

MPT 1362
CODE OF PRACTICE
For the installation of mobile radio
and related ancillary equipment in
land based vehicles
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Foreword

Successful mobile radio fitting relies to a great extent on the individual skill, craftsmanship and common-sense of the installer. There are, however, certain guidelines, which will help towards achieving the ultimate aim:

A SATISFIED CUSTOMER WITH A SAFE AND EFFICIENT INSTALLATION

Where equipment and vehicle manufacturers' procedures for installation exist, they take precedence over procedures stated in this document.

Apart from the general quality of the mobile equipment installation, particular consideration must be given to the antenna location.

The mobile equipment should, where possible, harmonise with the vehicle's interior and appear as an integral part of the vehicle.

NOTE: Any reference to 'customer' includes the customer, their agent or their appointed agent.

Aspects on safety are contained in this code of practice. The following sections are also considered relevant to the customer or any third party:

3.2.1 Customer installation requirements

3.3 Legal and Safety Requirements

3.8.5 Gas-propelled vehicles

5.2.1.2.4 Antenna safety

5.2.2 Installation of mobile equipment

5.2.3 Routing of cables

6.2 Interference Checks

7.1 General

7.2 Safety Instructions

7.3 Handing Over

The groups and organisations that have contributed to this code of practice are listed in section 10.

The Radiocommunications Agency has a 'web site', which can be accessed on <http://www.open.gov.uk/radiocom/rahome.htm>. It is planned that all of the MPT 1300 series of specifications will be available on here.

Radiocommunications Agency
Information and Library Service
Wyndham House
189 Marsh Wall
London
E14 9SX

Tel: 020 7211 0211

Fax: 020 7211 0507

For further information on all radio matters please contact the Agency's 24 Hour Telephone Service: 020 7211 0211

1 Scope

This code of practice provides guidance for the installation in vehicles of:

- Private mobile radio;
- mobile telephones;
- “in-car” mounting kits for transportable and handheld equipment;
- ancillary equipment associated auxiliary with the above.
- mobile equipment.

This code of practice:

- details the recommended methods for the safe and efficient installation of the equipment in the vehicle;
- covers those aspects of safety relating to installation of additional physical equipment in vehicles;
- recommends the installation methods to minimise the possibility of Electromagnetic interference (EMI) between the installed equipment and the vehicle electrical and electronic systems;
- gives recommendations for instructing vehicle users in the efficient use of radio equipment along with reference to the statutory requirements associated with the operation of radio equipment in moving vehicles.

The code does not cover the installation of equipment in aeronautical or marine environments.

2 Definitions and Abbreviations

2.1 Definitions

For the purposes of this Code of Practice, the following definitions apply:

Ancillary equipment:	any equipment required as part of the installation in addition to the radio (e.g. voltage converter)
Auxiliary equipment:	any equipment which forms additional communication functions (e.g. vehicle tracking)
Equipment supplier:	the supplier of the equipment to the installer, which may be a dealer, distributor or manufacturer
Floating system:	isolated earth return
Ground plane:	a conducting plane of a minimum dimension proportional to the wavelength on which a panel mount antenna is fitted
Installer:	radio equipment installation technician
Radiating element:	the part of an antenna which radiates the signal; commonly known as a "whip"
Radio system:	the complete radio installation in a vehicle
Vehicle supplier:	the supplier of the vehicle, which may be a dealer or the manufacturer/importer of the vehicle

2.2 Abbreviations

For the purposes of this Code of practice, the following abbreviations apply:

BABT	British Approvals Board for Telecommunications
CNG	Compressed Natural Gas
DC	Direct Current
ECU	Electronic Control Unit
EMC	Electromagnetic Compatibility
HT	High Tension i.e. the high voltage circuits of the ignition system
ICE	In Car Entertainment
ISO	International Standards Organisation
LPG	Liquid Petroleum Gas
PC	Personal Computer
PMR	Professional/Private Mobile Radio
PTT	Press To Talk
RA	Radiocommunications Agency
RF	Radio Frequency
RQAS	Radiocommunications Quality Assurance Scheme
VIN	Vehicle Identification Number
VSWR	Voltage Standing Wave Ratio.

3 General

3.1 Recommended Tool Requirements

A good quality general tool kit to include screwdrivers, spanners, socket set etc.
Any specialist tools relative to the type of vehicle undergoing an installation:

- VSWR meter
- Multi-meter
- Measuring tape
- Power drill kit
- Cone cutter
- RF connector ratchet crimp tool
- DC connector ratchet crimp tool
- Portable soldering iron

All tools and equipment used should be functionally working and suitably calibrated.

Note; If accurate electrical measurement is required, the relevant test equipment must be regularly checked and calibrated against a recognised national standard.

3.2 Customer Liaison

3.2.1 Customer installation requirements

The customer should be:

- advised of the equipment and vehicle manufacturers' installation instructions;
- advised on the most suitable antenna for the particular application and optimum position;
- made aware of the various fixing locations and mounts available for the items to be fitted;
- made aware of any configuration options;
- asked whether an ignition switched supply to the equipment is required.

NOTE: Items shall be mounted in such a way that they do not affect the safety of the vehicle or cause possible injury.

3.2.2 Electrical and electronic equipment

In the case of those vehicles fitted with a Master Isolation Switch, the supply to the radio equipment should normally be connected to the "switched" side. However for certain applications this may not be practicable. In these instances the customer must specify, in writing, if the switch is to be by-passed and this fact recorded in the installation documentation.

In consultation with the customer, the installer should ensure that the installation complies with any regulations pertaining to that class of vehicle.

In certain cases when the vehicle battery is disconnected problems may occur with certain types of electrical equipment, in particular:

- engine management systems and other in-car ECU's. (Affecting the engine management unit may result in damage to a Catalyst exhaust system);
- vehicle alarm systems;
- in-car entertainment which is fitted with anti-theft security code.

Check with the customer that they have the necessary information to make the equipment function correctly if the battery is disconnected.

3.3 Legal and Safety Requirements

3.3.1 Legal requirements

The installer should be aware that the equipment being installed and the installation must comply with all relevant legal requirements. Radio equipment must comply with the UK's radio Interface Requirements as published by the RA.

In most cases new equipment must carry a "CE" mark to show compliance with directive 1999/5/EC (R&TTE).

For installations from 1 October 2002 in a car or a commercial vehicle which has undergone EC/95/54 approval, the installer must ensure that all new radio systems are also marked with an "e" approval mark in order to ensure the radio system is compliant with the European Automotive legislation for EMC The "e" approval mark must be as shown:

- **yy**
- **02XXXX**

yy = country of issue number
XXXX = approval number

The automotive approval will include the equipment manufacturer's installation instructions. These must be followed to ensure that the vehicle does not contravene the UK's Construction and Use regulations.

This requirement for automotive EMC approval also includes relevant support equipment such as a voltage converters.

Similar legislation exists for 2/3 wheeled vehicles and for forestry/agricultural tractors. The installer is advised to take expert advice before fitting to these vehicle types.

3.3.2 Specialised vehicles

Any installation in a vehicle intended for the transport of dangerous goods (e.g. petrol/gas) must comply with the European ADR regulations and also with the relevant UK code of practice for that industry. Emergency Service Vehicles, Agricultural equipment and gas propelled vehicles may be subject to further safety regulations e.g. Specific Intrinsically Safe and Petro-chemical Specifications.

Any equipment installed in a public service vehicle should comply with the UK's requirements for this intended use.

3.3.3 Safety guidelines

The installation should be such as not to contravene the essential safety of the interior fittings of the vehicle as originally supplied by the vehicle manufacturer. Essentially there should be no rough, sharp, or protruding edges that could be impacted by the driver or passenger in an accident. The full details of the requirements placed on the vehicle manufacturer are defined in EC directive 74/60/EEC.

The controls, displays and cabling of installed equipment should never obscure nor obstruct instruments or vehicle controls, neither should their operation distract the driver.

The prime requirement is that the equipment should be in such a position as to be suitable for use by occupants of the vehicle. The principal user should correctly position controls and displays for use.

UNDER NO CIRCUMSTANCES MUST THE MOBILE EQUIPMENT BE LEFT LOOSE IN THE VEHICLE. IT MUST BE SECURELY MOUNTED IN POSITION.

3.3.4 Equipment or vehicle supplier's instruction

It is strongly recommended that the installer obtains from equipment and vehicle suppliers any information available regarding the installation of mobile radio equipment.

When information is available it is essential that it is used as the prime guide for the installation.

3.3.5 Equipment or vehicle supplier's warranty

Installation of mobile radio equipment to any part of the vehicle, other than an authorised connection or mounting point may invalidate the vehicle warranty. If in doubt the vehicle or equipment suppliers should be consulted.

3.3.6 Electromagnetic and radio frequency interference

Full consideration should be given to the positioning of mobile radio equipment to minimise electromagnetic interference (EMI) and radio frequency interference (RFI) between the mobile radio equipment being installed and the vehicle electrical and electronic systems.

Mobile equipment includes the transceiver and all ancillary equipment particularly antenna and coaxial cable.

3.3.7 General safety

When taking supply from a 24 or higher volt "floating system" always use a suitable converter providing DC isolation, i.e. no DC continuity between battery and 12 volt output. After fitting the converter, check that isolation has been maintained.

DO NOT TAKE A 12-VOLT TAP FROM ANY 24-VOLT OR HIGHER SYSTEM.

The installation on certain specialised vehicles, such as Petrol Tankers and Fire Appliances, may be subject to further safety regulations. In general the information contained in this code of practice covers vehicles of any type, but there may well be additional regulations pertinent to the customer or his type of business.

Certain installation locations such as petro-chemical sites may impose restrictions on the type of hand tools that can be used e.g. gas soldering iron. Before commencing work always confirm with the Safety Officer of that company, or some other responsible person that you are complying with their safety regulations.

3.3.8 Safety of personnel

Any person installing mobile radio or any other equipment into motor vehicles must be mindful of personal safety and safety of others at all times. The installer concerned shall work in accordance with the Health and Safety at Work Act 1974 and use power tools that are regularly checked and maintained.

3.3.9 Insurance

The installer must have adequate insurance to cover against any reasonable claim and must provide evidence of this cover on request. The level of insurance cover should be in line with current insurance recommendations.

3.4 Antenna Mounting - Mechanical Safety

The antenna must NOT be located where:

- it could distract the driver when the vehicle is in motion;
- the radiating element can, of its own accord, hinge down and protrude from the vehicle thereby causing a hazard to pedestrians, cyclists etc.

On-glass antennas must be firmly fixed as per manufacturer's instructions and located such that driver visibility is not impaired - no part of the antenna should be within the swept area of the front windscreen.

It should be noted that an antenna mounted on the boot lid will be horizontal when it is opened, and therefore it presents a potential danger of eye or facial injury - this is particularly relevant to antennas for the lower PMR frequencies.

The radiating element should be adjusted such that with the boot open, it does not protrude in a dangerous manner.

When it is necessary to cut the antenna to a particular frequency do NOT leave a sharp point at the top of the rod – a protective cap should be fitted.

A "magnetic base" antenna is intended to be placed on a flat area of steel separated only by the paint finish, in most cases it is NOT suitable for fitting on a vinyl covered roof. Always ensure that the magnet is of a suitable size for the antenna that will be fitted to it.

3.5 Radio Equipment and Ancillary Items

Before installing the radio equipment or any other ancillary items, ensure that all equipment suppliers' instructions are followed so that the vehicle safety is not impaired.

Care must be taken when planning the installation that any additional fitments used do not constitute a safety hazard.

Care should be taken to ensure that the microphone/handset lead is not installed such that the lead can interfere with the vehicle controls or driver.

Where a handportable or transportable unit is to be installed "in car", the correct car adapter kit must be used.

3.6 Documentation

See Appendix B for a list of reference documents.

3.7 Further Information

See Appendix C for a list of organisations who may be able to supply further information relating to installation of mobile radio equipment.

3.8 Precautions to be Taken When Working on Vehicles

3.8.1 General

Care should be taken during all phases of the installation and de-installation process to prevent damage to people, the vehicle, equipment and materials. Aspects considered should include:

- providing adequate access for the installer to fit the installation;
- handling of tools and equipment;
- ensuring that all holes and cuts in materials are de-burred and all sharp edges removed.

3.8.2 Drilling holes

3.8.2.1 Preparation

Before drilling a hole, the installer must check what is located behind the material to be drilled and carry out the drilling in a way, which prevents damage. Care must be taken to avoid petrol tanks, fuel lines, brake pipes and battery cables etc. In the case of double skinned panels the installer must check that it is safe to drill through both skins.

It is recommended that no holes should be made through the vehicle underbody; where this is unavoidable adequate anti-corrosion precautions should be taken and the customer advised that this may affect vehicle corrosion warranty.

3.8.2.2 Drilling

Care should be taken to mark the point to be drilled, and to select the appropriate speed of cut. Drill bits should be fitted with a 'stop bit' to avoid inadvertently drilling beyond the measured depth. Particular care should be taken when drilling through carpets to prevent snagging or pulling.

3.8.2.3 Sealing and protection

All holes should be de-burred and smoothed after drilling to prevent damage to materials and people. Holes drilled through panels, which may allow dirt or water through, must be sealed with a waterproof, flexible sealant. Holes through which cables pass, should be fitted with a grommet.

3.8.3 Fixings

Wherever possible use bolts with locking nuts, plain nuts with shakeproof washers or hank-bushes, particularly where the fixing is for a heavy item or where it may be subject to rough handling.

Self-tapping screws may be used but care must be taken. They give a sharp protrusion on the other side of the material and sometimes work loose.

3.8.4 Diesel/petrol-propelled vehicle

Before starting the installation, establish there are no fuel leaks, particularly in the boot and engine compartment. If a fuel leak is identified, installation must NOT continue, the vehicle must be moved outside the premises and the customer must be notified.

DO NOT ATTACH ANY WIRE OR CABLE TO THE FUEL FEED PIPE OR USE A COMMON HOLE THROUGH A BULKHEAD.

3.8.5 Gas-propelled vehicles

The following precautions must be taken BEFORE installation commences:

- the Health and Safety representative onsite must be made aware that there is to be an installation in this type of vehicle at the premises;
- establish if there are any gas leaks. **DO NOT USE A FLAME.**

NOTE: Butane and Propane are heavier than air. If there is a leak the gas may lie on the floor and is detectable by its characteristic smell. The point of escaping gas may show signs of frosting.

If the above checks are completed satisfactorily the manual shut-off valve must be closed. This is usually located near the gas cylinder. Installation may now commence but care must be taken not to inadvertently drill the cylinder.

Where possible, cables should be run on the opposite side of the vehicle to the gas pipe. Under no circumstances may this wiring be attached to the fuel pipe or use a common hole through which the fuel pipe passes.

When the installation is complete, open the manual gas valve and check that the work done has not caused a gas leak.

3.8.6 Electric powered vehicles

This type of vehicle is fitted with a large bank of batteries, which are a source of high energy. Caution should be exercised when working on this type of vehicle and the location of the isolation switch should be noted. Where it will have no adverse effect to on-board equipment, it is recommended that the supply is isolated during the installation.

4 Planning, Preparation and Pre-Installation

4.1 Planning

As early as possible the details of the installation must be checked to ensure that:

- the installer has knowledge of the physical layout of the vehicle or access to relevant information;
- the location where the installation is to be carried out is such that a good quality installation can be completed in safety;
- fixings required for the installation, and which are not supplied with the equipment to be installed, are identified and procured;
- special requirements of vehicle or equipment are identified and arrangements made to provide for them.
- on site requirements are met regarding Health & Safety, Site Access times, Special Clothing, etc.

NOTE: At all times when planning and carrying out the installation of equipment consideration must be given to the ultimate safety of the driver and occupants of the vehicle.

4.2 Preparation

Before commencing the installation work on the customer's vehicle the installer must check that:

- the workplace is clean and suitable and that there is adequate access to the vehicle to carry out the installation;
- all items of equipment and fixings required for installation are complete and are to hand;
- all relevant information (e.g. radio/security codes) is known
- all installation instructions are to hand
- suitable tools and test equipment are available;
- the vehicle is protected by a suitable covering in the appropriate areas;
- appropriate dress is worn so as not to cause damage to the installer or the vehicle e.g.
 - a) a clean overall/dust coat, free from unprotected sharp buttons and zip fasteners is worn;
 - b) tools are removed from pockets;
 - c) a watch or other metallic items which could damage paintwork or come in contact with the battery supply are removed. If a ring cannot be removed it should be covered with suitable insulating material.

4.3 Pre-Installation

4.3.1 Pre-check of mobile equipment

When required the equipment should have been tested before it is installed in the vehicle. At this stage all the basic functions can be checked. Only a suitably qualified person, using calibrated test equipment should carry out any internal adjustments.

EMC

Interference either with the vehicle systems or with the installed radio system can be due to emissions or susceptibility in either system. If there is a problem then it is handled like any other installation problem.

To minimise the risk it is good practice for the installer to check that the radio equipment carries an appropriate CE or 'e' mark or both (dependent on the implementation date of

95/54EC). If it does not then a statement should be recorded on the installation report that the equipment does not carry a regulatory mark and that the customer accepts the risks associated. The customer should sign the statement.

4.3.2 Installation documentation

4.3.2.1 Job sheet

If supplied, this outlines the work to be carried out and includes the installation date / time, address, vehicle details, equipment types and any special instructions applicable.

4.3.2.2 Installation report

This forms a record of the installation or de-installation and notes vehicle condition before and after the work is carried out. It also records the equipment fitted or removed as well as functional tests.

It also acts as a Certificate of Compliance, which confirms that the installation has been carried out to the required standard and/or the customer's requirements. Additional certification may be required for specialised vehicles e.g. Petro-chemical (refer to 3.3.2).

It is recommended that a multi-part form as per model in Appendix D be used unless an alternative is provided by the equipment supplier - one copy to customer and at least one retained by installer.

Where two vehicles are involved in a job (e.g. De-install from vehicle A/Install to vehicle B), then an Installation Report should be completed for each vehicle.

4.4 Pre-Installation Procedure

Any problems identified during the pre-installation inspection should be noted and a course of action agreed with the customer before any work proceeds. Typical points to be checked are included in the sample installation report (Appendix D) which will provide a record of the vehicle condition before and after installation.

4.4.1 Vehicle inspection

For the vehicle inspection it is recommended that a checklist be used to ensure a consistent standard of inspection of all vehicles by any installer in the organisation.

Details of items covered during the vehicle inspection should be recorded on the report. This should include the physical inspection of the external bodywork, internal trim and seating, and the functioning of electrical and electronic fittings both external and internal.

Any defects should be clearly indicated on the report and brought to the attention of the customer.

4.4.2 Customer instructions

The positions of the antenna, radio unit, handset, control panel, loudspeaker unit (if separate from the handset), microphone etc. and operational features (e.g. ignition sense/audio mute) should be discussed and agreed with the customer. All requirements should be clearly stated on the report.

The make and model numbers of the items to be installed in the vehicle should be recorded, and also the make, model, Vehicle Identification No. (VIN) and registration number of the vehicle.

For guidance on recommended equipment location see section 5.

4.4.3 Pre-installation sign-off

The customer should sign the pre-installation report as an indication that he agrees with the vehicle inspection report and the proposed installation so that the work may be carried out.

In the event of no authorised person being available a note must be made of this on the report.

4.5 Protection

4.5.1 Battery isolation

Some electronic equipment fitted to vehicles (e.g. ECU.) may malfunction or require resetting when disconnected from the power source; therefore it is recommended that the battery is NOT disconnected. Adequate safety precautions must be taken to prevent any damage to existing electrical circuits. The power should be only connected to equipment on completion of installation.

4.5.2 Gas propelled vehicles

When installing in vehicles of this type (such as LPG / dual fuel and CNG) the manual shut-off valve must be closed. This may be located near the gas cylinder (refer 3.8.5 and to vehicle documentation for details).

4.5.3 Protection of bodywork and interior

Protect the customer's property throughout the installation by using clean protective covers on the seats and other areas that are being worked on and by removing items from the vehicle and storing them in a safe, clean, dry place.

If any damage is caused to the customer's property whilst under the care of the installer the customer must be informed as soon as possible and details noted on the Installation Report.

5 Installation

5.1 Preparation of Equipment

Ensure all component parts of the equipment to be fitted are present and in serviceable condition to enable the completion of the job.

5.1.1 De-installation from previous vehicle

It is sometimes necessary to remove equipment from a previous vehicle prior to fitting in a new vehicle. An additional Installation Report should be completed.

5.2 The Installation Process

5.2.1 Installation of antenna and coaxial cable

5.2.1.1 General

The antenna is probably the most important single item of the installation; it dictates the entire quality of operation of the mobile radio. When fitting the antenna, coaxial cable and connectors, it is essential that the manufacturer's instructions, (where supplied) are adhered to.

Antennas for terrestrial radio systems (e.g. cellular and mobile radio) are usually vertically polarised and need to radiate towards the horizon, as the network base station will usually be located on a mast/tower or building structure, relatively close to ground level.

Antennas for GPS and satellite communication systems need to have an unimpeded view to the sky - generally the network signal levels from satellite systems are lower, so antenna positioning is likely to be more critical to ensure effective operation.

Increasingly, the trend is towards the installation of internal, discreet or covert type antennas, (particularly for UHF and cellular bands) - these generally have a reduced performance compared to conventional types, due to their design and/or mounting location. Consideration should be given to their suitability for the customers' application before fitting this type of antenna and vehicle manufacturer guidelines must be adhered to.

It is not advisable to "mix and match" antenna bases and whips from different manufacturers as this can result in an impedance mismatch, particularly with glassmount types, which are generally supplied as a complete kit.

Active type antennas should have CE or 'e' mark approval before 1st October 2002 and have 'e' mark approval after 1st October 2002.

Care must be exercised in:

- choosing the correct type of antenna;
- siting it in the recommended location;
- installing it correctly;
- ensuring that all coaxial cable connections are sealed to prevent ingress of dirt and water as this would affect the performance of the antenna system;
- ensuring all connections are electrically tested;
- ensuring a satisfactory VSWR reading is obtained.

Additional information on testing antennas is contained in paragraph 5.3.1 and radiation patterns in Appendix E.

5.2.1.2 Location of antennas on vehicles

5.2.1.2.1 Panel mount antennas and ground planes

A conventional panel mount antenna needs to be mounted **vertically** on a horizontal ground plane; the ground plane acts as the “counterpoise” for the antenna and should be considered as a component of the antenna system. Ideally the antenna will be mounted in the centre of a ground plane, with a radius of at least a $\frac{1}{4}$ wavelength at the lowest frequency band being used - on lower frequency bands (e.g. Band 1/Low Band) this may be difficult or impossible to achieve. For these cases the antenna may need adjustment of length (usually shortened) to compensate for the smaller ground plane - see 5.3.1 antenna checks

Table 1 - Approximate Frequency to wavelength conversion.

Band Name	Frequency (MHz)	Wavelength (cm)	1/4 Wavelength (cm)
Citizen's Band	27	1100	275
Band 1	50	600	150
Low Band	80	375	94
VHF High	150	200	50
Band 3	200	150	38
TETRA	400	75	19
UHF 1	420	71.5	18
UHF2	460	65	16
GSM900	900	33	8
GSM1800	1800	16.5	4
UMTS	2100	14	3.5

The antenna should be located as high as possible; the ideal location is on the roof of the vehicle. Any other location may have a marked affect on the radiation pattern of the antenna.

5.2.1.2.2 Radiation patterns

To achieve as close to a symmetrical, omni-directional radiation pattern as possible, the ideal location is in the centre of the roof of the vehicle; this is not always possible, but any other location will have some affect on the radiation pattern of the antenna. “On glass” and window clip type antennas will always suffer some distortion to the symmetrical pattern due to their mounting positions.

The antenna should not be located close to any vertical structure, windscreen pillar, or any structure on the roof, etc., which could act as a screen or reflector.

Care should be taken when siting it close to an existing antenna, ensure that there is a separation of at least $\frac{1}{4}$ wavelength for transmit frequencies below 600 MHz and one wavelength for transmit frequencies above 600MHz (see table 1).

5.2.1.2.3 Sun roofs

If a sunroof is fitted, then the antenna should be mounted at least $\frac{1}{4}$ wavelength from the opening (see table 1). Care should be taken to ensure that the selected position does not foul the sunroof or its' operating mechanism.

5.2.1.2.4 Fuel filler caps

The antenna location should be a minimum of 30 cm from the fuel filler cap.

5.2.1.2.5 Antenna safety

The antenna must be installed on a vehicle so that the radiating element does not create a hazard.

On high vehicles, the length of the antenna should be considered and how this affects the overall height, particularly where the vehicle will be used in areas with reduced height entrances etc. in order to reduce the possibility of damage to the antenna and or vehicle.

In the case of a high power mobile radio (over 10W equipment), care should be taken to mount the antenna in such a position that no part of the human body will normally rest within 20 cm of any part of the antenna for more than a few minutes whilst the equipment is in use.

5.2.1.2.6 Antennas on non-metallic panels

When the antenna installation is to be carried out on a non-metallic surface:

- a ground plane independent antenna can be fitted directly to any surface (Glass fibre etc.) or onto a mounting bracket which may be supplied by the manufacturer;
- a standard antenna can be used with a ground plane fitted to the underside of the panel e.g. an alloy plate complying with dimensions in Table 1 (see in 5.2.1.2.1).

5.2.1.3 Fitting the antenna

5.2.1.3.1 Panel mount antennas

Before fitting the antenna in the desired location, check for adequate clearance under the panel and ensure that it will not interfere with the structure or operation of the vehicle. Protect the surrounding area inside and out from swarf and ensure that there is sufficient clearance to prevent the drill bit from snarling on anything on penetration of the bodywork, e.g. the headlining. If in doubt fit a stop to the bit.

De-bur the hole and remove an area of paint/primer from the underside of the panel to ensure a good earth connection for the antenna mount. Petroleum jelly or a similar substance should be applied to the exposed metal to prevent subsequent corrosion occurring.

Care should be taken not to over-tighten the mount as this could cause distortion of the panel.

5.2.1.3.2 "On-glass" antennas

Care should be taken to ensure the antenna is mounted clear of the window heater elements, decorative coating, washer/wiper and integral screen receiver antenna where fitted. Before fitting an on-glass antenna, refer to manufacturer's instructions and recommendations. In some cases this type of antenna may constitute a safety hazard and could invalidate the vehicle manufacturer's warranty. On-glass antennas may not be suitable for vehicles with double-glazed screens, reflective coatings or other special glass.

NOTE: After fitting, If interference occurs to in-car entertainment equipment or other vehicle electrical equipment, repositioning or a different type of antenna should be considered.

Scrupulous cleanliness must be observed and care should be taken not to touch the adhesive surfaces or the glass after cleaning prior to fixing. Care should be taken to ensure that the glass is within the specified temperature range when fixing the antenna

mount in order to obtain a good bond. In cold weather, it is good practice to ensure that both the glass and the antenna mounting components are warm

5.2.1.3.3 Specialist antennas

These can include combined (dual or multi frequency), ground plane independent, low profile or “disguised” types.

If the antenna includes a broadcast receive function, it may incorporate an active amplifier that requires a 12volt +ve feed. Dependent on the type of antenna and/or broadcast receiver this can be provided by one of two different methods:

- Phantom feed - 12volt +ve feed via coaxial cable from the broadcast receiver;
- Separate feed - a separate 12volt +ve feed – usually a switched source output from the broadcast receiver.

Reference to both the antenna installation instructions and vehicle/receiver handbook may be required to determine the correct connection method.

Combined antennas may be supplied with a separate diplexer unit, which should be securely fixed in a dry location.

5.2.1.3.4 Covert antennas

Special care should be taken when considering the location of covert antennas:

- The mounting position should not be close to any ECU device;
- Consideration should be given to the attenuation of signal caused by being fitted behind trim material (e.g. A pillar’ trim or dashboard covering);
- The antenna will still radiate sufficiently to enable effective operation on the radio network.

5.2.1.3.5 GPS and satellite communication antennas

Antennas for these systems need to have a clear view towards the sky to enable acquisition of satellite signals – the location of the antenna will have a marked effect on its performance.

AVL (Automatic Vehicle Location) systems, vehicle management systems and navigation systems often use GPS to provide location information. The customer should be consulted as to how critical the constant availability of position information is to the system operation; some systems only require GPS position information occasionally (e.g. navigation systems), so can utilise a GPS antenna that is fitted in a less effective location.

5.2.1.3.6 Temporary antennas

These can include boot mount, magnetic mount, gutter mount and window clip types.

Care should be taken when routing the coaxial cable through door/boot openings to minimise risk of damage to the cable.

The selected body panel position should always be cleaned before a magnetic mount is placed to avoid damage to the bodywork. The magnet should have been supplied with a protective pad/boot - no other material should be placed between the magnet and the roof (e.g. cloth or plastic).

5.2.1.4 Connection of coaxial cable to antenna

A suitable coaxial cable (of the correct impedance, usually 50Ω), correctly terminated (see section 5.2.1.6), should be used to provide a continuous run between the antenna and the radio equipment. Excess coaxial cable should NOT be coiled up as this may affect the tuning of the antenna as well as producing electrical interference.

It is best practice to cut the cable to the correct length and then terminate it accordingly.

If the provided cable is too short, where possible, a suitable cable of the correct length should replace it.

If an extension cable is required then the correct type should be used, terminated with good quality, low loss connectors. The consequences of the additional loss should be considered, particularly at frequencies above 400MHz – it may be more appropriate to find another location for the antenna to achieve a shorter cable run.

5.2.1.5 Routing of the coaxial cable

Ensure that the cable is properly secured, and routed in a way to avoid sharp bends and where possible existing vehicle wiring and electronic modules. Ensure that the cable is not strained or distorted e.g. by excessive tightening of cable ties. When vehicle trim is replaced, make sure that the panels do not trap the cable. Additional care should be taken when installing a glass mount antenna to the rear screen of a hatchback type vehicle to allow opening and to prevent damage to the cable over a period of time – this may be achieved by providing a loop of cable across the opening.

5.2.1.6 Fitting of coaxial connectors

Fit the correct antenna connectors at each end of the coaxial cable to match the equipment using either crimp or soldered connectors as appropriate. In the case of crimp connectors, use only the correct ratchet tool. Ensure that the joints are electrically and mechanically sound.

NOTE: Before and after replacing any vehicle trim that may have been removed to install the antenna, it is advisable to carry out the antenna checks specified in paragraph 5.3.1.

5.2.2 Installation of mobile equipment

5.2.2.1 Location of controls

All necessary controls should be positioned within reach of the driver (if the driver is the prime user) but not in such a way that the driver's attention is distracted from the road. Refer to ISO 4513 – Road Vehicles –Visibility – methods of establishment of eyeline for driver's eye location. This document is available from 'British Standards Online'

5.2.2.2 Mounting of equipment in the vehicle

The equipment installed in the vehicle should be fitted in accordance with safety requirements, legislation and agreed customer's instructions. Some vehicles are designed so that the fascia, glove pocket and/or parcel shelf can collapse under impact in the event of an accident. Fitting any item of the mobile installation to these vehicles may modify such features and must be taken into consideration. This also applies to any external ancillary equipment used in conjunction with the installation.

Equipment should be located in such a manner that:

- it conforms with equipment and vehicle manufacturer's instructions;
- it is not susceptible to damage nor its ventilation restricted;

- special care should be taken to ensure that equipment cannot be exposed to water damage;
- access is not barred to vehicle equipment in the load storage area e.g. wheel jack, fire extinguishers, spare wheel;
- the connections to the equipment should be easily accessible in order that the equipment may be removed for operation in transportable mode, or for repairs and servicing;
- it does not hinder the operation of airbags or other safety equipment.

5.2.3 Routing of power and control cables

5.2.3.1 General

Refer to vehicle manufacturer's instructions where available.

Where possible, all cables should pass under carpets and through mouldings in such a way as to afford maximum protection. If necessary, use sleeving, a proprietary protector and/or cable ties where required. Also Scotchlok type connectors should not be used to break into existing cables

5.2.3.2 Grommets

Whenever the cables pass through a bulkhead, a grommet must be fitted. It is always better to use an existing hole rather than drilling another, provided that it is in the right position, is large enough, and is fitted with a grommet. The quality of the original seal should not be impaired.

5.2.3.3 Routing

Select a route for the cables, ideally on the opposite side of the vehicle to the fuel pipe, clear of brake pipes, cables, controls, pedal box, steering column, vehicle wiring and any hot components. Under no circumstances should any cables be attached to any of these.

Cables should be routed so that they avoid:

- sharp edges;
- continual bending;
- stress or strain;
- abrasion;
- extreme temperature;
- creating a hazard to the occupants of the car.

5.2.4 Components of the installation

Typical items may consist of a:

- microphone
- loudspeaker
- distribution \ transceiver box (not all products)
- control head \ handset (incorporating microphone and earpiece)
- remote controls

5.2.4.1 Microphone and loudspeaker proximity

Microphone and loudspeaker positions should be selected to avoid audio clipping or feedback problems, which could be caused by:

- the units being too close together;
- the units directly facing each other;

- mounting the microphone on a resonating panel.

The microphone and loudspeaker should not be located so as to cause a hazard to the vehicle occupants.

5.2.4.2 Handsfree microphone

Mount the microphone on a non-resonating panel in a position ideally not more than 50 cms from the user's mouth. Ensure the microphone will work with the sun visor in all positions and is clear of all normal driver's movements.

The microphone feed wire should be routed so as not to distract the driver. Care should be taken to avoid routing the cable near pedal controls, steering column and other moving parts.

5.2.4.3 Handset/microphone

Ensure that the handset is mounted in a position such that it can be lifted to the driver's head height when in a normal seated position. Any cabling must not interfere with vehicle controls when in use or stowed. Handsets incorporating displays and controls refer to 5.2.4.6.

5.2.4.4 Loudspeaker

The loudspeaker shall be positioned in such a way as to make certain that any vehicle occupant is not likely to be deafened and to provide an unobstructed audio path to the user.

To avoid the possibility of acoustic feedback the speaker shall not point directly towards the microphone. The distance between speaker and microphone should comply with manufacturer's recommendation.

Fix any volume and mute control in a position that is convenient for the operator.

Fit the loudspeaker to a firm surface, considering any equipment behind the panel and the possible adverse effect by the magnetic field from the speaker magnet e.g. airbag actuator, fuel cut-off switch.

5.2.4.5 Distribution box / transceiver

Where a distribution box is provided it should be securely fitted and the various components plugged in as detailed in the manufacturer's instructions. Care should be taken to avoid strain on any cabling, likely to cause broken connections.

5.2.4.6 Control head

The control head should be positioned such that it;

- does not obstruct the driver's view of the road scene
- is as close as practicable to the driver's field of vision

5.2.4.7 Remote controls

Any remote controls, such as PTT, should be operable from a normal driving position.

5.2.5 External alert facility

Where an external alert facility is provided, the fitting should comply with current Vehicle Construction and Use regulations.

5.2.6 In-car entertainment mute

When an ICE mute is available and asked for by the customer, the compatibility of the equipment must be checked. Care should be taken not to damage or compromise the existing vehicle wiring.

Depending on the equipment, the muting method may be one of the following:

- manufacturer's built-in interface harness that will require an additional interface lead
- vehicle specific tele-mute lead (possibly incorporating power supply lead) that connects directly into the vehicle radio harness.
- muting the ICE, using an interface unit on the ICE loudspeakers, allowing the mobile radio equipment to use the ICE speakers;
- muting the ICE by a direct feed, allowing the mobile radio equipment to be used with its own hands free speaker;
- mobile radio equipment mute line operates a normally closed relay to switch off the ignition feed to the ICE.

5.2.7 Power supply

5.2.7.1 General

When available, the manufacturer's instructions for the vehicle, communications and ancillary equipment should be used as the primary guide for the connection of a power supply.

If information is not provided or is unclear, then the following guidelines should be used.

In the case of specialised vehicles, such as Petrol/Gas Tankers, Emergency and Public Service Vehicles, Agricultural equipment and gas-propelled vehicles may be subject to further installation instructions/specifications e.g. Specific Intrinsically Safe and Petro-chemical Specifications. Where this is the case, in the interest of safety, these instructions should be followed.

5.2.7.2 Provision of a dedicated/permanent supply

A dedicated supply cable should be used for the mobile installation, which should be fused in both power lines as close as possible to the battery, with the negative fuse being three times the rating of the one in the positive line. This assumes that the vehicle has a negative earth. The supply cables should be connected to the battery positive and negative` connections. Do not connect directly to the battery pillars but use the battery terminals provided.

It is also recommended that unless a moulded twin supply cable is used, then the two supply lines be twisted together along their length in order to reduce induced noise.

Fuse holders should be of a water-resistant type and fuses must be of the manufacturer's recommended rating and type.

The supply cable from the radio equipment should approach the battery in such a way that when terminated the two wires cannot be inadvertently reversed e.g. one wire is shorter than the other.

5.2.7.3 Radio mute lead with combined power + earth

When installing a custom made unit to mute the radio when the handset is in use, which includes the constant power feed, ignition switched power feed and earth leads. The following checks should be made.

- The constant and switched feeds should be checked i.e. constant is constant and that the switched feed is off when ignition is switched off.
- That the radio earth remains earthed to the vehicle when the ignition is switched off.
- Correct fuses should be used in the power cables.

No other accessories should be connected to any of the leads, which are used in this installation.

5.2.7.4 Provision of a switched supply via the ignition switch

Most types of equipment have an ignition sense supply lead available.

When this facility is required it should be connected to either the auxiliary or ignition terminal of the ignition switch. If the facility is not required it should be connected to a permanent positive supply. In either event the lead must be via an in-line fuse.

CONNECTIONS SHOULD NOT BE MADE TO ANY ECU FEEDS UNDER ANY CIRCUMSTANCES.

Where an ignition sense feed is not fitted and a switched supply is required, then a suitable relay of correct current and voltage rating may be used. The supply for the relay energising coil or ignition sense feed should be fused close to the supply take-off point, or may be taken from one of the vehicle's fuses which are live when the ignition switch is on. The relay contacts are connected in the dedicated supply cable. If a change-over relay is used, then the normally open contact should be connected to the live side, and the change-over contact should be connected to the equipment side of the supply cable.

5.2.7.5 Supply cable and routing

In addition to Clause 5.2.3 the following should be taken into account.

When fitting a supply cable, the following should be considered:

- heavy duty cable should be used on long cable runs to minimise voltage drop;
- the cable should be of a higher current capacity than the protection fuse and the correct fuse fitted;
- the cable should be as short as possible;
- the cable should be secured well clear of moving parts, e.g. shock absorbers, steering, drive shaft, control pedals etc.;
- the cable should be secured well clear of the engine, exhaust or other hot items;
- the supply cable run should, where possible, be separate from that of the ICE equipment control cables, although they may pass through the same holes in the chassis and body for ease of fitting. Suitable grommets should be fitted if additional holes are drilled;
- the cables should be supported, avoiding sharp bends and not be subjected to strain;
- the cable should be sited away from ignition coil, HT circuits and ECUs, antenna coaxial cables and, where possible, other vehicle wiring.

5.2.7.6 Vehicle supply greater than 12 volt

5.2.7.6.1 General

Most mobile radio equipment operates from a 12 volt supply. If the vehicle has a supply greater than 12 volts then it is essential that a suitable regulator or converter is used which will provide the nominal supply voltage and current for which the radio equipment is designed. It must also comply with vehicle EMC requirements.

A 12 VOLT TAP MUST NOT BE TAKEN FROM THE VEHICLE BATTERIES

A means of switching off the regulator or converter must also be provided; this can be via the ignition switch, direct switching from the mobile radio, a master switch or some other means agreed with the customer.

The supply cable to the regulator or converter must be as short as practicable and suitable fuses should be fitted as close as possible to the supply. The unit should be mounted in accordance with the manufacturer's instructions. Unless environmentally protected it should be located in a dry and well-ventilated position.

5.2.7.6.2 Isolated power supply

The installation of the mobile radio equipment should be carried out in such a manner that the integrity of the vehicle isolated power supply is not impaired. Continuity checks between the positive and negative supplies and the vehicle chassis must be carried out before and after installation to ensure isolation of the power supply is maintained. The checks should be carried out with the isolation switch in the 'on' position.

5.2.8 Installation of auxiliary mobile equipment

5.2.8.1 Definition

This equipment is addition to the normal radio equipment installed within the vehicle. In many cases it uses the existing voice transceiver to communicate information. Examples of auxiliary mobile equipment are given below:

- Interface;
- Modem;
- Data terminal equipment, fax or PC;
- Tracking and alarm systems;
- Navigation systems;
- Camera;

Care should be taken when interfacing with the radio equipment to ensure both systems operate correctly. The equipment should be installed in a safe and correct manner as given in this document. Where possible the manufacturer installation instructions should be followed.

5.2.8.2 Power requirements

In some cases auxiliary equipment can be powered from its own internal battery supply. However, where the equipment requires power, then a separate fused supply should be installed in line with the instructions given within this document.

Where the equipment has high power consumption the vehicle should be specially adapted and the capacity of the battery and charging circuit increased to meet the current requirement of any additional equipment.

If the equipment draws power directly from the mobile radio, consideration should be given to the rating of fuses and the existing wiring to ensure each will handle the additional current demand. Fuse rating must not be increased to such a point that the

wiring of the mobile radio or vehicle is no longer protected. The mobile radio equipment should also be designed to handle the power requirements of the auxiliary equipment.

5.2.8.3 Installation process

Data equipment should be securely mounted to prevent its movement while the vehicle is in motion.

It is recommended that all data equipment and wiring is kept away from the antenna coaxial cable of the mobile radio equipment.

All equipment installed should be suitable for use in a mobile environment.

5.3 Basic Checks

5.3.1 Antennas

Ensure that the antenna radiating element is of the type and length specified by the manufacturer for the relevant frequency in use.

Before connection to the equipment, the antenna system should be DC tested as follows:

- Centre conductor continuity check - low resistance between the centre pin of the co-axial connector and the antenna radiating element (less than 0.1 ohm);
- Earth continuity check - low resistance between the body of the co-axial connector and vehicle earth. (less than 0.1 ohm) - this test is applicable to standard body mounts;
- Short circuit check - no connection between the centre pin and body of the co-axial connector.

Note: Testing is to be carried out at the equipment end of the coaxial cable. Some types of antenna present a DC short across the coaxial cable e.g. some glassmount, centre tapped, end-fed 1/2 wave etc. In this case, the cable should be disconnected from the antenna (where possible) and checks for continuity and no short circuit carried out before re-connection to the antenna. Consult the manufacturer's installation instructions for guidance where applicable.

5.3.2 Equipment power supply

5.3.2.1 Isolated supply system

Where there is an 'isolated' supply system, ensure that the installed equipment has not degraded the insulation between each terminal of the battery and chassis, i.e. positive to chassis, and negative to chassis.

5.3.2.2 Converter or regulator

Where a converter or regulator is used, ensure that the fused supply to the converter is capable of being switched off. This can be achieved using the isolating switch or via the ignition switch.

5.4 Power Up Test

5.4.1 VSWR measurements (transmitting antennas)

With all doors, bonnet, boot, etc. closed, check the match of the antenna by using a suitable calibrated VSWR meter or through-line wattmeter. The VSWR should be 1.5 to 1 or better (i.e. less than 1.5:1).

The value should be recorded on the installation report.

Note: When considering the results of a VSWR test, consideration should be given to the calibration accuracy of the meter and the test location (e.g. sometimes it is possible to obtain erroneous readings when testing a GSM cellular antenna installation in close proximity to a base station).

5.4.2 Transmitter output power

Where appropriate, the power output from the transmitter should be measured using a r.f. wattmeter connected temporarily to the transmitter output coaxial socket. The measured power should be checked with the licence conditions. If the licence stipulates ERP this should be calculated from the transmitter output power and the known antenna gain and feeder loss.

5.4.3 Ignition sense

Where an ignition sense supply is used, ensure that the mobile equipment turns off when the ignition is switched off.

NOTE: This test should be carried out with the in-car entertainment unit switched on, and repeated again with the unit switched off.

Additional checking of transportable equipment may be necessary due to the internal battery supply that may be fitted. In these cases the power supply lines and fuses should be checked independently.

5.5 Re-assemble vehicle

When re-fitting panels and trim, ensure that cables are not trapped or damaged or below screw fixing positions.

Care should be taken not to damage panels during re-fitting.

6 Test and Final Inspection

6.1 Test Calls

Test calls should be made in both transmit and receive modes, to check all functions of the mobile radio equipment wherever possible. These checks should be made with the vehicle systems in use after the equipment has been fully installed.

6.2 Interference Checks

If the radio system causes interference to the normal operation of the vehicle, the radio system shall be de-activated until the radio manufacturer advises suitable corrective action.

Checks should be made for interference from and to all electrical and electronic equipment in the vehicle, both in standby and transmit modes. This should be carried out initially with the ignition switch on but the engine not running, all tests should be repeated with the engine running.

If any interference occurs then every effort should be made to locate and rectify any installation problem.

If a problem is found and cannot be rectified, and it is suspected that the equipment or vehicle is out of specification, then the appropriate manufacturer, agent or supplier should be consulted. If, after following the manufacturer's, agent's or supplier's advice, the problem with the vehicle still exists, it should be noted and the customer must be advised.

UNDER NO CIRCUMSTANCES SHOULD ANY INSTALLATION TECHNICIAN ATTEMPT TO MODIFY ANY DEVICE OR SYSTEM THAT IS BEING AFFECTED.

6.3 Vehicle and Site Check

A visual check must be made to ensure that tools, items excess to requirement, waste and other debris not required by the customer are cleared from the vehicle and the site.

6.4 Installation Checks

For vehicle inspection, it is recommended that an installer uses a check list system to ensure a consistent standard. It also must be taken into consideration that several checks, which are not necessarily on the checklist, such as door, boot, bonnet and seat belt operation should be performed at this time.

Check that the installation is in accordance with the customer's requirements, and complies with the recommendations in this Code of Practice.

The make/model/serial/mobile user number and type of antenna should be recorded. The antenna VSWR should also be recorded and where appropriate the output power from the mobile transmitter.

All functions of the equipment should be checked; a separate test report on the functions may be needed for the different types of equipment i.e. private mobile radio, public radiophone systems, Band III, trunked systems, etc.

The installer should sign the post-installation report to confirm that the work has been carried out, and the vehicle may be released. The customer should then sign to state that the work has been carried out to his satisfaction.

The post-installation form may include the following statement:

"This equipment has been installed in accordance with the customer's instructions and complies with Code of Practice MPT 1362."

If the installation does not fully comply with the code then the statement should be deleted and a further statement should be made stating why it does not conform.

The pre and post installation report may be combined on one form. An example of a typical form can be found in Appendix D.

6.5 Final Tests

6.5.1 Static tests of vehicle functions

After the installation is completed, all vehicle functions previously tested should be re-tested to ensure that they work as before. The customer should be advised to drive the vehicle with special care until he is fully confident that there are no problems. The customer should sign a statement of acknowledgement

6.5.2 Road testing - special vehicles and installations

Where a range of special equipment is installed into a vehicle it is good practice to road test the vehicle before and after the installation of the equipment. This particularly applies to special vehicles such as Fuel tankers, Police, Fire and Ambulance vehicles. Where the installer is not qualified and insured to drive the vehicle the customer should be informed that a road test is required, and asked to provide a suitably qualified and insured driver for the road test.

A suitable statement should be included in the installation report to advise the customer. If the customer decides not to have a road test then a statement should be included in the installation report to that effect and signed off by the customer. Wherever possible the usual driver of the vehicle should carry out the road tests. This provides an additional degree of quality assurance, in that the driver is familiar with the vehicle and can better check if there is any degradation of vehicle performance.

7 Demonstration and Customer Training

7.1 General

Correct operation of the equipment and all the facilities of the installation should be demonstrated to the customer, user or nominated representative and relevant documentation handed over.

In the case of a PMR installation, the customer should be instructed on the correct procedures to be used over the air, i.e. use of call signs; messages to be kept brief and to the point; and where appropriate, to monitor the channel before passing a message.

7.2 Safety Instructions

The user should be made aware of current Highway Code and other Regulations within the Road Traffic Act, which refer to the use of handheld microphones.

The customer should be instructed to operate the equipment with caution, until satisfied with its operation in the vehicle.

Where electronic devices are fitted to the customers vehicle, such as electronic ignition, fuel injection, anti-lock braking, in-car entertainment, etc., the customer should be warned that any such device may be affected whilst in the presence of an RF field.

7.3 Handing Over

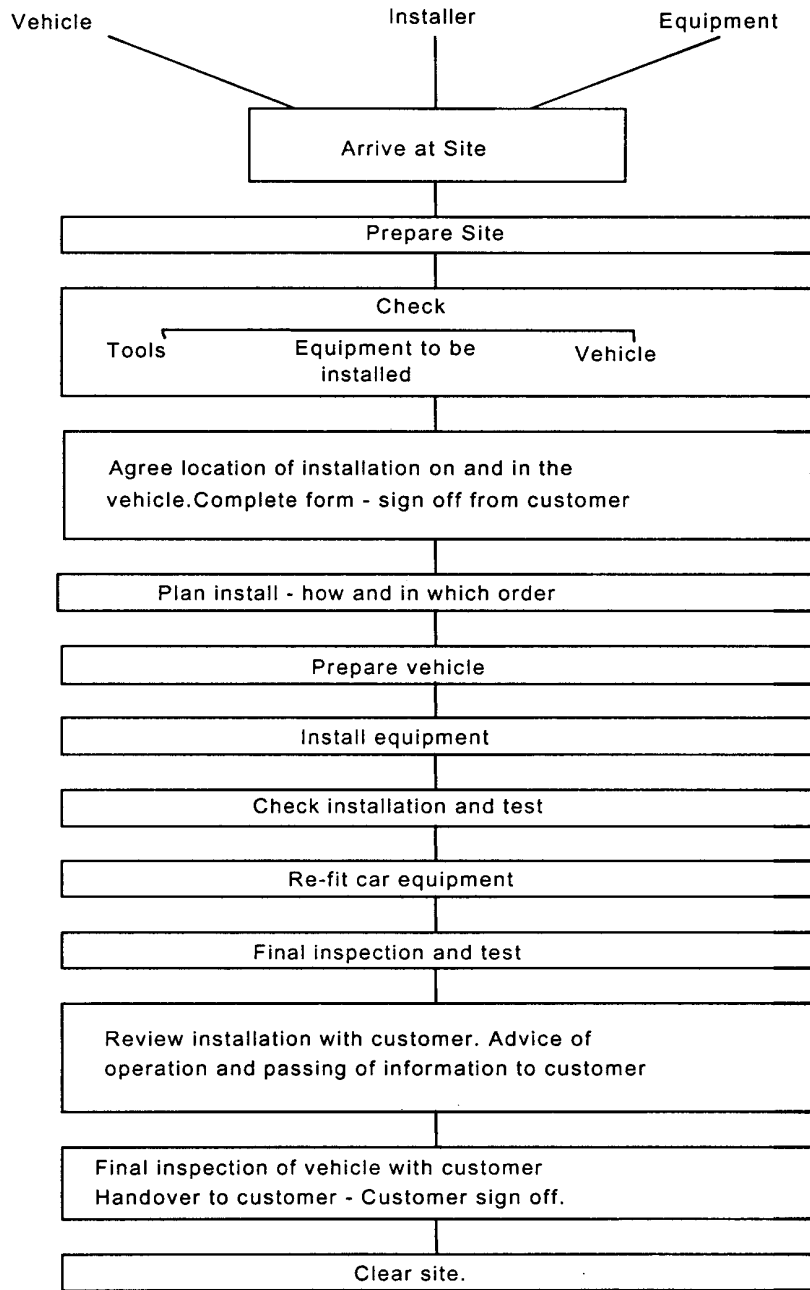
All documents associated with the installation and conformity of the equipment should be handed over to the customer together with the vehicle. The customer should sign to state that the installation is satisfactory.

8 Organisations Involved in the Update Group

Allen	Norman	Fone Logistics
Bouchard	Peter	Fone Logistics
Gent	Stewart	NCF
Hoye	Steve	RA
Matthews	Anton	FCS
Naylor	David	Calvale Associates
Thomson	John	Panorama Antennas
Allison	Trevor	RA
Rumens	Dave	Vodafone
Taylor	Steve	Dashmount
Malcolm	J	FCS
Parsons	Simon	JRC
Bailey	Trevor	Vodafone
Peirce	Richard	Haystechnology
Norris	Brian	Orange
Swan	Peter	ICL

Radiocommunications Quality Council,
Radio Society of Great Britain
and representatives from equipment and vehicle manufacturers.

Appendix A: Installation Process Flow Chart



Appendix B: Documentation

The following reference documents may be consulted if applicable:

Wireless Telegraphy Acts

Licence Conditions for the radio service

Health and Safety Acts

Highway Code

Road Traffic Acts

Workmanship Standards Manual

ISO 9000

RQAS 1 SGN C.03 (The Installation and Commissioning and test of civil land mobile radio equipment in vehicles).

Vehicle Construction and Use Regulations

Generic EMC Directive 89/336/EEC

Automotive EMC Directive 95/54/EC

EU principles on Human / Machine Interface - 2000/53/EC

Appendix C: Further Information

Further information relating to installation of mobile radio equipment may be available from the following:

BABT	Claremont House, 34 Molesey Road, Hersham, Walton on Thames, Surrey, KT12 4RQ Tel: 01932 222289
Department of Trade and Industry (for EMC advice)	Automotive EMC Club, c/o MIRA, Watling Street, Nuneaton, Warwickshire, CV10 0TU Tel: 01203 355495 Fax : 01203 350322 (Contact Mr. Terry Beadman)
Department of Transport (for VCA)	(c/o VTAC, Watling Street, Nuneaton, Warwickshire, CV10 0TU (Contacts Tony Hedges / Tony Stenning) Tel: 01179 524114 (J.H.) 01179 524111 (T.S.)
Federation of Communication Services (Trade Association)	Burnhill Business Provident House Burrel Row Beckenham Kent, BR3 1AT Tel : 020 8249 6363 Fax : 0870 120 5927 E-mail: fcs.org.uk
Institute of Petroleum	61, New Cavendish Street, London, W1M 8AR Tel: 020 8467 7100
Motor Industry Research Association	Watling Street, Nuneaton, Warwickshire, CV10 0TU Tel: 01203 355495
Radio Society of Great Britain	Lambda House, Cranborne Road, Potters Bar, Hertfordshire, EN6 3JE Tel: 01707 659015
Radiocommunications Agency	Type Approvals Section, Wyndham House, 189 Marsh Wall, London, E14 9SX Tel: 020 7211 0168

Appendix D: Installation Report Form

Installation Report

SALES ORDER NO.		JOB NO.		JOB TYPE	MAKE	
EQUIPMENT		LOCK		INSTALL	MODEL	
ESN				DE-INSTALL	REG.NO.	
MOBILE NO.				SERVICE	MILEAGE	
CUSTOMER				IGN.SENSE	YES	NO
					12V	24V
				INSTALLER	DATE	

Vehicle Condition	Note: Tick if working normally or ingood condition/Cross if defective B=Before installation A+After installation											
	B	A		B	A		B	A		B	A	
1 Lights side front			12 Wipers front			23 Audio system			34 Security alarm			
2 Lights tail rear			13 Wiper rear			24 Audio system code			35 Heated front screen			
3 Headlights dip			14 Screenwash front			25 Electric radio aerial			36 Headlamp wash/wipe			
4 Headlights main			15 Screenwash rear			26 Clock (reset)			37 Air conditioning			
5 Stop lights			16 Heated rear window			27 Dashboard lighting			38 Engine management			
6 Aux lights front			17 Electric windows front			28 Dash warning lights			39 Anti lock brake system			
7 Fog lights rear			18 Electric windows rear			29 Indicator warning light			40 Instruments & displays			
8 Reversing lights			19 Electric mirrors			30 Main beam indicator			41 Seat belt operation			
9 Indicators R.H.			20 Electric sunroof			31 Trip computer (reset)			42 Exterior bodywork			
10 Indicators L.H.			21 Electric seats			32 Interior lighting			43 Interior trim			
11 Hazard warning			22 Central locking			33 Boot/load space light			44 Roof lining			

Every reasonable precaution will be taken to protect your vehicle and interior but we cannot accept responsibility for loss or damage incurred. The items listed above have been checked and found to be in good working condition or defective as shown:-

Location of	
ANTENNA	TYPE
TCVR/BOOSTER	
HANDSET	
LOOM	
SPEAKER	H/F MIC
OTHER ITEMS	

I have read and agree with the above details and give permission for installation to proceed. I confirm that, where applicable, I hold a licence to operate the above equipment. **Customer Authorised Signatory :**

NAME (PRINT) _____ COMPANY NAME _____
SIGNATURE _____ DATE _____

INSTALLATION COMPLETE					
Tests					
VSWR		EXTRAS SUPPLIED & FITTED			COST
D.C.					
IS PHONE LIVE	YES	NO			
FUNCTION, LOCK, H/F ETC					
The installation has been carried out in accordance with the Customer's instructions and complies with the R.A. Code of Practice MPT 1362 unless indicated below:- DETAILS					
DEALER CODE		SIGNED BY INSTALLER			NAME CODE
The work has been carried out to my satisfaction. Customer Authorised Signatory :					
NAME (PRINT) _____					
SIGNATURE _____ DATE _____					

Appendix E: Antenna Radiation Patterns

Typical radiation patterns for various antenna positions on a typical saloon car are shown in the following figures.

Figures suffixed with 'a' are typical for a low band PMR (66-88MHz) $\frac{1}{4}$ wavelength whip and figures suffixed with 'b' are typical for a 900 MHz band mobile phone antenna with gain.

Figures 1a and 1b show an antenna mounted on the centre of the roof.

Figure 2c shows a typical radiation pattern for a vehicle where the rear slopes away sharply e.g. a 'hatch-back', an estate, or van. This pattern can be compared with that in figure 2a.

Figures 3a and 3b show an antenna mounted on the rear offside wing.

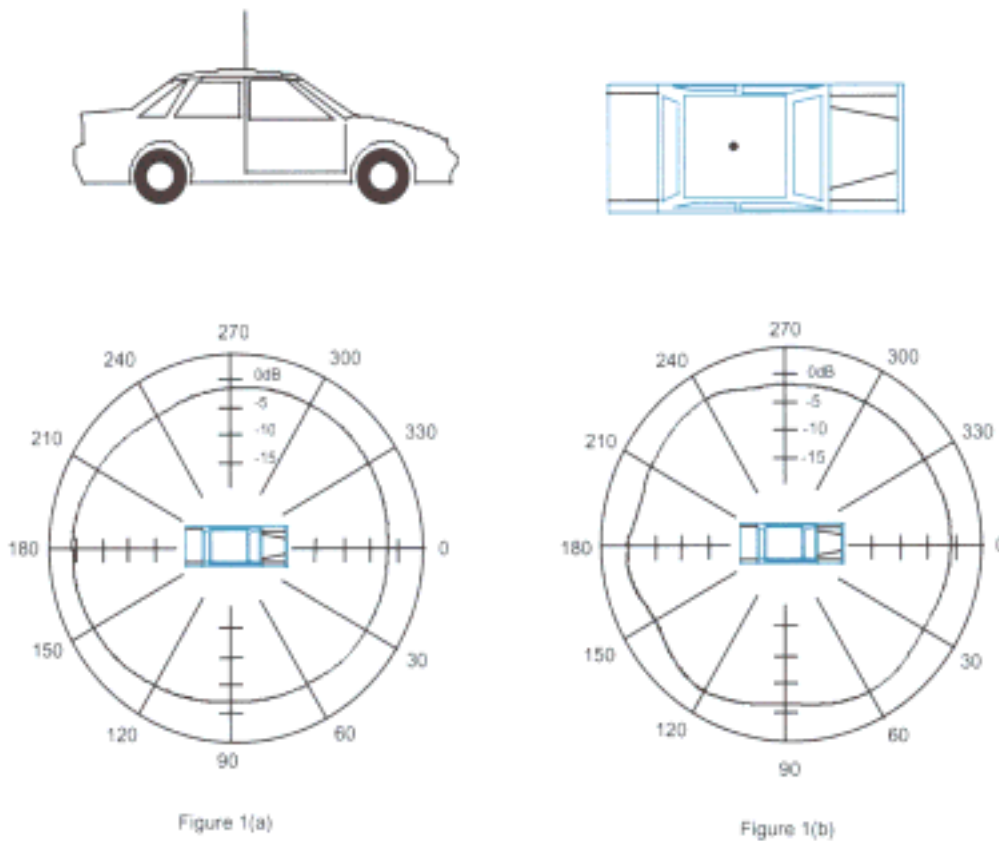
In general the best position for an antenna is on the roof of a vehicle, preferably towards the centre but where possible a $\frac{1}{4}$ wavelength from any opening, such as a sun roof.

However, if the antenna is mounted level with or below any fixings on or above the roof of the vehicle, such as a roof rack or flashing beacons, then the radiation pattern will be affected. The antenna should therefore be mounted as high as possible on a suitable ground plane.

If the antenna is to be mounted on the boot lid, it is essential that the lid should be grounded to the rest of the vehicle with separate earthing cables.

NEVER MOUNT AN ANTENNA NEAR TO THE FUEL FILLER CAP (MINIMUM 30cms).

Antenna mounted on the centre of the roof



Antenna mounted towards the rear of the roof

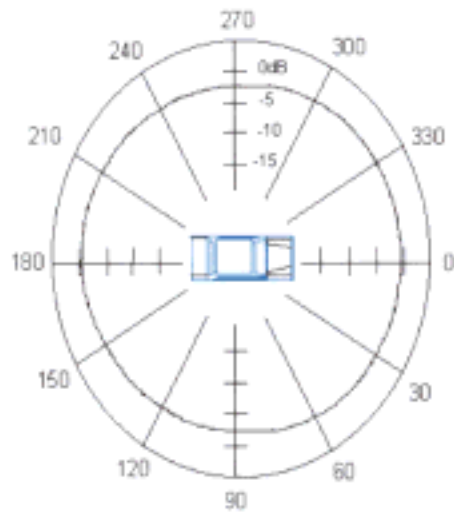


Figure 2 (a)

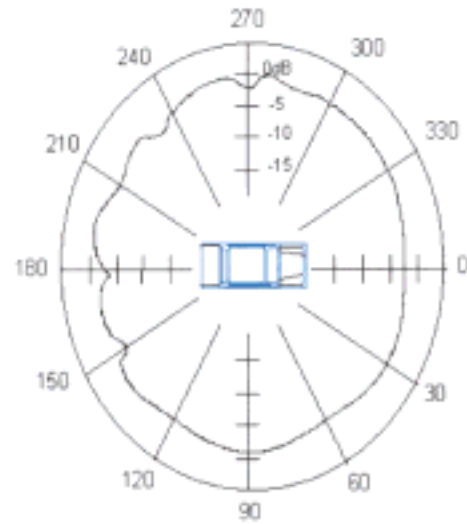


Figure 2 (b)

Figure 2(a) can be compared with figure 2(c) which shows a typical radiation pattern for a vehicle with a sloping back, such as a hatch-back

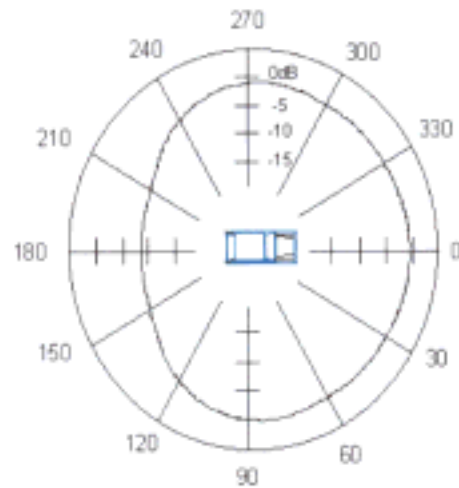


Figure 2 (c)

Antenna mounted on the rear off-side wing

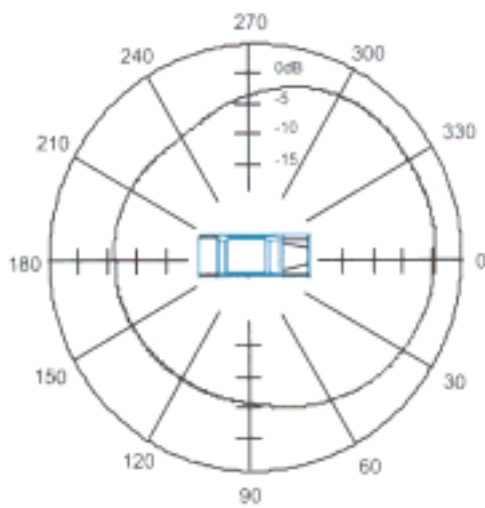
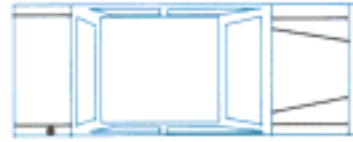
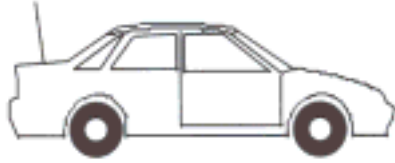


Figure 3(a)

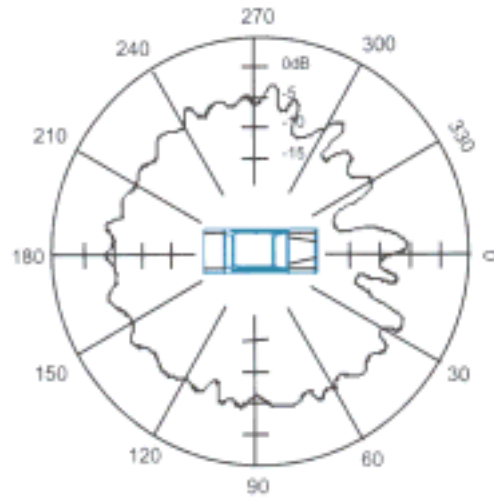
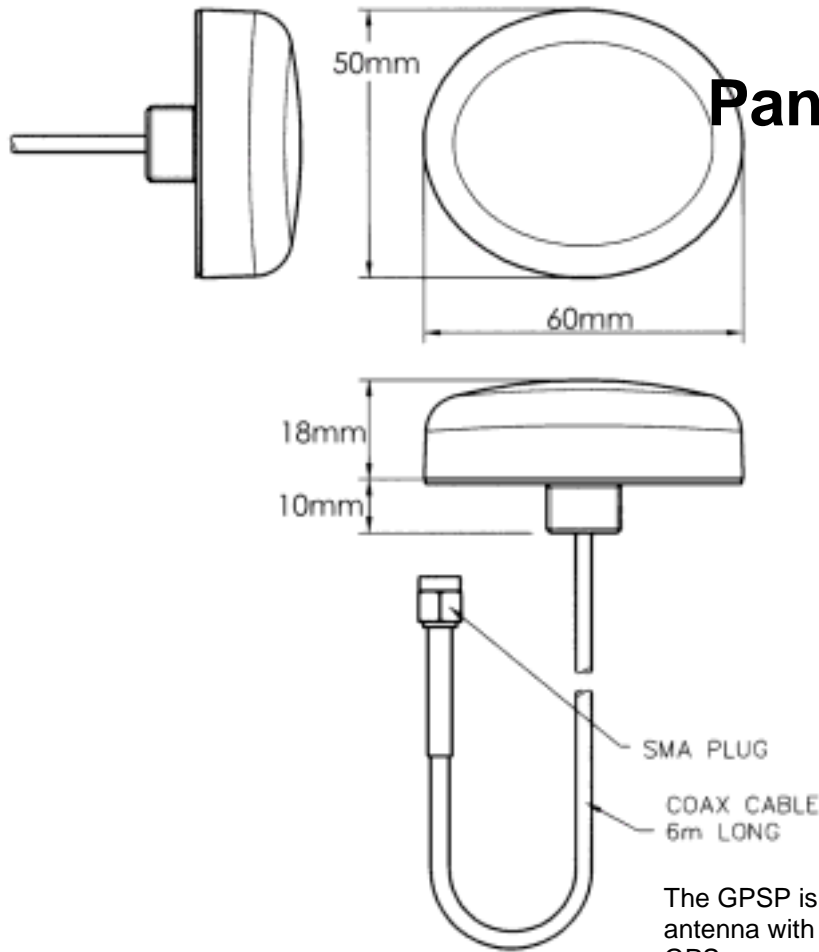
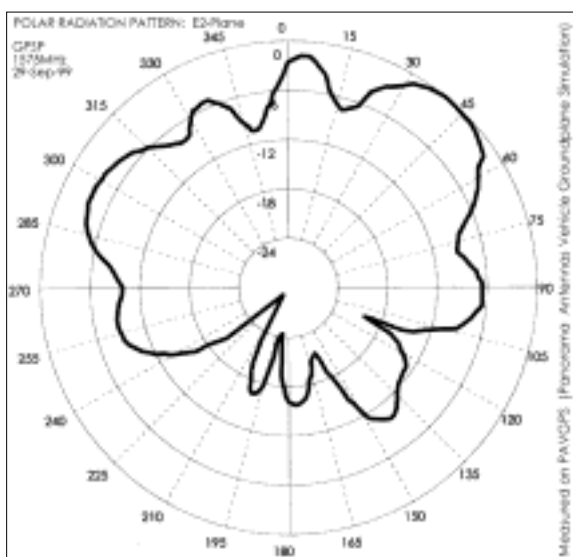


Figure 3(b)

GPSP Panel mount antenna



The GPSP is a panel mount GPS antenna with an active element for GPS.



Dimensions	Length-60mm Width-50mm Height-18mm
Colour	black
Hole size	15mm
Mounting depth	14mm (max)
Frequency range	1575 MHz +/- 4MHz
VSWR	<2.0:1
Impedance	50 ohms
LNA Gain	26dB
Polarisation	Right Hand Circular
Operating Voltage	+5V DC (fed via coax)
Current	20mA
Coaxial cable	6metres 3mm o.d (1.5D-2V)
Connector	SMA male plug

TDE-3F dual band 0dBd 900MHz & 1800MHz

