

# Engineering and performance standards parameters for long distance road transport in the United States: the special case of horses

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## Summary

The transportation conditions of slaughter horses for human consumption have become a public and regulatory issue in the United States in the last two decades. Federal regulations were developed partially using the results of funded research projects that examined the types of vehicles, characteristics of slaughter horse candidates, types of injuries during transport, duration of transit, stocking densities and other behavioural and physiological indices during long-distance road transport. Additionally, the physiological responses of horses travelling long distances in vans while cross-tied by their halters in individual stalls were also studied. Both engineering- and performance-based standards were developed from the scientific studies and implemented in the federal regulations to ensure the humane movement of equines to slaughter facilities via commercial road transportation.

## Keywords

Handling, Horse, Regulation, Slaughter, Stress, Transportation, United States, Welfare.

## Parametri standard di progettazione e prestazione per trasporti su strada di lunga distanza negli Stati Uniti: il caso specifico dei cavalli

### Riassunto

*Negli Stati Uniti nelle ultime due decadi le condizioni di trasporto dei cavalli da macello destinati al consumo umano sono diventate una questione pubblica da regolamentare. La legislazione federale al riguardo è stata parzialmente attuata utilizzando i risultati di progetti di ricerca finanziati che hanno preso in esame il tipo di veicolo, le caratteristiche dei cavalli destinati al macello, i tipi di incidente durante il trasporto, la lunghezza dello spostamento, l'ammassamento dei capi ed altri indici comportamentali e fisiologici nei trasporti a lunga distanza. Inoltre sono stati studiati i parametri fisiologici dei cavalli nei trasporti a lunga distanza, legati nei van in box singoli. I parametri standard inerenti la progettazione e le prestazioni sono stati desunti da studi scientifici implementati dalla legislazione federale, per assicurare ai cavalli un trattamento umano nel trasporto commerciale su strada verso gli impianti di macellazione.*

### Parole chiave

Benessere, Cavallo, Legislazione, Mattatoio, Trattamento, Stati Uniti, Stress, Trasporto.

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## Introduction

The role of the horse has dramatically changed throughout the history of the United States. The horse once provided draught power in agricultural fields and was the primary source of transportation. Horses were an integral part of warfare in the United States, especially during the Revolutionary and Civil wars. More recently, horses have been valued for their recreational and entertainment uses, such as the competitive performance events of racing and showing, and have become icons on movie screens and television. Today, the horse serves as a companion animal in United States society and is close to dogs in emotional appeal (15). The animal is not primarily raised for food or fibre. This change over the centuries is perhaps a reflection of people with diverse ethnic origins that have come to live in the country. The change in the role of the horse, and animals in general, has also been paralleled by society's new ethic for animals. This new ethic is driven by a more urbanised population, which is more sensitive to animal suffering and more favourable to developing regulations for animal protection (15).

Horses in the United States have historically been the focus of many animal welfare issues. Commencing as early as the 1860s, the political activities of Henry Bergh in the state of New York lead to the founding of the organisation known as the American Society for the Protection of Cruelty to Animals. His focus at the time was the abuse of overworked horses used to pull streetcars in New York City and the filthy and hazardous stabling conditions of the city's horses. Henry Bergh's commitment to alleviating mistreatment of horses was graphically depicted in the seal adopted by the ASPCA, showing an angel rising up to protect a fallen carriage horse being beaten by its driver. His mission widened to embrace the common cruelties of many animals of the time, such as the scalding of a howling cat, the stoning of a stray dog, atrocities of the slaughterhouses, the whipping of a lazy horse and the brutalities of vivisection. Henry Bergh's eccentric activities and messages concerning animal abuse were often ridiculed

by the press, but eventually aroused the public and prompted independent branches of the society to be established in surrounding towns and throughout the country (11). Today, there is the presence of an established association to prevent cruelty to animals including horses in almost every community in the United States.

After World War II, old and lame horses were processed for affordable red meat for consumers in Europe. However, the consumption of horse meat was never accepted in the diets of countries such as Canada, the United Kingdom or the United States (14). Live horses were transported from the United States by ship for slaughter in other countries prior to 1976. These ocean journeys were associated with high mortality and poor care standards such that a United States federal regulation was passed that prohibited the international shipping of live horses for slaughter purposes. Thus, foreign businesses financed slaughter facilities in the United States to export meat products for their markets abroad. There were sixteen federally inspected slaughter facilities in the late 1980s for horses in the United States. However, by the 1980s, the perspective of most Americans on the role of horses in society had shifted from agricultural to companion animals. As such, horses were offered the same treatment and care as companion animals and those practices commonly used in managing livestock for the production of food and fibre were no longer considered acceptable.

Many animal welfare issues in the 1990s were fed to the United States media by various animal protection and grass roots organisations regarding the need for humane care of horses marketed for slaughter. These media stories aroused the emotion of many horse owners, legislators and, most importantly, the general public. These beliefs, whether based on fact or myth, included ideas that young and healthy horses, treasured wild mustangs, or helpless foals were being shipped to slaughter. The dreadful conditions of transport were often highlighted in the media stories, such as over-crowded stocking of trucks that travelled extreme durations without feed or water and the use of 'pot-belly'

or double-deck semi-trailers with limited head room (12). By 2006, only three processing plants were operational in the United States. Since the vast majority of Americans today are opposed to eating horse meat, the forefront of the issue has expanded to debating whether the United States society should support the marketing of horse meat products to other countries. Both state and federal legislation is currently progressing to eliminate the processing of horses for meat products for human consumption in the United States. However, the transport of horses from the United States to processing facilities in Canada and Mexico continues as a viable option, and the number of exported horses may increase in the future.

### Regulatory activities

There was a growing interest in the mid-1990s to establish regulations and standards for the transport of horses to slaughter. The United States Senate bill entitled *Humane and Safe Commercial Transport of Horses for Slaughter Act* was incorporated into the 1996 Farm Bill. The original language regulating the handling and conditions of horses transported in double-deck trailers was transformed to stipulate that the Secretary of Agriculture should issue guidelines for the regulation of commercial transportation of horses to slaughter (20). The development of specific regulations was delegated to the leadership in the United States Department of Agriculture (USDA) who wanted to base the regulations and recommendations on scientific data. At the time, there was very little science to support any guidelines including maximum transit duration, loading densities, water deprivation, defining 'unfit to travel' and trailer design. Government contracts and funds were appropriated to three researcher workers located at Colorado State University (Temple Grandin), Texas A&M (Theodore Friend) and University of California, Davis (Carolyn Stull) to study these issues. The research projects were designed around the issues facing the road transport of slaughter horses, but the results and auxiliary studies have implications

for the transport of competitive, breeding or recreational horses.

## Research

### Vehicles

The majority of horses in the United States procured for slaughter are purchased by commercial buyers at auction facilities and through private agreements, although horse owners can directly market and transport their horses to a processing plant. In the late 1990s, when the research studies were conducted, there were only three processing facilities for slaughter horses in the United States which were located in Texas or Illinois; thus, horses often travelled long distances to a slaughter facility. Once the commercial purchaser gathered an appropriate number of horses, the horses were commonly loaded for long-distance road transport into several types of trailers, including the double-deck semi-trailers ('pot-belly') (Fig. 1) with a capacity for 44 horses or the straight-deck (single level) semi-trailers with a capacity for 38 horses (Fig. 2). For smaller loads of less than 15 horses, goose-neck trailers pulled by trucks were more often used to deliver horses to slaughter facilities (Fig. 3). Data collected in 1998 showed that 49% of horses arrived at slaughter plants in gooseneck trailers, 42% were transported in double-deck semi-trailers and only 9% in straight-deck semi-trailers (8). The reduced utilisation of the straight-deck semi-trailers for slaughter horses was probably due to limited availability of these semi-trailers for commercial transport of other livestock species and the economic advantages of the larger stocking capacity offered by the double-deck semi-trailers.



Figure 1  
Semi-truck and double-deck trailer ('pot-belly'), with blue lines indicating the principal compartments



Figure 2  
Semi-truck and straight-deck trailer



Figure 3  
Goose neck single-tier trailer common for the transportation of medium-sized loads of horses to slaughter

### Slaughter horse characteristics

As with many animal abuse and neglect stories in the United States, the realistic issues contributing to issues concerning the transport of slaughter horses needed to be defined and sifted out from the sensationalised stories. This was particularly important for the development of science-based research that would enhance the well-being of slaughter horses, particularly during transport. One such dramatic image was that slaughter horses were broken-down racehorses, family pets and young foals (12). Since the horse population in the United States is composed of many different breeds and sizes of horses, a factual documentation of the types and physical condition of the slaughter horses was necessary to develop applicable regulations to ensure their welfare during transport. Data was collected on the characteristics of 306 horses that were commercially procured

for slaughter and subsequently transported in one of nine loads to a processing facility (16). The mean age was 11.4 ( $\pm 0.4$ ) years old, with a range of 1 to 30 years. The mean wither height of the horses was 1.50 m ( $\pm 0.01$ ), while the mean weight was 432 ( $\pm 3.3$ ) kg. There were fewer than 3% stallions, with mares (50%) and geldings (47%) accounting for approximately equal portions of the slaughter horse candidates. The breed categories of the slaughter horses reflected the general United States horse population with 48% classified as Quarter Horses, 18% Thoroughbreds and the remaining included Morgans, Standardbreds, Arabians, Appaloosas, draught and pony breeds. The mean body condition score was 5.6 ( $\pm 0.08$ ) and ranged from 2 to 9, using a 1 (thin) to 9 (obese) scale (10). These general characteristics of the slaughter horses reflected a middle-aged, moderately fleshy Quarter Horse, or Thoroughbred, which are popular in the United States for recreational activities, competitive events and racing. The data on horse characteristics provided the platform for developing recommendations for federal regulations on the appropriate design of transport vehicles, loading and handling management, and maximum transit times for transporting slaughter horses.

### Injuries

The media also delivered messages on the neglected, diseased and injured conditions of horses shipped to slaughter, often with graphic pictures of compromised horses clearly unfit to endure travel. Double-deck semi-trailers were primarily engineered and designed to transport cattle, but have been used to transport horses to slaughter with little or no modifications. Straight-deck trailers were designed to transport horses but could be modified to transport other species, such as pigs or cattle. The name 'pot-belly' (double-deck) denotes the two similarly sized compartments that are vertically stacked between the front and rear axles of the trailer. The ceiling heights of these stacked compartments of the double-deck semi-trailers (1.7 to 1.8 m) are lower than the ceilings (2.1 to 2.7 m) of straight-deck semi-trailers (Fig. 4). This limited head room for horses in the double-

deck semi-trailers attracted criticism from several animal advocate groups.



Figure 4  
Horse in lower compartment of double-deck trailer

Studies compared multi-disciplinary data collected from horses transported in double-deck and straight-deck semi-trailers to slaughter facilities. Physiological data, including cortisol concentration, white blood cell measurements and other indices, showed greater responses in horses shipped in the straight-deck compared to the double-deck semi-trailers; this data supported the use of the straight-deck semi-trailer. However, the number of injuries (lacerations and abrasions) sustained during transport was 3.5 times greater ( $p < 0.05$ ) in double-deck (29%) compared to straight-deck semi-trailers (8%) (16). The most likely location on the body of these injuries was the face/neck (58%) (Fig. 5),



Figure 5  
Head injury during transport in a double-deck trailer

thus indicating that the injuries were due to the lower ceiling height or the design and size of the loading ramps into compartments of the double-deck semi-trailers was inappropriate for horses.

An extensive survey study provided data on the physical condition of 1 008 horses arriving at United States slaughter plants in the summer of 1998. Pre-transit conditions of emaciation, fractured limbs, laminitis or weakness was recorded in 1.5% of the horses, whereas, 92% arrived in good condition. One horse was dead on arrival and two horses died prior to slaughter. Interestingly, the survey concluded that the proportion of owner neglect and abuse (6%) occurring prior to transit was much greater than the number of injuries (2%) that occurred during marketing and transport. Horses travelling loose in small groups may interact aggressively causing injuries and bruising. Damage caused by kicking was not observed on live horses, but bruising was documented on 25% of the carcasses with the majority of bruises possessing the characteristic pattern of bites or kicks. The authors concluded that the management of slaughter horses should consider methods to reduce injuries from fighting during transit, such as the mixing of unfamiliar horses prior to transport and the segregation of stallions or aggressive horses during transit (8).

Stocking density may play a role in contributing to stress, immune compromise, and injuries in horses. The flooring space in vans and many bumper-hitch trailers designed for race, show or recreation horses typically ranges from 1.4 to 2.0 m<sup>2</sup>/horse. Commercial double-deck and straight-deck trailers have been documented to provide 1.14 to 1.54 m<sup>2</sup>/horse, with horses travelling loose in small groups (6 to 12 horses) within 4 to 6 compartments. Many physiological parameters for stress, weight loss and immunological responses showed ( $p < 0.05$ ) a smaller response between pre- and post-transport samples for horses provided with high floor area (1.4 to 1.54 m<sup>2</sup>/horse). Conversely, injuries were much greater ( $p < 0.05$ ) in horses with high floor area

(29%) compared to low floor area (1.14 to 1.31 m<sup>2</sup>/horse, 8%) (16).

Injuries may also be attributed to road conditions or the skill of the driver. The effect of severe driving conditions consisting of hard breaking, rapid accelerations and severe turns during a short 25 min transport were examined in horses provided with floor space of 1.28 or 2.23 m<sup>2</sup>/horse. The adverse driving manoeuvres were more intense than normally experienced under commercial highway conditions for slaughter horses. The incidence of falls and injuries was greater ( $p < 0.05$ ) in the horses provided with low floor area (high stocking density), supporting increased floor space for horses travelling loose in groups (2). From the series of different research studies, recommendations on appropriate stocking densities for groups of horses travelling loose depend on many factors, including vehicle design, road conditions, driver ability, weather, flooring conditions, familiarity of horses within a group, sorting of horses prior to transport and the size, weight and fitness for travel of the individual horse.

### Dehydration and water availability

Horses travelling for long durations in hot summer conditions would be expected to experience some degree of dehydration, especially if there is no access to water during transit. Often, slaughter horses have limited accessibility to feed and water in market channels prior to shipping which may affect hydration status. Water deprivation during transport is a valid concern not only to the well-being of the horse, but also to the purchasers of slaughter horses due to the reduction in monetary payments associated with the loss in body weight caused by dehydration. The possibility of dehydration during long-term transport in slaughter horses was evaluated in a study of nine loads of horses commercially transported to slaughter facilities (16) and another study with a controlled experimental design using four groups of horses that were watered or non-watered and either transported or remained in pens (3, 4). Both studies concur in their results showing an incremental rise in physiological

dehydration indices with duration of transport up to 30 h. Additionally, dehydration may become a clinical concern in transporting slaughter horses during summer conditions with transit durations lasting more than 24 h.

Offering water during long-term transport may alleviate dehydration. However, the appropriate time, amount and method needed to be defined before developing recommendations. Vans in which horses are cross-tied by their halters in individual stalls and provided with hay and water are often used for road transport of high quality horses. Water consumption was studied in 15 horses travelling in a van for 24 h in hot environmental conditions (19-39°C). Although water was offered from buckets five times during the 24 h transit period, 91% of the water was consumed after 12 h of transport with a mean consumption of  $22.7 \pm 6.4$  l (18). In a study using slaughter horse conditions, including horses travelling in small groups, ambient temperatures between 23°C and 36°C and withholding feed and water for 4 h prior to transit, on-board water troughs and stocking density were evaluated during an 8 h trip. Horses were offered water on-board from troughs attached to the inside of the trailers at the destination. All horses drank water from the on-board troughs after 8 h of transportation (12 h of water deprivation), provided the stocking density allowed adequate room to access the water troughs (6). A subsequent study examined the effect of one hour on-board rest stops with and without access to water in groups of loose horses travelling for long durations. Video cameras provided data on the activity of the horses during rest stops after 8 h and at the conclusion of 16-20 h of transport (Fig. 6). Compared to the horses deprived of water, the horses provided with water during the rest stops exhibited an increased movement for the first 10 to 15 min of the rest stop as horses moved to the water or were aggressive among herd mates for access to water bowls (5).

### Stress response

Transportation elicits stress response in most animal species and the severity is dependent

on the number and duration of multiple factors, including the health status of the animal, environmental parameters, such as noise, temperature, pathogen challenges, air quality, humidity and lighting, and the physical conditions, such as space availability, ventilation, feed and water access, suitable flooring, road conditions and trailer design. Additionally, other factors can be perceived as stressful to a horse, such as loading density, novel environments, handling techniques, social isolation or interactions with other horses and previous transport experiences. The stress response during and following transportation has been implicated as a predisposing factor in horses to infectious disease, especially respiratory disease (1, 13, 19).



Figure 6  
Trailer interior with study cameras on roof in straight-deck trailer

During stressful situations, such as transportation, the activation of the hypothalamic-pituitary-adrenal axis results in an increase in plasma cortisol. This physiological marker has been used to quantify the stress response in studies examining commercial slaughter horses travelling loose in small groups. Blood samples were collected from slaughter horses ( $n = 306$ ) before and after transportation of varying durations from about 6 to 30 h in hot summer conditions. Mean cortisol concentrations increased from 46 ng/ml to 58 ng/ml, but no difference ( $p > 0.05$ ) was demonstrated for duration of trip or floor area allowed per horse. Unexpectedly, horses travelling in

straight-deck semi-trailers showed a greater ( $p < 0.05$ ) elevation in cortisol concentration compared to double-deck semi-trailers. An elevation in cortisol concentration due to stress may lead to a neutrophilia and lymphopenia, and thus can be quantified by calculating the N:L ratio. The N:L ratio is a more reliable indicator of stress than cortisol (9). In slaughter horses that travelled loose, transportation increased the N:L ratio from 3.1 to 4.4 (16). Similar to the cortisol response, the N:L ratio from horses transported in straight-deck semi-trailers showed a greater elevation ( $p < 0.05$ ) than horses shipped in double-deck semi-trailers. This difference in both cortisol concentration and N:L ratio between horses travelling in straight deck and double-deck trailers may be due to the fact that the amount of ventilation was limited on the sides of the straight-deck semi-trailers and this may have contributed to additional thermal stress during the hot summer conditions. The N:L ratio also showed a greater increase ( $p < 0.05$ ) in slaughter horses provided with low floor area (1.14 to 1.31 m<sup>2</sup>/horse) compared with high floor area (1.40 to 1.54 m<sup>2</sup>/horse) (16).

High quality horses such as race, breeding and show horses are commonly transported by road in vans with each horse cross-tied by their halters in individual compartments. Horses ( $n = 15$ ) travelling in a van for 24 h exhibited peak cortisol concentrations ( $101 \pm 41$  ng/ml) greater than the cortisol concentration of slaughter horses ( $58 \pm 2$  ng/ml) travelling loose with transit durations between 6 and 30 h. The N:L ratio was also greater in horses transported in vans with the peak elevation of the N:L ratio ( $11.9 \pm 12.1$ ) occurring 3 h after unloading the horses from the van. The restricted movement of the head and neck due to cross-tying the halter during transport in the van may have contributed as an additional stressor in comparison to slaughter horses which travelled loose without restrictions to head and neck movements. Additionally, the rise in cortisol influencing the immune system, exhibited by the elevated N:L ratio, may contribute to disease susceptibility of horses following transport in vans (18, 19).

## Discussion

The results of the USDA-sponsored research studies and other published studies provided a platform for the development of the proposed federal regulations on commercial transport of equines to slaughter (21). The research provided science-based information that could be applied to slaughter horses in a wide variety of common transport situations. Many of the proposed federal regulations were developed on performance standards rather than strictly engineering standards (14, 17). The design of performance standards is based on the requirement in the federal regulations that the shipper/owner of the load of horses being transported to slaughter is required to complete and sign a certificate prior to loading the horses that provides a description of each horse, including any injuries or unusual conditions that may require special handling needs, application of a numbered back tag to each horse, description of the conveyance, place and time of loading and shipper/owner's compliance to uphold the care of the horses during transport. The 'performance' of each shipment is evaluated upon arrival at the slaughter facility by a USDA representative with the inspection of the horses for injuries and appropriate fitness to travel, proper conveyance design and maintenance, and other mandatory documentation presented on the shipper/owner certificate. Violation of any part of the regulations may be assessed up to US\$5 000, with each equine of the shipment being considered a separate violation (22). Since the regulations were implemented (January 2002 to December 2006), 198 violation penalties have been assessed. While the number of violations has increased each year since the implementation of the regulations, more violations have been due to minor deficiencies, such as the failure to properly complete the shipper/owner certificate. The number and the degree of egregious cases due to humane care infringements decreased between 2002 and 2006 (T. Cordes, personal communication). This decrease in humane care violations over the last four years is indirect evidence of the positive impact of the

implementation of the federal programme and regulations on ensuring compliance for the humane and safe transport of horses to slaughter facilities.

Several regulations were developed using the results of the injury and physiological data that also included engineering standards. Well-designed transport vehicles make efficient and humane transport easier to achieve (7). Regulations for the commercial transport of horses to slaughter required a means to segregate each stallion or aggressive equine to avoid contact with other horses in the conveyance. Another requirement was that each horse should be provided enough floor space to ensure that no equine suffers discomfort or injury due to crowding. The requirement for standards of conveyances (transport vehicles) includes a ceiling that is high enough to allow a horse to stand with its head extended to the fullest normal postural height (Fig. 7) and be equipped with doors and ramps of sufficient size to ensure safe loading and unloading (Figs 8 and 9). This engineering standard promulgated the regulation that the conveyances with two or more stacked levels (e.g. double-deck trailers) would be prohibited from transporting equines after December 2006. A period of 'grace' of five years was offered to the trucking industry for transition to other transport vehicles for horses and to lessen the economic impact of those dependent on the use of double-deck trailer. Nevertheless, the shipper/owner was responsible for any injuries that occurred among horses transported in double-deck trailers during this period of grace (2001-2006) (22).

The humane care and well-being of the horse during transport is dependent on the fitness of the horse to travel prior to loading. Fitness to travel was defined in the federal regulations as the ability to bear weight on all four limbs, ability to walk unassisted, not being blind in both eyes, being over 6 months of age and not being likely to give birth during the trip. Horses are to be provided with appropriate food, water and rest for a minimum of 6 h prior to loading. The regulations also take into account horse care and maximum duration allowed for transport. Shippers must offload





Figure 7  
Horses in straight-deck trailer with cameras on the roof



Figure 8  
Well designed loading ramp from a straight deck trailer



Figure 9  
Horses assembled in chute for loading onto a trailer

from the conveyance any equine that has been on the conveyance for over 28 consecutive hours and provide feed, water and rest for at least 6 consecutive hours (22). Only one-third of the animal handling equation is contributed by engineering and equipment, the other two-thirds are devoted to employee training and management committed to animal care (7). Often the shipper of slaughter horses is only the intermediary between the owner and the slaughter plant and thus may not be trained or fully committed to the humane handling and care of horses in transit. All standards in the final regulations for humane care and handling of slaughter horses in transit were not based on specific data from research studies but were also developed from personal observations of the researchers and the experience of people handling and transporting horses to slaughter. The following general guidelines define the responsibilities and accountability of the owner/shipper when handling slaughter horses throughout the transport process:

- the owner/shipper must drive in a manner to avoid causing injury to the horses
- the owner/shipper must check the physical condition of the horses at least every 6 h during transit and must obtain veterinary assistance as soon as possible for any equines in obvious physical distress
- handling of equines in commercial transportation to a slaughter facility shall be done as expeditiously and carefully as possible in a manner not to cause

unnecessary discomfort, stress, physical harm, or trauma

- regulations prohibit the use of electrical prods for any purpose including loading and offloading, except when human safety is threatened (22).

## Conclusions

Processing plants in the United States that slaughter horses for human consumption have progressively decreased in number during the last decade due to several factors, including the decline in the number of horses slaughtered, increased interest in animal welfare by much of society and the political pressures of the United States public whose cultural background and current beliefs generally do not accept the processing of horses for meat products marketed for human consumption. In the late 1980s, there were sixteen federally inspected plants for horses in the United States that processed over 300 000 horses per year but, by 2006, only three plants were operational and processed approximately 100 000 horses. Legislation has been repeatedly introduced to Congress and at the state level to prohibit the slaughter of horses for human consumption in the United States. Currently (2007) only one slaughter facility is processing horses in the United

States. In 2006, approximately 20 000 live horses were transported to Canada for processing, while 2 500 were shipped to Mexico for slaughter. This number of horses exported from the United States to neighbouring countries for processing is expected to increase with the concomitant decrease or elimination in the number of available United States slaughter facilities. Shippers and/or owners of horses originating from the United States and offloading at Canadian slaughter facilities or at the Mexican border are still obliged to comply with the current United States federal regulations. The development of these federal regulations and programmes based on both engineering and performance standards has educated the industry and sought a minimum level of compliance for the humane movement of horses. The United States animal welfare movement continues to be progressive and active about issues concerning horses. The further development of regulations for other facets of the horse industry or other species can be expected in the near future. The engineering- and performance-based standards developed through the collection of scientific data and practical experience may serve as a model for effective future welfare regulations and legislation.

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