



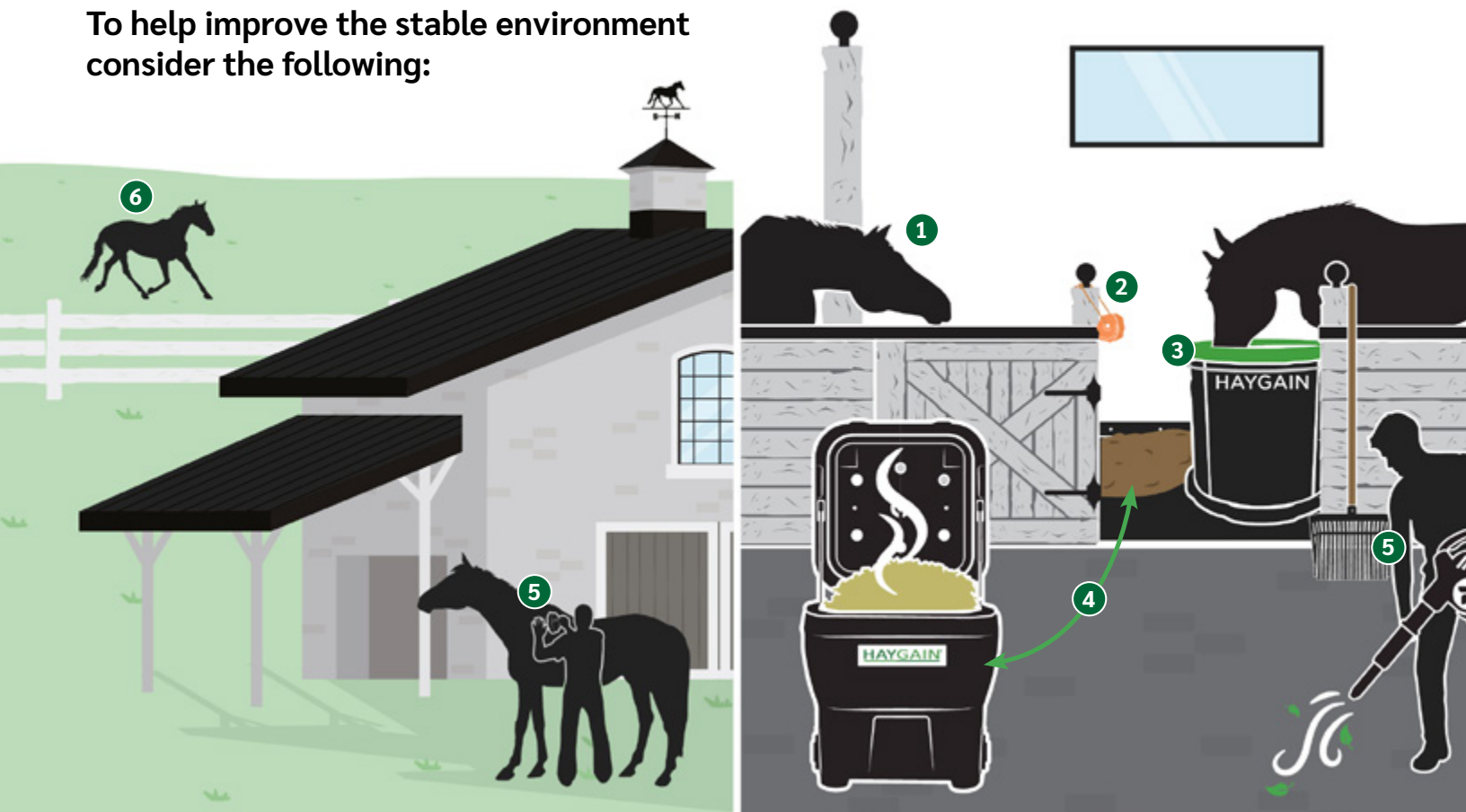
HAYGAIN[®]

Optimising the Stable Environment

INTRODUCTION

Horses are herd animals designed to live in a social group and travel many kilometres every day. They are trickle feeders who need to graze for up to 18 hours per day. When we stable horses, we take away the ability for them to do the things they would naturally do, for example – move, forage and socialise. Stabling, or at least

To help improve the stable environment consider the following:



part-time stabling, is often required for convenience, pasture management, weight management and injury prevention, among other reasons. It is important to make the stable environment as natural and suitable for horses as possible.

- 1 Visual contact with other horses is essential, but physical contact is preferable. Windows between stables allow horses to make contact with each other or, better still, adopt a group housing system.
- 2 Provide salt/mineral licks or make small frozen licks by pureeing vegetables and freezing them.
- 3 Provide access to forage as much as possible and consider using a Slow Feeder to allow your horse to eat in a natural position and regulate their pace – this is preferable over the use of haynets.

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- 4 Provide low dust options for feed and bedding such as steamed hay and dust-extracted wood shavings.
- 5 Activities such as mucking out, sweeping and leaf blowing all generate airborne dust and should be done while the horse is outside the stable, ideally during turnout. Grooming can also generate dust and is best done outside.
- 6 Provide a minimum one hour of exercise per day, preferably turnout as many hours as possible.



STABLE DESIGN

Construction of Stables

The building should be constructed soundly, with no exposed surfaces or projections likely to cause injury. All surfaces should be capable of being cleaned and disinfected. If surfaces are treated, non-toxic paints or non-toxic wood preservatives should be used.

Fixtures and fittings such as tie rings, hay racks and automatic drinkers should be free of sharp edges and positioned to avoid injury, particularly to the eyes.

Doors should be a suitable size for the individual horse as a guide 1.25m (4ft) wide. The height of the door should allow the horse or pony to see out over the door.

Enough light is essential within all stabling both for the horse to see adequately and to allow inspection and safe handling of horses at all times.

Stable Sizes

Stabling type and size vary around the world and across disciplines/industries. 2008 research led by Kelly Yarnell at Nottingham Trent University revealed some of the most compelling evidence relating to the way in which confinement affects the well-being of horses. The researchers measured the physiological and behavioural stress responses of horses housed in 4 different conditions (single housing, paired, group, single semi contact). They found that as housing became more isolated, horses exhibited higher levels of faecal corticosterone, a key indicator of stress (Yarnell et al., 2008).

The predominant housing used for domestic horses is individual stabling in loose boxes/stalls, with horses often confined there for much of the day.

Following Yarnell’s Research, the Swiss Government enacted Equine protection laws that mandated minimum sizes for box stalls and established requirements for access to or opportunities for social interaction among horses. The following table details the relevant stall and paddock sizes dependant on size of horse.






Other popular arrangements in Europe include housing compatible horses in pairs in double-sized stalls, as well as group barns. The Spanish Riding School’s stud farm uses double sized stalls for its broodmares, with mares going into private box stalls only at foaling time.

HORSES

Animal Category	Horse						
	Withers Height	< 120 cm	120 - 134 cm	134 - 148 cm	148 - 162 cm	162 - 175 cm	> 175 cm
Area per horse							
Single box ^{1,2} or one-room group box ^{1,3,4}	m ²	5.5	7	8	9	10.5	12
Tolerance value ⁵	m ²	—	—	7	8	9	10.5
Lying area in multiple room loose house ^{1,3,4,6}	m ²	4	4.5	5.5	6	7.5	8
Room height in area of horses							
Minimum height	m	1.8	1.9	2.1	2.3	2.5	2.5
Tolerance value ⁵	m	—	—	2.0	2.2	2.2	2.2
Paddock area^{3,7} per horse							
Permanently accessible from stable, minimum area	m ²	12	14	16	20	24	24
Not adjacent to stable, minimum area	m ²	18	21	24	30	36	36
Recommended area ⁸ per horse	m ²	150	150	150	150	150	150

ANIMAL WELFARE ORDINANCE (2008) THE SWISS FEDERAL COUNCIL. ▶

As a guide in the UK, the British Horse Society’s minimum stable size recommendations are:

				
PONIES	LARGE PONIES	HORSES	LARGE HORSES	FOALING BOX
3.05m x 3.05m (10ft x 10ft)	3.05m x 3.65m (10ft x 12ft)	3.65m x 3.65m (12ft x 12ft)	3.65m x 4.25m (12ft x 14ft)	4.25m x 4.25m (14ft x 14ft)

Stable Ventilation

The objective of ventilation is to provide a constant supply of fresh air to the horse. Ventilation is achieved by simply providing sufficient openings in the stable/building so that fresh air can enter and stale air will exit.

Ventilation involves two simple processes:

- 1 Air exchange where stale air is replaced with fresh air.
- 2 Air distribution where fresh air is available throughout the stable (avoid dead air pockets)

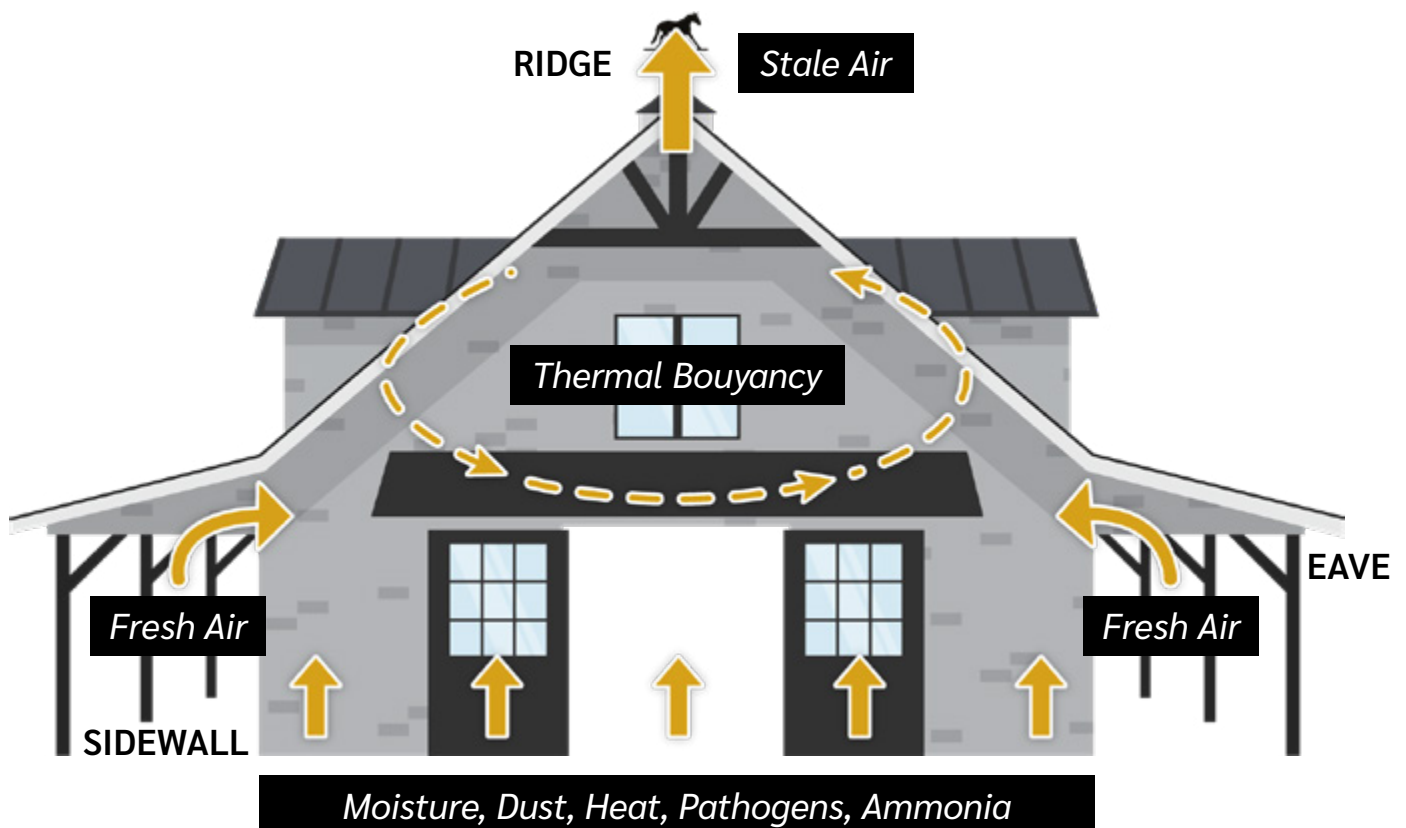
In winter, a ventilation rate of 12–19 L/sec (25–40 CFM, or cubic feet per minute) per horse housed is ideal. In summer, ventilation rates as high as 142 L/sec (300 CFM) per horse are needed to keep barn air temperatures from rising.

Air has two very important properties that need to be understood: thermal buoyancy and moisture holding capacity:

THERMAL BUOYANCY OF AIR

Buoyancy is the tendency of warm air to rise. Warm air is less dense than cold air, so it is lighter. This principle works well in natural ventilation systems where the warmer barn air, caused by horse body heat, is allowed to rise up and exhaust in a peak vent or chimney, carrying the respired moisture and active gases with it. The greater the temperature difference between inside the barn and outside the barn, the larger the uplift or buoyancy force to exhaust this foul air.

Buoyancy is not effective in warm weather because there is very little temperature difference between inside and outside. For these conditions, natural ventilation relies on summer breezes to remove moisture, heat, odours, and active gases.



MOISTURE HOLDING CAPACITY

Air has the capacity to hold moisture in water vapor form. The amount of moisture held by a fixed volume of air increases as the temperature of that air rises. For example, cold outside air has very little moisture-holding capacity, whereas warm air has a significantly higher moisture-holding capacity. For every 10°C increase in air temperature, moisture-holding capacity of the air doubles.

NATURAL VENTILATION

*USES AIR BUOYANCY AND WIND EFFECTS TO MOVE AIR
(REFER TO FIGURE ON PAGE 5)*

The length of the building must be perpendicular to the prevailing wind. Obstructions around the barn prevent fresh air movement, especially when they are located within a distance ten times the height of the ridge peak of the horse barn. If obstructions cannot be removed, use mechanical ventilation. Naturally ventilated barns must be appropriately designed in terms of animal density and height of the roof to permit thermal buoyancy to occur.

Barns with poor ventilation are often improved mechanically with fans or air inlets. However, one study showed that box fans are not effective at reducing ammonia levels in the 12" breathing zone of the horse but instead just circulate the air (Hayes, 2005).

Types of Stable

The main types of stables are either loose boxes (single stables/stalls next to each other) or American Barn (multiple stables/stalls under the same roof). Both set ups have advantages and disadvantages. For example, an American Barn provides a pleasant atmosphere for yard staff and allows horses to see one another easily. Loose boxes are good for disease control.

A well-designed stable promotes the health, safety, and performance of your horses. Must-have features include stables that are secure with nonslip flooring, proper drainage, good ventilation and safe lighting.



EXAMPLE OF LOOSE BOX STABLING



EXAMPLE OF AMERICAN BARN STABLING

Jones et al., (1987) reported serious negative consequences, in terms of respiratory health, when seven horses shared airspace, particularly during calm conditions when the ventilation rate was low at only 6.6 changes of air/hr. Increasing the ventilation rate in an American Barn system by leaving windows and doors open was reported to significantly decrease particulate matter in the air. However, horse owners often cite inclement weather as a reason for closing doors and windows

It is also important to consider the activities of the adjacent stables and the day-to-day activities on the yard. If you adopt a low dust regime of steamed hay and

low dust bedding, but the neighbouring stable is using straw and dry hay, the benefits of your regimen can be lost due to cross contamination (Auger and Moore-Colyer, 2017).

In single loose boxes, the airspace available to the horse is restricted by roof height and air movement can be negligible particularly if back or side windows are kept closed. However, the horse only inhales dust created from its own bedding and forage and does not have to be subjected to the dust created from neighbouring

stables or from horse management activities such as yard sweeping, leaf blowing, filling hay nets and grooming (Art, 2002). Further research has shown that stables positioned near the trainer's office or an adjacent stable increased exposure to dust more than those further away due to increased activity (Ivester et al., 2018).

It is also important to consider the location and storage of the dry hay. Ensure hay is stored in a separate barn where possible to help improve air quality.

HOW THE ENVIRONMENT IMPACTS HEALTH

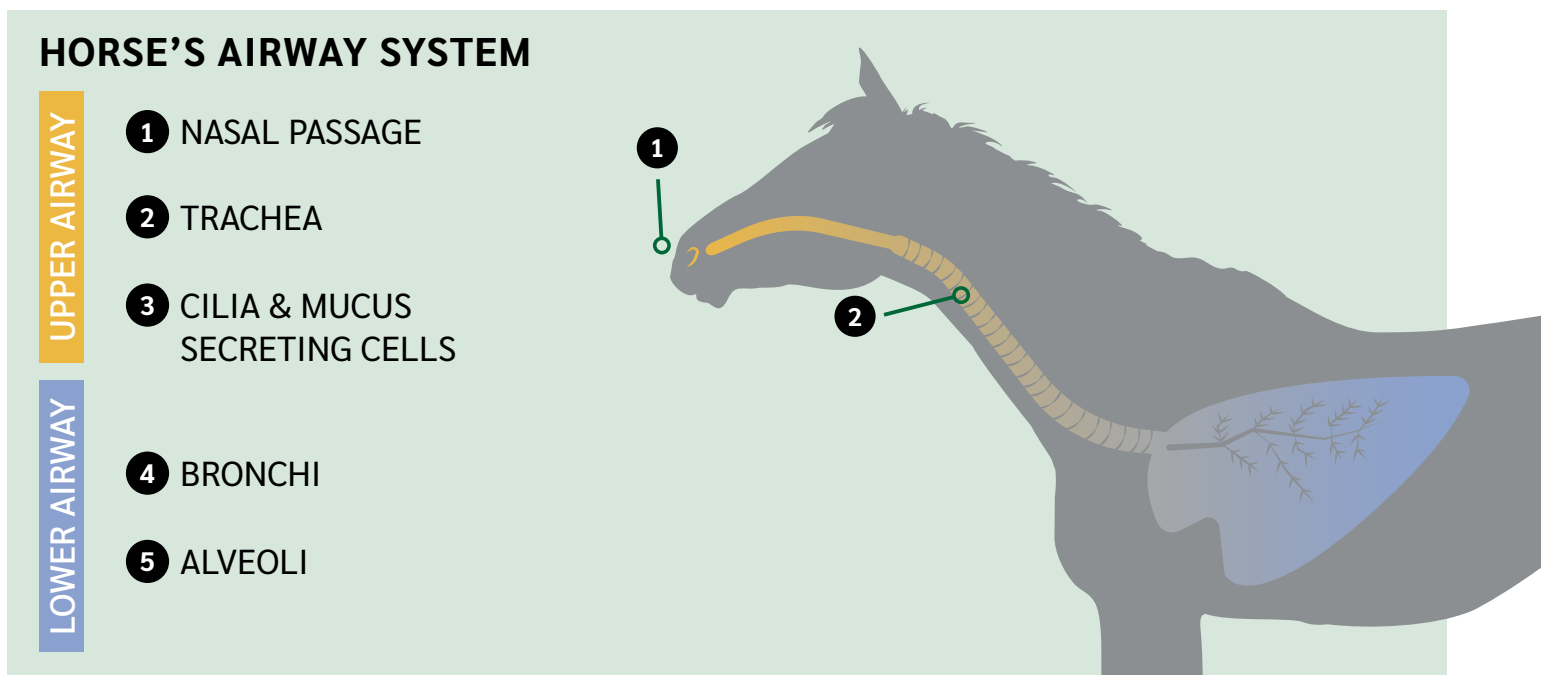
Respiratory health for the stabled horse

All stabled horses inhale allergens and will be affected even if they do not show clinical signs. It is widely acknowledged that airborne respirable dust (ARD) of <5 µm in size found in the stable environment has a major negative impact on respiratory health in horses and can cause the debilitating conditions known as equine asthma.

Ample research demonstrates that over 80% of active horses have some degree of respiratory challenges – like the Mild and Moderate Inflammatory Airway

Disease that exist on the Equine Asthma Spectrum. One example is current research identifying 1 in 6 horses in the UK as suffering from Severe Equine Asthma, and 4 out of 5 (2yr old racehorses) suffering from Inflammatory Airway Disease.

In fact, respiratory disorders are the second most common performance limiting factor! Poor performance and exercise intolerance has been found to be more frequent in horses with fungal particles found in their



airway than in horses without it (Dauvillier et al., 2018). Horses with respiratory disorders also had 4x the risk of lameness due to fatigue, tiredness and less oxygen to the muscles (Murry et al., 2009).

It is important we reduce exposure to allergens in the stable environment to aid respiratory health. **We know that the majority of dust is brought into the stable in the form of bedding and hay.**

Hay is the single most common source of dust and mould spores in the stable. - DR. DAVID MARLIN

Bedding is another major source of inhaled particles in the equine environment.

Certain types of bedding and forage represent significant risk factors for equine asthma, with dry hay and straw not recommended. Straw can be a source of fungal particles closely linked to respiratory problems. The negative effects of this combination are magnified in American Barn set-ups with shared airspace. The best management regimen is to feed steamed hay and bed on dust-free shavings where possible (Auger and Moore-Coyler, 2017).

Daytime total and respirable particulate concentrations have been found to be nearly double the concentrations measured overnight, independent of management system, further reinforcing the impact of activity within the barn on particulate exposure. Where possible, muck out and sweep the barn when the horses are out in the field or being exercised (Ivester et al., 2014).

AMMONIA EXPOSURE

A horse's urine contains urea, which is a by-product of the digestion and metabolism of protein in the horse's diet. Urea is broken down by bacteria and off-gases as ammonia.

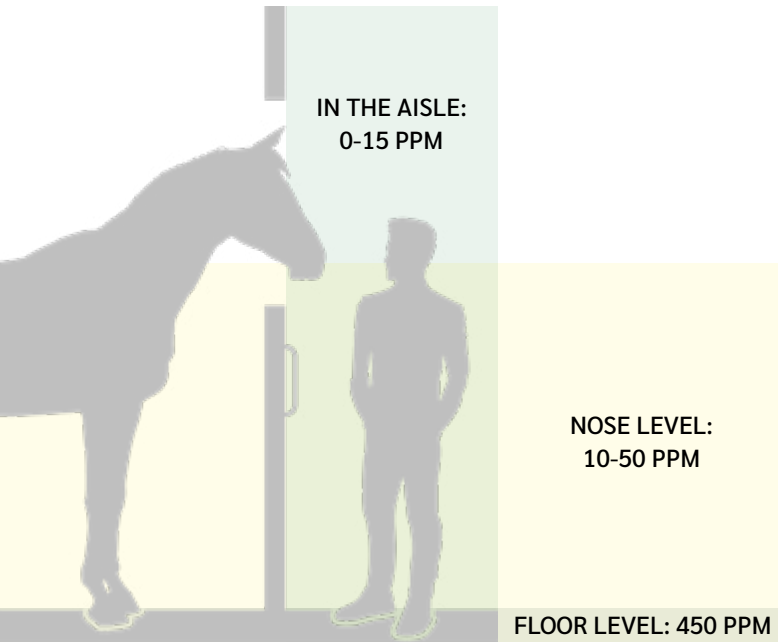


Ammonia levels will vary depending on the stable set-up, ventilation, amount of urine produced by the horse, how often the stable is mucked out/cleaned/disinfected and the flooring itself.

Highest levels are found 12" from floor level (80-450ppm). Exposure levels of 220ppm for 10-30mins. correlate to irritation of the respiratory tract, eyes and nose. This occurs at lower levels when horses are exposed for longer periods of time.

Ammonia production is often particularly high on deep bedding systems, in which wet matter is allowed to seep through layers of bedding to the subfloor. Without sealed flooring and/or heat or chemically treated bedding material, bacteria can accumulate and proliferate. The rule of thumb is that, if you can smell ammonia, it is already at a level that will irritate airways; yours and your horse's.

AMMONIA LEVELS IN THE STABLE:



A non-porous floor such as Comfortstall enables you to muck out the wet bedding, remove all the urine and starve subterranean populations of bacteria that have been thriving on a steady supply of urea. As a sealed, one-piece flooring system, ComfortStall allows you to contain the urine and gives the bedding more chances to absorb it. It also allows for easy and efficient cleaning with disinfectant.

IMPLICATIONS OF AMMONIA EXPOSURE

A 2001 study by the Equine Pulmonary Laboratory at Michigan State University's School of Veterinary Medicine found that young horses stabled during training suffered respiratory distress when compared to pastured horses of the same age. While dust and mould in feed and bedding played a part in pulmonary problems, exposure to ammonia also negatively impacts their respiratory systems (Hayes, 2005).

In humans, ammonia exposure causes narrowing of the throat and bronchi, fluid in the lungs, eye irritation, nausea, vomiting, and dizziness. According to the North Carolina Department of Health and Human Services, extended exposure to ammonia fumes can cause chronic inflammation of bronchi, airway hyperactivity, and chronic irritation of the eye membranes.

What can you do to reduce exposure and improve respiratory burden of the stabled horse?

KEEP HORSES OUTSIDE:

Multiple benefits of keeping horses outside include fresh air, constant grazing, and regular movement. In open air, urine will not be trapped, and horses will not breathe high concentrations of ammonia. Those warm, closed barns compound the ammonia problem as the heat spurs on bacterial growth while also agitating ammonia molecules and causing the gas to rise.



CLEAN STABLES/STALLS REGULARLY:

Remove visible urine and wet bedding as the first and most basic step to reducing ammonia levels in stalls. Make stall cleaning a daily or twice-daily practice to create sanitary living conditions for your horse. When cleaning stalls, remove all soiled bedding.



Deep cleaning with suitable disinfectant as regularly as possible, at least seasonally and always between horse change overs.

CHOOSE BEDDING WISELY:

- bedding with higher levels of absorbency results in lower levels of ammonia in a stall.



EXTRA PROTEIN MEANS MORE AMMONIA:

Excess protein fed to a horse is expelled in the urine and contributes to the production of ammonia in the stable.



ELIMINATE URINE ESCAPE ROUTES:

Seams and gaps create the perfect place for urine to disappear until the ammonia starts to rise up from the depths of the floor. Once urine is trapped under matting, flooring material, or in the drain, urine gathers and your own 'petri dish' starts growing right under your horse's nose.



Flooring Systems and Bedding Choices

There are a wide variety of bedding choices available. Some are more economical, absorbent, dust-free, odour suppressing or simply quicker and easier to muck out.

Commonly used equine beddings:

STRAW:

Concrete stables with deep straw bedding are common. They are very aesthetically pleasing, the straw breaks down easily for muck disposal and is relatively cheap. However, straw contains high levels of dust and has low absorbency compared to other bedding choices.

Research has shown that Straw and dry hay produce highest levels of airborne respiratory particles in the breathing zone and stable zone of the horse (Auger and Moore-Coyler, 2017).

WOOD SHAVINGS:

Shavings are a popular type of bedding, but dust levels can vary enormously; not all are dust extracted. They do, however, provide a non-palatable, easy, clean product to use which makes an aesthetically pleasing bed.

Research has shown that shavings from two kinds of pine trees showed significantly less bacterial growth, when exposed to bacteria in a lab setting, than spruce shavings, hemp, and straw. Also showing three times the absorbency levels compared to hemp and straw (Yarnell et al, 2016).

WOOD PELLETS:

These are made from heat-treated and compact sawdust. To use them, water must be added to fluff them up and increase their absorbency; this creates an easily compostable, eco-friendly highly absorbent bedding. They are normally dust free and can be odour suppressing. Does not create an aesthetically pleasing deep bed.

HEMP, FLAX, OR MISCANTHUS:

Made from the chopped stems of hemp or flax, this option offers an alternative to shavings and paper. More absorbent bedding than shavings, it is low-dust and breaks down rapidly but can be expensive.

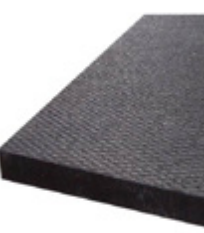
PAPER OR CARDBOARD:

Made from a mixture of newspaper, magazine, and other unwanted printed matter. It is often considered to be a cheaper option, but a large number of bales may be needed to create a thick bed. A particularly good choice for allergy suffering horses: it's dust free and non-palatable.

STABLE MATTING:

A non-slip base to protect against hock sores, injury from casting, reduce bedding costs and save time and money on mucking out.

There are a number of stable matting options available.



INDIVIDUAL STALL MATS:

Non-reinforced rubber crumbles, degrades and usually laid on concrete, brick, or compacted earth. Stable mats are only marginally softer than the cold floor beneath. Escape routes for bedding, urine and manure between the mats provide a breeding ground for bacteria.

COATED GEOTEXTILE/RUBBER CRUMB:

Prone to stretch, wrinkle, bubble, wears quickly and is prone to punctures/tears. This material can also soak up the urine, promoting bacterial growth.

COMFORTSTALL SEALED ORTHOPEDIC FLOORING:

The best solution for controlling ammonia and improving air quality is to eliminate all areas where urine collects and reduce the quantity of bedding needed to only that required to absorb urine.

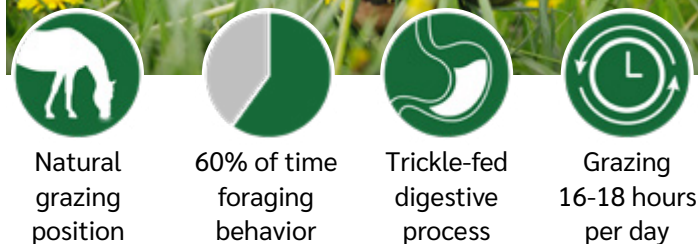
Seamless mats that ensure urine cannot penetrate or gather are preferable. They also require less bedding and are much easier/quicker to keep clean whilst providing joint support and encouraging lying down and REM sleep.

Feeding the Stabled Horse

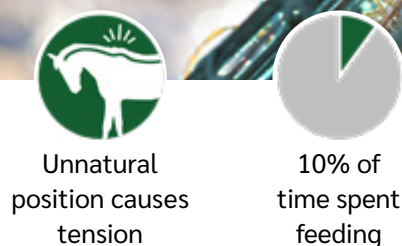
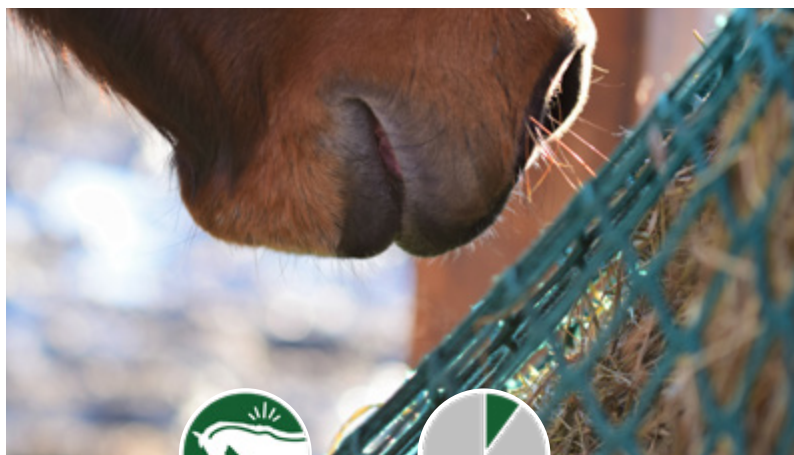
To meet their physiological and psychological needs, horses have evolved to trickle feed. In the wild, horses would spend up to 60% of their daily time budget grazing low quality forage. The stabled horse often spends only 10% of its day eating. And 90% of their time engaged in other – often boredom-driven -- behaviours. This environment has negative health implications and can lead to the development of gastric ulcers, colic, obesity, laminitis and stereotypic behaviours like cribbing and stall weaving.

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NATURAL FEEDING



DOMESTIC FEEDING



Fibre is a vital part of the horse's diet and is predominately made up of pasture, hay and haylage with short chop fibres added to concentrate meals. Fibre in the stomach helps to buffer the acidic environment, reducing the risk of developing ulcers. Fibre is broken down in the hind gut by microorganisms that produce volatile fatty acids that the horse uses for energy. A further benefit of a high fibre diet is warmth. Fibre fermentation produces heat



CONSERVED GRASS – HAY/HAYLAGE:

Conserved forage is naturally high in respirable particles (made up of mould, bacteria, and fungal spores as well as microorganisms). Particles smaller than 5 microns in size, (a human hair is 150 microns), have a 50% chance of being inhaled deep into the lungs, causing respiratory disorders such as Equine Asthma. It is the dust we can't see that is the problem: even hays of good nutrient quality are high in respirable particles. To improve the hygienic quality of the hay without compromising the nutritional value, horse owners are advised to use a commercial hay steamer such as a Haygain. [VIEW RESEARCH - Forages & Feeding Your Horse](#)

which helps keep the horse warm during winter. Horses require 1.5-2% of their bodyweight per day in forage as a minimum for optimum health.

Domestication of the horse has created a challenge to maintaining the correct body weight and meeting its energy needs. Grasses are far more productive so many landowners heavily fertilise their pasture to make them more suitable for dairy cattle than horses. Horses have also evolved to eat a varied diet and walk miles grazing – meaning their energy output is high for low calories in return.

In modern horse management, we provide high calories, high sugar grasses for little calorie output. This can lead to obesity and metabolic issues such as laminitis. We therefore often must restrict access to pasture and substitute this for other forms of lower quality forage such as hay, haylage and higher digestible energy or fibre feeds – this is a fine balancing act!



THE HAYGAIN STEAMERS


are the ONLY scientifically proven way to achieve thorough steaming at temperatures up to and around 100°C within the forage. This reduces the respirable particles by up to 99% and kills harmful mould and bacteria implicated in Equine Asthma.

PRESENTING FORAGE TO HORSES

The amount and way in which we feed forage to stabled horses is critical.


There are a variety of methods to feed forage to horses to reduce intake rate and wastage caused by contamination with urine and faeces in the stable.

LOOSE HAY:



Feeding loose hay on the floor is the quickest way to feed forage and allows horses to eat in a natural position. However, research has shown 50% of hay fed on the floor is contaminated and subsequently wasted. Loose feeding also allows a horse to eat at their own pace, which is unsuitable for horses that require a regulated consumption pace.

HAY NETS:



Many horse owners use haynets of varying sizes in the attempt to reduce intake rates. There is some evidence to show effectiveness with small holed haynets, but not without consequence. Use of haynets have been linked to dental disorders, increased musculoskeletal tension, particularly of the head joint, neck and back, as well as inducing frustration (Dixon and Dacre, 2005; Ellis et al., 2015). Haynet feeding dry hay increases airborne respirable particles in the breathing zone of the horse by 4 times compared to floor feeding (Ivester et al., 2014).

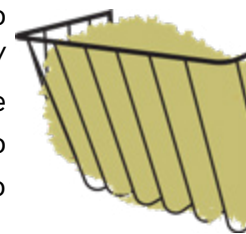


WATER INTAKE:

Horses drink approximately 25 to 55 litres of water per day depending on the weather, their diet, and their level of work. Water is essential to maintain a horse's health and it is vital that horses always have access to fresh clean water.



HAYBARS AND HAYRACKS:



Haybars and Hayracks contain forage but do not prevent the horse from removing the hay/haylage and spreading it around the stable creating wastage. Haybars can be difficult to keep clean and hay racks can force a horse to eat in an unnatural, raised-head position.

SLOW FEEDERS:



Slow feeders have been designed to regulate intake rates and encourage a more natural feeding position. The Haygain Forager allows horses to eat in a more natural position whilst regulating the pace at which they do so. The Forager can reduce the consequences associated with food deprivation such as colic and gastric ulcers and muscular tension caused by unnatural feed positions. Placing hay inside the Forager container keeps it hygienic, reducing wastage caused by contamination with bedding, faeces and urine. [VIEW RESEARCH - Improve The Way You Feed Your Horse](#)



Importance of Equine Sleep

There are three stages of physiological sleep. Horses can achieve stages one (light sleep) and stage 2 (slow wave or deep sleep) while standing up. The third and most important stage is rapid eye movement (REM) sleep that occurs only while the horse is lying down due to the complete muscle relaxation required. In a 24-hour period, horses have been shown to have a total sleep time of 3.5 hours per night, but require a minimum of 30 minutes of lying down flat to fulfil their total REM sleep needs.

There are a range of factors which can affect quality of sleep such as stable size, bedding type, bedding depth and stable light. Research has shown that horses on straw beds spent a greater proportion of the night lying down (29%) compared with horses bedded on shavings (12%) (Greenings, 2018). Further work showed that use of a night light and bedding depths of 5cm compared with 15cm resulted in a reduction in REM sleep (Amiouny, 2020).

Other factors include any change in environment – how safe a horse feels, or any form of injury or orthopaedic pain can affect REM sleep (Fuchs, 2019).

When a horse gets inadequate sleep and suffers sleep deprivation this can in some cases lead to collapse. Cases of collapse are most often seen in horses with restless sleep profiles. Research by Fuchs (2019) found that REM sleep phases were shorter and occurred while horses were standing. In 86% of cases, REM sleep happened during, or immediately before the collapse (Fuchs, 2019).

Sleep is also important for performance. Research has shown a positive correlation between competition performance and average duration of nocturnal recumbent behaviour (Greening, 2018 and Colley, 2015).

CONCLUSION

Stabling is common practice required for all or part of the year for most domestic horses. However, not all stable environments accommodate a horse's needs. Many have unnaturally high dust levels that can overwhelm their respiratory system. Horse owners can seek to improve the stable environment and subsequent health and behaviour of their horses by considering stable design, ventilation, air quality, bedding, and hay source as well as the psychological needs of the horse. Providing a comfortable, safe environment for the stabled horse will help with rest and recovery after exercise.

Feeding Haygain Steamed Hay and using dust extracted/low dust bedding options will help control the two biggest sources of respirable dust in the stable environment, and two of the biggest contributors to conditions on the Equine Asthma Spectrum.

Providing horses with time at pasture whenever possible will aid both their psychological and physiological needs.



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