EVALUATION OF A TREADMILL WITH INTEGRATED FORCE PLATES FOR
KINETIC GAIT ANALYSIS OF SOUND AND LAME DOGS AT A TROT

A Thesis

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The Faculty of Graduate Studies

of

The University of Guelph

by

NICHOLAS SCOTT BREBNER

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ABSTRACT

EVALUATION OF A TREADMILL WITH INTEGRATED FORCE PLATES FOR KINETIC GAIT ANALYSIS OF SOUND AND LAME DOGS AT A TROT

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University of Guelph, 2004

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Dr. Noël M.M. Moens

The thesis is an investigation of the use of a treadmill with integrated force plates (TM) for kinetic gait analysis of sound and lame dogs at a trot. Our objectives were to assess the feasibility and ease of data collection for sound and lame dogs at a trot using TM and to compare the mean peak vertical force (mPVF) obtained with this system to the mPVF obtained on a single piezoelectric force platform (FP). A secondary objective was to report the inter-step variability associated with each testing system for both sound and lame dogs and to assess the effect of lameness on this parameter. Our hypothesis was that the treadmill-force plate system would accurately reproduce mPVF at a trot for sound and lame dogs as compared to the piezoelectric force platform with high concordance and correlation coefficients and that the treadmill with integrated force plates would represent an effective instrument for canine kinetic gait analysis.

Six sound dogs and six dogs with a grade 2/5 forelimb lameness were trained and acclimatized on both systems and assigned an individual target velocity (1.8-2.2 m/s) based on treadmill training. Mean PVF measurements were obtained for both TM and FP. Subject velocity and acceleration was controlled by belt speed on TM and restricted to

0.25 M/s above or below the individual assigned target velocity, acceleration was limited to $\pm 0.3 \text{ M/s}^2$.

The treadmill with integrated force plates provided rapid mPVF measurements with good concordance for the hind limbs and substantial concordance for the forelimbs in both sound and lame dogs at a trot as compared to single piezoelectric force plate. Both systems demonstrated excellent inter-step variability for both lame and sound dogs. Based on these results, the hypothesis that mean peak vertical force as measured on a treadmill with integrated force plates would demonstrate high concordance and correlation with mean peak vertical force obtained with a single piezoelectric force plate for sound and lame dogs at a trot was accepted.

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This thesis is dedicated to the memory of my father, Professor John Low Brebner, PhD.; a passionate researcher, a loving and caring father and husband. He is deeply missed.

I would also like to dedicate this thesis to my beautiful wife Amélie for her unconditional love and support.

DECLARATION OF WORK PERFORMED

I declare that with the exceptions of the items listed below, all work reported in this thesis was performed by Nicholas Brebner.

Amanda Hathaway provided assistance during physical and orthopaedic examinations of the dogs as well as force plate and treadmill testing and training. Annette Morrison, the staff of the Central Animal facility and staff of the Small Animal Teaching Hospital of the University of Guelph (Guelph, ON) provided assistance with caring of the dogs.

The statistical analysis was performed by Gabrielle Monteith, technician in the Department of Clinical Studies, Ontario Veterinary College, in consultation with Dr William Sears, statistician, Department of Population Medicine, Ontario Veterinary College.

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1.0 INTRODUCTION

Gait analysis is used to accurately assess normal and abnormal gait. Consistent and accurate gait assessment is essential to evaluate the effectiveness of therapeutic treatments of lameness. Visual observation of gait is limited by its subjective nature and complicated by the speed at which multiple events occur during locomotion. Outside of the extremes of lameness, visual assessment of lameness in dogs is considered inaccurate (Waxman, Robinson, Evans et al. 2006). In contrast, kinetic gait analysis, using a force platform, provides an objective method of assessing gait that allows computational measurement of ground reaction forces (McLaughlin 2001). These ground reaction forces can be used to quantify the amount of force applied to each foot strike on the ground. It is considered the gold standard for the measurement of limb function in dogs (Waxman 2006).

Unfortunately, traditional canine kinetic gait analysis can be time consuming, and it is labour intensive (Richardson, Boston, Kapatkin, 2004) . In addition, only ipsilateral foot strikes can be assessed during one trial (McLaughlin 2001). The treadmill with integrated force plates offers the potential advantages of rapid data collection of ground reaction forces of all four limbs for trotting dogs (Waltraud, Matis, 1997). In addition, the treadmill allows precise control of velocity of the testing subject (Kistler instruments brochure).

A treadmill with two integrated force plates has been developed by Kistler Instruments and is amenable to use by canine testing subjects. Validation of the treadmill with integrated force plates, as compared to the single force platform for canine kinetic

gait analysis has not been performed. The treadmill with integrated force plates has the potential to rapidly produce ground reaction forces for all four limbs for sound and lame dogs at a trot and warrants investigation.

1.1 OBJECTIVES AND HYPOTHESES

This study was designed to evaluate a treadmill with integrated force plates for canine kinetic gait analysis of sound and lame dogs at a trot. The objectives were:

1. Assess the feasibility and ease of data collection for sound and lame dogs at a trot with the treadmill with integrated force plates.
2. Compare the mean peak vertical force obtained with the treadmill with integrated force plates with the single force plate system and assess concordance, correlation and bias between the two systems.
3. Report the inter-step variability for both the treadmill with integrated force plates and the single force plate system for sound and lame dogs.

The hypothesis for this thesis was:

The treadmill with integrated force plates should rapidly and accurately reproduce mean peak vertical force at a trot for sound and lame dogs as compared to the single force plate system.

1.2 LITERATURE REVIEW

1.2.1 INTRODUCTION

Locomotion is defined as the controlled and deliberate movement of an animal's center of mass between two locations. Locomotion analysis, or gait analysis, is generally performed in order to 1) establish whether or not an animal's gait is abnormal, 2) identify which part of the locomotor pattern is abnormal and 3) establish the cause of the abnormal locomotor pattern observed.

Many methods of gait analysis have been developed to better understand normal and abnormal gait in dogs. The simplest form of gait analysis is visual observation during locomotion. While still an integral part of gait analysis, visual evaluation of locomotion is difficult, owing to the speed with which multiple diagnostic events occur with each stride. The most significant drawback of visual observation is its inherent subjectivity. Consequently, researchers have relied on kinesiology, and more specifically kinetic analysis, to provide objective information on locomotion.

Kinesiology is the science of motion in animals. This discipline is subdivided into kinematics and kinetics where the former represents the temporal and geometric characteristics of motion, and the latter, the forces that affect motion. While kinetics and kinematics are intimately related, this literature review will focus primarily on canine kinetic gait analysis.

1.2.2 CANINE KINETIC GAIT ANALYSIS

Kinetic gait analysis is non-invasive and has been typically performed using a single force plate. Force plates measure ground reaction forces (GRF) occurring during the stance phase of the stride (Budsberg, Verstraete, Souta-Little, 1987). When a subject steps on the force plate, the magnitude of the force is measured by deflection of the sensing elements within the plate (McLaughlin 2001). The displacement of the sensing elements is proportional to the force applied. Three orthogonal GRF are measured: medio-lateral (F_x), cranio-caudal or braking/propulsion (F_y) and vertical (F_z) (Budsberg, 1987; McLaughlin 2001). This provides the observer with objective, quantifiable data that can be used to evaluate an animal's gait. Analysis of kinetic parameters allows discrimination between lame and normal dogs and is a more sensitive test than visual observation (Evans, Horstman, Conzemius, 2005). In addition to the three force components, temporal parameters can also be analyzed. Parameters such as impulse, ascending and descending slope and stance time provide information on the force distribution over time and significantly complement ground reaction forces in gait analysis. A combination of these parameters has been shown to provide a more accurate and objective assessment for discrimination between lame and sound dogs than univariate GRF analysis (Evans, 2005).

Typical parameters measured with the force plate are peak force, stance time, average force, impulse (force over time), rate of loading and rate of unloading (Budsberg, Verstraete, Brown et al., 1995). Force plate data is most often normalized to the subject's

body weight allowing comparisons to be made between dogs of different breed and size (Budsberg, 1987). In general, the mean value of 5 trials is used for statistical comparisons between dogs. A review of canine kinetic gait analysis revealed that the use of between 3 and 10 trials has been reported. Recently it has been suggested that it could be possible to accept as few as 2-3 trials per side in lame dogs since data generated during single force plate trials demonstrated an extremely high degree of consistency (Richardson, 2004).

The data acquired during a force plate trial can be displayed as a force Vs time curve, which can be decomposed by Fourier analysis in order to identify subtle gait changes indicative of lameness (Schneider, Chao, 1993; Lee, Bertram, Todhunter et al., 2002).

1.2.2.1 FORCE PLATE DESIGNS

Four basic force plate designs have been developed with each system using different properties to measure the forces applied. The four types of force plates are 1) mechanical springs and pointer force plates; 2) linear variable differential transformers; 3) electrical resistance strain gauges and 4) piezoelectric force plates.

Mechanical spring and pointer systems were the earliest force plates developed and they required application of very large forces for displacement. As such, only dynamic forces could be measured with this system (McLaughlin, 2001). Force plates

that utilize electronic devices to calculate the forces applied to the force plate have now replaced this system.

The linear variable differential transformer is a series of coils with a core magnet material that converts mechanical displacement into an electrical impulse (McLaughlin, 2001). The impulse generated is proportional to the force applied to the force plate.

The strain gauge force plate system relies on strain gauges in the force plate that are connected to an electrical circuit. A strain gauge is a thin piece of wire or foil attached to a metal sensor. When a force is applied to the force plate, the wire or foil in the strain gauge undergoes mechanical deformation (McLaughlin, 2001). Deformation of the strain gauge results in a change in resistance in the electrical circuit, proportional to the force applied. Strain gauges are very durable, sensitive and create only small variations in the force measured (McLaughlin, 2001). This technology is employed with AMTI force plate systems (Advance Medical Technologies Inc, Newton Mass.) and with the pressure walkway systems (Besancon, Conzemius, Derrick et al. 2003; Lascelles, Roe, Smith et al., 2006).

The piezoelectric force plate is highly sensitive over a large measuring range (McLaughlin, 2001). Quartz crystals, placed in the corners of the force plate, undergo deformation when a force is applied to the plate (McLaughlin, 2001; Anderson, Mann, 1994). This deformation produces a voltage that is proportional to the applied force. The voltage is then amplified and data can be recorded.

1.2.2.2 GAIT ANALYSIS OF SOUND AND LAME DOGS

The single force plate has been used extensively in canine gait analysis in sound dogs and in dogs with experimentally induced and naturally occurring lameness. Studies in normal dogs have attempted to quantify normal gait in various phases of locomotion such as walking (Budsberg, 1987; McLaughlin, Roush, 1994; Roush, McLaughlin, 1994; McLaughlin, Roush 1995) trotting (Budsberg, 1995; Jevens, Hauptman, DeCamp, 1993; Riggs, DeCamp, Soutas-Little, 1993; Rumph, Lander, Kincaid, 1994; McLaughlin 1995, Rumph, Steiss, Montgomery, 1997, Rumph, Steiss, West 1999, Renberg, Johnston, Keying et al., 1999, Budsberg, Rytz, Johnston, 1999) jumping (Yanoff, Hulse, Hogan, 1992), and to evaluate normal limb symmetry (Budsberg, Jevens, Brown, 1993).

Force plate gait analysis has been used to evaluate lame dogs with experimentally induced synovitis (Rumph, Kincaid, Baird, 1993; Cross, Budsberg, Keefe et al, 1997;) and osteoarthritis (Budsberg, 2001; Kennedy. Lee, Bertram et al., 2003) and to assess the response to medical treatment of osteoarthritis using non-steroidal anti-inflammatory drugs (Budsberg, 2001; Vasseur, Johnson, Budsberg, 1995; Budsberg, Johnston,

Schwartz, 1999; Moreau, Dupuis, Bonneau et al., 2004; Karnik, Johnston, Ward et al., 2006; Griseneaux, Dupuis, Pibarot et al. 2003; Horstman, Conzemius, Evans et al., 2004) and neutraceuticals (Moreau, Dupuis, Bonneau 2004). In addition, force plate analysis has been used to evaluate the relationship between limb function and the presence of radiographic evidence of osteoarthritis (Gordon, Conzemius, Riedesel, 2003).

The effectiveness of surgical treatment of experimental and naturally occurring cranial cruciate rupture (Dupuis, Harari, Papgeorges et al., 1994, Budsberg, Verstraete, Soutas-Little, 1988; Jevens, DeCamp, Hauptman, 1996; Adrian, Matis, 2002; Conzemius, Evans, Besancon, 2005; Hoezler, Millis, Francis et al., 2004, Evans 2005; Ballagas, Montgomery, Henderson et al., 2004; Mason, Robinson, Evans et al., 2004) post-operative rehabilitation following repair of cranial cruciate rupture (Marsolais, Dvorak, Conzemius, 2002) and meniscal injury associated with cranial cruciate rupture (Trumble, Billingham, Bendele et al., 2005) have been objectively assessed using kinetic gait analysis. Results of surgical treatment of other orthopaedic conditions such as hip dysplasia (Dueland, Bartel, Antonson, 1977; Anderson, Hearn, Taves, 1988; Budsberg, Chambers, Van Lue et al. 1996; McLaughlin, Miller, Taces, 1991; Manley, 1990) fracture repair (Muir, Markel, Bogdanske, 1995), fragmented coronoid process (Theyse, Hazewinkel, van der Brom, 2000), calcification of supra-spinatus tendon (Kirpensteijn, van der Bos, van der Brom et al, 2000) and OCD of the shoulder have been assessed using force plate analysis (Person, 1989). Other studies in dogs have evaluated gait assessment after limb amputation (Kirpenstien, van den Bos, van den Brom, 2000), ground reaction forces of puppies with abnormal hip laxity (Lopez, Quinn, Markel, 2006)

and post-operative results of dorsal decompression for treatment of degenerative lumbosacral stenosis (van Klaveren, Suwankong, De Boer et al., 2005). In another study, ground reaction forces were recorded before and after experimental tibial nerve injury to document subsequent peripheral nerve regeneration (Rumph, Steiss, 1998). Finally, force plate gait analysis has been used to measure redistribution of vertical ground reaction forces after experimentally induced lameness (Rumph 1993; Rumph, Kincaid, Visco, 1995; Griffon, McLaughlin, Roush, 1994).

1.2.2.3 SOURCES OF VARIATION

Accurate and precise kinetic gait analysis requires an understanding of the sources of variation that can affect data collection. Numerous studies have been performed to identify potential sources of variation that affect the generation of ground reaction forces during normal gait. These sources can be divided into mechanical parameter variables and subject and trial protocol variables, and must be addressed when designing a research protocol.

1.2.2.3.1 MECHANICAL PARAMETER VARIANCE

Mechanical parameters such as subject velocity, stance time and acceleration, deceleration and their affect on GRF in different phases of the gait have been documented.

The effect of subject velocity within a specific gait (trot) on ground reaction forces has been investigated. It was determined that changes in subject velocity caused a significant difference in peak vertical forces and consequently must be defined and rigidly controlled in an experimental design (Jevens, 1993). The type of gait studied (trotting vs. walking) will inherently determine the velocity of the test subject. Trotting gait has been reported to be more sensitive and specific for detection of low-grade lameness in dogs as compared to a walking gait (Voss, Imhof, Kaester et al., 2006). More severe lameness may preclude the subject's ability to trot. The crucial factor to ensure reproducible kinetic gait analysis is to minimize the range of subject velocity. Significant differences in PVF and VI were noted in sound Greyhound dogs trotted at different velocities: these significant differences were present even if the velocity variation was as low as 0.6 M/s between groups (McLaughlin, Roush 1994). In an effort to decrease variation attributed to velocity, trials in which the subject velocity is outside of a narrow, predetermined range are excluded from analysis. Trotting speeds of 1.5 M/s to 3.0 M/s have been reported in the literature, however no specific guidelines exist for acceptable subject velocity range. Intuitively, the smallest subject velocity range would result in the least variation of GRF.

Subject stance time has been evaluated as an indicator of subject velocity and was found to be an accurate and sensitive method of determining subject velocity (Roush, 1994). Subject stance time can be used to normalize trial data and document consistency in velocity in normal Greyhounds at a walk and a trot (Roush, 1994). This statement was based on the finding that stance time had a strong negative correlation with velocity. This

was re-iterated in another study that investigated the use of both stance time and velocity as control variables in lame dogs and found no significant differences in GRF using either parameter (Renberg, 1999). However, it must be noted that lame dogs tend to load the affected limb slower and unload quicker than the sound limb leading to a shortened stance time on the lame leg (Budsberg, 1995). It has therefore been speculated that if stance time changes due to an induced lameness, and stance time is used as an initial control variable for force plate evaluation prior to the onset of lameness, the velocity of subsequent trials must be different with respect to the baseline trials. This conclusion is based on the relationship that exists between stance time and velocity: as the velocity of the subject decreases, stance time increases. Therefore assessment of normal dogs can be made using either stance time or velocity as a control variable; however, it is preferable to use velocity as a control variable in lameness studies.

Since subject velocity affects GRF, it is logical that changes in velocity over time, i.e. acceleration or deceleration, would have an effect on GRF. The relationship was confirmed when the effect of acceleration and deceleration on GRF within a given range of velocity was documented (Budsberg, 1999a). These findings demonstrated the presence of significant differences in GRF, mainly in the cranio-caudal axis, with variations in the acceleration and deceleration of the subject. Therefore subject acceleration and deceleration, in addition to subject velocity must be minimized in any gait analysis protocol.

Visual observation alone to assess changes in velocity is inconsistent and mechanical documentation of subject velocity is required (Budsberg, 1999a). In order to assess subject velocity, acceleration and deceleration, a series of photocell timers have traditionally been used. Photocell timers are placed at different spacing intervals over the walkway and force plate. Review of the literature indicated that previous studies have used between 2 and 4 photocells timers. Since 2 photocells result in only one velocity interval, subject acceleration and deceleration cannot be determined. For this reason more than two photocells should be used to ensure accurate assessment of subject acceleration and deceleration in addition to subject velocity.

1.2.2.3.2 SUBJECT AND TRIAL PROTOCOL VARIANCE

When performing a kinetic gait analysis trial, a handler leads a dog across the force plate. Possible sources of variation in these measurements include: subject starting distance, the dog, the handler and trial repetition. Subject starting distance does not appear to affect ground reaction forces (DuLaney, Puriton, Budsberg, 2005). The contribution of dogs, handlers and trial repetitions to variance for peak vertical forces and for cranio/caudal impulses recorded from healthy dogs while trotting has been studied. The percentage of variance attributable to handlers varied between 0 and 7% whereas dogs and trial repetition contributed from 14 to 69% and from 29 to 85% respectively (Jeves, 1993). According to this study, the amount of variation introduced by handlers was trivial and that experiments with multiple handlers may be used without appreciable influence on results (Jeves, 1993) Ground reaction forces in dogs, as in humans, appear

to be highly individualized and as such inter-subject variability contributes significantly to variance in kinetic trials (Roy, 1988).

Ideally, gait analysis studies are performed using one breed of dog in order to limit inter-subject variability that may arise due to conformational differences between breeds. Greyhounds were used extensively in the characterization of normal canine gait kinetics (Riggs, 1993; McLaughlin, 1994; Roush, 1994; McLaughlin, 1995; Rumph, 1997; Rumph, 1999). Canine morphometric characteristics such as muscle mass, limb angulation and length, stride frequency, center of gravity and whether the dog is a sustained trotter or a galloper were found to introduce variance on an individual basis and supported the use of one breed for kinetic gait analysis (Rumph, 1994). However, Budsberg reported that ground reaction forces and impulses correlated with morphometric measurements, with body weight having the best correlation (Budsberg, 1987). In addition, trotting gaits of Labrador Retrievers and Greyhounds were compared and differences in trotting gait were attributable to size but the 2 breeds moved in a dynamically similar manner (Bertram, Lee, Case, 2000). Therefore, despite breed differences in stride length and frequency, when GRF values were normalized to body weight, most measurable differences between breeds were eliminated (Budsberg, 1987). Thus normalization of GRF to body weight allows comparison of GRF between breeds. As a result of these findings, many studies with normal mesomorphic dogs have subsequently been performed.

Other factors such as GRF testing on different days, selection and habituation may contribute to variance. Significant inter-day variation in vertical ground reaction forces was documented in clinically normal dogs; however, within day GRF's were consistent (Rumph, 1999). Based on these findings, testing protocols should be performed on the same day for each subject. In the event that testing on the same day is not possible, a statistical model was created to calculate the number of repetitions required to overcome the variance introduced by inter-day testing (Rumph, 1999).

The effects of subject habituation and selection have been studied. Selection and habituation of testing subjects resulted in smaller coefficients of variation between dogs (Rumph, 1997). Reducing inter-dog variation implies that fewer trials are necessary to obtain statistically significant data. Since the number of trials performed is an important contributor to variance, habituation may indirectly decrease variance by decreasing the number of trials (Rumph, 1997). One way to assess the level of habituation is to measure the stance phase. As dogs become habituated to the gait analysis system, they display less reluctance to ambulate which is translated into shorter a stance phase (Rumph, 1997).

1.2.2.4 LIMITATIONS OF THE SINGLE FORCE PLATE

The major disadvantage of a single force plate system is the inability to measure consecutive strides during locomotion; giving a mere snapshot of the complex phenomenon of locomotion (McLaughlin, 2001; Anderson, 1994; Besancon, 2003). Information about the function in the swing phase of the step cycle is not available

(Besancon, 2003). Therefore, complete analysis of the gait using a single platform system requires the additional incorporation of kinematic analysis (McLaughlin, 2001; Besancon, 2003). Quadrupedal gait involves extensive simultaneous foot contact, most often of the contra-lateral limbs (Besancon, 2003). Conventional single platform systems cannot differentiate between footfalls and summation of forces occurs when a footstrike is not isolated. Single force plate systems are limited to footfalls of the ipsilateral limbs with only partial kinetic data available; the contralateral limb is not evaluated on the same trial.

Moreover, since single force plate systems measure only one footfall, variability between consecutive footfalls, defined as inter-step variability, cannot be evaluated (Besancon, 2003). Finally, compensatory gait redistribution of forces may occur when one limb is affected (Rumph, 1993; Kennedy, 2003; Leach, 1989) and single force plate may not allow for accurate, simultaneous evaluation of compensatory loading in other limbs (Rumph, 1993).

1.2.2.5 ALTERNATIVES TO SINGLE FORCE PLATE ANALYSIS

Canine gait researchers have developed other force plate systems to overcome these limitations including a multiple force platform system, (Bertram, 1997; Bertram 2000) a serial force plate system (Kennedy, 2003) and a pressure walkway system (Besancon, 2003; Lascelles, 2006) and the integration of force plates on a mechanized treadmill (Waltraud, Matis, 1997a,b; Adrian, Matis, 2002).

1.2.2.5.1 MULTIPLE FORCE PLATE SYSTEM

Four single force plates were placed end to end to create a “force plate walkway” for kinetic gait analysis in dogs, allowing the measurement of eight consecutive footfalls (Bertram, 1997). Six of the eight footfalls occurred simultaneously on different force plates yielding complete force records from three sequential steps. Characteristics such as mean velocity, stride period, relative phase of maximum force and duty factor for each fore and hind limb were obtained in addition to conventional force plate data with this system. The summation of forces on all feet at one time was also calculated, giving a complete description of whole animal kinetics (Bertram, 1997). The use of two, rather than four, force plates in series has also been reported (Bertram, 1997; Bertram 2000, Kennedy, 2003)

1.2.2.5.2 PRESSURE WALKWAY SYSTEM

A commercially available pressure walkway system has been developed and its use has been reported in dogs (Besancon, 2003; Lascelles, 2006). The pressure walkway consists of a 2-meter by 0.75-meter sensor pad that contains an ultra thin (0.1 mm) flexible printed circuit. Within the circuit are thousands of sensing elements that act as variable resistors in an electrical circuit. The output resistance created when sensors are loaded and unloaded is converted to a raw sum that is used for analysis (Besancon, 2003). The pressure walkway system offers several advantages over the force plate system including the ability to measure multiple readings and simultaneous, consecutive and

contralateral footstrikes (Besancon, 2003). This leads to fewer trials necessary for data acquisition, thus decreasing the variance of the data. The pressure walkway is also portable and can be used to measure body weight distribution (Lascelles, 2006).

Ground reaction forces of clinically normal dogs obtained with the pressure walkway system and have been directly compared to ground reaction forces obtained with a strain gauge AMTI force plate (Lascelles 2006). Significant differences in PVF and VI were present between testing systems and were attributed to differences in calibration techniques and a lower sampling frequency of the pressure walkway system. Disadvantages of the pressure walkway system include: the inability to measure medio-lateral and cranio-caudal forces, a lower sampling frequency and lengthy data analysis (Lascelles, 2006).

1.2.2.5.3 TREADMILL WITH INTEGRATED FORCE PLATES

A treadmill with two integrated piezoelectric force plates has been developed by Kistler Instruments®. The treadmill belt (150cm X 50 cm) runs over two 50cm X 50 cm piezoelectric force plates that are built into the frame (Figure 2-1). Velocity of the treadmill belt is controlled electronically and can be increased in increments of 0.1 M/s to a maximum speed of 6.1 M/s (22 km/hr). The treadmill can also be inclined up to an angle of 13.5 degrees (Kistler information brochure).

The treadmill with integrated force plates overcomes the limitation of single footfall data of the single force plate system. The treadmill system allows continuous measurement of vertical ground reaction forces of successive foot-strikes, over a chosen period of time (Waltraud, Matis, 1997a,b; Adrian 2002). A more complete kinetic analysis is therefore possible, potentially offering new information and a better understanding of the complex phenomenon of canine locomotion. Trials lasting several minutes can be performed allowing subtle changes in a gait over time to be quantified.

The ability to measure ground reaction forces of consecutive steps also allows accurate assessment of inter-step variability and has the capacity to demonstrate compensatory gait redistribution (Waltraud, Matis, 1997a,b). In addition, the treadmill system permits accurate and precise control of subject velocity, acceleration and deceleration by controlling belt speed (Waltraud, Matis, 1997a,b; Kistler information brochure).

Data acquisition using a traditional single force plate system to obtain 5 valid trials can take up to an hour and sometimes greater than 100 passes over the single force plate (Richardson, 2004). The treadmill system offers the advantage rapid data collection, producing significantly more data over a much shorter period of time than the single force plate system, with the strict control of subject velocity and acceleration. This results in a decrease in the number of trials required, a major source of variance in canine gait analysis (Jevens, 1993) using the treadmill system. Potential limitations of the treadmill with integrated force plates include the possibility of summation of ground reaction

forces due to crossover of fore and hind limbs resulting in decreased available kinetic data and the potential existence of biomechanical differences between over-ground and treadmill trotting

Canine kinetic studies have been performed using a treadmill with integrated force plates (Waltraud, Matis, 1997a,b; Adriany 2002, Fanchon, Valette, Sanaa. 2006). However, to this author's knowledge a treadmill with integrated force plates has yet to be validated with respect to the single force platform system for canine kinetic gait analysis.

1.2.3 OVERGROUND VERSUS TREADMILL LOCOMOTION

Different treadmill systems have been used for kinematic gait analysis in dogs in an attempt to determine whether differences exist between over-ground and treadmill locomotion. Greyhound dogs trotted on a treadmill demonstrated comparable joint angles and angular velocities as compared to published values for over-ground trotting with a high level of consistency and a steady state of trotting was obtained within 30 seconds (Owen, Richards, Clements et al., 2004). This would suggest that based on joint angles and angular velocities, treadmill trotting is similar to over-ground trotting and is highly consistent. A more recent publication investigating treadmill kinematic parameters in normal Labrador retrievers at different gait cycles demonstrated that angular displacement and angular velocities of the elbow and stifle were highly variable within trotting sessions (Clements, Owen, Carmichael et al, 2005). This contradicts Owen et al.'s earlier results that suggested that treadmill trotting was highly consistent. However, the

dogs in the Clements et al. study were treadmill-naïve dogs and the authors suggested that the test subjects had not achieved habituation on the treadmill perhaps due to the insufficient length of sessions or the selected velocity being too high (Owen, 2004). If these differences are clinically significant, this emphasizes the necessity of appropriate training, acclimatization and habituation prior to testing dogs on a treadmill.

Equine kinematic studies comparing treadmill versus overground locomotion have been performed more extensively than in dogs and may give insight into treadmill locomotion in dogs. Kinematic studies using Dutch Warmblood on a treadmill had a decrease in stride duration, a decrease in vertical displacement of the withers and an increased stance time of the forelimbs during treadmill trotting as compared to overground trotting (Buchner, Savalberg, Schamhardt et al., 1994) implying that quadrupedal adaptation occurs during treadmill trotting and that over-ground kinematic and kinetic analysis should not be used in conjunction with treadmill kinematic and kinetic analysis

Treadmill kinetic and kinematic analyses are routinely used in human biomechanics studies. Care must be taken when making any reference to human biomechanics because of the inherent differences between bipedal and quadruped gait. With this in mind, significant differences in kinematics between treadmill running and overground running (Nigg, DeBoer, Fisher, 1995; Nelson, Dillman, Lagasse et al., 1972) as well as treadmill walking and overground walking (Alton, Badley, Caplan et al, 1998), have been demonstrated and remain unexplained. These studies suggest that the biomechanics of walking and running on a treadmill, while similar to overground

biomechanics, are inherently different in people. Comparative kinetic gait analysis data between treadmill and overground walking in people have been performed and demonstrated that the pattern of force Vs time curves were similar for both methods with a high correlation between curves (White, Yack, Tucker et al., 1998). Based on these findings it was concluded that acceleration patterns were similar between the systems for people. However, significant differences in peak force magnitude between systems of 5-9% during mid-stance, and 5-6% in late stance were identified (White, 1998). During mid-stance, the magnitude of the forces were greater on the treadmill than the force plate and in late stance, the magnitude of the forces were greater on the force plate than the treadmill (White, 1998).

1.2.4 PREFERRED SUBJECT VELOCITY

Over-ground kinetic gait analysis requires that the subject's velocity and acceleration be controlled within a strict, predetermined range to minimize their influence on GRF. In human studies, the investigator can control a subject's stride frequency by having the subject synchronize their stride frequency to an audible metronome. Although the subject's speed is also influenced by stride length, this technique allows the investigator to modify a subject's velocity. In canine kinetic overground testing, the handler will guide the dog to gait at approximately the desired speed, however, the dog ultimately decides at what exact velocity it chooses to ambulate. Since the dog's velocity cannot be as precisely controlled, the investigator must select trials in which the subject's

velocity and acceleration are within an acceptable range and reject trials that do not meet these criteria.

With the treadmill system, subject velocity can be selected by the investigator by choosing the belt speed. The belt speed for the Kistler instrumented treadmill can be adjusted in increments of 0.1M/s giving the investigator unprecedented control over the dog's velocity. However, the selected velocity may force to the subject to ambulate at an uncomfortable speed. Human kinetic studies suggest that there is an optimum speed for walking that is the most energetically efficient. Outside of this speed "comfort zone" there is an increased variability of GRF in the vertical axis (Masanei, Kouzaki, Fukunaga et al., 2002). It can be extrapolated that if the dog is forced to trot at an uncomfortable speed, as selected by the investigator, then an increase in the variability of ground reaction forces is to be expected. If the subject is lame, the subject's acceptable, comfortable velocity may change due to the changes in kinetics and kinematics that occur with lameness. To the author's knowledge, there are no studies comparing the variability of ground reaction forces of sound or lame dogs at different speed in dogs.

In order to overcome this potential limitation, the investigator should determine, as best as possible, a subject's preferred trotting velocity both over ground and on the treadmill before testing. Therefore during the training and acclimatization period, a 'comfortable' range of velocity for both sound and lame subjects should be determined to minimize this potential source of variability.

1.2.5 COMPARING TWO MEASUREMENT DEVICES

Various statistical methods have been suggested to compare two measuring devices: the Pearson correlation coefficient, the paired t-test and the coefficient of variation or the intra-class correlation coefficient. Alone, none of these tests can completely assess the desired reproducibility characteristics (Lin, 1989). The Pearson correlation coefficient (ρ) measures the precision of a linear relationship between two variables. Since it fails to detect a departure from the 45-degree line it cannot be used alone to measure the agreement. Location shift, scale shift and a combination of location and scale shift are examples of when the Pearson correlation coefficient fails to detect agreement. Both the paired t-test and least squares analysis can falsely reject (accept) the hypothesis of high agreement when the residual error is small (large). The coefficient of variation and the intraclass correlation coefficient allow duplicate readings to be interchangeable, in other words, these methods consider duplicate readings to be random rather than distinct readings. (Lin, 1989)

For an instrument validation process, the method agreement, or reproducibility of measurements, from instrument to instrument is of interest. Lin developed the concordance correlation coefficient (ρ_c) as a means to evaluate reproducibility (Lin, 1989; Lin, 1992; Lin, 2000). It contains the measurements of accuracy and precision. The premise of the concordance correlation coefficient is to plot the results from both instruments on a same graph and evaluate the agreement between two readings from the same sample by measuring the variation from the 45-degree line through the origin from

which both concordance coefficients (r^2) and correlation coefficients (ρ) are calculated. The concordance coefficient (r^2) compares the actual agreement obtained with the agreement obtained by chance alone. The agreement is poor if $r^2 < 0.2$, fair if $r^2 < \text{or} = 0.4$, moderate if $r^2 < \text{or} = 0.6$, substantial if $r^2 < \text{or} = 0.8$, and good if $r^2 > 0.8$ (Petrie, Watson, Blackwell, 1999).

In combining the correlation and concordance coefficients, an effective method of assessing agreement between two measuring devices is possible (Lin, 1989). The concordance-correlation coefficient can be used to assess agreement of PVF obtained by the single force plate and the treadmill with integrated force plates.

It must be noted that, although concordance-correlation coefficient provide an estimation of the agreement between two systems, it does not determine which of the two systems is more accurate (Lin, 1989).

The Bland-Altman plot, which explicitly shows differences between the two measures (on the Y axis) over their range (on the X axis) can be used to demonstrate the presence of bias between two testing systems (Bland, Altman, 1999). Bland-Altman analysis assumes that neither system is a “gold standard” and that the test is only a comparison between the two systems.

1.2.6 SUMMARY

In the present literature, kinetic gait analysis studies have enabled researchers to better understand the biomechanics of normal canine gait, as well as the biomechanics of lameness. Kinetic gait analysis is an essential tool for accurate assessment of the efficacy of medical and surgical treatment of lameness. Factors that affect variance have been identified and must be minimized and controlled to ensure accurate and consistent data collection.

Kinetic gait analysis remains a research-based tool at this time but its impact on future treatment options for canine lameness is irrefutable. With the advent of force plate systems such as the treadmill with integrated force plates that allow accurate and rapid assessment of lameness, their integration in a clinical setting is fast approaching.

Little data exists regarding kinetic gait analysis using a treadmill with integrated force plates. Therefore, a controlled prospective, experimental study was undertaken to compare and evaluate the use of a treadmill with integrated piezoelectric force plates for canine kinetic gait analysis in lame and sound dogs at a trot, as compared to a single piezoelectric force plate.

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EVALUATION OF A TREADMILL WITH INTEGRATED FORCE PLATES FOR KINETIC GAIT ANALYSIS OF SOUND AND LAME DOGS AT A TROT

2.0 INTRODUCTION

Canine kinetic gait analysis can be performed using a force plate to obtain non-invasive, objective and quantitative assessment of ground reaction forces (GRF) occurring during the stance phase of the stride^{1,2}. Different force platform measuring systems have been used for canine kinetic gait analysis³⁻¹⁰ with the piezoelectric force platform considered the current gold standard. This system is highly sensitive over a large measuring range¹¹ and has been used extensively in canine gait analysis to assess both normal^{1,11-25} and lame dogs^{26,27} as well as to assess the effect of therapy for lame dogs affected with a range of diseases.²⁷⁻³²

A major disadvantage of a single force platform is the inability to measure consecutive strides during locomotion, essentially obtaining only a snapshot of the complex phenomenon of locomotion.^{2,11,5,6} Variability between successive footfalls, defined as inter-step variability, cannot be easily evaluated.⁵ In addition, single force platform systems are limited to analyzing footfalls of the ipsilateral limbs to avoid summation of GRF with the contra-lateral limb. Therefore, a single force platform system does not allow simultaneous evaluation of the contra-lateral limb or compensatory loading in other limbs.²⁸

The effects of subject velocity and acceleration on GRF has been well documented and rigorous control of these variables is essential for accurate and reproducible results using a single platform system.^{14-16,18,21,22} To remain within an acceptable range of speed and acceleration, a high number of repetitions are often required to obtain valid trials making data collection labour intensive and time consuming. Increasing the number of trials has also been reported to increase variability.¹³

Canine gait researchers have developed other force plate systems to overcome limitations of the single force platform system. These include using multiple force platforms,^{3,5,6} a pressure walkway system^{7,8} and the integration of force plates on a mechanized treadmill (Figure 1).^{4,9,10}

The integration of force plates on a mechanized treadmill system allows continuous measurement of vertical GRF of successive foot-strikes, over a chosen period of time.³⁴ This allows assessment of consecutive steps for the calculation of inter-step variability⁵ and, because it also records GRF for all four limbs simultaneously, it has the capacity to demonstrate compensatory gait redistribution.²⁶ The ability to control the belt speed of the treadmill permits accurate and precise control of subject velocity and acceleration.³⁴ This, combined with the generation of continuous data for consecutive foot strikes, eliminates the necessity of performing multiple trials, a major source of variance in canine gait analysis. Finally, the treadmill system offers the advantage of

rapid data collection, producing more data over a shorter period of time than the single, or even the multiple force platform system.

Dogs have been tested and trained on treadmills for kinetic and kinematic gait analysis studies^{4,9,10,33,34,35}. Recently, Bockstahler et al. analyzed the gait of dogs at a walk on a treadmill and concluded that ground reaction forces determined by a treadmill system were reproducible at a walk; however, the ground reaction forces obtained were not directly compared to over ground walking³⁶.

To the authors knowledge a treadmill with integrated force plates has yet to be validated with respect to the single force platform system. Our objective was to assess the feasibility and ease of data collection for sound and lame dogs at a trot using a treadmill with two integrated force plates and to compare the PVF obtained with the treadmill to PVF obtained on a single piezoelectric force platform. We hypothesized that the treadmill-force plate system should accurately reproduce mean peak vertical force at a trot for sound and lame dogs as compared to the piezoelectric force platform with a high concordance correlation coefficient. A secondary objective was to report the inter-step variability associated with each testing system for both sound and lame dogs and to assess the effect of lameness on the inter-step variability on each of the two systems.

2.1 MATERIAL AND METHODS

2.1.1 PART I: SOUND DOGS

2.1.1.1 DOG SELECTION, TRAINING AND ACCLIMITIZATION

Eight healthy mixed breed dogs without any evidence of clinical lameness were obtained for the duration of the study from the Central Animal Facility of the University of Guelph. The research protocol was approved by the Animal Care Committee of the University of Guelph. All of the animals underwent a physical examination and an orthopaedic examination prior to the start of the study. The animals were housed at the Central Animal Facility during the acclimatization and testing periods. The individual dogs were trotted on the treadmill and the force platform for three consecutive days before testing. Treadmill training consisted of a series of short trotting sessions of increasing duration beginning with 30 seconds, and gradually increasing to two minutes of trotting time. Each session lasted approximately one hour. During these trials, the preferred trotting speed for each dog was determined. The preferred trotting speed, or target velocity, was selected when the dog appeared to be trotting comfortably for a minimum of 30 seconds, without trying to accelerate or decelerate. The dogs were then trained on the force platform, by making multiple passes over the force platform over a period of one hour. The same handler was used for all acclimatization and testing trials. Those dogs that did not trot consistently or showed signs of reluctance to trot after acclimatization were rejected. Seven healthy dogs were accepted based on the above

criteria. One developed a non-weight bearing lameness of the right forelimb immediately prior to testing and was rejected. The remaining six dogs, ranging from 20.0 to 25.5 kg, were assessed and tested on both systems.

2.1.1.2 STUDY DESIGN

The dogs were randomly assigned a side for analysis (2= right, 4 = left) and the order of testing was also randomly assigned. In order to avoid day-to-day variation in vertical ground reaction forces, testing for an individual dog occurred on the same day²⁰. The force platform, and the two force platforms integrated in the treadmill were calibrated prior to testing. The animals were weighed on the digital scale of the force plates integrated into the treadmill immediately prior to testing. Dogs were tested on the treadmill first and then given a minimum of two hours of rest before being tested on the force platform.

2.1.1.3 TREADMILL WITH INTEGRATED FORCE PLATES

The force measurements were acquired using a Gaitway® instrumented treadmill^a (TM) with two built-in force plates to determine peak vertical force and centre of pressure³⁷. Based on acclimatization testing, each dog was assigned an individual target velocity which ranged between 1.8 and 2.2 m/s. Data acquisition was initiated only when the animal displayed consistent trotting with minimal lateral movement or 'head bobbing'. All of the trials were monitored with two analogue video cameras, positioned

at right angles to one another. One camera was perpendicular to the plane of progression; the other was positioned behind the dog in the plane of progression. The video recorded was reviewed after each testing session to ensure that contact of the front limbs on the rear force plate or rear limbs on the front force plate was minimized. Although the position of the dog on the treadmill was adjusted within the plane of progression to minimize these interferences, some cross over did occur and was often inevitable.

The data acquisition was started as soon as the treadmill had reached the desired velocity and the dog was trotting consistently. The data was acquired for a period of 15 to 30 seconds at 200 Hz. The vertical forces (F_z) and the centre of pressure (A_x) were recorded over time using Bioware™ data acquisition software^b. The recording of the centre of pressure enabled identification of limb side. For each dog, data collection was repeated five times. From each of the five trials, five seconds of consistent gait were selected based upon a review of the video analysis and analysis of the tracing of GRF over time. This data was then exported to an Excel^c file for further processing and analysis.

2.1.1.4 FORCE PLATFORM

A single, floor mounted, force plate^d was used for data acquisition (FP) (Kistler® Multi-component Force Plate for Biomechanics Type 9281C). A series of four photocells^e were placed along the runway, at 0.5 meter intervals, centred over the force plate. The dogs were allowed to trot freely with minimal guidance from the handler. The

accepted trotting velocity parameters were restricted to 0.25 m/s above or below the selected individual velocity for treadmill testing. The accepted acceleration parameters were restricted to $\pm 0.3 \text{ m/s}^2$. All four photocells had to be triggered or the trial was rejected. Data was collected from the assigned ipsilateral front and rear limb using Bioware™ data acquisition software^b at a sampling rate of 200 Hz. Each pass of the dog across the force platform was recorded with analogue video recording. Video footage was analyzed in slow-motion to ensure the side was correctly identified and that both front and rear ipsilateral foot strikes were centred on the force platform. A minimum of five valid trials was required for each dog. Post collection data analysis revealed that two of the six dogs did not fulfil all inclusion criteria for all five trials and only four valid trials could be analyzed for these two dogs.

2.1.2 PART II: Lame dogs

2.1.2.1 DOG SELECTION, TRAINING AND ACCLIMITIZATION

Eight dogs belonging to staff and students at the Ontario Veterinary College of the University of Guelph, with a grade 2/5 forelimb lameness (weight bearing lameness, visible at a trot) were used for the study. Owner consent was required for acceptance into the study. The dogs underwent a physical examination and a gait evaluation before acclimatization and testing. They were trained on both systems prior to testing and testing occurred on the same day for each individual dog. Only dogs that were able to trot on

both systems were accepted for the study. Of the eight dogs trained, six, with weights ranging from 17.0 to 36.1 kg were selected for testing.

2.1.2.2 STUDY DESIGN

The testing protocol was identical to that of the dogs in group I except that both the left and right sides were assessed for each dog..

2.1.3 STATISTICAL ANALYSIS

The raw data was filtered using a running average ($n=3$). The mean peak vertical force (PVF) was obtained with TM for each assigned limb for each dog and compared to the mean PVF obtained with FP for the same limb. Concordance coefficient (r^2) and correlation coefficient (ρ_c) were calculated. A paired t-test on the mean difference between testing systems and a Bland-Altman plot were used to determine bias. Inter-step variability (interclass correlation coefficient (IC)) was calculated by measuring the proportion of variation between the steps to the total variation in a mixed ANOVA model for repeated measures. In the model used, the random effects consisted of Dog; Dog X Leg; step (Dog X Leg); with side as a fixed effect. The data was log transformed to improve normality. In an effort to minimize the difference in methodology of data collection between the two systems, a separate IC for each of the five trials on the TM was calculated and their average reported.

2.2 RESULTS

2.2.1 CORRELATION AND CONCORDANCE COEFFICIENTS

For the sound dogs (group I), concordance and correlation coefficients of the mean PVF between the FP and the TM for the front limbs was 0.79 and 0.76 respectively. Concordance and correlation for the rear limbs was 0.90 and 0.81 respectively. For the lame dogs (group II), concordance and correlation for the front limbs was 0.73 and 0.59 respectively. Concordance and correlation for the rear limbs was 0.89 and 0.95 respectively (Table 2-1).

2.2.2 INTER-STEP VARIABILITY

Inter-step variability for the assigned limbs in the sound dogs was calculated to be 0.94 with the TM and 0.84 with the FP. Inter-step variability for the lame limb in the lame dogs was calculated to be 0.96 with the TM and 0.87 with the FP (Table 2-2).

2.2.3 BIAS

The mean difference between systems was calculated and for both forelimbs and hind limbs in sound and lame dogs the mean peak vertical force was greater for the force plate than the treadmill. For the sound dogs, the mean difference in the forelimbs and hind limbs was 11.84 N ($p=0.099$) and 0.64 N ($p=0.867$) respectively. For the lame

dogs, the mean difference in the forelimbs and hind limbs was 13.88 N ($p = 0.41$) and 19.2 N ($p = 0.0001$) respectively. Only the mean difference in the hind limbs of the lame dogs was statistically significant.

2.3 DISCUSSION

2.3.1 CONCORDANCE AND CORRELATION RESULTS

For an instrument validation process, the reproducibility of measurements, from instrument to instrument, is of interest. Lin developed the concordance correlation coefficient as a means to evaluate reproducibility^{38,39}. The premise is, to plot the results from both instruments on a same graph and evaluate the agreement between two readings, from the same sample by measuring the variation from the 45-degree line through the origin from which concordance and correlation coefficients are calculated. However, it must be noted that, although concordance provides an estimation of the agreement between two systems, it does not determine which of the two systems is more accurate. Based upon the combination of concordance and correlation coefficients, one can estimate the reproducibility of measurements.

Ideally, perfect concordance and correlation coefficients would have been obtained for both testing groups for both forelimbs and hind limbs. This is an unrealistic goal because mechanical parameters that influence GRF, such as: velocity, stance time, acceleration/deceleration of the subject, can only be partially controlled but not completely eliminated.^{12,14,16,21,22} The testing protocol was designed to eliminate as many sources of variability as possible, and to minimize the effects of those sources that were not eliminated. Current references for concordance state that coefficients of concordance

<0.2 are poor, from 0.2-0.4 are fair, from 0.4-0.6 are moderate, from 0.6-0.8 are substantial and > 0.8 are good⁴⁰.

Using these references, our results demonstrate that for the dogs in the sound group, concordance of mean PVF for the hind limbs was good and concordance of mean PVF for the forelimbs was substantial. While for the lame dogs, the concordance was good for the hind legs and only substantial for the front legs (Table 2-1). Both, concordance and correlation coefficients of mean PVF were higher for the hind limbs than the forelimbs in both sound and lame dogs.

Several factors may have contributed to the less than perfect concordance and correlation: Firstly there may be an inherent bias between the two testing system that could decrease the concordance coefficient. An overall trend of higher peak vertical force was noted on the force plate, although only significant for the hind limbs of the lame dogs. Calibration was performed prior to testing to ensure that instrument bias was minimized. White et al. demonstrated that in humans, vertical ground reaction forces during over-ground walking and treadmill walking had a high correlation between force Vs time curves. However significant differences in force magnitude were noted⁴¹. More specifically, during the push-off phase, peak forces were 5-6% less on the treadmill than over-ground. The authors of the report suggest that the propulsive shear forces of push-off result in positive work on the treadmill leading to increased belt speed with subsequent energy transfer from the belt to the subject resulting in a reduction in magnitude of peak vertical force.⁴¹

The treadmill belt may also have a dampening effect on ground reaction forces creating a bias. The material properties of the belt and the friction of the running belt may have cushioned the impact of the foot strikes, thereby decreasing the peak vertical force.

Another explanation may be the existence of an inherent biomechanical difference between treadmill trotting and overland trotting in dogs. Although several studies have been published recently on the subject, the topic remains controversial. Owen et al. reported that Greyhound dogs trotted on a treadmill have comparable joint angles and angular velocities as compared to published values for over-ground trotting with a high level of consistency³⁵. A more recent publication by Clements et al. investigating treadmill kinematic parameters in normal Labrador retrievers at different gait cycles demonstrated that angular displacement and angular velocities of the elbow and stifle were highly variable within trotting sessions³³. This contradicts earlier findings that suggested that treadmill trotting was highly consistent and a steady state of trotting was obtained within 30 seconds³⁵. In horses, a kinematic study demonstrated a decrease in stride duration, a decrease in vertical displacement of the withers and an increased stance time of the forelimbs during treadmill trotting as compared to over-ground trotting⁴² implying that quadrupedal adaptation occurs during treadmill trotting.

Treadmill kinetic and kinematic analyses are routinely used in human biomechanics studies and may give us insight into the canine situation. Because of the inherent differences between bipedal and quadruped gait, care must be taken when

making any reference to human biomechanics. With this in mind, significant differences in kinematics between treadmill running and over-ground running have been demonstrated and remain unexplained^{43, 44}. These studies suggest that the biomechanics of running on a treadmill, while similar to over-ground biomechanics, are inherently different in humans. Such differences may be present for dogs trotting on the treadmill and may explain the lack of perfect concordance and correlation.

Another factor that we believe may have contributed to the less than ideal concordance and correlation coefficients for both sound and lame dogs is that the subjects were forced to trot at a predetermined speed. Care was taken to determine their preferred speed during the acclimatizing period; however, this evaluation was subjective and the preferred speed may have changed throughout the study as the dog became more accustomed to the treadmill or the force plate. It is also possible that the target speed selected was slightly inadequate for some dogs, particularly for the lame dogs that may have been forced to trot at an uncomfortable speed. Human kinetic studies suggest that there is an optimum speed for walking that is the most energetically efficient. Outside of this speed, there is an increased variability of GRF⁴⁵. This may parallel what we noticed in dogs at a trot; that outside of their individual comfort zone, dogs frequently attempt to modify their speed by accelerating or slowing down, resulting in a more variable gait.

In order to minimize this effect, different trotting velocities were used to assess a given dog's ability to trot on the treadmill during the acclimatization period. Conversion from a fast walk to trotting was typically noted at approximately the same velocity for

each individual dog with most dogs having a comfortable trotting range on the treadmill between 1.8 and 2.2 m/s. If the velocity was outside the dogs 'comfort zone' more irregular PVF readings were noted and a more erratic gait, with increased lateral movements and attempts to accelerate or decelerate combined with increased head bobbing was observed. Any movement of the head, during gait recording, resulted in profound effects on PVF. This effect was much more pronounced on PVF of the forelimbs than on the PVF of the hind limbs, which remained relatively constant. This increased variation on the forelimbs may explain why concordance and correlation were generally better for the hind limbs than for the forelimbs. This effect was most evident on the treadmill because of the strict control of the speed but also because the treadmill allowed the recording of multiple consecutive footsteps for over 30 seconds, enabling to easily observe such variability. It is the authors' impression that the same source of variation would also be observed on the force plate if the control of speed was as strict as that of the treadmill.

For dogs in the lame group, both concordance and correlation for the forelimbs were lower than the sound dogs, however, the concordance and correlation of the hind limbs was comparable to the sound group. In the lame group, the forelimb was responsible for the lameness in all dogs, from a variety of diseases processes, possibly increasing variability of the forelimb PVF with respect to the sound hind limbs. Secondly, it is likely that dogs that are lame may be less comfortable and willing to run on a treadmill, making the determination of their preferred speed difficult. As the lameness worsens, a dog may not be willing to trot any longer and will experience pain

and anxiety, which will result in an alteration in gait that will be reflected more in the forelimbs than the hind limbs. Another factor that may have decreased concordance is the fact that as the testing progressed, the lameness may have been exacerbated by exercise resulting in more variable data. All of the dogs were given a minimum of a two hour break between testing systems, however that may not been adequate as some dogs showed an increase lameness as testing progressed.

Based on these observations, it appears important to determine the preferred trotting speed of each individual dog on the treadmill and to maintain that speed throughout the trials, rather than forcing the dogs to adopt a speed outside of their comfort range. This limitation may need to be taken into account when selecting the test population and it may be beneficial, in order to minimize the source of variation, to select dogs of similar weight, size and body shape for treadmill testing. Another factor that may need to be considered, when designing a project, is the fact that the preferred trotting speed of a specific dog may vary as the lameness increases, making comparisons pre- and post- treatment difficult. More in depth combined kinetic and kinematic analysis would be required to confirm or infirm these subjective findings and their effect on GRF.

Better concordance and correlation may have been obtained with a larger sample size, a larger number of trials and by randomizing the order of system testing. Our sample size and number of trials were based on previous research and availability of the testing systems dictated the testing system order.

2.3.2 INTER-STEP VARIABILITY

The inter-step variability was excellent (>0.75) for both TM (sound: 0.94, lame: 0.96) and FP (sound: 0.84, lame: 0.87) dogs⁴⁰. The presence of lameness did not appear to greatly affect the inter-step variability within a testing system. As the methodologies for data collection were inherently different for each testing systems, direct comparison of the inter-step variability of each system is not possible.

2.3.3 TIME FOR DATA ACQUISITION

The time required for data acquisition for TM was considerably less than the time required for FP. Each trial on the treadmill takes between 30 seconds to one minute to complete. The five seconds of data selected for analysis produced, eight to ten consecutive foot strikes for each of the four legs. Collecting the same amount of information with a force plate would likely take several hours. Considering that lameness can be exacerbated by exercise and activity, shorter testing periods may produce more uniform results. Equally important is the fact that the number of trials required for force platform testing has been reported to be an important contributing factor to variability¹³.

2.3.4 TRAINING AND ACCLIMITIZATION

There are many benefits of acclimatization and training of test subjects. Firstly it allows a standardized testing protocol to be established for each system and instrumentation and data collection can be refined. When used for force platform testing, acclimatization results in smaller coefficients of variation between dogs,¹⁹ reducing inter-dog variation and therefore requiring fewer trials to obtain statistically significant data. Training appears even more important on the treadmill than on the force plate as very few dogs are comfortable enough to trot on their first trial. Furthermore, several trials are usually necessary to determine each dog's preferred speed. In this study, determination of the dog's preferred speed was accomplished by increasing the belt velocity in 0.2m/s increments and subjectively assessing the dog's gait using analogue video of each trotting session. In addition, the consistency of the force vs. time curve was assessed. Based on these two criteria, the dogs were assigned an individual target speed. This speed was used for treadmill testing and was the target velocity for force platform testing.

Subjectively, training on the treadmill with a positive reward system was simple and effective for both normal and lame dogs. Determination of potential testing candidates was made during the three day acclimatization period. The animal was first introduced to the testing environment and then, once familiar with the environment, was invited to stand on the treadmill. Initially, very short trials at low velocity were performed, gradually increasing the duration and velocity of each trial until a comfortable trot was achieved consistently and maintained for 30 to 45 seconds. Acclimatization to

the force platform proceeded in a similar fashion with environment acclimatization followed by repeated trials on the force platform.

Currently there are not any guidelines for restraint of animals used on a treadmill and its effect on treadmill gait analysis has not been quantified. Ideally, dogs would trot on the treadmill without any restraint. However, minimal restraint was required to ensure the safety of the test subjects and to maintain the dog in the optimal position over the force plates. The handler sat facing the dog and securely held the collar of the dog on both sides. Traction was not placed on the collar during data acquisition. Restraint by the handler could introduce error as the dog pulled away or to one side. In order to minimize this effect, if the handler noted any traction during data acquisition, the data was discarded.

Only one out of eight dogs in the normal group and two out of eight dogs in the lameness group that were acclimatized for three days were rejected based on poor performance. It is important to note that of these three rejected dogs, one dog was removed because of an acute onset of lameness of unknown cause that developed while housed for the night and the two remaining dogs were rejected due to poor compliance on the force platform, not the treadmill. This result strongly suggests that both normal dogs and dogs with a mild lameness can be successfully trained for treadmill trotting.

2.3.5 LIMITATIONS

For the lame group, dogs with grade 2/5 lameness were specifically selected to ensure that the lameness would not impede the dog from trotting. Trotting entails simultaneous contact of the contra-lateral forelimb and hind limb resulting in one forelimb foot strike for the front force plate and one hind limb foot strike for the rear force plate on the treadmill. Walking typically results in multiple foot strikes on the same force plate and would result in summation of the forces registered on the plates. This is an important limitation of the force plate integrated treadmill system used in this study, and we recognize that dogs with more severe lameness may not be able to trot on this system. Treadmills designed with four plates overcome this limitation because each limb has its own dedicated force plate^{4,9,10,37}.

Mechanical parameters that influence GRF such as velocity, stance time, acceleration/deceleration of the subject, and have been well documented.^{12,14,16,21,22} The treadmill allows precise control of subject velocity by controlling the treadmill belt velocity³⁷. In horses, a 9% change in belt speed velocity was noted during the stance phase during treadmill trotting⁴². Due to the markedly inferior mass of the dog as a testing subject, we assumed this to be of minimal significance in dogs. Unfortunately, this assumption could not be confirmed, because the treadmill belt speed could not be specifically measured in this study. Despite a constant treadmill belt speed, acceleration and deceleration of the subject is still possible, however, the handler should be able to appreciate this by forward or backward traction on the animal's collar. Nelson has

suggested that in humans, the constant speed of the treadmill resulted in less acceleration/deceleration than over-ground running⁴⁴. Based on our study we are not able to substantiate this claim in dogs.

Other limitations include the absence of other kinetic parameters to compare the testing systems. The two force plate system integrated into the treadmill did not allow evaluation of the cranio-caudal and medio-lateral forces. In addition, some overlap of the ipsilateral forelimb and hind limb often occurred during trotting. This was noted at the beginning of the ascending and descending slopes and precluded the exact calculations of these variables and impulses. These limitations should hopefully be overcome in future studies with adequate software that can separate ipsilateral foot strikes or by selecting dogs that are able to trot with minimal overlap.

While the treadmill offers several advantages over the single force platform, perhaps the most important potential limitation of treadmill kinetic analysis is whether trotting on a treadmill is comparable to over-ground trotting. This fundamental question remains unanswered.

2.4 CONCLUSION

The treadmill with integrated force plates provided rapid peak vertical force measurements in sound and lame dogs at a trot with good concordance and correlation for the hind limbs in both sound and lame dogs as compared to the single force platform. The concordance coefficients for the forelimbs were substantial for the sound and lame dogs. The control of subject velocity and acceleration, and rapid acquisition of ground reaction forces of consecutive footfalls are important advantages of the treadmill with integrated force plates. Both sound dogs and dogs with a grade 2/5 forelimb lameness were successfully trained for treadmill trotting. The force plate, and treadmill, demonstrated excellent inter-step variability for both sound dogs and dogs with a grade 2/5 forelimb lameness.

Based on our results, the treadmill with integrated force plates represents an effective alternative for assessment of mean peak vertical force in sound dogs and dogs with a grade 2/5 forelimb lameness.

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- a. Gaitway Instrumented Treadmill Type 9810AS10. Kistler Instrument Corp., Amherst, NY 14228-2171. USA.
 - b. Bioware Data Acquisition Software, Kistler Instrument Corp., Amherst, NY 14228-2171. USA.

- c. Excel® spreadsheet software. Microsoft Canada Co. 1950 Meadowvale Blvd
Mississauga, Ontario L5N 8L9, Canada.
- d. Multicomponent Force Plate for Biomechanics Type 9281C. Kistler Instrument
Corp., Amherst, NY 14228-2171. USA.
- e. Alge-Timing Equipment GmbH & Co, Rotkreuzstrasse 39, 6890 Lustenau,
Austria.

Table 2-1: Concordance (r^2) and correlation (ρ) coefficients for forelimbs and hind limbs of lame and sound dogs. Bias, reported in Newtons, with significance ($p < 0.05$) of t-test of mean difference between systems with upper (UL) and lower limits (LL) of 95% confidence interval (CI).

	r^2	ρ	Bias (N)	P-value	95% CI (N)	
					LL	UL
Sound dogs						
Forelimbs	0.79	0.76	+11.84	0.099	-3.24	+26.93
Hind limbs	0.90	0.81	+0.65	0.87	-8.90	+10.21
Lame dogs						
Forelimbs	0.73	0.59	+13.88	0.41	-21.91	+49.66
Hind limbs	0.89	0.95	+19.2	0.0001	+11.92	+26.47

Table 2-2: Inter-step variability for the force platform (FP) and the treadmill (TM) for sound dogs and lame dogs.

	FP	TM
Sound dogs	0.84	0.94
Lame dogs	0.87	0.96

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2.6 GENERAL DISCUSSION

We determined that the treadmill with integrated force plates can be used effectively to obtain mean peak vertical force measurements in both sound and lame dogs at a trot. The treadmill with integrated force plates provided more rapid data collection than the traditional single force plate and allowed the measurement of consecutive foot strikes of all four limbs (Figure 2.10).

Calibration was performed to minimize instrument bias. A 50 Newton calibration weight was placed on the piezoelectric force plate and data was recorded for 5 seconds. The average value of force reading for the 50 Newton calibration weight was calculated. Subsequently, a 100 Newton weight was placed on the force plate and the average value of the force measurement over 5 seconds was calculated. From this data, the average recorded force values were plotted against the known calibration weights of 50 and 100 Newtons to obtain a calibration curve. The equation of the calibration curve was calculated and the values obtained from force plate testing were then multiplied by the value of the slope of the calibration curve. This procedure was repeated for the treadmill with integrated force plates.

Re-examining our hypothesis, we accepted that the treadmill with integrated force plates would accurately reproduce mean peak vertical force for both sound and lame dogs at a trot based on our concordance and correlation coefficient results. However, it should be noted that mean peak vertical force in the hind limbs demonstrated good concordance

between testing systems, while the mean peak vertical force in the forelimbs demonstrated only substantial concordance between testing systems. We believe the difference in concordance results between the forelimbs and the hind limbs is due to the fact that the forelimbs may play a more important role than the hind limbs in continuous gait adjustments that occur during locomotion. When dogs appeared uncomfortable during a trotting session, exaggerated movement of the head was noted. At the same time, increased variability in the vertical ground reaction forces of the forelimbs was present; however the hind limb vertical ground reaction forces remained relatively constant. This may explain the difference in concordance and correlation between the forelimbs and hind limbs in sound dogs. This difference was exaggerated in the lame group since the forelimb was responsible for the lameness in all of the dogs. One would expect that the forces applied to a lame limb would be more variable than a sound limb due to pain and discomfort or a reluctance to use the limb. In addition, exercise could potentially aggravate the lameness, resulting in less weight bearing in the lame limb, and subsequently more variation in ground reaction forces, as testing progressed.

Training and acclimatization was performed with a positive reward system and dogs selected for this study quickly learned how to trot effectively on the treadmill. Dogs that were not fearful or timid, and that had a good disposition were preferentially selected for testing. Training on the treadmill was performed by gradually increasing the treadmill belt velocity so as to assess at what speed the subject began to trot and to estimate a velocity range at which the subject appeared most comfortable. This comfortable velocity range tended to be more elevated in the larger dogs, probably due to

their increased stride length. Dogs that were very large tended to have increased cross-over of the front limbs on the rear force plate or rear limbs on the front force plate. Smaller dogs did not encounter this problem as frequently. This may be due to the fact that smaller dogs adapted to treadmill trotting by increasing their stride frequency while decreasing their stride length. This would lead to a decreased incidence of cross-over. We did not measure these kinematic parameters so cannot confirm this hypothesis. The largest dog in this study, an Irish wolfhound cross, was able to successfully trot on the treadmill with minimal crossover.

During the treadmill training sessions, some of the dogs appeared to adapt to the treadmill velocity and changed the speed at which they began trotting. In extreme situations, some test subjects continued to walk, refusing to convert to a trot at high treadmill belt velocities (2.0-2.2 M/s). This fact must be taken into consideration when testing is performed over several days or at repeated intervals. In addition, alterations in gait are to be expected if lameness is induced, either experimentally or naturally. The preferred speed of a sound subject could be altered by the induction of lameness. This may limit the usefulness of the treadmill for assessing experimentally induced lameness in dogs at a trot since the acclimatization and training performed when the dog was sound may not be appropriate for the same dog with lameness.

An important question that this study cannot completely answer is whether treadmill trotting and over-ground trotting are biomechanically similar. Based on peak vertical force, a trend of higher peak vertical force readings on the single force plate than

the treadmill with integrated force plates was noted in this study. This may be a result of adaptation by the testing subject to trotting on the treadmill. In addition, subjective differences in stride length were noted with dogs appearing to have a shorter stride length and increased stride frequency on the treadmill as compared to over-ground. Kinematic studies comparing over-ground trotting to treadmill trotting are inconclusive at this time. Combined kinetic and kinematic studies comparing over-ground and treadmill trotting are necessary to determine whether differences in trotting biomechanics exist between treadmill and over-ground locomotion. Until this fundamental question is answered, the treadmill with integrated force plates should be used as an alternative method for canine kinetic gait analysis, and not as an adjunctive method with the traditional single force plate system.

Inter-step variability for both systems was excellent. Due to the difference in data collection methods, the inter-step variability between the treadmill with integrated force plates and the single force plate system could be directly compared. As such we are unable to make a statement on which system results in less inter-step variability. With force platform testing, inter-step variability is a direct reflection of trial variability since each recorded footstrike is associated with one trial. With the treadmill, one can obtain multiple consecutive footstrikes in one trial, removing the variability associated with different trials, thus decreasing the inter-step variability. However, in an attempt to minimize the difference in data collection between the two systems, the mean inter-step variability for each of the five treadmill trial was calculated and compared to the mean of five force platform footstrikes.

A major limitation of this study is that only peak vertical force was measured. Other kinetic parameters such as ascending and descending slopes and impulse were not calculated. Ascending and descending slopes and impulse could not be accurately calculated due to the presence of overlapping of successive foot strikes on the integrated force plates on the treadmill. This represents a major limitation of this study as only partial kinetic data is available for analysis. Future studies may benefit from more advance software that may be able to extrapolate and calculate other kinetic parameters. Forces in the cranio-caudal and latero-medial axis were also not analyzed.

Dogs that are unable to trot due to lameness cannot be assessed with the treadmill with integrated force plates. This limits its clinical applications to the study of mild lameness which would not preclude an animal's ability to trot. Treadmills with four integrated force plates overcome this limitation, enabling kinetic analysis at any gait since each limb has its own dedicated force plate.

2.6 TABLES

Table 2-3: Mean Peak Vertical Force (mPVF) in Newtons (N) for the treadmill with integrated force plates (TM) and the single force plate (FP) for sound dogs in Group I

Dog	Leg	Side	TM mPVF	FP mPVF
Betty	Front	Left	280,61	291,14
Chester	Front	Right	273,89	285,39
Danny	Front	Right	251,55	259,02
Kansas	Front	Left	332,15	328,46
Pedrino	Front	Left	285,88	324,91
Pequeena	Front	Left	260,14	266,37
Betty	Rear	Left	186,94	196,85
Chester	Rear	Right	162,00	163,51
Danny	Rear	Right	179,62	167,26
Kansas	Rear	Left	199,79	191,27
Pedrino	Rear	Left	189,33	195,10
Pequeena	Rear	Left	143,31	150,92

Table 2-4: Mean Peak Vertical Force (mPVF) in Newtons (N) for the treadmill with integrated force plates (TM) and the single force plate (FP) for lame dogs in Group II with the lame limb highlighted

Dog	Leg	Side	TM mPVF	FP mPVF
Guinness	Front	L	308,7	432,2
Guinness	Front	R	300,4	348,1
Harvey	Front	L	378,1	286,1
Harvey	Front	R	387,4	347,4
JayJay	Front	L	325,6	329,0
JayJay	Front	R	340,1	306,2
Madison	Front	L	217,3	210,7
Madison	Front	R	181,7	168,8
Meg	Front	L	280,2	318,0
Meg	Front	R	311,9	346,2
Winston	Front	L	407,6	467,5
Winston	Front	R	393,4	438,7
Guinness	Rear	L	232,7	276,7
Guinness	Rear	R	199,8	234,5
Harvey	Rear	L	203,1	216,5
Harvey	Rear	R	199,4	226,9
JayJay	Rear	L	166,0	180,5
JayJay	Rear	R	164,1	180,1
Madison	Rear	L	130,3	139,0
Madison	Rear	R	131,3	143,6
Meg	Rear	L	228,7	233,1
Meg	Rear	R	215,8	226,9
Winston	Rear	L	252,3	274,6
Winston	Rear	R	260,7	282,2

2.7 FIGURES

Figure 2-1: Dimensions (mm) and images of treadmill with integrated force plates. (Gaitway Instrumented Treadmill Type 9810AS10. Kistler Instrument Corp., Amherst, NY 14228-2171. USA.)

Side View

Table 2-1: Dimensions of the treadmill structure (mm)

Top View

Sound Dogs: Forelimbs

Figure 2-2: Concordance and correlation coefficients graphs for the forelimbs of sound dogs. Mean peak vertical force for each dog tested on both the treadmill with integrated force plates (Treadmill) and the single force plate (Force plate) are plotted in Newtons (N)

Sound Dogs: Hind Limbs

Figure 2-3: Concordance and correlation coefficients graphs for the hindlimbs of sound dogs. Mean peak vertical force for each dog tested on both the treadmill with integrated force plates (Treadmill) and the single force plate (Force plate) are plotted in Newtons (N)

Lame Dogs: Forelimbs

Figure 2-4: Concordance and correlation coefficients graphs for the forelimbs of lame dogs. Mean peak vertical force for each dog tested on both the treadmill with integrated force plates (Treadmill) and the single force plate (Force plate) are plotted in Newtons (N)

Lame Dogs: Hind Limbs

Figure 2-5: Concordance and correlation coefficients graphs for the hind limbs of lame dogs. Mean peak vertical force for each dog tested on both the treadmill with integrated force plates (Treadmill) and the single force plate (Force plate) are plotted in Newtons (N)

Figure 2-6: Bland-Altman plot of mean difference between treadmill (negative) and force plate (positive) in peak vertical force in Newtons (N). Two-sided upper and lower tolerance limits on differences as well as upper and lower limits of 95% confidence interval on difference for forelimbs of sound dogs in Group I.

Figure 2-7: Bland-Altman plot of mean difference between treadmill (negative) and force plate (positive) in peak vertical force in Newtons (N). Two-sided upper and lower tolerance limits on differences as well as upper and lower limits of 95% confidence interval on difference for the hind limbs of sound dogs in Group I.

Figure 2-8: Bland-Altman plot of mean difference between treadmill (negative) and force plate (positive) in peak vertical force in Newtons (N). Two-sided upper and lower tolerance limits on differences as well as upper and lower limits of 95% confidence interval on difference for the forelimbs of lame dogs in Group II

Figure 2-9: Bland-Altman plot of mean difference between treadmill (negative) and force plate (positive) in peak vertical force in Newtons (N). Two-sided upper and lower tolerance limits on differences as well as upper and lower limits of 95% confidence interval on difference for the hind limbs of lame dogs in Group II

Figure 2-10: Force (Newtons) versus time (seconds) curve of the data obtained with the treadmill with integrated force plates. Solid lines represent the forelimbs, dashed lines represent the hind limbs.

Table A-1: Timing data for force plate trial for sound dogs. Start and numbered stops indicate photocell timers. Vel indicates velocity for the designated intervals. Accel indicates acceleration for the designated intervals
Speed indicates subject target speed

Dog	Trial	Speed	Side	Start	Stop 1	Stop 2	Stop 3	Vel 0-1	Vel 1-2	Vel 2-3	Vel 0-3 (m/s)	Accel 0-2	Accel 1-3	Accel 0-3 (m/s ²)
Betty	1	2	L	0,0	0,3	0,5	0,7	2,0	2,3	2,1	2,1	0,6	0,3	0,2
Betty	2	2	L	0,0	0,2	0,5	0,7	2,2	2,3	2,2	2,2	0,2	0,1	0,1
Betty	3	2	L	0,0	0,2	0,5	0,7	2,0	2,3	2,2	2,2	0,5	0,1	0,3
Betty	4	2	L	0,0	0,3	0,5	0,7	2,0	2,2	2,1	2,1	0,3	0,2	0,1
Betty	5	2	L	0,0	0,3	0,5	0,8	1,9	2,0	1,8	1,9	0,2	0,3	-0,1

Dog	Trial	Speed	Side	Start	Stop 1	Stop 2	Stop 3	Vel 0-1	Vel 1-2	Vel 2-3	Vel 0-3 (m/s)	Accel 0-2	Accel 1-3	Accel 0-3 (m/s ²)
Chester	11	2	R	0,0	0,2	0,5	0,7	2,0	2,2	2,0	2,1	0,4	0,4	0,0
Chester	12	2	R	0,0	0,2	0,4	0,7	2,2	2,3	2,1	2,2	0,4	0,5	-0,1
Chester	13	2	R	0,0	0,2	0,5	0,7	2,1	2,2	2,1	2,1	0,1	0,2	-0,1
Chester	15	2	R	0,0	0,2	0,5	0,7	2,0	2,1	2,0	2,1	0,2	0,1	0,0

Dog	Trial	Speed	Side	Start	Stop 1	Stop 2	Stop 3	Vel 0-1	Vel 1-2	Vel 2-3	Vel 0-3 (m/s)	Accel 0-2	Accel 1-3	Accel 0-3 (m/s ²)
Danny	3	2,2	R	0,0	0,2	0,4	0,6	2,2	2,6	2,2	2,3	0,9	0,9	0,0
Danny	6	2,2	R	0,0	0,2	0,4	0,6	2,3	2,7	2,3	2,4	1,0	1,0	0,0
Danny	10	2,2	R	0,0	0,2	0,4	0,6	2,3	2,6	2,4	2,4	0,7	0,5	0,2
Danny	12	2,2	R	0,0	0,2	0,4	0,6	2,3	2,5	2,3	2,4	0,4	0,4	0,0

Dog	Trial	Speed	Side	Start	Stop 1	Stop 2	Stop 3	Vel 0-1	Vel 1-2	Vel 2-3	Vel 0-3 (m/s)	Accel 0-2	Accel 1-3	Accel 0-3 (m/s ²)
Kansas	1	2	L	0,0	0,3	0,5	0,7	2,0	2,2	2,1	2,1	0,5	0,2	0,2
Kansas	8	2	L	0,0	0,2	0,5	0,7	2,1	2,3	2,2	2,2	0,6	0,3	0,2
Kansas	9	2	L	0,0	0,2	0,5	0,7	2,0	2,2	2,2	2,1	0,4	0,0	0,3
Kansas	11	2	L	0,0	0,3	0,5	0,8	1,9	2,0	1,9	1,9	0,3	0,3	0,0
Kansas	12	2	L	0,0	0,3	0,5	0,7	2,0	2,4	2,1	2,1	0,9	0,7	0,1

Dog	Trial	Speed	Side	Start	Stop 1	Stop 2	Stop 3	Vel 0-1	Vel 1-2	Vel 2-3	Vel 0-3 (m/s)	Accel 0-2	Accel 1-3	Accel 0-3 (m/s ²)
Perdino	6	2	L	0,0	0,2	0,5	0,7	2,1	2,4	2,1	2,2	0,6	0,7	0,0
Perdino	7	2	L	0,0	0,2	0,5	0,7	2,1	2,3	2,1	2,2	0,5	0,4	0,1
Perdino	11	2	L	0,0	0,3	0,5	0,8	2,0	2,2	1,9	2,0	0,5	0,7	-0,1
Perdino	18	2	L	0,0	0,3	0,5	0,7	2,0	2,3	2,0	2,1	0,7	0,6	0,0
Perdino	19	2	L	0,0	0,3	0,5	0,8	1,8	1,9	1,8	1,8	0,3	0,2	0,0

Dog	Trial	Speed	Side	Start	Stop 1	Stop 2	Stop 3	Vel 0-1	Vel 1-2	Vel 2-3	Vel 0-3 (m/s)	Accel 0-2	Accel 1-3	Accel 0-3 (m/s ²)
Pequeena	3	2	L	0,0	0,3	0,5	0,7	2,0	2,3	2,0	2,1	0,7	0,6	0,1
Pequeena	6	2	L	0,0	0,2	0,5	0,7	2,0	2,3	2,0	2,1	0,6	0,7	-0,1
Pequeena	7	2	L	0,0	0,3	0,5	0,7	1,9	2,3	2,0	2,0	0,7	0,6	0,1
Pequeena	10	2	L	0,0	0,3	0,5	0,8	1,9	2,2	1,9	2,0	0,6	0,6	0,0
Pequeena	11	2	L	0,0	0,3	0,5	0,8	1,8	2,0	1,9	1,9	0,3	0,1	0,2

Table A-2: Calibrated peak vertical force (Cal PVF) in Newtons (N) for sound dogs at a trot on the single force plate. Target speed is indicated in m/s.

Day	dog	Trial	Speed	Kg	Leg	Side	Step	Cal PVF
1	Betty	1	2	24,5	Front	Left	1	265,63
1	Betty	1	2	24,5	Rear	Left	1	184,45
1	Betty	2	2	24,5	Front	Left	1	285,26
1	Betty	2	2	24,5	Rear	Left	1	199,40
1	Betty	3	2	24,5	Front	Left	1	283,69
1	Betty	3	2	24,5	Rear	Left	1	197,51
1	Betty	4	2	24,5	Front	Left	1	283,69
1	Betty	4	2	24,5	Rear	Left	1	190,41
1	Betty	5	2	24,5	Front	Left	1	337,43
1	Betty	5	2	24,5	Rear	Left	1	212,47
1	Chester	1	2	22,87	Front	Right	1	289,90
1	Chester	1	2	22,87	Rear	Right	1	170,91
1	Chester	2	2	22,87	Front	Right	1	287,32
1	Chester	2	2	22,87	Rear	Right	1	156,13
1	Chester	3	2	22,87	Front	Right	1	284,15
1	Chester	3	2	22,87	Rear	Right	1	156,13
1	Chester	4	2	22,87	Front	Right	1	280,19
1	Chester	4	2	22,87	Rear	Right	1	170,86
1	Danny	1	2,2	20,4	Front	Right	1	262,65
1	Danny	1	2,2	20,4	Rear	Right	1	166,35
1	Danny	2	2,2	20,4	Front	Right	1	260,76
1	Danny	2	2,2	20,4	Rear	Right	1	168,29
1	Danny	3	2,2	20,4	Front	Right	1	257,53
1	Danny	3	2,2	20,4	Rear	Right	1	156,96
1	Danny	4	2,2	20,4	Front	Right	1	255,15
1	Danny	4	2,2	20,4	Rear	Right	1	177,43
1	Kansas	1	2	25,45	Front	Left	1	318,58
1	Kansas	1	2	25,45	Rear	Left	1	121,31
1	Kansas	2	2	25,45	Front	Left	1	335,28
1	Kansas	2	2	25,45	Rear	Left	1	210,56
1	Kansas	3	2	25,45	Front	Left	1	335,35
1	Kansas	3	2	25,45	Rear	Left	1	206,56
1	Kansas	4	2	25,45	Front	Left	1	311,24
1	Kansas	4	2	25,45	Rear	Left	1	197,28
1	Kansas	5	2	25,45	Front	Left	1	341,83
1	Kansas	5	2	25,45	Rear	Left	1	220,66
2	Perdino	1	2	23,6	Front	Left	1	338,58
2	Perdino	1	2	23,6	Rear	Left	1	193,95
2	Perdino	2	2	23,6	Front	Left	1	313,56
2	Perdino	2	2	23,6	Rear	Left	1	194,89
2	Perdino	3	2	23,6	Front	Left	1	317,92
2	Perdino	3	2	23,6	Rear	Left	1	194,53
2	Perdino	4	2	23,6	Front	Left	1	327,10

2	Perdino	4	2	23,6	Rear	Left	1	196,62
2	Perdino	5	2	23,6	Front	Left	1	327,39
2	Perdino	5	2	23,6	Rear	Left	1	195,54
2	Pequeena	1	2	20,04	Front	Left	1	267,12
2	Pequeena	1	2	20,04	Rear	Left	1	159,78
2	Pequeena	2	2	20,04	Front	Left	1	274,94
2	Pequeena	2	2	20,04	Rear	Left	1	158,49
2	Pequeena	3	2	20,04	Front	Left	1	263,17
2	Pequeena	3	2	20,04	Rear	Left	1	149,90
2	Pequeena	4	2	20,04	Front	Left	1	262,10
2	Pequeena	4	2	20,04	Rear	Left	1	153,75
2	Pequeena	5	2	20,04	Front	Left	1	264,49
2	Pequeena	5	2	20,04	Rear	Left	1	132,67

Table A-3: Timing data for force plate trial for lame dogs. Start and numbered stops indicate photocell timers. Vel indicates velocity for the designated intervals. Accel indicates acceleration for the designated intervals
Speed indicates subject target speed (m/s)

Dog	Trial	Speed	Side	Start	Stop 1	Stop 2	Stop 3	Vel 0-1	Vel 1-2	Vel 2-3	Vel 0-3 (m/s)	Accel 0-2	Accel 1-3	Accel 0-3 (m/s ²)
Guinness	2	2	L	0,0	0,2	0,5	0,7	2,4	1,7	2,4	2,1	-1,4	1,1	0,1
Guinness	4	2	L	0,0	0,2	0,5	0,8	2,2	1,8	2,0	2,0	-0,9	0,3	-0,3
Guinness	5	2	R	0,0	0,2	0,5	0,7	2,2	1,7	2,3	2,0	-1,0	0,8	0,1
Guinness	6	2	R	0,0	0,2	0,5	0,7	2,3	1,9	2,4	2,2	-0,9	0,7	0,1
Guinness	8	2	L	0,0	0,2	0,4	0,7	2,3	2,2	2,2	2,2	-0,1	0,0	-0,1
Guinness	9	2	R	0,0	0,2	0,5	0,7	2,2	1,9	2,1	2,1	-0,6	0,3	-0,1
Guinness	13	2	R	0,0	0,2	0,5	0,7	2,1	2,1	2,1	2,1	-0,1	0,0	0,0
Guinness	14	2	L	0,0	0,2	0,5	0,8	2,0	2,2	1,8	2,0	0,4	-0,6	-0,3
Guinness	18	2	R	0,0	0,3	0,5	0,7	1,9	2,3	1,9	2,0	0,9	-0,5	0,0
Guinness	19	2	L	0,0	0,2	0,5	0,7	2,2	1,9	2,1	2,0	-0,5	0,2	-0,1

Dog	Trial	Speed	Side	Start	Stop 1	Stop 2	Stop 3	Vel 0-1	Vel 1-2	Vel 2-3	Vel 0-3 (m/s)	Accel 0-2	Accel 1-3	Accel 0-3 (m/s ²)
Winston	2	2	R	0,0	0,3	0,5	0,8	2,0	1,9	2,1	2,0	-0,2	0,3	0,2
Winston	3	2	L	0,0	0,3	0,5	0,7	1,9	2,3	2,0	2,1	0,8	-0,5	0,0
Winston	4	2	L	0,0	0,2	0,5	0,7	2,1	2,3	2,1	2,2	0,5	-0,3	0,1
Winston	7	2	R	0,0	0,2	0,5	0,7	2,2	2,2	2,1	2,2	0,1	-0,2	-0,2
Winston	9	2	R	0,0	0,2	0,5	0,7	2,1	2,3	2,0	2,1	0,4	-0,4	-0,2
Winston	10	2	L	0,0	0,3	0,5	0,7	2,0	2,4	2,0	2,1	0,9	-0,5	0,1
Winston	18	2	L	0,0	0,2	0,4	0,7	2,1	2,3	2,0	2,1	0,4	-0,5	-0,3
Winston	19	2	R	0,0	0,2	0,5	0,7	2,0	2,3	2,1	2,1	0,5	-0,3	0,1
Winston	24	2	L	0,0	0,2	0,5	0,7	2,1	2,4	2,1	2,2	0,7	-0,4	0,1
Winston	25	2	R	0,0	0,2	0,5	0,7	2,1	2,3	2,1	2,2	0,3	-0,2	0,0

Dog	Trial	Speed	Side	Start	Stop 1	Stop 2	Stop 3	Vel 0-1	Vel 1-2	Vel 2-3	Vel 0-3 (m/s)	Accel 0-2	Accel 1-3	Accel 0-3 (m/s ²)
Madison	2	2	R	0,0	0,2	0,5	0,7	2,2	2,2	2,1	2,2	0,1	-0,1	-0,1
Madison	4	2	L	0,0	0,3	0,6	0,8	1,8	1,8	2,0	1,9	-0,1	0,3	0,3
Madison	6	2	R	0,0	0,2	0,5	0,7	2,2	2,2	2,3	2,2	-0,1	0,1	0,1
Madison	11	2	L	0,0	0,3	0,5	0,8	1,9	1,9	1,7	1,8	0,1	-0,3	-0,3
Madison	13	2	L	0,0	0,2	0,5	0,7	2,2	2,1	2,0	2,1	-0,2	-0,1	-0,3
Madison	18	2	L	0,0	0,2	0,5	0,7	2,2	2,1	2,1	2,1	-0,1	0,1	0,0
Madison	20	2	L	0,0	0,3	0,5	0,8	1,5	3,2	1,7	1,9	3,4	-1,9	0,2
Madison	23	2	R	0,0	0,3	0,5	0,8	1,9	2,1	2,0	2,0	0,3	-0,1	0,1
Madison	26	2	R	0,0	0,2	0,5	0,8	2,1	2,1	1,9	2,0	0,0	-0,2	-0,3
Madison	27	2	R	0,0	0,2	0,5	0,7	2,1	2,1	1,9	2,0	-0,1	-0,2	-0,2

Dog	Trial	Speed	Side	Start	Stop 1	Stop 2	Stop 3	Vel 0-1	Vel 1-2	Vel 2-3	Vel 0-3 (m/s)	Accel 0-2	Accel 1-3	Accel 0-3 (m/s ²)
Harvey	1	2.2	R	0,0	0,2	0,5	0,7	2,0	2,1	2,2	2,1	0,2	0,1	0,3
Harvey	4	2.2	L	0,0	0,2	0,4	0,6	2,3	2,4	2,5	2,4	0,3	0,1	0,3
Harvey	5	2.2	L	0,0	0,2	0,5	0,7	2,1	2,3	2,1	2,2	0,5	-0,2	0,1
Harvey	7	2.2	L	0,0	0,2	0,4	0,7	2,1	2,4	2,4	2,3	0,6	-0,1	0,3
Harvey	10	2.2	R	0,0	0,2	0,5	0,7	2,0	2,1	2,2	2,1	0,2	0,1	0,3
Harvey	11	2.2	L	0,0	0,3	0,5	0,7	1,9	2,6	1,9	2,1	1,4	-0,9	0,0
Harvey	12	2.2	R	0,0	0,2	0,4	0,6	2,2	2,8	2,3	2,4	1,5	-0,8	0,2
Harvey	15	2.2	L	0,0	0,3	0,5	0,7	2,0	2,3	2,2	2,2	0,7	-0,2	0,3
Harvey	16	2.2	R	0,0	0,2	0,4	0,7	2,0	2,5	2,0	2,1	1,0	-0,7	-0,1
Harvey	17	2.2	R	0,0	0,2	0,4	0,7	2,0	2,8	2,0	2,2	1,7	-1,1	-0,1

Dog	Trial	Speed	Side	Start	Stop 1	Stop 2	Stop 3	Vel 0-1	Vel 1-2	Vel 2-3	Vel 0-3 (m/s)	Accel 0-2	Accel 1-3	Accel 0-3 (m/s ²)
Meg	3	1.8	L	0,0	0,3	0,5	0,8	1,9	1,9	1,8	1,9	0,1	-0,2	-0,2
Meg	5	1.8	R	0,0	0,3	0,7	1,0	1,5	1,5	1,7	1,6	-0,1	0,3	0,2
Meg	6	1.8	R	0,0	0,3	0,6	0,8	1,7	1,8	1,9	1,8	0,2	0,0	0,2
Meg	9	1.8	L	0,0	0,3	0,6	0,9	1,6	1,7	1,7	1,7	0,1	0,0	0,1
Meg	10	1.8	R	0,0	0,3	0,6	0,8	1,9	1,7	2,0	1,8	-0,5	0,4	0,0
Meg	11	1.8	R	0,0	0,2	0,5	0,8	2,1	1,8	2,0	2,0	-0,5	0,2	-0,1
Meg	12	1.8	L	0,0	0,3	0,6	0,9	1,6	1,7	1,7	1,7	0,1	0,0	0,1
Meg	14	1.8	L	0,0	0,3	0,6	0,8	1,8	1,9	1,9	1,8	0,2	0,1	0,2
Meg	16	1.8	R	0,0	0,3	0,6	0,8	1,8	1,7	2,0	1,8	-0,2	0,3	0,2
Meg	18	1.8	L	0,0	0,3	0,6	0,9	1,7	1,4	1,9	1,7	-0,5	0,6	0,2

Dog	Trial	Speed	Side	Start	Stop 1	Stop 2	Stop 3	Vel 0-1	Vel 1-2	Vel 2-3	Vel 0-3 (m/s)	Accel 0-2	Accel 1-3	Accel 0-3 (m/s ²)
J.J.	1	2	R	0,0	0,2	0,5	0,7	2,1	2,2	2,3	2,2	0,3	0,1	0,3
J.J.	3	2	R	0,0	0,3	0,5	0,8	1,9	1,9	2,0	1,9	0,0	0,2	0,2
J.J.	4	2	R	0,0	0,3	0,5	0,8	2,0	2,0	2,0	2,0	0,2	-0,1	0,1
J.J.	5	2	L	0,0	0,3	0,5	0,8	1,9	2,0	2,0	2,0	0,3	-0,1	0,1
J.J.	6	2	L	0,0	0,3	0,6	0,8	1,7	1,8	2,0	1,9	0,1	0,2	0,3
J.J.	8	2	L	0,0	0,3	0,5	0,8	1,8	2,0	1,9	1,9	0,3	-0,1	0,1
J.J.	9	2	R	0,0	0,3	0,5	0,7	2,0	1,9	2,2	2,0	-0,1	0,4	0,3
J.J.	10	2	L	0,0	0,3	0,5	0,7	2,0	2,0	2,0	2,0	0,0	0,0	0,1
J.J.	11	2	L	0,0	0,2	0,5	0,7	2,0	2,2	2,1	2,1	0,4	-0,1	0,1
J.J.	13	2	R	0,0	0,3	0,5	0,8	1,8	1,8	2,0	1,9	0,1	0,2	0,3

Table A-4: Calibrated peak vertical force (Cal PVF) in Newtons (N) for lame dogs at a trot on the single force plate. Target speed is indicated in m/s. Weight is indicated in kg.

Day	Dog	Weight	Trial	Speed	Leg	Side	Step	Cal PVF
1	Guinness	33,1	1	2	Front	L	1	455,93
1	Guinness	33,1	1	2	Rear	L	1	272,68
1	Guinness	33,1	2	2	Front	L	1	414,22
1	Guinness	33,1	2	2	Rear	L	1	283,89
1	Guinness	33,1	3	2	Front	L	1	451,02
1	Guinness	33,1	3	2	Rear	L	1	279,18
1	Guinness	33,1	4	2	Front	L	1	420,06
1	Guinness	33,1	4	2	Rear	L	1	273,05
1	Guinness	33,1	5	2	Front	L	1	419,83
1	Guinness	33,1	5	2	Rear	L	1	274,60
1	Guinness	33,1	6	2	Front	R	1	350,61
1	Guinness	33,1	6	2	Rear	R	1	245,08
1	Guinness	33,1	7	2	Front	R	1	350,55
1	Guinness	33,1	7	2	Rear	R	1	230,70
1	Guinness	33,1	8	2	Front	R	1	347,06
1	Guinness	33,1	8	2	Rear	R	1	245,52
1	Guinness	33,1	9	2	Front	R	1	340,40
1	Guinness	33,1	9	2	Rear	R	1	212,33
1	Guinness	33,1	10	2	Front	R	1	351,69
1	Guinness	33,1	10	2	Rear	R	1	238,82
1	Winston	36,07	1	2	Front	L	1	464,25
1	Winston	36,07	1	2	Rear	L	1	271,12
1	Winston	36,07	2	2	Front	L	1	475,16
1	Winston	36,07	2	2	Rear	L	1	283,16
1	Winston	36,07	3	2	Front	L	1	468,87
1	Winston	36,07	3	2	Rear	L	1	280,22
1	Winston	36,07	4	2	Front	L	1	459,50
1	Winston	36,07	4	2	Rear	L	1	263,07
1	Winston	36,07	5	2	Front	L	1	469,71
1	Winston	36,07	5	2	Rear	L	1	275,22
1	Winston	36,07	6	2	Front	R	1	417,17
1	Winston	36,07	6	2	Rear	R	1	283,78
1	Winston	36,07	7	2	Front	R	1	444,44
1	Winston	36,07	7	2	Rear	R	1	282,23
1	Winston	36,07	8	2	Front	R	1	434,74
1	Winston	36,07	8	2	Rear	R	1	276,80
1	Winston	36,07	9	2	Front	R	1	448,37
1	Winston	36,07	9	2	Rear	R	1	279,15
1	Winston	36,07	10	2	Front	R	1	448,77
1	Winston	36,07	10	2	Rear	R	1	289,27
1	Madison	16,95	1	2	Front	L	1	212,72
1	Madison	16,95	1	2	Rear	L	1	151,98

1	Madison	16,95	2	2	Front	L	1	206,88
1	Madison	16,95	2	2	Rear	L	1	135,33
1	Madison	16,95	3	2	Front	L	1	218,27
1	Madison	16,95	3	2	Rear	L	1	138,45
1	Madison	16,95	4	2	Front	L	1	209,84
1	Madison	16,95	4	2	Rear	L	1	134,29
1	Madison	16,95	5	2	Front	L	1	205,96
1	Madison	16,95	5	2	Rear	L	1	135,18
1	Madison	16,95	6	2	Front	R	1	136,81
1	Madison	16,95	6	2	Rear	R	1	180,39
1	Madison	16,95	7	2	Front	R	1	165,99
1	Madison	16,95	7	2	Rear	R	1	149,01
1	Madison	16,95	8	2	Front	R	1	172,87
1	Madison	16,95	8	2	Rear	R	1	135,66
1	Madison	16,95	9	2	Front	R	1	167,53
1	Madison	16,95	9	2	Rear	R	1	146,04
1	Madison	16,95	10	2	Front	R	1	182,50
1	Madison	16,95	10	2	Rear	R	1	141,62
1	Harvey	33,8	1	2,2	Front	L	1	312,66
1	Harvey	33,8	1	2,2	Rear	L	1	243,16
1	Harvey	33,8	2	2,2	Front	L	1	310,36
1	Harvey	33,8	2	2,2	Rear	L	1	230,22
1	Harvey	33,8	3	2,2	Front	L	1	304,11
1	Harvey	33,8	3	2,2	Rear	L	1	229,81
1	Harvey	33,8	4	2,2	Front	L	1	320,76
1	Harvey	33,8	4	2,2	Rear	L	1	237,88
1	Harvey	33,8	5	2,2	Front	L	1	322,36
1	Harvey	33,8	5	2,2	Rear	L	1	248,31
1	Harvey	33,8	6	2,2	Front	R	1	347,96
1	Harvey	33,8	6	2,2	Rear	R	1	212,24
1	Harvey	33,8	7	2,2	Front	R	1	353,89
1	Harvey	33,8	7	2,2	Rear	R	1	218,41
1	Harvey	33,8	8	2,2	Front	R	1	345,79
1	Harvey	33,8	8	2,2	Rear	R	1	224,06
1	Harvey	33,8	9	2,2	Front	R	1	366,96
1	Harvey	33,8	9	2,2	Rear	R	1	231,68
1	Harvey	33,8	10	2,2	Front	R	1	343,78
1	Harvey	33,8	10	2,2	Rear	R	1	224,66
1	Meg	31,27	1	1,8	Front	L	1	310,96
1	Meg	31,27	1	1,8	Rear	L	1	243,16
1	Meg	31,27	2	1,8	Front	L	1	310,36
1	Meg	31,27	2	1,8	Rear	L	1	230,22
1	Meg	31,27	3	1,8	Front	L	1	304,11
1	Meg	31,27	3	1,8	Rear	L	1	229,81
1	Meg	31,27	4	1,8	Front	L	1	320,76
1	Meg	31,27	4	1,8	Rear	L	1	237,88
1	Meg	31,27	5	1,8	Front	L	1	322,36
1	Meg	31,27	5	1,8	Rear	L	1	247,94

1	Meg	31,27	6	1,8	Front	R	1	347,96
1	Meg	31,27	6	1,8	Rear	R	1	212,24
1	Meg	31,27	7	1,8	Front	R	1	347,96
1	Meg	31,27	7	1,8	Rear	R	1	218,41
1	Meg	31,27	8	1,8	Front	R	1	345,79
1	Meg	31,27	8	1,8	Rear	R	1	224,06
1	Meg	31,27	9	1,8	Front	R	1	366,96
1	Meg	31,27	9	1,8	Rear	R	1	231,68
1	Meg	31,27	10	1,8	Front	R	1	343,78
1	Meg	31,27	10	1,8	Rear	R	1	224,66
1	JayJay	25,6	1	2	Front	L	1	319,71
1	JayJay	25,6	1	2	Rear	L	1	173,50
1	JayJay	25,6	2	2	Front	L	1	321,39
1	JayJay	25,6	2	2	Rear	L	1	168,69
1	JayJay	25,6	3	2	Front	L	1	327,28
1	JayJay	25,6	3	2	Rear	L	1	171,36
1	JayJay	25,6	4	2	Front	L	1	333,01
1	JayJay	25,6	4	2	Rear	L	1	164,48
1	JayJay	25,6	5	2	Front	L	1	329,00
1	JayJay	25,6	5	2	Rear	L	1	170,70
1	JayJay	25,6	6	2	Front	R	1	319,20
1	JayJay	25,6	6	2	Rear	R	1	183,76
1	JayJay	25,6	7	2	Front	R	1	315,31
1	JayJay	25,6	7	2	Rear	R	1	179,75
1	JayJay	25,6	8	2	Front	R	1	281,68
1	JayJay	25,6	8	2	Rear	R	1	186,10
1	JayJay	25,6	9	2	Front	R	1	285,89
1	JayJay	25,6	9	2	Rear	R	1	179,95
1	JayJay	25,6	10	2	Front	R	1	315,32
1	JayJay	25,6	10	2	Rear	R	1	183,23

Table B-1: Peak Vertical Force (Cal PVF) for Treadmill

Day	dog	trial	speed	leg	side	step	Cal PVF
1	Betty	1	2	Front	Left	1	275,4221
1	Betty	1	2	Front	Left	2	280,7731
1	Betty	1	2	Front	Left	3	291,6415
1	Betty	1	2	Front	Left	4	307,6647
1	Betty	1	2	Front	Left	5	300,6116
1	Betty	1	2	Front	Left	6	276,4798
1	Betty	1	2	Front	Left	7	266,8517
1	Betty	1	2	Front	Left	8	278,3855
1	Betty	1	2	Front	Left	9	290,2531
1	Betty	1	2	Front	Left	10	
1	Betty	1	2	Rear	Left	1	177,8711
1	Betty	1	2	Rear	Left	2	180,6763
1	Betty	1	2	Rear	Left	3	180,0289
1	Betty	1	2	Rear	Left	4	190,7356
1	Betty	1	2	Rear	Left	5	187,8045
1	Betty	1	2	Rear	Left	6	191,3077
1	Betty	1	2	Rear	Left	7	185,3617
1	Betty	1	2	Rear	Left	8	179,0142
1	Betty	1	2	Rear	Left	9	178,3007
1	Betty	1	2	Rear	Left	10	
1	Betty	2	2	Front	Left	1	284,0925
1	Betty	2	2	Front	Left	2	294,0801
1	Betty	2	2	Front	Left	3	289,0524
1	Betty	2	2	Front	Left	4	279,8325
1	Betty	2	2	Front	Left	5	285,2387
1	Betty	2	2	Front	Left	6	285,707
1	Betty	2	2	Front	Left	7	288,0341
1	Betty	2	2	Front	Left	8	281,0328
1	Betty	2	2	Front	Left	9	292,2263
1	Betty	2	2	Front	Left	10	
1	Betty	2	2	Rear	Left	1	178,1413
1	Betty	2	2	Rear	Left	2	172,8013
1	Betty	2	2	Rear	Left	3	171,3489
1	Betty	2	2	Rear	Left	4	170,6815
1	Betty	2	2	Rear	Left	5	187,2088
1	Betty	2	2	Rear	Left	6	193,0284
1	Betty	2	2	Rear	Left	7	183,2865
1	Betty	2	2	Rear	Left	8	187,754
1	Betty	2	2	Rear	Left	9	169,0078
1	Betty	2	2	Rear	Left	10	
1	Betty	3	2	Front	Left	1	272,8828
1	Betty	3	2	Front	Left	2	270,7526
1	Betty	3	2	Front	Left	3	272,3045
1	Betty	3	2	Front	Left	4	273,3043
1	Betty	3	2	Front	Left	5	278,7236

1	Betty	3	2	Front	Left	6	275,9372
1	Betty	3	2	Front	Left	7	278,162
1	Betty	3	2	Front	Left	8	286,0163
1	Betty	3	2	Front	Left	9	284,6162
1	Betty	3	2	Front	Left	10	
1	Betty	3	2	Rear	Left	1	186,4455
1	Betty	3	2	Rear	Left	2	190,0687
1	Betty	3	2	Rear	Left	3	191,2488
1	Betty	3	2	Rear	Left	4	191,6173
1	Betty	3	2	Rear	Left	5	184,8375
1	Betty	3	2	Rear	Left	6	188,1301
1	Betty	3	2	Rear	Left	7	193,4027
1	Betty	3	2	Rear	Left	8	192,9827
1	Betty	3	2	Rear	Left	9	
1	Betty	3	2	Rear	Left	10	
1	Betty	4	2	Front	Left	1	261,0755
1	Betty	4	2	Front	Left	2	274,1979
1	Betty	4	2	Front	Left	3	268,211
1	Betty	4	2	Front	Left	4	264,2144
1	Betty	4	2	Front	Left	5	281,689
1	Betty	4	2	Front	Left	6	277,4701
1	Betty	4	2	Front	Left	7	273,7974
1	Betty	4	2	Front	Left	8	273,4262
1	Betty	4	2	Front	Left	9	274,121
1	Betty	4	2	Front	Left	10	
1	Betty	4	2	Rear	Left	1	199,515
1	Betty	4	2	Rear	Left	2	196,3598
1	Betty	4	2	Rear	Left	3	196,4886
1	Betty	4	2	Rear	Left	4	190,2405
1	Betty	4	2	Rear	Left	5	192,4685
1	Betty	4	2	Rear	Left	6	180,9716
1	Betty	4	2	Rear	Left	7	188,8961
1	Betty	4	2	Rear	Left	8	191,6101
1	Betty	4	2	Rear	Left	9	
1	Betty	4	2	Rear	Left	10	
1	Betty	5	2	Front	Left	1	290,5423
1	Betty	5	2	Front	Left	2	282,6115
1	Betty	5	2	Front	Left	3	284,0163
1	Betty	5	2	Front	Left	4	281,4898
1	Betty	5	2	Front	Left	5	276,414
1	Betty	5	2	Front	Left	6	280,8584
1	Betty	5	2	Front	Left	7	279,7406
1	Betty	5	2	Front	Left	8	281,0368
1	Betty	5	2	Front	Left	9	282,3541
1	Betty	5	2	Front	Left	10	
1	Betty	5	2	Rear	Left	1	198,3946
1	Betty	5	2	Rear	Left	2	191,5326
1	Betty	5	2	Rear	Left	3	198,1521
1	Betty	5	2	Rear	Left	4	189,7615

1	Betty	5	2	Rear	Left	5	186,1738
1	Betty	5	2	Rear	Left	6	187,4598
1	Betty	5	2	Rear	Left	7	185,7011
1	Betty	5	2	Rear	Left	8	188,3902
1	Betty	5	2	Rear	Left	9	193,3642
1	Betty	5	2	Rear	Left	10	
1	Chester	1	2	Front	Right	1	278,1439
1	Chester	1	2	Front	Right	2	265,75
1	Chester	1	2	Front	Right	3	268,2107
1	Chester	1	2	Front	Right	4	274,5774
1	Chester	1	2	Front	Right	5	276,0247
1	Chester	1	2	Front	Right	6	272,2198
1	Chester	1	2	Front	Right	7	280,07
1	Chester	1	2	Front	Right	8	278,3068
1	Chester	1	2	Front	Right	9	266,4692
1	Chester	1	2	Front	Right	10	
1	Chester	1	2	Rear	Right	1	159,4572
1	Chester	1	2	Rear	Right	2	157,0285
1	Chester	1	2	Rear	Right	3	164,0787
1	Chester	1	2	Rear	Right	4	163,8667
1	Chester	1	2	Rear	Right	5	159,906
1	Chester	1	2	Rear	Right	6	154,1337
1	Chester	1	2	Rear	Right	7	161,6546
1	Chester	1	2	Rear	Right	8	153,272
1	Chester	1	2	Rear	Right	9	153,7922
1	Chester	1	2	Rear	Right	10	
1	Chester	2	2	Front	Right	1	269,2136
1	Chester	2	2	Front	Right	2	265,3347
1	Chester	2	2	Front	Right	3	258,6518
1	Chester	2	2	Front	Right	4	266,3158
1	Chester	2	2	Front	Right	5	262,7274
1	Chester	2	2	Front	Right	6	264,1388
1	Chester	2	2	Front	Right	7	259,995
1	Chester	2	2	Front	Right	8	265,5724
1	Chester	2	2	Front	Right	9	265,764
1	Chester	2	2	Front	Right	10	
1	Chester	2	2	Rear	Right	1	166,0074
1	Chester	2	2	Rear	Right	2	166,3863
1	Chester	2	2	Rear	Right	3	162,8007
1	Chester	2	2	Rear	Right	4	155,7486
1	Chester	2	2	Rear	Right	5	162,9657
1	Chester	2	2	Rear	Right	6	158,6726
1	Chester	2	2	Rear	Right	7	159,4616
1	Chester	2	2	Rear	Right	8	158,5033
1	Chester	2	2	Rear	Right	9	169,813
1	Chester	2	2	Rear	Right	10	
1	Chester	3	2	Front	Right	1	270,7242
1	Chester	3	2	Front	Right	2	270,9358

1	Chester	3	2	Front	Right	3	267,0884
1	Chester	3	2	Front	Right	4	275,7564
1	Chester	3	2	Front	Right	5	269,5945
1	Chester	3	2	Front	Right	6	271,2268
1	Chester	3	2	Front	Right	7	275,7781
1	Chester	3	2	Front	Right	8	273,5035
1	Chester	3	2	Front	Right	9	269,3154
1	Chester	3	2	Front	Right	10	278,8929
1	Chester	3	2	Rear	Right	1	161,2816
1	Chester	3	2	Rear	Right	2	161,6067
1	Chester	3	2	Rear	Right	3	158,8156
1	Chester	3	2	Rear	Right	4	161,8952
1	Chester	3	2	Rear	Right	5	164,7103
1	Chester	3	2	Rear	Right	6	164,5473
1	Chester	3	2	Rear	Right	7	167,8585
1	Chester	3	2	Rear	Right	8	161,2898
1	Chester	3	2	Rear	Right	9	159,2808
1	Chester	3	2	Rear	Right	10	
1	Chester	4	2	Front	Right	1	281,7963
1	Chester	4	2	Front	Right	2	281,5398
1	Chester	4	2	Front	Right	3	278,9745
1	Chester	4	2	Front	Right	4	282,7432
1	Chester	4	2	Front	Right	5	286,654
1	Chester	4	2	Front	Right	6	277,0664
1	Chester	4	2	Front	Right	7	279,8885
1	Chester	4	2	Front	Right	8	280,7572
1	Chester	4	2	Front	Right	9	286,6706
1	Chester	4	2	Front	Right	10	
1	Chester	4	2	Rear	Right	1	164,9173
1	Chester	4	2	Rear	Right	2	159,6965
1	Chester	4	2	Rear	Right	3	151,7192
1	Chester	4	2	Rear	Right	4	158,546
1	Chester	4	2	Rear	Right	5	163,5044
1	Chester	4	2	Rear	Right	6	166,7927
1	Chester	4	2	Rear	Right	7	172,0158
1	Chester	4	2	Rear	Right	8	163,2341
1	Chester	4	2	Rear	Right	9	159,9556
1	Chester	4	2	Rear	Right	10	158,9464
1	Chester	5	2	Front	Right	1	279,711
1	Chester	5	2	Front	Right	2	283,597
1	Chester	5	2	Front	Right	3	277,2373
1	Chester	5	2	Front	Right	4	275,6693
1	Chester	5	2	Front	Right	5	274,766
1	Chester	5	2	Front	Right	6	275,0994
1	Chester	5	2	Front	Right	7	271,1318
1	Chester	5	2	Front	Right	8	281,4814
1	Chester	5	2	Front	Right	9	276,6503
1	Chester	5	2	Front	Right	10	281,1567
1	Chester	5	2	Rear	Right	1	162,3727

1	Chester	5	2	Rear	Right	2	164,5159
1	Chester	5	2	Rear	Right	3	169,4968
1	Chester	5	2	Rear	Right	4	162,9072
1	Chester	5	2	Rear	Right	5	167,2959
1	Chester	5	2	Rear	Right	6	162,8219
1	Chester	5	2	Rear	Right	7	167,2335
1	Chester	5	2	Rear	Right	8	166,6311
1	Chester	5	2	Rear	Right	9	160,5644
1	Chester	5	2	Rear	Right	10	
1	Danny	1	2,2	Front	Right	1	245,9036
1	Danny	1	2,2	Front	Right	2	256,4965
1	Danny	1	2,2	Front	Right	3	245,934
1	Danny	1	2,2	Front	Right	4	237,2946
1	Danny	1	2,2	Front	Right	5	233,3185
1	Danny	1	2,2	Front	Right	6	247,4737
1	Danny	1	2,2	Front	Right	7	254,2912
1	Danny	1	2,2	Front	Right	8	254,6891
1	Danny	1	2,2	Front	Right	9	245,7633
1	Danny	1	2,2	Front	Right	10	258,9664
1	Danny	1	2,2	Rear	Right	1	176,8355
1	Danny	1	2,2	Rear	Right	2	180,1206
1	Danny	1	2,2	Rear	Right	3	181,7005
1	Danny	1	2,2	Rear	Right	4	179,3108
1	Danny	1	2,2	Rear	Right	5	189,9971
1	Danny	1	2,2	Rear	Right	6	185,5321
1	Danny	1	2,2	Rear	Right	7	179,7667
1	Danny	1	2,2	Rear	Right	8	189,686
1	Danny	1	2,2	Rear	Right	9	179,9744
1	Danny	1	2,2	Rear	Right	10	183,5862
1	Danny	2	2,2	Front	Right	1	237,1272
1	Danny	2	2,2	Front	Right	2	252,6006
1	Danny	2	2,2	Front	Right	3	253,2664
1	Danny	2	2,2	Front	Right	4	251,0038
1	Danny	2	2,2	Front	Right	5	257,2282
1	Danny	2	2,2	Front	Right	6	263,9997
1	Danny	2	2,2	Front	Right	7	256,0305
1	Danny	2	2,2	Front	Right	8	250,9167
1	Danny	2	2,2	Front	Right	9	252,1497
1	Danny	2	2,2	Front	Right	10	256,7489
1	Danny	2	2,2	Rear	Right	1	177,0173
1	Danny	2	2,2	Rear	Right	2	180,2493
1	Danny	2	2,2	Rear	Right	3	181,1201
1	Danny	2	2,2	Rear	Right	4	186,0211
1	Danny	2	2,2	Rear	Right	5	179,0825
1	Danny	2	2,2	Rear	Right	6	174,8605
1	Danny	2	2,2	Rear	Right	7	180,0254
1	Danny	2	2,2	Rear	Right	8	178,4341
1	Danny	2	2,2	Rear	Right	9	178,2769

1	Danny	2	2,2	Rear	Right	10	185,5799
1	Danny	3	2,2	Front	Right	1	266,7529
1	Danny	3	2,2	Front	Right	2	260,5258
1	Danny	3	2,2	Front	Right	3	245,7485
1	Danny	3	2,2	Front	Right	4	251,2885
1	Danny	3	2,2	Front	Right	5	250,1035
1	Danny	3	2,2	Front	Right	6	249,7235
1	Danny	3	2,2	Front	Right	7	262,8889
1	Danny	3	2,2	Front	Right	8	269,4345
1	Danny	3	2,2	Front	Right	9	259,7993
1	Danny	3	2,2	Front	Right	10	257,9039
1	Danny	3	2,2	Rear	Right	1	178,2863
1	Danny	3	2,2	Rear	Right	2	176,4668
1	Danny	3	2,2	Rear	Right	3	173,2416
1	Danny	3	2,2	Rear	Right	4	178,4383
1	Danny	3	2,2	Rear	Right	5	173,4622
1	Danny	3	2,2	Rear	Right	6	171,8503
1	Danny	3	2,2	Rear	Right	7	179,0381
1	Danny	3	2,2	Rear	Right	8	177,1832
1	Danny	3	2,2	Rear	Right	9	174,3369
1	Danny	3	2,2	Rear	Right	10	
1	Danny	4	2,2	Front	Right	1	241,9559
1	Danny	4	2,2	Front	Right	2	246,3055
1	Danny	4	2,2	Front	Right	3	254,1747
1	Danny	4	2,2	Front	Right	4	266,5501
1	Danny	4	2,2	Front	Right	5	260,9449
1	Danny	4	2,2	Front	Right	6	274,5896
1	Danny	4	2,2	Front	Right	7	247,5122
1	Danny	4	2,2	Front	Right	8	247,2109
1	Danny	4	2,2	Front	Right	9	251,2605
1	Danny	4	2,2	Front	Right	10	237,3937
1	Danny	4	2,2	Rear	Right	1	170,6518
1	Danny	4	2,2	Rear	Right	2	176,9315
1	Danny	4	2,2	Rear	Right	3	181,8018
1	Danny	4	2,2	Rear	Right	4	183,1464
1	Danny	4	2,2	Rear	Right	5	169,9796
1	Danny	4	2,2	Rear	Right	6	188,4251
1	Danny	4	2,2	Rear	Right	7	183,3206
1	Danny	4	2,2	Rear	Right	8	172,8211
1	Danny	4	2,2	Rear	Right	9	183,8516
1	Danny	4	2,2	Rear	Right	10	172,2576
1	Danny	5	2,2	Front	Right	1	253,1757
1	Danny	5	2,2	Front	Right	2	254,4934
1	Danny	5	2,2	Front	Right	3	238,703
1	Danny	5	2,2	Front	Right	4	249,1888
1	Danny	5	2,2	Front	Right	5	254,72
1	Danny	5	2,2	Front	Right	6	239,7025
1	Danny	5	2,2	Front	Right	7	245,0809
1	Danny	5	2,2	Front	Right	8	242,894

1	Danny	5	2,2	Front	Right	9	244,1585
1	Danny	5	2,2	Front	Right	10	242,2222
1	Danny	5	2,2	Rear	Right	1	179,1502
1	Danny	5	2,2	Rear	Right	2	183,3489
1	Danny	5	2,2	Rear	Right	3	183,6395
1	Danny	5	2,2	Rear	Right	4	185,7024
1	Danny	5	2,2	Rear	Right	5	176,9609
1	Danny	5	2,2	Rear	Right	6	184,2049
1	Danny	5	2,2	Rear	Right	7	177,5351
1	Danny	5	2,2	Rear	Right	8	170,0193
1	Danny	5	2,2	Rear	Right	9	181,7108
1	Danny	5	2,2	Rear	Right	10	186,4813
1	Kansas	1	2	Front	Left	1	309,6264
1	Kansas	1	2	Front	Left	2	306,6348
1	Kansas	1	2	Front	Left	3	303,9319
1	Kansas	1	2	Front	Left	4	314,8396
1	Kansas	1	2	Front	Left	5	323,7635
1	Kansas	1	2	Front	Left	6	318,8458
1	Kansas	1	2	Front	Left	7	322,9885
1	Kansas	1	2	Front	Left	8	336,9893
1	Kansas	1	2	Front	Left	9	
1	Kansas	1	2	Front	Left	10	
1	Kansas	1	2	Rear	Left	1	209,7008
1	Kansas	1	2	Rear	Left	2	216,0631
1	Kansas	1	2	Rear	Left	3	208,428
1	Kansas	1	2	Rear	Left	4	184,9326
1	Kansas	1	2	Rear	Left	5	208,5831
1	Kansas	1	2	Rear	Left	6	194,2945
1	Kansas	1	2	Rear	Left	7	201,1448
1	Kansas	1	2	Rear	Left	8	191,0702
1	Kansas	1	2	Rear	Left	9	191,2538
1	Kansas	1	2	Rear	Left	10	
1	Kansas	2	2	Front	Left	1	327,8111
1	Kansas	2	2	Front	Left	2	325,9776
1	Kansas	2	2	Front	Left	3	327,1206
1	Kansas	2	2	Front	Left	4	322,7524
1	Kansas	2	2	Front	Left	5	333,5137
1	Kansas	2	2	Front	Left	6	326,6228
1	Kansas	2	2	Front	Left	7	327,7235
1	Kansas	2	2	Front	Left	8	348,6972
1	Kansas	2	2	Front	Left	9	
1	Kansas	2	2	Front	Left	10	
1	Kansas	2	2	Rear	Left	1	208,1242
1	Kansas	2	2	Rear	Left	2	181,8422
1	Kansas	2	2	Rear	Left	3	196,8848
1	Kansas	2	2	Rear	Left	4	199,3236
1	Kansas	2	2	Rear	Left	5	195,2537
1	Kansas	2	2	Rear	Left	6	186,1513
1	Kansas	2	2	Rear	Left	7	196,5223

1	Kansas	2	2	Rear	Left	8	193,6033
1	Kansas	2	2	Rear	Left	9	163,0924
1	Kansas	2	2	Rear	Left	10	
1	Kansas	3	2	Front	Left	1	337,703
1	Kansas	3	2	Front	Left	2	343,0099
1	Kansas	3	2	Front	Left	3	348,9397
1	Kansas	3	2	Front	Left	4	320,4836
1	Kansas	3	2	Front	Left	5	338,3556
1	Kansas	3	2	Front	Left	6	351,572
1	Kansas	3	2	Front	Left	7	347,2554
1	Kansas	3	2	Front	Left	8	337,5019
1	Kansas	3	2	Front	Left	9	
1	Kansas	3	2	Front	Left	10	
1	Kansas	3	2	Rear	Left	1	204,6944
1	Kansas	3	2	Rear	Left	2	194,5783
1	Kansas	3	2	Rear	Left	3	196,5209
1	Kansas	3	2	Rear	Left	4	197,5337
1	Kansas	3	2	Rear	Left	5	201,6725
1	Kansas	3	2	Rear	Left	6	205,0599
1	Kansas	3	2	Rear	Left	7	203,0526
1	Kansas	3	2	Rear	Left	8	201,7392
1	Kansas	3	2	Rear	Left	9	198,2318
1	Kansas	3	2	Rear	Left	10	
1	Kansas	4	2	Front	Left	1	371,9296
1	Kansas	4	2	Front	Left	2	344,5636
1	Kansas	4	2	Front	Left	3	327,3796
1	Kansas	4	2	Front	Left	4	336,6996
1	Kansas	4	2	Front	Left	5	334,3217
1	Kansas	4	2	Front	Left	6	333,0272
1	Kansas	4	2	Front	Left	7	355,8038
1	Kansas	4	2	Front	Left	8	343,4113
1	Kansas	4	2	Front	Left	9	
1	Kansas	4	2	Front	Left	10	
1	Kansas	4	2	Rear	Left	1	204,4396
1	Kansas	4	2	Rear	Left	2	204,1171
1	Kansas	4	2	Rear	Left	3	201,2302
1	Kansas	4	2	Rear	Left	4	196,5266
1	Kansas	4	2	Rear	Left	5	196,7178
1	Kansas	4	2	Rear	Left	6	198,3127
1	Kansas	4	2	Rear	Left	7	204,4681
1	Kansas	4	2	Rear	Left	8	197,7128
1	Kansas	4	2	Rear	Left	9	192,0418
1	Kansas	4	2	Rear	Left	10	
1	Kansas	5	2	Front	Left	1	338,2665
1	Kansas	5	2	Front	Left	2	324,5337
1	Kansas	5	2	Front	Left	3	328,0541
1	Kansas	5	2	Front	Left	4	316,3958
1	Kansas	5	2	Front	Left	5	329,2935
1	Kansas	5	2	Front	Left	6	326,1734

1	Kansas	5	2	Front	Left	7	332,169
1	Kansas	5	2	Front	Left	8	339,7602
1	Kansas	5	2	Front	Left	9	333,5067
1	Kansas	5	2	Front	Left	10	
1	Kansas	5	2	Rear	Left	1	202,0561
1	Kansas	5	2	Rear	Left	2	208,4542
1	Kansas	5	2	Rear	Left	3	209,5254
1	Kansas	5	2	Rear	Left	4	202,1114
1	Kansas	5	2	Rear	Left	5	203,4441
1	Kansas	5	2	Rear	Left	6	204,3925
1	Kansas	5	2	Rear	Left	7	214,0245
1	Kansas	5	2	Rear	Left	8	207,1967
1	Kansas	5	2	Rear	Left	9	214,5825
1	Kansas	5	2	Rear	Left	10	
2	Pedrina	1	2	Front	Left	1	300,3667
2	Pedrina	1	2	Front	Left	2	294,8117
2	Pedrina	1	2	Front	Left	3	297,8578
2	Pedrina	1	2	Front	Left	4	312,9676
2	Pedrina	1	2	Front	Left	5	310,5503
2	Pedrina	1	2	Front	Left	6	306,8891
2	Pedrina	1	2	Front	Left	7	302,5486
2	Pedrina	1	2	Front	Left	8	305,1201
2	Pedrina	1	2	Front	Left	9	
2	Pedrina	1	2	Front	Left	10	
2	Pedrina	1	2	Rear	Left	1	175,8419
2	Pedrina	1	2	Rear	Left	2	176,9601
2	Pedrina	1	2	Rear	Left	3	199,7492
2	Pedrina	1	2	Rear	Left	4	209,5286
2	Pedrina	1	2	Rear	Left	5	171,067
2	Pedrina	1	2	Rear	Left	6	193,7464
2	Pedrina	1	2	Rear	Left	7	192,0613
2	Pedrina	1	2	Rear	Left	8	193,9021
2	Pedrina	1	2	Rear	Left	9	181,9846
2	Pedrina	1	2	Rear	Left	10	
2	Pedrina	2	2	Front	Left	1	286,338
2	Pedrina	2	2	Front	Left	2	272,8108
2	Pedrina	2	2	Front	Left	3	269,6989
2	Pedrina	2	2	Front	Left	4	266,3151
2	Pedrina	2	2	Front	Left	5	277,852
2	Pedrina	2	2	Front	Left	6	282,2209
2	Pedrina	2	2	Front	Left	7	276,593
2	Pedrina	2	2	Front	Left	8	259,3551
2	Pedrina	2	2	Front	Left	9	
2	Pedrina	2	2	Front	Left	10	
2	Pedrina	2	2	Rear	Left	1	181,5896
2	Pedrina	2	2	Rear	Left	2	196,5056
2	Pedrina	2	2	Rear	Left	3	177,4988
2	Pedrina	2	2	Rear	Left	4	205,7557
2	Pedrina	2	2	Rear	Left	5	0

2	Pedrino	2	2	Rear	Left	6	183,5014
2	Pedrino	2	2	Rear	Left	7	198,2018
2	Pedrino	2	2	Rear	Left	8	206,9117
2	Pedrino	2	2	Rear	Left	9	
2	Pedrino	2	2	Rear	Left	10	
2	Pedrino	3	2	Front	Left	1	285,0834
2	Pedrino	3	2	Front	Left	2	278,2273
2	Pedrino	3	2	Front	Left	3	278,4586
2	Pedrino	3	2	Front	Left	4	290,1048
2	Pedrino	3	2	Front	Left	5	273,5342
2	Pedrino	3	2	Front	Left	6	283,7499
2	Pedrino	3	2	Front	Left	7	276,1765
2	Pedrino	3	2	Front	Left	8	266,253
2	Pedrino	3	2	Front	Left	9	277,524
2	Pedrino	3	2	Front	Left	10	
2	Pedrino	3	2	Rear	Left	1	204,8328
2	Pedrino	3	2	Rear	Left	2	204,7421
2	Pedrino	3	2	Rear	Left	3	197,427
2	Pedrino	3	2	Rear	Left	4	203,9379
2	Pedrino	3	2	Rear	Left	5	205,154
2	Pedrino	3	2	Rear	Left	6	182,3042
2	Pedrino	3	2	Rear	Left	7	188,6039
2	Pedrino	3	2	Rear	Left	8	209,3059
2	Pedrino	3	2	Rear	Left	9	
2	Pedrino	3	2	Rear	Left	10	
2	Pedrino	4	2	Front	Left	1	279,1597
2	Pedrino	4	2	Front	Left	2	277,8348
2	Pedrino	4	2	Front	Left	3	285,7342
2	Pedrino	4	2	Front	Left	4	286,9914
2	Pedrino	4	2	Front	Left	5	282,1544
2	Pedrino	4	2	Front	Left	6	280,532
2	Pedrino	4	2	Front	Left	7	285,7998
2	Pedrino	4	2	Front	Left	8	281,804
2	Pedrino	4	2	Front	Left	9	
2	Pedrino	4	2	Front	Left	10	
2	Pedrino	4	2	Rear	Left	1	197,1141
2	Pedrino	4	2	Rear	Left	2	201,145
2	Pedrino	4	2	Rear	Left	3	183,1398
2	Pedrino	4	2	Rear	Left	4	181,3821
2	Pedrino	4	2	Rear	Left	5	200,8755
2	Pedrino	4	2	Rear	Left	6	195,375
2	Pedrino	4	2	Rear	Left	7	196,5986
2	Pedrino	4	2	Rear	Left	8	191,1809
2	Pedrino	4	2	Rear	Left	9	188,5482
2	Pedrino	4	2	Rear	Left	10	
2	Pedrino	5	2	Front	Left	1	287,5184
2	Pedrino	5	2	Front	Left	2	284,2117
2	Pedrino	5	2	Front	Left	3	287,0522
2	Pedrino	5	2	Front	Left	4	294,703

2	Pedrino	5	2	Front	Left	5	293,7651
2	Pedrino	5	2	Front	Left	6	288,8034
2	Pedrino	5	2	Front	Left	7	293,0706
2	Pedrino	5	2	Front	Left	8	295,0499
2	Pedrino	5	2	Front	Left	9	291,2066
2	Pedrino	5	2	Front	Left	10	
2	Pedrino	5	2	Rear	Left	1	193,8111
2	Pedrino	5	2	Rear	Left	2	197,641
2	Pedrino	5	2	Rear	Left	3	201,6324
2	Pedrino	5	2	Rear	Left	4	196,8844
2	Pedrino	5	2	Rear	Left	5	183,5019
2	Pedrino	5	2	Rear	Left	6	193,8639
2	Pedrino	5	2	Rear	Left	7	204,4943
2	Pedrino	5	2	Rear	Left	8	203,6445
2	Pedrino	5	2	Rear	Left	9	
2	Pedrino	5	2	Rear	Left	10	
2	Pequeena	1	2	Front	Left	1	246,4476
2	Pequeena	1	2	Front	Left	2	244,6947
2	Pequeena	1	2	Front	Left	3	233,6707
2	Pequeena	1	2	Front	Left	4	248,4537
2	Pequeena	1	2	Front	Left	5	258,1076
2	Pequeena	1	2	Front	Left	6	256,095
2	Pequeena	1	2	Front	Left	7	252,8101
2	Pequeena	1	2	Front	Left	8	252,7998
2	Pequeena	1	2	Front	Left	9	257,77
2	Pequeena	1	2	Front	Left	10	253,3857
2	Pequeena	1	2	Rear	Left	1	153,2031
2	Pequeena	1	2	Rear	Left	2	148,075
2	Pequeena	1	2	Rear	Left	3	154,4664
2	Pequeena	1	2	Rear	Left	4	147,2051
2	Pequeena	1	2	Rear	Left	5	144,5071
2	Pequeena	1	2	Rear	Left	6	146,4625
2	Pequeena	1	2	Rear	Left	7	149,5834
2	Pequeena	1	2	Rear	Left	8	148,5207
2	Pequeena	1	2	Rear	Left	9	135,9799
2	Pequeena	1	2	Rear	Left	10	129,0036
2	Pequeena	2	2	Front	Left	1	244,6935
2	Pequeena	2	2	Front	Left	2	247,8603
2	Pequeena	2	2	Front	Left	3	246,6438
2	Pequeena	2	2	Front	Left	4	249,2794
2	Pequeena	2	2	Front	Left	5	240,4408
2	Pequeena	2	2	Front	Left	6	246,4573
2	Pequeena	2	2	Front	Left	7	247,7273
2	Pequeena	2	2	Front	Left	8	247,7412
2	Pequeena	2	2	Front	Left	9	248,7098
2	Pequeena	2	2	Front	Left	10	252,775
2	Pequeena	2	2	Rear	Left	1	145,1862
2	Pequeena	2	2	Rear	Left	2	136,8754
2	Pequeena	2	2	Rear	Left	3	135,7024

2	Pequeena	2	2	Rear	Left	4	150,1003
2	Pequeena	2	2	Rear	Left	5	138,4875
2	Pequeena	2	2	Rear	Left	6	154,1814
2	Pequeena	2	2	Rear	Left	7	147,6361
2	Pequeena	2	2	Rear	Left	8	143,3978
2	Pequeena	2	2	Rear	Left	9	129,5811
2	Pequeena	2	2	Rear	Left	10	140,4306
2	Pequeena	3	2	Front	Left	1	259,5848
2	Pequeena	3	2	Front	Left	2	245,0291
2	Pequeena	3	2	Front	Left	3	253,6103
2	Pequeena	3	2	Front	Left	4	265,2638
2	Pequeena	3	2	Front	Left	5	258,7902
2	Pequeena	3	2	Front	Left	6	260,577
2	Pequeena	3	2	Front	Left	7	252,0241
2	Pequeena	3	2	Front	Left	8	251,4922
2	Pequeena	3	2	Front	Left	9	249,5536
2	Pequeena	3	2	Front	Left	10	
2	Pequeena	3	2	Rear	Left	1	142,3781
2	Pequeena	3	2	Rear	Left	2	136,5511
2	Pequeena	3	2	Rear	Left	3	139,8979
2	Pequeena	3	2	Rear	Left	4	128,0999
2	Pequeena	3	2	Rear	Left	5	141,6164
2	Pequeena	3	2	Rear	Left	6	130,9615
2	Pequeena	3	2	Rear	Left	7	137,1172
2	Pequeena	3	2	Rear	Left	8	133,246
2	Pequeena	3	2	Rear	Left	9	138,0753
2	Pequeena	3	2	Rear	Left	10	138,1238
2	Pequeena	4	2	Front	Left	1	287,9991
2	Pequeena	4	2	Front	Left	2	285,4216
2	Pequeena	4	2	Front	Left	3	291,0879
2	Pequeena	4	2	Front	Left	4	278,1001
2	Pequeena	4	2	Front	Left	5	274,8171
2	Pequeena	4	2	Front	Left	6	283,4812
2	Pequeena	4	2	Front	Left	7	276,7036
2	Pequeena	4	2	Front	Left	8	273,3861
2	Pequeena	4	2	Front	Left	9	291,1458
2	Pequeena	4	2	Front	Left	10	291,0989
2	Pequeena	4	2	Rear	Left	1	143,7977
2	Pequeena	4	2	Rear	Left	2	150,6124
2	Pequeena	4	2	Rear	Left	3	149,6073
2	Pequeena	4	2	Rear	Left	4	148,5194
2	Pequeena	4	2	Rear	Left	5	151,4633
2	Pequeena	4	2	Rear	Left	6	147,6727
2	Pequeena	4	2	Rear	Left	7	150,4297
2	Pequeena	4	2	Rear	Left	8	152,9787
2	Pequeena	4	2	Rear	Left	9	140,3661
2	Pequeena	4	2	Rear	Left	10	
2	Pequeena	5	2	Front	Left	1	266,2035
2	Pequeena	5	2	Front	Left	2	263,0226

2	Pequeena	5	2	Front	Left	3	267,1772
2	Pequeena	5	2	Front	Left	4	271,3028
2	Pequeena	5	2	Front	Left	5	257,3944
2	Pequeena	5	2	Front	Left	6	268,1583
2	Pequeena	5	2	Front	Left	7	265,7674
2	Pequeena	5	2	Front	Left	8	253,7441
2	Pequeena	5	2	Front	Left	9	260,7604
2	Pequeena	5	2	Front	Left	10	267,4958
2	Pequeena	5	2	Rear	Left	1	131,4786
2	Pequeena	5	2	Rear	Left	2	149,5311
2	Pequeena	5	2	Rear	Left	3	145,4371
2	Pequeena	5	2	Rear	Left	4	139,8759
2	Pequeena	5	2	Rear	Left	5	139,7544
2	Pequeena	5	2	Rear	Left	6	149,0688
2	Pequeena	5	2	Rear	Left	7	153,1239
2	Pequeena	5	2	Rear	Left	8	149,1422
2	Pequeena	5	2	Rear	Left	9	141,1656
2	Pequeena	5	2	Rear	Left	10	

Table B-2 : Calibrated peak vertical force (Cal PVF) in Newtons (N) for lame dogs at a trot on the treadmill. Target speed is indicated in m/s. Weight is indicated in kg.

Day	dog	weight	trial	speed	leg	side	step	Cal PVF
1	Guinness	33,1	1	2	Front	Left	1	326,6044
1	Guinness	33,1	1	2	Front	Left	2	320,75
1	Guinness	33,1	1	2	Front	Left	3	315,0526
1	Guinness	33,1	1	2	Front	Left	4	311,988
1	Guinness	33,1	1	2	Front	Left	5	319,7465
1	Guinness	33,1	1	2	Front	Left	6	333,2779
1	Guinness	33,1	1	2	Front	Left	7	314,5951
1	Guinness	33,1	1	2	Front	Left	8	301,6923
1	Guinness	33,1	1	2	Front	Left	9	296,5387
1	Guinness	33,1	1	2	Front	Left	10	
1	Guinness	33,1	1	2	Front	Right	1	
1	Guinness	33,1	1	2	Front	Right	2	321,5611
1	Guinness	33,1	1	2	Front	Right	3	320,5173
1	Guinness	33,1	1	2	Front	Right	4	309,1795
1	Guinness	33,1	1	2	Front	Right	5	319,4276
1	Guinness	33,1	1	2	Front	Right	6	327,8284
1	Guinness	33,1	1	2	Front	Right	7	329,8446
1	Guinness	33,1	1	2	Front	Right	8	313,3218
1	Guinness	33,1	1	2	Front	Right	9	303,7787
1	Guinness	33,1	1	2	Front	Right	10	312,1352
1	Guinness	33,1	1	2	Rear	Left	1	
1	Guinness	33,1	1	2	Rear	Left	2	237,4839
1	Guinness	33,1	1	2	Rear	Left	3	255,3161
1	Guinness	33,1	1	2	Rear	Left	4	255,8263
1	Guinness	33,1	1	2	Rear	Left	5	216,1937
1	Guinness	33,1	1	2	Rear	Left	6	230,7851
1	Guinness	33,1	1	2	Rear	Left	7	242,4256
1	Guinness	33,1	1	2	Rear	Left	8	242,4671
1	Guinness	33,1	1	2	Rear	Left	9	222,6771
1	Guinness	33,1	1	2	Rear	Left	10	208,3083
1	Guinness	33,1	1	2	Rear	Right	1	0
1	Guinness	33,1	1	2	Rear	Right	2	230,2619
1	Guinness	33,1	1	2	Rear	Right	3	219,7085
1	Guinness	33,1	1	2	Rear	Right	4	236,8497
1	Guinness	33,1	1	2	Rear	Right	5	204,2853
1	Guinness	33,1	1	2	Rear	Right	6	211,2081
1	Guinness	33,1	1	2	Rear	Right	7	215,7067
1	Guinness	33,1	1	2	Rear	Right	8	233,9898
1	Guinness	33,1	1	2	Rear	Right	9	208,4172
1	Guinness	33,1	1	2	Rear	Right	10	198,7706
1	Guinness	33,1	2	2	Front	Left	1	328,9145
1	Guinness	33,1	2	2	Front	Left	2	336,3493
1	Guinness	33,1	2	2	Front	Left	3	337,6221

1	Guinness	33,1	2	2	Front	Left	4	325,9218
1	Guinness	33,1	2	2	Front	Left	5	340,1918
1	Guinness	33,1	2	2	Front	Left	6	333,7633
1	Guinness	33,1	2	2	Front	Left	7	338,783
1	Guinness	33,1	2	2	Front	Left	8	332,5444
1	Guinness	33,1	2	2	Front	Left	9	328,4194
1	Guinness	33,1	2	2	Front	Left	10	0
1	Guinness	33,1	2	2	Front	Right	1	318,4749
1	Guinness	33,1	2	2	Front	Right	2	325,1487
1	Guinness	33,1	2	2	Front	Right	3	330,1961
1	Guinness	33,1	2	2	Front	Right	4	323,1611
1	Guinness	33,1	2	2	Front	Right	5	321,6548
1	Guinness	33,1	2	2	Front	Right	6	331,3423
1	Guinness	33,1	2	2	Front	Right	7	323,7813
1	Guinness	33,1	2	2	Front	Right	8	335,6431
1	Guinness	33,1	2	2	Front	Right	9	323,5515
1	Guinness	33,1	2	2	Front	Right	10	0
1	Guinness	33,1	2	2	Rear	Left	1	221,9893
1	Guinness	33,1	2	2	Rear	Left	2	201,4323
1	Guinness	33,1	2	2	Rear	Left	3	224,1742
1	Guinness	33,1	2	2	Rear	Left	4	204,2246
1	Guinness	33,1	2	2	Rear	Left	5	243,6971
1	Guinness	33,1	2	2	Rear	Left	6	196,1873
1	Guinness	33,1	2	2	Rear	Left	7	207,3447
1	Guinness	33,1	2	2	Rear	Left	8	246,686
1	Guinness	33,1	2	2	Rear	Left	9	221,1646
1	Guinness	33,1	2	2	Rear	Left	10	232,8425
1	Guinness	33,1	2	2	Rear	Right	1	199,0357
1	Guinness	33,1	2	2	Rear	Right	2	210,0041
1	Guinness	33,1	2	2	Rear	Right	3	198,2995
1	Guinness	33,1	2	2	Rear	Right	4	201,6751
1	Guinness	33,1	2	2	Rear	Right	5	198,9887
1	Guinness	33,1	2	2	Rear	Right	6	213,7487
1	Guinness	33,1	2	2	Rear	Right	7	212,3637
1	Guinness	33,1	2	2	Rear	Right	8	201,9562
1	Guinness	33,1	2	2	Rear	Right	9	210,6656
1	Guinness	33,1	2	2	Rear	Right	10	0
1	Guinness	33,1	3	2	Front	Left	1	
1	Guinness	33,1	3	2	Front	Left	2	335,5759
1	Guinness	33,1	3	2	Front	Left	3	330,0536
1	Guinness	33,1	3	2	Front	Left	4	334,5078
1	Guinness	33,1	3	2	Front	Left	5	356,7101
1	Guinness	33,1	3	2	Front	Left	6	327,313
1	Guinness	33,1	3	2	Front	Left	7	345,0023
1	Guinness	33,1	3	2	Front	Left	8	350,1524
1	Guinness	33,1	3	2	Front	Left	9	334,6027
1	Guinness	33,1	3	2	Front	Left	10	0
1	Guinness	33,1	3	2	Front	Right	1	328,3543

1	Guinness	33,1	3	2	Front	Right	2	329,8595
1	Guinness	33,1	3	2	Front	Right	3	337,3875
1	Guinness	33,1	3	2	Front	Right	4	332,4369
1	Guinness	33,1	3	2	Front	Right	5	324,7049
1	Guinness	33,1	3	2	Front	Right	6	332,7627
1	Guinness	33,1	3	2	Front	Right	7	338,482
1	Guinness	33,1	3	2	Front	Right	8	328,4431
1	Guinness	33,1	3	2	Front	Right	9	338,8585
1	Guinness	33,1	3	2	Front	Right	10	0
1	Guinness	33,1	3	2	Rear	Left	1	241,642
1	Guinness	33,1	3	2	Rear	Left	2	242,4523
1	Guinness	33,1	3	2	Rear	Left	3	242,3596
1	Guinness	33,1	3	2	Rear	Left	4	245,4977
1	Guinness	33,1	3	2	Rear	Left	5	253,5558
1	Guinness	33,1	3	2	Rear	Left	6	235,5077
1	Guinness	33,1	3	2	Rear	Left	7	244,7767
1	Guinness	33,1	3	2	Rear	Left	8	244,375
1	Guinness	33,1	3	2	Rear	Left	9	227,1079
1	Guinness	33,1	3	2	Rear	Left	10	0
1	Guinness	33,1	3	2	Rear	Right	1	0
1	Guinness	33,1	3	2	Rear	Right	2	214,2979
1	Guinness	33,1	3	2	Rear	Right	3	211,5361
1	Guinness	33,1	3	2	Rear	Right	4	211,5878
1	Guinness	33,1	3	2	Rear	Right	5	209,1329
1	Guinness	33,1	3	2	Rear	Right	6	211,3251
1	Guinness	33,1	3	2	Rear	Right	7	212,4834
1	Guinness	33,1	3	2	Rear	Right	8	212,0972
1	Guinness	33,1	3	2	Rear	Right	9	214,4166
1	Guinness	33,1	3	2	Rear	Right	10	208,3638
1	Guinness	33,1	4	2	Front	Left	1	353,6831
1	Guinness	33,1	4	2	Front	Left	2	350,2829
1	Guinness	33,1	4	2	Front	Left	3	336,7206
1	Guinness	33,1	4	2	Front	Left	4	343,7458
1	Guinness	33,1	4	2	Front	Left	5	348,4318
1	Guinness	33,1	4	2	Front	Left	6	346,4856
1	Guinness	33,1	4	2	Front	Left	7	330,4971
1	Guinness	33,1	4	2	Front	Left	8	340,7467
1	Guinness	33,1	4	2	Front	Left	9	349,9205
1	Guinness	33,1	4	2	Front	Left	10	0
1	Guinness	33,1	4	2	Front	Right	1	327,1816
1	Guinness	33,1	4	2	Front	Right	2	330,5003
1	Guinness	33,1	4	2	Front	Right	3	329,1345
1	Guinness	33,1	4	2	Front	Right	4	330,1061
1	Guinness	33,1	4	2	Front	Right	5	333,5868
1	Guinness	33,1	4	2	Front	Right	6	332,844
1	Guinness	33,1	4	2	Front	Right	7	327,3676
1	Guinness	33,1	4	2	Front	Right	8	334,3505
1	Guinness	33,1	4	2	Front	Right	9	330,8075

1	Guinness	33,1	4	2	Front	Right	10	0
1	Guinness	33,1	4	2	Rear	Left	1	254,4372
1	Guinness	33,1	4	2	Rear	Left	2	253,0291
1	Guinness	33,1	4	2	Rear	Left	3	259,653
1	Guinness	33,1	4	2	Rear	Left	4	249,8207
1	Guinness	33,1	4	2	Rear	Left	5	256,0765
1	Guinness	33,1	4	2	Rear	Left	6	251,0134
1	Guinness	33,1	4	2	Rear	Left	7	260,5428
1	Guinness	33,1	4	2	Rear	Left	8	254,2058
1	Guinness	33,1	4	2	Rear	Left	9	251,7506
1	Guinness	33,1	4	2	Rear	Left	10	0
1	Guinness	33,1	4	2	Rear	Right	1	211,7732
1	Guinness	33,1	4	2	Rear	Right	2	232,351
1	Guinness	33,1	4	2	Rear	Right	3	226,2508
1	Guinness	33,1	4	2	Rear	Right	4	219,4952
1	Guinness	33,1	4	2	Rear	Right	5	223,7781
1	Guinness	33,1	4	2	Rear	Right	6	226,6155
1	Guinness	33,1	4	2	Rear	Right	7	220,668
1	Guinness	33,1	4	2	Rear	Right	8	219,4498
1	Guinness	33,1	4	2	Rear	Right	9	231,3963
1	Guinness	33,1	4	2	Rear	Right	10	0
1	Guinness	33,1	5	2	Front	Left	1	345,1196
1	Guinness	33,1	5	2	Front	Left	2	352,6894
1	Guinness	33,1	5	2	Front	Left	3	346,3991
1	Guinness	33,1	5	2	Front	Left	4	359,0232
1	Guinness	33,1	5	2	Front	Left	5	356,8476
1	Guinness	33,1	5	2	Front	Left	6	343,8923
1	Guinness	33,1	5	2	Front	Left	7	356,5163
1	Guinness	33,1	5	2	Front	Left	8	346,0431
1	Guinness	33,1	5	2	Front	Left	9	355,4185
1	Guinness	33,1	5	2	Front	Left	10	0
1	Guinness	33,1	5	2	Front	Right	1	0
1	Guinness	33,1	5	2	Front	Right	2	321,7314
1	Guinness	33,1	5	2	Front	Right	3	330,0883
1	Guinness	33,1	5	2	Front	Right	4	332,4281
1	Guinness	33,1	5	2	Front	Right	5	327,6833
1	Guinness	33,1	5	2	Front	Right	6	328,7878
1	Guinness	33,1	5	2	Front	Right	7	331,8267
1	Guinness	33,1	5	2	Front	Right	8	330,123
1	Guinness	33,1	5	2	Front	Right	9	325,6219
1	Guinness	33,1	5	2	Front	Right	10	331,6794
1	Guinness	33,1	5	2	Rear	Left	1	
1	Guinness	33,1	5	2	Rear	Left	2	261,7993
1	Guinness	33,1	5	2	Rear	Left	3	268,2259
1	Guinness	33,1	5	2	Rear	Left	4	262,7837
1	Guinness	33,1	5	2	Rear	Left	5	262,9089
1	Guinness	33,1	5	2	Rear	Left	6	274,1395
1	Guinness	33,1	5	2	Rear	Left	7	268,258

1	Guinness	33,1	5	2	Rear	Left	8	273,4289
1	Guinness	33,1	5	2	Rear	Left	9	266,193
1	Guinness	33,1	5	2	Rear	Left	10	254,1532
1	Guinness	33,1	5	2	Rear	Right	1	234,3036
1	Guinness	33,1	5	2	Rear	Right	2	222,8482
1	Guinness	33,1	5	2	Rear	Right	3	218,8833
1	Guinness	33,1	5	2	Rear	Right	4	236,7231
1	Guinness	33,1	5	2	Rear	Right	5	235,6069
1	Guinness	33,1	5	2	Rear	Right	6	224,4369
1	Guinness	33,1	5	2	Rear	Right	7	233,4731
1	Guinness	33,1	5	2	Rear	Right	8	228,2445
1	Guinness	33,1	5	2	Rear	Right	9	230,7665
1	Guinness	33,1	5	2	Rear	Right	10	
1	Winston	36,07	1	2	Front	Left	1	459,1571
1	Winston	36,07	1	2	Front	Left	2	431,4496
1	Winston	36,07	1	2	Front	Left	3	429,5824
1	Winston	36,07	1	2	Front	Left	4	444,5743
1	Winston	36,07	1	2	Front	Left	5	432,0163
1	Winston	36,07	1	2	Front	Left	6	435,4867
1	Winston	36,07	1	2	Front	Left	7	440,2854
1	Winston	36,07	1	2	Front	Left	8	440,5247
1	Winston	36,07	1	2	Front	Left	9	441,1491
1	Winston	36,07	1	2	Front	Left	10	451,7201
1	Winston	36,07	1	2	Front	Right	1	450,4844
1	Winston	36,07	1	2	Front	Right	2	431,1751
1	Winston	36,07	1	2	Front	Right	3	431,5751
1	Winston	36,07	1	2	Front	Right	4	437,6157
1	Winston	36,07	1	2	Front	Right	5	440,4153
1	Winston	36,07	1	2	Front	Right	6	427,8979
1	Winston	36,07	1	2	Front	Right	7	414,3232
1	Winston	36,07	1	2	Front	Right	8	436,8848
1	Winston	36,07	1	2	Front	Right	9	425,7621
1	Winston	36,07	1	2	Front	Right	10	0
1	Winston	36,07	1	2	Rear	Left	1	262,393
1	Winston	36,07	1	2	Rear	Left	2	272,5888
1	Winston	36,07	1	2	Rear	Left	3	276,1052
1	Winston	36,07	1	2	Rear	Left	4	273,6833
1	Winston	36,07	1	2	Rear	Left	5	275,8156
1	Winston	36,07	1	2	Rear	Left	6	278,2609
1	Winston	36,07	1	2	Rear	Left	7	272,1498
1	Winston	36,07	1	2	Rear	Left	8	278,6506
1	Winston	36,07	1	2	Rear	Left	9	278,1949
1	Winston	36,07	1	2	Rear	Left	10	0
1	Winston	36,07	1	2	Rear	Right	1	282,5689
1	Winston	36,07	1	2	Rear	Right	2	273,5806
1	Winston	36,07	1	2	Rear	Right	3	279,0414
1	Winston	36,07	1	2	Rear	Right	4	272,334
1	Winston	36,07	1	2	Rear	Right	5	280,3925

1	Winston	36,07	1	2	Rear	Right	6	292,0353
1	Winston	36,07	1	2	Rear	Right	7	260,2999
1	Winston	36,07	1	2	Rear	Right	8	275,4029
1	Winston	36,07	1	2	Rear	Right	9	285,7889
1	Winston	36,07	1	2	Rear	Right	10	277,4709
1	Winston	36,07	2	2	Front	Left	1	405,4935
1	Winston	36,07	2	2	Front	Left	2	399,5992
1	Winston	36,07	2	2	Front	Left	3	405,8564
1	Winston	36,07	2	2	Front	Left	4	402,9678
1	Winston	36,07	2	2	Front	Left	5	395,19
1	Winston	36,07	2	2	Front	Left	6	384,6852
1	Winston	36,07	2	2	Front	Left	7	406,4733
1	Winston	36,07	2	2	Front	Left	8	399,3418
1	Winston	36,07	2	2	Front	Left	9	396,0854
1	Winston	36,07	2	2	Front	Left	10	378,9703
1	Winston	36,07	2	2	Front	Right	1	395,1512
1	Winston	36,07	2	2	Front	Right	2	391,1769
1	Winston	36,07	2	2	Front	Right	3	392,0154
1	Winston	36,07	2	2	Front	Right	4	396,1836
1	Winston	36,07	2	2	Front	Right	5	384,6905
1	Winston	36,07	2	2	Front	Right	6	403,8202
1	Winston	36,07	2	2	Front	Right	7	403,4733
1	Winston	36,07	2	2	Front	Right	8	396,4963
1	Winston	36,07	2	2	Front	Right	9	386,1151
1	Winston	36,07	2	2	Front	Right	10	0
1	Winston	36,07	2	2	Rear	Left	1	270,8769
1	Winston	36,07	2	2	Rear	Left	2	260,7137
1	Winston	36,07	2	2	Rear	Left	3	272,0466
1	Winston	36,07	2	2	Rear	Left	4	262,1781
1	Winston	36,07	2	2	Rear	Left	5	261,4175
1	Winston	36,07	2	2	Rear	Left	6	264,6109
1	Winston	36,07	2	2	Rear	Left	7	273,4436
1	Winston	36,07	2	2	Rear	Left	8	258,9787
1	Winston	36,07	2	2	Rear	Left	9	263,1864
1	Winston	36,07	2	2	Rear	Left	10	0
1	Winston	36,07	2	2	Rear	Right	1	261,9425
1	Winston	36,07	2	2	Rear	Right	2	263,7459
1	Winston	36,07	2	2	Rear	Right	3	259,2859
1	Winston	36,07	2	2	Rear	Right	4	270,3699
1	Winston	36,07	2	2	Rear	Right	5	263,9704
1	Winston	36,07	2	2	Rear	Right	6	267,9572
1	Winston	36,07	2	2	Rear	Right	7	276,9355
1	Winston	36,07	2	2	Rear	Right	8	268,4753
1	Winston	36,07	2	2	Rear	Right	9	269,0657
1	Winston	36,07	2	2	Rear	Right	10	279,8064
1	Winston	36,07	3	2	Front	Left	1	432,7582
1	Winston	36,07	3	2	Front	Left	2	435,169
1	Winston	36,07	3	2	Front	Left	3	437,0718

1	Winston	36,07	3	2	Front	Left	4	432,2246
1	Winston	36,07	3	2	Front	Left	5	446,3509
1	Winston	36,07	3	2	Front	Left	6	437,0398
1	Winston	36,07	3	2	Front	Left	7	440,8145
1	Winston	36,07	3	2	Front	Left	8	431,9613
1	Winston	36,07	3	2	Front	Left	9	435,7393
1	Winston	36,07	3	2	Front	Left	10	0
1	Winston	36,07	3	2	Front	Right	1	427,4892
1	Winston	36,07	3	2	Front	Right	2	423,5197
1	Winston	36,07	3	2	Front	Right	3	432,7564
1	Winston	36,07	3	2	Front	Right	4	429,7957
1	Winston	36,07	3	2	Front	Right	5	411,1289
1	Winston	36,07	3	2	Front	Right	6	415,714
1	Winston	36,07	3	2	Front	Right	7	406,6282
1	Winston	36,07	3	2	Front	Right	8	414,4684
1	Winston	36,07	3	2	Front	Right	9	419,1412
1	Winston	36,07	3	2	Front	Right	10	410,4753
1	Winston	36,07	3	2	Rear	Left	1	272,7145
1	Winston	36,07	3	2	Rear	Left	2	269,7444
1	Winston	36,07	3	2	Rear	Left	3	264,0627
1	Winston	36,07	3	2	Rear	Left	4	274,611
1	Winston	36,07	3	2	Rear	Left	5	257,9585
1	Winston	36,07	3	2	Rear	Left	6	267,7088
1	Winston	36,07	3	2	Rear	Left	7	274,7744
1	Winston	36,07	3	2	Rear	Left	8	268,1767
1	Winston	36,07	3	2	Rear	Left	9	267,3799
1	Winston	36,07	3	2	Rear	Left	10	275,8263
1	Winston	36,07	3	2	Rear	Right	1	274,0915
1	Winston	36,07	3	2	Rear	Right	2	277,5294
1	Winston	36,07	3	2	Rear	Right	3	268,5959
1	Winston	36,07	3	2	Rear	Right	4	258,7999
1	Winston	36,07	3	2	Rear	Right	5	257,0677
1	Winston	36,07	3	2	Rear	Right	6	272,8692
1	Winston	36,07	3	2	Rear	Right	7	261,364
1	Winston	36,07	3	2	Rear	Right	8	274,1501
1	Winston	36,07	3	2	Rear	Right	9	263,1555
1	Winston	36,07	3	2	Rear	Right	10	0
1	Winston	36,07	4	2	Front	Left	1	415,4549
1	Winston	36,07	4	2	Front	Left	2	419,0183
1	Winston	36,07	4	2	Front	Left	3	423,8561
1	Winston	36,07	4	2	Front	Left	4	417,7201
1	Winston	36,07	4	2	Front	Left	5	399,5112
1	Winston	36,07	4	2	Front	Left	6	422,763
1	Winston	36,07	4	2	Front	Left	7	430,6718
1	Winston	36,07	4	2	Front	Left	8	425,8146
1	Winston	36,07	4	2	Front	Left	9	427,2714
1	Winston	36,07	4	2	Front	Left	10	0
1	Winston	36,07	4	2	Front	Right	1	404,1659

1	Winston	36,07	4	2	Front	Right	2	411,0799
1	Winston	36,07	4	2	Front	Right	3	415,361
1	Winston	36,07	4	2	Front	Right	4	416,5043
1	Winston	36,07	4	2	Front	Right	5	409,2818
1	Winston	36,07	4	2	Front	Right	6	431,6964
1	Winston	36,07	4	2	Front	Right	7	421,4273
1	Winston	36,07	4	2	Front	Right	8	416,5912
1	Winston	36,07	4	2	Front	Right	9	412,1913
1	Winston	36,07	4	2	Front	Right	10	406,9284
1	Winston	36,07	4	2	Rear	Left	1	260,4821
1	Winston	36,07	4	2	Rear	Left	2	267,9118
1	Winston	36,07	4	2	Rear	Left	3	277,0689
1	Winston	36,07	4	2	Rear	Left	4	269,6761
1	Winston	36,07	4	2	Rear	Left	5	261,7972
1	Winston	36,07	4	2	Rear	Left	6	272,6937
1	Winston	36,07	4	2	Rear	Left	7	269,0354
1	Winston	36,07	4	2	Rear	Left	8	273,0953
1	Winston	36,07	4	2	Rear	Left	9	269,2134
1	Winston	36,07	4	2	Rear	Left	10	269,8712
1	Winston	36,07	4	2	Rear	Right	1	267,5538
1	Winston	36,07	4	2	Rear	Right	2	282,4805
1	Winston	36,07	4	2	Rear	Right	3	275,6963
1	Winston	36,07	4	2	Rear	Right	4	258,1749
1	Winston	36,07	4	2	Rear	Right	5	279,5117
1	Winston	36,07	4	2	Rear	Right	6	265,6249
1	Winston	36,07	4	2	Rear	Right	7	284,6628
1	Winston	36,07	4	2	Rear	Right	8	282,6434
1	Winston	36,07	4	2	Rear	Right	9	277,2795
1	Winston	36,07	4	2	Rear	Right	10	
1	Winston	36,07	5	2	Front	Left	1	
1	Winston	36,07	5	2	Front	Left	2	440,8815
1	Winston	36,07	5	2	Front	Left	3	421,8677
1	Winston	36,07	5	2	Front	Left	4	424,8956
1	Winston	36,07	5	2	Front	Left	5	426,2073
1	Winston	36,07	5	2	Front	Left	6	458,351
1	Winston	36,07	5	2	Front	Left	7	434,3898
1	Winston	36,07	5	2	Front	Left	8	429,2656
1	Winston	36,07	5	2	Front	Left	9	427,5722
1	Winston	36,07	5	2	Front	Left	10	415,6873
1	Winston	36,07	5	2	Front	Right	1	434,6634
1	Winston	36,07	5	2	Front	Right	2	432,1339
1	Winston	36,07	5	2	Front	Right	3	425,2474
1	Winston	36,07	5	2	Front	Right	4	433,1493
1	Winston	36,07	5	2	Front	Right	5	433,3192
1	Winston	36,07	5	2	Front	Right	6	436,1794
1	Winston	36,07	5	2	Front	Right	7	441,6841
1	Winston	36,07	5	2	Front	Right	8	427,4576
1	Winston	36,07	5	2	Front	Right	9	426,7288

1	Winston	36,07	5	2	Front	Right	10	0
1	Winston	36,07	5	2	Rear	Left	1	266,4749
1	Winston	36,07	5	2	Rear	Left	2	255,3875
1	Winston	36,07	5	2	Rear	Left	3	263,8197
1	Winston	36,07	5	2	Rear	Left	4	268,7108
1	Winston	36,07	5	2	Rear	Left	5	264,7413
1	Winston	36,07	5	2	Rear	Left	6	248,8263
1	Winston	36,07	5	2	Rear	Left	7	265,6165
1	Winston	36,07	5	2	Rear	Left	8	270,8025
1	Winston	36,07	5	2	Rear	Left	9	273,0391
1	Winston	36,07	5	2	Rear	Left	10	0
1	Winston	36,07	5	2	Rear	Right	1	267,1507
1	Winston	36,07	5	2	Rear	Right	2	264,8001
1	Winston	36,07	5	2	Rear	Right	3	281,2969
1	Winston	36,07	5	2	Rear	Right	4	263,3201
1	Winston	36,07	5	2	Rear	Right	5	259,5204
1	Winston	36,07	5	2	Rear	Right	6	281,7339
1	Winston	36,07	5	2	Rear	Right	7	276,194
1	Winston	36,07	5	2	Rear	Right	8	265,7925
1	Winston	36,07	5	2	Rear	Right	9	270,6281
1	Winston	36,07	5	2	Rear	Right	10	0
1	Madison	16,95	1	2	Front	Left	1	192,4049
1	Madison	16,95	1	2	Front	Left	2	194,9794
1	Madison	16,95	1	2	Front	Left	3	193,2898
1	Madison	16,95	1	2	Front	Left	4	194,0911
1	Madison	16,95	1	2	Front	Left	5	198,958
1	Madison	16,95	1	2	Front	Left	6	190,3161
1	Madison	16,95	1	2	Front	Left	7	197,4292
1	Madison	16,95	1	2	Front	Left	8	199,6934
1	Madison	16,95	1	2	Front	Left	9	196,9486
1	Madison	16,95	1	2	Front	Left	10	198,5393
1	Madison	16,95	1	2	Front	Right	1	175,6823
1	Madison	16,95	1	2	Front	Right	2	172,4632
1	Madison	16,95	1	2	Front	Right	3	170,0247
1	Madison	16,95	1	2	Front	Right	4	175,7051
1	Madison	16,95	1	2	Front	Right	5	179,7874
1	Madison	16,95	1	2	Front	Right	6	178,2896
1	Madison	16,95	1	2	Front	Right	7	176,9148
1	Madison	16,95	1	2	Front	Right	8	173,5296
1	Madison	16,95	1	2	Front	Right	9	174,6608
1	Madison	16,95	1	2	Rear	Right	10	180,2006
1	Madison	16,95	1	2	Rear	Left	1	133,6489
1	Madison	16,95	1	2	Rear	Left	2	128,784
1	Madison	16,95	1	2	Rear	Left	3	128,1251
1	Madison	16,95	1	2	Rear	Left	4	127,701
1	Madison	16,95	1	2	Rear	Left	5	136,0281
1	Madison	16,95	1	2	Rear	Left	6	138,8122
1	Madison	16,95	1	2	Rear	Left	7	130,0304

1	Madison	16,95	1	2	Rear	Left	8	132,3496
1	Madison	16,95	1	2	Rear	Left	9	127,7143
1	Madison	16,95	1	2	Rear	Left	10	131,9619
1	Madison	16,95	1	2	Rear	Right	1	132,1451
1	Madison	16,95	1	2	Rear	Right	2	137,98
1	Madison	16,95	1	2	Rear	Right	3	131,6557
1	Madison	16,95	1	2	Rear	Right	4	129,8896
1	Madison	16,95	1	2	Rear	Right	5	137,8007
1	Madison	16,95	1	2	Rear	Right	6	133,644
1	Madison	16,95	1	2	Rear	Right	7	136,7936
1	Madison	16,95	1	2	Rear	Right	8	139,8491
1	Madison	16,95	1	2	Rear	Right	9	135,2102
1	Madison	16,95	1	2	Rear	Right	10	131,8344
1	Madison	16,95	2	2	Front	Left	1	222,5187
1	Madison	16,95	2	2	Front	Left	2	218,9837
1	Madison	16,95	2	2	Front	Left	3	222,1166
1	Madison	16,95	2	2	Front	Left	4	222,9461
1	Madison	16,95	2	2	Front	Left	5	221,6671
1	Madison	16,95	2	2	Front	Left	6	217,8176
1	Madison	16,95	2	2	Front	Left	7	223,5793
1	Madison	16,95	2	2	Front	Left	8	219,6698
1	Madison	16,95	2	2	Front	Left	9	211,7475
1	Madison	16,95	2	2	Front	Left	10	219,1388
1	Madison	16,95	2	2	Front	Right	1	0
1	Madison	16,95	2	2	Front	Right	2	180,8153
1	Madison	16,95	2	2	Front	Right	3	178,9176
1	Madison	16,95	2	2	Front	Right	4	185,3263
1	Madison	16,95	2	2	Front	Right	5	183,2107
1	Madison	16,95	2	2	Front	Right	6	187,9018
1	Madison	16,95	2	2	Front	Right	7	184,5566
1	Madison	16,95	2	2	Front	Right	8	186,0099
1	Madison	16,95	2	2	Front	Right	9	182,241
1	Madison	16,95	2	2	Front	Right	10	183,3772
1	Madison	16,95	2	2	Rear	Left	1	138,6405
1	Madison	16,95	2	2	Rear	Left	2	131,7194
1	Madison	16,95	2	2	Rear	Left	3	134,754
1	Madison	16,95	2	2	Rear	Left	4	137,5659
1	Madison	16,95	2	2	Rear	Left	5	132,8945
1	Madison	16,95	2	2	Rear	Left	6	130,9617
1	Madison	16,95	2	2	Rear	Left	7	133,4027
1	Madison	16,95	2	2	Rear	Left	8	132,3976
1	Madison	16,95	2	2	Rear	Left	9	128,9285
1	Madison	16,95	2	2	Rear	Left	10	135,1879
1	Madison	16,95	2	2	Rear	Right	1	131,3193
1	Madison	16,95	2	2	Rear	Right	2	134,11
1	Madison	16,95	2	2	Rear	Right	3	133,1348
1	Madison	16,95	2	2	Rear	Right	4	130,5385
1	Madison	16,95	2	2	Rear	Right	5	127,9235

1	Madison	16,95	2	2	Rear	Right	6	135,4467
1	Madison	16,95	2	2	Rear	Right	7	131,9952
1	Madison	16,95	2	2	Rear	Right	8	132,546
1	Madison	16,95	2	2	Rear	Right	9	132,2033
1	Madison	16,95	2	2	Rear	Right	10	134,8342
1	Madison	16,95	3	2	Front	Left	1	210,9728
1	Madison	16,95	3	2	Front	Left	2	213,01
1	Madison	16,95	3	2	Front	Left	3	214,2259
1	Madison	16,95	3	2	Front	Left	4	217,9112
1	Madison	16,95	3	2	Front	Left	5	214,8448
1	Madison	16,95	3	2	Front	Left	6	219,7883
1	Madison	16,95	3	2	Front	Left	7	215,7253
1	Madison	16,95	3	2	Front	Left	8	219,0495
1	Madison	16,95	3	2	Front	Left	9	207,6304
1	Madison	16,95	3	2	Front	Left	10	213,2272
1	Madison	16,95	3	2	Front	Right	1	180,6223
1	Madison	16,95	3	2	Front	Right	2	186,9846
1	Madison	16,95	3	2	Front	Right	3	183,8637
1	Madison	16,95	3	2	Front	Right	4	181,789
1	Madison	16,95	3	2	Front	Right	5	184,0533
1	Madison	16,95	3	2	Front	Right	6	182,7017
1	Madison	16,95	3	2	Front	Right	7	184,4322
1	Madison	16,95	3	2	Front	Right	8	179,1004
1	Madison	16,95	3	2	Front	Right	9	172,7315
1	Madison	16,95	3	2	Front	Right	10	178,9468
1	Madison	16,95	3	2	Rear	Left	1	127,8819
1	Madison	16,95	3	2	Rear	Left	2	131,7831
1	Madison	16,95	3	2	Rear	Left	3	127,0545
1	Madison	16,95	3	2	Rear	Left	4	131,6825
1	Madison	16,95	3	2	Rear	Left	5	132,4904
1	Madison	16,95	3	2	Rear	Left	6	132,2848
1	Madison	16,95	3	2	Rear	Left	7	130,6042
1	Madison	16,95	3	2	Rear	Left	8	127,0061
1	Madison	16,95	3	2	Rear	Left	9	133,6099
1	Madison	16,95	3	2	Rear	Left	10	133,4971
1	Madison	16,95	3	2	Rear	Right	1	129,6327
1	Madison	16,95	3	2	Rear	Right	2	133,7566
1	Madison	16,95	3	2	Rear	Right	3	131,054
1	Madison	16,95	3	2	Rear	Right	4	129,0936
1	Madison	16,95	3	2	Rear	Right	5	130,3042
1	Madison	16,95	3	2	Rear	Right	6	130,0286
1	Madison	16,95	3	2	Rear	Right	7	132,1398
1	Madison	16,95	3	2	Rear	Right	8	134,1954
1	Madison	16,95	3	2	Rear	Right	9	123,9212
1	Madison	16,95	3	2	Rear	Right	10	128,1852
1	Madison	16,95	4	2	Front	Left	1	230,0771
1	Madison	16,95	4	2	Front	Left	2	231,4974
1	Madison	16,95	4	2	Front	Left	3	229,8862

1	Madison	16,95	4	2	Front	Left	4	235,0784
1	Madison	16,95	4	2	Front	Left	5	232,7027
1	Madison	16,95	4	2	Front	Left	6	237,6897
1	Madison	16,95	4	2	Front	Left	7	237,9217
1	Madison	16,95	4	2	Front	Left	8	238,0197
1	Madison	16,95	4	2	Front	Left	9	237,8746
1	Madison	16,95	4	2	Front	Left	10	234,1151
1	Madison	16,95	4	2	Front	Right	1	191,779
1	Madison	16,95	4	2	Front	Right	2	194,5946
1	Madison	16,95	4	2	Front	Right	3	188,7473
1	Madison	16,95	4	2	Front	Right	4	188,4236
1	Madison	16,95	4	2	Front	Right	5	184,433
1	Madison	16,95	4	2	Front	Right	6	191,3951
1	Madison	16,95	4	2	Front	Right	7	188,4816
1	Madison	16,95	4	2	Front	Right	8	186,5159
1	Madison	16,95	4	2	Front	Right	9	192,479
1	Madison	16,95	4	2	Front	Right	10	191,9152
1	Madison	16,95	4	2	Rear	Left	1	129,5862
1	Madison	16,95	4	2	Rear	Left	2	126,4056
1	Madison	16,95	4	2	Rear	Left	3	125,4658
1	Madison	16,95	4	2	Rear	Left	4	127,3307
1	Madison	16,95	4	2	Rear	Left	5	122,9614
1	Madison	16,95	4	2	Rear	Left	6	127,9473
1	Madison	16,95	4	2	Rear	Left	7	125,3018
1	Madison	16,95	4	2	Rear	Left	8	127,2312
1	Madison	16,95	4	2	Rear	Left	9	130,7224
1	Madison	16,95	4	2	Rear	Left	10	123,2667
1	Madison	16,95	4	2	Rear	Right	1	124,6296
1	Madison	16,95	4	2	Rear	Right	2	126,2621
1	Madison	16,95	4	2	Rear	Right	3	121,6763
1	Madison	16,95	4	2	Rear	Right	4	127,3692
1	Madison	16,95	4	2	Rear	Right	5	121,1318
1	Madison	16,95	4	2	Rear	Right	6	123,3672
1	Madison	16,95	4	2	Rear	Right	7	123,3858
1	Madison	16,95	4	2	Rear	Right	8	124,5494
1	Madison	16,95	4	2	Rear	Right	9	121,0194
1	Madison	16,95	4	2	Rear	Right	10	126,8429
1	Madison	16,95	5	2	Front	Left	1	224,4668
1	Madison	16,95	5	2	Front	Left	2	223,9454
1	Madison	16,95	5	2	Front	Left	3	221,0854
1	Madison	16,95	5	2	Front	Left	4	224,7267
1	Madison	16,95	5	2	Front	Left	5	219,9732
1	Madison	16,95	5	2	Front	Left	6	215,7311
1	Madison	16,95	5	2	Front	Left	7	217,4134
1	Madison	16,95	5	2	Front	Left	8	219,9922
1	Madison	16,95	5	2	Front	Left	9	221,6311
1	Madison	16,95	5	2	Front	Left	10	226,9421
1	Madison	16,95	5	2	Front	Right	1	195,8855

1	Madison	16,95	5	2	Front	Right	2	198,1382
1	Madison	16,95	5	2	Front	Right	3	186,7251
1	Madison	16,95	5	2	Front	Right	4	195,6279
1	Madison	16,95	5	2	Front	Right	5	201,2365
1	Madison	16,95	5	2	Front	Right	6	200,3023
1	Madison	16,95	5	2	Front	Right	7	196,1858
1	Madison	16,95	5	2	Front	Right	8	196,612
1	Madison	16,95	5	2	Front	Right	9	192,5453
1	Madison	16,95	5	2	Front	Right	10	196,0765
1	Madison	16,95	5	2	Rear	Left	1	128,735
1	Madison	16,95	5	2	Rear	Left	2	133,7307
1	Madison	16,95	5	2	Rear	Left	3	127,5565
1	Madison	16,95	5	2	Rear	Left	4	125,1444
1	Madison	16,95	5	2	Rear	Left	5	136,1682
1	Madison	16,95	5	2	Rear	Left	6	129,8145
1	Madison	16,95	5	2	Rear	Left	7	128,254
1	Madison	16,95	5	2	Rear	Left	8	126,2191
1	Madison	16,95	5	2	Rear	Left	9	123,4984
1	Madison	16,95	5	2	Rear	Left	10	127,981
1	Madison	16,95	5	2	Rear	Right	1	127,1826
1	Madison	16,95	5	2	Rear	Right	2	128,6684
1	Madison	16,95	5	2	Rear	Right	3	131,1747
1	Madison	16,95	5	2	Rear	Right	4	131,4592
1	Madison	16,95	5	2	Rear	Right	5	136,1409
1	Madison	16,95	5	2	Rear	Right	6	130,4532
1	Madison	16,95	5	2	Rear	Right	7	128,8262
1	Madison	16,95	5	2	Rear	Right	8	133,672
1	Madison	16,95	5	2	Rear	Right	9	124,8375
1	Madison	16,95	5	2	Rear	Right	10	130,3822
1	Harvey	33,8	1	2,2	Front	Left	1	394,2952
1	Harvey	33,8	1	2,2	Front	Left	2	400,4854
1	Harvey	33,8	1	2,2	Front	Left	3	399,1657
1	Harvey	33,8	1	2,2	Front	Left	4	389,7173
1	Harvey	33,8	1	2,2	Front	Left	5	385,5912
1	Harvey	33,8	1	2,2	Front	Left	6	397,2979
1	Harvey	33,8	1	2,2	Front	Left	7	390,4042
1	Harvey	33,8	1	2,2	Front	Left	8	397,9245
1	Harvey	33,8	1	2,2	Front	Left	9	393,4992
1	Harvey	33,8	1	2,2	Front	Left	10	0
1	Harvey	33,8	1	2,2	Front	Right	1	408,3032
1	Harvey	33,8	1	2,2	Front	Right	2	405,5725
1	Harvey	33,8	1	2,2	Front	Right	3	416,9807
1	Harvey	33,8	1	2,2	Front	Right	4	429,115
1	Harvey	33,8	1	2,2	Front	Right	5	415,8236
1	Harvey	33,8	1	2,2	Front	Right	6	410,3084
1	Harvey	33,8	1	2,2	Front	Right	7	410,6976
1	Harvey	33,8	1	2,2	Front	Right	8	426,154
1	Harvey	33,8	1	2,2	Front	Right	9	425,9934

1	Harvey	33,8	1	2,2	Front	Right	10	0
1	Harvey	33,8	1	2,2	Rear	Left	1	213,2036
1	Harvey	33,8	1	2,2	Rear	Left	2	214,9778
1	Harvey	33,8	1	2,2	Rear	Left	3	223,6188
1	Harvey	33,8	1	2,2	Rear	Left	4	223,2635
1	Harvey	33,8	1	2,2	Rear	Left	5	215,0931
1	Harvey	33,8	1	2,2	Rear	Left	6	206,9699
1	Harvey	33,8	1	2,2	Rear	Left	7	213,4295
1	Harvey	33,8	1	2,2	Rear	Left	8	223,7356
1	Harvey	33,8	1	2,2	Rear	Left	9	220,6566
1	Harvey	33,8	1	2,2	Rear	Left	10	0
1	Harvey	33,8	1	2,2	Rear	Right	1	215,4112
1	Harvey	33,8	1	2,2	Rear	Right	2	212,3092
1	Harvey	33,8	1	2,2	Rear	Right	3	214,829
1	Harvey	33,8	1	2,2	Rear	Right	4	222,7271
1	Harvey	33,8	1	2,2	Rear	Right	5	208,7254
1	Harvey	33,8	1	2,2	Rear	Right	6	207,5255
1	Harvey	33,8	1	2,2	Rear	Right	7	211,8222
1	Harvey	33,8	1	2,2	Rear	Right	8	217,4177
1	Harvey	33,8	1	2,2	Rear	Right	9	213,4636
1	Harvey	33,8	1	2,2	Rear	Right	10	0
1	Harvey	33,8	2	2,2	Front	Left	1	403,2669
1	Harvey	33,8	2	2,2	Front	Left	2	412,1094
1	Harvey	33,8	2	2,2	Front	Left	3	408,786
1	Harvey	33,8	2	2,2	Front	Left	4	398,3374
1	Harvey	33,8	2	2,2	Front	Left	5	403,3978
1	Harvey	33,8	2	2,2	Front	Left	6	411,2705
1	Harvey	33,8	2	2,2	Front	Left	7	407,3935
1	Harvey	33,8	2	2,2	Front	Left	8	411,148
1	Harvey	33,8	2	2,2	Front	Left	9	408,9367
1	Harvey	33,8	2	2,2	Front	Left	10	0
1	Harvey	33,8	2	2,2	Front	Right	1	431,0448
1	Harvey	33,8	2	2,2	Front	Right	2	432,5825
1	Harvey	33,8	2	2,2	Front	Right	3	434,9581
1	Harvey	33,8	2	2,2	Front	Right	4	416,2732
1	Harvey	33,8	2	2,2	Front	Right	5	430,3026
1	Harvey	33,8	2	2,2	Front	Right	6	431,3632
1	Harvey	33,8	2	2,2	Front	Right	7	426,7907
1	Harvey	33,8	2	2,2	Front	Right	8	418,494
1	Harvey	33,8	2	2,2	Front	Right	9	432,9138
1	Harvey	33,8	2	2,2	Front	Right	10	0
1	Harvey	33,8	2	2,2	Rear	Left	1	225,0251
1	Harvey	33,8	2	2,2	Rear	Left	2	235,3321
1	Harvey	33,8	2	2,2	Rear	Left	3	227,0328
1	Harvey	33,8	2	2,2	Rear	Left	4	226,1825
1	Harvey	33,8	2	2,2	Rear	Left	5	223,7613
1	Harvey	33,8	2	2,2	Rear	Left	6	233,1056
1	Harvey	33,8	2	2,2	Rear	Left	7	224,9992

1	Harvey	33,8	2	2,2	Rear	Left	8	219,5494
1	Harvey	33,8	2	2,2	Rear	Left	9	220,4396
1	Harvey	33,8	2	2,2	Rear	Left	10	0
1	Harvey	33,8	2	2,2	Rear	Right	1	219,1539
1	Harvey	33,8	2	2,2	Rear	Right	2	223,0101
1	Harvey	33,8	2	2,2	Rear	Right	3	228,7686
1	Harvey	33,8	2	2,2	Rear	Right	4	225,461
1	Harvey	33,8	2	2,2	Rear	Right	5	213,2292
1	Harvey	33,8	2	2,2	Rear	Right	6	220,1746
1	Harvey	33,8	2	2,2	Rear	Right	7	222,0871
1	Harvey	33,8	2	2,2	Rear	Right	8	217,8413
1	Harvey	33,8	2	2,2	Rear	Right	9	219,5754
1	Harvey	33,8	2	2,2	Rear	Right	10	0
1	Harvey	33,8	3	2,2	Front	Left	1	421,5742
1	Harvey	33,8	3	2,2	Front	Left	2	418,2481
1	Harvey	33,8	3	2,2	Front	Left	3	425,2461
1	Harvey	33,8	3	2,2	Front	Left	4	428,6015
1	Harvey	33,8	3	2,2	Front	Left	5	433,6452
1	Harvey	33,8	3	2,2	Front	Left	6	431,5323
1	Harvey	33,8	3	2,2	Front	Left	7	423,4444
1	Harvey	33,8	3	2,2	Front	Left	8	430,0175
1	Harvey	33,8	3	2,2	Front	Left	9	420,1708
1	Harvey	33,8	3	2,2	Front	Left	10	0
1	Harvey	33,8	3	2,2	Front	Right	1	0
1	Harvey	33,8	3	2,2	Front	Right	2	424,3702
1	Harvey	33,8	3	2,2	Front	Right	3	436,5353
1	Harvey	33,8	3	2,2	Front	Right	4	436,7165
1	Harvey	33,8	3	2,2	Front	Right	5	446,8428
1	Harvey	33,8	3	2,2	Front	Right	6	431,6627
1	Harvey	33,8	3	2,2	Front	Right	7	436,0735
1	Harvey	33,8	3	2,2	Front	Right	8	421,0776
1	Harvey	33,8	3	2,2	Front	Right	9	446,4273
1	Harvey	33,8	3	2,2	Front	Right	10	441,1519
1	Harvey	33,8	3	2,2	Rear	Left	1	0
1	Harvey	33,8	3	2,2	Rear	Left	2	237,9893
1	Harvey	33,8	3	2,2	Rear	Left	3	234,005
1	Harvey	33,8	3	2,2	Rear	Left	4	229,3307
1	Harvey	33,8	3	2,2	Rear	Left	5	222,1696
1	Harvey	33,8	3	2,2	Rear	Left	6	228,0617
1	Harvey	33,8	3	2,2	Rear	Left	7	238,9002
1	Harvey	33,8	3	2,2	Rear	Left	8	230,1444
1	Harvey	33,8	3	2,2	Rear	Left	9	234,1876
1	Harvey	33,8	3	2,2	Rear	Left	10	226,3342
1	Harvey	33,8	3	2,2	Rear	Right	1	218,1833
1	Harvey	33,8	3	2,2	Rear	Right	2	215,1993
1	Harvey	33,8	3	2,2	Rear	Right	3	225,0104
1	Harvey	33,8	3	2,2	Rear	Right	4	216,7602
1	Harvey	33,8	3	2,2	Rear	Right	5	225,845

1	Harvey	33,8	3	2,2	Rear	Right	6	226,3355
1	Harvey	33,8	3	2,2	Rear	Right	7	225,0153
1	Harvey	33,8	3	2,2	Rear	Right	8	224,2078
1	Harvey	33,8	3	2,2	Rear	Right	9	231,5794
1	Harvey	33,8	3	2,2	Rear	Right	10	0
1	Harvey	33,8	4	2,2	Front	Left	1	407,1055
1	Harvey	33,8	4	2,2	Front	Left	2	410,3954
1	Harvey	33,8	4	2,2	Front	Left	3	407,8337
1	Harvey	33,8	4	2,2	Front	Left	4	412,1714
1	Harvey	33,8	4	2,2	Front	Left	5	410,0359
1	Harvey	33,8	4	2,2	Front	Left	6	397,2686
1	Harvey	33,8	4	2,2	Front	Left	7	409,4013
1	Harvey	33,8	4	2,2	Front	Left	8	413,2725
1	Harvey	33,8	4	2,2	Front	Left	9	423,5721
1	Harvey	33,8	4	2,2	Front			0
1	Harvey	33,8	4	2,2	Front	Right	1	442,3818
1	Harvey	33,8	4	2,2	Front	Right	2	434,9889
1	Harvey	33,8	4	2,2	Front	Right	3	433,9562
1	Harvey	33,8	4	2,2	Front	Right	4	440,7526
1	Harvey	33,8	4	2,2	Front	Right	5	437,337
1	Harvey	33,8	4	2,2	Front	Right	6	429,9069
1	Harvey	33,8	4	2,2	Front	Right	7	428,5335
1	Harvey	33,8	4	2,2	Front	Right	8	428,8467
1	Harvey	33,8	4	2,2	Front	Right	9	424,1433
1	Harvey	33,8	4	2,2	Front	Right	10	0
1	Harvey	33,8	4	2,2	Rear	Left	1	230,9268
1	Harvey	33,8	4	2,2	Rear	Left	2	233,2759
1	Harvey	33,8	4	2,2	Rear	Left	3	226,1458
1	Harvey	33,8	4	2,2	Rear	Left	4	222,0903
1	Harvey	33,8	4	2,2	Rear	Left	5	232,3551
1	Harvey	33,8	4	2,2	Rear	Left	6	223,8392
1	Harvey	33,8	4	2,2	Rear	Left	7	216,6211
1	Harvey	33,8	4	2,2	Rear	Left	8	223,3018
1	Harvey	33,8	4	2,2	Rear	Left	9	229,5919
1	Harvey	33,8	4	2,2	Rear	Left	10	0
1	Harvey	33,8	4	2,2	Rear	Right	1	220,9942
1	Harvey	33,8	4	2,2	Rear	Right	2	223,6774
1	Harvey	33,8	4	2,2	Rear	Right	3	226,2851
1	Harvey	33,8	4	2,2	Rear	Right	4	229,1556
1	Harvey	33,8	4	2,2	Rear	Right	5	223,5999
1	Harvey	33,8	4	2,2	Rear	Right	6	212,6935
1	Harvey	33,8	4	2,2	Rear	Right	7	219,6526
1	Harvey	33,8	4	2,2	Rear	Right	8	221,727
1	Harvey	33,8	4	2,2	Rear	Right	9	226,1535
1	Harvey	33,8	4	2,2	Rear	Right	10	0
1	Harvey	33,8	5	2,2	Front	Left	1	418,7057
1	Harvey	33,8	5	2,2	Front	Left	2	417,6509
1	Harvey	33,8	5	2,2	Front	Left	3	428,6192

1	Harvey	33,8	5	2,2	Front	Left	4	428,113
1	Harvey	33,8	5	2,2	Front	Left	5	423,9808
1	Harvey	33,8	5	2,2	Front	Left	6	416,4799
1	Harvey	33,8	5	2,2	Front	Left	7	416,9267
1	Harvey	33,8	5	2,2	Front	Left	8	422,7001
1	Harvey	33,8	5	2,2	Front	Left	9	416,8644
1	Harvey	33,8	5	2,2	Front	Left	10	0
1	Harvey	33,8	5	2,2	Front	Right	1	0
1	Harvey	33,8	5	2,2	Front	Right	2	443,8226
1	Harvey	33,8	5	2,2	Front	Right	3	443,1694
1	Harvey	33,8	5	2,2	Front	Right	4	446,1237
1	Harvey	33,8	5	2,2	Front	Right	5	436,4626
1	Harvey	33,8	5	2,2	Front	Right	6	439,831
1	Harvey	33,8	5	2,2	Front	Right	7	443,3949
1	Harvey	33,8	5	2,2	Front	Right	8	441,6501
1	Harvey	33,8	5	2,2	Front	Right	9	431,2114
1	Harvey	33,8	5	2,2	Front	Right	10	419,8883
1	Harvey	33,8	5	2,2	Rear	Left	1	0
1	Harvey	33,8	5	2,2	Rear	Left	2	225,5638
1	Harvey	33,8	5	2,2	Rear	Left	3	227,3377
1	Harvey	33,8	5	2,2	Rear	Left	4	233,4468
1	Harvey	33,8	5	2,2	Rear	Left	5	226,1037
1	Harvey	33,8	5	2,2	Rear	Left	6	230,8033
1	Harvey	33,8	5	2,2	Rear	Left	7	230,0146
1	Harvey	33,8	5	2,2	Rear	Left	8	229,7429
1	Harvey	33,8	5	2,2	Rear	Left	9	221,319
1	Harvey	33,8	5	2,2	Rear	Left	10	223,2608
1	Harvey	33,8	5	2,2	Rear	Right	1	226,3745
1	Harvey	33,8	5	2,2	Rear	Right	2	223,9606
1	Harvey	33,8	5	2,2	Rear	Right	3	230,1733
1	Harvey	33,8	5	2,2	Rear	Right	4	232,8868
1	Harvey	33,8	5	2,2	Rear	Right	5	224,9036
1	Harvey	33,8	5	2,2	Rear	Right	6	228,8579
1	Harvey	33,8	5	2,2	Rear	Right	7	228,2697
1	Harvey	33,8	5	2,2	Rear	Right	8	228,7619
1	Harvey	33,8	5	2,2	Rear	Right	9	221,9915
1	Harvey	33,8	5	2,2	Rear	Right	10	0
1	Meg	31,27	1	1,8	Front	Left	1	312,4249
1	Meg	31,27	1	1,8	Front	Left	2	318,3842
1	Meg	31,27	1	1,8	Front	Left	3	315,2405
1	Meg	31,27	1	1,8	Front	Left	4	322,2797
1	Meg	31,27	1	1,8	Front	Left	5	316,8712
1	Meg	31,27	1	1,8	Front	Left	6	318,6037
1	Meg	31,27	1	1,8	Front	Left	7	315,1891
1	Meg	31,27	1	1,8	Front	Left	8	319,1266
1	Meg	31,27	1	1,8	Front	Left	9	319,8597
1	Meg	31,27	1	1,8	Front	Left	10	0
1	Meg	31,27	1	1,8	Front	Right	1	341,4041

1	Meg	31,27	1	1,8	Front	Right	2	347,1752
1	Meg	31,27	1	1,8	Front	Right	3	353,1323
1	Meg	31,27	1	1,8	Front	Right	4	358,3956
1	Meg	31,27	1	1,8	Front	Right	5	358,9054
1	Meg	31,27	1	1,8	Front	Right	6	352,458
1	Meg	31,27	1	1,8	Front	Right	7	355,9328
1	Meg	31,27	1	1,8	Front	Right	8	350,524
1	Meg	31,27	1	1,8	Front	Right	9	354,085
1	Meg	31,27	1	1,8	Front	Right	10	0
1	Meg	31,27	1	1,8	Rear	Left	1	253,3116
1	Meg	31,27	1	1,8	Rear	Left	2	247,0621
1	Meg	31,27	1	1,8	Rear	Left	3	249,2669
1	Meg	31,27	1	1,8	Rear	Left	4	244,8896
1	Meg	31,27	1	1,8	Rear	Left	5	243,786
1	Meg	31,27	1	1,8	Rear	Left	6	242,5427
1	Meg	31,27	1	1,8	Rear	Left	7	238,1805
1	Meg	31,27	1	1,8	Rear	Left	8	240,035
1	Meg	31,27	1	1,8	Rear	Left	9	244,8861
1	Meg	31,27	1	1,8	Rear	Left	10	0
1	Meg	31,27	1	1,8	Rear	Right	1	242,0431
1	Meg	31,27	1	1,8	Rear	Right	2	246,0209
1	Meg	31,27	1	1,8	Rear	Right	3	233,3265
1	Meg	31,27	1	1,8	Rear	Right	4	230,9384
1	Meg	31,27	1	1,8	Rear	Right	5	237,3547
1	Meg	31,27	1	1,8	Rear	Right	6	236,8206
1	Meg	31,27	1	1,8	Rear	Right	7	241,3553
1	Meg	31,27	1	1,8	Rear	Right	8	241,9649
1	Meg	31,27	1	1,8	Rear	Right	9	241,0419
1	Meg	31,27	1	1,8	Rear	Right	10	0
1	Meg	31,27	2	1,8	Front	Left	1	316,975
1	Meg	31,27	2	1,8	Front	Left	2	316,6126
1	Meg	31,27	2	1,8	Front	Left	3	320,2652
1	Meg	31,27	2	1,8	Front	Left	4	319,8165
1	Meg	31,27	2	1,8	Front	Left	5	318,2169
1	Meg	31,27	2	1,8	Front	Left	6	318,0284
1	Meg	31,27	2	1,8	Front	Left	7	315,1284
1	Meg	31,27	2	1,8	Front	Left	8	322,8809
1	Meg	31,27	2	1,8	Front	Left	9	319,3611
1	Meg	31,27	2	1,8	Front	Left	10	0
1	Meg	31,27	2	1,8	Front	Right	1	351,9012
1	Meg	31,27	2	1,8	Front	Right	2	345,256
1	Meg	31,27	2	1,8	Front	Right	3	356,4239
1	Meg	31,27	2	1,8	Front	Right	4	356,0477
1	Meg	31,27	2	1,8	Front	Right	5	351,4828
1	Meg	31,27	2	1,8	Front	Right	6	353,9925
1	Meg	31,27	2	1,8	Front	Right	7	350,369
1	Meg	31,27	2	1,8	Front	Right	8	353,0814
1	Meg	31,27	2	1,8	Front	Right	9	355,2379

1	Meg	31,27	2	1,8	Front	Right	10	0
1	Meg	31,27	2	1,8	Rear	Left	1	234,3943
1	Meg	31,27	2	1,8	Rear	Left	2	218,0291
1	Meg	31,27	2	1,8	Rear	Left	3	239,7056
1	Meg	31,27	2	1,8	Rear	Left	4	232,4799
1	Meg	31,27	2	1,8	Rear	Left	5	242,085
1	Meg	31,27	2	1,8	Rear	Left	6	228,7179
1	Meg	31,27	2	1,8	Rear	Left	7	237,3294
1	Meg	31,27	2	1,8	Rear	Left	8	242,2656
1	Meg	31,27	2	1,8	Rear	Left	9	236,914
1	Meg	31,27	2	1,8	Rear	Left	10	0
1	Meg	31,27	2	1,8	Rear	Right	1	215,7582
1	Meg	31,27	2	1,8	Rear	Right	2	233,8719
1	Meg	31,27	2	1,8	Rear	Right	3	222,5766
1	Meg	31,27	2	1,8	Rear	Right	4	223,0551
1	Meg	31,27	2	1,8	Rear	Right	5	223,0774
1	Meg	31,27	2	1,8	Rear	Right	6	221,8856
1	Meg	31,27	2	1,8	Rear	Right	7	218,9196
1	Meg	31,27	2	1,8	Rear	Right	8	225,2887
1	Meg	31,27	2	1,8	Rear	Right	9	222,4121
1	Meg	31,27	2	1,8	Rear	Right	10	0
1	Meg	31,27	3	1,8	Front	Left	1	293,9655
1	Meg	31,27	3	1,8	Front	Left	2	300,7379
1	Meg	31,27	3	1,8	Front	Left	3	300,4629
1	Meg	31,27	3	1,8	Front	Left	4	292,2894
1	Meg	31,27	3	1,8	Front	Left	5	292,2803
1	Meg	31,27	3	1,8	Front	Left	6	297,5878
1	Meg	31,27	3	1,8	Front	Left	7	298,4288
1	Meg	31,27	3	1,8	Front	Left	8	305,3906
1	Meg	31,27	3	1,8	Front	Left	9	304,8101
1	Meg	31,27	3	1,8	Front	Left	10	0
1	Meg	31,27	3	1,8	Front	Right	1	0
1	Meg	31,27	3	1,8	Front	Right	2	334,6616
1	Meg	31,27	3	1,8	Front	Right	3	336,3815
1	Meg	31,27	3	1,8	Front	Right	4	324,7432
1	Meg	31,27	3	1,8	Front	Right	5	325,5212
1	Meg	31,27	3	1,8	Front	Right	6	330,923
1	Meg	31,27	3	1,8	Front	Right	7	332,5786
1	Meg	31,27	3	1,8	Front	Right	8	338,8685
1	Meg	31,27	3	1,8	Front	Right	9	356,5372
1	Meg	31,27	3	1,8	Front	Right	10	335,0895
1	Meg	31,27	3	1,8	Rear	Left	1	0
1	Meg	31,27	3	1,8	Rear	Left	2	246,5639
1	Meg	31,27	3	1,8	Rear	Left	3	245,1839
1	Meg	31,27	3	1,8	Rear	Left	4	221,4481
1	Meg	31,27	3	1,8	Rear	Left	5	241,4254
1	Meg	31,27	3	1,8	Rear	Left	6	251,8335
1	Meg	31,27	3	1,8	Rear	Left	7	236,3021

1	Meg	31,27	3	1,8	Rear	Left	8	256,9026
1	Meg	31,27	3	1,8	Rear	Left	9	254,3176
1	Meg	31,27	3	1,8	Rear	Left	10	249,7818
1	Meg	31,27	3	1,8	Rear	Right	1	215,7537
1	Meg	31,27	3	1,8	Rear	Right	2	220,4867
1	Meg	31,27	3	1,8	Rear	Right	3	213,0855
1	Meg	31,27	3	1,8	Rear	Right	4	212,5083
1	Meg	31,27	3	1,8	Rear	Right	5	219,8063
1	Meg	31,27	3	1,8	Rear	Right	6	218,6866
1	Meg	31,27	3	1,8	Rear	Right	7	217,9416
1	Meg	31,27	3	1,8	Rear	Right	8	216,9724
1	Meg	31,27	3	1,8	Rear	Right	9	221,9075
1	Meg	31,27	3	1,8	Rear	Right	10	0
1	Meg	31,27	4	1,8	Front	Left	1	309,2123
1	Meg	31,27	4	1,8	Front	Left	2	311,6359
1	Meg	31,27	4	1,8	Front	Left	3	300,5388
1	Meg	31,27	4	1,8	Front	Left	4	304,7657
1	Meg	31,27	4	1,8	Front	Left	5	307,8565
1	Meg	31,27	4	1,8	Front	Left	6	307,5426
1	Meg	31,27	4	1,8	Front	Left	7	301,4862
1	Meg	31,27	4	1,8	Front	Left	8	311,8408
1	Meg	31,27	4	1,8	Front	Left	9	308,1995
1	Meg	31,27	4	1,8	Front	Left	10	0
1	Meg	31,27	4	1,8	Front	Right	1	0
1	Meg	31,27	4	1,8	Front	Right	2	346,5572
1	Meg	31,27	4	1,8	Front	Right	3	341,4845
1	Meg	31,27	4	1,8	Front	Right	4	335,9566
1	Meg	31,27	4	1,8	Front	Right	5	334,3382
1	Meg	31,27	4	1,8	Front	Right	6	332,1126
1	Meg	31,27	4	1,8	Front	Right	7	340,54
1	Meg	31,27	4	1,8	Front	Right	8	342,1882
1	Meg	31,27	4	1,8	Front	Right	9	344,1323
1	Meg	31,27	4	1,8	Front	Right	10	339,3723
1	Meg	31,27	4	1,8	Rear	Left	1	0
1	Meg	31,27	4	1,8	Rear	Left	2	242,5657
1	Meg	31,27	4	1,8	Rear	Left	3	235,189
1	Meg	31,27	4	1,8	Rear	Left	4	234,1748
1	Meg	31,27	4	1,8	Rear	Left	5	234,6109
1	Meg	31,27	4	1,8	Rear	Left	6	238,5102
1	Meg	31,27	4	1,8	Rear	Left	7	236,4301
1	Meg	31,27	4	1,8	Rear	Left	8	237,1427
1	Meg	31,27	4	1,8	Rear	Left	9	232,9732
1	Meg	31,27	4	1,8	Rear	Left	10	230,944
1	Meg	31,27	4	1,8	Rear	Right	1	228,3049
1	Meg	31,27	4	1,8	Rear	Right	2	220,0706
1	Meg	31,27	4	1,8	Rear	Right	3	212,6201
1	Meg	31,27	4	1,8	Rear	Right	4	221,0081
1	Meg	31,27	4	1,8	Rear	Right	5	222,5061

1	Meg	31,27	4	1,8	Rear	Right	6	225,5388
1	Meg	31,27	4	1,8	Rear	Right	7	225,9857
1	Meg	31,27	4	1,8	Rear	Right	8	223,4785
1	Meg	31,27	4	1,8	Rear	Right	9	220,0531
1	Meg	31,27	4	1,8	Rear	Right	10	0
1	Meg	31,27	5	1,8	Front	Left	1	318,9286
1	Meg	31,27	5	1,8	Front	Left	2	315,7065
1	Meg	31,27	5	1,8	Front	Left	3	319,087
1	Meg	31,27	5	1,8	Front	Left	4	312,0108
1	Meg	31,27	5	1,8	Front	Left	5	309,6078
1	Meg	31,27	5	1,8	Front	Left	6	314,3204
1	Meg	31,27	5	1,8	Front	Left	7	313,9349
1	Meg	31,27	5	1,8	Front	Left	8	319,6007
1	Meg	31,27	5	1,8	Front	Left	9	314,5696
1	Meg	31,27	5	1,8	Front	Left	10	0
1	Meg	31,27	5	1,8	Front	Right	1	362,4035
1	Meg	31,27	5	1,8	Front	Right	2	368,6373
1	Meg	31,27	5	1,8	Front	Right	3	349,7525
1	Meg	31,27	5	1,8	Front	Right	4	346,3289
1	Meg	31,27	5	1,8	Front	Right	5	344,596
1	Meg	31,27	5	1,8	Front	Right	6	350,8143
1	Meg	31,27	5	1,8	Front	Right	7	340,5733
1	Meg	31,27	5	1,8	Front	Right	8	354,9842
1	Meg	31,27	5	1,8	Front	Right	9	357,7774
1	Meg	31,27	5	1,8	Front	Right	10	0
1	Meg	31,27	5	1,8	Rear	Left	1	318,0496
1	Meg	31,27	5	1,8	Rear	Left	2	306,9741
1	Meg	31,27	5	1,8	Rear	Left	3	301,9721
1	Meg	31,27	5	1,8	Rear	Left	4	319,4979
1	Meg	31,27	5	1,8	Rear	Left	5	318,739
1	Meg	31,27	5	1,8	Rear	Left	6	320,1057
1	Meg	31,27	5	1,8	Rear	Left	7	311,3873
1	Meg	31,27	5	1,8	Rear	Left	8	302,4367
1	Meg	31,27	5	1,8	Rear	Left	9	295,6491
1	Meg	31,27	5	1,8	Rear	Left	10	0
1	Meg	31,27	5	1,8	Rear	Right	1	293,4486
1	Meg	31,27	5	1,8	Rear	Right	2	291,7685
1	Meg	31,27	5	1,8	Rear	Right	3	299,5467
1	Meg	31,27	5	1,8	Rear	Right	4	298,3166
1	Meg	31,27	5	1,8	Rear	Right	5	297,6025
1	Meg	31,27	5	1,8	Rear	Right	6	296,0938
1	Meg	31,27	5	1,8	Rear	Right	7	302,7784
1	Meg	31,27	5	1,8	Rear	Right	8	296,1213
1	Meg	31,27	5	1,8	Rear	Right	9	300,1565
1	Meg	31,27	5	1,8	Rear	Right	10	0
1	JayJay	25,6	1	2	Front	Left	1	313,7253
1	JayJay	25,6	1	2	Front	Left	2	300,0989
1	JayJay	25,6	1	2	Front	Left	3	312,2204

1	JayJay	25,6	1	2	Front	Left	4	327,6518
1	JayJay	25,6	1	2	Front	Left	5	307,4311
1	JayJay	25,6	1	2	Front	Left	6	313,9247
1	JayJay	25,6	1	2	Front	Left	7	313,5183
1	JayJay	25,6	1	2	Front	Left	8	306,2943
1	JayJay	25,6	1	2	Front	Left	9	313,9585
1	JayJay	25,6	1	2	Front	Left	10	307,4262
1	JayJay	25,6	1	2	Front	Right	1	329,8743
1	JayJay	25,6	1	2	Front	Right	2	333,1134
1	JayJay	25,6	1	2	Front	Right	3	319,1798
1	JayJay	25,6	1	2	Front	Right	4	328,5588
1	JayJay	25,6	1	2	Front	Right	5	321,1054
1	JayJay	25,6	1	2	Front	Right	6	327,0631
1	JayJay	25,6	1	2	Front	Right	7	322,6268
1	JayJay	25,6	1	2	Front	Right	8	319,4034
1	JayJay	25,6	1	2	Front	Right	9	321,6688
1	JayJay	25,6	1	2	Front	Right	10	324,9129
1	JayJay	25,6	1	2	Rear	Left	1	152,7987
1	JayJay	25,6	1	2	Rear	Left	2	154,001
1	JayJay	25,6	1	2	Rear	Left	3	157,4293
1	JayJay	25,6	1	2	Rear	Left	4	157,7661
1	JayJay	25,6	1	2	Rear	Left	5	156,12
1	JayJay	25,6	1	2	Rear	Left	6	162,6464
1	JayJay	25,6	1	2	Rear	Left	7	163,0862
1	JayJay	25,6	1	2	Rear	Left	8	160,3391
1	JayJay	25,6	1	2	Rear	Left	9	161,87
1	JayJay	25,6	1	2	Rear	Left	10	162,4194
1	JayJay	25,6	1	2	Rear	Right	1	157,4678
1	JayJay	25,6	1	2	Rear	Right	2	163,3825
1	JayJay	25,6	1	2	Rear	Right	3	163,4051
1	JayJay	25,6	1	2	Rear	Right	4	156,7508
1	JayJay	25,6	1	2	Rear	Right	5	157,4253
1	JayJay	25,6	1	2	Rear	Right	6	165,7848
1	JayJay	25,6	1	2	Rear	Right	7	167,6272
1	JayJay	25,6	1	2	Rear	Right	8	169,3594
1	JayJay	25,6	1	2	Rear	Right	9	176,5766
1	JayJay	25,6	1	2	Rear	Right	10	162,454
1	JayJay	25,6	2	2	Front	Left	1	325,8489
1	JayJay	25,6	2	2	Front	Left	2	333,9216
1	JayJay	25,6	2	2	Front	Left	3	318,6555
1	JayJay	25,6	2	2	Front	Left	4	309,9929
1	JayJay	25,6	2	2	Front	Left	5	313,351
1	JayJay	25,6	2	2	Front	Left	6	318,3526
1	JayJay	25,6	2	2	Front	Left	7	308,1653
1	JayJay	25,6	2	2	Front	Left	8	310,9999
1	JayJay	25,6	2	2	Front	Left	9	343,8278
1	JayJay	25,6	2	2	Front	Left	10	329,792
1	JayJay	25,6	2	2	Front	Right	1	347,7079

1	JayJay	25,6	2	2	Front	Right	2	346,2233
1	JayJay	25,6	2	2	Front	Right	3	326,6763
1	JayJay	25,6	2	2	Front	Right	4	322,3247
1	JayJay	25,6	2	2	Front	Right	5	340,6112
1	JayJay	25,6	2	2	Front	Right	6	337,8199
1	JayJay	25,6	2	2	Front	Right	7	326,7751
1	JayJay	25,6	2	2	Front	Right	8	334,2576
1	JayJay	25,6	2	2	Front	Right	9	338,6381
1	JayJay	25,6	2	2	Front	Right	10	351,4905
1	JayJay	25,6	2	2	Rear	Left	1	159,7879
1	JayJay	25,6	2	2	Rear	Left	2	168,9569
1	JayJay	25,6	2	2	Rear	Left	3	154,0433
1	JayJay	25,6	2	2	Rear	Left	4	152,1737
1	JayJay	25,6	2	2	Rear	Left	5	166,1088
1	JayJay	25,6	2	2	Rear	Left	6	154,5783
1	JayJay	25,6	2	2	Rear	Left	7	158,5981
1	JayJay	25,6	2	2	Rear	Left	8	157,4928
1	JayJay	25,6	2	2	Rear	Left	9	147,8942
1	JayJay	25,6	2	2	Rear	Left	10	131,3714
1	JayJay	25,6	2	2	Rear	Right	1	168,5735
1	JayJay	25,6	2	2	Rear	Right	2	167,6092
1	JayJay	25,6	2	2	Rear	Right	3	156,357
1	JayJay	25,6	2	2	Rear	Right	4	165,2188
1	JayJay	25,6	2	2	Rear	Right	5	159,7585
1	JayJay	25,6	2	2	Rear	Right	6	158,9424
1	JayJay	25,6	2	2	Rear	Right	7	160,1941
1	JayJay	25,6	2	2	Rear	Right	8	159,1725
1	JayJay	25,6	2	2	Rear	Right	9	144,522
1	JayJay	25,6	2	2	Rear	Right	10	0
1	JayJay	25,6	3	2	Front	Left	1	331,8404
1	JayJay	25,6	3	2	Front	Left	2	333,0613
1	JayJay	25,6	3	2	Front	Left	3	324,7898
1	JayJay	25,6	3	2	Front	Left	4	326,7566
1	JayJay	25,6	3	2	Front	Left	5	324,6056
1	JayJay	25,6	3	2	Front	Left	6	310,6382
1	JayJay	25,6	3	2	Front	Left	7	311,0621
1	JayJay	25,6	3	2	Front	Left	8	313,2579
1	JayJay	25,6	3	2	Front	Left	9	330,4734
1	JayJay	25,6	3	2	Front	Left	10	348,3836
1	JayJay	25,6	3	2	Front	Right	1	337,7882
1	JayJay	25,6	3	2	Front	Right	2	326,38
1	JayJay	25,6	3	2	Front	Right	3	328,4033
1	JayJay	25,6	3	2	Front	Right	4	332,4905
1	JayJay	25,6	3	2	Front	Right	5	320,0423
1	JayJay	25,6	3	2	Front	Right	6	327,0349
1	JayJay	25,6	3	2	Front	Right	7	325,0979
1	JayJay	25,6	3	2	Front	Right	8	339,4909
1	JayJay	25,6	3	2	Front	Right	9	326,4893

1	JayJay	25,6	3	2	Front	Right	10	337,7586
1	JayJay	25,6	3	2	Rear	Left	1	158,9307
1	JayJay	25,6	3	2	Rear	Left	2	164,6621
1	JayJay	25,6	3	2	Rear	Left	3	160,4041
1	JayJay	25,6	3	2	Rear	Left	4	171,4704
1	JayJay	25,6	3	2	Rear	Left	5	165,9677
1	JayJay	25,6	3	2	Rear	Left	6	170,275
1	JayJay	25,6	3	2	Rear	Left	7	173,1716
1	JayJay	25,6	3	2	Rear	Left	8	171,3343
1	JayJay	25,6	3	2	Rear	Left	9	152,3427
1	JayJay	25,6	3	2	Rear	Left	10	150,4494
1	JayJay	25,6	3	2	Rear	Right	1	158,7623
1	JayJay	25,6	3	2	Rear	Right	2	160,749
1	JayJay	25,6	3	2	Rear	Right	3	160,9991
1	JayJay	25,6	3	2	Rear	Right	4	160,6862
1	JayJay	25,6	3	2	Rear	Right	5	165,2454
1	JayJay	25,6	3	2	Rear	Right	6	169,2984
1	JayJay	25,6	3	2	Rear	Right	7	166,0004
1	JayJay	25,6	3	2	Rear	Right	8	162,8509
1	JayJay	25,6	3	2	Rear	Right	9	157,1406
1	JayJay	25,6	3	2	Rear	Right	10	136,3984
1	JayJay	25,6	4	2	Front	Left	1	324,4033
1	JayJay	25,6	4	2	Front	Left	2	324,2799
1	JayJay	25,6	4	2	Front	Left	3	328,3988
1	JayJay	25,6	4	2	Front	Left	4	329,0991
1	JayJay	25,6	4	2	Front	Left	5	326,5527
1	JayJay	25,6	4	2	Front	Left	6	323,2454
1	JayJay	25,6	4	2	Front	Left	7	317,1078
1	JayJay	25,6	4	2	Front	Left	8	313,5199
1	JayJay	25,6	4	2	Front	Left	9	330,1743
1	JayJay	25,6	4	2	Front	Left	10	324,0849
1	JayJay	25,6	4	2	Front	Right	1	345,9399
1	JayJay	25,6	4	2	Front	Right	2	351,3999
1	JayJay	25,6	4	2	Front	Right	3	351,9051
1	JayJay	25,6	4	2	Front	Right	4	346,7126
1	JayJay	25,6	4	2	Front	Right	5	354,2025
1	JayJay	25,6	4	2	Front	Right	6	355,1962
1	JayJay	25,6	4	2	Front	Right	7	345,8264
1	JayJay	25,6	4	2	Front	Right	8	345,3209
1	JayJay	25,6	4	2	Front	Right	9	336,586
1	JayJay	25,6	4	2	Front	Right	10	339,4584
1	JayJay	25,6	4	2	Rear	Left	1	162,1166
1	JayJay	25,6	4	2	Rear	Left	2	174,4827
1	JayJay	25,6	4	2	Rear	Left	3	172,7892
1	JayJay	25,6	4	2	Rear	Left	4	166,8603
1	JayJay	25,6	4	2	Rear	Left	5	169,4851
1	JayJay	25,6	4	2	Rear	Left	6	166,6753
1	JayJay	25,6	4	2	Rear	Left	7	171,2586

1	JayJay	25,6	4	2	Rear	Left	8	172,4467
1	JayJay	25,6	4	2	Rear	Left	9	177,776
1	JayJay	25,6	4	2	Rear	Left	10	182,1776
1	JayJay	25,6	4	2	Rear	Right	1	168,5047
1	JayJay	25,6	4	2	Rear	Right	2	169,1584
1	JayJay	25,6	4	2	Rear	Right	3	171,4215
1	JayJay	25,6	4	2	Rear	Right	4	172,6334
1	JayJay	25,6	4	2	Rear	Right	5	169,0413
1	JayJay	25,6	4	2	Rear	Right	6	178,7384
1	JayJay	25,6	4	2	Rear	Right	7	171,9373
1	JayJay	25,6	4	2	Rear	Right	8	179,3465
1	JayJay	25,6	4	2	Rear	Right	9	174,2808
1	JayJay	25,6	4	2	Rear	Right	10	177,5919
1	JayJay	25,6	5	2	Front	Left	1	344,6774
1	JayJay	25,6	5	2	Front	Left	2	357,6382
1	JayJay	25,6	5	2	Front	Left	3	345,7018
1	JayJay	25,6	5	2	Front	Left	4	339,102
1	JayJay	25,6	5	2	Front	Left	5	337,4836
1	JayJay	25,6	5	2	Front	Left	6	343,4336
1	JayJay	25,6	5	2	Front	Left	7	341,1358
1	JayJay	25,6	5	2	Front	Left	8	352,3112
1	JayJay	25,6	5	2	Front	Left	9	344,1829
1	JayJay	25,6	5	2	Front	Left	10	349,6542
1	JayJay	25,6	5	2	Front	Right	1	354,1085
1	JayJay	25,6	5	2	Front	Right	2	362,5796
1	JayJay	25,6	5	2	Front	Right	3	360,2782
1	JayJay	25,6	5	2	Front	Right	4	368,3207
1	JayJay	25,6	5	2	Front	Right	5	363,497
1	JayJay	25,6	5	2	Front	Right	6	357,1951
1	JayJay	25,6	5	2	Front	Right	7	357,7707
1	JayJay	25,6	5	2	Front	Right	8	362,1442
1	JayJay	25,6	5	2	Front	Right	9	363,7948
1	JayJay	25,6	5	2	Front	Right	10	361,8513
1	JayJay	25,6	5	2	Rear	Left	1	176,4524
1	JayJay	25,6	5	2	Rear	Left	2	174,8913
1	JayJay	25,6	5	2	Rear	Left	3	183,3287
1	JayJay	25,6	5	2	Rear	Left	4	178,2033
1	JayJay	25,6	5	2	Rear	Left	5	186,4249
1	JayJay	25,6	5	2	Rear	Left	6	189,4628
1	JayJay	25,6	5	2	Rear	Left	7	175,1359
1	JayJay	25,6	5	2	Rear	Left	8	178,5602
1	JayJay	25,6	5	2	Rear	Left	9	182,4091
1	JayJay	25,6	5	2	Rear	Left	10	180,0384
1	JayJay	25,6	5	2	Rear	Right	1	176,8179
1	JayJay	25,6	5	2	Rear	Right	2	181,5729
1	JayJay	25,6	5	2	Rear	Right	3	176,7673
1	JayJay	25,6	5	2	Rear	Right	4	184,9615
1	JayJay	25,6	5	2	Rear	Right	5	182,0306

1	JayJay	25,6	5	2	Rear	Right	6	185,1685
1	JayJay	25,6	5	2	Rear	Right	7	177,8716
1	JayJay	25,6	5	2	Rear	Right	8	181,917
1	JayJay	25,6	5	2	Rear	Right	9	172,6812
1	JayJay	25,6	5	2	Rear	Right	10	172,9613