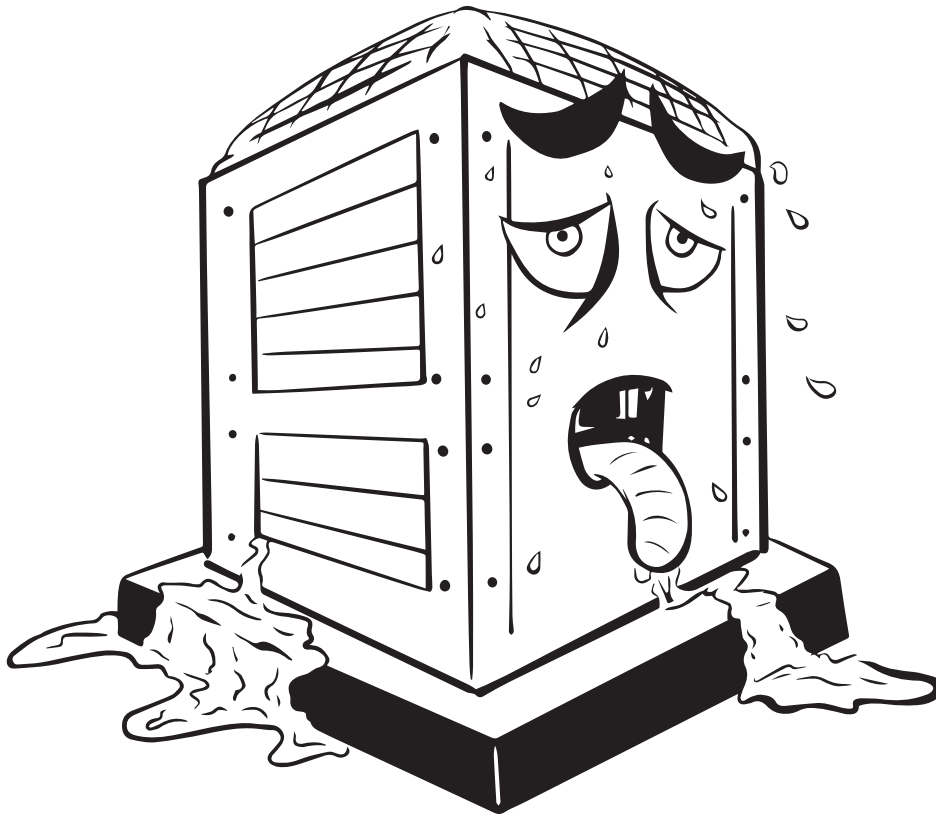


TPM

TOTAL PRODUCTIVE MAINTENANCE



DEFINITION

- TPM is a strategic, team-based, data-driven improvement process involving ALL employees and departments. TPM is made up of 8 pillars which are applied to ensure equipment is performing at optimal condition to achieve zero losses, defect-free production, and long-term reliability and capability. TPM is a critical part of an overall Operational Excellence initiative.
- Seiichi Nakajima, the 'father' of TPM, defines TPM as "productive maintenance carried out by all employees through small group activities," with the goals of "zero breakdowns and zero defects."

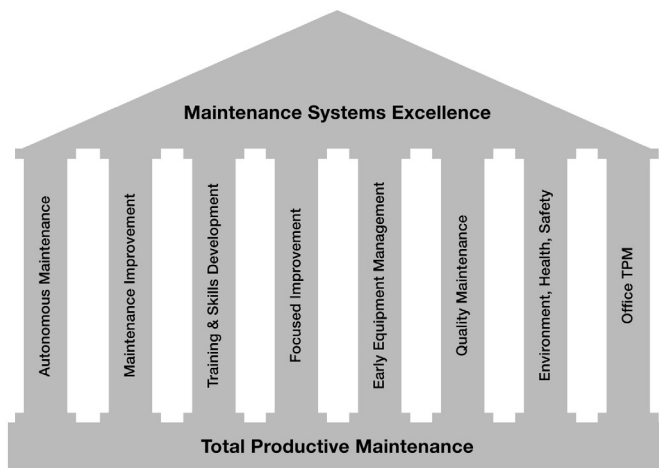
Keep in mind!

The "total" in TPM refers to total effectiveness, total maintenance system, and total participation of all employees.

TPM is NOT a maintenance-department program.

TPM – TOTAL PRODUCTIVE MAINTENANCE

TPM PILLARS



The essence of TPM lies in its 8 Pillars. Collectively they address the process and people change needed to manage and maintain assets so they provide maximum value throughout their life cycle. Here's a snapshot of roles and responsibilities for each Pillar:

AM (Autonomous Maintenance)

In partnership with maintenance technicians, process owners take responsibility for daily, routine maintenance of equipment and create provisional standards to prevent and control deterioration.

MI (Maintenance Improvement)

Maintenance technicians support process owners in their AM activities and focus on planned, preventive, and predictive maintenance as well as proper stores management. They partner with quality and engineering on design for maintainability, and new equipment design/install.

Training & Skills Development

Process owners and maintenance techs participate in both technical training as well as cultural/social skill development to carry out all the required TPM activities.

FI (Focused Improvement)

Cross functional teams of process owners, maintenance techs and others work to investigate, test, and correct chronic losses. FI techniques can also be applied to new equipment design and existing equipment redesign.

EEM (Early Equipment Management)

Engineers work with production process owners, quality, and maintenance techs to ensure new equipment goes into production ready to run at optimal performance, ensuring quality output is achieved from the first production day.

QM (Quality Maintenance)

Like safety, quality is everyone's responsibility. In this pillar, quality managers, engineers, maintenance techs, and process owners work together using root-cause problem-solving techniques to analyze defects to prevent them from reoccurring.

(EH&S) Environment, Health, Safety

TPM activities and the EHS effort combine with a focus on improving equipment reliability and preventing defects and accidents. Common workplace dangers are removed while material waste, power, water, and noise pollution are reduced.

Office TPM

With TPM activities being a carried out in the production area, it is the administrative departments' responsibility to process information, advise on, and assist production and maintenance to help reduce cost, and work to eliminate waste from their administrative value streams.

KEY TPM METRICS

OEE (Overall Equipment Effectiveness)

The principal TPM performance measure, OEE, is used by operators, maintenance, and engineering to indicate how effectively a machine/process is running.

$$OEE = Availability \times Performance Efficiency \times Quality$$

The 6 major losses (listed below) that affect OEE must be identified and reduced/eliminated in order to achieve the goal of world class OEE of 85%+. OEE can be improved through applying AM, FEI, PM Analysis, Changeover reduction, etc.

| | |
|-------------------------|--|
| Availability (downtime) | 1. Equipment failure (breakdowns) |
| | 2. Setup and adjustment |
| | 3. Idling and minor stoppages |
| Performance (speed) | 4. Reduced speed of operation |
| | 5. Process defects (scrap, repairs) |
| Quality (defects) | 6. Reduced yield (from startup to stable production) |

MTBF (Mean Time Between Failures)

Measures the average time a piece of equipment fails (Downtime, Minor Stops, etc.) during a given period of machine run time. The higher the time between failure, the more reliable the system.

$$MTBF = total\ time / \#\ of\ failures$$

MTTR (Mean Time To Repair)

Measures the efficiency of a system's repairs by looking at the average time it takes to repair a system once a failure has been detected.

$$MTTR = total\ breakdown\ time / \#\ of\ failures$$

TPM — TOTAL PRODUCTIVE MAINTENANCE

ARE YOU GETTING BETTER?

Take a look at the following key performance indicators to help you gauge the success of your TPM initiative:

- Build to Schedule (a simpler metric to gauge production status vs calculating OEE)
- Reduced unplanned downtime and maintenance costs
- Improved flexibility and number of inventory turns
- Reduced production losses and shortened lead times
- Improved first pass yield and operating capacity
- Optimized spare parts inventory
- Improved/lowered Life Cycle Costs (Acquisition cost + Ownership cost)
- Improved percentages of reactive, predictive, and preventive maintenance
- Reduced WIP / supermarkets
- Improved environmental, health and safety concerns
- Improved on-time delivery
- Increased Right First Time and reduced number of errors/rework
- Reduced overtime hours
- Reduced customer complaints / improved customer and employee satisfaction

TAKING IT BACK HOME / FOR REFLECTION

Think about the ways TPM principles are a part of our daily lives, and what a difference proactive vs. reactive maintenance makes in ways we often take for granted. For example, do we:

1. take our cars in for routine service to keep them running efficiently, thereby preventing unplanned failures?
2. go to the doctor for routine checkups to make sure our bodies ('human machines') are also functioning properly, and to detect any issues before they become chronic failures?
3. perform routine checks throughout our households to ensure appliances, electronic devices, etc. are running properly so we don't find ourselves without heat on a holiday weekend in the middle of winter?

FAMOUS QUOTES RELATED TO RELIABILITY

"Total Productive Maintenance is equipment maintenance carried out on a company-wide basis."

"In striving for zero breakdowns, TPM promotes defect-free production, just-in-time production, and automation. It is safe to say that without TPM, the Toyota Production System could not function."

— Seiichi Nakajima, the 'father' of TPM

NOT-SO FAMOUS QUOTE

"Like gator eggs, equipment abnormalities typically start small. If they go unnoticed or ignored, they hatch and grow. Wait longer, and those hatchlings will eventually grow into ten to twelve-footers, even eighteen-footers. What would you prefer to wrestle, a gator egg or an eighteen-footer? The eggs don't bite!"

— Ellis New, TPM Consultant and Master Gator Hunter

