team communication and engagement throughout the incident.

Scenario 3: There is a situation where an employee is unclear on the importance of ESD control protocols. How would you explain the critical role of ESD in testing while ensuring the employee feels supported and engaged in the process?

Activity	Duration	Resources used
Simulating a Telecom Wafer Testing Scenario with a Focus on ESD Control, Safety, and Employee Engagement	60 minutes	Whiteboard or flipchart, Markers, Sticky notes (different colors), Scenario cards (described below), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Encourage participants to think critically and share their thoughts openly, ensuring all voices are heard.
- Make sure the group discussions focus on the real importance of proper ESD practices and handling techniques to prevent damage and maintain test accuracy.
- Focus on developing actionable solutions that consider both technical and human factors, promoting employee engagement and safety alongside testing integrity.

Exercise

Multiple Choice Questions (MCQs)

1. Which of the following is the main purpose of an SOP in telecom wafer testing?
   a) To describe the types of telecom wafers used in testing
   b) To identify the specific procedures and guidelines for testing a particular type of wafer
   c) To list the environmental factors affecting testing
   d) To perform regular calibration of equipment

   Answer: b) To identify the specific procedures and guidelines for testing a particular type of wafer

2. Which of the following environmental factors is NOT typically a concern when testing telecom wafers?
   a) Temperature
   b) Humidity
   c) Altitude
   d) Vibration

   Answer: c) Altitude

3. What is the primary function of test accessories like probes in telecom wafer testing?
   a) To monitor the environmental conditions of the test area
   b) To adjust test parameters in real-time
   c) To physically interface with the wafer and facilitate electrical testing
   d) To clean the test equipment

   Answer: c) To physically interface with the wafer and facilitate electrical testing

4. Why is calibration important for telecom wafer test equipment?
   a) It ensures that the wafer is free from defects
   b) It guarantees the accuracy of test results
   c) It helps in storing wafer test data
   d) It prevents environmental interference

   Answer: b) It guarantees the accuracy of test results

Fill in the blanks

1. The specific procedure for testing telecom wafers is outlined in a _____ document, known as an SOP.

   Answer: Standard Operating Procedure (SOP)

2. _____ is the process of verifying the performance of test equipment to ensure it operates correctly and accurately.

   Answer: Calibration

3. The principle of _____ ensures that no static charge builds up and damages the wafer during handling.

   Answer: Electrostatic Discharge (ESD) control

4. _____ refers to the environmental conditions like temperature and humidity that can affect the performance of the test equipment during telecom wafer testing

Answer: Environmental factors

Match the following

Column A	Column B
1. SOP (Standard Operating Procedure)	a) Electrostatic Discharge (ESD) control
2. Test Accessories (e.g., probes)	b) Describes specific procedures for testing wafers
3. Calibration	c) Used to interface with the wafer for testing
4. ESD-Safe Tools (e.g., grounded twee-zers)	d) Ensures equipment accuracy and correct opera-tion

Answers: 1 - b, 2 - c, 3 - d, 4 - a

Match the following

Column A	Column B
1. Visual Inspection Techniques	a) Used to monitor test environment conditions
2. Wafer Labeling Protocols	b) Involves using high magnification tools to detect de-fects
3. Test Environment Monitoring Tools	c) Ensures wafers are identified and tracked during testing
4. Wafer Test Equipment	d) Includes tools like probes and test heads for testing

Answers: 1 - b, 2 - c, 3 - a, 4 - d

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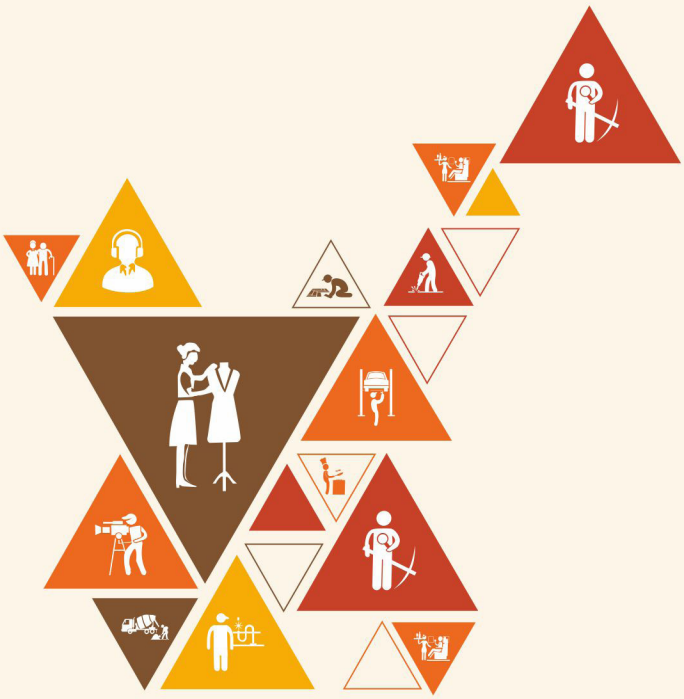
3. Carry Out Wafer Testing

Unit 3.1: Understanding Test Programs and Wafer Functionalities
Unit 3.2: Configuring and Executing Test Programs
Unit 3.3: Monitoring Test Data and Identifying Wafer Defects
Unit 3.4: Applying Pass/Fail Criteria and Documenting Results
Unit 3.5: Data Storage, Archiving, and Company Policies



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Key Learning Outcomes

At the end of this module, the participant will be able to:

1. Discuss the relevant SOP for loading and configuring the test program.
2. Discuss the importance of selecting the appropriate test program based on wafer type and functionalities
3. Describe the different categories of test programs typically used for telecom wafer testing (e.g., functional, parametric).
4. Explain the relationship between the chosen test program and the functionalities it assesses within the wafer.
5. Explain the purpose and specific tests included in a chosen program based on its description.
6. Explain the significance of different data types displayed during testing (e.g., voltage, current, timing) in the context of wafer functionalities.
7. Discuss how data trends and values can be interpreted to assess the performance of specific functionalities under test.
8. Discuss how deviations from expected data patterns might indicate potential issues with the wafer under test.
9. Explain the role of pass/fail criteria established for specific test programs in evaluating wafer performance.
10. Discuss the potential correlation between data anomalies observed during testing and specific types of wafer defects.
11. Describe the information typically found in test logs, including data points, measurements, and any error messages encountered.
12. Perform the following steps on the wafer test equipment:
    - o Access the user interface.
    - o Locate the designated function for loading test programs.
    - o Upload the chosen test program file using the SOP as a guide.
    - o Verify successful program loading.
13. Demonstrate adjusting relevant parameters (e.g., voltage levels, timing specifications) according to the test requirements.
14. Perform initiating the test program execution by activating the appropriate button or command.
15. Demonstrate how to pay close attention to the interface throughout the test, observing any unexpected behavior or error messages.
16. Demonstrate handling prompts (e.g., user confirmation for specific test steps) and troubleshooting error messages.
17. Demonstrate how to access the designated forms or electronic tools for recording test results.
18. Show how to transfer relevant data from the equipment interface to the documentation (e.g., wafer identification, test program name, pass/fail status).
19. Explain how to interpret error messages displayed during testing to identify potential causes of issues.
20. Discuss the basic principles of defect analysis methodologies (e.g., B defect analysis) used to interpret test results.

21. Explain the established pass/fail criteria for the specific test program used and how they are applied to determine wafer performance.
22. Discuss the importance of secure and accessible data storage for test results and the role of archiving procedures.
23. Explain how established company policies regarding data storage and accessibility impact the selection of archiving procedures.
24. Perform documenting concerns in test records, including details about observed irregularities.

Unit 3.1: Understanding Test Programs and Wafer Functionalities

Unit Objectives

At the end of this unit, the participants will be able to:

1. Discuss the Standard Operating Procedures (SOPs) for loading and configuring test programs.
2. Explain the importance of selecting appropriate test programs based on wafer type and functionalities.
3. Describe the categories of test programs used for telecom wafer testing, such as functional and parametric tests.
4. Understand the relationship between the chosen test program and the functionalities it assesses in the wafer.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the importance of Standard Operating Procedures (SOPs) for loading and configuring test programs, how to select the right test programs based on the wafer type and functionality, the different categories of test programs, and the relationship between test programs and wafer functionalities. The correct application of these principles ensures effective and accurate telecom wafer testing.

Ask

Ask the participants the following questions:

- Why is it important to choose the correct test program for telecom wafer testing?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Standard Operating Procedures (SOPs) for Loading and Configuring Test Programs Standard Operating Procedures (SOPs) ensure that test programs are loaded and configured accurately, maintaining consistency and quality across wafer testing. SOPs include step-by-step instructions for initializing test equipment, selecting the correct test parameters, and calibrating equipment. Following these procedures minimizes errors and guarantees that the testing is performed under optimal conditions, ensuring accurate results.

Importance of Selecting Appropriate Test Programs Based on Wafer Type and Functionalities

Selecting the appropriate test program is crucial for obtaining valid test results. The test program must align with the specific type of wafer being tested and its functionalities. Wafer types may have varying electrical characteristics, and different functionalities may require distinct testing methodologies to assess performance. Using the correct test program ensures that relevant parameters are measured, avoiding inaccurate results.

Categories of Test Programs for Telecom Wafer Testing

Test programs for telecom wafer testing typically fall into two main categories

- **Functional Tests:** Functional tests are designed to evaluate the operational capabilities of telecom wafers. These tests focus on assessing whether the wafer can perform its intended functions effectively, such as transmitting and receiving signals. During functional testing, the wafer's overall performance is examined under conditions similar to real-world operations. The goal is to ensure that the wafer meets the performance standards required for its intended use in telecom systems. These tests play a crucial role in verifying that the wafer can handle the demands of communication tasks, ensuring it operates reliably in the field.
- **Parametric Tests:** Parametric tests are focused on measuring the specific electrical characteristics of a telecom wafer, such as voltage, current, and resistance. These tests provide detailed insights into the wafer's electrical behavior, checking its compliance with predefined electrical specifications. Unlike functional tests, which assess the wafer's ability to perform tasks, parametric tests examine the wafer's internal components and ensure they meet the required electrical standards. These tests are essential for detecting potential issues in the wafer's design or manufacturing that may affect its performance and reliability in telecom applications.

Relationship Between the Chosen Test Program and the Functionalities

The test program selected must correspond to the functionalities that need to be evaluated on the wafer. For example, if the wafer is designed to transmit signals, the functional test program will assess the signal transmission capabilities. Similarly, if measuring electrical performance is necessary, a parametric test program will evaluate the wafer's electrical characteristics. The relationship ensures that the correct parameters are tested to verify the wafer's intended function.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Green Hydrogen Production: Handling Employee Engagement and Safety Challenges

Group Size: 4-6 participants

Materials:

- Whiteboard or flipchart
- Markers
- Sticky notes (different colors)
- Scenario cards (described below)

Activity Duration: 60 minutes

Instructions:

1. Divide participants into small groups (4-6 people).
2. Explain the objectives of the activity: Participants will work through a hypothetical situation in green hydrogen production, focusing on employee engagement and safety protocols.
3. Provide a brief review of the green hydrogen production process, employee engagement principles, and safety protocols.
4. Distribute scenario cards: Each group will receive a scenario card that outlines a challenge related to green hydrogen production.
5. Discuss the scenario: Each group should analyze the situation and answer the following questions:
    - Which stage of the green hydrogen production process is impacted by this scenario?
    - How does this scenario affect employee morale and engagement?
    - What safety protocols should be considered when addressing this scenario?
    - What steps can be taken to resolve the issue while maintaining safety and employee engagement?
6. Group presentations: After 20 minutes of discussion, each group presents its scenario, analysis, and proposed solutions to the class. Encourage questions and discussions from other groups.
7. Debriefing: Facilitate a class discussion to debrief the activity. Focus on how different groups approached the scenarios, the importance of safety protocols, and how employee engagement influenced their decisions.

Scenario Cards (Examples):

Scenario 1: During a routine maintenance check, a technician discovers a minor leak in a hydrogen pipeline. The leak does not pose an immediate safety hazard but needs repair. How would you communicate this to your team and ensure the repair process is completed efficiently while maintaining employee engagement and safety?

Scenario 2: You notice a decline in employee morale and productivity lately. Some employees have expressed concerns about the workload and the potential risks associated with working in a green hydrogen production plant. How would you address these concerns and improve employee engagement while ensuring safety protocols are strictly followed?

Scenario 3: The plant is experiencing a temporary shortage of water, a critical element in the electrolysis process. How would you optimize production processes to minimize water usage while keeping your team informed and engaged throughout this challenge?

Activity	Duration	Resources used
Green Hydrogen Production: Handling Employee Engagement and Safety Challenges	60 minutes	Whiteboard or flipchart, Markers, Sticky notes (different colors), Scenario cards (described below), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- During the group discussions, remind participants to consider safety protocols at each stage, especially when troubleshooting equipment or working with sensitive test materials.
- Encourage team members to share ideas openly and work together to identify practical solutions to the given scenarios, ensuring everyone is engaged and contributing.
- Relate the scenarios to real-life testing environments, explaining how equipment configuration and troubleshooting directly affect the testing process, quality assurance, and overall performance of telecom wafers.

Unit 3.2: Configuring and Executing Test Programs

Unit Objectives

At the end of this unit, the participants will be able to:

1. Demonstrate the steps for loading a test program into the wafer test equipment using the user interface.
2. Adjust relevant parameters such as voltage levels and timing specifications according to test requirements.
3. Initiate test program execution and observe the equipment interface for any unexpected behaviors or error messages.
4. Troubleshoot issues by handling prompts and identifying causes of errors during test execution.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the process of loading test programs into wafer test equipment, adjusting key parameters for accurate testing, and troubleshooting potential issues during test execution. You will also learn the importance of monitoring the test process for any errors or unexpected behaviors to ensure accurate results.

Ask

Ask the participants the following questions:

- Why is it important to adjust the voltage and timing parameters when performing wafer tests?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Loading a Test Program into the Wafer Test Equipment Using the User Interface

To load a test program into the wafer test equipment, begin by accessing the equipment's user interface. Navigate to the test program section, select the desired test program from the available list, and load it into the system. Ensure the program is compatible with the specific wafer type and test requirements before initiating the process.

Adjusting Relevant Parameters According to Test Requirements

Once the test program is loaded, adjust parameters such as voltage levels, current settings, and timing specifications based on the test requirements. Ensure these parameters align with the specific characteristics of the wafer being tested, as improper settings could lead to inaccurate results or potential damage to the wafer.

Initiating Test Program Execution and Observing for Errors

After confirming the settings, initiate the execution of the test program. Monitor the test equipment interface closely for any unexpected behaviors or error messages. These could indicate issues with the program or the setup. Address any warnings promptly to ensure smooth test execution and accurate data collection.

Troubleshooting Issues During Test Execution

If any errors or issues arise during the test execution, handle the prompts displayed by the equipment. These prompts often provide valuable information for diagnosing the cause of the error. Common issues could include incorrect parameter settings, connection problems, or equipment malfunctions. Troubleshoot accordingly by checking the program, settings, and connections, or consult the user manual for further guidance.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Simulating a Telecom Wafer Testing Scenario with a Focus on Equipment Configuration, Troubleshooting, and Safety

Group Size: 4-6 participants

Materials: Whiteboard or flipchart, markers, sticky notes (different colors), scenario cards (described below)

Activity Duration: 60 minutes

Instructions:

Divide participants into groups and explain the activity objectives. Briefly review the wafer testing process, the importance of test program configuration, and the safety protocols related to equipment handling.

Distribute scenario cards (one per group). Each card will describe a hypothetical situation that could arise during the telecom wafer testing process. The scenario should introduce a challenge that requires the group to consider the stages of testing, equipment configuration, troubleshooting, and safety protocols.

Group Discussion and Planning (20 minutes):

Each group should discuss their scenario using the following prompts:

1. What stage of the wafer testing process is impacted by this scenario?
2. What are the possible causes of the issue described in the scenario?
3. What safety protocols should be considered when addressing this issue?
4. How would you troubleshoot the problem and adjust parameters to ensure proper test execution?
5. What steps can be taken to maintain employee engagement and minimize risks during troubleshooting?
6. As a team, propose solutions or actions to address the challenge, ensuring that safety and accurate testing are prioritized.

Group Presentations (20 minutes):

Each group will present their scenario, analysis, and proposed solutions to the rest of the class. Encourage questions and discussions from other groups to deepen the understanding of different approaches.

Debriefing and Key Takeaways (20 minutes):

Facilitate a class discussion to debrief the activity. Key points to consider:

1. What different strategies did each group propose to resolve the issue?
2. How did the groups prioritize safety and employee engagement while troubleshooting?
3. What are the key learnings from this activity regarding wafer testing processes, equipment configuration, and safety protocols?

Scenario Cards (Examples):

Scenario 1: During a routine test on a telecom wafer, the equipment displays an error message indicating a mismatch between the test program settings and the wafer's specifications. How would you resolve this issue while ensuring that the test is reconfigured properly and safely?

Scenario 2: The temperature in the testing environment has deviated from the optimal range, and the test results are fluctuating. How would you address this issue, monitor environmental conditions, and ensure that the testing process continues safely and effectively?

Scenario 3: You notice a decline in test accuracy when using a specific test head accessory. After performing basic checks, you realize the accessory needs calibration. How would you address this situation, ensuring that the test head is properly calibrated while maintaining safety and quality control?

Activity	Duration	Resources used
Simulating a Telecom Wafer Testing Scenario with a Focus on Equipment Configuration, Troubleshooting, and Safety	60 minutes	Whiteboard or flipchart, markers, sticky notes (different colors), scenario cards (described below), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- During the group discussions, remind participants to consider safety protocols at each stage, especially when troubleshooting equipment or working with sensitive test materials.
- Encourage team members to share ideas openly and work together to identify practical solutions to the given scenarios, ensuring everyone is engaged and contributing.
- Relate the scenarios to real-life testing environments, explaining how equipment configuration and troubleshooting directly affect the testing process, quality assurance, and overall performance of telecom wafers.

Unit 3.3: Monitoring Test Data and Identifying Wafer Defects

Unit Objectives

At the end of this unit, the participants will be able to:

1. Explain the significance of different data types (e.g., voltage, current, timing) displayed during testing.
2. Interpret data trends and values to assess the performance of specific wafer functionalities.
3. Recognize deviations from expected data patterns and their correlation to potential wafer defects.
4. Discuss the principles of defect analysis methodologies, such as B defect analysis, to interpret test results.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the importance of understanding various data types and trends during telecom wafer testing. You will learn how to interpret key data points such as voltage, current, and timing to assess wafer functionality. We will also explore how deviations in data patterns relate to potential defects and the principles behind defect analysis methodologies used for accurate interpretation of test results.

Ask

Ask the participants the following questions:

- How can voltage, current, and timing measurements help in assessing the functionality of telecom wafers during testing?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Significance of Different Data Types during Testing

During wafer testing, various data types such as voltage, current, and timing are critical in assessing the performance and functionality of telecom wafers. Voltage measurements help determine the operational capacity of the wafer's electrical circuits. Current data provides insights into the flow of electricity through the components, indicating potential issues in conductivity or resistance. Timing

data is essential for ensuring that the wafer's functions are executed within acceptable time frames, indicating the overall speed and efficiency of the components.

Interpreting Data Trends and Values:

Interpreting the data trends and values displayed during testing helps in evaluating the specific functionalities of the wafer. By analyzing voltage, current, and timing data over multiple test cycles, engineers can assess whether the wafer meets performance standards. Any consistent trends or patterns in the data can provide valuable information about the functionality of specific components, enabling accurate identification of performance issues.

Recognizing Deviations and Their Correlation to Potential Wafer Defects

Recognizing deviations from expected data patterns is critical in identifying potential defects in telecom wafers. When voltage, current, or timing readings fall outside their designated ranges, it often signals issues such as faulty circuitry, short circuits, or damaged components. These deviations allow engineers to quickly pinpoint problems, perform targeted troubleshooting, and minimize the chances of defective wafers advancing through production. Early detection of these irregularities improves quality control, ensures higher yields, and helps in maintaining the reliability of telecom applications. Recognizing deviations helps reduce the risk of defects, ensuring only functional wafers move forward in the testing and production process.

Principles of Defect Analysis Methodologies

- **Systematic Approach:** Defect analysis methodologies, like B defect analysis, provide a structured framework for identifying and evaluating defects in wafers.
- **B Defect Analysis:** This method focuses on physical defects in the wafer, such as cracks or contamination, that can impact the wafer's functionality and performance.
- **Fault Isolation:** These methodologies help engineers isolate specific faults by examining the test results and identifying unusual data patterns linked to defective areas of the wafer.
- **Impact Assessment:** By analyzing defects, engineers can assess how each issue affects the overall performance of the wafer, whether it compromises its functionality or operational reliability.
- **Corrective Actions:** The goal of defect analysis is to provide insights into the root causes of defects, enabling corrective actions that enhance wafer quality and improve overall yield during manufacturing.
- **Improved Yield:** By identifying and addressing defects early in the process, defect analysis methods help optimize production, minimize waste, and ensure that only fully functional wafers pass testing.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Wafer Test Equipment Troubleshooting with a Focus on Employee Engagement and Safety

Group Size: 4-6 participants

Materials:

- Whiteboard or flipchart
- Markers
- Sticky notes (different colors)
- Scenario cards (described below)
- Access to a simple test equipment diagram or mock-up

Activity Duration: 60 minutes

Instructions:

1. Divide participants into groups.
2. Briefly review the wafer test equipment processes, the importance of employee engagement during troubleshooting, and safety protocols involved in testing.
3. Distribute scenario cards (one per group). Each card will describe a hypothetical situation related to wafer testing. The scenario should present a challenge in the testing process, focusing on equipment malfunction, test results deviation, or safety concerns.
4. Groups will discuss the scenario, focusing on resolving technical issues while maintaining employee engagement and following safety protocols.

Group Discussion and Planning (20 minutes):

Each group should discuss their scenario using the following prompts:

- What aspect of the wafer test equipment is impacted by the situation?
- How does the issue impact employee morale, efficiency, or engagement during the troubleshooting process?
- What safety protocols should be prioritized during troubleshooting?
- What corrective actions or solutions should be proposed to resolve the issue while engaging employees and ensuring safety?

Group Presentations (20 minutes):

Each group will present their scenario, analysis, and proposed solutions to the rest of the class. Encourage questions and discussions from other groups.

- How did safety and employee engagement influence your decision-making?
- What challenges did you face while troubleshooting the equipment?
- What was your approach to resolving the issue effectively?

Debriefing and Key Takeaways (20 minutes):

Facilitate a class discussion to debrief on the activity. Key points to consider:

- What were the different approaches taken by each group to address the scenario?

- How did employee engagement and safety protocols influence decision-making?
- What are some key learnings regarding troubleshooting wafer test equipment while prioritizing employee well-being and safety?

Scenario Cards (Examples):

Scenario 1: During a routine test, the equipment displays unexpected voltage readings, causing an error message. The test fails, but there is no obvious cause. How would you engage your team to troubleshoot the issue, ensuring everyone feels supported and safe while addressing the problem?

Scenario 2: The test equipment has been producing inconsistent timing results for the last few hours. Employees are concerned about the accuracy of the tests. How would you address these concerns and restore morale while adhering to safety procedures?

Scenario 3: A technician reports physical strain and fatigue after long hours of troubleshooting the wafer test equipment. How would you ensure their safety while maintaining the team's engagement and addressing the ongoing equipment issue?

Activity	Duration	Resources used
Wafer Test Equipment Troubleshooting with a Focus on Employee Engagement and Safety	60 minutes	Whiteboard or flipchart, Markers, Sticky notes (different colors), Scenario cards (described below), Access to a simple test equipment diagram or mock-up, etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Foster an environment where each participant shares ideas on how to solve the issues while emphasizing teamwork and mutual support.
- Always remind participants that safety protocols should be a priority when dealing with equipment malfunctions or other challenges.
- Stress the importance of maintaining positive morale during troubleshooting. Ask questions about how each group can enhance employee involvement and well-being during high-pressure situations.

Unit 3.4: Applying Pass/Fail Criteria and Documenting Results

Unit Objectives

At the end of this unit, the participants will be able to:

1. Explain the pass/fail criteria for specific test programs and their role in evaluating wafer performance.
2. Perform proper documentation of test results, including wafer identification, program name, and pass/fail status.
3. Demonstrate transferring relevant data from the equipment interface to test records or designated electronic tools.
4. Document any observed irregularities or concerns in test records with clarity and detail.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the importance of pass/fail criteria in wafer testing, the proper documentation of test results, and how to record any irregularities or concerns during the testing process. These practices are essential for ensuring accurate and efficient wafer evaluation, maintaining quality control, and providing insights for troubleshooting and improvement.

Ask

Ask the participants the following questions:

- Why is it important to document the test results accurately and track observed irregularities in wafer testing?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Pass/Fail Criteria for Test Programs and Role in Evaluating Wafer Performance

The pass/fail criteria play a vital role in evaluating wafer performance by providing a clear benchmark for determining whether a wafer meets the required standards. These criteria help in identifying whether the wafer is functioning within the specified electrical and operational limits. If the wafer meets these predefined thresholds, it is considered functional and suitable for its intended application.

On the other hand, if the wafer does not meet the criteria, it is flagged as potentially defective, allowing engineers to perform further analysis or make necessary adjustments. By implementing pass/fail criteria, manufacturers can ensure consistent quality control, reduce the chances of defective wafers reaching the market, and streamline the production process by identifying issues early on.

Proper Documentation of Test Results

Documenting test results accurately is crucial for tracking wafer performance and maintaining quality control. Test results should include wafer identification, the test program used, and the pass/fail status of the test. This documentation serves as a record for future reference, troubleshooting, and ensuring that quality standards are met consistently. Clear and detailed records help in identifying trends, potential defects, and maintaining an audit trail for testing procedures.

Transferring Relevant Data from Equipment Interface to Test Records

After completing a test, it is important to transfer relevant data from the equipment interface to the designated test records or electronic tools. This data includes test results, performance metrics, and any errors or irregularities observed during testing. Proper data transfer ensures that information is accurately stored and easily accessible for future analysis, quality assurance, and troubleshooting efforts.

Documenting Observed Irregularities or Concerns in Test Records

If any irregularities or concerns arise during testing, they must be documented in detail. These observations might include unexpected test results, equipment malfunctions, or deviations from expected patterns. Clear documentation helps in pinpointing the root cause of issues and provides a basis for corrective actions. It also ensures that the testing process remains transparent and that any anomalies are addressed promptly and effectively.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Simulating Wafer Test Failures and Troubleshooting in a Semiconductor Production Environment

Group Size: 4-6 participants

Materials:

- Whiteboard or flipchart
- Markers
- Sticky notes (different colors)
- Scenario cards (described below)

Activity Duration: 60 minutes

Instructions:

1. Divide participants into groups.

2. Explain the activity objectives, which focus on recognizing wafer test failures, troubleshooting, and documenting results.
3. Briefly review the key aspects of wafer testing, including pass/fail criteria, test parameters, and documentation processes.
4. Distribute scenario cards to each group. Each card will describe a hypothetical situation related to wafer testing failures and troubleshooting.
5. Each group should discuss and plan how to handle the failure scenario by identifying the causes, proposing solutions, and ensuring proper documentation.

Group Discussion and Planning (20 minutes):

Each group discusses their scenario, focusing on:

- What specific test failure occurred?
- What could be the cause of the failure?
- How can they troubleshoot the issue?
- What steps should be taken to document the failure?

Groups must work together to propose solutions that follow best practices in troubleshooting and documentation.

Group Presentations (20 minutes):

1. Each group presents their scenario, analysis, proposed solutions, and documentation practices to the rest of the class.
2. Encourage questions and discussions from other groups to help refine ideas and approaches.

Debriefing and Key Takeaways (20 minutes):

1. Facilitate a class discussion about the different approaches taken by each group to address the failure scenario.
2. Discuss how troubleshooting methods and documentation practices were applied in each case.
3. Key points to consider:
   - How did different groups approach problem-solving?
   - What were the best practices for troubleshooting and documenting test failures?
   - How can recognizing test failures early in the process benefit wafer quality and production efficiency?

Scenario Cards (Examples):

Scenario 1: During a wafer test, the voltage levels fall below the required threshold, causing a test failure. What steps would you take to troubleshoot this issue and ensure accurate documentation of the results?

Scenario 2: A technician encounters an unexpected error message during the test execution that affects multiple test parameters. How would you handle this issue and document the steps taken to resolve it?

Scenario 3: A wafer passes some tests but fails to meet the required current specifications in the final stage. What potential causes should be considered, and how would you document this anomaly for further analysis?

Activity	Duration	Resources used
Simulating Wafer Test Failures and Troubleshooting in a Semiconductor Production Environment	60 minutes	Whiteboard or flipchart, Markers, Sticky notes (different colors), Scenario cards (described below), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Make sure each group communicates their findings clearly and documents their approach to troubleshooting and resolution. Encourage them to think about the sequence of steps involved in identifying and fixing the issues.
- Ensure that participants emphasize how documenting each failure, including causes and actions taken, is essential to the overall production and quality assurance process.
- If any group struggles with identifying potential solutions, help them think through common causes of test failures and troubleshooting techniques, such as checking connections, recalibrating equipment, or running diagnostic tools.

Unit 3.5: Data Storage, Archiving, and Company Policies

Unit Objectives

At the end of this unit, the participants will be able to:

1. Discuss the importance of secure and accessible data storage for test results.
2. Explain company policies related to data storage, accessibility, and archiving procedures.
3. Identify how company guidelines impact the selection of archiving methods for test results.
4. Understand the role of proper data management in ensuring traceability and quality assurance.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the significance of secure data storage and management in test processes. We will explore company policies related to storing and archiving test results, the impact of these policies on data accessibility, and how proper management ensures traceability and maintains quality assurance. Understanding these aspects is essential for maintaining compliance, security, and accuracy in test records.

Ask

Ask the participants the following questions:

- Why is it important for companies to have secure and well-managed data storage systems for test results?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Importance of Secure and Accessible Data Storage for Test Results

Secure and accessible data storage ensures that test results are protected from unauthorized access, loss, or corruption. It allows for efficient retrieval when needed for analysis or audits, maintaining data integrity over time. Proper storage methods safeguard valuable test information, supporting transparency, accountability, and compliance with regulatory requirements, while also enabling easy access by authorized personnel for troubleshooting or quality checks.

Company Policies Related to Data Storage, Accessibility, and Archiving Procedures

Company policies set clear guidelines for how test data is stored, accessed, and archived. These policies help maintain data security by defining who can access test results and under what circumstances. They also establish the procedures for archiving test results to ensure they are kept for the required duration, ensuring compliance with industry standards or regulatory bodies. These policies also address encryption, backups, and data recovery procedures.

Impact of Company Guidelines on the Selection of Archiving Methods for Test Results

Company guidelines play a significant role in determining which archiving methods are chosen for test results. These guidelines dictate the level of security required for data, influencing the use of digital or physical storage solutions. The guidelines ensure that archiving methods comply with legal, regulatory, and quality standards. For example, long-term storage solutions may involve cloud-based systems, external hard drives, or secure data centers that guarantee data safety and quick access when required.

Role of Proper Data Management in Ensuring Traceability and Quality Assurance

- **Traceability:** Proper data management allows for a detailed record of test results that can be traced back to specific tests, including the test date, conditions, and equipment used. This traceability is crucial for auditing, troubleshooting, and verifying the history of a product's testing.
- **Consistency and Accuracy:** Managing data correctly ensures that test results are accurate and consistent across multiple tests. This allows for better evaluation of performance and helps in identifying any variations or anomalies in the test data.
- **Trend Identification:** Well-managed data allows for the identification of trends over time, which is important for detecting recurring issues, improving processes, and predicting potential future problems. Analyzing historical data provides valuable insights for continuous improvement.
- **Quality Assurance:** Reliable data ensures that quality standards are met by providing concrete evidence of the quality of the product through its test results. It supports decisions regarding product improvements, troubleshooting, and meeting compliance requirements.
- **Proof of Compliance:** Proper data management provides necessary documentation to demonstrate compliance with industry standards, regulations, and internal quality processes. This is important during audits, reviews, or investigations.
- **Efficient Issue Resolution:** With traceable, well-organized test data, any defects or issues in the product can be quickly traced back to their origin. This facilitates quicker identification of root causes and effective corrective actions.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Data Management and Test Result Documentation in Wafer Testing

Group Size: 4-6 participants

Materials: Whiteboard or flipchart, markers, sticky notes, scenario cards (described below)

Activity Duration: 60 minutes

Instructions:

Divide participants into groups.

Explain the activity's objectives and the importance of secure data management, documentation, and archiving in wafer testing. Briefly review wafer testing processes, company data policies, and best practices for managing test results.

Distribute Scenario Cards:

Each card will describe a hypothetical situation that requires the group to assess how test results are handled and documented. The scenario should focus on aspects such as proper data storage, traceability, or irregularities in test results.

Group Discussion and Planning (20 minutes):

Each group should discuss their scenario and answer the following prompts:

1. How would you ensure that test results are properly documented and stored?
2. What are the steps involved in handling test result irregularities and ensuring traceability?
3. What would be your approach to comply with company policies on data archiving and accessibility?
4. How do you ensure that the test results are accurate, complete, and properly archived?

Group Presentations (20 minutes):

Each group will present their scenario analysis, proposed solutions, and how they would manage the data process. Encourage questions and facilitate discussions between groups.

Debriefing and Key Takeaways (20 minutes):

Facilitate a class discussion to reflect on the activity. Key discussion points:

1. How did each group approach the documentation of test results and data management?
2. What were the challenges in ensuring traceability and quality assurance during the activity?
3. How did company policies and guidelines influence their decision-making process?
4. What were the key learnings regarding data management in wafer testing?

Scenario Cards (Examples):

Scenario 1: During a wafer test, a technician notices an irregularity in the voltage reading, which may suggest a potential defect in the wafer. How would you document this irregularity, and what steps would you take to ensure the test result is recorded and stored securely, while following company policies?

Scenario 2: A batch of test results from a particular wafer testing program has been flagged for possible inconsistencies. How would you handle the situation and ensure proper data validation and archiving according to company guidelines?

Scenario 3: A test result needs to be retrieved from an archive for review by a quality assurance team. Describe how you would ensure the proper retrieval, accessibility, and confidentiality of the test result, while complying with company data storage policies.

Activity	Duration	Resources used
Data Management and Test Result Documentation in Wafer Testing	60 minutes	Whiteboard or flipchart, markers, sticky notes, scenario cards (described below), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Emphasize the importance of clear, accurate, and detailed documentation. Ensure groups understand the need for traceability and how it relates to overall quality assurance.
- Encourage participants to apply company-specific data management policies, including archiving methods, data accessibility, and security, in their solutions.
- Guide the groups to think critically about potential issues such as test result irregularities or compliance with data storage policies, and provide practical solutions to maintain quality and traceability.

Exercise

Multiple Choice Questions (MCQs)

1. What is the primary reason for selecting an appropriate test program based on the wafer type?
   a) To save time during testing
   b) To assess the wafer's functionalities and quality
   c) To avoid data anomalies
   d) To reduce testing cost

   Answer: b) To assess the wafer's functionalities and quality

2. Which of the following is typically included in a test log?
   a) Test program name, wafer ID, measurements, error messages
   b) Test results only
   c) Wafer appearance
   d) None of the above

   Answer: a) Test program name, wafer ID, measurements, error messages

3. In wafer testing, deviations from expected data patterns could indicate:
   a) An efficient test process
   b) Potential issues or defects in the wafer
   c) Accurate data readings
   d) No issues with the wafer

   Answer: b) Potential issues or defects in the wafer

4. What is the role of pass/fail criteria in wafer testing?
   a) To interpret the test data
   b) To determine the quality of the wafer
   c) To adjust test parameters
   d) To validate the test equipment

   Answer: b) To determine the quality of the wafer

Fill in the Blanks:

1. The chosen test program for a wafer should be selected based on its _____ and the specific functionalities to be assessed.

   Answer: type

2. Data trends during testing, such as changes in _____ and _____, are important to assess the wafer's performance.

   Answer: voltage, current

3. When deviations from expected data are detected, they may indicate potential _____ in the wafer under test.

   Answer: defects

4. In defect analysis methodologies, a common approach used to assess the performance of wafers is _____ defect analysis.

   Answer: wafer-level

Match the following

Column A	Column B
1. Pass/Fail Criteria	a) Ensures test results are secure and retrievable
2. Test Program	b) Defines limits for acceptable wafer performance
3. Test Log	c) Tracks test results, measurements, and errors
4. Data Archiving Procedures	d) Determines the specific tests to be performed

Answers: 1 - b, 2 - d, 3 - c, 4 - a

Match the following

Column A	Column B
1. Test Program Selection	a) Ensures accurate and reliable test results
2. Error Messages in Testing	b) Indicates potential issues with wafer performance
3. Data Trends and Values	c) Essential for troubleshooting and identifying faults
4. Secure Data Storage and Archiving	d) Helps in monitoring wafer functionality over time

Answers: 1 - d, 2 - b, 3 - a, 4 - c

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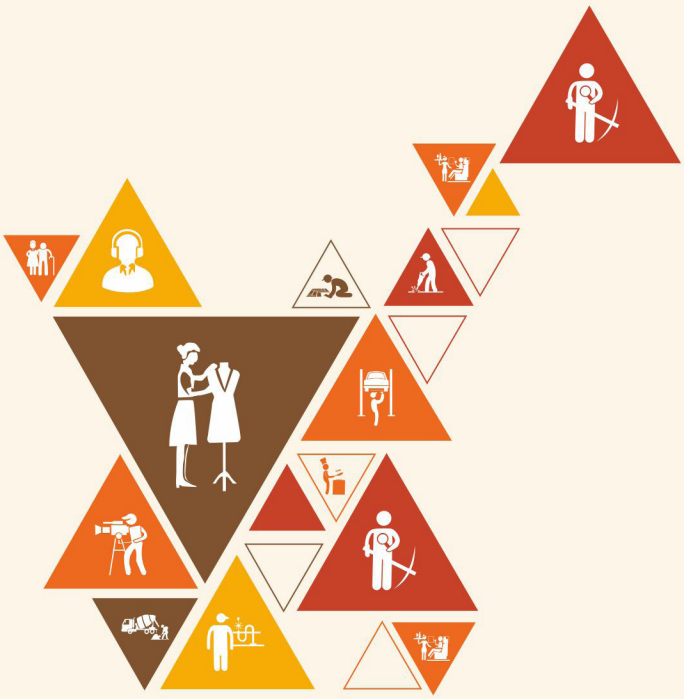
Sector
Skill
Council

4. Perform Analysis of Wafer Test Data

Unit 4.1: Statistical Process Control (SPC) and Wafer Data Analysis
Unit 4.2: Identifying Wafer Defects and Failure Mechanisms
Unit 4.3: Wafer Maps and Spatial Defect Analysis
Unit 4.4: Failure Analysis and Corrective Actions
Unit 4.5: Reporting and Visualization of Test Results



Key Learning Outcomes

At the end of this module, the participant will be able to:

1. Explain the principles of SPC and its application in analyzing wafer test data.
2. Discuss how to identify trends, patterns, and outliers in test data using control charts.
3. Describe how to interpret the results of statistical analysis to assess process capability and identify areas for improvement.
4. Discuss the relationship between specific test parameters and potential wafer defects.
5. Explain how data analysis techniques can be used to interpret complex test data sets and identify potential failure points.
6. Describe the basic concepts of semiconductor device failure mechanisms and their connection to observed data anomalies.
7. Explain how to utilize wafer maps to correlate test data points with their corresponding locations on the wafer.
8. Discuss the process of analyzing spatial patterns of defects to identify potential causes related to specific locations within the fabrication process.
9. Explain how knowledge of circuit design and fabrication processes can be used to infer potential root causes based on the type of test performed and observed defects.
10. Discuss the difference between random defects and systematic issues affecting multiple devices or wafers (KU9).
11. Demonstrate the use of SPC software or tools to generate and interpret control charts for analyzing test data.
12. Perform the selection of appropriate SPC charts based on the specific test parameter and wafer functionality under evaluation.
13. Identify trends, shifts, or outliers in control chart data that might indicate potential process issues.
14. Calculate basic statistical metrics (e.g., Cpk) to assess process capability and identify opportunities for improvement.
15. Perform the comparison of test data for each wafer against established criteria or historical data, considering tolerances and expected variations.
16. Identify any outliers, unexpected dips or spikes in parameters, or deviations from normal test results, categorizing them by severity (critical, minor).
17. Utilize wafer maps to pinpoint the locations of specific test data points on the wafer.
18. Analyze spatial patterns of defects to identify potential causes related to specific locations within the wafer fabrication process.
19. Document the classification (pass/fail) of each wafer and any associated defect information in the designated test record or electronic documentation system.
20. Utilize data visualization tools (e.g., charts, graphs) to effectively represent test results and highlight key findings for improved clarity in reports.
21. Explain how to classify failing devices based on the type and severity of the defect.
22. Discuss the impact of failing devices on overall wafer functionality, considering redundancy or isolation mechanisms within the circuit design.
23. Discuss and recommend appropriate next steps for failing devices, including retesting, scrapping, or further investigation using specialized equipment.

24. Discuss how to analyze data from multiple wafers and test runs to identify patterns or trends that suggest systematic problems within the manufacturing process.
25. Explain how statistical analysis tools can be used to pinpoint potential causes behind identified issues.
26. Discuss and recommend corrective actions or process improvements to address systematic problems and prevent future occurrences.
27. Compile well-structured and concise test reports summarizing the findings from the wafer testing process, including:
    - Overall pass/fail rates
    - Defect classifications with severity levels
    - Identified trends or anomalies

Unit 4.1: Statistical Process Control (SPC) and Wafer Data Analysis

Unit Objectives

At the end of this unit, the participants will be able to:

1. Explain the principles of Statistical Process Control (SPC) and its role in analyzing wafer test data.
2. Demonstrate the use of SPC software/tools to generate and interpret control charts for analyzing test data.
3. Identify trends, shifts, and outliers in control chart data that might indicate process issues.
4. Perform the selection of appropriate SPC charts based on specific test parameters and wafer functionalities.
5. Calculate basic statistical metrics (e.g., Cpk) to assess process capability and identify areas for improvement.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the principles and applications of Statistical Process Control (SPC) in wafer testing. We will explore the use of SPC tools, the interpretation of control charts, and the calculation of statistical metrics to monitor and improve process quality. By understanding these concepts, learners will gain the skills to ensure consistency and address process variations effectively.

Ask

Ask the participants the following questions:

- What is the primary purpose of using Statistical Process Control (SPC) in wafer testing?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Principles of Statistical Process Control (SPC) and Its Role in Analyzing Wafer Test Data

Statistical Process Control (SPC) utilizes statistical methods to monitor and control processes to ensure quality and consistency.

- Monitoring Process Stability: SPC involves tracking process performance over time to identify stability or variations.
- Use of Statistical Tools: Techniques like control charts and histograms are used to analyze data trends and variations.
- Differentiating Variations: SPC helps distinguish between common cause (natural) and special cause (unexpected) variations.
- Defect Prevention: By monitoring key parameters, SPC aids in early detection and correction of process issues.
- Continuous Improvement: SPC supports ongoing enhancements by identifying areas of inefficiency or inconsistency.

Use of SPC Software/Tools to Generate and Interpret Control Charts

SPC software facilitates the creation of control charts, which help visualize process data over time. These tools enable users to identify normal variations and potential process deviations. Interpreting control charts provides insights into trends and informs decisions for maintaining consistent quality.

Identifying Trends, Shifts, and Outliers in Control Chart Data

Control charts reveal patterns that may indicate underlying process issues. Trends suggest gradual changes, shifts point to sudden deviations, and outliers highlight abnormalities. Recognizing these elements helps in diagnosing problems and taking corrective actions.

Selection of Appropriate SPC Charts Based on Test Parameters

Choosing the right SPC chart depends on the type of data and test parameters. For example, X-bar charts are used for average measurements, while p-charts are suitable for proportions. Proper chart selection ensures accurate monitoring and meaningful analysis.

Calculating Basic Statistical Metrics (e.g., Cpk) for Process Capability

Process capability metrics, like Cpk, measure a process's ability to produce outputs within specification limits. Calculating these metrics identifies areas of improvement, helps optimize processes, and ensures compliance with quality standards.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Optimizing SPC for Wafer Testing with a Focus on Defect Analysis and Process Improvement

Group Size: 4-6 participants

Materials:

- Whiteboard or flipchart
- Markers
- Sticky notes (different colors)
- Example data sets (charts, tables, or trends in wafer test data)
- Scenario cards with specific SPC challenges

Activity Duration: 60 minutes

Instructions:

Introduction (10 minutes):

- Divide participants into groups and explain the activity objectives.
- Provide a brief overview of Statistical Process Control (SPC), its tools, and its significance in wafer testing and quality assurance.
- Distribute scenario cards, each presenting a specific challenge related to SPC in wafer testing.

Group Discussion and Problem-Solving (20 minutes):

- Groups analyze their scenario and discuss the following:
  - What type of SPC chart or tool is most suitable for this situation?
  - How can trends, shifts, or outliers in data be identified and interpreted?
  - What actions can be taken to address the observed issues while ensuring quality?
- Propose actionable steps to optimize SPC application and address the challenge.

Group Presentations (20 minutes):

- Each group presents their scenario, analysis, and solutions to the class.
- Encourage peer questions and discussions to explore diverse perspectives.

Debriefing and Key Takeaways (10 minutes):

- Facilitate a class discussion on the following points:
  - What were the unique approaches adopted by different groups?
  - How did SPC principles help in problem-solving?
  - What lessons can be applied to real-world wafer testing scenarios?

Scenario Cards (Examples):

Scenario 1: A control chart for a specific wafer test parameter shows repeated minor deviations from the upper control limit. How would you identify the root cause and implement corrective actions?

Scenario 2: A significant shift in the process mean is observed in the control chart. How would you interpret this trend and address its implications for wafer quality?

Scenario 3: Data outliers are consistently appearing in parametric test results, potentially indicating a recurring defect. How would you use SPC tools to isolate the issue and improve the process?

Activity	Duration	Resources used
Optimizing SPC for Wafer Testing with a Focus on Defect Analysis and Process Improvement	60 minutes	Whiteboard or flipchart, Markers, Sticky notes (different colors), Example data sets (charts, tables, or trends in wafer test data), Scenario cards with specific SPC challenges, etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Encourage participants to actively engage in discussions and think critically about how SPC principles apply to the given scenarios.
- Provide simple explanations of statistical tools like control charts or process capability indices for groups that need additional guidance.
- Highlight the importance of teamwork and clear communication in achieving effective solutions.

Unit 4.2: Identifying Wafer Defects and Failure Mechanisms

Unit Objectives

At the end of this unit, the participants will be able to:

1. Discuss the relationship between specific test parameters and potential wafer defects.
2. Describe the basic concepts of semiconductor failure mechanisms and their connection to observed data anomalies.
3. Explain the difference between random defects and systematic issues affecting multiple devices or wafers.
4. Interpret test results to identify potential failure points using statistical and analytical techniques.
5. Utilize knowledge of circuit design and fabrication processes to infer root causes based on observed defects.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss how to analyze test parameters, interpret data anomalies, and distinguish between random and systematic defects in wafers. We will explore failure mechanisms and apply statistical and analytical techniques to infer root causes, enhancing the ability to diagnose and address potential issues in semiconductor manufacturing.

Ask

Ask the participants the following questions:

- What is the difference between random defects and systematic issues in wafer testing?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Relationship Between Specific Test Parameters and Potential Wafer Defects

The relationship between specific test parameters and potential wafer defects lies in the direct connection between the measured values and the wafer's operational integrity. Parameters such as voltage, current, and timing are critical indicators of a wafer's electrical and functional health.

For instance:

- Voltage variations may point to issues like breakdowns in insulation or leakage currents, which can signal short circuits.
- Current irregularities might indicate open connections, high resistance paths, or defective transistors.
- Timing discrepancies often reflect synchronization issues in circuit elements, which can lead to performance degradation or failure.

By analyzing deviations from expected parameter ranges, engineers can pinpoint defects, evaluate their impact on device functionality, and determine necessary corrective actions.

Basic Concepts of Semiconductor Failure Mechanisms and Connection to Data Anomalies

- **Material Defects:** Imperfections in the semiconductor crystal, such as dislocations or voids, can cause electrical irregularities, leading to unexpected current leakage or resistance changes during testing.
- **Contamination:** Foreign particles or impurities introduced during manufacturing can disrupt the wafer's electrical pathways, often reflected as voltage instabilities or short circuits in test data.
- **Design Flaws:** Inaccurate or suboptimal circuit designs can lead to functional inconsistencies, such as timing errors or mismatched signal outputs, visible as data anomalies during tests.
- **Thermal Stress:** Overheating or thermal cycling during operation or testing can cause damage like metal migration or cracking, detected as variations in performance metrics such as power dissipation or response delays.
- **Electrical Overstress (EOS):** Exposure to excessive voltage or current can degrade device performance, showing up in test results as shifts in threshold voltage or reduced signal integrity.

By analyzing these anomalies, engineers can trace back to the root causes of semiconductor failures, improving both design and manufacturing processes.

Difference Between Random Defects and Systematic Issues

Random defects occur sporadically and are often the result of unpredictable factors such as contamination, equipment malfunctions, or environmental conditions during manufacturing. These defects typically impact individual devices or wafers without a discernible pattern. In contrast, systematic issues arise from consistent errors embedded within the design, materials, or production processes, affecting multiple devices or wafers in a similar way. Recognizing whether a problem is random or systematic is crucial for implementing effective corrective actions, as it determines whether the focus should be on improving process control or addressing inherent design flaws.

Interpreting Test Results to Identify Potential Failure Points

Interpreting test results involves leveraging statistical and analytical techniques, such as control charts, trend analysis, and data visualization, to pinpoint abnormalities and deviations in performance metrics. These methods help identify failure points by revealing patterns that deviate from expected norms, indicating possible defects or process inefficiencies. By systematically analyzing these deviations, engineers can focus investigations on specific areas, leading to more effective troubleshooting and quality improvements.

Using Circuit Design and Fabrication Knowledge to Infer Root Causes

A thorough understanding of circuit design and wafer fabrication processes is essential for diagnosing defects. Engineers can link observed anomalies, such as irregular current flow or voltage drops, to specific stages in the manufacturing process or design configurations. This knowledge facilitates identifying the root causes of defects, whether they stem from material inconsistencies, process variations, or design limitations, enabling targeted corrective actions and optimized production workflows.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Analyzing Wafer Test Results for Defect Identification

Group Size: 4–6 participants

Materials:

- Whiteboard or flipchart
- Markers
- Sample test result datasets (printed or digital)
- Scenario cards (described below)

Activity Duration: 60 minutes

Instructions:

1. **Divide Participants into Groups:** Organize participants into groups of 4–6 members. Explain the activity objectives and relevance to semiconductor testing and defect analysis.
2. **Brief Review:** Provide a quick overview of statistical analysis techniques, defect types, and common wafer test parameters.
3. **Scenario Cards Distribution:** Each group receives a scenario card detailing a test result with anomalies. The card will include key test parameters and observations requiring analysis.

Group Discussion and Analysis (20 minutes):

- Analyze the test results using the given dataset.
- Discuss potential wafer defects based on the anomalies observed.
- Identify whether the issue stems from random defects, systematic issues, or process inefficiencies.
- Propose actions to address the identified defects.

Group Presentations (20 minutes):

- Each group presents their findings and proposed solutions to the class.
- Encourage questions from other groups for deeper insights.

Debriefing and Key Takeaways (20 minutes):

- Discuss the approaches taken by each group to analyze test data.
- Highlight how statistical tools and fabrication knowledge informed defect identification.
- Summarize the importance of systematic analysis in maintaining wafer quality.

Scenario Cards (Examples):

Scenario 1: A technician discovers a minor hydrogen leak during a routine maintenance check. Although it doesn't pose an immediate safety hazard, it requires repair. The challenge is to communicate the issue to the team and ensure a quick repair while maintaining safety protocols and keeping employee morale high.

Scenario 2: There has been a noticeable decline in employee morale and productivity. Workers have expressed concerns about the growing workload and potential safety risks in the plant. The challenge is to address these concerns, improve engagement, and ensure safety standards are met.

Scenario 3: The plant is dealing with a temporary water shortage, which affects the electrolysis process. This shortage could slow down production. The challenge is to minimize water usage, keep the team informed, and maintain their engagement during this difficult period.

Activity	Duration	Resources used
Analyzing Wafer Test Results for Defect Identification	60 minutes	Whiteboard or flipchart, Markers, Sample test result datasets (printed or digital), Scenario cards (described below), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Ensure all participants understand the test parameters and common defects before starting.
- Encourage collaboration within groups by assigning roles, such as data analyst, presenter, and recorder.
- Provide guidance during discussions to ensure participants consider both statistical and practical aspects of defect analysis.

Unit 4.3: Wafer Maps and Spatial Defect Analysis

Unit Objectives

At the end of this unit, the participants will be able to:

1. Utilize wafer maps to correlate test data points with their corresponding locations on the wafer.
2. Analyze spatial patterns of defects to identify potential causes related to specific locations within the fabrication process.
3. Perform comparison of test data against established criteria or historical data, considering tolerances and expected variations.
4. Identify outliers, deviations, or unexpected spikes in parameters and classify them by severity (critical, minor).
5. Document defect information and pass/fail classification in designated test records or systems.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss how to analyze test data from semiconductor wafers using wafer maps and identify spatial patterns of defects. We will also cover how to compare test data with historical benchmarks, classify deviations, and document defects. The goal is to enable efficient troubleshooting and process improvement based on observed data.

Ask

Ask the participants the following questions:

- How can analyzing the spatial patterns of defects on a wafer help identify the root causes of issues in the fabrication process?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Utilizing Wafer Maps to Correlate Test Data

Wafer maps provide a graphical representation of the wafer layout, with each point on the map corresponding to a specific location on the wafer. By associating test data points with their corresponding locations on the wafer, engineers can pinpoint where specific issues arise. This helps to identify localized

defects or process inconsistencies, which would otherwise be difficult to detect. This visual mapping facilitates more efficient troubleshooting, as engineers can focus their analysis on the affected areas, rather than on the wafer as a whole.

Analyzing Spatial Patterns of Defects

Spatial analysis of defects is a crucial aspect of semiconductor testing. By examining where defects occur across the wafer, engineers can detect trends that indicate potential causes. For example, if defects are concentrated in a specific area, it could point to issues with equipment calibration, contamination in the process, or material inconsistencies. Understanding the spatial distribution of defects enables engineers to target the root cause more precisely and make adjustments to the fabrication process accordingly, improving wafer yield and quality.

Performing Comparison of Test Data Against Criteria

After collecting test data from the wafer, comparing it against established criteria or historical data allows for a thorough evaluation of the wafer's performance. This comparison helps to identify whether the wafer is meeting predefined quality standards and specifications. Variations in test data may be expected due to certain tolerances, but large deviations could indicate potential issues. By analyzing these discrepancies, engineers can determine if the wafer's performance is within acceptable limits or if corrective actions are needed to ensure the final product meets quality standards.

Identifying Outliers and Classifying Deviations

Test data can sometimes reveal outliers or unexpected deviations from the norm. These outliers could be indicative of defects or irregularities that affect the functionality of the wafer. It's essential to classify these deviations based on their severity—whether they are critical, which would require immediate corrective action, or minor, which may not significantly impact the wafer's overall performance. This classification helps prioritize corrective measures, ensuring that resources are directed toward addressing the most pressing issues first.

Documenting Defect Information and Pass/Fail Classification

Proper documentation is key in the wafer testing process, as it ensures that defects are tracked and analyzed over time. Recording defect information, including the nature of the defect, location, and the corresponding pass/fail classification, helps maintain a clear historical record. This record is essential for quality control, as it allows engineers to trace defects back to specific points in the production process and monitor trends over time. In addition, proper documentation aids in process improvement by providing valuable data for refining fabrication techniques and identifying areas for optimization.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Analyzing Semiconductor Defects and Process Optimization

Group Size: 4-6 participants

Materials: Whiteboard or flipchart, Markers, Sticky notes (different colors), Scenario cards (described below)

Activity Duration: 60 minutes

Instructions:

1. Divide participants into small groups.
2. Explain the objectives of the activity: analyzing semiconductor defects and understanding the root causes in the context of process optimization.
3. Briefly review wafer test data analysis, failure mechanisms, and process optimization principles.
4. Distribute scenario cards (one per group). Each card will describe a specific situation related to semiconductor defects in the testing phase or fabrication process.
5. Groups should discuss the scenario and apply their knowledge to analyze potential causes of defects, propose process improvements, and ensure the quality control system is maintained.

Group Discussion and Planning (20 minutes):

Each group should discuss their assigned scenario using the following prompts:

- What specific test data or wafer map patterns are relevant to the scenario?
- What are the potential causes of the observed defects (random vs. systematic issues)?
- How might this scenario impact the overall yield and performance?
- Propose solutions or process adjustments to resolve the issue while maintaining high standards of quality control.

Group Presentations (20 minutes):

Each group will present their scenario, analysis, and proposed solutions to the rest of the class. Encourage questions and feedback from other groups. This will help stimulate discussion on different approaches to defect analysis and process improvement.

Debriefing and Key Takeaways (20 minutes):

Facilitate a class discussion to summarize the activity. Key points to consider:

Scenario Cards (Examples):

Scenario 1: During a routine test, a group of wafers shows a significant deviation in threshold voltage, concentrated in one area of the wafer. The wafers have passed all previous quality checks. What steps would you take to investigate the issue and identify the root cause?

Scenario 2: An analysis of test data reveals a high rate of failure in a specific batch of semiconductors, but the test data shows no apparent outliers. How would you approach the issue, considering possible systematic causes or equipment-related problems?

Scenario 3: A significant number of wafers fail to meet the acceptable limits for leakage current during testing, but the defect is not consistent across all wafers. How would you analyze the defect pattern and suggest improvements to minimize future failures?

Activity	Duration	Resources used
Analyzing Semiconductor Defects and Process Optimization	60 minutes	Whiteboard or flipchart, Markers, Sticky notes (different colors), Scenario cards (described below), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Encourage participants to think critically about the root causes of defects, using both statistical tools and knowledge of the fabrication process.
- Remind participants to consider both random and systematic issues when analyzing test data and wafer maps.
- Facilitate discussion on the importance of proactive quality control measures and their impact on production yield.

Unit 4.4: Failure Analysis and Corrective Actions

Unit Objectives

At the end of this unit, the participants will be able to:

1. Explain how to classify failing devices based on the type and severity of defects.
2. Discuss the impact of failing devices on overall wafer functionality considering redundancy or isolation mechanisms in circuit design.
3. Recommend appropriate next steps for failing devices, including retesting, scrapping, or further investigation.
4. Analyze data from multiple wafers and test runs to identify trends that suggest systematic problems.
5. Use statistical analysis tools to pinpoint potential causes and recommend corrective actions to prevent recurrence.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the processes for classifying and addressing failing devices on wafers, identifying trends that point to systemic issues, and using statistical tools to analyze test data. Additionally, we will explore how redundancy in circuit design impacts the overall functionality of wafers and determine the next steps for handling failing devices.

Ask

Ask the participants the following questions:

- How can we differentiate between a minor failure and a critical defect in semiconductor devices during testing?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Classifying Failing Devices Based on Type and Severity of Defects

Failing devices can be classified based on the type of defects observed, such as electrical failures, short circuits, or open circuits, and their severity, ranging from minor deviations that don't impact

performance to critical failures that can render the device nonfunctional. The classification helps in prioritizing corrective actions and determining the potential impact on the final product's quality and performance.

Impact of Failing Devices on Overall Wafer Functionality

Failing devices can affect the overall functionality of a wafer, especially when redundancy or isolation mechanisms in the circuit design are limited. In circuits with redundancy, some failures might not impact the wafer's performance as other components can take over. However, in designs without redundancy, a single failure can lead to significant issues, potentially reducing yield or affecting the wafer's functionality.

Next Steps for Failing Devices

For failing devices, it is important to determine whether they need to be retested, scrapped, or further investigated. Retesting helps verify the initial results or confirm potential intermittent issues. Scrapping might be necessary if defects are irreparable or affect critical performance. Further investigation should focus on identifying the root cause, whether it's related to the fabrication process, design flaws, or material issues.

Analyzing Data from Multiple Wafers to Identify Trends

Analyzing data from multiple wafers and test runs allows engineers to identify recurring trends or patterns that may suggest systematic problems, such as consistent defects occurring in a specific location on the wafer. These trends indicate that the issue might be process-related, requiring a deeper analysis of the production parameters to determine the root cause.

Using Statistical Analysis Tools for Root Cause Analysis

Statistical analysis tools, such as regression analysis, control charts, or root cause analysis methods, can be used to pinpoint potential causes of defects. These tools help to quantify variations in the test data and correlate them with specific factors in the fabrication or testing process. Based on the findings, corrective actions, such as process adjustments or equipment maintenance, can be recommended to prevent similar issues from recurring.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Managing Device Failures and Improving Yield in Wafer Production

Group Size: 4-6 participants

Materials: Whiteboard or flipchart, Markers, Sticky notes, Scenario cards (described below)

Activity Duration: 60 minutes

Instructions:

- **Introduction:** Briefly review the wafer production process, types of defects, the importance of classifying failures, and the use of statistical analysis in identifying causes and improving yield.

- **Scenario Cards:** Distribute one scenario card to each group. The card will describe a situation related to wafer defects, data analysis, or quality control.
- **Group Discussion and Planning (20 minutes):**
  - Discuss the impact of the scenario on the wafer's functionality and yield.
  - Identify potential causes of the defect and suggest appropriate actions based on severity (e.g., retesting, scrapping, or investigating further).
  - Consider how statistical tools can be used to analyze trends and inform decisions.
- **Group Presentations (20 minutes):**
  - Each group presents their scenario, analysis, and proposed solutions.
  - Encourage other participants to ask questions and suggest improvements.
- **Debriefing and Key Takeaways (20 minutes):**
  - Facilitate a class discussion about the different approaches taken by each group.
  - Discuss the role of statistical analysis in root cause analysis and corrective actions.
  - Summarize key learnings, particularly in identifying and addressing wafer defects.

Scenario Cards (Examples):

Scenario 1: A batch of wafers has been identified with defects concentrated in a specific region of the wafer. The defects are minor but persistent across multiple wafers. How would you analyze the test data to determine if this is a random anomaly or a systematic issue? What steps would you take to address this problem?

Scenario 2: During routine testing, several wafers fail due to electrical shorts, while others pass. The shorts are localized in different areas of the wafer. What statistical tools would you use to identify patterns or trends, and how would you prioritize corrective actions?

Scenario 3: A wafer exhibits multiple small defects, but the overall yield is still above acceptable limits. However, customer feedback indicates a performance issue with the final products. How would you approach the situation to identify if the defects are causing the performance issues and what steps you would take to improve the final yield?

Activity	Duration	Resources used
Managing Device Failures and Improving Yield in Wafer Production	60 minutes	Whiteboard or flipchart, Markers, Sticky notes, Scenario cards (described below), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Ensure that participants understand the importance of using data analysis to detect trends and identify systematic issues, as well as the need to prioritize corrective actions based on defect severity.
- Ask participants to think beyond the surface-level symptoms of defects and explore root causes using statistical tools and other methods of analysis.
- Foster an environment where participants can share different perspectives and work together to formulate effective solutions, emphasizing the importance of teamwork in resolving production challenges.

Unit 4.5: Reporting and Visualization of Test Results

Unit Objectives

At the end of this unit, the participants will be able to:

1. Utilize data visualization tools (e.g., charts, graphs) to represent test results effectively.
2. Compile well-structured and concise test reports summarizing key findings, including:
   - Overall pass/fail rates
   - Defect classifications with severity levels
   - Identified trends or anomalies
3. Explain the significance of presenting findings clearly to facilitate process improvements and decision-making.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the importance of using data visualization tools to represent test results and the key elements of compiling concise and structured test reports. We will explore how clear communication of test findings supports better decision-making and process improvements in semiconductor production.

Ask

Ask the participants the following questions:

- How can data visualization tools and clear test reporting help improve the quality control process in semiconductor production?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Utilizing Data Visualization Tools to Represent Test Results Effectively

Data visualization tools like charts and graphs are essential for transforming raw test data into easily interpretable visual formats. These tools highlight key performance indicators such as pass/fail rates, defect distributions, and anomalies. By visualizing test results, engineers and decision-makers can

quickly grasp the health of the production process and identify areas that require further attention, improving the efficiency of data interpretation and communication.

Compiling Well-Structured and Concise Test Reports

A well-structured test report concisely summarizes key findings from testing, including overall pass/fail rates, defect classifications with severity levels, and identified trends or anomalies. These reports serve as critical documents for quality control, allowing stakeholders to assess wafer performance, make informed decisions, and initiate corrective actions as needed. Clear, concise reports ensure that the information is accessible and actionable for all involved parties.

Significance of Presenting Findings Clearly

Presenting findings clearly in test reports and visualizations is crucial for facilitating process improvements and informed decision-making. Clear presentations allow stakeholders to easily identify potential issues, understand their severity, and prioritize corrective actions. Effective communication of test results leads to quicker decision-making, better resource allocation, and ultimately, improved production outcomes and product quality.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Managing Test Failures and Data Interpretation in Semiconductor Manufacturing

Group Size: 4-6 participants

Materials: Whiteboard or flipchart, Markers, Sticky notes, Scenario cards (described below)

Activity Duration: 60 minutes

Instructions:

- Divide participants into groups and explain the objectives of the activity. Provide a brief review of the wafer testing process and the importance of interpreting test results.
- Distribute one scenario card to each group. The scenario card will describe a potential issue or challenge that can occur during wafer testing and data interpretation.
- Each group will work together to address the scenario using the following prompts:
    - What specific test data is impacted by this scenario?
    - How would the identified issue affect overall wafer functionality?
    - What next steps would you propose for handling the failing device(s)?
    - How would you document this issue and communicate findings to relevant stakeholders?
- **Group Discussion and Planning (20 minutes):** Each group should analyze the scenario and come up with solutions or actions.
- **Group Presentations (20 minutes):** Each group will present their scenario, analysis, and proposed solutions to the class.
- **Debriefing and Key Takeaways (20 minutes):** Facilitate a class discussion to reflect on the activity and extract key learning points.

Scenario Cards (Examples):

Scenario 1: During the testing phase, you notice a significant spike in failure rates from one specific batch of wafers. The failure seems to stem from an unexpected defect in the process, but the root cause is unclear. How would you approach investigating this anomaly, and what actions would you take to identify and resolve the underlying issue?

Scenario 2: A set of test data shows a gradual decrease in performance, with several failing devices classified as minor defects. However, the overall pass rate is still within acceptable limits. How would you handle this situation, and would you recommend retesting, further investigation, or scrapping the affected devices?

Scenario 3: Multiple test runs have produced inconsistent results, and the defects appear to be concentrated in specific regions of the wafer. How would you analyze the data to identify whether this is a random defect or indicative of a larger, systematic issue? What steps would you take to prevent recurrence?

Activity	Duration	Resources used
Managing Device Failures and Improving Yield in Wafer Production	60 minutes	Whiteboard or flipchart, Markers, Sticky notes, Scenario cards (described below), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Focus on encouraging participants to think critically about the root cause of issues, not just addressing symptoms. Guide them to use available test data and tools for problem-solving.
- Promote team discussions and ensure everyone contributes ideas during the analysis and solution development stages. Diverse perspectives can help uncover solutions.
- Remind participants about the importance of accurate documentation in semiconductor manufacturing. How they document and communicate the findings will play a key role in the troubleshooting and corrective actions process.

Exercise

Multiple Choice Questions (MCQs)

1. Which of the following statistical tools is commonly used to monitor process stability and identify trends, shifts, or outliers in test data?

   a) Histogram

   b) Control Chart

   c) Pareto Chart

   d) Scatter Plot

   Answer: b) Control Chart

2. What does the Cpk metric assess in semiconductor wafer testing?

   a) Process capability index

   b) Process yield rate

   c) Test parameter deviation

   d) Outlier classification

   Answer: a) Process capability index

3. In a wafer test, if a defect is identified at multiple points along a specific region of the wafer, it is likely indicative of a:

   a) Random defect

   b) Systematic issue

   c) Data anomaly

   d) Passable result

   Answer: b) Systematic issue

4. What is the primary benefit of using wafer maps in the analysis of test data?

   a) To identify random defects

   b) To correlate test data points with specific locations on the wafer

   c) To summarize test results in graphs

   d) To classify defects based on severity

   Answer: b) To correlate test data points with specific locations on the wafer

Fill in the Blanks

1. The process of using statistical techniques to monitor and improve the quality of semiconductor manufacturing is known as _____.

   Answer: Statistical Process Control (SPC)

2. A control chart helps to identify _____ in the test data, such as shifts or trends that may indicate a process issue.

   Answer: outliers

3. The process capability index (Cpk) is used to assess how well a process is performing relative to _____.

   Answer: established specifications.

4. To identify potential failure points in a semiconductor device, data analysis techniques are applied to interpret complex _____ data sets.

Answer: test

Match the following

Column A	Column B
1. Control Charts	a) Defects related to consistent issues in the fabrication process
2. Cpk	b) Measure the ability of a process to produce within specification limits
3. Systematic Defects	c. Identify trends and outliers in test data
4. SPC Tools	d. Used to monitor the stability of a manufacturing process over time

Answers: 1 - c, 2 - b, 3 - a, 4 - d

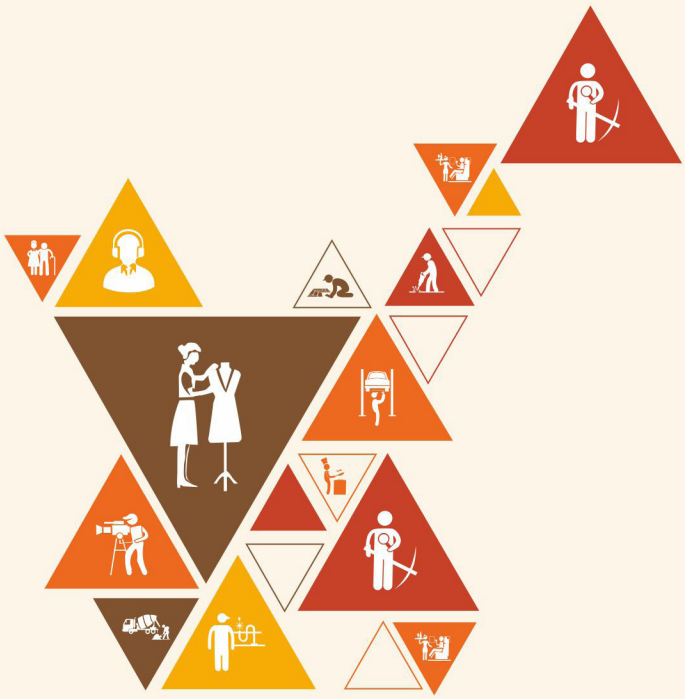
Match the following

Column A	Column B
1. Wafer Maps	a. Classification of devices as pass/fail
2. Defect Severity Levels	b. Identifies defect locations on the wafer
3. Test Reports	c) Helps determine process improvement opportunities
4. Statistical Analysis Tools	d) Used to identify patterns and causes of wafer defects

Answers: 1 - b, 2 - a, 3 - c, 4 - d

5. Maintain Wafer Test Equipment

Unit 5.1: Preventive Maintenance and Equipment Cleaning
Unit 5.2: Identifying and Troubleshooting Equipment Issues
Unit 5.3: Reporting and Escalating Equipment Issues
Unit 5.4: Organizing Maintenance Tools and Documentation



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Key Learning Outcomes

At the end of this module, the participant will be able to:

1. Explain the importance of preventive maintenance for maintaining optimal equipment performance and preventing costly downtime.
2. Discuss the basic principles of cleaning procedures to prevent contamination within the wafer test equipment.
3. Explain safe handling and storage procedures for cleaning materials and tools to avoid hazards or contamination.
4. Recognize potential dangers and indications of equipment failure during operation (e.g., unusual noises, error messages).
5. Explain how to utilize equipment manuals, troubleshooting guides, and diagnostic tools to identify the source of potential failures.
6. Discuss the limitations of one's own troubleshooting abilities and when to escalate issues to qualified personnel.
7. Describe the importance of clear and concise communication when reporting equipment malfunctions.
8. Explain the importance of maintaining accurate and complete maintenance records for future reference.
9. Discuss company policies for organizing and storing maintenance logs and records for traceability.
10. Demonstrate cleaning various components of the wafer test equipment, utilizing appropriate cleaning materials for specific components
11. Show how to organize and maintain a clean and clutter-free workspace around the test equipment.
12. Demonstrate disposal of used cleaning materials and waste generated during maintenance activities (PC9).
13. Show how to maintain tools and equipment used for cleaning and maintenance organized and readily accessible for efficient use.
14. Demonstrate recognizing potential dangers and indications of equipment failure during operation (e.g., unusual noises, error messages).
15. Perform basic troubleshooting steps as per established procedures or manufacturer recommendations (e.g., restarting the equipment, checking cable connections).
16. Document the troubleshooting steps taken and their outcomes for future reference.
17. Show the impact of troubleshooting failure on test operations (e.g., complete test stoppage, partial functionality loss).
18. Demonstrate how to report equipment malfunctions requiring repair work beyond basic troubleshooting capabilities to designated personnel (e.g., maintenance technicians) following established company protocols.
19. Demonstrate how to record maintenance activities performed on the test equipment, including cleaning, preventive maintenance, and repairs.
20. Show use of designated logbooks or a computerized maintenance management system to document maintenance activities, including the date, type of maintenance performed, specific actions taken, replacement parts used (if applicable), and any observations made.

Unit 5.1: Preventive Maintenance and Equipment Cleaning

Unit Objectives

At the end of this unit, the participants will be able to:

1. Explain the importance of preventive maintenance in ensuring optimal equipment performance and minimizing costly downtime.
2. Discuss the basic principles of cleaning procedures to prevent contamination within wafer test equipment.
3. Demonstrate cleaning various components of wafer test equipment using appropriate cleaning materials for specific parts.
4. Show safe handling and storage procedures for cleaning materials and tools to avoid hazards or contamination.
5. Demonstrate proper disposal of used cleaning materials and waste generated during maintenance activities.
6. Explain how to maintain a clean and clutter-free workspace around the test equipment.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the importance of preventive maintenance in ensuring equipment performance and minimizing downtime. We will also cover essential cleaning procedures, safe handling of cleaning materials, proper disposal techniques, and maintaining a clean and safe workspace around wafer test equipment.

Ask

Ask the participants the following questions:

- Why is preventive maintenance crucial for the effective operation of wafer test equipment?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Importance of Preventive Maintenance

Preventive maintenance is a proactive approach that focuses on regularly inspecting and servicing wafer test equipment to detect potential problems before they lead to equipment failure. By scheduling routine checks, calibration, and adjustments, preventive maintenance ensures that the equipment operates at peak performance. Identifying small issues early can prevent them from escalating into costly repairs or major breakdowns, saving time and money in the long run. This proactive approach reduces the likelihood of unexpected downtime, which can disrupt production and delay deadlines. Additionally, regular maintenance extends the lifespan of the equipment, ultimately leading to better return o

onsistent performance.

Basic Principles of Cleaning Procedures

Proper cleaning procedures are vital to prevent contamination of wafer test equipment, which can affect test accuracy and device performance. Cleaning must be done with suitable materials that do not damage sensitive components.

- **Prevention of Contamination:** Cleaning procedures are crucial to avoid contaminants such as dust, oils, or chemicals that could affect the accuracy of wafer tests and the performance of the devices being tested.
- **Use of Appropriate Materials:** Only use cleaning materials that are specifically designed for wafer test equipment. Harsh chemicals or abrasive tools could damage delicate components and negatively impact test results.
- **Established Protocols:** Following standard operating procedures (SOPs) for cleaning ensures consistency, reduces errors, and maintains the reliability of test results. These protocols help prevent cross-contamination between tests or between components.
- **Non-Damaging Cleaning Methods:** Ensure that cleaning is done gently and carefully to avoid damaging sensitive parts, such as sensors, probes, or electrical connections, which are crucial to test accuracy.
- **Safety and Equipment Integrity:** Cleaners and cleaning methods must be chosen with care to maintain the integrity of both the equipment and the wafers. Contamination can interfere with wafer testing, leading to inaccurate readings and compromised device performance.

Demonstrating Cleaning of Components

Cleaning various components of wafer test equipment requires using appropriate cleaning materials designed for each specific part. For example, delicate optics may require lint-free cloths, while heavier machinery may need specialized solvents or cleaning brushes. Ensuring that the correct cleaning materials are used prevents wear and damage to the equipment.

Safe Handling and Storage of Cleaning Materials

Safe handling and storage of cleaning materials are essential to prevent accidents, contamination, or damage. Cleaning solutions and tools must be stored in clearly labeled containers and kept in designated storage areas. Additionally, personal protective equipment (PPE) should be used to avoid exposure to hazardous materials.

Proper Disposal of Used Cleaning Materials and Waste

Used cleaning materials and waste generated during maintenance activities must be disposed of according to safety guidelines. This prevents environmental contamination and ensures workplace safety. All used materials should be segregated, labeled, and disposed of in accordance with hazardous waste protocols.

Maintaining a Clean Workspace

Maintaining a clean and clutter-free workspace around wafer test equipment is essential for safe and efficient operation. It prevents accidents, contamination, and equipment damage. A well-organized workspace also allows for quick access to tools and materials, improving workflow and minimizing time lost in searching for items.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Analyzing Semiconductor Equipment Maintenance and Safety Protocols

Group Size: 4-6 participants

Materials: Whiteboard or flipchart, markers, sticky notes, scenario cards

Activity Duration: 60 minutes

Instructions:

- Divide participants into groups of 4-6 people.
- Briefly explain the importance of maintaining wafer test equipment, preventive maintenance principles, and safety protocols.
- Distribute scenario cards to each group. Each card will describe a hypothetical situation that could occur during semiconductor equipment maintenance and cleaning. The scenario should highlight the challenges of maintaining optimal equipment performance while ensuring employee safety and reducing contamination risks.
- Groups will discuss their scenario and address the following prompts:
    - Which aspect of the equipment maintenance process does the scenario impact (e.g., cleaning, preventive maintenance, equipment repair)?
    - How could this situation affect employee morale and the overall workflow?
    - What safety protocols should be applied to address the issue in the scenario?
    - What preventive maintenance actions can be taken to prevent similar situations in the future?
    - What cleaning and waste disposal procedures must be followed to maintain equipment and work area hygiene?

Group Discussion and Planning (20 minutes):

- Each group should discuss the scenario and propose solutions to mitigate the risks, ensuring that employee engagement, safety, and equipment performance are prioritized.
- Encourage the group to consider how communication with the team can help maintain morale and engagement while addressing safety concerns.

Group Presentations (20 minutes):

- Each group will present their scenario, the analysis, and their proposed solutions to the class.
- Encourage other groups to ask questions and share feedback.

Debriefing and Key Takeaways (20 minutes):

- Facilitate a class discussion to debrief on the activity.
- Highlight key lessons learned, including how to balance safety protocols with efficient maintenance practices, how to foster employee engagement during challenging maintenance tasks, and how to maintain a clean and safe work environment.

Scenario Cards (Examples):

Scenario 1: A technician notices that the air filtration system in the wafer test equipment is not functioning correctly. This could lead to contamination risks and negatively impact test accuracy. How do you communicate this issue to the team, ensure corrective action is taken, and maintain safety?

Scenario 2: During equipment cleaning, a worker is exposed to cleaning chemicals that are not handled properly. How do you address this safety concern, ensure proper training, and minimize potential health risks to employees?

Scenario 3: The equipment requires preventive maintenance, but there is a backlog of work orders, and employees are feeling overburdened. How do you manage this challenge while maintaining the workflow and ensuring that safety and preventive maintenance procedures are not compromised?

Activity	Duration	Resources used
Analyzing Semiconductor Equipment Maintenance and Safety Protocols	60 minutes	Whiteboard or flipchart, markers, sticky notes, scenario cards, etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Encourage participants to engage in collaborative discussions, where each team member's input is valued. Focus on teamwork and how diverse perspectives can lead to more effective problem-solving.
- Encourage participants to draw on personal experiences or case studies to illustrate points related to maintenance practices, employee safety, and engagement.
- Stress the importance of safety and cleanliness in semiconductor manufacturing environments, as contamination risks and safety hazards can severely impact both equipment performance and employee well-being.

Unit 5.2: Identifying and Troubleshooting Equipment Issues

Unit Objectives

At the end of this unit, the participants will be able to:

1. Recognize potential dangers and indications of equipment failure during operation, such as unusual noises or error messages.
2. Utilize equipment manuals, troubleshooting guides, and diagnostic tools to identify the source of failures.
3. Demonstrate basic troubleshooting steps as per established procedures or manufacturer recommendations (e.g., restarting equipment, checking cable connections).
4. Discuss the limitations of troubleshooting abilities and explain when to escalate issues to qualified personnel.
5. Show how to document troubleshooting steps taken and their outcomes for future reference.
6. Analyze the impact of troubleshooting failure on test operations, such as partial functionality loss or complete stoppage.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the essential skills needed for troubleshooting wafer test equipment, including how to recognize potential equipment failures, utilize diagnostic tools, and implement basic troubleshooting procedures. We will also cover when to escalate issues and the importance of documenting troubleshooting steps for future reference.

Ask

Ask the participants the following questions:

- What are the common signs that indicate equipment failure during wafer testing, and how should you respond to them?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Recognizing Potential Dangers and Indications of Equipment Failure

Recognizing potential dangers and indications of equipment failure is crucial for maintaining smooth operations. Early signs such as unusual noises, error messages, or fluctuating performance can point to underlying problems like worn-out parts or electrical malfunctions. These early warnings are valuable because they help prevent more serious breakdowns, reduce the risk of accidents, and ensure the equipment continues functioning safely. Identifying and addressing these issues promptly can prevent costly repairs, minimize downtime, and enhance overall safety in the workspace.

Utilizing Equipment Manuals, Troubleshooting Guides, and Diagnostic Tools

When equipment malfunctions, it's crucial to consult the manuals, troubleshooting guides, and diagnostic tools provided by the manufacturer. These resources provide step-by-step instructions for identifying and resolving issues, ensuring that maintenance personnel can troubleshoot effectively and restore equipment functionality.

- **Consulting Equipment Manuals:** Equipment manuals contain detailed information about the system's components, functionality, and troubleshooting instructions. These manuals often include common issues, their symptoms, and suggested solutions, allowing maintenance personnel to quickly identify and address the problem.
- **Using Troubleshooting Guides:** Troubleshooting guides are typically step-by-step instructions designed to guide personnel through the process of diagnosing and fixing specific issues. These guides provide a structured approach to isolating faults, making it easier to pinpoint the source of malfunction.
- **Leveraging Diagnostic Tools:** Diagnostic tools, such as software utilities or hardware testers, help identify faults by performing automated checks or monitoring system performance. These tools can detect specific errors that may not be visible through manual inspection, enabling precise identification of issues.
- **Ensuring Effective Troubleshooting:** By combining the information from manuals, guides, and diagnostic tools, maintenance personnel can troubleshoot efficiently. These resources help eliminate guesswork, reduce the time needed to restore equipment functionality, and increase the likelihood of a successful repair.

Demonstrating Basic Troubleshooting Steps

Basic troubleshooting involves following established procedures or manufacturer recommendations. This may include:

- **Restarting the Equipment:** A simple restart can resolve many issues related to system hang-ups, software glitches, or minor memory-related problems. Restarting allows the equipment to reset and can eliminate temporary malfunctions that may have occurred.
- **Checking Cable Connections:** Loose or disconnected cables are common causes of equipment failure. Ensure all cables are properly plugged in and securely connected to prevent communication or power issues that might cause malfunction.
- **Verifying Power Supply:** Sometimes, the issue could be as simple as a lack of power. Checking power cables, outlets, and switches ensures that the equipment is receiving the necessary power supply to function properly.
- **Inspecting Indicators or Error Messages:** Many devices have indicator lights or display messages that can help pinpoint the problem. Check for any error codes or warning lights and refer to the manual to understand their meaning.

- **Performing a System Check:** Use any built-in diagnostic features to check the overall status of the system. Running a basic system check can help identify any potential issues that are preventing the equipment from working properly.
- **Following Manufacturer Recommendations:** Manufacturer troubleshooting guidelines provide proven methods for addressing common problems. Following these recommendations ensures consistency in handling issues and reduces the risk of further damage to the equipment.

Discussing the Limitations of Troubleshooting Abilities

While troubleshooting can solve many issues, there are limitations. In cases where the problem is complex or involves specialized knowledge, it's important to escalate the issue to qualified personnel. Escalation ensures that the problem is addressed appropriately, preventing further damage and minimizing downtime.

Documenting Troubleshooting Steps and Outcomes

Proper documentation of troubleshooting efforts is vital for future reference. Recording the steps taken, outcomes, and any lessons learned helps to streamline future troubleshooting processes and provides valuable insights for maintenance teams to address similar issues more efficiently.

Analyzing the Impact of Troubleshooting Failure on Test Operations

When troubleshooting fails to resolve an issue, it can significantly impact test operations. This could lead to partial functionality loss, where some equipment functions but not optimally, or complete stoppage, causing delays and potential disruptions in production or testing schedules. It's important to assess the impact and plan for rapid resolution.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Simulating a Semiconductor Wafer Test Scenario with a Focus on Troubleshooting and Documentation

Group Size: 4-6 participants

Materials: Whiteboard or flipchart, markers, scenario cards, laptops/tablets (for digital resources, if available)

Activity Duration: 60 minutes

Instructions:

Introduction (10 minutes):

- Divide participants into small groups.
- Briefly explain the objectives of the activity and the importance of troubleshooting in wafer testing, including documenting each troubleshooting step.
- Review the key components of wafer test equipment, common failure modes, and the importance of accurate documentation.

Scenario Assignment (5 minutes):

- Distribute one scenario card to each group. Each card will describe a hypothetical issue with wafer testing equipment that requires troubleshooting.
- Scenarios could involve equipment failure, software issues, or sensor malfunctions.

Group Discussion and Problem Solving (25 minutes):

- Each group should discuss the assigned scenario using the following prompts:
  - What potential equipment failures or issues are causing the problem?
  - What are the first troubleshooting steps you would take based on available diagnostic tools and manuals?
  - How would you document your troubleshooting steps and outcomes?
  - What safety protocols should be followed during troubleshooting?
- Groups should write down their findings and solutions on the whiteboard or flipchart.

Group Presentations (15 minutes):

  - Each group will present their scenario, troubleshooting process, solutions, and documentation approach to the class.
  - Encourage the rest of the participants to ask questions and offer suggestions during the presentations.

Debrief and Key Takeaways (10 minutes):

- Facilitate a discussion to debrief on the activity. Consider the following key points:
  - How did each group approach the troubleshooting process?
  - What were the challenges in identifying the issue, and how did the team overcome them?
  - Why is documentation crucial in troubleshooting and maintaining equipment?
  - How do the troubleshooting steps impact overall wafer test operations and productivity?

Scenario Cards (Examples):

Scenario 1: During a wafer test, the system displays an error message that the sensor is not responding, but the test still seems to run. How would you troubleshoot this, and how would you document your findings?

Scenario 2: The wafer test results show inconsistent data, and the software suggests a malfunction in the data analysis algorithm. How would you identify the source of the issue and resolve it? What diagnostic tools would you use, and how would you document the steps taken?

Scenario 3: After performing a test, the equipment emits a strange noise, and the temperature gauge for a specific component is rising faster than expected. How would you approach this issue to prevent further damage to the equipment, and what safety procedures would you follow?

Activity	Duration	Resources used
Simulating a Semiconductor Wafer Test Scenario with a Focus on Troubleshooting and Documentation	60 minutes	Whiteboard or flipchart, markers, scenario cards, laptops/tablets (for digital resources, if available), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Encourage every group member to contribute their ideas during the troubleshooting process. This will enhance collaborative problem-solving and ensure diverse perspectives are considered.
- Reinforce the importance of clear and detailed documentation throughout the troubleshooting process. This is crucial not only for immediate reference but also for future troubleshooting and process improvement.
- If groups face challenges in solving the scenario, guide them toward using available resources like equipment manuals, troubleshooting guides, and diagnostic tools. Help them understand when they should escalate issues to more qualified personnel.

Unit 5.3: Reporting and Escalating Equipment Issues

Unit Objectives

At the end of this unit, the participants will be able to:

1. Explain the importance of clear and concise communication when reporting equipment malfunctions.
2. Demonstrate how to report equipment malfunctions requiring repair work beyond basic troubleshooting capabilities to designated personnel following company protocols.
3. Describe company policies for organizing and storing maintenance logs and records for traceability.
4. Show how to maintain accurate and complete maintenance records for future reference.
5. Discuss the importance of documenting specific actions taken, observations made, and replacement parts used in maintenance activities.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss the importance of clear communication when reporting equipment malfunctions, the protocols for escalating issues, and how to maintain thorough and accurate maintenance records. We will also explore company policies related to organizing logs and documenting actions, ensuring that all maintenance activities are well-documented for future reference and accountability.

Ask

Ask the participants the following questions:

- Why is it important to document every maintenance action, including observations and parts used, when dealing with equipment malfunctions?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Clear and Concise Communication When Reporting Equipment Malfunctions

Effective communication is critical when reporting equipment malfunctions to ensure that issues are understood clearly and can be addressed promptly. Providing detailed and precise information about the symptoms, possible causes, and any initial troubleshooting steps taken helps the recipient assess the severity of the issue. Clear communication minimizes misunderstandings, reduces downtime, and ensures that appropriate actions are taken to fix the equipment efficiently.

Reporting Equipment Malfunctions Requiring Repair Work Beyond Basic Troubleshooting

When equipment malfunctions require repairs beyond basic troubleshooting, it is essential to follow the company's reporting protocols. This typically involves documenting the issue with as much detail as possible, including the nature of the problem, any impact on operations, and the actions taken. The report should then be sent to the designated repair team or qualified personnel, ensuring that the issue is prioritized and handled by those with the proper expertise and tools.

Company Policies for Organizing and Storing Maintenance Logs and Records

- **Traceability:** Organized maintenance logs allow for easy tracking of past maintenance activities, repairs, and inspections. This ensures that every action taken is recorded and can be referenced when needed.
- **Accountability:** Proper storage of maintenance records ensures that responsibility for maintenance tasks is clearly attributed to the personnel involved. It supports transparent processes and helps to identify who performed each task.
- **Easy Access:** Company policies typically ensure that maintenance logs are stored in a way that allows easy access for authorized personnel. This can be in both digital and physical formats, but digital storage is often preferred for quicker retrieval and sharing.
- **Auditing Purposes:** Maintenance records must be kept in a well-organized manner to support audits. Regular audits of these records ensure that equipment maintenance is performed according to industry standards and internal company protocols.
- **Future Reference:** Storing logs systematically ensures that they can be accessed for future reference when troubleshooting issues, conducting repairs, or planning for preventative maintenance. This also helps identify recurring issues with equipment.
- **Data Protection:** Maintenance logs, particularly digital ones, need to be stored securely to prevent unauthorized access or loss of data. Backup systems should be in place to protect against data loss.
- **Long-Term Use:** Proper organization ensures that records can be easily used over the long term, assisting with equipment lifecycle management and facilitating informed decisions about future maintenance needs.

Maintaining Accurate and Complete Maintenance Records for Future Reference:

Accurate and complete maintenance records are essential for ensuring the longevity and proper functioning of equipment. These records should include all details about the equipment's condition, the maintenance activities performed, and any replacement parts used. Having up-to-date records allows technicians and operators to refer to previous repairs and inspections, making it easier to identify recurring problems or plan for preventative maintenance.

Documenting Specific Actions Taken, Observations Made, and Replacement Parts Used:

Documenting the specific actions taken during maintenance helps create a detailed history of the equipment's care. Observations about the equipment's condition, performance, or any anomalies noted during maintenance should be recorded. Additionally, any replacement parts used should be documented with part numbers and installation details. This ensures traceability and helps in evaluating the effectiveness of repairs or replacements, as well as planning future maintenance needs.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Simulating an Equipment Maintenance and Troubleshooting Scenario

Group Size: 4-6 participants

Materials: Whiteboard or flipchart, Markers, Scenario cards, Sticky notes (optional)

Activity Duration: 60 minutes

Instructions:

- **Divide Participants into Groups:** Split the participants into smaller groups of 4-6.
- **Explain Activity Objectives:** Briefly introduce the goal of the activity, which is to simulate a scenario where equipment malfunctions, requiring troubleshooting, maintenance, and documentation. The focus will be on clear communication, following company protocols, and ensuring safety during the process.
- **Review Key Concepts:** Ensure participants are familiar with the equipment troubleshooting process, documentation practices, and safety protocols that apply to the scenario.
- **Distribute Scenario Cards:** Provide each group with a scenario card (one per group). The card will describe a hypothetical situation related to equipment malfunction, such as detecting an error message or unusual equipment behavior. Each scenario will include a potential troubleshooting challenge that requires specific actions.
- **Group Discussion and Planning (20 minutes):** Instruct each group to:
    - Identify which equipment is malfunctioning.
    - Determine the steps needed to diagnose and troubleshoot the issue.
    - Consider the necessary safety precautions while troubleshooting.
    - Discuss how to document the issue, the actions taken, and the final solution.
    - Develop a communication plan for reporting the issue and escalating it if necessary.
- **Group Presentations (20 minutes):** Each group will present their scenario, the troubleshooting steps they took, and the outcome. Encourage other groups to ask questions and provide feedback.
- **Debriefing and Key Takeaways (20 minutes):** After all presentations, conduct a group discussion on:

- What solutions were proposed by the groups?
- How did each group ensure clear communication and effective documentation?
- How were safety protocols addressed during the troubleshooting process?

Scenario Cards (Examples):

Scenario 1: During testing, an equipment display shows an error code, and the system halts. The error doesn't provide much detail, and the technician is unsure whether it is a minor issue or a more significant malfunction. How would you troubleshoot and escalate the issue, and how would you report the situation to management?

Scenario 2: You're inspecting equipment after a previous failure and notice some unusual wear and tear on cables. The cables are integral to the system's performance, and you need to ensure the equipment is safe to operate. How would you handle this situation, and what steps would you take to prevent further damage?

Scenario 3: While conducting regular maintenance on equipment, you realize that the malfunction appears to be a recurring issue despite previous fixes. How do you document the findings, and when do you escalate this issue to a more senior technician or management?

Activity	Duration	Resources used
Simulating an Equipment Maintenance and Troubleshooting Scenario	60 minutes	Whiteboard or flipchart, Markers, Scenario cards, Sticky notes (optional), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Emphasize the importance of clear and concise communication when describing the issue and the steps taken. This includes reporting potential failures and escalating them according to company protocols.
- Remind participants to always consider safety protocols when troubleshooting or repairing equipment. Ensure that they understand the importance of documenting each step taken, including any parts replaced or actions performed.
- After each group presents their solution, encourage other groups to ask questions about the process and what they would have done differently. This fosters a collaborative learning environment where participants can refine their troubleshooting and communication skills.

Unit 5.4: Organizing Maintenance Tools and Documentation

Unit Objectives

At the end of this unit, the participants will be able to:

1. Show how to organize and maintain tools and equipment used for cleaning and maintenance for efficient use.
2. Demonstrate use of designated logbooks or computerized maintenance management systems to document maintenance activities.
3. Record maintenance activities, including:
    - Type of maintenance performed
    - Date of maintenance
    - Specific actions taken
    - Replacement parts used (if applicable)
    - Observations made
4. Discuss how to utilize maintenance records to analyze recurring issues and identify improvement opportunities.
5. Demonstrate the use of maintenance tools and systems to ensure equipment remains in optimal condition.

Resources to be Used

Participant handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer, etc.

Note

In this unit, we will discuss how to effectively organize, document, and track maintenance activities to ensure the continuous optimal performance of equipment. Emphasis will be placed on maintaining proper records, utilizing maintenance management systems, and leveraging maintenance tools to prevent downtime and improve operational efficiency.

Ask

Ask the participants the following questions:

- How can systematic maintenance and accurate record-keeping improve equipment performance and reduce operational interruptions?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate clues from the answers and start teaching the lesson.

Elaborate

In this session, we will discuss the following points:

Organizing and Maintaining Tools and Equipment for Cleaning and Maintenance

Efficient use of tools and equipment starts with their proper organization. Tools should be arranged in an easily accessible manner, ensuring they are in good condition and ready for use when needed. Regular inspection and proper storage are essential to prevent tool wear or loss. An organized workspace also reduces downtime and improves the speed and accuracy of maintenance tasks.

Use of Designated Logbooks or Computerized Maintenance Management Systems (CMMS)

Utilizing logbooks or computerized systems to document maintenance activities ensures a systematic record-keeping process. These tools help track equipment maintenance history, monitor service schedules, and plan for future maintenance needs. CMMS allows for automated tracking, which enhances accuracy and prevents human error in documenting maintenance tasks.

Recording Maintenance Activities

Accurate recording of maintenance activities is crucial for future reference and analysis. Each entry should detail the type of maintenance performed, the date of the maintenance, and specific actions taken, such as repairs or adjustments. When applicable, the replacement parts used should be noted, along with any observations made during the maintenance process. This record helps maintain a reliable service history.

Utilizing Maintenance Records to Analyze Recurring Issues

Maintenance records serve as a valuable tool for identifying recurring problems. By reviewing these logs, trends can be detected that may indicate underlying issues with equipment. This analysis helps to pinpoint areas for improvement, enabling teams to take proactive measures, such as modifying maintenance schedules or improving equipment performance, thereby reducing downtime.

Use of Maintenance Tools and Systems to Ensure Optimal Equipment Condition

Maintaining tools and systems in optimal condition is essential for minimizing breakdowns and extending equipment life. Regular use of maintenance tools like lubricants, cleaning devices, and diagnostic tools ensures that all components function properly. Proper training on the use of these tools and systematic maintenance scheduling can help prevent equipment failures and maintain high operational standards.

Say

Let us participate in an activity to explore the unit a little more.

Activity

Group Activity: Simulating Equipment Maintenance Scenarios in a Green Hydrogen Production Facility

Group Size: 4-6 participants

Materials: Whiteboard or flipchart, markers, sticky notes (different colors), scenario cards (described below)

Activity Duration: 60 minutes

Activity Instructions:

Introduction (5 minutes):

Begin by briefly reviewing the green hydrogen production process and the importance of maintaining equipment for operational efficiency. Highlight how equipment failure can disrupt production and safety and how proper maintenance helps prevent such failures.

Distribute Scenario Cards (5 minutes):

Give each group a scenario card that describes a situation where equipment maintenance is needed. Each scenario will involve different aspects of maintenance and safety protocols, including recognizing issues, reporting, and ensuring employee engagement.

Group Discussion and Planning (20 minutes):

In their groups, participants should discuss the following prompts based on their scenario:

- What type of maintenance issue is involved (e.g., minor leak, malfunctioning equipment, etc.)?
- How might this situation impact the production process, employee safety, and morale?
- What actions need to be taken to resolve the issue, following company protocols for maintenance, safety, and communication?
- How will you ensure clear communication with the team and maintain engagement during this challenge?
- What safety measures should be prioritized in addressing the issue?

Group Presentations (20 minutes):

Each group presents their scenario, analysis, and proposed solutions to the class. Encourage other participants to ask questions and offer feedback. This will foster discussion on different approaches to solving maintenance challenges while considering employee engagement and safety.

Debriefing and Key Takeaways (10 minutes):

Facilitate a class-wide discussion to reflect on the activity. Key discussion points should include:

- The different solutions proposed by each group.
- How employee engagement and safety were integrated into the proposed solutions.
- What strategies worked best in addressing maintenance challenges and improving communication.
- Key learnings about the importance of maintenance in the green hydrogen production process.

Scenario Cards (Examples):

Scenario 1: During routine equipment checks, a technician finds that the hydrogen compressor is not operating at full capacity. The issue is minor but needs attention to avoid a potential future breakdown. How would you address this with your team, ensuring maintenance is done efficiently while keeping morale high and prioritizing safety protocols?

Scenario 2: An employee reports feeling overworked and concerned about the potential risk of equipment failure due to a heavy maintenance schedule. How would you handle this situation to ensure that safety is not compromised and employees feel supported and engaged?

Scenario 3: The facility experiences a sudden malfunction in the water filtration system, which is critical for electrolysis. How would you communicate the situation to your team, maintain safety protocols, and find an immediate solution while keeping the workforce motivated?

Activity	Duration	Resources used
Simulating Equipment Maintenance Scenarios in a Green Hydrogen Production Facility	60 minutes	Whiteboard or flipchart, markers, sticky notes (different colors), scenario cards (described below), etc.

Do

- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation

- Ensure all participants contribute their thoughts and encourage creative solutions. Focus on communication methods that address both technical and human factors (e.g., team morale, employee concerns).
- Emphasize the balance between safety and employee engagement when troubleshooting and maintaining equipment. Safety is paramount, but team morale should not be neglected during problem-solving discussions.
- After each group's presentation, prompt the rest of the class to reflect on the solutions presented. Encourage constructive feedback and ask questions to deepen understanding of both the technical and interpersonal aspects involved in maintenance activities.

Exercise

Multiple Choice Questions (MCQs)

1. What is the primary goal of preventive maintenance in equipment management?
   a) To ensure equipment looks clean
   b) To prevent breakdowns and costly downtime
   c) To replace parts frequently
   d) ZTo increase the speed of operation

   Answer: b) To prevent breakdowns and costly downtime

2. When cleaning wafer test equipment, what is the main concern in order to maintain quality?
   a) Reducing the cleaning time
   b) Preventing contamination within the equipment
   c) Using the cheapest cleaning materials
   d) Maximizing the workforce involved in cleaning

   Answer: b) Preventing contamination within the equipment

3. When troubleshooting equipment failure, why is it important to refer to the manufacturer's manual or diagnostic tools?
   a) To understand how the equipment looks
   b) To identify the source of the potential failure quickly
   c) To keep the equipment clean
   d) To increase the cost of maintenance

   Answer: b) To identify the source of the potential failure quickly

4. Which of the following is a reason for documenting maintenance activities?
   a) To track only the equipment's appearance
   b) To ensure compliance with company regulations and facilitate traceability
   c) To replace parts unnecessarily
   d) To limit employee involvement in maintenance

   Answer: b) To ensure compliance with company regulations and facilitate traceability

Fill in the Blanks

1. Preventive maintenance helps to maintain _____ equipment performance and avoid _____ downtime.

   Answer: optimal, costly

2. When cleaning wafer test equipment, it is important to use the appropriate cleaning materials to prevent _____ within the system.

   Answer: contamination

3. Maintenance logs should be organized and stored to ensure _____ and _____ in future troubleshooting and audits.

   Answer: traceability, accessibility

4. When an equipment malfunction exceeds basic troubleshooting abilities, it is important to _____ the issue to qualified personnel according to company protocols.

Answer: escalate

Match the following

Column A	Column B
1. Preventive Maintenance	a) Communicate issues to designated personnel
2. Cleaning Procedures	b) Restarting equipment, checking connections
3. Basic Troubleshooting	c) Reduces contamination within wafer test equipment
4. Reporting Malfunctions	d) Prevents equipment failures and downtime

Answers: 1 - d, 2 - c, 3 - b, 4 - a

Match the following

Column A	Column B
1. Safe Handling of Cleaning Materials	a) Keep a record of all maintenance activities
2. Maintenance Logs	b) Prevent hazards or contamination
3. Correct Use of Diagnostic Tools	c) Identify and resolve equipment malfunctions
4. Escalation of Issues	d) Report problems beyond basic troubleshooting

Answers: 1 - b, 2 - a, 3 - c, 4 - d

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कौशल भारत - कुशल भारत

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GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

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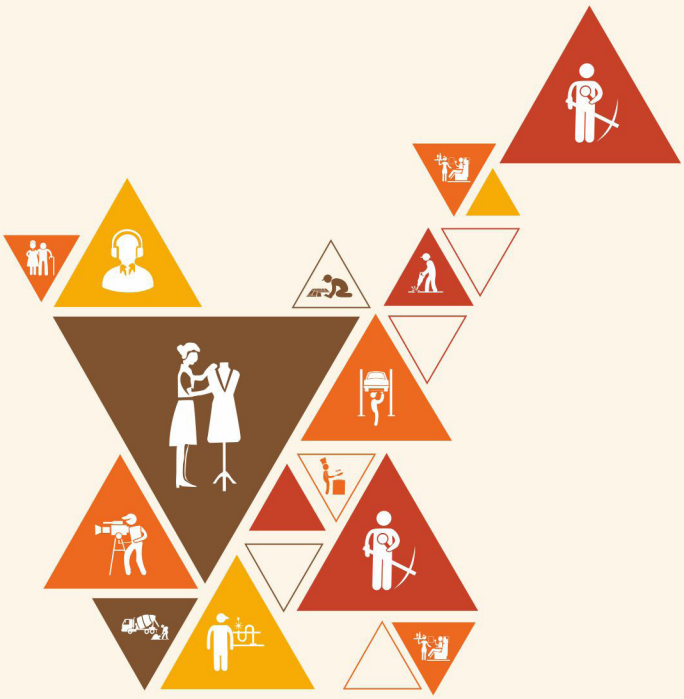
National
Skill Development
Corporation
Transforming the skill landscape

Telecom
Sector
Skill
Council

6. Employability Skills



DGT/VSQ/N0102

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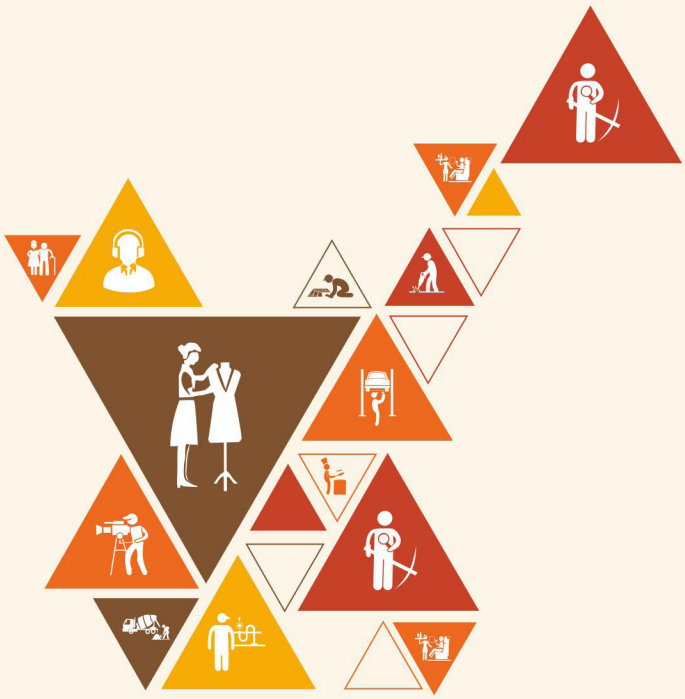
Employability Skills

7. Annexures

Annexure I
Annexure II
Annexure III



Annexure - I

Training Delivery Plan

Program Name:	Assembly Process Technician - Wafer Testing		
Qualification Pack and reference ID	Assembly Process Technician - Wafer Testing - TEL/Q7201		
Version No.	4.5	**Version Update Date**	NA
Pre-Requisite License or Training	**NA**		
Training Outcomes	**At the end of the program, the learner should have acquired the listed knowledge and skills.** • Operate and maintain wafer testing equipment for telecom applications. • Identify and document defects in semiconductor wafers. • Analyze test results and collaborating with engineering teams for corrective actions. • Understand industry-specific standards for quality assurance in wafer testing. • Follow established testing procedures to ensure high product reliability		

S No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools Aids	Duration
1	Role and Responsibilities of Assembly Process Technician – Wafer Testing	Fundamentals of Telecom Networks and the Indian Telecom Market	1. Understand the basics of telecom networks, including wired and wireless types. 2. Explain the components and infra-tructure of telecom networks. 3. Analyze the potential growt h of the Indian telecom market over the next decade. 4. Identify opportunities for skill development in the evolving telecom industry.	TEL/ N7201: Assemble Wafer Test Equipment	Interactive Lecture in the Class	Whiteboard, marker, duster, projector, laptop, PowerPoint Presentation PPE Kit	T: 05:00 P: 00:00
		Basics of Semiconductors and Wafer Fabrication	1. Define semiconductors and explain their role in telecom devices. 2. Understand the process of wafer fabrication and its significance. 3. Describe the the relationship between semiconductors and telecom advancements.		Interactive Lecture in the Class	Whiteboard, marker, duster, projector, laptop, PowerPoint Presentation PPE Kit	T: 05:00 P: 00:00
		Wafer Testing and Quality Assurance	1. Explain the importance of wafer testing in telecom device quality and functionality. 2. Identify methods and processes involved in wafer testing. 3. Understand the role of industry standards and regulations in ensuring quality.		Interactive Lecture in the Class	Whiteboard, marker, duster, projector, laptop, PowerPoint Presentation PPE Kit	T: 05:00 P: 00:00

S No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools Aids	Duration
			4. Recognize how testing contributes to reliable telecom equipment.				
		Wafer Testing and Quality Assurance	1. Explain the importance of wafer testing in telecom device quality and functionality. 2. Identify methods and processes involved in wafer testing. 3. Understand the role of industry standards and regulations in ensuring quality. 4. Recognize how testing contributes to reliable telecom equipment.		Interactive Lecture in the Class	Whiteboard, marker, duster, projector, laptop, PowerPoint Presentation PPE Kit	T: 05:00 P: 00:00
		Safety in Cleanroom Environments and PPE Usage	1. Understand the concept of cleanroom environments and their role in wafer testing. 2. List essential safety precautions to follow in cleanroom settings. 3. Identify the importance of Personal Protective Equipment (PPE) in ensuring worker safety. 4. Demonstrate the correct methods of wearing and handling PPE.		Interactive Lecture in the Class	Whiteboard, marker, duster, projector, laptop, PowerPoint Presentation PPE Kit	T: 05:00 P: 00:00
		Role of Assembly Process Technicians and Career Development	1. Define the responsibilities of Assembly Process		Interactive Lecture in the Class	Whiteboard, marker, duster, projector,	T: 05:00 P: 00:00

S No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools Aids	Duration
			2. Understand their role in maintaining quality standards in telecom equipment. 3. Identify essential professional skills for career advancement in the field. 4. Develop a plan for upskilling and exploring growth opportunities.			laptop, PowerPoint Presentation PPE Kit	
2.	Prepare Test Environment	Understanding SOPs and Essential Tools for Telecom Wafer Testing	1. Understand the basics of telecom networks, including wired and wireless types. 2. Explain the components and infrastructure of telecom networks. 3. Analyze the potential growth of the Indian telecom market over the next decade. 4. Identify opportunities for skill development in the evolving telecom industry.	TEL/ N7201: Assemble Wafer Test Equipment	Interactive Lecture in the Class	Training kit (Trainer guide, Presentations), Whiteboard, Marker, Projector, Laptop, Presentation, Participant Handbook, etc. Standard Operating Procedures (SOPs) documents, Thermometers, Hygrometers, Test equipment (specific model depends on application), Test accessories (e.g., test heads, probes) specific to telecom wafer testing, Grounded tweezers, Vacuum tweezers (optional), Transport carriers for wafers, Calibration tools (specific tools depend on calibration procedures), Reference	T: 05:00 P: 40:00

S No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools Aids	Duration
						standards (for calibration), ESD wrist straps, Compressed air supply (optional), Dehumidifiers (optional), Air conditioners (optional)	
		Environmental Factors and Test Equipment Specifications	1. Identify key environmental factors such as temperature and humidity and their acceptable ranges for wafer testing. 2. Utilize tools like thermometers and hygrometers to monitor environmental conditions. 3. Understand test program specifications and use them to configure telecom wafer testing equipment. 4. Differentiate between types of wafer test equipment used in telecom applications.		Interactive Lecture in the Class	Training kit (Trainer guide, Presentations), Whiteboard, Marker, Projector, Laptop, Presentation, Participant Handbook, etc. Standard Operating Procedures (SOPs) documents, Thermometers, Hygrometers, Test equipment (specific model depends on application), Test accessories (e.g., test heads, probes) specific to telecom wafer testing, Grounded tweezers, Vacuum tweezers (optional), Transport carriers for wafers, Calibration tools (specific tools depend on calibration procedures), Reference standards (for calibration), ESD wrist straps, Compressed air supply (optional), Dehumidifiers (optional), Air conditioners (optional)	T: 05:00 P: 40:00

S No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools Aids	Duration
		Wafer Test Equipment and Accessories	1. Explain the basic principles of operation of wafer test equipment. 2. Identify the functions and proper use of test accessories such as test heads and probes. 3. Demonstrate the process of installing test accessories securely for optimal performance. 4. Perform necessary adjustments or report equipment issues for maintenance.		Interactive Lecture in the Class	Training kit (Trainer guide, Presentations), Whiteboard, Marker, Projector, Laptop, Presentation, Participant Handbook, etc. Standard Operating Procedures (SOPs) documents, Thermometers, Hygrometers, Test equipment (specific model depends on application), Test accessories (e.g., test heads, probes) specific to telecom wafer testing, Grounded tweezers, Vacuum tweezers (optional), Transport carriers for wafers, Calibration tools (specific tools depend on calibration procedures), Reference standards (for calibration), ESD wrist straps, Compressed air supply (optional), Dehumidifiers (optional), Air conditioners (optional)	T: 05:00 P: 40:00
		Calibration and Documentation in Wafer Testing	1. Describe the significance of regular calibration in maintaining equipment accuracy 2. Identify various types of calibration		Interactive Lecture in the Class	Training kit (Trainer guide, Presentations), Whiteboard, Marker, Projector, Laptop, Presentation,	T: 05:00 P: 40:00

S No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools Aids	Duration
			procedures used in telecom wafer testing. 3. Explain the importance of documenting calibration results for traceability and quality assurance			Participant Handbook, etc. Standard Operating Procedures (SOPs) documents, Thermometers, Hygrometers, Test equipment (specific model depends on application), Test accessories (e.g., test heads, probes) specific to telecom wafer testing, Grounded tweezers, Vacuum tweezers (optional), Transport carriers for wafers, Calibration tools (specific tools depend on calibration procedures), Reference standards (for calibration), ESD wrist straps, Compressed air supply (optional), Dehumidifiers (optional), Air conditioners (optional)	T: 05:00 P: 40:00
		ESD Control and Safe Handling of Telecom Wafers	1. Understand the principles of Electrostatic Discharge (ESD) control and its consequences on wafers. 2. Demonstrate proper handling techniques using ESD-safe tools such as grounded tweezers. 3. Implement ESD control procedures during wafer loading		Interactive Lecture in the Class	Training kit (Trainer guide, Presentations), Whiteboard, Marker, Projector, Laptop, Presentation, Participant Handbook, etc. Standard Operating Procedures (SOPs) documents,	T: 05:00 P: 40:00

S No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools Aids	Duration
			and testing processes. 4. Identify the importance of loading patterns specific to test equipment models.			Thermometers, Hygrometers, Test equipment (specific model depends on application), Test accessories (e.g., test heads, probes) specific to telecom wafer testing, Grounded tweezers, Vacuum tweezers (optional), Transport carriers for wafers, Calibration tools (specific tools depend on calibration procedures), Reference standards (for calibration), ESD wrist straps, Compressed air supply (optional), Dehumidifiers (optional), Air conditioners (optional)	
		Visual Inspection and Labelling of Telecom Wafers	1. Describe various visual inspection techniques to identify physical defects on wafers. 2. Perform visual inspections to detect potential damage that might affect testing. 3. Explain protocols for labelling telecom wafers for proper entificationton and tracking. 4. Understand the significance		Interactive Lecture in the Class	Training kit (Trainer guide, Presentations), Whiteboard, Marker, Projector, Laptop, Presentation, Participant Handbook, etc. Standard Operating Procedures (SOPs) s,Thermometers, Hygrometers, Test equipment (specific model depends on application),	T: 05:00 P: 40:00

S No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools Aids	Duration
			of tracking and labelling in ensuring test process accuracy.		Interactive Lecture in the Class	Test accessories (e.g., test heads, probes) specific to telecom wafer testing, Grounded tweezers, Vacuum tweezers (optional), Transport carriers for wafers, Calibration tools (specific tools depend on calibration procedures), Reference standards (for calibration), ESD wrist straps, Compressed air supply (optional), Dehumidifiers (optional), Air conditioners (optional)	
3.	Carry Out Wafer Testing	understanding Test Programs and Wafer unctionalities	1. Discuss the Standard Operating Procedures (SOPs) for loading and configuring test programs. 2. Explain the importance of selecting appropriate test programs based on wafer type and functionalities. 3. Describe the categories of test programs used for telecom wafer testing, such as functional and parametric tests. 4. Understand the relationship between the chosen test	TEL/ N7202: Perform Wafer Test Procedures	Interactive Lecture in the Class	Participant Handbook, etc. Standard Operating Procedures (SOPs) documents, Thermometers, Hygrometers, Test equipment (specific model depends on application), Test accessories (e.g., test heads, probes) specific to telecom wafer testing, Grounded tweezers, Vacuum tweezers (optional), Transport carriers for wafers, Calibration tools (specific tools depend on calibration procedures)	

S No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools Aids	Duration
			program and the functionalities it assesses in the wafer.			standards (for calibration), ESD wrist straps, Compressed air supply (optional), Dehumidifiers (optional), Air conditioners (optional)	T: 20:00 P: 70:00
		Configuring and Executing Test Programs	1.Demonstrate the steps for loading a test program into the wafer test equipment using the user interface. 2. Adjust relevant parameters such as voltage levels and Timing specifications according to test requirements. 3. Initiate test program execution and observe the equipment interface for any unexpected behaviors or error messages. 4. Troubleshoot issues by handling prompts and identifying causes of errors during test execution.		Interactive Lecture in the Class	Participant Handbook, etc. Standard Operating Procedures (SOPs) documents, Thermometers, Hygrometers, Test equipment (specific model depends on application), Test accessories (e.g., test heads, probes) specific to telecom wafer testing, Grounded tweezers, Vacuum tweezers (optional), Transport carriers for wafers, Calibration tools (specific tools depend on calibration procedures) standards (for calibration), ESD wrist straps, Compressed air supply (optional), Dehumidifiers (optional), Air conditioners (optional)	T: 20:00 P: 70:00
		Monitoring Test Data and Identifying Wafer Defects	1. Explain the significance of different data types (e.g., voltage, current, timing) displayed duringtesting.		Interactive Lecture in the Class	Participant Handbook, etc. Standard Operating Procedures (SOPs)	T: 20:00 P: 70:00

S No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools Aids	Duration
			2. Interpret data trends and values to assess the performance of specific wafer functionalities. 3. Recognize deviations from expected data patterns and their correlation to potential wafer defects. 4. Discuss the principles of defect analysis methodologies, such as B defect analysis, to interpret test results.			documents, Thermometers, Hygrometers, Test equipment (specific model depends on application), Test accessories (e.g., test heads, probes) specific to telecom wafer testing, Grounded tweezers, Vacuum tweezers (optional), Transport carriers for wafers, Calibration tools (specific tools depend on calibration procedures) standards (for calibration), ESD wrist straps, Compressed air supply (optional), Dehumidifiers (optional), Air conditioners (optional)	T: 20:00 P: 70:00
		Applying Pass/ Fail Criteria and Documenting Results	1. Explain the pass/fail criteria for specific test programs and their role in evaluating wafer performance. 2. Perform proper documentation of test results, including wafer entificationton, program name, andpass/fail status. 3. Demonstrate transferring relevant data from the equipment interface to test records or designated electronic tools.		Interactive Lecture in the Class	Participant Handbook, etc. Standard Operating Procedures (SOPs) documents, Thermometers, Hygrometers, Test equipment (specific model depends on application), Test accessories (e.g., test heads, probes) specific to telecom wafer testing, Grounded tweezers, Vacuum tweezers (optional), Transport carriers	T: 20:00 P: 70:00

S No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools Aids	Duration
			4. Document any observed irregularities or concerns in test records with clarity and detail.			for wafers, Calibration tools (specific tools depend on calibration procedures) standards (for calibration), ESD wrist straps, Compressed air supply (optional), Dehumidifiers (optional), Air conditioners (optional)	
		Storage, Archiving, and Company Policies.	1. Discuss the importance of secure and accessible data storage for test results. 2. Explain company policies related to data storage, accessibility, and archiving procedures. 3. Identify how company guidelines impact the selection of archiving methods for test results. 4. Understand the role of proper data management in ensuring traceability and quality assurance.		Interactive Lecture in the Class	Participant Handbook, etc. Standard Operating Procedures (SOPs) documents, Thermometers, Hygrometers, Test equipment (specific model depends on application), Test accessories (e.g., test heads, probes) specific to telecom wafer testing, Grounded tweezers, Vacuum tweezers (optional), Transport carriers for wafers, Calibration tools (specific tools depend on calibration procedures) standards (for calibration), ESD wrist straps, Compressed air supply (optional), Dehumidifiers (optional), Air conditioners (optional)	T: 20:00 P: 70:00

S No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools Aids	Duration
4.	Perform Analysis of Wafer Test Data	Statistical Process Control (SPC) and Wafer Data Analysis	1. Explain the principles of Statistical Process Control (SPC) and its role in analyzing wafer test data. 2. Demonstrate the use of SPC software/tools to generate and interpret control charts for analyzing test data. 3. Identify trends, shifts, and outliers in control chart data that might indicate process issues. 4. Perform the selection of appropriate SPC charts based on specific test parameters and wafer functionalities. 5. Calculate basic statically metrics (e.g., Cpk) to assess process capability and identify areas for mprovement.	TEL/ N7203: Perform Analysis of Wafer Test Data	Interactive Lecture in the Class	Training Kit - Trainer Guide, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films, Computer with SPC Software or Tools, Electronic Data Files (Test Results), Wafer Map, Data Visualization Software (Optional) & Report Generation Software (Optional)	T: 10:00 P: 50:00
		Identifying Wafer Defects and Failure Mechanisms	1. Discuss the relationship between specific test parameters and potential wafer defects. 2. Describe the basic concepts of semiconductor failure mechanisms and their connection to observed data anomalies. 3. Explain the difference between		Interactive Lecture in the Class	Training Kit - Trainer Guide, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films, Computer with SPC Software or Tools, Electronic Data Files (Test Results), Wafer Map, Data Visualization Software (Optional) & Report Generation Software (Optional)	T: 10:00 P: 50:00

S No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools Aids	Duration
			random defects and systematic issues affecting multiple devices or wafers. 4. Interpret test results to identify potential failure points using statistical and analytical techniques. 5. Utilize knowledge of circuit design and fabrication processes to infer root causes based on observed				
		Wafer Maps and Spatial Defect Analysis	1. Utilize wafer maps to correlate test data points with their corresponding locations on the wafer. 2. Analyze special patterns of defects to identify potential causes related to specific locations within the fabrication process. 3. Perform comparison of test data against established criteria or historical data, considering tolerances and expected variations. 4. Identify outliers, deviations, or unexpected spikes in parameters and classify them by		Interactive Lecture in the Class	Training Kit - Trainer Guide, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films, Computer with SPC Software or Tools, Electronic Data Files (Test Results), Wafer Map, Data Visualization Software (Optional) & Report Generation Software (Optional)	T: 10:00 P: 50:00

S No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools Aids	Duration
			severity (critical, minor). 5. Document defect information and pass/fail classificationton in designated test records or systems.				T: 10:00 P: 50:00
		Failure Analysis and Corrective Actions	1. Explain how to classify failing devices based on the type and severity of defects. 2. Discuss the impact of failing devices on overall wafer functionality considering redundancy or isolation mechanisms in circuit design. 3. Recommend appropriate next steps for failing devices, including retesting, scrapping, or further investigation. 4. Analyze data from multiple wafers and test runs to identify trends that suggest systematic problems.		Interactive Lecture in the Class	Training Kit - Trainer Guide, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films, Computer with SPC Software or Tools, Electronic Data Files (Test Results), Wafer Map, Data Visualization Software (Optional) & Report Generation Software (Optional)	T: 10:00 P: 50:00
		Reporting and Visualization of Test Results	1. Utilize data visualization tools (e.g., charts, graphs) to represent test results effectively. 2. Compile well-structured and concise test reports summarizing key findings, including overall		Interactive Lecture in the Class	Training Kit - Trainer Guide, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films, Computer with SPC Software or Tools, Electronic Data Files (Test Results), Wafer	T: 10:00 P: 50:00

S No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools Aids	Duration
			pass/fail rates, Defect classifications with severity levels and identified trends or anomalies. 3. Explain the significance of presenting findings clearly to facilitate process improvements and- decision making.			Map, Data Visualization Software (Optional) & Report Generation Software (Optional)	
5.	Maintain Wafer Test Equipment	Preventive Maintenance and Equipment Cleaning	1. Explain the importance of preventive maintenance in ensuring optimal equipment performance and minimizing costly downtime. 2. Discuss the basic principles of cleaning procedures to prevent contamination within wafer test equipment. 3. Demonstrate cleaning various components of wafer test equipment using appropriate cleaning materials for specific parts. 4. Show safe handling and storage procedures for cleaning materials and tools to avoid hazards or contamination. 5. Demonstrate proper disposal of used cleaning materials and waste generated	TEL/ N7204: Maintain Wafer Test Equipment	Interactive Lecture in the Class	Training Kit - Trainer Guide, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films, Lint-free wipes, Isopropyl alcohol (IPA) or other approved cleaning solvents, Cotton swabs, Compressed air (oil-free), Ultrasonic cleaner (for certain components), Deionized (DI) water,Disposable gloves, Safety glasses, Screwdrivers (various sizes and types), Allen wrenches (hex keys),Tweezers, Anti-static wrist strap and grounding mat, Torque screwdrivers (for calibrated ghtening), Calibration tools (specific to eachquipment type), Vacuum cleaner (with HEPA filter),Spare parts (e.g., fuses, lamps), Equipment manuals, Service manuals, Preventive maintenance checklists, Cleaning procedures	T: 10:00 P: 20:00

S No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools Aids	Duration
			during maintenance activities. 6. Explain how to maintain a clean and clutter-free workspace around the test equipment. 1. Recognize potential dangers and indications of equipment failure during operation, such as unusual noises or error messages. 2. Utilize quipment ,roubleshooting guides, and diagnostic tools to identify the source of failures. 3. Demonstrate basic troubles-hooting steps as per established procedures or manufacturer commendations (e.g., restarting equipment, checking cable connections). 4. Discuss the limitations of troubleshooting abilities and explain when to escalate issues to qualified personnel. 5. Show how to document troubleshooting steps taken and their outcomes for future reference. 6. Analyze the impact of troubleshooting failure on test operations, such as partal functionality loss or complete age.			(SOPs), and book or computerized maintenance management system (CMMS) or computerized maintenance management system (CMMS) Training Kit - Trainer Guide, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films, Lint-free wipes, Isopropyl alcohol (IPA) or other approved cleaning solvents, Cotton swabs, Compressed air (oil-free), Ultrasonic cleaner (for certain components), Deionized (DI) water,Disposable gloves, Safety glasses, Screwdrivers (various sizes and types), Allen wrenches (hex keys),Tweezers, Anti-static wrist strap and grounding mat, Torque screwdrivers (for calibrated ghtening), Calibration tools (specific to each equipment type), Vacuum cleaner (with HEPA filter),Spare parts (e.g., fuses, lamps), Equipment manuals, Service manuals, Preventive maintenance checklists, Cleaning procedures (SOPs), and book or computerized maintenance management system (CMMS) or computerized maintenance management system (CMMS)	
		Identifying and trableshooting Equipment Issues			Interactive Lecture in the Class		T: 10:00 P: 20:00

S No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools Aids	Duration
		Reporting and Escalating Equipment Issues	1. Explain the importance of clear and concise communication when reporting equipment malfunctions. 2. Demonstrate how to report equipment malfunctions requiring repair work beyond basic troubleshooting capabilities to designated personnel following company protocols. 3. Describe company policies for organizing and storing maintenance logs and records for traceability. 4. Show how to maintain accurate and complete maintenance records for future reference. 5. Discuss the importance of documenting specific actions taken, observations made, and replacement parts used in maintenance activities.		Interactive Lecture in the Class	Training Kit - Trainer Guide, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films, Lint-free wipes, Isopropyl alcohol (IPA) or other approved cleaning solvents, Cotton swabs, Compressed air (oil-free), Ultrasonic cleaner (for certain components), Deionized (DI) water,Disposable gloves, Safety glasses, Screwdrivers (various sizes and types), Allen wrenches (hex keys),Tweezers, Anti-static wrist strap and grounding mat, Torque screwdrivers (for calibrated ghtening), Calibration tools (specific to each equipment type), Vacuum cleaner (with HEPA filter),Spare parts (e.g., fuses, lamps), Equipment manuals, Service manuals, Preventive maintenance checklists, Cleaning procedures (SOPs), and book or computerized maintenance management system (CMMS) or computerized maintenance management system (CMMS)	T: 10:00 P: 20:00

S No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools Aids	Duration
		Organizing Maintenance Tools and Documentation	1. Show how to organize and maintain tools and equipment used for cleaning and maintenance for efficient use. 2. Demonstrate use of designated logbooks or computerized maintenance management systems to document maintenance activities. 3. Record maintenance activities, including type of maintenance performed, date of maintenance, specific actions taken, replacement parts used (if applicable) and observations made. 4. Discuss how to utilize maintenance records to analyze recurring issues and identify improvement opportunities. 5. Demonstrate the use of maintenance tools and systems to ensure equipment remains in optimal condition.		Interactive Lecture in the Class	Training Kit - Trainer Guide, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films, Lint-free wipes, Isopropyl alcohol (IPA) or other approved cleaning solvents, Cotton swabs, Compressed air (oil-free), Ultrasonic cleaner (for certain components), Deionized (DI) water,Disposable gloves, Safety glasses, Screwdrivers (various sizes and types), Allen wrenches (hex keys),Tweezers, Anti-static wrist strap and grounding mat, Torque screwdrivers (for calibrated ghtening), Calibration tools (specific to each equipment type), Vacuum cleaner (with HEPA filter),Spare parts (e.g., fuses, lamps), Equipment manuals, Service manuals, Preventive maintenance checklists, Cleaning procedures (SOPs), and book or computerized maintenance management system (CMMS) or computerized maintenance management system (CMMS)	T: 10:00 P: 20:00

S No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools Aids	Duration
6.	Employability Skills	Employability Skills		DGT/VSQ/ N0102	Interactive Lecture in the Class	LCD Projector for PPT and Video Presentation, Speakers, and Whiteboard & marker	T: 60:00 P : 00:00
7.	On-the-Job Training						60 Hours

Annexure-II

Assessment Criteria

CRITERIA FOR ASSESSMENT FOR TRAINEES

Job Role	Assembly Process Technician- Wafer Testing
Qualification Pack	TEL/Q7201
Sector Skill Council	Telecom Sector Skill Council

S No.	Assessment Guidelines
1.	Criteria for assessment for each Qualification Pack will be created by the Sector Skill Council. Each Performance Criteria (PC) will be assigned marks proportional to its importance in NOS. SSC will also lay down the proportion of marks for Theory and Skills Practical for each PC.
2.	The assessment for the theory part will be based on the knowledge bank of questions created by the SSC.
3.	Assessment will be conducted for all compulsory NOS, and where applicable, on the selected elective/option NOS/set of NOS.
4.	Individual assessment agencies will create unique question papers for the theory part for each candidate at each examination/training center (as per assessment criteria below).
5.	Individual assessment agencies will create unique evaluations for skill practical for every student at each examination/ training center based on these criteria.
6.	To pass the Qualification Pack assessment, every trainee should score a minimum of 70% of % aggregate marks to successfully clear the assessment.
7.	In case of unsuccessful completion, the trainee may seek reassessment on the Qualification Pack

NOS	Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
TEL/N7201: Assemble Wafer Test Equipment	*Prepare Test Environment according to SOPs*	**10**	**14**	-	**3**
	PC1. review SOPs for specific test requirements for RF (Radio Frequency) devices like Band-pass filters (BI wafers) or Transceiver Optical Modules (T Optical type)	1	1	-	-
	PC2. identify and gather all necessary materials and tools listed in the SOPs for the specific RF wafer test (e.g., cleaning supplies, transport carriers)	1	2	-	1
	PC3. verify the functionality and proper calibration of any required measuring tools for RF testing (e.g., Signal Generators, Spectrum Analyzers)	1	2	-	1
	PC4. consult equipment recommendations or SOPs for the ideal temperature and humidity range for optimal RF test performance	1	1	-	-
	PC5. utilize thermometers and hygrometers to monitor the test environment conditions	1	1	-	-
	PC6. adjust environmental controls (e.g., air conditioning, dehumidifiers) as needed to maintain the specified temperature and humidity levels for RF device testing	1	2	-	-
	PC7. verify that essential utilities like compressed air and power supply are available and functioning properly	1	1	-	-
	PC8. conduct a visual inspection of utility lines and connections for any signs of damage or leaks	1	1	-	-
	PC9. test the functionality of compressed air pressure and power supply voltage according to established procedures	1	2	-	-
	PC10. document the test environment conditions (temperature, humidity, etc.) and any adjustments made according to SOPs	1	1	-	1
	Set up & Calibrate Wafer Test Equipment	**15**	**18**	-	**4**
	PC11. analyze the type of RF wafers (e.g., Band-pass filters (BI), Transceiver Optical Modules (T Optical)) to be tested	1	1	-	-
	PC12. review test program requirements for specific RF functionalities to be evaluated (e.g., signal attenuation for filters, data transmission characteristics for T Optical modules)	1	1	-	-
	PC13. identify the appropriate RF test equipment model from available options (e.g., RF Parameter Analyzer, Vector Network Analyzer) based on wafer type & test needs and consult SOPs for the selected RF test equipment model RF test equipment model	1	1	-	2
	PC14. identify and gather required test accessories like RF probes and test fixtures suitable for contacting test points on the specific RF wafers (e.g., grounded-signal probes for filters, high-frequency probes for T Optical modules)	1	2	-	-

	PC15.carefully install the accessories onto the designated ports or fixtures on the RF test equipment, following established procedures, ensuring proper connection and secure positioning of the RF test heads and probes for optimal test performance	1	1	-	-
	PC16.configure relevant equipment parameters (e.g., sweep frequencies for filters, data bit rate for T Optical modules), based on the specific RF test program (e.g., filter response analysis, data transfer rate measurement)	**1**	**1**	-	-
	PC17.ensure parameter settings align with the requirements outlined in the test program for accurate testing of the desired RF functionalities (e.g., communication channel bandwidth, data integrity)	1	1	-	-
	PC18.conduct a visual inspection of the RF test heads and probes to ensure proper alignment and positioning for contacting the designated RF test points on the wafers	1	1	-	-
	PC19. utilize calibration tools or procedures outlined in SOPs to verify the calibration of RF test heads and probes for accurate measurements during testing.	1	1	-	-
	PC20.perform necessary adjustments or report the issue for maintenance personnel to address the issue, if calibration is out of specification	1	2	-	-
	PC21.initiate a system check function on the RF test equipment as per SOPs	1	1	-	-
	PC22.verify that all components of the RF test equipment, including accessories, are functioning properly as a system before proceeding with actual testing of the RF wafer	1	1	-	-
	PC23.identify the relevant test parameters requiring calibration for the specific RF wafer test (e.g., frequency response for filters, signal integrity parameters for T Optical modules)	1	1	-	-
	PC24.perform calibration routines for each identified parameter according to established procedures for RF equipment	1	1	-	1
	PC25.document calibration results, including dates, performed adjustments, and reference standards used, for traceability purposes in designated calibration logs or electronic systems - (e.g., RF Parameter Analyzer, Vector Network Analyzer), performed tests (e.g., filter response calibration, data rate calibration)	1	1	-	-
	Load Wafers into the Test Equipment Following Handling Protocols	**15**	**18**		**3**
	PC26. review SOPs for specific handling procedures for the type of RF wafer being tested (e.g., Band-pass filters (BI), Transceiver Optical Modules (T Optical)	1	1	-	-
	PC27. visually inspect the wafers for any physical damage or defects that might affect testing (e.g., scratches, cracks)	1	1	-	-

	PC28. clearly label the wafers with identification information according to established protocols for traceability throughout the RF testing process (e.g., wafer type, lot number)	1	2	-	1
	PC29. select and utilize appropriate handling tools (e.g., vacuum tweezers, transport carriers) designed for safe handling of delicate RF wafers	1	1	-	-
	PC30. refer to SOPs or the RF test equipment manual for the designated loading pattern (e.g., ensuring proper alignment for signal transmission/reception) specific to the type of RF wafer being tested	2	2	-	-
	PC31. verify that all wafers are loaded according to the pattern to optimize testing efficiency and avoid potential issues during the RF testing process (e.g., ensuring proper data transfer between wafers and test equipment)	2	2	-	-
	PC32. double-check the orientation of each loaded wafer to ensure it aligns with the RF test head and probe configuration for proper contact with the designated RF test points	2	2	-	-
	PC33. verify that all wafers are securely positioned within the carrier or fixture to prevent any movement or misalignment during RF testing (e.g., which could cause inconsistencies in signal transmission/reception measurements)	1	2	-	1
	PC34. secure the wafer carrier or fixture within the RF test equipment using the designated locking mechanisms to ensure a stable testing environment	1	2	-	-
	PC35. implement established electrostatic discharge (ESD) control procedures throughout the RF wafer handling process	2	2	-	1
	PC36. utilize ESD-safe tools (e.g., grounded tweezers), wear ESD wrist straps grounded to the equipment, and maintain a clean and ESD-safe work environment	1	1	-	-
	NOS Total	**40**	**50**	-	**10**
TEL/N7202: Perform Wafer Test Procedures	*Select & Execute Appropriate Test Program*	20	30	-	5
	PC1. analyze the traveler sheets or batch records to determine the type of RF wafers being tested (e.g., Band-pass filters (BI wafers) for signal filtering, Transceiver Optical Modules (T Optical) for data transmission)	1	2	-	-
	PC2. review the specifications of the wafers, considering factors like their intended functionalities within a telecom system (e.g., signal filtering characteristics for filters, data transfer rate and communication protocols for T Optical modules)	2	2	-	1
	PC3. consult the traveler sheets or batch records to understand the specific test requirements for the RF wafers	1	2		

	PC4. access the library of available test programs for the RF test equipment being used	1	2	-	-
	PC5. select the appropriate test program that aligns with the specified test requirements, based on the identified wafer type and functionalities	2	2	-	-
	PC6. review the documentation associated with the selected test program to understand its objectives (e.g., measuring filter response across a frequency range, evaluating data transmission characteristics)	1	1	-	-
	PC7. identify the scope of the test program, considering the specific functionalities it will assess within the RF wafer (e.g., comprehensive filter response analysis, high-speed data transfer testing)	1	2	-	1
	PC8. initiate the process of loading the selected test program by following the SOPs (Standard Operating Procedures) for the RF test equipment	2	3	-	-
	PC9.access the program settings within the loaded test program	2	2	-	-
	PC10.configure relevant program parameters (e.g., sweep frequencies for filter response, data bit rate for T Optical modules) based on the specific test requirements, to ensure the test aligns with the intended evaluation	2	3	-	1
	PC11.initiate the test program execution on the RF test equipment	1	3	-	1
	PC12.monitor the test progress through the equipment interface, observing any real time data displays or progress indicators	1	2	-	-
	PC13.prepare to respond to prompts or error messages that might appear on the equipment interface during test execution	1	2	-	-
	PC14.follow established procedures for handling prompts (e.g., user confirmation for specific test steps) and troubleshooting error messages (e.g., consulting troubleshooting guides or notifying maintenance personnel)	1	3	-	1
	Monitor Test Progress & Document Test Results	15	25	-	5
	PC15.analyze the real-time test data displayed on the equipment interface during test execution. (parameters e.g., filter attenuation characteristics, data transmission error rates)	2	2	-	-
	PC16.interpret the meaning of the displayed data based on your understanding of the test program and the functionalities under evaluation (e.g., identifying trends in filter response curves, analyzing data packet error rates)	1	2	-	-
	PC17.identify any trends, outliers, or irregularities that deviate from expected values or established pass/fail criteria, while monitoring the test data	1	2	-	-
	PC18.configure suitable alarms and notifications within the test program or on the equipment itself to alert you of critical events during testing	1	2	-	1

	PC19. analyze the test logs generated by the test program. These logs might provide detailed information about the test execution, including data points, measurements, and any error messages encountered	1	1	-	-
	PC20.identify the potential root cause of any anomalies or failures observed during testing (e.g., faulty components within the filter, data transmission protocol mismatch with the test program) based on the analysis of real-time data and test logs	2	2	-	1
	PC21.review the overall test outcomes, including pass/fail status for the RF wafers based on the defined criteria after test completion	1	2	-	-
	PC22.utilize appropriate forms or electronic documentation tools as per company policy to document the test results	1	1	-	-
	PC23.verify the accuracy and completeness of all documented test data, including parameters, measurements, and observations	1	2	-	1
	PC24. identify passing and failing wafers, based on the defined pass/fail criteria established for the specific test program and RF wafer functionalities	1	2	-	1
	PC25. document the concerns in the test records for any wafers exhibiting anomalies or borderline results that don't meet a clear pass/fail criterion	1	1	-	-
	PC26. include details about the observed irregularities and any potential root causes identified during analysis	1	2	-	-
	PC27. store the test data in a secure and accessible manner by following established company policies	1	1	-	-
	PC28. ensure proper archiving procedures are followed to maintain the data for future reference and traceability purposes	1	2	-	1
	NOS Total	**35**	**55**	-	**10**
TEL/N7203: Analyze Wafer Test Data	*Analyze & Evaluate Test Results*	**25**	**35**	-	**5**
	PC1. utilize statistical process control (SPC) techniques to analyze the collected test data for RF wafers (e.g., Band-pass filters, Transceiver Optical Modules)	2	2		1
	PC2. select appropriate SPC charts (e.g., control charts, Pareto charts) based on the specific test parameters and wafer functionalities	1	2	-	-
	PC3. interpret control chart data to identify trends, shifts, or outliers that might indicate potential process issues	1	2	-	-
	PC4. calculate statistical metrics (e.g., Cp, Cpk) to assess process capability and identify opportunities for improvement	2	2	-	-
	PC5. compare the test data for each wafer against established criteria or historical data, considering tolerances and expected variations	1	2	-	-
	PC6. identify any outliers, unexpected dips or spikes in parameters, or deviations from normal test results, categorizing them by severity (critical, minor)	2	2	-	-

	PC7. utilize wafer maps or reference markers to correlate specific test data points with their corresponding locations on the RF wafer	1	2	-	-
	PC8. analyze spatial patterns of defects to identify potential causes related to specific locations within the wafer fabrication process	2	3	-	1
	PC9. apply knowledge of RF circuit design principles and Semiconductor Manufacturing Processes to understand the potential causes of the identified defects based on the type of test performed	2	3	-	1
	PC10. consult with design engineers or process specialists to gain further insights into potential root causes based on their expertise	2	3	-	-
	PC11. classify failing devices based on the type of defect (e.g., electrical, physical) and its severity level (critical, moderate, marginal)	1	2	-	-
	PC12. evaluate the impact of failing devices on overall wafer functionality, considering redundancy or isolation mechanisms within the circuit design	2	**2**	-	**-**
	PC13. recommend appropriate next steps for failing devices, including retesting, scrapping, or further investigation using specialized equipment	2	2	-	-
	PC14. analyze data from multiple wafers and test runs to distinguish between random defects (isolated incidents) and systematic problems (affecting multiple devices or wafers)	1	2	-	-
	PC15. utilize statistical analysis tools to identify patterns or trends that suggest systematic issues within the manufacturing process	2	2	-	-
	PC16. recommend corrective actions or process improvements to address identified systematic problems and prevent future occurrences	1	2	-	-
	Document, Report & Communicate Results	**10**	**20**	-	**5**
	PC17. apply the pre-defined pass/fail criteria established for the specific RF wafer test program to categorize each wafer	1	3	-	1
	PC18.document the classification (pass/fail) of each wafer and any associated defect information in the designated test record or electronic documentation system	1	**2**	-	**1**
	PC19. utilize data visualization tools (e.g., histograms, scatter plots) to represent test results and highlight key findings for improved clarity in reports	1	3	-	-
	PC20. archive test data and associated documentation securely and electronically as per company policy for future reference and traceability purposes	1	2	-	1
	PC21.compile well-structured and concise test reports summarizing the findings from the RF wafer testing process	1	3	-	

	PC22.include key information like overall pass/fail rates, defect classifications with severity levels, and any identified trends or anomalies	2	2	-	-
	PC23.tailor test reports to the audience (e.g., engineers, quality control) by emphasizing relevant details and technical aspects	2	3	-	1
	PC24.disseminate the test data and findings to designated personnel through meetings, emails, or a centralized information sharing platform, following established communication protocols	1	2	-	1
	NOS Total	**35**	**55**	-	**10**
TEL/N7204: Maintain Wafer Test Equipment	*Perform routine cleaning and preventive maintenance of equipment*	**12**	**24**	-	**4**
	PC1. follow established SOPs (Standard Operating Procedures) for cleaning various components of the RF wafer test equipment (e.g., Automatic Test Equipment (ATE), Probe Stations)	1	3	-	1
	PC2. identify and utilize appropriate cleaning materials and equipment for specific components (e.g., lint-free wipes, compressed air for delicate parts, specialized cleaning solutions for certain contaminants)	1	3	-	1
	PC3. perform cleaning tasks to ensure a dust-free and contamination-free environment within the test equipment, minimizing potential issues like test signal degradation or device damage	1	2	-	-
	PC4. ensure cleaning of areas crucial for proper test execution (e.g., test fixtures, probe tips, wafer contact surfaces)	1	2	-	-
	PC5. identify and perform routine maintenance activities on the RF test equipment according to established schedules (eg. lubricating moving parts, replacing air filters, and calibrating specific test instruments to ensure optimal performance)	2	3	-	-
	PC6. maintain a log of completed preventive maintenance activities for each piece of equipment, including dates and details of actions performed	1	1	-	-
	PC7. visually inspect the equipment for any signs of wear or damage during cleaning and maintenance procedures, reporting any concerns to appropriate personnel	1	2	-	-
	PC8. organize and maintain a clean and clutter-free workspace around the RF test equipment to prevent accidental damage or contamination of wafers and test components	1	2	-	-
	PC9. properly dispose of used cleaning materials and waste generated during maintenance activities in designated bins or containers	1	1	-	-
	PC10. keep tools and equipment used for cleaning and maintenance organized and readily accessible for efficient use	1	3	-	1

	PC11. report any spills or contamination incidents within the work area promptly for proper cleaning and containment	1	2	-	1
	Identify, Troubleshoot & Report Equipment Malfunctions	**22**	**35**	**-**	**6**
	PC12. recognize potential dangers and indications of equipment failure during operation, such as unusual noises, error messages, or unexpected behavior in test results	2	4	-	1
	PC13. utilize equipment manuals, troubleshooting guides, and diagnostic tools (e.g., built-in self-test functions) to identify the source of potential failures	2	3	-	1
	PC14. observe and document specific details about the malfunction, including error messages displayed, test interruptions, or abnormal equipment behavior	1	3		1
	PC15. consult with experienced personnel (e.g., engineers, maintenance technicians) for further diagnosis and guidance, when encountering unfamiliar issues	2	3	-	1
	PC16. perform basic troubleshooting steps as per established procedures or manufacturer recommendations, such as restarting the equipment, checking cable connections, or resetting specific settings	2	4	-	-
	PC17. document the troubleshooting steps taken and their outcomes for future reference and to inform further repair efforts	2	3	-	1
	PC18. clearly identify the problem and its impact on test operations (e.g., complete test stoppage, partial functionality loss), if basic troubleshooting fails to resolve the issue	2	3	-	-
	PC19. report equipment malfunctions requiring repair work beyond basic troubleshooting capabilities to designated personnel (e.g., maintenance technicians) following established company protocols	1	4	-	-
	PC20. record all maintenance activities performed on the RF test equipment in a detailed and comprehensive manner, including cleaning, preventive maintenance, and repairs	1	3	-	-
	PC21. utilize designated logbooks or a computerized maintenance management system to document maintenance activities, including the date, type of maintenance performed, specific actions taken, replacement parts used (if applicable), and any observations made	1	3	-	-
	PC22. adhere to company policies for organizing and storing maintenance logs and records electronically or in designated physical binders for future reference and traceability purposes	2	3	-	1
	NOS Total	**30**	**60**	-	**10**
DGT/VSQ/N0102: Employability Skills (60 Hours)	*Introduction to Employability Skills*	1	**1**	**-**	**-**

	PC1. identify employability skills required for jobs in various industries			-	
	PC2. identify and explore learning and employability portals	-	-	-	-
	Constitutional values – Citizenship	**1**	**1**	-	-
	PC3. recognize the significance of constitutional values, including civic rights and duties, citizenship, responsibility towards society etc. and personal values and ethics such as honesty, integrity, caring and respecting others, etc.	-	-	-	-
	PC4. follow environmentally sustainable practices	-	-	-	-
	Becoming a Professional in the 21st Century	2	4	-	-
	PC5. recognize the significance of 21st Century Skills for employment	-	-	-	-
	PC6. practice the 21st Century Skills such as Self-**Awareness, Behaviour Skills, time management, critical and adaptive thinking, problem-solving, creative thinking, social and cultural awareness, emotional awareness, learning to learn for continuous learning etc. in personal and professional life**	-	-	-	-
	Basic English Skills	2	3	-	-
	PC7. use basic English for everyday conversation in different contexts, in person and over the telephone	-	-	-	-
	PC8. read and understand routine information, notes, instructions, mails, letters etc. written in English	-	-	-	-
	PC9. write short messages, notes, letters, e-mails etc. in English	-	-	-	-
	Career Development & Goal Setting	**1**	**2**	-	-
	PC10. understand the difference between job and career	-	-	-	-
	PC11. prepare a career development plan with short- and long-term goals, based on aptitude			-	-
	Communication Skills	**2**	**2**	-	-
	PC12. follow verbal and non-verbal communication etiquette and active listening techniques in various settings	-	-	-	-
	PC13. work collaboratively with others in a team	-	-	-	-
	Diversity & Inclusion	**1**	**2**	-	

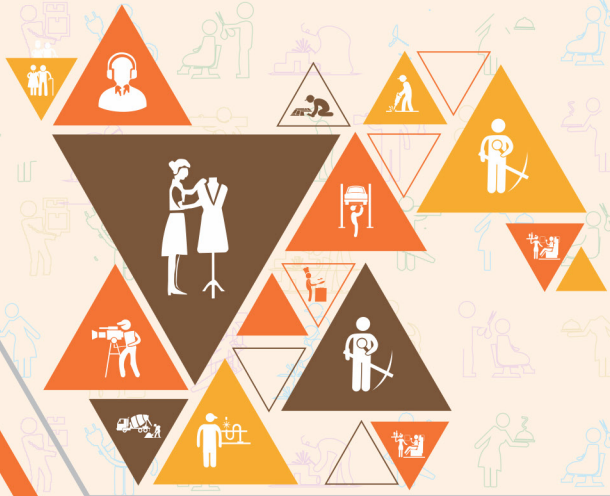
	PC15. escalate any issues related to sexual harassment at workplace according to POSH Act	-	-	-	-
	Financial and Legal Literacy	**2**	**3**	-	-
	PC16. select financial institutions, products and services as per requirement	-	-	-	-
	PC17. carry out offline and online financial transactions, safely and securely	-	-	-	-
	PC18. identify common components of salary and compute income, expenses, taxes, investments etc	-	-	-	-
	PC19. identify relevant rights and laws and use legal aids to fight against legal exploitation	-	-	-	-
	Essential Digital Skills	**3**	**4**	-	-
	PC20. operate digital devices and carry out basic internet operations securely and safely	-	-	-	-
	PC21. use e- mail and social media platforms and virtual collaboration tools to work effectively	-		-	-
	PC22. use basic features of word processor, spreadsheets, and presentations	-	-	-	-
	Entrepreneurship	**2**	**3**	-	-
	PC23. identify different types of Entrepreneurship and Enterprises and assess opportunities for potential business through research	-	-	-	-
	PC24. develop a business plan and a work model, considering the 4Ps of Marketing Product, Price, Place and Promotion	-	-	-	-
	PC25. identify sources of funding, anticipate, and mitigate any financial/ legal hurdles for the potential business opportunity	-	-	-	-
	Customer Service	**1**	**2**		-
	PC26. identify different types of customers	-	-		-
	PC27. identify and respond to customer requests and needs in a professional manner	-	-	-	-

	PC28. follow appropriate hygiene and grooming standards				
	Getting ready for apprenticeship & Jobs	**2**	**3**	-	-
	PC29. create a professional Curriculum vitae (Résumé)	-	-	-	-
	PC30. search for suitable jobs using reliable offline and online sources such as Employment exchange, recruitment agencies, newspapers etc. and job portals, respectively	-	-	-	-
	PC31. apply to identified job openings using offline /online methods as per requirement	-	-	-	-
	PC32. answer questions politely, with clarity and confidence, during recruitment and selection	-	-	-	-

Annexure-III

Chapter Name	Unit No.	Topic Name	Page No.	Link to QR code	QR code
Module 1: Role and Responsibilities of Assembly Process Technician	Unit 1.1: Fundamentals of Telecom Networks and the Indian Telecom Market	1.1.1: Understand the basics of telecom networks, including wired and wireless types.	27	https://youtu.be/dFxvx2uKMhc?si=uJX0x9s8D-_pmxXD	What is network?
Module 1: Role and Responsibilities of Assembly Process Technician	Unit 1.2: Basics of Semiconductors and Wafer Fabrication	1.2.1: Define semiconductors and explain their role in telecom devices.	27	https://youtu.be/DvYfs6rXKuE?si=1efD6atfnVmaQ9VQ	Types of Semiconductors
Module 1: Role and Responsibilities of Assembly Process Technician	Unit 1.4: Safety in Cleanroom Environments and PPE Usage	1.4.2: List Essential safety precautions to follow in cleanroom settings.	27	https://youtu.be/Qyy0Svl1kZI?si=54AIAoe1rsCnmLZu	PPE Safety
Module 2: Prepare Test Environment	Unit 2.2: Environmental Factors and Test Equipment Specifications	2.2.1: Identify key environmental factors such as temperature and humidity and their acceptable ranges for wafer testing.	27	https://youtu.be/wn2P0LbW98Q?si=wZzbTOlfXtMTW1di	Humidity and Temperature
Module 2: Prepare Test Environment	Unit 2.4: Calibration and Documentation in Wafer Testing	2.4.2: Identify various types of calibration procedures used in telecom wafer testing.	27	https://youtu.be/ejmt1atj0XY?si=Ujby5cUGQpzVNwbu	Calibration Process
Module 2: Prepare Test Environment	Unit 2.6: Visual Inspection and Labelling of Telecom Wafers	2.6.1: Describe various visual inspection techniques to identify physical defects on wafers.	119	https://youtu.be/WO5Gm3ixS9I?si=vwOrHC6NCWe-YdAJ	Defect study
Module 3. Carry Out Wafer Testing	Unit 3.1: Understanding Test Programs and Wafer Functionalities	3.1.1: Discuss the Standard Operating Procedures (SOPs) for loading and configuring test programs.	119	https://youtu.be/tuFztgq8hDw?si=CsMjbOczUKTPUmOj	SOP (STANDARD OPERATING PROCEDURE)

Module 3. Carry Out Wafer Testing	Unit 3.3: Monitoring Test Data and Identifying Wafer Defects	3.3.1: Explain the significance of different data types (e.g., voltage, current, timing) displayed during testing.	119	https://youtu.be/il7hh8_T2b0?si=2ugoHXgXgZ490U2U	 What is Voltage Current
Module 3. Carry Out Wafer Testing	Unit 3.5: Data Storage, Archiving, and Company Policies	3.5.2: Explain company policies related to data storage, accessibility, and archiving procedures.	119	https://youtu.be/fdYke5rcd6I?si=LayCuUQuQaTOrFj-	 Data Archive Storage
Module 4: Perform Analysis of Wafer Test Data	Unit 4.1: Statistical Process Control (SPC) and Wafer Data Analysis	4.1.1: Explain the principles of Statistical Process Control (SPC) and its role in analyzing wafer test data.	119	https://youtu.be/PJFQzk53CjA?si=O79qesg9OY3Funut	 Statistical Process Control (SPC)
Module 4: Perform Analysis of Wafer Test Data	Unit 4.3: Wafer Maps and Spatial Defect Analysis	4.3.3: Perform comparison of test data against established criteria or historical data, considering tolerances and expected variations.	119	https://youtu.be/ezpxpfeHmcU?si=he-P08uvatNgbqZJ	 Analyzing Data
Module 5. Maintain Wafer Test Equipment	Unit 5.1: Preventive Maintenance and Equipment Cleaning	5.1.2: Discuss the basic principles of cleaning procedures to prevent contamination within wafer test equipment.	119	https://youtu.be/dlAhzF_hxWY?si=Ug8YQn7-c-JSWqGI	 Technique for Cleaning
Module 5. Maintain Wafer Test Equipment	Unit 5.3: Reporting and Escalating Equipment Issues	5.3.1: Explain the importance of clear and concise communication when reporting equipment Malfunctions	119	https://youtu.be/FxIwXNmijJw?si=Ck-zXJqaOcUeHC4L	 Effective communication



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