

# Counterfeit and imitation Apple chargers

*98% Safety Test Failure Rate*





## About Electrical Safety First

Electrical Safety First is the UK charity dedicated to reducing deaths and injuries caused by electrical accidents. Our aim is to ensure everyone in the UK can use electricity safely. We campaign on behalf of consumers and electrical trade professionals to improve safety regulation and ensure safety messages are appropriate, up to date and well communicated.

We provide expert information and advice to assist the public in protecting themselves from faulty, damaged, sub-standard, and poorly maintained electrical installations and electrical appliances. Additionally, we offer expert advice to manufacturers and retailers on compliance, risk and other areas of safety.

We are recognised by government and industry as the leading campaigning charity and technical authority on electrical safety.

## Counterfeit and imitation Apple chargers *98% Safety Test Failure Rate*

### Background

Electrical Safety First (ESF) has been monitoring the problems caused by counterfeit electrical products for a number of years, and it has become clear that this problem is steadily growing, with counterfeits becoming ever more difficult to detect, and even the most sophisticated consumer products now falling victim.

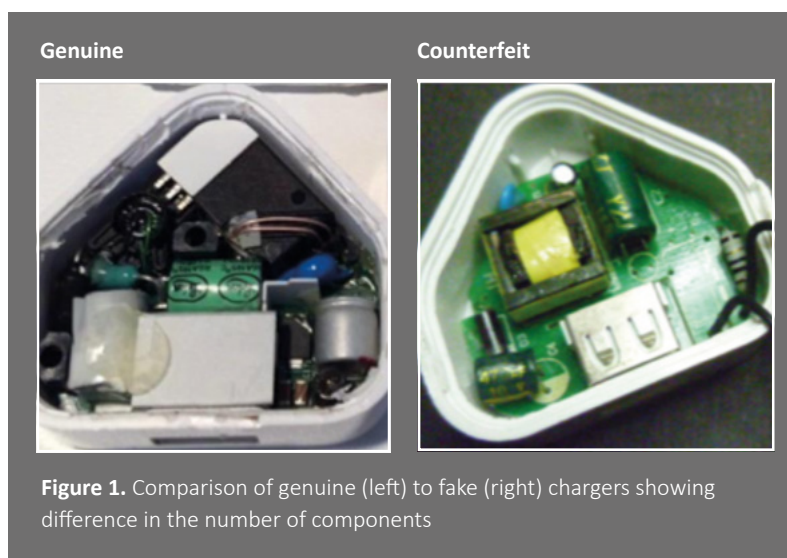
In 2015,<sup>1</sup> ESF conducted research into counterfeit electrical products being sold in the UK, and the most potentially dangerous items tested

during the course of this research were counterfeit Apple iPhone chargers. These products were also extremely cheap and widely available, both online and from markets and smaller independent retail outlets.

ESF and others, including Underwriters Laboratories and the London Fire Brigade, have investigated these products and found a number of common safety issues. Usually with these counterfeits, the appearance is the simplest method of identification. Spelling mistakes and poor-quality

markings are common, and the general outside build quality can often appear poor. However, this is not always the case and even professionals find that some can be difficult to identify as “fake”. Regardless of the outside appearance, it’s inside where the real problems lie with counterfeits. Previous ESF studies have shown that the number of components typically contained within a counterfeit model are also significantly different to a genuine product. A genuine charger would contain over 60 individual components, whilst a counterfeit averaged just 25 (see figure 1.)

Counterfeit and sub-standard goods present a particularly insidious threat to the consumer, undermining legitimate manufacturers and retailers whilst often posing a risk of fire, serious electric shock or even electrocution.



<sup>1</sup> ESF (2015) A shocking rip off. The true cost of counterfeit electrical products. Available from: <http://www.electricalsafetyfirst.org.uk/mediafile/100492991/True-Cost-of-a-Counterfeit.pdf> [Accessed 28 February 2017]

# Executive Summary

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In recent years the UK and European markets have seen a proliferation of counterfeit and lookalike chargers, both online and at independent discount retail locations. Online selling platforms in particular are a major conduit for the sale of these counterfeits and knock-offs, where consumers are often duped into believing they are purchasing a genuine product, and may not realise they have bought a counterfeit even after the item is received. Many documented safety incidents over several years have shown that these types of counterfeit and lookalike chargers can pose a significant consumer safety risk during ordinary use.

Legitimate manufacturers - such as Apple – ensure that their chargers undergo rigorous testing for safety and reliability and that they meet government and industry safety standards around the world. By contrast, counterfeit and lookalike Apple chargers are typically produced as cheaply as possible, often as part of a criminal enterprise, and are not designed with safety and reliability in mind. They are often poorly constructed with inferior or missing components, flawed design, and inadequate electrical insulation. Furthermore, they are unlikely to have been subject to the same safety testing as the chargers produced by Apple.

This report highlights some of the serious safety concerns associated with counterfeit and imitation Apple iPhone chargers. ESF, in conjunction with the independent laboratory Nemko Ltd, subjected a sample of counterfeit and lookalike Apple chargers to a range of industry standard tests designed to assess their safety, performance and suitability.

#### **Of the 64 chargers tested as part of this study,**

- 63 (98%) failed one or more of the mechanical and electrical tests, meaning that they are highly unsuitable for use.
- In many cases, these chargers could overheat, catch fire, and deliver a potentially lethal electric shock to consumers while in normal use.

**This report concludes that these chargers “pose a significant risk to the health and safety of users, and at the very least, present a risk of damaging connected equipment”.**

These findings match those of similar studies conducted elsewhere, including a recent white paper produced by the US consumer product safety organisation Underwriters Laboratory (UL) which found a 99% failure rate based on a study of 400 counterfeit and lookalike 5W Apple chargers<sup>2</sup>.



<sup>2</sup> See report “Counterfeit iPhone Adapters,” September 16, 2016, [http://library.ul.com/wp-content/uploads/sites/40/2016/09/10314-CounterfeitiPhone-WP-HighRes\\_FINAL.pdf](http://library.ul.com/wp-content/uploads/sites/40/2016/09/10314-CounterfeitiPhone-WP-HighRes_FINAL.pdf)

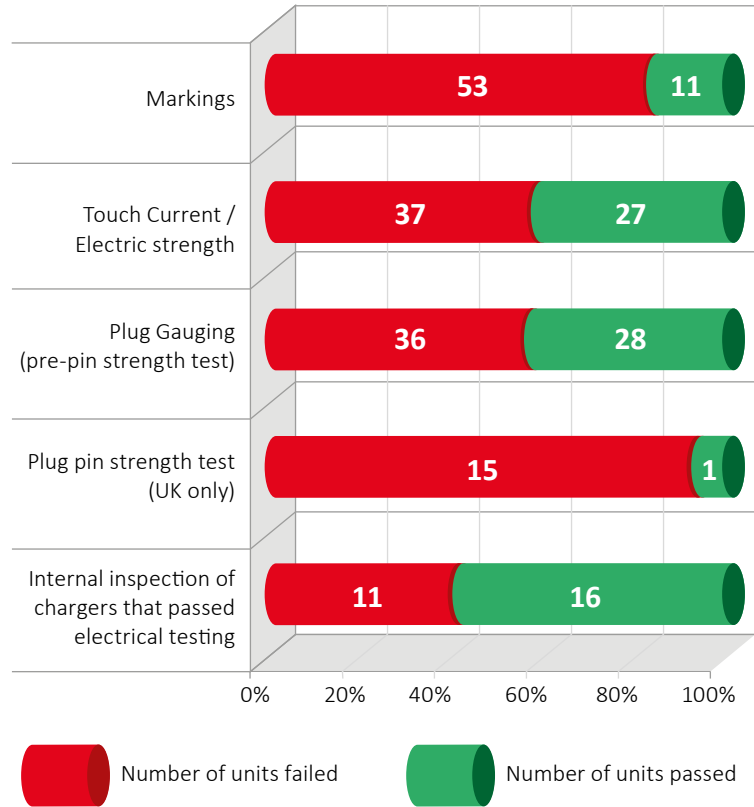
# 1. Overview of study

**This report considers the findings from a safety screening investigation carried out on 64 UK and EU plug-in charging devices that are counterfeit or lookalike Apple chargers and marketed for use with Apple branded portable devices (iPhones).**

ESF managed the investigation, working with an independent laboratory, Nemko Ltd, to fulfil the safety screening.

Apple provided 64 chargers (50 UK and 14 EU) for examination and testing, obtained from a variety of sources, including from a number of different online and independent discount high street retailers in the UK and mainland Europe. The chargers were subject to a bespoke test programme incorporating a variety of different tests designed to most readily identify any potential safety issues. The test criteria was developed with reference to applicable product safety standards and the Electrical Equipment (Safety) Regulations 1994.

Essentially, a 'progressive' screening approach was taken whereby each sample had to meet a hierarchy of safety criteria in order to progress to the next stage in the test schedule. In addition, a selection of samples that failed basic safety criteria were further scrutinised to identify the cause of failure.



**Figure 2.** Overall (EU & UK) pass to fail ratio for each test criteria

**RESULTS**  
**Only one of the 64 chargers in this investigation passed all of the mechanical and electrical tests - a 98% failure rate.**



## 2. Failure analysis

### 2.1 Markings

**53 chargers (83%) failed to meet the required markings**

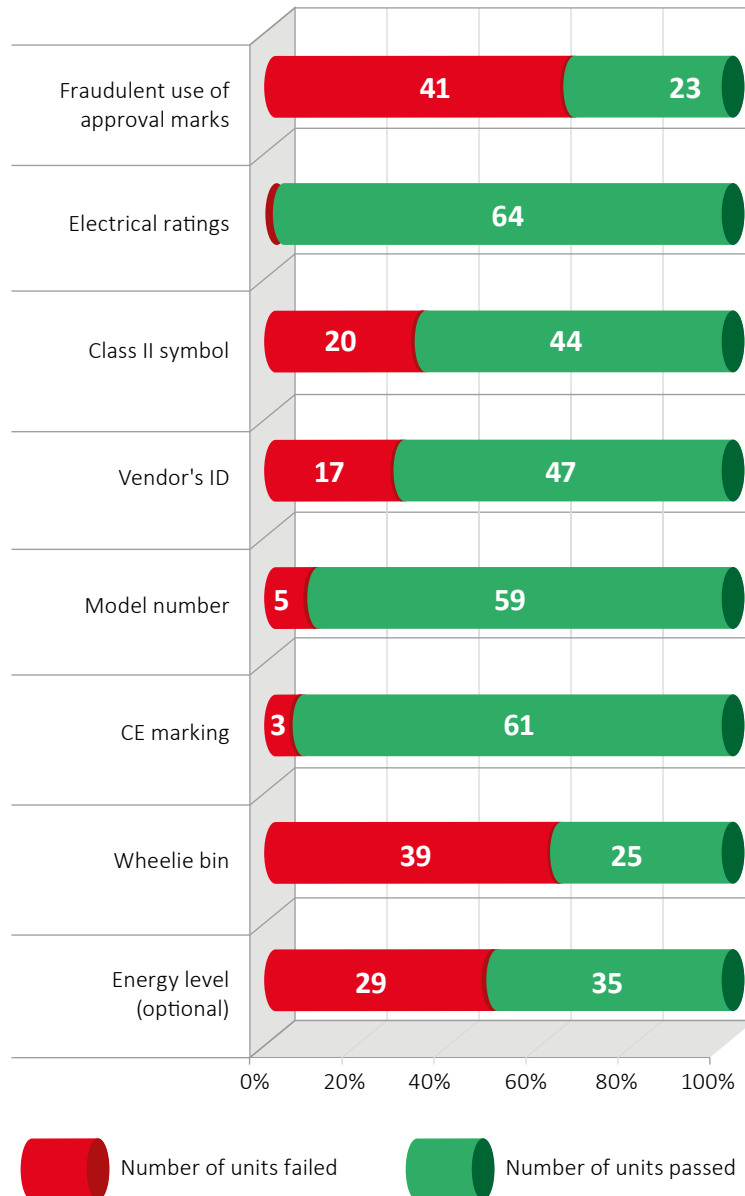
In addition to the markings required for safety, genuine iPhone chargers are marked with the name of the factory, the international energy efficiency symbol V (level 5) and the Nemko approval mark. Genuine UK iPhone chargers are also marked with the Singapore safety approval mark.

Over half (64%) were fraudulently marked with safety approval markings, and 45% were falsely marked with the international energy efficiency symbol V (level 5).

In some cases, attempts to copy other markings from genuine iPhone chargers resulted in errors, such as spelling mistakes. (see figure 3 below)



**Figure 3.** Poor copy of genuine iPhone charger markings. Spelling mistakes: 'Designed dy Apple in Cahifornia' 'Emeston Network Power'



**Figure 4.** Summary of marking failures

## 2.2 Touch Current and Electric strength

### 37 chargers (58%) failed the electric strength test

Touch current and electric strength tests are basic safety critical checks to ensure the electrical separation between mains circuitry and parts that the user can touch is sufficient to prevent electric shock.

A failure of either of these tests is an indication of inadequate insulation inside the product, which in normal use could become further compromised and pose a severe risk of electric shock to the user.

Although there were no failures for the touch current test, 58% failed the electric strength test, and could therefore lead to **a severe risk of electric shock**.

A breakdown of insulation is most often linked to deficiencies in the design and / or construction and quality of a charger's internal circuitry. There should be a zero failure rate for this safety test for products manufactured in a factory with a quality system. The high failure rate in the electric strength test indicates that these chargers were produced in a sub-standard facility with no consideration given to product safety.

## 2.3 Internal inspection of samples that failed the electric strength test

### The most serious failures found from internal inspection were in the following areas:

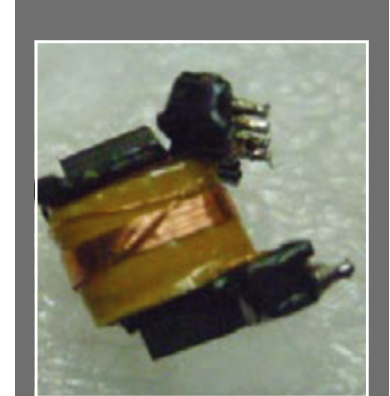
- **Non-approved capacitors bridging live and accessible circuitry**
- **Inadequate or zero spacing (creepage distance and clearance) between primary and secondary windings in the transformer**
- **Inadequate spacing (creepage distance and clearance) between components or tracks on the printed circuit board**
- **Incorrect routing or inadequate security of internal wiring.**

A selection of 10 samples (six UK chargers and four EU chargers) that failed the electric strength tests were further investigated to identify possible failure modes.

### The following examples provide some insights into the causes of failure found:

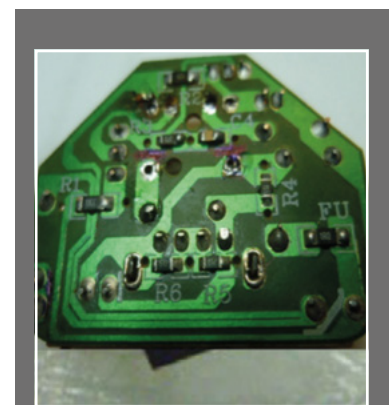
### Example 1 - UK charger No. 50

The transformer windings (see Figure 5.) were NOT triple insulated and failed the electric strength test at just 700 V AC (limit is 3000 Volts AC min).



**Figure 5.** Transformer windings not adequately insulated between primary and secondary

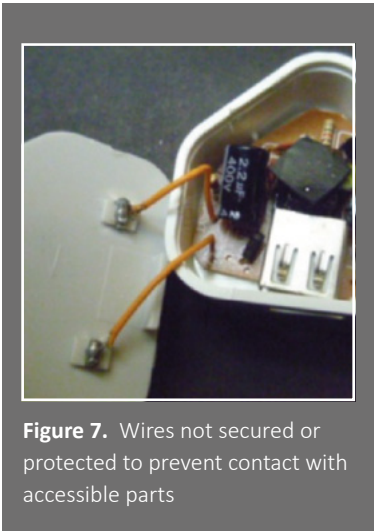
Further inspection revealed an inadequate creepage distance between LIVE and accessible tracks on the printed circuit board measured to be 0.6mm (limit is 5.0mm min). The clearance between LIVE and accessible tracks was measured to be 0.6mm (limit is 4.0mm min). See Figure 6.



**Figure 6.** Inadequate creepage and clearance distances on the printed circuit board

### Example 2 - UK charger No.35

Wires are not secured down to prevent a short circuit in the event of the wires becoming detached and lack of insulating sheet over the LIVE terminals could pose a risk of shock if a detached wire came into contact with accessible parts. See Figure 7.

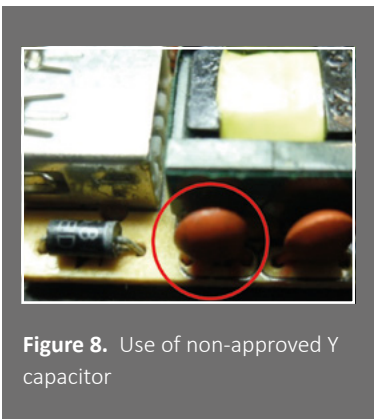


**Figure 7.** Wires not secured or protected to prevent contact with accessible parts

### Example 3 - EU Charger No.11

A non-approved Y capacitor is used, bridging live and accessible circuitry. See figure 8.

Unless correctly rated and approved as “Type Y” capacitors, such capacitors can break down at any time, giving rise to an electric shock hazard.



**Figure 8.** Use of non-approved Y capacitor

## 2.4 Plug gauging test

**36 chargers (56%) failed the plug gauging test**

**After pin mechanical strength tests, a total of 48 chargers (75%) failed the plug pin gauging test**

The plug gauging test is required to ensure that the size, alignment and disposition of the plug pins will not impose undue stress on socket-outlets.

The plug gauging test was applied to all 64 samples prior to, and after, other plug pin mechanical tests.

Prior to any other mechanical tests, 22 out of 50 UK chargers, and all 14 of the EU chargers, failed the gauge test. After the chargers had been subjected to the mechanical pin strength tests, a further 12 UK chargers failed the gauge. Incorrectly sized and misaligned plug pins can result in poor connection and undue wear and tear to socket contacts which can cause overheating and risk of fire.

## 2.5 Plug pin mechanical strength test

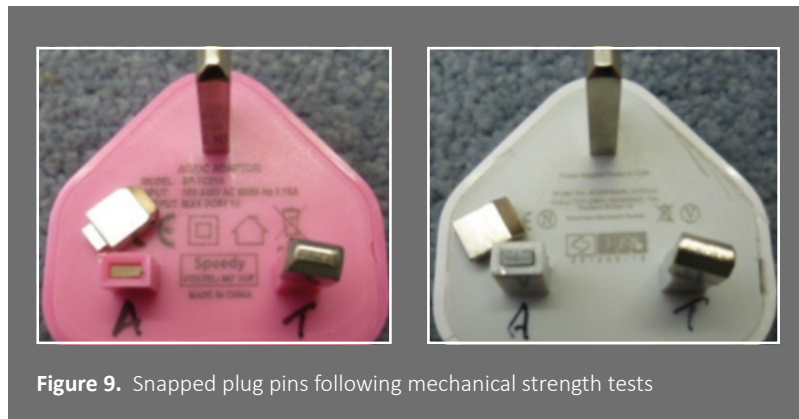
**15 chargers (94%) failed the plug pin mechanical strength tests**

The mechanical strength test applies twisting and bending forces to plug pins to ensure they can withstand the stresses of normal use, such as inserting and withdrawing from a socket-outlet, and will not become distorted or break.

If a plug pin is not sufficiently strong, there is a danger that it could break off inside a mains socket with a resultant risk of electric shock from an exposed live pin.

16 UK chargers that passed both the electric strength test and internal inspection were subject to a plug pin mechanical strength test.

Only one charger passed the mechanical tests and subsequently managed to fit the pin gauge. Many of the chargers that failed the test suffered severely bent and twisted pins and for four samples, the pins snapped off. Broken pins could be left exposed inside the mains socket, again representing a **significant risk of electric shock**.



**Figure 9.** Snapped plug pins following mechanical strength tests



### 3. Conclusion

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It is extremely concerning that only one of the chargers in this investigation passed all of the electrical and mechanical safety criteria.

Although one sample passed all of the mechanical and electrical tests - failing only the markings requirements - it must be stressed that full compliance testing was not carried out and marking deficiencies are often indicative of other serious failings that more extensive testing may have revealed.

This investigation identified fundamental safety issues that have the potential to cause injury or harm and compromise the safety of a user.

**Over half of the chargers failed the electric strength test.** Adequate insulation and creepage distances are critical to prevent users from coming into contact with potentially harmful voltages and currents over the lifetime of the product. A breakdown of the insulation barrier, as observed for 37 samples in this investigation, has the potential to result in the USB output voltage (normally 5 Volts) rising to

mains voltage (around 240 Volts) presenting a **real and unnecessary risk of fire and electric shock.**

The very thin lacquer coating separating the primary and secondary transformer windings found in many of the samples in this investigation is a very common trait of sub-standard cheap chargers and, as such, would not be difficult for a competent laboratory to pick up during testing.

Inadequately terminated internal wires are another common trait of low-cost sub-standard design and manufacturing.

As chargers are portable devices, and frequently handled in normal use, it is likely that internal wires may become displaced. This may be particularly relevant where reliance is placed on solder alone to maintain wires in position.

The use of non-approved capacitors bridging input and output circuits seriously compromises the minimum recognised level of protection to prevent a user coming into contact with dangerous mains voltage and increases the potential risk of electric shock.

Although the absence of required markings does not pose a direct risk of injury to the user, in ESF's experience the absence of such markings is indicative of other failings that may compromise safety. Over a quarter of the samples didn't bear the manufacturer's name or trademark which are important in the event of any corrective action, such as a product recall.

None of the samples were supplied with sufficient safety or warning information to ensure their safe and correct use. Although not an immediate safety issue, this would be regarded as a serious technical breach of the Electrical Equipment (Safety) Regulations.

Overall, it was concluded that none of the samples had been supplied and / or designed and manufactured in accordance with the principal elements of the safety objectives given in Schedule 1 of the Electrical Equipment (Safety) Regulations 1994, and **all but one of the samples were considered to offer a potential risk of injury to the user.**

Furthermore, this means that the users are exposed to a level of risk that has not been reduced to a minimum, as required by the Consumer Protection Act.

**Electrical Safety First is of the opinion that these counterfeit and imitation Apple iPhone chargers pose a significant risk to the health and safety of users, and at the very least, present a risk of damaging connected equipment. The problem is made more serious by the fact that many who buy these fake goods will be doing so without realising it and unwittingly placing their loved ones and property at risk as a result.**

**We hope that this report will help raise awareness of the issue and the very real threat that counterfeits pose to consumers.**

# A quick guide on how to spot counterfeit Apple chargers

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There are a number of quick checks that can be done without specialised equipment to see if an Apple charger of the type discussed in this report is genuine.

Whilst most are easy, some are greatly assisted by the person inspecting being familiar with the genuine product or having one available to compare and contrast.

### 1. Text and markings on the plug face.

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Missing markings, such as CE mark or spelling mistakes. The Singapore safety mark should be dead centre between the two live plug pins.



“SAEETY MARK”

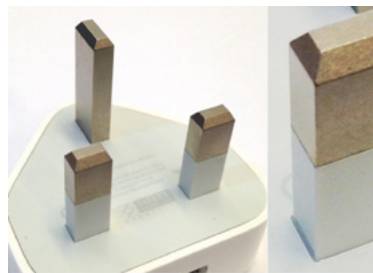


“Designed dy Apple in Cahifornia”

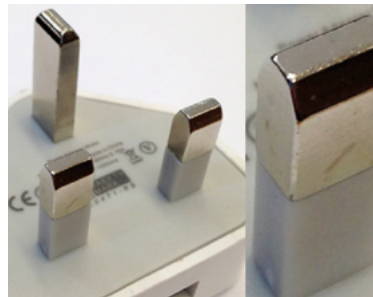
### 2. Plug pin finish and material

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Plug pin finish and material is another fairly obvious indicator that the product is either counterfeit or substandard. The finish on the plug pins on a genuine charger is high quality, matt and uniform. On counterfeit chargers the finish is usually glossy or shiny with imperfections.



Genuine

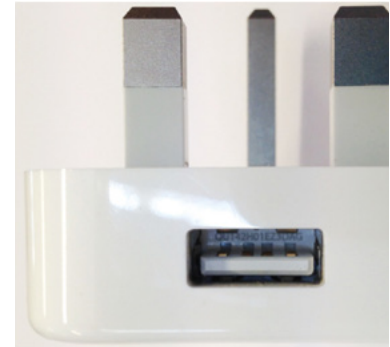


Fake

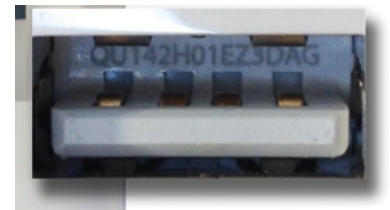
### 3. USB port

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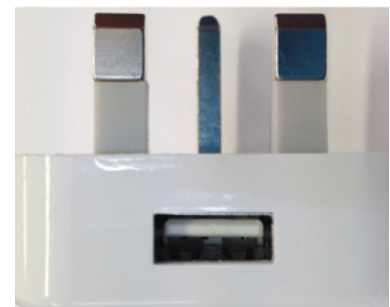
A counterfeit USB port might have a different orientation. The genuine charger also has a serial no. at the back of the USB port.



GENUINE



GENUINE – serial no. inside USB socket



COUNTERFEIT – USB port different orientation



## 4. Materials

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Materials used in most cases are different. As the testing has shown, the pins on counterfeit models are much weaker than required by the standard, and this is typically because they are metal coated hollow plastic, rather than the solid metal used in genuine products. An easy check for this is to simply flick the earth (largest) pin and listen to the noise it makes. A genuine plug will sound and feel solid, whilst counterfeit models will make a pronounced “plasticity” noise and feel hollow.

## 5. Weight

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As counterfeit chargers contain very few, if any, of the higher quality components required for safety, they are usually significantly lighter than genuine chargers. The charger should weigh at least 40g.

## 6. Shape and dimensions

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The plug pins on counterfeit products can also vary significantly from the dimensions and positioning required for safety. The dimensions can be harder to check, but it is relatively straight forward using the Electrical Safety First plug checker.



These can be ordered from the Electrical Safety First website at: <https://www.electricalsafetyfirst.org.uk/electrical-professionals/product-safety-unit/plug-checker>

## Useful Resources:

The increase in the popularity of online shopping makes it even easier for dodgy goods to slip through the net. A guide to help consumers to look out for the most common problems with buying electrical products online can be viewed:

[www.electricalsafetyfirst.org.uk/safeshopping](https://www.electricalsafetyfirst.org.uk/safeshopping)



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**Safety First**

The UK's electrical safety experts