



# **Owner's Manual for CZ PoleTrailers**

**CZ Engineering, Inc.  
33863 Highway E  
Dixon, MO 65459  
(573) 759-2144  
[www.cze.com](http://www.cze.com)**

This page intentionally left blank.

Thank-you for purchasing a CZ trailer . Many man-hours of labor by skilled craftsmen have been spent in the manufacture of your trailer. We have taken great care to ensure quality design and production, but, we realize any product has room for improvement. We appreciate any input you might have concerning the improvement of our trailers or distribution system.

This manual will help you make better use of your new CZ trailer. It contains information on safe operation and maintenance procedures to protect you and your trailer.

Your CZ trailer was built to require a minimum of maintenance, but a little care by you will increase its useful life as well as keep it looking great for a long time.



CZ Engineering, Inc.

COPY BY PERMISSION ONLY  
NO ADDITIONS OR DELETIONS ALLOWED

This page intentionally left blank.

# TABLE OF CONTENTS

## SECTION 1

Operating Instructions .....	Page 1
Safety Chains .....	Page 1
Loading .....	Page 2
Weights & Balance .....	Page 2
Tires & Wheels .....	Page 4
Tire Table .....	Page 5
Electrical System .....	Page 6
Break-a-way System .....	Page 6
Maintenance .....	Page 7-11
Brakes .....	Page 7
Bearing & Seals .....	Page 8
Lubrication .....	Page 9
Paint .....	Page 10
Wheel Mounting .....	Page 10
Bolt Torque Limits (suspension) .....	Page 11
Expressed Warranty .....	Last Page

## SECTION 2

### Axle Information

Brakes  
Bearings  
Seals  
Etc.

This page intentionally left blank.

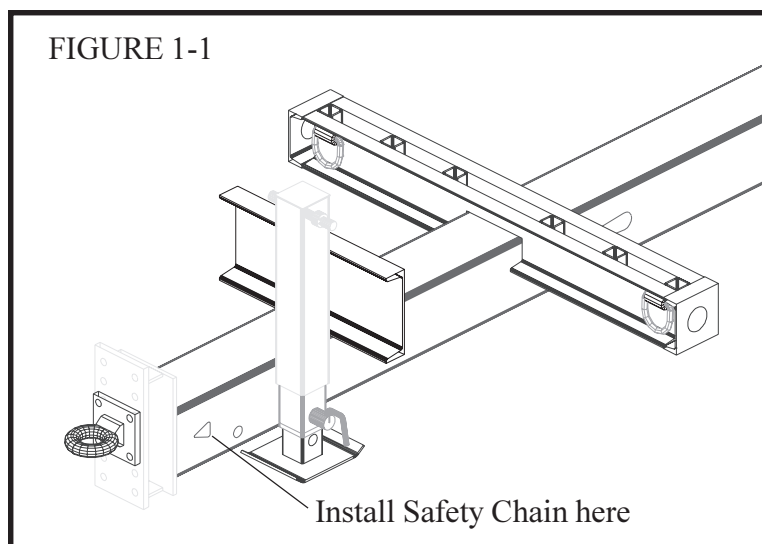
## USE/OPERATING INSTRUCTIONS

Your trailer should be coupled to the towing vehicle only by approved pintle hooks and eyes suited to the capacity of the trailer. No other coupling system is authorized by the manufacturer. When empty the trailer should sit level to slightly front-high so it will ride level when loaded. Adjust the pintle eye into one of its' 5 positions to match the hook on the truck. If the range of adjustment does not suit the truck, then adjust the hook on the truck to the desired range. Inspect all truck and trailer connections thoroughly to ensure their capability and safety.

**WARNING:** Always check the tightness of the pintle eye bolts before using the trailer.

### SAFETY CHAINS

Every CZ trailer has built-in provisions for custom safety chains. These provisions are triangle shaped cutouts at the front of the drawbar (tongue) just behind the coupling plate. (see figure 1-1) These holes permit you to install a chain of the proper size and length for your application. We recommend that you only use hardened chains. Safety chains must be of sufficient strength to carry the dynamic loading of the trailer when loaded in the heaviest tongue-loaded configuration for your range of applications. Use a minimum of 3/8" grade 70 chains.



**WARNING:** Never operate a tag-a-long trailer without a safety chain.

**HOOKING UP**

**WARNING**

**SAFETY CHAINS**

**WARNING**

The safety chain should be one length and pass through both triangular holes in the tongue of the trailer in such a fashion as to prevent them from accidentally unfastening. Both ends of the chain should be fastened to a secure part of the towing vehicle. DO NOT hook the ends of the chains to the coupler on the truck or any other member that is prone to failure under severe loading. Attachment to the towing vehicle should be at least as strong as the chain. **Chains should be long enough to permit a full turn and short enough to prevent the tongue of the trailer from contacting the ground in the event of a break-a-way. Crossing the chains may help.**

**LOADING**

**LOADING**

In order for a tag type trailer to handle properly, tongue load should be at least 10 to 15% of the Gross Vehicle Weight (GVW). Proper placement of the line poles is necessary to achieve this tongue load. Line poles have a trapezoidal shape, thus the center of gravity is not in the middle of the pole. The following information will assist the operator to achieve proper trailer loading.

**CENTER OF GRAVITY FOR LIGHT WEIGHT POLES**

Length of Pole	Distance from butt end to center of gravity
30' class 6	13' 6"
35' class 6	16'
40' class 6	18' 2"
45' class 6	20' 4"
50' class 5	22' 4"
55' class 5	24' 6"
60' class 3	27'

**NOTE:** The center of gravity of poles with lower class numbers will be closer to the butt end of the pole.

**NOTE:** Poles that have been used will be much heavier at the butt end than the rest of the pole.



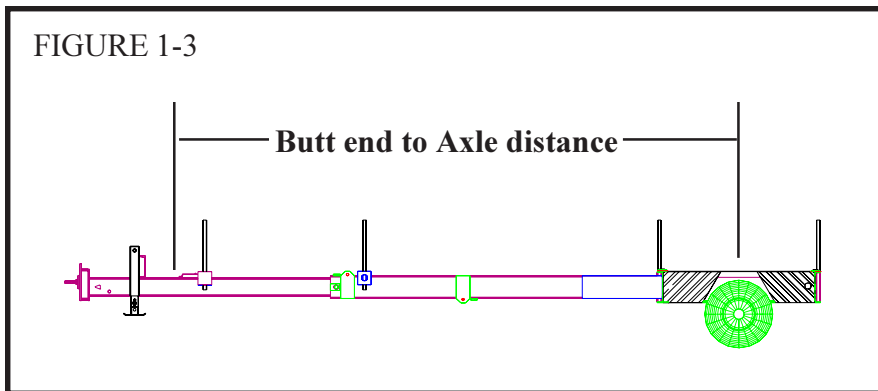
Poles should be loaded so their center of gravity is placed in front of the axle to achieve the proper tongue load. The following table lists the recommended distance from the butt end of the pole to the axle of the trailer.

Pole Length	Distance from butt to axle
30' class 6	16' 10"
35' class 6	19' 2"
40' class 6	21' 10"
45' class 6	24' 3"
50' class 5	26' 7"
55' class 5	29' 4"
60' class 3	32' 6"

 **NOTE**

 **TIP**

**WEIGHTS & BALANCES**



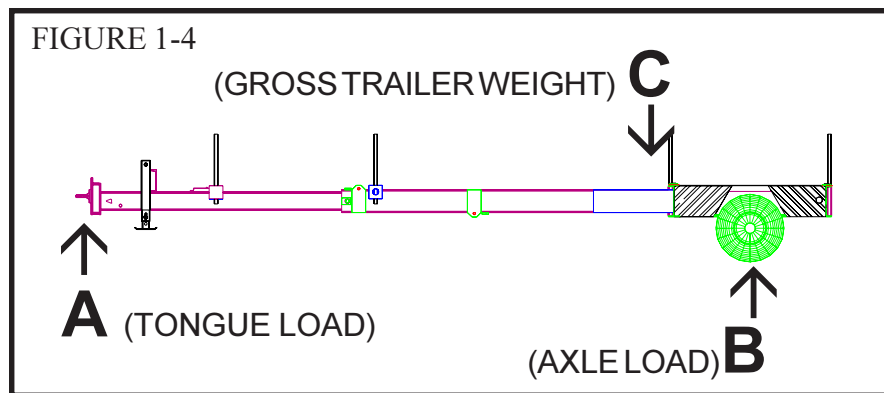
\* \* \* \* \* **GVWR** \* \* \* \* \*

The **Gross Vehicle Weight Rating** for your CZ trailer can be found on the Data Plate fastened to the front of the trailer. The GVWR is the sum of the loads imposed on the axles and through the coupler to the truck. The GVWR of a properly designed trailer is greater than the axle capacity because the axles can be loaded to capacity and additional weight can be transferred to the truck.

 **NOTE**

**GVWR**

**Butt end to Axle distance**



**WARNING:** GVWR and tongue load ratings are for the trailer only. Make certain the towing vehicle and its components are capable of these ratings.

**TIRES AND WHEELS**

**TIRES & WHEELS**

Consult the tire side walls for the tire weight ratings and inflation pressures for your tires. Light truck tires (16" or 16.5" tires) manufactured by most domestic tire manufacturers can have their ratings increased by 9% when operated at 54 M.P.H. or slower. Heavy truck tires manufactured by most domestic tire manufacturers are allowed a 9% increase when operated below 50 M.P.H. (See Figure 1-6)

215/75R/17.5 16-ply tire ratings are specified in Figure 1-5.

<u>M.P.H.</u>	<u>215/75R/17.5 16 P.R.</u>
62	18160# @ 125 PSI
33	20000# @ 125 PSI
<b>TIRE CAPACITY (per axle)</b>	

FIGURE 1-5



**WARNING:** NEVER EXCEED THE AXLE CAPACITY

Check the tightness of wheel lug nuts daily. Use soapy water to lubricate the threads and bearing surfaces prior to reinstallation. Periodically inspect the wheels and rims for cracks especially around connection points and lug holes.

<b>TABLE 1 - LIGHT TRUCK TIRES</b>				
The service load and minimum (cold) inflation must comply with the following limitations:				
SPEED RANGE (MPH)	INFLATION PRESSURE INCREASE		% INCREASE (+) OR DECREASE (-) IN LOADS	
75 THRU 84	+ 10 PSI		- 10%	
65 THRU 74	+ 10 PSI		None	
55 THRU 64	No Increase		None	
45 THRU 54	No Increase		+9%	
35 THRU 44	No Increase		+16%	
25 THRU 34	No Increase		+24%	
15 THRU 24	No Increase		+32%	
The inflations shown in the light truck tire tables are minimum cold pressures for the various loads listed. Higher pressures should be used as follows:				
A. When required by the above speed/load table				
B. When higher pressures are desirable to obtain improved operating performance.				
The combined increases of A & B should not exceed 10 PSI above the inflation specified for the maximum load of the tire.				
<b>THE MAXIMUM RIM CAPACITY MUST NOT BE EXCEEDED</b>				
<b>TABLE 2 - TRUCK-BUS TIRES</b>				
For Tires Shown in Tables TB-2, TTB-2, WBTB-2 and STB-1C				
The service load and minimum (cold) inflation must comply with the following limitations:				
SPEED RANGE (MPH)	INFLATION PRESSURE INCREASE		% INCREASE (+) or DECREASE (-) IN LOADS	
	DIAGONAL (BIAS) PLY TIRES	RADIAL PLY TIRES	CONVENTIONAL TIRES	WIDE BASE TIRES
71 THRU 75	+ 10 PSI	+ 10 PSI	- 10 %	- 10 %
61 THRU 70	+ 10 PSI	+ 10 PSI	None	None
51 THRU 60	No Increase	No Increase	None	None
41 THRU 50	No Increase	No Increase	+9%	+7%
31 THRU 40	No Increase	No Increase	+16%	+9%
21 THRU 30	No Increase	+ 10 PSI	+24%	+12%
11 THRU 20	No Increase	+ 15 PSI	+32%	+17%
The inflations shown in the referenced tables are minimum cold pressures for the various loads listed. Higher pressures should be used as follows:				
A. When required by the above speed/load table				
B. When higher pressures are desirable to obtain improved operating performance.				
The combined increases of A and B should not exceed 20 psi above the inflation specified for the maximum load of the tire.				

FIGURE 1-6

**WARNING:** The maximum rim capacity must not be exceeded.

 **WARNING**

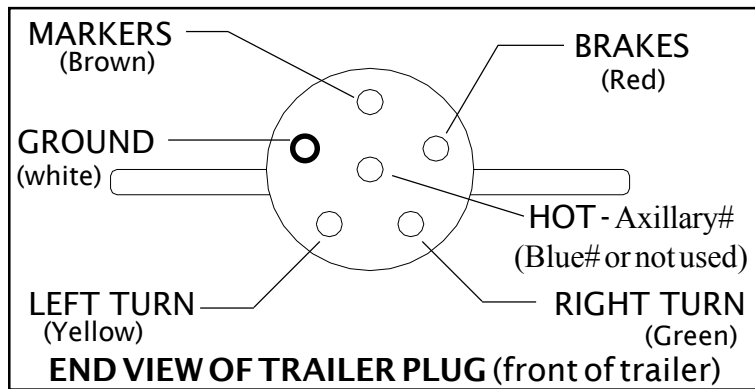
**ELECTRICAL**

**ELECTRICAL**

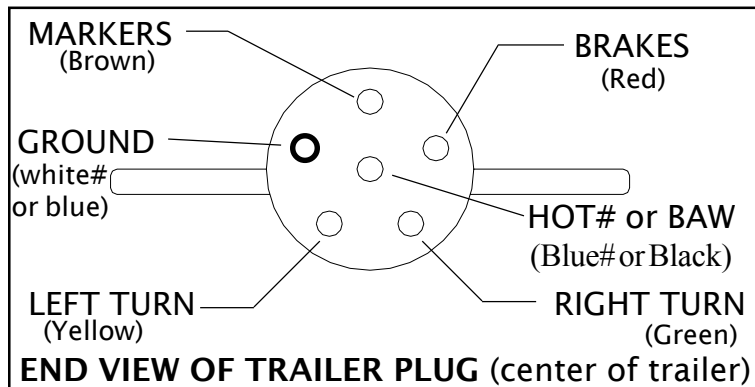
When hooking up the electrical system be sure the trailer and truck plug ends are compatible and the wiring on the truck is of sufficient size to carry the electrical load to the trailer lights and the break-a-way system (on electric brake trailers). Always use an electric brake controller of sufficient capacity for your trailer.

**NOTE:** The electric brake circuit should be at least 14 AWG wire.

The trailer end (front of trailer) of the electrical coupling is wired as detailed in figure 2-1. The plug at the center of the pole trailer is used when adjusting its length. That plug is wired as shown in figure 2-2



**FIGURE 2-1**



**FIGURE 2-2**

As of September 2005

# Applies to trailers with electric over hydraulic brakes.

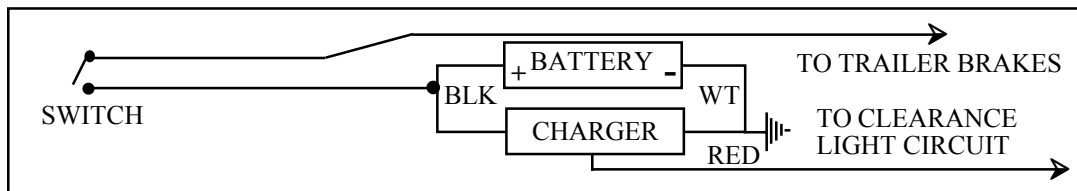
**BREAK AWAY SYSTEMS**

All models of CZ trailers use the same basic electrical components. Tail and clearance lights are the sealed beam type and must be replaced as a unit. You can replace just the bulb on the license plate light. Both types can be obtained at many auto parts stores or RV dealers.

A Break-Away device applies the trailer brakes in the event of a separation of the trailer from the towing vehicle. (Hydraulic and air brake trailers have break-away systems

built in. All electric brake trailers must have the break-away kit installed.) Before operating your trailer be sure the break-away device meets all the requirements of your application.

Your electric brake trailer is equipped with a break-away system. It has provisions for charging the battery while the trailer is in use. The trailer battery will only charge when the running lights are on. (Except for trailers with electric over hydraulic brakes, which charge full time.) You must operate the lights a sufficient amount of time to keep the battery charged. If full time charging is desired you can wire a separate charging circuit. The two possible wiring circuits (full and part time charging) are detailed in Fig. 2-2 and 2-3.



**Part Time Charging**

**FIGURE 2-3**

A battery condition indicator is located in the battery box in the platform area of the trailer. An indicator button will illuminate a green light if the battery is fully charged.

## MAINTENANCE

Your trailer was designed to require as little maintenance as possible, but, a little attention to the following maintenance items will be well worth your while.

### BRAKES

The brakes on all CZ Pole Trailers are self adjusting.

A properly adjusted air brake will have a space the thickness of a business card between the lining and the drum. Other drum type brakes should slightly rub on the drum, but not enough to cause excessive drag when the wheel is rotated. Air brakes with automatic slack adjusters will adjust each time the brakes are applied, regardless of direction of travel.

The self adjusters on electric and hydraulic brakes are actuated by applying the brakes while backing the trailer. Most trailers are backed enough in everyday use to keep the brakes adjusted, but you may occasionally have to deliberately adjust the brakes by backing up and braking several times. In addition to automatic adjustment all shoe type brakes can be adjusted manually like any conventional drum/shoe brake.

NOTE: For trailers with a circuit breaker box, including electric over hydraulic brake trailers, see the electrical wiring supplement.

### BRAKES

See the technical bulletin at the end of this manual for more important information about your brake system

## BRAKE INSPECTIONS

### BRAKE INSPECTIONS

It is not practical to suggest a brake inspection interval for all applications. Mileage has little to do with brake life. The number of stops you make and the loading of the brake components as a result of those stops will determine your brake lining life. A trailer used in the city will not get as much mileage from its brakes as one used primarily on open roads.

We suggest you inspect your brake linings after the first six months of use. From this inspection you should be able to determine the approximate rate of wear for your application and can adjust your inspection intervals accordingly.



**NOTE:** Brake components **MUST** be inspected at least once every twelve months.

Service of trailer brakes is similar to the service of automobile brake systems. Electric brakes will require occasional replacement of the magnets. Magnets should be inspected with the brake linings.

## BEARINGS & SEALS

### BEARINGS & SEALS

CZ trailer wheel bearings are lubricated with SAE EP-90 weight hypoid gear oil. Oil levels should be checked daily when the trailer is in use. The oil level can be checked through the clear dust covers on the end of the hubs. An oil level line is molded into the cover. Oil can be added through the rubber plug in the end of the dust cover.



**NOTE:** It may take a while for the oil to run through the bearings to the inner chamber of the hub. **DO NOT OVERFILL** the hub with oil.

The area around the dust covers and on the back side of the hub and drum should be inspected frequently for oil leaks. If oil is observed in these areas the dust cover and inner seal should be checked.



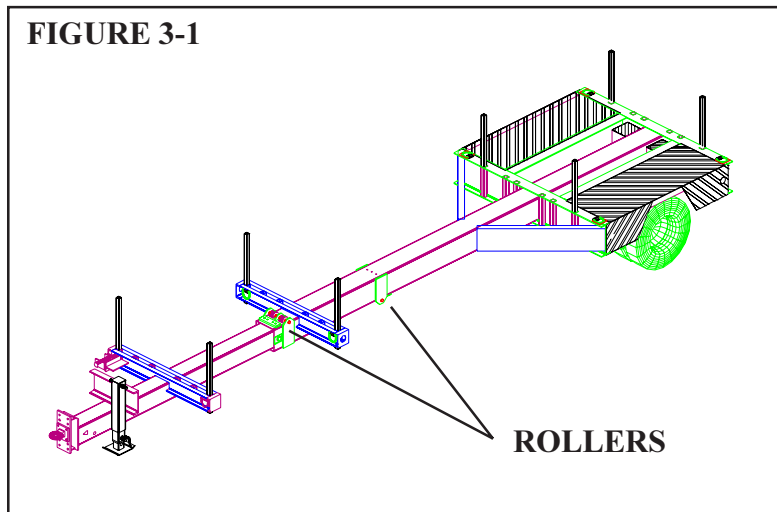
**NOTE:** We recommend you replace the inner bearing seals each time the hubs are removed. Be careful not to pinch the bearing seals during the installation of the hub. Leakage after installation may indicate the seals have been pinched.

Check end play in the wheel bearings after the first 100 miles of use and after each replacement. Remove and inspect bearings at least once every twelve months. Adjustment of CZ trailer bearings is conventional.

## LUBRICATION

Your new trailer requires little lubrication. The suspension is a rubber bushed system which requires no lubrication, but it does require that you maintain proper torque. See page 11 for details.

The only lubrication required of your Pole Trailer is the tongue rollers. There are grease fittings on the ends of the roller axles. Note that there is one set of rollers on the top and one set on the bottom of the tongue. See figure 3-1



**NOTE:** Excessive lubrication is as bad as too little.

 **NOTE**

When the trailer has been greased make sure the suspension bolts are torqued properly. (Refer to the suspension torque decal on the trailer for correct torque limits). Notice that the torque requirements are greater for dry bolts than oiled bolts.

**PAINT**

**PAINT**

DuPont Centari automotive paint code number 7378A is the standard CZ paint color. This is similar to the color most state highway departments use.

We have taken great care to ensure the quality of the paint job on your trailer. Everything from surface preparation to paint application has been done to our exacting standards. Unfortunately, a quality paint job is no substitute for proper paint care. A trailer is always “tailgating”, so it has a rough life. **The use of good mud flaps on the towing vehicle will help save the paint on the front of your CZ trailer.**

**HAYES AXLE DUAL WHEEL MOUNTING INSTUCTIONS**

**WHEEL MOUNTING**

**Note:** You may have different wheels or suspension than the ones listed in this section. Consult the label on the axle and check the last section in this manual for brand specific instructions.



**WARNING:** Proper wheel nut torque is mandatory to prevent accidental wheel loosening or damage.

1. Remove rust, dirt, and paint from studs. Inspect studs and nuts carefully for excessively worn or damaged threads.
2. Remove rust, dirt, oil, grease, and paint from hub and wheel mounting surfaces. Inspect hubs and wheels and their mounting surfaces for damage or cracks.
3. Mount wheels and start nuts by hand to prevent cross threading.
4. Tighten all nuts to 50 ft-lb. using the sequence shown, continue to full torque in the same sequence, use chart below.

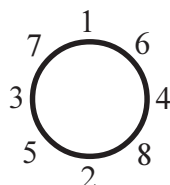
NUT SIZE/TYPE	5/8 SWIVELING FLANGE NUT (9K & 10K AXLE)	3/4 SWIVELING FLANGE NUT (12K & 16K AXLE)
TORQUE RQM'T	250-300 ft-lbs	350 - 400 ft-lbs



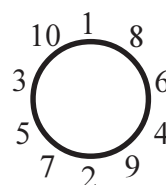
**WARNING:** Over torquing or under torquing can result in sudden or premature stud failure or wheel loss.

5. Hubs with 10 bolts require the use of 2 in. dia. flange nuts.
6. After the first 50 to 100 miles the torque should be rechecked, tightened if necessary. Check torque at regular intervals.
7. Repeat all steps above after every change in wheel mounting.

**8 BOLT HUB  
TIGHTENING SEQUENCE**



**10 BOLT HUB  
TIGHTENING SEQUENCE**





**9K-16K AXLE SUSPENSION**

**NOTE:** Daily visual inspection is recommended

**PERIODIC INSPECTION**

An inspection of the suspension is recommended at regular intervals following initial inspection at 3,000 miles. All bolts and nuts to be checked and tightened to the torque values below, if required.

Nut torque values for bolts with clean threads. Position equalizer horizontal while torquing.

**3/4" Spring eye** 225-275 ft-lbs

**3/4" Roller snug fit or welded.** Roller must roll      **5/8" U-Bolt** 120 ft-lbs

**WARNING:** Failure to maintain proper bolt torque may result in damage to the suspension components

**NOTE:** All bolts to be inserted from outside of trailer in all hangers to allow torquing of nuts without removing tires and wheels.

**HUTCHENS SUSPENSION TORQUE REQUIREMENTS**

**WARNING:** Follow all torque requirements

**WARNING:** Do not use any component with visibly worn or damaged threads.

**WARNING:** Failure to follow these safety alerts can lead to loss of vehicle control, property damage, serious personal injury or death.

After an initial break in period, approximately 1000 miles, and at least every 4 months periodically thereafter, ALL bolts and nuts should be checked to insure that recommended torque values are being maintained.

Oiled torque values listed are for new fasteners with lubricated threads. It is recommended that new installations be performed with oiled fasteners. For dry threads which have been in service, use the higher torque values which are noted below.

	<b>OILED</b>	<b>DRY</b>
1 1/8-7 (9600/9700 Rocker Bolt) .....	590 lb-ft	790 lb-ft
1-14 (7700 Radius Rod Bolt) .....	540 lb-ft	720 lb-ft
7/8-14 (Axle U-Bolts & 7600 Rad. Rod Bolt) .....	350 lb ft	470 lb-ft
3/4-16 (Axle U-Bolts) .....	310 lb-ft	420 lb-ft
5/8-18 (7600/7700 Rocker Step Bolt & Cast Rad. Rod Clamp Bolt) .....	130 lb-ft	170 lb-ft
5/8-18 (Spring Retainer Bolt) .....	35 lb-ft	50 lb-ft
1/2-20 (Rad. Rod Clamp Bolt) .....	65 lb-ft	85 lb-ft

 **NOTE**

 **WARNING**

 **NOTE**

 **WARNING**

 **WARNING**

 **WARNING**

**Note:** You may have different wheels or suspension than the ones listed in this section. Consult the label on the axle and check the last section in this manual for brand specific instructions.

This page intentionally left blank.

# Expressed Warranty

CZ Engineering, Inc., Inc., hereinafter referred to as Manufacturer, warrants each new trailer to be free from defects in material and workmanship under normal use and service for a period of two (2) years from the date of original sale.

This warranty is expressly in lieu of all other warranties and representations, expressed or implied, and all other obligations or liabilities on the part of the manufacturer.

Manufacturer's liability and obligation is limited to repair, or replacement of the product or a refund of purchase price, at manufacturer's option, provided the purchaser returns the claimed defective product to the manufacturer, with transportation charges prepaid, and an examination by manufacturer discloses the product is defective.

Manufacturer makes no warranty with respect to tires, wheels, brake systems, axle assemblies, or hitches, or other accessories not manufactured by manufacturer, as these items are usually warranted specially by the respective manufacturers of those items.

This warranty does not cover any product which has been repaired or altered outside of the factory of manufacturer in any way so as to, in the judgment of the manufacturer, affect the stability, reliability, or performance of the product. This warranty does not cover damage or product failure caused by accident, misuse, negligence, or tampering.

This warranty excludes any and all liability for consequential or incidental damages. Some states do not allow this exclusion or limitation of incidental or consequential damages, so the foregoing limitation or exclusion may not apply to you.

This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

**CZ Engineering, Inc.**

33863 Highway E

Dixon, MO 65459

(573) 759-2144

This page intentionally left blank.

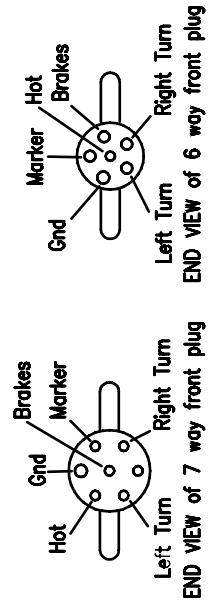
# POLE TRAILER WIRING

As of 10/20/2005  
(Junction Box on tongue)

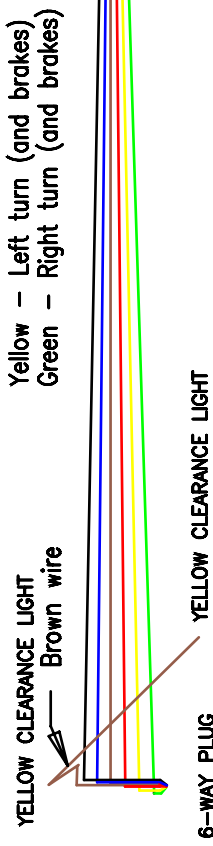
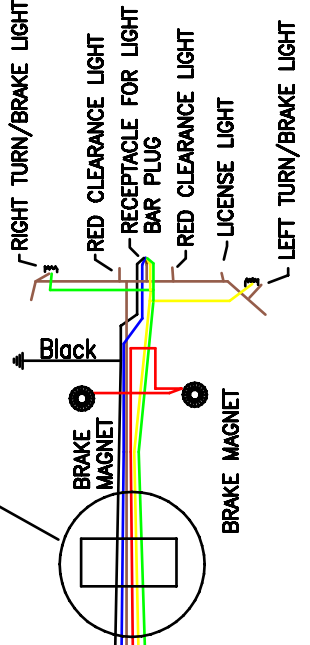
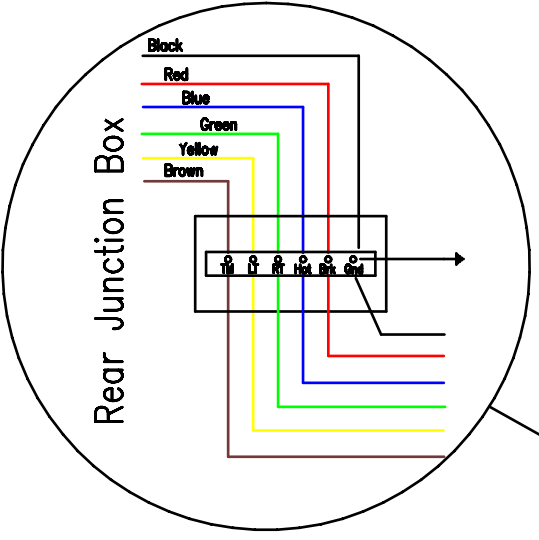
Insert Scale: 110.00000000000000

DATE: 7/22/91

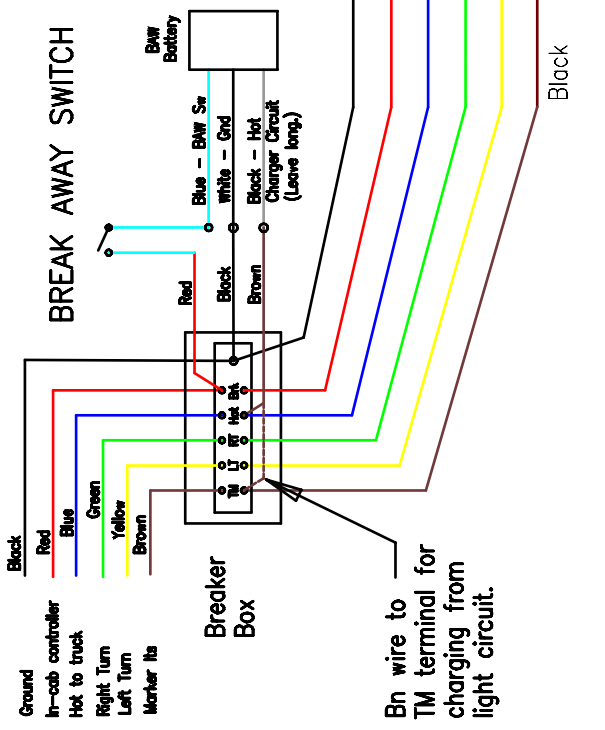
CZ Engineering, Inc.



Wire Colors - Top to Bottom  
 Black or White - Ground  
 Blue - 12 volts from truck  
 Brown - Marker lights  
 Red - Electric brakes  
 Yellow - Left turn (and brakes)  
 Green - Right turn (and brakes)

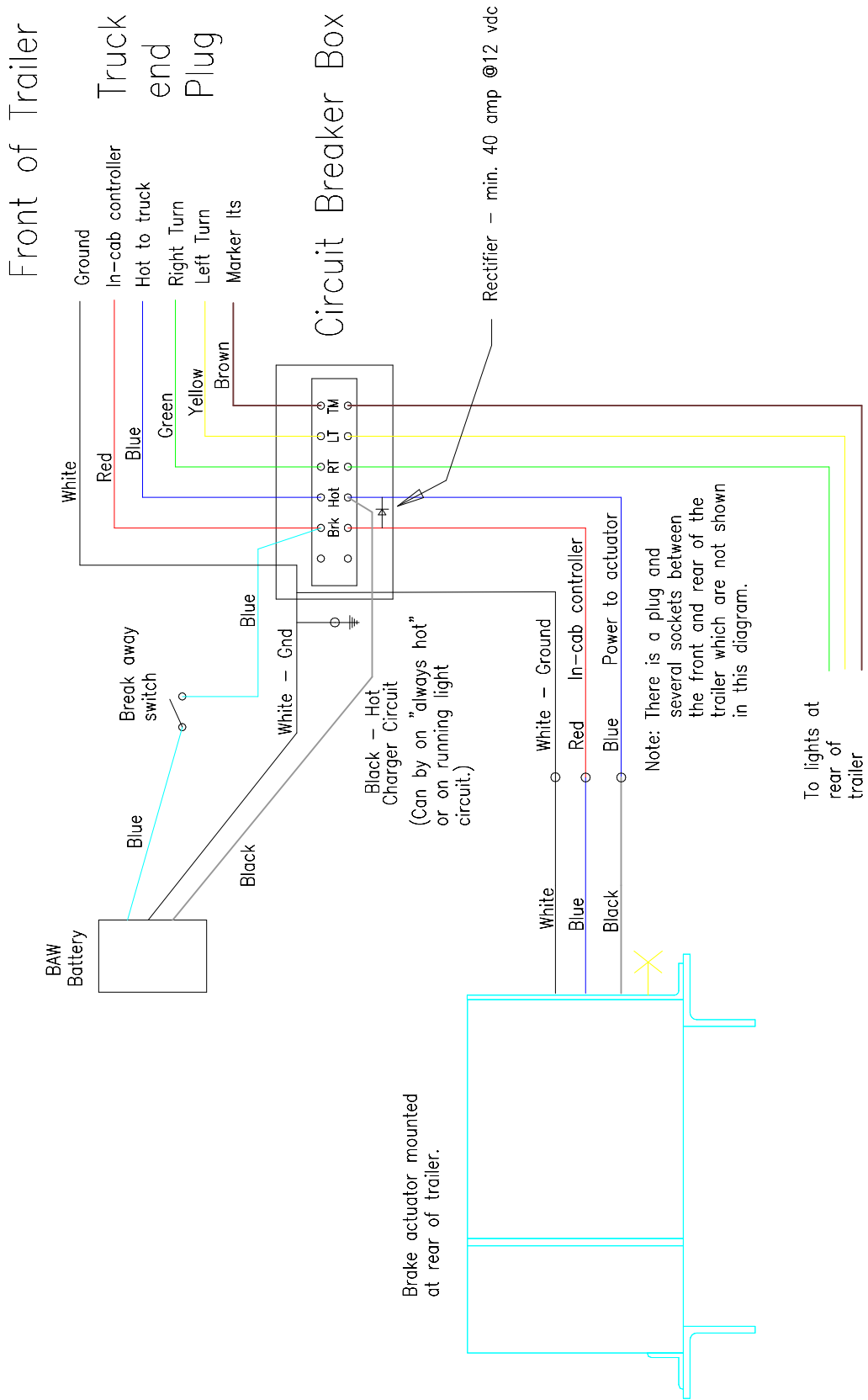


Truck end Plug



PROJECT: Pole Trailer - Wire Diagram  
 PLOT DESC: Wire---D  
 DRAWN BY: RC/CD  
 LAST REV. DATE: 10/27/2005 RC

This page intentionally left blank.



NOTE:  
 This diagram applies to trailers built after 07/25/2007.  
 These trailers use the Carlisle Hydrastar electric over hydraulic brake actuator with a built-in HBA-CAM to make them compatible with sensing brake controllers.

Insert Scale: 4.5000000000000000

DATE: 01/24/2008

CZ Engineering, Inc.

PROJECT: HydraStar Wiring - built in HBA-CAM  
 PLOT DESC. 0Hydrastar-Wire2  
 DRAWN BY: RC  
 LAST REV. DATE:

This page intentionally left blank.





## Recommended Oil Lubrication Specification

---

Use:	Axle hubs with tapered roller bearing
Service Designation:	API-GL-3 or API-GL-4 or API-GL-5
Viscosity:	SAE 90 or SAE 80w-90 or SAE 80W-85W-90 or SAE 75W-90
Pour Point:	-18°C (0°F) Maximum
Additives:	Corrosion and oxidation inhibitors, foam inhibitors, EP additives
Compatability:	Must be compatable with nitrile and neoprene seals and polycarbonate plastic oil caps
Approved Sources:	Ashland Oil Valvoline High Performance Gear Lube 80W90 Cato Oil & Grease Company PMO Gear Lubricant Code 1505 Universal 2105 Gear Lubricant Code 1633 Mystik JT-7 Gear Lubricant Code 1617 Mystik 825 Gear Lubricant Code 1600 Exxon Company Gear Oil GX 80W-90 Kendal Refining Co., Division of Witco Corp. Kendall NS-MP Hypoid Gear Lube SAE 80W-90 Lubriplate Div./Fiske Brothers Refining Co. Lubriplate APG 90 Mobil Oil Corporation Mobilube SHC 75W-90 Pennzoil Products Company Multi-Purpose Gear Lubricant 4092 or 4096 Oil Center Research Liquid-O-Ring #750 Southwest Petro-Chem Division, Witco Corp. GL-5 Gear Lubricant Code SB8365013 Sun Refining & Marketing Company Sunfleet GL-5 Code 110402 or 110502 Union Oil Company Unocal MP Gear Lube-LS 80W-90

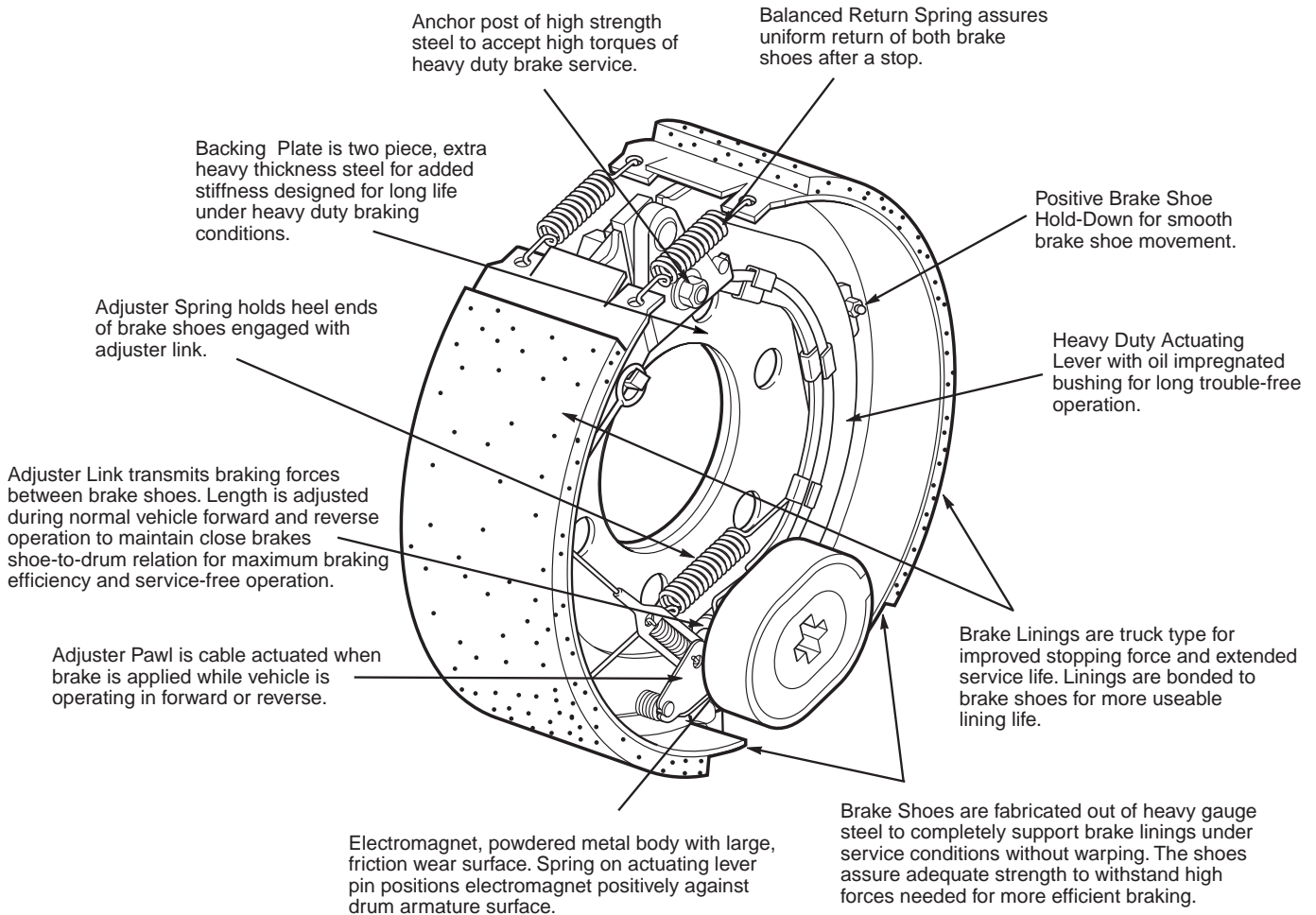
## Bearing Adjustment

---

*For double nut construction. Bearing end play is .001 to .010*

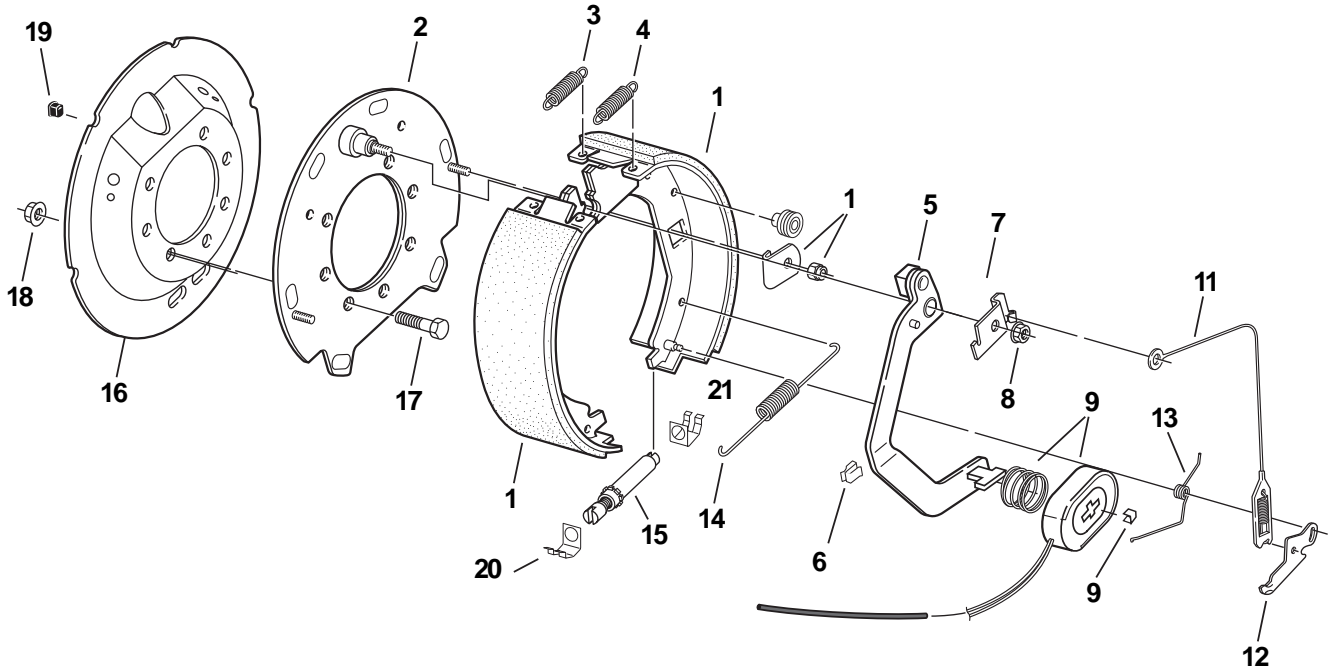
1. Tighten inner nut to 100 lb.-ft. while rotating hub to seat bearings.
2. Loosen nut to remove preloaded torque without rotating hub.
3. Hand tighten nut then back off  $\frac{1}{8}$  turn minimum,  $\frac{1}{4}$  turn maximum.
4. Install tab washer and outer nut. Torque outer nut to 225 to 250 lb.-ft. Insure that the inner nut does not turn.
5. Bend two tabs over outer nut to secure in place.

# Forward Self-Adjusting Electric Brake



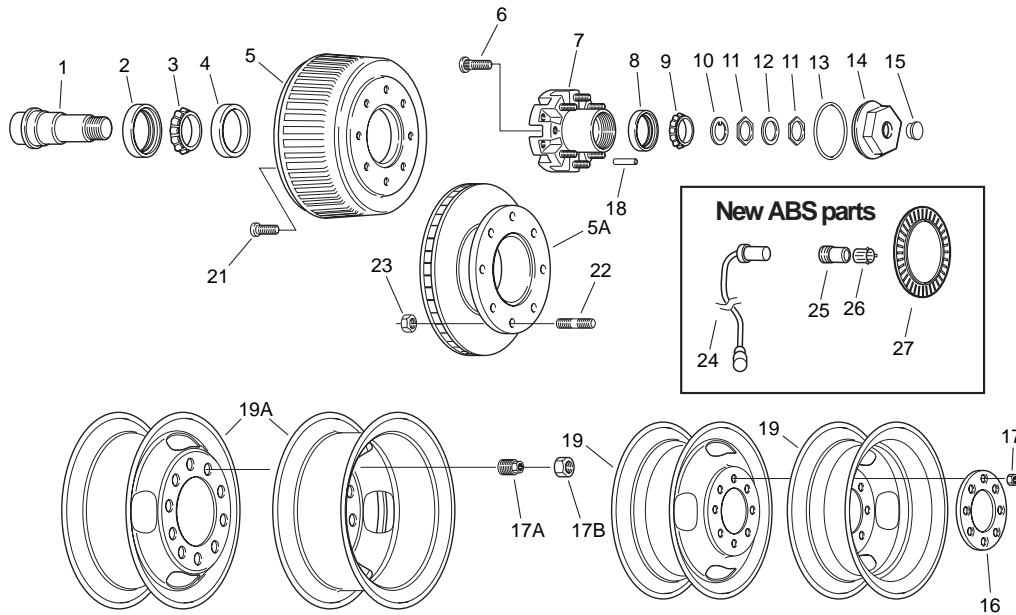
Size	Capacity	Part No. LH	Part No. RH
12 $\frac{1}{4}$ x3 $\frac{3}{8}$ "	9K, 10K GD	023-195-00	023-196-00
12 $\frac{1}{4}$ x4"	10K	023-198-00	023-199-00
12 $\frac{1}{4}$ x5"	12K	023-201-00	023-202-00
12 $\frac{1}{4}$ x5"	15K	023-204-00	023-205-00

# Electric Brake Parts



Item	Description	Qty. Per Brake	12 <sup>1</sup> / <sub>4</sub> x 3 <sup>3</sup> / <sub>8</sub> 9K & 10K GD Part No.	12 <sup>1</sup> / <sub>4</sub> x 4 10K Part No.	12 <sup>1</sup> / <sub>4</sub> x 5 12K Part No.	12 <sup>1</sup> / <sub>4</sub> x 5 15K Part No.
1	LH Shoe & Lining Kit containing:	1	K71-049-00	K71-051-00	K71-053-00	K71-053-00
	LH Primary	1	040-110-01	040-108-01	040-102-01	040-102-01
	LH Secondary	1	040-111-02	040-109-02	040-103-02	040-103-02
	Shoe Hold Down Washer	2	005-107-00	005-107-00	005-107-00	005-107-00
	Lock Nut	2	006-127-00	006-127-00	006-127-00	006-127-00
1	RH Shoe & Lining Kit containing:	1	K71-050-00	K71-052-00	K71-054-00	K71-054-00
	RH Primary	1	040-111-01	040-109-01	040-103-01	040-103-01
	RH Secondary	1	040-110-02	040-108-02	040-102-02	040-102-02
	Shoe Hold Down Washer	2	005-107-00	005-107-00	005-107-00	005-107-00
	Lock Nut	2	006-127-00	006-127-00	006-127-00	006-127-00
2	Backing Plate Assembly	1	036-072-05	036-072-05	036-072-06	036-072-06
3	Shoe Return Spring (Rear-Black)	1	046-071-00	046-071-00	046-071-00	046-071-00
4	Shoe Return Spring (Front-Green)	1	046-083-00	046-083-00	046-083-00	046-083-00
5	LH Actuator Arm Assembly	1	047-123-38	047-123-06	047-123-04	047-123-04
	RH Actuator Arm Assembly	1	047-123-37	047-123-05	047-123-03	047-123-03
6	Wire Clip	3	027-039-00	027-039-00	027-039-00	027-039-00
7	LH Arm/Shoe Retainer	1	071-455-01	071-455-01	071-455-01	071-455-01
	RH Arm/Shoe Retainer	1	071-455-02	071-455-02	071-455-02	071-455-02
8	Flange Nut	1	006-062-00	006-062-00	006-062-00	006-062-00
9	Magnet Kit containing:	1	K71-376-00	K71-376-00	K71-377-00	K71-378-00
	Magnet Retainer Clip	1	027-050-00	027-050-00	027-050-00	027-050-00
	Magnet Assembly	1	042-129-00	042-129-00	042-130-00	042-131-00
	Magnet Mtg. Spring	1	046-117-00	046-117-00	046-117-00	046-117-00
11	Adjuster Cable	1	071-020-00	071-020-00	071-020-00	071-020-00
12	LH Adjuster Lever	1	071-019-01	071-019-01	071-019-01	071-019-01
	RH Adjuster Lever	1	071-019-02	071-019-02	071-019-02	071-019-02
13	LH Adjuster Lever Spring	1	046-073-00	046-073-00	046-073-00	046-073-00
	RH Adjuster Lever Spring	1	046-074-00	046-074-00	046-074-00	046-074-00
14	Adjuster Spring	1	046-072-00	046-072-00	046-072-00	046-072-00
15	LH Adjuster Assembly	1	048-009-00	048-009-00	048-009-00	048-009-00
	RH Adjuster Assembly	1	048-010-00	048-010-00	048-010-00	048-010-00
16	Dust Shield Kit	1	036-115-21	036-115-22	036-115-23	036-115-23
17	Brake Mounting Screw	7	007-116-00	007-116-00	007-116-00	007-116-00
18	Brake Mounting Nut	7	006-092-00	006-092-00	006-092-00	006-092-00
19	Sleeve	1	027-014-00	027-014-00	027-014-00	027-014-00
20	Adjuster Clip (Thread End)	1	046-132-00	046-132-00	046-132-00	046-132-00
21	Adjuster Clip (Barrel End)	1	046-133-00	046-133-00	046-133-00	046-133-00
ns	Wire Grommet	1	046-016-00	046-016-00	046-016-00	046-016-00

# 10K, 12K and 15K Hub Groups



Item	Description	10K		12K		15K		15K		15K
		8 on 6.50	8 on 6.50	10 on 11.25	8 on 6.50	8 on 6.50	8 on 6.50	10 on 8.75	6 on 8.75	10 on 11.25
2	Unitized Oil Seal	010-056-00	010-056-00	010-056-00	010-056-00	010-056-00	010-056-00	010-056-00	010-056-00	010-056-00
3	Inner Bearing Cone	031-022-02 (395S)	031-022-02 (395S)	031-022-02 (395S)	031-022-02 (3984)	031-020-02 (3984)	031-020-02 (3984)	031-020-02 (3984)	031-020-02 (3984)	031-020-02 (3984)
4	Inner Bearing Cup	031-022-01 (394A)	031-022-01 (394A)	031-022-01 (394A)	031-020-01 (3920)	031-020-01 (3920)	031-020-01 (3920)	031-020-01 (3920)	031-020-01 (3920)	031-020-01 (3920)
5	Brake Drum	009-027-01		009-027-01	009-028-01	009-028-01		009-028-01	009-028-01	009-028-01
5	Brake Drum-ABS	009-027-03		009-027-05	009-028-05	009-028-05		009-028-05	009-028-05	009-028-05
5A	Brake Drum Rotor		070-006-01				070-006-01			
5A	Brake Drum Rotor-ABS		070-006-02				070-006-02			
6	Wheel Mtg. Stud RH	007-115-00	007-115-00	007-102-01	007-115-00	007-115-00	007-115-00	025-013-01	025-013-01	007-102-01
	Wheel Mtg. Stud LH	None	None	007-102-02	None	None	None	025-013-02	025-013-02	007-102-02
7	Hubs w/Cups & StudsRH	008-214-05	008-214-06	008-263-08	008-216-08	008-214-08	008-214-10	008-217-05	008-217-09	008-263-11
	Hubs w/Cups & StudsLH	None	None	008-263-28	None	None	None	008-217-25	008-217-29	008-263-31
8	Outer Bearing Cone	031-019-01 (382A)	031-019-01 (382A)	031-019-01 (382A)	031-021-01 (28622)	031-021-01 (28622)	031-021-01 (28622)	031-021-01 (28622)	031-021-01 (28622)	031-021-01 (28622)
9	Outer Bearing Cup	031-019-02 (387A)	031-019-02 (387A)	031-019-02 (387A)	031-021-02 (28682)	031-021-02 (28682)	031-021-02 (28682)	031-021-02 (28682)	031-021-02 (28682)	031-021-02 (28682)
10	Spindle Washer	005-060-00	005-060-00	005-060-00	005-060-00	005-060-00	005-060-00	005-060-00	005-060-00	005-060-00
11	Spindle Nut	006-084-00	006-084-00	006-084-00	006-084-00	006-084-00	006-084-00	006-084-00	006-084-00	006-084-00
12	Tang Washer	005-059-00	005-059-00	005-059-00	005-059-00	005-059-00	005-059-00	005-059-00	005-059-00	005-059-00
13	Oil Cap "O" ring	010-050-00	010-050-00	010-050-00	010-050-00	010-050-00	010-050-00	010-050-00	010-050-00	010-050-00
14	Oil Cap	021-036-00	021-036-00	021-036-00	021-036-00	021-036-00	021-036-00	021-036-00	021-036-00	021-036-00
15	Oil Cap Plug	046-032-00	046-032-00	046-032-00	046-032-00	046-032-00	046-032-00	046-032-00	046-032-00	046-032-00
16	Wheel Clamp Ring	033-052-01	033-052-01		033-052-01	033-052-01	033-052-01			
17	Wheel Nut RH	006-109-00	006-109-00	006-064-01	006-109-00	006-109-00	006-109-00			006-064-01
	Wheel Nut LH			006-064-02						006-064-02
17A	Inner Nut RH							006-069-01	006-069-01	
	Inner Nut LH							006-069-02	006-069-02	
17B	Outer Nut RH							006-070-01	006-070-01	
	Outer Nut LH							006-070-02	006-070-02	
18	Locating Pin	056-008-00	056-008-00		056-008-00	056-008-00				
19	14.5 x 7.00 MH Dual				017-186-00					
	16 x 6K Dual		017-279-00			017-279-00	017-279-00			
	16.5 x 6.75 Dual	017-157-00	017-157-00		017-157-00	017-157-00				
	17.5 x 6.75 HC Dual							017-185-00		
ns	17.5 x 8.25 HC Single	017-176-00	017-176-00		017-176-00	017-176-00				
	17.5 x 6.75 HC	017-298-00	017-298-00							
21	Drum Mounting Screw	007-244-00		007-244-00	007-244-00	007-244-00		007-244-00	007-244-00	007-244-00
22	Rotor Mounting Stud		025-014-00				025-014-00			
23	Rotor Mounting Nut		006-046-00				006-046-00			
24	ABS Sensor, straight	097-004-00	097-004-00	097-004-00	097-004-00	097-004-00	097-004-00	097-004-00	097-004-00	097-004-00
25	ABS Sensor Block	024-204-00	024-204-00	024-204-00	024-204-00	024-204-00	024-204-00	024-204-00	024-204-00	024-204-00
26	ABS Sensor Clip	097-002-00	097-002-00	097-002-00	097-002-00	097-002-00	097-002-00	097-002-00	097-002-00	097-002-00
27	ABS Tone Ring	024-203-00	024-203-00	024-203-00	024-203-00	024-203-00	024-203-00	024-203-00	024-203-00	024-203-00

NS - not shown



# Suspension Kits

## 9K 38" MULTI-AXLE CONVERSION KIT HAP-205-01

Part No.	Qty.	Description
029-039-04	2	Center Hanger
013-117-03	2	Equalizer
007-181-00	2	Spring Eye Bolt
007-007-00	2	Keeper Bolt
007-182-00	2	Equalizer Bolt
006-038-00	2	5/8-11 UNC Locknut
006-011-00	2	5/16-18 UNC Locknut
006-112-00	2	1-8 UNC Locknut

## 42.25" MULTI-AXLE CONVERSION KIT HAP-205-02

Part No.	Qty.	Description
029-039-04	2	Center Hanger
013-118-03	2	Equalizer
007-181-00	2	Spring Eye Bolt
007-007-00	2	Keeper Bolt
007-182-00	2	Equalizer Bolt
006-038-00	2	5/8-11 UNC Locknut
006-011-00	2	5/16-18 UNC Locknut
006-112-00	2	1-8 UNC Locknut

## 48.5" MULTI-AXLE CONVERSION KIT HAP-205-03

Part No.	Qty.	Description
029-039-04	2	Center Hanger
013-119-03	2	Equalizer
007-181-00	2	Spring Eye Bolt
007-007-00	2	Keeper Bolt
007-182-00	2	Equalizer Bolt
006-038-00	2	5/8-11 UNC Locknut
006-011-00	2	5/16-18 UNC Locknut
006-112-00	2	1-8 UNC Locknut

## 9K SINGLE AXLE HAP-105-00

Part No.	Qty.	Description
028-068-04	2	Front Hanger
030-068-01	2	Rear Hanger
007-181-00	2	Spring Eye Bolt
007-007-00	2	Keeper Bolt
006-038-00	2	5/8-11 Locknut
006-011-00	2	5/16-18 Locknut

## 10K GD SINGLE AXLE HAP-156-00

Part No.	Qty.	Description
028-059-00	1	Hanger
028-060-00	1	Hanger
030-061-02	2	Rear Hanger
007-135-02	2	Spring Eye Bolt
006-113-00	2	Locknut

## 10-15K SINGLE AXLE HAP-103-00

Part No.	Qty.	Description
028-067-04	2	Front Hanger
030-066-01	2	Rear Hanger
007-169-00	2	Spring Eye Bolt
007-095-00	2	Keeper Bolt
006-046-00	2	1/2-20 Locknut
006-112-00	2	1-8 Locknut

## 10K GD 38" MULTI-AXLE CONVERSION KIT HAP-256-01

Part No.	Qty.	Description
006-112-00	2	Locknut
006-113-00	2	Locknut
007-135-02	2	Spring Eye Bolt
007-136-02	2	Equalizer Bolt
013-080-01	1	LH Equalizer
013-081-01	1	RH Equalizer
029-033-00	2	Center Hanger

## 42.25" MULTI-AXLE CONVERSION KIT HAP-256-02

Part No.	Qty.	Description
006-112-00	2	Locknut
006-113-00	2	Locknut
007-135-02	2	Spring Eye Bolt
007-136-02	2	Equalizer Bolt
013-082-01	1	LH Equalizer
013-083-01	1	RH Equalizer
029-033-00	2	Center Hanger

## 48.5" MULTI-AXLE CONVERSION KIT HAP-256-03

Part No.	Qty.	Description
006-112-00	2	Locknut
006-113-00	2	Locknut
007-135-02	2	Spring Eye Bolt
007-136-02	2	Equalizer Bolt
013-084-01	1	LH Equalizer
013-085-01	1	RH Equalizer

## 10-15K 38" MULTI-AXLE CONVERSION KIT HAP-203-01

Part No.	Qty.	Description
029-037-04	2	Center Hanger
013-107-07	1	LH Equalizer
013-107-08	1	RH Equalizer
007-169-00	2	Spring Eye Bolt
007-095-00	2	Keeper Bolt
007-170-00	2	Equalizer Bolt
006-046-00	2	1/2-20 Locknut
006-072-00	2	1 1/8-7 Locknut
006-112-00	2	1-8 Locknut

## 42.25" MULTI-AXLE CONVERSION KIT HAP-203-02

Part No.	Qty.	Description
029-037-04	2	Center Hanger
013-108-03	1	LH Equalizer
013-108-04	1	RH Equalizer
007-169-00	2	Spring Eye Bolt
007-095-00	2	Keeper Bolt
007-170-00	2	Equalizer Bolt
006-046-00	2	1/2-20 Locknut
006-072-00	2	1 1/8-7 Locknut
006-112-00	2	1-8 Locknut

## 48.5" MULTI-AXLE CONVERSION KIT HAP-203-03

Part No.	Qty.	Description
029-037-04	2	Center Hanger
013-109-03	1	LH Equalizer
013-109-04	1	LH Equalizer
007-169-00	2	Spring Eye Bolt
007-095-00	2	Keeper Bolt
007-170-00	2	Equalizer Bolt
006-046-00	2	1/2-20 Locknut
006-072-00	2	1 1/8-7 Locknut
006-112-00	2	1-8 Locknut

## 9K AXLE ASSEMBLIES

**38"                      42.25"                      48.50"**

*For single axle assemblies use (1) HAP-105-00*

Tandem	(1) HAP-105-00 (1) HAP-205-01	(1) HAP-105-00 (1) HAP-205-02	(1) HAP-105-00 (1) HAP-205-03
Triple	(1) HAP-105-00 (2) HAP-205-01	(1) HAP-105-00 (2) HAP-205-02	(1) HAP-105-00 (2) HAP-205-03

## 10K GD AXLE ASSEMBLIES

**38"                      42.25"                      48.50"**

*For single axle assemblies use (1) HAP-156-00*

Tandem	(1) HAP-156-00 (1) HAP-256-01	(1) HAP-156-00 (1) HAP-256-02	(1) HAP-156-00 (1) HAP-256-03
Triple	(1) HAP-156-00 (2) HAP-256-01	(1) HAP-156-00 (2) HAP-256-02	(1) HAP-156-00 (2) HAP-256-03

## 10-15K AXLE ASSEMBLIES

**38"                      42.25"                      48.50"**

*For single axle assemblies use (1) HAP-103-00*

Tandem	(1) HAP-103-00 (1) HAP-203-01	(1) HAP-103-00 (1) HAP-203-02	(1) HAP-103-00 (1) HAP-203-03
Triple	(1) HAP-103-00 (2) HAP-203-01	(1) HAP-103-00 (2) HAP-203-02	(1) HAP-103-00 (2) HAP-203-03

# Tire and Wheel Application and Capacities



Axle	Brake	Tire	Load @ PSI	Dual	Rim	Wheel	Capacity @ PSI	Bolt Circle	W&T	Stand	MAX.	MIN.
10K Single	Electric	11R17.5HC (H)	5530@120	N/A	17.5x8.25HC	017-176-00	5000@120	8 on 6.50	10,000	74.0	47.0	43.0
	Hyd. Air	215/75R17.5 (H)	4805@125	N/A	17.5x6.75HC	017-240-00	4500@125	8 on 6.50	9,000			
10K Dual 64 mph max	Electric	7.5016LT (E)	2440@75	11.0	16x6K	017-279-00	3000@80	8 on 6.50	9,760			
	Hyd.	7.50R16LT (F)	2756@80	11.0	16x6K	017-279-00	3000@80	8 on 6.50	11,024	74.0	47.0	43.0
	Air	9.50-16.5LT (E)	2790@75	11.0	16.5x6.75	017-157-00	3000@80	8 on 6.50	11,160	66.0	39.0	35.0
12K Dual Hvy Duty 54 mph max	Electric	9.50R16.5LT (E)	2790@80	11.0	16.5x6.75	017-157-00	3000@80	8 on 6.50	11,160			
	Hyd. Air	9-14.5LT (F)	3095@100	11.3	14.5x7.00MH	017-186-00	3000@100	8 on 6.50	12,000	74.5 70.5 66.5	40.0 36.0 32.5	33.5 29.5 25.5
12K Dual Hi-Profile 54 mph max	Electric	7.5016LT (E)	2660@75	11.0	16x6K	017-279-00	3000@80	8 on 6.50	10,640			
	Hyd. Air	7.50R16LT (F)	2756@80	11.0	16x6K	017-279-00	3000@80	8 on 6.50	11,024	74.0	45.5	33.0
15K Dual DISC Wheels	Air	9.50-16.5LT (E)	3040@75	11.0	16.5x6.75	017-157-00	3000@80	8 on 6.50	12,000	66.0	37.5	25.0
	Air	9.50R16.5LT (E)	3040@80	11.0	16.5x6.75	017-157-00	3000@80	8 on 6.50	12,000			
15K Dual DISC Wheels	Electric	8.25-15TR (G)	3470@100	11.0	15-6.50T		4290@100	10 on 8.75	13,880	75.0	44.5	42.0
	Hyd. Air	8.25R15TR (G)	3470@105	11.0	15-6.50T		4290@105	10 on 8.75	13,880	67.0	36.5	34.0
15K Dual DISC Wheels	Electric	9R17.5HC (H)	3970@110	12.4	17.5x6.75HC	017-185-00	4710@120	10 on 8.75	15,880			
	Hyd.	215/75R17.5 (H)	4540@125	12.4	17.5x6.75HC	017-185-00	4710@120	10 on 8.75	18,160	73.5	43.0	40.5
	Air	9.00-15TR (F)	3760@85	12.0	15-7.00T		4500@105	10 on 8.75	15,040	65.5	35.0	32.5
		10R17.5 (H)	4410@110	12.4	17.5x6.75HC	017-185-00	4710@120	10 on 8.75	17,640			

Note: For 15K axle with the 10 on 11¼" bolt circle, single wheel hub, the maximum spring center is hub face minus 24". The hub is designed for a wheel with an outset between 1.87" and 2.25". The minimum spring center is track minus 33."

## Running Gear Installation Dimensions

Axle	Tire	Bottom of Frame to Top of Tire	Frame Ht.	Ground Clearance	Bottom of Frame to Top of Tire	Frame Ht. Tandem	Bottom of Frame to Top of Tire	Frame Ht. Triple	SLR Static Loaded Radius	Overall Dia.
10K Single Wheel	11R 17.5HC (H)	12.1	22.9	9.7	12.6	22.4	12.8	22.2	16.9	36.2
10K Dual and 12K Wheels	7.50-16 LT (E)	10.3	21.1	7.9	10.8	20.6	11.0	20.4	15.1	32.5
	7.5R16LT (F)	9.9	20.6	7.4	10.4	20.1	10.6	19.9	14.6	31.7
	9.50-16.5LT (E)	9.4	20.2	7.0	9.9	19.7	10.1	19.5	14.2	30.7
	9.50R16.5LT (E)	9.4	20.2	7.0	9.9	19.7	10.1	19.5	14.2	30.7
	LT235/85R16	9.9	20.6	7.4	10.4	20.1	10.6	19.9	14.6	31.7
12K Dual Wheels	9-14.5LT (F)	8.2	19.3	6.1	8.7	18.8	8.9	18.6	13.3	28.3
15K Dual Wheels	8.25-15TR (G)	10.7	21.7	8.5	11.2	21.2	11.4	21.0	15.7	33.3
	8.25R15TR (G)	10.7	21.5	8.3	11.2	21.0	11.4	20.8	15.5	33.3
	215/75R17.5 (H)	9.1	19.9	6.7	9.6	19.4	9.8	19.2	14.1	29.2
	9R17.5HC (H)	10.6	21.6	8.4	11.1	21.1	11.3	20.9	15.6	33.1
	9.00-15TR (F)	11.4	22.3	9.1	11.9	21.8	21.1	21.6	16.3	34.8
	10R17.5 (H)	10.9	21.7	8.5	11.4	21.2	11.6	21.0	15.7	33.8

For diagram, see page 18

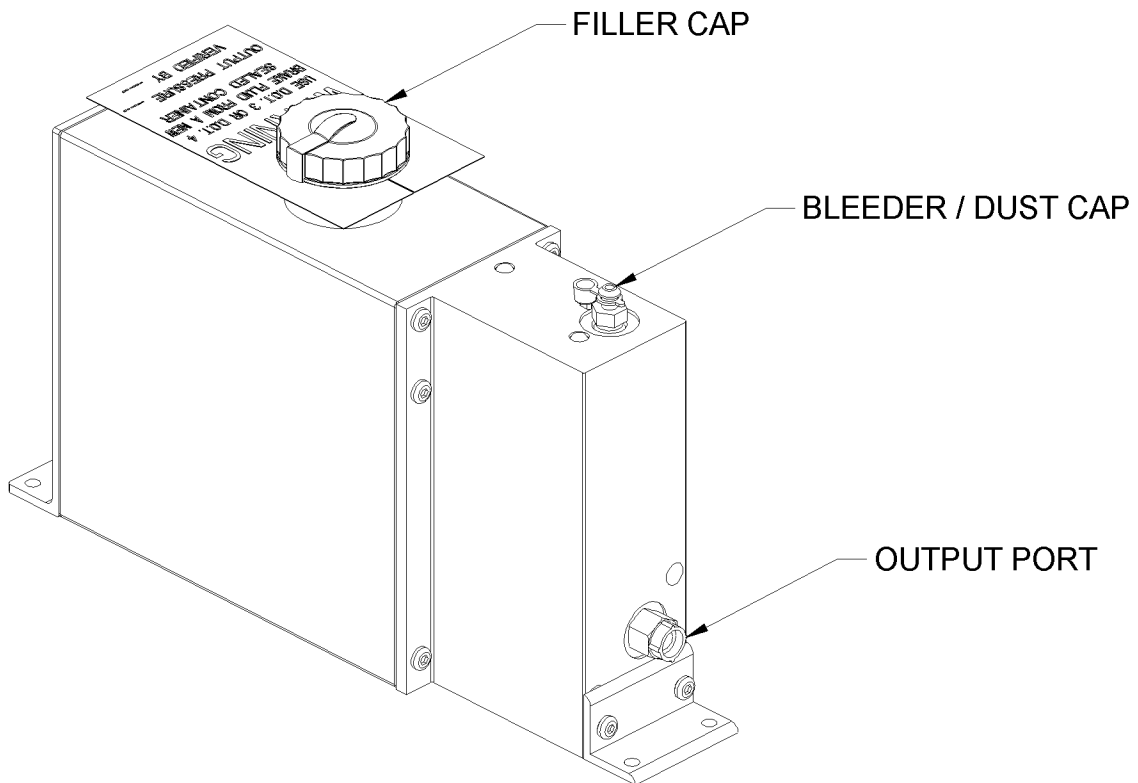
Note: All dimensions are with the axles loaded to capacity.



## MANUAL 440-1023

# CARLISLE SERVICE MANUAL FOR HYDRASTAR™ HYDRAULIC BRAKE ACTUATORS

THIS DOCUMENT TO BE USED FOR  
HBA-10, HBA-12, and HBA-16  
ACTUATORS



### WIRE COLORS – FUNCTION

**SOLID BLACK** – 25-40\* amp 12 volt supply from tow vehicle

**SOLID BLUE** – Output from in-cab electronic brake controller

**SOLID WHITE** – Ground / must be directly connected to tow vehicle ground

**SOLID YELLOW OR BLUE W/ WHITE STRIPE** – Cold side of breakaway switch

\* = Cold temperature (below 0° F) applications require 40 amp.

<b>TABLE OF CONTENTS</b>	
<b>SECTION</b>	<b>PAGE</b>
<b>A. WARNINGS</b>	<b>2</b>
<b>B. ACTUATOR INSTALLATION INSTRUCTIONS</b>	<b>3</b>
<b>C. ELECTRICAL INSTALLATION REQUIREMENTS</b>	<b>4</b>
<b>D. TEST ELECTRICAL OPERATION</b>	<b>5</b>
<b>E. BLEEDING AND ADJUSTING THE BRAKES</b>	<b>6</b>
<b>F. TESTING &amp; ADJUSTMENT OF ELECTRONIC CONTROLLER UNIT</b>	<b>7</b>
<b>G. REPLACEMENT PARTS LIST / MOUNTING DIMENSIONS</b>	<b>7</b>
<b>H. TROUBLE SHOOTING GUIDE</b>	<b>8</b>
<b>I. WARRANTY</b>	<b>10</b>

## **A. WARNINGS**

**PROPER INSTALLATION REQUIRED** - The HydraStar™ actuator must be installed by a qualified individual. Failure to properly install, protect, operate, and maintain the system can cause malfunction resulting in possible serious or fatal injuries and or property damage.

**MUST BE PROPERLY SIZED TO THE TOWED VEHICLE** - The HydraStar™ actuator is intended to provide flow and pressure to the brake system on the towed vehicle in accordance with applicable state and federal laws. It is the sole responsibility of the installer to see that the actuator is properly sized with the brake system on the towed vehicle so that the time required to build pressure in the towed vehicle brake system is not excessive.

**SELECT THE CORRECT OUTPUT PRESSURE** - Over pressurizing the brakes on the trailer can cause permanent damage to the trailer brake system. It is the sole responsibility of the installer to determine the appropriate model of HydraStar™ to insure that over pressurization of the trailer brake system does not occur.

**NOT INTENDED TO BE USED AS A PARKING BRAKE** - The HydraStar™ actuator and trailer brakes are intended only to supplement the service brake system on the towing vehicle. The HydraStar™ actuator and trailer brakes are not designed to function as a park brake. At no time should the towed vehicle brake system be used as the primary source of braking for the towing vehicle.

**REQUIRES AN IN-CAB ELECTRONIC BRAKE CONTROL** - The HydraStar™ actuator is intended to be used with an in-cab electronic brake controller. The unit will operate with a wide variety of controllers but provides optimum performance when used with a CARLISLE® electronic brake controller. Contact your dealer for a list of approved brake controllers. The list is also available online at [www.carlislebrake.com](http://www.carlislebrake.com). The in-cab controller must have an output capacity of at least 5 amps for proper operation of the HydraStar™ actuator.


**EXTENDED STOPS CAN GENERATE EXCESSIVE HEAT** - When stopped for extended periods (i.e. such as at railroad crossings and traffic jams), apply the park brake on the towing vehicle and release the service brake pedal so that the HydraStar™ actuator does not run continuously. Failure to follow this guideline will cause the HydraStar™ unit to overheat and will damage the HydraStar™ unit.

**EMERGENCY BREAKAWAY BATTERY MUST BE CHARGED** - Do not attempt to tow the towed vehicle unless the emergency breakaway battery is fully charged.

**DO NOT POWER WASH THE HYDRASTAR™ UNIT** - Although the HydraStar™ unit is weather tight, it is not designed to withstand the direct high pressure spray from a power / car wash. Care should be taken to protect the HydraStar™ unit from direct spray when washing the trailer.



## B. ACTUATOR INSTALLATION INSTRUCTIONS


 **CAUTION** – Wheels must be properly blocked to prevent the trailer and tow vehicle from rolling.

### GETTING STARTED:

1. The following materials are required to properly install the HydraStar™ unit:
  - If your trailer is not already equipped with brake lines, you will need enough 3/16" diameter automotive brake line to connect the trailer brakes to the HydraStar™ unit. (Note that 1/4" diameter brake line will improve response time.) Where possible, steel tubing is preferred.
  - 4 pieces of #10 mounting hardware to mount the HydraStar™ unit to the trailer
  - ( 1 ) quart of DOT 3 or DOT 4 brake fluid (from a new, sealed container)
  - ( 1 ) emergency breakaway kit - must include a 12 volt, 5 amp hour (minimum) battery
  - Wire (see Section C. ELECTRICAL INSTALLATION REQUIREMENTS for proper wire size)


**LOCATION** of the HydraStar™ actuator is at the discretion of the vehicle owner. When determining location, consideration should be given to the following:

1. The shorter the brake lines are between the HydraStar™ unit and the trailer brakes, the faster the brakes on the trailer will respond.
2. The unit should be located so that the electrical wiring and brake lines can be neatly routed directly to the towing vehicle and trailer brakes. Special care should be taken to minimize the number of bends and fittings in the brake line circuits.
3. An emergency breakaway kit must be located on the trailer so that the trailer breakaway cable can be easily attached to the towing vehicle.
4. The HydraStar™ actuator is powered from the electrical system on the tow vehicle. In order for the HydraStar™ unit to function properly, it must have adequate electrical power. (See Section C. ELECTRICAL INSTALLATION REQUIREMENTS)
5. The HydraStar™ unit should not be placed in an area where it is susceptible to damage from trailer loads, road debris, or from being stepped on. Failure to protect the HydraStar™ unit from damage can cause the unit to malfunction and void the HydraStar™ warranty.

 **CAUTION** – In stop and go traffic, the unit can get quite warm to the touch. This is normal and should not be of concern. Care should be taken to locate the unit in an area where your skin will not come in direct contact with the unit.

**MOUNTING:** Consideration should be given to the following:


1. The HydraStar™ unit must be level, with the filler neck up.
2. It is the responsibility of the customer to provide necessary fasteners for attachment of the HydraStar™ actuator to the trailer. 4 pieces of #10 *mounting hardware required.*

 **CAUTION** – The HydraStar™ unit contains sensitive electronics that must be protected. Drilling additional holes in the housing or electrostatically painting the HydraStar™, or welding anywhere on the HydraStar™ unit will damage the unit making it inoperable and will void the manufacturer's warranty. Always remove the HydraStar™ from the trailer before doing any welding repair or modifications to the trailer structure.


**CONNECT** the brake line on the towed vehicle to the HydraStar™ actuator.

1. Remove the red plastic plug from the brake port on the HydraStar™ unit. This will expose a 3/16" inverted flare fitting.
2. Brake line must be compatible with DOT 3 & DOT 4 brake fluid.
3. Flush existing brake system and lines with mineral spirits (**not mineral oil**), DOT 3 or DOT 4 brake fluid prior to connecting the HydraStar™ unit.
4. Connect the brake line from the trailer brakes to the 3/16" inverted flare fitting on the HydraStar™ actuator.

**FILL** the unit with DOT 3 or DOT 4 brake fluid to the bottom of the reservoir filler neck. When putting filler cap back on it should be turned clockwise until snug.

 **CAUTION** – Always use new, DOT 3 or DOT 4 brake fluid, from a sealed container. Never attempt to reuse old or dirty fluid. Do not overfill the unit. Take care to protect painted surfaces from contact with the brake fluid. Wash off any spilled brake fluid.

**MOUNT** the emergency breakaway switch and emergency breakaway battery on the trailer as detailed in the instruction sheets provided with the emergency breakaway kit.

 **CAUTION** – Do not attempt to tow the towed vehicle unit until the emergency breakaway battery is fully charged.

## C. ELECTRICAL INSTALLATION REQUIREMENTS

### **WIRE SIZE IS CRITICAL / LOW VOLTAGE CONDITION – Failure to follow these guidelines will damage the HydraStar™ unit and void your warranty.**

It is critical that the BLACK power lead and WHITE ground lead from the tow vehicle to the input of the HydraStar™ actuator are sized and terminated, (i.e. dedicated 25-40\* amp circuit on the tow vehicle – 12 gauge wire minimum). 10 gauge wire is recommended to optimize performance. Consult the SAE wiring guidelines for proper trailer electrical harness design.

It is critical that the solid blue wire from the in-cab electronic brake control is connected to the solid blue wire on the HydraStar™ actuator. It is also critical that the yellow or blue w/ white striped wire from the HydraStar™ actuator is connected to the cold side of the trailer emergency breakaway switch. Under no circumstances should the solid blue wire and the yellow or blue w/ white stripe wire be connected together.

\* = Cold temperature (below 0° F) applications require 40 amp.

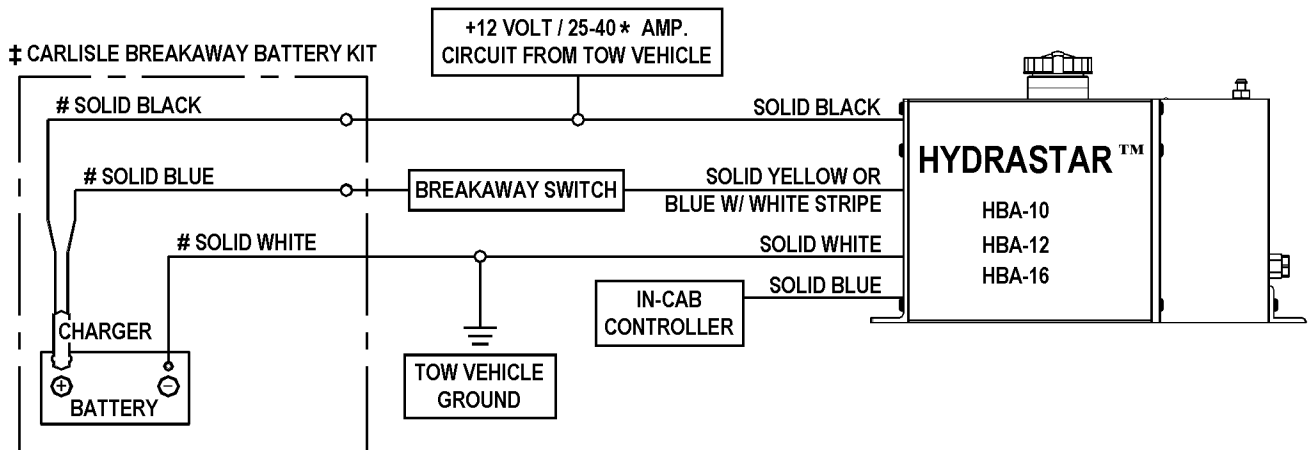
**REQUIRES AN IN-CAB ELECTRONIC CONTROL** – The HydraStar™ actuator is intended to be used with an in-cab electronic brake controller. The unit will operate with a wide variety of controllers but provides optimum performance when used with a CARLISLE® electronic brake controller. Contact your dealer for a list of approved brake controllers. The list is also available online at [www.carlislebrake.com](http://www.carlislebrake.com). The in-cab controller must have an output capacity of at least 5 amps for proper operation of the HydraStar™ actuator.

**ELECTRICAL CONNECTIONS** – Make sure all electrical connections are clean, dry, weather tight, and secure to prevent damage to the wiring from dragging or becoming entangled with foreign objects. CARLISLE® highly recommends soldering all electrical connections. A dedicated ground connection between the tow vehicle and trailer is also required.

**BREAKAWAY BATTERY REQUIREMENT** - To comply with federal requirements, the trailer must be equipped with a breakaway switch and battery. The breakaway battery needs to have a minimum capacity of 5 amp hours and needs to be maintained in a fully charged condition at all times. The breakaway battery should be checked for proper charge level before every use.

**CHARGING THE BREAKAWAY BATTERY** – A separate battery charger is included in the Carlisle® breakaway battery kit that draws power from the keyed accessory terminal on the tow vehicle. Attempting to charge the breakaway battery directly from the keyed accessory terminal without the appropriate charger will over heat and damage the trailer breakaway battery.

# ELECTRICAL SCHEMATIC



\* = COLD TEMPERATURE ( BELOW 0° F ) APPLICATIONS REQUIRE 40 AMP.

‡ = THIS ELECTRICAL SCHEMATIC REPRESENTS THE USE OF A CARLISLE BREAKAWAY BATTERY KIT. PLEASE NOTE THAT IF YOU ARE USING A DIFFERENT BREAKAWAY BATTERY KIT, THERE MAY BE A DIFFERENT NUMBER OF WIRES AND THE CHARGING +12VOLT, BREAKAWAY, AND GROUND CIRCUITS MAY BE IDENTIFIED BY COLORS OTHER THAN THOSE DEPICTED IN THIS SCHEMATIC. PLEASE CONSULT THE MANUFACTURER'S INSTRUCTIONS TO IDENTIFY THE AFOREMENTIONED CIRCUITS.

# = CIRCUITS FOR THE CARLISLE BREAKAWAY BATTERY KITS WILL BE IDENTIFIED AS FOLLOWS:

CHARGING +12 VOLT CIRCUIT - BLACK  
 BREAKAWAY CIRCUIT - BLUE  
 GROUND CIRCUIT - WHITE

Note – The HydraStar™ actuator does not draw power from the tow vehicle accessory lead unless the brakes on the tow vehicle are actuated.

## IMPORTANT – CONSULT YOUR VEHICLE OWNER'S MANUAL

Be sure to read your vehicle owner's manual to see what it says about vehicle to trailer wiring. More and more vehicle manufacturers are recommending special precautions be taken to protect the more sophisticated electronics on the newer vehicles.

## D. TEST ELECTRICAL OPERATION

1. Attach trailer to towing vehicle.
2. Pull the breakaway switch. The HydraStar™ unit should run. If the unit does not run, check battery condition and system wiring. Reset the breakaway switch, which will turn the unit off.

**Note:** When the unit is running the motor will generate a “hum” that changes pitch as the unit builds pressure.

3. Turn the ignition switch on and turn the in cab electronic brake controller on. The HydraStar™ unit should run whenever the brake pedal is depressed. If the unit does not run, check system wiring.

**CAUTION** – Testing the HydraStar™ unit confirms that it is operating. It does not confirm that the brakes are operating properly. Regular inspection, adjustment, and maintenance of the brakes, lines, hoses, drums, discs, fluid, and other associated components is necessary to ensure proper brake operation.

## E. BLEEDING AND ADJUSTING THE BRAKES

1. It typically is much easier to bleed the brakes with two people working together or use of a power bleeding device.
2. Special care must be taken to insure that the HydraStar™ unit does not run out of brake fluid. Check the fluid level frequently during the bleeding process.
3. Block the wheels on the trailer and towing vehicle.
4. If the trailer is equipped with drum brakes, check that the brake running clearances are properly adjusted consistent with the trailer manufacturer's recommendations. Even the slightest amount of brake drag will generate heat and will damage the trailer brake system voiding the manufacturer's warranty.



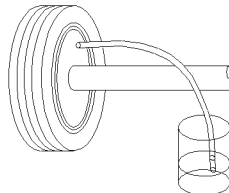
**CAUTION** – Failure to properly adjust the brakes on trailers equipped with drum brakes can result in sluggish operation of the HydraStar™ unit. Eye protection should be worn at all times while bleeding the HydraStar™ unit and trailer brake system.

5. Remove the dust cap from the bleed screw on the HydraStar™ unit and install plastic tubing onto the bleeder
6. Immerse the free end of the plastic tubing in a clean container partially filled with brake fluid.
7. With eye protection on, open the bleeder screw one half turn on the HydraStar™ unit. Take care to protect yourself and the trailer from brake fluid expelled from the bleeder.
8. Activate the HydraStar™ unit by turning on the ignition switch and pressing on the brake pedal or the manual control on the in-cab controller.
9. Watch the free end of the bleeder hose for air bubbles escaping into the container.
10. Continue to bleed until the fluid becomes clear and free of bubbles.
11. Tighten the bleeder screw, turn off the HydraStar™ unit, and remove the plastic tubing from the bleeder screw. Bleeding of the HydraStar™ unit is now complete.
12. Install plastic tubing onto the bleeder screw of the wheel cylinder/caliper.
13. Immerse the free end of the plastic tube in a clean container partially filled with brake fluid.
14. With eye protection on, open the bleeder screw one half turn on the wheel cylinder/caliper farthest from the HydraStar™ unit. (*If towed vehicle has multiple axles, always start with the rear axle first.*)
15. Activate the HydraStar™ unit. (*Turn the ignition switch on and press on the brake pedal.*)
16. Watch the free end of the bleeder hose for air bubbles escaping into the clear container. Continue to bleed the wheel cylinder/caliper until the fluid becomes clear and free of bubbles.



**CAUTION** – Do not run the HydraStar™ unit without adequate brake fluid in the reservoir as it will damage the unit and void the manufacturer's warranty. Check all bleeder screws to ensure that they are securely closed and do not leak.

17. Tighten the bleeder screw, turn off the HydraStar™ unit, and remove plastic tubing from the bleeder screw. Bleeding of the wheel cylinder/caliper is now complete.
18. Refill the HydraStar™ unit with brake fluid.
19. Continue the above process (steps 12 through 18) on the next farthest brake away from the HydraStar™ unit. Repeat these steps until all the brakes have been bled.



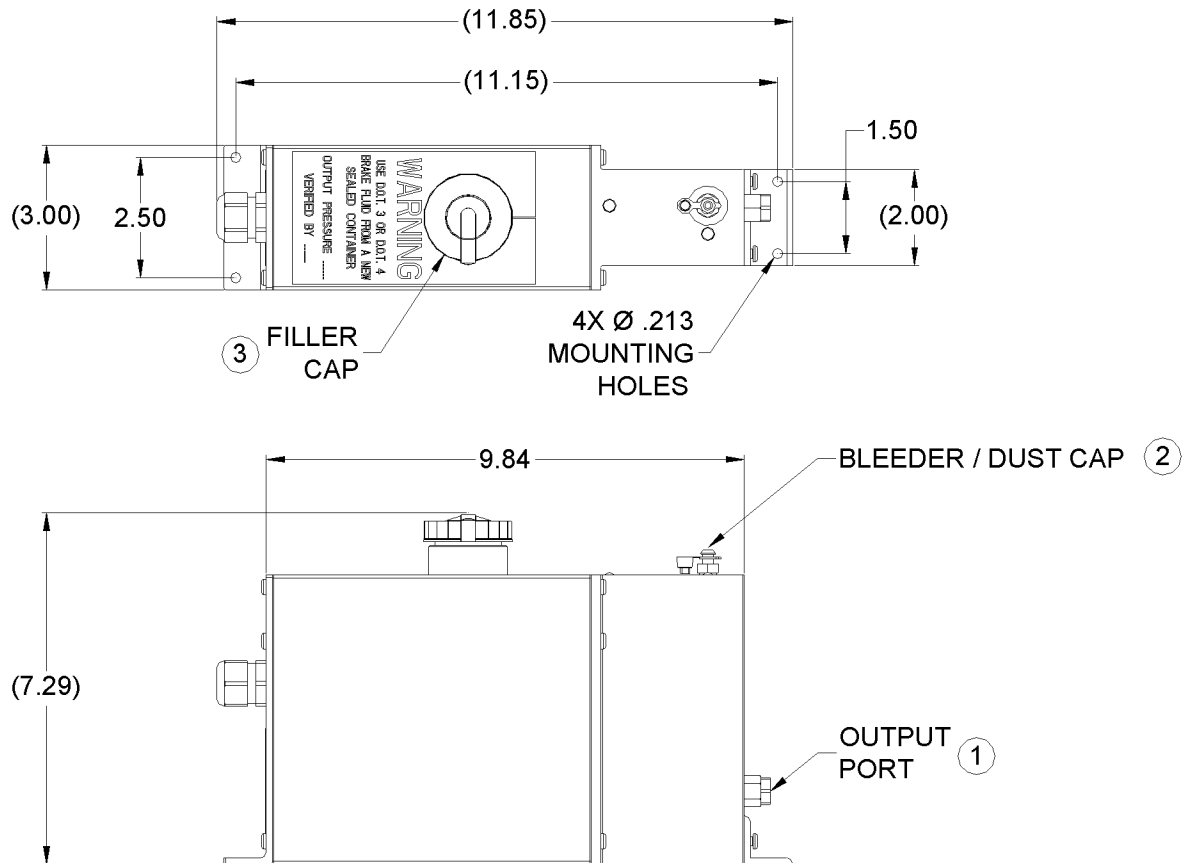
**WARNING** – Failure to properly adjust the trailer brakes and to properly fill and bleed the HydraStar™ unit and brakes may result in sluggish brake performance. This may result in serious or fatal injuries and/or property damage. As a precautionary measure, CARLISLE® recommends bleeding the brakes a second time after the trailer has been in service for 7 – 10 days. CARLISLE® also recommends checking the temperature of the hubs on a regular basis to insure that the trailer brakes are not dragging.

## F. TESTING AND ADJUSTMENT OF ELECTRONIC CONTROLLER UNIT

1. Adjust the gain setting on the in-cab controller to a mid range setting and the sync setting to the maximum (most aggressive) setting.
2. Drive vehicle at 10 to 15 mph.
3. Apply the brakes. If braking is too severe, adjust the gain setting down to decrease pressure, and retest. If braking is inadequate, increase the gain setting on the in-cab electronic controller and retest.
4. Repeat this process until the brakes respond appropriately.

**⚠ WARNING** – The appropriate pressure setting will vary depending on the weight of the load being transported on the trailer, weather conditions, road conditions, brake lining wear, and brake displacement. The “TESTING AND ADJUSTMENT OF ELECTRONIC CONTROLLER UNIT” procedure should be repeated each time the trailer is used. Failure to properly adjust the HydraStar™ unit may result in poor brake performance which could result in serious or fatal injuries and/or property damage.

## G. REPLACEMENT PARTS LIST / MOUNTING DIMENSIONS



REPLACEMENT PARTS LIST		
ITEM	PART NUMBER	DESCRIPTION
1	192-7089	OUTPUT PORT ADAPTER ASSEMBLY 3/16" INVERTED FLARE
1	304-7107	OUTPUT PORT ADAPTER ASSEMBLY 1/4" INVERTED FLARE KIT
2	381-7037	BLEEDER VALVE / DUST CAP KIT
3	32-7640	FILLER CAP
NOT SHOWN	496-82	BREAKAWAY BATTERY KIT

## H. TROUBLESHOOTING GUIDE

### **Brakes are slow to respond**

- Re-bleed the trailer brakes and actuator.
- If the trailer is equipped with drum brakes, re-adjust the drum brakes to the trailer manufacturer's recommended running clearance.
- Slow response can be caused by trailer wiring that is too small. See Section C. ELECTRICAL INSTALLATION REQUIREMENTS – WIRE SIZE IS CRITICAL / LOW VOLTAGE CONDITION.
- Slow response can be caused by brake lines that are too restrictive on the trailer (i.e. small diameter / long length restrictive fittings / routings).
  - ❑ The trailer brake lines must be at least 3/16 inches in diameter / steel tubing is preferred over flexible hoses.
  - ❑ If it is not practical to locate the HydraStar™ unit closer to the brakes, consider increasing the size of the trailer brake lines.

### **Unit will not run or the unit will not shut off**

- Verify that the trailer and tow vehicle are wired according to the electrical schematic shown on page 5.
- Perform the following checks to determine if the unit is functioning properly:

#### **Step 1**

- With the unit running and brake pressure applied, determine that a minimum of 8.5 volts DC are reaching the HydraStar's™ black wire.
- Check to see if the white ground wire runs directly to the tow vehicle ground. IT MUST NOT BE GROUNDED TO THE TRAILER ONLY. IT IS IMPORTANT THAT THIS GROUND WIRE RUNS DIRECTLY TO THE TOW VEHICLE'S BATTERY GROUND. NO EXCEPTIONS.

#### **Step 2**

- Detach all wires from the HydraStar™ leaving only the blue, black, white, and yellow or blue w/ white striped wires. It is important that the unit is disconnected from any other wires going to the towing vehicle or breakaway switch and breakaway battery. Failure to do so may result in a faulty test.

#### **Step 3**

- Using a 12 volt battery, connect the white wire to the negative (-) terminal of the battery.
- Connect the black wire to the positive (+) terminal of the battery.
- The motor should not run.
- If the motor runs, the unit needs repaired.

#### **Step 4**

- Leave the white wire connected to the negative (-) terminal of the battery.
- Connect the blue and black wires together to the positive (+) terminal of the battery.
- The motor should run and the unit should pressurize.
- If this does not occur, the unit needs repaired.

#### **Step 5**

- Leave the white wire connected to the negative (-) terminal of the battery.
- Connect only the yellow or blue w/ white striped wire to the positive (+) terminal of the battery.
- The motor should run and the unit should pressurize.
- If this does not occur, the unit needs repaired.

#### **Step 6**

- If the unit checks OK, reconnect the wires leading to the trailer plug and repeat steps 2 through 4. If you do not get the same results as before, the problem is in the trailer wiring or the electronic brake controller.

### **Breakaway test procedure**

- Pull the breakaway switch on the trailer.
  - ❑ If the unit runs and builds pressure, the problem most likely is a defective in-cab controller or defective wiring between the tow vehicle and HydraStar™ unit.
  - ❑ If the unit runs but will not build pressure, the problem most likely is a defective proportional valve in the HydraStar™ unit and the actuator should be returned for repair.

- If the unit still does not run after the breakaway battery is fully charged, verify that the voltage between the white wire and the yellow or blue w/ white stripe wire is at least 12 volts.
  - ◆ If the voltage is less than 12 volts, either the breakaway switch or the breakaway wiring is defective.
  - ◆ If the voltage is greater than 12 volts, the HydraStar™ actuator should be returned for repair.
  - ◆ After completing the above steps, reset the breakaway switch.

**Trailer brakes too aggressive**

- Reduce the gain setting on the in-cab electronic brake controller.
- Check brake adjustment.

**Trailer brakes not aggressive enough**

- Increase the gain setting on the in-cab electronic brake controller.

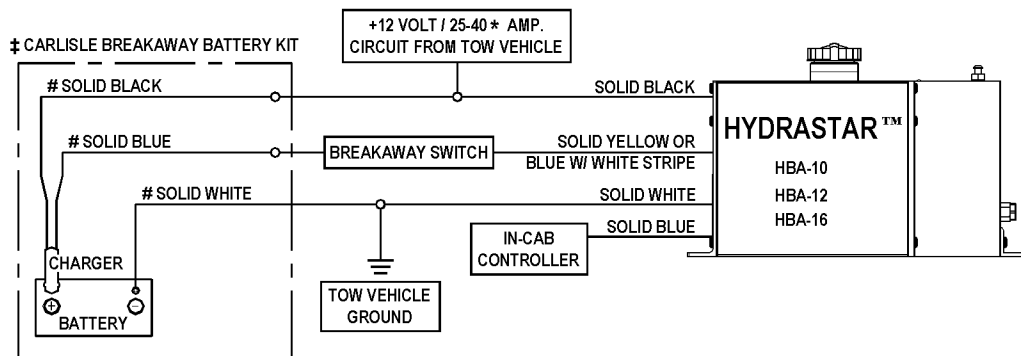
**Clicking sound comes from unit on a repetitive basis**

- Make sure the brake controller is on Carlisle's approved list. See Section C. ELECTRICAL INSTALLATION REQUIREMENTS – REQUIRES AN ELECTRONIC IN-CAB CONTROL.

**Brakes will not release**

- Loosen bleeder or brake line connection. If brakes remain locked, out-of-round drums, worn, jammed, or broken shoes or pads most likely caused the problem.
- Make sure the in-cab controller is on the “approved list”. (See Section C. ELECTRICAL INSTALLATION REQUIREMENTS – REQUIRES AN ELECTRONIC IN-CAB CONTROLLER.) Check to see if the in-cab controller is putting out power when the brakes are not being used.
- Disconnect trailer plug and positive terminal on breakaway battery on the trailer. If the brakes release, the problem is electrical.
  - Check to see if an adapter plug is used. If an adapter plug is being used, make sure the pins from one plug go to the corresponding pins on the second plug. Make sure power is going to the HydraStar™ as shown in the service manual. (See ELECTRICAL SCHEMATIC below.) Try running current direct by using jumpers from a fully charged 12 volt battery, and from the in-cab controller output wire.
  - If the HydraStar™ works, reconnect the positive lead to the breakaway battery. If the HydraStar™ does not function correctly, the problem is in the wiring of the breakaway battery circuit, or if equipped with a trickle charger, the wiring of the charger may be incorrect. Do not rely on wire color codes. Use the schematic in the HydraStar™ service manual. (See ELECTRICAL SCHEMATIC below.)
  - In some cases, the problem is in the vehicle plug wiring. Make sure the plug pins go to the proper terminals on the trailer plug.

**ELECTRICAL SCHEMATIC**



\* = COLD TEMPERATURE ( BELOW 0° F ) APPLICATIONS REQUIRE 40 AMP.

‡ = THIS ELECTRICAL SCHEMATIC REPRESENTS THE USE OF A CARLISLE BREAKAWAY BATTERY KIT. PLEASE NOTE THAT IF YOU ARE USING A DIFFERENT BREAKAWAY BATTERY KIT, THERE MAY BE A DIFFERENT NUMBER OF WIRES AND THE CHARGING +12VOLT, BREAKAWAY, AND GROUND CIRCUITS MAY BE IDENTIFIED BY COLORS OTHER THAN THOSE DEPICTED IN THIS SCHEMATIC. PLEASE CONSULT THE MANUFACTURER'S INSTRUCTIONS TO IDENTIFY THE AFOREMENTIONED CIRCUITS.

# = CIRCUITS FOR THE CARLISLE BREAKAWAY BATTERY KITS WILL BE IDENTIFIED AS FOLLOWS:

CHARGING +12 VOLT CIRCUIT - BLACK  
 BREAKAWAY CIRCUIT - BLUE  
 GROUND CIRCUIT - WHITE



## LIMITED WARRANTY and LIMITATION OF LIABILITY

Carlisle Industrial Brake & Friction (the "Company") warrants its trailer brake actuator products, including, but not limited to, HydraStar, HydraStar XL, and ElectraStar ("Products"), under normal use and service, to be free from defects in material and workmanship for a period not to exceed two years from the date of sale to the original consumer, or to the first retail purchaser, of a trailer or other towed device (the "Warranty"). Any receipts, proof of purchase, or other documents obtained at the time a Product manufactured by the Company is purchased from a dealer / distributor, should be retained. This Warranty is not transferable.

The obligations of the Company under this Warranty shall be limited to crediting the account of Carlisle's direct buying Distributor or OEM trailer manufacturer, replacing or repairing those Products which are determined, to the satisfaction of the Company, to be defective in material and/or workmanship, within sixty (60) days from the date of receipt of such products by the Company. Any replacements or repairs will be made at the Company's designated facility and at the Company's expense. Returned product found not to be defective will be returned at the sender's expense.

This Warranty shall not extend to any Products, or any parts thereof, which have been improperly installed, installed contrary to the provided instructions, altered, tampered with, or the engineering and design of which have been changed in any way, nor shall this Warranty extend to any defects arising from abuse, misuse, accident, improper wiring, or negligence of an installer or of the consumer. Refer to the instruction manual packed with your unit. Copies of the instruction manual are available on our website at [www.carlislebrake.com](http://www.carlislebrake.com). A hard copy can be ordered from Carlisle for \$15.00 by contacting customer service at 800-873-6361.

**EXCEPT AS EXPRESSLY SET FORTH ABOVE, NO OTHER WARRANTY, EXPRESS OR IMPLIED, AT LAW OR IN EQUITY, IS MADE BY THE COMPANY IN RESPECT OF THE PRODUCTS, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHER WARRANTY AND ANY SUCH WARRANTIES ARE EXPRESSLY DISCLAIMED.**

**REGARDLESS OF WHETHER ANY REMEDY SET FORTH HEREIN FAILS OF ITS ESSENTIAL PURPOSE, IN NO EVENT SHALL THE COMPANY BE LIABLE TO PURCHASE OR ANY THIRD PARTY FOR ANY LOST PROFITS, CONSEQUENTIAL, EXEMPLARY, INDIRECT, PUNITIVE, INCIDENTAL, OR SPECIAL DAMAGES OR COSTS ( INCLUDING ATTORNEYS' FEES ) OR LOSS OF GOODWILL RESULTING FROM ANY CLAIM ( INCLUDING BUT NOT LIMITED TO ANY CAUSE OF ACTION SOUNDING IN CONTRACT, TORT, NEGLIGENCE , STRICT LIABILITY OR PRODUCTS LIABILITY ), REGARDING THIS AGREEMENT, EVEN IF THE COMPANY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.**

Certain jurisdictions do not permit limitations on the duration of a Warranty; accordingly, the limitations included herein may not apply. This Warranty is expressly in lieu of all other express or implied Warranties and any and all other obligations or liabilities on the part of the Company. There are no Warranties which extend beyond the description on the face hereof. No dealer / distributor, employee, or representative of the Company is authorized to modify this Warranty in any way or to grant any other Warranty.

If you have a problem with your Product, see the next page.



## IF YOU EXPERIENCE A PROBLEM WITH YOUR CARLISLE TRAILER BRAKE ACTUATOR

1. Trouble shoot the unit as described in the owners manual. If a copy of the manual is unavailable contact your dealer/distributor or you can download the manual off our website at [www.carlislebrake.com](http://www.carlislebrake.com) Additional hard copies of the manual can be ordered from Carlisle customer service for \$15.00 each, call 812-336-3811.
2. If, after trouble shooting, it is believed that a valid claim exists, contact the dealer/distributor, from which the Product was purchased.
3. If it is deemed that the Product should be returned to Carlisle for inspection and warranty consideration, the dealer/distributor will make the claim through their Carlisle supplier.
4. **Carlisle can not be responsible for units returned directly by consumers.**

### TO MAKE A CLAIM

1. All claims must include proof of purchase information. The required information is:
  - Copy of receipt or itemized bill showing name and address of purchaser, date of purchase.
  - Product model number and serial number. These are found on a label on the product.
  - Bills or receipts from a legitimate dealer or repair center itemizing labor charges for replacement.
2. All returns require a Return Merchandise Authorization number (RMA). Direct accounts can obtain an RMA by contacting Carlisle customer service at 812-336-3811. You will be asked to provide proof of purchase information per item #1 directly above.
3. The direct account will return the Product prepaid, and securely packed in proper packaging. The Product must be free of mud, dirt, sand, or other debris, with the brake fluid completely drained. The carton must be clearly marked with the RMA number when the Product is returned to the Company for inspection.
4. If the Company determines that the claim is valid, the Product will be repaired or replaced or credit issued to Carlisle's direct account. If a labor claim is made, Carlisle will issue credit to reimburse for up to one hour of labor, not to exceed \$70.00, to replace the defective unit. If a claim is deemed invalid and the Product is found to work properly the account will be notified and no credit will be issued for the unit or labor. Invalid Product will be returned to the submitter, freight collect, unless otherwise instructed.

This page intentionally left blank.

This page intentionally left blank.

