



Injection Moulding Training Summary



Module 1 – Health and Safety in the Workplace

Target Audience – all areas of the business (e.g. operators, technical staff, apprentices, and management team etc.).

Prerequisites – no prior knowledge as course is aimed at beginners, trainee setters, quality, management etc.

Aims - To provide an overview of the safety requirements, relevant to the injection moulding industry.

- Workplace hazards
- Use of PPE
- Machine hazards
- Your contribution
- Lifting equipment
- Plastic industry related illnesses

Outcome – improve Health & Safety awareness across the business and standardise understanding of responsibilities with respect to Health and Safety.

Module 2 – Fundamental Principles of Pressure and Speed

Target Audience – tool hangers, trainee setters, setters, process technicians, apprentices, team leaders and quality personnel.

Prerequisites – no prior knowledge as course is aimed at beginners, trainee setters, quality, management etc.

Aims - to provide an understanding of the impact of pressure on the injection moulding process covering.

- What is Pressure.
- How is Pressure is created.
- What is the effect of Pressure on the process.
- How is Pressure controlled?
- Where is Pressure used in the Moulding Process?
- Why Should we Monitor and Cap Pressure?
- What is the relationship between Pressure and Speed?

Outcome – improve skills and understanding of the impact of pressure on the moulding process from clamp to injection. Improve the confidence of the team with respect to impact of pressure on quality and profitability .



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Module 3 – Mould Protection

Target audience - tool hangers, mould operators, trainee setters, setters, process technicians, apprentices, team leaders, tool makers, tool build technicians, costing engineers, estimators and quality personnel.

Prerequisites – no prior knowledge as course is aimed at beginners, trainee setters, quality, management etc.

Aims - To identify the importance of mould protection.

- Mould Protection Position.
- Mould Protection Speed.
- Mould Protection Pressure.
- Mould Protection Time.
- What is mould protection and how to set it.
- The Importance of getting it right.

Outcome – to reduce downtime, increase efficiency by improving improve tool management. Provide understanding of setup and cycle time impact for costing engineers and estimators.

Module 4 – Fundamental Principles of Injection Moulding

Target audience - all areas of the business (e.g. operators, technical staff, apprentices, quality, tooling staff and management team etc.).

Prerequisites – no prior knowledge as course is aimed at beginners, trainee setters, quality, management etc.

Aims – for attendees to understand the basic principles of the injection moulding process.

Outcome – for all team members to have an understanding of the injection moulding process and thereby improve communication and knowledge of the team.

Module 5 – The importance of process monitoring

Target audience - tool hangers, trainee setters, setters, process technicians, apprentices, team leaders and quality personnel.

Prerequisite: some knowledge of injection moulding technology, or should have completed some previous S57C training.

Aims – to reinforce the importance of process monitoring with respect to:

- selection and set up of Process Monitoring
- consequences of no process monitoring.



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Outcome – improved efficiency, reduced maintenance, developed process control (reduced variations), improved part quality, increased process understanding by management team, improved communication by management to process team.

Module 6 – Machine Design and Construction

Target audience – trainee setters, technicians, team leaders, middle management.

Prerequisite: some knowledge of injection moulding technology, or should have completed some previous S57C training.

Aims – To increase the understanding of the following aspects of machine design/construction

- Understand the Operation of the Clamp Unit.
- Consider the Differences between Toggle and Direct Lock.
- Understand how to set the Mould Height.
- Understand the Various Components of the Injection Unit.
- Basic's of Screw Design.
- Back Pressure.
- Nozzle Design.
- Shear and Direct heat Transfer and Effect on Plasticising.

Outcome – improve the understanding of all aspects of the injection moulding machine to improve overall utilisation and efficiency.

Module 7 – Clamp Force and Shot Weight Calculation

Target audience - trainee setters, technicians, team leaders, middle management

Prerequisite: some knowledge of injection moulding technology, or should have completed some previous S57C training.

Aims – to introduce the aspects of how the following criteria impact on overall process efficiency

- Consider Material Melt Stiffness
- Understand Projected Area
- Calculate Clamp Force
- Calculate Shot Volume
- Short Shot Technique



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Outcome – identify tool abuse and thereby reduce energy requirements, identify tool defects (T zero), develop robust SOP's and optimize the injection process.

Module 8 – Machine control

Target audience – trainee setters, technicians, team leaders, middle management.

Prerequisite: some knowledge of injection moulding technology, or should have completed some previous S57C training.

Aims – to introduce the aspects of how the following criteria can impact on machine control efficiency

- Know the five basic control parameters on an injection moulding machine.
- Understand how basic control devices work.
- Understand basic hydraulic systems.
- Have a basic understanding of how electric machines differ from hydraulic.

Outcome – improve the teams understanding of machine control to reduce downtime and increase shop efficiency.

Module 9 – Common moulding process faults, their causes and remedies

Target audience - mould operators, trainee setters, setters, process technicians, apprentices, team leaders, costing engineers, estimators, quality personnel and management team.

Prerequisite: some knowledge of injection moulding technology, or should have completed some previous S57C training.

Aims – to improve understanding of process problems and identify solutions:

- Closing Phase Faults, Causes and Remedies.
- Injection Phase Faults, Causes and Remedies.
- Holding Phase Faults, Causes and Remedies.
- Cooling Phase Faults, Causes and Remedies.
- Out of Cycle Faults, Causes and Remedies.
- Correct use of Injection, Holding, Back Pressure and Screw Rotation profiles.

Outcome – reduce scrap, improve quality, improve the ability of the team to undertake root cause analysis.



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Module 10 – The importance of Quality

Target audience – any member of the business

Prerequisites – no prior knowledge as course is aimed at beginners, trainee setters, quality, management etc.

Aims – attendees will learn the following aspects as to how quality impacts the business;

- What is the Definition of Quality.
- Consequences to the Organisation of Non-Conformance.
- Cost to the organisation of Customer Complaints.
- Perception to Customers and Loss of Credibility.
- Manufacturing Quality Foundation Pillars

Outcome - reduced scrap, reduction in customer quality issues, increased productivity (Overall Equipment Efficiency OEE), increased profitability, instil a right first-time culture.

Module 11 – Simple tool care and maintenance

Target audience –tool hangers, IMM operators, setters, technicians, team leaders, apprentices.

Prerequisites – no prior knowledge as course is aimed at beginners, trainee setters, quality, management etc.

Aims – educate attendees how to look after and increase tool life by:

- Correct Use of Mould Protection Spray.
- Vents and How to Clean.
- How to apply grease to dowels, slides and pressure plates.
- Good housekeeping. How to store tools correctly.
- Cleaning the core and cavity.
- Shutting down the machine – tool close position and hot runner.
- Evacuation of water circuits.

Outcome – reduced down time caused by poor tool maintenance, increased longevity of tool life, instil a duty of care mentality of asset protection, improved productivity due to less tooling issues.



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Module 12 - Materials Level One - Basic Material Concepts

Target audience – material handlers, trainee setters, IMM operators, apprentices, quality personnel, procurement, estimators and middle management.

Prerequisites – no prior knowledge as course is aimed at beginners, trainee setters, quality, management etc.

Aims- Provide a basic understanding of polymer materials

- What are Plastics, and where do they come from.
- Uses of Plastics and the Diversity of the Plastics Industry.
- Classification of Plastics Materials.
- Understanding Material data sheets, level 1.
- Simple molecular construction of plastics materials and Polymerisation.
- Drying and Handling requirements.

Outcome – improved material handling, reduced scrap, increased basic polymer knowledge.

Module 13 – Materials Level Two - Polymers and Additives

Target audience – material handlers, trainee setters, IMM operators, apprentices, quality personnel, procurement, estimators and middle management.

Prerequisite: some knowledge of injection moulding technology, or should have completed some previous S57C training.

Aims-increase the knowledge of attendees with respect to different polymer families.

- Homo-Polymers, Co-polymers, Ter-Polymers, Blends and Alloys.
- Amorphous and Semi-Crystalline Plastics.
- Intermediate Molecular Structures of Plastics.
- Incorporation and need for Additives.

Outcome - improved material handling, reduced scrap, increased basic polymer knowledge, enable management team to understand the the material handling process, improve CAPEX requirements and understanding with respect to material handling needs.

Module 14 – Materials Level Three - Morphology and Crystallinity

Target audience – Trainee setters, technicians, process engineers

Prerequisites: Good understanding of injection moulding technology or should have completed some previous S57C training.

Aims: to increase the material knowledge of attendees further and build on learning from Modules two and three



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- Crystallinity.
- Advanced Molecular Structure of Polymers.

Outcomes - further understanding of materials technology to aid process set up and part manufacture

Module 15 – Materials Level Four - TG and Design Influences

Target audience – process technicians and process engineers

Prerequisites: excellent understanding of injection moulding technology or should have completed some previous S57C training.

Aims – introduce the concept of material rheology:

- The Glass Transition Temperature.
- Factors Influencing Design with Plastics.
- Strength of Plastics Materials (Understanding Modulus)
- Further Understanding of Material Data Sheets.
- Bio and Bio-degradable plastics.

Outcome – improve the understanding of material rheology, improve production process, achieve process stability.

Module 16 – Fluid Dynamics

Target audience – process technicians, process engineers, project engineers

Prerequisites: excellent understanding of injection moulding technology or should have completed some previous S57C training.

Aims – to introduce the basic dynamics of injection moulding (fluid dynamics)

- Overview of flow analysis (with respect to injection moulding)
- Understanding of the three-dimensional (3D) non-isothermal, non-Newtonian fluid flow of polymer melt.
- Predict how much pressure is required in advance using calculations of fluid dynamics.
Understand that molten plastic has some viscosity (resistance to flow), and the impact of the viscosity changes upon time (as the plastic cools, the viscosity increases making it more difficult to flow). The equations of calculations of fluid dynamics are explored

Outcome – improved understanding of material rheology, viscosity and fluid flow. Improved quality, increased efficiency of material usage and improved process control.



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Module 17 – The Scientific Process Setup.

Target audience – process technicians, process engineers and project engineers

Prerequisites: excellent understanding of injection moulding technology or should have completed some previous S57C training.

Aims – to provide an understanding that moulding is a diverse discipline and how a systematic approach to injection moulding based on the principles of the scientific methodology can improve productivity and deliver robust processes.

- Dosage and Screw Surface Speed Calculation.
- Rheology. Selection of Correct Injection Speed.
- Application of Suitable Holding Pressure and Time.
- Cooling Time Calculation.
- Clamping Force Optimisation.
- Cycle Time Optimisation.
- Process Capability Study.

Outcome – improved efficiency, productivity, FMEA validation and improved process control (OEE)

Module 18 - IMM safe start up and shut down procedure

Target audience – trainee setters, setters, process technicians, apprentices, team leaders

Prerequisites – no prior knowledge as course is aimed at beginners and trainee setters, etc.

Aims – to provide an understanding of safe start up and shut down methodology.

- Identify and Check Ancillary Equipment.
- Identify Machine Controls and Check Barrel Temperatures.
- Identify and Check Plastics Material.
- Identify and Check Mould Tool.
- Identify Necessary Hand Tools and PPE.
- Recognise Correct Safety Protocols.
- Perform Safe Start-up Procedure
- Perform Safe Shut-down Procedure



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Outcome – improved understanding of safe start up and shut down of Injection Moulding process

Module 19 – Introduction to Hydraulic components for IMM

Target audience – Electrical / Maintenance and Process technicians moving into the field of hydraulic systems

Prerequisites - Good understanding of injection moulding and basic machine functions

Aims – to provide an understanding of hydraulic components with respect to IMM.

- Pumps and motors
- Cylinders
- Valves – directional and proportional
- Accessories
- Component identification – practical

Outcome – After the course the participant can understand the function of each individual hydraulic component, its ISO standard symbol (ISO 1219-1:2012) and its place in an injection moulding machine

Module 20 – Reading Hydraulic drawings and circuits for IMM

Target audience – Electrical / Hydraulic / Maintenance and Process technicians

Prerequisites - Good understanding of injection moulding and have worked on hydraulic systems to a component level or have completed the hydraulics components course (Module 19)

Aims – to provide the ability and understanding to interpret hydraulic drawings and circuits:

- Breakdown of each machine movement, closing ejector injection etc.
- Understand the concept of the control system outputs for each component
- The role of calibration for the hydraulic system
- Troubleshooting exercises and tasks for the system – practical

Outcome – After the course the participant can understand the hydraulic drawing, break down the circuit into each individual movement and target any components to fault find on an injection moulding machine



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Module 21 – Introduction to electrical components for IMM

Target audience – Electrical / Hydraulic / Maintenance and Process technicians moving into the field of electrical systems

Prerequisites - Good understanding of injection moulding and basic machine functions

Aims – to provide an understanding of electrical components with respect to IMM:

- Power Supply and voltage generation
- Contactors and relays
- Transducers
- Heating circuits and control
- Electronic structure
- Component identification - practical

Outcome – After the course the participant can understand the function of each individual electrical component, its ISO standard symbol (IEC 60617 | BS 3939) and its place in an injection moulding machine

Module 22– Reading electrical drawings and circuits for IMM

Target audience – Electrical / Hydraulic / Maintenance and Process technicians

Prerequisites - Good understanding of injection moulding and have worked on electrical systems to a component level or have completed the electrical components course (Module 21)

Aims – to provide the ability and understanding to interpret electrical drawings and circuits with respect to IMM:

- Breakdown of the electrical panels (415, 240, 110, 24v systems)
- Control circuit voltage generation
- Safety circuits
- Electronic outputs
- Electronic inputs
- Understand the calibration status of the electronic system
- Practical exercises



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Outcome – After the course the participant can understand the hydraulic drawing, break down the circuit into each individual movement and target any components to fault find on an injection moulding machine

Module 23– Maintenance Tasks IMM

Target audience – Electrical / Hydraulic / Maintenance and Process technicians

Prerequisites - Good understanding of injection moulding and basic machine functions

Aims – To understand the actions required to keep an IMM maintained:

- Mechanical and hydraulic maintenance tasks
- Maintenance schedule – online or standalone
- OEM recommendations
- Maintenance task level
- Machine status for recommended tasks
- Carry out practical tests

Outcome – After the course the participant can understand the maintenance that needs to be carried out to keep the machine in a good condition

Module 24 – Maintenance Tasks for Robots

Target audience – Automation / Electrical / Hydraulic / Maintenance and Process technicians

Prerequisites - Good understanding of injection moulding / automation and basic machine functions

Aims – To understand the actions required to keep a robot maintained in good condition:

- Mechanical and pneumatic maintenance tasks
- Maintenance schedule – online or standalone
- OEM recommendations
- Maintenance task level
- Robot status for recommended tasks
- Carry out practical tests

Outcome – After the course the participant can understand the maintenance that needs to be carried out to keep the robot in a good condition



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Module 25 – Robot construction and components

Target audience – Automation / Electrical / Hydraulic / Maintenance and Process technicians

Prerequisites - Good understanding of injection moulding / automation and basic machine functions

Aims – To understand the construction and components of a robot covering::

- Robot structure – axis designation
- Stroke lengths and rotational limits
- Vacuum and gripper systems
- Monitoring of vacuum and grippers
- Input and output functions and their use
- Use of safety areas – anti collision
- Basic program structure

Outcome – After the course the participant can understand the robot structure and its associated operational components

Module 26 – Robot – programming design and standard structures

Target audience – Automation / Electrical / Hydraulic / Maintenance and Process technicians

Prerequisites - Good understanding of automation construction and basic programming skills – graphical and/or textual

Aims – To understand the requirements to design and build a program structure covering:

Modular structures

- Demoulding
- Deposit
- Reject
- Quality
- Insert loading
- Other functions

Programming commands for your equipment

- Move



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- Timers
- Jump, when, if
- Grids – deposit and pick up
- Inputs and outputs

Creating various programme structures – practical

Outcome – After the course the participant can design and build a program structure for ease of operation and simplicity for the user

Optional Module A – Zero parameter set up for clamp end

Target audience – tool hangers, setters, process technicians and process engineers.

Prerequisites: Good understanding of injection moulding technology or should have completed some previous S57C training.

Aims – review and understand the importance of:

- Set Positions.
- Set Speeds.
- Set Pressures.
- Set Ejectors.
- Set Mould Safety.
- Set Clamp force.
- Set Mould temperatures.

Outcomes: reduction in down time, improve efficiency, improve right first time, repeatable process parameters via SOP

Optional Module B – Zero parameter set up injection end.

Target audience - tool hangers, setters, process technicians, process engineers, quality technicians and quality engineers.

Prerequisites: Good understanding of injection moulding technology or should have completed some previous S57C training.

Aims- review and understand the importance of:

- Set Temperatures
- Set Shot size and hold pressure position.



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- Set Screw speed and back pressure.
- Set Injection speed.
- Set Injection pressure.
- Set Holding pressure and time.
- Set Cooling time.

Outputs - reduction in down time, improve efficiency, improve right first time, repeatable process parameters via SOP

Optional Module C – Basic tool design

Target audience – setters. Technicians, process engineers, design engineers, toolmakers, tooling engineers, tool designers engineers

Prerequisite: some knowledge of injection moulding technology, or should have completed some previous S57C training.

Aims: to introduce the various tool construction methods used:

- Two Plate Tools
- Multi-plate Tools
- Hot Runner Tools
- Stack Moulds
- Ejection Types
- Core Pulling
- Gate and Runner Design
- Venting
- Mould Temperature control

Outputs – increased tool construction knowledge, understanding of tool variation with respect to ejection options.

Optional Module D – Processing and Trouble Shooting

Target audience – setters, process technicians, process engineers, quality technicians, quality engineers, product designers, procurement engineers

Aims – Understanding the processing Characteristics of Modern Plastics.

- Temperatures.



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- Injection Phase.
- Holding Phase.
- Cooling Phase.
- Trouble-Shooting Techniques

Outputs – increased efficiency, greater process understanding by the team, robust trouble shooting techniques.

Optional Module E – Safe Mould Mounting

Target audience – tool hangers, tool slingers, apprentices, team leaders, middle management

Prerequisites – no prior experience as course is aimed at beginners, trainee setters, quality, management etc.

Aims – to provide understanding of the safety aspects associated with mould mounting

- Inspection Of Lifting Equipment.
- Correct use of Hand Tools.
- Understanding of Torque.
- Measuring a Mould Tool and Ejector Bar for Correct Fitment.
- Safe and Correct Storage of a Mould Tool.
- Safe Installation and Fitting of a Mould Tool.
- Fitment of Water Pipes and Tracing Circuits.
- Safe use of Hydraulic Hoses and fittings.
- Safe Fitment of Ancillary Services such as Hot Runners and Robot Grippers.

Outputs – endorse safe working practice, improve SMED, accident reduction, increase OEE by faster tool changes.

Optional Module F – Team Leaders Injection Moulding Appreciation

Target audience –team leaders, middle management

Prerequisites – no prior experience as course is aimed at providing an overview of the Injection Moulding process.

Aims –To provide an understanding of the elements involved in injection moulding

- to provide understanding of the safety aspects associated with mould mounting



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- An appreciation of Injection Moulding Principles.
- Process Safety and Applied Safe Working Practices.
- Safe and Efficient Start-up and Shut Down of an IMM.
- Detailed Construction, Control and Operation of an IMM.
- Understanding of Mould Tool Construction.
- Auxiliaries and their uses.
- Basic Knowledge of Polymers.
- Common Moulding Defects and Possible Solutions.
- Understanding of IMM Monitoring and Quality Control systems.

Outputs – increased team leader and middle management awareness of mould shop principles.

Optional Module G – Risk Assessment

Target Audience – technicians, team leaders, middle management

Prerequisites – no prior knowledge as course is aimed at improving the understanding of risk associated with injection moulding.

Aims – to provide understanding of the risk assessments to be considered in an injection moulding environment

- Understanding what Risk Assessment is.
- Risk Assessment and the Law.
- Understanding Hazards and Risks.
- Objectives of Risk Assessment.
- The Five Steps to Risk Assessment.
- Hazard Identification methods.
- Evaluating the Risk and Deciding on Precautions.
- Implementing Control Measures.

Outputs – increased team leader and middle management awareness of risk assessment principles.



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Optional Module H – Basic Mathematics

Target audience – team leaders, middle management

Prerequisites – a basic knowledge of mathematics and the injection moulding process.

Aims – To give the trainee a basic understanding of mathematical principals used in the injection moulding process.

- Whole Numbers, Negative Numbers and Decimals
- Using a Calculator
- Addition, Subtraction, Multiplication and Division
- Rounding Numbers and Significant Figures
- Formulas, Equations and Order of Operations
- Common unit conversions in the moulding process
- Calculation of Area
- Calculation of Volume & Flow
- Calculation of Weight, Mass and Force
- Understanding Percentages
- Calculating of Clamp Force requirements
- Understanding ratios
- General IMM process calculations

Outputs – Setters and Technicians will be more prepared to calculate data, enabling them to match mould requirements with appropriate machines and avoid common defects that cause mould and machine damage.



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Optional Module J – Mould Tool Construction and Terminology

Target audience – setters. Technicians, process engineers, design engineers, toolmakers, tooling engineers, tool design engineers

Prerequisite: some knowledge of injection moulding technology or should have completed some previous S57C training.

Aims – To introduce the terminology used for features in injection moulding tools

- Mould tool construction and cost drivers
- Mould tool terminology for tool elements
- Material injection options
- Ejection options
- Part design considerations that effect tooling decisions

Outputs – increased tool terminology understanding and better communication between toolmakers and technicians.

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