How mobile cameras work: technical facts

Mobile speed cameras are one of the most efficient ways to enforce speed limits. They are only set up in areas that are accident-prone, or where there is a problem with speeding.

How speed cameras work

Mobile speed camera systems are controlled by invisible beams, or radar.

The radar control device sends radio waves across the road to measure the speed of all passing vehicles.

The radar control unit measures speed using the scientific principle known as the Doppler Effect, which was discovered by physicist Christian Doppler in 1842.

The Doppler effect

Ever heard an ambulance passing by? Remember how the siren's pitch changed as the vehicle raced towards, and then away from you?

First the pitch became higher, then lower. This change in pitch comes from the Doppler frequency shift in the sound waves.

Using the radar beam

The radar unit sends out a continuous wave at a frequency of 24.125 GHz, in a narrow beam at an angle of 20 degrees across the roadway.

When a passing car enters the radar beam, the reflected frequency changes because of the relative motion between the radar and the vehicle.

If the relative motion brings the target closer to the radar, the reflected frequency will be increased.

If the vehicle is travelling away from the radar, the returned frequency will decrease.

How much the frequency is increased or decreased is directly proportional to the speed of the passing vehicle.

It only measures moving objects

What is most important about the Doppler effect is that the frequency change happens only when there is relative motion between the objects.

If both objects are standing still (eg parked vehicles) there is no relative motion, and the reflected signal has the same frequency as the transmitted signal.

The radar used in mobile speed cameras simply measures this change in frequency and converts it to a speed reading.

Working out direction

Mobile speed cameras can also tell what direction a vehicle is travelling.

By detecting whether there is an increase or decrease in the reflected frequency, the direction of travel can be determined.

Calculating the speed of a vehicle

The size of the increase or decrease in the reflected frequency is used to calculate the speed of the passing object.

Because the beam is directed across the road at a slant angle of 20 degrees, the Doppler frequency shift recorded will indicate a speed that is slower than the target's true speed.

The radar unit makes an automatic calculation for the slant angle.

It then uses trigonometry to calculate the true speed in the direction of travel.

Certification and calibration

All mobile cameras and radar units must be regularly certified and checked by scientific testing laboratories.

Every time the cameras and control units are set up by the side of the road they are calibrated to ensure their accuracy.