

# Learning for CPCS

## Vacuum Excavator - A78



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### Learning Outcomes

Through a combination of targeted training and experience, an individual with a vacuum excavator will be able to:

<p><b>Roles and responsibilities</b></p>	<ul style="list-style-type: none"> <li>Describe the nature of the sector of industry and their role and responsibilities as a plant operator</li> </ul>
<p><b>Preparing for work</b></p>	<ul style="list-style-type: none"> <li>Name and explain the purpose of principal components, the basic construction, controls and terminology</li> <li>Conform with manufacturer's requirements as per the operator's handbook, other types of information source and relevant regulations and legislation</li> </ul> <p><b>Additional Endorsements A to F:</b></p> <ul style="list-style-type: none"> <li>Undertake all pre-use check on the host vehicle/chassis and excavator unit including remote control units</li> </ul> <p><b>Additional Endorsements G &amp; H (Second Operator):</b></p> <ul style="list-style-type: none"> <li>Undertake all pre-use checks on the excavator unit including remote control units</li> </ul>
<p><b>Travelling and manoeuvring</b></p>	<p><b>Additional Endorsements A to F:</b></p> <ul style="list-style-type: none"> <li>Configure and ready for travel (site and highway – where applicable)</li> <li>Manoeuvre in confined spaces</li> </ul> <p><b>Additional Endorsements C to F</b></p> <ul style="list-style-type: none"> <li>Travel over rough, undulating ground both loaded and unloaded</li> </ul>
<p><b>Setting up for work</b></p>	<ul style="list-style-type: none"> <li>Configure and set for excavating duties</li> <li>Check and prepare hose components and fittings</li> <li>Identify, from given information, the working area and safe working positions for the main operator and the second operator</li> <li>Explain the principle requirements for a plan of works</li> <li>Explain actions required for hazards including underground and overhead services, confined areas and when working at height/near to edges</li> <li>Explain relevant communication protocols with others involved in the operation</li> <li>Ensure exclusion zones are sufficient for the intended work, and maintained accordingly</li> </ul>

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<p><b>Setting up for work</b> (Continued)</p>	<ul style="list-style-type: none"> <li>• Explain procedures and legal requirements for transporting waste on public highways</li> <li>• Explain procedures and precautions when excavating on the public highway and in pedestrian areas</li> </ul> <p><b>Additional Endorsements A to F:</b></p> <ul style="list-style-type: none"> <li>• Position the host vehicle/trailer to excavate given areas</li> </ul>
<p><b>Working tasks</b></p>	<ul style="list-style-type: none"> <li>• Remove various types of material to form excavations according to given specifications</li> <li>• Remove material around and expose buried services and objects</li> <li>• Using air or water systems to dislodge materials</li> <li>• Explain the functions, attributes, safety aspects and correct operating procedures of various types of ground agitating tools (air and water) and hose attachments</li> <li>• Explain how the type of terrain can affect tool and attachment selection, and factors that can alter operating procedures</li> <li>• Explain the procedures for safety issues of dealing with blockages</li> <li>• Maintain stability during excavating and discharging operations</li> </ul> <p><b>Additional Endorsements A to F:</b></p> <ul style="list-style-type: none"> <li>• Discharge/remove excavated materials at designated points and into suitable receptacles</li> </ul>
<p><b>Completing work</b></p>	<ul style="list-style-type: none"> <li>• Carry out cleaning procedures following excavation work</li> <li>• Store remote units in appropriate locations (where applicable)</li> <li>• Carry out shut down, securing and isolation procedures</li> <li>• Explain maintenance procedures applicable for ensuring safe operations</li> </ul> <p><b>Additional Endorsements A to F:</b></p> <ul style="list-style-type: none"> <li>• Undertake all post-use check on the host vehicle/vacuum unit including remote control units</li> </ul> <p><b>Additional Endorsements G &amp; H:</b></p> <ul style="list-style-type: none"> <li>• Undertake all post-use checks on the vacuum unit including remote control units</li> </ul>

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### Syllabus

Learning outcome	Training content	
<ul style="list-style-type: none"> <li>Describe the nature of the sector of industry and their role and responsibilities as a plant operator</li> </ul>	<ul style="list-style-type: none"> <li>Industry type</li> <li>Customer/client needs</li> <li>Sector contribution</li> <li>Role</li> <li>Reporting structures</li> <li>Social responsibilities</li> <li>Lifelong skills</li> </ul>	<ul style="list-style-type: none"> <li>Health and Safety at Work Act</li> <li>Environmental issues</li> <li>Other trades</li> <li>Working practices</li> <li>Communication with colleagues / management / other trades</li> </ul>
<ul style="list-style-type: none"> <li>Name and explain the purpose of principal components, the basic construction, controls and terminology</li> </ul>	<ul style="list-style-type: none"> <li>Differing Types</li> <li>Function/applications</li> <li>Power units</li> <li>Hydraulic systems</li> <li>Chassis types</li> <li>Remote control units</li> </ul>	<ul style="list-style-type: none"> <li>Stability / ground pressure</li> <li>Hoses</li> <li>Attachments</li> <li>Safety systems</li> </ul>
<ul style="list-style-type: none"> <li>Conform with manufacturer's requirements as per the operator's handbook, other types of information source and relevant regulations and legislation</li> </ul>	<ul style="list-style-type: none"> <li>Operators Manual</li> <li>Machine decals</li> <li>H &amp; S at Work Act</li> <li>PPE</li> <li>Codes of Practice</li> <li>Site plans / drawings</li> </ul>	<ul style="list-style-type: none"> <li>Method statements</li> <li>Risk assessments / COSHH</li> <li>Inspection and reporting forms / procedures</li> <li>Working at height</li> </ul>
<ul style="list-style-type: none"> <li>Undertake all pre-use checks</li> </ul>	<ul style="list-style-type: none"> <li>Regular and non-scheduled maintenance procedures</li> <li>Working at height</li> </ul>	<ul style="list-style-type: none"> <li>Sequence of pre-use checks</li> <li>Defect reporting</li> </ul>
<ul style="list-style-type: none"> <li>Configure and ready for travel (site and highway)</li> </ul>	<ul style="list-style-type: none"> <li>Travel controls</li> <li>Attachments / accessories</li> <li>Travel position</li> <li>Site travel</li> </ul>	<ul style="list-style-type: none"> <li>Visibility</li> <li>Road Travel</li> <li>Road Traffic Act</li> </ul>
<ul style="list-style-type: none"> <li>Manoeuvre in confined spaces</li> </ul>	<ul style="list-style-type: none"> <li>Visibility</li> <li>Limitations of vision</li> <li>Protection of ground/tight turns</li> </ul>	<ul style="list-style-type: none"> <li>Environmental / noise / fumes</li> <li>Height restrictions</li> <li>Marshalling assistance</li> </ul>

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### Syllabus (Continued)

Learning outcome	Training content	
<ul style="list-style-type: none"> <li>Travel over rough, undulating ground, both loaded and unloaded</li> </ul>	<ul style="list-style-type: none"> <li>Driving controls</li> <li>Ground conditions and speed</li> <li>Traction / aids</li> <li>Starting / travelling on inclines</li> <li>Hazards</li> </ul>	<ul style="list-style-type: none"> <li>Working area</li> <li>Site travel procedures</li> <li>Environment protection / minimise damage</li> </ul>
<ul style="list-style-type: none"> <li>Configure and set for excavating duties</li> </ul>	<ul style="list-style-type: none"> <li>Ground conditions</li> <li>Proximity hazards</li> <li>Work specifications</li> </ul>	<ul style="list-style-type: none"> <li>Exclusion zones</li> <li>Attachments</li> <li>Configuration requirements</li> </ul>
<ul style="list-style-type: none"> <li>Check and prepare hose components and fittings</li> </ul>	<ul style="list-style-type: none"> <li>Types of hoses</li> <li>Types of fittings</li> <li>Checks and inspection procedures</li> <li>Types of defects</li> </ul>	<ul style="list-style-type: none"> <li>Causes of defects</li> <li>Reporting of defects</li> <li>Safety systems</li> <li>Securing types and methods</li> </ul>
<ul style="list-style-type: none"> <li>Identify, from given information, the working area and safe working positions for the main operator and the second operator</li> </ul>	<ul style="list-style-type: none"> <li>Information sources</li> <li>Procuring relevant information</li> <li>Types of information</li> <li>Permit to work requirements</li> </ul>	<ul style="list-style-type: none"> <li>Hazards</li> <li>Working at height/edge protection</li> <li>Proximity to machine components</li> <li>Localised restrictions</li> <li>Excavating/tipping areas</li> </ul>
<ul style="list-style-type: none"> <li>Explain the principle requirements for a plan of works</li> </ul>	<ul style="list-style-type: none"> <li>Information required for planning</li> <li>Risk assessment</li> <li>Method statement</li> </ul>	<ul style="list-style-type: none"> <li>Extracting relevant information</li> <li>Content and plan layout</li> <li>Working area</li> <li>Segregation requirements</li> </ul>
<ul style="list-style-type: none"> <li>Explain actions required for hazards including underground and overhead services, confined areas and when working at height/near to edges</li> </ul>	<ul style="list-style-type: none"> <li>Types of typical services</li> <li>Warning/identification systems</li> <li>Permits to enter</li> <li>Access/egress procedures</li> <li>Emergency procedures</li> <li>Trench collapses</li> </ul>	<ul style="list-style-type: none"> <li>Reporting procedures for damages to services</li> <li>Minimum distances and clearances</li> <li>Operating procedures</li> <li>Access procedures to excavations</li> </ul>

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### Syllabus (continued)

Learning outcome	Training content	
<ul style="list-style-type: none"> <li>Explain relevant communication protocols with others involved in the operation</li> </ul>	<ul style="list-style-type: none"> <li>Limitations to methods of communication</li> <li>Methods of verbal instructions</li> <li>Types of signals</li> <li>Effective communication methods for varying types of work</li> </ul>	<ul style="list-style-type: none"> <li>Organisational procedures</li> <li>Radio communication protocols</li> <li>Level and depth of working instructions</li> <li>Role of second operator</li> </ul>
<ul style="list-style-type: none"> <li>Ensure exclusion zones are sufficient for the intended work, and maintained accordingly</li> </ul>	<ul style="list-style-type: none"> <li>Methods of exclusion</li> <li>Signage</li> <li>Safe systems of work</li> <li>Sufficiency of area for intended works and working radius</li> <li>Procedures when others enter the working area</li> </ul>	<ul style="list-style-type: none"> <li>Area of works and safety parameters</li> <li>Regular checks for exclusion integrity</li> <li>Alternative marked routes for pedestrians</li> </ul>
<ul style="list-style-type: none"> <li>Explain procedures for transporting waste on public highways</li> </ul>	<ul style="list-style-type: none"> <li>Legal requirements</li> </ul>	<ul style="list-style-type: none"> <li>Notification procedures</li> </ul>
<ul style="list-style-type: none"> <li>Explain procedures and precautions when excavating on the public highway and in pedestrian areas</li> </ul>	<ul style="list-style-type: none"> <li>Legal requirements</li> <li>Signage and lighting</li> <li>Notification procedures</li> </ul>	<ul style="list-style-type: none"> <li>Main Operator/second operator safety</li> <li>Alternative routing</li> </ul>
<ul style="list-style-type: none"> <li>Position the host vehicle/trailer to excavate given areas</li> </ul>	<ul style="list-style-type: none"> <li>Following signals</li> <li>Visibility</li> <li>Ground conditions</li> <li>Effective positioning for the relevant work type</li> <li>Proximity hazards</li> <li>Work specifications</li> </ul>	<ul style="list-style-type: none"> <li>Reversing requirements</li> <li>Vehicle stability</li> <li>Exclusion zones</li> </ul>
<ul style="list-style-type: none"> <li>Remove various types of material to form excavations according to given specifications</li> </ul>	<ul style="list-style-type: none"> <li>Productive methods</li> <li>Ground breaking techniques</li> <li>Procedures for remote control operation</li> <li>Complying with given specifications</li> </ul>	<ul style="list-style-type: none"> <li>Material types (what can and cannot be excavated)</li> <li>Attachments</li> <li>Proximity hazards</li> <li>Methods of soil removal</li> <li>Operator positioning</li> </ul>

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### Syllabus (continued)

Learning outcome	Training content	
<ul style="list-style-type: none"> <li>Remove material around and expose buried services and objects</li> </ul>	<ul style="list-style-type: none"> <li>Distances and clearances</li> <li>Types of services</li> <li>Identification procedures</li> <li>Location of services</li> </ul>	<ul style="list-style-type: none"> <li>Reporting procedures for damages</li> <li>Access/egress requirements for below ground work</li> <li>Operating procedures</li> </ul>
<ul style="list-style-type: none"> <li>Using air or water systems to dislodge materials</li> </ul>	<ul style="list-style-type: none"> <li>Procedures</li> <li>Safety issues</li> <li>Operator protective equipment</li> </ul>	<ul style="list-style-type: none"> <li>Segregation</li> <li>Methods for particular types of soils</li> <li>Isolation of operating controls</li> </ul>
<ul style="list-style-type: none"> <li>Explain the functions, attributes, safety aspects and correct operating procedures of various types of ground agitating tools and hose attachments</li> </ul>	<ul style="list-style-type: none"> <li>Types</li> <li>Limitations of each type</li> <li>Suitability for ground types</li> <li>Power sources</li> <li>Additional personnel</li> <li>Methods of agitation</li> <li>Operating safety</li> </ul>	<ul style="list-style-type: none"> <li>PPE requirements</li> <li>Cleaning and storage requirements</li> <li>Types of attachments</li> <li>Function and applications</li> <li>Safe working procedures and practices</li> <li>Debris control measures</li> </ul>
<ul style="list-style-type: none"> <li>Explain how the type of terrain can affect tools and attachment selection, and factors that can alter operating procedures</li> </ul>	<ul style="list-style-type: none"> <li>Terrain/soil types</li> <li>Seasonal variations of soil</li> <li>Ground engaging tool type selection</li> </ul>	<ul style="list-style-type: none"> <li>Dangers of incorrect attachment selection</li> <li>Dangers of incorrect hose operating procedures</li> </ul>
<ul style="list-style-type: none"> <li>Explain the procedures for and safety issues of dealing with blockages</li> </ul>	<ul style="list-style-type: none"> <li>Shut-down/isolation procedures</li> <li>Hazards/safety requirements</li> <li>Types and causes of blockages</li> <li>Methods of clearing</li> <li>Sequence of operation</li> </ul>	<ul style="list-style-type: none"> <li>PPE and other personal equipment</li> <li>Segregation procedures</li> <li>Components subject to blockages</li> <li>Environmental considerations</li> </ul>
<ul style="list-style-type: none"> <li>Maintain stability during excavating and discharging operations</li> </ul>	<ul style="list-style-type: none"> <li>Ground types</li> <li>Support requirements</li> <li>Vehicle sizes, weights and ground pressures</li> <li>Vehicle overloading</li> <li>Stabilisers</li> </ul>	<ul style="list-style-type: none"> <li>Vehicle weight distribution</li> <li>Slopes, inclines and gradients</li> <li>Underground services</li> <li>Discharging procedures</li> </ul>

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### Syllabus (continued)

Learning outcome	Training content	
<ul style="list-style-type: none"> <li>Discharge/remove excavated materials at designated points and into suitable receptacles</li> </ul>	<ul style="list-style-type: none"> <li>Discharging areas</li> <li>Stop blocks/vehicle overrunning methods</li> <li>Vehicle centres if gravity/stability</li> <li>Tipping over edges</li> </ul>	<ul style="list-style-type: none"> <li>Documentation procedures</li> <li>Environmental issues</li> <li>Ground conditions</li> <li>Material jams</li> <li>Discharging on inclines</li> <li>Signalling/following instructions</li> </ul>
<ul style="list-style-type: none"> <li>Carry out cleaning procedures following excavation work</li> </ul>	<ul style="list-style-type: none"> <li>Cleaning procedures</li> <li>Cleaning areas</li> <li>Waste discharging procedures</li> <li>Safety procedures</li> </ul>	<ul style="list-style-type: none"> <li>PPE requirements</li> <li>Cleanliness of work</li> <li>Hazards</li> <li>Environmental considerations</li> </ul>
<ul style="list-style-type: none"> <li>Store remote units in appropriate locations</li> </ul>	<ul style="list-style-type: none"> <li>Shut down and isolation</li> </ul>	<ul style="list-style-type: none"> <li>Organisational procedures</li> </ul>
<ul style="list-style-type: none"> <li>Carry out shut down, securing and isolation procedures</li> </ul>	<ul style="list-style-type: none"> <li>Shut down procedures</li> <li>Isolation requirements</li> </ul>	<ul style="list-style-type: none"> <li>Parking and positioning</li> </ul>
<ul style="list-style-type: none"> <li>Explain maintenance procedures applicable for ensuring safe operations</li> </ul>	<ul style="list-style-type: none"> <li>Information sources</li> <li>Types and levels of maintenance</li> <li>Tools and additional equipment</li> </ul>	<ul style="list-style-type: none"> <li>Typical maintenance requirements</li> <li>Access procedures</li> <li>Working at height</li> <li>Key safety requirements</li> </ul>
<ul style="list-style-type: none"> <li>Undertake post-use checks</li> </ul>	<ul style="list-style-type: none"> <li>Regular and non-scheduled maintenance procedures</li> </ul>	<ul style="list-style-type: none"> <li>Sequence of post-use checks</li> <li>Defect reporting</li> </ul>

**Note:** The listed training content should not be considered exhaustive and subjects may be added to reflect the individuals' working environment.

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### Safety critical

Emphasis to be placed on the following topics:

Topic	Emphasis
<ul style="list-style-type: none"> <li>Emergency procedures</li> </ul>	<ul style="list-style-type: none"> <li>Second operator in the vicinity able to shut down and isolate the machine in an emergency</li> <li>Providing sufficient briefing to others on what procedures need to be undertaken in the event of emergencies, including location and function of isolating devices</li> </ul>
<ul style="list-style-type: none"> <li>Working Practices for lone working</li> </ul>	<ul style="list-style-type: none"> <li>The hazards of lone working and maintaining continual communication and checks by supporting staff/others</li> </ul>
<ul style="list-style-type: none"> <li>Manoeuvring</li> </ul>	<ul style="list-style-type: none"> <li>No manoeuvring or reversing to commence unless authorised by a nominated vehicle marshaller in defined areas</li> </ul>
<ul style="list-style-type: none"> <li>Exclusion zones</li> </ul>	<ul style="list-style-type: none"> <li>Effective exclusion zones that prevent unauthorised access to the working area and sufficient zone of safety to prevent noise and dust to nearby people</li> </ul>
<ul style="list-style-type: none"> <li>Working area</li> </ul>	<ul style="list-style-type: none"> <li>Effective exclusion zone which contains full operating radius or reach of boom and/or hose nozzle</li> </ul>
<ul style="list-style-type: none"> <li>Working area</li> </ul>	<ul style="list-style-type: none"> <li>Working near to excavation edges or within excavations and the causes and dangers of edge and excavation collapses</li> </ul>
<ul style="list-style-type: none"> <li>Entry to exclusion zones</li> </ul>	<ul style="list-style-type: none"> <li>Procedures to stop all works, move components/hose to a safe position and machine isolated when operator is approached by others</li> </ul>
<ul style="list-style-type: none"> <li>Buried Services</li> </ul>	<ul style="list-style-type: none"> <li>Procedures and hierarchy procedures for identification and location of buried services</li> </ul>
<ul style="list-style-type: none"> <li>Remote control operation</li> </ul>	<ul style="list-style-type: none"> <li>Sufficiency of length of the umbilical cord when operating with a pendant control unit to allow operations in a safe place</li> <li>Isolating of all operating controls when using a remote unit, when carrying out other functions or during rest periods</li> <li>The dangers of using unguarded/damaged remote units and preventing inadvertent movement of controls</li> </ul>
<ul style="list-style-type: none"> <li>Working practices</li> </ul>	<ul style="list-style-type: none"> <li>Prevention of working directly beneath the boom and/or hose nozzle</li> </ul>
<ul style="list-style-type: none"> <li>Working Practices</li> </ul>	<ul style="list-style-type: none"> <li>Dangers of damages to services and machine components if the nozzle is used directly to dislodge soil and materials</li> </ul>
<ul style="list-style-type: none"> <li>Working at height</li> </ul>	<ul style="list-style-type: none"> <li>The dangers of working at height to clear blockages</li> </ul>



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### Duration / Ratios

To allow effective learning, these training times are recommended for this category. Candidates must be profiled to establish learning needs. Durations should be of a length to ensure the learning outcomes are met.

Experience	Accumulated hours
• Novice operators with no industry or machine experience	35*
• Novice operators with industry experience but no machine experience	28
• Operators with unrelated machine experience	14
• Operators with similar (vacuum excavating) machine experience	7

All candidates must have received the equivalent to 7 hours of site safety and induction training

*To allow effective learning, the listed candidate / machine / instructor ratio is the maximum recommended for this category*

*\* Notional value for endorsements A & D. Other endorsements will require additional training time of around 70 hours*

4 candidates : 2 machines: 1 instructor

### Resources

Practical equipment	Theory equipment
<ul style="list-style-type: none"> <li>• Vacuum excavator that meets current legislation</li> <li>• Operators manual for the machine(s)</li> <li>• Sufficient area of ground suitable for excavating</li> <li>• Ground with buried services for excavation work</li> </ul>	<ul style="list-style-type: none"> <li>• PUWER 1998 Regulations</li> <li>• LOLER 1998 Regulations</li> <li>• HSE GS6</li> <li>• Operators Manual</li> <li>• CPA Good Practice Guide on Safe Use of Suction and Vacuum Excavators</li> <li>• Specifications for types of vacuum excavators</li> </ul>
<p><b>PLUS</b></p> <p>Suitable PPE (including harness for working at height)</p> <ul style="list-style-type: none"> <li>• Risk assessment for all areas where training is occurring</li> </ul>	<p><b>PLUS</b></p> <ul style="list-style-type: none"> <li>• Suitable room for theory training purposes</li> <li>• Welfare and rest facilities during training</li> </ul>

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### Training attributes

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**\*To help candidates in learning the necessary skills for each category, it would be ideal if they possess one or more of the following:**

- Construction or related experience
- Driving licence or driving experience
- Able to calculate basic formula
- Able to record basic details
- Understand basic written words
- Have received site safety and induction training
- Possess good eye and hand co-ordination
- Have mechanical appreciation
- Medically able to operate machinery (including eyesight)
- Have received training for wearing a harness

**\*Note:** Lack of any of these attributes does not prevent anyone from being trained for this category.

### Category

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#### Category description and types

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CPCS defines a category as an item of plant or equipment used within the construction or allied industries and worked in accordance with the manufacturer's basic design. Although this category can have varying uses within industry and is used with many attachments, for CPCS training and assessment standards, the descriptions reflect basic core use. Endorsements are sub-categories that reflect the variations for this category by chassis type.

To identify a machine within this category, a typical vacuum excavator (also known as a suction excavator) would normally have the listed features and be used within the described characteristics.

Category features	Category characteristics
<ul style="list-style-type: none"><li>• Mounted on a mobile vehicle chassis or trailer</li><li>• Power-unit driven air compressor</li><li>• Flexible suction hose mounted on a manipulable arm</li></ul>	<ul style="list-style-type: none"><li>• Able to travel in forward and reverse and change direction during travel (s/p units)</li><li>• Can travel and operate on limited uneven and loose ground, and inclines</li><li>• Carry out excavation and extraction duties using air displacement</li><li>• Can store received excavated materials and discharge at given locations</li></ul>

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### Endorsement characteristics

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- **Endorsement A** - Trailer - manual arm - mounted on a towed trailer and equipped with a hand-held suction hose
- **Endorsement B** - Trailer – semi-powered arm – mounted on a towed trailer and equipped with a hydraulically-powered arm partially operated by both remote control and hand
- **Endorsement C** - Non – LGV manual arm - mounted on an non-LGV-based vehicle chassis or a self-propelled item of plant (tracked or wheeled) and equipped with a hand-held suction hose
- **Endorsement D** - Non – LGV semi-powered arm - mounted on an non-LGV-based vehicle chassis or a self-propelled item of plant (tracked or wheeled) and equipped with a hydraulically-powered arm partially operated by both remote control and hand
- **Endorsement E** - LGV Semi-powered arm - mounted on an LGV-based vehicle chassis and equipped with a hydraulically-powered arm partially operated by both remote control and hand
- **Endorsement F** - LGV Fully-powered arm - mounted on an LGV-based vehicle chassis and equipped with a hydraulically-powered arm operated by remote control
- **Endorsement G** - LGV Semi-powered arm – Second Operator (Non-LGV Driver)
- **Endorsement H** - LGV Fully powered arm – Second Operator (Non-LGV Driver)

**Note:** *At the recommendation of the vacuum excavator working group, CPCS cards for endorsements E and F will not be issued unless the applicant holds a valid EU driving licence bearing class C as a minimum.*