

# Kenworth HVAC Systems

## Mobile Air Conditioning Society Worldwide 2017 Convention



# Topics

- Introductions
- System Components
  - Kenworth Electrical
- Truck System Information
  - B-Cab
    - T2000/T700
    - NGP 680/880
- Testing/Troubleshooting
  - Scan Tool
- K Series Medium Duty
- T Series Medium Duty
  - KIMS

# Who is PACCAR/Kenworth

**PACCAR** is the corporate umbrella for truck, and supply related manufacturing companies, headquartered in Bellevue, Washington. Initially manufactured railroad cars and logging equipment, starting in 1905.

## **Heavy-duty truck manufacturing market segments:**

- Kenworth Motor Truck Company, USA, in 1945
- Peterbilt Motors Company, USA, in 1958
- Dart Truck Company, USA, in 1958
- Foden Trucks UK in 1981
- DAF Trucks N.V. in 1996
- Leyland Trucks UK in 1998

## **Truck Subsidiaries:**

- Kenworth Mexicana VILPAC 1966
- Kenworth Australia, in 1970
- Paccar Engine Manufacturing NA, in 2010

# Kenworth Models

## Class 8 – Heavy Duty, Off Highway

+80,000# GVWR

### 2.3m (Wide Cab)

- T2000 - > T700: No longer produced

### 1.9m B-Cabs

- T800, W900, T600 -> T660, C500, C550, T440, 963

### 2.1m Next Generation Product (NGP)

- Kenworth: T680, T880
- Peterbilt: 579, 567

### COE

- K500: Off highway ONLY
- K100: No longer produced

### MONSTER TRUCK: up to 400,000# GVWR

- 963/965: Off highway ONLY – modified B-Cab electrics





# Kenworth Models

## Class 7, 6 & 5 – Medium Duty

33,000# – 16,001# GVWR

- **T370, T270, T170**  
Conventional Cab,  
Built in Saint Therese, Canada
  - T370 Class 7: 26,001 - 33,000# GVWR
  - T270 Class 6: 19,501 - 26,000# GVWR
  - T170 Class 5: 16,001 – 19,500# GVWR
- **K370, K270 (LFNA: LF North America)**  
COE, Cab built in Holland,  
Assembled onto chassis in Mexico
  - K370 Class 7: 26,001 - 33,000# GVWR
  - K270 Class 6: 19,501 - 26,000# GVWR
  - Use DAVIE 4 to service cab's electrical



Simplified  
B-Cab  
Electrical  
System



24VDC – Cab  
12VDC – Chassis

# Kenworth/Peterbilt Model Comparison

| Models                                                                                               | Production Built Dates | Engine Emissions Level |
|------------------------------------------------------------------------------------------------------|------------------------|------------------------|
| <b>PB:</b> 357, 378, 379, 385, 386<br><b>KW:</b> C500, T600, T800, W900, Off-Highway                 | 2004 - 2006            | 1998, 2004             |
| <b>PB:</b> 365, 367, 384, 386, 388, 389<br><b>KW:</b> C500, T440/T470, T660, T800, W900, Off-Highway | 2007 - 2009            | 2007                   |
| <b>PB:</b> 387<br><b>KW:</b> T2000                                                                   | 2008 - 2009            | 2007                   |
| <b>PB:</b> 325, 330, 337, 348, 587                                                                   | 2010 - 2011            | 2010                   |
| <b>KW:</b> T170, T270, T370, T700                                                                    | 2010 - present         |                        |
| <b>PB:</b> 325, 330, 337, 348                                                                        | 2012 - present         |                        |
| <b>PB:</b> 587                                                                                       | 2012                   |                        |
| <b>PB:</b> 365, 367, 384, 386, 388, 389                                                              | 2010 - 2012            | 2010                   |
| <b>KW:</b> C500, T440/T470, T660, T800, W900, Off-Highway                                            | 2010 - present         |                        |
| <b>PB:</b> 579<br><b>KW:</b> T680                                                                    | 2012 - present         |                        |
| <b>PB:</b> 365, 367, 384, 386, 388, 389                                                              |                        |                        |
| <b>PB:</b> 587                                                                                       | 2013 - present         | 2013                   |



# System Components

# Mechanical Components



Most current applications use Sanden, compressors.

SD5H14 and SD7H15

# Mechanical Components



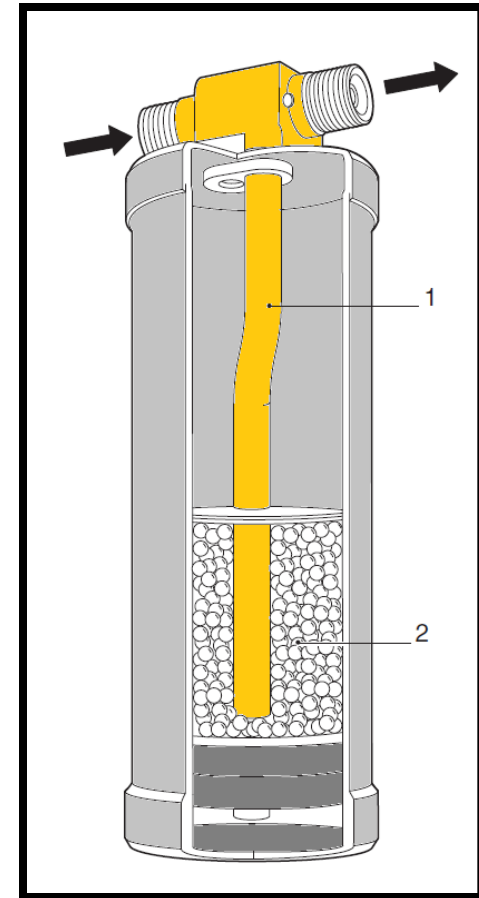
Condenser, sized per application parameters.

# Mechanical Components

## Receiver-Drier:

Normal application, absorbs system moisture and also filters and stores the liquid coolant

Uses either XH7 or XH9 desiccant package.





<https://truckmanualshub.com/>

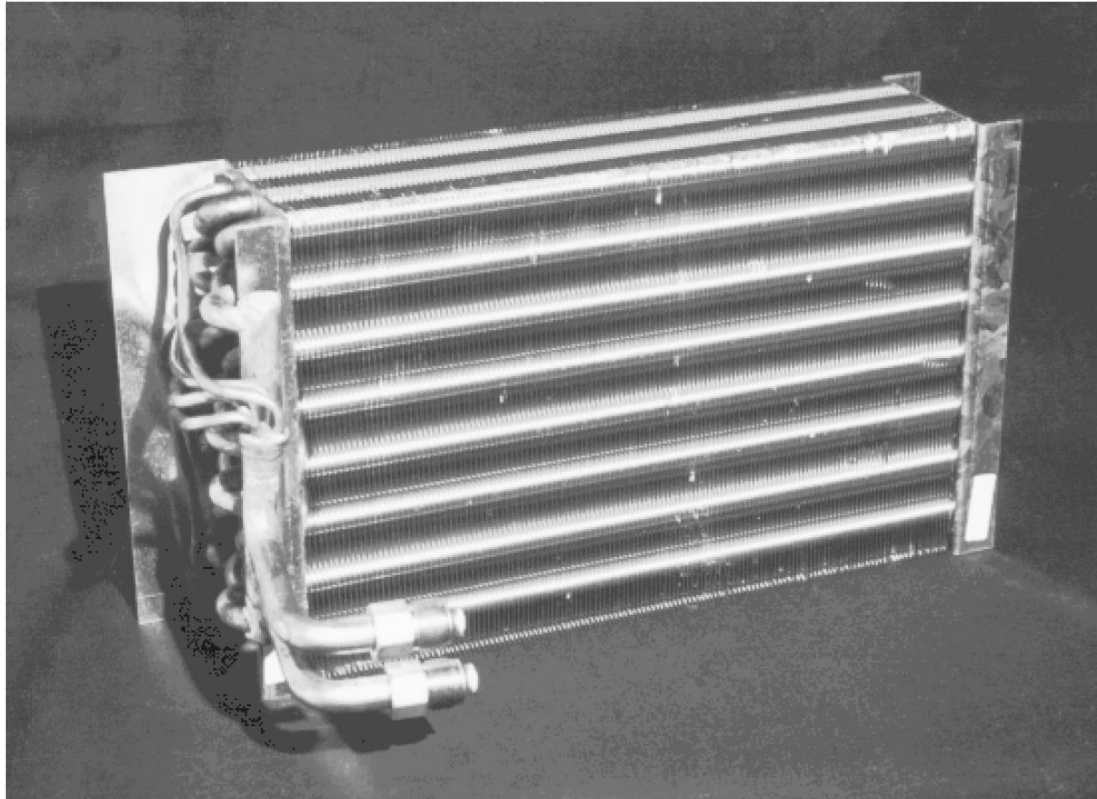
# Mechanical Components

## Expansion Valve





# Mechanical Components

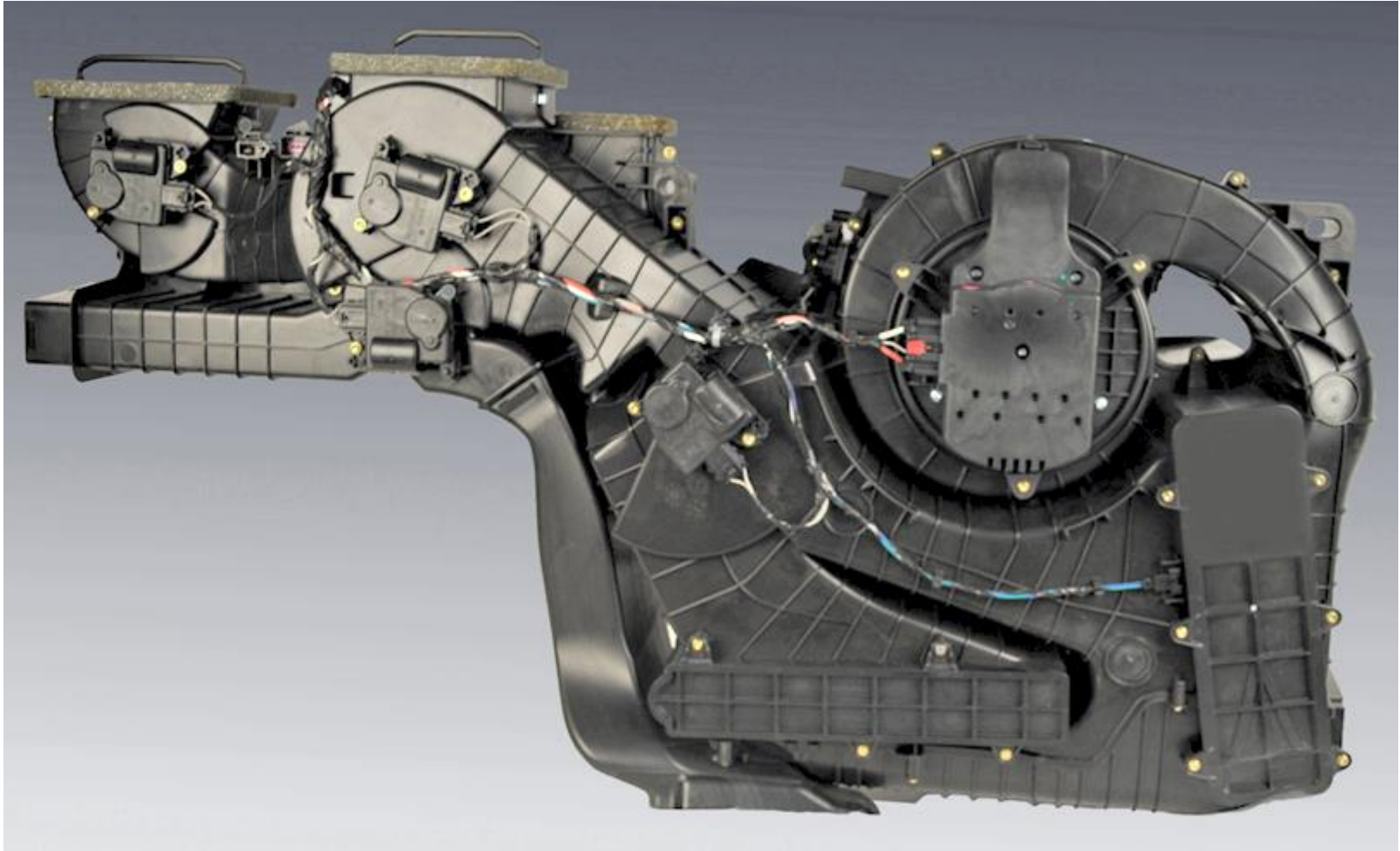


Evaporator:

- Changes low pressure liquid into a low pressure gas by absorbing heat from cab air

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# Mechanical Components





# Mechanical Components



# **Electrical Systems**

# CAN Electrical Systems Definitions

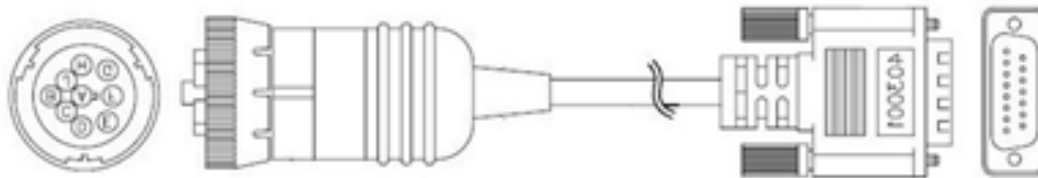
## Definitions

**Instrumentation Control Unit (ICU)** – 1<sup>st</sup> generation *Instrumentation-only* Multiplex

**Cab Electronic Control Unit (CECU)** – 2<sup>nd</sup> generation Multiplex, includes systems other than instrumentation. CECU's variants relate to vehicle model and the engine emissions standard. Identifying which CECU in the vehicle helps determine what features are present and also aids in troubleshooting.

**North American MultipleXing (NAMUX)** - The CAN electrical architecture used by Kenworth and Peterbilt Divisions.

**Electronic Service Analyst (ESA)** - Software Program needed for all CAN system malfunction code reading and service related operations. NEXIQ scan tool used with ESA software.

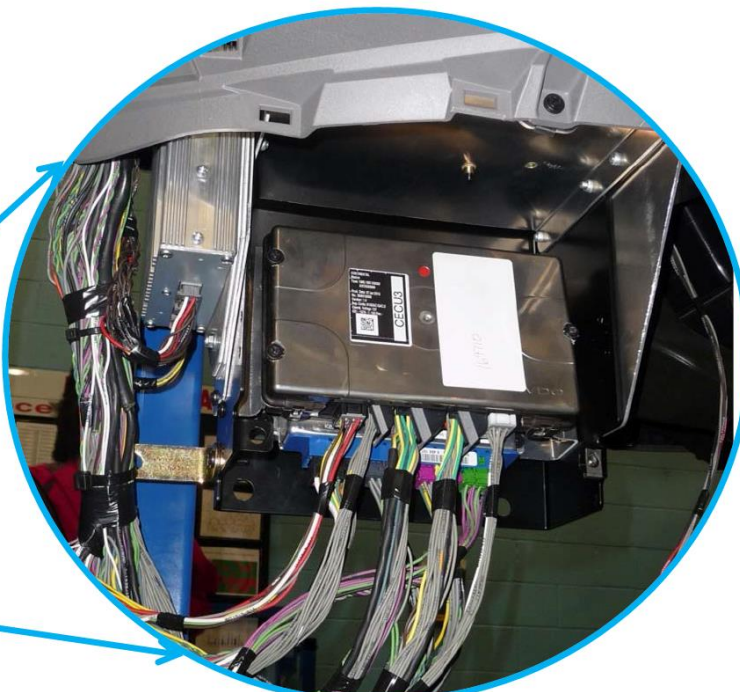


## Kenworth Electrical Systems – 2 Iterations

- **Traditional Electrical Systems:**
  - (Legacy - thru - 2004) – **KM815001**
- **CAN Based Instrumentation:**
  - ICU – NAMUX (2005-2007) – **KM815054/PM819010**
  - CECU – NAMUX2 (2007-2010) – **KM815054/PM819010**
    - Service manual change, see page 38/39
- **CECU<sub>3</sub> – NAMUX<sub>3</sub>/ NAMUX<sub>4</sub> (2010 – Present) w/Chassis Node**
  - B-Cab = NAMUX 3 – **KM815056** (includes DTC codes)
  - NGP = NAMUX 4 - **KM815057** (includes DTC codes)

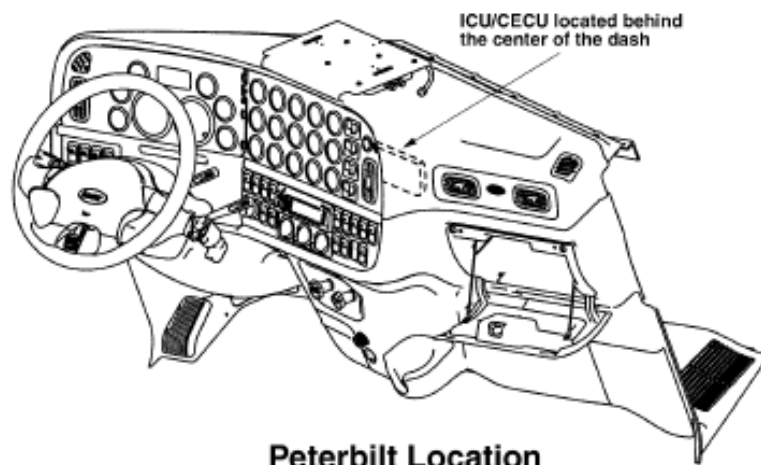


# Electrical - Typical ICU/CECU Locations



**Note:** T2000 and T700 is at the front of the passenger footwell.

2010 emissions compliant T170, T270, T370 medium duty, is behind the lower center of the dash panel. Peterbilt versions, behind the top center of the dash panel.



# Electrical - 1st Iteration

## Standard Electrical Systems – 1st Iteration

Original Circuit Wiring Key for production prior to phase out for CAN  
thru 2004

### Example: C17SR

Function . . . . . C = Components

Circuit Number . . . . . 17 = Starter Solenoid

Destination or Purpose . . . . SR = Starter

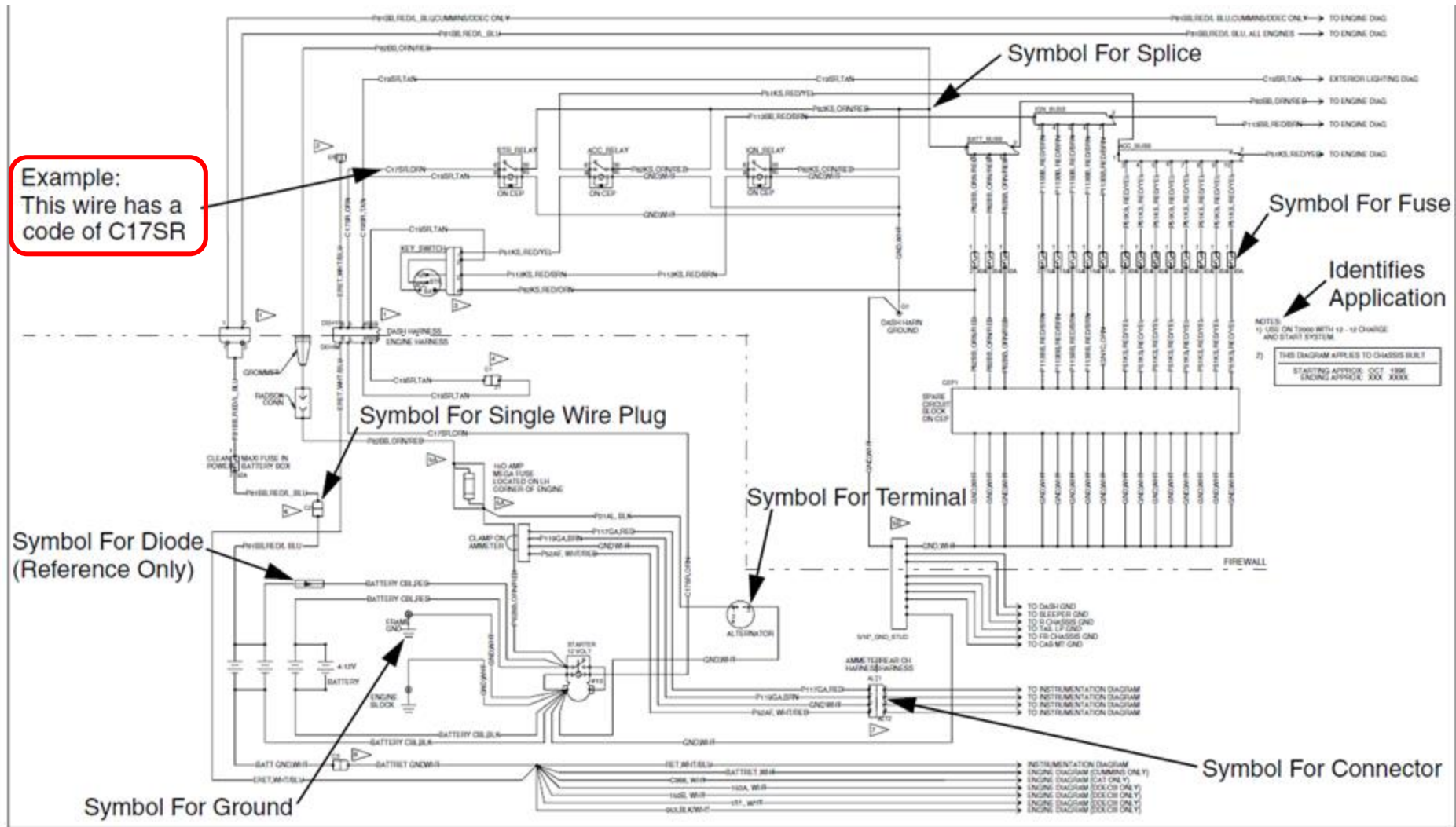
## Brief Examples of Each Category Definition

| FUNCTION LETTER | DESCRIPTION | Circuit No. | Circuit Description      | Color Code | Destination or Purpose |                  |
|-----------------|-------------|-------------|--------------------------|------------|------------------------|------------------|
|                 |             |             |                          |            | A                      |                  |
| 10              | C           | Gnd         | Ground                   | ATA White  | ABS                    | Anti-Lock Brake  |
|                 | E           | 1.          | Tail and Park Lamps      | ATA Brown  | AC                     | Air Conditioning |
|                 | G           | 2.          | Stop Lamps               | ATA Red    | AD                     | Air Dryer        |
|                 | GND         | 3.          | Marker & Clearance Lamps | ATA Black  | AF                     | Accessories Feed |

Models Covered by Elect Wiring Key—T2000, T6/T8/T4, W900B, C500B, K100E

## Service Manual KM815001

# Electrical - 1st Iteration



P94-1113

[illegible]

# Electrical - 1st Iteration

## Electrical Circuit Matrix

See “Electrical  
Circuit Matrix” on  
previous page for  
instructions on  
how to identify  
circuit number  
and name.

| Stripe    | Solid Color                  |                                      |                  |                  |                  |          |            |                  |           |           |                               |          |            |                                     |                                |
|-----------|------------------------------|--------------------------------------|------------------|------------------|------------------|----------|------------|------------------|-----------|-----------|-------------------------------|----------|------------|-------------------------------------|--------------------------------|
|           | Black                        | Blue                                 | Brown            | Green            | Gray             | Lt. Blue | Lt. Green  | Orange           | Pink      | Purple    | Red                           | Tan      | Violet     | White                               | Yellow                         |
| Black     | 3<br>21<br>22<br>ALTI<br>PCB | 108                                  | 37               | 34<br>76         | 27<br>28<br>29   | 30       | 98         | 111              | 53        |           | 6<br>49                       | 72       |            | 52                                  | 33<br>166                      |
| Blue      |                              | 4<br>103<br>104<br>105<br>106<br>107 | 215<br>308       |                  | 173              |          | 56         | 64<br>226        | 50        |           | 68<br>120                     | 223      | 163        | RET                                 | 47<br>169                      |
| Brown     |                              |                                      | 1<br>119         | 58               |                  | 44       | 320        | 139              | 245       |           | 113                           |          | 155        | 174                                 | 200<br>248                     |
| Green     | 71<br>75<br>304              | 208                                  | 45<br>129        | 36<br>157<br>186 | 138<br>201       | 97       |            | 74<br>140        | 65        | 204       | 147<br>118                    | 23       | 162        | 11                                  | 32<br>70                       |
| Gray      | 137                          | 78                                   | 127<br>132       | 135              | 13<br>69         | 311      | 317        | 133              |           |           | 8<br>183                      |          |            | 131                                 | CAP                            |
| Lt. Blue  | 306                          | 109                                  | 309<br>110       | 101              | 63<br>177        | 5        |            | 229              | 249       | 203       | 81                            | 86<br>92 |            | 178                                 | SPS                            |
| Lt. Green | 95                           | 205                                  | 310<br>216       |                  | 136              | 313      | 18         | 244              |           | 233       | 231                           | 222      | 232        | 144                                 | 170                            |
| Orange    | 84<br>305                    | 77<br>247                            | 158              | 43<br>152        | 134              | 314      | 122        | 17<br>143<br>IGN |           |           | 80                            |          | 164        | 175<br>220                          | 168                            |
| Pink      | 307                          | 24                                   | SPE              | 94               | 60               | 315      | 184        |                  | 25<br>SPR | 154       | 39                            |          |            | ERET                                | 199                            |
| Purple    |                              |                                      |                  | 238              | 239              | 316      | 319        | 172              | 153       | 9         | 228                           | 221      |            | 180<br>219                          | 31                             |
| Red       | 148<br>192<br>195<br>303     | 150<br>190<br>207                    | 128<br>194       | 42<br>191<br>210 | 16<br>182        | 91       | 99         | 82<br>141        | 116       | 90        | 2<br>117<br>181<br>BAT<br>123 | 73       |            | 54<br>100<br>193                    | 38<br>62                       |
| Tan       | 230                          | SPC                                  | 83               | 46               |                  | 93<br>85 |            |                  |           | 237       | 14                            | 19<br>59 |            | 179                                 | 171                            |
| Violet    |                              |                                      | 156              | 246              | 176              |          |            |                  |           |           | 40<br>126                     |          | 26         | OATI                                | 151                            |
| White     | 112<br>115<br>301            | 7<br>206                             | 159<br>41        | 12               |                  | 318      | 124<br>102 | 160<br>88        | 79        | 10<br>236 | 48<br>234                     | 114      | 66<br>235  | 61<br>145<br>146<br>GND<br>V<br>187 | 167<br>87                      |
| Yellow    | 302                          | 55<br>196                            | 89<br>217<br>312 | 211              | 149<br>15<br>202 | 20       | 96<br>125  | 161<br>198       |           | 57        | 51<br>197<br>240              | 67       | 165<br>241 | OAT2                                | 35<br>121<br>142<br>ACC<br>185 |



# Kenworth Wire Numbering System

## **P12HN** – Kenworth Circuit Code

Circuit function - **P**

Circuit number

Color of the wire

Destination of circuit or purpose of the circuit

Using Electrical Circuit Matrix

# Kenworth Wire Numbering System

Example: **P12HN**

Circuit function - **P**

| FUNCTION<br>LETTER | DESCRIPTION |
|--------------------|-------------|
|--------------------|-------------|

|     |                                  |
|-----|----------------------------------|
| C   | Components                       |
| E   | ECU / Electronic Control         |
| G   | Gauges                           |
| GND | Ground                           |
| H   | Heating / Air Conditioning       |
| L   | Lighting                         |
| P   | Power                            |
| PCB | Power from Spare Circuit Breaker |
| R   | Relay                            |
| S   | Spare                            |

**P - identifies circuit  
function: Power**

# Kenworth Wire Numbering System

**Example: P12HN**

Circuit function

Circuit number - **12**

Color of the wire

Destination of the circuit or purpose of the circuit

Using Electrical Circuit Matrix

# Kenworth Wire Numbering System

Example: **P12HN**

Circuit number -

Color of the wire

**12 - Identifies circuit color:  
Green/White**

**12 - Identifies circuit  
description:  
Horn Relay Hot**

Electrical: Electrical System

| Circuit No. | Circuit Description                       | Color Code   |
|-------------|-------------------------------------------|--------------|
| Gnd         | Ground                                    | ATA White    |
| 1.          | Tail and Park Lamps                       | ATA Brown    |
| 2.          | Stop Lamps                                | ATA Red      |
| 3.          | Marker & Clearance Lamps                  | ATA Black    |
| 4.          | Hot Wire for Auxiliary Devices on Trailer | ATA Blue     |
| 5.          | Head Lamps                                | Lt. Blue     |
| 6.          | Low Beam                                  | Red/Black    |
| 7.          | High Beam                                 | Blue/White   |
| 8.          | Control Circuit for Accessory Relays      | Red/Gray     |
| 9.          | LH Road or Fog Lamp                       | Purple       |
| 10.         | RH Road or Fog Lamp                       | Purple/White |
| 11.         | Horn Relay Ground                         | White/Green  |
| 12.         | Horn Relay Hot                            | Green/White  |
| 13.         | Panel Lamps                               | Gray         |
| 14.         | Head and Tail Lamps                       | Red/Black    |

| Circuit No. | Circuit Description                        | Color Code     |
|-------------|--------------------------------------------|----------------|
| 32.         | Service Brake Sense                        | Yellow/Green   |
| 33.         | Left Front Directional Signal Lamp         | Yellow/Black   |
| 34.         | Right Front Directional Signal Lamp        | Green/Black    |
| 35.         | Left Rear Directional Signal Lamp          | ATA/Yellow     |
| 36.         | Right Rear Directional Signal Lamp         | ATA/Green      |
| 37.         | Idle Validation Off                        | Brown/Black    |
| 38.         | Idle Validation Signal                     | Yellow/Red     |
| 39.         | Hot Feed Line to Pressure Auxiliary Switch | Red/Pink       |
| 40.         | Return Line from Pressure Auxiliary Switch | Red/Violet     |
| 41.         | Sanders                                    | Brown/White    |
| 42.         | Radio Receiver                             | Green/Red      |
| 43.         | Radio Transmitter                          | Green/Orange   |
| 44.         | Differential Lock                          | Lt. Blue/Brown |
| 45.         | Fifth Wheel Lock                           | Brown/Green    |
| 46.         | Low Air                                    | Green/Tan      |



**KENWORTH**

# Kenworth Wire Numbering System

Example: **P12HN**

Circuit function

Circuit number

Color of the wire

Destination of the circuit or purpose of the circuit -  
**HN**

Using Electrical Circuit Matrix



# Kenworth Wire Numbering System

Example: **P12HN**

Circuit purpose – **HN**

**HN - identifies circuit destination or purpose:**

**Horn**

## Destination or Purpose

|     |                      |
|-----|----------------------|
| GP  | Grow Plug            |
| H   |                      |
| HB  | High Beam            |
| HC  | Hydrotone Fan Clutch |
| HH  | High Heat            |
| HI  | High                 |
| HL  | Headlamps            |
| HM  | Hours Hour Meter     |
| HN  | Horn                 |
| HP  | High Pressure        |
| HS  | Heat Sensor          |
| HW  | High Water - Low Oil |
| I   |                      |
| IGB | Ignition Bus Bar     |
| J   |                      |
| JB  | Jacob's Brake        |
| JE  | Jacob's Brake Full   |



**KENWORTH**

# Kenworth Wire Numbering System

**Example: GREEN / WHITE**

Circuit function

Circuit number

Color of the wire

Destination of the circuit or purpose

**Using Electrical Circuit Matrix**

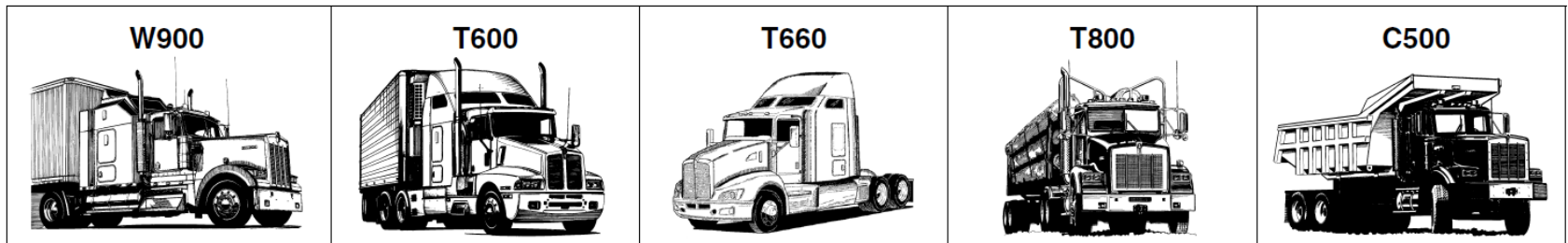
| Electrical Circuit Matrix                                                                                    |                              |                                      |                  |                  |                  |          |            |                  |           |           |                               |          |            |                              |                                |  |
|--------------------------------------------------------------------------------------------------------------|------------------------------|--------------------------------------|------------------|------------------|------------------|----------|------------|------------------|-----------|-----------|-------------------------------|----------|------------|------------------------------|--------------------------------|--|
| See "Electrical Circuit Matrix" on previous page for instructions on how to identify circuit number and name |                              |                                      |                  |                  |                  |          |            |                  |           |           |                               |          |            |                              |                                |  |
| Stripe                                                                                                       | Solid Color                  |                                      |                  |                  |                  |          |            |                  |           |           |                               |          |            |                              |                                |  |
|                                                                                                              | Black                        | Blue                                 | Brown            | Green            | Gray             | Lt. Blue | Lt. Green  | Orange           | Pink      | Purple    | Red                           | Tan      | Violet     | White                        | Yellow                         |  |
| Black                                                                                                        | 3<br>21<br>22<br>ALTI<br>PCB | 108                                  | 37               | 76               | 27<br>28<br>29   | 30       | 98         | 111              | 53        |           | 6<br>49                       | 72       |            | 52                           | 33<br>166                      |  |
| Blue                                                                                                         |                              | 4<br>103<br>104<br>105<br>106<br>107 | 215<br>308       |                  | 173              |          | 56         | 64<br>226        | 50        |           | 68<br>120                     | 223      | 163        | RET                          | 47<br>169                      |  |
| Brown                                                                                                        |                              |                                      | 1<br>119         | 58               |                  | 44       | 320        | 139              | 245       |           | 113                           |          | 155        | 174                          | 200<br>248                     |  |
| Green                                                                                                        | 71<br>75<br>304              | 208                                  | 45<br>129        | 36<br>157<br>186 | 138<br>201       | 97       |            | 74<br>140        | 65        | 204       | 147<br>118                    | 23       | 162        | 11                           | 32<br>70                       |  |
| Gray                                                                                                         | 137                          | 78                                   | 127<br>132       | 135              | 13<br>69         | 311      | 317        | 133              |           |           | 8<br>183                      |          |            | 131                          | CAP                            |  |
| Lt. Blue                                                                                                     | 306                          | 109                                  | 309<br>110       | 101              | 63<br>177        | 5        |            | 229              | 249       | 203       | 81<br>86<br>92                |          |            | 178                          | SPS                            |  |
| Lt. Green                                                                                                    | 95                           | 205                                  | 310<br>216       |                  | 136              | 313      | 18         | 244              |           | 233       | 231                           | 222      | 232        | 144                          | 170                            |  |
| Orange                                                                                                       | 84<br>305                    | 77<br>247                            | 158              | 43<br>152        | 134              | 314      | 122        | 17<br>143<br>IGN |           |           | 80                            |          | 164        | 175<br>220                   | 168                            |  |
| Pink                                                                                                         | 307                          | 24                                   | SPE              | 94               | 60               | 315      | 184        |                  | 25<br>SPR | 154       | 39                            |          |            | ERET                         | 199                            |  |
| Purple                                                                                                       |                              |                                      |                  | 238              | 239              | 316      | 319        | 172              | 153       | 9         | 228                           | 221      |            | 180<br>219                   | 31                             |  |
| Red                                                                                                          | 148<br>192<br>195<br>303     | 150<br>190<br>207                    | 128<br>194       | 42<br>191<br>210 | 16<br>182        | 91       | 99         | 82<br>141        | 116       | 90        | 2<br>117<br>181<br>BAT<br>123 | 73       |            | 54<br>100<br>193             | 38<br>62                       |  |
| Tan                                                                                                          | 230                          | SPC                                  | 83               | 46               |                  | 93<br>85 |            |                  |           | 237       | 14                            | 19<br>59 |            | 179                          | 171                            |  |
| Violet                                                                                                       |                              |                                      | 156              | 246              | 176              |          |            |                  |           |           | 40<br>126                     |          | 26         | OAT1                         | 151                            |  |
| White                                                                                                        | 112<br>115<br>301            | 7<br>206                             | 159<br>41        | 12               |                  | 318      | 124<br>102 | 160<br>88        | 79        | 10<br>236 | 48<br>234                     | 114      | 66<br>235  | 61<br>145<br>GND<br>V<br>187 | 167<br>87                      |  |
| Yellow                                                                                                       | 302                          | 55<br>196                            | 89<br>217<br>312 | 211              | 149<br>15<br>202 | 20       | 96<br>125  | 161<br>198       |           | 57        | 51<br>197<br>240              | 67       | 165<br>241 | OAT2                         | 35<br>121<br>142<br>ACC<br>185 |  |



**KENWORTH**

# Electrical – CAN Code Designations

<https://truckmanualshub.com/>



## PACCAR Electrical Circuit Code Designations

- Multiplex migration began in 2004 in models T600, T660, T800, W900, C500 and Off-Highway models with instrumentation.
- Crossover trucks use a mixture of original circuit designations for existing electrical truck and chassis components, while “phasing” in the PACCAR circuit numbering system to support the multiplexed instrumentation
- *Circuits numbers and alpha characters used to identify each circuit are much different than in our legacy circuit wiring key*

**Service Manual KM815052**

# Electrical – Can Systems

<https://truckmanualshub.com/>

## 2005-2010 Multiplex, with ICU, CECU, CECU2, and CECU3 w/o Chassis Node Circuit Code Numbering and Abbreviations

### Example: YEL 2111

**YEL— Function:** The first three alpha characters represent the color of the wire and define the primary electrical function of the circuit.

**2111— Component:** The four-digit circuit code describes the component or component subsystem that the wire supports. The components and subsystems are grouped hierarchically.

**For example,** in the lighting category:

- A general, lighting only circuit is labeled XXX2000.
- A less general, headlamps only circuit is labeled XXX2100.
- A more specific, low beam headlamps only circuit is labeled XXX2110.
- A very specific, left low beam headlamp circuit is labeled XXX2111.

# Electrical – 2<sup>nd</sup> and Later Iterations

<https://truckmanualshub.com/>

## Circuit Code Numbering and Abbreviations

### Example: YEL 2111

| Insulation Color      | Color Code | Electrical Function                               |
|-----------------------|------------|---------------------------------------------------|
| Red with white stripe | R/WXXXX    | Direct battery power                              |
| Red                   | REDXXXX    | Protected battery power                           |
| Orange                | ORNXXXX    | Ignition<br>Accessory<br>Start power              |
| Yellow                | YELXXXX    | Activated power                                   |
| Brown                 | BRNXXXX    | Indicator illumination<br>Backlit illumination    |
| Black                 | BLKXXXX    | Load return                                       |
| Gray                  | GRAXXXX    | Control                                           |
| Violet                | VIOXXXX    | Reference voltage                                 |
| Light blue            | BLUXXXX    | Sensor signal                                     |
| Light green           | GRNXXXX    | Sensor common not connected<br>directly to ground |
| White                 | WHTXXXX    | Ground                                            |

Table 1: Color Codes

| Number                  | Category                     |
|-------------------------|------------------------------|
| XXX0000 through XXX0999 | General                      |
| XXX1000 through XXX1999 | Power supply                 |
| XXX2000 through XXX2999 | Lighting                     |
| XXX3000 through XXX3999 | Power train                  |
| XXX4000 through XXX4999 | Instrumentation, MMI         |
| XXX5000 through XXX5999 | Safety systems               |
| XXX6000 through XXX6999 | Convenience, Security        |
| XXX7000 through XXX7999 | HVAC                         |
| XXX8000 through XXX8999 | (Category not Defined)       |
| XXX9000 through XXX9999 | Trailer/Customer/Bodybuilder |

Table 2: Circuit Code General Categories

### Additional Wiring Detail Tables

Table 3: Data-Bus Wire Color

Table 4: Trailer/Body Builder Circuits

Table 5: Circuit Code Master List

# CAN Communication

<https://truckmanualshub.com/>

## How many individual CANs may be found on a Kenworth?

- B-Cab? **Seven**
- T680/880? **Eight**
- New in 2016 **GREEN** 9 Pin
  - Onboard Diagnostic (O-CAN) to allow direct communication from DAVIE (scan tool) to the PCI

|                                                 |                                |
|-------------------------------------------------|--------------------------------|
| <b>Aftertreatment (A-CAN)</b>                   | <b>Engine (E-CAN)</b>          |
| <b>Body Builder (B-CAN)</b> <sub>optional</sub> | <b>Frame (F-CAN)</b>           |
| <b>Cab (C-CAN)</b> [T680/880]                   | <b>Instrumentation (I-CAN)</b> |
| <b>Diagnostic (D-CAN)</b>                       | <b>Vehicle (V-CAN)</b>         |



# CAN Wire Numbering System

<https://truckmanualshub.com/>

## Table 1 Color Codes

PACCAR Electrical Circuit Code

| Insulation Color    | Color Code | Electrical Function                                           |
|---------------------|------------|---------------------------------------------------------------|
| Red w/ white stripe | R/WXXXX    | Direct battery power                                          |
| Red                 | REDXXXX    | Protected battery power                                       |
| Orange              | ORNXXXX    | Ignition, Accessory,<br>Low Voltage Disconnect,<br>StartPower |
| Yellow              | YELXXXX    | Activated Power                                               |
| White               | WHTXXXX    | Ground                                                        |
| Black               | BLKXXXX    | Load Return                                                   |
| Gray                | GRAXXXX    | Control                                                       |
| Brown               | BRNXXXX    | Indicator Illumination<br>Backlit Illumination                |
| Violet              | VIOXXXX    | Reference Voltage or +5VDC or<br>Sensor Power                 |
| Light Blue          | BLUXXXX    | Sensor Signal                                                 |
| Light Green         | GRNXXXX    | Sensor common or<br>Sensor Ground                             |

**Example:**

**YEL5971**



**KENWORTH**

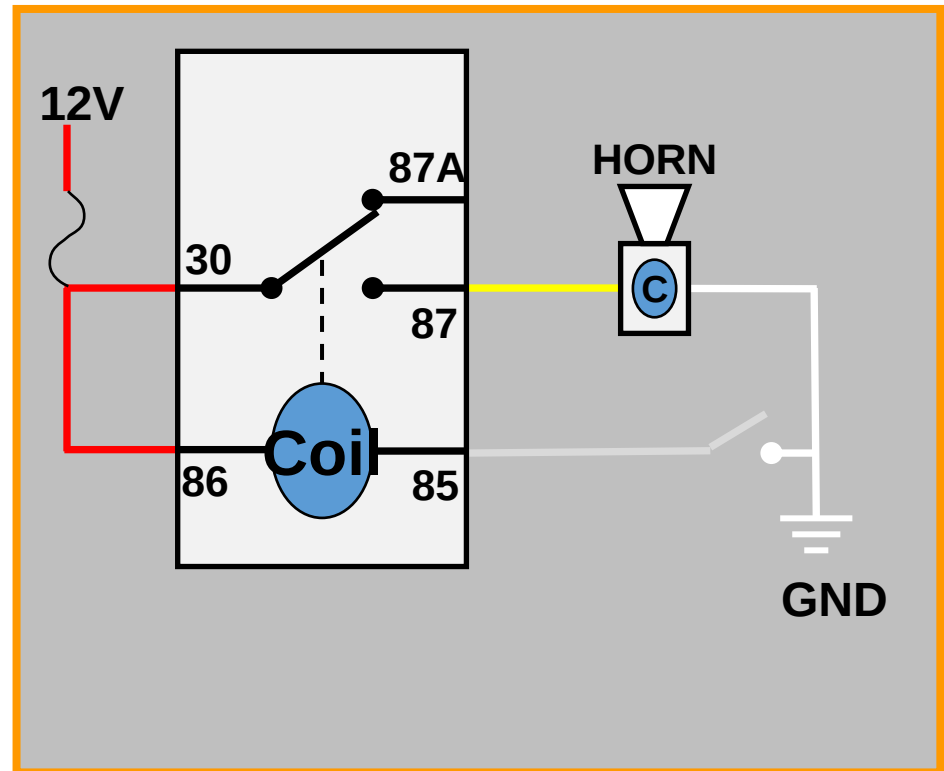
# PACCAR Wire Numbering System

## Example: YEL5971

| PACCAR Electrical Circuit Code |            |                                                               |
|--------------------------------|------------|---------------------------------------------------------------|
| Insulation Color               | Color Code | Electrical Function                                           |
| Red w/ white stripe            | R/WXXXX    | Direct battery power                                          |
| Red                            | REDXXXX    | Protected battery power                                       |
| Orange                         | ORNXXXX    | Ignition, Accessory,<br>Low Voltage Disconnect,<br>StartPower |
| Yellow                         | YELXXXX    | Activated Power                                               |
| White                          | WHTXXXX    | Ground                                                        |
| Black                          | BLKXXXX    | Load Return                                                   |
| Gray                           | GRAXXXX    | Control                                                       |
| Brown                          | BRNXXXX    | Indicator Illumination<br>Backlit Illumination                |
| Violet                         | VIOXXXX    | Reference Voltage or +5VDC or<br>Sensor Power                 |
| Light Blue                     | BLUXXXX    | Sensor Signal                                                 |
| Light Green                    | GRNXXXX    | Sensor common or<br>Sensor Ground                             |

Using the color you can identify the circuit's FUNCTION

Red, Yellow, Gray and White are illustrated below



# CAN Wire Numbering System

## Data-Bus Wire Color

Most common:

- J1939, YEL & GRN
- J1587/1708, VIO & GRN
- Single-wire, BLU

**Table 3 — Data-Bus Wire Color**

| <b>Color<br/>Low side</b> | <b>Color<br/>High side</b> | <b>DATA Bus</b>   |
|---------------------------|----------------------------|-------------------|
| Light Green               | Violet                     | SAE J1587 & J1708 |
| Light Green               | Orange                     | SAE J1922         |
| Light Green               | Yellow                     | SAE J1939         |
| Light Green               | Red                        | OEM, Private bus  |
| Light Green               | Gray                       | CAN               |
| -                         | Light blue                 | Single-wire bus   |

# CAN Wire Numbering System

## Trailer/Body Builder Circuits

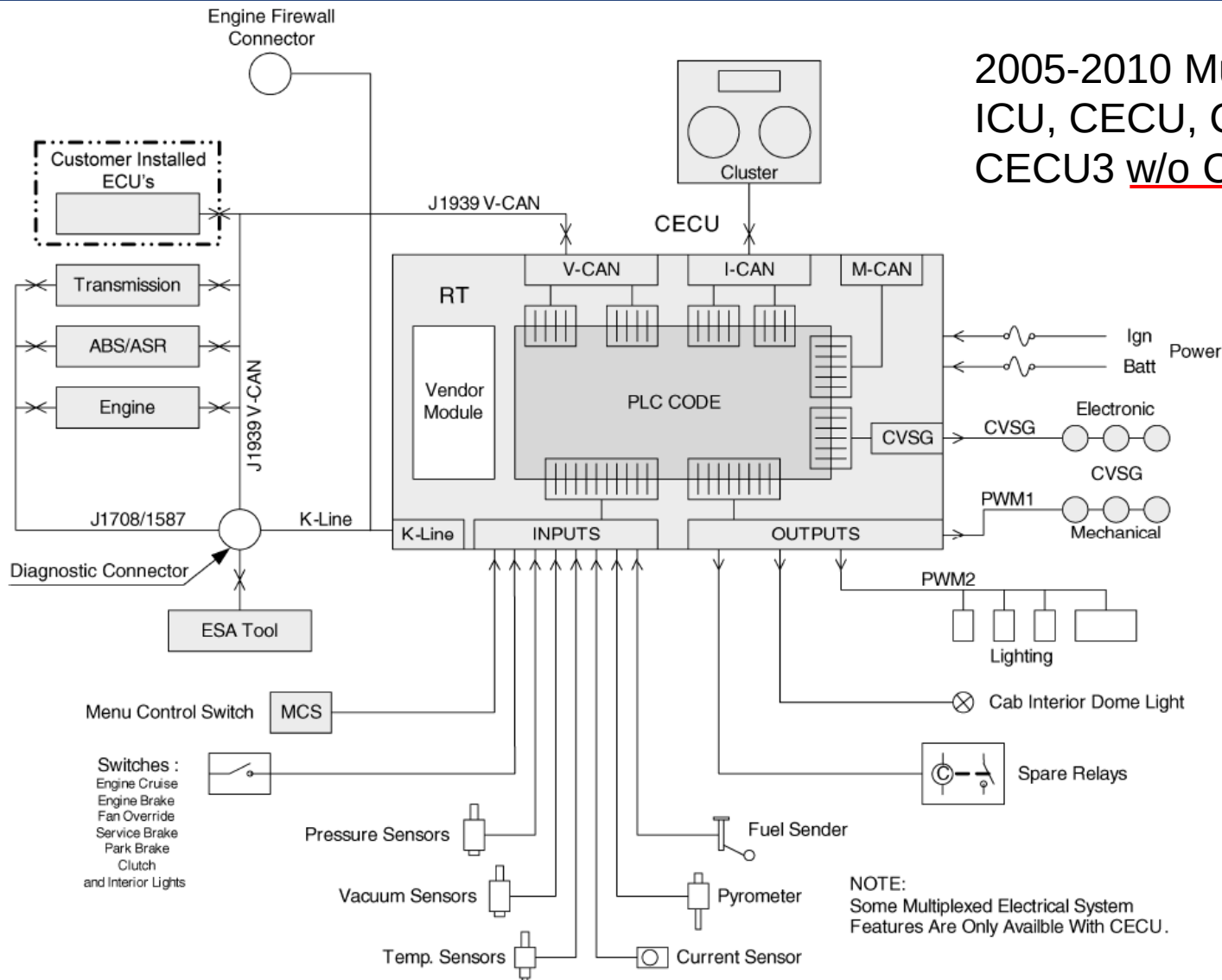
These are only on trailer circuits inside the green, yellow trailer cable jackets and special body builder circuits.

**Table 4 — Trailer/Body Builder Circuits**

| <b>Color</b>       | <b>Electrical Function</b>         |
|--------------------|------------------------------------|
| <b>White</b>       | <b>Ground</b>                      |
| <b>Black</b>       | <b>Clearance, ID, Marker lamps</b> |
| <b>Yellow</b>      | <b>Left turn lamps</b>             |
| <b>Red</b>         | <b>Stop lamps</b>                  |
| <b>Light green</b> | <b>Right turn lamps</b>            |
| <b>Brown</b>       | <b>Tail lamps</b>                  |
| <b>Light blue</b>  | <b>ABS power, Auxiliary</b>        |

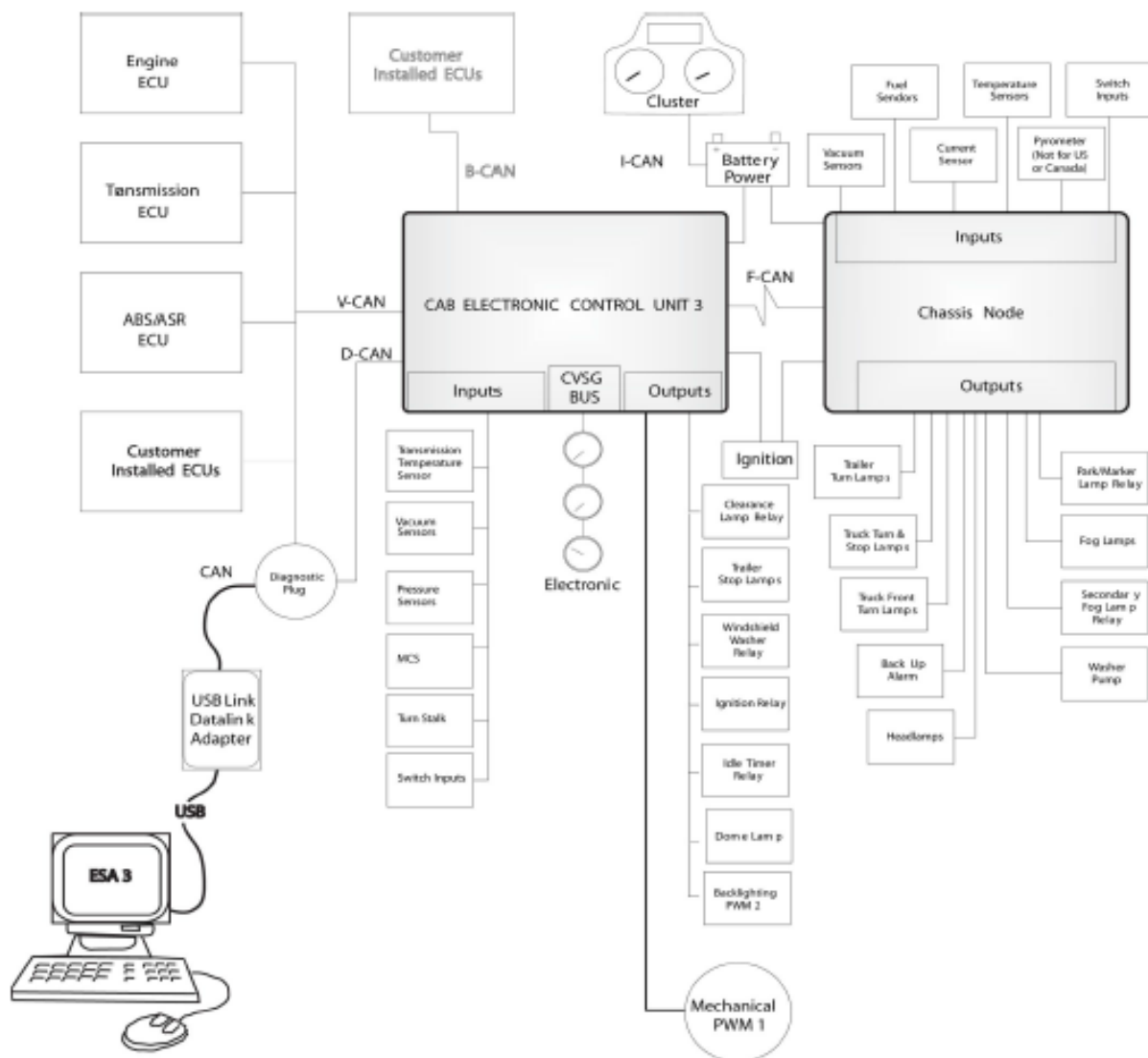
# Electrical – CAN Iterations

2005-2010 Multiplex, with  
ICU, CECU, CECU2, and  
CECU3 w/o Chassis Node



# Electrical – Latest CAN Iteration

<https://truckmanualshub.com/>



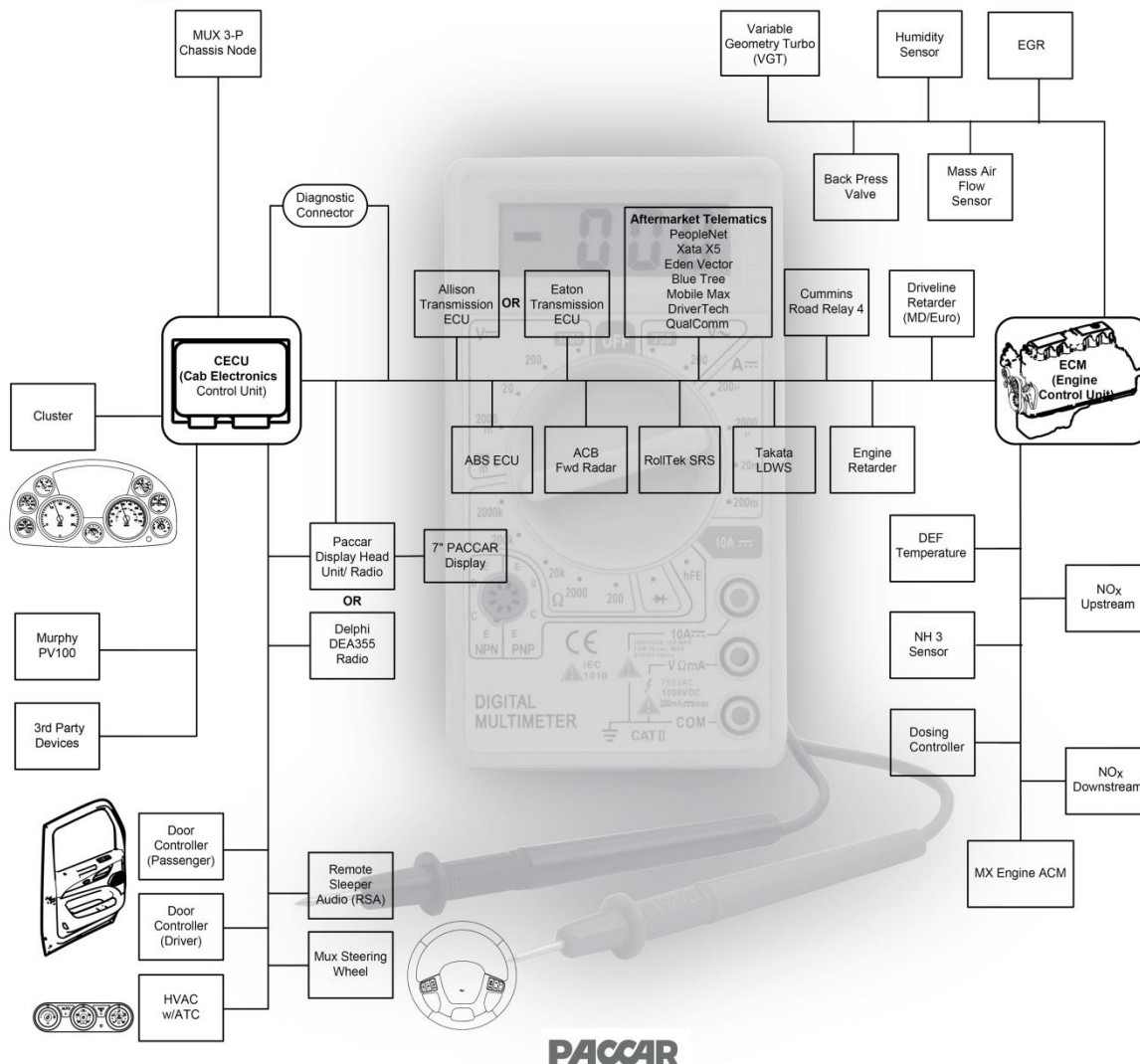
**2010 Multiplexed  
Electrical  
System Service  
Manual —  
CECU3  
w/Chassis Node**

**B-Cab = NAMUX 3**



# Electrical – Latest CAN Iteration

<https://truckmanualshub.com/>



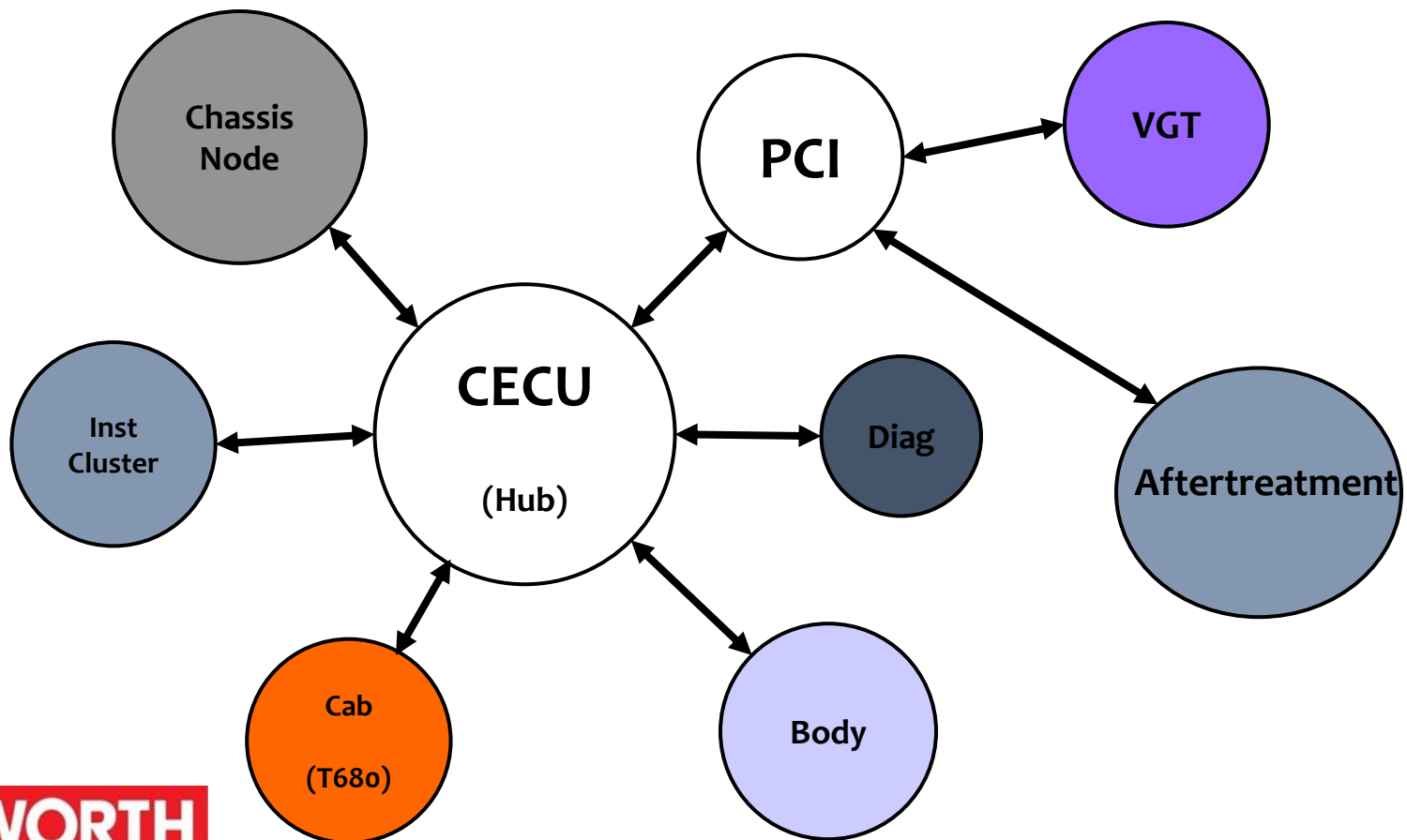
**2012 Multiplexed  
Electrical System  
Service Manual  
— (P30-1011)**

**NGP = NAMUX 4**

**Service Manual KM815057/PM819023**

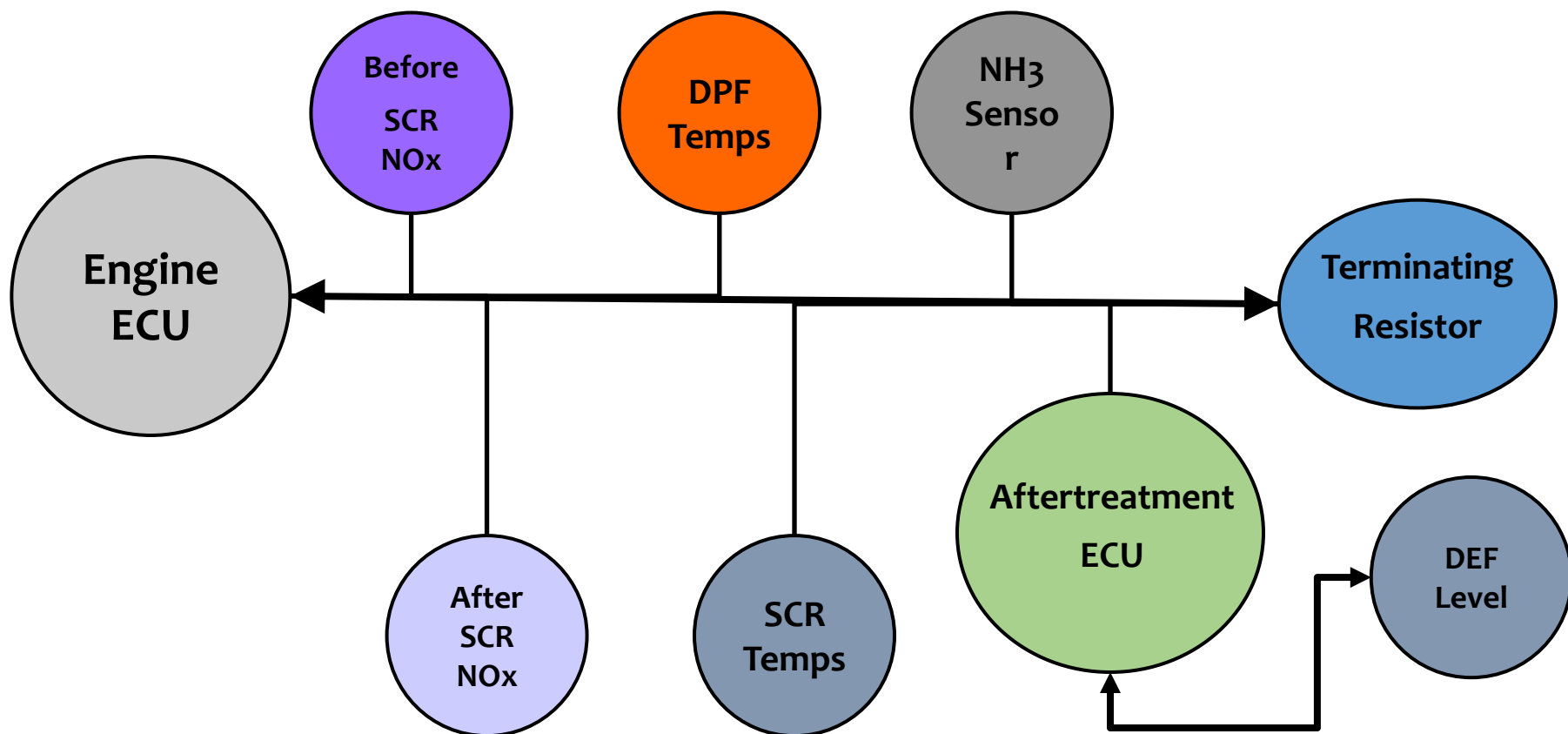
# CAN – Hub and Spoke

Central hub receives and relays information between different devices that are on separate CANs



# CAN – Architecture

## Local CAN architecture (A-CAN)

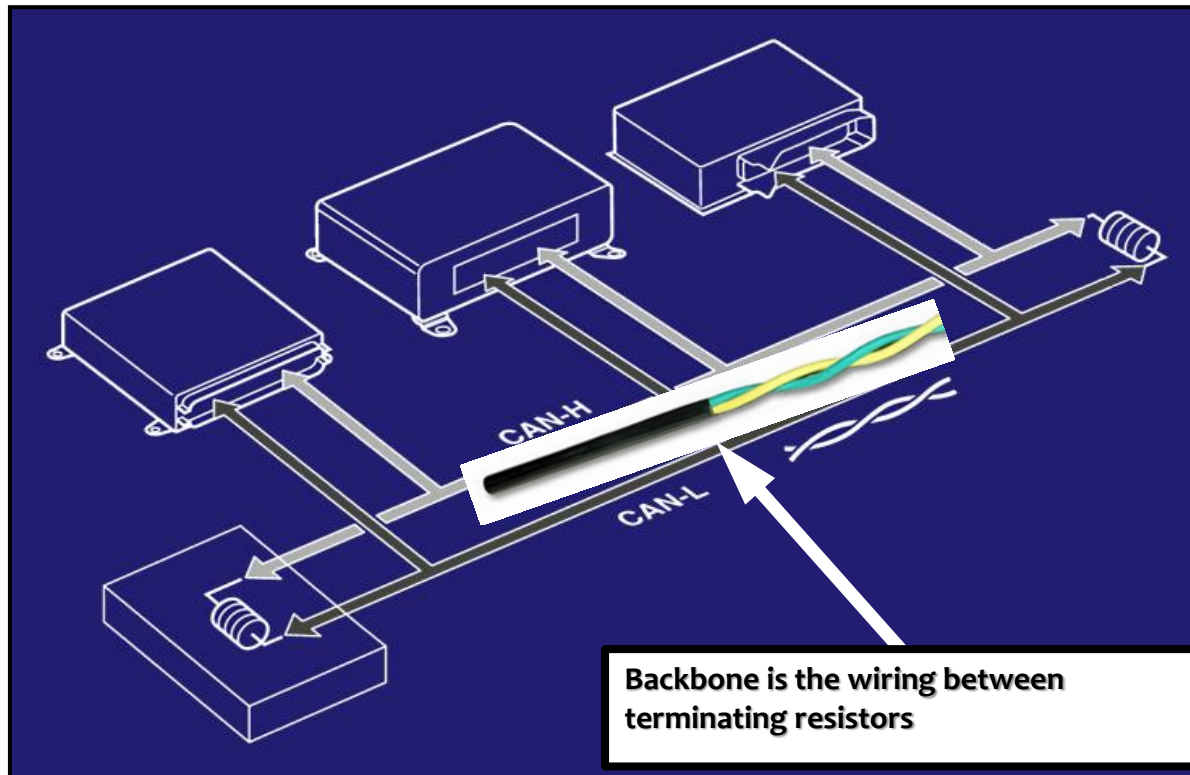


# CAN – Backbone

<https://truckmanualshub.com/>

## Backbone

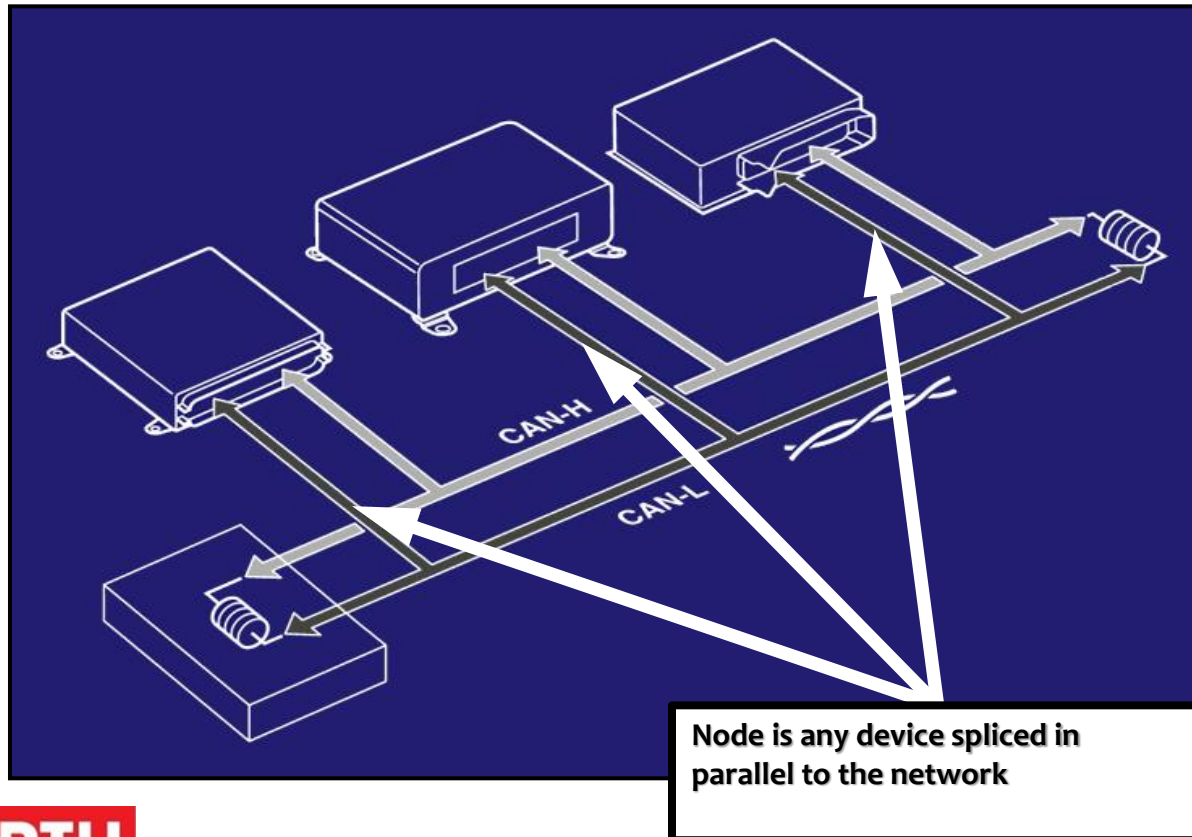
- Wiring between terminating resistors
  - One backbone for each CAN on the truck
  - Not one backbone for the whole truck



# CAN – Node

## Node

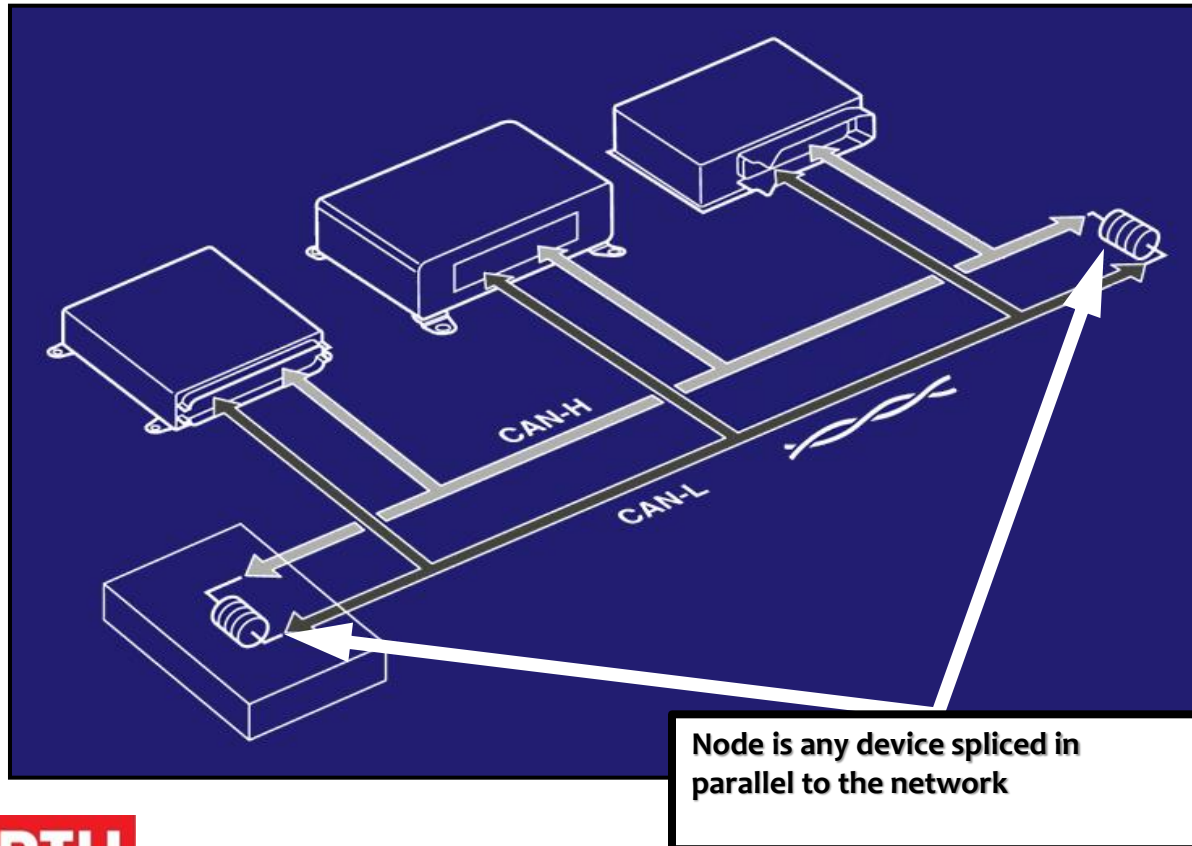
- Device spliced in parallel to the backbone, this includes wiring from splice to the device



# CAN – Resistors

## Terminating Resistor

- Resistor placed at one end of the backbone
- Can be in the harness or inside of an ECU





# J1939 – Details

**Local** ECUs are connected to a backbone circuit

- Backbone will be a twisted pair of yellow and green wires **between** the terminating resistors
  - CAN Hi **Yellow**
  - CAN Lo **Light Green**
  - Why twisted?
- Any EMI affects both wires



# Power Distribution Centers

## Class 8 – Heavy Duty

- **Wide Cab**

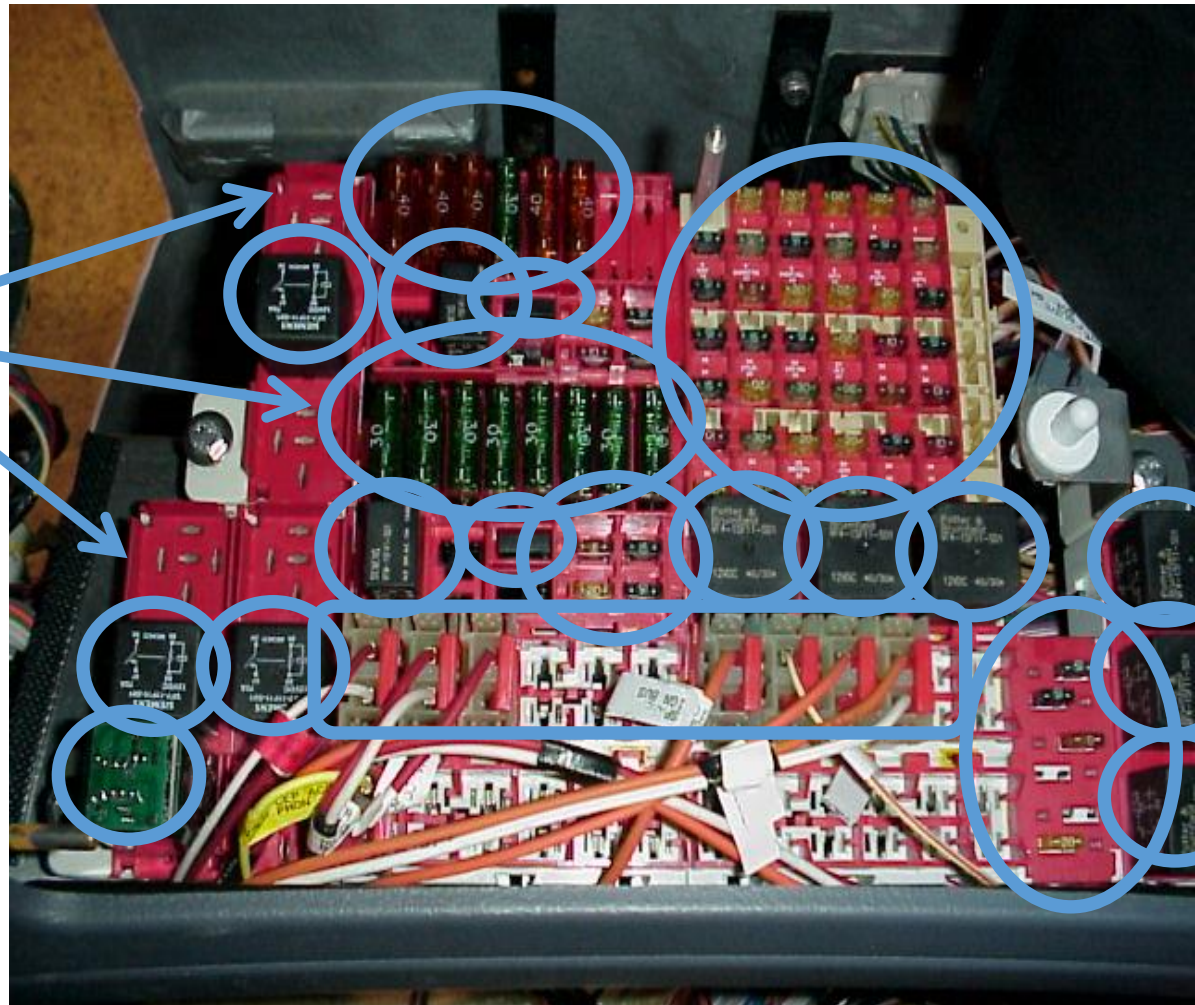
- T2000
- T700

## Part of IP Harness

Access: remove glove box

### E-Blocks

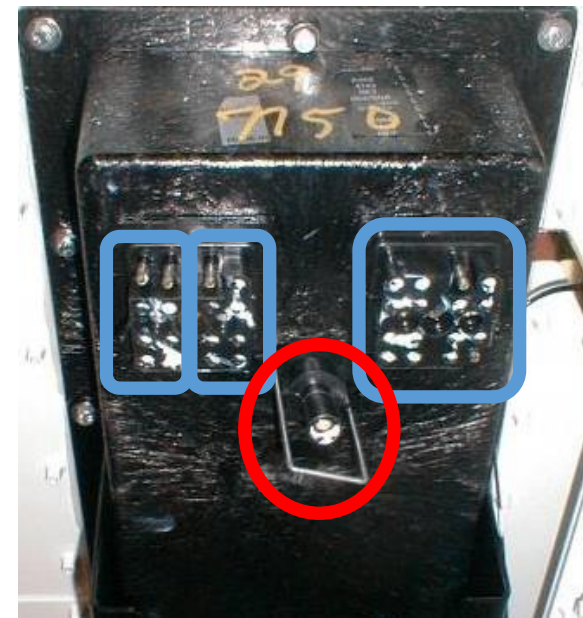
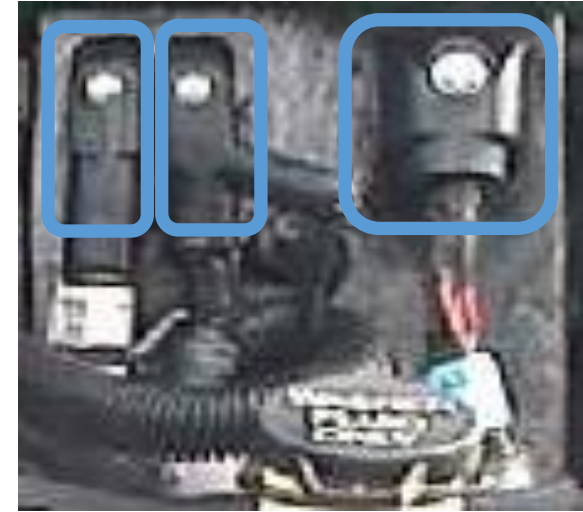
- (16) MAXI fuses
- (55) Mini fuses
- (4) Diodes
- (3) 70A Relays
- (11) ISO Relays
- (4) Half ISO Relays
- (1) Flasher
- (12) Spare Power taps



# Power Distribution Centers

## Class 8 – Heavy Duty, Off Highway

- **B-Cab - Pre 2001: KM815020**
  - T800, W900, T600, C500
  - KM815020, Service Manual
- **Engine side molded connectors:**
  - Chassis Harness (1) 16-way
  - Trailer Harness (1) 8-way
  - Headlamp Harness (1) 8-way
  - Power Feed Harness (1) 1-way



# Power Distribution Centers

## Class 8 – Heavy Duty, Off Highway

- **B-Cab - Pre 2001:**
  - T800, W900, T600, C500
  - KM815020, Service Manual
- **Cab side molded connectors:**
  - IP Harness (11) 8-ways
  - Spare BATT power strip

Half of the cover's vents open to the top, letting in water/snow.

Check bottom row of fuses & relays.

## Cab Side View





# Power Distribution Centers

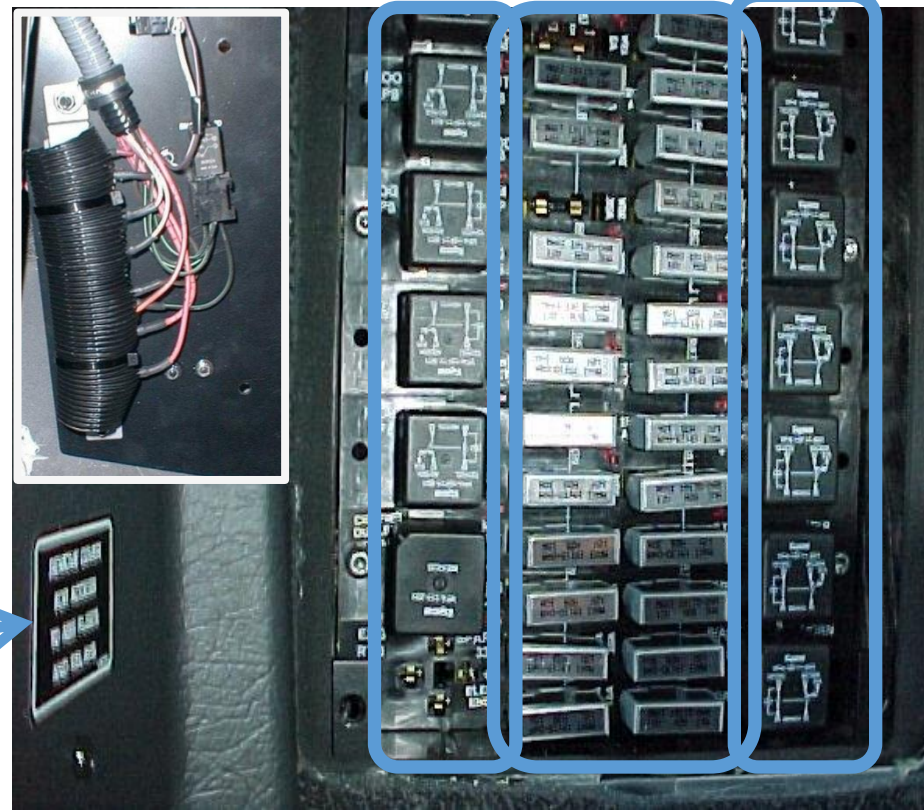
## Class 8 – Heavy Duty, Off Highway

- **B-Cab - Pre 2001:**
  - T800, W900, T600, C500
  - KM815020, Service Manual

(26) ATO Fuses or  
Type 1 Circuit Breakers (before 2001)  
Type 2 Circuit Breakers (after 2001)  
(14) ISO Relays  
(1) Flasher  
(1) HVAC Shorting Relay (after 2000)

Relays and circuit breakers in  
Driver's side kick panel

## Cab Side View

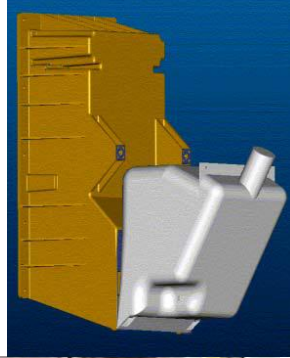


<https://truckmanualshub.com/>

# Power Distribution Centers

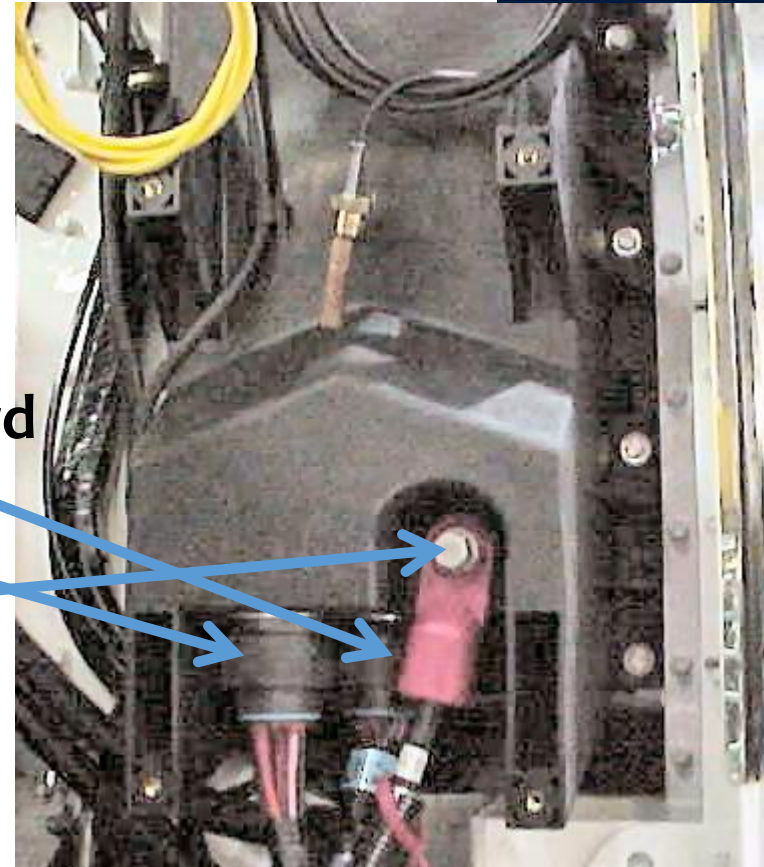
## Class 8 – Heavy Duty, Off Highway

- **B-Cab - Post 2001:**
  - T8, W9, T6, C5, T440
  - KM815055, Service Manual



### Engine side connections:

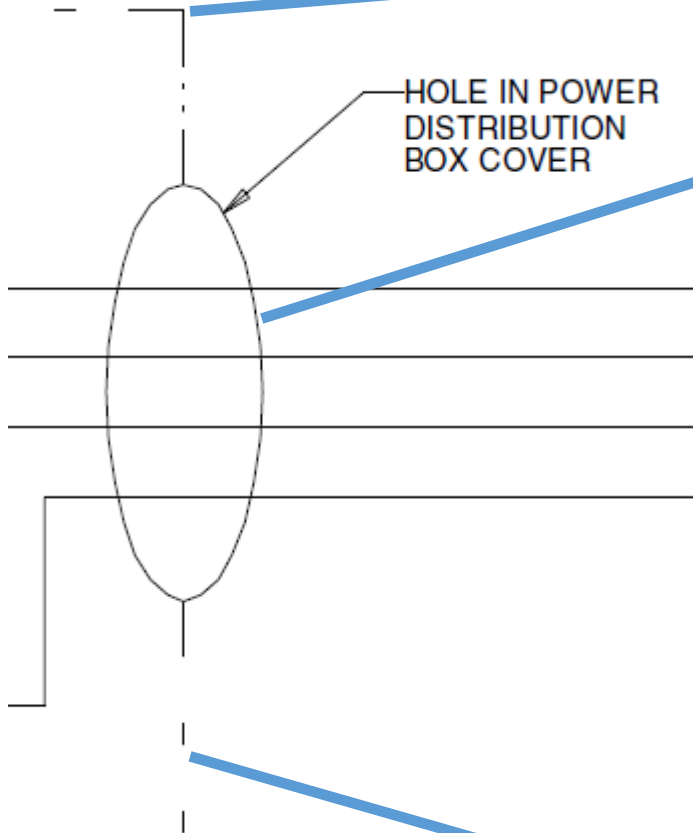
- **Chassis Harness, bottom rear**
  - (1) Deutsch HDP30 29-way
- **Trailer Harness, bottom forward**
  - (1) Deutsch HDP30 9-way
- **Power Feed Harness, on box**
  - (1) Battery cable terminal





# Power Distribution Centers

## Class 8 – Heavy Duty, Off Highway



1:  
T440  
Service Manual  
SS  
pedal  
with metal panel  
snapped on cover

XXX



# Power Distribution Centers

## Class 8 – Heavy Duty, Off Highway

- **B-Cab - Post 2001: KM815055**
  - T8, W9, T6, C5, T440
  - KM815055, Service Manual

**Block 92-4319 IP Harness drawing**

(60) ATO fuses and Type II Circuit breakers

Find CEP (central electrical panel)

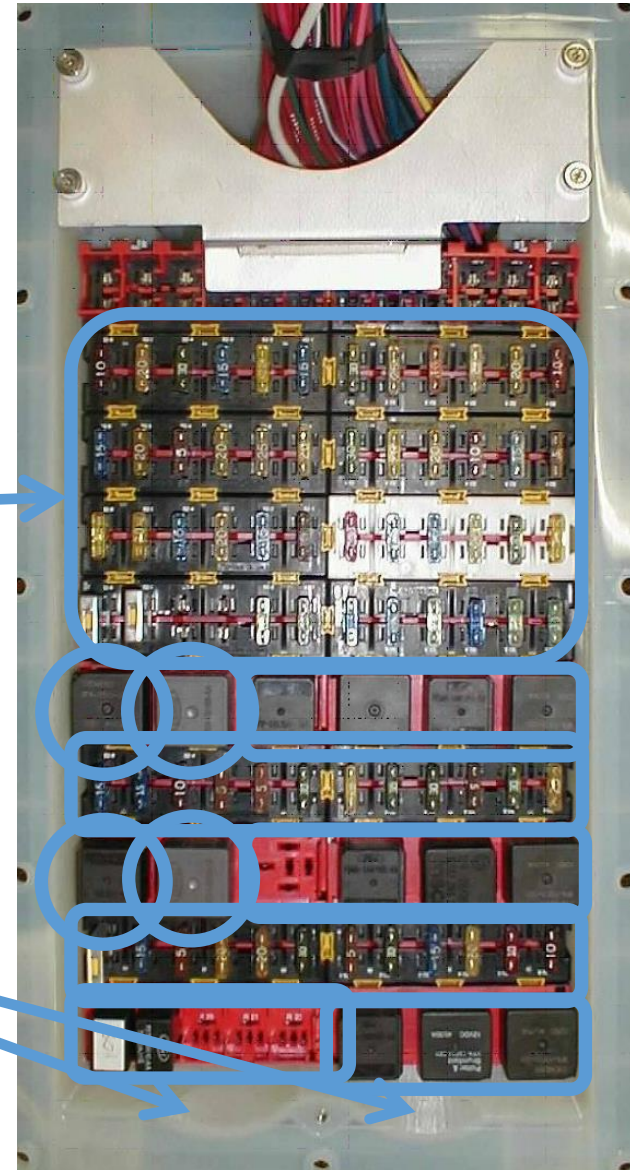
(2) 70A Relays: coils controlled by key switch  
connector part number: \_\_\_\_\_

(13) ISO Relays

Look up in ServiceNet.

(5) Half ISO Relays

Depressions let water out



# Power Distribution Centers

<https://truckmanualshub.com/>

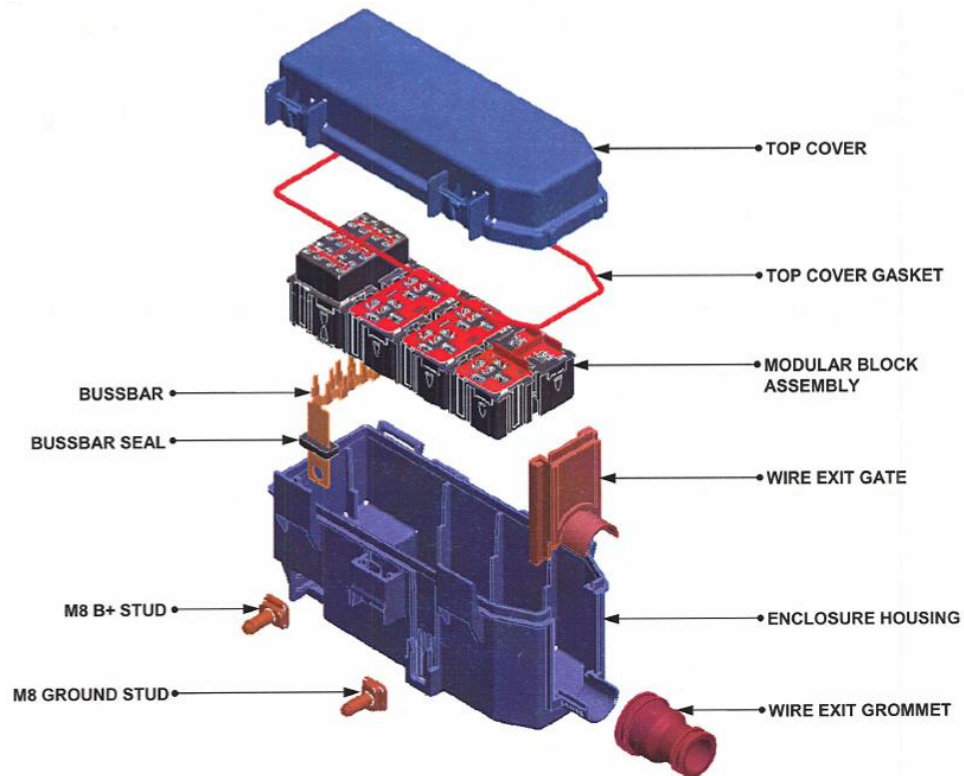
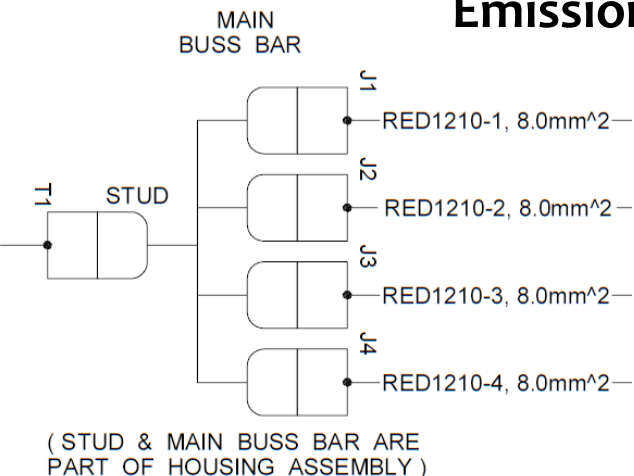
## Class 8 – Heavy Duty, Off Highway

- B-Cab – 2010 and on:
  - T8, W9, T6, C5, T440
- Chassis Load Center

Content varies

Engine Type

Emission Level





# Power Distribution Centers

## Class 8 – Heavy Duty, Off Highway

- NGP: T680, T880, 579, 567

## Class 7, 6, 5 – Medium Duty

- T370, T270, T170

TIB 34-051 – Probing guide for these load centers

**DO NOT USE** a test lamp or VOM probes in forked terminals!

- Use MINI fuse cut in half or a blown fuse!
- Use Power Probe #AA4, [www.powerprobe.com](http://www.powerprobe.com)

**GOOD**

**NO Repair**

**BAD**

P27-1147-0000

P27-1147-0000

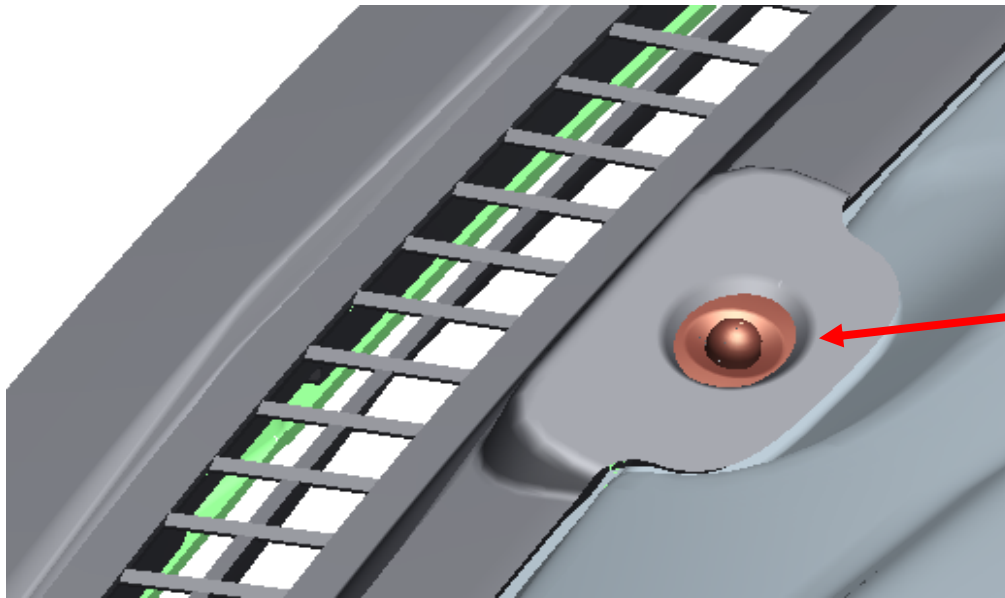
P27-1164-000

P27-1135-0100



**KENWORTH**

# Sun Load Sensor - DTC919



Sun load  
Sensor

Sensor resistance across pins A and B is 150K to 190K with no direct sun light

Sensor should have 5 volts to sensor and 0 to 5 volt signal from sensor

Check continuity of wires between sensor and HVAC control head connector

# Sun Load Sensor

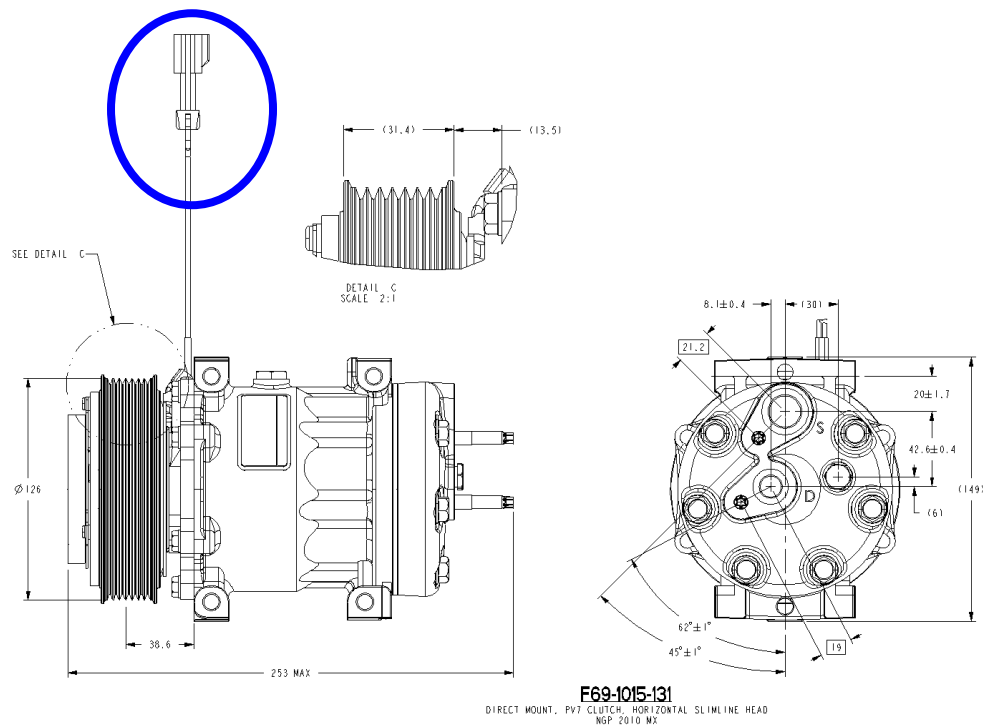
<https://truckmanualshub.com/>



**Secure sensor wiring harness connector to prevent it from falling down into the dash!**



# Compressor Clutch Relay Circuit - DTC 876



- Check clutch resistance between A and B – **2.8 to 4.4 ohms in clutch**
- Check mating connector (A = Gnd and B = 12 V input – need **at least 11.5 volts for clutch to operate properly.**
- Check control circuit to relay in PDC

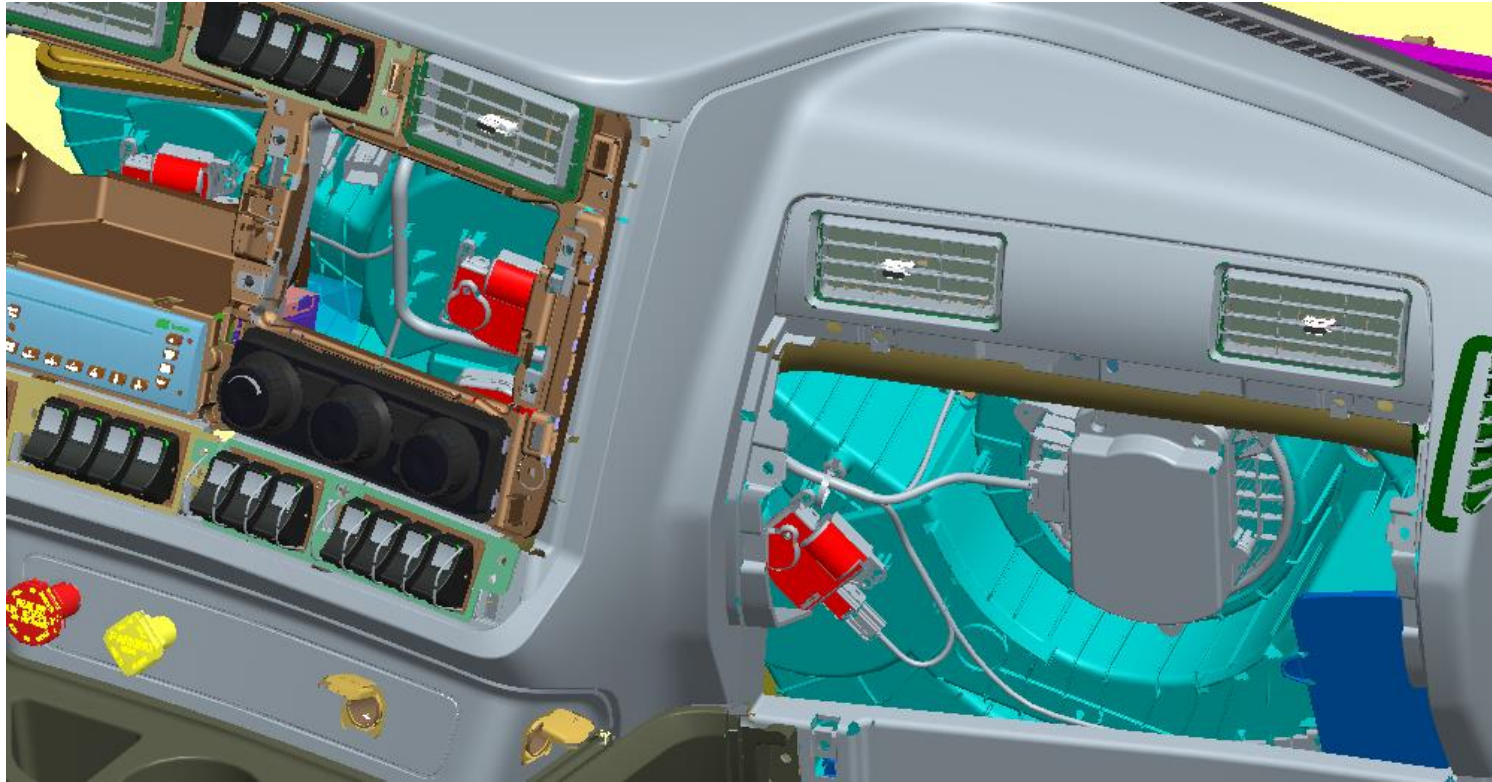
# Outside Air Temperature (OAT) Sensor

| Temp (deg C) | Min<br>Resistance<br>(kOhms) | Nom<br>Resistance<br>(kOhms) | Max<br>Resistance<br>(kOhms) |
|--------------|------------------------------|------------------------------|------------------------------|
| -40          | 315.108                      | 336.479                      | 358.975                      |
| -35          | 228.013                      | 242.682                      | 258.063                      |
| -30          | 166.804                      | 176.976                      | 187.599                      |
| -25          | 123.302                      | 130.422                      | 137.829                      |
| -20          | 92.054                       | 97.083                       | 102.294                      |
| -15          | 69.376                       | 72.957                       | 76.654                       |
| -10          | 52.758                       | 55.329                       | 57.972                       |
| -5           | 40.469                       | 42.327                       | 44.23                        |
| 0            | 31.298                       | 32.65                        | 34.03                        |
| 5            | 24.401                       | 25.391                       | 26.397                       |
| 10           | 19.173                       | 19.902                       | 20.641                       |
| 15           | 15.17                        | 15.71                        | 16.255                       |
| 20           | 12.089                       | 12.491                       | 12.895                       |
| 25           | 9.7                          | 10                           | 10.3                         |
| 30           | 7.797                        | 8.055                        | 8.315                        |
| 35           | 6.309                        | 6.532                        | 6.757                        |
| 40           | 5.132                        | 5.324                        | 5.519                        |
| 45           | 4.202                        | 4.368                        | 4.537                        |
| 50           | 3.459                        | 3.602                        | 3.748                        |
| 55           | 2.861                        | 2.986                        | 3.113                        |
| 60           | 2.38                         | 2.488                        | 2.599                        |
| 65           | 1.989                        | 2.083                        | 2.179                        |
| 70           | 1.67                         | 1.752                        | 1.836                        |
| 75           | 1.408                        | 1.48                         | 1.554                        |
| 80           | 1.192                        | 1.255                        | 1.32                         |
| 85           | 1.015                        | 1.07                         | 1.127                        |

- Negative Temperature Coefficient (NTC) Sensor
- Located on driver's side mirror
- Check dash display to confirm sensor functioning relative to ambient temperature

# Cab Actuators

<https://truckmanualshub.com/>



- DTC 3981 - panel mode actuator
- DTC 3986 - temperature actuator
- DTC 3984 - fresh / recirc actuator
- DTC 520196 - defrost mode actuator
- DTC 520197 - floor mode actuator

# Access to Service Information

<https://truckmanualshub.com/>

Unfortunately due to purely commercial nature of HD and off road, plus high RD and now governmental regulation costs, access to service information is strictly controlled.

Kenworth's primary responsibility is to provide it's Dealers with up to the moment information to fulfill warranty responsibilities.

Secondary service information access is available, in various levels and costs to:

- Fleets
  - Direct
  - Dealer Sponsored
- Independent Service Providers
- Colleges and Technical Schools
- Body Builders

# Access to Service Information

<https://truckmanualshub.com/>

- Paccar, as with all HD manufacturer's, is very protective of it's intellectual information. It does, however, realize that a legitimate need for service information exists outside the Dealer environment.
- The single "best" approach for ISPs to service information is to develop a working relationship with your local KW/PB dealer.
- Dealer Sponsored Fleet
  - Service Information not for sale otherwise
  - ESA/Davie Software/Scan Tool
  - Parts
- Fleet Web ECAT (subscription cost type arrangement)
  - Service Information, bulletins, specs, and Wiring Diagrams
- Colleges & Technical Schools
  - Get a Dealer Sponsored Fleet Designation
  - Full access to information, diagrams, flat rate times, etc
- Right to Repair Policy
  - Yet to be completed
  - Will change policies outlined above

# Truck System Information



“B” Cab (1.9m cab)  
W900 / T440 / T660 / T800 / C500 / 963

# Kenworth Models

## Class 8 – Heavy Duty:

- B-Cab Series: T440, C500, T600 -> T660, T800, W900



<https://truckmanualshub.com/>

# Kenworth Models

- **Monster Trucks:** Off highway heavy duty up to 400,000# GVW



# B-Cab: <https://truckmanualshub.com/> Apr 1994 to Feb 2001

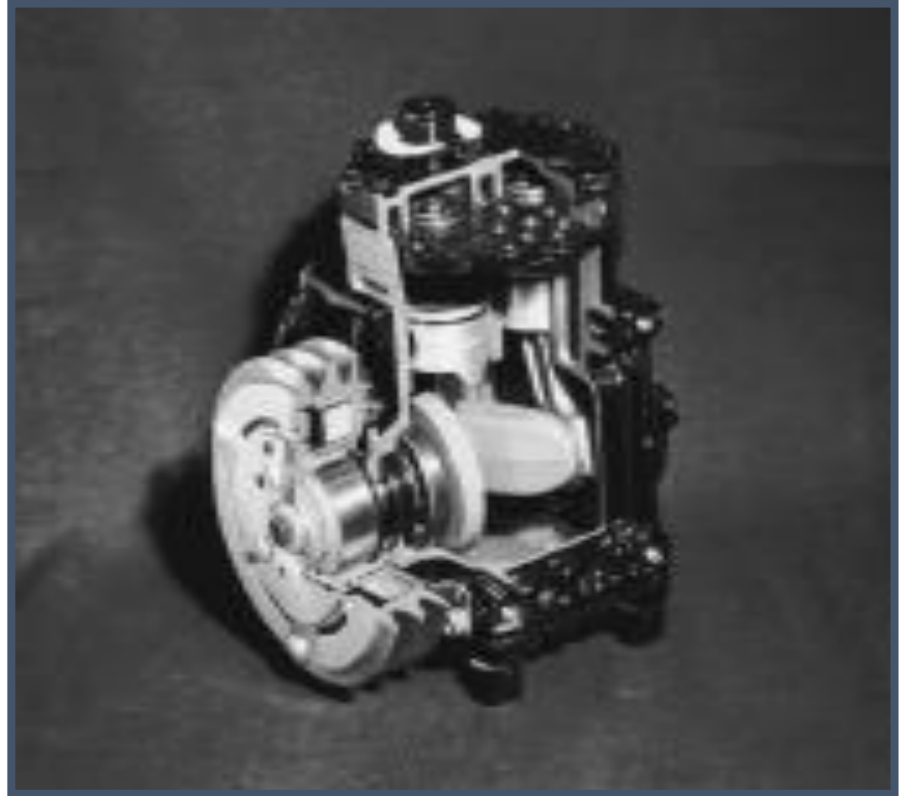
- Pneumatic (air) actuated mode controls
- Cable actuated heater control valve
- 3 Blower fan speeds (Low, Med, High) controlled by a resistor block
- 1 HVAC Relay (coil grounded through fan switch)
- Binary Pressure Switch

# Early Climate Control Compressor

<https://truckmanualshub.com/>

## Standard Piston Type Compressor

- Pistons lubricated with oil from bottom of the case
- Oil level should be measured each time the system is opened
- Vertical Mount, curved dip stick
- Horizontal mount, straight dip stick
- **Discontinued standard use in 2001,**  
\* limited use for some export, non-emission apps. going forward





<https://truckmanualshub.com/>

# B-Cab Controls

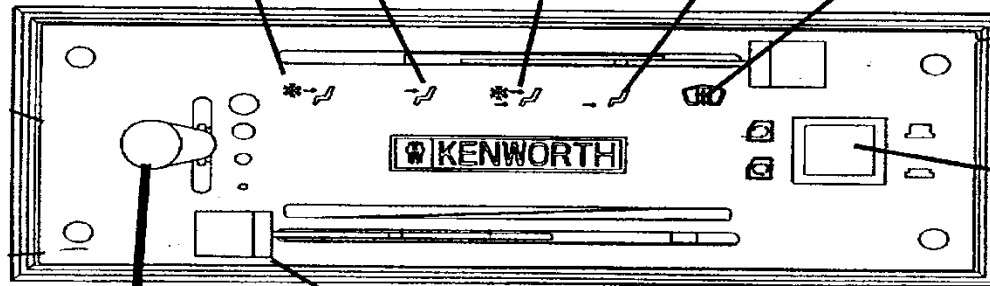
**A/C :** CLOSSES THE COMPRESSOR MICRO SWITCH AND DIRECTS THE AIR FLOW THROUGH THE DASH VENTS.

**BI-LEVEL:** CLOSSES THE COMPRESSOR MICRO SWITCH AND DIRECTS THE AIR FLOW THROUGH THE FLOOR AND DASH VENTS.

**HEAT:** DIRECTS THE AIR FLOW THROUGH THE FLOOR VENTS. THE ACTUAL HEATING IS CONTROLLED WITH THE TEMPERATURE LEVER.

**VENT:** OPENS THE COMPRESSOR MICRO SWITCH AND DIRECTS AIR FLOW THROUGH THE DASH VENTS.

**DEFROST:** CLOSSES THE COMPRESSOR MICRO SWITCH, DIRECTS THE AIR FLOW TO THE WINDSHIELD VENTS AND OPENS THE FRESH AIR DOOR.



**FRESH/ RECIRCULATION** WHEN THE BUTTON IS OUT, THE FRESH AIR DOOR OPENS. OUTSIDE AIR FLOWS THROUGH THE VENTS. WHEN THE BUTTON IS PUSHED IN, THE CAB AIR IS RECIRCULATED.

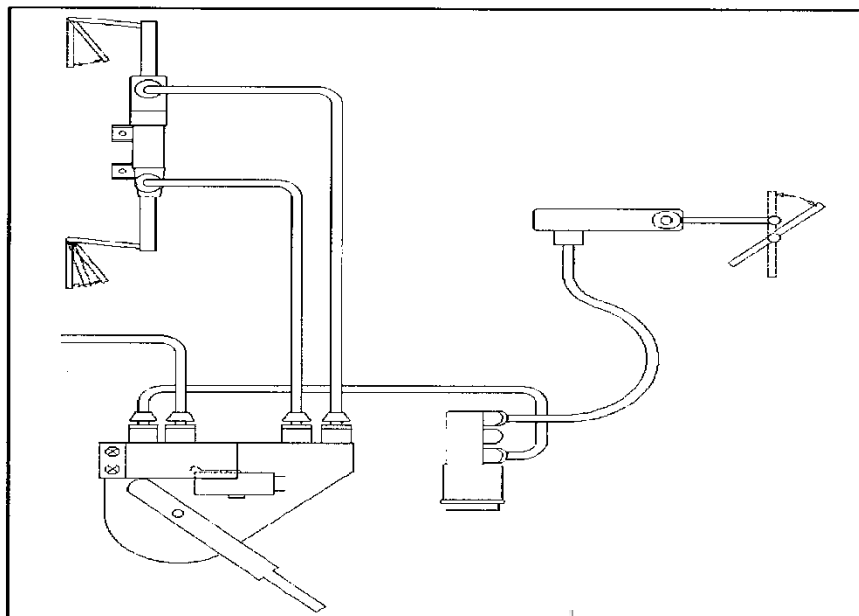
**BLOWER SWITCH:** FOUR POSITIONS: OFF, LOW, MEDIUM, AND HIGH. MUST BE ON FOR THE A/C SYSTEM TO WORK

**TEMPERATURE LEVER:** OPENS THE VALVE THAT ALLOWS HOT ENGINE COOLANT TO FLOW THROUGH THE HEATER CORE. THE COOL POSITION COMPLETELY CLOSSES THE VALVE, THE WARM POSITION COMPLETELY OPENS IT.

## Used on B-Cab from 1995 to 2001.



# Actuator Control



Early B-CAB uses a pneumatic pressure system for door and vent controls

**Year range:**

**1995 to 2001**

| Mode Control Position | Heat/AC Air to Cylinder Door | AC/Defrost Air to Cylinder/Door | Fresh/Recirc Air to Cylinder/Door | Compressor Clutch Microswitch |
|-----------------------|------------------------------|---------------------------------|-----------------------------------|-------------------------------|
| A/C                   | No Pressure/<br>Closed       | Pressure/<br>Closed             | Pressure/<br>Closed               | Closed                        |
| Vent                  | No Pressure/<br>Closed       | Pressure/<br>Closed             | Optional                          | Open                          |
| Bi-Level              | Pressure/<br>1/2 Open        | Pressure/<br>Closed             | Optional                          | Closed                        |
| Heat                  | Pressure/<br>Open            | No Pressure/<br>Open            | Optional                          | Open                          |
| Defrost               | No Pressure/<br>Open         | No Pressure/<br>Open            | No Pressure/<br>Open              | Closed                        |

# Freeze Switch



Both B-Cab and T2000 use the freeze switch in the ground side of the HVAC relay control circuit. The freeze switch *opens* at **31.5° F** and *closes* at **40°F**.

(The B-Cab freeze switch is located in the blower housing, on the engine side of the fire wall)

# Testing Thermostatic Switch (N/C)

<https://truckmanualshub.com/>



If freeze switch fails closed, compressor runs all the time and never cycles – evaporator eventually freezes up

If freeze switch fails open, the compressor will never engage.

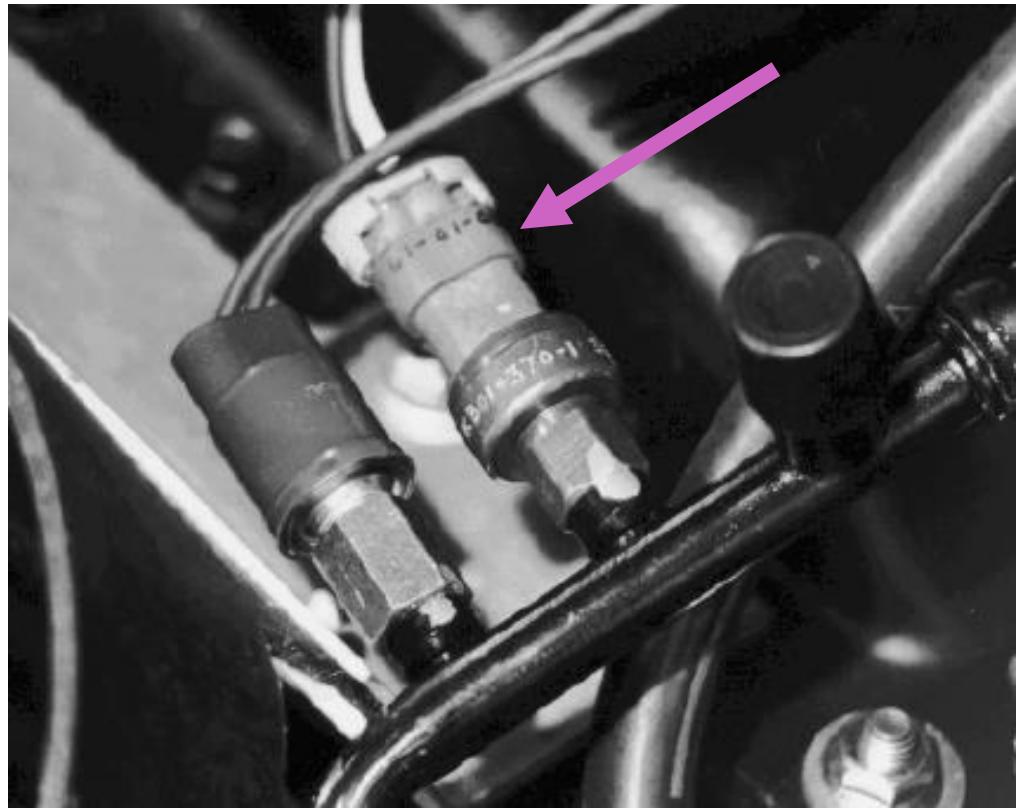
If wrong calibration, we will not meet duct temperature

# Pressure Switch

<https://truckmanualshub.com/>

B-Cab uses a binary cutout switch on the power side of clutch:

- Low pressure setting opens at 26 psi
- High pressure setting opens at 400 psi



# B-Cab HVAC Changes By Years

<https://truckmanualshub.com/>

- April 1994 to Feb. 2001: use W/D's R115-5646, sleeper P94-1333
- March 2001 to Dec 2001 (**two HVAC relays and electronic controls & actuators**): use W/D P94-1084
- Dec 2001 to June 2004 (**two HVAC relays and electronic controls & actuators**): use W/D P94-1391
- July 2004 to Jan 2007 (**added in the linear power module and electronic actuated water valve (NBI)**): DO NOT use P94-1459, use P94-1587. Sleeper use P94-1478
- NAMUX 2 with 07 emissions engine (**eliminated binary switch and added in high and low pressure switches at expansion valve**): use P94-1698
- **Changed to NAMUX 3 for 2010 engines and sleeper**: use P94-1852 / P94-1958

# Operating Temperatures

## CONVENTIONAL MODELS WITHOUT SLEEPER

| Outside Temperature in Degrees F. | Center Duct Temperature | High Side Gauge Reading (PSI) | Low Side Gauge Reading (PSI) |
|-----------------------------------|-------------------------|-------------------------------|------------------------------|
| 70                                | 43 - 49                 | 95 - 130                      | 7 - 14                       |
| 80                                | 47 - 51                 | 100 - 135                     | 10 - 17                      |
| 90                                | 53 - 57                 | 120 - 155                     | 14 - 21                      |
| 100                               | 59 - 63                 | 155 - 185                     | 19 - 26                      |
| 110                               | 65 - 69                 | 185 - 205                     | 24 - 31                      |
| High Humidity Adjustment          | 0 - 15                  | No change                     | High side of range           |

If the humidity is over 70%, the duct temperatures will be from normal to 15° higher

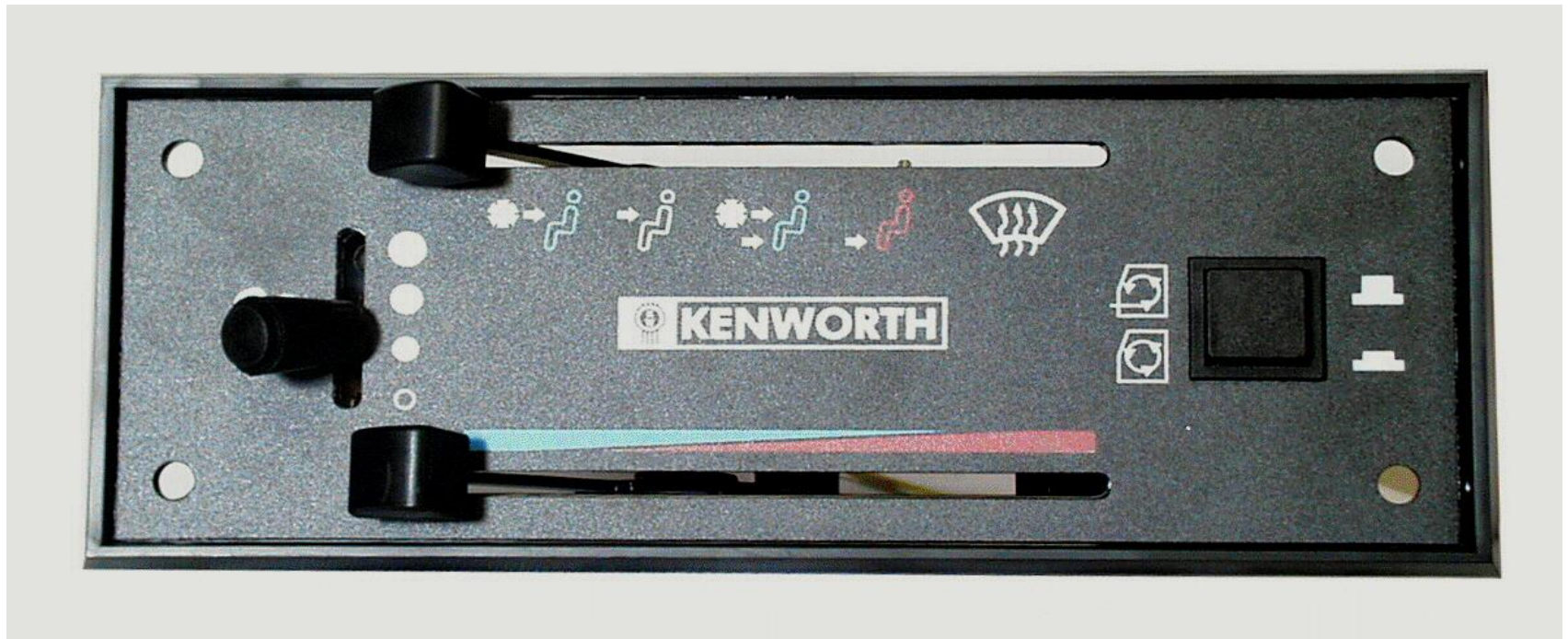


# B-Cab: <https://truckmanualshub.com/> Mar 2001 to Dec 2001

- Electrically actuated mode controls
- Cable actuated heater control valve
- 3 Blower fan speeds (Low, Med, High) controlled by a resistor block
- 2 HVAC Relays
- Binary Pressure Switch

<https://truckmanualshub.com/>

# Blower Controls



# Mode Actuator Specifications

<https://truckmanualshub.com/>

## Face Mode, Position 1

11 – 12 volts – signal wire to ground

## Bi-Level Mode, Position 2

9 to 10 volts – signal wire to ground

## Floor Mode, Position 3

6 – 7 volts – signal to ground

## Blend Mode, Position 4

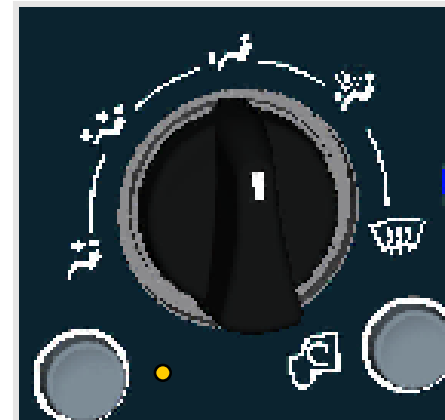
2.5 – 3.5 volts signal to ground

## Defrost Mode, Position 5

0 to 1 volts – signal to ground

**Fresh Air Position** (+) 11-12 volts (A to B)

**Recirc. Position** (-) 11-12 volts (A to B)



# B-Cab: Dec 2001 to June 2004

<https://truckmanualshub.com/>

- Electrically actuated mode controls
- Cable actuated heater control valve
- 3 Blower fan speeds (Low, Med, High) controlled by a resistor block
- 2 HVAC Relays
- Binary Pressure Switch



# Hot Water Valve



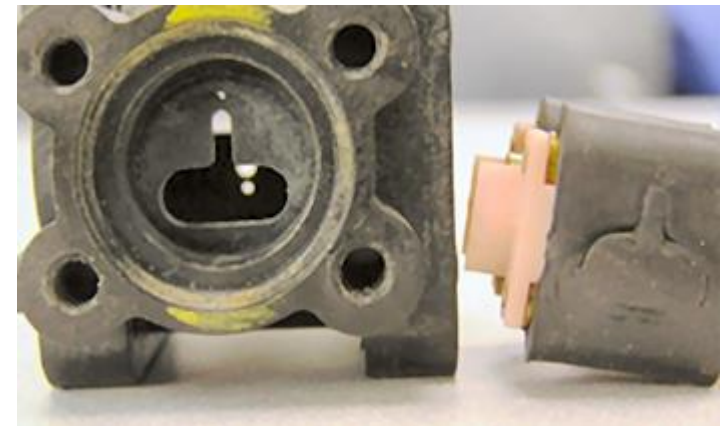
Kenworth utilizes hot water valves in many HVAC systems, with two basic types:  
Cable operated and Electronic

**Cable Operated** – T-Series M/D prior to Jan 2016, K-Series M/D, B-Cab prior to July 2004

**Electronic** – B-Cab after July 2004, T-Series M/D after Jan 2016

# Common Issue - Water Valves Leaking

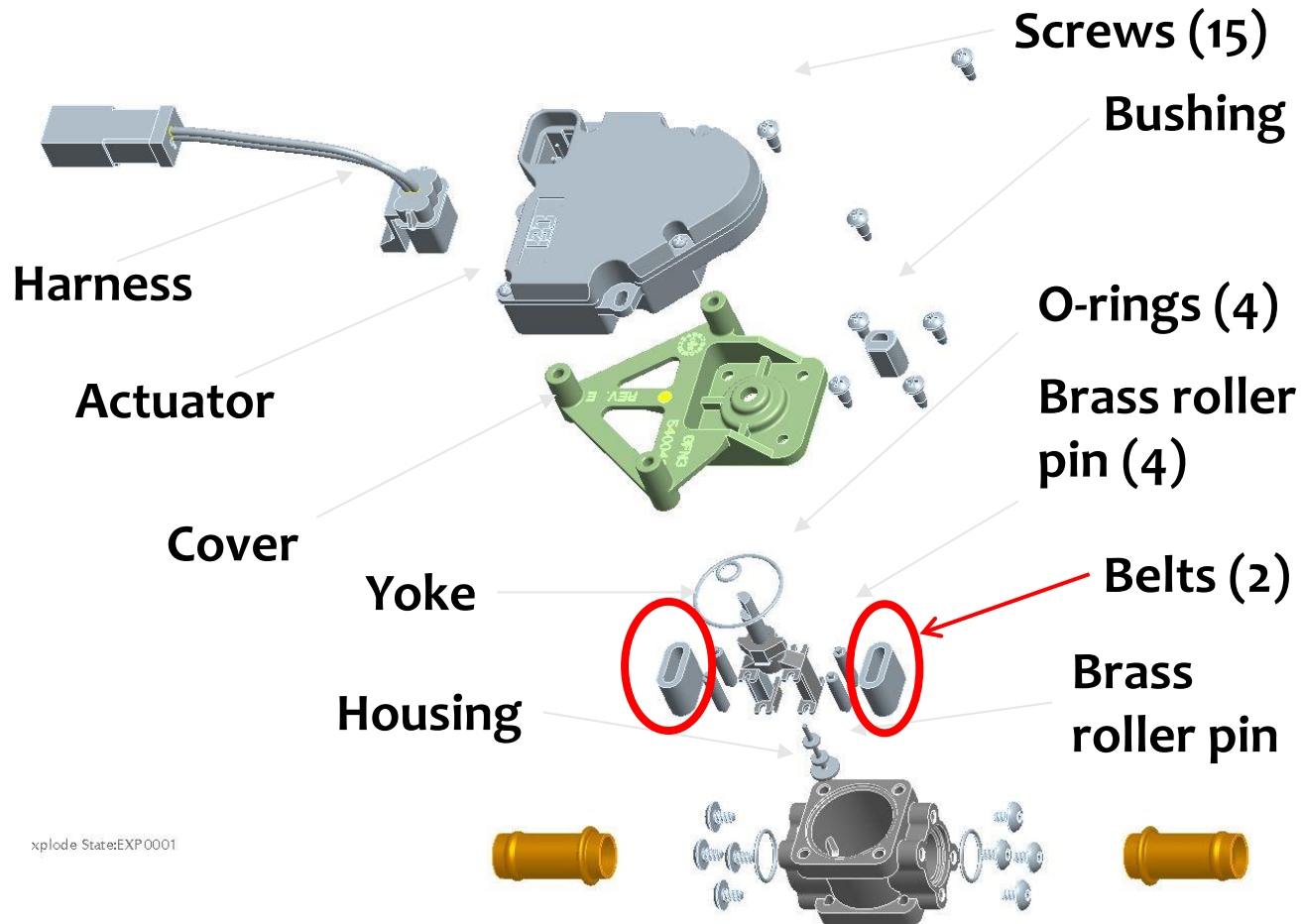
- Complaint
  - Water valve rubber seal becomes wedged in valve which doesn't allow the driver to shut off the heat
- Cause
  - Coolant or Coolant Additives causes rubber to swell
  - Chassis Affected
    - Legacy models
- Correction
  - Revised part implemented
  - Gen 2 valve does not have a belt to swell, the housing has a material developed specifically for Organic Acid Technology (OAT) coolant which eliminated stripping/cracking
  - Gives enhanced performance using with all typical automotive coolants, at elevated temperatures and pressures commonly seen in emissions engines





# Early Heater Control Valve - Belt Style

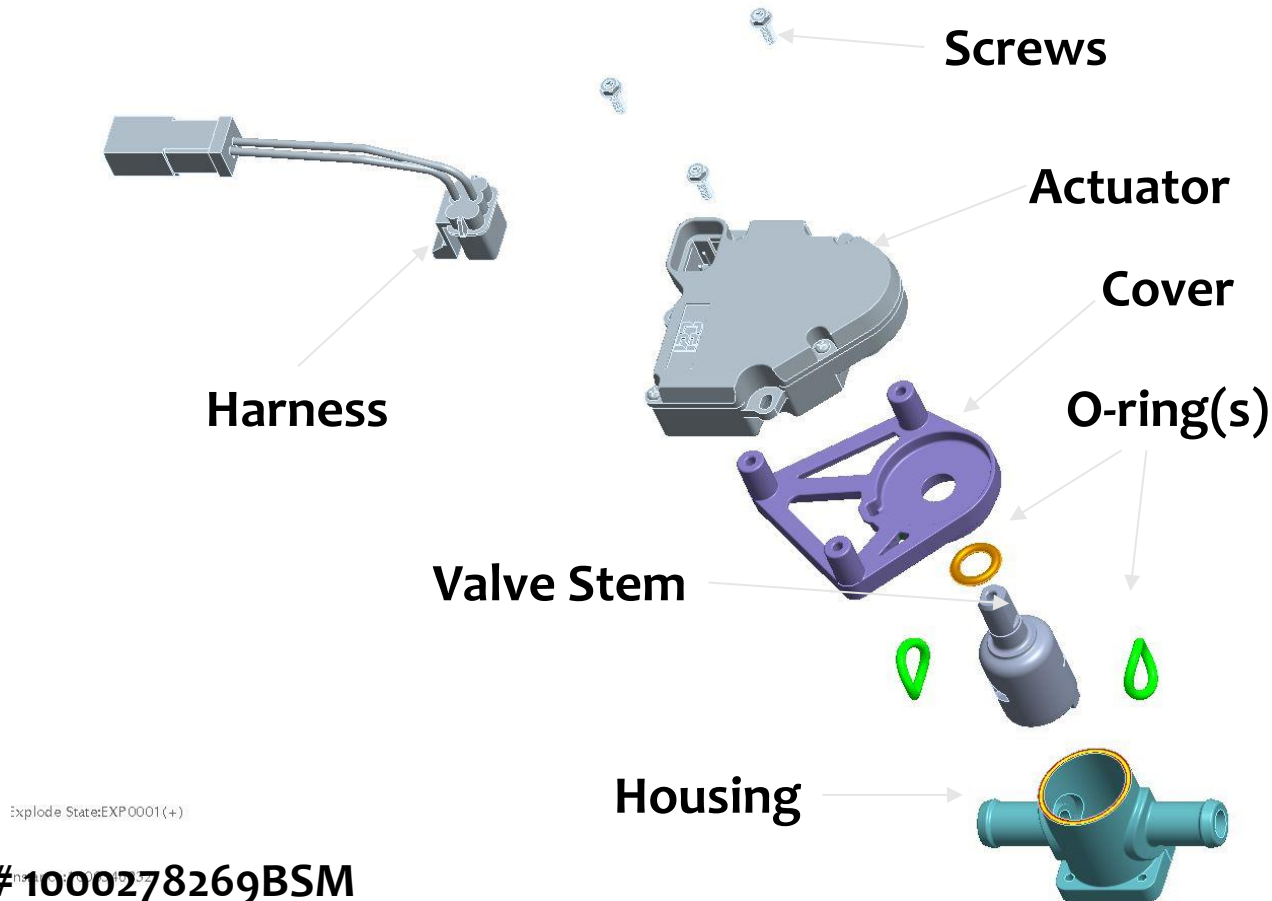
## 34 Components



# Heater Control Valve Components – Gen II

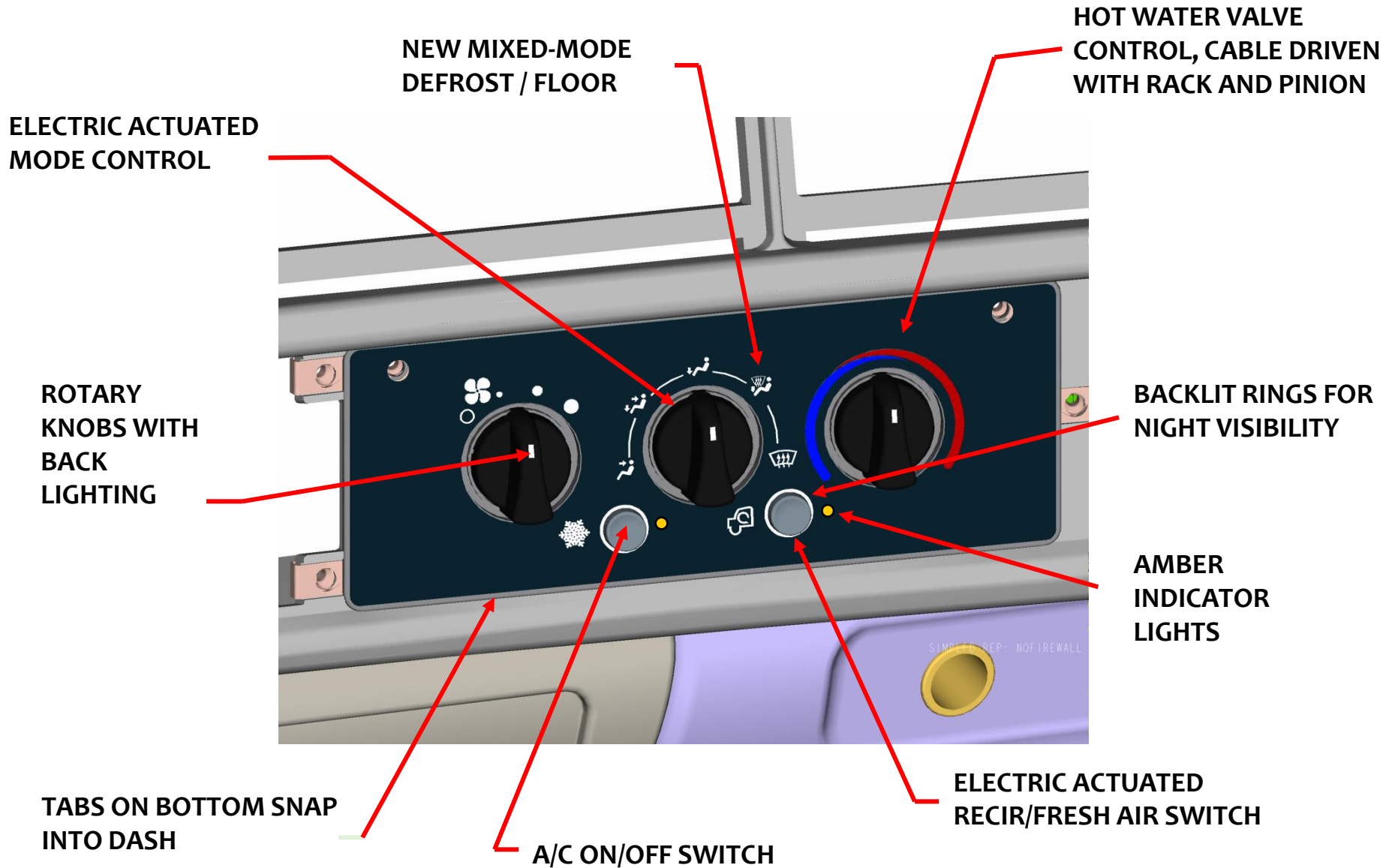
<https://truckmanualshub.com/>

## 11 Components



# HVAC Control Panel

<https://truckmanualshub.com/>



# Kenworth HVAC Systems

- B-Cab HVAC Upgrade Changes
- March 5, 2001 through December 2001



# P. D. Box Changes

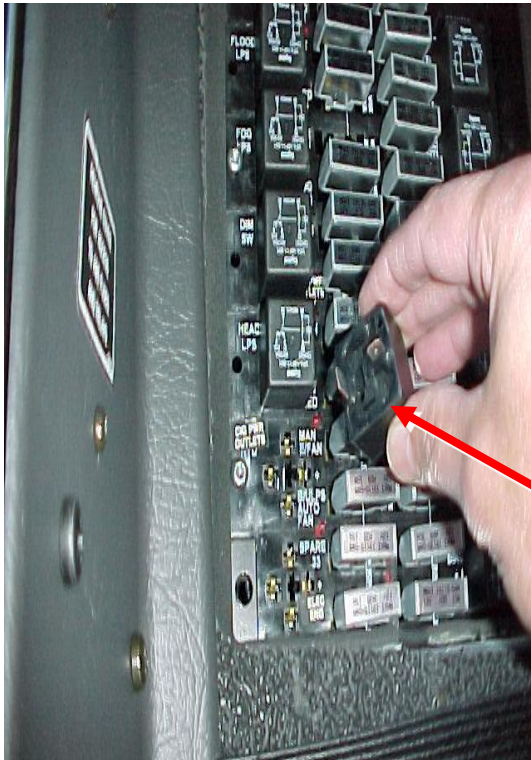
<https://truckmanualshub.com/>

The functions of two relay positions have changed:

1. The ENG RTD 1 relay position has been relabeled as “Cig. Pwr. Outlet” This jumper wire (P/N VF4111Z01) now powers the cigar lighter and power wells in the cup holder. NOTE: The control circuit (85 & 86) is a live circuit and so if the jumper is replaced with a standard relay, the circuit will work but there will be a milliamp parasitic draw all the time
2. The LOW MIR HT. Relay is relabeled “HVAC Control” and powers the HVAC Control Head and electronic actuators. The Cab A/C relay still controls HVAC clutch as it previously did.

# P.D. Box

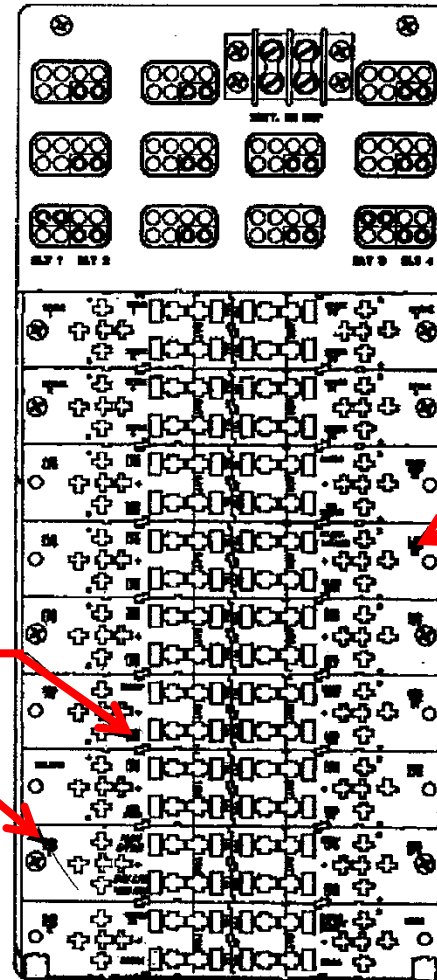
B Cab Upgrade to PD Box  
from March 3, 2001 Until  
CEP Style was introduced  
December 2001



WAS: ENG  
RTD  
IS: CIG PWR  
OUTLETS

WAS: ENG RTD 1  
IS: CIG PWR  
OUTLETS

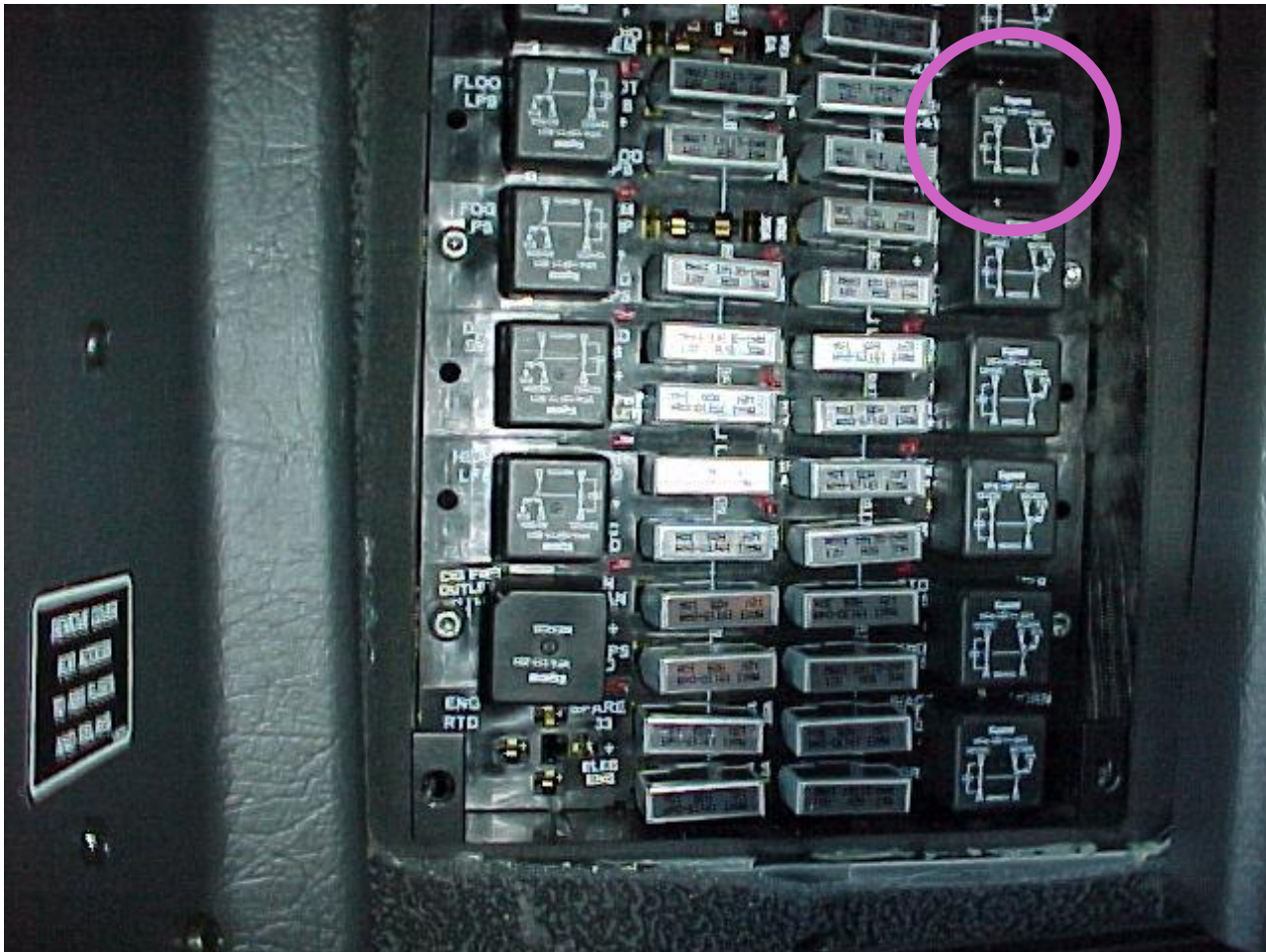
NOTE: Use Jumper  
Relay P/N VF4111Z01  
in this location



WAS: LOW  
MIR HT  
IS: HVAC  
CONTROL



## B-CAB - Sends Power To The A/C Clutch



# B-Cab: <https://truckmanualshub.com/> July 2004 to Jan 2007

- Electrically actuated mode controls
- Electrically actuated heater control valve
- 2 HVAC Relays
- Linear Power Module
- Binary Pressure Switch

<https://truckmanualshub.com/>

# Electronic Hot Water Valve



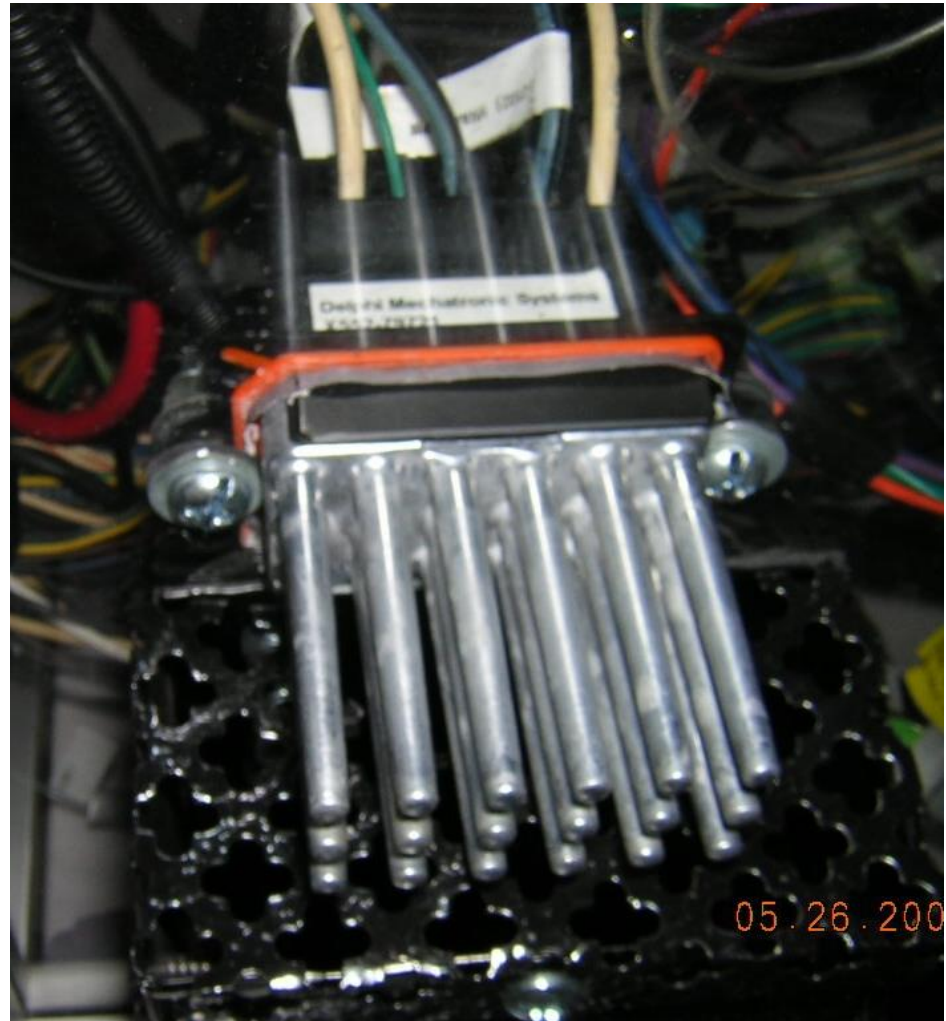
**Five Wire Electronic Actuator**



# Linear Power Module

<https://truckmanualshub.com/>

- Check for a varying voltage on the gray control wire when the fan speed knob is moved on the control head.
- Voltage on the black wire should also vary in conjunction with the fan speed knob and gray control wire.
- **During fan operation, there may be voltage on the cooling rods, depending upon fan speed setting.**



**Replaces the Resistor Block / Thermal Fuse**

# B-Cab: NAMUX 2 with '07 Emissions Engine

<https://truckmanualshub.com/>

- Electrically actuated mode controls
- Electrically actuated heater control valve
- 2 HVAC Relays
- Linear Power Module
- High & Low Pressure Switches

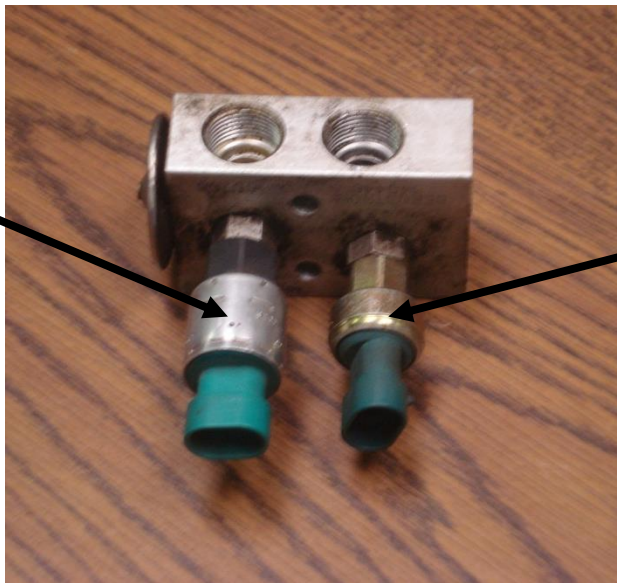
# B-Cab low pressure switch

(2007 – present)

- Cut out = 10 +/- 4 PSI
- Cut in = 30 +/- 4 PSI

Faster cycle times in cooler weather because low pressure switches off compressor before freeze switch reaches set point

Low  
Pressure  
switch



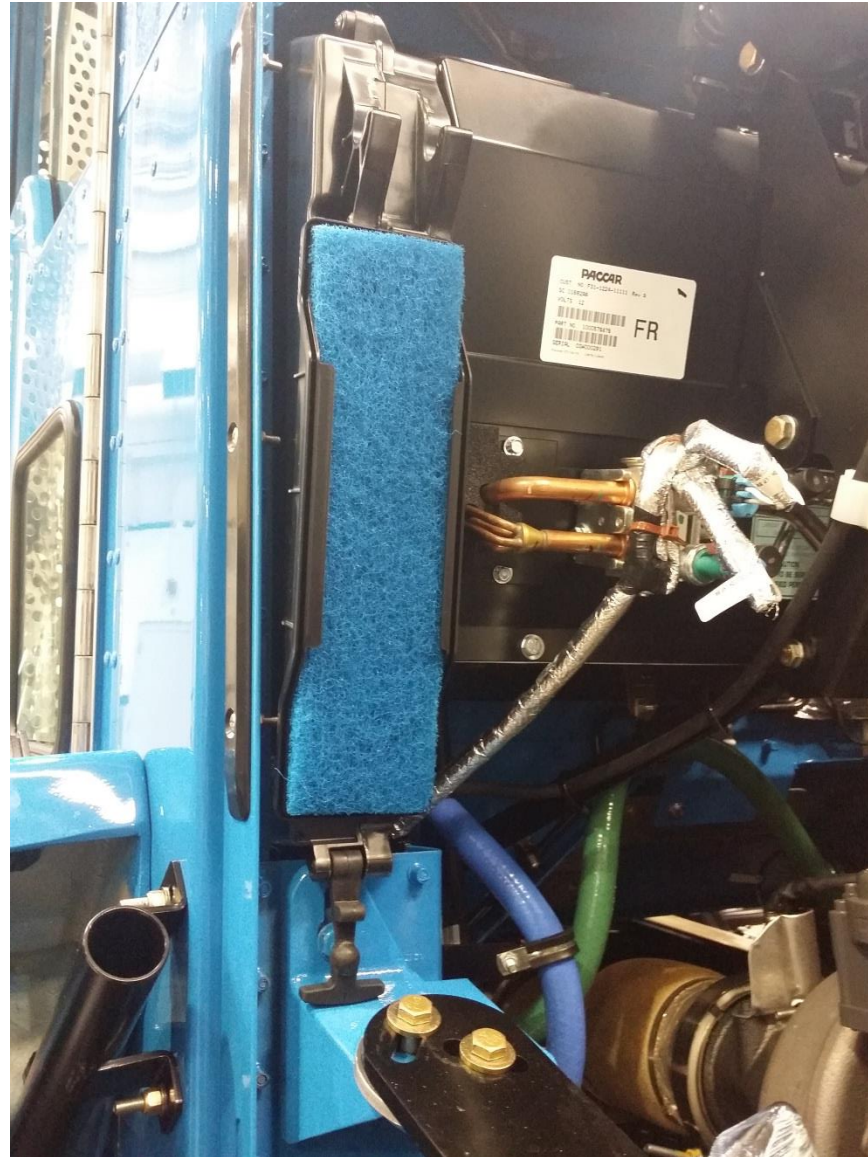
High  
Pressure  
switch

Fitting Assembly Torque:  
3-5 Nm (27-44 in. lbs.)

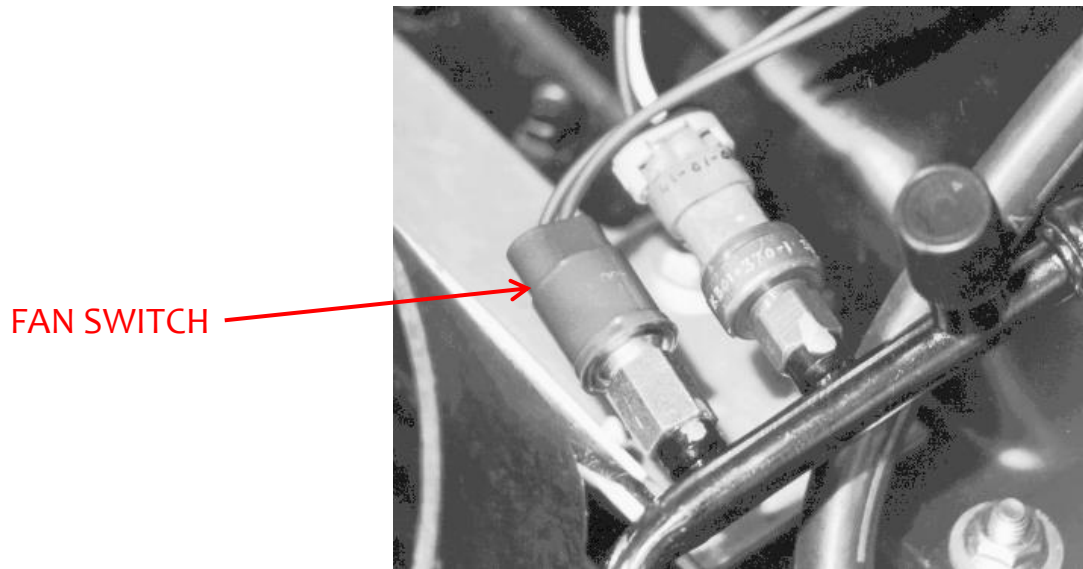


# B-Cab Fresh Air Filter

<https://truckmanualshub.com/>



# Engine Fan Override Switch



- The fan switch engages the electric engine fan when **high side pressures exceeds  $275 \pm 10$  psi.**
- The fan switch disengages the electric engine fan when the **high side pressures fall below  $230 \pm 10$  psi.**
- Fan switches on COE models, off highway models and with roof-mounted condensers may use a fan switch with higher set points. This reduces fan operation because of a slightly more efficient condenser which causes slightly lower operating pressures.

# Engine Fan Override Switch

P92-1873 page 5

P92-2040 page 7

P92-2147 Page 7

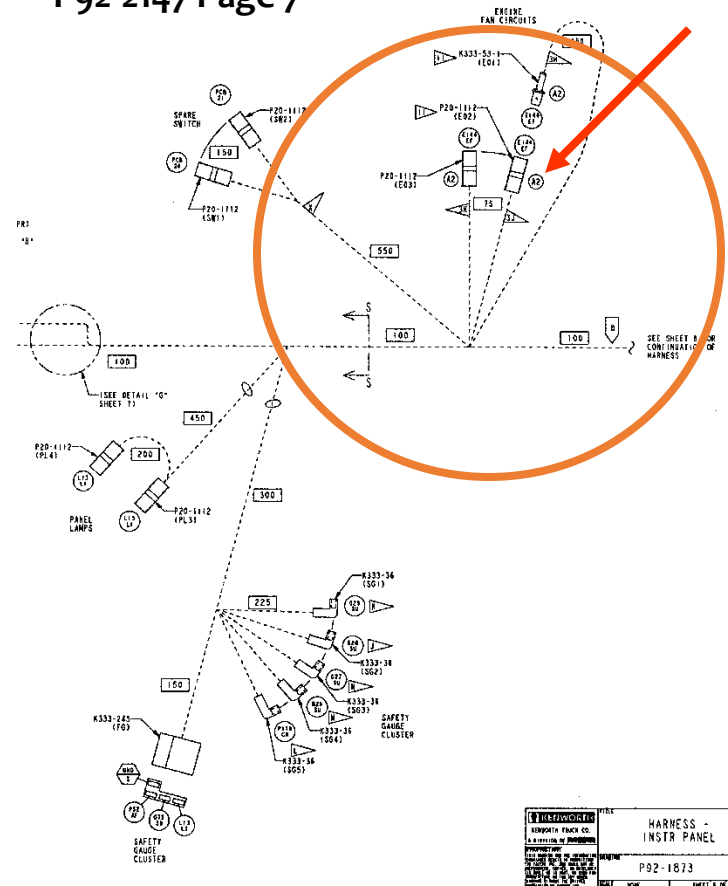
USAGE NOTE:  
USE ON B1/B11/B111 CABS WITH ALL ENGINES  
EXCEPT DUC ENGINES.

Fan Logic for Cat and Cummins are opposite (Cat - Closed and Cummins - Open)

Connect wire to 3 J for Cat engines

Connect wire to 3 K for Cummins engines

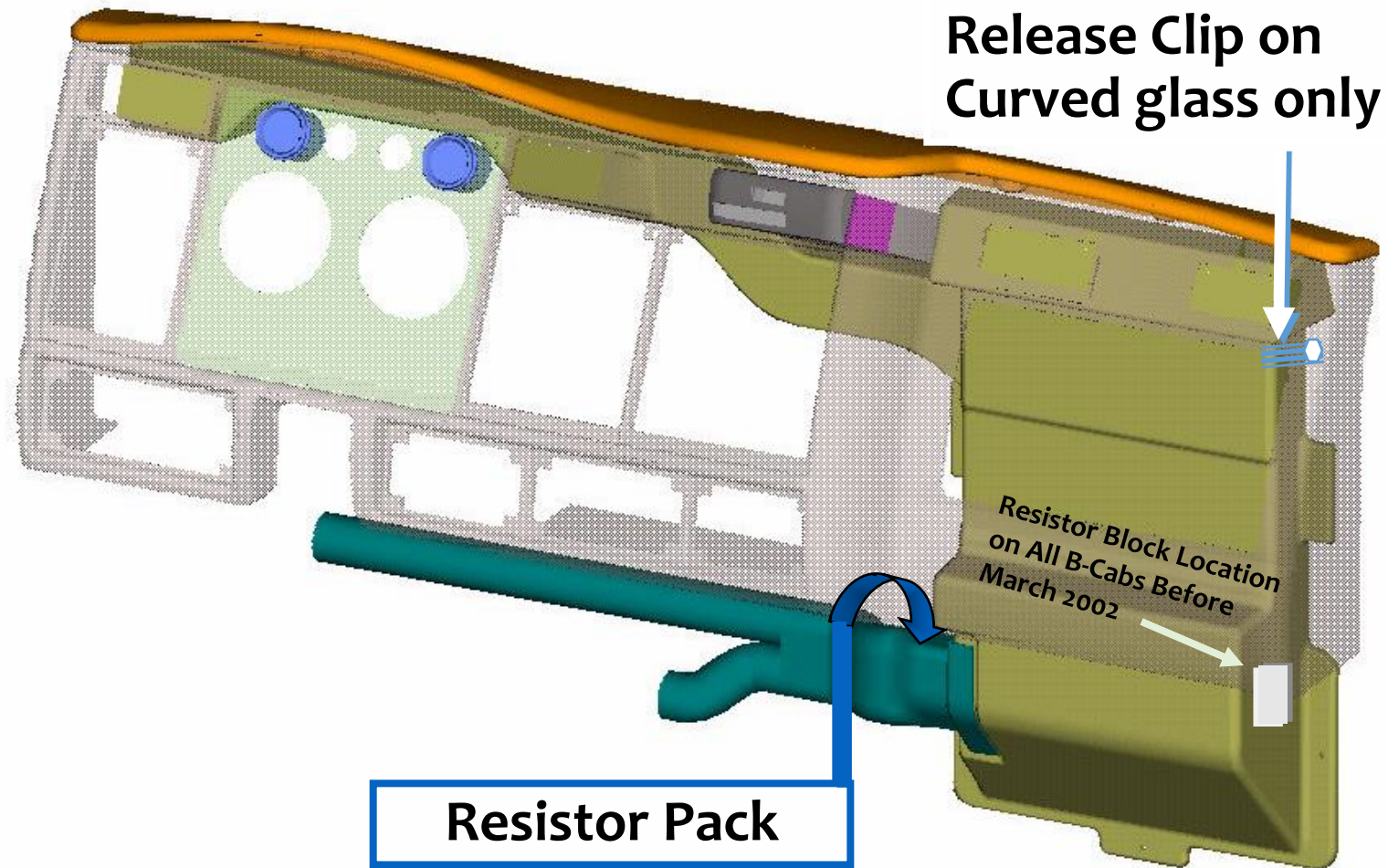
Note : Connector is found behind the safety gauge panel.



|                       |   |
|-----------------------|---|
| HARNESS - INSTR PANEL |   |
| P92-1873              | A |

<https://truckmanualshub.com/>

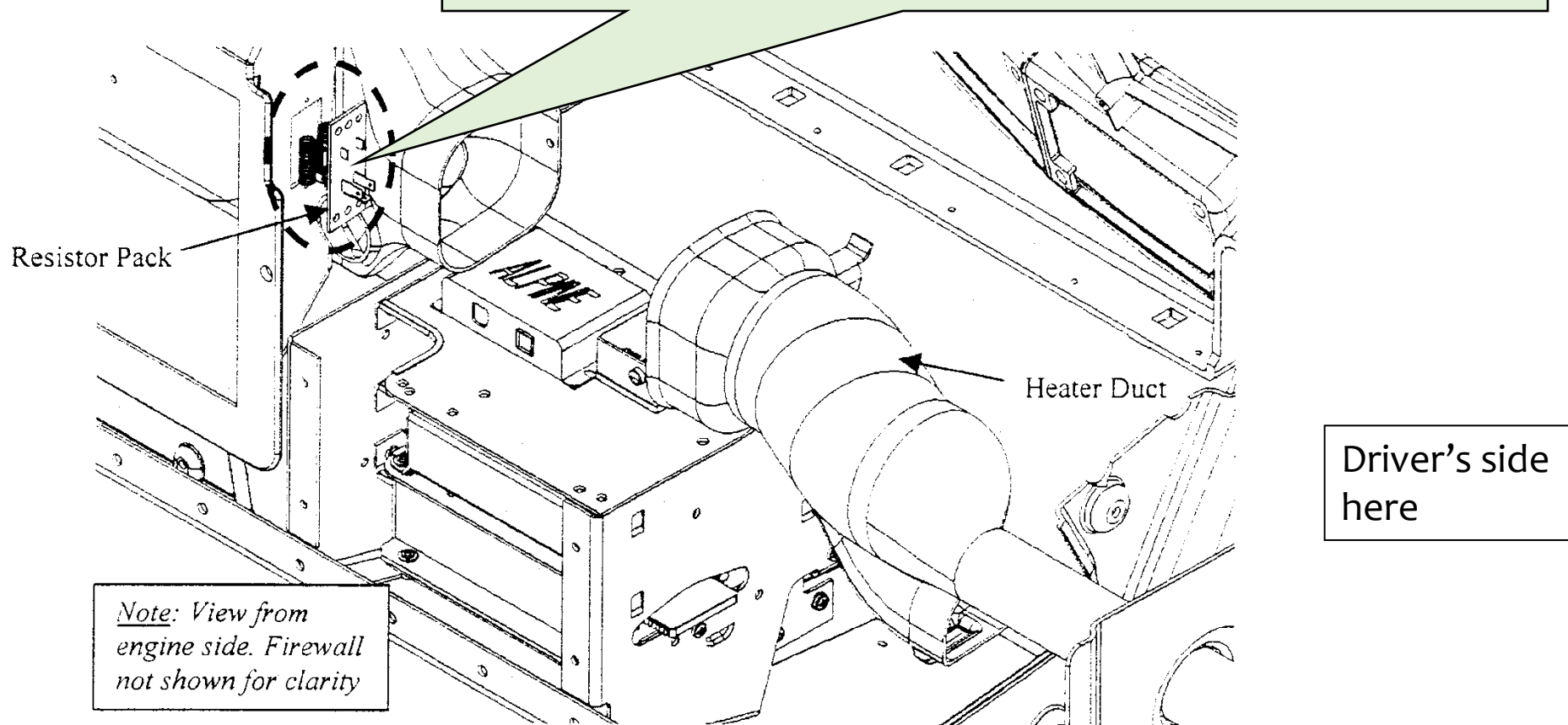
# HVAC Duct Work





# Resistor Pack Location

Viewing the Resistor Pack from the firewall

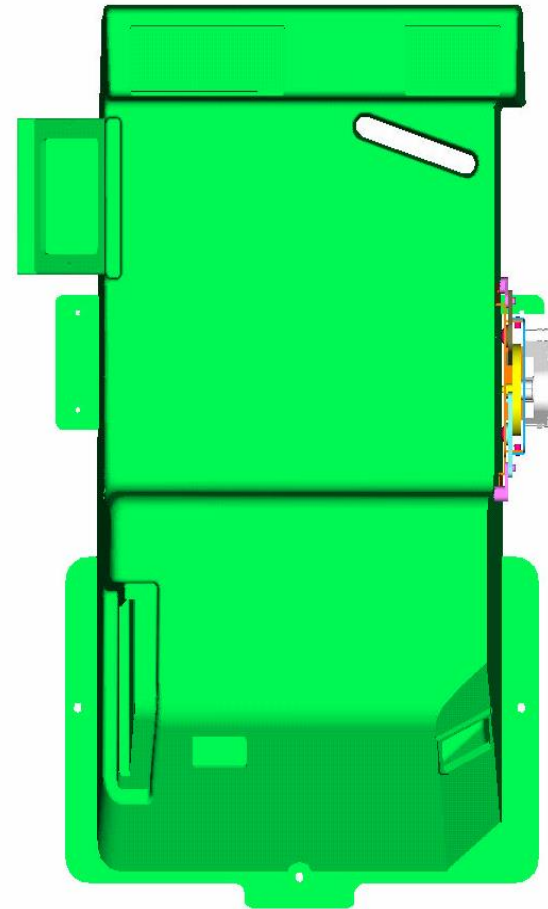
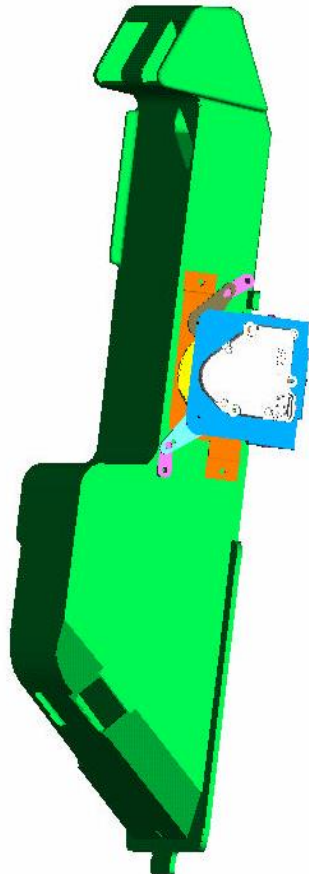


\* Must remove cup holder to get at resistor pack. Slide heater duct towards Driver's Side



<https://truckmanualshub.com/>

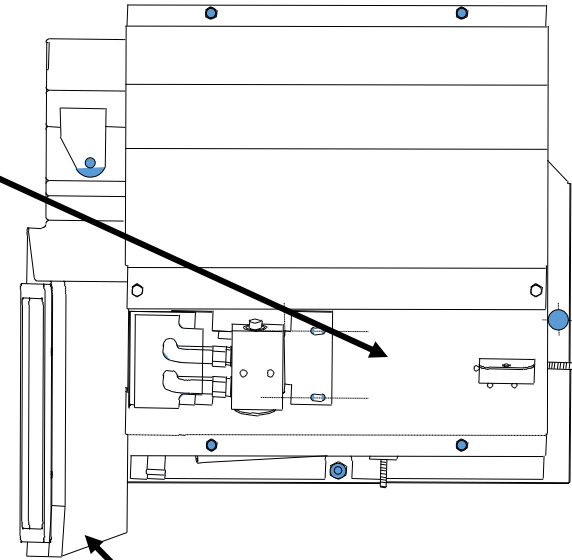
# Mode Door Actuator



# HVAC Unit – Under Hood

<https://truckmanualshub.com/>

Electric Fresh Air/Recirc Actuator  
Rated At 221°F



High Density Polyethylene Fresh  
Air Duct Rated @ 190°F

# Electronic Mode Actuator - Behind Glove Box

<https://truckmanualshub.com/>



# Sleeper Troubleshooting – Temp Sensor Check



Blow gently on sensor and watch to see that voltage goes up and returns when you stop.



Have voltmeter in C77 SU wire and to ground, to check voltage change when blowing on Temp sensor



# Sleeper Troubleshooting Rocker Switch

## Rocker Switch



Rocker Switch - H124AC = 12 volt supply (top)

GND = ground (bottom terminal)

C77SU = control voltage (center)

If the switch is in “AUTO” (or open) the voltage is controlled by the module.

If switch is in “MAX HEAT” C77SU is switched to Gnd.

If switch is in “MAX A/C” C77SU power goes through a 1500 ohm resistor.



# TIB 01-057 Sleeper HVAC Expansion Valve

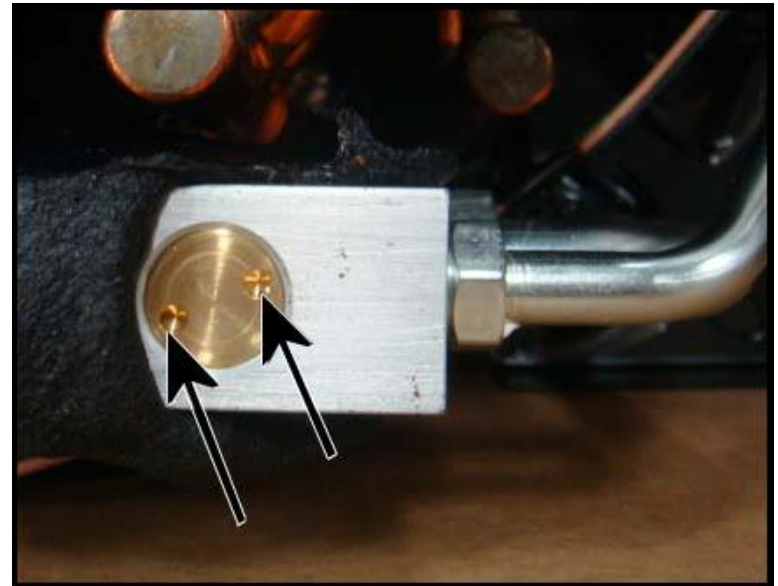
<https://truckmanualshub.com/>



If there is no green mark, cut and peel the black insulating tape from the end of the expansion valve on the side facing UP (the end without the large round disk).

If there is a brass set plug with two drilled removal tool holes, **replace the expansion valve.**

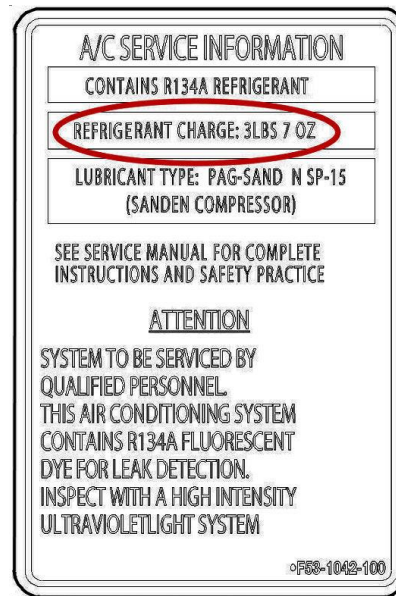
*Note: Very Short Production, probably not seen in aftermarket repair facilities after warranty.*



# TIB 01-058 A/C Charge Label

<https://truckmanualshub.com/>

- A/C Charge Label on C500, T800 and W900 Day Cab Chassis, built between 04/14/09 – 09/10/12.



Some customers may realize improved A/C performance with a refrigerant charge and future recharge to current specifications. **Kenworth has subsequently determined that a more optimal charge is 3lb-7oz to 3lb-8oz, instead of the original 4lb-0oz.**

# B-Cab: NAMUX 3 with 2010 Emissions

## (Current Production Configuration)

- Electrically actuated mode controls
- Electrically actuated heater control valve
- 2 HVAC Relays
- Linear Power Module
- High & Low Pressure Switches

# R-134a Refrigerant Considerations

<https://truckmanualshub.com/>

- Kenworth uses HNBR O-rings (Hydrogenated Nitrite Butadiene Rubber) (may be tinted green). Lubricate O-rings with system specific oil.
- Require special oil - Either POE (Early Climate Control Compressors) or PAG (Sanden Compressors). Oil used should not be intermixed.
- DO NOT lubricate slim-line seals on T680/T880 and T-series MD with oil. These must be installed on clean, dry fittings.

# B-Cab Component Oil Charge

<https://truckmanualshub.com/>

| Component      | Oil Charge                                 |
|----------------|--------------------------------------------|
| Evaporator     | 2 ounces                                   |
| Compressor     | 2 – 4 ounces (**drain compressor- balance) |
| Condenser      | 1 ounces                                   |
| Receiver Dryer | 0.5 to 1.5 ounces                          |
| AC Lines       | .5 - 1 ounce per line                      |



# A/C System Oil Charge Issues

<https://truckmanualshub.com/>

**Oil charge imbalance is one of the most frequently seen problems HD systems.**

Signs of potential A/C system oil over-charge include:

- Poor or marginal performance
- Low side line, after evaporator core, sweating
- Excessive oil drained when recovering refrigerant
- History of repeated compressor replacement
- Early compressor failure

# T2000 / T700

# Kenworth Models

## Wide Cab T2000 - > T700

No longer being produced



# HVAC Changes By Years

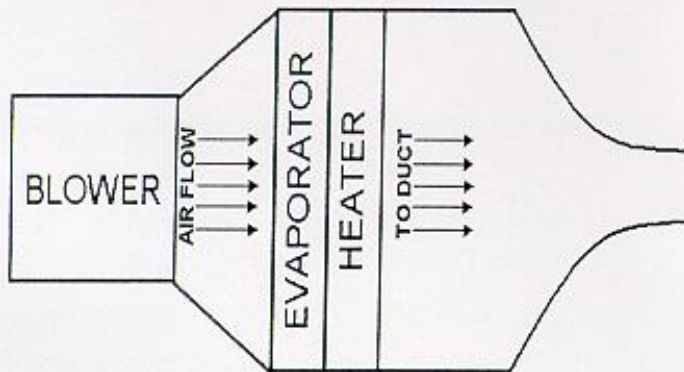
<https://truckmanualshub.com/>

- 1996 to Oct. 26, 1998 has APADS (**A/C Protection and Diagnostics System**): use P94-1125
- APADS Bypass: use P94-1224
- Oct 28, 1998 to 2009 factory installed non-APADS: use P94-1105
- T2000 with NAMUX 2: use P94-1567
- T700: use P94-1944

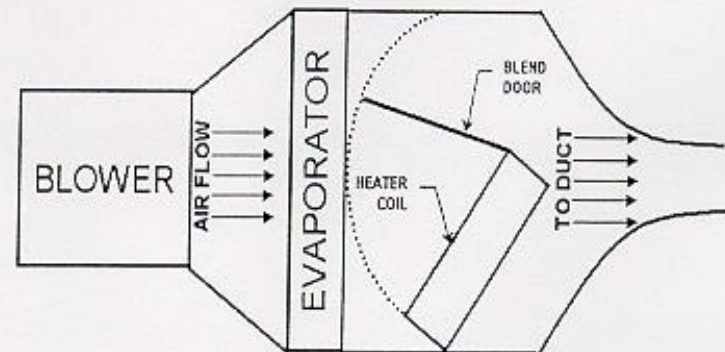
# Heater and A/C Operation

## Stacked Coil versus Blend Air

Parallel Flow System



Blend Air System



**“B” Cab System**

**T2000 System**

(T2000 and T700 use a Bergstrom system)



# APADS System

September 1, 1996 through October 26, 1998

First rudimentary full climate control system



**Automatic Temperature Control**  
**No A/C switch on the control panel**

# APADS Bypass

Most APADS Systems Updated (TIB 01-42B)



A/C switch on the right side of the control panel

<https://truckmanualshub.com/>

# Non-APADS

October 27, 1998 to NAMUX 2



A/C switch on the left side of the control panel

# Control Circuit for the BY-PASS

- T2000 (APADS By-Pass) TIB 01-42A
- When removing APADS, the C102ACP is connected to the P30CHD changing the High PSI Switch, Low PSI Switch, and the Freeze Switch to power side of the control circuit.



# Blower Controls



The T2000 has the cab blower circuit wired up as ground side switching and sleeper blower circuit is the opposite - power side switching.



# Fresh Air Door Control

<https://truckmanualshub.com/>



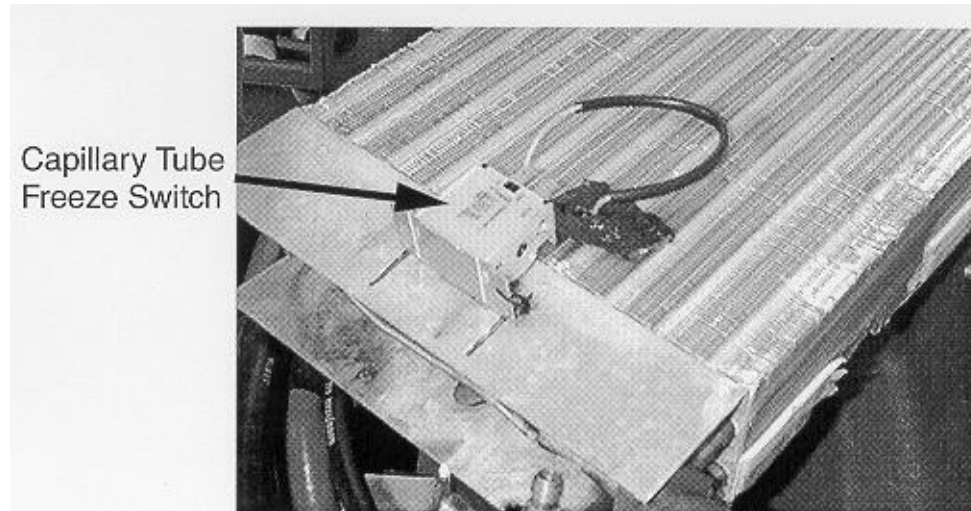
T2000 - uses an electric actuator to control fresh air door using voltages of 12V and <1V

# Mode Control Doors



**Put unit into defrost mode before removing unit from under dash, as the tabs will be damaged during removal otherwise.**

# Freeze Switch



Both B-Cab and T2000 trucks use a freeze switch in the ground side of the HVAC relay control circuit

**Freeze switch opens at 31.5°F and closes at 40°F**

# Pressure Switches

T2000 - Uses low and high pressure switches in the relay control ground circuit.  
(Similar to B-Cab after 2007)



- Low pressure settings opens at 10 +/- 4 psi
- High pressure setting opens at 350 +/- 20 psi

# T2000 w/NAMUX 2

<https://truckmanualshub.com/>

- Electrically actuated mode controls
- 4 Blower fan speeds (Low, Med-lo, Med, High) controlled by a resistor block
- 1 HVAC Relay
- High & Low Pressure Switches
- Fan Switch



# Operating Temperatures

## T2000 R-134a Ambient Sweep Data

| Outside Air<br>Temp.(Deg F) | Cab Unit<br>Center Duct<br>Outlet Temp. | Discharge<br>Pres.(psig) | Suction<br>Pres.(psig) |
|-----------------------------|-----------------------------------------|--------------------------|------------------------|
| 70                          | 48-53                                   | 110-135                  | 14-30                  |
| 80                          | 50-55                                   | 130-145                  | 22-28                  |
| 90                          | 55-60                                   | 150-165                  | 25-31                  |
| 100                         | 58-63                                   | 170-185                  | 28-34                  |
| 110                         | 62-67                                   | 215-230                  | 33-39                  |

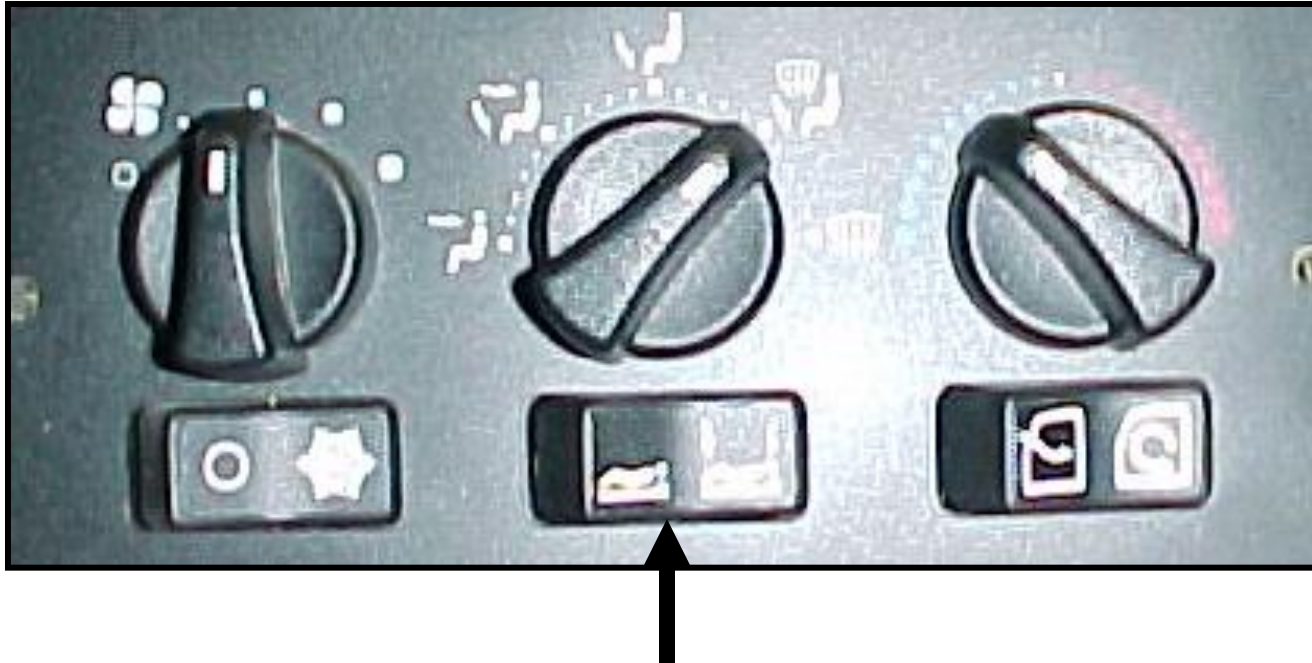
| Outside Air<br>Temp.(Deg F) | Bunk Unit<br>Lower Duct<br>Outlet Temp. | Discharge<br>Pres.(psig) | Suction<br>Pres.(psig) |
|-----------------------------|-----------------------------------------|--------------------------|------------------------|
| 70                          | 43-48                                   | 110-135                  | 14-30                  |
| 80                          | 45-50                                   | 130-145                  | 22-28                  |
| 90                          | 50-55                                   | 150-165                  | 25-31                  |
| 100                         | 53-58                                   | 170-185                  | 28-34                  |
| 110                         | 56-61                                   | 215-230                  | 33-39                  |

**Engine Fan on Manual**

**Engine RPM @ 1500**

**Doors and Windows Open**

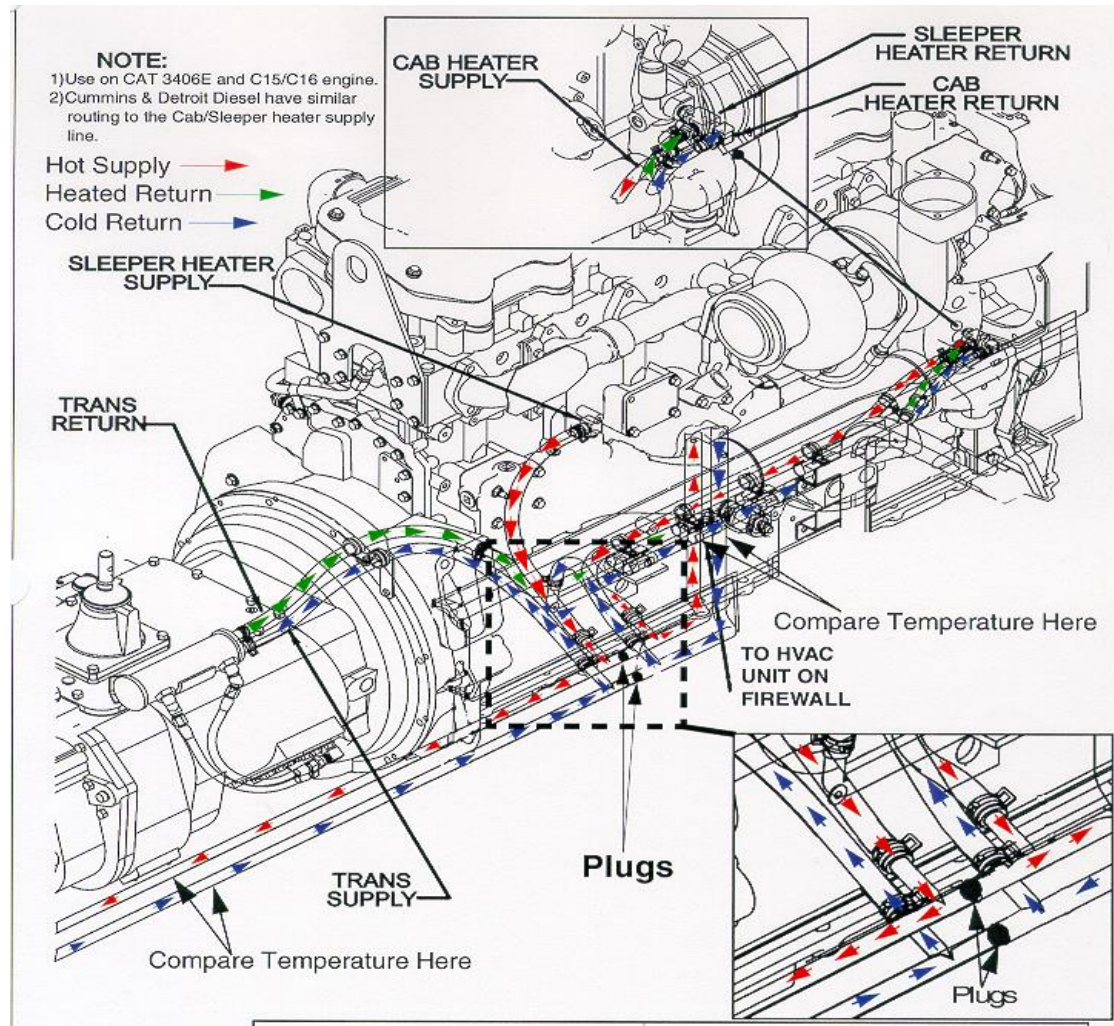
# Sleeper Control



The Sleeper Rocker Switch controls power to the Sleeper Control Panel through circuit number P124SHA.

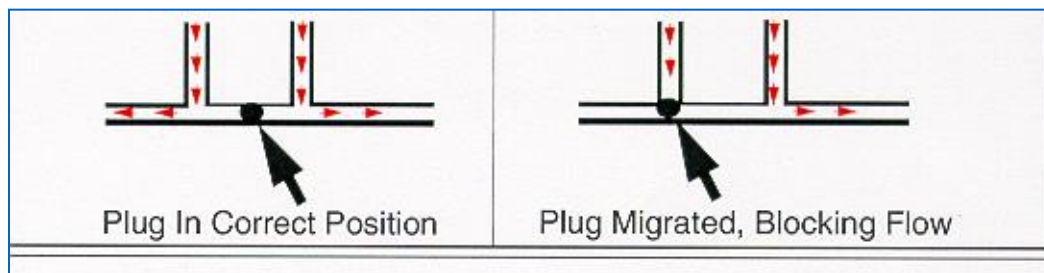
# T2000 Sleeper Heater Lines

<https://truckmanualshub.com/>



**\* No Heat From Cab and/or Sleeper**

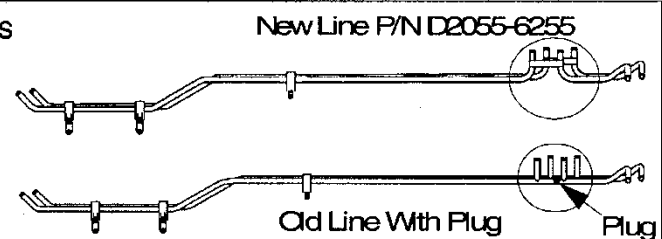
1. Run engine to operating temperature
2. Turn Cab & Sleeper heater controls to maximum heat position - (Do not select Defrost Mode, A/C will cycle and heat up the A/C lines as well).
3. If no heat blows from cab or sleeper heater vents, check for heated coolant flow through supply lines.
4. If cab and sleeper heater supply lines are at operating temperature and about the same temperature, then coolant flow may be the problem. Verify correct operation of HVAC controls and blend air door operation.



← Problem

Cure

T2000 Sleeper Heater Coolant Lines



# T2000 Wrap Up

<https://truckmanualshub.com/>

- Why spend time covering an almost 20 yr old truck system??
- There are still a small number of trucks still working every day with full OE APADS
- A significant number of trucks still in service with TIB converted APADS systems
- Most importantly, the TIB converted APADS systems became the basis for the T700 model truck A/C system



# T700 (All Years)

<https://truckmanualshub.com/>

- Electrically actuated mode controls
- 4 Blower fan speeds (Low, Med-lo, Med, High) controlled by a resistor block
- 1 HVAC Relay
- High & Low Pressure Switches
- Fan Switch

# T680/T880 (2.1m Cab)

## NGP (Next Generation Product)

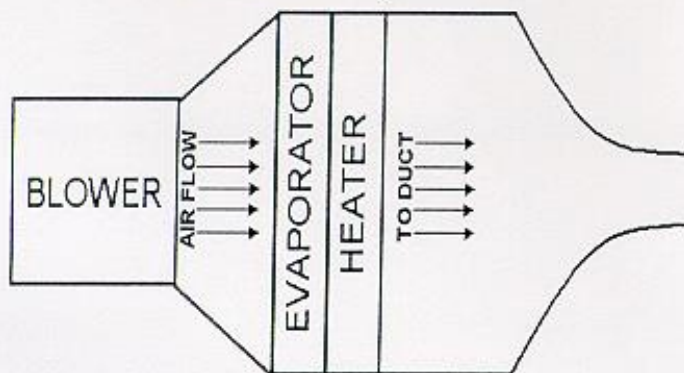
Kenworth: T680, T880/Peterbilt: 579, 567



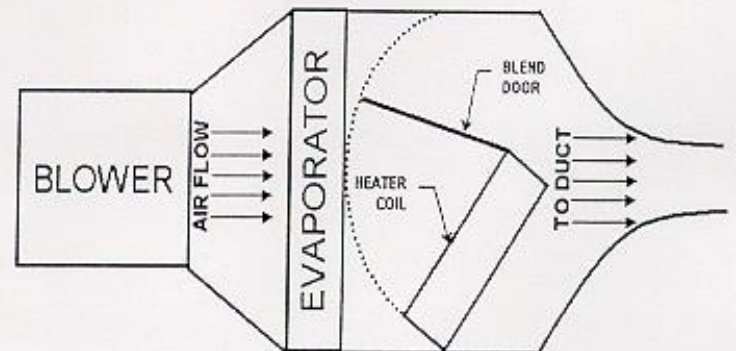
# Heater and A/C Operation

## Stacked Coil versus Blend Air

Parallel Flow System



Blend Air System



“B” Cab System

T680/T880 uses a  
Behr system

# HVAC Electrical Components

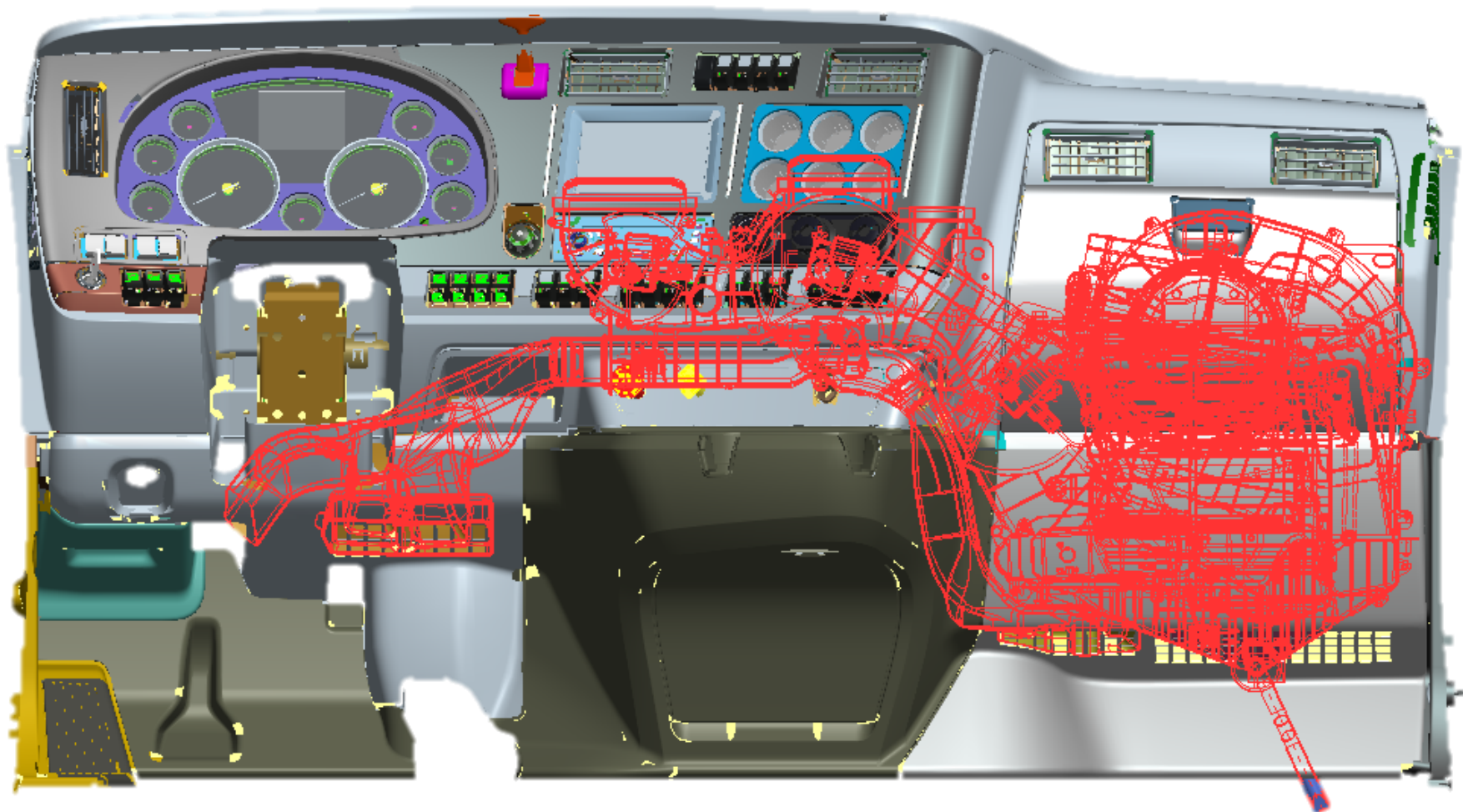
| Component                        | B Cab                                    | NGP                          |                                   |
|----------------------------------|------------------------------------------|------------------------------|-----------------------------------|
| Compressor                       | Sanden                                   | Sanden                       |                                   |
| AC Relay                         | Yes Controls power to clutch             | Yes Controls power to clutch |                                   |
| High Pressure switch             | 2007 emissions engines                   | No                           |                                   |
| Low Pressure switch              | 2007 emissions engines                   | No                           |                                   |
| Binary Switch                    | 1994 - 2006                              | No                           |                                   |
| Blower Fan switch                | yes                                      | yes                          |                                   |
| Blower motor                     | Yes                                      | Yes – but                    | Direct DC Current                 |
| Resistor block with thermal fuse | Cab till 2002 – then linear power module | linear power module          | Still used on all sleeper modules |
| Freeze switch                    | Yes                                      | No                           |                                   |
| Engine fan switch                | Yes                                      | No                           |                                   |





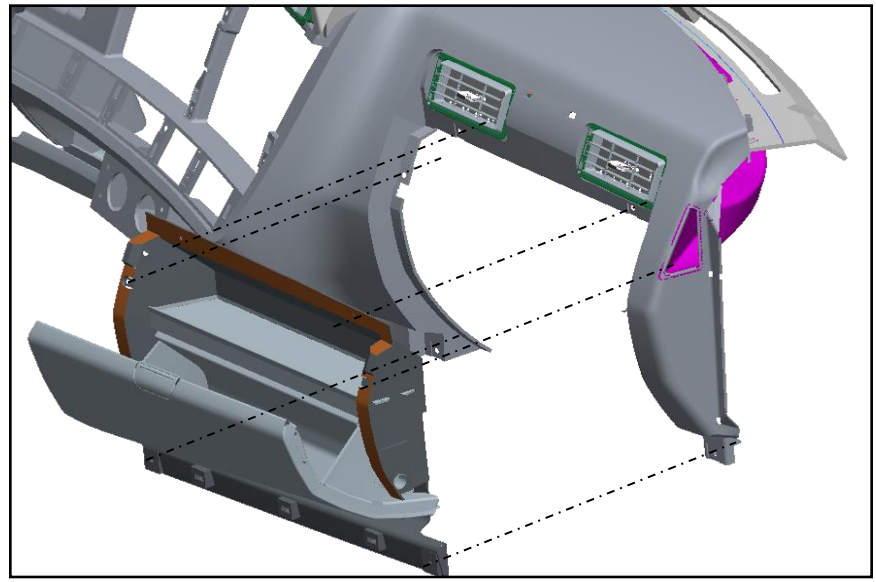
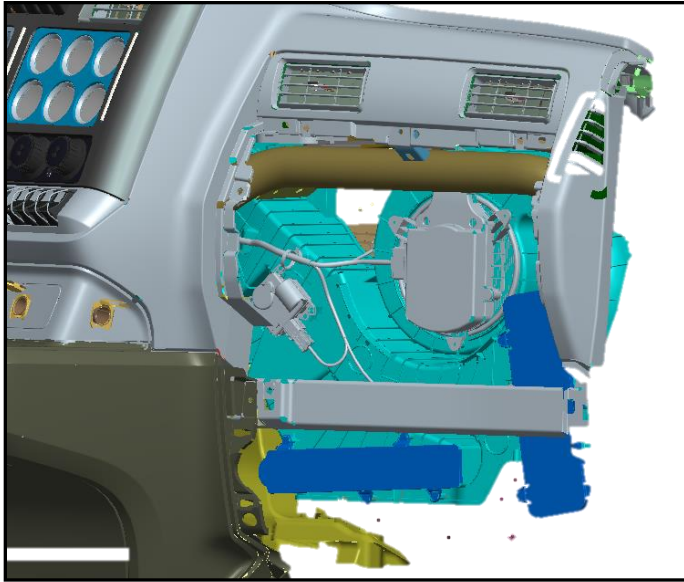
<https://truckmanualshub.com/>

# Cab HVAC



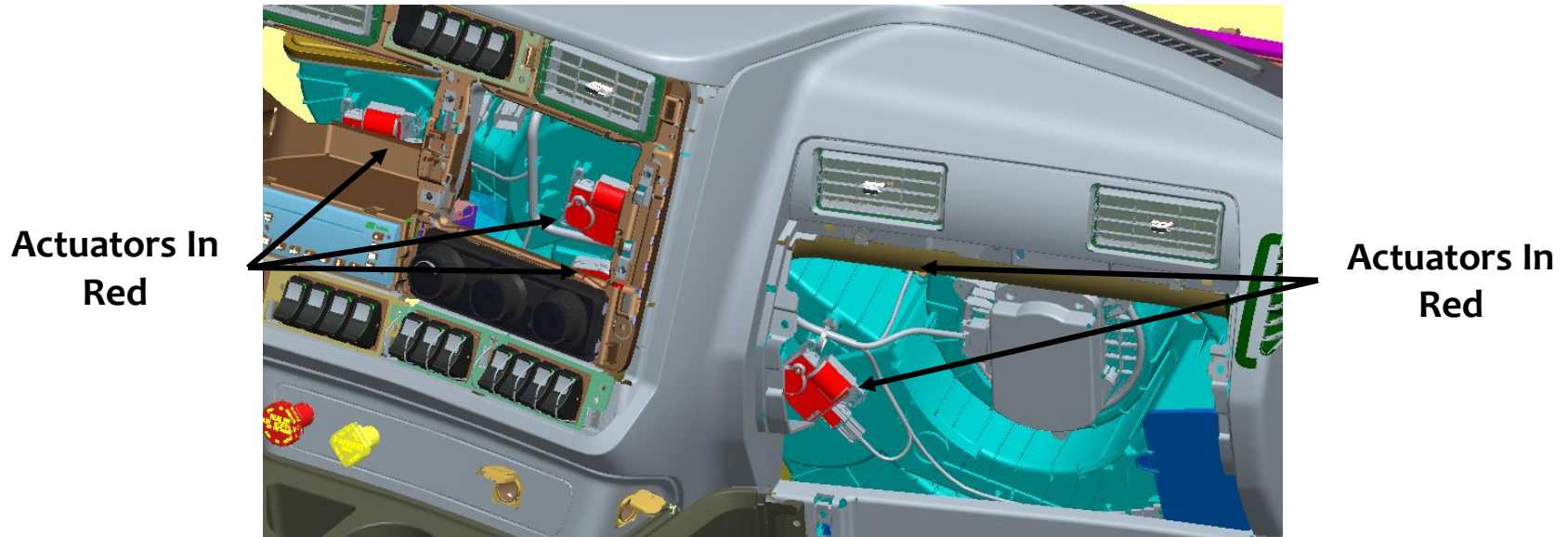
# Cab HVAC Service Location

<https://truckmanualshub.com/>



- HVAC Components Are Serviced By Removing The Glove Box And Dash Trim.
  - Blower Motor, Actuators, Heater Core, Evaporator, Freeze Sensor, Air Filter.
- Components Not Serviceable Through Glove Box Opening.
  - Plastic Housings, Air Directing Doors, Foam Seals, IP Ducts.

# Actuator Service



- Disconnect battery power from HVAC.
- Remove glove box & b-panels to access actuators.
- Disconnect the wire harness connector.
- Remove (2) T-20 torx screws.
- Replace actuator and connect wire harness.
- Replace trim panels.
- Connect battery power and listen for HVAC to calibrate.



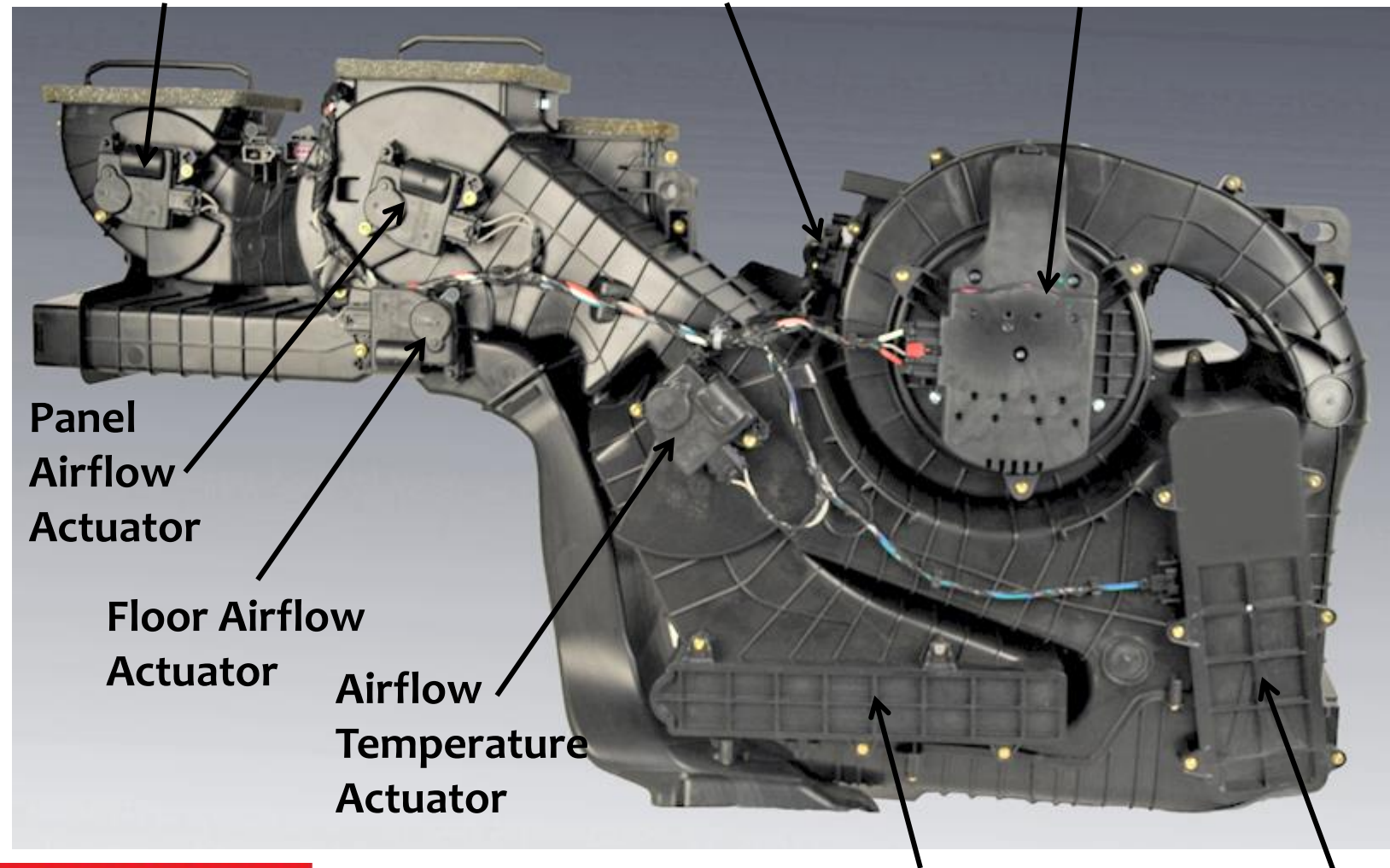
<https://truckmanualshub.com/>

# Cab HVAC Unit

**Defrost Airflow  
Actuator**

**Fresh/Recirc  
Airflow Actuator**

**BLDC Blower  
Motor**



**Panel  
Airflow  
Actuator**

**Floor Airflow  
Actuator**

**Airflow  
Temperature  
Actuator**

**Heater Core**

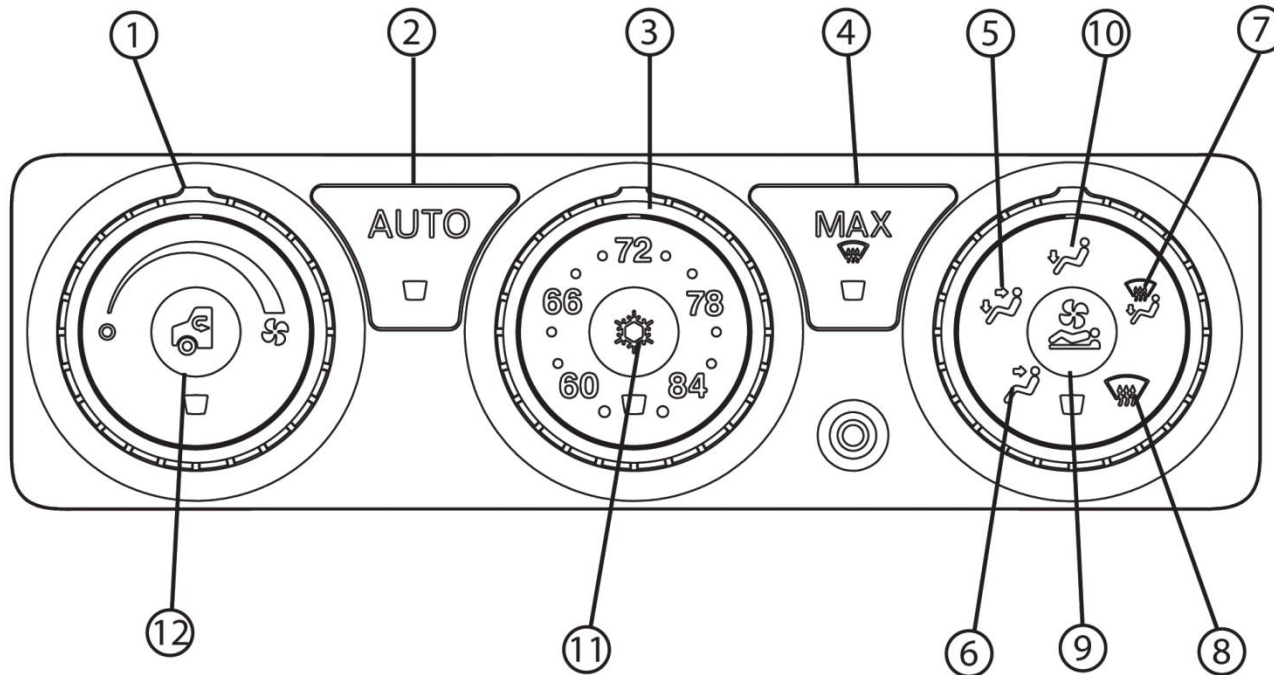
**Evaporator Core**



**KENWORTH**

# KW Cab Control With Bunk Override

<https://truckmanualshub.com/>



1. Fan Control Dial

2. AUTO Mode

3. Temperature Control Dial

4. Defrost Button

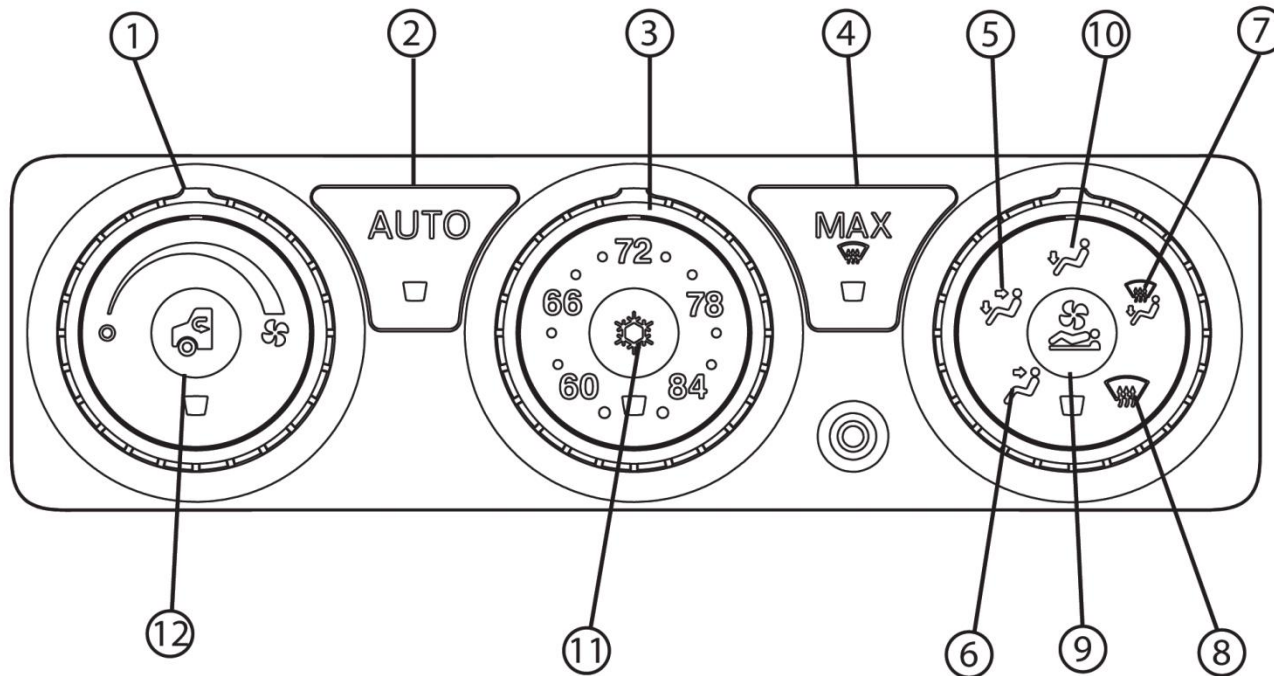
5. Dash & Floor

6. Dash



# KW Cab Control With Bunk Override

<https://truckmanualshub.com/>



7. Floor & Defrost

8. Defrost

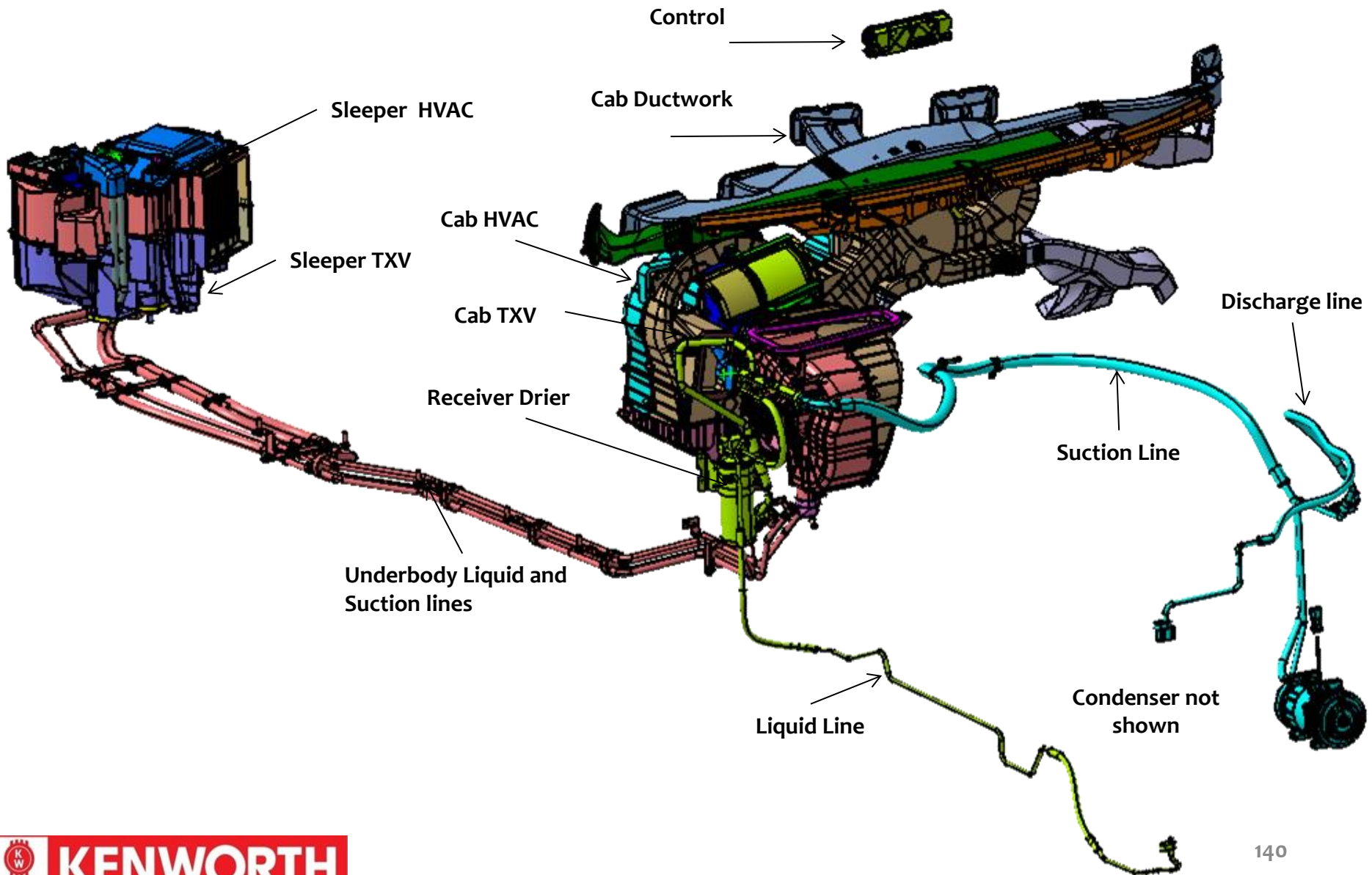
9. Sleeper Override  
(if equipped)

10. Floor

11. Air Conditioner  
Enable

12. Fresh Air /  
Recirculate

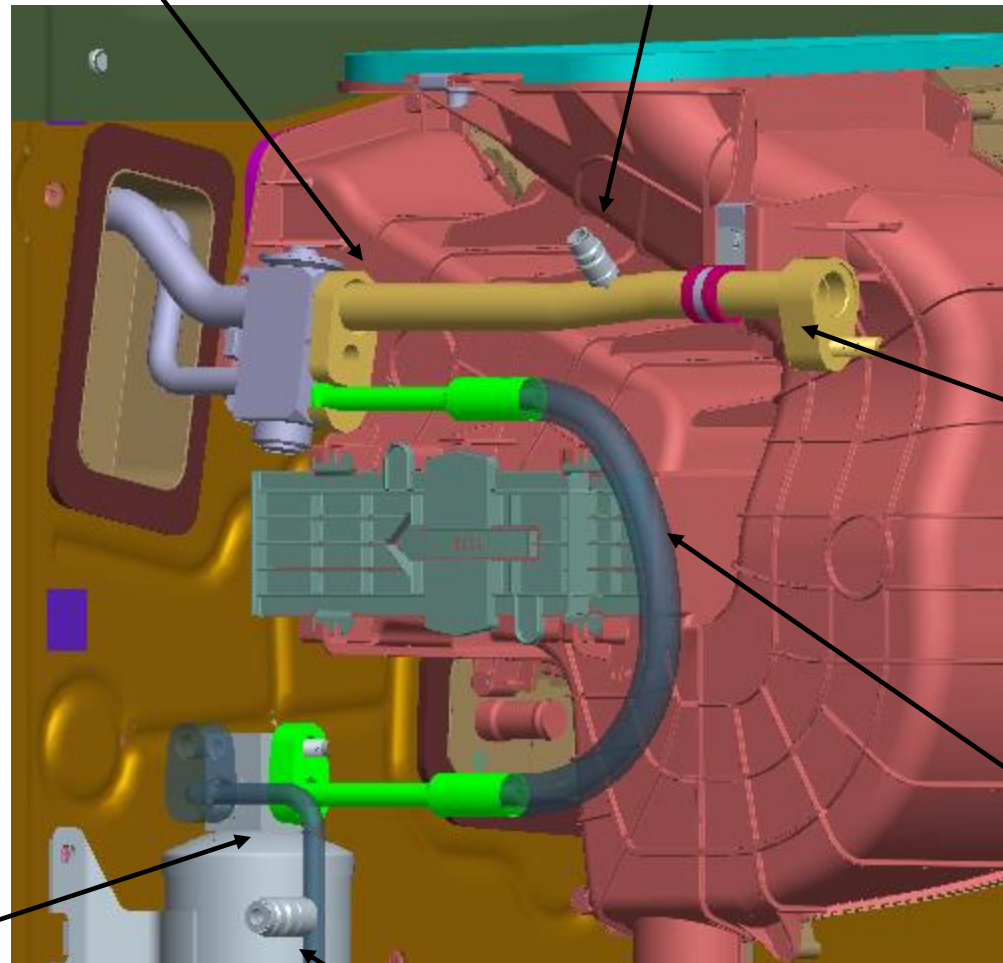
# NGP HVAC System



# Firewall – Cab Only, HVAC R-134a Lines

Suction Line Clamp

Low Side Charge Port



Suction Line

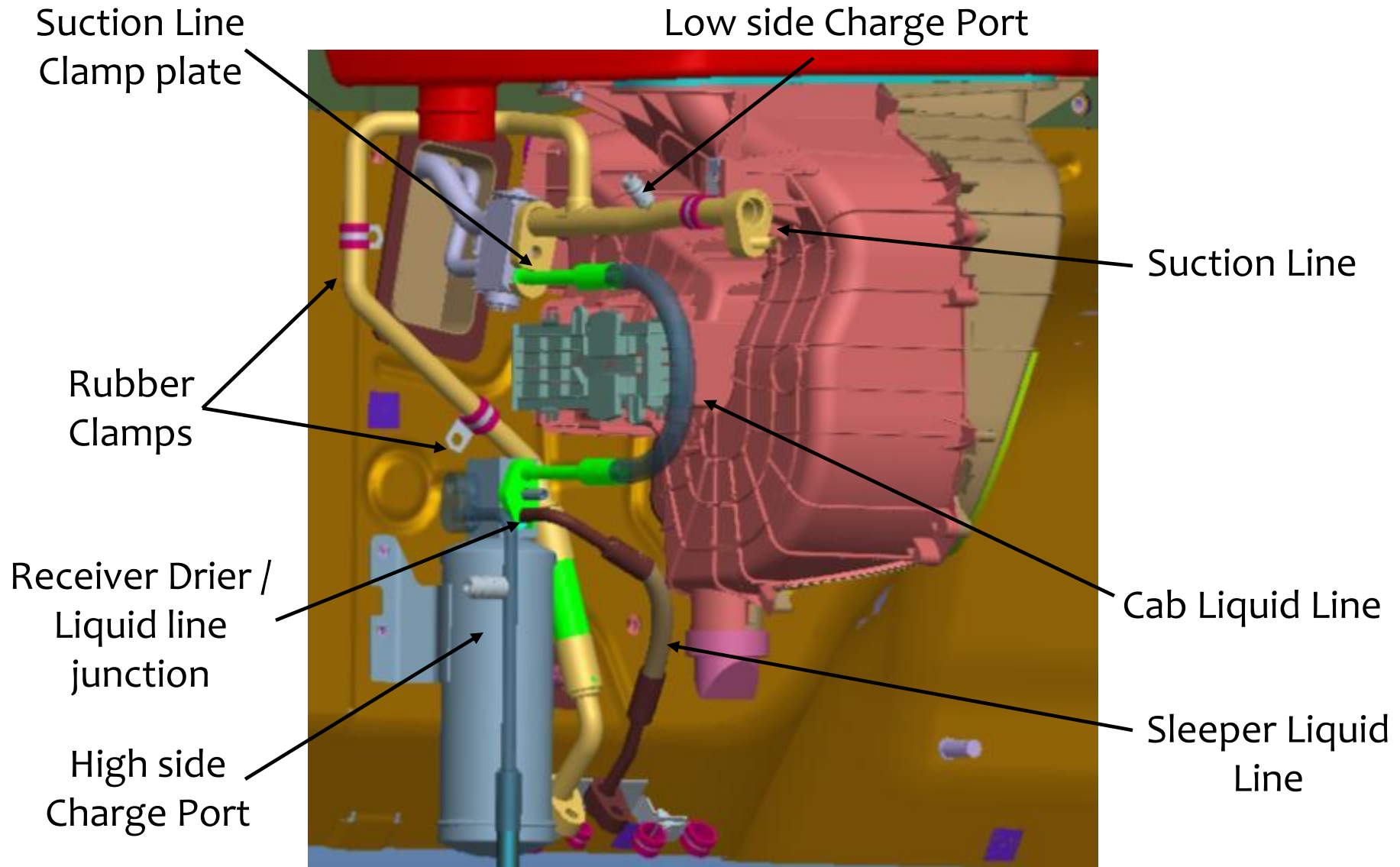
Liquid Line

Receiver Drier /  
Liquid Line  
Junction

High Side Charge Port

# Firewall – Cab & Sleeper, HVAC R-134a Lines

<https://truckmanualshub.com/>



# HVAC - Cab and Sleeper

<https://truckmanualshub.com/>

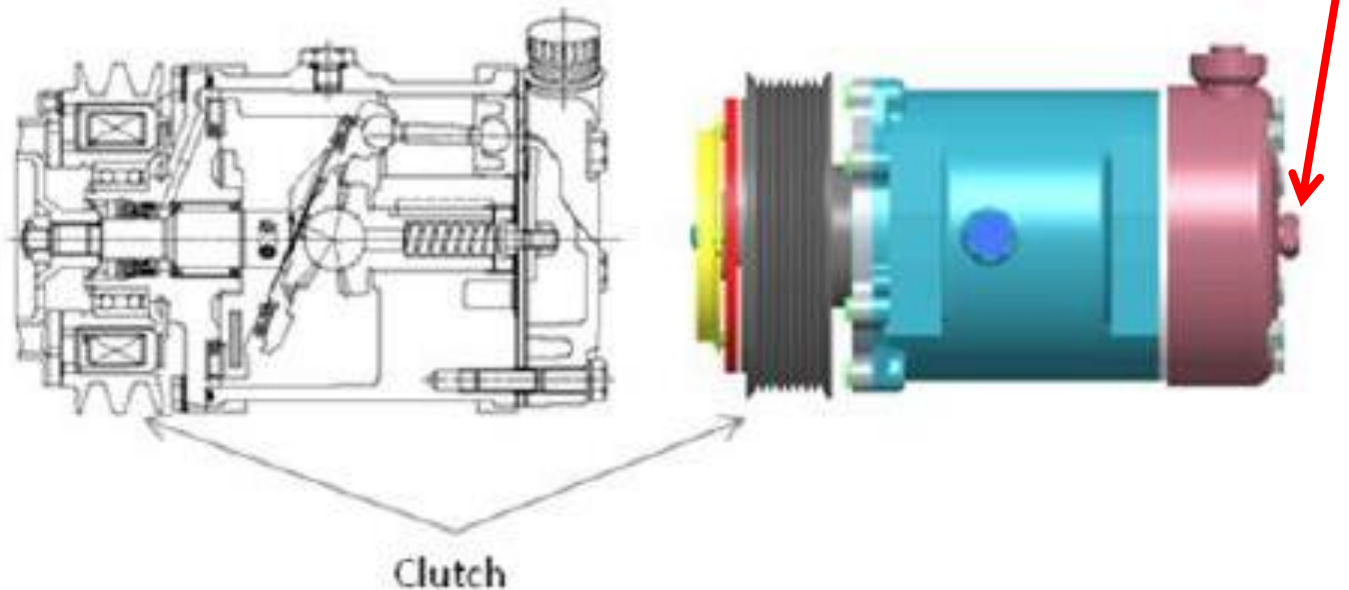
- Cab
  - ATC – Automatic Temperature Control (temperature, mode and fan speed)
  - Long-life Brushless DC (BLDC) blower motor – double current component life
  - Lightweight Aluminum Heater Core - serviced thru glove box
- Sleeper
  - Register positioning optimizes sleeper airflow
  - Filtered & re-circulated air (like home A/C) used to maximize heating / cooling performance
  - Uses an additional recirculation filter in sleeper



# Sanden Compressor

<https://truckmanualshub.com/>

- Same Sanden compressor as today
  - Slimline seal technology added to NGP



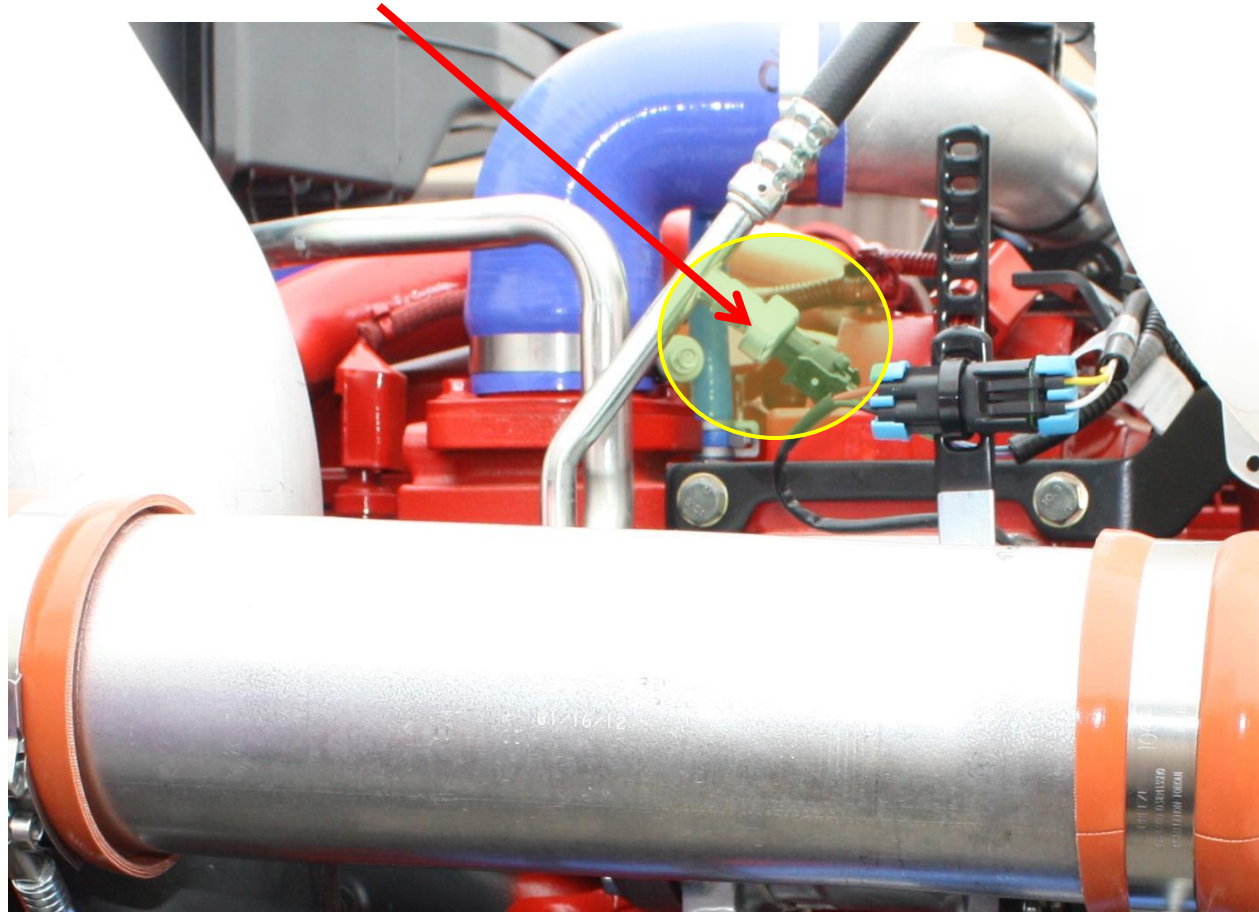
# Discharge Pressure Transducer

<https://truckmanualshub.com/>

Acts as a combination high/low pressure clutch switch. It will disable compressor when pressure is above 424 psi or too low.

Based on an algorithm using vehicle speed, pressure reading and ambient temp over 3 to 5 key cycles.

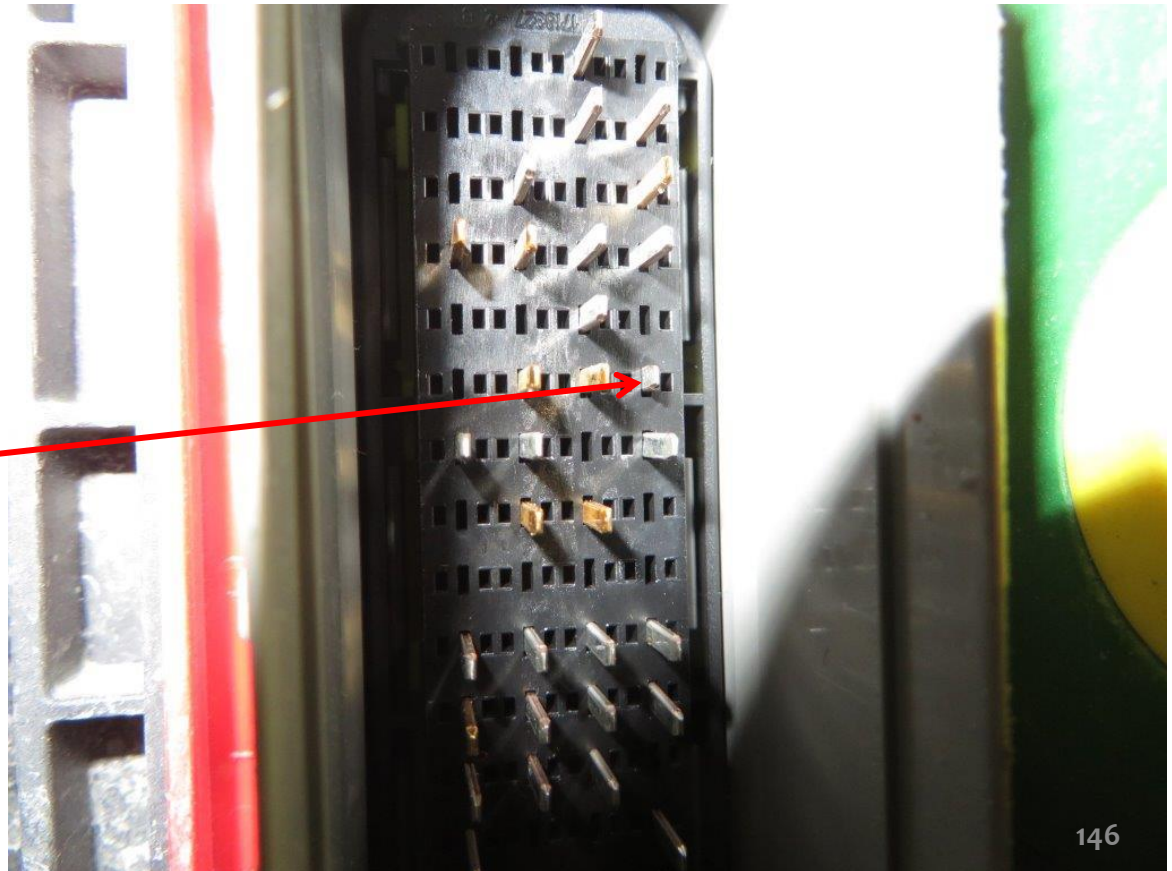
Discharge Pressure Transducer



# No fault codes for any HVAC issues

<https://truckmanualshub.com/>

**A/C would not cool because compressor would not engage. ESA showed Pressure transducer pressure at 427 PSI.**



**Transducer wires at  
fire wall connector**

# Evaporative Thermistor



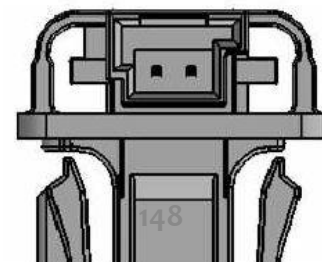
Settings are approx. 39°F (4°C) and 46°F (8°C)



# A/C Evaporator Sensor Resistance Values

| Temp<br>[°F] | R min<br>[Ω] | R nom<br>[Ω] | R max<br>[Ω] | Temp<br>[°F] | R min<br>[Ω] | R nom<br>[Ω] | R max<br>[Ω] | Temp<br>[°F] | R min<br>[Ω] | R nom<br>[Ω] | R max<br>[Ω] |
|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| 32           | 7200         | 9000         | 10800        | 54           | 3947         | 4934         | 5920         | 76           | 2259         | 2824         | 3389         |
| 33           | 6999         | 8749         | 10498        | 55           | 3844         | 4805         | 5766         | 77           | 2206         | 2757         | 3308         |
| 34           | 6804         | 8505         | 10206        | 56           | 3745         | 4681         | 5617         | 78           | 2153         | 2691         | 3229         |
| 35           | 6615         | 8269         | 9923         | 57           | 3648         | 4560         | 5472         | 79           | 2101         | 2626         | 3152         |
| 36           | 6432         | 8039         | 9647         | 58           | 3555         | 4443         | 5332         | 80           | 2051         | 2564         | 3076         |
| 37           | 6254         | 7817         | 9381         | 59           | 3464         | 4330         | 5196         | 81           | 2002         | 2502         | 3003         |
| 38           | 6082         | 7602         | 9122         | 60           | 3376         | 4220         | 5064         | 82           | 1954         | 2443         | 2931         |
| 39           | 5915         | 7394         | 8872         | 61           | 3290         | 4112         | 4935         | 83           | 1908         | 2385         | 2862         |
| 40           | 5754         | 7192         | 8631         | 62           | 3207         | 4008         | 4810         | 84           | 1863         | 2329         | 2795         |
| 41           | 5599         | 6998         | 8398         | 63           | 3125         | 3907         | 4688         | 85           | 1820         | 2274         | 2729         |
| 42           | 5447         | 6809         | 8171         | 64           | 3047         | 3808         | 4570         | 86           | 1777         | 2221         | 2665         |
| 43           | 5301         | 6626         | 7951         | 65           | 2970         | 3713         | 4455         | 87           | 1736         | 2170         | 2604         |
| 44           | 5158         | 6448         | 7737         | 66           | 2896         | 3620         | 4344         | 88           | 1695         | 2119         | 2543         |
| 45           | 5020         | 6275         | 7530         | 67           | 2824         | 3530         | 4236         | 89           | 1656         | 2070         | 2484         |
| 46           | 4885         | 6107         | 7328         | 68           | 2755         | 3443         | 4132         | 90           | 1618         | 2022         | 2427         |
| 47           | 4755         | 5944         | 7133         | 69           | 2686         | 3358         | 4029         | 91           | 1580         | 1975         | 2371         |
| 48           | 4629         | 5786         | 6943         | 70           | 2620         | 3275         | 3930         | 92           | 1544         | 1930         | 2316         |
| 49           | 4507         | 5633         | 6760         | 71           | 2555         | 3194         | 3833         | 93           | 1509         | 1886         | 2263         |
| 50           | 4388         | 5485         | 6582         | 72           | 2493         | 3116         | 3739         | 94           | 1474         | 1843         | 2211         |
| 51           | 4273         | 5341         | 6410         | 73           | 2432         | 3040         | 3648         | 95           | 1440         | 1800         | 2160         |
| 52           | 4161         | 5202         | 6242         | 74           | 2373         | 2966         | 3559         | -            | -            | -            | -            |
| 53           | 4053         | 5066         | 6079         | 75           | 2315         | 2894         | 3473         | -            | -            | -            | -            |

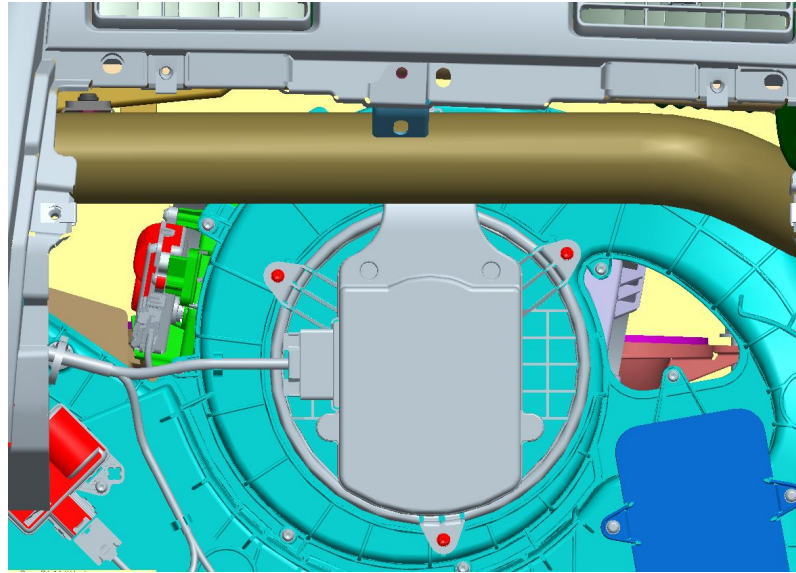
R min and R max values for the Evaporator Sensor are given a  $\pm 20\%$  tolerance to account for variations in measurement equipment



# KENWORTH

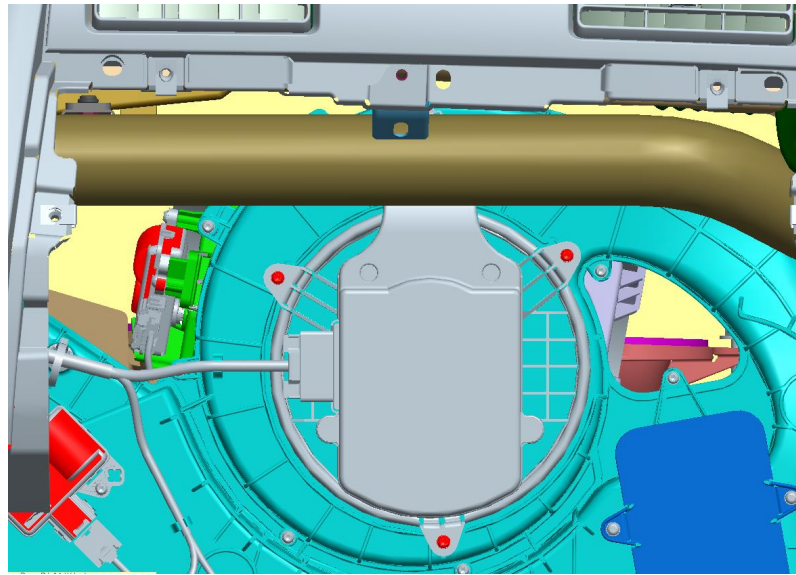


# Cab HVAC Blower Motor



- Brushless DC Motor
- Integrated Linear Power Module is cooled by system air flow through vented cover.
- Thermally Protected - maximum temperature of 221°F (105°C)

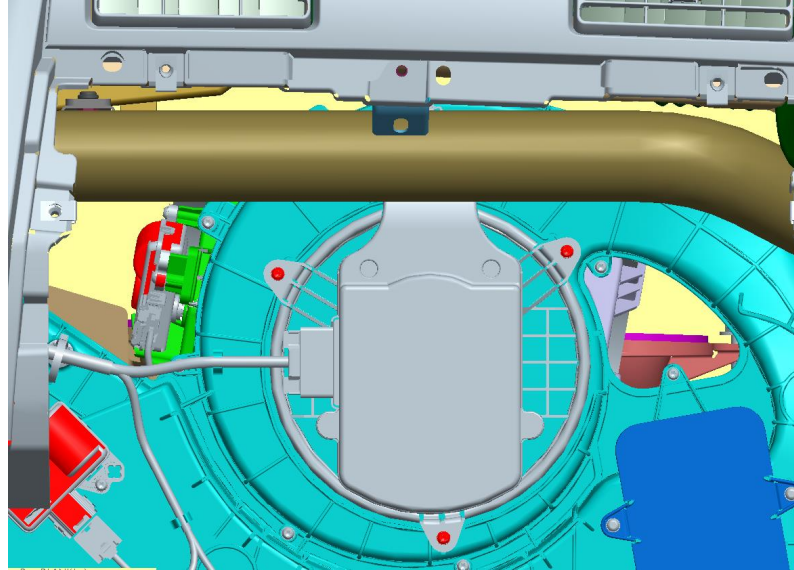
# Cab HVAC Blower Motor



- The fan speed is controlled by a 35Hz PWM signal provided by the control head. Voltage on this wire varies with the position of the fan knob from ~12V @ low to >1 V @ max.
- This is similar to the LPM control signal on the B-Cab models.
- **Do all diagnostic testing in cab with wires connected normally, DO NOT bench test.**

# Cab HVAC Blower Motor - DTC 1553

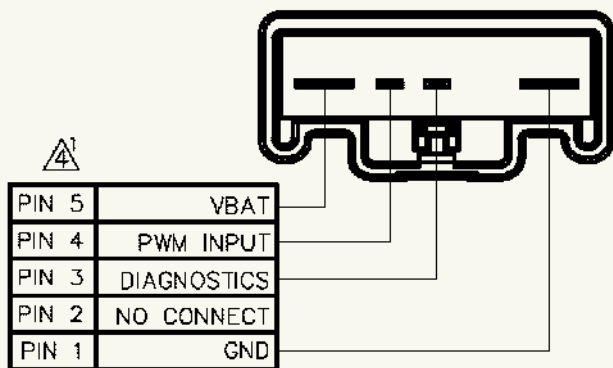
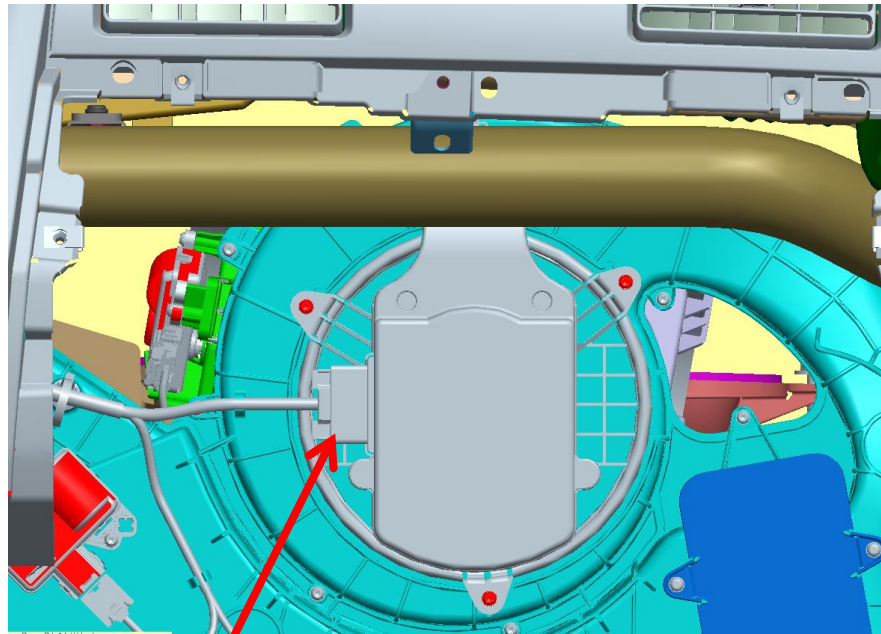
<https://truckmanualshub.com/>



- Check blower operation in manual mode
- Check for good power and ground at blower motor connector pins 5 (V bat) and pin 1 (Gnd)
- You can not check resistance test through Cab DC motor
- Check wiring continuity between control head and signal wire

# Testing Brushless Blower

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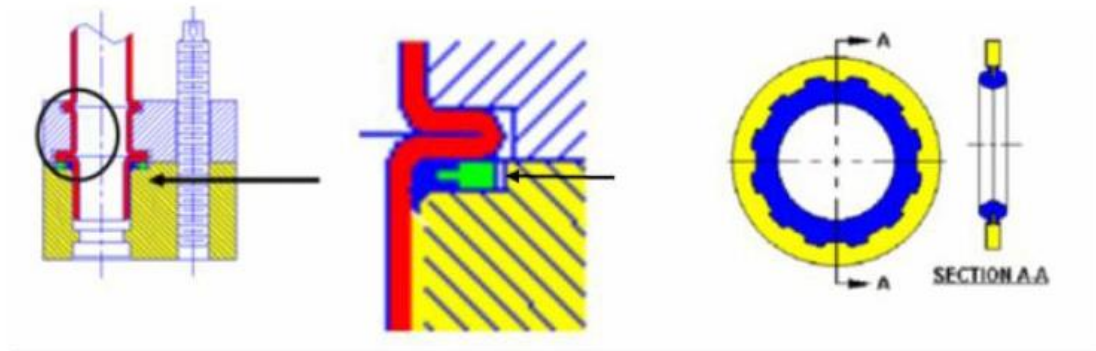
**Multi meter have negative lead in pin 1 and have the positive lead at PWM input pin 4 to check for 35hz signal**

# Slim Line Seals

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- Slimline seal technology instead of O-rings
- Superior sealing properties to O-rings
- Slimline technology decrease the leakage rate by more than 50%.
- Slimline seals at ALL A/C connections

Slim Line Seal



***Per Parker Engineering (manufacturer of the seals), these are not to be lubricated during installation.***



# Expansion Valve HVAC Lines - Torque

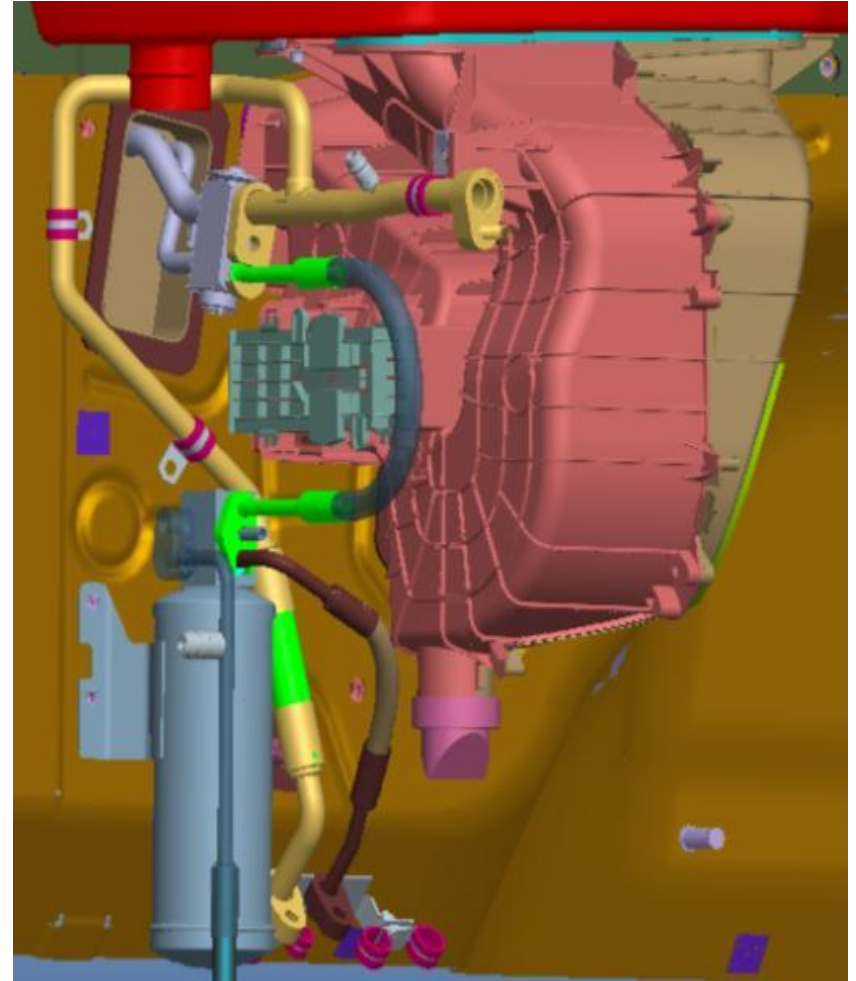
| Component                            | Torque           |              |
|--------------------------------------|------------------|--------------|
|                                      |                  |              |
| Expansion valves to evaporator bolts | 3.3 lb-ft ± 0.3  | 4.5 Nm ± 0.5 |
| All other AC connections             | 15.5 lb-ft ± 2.2 | 21 Nm ± 3    |

# PACCAR Evaporator Line Twist

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**Bench Top Vice With Evaporator Secured**



# PACCAR Evaporator Line Twist

<https://truckmanualshub.com/>

21Nm (per spec) applied to line fastener nut without securing TXV will result in ~10-15 degree movement of TXV due to the liquid and suction lines relative to evaporator moving.



*Starting Position of TXV Relative to Evaporator Before Torque Applied*



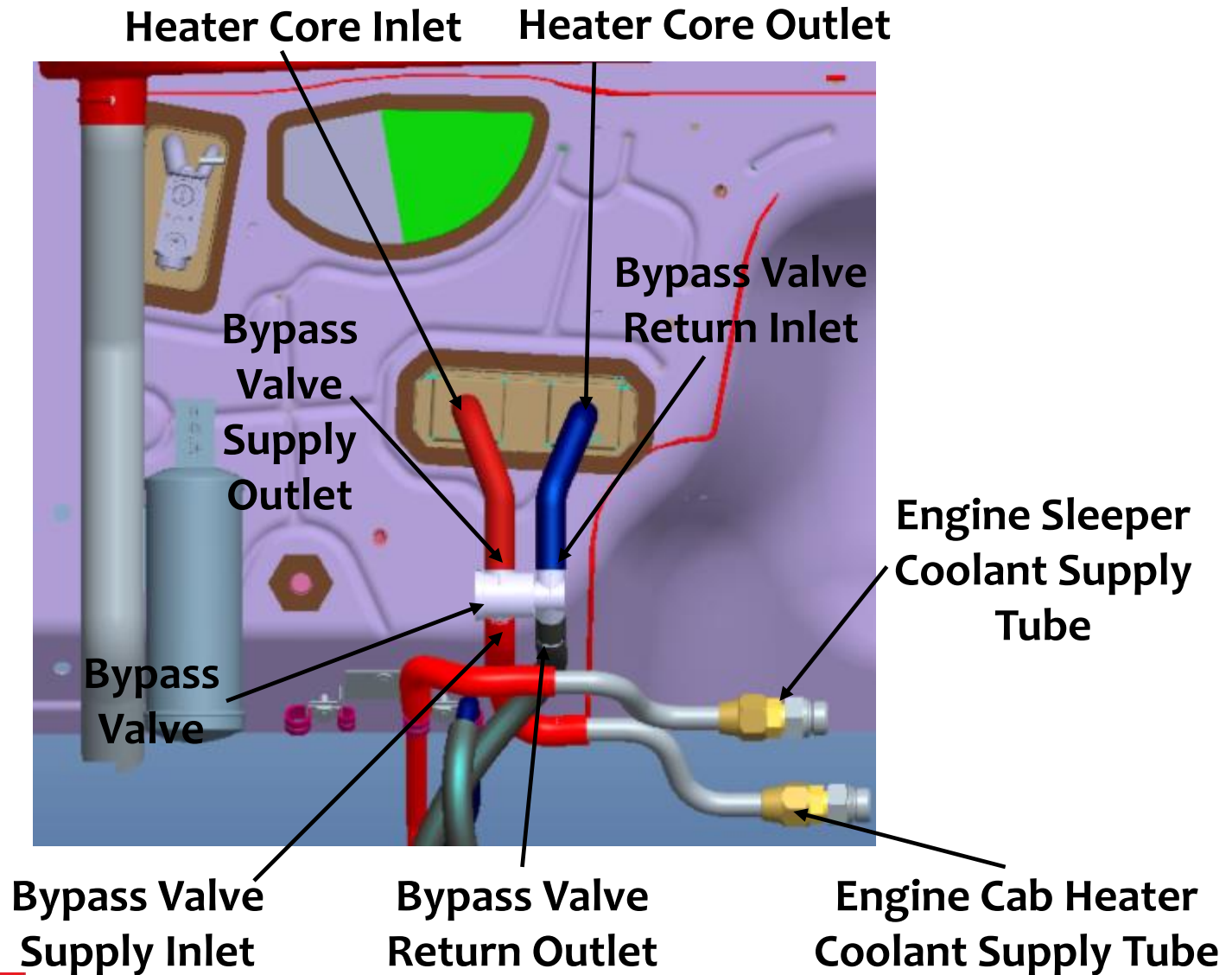
*Finished Position of TXV Relative to Evaporator after Torque Applied*

Parts pressure tested using 250psi of Nitrogen and being held under water for 30 minutes to review for air-bubbles (an indication of a leak) There were no leaks But -

# Firewall – Cab & Sleeper, Heater Lines

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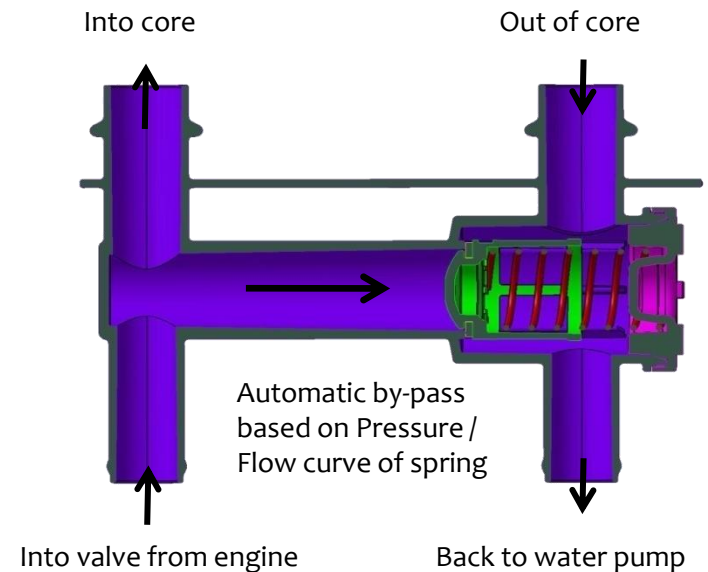
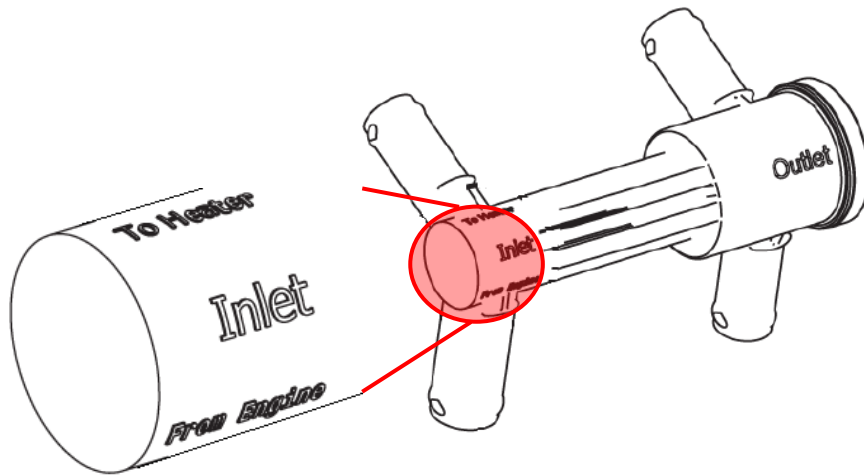
Front  
View





# Cab Heater By-Pass Valve

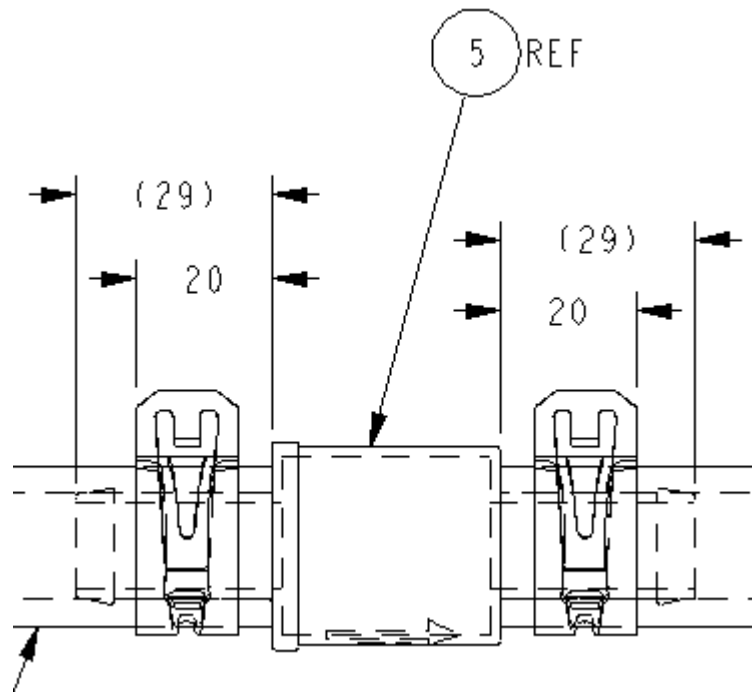
- Protects heater core from high coolant pressure/flow (max is 6.5 GPM).
  - Maximizing Life Of Heater Core.
  - Allows Flow Up To A Defined Point.
- Valve is flow directional.
- Valve is serviceable as complete assembly.





# Sleeper Heater Flow Restrictor

- The flow restrictor reduces the velocity of coolant restricting coolant flow to less than 5.5 gpm to eliminate cavitation of the sleeper heater core
- Located under sleeper, in the coolant line.



# HVAC System Protection

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- **Pressure Transducer**

- Clutch Disengages at 424 psi (29.3 bar) Locks out compressor at 430 psi (29.6 bar)
- The fan clutch is requested on at 330 psi (22.8 bar) and requested off at 235 psi (16.4 bar)

- **Evaporator Thermistor**

- Mounted in the HVAC unit
- Clutch Disengages if evaporator temp is 39°F (~4°C) or lower. Clutch is allowed to come back on when evaporator temperature reaches 46°F (~8°C.)

- **Compressor Pressure Relief Valve (PRV)**

- Not a serviceable component - part of the compressor
- Relief Valve vents the system at 508-595 psi

# Other Sensors

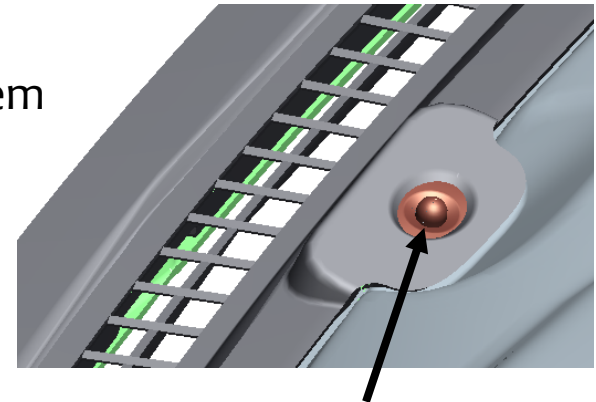
<https://truckmanualshub.com/>

- Cabin Air Temperature Sensor
  - Integrated Thermal Optical Sensor, (ITOS sensor)
  - Located on the control head



**Cabin Temp Sensor**

- Sun Load Sensor
  - Located on driver's side of dash panel
  - This sensor measures the intensity of the sun and influences temperature control of the HVAC system
  - Do not block this sensor



**Sun Load Sensor**

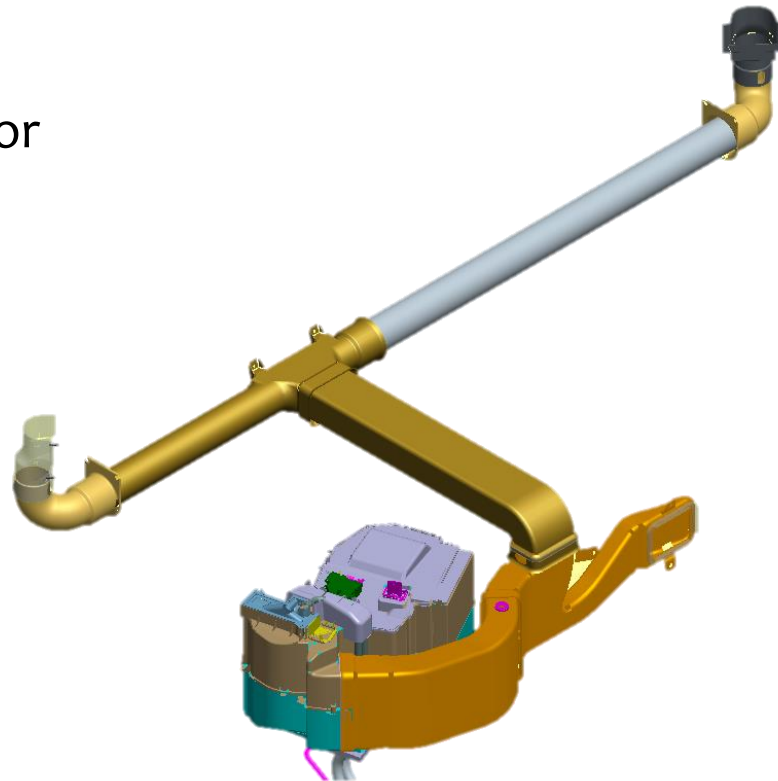
# Other Components

- Outside Air Temperature Sensor (OAT)
  - Located on the bottom of the driver's mirror
- Resistor
  - For the sleeper HVAC unit only
  - Is used to control blower speed by varying the voltage to the blower motor

Thermal limiter is set at 363°F (184°C)

# Sleeper HVAC Overview

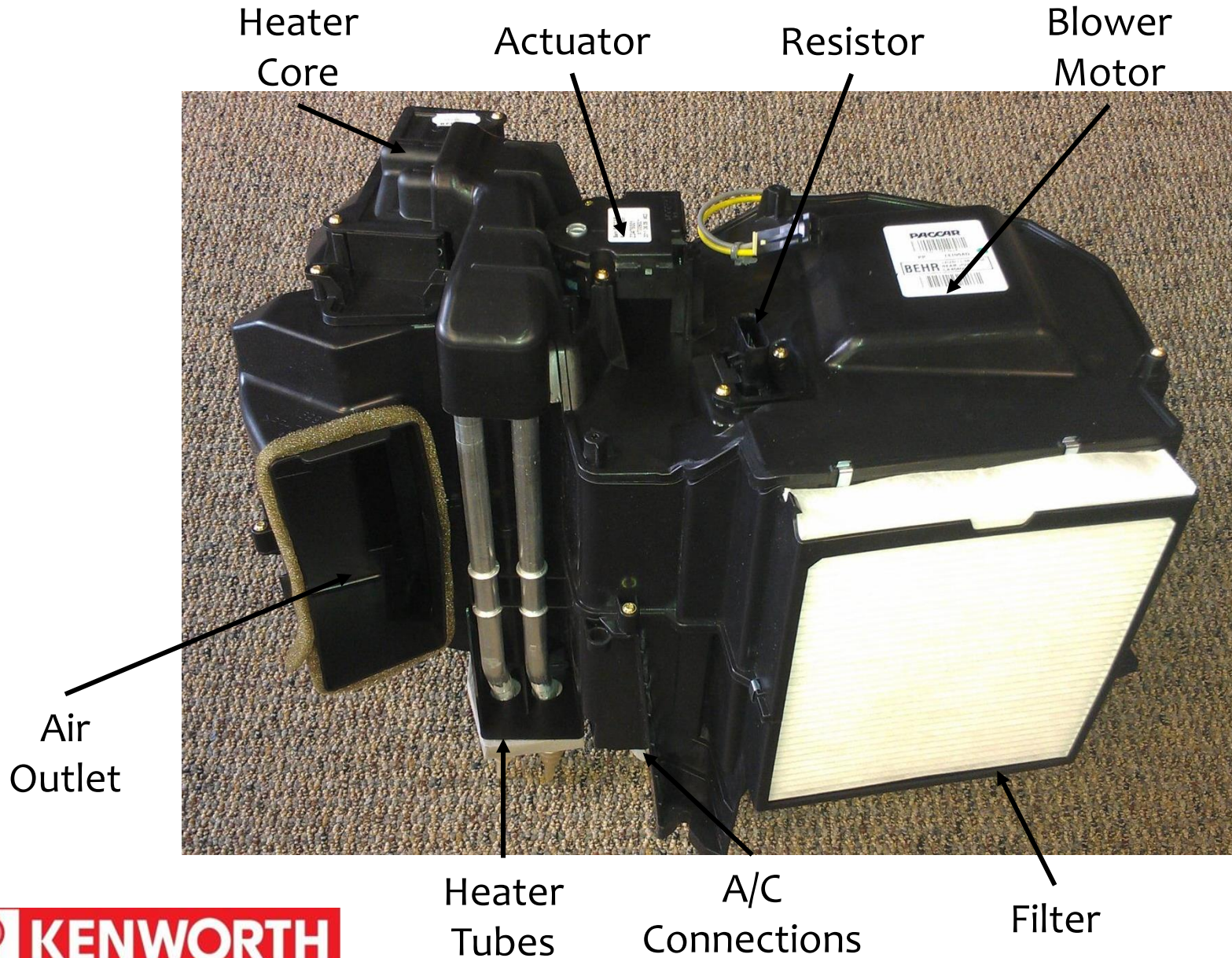
- Plastic Housings
- Aluminum Heat Exchangers
- DC Blower Motor With Resistor
- Pleated Air Filter
- 1 Electric Actuator
- Air Temperature Sensor
- TXV
- Service Cover





# Sleeper HVAC Components

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# Sleeper HVAC Control

<https://truckmanualshub.com/>



Fan Control    A/C Enable

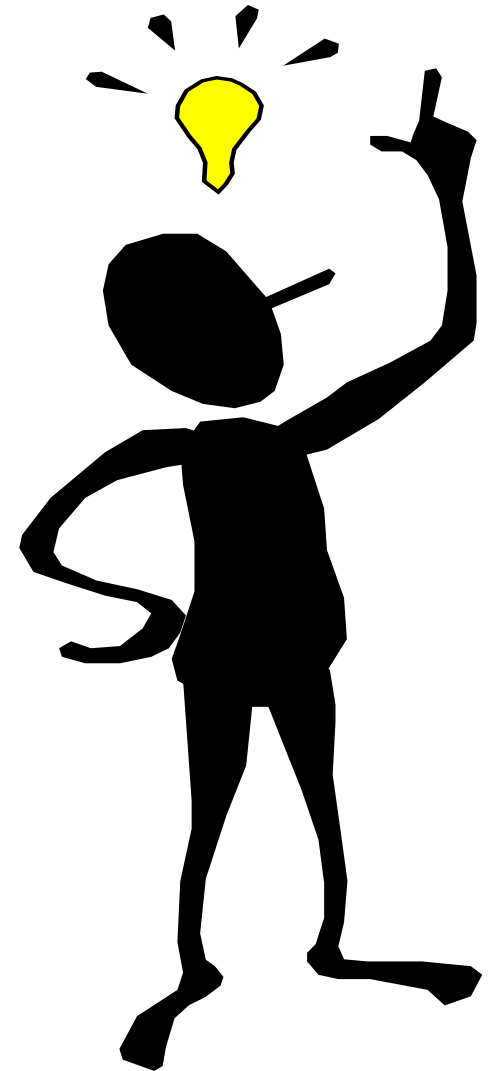
Temperature Control

**Note:** Sleeper AC function will not work without the sleeper enable button pushed on the *cab* HVAC control head.

The Sleeper Control Head “ENABLE” button provides a ground signal to the Cab Control Head.

# Performance Testing & Mechanical Troubleshooting





# Repair Strategy

- **Verify Complaint**
- **Visual Inspection**
- **Record Pressures & Temperatures**

*Determine if the problem is Mechanical or Electrical!*

*If it is a Mechanical problem:*

- **Recover Refrigerant**
- **Make System Repairs**
- **Evacuate the System**
- **Recharge the System**
- **Performance Testing**



# Normalized Resting Pressures

RESTING PRESSURE-is the pressure when the AC system has been turned off for 15-20 minutes and equalized. (Chart 7-13)

ARE THE PRESSURES EQUAL ? : Unequal pressures usually means that a restriction in the system is preventing the high side pressure from flowing into the low side when the clutch is off.

High pressure - means the system is contaminated (usually with air)

Low pressure - usually means most of the refrigerant has leaked out. Charge with at least 50 PSI and leak test. (KM811231)

# Resting Pressures

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| AMBIENT<br>TEMPERATURE ° F | SYSTEM<br>PRESSURE psi |  | AMBIENT<br>TEMPERATURE ° C | SYSTEM<br>PRESSURE Kpa |
|----------------------------|------------------------|--|----------------------------|------------------------|
| 45                         | 40.0                   |  | 7.2                        | 5.8                    |
| 50                         | 45.4                   |  | 10                         | 6.6                    |
| 55                         | 51.2                   |  | 12.7                       | 7.4                    |
| 60                         | 57.4                   |  | 15.5                       | 8.3                    |
| 65                         | 64.0                   |  | 18.3                       | 9.3                    |
| 70                         | 71.1                   |  | 21.1                       | 10.3                   |
| 75                         | 78.6                   |  | 23.9                       | 11.4                   |
| 80                         | 86.7                   |  | 26.7                       | 12.6                   |
| 85                         | 95.2                   |  | 29.4                       | 13.8                   |
| 90                         | 104.3                  |  | 32.2                       | 15.1                   |
| 95                         | 113.9                  |  | 35                         | 16.5                   |
| 100                        | 124.1                  |  | 37.8                       | 18                     |
| 105                        | 134.9                  |  | 40.6                       | 19.6                   |
| 110                        | 146.3                  |  | 43.3                       | 21.2                   |



# Operating Temperatures

## CONVENTIONAL MODELS WITHOUT SLEEPER

| Outside Temperature in Degrees F. | Center Duct Temperature | High Side Gauge Reading (PSI) | Low Side Gauge Reading (PSI) |
|-----------------------------------|-------------------------|-------------------------------|------------------------------|
| 70                                | 43 - 49                 | 95 - 130                      | 7 - 14                       |
| 80                                | 47 - 51                 | 100 - 135                     | 10 - 17                      |
| 90                                | 53 - 57                 | 120 - 155                     | 14 - 21                      |
| 100                               | 59 - 63                 | 155 - 185                     | 19 - 26                      |
| 110                               | 65 - 69                 | 185 - 205                     | 24 - 31                      |
| High Humidity Adjustment          | 0 - 15                  | No change                     | High side of range           |

• THE HUMIDITY IS OVER 70% THE DUCT TEMPERATURES WILL BE FROM THE SAME AS IN THE MASTER TABLE TO 15 DEGREES MORE

Performance testing:

Fan on high

Doors or windows open

Switch on fresh air

Manual over ride switch on (Engine fan running)

Run engine at 1500 rpm

# Leak Testing

<https://truckmanualshub.com/>

1. Make sure A/C system has at least 50 psi refrigerant charge.
2. Make sure detector is rated for type of refrigerant used.
3. Calibrate tester close to where you will be working
4. Hold the tip about 1/2" below where you want to test and move the tip slowly (moving too fast may push R-134a away).
5. Follow the entire route of the A/C system
6. Test the evaporator by using the blower to clear out residual R-134a, then wait about 5 min. for more to accumulate and check by inserting test probe under a dry drip tube.

# Leak Testing (Nitrogen)

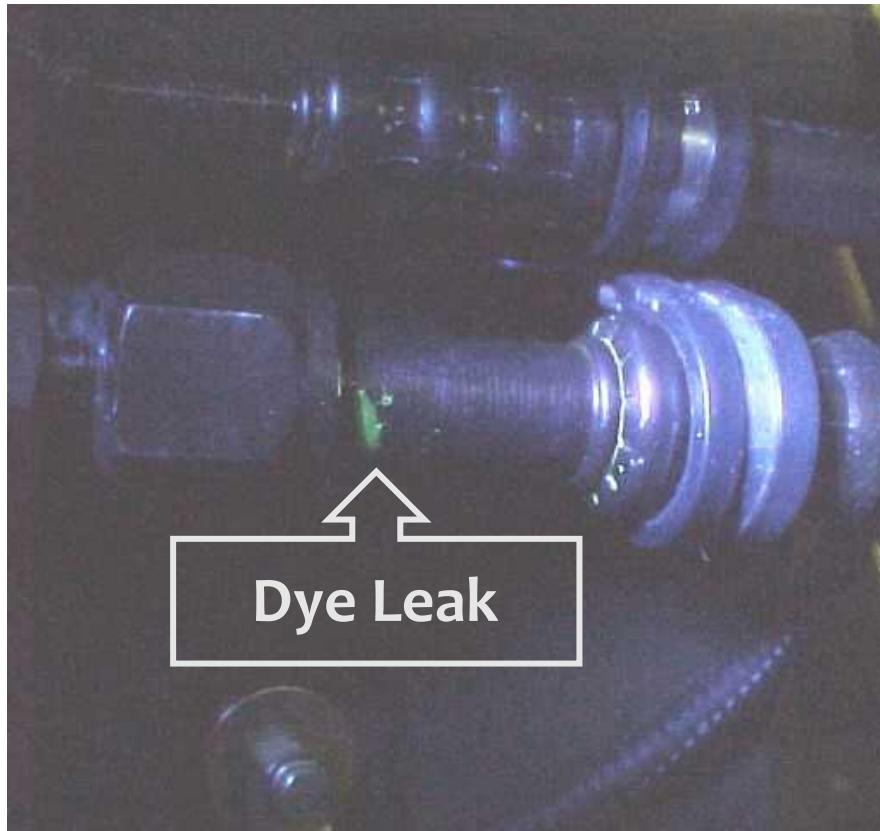
<https://truckmanualshub.com/>

1. Nitrogen should be used to charge the A/C system, then use soap solution to look for leaks.
2. Shop air should NEVER be used to check for leaks. Compressed air can inject moisture into the system, damage system components, and possibly cause bodily injury.
3. After charging the system with approximately 60-70 (\* 200 max) psi of nitrogen, apply the soap bubble solution to all connections.
4. Bubbles will be generated at any leak site(s).



# TIB 01-48 Leak Detection Fluorescent Dye

<https://truckmanualshub.com/>



Dye wafer - Factory  
Installed since 10/29/01



# Performance Test - Compressor

<https://truckmanualshub.com/>

Fast compressor cycling can be caused by:

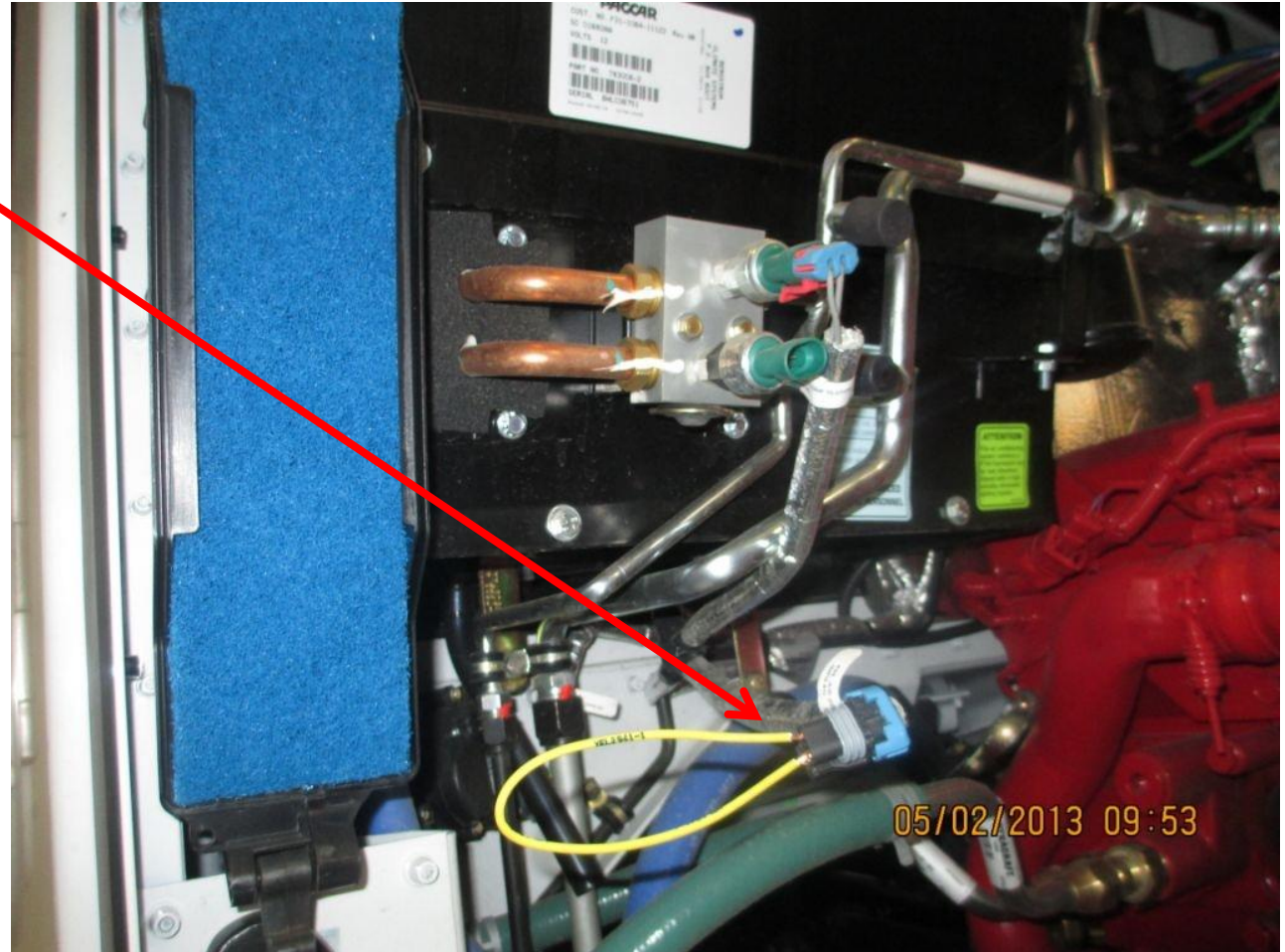
- system overcharge
- system contamination
- system undercharge
- bad freeze switch
- checking system at cooler temperatures

Faster cycling times are caused by low pressure side reaching low pressure switch cut out pressures under low load conditions (low ambient temperatures) . Sanden recommends no more than 4 clutch cycles per minute and the suction pressure to be 7 psi or above.

# Performance Test - Compressor

<https://truckmanualshub.com/>

It is OK to bypass low pressure switch to do performance test once you are sure system is approximately at right charge.



# System Troubleshooting

| GAUGE READINGS                                         | THERMOMETER READINGS           | POSSIBLE OBSERVATIONS                                                                 | POSSIBLE CAUSES                                                                              | FURTHER TROUBLESHOOTING                                                                                                                          |
|--------------------------------------------------------|--------------------------------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| High Side: low<br>Low Side: low                        | high to little below ambient   | Almost no R-134a in the system.<br>Oil drips below fittings.                          | Low R-134a due to leak, lack of maintenance or undercharging                                 | Thorough leak detector test                                                                                                                      |
| High Side: low<br>Low Side: very low                   | ambient                        | Binary switch open/ compressor not running.<br>Oil drips below fittings.              | No R-134a due to leak or lack of maintenance                                                 | Thorough leak detector test                                                                                                                      |
| High Side: high<br>Low Side: high                      | ambient or warm                | High side hoses hot.                                                                  | Condenser improperly aligned<br>Overcharged<br>R-12 contamination                            | Condenser inspection<br>Recover and recharge<br>Recover and dispose of contaminated R-12                                                         |
| High Side: high<br>Low Side: normal to low             | ambient or warm                | High side hoses or condenser with hot and cool spots.                                 | Condenser blocked<br>Hose or condenser blockage                                              | Condenser inspection: check for spot it changes from warm to cool.<br>Inspect Hoses for restriction                                              |
| High Side: low<br>Low Side: high                       | ambient to warm                | Compressor belt shiny.<br>Compressor clutch not engaging.<br>Compressor making noise. | Compressor belt loose or worn<br>Compressor clutch not engaging<br>Compressor failing        | Compressor inspection.<br>Electrical test of clutch and clutch circuit.                                                                          |
| High Side: high<br>Low Side: low to very low           | high to a little below ambient | Normal sight glass.<br>Compressor running, not cycling.<br>Moisture indicator pink.   | Blocked or failed expansion valve                                                            | Check sleeper unit<br>Warm the expansion valve/ evaporator.<br>Bench Test the expansion valve.                                                   |
| High Side: normal to high<br>Low Side: low to very low | high to a little below ambient | Compressor running, not cycling.<br>Frost on low side hoses.                          | Low side hose blocked/ kinked                                                                | Inspect hoses.                                                                                                                                   |
| High Side: normal<br>Low Side: high                    | high to ambient                | Compressor running, not cycling.<br>Low side hoses sweating.                          | Expansion valve failed open                                                                  | Warm the evaporator/ expansion valve.<br>Bench test the expansion valve.                                                                         |
| High Side: normal<br>Low Side: normal to low           | high                           | Compressor running, not cycling                                                       | Coolant leaking through heater core<br>Freeze switch stuck closed<br>Evaporator fins clogged | Measure duct temperature with AC off.<br>Electrical test freeze switch.<br>Warm evaporator with a heater.<br>Physically inspect evaporator core. |
| High Side: low<br>Low Side: high                       | high                           | Compressor clutch not engaging                                                        | Binary switch low pressure cut-out point too high                                            | Check refrigerant charge level.<br>Electrical test of binary switch.                                                                             |



# Evaporator Performance

Check the evaporator performance after the first fifteen (15) minutes of operation.

- Operate truck with windows rolled down.
- Insert thermometer in center vent while A/C system is operating. Compare reading to chart to see if within specs.
  - A general rule is the difference between ambient and duct temp should be 25 - 30 °f.
- As a secondary check, compare evaporator lines - there should be about a 5 - 15°f differential. (Temperature differential is very dependent upon ambient conditions, temperature & humidity).
- Check air flow through evaporator for debris or clogged cabin air filter (usually normal pressures)
- Check evaporator drains to make sure water is dripping and evacuator valves are on.



# Condenser Performance

- Check temperature in (top) and out (bottom) - should be 10 to 15 degree difference. Too much temperature drop could indicate a restriction. Remember, the temperature change is not as important as confirming a state change in the refrigerant.
- Check air flow and obstructions (oil coolers and winter fronts), bent fins, bent tubes and tight fittings
- Check to see if engine fan comes on, and at the right pressures
- Check to see that the hood closed correctly.

# Saturation Point of Refrigerant



Many refrigerant gauge sets have an inner scale that reads the saturation (boiling) point of the refrigerant.

For the purposes of condenser and evaporator testing, use an average value based on the pressures during compressor cycles. (High side for condenser, Low side for evaporator)

Example: Gauge reads between 100 and 300 PSI during compressor cycling. Using an average of 200 PSI for the high side pressure, from outer scale – refrigerant changes state at 132 degrees F (inner scale) – use this temp for condenser performance testing.

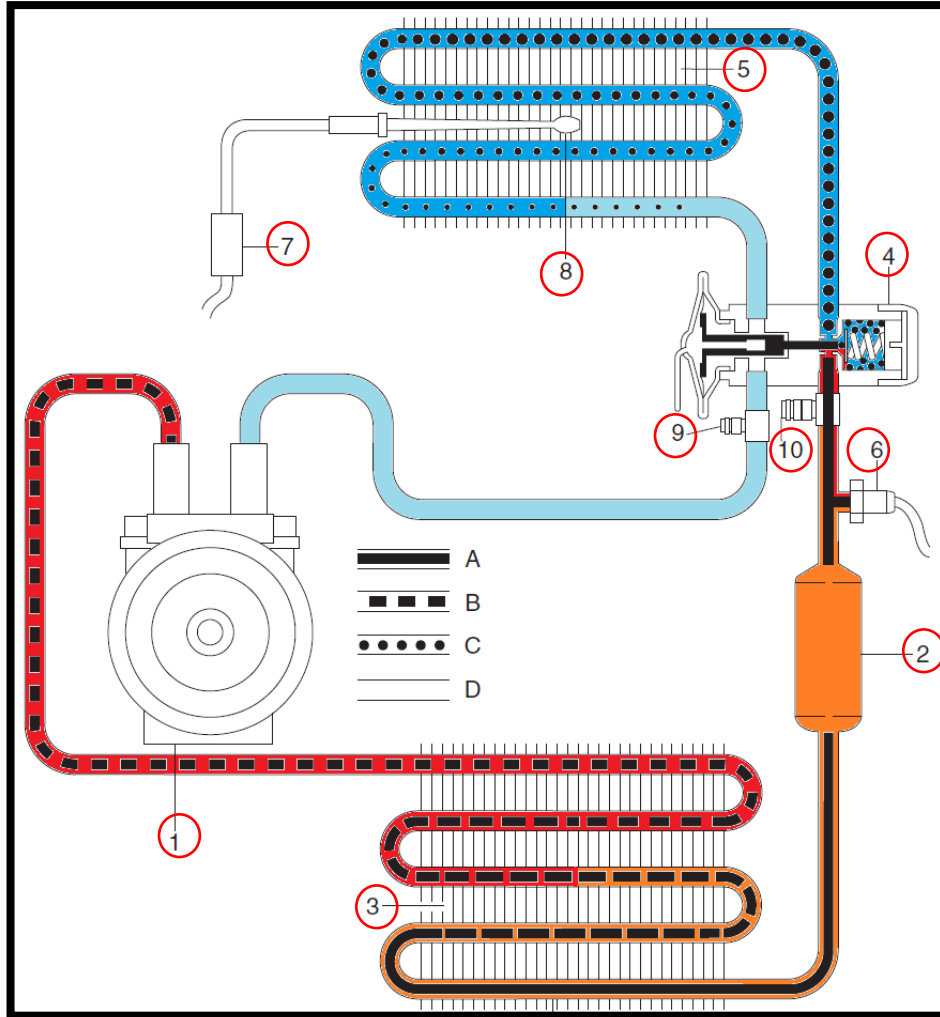
# High Side Pressure Chart

<https://truckmanualshub.com/>

| High side pressure | Temperature at which change of state occurs |
|--------------------|---------------------------------------------|
| 90 psi             | 83 degree F                                 |
| 125 psi            | 100 degree F                                |
| 150 psi            | 115 degree F                                |
| 175 psi            | 125 degree F                                |
| 200 psi            | 130 degree F                                |
| 225 psi            | 138 degree F                                |
| 250 psi            | 146 degree F                                |

# Inspecting the A/C System by Temperatures

<https://truckmanualshub.com/>



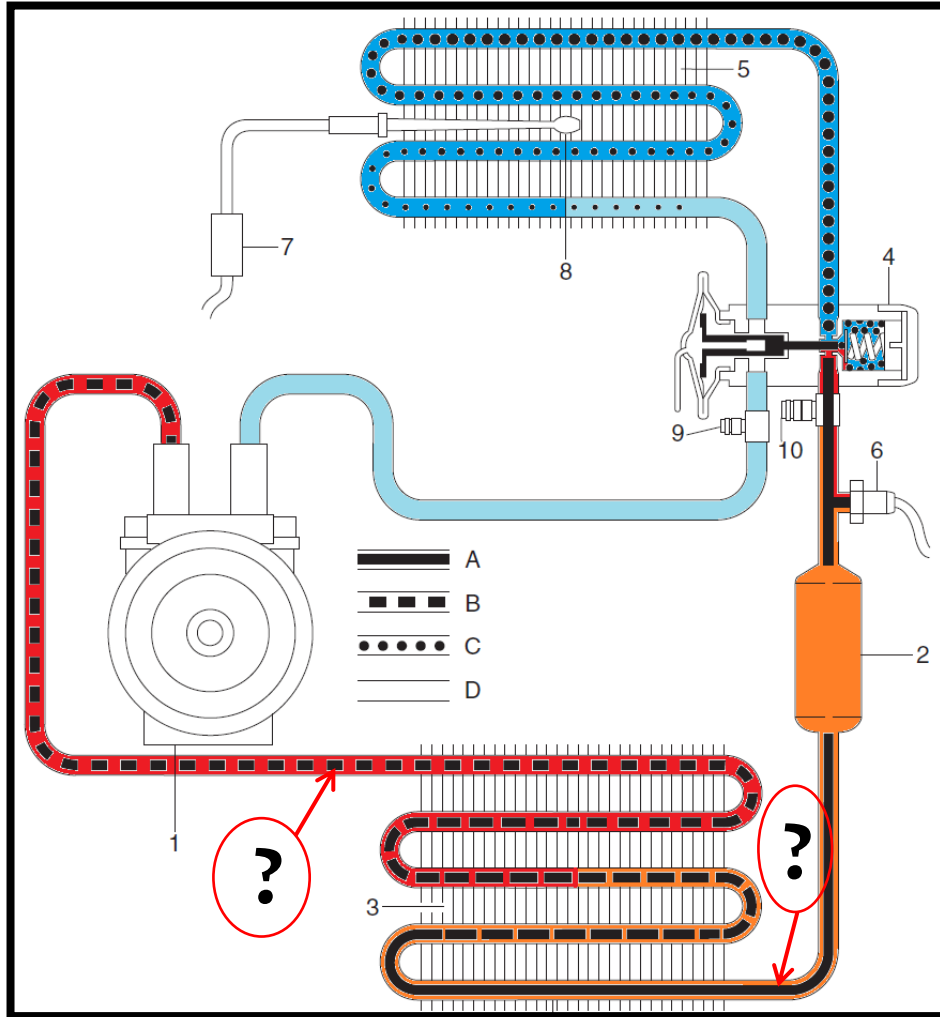
- When the system is functioning correctly:
  - The pipe between the evaporator (5) and the compressor (1) should be cold
  - The pipe between the compressor (1) and the condenser (3) should be hot
  - The pipe between the condenser (3) and the evaporator (5) (via the dryer 2) the pipe temperature should be between hot and cold.

## A/C R134-a Status

|                           |
|---------------------------|
| A: High pressure, liquid  |
| B: High pressure, gaseous |
| C: Low pressure, liquid   |
| D: Low pressure, gaseous  |

# Inspecting the A/C System by Temperatures

<https://truckmanualshub.com/>

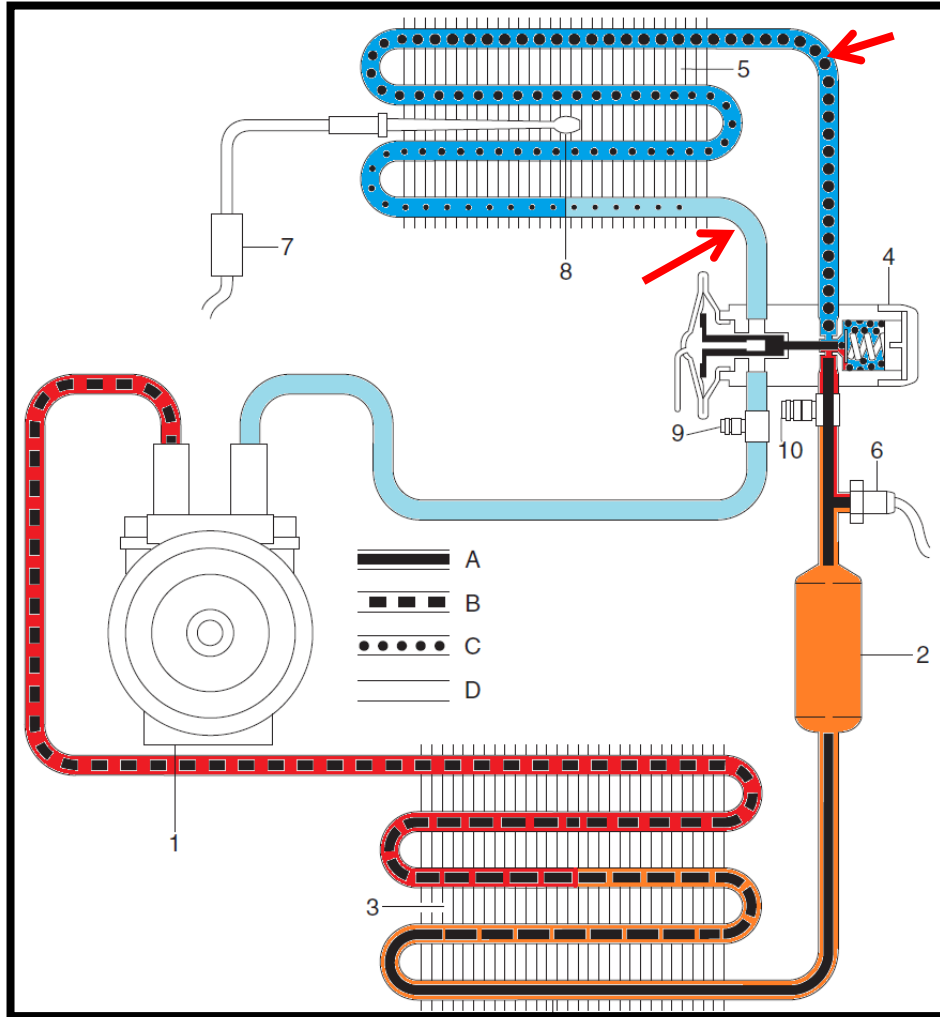


- Based on the average high side pressure:
  - the temperature of the high pressure line should be above the saturation temperature entering the condenser
  - the temperature of the high pressure line should be below the saturation temperature leaving the condenser.
  - **THIS IS CRITICAL** for system performance.



# A/C System Temperature Inspection

<https://truckmanualshub.com/>



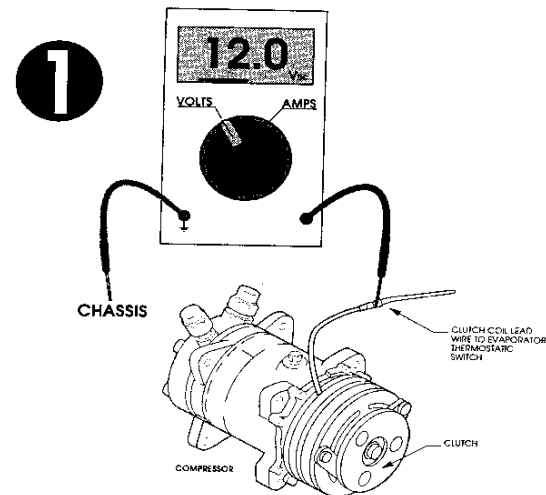
- There should be a ~10 degree F change across the evaporator core inlet and outlet pipes. (This can vary based on where the temperature readings are taken relative to the TXV.)
- The temperature drop from the center vent should be at least 20 degrees F.

## A/C R134-a Status

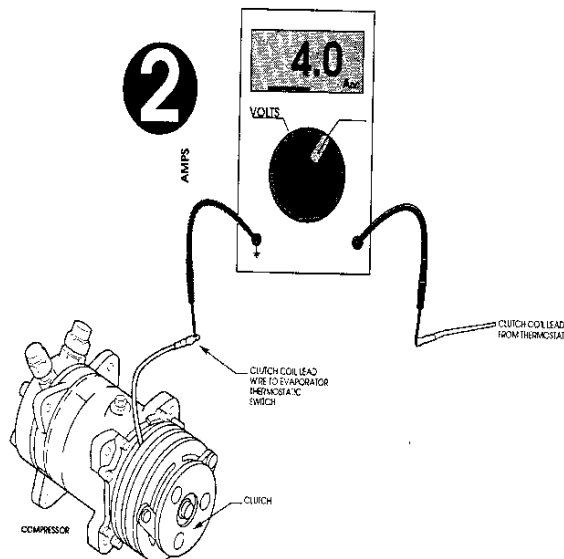
|                           |
|---------------------------|
| A: High pressure, liquid  |
| B: High pressure, gaseous |
| C: Low pressure, liquid   |
| D: Low pressure, gaseous  |

# Compressor Clutch Performance

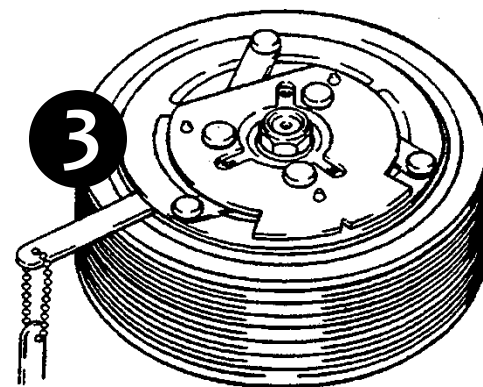
1. Measure available voltage at the clutch (SYSTEM VOLTAGE or above 11.5 volts)



2. Measure current draw. (3.6 to 4.2 amps at 12 volts)



3. Measure Clutch air gap should be 0.016 - 0.031 inch.



# Operational Modes – Automatic (ATC)

- The controller will regulate cabin comfort automatically with inputs from:
  - ITOS (in-cab temp) sensor
  - Sun Load Sensor
  - CECU via C-CAN (incl. coolant temp, outside air temp, engine coolant temp, engine speed, vehicle speed)
- The control will have a full automatic mode, temperature, and fan operation once the ATC has been activated.

# Operational Modes – Automatic (ATC)

- The controller will regulate cabin comfort automatically with inputs from:
  - ITOS (in-cab temp) sensor
  - Sun Load Sensor
  - CECU data via C-CAN
    - coolant temp
    - outside air temp
    - engine coolant temp
    - engine speed
    - vehicle speed
- The control will have a full automatic mode, temperature, and fan operation once the ATC has been activated.

# Operational Modes – Semi-Automatic

- When the HVAC control is placed in Automatic Mode, it is possible to manually override either the fan speed or the mode setting (floor, panel, bilevel, etc...).
- During the semi-automatic mode, the manually-overridden function will maintain its state whereas all other functions will vary based off of the ATC-logic in order to attain the operated requested conditions.
  - Please note that the manual override of both the fan speed and the mode setting will result in the control head returning to a full manual functioning.
  - It should also be noted that the override of the A/C function will place the control head in full manual mode.
  - Selecting the recirculation function makes no functional mode change.



# Operational Modes – 30% Recirculation

<https://truckmanualshub.com/>

- When in “Fresh Air” manual mode, and the ambient temperature is below 23°F (-5°C), recirculation door will be set to provide 30% recirculated air to assist with heater performance.
- Normal operation will return when ambient temperature is above 32°F (0°C).
- Manual over ride (100% recirculation ) is permitted.
- No other mode, including ATC, is impacted.

# Operational Modes - Manual

- The HVAC module will keep the following constant:
  - blower speed,
  - mode position (panel, floor, etc..)
  - recirculation (fresh air or recirculated air)
  - compressor operation.
- The temperature door is able to reset it's position, to meet the operator-requested temperature
- The temperature door position is fixed, when the temperature knob is set to max hot or cold. These are the only conditions where the HVAC operates in a true "manual" fashion.

## ESA Scan Tool Monitors

- HVAC Switch On/Off
- A/C Compressor Outlet Pressure – Pressure the HVAC control head is seeing from Pressure transducer
- Fan Percent On – engine fan request
- Requested Fan Speed – the position of the fan knob
- Temperature Knob Percent Open – the position of the temperature knob

# ESA Interface

<https://truckmanualshub.com/>

**ESA**  
Electronic Service Analyst

 Disconnect

 Diagnose

 Monitor

 Simulate

 Program

External Applications

Monitor/Simulate Components

ESA Home

ServiceNet

**Custom Views**

Open View

Delete View

Save View

**Unit of Measure**☒ Standard ☐ Metric

Expand All

Collapse All

Close All

☐ CECU3☒ HVAC☒ Self Tests☒ Self Tests Control

Monitor Data View

 **Monitor**

Print Preview

Close

Self Tests Control

☐ Select All Self Tests☒ Actuator Calibration

View Previous Results

Run Selected

Close



# ESA Interface

<https://truckmanualshub.com/>

**ESA**  
Electronic Service Analyst

 Disconnect

 Diagnose

 Monitor

 Simulate

 Program

External Applications

Monitor/Simulate Components

Print Preview Close

ESA Home

ServiceNet

Custom Views

Delete View

Unit of Measure

☒ Standard ☐ Me

Expand All

☒ CECU3☒ HVAC☒ Self Tests☒ Self Tests C

Monitor Data View

**HVAC Self Test Details Dialog**Overall Status: 

Print Preview Close

# ESA Interface

<https://truckmanualshub.com/>

**ESA**  
Electronic Service Analyst

Disconnect

Diagnose

Monitor

Simulate

Program

External Applications

Monitor/Simulate Components

Print Preview Close

ESA Home

ServiceNet

Custom Views

Delete View

Unit of Measure

☒ Standard ☐ Me

Expand All

☒ CECU3☒ HVAC☒ Self Tests☒ Self Tests C

Monitor Data View

**HVAC Self Test Details Dialog**

Overall Status:

Print Preview Close

# ESA Interface

<https://truckmanualshub.com/>

 **ESA**  
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 Disconnect

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ESA Home

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Delete View

Unit of Measure

☒ Standard ☐ Me

Expand All

☐ CECU3☒ HVAC☒ Self Tests☒ Self Tests C

Monitor Data View

**HVAC Self Test Details Dialog**Overall Status: 

| Component            | Sub Test            | Valid Range | Value      | Status                                                                               |
|----------------------|---------------------|-------------|------------|--------------------------------------------------------------------------------------|
| Actuator Calibration |                     | Pass - Fail | In Process |   |
|                      | Panel Motor         | Pass - Fail | In Process |   |
|                      | Floor Motor         | Pass - Fail | In Process |   |
|                      | Recirculation Motor | Pass - Fail | In Process |   |
|                      | Defrost Motor       | Pass - Fail | Pass       |   |
|                      | Temperature Motor   | Pass - Fail | Pass       |  |

Print Preview Close

# ESA Interface

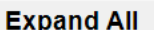
<https://truckmanualshub.com/>

**Disconnect****Diagnose****Monitor****Simulate****Program**

External Applications

Monitor/Simulate Components

 **ESA Home**  
 **ServiceNet**

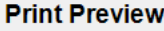
**Custom Views**  
 **Delete View**  
**Unit of Measure**  
☒ **Standard** ☐ **Me**  
 **Expand All**  
 **CECU3**  
 **HVAC**  
 **Self Tests**  
 **Self Tests**

**Monitor Data View**

**HVAC Self Test Details Dialog**  
**Overall Status:** 

| Component            | Sub Test            | Valid Range | Value | Status                                                                              |
|----------------------|---------------------|-------------|-------|-------------------------------------------------------------------------------------|
| Actuator Calibration |                     | Pass - Fail | Pass  |  |
|                      | Panel Motor         | Pass - Fail | Pass  |  |
|                      | Floor Motor         | Pass - Fail | Pass  |  |
|                      | Recirculation Motor | Pass - Fail | Pass  |  |
|                      | Defrost Motor       | Pass - Fail | Pass  |  |
|                      | Temperature Motor   | Pass - Fail | Pass  |  |

  
 **Print Preview**  **Close**

 **Print Preview**  **Close**

# ESA Interface

<https://truckmanualshub.com/>

**ESA**  
Electronic Service Analyst

 Disconnect

 Diagnose

 Monitor

 Simulate

 Program

External Applications

Monitor/Simulate Components

**Custom Views**  
 Open View  
Delete View Save View

**Unit of Measure**  
☒ Standard ☐ Metric

Expand All Collapse All Close All

☒ CECU3

- ☐ Cluster
- ☐ Data Buses
- ☐ Editable Telltales
- ☐ Electrical
- ☐ Gauges
- ☐ Sounds
- ☐ Steering Wheel Controls
- ☒ Switches
- ☐ Telltales

☐ HVAC

Monitor Data View

 **Monitor** Print Preview Close

Close

HVAC Switch  
 ON

Close

Close

Key Switch  
 ACC  
IGN  
START

Close

Close

Manual Fan Switch  
 OFF

Close

Close

Marker Flash Switch  
 OFF

Close

Close

MCS Knob  
 L PUSH R

Close

Close

Park Lamp Switch  
 OFF

Close

# ESA Interface

<https://truckmanualshub.com/>

 Disconnect Diagnose Monitor Simulate Program

External Applications

 ESA Home

 ServiceNet

 PEP Web Site

Monitor/Simulate Components

**Custom Views**

Open View

Delete View

Save View

**Unit of Measure**

☒ Standard ☐ Metric

Expand All

Collapse All

Close All

☒ CECU3

- ☐ Cluster
- ☐ Data Buses
- ☐ DPA
- ☐ Editable Telltales
- ☐ Electrical
- ☐ Gauges
- ☒ HVAC
  - ☒ AC Compressor Outlet Pressure
  - ☒ Fan Percent On
  - ☒ Requested Percent Fan Speed
  - ☒ Temperature Knob Percent Open
- ☐ Sounds
- ☐ Steering Wheel Controls
- ☐ Switches
- ☐ Telltales

☐ HVAC

Monitor Data View

 **Monitor - EMULATION MODE**

Print Preview

Close

| AC Compressor Outlet Pressure                                                                 | Fan Percent On                                                                           | Requested Percent Fan Speed                                                               | Temperature Knob Percent Open                                                             |
|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| <br>0.00 PSI | <br>0% | <br>0% | <br>0% |
| <div>Close</div>                                                                              | <div>Close</div>                                                                         | <div>Close</div>                                                                          | <div>Close</div>                                                                          |



# K370/K270 Cab Over Engine Medium Duty Trucks

<https://truckmanualshub.com/>

# Kenworth COE Medium Duty Models

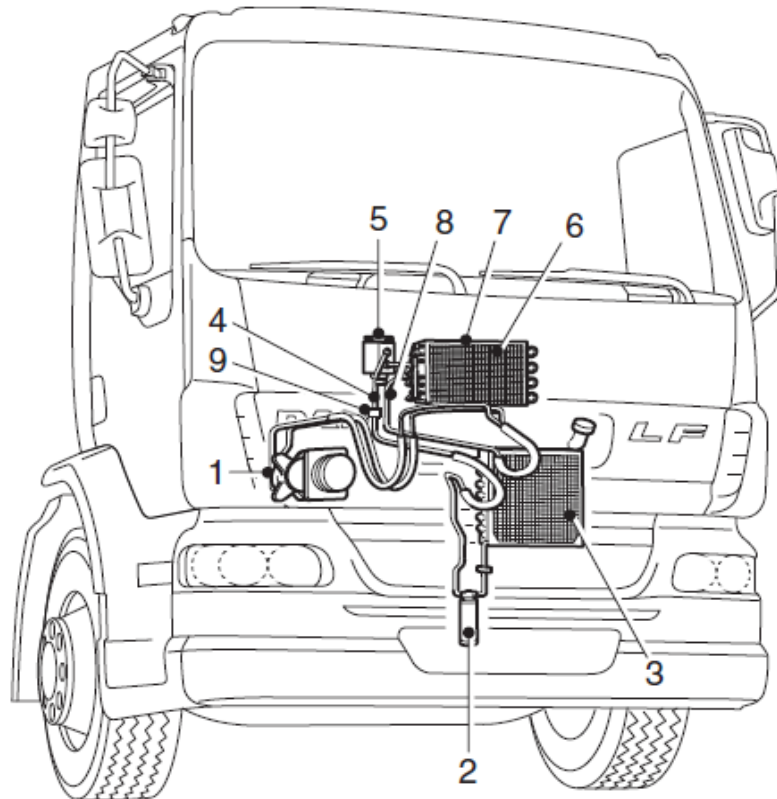
## COE Medium Duty Class 5, 6, 7 – K Series



# HVAC System Layout

<https://truckmanualshub.com/>

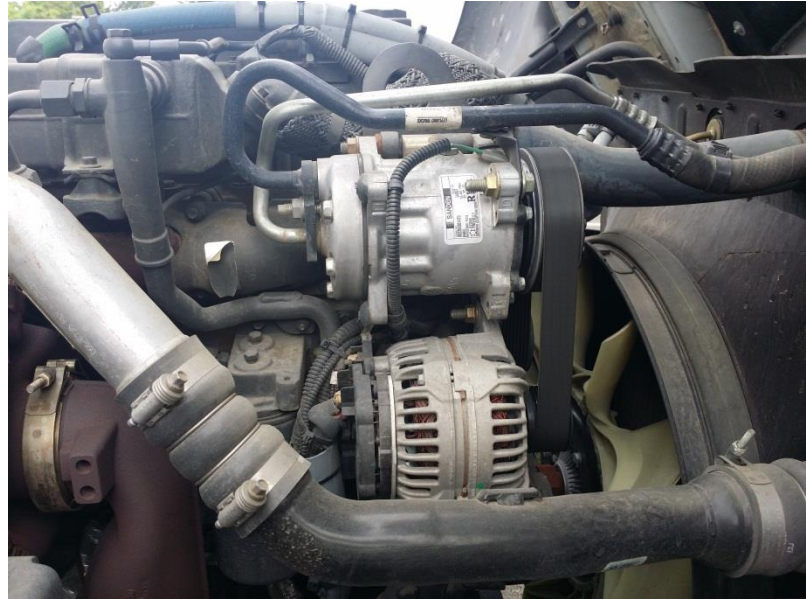
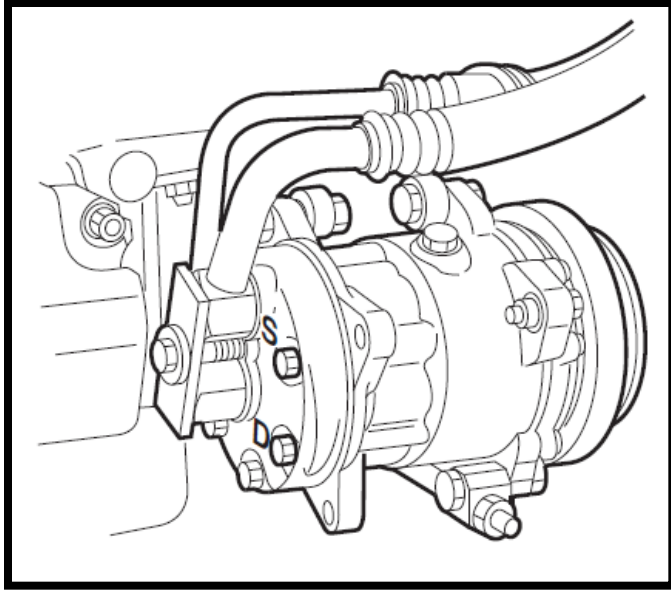
| Pos | Description                                                          |
|-----|----------------------------------------------------------------------|
| 1   | Air conditioning compressor                                          |
| 2   | Dryer                                                                |
| 3   | Condenser                                                            |
| 4   | Service valve, high-pressure side                                    |
| 5   | Expansion valve                                                      |
| 6   | Evaporator                                                           |
| 7   | A/C compressor temp. switch<br>(sited at the rear of the evaporator) |
| 8   | Service valve, low-pressure side                                     |
| 9   | Air conditioning Switch. high/low press.                             |



The air conditioning system is a closed system filled with R134a refrigerant. The A/C Includes a 24V Compressor.

# 24V Compressor

<https://truckmanualshub.com/>



Sanden Compressor uses a 24 volt clutch

# 24 Volt A/C Compressor Clutch Specifications

- Confirm that the clutch is receiving 22.5 V (minimum) for 24 V system engagement
- 24 Volt coil resistance should measure between 14.5  $\Omega$  and 18.2  $\Omega$  @ room temperature
- Air gaps exceeding 0.051" (1.3 mm) can prevent engagement. Specification is 0.016" - 0.031" (0.4 - 0.8mm).

# HVAC System Oil Capacities

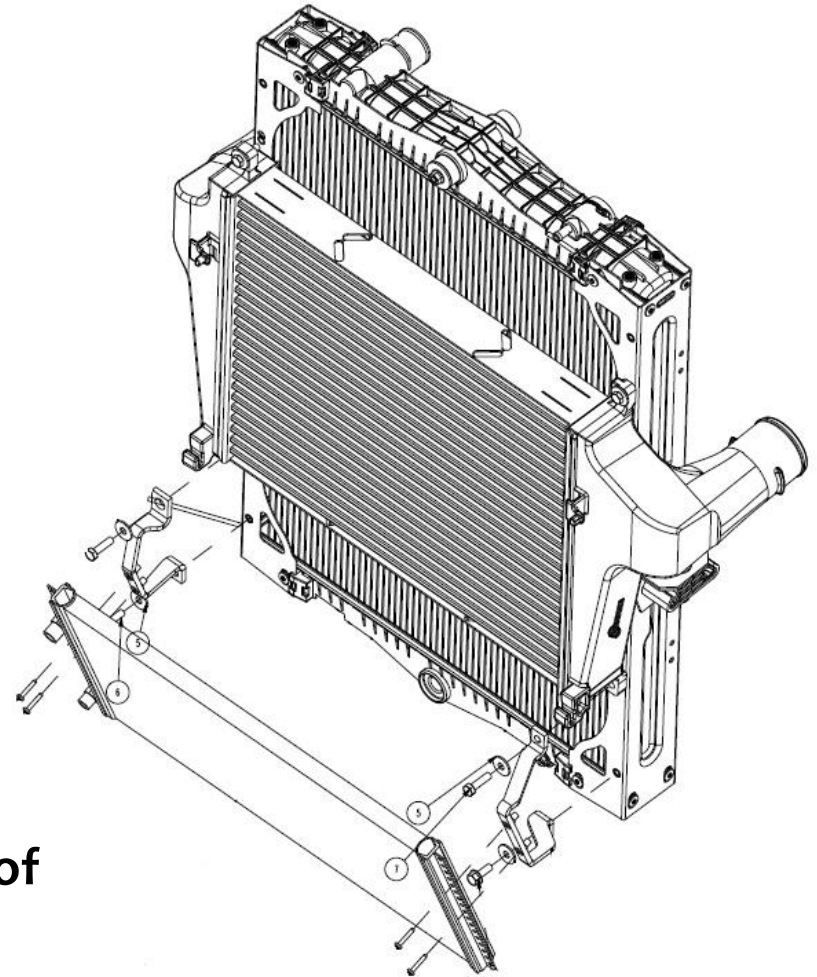
| Filling Capacities          |                   |
|-----------------------------|-------------------|
| A/C system coolant capacity | 2 lbs (900 grams) |
| Compressor oil type         | PAG oil           |
| System oil capacity         | 6 oz (175 cc)     |

| Compressor oil refilling quantity when replacing: |                 |
|---------------------------------------------------|-----------------|
| dryer                                             | 0.6 oz (20 cc)  |
| condenser                                         | 1.7 oz (50 cc)  |
| evaporator                                        | 1.3 oz (40 cc)  |
| compressor                                        | 4.6 oz (135 cc) |
| pipe                                              | 0.6 oz (20 cc)  |



# Condenser Location

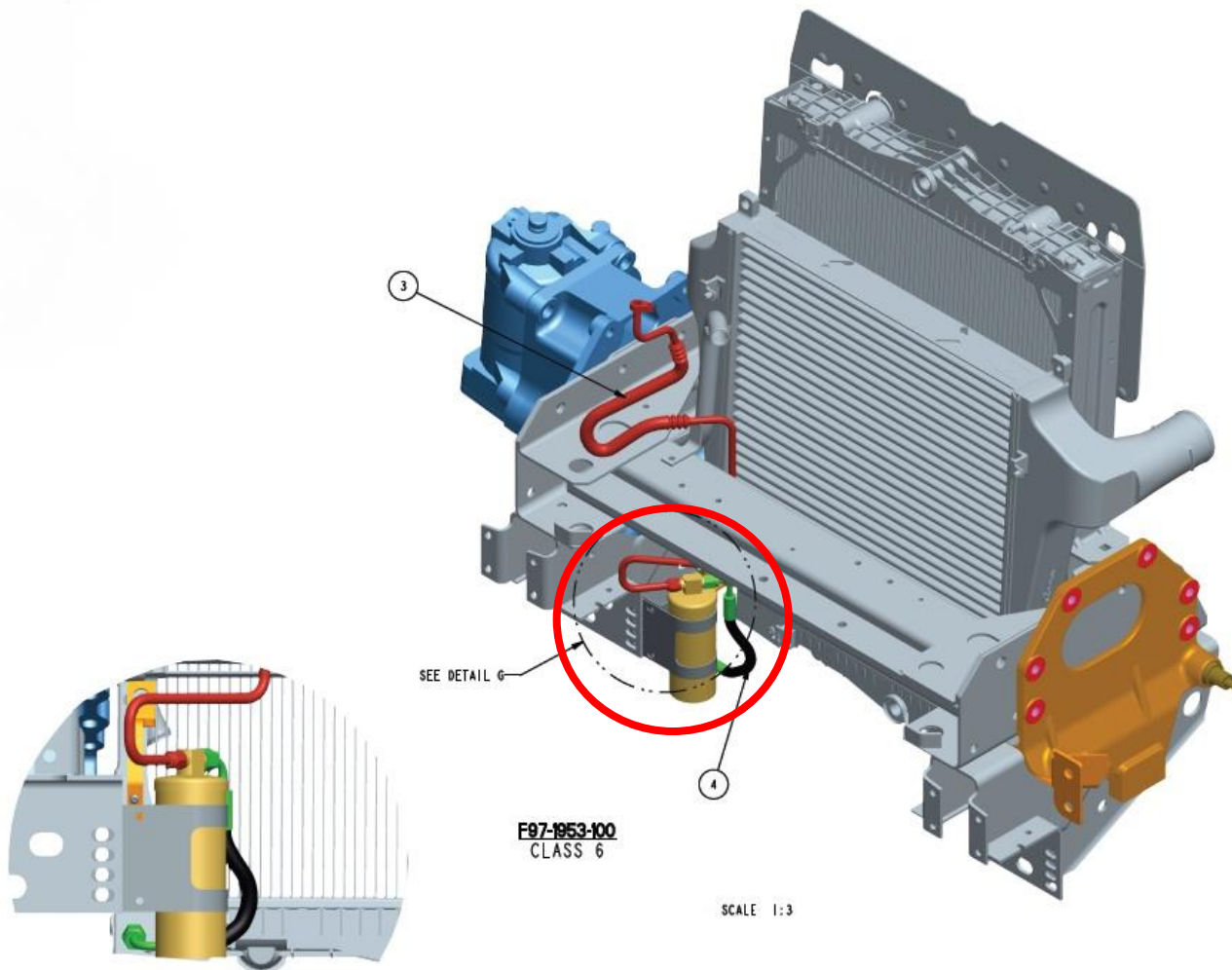
<https://truckmanualshub.com/>



**Note: Due to the low mount design of the condenser, road debris buildup inspection is an initial diagnostic step**

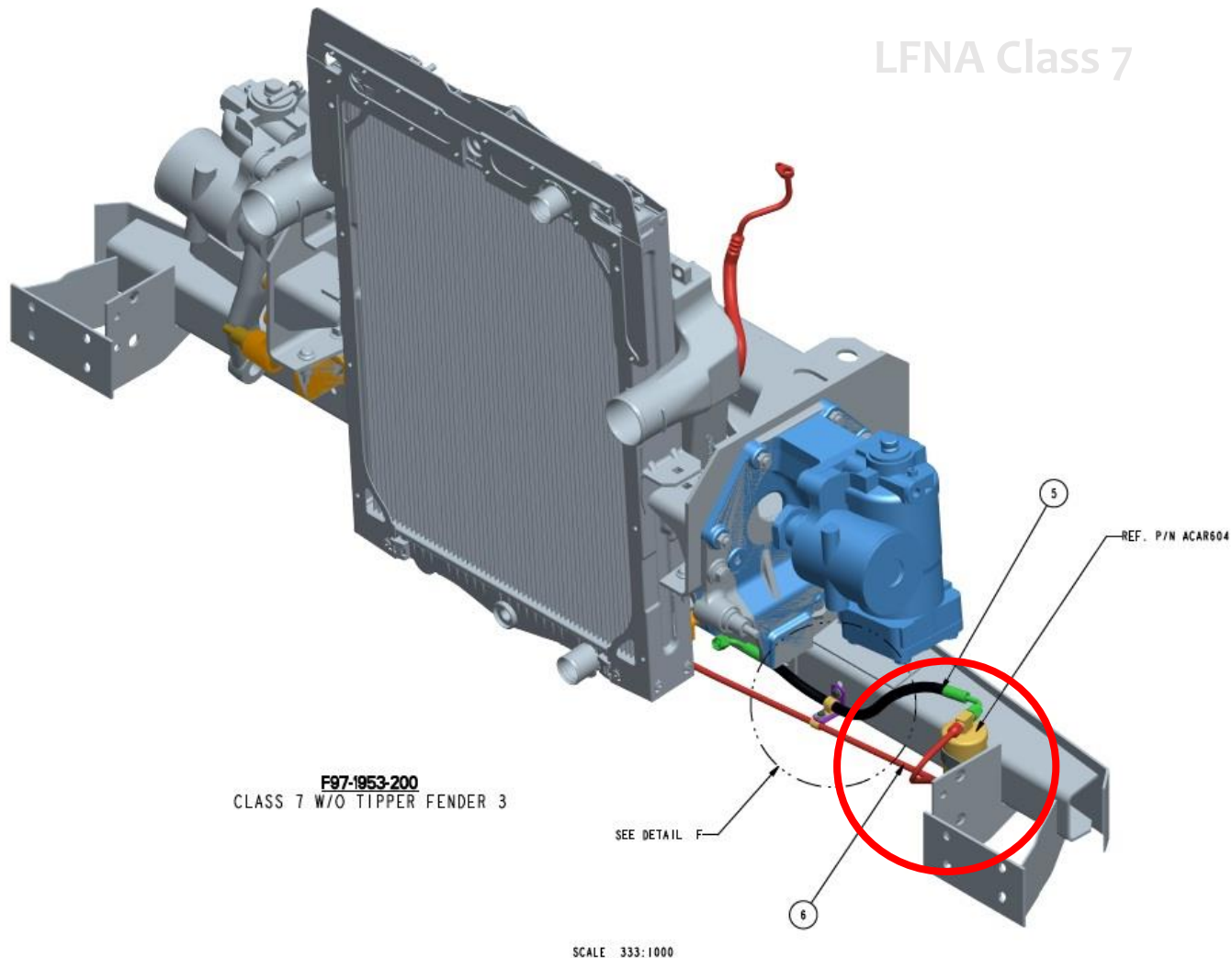
# Receiver-Drier Locations

LFNA Class 6



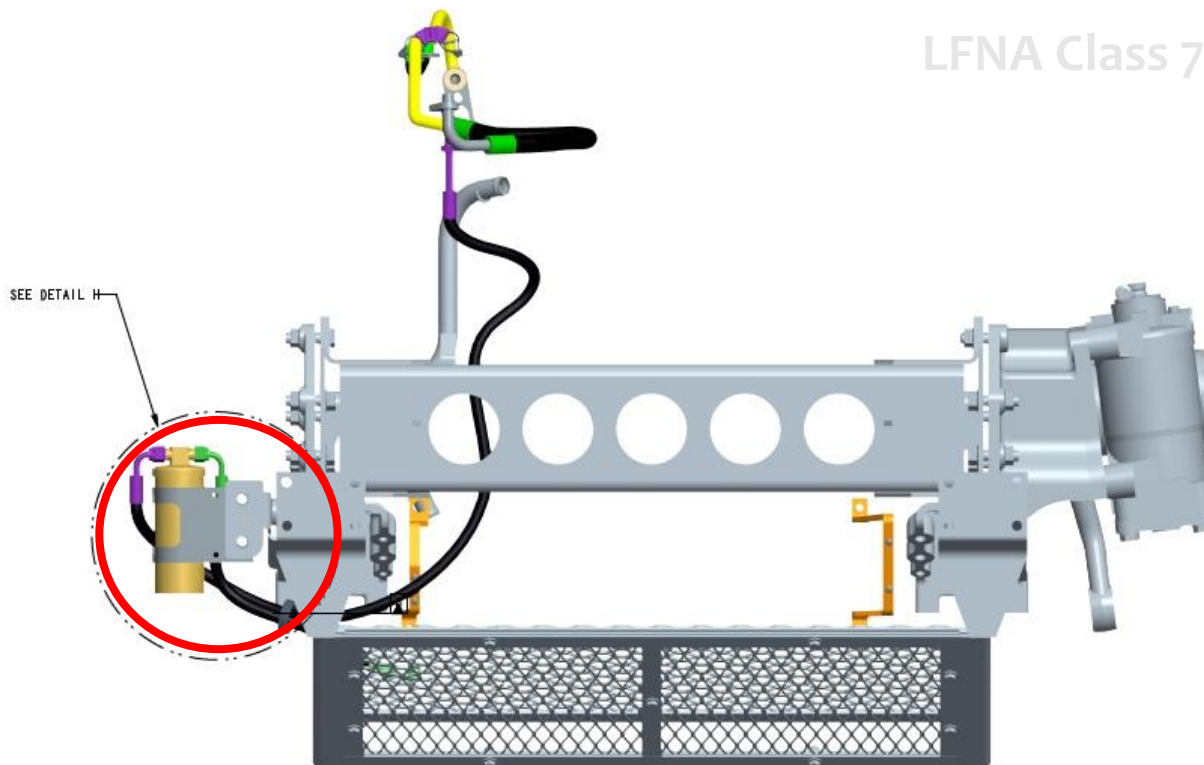
# Receiver-Drier Locations

LFNA Class 7

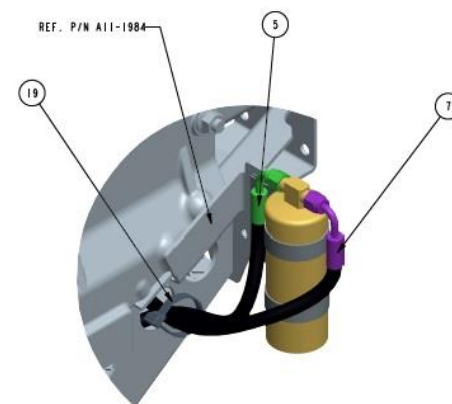


# Receiver-Drier Locations

LFNA Class 7



**F97-1953-300**  
CLASS 7 W/ TIPPER FENDER 3  
SCALE 333:1000

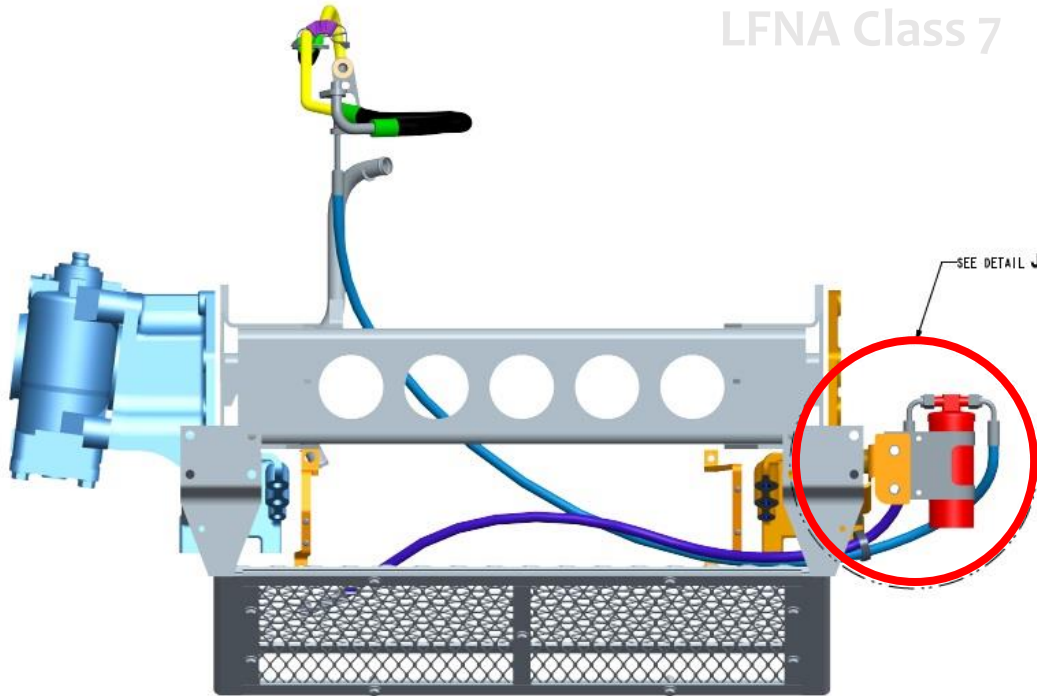


**DETAIL\_H**  
SCALE 1:2  
(VIEW ROTATED FOR CLARITY)

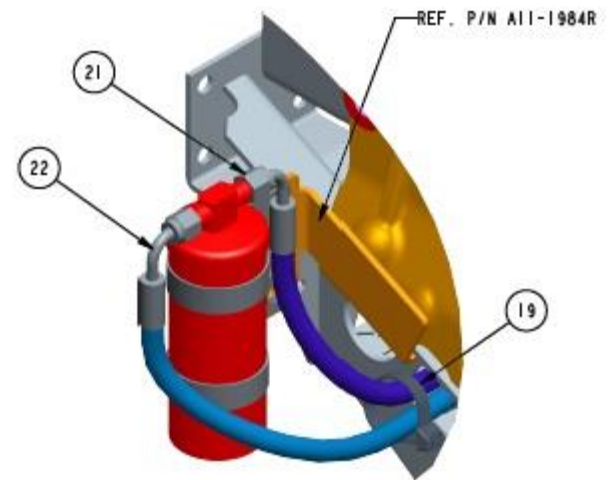


# Receiver-Drier Locations

LFNA Class 7



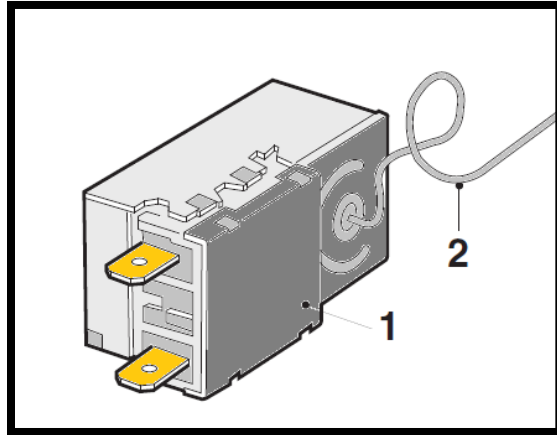
F97-1953-400  
CLASS 7 SWEEPER RH DRIVE  
SCALE 1:3



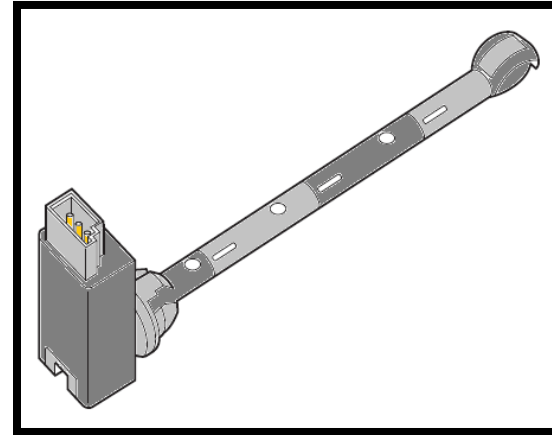
DETAIL J  
SCALE 1:2  
(VIEW ROTATED FOR CLARITY) 210

# Evaporator Temperature Controls

<https://truckmanualshub.com/>



- Temperature Switch
  - Cut-out temperature of compressor  $\leq 36^{\circ}\text{F}$  ( $\leq 2^{\circ}\text{C}$ )
  - Cut-in temperature of compressor  $\geq +45^{\circ}\text{F}$  ( $\geq +7^{\circ}\text{C}$ )



- Temperature Sensor
  - Cut-out temperature of compressor  $\leq +32^{\circ}\text{F}$  ( $\leq +2^{\circ}\text{C}$ )
  - Cut-in temperature of compressor  $\geq +45^{\circ}\text{F}$  ( $\geq +7^{\circ}\text{C}$ )



# Temperature Sensor Fuse

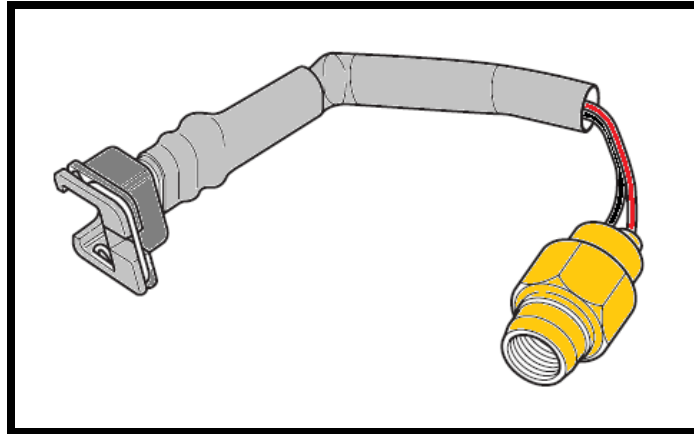


## NOTE

In some vehicles, the temperature sensor has a 5-A fuse. This fuse is located in the cable harness of the temperature sensor.

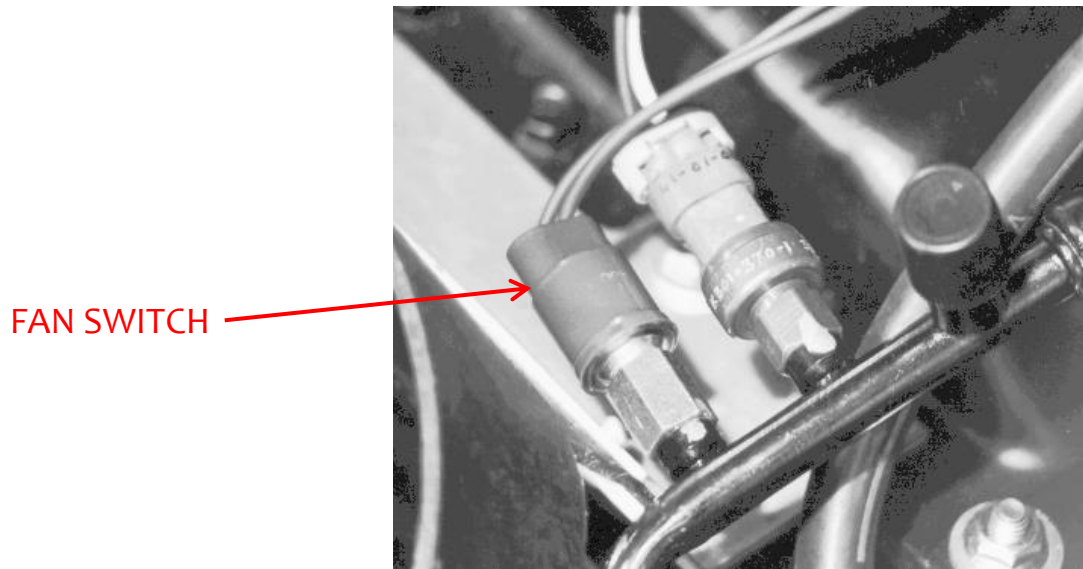
# High/Low Pressure Cut-out Switch

<https://truckmanualshub.com/>



- System pressure at which the compressor is deactivated  
<29 psi and >464 psi (<2 bar and >32 bar)

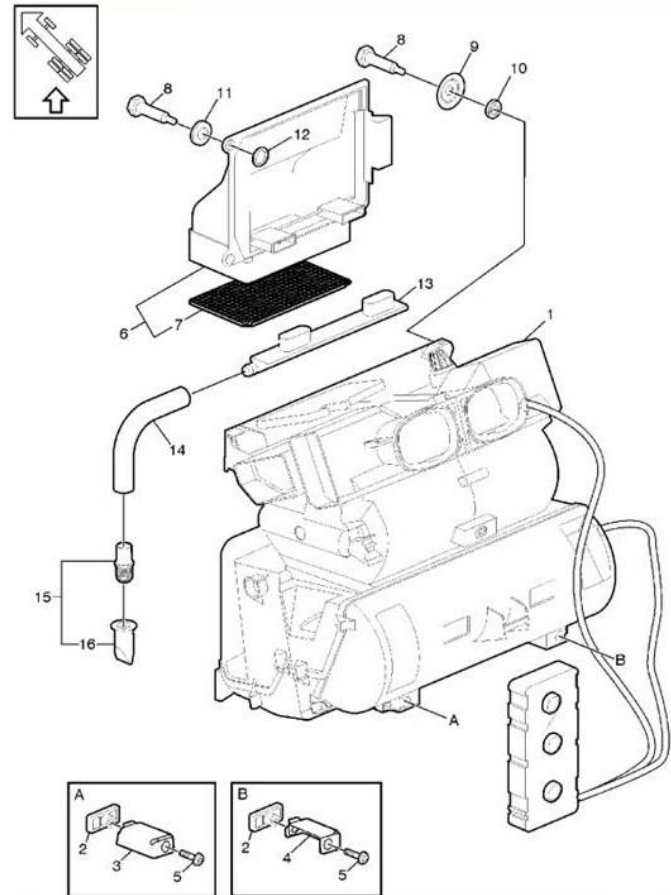
# Engine Fan Override Switch



- The fan switch engages the electric engine fan when **high side pressures exceeds  $275 \pm 10$  psi.**
- The fan switch disengages the electric engine fan when the **high side pressures fall below  $230 \pm 10$  psi.**
- **COE, off highway, and models with roof-mounted condensers may use a fan switch with higher set points.** This reduces fan operation because of a slightly more efficient condenser which causes slightly lower operating pressures.

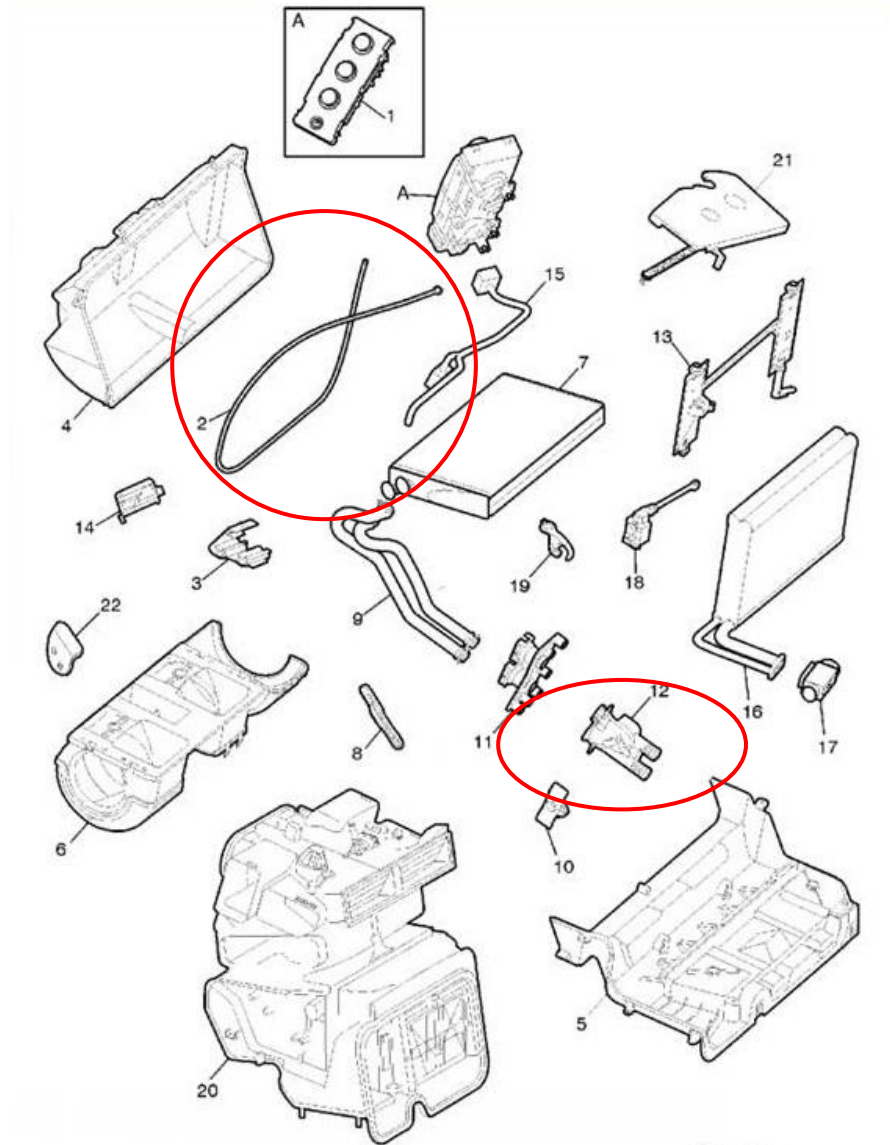
# HVAC Control Panel

<https://truckmanualshub.com/>

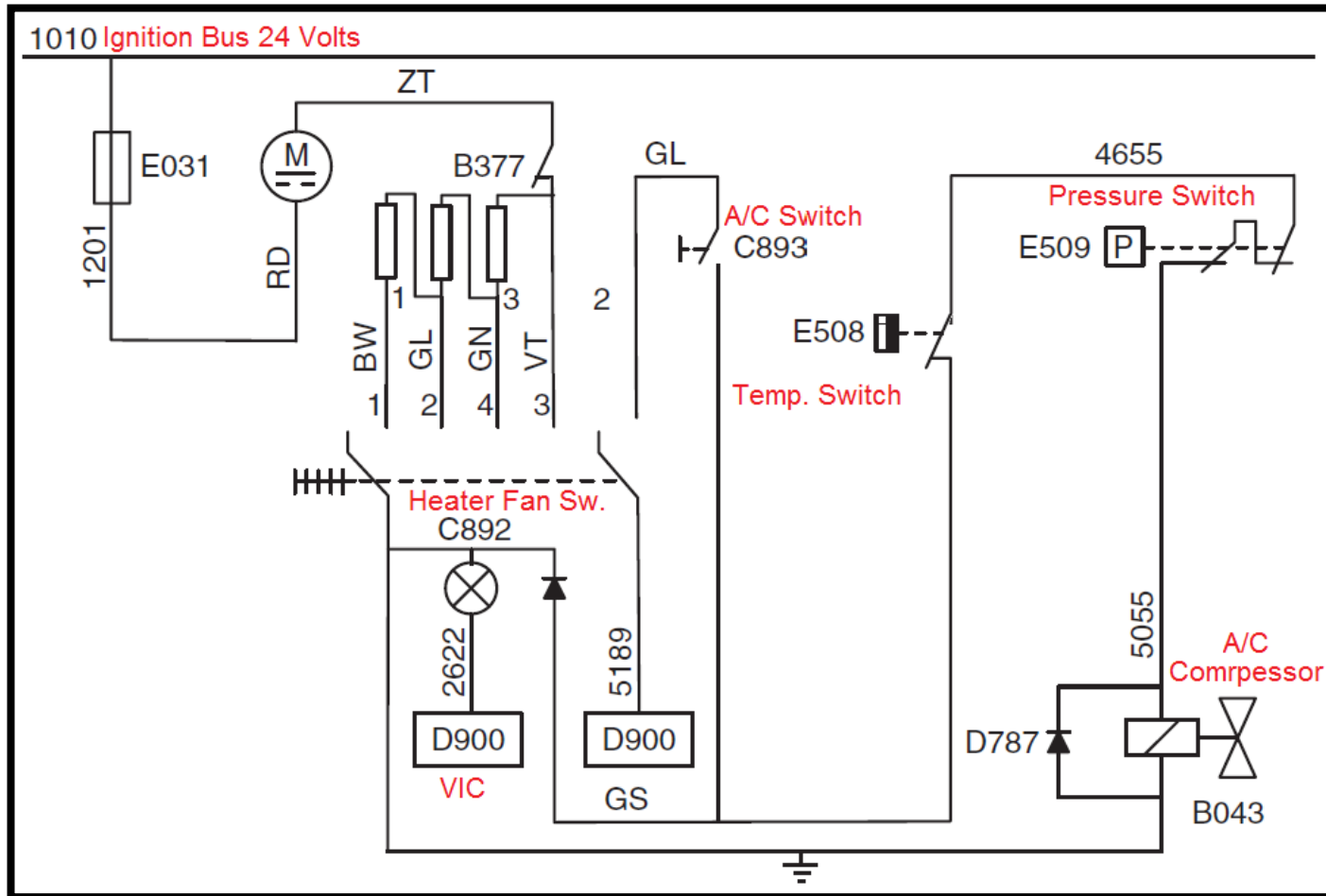


# HVAC Heater Valve

Coolant flow to the heater core is controlled by a cable operated heater valve.



# A/C System Operation - Electrical Circuit



The Compressor is energized by VIC via Temperature Switch and Pressure Switch. The VIC communicates with the engine ECU via V-CAN, and will de-energize the A/C circuit (GRA5189-0) when coolant temp goes above 216°F (102°C) and re-energize it when coolant drops below 208°F (98°C).



# T170/T270/T370 Medium Duty Trucks

<https://truckmanualshub.com/>

# Kenworth Medium Duty Models

## Medium Duty Class 5, 6, 7 – T Series



# T-Series M/D HVAC

- NAMUX 2 for 2010 engines: use P94-1912
- NAMUX 2 for 2016/2017 engines: use S92-1117  
(until S94-1007 is released)

# T-Series M/D - NAMUX 2 with 2010 Emissions

<https://truckmanualshub.com/>

## (Pre- 1/11/2016)

- Electrically actuated mode controls
- Cable actuated heater control valve
- 3 Blower fan speeds (Low, Med, High) controlled by a resistor block
- 3 HVAC Relays
- High & Low Pressure Switches

# KIMS (Kenworth Idle Management System)

# Kenworth Idle Management System

<https://truckmanualshub.com/>

## T680 ADVANTAGE



Maximum Fuel Efficiency



**STEPS THAT DRIVERS CAN TAKE TO IMPROVE FUEL ECONOMY AND REDUCE OPERATING COSTS**

- Drive as consistent as possible
- Keep your distance to the vehicle in front of you
- Avoid unnecessary acceleration
- Use cruise control whenever possible
- Keep the RPMs in the sweet spot of the engine
- Always cruise in the highest possible gear
- Only use extra lighting and other power consumers when needed
- Avoid using AC unless necessary
- Reduce vehicle cruising speed
- Refrain from idling the engine unless absolutely necessary

**REAL TIME INFORMATION FOR MAXIMUM PERFORMANCE**

78°F  
Trip A Active 1526.8 Mi  
Trip Info: Summary: Trip A  
Fuel Econ = 8.8 MPG  
Avg Speed = 48 mph  
Eng Hours = 31.8 hrs  
Fuel Used = 17.3 gals

To drive a truck efficiently, you need real-time information – especially true today when drivers must track the performance of fuel, vehicle and safety systems on the go. The new Kenworth Driver Performance Center offers, at a glance, everything you need to know about operating in the sweet spot between performance and efficiency. Truck diagnostics and performance indicators pop up to alert the driver with real-time feedback. Trip details and multi-route comparisons allow them to maximize performance every day.

### KENWORTH IDLE MANAGEMENT SYSTEM

Kenworth's factory installed battery based anti-idle system is designed to help long-haul fleets in hot and cold climates reduce idling time and fuel usage without compromising performance. As a split system, Kenworth's factory installed option provides one of the smallest footprints in the industry, allowing for maximum storage under the bunk. It also features on-board diagnostics, full automatic temperature control in AC and heating modes, a digital LCD display that makes it easier for drivers to control the unit, and provides battery monitoring capabilities.



The compact brushless DC compressor and evaporator assembly is conveniently located in the sleeper storage area.



The remote condenser with brushless fan assembly is installed centrally on the upper exterior wall for optimum performance.



The user interface control with a LCD display provides automatic temperature control in both AC and Heating modes.



Four Group 31 AGM batteries electrically isolated from the truck serve as starting batteries to power the system. The system includes battery monitoring capabilities.



# Kenworth Idle Management System

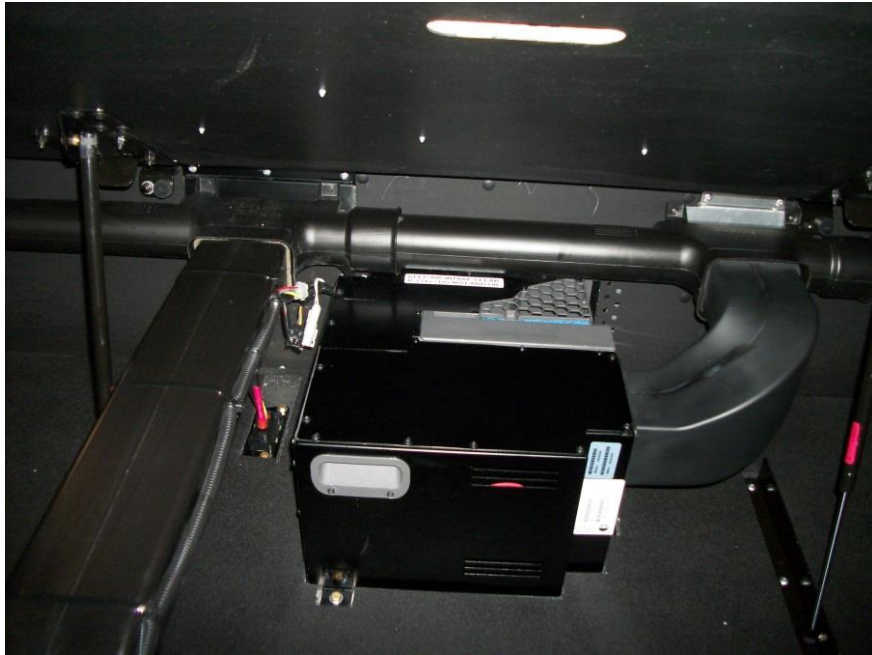
<https://truckmanualshub.com/>

- KIMS SOP – February 3, 2014
  - Available on Model T680
  - Peterbilt SmartAir launched July, 2013, all models 48” sleepers and larger
- PACCAR product is identical with the exception of condenser location, external refrigerant lines, and user interface
- Weight is listed at 565 lbs – weight exemption 550 lbs

- Engine-off No-Idle Operation only
  - Ignition Interlock
- Compliments standard sleeper HVAC
- Separate battery bank: 4 Deep cycle AGM
- Alternator requirement-300 amp
- 300 Amp Battery Separator
- Battery Management System (BMS)
- Duct gravity doors
- Vehicle insulation upgrade

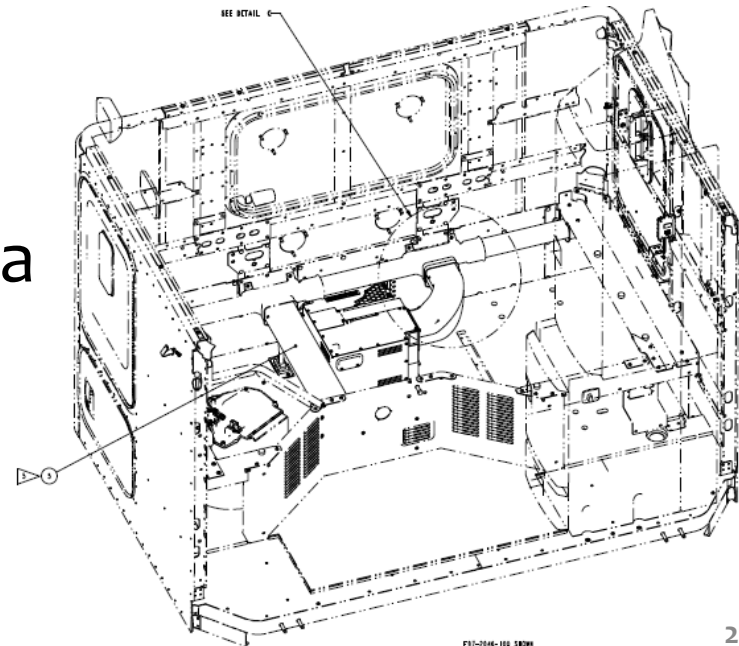
# KIMS Components

<https://truckmanualshub.com/>



- The main unit resides under the sleeper bunk and contains the system's evaporator, blower, compressor and the air filter.

Since it's integrated, it has a very small under-bunk footprint to maintain storage space for drivers.

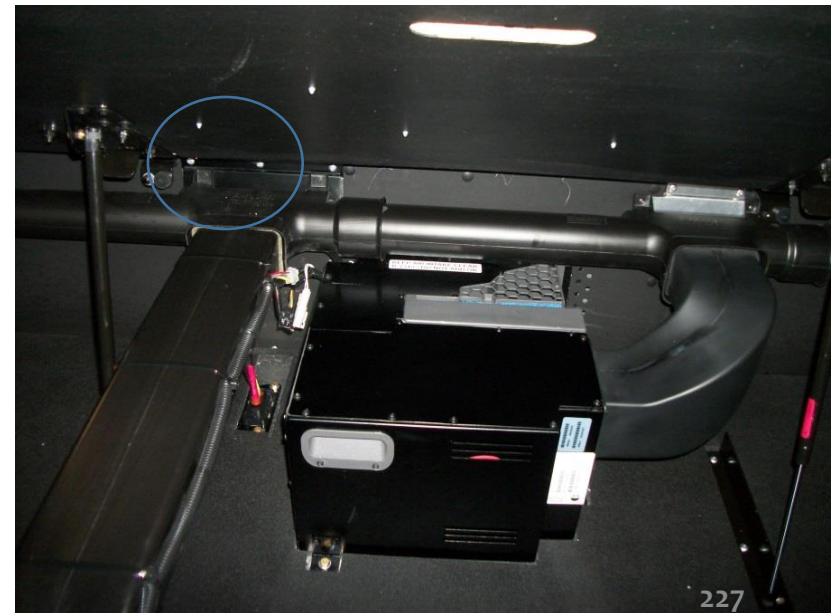


<https://truckmanualshub.com/>

# Gravity Door



- The gravity door is located in the fore/aft factory duct in the T680.
- This keeps the KIMs system air from flowing back into the OE unit.

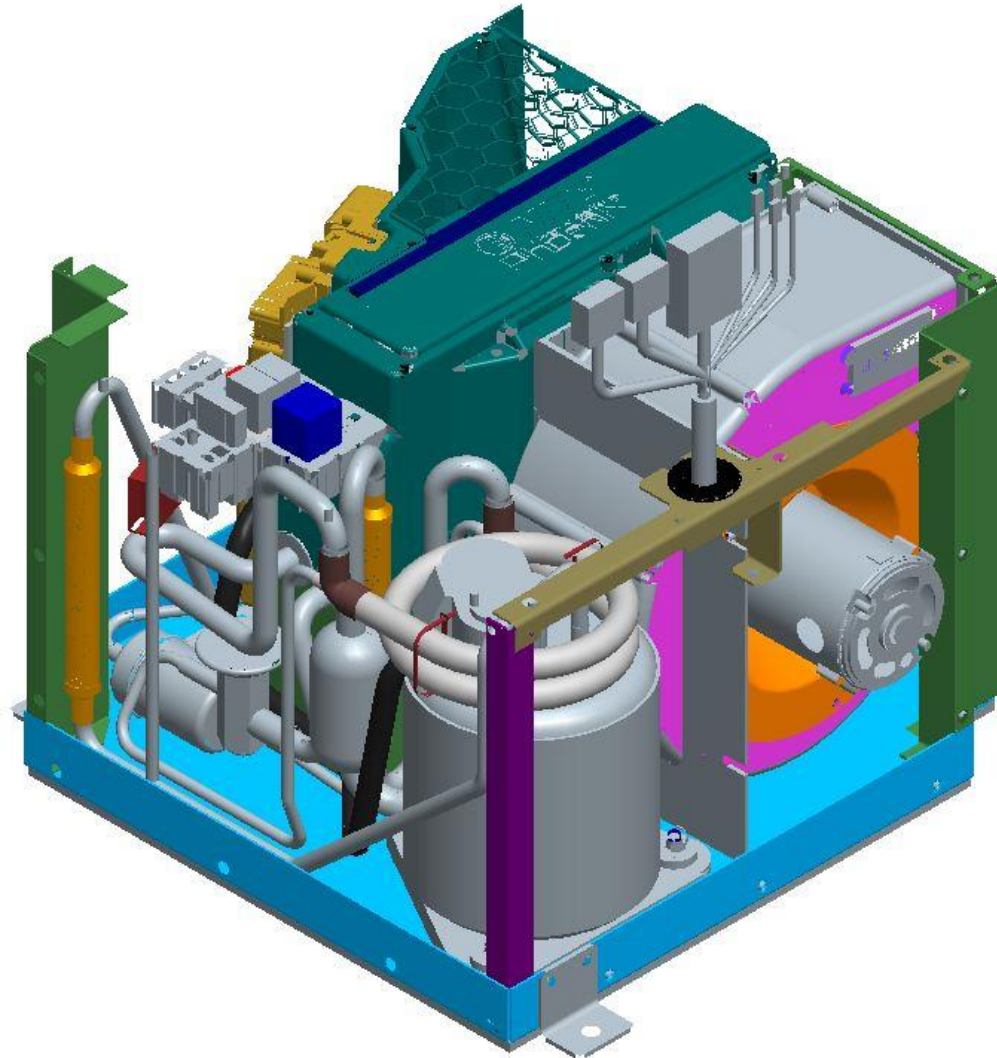




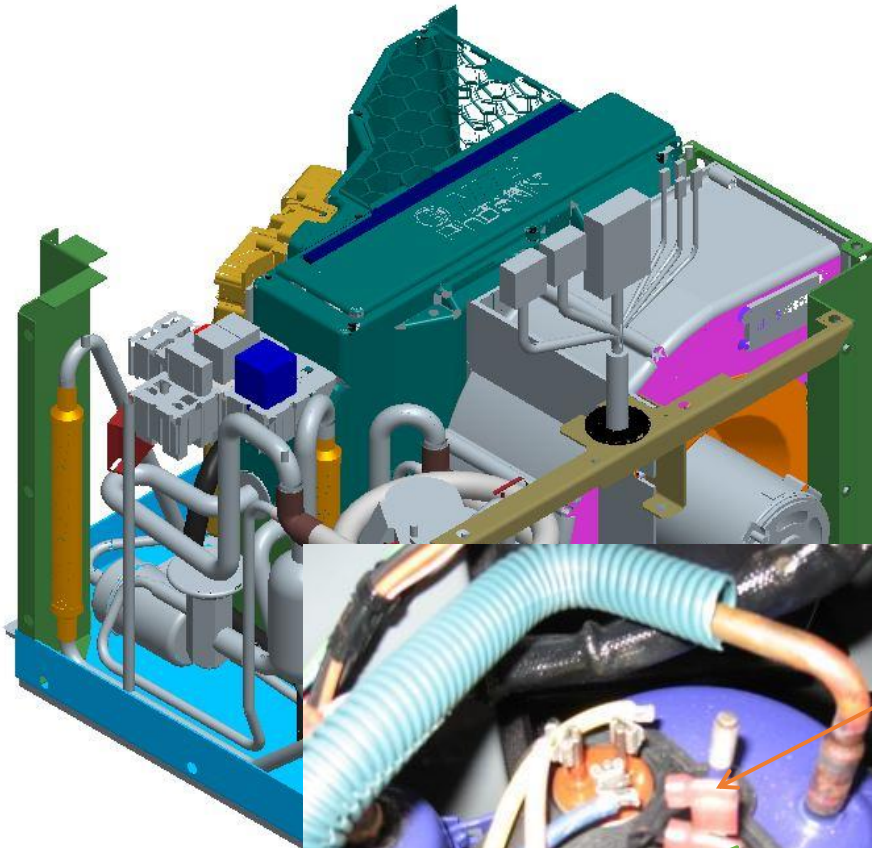
# KIMS System Overview

<https://truckmanualshub.com/>

- Sealed Electric Compressor
- Evaporation Coil
- Suction Line Heat Exchanger
- Blower Motor Assy.
- Electrical Center
- Serviceable Filter



# Sealed Compressor



**Compressor uses PVE oil only. Never contaminate with PAG oil**

**System can be evacuated and charged up to 3 times (21 oz or 1.31 lbs)**



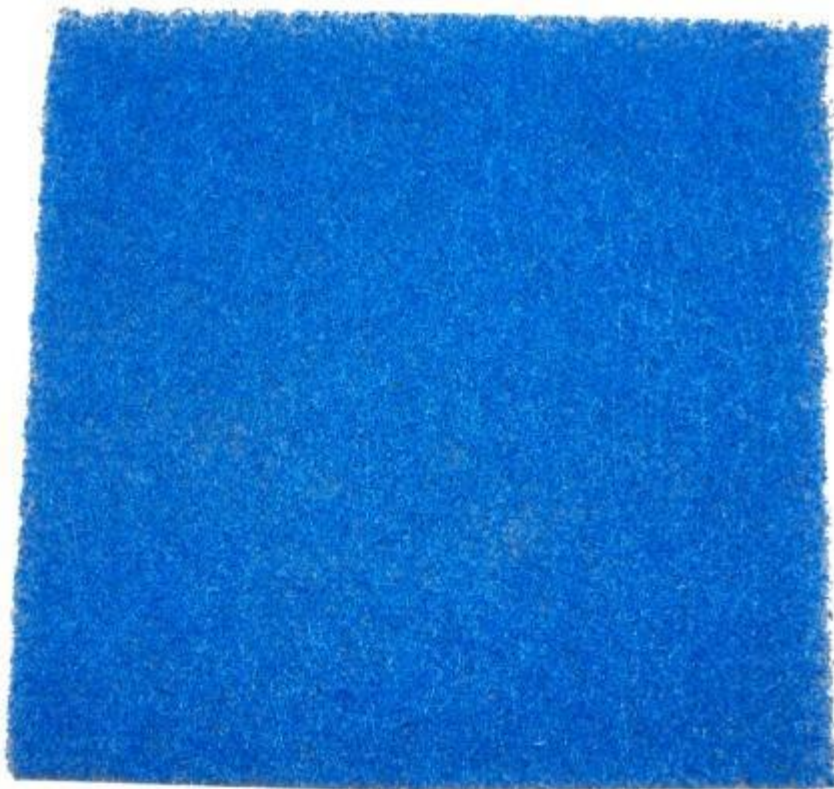
**High Pressure switch normally closed - will open if pressure gets too high (non serviceable)**

**Thermal limit switch – normally closed and auto reset to protect compressor from high temperatures**



# Evaporator Inlet Filter

<https://truckmanualshub.com/>



- This filter protects the evaporator coil from dust and debris. It is washable and should be serviced periodically during routine maintenance.
- When necessary, Check Filter indicator will notify you that the Evaporator filter must be cleaned or changed.
- To reset Check Filter: at screen 1 press and hold enter button for 3 seconds.

# Discharge Temperature Sensor

<https://truckmanualshub.com/>



a.k.a. “the Freeze Switch”:

This sensor monitors the evaporator outlet temperature as it enters the vehicle duct system.

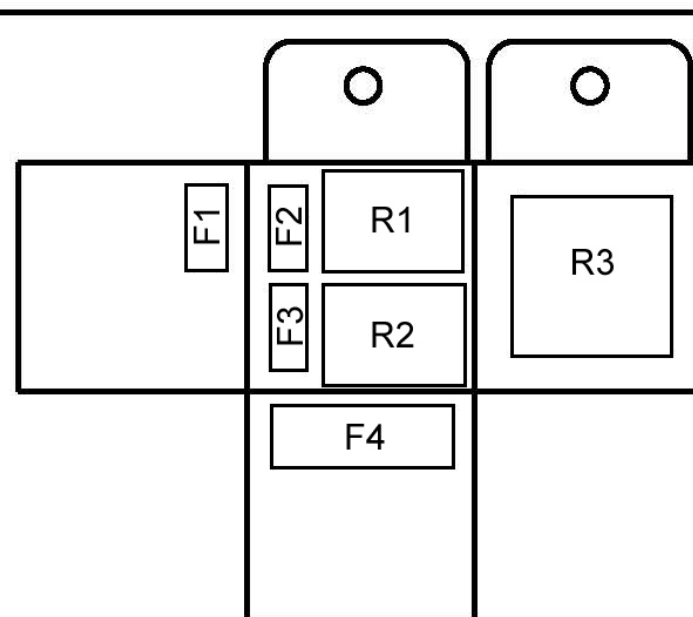
# Linear Power Module

<https://truckmanualshub.com/>



This module controls the amount of voltage delivered to the evaporator blower creating variable blower speeds. It is located in the return air in front of the evaporator coil.

# Electrical Center



F1 10A Red minifuse (system controller)  
F2 10A Red minifuse (condenser fan)  
F3 20A Yellow minifuse (blower motor)  
F4 60A Blue maxifuse (compressor)

R1 Micro 280 Form 1C Relay (condenser fan)  
R2 Micro 280 Form 1C Relay (blower motor)  
R3 100A 12V w/resistor relay (compressor)



# KIMS External Condenser

<https://truckmanualshub.com/>



- The condenser is mounted to the exterior of the rear sleeper wall.

# KIMS External Condenser

<https://truckmanualshub.com/>



- Brushless motor construction
- Quiet airflow characteristics





# KIMS Batteries

<https://truckmanualshub.com/>

Battery  
Separator  
Solenoid



Four auxiliary batteries are mounted on the exterior of the vehicle, to power the system in addition to the starting batteries.

# <https://truckmanualshub.com/> KIMS Batteries

## Typical Installation



The four auxiliary batteries are installed in the passenger side step assembly. This may relocate the SCR & DPF assemblies to the area between the frame rails.

# Battery Management System



This device monitors the auxiliary batteries for state of charge, communicates with the KIM system and controls the battery separator solenoid.

LED light on this device indicates power to the device and does not provide diagnostics. Power inputs to this device are fuse protected.

If one of the BMS fuses blows, the solenoid will disengage.

# Battery Separator Solenoid

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- This device connects the truck batteries to the Aux batteries. When the starting batteries are at or above 13.2 volts, the battery management device will engage the solenoid to allow the alternator to charge the auxiliary batteries.
- When the voltage drops to or below 12.5 volts the battery management system will disengage the solenoid to prevent the truck starting batteries from being discharged below the engine start level.



# KIMS User Interface

<https://truckmanualshub.com/>



- User Interface features:
  - Default home screen
    - Temp set point, mode
  - Blower speed control
  - Battery “state of charge” level

# KIMS User Interface

<https://truckmanualshub.com/>



Icons indicate:

- Fan Speed
- Accumulative hours since last reset
- System error
- Temperature (60 – 85 degrees F)
- Auto temperature control
- Heat manual system mode
- Cool manual system mode
- Check filter – clean or inspect
- Battery health – charge status of auxiliary batteries



# KIMS User Interface

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- The user interface has a display screen on the top and 4 buttons on the bottom.
- The left button turns the unit on and off.
- The right button is the enter button and is used to select the setting to be changed.
- The up and down arrows allow the user to change system settings.

# Turning on the system

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Turning the system on requires one of these :

- Key switch in the off position
- Key switch in the accessory position
- Note: There is a 5 to 6 second delay when you key on and back off for system to shut down completely

The system will not turn on if the switch is in the IGN (on) position or the engine is running

# KIMS Operation Tips

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- Before operating the KIMS HVAC unit, **the sleeper interior temperature should first be brought to the desired temperature with the engine running, and the bunk curtain open.**
- The KIMS HVAC system is designed to maintain an established comfortable bunk temperature while the engine is off and **the bunk curtain is closed.**

- Once the truck is shut down, the driver simply uses the control panel in the sleeper to maintain temperature control
- As a safeguard, the system features integrated power management to maximize cooling performance.

# Retrieving Service Faults



- To enter SERVICE MODE: Push both the ON/OFF and ENTER button simultaneously, at any time.
- Display will show service indicator and a code #1- #2- #3. Use up and down arrows to scroll through the Fault Codes.
- DTC 01 - Evaporator sensor open or shorted high
- DTC 02 - Evaporator sensor shorted low
- DTC 03 - High pressure switch open or shorted high



# KIMS w/ KW Auto-Start

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The systems are largely independent and they don't communicate directly with each other. But here is how they work together:

KIMS is powered from the truck Auxiliary (Aux) batteries.

- KIMS will draw the Aux batteries down to 0% state of charge (SOC) (approx 11.3 V) if Auto Start is not present or enabled

Auto Start monitors the truck Auxiliary batteries.

- If enabled, Auto Start will start the truck when Aux batteries reach 20%
- The batteries will continue charging until the Aux batteries reach 80% then engine will shut down.
- KIMS will continue to run during auto start engine run
  - KIMS shuts off if the key is in IGN to prevent KIMS from being left running while the truck is being driven. This shutoff does not apply to Auto Start events

**This concludes the presentation.**

**Thank you for your attention!**

**Questions?**

# Conclusion