

# Scientific Management Techniques, Inc.

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Scientific Management Techniques, Inc.  
19 Star Drive, Suite E  
Merrimack, NH 03054  
(603) 421-0222

Dear Mr. Jones,

As we have discussed, SMT's Mechatronic Skills training program is customizable regarding length (time) and content.

The below training outline represents 64 hours of Mechatronic Skills training delivered over four weeks. We typically deliver training four days each week in two 4 hour blocks each day to accommodate your shift dynamics. The same class delivered twice daily to two different groups of employees. This outline includes Mechanical and Electrical skills training.

This document is intended as an outline of a 64 hour program (128 hours of training, 2 classes). You can choose those training units and volumes applicable to your training needs and objectives, and "plug" the volumes into this, or any, training schedule.

Please review our "Training Objectives" document for a detailed overview of the skills trained in each Unit/Volume.

This quote includes the following SMT mechatronics training volumes:

## MECHANICAL

- VOLUME 5 - BASIC MECHANICAL COMPONENTS I (14 HOURS)
- VOLUME 6 - BEARINGS AND LUBRICATION (4 HOURS)
- VOLUME 7 - BASIC MECHANICAL COMPONENTS II (6 HOURS)
- VOLUME 8 - MACHINE ADJUSTMENT FUNDAMENTALS USING THE ATM (10 HOURS)
- VOLUME 21 - MACHINE ADJUSTMENT FUNDAMENTALS USING THE PMS (14 HOURS)

## ELECTRICAL

- VOLUME 9 - ELECTRICAL COMPONENTS (16 HOURS)

## Volume 5

**BASIC MECHANICAL COMPONENTS I**

<b>Unit 1:</b>	The Basic Machines
<b>Unit 2:</b>	Shafts, Couplings, Pulleys, Belts, and Chain Drives
<b>Unit 3:</b>	Gears and Gear Ratios
<b>Unit 4:</b>	Advanced Couplings
<b>Unit 5:</b>	Basic Alignment

(Approximately 14 classroom hours)

**Basic Mechanical Components I – Volume 5, Unit 1**

## Basic Machines

1. Find the mechanical advantage of a pulley and be familiar with its common applications.
2. Find the mechanical advantage of a wheel and axle and be familiar with its common application.
3. Find the mechanical advantage of a lever and be familiar with its common applications.
4. Find the mechanical advantage of an inclined plane and be familiar with its common applications.
5. Be familiar with the common applications of a wedge,
6. Find the mechanical advantage of a screw and be familiar with its common applications.

**Basic Mechanical Components I – Volume 5, Unit 2**

## Shafts, Couplings, Pulleys, Belts, and Chain Drives

1. Be familiar with the functions of shafts, keys, and pins.
2. Be familiar with the major types of shaft couplings.
3. Be familiar with V-Belt and Pulley drive mechanisms.
4. Calculate speed and pulley size for V-Belt and Pulley drive mechanisms.
5. Be familiar with Gear Belt and Pulley drive mechanisms.
6. Calculate speed and pulley size for Gear Belt and Pulley drive mechanisms.
7. Be familiar with Chain and Sprocket drive mechanisms.
8. Calculate speed and pulley size for Chain and Sprocket drive mechanisms.

**Basic Mechanical Components I – Volume 5, Unit 3**

## Gears and Gear Ratios

1. Be familiar with the basic terminology of gearing
2. Calculate pitch diameter and number of gear teeth using Diametrical Pitch.
3. Spur gears – Calculate their speed and number of teeth.
4. Be familiar with helical and herringbone gearing.
5. Be familiar with worm gears and calculate their speed.
6. Be familiar with bevel, miter, and spiral gearing.
7. Be familiar with gear trains and calculate their speed.

**Basic Mechanical Components I – Volume 5, Unit 4****Couplings**

1. Discuss the various categories of couplings.
2. Define the types of couplings in each category.
3. Explain the advantages and disadvantages of each coupling.
4. Relate coupling type to typical applications.

**Basic Mechanical Components I – Volume 5, Unit 5****Basic Alignment**

1. Define why alignment is important.
2. Determine when alignment is required.
3. Explain the benefits of accurate alignment.
4. Define the terms used in alignment procedures.
5. Stress the importance of safety procedures.
6. Understand the typical tools used in basic shaft alignment.
7. Assess the conditions prior to alignment.
8. Define measurements that are made prior to alignment.
9. Teach the basic method of shaft alignment.
10. Suggest recording procedures for the alignment process.
11. Understand the basics of thermal growth.

**Volume 6****BEARINGS AND LUBRICATION**

<b>Unit 1:</b>	Principals of Bearing Operation, Components, Bearings
<b>Unit 2:</b>	Lubricants, Types and Functions, Lubrication System, Handling and Storage

(Approximately 4 classroom hours)

**Bearings and Lubrication – Volume 6, Unit 1****Principles of Bearing Operation, Components, Journal Bearings, Ball and Roller Bearings**

1. Be familiar with bearing technology.
2. Be familiar with the characteristics and functions of plain bearings.
3. Be familiar with the characteristics and functions of ball bearings.
4. Be familiar with the characteristics and functions of roller bearings.
5. Be familiar with the rotational forces on shafts and bearings.
6. Be familiar with the characteristics and functions of thrust bearings.
7. Be familiar with bearing lubrication.
8. Be familiar with bearing maintenance technique.

**Bearings and Lubrication – Volume 6, Unit 2**

## Principles of Friction and Lubricants

1. Be familiar with the characteristics of friction.
2. Compare the static and kinetic friction of lubricated and non-lubricated sliding elements.
3. Be familiar with the functions of lubricants.
4. Be familiar with the major types of lubricants.
5. Be familiar with the lubrication of gear mechanisms.
6. Be familiar with the lubrication of plain and anti-friction bearings.
7. Recognize the major methods of lubrication.
8. Be familiar with techniques for storing and handling lubricants.

**Volume 7****BASIC MECHANICAL COMPONENTS II**

<b>Unit 1:</b>	Lever, Cranks, Linkages, and Springs
<b>Unit 2:</b>	Types and Uses of Cams and Timing Adjustments
<b>Unit 3:</b>	Use of Elementary Timing Model in Timing Adjustments

(Approximately 6 classroom hours)

**Basic Mechanical Components II – Volume 7, Unit 1**

## Lever, Cranks, Linkages, and Springs

1. Be familiar with levers as machine elements.
2. Calculate force and distance adjustments in simple lever applications.
3. Be familiar with the cranks as machine elements.
4. Be familiar with linkages and how they function.
5. Be familiar with the four bar linkage and its variations.
6. Be familiar with springs as machine elements.
7. Identify simple machine elements in compound machinery.

**Basic Mechanical Components II – Volume 7, Unit 2**

## Cams and Timing

1. Be familiar with cams as machine elements.
2. Recognize the major types of cams.
3. Be familiar with the components of cam applications.
4. Layout a simple plate cam.
5. Measure the relationship between cam shape and stroke length in a given application.
6. Measure the relationship between cam shape and stroke timing in a given application.
7. Be familiar with cam maintenance techniques.
8. Identify machine elements in cam applications.

**Basic Mechanical Components II – Volume 7, Unit 3**

## Use of Elementary Timing Model in Timing Adjustments

1. Be familiar with the elements of machine drawing.
2. Be familiar with the interaction of timing elements.
3. Be familiar with the installation and use of timing wheels.
4. Construct standard and bar timing charts.
5. Be familiar with basic timing adjustments.
6. Make basic timing adjustments using the Elementary Timing Model.
7. Chart basic timing adjustments for the Elementary Timing Model.

**Volume 8****MACHINE ADJUSTMENT FUNDAMENTALS USING THE ATM**

<b>Unit 1:</b>	Troubleshooting, Problem Identification, and Principles of Problem Solving
<b>Unit 2:</b>	Problem Solving and Multiple Systems, Use of the Advanced Timing Model, Set up Standards on Machines, and Timing Charts
<b>Unit 3:</b>	Machine Adjustments II: Set Tolerances, Machine Records, Complete Documentation of Advanced Timing Model

(Approximately 10 classroom hours)

**Machine Adjustment Fundamentals Using The Advanced Timing Model – Volume 8, Unit 1**

## Troubleshooting, Problem Identification, Principles of Problem Solving

1. Be familiar with the principles of problem solving.
2. Be familiar with problem description and downtime reports.
3. Be familiar with possible and probable cause.
4. Be familiar with corrective procedures and solution verification.
5. Be familiar with troubleshooting charts.
6. Make up a troubleshooting chart.
7. Practice using problem solving techniques.

**Machine Adjustment Fundamentals Using The Advanced Timing Model – Volume 8, Unit 2**

## Set up Machine Standards Using the Advanced Timing Model

1. Be familiar with problem solving techniques as they apply to multiple systems.
2. Be familiar with the construction of the Advanced Timing Model.
3. Be familiar with the eight systems of the Advanced Timing Model.
4. Be familiar with the operating standards of the Advanced Timing Model.
5. Be familiar with the major types of machine adjustments.
6. Set the Advanced Timing Model to operating standards.
7. Chart the timing of the Advanced Timing Model.

**Machine Adjustment Fundamentals Using The Advanced Timing Model – Volume 8, Unit 3**  
 Problem Solving on Multiple Systems Using the Advanced Timing Model

1. Be familiar with troubleshooting charts for the Advanced Timing Model.
2. Describe and solve adjustment problems of the Advanced Timing Model.
3. Be familiar with the significance of settings and tolerances.
4. Determine the range of tolerances for different systems within the Advanced Timing Model.
5. Be familiar with Machine Standards Records.
6. Complete Machine Standards Records for the Advanced Timing Model.

**Volume 21**

**MACHINE ADJUSTMENT FUNDAMENTALS USING THE PMS**

<b>Unit 1:</b>	Troubleshooting, Problem Solving, and Problem Identification Techniques
<b>Unit 2:</b>	Set Up Machine Standards Using the Packaging Machine Simulator
<b>Unit 3:</b>	Problem Solving on Multiple Systems Using the Packaging Machine Simulator

(Approximately 12 classroom hours)

**Advanced Machine Adjustment Fundamentals Using the Packaging Machine Simulator – Volume 21, Unit 1**

Troubleshooting, Problem Solving, and Problem Identification Techniques

1. Be familiar with the principles of problem solving.
2. Be familiar with problem description and downtime reports.
3. Be familiar with possible and probable cause.
4. Be familiar with corrective procedures and solution verification.
5. Be familiar with troubleshooting charts.
6. Make up a troubleshooting chart.
7. Practice using problem solving techniques.

**Advanced Machine Adjustment Fundamentals Using the Packaging Machine Simulator – Volume 21, Unit 2**

Set Up Machine Standards Using the Packaging Machine Simulator

1. Be familiar with problem solving techniques as they apply to multiple systems.
2. Be familiar with the construction of the Packaging Machine Simulator.
3. Be familiar with the mechanical, pneumatic, and electric functions of the PMS.
4. Be familiar with the operating standards of the Packaging Machine Simulator.
5. Be familiar with the major types of machine adjustments.
6. Set the Packaging Machine Simulator to operating standards.
7. Chart the timing of the Packaging Machine Simulator.

## Advanced Machine Adjustment Fundamentals Using the Packaging Machine Simulator – Volume 21, Unit 3

### Problem Solving on Multiple Systems Using the Packaging Machine Simulator

1. Be familiar with troubleshooting charts for the Packaging Machine Simulator.
2. Describe and solve adjustment problems on the Packaging Machine Simulator.
3. Be familiar with the significance of settings and tolerances.
4. Determine the range of tolerances for different systems within the Packaging Machine Simulator.
5. Be familiar with Machine Standards Records.
6. Complete Machine Standards Records for the Packaging Machine Simulator.

## Volume 9

### ELECTRICAL COMPONENTS

<b>Unit 1:</b>	Principles of Electricity and AC/DC Circuits
<b>Unit 2:</b>	Basic Circuit Components, Switches, and Relays
<b>Unit 3:</b>	Digital Multimeter and Basic Measurements
<b>Unit 4:</b>	Input and Output Devices
<b>Unit 5:</b>	Electrical Schematics
<b>Unit 6:</b>	Generators & Transformers
<b>Unit 7:</b>	DC Machines
<b>Unit 8:</b>	Three-Phase AC & DC Motors

(Approximately 16 classroom hours)

### Electrical Components – Volume 9, Unit 1

#### Principles of Electricity, AC/DC Circuits

1. Be familiar with the nature of electricity.
2. Be familiar with the elements of electrical flow.
3. Be familiar with basic electrical measurements.
4. Be familiar with electrical circuits and circuit diagrams.
5. Be familiar with the concept of power in electrical circuits.
6. Be familiar with basic safety rules for working with electrical circuits.
7. Be familiar with simple DC circuits and measure their electrical properties.
8. Be familiar with simple AC circuits and the properties of inductance and capacitance.

**Electrical Components – Volume 9, Unit 2**

## Basic Circuit Components, Switches, and Relays

1. Be familiar with common types of electrical conductors.
2. Be familiar with common types of conductor insulation and mechanical protection.
3. Be familiar with basic National Electrical Code (NEC) definitions.
4. Recognize and make common splices and joints for electrical circuits.
5. Be familiar with fuses and circuit breakers.
6. Be familiar with common electrical switches.
7. Be familiar with solenoids and relays.
8. Be familiar with techniques for troubleshooting electrical circuits.

**Electrical Components – Volume 9, Unit 3**

## Digital Multimeter and Basic Measurements

1. Use the multimeter for testing and measuring.
2. Understand the four main electrical measurements: Voltage, Current, Resistance, and Continuity.
3. Understand practical application of multimeter measurements as a troubleshooting device in industrial environments.
4. Select the DMM required for specific category ratings.
5. Be able to take accurate measurements of voltage, current, resistance, and continuity in a practical circuit of the kind typically used in industry.
6. Understand and follow correct safety procedures for taking measurements used in industry.
7. Be familiar with simple electrical circuits and understand how to simplify and calculate the main parameters.

**Electrical Components – Volume 9, Unit 4**

## Input and Output Devices

1. Be familiar with I/O Devices within an electrical system.
2. Understand the operation of the most common Input devices: Switches, Sensors, Thermocouples, and Transducers.
3. Be familiar with the operation of electrical motors: AC and DC Motors
4. Understand the operation of the most common Output devices: Motors, Lights, Heaters, Pumps, and Solenoids.

**Electrical Components – Volume 9, Unit 5**

## Electrical Schematics

1. Identify and understand functions of electrical components used in industry.
2. Learn to identify graphic symbols in electrical drawings.
3. Learn to interpret electrical drawings used in industry.
4. Learn how to follow control schemes from the point of understanding and troubleshooting the circuit.
5. Construct simple circuits by correctly following circuit schematics to help understand the principles of electrical flow.



**Electrical Components – Volume 9, Unit 6**

## Generators and Transformers

1. Understanding voltage generation through a magnetic field.
2. Understanding sine wave generation.
3. Understanding the generator principle.
4. Understanding transformer principles.
5. Understanding transformer current and power relationships.
6. Solving transformer problems using turn ratio, ohms law, and power formulas.
7. Understanding advantages and uses of transformers.
8. Understanding line load and line loss, as well as voltage drop.

**Electrical Components – Volume 9, Unit 7**

## DC Machines

1. Understand Electrical Machine definitions.
2. Understand the separately excited generator.
3. Understand the self-excited generator.
4. Understand motor principles.
5. Understand motor/generator relationships.
6. Principles of counter torque and counter voltage.
7. Energy flow of DC machines.
8. Starting a DC motor.
9. Motor speed control.
10. Understand series motors.
11. Understand motor braking.

**Electrical Components – Volume 9, Unit 8**

## Three- Phase AC and DC Motors

1. Understand common voltage point and grounding.
2. Introduction to three-phase voltage.
3. Understand Wye and Delta connections.
4. Understand and calculate phase voltage, and phase current.
5. Understand three-phase power.
6. Understand three-phase induction motors.
7. Understand and calculate motor synchronous speed.
8. Understand speed control using frequency inverters and variable frequency power supplies.
9. Understand wound rotor motors and squirrel case motors.
10. Understand the starting requirements for three-phase motors.
11. Understand braking of AC motors.
12. Understand single-phase motors. Brush type, induction, and synchronous types.

Should you decide that this service can assist you in any way, we will be pleased to discuss your needs and plans.

With Best Regards,

A handwritten signature in black ink, appearing to read "Stephen Berry". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

Scientific Management Techniques, Inc.

Stephen Berry, President

[sberry@Scientific-Management.com](mailto:sberry@Scientific-Management.com)

[www.Scientific-Management.com](http://www.Scientific-Management.com)