Non-commercial Horse Transport:
New Standards for Trailers in Canada

Sharon E. Cregier, Rebecca Gimenez, Editors

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Volunteer Committee

Members contributing to this report share over four centuries' involvement in large-animal transport. Their insight covers animal behavior in transport, biology, metallurgy, large-animal technical rescue, and automotive dynamics.

One member has been a European Union government official inspecting livestock transport. Others have served on international, European, and United States animal welfare and government committees to set competencies and standards for transport by road, sea and air.

Some are the first responders who must extricate humans and animals from the equipment failures and driver miscalculations.

Several have been instructors at local, national and international levels in all aspects of transport. Many have worked with the veterinary and first responders to develop and share techniques for animal and human management at crash scenes.

Chairman Sharon E. Cregier, PhD, FIASH (Hon., Edin.); North American Editor Emerita, Equine Behaviour. Twice awarded the international Animal Transportation Association (ATA) animal welfare award, Dr. Cregier has been involved with horse transport issues since 1974. Dr. Cregier's doctoral thesis and 1982 Journal of Equine Veterinary Science review of horse transport problems were the catalyst for the rise of international interest and research on the topic. She has published two books and over 2000 articles in refereed journals and the popular press. She is a member of the ATA, the Animal Behavior Society, the International Society for Applied Ethology, and the British Veterinary Forensic and Law Society. She was the ATA's Equine Committee chairman, 2011-2012. She is currently compiling a history of the changing practices in the transportation of horses by waves, wings, and wheels.

Rebecca Gimenez, PhD, Primary Instructor for Technical Large Animal Emergency Rescue (TLAER) and Major, Signal Corps, United States of America (USA) ARMY Reserves. Dr. Gimenez initiated the first collection of data involving large animal deaths (particularly horses) and injuries during transport, currently numbering 2,000 and rising. Her findings have inspired EquiBalance trailer to design a trailer to contain the animal within the transport during collisions or overturns. As founder of TLAER (tlaer.org) she travels internationally to train police, firemen, first responders, and laymen on extrication of large animals from a variety of incidents. In 2012, she won the international ATA Robert D. Campbell award for her outstanding contributions to animal and human welfare. As a Major in the USA Army Reserves, she is a communications officer but has trained Special Forces soldiers in large animal handling before their deployments, and is trained in incident command. She holds degrees in biology, and animal physiology. She has served as logistics officer for the Veterinary Medical Assistance Team (VMAT). (Consisting of 50 members around the USA, VMAT-2 can set up a field hospital, providing emergency care for pets, search and rescue dogs, livestock, wildlife and zoo animals. It assists with food safety concerns, zoonotic disease, terrorist events and toxicological problems).

Dr. Gimenez's current research is a national survey of trailer accident causality, and an investigation into poor nutrition in horse neglect cases. With contributing authors, she edited and published Technical Large Animal Emergency Rescue (2008), the very first textbook on heavy

rescue of large animals and featuring two chapters on extrication from overturned trailers, (floats) and vans. In August 2011, she helped conduct the first US Department of Agriculture, Animal and Plant Health Inspection Service and Federal Aviation Administration coordinated exercise in rescuing large animals from crippled aircraft in Miami, Florida.

Eddie Harper, MBE Livestock Transport Consultant. Past chairman of the Road Haulage Associations Livestock Hauliers Group. Informally acknowledged as "the Pope of animal transport," Mr. Harper has been involved in the transport of animals for 50 years. His specialist knowledge is in demand by local and national authorities and animal welfare interests. In the past, he was heavily involved with the former Silsoe and Roslin research institutes on livestock transport research. He designs and runs training courses in livestock transport and is a consultant for or member of national government authorities and farm animal welfare councils. He is also familiar with the welter of conflicting road-transport legislation in the EU. He is a transport advisor to Red Tractor Farm Assurance. Familiar with North American and European animal transport industries, he has presented at numerous conferences and seminars in the United Kingdom (UK), Europe, and Canada.

Tim Harris, SDA, Edin. **Pet Relocations Manager, Manoir Kanisha, Montreal**. Mr. Harris is a specialist in the transport of animals, which includes horses. Trained in Agriculture (Edinburgh 1959-1961) he specialised in the breeding of Landrace pigs, an endeavor which saw pigs exported to over 40 countries. He oversaw the transport of more than 10,000 cattle, dogs, sheep and pigs to France between 1964 and 1974, and launched a trade in genetics and breeding stock into Malaysia, Singapore, Philippines, Thailand, Korea, Japan, and Australia. He invented the water-tube and nipple drinking system used for pigs in aircraft and dedicated double- and triple-deck containers for sheep, pigs, and goats transported by air. After the conflict with Argentina in 1982, he was asked by the UK government to fill the Dina Khalaf cattle ship with 250 animals of five different rare breeds for a 36-day voyage to the Falkland Islands. This comprised sheep, cattle, pigs, goats and horses. Health requirements, limits on gestation periods despite delays, and a welter of conflicting animal-welfare regulations were surmounted Subsequently he was for 12 years a member of the Farm Animal Welfare Council (to advise government ministers) chairing the Animal Transport Group. From this he was appointed as a specialist observer to the Council of Europe in writing the Guidelines for the Long Distance Transport of Animals and is the editor of the AATA (Animal Air Transportation Association, now Animal Transportation Association) Manual for the Transportation of Live Animals By Road. He also co-wrote the OIE (World Organisation for Animal Health) Guidelines for the Transport of Animals by Sea. He is a consultant to insurance interests, animal welfare bodies and governments. A visiting lecturer and trainer in animal welfare and handling, he trains air ground staff and farm students, and lectured in Poland, the Slovak Republic, France, Scotland, Germany, Hong Kong, and the States. Mr. Harris was also instrumental in establishing the ATA's competency training and certification program for grooms accompanying animals in transit. He thought he would retire to Canada but has found a wife and a more arduous occupation than farming. He is currently the pet relocations manager for Manoir Kanisha, Montreal, where he has developed a database of documentation, health, welfare, export/transit/import permits, container design and construction for aircraft and ships.

Odessa Holmes, Dip. Ed. **Director of EquiBalance horse trailers, New Zealand**. Ms. Holmes applies her background in psychology, teaching and team leadership skills to demonstrating safer transport for horses. Together with her late sister, professional heavy-goods

driver and successful show jumper, Sheri Holmes, she has tested a variety of materials, road conditions, terrain, axle components, partitions, and horses. The result is horse transport guided by the World Animal Protection/OIE (WAP) Five Freedoms and recommendations for humane transport. The originator of the rear-face, two-horse trailer, the sisters' father, David J. Holmes, anticipated by 30 years the University of Sydney findings that horses need to lower their heads during transport to maintain a healthy respiratory tract. Ms. Holmes was an invited speaker at the 2008 International Equine Science symposium in Regensburg and the 2012 international ATA conference in Vancouver, B.C.

Joseph "Jody" Purswell, PhD., PE., **Research Agricultural Engineer.** Dr. Purswell is located at the USDA Agricultural Research Service's Poultry Research Unit at Mississippi State. His research program focuses on improving production efficiency in commercial poultry in the USA through improved design of ventilation, environmental control, and housing and husbandry systems. He maintains a strong interest in animal transport, both animal status and environmental variables. His initial experience with animal transport comes from life on a small cow-calf operation in southeast Texas and competition team roping. His doctoral work focused on characterizing the thermal environment within a trailer during road transport of horses. A study of the thermal environment was undertaken to determine the effects of animal presence, travel speed, and vent/window configuration on transport conditions. A novel application of tracer gas techniques allowed for the only full-scale measurement and estimation of trailer ventilation rate with animals present. Results of these studies indicated that the current system of windows and roof vents does not provide sufficient ventilation to maintain interior trailer air temperature within an acceptable range, even during mild weather. Dr. Purswell has experience with transport research with cattle by ship, commercial poultry, and horses by road and airplane. In addition, he has extensive experience in developing measurement systems for assessment of thermal status in cattle, horses, and poultry. He is a registered professional engineer in the Commonwealth of Kentucky.

Tom Scheve, CEO, EquiInternational. The EquiSpirit trailer features (http://www.equispirit.com/trailertour/photos/tour) split back-entry doors designed to protect the handler from the horse during loading and unloading. The interior dividers are designed to survive major accidents and reduce injury. A ramp helps protect the horses from rear-end collisions. The emphasis in his trailers is aero-dynamic design, ventilation, break-away quick release breast and butt bars. Mr. and Mrs. Scheve have published Hawkins' Guide: Horse Trailering On The Road as well as Equine Emergencies On The Road with Jim Hamilton, DVM. Mrs. Scheve's textbook on horse trailers, The Complete Guide To Buying, Maintaining, and Servicing A Horse Trailer, is considered the bible of the industry. The Scheves are involved in safety clinics at universities, expositions, and national organizations such as Pony Club and National Trail Riders Association. Mrs. Scheve is also co-developer of the Moore County, North Carolina Equine Emergency Response Unit, one of the few county-wide emergency plans in the country. The firm also developed an equine ambulance and portable dolly with sling to be used in emergencies for horse rescue. Mrs. Scheve served on VMAT (Veterinary Medical Assistance Team, affiliated with the American Veterinary Medical Association and the Federal Emergency Management Agency), and was part of the search and rescue team sent to Eastern North Carolina during the 1999 flood.

Johann Sigurdson, BSc, MNRM, President, Aero-Equis, Inc. Mr. Sigurdson is an animal behaviorist and wildlife biologist with over 20 years directing biological research and

environmental impact assessment programs with the federal and provincial governments. Since the early 1980s, he has immersed himself in industrial design, marine, and horse trailers. As a horseman he has been in the business of non-commercial trailer manufacture for over 30 years. He is conversant with the European restrictions on trailer weight, design, construction and use. Eliminating vibration problems adds years of life to his product. For the past 35 years, he has built and used the rear face mode of horse transport for his polo ponies and high-value competition horses. His trailers are also recyclable to protect the environment. An ordinary saw, in an emergency, can, without sparking, create a rescue opening for the occupants. The jaws of life are not required. His companies have supplied hundreds of specialized horse trailers for clients throughout North America and Europe as well as organizations such as the Canadian military. He has also provided consulting services in horse transport to the Royal Canadian Mounted Police Musical Ride. One of the many products developed for commercial application is the design and production of off-road ambulances for use in remote communities and the oil fields. Featured at the 2009 GO-EXPO in Calgary, it attracted interest from China, Kuwait, France and Korea. He applied the over-specifications strength attributes of the ambulance to horse trailer manufacture. These changes increased the safety of the horse by providing a protective rollover cage and by accommodating the horse's balancing needs. He has also undertaken several assignments in Central America, Europe, and Scandinavia to provide local companies assistance in improving aluminum product manufacturing processes and techniques. He continues to innovate and study new opportunities to further the development of more advanced and innovative means of ensuring the safety and comfort of animal transport. The international Explorers Club, of which he is a member, demands quality transport for their horses as a primary factor in the success of an expedition. An active horseman, he enjoys playing polo internationally.

Suzy Stennett, Underwriter for Crowe Livestock Insurance. Ms. Stennett specialises in animal transport. She is the past President of the international Animal Transportation Association. Ms. Stennett started her career in insurance at her local National Farmers Union Mutual office in 2000 where she gained extensive experience in general insurance. In 2002 Ms. Stennett joined Crowe Livestock Underwriting Limited, specialising in the underwriting of livestock, in particular aquatics, exotics, camelids, and deer. Using her knowledge acquired in this area, Ms. Stennet is involved in the rewriting of the Lloyds UK and Overseas Livestock All Risks of Mortality wording LMA 3093. Ms. Stennett was appointed Underwriting Manager of Crowe Livestock, part of the Amlin Group, in 2010.

Les Warrington, BA, BSc. **Reliability Engineering Professional.** Mr. Warrington is equipped to advise on failure analysis, experiment design, reliability, root-cause analysis, engineering management, and systems engineering. Former engineer and squadron leader with the Royal Air Force (1975-1993), he was the Royal Air Force forensic specialist for military aviation incidents. He was a senior fellow at the University of Warwick (1993-2005) and is a lifelong horseman.

Jennifer Woods, MSc. **CEO J. Woods Livestock Services.** Ms. Woods is the 2013-2014 President of the Animal Transportation Association. Since 1998, she has trained professionals on accident preparedness, containment, and rescue, particularly in regard to cattle and horse liners. She designed a program to provide training for firefighters, police, producers, and truck drivers involved in cattle liner and other livestock transport incidents. She wrote the chapter in Gimenez's Technical Large Animal Emergency Rescue textbook about response to livestock

liner incidents. In consultation with responders in European countries, her training emphasizes improved efficiencies, improved animal welfare and decreased monetary losses. She continues to work with her former Colorado State University professor, Dr. Temple Grandin. She certifies Canadian universities for the Canadian Council on Animal Care and developed a livestock behavior and handling curriculum for colleges. She wrote the animal welfare audit for horses at slaughter and developed the Horse Hauling Course in collaboration with the Horse Welfare Alliance of Canada.

Roger Wrapson, Livestock Transport Consultant. Mr. Wrapson is the communications director for the Federation of British Historic Vehicle Clubs, author, and broadcaster. For many years, he was the senior manager of the UK Road Haulage Association and Secretary of the Association's Livestock Carriers Group. With Eddie Harper, MBE, and Tim Harris, he worked with the European Commission on the revision of the current Protection of Animals in Transport Regulations. Prior to this, he was transport and distribution director for UK market leader PLC. He is a qualified international transport manager and a member of the Institute of Road Transport Engineers.

Important Notice

This document is intended to represent, encourage and achieve better outcomes for human safety and animal welfare in equine transport. Nevertheless, the driver always retains the primary responsibility for ensuring safe operation of the vehicle under all operating conditions.

Improvements to trailer manufacture and materials may allow a greater margin of error or increase forgiveness factors for tow-vehicle operators. The recommended improvements cannot solve the problems of incorrect use of equipment, lack of maintenance, or distracted driving. Carelessness, lack of training, or inattention to hauling technique, are human choices and evidence of disregard for potential tragedy. Even where the required or recommended range of hitch load and inspection is mandatory, for example, it is up to the individual trailer owner or hauler to meet or exceed those stipulations.

This is a draft document intended for the use of a volunteer non-commercial horse trailer standards committee. The views, suggestions, practices and findings have not been approved by any government agency, credentialed equine behavior professional, or business. This document does not constitute legal or other professional advice. Professional consultation is advised on any aspect of this document. Individuals using any of the products or services mentioned in this document assume responsibility for their use. Illustrations used in a way not intended by the owner or publisher of that illustration are not condoned by the committee, the provider of the illustration, or the manufacturer so illustrated.

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The term “standard” used in this document includes international standards, technical specifications, publicly available specifications and guides, recommendations, codes, a best practice, a shared practice, whether for good or ill, or a regulation.

Preface

The catalyst for this document originated at an international 2012 meeting of the ATA in Vancouver, British Columbia. Manufacturers, horsemen, international horse transporters, large animal emergency rescue services (particularly those involving highway incidents), animal welfare representatives attending the conference and the ATA were in accord.

Currently, there are low- to non-existent barriers to entry into the manufacturing business that caters to horse and small livestock trailers under 10,000 lbs. The buying public assumes that trailers have been subjected to rigorous standards for chassis and frame strength. However, there are no universal established standards for these or other components. The need to improve horse-transport modes is overdue, particularly among the non-commercial (private) sectors of the industry.

At the suggestion of members of Transport Canada, the committee offered to help government, insurance, trailer manufacturers, and regulatory interests identify the specific issues and offer solutions. Outcomes are available to other North American, Asia-Pacific and European countries interested in further implementation.

The concerns of committee members were reinforced by attendees at the November 2013 International Large Animal Rescue (ILAR) conference at Adelaide, Australia's, Roseworthy Veterinary College. Here, the failings of road transport for the horse of current practices and equipment were presented from the viewpoint of haulers and emergency workers (*R. Gimenez. Current issues, topics and research themes in transport. Retrieved September 1, 2014. https://www.youtube.com/watch?v=y4OHjLZHyjY*).

Further evidence of a need for improved standards is provided by privately collected statistics, interest by insurance companies, involvement of emergency rescue personnel, victims, veterinary cases, individual incident reports, legal cases, media reports, and the recent increased involvement by the US Department of Transportation.

The lack of available data in some areas in no way limits the need for change. As Brown University Research Fellow M. J. Dunkelman noted: "If a question is worth answering, then the underlying issue [is] worthy of simple and sustained observation" (*Dunkleman, M. J. Aug. 19, 2014. What data can't convey. Washington Post*).

Fig. 1

Illustration Credits

Illustrations not credited were drawn from screen shots, fire and rescue companies, news reports and publicly available sites.

S. Bellette: Fig. 11.9

R. Couch, Balanced Ride HorseTrailers: Fig. 3.7`

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J. Johnson: Fig. 7.3

Kentucky Highway Patrol:, Fig. 25.7

M. Leighton and M. Staples, 2012. Equine Emergency Rescue, EquineER.com: Fig. 8.4

C. Lichtwark, (n.d, ca. 1905). Educating the Horse. Privately published, Taranaki, N.Z., p. 149: Fig. 11.5

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B. Robinson: Fig. 11.8, Fig. 17.6, Fig. 17.7, Fig. 17.8

Royal Jordanian Airlines: Fig. 10.5

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J. Sigurdson, AeroEquis: Fig. 19.6, Fig. 19.7, Fig. 20.7, Fig. 25.15

Vella, Save A Horse Australia Horse and Rescue Sanctuary: Fig. 5.10

S. Weston: Fig. 19.9, Fig. 10.4

G. Williams: Fig. 9.3

1 History

1.1 Sea Transport

The transport of livestock has a history dating from the Ice Ages when coracles (hide covered, bitumen sealed woven baskets for water transport) were used (coraclesociety.org.uk), Marco Polo (1254-1324), Ibn Battuta (1304-1369) and observers down to modern times describe coracles of Yemeni origin freighting horses to India (*Stark, F. 1936. Southern Gates of Arabia. London: John Murray p. 27*).

Ancient Egyptian and other Mediterranean peoples commonly shipped cattle, including horses, on waterways. Persians, Greeks, and Romans had specialized horse transports, some of which features were incorporated into medieval ships for the Crusaders. Less elaborate shipping in long boats is seen in the Bayeux Tapestry (1070s A.D.) or re-enacted at Viking historical sites.

1.2 Land Transport

Land transport appears to have originated much later. The earliest, though unsupported, reference describes ancient Romans conveying their horses in wagons from Spain to racetracks in Italy (*Blancou, J. and I. Parsonson, 2008. Historical perspectives on long distance transport of animals. Veterinaria Italiana 44:1, pp 19-30. Retrieved June 28, 2014.* *http://www.izs.it/vet_italiana/2008/44_1/19.pdf*).

Confirmed records of transporting horses on land appear in 18th century England. The first may have been Queen Anne's (reigned 1702-1714) practice of conveying her racehorses in a leather slung pumpkin-shaped carriage. The first recorded instance of vanning was that of the famed thoroughbred, *Eclipse*, in 1771. Its feet were so badly affected by laminitis, there was no other way of taking it to stud (*Longrigg, R., 1972. History of Horse Racing. New York: Stein and Day, p. 80*).

1.3 Early Welfare Concerns

Disabled, dying, and ill horses were seldom afforded such care in transport. Horses bound for slaughter were the object of an 1822 law. Crusader for animal welfare Richard (Humanity Dick) Martin urged his fellow British Members of Parliament to ban the carrying of any living horse on any wagon or truck, dray or cart, or drag any horse having a disabled limb by attaching it to a vehicle, under penalty of paying £5 or being subjected to 3 months' hard labour (*Lynam, S., 1975. Humanity Dick: a Biography of Richard Martin, M. P., 1754-1834. London: Hamilton, p. 231*). Similar to today's regulations and codes governing "fit for transport," the law was meant to discourage subjecting infirm animals to transport. Humanity Dick's law is echoed today in federal and international animal transport welfare regulations and codes (*Retrieved August 2, 2014.* *http://www.victoriaadvocate.com/news/2014/aug/02/livestock_trailers_bm_080314_245125/?news*)

1.4 Accommodating the Performance Horse

Vanning for the performance horse entered the racing scene in 1816. It became well launched in 1836 when Lord Litchfield, using horse team relays, secretly vanned *Elis* 250 miles

to Doncaster. Bettors who assumed that the horse would never make the customary walk to the track in time were outwitted, losing thousands of pounds (*Longrigg, R., 1972. History of Horse Racing. New York: Stein and Day, p. 120*). A wheel from this van is preserved at the Jockey Club in London.

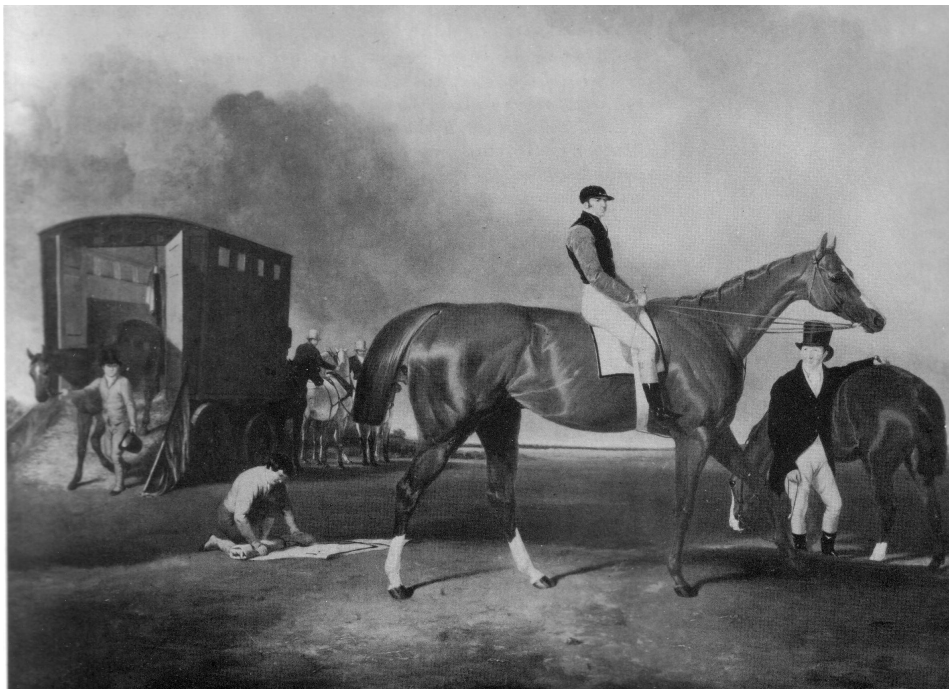

Fig. 1.1: This painting by Abraham Cooper depicts the arrival of Elis, together with its travel companion, The Drummer, at Doncaster, 1836. Though not the first horse to be vanned—that distinction belongs to Eclipse (see text)—its 250 mile secret journey and win popularized vanning instead of riding or leading horses to races.

From the start of transport, there were refusals of horses to load and problems unloading. Horses are apprehensive of enclosed areas, hollow or undulating surfaces, noise, or separation from the familiar herd. Throughout the 1830s until the early 20th century, these objections were met in part by elaborate vans that, during loading, provided the lure of light and an escape. They opened at the front, behind the driver's seat, which was swung out of the way to allow the horses to walk forward and unload. Lowered axles and more gently sloping ramps did little to ease loading problems. Many commentators of the time remarked on the horses' timidity about the process. Prey animal behavior or the horse's need to have no action or noise occurring behind itself was seldom accommodated even when acknowledged.

Fig. 1.2: James Pollard's 1842 *Derby Pets: The Arrival,* shows how coachbuilders used ramps to load and avoid reversing the horses off transport. The coachman's seat is swung aside. This van is lower than the 1836 specially built conveyance for *Elis*.

1.5 Motorized Transport

By 1912, horseboxes were fitted to motorcar chassis and mass-produced by Vincent Horseboxes of Reading, England. At the start of World War I, these were commandeered by the war effort, delaying the private use of motorized vans and boxes until demobilization in 1918. Hundreds of trained drivers were then released to serve the sporting interests.

From the start of the motorized horse box trade in the 1920s and early 1930s, most of the Vincent Horseboxes, the leading manufacturer at the time, were built to face the horses away from the direction of travel (*Johnstone, Alan. Pers. corr. June 24, 2014. Mr. Johnstone worked in the drawings office of Vincent Horseboxes and has donated his collection of Vincent photos, letters, and advertising material to the Berkshire Record Office, Reading, United Kingdom [UK]*).

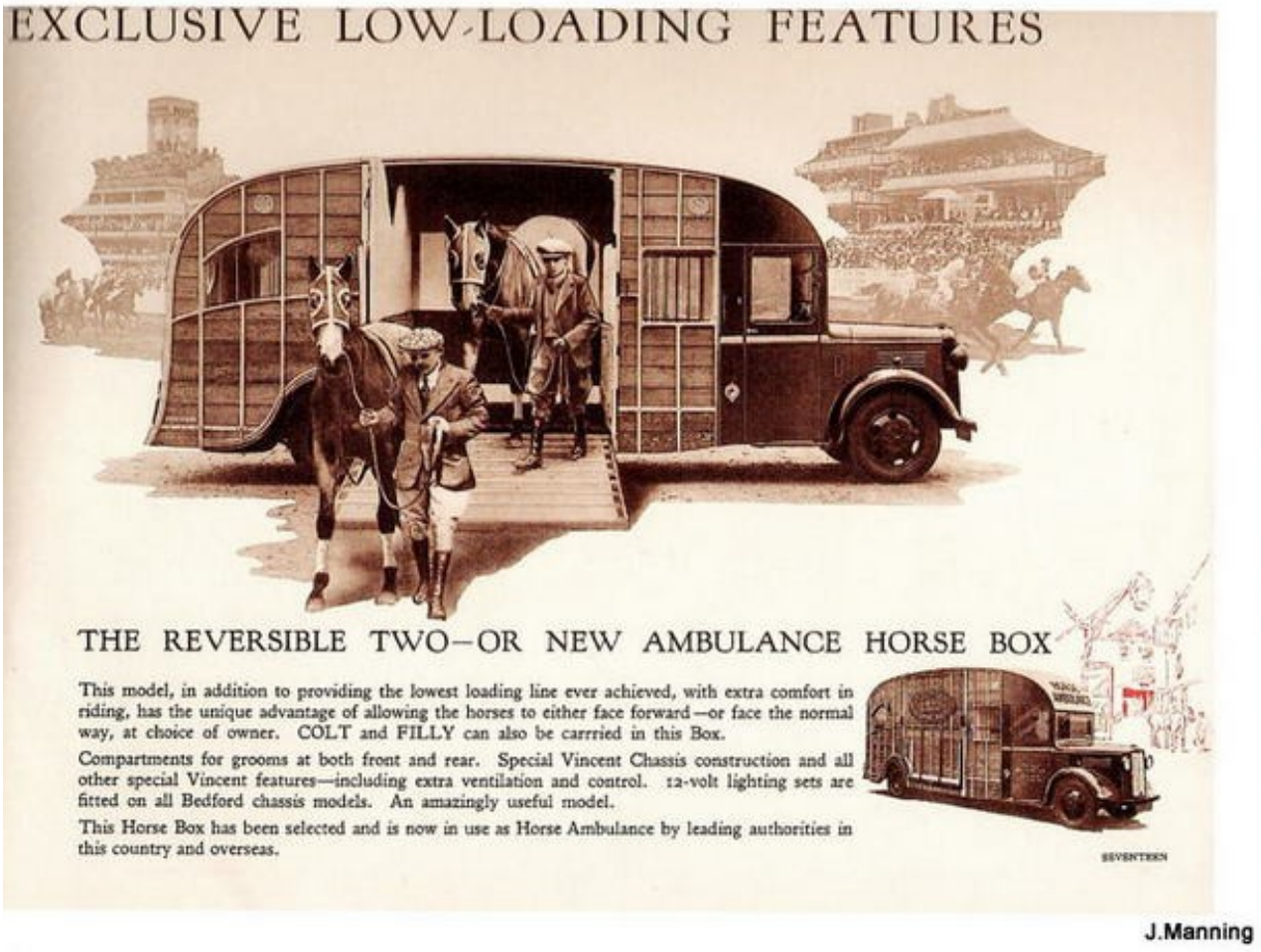

Fig. 1.3: Facing horses away from the direction of travel was long the norm for motorized transport. Grooms frequently traveled in front of the rear facing horses. Economics, the dwindling supply and affordability of grooms, the lack of knowledge about horse behavior and balance on a moving platform, and human anthropomorphism dictated the turn toward transport placing the horses facing the direction of travel.

What had begun as a larger version of the carts used for centuries to freight calves or other young stock to market became, by the 1930s, specialized wooden or metal trailers, intended to haul one or more horses. Some designs accommodated the rear-facing practice by loading the horse from the front or side of the trailer or van to stand its neck over the interior wheel well. The 8-miles-an-hour horse-drawn van was now hauled at 30 and 40 miles an hour on twisty roads.

No such doubtful luxury was afforded horses transported in the backs of pick-up trucks. There was little or no barrier between them and road dust, insects, temperature, or weather.

Fig. 1.4: Expediency continues to dictate this type of horse transport, whether open trailer or pickup truck.

As the interstate highway system grew and engine size increased, horse trailers, particularly in North America, became more popular especially in the 1950s and 1960s. They were little more than versions of the early horse-drawn vans minus the shafts that were replaced by v-shaped drawbars extending from the trailer to the motor transport. The rear-facing mode was abandoned when the wheels were moved outside the trailer frame. It also saved the expense and weight of the two ramps, entry and exit. The horses were now loaded to face the direction of travel. Grooms no longer traveled sitting in front of the horses, ready to unload out the back of the van or trailer.

As the popularity of horse trailers grew, the industry adopted steel, aluminum, fiberglass, or fiberglass impregnated materials. Each had its advantages and disadvantages. Materials, like aluminum, which tended to sheer or become brittle and suffer from catalytic action, a type of metal rot, were used for their lightness but could lose in strength. Steel tended to rust until galvanizing processes (some more effective than others) became common. Fiberglass was incapable of retaining a horse within the trailer in the event of an incident but made rescuing a trapped horse easier. Thin skinned trailers of any material presented a hazard if kicked or penetrated by a raised head. Little thought was given then or now to accident avoidance or survival, ventilation or suspension. Quality could vary widely within the same factory or in the same model line.

Whatever the conveyance, it likely ignored the effect of noise on the intended passenger. Noise has long been known to adversely affect a horse's health and behavior (*Richardson, A. 2011. Veterinary hospitals in the Imperial Roman Army Camp. Veterinary History 16:2, pp. 182-187*). Some manufacturers, for example, point proudly to aptly termed "slam latches" on partitions yet it has long been known that such noise is implicated in suppressing immune responses and tiring the passenger (*Axe, J. W., 1905. The Horse: Its Treatment in Health and Disease, Vol. 9. London: Greshan, p. 464-5* and *Minko, N. and J. Ayo. 2009. Physiological responses of food animals to road transportation stress. African Journal of Biotechnology 8:25, pp. 7415-7427*).

1.6 Lingering Problems

What is consistent throughout the decades of horse transport are problems such as shipping fever, destruction of the transport environment, weight loss, injuries during transit, refusal to load, and injuries either during loading and unloading. Incidents are commonly attributed to the horse. Little attention is paid to horse behavior, how to accommodate the horse's standing balance on a moving platform, or the interaction of live weight, trailer, and automotive dynamics. Human and equine safety is frequently compromised while handling tow vehicle, trailer, or horse.

Not only were the fundamental flaws in transport overlooked, but so too were animal handling skills that might have prevented the negative behavior in the first place (*Retrieved Jan 1, 2014 https://www.academia.edu/6616378/Equine_Transport_Prescriptive_or_Preventive*).

Prescriptive and mechanistic approaches to transport problems persist. These may be tranquillisers, blindfolds, inducing thirst and hunger to entice the horse to enter the trailer for water and feed, a hydraulic bar to push the horse into the trailer, portable gates or specialized harness to push or winch the horse in (*Badland, B.J. and M. I. Plant. 1980. Trailer Manual. Mechanical Services Trailer Engineers: Bolton, p. 139*). These remedies can compromise the horse's health and safety. None eliminate the original causes of resistance. Human perspectives augmented by force, mechanical methods, or deprivation overrode consideration of the horse reacting as a prey animal.

Fig. 1.5: A variety of coercive approaches are sold to train or force horses into conventional transport. This loading harness places the handler in a dangerous position. Should the horse leap forward, the handler may be trapped.

1.7 Toward Solutions

Incremental changes in transport design and horse handling began in the late 20th century with reference in the scientific press of work by biophysicist and advisor to Rudioso Downs race course, Col. J. Stapp, engineer, West Point instructor and horseman Wentworth Tellington, horseman and automotive engineer David J. Holmes, and historian and applied equine behaviorist Sharon Cregier.

Fig. 1.6: From its inception, the practice of vanning recognized the hazards associated with reversing horses to unload. Horses may react to novel stimulus from behind or uncertain footing by jumping forward or kicking. Provision was made in many vans, including this one from 1897, to place the handler at the horse's head and unload forward from the front of the van. The team for this horse drawn van has just been unhitched and led away.

These works were followed by the University of Edinburgh Royal (Dick) School of Veterinary Medicine's horsewoman and animal behaviorist, Natalie Waran and the University of Glasgow's the late T. D. M. Roberts, a neurophysiologist, international authority on balance, and horseman.

Aspects of these studies were researched at Massey University, New Zealand; the University of Sydney, Queensland, Cornell; the University of California-Davis; the Japan Racing Association; and others. Few, with the exception of those by Holmes, the Royal (Dick) School of Veterinary Medicine, and Walden University, attempted to study all facets of the transport process. For most of the rest, the complex relationships among horse behavior, safety for horse and human, automotive dynamics and transport design were largely overlooked. The horse was still expected to adapt to the transport rather than the transport adapting to the horse. Remedies remained prescriptive, e.g., more training, tranquilizers, or greater restriction in transport.

Lessons learned on scene by firefighters and large animal emergency rescue professionals, involved in response to both commercial and non-commercial (private) horse transport incidents, indicate how much further we have to go before the best practices in trailer manufacturing and horse transport are available and adopted.

Factors contributing to incidents are inappropriate design, poor suspension, tires, ventilation, the presence of carbon monoxide in the trailers, and noise. The best trailers minimize or eliminate these factors, providing a smooth ride under way and security for the horse, psychologically and physically, at all times.

Until then, 19th century "solutions" prevail in many areas.

2 Inclusions

2.1 Mandates and Minimums

Professional transport usually mandates training of employees; is under the scrutiny of occupational health and safety procedures, federal and state or provincial regulations; and has reference to scientific studies and literature for improvement as well as lessons learned and recalls. These advantages are largely lacking or ignored in the private sector. Trailers or horse transports less than 10,000 pounds in the USA and Canada are not affected.

Commercial trailers usually have much stronger and lower attachment points. They are designed to haul and retain their loads better than the typical amateur horse trailer (*Lichentenstien, I., Pers. corr. June 20, 2014*).

Without these advantages, the private sector, including handlers, haulers, and other highway users, are subjected, as is the horse, to greater hazards.

Although mandates exist as to a trailer's maximum weight allowance (Gross Vehicle Weight Rating), there are no checks on private trailers. The rating is readily exceeded when horses are too large for the trailer capacity and hay, straw, bedding, water, tack, and other personal items are added. The overloaded trailer is often towed by a vehicle that is not rated for these additions, changing the weight ratio and physics of the entire combination.

Without mandated oversight by which commercial haulers operate, it is impossible to improve the welfare of horses in transport with concurrent human and highway safety. This is particularly true concerning the most popular (cheapest) form of transport, the two-horse, non-commercial trailer. It applies equally to all horse trailers towed by vehicles categorized as non-commercial.

2.2 Engineering Welfare and Safety

The standards recommended in this document are directed toward horse trailers not exceeding a weight of 4,540 kg or 10,000 pounds or 5 tons. In keeping with the Society of Automotive Engineers International (SAE International) standards for trailer couplings, hitches, and safety chains, the standards recommended in this document are for horse trailers towed by passenger cars, trucks, and multipurpose passenger vehicles. Nevertheless, the recommended standards here can and probably should in many instances be adapted and applied to commercial or heavier horse trailers, tow vehicles and hitches.

For the engineers and standards writers involved, this document identifies some of the hazards accompanying the non-commercial transport of horses. These hazards, educational materials, professional standards, and the best welfare outcomes are referenced.

2.2.1 Role of the Five Freedoms

The transported horse is subjected to colic, diarrhea, pneumonia, laminitis, separation anxiety, confinement, ventilation and humidity fluctuations, exposure to fumes and particulates, loss of balance, rapid intensity or fluctuations in light levels, accelerations and decelerations, decreased function of the immune system and uncertain footing (*Stull, C., A. Rodiek, J. Jones, D. Leadon, & M. Ball. 2009. Reducing the stress when transporting horses by road and air. University of California Davis Center for Equine Health Horse Report September*).

The need for improvement in transport is recognized in the World Animal Protection (OIE) and European Union regulations and codes. It is acknowledged in the Canadian Agri-Food Research Council's Recommended Code of Practice for the Care and Handling of Farm Animals in Transport. These regulations and codes implicitly recognize animals as "sentient beings" worthy of protection from avoidable pain or suffering. The implication is that the animal's perspective is the paramount component of the transport environment.

All major animal welfare organizations, and the OIE, have adopted the 1979 Farm Animal Welfare Council (FAWC) Five Freedoms. Originally known as the Brambell Report, it described ideal states for an animal to access. This 1965 work, still referred to in some quarters as Brambell's Five Freedoms, is a tool for assessing an animal's well-being. Commercial transport design and practice, particularly in Europe, considers the Five Freedoms with regard to safety and welfare for humans and animals at all points along the transport continuum.

The Five Freedoms concern the animal's:

1. Freedom from hunger and thirst.
   Affecting the horse's ability to eat and drink is transport choke. Under stress, the horse's saliva may dry up and the horse choke. It can take weeks for the damaged esophagus to heal. Until then, swallowing may be uncomfortable for the horse (*Retrieved January 1, 2014. http://archive.agric.wa.gov.au/objtwr/imported_assets/content/pw/ah/welfare/codeofpractice_horsetransportation.pdf*)
2. Freedom from discomfort.
   The provision of an appropriate environment, including a comfortable resting area, for the horse is considered.
3. Freedom from pain, injury or disease.
   These freedoms require foreseeable prevention of the incident in the first instance and rapid diagnosis and relief in the event of a failure.
4. Freedom to express normal behavior.
   The animal will be provided facilities conducive to its nature.
5. Freedom from fear and distress.
   Conditions should prevent physical maltreatment and avoid mental suffering.

When transport practices ignore these freedoms, it is to the detriment of the industry and the safety of horse, handler, and highway user.

2.2.2 Engineering Concerns

These proposed standards distinguish between live and dead weight, just as tanker trucks hauling oil, milk, or water must meet different standards from those hauling gravel or oats to stop safely, avoid roll-overs, and maintain stability. As live weight, "The horse may be thought of as a 400-kilogram barrel standing on toothpicks with a lever sticking out in front (head and neck) weighing 75 kilos which functions with the thoracic sling and the muscles to balance the horse" (*Gimenez, T. June 23, 2014. Pers. corr.*)

Unfortunately, current tow vehicle and trailer manufacturers may not differentiate between static and kinetic loads when recommending their product (*Retrieved June 28, 2014. Safety in the trailer. HTTP://NCHorseBlogspot.ca/2012/08/safety-in-trailer-use-little-horse-sense.HTML* and *Noble, B., C. Riley, & K. Thomson, 2013. Horse Float Safety Survey, International Large Animal Rescue Conference, Adelaide, Australia. http://www.youtube.com/watch?v=wrmVIerq_08*)

2.2.3 User Safety and Design

The relationship of these standards to property safety, bio-security, and human and animal welfare is key. To this end, the committee has identified the user groups for horse trailers, including particularly vulnerable users such as women and children.

Identifying user groups and offering an understanding of how the equipment is used or intended to be used, points the way to solutions (*Wrapson, R. Pers. corr., April 16, 2013*). As an example, Appendix I compares two types of two-horse trailers, the common side-by-side, and the original balanced-ride designs to show how each affects user and horse.

In keeping with the International Standards Organization (ISO) Guidelines on Safety Aspects (*Retrieved June 23, 2014*.

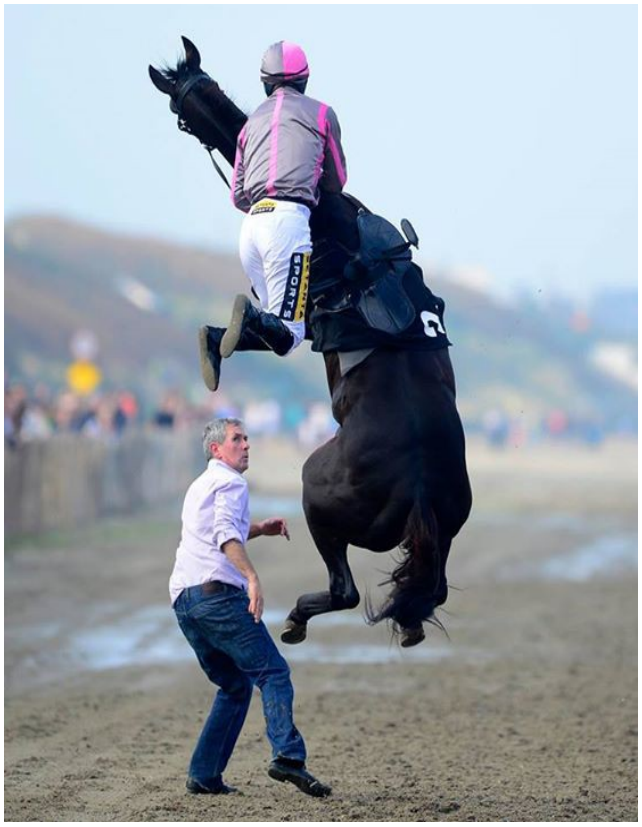

Fig. 2.1: Horses can react explosively to sound or sight of the familiar or unfamiliar. Popularly considered a prey animal, the horse will instinctively jump, thrash, run, kick or strike when it feels threatened.

http://publicaa.ansi.org/sites/apdl/Documents/News%20and%20Publications/Links%20Within%20Stories/ISO_IEC_CD_2_Guide_51.pdf. NB: ISO safety guides are available free to any standards committee), this document examines ways to reduce risks associated with automotive dynamics, human behaviors, and horse behaviors. Both the manufacturer and the end user are crucial in following a risk reduction procedure:

- What is the inherently safer design?
  - What risk reduction measures can be employed?
  - How can information be conveyed to users?

It is emphasized that standards rarely eliminate a risk but are intended to reduce it. This is especially true considering the "predictably unpredictable" nature of the horse.

2.2.4 Building a Base

Headquartered in Kansas, the National Association of Trailer Manufacturers (NATM) has already established minimum standards for tires, wheels, and axles. These minimum standards may not always be observed by manufacturers outside the nearly 750-member international NATM membership. These minimums may not meet higher requirements such as maintaining tire balance or accommodating horse behavior, but they are the best attempt in North America to address some of the concerns. Any of the 110 horse-trailer manufacturer NATM members meeting these minimum standards may display the NATM logo as a selling feature.

This committee would like to emphasize the importance of maintenance and driver training in maximizing road and human safety and have made references to existing training programs.

Typically, manufacturers' names are not included in recommended standards documents. They are included here to show that, due to their lack or minimal standards, some manufacturers have sought to improve conditions on their own. Mention of a product by name does not constitute an endorsement or condemnation by this committee.

Fig. 2.2: Driver behavior, weight placement, and hitching are crucial contributors toward maintaining control.

Recommended standards herein are goal or performance based rather than prescriptive. Standards that might be explored as possibly assisting in achieving these goals are noted and contrasted with existing practices where appropriate. Goal and performance-based standards allow maximum freedom for technical development and are thus emphasized.

The goal of any recommended standards should be that where possible no single failure of a component, e.g., a sway bar, wire, tire, hitch, chain, suspension, brake, etc., leads to a hazard.

2.2.5 Economic Benefits

Committee members are concerned that conscientious manufacturers must contend with competitors' cheaply made trailers. One Canadian manufacturer has generously loaned her photo record of poor products by competitors sold on the Canadian market.

The Committee will summarize the probable economic benefit to the North American economy. It will comment on the steps required to obtain the optimum available goals.

Lastly, it is hoped that manufacturers of other trailer types (boat, utility, lawn, etc.) will be interested in adopting some of these standards to improve the safety of their users.

2.2.6 Funding and Publicity

The Committee offers outside this document a list of probable donors (associations, vet schools, manufacturers, and horse transporters) in the expectation that these interests will support its efforts to establish comprehensive horse-trailer manufacturing standards.

Also available from the chairman are national and international media outlets common to the equine industry.

2.2.7 Tow Vehicle Exclusions

These recommendations recognize, but the committee cannot address, the limits of passenger cars, light-duty trucks, and multipurpose passenger vehicles towing capabilities. This type of vehicle is rarely suitable for hauling more than 2,000 lbs in gross vehicle weight, and fundamentally should not be sold for use in hauling live horses. Trailers over one ton are not allowed in Japan.

Tow-vehicle manufacturers commonly make claims as to their product's towing capacity that may require unannounced modifications, do not remind the owner of restrictions on towing capabilities, disregard the type of cargo hauled that could affect towing capabilities, and may not provide braking systems compatible with cargo type or road conditions when sold as is or at the manufacturer's suggested retail price.

The National Association of Trailer Manufacturers together with the Society of Automotive Engineers (SAE) has prevailed upon vehicle manufacturers in America to adhere to standard tests to validate the towing capacity claims for their products. Since late 2013, tow-vehicle claims must pass SAE International field tests. The manufacturer is now constrained in his claims regarding propulsion, stability, and engine power.

Thus, this committee did not make recommendations regarding towing vehicle capacities.

2.3 Training and Competency

Many of those involved in horse trailer manufacture do not have sufficient knowledge about prey-animal behavior and how to accommodate the horse. For centuries, the approach has been to fit the "hoof to the shoe and not the shoe to the hoof." Now we know that the best training avoids mechanistic approaches to forcing the horse to conform, such as painful "nut cracker" halters, whips to drive the horse on, sudden braking to "teach" the horse attempting to escape to "behave," or electric shocks to "teach" the horse to stand up in conventional transport.

Driver training, horse handling with reference to transport, and trailer maintenance can be established through numerous existing programs. These would include the J. Woods Livestock Services, the international Animal Transportation Association, Technical Large Animal Emergency Rescue, the British Horse Society and the motor vehicle driver testing authorities in the UK as well as a variety of so-called natural horsemanship equine behavior clinicians (*Tellington-Jones, John Lyons, Pat Parelli, Lucy Rees, etc.*)

Any such training must account for the special requirements of horse welfare, the effects of horse behavior on vehicular behavior and vice-versa, and the requirements of emergency rescue personnel who are faced with complex extrication of animals from what may be an unfamiliar occupancy type.

Testing methods for each recommended standard will be left to authorities in the area of materials strength and ideal function in order to obtain the outcomes sought in this document. Live animal testing is recommended where possible for proof of concept of these standards in the process of development.

The specifics of manufacturing and possible future training standards are to be determined by the engineers and occupational health and safety personnel.

2.4 Stipulations and Conformity

The ultimate implications of the uses of “shall”, “will”, “may”, “should” are reserved for standards writers to modify as required.

Conformity assessment to the standards is recommended and discussed but not detailed.

3 Economic and Regulatory Sectors Affected

3.1 Economic

Horses and their transport by road involve numerous sectors. The economic sectors affected by improvements, or their lack, in the transport of the horse include but are not limited to:

3.1.1 Agriculture

Farm extension, riding and youth programs such as 4-H and Pony Club rely on the best practices to managing, handling and protecting people and livestock. Death and injury in the agricultural sector reflects hours of care and breeding lost to a frequently preventable incident.

3.1.2 Biosecurity

California has recognized the importance of keeping liquid and solid waste confined to livestock trailers. Trailers should be designed to meet this requirement.

3.1.3 Consumer Products and Safety

Many current trailer designs, because horse and handler risk being together with only one exit available, are rated as a hazardous "confined space" by emergency rescue services and their standards. Their response to an incident can be greatly limited by issues of construction and access to the horses (or people) inside the trailer.

3.1.4 Education and Training

There is a great need for special training and licensing requirements before a private driver should be allowed to take a trailer on the highway. Current practice allowing anyone with a basic license to hitch and tow any non-commercial trailer less than 10,000 pounds contributes greatly to the tragedies we documented related to trailer safety on the road. Federal regulations require a combined truck and trailer weight of 26,000 pounds before mandating a Commercial Drivers' License, Class A. (*Retrieved June 23, 2014. http://www.yesterdaystractors.com/cgi-bin/viewit.cgi?bd=tport&th=10140* and *retrieved June 23, 2014, http://www.equispirit.com/info/articles/fedrgulations.htm*).

3.1.5 Electrotechnology

This sector offers additional means of improving safety through electronic sway prevention; monitors for tracking carbon monoxide; ventilation and temperature; and improved braking, tire, and hitch performance.

3.1.6 Equine Events

It is commonplace for show ground authorities to deal with loading and unloading events and injuries on their premises. Many horses have been eliminated due to travel related incidents.

3.1.7 Health Services

The cost to health services, veterinary and human medical, can easily range into the thousands for each travel related incident.

Highway Safety: As well as lives, hours of commuting time and productivity are risked with each road incident.

3.1.8 Inspection Services

With the improvement in standards or design, the trailer user and motor vehicle inspector (where this service exists) should be given more freedom to check for deterioration and poor quality original or after-market equipment, welds, cross-members, fasteners, tires, axles, and frames.

3.1.9 Insurance

Companies offering private and commercial horse-transport coverage report high use of their services. A wreck involving horse transporters frequently involves other road users when a trailer breaks loose, overturns, or a horse escapes from the trailer. Insurance companies that offer highway assistance to policy holders are sometimes ignorant of the proper way to service an occupied disabled horse trailer, endangering the public.

3.1.10 Law

Lawyers and expert witnesses specialize in horse transport incidents.

3.1.11 Manufacturing

The horse-trailer manufacturing sector is a key component to improved practices and standards.

3.1.12 Rescue Services

Emergency Fire and Rescue services have much to offer in recommendations for improvements to trailer components to add to equine and human safety and egress.

3.1.13 Veterinary Services

Veterinarians are expected to deal with the aftermath of trailer incidents, whether injury from fittings, a horse down in the trailer, escaped from the trailer, limbs having penetrated the trailer frame or skin, injured during loading or unloading, or dealing with physiologic intestinal and respiratory distress.

Fig. 3.1: Extrication of a downed horse requires trained personnel, quiet approach and specialized equipment. Over the last 20 years, technical rescue of animals in these situations has contributed to much of our knowledge of how to design and manufacture aspects of trailers more safely.

3.2 Regulatory

"There are currently no Canadian Motor Vehicle Safety Standards to regulate the strength and performance of trailer chassis or frame materials nor are there any crash tests to evaluate their performance during an accident. The Motor Vehicle Safety Act does not set any requirements regarding the type of materials used for any components." (*Math. Yelle, Motor Vehicle Regulatory Enforcement Officer, Transport Canada. Pers. corr. August 19, 2011.*)

In the trailer industry, existing regulations may differ or conflict in different regions in four basic areas:

- Axles, rims, and tires
- Brakes or no brakes
- Coupler strength
- Lights/reflective for color and location

There is no requirement for structural testing of any of the following:

- Mainframe or floor
- Safety of the equine body for survivability of impacts (air bags and shoulder belts do not exist in trailers)
- Braking efficiency and stopping distance

- Chest/breast and butt bars
- Hinges/fasteners

There are no standards for flammability and toxicity of interior furnishing, rubber mats, Styrofoam® insulation, etc.

Fig. 3.2: Electrical shorts, gasoline or propane leaks, hay, flying cigarettes, or other causes can easily ignite some cargo or the trailer. All release toxic gases. Fortunately, no horses were in this trailer.

Wiring quality is not standardized or specified (*Sigurdson, J. 2012. Putting information and technology into work for transport. 38th Animal Transportation Association Conference March 18-21, Vancouver, B.C.*)

Despite their inherent instability, single-axle horse trailers are still offered for sale. Preferred by uneducated drivers for their lighter weight, they are almost invariably unstable in cross winds, during vacuum drag by an overtaking vehicle (which also affects dual axle trailers but to a lesser extent) and risk the danger of even one tire failing. Although aerodynamics and the width of the tow vehicle can compensate for some instability, reliance on a single axle is unsafe.

Fig. 3.3: Single-axle trailers are probably the least stable trailer in use. Place a high-centered load, like a horse in them, and the tendency to snake is increased.

Fig. 3.4: Sold as new in 2014, this trailer needs rear side and front side lights and reflex reflectors to conform to the National Highway Traffic Safety Administration rules for conspicuity. Over 80" wide, the trailer would also require rear clearance and identification lamps and front clearance lamps.

3.2.1 Conflicting Regulations

Where the trailer is overloaded or the tow vehicle is insufficiently powered to haul or halt the trailer, the lack of brakes can cause an incident. Yet brakes are not always required.

Some state and Canadian provincial jurisdictions do not require brakes on tandem axle trailers or trailers under a varying weight limit (*Retrieved June 23, 2014. http://www.rvda.ca/ProvBrakeReqts.asp*). Non-commercial vehicles may escape brake regulations altogether or require brakes on trailers as light as 1,000 gross vehicle weight rating (*Retrieved June 29, 2014. Lancaster, C. 2012. Trailers: flexible necessities. Rental Management. May 3. http://www.rentalmanagementmag.com/Article/tabid/670/ArticleID/16408/t/Default.aspx*).

Trailers under 2,500 pounds are not required to have brake lights in some states (*Retrieved June 29, 2014. Randhawa, P. J. 2013. Shealy to prefile bill establishing safety standards. November 12.* http://www.wistv.com/story/23948251/shealy-to-prefile-bill-establishing. Shealey is a South Carolina Senator. On the WISTV site, above, she writes that no lights are required on trailers under 3000 lbs gross weight or less. Boat, utility, and numerous other trailers are therefore exempted from the lights requirement.)

In South Carolina, USA, trailers with an empty weight of 2,500 pounds or less do not have to meet any safety standards. The death of a young man struck by such a loose trailer has led to a petition for "Charlie's Law" requiring such trailers to have brake and tail lights, turn signals, and a secure connection to the tow vehicle. Without these laws, the culpable trailer hauler could not be charged (*Retrieved June 29, 2014.* www.gtowntimes.com/story/-Charlie-s-Law-would-establish-standards-for-trailers-pulled-behind-passenger-vehicles).

Where trailers are under a rating of 10,000 pounds or of non-commercial registry even over that limit, there is no mandatory training for acquiring hauling skills or conducting safety and maintenance checks and repairs. Safety awareness, horse behavior and driving skill are left to the individual hauling non-commercially. Yet there are NO known organizational, official or unofficial training programs for the non-commercial hauler.(For a comprehensive list of varying state regulations and laws concerning trailers in Canada and the US, see the American Automobile Association's Digest of Motor Laws on its website).

Such regulations as exist are seldom enforced for the non-commercial driver due to:

- Low return on paperwork and time costs to police
- Fines are small
- Officers are not informed enough regarding the regulations and regulations are different in each state
- Nothing associated with safety (chains, axles, tires, lights) has ever been looked at by an officer or anyone else in 30 years of two committee member's experience

The mismatch by some American manufacturers between suspension capability, axle weight and carrying capacity are not observed by Canadian inspectors who are guided by whether or not the manufacturer is registered in Canada. That is all that is required (*Porlier, V. 2013. Pers. corr. March 4*)

3.2.1.1 Inspections

Mandated annual inspections (where held) are cursory at best. Inspectors are not allowed to disassemble suspect parts to check for corrosion, poor welds, indicate inadequate wheel or axle type or size, or inferior wiring. Nor are they encouraged to report defective parts or suggest changes to the original structure such as adding more cross members for support. New York State trailer inspections may include the hitch, allowable tracking variance (how closely the trailer tracks the tow vehicle), and braking efficiency as well as insurance (not required for non-commercial trailers), vehicle identification numbers, brakes, and lights (Retrieved June 28, 2014. *http://www.semasan.com/semaga/TagTitleToolbox_NY.pdf* and *http://nysdmv.custhelp.com/app/answers/detail/a_id/570/~/the-requirements-for-trailers*).

Although horse trailer brakes are tested at some inspections, it is never with the intended live-weight cargo on the trailer. To test braking efficiency with a live load risks jackknifing the trailer, ejecting, killing or injuring the horse(s). The inspected brakes are passed as adequate to halt without incident the tow vehicle and loaded to capacity trailer even though the trailer is tested while empty (*Retrieved June 28, 2014. Trevor, M. July 4, 2013.* *http://www.soe.org.uk/discussion-forum/thread?thread=514*)

There are states where no inspection of horse trailers is required. There are a few states where police may stop trailers to check Coggins certificates related to biosecurity (FL, CA, AZ, GA, NY are the most common) but none of these check the integrity of the trailer itself (*R. Gimenez, T. Gimenez and K. A. May. 2008. Technical Large Animal Emergency Rescue. Iowa: Wiley-Blackwell, p. 152-153*).

In some USA and Canadian jurisdictions, homemade trailers are not required to undergo any inspection before registration.

In Quebec, trailers with a GVWR lower than 4,500 kg have no obligatory inspection for any part or for load capacity (*Porlier, V. 2013. Pers. corr. March 4*). Again, in Quebec homemade trailers lower than 900 kg receive a lifetime registration for $70, no serial number and no inspection. "A trailer may be built with a bed frame" (*Porlie, V. 2013. Pers. corr. March 4*).

Fig. 3.5: A homemade trailer offers no containment or protection of the animal (in this case one that weighs over 1000 kilograms) from flying debris, sand, dust, cans and cigarettes thrown from passing vehicles. No test for road worthiness is currently required.

Although the U.K. maintains stringent quality standards for many of its vehicular products, there are no Ministry of Transport tests ensuring horse trailer safety. Making sure a trailer is safe and legal is entirely left to the owner of the trailer though no training in this regard is available (*Retrieved September 26, 2014. http://www.bluecross.org.uk/2146-92964/trailer-safety.html*).

Efforts to mandate inspections were defeated by special interests in the UK. The National Farmers' Union secured exemptions for agricultural vehicles, including horse trailers, from Ministry of Transport testing following a vote by the European Union Parliament (*Harris, T. March 12, 2014. Pers. corr.*)

In Louisiana, single-axle trailers do not have to be inspected though one legislator had seen "trailers make major damage on the road" (*Connelly, K. Mar. 18, 2014, Bills could change vehicle trailer laws. Capital*).

According to the United States National Highway Traffic Safety Association, more than 51,825 crashes involving passenger vehicles towing trailers occurred in 2012 in the US, 11,207 more than the previous year. In 2012, the last year for which figures are available, there were 390 fatalities and 17,677 injuries (*Motor vehicle traffic crashes involving a passenger vehicle with a trailing unit: 1975-2012. December 12, 2013. National Center for Supercomputing Applications (NCSA): University of Illinois at Urbana-Champagne. Data were obtained from the National Highway Safety Administration's General Estimates System*).

3.2.1.2 Effect on the Private Hauler

A 2006 survey by Master Lock of non-commercial trailer haulers in the United States found that 70 percent did not know how to tow a trailer safely (*Retrieved September 21, 2014. http://en.wikipedia.org/wiki/Towing*).

Fig. 3.6: Trailers are susceptible to overturning when overtaking, hitting an obstacle in the road, heavy or uneven braking, or swerving to avoid a collision. This trailer overturned in a roundabout when the driver had to brake to avoid another vehicle.

The incentives for improving safety by persons towing cargo are, practically speaking, non-existent except for personal safety and loss of equipment. For most, these are marginal concerns as there is minimal comprehension of trailering concepts or horse behavior, and "everyone" considers themselves to be capable haulers. In a study of 191 respondents to a questionnaire, the second greatest cause of injury were trailer incidents after paddock injuries. Most of the respondents characterized themselves as experienced, their own management unrelated to the horses' injuries (*Retrieved Sept 9, 2014. Darth, A-C. 2014. Identifying causes and preventing injuries to horses. Uppsala: Swedish University of Agricultural Sciences, p. 16*). Many haulers are unaware of the danger to them or their live cargo if a wreck occurs (*Retrieved September 21, 2014. http://www.heavyhorsesonline.co.uk/articles/horse-rescue.html*).

Conscientious manufacturers, organizations like the NATM and private individuals are left to attempt to educate the public (who don't realize they need the education) and manufacturers.

One USA horse-trailer manufacturer screws the retainer for upper doors through thin aluminium sheathing into polystyrene.

Fig. 3.7: This top door closes above a rear ramp. The door holder is screwed into a .04 (or thinner) aluminum sheet with polystyrene "sandwiched" between a similar inside sheet. There is no added support or material to prevent the self-tapping metal screw from pulling out. This is a common wall and door construction for horse trailers.

4 Need for Horse Trailer Standards

4.1 Unsafe at any speed

"Even where a trailer meets legal requirements, it is still considered hazardous as a transporter" (*Virginia Commonwealth University. 2006. Crash Investigation Team Technical Alert Number 14. January. 11pp*)

The need for horse trailer standards is indicated by:

- statistical evidence
- insurance company policies
- emergency rescue personnel in training and buying equipment
- veterinary cases
- incident reports
- fatalities
- medical involvement
- legal cases
- trailer body and repair shops
- media reports

A recent move by the USA Department of Transport to require a commercial driver's license of all drivers hauling more than 10,000 pounds indicates the need for greater oversight and improved standards. Nevertheless, heavier trailers' design, frame, and chassis strength also remain with the manufacturer with selection of load retention provisions left to the operator or purchaser (*M. Ryan, NATM Communications Director. Pers. corr. June 30, 2014*).

Homemade trailers may be constructed of any available materials. "Roadworthiness" inspection is not required for registration, except in New York State. There are no dimensional, design, material, or other specifications other than those concerning axles, lights, and brakes. Such inspections as exist do not specify chain strength or identify acceptable hitches or reflective requirements.

Existing practices and standards are directed at the weight-carrying capacities of boat or similar deadweight cargo trailers. These cannot compensate for the high center of balance of horses and other livestock, where over 80 percent of their weight may be 1 meter or higher than the floor of the trailer.

The assumption by many in the horse community is that a horse "stands like a table with its weight equally distributed among its four legs" (*Retrieved February 5, 2015. http://iml.jou.ufl.edu/projects/Fall08/Scheff/halt.htmlI*). This assumption underestimates the strain placed on the horse confined to a moving platform. The horse immediately uses its brain, muscles, and reflexes to attempt to find the most comfortable position. It must frequently shift it's feet. Confined to a position where it cannot choose, it makes the best effort. In appropriate transport, it will often lower its head, close its eyes, and rest a hindquarter. Relaxed, it

effortlessly makes small positional adjustments, seldom shifting its feet while in transit, especially on high-speed roadways.

Fig. 4.1: A front panel, rear sides and a dent high in the rear door bear marks typical of a horse's attempts to retain its balance during transport.

Fig. 4.2: A close-up look of the rear side of this trailer's aptly named kick board, shows the marks of a horse attempting to broaden its rear leg stance. Some trailers on the market flare the sides to accommodate these attempts, but these interior flares continue to record the horses' struggles.

4.2 Available standards limitations

Existing standards may be limited to items such as hitch heights, reflectors or brake light placement, wheel or mud guards, and sometimes, depending on state province, or region number of axles, trailer weight and braking capabilities. None take into account that these are rated for boat and camper trailers under average driving conditions and not for the shifting, top-heavy cargo that is the horse (*Retrieved June 28, 2013. May no longer be available. Scheve, T. and N. Scheve.* [*bayquest.info/static/trailers4.htm*](bayquest.info/static/trailers4.htm)).

The lack of standards essentially places horse trailers in the homemade category. There are very low barriers to entry into trailer manufacturing meaning that almost anyone with a welding shop can build and sell a horse trailer (*Lancaster, C. 2012. The trailer industry: today and tomorrow. 38th Animal Transportation Association conference. March 18-21, Vancouver, BC*).

Typically, only one or a few issues may be addressed by an engineer or manufacturer without recognizing its domino effect on the horse or tow vehicle. Examples:

- A suspension system that suits a static load of fertilizer may not accommodate a live load given to shifting to retain balance.

- A surge brake engagement bump may be just the nudge required to cause the precariously balanced live weight on stilts to lose its equilibrium.
- Large windows may encourage the horse to escape through them.

Fig. 4.3: Single-axle garden trailers are not appropriate for hauling live weight. There are numerous examples of tragic accidents with this type of trailer.

4.3 Legal implications

There are no ratings or tests available to manufacturers who are then free to use their own judgments regarding welds and materials. There is no guarantee of how items will hold up under highway use. There is an implied danger here and could increase the operators' liability (*Whidford, F. 2013. Truck, trailer and hitch components. Indiana: Purdue University, p. 40 and Kentucky Mounted Patrol report: Trailer disintegrates on interstate I-75. Retrieved September 21, 2014.* https://www.facebook.com/media/set/?set=a.374344925999249.1073741834.234513103315766&type=1).

e loaded with newspapers at h failure sent this trailer into The impact caused the trailer Although rarer than improper h installation failure does he bolts work loose, pins are , or welds fail.

two horses in the trailer disaster. It came unhooked vehicle. Poorly configured open when insufficient egrity is provided — in this er was made of fiberglass

w

Fig. 4.6: This trailer, the same as that shown in Fig. 4.5, shows the typical angle floor frame with 1x1 tube side frame up to 1.2 meters apart with smooth fiberglass side walls. Plywood lines the inside walls. Side-to-side floor boards are not recommended, especially with only one piece of metal beneath. Other viewers suspect that the wood liner may have retained moisture, rotting the wall supports.

The lack of standards results in differing priorities among trailer purchasers, regulators, manufacturers and engineers. For example, Nevada does not require safety chains on trailers despite the federal requirement to do so. South Carolina does not require brake lights unless the trailer blocks the tow vehicle light. Purchasers and manufacturers may ignore safety considerations or remain unaware in favor of lower costs.

Regulators may be concerned mainly with the "letter of the law" even though its application and enforcement jeopardizes the safety of the unit. For example, surge brakes are mandated for trailers in Germany though experience indicates that they are hazardous when used on ice or in wet downhill applications, cannot be controlled from the cab, and cannot hold a trailer on an uphill incline.

Fig. 4.7: Two horses, unprotected from dust, insects, and road debris are carried on a single-axle equipment trailer.

5 Supporting Documentation: Statistics

5.1 Canada: Transport by Numbers

Although there are no official sources for the number of Canadian highway incidents or statistics involving horse trailers, Equine Canada tracks equestrian activity that indicates potential. An Australian study by veterinarians Chris Riley (formerly of the Atlantic Veterinary College, Canada) and Brenda Noble have catalogued incidents, injuries and fatalities.

Eighty per cent of the 500,000 Canadian horse owners will transport one or more horses off farm for competition, pleasure, breeding, or veterinary attention at least once a year. They may be accompanied by one or more of the additional 350,000 youth involved in horse activities throughout Canada.

The annual value of Canadian owner-trailering activities is $177,431,061. Transport services purchased are cited as $88,651,367 annually. (*Equine Canada. 2010. Canadian Horse Industry Profile Study.* strategicequine.ca).

The available news reports indicate that Canadian horse trailer haulers are no less vulnerable to trailer rollovers, detachments, and defects than their USA, European, or Australasian counterparts.

5.2 Incident Reporting

According to the USA National Highway Traffic Safety Administration (NHSTA), 17, 085 fatalities, over 320,000 people were injured, and 1,364,891 trailer crashes occurred from 1975 through 2013. An average of 450 people, or at least one person a day, die annually. The odds of an injury are one in four.

Many of those fatalities and injuries contributing to the $4 billion annual cost of these incidents occurred because the trailer broke loose from the towing vehicle due, in many cases, to failed safety chains (*Aghazadeh, F. and A. Pisharody. 2014. Analysis of accidents in trailer towing. In: Advances in Safety Management and Human Factors. Proceedings of the 5th International Conference on Applied Human Factors on Ergonomics. 19-23 July 2014. P. Arezes and P. Carvalho, eds. Jagiellonian University, Krakow, Poland* [this is the most succinct report with the best presentation of statistical charts.] and *Copeland, L. July 6, 2010 State laws target safety of towed trailers. Retrieved September 21, 2014.* *http://usatoday30.usatoday.com/news/nation/2010-07-05-trailer-laws_N.htm and Retrieved December 15, 2013.* *http://www.poynter.org/how-tos/newsgathering-storytelling/214316/minneapolis-station-crashes-trailer-to-demonstrate-safe-towing-for-memorial-day-weekend*/. [The trailer crash demonstration is buried deep in this video]).

Property damage, when loose trailers strike other cars, people or structures, are rising. Dangeroustrailers.org gathers data involving trailers, including horse trailers, towed by passenger vehicles, from NHSTA. The non-profit service reports that the 2008 figures of 49,107, although showing a decline in fatalities and injuries, demonstrated a 21 percent increase in property damage over the previous year. (*Retrieved September 21, 2014.* *http://www.prweb.com/releases/2008/07/prweb2339064.htm*).

Fig. 5.1: An overturned horse trailer totaled this vehicle. It is not uncommon for trailers to land on passing vehicles when they roll.

Unlike horse trailer incidents, motorcycle incidents are treated separately from cars, trucks, and other vehicular incidents for statistical analysis. Their special status is due to their unprotected cargo, precarious balance, size, vulnerability to cross-winds, and the effect of a single tire failing.

Similarly, hauling live cargo has distinctive requirements and is subject to added dynamics to successfully maintain live weight in situ. Similar to motorcycles, horse trailers have unprotected live cargo, are subject to cross-winds, imbalance, and, on single-axle trailers, the increased danger if a tire fails.

During an incident, the behavior of the tow vehicle, trailer, and live weight will affect outcomes in ways different from that of the typical passenger or utility vehicle hauling dead weight. Unlike motorcycles, however, this distinction is not accorded horse trailers for statistical analysis. There is no authoritative government or industry-sponsored source anywhere in the world, including Canada, relating to incidents involving horses and trailers, either commercial or non-commercial.

Many incidents will not be reported in the media unless there is a fatality, gross vehicle damage, or sheer public demolition. Other incidents are considered too routine to catalog or record. Minnesota, for example, keeps no statistics on deaths caused by trailers (*Retrieved Sept. 21, 2014. http://www.kare11.com/story/local/2013/05/21/3837687/*).

Only 25 percent at most of horse-trailer incidents make it to the popular media (*Gimenez, R., 2012. Personnel, horse and highway safety: The trailer. Animal Transportation Association, 38th Annual Conference. Vancouver, B.C. March 18-21*).

There is rarely follow up to determine if the horse or human survived the incident beyond the initial response. Delayed fatalities from injuries originating in the incident may not occur until days, weeks, months, or even years later. These may initially appear unrelated, but forensic analysis attributes the ultimate death months or years later to the original injury in people, and there is no reason to assume differently for animals (*Retrieved September 21, 2014. http://work.alberta.ca/documents/2013-motor-vehicle-fatalities.pdf*).

Although the British Horse Society offers a map showing incidents involving trailers, these data are submitted with no specifics and by random volunteer sightings of news reports or involvement. Compounding the lack of data sources is the reluctance of many horsemen to acknowledge or report transport injuries (*Green, J. 2013. Safer animal rescue: The journey so far. International Large Animal Rescue Conference, Adelaide. Retrieved September 21, 2014. http://www.youtube.com/watch?v=F7J1Umo8c2k&feature=youtu.be*). Survivors may brag instead about surviving an incident as if their "qualifications" or "skills" contributed to their survival, whatever the damage (*Retrieved Sept. 21, 2014. http://cs.thehorse.com/blogs/horse-911-whats-your-emergency/archive/2011/10/23/ever-hear-quot-caught-between-a-rock-and-a-hard-place-quot.aspx*).

Fig. 5.2: This texting driver rear ended the horse trailer. Reinforced ramps, frames and possibly underrider guards are needed to protect horses from these frequent incidents.

Reporters unfamiliar with trailer types and equine terminology may confuse the issue by reporting a gooseneck as a bumper pull or tag along, a pony as a horse, a gelding as a stallion, a filly as a colt or mare. This makes assessing the origins of problems based on animal behavior and trailer and tow vehicle type difficult and incomplete.

5.3 Roadworthiness Reports

An Automated Safety Inspection Program in Louisiana inspected 51,213 trailers. Of these, 23,888 or 46 percent had inadequate chains. 18,523 had inadequate lighting. 14,119 had inadequate brakes. Inappropriate or poorly maintained tires were reported on 6,716 trailers. Breakaway cables or mechanisms were defective on 5,472 trailers. Flooring was inadequate on 3,201. 1,207 had weak frames (*Milazzo, J. n.d. Safe-Tow: Patented life-saving technology*).

Trailer safety spot inspections conducted by state police typically find 50 percent of trailers in violation of safety standards. (*Anon. 2009, July 29. dangeroustrailers.org releases 2008 accidents [sic] statistics. Retrieved September 21, 2014.* *http://www.prweb.com/releases/2008/07/prweb2339064.htm*).

Trailer tires have long been a contributing factor to injury and incidents. An early reference to a two-state tour by J. S. Baker, director of research for the Traffic Institute of Northwestern University, found blown trailer tires "as common as dirty rags around a service station." (*Rollman, A. R. 1971. How to tow a trailer. Popular Mechanics. May. 135:5, p. 141ff*).

5.4 Injuries and Statistics

The unpredictable behavior of an animal packing one ton of force (10,000 Newtons) in a kick makes the prevention of injuries and death difficult (*Kriss, T.C. and V.M. Kriss. 1997. Equine-related neurosurgical trauma: a prospective series of 30 patients. J. Trauma. 1997 43:1, p. 97*).

Fig. 5.3: Unloading from an air freight container, "Mr. Lomandy" illustrates the unpredictable nature of horses. It is possible that a leg wrap had irritated the horse, but as prey animals any horse is capable of such feats of abject power in flight mode.

Horse-related injuries to humans are the eighth cause of emergency-room admissions in the USA even though horse related activities have fewer participants than other sports or recreation. Within 2001 and 2003, American emergency departments dealt with an estimated 102,904 non-fatal horse-related injuries (*Thomas, K.E., et al. 2006. Non-fatal horse related injuries treated in emergency departments in the United States, 2001-2003. Br. J. Sports Med. 40:7, 619-26, p. 619*).

Injuries occurring to horses and humans during loading and unloading tend to be deeper and more serious than injuries acquired in other handling scenarios (*Westfall, P. 2012. Safety in the trailer — Use a little horse sense. August 20. Retrieved September 21, 2014.* http://nchorse.blogspot.ca/2012/08/safety-in-trailer-use-little-horse-sense.html).

An informal survey of equine veterinarians attending TLAER courses revealed that their guesstimate for the percentage of acute injuries they treat in horses that have some association with a trailer (loading, transport or unloading) is between 30 percent and 40 percent (*Gimenez, R., Pers. corr., 2014*).

The typical injury for a human confronted with hazardous design or weak equipment is associated with falling ramps, hands caught in equipment, back strain lifting heavy ramps, having the trailer door blown into their faces, being kicked during well-meaning attempts to rescue a horse panicking in a trailer, hurt when chasing one escaped from the trailer into traffic, or other horse handling incident within or associated with the trailer. Slips, falls, crushing, barging, and kicking of the handler during loading and unloading are common causes of injuries to both horses and handlers (*Retrieved September 21, 2014.* http://www.heavyhorsesonline.co.uk/articles/horse-rescue.html).

Rearing in a confined space or on approaching the entry of a confined space results in head and other injuries (*Gerding, J. C., et al. 2014. Equine orbital fractures: a review of 18 cases, 2006-2013. Veterinary Ophthalmology online edition*).

Fig. 5.4: Scalped by the bow in Fig. 20, this horse will require veterinary attention. This is a very common injury type in horses in trailer incidents where the driver hard brakes — the horse is thrown into the front of the trailer.

Fig. 5.5: Exposed roof bows are frequent causes of injury when a horse raises its head. The small bloody mark on this roof bow doesn't begin to indicate the damage done to the horse. A horse has to raise and lower its head to maintain balance while in transit and needs at least one meter above its withers for this purpose.

Fig. 5.6: This horse was injured by a protruding fitment on the interior of the trailer when it reared.

Fig. 5.7: The horse's eyes are particularly vulnerable to injury when loading, unloading or from fittings within the transport.

Injuries occurring to an unmounted handler are typically directed to the head and abdomen. In a study of 284 cases involving horse and human interaction, three deaths were attributed to loading a horse into a trailer due to chest and head injury (*Carmichael, S., D. Davenport, P. Kearney, et al. 2014. On and off the horse: Mechanisms and patterns of injury in mounted and unmounted equestrians. Injury 45:9, pp. 1479-1483*).

Acclimation to transport demands is vital to horse and human safety. The most docile horse can react beyond human control or training to a perceived danger. Training, even when diligently applied by internationally known trainers, is over-ridden by the equine instinct to survive principally by running away, or if trapped, kicking and thrashing. A horse that loses its footing or balance is a horse that feels threatened by impending death and may react explosively.

Fig. 5.8: A 1200-pound Quarter Horse panicked during loading. Firefighters from Level, Maryland cut and removed the divider over which the horse was stuck, head down. Before extricating the horse, a veterinarian had to sedate it.

The high rate of transport injuries in the state of Kentucky has led to specialisation by lawyers as transporter and horse owner seek damages (*Retrieved September 21, 2014. Miller, T. W. and E. Woodford. n.d. Litigating the horse transport claim.* http://www.horselaw.com/pdfs/article_tmiller02.pdf).

5.5 Incidents Statistics

5.5.1 From 1970 through 2013

Fatalities involving all types of trailers towed by a passenger vehicle numbered 10,691 between 1975 and 2011 (*Aghazadeh, F. and A. Pisharody. 2014. Analysis of accidents in trailer towing. In: Advances in Safety Management and Human Factors. Proceedings of the 5th International Conference on Applied Human Factors on Ergonomics. 19-23 July 2014. P. Arezes and P. Carvalho, eds. Jagiellonian University, Krakow, Poland, p. 241*).

Since late 2003, USRider Insurance consultant and committee member Dr. Rebecca Gimenez have spearheaded the collection of personal and news reports involving horse-trailer incidents. These are confined to North America with most in the USA. As president and co-founder of Technical Large Animal Emergency Rescue (tlaer.org), Dr. Gimenez is uniquely equipped to analyse the reports and videos. They currently number 2,000-plus (*Gimenez, R. April 3, 2014. Pers. corr.*). This is more than enough to establish evidentiary trends and analyse for publication.

A preliminary study by TLAER (tlaer.org) was of 485 incidents from 1970 through 2009. With better data than typical reports, it represents 1,376 people who were involved in trailer incidents on the highway or during handling related to transport (tow or other vehicle) and 1,297 horses.

Of the 1,276 people involved, 446, whether they went to hospital or not, were injured. Of the 1,297 horses, 573 horses were injured.

The reported deaths of those in the preliminary 1970–2009 study, other than railroad incidents, whether associated with a trailer or other vehicle, are 206 humans and 376 horses.

The incomplete 2010 through 2012 data shows 228 humans in 214 vehicles and 312 horses have been involved in horse-trailer incidents. The number of incidents recorded so far for these years is 122.

Fig. 5.9: Hitch separation followed an undescribed impact, causing the trailer to detach from the Ford F-150 and roll. A horse had to be extracted and is said to have survived. Although probably caused by incorrect hitching, this does happen in cases of hitch failure.

5.5.2 Trains and Trailers

The low undercarriage and rearward axle placement of the conventional horse trailer increases the tendency of the trailer to be high centered by strike, scrape, or entrapment on railroad crossings. Railroad horse-trailer incidents, not associated with the figures above, comprise 15 incidents. Gimenez reported twenty humans, 29 horses and 18 vehicles involved in train-horse trailer collisions.

Train –horse-trailer collisions reported in the 1970-2009 study resulted in six human deaths and seven horse deaths. Thirteen humans suffered injury and 11 horses suffered injury.

Train incident data are incomplete for the years 2010 through 2014.

5.5.3 Attributing Cause

An early Joint Engineering Enforcement Project sponsored by the Office of Highway Safety, USA Bureau of Public Roads, examined incidents on Route 66 between Chicago and Los Angeles. Cars towing trailers were determined to have four times the risk of an incident than the same number of cars without trailers (*Baker, J. S. 1967. Single-vehicle accidents on Route 66. Jl. of Criminal Law and Criminology and Police Science, 58:4, pp. 583-595*).

In a 2013 horse-float safety survey of 223 South Australian and Victoria horsemen involved in hauling horses to horse events, Dr. Belinda Noble recorded that few had any idea of the towing capacity of their vehicle. Nor did they know how to adjust for a kinetic load that puts more strain on a tow ball.

The respondents ranged in age from 18 to 78 years. They were associated with 193 trailers or floats and 30 trucks averaging 50 trips annually.

Seventy-three percent of the respondents blamed the horse for a transport problem. Only 6 percent took responsibility for problems (*Noble, B., C. Riley, K. Thomson. 2013. Horse float*

safety survey, International Large Animal Rescue Conference, Adelaide, Australia. Retrieved September 21, 2014. http://www.youtube.com/watch?v=wrmVIerq_08). Twenty-three percent of the respondents in the 2013 Australian survey reported horses injured during transit. This is considered "quite high" by the researcher, Dr. B. Noble.

One-third of the injuries involved hind legs and hindquarters, followed by front legs, head, muzzle, chest, and neck. (*Noble, B., C. Riley, K. Thomson. 2013. Horse float safety survey, International Large Animal Rescue Conference, Adelaide, Australia. Retrieved September 21, 2-14. http://www.youtube.com/watch?v=wrmVIerq_08*).

Trailer design is acknowledged by horsemen involved in Pony Club, endurance, and show events in Dr. Noble's Australian survey as the most common risk factor for causing injuries to horses (*Retrieved September 21, 2014. http://www.horseyard.com.au/horse-information/horse-news/282815-equitana-transport-review*).

Fig. 5.10: Decades of hauling over 500 horses did not prepare this driver for the worst experience of her life. Quiet through many previous trips, this 16h Thoroughbred gelding panicked as the trailer began to move. Thrashing, kicking, and losing its balance, it trapped its travel companion as well, jamming both butt bars. Quick action by a veterinarian saved its life.

Fig. 5.11: This trailer's side vents are placed higher to discourage entrapment of a kicking horse's hoof or legs.

Conventional trailer and van design place both handler and horse in the most danger during loading and unloading (*Westfall, P. 2012. Safety in the trailer. Retrieved September 21, 2014. http://nchorse.blogspot.ca/2012/08/safety-in-trailer-use-little-horse-sense.html* and *Noble, B., C. Riley, K. Thomson. 2013. Horse float safety survey, International Large Animal Rescue Conference, Adelaide, Australia. http://www.youtube.com/watch?v=wrmVIerq_08*).

Fig. 5.12: The head is especially vulnerable to injuries during the transport process.

Forty-four percent of 151 respondents in the Australian survey reported injuries while driving. Scrambling (failure to maintain balance) was at the top of the list for injury.

Fig. 5.13: A horse accustomed to transport suddenly panics and scrambles, tearing out rivets from the side padding and losing a part of its hoof. Scrambling is most often due to loss of balance (driver or trailer induced), panic by the horse, stings from insects inside the trailer, and micro shocks from shorts in the trailer wiring.

Although it is likely lack of driver skill that initiates the scrambling, which frequently occurs on curves, only 4 percent of those interviewed attributed scrambling injuries to driver error. There was no difference in injury rates in horses going by truck or float (*Noble, B., C. Riley, K. Thomson. 2013. Horse float safety survey, International Large Animal Rescue Conference, Adelaide, Australia. Retrieved September 21, 2014.* http://www.youtube.com/watch?v=wrmVIerq_08).

Ten per cent of injuries were attributed to mechanical failure associated with the trailer. Eighty-seven percent or 167 members of the Equine Rescue Services, UK required roadside assistance with horsebox or trailer breakdowns during January through June, 2013. (http://www.equinerescue.co.uk/).

In order of occurrence, the commonest first, trailer associated injuries were due to rotten flooring, hitch failure, broken dividers, and suspension failure leading to overturning (*Noble, B., C. Riley, K. Thomson. 2013. Horse float safety survey, International Large Animal Rescue Conference, Adelaide, Australia. Retrieved September 21, 2014.* http://www.youtube.com/watch?v=wrmVIerq_08).

An earlier study by the then American Horse Shows Association paralleled that of the Australian 2013 study. The AHSA analysis of 700 usable forms out of 2,952 distributed by the association (now called the United States Equestrian Federation) to horse show veterinarians revealed that lacerations constituted 29.5 percent of reported injuries to horses and that more than a third were associated with horse trailers at shows (*Vogel, D. 1986. University study reveals facts on show safety. Equus #108, p. 19, 22-23*).

Reported incidents not associated with maintenance issues, include:

- Handler:
  - Handler trapped in trailer or kicked outside trailer
  - Loss of finger by a dentist and pianist
  - A veterinarian's back broken by a trailer injured horse during trailer extrication

- Handlers stepped on while loading or unloading
- Struck in the head by the horse during loading or unloading
- Trapped in the trailer despite an escape door
- Handlers and horses injured on protrusions and doors associated with the trailer

- Horse and equipment:
  - Ramps falling off
  - Trailer overturns
  - Loose trailers
  - Floor failure
  - Horses escaping and running loose on highway
  - Horses choking
  - Horses overcome by carbon monoxide
  - Degloving of equine limbs
  - Loss of hooves
  - Horses trapped in narrow "escape" doors, mangers or windows
  - Poll injuries
  - Broken bones and necks
  - Hyper- and hypothermia
  - Horses falling from the back of the trailer
  - Down in the trailer
  - Horses going through the front, the roof, or the window during transit and similarly during trailer overturns as the horse struggles to right itself
  - Horses trapped by breast or rump restraints

5.5.4 Costs

The average cost of an incident in the UK is $2,357 without hospitalization or $16,218 with hospitalization. This excludes rehabilitation or psychiatric costs. It does not include human deaths caused in trailer incidents. Veterinary costs are not averaged (*Beshear, J. ca. 2009. Saddle up safely: horse-related injury. p. 2. Retrieved September 21, 2014. http://ukhealthcare.uky.edu/uploadedFiles/about/community/saddleup/Horse-Related-Injury-brochure.pdf* and reader reports of equestrian trailer injuries, *Retrieved June 28, 2013. No longer available. Was:http://ukhealthcare.uky.edu/Default.aspx?id=5079#.UQXX0h3O03M*).

Each automotive-related incident, according to the USA Centers for Disease Control and Prevention with figures from that service and NHTSA, costs USA drivers $500 or more annually for medical, traffic delay, and health expenses. The costs arose primarily through insurance premiums, traffic delays, productivity losses, and taxes. In 2012, the average insurance claim in the USA for bodily injury resulting from incidents was $14,653.

If a single human fatality results from a trailer incident, the cost, in the USA is statistically reported as a loss to the economy and community of $9.1 million (value of statistical life). Based on the data gathered by Gimenez, a conservative estimate of 206 human deaths associated with horse trailers between 1970 and 2009 is $18,746,000,000. (*Retrieved September 21, 2014. http://www.rmiia.org/auto/traffic_safety/Cost_of_crashes.asp*).

5.5.5 Remedial Action

It is estimated that there are over 32 million trailers pulled by passenger vehicles on USA roads (*Retrieved December 15, 2013. Charlie's law would establish standards for trailers pulled behind passenger vehicles. http://www.southstrandnews.com/article/20130828/GTT01/308289996*). However, there are no figures available as to how many of these would be horse trailers.

Incidents involving livestock transport are frequent enough to be recorded as "hazardous material" (hazmat) incidents requiring special approaches, handling, and conclusions (*Green, J. 2013. Safer animal rescue: The journey so far. International Large Animal Rescue Conference, Adelaide Retrieved June 28, 2014. http://www.youtube.com/watch?v=F7J1Umo8c2k&feature=youtu.be*).

A UK insurance company, Cornish Mutual and the Devon and Somerset Fire and Rescue Service (DSFRS), together with the Royal Society for the Prevention of Cruelty to Animals report horses are by far the most frequently rescued large animal. The DSFRS is frequently called upon to extricate horses from wrecked trailers. Such specialist rescue, reports the DSFRS Animal Rescue Officer Neil Giddings, is required to offer the best chance of survival to the animal and reduce risk to the public (*Giddings, Neil. 2013. HorseSafe. Retrieved April 15, 2014. http://www.youtube.com/watch?v=FNixdCJJ0mc*).

Fig. 5.14: An on-road incident can tie up traffic for hours — this trailer ended up on the guard rail. Multiple layers of responders require inter-agency co-ordination and co-operation to effect the least traumatic rescue for the horses and return traffic to normal.

Recognizing the rising incidences involving horse trailers for the years 2004 through 2011, the US Department of Transport has decided to enforce regulations requiring tow vehicle operators of rigs over 10,000 pounds to have a commercial driver's license. (*Retrieved October 15, 2014. gohorseshow.com/article.cfm?articleID+34603*). The commercial driver's license usually requires a medical exam, a written test, a road test with the trailer, hitching methods, and knowledge of air brakes where used.

European Union legislation requires that commercial transport for horses be designed to avoid injury, prevent the animals from falling out, provide inspection, rescue, feeding, watering and rescue ports, and anti-slip flooring (*Retrieved June 28, 2014. http://www.dardni.gov.uk/5transport_vehicle_spec_livestock.pdf*).

5.5.6 The Non-commercial Example

In some jurisdictions, homemade trailers are not required to be inspected. Even where licensing, titling, and registration requirements are in place, these have no bearing on construction or material. Registration can be achieved despite defects (*Virginia Commonwealth University. 2006. Crash investigation team technical alert: Number 14. Retrieved June 29, 2014. http://www.vcu.edu/cppweb/tstc/pdfs/TA14.pdf*).

A lack of rigorous inspection protocol for both homemade and manufactured trailers has further contributed to the injuries to and deaths of handlers, horses, and other highway users (*Retrieved May 15, 2014 http://www.horseproblems.com.au/problem_horse_or_problem_horse_f.htm* and *Retrieved June 29, 2014. http://www.heavyhorsesonline.co.uk/articles/horse-rescue.html*).

Transport Canada defines a "safety defect" as a problem originating at the design, manufacturing or assembly stages.

Defects, ranging from tires, latches, axles, wiring, flooring to poor placement or securing of live weight, interfere with the control of both the trailer and the tow vehicle. The vehicle and trailer cargo are endangered as well as other road users. The problems manifest themselves "with little or no warning and [are] not . . . due to everyday wear and tear, a lack of proper maintenance, or negligence on the part of the owner" (*What is a Safety-Related Defect? Retrieved April 15, 2014. https://wwwapps.tc.gc.ca/Saf-Sec-Sur/7/PCDB-BDPP/fc-cp.aspx?lang=eng*).

Surveys of horse trailer problems sponsored by the USRider Roadside Assistance Program revealed incorrectly rated tires, poor quality tires, wrong size tires and inflation levels, inadequate protection, insulation, and installation of wiring, poor quality flooring, axles, cross-members, exposed sheet metal edging, and only minimum lighting and reflective requirements (*Gimenez, R., T. Gimenez and K. A. May. 2008. Technical Large Animal Emergency Rescue. Iowa: Wiley-Blackwell, p. 152-153* and *Retrieved June 1, 2014. http://cs.thehorse.com/blogs/horse-911-whats-your-emergency/archive/2012/03/27/causes-of-horse-trailer-accidents-on-the-road.aspx*).

Trailer incidents, particularly involving hitches, have constituted the greatest number of claims from rental managers for insurance (*Retrieved June 29, 2014. http://www.rentalmanagementmag.com/Article/tabid/670/ArticleID/16408/t/Default.aspx*).

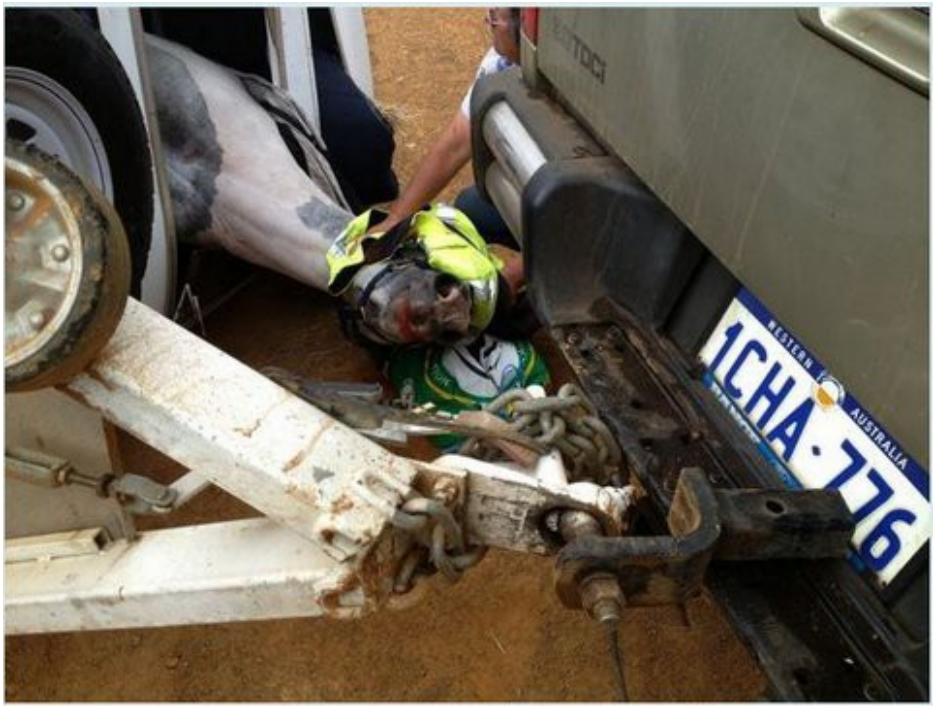

Fig. 5.15: Hitch separation (note the lack of the hitch pin) on a graveled road caused this trailer to overturn, although the chains maintained its attachment to the towing vehicle. The horse is ejected partly through the front of the trailer's "picture window," even though the driver was proceeding slowly.

Fig. 5.16: This is the interior of Fig. 5.15. The trailer, a typical Australian slantload where the horses are standing with their noses away from the crown of the road (which is incorrect — they should be slanted the other way as Australians drive on the left) has tipped on its side. The horse was thrown forward through the "picture window," with its head exposed and legs entrapped.

An inspection of a variety of trailers in Australia by a member of the Horse Trailer Standards Committee during the 2013 international conference at Roseworthy College revealed that not one manufacturer provided other than low-quality minimum-standard axles, a finding similar to that of a New Zealand horse trailer repair shop.

Fig. 5.17: Homemade single-axle trailers are popular with the handyman mentality who view it as simply a bigger box on wheels, when, in fact, a professionally designed and manufactured trailer should have many reviews by knowledgeable horsemen, veterinarians, and emergency rescue personnel to determine possible solutions for safety.

A near text-book example of driver, standards, and inspections failures is this well done report, photography and video of a December 26, 2015 incident and rescue in Yell County, Arkansas. (*Retrieved January 6, 2015. Jostmeyer, M. 2015. Yell County Mounted Patrol rescue trapped horse from overturned trailer. River Valley Leader, December 27. http://www.rivervalleyleader.com/news/article_b779a2c4-8d99-11e4-bad9-5bcd5baf4065.html#.VKqLGs1zl2c.facebook, with additional photo links,* and *https://www.youtube.com/watch?v=_j2EU5pQKqE&feature=youtu.beCourtesy of M. Jostmeyer and dangeroustrailers.org*).

Price, not safety, is the main consideration of trailer purchasers. However, even when a buyer stipulates improvements in custom-built products, unless money can be made on the extras, the manufacturer may ignore these stipulations (*Hannah, M.J. 23 Aug 2009. Pers. corr.*).

Some trailer manufacturers warn users of the dangers of trailer transport to horse and human. (*Retrieved April 15, 2014. http://www.4startrailers.com/sites/4startrailers/uploads/documents/Owners_Manuals/4-Star_Gooseneck_Horse_Trailers.pdf*)

5.5.7 Confined Space Hazards

With few exceptions, horse trailers may be categorized as a hazardous confined space under the US Occupational Health and Safety Act. As a confined space, they are dangerous when occupied by a horse or a horse and human. The situation warrants a confined space warning label. Hazardous confined spaces so designated should require two exits (*Retrieved January 15, 2013. http://equijay.com/2012/11/11/kicked-to-death-in-a-horsebox-a-preventable-tragedy-or-just-a-risk-we-take/*).

The "confined space" danger is magnified, not only on loading and unloading operations, but when the horse must be extricated. Commonly, the horse will have gone over partition, butt or breast restraints, become hung up in the manger or door, cast in the trailer, gone through the floor, or penetrated the skin or partition with head or hoof (*Bradley, C. 2012. Man killed by horse in Lancashire. Nov. 1. clicklancashire.com. Roberts, J. 2012. Kicked to death in a horsebox–a preventable tragedy or a risk we take? Equijay.com and Gimenez, R. 2013 November 21 Horses in the Morning Radio 26:35*).

Fig. 5.18: No two trailer incidents are alike. Resources, on-scene conditions, and skills vary and must be assessed and co-ordinated. One rescuer here lacks a safety helmet.

As a "confined space," extricating horses from trailers presents special dangers to both animals and rescue personnel (*National Fire Protection Association NFPA 1670 Standard 2014 edition On Operations and Training for Technical Search and Rescue Incidents. 17.4.3 (9), p. 32 or Retrieved April 15, 2014.* http://www.nfpa.org/catalog/services/onlinepreview/viewer.asp?id=167014).

Weight shifts; flammables; slippery surfaces; obstacles such as haynets, dividers, jammed latches, pins, and fasteners; ropes; and chains hinder horse handling, handler escape or rescue crews.

6 Manufacturing Failures

There are no manufacturing standards for non-commercial horse trailers in North America, Europe, or the Antipodes. In fact, none can be found in any state or country of record. Motor vehicle regulatory enforcement officer for Transport Canada, Mathieu Yelle, notes that horse trailers are exempt from Canadian Motor Vehicle Safety standards (*August 19, 2011. Pers. corr.*). These standards would otherwise regulate at least the strength and performance of the trailer chassis, undercarriage or frame.

6.1 Material Exemptions

There are no specifications or requirements regarding the type of materials used for any components of horse transports (*Yelle, M. Motor Vehicle Regulatory Enforcement Officer. Transport Canada. August 2011. Pers. corr.*).

Without specifications, attempts to remedy design shortcomings, flooring, running gear, wheel, wiring or other identified defects are also hampered by the lack of mandatory recall of defective parts, the naiveté of purchasers, misreading equine behavior, and the universal lack of standards on the building of non-commercial horse trailers intended to be hauled by people who do not have a commercial drivers' license but who drive passenger vehicles or trucks.

For example, in New Zealand, a business exists to convert a garden trailer to a horse trailer.

Fig. 6.1: A simple box bolted onto a garden trailer at four points passes for a horse trailer.

Fig. 6.2: There appears to be a window in the front of this makeshift trailer which could entice the horse to lunge through it. If it is open, it does nothing to shield the horse from exhaust or the elements.

This represents many areas where the lack of standards has failed the purchaser, the animal, and safety considerations, even where the manufacturer specializes in horse trailers. This new trailer had flooring, sidewall, restraint, weld, and wiring failures. Poor fittings injured the stock during transport. (*Retrieved April 15, 2013. www.yellowstone.ws/ponderosatrailers.html*).

More money for a trailer does not guarantee quality. A new, empty trailer, right off the dealer's lot, came within sixty miles of home when it required servicing. The repair shop identified numerous problems and refused to let the repaired trailer out of its care until the passenger car tow vehicle was replaced with a heavier truck. (*Retrieved November 17, 2014. Wood, Lisa. TLAER.org Facebook*).

6.2 Crash Tests and Data Failures

There are no crash tests to evaluate the performance of the trailer chassis, undercarriage or frame materials during an incident. Such tests as occur are anecdotal reports from the field. For example, Jamco horse trailers reports one of its trailers surviving a 26 miles per hour strike by a train engine with no intrusion into the trailer, although one horse was killed. (*Retrieved November 28, 2014. Jamco Difference, Part 1. https://www.youtube.com/watch?v=6bLGOYebavE*.) A rear-face trailer owner reported a collision with a jack-knifing 60-foot tractor trailer on Mt. Messenger in New Zealand, badly holing the front of the trailer and cutting off two wheels of the trailer. The horses were uninjured (*Zimmerman, R.A. 1977. Pers. corr.*).

Without recourse to accident data or standards and where only cursory inspections exist, the likelihood of recalls on defective trailers, despite thousands of horse and human injuries or fatalities, is very small. Occasionally, a driver may sue a manufacturer seeking damages based on a specific incident; but even then there is no trace-back or recalls to fix other trailers with the defect or problem. (Compare this with regulations and standards which, after one infant death, forced the recall of 200,000 Peapod baby carriers.)

When one committee member, knowing of three incidents involving the brand, approached a popular manufacturer asking for wreck data on their trailers, the terse reply from their lawyer was that none were known of. Also, of the letters that were sent to over 67 manufacturers requesting this type of information, none were returned with any admission of incidents involving their trailers (*Gimenez, R. 2012. Pers. corr. April 9*).

6.3 Muting Early Warnings

Further complicating tracing of defective parts is that a central factory may supply several trailer manufacturers. Unsafe products are then distributed throughout numerous dealerships resulting in even low-mileage trailers experiencing poor wiring, axle, and tire problems (*Retrieved June 29, 2014. http://www.horsetackreview.com/review-display/11121.html*).

Removable vehicle identification numbers make tracking defective or stolen trailers difficult, allowing them to be registered as "homemade" to evade taxes, facilitating theft and circumventing inspection.

6.4 Limitations of Regulations

Conscientious manufacturers emphasize safety beyond the existing legal requirements which are rarely up to the better safety considerations. (*Kemp, L. 2014. The good ride. #31484. TheHorse.com*)

An Early Warning Reporting protocol issued by the US Department of Transportation's National Highway Traffic Safety Administration is intended, in part, to increase horse trailer safety. In effect since 2003, it covers materials, design, and construction of horse trailers.

The Early Warning Reporting protocol alerts manufacturers that they must be more cognizant of the materials they use in their trailers. The manufacturer is responsible for collecting reports of property damage, injuries or deaths while a product is in use. Recurring problems are identified and brought to the attention of the manufacturers or suppliers who must then alert consumers.

The Early Warning Reporting protocol in the USA requiring trailer manufacturers to report customer complaints and name the products involved, is not necessarily honored by either dealers or manufacturers (*Retrieved June 29, 2014. See Federal Register Vol. 67:132 July 10, 2002.* I.15 *http://www.gpo.gov/fdsys/pkg/FR-2002-07-10/html/02-17103.htm*). Purchasers of defective equipment are responsible for having the defect corrected when notified (*Weber, Rick. 2013. A look at revised guidelines. Retrieved June 29, 2014. trailer-bodybuilders.com/archive/look-revised-guidelines, p. 3*).

According to a legal overview, the Early Warning Rule can be over-ridden by the self-interests of the regulatory authorities and manufacturing interests (*Retrieved June 29, 2014. http://www.jerebeasleyreport.com/media/2008/09/2007_12_december.pdf, p. 14 -15*).

The cut off for reporting an accident involving a horse trailer to the federal authorities may be dependent on the gross vehicle weight of the tow vehicle. If the tow vehicle is under that limit, trailer manufacturers can claim "a flawless safety record" (*Retrieved April 15, 2014. J. Swan Feb 19, 2008 in: http://www.chronofhorse.com/forum/showthread.php?134656-Check-your-Sundowner-Trailer-before-use*). In any event, federal authorities are reluctant to record, research, or react to incidents (*http://www.nytimes.com/2014/09/15/business/regulator-slow-to-*

respond-to-deadly-vehicle-defects.html?emc=edit_th_20140915&nl=todaysheadlines&nlid=13908104&_r=0).

Horse trailer manufacturers who build fewer than 500 units a year—and there are many—are not affected or required to adhere to this rule (*Retrieved May 15, 2014. www.equispirit.com/info/articles/safety-regulations.htm*).

6.5 Recall Delays

When they occur, recalls are typically issued after the damage has been done (*Retrieved June 29, 2014. http://www.nblawoffices.com/accident-risk-prompts-big-tex-trailer-recall/*). Since 2003, there have been two trailer recalls in North America, one having to do with an add-on awning and the other with jamming deadbolt locks on the doors. The latter affected numerous horse trailers probably because the different manufacturers relied upon a single supplier (*Retrieved June 28, 2014. http://www.nblawoffices.com/horse-trailer-recall/).*

The UK will issue recalls on some horse trailer defects, in one instance due to floor panel failure (*Retrieved June 29, 2014. http://www.recalluk.com/latest/vehicle-recall.aspx*). See *Bateson Deauville Horse Trailer Recall*. [This website closed June 30, 2014 due to lack of funding]).

6.6 Consequences

The resulting lack of standards allows the unprotected horse to be transported in dog wire cages, in the back of pickup trucks, in home-made trailers of plywood, in garden trailers, and open-top trailers. Aside from the risk to the horse, the animal is not confined in the event of an incident and can become a road hazard if ejected or able to crawl out of the trailer (*Retrieved November 28, 2014. Gimenez, R. March 27, 2012. http://cs.thehorse.com/blogs/horse-911-whats-your-emergency/archive/2012/03/27/causes-of-horse-trailer-accidents-on-the-road.aspx*).

Fig. 6.3: Escaped horses cause havoc on the highway.

The lack of standards has subjected the Canadian market to cheaper and sometimes unsafe trailers from the states. (*Retrieved September 15, 2014. Horreur americaine.*

https://www.facebook.com/media/set/?set=a.136877186385894.29195.107922682614678&type=3).

Without an authoritative, independent source to assess trailer safety and manufacturing practices, the buyer is left on his own to search for safe features and make comparisons. One recourse is to consult websites reporting legal cases involving defective trailers or listing defects or recalls such as www.allworldauto.com, subrogationrecoverylawblog.com, or sites reporting personal experience or court cases involving trailer failures.

7 Ramps

7.1 Hazards

Trailer ramps may be located to the rear, side, or adjacent to the hitch. Trailers with ramps in two locations allow horses to be loaded and unloaded from dedicated entries or exits. Trailers with two ramps provide rescuers with greater opportunity to safely extricate a horse if there is an incident.

Ramps requiring the operator to stand within the space for raising or lowering are hazardous to users and horses. Ramps have been known to fall on the operator . Whether on opening, adjusting, or closing, the operator is in danger of being kicked, run over or backed over by the horse. Horses have been known to force the ramp onto the operator, injuring, paralyzing or killing the operator, and escaping. (*Gimenez, R. Pers. corr. June 28, 2014. See also: Retrieved June 29, 2014.* http://www.horseandhound.co.uk/news/397/309125.html).

Ramps are known to fail when the trailer is under way, injuring the horses relying on them for support when closed or allowing the horse to escape. There should always be at least two restraints keeping horses in a trailer (e.g., a butt chain or bar and a ramp or door). (*Retrieved September 20, 2014, 2000 Featherlite 1630 user in Frankston, Texas, comment.* http://www.allworldauto.com/comments/viewthread.php?cid=210353).

7.2 Fittings

Fig. 7.1: The forward movement of the transport throws this horse to the rear and out of the transport.

Ramp fittings, such as springs, are known to injure horses and humans, though the dangerous side springs have largely given way to pre-loaded springs in the hinge. Older trailers may have garage-door type springs attached to the sides of the ramp. Springs can break, and they usually do while extended (loaded).

Sometimes a small winch and cable are substituted for the springs. The winch and cable are a cheap solution as the winches have little mechanical advantage, exposing the wire rope to excessive wear and eventual breakage. If only one is used, the trailer frame to which it is attached may be overloaded. Electrically powered ramps with no mechanical override may fail, trapping the horse or handler.

Because the ramp may weigh hundreds of pounds, the ramp is more manageable with assists. Modern trailers will have torsion spring-loaded hinges where the ramp attaches to the trailer.

Portable sides or "floats" are placed on higher ramps to guide the horse.

7.3 Footing

Cocoa mats, long a staple for horse shipments on land or sea, are used to prevent horses from sliding or falling off while unloading and loading. Footing on ramps may be enhanced by cleats offering greater security on a frozen or wet surface. However, cleat spacing is arbitrary because the size and conditions of hooves among individuals and breeds will vary (*Retrieved September 20, 2014. Grandin, T. 2008. Engineering and design of holding yards, loading ramps.* http://www.izs.it/vet_italiana/2008/235_245.pdf).

Fig. 7.2: A typical injury to a horse reversed from a step-up or rampless trailer. The horse's hind legs slid beneath the trailer on unsuitable ground or the horse my fight loading, slip, and fall.

7.4 Restraints

Some trailers have three restraints: butt restraint gate, back doors, and ramp. This is safer for people because it prevents horses from attempting to unload themselves if they are untied or slamming the ramp down onto the operator while unloading and loading the horses.

7.5 Capability

Ramps should be substantial enough at the hinge and the end on the ground to support the weight of the intended cargo and handler standing on it. Note that platform load ramps require support which brings it level to the interior deck or slightly higher. The loading platform is parallel to the ground. The leading edge is not placed upon the ground unless it is lowered as a ramp to unload the horses.

Fig. 7.3: Trailer skin wrapped around the hinge concealed the weakening of the ramp. Photo: Courtesy of J. Johnson.

7.6 Maintenance

At least one horse trailer firm insists ramps be replaced every 5 years (*Retrieved June 29, 2014.* (*https://www.youtube.com/watch?v=kmJn05fOKl8&list=PL8UI4CaAAi7KqPxImBoE_P8tDloZu9H-X&index=46 For further problems involving ramps, see: Retrieved June 29, 2014 Gimenez, R.*

http://cs.thehorse.com/blogs/horse-911-whats-your-emergency/archive/2013/06/13/horse-trailer-ramp-safety.aspx).

7.7 Proposed Standards

Loading and unloading ramps should be as low as possible, not exceeding a 20 degree slope for conventional trailers.

Rear ramps should extend the width of the trailer and at least one-half to three quarters of the full height of the trailer.

Loading ramps should have a spring or support and closure device located away from the horses' legs and head during the load and unload procedures, preferably in the frame at the base and sides of the trailer.

The gap between the ramp and trailer deck, intended to shed debris, can still entrap a shod horse's hoof when the shoe caulks or heels get caught in the gap. Two inches are a recommended maximum for this gap.

Loading ramps should be supplied with a fixed, non-slip surface when the surface is damp or wet. Non-slip surfaces such as those used on the exterior of submarines might be considered.

For conventional trailers exposing handlers at the entry/exit to the hindquarters, a side swinging door to close off the stall as the horse is loaded may act as a buffer between the handler and horse. (*Retrieved September 20, 2014. Horse kicks ramp; ramp . . . breaks [woman's] arm and leg. Life Flight Trust. December 25, 2011. http://wellington.scoop.co.nz/?p=41433). and Temple Grandin,ed. 1993. Livestock Handling and Transport Oxon: CAB p. 247*).

Doors and ramps shall be built to a secure standard to prevent opening under way, even when pushed upon by a panicked horse. Ramps using electric winches shall reinforce the framing to which the winch is attached.

Powered ramp winches shall have a manual override in case of electrical failure or fire.

Ramps shall be buffered from noise of hooves loading onto them and when latched and protected from impact with the ground or frame and from deterioration by weather.

Platform load ramps shall have the adjustable platform support strong enough to support the intended weight of two horses and their handler being loaded or unloaded simultaneously.

Garage-door type external springs may not be used to lower and raise the ramp unless fully enclosed and confined without risk to a handler or animal should they break. If used, they must have safe hardware to attach them to the frame and ramp, and where a hoof or leg cannot be inserted between them.

Ramps shall have sturdy latches capable of being additionally locked in the closed position with a heavy duty carabiner or padlock.

Lubrication points for any parts of the ramp shall be readily accessible and identified.

Ramps should have protection on the end that contacts the ground to minimize damage to the ramp.

8 Loading Safety

8.1 Risks in current practice

Conventional forward-facing, one- or two-horse trailer transports frequently place the handler within the "kicking zone" of the horse as it passes into or exits from the trailer. The horse must pass by the handler on entry or exit.

Fig. 8.1: While intended to keep a horse calmer during the loading or unloading process, the practice of entering a trailer with a live animal, considered a hazardous confined area, is dangerous. The two girls lifting the ramp could also be hurt should the horse back through or kick beneath the rump bar.

To avoid getting kicked, or to encourage the horse to enter the trailer, some handlers lead a horse into the trailer. They risk getting trapped or injured as the inside of a trailer meets the US Occupational Safety and Health Administration definition of a "confined space"(*Retrieved September 21, 2014. https://www.osha.gov/SLTC/confinedspaces/*).

> Many workplaces contain areas that are considered "confined spaces" because while they are not necessarily designed for people, they are large enough for workers to enter and perform certain jobs. A confined space also has limited or restricted means for entry or exit and is not designed for continuous occupancy.

See regulations at https://www.osha.gov/law-regs.html

Further guidance may be obtained from American National Standard ANSI Z117.1-1989, Safety Requirements for Confined Spaces. This standard provides minimum safety requirements to be followed while entering, exiting, and working in confined spaces at normal atmospheric pressure.

Fig. 8.2: A downed horse in a conventional trailer presents a dilemma for untrained rescuers. Here they are attempting to get webbing around the animal's body but have entered the trailer space and the horse is still tied. This is very dangerous for humans and the horse.

8.2 Training

Horses frequently resist loading or injure themselves or handlers when loading or unloading.

Fig. 8.3: As a forest fire threatens, this horse refuses to load. Rescuers frequently face evacuation delays due to untrained horses or the lack of skills in loading them or knowledge of least-resistance platform loading.

To avoid entrapment or injury to themselves, some handlers train the horse to enter the conventional trailer when signaled from a safe distance. The horse may be beyond the control of the handler at some point. Or this may not be feasible if it is a mare and foal.

Loading and unloading skills usually require specialised, and frequently aversive, trauma-inducing training. Recent methods incorporate the more useful positive reinforcement and desensitization training (*D. L. Ferguson and J. Rosales-Ruiz. 2001. Loading the problem loader: the effects of target training . Jl. of Applied Behavior Analysis 34:4, 409-424*).

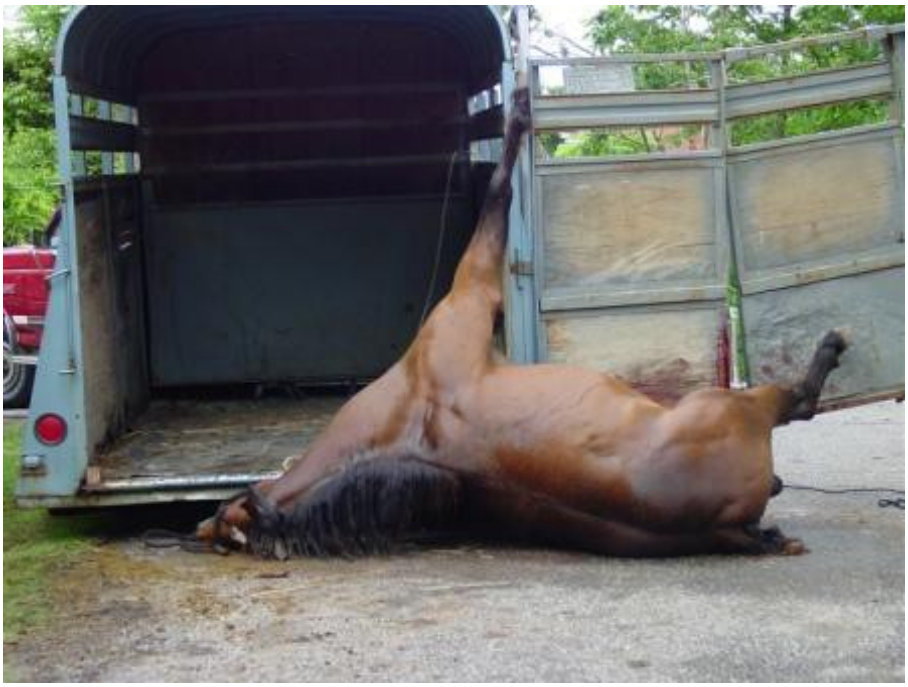

Fig. 8.4: Many forms of transport offer numerous traps for a horse's hooves and long legs. Loading and unloading are the most dangerous aspects of horse handling around trailers—both to the horses and to the humans.

8.3 Platform Loading

Platform loading, associated with traveling horses balanced over their forequarters, lessens or eliminates resistance to loading and maximizes handler and horse safety. The horse may be signalled to load when the handler is off the platform or the handler may share the platform with the horse during loading and unloading. However, the handler is never within the confines of the trailer and is always in control of the horse’s head.

Platform loading has been successfully employed by horsemen as young as 7 years. (NB: Committee members are divided on the wisdom of allowing anyone under 18 to load or unload any size horse under any circumstances.)

Fig. 8.5: A nine-year-old girl platform loads her horse. The system allows her to remain at the horse's head at all times, well away from the kicking or "hot" zone.

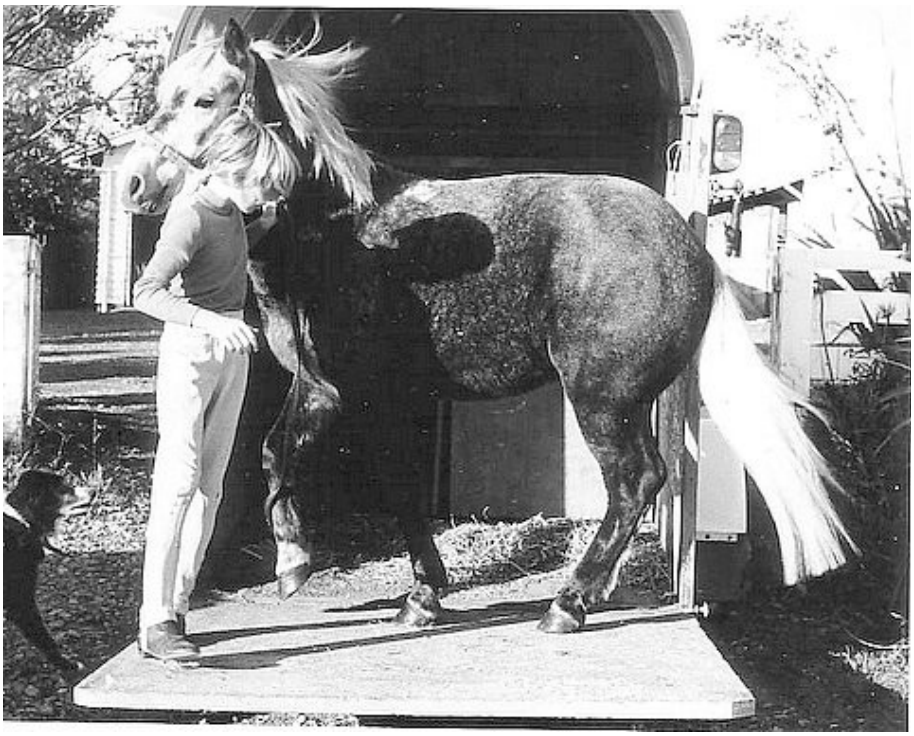

Fig. 8.6: A Pony Club mount readily platform loads at the direction of its young handler.

Fig. 8.7: Horse, pony, and their riders are ready to leave for a Pony Club event having loaded their own horses. Platform loading is resisted by many people with horses because familiar or intuitive aversive training cannot be employed. The horse cannot be forced into the trailer. Training for platform loading is based on the horse's need for security in its rearward blind spot. En route, the trailer accommodates the horse's natural forward-resting lean, maintaining its trust and normal forward leaning, head-free posture.

An animated illustration of some of the steps for introducing a horse to platform loading can be seen at http://naturalhorsetrim.com/Section_21_full.htm

8.4 Proposed Standards

The loading and unloading process should remove the handler from the danger of being kicked, run over, trapped, or injured by the horse or equipment associated with the trailer. The ideal loading process places the handler in control of the horse's head at all times without entering a confined area and without exposure to the hindquarters.

9 Stability During Transport

9.1 Reaching for Remedies

Horse handling, trailer design and horse orientation during transport are integral to horse and highway safety. Few studies have considered all factors involved in transporting horses in a manner most fully compatible with the animal's welfare and transport safety. Some studies may focus on the physiological effects. Others on driver behavior. Others on the effect of suspension.

What has been consistently overlooked is consideration as a whole of the horse's requirements for physical and psychological security, balance, and the effect of transport design and driver actions upon each. Without these considerations, there is a likely misdirection of use and functioning of one component or another invariably associated with injury, disease, or accident.

Prescriptive solutions such as more training, tranquilizers, compression suits to ward off muscle fatigue in transit (*Retrieved September 16, 2014. http://horsetalk.co.nz/2012/03/23/hi-tech-body-suits-enter-the-equine-sphere/ or http://www.hidez.com.au/*) and even electric shocks delivered beneath the horse's tail typically avoid the sources of the problems (*http://www.academia.edu/6616378/Equine_Transport_Prescriptive_or_Preventive*).

Fig. 9.1: Frustrated by problems in transport, this trainer advocates hobbling and/or, perhaps jokingly, nailing the horse's hooves to plywood to "teach" it to stand still. Movement in a trailer contributes to instability and loss of control under way. None of these methods is recommended and are considered abusive training practices by most horsemen and women.

9.2 Factors

9.2.1 Anatomy

Such segmented "remedies" frequently ignore basics of equine physiology. Overlooked is the melding of all the known aspects that contribute to safety and the integrity of the animal and the transport. For example, some approaches to horse balance currently and erroneously argue that the horse stands like a table with its weight equally distributed on all four legs.

This claim was disproved in the 19th century. François Baucher studied the horse's weight distribution with the head in different positions. With the nose at wither level, 20 kg is transferred to the hindquarters (*Froissard, J. 1983. Grammar of riding. Equi #16, p.17-19*).

Even a cantle pack, located close to or on the horse's sacroiliac joint, further from the horse's center of balance, risks fatiguing and soring the horse (*Deans, W. 1996. Pros and cons of cantle packs. Western Horseman September 6:9, pp. 139-140, 142*).

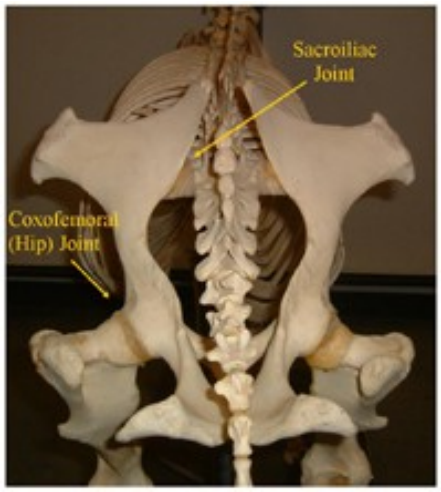

Fig. 9.2: The sacroiliac joint is at risk of fracture when it must bear additional weight. Hunter-jumpers are also susceptible to this type of injury. Pathologists report that in dissecting carcasses, it is easy to split the sacroiliac joint by hand.

Fig. 9.3: This pony presented with lameness following transport. The source was traced to sacroiliac strain.

Overlooked in current studies is action of the horse's thoracic sling, a crucial component acting like a gimbal to maintain stationary balance.

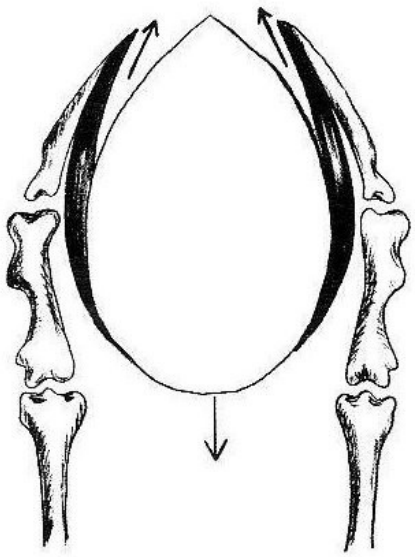

Fig. 9.4: The horse's thorax is slung between its two shoulder blades. The cradle action at standstill or in motion acts as gimbals to keep the horse balanced and upright.

This function is disabled when the horse faces the direction of travel. It can be compromised when, facing away from the direction of travel, stall length is too short or the horse's head is too restricted to act as a spontaneous counterweight and balancer in conjunction with the thoracic sling. A horse is particularly susceptible to its loss of balance. A prey animal, it instinctively knows that if it is off its feet and down, it is a dead horse. The horse's frantic efforts to remain upright may destabilize the trailer.

Fig. 9.5: A swaying trailer sent the pickup towing this trailer out of control. Ricocheting from one to the opposite a guardrail, the pickup launched off the bridge, crashed, and burned. The trailer, carrying two horses, detached coming to rest on a guardrail.

9.2.2 Rollovers

This 2-minute clip illustrates trailer sway and rollover with two horses aboard. It is also an excellent demonstration of the dangers of loading (*Retrieved September 20, 2014. Rescue 911: Episode 491 Racehorse Rescue Part 1 of 2 Parts.* https://www.youtube.com/watch?v=jMg3KCGgCSY).

Load placement is considered a critical factor in preventing or contributing to rollovers. It also affects handler safety during loading, unloading and emergency rescue of the horse. The Society of Operations Engineers, which promotes best practices in operational, health, and safety initiatives, notes that most rollovers occur due to factors associated with the load. However, it must be noted that the horse's movement within the trailer is usually NOT the cause of the rollover. Movement within the trailer only contributes to the rollover occurrence *after* the rollover threshold has been achieved. This is approximately a 5 percent change in angle based on Jennifer Wood's work on semi-trailers hauling livestock.

Instant instability occurs when there is a weight shift around the center line of the cargo to outside of the suspension attachment center. Horses have a high center of balance (gravity) or

mass, making the horse trailer particularly vulnerable to swaying or exceeding the rollover threshold (*Rebecca Gimenez, T. Gimenez, K. May 2008. Technical Large Animal Emergency Rescue. Iowa: Wiley-Blackwell, p. 152*).

Fig. 9.6: An overturned trailer on a German highway has crushed a car alongside. The horse is rolled into a position that prevents its ability to get up.

Partly due to the horse's high center of balance the trailer's overturn rarely halts in a partial rollover. Momentum and cargo shift often carries the trailer on to its full side or roof. Depending on the points of primary and secondary collision and trailer quality, the horse may be ejected from the conveyance (*Retrieved September 26, 2014. Horse ejected from trailer I-75, June 2013. http://www.wkyt.com/news/headlines/Accident-involving-horse-trailer-shuts-down-I-75-south-210692621.html*).

Horses or live loads involved in a collision or panicking during transport may thrust their weights fore and back. The action alternately loads and unloads the tongue weight, contributing to loss of control of the tow vehicle or trailer (*Retrieved September 21, 2014. Nicholas Edwards. 2011. Vehicle Rollover. Society of Operations Engineers. http://www.soe.org.uk/resources/technical-guides/*). The trailer may be thrown onto the rear doors, especially when incorrectly attached to the tow ball in the first place.

Fig. 9.6: Inadequate hitching or mismatched ball and coupler, a failed or disconnected electrical brake are among the contributors to incidents landing trailers on their rear doors.

9.2.3 Driver Skill and Care

Cargo and trailer stability are also affected by road camber, tire type, sidewalls and inflation, road conditions, excessive speed, round-abouts, high winds, adjustment of load levellers or sway bars, insufficient training, distraction, impacts on the curb, suspension, double-bends, over-correcting, and abrupt lane changes.

As witnessed by this reporter, a horse can go down in a conventional trailer despite a textbook-smooth lane change. In August 2014, co-editor Gimenez witnessed a draft cross horse that was "down in a trailer" from hitting a bump. Not knowing how to remove the mare, the veterinarian and owner elected to euthanize the 12-year-old intermediate level dressage mare in the trailer.

Driver behavior is a critical factor in maintaining load stability. A study of calves, pigs, cattle, and sheep during group transport in European Union-approved conditions over a variety of road surfaces and speeds revealed many hazards associated with stock transport. The least skilled drivers subjected unconfined animals to more bruising and falling than the better drivers (*Retrieved September 9, 2014. Michael Cockram, et al. The effects of driver behavior on the behavior of livestock in transit. University of Edinburgh. 84 mins. youtube/4sQ3Etj9K5I*).

10 Reaction of Horses to Transport

10.1 Equipment Dangers

In the typical two-horse trailer in which the horse faces the direction of travel, the horse raises its head above its wither level and squats rearward. The horse frequently supports its weight on the butt bar, chain, closed ramp or door. It may be trying to avoid being thrown forward on braking. Or it may be trying to compensate for the sensation of the ground moving from its hind to its forequarters, like a rug being pulled back to front beneath it as the trailer moves off.

Horses caught on the breast bar or partition are a common occurrence (*Retrieved September 21, 2014. http://www.horsesinthemorning.com/hitm-for-08-15-2013-by-tlaer-emergency-prep-horse-trailer-hang-ups-building-response-teams/#t=10:45.829*).

Fig. 10.1: Horses over partitions or chest bars are a common trailer rescue scenario. If the latches/pins are jammed or inoperable due to the horse's weight on them, the rescue will be delayed to make cuts and further injury may be incurred.

Fig. 10.2: This stallion jumped the breast bar in a conventional two-horse trailer as it headed toward the showground exit. The owner speculates that on a hot day, the trailer was not moving fast enough to provide fresh air to the horse and it panicked. Lack of good ventilation is a huge problem in horse transports of all types.

Chest and butt restraints, meant to confine the horse within the trailer and/or to minimize movement of the horse and stabilize partitions and framing walls, may entrap horses. Horses can slide beneath them during a traffic maneuver or when attempting to escape or get a quarter or hind leg over them. Several types are marketed purporting to be "instantly removable" or to "collapse under downward weight" to counteract this type of entrapment, potential injury and assist rescuers.

Typical of the prescriptive vs. preventive approach to horse transport problems are "on-board safety belts." These are placed within the hollow ahead of the horse's withers to prevent it from rising and straddling the breast restraint or partitions during transport (*John O'Leary. June 16, 2012 Pers. corr.*)

Fig. 10.3: Some horse transporters prevent the horse from attempting to escape the sensation of the floor moving from back to front by anchoring the horses' necks to the breast bar. This is not a common practice and may not be well advised.

10.2 Travel Posture

Horses also assume a widened rear leg stance in an attempt to balance and to support the added thrust of their rearward weight. One trailer manufacturer offers flared lower trailer sides to accommodate this widened stance. Accommodating the stance, however, does not relieve the horse of weight on its fragile sacroiliac joint or strain on the pubio-femoral ligament.

Fig. 10.4: Horses facing the direction of surface travel engage learned behavior requiring additional muscular efforts to balance. This horse anticipates the forward movement of the trailer and props itself. Its hindlegs extend sideways to widen its base and carry the additional weight shift of its higher held head.

Fig. 10.5: Partitions and kick boards in conventional floats record the efforts of the horse to remain upright.

Horses travelled in this manner expend nervous and muscular energy in maintaining their balance off their hindquarters. (*G. Giovagnoli, M. Trabalza Marinucci, A. Bolla, A. Borghese. 2002. Transport stress in horses: an electromyographic study on balance preservation. Livestock Production Science Volume 73, Issue 2 , Pages 247-254*).

Fig. 10.6: Horses facing the direction of travel tense and seek to stabilize themselves even before this air freight stall moves off. Their hind legs are spread outside the hip joint as widely as the confines allow. This position puts strain on the stall partitions and fittings. Horses feel more comfortable and scramble less or not at all when they have freedom of movement to balance without strain.

Fig. 10.7: This horse's fragile sacroiliac was fractured during a trailering incident, making it impossible for it to stand. It was soon euthanized.

10.3 Effect on Axle and Hitch

Conventional two-horse trailers in which the horses are positioned facing the direction of travel place the axles rearwards to maintain 10 percent of the total load of the trailer on the hitch when the trailer is stationary. Once the trailer moves off, the rearward placement of the axles also supports the typical rearward thrust of the weight of the squatting horse on the butt bars or butt restrainers. When the live load shifts, the percentage is in flux affecting tow vehicle control.

10.4 Effect on Muscles

Studies of equine anatomy indicate that neck muscles are relied upon to maintain equilibrium of neck and thorax. However, if forced to compensate for imbalance, the muscles are strained. If the neck and thorax are compromised, their stabilizing factors are not transferred to the spine (*Retrieved September 9, 2014. Clothier, J. 2014. How the anatomy books unintentionally fail us over the nuchal ligament. In press: Journal of Equine Veterinary Science.* http://thehorsesback.com/nuchal-ligament/).

Horses subjected to conventional transport typically increase in wither height from 2 to 10 cm (1 to 4 inches) depending on what sort of vehicle is used. Before being measured by show stewards, horses are walked upon arrival to settle their height (*Vachon, R. 1980. Pers. corr.* and *Hickman, J. and C. Colles. 1984. Measurement of horses. Veterinary Record, May 19. Vol. 114, No. 20, pp. 491-493* and *Anon. 1982. Laser beams measure up. Equus November. No. 61, p. 122*). Engineer C. M. Haslegrave has observed that it is likely that vibration is also a factor in the increased height of the transported horse (*Haslegrave, C.M. November 29, 1990. Pers. corr.*).

Delayed onset muscle soreness is thought to result from transport-induced vibrations. The University of Queensland is studying the relationships among trailer vibration, increased height during transport, and muscle soreness induced by attempts to remain balanced (*Retrieved September 21, 2014.* http://www.thehorse.com/articles/16151/trailer-noise-and-vibration-study and *Harris, A. March 3, 2013. Pers. corr.*).

10.5 Physiological Reaction

The horse's apprehension of instability leads to frequent dunging and sometimes choke. Nutritionists and veterinarians warn of choking risk due to increased tension (*Tyznik, W. J. 1979. About feeding horses. Hoofbeats Vol. 46, No. 12, p. 98* and *Maderious, W. 1976. Equine first aid. Horse Lover's National Magazine, June-July. 41:3, p. 64 and Equine Nutritionist Kentucky Equine Research. Retrieved September 13, 2014.* http://www.equinews.com/answer-exchange/equine-nutritionist-qa-eating-on-the-go).

Transport stress lowers a horse's immunity. Bacterial toxins arising from transport stress were found to have killed race horse Phar Lap (*Meszoly, J. 2001. Authors resolve Phar Lap mystery. Equus. No. 279, p. 54*).

Some current horse transport configurations and practices significantly increase the horses' plasma levels of immuno-reactive, beta-endorphin-like substance through the first hour of shipping. The levels are higher than the levels following a slow gallop (*Wi, L. and C. L. Chen. 1987. Running and shipping elevate plasma levels of beta-endorphin-like substance (B-END-LI) in thoroughbred horses. Life Sciences 6:40, 1411-21* and *Fazio, F., P. Medica, V. Aronica, L. Grasso and A. Ferlazzo. 2008. Circulating beta-endorphin, adrenocorticotrophic hormone and cortisol levels of stallions before and after short road transport: stress effect of different distances. Acta Veterinaria Scandinavica 50:6, Retrieved September 21, 2014.* http://www.biomedcentral.com/content/pdf/1751-0147-50-6.pdf).

Lab tests reveal that even horses familiar with transport experience physiological stress. One university study loaded daily, over the course of 12 weeks, 14 Quarter Horses accustomed to travel. Once a week at the same time the horses were loaded facing forwards and transversely. The horses loaded readily and appeared to stand quietly for one minute before they were

unloaded. Laboratory tests for packed cell volume and adrenaline showed that the horses' apprehension, though not visually observed, did not decrease as expected over the 12 weeks (*Padalino, B., et al. 2014. Effect of loading into a truck, short isolation and unloading on packet [sic] cell volume (PCV) behavior and physiological parameters in Quarter Horses. In press.* and *Padalino, May 28, 2014. Personal corr.*).

10.6 Loading Resistance

Physiological reactions are triggered at the time of loading. Coincidentally, both loading and unloading are associated with the greatest danger to handler and horse.

Horses instinctively avoid entering shadowed, dark or noisy areas. Overcoming this reaction typically requires hours and sometimes days of careful introduction. At many points in the process, both horse and handler are at risk from equipment, falls, slips, kicks, and entanglement in equipment (*Retrieved September 21, 2014.* *http://www.stuff.co.nz/dominion-post/6255836/Fingers-saved-in-17-hours-of-surgery*).

Fig. 10.8: Two handlers, both in dangerous areas, attempt to load a horse. The animal draws away from the tightened rope, perceiving the handler facing it as threatening. Loading scenes typically draw a lot of "riders in the stands" to offer uneducated advice, cruel brawn, and occasionally behavioral brain.

10.7 Toward a Solution

Hooved animals subjected to transport suffer less stress and injury when transported facing away from the direction of travel (*Retrieved February 1, 2015.* *www.youtube.com/watch?v=2kxWuJxo6Ko* and *Fowler, M. 1978. Restraint and Handling of Wild and Domestic Animals. Iowa State University Press. pp. 242, 246*). Exotics may be transported loose in compatible groups so that they can choose their direction.

To accommodate this orientation in conventional trailers, and to reduce the resistance and hazards associated with loading and unloading, some trailers use platform loading. As the horse

cannot be forced in, no aversive devices , pain-inducing halters, threatening ropes, etc., are used. The horse never faces the entry. The horse is led parallel to the entry, turned on the forequarters, and reversed in. Similar to the rapid and efficient police cruiser "A Turn," the maneuver has been used for centuries to put a horse single-handed to a wagon or to reverse a horse and wagon into a bay or chariot stall. To unload, the platform becomes a ramp and the horse is led out. As the handler remains at the side of the horse's head or shoulder and no one is ever behind the horse, the handler is in little danger of being kicked or struck by a front hoof or run over.

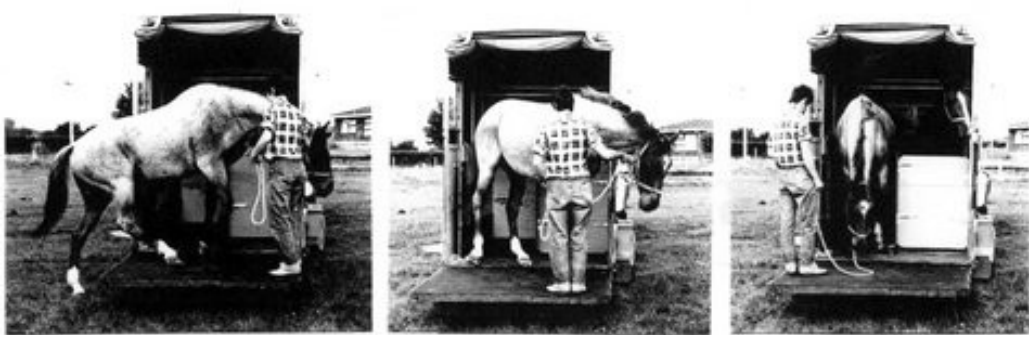

Fig. 10.9: A horsewoman platform loads one of two 17-hand show jumpers into a rear face trailer. The horse readily lowers its head. Fifty-thousand miles on this trailer, and there is not one mark on partition or sides to indicate the horses had balance problems. A stable cargo increases the safety of the rig.

10.8 Recommendations

10.8.1 Restraints

Rear and chest restraints shall be removable even when loaded with the horse's weight.

Rear and chest restraints will release when weighted from the top.

Restraints will be protected on release from injuring the horse.

Restraints will be removable without endangering personnel.

10.8.2 Systems

Horses shall be loaded by a system presenting the least danger to personnel and the horse.

10.8.3 Balance

Horses shall be travelled in a manner without compromising their normal balance off the forequarters. The standards recognize that in some instances, horses may be required to balance off their hind quarters if a forequarter injury is being treated.

11 Rear-Facing Trailers

11.1 Back to the Future

Transport facing horses away from the direction of travel is growing in popularity in Europe and parts of North America. This chapter gives a brief overview of the practice which was common in the 1920s and 1930s.

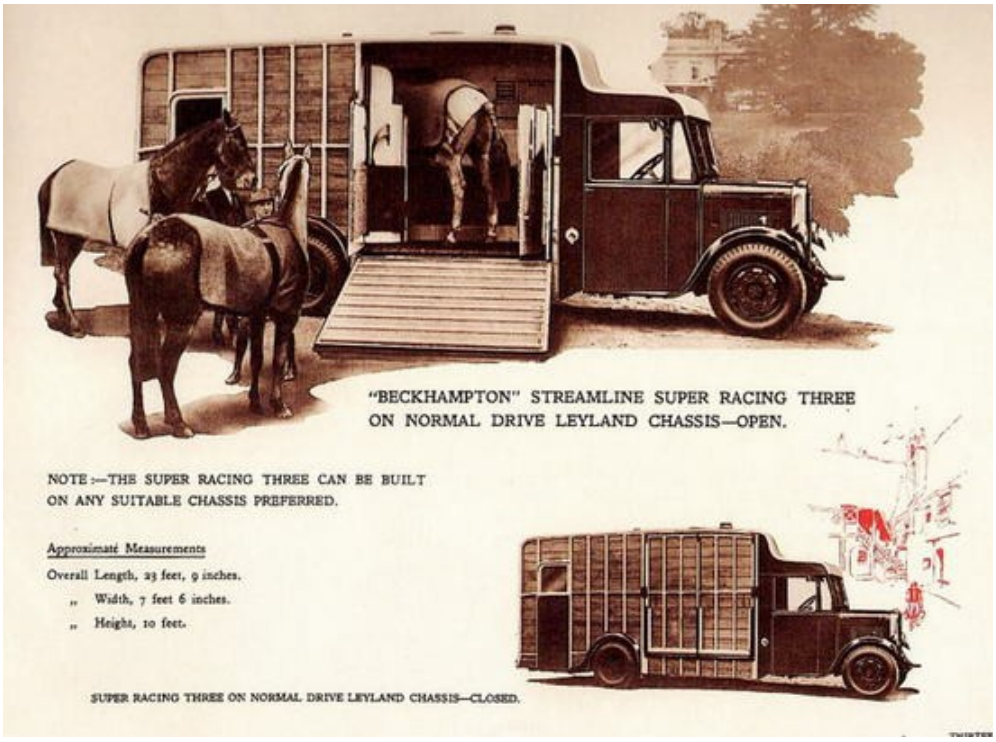

Fig. 11.1: Three horses are loaded facing the rear in this Vincent horsebox.

Fig. 11.2: This 1930s trailer by Rice loaded the horse from the front of the trailer to face away from the direction of travel. This method, re-popularized today, places the horse near the hitch and possible injury if there was an incident. It also did not eliminate the presence of a handler within the trailer.

Loose or properly stalled, horses facing away from the direction of travel record lower heart rates and cortisol levels. These indicate a diminished fear response compared to horses facing the direction of travel or tied parallel to the direction of travel (*Padalino, B., A.*

Maggiolino, M. Boccaccio, et al. 2012. Effects of different positions during transport on physiological and behavioral changes of horses. Vol. 7, Journal of Veterinary Behavior, 7, 135-141).

Argentine veterinarians involved in ground and air transport of horses recommend traveling horses to face the rear of the vehicle with the body either oblique or parallel to the longitudinal axis. The authors noted that facing horses toward the direction of travel risks respiratory and traumatic injury, as does travel transverse to the longitudinal axis (*Catalli, J., et al. 2008. Bienstar en el Transporte de Caballos. Care of horses in transport. Veterinaria 25:242, 106-109. Trans. by A. H. O'Malley, Multilingual Services Directorate, Government of Canada*).

University of Sydney researchers cross tied horses with a 50-cm tie fastened to the lower halter D-ring. The horses were assigned same size bays. Horses cross-tied traveling facing away from the direction of travel rested a hindquarter at will during transit even though unable to lower their heads to floor level. Horses facing the direction of travel could not rest a hindquarter (*Padalino, B. April 12, 2014. Pers. corr.*)

11.2 Load Placement

11.2.1 Effects on Safety

Non-livestock trailer manufacturers have recognized the need for designs to make loading and unloading of goods safer (*Retrieved September 21, 2014. http://www.rentalmanagementmag.com/Article/tabid/670/ArticleID/16408/t/Default.aspx*).

Best practices associated with live cargo placement are intended to minimise the exposure of the handler to kicks, bites, and entrapment within a confined space or during a loading or unloading process (*Retrieved September 21, 2013. Unsafe loading practices: https://www.youtube.com/watch?v=jMg3KCGgCSYhttp://youtu.be/j2O_ItTcR9M*).

With the handler at the head of the horse throughout loading, rear-facing transport reverses the horse from a platform into the trailer. There is minimal chance of the handler being trapped, kicked, or bitten. A 10-year employee of Canada's Occupational Health and Safety familiar with animal behavior rated the loading and unloading system as the safest he'd ever seen (*Clifton, M. 2012. Interview. Animal Transportation Association Conference, Vancouver May 18-21*).

Fig. 11.3: This Warmblood has just been introduced to platform loading in a rear face trailer custom built to the original concept. The handler is never in the kicking zone or trapped within the confines of the trailer.

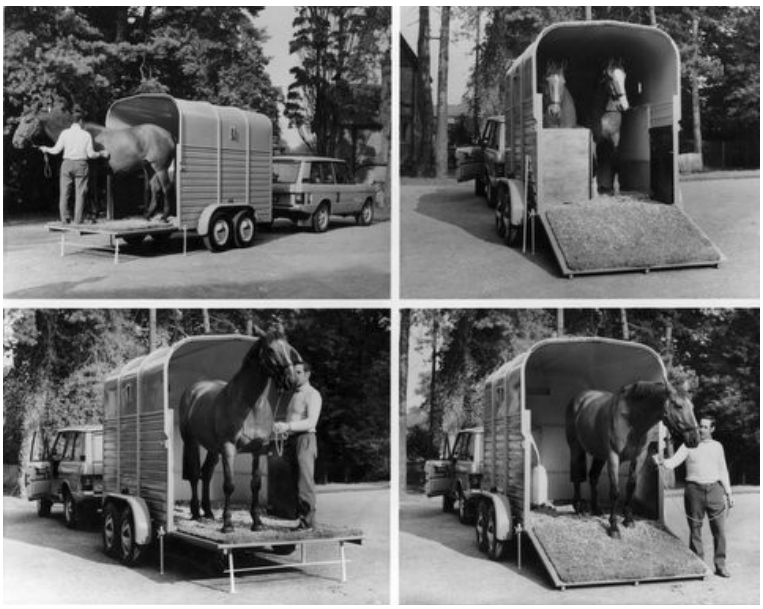

Fig. 11.4: Two 17-hand hunters are loaded into the original rear face trailer. Previously a "hard loader", the mare was then loaded by a 14-year-old girl after introduction to this trailer. The 14-inch platform accommodates rougher show grounds. Other models are lower.

11.2.2 Balancing

Once loaded, the animal is positioned between the axles, allowing the horse freedom of head and neck movement. The horse is then able to maintain its automatic effortless balance off its forequarters.

Fig. 11.5: A horse balances normally off its forequarters, resting a hindleg. Properly provided for in rear face transport, it will assume this posture and doze during transit.

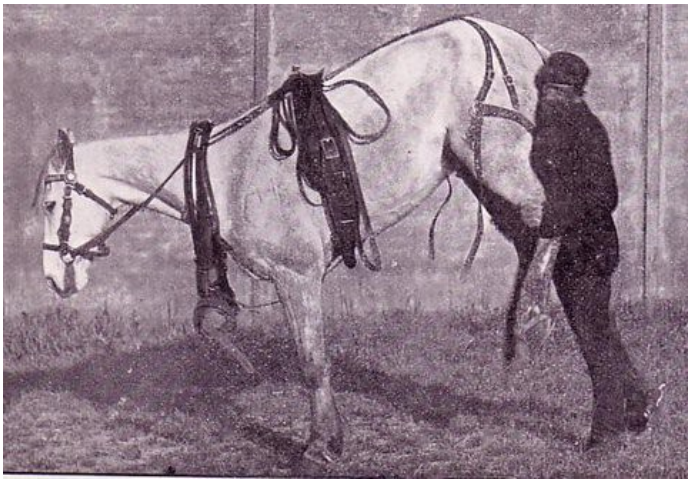

Fig. 11.6: An early horse tamer, "Prof. Lichtwark," demonstrates the ability of a horse to balance off its forequarters. Cregier has done the same by reversing between the 15 hand horse's hind legs and lifting it by the hocks. As the weight is supported on the forequarters, it is not that difficult.

The horses readily stand resting a hip, even before the trailer is in motion. Male horses stretch and stale or urinate at any time as their balance is not affected.

Fig. 11.7: Two of three horses are platform loaded into this trailer which shows no scramble marks. They immediately assume a hip shot resting stance. The windows behind the horses and the tying method (draping the lead ropes over the shared breast bar) is not recommended.

Fig. 11.8: Eyes closed, ears aslant, hind hoof cocked, one horse begins to doze as its travelling companion is loaded by its young owner.

Facing the horses away from the direction of travel reduces the demand on the horse to actively compensate for erratic trailer movements. It contributes to the horse's ability to automatically compensate for changes in direction and speed; maintains near or at normal metabolic and respiratory activity; provides an environment conducive to resting physiological states as indicated by variable heart rate measurements, minimum muscular efforts, hindquarter resting, a low head; and encourages minimum restiveness.

Users report no marks on the equipment from kicking or balancing efforts (*Bellette, S. November 28, 2014. Pers. corr.*)

11.2.3 Engineering Stability

Facing horses away from the direction of travel contributes to load stability and safety, but axle placement and hitch weight are also factors in optimum stability.

For the two-horse trailer transporting horses facing away from the direction of travel, the axles are repositioned forward such that, when empty, the trailer, without a dressing or storage area added, is evenly balanced. A rundown or jockey wheel is not required to prevent the hitch from falling when stationary.

The horses' thoracic sling is placed between the two axles, the point of least rotational movement in the trailer. By placing the horses' forequarter weights and the thoracic slings functioning as gimbals in this area, a more even tongue weight is maintained throughout traffic maneuvers including braking. The shorter axle to hitch distance also minimizes bounce (*Fathauer, G. April 27. 2014. Pers. corr.*).

Fig. 11.9: This horse's weight in a rear face position is located between the axles, at the point of least rotation. Its thoracic sling is free to act as gimbals, which tends to make the horse more comfortable in transport.

11.3 Braking

As originally designed, the New Zealand platform load two horse trailer stability was verified by automotive engineer, Raymond C. Hill. Mr. Hill was supervisor of the Newton King, New Plymouth, motor department in early 1967. He was in charge of engineering, motor works and chassis repair.

The trailer was tested to New Zealand braking requirements with its intended cargo. The test involves a full stop at 20mph within 30 feet, with horses aboard, without jackknifing the trailer or upsetting the horses. As it is impossible for conventional trailers to do this safely, they are never tested with horses aboard despite requirements.

This achievement is all the more remarkable when compared to passenger car stopping distances (*Retrieved October 10, 2014. http://www.driveandstayalive.com/info%20section/stopping-distances.htm*).

Braking can also control or exacerbate sway. This is especially important when the softer suspension of passenger cars is involved.

Axle and hitch distance ratios can be compromised if conventional trailer axles are moved forward to accommodate the shorter wheelbases on sports utility vehicles. In the conventional trailer, this puts the horses' weight toward the rear of the trailer, behind the rear axle. This weight placement contributes to fishtailing or sway as the horses move (*Retrieved Sept 9, 2014. http://www.equispirit.com/info/towing.htm*).

Mechanisms associated with electric brakes can automatically correct trailer sway. (See chapter 22 on braking).

11.4 Tongue Weight and Stability

Tongue weight is said to be important in reducing the susceptibility of the trailer to cross winds and vacuum drag, but it may not be the only factor. The current American recommendation of 10 percent or more seems to be the recommendation only because North American vehicles are capable of this load. Heavier weights require stouter suspensions and weight distributing hitches when not towed by appropriate larger vehicles.

In Europe, 3 percent of trailer weight is considered sufficient tongue weight to maintain hauling integrity for their road systems. Trailers with a gross vehicle weight no greater than 3500kg or less qualify for the least expensive driver's license. This regulation has led to the development of lighter trailers. pulled by smaller vehicles.

Lighter weights with proper position of cargo and axles are achievable with no loss of safety and perhaps increased safety (*Sigurdson, J. June 7, 2013. Pers. corr.*). Higher quality European trailer models are designed to be very stable at autobahn speeds far in excess of North American highway speeds, in cross winds and heavy vehicle traffic (*Sigurdson, J. October 30, 2014. Pers. corr.*).

Loaded to capacity, the two-horse platform load rear face trailer without an added dressing, water, or tack storage area is said not to exceed 120 pounds tongue weight, nor be less than 80 pounds.

Both Brenderup, a conventional two-horse trailer, and the New Zealand platform–load, rear-face two-horse trailer could be maneuvered by hand onto a hitch when empty.

These lighter tongue weights are controversial in North America.

North American haulers argue that heavier hitch weights prevent sway and jackknife when the trailer is passed by large trucks on the interstate. The Brenderup is said to be susceptible to sway in these situations.

When hauling the New Zealand two-horse platform load, forward axles, rear face trailer, however, Cregier did not experience sway. Travel was over 10,000 miles on interstates, secondary, and mountain gravelled roads. However, as a precaution, she had one adjustable sway bar although assured by the hitch dealer that it was not necessary.

11.5 Securing the Load

In the best practices of rear-face transport, the horses are secured opposite the withers. This allows their heads and necks to lower to the deck at will, maintaining balance and respiratory tract clearance. Horses unable to lower their heads suffer an immediate 50 percent loss in their ability to clear their respiratory systems (*Derksen, F. 2004. Pulmonary defence mechanisms and equine transport. Veterinary Journal. 168. pp. 194*-205). The sudden restriction of head movement, which can cause panic in horses, is typical of most trailer tie-ups, but is eliminated in the rear-face mode.

Fig. 11.10: Just loaded for the first time, this Warmblood demonstrates freedom of head and neck movement. Secured opposite its withers, it is not subject to sudden restriction of its head which can panic a horse.

The tying method, similar to single pillar rein, also discourages the horses from surging forward or rising to straddle the chest bar.

Properly secured, the horse facing away from the direction of travel cannot escape even if the ramp falls open or off.

In the two-horse, rear-face trailer, all activity behind the horse is eliminated, protecting its sensitive blind area from interference and increasing its feeling of security. There is nothing happening behind it to drive it forward.

As the back of the horse trailer behind the horses is featureless, no butt restrainer requiring human operation in the kicking zone is required. (An access door into a conventional trailer normally requires a minimum of two restraints to the outside). The horses readily stand resting a hip, even before the trailer is in motion. Male horses can stretch and stale or urinate while the trailer is in motion.

11.6 Meeting Load Placement Guidelines

Having the horses' weights near the centre line of the vehicle, their rumps presented to the bulkhead and their forequarter weight centered between the axles, meets the safety codes in goods hauling (*Department for Transport. 2006. Code of Practice: Safety of Loads on Vehicles, 3rd ed. TSO: London, pp. 19, 40*).

Fig. 11.11: A protected entry against possible head injuries and the elimination of activity behind it and rear restraints, reduces the chances of a loading or unloading incident. A flat white interior presents no glare.

11.6.1 Conforming to Highway Regulations

Facing horses away from the direction of travel conforms to laws forbidding the deposit of dung, urine and litter on the highway. As the adrenaline builds, horses' feces become watery and loose.

Contrary to California law, horses in conventional transport are positioned to eject urine (mares) and feces onto following cars and the highway. In two reported instances, this action resulted in aversive driver behavior as the manure descended on windshields and through a sunroof (*Gimenez, R. March 4, 2013. Pers. corr.* and *G. Kirkland. 2004. Never Stand Behind A Loaded Horse. Saskatoon: Thistledown Press*). Using Amazon's book search feature, you can read the details of the urine entering the following car's ventilation system. Heavy traffic prevented avoidance by the following vehicle. Horse trailer manufacturers who design flooring to drain urine onto the highway are in contravention of California law.

11.6.2 Ramp Safety

Facing the horses away from the direction of travel protects following drivers and keeps the load and unload platform/ramp clear of feces and urine.

Fig. 11.12

11.7 Recommendations

Regardless of the load placement in a trailer, trailers should be provided with suspensions that, together with proper tires, hitch design, and other features such as "spoilers" or rooftop fins which lessen vacuum drag, dampen trailer sway.

Manufacturers may wish to consult the trailer and suspension requirements SAE 840130, "new trailer." SAE 840130 incorporates technological advances from other automotive applications. It is aimed primarily at horse trailers where good ride quality is important. It reduces hitch load to 3 percent of trailer mass.

The Society of Automotive Engineers standards for trailer sway response SAE J2664 should be investigated for testing all loaded-to-capacity trailers at speed and during deceleration. However, it is not certain that SAE J2664 applies to live cargo.

12 Ventilation

12.1 Practice and welfare

Ventilation improvements have long been urged for horse transport (*Green, A.R., J.L. Purswell, J.D. Davis, et al. 2003. Methods for assessing horse well being during transport. ASAE International Meeting, July 27-30, Las Vegas, NV, Paper No.034092* and *Green, A. R., R.S. Gates, J. L. Purswell, et al. 2004. Horse physiological response to short duration transport. ASAE International Meeting, Ottawa, Ontario. August 1-4 Paper No. 044035* and *Green, A.R., R.S. Gates, L.R. Purswell, and L.M. Lawrence. 2004. Instrumentation reliability and performance for continuous monitoring of core body temperature and heart rate in horses. ASAE International Meeting, Ottawa, Ontario. August 1-4 ASAE Paper No. 04-403* and *Goldhawk, C., T. Crowe, E. Janzen, et al. 2014. Trailer microclimate during commercial transportation of feeder cattle and relationship to indicators of cattle welfare. Jl. of Animal Science. 92:11, pp.5155-5165* and *Loving, N. 2013. Shipping fever: Prevention is key. Retrieved September 21, 2014. TheHorse.com http://www.thehorse.com/articles/27592/shipping-fever-prevention-is-key*).

The interior thermal micro-environment is a major factor compromising equine welfare (*Kettlewell, P., M. Mitchell, R. Hoxey, et al. 2001. Mechanical ventilation of livestock transport vehicles. Determination of ventilation requirements. Animal Transportation Association Annual Conference, April 29-May 2. Toronto*).

Trailers and vans offer minimal to comparative maximum, but still inadequate, ventilation. Those used to transport horses and ponies in Iceland have one small vent at the front of the trailer (*Roy, R.C., February 22, 2013. Interview*). Stock trailers offer one or more rows of ventilation along the sides, back, or front.

12.2 Effect on Horses

Poor air circulation in trailers adds to the horses' heat stress, encourages the development of shipping fever and may cause escape attempts by the horses. Heat and stale air tend to collect around the horses' legs and beneath their bellies during transit and at a standstill.

Canadian meat packers report that temperature fluctuations in spring and fall result in the highest percentage of dark cutting carcasses and urge improved ventilation in transport to reduce the problem (*Retrieved September 21, 2014. www.producer.com/2003/06/animal-transport-costs-dollars-pounds/*).

12.2.1 Purswell Studies

Committee member Joseph Purswell and his colleagues studied the ventilation patterns in a four horse trailer. They determined that even with all windows in front of the horse, at the rear of the horse, and all vents above the horses and the back upper doors open, at 97 kph (60 mph)ventilation rates were half the recommended rate for stabled horses (*Retrieved September 21, 2014. Purswell, J., et al. 2006. Air exchange rate in a horse trailer during transport. http://naldc.nal.usda.gov/download/1453/PDF*).

It is not enough to raise ventilation standards to that recommended for stables (340 to 595 m3 h-1 per 450 kg horse during warm weather). While stabled, the horse is expending little energy. In transport, the horse's body heat will increase with the effort to remain balanced.

The typical 1,200 lb horse at a walk (which is said to be the effort expended by horses for the duration of conventional transport) generates 1,029 W of heat, 80 percent of which needs to be compensated for with ventilation (*Purswell, J. February 6, 2012. Pers. corr. to R. Gimenez*).

Even were it possible to match trailer ventilation to that recommended for stables, humid air within the trailer increases the horses' self-cooling efforts. Humidity and air temperature approaching body heat temperature require greater ventilation. Without it, the problems of increased ammonia, inhalation of particulates, weight loss, and dehydration remain (*Saastamoinen, M.T. 2008. Nutrition of the Exercising Horse. Wageningen Academic Pub. p. 88*).

12.2.2 Carbon Monoxide Intake

A little studied factor affecting horse health in transport is carbon monoxide (CO) build up within the trailer. Horses in conventional trailers, facing the direction of traffic, with side and sometimes front windows open, are at risk of CO from the tow-vehicle exhaust. Deaths of horses due to exhaust fumes entering the trailer have been reported (*Stull, C., J. Jones, D. Leadon, M. Ball. 2013. Transporting horses by road and air. CEH Horse Report July, p. 9*).

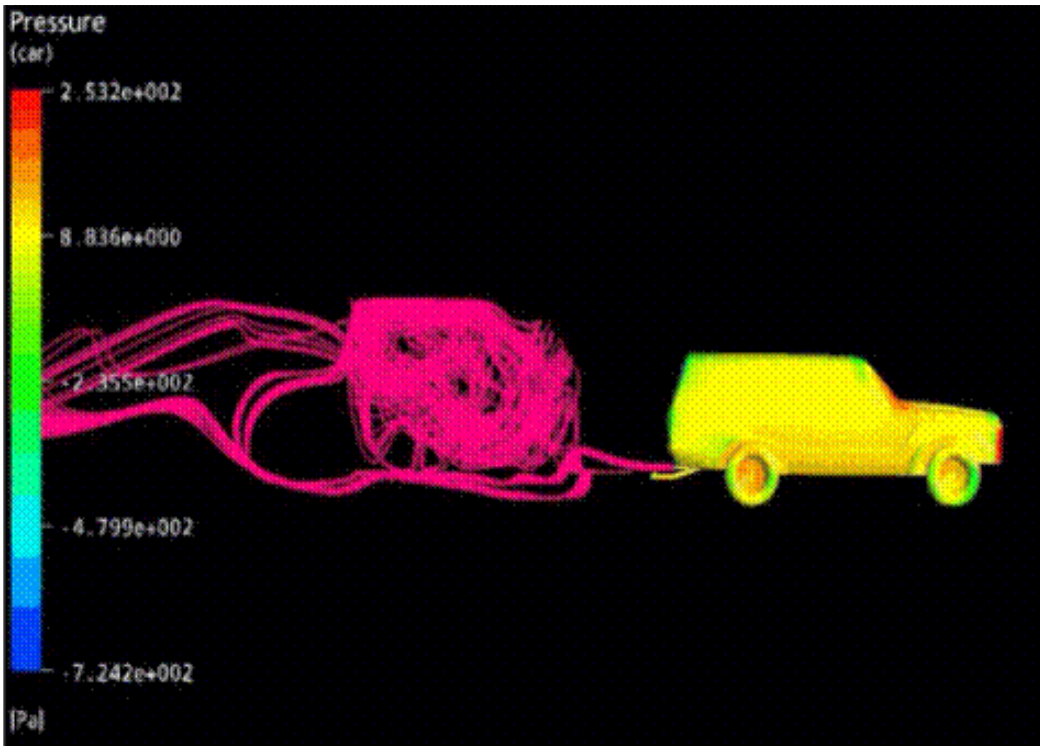

Fig. 12.1: At forty miles per hour with a light crosswind, exhaust (pink lines) fills the trailer. Exhaust patterns depend on tow vehicle shape as well as prevailing crosswinds. Exhaust seeps up through the floor, the front ventilation, and may be sucked into the open back.

Airflow around a vehicle forms low-pressure areas, particularly across a flat rear surface, that collects exhaust. An air-conditioned vehicle traveling in a construction zone with an inside

CO monitor in re-circulate mode (little outside air used) detected a vehicle interior level of 35 ppm of CO (*Lichtenstein, I. May 14, 2013. Pers. corr.*). Federal air standards state that 9 ppm in the air is hazardous to human health. (*Retrieved January 7, 2015.* http://www.epa.gov/oar/criteria.html)

CO poisoning has killed children riding under a tarp in a pickup. Opened only a crack, rear windows of vehicles, including station wagons, create a suction effect that pulls exhaust fumes inside. It is a likely contributor to accidents or death (*Retrieved September 21, 2014. Jones, G. n.d. How a pickup truck can kill your child. http://www.canadafreepress.com/medical/cardio-vascular071292.htm*).

12.2.3 Ammonia Buildup

Ammonia fumes in transport also affect respiratory health. Precise detrimental levels have not been determined for horses but can exceed 200 ppm in a stall. A 35 ppm level during a 15-minute exposure limit is the maximum allowed for humans. In a trailer, levels of 40 to 130 ppm over a 40-hour period had a negative effect on the horses' health (*Retrieved September 9, 2014. http://www.thehorse.com/free-reports/30023/ammonia-and-respiratory-health*).

Ventilation System Limits

Horses distressed by the transport environment can compromise the cooling efficiency of some ventilation systems (*Taylor, G.B. 1980. Pegasus and his equilibrium. Country Life Aug. 28, p. 728-729*).

Ventilation relying on fins is easily clogged, nullifying effectiveness (*Purswell, J. Aug. 26 2013. Pers. corr.*). Metal fins on some of these units are considered a hazard to horses because of the potential for damage by the horse. Some manufacturers overcome this possibility by offering vents of flexible material (*Retrieved September 21, 2014. www.horsetraileraccessorystore.com*).

An enclosed trailer with powered ventilation conserves fuel and offers temperature control but must be backed up with emergency-natural ventilation in the event of fan failure.

Although some cooling systems claim low-power requirements, low-power ratings of 7.2A x 12V = 86 W. can only offset 10 percent of the heat load of a 500 kg horse without affecting the heat load transmitted through the walls. One commercial cooling system claiming this low-power rating is not considered effective enough to warrant adoption (*Purswell, J. Aug 26, 2013. Pers. corr.*).

Horse trailers outfitted with remote thermal sensors let the driver monitor the temperature inside the trailer.

There has been some suggestion that deflectors added to the roofs of some horse trailers prevent exhaust fumes from entering the rear, but details as to efficacy have not been located.

12.3 Recommendations

The following recommendations were developed in personal correspondence with J. Purswell on April 16, 2012.

- Ventilation should be selected on whether it is to be dual or single-purpose, extraction, intake, or both.
- Manufacturers should consider increasing the open vent areas either in size and number or the size of windows.
- Vents and windows must be located in areas least susceptible to, or protected from, intake by exhaust fumes from the tow vehicle.
- Vents and windows should be operable either passively, mechanically, or powered to achieve comfortable levels of temperature and humidity dependent on the season, the speed of travel, and the number of horses in the trailer. If the ventilation is powered, an override should be provided to allow manual operation in the event of power failure.
- Air intake and outflow should be designed such that exposure to tow-vehicle CO fumes is minimized or the fumes re-directed outside the confines of the trailer.

A fan for each stall hardwired to the trailer electrical system has been found to be reliable and beneficial in the Florida climate (*John Haven, April 13, 2012. Pers. corr*.). Fans for each stall have been satisfactory for cross country transport (Gimenez, T., 2010. TLAER clinic).

An exhaust diverter should be used with the tow vehicle when towing a trailer with livestock.

13 Insulation

Insulation reduces the sound level of outside noise events. It maintains air and humidity levels appropriate for horses whether the transport is stationary or under way.

13.1 Comfort Zones

Recommendations for temperature comfort ranges for horses vary. International Animal Transportation Association recommends temperatures between 10° Celsius (c) or 50° Fahrenheit (F) at the lowest and 19° C (66° F) at the highest although some carriers advise 40° to 80° F (10° to 21.1° C) is acceptable (*Anon. 2012. Safe transport of live animal cargo. Aero Quarterly p.2*). Horses are most comfortable at windless ambient temperatures between 10° to 25° C with the upper limit for comfort thought to be 25° to 27° C (*Saastamoinen, M.T. 2008. Nutrition of the Exercising Horse. Wageningen Academic Pub p.73* and *Grandin, T., ed. 1993. Livestock Handling and Transport. Oxon: CAB p. 244*).

Interior trailer temperature is usually 5° to 8° C warmer than the outside. Winter temperatures do not mandate closing all vents as indirect air flow is still required for cleaner air and comfort. (*Retrieved September 21, 2014. Woods, J. n.d. Minimizing stress during horse transportation. horsewelfare.ca* and *Livestock Weather Safety Index. http://www.albertahorseindustry.ca/images/stories/aweather_index.pdf*).

Recommended temperature levels vary with breed and the fitness level of the horse. The slender Arabian will withstand and dissipate higher temperatures than the stocky draft breeds. Icelandic ponies, popular in Canada, can tolerate temperatures in a windless, non-precipitant environment from -8° C to 20° C (*Roy, R.C., February 22, 2013. Interview*).

Royal Canadian Mounted Police horses, in their winter coats, were found to be most comfortable with barn temperatures at 45° F (7.2° C). Above that temperature, the horses became restless (*Anderson, Insp. A.L. May 16, 1979. Interview*).

High humidity levels require attention to increased ventilation or powered controls. Once a humidity level reaches 75 percent, sweat isn't efficiently evaporated. Heat stress is risked if the horse is worked. Transport is considered work.

When the ambient Fahrenheit temperature plus relative humidity is less than 130°, the horse works efficiently. Greater than 150°, efficiency and cooling capabilities decrease. Over 180° with no mechanical or passive relief, conditions could be fatal if the horse is stressed (*Retrieved September 21, 2014. Nadeau, J. n.d. Heat stress. Too hot to trot? http://animalscience.uconn.edu/extension/documents/heatstress.pdf*). High humidity levels require increased ventilation or powered temperature controls.

13.2 Recommendations

Large temperature swings in the stationary or moving trailer can be modified with proper insulation. Insulation should prevent the temperature from falling below freezing including any ambient wind chill factor (*Defra. 2013. Welfare of Animals During Transport: Advice for transporters of horses, ponies, and other domestic equines. London:Defra Publications, p.7*).

Insulation should moderate the interior temperatures during transport such that it does not exceed 30° C for the horse in summer coat or 45° F for the healthy horse in winter coat. In

warmer temperatures and humidity conducive to sweating in transport, haulers should consider cooling by air conditioning, hauling during cooler hours, sponging, showering if the horse is in summer coat, or fans to keep the horses comfortable (*Green, A.R., J.L. Purswell, J.D. Davis, et al. 2003. Methods for assessing horse well being during transport. ASAE International Meeting, July 27-30, Las Vegas, NV, Paper No.034092* and *Green, A. R., R.S. Gates, J. L. Purswell, et al. 2004. Horse physiological response to short duration transport. ASAE International Meeting, Ottawa, Ontario. Paper No. 044035* and *Green, A.R., R.S. Gates, J.L. Purswell, et al. Instrumentation reliability and performance for continuous monitoring of core body temperature and heart rate in horses. ASAE International Meeting. Ottawa, Ontario. Paper No. 04403*).

As the highest temperatures are usually toward the roof, insulation should prevent the overheating of the horse bay by the sun and insulate it against significant external temperature changes (*Anon. 2010. Welfare of animals during transport-Guidance notes and checklist. Council Regulation EC No. 1/2005*).

14 Noise

14.1 Effects

Noise is unwanted sound. Noise levels ranging from "desert quiet" to normal conversation (35 dB to 55 dB) are tolerated by animals. Horses' hearing capabilities range well beyond this, able to detect the low frequency vibrations which precede earthquakes and frequencies up to 25 kHz (25,000 cps) (*Waring, G. 1983. Horse Behavior. Park Ridge: Noyes Publications, pp. 16-17*). Animals can react negatively to noises inaudible to man. In transport, these can come from the engine or materials in the trailer. Animals also react negatively to cracking whips, barking dogs, and shouts. Heard or inaudible noise disrupts the endocrine system, immune response, resting behavior, and blood circulation. Noise up to 120 dB (rock concert levels) causes weight loss (*Minka, N. and J. Ayo. 2009. Physiological responses of food animals to road transportation stress. African Jl. of Biotechnology 8:25, pp. 7415-27*).

14.2 Sources

Trailer noise sources originate in rattling panels, fittings, loose gear, insecure flooring, and tie chains (*Retrieved September 21, 2014. O'Leary, J. Noise levels in a typical horse float. https://www.youtube.com/watch?v=aVfGQnu_gsA*).

14.3 Recommendations

Sound-deadening materials and construction methods should be used to prevent excessive noise within the trailer and to reduce the penetration of outside noise events; e.g., windshields on some motor vehicles have noise reduction capabilities (*Retrieved September 21, 2014.4-Star Trailers "Quiet Ride". https://www.youtube.com/watch?v=ZmLNIF_81Ms*).

For example, rubber buffers attached to contact points between fittings have been adopted by some manufacturers to dampen the noise of trailer gates opening against corral railings or other permanent structures (*Moffat, L. April 23,2014 ATA Webinar Improvements achieved for animals by transport organizations cooperating instead of closing doors* and *Retrieved September 21, 2014. http://cimarrontrailers.com/does-trailer-design-impact-horse-stress-3m-sound-and-vibration-study/*).

A noise requirement should be specified in the Standard. As the noise origins and frequencies from road, air flow, external sounds, structure, and internal items, are highly variable, a noise, vibration, and harshness expert from the automotive industry is recommended to help set this standard (*Warrington, L., April 20, 2014. Pers. corr.*).

15 Flooring

Trailer manufacturers offer a variety of floor types. (*Retrieved September 15, 2014. info.thetrailerspecialist.com/the-trailer-specialist-blog/bid/309702/Horse-Trailer-Floors-Comparing-Aluminum-and-Wood*).

A trailer floor may have to accommodate a variety of weights. Special accommodation may have to be made for horses over the "average' 1,000-1,200 pounds. The variability in weights above the "norm" places the onus on the manufacturer and hauler to ensure the safety of the conveyance (*Purswell, J. February 6, 2012. Pers. corr. to Gimenez, R. and Clemmons, B. November 24, 2014. Pers. corr.*). A horse may weigh up to 2,500 pounds (*Retrieved July 17, 2014. http://www.mysanantonio.com/news/local/article/Tallest-Horse-passes-away-at-Texas-ranch-5625535.php*).

15.1 Failures

Floors have collapsed or horses have gone through flooring on even new trailers. An equestrian road insurance company purchased new a two-horse trailer to donate to a university Technical Large Animal Emergency Rescue training. When it was inspected by the students, the floor boards were 3 inches short, making them a half inch from failure on each side (*Gimenez, R. July 2014. Pers. corr.*). Composite flooring can also be improperly secured or supported (*Retrieved December 6, 2014. Gimenez, R. May 5, 2012. http://cs.thehorse.com/blogs/horse-911-whats-your-emergency/archive/2012/05/05/ensuring-trailer-floors-don-t-fail.aspx*).

Fig. 15.1: Minimal support over the axles and no attempt to attach the floorboards to the frame have resulted in both horses dragged after falling through the floor. Both were euthanized. Photo by Milton Fire Dept., GA

Floors fail due to insufficient cross members, inappropriate materials, or rot.

Fig. 15.2: Insubstantial flooring, widely spaced cross-members, and possibly lack of maintenance contributed to the death of the horse.

Composite flooring, such as plastic and wood, has been known to fail as the plastic prevents the wood from drying out.

Some manufacturers do not attach the flooring to the frame.

Fig. 15.3: Shortly after overturning, the unsecured floorboards on this trailer cascaded to the interior.

This video shows unsecured floorboards cascading off a horse trailer chassis when the trailer overturned (*Retrieved September 21, 2014. http://www.wkyt.com/home/headlines/A-horse-trailer-overturns-on-I-75-194640241.html*. [The link may not resolve unless reduced to *wwww.wkyt.com A-horse-trailer-overturns-on-I-75*]).

Fig. 15.4: Horses and cattle falling through new (unattached) or poorly maintained flooring are not uncommon. Wood in particular is subject to failure due to rot and should be replaced at a minimum every 10 years, or sooner if there is indication of rotting. This horse was spared greater injury by the use of leg wraps on the lower legs.

Some floors undulate while the horses are loading, travelling, or unloading or at a standstill (*Retrieved May 5,2013. Prestigetrailers.co.nz/tips* and *Fathauer, G. Float design and horse security. March 16, 2012. Pers. corr.*).

Some trainers urge handlers to teach their horses to teeter-totter to accustom them to the undulations (*Retrieved June 28, 2014. Westfall, P. 2012. Safety in the trailer. HTTP://NCHorseBlogspot.ca/2012/08/safety-in-trailer-use-little-horse-sense.HTML*).

Some trailers are sold with flooring too weak to support either the expected load of the cargo or last the life of the trailer. A heavy horse in a lightweight trailer will shorten the trailer's safe or useful life (*Retrieved September 21, 2014. Bateson trailers recalled http://www.horseandhound.co.uk/news/397/312758.html* and *Retrieved January 7, 2015. Scheve,*

T. and N. n.d. Horse trailer tow vehicles – Which is right? www.bayequest.info/static/trailers4.htm).

Problem trailers do not support the flooring forward of the horse. Unless the trailer floor is up to the weight of the cargo and its load specifications run forward of the horse area, a horse jumping the breast bar can fall through the forward area.

Fig. 15.5: This horse, draped on the chest bar, has its forehooves trapped in the thin forward flooring. Horses orient toward the light and this horse may have been enticed forward by the front window in the trailer.

Exposed trailer flooring may also absorb road heat, compromising ventilation and the horses' hoof health.

15.2 Mitigating Failures

Many trailers attach the tongue or draw bars to or under the outer corners of the trailer. The attachment area is subjected to more movement failure than draw bars which are an integral part of the frame or run beneath the floor, as additional support, to the axles.

Rubber mats provide cushioning and may prevent total penetration of a hoof through a failed floor (*Lichtenstein, I. May 4, 2012. Pers. corr.*).

Sealed flooring can hide defective subflooring (*Retrieved Sept 15, 2014. http://www.horseandhound.co.uk/forums/archive/index.php/t-480910.html*).

Without an established federal standard, the National Association of Trailer Manufacturers can only suggest minimal standards on floors. Nevertheless, the Association is working on standards for chemical resistance analysis for the special requirements of livestock and horse excrement, urine, and sweat. These factors are an established contributor to the destruction of trailer flooring (*Lancaster, C. 2012. The trailer industry today and tomorrow. 38th Annual Conference Animal Transportation Association March 18-21, Vancouver, B.C.*).

Measuring deflection or movement in flooring and the stress on the boards and recording the degree of vibration is beneficial. Purdue University engineer J. Purswell has worked with an accelerometer attached to a horseshoe to record vibration of the foot-floor space and an accelerometer at different points of the trailer to record the movement (or flex) of the trailer sections, walls, and fittings (*Purswell, J. April 16, 2012. Pers. corr.*).

A non-slip trailer floor, together with safe driving practices, influences the behavior of the animals in transport. The animals' physiological and behavioral measurements indicate less stress (*Stockman, C.A., et al. 2013. Flooring and driving conditions during road transport influence the behavioral expression of cattle. Applied Animal Behaviour Science. 143:1, 18-30*).

15.3 Recommendations

Trailer flooring should be non-slip in both wet and dry conditions, such as the surface area used on submarine exteriors. (*Stockman, C., Collins, T, Barnes, A., et al. 2013. Flooring and driving conditions during road transport influence the behavioral expression of cattle. Applied Animal Behaviour Science. 143:1, 18-30*).

Trailer flooring should meet bio-security needs by being easy to clean and disinfect to minimize the opportunity for bacteria and waste material being lodged in the flooring or sidewalls.

If the floor is fully sealed leaving the substrate unable to be inspected, that substrate should not rust, corrode, or be subject to catalytic action.

The floor should be shock absorbing.

Wood flooring should be at least 5 cm x 15 cm or larger (*Grandin, T. 1993. Livestock Handling and Transport. Oxon: CAB p. 244*). Oak or teak may typically be smaller though double-floored.

Metal flooring, provided it is cushioned against road and wiring shock, must be sufficient to support the weight of the intended maximum cargo without disengaging during transport and should be inspected for corrosion or catalytic action.

Because it conducts heat, cold, and is noisy, metal flooring should be used in conjunction with insulation and non-slip flooring.

Flooring shall be strong enough to maintain and sustain at least half again the weight of the horses the trailer is designed to haul.

Flooring strength shall be applicable for the width and length of the entire trailer deck including the area outside the stall bays.

The floor shall be strong enough to support the load of a horse's hoof on 6 inches square of surface when the horse's entire weight is directed on that hoof.

The floor shall be strong enough to support the entire weight of the horse on one hoof without the flooring splintering, buckling, or disengaging from the frame.

Flooring shall be designed such that regular inspection is enabled except where rot, corrosion, or fatigue failure is inherently prevented by design and materials used.

Flooring sections shall be secured to the frame in such a manner that a trailer overturn, either partial or full, will not dislodge them (*http://cs.thehorse.com/blogs/horse-911-whats-your-emergency/archive/2012/05/05/ensuring-trailer-floors-don-t-fail.aspx*).

If cleats are provided, they should be no more than 8 mm in height to avoid severe bruising should the animal fall or hoof damage if stood upon for a prolonged period.

16 Travel Space

16.1 Feed Bunks

Horse trailers with fixed feed bunks do not allow the horse to relax its neck fully. The enforced high head carriage is known to induce respiratory distress and the flight response.

16.2 Stalls

Conventional horse trailer stalls are seldom long enough to allow the male horse to stretch and urinate or stale especially while the trailer is in motion. Some shippers recommend regularly off-loading the male horses to allow them to relieve themselves and avoid bladder damage (*Retrieved January 7, 2015*. *https://www.extension.org/pages/12239/considerations-when-hauling-a-horse#.U6MeTZRdUoM*). Stalls for some unit loading devices used to air freight horses may not be long enough for the male horse to stale. Water is sometimes withheld from male horses for 2 hours prior to loading into the container.

Young horses, smaller in body length than adults, may not fill the stall provided. Traveling facing the direction of travel throws the weight back on the hindquarters, allowing for a backward drift toward the tailgate. If tied short, the halter then places pressure behind the ears before the hind can be supported on the tail gate or rump bar. Traveling up an incline can increase the pressure. If the horse leans backward heavily enough, the back legs slip out from beneath the animal or it can push back through the pressure and launch itself over the chest bar. There is enough room behind the horse and the weight is already on the hind encouraging the horse to go up and over. It is common for young horses to launch themselves forward over the breast bar as a result.

Horses that fill the stall lengthwise will shift backwards, but the hindquarters touch the tail gate before the tie rope goes taut and places pressure on their heads. This holds true as long as the horses are not tied too short (*Bellette, S. December 1, 2014. Pers. corr.*).

16.3 Height

Current head room recommendations for horse transport recommend that there be at least 2.5 cm (1 inch) of clearance for each hand (4 inches) of horse's height at the withers (*Canadian Agri-Food Research Council.1998. Recommended Code of Practice for the Care and Handling of Farm Animals. Ottawa: Canadian Agri-Food Research Council, p. 13*). The recommendations do not account for increased wither height, up to 4 inches or 10 cms due to transport induced tension and trailer vibration.

Nor do the recommendations account for the bucking action of some trailer decks that throw the horses upward.

16.4 Width

Horses traveled facing the direction of travel require sufficient room to either side of the hips to abduct and prop their hind legs to the outside of the hip joint. The effort helps prevent falling backwards or sliding beneath the butt restrainer. This is an uncomfortable position for the horse as it can strain the pubio-femoral ligament and sacroiliac joint during prolonged transit. (*See also, Harris, T. October 14, 2012. Pondering penning positions. Pers. corr.*).

16.5 Balance

Regulatory space requirements, as in Europe, are meant to allow the horse to stand in a "normal position," presumably with at least freedom of head and neck movement. As we have seen, the horse may have to assume a high-headed, hind-legs spread, abnormal position.

The horse is most vulnerable to imbalance when travelled side-on to the forward movement of the transport. Horses have poor ability to balance side-to-side at a 90-degree angle to the direction of tow.

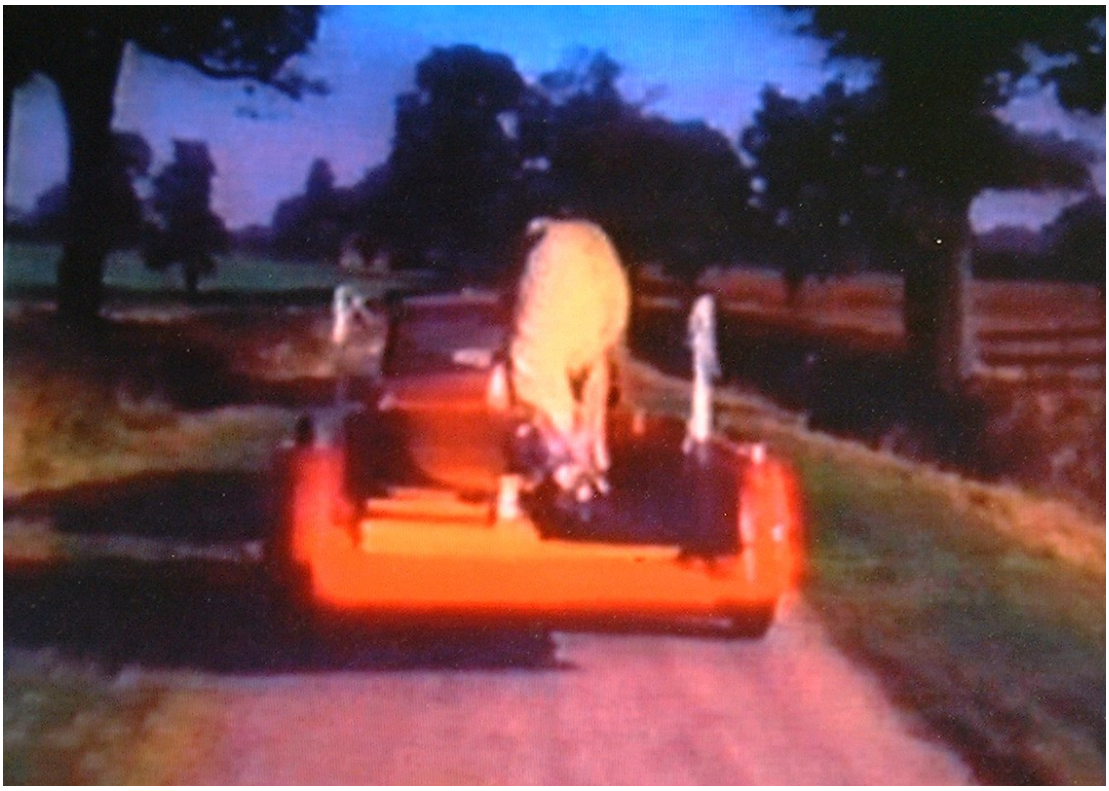

Fig. 16.1: Although provided no partitions, chest or rump bars in this experiment, the cob travels at speeds up to 50 mph on a winding road. It can relieve an itch or clear its respiratory tract at will. An opaque blindfold protects its eyes from insects or debris and eliminates any possible anticipation of upcoming bends.

During slant load transport horses face front or rear at a 45-degree angle or less. Anecdotal reports indicate that after a long journey a horse may arrive sore in one forequarter or the other but there are no studies verifying this observation.

16.6 Recommendations for Stall Size and Placement

Space allowance should be variable to allow for up to 10 percent maximum over standard for adult horses and 20 percent maximum over standard for young stock. Meteorological conditions also affect stall size. Larger stalls should be provided for particularly hot or humid conditions.

Recommended or regulated, stall sizes vary from country to country and user to user. Partitions, stanchions, stalls, or bays for horses in transport currently must, at a minimum, adhere to the European Union space requirements per individual for road or rail travel (*Retrieved*

September 21, 2014. http:www.drivinghorseboxes.co.uk/travelling_welfare.htm and Harris, T. n.d. AATA Manual for the Transportation of Live Animals by Road. Redhill, U.K.: Animal Transportation Association, p. 66).

- Adult horses: 1.75 m²
- Young horses (6 to 24 months old) for journeys over 48 hours: 1.2 m²
- Young horses (6 to 24 months old) for journeys over 48 hours: 2.4 m²
- Ponies (under 144 cm): 1.0 m²
- Foals (0 to 6 months): 1.4 m²
- During long journeys, foals and young horses must be able to lie down

Horses of 500 kg and up should have a minimum space of 2.20 m2 each with smaller animals of 300 kg or 13.2 hands (135 cm) having 1.3 0m2 per animal.

Horses of average weight, 550 kg should be allotted around 90 cm in width and 2.4 m in length and height of standing space allowing 0.3 m of movement forward and back. These provisions will vary by a maximum of 10 percent for adult horses and 20 percent for younger horses depending on weather, journey times, weight, size and condition of the animal (*Retrieved June 28, 2014. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1995:148:0052:0063:EN:PDF*).

Horses also require sufficient space above the head to extend the poll and ears upward while standing without engaging the interior roof.

The front of the stall ahead of the chest bar should allow the horse to lower its poll (top of its head between and behind the ears) to at least shoulder height to allow the horse to clear its respiratory tract and maintain its balance over its forequarters. Ideally, the horse should be able to fully stretch its neck and head down in normal grazing position. (*Grandin, T., ed. 1993. Livestock Handling and Transport. Oxon: CAB International. p. 243, 247*).

Fig. 16.2: A horse is most vulnerable to falling when struck side on. Stallions fight to unbalance each other with sidewards pushes. Thrown off its feet, a horse sometimes loses the will to live or fight.

17 Partitions

17.1 Hazards

Horses may attempt to climb or jump partitions. If the partitions are not easily released, rescue is prolonged and further injury may result (*Retrieved September 21, 2014.* *www.sleafordstandard.co.uk/news/local/firefighter-free-horse-trapped-in-transporter-1-5756938*).

Falling in the stall also makes rescue difficult.

Fig. 17.1: A downed horse presents a dilemma for untrained rescuers. Here they are attempting to get a webbing around the animal's body but have entered the trailer space and the horse is still tied. This is very dangerous for humans and the horse.

Partitions are susceptible to breakage when kicked, weighted, or stood upon (*Retrieved September 21, 2014.* *http://www.independent.com/news/2014/jun/06/lawsuit-filed-highway-154-horse-deaths/*).

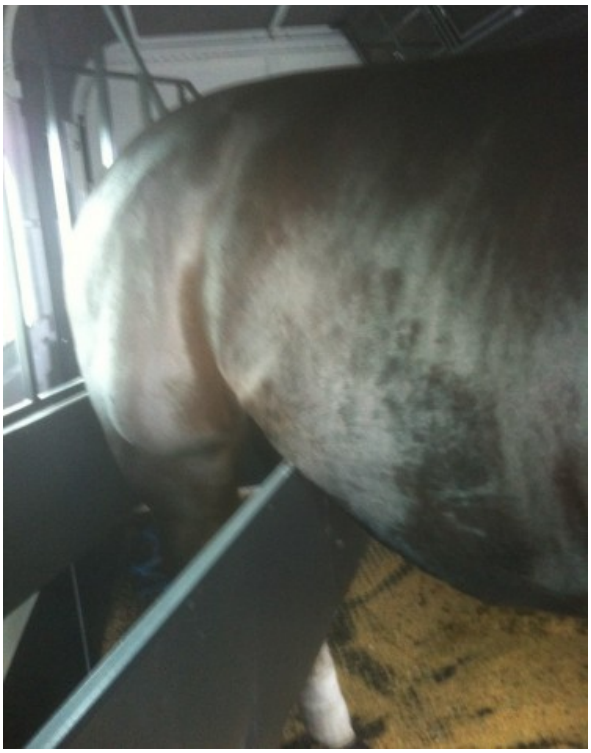

Fig. 17.2: A weighted partition makes removal of the equipment or the horse difficult. Attempts to move the partition may provoke a violent reaction from the horse.

If a hoof penetrates the partition, tendons are likely to be severed requiring euthanasia (*Retrieved September 21, 2014. http://www.keyt.com/news/trailer-crash-leaves-two-horses-dead-several-other-horses-injured/25214274* and *http:www.drivinghorseboxes.co.uk/travelling_welfare.htm*).

Partitions fitted with head dividers made with thin rods or mesh can snap, presenting a hard, sharp surface to the horse, particularly in the head area.

The partition can collapse upon the horse beneath it increasing the likelihood of suffocation or injury.

Partitions topped with wide-spaced bars can also trap a horse.

Fig 17.3: One leg went through an opening and another through the upper partition bars in this December 2014 incident. Driver cornering appears to have unbalanced this 22-year-old 16.3h dressage and jumping horse.

Fig 17.4: A dislodged partition panel, blood, and dying horse ended with the animal left for dead at the side of the road. A necropsy concluded that the horse had severe bruising of the poll, left rib cage, and a large hematoma near a kidney, and blood congestion of the left side consistent with prolonged recumbency.

Fig. 17.5: This is a typical position of a horse in an overturned two-horse trailer because the tires make the side of the trailer uneven. Rescuers must deal with kicking hind legs. In this instance, the horse was extracted by removing the roof, which is commonly the easiest access.

One trailer manufacturer has designed partitions for easier removal when the horse goes down and must be extricated (*Retrieved September 21, 2014.* *mr.trailer/http://www.mrtrailer.commerhow/20*).

Partitions made with exposed right angles instead of 45° angles or rounded edges present bruising or worse when a horse falls against them.

17.2 Mitigating Hazards

Partitions designed by Professor Natalie Waran, Royal (Dick) Veterinary School and her engineer husband were hung from the interior roof of their rear facing van, allowing ease of adjustment and stronger partitions. (*Waran, N. December 2010. Interview. See also*: *Retrieved September 18, 2014. http:www.drivinghorseboxes.co.uk/travelling_welfare.htm*).

To encourage horses to rely on their thoracic sling, some rear-facing trailers use flexible partitions. Unit loading devices, or enclosed stables for air freighting horses, use flexible partitions to make retrieval of a downed horse more convenient (*Weil, A. van der. Jan 24, 2014. Pers. corr.*).

Flexible partitions in front-facing trailers cannot be expected to relieve the horses' hindquarters of tension but do allow the horse to borrow from its neighbor's space (*Retrieved October 10, 2014. http://www.youtube.com/watch?v=12ex7nuzJuE*).

Partitions are either full, reaching to the floor, or half, about level with the horse's belly. The former prevents horses from stepping on each other. The latter allows horses to spread their hindlegs to support the rearward thrust of weight.

For rear-facing horses, some partitions are designed to extend to the floor but only at the rear. The front part is open to allow the horse to rock to either side on its forequarters. Unless new to the sensation, the rear-facing horse seldom requires this space, travelling with its forelegs beneath its brisket or just outside it.

The design also improves air circulation around the horses (*Carter, G. C. 1975. Observations on problems associated with transport of horses from overseas. Animal Quarantine. Jan-Feb 4:1, pp. 15-17*).

Fig. 17.6: These vans travel twelve horses facing away from the direction of travel and one parallel to the direction of travel. The latter is not recommended as horses have poor sideways balance.

Fig. 17.7: Wide loading ramps in this rear facing van encourage easier loading. The featureless rear of the stalls leaves no butt bar to trap a horse. Ramps are shallower angled on most conventional two-horse trailer transport.

Fig. 17.8: Cut-away partitions in this thirteen-horse rear-facing van allow greater air circulation. Solid head dividers are better replaced by barred dividers, not only for air circulation, but horses travel more quietly when other horses are in view.

17.3 Recommendations

Partitions should be quickly removable in the event a horse is trapped under or over the partition.

Partitions must be strong enough to withstand the weight of animals being carried.

Partitions must be able to survive a highway incident without being rendered inoperable or unsafe.

Partitions should be adjustable to suit the size and needs of the horses being transported (*Retrieved September 21, 2014. http://www.drivinghorseboxes.co.uk/travelling_welfare.htm*).

Where possible, partitions should join the floor to prevent horses from becoming trapped beneath them, withstand normal equine bumping, leaning, kicking, be easily lubricated, and be removable with weight on them.

Partition edges and fittings should be spaced, rounded or angled or counter-sunk such that an animal in contact with them will not be bruised, cut, degloved, or trapped.

Head dividers where used must be of material substantial enough to withstand normal equine bumping and nosing without breakage and risk to the horse.

18 Fasteners and Latches

Unreliable latches on equipment intended to restrain the horse bruise, maim, or kill when raised, unlatched, or give way. This is particularly an issue where the horse rests its weight on the butt bar or tailgate (*Lichtenstein, I. September 18, 2014. Pers. corr.*).

A variety of latches on tail doors are known to fail, spilling the horse into traffic (*Retrieved October 10, 2014. http://www.petroliatopic.com/2014/03/24/horse-dragged-down-oil-springs-line#comment-1301422067*). Even where the latch may be to sufficient strength, the latches themselves may be improperly mounted, attached, or be missing a vital locking pin (*Retrieved October 10, 2014. http://www.allworldauto.com/comments/FEATHERLITE_comments_and_complaints_396-1.html*).

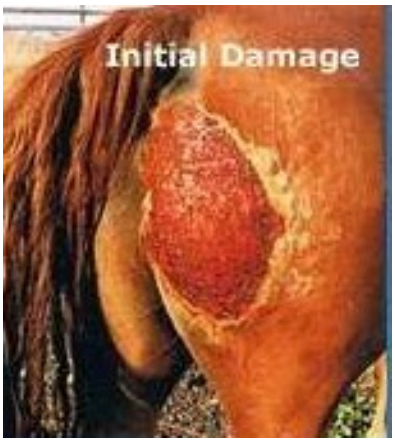

Fig.18.1: The latch on this two horse trailer failed at 65 mph. Both horses fell out. One survived with back wounds and severe abrasion on the right quarter.

Fasteners, pins, screws, rivets, latches, and bolts of all descriptions are capable of delivering injuries requiring veterinary attention. Where possible, it is better to recess the fastening.

Fig. 18.2: A horse is badly injured along the belly by a protruding latch when loading.

Fig. 18.3: An immovable fixture degloved the horse's belly.

Fig. 18.4: Breast bar pins like this, too long and too sharp, are known to penetrate jugular veins, get caught on halters or lead ropes, and cause other injuries. Pins should have a safety pin through the bottom to prevent removal until warranted. Chest bars are very difficult to remove with the weight of a horse on top of them, and improved designs to facilitate removal have been slow.

Fig. 18.5: This rump or butt bar is "as narrow as a shoelace" and offers scant support to a horse's weight if the horse pushes on it. It cannot be swung completely out of the way and presents a fixed hazard to both people and horses when loading or unloading.

Fig. 18.6: This projecting latch presents a hazard to passersby and horses.

Fig. 18.7: With capillaries close to the leg surface, the loss of blood for a horse is copious. This horse tore its hoof wall on fittings within the trailer while scrambling.

Fig. 18.8: Wherever possible, latches should be recessed or otherwise protected from injuring horses or humans.

One popular drop latch on horse trailer tailgates tends to jam, requiring tools and banging as the attendant struggles to release it (*Retrieved October 10, 2014. http://www.youtube.com/watch?v=-wLtYJJgf7c*).

Latch failure on upper doors allows them to swing open, exposing following traffic to manure and urine.

Many fasteners are noisy in operation or rattle as the trailer gets under way.

18.1 Recommendations

Latches shall be of sufficient strength to contain the horse and withstand the strain of loading, unloading, and the kinetic or stationary weight of the animal against it.

Latches exposed to the horse at any time shall be free of sharp edges or points.

All fastenings should be insulated against noise.

Latches pertaining to entries, either human or animal, should be positive latches that require handles to be recessed when not in use and preferably pinned as on commercial freight trailers.

Partitions or stall or head dividers or any necessary interior or exterior fitting or fastening of any material should have edges rounded or otherwise protected to prevent scalping, puncture, or abrasion of the horse.

Fittings, hinges, and fasteners shall be recessed where possible.

If butt or breast restraints for the horse give way, the doors and latches must be capable of supporting the added strain. Hinges and catches installed should have a tested rating with known work load and failure points.

Partitions must be fitted with catches, hinges, and fastenings designed for quick and easy operation in closing and releasing.

All catches and fasteners in the horse bays and outside the trailer should be such that they will not ensnare horse equipment such as horseshoes, hooves, halters or blankets or abrade, deglove, or puncture a horse coming in contact with them.

Federal Motor Vehicle Safety Standards have minimum standards for components such as hinges, latches and the test protocol for each. Some latches meeting the standard are already available and such FMVSS components should be part of every horse trailer.

19 Chest, Wither, Head, and Butt Restraints

19.1 Carrying Live Loads

Restraint is of paramount importance in the transport of any load type. The effect of kinetic loads on axle performance, braking, and control are detailed in, e.g., Australian and United Kingdom government documents (*Department for Transportation. 2006. Code of Practice: Safety of Loads on Vehicles, 3rd ed. TSO:London*).

The horse provides several problems of containment. It is a reactive, large animal. It has no surface friction with the flooring of the transport. Its center of balance is located considerably higher than, and frequently in opposition to, the conventional trailer's center of balance.

During changes of direction, the unsecured or even rigidly confined horse in conventional transport will continue moving, its kinetic energy being greater than that of the tow vehicle or tractor. During emergency braking, the horse's forward direction can equal that of the forces acting downward on the vehicle (*Department for Transportation. 2006. Code of Practice: Safety of Loads on Vehicles, 3rd. ed. TSO:London, p.14*).

Fig. 19.1: Loaded parallel to the direction of travel, this horse is unable to retain its balance, leaned on the rear panels and is dragged because it is still tied to the van's halter ring.

19.2 Live Load Restraints

19.2.1 Fixed Restraint

Many trailer manufacturers try to overcome some of these dangers with fixed restraints, such as strong tie points, partitions, butt and chest bars. Fixed restraints pose a hazard to horses in transport. If a horse feels its head suddenly restrained, it is likely to panic. When it falls, is thrown, or rears upon or against restraints, it is frequently trapped. Legs are also at risk of being trapped over a butt bar, rear restraint, hung on a chain or thrust through bars. The resultant injuries are severed hocks, tendons, damaged hides, flesh, and broken bones or necks.

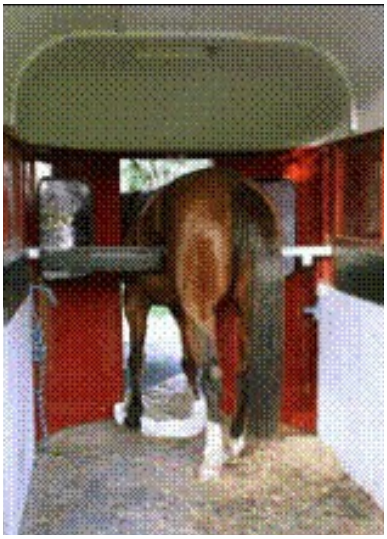

Fig. 19.2: This horse has leaped the breastbar and impaled the deck ahead of the breast bar with a hoof. Often the forward area is not built with the same support as the area that the horses stand on. This demonstrates why the entire floor should be well supported.

Fig. 19.3: Being transported is not a requirement for horses to go over bars or gates.

Fig. 19.4: Weighing between 1600 and 1800 pounds on a cattle weight tape, this 17 hand mule merely leaned against 2 x 6 oak boards, secured with pole barn spikes, 6" heavy lag screws and washers. He is able to jump a chest high chain provided there is a good place to land. He gives a good demonstration of what trailer manufactures must consider when it comes to restraints.

Solid bars pose a threat to the horses' sternums and jugulars in the event of being pitched forward, to the horses' hind legs if the legs get over them, and to the horses' backs if the horses fall beneath them. Some solid bars and doors require the horse to rest its airway against them to lower its head or maintain its balance (*Retrieved September 21, 2014. http://www.an-eventful-life.com.au/eventing-news/tale-about-towing Comment #28*).

At least one chest bar has been tested to withstand 5 Gs of force for a 1000 lb horse or 3 Gs of force for a 1000 kg horse, in a trailer weighing less than 1600 lbs. The bar was heavily padded and the latch carried a CMVSS rating. (*Sigurdson, J. November 19, 2014. Pers. corr.*).

19.2.2 Air Bags

Although air bags deployed on vehicular impact or rollover have been suggested for horse bays, the horse, unlike the human, is not belted in and relatively stationary. During a collision, the horse is in a tumbling position out of range of the air bag that is targeted at a predetermined area. The horse's fragile head could come into the target zone of a deploying air bag and suffer fracture or worse.

19.3 Head Restraints

The horse's head is typically secured to a ring beside the head or ahead of the horse. If the horse's butt is not supported solidly by a butt bar or tail gate, or is in a stall too long for the length of the horse, the horse can pull back on the tie rope. Pulling back on the tie rope, as when the horse's hind legs slide beneath it or the trailer is going up an incline, pulls it taut, placing pressure on the horse's sensitive poll. To escape the pressure, the horse commonly launches itself forward over the chest bar (*Bellette, S. November 30, 2014 and December 1, 2014. Pers. corr.*).

A departure from this practice is that of the EquiBalance trailer that secures the horse at an anchor point opposite the withers for the horses facing away from the direction of travel. Should the ramp fall off, the horse cannot fall out of the trailer. This method of securing also lessens the chance of the horse jumping the breast bar or low restraining gate. If the horse attempts to rise or push forward, it works against its own weight as it presses against the halter noseband.

Fig. 19.5: Gypsy, on the left, is properly tied back at the withers. Copernicus is carelessly tied and could readily leap the breast bar. The partition is not quite to the floor and could trap a shod horse. The exposed bow frames are not recommended. However, there are no scramble or kick marks on the partition or sides of this early version of rear face trailer transport.

19.4 Restraint Disengagement

Sudden release of restraints can injure the horse if the restraining device strikes the horse.

A restraint release within the trailer places the operator in danger of being injured by the horse.

Some manufacturers design removable restraints released by a pin (*Fautras. February 27, 2011. Pers. corr.*). The pin is subject to jamming if the horse's weight pulls sideways against it.

Some manufacturers use a release that disengages toward the horse when, with its leg over it, the animal pulls back on it or exerts more than 300 pounds of pressure on it. In the illustrations below, fewer pounds trigger the release.

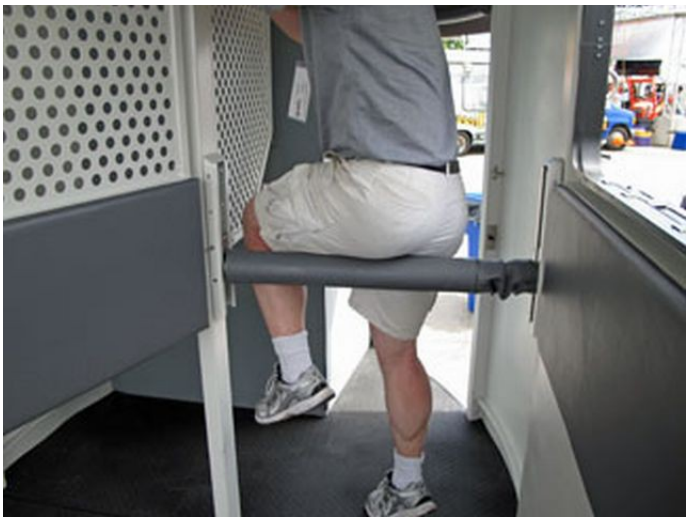

Fig. 19.6: A downward weight will release this breast bar.

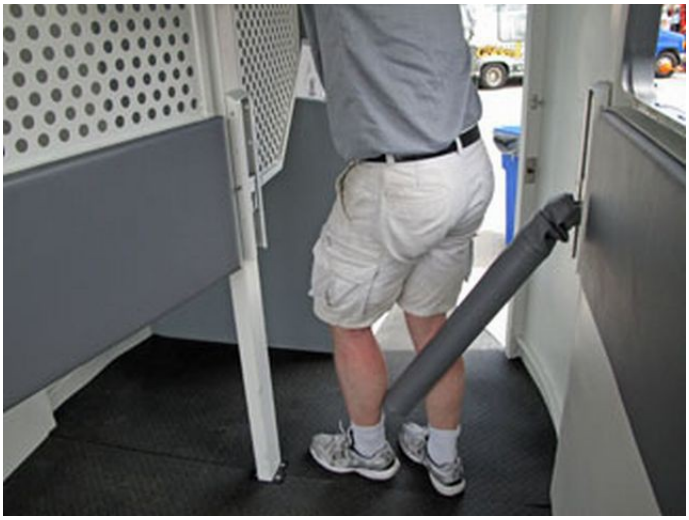

Fig. 19.7: The breast bar releases to prevent a horse from getting trapped above or below it.

Some manufacturers avoid having rescuers search for a tool to release the restraint by designing restraints that collapse when weighted from the top (*O'Leary, J. June 14, 2012. Pers. corr*.).

If the horse gets over or past the automatically disengaged breast restraint without the driver being aware, the horse could then pitch forward into or through the front of the trailer on braking.

Fig. 19.8: Thirty-five year old Cloudy falls when his driver, cut off by another driver on I-15, is forced to brake hard. The hard braking and fall make the trailer start "hopping and bopping." Cloudy was found exhausted and wedged in the nose of the trailer. Highway patrol, a vet bill, and five caring friends were involved in Cloudy's eventual recovery.

A "wither safety belt" is offered as an option to prevent the horse from leaping or disengaging the breast bar. Its use requires that the handler be in the trailer, a confined and hazardous area, with the horse.

Others close off the forward area to discourage the horse from leaping forward. The arrangement prevents the horse from lowering its head to clear its respiratory tract and does not guarantee that the horse won't end up jammed into and trapped in the area in any event (*Anderson, Insp. A.L. January 5, 1979. Interview*).

Webbing materials cannot be part of any restraint system unless fire-retardant and specifically designed for that purpose (*Retrieved October 10, 2014. https://www.youtube.com/watch?v=fsnkwNre_H4*).

Heavy 8-inch wide hemp canvas with a spreading stick and grommets at each end has replaced fixed bars. The canvas was attached at either side of the stall preventing injuries during rough weather and restraining the horse during sea shipments. The arrangement adjusted to the horses' forward balance and the horses developed their "sea legs" much faster when allowed to rock with the ship (*Carter, W.H. 1902. Horses, Saddles and Bridles. Baltimore: The Lord Baltimore Press. p. 387-389*). Because the webbing flexes under pressure, there is less incentive for the horse to jump it.

Fig. 19.9: In this rear facing trailer, poor tying practices did not prevent the horse from leaping the chest barrier. The added barrier in front of the horse is intended to discourage a leap, but is unlikely to do so. It will also prevent the horse from lowering its head to clear its respiratory system.

Ten-inch wide webbing is strong enough to restrain the jet planes on flight decks. Today, canvas chest or breast straps are used in the air freighting of horses such as in the HMJ/HMA triple horse container (*Retrieved September 21, 2014. Triple Horse container-HMJ/HMA* http://www.afsonline.nl/stallSystem?id=HMJ&stall=Horse%20Container).

19.5 Recommendations

Restraints should be provided with emergency release from outside the trailer (*R. Gimenez. June 14, 2012. Pers. corr.*).

An outside release should consider the need for security against casual or opportunistic vandalism.

Chest and butt bars or webbing should be tested to 5,000 lbs forward and backward forces with an emergency release set at a maximum 300 lb downward direction.

Webbing is readily tested to a rating since it would be constructed similarly to cargo lifting equipment which is all tested for working load and failure (*Sigurdson, J. November 19, 2014*).

The sudden release of the butt or breast bar should not expose the horse to a sharp surface or hard part of that equipment.

Should the restraint disengage automatically, secondary containment (door, ramp, etc.) is necessary to prevent the animal falling out.

The Hampshire Fire and Rescue Services advise that a butt bar be such that one handler can secure the horse, and that the butt restraint can be released in an emergency outside the trailer without tools (*Retrieved September 26, 2014.* http://www.horseit.com/en/riding2001/Transport/tuiesafetybar_200109_horse_transport.htm).

20 Skin

20.1 Materials

Trailer skin and roofing ranges from canvas and fiberglass to lighter or heavier metal gauges.

Fig. 20.1: While it meets the criteria of shelter from the elements, this canvas skin is unlikely to survive a restive horse or protect the horse during an incident.

20.2 Drawbacks

Some trailer skins are so thin that a horse's raised head punctures the material. Few trailer sides or roofs support the weight of a standing or fallen horse, shod or unshod, should the trailer roll or the horse panic.

Trailer skins meeting no standards may have roof skins of .030-.040 and of a low alloy, adding no structural strength and doing little more than keep the rain out. If a horse's head or hoof penetrates the skin, the holes are sharp and the horse will lacerate itself, lose an eye or sustain cut tendons and ligaments.

Fig. 20.2: The thin skin of most horse trailers cannot contain a hoof or head during an incident. In this case, the horse's front legs went through. Emergency responders are attempting to discern an extrication method while the owner, in a very unsafe position, soothes the horse.

Fig. 20.3: The overturned trailer has thrown the horse on its side, its hooves penetrating the skin. Wraps have prevented abrasions and cuts on the lower legs.

Horse trailer skins are known to shatter, spilling their live contents onto the road surface (*Gimenez, R. July 2014. Pers. corr.*).

Fig. 20.4: Thrown from the trailer during an incident, a horse lies dead in a ditch. Similar to humans that are not belted in, ejection of animals from the confines of a trailer is commonly fatal.

Fig. 20.5: A blown tire on the tow vehicle sent the horse trailer into the guardrail, demolishing it. One of three horses was thrown from the trailer onto the verge. First responders, one in a dangerous position between the horse's legs, sedate the horse.

Fig. 20.6: A moving van rear ended this trailer, pushing the tow vehicle, a pickup, into a third vehicle. Only two manufacturers the committee could locate have conducted any citeable testing to determine safer ways to protect the horse from this type of impact.

Poor-quality trailer skin offers no protection against steel-belted radials or other debris exploding into the trailers, similar to non-standard school buses (*Retrieved September 21, 2014. Report to Congress: School Bus Safety Crashworthiness Research. NHTSA. April 2002. http://www.nhtsa.gov/Research/Crashworthiness/School+Bus+Crashworthiness+Research*).

In the experience of large-animal technical rescue crews, even the better fibreglass skins cannot contain the horse in the event of a collision (*Retrieved Sept 15, 2014. http://www.equineer.com/wp-content/uploads/2011/11/EE-Let-Me-Count-the-Ways.pdf*).

However, in some instances, the ability to cut easily through fibreglass helped to extricate the horse.

20.3 Strength

A metal type developed by committee member Sigurdson does not shatter and can be cut without the use of the jaws of life. The roof is 5052 H32 aluminum which can be cut with circular handsaws during fabrication without sparking. This characteristic eliminates the chance of ignition, an important factor on the shop floor or during a transport incident.

With thickness varying from .090 - .125 inches thick or up to 3 mm, the roof and floors in the trailers are of the same thickness, capable of withstanding kicks or allowing a horse to safely stand on the roof without penetrating it (*Sigurdson, J. November 4, 2014. Pers. corr.*).

Fig. 20.7: Committee member J. Sigurdson stands with one of his firm's unibody horse trailers. Built to field ambulance standards, its skin of up to 3mm thickness of 5052 H32 aluminum allows a horse to safely stand on the roof without penetrating.

20.4 Noise

Poorly attached skin of any material can be an adverse noise factor.

At least one trailer skin and glue has been found to eliminate or reduce noise and withstand a blow of 450 pounds per square inch (*Retrieved September 21, 2014.* *http://pollardeventing.com/road-to-recovery-2/?utm*).

20.5 Recommendations

The materials used to cover the exterior or interior of the trailer frame shall be such that no part of the horse escapes during transit or when in a collision.

The skin shall deflect or prevent penetration from outside objects such as tire debris, lumber, or gravel.

Standards applied to small school bus crashworthiness and ability to resist intrusion from outside debris could be adapted to horse trailers.

Depending on the amount of framing offered, a galvanized frame encased in fibreglass might be a compromise between strength and lightness.

Noise-dampening materials and methods shall be used when attaching the skin to the frame or chassis.

21 Windows

21.1 Equine Behavior

Windows are installed to allow light and air into the interior. Horses attracted to the light may see it as an escape route and attempt to jump through even small windows (*Retrieved September 21, 2014. https://www.facebook.com/photo.php?v=223571357692445&set=vb.100001187477564&type=2&theater*).

Fig. 21.1: Agitated in transit possibly by an insect, this horse attempts to escape through the "escape door" but gets trapped on top of the chest bar and in the door. The driver pulled off the interstate next to the guard rail.

Fig. 21.2: Horses will attempt an escape through any perceived opening. This one was caught at the hips. Hay bales provide support while inside the van workers are cutting through metal.

Fig. 21.3: Fore and hind quarters unsupported, this mare teeters on a feed window edge before suddenly thrashing and lunging over and beside the picnic table as the rescuers scramble for safety.

Fig. 21.4: Horses orient toward light. Good lighting in a trailer is helpful for loading and working with animals inside, but large windows present numerous hazards. This window does not have structural integrity to protect against protrusion of the horse's head or hooves in collisions or even if the animal panics and attempts to leave the trailer.

Windows placed lower down in rear-facing trailers encourage the horse to maintain a low head height and allow inspection of the closed trailer. Lower heads also defuse the fight-or-flight reaction.

Wentworth Tellington, in his cross-country (1,500 miles non-stop) study, found that horses travelled more quietly with no view.

Some trailers in Australia feature .75 m tall by 2 meter wide windows in front (bulkhead) to provide the driver with the ability to see the horses and encourage horses to enter. However, in a collision this would be disastrous.

21.2 Preventing Escape

Barred windows may discourage horses from jumping through these windows. Appropriately distanced bars on windows may also discourage penetration by a hoof in collisions (*Retrieved September 21, 2014.* *http://articles.chicagotribune.com/1996-08-12/news/9608120159_1_horse-sense-horse-trailer-firefighters* and *https://www.facebook.com/photo.php?v=223571357692445&set=vb.100001187477564&type=2&theater*).

21.3 Aiding Rescue

Windows with identifiable exterior removal points assist rescuers in freeing trapped horses. These points are identified with decals or a contrast outline indicating removal or cutting points.

21.4 Recommendations

Vents and windows shall be protected against the penetration of a hoof or against attempts of the horse to jump through them.

Operable vents and windows shall be screened against insects and road debris such as cigarettes, bottles, cinders (*Retrieved September 21, 2014. http://www.wral.com/tossed-cigarette-likely-sparked-trailer-fire-that-killed-six-horses/9450904/*).

Windows shall be heavy duty framed.

Removal points shall be identified for rescue removal.

22 Brakes and Electronic Stability

22.1 Performance Limits

The issue in all types of braking systems is adjustment, maintenance, protection of brake lines from sheer or breakage, and understanding their limitations and capabilities when hauling live weight.

Fig. 22.1: At high or low speeds, trailers can overturn due to hitch failure, loss of control on ice, hard braking, or wind gust. On the highway, other vehicles become potential landing zones for this type of incident.

Although dealers will point to engine size as related to towing capability, what is equally or more important is the braking capacity for the tow vehicle. It is possible to tow a horse trailer behind a two-stroke motor-bike or a bicycle (*Retrieved September 21, 2014.* *http://www.rvmagonline.com/features/0808rv-airstream-trailer-history/innovations.html*). Braking the trailer would be a problem, however.

22.2 Regulations and Reality

The braking system required in New Zealand must stop the trailer within 30 feet at 20 mph without upsetting the cargo or jackknifing (*Retrieved September 21, 2014. Flaxman, R. 2013. Check load before you hit the road. 15 December. The Sun, New Zealand.* *http://www.baydriver.co.nz/news/60179-check-load-before-you-hit-road.html* and *http://www.aa.co.nz/cars/maintenance/towing/driving-with-trailer/* and *http://www.nzta.govt.nz/resources/rules/heavy-vehicle-brakes-schedule3.html*). Despite the regulation, it has never been tested in New Zealand with the intended cargo, dead or live. The only time it has, with a cob or large pony, was demonstrated in a video done for Rice Horse

Trailers, United Kingdom in 1973 (*Retrieved October 1, 1014.* https://www.youtube.com/watch?v=j2O_ItTcR9M).

Fig. 22.2: Complying with New Zealand braking regulations to stop the trailer within thirty feet at twenty miles an hour, this cob demonstrates that horses automatically lean away from the point of impact when head free facing away from the direction of travel. The blindfold ensured that the horse could not anticipate directional events during the demonstration. The cob had never previously been hauled about face.

Stopping distances for vehicles, with nothing attached, are formulated at http://www.csgnetwork.com/stopdistinfo.html (*Retrieved September 21, 2014*). Stopping distances increase with a loaded trailer, in less than ideal road conditions, and even more with live weight.

22.3 Surge Brakes

Surge brakes are mandated for use on the European continent by vehicles registered outside of the United Kingdom. Surge brakes have been illegal in the USA for use on commercial interstate vehicles and certain tow vehicle-trailer weight ratios (*Retrieved June 29, 2014. Weber, Rick. 2013. A look at revised guidelines. www.trailer-bodybuilders.com/archive/look-revised-guidelines, p. 2*).

Since 2007, USA federal authorities allowed surge brakes on small and medium trailers used in interstate commerce as a concession to the rental industry (*Retrieved September 21, 2014. http://ca.ararental.org/GovernmentAffairs/SurgeBrakes.aspx*).

Surge or override brakes depend on the trailer pushing against the slowing tow vehicle. This push or bump may destabilize the horse during conventional transport (*Retrieved September 21, 2014. http://www.bipac.net/ararental/Trailer_Surge_Brake_Enforcement_091404.pdf*). There is no-back up system to activate them should surge brakes fail (*Retrieved September 21, 2014. http://www.redtrailers.com/ShowArticle.asp?id=2*).

Surge brakes reportedly can contribute to jack knifing on icy pavement and slick road conditions. Surge brakes will not hold a trailer stopped on an uphill incline but require the

weight and brakes of the tow vehicle to do so. Additionally, surge brakes are more expensive to install and maintain.

Federal authority, wrote Gov. Parris Glendening of Maryland in vetoing a push to legalize surge brakes, "requires brakes to work at all times and under any conditions. Surge brakes do not meet these criteria because they only work when a trailer is moving forward. . . . The brakes do not work at all when a vehicle is" reversing (*Retrieved September 26, 2014. http://www.offshoreonly.com/forums/trucks-trailers-transportation/147984-trailer-electric-surge-brakes-debate.html*).

22.4 Electric Brakes

Electric brakes are more common in North America and can be set and controlled from within the cab, as well as engaged off the cab brake pedal. This requires the operator to be knowledgeable in setting the braking system based on weight in the trailer. Anti-lock brake systems on tow vehicles require that any towed unit be equipped with an electronic brake controller (*Retrieved Sept 14, 2014. http://www.bipac.net/ararental/Trailer_Surge_Brake_Enforcement_091404.pdf*).

Electric-brake–assist levels can be adjusted according to load, adding a significant safety factor and ability to reduce sway and avoid skidding while adding power when fully loaded to appropriate stopping distances (*Haven, J.S., August 11, 2011. Pers. corr.*).

Electric brake systems can be vulnerable to moisture, grease, and cracked wires.

22.5 Disc Brakes

Disc brakes are not recommended by some as, improperly adjusted, they may grab too suddenly and upset the live weight.

22.6 Anti-lock Braking System

Used in conjunction with hydraulic disc brakes, four-wheel ABS has recently been developed for trailers under 10,000 pounds. Several available controllers, which co-ordinate deceleration and speed, offer full brake controller function. Stops are smooth, fast and depending on the controller, give up to 50 percent less stopping distance. A manual override lever is also included.. (*Retrieved January 6, 2015. http://mrtruck.com/mrtrailer.com/wp-content/uploads/old/direclink-brakes.htm*). The trailer tests were done with steel horse mannequins so it is not known what happens to a live horse in these shorter, faster stops.

22.7 Brake Lines

Brake lines are subject to breakage from road debris (*Retrieved September 21, 2014. 2005 4-Star Trailers. http://www.allworldauto.com/comments/viewthread.php?cid=605674*).

22.8 Breakaway-Brake Cables

Breakaway-brake cables are activated either electrically or mechanically. The mechanical provision loops around a secure attachment on the tow vehicle, acting as a backup in case the coupler is detached when under way. The cable remains attached pulling the trailer handbrake on to slow or halt the trailer. It is not heavy enough to tow a trailer but warns the driver of an

event (*Badland, B. J. and M. I. Plant. 1980. Trailer Manual. Bolton, U.K.: Mechanical Services Trailer Engineers. p. 27*).

Electric breakaway cables are often dependent on batteries that are frequently under-charged or dead, a concern the National Association of Trailer Manufacturers is studying (*Lancaster, C. 2012. The trailer industry today and tomorrow. 38th Annual Conference Animal Transportation Association March 18-21, Vancouver, B.C*).

22.9 Electronic Stability

Trailer safety has been recently enhanced with electronic trailer stability. The system detects the sway of a trailer and counteracts it by braking individual wheels. Simultaneously, engine torque is reduced and the vehicle is slowed (*Retrieved September 26, 2014. http://pid.sagepub.com/content/223/4/471*).

It is an added margin of safety for vehicles commonly used for, but not recommended for such purpose, towing the conventional two-horse trailer: sports utility vehicles, station wagons, and other passenger cars.

Fig. 22.3: Responders approach this detached, upended trailer. A properly hitched trailer does not come detached. Electronic brake controls might have prevented this incident.

Fig. 22.4: Trailer sway sent this rig ricocheting from one guardrail to another across the road. The trailer, carrying two horses, detached to hang over the side of the bridge. The pickup plunged thirty feet below. The 17-year old driver and her young sister escaped before the truck burst into flames.

An electronic stability program for livestock trailers has been developed. Prime candidates for electronic stability programs are horse trailers with living quarters or with weight supported beyond the back half of the center of balance of the trailer (*Retrieved June 29, 2014.* *http://www.rightconnections.co.uk/trailer-stability* and *http://www.horsetrailerworld.com/Home/contribute/Homepage/MrTruck9-8-08/index.asp* and *http://en.wikipedia.org/wiki/Trailer_Stability_Program*).

22.10 Recommendations

The brake system must allow for the manual or automatic adjustment of braking force to accommodate the differences in a fully or partially loaded trailer.

The brake system must allow for the early or delayed engagement of the trailer brakes at the option of the driver to accommodate varying road conditions.

The braking system should be able to stop the trailer loaded to the maximum of its gross vehicle weight rate within 30 feet at 20 mph, similar to that already required by New Zealand motor laws for both light- and heavy-goods trailers.

The principal concern is not with injury or fatality affecting the horse as it is with people and traffic that could be struck by a loose trailer. It is strongly recommended that every trailer, regardless of weight, shall be equipped with a breakaway brake device. This device will automatically apply, with or without electrical assistance, and hold the trailer brakes should the trailer become detached from the towing unit while in motion.

Any permitted adjustment of the brake assist shall not adversely affect the trailer stability.

Brake lines will be protected from shear and road debris.

Manufacturers should be encouraged to offer an electronic stability program.

23 Monitors

23.1 Types

Monitors are available for noting temperature, humidity, tire inflation, and response of the horse to a driver's skill. The most popular is the in-cab camera. Cameras are ideally used in conjunction with a remote data sensor for temperature and humidity (*Roy, R. C. 2013. Interview. February 22*). Many professional horsemen or drivers include a remote sensor inside the trailer that they can monitor from the cab.

23.2 Camera Limitations

Cameras are highly recommended for monitoring horses' reactions and dangers inside the trailer. However, they require a passenger other than the driver for continuous monitoring. Otherwise, cameras require drivers to remove their eyes from the road.

Cameras cannot divine, as well as human observers together with heart rate monitors, the subtler behaviors that indicate a horse's distress (*Padalino, B., A. Maggiolino, M. Boccaccio, et al. 2012. Effects of different positions during transport on physiological and behavioral changes of horses. Jl. of Veterinary Behavior. p. 135-14*). Some of the signs which a camera would overlook or for which it would not provide enough detail are the tightening or shortening of a horse's mouth or chin, short and rapid flank movements, or the growing lack of focus in the eyes indicating distress.

Cameras can malfunction due to their sensitivity to blows, humidity and temperature change.

23.3 Mobile Phone Applications

Applications are available that allow a monitor within the cab of the tow vehicle to be immediately alerted as to what is happening to the horse in terms of its effort to remain balanced (*Sigurdson, J. 2012. Putting information and technology into work for transport. 38th Animal Transportation Association Conference March 18-21, Vancouver, B.C.*)

23.4 Recommendations

This committee recommends equipment which will monitor temperature, humidity and the stability of the horse in transport without driver distraction.

Monitors for air flow rate are also a plus (*Kettlewell, P., M. Mitchell, et al. 2001. Research results in road transport. AATA Conference, Toronto. April 29 – May* 2).

24 Towing Weight

24.1 Limitations of Weight Regulations

Trailer weight limits are frequently compromised by a failure to ascertain the exact weight of the load.

The problem concerns human error compounded by tow vehicle marketing hype. The typical horseman or livestock evaluator underestimates a horse's weight. There is **no** relationship between years of experience and accuracy of estimation. Eighty-eight per cent of evaluations **underestimate** horse weights by 186 pounds. Visual estimation produces errors of 20 percent to 25 percent (or 92 pounds). Visually inspected, a 1,000 lb horse could weigh 750 or 1,250 pounds (*Johnson, E.L., R.L. Asquith and J. Kivipelto. 1989. Accuracy of weight determination of equids by visual estimation. Proc. 11th Equine Nutrition and Physiology Symposium. Stillwater, Oklahoma. p. 240*).

Truck purchasers cannot go by the engine ratings or vehicle size as the sole criteria for hauling weights. Capabilities are related to spring ratings, axle ratio, engine size, type, transmission, frame strength, tire size and brakes, each of which can be drastically different in a truck series by the same manufacturer (*Whitford, F., et al. 2013. Truck, trailer and hitch components: Making sure the numbers add up. Indiana: Purdue University, p. 12*).

24.2 Other Regulatory Failures

The European Union mandates the maximum weight that may be towed by a four-wheeled vehicle.

This limitation has encouraged development of light-weight trailers that can be pulled by smaller vehicles. Unfortunately, these may become unstable in cross-winds, at high speeds, or when being overtaken by larger vehicles. They are inappropriate for the North American market where interstate and multi-lane highways shared with larger vehicles and travelled at high speeds are common.

To protect the trailer integrity, consideration must be given to correct matching of tow vehicle towing capacity and the intended trailer (*Wrapson, R. July 30, 2012. Pers. corr.*).

24.3 Recommendations

Whatever the stated towing capacity of the tow vehicle, the purchaser should be advised to get more power and braking capacity than he expects to need. Because some day he will need it. The central question remains: Can the loaded, and perhaps overloaded, to capacity trailer be safely halted at safe speeds with the vehicle towing it? (*Gimenez, T. 1999. Observation to class*).

25 Frame and Chassis

25.1 Current Problems

25.1.1 Escapes

Many road users and horses have been killed when the horse escaped or is catapulted outside the trailer, either during a rollover, collision, or when a door, ramp or latch fails.

Fig. 25.1: This horse has been thrown from its trailer. Firemen approach cautiously, planning to restrain it for treatment and before it can get into traffic.

If the animals remain within the transport, the horses have fewer injuries, a greater chance of survival, and present no hazard to traffic or rescuers working outside the transport (*Gimenez, R., T. Gimenez, K. May. 2008. Technical Large Animal Emergency Rescue. Iowa: Wiley-Blackwell, p. 149*).

Fig. 25.2: A loose animal on the highway is lethal, its long slim legs are the only clue in headlights that there is a heavier object on top. This is a typical presentation when horse, or moose, meets car and driver.

Despite this needed safety feature, no structural design requirements could be found in any country for non-commercial trailers to prevent the horse from escaping due to a collision or roll-over. Trailers may be constructed of bed frames or garden trailers. Frame rails, bows, cross-member materials and strengths, ramp attachments, and all structural components are left to the manufacturer or user in all respects.

Fig. 25.3: What passes for a horse trailer, despite an insecure load, can even comprise wire fencing.

One horse owner and repairman routinely replaces whole under-frames rather than rely on the original channel steel to resist mud and rust (*Stevas, A. September 17, 2014. TLAER Facebook*).

A TLAER member reports repeated ramp attachment problems requiring rebuilding the trailer rear with new steel or aluminum parts (*Lichtenstein, I. September 18, 2014. TLAER Facebook*).

Ramp attachment and trailer skin can also hide frame problems despite visual inspection even on new, high-end trailers (*Johnson, J. September 17, 2014. TLAER Facebook*).

Even where the animal is contained, weak bows, fiberglass or poor framing, make it difficult for rescue workers to support inherently weak trailers to extricate trapped animals or expeditiously remove the wreck from traffic.

Fig. 25.4: Less than a week old, this aluminum trailer has overturned. The weakness of the trailer/float skin, frame and bows can hinder rescuers from using support cribbing to stabilize the trailer and requires careful evaluation of strut or cribbing placement.

Fig. 25.5: This large trailer split open on impact, exposing the horses within. This indicates very poor construction providing no structural integrity.

Many trailer buyers assume that the product has been crash tested. But there are no requirements to do so as humans are not permitted to ride in them. With the demand for ever lighter-weight trailers to beat petrol prices and commercial driver's license regulations, trailers have become even more fragile (*Lichtenstein, I. October 11, 2014. TLAER Facebook*).

There are reports of the mainframe or trailer "skeleton" becoming unattached from the chassis with disastrous results. As the trailer splits, it may eviscerate the horse (*Gimenez, R., T. Gimenez and K.A. May. 2008. Technical Large Animal Emergency Rescue. Ames: Wiley-Blackwell p. 276. See a similar incident in the photo by J. Van Hoosen attached to this document's cover letter. The Van Hoosen photos are distributed to committee members and consultants only and are not for general circulation or publication. The incident and other illustrations may be found at: Retrieved May 15, 2014. http://www.examiner.com/article/murray-state-university-rodeo-team-loses-horse-accident*).

25.1.2 Ejection

During a collision, horses risk being thrown outside the trailer confines, either when the sidewall is breached on impact, through the front or rear of the trailer or limbs puncturing and getting trapped in the trailer skin (*Retrieved October 3, 2014. http://www.equineER.com and McLeod, T.M. September 28, 2014. TLAER Facebook. Active rescue scene*).

Fig. 25.6: A tire on the tow vehicle failed, despite having been inspected within the last 24 hours. Rig control was lost, the trailer came unhitched, started to roll, then landed. The impact loosened the sidewall, and four of the five horses exited through the opening. The tow vehicle rolled five times.

Fig. 25.7: A horse trailer wreck in Kentucky demonstrates the flimsy construction of many horse trailers. Axles, sidewalls, roofing, flooring and framing do not hold up to the impact of collision. Surviving larger pieces are readily broken up for salvage or junk.

Horseboxes have had to have the wall between cab and horse section reinforced to prevent the horse from breaking through into the cab even on a routine trip. One such incident trapped the driver in the cab as well as the horse (*Retrieved September 21, 2014. http://www.bbc.co.uk/news/uk-england-sussex-11187016*).

Fig. 25.8: This horse broke through into the cab of the van, trapping the jockey. Manufacturers of horse trailers and vans must strengthen the bulkhead against such events.

Horses may become ejected from the front or back of the horse trailer, or even a van, during a collision, braking, or attempts to escape in transit. They then become hazards to themselves and other traffic.

Fig. 25.9: A racehorse awaits rescue from a trailer which slid on black ice and overturned. The horse's leg is wedged in damaged trailer parts or through the window, but animals do not wait quietly and will continue to struggle and damage themselves.

(*Retrieved April 15, 2014.* *http://www.chiefads.com/news/local/horse-put-down-after-fender-bender-near-mall/article_6a15135e-129b-11e2-aa4d-0019bb2963f4.html* *and Horse ejected from trailer. Spins across interstate* *http://www.wkyt.com/home/headlines/Accident-involving-horse-trailer-shuts-down-I-75-south-210692621.html* and *Rescue 911 Episode 421 Racehorse rescue, pt. 2 of 2 parts* *https://www.youtube.com/watch?v=CVXLbFCb1pY*. *NB: Extrication approaches used in part 2 of Episode 421 "Racehorse rescue" are not recommended. As Technical Large Animal Emergency Rescue techniques are more widely adopted, it is hoped that fewer errors will occur*).

25.2 Rear and Side-Impact Guards

Many reports of horse trailer incidents indicate crash conditions that were low speed or straightforward incidents where the expectation would be a positive outcome for the occupants. Nevertheless, the animals endured horrific injuries or death. Humans, too, have died in these crashes.

Fig. 25.10: Underride guards and better framing could protect many horse trailers from maximum intrusion when rear ended or rammed from the side. Maximum use of forward exits large enough for horses is preferred. Additionally, improved reflective provisions would allow following drivers to see the rig in the first place.

Fig. 25.11: This driver was stopped on a two-lane highway, waiting for traffic to clear to make a right hand turn when struck by a truck. The horse escaped unharmed according to initial examination, but the results demonstrate the need for stronger framing, multiple exits, and improved reflective markings.

When a two-horse trailer towed by a recreational vehicle was rear ended by an 18 wheeler, the driver of the 18 wheeler and both horses were killed on impact. The trailer roof sliced through the windshield and into the cab of the 18 wheeler. The attending veterinary technician

described the trailer as thoroughly "demolished all the way to the bulkhead except for the hitch." The hitch and recreational vehicle frame were driven forward about 8 feet under the recreational vehicle.

In one instance, a horse trailer was rear ended by an 18-wheeler doing 55 mph with ¼ mile visibility. No horses were aboard. There was no damage to the tow vehicle. The Sundowner rear doors were totaled and the front walls expanded 6 inches. A horse in the rear would have been badly injured or killed. Floor and walls remained intact (*Retrieved September 21, 2014. Badger. April 16, 2009.* http://www.chronofhorse.com/forum/archive/index.php/t-200367.html).

Trailers imported into Canada over 10,000 lbs or 4535 kilos are supposed to have a rear-impact guard. The medium-weight trailer has no rear-impact requirement, possibly because they are usually lower to the ground. However, Canadian improvements in rear-impact guards for trailers under 10,000 pounds are being studied by the National Association of Trailer Manufacturers (*Lancaster, C. 2012. The trailer industry today and tomorrow. 38th Annual Conference Animal Transportation Association March 18-21, Vancouver, B.C.*).

Fig. 25.12: A van collided with this stopped lorry, killing one horse.

Though fitted to National Highway and Transportation Safety Association standards, some rear-impact guards are of doubtful value in preventing deaths to occupants of the impacted or following vehicle (*Underridernetwork.org*).

25.3 Collision, Confinement and Control

Keeping the horse confined to its conveyance during a collision or should the horse become uncontrollable, are already set by standards for the airline industry.

For road transport, one-horse trailer manufacturer, EquiBalance of New Zealand, offers a patent-pending hind-quarter impact barrier for horse trailers and vans. Dual purpose, it protects the live cargo and prevents it from escape or ejection during a collision. Computerized design and testing indicates that it can withstand a 3.5 tonne impact and keep the horses within the trailer.

The same design also prevents the horses from being pitched through the front of the trailer during an incident (*Holmes, O. 2012. Are rear-facing trailers the future of equine transport? March 18-21. 38th Annual Conference Animal Transportation Association, Vancouver, B.C.* and *Retrieved Sept. 15 2014. http://www.google.com/patents/WO2012165979A1?cl=en*).

Fig. 25.13: Doors and frame diffused some of the impact, putting the horses in this rear ended Featherlite trailer at less risk than in some trailers.

Aware of the necessity to protect the horse and motor vehicle occupants from rear-end collisions, some manufacturers fit a ramp over the rear entry doors as an added barrier. (*Retrieved December 15, 2014. http://www.equispirit.com/trailertour/photos/tour-1.htm*). However, the amount of force that this arrangement could deflect, absorb, or prevent from striking occupants of the trailer is not specified.

25.4 Side Collisions

Properly designed and installed side guards allow a vehicle to survive a 65 kph crash test.

Reports on Internet forums indicate there are some American-made trailers that have withstood certain types of crashes. A report of a pick-up truck exiting a farm lane and hitting the side of one such trailer ruined the truck's front axle and front end of the pick-up. The horse trailer interior withstood the damage without immediately apparent injury to the horses (*Badger. April 16, 2009. Retrieved September 26, 2014. http://www.chronofhorse.com/forum/archive/index.php/t-200367.html*) *and Clark, E. Daily Mail, August 12, 2012. Horse killed in motorway crash http://www.dailymail.co.uk/news/article-2187872/M6-Crash-Horse-killed-motorway-crash-whos-joker-skateboard-weaving-traffic.html* and *http://www.itv.com/news/central/2012-08-14/m6-crash-cars-were-stationary-at-time-of-collision/*).

25.5 Air and Land Solutions

Tests have already shown that it is possible to protect a vehicle's frame, such as horse trailer frames, from having to absorb 90 percent to 100 percent of an impact. The strength testing and energy absorption requirements are outlined in FMVSS No. 223 (*Rear Impact Guard, www.underridenetwork.org*).

The HINO Motors Concept Truck, about the size of a two-horse van, is equipped with a front crash cushion, rounded corners to divert vehicles and outer frame side protection. In order to spread the impact energy, there are no sharp angles. Corners are protected for offset crashes and there is a rear energy absorbing guard. Tests show that fatalities to all types of other road users are significantly reduced (*Underridenetwork.org*)

Fig. 25.14: Unbelievably, the two horses survived this rollover.

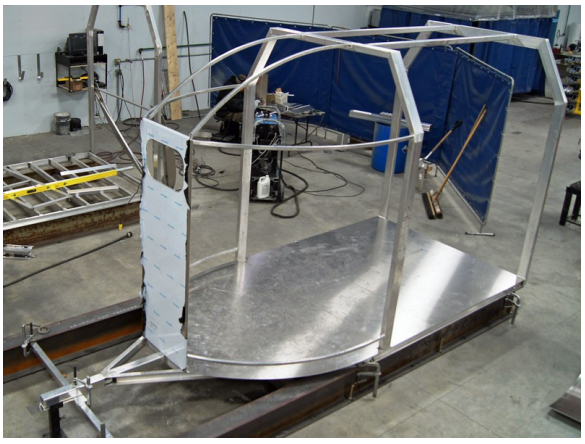

Fig. 25.15: A rollcage to field ambulance specifications and one-piece floor with the same weight bearing strength throughout contains horses within the trailer in the event of a rollover, collision, or dislodged breast bar.

Containers for air freighting horses must meet rigorous standards. The Instone Airstable meets European Aviation Safety Agency (+CAA/FAA) certification procedure including stress testing to aviation standards. It must withstand certain G forces in all directions to protect the fuselage of a plane.

The intent of the Aerospace Recommended Practice strength testing is to ensure that horses will not spill out and damage the aircraft even in extreme circumstances.

The Instone Airstable is considered to be over-engineered for transport over roads. It should still be studied as a guide or checklist to look into all possible factors, and perhaps novel solutions, affecting protection of live cargo and the hauling environment, including other road users.

Instone Airstables has offered any technical information a standards committee may require (*Jeremy Instone. June 13, 2012. Pers. corr.*).

A feature of some of these stables is that they can be collapsed when empty for space saving shipping.

Because there are currently no standards for horse trailers, Aero-Equis of Canada developed its own by referring to the existing standards for off-road ambulances. These horse trailers meet or exceed all the off-road ambulance standards mandated by the Canadian FMVSS. The result is probably the strongest available frame and body in North America.

Manufacturers may also look to jet fighters for ideas. Assisting in rescue in the event of an incident would be cockpit canopy, or trailer roof in this case, releases for rescuers to activate. This system was already in place decades ago for animal ambulances designed and used by the Old War Horse Memorial Hospital in Egypt and for some school buses.

Still another novel approach is considering the feasibility of installing pop-out windows and pop-out escape doors as mandated by the Transportation Safety Board Canada in aircraft to assist with rescue.

A summary of nine school-bus collisions built to post-1980 standards indicated that the windows were effective in restraining occupants. No joint ruptures occurred, although five of the crashes were severe; and, of the 248 occupants involved, there were only 10 major injuries. No injuries were due to intrusion into the bus (*Transport Canada. 1998. School Bus Collision Summary: Canada 1989-1997. T.P. 13412 E. p. 8*).

25.6 Computerized Crash and Stress Testing

Manufacturers may wish to consider computerized stress testing of their designs, components and materials. Computerized Finite Element Analysis is a program used to identify stress points (*Retrieved September 9, 2014. http://usa.autodesk.com/adsk/servlet/item?siteID=123112&id=17670721*).

Computerized strength tests and simulations are quite accurate but the process is not standardized throughout the industry. A variety of computerized strength tests and simulators are used throughout the aircraft industry, for example, and accepted as valid.

Non-invasive testing protocols for a variety of fastenings, noise sources and levels, lubrication, welding, joins, and material strength are conducted by the British Institute of Non-Destructive Testing for engineers in the aerospace industry.

The Canadian Motor Vehicle Standards does identify how to conduct stress testing for components of specific vehicles, such as infant and adult restraints, door, joint, rear impact guard strengths, and cargo anchoring devices with no deviation from the standard (*Retrieved June 28,*

2014. https://www.tc.gc.ca/eng/motorvehiclesafety/safevehicles-mvstm_tsd-index_e-629.htm#tm).

25.7 Recommendations

Manufacturers should adopt frames and doors/ramps on a horse trailer that can meet or exceed the rear impact guard standards of trailers over 10,000 pounds.

Frames should be such that the live cargo is retained within the confines of the trailer during minor and intermediate crashes, or in the event of all but a catastrophic (hit by a train, an 18-wheeler, rear-ended at a standstill by another vehicle) collision.

Frames and chassis should be of a material known to be robust and intended for long-term use, or resistant to corrosion for a minimum of 5 years after purchase.

Frames should be securely fastened to the chassis.

Frame components related to safety should be as accessible as possible for inspection for wear, corrosion, cracks, or failure.

Robust cross-members beneath the flooring shall be placed at intervals no greater than every 30 cms.

All structural elements should be conveniently inspected visually without dismantling them except where rot, corrosion, or fatigue failure is inherently prevented by design and materials used.

Should the strength of the structural elements fall below the original standard within 5 years of purchase as new, the structural element(s) affected (floor, frame, or draw bars) shall be replaced.

Roof and side bows, as part of the frame, must not be exposed in the interior of the trailer. Exposed roof bows risk scalping or injuring horses' raised or flung heads. Exposed side bows risk bruising the horse during a rollover.

Roof and side bows should be such that the trailer can be supported and stabilized by emergency equipment in the event of a highway incident. Currently, the skin, roof, and side bows are only meant to protect the cargo from the elements and will bow out under pressure from the load striking and weakening the structure during an incident. (*White, Steve. n.d. Heavy vehicle extrication: Cab components. Retrieved June 29, 2014. Youtube http://www.fireengineering.com/topics/m/video/41101776/heavy-vehicle-extrication-cab-components.htm*).

Trailers will be designed to keep large animals confined within the trailer during normal transport, or a rollover, or collision. Confining the live cargo during these incidents reduces fatalities and injuries to other road users and public.

A horse trailer shall withstand a minimum of 3.5 tonne interior or exterior load distributed in any direction.

A horse trailer skin and frame shall resist or prevent intrusion from debris to the extent of that afforded by the skin and frame of a school bus or greater.

26 Drawbar and Framing Gaps

26.1 Hazards

The open A-frame or drawbars ahead of the trailer front carries the hitch ball, possible surge brake, brake battery, wiring and sometimes the spare tire. It is a hazard. A loose or panicked horse can readily get its hoof or leg trapped in the opening between the drawbars with grave consequences.

Animals being loaded at the front of the trailer near the drawbar have been known to get trapped when resisting loading.

Fig. 26.1: Though not a drawbar, this is a common failing of many trailers, old and new. Their open frames and braces can trap a hoof or extremity.

Fig. 26.2: Horses have killed themselves when a leg is caught in the open drawbar A-frame. A weight-bearing cover should be used to prevent insertion of an extremity.

Fig. 26.3: The drawbar frame of this trailer is solid to prevent a horse from getting its leg trapped.

The drawbars can provide protection for break-away brake and electric lighting wiring cables that should be run beneath the drawbars to protect the wiring and cables' integrity.

Some drawbars are welded or otherwise fastened to the outermost corners of the trailer front. These are weak areas subject to movement.

26.2 Recommendations

Trailers hauling livestock must cover the tow bar gap with material sufficient to prevent an animal from penetrating the material and becoming trapped or injured.

The available support offered by the draw bar covering shall equal that of the horse compartment flooring of the trailer.

Manufacturers should consider running the drawbars beneath the trailer to the front axle. This provides better support to the floor and avoids the front corner attachment strain.

27 Tires

27.1 When Substandard is the Standard

Some manufacturers use substandard, under-sized, used, re-treaded, passenger type, or tires otherwise not intended for use on a trailer. (*Lancaster, C. 2013. Hot topic: used tires on New Trailers. Tracks April/May, p.l41*).

Tire manufacturers may also be uncertain of the proper tires and inflation for trailers. One manufacturer recommended passenger tire inflation for trailers which meant that the tire would likely be underinflated and overloaded. (*Rollman, A.R. 1971. How to tow a trailer. Popular Mechanics 135:5, p. 14*).

Tire performance will be dependent, among other variables, upon hitch load, distance and height from hitch to the leading axle, spacing between the axles, proper axle arch, wheel camber, center of balance and weight of the trailer, tire pressure of other tires, the frequency of oscillation action of the tow vehicle, how well the trailer follows the tracks of the tow vehicle, and trailer suspension on that particular section of road. The wrong tire or an ill maintained tire exacerbates problems.

Some trailer dealers provide light truck tires (LT) for horse trailers up to 16,000 pounds. But meant for passenger vehicles, their flexible sidewalls can amplify sway. This is especially true if the load has a high center of gravity, like a horse trailer, or is heavy, like a horse. (*Retrieved December 1, 2014. Trailer tires vs. passenger vehicle tires. http://www.tirerack.com/tires/tiretech/techpage.jsp?techid=219*).

Special trailer tires (ST) offer more lateral stability If sway begins, they will dampen it. More robust than passenger vehicle tires, ST tires have increased carrying capacity, ride cooler, allow the trailer to haul straighter, usually carry 10% more load than a similar LT tire or 40% more load than a passenger tire and are built to take the less complex suspension system on trailers.

Some trailer brands are notorious for tire failure and for having wrong-sized tires even when the trailer is new. A tire rated lower than the expected trailer cargo weight is cheaper than a tire rated for heavier loads and mileage. Purchaser supplied tires, which must be installed by the manufacturer at the purchaser's request only, rated for a lower weight are a poor fit for axles rated for higher weights. This mismatch can lead to overweighting the tires.

Cheap axles hinder tire balance but tires are rarely checked for imbalance by drivers. The result is a substandard ride and increasing distress for the animal (*Gimenez, R. April 6, 2014, Pers. corr.*).

27.2 Tire Failure Scenarios

ST tires on trailers under 10,000 pounds are not required to be tested for tire retention (FMVSS 110. *Conner, D. and D. Potter. 2013. NATM convention showcases impact of government affairs program. Tracks. April/May, p. 44*).

Trailer tires affect trailer hauling. Underinflated due to lack of maintenance or to provide a smoother ride for the animal passenger, they risk jackknifing, overturning, and swaying.

When a tire on a back axle fails, the driver frequently loses control. Unbalanced trailers are especially prone to this danger. Single-axle trailers are particularly susceptible to wrecks when a tire blows (*Retrieved April 15, 2013.* *http://cs.thehorse.com/blogs/horse-911-whats-your-emergency/archive/2012/03/27/causes-of-horse-trailer-accidents-on-the-road.aspx* and *Retrieved October 20, 2014*. [Details the work of rescuers after a trailer's blown tire crashed the trailer and SUV.] *http://www.nc911.com/fire_wrecks_pages/072204truckoverturned.htm*).

ST tires should not be hauled at speeds over 60 mph or at speeds beyond the wheel's maximum rated pressure even where some makes are advertised as being capable of speeds up to 75 mph (121 km/h).

Haulers involved in an accident with rims and tires mismatched, poorly maintained, not rated for the job, improperly inflated, or otherwise contributing to an incident, face civil and legal penalties (*Retrieved April 15, 2013. Whitford, F., et. al. n.d. Tires for the Road and Field, p. 78* *http://www.extension.purdue.edu/extmedia/PPP/PPP-99.pdf*).

27.3 Necessity for Two Spares

When one tire fails, another frequently fails shortly after, sometimes on the same journey, short or long (*Retrieved November 20, 2014. Trailer tires: tips and best practices. Carlisletransportationproducts.com*).

Fig. 27.1: An empty cattle trailer's tire blows before the trailer is loaded. Control is maintained, and the tire replaced.

Fig. 27.2: During the same trip, another tire on the empty cattle trailer blows. Fortunately, both incidents occurred near exits.

Because of the frequency of tire failures, one horse-trailer road-side assistance program urges policy holders to carry two spare tires. Fifty to 60 tires fail daily across the USA among those insured by USRider (*Gimenez R., T. Gimenez, K. May. 2008. Technical Large Animal Emergency Rescue. Iowa: Wiley-Blackwell. p. 150*). If one tire blows, the other tire on the same side of the trailer should be replaced at the same time, as it has experienced an overloaded

condition to compensate for the lost weight-bearing tire (*Retrieved October 20, 2014.* *http://www.horsetrailerworld.com/forum/printer-friendly.asp?threadid=7328#* *and* *http://mydestinysharinghope.com/two-tires-blew-in-one-tri and McLeod, T. M. 2014. TLAER Facebook, May 12*).

Fig. 27.3: A blown tire jackknifed the trailer, causing the tow vehicle to lose control and another truck to overturn in an avoidance maneuver.

The frequency of tire failures prompted Purdue University to develop a tire that alerts drivers to developing problems. Sensors in the tire detect and alert to unbalanced air pressure between tires, improper inflation, road hazard damage, and tread measurement. Engineer Gary Krutz developed the sensors after replacing all four tires on a car with only 10,000 miles. Five hundred deaths a year occur due to faulty tires. (*Retrieved December 1.* *https://engineering.purdue.edu/ABE/AboutUs/NewsAndEvents/Spotlights/Newsmarttiresensesdamageincreasessafety* *and Krutz, G. December 4, 2014. Pers. corr.*).

27.4 Recommendations

This committee recommends consultation with the National Association of Trailer Manufacturers as to appropriate tires for hauling livestock.

A basic special trailer tire (ST) is considered to be permissible for gross vehicle weight ratings of up to 10,400 pounds but this rating must be conveyed to trailer purchasers as the basic option and a minimum standard and tires with a higher rating should be offered where appropriate.

This committee recommends the use of tire inflation monitors.

Purchasers should be apprised of the availability of smart tires which can alert to developing problems.

Storage for two spare trailer tires should be a highly recommended option.

Tires must be able to hold their balance on axles that exceed the minimum standard.

28 Wheels

28.1 Hidden Faults

When wheel components are incompatible or below ideal performance levels under load, the trailer is at risk at its maximum allowable speed. This is generally accepted as being 5 mph under the speed limit, either as a gooseneck or "bumper pull," when the trailer is fully laden (*Retrieved June 28, 2014. http://www.equispirit.com/info/articles/drivingtrailer.htm* and *Retrieved June 29, 2014 http://drivinglaws.aaa.com/laws/trailer-speed-limits/* and *Retrieved June 28, 2014. http://towatrailer.com/trailer-training-trailer-lessons-at-sirens-driving-academy/towing-a-horse-trailer-tow-a-trailer/*).

These faults defy inspection as they are hidden or the inspector assumes that the manufacturer has consulted Society of Automotive Engineers standards even where not mandatory. Thus, despite inspection, wheels still tend to come off when a trailer is under way. This is irrespective of trailer type or size. One of our committee members lost a wheel in Virginia at 70 mph; and, despite exhaustive searching in the mowed interstate verges at the point of loss, never found the wheel. It is assumed that it must have jumped the fence into the woods. The identified failure was at the cotter pin holding the castle nut onto the spindle. Another committee member lost a rear wheel on the an interstate highway. It was discovered the lugs supplied were shorter than the Society of Automotive Engineers' standard.

The critical need for standards is indicated in the fact that just 3 mm of paint forces a wheel to lose 25% of its torque in 24 hours (*Lancaster, C. 2012. The trailer industry today and tomorrow. 38th Animal Transportation Association Conference, Vancouver. March 18-2*).

Many trailers move very few miles in their lives. Others of the same age may have moved thousands or hundreds of thousands of miles, preventing the used trailer buyer from knowing anything about previous use. Additionally, trailer owners tend to underestimate mileage in their trailers, failing to provide oil, brake, wiring, flooring and other maintenance at the appropriate time or distance of use or non-use.

28.2 Human Error

The driver must not assume that tire- and wheel-service people know their job. Wheels have been lost due to over-tightening, under-tightening, or otherwise ignoring manufacturer specifications for torque. Different torque wrenches can also differ in readings on the same lug nut. Some drivers do not realize that, after the first 100 to 300 miles, some wheels require re-torquing (*Retrieved October 20, 2014. http://www.chronofhorse.com/forum/archive/index.php/t-203849.html*).

28.3 Reducing Incidents

The National Association of Trailer Manufacturers (NATM), with about 750 members world wide, have developed a minimum standard to reduce wheel failure on all trailers.

The NATM's 350 p. E-book, Understanding the Wheel Fastening System, is a study of wheel loss, nut, bolt, and hub testing and the advantages and disadvantages of steel and aluminum. It offers 200 pages of engineering studies and American National Standards Institute recommended practices for assembly of wheels on trailers.

NATM works with its members, who make 75 percent of the trailers sold in the US, to inform them of requirements affecting tire and wheel performance (*Copeland, L. July 6, 2010. State laws target safety of towed trailers. USA Today*).

28.4 Recommendations

NATM recommendations encompass tires, rims, and wheel fastenings and should be met or exceeded.

Hubodometers should be recommended to track the number of miles on a trailer.

This committee recommends the use of lug nut or wheel fastener security indicators. The inexpensive product is available in Europe, the Middle East and North America (*Retrieved April 15, 2013. http://www.youtube.com/watch?v=GCRxE7j-SpY*).

Trailer wheels should be located far enough apart, or the gap protected by a guard, to avoid having a horse tied near the wheels that could entrap its shod or unshod hoof.

Tires, wheel assembly, and axles supplied with the trailer by the manufacturer or dealer shall be of integrity sufficient to maintain the safe operation of the trailer at its maximum recommended sustained speed and load or percentage points above.

29 Axles

29.1 Factory Error

Users of horse trailers must not assume that the manufacturer has used suitable or properly positioned axles for the intended load. Users should always check for tongue weight not only to monitor load placement but also axle misplacement. One manufacturer sold a trailer with axles placed to put over 30 percent of the empty trailer's weight on the tongue.

In another case, the axles had not been installed perpendicular to the frame, making the trailer track unevenly (*Retrieved October 20, 2014. http://www.sherline.com/disaster.htm*).

Factory-installed axles may also have an improper arch contributing to blown or prematurely worn tires.

Over-weighted axles can bend, losing their arch and throwing tire camber out of alignment (*Retrieved October 20, 2014. www.tirelife.com*).

Axles have been known to fail even on new trailers when welds are too small or the base metals or the bearings are of poor quality.

Haulers are lulled into a false sense of security by manufacturers' assurance of maintenance-free axles or bearings. At least once-a-year inspections and oil changes, whether or not the trailer was used, are urged. Axle failure happens frequently enough that USRider, a road-side assistance program for horsemen, urges that haulers carry spare axle bearings and grease seals (*Retrieved October 20, 2014. http://www.usrider.org/news_03_09.html*).

29.2 Axle Options

Hybrid or airbag/torsion bar axles tie axles in tandem as do leaf springs. The hybrid is said to give a smoother ride over bumps and offers the option of lowering the trailer about 3 inches for loading horses. Torsion bars may have less travel (2 to 3 inch of rise and fall) when under way compared to hybrids, which may have up to 5 inches of travel (*Retrieved September 10, 2014. http://mrtrailer.com/airaxlehybrid.htm*).

Leaf springs are believed to be better for mountain driving and twisty roads, able to equalize the load on each wheel, although this may be truer for dead than live weight. Torsion-bar axles are said to give better control in the event of a tire failure (*Retrieved October 20, 2014. http://www.chronofhorse.com/forum/archive/index.php/t-260931.html*).

Torsion-bar axles absorb much of the road shock and vibration. Should a tire go flat, this characteristic helps maintain control of the rig until a lay-by allows a tire change (*Retrieved June 28, 2014. Scheve, N. and T. Scheve. n.d. Purchasing the right horse trailer: From the horse's point of view. www.bayequest.com/static/trailers1.htm*).

29.3 Recommendations

Axles shall be both welded and bolted to the frame.

Axles shall have maximum vibration dampening and minimum noise in operation.

On aluminum trailers, axles shall be protected from catalytic action where they are attached to the frame (*Retrieved June 28, 2014 http://www.equispirit.com/info/articles/safetychecks.htm*).

Axle mountings shall be sufficient to keep the torsion bar axles from rotating out of their mounts (*Retrieved June 28, 2014.* *http://www.dangeroustrailers.org/Axle_Came_Flying_Off.html*).

30 Hitches

30.1 Hitch Failure Points

Hitches are rated by towing capacity and weight capacity: the weight it is capable of towing and the weight it is capable of bearing on the hitch or tongue.

Hitches fail due to a mismatch between ball and coupler; overloading; insecure attachment; failure of backup such as a hitch pin being forgotten or rusted; the hitch receiver failing, possibly due to poor welds or underrated bolts (*Retrieved October 20, 2014. http://www.titantalk.com/forums/titan-towing-hauling/149960-new-hitch-failure-another-one.html*); equalizer hitch components buckling even when rated for the load (Retrieved October 20, 2014. *http://www.tundrasolutions.com/forums/towing/197856-equal-i-zer-hitch-failure/*); and factory-installed hitches missing crucial components; or users overloading the hitch (*Retrieved October 20, 2014. http://dangeroustrailersaccidentsthatjust.blogspot.ca/2009/02/broken-hitch-almost-sends-trailer.html*).

Removable hitches have lead to failure when users or dealers were not notified of their limitations or of necessary upgrades.

Fig. 30.1: Hitch failure (separation of the frame of the nose of the trailer from the body of the trailer) caused this overturn, leaving the horses unprotected and injured. The construction of this trailer is cheap in every way.

Fig. 30.2: This two-horse trailer was sent careening when the detachable (not bolted to the tow vehicle frame) tow bar failed. Numerous reports of this type of hitch failure have demolished horse and pony trailers.

Fig. 30.3: The two-horse trailer, crashed with two horses aboard when the detachable tow bar came loose, is recovered as a write-off. Gratifyingly, the show horses survived the incident.

Fig. 30.4: The detachable tow bar in question was assured by the dealer as appropriate for a horse trailer and fitted for that purpose. Other dealers dispute the appropriateness, showing the need for an inarguable standard.

30.2 Tow-ball

Tow balls come in standard sizes but though a vital part of a hitch, are not standardized for size and strength. They may not be matched in performance with the hitch or load.

Hitch pins, meant to retain the ball mount in the receiver, can also fail when rusted, undersized, or insecure. In one instance, the unloaded hitch became air borne, bounding into following traffic and the car (see Fig. 30.5) when a rusted hitch pin failed.

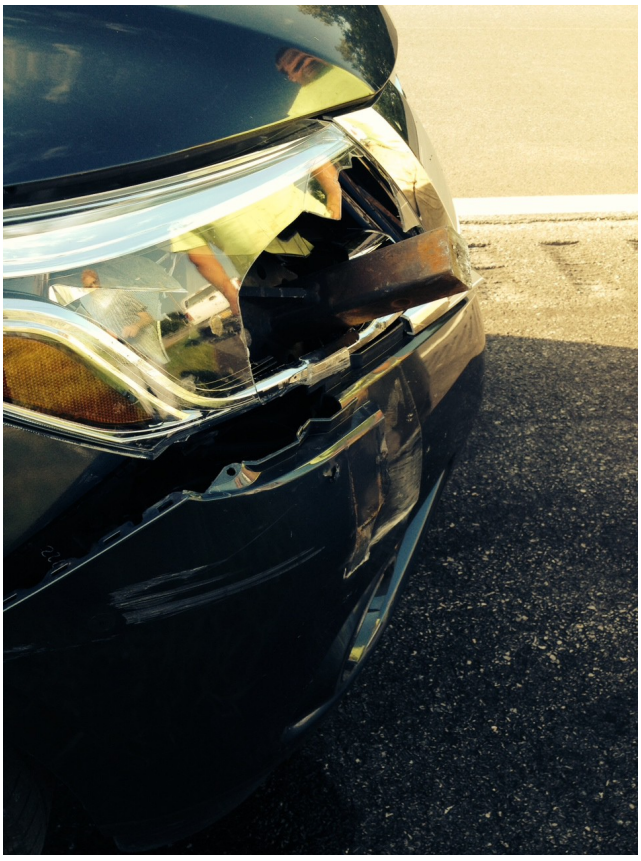

Fig. 30.5: A rusted hitch pin sent the unladen hitch pin bounding into high speed traffic and into the grill of this car.

Hitch component parts, such as the R-pin or cotter pin, rarely have a back-up in case of failure. A locking pin is suggested by this committee to always be used (*Retrieved April 8, 2014. http://www.an-eventful-life.com.au/eventing-news/tale-about-towing*).

Equalizer bars, meant to level the load and reduce sway, can also contribute to hitch failure. (*Retrieved December 9, 2014. http://caravansplus.com.au/catalog/product_info.php?products_id=10958&osCsid=71j1b8he52hneq6gqgecuvtes6*). They may be a symptom of a too-small tow vehicle for the trailer. But one equalizer bar component failure forced the stock trailer to travel sideways down four lanes of Interstate 95 in the USA, coming to a stop on its side (*Lichtenstein, I. May 4, 2012. Pers. corr.*).

Some hitch designs, either the original or a re-purposed hitch, do not protect the gas tank of the towing vehicle from rear-impact fire hazards.

Dealers may be confused about what constitutes a hitch rating for what purpose and part of the towing package. No training package related to trailer ratings for dealers is available. Thus, erroneous and dangerous advice is commonly given to purchasers (*Scheve, T. and N. K. Scheve. n.d. EquiSpirit trailer terms*).

Hitch failure has also been known to cause a fire when sparks from the grounded hitch fly to ignite brush and grass.

As live weight movement within a trailer will stress a hitch more than rock-steady dead weight, it is especially crucial that horsemen get properly hitched from the start.

Fig. 30.6: Hitch failure sent this trailer rolling down an embankment. Two horses are inside. One is safely extricated but the other, in attempting to stand, goes through the side panel and is trapped.

30.3 Recommendations

Vehicles towing trailers must have a hitch meeting Society of Automotive Engineers strength ratings to match or exceed the gross vehicle weight rating of the trailer under tow (*Copeland, L. July 6, 2010. State laws target safety of towed trailers. USA Today*).

Society of Automotive Engineers specifications J684 for hitches, chains, and couplings have been reviewed and are currently affirmed (*Retrieved June 28, 2014. http://standards.sae.org/j684_200507/*).

Hitch components of ball and hitch must be compatibly rated to the same tonnage, equal to hauling the maximum gross vehicle weight rating of the trailer. The evaluations should include the speculated weight of additional tack, water, hay, and other convenience items in the "tack room" of a trailer (at least an additional 750 lbs [300 kilos]).

Trailers with living quarters should have a fudge factor of at least 1,500 lbs, the equivalent of another horse, for these items in the gross vehicle weight of the trailer. This additional weight is usually positioned in front of the axles, changing the tongue weight of the trailer.

The hitch shall accommodate the movement and storage of both the live- and dead-weight cargo by retaining the fluctuating tongue weight within the range limits established by stability testing.

Particular attention shall be given to the ball shank, which determines the hitch point strength.

31 Suspension

31.1 Tipping Points

Suspension and stability are dependent upon the tow vehicle's suspension, tires of both tow vehicle and trailer, driver control, cross wind speed, load placement and shift, and axle length.

A capsizing trailer can also cause the tow vehicle to capsize, even at slow speeds.

Attempts to cause experimental capsizes with a well-maintained and equipped tow vehicle and trailer are difficult. With proper hitching, towing, and suspension, the 5-percent tip that contributes to sway is elusive. The experiments indicated that driver contribution to capsizes in such incidents is fundamental (*R. Gimenez, July 2014. Pers. corr.*).

Fig. 31.1: Righting capsized trailers requires knowledge of how they balance and can be controlled without continuing to roll in a 180 degree flip. Usually animals are extricated before the capsized trailer is righted.

Fig. 31.2: Two horses survived this crash with minor injuries. The trailer remained fully intact. Note the leg wraps on the tailgate which undoubtedly prevented further injury.

Fig. 31.3: A mismatch between trailer and tow vehicle caused this overturn. The owner insisted on the correctness of the rig. Note the plywood fore floor which would not support a horse, and the unprotected wiring.

Fig. 31.4: Sway and a loss of control sent this detached trailer flipping three times.

Fig. 31.5: Stock trailers and trucks are especially susceptible to tipping on roundabouts, even at slow speeds. This stock trailer was carrying sheep.

31.2 Recommendations

Suspension systems shall meet the minimum threshold for roll over as defined by a live weight loaded-to-capacity trailer circling a specified diameter at speed with the intended tow vehicle.

Live weight testing should emulate the balancing efforts and effect of a horse in the trailer. A weighted gimbal and balancing arm may have to be used for testing rear facing trailers where

the horse's heaviest weight is placed between the axles and remains there during braking maneuvers.

Tests shall rate the trailer to incrementally higher standards for negotiating a circle at increasing speeds without overturning, swaying, or otherwise destroying the trailer.

32 Safety Chains and Vehicle Disengagement

32.1 Chained and Unchained

On average, 440 people die annually in the USA due to trailers becoming detached. 17,085 were killed between 1975 and 2013 with over 320,000 injured out of 1.264 million trailer crashes (*Milazzo, J. n.d. Citing National Center for Statistics and Analysis in: Safe-Tow: Patented life-saving technology, n.p. [Milazzo was the 2001 winner of the annual Occupational Safety and Health innovator award]* and *R. Melancon citing unpublished Annual Report File. National Center for Statistics and Analysis*).

Safety chains' use come with many caveats. Intended to prevent the separation of tow vehicle and trailer in the event of hitch failure, they can start fires when dragged and sparking (*www.preventwildfireca.org*). They may also contribute to loss of vehicle control.

In the USA, safety chain usage is controlled by each state. Some states do not mandate the use of safety chains.

The uncoupled trailer, secured only by the safety chains to the tow vehicle, can get into a violent left-right swaying movement with an incorrectly matched tow vehicle. Vehicle and trailer overturn as a result depending on speed, road conditions, type of trailer, load, length of chains, and vehicle model. Other unidentified factors may also come into play.

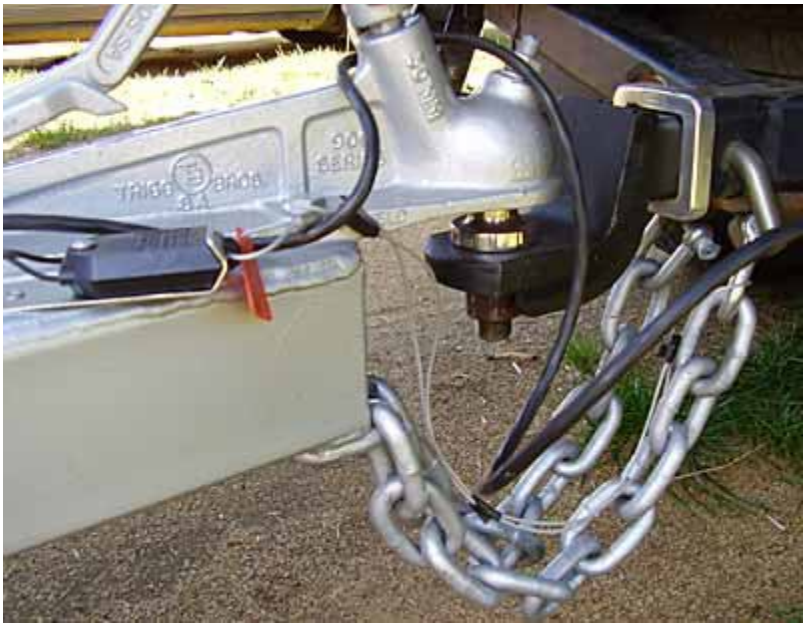

Fig. 32.1: Heavy chains help guard against complete separation of the trailer from the tow vehicle but do not offer directional control. Chains must be maintained, and should be correctly attached to both the tow vehicle and trailer. While it is illegal to improperly hitch a trailer, hitch parts are not standardized for non-commercial use. Components may be recommended by guess-and-by-gosh and "nobody ever complained" at a dealership. It is always worthwhile to consult a trusted, certified mechanic who takes a keen, searching interest in these things or a dedicated professional association.

Safety chains have been implicated in tow vehicle rollovers. The swaying action of the trailer transfers to the tow vehicle through the chains and draw bar (*Retrieved June 28, 2014. http://www.youtube.com/watch?v=MTBKdyzQafA*). If the tow vehicle is positioned or displaced

sideways of its trajectory, there is a great chance the tow vehicle will flip, even at low speeds, especially if it is a four-wheel drive sports-utility–type vehicle with its higher center of gravity.

Fig. 32.2: An unsuitable tow vehicle together with a soft suspension can lead to loss of control of the rig. Sway bars are said to be unnecessary if the rig and trailer are properly matched, but very high wind conditions could mandate their use.

Aware of the potential of "going down with the ship," some haulers use duck tape to attach the chains and to appear legal instead of doing the proper thing which is to attach the trailer to a larger tow vehicle (*Retrieved April 15, 2014. http://www.mlive.com/news/grand-rapids/index.ssf/2010/04/rockford_man_who_secured_trail.html*).

A device that maintains a permanent link with the trailer would be unpopular with drivers seeking to detach from an out-of-control trailer.

32.2 Ratings and Remedies

Chains are difficult to maintain. The open links allow the use of unreliable C-links and S-hooks for securing. These may not match the rating of the chains that themselves should be rated (*Retrieved April 8, 2013. Connect, K. Aug 14, 2012. http://www.fireengineering.com/topics/m/video/61092303/heavy-wrecker-use-in-vehicle-extrication.htm*).

Should chains fail, some rigs depend on on-board batteries to lock up the brakes. These batteries are often not charged enough to run lights and are never inspected. On disengaging from the vehicle when under tow, a mechanical emergency brake on the trailer should be provided.

Fig. 32.3: An SUV pulling four horses flipped numerous times near Baltimore, ejecting one horse, leaving the remaining three to escape on their own, one of which ran into the traffic before being caught.

Even the most conscientious inspection of a hitch before towing can overlook some hidden defect in the process with tragic results (*Retrieved June 29, 2014.* *http://www.reporterherald.com/ci_19658602*).

Concerned about the deaths and injuries caused by unstable connections between tow vehicle and trailer, the Louisiana State Senate has taken action. A bill, SLS 14RS SB 127 would mandate devices to afford directional stability and control and prevent the trailer tongue from dropping to the ground should the trailer become unhitched while on the highway. (*Retrieved April 8, 2013. Safe Tow product demonstration: http://www.youtube.com/watch?v=V2-gSwnqo3A and http://www.legis.la.gov/legis/ViewDocument.aspx?d=875283* and *http://www.legis.la.gov/legis/ViewDocument.aspx?d=875283*).

The National Association of Trailer Manufacturers has developed a static and dynamic pull-failure test for safety chains.

Together with the Society of Automotive Engineers (SAE), the NATM solicited proposals for upgrading SAE J684 standards on hitches and safety chains intended for trailers 4,540 kg or 10,000 pounds gross vehicle weight rating. The SAE J684 rating is now (2014) current.

32.3 Recommendations

Strength and specifications are offered in SAE J684 trailer couplings, hitches, and safety chains. These specifications should be followed.

Safety chains shall be rated equal to or greater than twice the maximum gross trailer weight rating.

Safety chains shall be fastened to the frame of the vehicle. If the chains are used on a unibody vehicle, they must be attached to reinforced attachment points.

Safety chains may be fastened to a hitch that has holes or loops specifically for that purpose.

Safety chains with a certified rating tag for dynamic (jerk) pull shall be used.

A tested device to keep the trailer hitched to the tow vehicle in the event of collision, separation from the ball, or overturn may be used in place of safety chains.

Safety chains may not be attached to the tow vehicle or trailer by welding.

Safety chains or any anti-breakaway device shall have a backup system of a mechanically activated breakaway brake. This brake shall have the means to stop the trailer while the trailer is connected to the tow vehicle. It shall not be dependent on external power sources to stop the detached trailer in either inclined or declined circumstances.

33 Wiring

33.1 Prevalence of Poor Wiring

Mark Cole, retired USRider insurance managing member, reported that in the company's inspection of numerous trailers, including new ones, the company had yet to see a trailer with good wiring practices. Every trailer had multiple wiring issues (*Usrider.org Feb 9, 2006. USRider calls for improvements on trailer wiring*).

Wiring deficiencies identified by USRider insurance include:

- Contact with sharp metal edges
- Improper materials used to secure wires
- Wires fastened to trailer flooring with minimal or no use of protective tubing
- Underrated or incorrect wiring
- Poor routing
- Easily dislodged or disconnected with the lightest movement

In addition to the deficiencies noted above, this committee found that some manufacturers conceal poor wiring practices (*MacDonald, B. July 10, 2012. Pers. corr*.).

Poor wiring practices may affect the metal parts of the trailer, giving the horse or human a disturbing, or sometimes lethal, shock.

Unprotected wiring, typically run beneath the flooring and exposed to moisture and road debris, can be disabled by tire blowouts.

Fig. 33.1: These two entwined wires almost escaped discovery. Located in the wheel area, they will almost certainly short at some point from moisture and debris.

Fig. 33.2: The trailer owner has wrapped this wire with electrical tape to try to prevent moisture damage. Located between the trailer wheels, it could still be caught in a horse's pawing hoof.

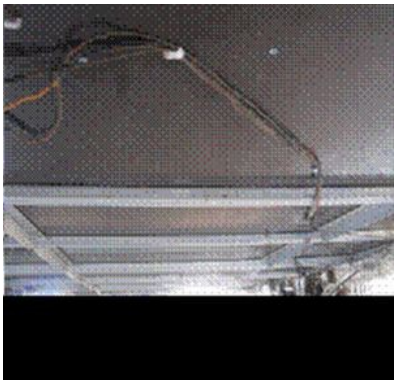

Fig. 33.3: Brake and light wires are exposed to the elements and debris by running them beneath the trailer. This is a common practice in the trailer industry.

Signal, brake, and running or clearance lights are affected, making the need for reflective tape and lenses all the more crucial.

Military specifications have offered the most dependable trailer wiring in the experience of one commercial horse transporter (*Matthews, R. Pers. corr.*), though military specifications are objected to by some manufacturers as "too expensive."

Ambulance standard wiring, a two wire system with an all common ground and no ground to the frame, is used in some instances (*Sigurdson, J., 2012. Aero-Equis Ultimate RF specifications*).

33.2 Recommendations

The voltage and current loading of lighting and electrical components shall not exceed the rating of the cable and connectors.

Connections must be a gas-tight (no vapor can get in) between wire and connector.

Wiring shall meet or exceed the load of the circuit. Wiring shall be capable of carrying the load in any one of the electrical circuits.

Wires run on the exterior of the trailer must be secured or cleated a minimum of every foot or 600 mm along its length and protected from road debris and water collecting in connectors.

Connections and connectors must be visible for inspection.

Wiring must be insulated at joints and all wiring protected from chafing.

Wiring must be soldered and heat shrink-wrapped to minimize damage from dampness and dust.

Wiring must be wholly protected from the actions of the horse by being run between trailer panels, preferably in metal conduit.

Wiring must have an earth return wire between the trailer and its hauling vehicle. It is not acceptable to use the trailer coupling or a safety chain or cable as an earth.

Australian government-mandated technical requirements for trailers refer to additional wiring practices in its ADR 62/01 (*Retrieved July 3, 2012.* *https://www.infrastructure.gov.au/roads/vehicle_regulation/bulletin/vsb1/vsb_01_b.aspx*).

Ambulance standard wiring should be considered as one of the more reliable systems.

Military standards for wiring may be considered by high-end trailers or offered as an option.

34 Lighting

34.1 Limitations

Trailer lighting is subjected to dust penetration and lenses breaking from equipment, road debris, or other impact.

Bottom-mounted signal lamps, such as on stock trailers, are out of the primary focal range by approaching or following drivers. Skin curvature on trailers sometimes bounces lighting upward, limiting intensity (*Retrieved September 18, 2014. Lamm, W. TLAER Facebook*).

34.2 Recommendations for Exterior Lighting

Lamps should be dust resistant.

Lamp lenses should be protected from impact.

LED lighting, signal, 4-way flashers and clearance lights are recommended.

Two color lights initiate faster traffic response than single color and should be used where possible. (*Retrieved September 18, 2014. Lamm, W. TLAER Facebook*).

34.3 Recommendations for Interior Lighting

Interior lights must be protected from a head or hoof strike by the horse.

It should be bright enough to allow a visual inspection for the horse's welfare, such as sweating, bleeding, nasal discharge, and tension in the flank, mouth, ears or large muscles.

35 Reflective Tape

35.1 Effective Reflective

Neither a white trailer or working tail and clearance lights afford adequate detection in low visibility conditions *(Retrieved August 11, 2013. https://www.youtube.com/watch?v=tFy37XurQpE&layer_token=dcc757283ac8918f*)

Fig. 35.1: A professional Technical Large Animal Emergency Rescue instructor owns this personal two horse trailer and has maximized its conspicuity markings. Note that even though it is a white trailer, the white is not visible in the dark when lit by following headlights.

Reflective material is a necessary adjunct to tail and running lights, offering added security in the event of a sudden lighting failure which is extremely common due to the poor wiring practices as detailed in Chapter 33. (*View demonstrations of nighttime and daylight conditions with and without lights or reflective tape [Retrieved September 9, 2014. Do Make A Difference at Night: www.cautionhorses.com]*).

Florida and Pennsylvania police investigating 10,596 highway crashes noted that reflective tape reduced collisions by 29 percent in dark and unlit, dark and lit, dusk and dawn conditions. Side and rear collisions were reduced by 41 percent and injuries to the driver of any vehicle by 44 percent (*Retrieved June 19, 2014. http://www.nhtsa.gov/cars/rules/regrev/evaluate/809222.html*).

In the Gimenez on-going study of trailer wrecks, poor or non-existent reflective tape contributed to accidents, particularly in being rear-ended or side-impacted by other vehicles while the trailer was turning.

Even in good lighting conditions, reflective material increases the safety of all road users. Generous and well-placed reflective tape helps motorists determine width, speed, and closing distance to the trailer (*Retrieved September 17, 2014. Lamm, W. TLAER Facebook*).

Trailers over 10,000 lbs are federally mandated by the USA to have a reflective stripe at the bottom and sides, a reflective patch or strip half way up on both back doors or ramp, and at the top, constituting a minimum of 10 percent of the available area (*Gimenez, R. April 14, 2014. Pers. corr.*). Smaller trailers (most horse trailers are rated at less than 10,000 pounds) have no requirements for reflectivity (*Retrieved September 21, 2014. http://infozing.com/reflective/federal-dot-reflective-tape-requirements-for-trucks-and-tractor-trailers/*).

Although the federal mandate meets minimum standards for larger trailers, it may not be enough to alert drivers who are distracted, cannot make the connection between the thin reflected outline and the size of the mass ahead, or are impaired by fog, smoke, rain, snow, or blowing snow (*NTSB/HAR-83/4. 1984. Multiple vehicle collisions and fires under limited visibility conditions, Interstate Route 75 Ocala, February 28, 1983*).

Reflective material placement well above the minimum is advisable (*Retrieved June 28, 2014. www.tc.gc.ca/eng/motorvehiclesafety/tp-tp13136-tr108-846.htm#lighting*). The National Association of Trailer Manufacturers recommends rear, side, and front reflectors on its trailers. Trailers over 80 inches wide also require additional rear and front clearance lamps (*Moore, R. Pers. corr. February 13, 2014*).

Fig. 35.2: This police horse van illustrates good reflective rear coverage.

Standards for reflective material on horse trailers to increase their visibility to other drivers could be drawn from standards already established for emergency vehicles. Placement, both high and low, is crucial.

Fig. 35.3: Despite a white top half, this trailer remains invisible at dusk.

Fig 35.4: With added reflective tape, the trailer in Fig. 35.3 is now conspicuous even by a camera flash.

Fig 35.5: Reflective tape added to the upper sides and top of the trailer increase its chances of being detected by vehicles behind an immediately following vehicle.

Additional tape for the inside of the doors and exposed ramp edges is also advisable. If doors or ramps have to be opened on a roadway at night, this reflectivity warns drivers of the widened or lengthened profile of the trailer (*Retrieved October 25, 2014. Rear Clearance Lamps, Rear Identification Lamps, and Front Clearance Lamps. Chart http://www.nhtsa.gov/cars/rules/standards/conspicuity/Trlrpstr.html and Retrieved October 24, 2014 https://www.usfa.fema.gov/downloads/pdf/publications/fa_323.pdf*).

35.2 Caveat

As the body tends to go where the eye goes, there are concerns that reflective material can hold the following driver's eyes without directing the driver away from the vehicle. Police and other emergency vehicles are struck even with all lights and reflective tape in order.

To lessen the chance of this happening, trailers that must park in a traffic area might consider the use of a strobe light. The pulsating strobes are uncomfortable to fixate upon, directing driver's eyes toward an escape opening away from the vehicle so outfitted.

However, horses should not be exposed to a strobe light.

35.3 Recommendations

Reflective material should be applied to a minimum of one quarter of the trailer's exposed rear to offer an earlier alert to following traffic and a greater psychological barrier.

Reflective material should be applied to an area at least half-way or further up the rear to avoid blocking it by an immediately following vehicle.

Trailer sides should be similarly outlined with appropriate colored reflective tape indicating a side-on obstacle both top and bottom.

36 Maintenance

36.1 Responsibility

Non-commercial trailer owners are notorious for neglecting maintenance. This can be due to the inaccessibility or awkwardness of the areas to be maintained; unquestioning acceptance of dealers' recommendations about the permanency of their product; ignorance of chemical reactions between two different but contingent metals; or not realizing the effect weather, humidity, and temperature have on a trailer even when stored or unused.

Fig. 36.1: Bearings too small for the load or wheel or not replaced with fresh grease on a regular basis whether or not the trailer is used, cause wheel failure and sometimes fires.

Fig. 36.2: Ramp hinges are notorious for failure. Covered by ramp skin or exposed, they collect urine, feces, and damp. Heavy matting discourages frequent removal for cleaning, drying, and inspection after each trip.

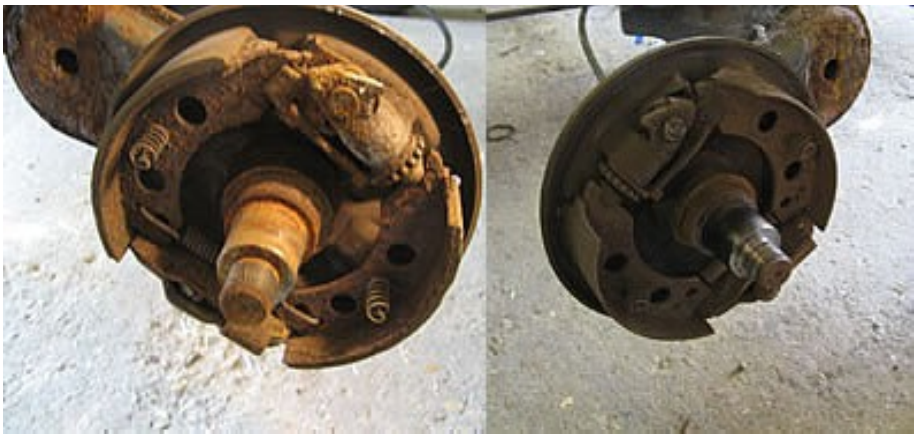

Fig. 36.3: Typical of poor trailer maintenance are inoperative, corroded, worn or poorly adjusted brakes. Haulers should be schooled in inspecting and adjusting brakes to the load.

36.2 Making Maintenance Easier

Maintenance routines recommended by manufacturers are not necessarily the provenance of this committee. However, two maintenance guides are noted for their detailed approach to helping purchasers look after their trailer, understand something of how trailers behave under tow, the dangers of equipment misuse, the effect of transport on horses, and the causes of trailer accidents.

The complimentary Hart horse trailer users manual and the commercially available EquiSpirit guide to buying and using a trailer detail many of the concerns and responsibilities (*Retrieved May 24, 2014.* *http://www.harttrailer.com/sites/www.harttrailer.com/files/Hart_Trailer_llc_users_manual.pdf* and *http://www.thehorse.com/articles/16773/trailer-maintenance-right-on-schedule* and *N. and T. Scheve. 1998. The Complete Guide to Buying, Maintaining and Servicing a Horse Trailer. New York: Howell Book House*).

36.3 Air Freight

Maintenance issues such as fasteners, flooring, and structural support could look to airline industry standards applied to flight stables. No airline can afford a mid-air incident due to overlooked maintenance or less-than-ideal and compatible materials.

36.4 Recommendations

Adopting standards that make all materials resistant to urine, feces, water, salt water corrosion and oxidation for a minimum of 5 years will simplify maintenance.

All structural elements shall be visible for inspection without dismantling.

Original factory and residual strengths should be verifiable with a visual, instrumented, or other means as appropriate to the part being inspected.

37 Conformity Assessment

37.1 Varying Expectations

Many components of a trailer, such as the protection of wiring, the impenetrability of trailer skins, the capability of the trailer to confine live cargo in an incident, are not legislated or regulated anywhere.

Others, like licensing, safety chains and lighting, may have varying or no requirements depending on the jurisdiction or trailer weight (Retrieved September 20, 2013. *http://drivinglaws.aaa.com/laws/trailer-hitch-signals/*).

Fig. 37.1: Two horses were in this trailer which came unhitched and rolled down an embankment. The large animal rescue team managed to extricate one but the second, on attempting to stand, went through the trailer skin.

In other areas, laws mandating trailer brakes vary between states and provinces.

This situation leaves the trailer user either in ignorance or "best guessing" as to what is appropriate or safe. Perusal of numerous blogs, group email chats and Facebook postings has indicated a wide variation of knowledge and understanding.

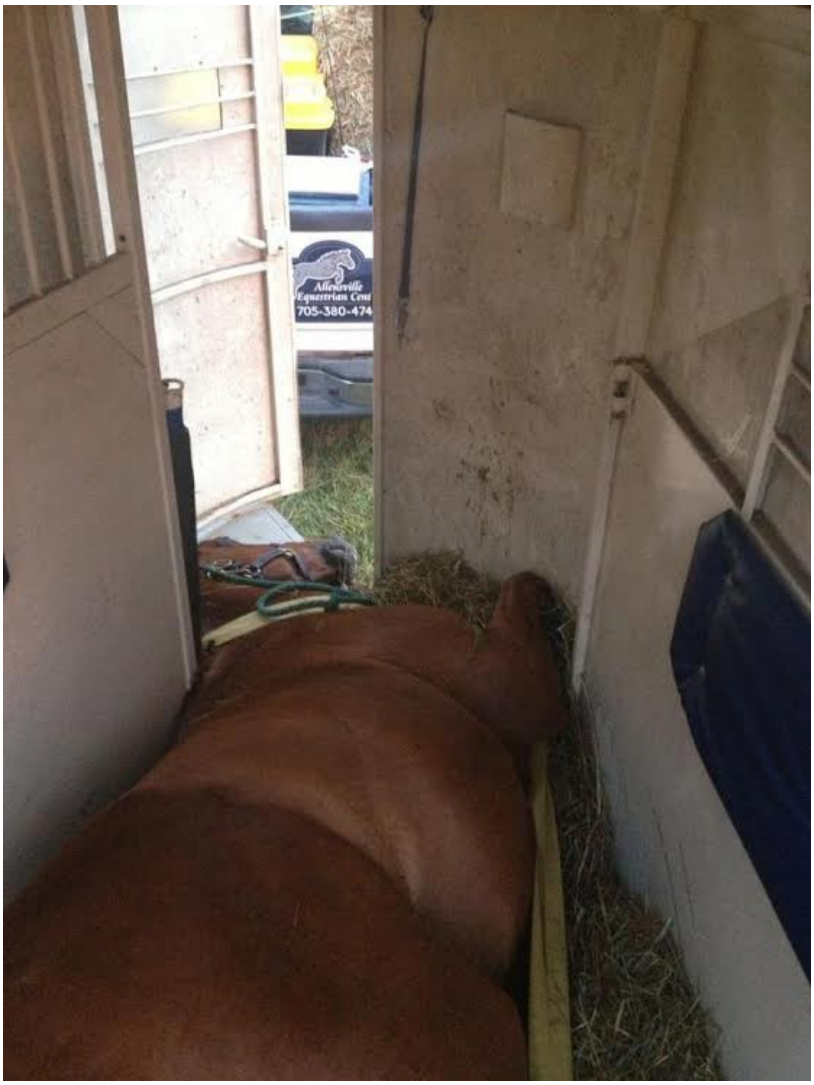

Fig. 37.2: Panicked in the narrow confines of an inline trailer — horses transported one behind the other — this horse awaits rescue, if alive, or recovery, if dead.

37.2 Highway Testing

To test the suitability of the trailer for highway conditions, the trailer should pass a braking standard while weighted to its maximum capacity towed by the vehicle with which it is regularly used or intended to be used.

The safety and security of the live cargo during braking, avoidance, or other highway maneuvers, such as negotiating round-abouts, should also be assessed and rated.

Fig. 37.3: A truck with a horse trailer lost control, ramming into another truck slowing or stopped for a stalled car, pushing the truck into an 18-wheeler. Three horses of the five horses aboard and one man died. The wreck shut down I-71 for four and half hours.

37.3 Roles and Results of Conformity Testing

New standards and their accompanying inspection points for safety-related components increase the likelihood of trailer owners maintaining their trailer to safer standards.

New standards give motor vehicle inspectors and mechanics room to advise the trailer owner on deteriorating quality beyond lights and brakes.

The National Association of Trailer Manufacturers, with about 750 members internationally, is well positioned to conduct conformity assessment for new standards.

37.4 Recommendations

A conformity assessment should be considered for each of the components requiring new standards and for those components currently standard but requiring modification to suit a live cargo. Conformity assessment is urged for the areas including but not limited to:

- Axles
- Axle attachments
- Frame bows
- Braking set up (in relation to live weight)
- Break-away brake cables or provisions
- Breast, chest, and butt bars
- Cargo (live) provision for confinement during an incident
- Cargo (live) placement in relation to axles

- Chassis
- Crash worthiness
- Cross members
- Egress (for horses and for people – TWO exits are urged by first responders)
- Fasteners and latches
- Flooring durability
- Framing
- Hazard reduction in confined areas
- Highway testing
- Inspection points or guidelines to check for wear, corrosion, leaks concerning wheels, flooring, frame, chassis, hitch, lights, brakes, ramps, doors, main body
- Insulation from road noise and heat (from road heat or sun shining onto trailer)
- Outer skin durability
- Partitions, gates, and doors
- Ramps
- Reflective material and placement
- Safety chains and fasteners
- Stability with the intended load aboard
- Structural components
- Tie rings
- Tires
- Tow bar attachment and durability
- Ventilation
- Wheel assembly
- Window guards
- Wiring and protection from road debris, moisture, and shorting

38 Trial and Triumph

38.1 Trial: The Human Factors

Establishing horse transport manufacturing, maintenance and usage standards will (like safety helmets) prevent or mitigate not all, but many, deaths and injuries.

Fig. 38.1: Control is rarely recovered when essential equipment is not up to the work, weight, or speed or not maintained. Powered ramps and doors should have a manual override in the event of power failure.

Fig. 38.2: This horse was rescued with severe burns to its head and forequarters. Rescuers took their lives in their hands to get to its head and cut it loose.

The always-explosive nature of the horse contrasts with predictable human inertia.

Fig. 38.3: "Mr. Lomandy" unloads from his air crate. He may have been irritated by a slipping leg wrap.

In meeting the goal of trailer standards, one can expect to deal with a horse culture wedded to dubious practices. The reasons are similar to the sport or construction sectors' initial objections to helmet use or the objections to seat belts, despite urgings by insurance companies and at least one short-lived automotive manufacturer. If the current practices are believed or seen to work, they are considered right even though the obvious safety and welfare of both horse and handler is at risk.

Fig. 38.4: Deceptively clear winter roads can tempt higher than safe speeds or wreck the best equipment on hidden black ice. Strong trailers and meticulously prepared equipment matched to conditions are necessary under every road condition to protect the horses and handlers.

Studies have shown that the "continuation bias" of the horse culture is based on anthropomorphism, peer practices, economics, and a distrust of scientific inquiry.

Many private transporters persist in favouring prescriptive add-ons such as tranquilizers, or painful "loading" harnesses and "loading" halters.

Assuming, as some cultures do, that children are not quite human, anthropomorphism is evident in the objection to seating children facing away from the direction of travel in school buses and in the back seats of passenger vehicles. Although the younger children readily accepted the practice, the adults were vociferous in their condemnation. This was despite studies showing that the children were safer, increasing their survivability and reducing injuries. The adult objection was based on learned behavior (*Transport Canada. 1998. School Bus Collision Summary: Canada, 1989-1997. T.P. 13412 E, p. 8*).

Similarly, anthropomorphism plays a role in objections to changes in familiar transport practices. Automotive dynamics and the horse's unique balance requirements are overlooked because the horse handler likes to face the direction of travel so "why wouldn't my horse?"

"Dominionism," as defined by Yale professor Stephen Kellert in a study commissioned by the USA Fish and Wildlife Service, also plays a role. Dominionism seeks satisfaction in the mastery over animals or weaker subjects.

It enhances the cowboy image of livestock handlers who prefer the showy performance of putting out fires rather than pursuing low-key handling techniques. Unless there is overwhelming evidence of a monetary profit to be made in a change, they prefer to project an image of facing danger unprotected (*Retrieved June 29, 2014. Curt Pate. Stockmanship and Stewardship: Programs for cattlemen. http://curtpatestockmanship.com/2014/02/06/video-2014-cattlemens-college-stockmanship-stewardship-demo/*).

This attitude pervades the horse culture. It makes the introduction of empathic approaches to riding or handling difficult or recasts some familiar aversive methods as "natural".

At least 70 percent of people with horses readily blame the horse rather than their own incompetence for transport incidents. Remedies are frequently sought in prescriptives e.g., sedatives or head-pinching halters or electric shock or further training, often aversive (*Waran, N. and H. Randle. 2013 August 25. Advancing evidence based practices and learning in equitation. International Society for Equitation Science*).

For these people, the familiar and socially acceptable feels right and the correct feels weird or wrong even where the benefits of change or better quality are clearly demonstrated (*Retrieved April 12, 2014. Riding with the mind: Part 4. www.mary-wanless.com*).

Integrated observations to apply to problem solving are also scarce. Emergency responders familiar with livestock behavior report that trainees do not comprehend how handling, animal behavior and automotive dynamics contribute to incident causes. This is true even with those formally trained in hauling livestock (*Leighton, M., Let me count the ways. Retrieved Sept 20, 2014. www.equineER.com*).

Recognition that many horse people cannot read even basic equine distress signals led to the founding of the International Society for Equitation Science. The ISES investigates fad training approaches and introduces rational techniques based on scientific investigation (*Bussires, G., C. Jacques, O. Lainay, et al. 2008. Development of a composite orthopaedic pain scale in horses. Research in Veterinary Science 85:2, pp. 294-306*, and *Roberts. J. 2014. Australian Broadcasting Corp. interview. Retrieved April 30, 2014 http://www.abc.net.au/news/2014-04-21/horse-stress-ghetto/5377674* and *Lesimple, C. and M. Hausberger 2014. How accurate are we at assessing others' well-being? The example of welfare assessment in horses. Frontiers in Psychology 5:21*).

The educational approach is constrained by economics and complacency, even when skills and equipment are vital to success. Educational events emphasizing transport safety, injury, and accident prevention were poorly attended at the annual international Equitana, which attracts hundreds of thousands of potential buyers. Rescue gear of impeccable quality and standards was dismissed by some large-animal emergency rescue squads in favor of cheaply made, poorly designed, less reliable, and untested counterfeits.

Stock death or injury risk is sometimes preferred over the perceived expense of improvements. The American Veterinary Medical Association (AVMA) policy on humane equine transport found that more horses suffer injuries during transport in double-decked trailers than in straight decked. When the AVMA urged straight-deck transports, it faced vigorous opposition from manufacturers, rodeo stock, and slaughter horse transporters. This was true even when the safety of humans and animals was manifestly improved (*Johnson, C. 2013. Understanding Animal Welfare Assessment and the American Veterinary Medicine Association's Updated Polices on Transportation. Animal Transportation Association Webinar. Nov. 12*).

Clinicians charge hundreds and thousands of dollars to train horses to load and unload. Typical courses may require hours or weeks. Yet, this economic sector may not be current with behavioral principles. Even where they are, much time is spent in educating the horse owner on the optimum relationship (which varies from Boss, to Leader, to Companion-Protector depending on the clinician's training philosophy) between horse and handler before accomplishing a goal (*Ferguson, D.L. and J. Rosales-Ruiz. 2001. Loading the problem loader: the effects of target training Jl. of Applied Behavior Analysis 34:4, 409-424*).

Fig. 38.4: A typical display of resistance endangers the handler and horse. Horses must be introduced sympathetically to entering a trailer. In conventional transport facing the direction of travel, the horse must be trained to reverse to unload on to various ground conditions.

With few exceptions, the manufacturing sector is not equipped to educate the buyer, keep current with scientifically established behavioural principles, or investigate improved transport. Many of the requirements for balanced travel, for example, are ignored when there is no provision for the horse to use its head and neck to balance or maintain its weight over its forequarters.

38.1.1 The Science of Change

As with helmets, seatbelts, or smoking, a huge cultural shift may be required. If elite competitors aren't adopting best practices, hoi polloi will also see themselves as above the need to improve transport for their horses or demand better quality in their transport (*Miller, A. and M. Levin. Driving with rented risks. Retrieved June 29, 2014. http://www.latimes.com/news/nationworld/nation/la-na-haul24jun24,0,2743640.htmlstory#axzz2thtxIajD*).

Working through "continuation biases" fed by peers or accepted practices has been dealt with by employing "choice architecture." The approach identifies and meets objections with suitable evidence (*Retrieved April 16, 2014. http://en.wikipedia.org/wiki/List_of_cognitive_biases*).

Choice architecture addresses misconceptions like the one that considers it a waste of time to improve transport because it is "normal" for horses to fall in trailers (*Retrieved June 28, 2014. Jesse Silverwolf on https://www.youtube.com/watch?v=kUnWyaHmNIM*).

38.1.2 Change in Action

Robust change is achieved by working through a variety of animal welfare organizations, insurance companies, manufacturers, associations, engineering interests, associations related to each field, and government authorities.

Animal welfare and professional organizations such as the American Veterinary Medical Association, the Brooke Hospital for Animals, the American Horse Council, and professional horse haulers associations have already invested time to promote one or more aspects of horse transport safety.

The National Association of Trailer Manufacturers (NATM) instituted mandatory compliance audits of members' factories and products. On average, 410 of its 750 members are audited every 2 years by the NATM's Federal Motor Vehicle Safety Standards compliance director (*Moore, R. September 9, 2014. Pers. corr.*).

European non-government organizations pursuing safety and animal welfare involved highway police in training for infractions and identifying welfare issues (*Moffat, L., April 23,2014 Animal Transport Association Webinar Improvements achieved for animals by transport organizations cooperating instead of closing doors*).

The international Animal Transportation Association (ATA) has offered to create a forum on its website to air views and experiences to take to industry heads. The ATA requires a plan of action from the standards associations to take to the board (*Stennett, S. May 2, 2012. Pers. corr.*).

38.2 And Triumph

People who may not travel their horse more than 50 miles from its base may be indifferent as to the details of quality and safety. Having standards for the industry will improve what is available.

Horse-trailer buyers must be made aware of the choices. Most horse people want the best and safest, but have no central authority on the subject except personal experience. This experience often comes at a great cost when it is based on such dealer-manufacturer outlandish claims that it is safer for the horse to be ejected from the trailer (*Sigurdson, J. 2012. Putting information and technology into work for transport. 38th Animal Transportation Association Conference March 18-21, Vancouver, B.C.*).

Science and the experience of conscientious horse trailer manufacturers are solidly on the side of those seeking improved transport for horses.

Despite legislators' keenness to limit journey times for animals, science has demonstrated that this is a "red herring" avoidance of the issues. Reports from the field and research by Peter Kettlewell, Malcolm Mitchell and others including members of this committee indicates that journey time for an animal is not as important for the animals' welfare as the quality of the transport. The better the quality of transport and en route management, the greater the welfare of the animal. Quality transport can greatly reduce factors such as thermal stress even when the transport occurs outside prescribed or mandated time and temperature ranges (*Mitchell, M. 2012. Welfare of animals in transit. May 18-21. Vancouver. 38th Annual Conference Animal Transportation Association*).

Fig. 38.6: This six-horse rear-face air conditioned trailer transports dressage, race and polo ponies from various studs, farms, training sites, and ranches rear face. After 50,000 miles, there were no marks on the side-walls or partitions. Photo: J. O'Brien

Lack of full scientific certainty should not be used as a reason for postponing measures to mitigate transport hazards. Where there are obvious, accepted or newly observed conditions contributing to better horse handling, automotive dynamics or equipment that increase human or animal safety and welfare, the Precautionary Principle applies.

39 The Business Advantage

39.1 Building Common Ground

Agreed standards and training promote reliability, safety, and quality. These attributes contribute to economic activity and human and animal welfare. They benefit manufacturers, insurers, legislators, law enforcement, regulatory agencies, and the user (*Green, J. 2013. Safer animal rescue: The journey so far. International Large Animal Rescue Conference, Adelaide. Retrieved June 15, 2014.* http://www.youtube.com/watch?v=F7J1Umo8c2k&feature=youtu.be).

Approved standards assist rescue personnel and the tracking of accidents and incidents, allowing comparison with the past.

The key criteria are already in place for to establish standards.

- Conscientious manufacturers with concern for quality and safety.
- There is a proof of principle in previously established safety standards in the automotive industry.
- There is a proof of practice in the tested modes of transport that reduce dangers to horses and humans.
- Those currently involved internationally share a common language.
- The principles and practice are easily apprehended in any language.
- A robust number of agencies (insurance, manufacturers, veterinarians, medical doctors, trainers, highway safety agencies, legislators, and emergency crews) have a stake in supporting a successful outcome.

39.2 Protecting Business and Buyer

Agreed standards are a vital protection for both customer and manufacturer in the event of a lawsuit (*Retrieved February 10, 2014.* http://www.doubledtrailers.com/customer-files-lawsuit-against-a-horse-trailer-manufacturer-and-dealer-for-being-overweight.html). Without standards, under-rated components could legally implicate customer and manufacturer as being at fault for an incident involving, for example, a collision (*Whitford, F. et al. 2013. Truck, trailer, and hitch components: Making sure the numbers add up. Indiana: Purdue University, p. 7*).

Without standards, Canadian and USA manufacturers using quality materials and processes bear an unequal economic risk. Cheaply made trailers are dumped on the Canadian market with the resulting loss of business. In 1990 there were over 20 trailer manufacturers in Quebec. Today there are a half dozen or fewer (*Porlier, V. March 2, 2013. Pers. corr.*).

Clients are also ill-served when manufacturers or dealers refuse to detail materials, measurements, type of metal used, etc., expecting to sell better quality as an upgrade once the seller has a deposit (*Schell, J. Aug 26, 2014. Pers. corr.*).

Standards would relieve Canadian manufacturers from pressure by USA cost-saving practices. These include fudging the actual suspension and axle capacities on the manufacturer's

label, which has led some Canadian manufacturers to do the same (*Porlier, V. March 4, 2013 March 4. Pers. corr.*).

One Canadian trailer manufacturer has kept an illustrated log of safety and materials defects brought into its shop for maintenance or repair (*Retrieved September 12, 2014. https://www.facebook.com/media/set/?set=a.136877186385894.29195.107922682614678&type=3*).

Manufacturing practices, design, and materials can vary greatly within the same factory under the imprimatur of the same manufacturer. Establishing standards will increase confidence in a seller's product and its continent-wide accountability.

Standards would provide an informed basis for manufacturing, insurance, regulatory, animal welfare, and public interests to compare trailer quality and engineering. Currently, commercial pressures prevent valuable safety experience from being shared by those involved in materials and design.

Standards will encourage sharing of safer approaches and more effective practices. No longer would a trailer purchaser be fobbed off with sales pitches excusing a flimsy trailer as "safer if the horse is thrown from the trailer."

As in the European Union, the market is distorted because of failure to impose recall notices, both formal and voluntary, and the absence of monitoring devices to record and assess animal behaviour and health in transport. (*Retrieved November 30, 2011. EU Press Notice. Animal welfare: Protection during transport improved. http://europa.eu/rapid/press-release_IP-11-1330_en.htm*). Differences in regulatory standard, such as the 104 inches allowable trailer width in the states vs. the 102 inches maximum in Canada, also hinder design and trade.

As European Union commercial transport regulations improved, the overall quality of animal welfare improved because of better transport vehicles. The European Union animal welfare commission reported an increasing and knowledgeable awareness of the needs of animals.

39.3 Sharing Applications

Many of the standard outcomes proposed for non-commercial horse trailers have applications across a number of products, making these standards high level. Similar concepts, technical principles, and characteristics are shared. One example might be the HINO concept vehicle. Designed for human or cargo transport, its chassis deflects vehicular impact in a collision. With some modification, this feature could also be applicable to livestock and deadweight carriers.

By providing technical assistance to legislators and stakeholders, standards can promote, on an international level, Canada's concern for animal welfare (*Harris, T. January 20, 2012. Pers. corr.*).

39.4 Promoting Safety

Occupational Health and Safety: Confined Space personnel could assist in hazard identification, management and control of related hazards and risks associated with loading and unloading horses.

Standards provide the impetus for improvements in driver training and long-distance transport welfare and safety.

Existing minimum standards, such as those endorsed by the National Association of Trailer Manufacturers, can launch improved wheel reliability. Airline standards for horse boxes, although over-engineered for road transport, could serve as a template for manufacture and safety of materials. These standards were written to keep the horse confined to its conveyance during an accident or prevent the horse from becoming uncontrollable.

Improved transport practices will increase veterinary and medically favourable outcomes for animals and humans involved in stationary and moving incidents, or better, prevent them from occurring.

Authorities, following the example of European non-government organizations involved in animal welfare, could involve the highway police in training for infractions and identifying welfare issues (*Moffat, L., April 23,2014 ATA Webinar. Improvements achieved for animals by transport organizations – cooperating instead of closing doors*).

Standards override the commercial pressures that prevent valuable safety experience from being shared by those involved in materials and trailer design.

40 Conclusion

The type of conveyance is a critical factor in the health and safety of both horse and human. The horses' negative reactions to transport, many too subtle for some people with horses to recognize or are accepted as "normal," the nearly daily occurrence of horse trailer wrecks in North America and elsewhere, are an indication that we have to change what we do. What is being done is not enough.

Safety delayed is safety denied.

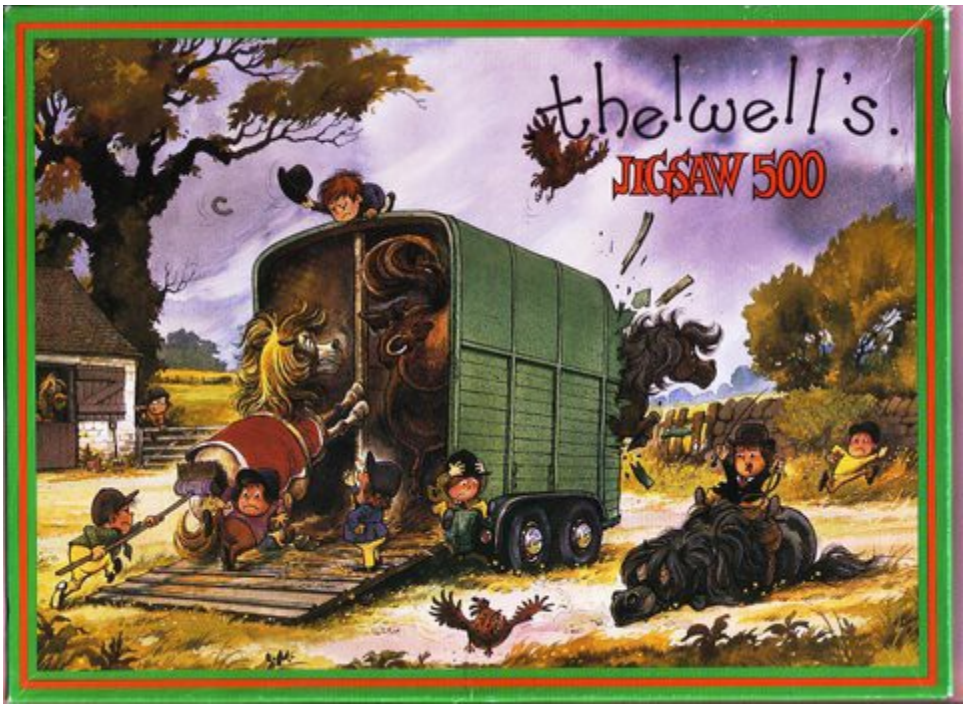

Fig. 40.1

Appendix I: Glossary

AATA: Animal Air Transportation Association. Now the **ATA** (see below).

ADTSEA: American Driver and Traffic Safety Education Association. Develops curricula for all levels of driver expertise and type. Training from this non-profit is available in person or online. Coordinates curricula with the commercial drivers' associations, American Automobile Association, National Highway Transportation Safety Association, and other national and state bodies. Works with national and state governments to secure funding and grants for driver education. Includes trailer hauling. www.adtsea.org and http://www.modsea.org/PDF%20files/3%200%20Curriculum-Online%20Presentation.pdf

ARP: Aerospace Recommended Practice. Develops industry standards with the Society of Automotive Engineers, establish protocols for carrying horses aboard aircraft. The ARP 1621 standard defines the minimum standards for unit loading devices to transport horses without injury, escape, and to protect the aircraft from corrosion by waste.

Anatomy: Typically, the horse carries 60 to 65 percent of its weight forward of the girth area. It takes very little effort to raise a horse by its hocks and wheelbarrow it in any direction as the horse balances off its forequarters. The horse has poor and limited balance off its hindquarters. See Figure I.1 for horse anatomy.

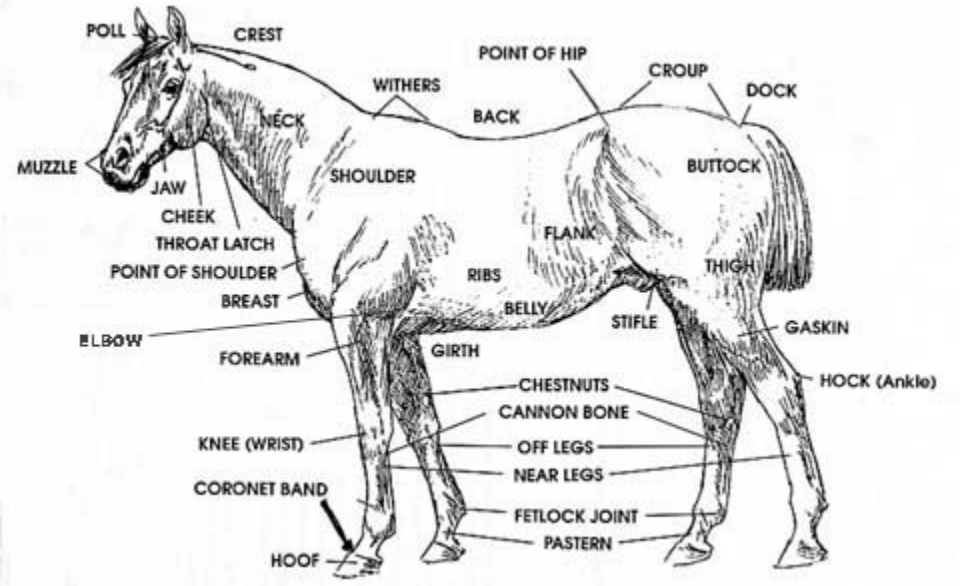

Fig. I.1

ATA: Animal Transportation Association. An international association of hauliers, agents, veterinarians, animal handlers, professional grooms, involved in sea, air, and land transport of all animals from aquatic to exotic. Considered by many in government and industry to be the international authorities to consult for standards and best practices.

Axle: Single-, double-, and triple-axle trailers are available for purchase. This committee does not recommend single axle horse trailers under any circumstances and believes they should be outlawed. Until then, axle performance and requirements for use should be outlined to the purchaser with limitations fully described.

Balanced ride: A conveyance that accommodates the horse's natural resting stance of a free head, forward lean, need to clear its respiratory tract, and resting hindquarter. Male horses can stretch and stale (urinate) at will.

Ball: The part of the hitch on the tow vehicle to which a **ball coupler** connects and encompasses. **Hitch balls** come in several sizes, depending on the size of the load being towed. A slider or fifth wheel does not use a hitch ball.

Ball coupler: The trailer part that "couples," and makes the connection to the tow vehicle. Usually, this indicates that it sits down and over and encompasses a trailer ball on a mount on the hitch, whether a **gooseneck** or **bumper pull**.

Ball platforms: Ball platforms or **ball mounts** come in various degrees of "drop" to assist matching the height of the trailer coupler with the tow vehicle's receiver. Weight-carrying hitches can generally accept complete loads of up to 3,000 or 3,500 pounds. On bigger trucks, this may get as high as 8,000 pounds gross trailer weight and 800 pounds maximum tongue weight.

Ball Sizes: If towing a smaller load, a **hitch ball** supported by a hitch bolted to the tow vehicle frame is likely used rather than a gooseneck or fifth-wheel hitch. This configuration is frequently referred to as "bumper pull" but it is more accurately described as "tag along." Trailer hitch balls come in many sizes that can be another source of confusion. Two balls of the same size may have different ratings from each other depending on their strength or because of the shank size of the bolt connecting them to the hitch.

The rating of the **hitch ball** plus its bolt and the hitch itself, must all match or exceed the maximum weight hauled by the truck and trailer, including the horses, the tack, the feed, etc.

British Institute of Non-Destructive Testing: Condition testing, diagnostic engineering, and quality control in all engineering disciplines. The Canadian Institute for Non-Destructive Testing, a member organization, is located in Hamilton, Ontario. www.cinde.ca

Bumper-pull: Also "Tag-Along." A type of hitch that implies the trailer is coupled to the ball mount on a hitch. This type of hitch was unfortunately poorly named. NO trailer of ANY size should ever be attached to the actual bumper of any vehicle. The bumper is not strong enough to tow anything. More accurate is the term "tag along" type.

Butt-bars or butt chains: Detachable bars or chains placed behind the horse's buttocks when hauling in conventional transport to prevent the horse reversing through the van or trailer exit until allowed to do so. Provides a crucial second barrier, other than the interior ramp or loading door, to maintain the horse inside the vehicle. Butt bars are sometimes expected to offer support to a sitting horse.

CDL: Commercial driver's license. Although states and provinces vary in their weigh station policies, all commercial vehicles are required to stop. In some states, this also applies to non-commercial vehicles. "All trucks," can be deemed to include pickup trucks, so it's probably best to err on the side of caution. This is one of the things you must consider before jumping into the horse-trailer market.

In some states and provinces, you may need to use commercial plates even if you don't haul horses for business purposes. Your driver's license and registration may be reviewed and your vehicle and horse trailer's weight and safety equipment inspected.

Your horse's health papers, Coggin's test results, etc., may be requested or a brand inspection may be imposed on you.

Personnel at weigh stations are often so busy with big rigs that they don't have time for smaller set-ups and you might be waved on. You may even be cautioned for having stopped. This is because a truck and horse trailer combination is often in the grey area and our enforcement officers have the right to impose inspections at will. However, at any sign indicating "Livestock," or "Vehicles with Trailers," pull in. Don't take a chance. In these situations, your horses will probably be inspected. Failing to stop could get you pursued, forced to return to the station and fined. Fines can be incredibly expensive and you could be inconvenienced for a fair amount of time.

CEH: California Equine Health, University of California, Davis. Under the direction of Dr Jim Jones, the Davis campus has done extensive research with the Japan Racing Association on horse transport problems.

CGVW: Combined gross vehicle weight. This is the total gross weight of tow vehicle and trailer, combined. This is a guesstimate weight. It seldom includes the reality of horses loaded on with all equipment and tack.

Competency: Non-commercial haulers are not subjected to tests examining their skills in hitching, turning, reversing, or braking an unloaded or loaded trailer. Non-commercial drivers with trailers should seek private classes or consult a CDL driver for lessons.

Components: The chart in Figure I.2 is for reference purposes only. Does not represent typical livestock trailer.

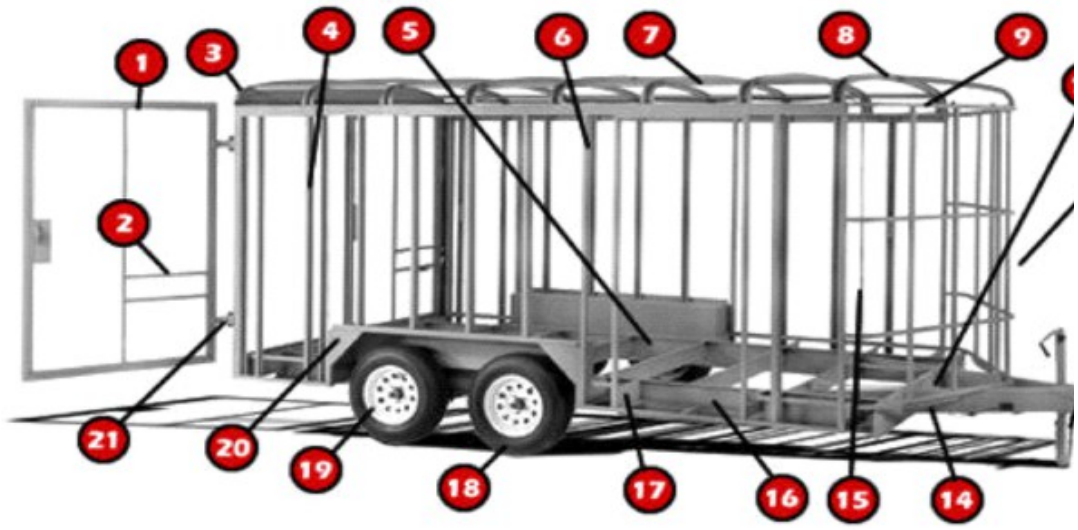

Fig. I.2: 1. Frame of rear door, 2. interior frame of door, 3. corner post, 4. vertical post, 5. cross-wise I beam, 6. wall studs, 7. roof runner, 8. roof bow, 9. front frame, 10. front and rear end rails, 11. nose frame or bulkhead, 12. approved safety chains, 13. lock ball coupler hitch, 14. trailer draw bars, 15. internal wiring, 16. length wise I beam, 17. cross-wise I beam, 18. tire, 19. wheel, 20. protective tire fender, 21. hinge for rear door.

Many of the components identified above can be recognized in a Merhow trailer tour of its construction methods: http://mrtrailer.com/merhow2010.htm

Cross-tie: A rope or chain shank tether attached to either side of the horse's halter and secured to a post on either side. It can prevent the horse from turning its head or turning around inside the transport. Tied too high, the horse cannot lower its head to clear its respiratory tract. Tied too low, the horse can step over it and panic.

Drawbar: The metal A-shaped tongue supporting the front of the trailer, or sometimes run beneath to provide support all the way to the front axle.

Flight distance: The distance an animal will seek to put between itself and a perceived threat. This distance increases with stress and fear. For example, a domesticated horse accustomed to people may consider 3 feet to be a safe distance from people in normal daily situations but when spooked will want to be hundreds of feet away.

Float: United Kingdom (UK) term for a horse box or trailer capable of being pulled behind a car or 4x4. May carry up to two horses. UK and European Union weight restrictions require floats to be light weight. A 2 -horse model might be able to accommodate two 17 **hands-high** horses. Float is also an antipodean term for the act of transporting an animal by float or trailer.

Three, four and five pony models are available in the UK and Europe. Normally this becomes a box, lorry, or truck with self-contained motive power, not a trailer. Heavier towing vehicles, and wider roads in North America, allow a horse box to contain more animals, up to fourteen in a single **gooseneck** trailer behind a truck.

For licensing restrictions, towing weights and the law, various types of trailers (**floats**), in the UK, see http://www.towinghorsetrailers.co.uk/licensing_laws.htm

Friction sway control: There are many kinds of sway control. The one in Figure I.3 dampens side to side action of the trailer.

Fig. I.3: Friction sway control.

FMCSA: Federal Motor Carrier Safety Administration.

Gooseneck: See Figures I.4 and I.5 for a sample of a gooseneck trailer. The trailer is hitched in the bed of a truck over the rear axle. "Gooseneck" was the original brand name now used to refer to many brands of this hitch type. For attaching the hitch to the ball on the mount of the frame (preferably), there are above and below the bed of the truck options on the truck.

Most of these have 7,500 lb **TW** (tongue weight) and are advertised as 30,000 lbs of **GTW** (gross tongue weight).

Fig. I.4

Fig. I.5: A gooseneck trailer hitched into the bed of a pick up.

GTW: Gross Trailer Weight. This term represents a rating assigned by the manufacturer to a trailer. It tells you the maximum amount that the trailer plus its complete load can weigh. It includes the guestimated full weight of the trailer, the horses, and everything else on it, from tack and mats to minimums for water, hay, and feed.

If the loaded trailer weight exceeds this number, it is both unsafe and illegal for you to haul it. The problem is that many people grossly over pack their trailers with items that were not included in the manufacturer's calculations.

GVW: Gross Vehicle Weight or Gross Weight. This term represents a rating assigned by the manufacturer to a tow vehicle (truck). This rating tells you the maximum amount the truck and its complete load can weigh and includes all fluids such as gasoline, oil, and coolant as well as all passengers and all other payload on the truck itself.

hh: Hands high. A horse is measured in hands of 4" for each hand. The measurement may or may not include the horse shoes. Transported horses may increase by 1 and 1/4" to 4" at the withers during transport due to the tension of maintaining their balance. The maximum height of the individual horse's head is important to consider in selecting a trailer height as the horse should be able to lift its head to balance without contacting the trailer interior.

Hitch: Hitch types come in different "weight classes" (see **Weight Classes**) and are available in five types (see Figure 6).

A hitch's rating will be stamped into the hitch's surface. "**Weight carrying**," indicates the hitch's weight threshold when used without **weight distribution bars**. Conversely, **"weight distribution**" refers to the hitch's threshold when used in conjunction with **weight distribution bars**. Both ratings will be visible on the hitch itself. The ball mount and ball will also indicate the weight ratings.

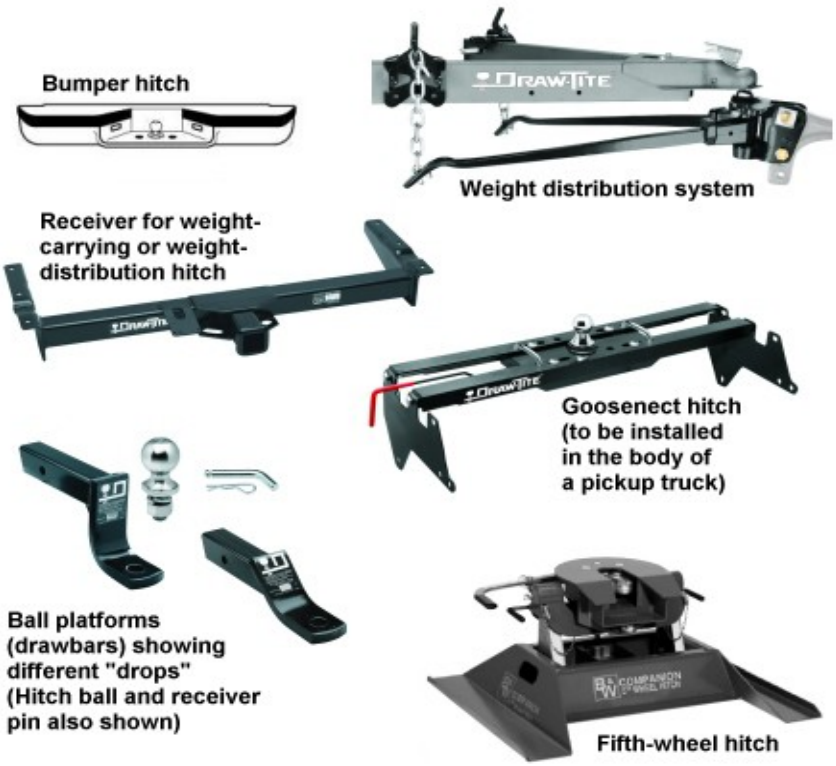

Fig. I.6

Hitch types; Hitches are identified by five different types:
1) Bumper hitch or step bumper
2) Weight-carrying hitch; bumper pull or tag along
3) Weight-distribution hitch; bumper pull or tag along
4) Gooseneck hitch
5) Fifth-wheel hitch

Here's a rundown on each type.

1. Bumper hitch or step bumper: This "hitch" comes as a standard unit on most pickup trucks. It's usually nothing more than a flat reinforced section in the middle of the rear bumper below the vehicle tag with a hole drilled in the center to accept a ball to mate with the trailer's coupler.

Bumper or step-bumper hitches are extremely dangerous and should not be used for any live animal. They are not rated for towing anything with live animals and should not be used. They are well known for failures, separations, and breakage.

Balls mounted on **step bumpers** can neither distribute the weight evenly throughout the tow vehicle nor are they adjustable. Per the FMCSA (Federal Motor Carrier Safety Administration) **ball and step bumper** set-ups may not be used to pull horse trailers that weigh more than 5,000 pounds.

The usual maximum load capacity of a step-bumper is only 2,000 pounds and includes the weight of the trailer and all payload items. Bigger trucks may have a higher capacity; but essentially, step bumper hitches are made for the occasional light load for small trucks, such as log splitters or utility wagons. And they have serious issues with failures.

Bumper-pull: A term that implies the trailer is coupled to the ball mount on a bumper. See **Hitch**. This type of hitch was unfortunately poorly named. NO trailer of ANY size should ever be attached to the actual bumper of any vehicle. The bumper is not strong enough to tow anything. It is a "bumper" only in the respect of being hauled behind the bumper, but is not supported by the tow vehicle's bumper. A more descriptive term is "tag-along."

Three horse bumper-pulls, or "tag-alongs" (see Figures I.7, I.8, I.9, and I.11), are available in the States but are known to be susceptible to separation, jackknife, and failure to brake properly.

Fig. I.7: Sold as a three horse bumper-pull, it cannot be safely towed by anything less than a 3,500i dual rear-wheel truck

There are myriad kinds of trailer hitches available in a variety of sizes and capacities.

The right hitch matches the trailer's coupler. It has adequate capacity to safely carry the full weight of your horses and any additional loads.

Fig. I.8: Bumper pull, AKA "tag along" coupler with safety pin in latch. This one is commonly referred to as a "bull dog" because the jaws of the hitch close around the ball, then a sliding latch closes over the jaws and is pinned in place.

Fig. I.9: This trailer was driven 20 miles with inadequate chains, cheap wiring set-up, and unsecured latch on the "bull dog" bumper pull type coupler. However, the ball is adequately secured to the mount and the mount is secured to the receiver.

2. Weight-carrying hitch: These hitches put the trailer's weight and start, stop, and turn forces onto the tow vehicle's frame rather than on just the truck's bumper. While this is fine for big trucks, keep in mind that the weight is still on the back of the vehicle and weight shifts in the trailer will still cause strong turn forces on smaller trucks. The hitch will often offer a removable **drawbar** and **ball mount** that fits into a hitch receiver that is permanently mounted on the truck or tow vehicle's frame. In this case, the hitch side will have a square receiver, usually 2" x 2." That means it "receives" a 2" x 2" square metal tubular drawbar with a hitch ball attached. This is also called a "**ball platform**" or "**ball mount**."

3. Weight-distribution hitch: Weight-distribution hitches use the same frame-mounted receivers as weight-carrying hitches, but they add a weight-distribution system that includes spring bars connected between the tow vehicle's receiver and trailer to apply leverage. This

distributes the trailer's weight to all of the tow vehicle axles and the trailer, which allows the tow vehicle to pull a heavier trailer.

It can provide a more level ride, more effective steering and braking for better and safer control.

Depending on your tow vehicle and the hitch's weight class, some can support up to 12,000 pounds **gross trailer weight** and 1,200 pounds maximum **tongue weight**. At this level, you're dealing with a general towing hitch that can carry significantly larger loads.

Weight distribution bars, often referred to as, "**equalizer**" or "**stabilizer bars**," distribute the horse trailer and tow vehicle's weight evenly throughout the rig. When a trailer's **tongue weight** rests primarily on a tow vehicle's rear end, it can cause the tow vehicle's front end to lift up. The **weight distribution bars** are designed to prevent this from occurring. They're also responsible for increasing the hitch's **GVWR**. They are absolutely critical when towing a longer horse trailer, a downsized tow vehicle or a tow vehicle with a short wheelbase.

You can only benefit from using **weight distribution bars**. But bear in mind that they are not the same as a "**sway bar**." When a rig seems to need a sway bar, this can be indicative of serious potential problems such as a trailer that doesn't travel level, uneven tire pressure or suspension problems. A larger appropriate-sized towing vehicle to match the trailer instead of sway bars is recommended.

4. Gooseneck hitch: This type of hitch connects to trailers using a "gooseneck." Gooseneck trailers couple to a heavy-duty ball installed in the bed of the tow vehicle offering a high load capacity. The ball couples through the vehicle's bed to the ball on the hitch itself, which is connected to the tow vehicle's chassis. This arrangement is often used on bigger pickup trucks having larger tow capacities. On some units, the ball will fold over or drop down so you can use the truck's bed without interference when not towing.

5. Fifth-wheel hitch: Hitches connect with a hinged plate and a pin rather than a heavy-duty ball (see Figure I.11). For these hitches, you need to pay attention to the "pin weight rating" rather than a "ball weight rating." A fifth-wheel hitch is the design used on tractor trailers (semis) to move freight, and is common for recreational vehicles as well.

Most fifth-wheel hitches must be bolted into the truck bed and are not easily removable, so moving other cargo with the truck requires adjusting it around the structure of the hitch. Determination of which hitch you'll need depends on which one comes on your trailer and your specific trailer-pulling needs.

Fig. I.10: A fifth wheel hitch in place.

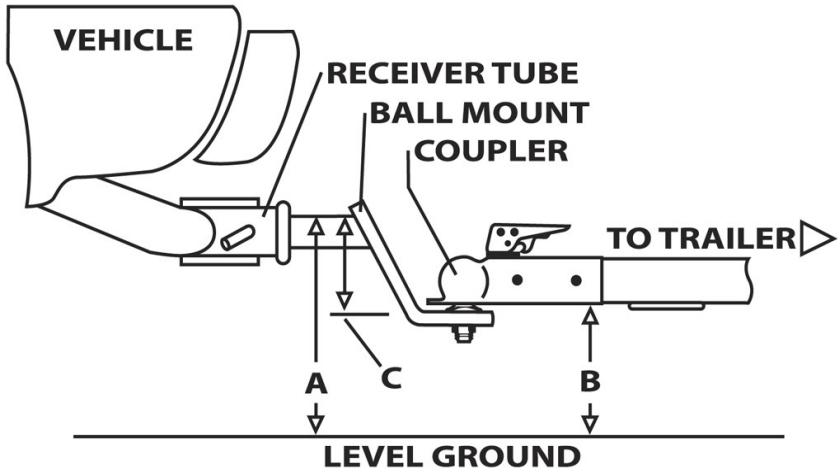

Fig. I.11: A leveler "bumper pull" or "tag along" hitch showing the coupler latch, but no receiver pin or chain connections are indicated. curtmfg.com

Fig. I.12: A common failing of hitches is that the trailer is not level.

The axle placement far behind the tow vehicle places added weight on the vehicle which is inadequate to the task in any case. This truck is far too small for this trailer loaded with horses and living quarters packed with tack and gear.

Fig. I.13: An incorrectly hitched trailer is susceptible to separation from the tow vehicle when braked too quickly or in a collision. Two horses inside, this trailer ended in a field.

Information about which hitch goes with a tag-along trailer and what horse-trailer owners should know about weigh stations and tag-along trailers hitches is available at http://horse-trailering.com/horsetrailering-horse-trailers-for-sales/horse-trailers/what-horse-trailer-owners-should-know-about-weigh-stations-tag-along-trailer-hitches/

A **frame-mounted Class 3 or Class 5 receiver hitch** is best for safe horse trailering. This is the only hitch that meets the legal requirements in all 50 states. The hitch must be welded or bolted to the tow vehicle's frame and features a square receiver for the **ball mount** to slide into.

A **ball mount** with the correct **drop** (see Figure I.11) keeps your horse trailer absolutely level, while in tow. Not being level creates an incredibly dangerous situation. When the trailer's tongue weight is compromised, a horse trailer wears its tires prematurely or can sway out of control. There is even some risk of the trailer popping off the ball due to unnatural forces. With a trailer that isn't traveling level, the horses will also find it extremely difficult to remain balanced, creating even more potential trailer control problems and stress for your horses.

Every part of a horse trailer hitch should be gauged and rated to match the trailer's **GVWR**. So, if a horse trailer has a **GVWR** of 5,000 pounds, the **ball, hitch, and ball mount**

must also have been rated for a minimum of 5,000 pounds. ***A rig's rating is only as high as its weakest component***.

Horsebox: In the UK any vehicle for carrying horses irrespective of size is a "horse box" or lorry. A trailer is referred to as a "float."

IATA: International Air Transport Association. Headquartered in Montreal, the IATA determines safe loading and crating practices for livestock carried by air, whether in open stalls or enclosed units (unit loading devices).

ILPH: International League for the Protection of Horses, now World Horse Welfare.

Impact barrier: As used in rear-facing horse trailers, horse and trailer are protected during sudden braking by a barrier the width of the trailer body. The barrier, comprised of vertical and horizontal bars, is braced forwards of the front axle of the trailer. Should the horse's rump come in contact with it, the force of the impact is transmitted to the trailer body. Two 700 kg horses were modeled in computer-simulated stress analysis demonstrating that the barrier was effective when the trailer was halted within 20 feet at 30 mph with 100% braking efficiency, compared to the average 75 to 85 percent efficiency.

In line: A one-horse wide trailer (see Figure I.14). In a two-horse in-line, horses are loaded directly behind each other. The arrangement is very poorly maneuverable, unstable, and horrific for horses in a crash as they have no room to attempt to right themselves. This committee does not recommend these trailers for any type of livestock or horses.

Fig. I.14

Jackknife: On the braking of a tow vehicle, the trailer continues to travel forward, essentially outrunning the tow vehicle to either flip, drag the towing vehicle with it, or if detached, it may appear alongside or ahead of the tow vehicle.

Jockey or rundown wheel (see Figure I.15): Supports the trailer at the drawbar when the trailer is unhitched. Various types.

Fig. I.15

Laminitis: The sensitive laminae lying immediately beneath the outer wall of the hoof becomes acutely inflamed and can permanently cripple the horse. Normally euthanasia is recommended. Can be induced by poor transport conditions, especially stress, lack of water, and colic.

Low-stress handling: Any method of driving, sorting, training, handling, or containing an animal with a minimum of fuss and noise, and/or use of equipment or methods based on the unthreatened animal's natural inclinations.

LQ: Trailer with living quarters. Normally larger box in front of the horse area in the trailer. Often a gooseneck hitch type is used.

NATM: National Association of Trailer Manufacturers. An initial impetus to forming the association was to work for better insurance rates for trailers, share information on regulatory updates, influence federal and state legislation concerning trailer safety having to do with brakes, lights, and reflective material. The NATM is a non-profit association in the USA. As a trade association, the NATM promotes safety and quality, working to ensure compliance with federal safety regulations and industry standards.

Together with the Society of Automotive Engineers, the NATM worked to standardize towing capacity claims of vehicle manufacturers. These were mandated in 2013. The test includes handling challenges that had not been previously considered by manufacturers. The NATM's compliance verification program is a requirement of membership, ensuring that members build light and medium duty trailers to meet or exceed standards or regulations. Members may be audited for compliance. The NATM has developed material for dealers and trailer users regarding towing safety, combination vehicle dynamics and maintenance.

The work of Technical Large Animal Emergency Rescue (TLAER) and NATM are important in broadening the scope of trailer accident data, currently a limited function of the

National Highway Transportation Safety Administration (NHTSA). It is hoped that improved data of this type will allow better research and development for equipment use and better development and enforcement of standards in the United States and Canada.

NFPA: National Fire Protection Association (USA and Canada). NFPA 1670 standards include a newly (2014) adopted section on large animal rescue from trailer incidents. This is considered to be a best practices document, not an enforcement document.

NHCA: National Horse Carriers Association. Founded in 1964, the association of professional drivers promotes the safest possible transport practices and strict accountability on the character and professionalism of its members. www.nationalhorsecarriers.com

Pillar rein: A cross-tie used in training haute ecole horses, such as the Lipizzaners. In a proper rear face transport set up, a single lead rope or tether is kept permanently in a secure ring opposite the horse's shoulders and snapped into the halter as needed. It can also be run through a second ring to keep it off the floor and available when needed or run the second ring and attach it to the horse's halter to prevent the horse from worrying its neighbor.

Rear face or balanced: In a one, two or three tag-along or larger goose neck, van or semi, horses travel facing away from the direction of travel. Axles and tie-up positions must be specially placed to accommodate the weight change in two- and three-horse models.

The horse may be reversed into position from a platform at the rear or walked through a forward door depending on the manufacturer. The latter puts both horse and handler into dangerous positions. Poorer executions of the original two- and three-horse concept do not allow for the horses' reactivity to movement behind itself, allow full freedom of the horses' heads, or prevent them from getting over the breast bar.

An example of one type of rear-face trailer can be seen at Figure I.16.

Fig. I.16: There are numerous kinds of rear-face trailer. In this design, the horse can get trapped in the open A-frame tongue. The people behind stand in the kicking zone. Without provision for a platform load, the entry ramp adds unnecessary weight. A similar arrangement to the one above earned the

handler a broken arm when the horse crowded against the handler leading it in. Many manufacturers provide a tie-up in the wrong position, allowing the horses to leap the breast bar.

Receiver: A square hollow channel part of the hitch permanently attached to the tow vehicle that receives the ball-mount.

Responders: Those first on the scene of an incident with a capability of contributing toward the safest resolution of the incident. Aside from medical personnel, it includes those who preserve evidence, photograph the scene, provide support during an operation, or can dispatch and organize responders to the greatest effect. Firefighters, police, sheriff's officers, veterinarians and animal-control or humane officers may be included.

Roadworthiness: Pertaining to mechanical and structural safety, a roadworthy horse trailer would be inspected for fasteners, brakes, hubs, axles, spare tire, any under-ride or impact barrier devices, stabilizing legs, hubs and road wheels, electrical wiring, and much else. A detailed planner and maintenance schedule could be based on: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/321988/guide-to-maintaining-roadworthiness.pdf

Roll-cage: Based on off-road ambulances, roll-cages to government standards incorporated into a horse or livestock trailer provide substantial protection from trailer skin and frame collapse during an incident.

SAE International: Formerly the Society of Automotive Engineers. U.S. based world authority on automotive, aeronautic, off highway vehicles active in setting testing and professional standards for design and components.

Shipping boots: Protective leather, felt, cotton, gauze or other material fastened by interlocking grips, snaps, or buckles to afford protection to a horse's legs in transport.

Shipping fever: Transport stress reduces the ability of the horse to ward off infection. Symptoms include fever, lack of appetite, weakness, nasal discharge, and distressed breathing.

Slant load: (See Figure I.17 for a sample drawing.) Horses travel on the diagonal, facing either the driver on the left (USA and Canada) or passenger's side, or facing either the left or right rear. The stall angle is usually at a 20 to 40 degree angle depending on the manufacturer, length, and width of the trailer. This tends to keep the horse's head facing to the crown of the road.

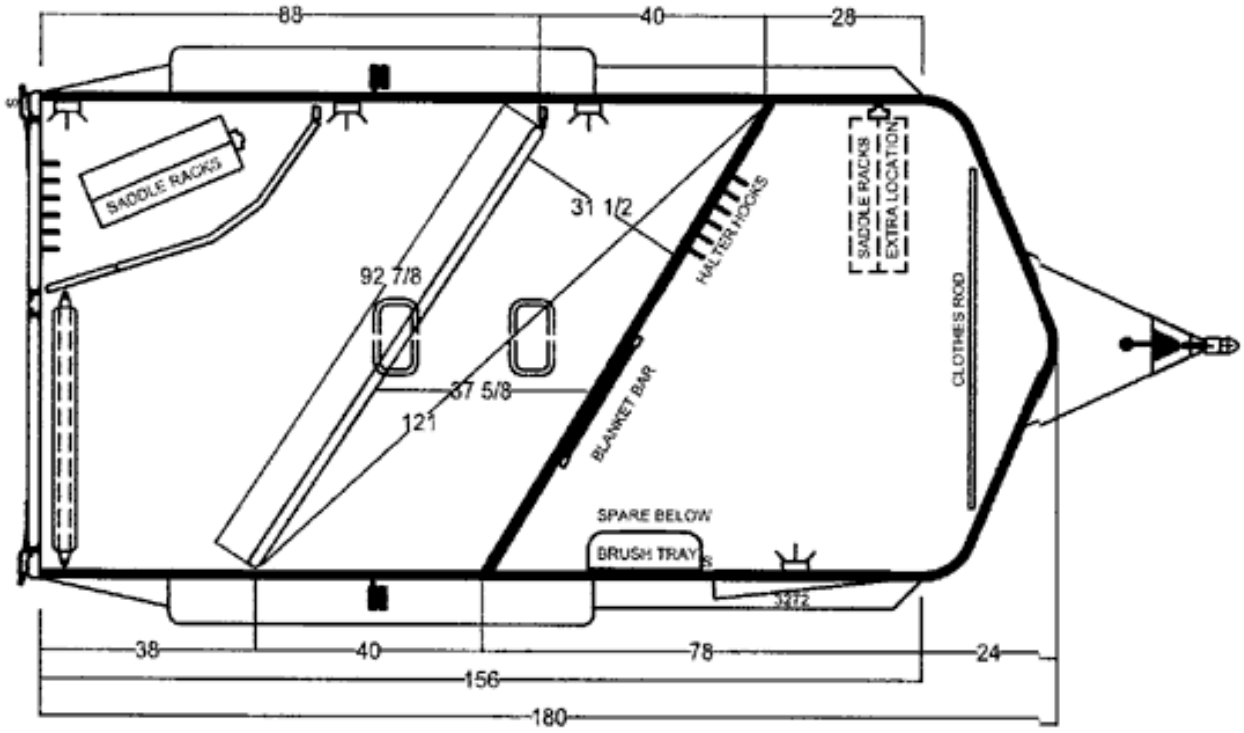

Fig. I.17: An example of a simple slant-load, two-horse, tag-along type trailer with a small tack and dressing room in front. Various designs can induce a variety of challenges under overturn or wreck conditions, and maximum access and egress methods to the horses is preferred.

Fig. I.18: Flipped to the left, this trailer shows how permanent structurally sound components can offer challenges to accessing the animals. Once the saddle racks and the rear doors are removed, this trailer will allow safer and easier access to the animals.

Stale: The act of urinating. Said of livestock.

Stock: Typically reserved for cattle, the taller versions of stock trailers can also be used for horses. These are usually open, with interior gates optional. They encourage the horse to seek its own position during transit, but have the issue of minimal protection of the horse's face, eyes, and body to the environment and debris. Eye protection is always recommended for horses hauled in this manner. There may be areas where the horse can get a hoof or a shoe caught.

Straight load: See Figure I.19.

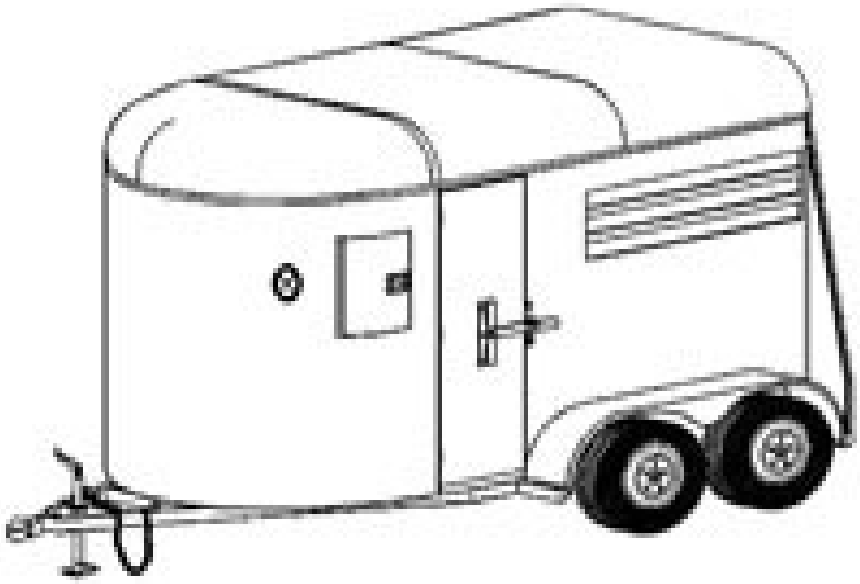

Fig. I.19: In this example, a tag along trailer in which the horses are loaded and transported facing the direction of travel. May also be gooseneck or 5th wheel versions.

See Figure I.20 for another example of a straight-load trailer.

Fig. I.20: Both horses were ejected from this straight load and had to be euthanized. Mangers are in front of the horses. The partition has collapsed. The axles failed and wheels fell off. Poorly maintained trailers are commonly involved in these types of accidents.

Sway bar: Brake pads in self-activating sway bars diminish or prevent trailer sway. Trailer sway can be initiated by the vacuum drag of a large passing truck, unbalanced load, abrupt steering, improperly inflated tires, wind, or other external factors. Sway bars mount to one or both sides of the vehicle with attachment points on the tongue and ball mount. They are a cheap alternative sought by those that refuse to purchase the appropriate sized towing vehicle. In this instance, you get what you pay for.

Tail-guard: A protective device of leather or fabric wrapped around the upper portion of a horse's tail. The purpose is to present loss of tail hairs or bruising when the horse sits on the butt bar.

TLAER: Technical Large Animal Emergency Rescue. The organization provides training internationally to responders in a variety of incidents involving animal safety. Emphasis is on prevention, mitigation, safety, and response to incidents involving horses and livestock in transport on and off the road. Other large animal emergencies trained for include but are not limited to barn fires, mud rescue, flooding or farm emergencies. www.tlaer.org

TW: Tongue weight. The vertical weight the trailer puts on the tow vehicle when properly balanced. A tongue weight of 400 pounds, e.g., is sitting on the hitch connected to your truck whether it's moving or parked.

When you start pulling your **trailer**, especially uphill or downhill, the forces from the combined weight of your trailer, horses, and other items loaded in it put an additional strong sideways force on the hitch and its mounting point (often a **hitch ball**) and on the trailer **coupler**.

Trailer: North American term for a **horse box** or **float** which can be towed by a vehicle.

Transit tetany: Afflicts horses after a prolonged road, rail, sea, or plane journey. Symptoms resemble those of tetanus in that the jaw locks, the horse loses its coordination, and it is unable to stale. Treatment requires antibiotics, calcium injections and muscle relaxants.

ULD: Unit loading device. A self contained stall, either open or enclosed, for shipping horses by air. ULDs may include a secure area for the groom to be with the horse for necessary inspection, feeding, and watering.

V-5: A minimum testing and rating system of trailer hitches established by the Trailer Hitch Manufacturers Association.

Weight Classes: When determining maximum towing capacities, you must view the entire tow vehicle, hitch, and trailer as a combination. Capacity cannot exceed the weakest link.

For example, if you want to haul a four-horse trailer, the trailer must be able to carry the weight of YOUR four horses, not a guesstimate. If some or all of them are draft horses, the trailer's weight capacity must be higher than if you're hauling only normal-sized horses or ponies.

In addition, the hitch and coupler must also be able to handle the full load of the trailer and its payload, as must your truck. The towing capacities of all these components must meet or exceed the load to be towed. The lowest weight hauling capacity of any one item determines the maximum capacity of your entire truck, hitch, and trailer combination.

WHW: World Horse Welfare. Formerly the International League for the Protection of Animals. A registered charity in England and Scotland. Anne, Princess Royal, is the patron.

WSPA: World Society for the Protection of Animals.

See chapters on electrical hookup, trailer brakes, safety chains, flooring, the breakaway brake (activates your trailer's brakes if it separates from your truck), and more for additional safety information.

Glossary sources were lifted from:

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Appendix II: Horse Transport Stressors

Table 1. Environmental Stressors Associated with Transport of Horses

Stressor Origin	Environmental Agent	Horse Reaction
Management of the transport environment	Noise, light, visual threat, insects	Flight
	Sway, braking	Loss of balance
	Axle placement, number of axles	Loss of balance if placement induces instability in relation to position of live weight
	Ventilation	Suffocation, panic, particulate inhalation, hypo/hyperthermia, poisoning, respiratory distress, lethargic, stumbling
	Flooring	Hooves dry, sore, shifting, slip, loss of balance
	Ramps	Improper angle causes strain, refusal; dampness, bedding or feces causes slipping
	Materials, position, entry, exit size, fittings	Point of hip, pastern, poll, withers injuries
	Vibration	Muscle soreness
Space	Rising stress levels	Choke. Displacement behavior; may bite or kick travel companion if issue not resolved
	No barrier to movement, noise behind animal	Flight
	Forced interaction with unfamiliars	Kicking, biting, tension
	Position in relation to travel	Balance--better balance facing away from direction of travel (transverse is poorest choice as horse finds it most difficult to balance); may jump chest restraint

Stressor Origin	Environmental Agent	Horse Reaction
Constraint and handling tools	Sudden restraint of head, dogs,	Panic
	Electric prods	Bolting
	Whips	Bruises
	Crushes, ropes, halters with "nut cracker" action on nose, poll, chin bone and nerves	Rearing, plunging, pulling back
	Sedatives	Loss of coordination, balance, increased reaction to stimuli, rearing backward, poor thermoregulation, unprovoked kicking
	Head tied short	Mucus, particulates congest air passages, lungs
Driver behavior	Slightest correction at wheel magnified at hitch	Kicking, loss of balance
	Taking corners, curves, overtaking or being passed initiates vacuum draft, trailer sway	Scrambling
	Route planning, driver physical, mental fitness	Best drivers give best trips
The horse	Nutritional state, temperament, conformation, fitness	

Table 2. Braking

Balanced Trailer	Conventional Trailer
Loaded trailer meets New Zealand regulation for emergency stopping within 30 feet at 20 mph without jackknifing the rig or disturbing the cargo; can be tested with live weight	Requires minimum of 120 feet at 20 mph to stop without endangering rig or cargo; never tested with deadweight or live cargo aboard
Animal's upright stance maintained with spontaneous downward adjustment of head, neck, thoracic sling	Horse shifts weight rearward to avoid pitching forward. May strike interior with head, scramble or become cast in stall
Minimal weight shift, maintaining weight on trailer axles and tow rig, providing constant braking contact with road surface	Horse's weight shifts forward and back, alternating pushing and pulling rig; weight not evenly sustained on hitch
Horse's thick-skinned, fleshed haunches may contact featureless interior, receiving full brunt of frontal collision or emergency stop; however, no evidence of contact of haunches with interior has been reported following emergency stops and one known frontal collision with tractor trailer	Full impact of emergency stop taken on horse's head, throat, neck, chest area; may strike manger; severe and fatal injuries reported
Horse spontaneously lowers head and buttocks in reaction to emergency stop; little movement otherwise	Horse thrust forward then fights to regain balance or escape forward movement; may damage sacroiliac, legs, forequarters

Table 3. Sway

Balanced Trailer	Conventional Trailer
Axles moved closer to tow rig reducing possibility of sway	Axles further from coupler may require additional equipment to prevent swaying
Horse positioned with its center of balance and 65% of its weight close to the center of dual axles; vectorial hitch change occurs at horse's hindquarters, which are not vital to spontaneous balancing during this event	Horse's center of balance shifts forward and back as trailer brakes or sways; horse must engage head high, hindquarters lowered, and spread hind legs to maintain balance
During transit, horse may experience the sensation of ground moving from its front to its rear; horse does not need to prop with hindquarters; few to no scramble marks on partitions or sidewalls	Horse may have sensation of substrate being snatched forward from beneath it. Falls backward or shifts hooves, scrambles, seeking to balance
Horse leans toward rear of trailer, maintaining bulk of weight on forequarters as is normal; horse's thoracic sling acts to spontaneously as gimbal; able to rest hindquarters at will	Horse must maintain abnormal position with weight toward hindquarters during transport; unable to rest a hindquarter
Facing away from the direction of travel, the horse's center of balance is between or near the axles, assisting a more constant hitch weight and reducing the possibility of jackknifing	Hitch weight subjected to fluctuation or movement of live cargo; can increase engine wear

Table 4. Equine Anatomy and Physiology

Balanced Transport	Conventional Transport
Forequarters cradled in thoracic sling, leaning forward, back, to the side in gimbal action	Cannot engage spontaneous use of thoracic sling
Tireless ligamentum nuchae carries head at normal withers or lower level for resting and dozing	Neck muscles engaged to support high held head; vertebrae coordinating horse's forequarters lock allowing loss of balance
Male horse can stretch and urinate during transit	Male horse cannot stretch during transit
Horse's head positioned in airy opening (studies incomplete on benefits)	Horse's head positioned close to exhaust
During braking, horse's sacroiliac is protected by its rump; not strained by additional weight	Horse, protecting forequarters and head from impact, shifts weight to hindquarters; sacroiliac region may be adversely affected
Horse arrives readier to perform	Horse arrives physically, hormonally pressured
Accommodates additional heavier crest of stallions and studs at its center of balance	Stallions and studs are considered more difficult to haul than mares or geldings
Horse able to lower head to substrate to clear respiratory tract	Limited or no capability to lower head to clear respiratory tract

Table 5. Equine Psychology and Transport

Balanced Trailer	Conventional Trailer
Horses protected from threatening activity in rearward blind spot	Horse with threat of activity behind itself may barge into or out of transport
Horses and handlers, mares and foals, maintain clear view of each other; stallions and studs are quieter with familiar handlers in sight	Handlers must approach from blind rear of horse, negating the maxim to never walk behind a horse; handlers are outside animal's visual field

Table 6. Positioning and Securing

Balanced Trailer	Conventional Trailer
Horses' heads at exit ready to be led out; may be led out singly or together	Horse's rump at exit; difficult to access head in emergencies; horse must reverse to exit, often onto uncertain footing
Horse is in no danger of escape or being dragged if tail door is lost	Loss of tail door increases horse's anxiety about its unprotected rear; in danger of being dragged
Horse restrained from moving forward by permanent tie. In two-horse models, butt restrainers not required	Butt bars required to prevent horse from reversing; endangers fallen horse
Horse's head lowers on braking	Horse may throw and injure head on braking
Horse's weight retained over forequarters	Horse sits on hindquarters and tail; tail guards required against abrasion and injury

Table 7. Training to Load and Unload

Balanced Platform Load Transport	Conventional Trailer
Uses familiar, passive, non-threatening aids such as straw bales; horse cannot be forced into transport	Active tactics and devices. Whips, ropes, painful nerve pressure on poll, nose, or jaw, tiring horse, hobbling, specialized loading bits, halters, food or water deprivation. Resort may be made to force.
Halter-broken ponies and horses trained in hours or less. Unbroken horses also transported.	Training may require weeks; horses traumatized by transport and may require retraining
Loading is similar to putting a horse to shafts single handedly; horse not confronted with a dark hole	Extra muscle may be required as horses are instinctively wary of dark holes
Loading sequence is simplified and expeditious; loading and ramp security takes place at one point; at no time is handler directly behind ramp	Handler required to fasten halter, butt restraints and presence required at two distant points; unloading similarly complex
Handler always in control at horse's head and out of kicking zone	At some point, handler in kicking zone, the most uncontrollable part of its anatomy
Minimum risk to horse's legs in stepping on level platform and reversing into level interior	Horse's legs in danger of bruising, cuts during loading and unloading, especially in step-in trailers; may slip and fall beneath trailer step up
Confining equipment is minimized, reducing chances of entanglement	Horse may thrust leg over butt bar or chain or fall beneath them risking injury to spine
Unload area free of slippery manure	Slippery feces, urine, bedding in load/unload zone
With platform engaged or as rear closure, loaded horse views activity while its rear is secure from exposure to light, movement	Once exit door is opened, horse may barge backwards on apprehension of activity behind itself
Although horse cannot be forced into platform load, horse is unlikely to object to subsequent loadings as it associates trailer with security from imbalance and action behind itself	Once unloaded, such as allowing the male horse to urinate, the horse may not readily reload
Although shipping boots and head bumpers may still be used, they are unlikely to be engaged as often, if ever	Shipping boots, head bumpers, tail guards essential; hard cases may require tranquilizers; especially difficult cases may require general anesthetic and veterinary attendance throughout trip

Appendix III: Good Practices

Introduction

The standards and good practices in the table have been adopted, adapted, or acknowledged as applicable to increased safety. Although there are no references to noise or vibration levels, they should be investigated. A noise test code and a vibration test code are available. The effect on the horse of vibration from trailers is being studied at the University of Sydney. As yet, roll prevention is not available for vehicles under 10 tons. A stability monitor is used by a Canadian horse trailer manufacturer.

Goal

Standards or good practices should be evaluated from the standpoint of hauling sentient, reactive, fragile, high-centered live weights weighing 1,000 pounds or more each.

Standards should be considered with reference to risk reduction on all vital fronts: reduction of anxiety in the horse; maintaining healthy heart, respiratory, and blood cortisol levels in the horse; and maximizing human and automotive handling safety.

Sources

The National Association of Trailer Manufacturers does supply members with some Society of Automotive Engineers (SAE) standards and lists applicable SAE standards for sale by the SAE. The National Standards Systems Network provides a comprehensive catalogue of standards adopted by the SAE and other international organizations, including trailer standards (www.nssn.org). It notes the most recent and identifies the standards that were approved, amended, or cancelled.

Standards established in the automotive, air and safety, and emergency large animal rescue interests could be used as a template to improve safety. A normative developed by a standards association, such as a protected overhead entry into a trailer, would establish the association as a source.

For a review of various horse trailers by manufacturers' names see http://mrtrailer.com

Fig. III.1: Horses have a way of providing drama in the most benign settings. This mare was rescued by cutting the tree down. She may have been rubbing her head on its rough bark and become trapped. Transport designs must take no aspect of a horse's quieter nature for granted.

Existing Standards and Good Practice for Livestock

The standards and good practices below are not definitive or exhaustive, and do not constitute recommendation or condemnation. They are provided as examples to guide development of horse trailer standards. Areas without clear good practice are also noted.

Summary of Available Standards

Goal	Title and Description	Document No.
Basic Safety Sources		
Incorporate safety considerations into a standard	*Safety Aspects: Guidelines for inclusion in standards 2012*	Guide 51 Committee Draft ISO/CD
	Safety of Machinery: Rules for drafting of safety standards. Distinguishes types of standards, verification requirements, and risk reduction measures, and formatting safety standards	ISO Guide 78:2012(E)

Goal	Title and Description	Document No.
	American National Standards: Safety requirements for confined spaces. Typical horse trailer configurations are considered a hazardous confined area.	ANSI Z117.1-1989
Increase safety of rescue personnel and handler	*Standard on Operations and Training for Technical Search and Rescue Incidents*. The National Fire Protection Association guidelines for rescue or retrieval of a horse from trailers. Trailer material and design hazards. Hazards requiring engineering to eliminate. [Removable roofs secured by latches on school buses. Similar to canopy for pilots. System expedites animal rescue].	NFPA 1670 2014
	Break-away Chest Bars. Human intervention not required to release when horse weights bar. May be released from outside the trailer.	No referencing standards.
	Rump Bar Release. Released from front of trailer to avoid standing behind horse.	No referencing standards.
	Non-Sparking Trailer Skin. Marine grade aluminum alloy non-sparking. Heavy duty power equipment not required in event of rescue or recovery operation.	No referencing standards.
	Safety Skin for Livestock Trailers. Marine grade aluminum alloy. In crash, does not shatter. Other types shatter, eviscerate horse or lacerate rescuers	No referencing standards.

Goal	Title and Description	Document No.
General Sources on Trailer Manufacture		
Overview of basic requirements. None distinguish between live and dead weight so are for information purposes only	*National Code of Practice: Building small trailers: Australian Design Rules*. Directed at trailers under 4.5 tonnes. Covers wiring, hitches, chains, running gear, wheels, tires, braking, etc. Offers contacts in customs, taxation, quarantine.	VSB.1 1999
	Guidelines for Recommended Minimum Manufacturing Practices for Light and Medium-Duty Trailers. Updated annually by the National Association of Trailer Manufacturers. Details recommended practices, federal, state and association contacts, standards, regulations and state laws. Gives no structure guidelines for frames, floors, or roof. Details extensive work on tires, wheel safety. With the SAE, prompted federal authorities to regularize tow vehicle hauling claims.	NATM 2014 Guidelines.
	ULD for Aircraft Transportation of Horses. Revised 2006. Details requirements for keeping horse containers escape proof	SAE ARP 1621

Goal	Title and Description	Document No.
Axles and Running Gear		
Provide axles capable of tracking true when hauled in a straight line; provide running gear capable of withstanding the load under a variety of road conditions	*Trailer Axle Alignment*. Properly aligned axles suited to cargo weight save tire wear, help maintain trailer stability, improve fuel economy. No measurement protocols endorsed by the SAE. Document provides fundamental assessment of measurement.	SAE J 875-2011
	Trailer Running Gear Test for minimum level of structural adequacy and performance, including axles, suspension, tires, wheels and brakes	CAN3-D313-FM85 (C2012)
	Trailer and Suspension Design Requirements for Excellent Towability	SAE 840130
	Suspension Support. Does not pound. Floor similar to commercial stock trailers over sub-structure frame channels 3/16” and ¼” thick.	No referencing standards
	Protection of Axle from Road Hazards. Skid plate truss from tongue to front axle	No referencing standards
Brakes		
Identify or develop a braking system that safely halts the combination trailer/tow vehicle under a variety of speeds and conditions. NB: **Passenger cars or light duty trucks rarely recommended for hauling horse trailers**	*Brake System Road Test Code: Passenger car and light duty truck-trailer combinations*	SAE J 134-2013
	Characteristics and Applications of Trailer Surge Brake Systems	SAE 670506
	Effects of Trailer Hookup Practices on Passenger Car Handling and Braking	SAE 780012
	Trailer Stabilization Through Active Braking of the Towing Vehicle	SAE 20040 1 1069

Goal	Title and Description	Document No.
	4 Channel Control Anti-Lock Brakes for Trailers. Shorter, faster stopping distance not tested for effect on live cargo	No referencing standards
Electrical		
Electrical wiring, connections, and attachment protected from debris, detachment, accidental disconnection, poor ground, vapors, and moisture	*Automobile Truck, Truck-Tractor, Trailer and Motor Coach Wiring*. Covers performance, operation integrity, efficiency, economy, uniformity, facility of manufacturing and service in wiring systems of less than 50 V	SAE J 1292-2008
	Caravan and Light Trailer Towing Components: Safety chains up to 3,500 kg capacity. Specifies design, construction and performance of detachable electrical connectors	No referencing standards.
	Ambulance Standard Wiring. Two-wire system. No ground to frame.	No referencing standards.
Equine Protection		
Head protection	*Trailer Entry Head Protector*. Protection of horse's head with malleable or flexible entry overhead.	No referencing standards.
Chest Restraint	*Flexible Breast Strapping for Restraint of Horses in Transport*. Chest restraints with give discourage horse from leaping restraint.	No referencing standards.

Goal	Title and Description	Document No.
Hitches and Chains		
Provide hitch components capable of withstanding the demands of the intended weight and strains including during an incident where the trailer might otherwise become completely separated from the tow vehicle	*Trailer Couplings, Hitches and Safety Chains: Automotive type*. For all types of trailers not exceeding 10,000 lb. Primarily for ball and socket couplers	SAE J 684-2014
	Caravan and Light Trailer Towing Components: Coupling body for ball couplings (Foreign). For trailers 3500 kg or less using 50 mm ball. Gives method for determining static and dynamic strength of the coupling body and its attachment to the trailer drawbar and tow ball	AS 4177.3-2004 Partial view of contents available free file:///C:/Documents%20and%20Settings/User/My%20Documents/Downloads/4177.3-2004.pdf
	Caravan and Light Trailer Towing Components - Safety chains up to 3500 kg capacity. Specifies the design requirements for safety chains	AS 4177.4-2004/Amdt 1-2006
	Development of Maximum Allowable Hitch Load Boundaries for Trailer Towing	SAE 800157
	Trailer and Tow Vehicle Combinations to Eliminate Weight-Distributing Hitches and Anti-Sway Bars	No referencing standards

Goal	Title and Description	Document No.
Impact Reduction and Confinement		
Retaining the live or dead horse within the trailer. Loose or dead beyond trailer horse presents a significant hazard	*Trailer Rear Impact Protection: Influence of guard support deformation*	SAE 2010-01-0227
	Hindquarter Impact Barrier for a Rear-Facing Horse Trailer. Not yet a standard, may be considered a good practice. Similar provision made at rear of trailer to enable it to withstand a 3 ton impact. Both crash tested by a computerized program used in automotive engineering. Prevents horse from being ejected from the trailer	PCT/NZ2012/000083
	Deck Support in Livestock Trailers. Flooring offers same weight bearing capacity throughout. Hitch beam and bars part of floor. Avoids corner joint strain	No referencing standards.
	Trailer Skin and Confinement of Livestock in Accidents. Roof and sides support 10,000 lbs without flex.	No referencing standards.
	Trailer Rear Impact and Handler Protection Doors. Full height rear doors secure horses allowing operator to handle ramp without getting kicked. Serves as solid structure behind horses that ramp, offers rear collision protection	No referencing standards.

Goal	Title and Description	Document No.
	Unit Loading Devices for Horses. Varies in number of horses accommodated. Groom protected from actions by horse. Partitions hung from top, easily maneuvered by hand. Solid breast frames protect attendants. All ULDs designed to contain horse within stall in event of incident. Stalls to withstand certain G forces in all directions	No referencing standards. Must meet Federal Aviation Administration, European Aviation Safety Agency, Civil Aviation Authority, International Air Transport Association, Live Animals and Perishables Board guidelines. Guidelines and perceived mandates sometimes conflict.
	Rollover and Live Cargo Protection. Roll-cage built into trailer. Body meets federal standards for off-road ambulances Marine grade aluminum alloy dissipates crash energy	No referencing standards.
	Rollover and Passenger Protection. USA school buses required in 1977 to improve crashworthiness, rollover protection, joint strength, passenger protection	Federal Motor Vehicle Safety Standards for School Buses.
Reflectivity/Conspicuosity		
Increase visibility of the horse trailer when parked or under way. Augment working or failed electrical lights	*Standard Specification for Retroreflective Sheeting.* The Department of Transport (US) specifications for reflective tape width, color, spacing, performance. Trailers under 10,000 pounds not required to have reflective tape but should be required. Important in event of an accident to demonstrate due diligence in terms of conspicuity	ASTM D4956-90, Type V sheeting and photometrics must meet the requirements of DOT-C2 (2" wide), DOT-C3 (3" wide), and DOT-C4 (4" wide

Goal	Title and Description	Document No.
	Chevron Reflective Striping Requirements for Emergency Vehicles Details minimums for type of sheeting used. Intended for emergency vehicles, has applications for civilian transport by indicating ideal placement, coverage, materials	NFPA 1901
Stability and Sway		
Reduce or prevent tendency of trailers to sway under way	*Road Vehicles: Passenger-car and Trailer Combinations: Lateral stability test*. For car-trailer combinations driven in straight-ahead conditions at several constant speeds. Combination tested for oscillation when a single brief adjustment is made in the steering wheel	ISO 9815:2010
	Trailer Sway Response Test Procedure. For trailers 26,000 pounds or less. Test applies to particular trailer-tow vehicle combinations including light- and medium-duty cars, and trucks. Must not exceed the linear response of the tires used	SAE J 2664 2006
	Crosswind Response and Stability of Car Plus Utility Trailer Combinations	SAE 820137
	Wind Effects on Dynamic Stability of Tractor Trailers in Winter Conditions	SAE 3009-01-2915
	Air Wing Trailer Stabilizer. Makes trailer less susceptible to truck draft and cross-wind	No referencing standards.

Goal	Title and Description	Document No.
	Monitoring Trailer Stability. Dashboard module gives auditory feedback of dynamic forces	No referencing standards.
Tires		
Provide best performing tire and rims	*Standard Test Method for Tires for Wet Traction in Straight-Ahead Braking, Using a Towed Trailer*. Measures braking action of tires on wet, paved surface	ASTM F408-99 2008
	Tire to Body Clearance Check for Recreational Vehicles	SAE J1214
	Tire Selection and Rims and Motor Home/Recreation Vehicle Trailer Load Carrying Capacity	FMVSS 110
Tow Bars and Towing Components		
Tow balls, shanks, and tow bars made compatible with each other in terms of strength suitable for the intended load.	*Caravan and Light Trailer Towing Components: Coupling body for ball couplings (Foreign)*. Updated January 2015, specifies the design and interchangeability tolerances, finish and marking requirements for up to 50 mm towballs on trailers up to 3.5 tonne	AS 4177.3-2004
	Caravan and Light Trailer Towing Components: Towbars and towing brackets (Foreign). Provides requirements for tow bars and towing brackets for use with 50 mm tow balls on trailers up to 3.5 tonnes	AS 4177.1 2004/Amdt 2-2006

Goal	Title and Description	Document No.
Ventilation		
Maintain trailer humidity and temperature at a level conducive to animal health and comfort.	*Environmental Control in Livestock Trailers.* Can be pressurized to prevent dust, exhaust entering. National Aeronautics and Space Administration ceramic paint to prevent overheating, condensation. Temperature, humidity and air movement monitor enables operator control of trailer environment	No referencing standards.
Weight Rating		
Provide an accurate assessment of tow vehicle and trailer weights in connection with performance	*Performance Requirements or Determining Tow-Vehicle Gross Combination Weight Rating and Trailer Weight Rating*. Establishes tow-vehicle performance requirements for combination vehicle acceleration, understeer, trailer sway, braking and park brake at GCWR and tow-vehicle hitch/attachment structure. Not intended to limit manufacturers' designs. Not expected to meet every variety of conditions experienced while trailering	SAE J 2807-2012

Goal	Title and Description	Document No.
Wheels		
Wheel attachment to be more rigorously supervised. E.g., paint thickness contributes to wheel failure.	*Understanding the Wheel Fastening System*. Not an official standard but points to safety *issues* concerning wheels. Has 200 pp of engineering studies, an ANSI recommended practice (Process Controls for Assembly of Wheels on Trailers). A good study of wheel loss, performance of steel and aluminum and assembly guidance	An E-book published by the NATM. 350pp.
	Wheels: Recreational and utility trailer test procedure (Reaffirmed: Oct 2012). Fatigue testing of ferrous and aluminum wheels during normal highway use. Two basic tests for cornering fatigue directed at the wheel disc and radial fatigue which also examines the rim	SAE J 1204-2012