

Small and Mini Harvesting & Extraction Machinery: a Guide to their Selection for Safety

Forest Research

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Technical Development helps develop, evaluate and promote safe and efficient equipment and methods of work, maintains output information, advises on forest operations and provides related specialist services.

The list of products/manufacturers in this report is not comprehensive, other manufacturers may be able to provide products with equivalent characteristics. Reference to a particular manufacturer or product does not imply endorsement or recommendation of that manufacturer or product by Forest Research or Technical Development.

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1 Summary

In this report we, in Technical Development, offer you, the forestry managers, supervisors, advisors, contractors and operators, information and advice on a range of small and mini-scale forest machinery. We hope you will use it when considering what equipment is best for your specific harvesting and extraction operations.

The report provides you with definitions of machinery from large-scale through to mini-systems. Small-scale has a weight range of between 3 and 6t. Machinery weighing less than 2.50t is classified as mini, including systems such as all-terrain cycles (ATC) and pedestrian controlled machines, such as the Iron Horse.

We also highlight information on the relevant safety regulations, including regulations implementing the EU Machinery Directive; the Lifting Operations and Lifting Equipment Regulations (LOLER) and the Provision and Use of Work Equipment Regulations (PUWER) etc. We tell you about the relevant publications and other safety standards manufacturers use to show that their product is fit for purpose and marketable within the European Community. Information is similarly set out referring to the Health & Safety at Work Act 1974 (HASAWA) and the Management of Health and Safety at Work Regulations 1999 (MHSWR) indicating the responsibilities for employers and the self-employed under the relevant regulations.

We highlight the importance of information on the safe operation of equipment by referring to documents, such as the Operators Manual/Handbook and Forest Industry Safety Accord (FISA) guides.

There is a reference guide to assist you to review systems and decide which machinery is suitable for your situation or conditions. To help you make your decision you will need other information, such as site, terrain, slope, crop, tree size, operator knowledge and ability.



The information we give highlights aspects of particular machines or combinations which may compromise their ability to form part of a safe system of work, especially in relation to roll over, falling object and operator protection.

Without a safe system there may be serious risk to life or limb.

In the Appendices you will find information on a selection of machines which we believe are examples of that class – from pedestrian controlled machines to small forwarders. We briefly describe the machine, drive, weight, power, load capacity, terrain suitability and training requirements. It is important to note that we do not promote or market any particular machine or system.

2 Introduction

Over the past 20 years we, in Technical Development (TD), have been involved in appraising machinery and systems for the harvesting and extraction of forest products. The most common are the large systems, such as tractor/winch combinations, tractors fitted with a loader/trailer combinations, tractor/prime mover with loader/harvester head through to the purpose-built machines, such as John Deere, Ponsse and Komatsu.

Where these machine types are not suitable on a particular forest site due to their size, weight, cost and capacity or the soil, terrain conditions, crop size and/or environmental considerations, you can often use smaller-scale equipment. In the past we have carried out appraisals on these systems, produced reports and organised workshop demonstrations to promote their use.

FC staff and many in the forest industry have raised concerns about where small and mini-scale equipment can be used safely and effectively without compromising operator safety. There is a need to clarify:

- how they comply with HASAWA and give guidance on how employers, self-employed and employees should operate and manage these systems safely in line with MHSWR;
- what provisions of the EU Machinery Directive 2006 (and earlier) have been implemented, especially regarding Roll Over Protection (ROPS), Falling Object Protection (FOPS) and Operator Protection (OPS); and
- how they comply with both LOLER and PUWER.

The **principle** output of this project is to provide clear and unambiguous information on the minimum health and safety requirements of small and mini-scale harvesting and extraction equipment.

In this report we have provided key statements in highlighted boxes:

Grey: Information



Blue: Practice



Suggested action



Warning



Consider

3 Project objectives

Produce clear and unambiguous written information on the minimum health and safety requirements for small and mini-scale harvesting and extraction equipment, linked to the relevant legislation.

Review and compile a list of the current small and mini-scale machinery, by types.

Develop a checklist/information to help you select equipment and safe systems of work, this includes:

- machine type;
- summary of technical information;
- traction – drive;
- drawbar weight limitations;
- machinery protection:
 - Roll Over Protection Structures (ROPS);
 - Falling Object Protection Structure (FOPS); and
 - Operator Protection Structures (OPS);
- terrain limitations;
- applicable site specifications; and
- operational limitations.

An accompanying report TD Job Report 150, 'Small and medium harvesting and extraction machinery-a guide to site suitability' describes the decision making process for appropriate selection of machinery for site and crop conditions.

4 Project method

The project was delivered by carrying out each of the following:

- literature search;
- field visits; and
- discussions and meetings with forest staff, machine operators, private forest companies and machine suppliers.

5 Key output

The key output of the project is Table 3 and its associated guidance that starts at Section 7.2. However, it is essential for anyone using this report to refer to the sections on:

- Health and safety law and requirements – Section 6; and
- The definitions and capabilities of machinery and systems – Section 7.

6 Health & safety law and requirements

6.1 Requirements for employers, the self-employed and those in control

There are several items of legislation that you need to be aware of if you are organising the use of small-scale machinery.

HASAWA describes the duties of employers to their employees. In Section 2 (2) it says that you must provide and maintain so far as reasonably practicable:

- plant and systems of work that are safe and without risk to health;
- systems for the handling, storage and transport of articles and substances that are safe and without risk; and
- information, instructions, training and supervision to ensure health and safety of their employees.

In Section 3(2) it says that the self-employed must conduct their operation so that, as far as is reasonably practicable, they and others are not exposed to risks to health and safety.

In general, when managing health and safety there is a hierarchy of control measures:

- **Eliminate** – don't do the work.
- **Substitute** – do the work a different way.
- **Engineering Controls** – these do not eliminate the hazards, but isolate people from the hazard.
- **Admin controls** – systems and processes, how people work. Do not remove the hazard, but limit people's exposure to it.
- **Personal protective equipment (PPE)** – least effective means of controlling the hazard.

When making decisions, you as the employer or self-employed should work through this **hierarchy**.

In terms of substitution, for example, you should consider larger/purpose-built machines first and / or using a suitable contractor with a safe system.

For engineering you should consider the need for ROPS including seat restraints, FOPS and OPS.

Admin controls will include documented safe systems of work, including training and competence.

Personal protective equipment, such as a helmet, is the last item on the hierarchy of controls and is there to mitigate the results of failure in engineering or systems.

6.2 Requirements for manufacturers or suppliers

There are several pieces of legislation that machine manufacturers or suppliers need to follow or be aware of to enable them to market and sell their machinery across the European Union.

1. EU Machinery Directive 98/37EC (Amended 2006/42/EC).
2. Supply of Machinery (Safety) Regulations 2008 (amended).
3. Health & Safety at Work Act (HASAWA) 1974, Section 6.
4. Provision and Use of Working Equipment Regulations (PUWER) 1998¹.
5. Lifting Operations and Lifting Equipment Regulations (LOLER) 1998.

The EU Machinery Directive, implemented by the Supply of Machinery (Safety) Regulations and HASAWA Section 6, require manufacturers (or authorised representatives in the EU) to ensure that all new machinery they supply is safe, including small scale equipment. This includes second-hand machinery which is new to the EU.

The regulations also require that:

- machinery meets all relevant Essential Health and Safety Requirements (EHSR) of the Supply of Machinery (Safety) Regulations and that documentation or instructions are in the language of the end user;
- a technical file for the product has been produced and examined by a notified/conformity assessment body;
- a Declaration of Conformity has been completed; and
- there is a CE mark on the machinery indicating 'Declaration of Conformity'.



It is important that employers and the self-employed understand that the CE marking 'Declaration of Conformity' indicates that the equipment is fit to sell and market, but please note that it does not necessarily indicate that it is fit for use in a specific manner, condition or task.

6.3 Relevant legislation

The Health and Safety at Work Act 1974 is supported by various Regulations, some of which also implement EU Directives, particularly the Machinery Directive.

¹ PUWER does not place a duty directly on the supplier, but they should be aware of its requirements so that they can facilitate compliance by duty holders.

The Management of Health and Safety at Work Regulations, sometimes referred to as the 'management' regulations, are aimed at employers, managers and others with responsibility for health and safety. They state that as part of managing the health and safety of any business, the risks in the workplace must be controlled. To do that you need to think through **risk assessment** about what might cause harm to people and decide whether you are taking reasonable steps to prevent that harm. We provide you with more information on the items, criteria and conditions that you need to consider when carrying out a risk assessment in Section 6.9.

The PUWER regulations require the proper selection of suitable work equipment by employers, the self-employed or those in control in terms of:

- its construction and design;
- where it is to be used; and
- what it is to be used for.



PUWER regulations require 'that where there is a risk of mobile work equipment overturning, or operators being struck by objects it is minimised – typically by the fitting of ROPS, FOPS and OPS structures'.

Information on HASAWA, LOLER and PUWER Regulations for forest operations is available from the HSE website, www.hse.gov.uk.

The LOLER regulations apply to employers, the self-employed and people in control of, or managing operations. They require that all lifting operations are properly planned, that lifting equipment is used in a safe manner and that, where necessary, lifting equipment is thoroughly examined. Forest machinery which lifts loads over people and lacks ROPS and FOPS are more likely to require a periodic thorough examination under LOLER.

6.4 ISO, British and EN Standards

Many machines constructed for forestry operations, from a chainsaw to a large purpose-built harvester, are constructed and tested following guidance from a vast range of International Standard Organisation (ISO), British (BSI) and European (EN) Standards. The most common ISO Standards for forest machine construction are those related to safety, construction and testing. Here are the titles of key standards and we provide more detail in Section 12.

- ISO 11850, Safety in Forest Machines.
- ISO 8082, Roll-over Protective Structures (ROPS).

- ISO 5700, Tractors for Agricultural & Forestry – Roll Over Protection.
- ISO 8083, Falling-object Protective Structures (FOPS).
- ISO 8084, Operator Protective Structures (OPS).
- ISO 5131, Acoustics: Noise Measurements at the Operators Workplace.
- ISO 2631, Mechanical Vibration and Shock, Human Exposure to Whole-body Vibration.

6.5 Operator’s manual or handbook

In the Supply of Machinery (Safety) Regulations 2008 there is a defined clause which indicates that the manufacturer of the equipment must supply an Operator’s Handbook or Manual when selling the machine. This also applies to the equipment being re-sold by another person or agent. The handbook or manual is a vital part of maintaining the safe and efficient operation of the equipment regardless of its type and it must always be available.

Unfortunately operator’s manuals are sometimes poorly written and do not always comply with the legal requirements or contain the information required.

A handbook or manual should give the operator guidance on the following.

1. **What the machine is.**
2. **Symbols and decals** – safety aspects for its operation and use.
3. **General safety precautions** – such as risk zones, rope dimension, access and exit.
4. **Assembly and parts** – parts and components required to complete fabrication.
5. **Fuel and oils** – type of fuel and oils and the method of filling.
6. **Starting and stopping** – standard stop-start method and identification of emergency stop procedures.
7. **Working and operational method** – an important part of the document highlighting the work and operational techniques to ensure safe operation. Specific training and certification that can be obtained from a professional training body or organisation before operation may also be stated in the handbook or by the manufacturer or their agent.
8. **Maintenance and schedules** – this may be in a separate document from the handbook and cover more technical aspects of the machine – aimed at an engineer/mechanic.
9. **Transportation** – safest method of transport or movement between sites.
10. **Technical data** – brief description of the machine, including traction aids and other supporting information, such as carrying, towing and tongue (bar holding the tow hitch) weight.



Individual machines, or in combination, must not be used outside the parameters set in the manufacturers’ guidance/manual.



A good example of this is the operation of an All Terrain Cycle (ATC) or mini-tractor where the tongue and towing weight of the 'Prime Mover' is compromised by the attachment and load.

6.6 Managing vibration

The management of vibration exposure is an important factor to consider in the health and well-being of machine operators. The two factors you need to consider are:

1. Hand-Arm Vibration Syndrome (HAVS); and
2. Whole-body Vibration Syndrome (WBVS).

As stated, manufacturers need to give an indication of the vibration levels for their equipment. Using these figures can help with calculating exposure values and action values so an operator can be removed from the exposure. Information is available on the HSE web page offering help with the protocols and facilities to manage vibration.

6.7 Operator competence and training

Information on operator training can initially be obtained from the manufacturer and the Machine Operators Manual/Handbook. You can get more information on specific training, competence, certification and awards from FC Learning and Development, LANTRA, (www.lantra.co.uk) and the National Proficiency Training Council, (www.nptc.co.uk).

6.7.1 Training and supervisory management

Training courses are available to help supervisory staff with managing forest operations, health and safety, risk assessment and contract management. You can get details on courses from FC Learning & Development, FISA and other providers.

6.8 Forest Industry Safety Accord (FISA) guidance

The forest industry within the United Kingdom has, for many years produced basic guidance on the health and safety of all forest operations, machinery and tasks. A suite of guides is available offering basic information on health and safety, personal protective clothing, operation of the equipment and general maintenance of various tools.

The following [FISA guides](#) are relevant to the use, management and supervision of small and mini-scale forest operations.

- FISA 501 – Tractor units in tree work
- FISA 502 – Extraction by skidder
- FISA 503 – Extraction by forwarder
- FISA 504 – Extraction by cable crane
- FISA 506 – Extraction by horse
- FISA 603 – Mechanised harvesting
- FISA 703 – Debogging and recovery of forest machines
- FISA 704 – Excavators in tree work
- FISA 705 – Steep slope working in forestry
- FISA 802 – Emergency planning
- FISA 804 – Electricity at work – Forestry
- FISA 805 – Training and certification.

6.9 Site and operations risk assessments

With all forest operations involving machinery and equipment, you have to carry out risk assessments to comply with the MHSWR to determine where the system can operate without compromising the safety of the operator, other individuals on site and the machine. You can use this for planning and selecting machinery and site management, as well as the operation and efficiency of the machine.

Here are some other factors you will need to consider in preparing a risk assessment:

Site – Site assessment needs to consider the terrain, slope and conditions. These are physical factors which you can use to plan the operation, for example to indicate the felling method and presentation, the extraction method, distance, route selection and roadside management. Assessment of the site will show you what machinery is suitable.

Crop – Such as tree volume, total volume and products likely to be produced also give an indication of the machinery you can use and the management of operators' health, safety and well-being.

Machinery - Here are some points you will need to consider.

- ⚠ Information on working technique from the Operator's Handbook or Manual.
- ⚠ Working limits of the machine (from Handbook).
- ⚠ Engineering safety checks and component inspection (from maintenance schedule in Operator's Handbook).
- ⚠ Safety structures on the machine e.g. ROPS, FOPS, OPS.
- ⚠ Extent of public access restrictions.
- ⚠ Risk Zone between machine/operators on site.

- ⚠ Lifting capacity of loader.
- ⚠ Load limit on ropes.
- ⚠ Load capacity of machine.
- ⚠ Towing capacity.
- ⚠ Tongue weight – particularly important on the potential use of ATCs (quad bikes) and Tractors.
- ⚠ Load weight distribution.
- ⚠ Mechanical safety controls.
- ⚠ Whole Body Vibration exposure.
- ⚠ Hand-arm Vibration exposure.
- ⚠ Working position of the operator.
- ⚠ Operator competence and training.

You can find more information on the procedure and practice for carrying out a risk assessment in [Health & Safety–Assess the Risk \(Operational Guidance Booklet 24\)](#).

7 Definitions and capabilities of machinery and systems

The use of small scale machines in Britain has been intermittent, with periods of high use and at other times low use with only a handful of systems in operation. They are more commonly used in Scandinavian countries where many farmers and forestry contractors have a small machine available when required or, in some cases, in continual use.

These range from mini pedestrian operated systems, such as the Iron Horse to the intermediate forwarder machines with a carrying capacity up to 5m³. Originally the manufacturers of the systems only supplied a forwarder unit with the timber cut and converted by chainsaw then loaded either manually or hydraulically. Now many of them offer a harvester which has been adapted from the forwarder unit.

7.1 Existing standards and classifications

There is no internationally recognised definition for machinery scale in forestry. ISO, British and European standards for forest machines indicate terms, definitions, classification and safety criteria for the equipment but do not define 'scales of machines'.

Within the UK forest sector the definition of small-scale has traditionally related to small equipment, such as all-terrain cycles, small agricultural tractors (designed for orchards or vineyards) and small purpose-built forwarders/harvesters.

Publications by Technical Development (TD) have traditionally made reference to the nominal working scale of operations i.e. Small 0-5ha, Medium 6-20ha and Large 20+ ha.

The definition of scale historically indicated by TD for machine size is shown in Table 1, from large to small.

Table 1 TD definition of large to small machines

Description by Machine Weight	Large	Medium		Small
	25 - 12 tonne	12 - 9 tonne	9 - 6 tonne	6 - 3 tonne
Harvester	Wheeled frame steered purpose built or purpose-built/modified excavator (can include self-levelling base).	Wheeled frame steered purpose built or purpose-built/modified excavator.	Wheeled frame steered purpose built or purpose-built/modified excavator.	Agri tractor or frame steered purpose-built + felling/shear head.
Guide to tree diameter	c 70 cm	c 60 cm	c 50 cm	c 30 cm
Harvester Head	Disc saw or Chainsaw – with accumulator.	Chainsaw, Disc saw, Shear – with accumulator.		Chainsaw or Shear.
Forwarder	15–20 t (payload)	10 -15 t	6 – 10 t	3 – 6 t
	Purpose-built - Wheeled frame steered.	Purpose-built – wheeled frame steered + Agri. Tractor.		Purpose-built wheeled frame steered.

A separate definition for MINI systems of less than 2.50 tonne was also identified and is shown in Table 2.

Table 2 TD definition of mini systems (<2.50t)

Description of Machine	Mini Systems			
Type	Mini Forwarder: Wheel frame steered purpose built unit.	Compact Tractors and Forwarding Trailer: 4-wheeled tractor either frame or standard steered.	All Terrain Cycles: Wheeled (Motor Cycle) unit and trailer/trailed system.	Pedestrian controlled: Wheeled/Tracked driven unit.
Load capacity (tonne)	< 2.5	< 2.5	Based on manufacturers towing capacity.	1 – 1.5

You can find more guidance on the definition of small-scale in the City & Guilds, NPTC Level 2 Award in Forest Machine Operations – Base Machine (QCF), 600/9102/2.

This states that any machine less than 2.50 tonnes (unladen weight), either tracked or wheeled, is classed as 'small scale'.



For the purpose of this project the machinery discussed will only include those defined by Technical Development as being in the Small and Mini categories.

To determine the classification of the systems available we have split them further into:

1. **Pedestrian controlled** – where the operators walks alongside the machine.
2. **Operator Ride On** – where the operators sits on (astride) the machine.
3. **Operator Sits In** – where the operator sits in (a Cab/Seat).

You can find examples of the machines and systems in Section 11.

7.2 Information and points to consider when selecting machinery

The selection of machinery for tree harvesting and extraction in the UK has historically been towards using large-scale systems and 20+ tonne base extraction systems. However, their use in small woodland plots, with small volume trees and on sensitive sites, especially where there may be soil and/or ground protection issues, are not always suitable and you may have to consider smaller machines.

The information offered in this document will help you identify suitable small or mini-scale machines for your operation.



Before determining the machine type or method a critical review of the operations is required considering:

- **Site**
- **Ground conditions**
- **Terrain classification²**
- **Proposed working method.**



Only then can you properly judge the machine or system that does not compromise the health, safety and well-being of anyone, if necessary eliminating some options.

Information on the systems described (Table 3) may help you select the right machinery. The list starts with small-scale systems and cascades down through the machinery to pedestrian systems.

When using the table you need to consider the hierarchy of the control measures as we have previously discussed:

- ⚠ Eliminate.
- ⚠ Substitute.
- ⚠ Engineering Controls.
- ⚠ Admin Controls.
- ⚠ Personal Protective Equipment.



If you are using these controls and there is still a health and safety risk to the operator, employee or others, and it cannot be removed, then do not use the machine or system and consider other systems.

The critical safety items are coloured using a 'Traffic light system':

² Forestry Commission, Technical Development Branch (2005). Terrain Classification. Technical Note 16/95

Green:



Engineered to specific controls that meet designated standards, so should be suitable within a safe system.

Amber:



Engineered to a defined control, however variable in standard (e.g. Different thickness in Polycarbonate glazing, mesh or plated protection, Operator working position and Hydraulic slew pot stops) so careful attention to system would be needed to ensure safe operation.

Red:



No engineered safety devices so in many situations safety would be compromised regardless of system.

Use the classification of characteristics from Green, through Amber to Red within your risk assessment process for the operation.



Green classifications imply fewest restrictions on the possible selection of the machine class, Amber implies that the machinery class may have greater limitations and Red the most restriction. In all cases machinery should only be used if the risks are assessed as acceptable, whatever the colour coding.



There may be variation in safety provision within a machinery class e.g. examples of 'Red' or 'Amber' in 'Green' machinery class, so you will need to individually assess the actual machine you intend to use.

Table 3 Machinery selection



Please read this table in conjunction with the previous page, so you can assess the overall suitability of any machine. See Section 11 for more details.

	SITE CAPABILITY	CROP – PRODUCTS CAPABILITY	SAFETY LIMITATIONS	OPERATION
Small Forwarder	<p>Gentle to moderate slopes 30 – 50%</p> <p>Defined tracks – reducing side slope.</p> <p>Low – moderate size and density of obstacles.</p> <p>Moderate extraction distance <450m.</p>	<p>Small trees from first thin operation.</p> <p>Second thin (trees $\geq 0.10\text{m}^3$)</p> <p>Small roundwood and logs up to 5.0m.</p> <p>Continuous Cover Forestry (CCF), Alternative to Clearfell (ATC), PAWS and standard forest conditions.</p>	<p>ROPS, FOPS, OPS variable dependant on manufacturer’s data. Advised to check specification against FISA and H&SE guidance.</p> <p>Load capacity range from 2.00 – 6.00t.</p>	<p>Sit in operation.</p> <p>Controls for loader in the cab.</p> <p>6 or 8 wheel drive.</p> <p>Trailer & 4x4/tractor to transport.</p>
Small Harvester	<p>Gentle to moderate slopes.</p> <p>Defined tracks – reducing side slope.</p> <p>Low – moderate size and density of obstacles.</p> <p>Moderate extraction distance <450m.</p>	<p>Small trees from first to second thin (trees 0.10 to 0.30 m³).</p> <p>Small round wood and short pole lengths.</p> <p>CCF, ATC, PAWS and standard forest conditions.</p>	<p>ROPS, FOPS, OPS very variable dependant on manufacturer’s data. Advised to check specification against FISA and H&SE guidance.</p>	<p>Sit in operation.</p> <p>Controls for loader in the cab.</p> <p>6 or 8 wheel drive.</p> <p>Trailer & 4x4/tractor to transport.</p>
Small Skidder	<p>Gentle to moderate slopes.</p> <p>Defined tracks – reducing side slope.</p> <p>Low to moderate size and density of obstacles.</p> <p>Moderate extraction distance <450m.</p>	<p>Small trees from first to second thin (small trees 0.10 to 0.30).</p> <p>Short pole lengths.</p> <p>CCF, ATC, PAWS and standard forest conditions.</p>	<p>ROPS, FOPS, OPS variable dependant on manufacturer; usually steel mesh at rear. Standard glazing at front (needs to be changed if not Polycarbonate).</p>	<p>Sit in operation, frame steered.</p> <p>Option of radio control winch actuation.</p> <p>Trailer & 4x4/tractor to transport.</p>
Small Tractors	<p>Gentle to moderate slopes.</p> <p>Defined tracks – reducing side slope.</p> <p>Low obstacles.</p> <p>Moderate extraction distance <450m</p>	<p>Small trees from first and possibly second thin operations (trees < 0.10m³).</p> <p>Small round wood and short pole lengths.</p> <p>Including CCF & ATC operations.</p>	<p>ROPS – either Arch-Bar Type or Cab structure.</p> <p>FOPS or OPS – check manufacturer’s data.</p> <p>Tractors used in forest conditions need to have Polycarbonate/safety glazing if cab is fitted.</p>	<p>Sit in or Sit on.</p> <p>Manual loading of trailer/ancillary equipment.</p> <p>On hydraulic systems operation could be from seat, side of trailer unit or tractor.</p> <p>Critical Risk</p>

	SITE CAPABILITY	CROP – PRODUCTS CAPABILITY	SAFETY LIMITATIONS	OPERATION
				assessment to evaluate loading/operator position.
Mini Forwarder	Gentle slopes. Defined tracks – reducing side slope. Low obstacles. Short extraction distances (200 - 250m).	Small trees from first thin operation. Second thin (trees ≥ 0.10) Small roundwood and logs up to 3.70m. CCF, ATC, PAWS and standard forest thinning and small tree clearfell conditions.	ROPS, FOPS, OPS very variable dependant on manufacturer's data. Advised to check specification against FISA and H&SE guidance. Load capacity range from 1.50 - 3.00.	Sit in operation. Controls for loader in the cab. 6 or 8 wheel drive. Car or 4x4 & trailer transportation.
Mini Trailers	Gentle slopes. Defined tracks – reducing side slope. Low obstacles. Short extraction distances.	Small trees from first and possibly second thin operations (trees < 0.10m ³). Small round wood and short pole lengths. Including CCF & ATC operations.	No ROPS, FOPS, OPS on the trailer. Operator Protection ROPS, FOPS & OPS may not be on the Prime mover – check before use. Suitable Prime Mover with adequate power. Risk Assess for PUWER in relation to FOPS/OPS of the operators working position especially with hydraulic loader. Low load capacity. Variable towing capacity. Variable tongue/ball hitch weight. Ancillary equipment to manufacturer's specification.	Sit on control (ATC - Mini Tractor). Manual loading of trailer/ancillary equipment. On hydraulic systems operation from seat, side of trailer unit. Critical Risk assessment to evaluate loading/operator position. Car or 4x4 & trailer transportation.
ATC	Gentle slopes 0 – 25%. Defined tracks – reducing side slope. Low obstacles – low roughness. Short extraction distances <200m. Brash free routes.	Small trees from first and possibly second thin operations (trees < 0.10m ³). Small round wood and short pole lengths. Including CCF & ATC operations.	No ROPS, FOPS or OPS Exposure to elements and overhead crop conditions. Risk assess for PUWER in relation to FOPS/OPS of the operators working	Sit on control for ATC. Low ground clearance. Option of manual loading. of trailer/ancillary equipment. On hydraulic systems operation from seat,

	SITE CAPABILITY	CROP – PRODUCTS CAPABILITY	SAFETY LIMITATIONS	OPERATION
	Small jobs.		<p>position especially if used with a trailer & hydraulic loader.</p> <p>Low load capacity (0.25 to 0.50t) including trailed unit.</p> <p>Low towing capacity.</p> <p>Low tongue/ball hitch weight, affected by terrain.</p> <p>Ancillary equipment to manufacturer's specification.</p>	<p>side of trailer unit. Critical risk assessment to evaluate loading/operator position.</p> <p>Car, 4x4 & trailer transportation.</p>
Pedestrian	<p>Gentle slopes 0 to 20%.</p> <p>Defined tracks – reducing side slope.</p> <p>Low number of Obstacles.</p> <p>Short extraction distances of <150m.</p> <p>Suited to small jobs.</p>	<p>Small trees from first and possibly second thin operations (trees < 0.10m³).</p> <p>Small round wood and short pole lengths.</p> <p>CCF & ATC.</p>	<p>No ROPS*, FOPS or OPS</p> <p>Exposure to elements and overhead crop conditions.</p> <p>Load capacity 0.50 to 1.00t.</p> <p><i>*In normal use ROPS is not an operator exposure issue</i></p>	<p>Walk/manual control.</p> <p>Manual loading/unloading method.</p> <p>Operation at side of the machine.</p> <p>Car, 4x4 and trailer transportation.</p>

8 Conclusions

In this report we have tried to offer you guidance on the 'Process' of selecting suitable 'Small and Mini-scale' harvesting equipment that will operate safely in a given situation.

The definitions of the systems are described and range from 'Mini' (less than 2.50 tonne), to 'Small' (up to 6 tonne). These include systems from pedestrian controlled to larger ride-in forwarders and harvesters.

We have highlighted information on machinery standards and regulations (ISO – PUWER - LOLER), safety legislation (HASAWA), risk assessment, FISA guidance and related requirements that will enable you to refer to the relevant documentation when managing these systems.

We have described a selection of systems offering you indicative guidance on the type of equipment that is available. However, we do not promote or market any individual machine or system.

You will also need to consider other information, such as site, terrain, slope, crop, tree size, operator knowledge and ability before you settle on a machine or system.

We have provided Table 3 in Section 7 as a reference to help you review the systems so you can decide on suitable machinery for your situation or conditions.

The information also highlights aspects of particular machines or combinations which may compromise their ability to form part of a safe system of work, especially in relation to ROPs and FOPs in the event of an overturning or falling objects.

You can get more information on managing forest operations and aspects of safety, risk assessment etc. from various training providers including FC Learning and Development.

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9 Contact


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11 Appendix 1 – Small and mini-scale machinery

Here we give you some brief descriptions of a selection of small-scale machinery. Other systems and equipment are available and the ones here are purely for illustration.



Slope factors in the tables were taken from the operator’s handbooks. Determine the appropriate slope limits for an operation on-site as part of your risk assessment procedure and agree it with the operator.

This should apply to all machine types identified in this report. The main controlling factor for identifying a slope limit is the risk of machine roll over as well as the operational confidence and competency of the operator.

11.1 Pedestrian controlled systems

A review of pedestrian controlled systems has identified the equipment shown in Table 4. Other systems and equipment are available, those we give here are purely for illustration.

Table 4 Examples of pedestrian controlled systems

Make/model	Iron Horse	OX 14 (Oxen)	Forest Horse MK18
The System	A pedestrian controlled ‘tractor’ with tracks. It can be used as a skidder making use of the integral winch or as a forwarder using a trailer (hand loaded).	Pedestrian controlled 6-wheeled system. Fitted with a manual actuated boom and hydraulic powered winch. Optional forwarder trailer.	Pedestrian controlled wheeled unit with winch and tilting ‘skidder bunk’ that acts as a butt plate for timber. Optional extra, forwarder trailer.
Engine	Honda GX270cc	Briggs & Stratton 14HP	Kohler Pro. 18HP
Drive	V-Belt Variator Transmission.		Hydro-static transmission, drive to front wheels.
Power (hp)	5 - 7	14	18
Weight (kg)	300	500	900
Ground pressure (kg/cm³)	0.15	0.19	0.215
Load (kg)			

Make/model	Iron Horse	OX 14 (Oxen)	Forest Horse MK18
Skidding	500	300	1 000
Forwarding	1 000	1 000	1 200
Trailer	Two wheeled bogie axle collapsible system.	Four wheeled bogie axle collapsible system.	Two wheeled single axle unit.
Winch rope	20m x 6mm	20m x 4mm	30m x 6mm
Site Suitability	Sensitive sites – Low ground impact: Gentle conditions, undulating with slopes. Free of large obstacles (rocks/stumps). (Field trials indicate traction issues, especially on wet gley soils where the wheels slipped within the track system – correct track tension needs to be monitored when in use).		Standard forest terrain with undulating slopes.
Slope Conditions¹ (%)	0 - 30	0 - 30	0 - 45
Engineering standard conformity	Covered by all main EC regulations, PUWER & LOLER however no ROPs, FOPs or Ops. (Ergonomic enhancements fitted and designed into the system to assist operations).		Machines covered by all main EC regulations, PUWER & LOLER however no ROPs, FOPs or Ops.
Training	NPTC Forest Operator Certification Scheme assessment for 'under 2.5 tonne' base unit (tracked or wheeled depending on the machine specification) plus line skidder unit or forwarder unit, dependant on the machine configuration ³ .		



1. Slope factors in Table 4 were taken from the operator's handbook. You will need to determine the appropriate slope limits for the operation on-site as part of your risk assessment procedure and agree it with the operator.

11.2 Operator ride-on

This definition covers systems where the operator sits 'astride' the machine. The usual prime mover is an All Terrain Cycle (ATC). There are many suppliers of these machines e.g. Honda, Suzuki, Kawasaki and Yamaha. The power (hp/kw), 'tongue weight' (weight on the ball hitch) and towing capacity are limiting factors on these machines. Depending on the power, the pulling capacity can be between 385kg for a Honda Foreman 400 and 550kg for a Yamaha 600FW. This includes the weight of the extraction equipment. Information on a range of extraction equipment that can be

³ Forestry Commission Learning and Development.

used with an ATC is given in Table 5. Other systems and equipment are available, those we give here are purely for illustration.



Site conditions are given as a guide but the machinery and system you use must be matched to the conditions using your risk assessment and other relevant site factors.

Table 5 Examples of extraction equipment for ATCs

Make/Model	ATC Skidding Arch	ATC Forwarder Trailer	ATC Trailer & Loading Arch
Description	A towed (ball hitch mounded) metal fabricated 'arch' system. Single axle. Fitted with an electric or petrol driven winch. Material is semi-suspended and skidded out of the forest.	A towed (ball hitch mounded) metal fabricated trailer system. Dual wheeled bogie system. Material manually loaded, using timber handling tools and ergonomic features on the trailer, or hydraulically loaded where built in.	A towed (ball hitch mounded) metal fabricated trailer system. Dual wheeled bogie system. Ancillary metal arch and petrol driven winch fitted to aid loading.
Prime Mover	All Terrain Cycle		
Weight (kg)			
ATC	250 -	250 -	250 -
Trailed Unit	75	150	150
Slope (%)	0 - 30	0 - 30	0 - 30
Drive to Trailer	No	No	No
Engineering standard conformity	ATC, trailer units, electric winches and hydraulic systems should meet all EU machinery regulations. They do not have ROPs, FOPs, OPs.		
Site suitability	Sensitive sites – low ground impact. Smoother, gentle conditions, undulating with slopes up to 25%, avoiding side slopes e.g. by using tracks. Site planning needs to be done to ensure extraction routes are free of large obstacles (rocks/stumps).		
Load capacity (kg)			
Level (slope)	450	500	500
Gentle	350	350	350
Moderate	250	250	250
*Outputs (m³/shr)	0.70 – 1.20	1.40 – 1.70	1.40 – 1.70
Training	NPTC – ATC. NPTC – Forwarder		
* Outputs obtained from work undertaken by Technical Development.			

There are many other manufacturers of small forwarder trailers that can be used with either an ATC or mini tractor, most of them are from north European countries.

Information on a selection of mini timber trailers for either ATC or tractor use is given in Table 6. Other systems and equipment are available, so those we give here are purely for illustration.

Table 6 Examples of mini timber extraction trailers

Make/Model	Riko COT15-330	RIKO COT30-470	Vahva Jussi 400	Kranman T1700
Description	A towed (ball hitch mounded) metal fabricated bolster/skeletal trailer. Dual wheeled bogie system. (Manual hand winch and boom loader). Optional; hydraulic actuated loader which is driven by on board petrol engine and hydraulic system.		A towed (ball hitch mounded) metal fabricated bolster/skeletal trailer. Dual wheeled bogie system. Fitted with a hydraulic actuated loader which is driven by on board petrol engine and hydraulic system.	
Prime Mover	All Terrain Cycle / Mini Tractor.			
Weight (kg)				
Trailed Unit	160	Not supplied	170	210
Loader	170		170	194
Hydraulic Pack	38		38	48
Loader Reach (m)	3.3	3.7	4.0	3.3
Loader Lift (kg)				
@ full	310	334	260	150
@ rear base	420	460	385	350
Loader Slew (°)	330	360	330	330
Drive to Trailer	Yes. Hydraulic actuated steel "capstan toothed wheel" to bogie tyres.	No	No	No
Engineering standard conformity	Trailer units and hydraulic systems meet with EU machinery regulations.			
Site suitability	Sensitive sites – Low ground impact: Gentle conditions, undulating with slopes. Site planning needs to be done to ensure extraction routes are free of large obstacles (rocks/stumps).			
Load capacity (kg)	1 500	3 000	1 500	1 500

Make/Model	Riko COT15-330	RIKO COT30-470	Vahva Jussi 400	Kranman T1700
Operator position*	Depending on the machine the operator can either be situated sitting on the seat (which swivels), kneeling on the seat (fixed) or standing at the rear/side of the ATC or Tractor.			
Training	NPTC – ATC/Mini Tractor & NPTC – Forwarder.			
* The equipment and components meet with EU Directive on their construction; however the working position of the operator may in some circumstances contravene PWER and LOLER Regulations where the load or part of the load can be suspended above the operator's head depending on the controls for the loader.				

11.3 Small articulated tractors

The use of small agricultural converted tractors is not new in forestry. In the early years of timber production the extraction was carried out using adapted tractors and then by dedicated systems, such as the Hydrostat, Holder and Ford County. Their use is gaining in popularity especially in orchards, vineyards, golf courses, green keeping, forestry, woodland management and in general parkland/ground care situations. Designed to have a low centre of gravity to help with traction and working ability, these can either be sit on or sit in. 'Sit in' usually occurs with machines having articulated steering and 'sit on' where the operator sits on a seat and the tractor is steered by the front axle or wheels.

These systems come in a range of sizes, horse power (20-100hp), design and configurations (operator cab – standard safety ROPS bars). Frame (articulated) steered or front wheeled steering. They are designed to be used with a wide range of implements from trailers, winches and grass cutters to snow ploughs and blowers. There are many manufacturers of these machines from across Europe and North America. Information on a selection of tractors is in Table 7. Other systems and equipment are available, so those we give here are purely for illustration.

Table 7 Examples of small scale tractors

Make/Model	Branson 2100	Branson 4520R	Tigrone 5500	AGT 850
Description	Small 4-wheeled drive, 3, cylinder - 21 hp diesel powered tractor. PTO & 3-point linkage system for implements and optional extra of front end loading arm.	Small 4-wheeled drive, 4, cylinder - 40 hp diesel powered tractor. PTO & 3-point linkage system for implements.	Small 4-wheeled drive, 4, cylinder - 48 hp diesel powered tractor. Frame steered, PTO & 3-point linkage system for implements.	Small 4-wheeled drive, 4, cylinder - 48 hp diesel powered tractor. Frame steered, PTO & 3-point linkage system for implements.
Weight (kg)	780	1 843	1 550	1 370

Drive	Manual Gearbox (6 forward – 2 reverse).	Manual Gearbox (8 forward – 4 reverse).	Synchronised Gearbox (12 forward – 12 reverse).
Driving Position	Isolated rubber mounted platform. Fixed seat, lap belt.		
Slope¹ (%)	0 - 30	0 - 30	0 - 35
Drive (hp) to Implement	18	35.5	38
Engineering standard conformity	All EC Machinery Regulations, LOLER, PUWER, ROPs (Front mounted folding bar) – No FOPs or Ops.		All Machinery Regulations, LOLER, PUWER, ROPs (Optional Operator’s cab or front mounted folding bar) – No FOPs or Ops.
Site Suitability	Sensitive sites – Low ground impact: Gentle conditions, undulating with slopes up to 30%. Site planning needs to be done to ensure extraction routes are free of large obstacles.		Same as other tractors, slope slightly increased to 35%.
Training	NPTC – Tractor/ATC . NPTC- Forwarder Unit or Skidder.		



1. Slope factors noted in Table 7 were taken from the operator’s handbook. You will need to determine the appropriate slope limits for the operation on-site as part of your risk assessment procedure and agreed with the operator.



You will have to assess the working position of the operator when using either an ATC or small tractor and a forwarder trailer to ensure that their safety is not compromised. Only after an appropriate risk assessment can you judge which machine/system does not compromise the health, safety and well-being of any individual.

Several mini forwarder trailer systems available have the operator standing at the rear of the headboard on a small plate, on the chassis or drawbar to actuate the loader controls.



If the boom, grapple or load may be suspended over the operator’s head at any stage during operation, you must act to prevent this by mechanical means or by re-positioning the working position of the operator.

11.4 Mini forwarders

The use of small forwarders in GB is not common with only a small number in operation. However, the number of machine manufacturers and suppliers is increasing, with a greater emphasis on marketing these within the UK. Brief descriptions of a range of mini forwarders are in Table 8. Other systems and equipment are available, those we give here are purely for illustration.

Table 8 Examples of mini forwarders

	Vimek 630 Mini- master	Alstor 8x8	Kranman 6000 6WD	Vimek 606TT	Falcon
Description	ATC style 4-wheeled prime mover fitted with steel "A" frame (ROPs). Loader controls on the frame and driven from hydraulic pump on machine. 4-wheeled skeletal trailer with stabiliser legs.	Purpose built 8 - wheeled unit, with integral engine, drive unit, hydraulic system and loader. Operator situated on seat on front section of the machine.	Purpose built 6-wheeled forwarder unit, integrated operator cabin engine, hydraulic system, loader and timber bunk.	Purpose built 6-wheeled forwarder unit, integrated operator cabin engine, hydraulic system, loader and timber bunk.	Purpose built 8 -wheeled unit, with integral engine, drive unit, hydraulic system, operator cab and loader.
Engine	Honda 630cc petrol.	Briggs & Stratton 16 – 81hp, petrol.	Vanguard 23hp 2, cylinder diesel.	Kubota, 18hp diesel.	Kohler 48hp diesel.
Weight (kg) Tractor + trailer/loader	1 200	1 300	1 900	2 960	3 100
Loader Reach (m)	3.60	3.50	3.50	4.60	5.3
Loader lift (kg)	Not Known	350	200	440	
Loader slew (°)	210		220	270	270
Slope¹ (%)	0 - 30	0 - 35	0 - 35	0 – 35	0-35
Drive to bogie	Hydraulic driven	Constant eight wheel	Hydraulic driven capstan	Hydraulic driven	Hydrostatic drive.

	Vimek 630 Mini-master	Alstor 8x8	Kranman 6000 6WD	Vimek 606TT	Falcon
	capstan to bogie wheels.	drive from hydraulic system.	to bogie wheels.	capstan to bogie wheels.	
Load (kg)	2 000	1 900	1 900	3 000	4 000
Engineering standard conformity	All EC machinery certification. ROPs – No FOPs or Ops.	All EC machinery certification, ROPs. No FOPs or Ops.	All EC machinery certification, ROPs. No FOPs or Ops.	All EC certification, ROPs, FOPs and Ops.	All EC certification, ROPs, FOPs and Ops.
Site Suitability	Sensitive sites – Low ground impact: Gentle conditions, undulating with slopes up to 35%. Site planning needs to be done to ensure extraction routes are free of large obstacles (rocks/stumps).			Sensitive to standard forest plantation conditions, slopes up to 35%. Site planning important to ensure operational efficiency.	
Operator position	To drive – sitting on seat with lap belt. Operating the loader kneeling on seat facing the trailer.			Inside the cab, seat rotates to enable operator to drive the machine or use the loader at the rear.	
Outputs	Not Available				
Training	NPTC Forwarder				



¹. Slope factors noted in Table 8 were taken from the operator's handbook. You will need to determine the appropriate slope limits for the operation on-site as part of your risk assessment procedure and agreed with the operator.



Plate 1 Vimek 606 Mini Forwarder



Plate 2 Alstor 8x8 Mini Forwarder

11.5 Small forwarders

A brief description of a selection of small forwarders is given in Table 9. Other systems and equipment are available, those we give here are for illustrative purposes only.

Table 9 Examples of small forwarders

	Novotny LVS 511	Novotny LVS 520	Malwa 560F
Description	Purpose built 8 -wheeled units, with integral engine, hydrostatic drive unit, hydraulic system and loader. Operator situated in cab on front section of the machine'		Purpose built 6 -wheeled unit with bunk and 4 wheeled trailer. Integral engine, hydrostatic drive unit, hydraulic system and loader'
Engine	Cummins 3.3T diesel		Caterpillar 3.4B diesel
Weight (kg)	4 475	6 400	4 400
Loader Reach (m)	5.2	6.1	6.1
Loader lift (kg)	420	570	550
Loader slew (°)	270		
Slope (%)	0 – 35		0 - 35
Drive to bogie	Constant eight wheel drive – hydrostatic system'		Constant six wheel drive – hydrostatic system''
Load (kg)	4 000	5 00	5 500
Engineering standard conformity	Full EC certification including ROPs, FOPs and Ops		
Site Suitability	Sensitive to standard forest plantation conditions, slopes up to 40%. Site planning important to ensure operational efficiency'		
Operator position	Inside the cab, seat rotates to enable operator to drive the machine or use the loader at the rear'		
Outputs	Not Available		
Training	NPTC Forwarder		



¹. Slope factors noted in Table 9 were taken from the operator's handbook. You will need to determine the appropriate slope limits for the operation on-site as part of your risk assessment procedure and agreed with the operator.

11.6 Small harvesters

Over the past 10 years there has been continual development on the availability of small scale harvester units. This trend is seen as a return to the original idea of mechanisation where earlier small forwarders, such as the Brunnett, Norcar and Gremo were adapted with a loader and harvester/processor head unit. Information on three small harvesters is in Table 10. Other systems and equipment are available, those we give here are for illustrative purposes only.

Table 10 Examples of small harvesters

	Usewood Pro	Vimek 404T5	Malwa 560H
Description	Purpose built 8-wheeled units, with integral engine, hydrostatic drive unit, hydraulic system and loader. Operator situated in cab on rear section of the machine.	Purpose built 6-wheeled units, with integral engine, hydrostatic drive unit, hydraulic system and loader.	
Engine	Kubota 23.5hp diesel	CAT 2.2T diesel	CAT 3.4B diesel
Weight (kg)	1900 – 2000	4 400	5 400
Loader Reach (m)	3.8	4.60	8.0
Loader lift (kg)	350	400	400
Loader slew (°)	270	250	270
Drive to bogie	Hydrostatic		
Cutting Attachment	UW160 energy to 180s felling grapple.	Keto Forst Silver	LogMax 928
Engineering standard conformity	Full EC certification including ROPs, FOPs and Ops.		
Site Suitability	Sensitive to standard early growth forest plantations, slopes up to 30%.	Sensitive to standard early growth forest plantations, slopes up to 40%.	
Outputs	Not Available		
Training	NPTC Harvester		

11.7 Small tracked skidders

The use of tracked excavators (Table 11) in the forest are mainly in the large scale range, however several smaller units are used for constructing paths, cycleways and for recreational tasks. Other systems and equipment are available, those we give here are for illustrative purposes only.

Table 11 Example of a small skidder

	OxTrac Skidder
Description	Rubber tracked skidder fitted with rope winch, dozer blade, tow hitch and hydraulic system that can accommodate a forwarder trailer with loader.
Engine	Perkins 35.5hp diesel engine.
Weight (kg)	1 800
Winch rope (m)	30
Load Pull Capacity (kg)	3 500
Drive	Hydrostatic transmission.
Attachments	Adaptable to be used with a timber winch or a forwarder trailer unit.
Engineering standard conformity	Meets EC machinery regulations, ROPS & FOPS, no OPS.
Site Suitability	Sensitive to standard forest plantation conditions, slopes up to 30%. Site planning important to ensure operational efficiency and safety.
Outputs	Not Available
Training	NPTC Tracked base unit, and skidder and forwarder base unit depending on use.

12 Appendix 2 – International safety standards

This information gives any owner or contractor guidance on managing the health, safety and welfare of operators and staff.

ISO 11850, Safety in Forest Machines

This standard covers a range of general safety features, components and parts on forest, engineering and industrial machine types. Such items include operator working environment, access method, ergonomics in relation to steps, handrails, safety pads/plates, electrical and engineering safety devices.

ISO 8082, Roll-over Protective Structures (ROPS)

This standard relates to the guidance on the construction and testing of Protective Structures on Forest Machinery - Machine Operator Cabins or Working Station. The standard indicates that the materials used (Steel box or tubing) in construction / fabrication on the Cab / Cabin has to be of such material and strength that it can withstand a complete roll over (360°) placing a force on it of twice the mass of the machine.

Therefore, for a machine with a total mass of 5t, the cabin construction/fabrication and materials must be able to withstand a force of 10t being placed on it in the event of a 360° roll over.

ISO 5700, Tractors for Agricultural & Forestry, Roll Over Protection (ROPS)

This standard relates to the test method and criteria for a ROPS cab or structure constructed or fitted onto or for use on a tractor used for agriculture and forestry. The scope of the standard covers all tractor-based machines either wheeled or tracked to a mass not less than 800kg. It does not cover low-level tractors, narrow vineyard or orchard tractors and certain forestry machines such as forwarders.

Research into ROPS Structures on small tractors less than 800kg was carried out by the HSE (HSL) and Institute of Agricultural Engineers (IAgE, SILSO) in 2001 and 2006 and indicated that machines with a lower mass as indicated in ISO 5700 require a suitable (fit-for-purpose) ROPS structure and restraint - seat/lap belt for the operator to help protect them in the event of a roll over.

The ROPS structure on these smaller machines does not fall into any defined ISO standard, but are recognised within the industry to offer adequate protection. They are mainly constructed with materials following guidelines from existing standards, EU Directives and other EU regulations.

ISO 8083, Falling-object Protective Structures (FOPS)

This standard relates to protective structures constructed on the machine and around the operator cab. These structures could include steel frames constructed around the machine to deflect objects damaging the components/cowling and structures around the cab that offer additional protection to the operator.

Usually these systems are incorporated at the time of manufacture and meet the manufacturer's approval.

Sometimes where these systems are retro-fitted onto the machine by an external engineer they must be to the specification and approval of the machine manufacturer, without compromising the original construction.

ISO 8084, Operator Protective Structures (OPS)

This standard specifically relates to safety glazing and additional protection for the operator while inside the cab. The standard gives guidance on the type of glazing (e.g. Polycarbonate) required for the operation. It does not however give specific information on dimension and size. For example one manufacturer may have their machine fitted with 9mm Polycarbonate following test procedures as per the ISO standard, while another manufacturer may have 12mm. Each manufacturer meets the requirements of the ISO and offers adequate protection against penetration by objects.

ISO 5131, Acoustics: Noise Measurements at the Operators Workplace and ISO 2631, Mechanical Vibration & Shock, Human Exposure to Whole-body Vibration

These standards indicate a 'specific test criteria and conditions' required by manufacturers to follow in obtaining results for noise and vibration that has to be available for any potential user or owner. The information from these tests must be included in the Operator's Handbook/Manual as per (Supply of Machinery (Safety) Regulations 2008 (amended) and Machinery Directive 98/37EC (Amended 2006/42/EC).