

5. AUTONOMOUS MAINTENANCE AND SMALL GROUP ACTIVITIES

Autonomous Maintenance

The principal way in which the production department participates in TPM is through autonomous maintenance- cleaning, inspection, and simple adjustments performed by operators systematically trained through a step-by-step programme.

The purpose of an autonomous maintenance program is threefold. First, it brings production and maintenance people together to accomplish a common goal – to stabilize equipment conditions and halt accelerated deterioration. Operators learn to carry out important daily tasks that maintenance personnel rarely have time for. These tasks include cleaning and inspection, lubrication, precision checks, and other light maintenance tasks, including simple replacements and repairs in some environments.

Second, an autonomous maintenance program is designed to help operators learn more about how their equipment functions, what common problems can occur and why, and how those problems can be prevented by the early detection and treatment of abnormal conditions. Third, the program prepares operators to be active partners with maintenance and engineering personnel in improving the overall performance and reliability of equipment.

Traditionally, the general attitude on the shop floor has been “I run it, you fix it”. Operators were responsible only for setting up workplaces, operating the equipment, and checking the quality of processed work. All management of the equipment’s condition was the responsibility of maintenance staff. By now it should be clear that this way of thinking does not promote optimal equipment performance.

The alternatives are sad indeed, because as operators you can easily prevent many breakdowns and quality problems by learning how to recognize abnormal conditions. A great deal of this learning can come about simply through your physical contact with the equipment – by taking a little time to tighten loose bolts, lubricating dry parts and cleaning away dirt, and by noticing dirt or grime on friction surfaces and switches – conditions that can shorten equipment life.

While these tasks are easy enough to do, in very few factories are they done well. Often you can find clogged drains, empty oil supply equipment, and other results of neglect.

Autonomous maintenance teaches you, the equipment operator, to understand your equipment. Equipment knowledge is no longer limited to operation; now it also includes a lot of things traditionally regarded as maintenance work. This approach is becoming increasingly important as factories introduce more robots and automated systems. Most important, you need the ability to look at the quality of the products and the performance of the equipment and notice when something is not right.

This depends on the following three skills:

1. Knowing how to distinguish between normal and abnormal conditions (the ability to establish equipment conditions).

2. Knowing how to ensure that normal equipment conditions are met (the ability to maintain equipment conditions).
3. Knowing how to respond quickly to abnormalities (the ability to restore equipment conditions).

When you have mastered all three skills, you will understand the equipment well enough to recognize the causes of future problems. You will realise when the machine is about to produce defects or break down. You will also be able to respond quickly. The following list describes some of the skills operators' need.

The ability to detect, correct, and prevent equipment abnormalities and make improvements. This includes understanding the important of

1. Proper lubrication, including correct lubrication methods and methods for checking lubrication.
2. Cleaning (inspection) and proper cleaning methods.
3. Improving equipment to reduce the amount of debris and prevent its accumulation and spread.
4. Improving operation and maintenance procedures to prevent abnormalities and facilitate their prompt detection.

The ability to understand equipment functions and mechanisms, and the ability to detect causes of abnormalities.

1. Knowing what to look for when checking mechanisms.
2. Applying the proper criteria for judging abnormalities
3. Understanding the relations between specific causes and abnormalities.
4. Knowing with confidence when the equipment needs to be shut off.
5. Being able to diagnose the causes of some types of failures.

The ability to understand the relationship between equipment and quality, and the ability to predict problems in quality and detect their causes

1. Knowing how to conduct a physical analysis of the problem.
2. Understanding the relationship between product quality characteristics and equipment mechanisms and functions.
3. Understanding tolerance ranges for static and dynamic precision, and how to measure such precision.
4. Understanding the causes of quality defects.

The ability to make repairs.

1. Ability to replace parts.
2. Understanding of life expectancy of parts.
3. Ability to deduce causes of breakdowns.
4. Ability to take emergency measures.
5. Ability to assist in overhaul repairs.

Obviously, anyone who masters all these skills has achieved a very high level indeed, and no one is expected to do that quickly. Instead, each skill should be studied and practiced for whatever time it takes to acquire proficiency.

Implementing Autonomous Maintenance in Seven Steps

Table below outlines the seven developmental stages of an autonomous maintenance program. These stages or steps are based on the experiences of many companies that have successfully implemented TPM. They represent an optimal division of responsibilities between production and maintenance departments in carrying out maintenance and improvement activities.

A Step-by-Step Approach

It is very difficult to do several things at the same time. That's why autonomous maintenance training takes a step-by-step approach, making sure each key skill is thoroughly learned before going on to the next. Autonomous maintenance is implemented in seven steps:

Step 1 : Conduct initial cleaning and inspection

Step 2 : Eliminate sources of contamination and inaccessible areas.

Step 3: Develop and test provisional cleaning, inspection and lubrication standards.

Step 4: Conduct general inspection training and develop inspection procedures.

Step 5 : Conduct general inspections autonomously.

Step 6 : Organise and manage the workplace.

Step 7: Ongoing autonomous maintenance and advanced improvement activities.

Seven Steps for Developing Autonomous Maintenance

Step	Activity	Goals for Equipment (workplace diagnosis)	Goals for Group Members (TPM group diagnosis)
1. Conduct initial cleaning	Thoroughly remove debris and contaminants from equipment (remove unused equipment parts)	Eliminate environmental causes of deterioration such as dust and dirt; prevent accelerated deterioration Eliminate dust and dirt; improve quality of inspection and repairs and reduce time required Discover and treat hidden defects	Develop curiosity, interest, pride and care for equipment through frequent contact Develop leadership skills through small group activities
2. Eliminate sources of contamination and inaccessible areas	Eliminate the sources of dirt and debris; improve accessibility of areas that are hard to clean and lubricate; reduce time required for lubrication and cleaning	Increase inherent reliability of equipment by preventing dust and other contaminants from adhering and accumulating Enhance maintainability by improving cleaning and lubricating	Learn equipment improvement concepts and techniques, while implementing small-scale improvements Learn to participate in improvement through small group activity Experience the satisfaction of successful improvements
3. Develop cleaning and lubrication	Set clear cleaning, lubrication and inspection standards that can be easily maintained over short intervals; the time allowed for daily/periodic work must be clearly specified	Maintain basic equipment conditions (deterioration-preventing activities) cleaning, lubrication, and inspection	Understand the meaning and importance of maintenance by setting maintaining our own standards (What is equipment control?) Become better team members by taking on more responsibility individually.
4. Conduct general inspection skills training	Conduct training on inspection skills in accordance with inspection manuals; find and correct minor defects through general inspections; modify equipment to facilitate inspection	Visually inspect major parts of the equipment; restore deterioration; enhance reliability Facilitate inspection through innovative methods, such as serial number plates, colored instruction labels, thermotape gauges and indicators see through covers etc.	Learn equipment mechanisms, functions, and inspection criteria through inspection training, master inspection skills Learn to perform simple repairs Leaders enhance leadership skill through teaching group members learn through participation Sort out and study general inspection data; Understand the importance of analyzed data.

5. Conduct inspection autonomously	Develop and use autonomous maintenance check sheet (standardize cleaning, lubrication, and inspection standards for ease of application)	<p>Maintain optimal equipment conditions once deterioration is restored through general inspection</p> <p>Use innovative visual control systems to make cleaning lubrication/inspection more effective</p> <p>Review equipment and human factors; clarify abnormal conditions</p> <p>Implement improvement to make operation easier.</p>	<p>Draw up individual daily and periodic check sheets based on general inspection manual and equipment data and develop autonomous management skills</p> <p>Learn importance of basic data-recording</p> <p>Learn proper operating methods, signs of abnormality, and appropriate corrective actions.</p>
6. Organize and manage the workplace	<p>Standardize various workplace regulations; improve work effectiveness, product quality, and the safety of the environment</p> <p>Reduce setup and adjustment time; eliminate work-in-process</p> <p>Material handling standards on the shop floor</p> <p>Collecting and recording data: standardization</p> <p>Control standards and procedures for raw materials, work-in-process, products, spare parts, dies, jigs, and tools</p>	<p>Review and improve plant layout etc.</p> <p>Standardize control of work-in-process defective products, dies, jigs, tools measuring instruments, material handling equipment, aisles, etc.</p> <p>Implement visual control systems throughout the workplace</p>	<p>Broaden the scope of autonomous maintenance by standardizing various management and control items</p> <p>Be conscious of the need to improve standards and procedures continuously, based on a standardization practice and actual data analysis</p> <p>Managers and supervisors are primarily responsible for continuously improving standards and procedures and promoting them on the shop floor</p>
7. Carry out ongoing autonomous maintenance and advanced improvement activities	Develop company goals; engage in continuous improvement activities; improve equipment based on careful recording and regular analysis of MTBF	<p>Collect and analyze various types of data; improve equipment to increase reliability, maintainability and ease of operation</p> <p>Pinpoint weaknesses in equipment based on analysis of data, implement improvement plans to lengthen equipment life span and inspection cycles</p>	<p>Gain heightened awareness of company goals and costs (especially maintenance costs)</p> <p>Learn to perform simple repairs through training on repair techniques</p> <p>Learn data collection and analysis and improvement techniques</p>

Organisation & Tidiness Standards in Autonomous Maintenance

FOCUS	ELEMENTS
Operator's responsibility	Organize standards for operator responsibilities; adhere to them faithfully (including data recording)
Work	Promote organized and orderly operations as well as

	visual control of work-in-process, products, defects, wastes and consumables (such as paint)
Dies, jigs and tools	Keep dies, jigs and tools organized and easy to find through visual control, establish standards for precision and repair
Measuring instruments and fool-proof devices	Inventory measuring instruments and fool-proof devices and make sure they function properly; inspect and correct deterioration; set standards for inspection
Equipment precision	Operators must check precision of equipment (as it influences quality) and standardize procedures

SMALL GROUP ACTIVITIES

Operators and maintenance personnel from small groups and they continue to refine the inspection process and to generate improvements that increase the equipment life and effectiveness. They are increasingly involved with maintenance in gathering and analysing equipment data such as the results of daily inspection, downtime statistics, oil and grease usage, quality defect data, tool wear records and so on. And they continue to build analytical and diagnostic skills by working on increasingly challenging improvement projects that reflect cooling improvement goals, such as reliability and maintainability improvement or quality activities. At this stage, the operators become full partners in the equipment management process and zero down time and zero defects become achievable targets.