


Specifying wood-based panels for structural use


Since June 2002 it has been mandatory for manufacturers/suppliers of wood-based panels intended for 'incorporation in a permanent manner in construction works' to be able to demonstrate that their products, and therefore the structures they are built into, will comply with the Construction Products Directive (CPD). The CPD in the UK is implemented through the Construction Products Regulations 1991. The most straightforward route to achieving this is by complying with the so-called 'harmonised Standard' for wood-based panels, EN 13986, published in the UK as *BS EN 13986: 2004 Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking.*

In all EU member states, apart from the UK, Ireland and Sweden, the only way to show compliance with the CPD is by CE marking. Although not compulsory in the UK, most wood-based panels intended for structural use are internationally traded and hence are likely to carry the CE mark. CE marking is described in more detail in the *TRADA Wood Information Sheet 2/3-56 CE marking: Implications for timber products.*

One of the reasons that the UK Government has not made CE marking mandatory is that it believes that there should be freedom to find alternative means of demonstrating compliance with the CPD. These alternatives are listed in *The Building Regulations 1991 Approved Document to support regulation 7- Clause 1.2.* One of the options is an independent assessment and certification of fitness for purpose for a specific end use. In such cases specifiers should check that their intended use is within the scope of the certification for the product and should remember that substitution of the material specified with a similar material may not comply with the CPD.

Products outside the scope of BS EN 13986 may be CE marked through a European Technical Approval (ETA) using a European Technical Approval Guideline (ETAG) or a

 1234 - CPD - 5678
Any Company P O Box ?? Any Town Country
05 EN 13986
EN 636-2 S E1 "Wall sheathing" 600 kg/m³, 9mm
Reaction to fire: Class D-s2,d0

 1234 - CPD - 5678
Any Company P O Box ?? Any Town Country
05 EN 13986
EN 636-1 S E1 "Flooring" >400 kg/m³, 18mm
Reaction to fire: Class D_{FL}-s1

Examples of CE marks for structural panels

Common Understanding of Assessment Procedures (CUAP).

Note: For products covered by BS EN 13986, but not within the scope of the supporting product standards, eg because they have much higher properties, the manufacturer can apply the CE mark and declare his own specification values according to Table 14 of BS EN 13986.

BS EN 13986 refers to a series of BS EN product standards for specifications and requirements for each panel type. These set out minimum properties and quality control procedures for different grades of panel, defined by:

- purpose: eg load-bearing or heavy duty load-bearing
- service class conditions in which they are suitable for use: dry, humid or exterior.

The Technical Classes of panel suitable for use in appropriate structural (load-bearing) applications according to BS EN 13986 are shown in Table 1.

Under BS EN 13986, manufacturers are required to have available a Declaration of Conformity and technical information on their product. These will include information on relevant characteristics as outlined below. Specifiers/purchasers should always obtain this information to ensure that the material being offered meets their requirements.

Performance characteristics

The required performance characteristics (properties) for panels in various applications are set out in BS EN 13986, although not all of the applications are structural. Structural components are listed under the following categories

- internal use as structural components in dry conditions
- internal use as structural components in humid conditions
- external use as structural components
- internal use as structural floor and roof decking on joists and structural wall sheathing on studs.

The performance characteristics may have been tested by the manufacturer and maintained through the production quality control process, or in some cases, standard values may be used.

Properties that must be assessed:

- bending strength and stiffness (quality control tests)
- bond quality/internal bond (quality control tests)
- durability - moisture resistance, thickness swelling (quality control tests)
- formaldehyde – a constituent of some adhesives, particularly aminoplastic resins (certain types of panel may not require testing if no formaldehyde-containing materials are added during, or post-production). For more details see BS EN 13986 Annex B
- pentachlorophenol (only if materials used contain more than 5 ppm PCP). For more details see BS EN 13986 Clause 5.18.

Table 1 Technical classes of panel listed in BS EN 13986 as suitable for structural applications

Panel type	Complying with: Standard	Technical class
Cement bonded particleboard	BS EN 634-2 Cement-bonded particleboards - Specification - Requirements for OPC bonded particleboards for use in dry, humid and exterior conditions	Modulus of elasticity class 1 or 2
Fibreboards:	BS EN 622-2 Fibreboards. Specifications. Requirements for hardboards	HB.LA Load-bearing, dry HB.HLA1 load-bearing, humid HB.HLA2 heavy duty load-bearing, humid
	BS EN 622-3 Fibreboards. Specifications. Requirements for medium boards	MBH.LA1 load-bearing, dry MBH.LA2 heavy duty load-bearing, dry MBH.HLS1 load-bearing, humid * MBH.HLS2 heavy duty load-bearing, humid *
	BS EN 622-4 Fibreboards. Specifications. Requirements for softboards	SB.LS load-bearing, dry * SB.HLS load-bearing, humid *
	BS EN 622-5 Fibreboards. Specifications. Requirements for dry process boards (MDF)	MDF.LA load-bearing, dry MDF.HLS load-bearing, humid *
OSB	BS EN 300 Oriented strand boards (OSB). Definitions, classification and specifications	OSB/2 load-bearing, dry OSB/3 load-bearing, humid OSB/4 heavy duty load-bearing, humid
Particleboard (resin bonded)	BS EN 312 Particleboards. Specifications	P4 load-bearing, dry P5 load-bearing, humid P6 heavy duty load-bearing, dry P7 heavy duty load-bearing, humid
Plywood	BS EN 636 Plywood. Specifications	EN 636-1 S structural, dry EN 636-2 S structural, humid EN 636-3 S structural, exterior
Solid wood panels	BS EN 13353 Solid wood panels (SWP) – Requirements	SWP/1 dry conditions SWP/2 humid conditions SWP/3 exterior conditions
* Fibreboards suitable only for structural applications where there are instantaneous or short-term loads only. This is indicated by the "S" in the type classification.		

Properties where standard values may be used:

- reaction to fire (values for certain products mounted without an air gap are given in BS EN 13986)
- water vapour permeability (values for certain products are given in BS EN 13986)
- airborne sound insulation and sound absorption (values for certain products are given in BS EN 13986)
- thermal conductivity (values for certain products are given in BS EN 13986)
- characteristic values of strength and stiffness (values in BS EN 12369, see Design considerations, below)
- mechanical durability – creep and duration of load (modification factors are given in BS EN 1995-1-1)
- biological durability (guidance is given in BS EN 335).

Properties required for a particular end use:

Depending upon the end use, additional criteria also need to be defined:

- floor and roof decking
BS EN 13986 requires soft body impact and concentrated load tests to be carried out, as described in *BS EN 12871 Wood-based panels* –

Performance specifications and requirements for load bearing boards for use in walls, floors and roofs. Products that meet the requirements should be marked “FLOORING” or “ROOFING” as appropriate.

- wall sheathing
BS EN 13986 requires a soft body impact test (to BS EN 596) to be carried out against the requirements of BS EN 12871. Products complying with this should be marked “WALL SHEATHING”.

These performance-based tests for floors, walls and roofs are carried out on small sections of components and the results are only relevant to the construction tested (eg panel type and thickness, joist spacings). Such data must now be provided by the manufacturer. Part of the BS EN 12871 testing is for impact which is a pass or fail test, the other part is a point load test which will give the load category.

Note: BS 7916: 1998 Code of practice for the selection and application of particleboard, oriented strand board (OSB), cement bonded particleboard and wood fibreboards for specific purposes, which used to give thickness/span data for various panel types in floors and roofs, has been withdrawn and should not be used.

Design considerations

Structural design calculations require design stresses and performance based values in the case of floor and roof decking and wall sheathing. Designs may be carried out in accordance with *BS 5268-2: 2002 Structural use of timber. Code of practice for permissible stress design, materials and workmanship* or *BS EN 1995-1-1: 2004 Eurocode 5: Design of timber structures. General rules and rules for buildings*.

BS 5268-2: 2002 gives grade stresses for a range of plywoods from Scandinavia and North America. These materials must now also demonstrate compliance with the CPD, by compliance with BS EN 13986 or some other means. For other materials, characteristic values (from BS EN 12369 or via the BS EN 789/BS EN 1058 route, see below) may be used and conversion factors are given in BS 5268-2 to modify these into grade stresses.

For designs to Eurocode 5, characteristic values are given in *BS EN 12369 Wood-based panels. Characteristic values for structural design*, published in two parts:

Part 1 includes the oriented strandboards, OSB/2, OSB/3, OSB/4, particleboards EN312-4, EN312-5, EN312-6, EN312-7, and fibreboards HB.HLA2, MBH.LA2, MDFLA, MDFHLS.

Part 2 gives characteristic values of mechanical properties for plywood in bending, based on a series of strength classes and modulus classes. It includes advice on determining characteristic values in tension and compression by a combination of testing and calculation. Conservative values for shear are included.

For other products, characteristic values must be determined by testing in accordance with *BS EN 789: 1996 Timber structures. Test methods. Determination of mechanical properties of wood-based panels* and calculation in accordance with *BS EN 1058: 1996 Wood-based panels. Determination of characteristic values of mechanical properties and density*.

Whether they are grade stresses or characteristic values, the properties listed include bending, tension, compression and shear. In the case of floors and roofs, this enables the behaviour under uniform loads to be assessed but there is no agreed method of calculating behaviour under concentrated loads or impact. These criteria must be tested as described above, and the data provided by the manufacturer.

Like all wood-based products, panels are affected by the duration of the load applied, both in relation to deflection (creep) and to failure. Both Eurocode 5 and BS 5268-2 give factors to account for these effects.

The above refers principally to design for structural criteria but other factors such as fire, acoustics and durability may also need to be taken into account in the design.

Correct specification

The simplest and most effective way of specifying a panel product for structural use is to require compliance with BS EN 13986. The specification should include the following factors as a minimum:

- the panel type – this may be generic, eg plywood, or a more specific technical class such as BS EN 300 OSB/3. Alternatively this may be left to the supplier if the performance criteria specified below are adequate
- the panel should be a load-bearing type complying with BS EN 13986. Reference should also be made to the appropriate product standard eg BS EN 312
- the Service Class for which the panel should be suitable, eg Service Class 2 requires a panel suitable for use in humid conditions
- minimum strength and stiffness properties – either by characteristic values or permissible stresses depending on whether Eurocode 5 or BS 5268 is being used as the design basis
- thickness
- fire performance rating
- durability requirement – In BS EN 13986 durability relates to thickness swelling and moisture resistance. If high moisture contents are anticipated panels may also require preservative treatment (see BS EN 335 for guidance)
- formaldehyde class.

In the case of floor and roof decking, the soft body impact test has to demonstrate that the requirements of BS EN 12871 can be met. The concentrated load test results are used to check the capacity of the panel against the design concentrated load, which in the UK is specified in BS 6399. These calculations may be carried out in accordance with BS 5268-2 or Eurocode 5. Design checks may also need to be carried out for any uniform load specified. Additional criteria, such as acoustics, may also need consideration in the specification.

In wall sheathing, design for racking resistance can be carried out using basic racking resistance values given in BS 5268-6 or by test in accordance with BS EN 594. Design to EC5 can be carried out on the basis of characteristic density and a knowledge of the fastener performance of the panels.

Note: If a specific brand of product has been found to be suitable and to comply with the CPD, then it may be specified directly. However, specifiers and suppliers should remember that substitution with a similar material will not automatically ensure compliance with the CPD.

Maintaining fitness for purpose

Compliance with the CPD and CE marking requires that anyone who handles or distributes a panel must be in a position to demonstrate its 'fitness for purpose'. Under the terms of the CPD, distributors and merchants now have a legal obligation to supply a product that is suitable for the communicated intended end-use.

Fitness for purpose can also be affected by the way that panels are handled, transported and stored at all stages through the supply chain, including construction sites. As a natural material, wood is hygroscopic; it can take up and release moisture from the atmosphere and its physical and mechan-

ical properties can change as a result. Wood-based panels behave in a similar way to solid wood, swelling if they absorb moisture and shrinking if moisture is lost. Panels should be installed into a building at a moisture content as close as possible to that which it will achieve in service. Correct storage, transportation, handling and conditioning are also vital to the correct performance of the panel in the finished building.

Guidance is given in the *Panel Guide* and in *DD ENV 12872 Wood-based panels. Guidance on the use of load-bearing boards in floors, walls and roofs*.

Example specifications

These examples illustrate the specification of typical structural components incorporating wood-based panels. *Note:* They are included for demonstration purposes only. 'Real life' specifications will vary depending on the governing factors of a particular design, and must be considered on a case by case basis.

Note: "x" denotes a value or grade which must be determined by the designer/specifier and included in the specification

BS ENs are the official English language version of European Standards ENs. Other versions may be designated, for example NF EN, France; SS EN, Sweden; DIN EN, Germany. These may appear in documentation and CE marks on panels manufactured outside the UK and, providing the EN number is the same, are equally acceptable.

Wall panel with OSB wall sheathing - Service Class 2 - Eurocode 5 and BS 5268 designs

Component	Specification	Purchasing	Notes
Sheathing	Oriented strand board compliant with EN 13986 for load bearing applications in humid conditions, ie OSB/3 compliant with EN 300, with additional impact testing carried out to EN 596 for wall sheathing.	Look for a CE mark which includes EN 13986 and states that the panel is OSB/3 (a structural panel will also show the notified body number, the directive (CPD) and the manufacturer's number). The mark will also include "Wall Sheathing" if the EN 596 test has been carried out. This may also be stated on the certificate of conformity.	For a material to be CE marked for load bearing humid conditions it has to comply with EN 300 requirements. OSB/3 is a load bearing board for use in humid conditions (Service Class 2). The EN 596 test is a pass/ fail test.
	For designs to Eurocode 5: minimum characteristic density of x kg/m ³ .	Manufacturer's technical information should state this.	Required to achieve the correct racking resistance according to Eurocode 5.
	Thickness: x mm.		Required to achieve the required racking resistance.
	Formaldehyde Class: Ex .	The CE mark will state whether the board is E1 or E2.	A formaldehyde class has to be stated.
Substrate	Softwood studs at x centres, fixed to top and bottom rail, of strength class x (BS EN 338), or species x of strength grade x to BS 4978 or BS EN 519, with dimensions of x mm by x mm by x mm long (Note: harmonised standard EN 14081 can be used when available), suitably treated for hazard class 2 environments as per BS 8417.	Timber shall be stamped with a strength class and/or strength grade mark certified by a third party approved by the UK Timber Grading Committee.	These elements carry load. The strength class and/or species and strength grade is important. Never purchase a lower grade or different dimensions.
Fixing type	x mm diameter by x mm galvanised to ISO 2081 annular ring shank nails compliant with BS 1202-1. (Note: harmonised standard EN 14592 can be used when available).	Nails shall be of the correct size and compliant with BS 1202-1 and ISO 2081.	To achieve the required racking resistance and corrosion resistance the nails must be of a certain standard.
Setting out	Lay edges vertical and centred on supports.	N/A	Required to achieve the required racking resistance.
	Expansion gap between adjacent boards (unless otherwise recommended by manufacturer): x mm.		The panels will change shape slightly with varying moisture contents; the gap is to reduce the risk of warping caused by the edges touching.
Fixing centres	x mm maximum around board edges. x mm along intermediate supports.	Check that fixing centres are equal to or closer than those in the manufacturer's BS EN 596 test and that they provide adequate racking resistance in accordance with BS 5268-2 or Eurocode 5.	Required to achieve the required racking resistance.
Fixing distance from edges	x mm from bottom edge and x mm from all other edges. (Guidance in ENV 12872).		

Plywood Floor - Service Class 1 - Eurocode 5 design

(Note consideration should be given to design and specification to Service Class 2, depending upon the risk of wetting during construction)

Component	Specification	Purchasing	Notes
Flooring	Plywood compliant with BS EN 13986, suitable for internal use as structural floor decking on joists, ie compliant with BS EN 636 grade EN 636-1 S, (or grade EN 636-2 S) with additional performance testing to conform to load category x on x mm span as per Eurocode 1 or BS 6399. Characteristic strength and stiffness values as follows...	Look for a CE mark which includes BS EN 13986 and states that the panel is EN 636-1 S (or EN 636-2 S). A structural panel will show the notified body number, the directive (CPD) and the manufacturer's number. The mark will also include "Flooring" to indicate that BS EN 12871 point load and impact tests have been carried out. The load category for a specific span can be found from the manufacturer or it may be stated on the CE mark. Characteristic strength and stiffness values can be obtained from the manufacturer or agent – they may be based on BS EN 12369-2 or derived from test data to BS EN 789. This information should also be stated on the certificate of conformity.	For a plywood to be CE marked for Service Class 1 conditions it must comply with BS EN 636 grade EN 636-1 S. For Service Class 2 conditions it must comply with grade EN 636-2 S. To be used as flooring the board must be categorised as load bearing with additional BS EN 12871 performance testing carried out.
	Thickness: x mm.		Required to meet design requirements.
	Formaldehyde Class: Ex .	The CE mark will state whether the board is E1 or E2.	A formaldehyde class has to be stated.
Substrate	x mm by x mm softwood joists of strength class x (BS EN 338), or of species x strength graded to x according to BS 4978 or BS EN 519 (Note: harmonised standard EN 14081 can be used when available), with dimensions of x mm by x mm by x mm long.	Timber shall be stamped with a strength class and/or strength grade mark certified by a third party approved by the UK Timber Grading Committee.	These elements carry load. The strength class and/or species and strength grade is important. Never purchase a lower grade or thickness.
	Joist spacing: x mm.	If BS EN 12871 performance tests for the particular joist spacing are not available, only purchase panels that have been tested with a larger span than required.	Required for the floor to perform as designed.
Setting out of panels	Direction of long edges with respect to joists in accordance with the manufacturer's specifications. All edges supported by a t&g profile or on noggings. End joints central over joists and staggered.	The manufacturer's technical information should indicate how the testing was carried out.	The panel must be used in the same configuration as the BS EN 12871 test set-up to achieve the performance stated by the manufacturer.
Expansion provision	Clear expansion gap of x mm around floor perimeter and at any upstands. Intermediate expansion/ movement joints x mm. Expansion gap of x mm around the edge of each individual board.	Based on manufacturer's information regarding moisture movement. Seek manufacturer's advice.	To avoid unwanted stress to the structure of the building or floor.
Fixing to joists	Fasteners: Type x , size x and corrosion resistance x . Fixing centres (maximum) x mm around floor perimeter and along short edges of each board x mm. Along intermediate supports x mm.	The manufacturer's technical information should indicate how the testing was carried out.	The panel must be used in the same configuration as the BS EN 12871 test set-up to achieve the performance stated by the manufacturer.

Plywood floor Service Class 1 – BS 5268 design.

(Note consideration should be given to design and specification to Service Class 2, depending upon the risk of wetting during construction)

Component	Specification	Purchasing	Notes
Flooring	Plywood compliant with BS EN 13986 and suitable for internal use as structural floor decking on joists, ie compliant with BS EN 636 grade EN 636-1 S (or grade EN 636-2 S). Type x . Grade x . Nominal thickness x . Number of plies x . Performance tests required for specified joist spacing.	Look for a CE mark which includes BS EN 13986 and states that the panel is EN 636-1 S (or EN 636-2 S) A structural panel will show the notified body number, the directive (CPD) and the manufacturer's number. The mark will also include "Flooring" to indicate that BS EN 12871 point load and impact tests have been carried out. The panel should be either one of those listed in BS 5268-2: 2002 (look for a grade mark as per this standard) or the manufacturer should provide characteristic values for design. This information may also be stated on the certificate of conformity.	For a plywood to be CE marked for Service Class 1 conditions it must comply with BS EN 636-1 S. For Service Class 2 conditions it must comply with BS EN 636-2 S. To be used as flooring the board must be categorised as load bearing, with additional BS EN 12871 performance testing carried out.
	Formaldehyde Class: Ex.	The CE mark will state whether the board is E1 or E2.	A formaldehyde class has to be stated.
Substrate	x mm by x mm softwood joists of strength class x (BS EN 338), or of species x strength graded to x according to BS 4978 or BS EN 519 (Note: harmonised standard EN 14081 can be used when available), with dimensions of x mm by x mm by x mm long.	Timber shall be stamped with a strength class and/or strength grade mark certified by a third party approved by the UK Timber Grading Committee.	These elements carry load. The strength class and/or species and strength grade is important. Never purchase a lower grade or thickness.
	Joist spacing: x mm.	If the BS EN 12871 performance tests for a particular joist spacing are not available, only buy panels that have been tested with a larger span than required.	Required for the floor to perform as designed.
Setting out	Direction of long edges with respect to joists in accordance with the manufacturer's specifications. All edges supported by a t&g profile or on noggings. End joints central over joists and staggered.	The manufacturer's technical information should indicate how the testing was carried out.	The panel must be used in the same configuration as the BS EN 12871 test set-up to gain the performance stated by the manufacturer.
Expansion provision	Clear expansion gap x mm around floor perimeter and any upstands. Intermediate expansion / movement joints x mm. Expansion gap of x mm around the edge of each individual board.	Based on manufacturer's information regarding moisture movement. Seek manufacturers advice.	To avoid unwanted stress to the structure of the building or floor.
Fixing to joists	Fasteners: Type x , size x and corrosion resistance x . Fixing centres (maximum) x mm around floor perimeter and along short edges of each board x mm. Along intermediate supports x mm.	The manufacturer's technical information should indicate how the testing was carried out.	The panel must be used in the same configuration as the BS EN 12871 test set-up to gain the performance stated by the manufacturer.

References

Standards

- BS 5268-2: 2002 Structural use of timber. Code of practice for permissible stress design, materials and workmanship.
- BS 5268-6.1: 1996 Structural use of timber. Code of practice for timber frame walls. Dwellings not exceeding four storeys.
- BS 5268-6.2: 2001 Structural use of timber. Code of practice for timber frame walls. Buildings other than dwellings not exceeding four storeys.
- BS 6399-1: 1996 Loading for buildings. Code of practice for dead and imposed loads.
- BS 6399-2: 1997 Loading for buildings. Code of practice for wind loads.
- BS EN 300: 1997 Oriented strand boards (OSB). Definitions, classification and specifications.
- BS EN 312: 2003 Particleboards. Specifications.
- BS EN 594: 1996 Timber structures. Test methods. Racking strength and stiffness of timber frame wall panels.
- BS EN 596: 1995 Timber structures. Test methods. Soft body impact test of timber framed walls.
- BS EN 622-2: 1997 Fibreboards. Specifications. Requirements for hardboards.
- BS EN 622 -3: 2004 Fibreboards. Specifications. Requirements for medium boards.
- BS EN 622-4: 1997 Fibreboards. Specifications. Requirements for softboards.
- BS EN 634-2: 1997 Cement-bonded particleboards – Specifications - Requirements for OPC bonded particleboards for use in dry, humid and exterior conditions.
- BS EN 636: 2003 Plywood. Specifications.
- BS EN 789: 1996 Timber structures. Test methods. Determination of mechanical properties of wood-based panels.
- BS EN 1058: 1996 Wood-based panels. Determination of characteristic values of mechanical properties and density.
- BS EN 1995-1-1: 2004 Eurocode 5:Design of timber structures. General rules and rules for buildings.
- BS EN 12369-1: 2001 Wood-based panels. Characteristic values for structural design. OSB, particleboards and fibreboards.
- BS EN 12369-2: 2004 Wood-based panels. Characteristic values for structural design. Plywood.
- BS EN 12871: 2001 Wood-based panels – Performance specifications and requirements for load bearing boards for use in walls, floors and roofs.
- BS EN 13353: 2003 Solid wood panels (SWP) – Requirements.
- BS EN 13986: 2002 Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking.
- DD ENV 12872: 2000 Wood-based panels. Guidance on the use of load-bearing boards in floors, walls and roofs.
- EN 14081-1 Timber structures - Strength graded structural timber with rectangular cross section - General requirements. *In preparation.*
- EN 14081-2 Timber structures - Strength graded structural timber with rectangular cross section - Machine grading; additional requirements for initial type testing. *In preparation.*
- EN 14081-3 Timber structures - Strength graded structural timber with rectangular cross section - Machine grading; additional requirements for factory production control. *In preparation.*
- EN 14081-4 Timber structures - Strength graded structural timber with rectangular cross section - Machine Grading - Grading machine settings for machine controlled systems. *In preparation.*
- EN 14592 Timber structures - Fasteners – Requirements. *In preparation.*

Other documents.

- DTLR The Building Regulations 1991. Materials and workmanship. Approved Document to support regulation 7: 1999 edition, amended 2000. The Stationery Office.
- Panel Guide. Panel Guide Partnership. 2004. View free of charge on the askTRADA website, Technical Information Library at www.trada.co.uk.
- TRADA Wood Information Sheet 2/3 - 56 CE marking: Implications for timber products.

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TRADA Technology Ltd

Stocking Lane, Hughenden Valley, High Wycombe, Buckinghamshire HP14 4ND, UK
Tel: +44 (0)1494 569600 Fax: +44 (0)1494 565487 email: information@trada.co.uk
www.trada.co.uk