Trailer Design Considerations

Load Distribution

The load distribution between the hitch and the running gear is determined by placement of the axles in relation to the center of gravity.

Hitch Weight for Conventional, Bumper Type Hitches

The hitch weight for conventional, bumper type hitches should be 10% to 14% of the gross weight of the vehicle. The remaining 86% to 90% of the load will be carried on the running gear, so make sure that the axles, wheels, and tires are properly matched and have sufficient capacity rating to support this load.

Hitch Weight for Fifth Wheel and Gooseneck Type Hitches

The hitch weight for fifth wheel and gooseneck type hitches should be 15% to 20% of the gross weight of the vehicle. The remaining 80% to 85% of the load will be carried on the running gear, so make sure that the axles, wheels, and tires are properly matched and have sufficient capacity rating to support this load.

Trailer Handling

Trailer handling may be adversely affected if the load(s) are concentrated at the ends of the vehicle. This condition can occur even when the hitch weight is within the recommended proportion of vehicle weight. Probable causes for this phenomenon may be excessive frame flexure and/or polar inertia.

Dynamic Loading

Polar inertia and frame flex can impose dynamic loading on the axles and suspension system which may exceed the design loads and result in bending and fatigue failure.

Frame Flexure

Excessive frame flexure can affect ride if the natural frequency of the vehicle's structure matches the frequency of the suspension. Once the flex of the frame is in phase with the suspension's vertical movement, the dynamic load input to the suspension will cause it to deflect more than it would under static load conditions. This greater loading of the suspension results in greater rebound which causes greater frame flexing. Now the larger degree of frame flexure is imposed on the suspension which causes an even greater vertical travel, and son on. If the condition exists, damage to the vehicle's structure can occur. Either the structure should be stiffened of the suspension characteristics should be altered to prevent this "in phase" behavior.

Dog-Tracking

Uneven side to side loading of a trailer can cause dog-tracking. For double eyed leaf springs and single slipper type springs, the front end of the spring is anchored to the vehicle frame. As the load increases, the spring arch flattens, resulting in a lengthening of the spring. Since the axle is attached near the mid-point of the spring, it will move rearward as the spring deflects. If the springs are unevenly loaded, the axle will be skewed relative to the vehicle centerline and may cause tracking problems.

Center of Gravity

A trailer designed to carry a load with a high center of gravity should have a wide enough axle track to prevent or diminish the tendency for the vehicle to tip over on curves or turns with little or no banking on the road surface.

Dexter Axle Company
2900 Industrial Parkway East
Elkhart, Indiana 46515
(574) 295-7888
www.dexteraxle.com

Trailer Design Considerations

Torflex Axles

Trailer equipped with Torflex axles must be towed in a level attitude to insure even loading on the axles. Out-of-level towing results in higher loads being imposed on the axle at the low portion of the frame and less load on the axle(s) at the high end. This uneven load distribution may cause excessive stress concentrations on the frame structure. Uneven loading of non-equalized suspensions can also affect the ride characteristics by altering the natural frequency of the structure.

Wheel and Tire Diameter

The wheel and tire diameter should be large enough to provide sufficient ground clearance when used with drop spindle type axles. Insufficient clearance may result in the axle components dragging the ground in the event of a flat tire.

Axle Spacing

Axles should be spaced to allow at least one (1) inch of clearance between the tires under any loading condition. To determine the proper spacing, find the manufacturer's maximum diameter for the tire and add one inch or more. The result will be the axle center to center dimension. If tire chain clearance is desired, additional clearance may be necessary.

Attachment System

When designing the attachment system for Torflex axles on aluminum trailer frames, it is important to understand the compressive stresses imposed by the fasteners against the aluminum surfaces. Yielding in the these areas can lead to loosening of the axles and could result in fatigue failure of the axle bracket and tube structure and/or the frame members. If non-metallic materials are to be used between the mating surfaces to prevent galvanic corrosion, the designer must consider the stability of these materials under the high clamp loads. Extrusion of these materials under load may also lead to loosening of the axle attachment.

Axle Mounting

Spread axle mounting will lend added support to frame structures but will result in more tire wear and impose higher stresses on the axle components and axle mountings. Increased tire wear usually results from the added side scrubbing that occurs when negotiating sharp turns or corners.

Higher Stresses

Wide-spread Torflex axles will be subjected to higher stresses at the bracket/tube interfaces as a result of frame racking. Racking occurs when the vehicle travels over uneven surfaces and the loads imposed at each wheel are substantially different. If the torsional stiffness of the vehicle structure is relatively low, the areas where the cross members are joined to the main frame rails and the axle bracket/tube welds must withstand the twisting that occurs in these critical regions. Excessive flexing may result in fatigue failures. To reduce the potential for problems due to racking, position the axles closer together.

Dexter Axle Company
2900 Industrial Parkway East
Elkhart, Indiana 46515
(574) 295-7888
www.dexteraxle.com

Trailer Design Considerations

Multiple Axles

Torflex axles should not be used in situations requiring more than two axles. These axles are non-equalized and are designed to carry more than their rated load during conditions that place all the load on one axle. This is what happens when traversing uneven operating surfaces such as driveway entries or speed bumps. However, it is not reasonable to expect one axle to carry the load of three or more axles when the foregoing conditions are encountered, even though these instances cause only momentary over-loading.

Ride Performance

Torflex axle ride performance is at its best when the torsion arm is at or nearest to horizontal when the vehicle is at its rated load. This is due to the geometric relationship of the arm to the direction of loading. Torsion arms operating above the horizontal tend to exhibit a stiffer ride. As an example, for a 3000 lb. wheel load acting perpendicular to a 6" long arm, the torque input to the suspension system is 18,000 inch pounds. For the same wheel load imposed on a 6" long arm at 45 degrees, the torque input to the suspension drops to 12,727 inch pounds.
(Torque = 6(.707) x 3000, since the sine of 45° is .707)

Axle Capacity

Axle capacity will be reduced by at least 50% when used without a suspension system. (axles or stubs attached directly to vehicle frame.) *This is NOT a recommended configuration as it transfers load directly to the frame rails and is a very harsh ride.*

Oil Lubrication

Oil lubrication systems for wheel bearings should not be used in applications in cases where the vehicle will be stationary for long periods of time. The oil will drain down to the bottom of the cavity and leave the exposed parts of the bearings subject to corrosion.

Dual Wheels

Dual wheels cannot be used as singles unless they are used on hubs that have been specifically designed for that application. The large offset of a dual wheel shifts the load line too far from the hub face or intended load line of most hubs. This condition will result in a serious degradation of the bearing life.

Brakes Requirements

Dexter recommends that all axles be equipped with brakes. For trailers used in commerce, the trailer axle(s) must be equipped with brakes unless the GAWR of the trailer axle is less than 3000 pounds and the hitch load imposed on the towing vehicle does not exceed 40% of the towing vehicles GVWR. For other details concerning commercial applications, refer to the Federal Motor Carrier Safety Regulations published by the U.S. Department of Transportation.

The recommended practice for any trailer design would be to use brakes on all axles. The use of trailer brakes can help prolong the life of the tow vehicle brakes as well as provide for safer operation.

Dexter Axle Company
2900 Industrial Parkway East
Elkhart, Indiana 46515
(574) 295-7888
www.dexteraxle.com

Wheels and Tires

The wheels and tires should be matched in capacity to the axle whenever possible. The Gross Axle Weight Rating of the running gear will be based on the lowest rated component.

Tires are designed to be mounted on specific rim sizes and contours as defined by The Tire and Rim Association. Mis-matching of these vital components is dangerous and can result in serious injuries, catastrophic failure or poor performance and reduced service life.

Tires of greater capacity should never be mounted on wheels of a lower capacity since most end-users will inflate and load them to the rating embossed in the tire. This practice can result in dangerous failure of the wheel which may lead to an accident. Wheels must also be matched to the particular hub and mounting system being used. Wheels are designed to be either hub piloted or stud piloted.

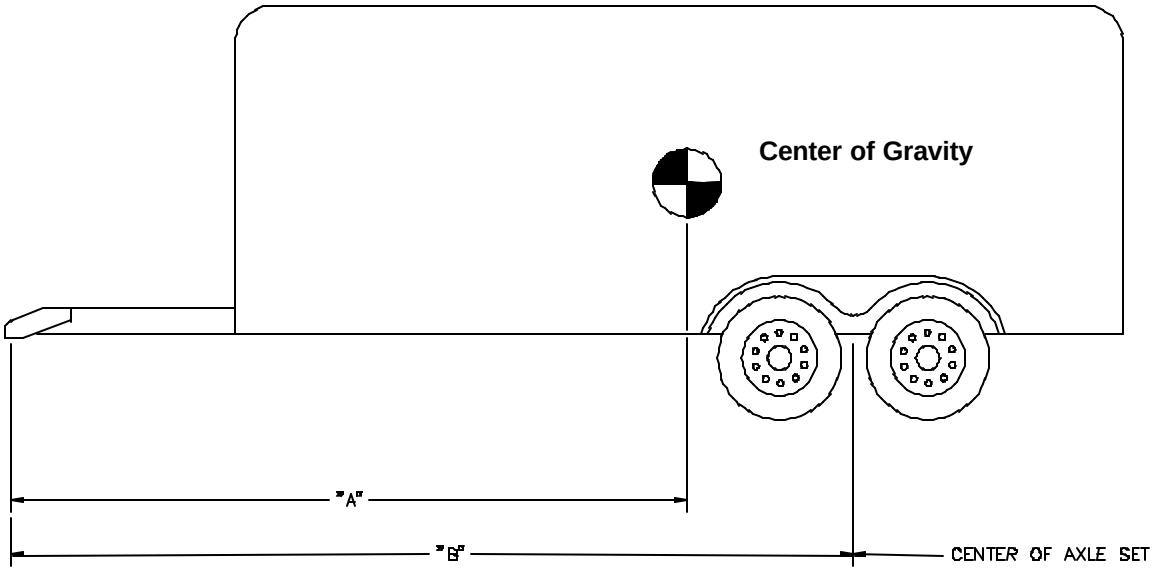
Hub piloted wheels have the center hole machined to a close tolerance and are intended to mate with a hub having a properly sized pilot. The bolt holes will be bored or stamped straight through the center disc which is designed to be fastened with either flanged nuts or a clamp ring using cone nuts.

Stud piloted wheels have a center hole which provides clearance to the hub nose. The bolt holes feature a tapered seat designed for clamping with properly matched cone nuts. The cone angle of the nut MUST match the cone angle around the bolt hole. Failure to properly match these components will result in catastrophic wheel loss.

Determining Dimensional Requirements

Note: “Center of Axle” on a Torflex axle is defined as the center of spindle.

1. Measure the distance from the center of the hitch to the center of gravity (Dimension A)
2. Divide this value by the percentage of the load to be carried by the running gear.
3. The result will be the distance from the center of the hitch back to the center of the axle set (Dimension B)



Dexter Axle Company
2900 Industrial Parkway East
Elkhart, Indiana 46515
(574) 295-7888
www.dexteraxle.com