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ABSTRACT

Designed to guide training and curriculum development to prepare machine operators for the national certification exam, this publication identifies the important knowledge required for productive performance by a plastics machine operator. Introductory material discusses the rationale for a national standard, uses of the Body of Knowledge, conducting of the job analysis, and results of the job analysis. The remainder of the publication presents the 7 major knowledge content areas: (1) basic process control with 2 subcontent areas--operations, procedures--and a relative weight of importance (RWI) of 16 percent; (2) preventive and corrective action on primary/secondary equipment with 3 subcontent areas--identifying, troubleshooting, and recording; preventive action; and corrective action--and an RWI of 12 percent; (3) handling, storage, packaging, preservation, delivery of materials with an RWI of 11 percent; (4) quality assurance with 2 subcontent areas--quality assurance concepts, inspection and testing--with an RWI of 18 percent; (5) safety with 2 subcontent areas--safety procedures, safety regulations and information--and an RWI of 21 percent; (6) tools and equipment with an RWI of 8 percent; and (7) general knowledge with 2 subcontent areas--basic knowledge, manufacturing knowledge--and an RWI of 14 percent. Each subcontent area is further subdivided into lists of procedures or steps. (YLB)

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Presents

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[redacted] *November 1997* [redacted]

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Certifying the Future in Plastics

The *Body of Knowledge and Content Framework* identifies the important knowledge required for productive performance by a plastics machine operator. It is designed to guide training and curricula development to prepare machine operator for the national certification exam.

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SPI's national program to certify plastics production workers has reached a major milestone by establishing the first national standard to identify what productive machine operators in blow molding, extrusion, injection molding or thermoforming should know. Known as the *Body of Knowledge and Content Framework* for the machine operator job level, this standard is the outcome of an extensive job analysis study of industry workers and supervisors. The *Body of Knowledge* is the blueprint on which the certification examinations will be constructed; it is expected that the *Body of Knowledge* will also be used by educators and employers to develop curricula for plastics training and education programs.

Why Establish a National Standard?

The plastics industry has been experiencing significant growth over the last several years, while also facing customer demand for higher quality products. At the same time, there has been a growing shortage of skilled production employees. Establishing a national standard makes it easier for employers and educators to identify the job-related knowledge, skills and abilities that are critical to attracting, training and retaining productive workers.

In response to a market survey performed in 1996, plastics manufacturing companies in blow molding, extrusion, injection molding and thermoforming expressed a need for a program which would certify production employees according to a national standard. More than 80 percent of survey respondents stated that they were likely to utilize this program for their employees.

The "Body of Knowledge" is the blueprint on which the certification examinations will be constructed.

How Will the *Body of Knowledge* Be Used?

The *Body of Knowledge* has several distinct functions. First, it is a benchmark against which employers and supervisors can measure an operator's level of knowledge as compared to an agreed-upon industry standard.

Second, it will be used to guide curriculum development. Educators, industry trainers and employers will be able to design training programs and curricula based on this document, confident that it indeed reflects the needed knowledge, skills and abilities to be productive.

Finally, it will be used to develop machine operator certification exams, using tasks and knowledge identified by the industry as being important. With the guidance of certification specialists, leading plastics operators and supervisors will write the exam questions based on the information in the *Body of Knowledge*. Each exam section will be weighted in accordance with the priorities identified by the job analysis.

How was the Job Analysis Conducted?

The foundation of a valid certification exam is an in-depth job analysis study. The in-depth job analysis will 1) identify the important knowledge and tasks required for productive job performance, 2) determine the similarities and differences in the work performed and knowledge required of machine operators in blow molding, extrusion, injection molding, and thermoforming, and 3) provide a basis for curriculum development and on-the-job training to help operators achieve a productive level of performance. The Chauncey Group International, a subsidiary of Educational Testing Service, Princeton, NJ, conducted the job analysis process for SPI.

The Chauncey Group reviewed industry literature and training materials, visited plants and conducted telephone interviews with machine operators, after which they compiled an initial list of knowledge and task items. A work group of operators and supervisors from each process reviewed the list, making modifications which resulted in a draft survey.

After being piloted to ten machine operators, the survey was mailed to a diverse sample of 4,489 machine operators and supervisors in 421 thermoplastics manufacturing facilities in the United States. They were asked to rate the importance of each task and knowledge item on a five-point "importance" scale. Over 2,000 participants returned the survey, a satisfactory return rate of 46.6 percent for a mail survey of its length. Seventy percent of survey respondents had worked in plastics for over four years, and 64 percent of respondents had worked in plants with fewer than 50 employees.

The "Body of Knowledge" will also be used to develop curricula for plastics training and education programs.

What Are the Results of the Job Analysis Study?

The surveys were analyzed by The Chauncey Group and their conclusions were presented to work groups of employees and supervisors representing all processes who validated the conclusions.

Key conclusions:

- Employees in each of the four thermoplastics processes indicated that most of the knowledge important to be a productive performer at the machine operator job level is similar, although there are some areas where process-specific knowledge is important.

- The seven content areas, in order of importance, are: safety; quality assurance; basic process control; general knowledge; preventive and corrective action on primary and secondary equipment; handling, storage, packaging and delivery of plastics materials; and tools and equipment.

- One national standard should be established for machine operators in the four processes, with separate versions of the exam for each process to accommodate the process-specific components.

- Responses were consistent across geographic areas.

The major knowledge content areas, subcontent areas and relative weights of importance are:

I. **Basic Process Control (16%)**
   A) Operations
   B) Procedures

II. **Preventive and Corrective Action on Primary/Secondary Equipment (12%)**
   A) Identifying, Troubleshooting, and Recording
   B) Preventive Action
   C) Corrective Action

III. **Handling, Storage, Packaging, Preservation, Delivery of Materials (11%)**

IV. **Quality Assurance (18%)**
   A) Quality Assurance Concepts
   B) Inspection and Testing

V. **Safety (21%)**
   A) Safety Procedures
   B) Safety Regulations & Information

VI. **Tools and Equipment (8%)**

VII. **General Knowledge (14%)**
   A) Basic Knowledge
   B) Manufacturing Knowledge

The job analysis supports the creation of one exam; however, SPI is creating four versions of the exam, one for each process. Machine operators who pass the exam, regardless of process, will obtain a credential which recognizes them as certified machine operators.

Where Are We Now?

The credentialing program is in the test development phase, using the *Body of Knowledge* contained in this report as its foundation. Throughout the next six months, the machine operator exam will undergo an intense review process, after which it will be pilot tested by 800 machine operators across the United States. The results of the pilot test will validate the passing score and exam content.

The exam will be available to the public in June, 1998 at computer testing centers throughout the country. Details regarding fees, locations, etc. will be provided in the *Candidate Handbook*, scheduled for publication in February, 1998.

BODY OF KNOWLEDGE & CONTENT FRAMEWORK FOR PLASTICS MACHINE OPERATOR

Basic Process Control

Knowledge of...

A. Operations

1. Machine Operations

- ❒ process flow from raw material to finished product
- ❒ pressure
- ❒ time
- ❒ heat

2. Secondary Operations

- ❒ decorating
- ❒ cutting & trimming

3. How to Operate the Machine

- ❒ computer use: menus, stations/zones, input/output
- ❒ process monitoring
- ❒ process control

4. Working Standards

- ❒ process parameter data
- ❒ master specifications

Basic Process Control... Cont'd

Knowledge of...

B. Procedures

1. Product Count Procedures

   - ❒ production reporting (yield & efficiency [cycle times]-scrap, rejects, good products)

2. Shift Change Procedures

   - ❒ communication - passing along information

3. Routine Procedures

   - ❒ for changeovers (color, resin, die, mold)
   - ❒ for end of production runs (labels, cartons, packaging, shop orders, lot change)

4. Established Machine Start-Up and Shutdown Procedures

   - ❒ work instructions, standard operating procedures, job safety analysis

Basic Process Control...Cont'd

Knowledge of...

B. Procedures...Cont'd

5. Machine Verification Setup Procedures

- ❒ setup sheets
- ❒ process parameters
- ❒ process logs

6. Standard Documentation Procedures

- ❒ operator checklist
- ❒ parameter logs
- ❒ operator instructions

7. Training Manual to Perform Your Job

- ❒ standard operating procedures
- ❒ operator training
- ❒ new employee training

Preventive & Corrective Action on Primary & Secondary Equipment

Knowledge of...

A. Identifying, Troubleshooting, and Recording

1. Proper Setup Procedures

   - ❒ work instructions
   - ❒ setup sheets
   - ❒ visual inspection (gauges, displays)

2. Identifying Equipment Problems

   - ❒ visual
   - ❒ smell
   - ❒ sound

3. How the Equipment Functions

   - ❒ what the equipment does

4. Equipment Operation

   - ❒ what it takes to make it do what it does

Preventive & Corrective Action on Primary & Secondary Equipment...Cont'd

Knowledge of...

A. Identifying, Troubleshooting, and Recording...Cont'd

5. Documentation Procedures for Equipment Problems

- ❒ maintenance requests/log book
- ❒ work orders

6. Safe Procedures to Use to Correct Equipment Problems Where it is Permissible for Machine Operator to Take Action

- ❒ notify supervisor
- ❒ notify repair person
- ❒ restart machine

7. Measures to Avoid and Reduce the Recurrence of Environmental Problems

- ❒ ear plugs - mufflers
- ❒ ventilation respirators
- ❒ proper cleanup and disposal of materials (liquid/pellets)

8. How to Document Preventive and Corrective Actions

- ❒ safety checks
- ❒ product defects
- ❒ preventive maintenance

9. Procedures to Handle and/or Document Nonstandard Conditions

- ❒ communicate process changes due to special conditions

Preventive & Corrective Action on Primary & Secondary Equipment...Cont'd

Knowledge of...

B. Preventive Action

1. Appropriate Sources of Information to Detect, Analyze and Eliminate Defects

- ❒ advisory
- ❒ troubleshooting guide and appropriate sources of information

2. Potential Causes of Nonconformity

- ❒ process and work operations affecting quality
- ❒ supplies
- ❒ audit results
- ❒ quality records

3. Steps Needed to Initiate Preventive Actions

- ❒ shutdown after power outage to prevent power surges
- ❒ maintenance requests

C. Corrective Action

1. Corrective Actions to Bring Product Up to Customer Specifications

- ❒ minor adjustments (weights, color, density)
- ❒ notify appropriate personnel

2. Resolving Internal Complaints and Customer Complaints

- ❒ corrective actions teams
- ❒ find the cause and fix it

Handling, Storage, Packaging and Delivery of Plastics Materials

Knowledge of...

1. Product/Material Identification Procedures

   - ❒ labeling
   - ❒ tagging
   - ❒ bar coding

2. Customer Packaging Specifications

   - ❒ corrugated cartons
   - ❒ poly bags
   - ❒ skid size
   - ❒ quantity

3. Scrap Handling Procedures

   - ❒ proper segregation (purging, trim scrap, contaminated material)
   - ❒ regrind

4. "Work in Process" Packaging Specifications

   - ❒ work instructions per customer (do it the same every time)
   - ❒ lot traceability

5. Staging Locations for Specific Materials in Your Area of Responsibility

   - ❒ labels
   - ❒ packaging material
   - ❒ raw materials

Quality Assurance

Knowledge of...

A. Quality Assurance Concepts

1. Quality Assurance Systems

- ❒ procedures
- ❒ quality manuals (FDA ISO)
- ❒ continuous improvement (CPK reports, cost of quality reports)

2. Customer Specifications and Product/Materials Specifications

- ❒ visual
- ❒ functional
- ❒ dimensional
- ❒ critical specifications
- ❒ spec sheet/drawing

3. How to Monitor Process to Stay in "Spec"

- ❒ process control
- ❒ basic concepts of quality control
- ❒ SPC and SQC

4. Basic Concepts of Statistical Process Control

- ❒ control limits
- ❒ averages/means
- ❒ trends
- ❒ ranges

Quality Assurance...Cont'd

Knowledge of...

A. Quality Assurance Concepts...Cont'd

5. Benefits of "Zero" Defects

- ❒ cost of quality
- ❒ do it right the first time
- ❒ customer satisfaction

B. Inspection and Testing

1. Appropriate Data and Sampling Procedures

- ❒ frequency and quantity
- ❒ recording information
- ❒ reference spec sheet/drawing

2. Inspection and Testing Procedures for Plastic Parts/Products

- ❒ frequency
- ❒ quantity
- ❒ comparison against a standard
- ❒ measurable or not

Quality Assurance...Cont'd

Knowledge of...

B. Inspection and Testing...Cont'd

3. What Defines a Defect

- ❒ meet specifications
- ❒ nonconformance
- ❒ outside the internal specifications that make it appear abnormal

4. Procedure to Handle and Document Defects During Production

- ❒ who to notify
- ❒ quarantine, hold out
- ❒ production reports

5. Inspection Equipment Usage Procedures

- ❒ proper use of types of equipment
- ❒ safe handling
- ❒ calibration
- ❒ consistency of measurement technique

6. Procedures for Nonconformances after Production (quarantine, hold out)

- ❒ what happens to nonconformances
- ❒ rework procedures

Safety

Knowledge of...

A. Safety Procedures

1. Equipment Safety Procedures and Devices for Assigned Machine Operations

   - ❒ guards, gates, emergency stops, safety pins. hydraulic safety
   - ❒ fire extinguishers

2. Hazardous Material Handling, Storage and Disposal

   - ❒ HAZMAT
   - ❒ fire cabinets
   - ❒ storage environment: temperature, ventilation
   - ❒ labeling
   - ❒ cleanup procedures

3. Plant Safety Procedures

   - ❒ dangers of working with hot plastics
   - ❒ incompatible plastic mixtures

4. "Lock-out Tag-out" Procedures

Safety...Cont'd

Knowledge of...

A. Safety Procedures...Cont'd

5. Accident Reporting and Documentation Procedures

- ❒ who to notify
- ❒ proper investigation
- ❒ near misses

6. Emergency Procedures

- ❒ evacuation plan
- ❒ first aid
- ❒ CPR
- ❒ emergency machine shut down
- ❒ firefighting
- ❒ proper notification
- ❒ cleanup of blood-borne pathogens

7. Housekeeping Procedures

- ❒ workspace cleanliness
- ❒ checklist
- ❒ proper floor markings
- ❒ clear exits, aisles, and electrical panels

Safety...Cont'd

Knowledge of...

B. Safety Regulations & Information

1. MSDS Information

- ❒ interpretation
- ❒ location (where to find it)
- ❒ hazardous communications

2. Basic Safety Techniques

- ❒ proper lifting
- ❒ awareness of environment

3. Personal Protective Equipment

- ❒ safety goggles
- ❒ gloves
- ❒ ear plugs
- ❒ proper footwear

4. Potentially Hazardous and Dangerous Conditions

- ❒ warning signs
- ❒ pinch points
- ❒ hot materials
- ❒ pressurized systems
- ❒ wet floors
- ❒ crushing

Safety...Cont'd

Knowledge of...

B. Safety Regulations & Information...Cont'd

5. Safety Regulations and Requirements

- ❒ OSHA
- ❒ EPA

6. Safety Issues for Material Handling Equipment

- ❒ fork truck certification
- ❒ moving material handling equipment

Tools and Equipment

Knowledge of...

1. Tools Used in Plastics Manufacturing

   - ❒ clippers
   - ❒ utility knives
   - ❒ checking fixtures
   - ❒ hand tools/power tools

2. Maintenance of Tools Used in Plastics Manufacturing

   - ❒ changing blades
   - ❒ proper storage

3. Equipment Used in Plastics Manufacturing

   - ❒ grinder
   - ❒ conveyors
   - ❒ blowers
   - ❒ controllers
   - ❒ die/mold temperature control (chillers, thermolators)
   - ❒ scales
   - ❒ dryers
   - ❒ material conveying systems (vacuum pumps, loaders, hoppers)

General Knowledge

Knowledge of...

A. Basic Knowledge

1. Communication Techniques (oral, written, interpersonal)

- ❒ shift-to-shift exchanges
- ❒ conveying information clearly
- ❒ proper terminology
- ❒ interpreting job-related written materials

2. Basic Math Concepts

- ❒ arithmetic
- ❒ proper units
- ❒ fraction-to-decimal

3. Mechanical Principles

- ❒ vacuum/pressure
- ❒ force
- ❒ temperature profile
- ❒ fluid flow
- ❒ heat transfer

4. Logical Problem Solving Methods and Procedures

- ❒ troubleshooting
- ❒ data collection/interpretation
- ❒ brainstorming

General Knowledge...Cont'd

Knowledge of...

B. Manufacturing Knowledge

1. Team Building and Work Group Techniques

- ❒ information sharing
- ❒ meeting participation
- ❒ team participation
- ❒ achieving consensus and compromise
- ❒ goal setting

2. Time Management Techniques

- ❒ organization
- ❒ planning

3. How to Initiate Changes for Quality Improvement

- ❒ implementing new procedures for performing tasks
- ❒ process improvements
- ❒ documenting and communicating improvement ideas

4. General Manufacturing Practices

- ❒ standards
- ❒ policies/procedures
- ❒ work instructions

5. How Defects Affect Final Product

- ❒ customer dissatisfaction

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