ZenPower International
Industry TPM Consultants

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Website: www.tpmquality.com

tpm/moses
TPM OVERVIEW

Manufacturing & Administrative Excellence.
Background of TPM

- Main manufacturing excellence approach of Toyota and other excellent Japanese companies since the 70’s.
- **TPM is foundation** for JIT, FA, Poka Yoke, Lean Manufacturing, Zero Defects.
- **TPM Reference Standard** - JIPM (Japan Institute of Plant Maintenance)
- **Comes from the best of Japanese Industrial Excellence and evolved from the heat of the continuing Energy Crisis and Globalization challenges to achieve More with Less.**
TPM GOALS

1. Increase asset Utilization and Equipment OEE
2. Foster Production Equipment Ownership
3. Equipment breakdown prevention (Planned Maintenance through CM, TBM, CBM)
4. Defect Prevention (QM Process & Poka Yoke)
5. Evolving into Self Directed Work Teams (SDWTs) and Lean Manufacturing.
TPM STANDARDS

1. TPM Structure & Organization
2. Equipment Improvement activities
3. Production Autonomous Maintenance
4. Planned Maintenance
5. Quality Maintenance
6. Product & Equipment Initial Control
7. Education & Training
8. Office TPM
9. Safety, Hygiene & Environment
10. Quantifiable TPM Measurement
Executive Overview Of

1. Autonomous Maintenance
2. Equipment Improvement
3. Planned Maintenance
4. Quality Maintenance
5. Office TPM
QUICK LOOK AT

Production

Autonomous

Maintenance
LOGIC OF AM STEPS

STEPS 1,2,3
IMPROVE THE
EQUIPMENT
USER-FRIENDLINESS

STEPS 4,5,6
IMPROVE WORKER
KNOW-HOW TO MAINTAIN
EQUIPMENT THROUGH
STRUCTURED SPECIFIC
SKILLS

STEP 7
FLATTENED
ORGANIZATION
# AM STANDARDS

<table>
<thead>
<tr>
<th>Step #</th>
<th>Step Goal</th>
<th>Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Restoration</td>
<td>=&gt; 85% repair rate</td>
</tr>
<tr>
<td>Step 2</td>
<td>Eliminate Sources of Contamination</td>
<td>=&gt;70% successful effort</td>
</tr>
<tr>
<td>Step 3</td>
<td>Improve Equipment Accessibility</td>
<td>=&gt;70% successful effort</td>
</tr>
<tr>
<td>Step 4</td>
<td>Initial Maintenance Standards</td>
<td>&gt; 50% sudden b/d reduction</td>
</tr>
<tr>
<td>Step 5</td>
<td>General Inspection Skills</td>
<td>&gt; 90% sudden b/d reduction</td>
</tr>
<tr>
<td>Step 6</td>
<td>Autonomous Inspection</td>
<td>&gt; 95% sudden b/d reduction</td>
</tr>
<tr>
<td>Step 7</td>
<td>Organise and manage workplace</td>
<td>TBD by management</td>
</tr>
</tbody>
</table>
(Step-1: Restoration Equipment)

1. Restoration Equipment

- Operators
  - Leader
  - Supervisors
  - Group Leader
  - Dept. Chief
  - Maint. Staff
  - Engr. Staff

2. Confirmation of Progress
- Dept. Chief
- Leader
- Supervisors
- Maintenance Staff
- Engineering Staff
- Autonomous Maintenance Group

3. Meeting to Plan Countermeasures
- Countermeasures
- Extended to all equipment

4. Audit
- Model Machine
- Follow up on audit feedback

5. Audit
- Dept. Chief
- Countermeasures extended to all equipment

 TPM/Moses
(Step-2: Eliminate Contamination & Stains on Area & Parts)

Complete Step-1

Step-1 Summary results & findings

AM Team => 70% Countermeasures


1st Pre-Audit by TPM Dept.

GM/Sponsors Audit

Present Countermeasures to TPM WC and implementation

Own area Buy - Off
(STEP 3: IMPROVE EQUIPMENT ACCESSIBILITY).

Model m/c Passed Step 2

Areas difficult or inaccessible for cleaning, checking & lubricating

Inaccessible

No Place To Stand

Wiring or piping obstruct

Cannot see easily

Time Consuming to clean

Inaccessible

AM Leader

Model Machine Goes To Step 4

Product Manager

Operator Leader/Operators

Supervisor

GM Audit

W/C Buy Off

Own Area Buy Off

Pre-Audit by TPM Dept.
(Step 4: Initial Maintenance Standards)

Model m/c passed Step 3

Initial maintenance standard

Hard to lubricate

Hard to check oil level

Abnormality in lubrication equipment

Abnormality in circulation of lubrication

Equipment gets dirty during oiling

Draft standards for cleaning, inspection & lubrication

Counter measure for cleaning and checking

Operator Leader/operator

Supervisor

Engineer & Maintenance

Attach identification label

Trial Period

TPM dept. Pre-audit

GM audit

Proliferation of Step 4
(Step 5: General Inspection skills)

- Lubrication
- Equipment parts tightening
- Pneumatics
- Hydraulics
- Electrical
- Drive System
- Water
- Fire prevention/safety

Select general inspection items:
- Manuals
- Checklist
- Cut away models
- Revised Maintenance standards

Prepare texts and daily schedules/check lists:
- Managers/supervisors participate in training
- Test
- Implement general Im..

TPM office Pre-Audit

GM Audit

Proliferate Step-5
(Step-6: Autonomous Inspection)

Maintenance | Inspection standards, breakdown analysis

Operators who understand their equipment (able to maintain inspection standards)

Step-5: Revise provisional standards

Step 1 to 3:
- Establish basic conditions (cleaning and lubrication)

Step 4:
- Daily checking, adjustment, and improvement of conditions for correct operation

Inspection skill check-up

Finalise standards for cleaning and lubrication
Step-7: Organise and Manage Workplace

Organise and set standards for:

- Equipment Precision
- Inspection Items
- Tools and Materials
- Standards for Individual Work Responsibilities
- Flow and Storage
QUICK LOOK AT

Planned Maintenance Pillar
GOAL OF PLANNED MAINTENANCE

Achieve “ZERO EQUIPMENT BREAKDOWNS” by implementing systems of “parts replacement before failure” through TBM and CBM.

EQUIPMENT TOTAL MAINTENANCE STANDARDS

PRODUCTION AUTONOMOUS MAINTENANCE SYSTEM.

P.M. STANDARDS

GENERAL INSPECTION STDS.

ANNUAL MAINTENANCE PLANS
PLANNED MAINTENANCE ACTIVITIES:

0 Support autonomous maintenance activities by technical support, breakdown analysis and demarcation between production & P.M. systems.

0 P-M analysis for chronic breakdowns.

0 Time based maintenance items

0 Condition based maintenance items.

0 Spares Mgmt & maintenance day practice.
QUICK LOOK AT

Equipment Improvement Pillar
ROLE OF PLANT EI TEAM

Achieve systematic breakthroughs in equipments’ 6 BIG LOSSES and establish Standards for Basic Machine Conditions.

The Basic Machine Conditions are:
1. Cleaning Standards.
2. Lubrication Standards.
<table>
<thead>
<tr>
<th>EQUIPMENT 6 BIG LOSSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>(FOCUS IS AT THE BOTTLENECK PROCESSES.)</td>
</tr>
<tr>
<td>1. BREAKDOWN LOSSES</td>
</tr>
<tr>
<td>2. SPEED LOSSES.</td>
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<tr>
<td>3. SETUP LOSSES.</td>
</tr>
<tr>
<td>4. DEFECT LOSSES.</td>
</tr>
<tr>
<td>5. START-UP OR YIELD LOSSES</td>
</tr>
<tr>
<td>6. MINOR STOPPAGES LOSSES</td>
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<tr>
<td>LOSSES</td>
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<tr>
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<tr>
<td>Breakdown losses</td>
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<tr>
<td>Setup Losses</td>
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<tr>
<td>Minor Stoppages</td>
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<tr>
<td>Speed Losses</td>
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<td></td>
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<tr>
<td>Defect &amp; Startup Losses</td>
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</tbody>
</table>
OVERALL EQUIPMENT EFFICIENCY

OEE => 85% target

Sporadic & Chronic Problems

Why-Why Analysis.

FOR PROBLEMS WITH CLEAR AND ASSIGNABLE CAUSES.

P-M Analysis.

FOR PROBLEMS WITH CLEAR CAUSES & NO EFFECTIVE COUNTER-MEASURES
Why-Why Analysis & P-M Analysis

• Used with other data analysis or data collection tools.
• Emphasize on logical reasoning to fully understand the whole chain of cause-effects so as to devise holistic multiple solutions.
• All defects, breakdowns, accidents and work – problems are result of an error by Man which is the Root Cause.
• Problems are traced to all the 4Ms
• Solution Sustained by linked to the TPM systems.
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</tr>
</thead>
<tbody>
<tr>
<td>Distance between the roller at the tip of the flyer and hook needle during hooking</td>
<td>4M Correlation</td>
<td>First Item</td>
<td>1006º to 180º NG</td>
<td>170º to 180º NG</td>
<td>1-1 Flyer rotation is not smooth when bad is applied.</td>
<td>15kg/cm² NG</td>
<td>20kg/cm² NG</td>
<td>1-1-1 Tension on Gauge</td>
<td>120g to 150g</td>
<td>170g to 300g NG</td>
<td>Carbon powder Clean</td>
<td>120g to 150g</td>
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<td></td>
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<td></td>
<td></td>
<td>Carbon co resistance</td>
<td>1-1-2 Gallon of spin down bearing</td>
<td>140g</td>
<td>180º place was used. 1/8 place)</td>
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<td></td>
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<td></td>
<td></td>
<td>Carbon slide ring</td>
<td>1-1-3 V-belt Push-up gauge</td>
<td>140g</td>
<td>from those in other the same spring</td>
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<td></td>
<td>0º to 6mm OK</td>
<td>1-1-4 Motor Thickness gauge</td>
<td>0.1 to 0.6mm OK</td>
<td>0.25mm OK</td>
<td></td>
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<td></td>
<td>1-1-5 Motor thickness gauge</td>
<td>0.1 to 0.6mm OK</td>
<td>0.25mm OK</td>
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<td></td>
<td></td>
<td>1-1-6 Dial gauge</td>
<td>in box 0.05</td>
<td>0.03mm OK</td>
<td>Replace 0.25mm</td>
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<td></td>
<td>Spindle shaft deflection</td>
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</table>
QUICK LOOK AT

Quality Maintenance Pillar
QUALITY MAINTENANCE:

IS ACTIVITIES TO SET EQUIPMENT CONDITIONS, BASED ON THE BASIC CONCEPT OF MAINTAINING PERFECT EQUIPMENT TO MAINTAIN PERFECT QUALITY OF PROCESSED GOODS. THE MACHINE CONDITIONS (Q-COMPONENTS) ARE CHECKED AND MEASURED IN TIME-SERIES TO VERIFY THAT MEASURED VALUES ARE WITHIN STANDARD VALUES TO PREVENT DEFECTS. THE TRANSITION OF MEASURED VALUES IS WATCHED TO PREDICT POSSIBILITIES OF DEFECTS OCCURRING AND TO TAKE COUNTERMEASURES BEFOREHAND.
ROLE OF PLANT TPM-QM

Achieve “ZERO DEFECT” by identifying all the upstream factors of Equipment causes of defects and implementing fool-proofing techniques to eliminate man and materials-caused defects.

1. Identify all the Q-components
2. Implement fool-proofing techniques to prevent man and materials-caused defects.
3. Eliminate all Chronic defects.
<table>
<thead>
<tr>
<th>Part of Machine</th>
<th>Plating Chemical</th>
<th>Flipper</th>
<th>B. Bar / C. Brush</th>
<th>Dryer Heater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement</td>
<td>Chemical Content</td>
<td>Tension</td>
<td>Contact Pressure</td>
<td>Hot Air Temperature</td>
</tr>
<tr>
<td>Std. Value</td>
<td>MSA: 37.5% +/- 5%</td>
<td>Upper &lt;= 250 g</td>
<td>Upper = 6 kg/cm</td>
<td>Upper = 130 deg. C</td>
</tr>
<tr>
<td></td>
<td>TIN: 37.5 g/l +/- 5 g/l</td>
<td>Nominal = 120 g</td>
<td>Nominal = 5.5 kg/cm</td>
<td>Nominal = 125 deg C</td>
</tr>
<tr>
<td></td>
<td>Additive: 2 g/l +/- 0.5 g/l</td>
<td>Lower =&gt; 60g</td>
<td>Lower = 5 kg/cm</td>
<td>Lower =&gt; 120 deg C</td>
</tr>
<tr>
<td>Interval</td>
<td>Daily</td>
<td>Weekly</td>
<td>Forthnightly</td>
<td>Daily</td>
</tr>
<tr>
<td>Quality Defect</td>
<td>Thickness Fail</td>
<td>Thickness Fail</td>
<td>Thickness Fail</td>
<td>Thickness Fail</td>
</tr>
<tr>
<td>Quality of M/c Part</td>
<td>Thickness Fail</td>
<td>Thickness Fail</td>
<td>Thickness Fail</td>
<td>Thickness Fail</td>
</tr>
<tr>
<td>Circularity</td>
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</tr>
<tr>
<td>Content</td>
<td></td>
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<tr>
<td>Deterioration</td>
<td></td>
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<tr>
<td>Smoothness</td>
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</tbody>
</table>

**EXAMPLE OF AN M-Q (MACHINE-QUALITY) MATRIX**

Q-Tag number & Revision: Q-tag # 60-001 Rev A, Q-tag # 60-002 Rev A, Q-tag # 60-003 Rev A, Q-tag # 60-004 Rev A
ABOUT OFFICE TPM

• Is a structured 5S program using Why-Why Analysis as a problem-solving tool.
• Has similar Autonomous Maintenance 5 Steps
• Improves “CRITICAL FUNCTIONS” of Ware-house, Storage Place, administrative areas’ through work-flow studies.
• Areas contributing to OEE losses are selected for Kai’zen activities.
The 5S step-by-step program.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - Cleaning &amp; Restoration.</td>
<td>Thoroughly restore &amp; clean. Motivation through participation.</td>
</tr>
<tr>
<td>2 - Eliminate Stains, Mixed, Contamination.</td>
<td>Study root causes of dirt, mixing, loss, damage and take actions.</td>
</tr>
<tr>
<td>3 - Improve Accessibility.</td>
<td>Achieve 1 minute accessibility time for documents + parts. Implement stock-management-at 1 glance.</td>
</tr>
<tr>
<td>4 - Standardization &amp; Control of Work.</td>
<td>Achieve a problem-free work flow in stock inventory, data availability.</td>
</tr>
<tr>
<td>5 - Self Management</td>
<td>Self managing work teams.</td>
</tr>
</tbody>
</table>
TOGETHER......
Towards World-Class Manufacturing Excellence
## TPM MASTERPLAN 2001 - 2003

<table>
<thead>
<tr>
<th>DEVELOPMENT PROGRAM</th>
<th>DESCRIPTION</th>
<th>INTRODUCTORY STAGE 2001</th>
<th>PRACTICE STAGE 2002</th>
<th>CONSOLIDATION STAGE 2003</th>
<th>FINAL STAGE 2004</th>
<th>JIPM AWARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy</td>
<td>Basic Objective</td>
<td>Proliferation and total involvement</td>
<td>Defects and breakdown prevention</td>
<td>Zero defects and zero breakdowns through every employee’s involvement</td>
<td></td>
<td>Challenge the standards</td>
</tr>
<tr>
<td>Basic TPM</td>
<td>Weekly WC mtgs</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Organisation &amp; Main Committees</td>
<td>Regular EI mtgs</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Regular PM mtgs</td>
<td></td>
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</tr>
<tr>
<td>Basic Strategy</td>
<td>Select Model Machine, form Teams, implement improvements on Model MCs &amp; then proliferate to all similar equipments to achieve a skilled workforce and equipment that do not breakdown.</td>
<td></td>
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<tr>
<td>Employee Suggestion Scheme for Continuous Improvement</td>
<td>Policy</td>
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<tr>
<td></td>
<td>Pilot Area</td>
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<tr>
<td></td>
<td>Proliferate</td>
<td></td>
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</tr>
<tr>
<td>TPM Measurements</td>
<td>OEE/ Breakdowns/Quality</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Autonomous Maintenance (5 Pilot Lines then 85% of rest of types of equipment)</td>
<td>Step 1: Restoration</td>
<td>Step 2: Eliminate Contamination</td>
<td>Step 3: Improve Accessibility</td>
<td>Step 4: Initial Standards</td>
<td>Step 5: General Inspection</td>
<td>Step 6: Autonomous Inspection</td>
</tr>
<tr>
<td></td>
<td>Pilot MCs</td>
<td>Step 2</td>
<td>Step 3</td>
<td>Step 4</td>
<td>Step 5</td>
<td>Step 6</td>
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<td></td>
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<td></td>
<td>Rest of MCs</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Equipment Improvements on 6 losses</td>
<td>Technical support for AM Baseline current m/c losses Model m/c basic conditions Model m/c losses improvements</td>
<td></td>
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</tr>
<tr>
<td>PM &amp; QM Systems</td>
<td>Planned maintenance schedules (Time &amp; condition based) Machine/Product Quality matrix</td>
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<tr>
<td>TPM Training and Skills Development</td>
<td>AM Skills workshops</td>
<td>PM Analysis workshops</td>
<td>Advanced workshops</td>
<td></td>
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<tr>
<td>Early Equipment &amp; Product Control</td>
<td>Develop trouble prevention checklists on</td>
<td></td>
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</tr>
<tr>
<td>Office TPM</td>
<td>5S Program for office</td>
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</tr>
<tr>
<td>Safety, Hygiene &amp; Environment</td>
<td>Equipment Safety Workplace environment &amp; waste treatment</td>
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</tbody>
</table>
THANK YOU