

Darting manual

Jonathan Cracknell BVMS CertVA CertZooMed MRCVS
Dan-inject edition | Version 1.3



WILDPHARM

CAPTURE • IMMOBILISATION • MEDICATION

Bob Lawrence

Telephone: 07831 323577

E-mail: safari.farm.bob@gmail.com

Website: www.wildpharm.co.uk



Darting Manual

Introduction & index



The Darting Manual was produced to be used as a training tool for operators being trained in the art of best practice in maintaining and preparing darting equipment. The manual is designed to accompany your newly purchased Dan-inject system. It is not designed to replace other texts or experience and readers are advised to refer to standard texts on remote chemical immobilisation for additional information. Other darting systems are available.

If you have any queries, further questions or comments on this manual then do not hesitate to contact the author. All images and graphics are copyright of the author.

Many thanks

Dr Jon Cracknell BVMS CertVA CertZooMed MRCVS

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UK Legislation	2
Dart anatomy: Dan-inject	3
Dan-inject: Dart assembly	
Check the plunger moves	5
Place sleeve on needle	6
Assess sufficient seal on needle	7
Inject drug into liquid drug chamber	8
Top up liquid drug chamber if needed	9
Attach needle to dart body	10
Pressurise dart air chamber	11
Dan-inject: Insert dart into rifle	13
Dan-inject: Pressure for rifle (JMSP)	14
Range finder use	15
Darting considerations	16
Dan-inject: Following darting	
Depressurise dart	17
Removal from animal	18
Remove dart from rifle	19
How to empty the dart if not used	20

Dan-inject: Dart cleaning	
Needle	21
Blocked needle	22
Dart body	23
Plunger maintenance	24
Flight maintenance	25
Dart storage	26
Anaesthetic record	27
Health and safety	
Operator and observers	28
Sighting the rifle/pistol	30
Opioid exposure emergency chart	BC



In the UK both the method of propelling the dart and the liquid used within the dart are considered under specific legislation. It is imperative that the operator is aware of their legal responsibilities before considering darting any animal.

Firearms legislation

Darting equipment are often referred to as dart rifles, tranquilising equipment or remote chemical immobilisation (RCI) equipment. In the UK dart rifles, pistols, blow pipes and their ammunition fall under section 5(1)(b) of the Firearms Act 1968 and are classed as prohibited weapons. By virtue of Section 8 of the Firearms (ammendment) Act 1997, veterinarians, zoo keepers etc are able to possess and use the equipment if they are in possession of a suitably conditioned firearm certificate. Without a firearms licence:

- it is illegal to handle a section five firearm (dart rifle, pistol or blowpipe)
- it is illegal to fire a section five firearm (dart rifle, pistol or blowpipe)
- there is no coverage by another's licence even for training, each individual must have a suitable licence (observation is permitted)

Possessing or distributing a prohibited weapon designed for the discharge of noxious liquid (this includes anaesthetic agents) carries a sentence of:

- Summary = 6 months or a fine of the statutory maximum, or both
- On indictment = 10 years or a fine, or both

In summary:

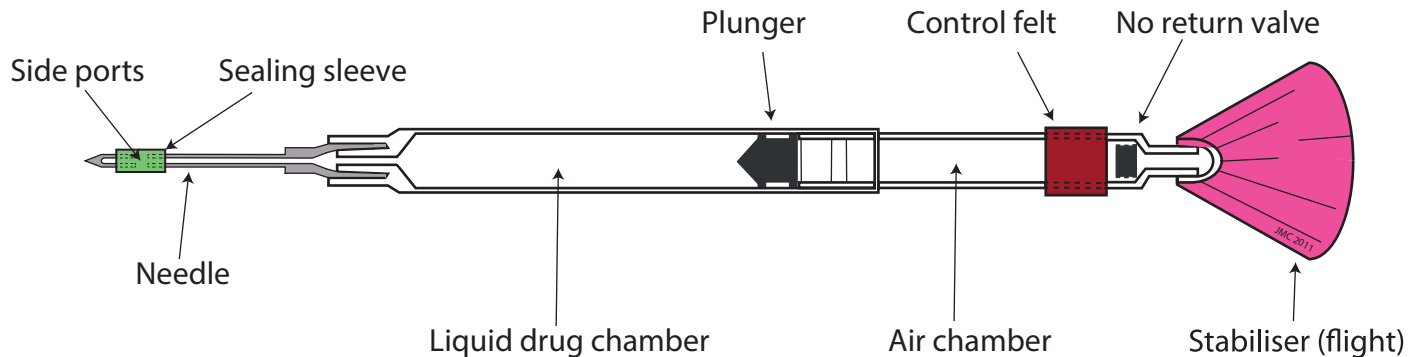
Firearms (Amendment) Act 1997: Section 8: Weapons and ammunition used for treating animals.

8. The authority of the Secretary of State [F1 or the Scottish Ministers (by virtue of provision made under section 63 of the Scotland Act 1998)] is not required by virtue of subsection (1)(aba), (b) or (c) of section 5 of the 1968 Act for a person to have in his possession, or to purchase or acquire, or to sell or transfer, any firearm, weapon or ammunition designed or adapted for the purpose of tranquillising or otherwise treating any animal, if he is authorised by a firearm certificate to possess, or to purchase or acquire, the firearm, weapon or ammunition subject to a condition restricting its use to use in connection with the treatment of animals.

Drugs legislation

Veterinary anaesthetics can only be given by a veterinarian or by a veterinary nurse under the direction of a veterinarian. In addition some of the anaesthetic agents used in zoo and wildlife medicine are covered by specific legislation. Some of the agents are covered by The Misuse of Drugs Regulations 2001 (and it's subsequent ammendments), these are referred to as controlled drugs e.g. etorphine, methadone, cinchocaine (somulose) and midazolam. Others are covered by import regulations under Special Treatment Certificates (STC), these include ketamine 200mg/ml (1g powder), medetomidine (40mg/ml), and tiletamine/zolazepam (zoletil). Some are both e.g. etorphine (M99). All must be recorded every time they are used and it is imperative operators are aware of their obligations in the use of these drugs.

Remote chemical immobilisation: Dan-inject dart anatomy

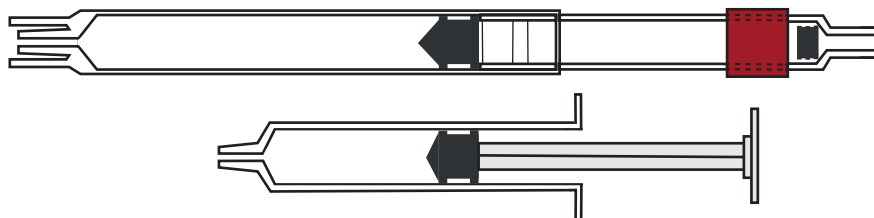


The Dan-inject dart consists of three main components, each requiring specific care and attention to ensure that a successful darting is achieved. Each component influences either the delivery of the dart to the target or the delivery of the pharmaceutical agent once the dart has reached the target.

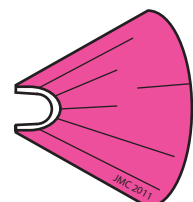
The first component is the **needle**, which for the Dan-inject has side ports for the expulsion of drug rather than an end port seen on more traditional syringe needle types, and the sealing sleeve which acts to cover the side ports allowing pressurisation of the drug chamber and expulsion of the drug contained within the dart after the dart has reached its target.



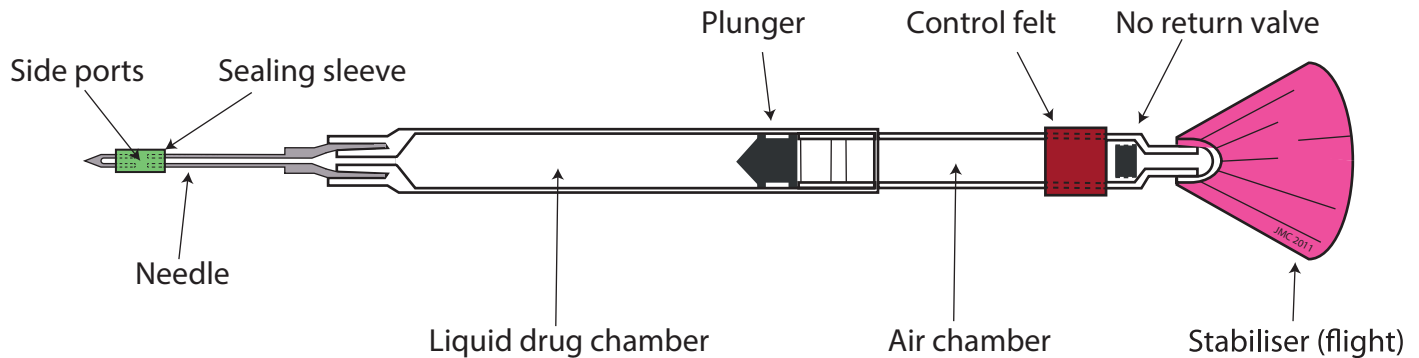
The second is the **dart** itself. The dart consists of a single unit that should not be dismantled and is designed to be recycled. With due care and attention the life span of a dart can be considerable, however any damage or failure of the unit should result in the dart being disposed of in a suitable fashion. The dart has a front liquid dart chamber which contains the drug to be delivered, this is separated from the rear air chamber by the syringe plunger. The air chamber, once pressurised, acts in a similar fashion to an operators thumb depressing a syringe plunger in a typical syringe (see below for comparison).



The final section is the stabiliser, also known as a **flight**. The flight plays an important role in ensuring the dart is accurate and reaches the target successfully. Flights should not be stored loose in the dart box but should be maintained in a compressed state similar to newly purchased ones using the dart sleeves provided by the manufacturer (see page 25).

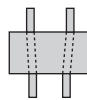


Remote chemical immobilisation: Dan-inject dart anatomy



Other essential pieces of equipment related to the dart include;

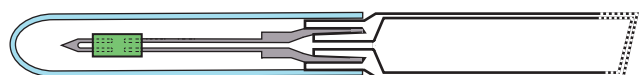
- **Dan-inject coupling adaptor:** this is an adaptor that fits both the air chamber, the liquid drug chamber and a normal leuer taper fitting found on most syringes. It is used principally in the pressurisation of the darts but also in cleaning. It is useful to have spare coupling adaptors as if lost then it is impossible to pressurise darts.



- **Deventing pin:** this is a 4-5 cm piece of wire that can be inserted into the air chamber, pushing the no return valve out of the way, resulting in the dart being depressurised. They are used prior to removing a dart from an animal if it is still pressurised or if a darting procedure is aborted or a dart is loaded but not fired. Commercial deventing pins are available but any stiff piece of wire will suffice.



- **Dart sleeves, dart cover or protection cap:** this is a transparent cover that is used to cover the needle on the dart at the time of pressurising or for transport of assembled darts. The primary role is to prevent either needle stick injury or accidental nebulisation of pharmaceutical agents into the operators face when pressurising the dart. Note: if needles have not been adequately secured then the needle cover will not protect from injury if the needle is forced off at the time of pressurisation. They are available as either 11mm or 13mm sleeves and the appropriate size should be used for the corresponding dart width (13mm = 5ml and 10ml darts).

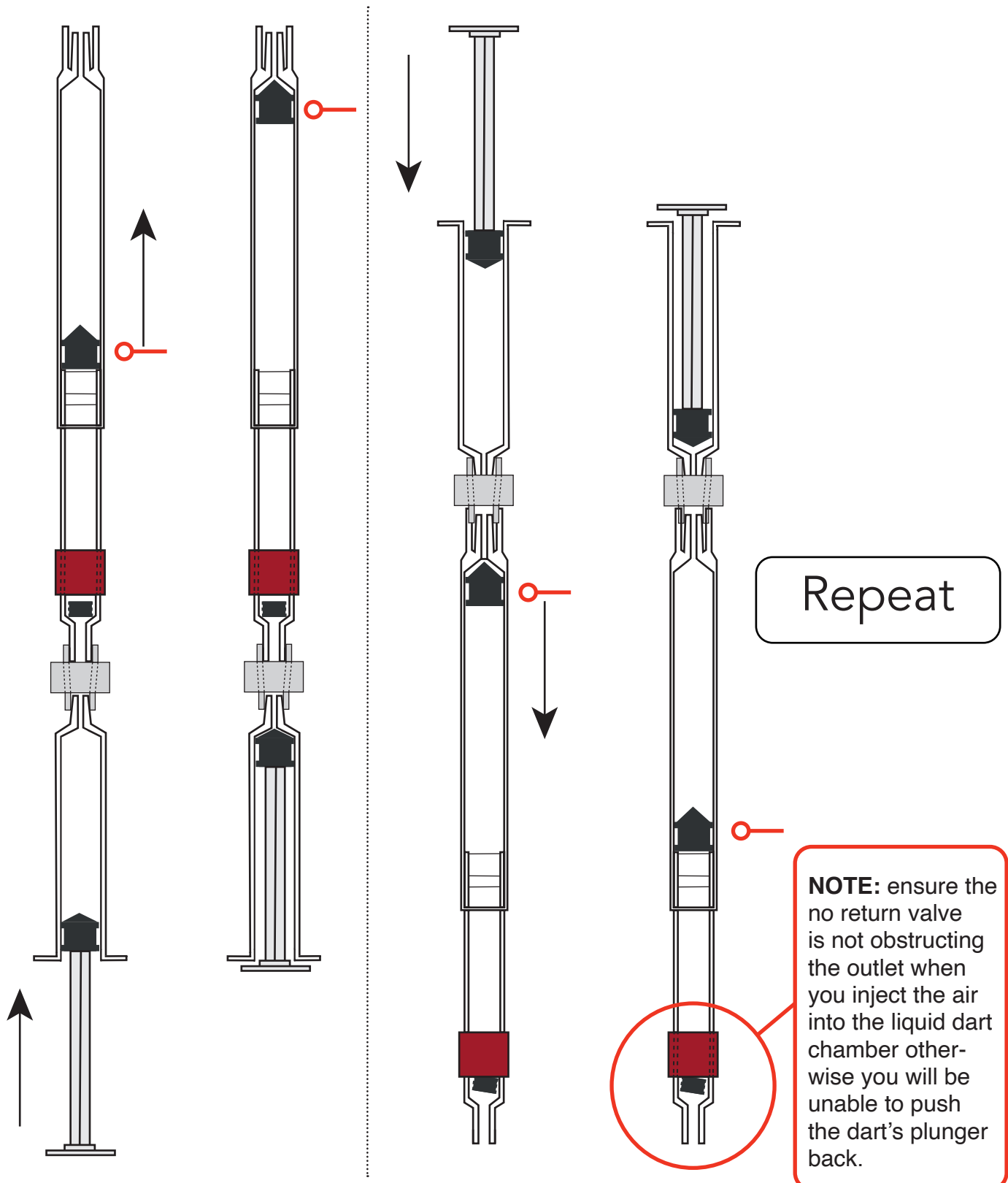


- **Pliers:** A set of pliers or a multipurpose tool is required to apply or remove the needle to or from the dart during the process of assembling or dismantling the dart respectively.

Dan-inject dart assembly: Check plunger moves



When assembling either a brand new or recycled Dan-inject dart it is imperative that the operator checks that the plunger is moving freely. Failure of the plunger is the second most common failure during darting following actually missing the target. Simply pressurise the air chamber (or liquid drug chamber to reset the plunger) and ensure the plunger moves, repeat until confident of the plunger's ability to move consistently.



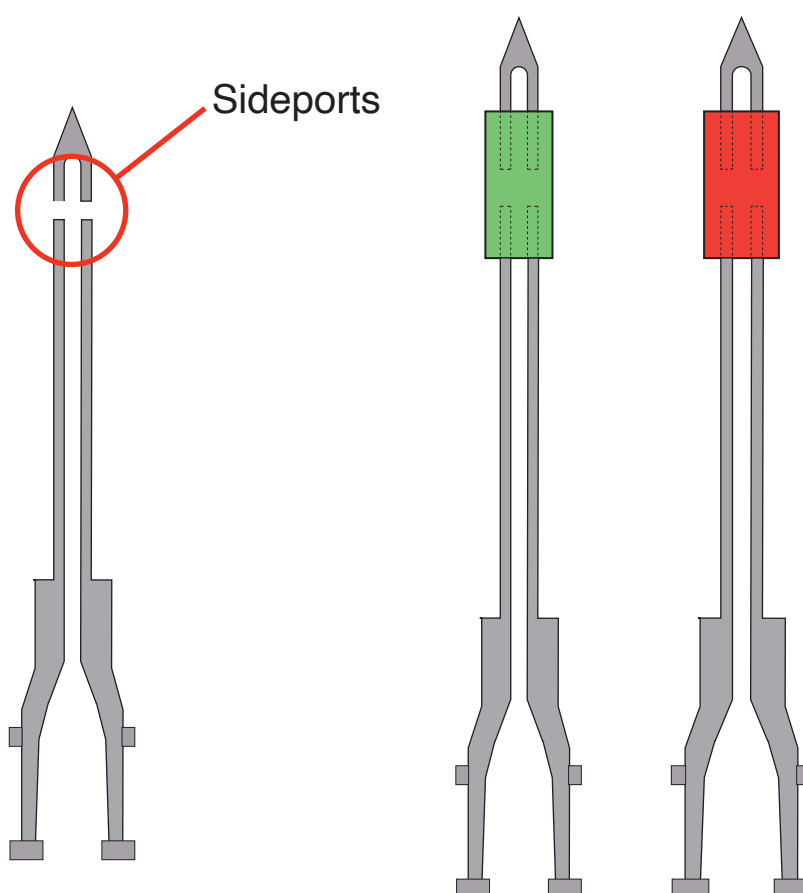
Dan-inject dart assembly: Place sleeve on needle



The needle sleeve covers the side ports and prevents premature drug release. On hitting the target the sleeve is pushed back by the skin, exposing the side ports and the drug is injected. Suitable needle choice and corresponding sleeve size is an important consideration.

Needle diameter

1.5mm 2.0mm
Green Red



Needle size:

1.5mm x 20mm

1.5mm x 25mm

1.5mm x 30mm

1.5mm x 38mm

2.0mm x 30mm

2.0mm x 40mm

2.0mm x 60mm

2.0mm x 100mm

2.2mm x 60mm

Species of animals:

Very small animals and for medication e.g. vaccination.

Fallow and red deer calves, roe deer adults, lynx, canids, ostrich, baboons and monkeys.

Fallow and red deer adults, equids, large felids, warthog, medium sized antelope and zoo species with minimal fat layers.

Large zoo species with fat layer

Large felids, red deer, bovid, small ursids and antelope.

Large bovids, bear, giraffe and large antelope.

Large ursids (inc polar bears), elephants, rhinoceros, and large giraffe.

Walrus, elephants, hippopotamus and large cetacea.

Hippopotamus and rhinoceros.

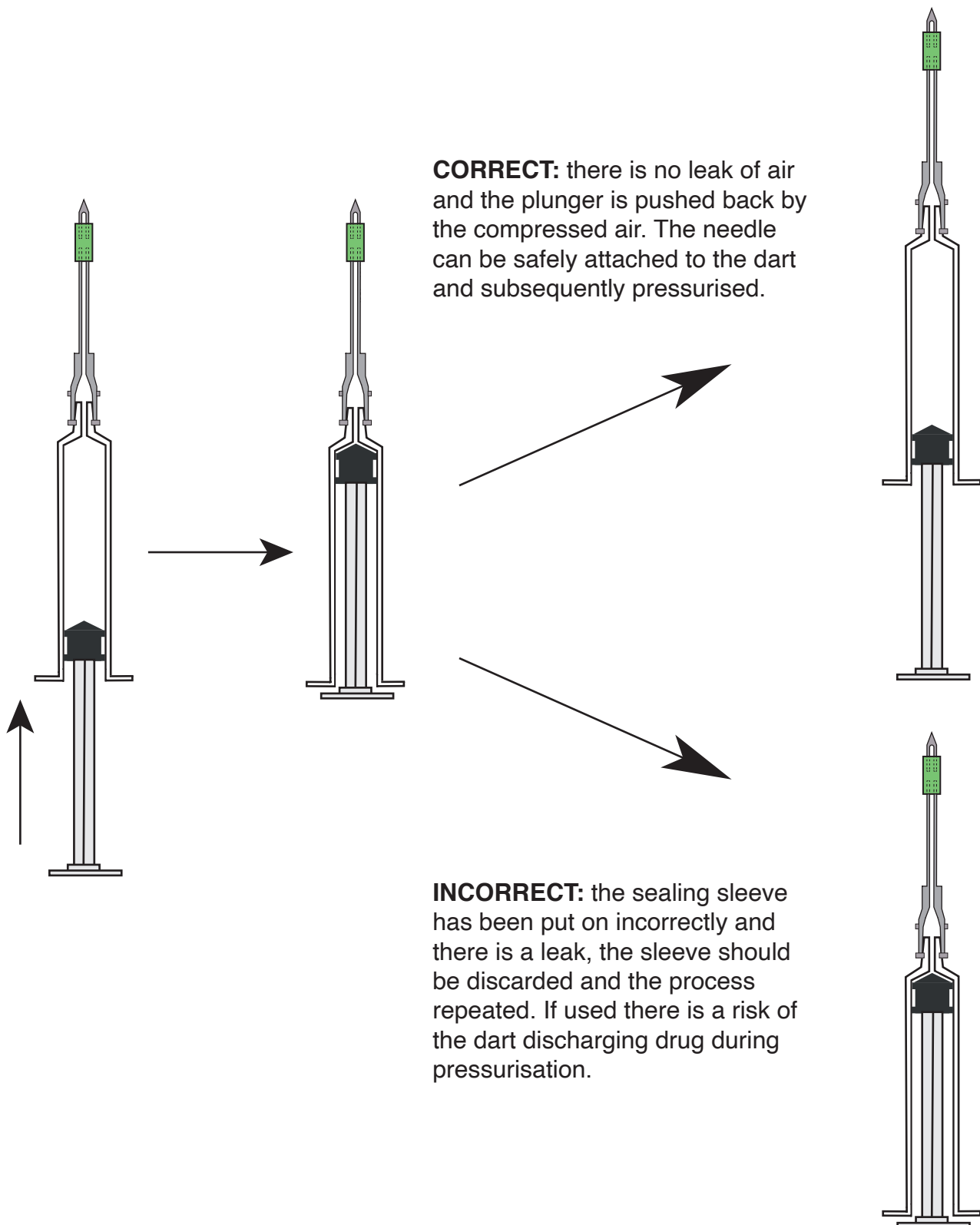


Note: these are the manufacturer's guidelines and needle selection should be based on the operator's personal choice and experience

Dan-inject dart assembly: Assess sufficient seal on needle



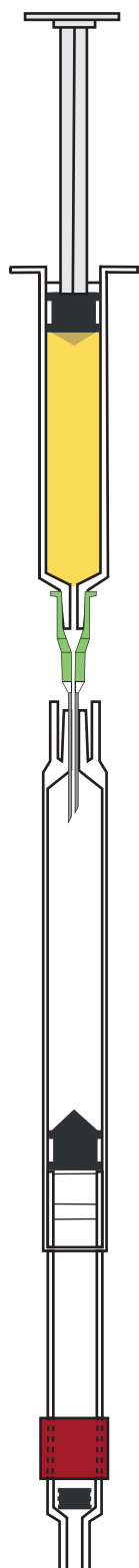
Once the sleeve is suitably fitted, covering the side ports, it is important to assess whether the side ports are truly sealed. On rare occasions the needle can be pushed through the edge of the needle sleeve creating a second hole but not obstructing the side ports. Simply inject air into the needle and the plunger should be pushed back if the holes are sealed. If not then throw away the sleeve and start again.



Dan-inject dart assembly: Inject drug into liquid drug chamber



A long green needle (21G 1.5inch) typically is used to inject liquid agents into the liquid drug chamber of the dart. It is important that a small gap is left between the injection port of the dart and the coloured part of the needle: if the needle is pressed against the dart it is possible for the pressure to increase in the liquid drug chamber and the drug to be ejected out of the dart, although this is uncommon. Drug should be injected slowly, if too quickly bubbles can form and again drug is expelled through the injection port.



INCORRECT



Note gap between needle hub and the injection port of the dart

CORRECT



Dan-inject dart assembly: Top up liquid drug chamber if required



The dart is projected to a target based on selecting a correct pressure for a set distance and a set weight of dart. To ensure that a dart is of a consistent weight it is important that it is fired only when the liquid dart chamber is full. An incompletely filled dart not only has a variable weight but if not full the liquid can move within the drug chamber during firing and alter the trajectory of the dart. It is preferred to use darts of the smallest size for the volume required, if this however means that the dart is not full then the difference should be made up with sterile water for injection.

A dart must only be fired when the liquid dart chamber is full: water for injection can be used to fill any space deficits that may occur

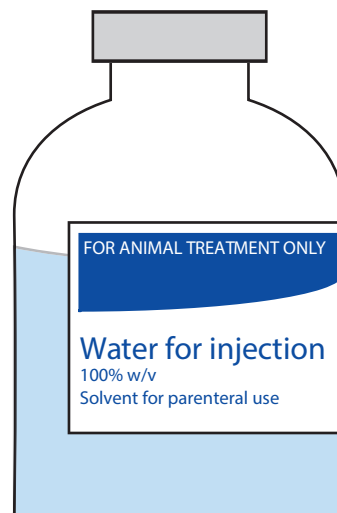


Full dart

or



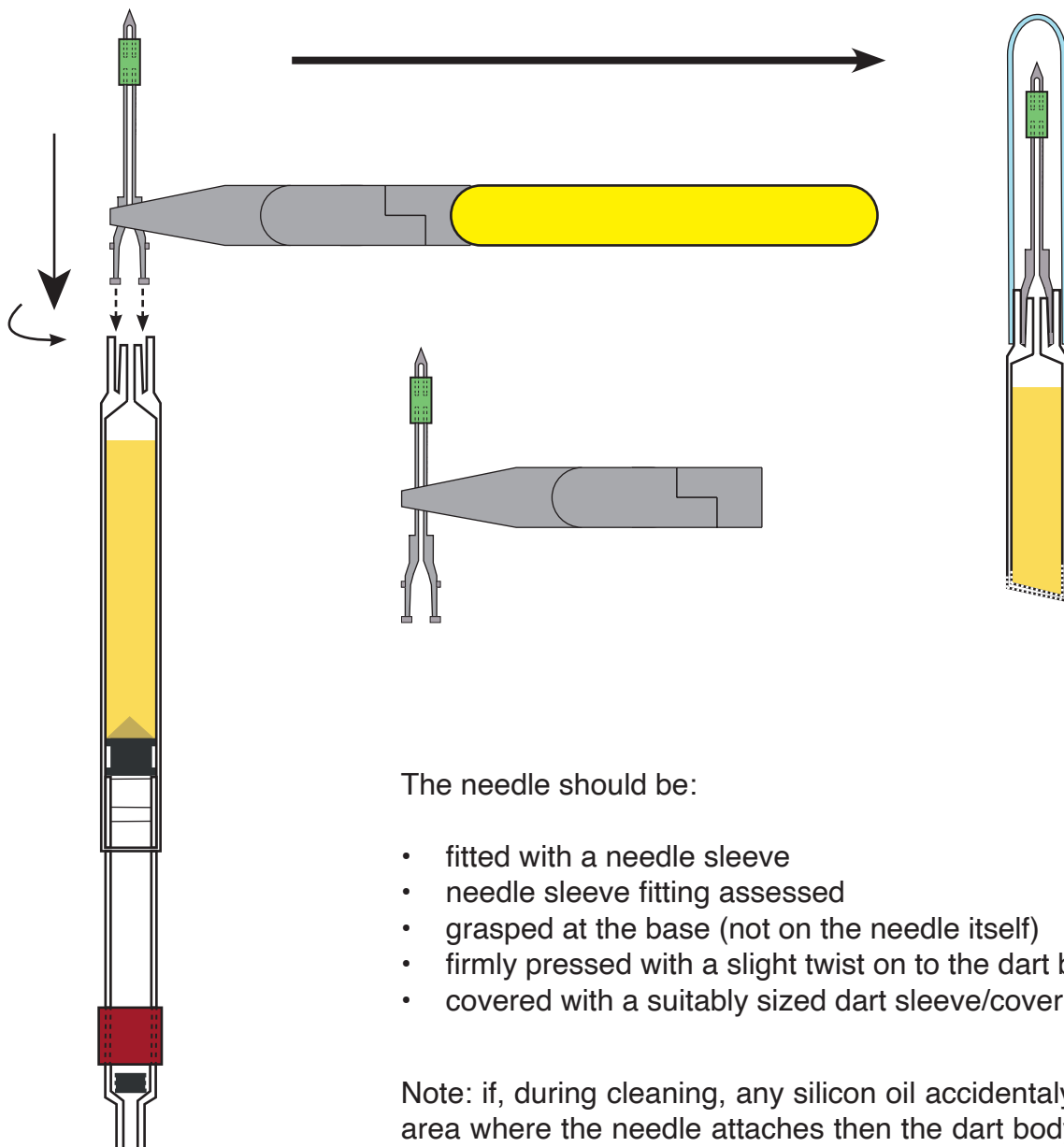
Partially filled dart topped up with water for injection



Dan-inject dart assembly: Attach needle to dart body



The needle, once the sleeve has been fitted and assessed (see page 7-8), can then be attached to the body of the dart. In the Dan-inject system the needle is designed to be held on by friction (similar to the leur taper system) and there are no leur lock systems. Needles should be grasped at the base and not on the needle itself using a pair of pliers or similar. This is then pressed firmly on to the dart body as shown. It is important not to excessively twist the needle as it is placed onto the dart body housing: to do so will damage the plastic and ultimately will result in the friction grip becoming loose and the needle potentially coming off at pressurisation (although this is rare). Once the needle is fitted a suitable dart sleeve should be placed over the needle and attached to the dart body: this prevents accidental needle stick injury, accidental knocking of the needle sleeve from the ports and reduces the risk of accidental aerosolisation of drug agent at pressurisation.

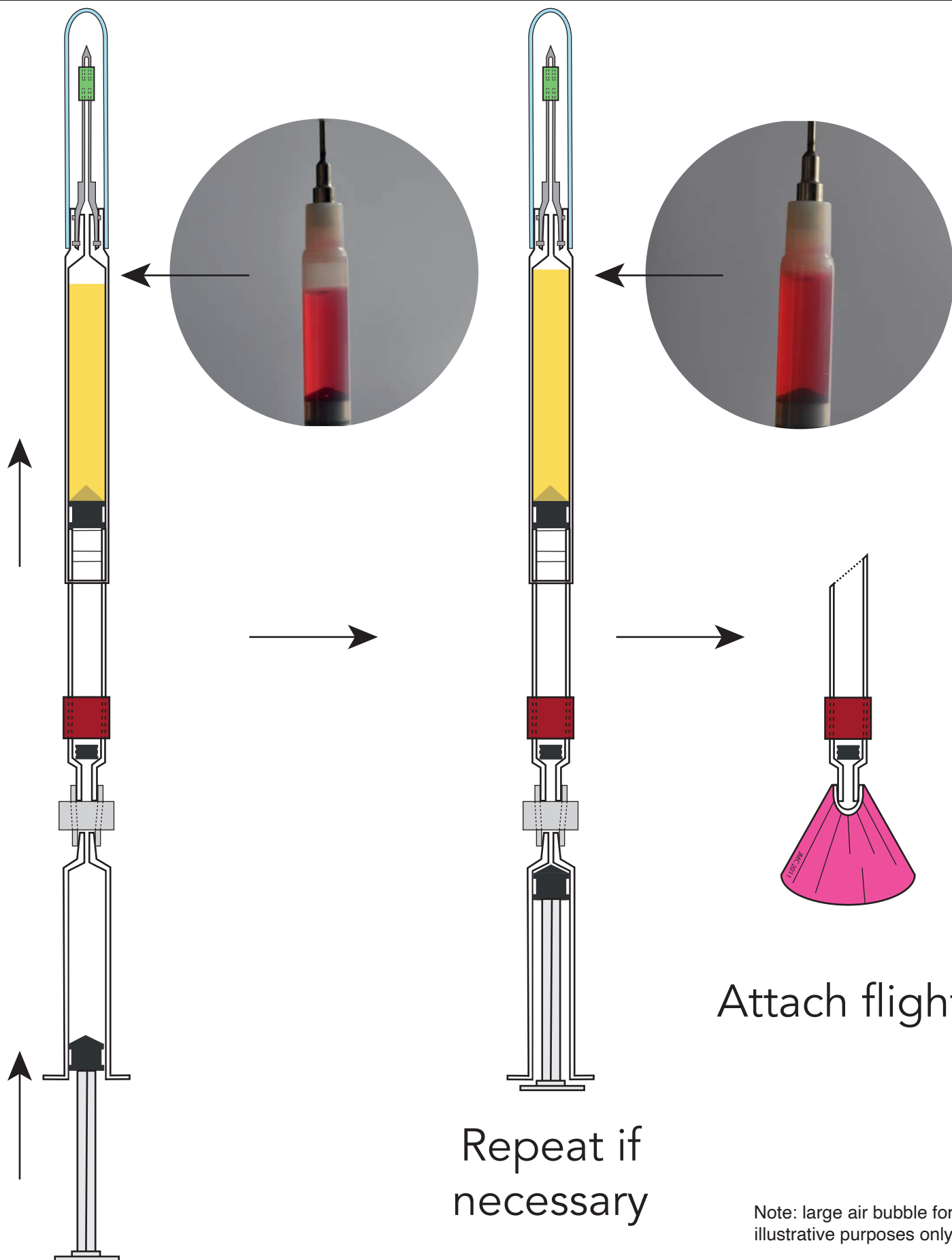


The needle should be:

- fitted with a needle sleeve
- needle sleeve fitting assessed
- grasped at the base (not on the needle itself)
- firmly pressed with a slight twist on to the dart body
- covered with a suitably sized dart sleeve/cover

Note: if, during cleaning, any silicon oil accidentally enters the area where the needle attaches then the dart body should be discarded.

Dan-inject dart assembly: Pressurise dart air chamber



Dan-inject dart assembly: Pressurise dart chamber



Now the dart has been suitably assembled the dart must now be pressurised to ensure that when it hits its target the contents of the liquid drug chamber are fully discharged. Ensuring the correct volume of air is injected into the air chamber ensures discharge of the plunger (assuming all the previous steps have been followed). To pressurise a dart the Dan-inject coupling adaptor must be attached to the air chamber (the flight must be removed to access this) and a suitably sized standard syringe is used to inject the appropriate volume of air. It is important that the dart body is held vertically with the needle pointing upwards (or slightly away from the operator) to ensure that the no return valve has dropped down to obstruct the air outlet at the time of pressurisation. Often a popping noise is made when the syringe is disconnected once a suitable pressure has been reached. The deventing pin can be used to gently press the no return valve to feel the pressure within the air chamber or alternatively a small volume of air can be left within the liquid drug chamber: once pressurised the plunger will move slightly compressing the air bubble. Not only does this verify adequate pressurisation but it also allows a visual back up in knowing whether a dart is pressurised or not.

Darts should only be pressurised immediately prior to placing the dart into the rifle or similar device. Even with tight seals within the air chamber slow leaks can occur and if any delay occurs depressurise the dart and re-pressurise it to ensure correct delivery.

Overpressurisation can occur, especially in older recycled darts, therefore more is not better. If overpressurised the dart can split or the needle can come off. These are rare events and only occur if darts are excessively recycled: old darts where any concern exists should not be re-used, they should be disposed of in an appropriate fashion.

As there is always a small risk of aerosolisation of drug agents pressurisation should occur away from observers in a well ventilated area with the side ports facing laterally to the operator. This risk is small but taking these steps reduces the risk further.

Air chamber - air pressures

1.5ml dart	10-12ml air
3.0ml dart	12-14ml air
5.0ml dart	15-20ml air
10.0ml dart	20-30ml air

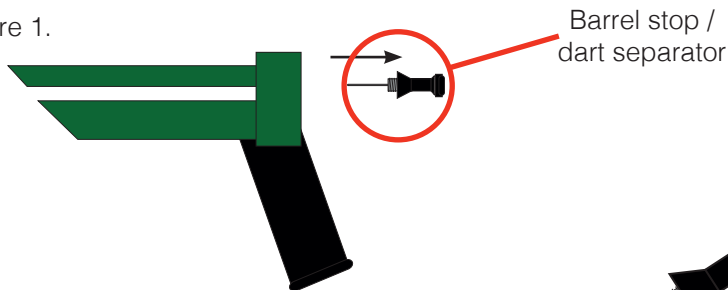
Manufacturer's recommended air pressure volumes for loading Dan-inject rifle and pistol darts

Dan-inject: Insert dart into rifle



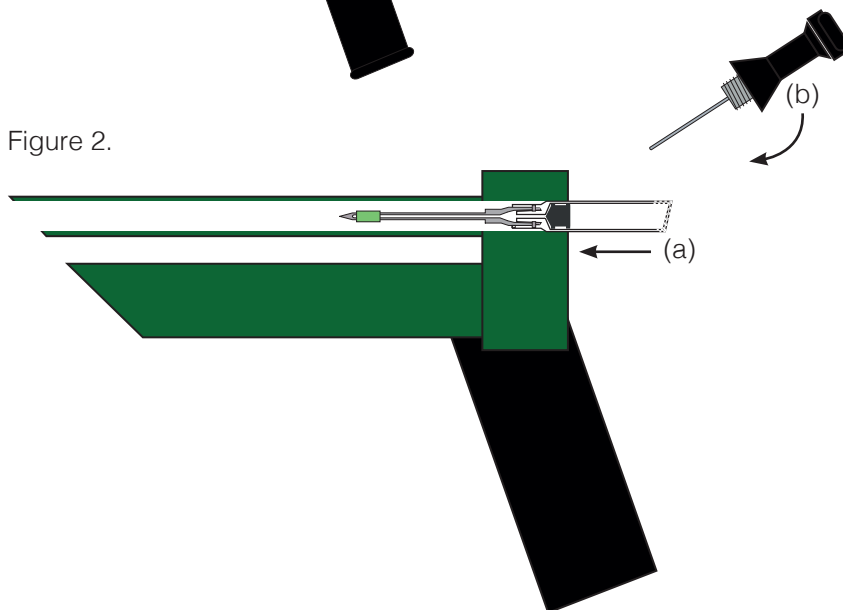
Inserting the dart into the Dan-inject JMSP rifle is relatively straight forward. Simply unscrew the rear barrel stop/dart separator (figure 1): this allows access to the barrel. Place the dart into the barrel making sure that the needle sleeve does not brush against the edge of the barrel (otherwise the dart will discharge). Once the body of the dart is in the barrel it can be pushed forward without risk of discharge (figure 2). The dart separator pushes the dart forward into the barrel so that the flight does not become trapped in the threads when replacing the barrel stop but also so that it is pushed cranial to the compressed gas outlet (figure 3). When screwing the barrel stop/dart separator back into place it is prudent to rotate the barrel stop 180° anticlockwise (left) to allow the screw fitting to seat properly then rotate clockwise (right) to seal the barrel. Note: this should be finger tight, not excessive otherwise the threads can be damaged. If a leak occurs check or replace the barrel stop

Figure 1.



The barrel stop/ dart separator must be unscrewed anticlockwise (left) to allow access to the barrel.

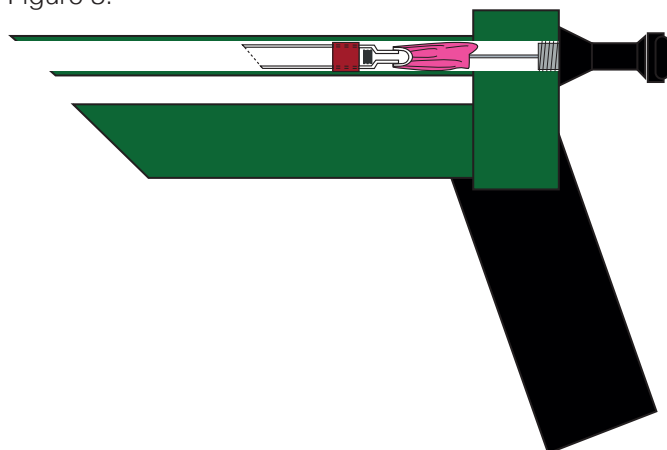
Figure 2.



The dart must be placed into the barrel ensuring that the needle sleeve does not become dislodged. Once the dart body is in the barrel this is no longer a risk.

The dart must be pushed in as far as possible.

Figure 3.



The dart separator pushes the dart into the correct position and prevents the flight from becoming trapped in the threads.

When sealing the barrel always turn the barrel stop/ dart separator one half turn anticlockwise (left) to allow it to seat properly in the threads. Then seal with finger tight pressure by turning clockwise (right).

ALUMINIUM AND BRASS BARREL

Dan-inject: Pressure for rifle



The most common reason for failure to hit the target is selecting the incorrect pressure for the distance

Obtaining an accurate distance to target is essential (see page 16). Once an accurate distance has been confirmed then the correct pressure should be selected using the CO₂ adjuster, which can then be read from the pressure dial. If the rifle has been suitably sighted then the pressures for each dart size below will deliver the dart to the target for that set distance. This information is often found on stickers attached to the side of the barrel.



Lateral view of the Dan-inject JMSP showing the location of the CO₂ adjuster. Note the rifle is labelled as to the distances the two scopes are set at.



The pressure dial is located adjacent to the CO₂ adjuster, just above the trigger. Note this is the 16 bar model.



The pressure dial as viewed by the operator, with the telescopic sight above and the laser to the left hand side.

1.5ml dart

Distance	Pressure
5 metres	2 bars
10 metres	3 bars
15 metres	5 bars
20 metres	6 bars
25 metres	7 bars
30 metres	9 bars
40 metres	12 bars

**5ml dart aim inch higher
and use 1.5ml pressures**

3.0ml dart

Distance	Pressure
5 metres	2-3 bars
10 metres	3-4 bars
15 metres	5 bars
20 metres	7 bars
25 metres	8 bars
30 metres	10 bars
40 metres	14 bars

**10ml dart aim inch higher
and use the 3.0ml pressures**

These are the manufacturer’s generic pressures and are suitable but should be verified with the operator’s own rifle

Range finder use



The most common reason for failure to hit the target is selecting the incorrect pressure for the distance

Incorrect pressure selection is the most common reason for failing to hit the target assuming a dart is appropriately assembled and that the sights are accurately sighted. Pressure is selected based on the known size of a filled dart (approximately consistent weight if completely filled) and the distance from the rifle to the target (the variable). The use of a range finder provides an accurate distance to target and therefore allows accurate pressure selection and subsequent dart placement. The range finder is an essential and cost effective tool.



For extremely experienced darting operators accurate distance assesment can be acheived, however the use of a range finder removes the variable element from the darting procedure and ensures success at each darting, expert or novice.



The range finder uses a laser that is aimed at the target animal using a cross hair. Depressing the button on the top of the range finder calculates the distance from the operator to the sighted target.



The target distance is provided at the bottom of the screen. Using the pressure tables the correct pressure can now be selected on the rifle / pistol.

Note: it is often useful to have a spotter that provides updates on the distance to target rather than the darter moving from range finder to rifle, although this is not always possible or appropriate.

Darting considerations: Target sites



There are multiple considerations to the art of darting which are beyond the scope of this manual

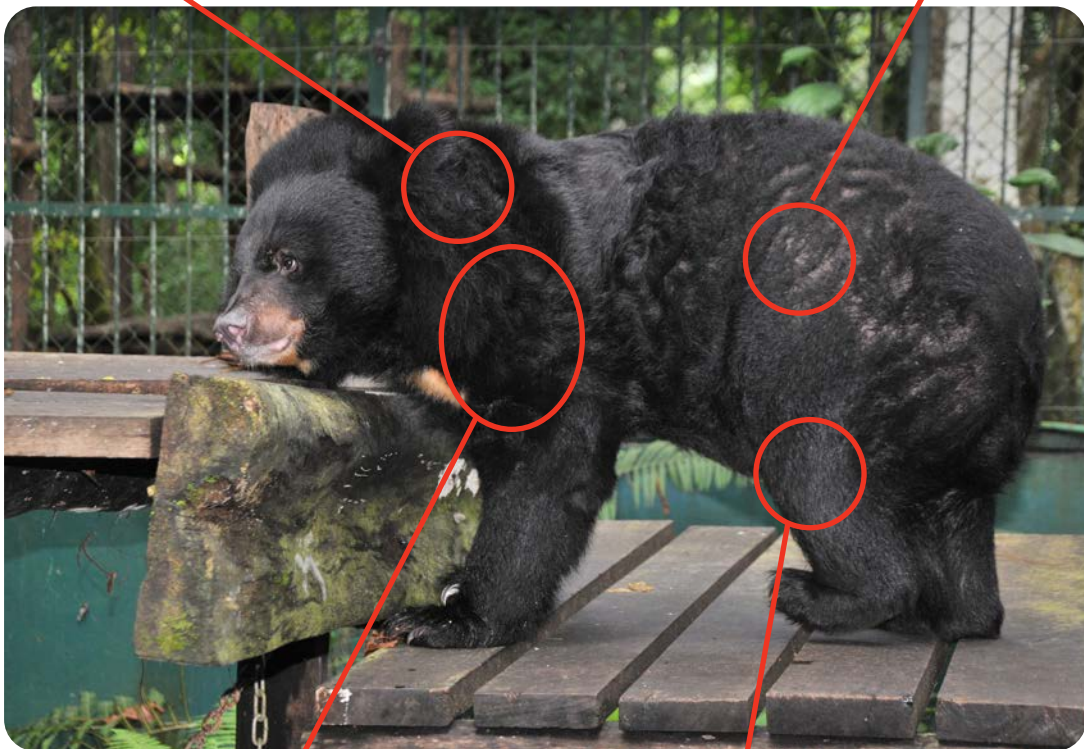
Recommended reading includes:

- Kock, M.D., and Burroughs, R. (2013) Chemical and Physical Restraint of Wild Animals, IWVS (Africa)
- Kreeger, T.J., and Arnemo, J.M. (2007) Handbook of Wildlife Chemical Immobilization (3rd Ed), Sunquest*
- Nielsen, L. (1999) Chemical immobilization of Wild and Exotic Animals, Iowa State University Press
- McKenzie, A.A. (1993) The Capture and Care Manual, WDSS
- Harthoorn, A.M. (1976) The Chemical Capture of Animals, Bailliere Tindall

*Note: Kreeger (2007) available from Wildpharm - please contact us for further information

Neck: in large animals such as rhino or deer this is possible: beware of cervical vertebrae and other structures ventrally such as the jugular vein and oesophagus

Proximal hind limb, proximal to the stifle is a popular site: beware of the femur



Proximal forelimb: not common place to dart due to superficial nature of the scapula and risk of fracture or penetrating the thorax

Distal limb only in well fattened animals where other sites not suitable e.g. bears and hippo: beware long bones and intraosseus injection

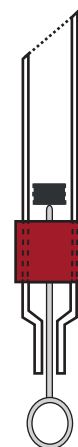
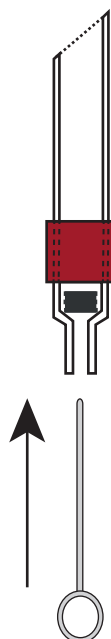
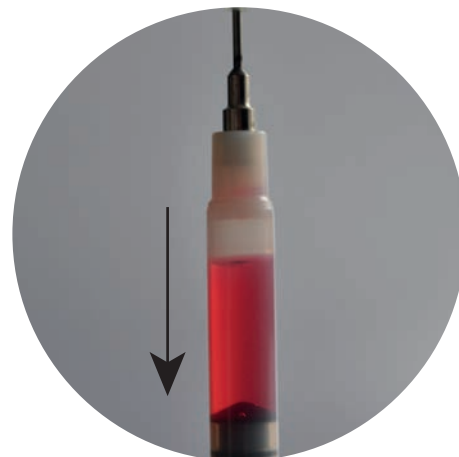
Dan-inject: Depressurise dart



To depressurise a dart simply take the deventing pin, remove the flight (if not already done so) and push the no return valve away from the opening, the air will be released and the dart is now depressurised with no risk of discharging it's contents. If a small bubble is contained within the liquid drug chamber then this will enlarge as the dart is depressurised (see below).

Reasons to depressurise a dart include:

- Aborted procedure and no need for dart: depressurise to remove dart contents
- Failure to identify individual or delayed darting: depressurise to then re-pressurise at a later time
- Dart in animal but still residual pressure within the dart: prevent discharge of any contents at time of removal
- During cleaning or storage as part of dart preparation



Note: large air bubble for illustrative purposes only

Air bubble compressed = pressurised

Air bubble present = depressurised

Dan-inject:

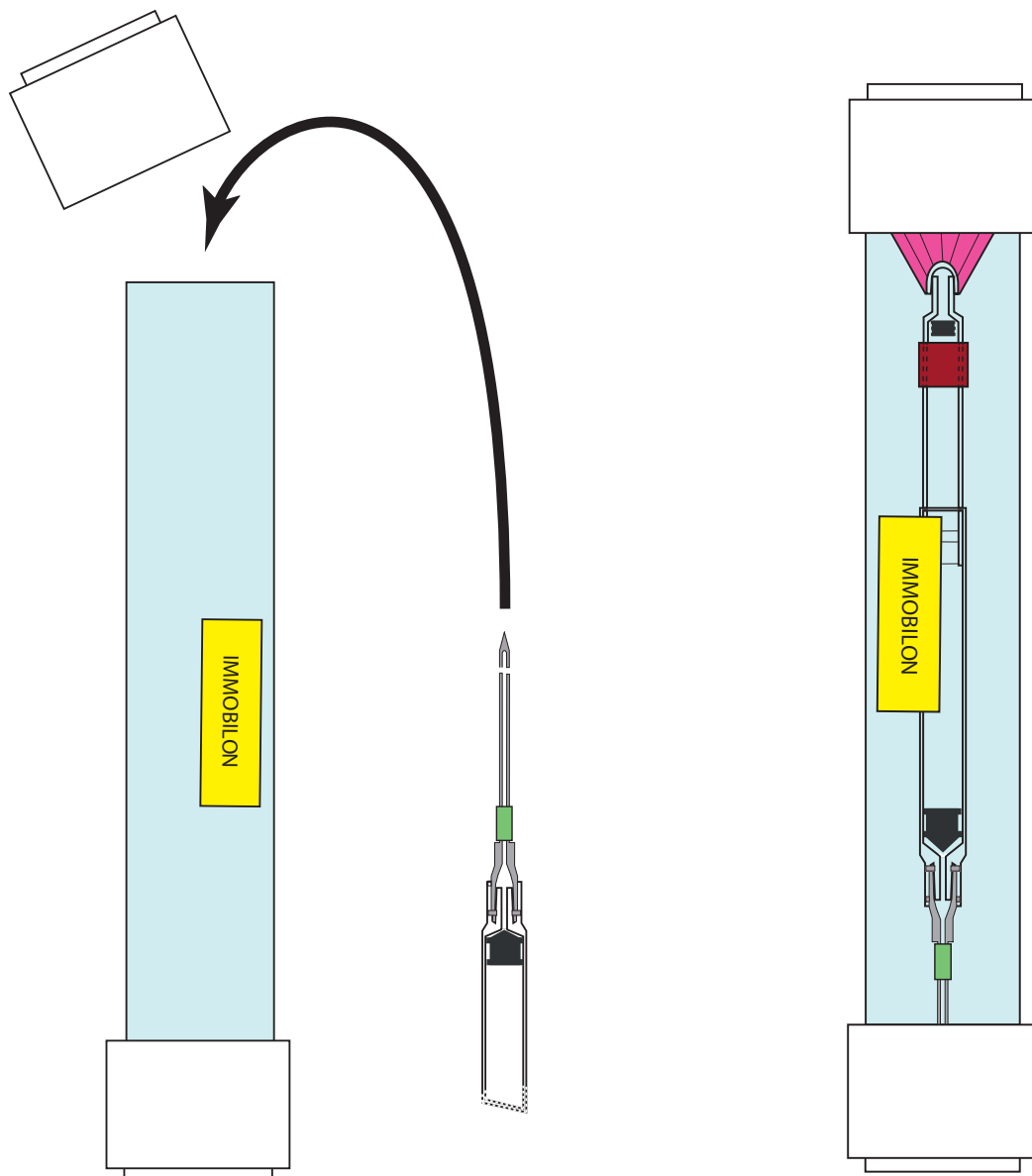
Removal from animal



Following induction and assessment that an animal is safe to approach it is important that the dart is removed and placed in a secure location where needle stick injury is not possible. Any container will do, this author uses a clear piece of aquarium pipe which is sealed at either end: the advantage being that the dart can be seen and any residue drug is visualised within the inert container.

To remove a dart:

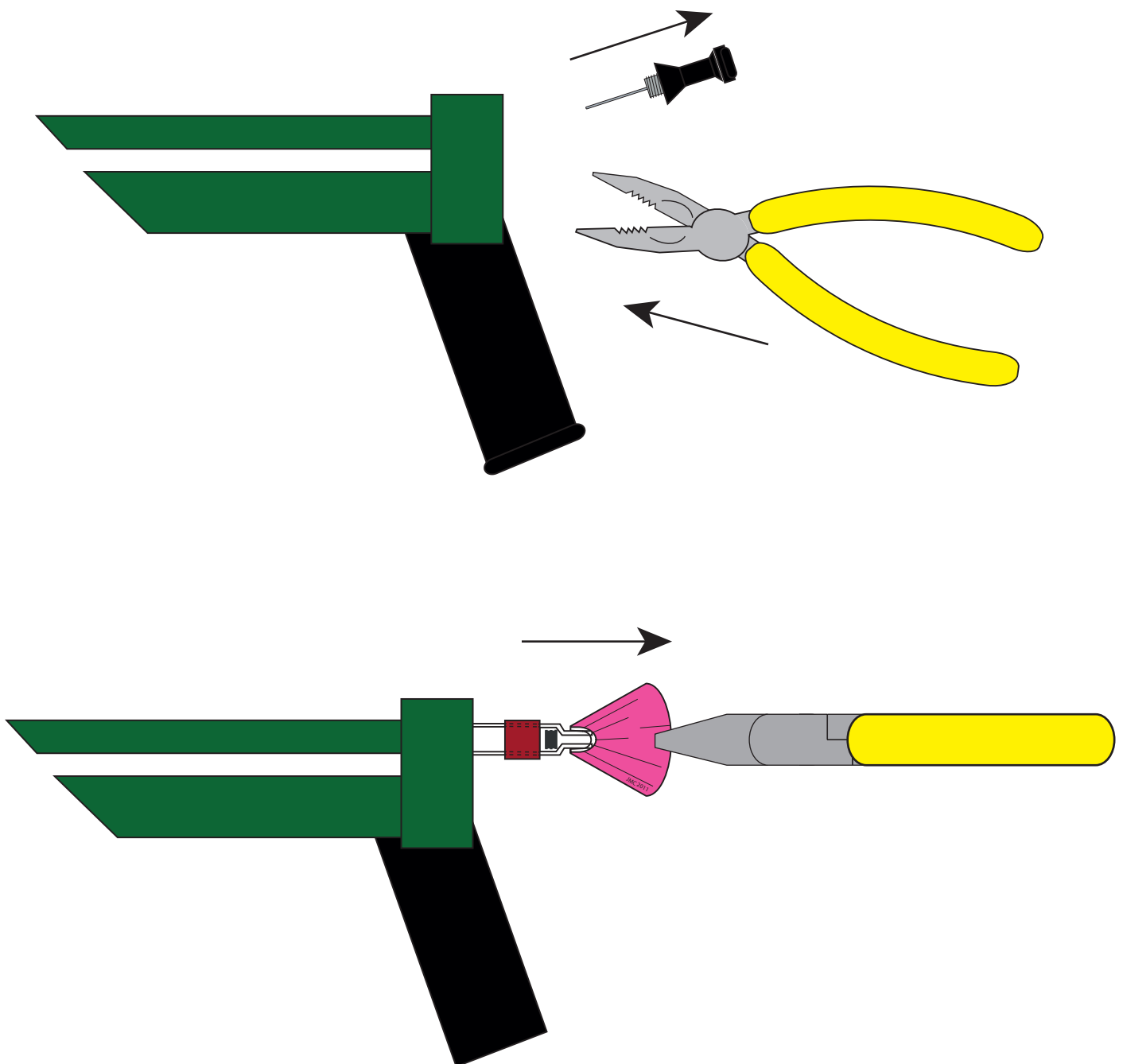
- Assess whether the no return valve is in place (pressurised) or moved (depressurised)
- Assess whether there is any drug remaining within the liquid drug chamber
- If required remove the flight and depressurise the dart
- Gently remove the dart (if collared or barbed this may require a small incision)
- Place the depressurised dart directly into the safety container
- If using potent opioids or similarly dangerous agents then it is worth marking the area where the dart was with a large animal livestock marker spray to ensure people do not touch the area



Dan-inject: Remove dart from rifle



Whatever the reason there maybe an occasion where a dart is loaded in the barrel yet a decision is made to abandon the darting at that time. To remove a loaded, pressurised dart from the barrel of the dan-inject rifle simply unscrew the barrel stop/ dart separator and careful grasp the flight using the pliers or multitool. Gently pull the dart out making sure that the needle sleeve does not catch against the side of the barrel. Then depressurise the dart immediately using the technique described on page 18. Place a dart sleeve over the dart or place the dart into a secure container to render it safe. Replace the barrel stop/ dart separator as described on page 13.



Dan-inject:

Empty dart if not used



If the operator requires to remove the drug from a loaded dart either for disposal or to reuse the agent the following steps should be followed. Drug should not be stored in a dart over night, preferably darts are made up at the time of use and if not used then the agents disposed of. This is especially so if combinations of anaesthetic agents are mixed together. Drug can be disposed of in denkit denaturing kits or in the medicines DOOP bin.

Option 1: Syringe evacuation of dart liquid drug chamber (mixed or single drugs)

- the dart is depressurised and made safe to handle (see page 18): ensure the no return valve moves when the dart is inverted
- the needle is removed and the dart held upside down with the liquid drug chamber pointing downwards at an angle of 45°
- a suitably sized syringe with a long green needle (21G 1.5inch) is inserted into the liquid dart chamber and the drug withdrawn in a similar fashion to taking drug from a bottle
- the dart is then submitted for cleaning

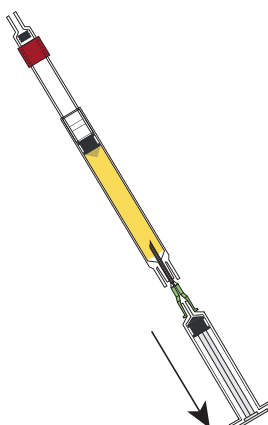
Option 2: Dart pressurised and discharged into a bottle (single drugs only)

- the dart is depressurised and made safe to handle (see page 18): note ensure the no return valve moves when the dart is inverted
- the dart is inverted and the needle sleeve pulled back exposing the side ports, the needle now inserted (still attached to the dart) into the original bottle of drug
- a second standard gauge needle is inserted into the rubber seal of the drug bottle (acts as a pressure release valve)
- the coupling adaptor is attached to the air chamber and air is injected in, pressurising the dart
- this results in the dart being discharged into the bottle
- the dart is then submitted for cleaning

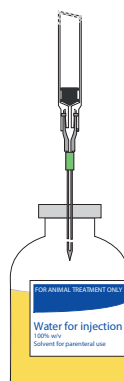
Option 3: Disposal of a depressurised dart with drugs still in

- in specific situations it maybe safer not to risk exposure to a drug and the whole dart is disposed of with the drug in e.g. etorphine filled darts
- DOOP bins should be used and darts must be clearly labelled as to their constituents if this is to be done

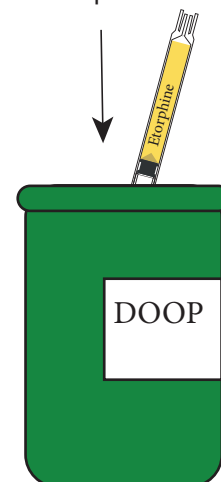
Option 1



Option 2



Option 3



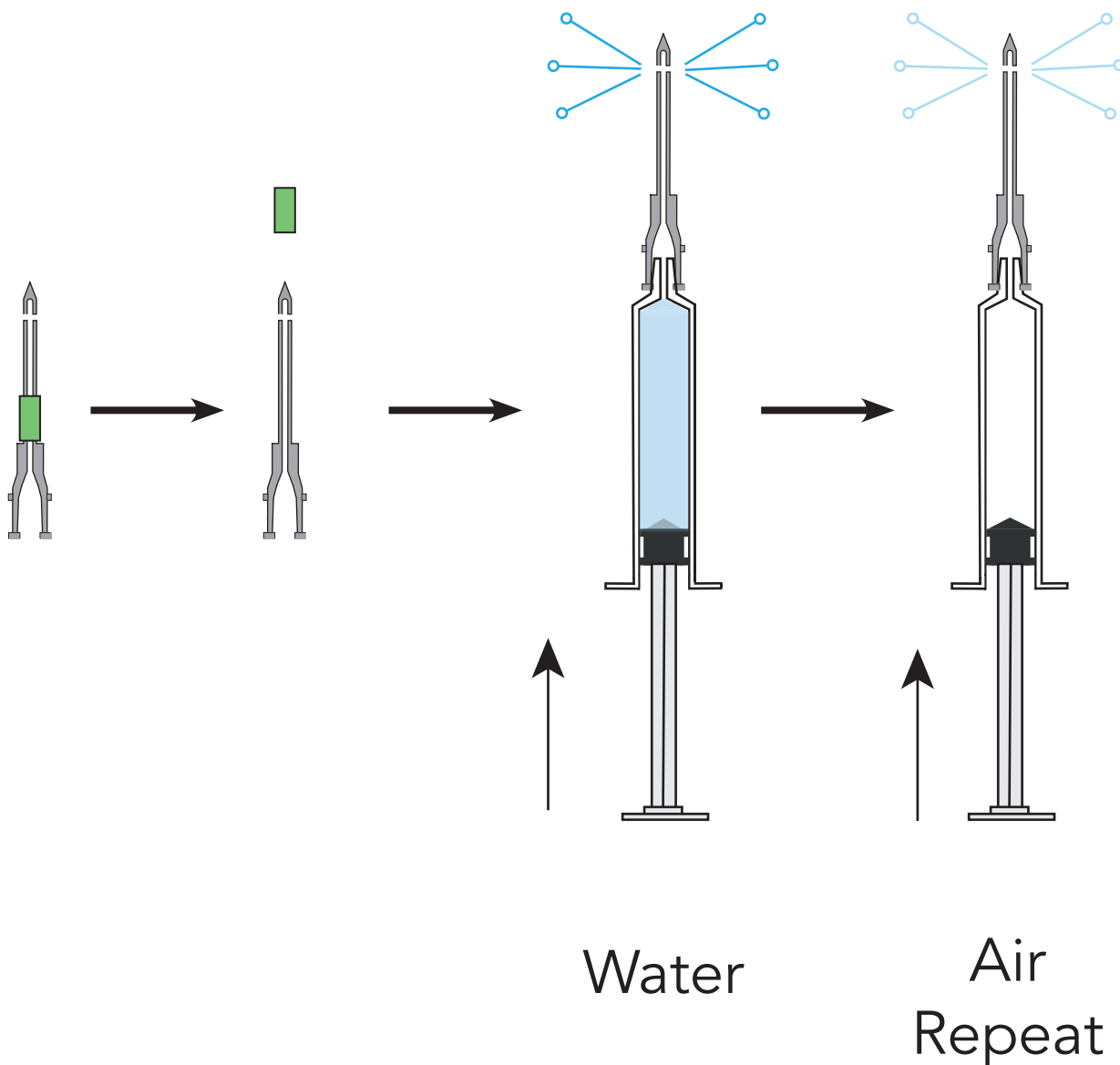
Dan-inject dart cleaning: Needle



Darts must be cleaned the same day of use to ensure adequate functionality

Following use the Dan-inject needle should be cleaned using the following procedure:

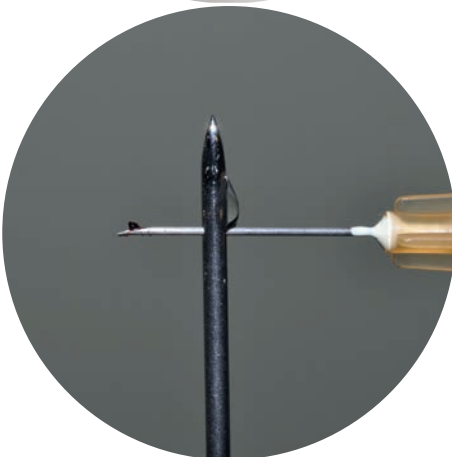
- remove the needle from the dart, reversing the process described on page 10
- remove the needle sleeve and any detritus on the needle: the needle can be scrubbed to remove any blood or tissues if present
- the needle then should be attached to a 20ml syringe full of warm water
- the water is then flushed through the syringe: note that the water will spray out through the side ports, these should be submerged in water to prevent inhalation of water and any residue drug (this can be done in a sink or a small container)
- Repeat as necessary
- Repeat the process with an air filled syringe
- Sterilise the needle either using wet sterilisation (e.g. milton tablets) or autoclave



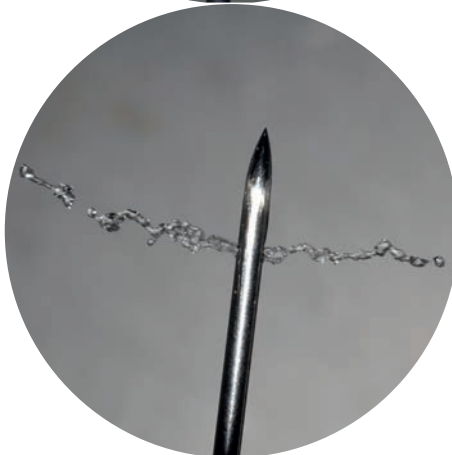
Dan-inject dart cleaning: Blocked needle



Occasionally when cleaning the needle the flushing liquid will only come out of one of the side ports: this means that one of the side ports is blocked: this is relatively common and is usually the result of tissue or dried blood blocking a hole.



An orange needle (25G) fits through the side ports easily and can be used to unblock the hole: note the small piece of material that caused the blockage in this case.



The needle can then be flushed and cleaned in the normal fashion as described on page 21. Note the flow is through both side ports now.

Needles can also be held up to the light and assessed: the operator should be able to see through both sides.



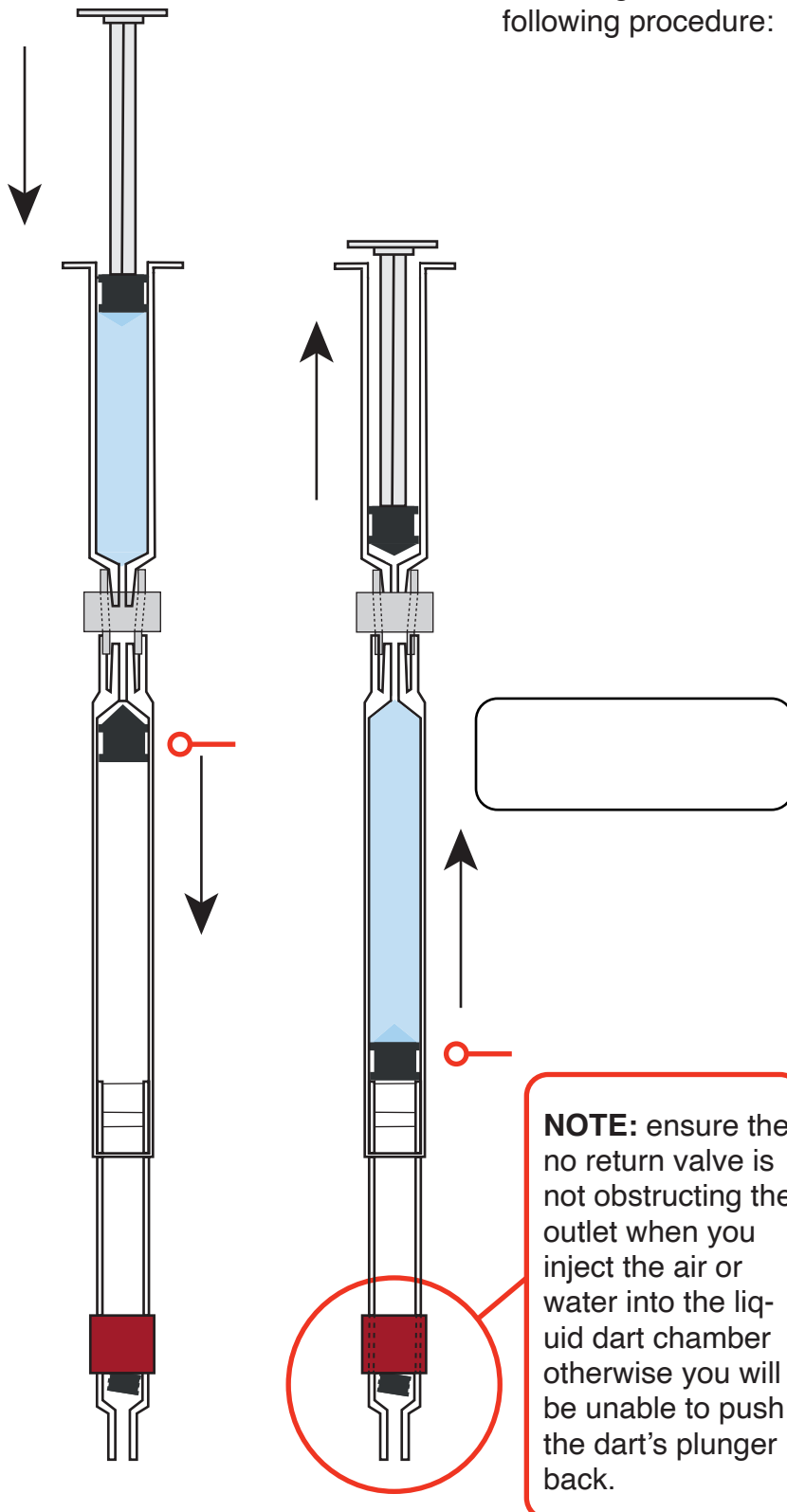
Very rarely a fault in manufacturing can occur with the side port not being punched out properly as seen here. Needles should be checked for patency every time the dart is assembled. If this occurs discard the needle and use a new one.

Dan-inject dart cleaning: Dart body



Darts must be cleaned the same day of use to ensure adequate functionality

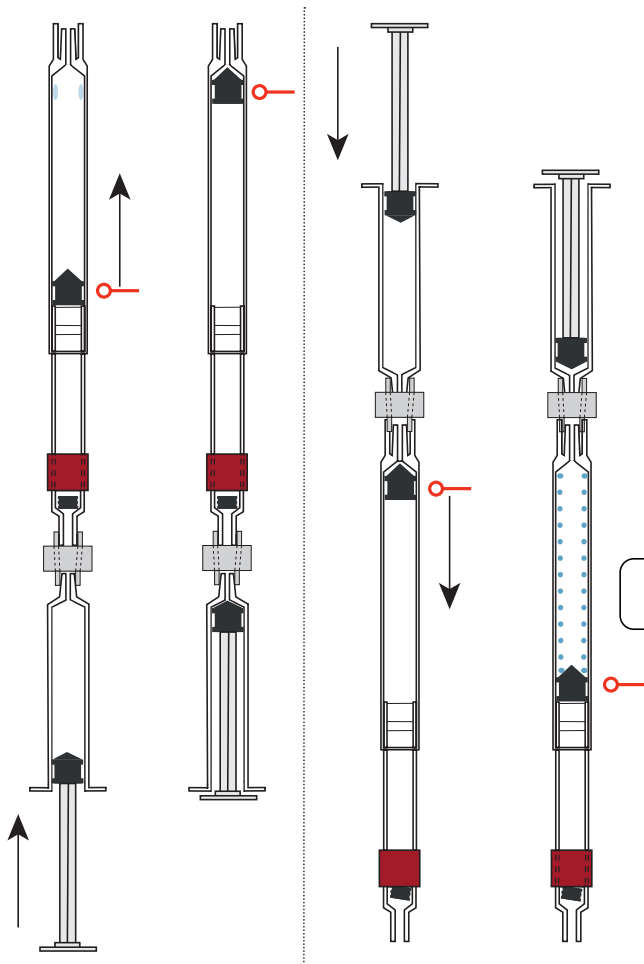
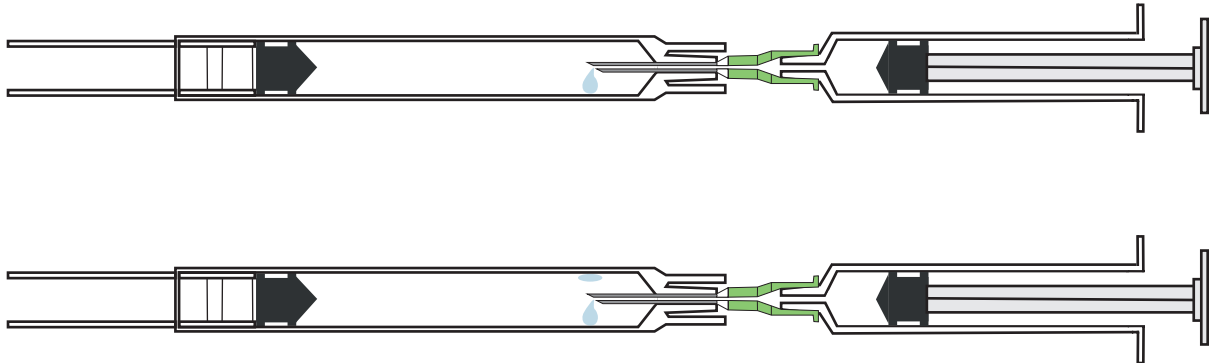
Following use the Dan-inject dart should be cleaned using the following procedure:



- ensure the dart is depressurised
- remove the flight and needle
- remove any residual drug as described on page 20
- invert the dart so that the no return valve drops away from the outlet or place the deventing pin in the outlet hole to the air chamber (this prevents repressurisation when liquid is injected into the liquid drug chamber)
- using the coupling adaptor a 20ml syringe filled with warm water should be attached to the liquid drug chamber inlet
- the water is flushed into the chamber and then sucked back out
- this is repeated as many times as felt appropriate depending on the drug used e.g. longer maybe required for thick or adherent drugs such as antibiotics
- water can be changed as needed
- once the liquid dart chamber is clean the chamber should be emptied (either suck the plunger to the discharged position or, using an air filled syringe pressurise the dart from the air chamber)
- the liquid dart chamber should then be filled with air with the plunger as far back as possible
- then move onto plunger maintenance (opposite, page 24)

If a dart is damaged, has deep bite marks or has failed to discharge then the dart should be discarded

Dan-inject dart cleaning: Plunger maintenance



- a long green needle (21G 1.5inch) is then used to add a single drop of silicon oil into the liquid drug chamber
- the dart is rotated 180° and a second drop of silicon oil is added (opposite the first drop)
- the plunger is then moved back and forth several times to spread the silicon oil around the whole of the liquid drug chamber: this is essential to minimise the plunger becoming stuck during discharge
- once complete the plunger should be left in the discharged position and the dart left pressurised: this prevents any residual water or drug drying within the lumen of the liquid drug chamber and presenting a possible obstruction to discharge when next used as well as preventing entry of any contaminants into the air chamber
- Note: it is important no silicon oil ends up in the needle housing gap: if it does the needle will not secure safely: discard the dart if unsure

**Darts should be stored with
the plunger in the discharged position and
the air chamber pressurised**

Dan-inject dart cleaning: Flight maintenance



Flights are the last, but often overlooked, part of the dart to consider during cleaning. Flights are there to support the dart on its journey from the rifle to the target. Any deformation of the flight will potentially impact the accuracy of the dart's trajectory. It is important that flights are given as much care as the rest of the dart and darning equipment.

Dan-inject flights should be cleaned using the following procedure:

- assess the flight for shape and consistency: if damaged or missing sections of flight then discard
- if dry material such as straw, leaf matter or other such material is mixed in with the strands of the flight a dry nail brush can be used to remove this material and return the flight to near new appearance
- If the flight is muddied, wet or covered in bodily fluids should lead to serious consideration to discarding the flight: often there is an excess of flights to darts so disposal should not be a problem. If deciding to clean this type of flight it can be run under water until the flight returns to normal colouration. The flight should be gently wrung out and left to dry completely before being returned to the dart box
- once cleaning has finished the flights must be reassessed for their aerodynamic shape: any deviation or concern then the flight should be discarded



A flight should retain a symmetrical aerodynamic shape and have no flight material missing or detritus within the flight

If a flight is in poor condition, is severely contaminated or the aerodynamic shape has been compromised then it should be discarded

Dan-inject dart cleaning: Dart storage



Darts must be cleaned the same day of use to ensure adequate functionality

Darts must be stored pressurised

Darts must be stored with the flights attached and in their original sleeves, similar to the method presented by the manufacturer

A minimum number of working darts should be kept in the dart box with replacement darts available on site: this allows easier identification of dart lifespan and removal of problem darts if a small number is reused



Anaesthetic record

An accurate anaesthetic record must be documented for each anaesthetic

Legal requirement

Documentation of use of controlled and STC drugs

Allows review and audit of procedures and improvement for future events


Provides a regular reminder to monitor the patient

Provides information and ability to evaluate trends and intervene before an emergency may occur

Forms part of the medical record for the animal

Anaesthetic record		Location:
Date: MASTER COPY	ARKS Number: MASTER COPY	
Species:	House name:	
Sex:	Microchip number:	
Age:	Other id:	
Reason for anaesthesia:		
Pre-ana assessment		
Resp:	Health status: Normal Abnormal	Environment: Temperature: Weather:
Heart:	Activity: Calm Active Excited	Immobilizing conditions: Outside enclosure Isolated Group Inside enclosure Transport cage Manual restraint
Other:	Demeanour: Depressed Alert Aggressive Apprehensive	Anaesthesia risk: Minimal risk (normal) Slight risk (subclinical disease) Moderate risk (clinical disease) High risk (disease threat to life) Grave risk (unlikely to survive)
BCS: (Thin) 1 / 2 / 3 / 4 (Fat)		
WEIGHT		
Weight/estimate (Date.....)		g/kg
1. Weight of animal and stretcher/cage		g/kg
2. Weight of empty stretcher/cage		g/kg
3. Actual weight (1.-2.=3)		g/kg
INDUCTION		
Class	Time	Drug
		Dose
		Dose rate mg/kg
		Total dose mg
		Conc. mg/ml
		Total volume ml
		Method / Route
		Area of admin
		Delivery success
		Stage
		Time of stage
Dart or jabstick information		
System		Distance metres
Dart Size		Comment on success of darting
Needle	Diam: mm / Length: mm	
Pressure	bar	
Anaesthesia information		
First effect		Surgery start time
Time lateral/sternal		Surgery finish time
Time intubated		Total ana time (ind to rec)

Temp (°C)		ARKS
		Species
		Weight
		Date
		Vet
		Recorded
		ET Tube
		Cannula
		Circuit
		Fluids
		Monitoring
		Oesop Steth Y/N
		Capnograph Y/N
		Pulse Ox Y/N
		Site Y/N
		ABG Y/N
		BP Y/N
		Type/Size Y/N
		ECG Y/N
		Thermometer Y/N
		Site
		Ana rating: 0/1/2/3/4/5
		Antagonist time given
		Time sternal
		Time standing
		Comments



Key

- HR -
- RR -
- IPPV -
- ETCO2 -
- Syst -
- Mean -
- Dlast -

NOTES

Health and safety:

Operator and observers



Dart rifles, pistols and blowpipes are firearms and as such should be treated with respect and care:

- **never point a firearm at any other person: loaded or not**
- **never point the firearm at anything that is not intended to be shot**
- **when the dart rifle is being carried it should be done so in a safe manner with the barrel point directly at the floor, preferably unloaded**
- **the safety must be on until immediately prior to darting**
- **the firearm should only be loaded immediately prior to firing**
- **assess the environment: ensure no one is within the firing range and that no animals or environmental factors may have an influence on your shot e.g. ricochet, poor visibility, trees, other animals etc.**

Dart preparation and handling is not without considerable risk, especially when considering the often concentrated pharmaceutical agents that are put into them:

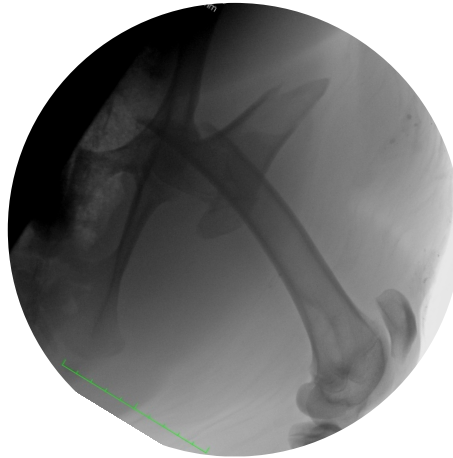
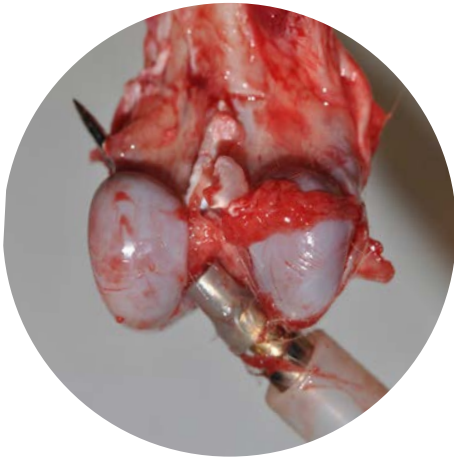
- **darts should not be carried loose: use specified containers**
- **if using air driven darts only pressurise them immediately prior to release**
- **beware of needle stick injury**
- **the high risk periods of handling darts are preparation and cleaning**
- **always wear appropriate PPE: nitrile gloves are considered the minimum**
- **do not reuse darts that are damaged or considered unfit for purpose: if unsure then often safer to discard them appropriately**
- **ensure darts are clean and maintained as per the manufacturer's instructions**

Pharmaceutical agents

- **understand the drugs that are being used and the specific risks that are associated with them**
- **understand the steps required to be taken in the case of accidental exposure**
- **if unsure ask the veterinarian**
- **be aware of the emergency response protocols**
- **if a person is exposed to any agents liaise with the veterinarian in charge and take appropriate steps, even if the person feels fine at the time**
- **be aware of drug leakage and exposure from darting sites on the animal: all potent opioid darting sites should be clearly marked when a dart is removed**
- **do not prepare darts on your own: have a buddy system in case of emergencies**

READ THE RELEVANT RISK ASSESSMENTS

Health and safety: Operator and observers



Darting is not atraumatic and can result in bruising, soft tissue or organ damage, fractures or intra-osseus injection. Ensure a clear line of sight, that the sites are accurate with the correct pressure for the required distance and dart size, and apply a practical anatomical knowledge to the target animal: considering general or unique anatomical variation. Fractures can be repaired, however prevention is better than cure.

Animals will often pull a dart out or chew it. All efforts must be made to retrieve a dart or distract the animal until it can be moved into a separate area to prevent ingestion related injuries.



All efforts should be made to follow best practice dart assembly methods. If a needle sleeve is not placed correctly, the needle checked and no dart sleeve applied then the spray from the needle as it is pressurised can be over a large distance and a wide arc: the risk of potential exposure is great (left). If a needle is not secured appropriately or the dart is old or the leur taper is damaged then the use of a dart sleeve will not stop a needle projectile blowing the top off the dart sleeve (middle).

All anaesthetic agents carry variable risk. In this case medetomidine 40mg/ml was sprayed in the author's face with heavy sedation occurring soon after: note the vasoconstriction (white) where the drops landed.

Sighting the rifle



The Dan-inject JMSP rifle has an optimal maximum range of 40-50m. However these distances are infrequently used in the captive setting. To ensure accuracy a set operating distance should be chosen and the sights set at that distance. These distances should be clearly marked for each sight system on each rifle. Confirmation and reassessment that the sights are correct should be performed monthly or if the operator is expecting long distant darting. Sighting a rifle or pistol is straight forward when using a sighting table.



A sighting table allows accurate and rapid assessment of the position of either laser or telescopic sights.

Set the distance between target and rifle using the range finder, in this case 5m for the laser sights. The rifle is fixed and rigid.



The sighting table is adjusted so that the laser is placed on the bulls eye. The distance is confirmed with the range finder and the appropriate pressure for the set distance and filled dart size is used as defined by the rifle's pressure tables.



The dart is fired and the accuracy of the sights can be assessed. In this case the sights are off by approximately 5cm to the left and down approximately 2cm.

The sighting table is not moved and the sights are adjusted to line up with the location of the dart on the target.



The sighting table is now moved to realign the sights on the bull of the target. A similar sized filled dart is loaded and fired at the target. If sighted correctly then the dart should now hit the bull and the sights have been correctly adjusted.

The distance the scope is sighted at should be recorded on the rifle (see page 14).

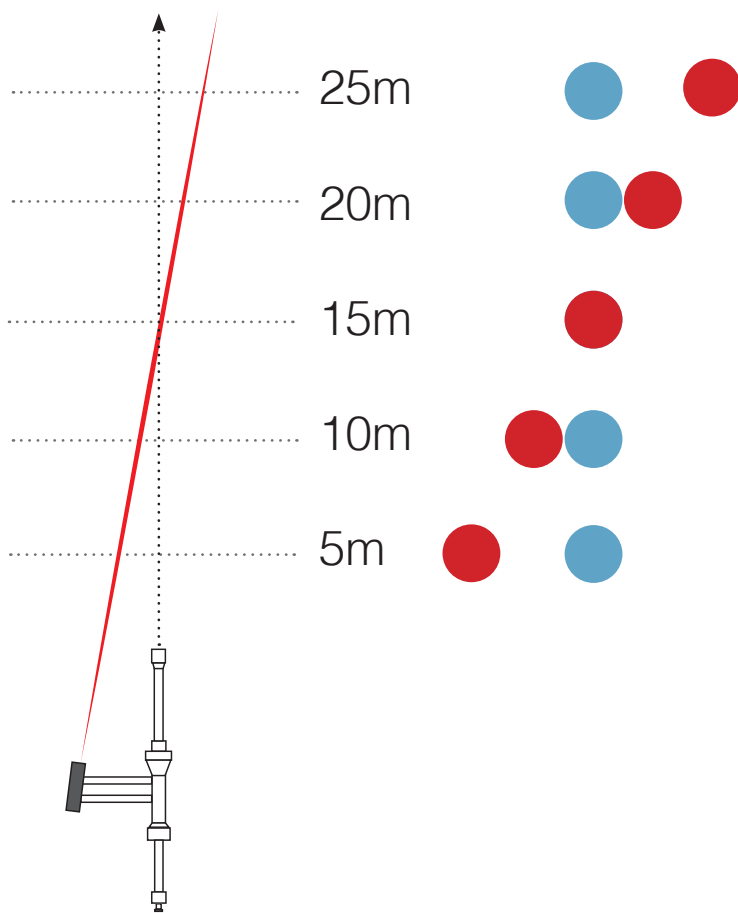
Sighting the rifle

Parallax error with set sight distances





With the rifle or pistol correctly sighted the operator must understand the variation between sight and location on the target when the rifle is used at distances that the scope is not sighted at. The variation is slight but can mean the difference between successful darting or a miss/trauma to the animal.

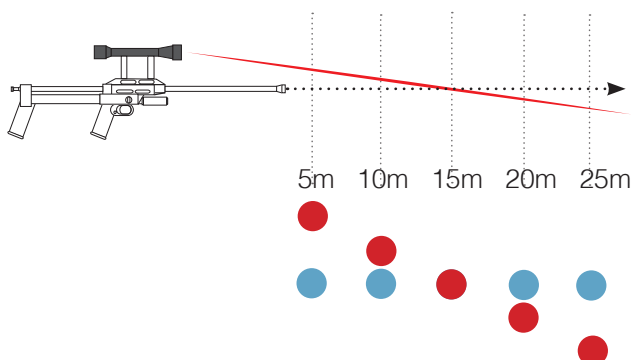
Side mount: sighted



In this case the laser sight is set to 15m, outside of these distances there is slight variation with the laser being to the left of where the dart will impact for distances $<15\text{m}$ and to the right for distances $>15\text{m}$. As demonstrated at distances close to the sight set distance there is only slight variation and therefore this makes little difference when darting larger animals. The effect of parallax error comes into its own when darting at distances vastly different to the sighted distance and for small animals where the target size is small.

-  Dart final resting place
-  Laser/telescopic site location

Top mount: sighted 15m



With a top mounted sight the variation is similar, however instead of left to right the variation is above and below as demonstrated.

Note: a dart's trajectory is not a straight line: this is a graphical representation



Emergency anaesthesia doses:

Note: These pages are intentionally blank for documenting emergency or induction doses that maybe required during a procedure or to recapture escaped animals.



Emergency anaesthesia doses:



Opioid exposure emergency response

Immediately inform another person

Call for person skilled in first aid but do not wait for them to arrive
Alert emergency services

Inject 2mls naloxone (narcane) INTRAMUSCULARLY

(0.4mg/ml naloxone)
Alternative route:
Intranasal spray (paramedic route)
Base of tongue if unconscious

Establish venous access

Continue IM / intranasal injections every 3 minutes until obtain IV access

Inject 2mls naloxone (narcane) INTRAVENOUSLY

Continue IM / intranasal injections every 3 minutes until obtain IV access

Repeat every 3 minutes until improvement occurs

Keep the patient calm and in the shade

Most capable person remains with patient until
emergency services arrive

Ensure information sheet accompanies patient to the
hospital

Cardiopulmonary resuscitation

AIRWAY: Maintain Respiration
BREATHING: Mouth to mouth
CARDIAC: Cardiac massage
DRUGS: Saline fluids if IV access

Symptoms opioid exposure

Dizziness and uncoordinated
Nausea and vomiting
Pinpoint pupils
Respiratory depression
Cold skin and extremities
Heart failure

Lethal human etorphine dose

0.03-0.12mg
(0.01-0.04ml LA immobilon)
(0.0025-0.01ml M99)

1 drop = approx 0.05ml