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WORKING GROUP
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SUBJECT
CATEGORY _____ Papermakers _____

RELATED
METHODS _____ See "Additional Information" _____

CAUTION:

This Test Method may include safety precautions which are believed to be appropriate at the time of publication of the method. The intent of these is to alert the user of the method to safety issues related to such use. The user is responsible for determining that the safety precautions are complete and are appropriate to their use of the method, and for ensuring that suitable safety practices have not changed since publication of the method. This method may require the use, disposal, or both, of chemicals which may present serious health hazards to humans. Procedures for the handling of such substances are set forth on Safety Data Sheets which must be developed by all manufacturers and importers of potentially hazardous chemicals and maintained by all distributors of potentially hazardous chemicals. Prior to the use of this method, the user must determine whether any of the chemicals to be used or disposed of are potentially hazardous and, if so, must follow strictly the procedures specified by both the manufacturer, as well as local, state, and federal authorities for safe use and disposal of these chemicals.

Training Standard for Paper Machine Tender *(Five-year review of Standard Guideline T 1501 sg-18)*

1. Introduction

Knowledge and leadership requirements for a machine tender today have been affected by several drivers in the industry:

- Retirements of experienced operators and the need to train new operators at a faster rate. Some mills are promoting operators to the level of machine tender three times as rapidly as was traditional.
- Process control technology gives operators excellent information on "what" is happening, but does not give them equal knowledge of "why" things happen.
- The culture of training has changed. The global norm for operators is the equivalent of a one or two year certificate or associate degree. In some countries it is the equivalent of a college level degree.

- In 2002-2004, the *Agenda 2020* group, which included TAPPI, listed the creation of a Technologically Advance Workforce as a strategic goal.
- The three components of creating a technology advanced operator today are:
 - On the job (OTJ) training and experience.
 - Traditional Training (focusing on equipment operations in depth and “what happens”)
 - Technical Training (focusing on technical skills and “why things happen”)

2. Scope

The purpose of this standard is to provide guidelines for skills and knowledge needed by a paper machine tender, often referred to as the paper machine first hand. The standard will be useful as a measure of the capabilities and understanding that a person must have to successfully perform the machine tender function as part of a technologically advanced workforce. Within the limitations described, the incumbent or candidate for this function should have the capability to know, understand, and appropriately utilize all of the standard skill and knowledge functions described. Secondly, as the first standard of this type based on the information sources referenced, this particular standard may serve as a model to see if similar standards would be useful for other pulp and paper mill job classifications.

3. Safety precautions

There are no particular safety precautions to reference for this guideline, although safety is an important element of the training process (See Section 6.9).

3. Limitations

The inherent limitations related to compiling standards of this sort relate to the wide variety of types of equipment used to manufacture different paper and paperboard products. For example, many formers are used today with specific equipment designs that differ significantly from a traditional fourdrinier, e.g., twin wire formers such as gap formers, gap roll/blade formers, hybrid formers; multi-ply formers, such as vat formers, and multiple fourdrinier and multi-layered headbox formers; a wide variety of tissue formers, etc. It would not be possible to develop a single standard that would cover all of the special nuances of each of these former types. Nonetheless, there are equipment similarities and fundamentals of operation that are common to all of these equipment types, and every effort has been made to identify and note the basic skills and knowledge elements that are required. Users of these standards may wish to incorporate other items as deemed necessary to cover specific equipment operations.

4. Information sources

The basis for this standard consisted of multiple meetings with qualified machine tenders throughout all sections of the country where paper products are manufactured. A modified DACUM process was used to identify tasks that need to be monitored and controlled as well as the knowledge and skills necessary to successfully function in this job classification. Additionally, some other information has been added based on comments from other subject matter experts who reviewed the DACUM data.

5. Requirements

5.1 A paper machine tender should have the following knowledge, skills, and capabilities:

- 5.1.1 *Paper Knowledge:* Understand the paper product being produced, including its structure and properties, to understand the causes and troubleshooting of variation in product quality test results.
 - 5.1.2 *Papermaking processes:* Understand the technology of papermaking processes and the effect of processes on product quality considerations. Have knowledge of the process variables, including effects of raw materials and pulp properties that affect paper machine performance. Have knowledge of the machine variables that automatic process control systems change (or machine tenders must manually change) when one grade is transitioned to the next.
 - 5.1.3 *Equipment and systems operation:* Describe the equipment and systems used in the papermaking process and how to start, stop, operate/utilize, and monitor the equipment.
 - 5.1.4 *Machine clothing:* Describe the machine clothing and clothing operation systems used in the papermaking process. Install machine clothing.
 - 5.1.5 *Process control equipment:* Describe and be able to use the equipment used to control the papermaking process, as well as product quality.
 - 5.1.6 *Process control tasks:* Start, stop, and use associated monitoring and control equipment.
 - 5.1.7 *Academic knowledge and skills:* Have knowledge of and be able to use practical math, chemical technology, and computer skills required in paper making.
 - 5.1.8 *Troubleshooting knowledge and skills:* Be able to identify quality and runnability problems, i.e. “troubleshoot” problem areas.
 - 5.1.9 *Preventive/predictive maintenance:* Define equipment maintenance requirements, and assist the Maintenance Department in repair, preventive and predictive maintenance.
 - 5.1.10 *Safety and safe work practices:* Have a thorough, practical knowledge of safety issues and procedures.
- 5.2 As much as possible, all of the paper making processes and related procedures are presented in a sequential, logical process flow.

6. Requirements for training

6.1 *Paper Product Knowledge: Product Properties and Quality*

- 6.1.1 Define paper and board structural properties, e.g. basis weight, density, bulk, formation, moisture content, caliper, fiber orientation, MD, CD, and Z profiles.
- 6.1.2 Define mechanical and strength properties, e.g. tensile, elastic modulus (extensional stiffness), stretch, TEA, ring crush, short span compression, stiffness, (where applicable, softness and others).
- 6.1.3 Define surface properties, e.g. roughness, pick strength, abrasion resistance, etc.
- 6.1.4 Define optical properties, e.g. brightness, opacity, gloss, color.
- 6.1.5 Define permeability to fluids, e.g. sizing degree, oil resistance, water absorbency, air resistance, etc.
- 6.1.6 Describe paper defects, e.g. curl, sort/hard edges, baggy edges, cockles, holes, dirt, pin holes, shives, etc.

6.2 *Papermaking process technology*

6.2.1 *Stock Preparation*

- 6.2.1.1 Be able to describe the characteristics of hardwood, softwood, and broke and relate to paper machine furnish (recipe) requirements as a function of species, freeness, fiber length, consistency, cleanliness, etc.
- 6.2.1.2 Be able to describe the characteristics of any recycled fiber used in the furnish, with respect to category of waste paper used, fiber types, outthrows, prohibitives, ash, freeness, contaminants (stickies), color, etc.
- 6.2.1.3 Describe the functional components of the stock preparation system: pulping (repulping) equipment for wet/dry lap, refining equipment, wet-end additive addition systems, and blending/metering stock equipment.
- 6.2.1.4 Explain the pulp cleaning system and its effect on runnability and sheet properties.
- 6.2.1.5 Understand what happens in a refiner and the effects of refining on fibers, paper machine process, and product properties.
- 6.2.1.6 Knowledge of the variables that affect stock prep refining. Define high and low intensity refining how each is achieved with refining tackle, how each is measured and controlled to optimize refining.

6.2.2 *Approach system*

- 6.2.2.1 Describe how basis weight is controlled, and the roles of the stuff box (if present), thick stock pump, and basis weight valve.
- 6.2.2.2 Describe the short white water loop, and how thick stock is diluted to the headbox consistency.
- 6.2.2.3 Describe the effects of and removal of air (if performed) from the furnish.

- 6.2.2.4 Describe the centrifugal cleaning system and functions of the primary, secondary, tertiary, etc. cleaners. Describe what happens in the cleaner.
- 6.2.2.5 Describe the function of and what happens in the headbox screen.
- 6.2.2.6 Describe the fan pump(s) and what they control.

6.2.3 *Headbox operations*

- 6.2.3.1 Describe the functions of the tapered header /flow spreader, and how it is controlled. Describe the purposes of the tube bank in the header.
- 6.2.3.2 Describe the two main types of headboxes (air cushioned and hydraulic) and how they operate differently to achieve uniform flow and good formation.
- 6.2.3.3 Knowledge of headbox internal components, variables, and operations that affect uniform basis weight profiles (MD & CD) and formation.
- 6.2.3.4 How do slices achieve uniform CD basis weight profile, and what causes misalignment of MD fiber orientation. Describe how dilution profiling operates in hydraulic headboxes.

6.2.4 *Paper forming and consolidation*

- 6.2.4.1 Explain jet/wire ratio, and its effects on fiber orientation and sheet formation, and how it is controlled. What are the effects on sheet paper characteristics such as tensile, tear, TEA, ring crush, STIFI etc.
- 6.2.4.2 Describe furnish factors (fiber types, refining, additives) that affect drainage.
- 6.2.4.3 Identify the fundamentals of how drainage foils on fourdriniers operate to control both drainage and formation.
- 6.2.4.4 Describe several methods that generate micro-turbulence on the table of a fourdrinier. Describe the concepts of micro-turbulence scale and intensity.
- 6.2.4.5 Discuss the roles of water incompressibility, kinetic energy, and centrifugal force operate to dewater and form the sheet in a gap former.
- 6.2.4.6 Describe how doctor blades operate to improve formation on gap formers.
- 6.2.4.7 Define filler/fines retention (first pass retention) and how it is measured.
- 6.2.4.8 Describe the broke system, and the importance/effect of broke on the furnish, wet end operations, and sheet properties. Describe what happens when the % broke gets too high or low.
- 6.2.4.9 Describe the white water long loop, and the save all system clarification of white water and recovery of fines and additives. Describe what happens if the save all system goes down for any reason.
- 6.2.4.10 Describe the cleaning systems (mechanical and chemical showering) used in the paper machine wet end and press section and their effects on sheet properties and machine runnability.
- 6.2.4.11 Outline and summarize the overall correlations between paper machine wet-end

variables and sheet/paper structure and properties (using as one option, a fishbone diagram to help organize the variables).

6.2.5 *Pressing*

- 6.2.5.1 Describe the role of the press section, its components and their functions.
- 6.2.5.2 Explain the theory of pressing (4 phases). Have knowledge of what happens in the nip.
- 6.2.5.3 Interpret hydraulic pressure in the press section and its effect on pressing and runnability.
- 6.2.5.4 Define nip impulse vs. dwell time effects in the press section.
- 6.2.5.5 Identify the variables affecting pressing.
- 6.2.5.6 Identify press configurations (roll and shoe) and their various applications.
- 6.2.5.7 Describe the effect of pressing on sheet structure and properties.
- 6.2.5.8 Describe the cleaning system components (mechanical and chemical showering) used in the paper machine press section and their effects on felt performance, sheet properties, and machine runnability.

6.2.6 *Drying*

- 6.2.6.1 Describe where water is held in the sheet as it leaves the press section and enters the dryers.
- 6.2.6.2 Describe the different zones of drying (warm up, constant rate, falling rate).
- 6.2.6.3 Describe the two main effects of drying on paper structure and properties.
- 6.2.6.4 Describe the differences between saturated steam and superheated steam.
- 6.2.6.5 Describe the steam properties used in each section of the dryers.
- 6.2.6.6 Describe how the steam distribution system works in the mill to supply dryer steam.
- 6.2.6.7 Describe condensate removal systems.
- 6.2.6.8 Describe pocket ventilation systems, how they work, and how they are properly controlled.
- 6.2.6.9 Describe how removal of water in the dryers increases sheet strength (bonding).
- 6.2.6.10 Describe the effects of sheet shrinkage on sheet properties.
- 6.2.6.11 Describe the purpose of machine draws and felt tension & their effects on paper performance.

6.2.7 *Calendering*

- 6.2.7.1 Describe all of the components of the calender, and what is the purpose and effects of calendering.
- 6.2.7.2 Knowledge of the variables (paper, calender rolls, operating) that influence the results.

6.2.7.3 Knowledge of how calendering is monitored and controlled.

6.2.8 *Winding*

6.2.8.1 Knowledge of winder variables (tension/nip load/torque, etc.) that affect roll quality and sheet properties (bulk, etc.)

6.2.8.2 Knowledge of common roll defects (damage, core, edge, slitting, wrinkles, etc.) and which defects are primarily due to winder operations and/or paper machine operations.

6.2.9 *Size Press*

6.2.9.1 Describe the role of sizing and surface treatments, e.g. coating application(s).

6.2.9.2 Understand size press variables that affect size press “pick up” furnish variations (pulp, refining, recycle, broke, etc.); starch variations (starch type, solids, viscosity, temperature, etc.), size press loading, roll cover applications, entering moisture content, variations in moisture content, etc.); and adjustments to meet quality requirements on grades produced.

6.3 *Equipment and systems operation*

6.3.1 Describe and utilize the fiber stock feeding and blending system components, e.g., mix stock chest tank, machine chest tank, stock proportioning system, etc.

6.3.2 Describe the significance of the refining plate designs used in your mill.

6.3.3 Describe and operate the machine approach system components – basis weight valve, fan pump, cleaners, screens, and tapered header/manifold.

6.3.4 Describe and operate the wet end chemical additive system.

6.3.5 Describe and operate the components in the deaeration/defoamer system.

6.3.6 Describe and operate the machine white water system, including both the machine short and long circulation loops, as well as fiber recovery (saveall) equipment.

6.3.7 Describe and operate the stock prep refiner(s) on the pulp blend to the paper machine.

6.3.8 Describe and operate the machine headbox.

6.3.9 Describe and operate the appropriate machine former, e.g. fourdrinier, gap, hybrid, multiply, or tissue formers.

6.3.10 Describe and utilize dewatering/drainage equipment including hydrofoils and low and high vacuum systems (if applicable).

6.3.11 Utilize the forming area high pressure water shower system for start-up, during normal operations, and during shut-down situations.

6.3.12 Describe and operate pulpers in the machine system, e.g. couch and press pulpers.

6.3.13 Describe and utilize the mechanical roll cleaning systems in both the wet end and press sections.

6.3.14 Utilize the wet end chemical cleaning system.

6.3.15 Utilize, relative to the press section, roll crown as well as variable crown rolls, their

components and functions.

- 6.3.16 Describe and utilize speed control systems, including draw control.
- 6.3.17 Describe and utilize the lube hydraulic system for rolls.
- 6.3.18 Describe and utilize the high-pressure hydraulic systems used in the forming and pressing sections.
- 6.3.19 Utilize the sheet-threading system.
- 6.3.20 Start/stop pumps and tank agitators in approach system.
- 6.3.21 Start/stop all low and high intensity refiners.
- 6.3.22 Start/stop flow of stock to paper machine, i.e., open-close basis weight valve, start/stop fan pump, cleaners, and screens.
- 6.3.23 Start/stop head box mechanical and support systems.
- 6.3.24 Start/stop white water system.
- 6.3.25 Start/stop and adjust lube shower system.
- 6.3.26 Start/stop high and low pressure showers.
- 6.3.27 Start/stop and adjust vacuum box system.
- 6.3.28 Start/stop and adjust fabric showers.
- 6.3.29 Start/stop and adjust trim squirts.
- 6.3.30 Stop/start, monitor, and adjust pulpers and broke system components.
- 6.3.31 Monitor and adjust sheet transfer and draw controls.
- 6.3.32 Start/stop and adjust tail threading system.
- 6.3.33 Monitor and adjust pick-up roll operation.
- 6.3.34 Monitor and adjust sheet draw into press section.
- 6.3.35 Install, as appropriate, press felt clothing.
- 6.3.36 Start/stop press section.
- 6.3.37 Monitor positions of and adjust web guides.
- 6.3.38 Monitor and adjust press section roll loading.
- 6.3.39 Monitor and adjust press section roll variable crowns.
- 6.3.40 Start/stop and adjust press section (Uhle box) vacuums.
- 6.3.41 Monitor and adjust doctor blades on press rolls.

6.4 *Machine clothing systems*

- 6.4.1 Define and describe forming fabric installation procedures.
- 6.4.2 Monitor and adjust felt tension through tension rolls.
- 6.4.3 Utilize proper inspection protocols to ensure forming fabric performance.
- 6.4.4 Describe and properly utilize the forming fabric tension control system.
- 6.4.5 Describe and properly utilize the forming fabric guides.
- 6.4.6 Describe and utilize the forming wire squirts.
- 6.4.7 Describe press clothing installation procedures.

- 6.4.8 Utilize clothing conditioning equipment.
- 6.4.9 Describe and utilize steam box equipment in the press section.
- 6.4.10 Utilize the press, felt guide system.
- 6.4.11 Describe and utilize lubrication shower water systems.
- 6.4.12 Describe and utilize wire and press clothing change systems.
- 6.4.13 Install, as appropriate, forming fabric(s).
- 6.4.14 Start/stop wire(s)/forming section.
- 6.4.15 Monitor and adjust guide rolls.
- 6.5 *Process control equipment*
 - 6.5.1 Describe and utilize the machine direct digital control (DDC) or the distributed control system (DCS).
 - 6.5.2 Utilize auxiliary control equipment, e.g., programmable logic controllers of quality control systems, etc.
- 6.6 *Process control tasks*
 - 6.6.1 Start/stop and utilize the machine DDC or DCS system including both informational and closed loop controls.
 - 6.6.2 Start/stop and utilize auxiliary control equipment.
 - 6.6.3 Start/stop the web break detector system.
 - 6.6.4 Monitor and adjust stock consistency and flows to refiners.
 - 6.6.5 Monitor and adjust stock consistency and flows into and from mix and machine chests.
 - 6.6.6 Monitor and adjust flows of wet end additives.
 - 6.6.7 Monitor and adjust approach system parameters, e.g. stock temperature, consistency, etc.
 - 6.6.8 Monitor and adjust white water flows.
 - 6.6.9 Monitor and adjust white water level(s) and flows.
 - 6.6.10 Monitor and adjust white water temperature.
 - 6.6.11 Monitor and adjust headbox variables as appropriate, e.g. total head, liquid level, pressure, etc.
 - 6.6.12 Monitor and adjust rush/drag (jet-to-wire ratio).
 - 6.6.13 Monitor and adjust CD basis weight profile.
 - 6.6.14 Monitor and adjust sheet moisture profile.
- 6.7 *Academic knowledge and skills*
 - 6.7.1 *Chemistry*
 - 6.7.1.1 Apply broad chemical principles applicable to papermaking, e.g. pH, water hardness, and the like which are useful in interpreting lab tests in order to maintain quality, safety, and respect environmental concerns.

- 6.7.1.2 Describe paper sizing and the impact on paper quality and runnability.
- 6.7.1.3 Define the role of fungicides and bactericides and their impact on paper quality and runnability.
- 6.7.1.4 Define the role of strength agents and their impact on paper quality and runnability.
- 6.7.1.5 Define the role of anti-stick and anti-lint agents and their impact on paper quality.
- 6.7.1.6 Define the role of retention chemistry (polymers, coagulants, dispersants, etc.) in the papermaking process.
- 6.7.1.7 Define the role of defoamers in the papermaking process.
- 6.7.1.8 Define the role of chemical agents in clothing conditioning.
- 6.7.1.9 Define the role of filler agents in the papermaking process.
- 6.7.1.10 Define the role of and use of chemical agents in cleaning paper machines during a shutdown.
- 6.7.1.11 Apply proper entry points for chemical additives on the paper machine.
- 6.7.1.12 Describe and use pitch control chemicals/materials.
- 6.7.1.13 Monitor and adjust, as appropriate, quantities of chemical additives such as retention aids, defoamers, sizing agents, and the like.
- 6.7.1.14 Monitor and adjust, as appropriate, quantities of clothing conditioning chemicals.

6.7.2 *Math*

- 6.7.2.1 Define and work with positive and negative numbers.
- 6.7.2.2 Convert decimals to fractions and fractions to decimals.
- 6.7.2.3 Work with ratios and percentages.
- 6.7.2.4 Interpret graphics such as bar chart and pie charts.
- 6.7.2.5 Define the concept of standard deviation.
- 6.7.2.6 Be able to prepare and interpret run and control charts.
- 6.7.2.7 Be able to use a simple calculator.

6.7.3 *Computer literacy*

- 6.7.3.1 Navigate on the internet/intranet to locate SOP's and ISO specifications and the like.
- 6.7.3.2 Define and describe automatic, manual, cascade, feedforward, and remote control operation and how it is performed.
- 6.7.3.3 Explain basic control loops.
- 6.7.3.4 Navigate in the DCS/command console and locate appropriate screens and control loops for sheet formation, sheet pressing, sheet drying and other process loops.
- 6.7.3.5 Navigate and use the mill Product Information System.

6.8 *Troubleshooting knowledge and skills*

- 6.8.1 Be able to use basic troubleshooting skills, i.e., identify, solve, and eliminate runnability and quality problems.

- 6.8.2 Have the ability to recognize problems and to assess the problem severity and seriousness in regard to impact on operations, production, customer satisfaction, safety, and the environment.
- 6.8.3 Be able to distinguish between problems that are normally corrected through known process adjustments or equipment repair and problems that will require the application of a structured problem solving process.
- 6.8.4 Collaborate in a team effort with process engineering to minimize the risk of exacerbating or adding additional problems to resolve runnability or quality issues as well as to assure that problem “fixes” are such that problem re-occurrence will be minimized or eliminated.
- 6.8.5 Verify the proper functioning of equipment during multiple “walk around,” physical inspections each shift/tour.
- 6.8.6 Identify runnability and sheet quality problems that may occur at all of the major steps in the wet-end papermaking process, i.e. stock preparation, sheet forming, and press section.
- 6.8.7 Identify runnability and quality problems that may emanate from wet-end ancillary equipment, e.g. white water system, vacuum system, hydraulic system, ventilation system, guiding system, etc.
- 6.9 *Preventive maintenance*
 - 6.9.1 Collaborate in a team effort with the Maintenance Department to plan scheduled shutdowns for stock preparation and paper machine wet-end jobs.
 - 6.9.2 Explain and execute proper shutdown and communication procedures involving emergency and/or unscheduled shutdowns.
 - 6.9.3 Assist Maintenance Department personnel, as appropriate, during machine shutdowns.
 - 6.9.4 Recognize the various types of pumps and their key parts.
 - 6.9.5 Describe the function, use of, causes of failure and maintenance of seals, valves, bearings, and steam joints/traps.
 - 6.9.6 Check for wear on wet-end elements such as foil blades, flat box covers, wire return rolls, doctor shower nozzles, Uhle box covers and the like during maintenance shutdowns.
 - 6.9.7 Prepare former and press sections for wire and fabric changes.
 - 6.9.8 Assist in changing wires and felts.
 - 6.9.9 Clean fabrics and forming section during shutdowns.
 - 6.9.10 During routine “walk around” tours, identify and record possible maintenance issues based on unique sounds, vibrations, pockets of fluids, spills, and the like that are different from standard operations.
 - 6.9.11 Using the DCS system, recognize equipment alarms that could signal maintenance needs.
- 6.10 *Safety*
 - 6.10.1 Read and interpret MSDS. Describe and use confined space entry protocol.
 - 6.10.2 Safely handle and use hand and power tools.

- 6.10.3 Define hearing protection protocol for various decibel/time exposures.
- 6.10.4 Apply crane sling safety while lifting objects.
- 6.10.5 Use hand signals while operating or assisting with the operation of an overhead crane.
- 6.10.6 Describe emergency eye washes and shower protocols.
- 6.10.7 Describe machine guard safety requirements.
- 6.10.8 Know how to use fire extinguishers.
- 6.10.9 Follow proper ergonomic procedures when working with/lifting heavy objects.
- 6.10.10 Be able to locate and use various respirators.
- 6.10.11 Describe lock-out/tag-out protocols.
- 6.10.12 Use appropriate personal protective gear, e.g., gloves, safety shoes, glasses, etc.
- 6.10.13 Describe the safety principles that apply to driving a lift truck.
- 6.10.14 Recognize toxic gas and fire alarms and follow evacuation protocol.
- 6.10.15 Apply appropriate safety techniques for handling and use of chemicals used in the paper machine area that are potentially harmful/toxic through inhalation, skin adsorption, or ingestion.
- 6.10.16 Describe all aspects of electrical safety practices and procedures for personnel working with equipment powered by electric motor/drive systems.
- 6.10.17 Utilize goggles, hand shield, and appropriate protective clothing when exposed to arc welding or arc cutting operations.
- 6.10.18 Apply proper safety procedures when checking operation and equipment when the machine is running.
- 6.10.19 Define safety issues involving nip roll points.
- 6.10.20 Use high pressure cleaning pumps safely.
- 6.10.21 Use air and water hoses safely.
- 6.10.22 Recognize and correct unsafe personnel behavior.

Keywords

Paper machines, Education, Personnel, Machine operation, Machine tenders, Training, Quality

Additional information

Effective date of issue: To Be Assigned

Your comments and suggestions on this procedure are earnestly requested and should be sent to the TAPPI Standards Department.

