



WARN INDUSTRIES, INC.

# Continuous Vacuum Locking Hub (VLH)

Warn Industries is an ISO 9001, ISO/TS 16949 and ISO 14001 certified supplier to the automotive industry.

## OEM Applications

### Kia Motors

Frontier Truck

### Ssangyong

Korando SUV

Musso SUV

Musso Sport SUV

### Asia Motors

Retona SUV



## Standard Specifications

|                       |                         |      |      |
|-----------------------|-------------------------|------|------|
|                       | Axle Pitch Diameter, mm |      |      |
|                       | Ø25                     | Ø29  | Ø32  |
| Weight, g:            | 875                     | 1000 | 1200 |
| Bolt Circle, mm:      | Ø80                     | Ø83  | Ø90  |
| Length, mm:           | 45                      | 55   | 65   |
| Overall Size, mm:     | Ø95                     | Ø105 | Ø110 |
| Load Capacity, N-m:   | 3700                    | 4500 | 6000 |
| Operating Temp:       | -40°C to 140°C          |      |      |
| Operating Vacuum:     | 170 to 700 mm-hg        |      |      |
| Max Axle Velocity:    | 1,600 rpm               |      |      |
| Corrosion Resistance: | 200 hrs Salt Spray      |      |      |
| Durability:           | 160,000 km              |      |      |
| Required Maintenance: | NONE                    |      |      |

## Continuous Vacuum Locking Hub Operation:

- The locking hubs engage automatically when the driver shifts the transfer case (T/C) to 4WD operation.
- The locking hubs disengage automatically as soon as the driver shifts the T/C to 2WD operation. No backing-up is necessary.

## Vehicle 4x4 System Requirements:

### All Vehicles:

- Vacuum source such as the engine or vacuum pump.
- Vacuum lines to each wheel end.
- Vacuum passage through the steering knuckle.
- Vacuum control solenoid.
- Vacuum reservoir with a check valve.
- Electric signal from the transfer case to the control solenoid.

- Wheel end seals designed for holding vacuum.

### Manual T/C Vehicles (no shift-on-the-fly):

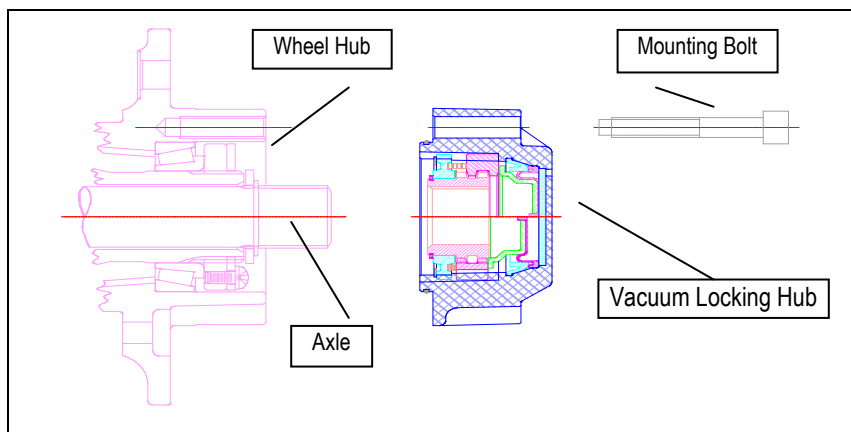
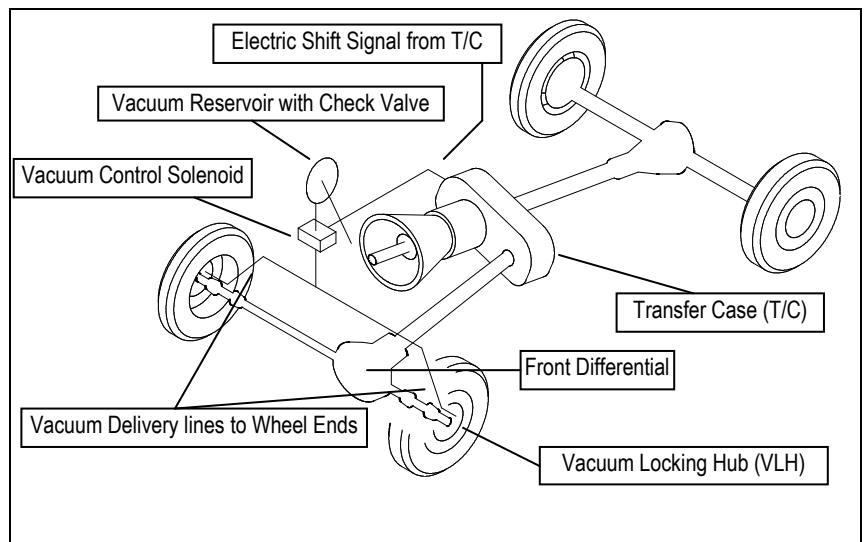
- No special requirements.

### Manual T/C Vehicles (with shift-on-the-fly):

- VLH engagement timing must be tested.

### Push Button T/C Vehicles:

- T/C and VLH engagement timing must be tested.



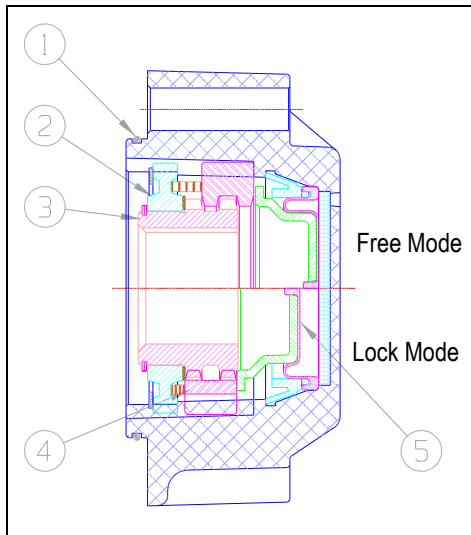
## Vacuum Locking Hub Assembly Procedure

1. Clean axle and wheel hub mounting surface of grease and debris.
2. Slide the Vacuum Locking Hub assembly over the axle until the hub contacts the wheel hub mounting surface.
3. Install six (6) mounting bolts.
4. Tighten each mounting bolt to the specified torque.



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## Continuous Vacuum Locking Hub (VLH)



### Continuous Vacuum Locking Hub (VLH) Components

1. O-Ring Seal: Provides a seal between the locking hub and the vehicle wheel end.
2. Bronze Bearing: Provides a bearing for 2WD operation.
3. Inner Drive Gear (IDG): Splined to match axle. Transmits torque from axle to other components.
4. Clutch Ring (CR): Splined to engage the IDG. Moves into engagement for 4WD operation (locked mode) and moves out of engagement for 2WD operation (2WD mode).
5. Vacuum Diaphragm Assembly: Applies force to move the CR into engagement for 4WD operation when vacuum is applied.

### Warn's Standard Bench Tests

VLH test samples must function after each of the following tests:

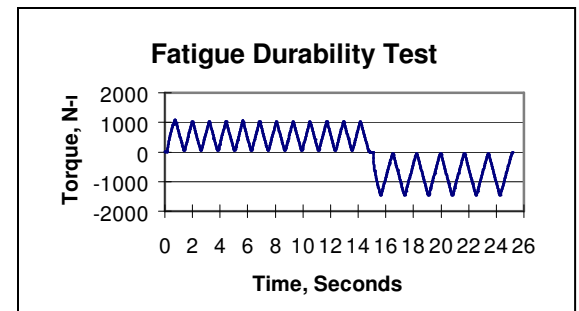
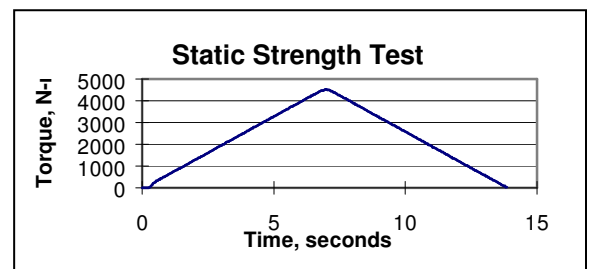
1. Static Strength: Apply specified torque load through the IDG with the sample in the locked mode.
2. Fatigue Durability: Apply a forward and reverse torque load through the IDG with the sample in the locked mode.
3. Ratcheting Durability: Rotate the sample at a specified speed. Attempt engagement by applying vacuum. Allow the IDG and CR splines to grind together (ratchet) for a specified amount of time.
4. Free Running (2WD Mode) Durability: Rotate the sample in the 2WD mode at a specified speed for a specified amount of time.
5. Vacuum Diaphragm Durability: Cycle the diaphragm between 2WD and 4WD positions under load.
6. Sealing Requirements: Water submersion with applied vacuum.
7. High and Low Temperature Operation: Soak the sample for a specified amount of time at extreme temperatures.
8. Cold Water Submersion and Freeze Operation: Operation in wet and icy conditions at temperatures below 0°C.

### Typical Vehicle Tests:

VLH test samples must function after each of the following tests:

1. Rapid Start: Locking hub torsional strength under maximum engine power.
2. Water Sealing: No water leaks when engaging the locking hub under water.
3. Off Road Durability: Locking hub torsional strength under frame twist conditions.
4. High and Low Temperature Operation: Locking hub operation at extreme temperature conditions.
5. High Speed Durability: Locking hub durability under high speed 2WD driving conditions.
6. High Altitude Operation: Low atmospheric pressure operation.

- **Warn's OEM Products:** Center Axle Disconnect Systems (electric and pneumatic) • Continuous Vacuum Locking Hubs • Manual Locking Hubs • Wheel Bearing Retention Systems • Pulse Type Vacuum Locking Hubs • Cam Type Automatic Locking Hubs • Integrated Wheel End Disconnect Systems
- Warn's Products are patent protected in the United States and overseas countries.



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