Operational Excellence Series

Book 4:

Pit Stop Maintenance with TPM

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Contents

Printers today must slash downtime and cut all the costs they can. Failure to recognize and do this can result in extinction. To survive, printers must look at and address production problems in terms of process issues, not personal or individual issues. To improve the current state of affairs, system and process excellence must become the driving forces for printers. Excellence begins with measuring processes, analyzing the information and data, then addressing what is found with objective and unbiased corrective and preventive actions. To accomplish system and process excellence, management must embrace Lean thinking.

Waste is the cost of time and materials that consume resources but don't add value to the product or result in product that is unacceptable to the customer and they are not willing to pay for.

When printing a scheduled run, there are only two activities that occur: value-added and non-value-added. **Value-added (VA)** activities are process actions and steps that actually convert the form, fit, or function of materials and information into items and products. VA activities are what a customer specifies and pays for.

Examples of printer's process actions that specifically add value are the activities and time it takes to:

- Output proofs
- Make plates
- Print ink on substrate (one sheet, signature, carton, or label)
- Cut one sheet, signature, carton, or label
- Fold one sheet, signature, carton, or label
- Collate/stitch/trim one book or magazine
- Package one job
- Ship to customer

NOTES

PIT STOP MAINTENANCE

To win races, cars must operate at optimum reliability and performance. To achieve this optimum reliability and performance, race cars must go through periodic maintenance during the races, known as pit stops. Pit stops are a combination of effective preventive and corrective maintenance performed in an efficient manner.

To achieve optimum effectiveness and efficiency pit crews have to objectively address the causes and effects influencing their performance. The X inputs are everything that is required and needed to produce the final product or service.

For racing, the pit crew X inputs are:

- **People:** abilities, training, and teamwork
- **Tools and materials:** tools, components, lubricants, cleaning chemicals
- **Machine:** design and manufacturing
- **Methods:** preparation, tasks, techniques, communications
- **Measurement:** Pit stop cycle time, equipment failure rate, car speed
- **Environment:** pit layout and organization

For the racing pit crew, the Y inputs are: Win the race!

Y outputs = the Function of the X inputs *or* $Y = F \times X$

The foundation of Pit Stop Maintenance is **Total Productive Maintenance** (TPM), which is a systematic program of optimizing equipment and processes by maintenance staff and operator teams achieving a desired state for equipment and processes reliability and performance.

The Steps to Process Stabilization

1. Assess a process's current state and conditions.
2. Bring the process up to desired performance through effective and corrective maintenance activities.
3. Sustain the process at the desired level through effective critical cares and maintaining necessary conditions.

Ultimate Goal—Zero Failures and Breakdowns

Equipment breakdowns can be placed in two basic categories: Operation-Loss Failures and Operation-Reduced Failures.

- **Operation-Loss Failures** are sudden and total mechanical/electrical failures of equipment; the equipment's production has totally stopped.
- **Operation-Reduced Failures** include product defects and minor equipment stoppages that do not totally shut down equipment but cause them to operate at reduced effectiveness. Operation-Loss Failure causes include accelerated deterioration and poor operating practices and techniques.

Make Note...

Pit stops are a combination of effective preventive and corrective maintenance performed in an efficient manner.

KEY ASPECTS OF TPM

- Periodically restore equipment to realistic conditions.
- Maintain necessary conditions.
- Stop deterioration.
- Lengthen equipment effective life.
- Reduce time between breakdowns and failures.
- Prevent human error.

TPM segregates equipment effectiveness influences and losses into several categories. Measuring and tracking performance of these categories enables easier detection of problems and issues that obstruct peak performance. The key to TPM and Pit Stop Maintenance is understanding and addressing, with corrective and preventive actions, the mechanical and operational issues that impact overall equipment effectiveness.

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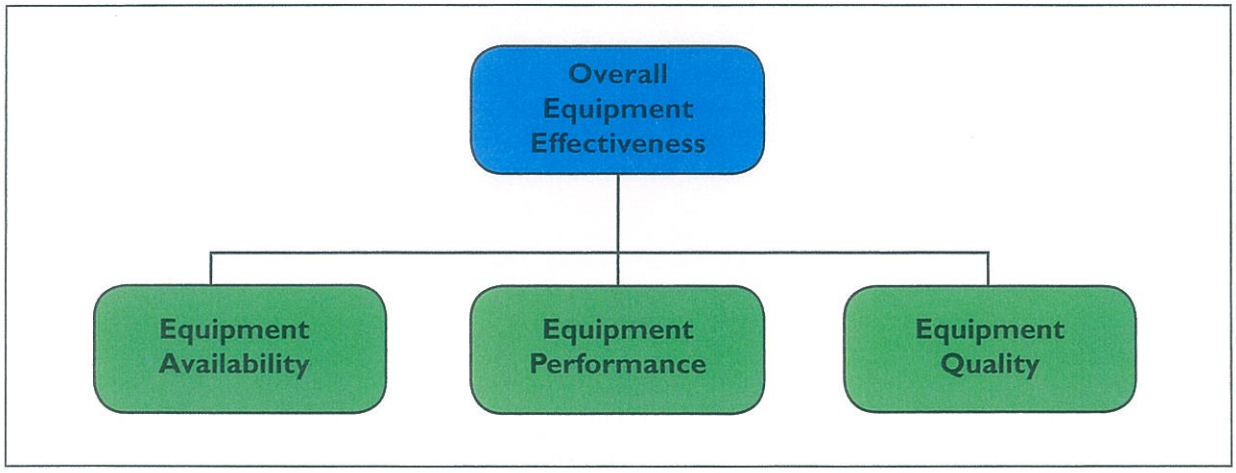


Equipment Availability Losses

1. Equipment failure/breakdown
2. Equipment setup and adjustment (makeready)

Equipment Performance Losses

3. Equipment idling and minor stops
4. Reduced running speeds

Equipment Quality Losses

5. Defective product
6. Startup and running waste

Make Note...

The key to TPM and Pit Stop Maintenance is understanding and addressing the mechanical and operational issues that impact overall equipment effectiveness.

NOTES

Equipment Availability Losses

Within the time equipment is scheduled to run with operators manning it, availability is the time equipment can actually produce (make proofs, make plates, print, cut, fold, collate-stitch-trim, etc.) product. There are two influences or losses that will occur to reduce availability.

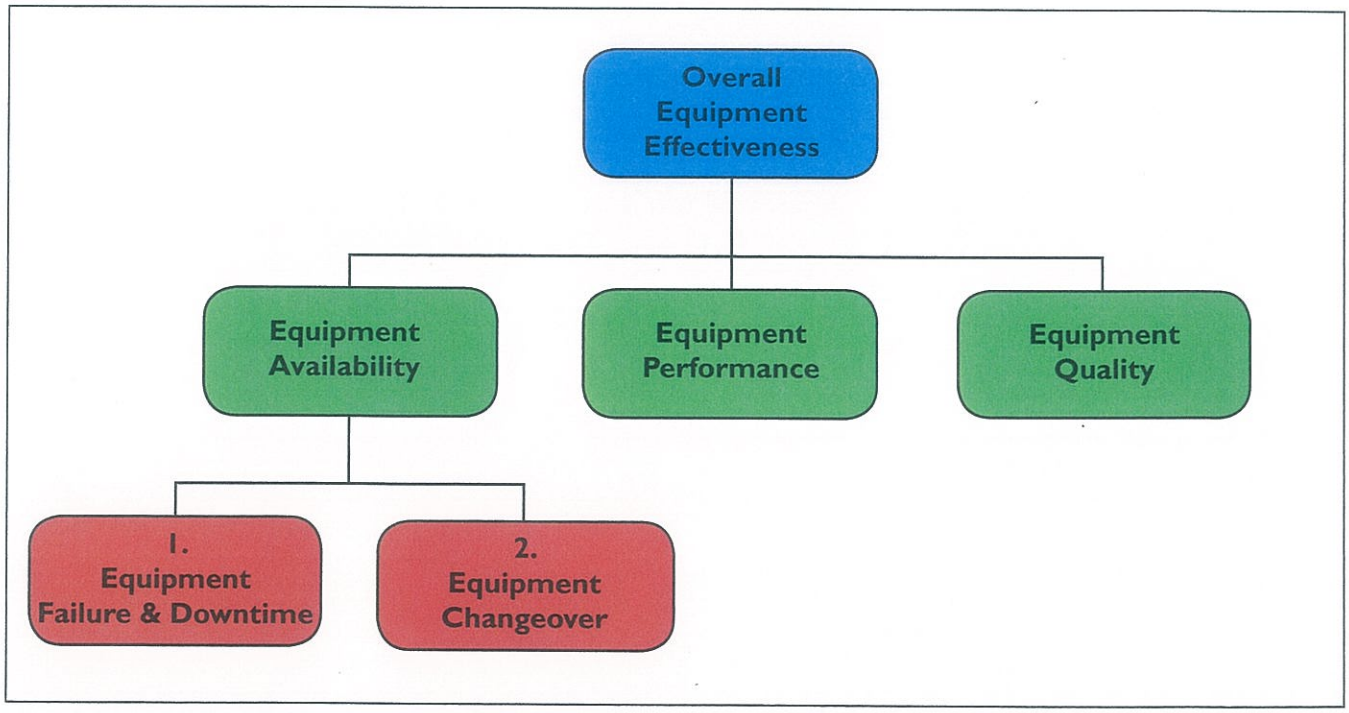
1. **Equipment Failure/Downtime:** The first element in the elimination of the six big losses is equipment break or failure and downtime. Equipment failures are sudden unscheduled breakdowns that can occur, shutting down equipment and requiring immediate corrective maintenance. Downtime can be the result of numerous issues:

   a. **Scheduled:** Planned downtime includes planned maintenance, such as preventive and corrective maintenance actions and waiting on customer approvals. Scheduled downtime can be reduced through process optimization and continuous improvement.

   b. **Unscheduled:** Various technical (tooling, equipment, and materials) and operational (people issues) stoppages. Unscheduled downtime must be addressed through corrective and preventive actions.

   Eliminating more equipment failures and downtime will result in increasing equipment availability time.

2. **Equipment Setup and Adjustment (Changeover):** The second area of focus for equipment lost time is equipment changeover, or makeready. With shorter run lengths and quicker turnaround expectations from customers, printers are experiencing increasing numbers of equipment changeovers and makereadies. Press makeready or equipment setup is the time lost when changing over from producing the last good saleable sheets/product



of one job to producing the first good saleable sheets/product of the next job: "Last Good ➡ First Good."

The following are some typical reasons for longer equipment changeover time; one or more of these issues must be evaluated and addressed.

- Information availability and accuracy
- Materials conditions
- Tooling and equipment conditions and availability
- Number of setup components changed
- Amount of adjustments to match job specifications

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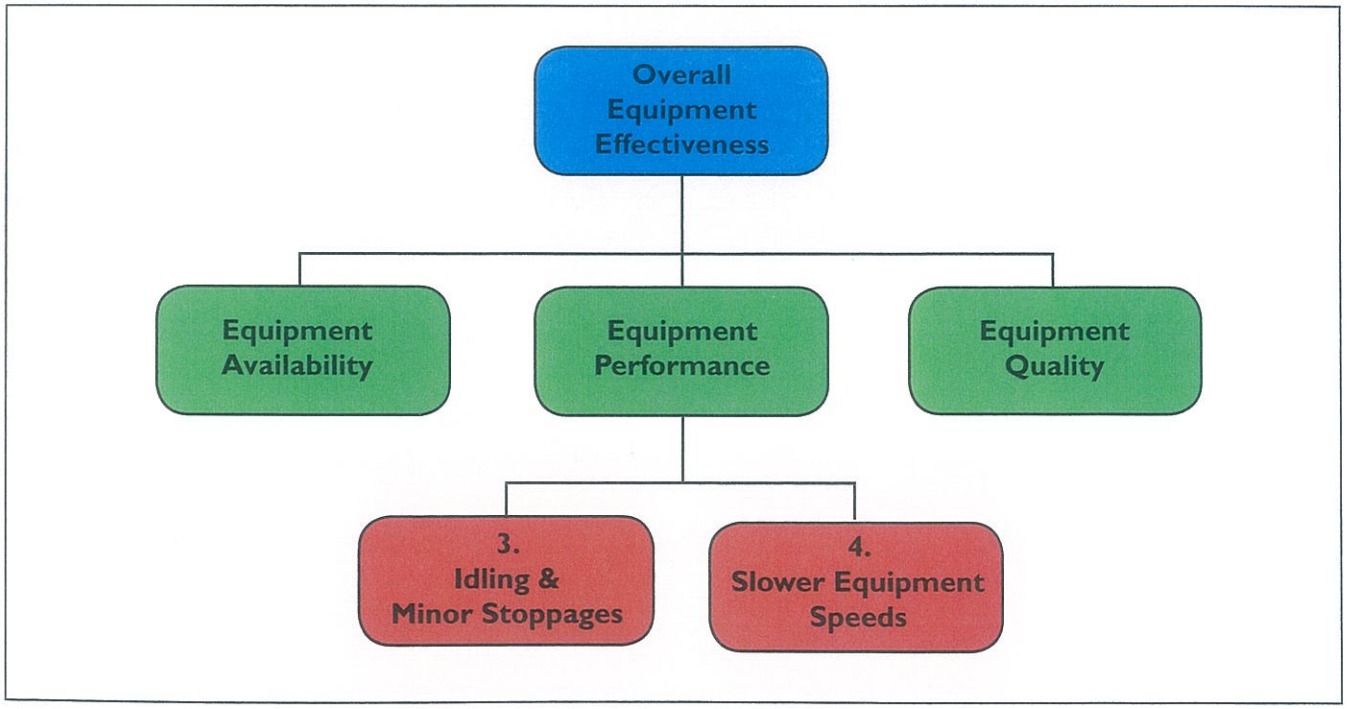
Equipment Performance Losses

3. **Idling and Minor Stops:** The third area—and one of the great causes for lower performance, waste, and spoilage—is idling and minor stoppages. Typically this includes stops that are under a few minutes and require operator intervention and not maintenance staff to address. Minor stops are usually frequent and include: component jams, misfeeds, delivery blockage, and product quality problems.

Typical reasons for idling and minor stops include the following, and one or more of these issues must be evaluated and addressed.

- Materials conditions
- Equipment conditions
- Inconsistent equipment setup
- Operator skills and knowledge



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4. **Slower or Reduced Running Speeds:** Slower equipment speeds are a loss because the machine is not operating at its designed rated speed. Slower equipment speed rate is defined as the difference between the manufacturer's rated equipment speed and the actual speed the equipment is running during normal production. The main goal for the printer is to start bringing the actual production speeds closer to the optimal or possibly rated speeds.

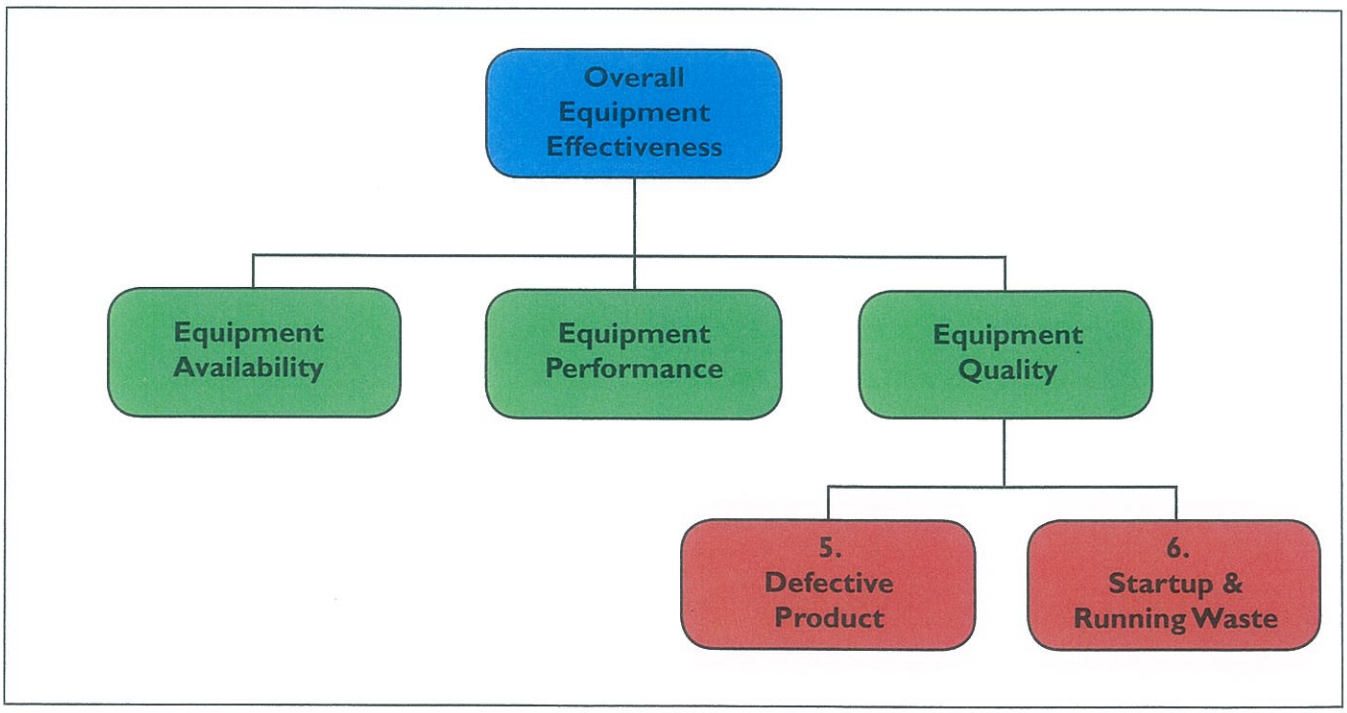
   Some of the typical reasons for slower equipment speeds follow; one or more of these issues must be evaluated and addressed.

   - Materials conditions
   - Equipment conditions
   - Equipment setup
   - Equipment operation
   - Operator skills and knowledge

Equipment Quality Losses

5. **Defective Product:** Defective product is all product run during production that is unacceptable to the customer. The amount above and beyond planned waste is known as ***spoilage*** and continues to be a nagging loss of production. Defective product is a loss due to cost of processing time and materials that have been consumed and for which no payment will ever be received. Defective product, whether it is work-in-process or final product, leads to extensive inspection by staff, production bottlenecks in the inspection area, time required to handle nonconforming product, job reruns, and production bottlenecks due to work-in-process defects.

   The following are some typical reasons for defective product; one or more of these issues must be evaluated and addressed.



- Information accuracy and availability
- Materials conditions
- Equipment conditions
- People's skills, knowledge, and teamwork
- Customer quality requirements

6. **Startup and Running Waste:** This is the lost time and materials used after the makeready is complete and production sheets/signatures are being counted. The equipment is frequently operating at a reduced speed, and defective product (color variation, plate scum, dirty halftones and screen tints, and folder position variation) are being identified in loads and pulled from stackers for disposal. All product run during equipment setup, startup, and beginning of production that is unacceptable to the customer due to tweaking and adjustment to bring the equipment process to balanced running is waste.

   Typical reasons for startup and running waste include the following. One or more of these issues must be evaluated and addressed.

   - Materials conditions
   - Equipment conditions
   - Equipment setup
   - Operator skills and knowledge

TPM COMPONENTS

TPM components are the primary provisions required to achieve effective and productive maintenance.

1. **Overall Equipment Effectiveness (OEE):** Identify and measure the six equipment losses.
2. **Preventive Maintenance:** Maintain equipment and prevent deterioration of components.
3. **Autonomous Maintenance:** Operator and staff perform effective maintenance and critical cares.
4. **Corrective Maintenance:** Restore equipment to desired state.
5. **Predictive Maintenance:** Predict and replace components before failure during scheduled preventive maintenance.
6. **Equipment Analysis:** Utilizing specific testing methods, targets, and instruments to measure and analyze the current state of the equipment, and comparing the findings to manufacturer and industry specifications and benchmarks.
7. **Optimize Maintenance Operations:** Effectively complete preventive, corrective, and predictive maintenance tasks and activities in a timely manner through the utilization of Kaizen team events.

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Make Note...

All product run during equipment setup, startup, and beginning of production that is unacceptable to the customer is waste.

NOTES

Best Practices—Overall Equipment Effectiveness (OEE)

OEE Metrics focus on a machine's total good production sheets/items/feet per minute versus running time, downtime for makeready, downtime (scheduled and unscheduled) multiplied by its factory optimum speed.

OEE provides a more balanced comparison between older and newer equipment and is a measure of how well machines are utilized in relationship to their optimal designed potential.

Simplified OEE Calculation for 24-hour shift

OEE = # of good sheets ÷ (24 hours X factory optimum rated speed)

OEE = Number of good sheets ÷ (120 hours X factory optimum iph)

OEE = 905,000 sheets ÷ (120 hours X 18,000 iph)

OEE = 905,000 ÷ 2,160,000 = 42% OEE

Metrics direct companies where to focus their process improvement initiatives.

The goal is increasing total good product in the current time frame.

✓ Sheets

✓ Signatures

✓ Cartons

✓ Labels

Increased OEE means increased sales and revenue because OEE metrics, coupled with process analysis, help to determine where to focus maintenance and improvement initiatives.

- Longer Production Runs:
  - ✓ Reduce downtime
  - ✓ Increase equipment speeds
  - ✓ Reduce idling and minor stoppages
- Shorter Runs and Frequent Makereadies and Setups:
  - ✓ Reduce makeready
- Older, Slower Equipment:
  - ✓ Reduce downtime
  - ✓ Increase equipment speeds
  - ✓ Reduce idling and minor stoppages

Equipment Reliability

Intrinsic reliability is built in through design and manufacturing. Intrinsic reliability is based on design, manufacturer, and installation of the equipment and its components.

Operational reliability is based on the printer's managers' and operators' techniques and the conditions under which the equipment is maintained and operated. Operational reliability will decline as a result of equipment being improperly set up, excessive and heavy-handed adjustments, wrong and poor quality tools used, and the lack of or inconsistent Critical Cares.

Total reliability combines intrinsic and operational reliability. Total reliability is dependent on the conditions within which the equipment is maintained and operated.

Equipment Losses

Chronic losses occur repeatedly, are difficult to detect, and are caused by subtle defects in equipment, materials, and operating methods. They can be solved through:

- Operator intervention
- Team brainstorming
- Establishing and adhering to effect operating methods for:
  - ✓ Setup
  - ✓ Production operation
  - ✓ Maintenance

Chronic losses consume the vast majority of equipment lost time.

Sporadic losses occur suddenly and infrequently, are very obvious total shutdowns, and show a large loss of time for each occurrence. Everyone panics when sporadic shutdowns occur. Maintenance staff and the manufacturers are contacted immediately. They can be solved through:

- Properly restoring and replacing equipment parts and components
- Consistent and effective Critical Cares

Equipment Analysis

Equipment conditions must be determined through examination and analysis. TPM analysis methods will determine where corrective actions and maintenance activities need to be focused.

Utilize analytical test targets, instruments, and methods:

- Running press test targets
- Lubrication monitoring and analysis of lubricants color and metal particle contamination
- Vibration monitoring and analysis

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- Thermal infrared monitoring and heat analysis
- Leak detection from oil and pressure lines
- Noise monitoring

Presses: Run press test targets to reveal if mechanical and materials attributes meet manufacturer-designed expectations.

Specifications: Verify if equipment is at manufacturer specifications for nip point pressures, settings and conditions, gripper components, etc.

Performance analysis: Increase equipment speeds till minor stoppages occur or quality becomes unsatisfactory.

If abnormal conditions are found, TPM says; ***FIX IT!***

Preventive Maintenance

Preventive maintenance is periodic maintenance, servicing, and inspection activities designed to eliminate, control, and reverse causes for:

- Equipment failures and breakdowns
- Production stoppages
- Detrimental loss of quality and optimal functions of components

Servicing includes the necessary cleaning and lubrication activities performed to equipment during planned maintenance downtime.

The aim of inspections is to uncover whether equipment and its components are operating and conform to the manufacturer's designed capabilities. If non-conformances are discovered, then corrective actions must be implemented immediately.

Equipment breakdowns include total mechanical and electrical problems and shutdowns. Production stoppages include minor interruptions and stoppages resulting from poorly maintained equipment and components exhibiting abnormal conditions.

Examples of detrimental loss of quality and optimal functions on offset presses include color variation, chronic plate dry-ups, image slurring and doubling, sheet nicking, hickeys, and spots in the printed work.

Preventive maintenance is carried out periodically based on manufacturer requirements for performing Critical Cares and maintaining necessary conditions.

- Daily
- Weekly

Make Note...

Run press test targets to reveal if mechanical and materials attributes meet manufacturer-designed expectations.

- Monthly
- Quarterly
- Annually
- All of the above

Corrective Maintenance

Quick repair is needed to bring failed equipment or components back on line as quickly as possible. The goal is to return equipment to proper conditions as soon as possible.

Replace worn and failed parts and component:

- With proper parts
- In a timely manner

Assess and revise maintenance procedures, tools, and techniques to prevent accelerated deterioration of parts and components.

Corrective maintenance requires a proactive approach:

- Efficient prioritizing of what and when corrective maintenance is performed.
- People conducting corrective maintenance must be skilled and knowledgeable in what they are doing.*
- Consultation and training from the original equipment manufacturer (OEM) may be needed.

NOTES

Maintenance Request							**Priority & Date**	**Safety**	**Immediate**	**Schedule**	**Request Number**	**Number**
Department:							**Equipment:**				**Date:**	
Work Needed:											Date needed	
											Requested	
											Approved	
											Work Satisfaction	Yes
												No
Maintenance Dept. Use Only												
Maintenance Plan:											Maint. Sup.	
											Maint. Tech 1	
											Maint. Tech 2	
											Maint. Tech 3	
Type of Work		Order/Schedule		Hour Costs		Total Costs					Hours Est.	
Safety		Materials		Mat. Costs							Hours/Tech	
Immediate		Parts		Parts Costs							Hours Total	
Scheduled		Construction		Con. Costs							Completion	

* *Note: Do not rely on subjective opinions and tribal knowledge.*

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Predictive Maintenance

Predictive maintenance predicts equipment components and parts failure and aims to replace parts and components during planned maintenance downtime. The replacement of parts "pre-failure" is conducted during planned downtime and requires skill and knowledge for measuring deterioration and detecting abnormalities

Technology Utilization and Analysis

- **Independent oil analysis**—looks for metal, particles, and contamination that would be a sign of damage or that accelerated deterioration is happening. Further investigation is required to find the root cause of the contamination.
- **Excessive equipment vibration**—indicates equipment leveling is out, the floor and foundation could be inadequate or failing, and equipment frames are deteriorating.
- **Excessive roller bearing play on presses and bindery/finishing equipment**—could be the result of improper bearing installation and lack of proper lubrication. This will result in equipment and component failure from deterioration and damage.
- **Thermal infrared measurement**—measuring and comparing equipment and component temperatures to established specifications can indicate if future failures are imminent.

Maintenance System Assessment

The maintenance system for each piece of production equipment must be assessed for completeness and operational integrity. The system assessment must objective* and based on actual manufacturer's specifications, information, and recommendations.

Make Note...

The system assessment must objective and based on manufacturer's specifications, information, and recommendations.

* *Note: Do not rely on subjective opinions and tribal knowledge.*

Maintenance System Integrity Assessment

1. Do PM activities meet factory specifications?
2. Do people understand PM tasks and activities?
3. Are PM tools and materials available?
4. How long do PM tasks/activities actually take?
5. Are PM tasks/activities performed effectively?
6. Are maintenance staff tasks and activities assigned?
7. Have you analyzed current equipment conditions/capabilities?

1. Do PM activities meet factory specifications?

Develop process and equipment lists including all of the company's processes, equipment, and instruments. The list must include all processes that exist within the graphic arts company (preproduction, prepress, press, and postpress), as well as all measurement instruments.

Preventive maintenance (PM) is a structured approach based on the manufacturer's requirements to prevent the sporadic and sudden failures that will totally shut down equipment.

The main things required for a quality preventive maintenance program include operators' and maintenance technicians' knowledge of the equipment's operating components, structured scheduling, and the discipline to adhere to standards and procedures.

PM activities checklists should be written out so that people who follow them can clearly understand them. One way to help accomplish a thorough understanding of documented procedures and checklists is to have the people who work on the processes and equipment help write them.

Difficult and misunderstood terminology within the documented checklists and procedures can be avoided when everyone is involved with procedure writing. Procedures can be in checklist form, which will enable them to be in sequential steps and to be verified as they are completed.

Key maintenance issues and frequencies, known as Critical Cares, follow.

1. Cleaning

❒ YES meets the manufacturer's requirements

❒ NO does not meet the manufacturer's requirement

2. Lubrication

❒ YES meets the manufacturer's requirements

❒ NO does not meet the manufacturer's requirement

NOTES

Make Note...

One way to establish a thorough understanding of documented procedures and checklists is by having the people who work on the processes and equipment help to write them.

NOTES

3. Parts and Component Settings

Tolerances, environmental, and materials (lubricants, cleaning chemicals and solvents)

❒ YES meets the manufacturer's requirements

❒ NO does not meet the manufacturer's requirement

Maintenance Program

❒ YES meets the manufacturer's requirements

❒ NO does not meet the manufacturer's requirement

What area needs immediate corrective action?

_____

_____

_____

_____

_____

_____

2. Do people understand PM tasks and activities?

Review of operator competency in the established PM tasks and activities should be conducted by supervisors and maintenance staff.

Typical operator PM activities include periodic effective cleaning, accurate inspection, proper lubrication, resetting and readjustment of components, and replacement of equipment filters and components that are subject to high degrees of friction and repetitive operations.

There needs to be a review of all operators' competency in the established PM tasks and activities. The review should be conducted by supervisors and maintenance staff.

All operators must be able to:

✓ Explain each PM task described in checklists

✓ Demonstrate PM tasks at or on the equipment

If necessary, effective PM training must be carried out for current and new crew members by specified existing crew members. The goal is to bring everyone involved in equipment operation up to an agreed-upon level of efficiency and competence.

Remember, a maintenance program is only as strong as its weakest link.

Operator Name:

_____

Equipment:

_____

❒ YES knows and understands manufacturer's requirements

❒ NO does not know and understand manufacturer's requirements

Areas Where Training Is Required

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

3. Are PM tools and materials available?

Tools and equipment must be correct to accurately carry out the function and be readily available for quick operator access. Tools and materials must be:

1. **Correct:** Must be the right ones to fit parts and components.
2. **Function properly:** Cannot be broken or worn out which may cause damage to parts and components or not carry out activity.
3. **Easily accessible:** Must be easily accessible at all times, retrievable in less than 30 seconds

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PM and Maintenance Tools and Materials List

PM tasks checklists

❒ YES checklists exist

❒ NO do not checklists exist

Grease

❒ YES meets the manufacturer's requirements

❒ NO does not meet the manufacturer's requirement

If no, what is needed?

_____

_____

Grease guns

❒ YES they work and meet the manufacturer's requirements

❒ NO they don't work or do not meet the manufacturer's requirement

If no, what is needed?

_____

_____

Oil

❒ YES meets the manufacturer's requirements

❒ NO does not meet the manufacturer's requirement

If no, what is needed?

_____

_____

Oil applicators

❒ YES meet the manufacturer's requirements

❒ NO do not meet the manufacturer's requirement

If no, what is needed?

_____

_____

Cleaning solvents

❒ YES meet the manufacturer's requirements

❒ NO do not meet the manufacturer's requirement

If no, what is needed?

_____

_____

Cleaning solvents applicators

Cleaning brushes

Tools

❒ YES meet the manufacturer's requirements

❒ NO do not meet the manufacturer's requirement

If no, what is needed?

_____

_____

Rags

❒ YES meet the manufacturer's requirements

❒ NO do not meet the manufacturer's requirement

If no, what is needed?

_____

_____

Transport carts

❒ YES meet requirements

❒ NO do not meet requirement

If no, what is needed?

_____

_____

Documented procedures

❒ YES meet requirements

❒ NO do not meet requirement

If no, what is needed?

_____

_____

NOTES

Make Note...

Eliminating more equipment failures and downtime will result in increasing equipment availability time.

NOTES

Extra bearings, fasteners, grease fittings supplies, etc.

❒ YES meet the manufacturer's requirements

❒ NO do not meet the manufacturer's requirement

If no, what is needed?

Equipment

❒ YES meets requirements

❒ NO does not meet requirement

PM and Maintenance Tools and Materials

❒ YES meet the manufacturer's requirements

❒ NO do not meet the manufacturer's requirement

Tools and materials requiring replacement:

4. How long do PM tasks/activities actually take?

PM activities are scheduled for a specific length of time. The amount of time to perform each PM task needs to be timed individually.

Establish the equipment PM team members for the event. Determine the responsibilities of everyone from the equipment crew to those conducting the timing of activities. Then execute the PM Kaizen event.

Record the time required to complete each PM task and activity. PM activities must be observed, timed, and then analyzed by maintenance and production departments. The goal is to determine how much value-added time (required for PM tasks) and non-value-added time (wasted) are being spent during maintenance activities.

Non-value-added PM time includes time spent searching for maintenance tools and supplies, determining who should do what, waiting on maintenance staff, and by machine operators watching but not assisting, and breaks. Record the non-value-added activities, record the amount of time wasted, and then work to eliminate it from the process.

PM and Maintenance Activities Times

❒ Capabilities study conducted to determine times for each maintenance task completed in timely manner?

❒ YES

❒ NO

If yes, the department and equipment:

_____

Maintenance Activity

❒ Daily:

_____

_____

❒ Weekly:

_____

_____

❒ Monthly:

_____

_____

❒ Quarterly:

_____

_____

NOTES

Make Note...

Determine how much value-added time and non-value-added time are being spent during maintenance activities.

NOTES

❒ Semiannual:

_____

_____

❒ Annual:

_____

_____

Maintenance Steps Activities and Time

Activity (cleaning, lubrication, inspection) Time (minutes)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____

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_____

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_____

Corrective and Preventive Actions Needed

NOTES

5. Are PM tasks/activities performed effectively?

You must determine whether each PM task is performed effectively for proper cleaning and lubrication, as well as for realistic inspection.

Equipment Failures Primary Causes

✓ Abnormal friction between moving parts from dirt, dust, and powder

✓ Excessive heat created and a lack of venting it out

Effective Cleaning

- Poor cleaning can cause faulty sensor operation, pumps to overheat, and air lines to clog.

Proper Lubrication

- Not enough lubrication will result in contaminants such as dirt, dust, sludge, and grime to remain within components. Parts and components will not operate freely, and accelerated deterioration of the equipment parts and components can occur.
- Too much lubrication will result in lubricants contaminating the equipment and product. Dust and dirt will accumulate on the excess lubricants.

Periodic audits conducted when operators carry out preventive maintenance activities.

❒ YES

❒ NO

NOTES

If yes, are maintenance activities properly carried out?

❒ YES

❒ NO

If no, what activities or actions were not properly carried out?

_____

_____

_____

_____

Measure and track lost time from equipment failures?

❒ YES

❒ NO

If yes, what metrics are tracked?

_____

_____

_____

_____

_____

_____

6. Are maintenance staff tasks and activities assigned?

The maintenance staff must look at improving equipment effectiveness the same as production does. Maintenance staff should be looking at ways to improve equipment makeready time, downtime, equipment speeds and production, uptime. Maintenance staff must look at streamlining necessary maintenance or how can maintenance activities be made easier to carry out.

Maintenance Management and Staff Review

❒ Maintain and periodically review maintenance records

❒ Plan effective overhaul maintenance

❒ Perform periodic equipment running checks

❒ Estimate parts replacement

❒ Select optimal: parts, lubricants, and materials

❒ Properly restore equipment as soon as possible

❒ Provide maintenance training for operators

❒ Continuously improve maintenance skills

What is the current state of maintenance program?

Fix-it-when-breaks system?

❒ YES

❒ NO

If yes, why?

_____

_____

_____

_____

What corrective and preventive action is required?

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

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_____

_____

_____

Proactive maintenance program?

❒ YES

❒ NO

If no, why not?

_____

_____

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If yes, what corrective and preventive actions are needed to improve it?

7. Have you analyzed current equipment conditions/capabilities?

Equipment must be evaluated to determine if its current state meets manufacturer-designed specifications and capabilities.

To help determine where initial corrective maintenance needs to be targeted, there must be realistic equipment evaluations performed to verify whether equipment attributes are satisfactory. Refer to OEM manuals and manufacturers for information concerning the equipment's original specifications and performance capabilities.

TPM analysis methods include utilizing analytical test methods:

- Test targets, such as certified test targets and forms
- Instrument measurements to determine if equipment is properly leveled
- Vibration analysis to determine if support and stabilizing components characteristics are within specifications
- Infrared heat measurements to reveal if abnormal heat conditions exist for motors, electrical circuits/components, press rollers, etc.
- Increasing equipment speeds until minor stoppages occur or quality becomes unsatisfactory

Then fix it!

Equipment Analysis Performed

❒ YES

❒ NO

Department and Equipment Tested and Analyzed

_____

Test(s) Conducted

_____

_____

_____

_____

Analysis Results

Equipment within manufacturer specifications

❒ YES

❒ NO

If no, what corrective action is needed?

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Autonomous Maintenance

Autonomous maintenance requires operator teams to perform effective preventive maintenance and Critical Cares consistently with little or no supervision. Preventive maintenance cleaning, lubrication, and inspection activities performed by equipment operators to prevent accelerated deterioration are essential. Autonomous maintenance involves the following.

- **Team members:** Equipment crews, maintenance technicians, and managers.
- **Maintenance tasks and activities:** Prevent equipment breakdowns and quickly repair deteriorated equipment.
- **Improvement tasks and activities:** Extend the equipment's life, reduce to required maintenance only.

Deterioration Prevention

- Requires operators to possess skills and knowledge for correct equipment operation:
  - ✓ Maintain necessary conditions.
  - ✓ Perform "Critical Cares."
  - ✓ Make correct adjustments.
  - ✓ Record equipment failures in maintenance log.

Deterioration Measurement

✓ Perform daily inspections of specific equipment components and conditions during startup and production.

✓ Perform specific periodic inspections during planned maintenance downtime.

Equipment Restoration

✓ Perform minor repairs on basic equipment components.

✓ Record quick and concise breakdown reports.

✓ Provide sporadic breakdown assistance to maintenance staff and manufacturer technicians.

Maintain Necessary Conditions

- Establish cleaning and lubrication standards.
  - ✓ Perform cleaning according to standard requirements that keeps equipment realistically clean and free of contamination and buildup from dirt, dust, grime.
  - ✓ Perform lubrication according to standard requirements so parts and components work freely, preventing premature wear, deterioration, and heat buildup.
- Establish equipment inspection standards.
  - ✓ Operators must check, tighten, and snug any loose equipment items, components, and mechanisms.
  - ✓ Operators must replace bolts, screws, and fasteners to prevent loose equipment items, components, and mechanisms from recurring.

Critical Cares

Critical Cares are essential maintenance activities required to prevent equipment deterioration. They include cleaning, lubrication, inspection, and operating within specifications.

Critical Cares—Cleaning

Operators need to thoroughly clean all dirt, dust, grease, and contaminants from equipment and components with proper cleaning supplies and materials.

Effective cleaning of all sections, components, and surfaces of equipment will remove dirt, dust, and contamination that cause increased friction, abrasion, reduced cooling, clogged and leaking air lines, and electrical component failures.

The following will be uncovered:

✓ Dirty CTP equipment sensors and clogged vacuum mechanism

✓ Dirty vacuum frame glass and deteriorated lines and seals

✓ Overheating dampening motors and cooling compressors

✓ Abnormal gripper bite from spray powder and paper lint buildup

✓ Bindery equipment bearing play

Implementing effective cleaning procedures and techniques can uncover hidden part and components abnormalities, but typically add little time to what is currently being taken for preventive operator maintenance.

Effective cleaning must be conducted when lubrication is being performed, and excessive lubricants must be cleaned off parts to prevent contamination of products.

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Make Note...

Implementing effective cleaning procedures and techniques can uncover hidden part and components abnormalities.

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Department and equipment

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Equipment cleaning standard within manufacturer specifications

❒ YES

❒ NO

If no, what corrective action is needed?

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Critical Cares—Lubrication

Operators must apply the correct type and proper amounts of lubricants to required equipment components at the necessary time frequency.

Proper lubrication of required equipment components is imperative or chronic and sporadic failures could occur. Neglecting lubrication will cause mechanical seizures, accelerated parts deterioration, and abnormal overheating of components.

Applying the correct type of lubricants is extremely important; newer equipment may require a different lubricant than older equipment, even if from the same manufacturer.

Less expensive lubricants may not meet the equipment manufacturer's requirements for maintaining basic conditions.

The use of necessary lubrication tools is another issue for consideration. For example, the grease guns used to apply lubrication to specific equipment must

be the right type, apply clean grease, and work properly. The wrong type of grease gun may not apply enough grease when applied by an operator or maintenance person.

The effectiveness of automatic lubrication systems is overlooked frequently, especially after a few years. During the initial equipment management development stage, consultation with the manufacturer is imperative concerning lubricants, lubrication tools, and automatic lubrication systems operation and life expectancy.

Department and equipment

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Equipment lubrication standard within manufacturer specifications

❒ YES

❒ NO

If no, what corrective action is needed?

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Critical Cares—Inspection

Operators must inspect equipment components during cleaning and lubrication to determine if they are operating properly or abnormal conditions exist.

Inspecting for proper operating mechanisms and connections parts can help eliminate major causes of equipment failures. If specific equipment components inspections are included as part of the cleaning process, hidden problems, such as loose bolts or play in gripper bars and loose pins in platemaking equipment, would be revealed. A single loose item will eventually break, possibly causing a total operational failure of the equipment. A single loose connecting part can cause sloppy operation, resulting in abnormal shaking and vibrations accelerating the deterioration of equipment.

In prepress, equipment should be inspected periodically for plate frame and CTP vacuum system leaks, loose pins, damaged or deteriorated vacuum frame seals, proper film and plate processor operation, and film and plate punch squareness.

On a press, the components that should be checked on a regular basis include plate-to-blanket squeeze, impression cylinder pressures, roller conditions and settings, fountain solution chemistry and temperature, infeed and side guide operation, delivery performance (nicking or dropping sheets), ink scumming problems on the plate, and any specific noises.

Any abnormalities discovered by equipment operators must then be recorded in maintenance and operator logs and maintenance request forms. It is then up to management and the maintenance staff to quickly develop and implement corrective actions.

Operators must inspect equipment components during the cleaning and lubrication process to determine if they are operating properly or abnormal conditions exist.

Department and equipment

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Equipment inspection standard within manufacturer specifications

❒ YES

❒ NO

If no, what corrective action is needed?

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Critical Cares—Specifications

Equipment must be operated and maintained within manufacturer's specifications and settings or abnormal performance and accelerated deterioration will result.

Maintaining the proper prepress, press, and postpress equipment component settings to manufacturer and supplier specifications will ensure the production process can attain color management industry specifications.

Quick makeready depends on the elimination of as many adjustments as possible. Accurate platemaking, true plate cylinders zero set, and effective plate mounting (both manual and semiautomated) on the press will accelerate makeready time.

The correct printing pressures include the right plate and blanket packing and recommended plate/blanket squeeze, the required impression cylinder, and stock pressure against the blanket for enough ink image transfer with minimal dot gain.

The proper ink and dampening roller settings and conditions, if maintained, will minimize roller deterioration and achieve effective ink and dampening control on press. The ink keys or slides must be working properly. Poorly operating and calibrated ink fountain mechanisms will cause delays in achieving acceptable color match and substantially extend makeready time. The goal for makeready is "first sheet good."

Maintaining necessary operating conditions relates to conditions that must be maintained for the equipment to operate at its optimally designed potential. For example, temperatures and humidity should be maintained within manufacturer's recommendations, vibration must be kept within the limits of the equipment's design, and dust and powder contamination must be prevented. The largest contributors to accelerated equipment deterioration include high and frequent temperature variations, pressroom paper dust, and spray powder contamination. If operators and maintenance staff do not perform correct equipment adjustments and maintenance, the equipment will be subject to poor conditions and greatly accelerated deterioration.

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Department and equipment

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Equipment is operated within manufacturer specifications

❒ YES

❒ NO

If no, what corrective action is needed?

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Maintenance Department

The maintenance department must become the process improvement coordinators for all maintenance tasks and activities.

Maintenance Departments Role and Scope

- Change "fix-it-when-it-breaks" maintenance mindset to proactive productive maintenance program.
- Improve equipment maintainability by continually learning industry best maintenance practices and techniques.
- Assist operators in autonomous maintenance by observing and assessing the current maintenance activities performed by operators. Then conduct training to establish a basic skills and knowledge benchmark for operators. Provide maintenance training to operators for effective and consistent critical cares: cleaning, lubrication, and inspection.
- Establish maintenance standards.
- Understand and scan gauges and meters readout information.
- Perform "Critical Cares" requirements.
  - ✓ Proper cleaning activities
  - ✓ Effective lubrication; the proper lubricants and lubrication activities
  - ✓ Inspection of equipment conditions by operators
    - Startup checks for abnormalities including pump noise and gauge readouts (component speeds and temperatures).
    - Running checks for abnormalities including pump noise, component vibration, and gauge readouts (component speeds variation and temperatures).
  - ✓ Maintain equipment specifications according to manufacturer specifications and best industry practices.
- Keep maintenance records evaluate results/effectiveness of maintenance program. Track equipment downtime causes to determine where process improvements are needed.
- Optimal tools and materials:
  - ✓ Parts must meet manufacturer specifications for size, makeup, fit, and life cycle.
  - ✓ Lubricants must be correct to keep parts and components working freely and prevent accelerated deterioration.
  - ✓ Tools and materials, such as filters and wrenches, must fit properly and keep contaminants from reaching components.

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- Continuously improve maintenance program by networking with manufacturers and other printers for new and improved best practices.

Keys to TPM Effectiveness

There are key issues that must be remembered to establish effective autonomous maintenance:

- Management must lead, champion, and drive TPM.
- Training and education must be provided to everyone. The training must include:
  - ✓ Lectures from qualified personnel and readings from factory manuals must be easily understood. Verification testing must be included to determine training effectiveness with everyone.
  - ✓ Hands-on training activities will provide the "how" and reinforce what operators learned from lectures and readings. Operators must be able to demonstrate they can actually perform the maintenance activity.
  - ✓ Standard operating procedures (SOPs) and checklists must be established to ensure the maintenance activities are conducted in the right sequences and frequencies. Adhering to standard operating procedures will further reinforce training and education.
- Inter-department cooperation between production departments and maintenance staff must be cooperative and include effective communications.
- Team activities are essential for the success of autonomous maintenance.
- Standards for cleaning, lubrication, and inspection must be established by the maintenance department/staff and adhered to by everyone.

Note: *If you lack of a maintenance department, the equipment manufacturers should be relied on for training and consultation.*

Make Note...

The best way to achieve Pit Stop Maintenance efficiency is to bring people together in a team problem-solving atmosphere.

PIT STOP MAINTENANCE

The goal of Pit Stop Maintenance is to reduce, daily, weekly, monthly, quarterly, semiannual, and annual maintenance time while improving its effectiveness. Optimize maintenance effectiveness by performing necessary Critical Cares effectively and efficiently.

Planned maintenance should be treated like equipment setup/makeready and running production: it must be optimized! The best way to achieve Pit Stop Maintenance efficiency is to bring people together in a team problem-solving atmosphere. The primary tool for this is the ***Kaizen Blitz*** event. *Kaizen* is Japanese and means to change, make good, continuous improvement.

Kaizen Events

Kaizen events are extremely intense incremental improvement initiatives. Kaizen events create a sense of urgency and energize improvement by focusing the process people on solving the problems.

To begin with, Kaizen events require a written purpose and scope.

Purpose

- What process is the event targeting?
- What issue is the event meant to overcome or improve on: downtime, changeover time, cycle time, waste, spoilage, etc.?

The Scope

- What are the dates and what is the timeline in days over which the Kaizen event is scheduled to take place?
- Determine and schedule availability of resources, including people, time, equipment, and supplies.

Safety

- It must be noted that any process improvement ideas, practices, techniques, and procedures must be safe and not put anyone at risk of personal injury. Any practices to the contrary must be avoided.

Teams

- Kaizen team membership must include people from the plant:
  - ✓ Equipment operators and crew members
  - ✓ Management and supervision (champion)
  - ✓ Maintenance management and technicians
- Team rules state members must...
  - ✓ Have equal status
  - ✓ Respect each other
  - ✓ Listen to input

NOTES

Make Note...

Kaizen events create a sense of urgency and energize improvement by focusing the process people on solving the problems.

NOTES

✓ Keep an open mind

✓ Reach consensus when making decisions

✓ Take responsibility and accountability

✓ Get things done

✓ Champion and drive change

Project/Event Charter

Champion Name:

Project/Event Name:

Department and Equipment:

Current State:

Project/Event Description:

Value Driver:

❒ Safety
❒ Productivity Improvement
❒ Product Quality
❒ Customer Satisfaction

Start Date: _____ Projected End Date: _____

Scope:

Approach:

Key Process Resources and Issues:

Future State Goals:

Performance Metrics:

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Project/Event Charter

EXAMPLE

Champion Name:

Chris Sigma

Project/Event Name:

Pit Stop Maintenance

Department and Equipment:

Bindery/Finishing Collator Stitcher #2

Current State:

Downtime is 24%, breakdowns account for 62% of the downtime

Planned maintenance accounts for 9% of the downtime

Project/Event Description:

Kaizen event to achieve effective and efficient maintenance on Collator Stitcher #2

Value Driver:

- ☑ Safety
- ☑ Productivity Improvement
- ☐ Product Quality
- ☐ Customer Satisfaction

Start Date: 01-03-12

Projected End Date: 01-12-12

Scope:

Utilize team problem solving

Approach:

Team to implement Kaizen, 5S, visual management, standard work methods

Key Process Resources and Issues:

Overcome skepticism

Get proper maintenance, 5S tools, and supplies

Get needed corrective maintenance done

Future State Goals:

Reduce breakdowns by 35%

Reduce planned PM time by 50%

Performance Metrics:

Scheduled downtime

Unscheduled downtime

Team members' active participation and decisions will be based on team input, analysis, consensus, and "Sustain the Gains." To ensure Kaizen event success, the team needs to be provided with an environment and tools that are conducive to getting things done effectively and efficiently.

Kaizen tools and equipment needed:

- ❒ Team meeting room and logistics
- ❒ Flip charts (with sticky back or masking tape for wall mounting)
- ❒ Markers (black, red, green, blue)
- ❒ Post-it Notes-style pads (multiple bright colors)
- ❒ Digital camera (for before-and-after pictures)
- ❒ Stopwatches
- ❒ Labeler with 1/2-in. tape cassettes (black-and-white)
- ❒ Cleaning materials
- ❒ Floor marking: white floor marking tape and paint for floor location identification
- ❒ Red tags
- ❒ Dumpster and contractor-strength garbage bags
- ❒ Machine locations identified by team during the event for point-of-use storage
  - ✓ Metric and standard tool sets (new)
  - ✓ Drawer and trays sets, color coded (trays for supplies)
  - ✓ Shadow boards (peg boards), peg board holders specific for various tools
  - ✓ Bulletin board for posting MR/PM procedures and 5S standards
  - ✓ Other:

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Kaizen Blitz Event Steps

1. The Current State Maintenance Process

The Pit-Stop Starting Point

Kaizen events must have a starting point. That starting point is the current state of the process from the standpoint of who, what, and how the process accomplishes its objective. To help determine what is actually happening the team needs a graphic representation of the process steps. The team must create a current state process map. The map needs to include the individual tasks, activities, and times using multi-color Post-it Notes. Kaizen team members together review and confirm the current maintenance tasks and activities. Separate process maps are required for daily, weekly, monthly, quarterly, and annual maintenance tasks and activities.

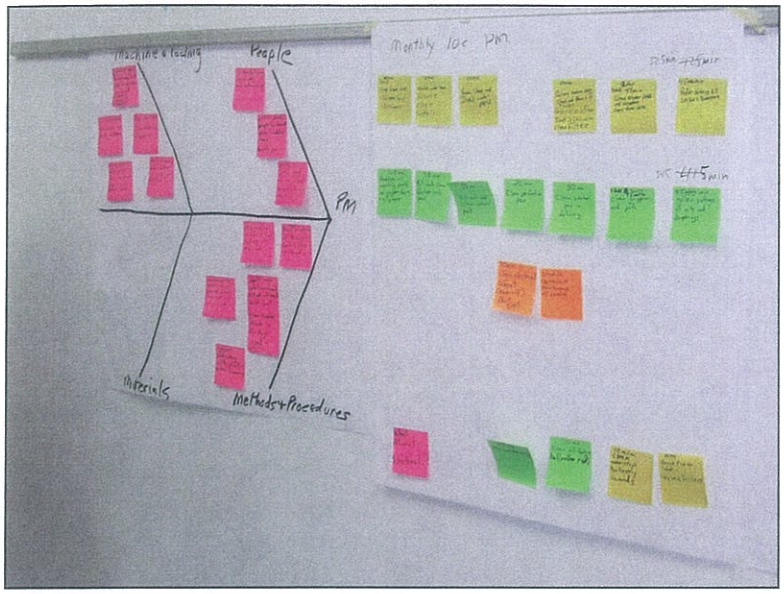
The champion must facilitate the team with development of the current state process and map. The champion/facilitator needs to ask each process person what they do to complete each process step and how long, in minutes, they think it takes for them to complete the task. The team members must be the ones to record the activities and times on the Post-it Notes, and the facilitator places them on the eraser board or flip charts.

Facilitating creating current state maintenance process map includes:

- Each person involved in maintenance tasks and activities on the equipment or process must be assigned to record their maintenance tasks using different-colored Post-it Notes to help differentiate each person involved.
- Each maintenance task and activity must be recorded by the Kaizen team, describing the maintenance activity and how many minutes they think it takes to complete each task. The champion will place each Post-it Note on the board or flip chart, building the process from left to right.

  Note: equipment shutdown and cleanup time must be recorded and included in the current state process map.
- Record and post any chronic problems and maintenance issues that occur on a separate fishbone diagram: people, machine, materials and information, methods, measurement, and environment. This is a parking lot for the planning and implementation of corrective and preventive actions.
- The champion adds up the times recorded for each person participating and writes the total times at the right side of the current state map for each person.
- The champion and team review the first phase of the current state process.

Process mapping needs to be carried out for each required maintenance segment including daily, weekly, monthly, quarterly, semiannually, and annually for the equipment or process the team is focused on.



2. Current State Confirmation

The Kaizen maintenance team must confirm the current state process they have documented, which may not be the real current state. The team must agree by consensus on what the current state really is.

- Team investigation of the current state should include making and recording personal observations and interviews with other operators during the actual maintenance process.
- During personal observations, spaghetti maps should be drawn to determine the distance operators are walking to retrieve tools and equipment, going to different locations on the equipment or process.
- Current maintenance documentation such as checklists, work instructions, and memos must be examined.

Are the maintenance documentation clear, concise, and complete?

❒ YES

❒ NO

If no, take notes and record why.

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- The team also needs to perform analysis of previously videotaped daily, weekly and monthly maintenance activities.
- The analysis is to compare and validate the current state process map developed by the team to the personal observations and interviews and the video taped maintenance activities.

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Are there differences between the video and the current state process map that was created and agreed upon by the team?

❒ YES

❒ NO

If yes, take notes and record the differences.

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Are there differences between the various shifts operating the equipment or process?

❒ YES

❒ NO

If yes, take notes and record the differences.

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The team needs to record notes.

- An agreed-upon current state process maintenance map will then be developed and established based on a consensus from the team.

3. Create Future State Process

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The Kaizen team now must create a future state or optimized Pit Stop Maintenance process map through team brainstorming. The team must develop objective actions to the following questions for each step of the maintenance process.

Ask the following questions during analysis:

- "Why do it like that?"

  Ask why five times, and look for the root causes.

- Can maintenance tasks be carried out during external time or when machine is in running operation?

To achieve a future state Pit Stop Maintenance process, the team champion must ask if tasks can be separated and converted from internal stopped time to external running time. Then the new internal and external tasks must be streamlined.

Separate Internal to External Tasks

Can the internal maintenance steps, which are currently being carried out when the equipment or process is stopped, be separated and converted to become external activities? In other words can the step be completed when the equipment of process is in operation mode? If so, then determine how it can be completed while equipment is in operation.

- Why must the equipment or process be stopped to carry out each maintenance task?
- How can the task be completed during an external time frame?
- Who should be doing the task externally—management, supervisors, staff, operators, or all of the above?

Streamline Internal and External Tasks

Can the maintenance tasks, whether they are done during internal or external time frames, be made easier, more simple, and quicker to do?

- For tasks that do require the equipment to be stopped, what is needed to make internal maintenance tasks easier to complete?
- Can you implement parallel operations and simultaneous tasks?
- Can more than one person be performing activities?
- Can tasks be assigned between crew and teams members?
- In terms of sequence of tasks, who's doing what and when?
- Have required times been established for each task?
- Can new techniques be developed and best practices initiated?

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- What non-value-added activities, wasted motion, and waiting can be eliminated?
- Can you utilize new or better tools, technology, and equipment?

Note: External staff, or people who do not operate equipment, should be assigned to assist operators during planned maintenance activities. At least one staff person should be a Kaizen maintenance team member.

The goal of Pit Stop Maintenance is to reduce planned maintenance time by more than 50%, as well as to reduce unscheduled equipment failures and downtime.

Facilitating the creation of the future state maintenance process and map includes.

- Each person involved in the future state maintenance tasks and activities on the equipment or process will record the new best practice maintenance tasks using different color Post-it Notes to help differentiate each person involved.
- Each future state maintenance task and activity must be recorded by the Kaizen team. On new Post-it Notes they must describe the maintenance best practices activities and how many minutes they think it takes to complete the best practices tasks. The champion will place each Post-it Note on the board or flip chart, building the process from left to right.

Chronic problems and maintenance issues must also be addressed.

During the future state map development process, chronic problems and maintenance issues recorded earlier during the current state process map must be addressed at this time. The Kaizen team must analyze fishbone diagram with problems and issues posted under people, machine, materials and information, methods, measurement, and environment. Corrective and preventive actions must be addressed, fixed, corrected, etc.

See sample future state PM map on the facing page.

4. Validate Future State Process

Once the new future state Pit Stop Maintenance processes maps have been developed and recorded, now the Kaizen team must validate them. In other words, the team must run the future state process and assess and analyze it.

- Operators are assigned to perform the future state Pit Stop Maintenance process on equipment. It is recommended that initially the Kaizen event for Pit Stop Maintenance focus on weekly and monthly maintenance activities, since they are the most frequently required.
- Each person performing the maintenance tasks and activities will have a team member assigned to them acting as a monitor through the entire process. The monitor will measure the actual times, utilizing stopwatches, for each maintenance task and activity and record the times and comments on observation sheets for each task.
- Separate observations sheets are used for each person being monitored. The observation sheet columns should include each step in the future state maintenance process (daily, weekly, monthly, etc.), the projected times agreed

Make Note...

The goal of Pit Stop Maintenance is to reduce planned maintenance time by more than 50%, as well as to reduce unscheduled equipment failures and downtime.

Web #1234 Monthly Press Crew PM 01.02.11 **Future State**

1st Pressman	**300 min** - Roller Maintenance one unit									
	#1 - 40 min Pull Rollers Out	**#2 - 25 min** Inspect Rollers	**#3 - 60 min** Clean Inside Unit	**#4 - 45 min** Replace Rollers where necessary	**#5 - 45 min** Install Rollers in Press	**#6 - 45 min** Set Roller Stripes	**#6 - 40 min** Check & Snug all Roller Bracket Bolts	**30 Min** Breaks	330 minutes 5.5 hrs	
Assistant	**300 min** - Roller Maintenance one unit									
	#1 - 40 min Pull Rollers Out	**#2 - 25 min** Inspect Rollers	**#3 - 60 min** Clean Inside Unit	**#4 - 45 min** Replace Rollers where necessary	**#5 - 45 min** Install Rollers in Press	**#6 - 45 min** Set Roller Stripes	**#6 - 40 min** Check & Snug all Roller Bracket Bolts	**30 Min** Breaks	330 minutes 5.5 hrs	
Roll Stand Operator	**240 min** – Lubricate Press									
	#1 - 75 min Lubricate Impression Cylinder & cassettes	**#2 - 15 min** Grease Roll Stand	**#3 - 5 min** Grease Main Motor	**#4 - 20 min** Grease Ink Fountains	**#5 - 5 min** Grease Pull Through	**#6 - 60 min** Grease Universal Drive	**#7 - 60 min** Drain & Clean Fountain Solution tank. Change Flo Clear Filters	**30 Min** Breaks	240 minutes 4 hrs	
1 Packer	**300 min** - Roller Maintenance one unit									
	#1 - 40 min Pull Rollers Out	**#2 - 25 min** Inspect Rollers	**#3 - 60 min** Clean Inside Unit	**#4 - 45 min** Replace Rollers where necessary	**#5 - 45 min** Install Rollers in Press	**#6 - 45 min** Set Roller Stripes	**#6 - 40 min** Check & Snug all Roller Bracket Bolts	**30 Min** Breaks	330 minutes 5.5 hrs	
2 Packer	**240 min** – Lubricate Press									
	#1 - 75 min Lubricate Impression Cylinder & cassettes	**#2 - 15 min** Grease Roll Stand	**#3 - 5 min** Grease Main Motor	**#4 - 20 min** Grease Ink Fountains	**#5 - 5 min** Grease Pull Through	**#6 - 60 min** Grease Universal Drive	**#7 - 60 min** Drain & Clean Fountain Solution tank. Change Flo Clear Filters	**30 Min** Breaks	240 minutes 4 hrs	

Process Optimization Chart

Process Steps:	Current Task Description	Time Minutes	Future State Tasks	Future State			Improvement Actions
				Internal	External	Time Minutes	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
22							
23							
24							
25							
	Total				*Total*		

upon by the Kaizen team, a column for actual recorded times, and notes and observations.

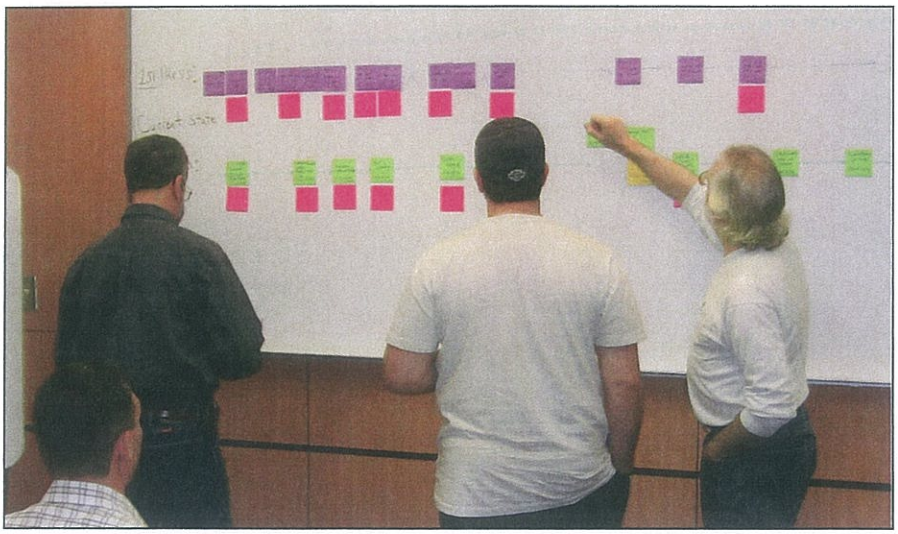
Event Validation

The event monitors will record:

- If any problems or issues occur, such as lubrication tools not working
- Any other best practices that may come out of the validation event process

The other team members will observe and take notes.

Note: Observations and notes should include tools availability, tools working or not, equipment and components conditions and malfunctions, operators' abilities to carry out tasks, distances operators had to travel, and any issues observed in the equipment or process work area.



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Observation Sheet

Process:		**Tasks and Activities:**		
Operator:		**Equipment:**		**Date:**
Step	*Description*	*Projected Time (minutes)*	*Actual Time (minutes)*	*Comments & Observations*
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
	Total minutes	*0*	*0*	

5. Kaizen Team Debrief the Event

After the future state validation phase of the event the Kaizen team must perform a debrief of the event. The team will review the future state, how long it took, if problems occurred, and general observations.

- Did the new process times process met or exceeded expectations? If not, why? What should be done next?
- Analyze the event findings.
  - ✓ Did the desired state map achieve the planned results? If not, why? What should be done next?
  - ✓ What activities took longer than projected?
  - ✓ What activities actually took even less time?
  - ✓ Were any unexpected issues encountered? If problems occurred, the team must develop corrective and preventive actions.
- Discuss lessons learned.
  - ✓ Were there any difficulties and obstacles? If so, how were they overcome?
  - ✓ How could the Kaizen event be improved before the next event?
- Update and revise the future process.
  - ✓ Through consensus agreement the team establishes the final future state maintenance processes.
  - ✓ The final process is then documented in either or both hard copy or electronic formats.

Event Debrief

Date: _____

Event Successful:

❒ YES

❒ NO

Event Focus and Goals:

_____

Event Results:

_____

Lessons Learned:

_____

_____

_____

_____

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6. Sustain the Gains

Estimate project savings in hours compared to previous times. Develop verification mechanism including tracking weekly and monthly maintenance time efficiency and cost savings. Then post maintenance time efficiency reports at the processes.

The Kaizen team must establish the methods your team will use to maintain adherence to the new maintenance standards

- Performance metrics tracking
  - ✓ The time planned maintenance activities (daily, weekly, monthly, quarterly, semiannually, and annually) actually take to complete
  - ✓ Unscheduled downtime from mechanical and electrical failures

    If metrics indicate that maintenance time is increasing more than 10% or equipment failures increase by more than 15%, then careful examinations must be conducted followed by corrective and preventive actions.
- Visual management concepts training
- Communication boards
- Before-and-after photos
- Visual standards and procedures
- Quarterly or semiannual assessments of actual maintenance activities being carried out.

Operational Excellence integration, and more methods to achieve Operational Excellence, continues with *Operational Excellence Book 5: Quick Changeover for Printers.*

OEE—Overall Equipment Effectiveness EXAMPLE		
Machine: Press	**Manufacturer**	
Downtime	40	33%
Makeready Time	20	17%
Run Time	60	50%
Total Hours	120	100%
Production/hour	7450	**62%**
Factory Speed	12000	
Performance	1440000	
Total Good Sheets	675000	
OEE	**47%**	

Machine: Press	**Manufacturer**	
Downtime	20	17%
Makeready Time	45	38%
Run Time	55	46%
Total Hours	120	100%
Production/hour	7450	**57%**
Factory Speed	13000	
Performance	1560000	
Total Good Sheets	575000	
OEE	**37%**	

OEE—Overall Equipment Effectiveness		
Machine: Press	**Manufacturer**	
Downtime		
Makeready Time		
Run Time		
Total Hours		
Production/hour		
Factory Speed		
Performance		
Total Good Sheets		
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About Printing Industries of America

Printing Industries of America, along with its affiliates, delivers products and services that enhance the growth, efficiency, and profitability of its members and the industry through advocacy, education, research, and technical information.

Printing Industries of America developed from the 1999 merger of the Graphic Arts Technical Foundation (GATF), founded in 1924, and Printing Industries of America (PIA), founded in 1887. This consolidation brought together two powerful partners: the world's largest graphic arts trade association representing an industry with more than 1 million employees and $156 billion in sales and a nonprofit, technical, scientific, and educational organization dedicated to the advancement of the graphic communications industries worldwide.

Printing Industries of America's staff of researchers, educators, and technical specialists helps members in more than 80 countries maintain their competitive edge by increasing productivity, print quality, process control, and environmental compliance and by implementing new techniques and technologies.

In addition to striving to advance a global graphic communications community through conferences, Internet symposia, workshops, consulting, technical support, laboratory services, and publications, Printing Industries of America promotes programs, services, and an environment that helps its members operate profitably.

Many of Printing Industries' members are commercial printers, allied graphic arts firms such as electronic imaging companies, equipment manufacturers, and suppliers. Its special industry groups, sections, and councils were developed to serve the unique needs of specific segments of the print and graphic communications industries and provide members with current information on their specific segment, helping them to meet the business challenges of a constantly changing environment. These groups focus on web offset printing, label printing, binding, financial executives, sales and marketing executives, and digital printing.

Printing Industries Press publishes books on nearly every aspect of the field; training curricula; audiovisuals and digital media; and research and technology reports. It also publishes *Printing Industries of America: The Magazine,* providing articles on industry technologies, trends, business management practices, economics, benchmarks, forecasts, legislative and regulatory affairs, human and industrial relations issues, sales, marketing, customer service techniques, and management resources. The magazine represents the consolidation of *GATFWorld* and *Management Portfolio,* formerly bi-monthly publications of the association.

For more information about Printing Industries of America, special industry groups, sections, products, and services, visit www.printing.org.

Printing Industries of America Affiliates

Canadian Printing Industries Association
Ottawa, Ontario
www.cpia-aci.ca

Graphic Arts Association
Trevose, PA
www.gaa1900.com

Pacific Printing and Imaging Association
Portland, OR
www.ppiassociation.org

Printing & Graphics Association MidAtlantic
Columbia, MD
www.pgama.com

Printing & Imaging/Association of MidAmerica
Dallas, TX
www.piamidam.org

Printing & Imaging Association of Georgia
Smyrna, GA
www.piag.org

Printing Association of Florida
Orlando, FL
www.flprint.org

Printing Industries Alliance
Amherst, NY
www.pialliance.org

Printing Industries of Arizona/New Mexico
Phoenix, AZ
www.piaz.org

Printing Industries Association of San Diego
San Diego, CA
www.piasd.org

Printing Industries Association Inc. of Southern California
Los Angeles, CA
www.piasc.org

Printing Industries of Ohio • N. Kentucky
Westerville, OH
www.pianko.org

Printing Industries of America Mountain States
Greenwood Village, CO
www.printincolorado.org

Printing Industries of the Gulf Coast
Houston, TX
www.pigc.com

Printing Industries of Michigan, Inc.
Southfield, MI
www.print.org

PINE
Southborough, MA
www.pine.org

Visual Media Alliance
San Francisco, CA
www.visualmediaalliance.org

Printing Industries of St. Louis, Inc.
Maryland Heights, MO
www.pistl.org

Printing Industries of Utah
West Jordan, UT
www.piofutah.com

Great Lakes Graphics Association
Pewaukee, WI
www.glga.info

Printing Industry Midwest
Roseville, MN
www.pimn.org

The Printing Industry of the Carolinas, Inc.
Charlotte, NC
www.picanet.org

Printing Industry Association of the South
Nashville, TN
www.pias.org

Publications of Interest from Printing Industries of America

- *2011 Sheetfed Productivity Benchmarks,* compiled by Printing Industries of America Economic and Market Research department.
- *Adding Value to Print,* by Manfred Breede.
- *Color Management Handbook: A Practical Guide,* by Dr. Richard M. Adams, Dr. Abhay Sharma, and Joseph Suffoletto.
- *Bindery Training Curriculum,* by Daniel G. Wilson and Printing Industries of America Staff.
- *Binding, Finishing, and Mailing: The Final Word,* by T.J. Tedesco, Dave Clossey, and Jean-Marie Hershey.
- *Ergonomics Training Program,* a collaboration by Printing Industries of America and others.
- *Guide to Troubleshooting for the Sheetfed Offset Press,* edited by Thomas M. Destree.
- *Guide to Troubleshooting for the Web Offset Press,* edited by Peter Oresick.
- *Lean Printing: Cultural Imperatives for Success,* by Kevin Cooper.
- *Lean Printing: Pathway to Success,* by Kevin Cooper, Dr. Malcolm Keif, and Ken Macro.
- *Materials Handling for the Printer,* by A. John Geis.
- *Prepress Skills Training Program,* by Joseph Marin.
- *Printing Plant Layout and Facility Design,* by A. John Geis.
- *Printing Production Management,* by Gary G. Field.
- *Process Controls Primer,* by Joseph Marin.
- *Sheetfed Offset Press Operating,* by Lloyd P. DeJidas and Thomas M. Destree.
- *Sheetfed Offset Press Training Curriculum,* by Printing Industries of America Staff.
- *Sustainability Studies in Print,* by Joe Deemer.
- *Total Production Maintenance: A Guide for the Printing Industry,* by Kenneth E. Rizzo.
- *Web Offset Press Operating,* by Daniel G. Wilson and Printing Industries Staff.
- *Web Offset Press Problem-Solving Training Program,* by Printing Industries of America Staff.
- *Web Offset Press Training Curriculum,* by Printing Industries of America Staff.
- *What You Need to Know for Safe Equipment Operation,* a collaboration by Printing Industries of America and others