



World Society for the Protection of Animals

**COMPANION & WORKING
ANIMALS UNIT**

Identification methods for dogs and cats

Guidance for WSPA staff and member societies

Aim: Identification is a vital tool in the management of dog and cat populations. The aim of this document is to describe the key methods of identification suitable for dogs and cats, in order to aid decision-making and provide guidance on procedures and equipment. The advantages and disadvantages of each method and any inherent animal welfare considerations are discussed.

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Introduction

The world's population of domestic dogs and cats is estimated at one billion, with stray¹ animals thought to account for the majority. This considerable number of stray companion animals presents a serious concern for both human and animal welfare, and places a significant burden on communities. For any intervention that aims to manage and/or reduce this population, the importance of effective identification of dogs and cats should not be underestimated. Firstly, identification of owned animals significantly reduces the likelihood that they will become stray, especially when identification is coupled with registration as part of a successful registration or licensing system. Secondly, a suitable identification system is often an essential component of programmes that manage stray animal populations; enabling the recognition of animals that have passed through the programme (e.g. for neutering or vaccination) and the capture of useful data allowing the impact of the programme to be evaluated.

Identification of owned animals

There are many reasons why identification of owned animals should be encouraged, including:

- Identification is the key mechanism for reuniting 'lost' dogs and cats with their owners; hence it reduces the number of animals in shelters (and the financial and administrative burden this incurs to authorities or animal welfare groups), the number of healthy animals that are euthanased, and owner anxiety.
- Identification helps ensure that responsibility for an animal's behaviour can be correctly attributed, for example in the event of a dog attack.
- Visible identification discourages cruelty, theft and fraud, thus helping safeguard the welfare of the animal.
- By clearly connecting owner and pet, identification can reduce the likelihood of abandonment and encourage owners to take responsibility for their animal's behaviour.
- Identification can be an essential component of legislative systems that seek to ensure owners take adequate responsibility for their animals².

Identification is thus an essential tool in the effective management of the owned dog and cat population. This is especially true when it is coupled with registration: a system whereby details of individual animals and their owners are recorded on a central (usually national) database. Each animal is allocated a unique code, which is identified on the animal with permanent identification (a tattoo or microchip). When referenced to the database, the code yields information such as the owner's contact details. Databases can hold additional information such as the animal's vaccination status as part of a disease control scheme. In rabies-endemic countries, for example, registration and identification of owned companion animals is highly beneficial for the enforcement of mandatory rabies vaccination.

A registration fee can help cover administrative costs whilst also encouraging responsible ownership through financial incentives. For example, activities such as adopting from a rehoming centre, neutering, vaccinating, deworming and (approved) dog training may incur a discount or exemption. Any profit from registration systems can be rechanneled into population management measures and responsible ownership education.

In a number of countries identification and registration of dogs and cats is mandatory. This allows for the ownership status of animals to be determined immediately, reducing pressure on authorities and shelters. If owned, the animal can be reunited with the owner. It is important, however, that this is not seen by owners as a license to allow their animal to roam with a guarantee it will be returned. A reunification fee can discourage this as well as harsher penalties for owners who repeatedly lose or abandon their animals.

¹ In this document, the term 'stray' refers to dogs and cats that are on public property and not under the direct control or supervision of an owner.

² International Companion Animal Management (ICAM) Coalition (2007) *Humane Dog Population Management Guidance*. Available from www.icam-coalition.org.

Identification of stray animals (as part of an intervention)

Although identification can help distinguish responsibly owned animals, it should not be assumed that a dog or cat without identification is unowned. Any intervention in which dogs or cats are removed from the streets (whether or not to be returned) should consider that at least some of those animals will be owned. Every effort should be made to find the owner and engage them with the programme.

Visible identification methods such as ear notches or collars are widely used to distinguish animals that have been neutered, vaccinated or treated as part of a dog or cat population management programme. This can have the additional benefit of indicating to the community that these animals are being cared for as part of a management programme, raising awareness of the organisation or authority carrying out the intervention and potentially enhancing public cooperation.

Some methods may be less visible or not visible at all, but enable the identification of individual animals—namely tattoos and microchips. These methods enable much more useful data to be recorded during the course of an intervention, enhancing our understanding of the dynamics of stray dog and cat populations. Individual identification can also generate data for a comprehensive population survey³, enabling more effective monitoring and evaluation. These methods do, however, need to be used in combination with visible methods of identification.

Choosing an identification method

There are several methods of animal identification appropriate for use with dogs and cats. Table 1 overleaf summarises the main methods used. In general, permanent methods are designed to last for the lifetime of the animal, semi-permanent for months to years (but are usually lost during the animal's lifetime) and temporary methods for no longer than a few weeks. Permanent methods can be coupled with registration on a database and offer enhanced security (against loss or falsification), and reliable certification (e.g. vaccination or legally permissible travel between countries). Non-permanent methods are usually cheaper, more visible and easier to administer, but less secure.

The identification method chosen should be the most humane and efficient of all available options, taking into account the target population, local conditions and the resources available. For population management programmes, the method chosen should be guaranteed to remain effective at least until the objectives of the programme are completed, and the animal should suffer no adverse effects on its immediate or long-term health or behaviour. The welfare implications of identification methods differ according to each situation, but the following factors should be assessed:

Capture, restraint and handling

- For nearly all methods of identification, some level of physical restraint will be required.
- Distress should be minimised by using techniques appropriate to the species, and bearing in mind the huge variety in size and shape of (dog) breeds.

The procedure

- The operator must be suitably trained (some methods require significant training).
- The time taken for the application should be minimised, but not at the expense of safety.
- Some methods can only be used on animals under general anaesthesia. Wherever possible, therefore, these methods should coincide with surgery (e.g. neutering), to minimise the time, cost and risk associated with performing general anaesthesia.
- Precautions must be taken to prevent the spread of infectious disease (either between animals or from animals to people).

Potential long-term implications

- Risk of infection or abscessation from skin damage or puncturing.
- Chafing from collars and injury caused by snagging or pulling of collars or tags.
- Toxicity e.g. from dye or ink.
- Ecological implications of increased visibility/altered appearance.
- Prolonged pain following procedure (e.g. due to growth restriction).

³ For further information and guidance on conducting a dog population survey, see World Society for the Protection of Animals (2008) *Surveying roaming dog populations: guidance on methodology*. Available from <http://groups.google.com/group/dog-population-survey-guidelines>

	PERMANENT				SEMI-PERMANENT		TEMPORARY	
	Tattoo	Microchip	Ear Tip/Notch	Freeze Brand	ID Collar	Ear Tag	Paint/Dye	Radio Transmitter
RELIABILITY	***	*****	****	*****	**	**	*	**
COST	***	*****	**	***	**	**	*	*****
VISIBILITY	*	—	***	****	*****	*****	****	—
LONGEVITY	****	*****	*****	****	**	**	*	**
REQUIRES ANAESTHESIA	****	**	*****	***	—	***	—	*
INVASIVENESS	***	**	*****	***	—	***	—	*
RISK OF HARM	**	*	***	**	****	*****	*	*
ACCURACY	****	*****	—	**	****	**	*	****
SPACE- RESTRICTED	*****	—	—	*****	****	**	***	—
UNIQUENESS	****	*****	—	**	****	***	*	*****
INSTANT IDENTIFICATION	**	—	*****	****	****	****	****	*
TRAINING REQUIRED	****	*****	*****	*****	*	***	*	*****
DATABASE REQUIRED	****	*****	—	**	**	***	—	*****

***** (Very high) ***** (High) *** (Medium) ** (Low) * (Very low) — (None / Not Applicable)

Table 1. Comparison of identification methods for dogs and cats.

Permanent Identification Methods

Tattoos

A tattoo is a mark created by puncturing an animal's skin and inserting a pigment (usually ink). This provokes an immune response, following which the pigment is left trapped within fibroblasts in the skin's upper dermis layer.

A tattoo is probably the oldest method of permanently identifying companion animals. It provides a permanent and effective way of individually marking an animal and hence is still widely used in dog population management programmes. However, as tattoos are not easily visible without close examination, they should be used in combination with another method such as ear notching (see Ear Tip/Notch), or collars (see Identification Collars) to allow visible recognition from a distance if catching is required.

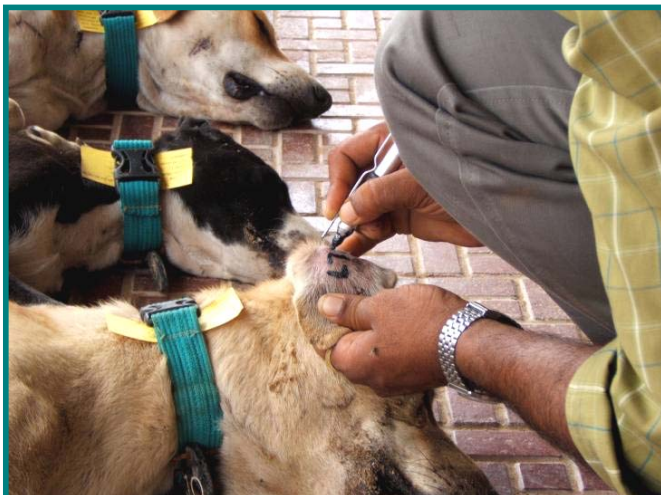


Figure 1. Neutered and vaccinated dogs identified with ear tattoos as part of an Animal Birth Control programme in Jodhpur, India.

Figure 1 demonstrates how tattoos can be easily applied to dogs just after neutering, while they are still unconscious. On recapture, the tattoo can be referenced to records of where and when the dog was released, its approximate age, weight, condition and treatment. This can then generate estimates of survival and movement, and help monitor and evaluate the impact of the intervention. Some countries use a standardised tattoo symbol to indicate an animal has been neutered. In Australia, for example, the symbol Φ is tattooed on the ear of dogs and cats nationwide at the time of the neutering operation. Some organisations use a very simple form of tattoo marking to identify neutered females, by blotting ink over a freshly closed incision (so a permanent mark remains when the tissue scars over).

For owned animal identification, tattoos are largely being replaced by microchips, which are considered more reliable. The international Pet Travel Scheme, PETS⁴, no longer accepts tattoos “because tattoos can fade or become unreadable over time. Numbers on a tattoo could also be changed by further tattooing.” Furthermore, there is a lack of international and national control on tattoo identification to prevent duplication. Tattoos have traditionally taken the form of an owner's telephone number or social security code, causing obvious problems with changes in ownership. For this method to be successful in identifying owned animals, the tattoo itself should comprise a unique alphanumeric code, which is registered on a central database. The animal then wears a collar and tag bearing the registry contact details.

ADVANTAGES

- A tattoo is a secure, permanent form of identification.
- Tattoos can deter theft of owned animals. For instance, in the USA, the act of tattooing a dog changes its theft from a local misdemeanour to a federal felony (as the theft then falls under the ‘Branded Animal Act’).
- Unlike microchips, tattoos can be detected without specialised equipment.
- Individual animals can be identified with a unique alphanumeric code.
- Personal details of owners do not have to be on public display.
- Although the initial cost of purchasing an electric tattooing needle or a tattoo forceps kit may be high, the running costs of applying tattoos are low.

⁴ The Pet Travel Scheme (PETS) controls the transport of pet animals across Europe and is legislated under the EU Regulation on the Movement of Pet Animals.

DISADVANTAGES

- Handling and restraint are necessary before tattoos can be located and deciphered (the degree of handling will depend on the location of the tattoo).
- Tattoos can fade and become illegible over time. This can have serious implications both for owned animal identification (e.g. reunification) and management programmes (e.g. data loss).
- Tattoos can be difficult to locate, especially on double-coated or long-haired animals.
- The procedure requires general anaesthesia (see Welfare Implications).
- Owned companion animal tattoos can often be arbitrary or illegible marks, with no useful function for identification.
- The procedure requires specialised equipment and a skilled, fully trained operator. The procedure can be time-consuming; needles have to be cleaned after each use, and (with tattoo forceps) the digits should be changed and tested before each animal is tattooed.
- Information is space restricted, e.g. by the size of a dog or cat's ear. If identifying a large number of animals, there may be insufficient space for the number of characters necessary to maintain a unique coding system.
- Tattoos can be removed or altered with additional marking or a laser, and ear tattoos can even provoke the removal or burning of the ear to remove the identification.
- This is not an immediate identification method (tattoos are generally illegible for several days after application).
- Legibility of tattoos is largely dependent on the equipment and skill of the operator.

WELFARE IMPLICATIONS

- The application of a tattoo is a painful procedure. WSPA recommends that tattoos are only applied whilst an animal is under general anaesthesia, for surgery, as controlled or supervised by a veterinarian.
- Tattooing requires puncturing of the skin, which can have infection implications and there is potential for disease transmission between animals. This risk can be minimised by ensuring all equipment and the application site is disinfected.
- The animal should be checked initially (and again on regaining consciousness) for signs of excessive bleeding, and ideally for the next few days for signs of local infection.
- The tattoo ink or paste used must be non-toxic.
- After a tattoo has been applied, a scab will develop at the site of application where the skin has been punctured, and there is likely to be initial redness of the skin. The site can take up to three weeks to fully heal.

PROCEDURE

The code

- Before implementing this identification method it is necessary to decide on a coding system. This should be devised on the basis of an estimate of the number of animals likely to be identified in the lifetime of the system or programme. **It is extremely important that each animal receives a unique tattoo.**
- Aim for maximum visibility of the marking within the available space. A combination of numbers (0 to 9) and letters (A to Z, excluding I, O and Q) yields the greatest number of permutations. Most tattooing forceps allow up to a six digit permutation of letters and numbers. One approach is to begin the code with a single letter followed by three numbers (e.g. A000, A001, A002 etc.) and after completing this sequence (i.e. after 999 codes have been issued) begin the code with the next letter in the alphabet. The letter could represent the year or month the animal was identified. This will allow for the identification of nearly 26,000 animals. Ensure a good supply of characters to maintain the order of your coding system.
- Each animal's code should be recorded in a database (manual or computerised), alongside a record of data. For owned animals, this will include details of ownership. For management programmes, this may include where and when captured, the date the animal was neutered, approximate age, breeding history, body condition score and any health problems.

The location

- It is important that the tattoo site is standardised when this is used as a system of identification. This will mean people know where to search when encountering an unknown animal, and in management programmes this will reduce handling time on recapture.
- The recommended location is on the **inside surface of the ear pinna** (see Figure 2). This is the most visible location, where a tattoo will be noticed even when not specifically searched for. The tattoo will not be covered by too much hair, and is less likely to be distorted by skin stretching during growth, making it more suitable for young animals.
- Another commonly used location is on the inside thigh of a rear leg. The stomach should be avoided as the tattoo may be later erased by surgery.



The method

The operator does not have to be a veterinarian, but must be adequately trained and competent. It is strongly recommended that tattoos are only administered on animals that are already under general anaesthesia (e.g. for neutering), which must be under veterinary supervision.

- Remove as much hair as possible from the tattoo site. Remove any dirt, loose skin, grease or wax from the area and thoroughly clean using cotton wool soaked in surgical spirit or alcohol. Allow the area to dry.
- Apply the tattoo using either a tattooing pen (see Method 1) or, for ear tattoos only, tattoo forceps (see Method 2). Ensure the equipment is sterile before use, and needles are suitably sharp so they will pierce the skin deeply enough to allow for the absorption of the ink. For ear tattoos, the ear should be held taut with no wrinkles.
- Do not remove excess ink from the tattoo site or attempt to clean the area** – this can reduce the effectiveness of the tattoo. Allow the site to dry and the ink will wear away naturally (this will take about 10 days).
- After each tattoo, clean the equipment thoroughly to remove any blood, ink or other debris, and soak in disinfectant. This is important as needles are likely to become contaminated with blood thereby facilitating disease transmission. Dry the equipment thoroughly and store in a safe and dry location when not in use. Characters for tattoo forceps should be cleaned using a small, stiff brush (e.g. a toothbrush) and the forceps should be regularly oiled.
- Record the animal's code on a record card and complete any other relevant documentation **after applying each tattoo** – avoid waiting and doing this in batches as errors may occur. For owned animal registration, tattoo operators need to provide the owner with a copy of the record card, and send another copy to the central registry within a specified time limit.

Method 1: Electric Tattooing Needle

This requires more skill than the next method (tattoo forceps), as the operator has to manually 'write' the inscription on the animal's skin, using a pen-style electric needle (see Figure 3). Hence, there is more scope for operator error in transposing the code, and there is also a lack of standardisation in the composition and appearance of the mark (e.g. how numbers or letters are written). With practice, however, this can be easier to apply and leave a more precise, fade-resistant tattoo.

The device comprises an electro-vibrator system of needles that simultaneously pierce the skin and inject ink. The needle is either dipped in ink, has an automatic feed supplying ink to the needle, or there is a reservoir of ink in the tip of the needle.

An electricity supply is required for this method.



Figure 3. Whilst still unconscious following a neutering operation, a dog's ear is tattooed using an electric tattooing device.

Method 2: Tattoo Forceps

This method is the cheapest and easiest way of tattooing companion animals, with minimal training required for an operator to successfully leave a legible mark. This method is only suitable for ear tattoos, as access is required on both sides of the area where the tattoo is to be applied.

Specialised tattoo forceps consist of a pair of forceps or pliers, with individual metal tablets slotted into a frame in the jaws (see Figure 4). The tablets have protruding pins which, when the forceps are clamped around the ear, pierce the skin and leave a pattern of letters and/or numbers. Ink or paste is then rubbed into the punctures to produce a permanent mark.

The exact procedure will depend on the particular model of forceps used – instructions supplied by the manufacturer should be followed carefully, but these are general guidelines:



Figure 4. Ritchey® ear tattoo forceps.



Figure 5. The ear of an anaesthetised dog is tattooed with forceps.

1. Open the lever lock bar and insert the desired characters into the forceps, taking care to insert them in the right order (in 'mirror' order). Close the lock bar.
2. It is advisable to test the forceps on a piece of card (the animal's record card for instance) to check the characters are inserted correctly and none are broken or too worn. This is important as it will be impossible to correct a mistake once the tattoo has been applied.
3. Shake the tattoo paste or ink to ensure an even concentration of pigment. Apply a small amount of liquid or paste ink directly to the tattoo site, using your thumb (or the roller dispenser of the container if applicable). Do not smear ink too liberally and obscure the veins. Apply some ink directly to the protruding pins of the forceps.
4. Before the ink on the tattoo site or pins has time to dry, position the forceps around the pinna avoiding hair, blood vessels or ribs where possible. The needles should be on the inside ear along the centre axis of the ear flap.
5. Pierce the ear through the ink with a quick, firm motion, avoiding excessive pressure but ensuring the forceps are fully closed, then release immediately (see Figure 5).
6. **Apply more ink or paste to the tattoo site (see Figure 6) and rub firmly (using thumb against fore finger) against the lay of hair into the puncture holes for at least 10 seconds to ensure penetration.** If there is bleeding, continue rubbing ink into the holes (if you use an ink with antiseptic or healing properties this will stem the bleeding). Do not remove excess ink.



Figure 6. Ink is applied to the ear of an anaesthetised cat that has been notched with tattoo forceps.

Fading and legibility

This seems to be influenced by a number of factors, including the location and proper preparation of the site, the procedure used, and the type and quality of ink or paste. If a tattoo mark is illegible it is likely it was not correctly administered. The following are some general rules for creating a longer lasting tattoo with tattoo forceps:

- Do not use turpentine or coal oil to prepare the tattoo site, as these will affect the ink.
- There should be three separate applications of ink or paste: to the site before application, to the pins of the forceps, and to the site after application.
- After the third application ensure the ink is thoroughly massaged into the puncture holes for 10 seconds.
- Tattoo forceps should be used properly with a firm, swift motion so that the punctures are of even penetration. If too much pressure is used, this can prompt profuse bleeding of the ear, which may continue after the ink has been applied and cause the ink to 'wash out' of the puncture holes.
- Ensure the forceps are closed completely when applying the tattoo – there will be a 'crunch' sound when this is done properly.
- Excess ink should not be removed, and if possible the area should remain dry and undisturbed until healed to prevent the ink from running (this can take several weeks).

Some other factors to consider are:

- A tattoo will not be clear for several days after it has been applied because of the presence of excess ink and the scab that forms where the skin has been punctured. It can take around three weeks before there is a clear, legible mark. Tattooing should thus be carried out some weeks in advance of identification being required and a temporary marker used initially.
- When a tattoo is applied, the pigment disperses down through the damaged epidermis and upper dermis layers. Its presence triggers an immune response, and phagocytes engulf the particles. As the area heals, the damaged epidermis flakes away, along with any surface pigment. As the upper dermis layer heals, pigment remains trapped within fibroblasts, concentrating in a layer just below the dermis–epidermis boundary. Its presence there is very secure, but over many years the pigment tends to migrate deeper into the dermis, and this can account for the long-term fading of tattoos.
- The uneven contours of the pinna, and irregular thickness especially near the base, may contribute to tattoo fading. Characters positioned towards the thin tip or fringe of the ear may be less defined, making the tattoo more difficult to read.
- The type and quality of ink used is critical in achieving a permanent, legible mark – see Equipment and Supply. The ink or paste should be highly contrasting with the colour of the animal's skin.
- Tattoos can fade in prolonged sun exposure. If this could be a problem then an alternative location such as the inner thigh may be more suitable (this will require the use of a tattooing pen).
- Forceps can hold characters of varying sizes. For dogs, characters around ¼ inch high seem to make the most readable ear tattoos.
- Tattoos remain the most legible when applied after the animal reaches adult height, and for ear tattoos there will be more room to correctly position the tattoo on adults. For puppies or kittens the inscription needs to be small and dark enough to withstand the distortion and fading caused when the skin stretches as the animal grows.
- In population management programmes, tattoos may be difficult to read in recaptured animals because of chronic skin infection or inflammation (which can cause darkening of the pinna) or scarring. The presence of ticks, other diseases or injuries can also obscure tattoos.

Tattoo needles/forceps

A tattoo forceps kit with characters and ink can be purchased for less than US\$100. If looked after properly, the forceps will last indefinitely. Forceps specifically designed for smaller animals are available (see Figure 7).

Electric tattooing devices are more expensive, with prices starting at around US\$150 (see Figure 8).

Tattooing ink or paste

- Tattoo ink or paste must be safe and non-toxic.
- The colour must be highly contrasting and is usually supplied in black or green.
- Ink and paste containing antiseptic properties should be used to reduce the risk of infection and stem bleeding.
- Ink sufficient for 50–60 applications costs around US\$8, and a 500g tub of antiseptic tattoo paste costs around US\$5.
- Ink may be supplied with a roll-on applicator (see Figure 9), which can be useful for application. This costs around US\$3.
- ‘Indian ink’ (also known as India ink or Chinese ink) has found to be a long lasting option for animal tattoos. This is a simple black ink commonly used in printing or drawing. Verbal reports indicate that tattoos last 10 years or more with little or no fading, compared with 5 years or less for other types of ink. However, there is a concern that non-tattoo ink contains impurities or toxins which may lead to infection.



Figure 7. Ketchum® tattoo forceps, set of characters (digits 0 – 9 and A – Z), and tattoo paste.



Figure 8. Jorgenson® complete small animal electric tattooing kit.



Figure 9. Ketchum® roll-on tattoo ink.

Suppliers

- **Ketchum Manufacturing** (UK and Canada) guarantee tattoos will be legible and permanent if their equipment and ink are used and the correct procedure is followed. They supply a wide range of tattoo equipment (forceps, pins and ink). www.ketchums.co.uk www.ketchums.ca
- **Ritchey plc** (UK) and **Ritchey Tagg** (International). Formerly Brookwick Ward & Co., this company based in Ripon, UK, specialise in animal identification and ship worldwide. They manufacture the Hauptner–Herberholz tattoo forceps and accessories (characters – 5mm, 6mm or 7mm in height, ink – in tubes of black, white or green, black liquid tattooing ink). They also produce special characters (5mm or 7mm). www.ritchey.co.uk <http://www.ritcheytagg.com/> Ritchey plc, Fearby Road, Masham, Ripon, Yorkshire HG4 4ES Tel: +44 (0) 1765 689541.
- **Vet Tech Solutions** (UK) have a range of products for animal identification, including a complete electric animal tattoo kit. <http://www.vet-tech.co.uk>
- **Tattoo Supply Corporation** (USA) sells animal marking kits (Figure 8), which include the electric tattooing needle (with a tube and needle removal system for cleaning and sterilisation). They will ship internationally. www.tattooequipment.com
- **Animal Identification and Marking Systems** (USA) specialise in tattooing equipment for laboratory animals but sell electric tattooing pens suitable for dogs and cats. Useful training is also provided on their website. <http://www.animalid.com/>

The Microchip

Microchipping is a form of radio frequency identification (RFID), whereby a signal is transmitted between a transponder (the microchip) and a reading device (the scanner). The microchip is implanted under an animal's skin, and transmits a unique alphanumeric code when energised by the radio signal generated by the scanner. The scanner provides a digital display of the code, which is registered on a database along with information pertaining to that animal. The identification of companion animals is arguably one of the most useful and widespread application of microchips.

The obvious disadvantage is that microchips do not provide visible identification; hence they need to be coupled with a visible method, preferably one that indicates the presence of a microchip (most microchip suppliers provide an accompanying tag to display on the animal's collar, as in Figure 10).



Figure 10. Identichip® microchip and accompanying tag.

Microchipping does, however, provide the only truly permanent and effective method of identifying companion animals to date, with enormous potential for animal health and welfare. By providing such effective reunification this method significantly reduces the number of lost animals that contribute to the stray population. It also provides traceability to owners who persistently allow their animals to roam; encouraging responsible ownership. Microchip identification allows shelters to avoid the expense of housing, feeding, providing medical care, rehoming or euthanising thousand of animals, because of the reunification it facilitates. Microchipping is becoming a standard practice at rehoming centres, with many requiring all outplaced animals to be microchipped (i.e. before being rehomed or returned to owners). Microchips are the preferred identification method when considering the requirements of a standardised international system¹⁶, and are now compulsory for cross-border pet travel under the Pet Travel Scheme (PETS) – no other methods are acceptable⁴.

Setting up a microchipping system requires considerable planning and infrastructure, which must take into account the aims of the system and scope of animals to be identified. The high start-up costs can be prohibitive. Because of this, combined with the importance of central control and administration, it is strongly recommended that companion animal microchipping systems are administered by government agencies. This will also enable greater negotiation with microchip suppliers. Microchipping is often now incorporated under municipality licensing programmes, and in many countries microchipping is replacing tattoos as the government-recommended form of companion animal identification.

Incompatibility of microchips and scanners (a result of manufacturers developing competing technologies) has historically presented a serious limitation of this method. With the development of ISO standards this is becoming less of an issue (see Standardisation), and universal scanners are now available that can read most types of microchip. It is very important that only systems compliant with ISO standards are used – other systems may be cheaper, but in effect this devalues the whole principle behind microchip identification. When implementing this method consider the microchips and scanner as a package, to ensure compatibility.

Educating dog and cat owners about the importance of permanent identification with microchips can only be effective if those agencies dealing with stray dogs and cats have the equipment available to detect them. Otherwise, the rapid reunification offered by this method breaks down. It is important that organisations encountering dogs and cats not only have easy access to universal scanners but are aware of how to use them correctly and understand the importance of scanning every animal properly. In more developed countries, microchip scanners are becoming increasingly prevalent in rescue centres, shelters and veterinary clinics, and many animal control officers and animal welfare groups now routinely carry portable scanning devices. Microchip manufacturers often supply organisations with scanners free of charge, in an attempt to facilitate the use of microchips (and as an incentive to purchase that company's technology).

ADVANTAGES

- Provides permanent, unequivocal identification for the duration of an animal's life (a microchip typically lasts 25 years).
- Microchips cannot be removed or tampered with without surgical intervention.
- Microchips will not cause any discomfort if implanted correctly, and will not alter the animal's appearance or affect its behaviour.
- Minimal handling and restraint is necessary to identify a microchipped animal – physical contact is not always required.
- The implanting procedure is quick and should cause minimal discomfort (comparable to a routine vaccination).
- The technology has proven to be safe with reported complications rare.
- This is the only method that can guarantee a unique, unalterable code.
- Personal information of owners will not be visible to the public.
- Low margin of operator error (the code is pre-programmed and read electronically).
- Provides traceability which may infer wider benefits in relation to long-term monitoring and data collection, e.g. longitudinal studies of feral cats, alerting breeders to congenital defects (hence encouraging responsible breeding practices) and general companion animal statistics such as adoption and death rates.

DISADVANTAGES

- The technology required can be expensive to purchase.
- Supply may present a problem in some regions. Unless scanners are made freely and widely available to equip all agencies encountering stray dogs and cats, microchipped animals may go unidentified.
- A microchipping registry requires significant infrastructure, incorporating a computerised database and a 24 hour staffed call centre or website access.
- Identification is only possible if a suitable scanner is available.
- No visible identification. The microchip needs to be accompanied by a visible indicator or it will not deter theft of owned animals and may impede chances of reunification.
- Technology obsolescence remains a concern, i.e. not all scanners are universal and non-ISO microchips are still being manufactured.
- There is a risk of subcutaneous migration of the microchip from the original implantation site, especially in loose-skinned animals, although with more recent methods and technology it is unlikely that the chip will migrate more than a few centimetres.
- Comprehensive operator training is required (see Procedure).
- Risk of microchip failure, or of 'scrambling' if a second chip is implanted.
- The accuracy of this method is dependent upon the owner, e.g. in informing the database provider of changes in contact details or ownership.

WELFARE IMPLICATIONS

- If implantation is carried out properly the animal should feel no more discomfort than for a normal injection, and the whole process should take around 2 minutes.
- There is no requirement for either a general or local anaesthetic, or for hair removal.
- Any animal which appears to be in a poor physical condition or is known to react to needles or be allergic to vaccinations should be referred to a veterinarian before microchip implantation.
- There is a risk of introducing infection to an animal during implantation but this is minimised as the equipment is supplied in sterile units (see The Microchip).
- The scanning process may cause distress to some animals, especially as it is often necessary to scan the whole body of an animal, perhaps multiple times. This could be particularly problematic with fearful or aggressive animals. Certain animals may react aversively to the sound emitted by scanning devices (some scanners have the option to deactivate the sound).
- Once an animal has been microchipped and registered, there will be complete records tracking the animal's ownership status for the duration of its life, which will help protect the animal's welfare (e.g. when it becomes lost, or is involved in an accident).

- The safety of microchips has been reviewed by many regulatory authorities, as with any other implantable medical device, and microchips have been consistently approved as a safe and effective method of animal identification. Although there have been reports a link between microchip implants and tumour formation in dogs and laboratory animals, this has certainly not been proven. Referring to safety of microchips for human use, the US Food and Drug Administration stated that *"In all the safety data the FDA has reviewed for this device, including extensive animal data, we have seen no evidence suggesting toxic or carcinogenic effects."*⁵ Although there is a need for continued scientific research into this technology, we know that many millions of dogs and cats have been microchipped worldwide with only a minute proportion reporting a problem – the World Small Animal Veterinary Association (WSAVA) Microchip Committee is aware of fewer than ten reports of tumours forming in association with a microchip⁶. WSPA believes that the benefits inferred by microchipping far outweigh this unsubstantiated risk to animal health.

THE MICROCHIP



Figure 11. Individual pre-sterilised microchip pack (PPS).

A microchip is an integrated circuit contained within a very small transponder, ranging in size from 12 to 28mm long and 2 to 3.5mm in diameter. The device is encased in biocompatible glass, so it can be inserted into living tissue without causing injury or adverse reaction, and can fit inside a compatible hypodermic syringe. The memory circuit of each microchip is programmed with a unique 15 digit alphanumeric code. The microchip itself is inactive with no internal power source – it is energised by the radio signal transmitted by the scanner.

Only microchips complying with ISO standards 11784 and 11785 should be used to identify companion animals (see Standardisation). Every microchip must be supplied in a 'pre-packed sterile' (PPS) unit (see Figure 11). The PPS unit should contain the microchip and needle, a sterilisation indicator, an expiry date and at least three self-adhesive bar codes containing the microchip's code



Figure 12. PPS unit including disposable syringe.

(one each for the owner, the implanter's records, and the database). In some units, the microchip will be contained within a needle already attached to a disposable syringe (as in Figure 12). In others, the microchip and needle will have to be placed in a re-usable 'gun' (see Figure 16).



Figure 13. Microchip and implanting needle.

Microchips 12mm in length or less have been shown to be least prone to migration or breaking in independent trials⁷. The needle gauge and needle outer diameter are also important to consider. The needle needs to be larger than a conventional needle as it must house the microchip, but should be as thin and sharp as possible to minimise discomfort and the risk of haematoma upon insertion (see Figure 13). The supplier should offer to repurchase unused PPS units (to ensure their safe disposal).

Manufacturers of microchip technology should provide trace-back capability ensuring a specific microchip number can be traced from its source of production to the animal into which it has been implanted. Distributors should ensure they have full product liability insurance.

⁵ Morrissey, S. (2007) Are microchip tags safe? *Time* www.time.com/time/health/article/0,8599,1672865,00

⁶ World Small Animal Veterinary Association (WSAVA) Microchip Committee. Microchip Safety and Efficacy. www.wsava.org/Chip999

⁷ Pet-Detect@ Microchipping Equipment (2008) Technical Information- Migration. <http://www.pet-detect.com/TIMicrochips.php>

THE SCANNER

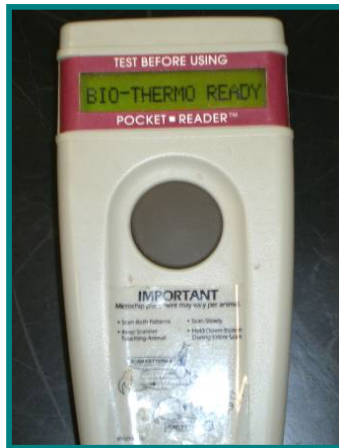


Figure 14. Portable microchip scanner.

Scanners generate a low frequency radio band that is intercepted by the microchip, which uses the energy from this band to power itself and transmit a return signal to the scanner. The scanner decodes the signal and displays the microchip's identification code on a liquid-crystal display window. With some scanners, the code can be relayed via computer interface to a database to instantly yield information about the microchipped animal (see Figure 14).

Scanners should have passed the ISO approved performance test (see Standardisation) and be able to read FDX-B (ISO 11784) microchips. They should also be compatible with the communication protocols in the geographic locale in which it is to be used, i.e. able to read microchips commonly used in the country. It is recommended that the scanner can read FDX-A microchips until 2026. Cheaper scanners will read fewer types of microchip. However, each additional technology to be read reduces the efficiency of the device's operation (e.g. speed, range etc), so the more expensive scanners should read most available microchips but may be slower to operate. Second-hand scanners should be avoided, as they may not be reliable.

Battery-powered scanners should have a low battery indicator and stop operating when operating function is compromised by low power input. Ensure batteries are always fully charged and that the manufacturer's directions for battery care are followed closely. As scanners emit and receive electromagnetic energy they may be affected by other electronic equipment or metallic objects and should be kept at least one metre away from these. If possible, avoid operating scanners on stainless steel tables and remove metal collars from animals prior to scanning.

PROCEDURE

Training

- In most countries microchip implantation is not considered a medical act and hence does not require a veterinary surgeon. Before setting up a microchipping system, however, it is important to check local and national regulations. According to the UK's Royal College of Veterinary Surgeons⁸, the procedure does not need to be performed by a veterinary surgeon unless:
 - the method used is *not* the subcutaneous route, an ear tag or bolus;
 - the entry site needs to be repaired or closed;
 - the animal needs to be chemically restrained; or
 - there is any undue risk to the health or welfare of the animal.

The American Veterinary Medical Association, however, categorises microchip implantation as a veterinary procedure, which must be performed by a veterinarian or under the direct supervision of a veterinarian⁹.

- Whether or not they are a veterinarian, the implanter should be suitably trained by a competent organisation or professional. All companies following the ICAR Code of Practice (see Standardisation) provide training courses in the use of their products. Training should be comprehensive and include: the implantation procedure, potential adverse reactions, standard implantation sites, microchip technology, animal handling, health and safety issues and registration. A certificate should be issued to non-veterinarian agents along with an Implantation Manual, which confirms the individual attended and understood the course.

⁸ Royal College of Veterinary Surgeons (2007) Guide to Professional Conduct

⁹ American Veterinary Medical Association (2006) The objectives and key elements needed for effective electronic identification of companion animals, birds and equids. http://www.avma.org/issues/pilcy/electronic_identification.asp

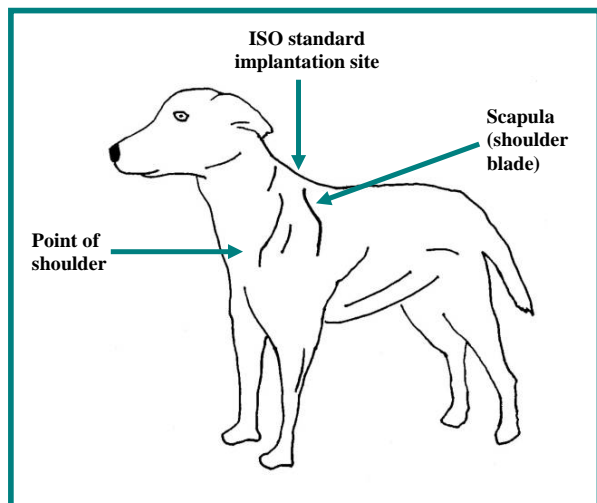


Figure 15. ISO standard microchip implantation site (at the back of the neck, midway between shoulder blades but slightly towards the head).

Implantation Site

It is crucial that the microchip implantation site is standardised for dogs and cats. For the signal to be transmitted efficiently between scanner and microchip the two devices must come into close proximity. This interaction will be optimised if operators know to target a standardised location, reducing restraint time and increasing efficiency.

The ISO standard implantation site for companion animals is **subcutaneously on the dorsal midline just cranial to the scapulae (shoulder blades)** (see Figure 15). This is also recognised by the WSAVA. The standard implantation site in continental Europe is in the midway region of the left neck, and this is the only other site recognised by the WSAVA.

Implantation Procedure

Before implantation, ensure that the animal does not already have a microchip– scan the whole body slowly and carefully (see Scanning Procedure), and check for any other forms of identification such as tattoos. **If a microchip is already present do not implant another one.** A second microchip may confuse the scanner leading to mis- or no identification.

The microchip should be fitted according to the manufacturer’s instructions (manufacturers should provide an Implantation Manual to each implanting agent), but the following are guidelines:



Figure 16. Microchip implanting gun.

1. Ensure the packaging of the PPS unit is not damaged. Before opening the PPS unit, scan the microchip to confirm it is functioning and the code corresponds with the barcode on the packaging (this will also check the scanner is working).
2. The animal should be humanely restrained and comforted by a second person, as would be required for a vaccination. The second person should hold the animal’s collar from the side while kneeling on the opposite side to the implanter, and facing in the same direction as the animal (Figure 17).

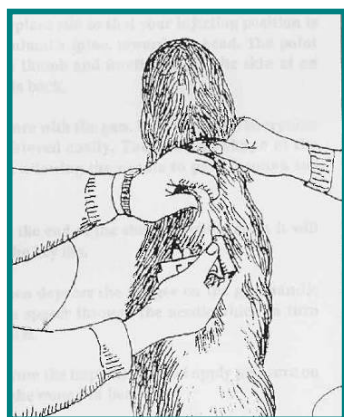


Figure 17. Implanting a microchip- one person restrains and comforts the animal, whilst another implants the microchip.

3. Clean the area around the implantation site thoroughly using a suitable antiseptic solution. This is essential for preventing bacteria from the surface being introduced to the animal during implantation.
4. Microchipping of dogs and cats is a simple straightforward subcutaneous (under the skin) injection. If the microchip is supplied already assembled with a syringe, simply remove from the PPS unit and it is ready for implanting.
5. For microchips not supplied in a pre-assembled syringe, open the PPS unit and remove the needle by taking hold of the plastic ‘flag’. Insert the tapered conical end into the front of the microchip implanting gun, like the one shown in Figure 16. Once the needle is engaged, remove the plastic holder and retain for replacement over the needle after implantation.
6. Take hold of the skin just behind the implantation site. To ensure the microchip is left in the correct position, avoid pinching too much loose skin (Figure 17).

7. If the implantation site is between the shoulder blades your injecting position is with the needle parallel with the animal's spine, pointing towards the head. The point of entry of the needle should be between thumb and forefinger into the skin at a 30 degree angle. Insert the needle by applying gentle pressure. Entry should be achieved easily because the sharp, bevelled needle point will make a small cut in the outer layers of skin, allowing the rest of the needle to pass through. Push the needle in fully to the end of the shaft (to the plastic hit if using a gun). If using a syringe, insert the needle fully and withdraw in a single smooth motion, whilst still pinching the surrounding skin. This and the angle of insertion minimises the possibility of the microchip accidentally being withdrawn with the implanting device. If using a gun, insert the needle fully and depress the trigger, then release. This will activate a plunger to push the spacer within the needle and expel the microchip into the subcutaneous layer of the animal.
8. Once the needle has been removed, apply pressure on the entry site with a finger for two or three seconds. The microchip should remain at a 30–45 degree angle to the longitudinal axis of the animal. (Over time, natural fibrocytes and collagen fibres will build up around the microchip anchoring it in location.)
9. Dispose of all needles and hypodermic syringes as clinical waste, in accordance with regulations.
10. Immediately after implantation, scan the implantation site to confirm successful placement of the microchip and ensure the device is functioning properly.
11. Complete the relevant documentation after implanting each microchip (see Registration).
12. Any adverse reactions or technology failures must be reported to the manufacturer and in some cases to a government body (e.g. in the UK the British Small Animal Veterinary Association (BSAVA) maintains a Microchip Adverse Reaction Reporting Scheme).

Scanning Procedure

Again, operators should familiarise themselves with the manufacturer's manual that should be supplied with each scanner, but the following are general guidelines:

1. Scanner function should be checked using a 'test' microchip, preferably an unused one, still in its PPS unit.
2. The scanner should be held horizontally, lightly touching the animal's fur, moving in small circular motions. Gently rocking the scanner from side to side will help locate microchips positioned at different angles.
3. Until a global standard implantation site is agreed on, scanning should concentrate on the site commonly used in that locality. If a microchip is not identified, a larger area should be scanned in slowly expanding circles for at least ten seconds.
4. The process should be repeated (with a different scanner if available) at least once before the animal is declared negative for microchip identification.



Figure 18. Scanning a dog for a microchip. It is important to scan the whole animal.

STANDARDISATION

When this identification method was first developed for use in companion animals, incompatibility of the various systems on the international market was a significant problem. Historically, manufacturers would only produce scanners capable of reading their own microchips. To overcome this problem, the International Organisation for Standardisation (ISO) developed two international standards, ISO 11784 and ISO 11785.

ISO 11784 is the standard that ensures the uniqueness of each microchip, by specifying the structure and information content of the 15 digit identification code it stores. Through a combination of country, manufacturer and identification codes, ISO 11784 offers countries or regulatory bodies a mechanism to ensure the uniqueness of international microchip identification. The first 3 digits of a 15 digit code that meets ISO 11784 will be either a country code or a manufacturer's code. The remaining 12 digits will be the identification code (ISO 11784 has reserved 274,877,906,944 possible combinations for the identification code). If a country code is used, it is the national responsibility of that country to ensure the uniqueness of these microchips. If there is no central database in operation, and microchips use a manufacturer's code, it is the responsibility of each manufacturer to ensure the uniqueness of those microchips.

The Country Code: The ISO has reserved 1024 possible combinations for country codes, which are defined under a separate ISO standard (ISO 3166: Codes for the Representation of Countries). Microchips that use a country code can only be used in countries that have one central database controlling the issue of identification numbers. This central database will allocate series of identification numbers to each manufacturer in that country, which can then produce microchips beginning with the three digit country code, followed by the 12 digit identification number. These microchips can only be sold within that country.

The Manufacturer's Code: In countries without a single central authority to control the issue of identification codes, a manufacturer's code is used. The ISO have appointed the International Committee for Animal Recording (ICAR) responsible for issuing the three digit manufacturer codes, and each manufacturer must apply to the ICAR to obtain one. In applying to ICAR the microchips will be thoroughly tested to ensure they comply with the ISO standards and the ICAR Code of Conduct, which includes an agreement on the part of the manufacturer to guarantee the uniqueness of the identification codes, and to allow full traceability of all animals identified. ICAR maintain a list of manufacturers who have signed the code of conduct on their website at www.icar.org.

ISO 11785 defines the technical aspects of communication between the microchip and the scanner. It permits either one way at a time signal transmission (Half Duplex) or simultaneous two-way signal transmission (Full Duplex). The new ISO regulation microchips operate at a frequency of 132.5 kHz, and are known as 'FDX-B' chips. When the ISO standards were introduced, there was an issue of 'backward' compatibility, in that the new scanners are still needed to read older, pre-ISO technology, for the duration of the lifetime of those animals. ISO 11785 was designed to address this issue in helping create a universal scanner that could read these new FDX-B microchips as well as the older technology such as FDX-A, HDX and FACAVA¹⁰.

These standards were agreed by a number of international bodies including the World Small Animal Veterinary Association and the Federation of European Companion Animal Veterinary Associations, and were implemented in Europe in 1996. Since then there has been international agreement regarding the total transition to using ISO microchip technology¹¹, and this is now standard across Europe and Asia. South America and Africa are not yet a priority for most manufacturers in terms of companion animal identification, although this is changing¹². Although manufacturers and distributors in the USA and Canada are able to implement ISO-standard microchipping systems in that region, unfortunately incompatible technologies continue to be produced and distributed, with the main impediment being how the cost and logistics of the transition to ISO-standard systems¹².

¹⁰ Note: Annex A of ISO 11785 was developed to address this issue during the transition period between prior and ISO standard technology and defined the need for readers to read three technologies (Destron, Datamars, and Trovan) for a period of 2 years. AVID was not included in Annex A because they elected not to provide the encryption code with which to read their encrypted microchips. However, this 2 year period ended in 1998 and hence Annex A is no longer applicable, and Annex A microchips are not true ISO standard microchips.

¹¹ WSAVA (2002) Microchip Survey Results <http://www.wsava.org/MicrochipSurvey1102.htm>

¹² WSAVA Recommendations on Adopting and Implementing Microchip Technology that Adheres to the ISO Standards. <http://www.wsava.org/MicrochipComm1.htm>

The ISO standards and vigorous ICAR testing provide assurance that animals identified with an ‘approved’ microchip will be recognised by an ‘approved’ scanner. Under the Pet Travel Scheme (PETS)⁴, if an animal’s microchip does not meet ISO standards the owner must provide their own scanner when they travel. The standardisation effort has obvious positive implications for recovery of companion animals and disease control, and will lead to the more widespread use of this identification method. This, in turn, should hopefully help reduce the prohibitive costs of microchipping technology through the competition created by the standardised markets.

REGISTRATION

A microchipping system is only as good as its supporting database. After every microchip implantation, the microchip’s unique code will permanently represent that animal and will correspond to a record on a central database where its details are stored. Without effective, reliable database administration, the system will fail.

When microchipping an animal the following information should be ascertained:

Essential details of animal:

Microchip code
Date of registration/implantation
Species
Breed
Sex
Colour/description
Health-related information
Spay/Neuter details.

If the owner is present:

Full name and address
Contact telephone numbers
Name of animal
Year of birth
Special e.g. dietary needs
Details of veterinarian
Medical problems e.g. allergies, diabetes and any medication

The following requirements should be considered:

- Following microchip implantation, a record card must be completed (Figure 19), and the code and essential details need to be communicated to the central database, either electronically or by paper, as quickly and efficiently as possible. Ideally, all relevant persons (including veterinarians, other microchip implanters, municipal officers and animal owners) should be able to access the database and input new entries or update existing entries immediately as required, via a secure website.
- After implanting a microchip an accompanying visible indicator should be supplied. Microchip providers often supply a unique tag to attach to the animal’s collar, e.g. Identichip (Figure 19). Another method is to tattoo an ‘M’ or ‘X’ on the inside ear (see previous chapter for tattoo procedure).
- When registering owned animals a registration fee is usually charged, which covers the cost of the microchip and implantation, and registration. The fee usually falls within the range of US\$30 to US\$75. Often, the procedure is included in the adoption fee charged by animal shelters.
- The owner should be provided with a certificate of identification. In some countries, owners are enabled to change their own details on the database, which has proven successful.
- It is the owner’s responsibility to contact the database service when information changes.
- The database should be fully accessible to all relevant authorities (including the veterinary profession, the police, municipality officials and NGOs involved in companion animal population management) 24 hours a day. Typically, database administrators provide a 24 hour, toll free telephone service, with the number advertised on the animal’s tag.
- All records must be maintained at least for the life of the animal and be regularly backed-up. They should comply with national data protection legislation and codes of practice.

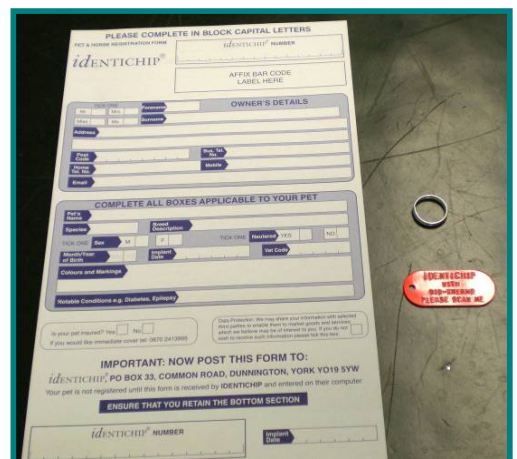


Figure 19. Identichip® registration form and tag.

Many organisations are already operating substantial companion animal databases. These include ICAR member organisations and animal protection organisations, as well as governments and municipalities. According to ISO 11784, ideally every country should maintain databases of information about all issued codes and the associated animals.

Worldwide there are three main manufacturers or distributors of microchips used in animal identification: AVID; Schering-Plough (manufactured by Destron Fearing); and Trovan (the main European supplier). AVID is a large US manufacturer and its products are supported by a pet-tracking database called PETrac™. The other main database in the USA is the Companion Animal Recovery (CAR) database, which is operated by the American Kennel Club (AKC). Together these two databases identify and track approximately four million companion animals. Also, in the USA, Schering-Plough markets the HomeAgain™ Companion Animal Retrieval System. In the UK the register is kept on the Petlog database (jointly run by the Kennel Club, the RSPCA and the SSPCA), which can link with registers in other countries (useful for international travel).

Often in-country microchip administrators try to disseminate the message that there is one central point of contact, to speed up the process for all relevant parties, i.e. police, dog wardens and public. For example the UK's Petlog initiative, administered by the Kennel Club, administers a Central Microchip Reunification Service telephone number available 24 hours a day, seven days a week. In 2006, Petlog reunited 19,440 dogs and 11,285 cats with their owners, in some cases many years after the animal originally went missing.

Ultimately, what is required is a single international system that is technologically neutral. Having numerous proprietary databases (i.e. one or more per country) complicates the search process and could result in an animal not being identified. Europe is moving towards this idea and has established EuroPetNet – an online accessible database that records microchip codes from all European member databases. For data protection purposes EuroPetNet will provide details of the particular database in which a chip is recorded, but not the contact details of the owner.

Ear Tips and Notches

Ear tipping or ear notching is the removal of part of the distal pinna of one of an animal's ears, to provide visible identification.

Ear tipping

Ear tipping (also referred to as ear 'clipping') is most commonly used to identify feral cats that have been neutered as part of a population management programme (see Figure 20). The procedure is carried out while the cat is under anaesthesia for the neutering operation.

WSPA regards ear tipping as the most humane, cost-effective and visible method of identification for feral cats in a managed colony. It is very important that all animal protection organisations working with feral cats use a universal identification method to signal that cats have been neutered. Identifying neutered cats (particularly females) can be very difficult without a visible indicator such as an ear tip, and unnecessary repeat surgery is both a waste of resources and traumatic for the cat.



Figure 20. Ear-tipped cat.

This identification method should be used as part of a controlled programme in which cats are returned to a managed site where they will be cared for. Feral, unsocialised or ownerless stray cats that have undergone treatment as part of this programme should always be ear tipped before being returned to the original site or relocated to a new colony. For owned cats, owner consent must be obtained before ear tipping occurs. If a cat has definite signs of a previous neutering operation, it should be ear tipped, but if there is any doubt then the cat should be neutered and ear tipped. It is hoped that ear tipping will become a universal indicator of a neutered cat that is being cared for as part of a management programme. In the UK, for example, an ear tip is officially recognised in this way, and animal control officers know when they encounter an ear tipped cat that it is part of a managed colony.



Figure 21. Ear-notched cat.

Ear notching

This is similar to ear tipping but a small notch is removed from the side of the ear, rather than the tip, as in Figure 21. Ear notching of cats is not recommended as the mark may not be recognised by all organisations and may be mistaken for natural injury, e.g. from fighting.

Ear notching is, however, commonly used to identify dogs that have been neutered and vaccinated in a population management programme, often in addition to a tattoo. This identification method can be very useful in studying stray dog populations, if coupled with tattoos, as it provides an identifying mark visible at a distance. For example, when ear notched dogs are recaptured, either accidentally or deliberately, this can generate invaluable data on survival and movement, and other parameters essential for understanding the dynamics of stray dog populations.

ADVANTAGES

- Ear tipping creates a characteristic silhouette visible from a distance (this is particularly beneficial given the nature of feral cats).
- Ear notches can provide visible identification of dogs from a distance, depending on ear anatomy.
- The immediate visual identification provided by this method allows animal control officers and other agencies to recognise that a cat is part of a managed colony and is being cared for.
- Absence of an ear tip can immediately identify unneutered newcomers to feral cat colonies.
- Ear tips or notches can prevent animals being subjected to the stress of recapture, examination and unnecessary repeat surgery.
- Ear tips and notches are relatively easy to perform on animals already under anaesthesia e.g. for a neutering operation.

DISADVANTAGES

- In some countries, it may be illegal to carry out ear tipping or ear notching, or it may be subject to strict regulations. This is because the procedure may be categorised as surgical mutilation. It is important to check local and national legislation.
- The procedure can only be performed by a veterinarian, and the animal must be under general anaesthesia.
- Visibility may be reduced in long-haired breeds.
- The mark can be obscured by scar tissue or heal over.
- Identification is lost if the ear is injured or mutilated, and can resemble a bite wound, reducing reliability.

WELFARE IMPLICATIONS

- Ear tipping or notching is a form of mutilation and may cause pain or severe blood loss if not performed correctly. However, the procedure is not inhumane if performed by a qualified veterinarian, under sterile conditions, whilst the animal is already under anaesthesia for other surgery.
- The distribution of blood vessels in the ear means that there is a danger of excessive bleeding in dogs, hence the requirement for a veterinarian to perform this method.
- By providing permanent visual identification to indicate they are part of a management programme, ear tipping can be crucial for the health and safety of feral cats.
- This method can prevent the trauma of recapture and, potentially, unnecessary repeat surgery.

PROCEDURE

Ear tipping or notching should be performed by a veterinarian while the animal is under general anaesthesia (it is usually performed just after neutering). It is advisable to be consistent, as far as possible, with which ear is tipped or notched (i.e. left or right).

1. Clean both ear canals to remove any source of irritation which could provoke rubbing or scratching of the head.
2. Clean and disinfect the pinna then dry it completely to remove cleaning agents such as surgical spirit which could delay blood clotting.
3. Remove the tip or notch – general guidelines are provided in the boxes.
4. Apply digital pressure, a styptic or a drying antiseptic powder to the cut edge to halt bleeding – even flour is effective if there is nothing else available. If bleeding continues the cut can be sealed with tissue adhesive or electrocautery.
5. Check for bleeding when the animal recovers consciousness and blood pressure rises, and again before releasing the animal.

Ear Tipping

For ear tipping, the standard ear to be tipped is the left¹³. Approximately 6–10mm should be removed from the ear tip, depending on the size of the ear. If too much of the pinna is removed the ear appears ‘cropped’ and may be aesthetically unacceptable, but if too little is removed the mark will not be identifiable from a distance. The aim should be clear recognition at 20 metres.

Place a straight haemostat across the distal tip of the pinna, parallel to the base of the ear, exposing the area to be removed. Alternatively, mark a straight line on the inner surface of the pinna using a ball-point pen.

Cut along the line using sterile surgical scissors or scalpel blade (see Figure 22). Cautery can also be used although some report that this produces a ragged effect on healing. To create a distinctive silhouette it is important that the cut is as straight as possible and the tip looks artificial.



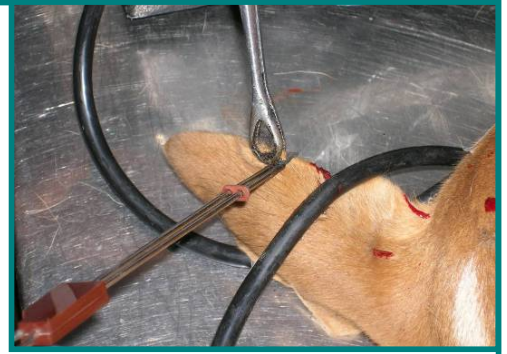
Figure 22. Whilst still unconscious following a neutering operation, the tip of a cat's left ear is removed.

¹³ Feline Advisory Bureau (2006) Feral Cat Manual. FAB Publication

Ear Notching

Ear notches can be cut using ear notch pliers, which should be kept sharp and disinfected between animals. Alternatively, a thermocautery device can be used to cut a semicircular notch out of the leading edge of the pinna (Figure 23).

Figure 23. Ear notching of anaesthetised dog.



Freeze Branding

Freeze branding, also referred to as cryo-branding, is the application of a mark using an extremely cold branding iron. This method was originally developed for identification of livestock. When a cooled freeze branding iron is placed on the skin for the correct time and at the correct pressure, the extremely cold temperature destroys the colour follicles at the brand site, so they can no longer produce pigment, but the hair can continue to grow from the growth follicles. The result is that hair at the brand site contains no pigment and appears white, which can create a highly visible mark on dark-haired animals. If the iron is held against the skin for a longer period of time, then the growth follicles will also be destroyed, and no hair will grow at all from the branding site. The latter technique is used for light-haired animals, as black or pink skin will be more visible than unpigmented hair.

Freeze branding requires the use of a coolant, usually liquid nitrogen although a mixture of dry ice and alcohol can be used. This has obvious implications for human safety and the handling and use of such material will be subject to local and/or national legislation and regulations.

Freeze branding is widely used to identify horses, as it produces a highly visible mark. The effectiveness of freeze branding for use on companion animals is not widely known. In the USA apparently it is common for hunting dogs to be freeze branded in the ear or flank, and some report it is also effective on cats¹⁴. However there are a number of limiting factors relating to this method (outlined below) and WSPA would not recommend freeze branding for the identification for dogs and cats.

ADVANTAGES

- Highly visible on dark-haired animals.
- Mark is permanent – it will not fade or distort and is tamper-proof.
- A standard, uniform white mark produced (depending on skill of operator).

DISADVANTAGES

- Freeze branding is not a well recognised method of identification for dogs or cats, and is not acknowledged for legal ownership.
- Fine characters cannot be depicted – the mark is limited to the size and shape of the iron used, hence this method could not individually identify a large number of animals.
- The process is time-consuming. The iron can take around 30 minutes to cool to the correct temperature, and the branding procedure itself can take up to 10 minutes per animal.
- The procedure is complex, involving a number of different steps and equipment. The iron must be held against the skin for exactly the right amount of time – this will depend on many factors such as age, skin thickness, hair colour and the type of metal and coolant used. Operators must require training to master the technique. If the iron is in contact for too long, the animal will be scarred, but for light-haired animals the duration of the branding needs to be extended to destroy the hair follicles (the brand then takes the appearance of a hot brand).
- Liquid nitrogen and other coolant materials can be difficult to obtain.
- Freeze branding does not provide immediate identification – the mark will not be clearly visible for some weeks after branding.
- Freeze brands are not as visible on light-haired or white coloured animals, unless branding time is extended for longer, as described above.

¹⁴ Farrell RK, Koger LM, Winward LDJ (1966) Freeze branding of cattle, dogs, and cats for identification. *Am. Vet. Med. Assoc.* 149(6):745-52

WELFARE IMPLICATIONS

- Freeze branding causes blistering of the animal's skin – the area will be swollen for a few days before a scab forms over the site. Whilst there is no puncturing of the skin, such blisters take time to heal (can be longer than a month) and can become infected should they burst.
- In a report of a working party set up by the UK's Royal College of Veterinary Surgeons to consider the mutilation of animals¹⁵, freeze branding was found to cause 'minimal discomfort and no subsequent pain' in horses, but there has been no similar investigation for other companion animals. The procedure does, however, have the potential to cause pain, although some report that animals do not react to freeze branding because the extreme cold produces a numbing effect. According to the UK's Companion Animal Welfare Council, freeze marking does not require sedation or anaesthesia¹⁶, but may cause pain '*depending on the skill of the operator, sensitivity of the animal and how long the 'brand' has to be held against the animal's skin*'.

HUMAN SAFETY IMPLICATIONS

- Great care must be taken when handling the coolant material, as this can cause injury because of the extremely cold temperature. Liquid nitrogen has a temperature of –240 degrees, and a dry ice – alcohol mixture will have a temperature of around –90 degrees. Precautions must be taken to avoid skin contact.
- Acetone and alcohol are extremely flammable and should only be used in open air or a well ventilated building, with no danger of open flames (e.g. smoking).
- Vapour from alcohol is dangerous to the tissues of the eyes and nose.
- The use of branding irons is subject to laws relative to each individual state or country.

¹⁵ Royal College of Veterinary Surgeons (1987) Report of working part established by RCVS Council to consider the mutilation of animals. UK. www.cdb.org/vets/mutilations

¹⁶ Companion Animal Welfare Council (2002) Report on the identification and registration of companion animals. UK. www.cawc.org.uk/sites/default/files/CAWCRPID&Registration02final.pdf

Semi-permanent identification methods

Identification Collars



Figure 24. Dog and cat wearing collars with identification tags.

A collar and tag is the most common identification method for owned dogs and cats. In many countries it is a legal requirement that companion animals wear collars displaying key information when in public. The owner's name and contact details, or those of a pet registry, and sometimes medical information, are inscribed either on a tag attached to the collar (as in Figure 24), or on the collar itself. Owners must ensure the information displayed by collars is accurate and up-to-date. Some pet registries will engrave a unique code on a tag to be issued when animals are registered, often to accompany a microchip.



Figure 25. 2008 'Red heart' rabies vaccination tag, provided by Ketchum Mfg. Co.®.

Collars can be an important component of compulsory registration schemes, as they are easily and cheaply administered, yet highly visible. For instance in countries where rabies vaccination is mandatory, collars or tags can be issued to owners at the time of vaccination (see Figure 25). The colour of the collars can be changed each year, providing a visible indicator that the dog or cat's vaccination status is up-to-date.

This identification method is, however, vulnerable to failure. Animals can slip through collars or they can easily be deliberately removed, and tags can become detached. It is therefore recommended that, for owned animals, collars are accompanied by permanent identification such as tattoos or microchips.

In dog population management programmes, a fabric or plastic collar provides one of the cheapest and easiest methods of identifying neutered and/or vaccinated dogs to prevent repeat catching. Childs *et al.* (1998), for example, found black plastic collars to be a useful marking method for use in distance sampling of rural dog populations¹⁷. Collars (or plastic tags attached to collars) can be colour-coded, for example to identify when the animal was captured, or in which locality. Collars can also be embroidered

¹⁷ Childs JE, Robinson LE, Sadek R, Madden A, Miranda ME, Miranda NL. (1998) Density estimates of rural dog populations and an assessment of marking methods during a rabies vaccination campaign in the Philippines. *Prev. Vet Med.* 33: 207-18

or printed with individual codes. A note of caution, however, as collars can be removed or lost, which can bias statistics if not accounted for, e.g. a survival estimate will be lower than it should be.

Unlike ear notches, the public can recognise collars used in a management programme, especially if they are brightly coloured or embroidered, perhaps with the name of the organisation carrying out the programme. This can reassure the public that an animal is being cared for as part of humane, managed programme, or that it has been vaccinated against rabies. This can have the additional benefit of enhancing the visibility of the programme in the community, potentially improving public awareness and cooperation.

There are welfare concerns with this method, as animals can get caught by their collars, which may lead to strangulation or other injury. It is very important that collars used in management programmes are safely fitted and will not strangle the animal if it grows, gains weight, or becomes caught, i.e. it must 'give' and be designed to break or open without too much force. Collars should not be put on puppies or kittens. Another concern is collars enable people to grab hold of dogs, and may in this respect encourage or facilitate cruel treatment.

Collars are not practical for identifying feral cats, as they are often lost or need to be adjusted or removed. Cats try to remove or slip out of their collars and often get their front legs stuck part way through the collar if it is not fitted correctly. Re-trapping cats in order to replace, remove or adjust a collar is traumatic for the cats, and potentially dangerous for the caretakers who need to handle them. For owned cats, there is also the risk of removal or injury, but this is reduced because of owner monitoring, and the benefits of a properly fitted collar arguably outweigh the risk of injury.

ADVANTAGES

- Provides highly visible identification.
- No additional equipment or investigation necessary to identify owner, unless e.g. municipal rabies tags where owner details must be retrieved via the municipal authority veterinary clinic.
- Inexpensive.
- Readily available.
- Quick and easy to administer.
- Variable in type and colour.
- Instant recognition of dog/owner details.
- Can be colour-coded or inscribed to identify individual or groups of animals.

DISADVANTAGES

- Can be easily removed from animal, deliberately or accidentally.
- Can break or become caught.
- Collars and tags are subject to various forms of degradation e.g. rust or fading, and can become illegible.

WELFARE IMPLICATIONS

- Collars can become caught, which can result in serious injury and death.
- Collars allow an animal to be grabbed, which can be used both positively (e.g. recovering a stray animal) and negatively (e.g. by enabling cruel treatment).
- The size of the collar must be carefully selected in order to allow for normal growth and activity of the animal.
- Collars should be fitted tight enough to ensure they will not slip off, get caught, or result in irritating movement, but loose enough to not cause discomfort or restrict movement. As a general rule, leave enough space for two fingers to be slipped underneath.
- It is the owner's responsibility to regularly check the collar for fit and safety.
- Collars should be made from materials that are comfortable and safe, that do not absorb moisture and maintain flexibility in low temperatures.
- Collar width is important if a leash is to be attached. If too narrow, then excessive pressure will be applied to the neck, resulting in abrasion and pressure necrosis. If too wide, this may restrict movement.
- Modifications such as bells or light-emitting material may interfere with the normal behaviour and social interactions of the animal, although this may be deliberate, e.g. owners wanting to protect wildlife from cats.
- Certain types of collar are available which have inherent welfare concerns. Electric shock collars and anti-bark collars, for instance, are cruel and unnecessary devices and are illegal in some countries.
- Zip ties (plastic fastenings that tighten but do not loosen) must never be used as collars as there is a very high risk of strangulation.

TYPES OF COLLAR

Buckle / Flat / Quick release collars

- Standard identification collar, considered the safest type of collar if fitted correctly.
- Usually made of leather or nylon webbing, but other materials include polyester, cotton or hemp.
- Fastens with either a buckle (as on a belt) or a quick-release catch, and has an adjustable circumference.
- Identification tags or barrels can be attached, or details inscribed on the collar with embroidery or ink.
- Usually has a metal loop to which a leash can be attached.

Break-away collars

- These are similar to buckle collars but have an in-built safety mechanism allowing the dog to break free when excessive force is applied.
- Recommended for situations when a standard buckle collar could get caught and cause strangulation.

EQUIPMENT, COST AND SUPPLY



Figure 26. Hand engraving tool for metal identification tags.



Figure 27. VetScribe™ automatic rabies tag engraver.



Figure 28. Identification 'barrel'.

- Many varieties of adjustable collars and tags may be purchased from pet stores, pet supply centres, feed stores, and other retailers that sell animal products.
- Collars should be made of materials which are durable; comfortable and safe for the animal; can withstand extreme environmental conditions; do not absorb moisture; and maintain their flexibility in low temperatures. Common materials used include flat nylon webbing.
- If identifying a large number of animals individually, plastic identification tags can be purchased, which are simple to assemble and durable.
- Alternatively, although more expensive, professional engraving hand tools or machines can be obtained to create rabies and ID tags. This enables instantly available identification details to be added to a collar, which can be created automatically (see Figures 26 and 27).
- Identification 'barrels' hang from the collar like tags, but the identification information is not visually apparent (see Figure 28). Instead, the information is recorded on a small piece of paper that fits inside the barrel. These may be preferable to collar identification or engraved tags, if the details are likely to change regularly, e.g. owners who move frequently.

Suppliers

- Ketchum Mfg. Co.** (USA). Specialists in animal ID tags and rabies tags. <http://www.ketchummfg.com/>
- NLS Animal Health** market the Vetscribe Rabies Tag Engraver (Figure 26), allowing the instant engraving of custom rabies or ID tags.
- Non Permanent Pet Identification Products.** Useful site linking to a variety of identification product sellers including ID collars and tags. <http://members.aol.com/TesterDesp/ID-other.html>
- Pet Tags Online** (USA). Supplies a variety of pet tags with fast international shipping. www.pet-tags-online.com
- Mastergrave** (UK). Supplies pet tags and a range of engraving tools (Figure 26), starting at US\$18. http://www.mastergrave.co.uk/catalogue/browse.php?product_Category_ID=117
- Animal Instinct** (UK). Supplies the dog identification barrel (Figure 28) at US\$3. http://www.animalinstinct.co.uk/acatalog/Pets_Products_Extending_Dog_Leads_12.html

Ear Tags

Ear tags come in a variety of materials and designs and are attached to the ear either through a purpose-made hole or via a metal clip. Tags can be used to identify individual animals with a unique code, or simply by the presence of a tag, which may be colour-coded. In some countries, proof of vaccination may be indicated by an ear tag.

Ear tagging is not a recommended method for the identification of companion animals because tags can be removed, fall off or become snagged, and there is a high risk of injury and infection.



Figure 29. Dog with metal ear tag.

ADVANTAGES

- Good visibility.
- Can identify individuals or groups of animals using a code or a colour.

DISADVANTAGES

- Tags can be removed accidentally or deliberately.
- Handling and restraint is required to read a tag number.
- Welfare implications due to risk of catching, injury and infection (see below).

WELFARE IMPLICATIONS

- Application of an ear tag that pierces the ear is a painful procedure and should be performed by a skilled and trained operator, whilst the animal is under general anaesthetic for another procedure (e.g. neutering), under the supervision of a veterinarian.
- Ears that have been tagged often become infected, especially if the tag is worn for prolonged periods and in hot climates, where it can cause fly strike.
- Ears with tags are more likely to be ripped or torn during fighting or grooming.
- Tags can be snagged e.g. on vegetation.
- When the tag is attached using an applicator that pierces the ear (rather than the tag itself) there is a risk of disease transmission if adequate precautions are not taken.
- Animals that have been ear tagged should be examined regularly to check for inflammation and other complications.
- Coloured ear 'streamers' and 'switches' are temporary markers sometimes used on larger mammals for greater visibility. They are usually attached through pierced holes or using metal clips. These can easily become caught on objects or be pulled by other animals, causing damage to the ear, and should not be used for dogs or cats.
- Tags that loop around the ear should not be used as they can easily become caught to objects, and do not allow for ear growth.

The RSPCA commissioned a study of the effects of ear tags on the welfare of sheep, which found that all ear tags result in an inflammatory response due to the wound created at insertion, but certain types of tags created less of a response than others. Metal tags caused major lesions, whereas flexible plastic tags caused less response¹⁸.

WSPA does not recommend the use of ear tags for identifying dogs or cats. The welfare implications outlined above, particularly the high risk of infection, outweigh any potential benefits of this method, and there are safer methods available for the same purpose, such as collars.

¹⁸ Edwards, D.S.; Johnston, A.M. (1999) *Welfare implications of sheep ear tags*, The Veterinary Record, May 29, 1999. Further research commissioned in 1999 by the RSPCA from A. M. Johnston, Royal Veterinary College, University of London.

Temporary identification methods

Paint or Dye

Paint or dye can be applied to the fur of dogs and cats for temporary marking that will last from a few weeks to several months (depending on moulting rate, wear, and fade).

The method of application varies from simple painting to compressed air spray. Stencils can be used for identification of individual animals, or more remote methods can be used if this is not required (e.g. brush-tipped pole). The colour should contrast with the colour of the animal. The mark should be allowed to dry before the animal is released.

ADVANTAGES

- Can be a highly visible form of marking.
- Easy to apply with minimal or no handling and restraint required either for application or for identification.
- Both flanks can be marked (for ground observation) or the back (for aerial observation).
- Non-invasive.

DISADVANTAGES

- Not an accurate technique for identifying individual animals.
- Temporary, unreliable and cannot predict longevity.
- Not suitable for long-haired animals as fur will be matted by the paint or dye.

WELFARE IMPLICATIONS

- Only non-toxic materials should be used as paint may be ingested in grooming. Turpentine or tar-based paints can be harmful.
- Fur matting may cause skin irritation.
- May alter the animal's behaviour (e.g. increased time spent grooming) and the behaviour of other animals towards it.

EQUIPMENT, COST AND SUPPLY

- There are a range of non-permanent marking products available, depending on requirements (see Figure 30).
- Dyes commonly used are: Nyanzol A, Nyanzol D, blackpowder, clothing dyes, human hair dyes, red and orange aniline dyes, and picric acid.
- Should be non-toxic and waterproof.



Figure 30. Various paint/dye animal marking products, from left: spray dye, dye pressure sprayer (for concentrate), non-toxic paint stick, coloured foam marker, long-lasting animal marking sticks, high-visibility spray in fluorescent colours.

- **Raidex** (Germany). Manufacture a range of animal marking products. <http://www.raidex.de/>
- **Ketchum** (Canada). Suppliers of animal identification products including temporary inks. <http://www.ketchum.ca/>
- **Ritchey Tagg** (UK but ships worldwide). Specialises in animal identification products and stocks a range of marking materials. <http://www.ritcheytagg.com/>
- **Vet Tech Solutions** (UK) have a range of products for animal identification, including markers. <http://www.vet-tech.co.uk>

Radio Transmitters

The attachment of small external radio transmitters to free-roaming mammals has become a common method of monitoring the location and movement of individuals, and is used successfully in a variety of mammalian species, although is not widely used to monitor the dynamics of dog and cat populations.

This is a temporary method – the transmitter is designed to eventually detach from the animal or be removed. There are a number of ways transmitters can be attached to an animal, including adhesive, implantation, and collars.

This method requires expensive technology and should only be implemented when project funding guarantees the capacity to monitor the animals for the life-span of the transmitter and remove it when no longer required.

Transmitters vary in size, weight and predicted lifespan, and are available from several commercial outlets. The basic system includes a transmitter, power supply, antenna, material to protect the electronic components and a collar, harness or adhesive to attach the transmitter to the animal. Transmitter packages should be as light in weight as possible. The total weight (i.e. collar, transmitter, battery, aerial and bonding material) should be no more than 5% of the animals' bodyweight.

Pet Locators

Global Positioning methodology is now being used by dog and cat owners to keep track of their animals, in case they roam or become lost. A lightweight, waterproof locator device is attached to the collar, and alerts the owner (e.g. via text message) when the animal leaves the radius of a specified location. The owner can then identify the animal's location on a computerised map, or by calling a helpline. This system has the potential to reduce the number of owned dogs and cats that stray.

Although cost-prohibitive, the system has potential for use in studies monitoring the movement of stray dogs, allowing continuous tracking.

A GPS pet locator can be purchased for approximately US \$200 (e.g. <http://www.zoombak.com/products/pet/>).

Future identification methods

Improvements in technology will allow other methods for the identification of dogs and cats in the future, as well improvements in methodology for some of the existing methods. Reliability, visibility, minimal invasiveness, accuracy and cost are the primary considerations.

DNA Profiling

DNA profiling is now well established as a reliable means of identification for dogs, and this may be the future for the identification of owned companion animals. An animal's DNA profile is unique and hence allows unequivocal individual identification. Also, because it is permanent, it can never be altered, modified or removed. Although the technology for this method is very complex, it is simple and non-invasive. Animals can be identified through samples of saliva, hair, blood or semen. If their DNA profile is then registered on a database, this will provide a permanent record via which the animal can always be identified. As with other permanent identification, it will be the owner's responsibility to ensure the database is up-to-date.

Currently DNA profiling is used primarily by dog breeders to provide proof of a dog's pedigree lineage, and also provides a genetic health screen for a number of genetic diseases and hence has the potential to improve the genetic health of dog populations. Knowledge of genetic disease transmission and carriage will enable better management of canine health.

Recently, scientists at the University of Cambridge in the UK, in collaboration with a genetics company Blueprint Healthcare Ltd, have developed new technology for canine DNA profiling that combines identity, pedigree and disease testing. Blueprint Healthcare Ltd can now offer DNA testing direct to dog owners and dog breeders. The DNA profiling service based on this technology was launched in the UK under the brand name DNAtag™. Blueprint Healthcare Ltd will be distributing swabs to all vets, police and animals shelters across the UK, in order to offer a free DNA profiling service, which will facilitate the speedy reunification of lost and stolen dogs. Presently, samples have to be sent to a laboratory for examination but when tests become portable they will presumably be more widely used.

RFID 'Invisible Ink'

In 2007 the US company Somark Innovations announced the development of a biocompatible 'RFID ink', which can be read through animal hairs. This passive technology could be used to identify companion animals using radio frequency identification but without the need for implanting microchips. The company is planning to licence the technology to markets that will include companion animal identification.

The ink in effect forms a fake fingerprint. It is apparently safe for human and animal use, contains no metals and is chemically inert. The ink can be either invisible or coloured, depending on requirements. The application process takes between 5 and 10 seconds and involves a geometric array of needles, an ink capsule, and a re-usable applicator. The ink is 'tattooed' on the animal with no need for hair removal. The ink remains in the dermal layer and can be read from four feet away. The amount of information the ink can contain depends on the amount of surface area available. In cattle, it is proposed that the ink will contain a 15 digit number, which can be linked to a database that contains additional data.

Retinal Scanning

Retinal scanning identifies animals by the distinctive vascular patterns at the back of the eye. This is generating interest as a potential identification method for animals because it is a non-intrusive identification process with almost 100% accuracy and declining cost. Studies indicate that changes to the retina over a dog's lifetime will not preclude positive identification of individual dogs by use of their retinal vascular patterns¹⁹. The technology is currently being developed by Optibrand but is still in the research phase.

¹⁹ Gionfriddo, J.R. et al. (2006) Evaluation of retinal images for identifying individual dogs. *Am. J. Vet. Research* 67(12): 2042-2045