British Glass

IS Machine – Health and Safety Guidance Document

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Part 1: Approach and regulatory overview

Purpose of document

The document provides practical guidance on the safe working practices that should be adopted in the operation of IS glass forming machines and the management controls needed to support them. The document has been prepared by a working party drawn from the leading UK container manufacturers and leading manufacturers of IS machines to the UK glass industry. The document aims to reflect the provisions of the various workplace regulations that govern the manufacturing activity, including but not limited to, the Provision and Use of Work Equipment Regulations 1998 (PUWER).

Regulatory framework

Whilst this document is principally based upon achieving compliance with PUWER, it is recognised that that there is overlap with other sets of regulations. These other regulations include but are not limited to:

- The Health and Safety at Work Act 1974;
- The Workplace (Health, Safety and Welfare) Regulations 1992;
- 2006/42/EC the revised version of the Machinery Directive;
- The Supply of Machinery (safety) regulations 2008;
- Feeder and IS standard EN 13042-1 (Machines and plants for the manufacture, treatment and processing of hollow glass. Safety requirements. Gob feeder);
- EN 13042-3 (Machines and plants for the manufacture, treatment and processing of hollow glass — Safety requirements —);
- The Lifting Operations and Lifting Equipment Regulations 1998 (LOLER);
- Manual Handling Operations Regulations 1992 (as amended) (MHOR);
- The Personal Protective Equipment at Work Regulations 1992;
- The Construction (Design and Management) Regulations 2015;
- The Management of Health and Safety at Work Regulations 1999.

Guidance – objectives and methodology

The objective of this guidance is to reduce risks to the lowest reasonable practicable level by taking preventative measures, in order of priority. The hierarchy of measures that need to be considered are as follows:

Elimination	Redesign the job or use substitute materials to remove or eliminate the hazard.
Substitution	Replace the process or material with a less hazardous one.
Engineering controls	Separate the hazard from the operator – guards
Administrative controls	Training, supervision, risk assessments
PPE	Appropriate workplace protective equipment.

The methodology employed to achieve the objective is one of Plan, Do, Check, Act.
For the purposes of IS machine operation the glass manufactures have adopted a practical hierarchy of: guards, safety devices and engineering controls, training and personal protective clothing; the choice of which being determined by site specific risk assessments.

The resultant safety strategies will by necessity be company-specific, but they should all embrace the following principles:

- A comprehensive and clear definition should exist for every foreseeable event that requires an intervention;
- It should be documented which parties are authorised to undertake the intervention;
- Individual risk assessments must have been made for the interventions and relevant staff must be fully aware of the implications and requirements of these assessments;
- Standard Operating Procedure (SOPs) must exist to cover all the interventions. The SOPs must provide clear and unambiguous instructions on how the task can be safely accomplished and what safety measures are required;
- Identification of Key Safe Behaviours of IS Machine personnel derived from the risk assessments that should be checked routinely.

Companies would be expected to provide evidence that:

- They have compiled a range of foreseeable interventions;
- Each intervention has been risk assessed;
- All IS users are aware of relevant risk assessments and have received relevant training;
- SOPs exist which provide clear and unambiguous instructions on how the various foreseeable interventions can be safely accomplished.

Part 2: All about IS machines

Glass container production and the independent section (IS) machine

The manufacturing process

Glass for bottles and jars is produced by melting and refining raw materials (sand, soda ash, limestone, as well as recycled glass) in a furnace at temperatures of around 1500°C. The molten glass must then be formed into the required shape.

Commercial container glass production is only economically viable if it is done on a large scale – and a typical container plant furnace will melt around 300 tonnes of glass per day and produce in the region of 50,000 bottles or jars per hour – or over 8 million per week depending on the size of the containers.

The glass in the furnace cannot be allowed to cool or set, and so production has to be a continuous process – 24 hours per day, 365 days of the year. The simplest and most effective method for feeding glass to the forming machines is to use a gravity feed.

The speed and cooling rate in production is critical: the glass must arrive sufficiently molten to be shaped, but during forming it must cool and stiffen enough that the container can be moved and does not sag on release from the mould.

The logistics of producing containers are largely determined by the need for:

- a large furnace
- The glass to remain within the necessary temperature range for the forming process.

The modern independent section (IS) machine has evolved to work within these constraints. These machines consist of a row of up to 20 individual but identical forming units, the *sections*. Each section is made up of two sides, known as the blank-side and the mould-side. The process for transforming the molten glass into containers is:

1. Each IS machine receives a constant gravity-fed supply of molten glass via a channel called a fore hearth.
2. Molten slugs of glass (called gobs) are gravity fed into a centrally located delivery mechanism, and nudged by a deflector plate into an individual section.
3. The gob is delivered to the blank-side, a plunger rises and presses the gob into a *parison* (partially formed container).
4. The partially formed container is released and moved through a 180° arc into the mould-side, where compressed air blows the glass into the final container shape.

It takes approximately 5 seconds for the molten gob to be fully formed into its final bottle/jar shape. Work with an IS machine typically falls into three categories, carried out by separate teams:

- Job change – procedures to set up the machine for a particular production run, which will include installing the correct moulds for the specific product and making necessary machine adjustment (for example to feed rate, timing, gob size etc).

- Routine operation – ensuring that all sections are producing containers to the correct specification and standard by carrying out action during production such as:

- swabbing (application of a release agent, known as *mould dope*).
- adjustments to timing.
- replacing mould sets.
- quality checks.

    - Maintenance / repair - Safe systems of work shall be in place for all the following activities;

        - Preventative maintenance of IS Machines components and equipment associated with production of container glass.
        - Essential maintenance of IS Machines during job changes.
        - Planned and unplanned replacement/repairs of IS Machine components and equipment.
        - Workshop repairs and preparation of essential IS Machine components.
        - Immediate response to breakdowns to minimise downtime.

Considerations and constraints

Transforming molten glass into bottles and jars at temperatures in excess of 1000°C is not necessarily a complex operation. IS machines are mechanical in nature, and present the hazards typically associated with moving machinery. However, there are further specific factors that must also be considered such as:

- Continuous operation – if sections are stopped they cool; once restarted and molten glass is reintroduced, containers will be misformed for a period until the correct operating temperature is achieved. This is not only costly but can require operators to free stuck glass, which poses a potentially hazardous operation in itself.

Therefore stopping individual sections, let alone the whole machine, must only be done with a consideration of the balance of risks. Consequently some routine operations may need to be performed while the section, or adjacent section, is still in use. However, this decision must be based on pre-determined risk-assessment and standard operating procedures and **not operator discretion.**

The need for constant operator intervention, continuous operation and the side-by-side section design pose unique challenges for machine guarding. Consequently, safety measures for operator interventions lie towards the bottom of the hierarchy of preventative measures and focus on administrative controls and PPE. Container glass manufacturers must strive to employ the highest hierarchy control possible and this should be considered when purchasing an IS Machine.

Specific hazards

These hazards are considered the main ones but this list should also consider any site-specific hazards that may exist on site.

Type of hazard	Source
Crushing	Moving machinery
Cutting / puncture	Broken glass Sharp surfaces
Entanglement	Moving machinery Moving conveyors
Drawing in or trapping	Moving machinery
Impact	Falling objects Striking against stationary objects
Electrical	Direct or indirect contact
Thermal (burns)	Hot machine parts Hot glass
Noise	Machine noise
Thermal heat radiation & ambient	High levels of radiation and wet bulb temp in area of machines potential for heat exposure if not controlled, rotation, refuges
Slip, trip and fall	Steps Trip hazards Floor condition
Weight – Manual handling	Manual handling of moulds Defector chutes, Job change parts
Exposure to chemicals	Degreasers, swabbing oils, maintenance release sprays, hot end coating sprays in maintenance
Inhalation of dusts, mists, vapours	Steam from scrapper directly below rising, oils from Swabbing, tin ppm

Different machine models

There is only a small number of companies in the world that supply IS machines. While machines from different suppliers are similar in appearance and operating principles, there are significant differences in their operating and control procedures.

A typical glass manufacturing site will operate between 10 and 15 IS machines. Individual machines cost hundreds of thousands of pounds and are the largest capital item in a glass factory after the furnace itself. They do, however, have a long operating life and seeing 20-year-old machines in use is not uncommon. Consequently many sites will operate several models of IS machine, and even if they are from the same manufacturer, their different age and condition will mean that no two machines can be considered identical.

All safety measures must recognise this variation and measures must be specific to individual machines e.g. different standard operating procedures and training where applicable.

Part 3: Roles and responsibilities for supply and use of IS machines

Suppliers

IS machines are supplied by a handful of multi-national companies, which will manufacture and install the machine.

The principal responsibility of the machine supplier is to provide a product that is safe to use with all the necessary documentation and certification. This includes:

- Identifying and assessing any health and safety hazard that might reasonably arise from the intended use of their product and seeking wherever possible to design out such hazards.
- Supplying suitable operating instructions which should include information on any risks including access (especially at heights) that the user will need to take into consideration.
- Meeting the requirements of applicable EU directives (for machines placed on the market within the European Economic Area[1]) - the CE marking, which newly supplied machines must carry, signifies these have been met.
- Complying with the essential health and safety requirements (EHSRs) of the Machinery Directive and supplying a *Declaration of Conformity* or a *Declaration of Incorporation.*
- Providing adequate safeguards including physical guarding, control interlocks, emergency stops (where appropriate) and appropriate signs to alert users to hazards that cannot be designed out or safeguarded against.
- Supplying a technical file, in English, containing mechanical and electrical drawings describing the function of the machinery and how the above responsibilities have been discharged.

The suppliers should also have a system to alert machine owners and users to any serious problems encountered by other users of the same equipment. The documentation from machine suppliers is of particular importance to the glass producer as this will form the basis from which they compile their own risk assessments, operating procedures and systems of work and training.

Purchaser/owner (employer)

The machine owner will be the glass manufacturing company, which has a duty to ensure the equipment it buys/refurbishes is safe to install and is used safely.

Only machinery that complies with the Machinery Directive (2006/42/EC), implemented in the UK by the Supply of Machinery (Safety) Regulations 2008 (SMSR), as amended, should be bought. Existing machines taken into service before the Machinery Directive came into force do not need to comply, although they need to comply with PUWER and be safe and fit for purpose.

It is important to note that modification of machines can be considered as a manufacture of a new machine, even if for use in-house, and any company modifying a machine needs to issue a Declaration of Conformity and CE marking.

As well as ensuring that the supplier has met its obligations, as listed in the previous section, it is the purchase/owner's responsibility to ensure that the machine:

[1] *Placing on the market* includes an organisation supplying a machine to itself, i.e. building or modifying machines for its own use, or importing machines into the EEA.

- conforms to the requirements as a whole (rather than simply being assembled from a number of conforming parts).
- used in accordance with the manufacturer's instructions.

User/employee responsibilities

Employees have a general legal duty to take reasonable care of themselves and others who could be affected by their actions, and to co-operate with their employer so that the employer can comply with their health and safety requirements. Employees must:

- Report any safety hazard they observe to their employer immediately.
- Properly use the equipment and safety devices supplied, in accordance with any training and instructions (unless they believe to do so would be unsafe, in which case they should seek further instructions before continuing).
- Not intentionally or recklessly interfere with or misuse anything provided in the interests of health, safety or welfare.

Keeping safety central to the buying process

It is important that safety is central in the specification and purchase of an IS machine. From the outset there should be cooperation between the supplier, purchaser and users to ensure that the safety features are adequate and appropriate. An example might be the location and operation of emergency stop buttons and where in the cycle the machine will come to a controlled stop.

Part 4: Specific requirements

Engineering controls

A wide range of safety features for IS machines have been designed and developed over the years. These include items such as:

- guards
- barriers
- blocking devices
- lifting devices
- conveyor ladders.
- automatic swabbing

To enable glass manufacturers to keep abreast of developments in engineering controls, and share experience and advice, British Glass coordinates an IS Machine working group that reviews safety features on an annual basis.

While there will be significant differences between machines and sites as to which controls are the most practicable to implement, it would be expected that all container manufacturers:

- Consider any newly available/proven safety features in the course of their routine review of risk assessments, improvement plans and standard operating procedures.
- Adopt engineering features where possible, in line with the hierarchical approach to risk prevention.
- Include clear instructions on use of existing engineering controls in all training, instructions and standard operating procedures.
- Work with British Glass and its other container manufacturing members to share experience and good practice.
- British Glass member companies are encouraged to share best practice via participation in working groups or other federation activity whilst respecting applicable competition rules.
- Avoid working on moving machinery where possible.

Leadership and supervision

Because safe operation of IS machines is largely dependent on measures to the lower end of the preventative measures hierarchy – such as appropriate PPE and training – it is vital that a culture of safe working is fostered throughout the organisation.

The actions of senior managers and production supervisors are central to delivering effective control of the health and safety risks in glass manufacturing.

Senior management must give visible indication to the workforce that board level decisions are responsive to health and safety concerns.

Production supervisors, by their everyday examples and actions, have an immediate influence on the safe working of their staff. They must ensure that employees are working to the safe systems of work at all times and appropriate action is taken when employees are found to not be complying with safe systems of work.

The company should be able to demonstrate:

- senior level commitment to health and safety issues (safety policy)
- systems to effectively communicate safety issues/decisions/changes to the workforce

- line mangers receiving formal training in supervisory skills and health and safety effectiveness
- supervisors and operators shall be aware of the hazards and control measures
- measurement of health and safety performance
- safety inspections and supervision of machine operators
- competence and skills assurance
- mechanisms to consult with and pro-actively engage the workforce on health and safety
- system to enable staff to report hazards
- effective disciplinary system for breaches of health and safety procedure

Risk assessments and improvement plans

Because of the nature and complexity of IS machine use, all companies will have dedicated risk assessments covering their IS machine job change, operation and maintenance/repair procedures. Risk assessments will not be confined solely to the mechanical operation of the machine but will also include such items as: COSHH, manual handling, compressed air use, slips and falls, hot surfaces, noise and broken glass.

The precise methodology for producing assessments will be company-specific and is outside the scope of this document. However, the following general principles should be followed in all companies:

- Assessments should be made for all significant and foreseeable aspects of operation, maintenance and repair and cleaning activities. Assessment of risk should include input from the IS users (or their representatives).
- Standard operating procedures and safe systems of work should mirror the control measures in the relevant risk assessments.
- Users of the IS machines should be made aware, through documented training, of all risk assessments that relate to their activities.
- Established users must be made aware of and understand any new risk assessments, or any changes to existing control measures.

Risk assessments should feed into an improvement plan that seeks to continuously reduce risks (as far as is reasonably practicable). The improvement plan should:

- Implement measures in line with hierarchical approach and included timescales and a named responsible manager for all measures stipulated.
- Be subject to documented reviews at regular intervals, which should be reported to senior management.

Instruction and information

Standard operating procedures

The risk assessments should be used as the basis for comprehensive standard operating procedures to cover all foreseeable hazards of IS machine operation, maintenance and repair and cleaning activities.

As a minimum, companies would be expected to ensure that SOPs are:

- specific to the particular make and model of IS machine.
- readily available to all employees involved in the activity in their current and correct version.
- true representation of actual working practices.
- subject to mechanisms for staff to raise concerns or make suggestions e.g. hazard and near miss reporting.
- subject to version control to show changes.
- trained and refreshed to all relevant employees.

Individual SOPs should, as a minimum, address:

- risks to the operator and control measures (engineering controls, PPE, COSHH etc.)
- plant start-up and shut-down.
- routine operating procedures and philosophy.
- abnormal operating procedures (glass jams).
- emergency and temporary operating procedures.
- engineering controls.
- personal protective equipment (PPE).

The following measures will help to make SOPs more user-friendly and easily understood:

- provide an overview of the task .
- keep language simple and use pictures and diagrams and avoid being overly prescriptive (this is especially important for staff who struggle with written English).
- use terminology that is consistent with the control, labels and signage on the machine.
- position warnings, cautions or notes immediately next to the hazard.
- involve the operators in writing the SOPs where possible.

Permit to work schemes

While SOPs based on risk assessments will be prepared for all foreseeable events, breakdown and maintenance situations will inevitably occur for which no formal risk assessment or SOP exists.

Companies must have procedures in place to cater for this, a detailed *permit to work* system which ensures appropriate controls and methods of working are in place for activities which lie outside of their normal SOP.

All work that is carried out that does not have risk assessment or SOP must be carried out under a permit to work. The permit to work must include assessment of hazards, control measures and a brief method statement.

The permit to work should be signed by an independent person from the work or task. Permit to work authorisers should have received relevant training on permit to work.

Supplier information

Material provided by machine suppliers, such as instruction sheets, manuals, instruction placards, warning labels and training manuals should also be documented and readily accessible as and when required.

Such documentation will be machine-specific and reflect the different operational and control features that exist between machine types.

Training

As the safe operation of an IS machine is heavily reliant upon safe systems of work, the importance of adequate and appropriate training cannot be over emphasised.

The complexity and importance of the machines dictates that companies will have a dedicated and documented training procedure for all activities. Individual companies will develop their own training strategies but essentially duties will fall under the broad headings of machine operation, maintenance and repair and cleaning activities.

All aspects of the training programme should be documented and a register detailing the training received and the competency achieved by each employee will be maintained. All such documentation will available for inspection by authorised regulating bodies when required.

As minimum companies would be expected to hold records to demonstrate that:

- only trained individuals who have been formally assessed as competent in specific activities are permitted to operate or otherwise work on IS machines
- training given is consistent with working practices, SOPs and instruction manuals
- trainee operators or maintenance personnel only access the machines under close supervision
- training is delivered by recognised company trainer
- all IS users have completed the basic factory induction course
- all IS users are retrained and/or reassessed in the event of significant changes to operating procedures, any prolong absence from the activity or a set time has elapsed (5-years is recommended).

As a minimum, the training should include:

- machine controls.
- operating manual.
- standard operating procedures.
- abnormal operating procedures.
- emergency and fire drills.
- firefighting equipment skills.
- starting/stopping a section.
- maintenance operations affecting the operator.
- reporting defects and safety concerns.
- working alongside others.
- manual handling.
- housekeeping.
- personal protective equipment.
- environmental hazards including; noise and elevated temperatures.
- key safe behaviors.
- risk assessments.
- disciplinary actions.

Housekeeping

The risks posed by poor housekeeping in the vicinity of IS machines include:

- inability to read control panels – from build-up of dirt/oil.
- slips and trips – from spilt swab lubricant/oil or temporary positioning of machine parts during repairs.
- fire – from storage of combustible materials or poorly maintained, oily or dirty machines being more likely to catch fire.
- cuts/punctures – from broken glass.

Housekeeping should be a planned and monitored activity, and companies are expected to provide evidence that:

- the person/people responsible for keeping the immediate area around the IS machine clean and tidy is clearly defined.
- floors are cleaned on a regular basis (minimum 1 per shift), preferably with a mechanical cleaner.
- equipment for cleaning spills is readily available.
- work area is routinely inspected and the results recorded e.g. daily observation report.

Personal protective equipment

Personal protective equipment (PPE) is at the bottom of the hierarchy of measures to be considered in a safety strategy, and is used when all practical engineering controls and safe systems of work have been applied yet some risk might remain.

In a working glass factory PPE is, and will remain, an indispensable feature. Companies should be expected to provide evidence that:

- risk assessment of activities has identified appropriate PPE.
- correct use of PPE forms part of the documented SOPs and training.
- prominent signage indicates areas where its use is required.
- disciplinary action is taken for non-compliance with PPE.
- PPE is provided free of charge.
- employees are provided with appropriate storage facilities for PPE.
- all PPE is CE marked.
- employees are trained in its proper use including the limitations of the item and how to detect and report faults with PPE.

Equipment should be chosen that suits the user with regards to size, fit and weight. Where possible get the users involved with choosing PPE options and this will ensure that the PPE is ‘fit for purpose’ and that the users’ needs are fulfilled as far as possible.