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General Description

Cummins B and C Series engines use a cable to connect the throttle pedal to the throttle lever on the engine. Vehicles built before June 1993 are equipped with a nonadjustable cable. From June 1993, the throttle cable can be adjusted at the throttle cable bracket. For examples see **Fig. 1**, **Fig. 2**, or **Fig. 3**. The cable runs from the pedal, through the frontwall, and directly to the engine throttle lever. Return springs return the throttle lever to the idle position when pressure on the throttle pedal is released.

Right-hand-drive vehicles with B-series engines use a deck-mounted throttle pedal with mechanical linkage. See **Fig. 4**. The cable runs across the top of the frontwall, and then down to the engine. See **Fig. 5**.

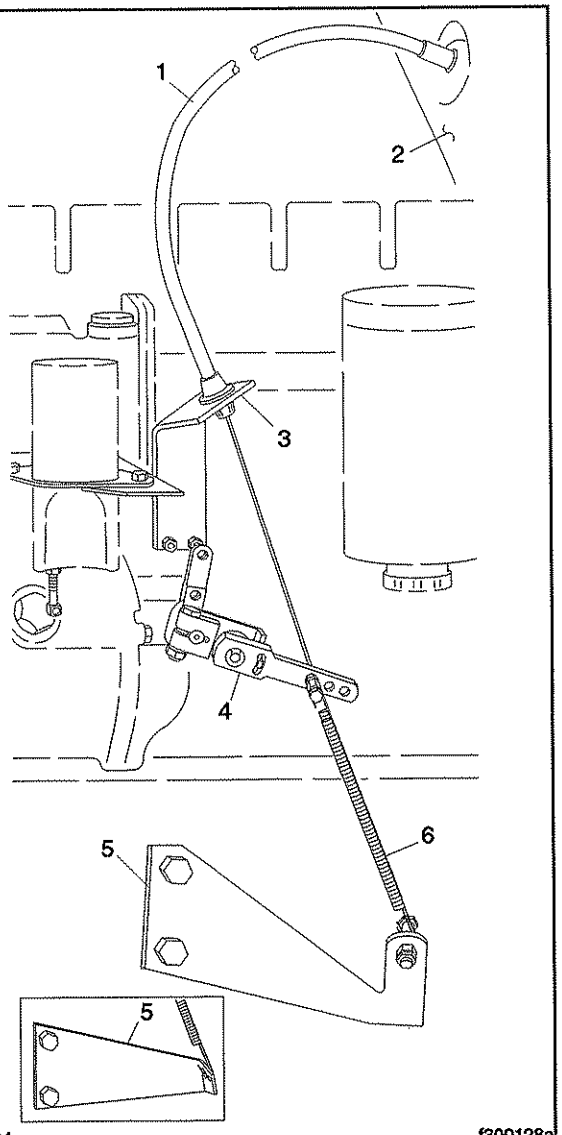
When depressed, the throttle pedal pulls the cable, and the cable pulls the engine throttle lever up to increase fuel delivery to the engine. The cable length enables the throttle pedal to operate the throttle lever through its full range, from idle to full throttle. The cable conduit prevents any interference with, or wear on, the throttle cable.

The throttle lever consists of two parts held in alignment by a breakover spring. See **Fig. 6** and **Fig. 7**. The rear half of the lever connects to the throttle cable. The forward half connects to a shaft which controls the fuel injection pump rack. As the throttle cable pulls the lever upward or releases it downward, the lever rotates the shaft to increase or decrease fuel delivery to the fuel injectors.

When the throttle cable pulls the rear half of the throttle lever as far upward as the injection pump shaft will rotate, additional force applied at the throttle pedal overcomes the breakover spring in the throttle lever. See **Fig. 8**. This allows the rear portion of the throttle lever to continue rotating upward as the throttle cable pulls, but the injection pump shaft is not forced to rotate beyond its rotation limit.

A throttle pedal stop prevents the cable from pulling the throttle lever beyond the breakover range.

Vehicles equipped with automatic transmissions have a throttle position sensor which is connected to the throttle lever by a cable. See **Fig. 9**, **Fig. 10**, **Fig. 11**, or **Fig. 12**.



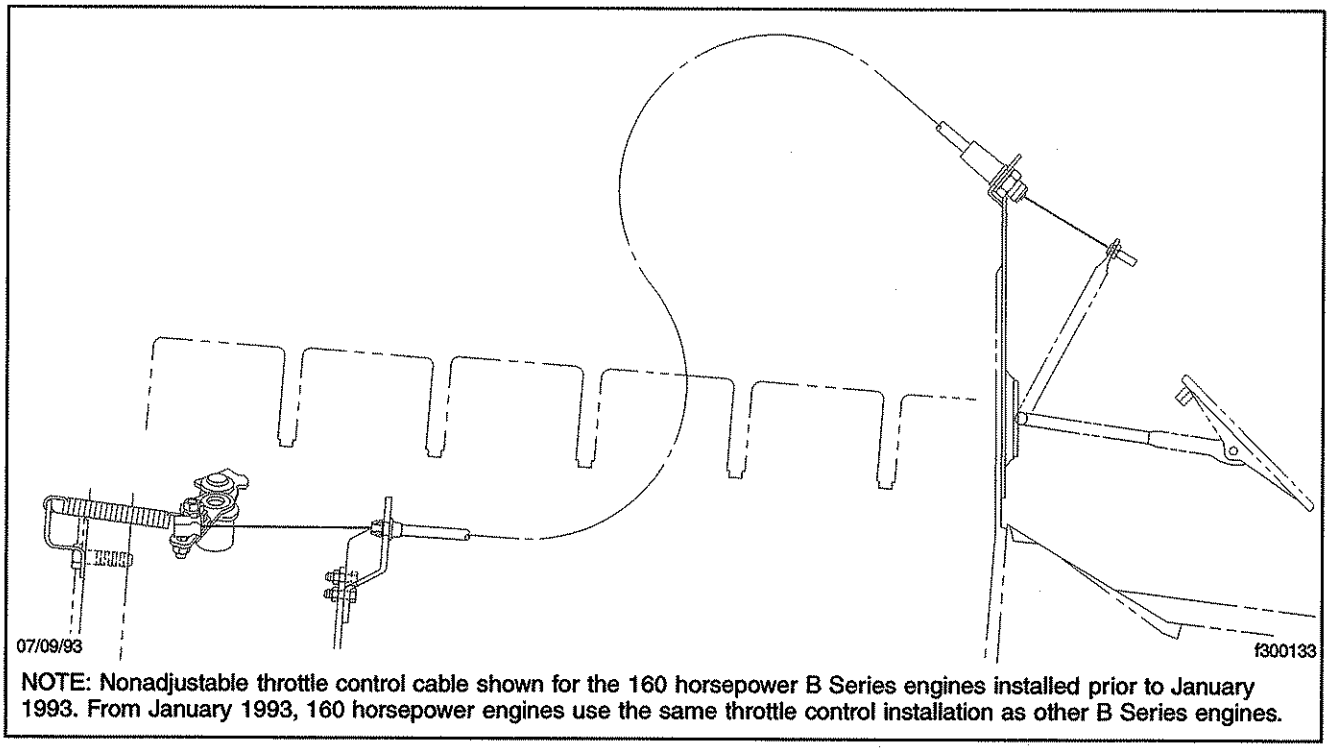
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NOTE: Nonadjustable throttle control cable shown for B Series engines, except the 160 horsepower engine.

1. Throttle Cable
2. Frontwall
3. Throttle Cable Bracket
4. Throttle Lever
5. Return Spring Bracket
6. Return Springs

Fig. 1, Nonadjustable Throttle Cable, Except the 160 Horsepower B Series Engine

General Information



NOTE: Nonadjustable throttle control cable shown for the 160 horsepower B Series engines installed prior to January 1993. From January 1993, 160 horsepower engines use the same throttle control installation as other B Series engines.

Fig. 2, Nonadjustable Throttle Cable, 160 Horsepower B Series Engine Only

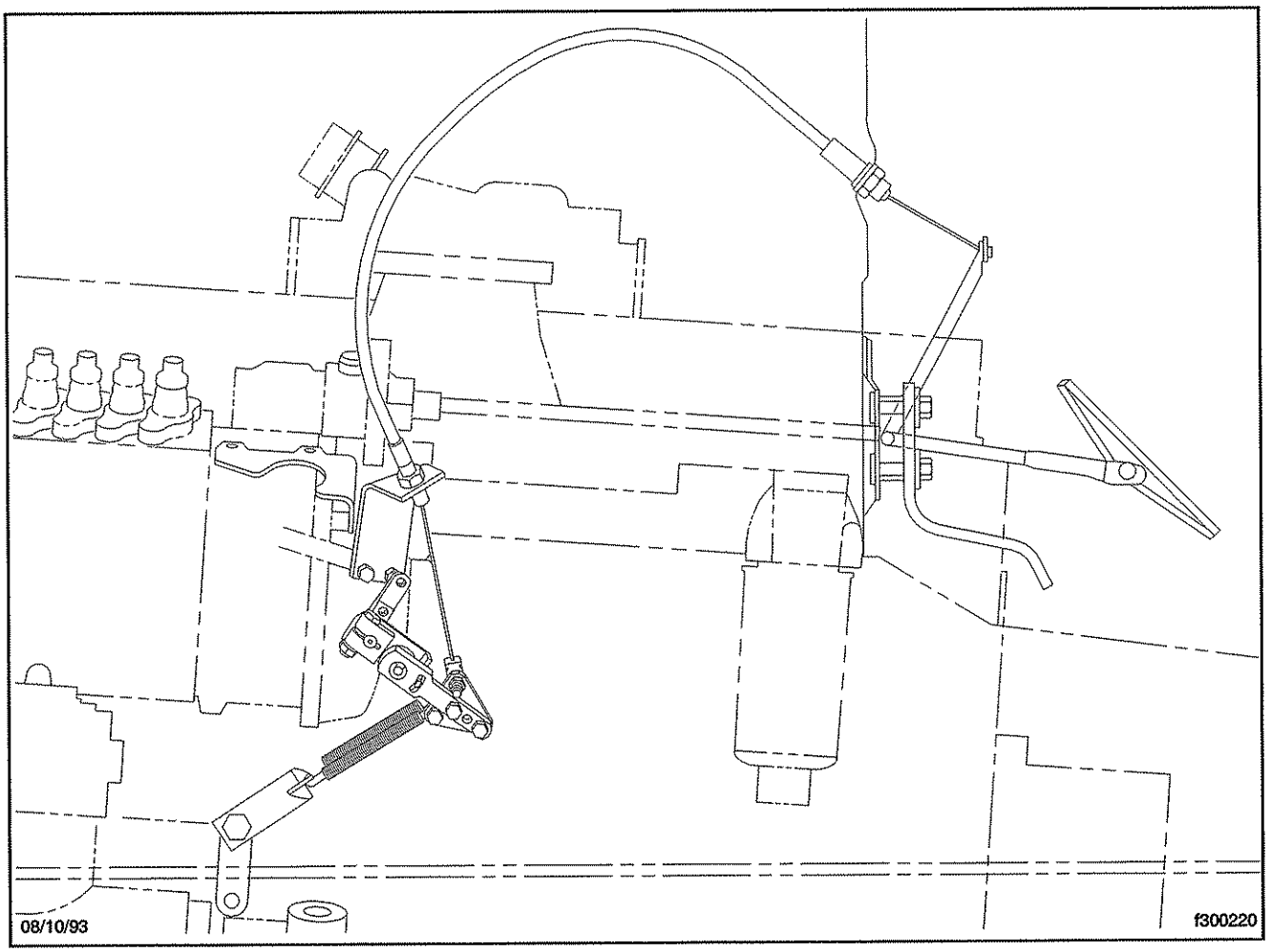


Fig. 3, Adjustable Throttle Cable, C Series Engine

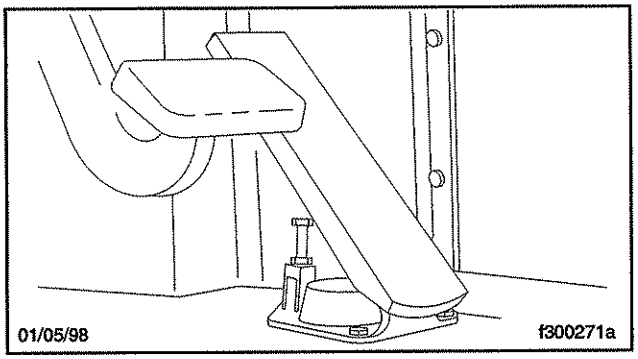
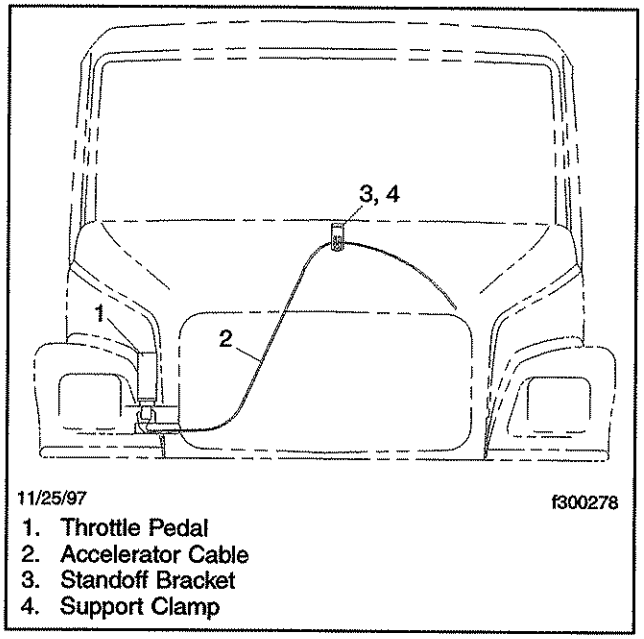


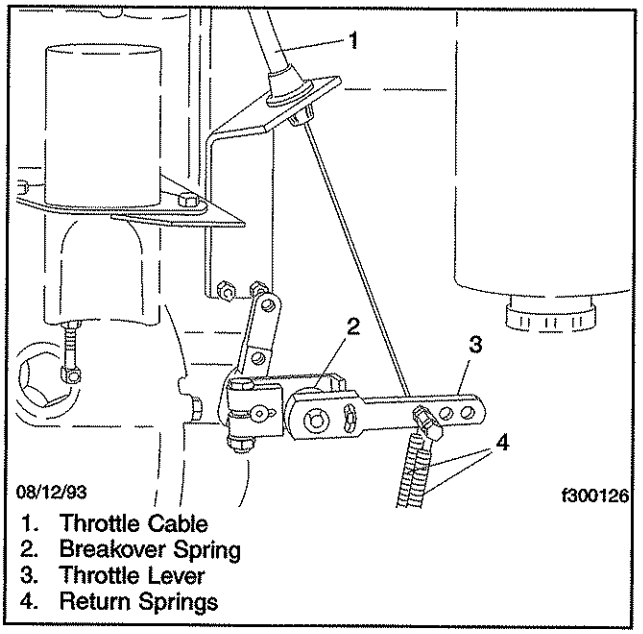
Fig. 4, Right-Hand Drive Throttle Pedal

General Information



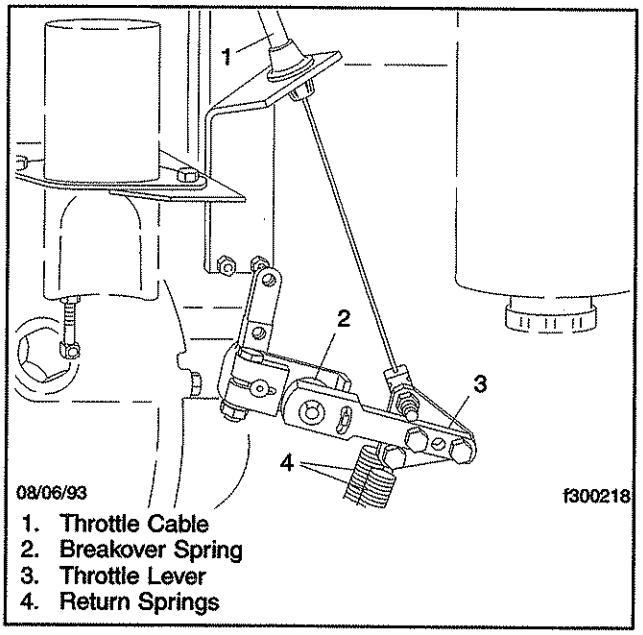
1. Throttle Pedal
2. Accelerator Cable
3. Standoff Bracket
4. Support Clamp

Fig. 5, Right-Hand Drive Throttle Control



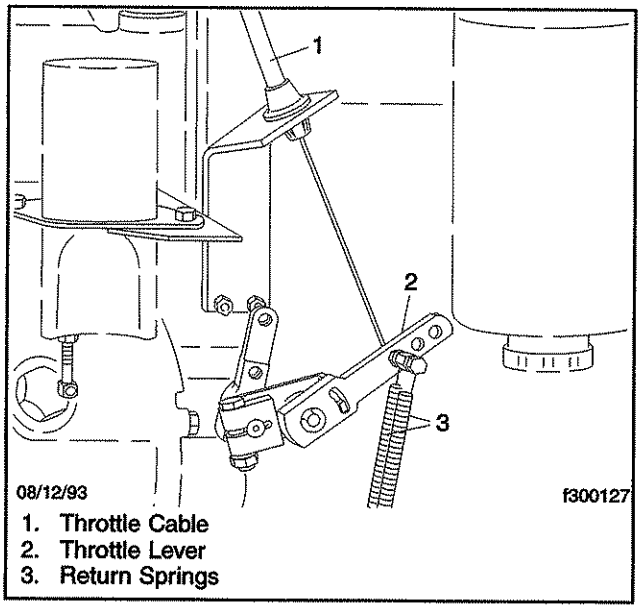
1. Throttle Cable
2. Breakover Spring
3. Throttle Lever
4. Return Springs

Fig. 7, Partial Throttle, B Series Engine



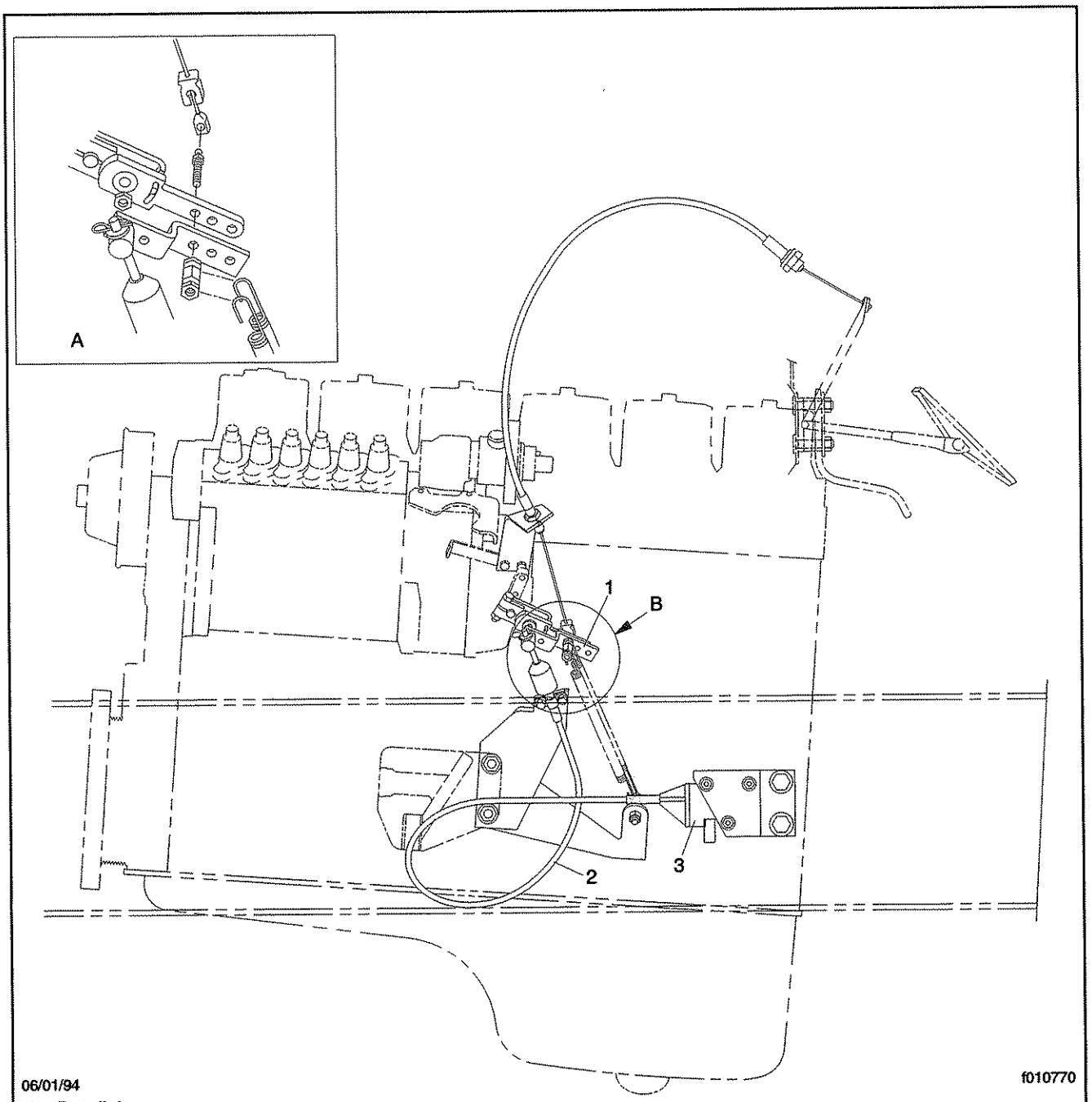
1. Throttle Cable
2. Breakover Spring
3. Throttle Lever
4. Return Springs

Fig. 6, Idle Position, C Series Engine



1. Throttle Cable
2. Throttle Lever
3. Return Springs

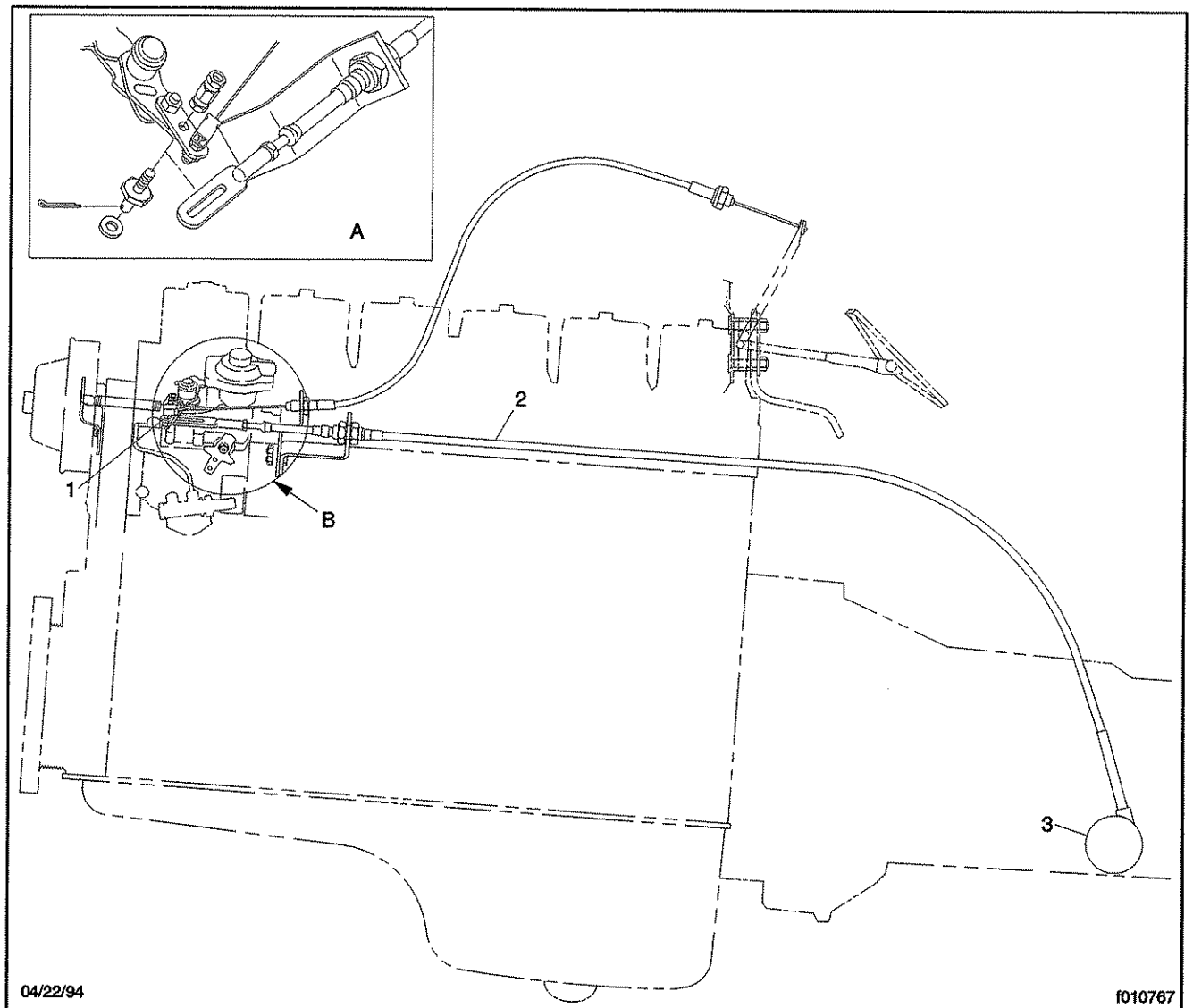
Fig. 8, Full Throttle, B Series Engine, Breakover Spring Overcome



A. Detail A
B. See Detail A
1. Throttle Lever
2. Throttle Position Sensor Cable
3. Throttle Position Sensor

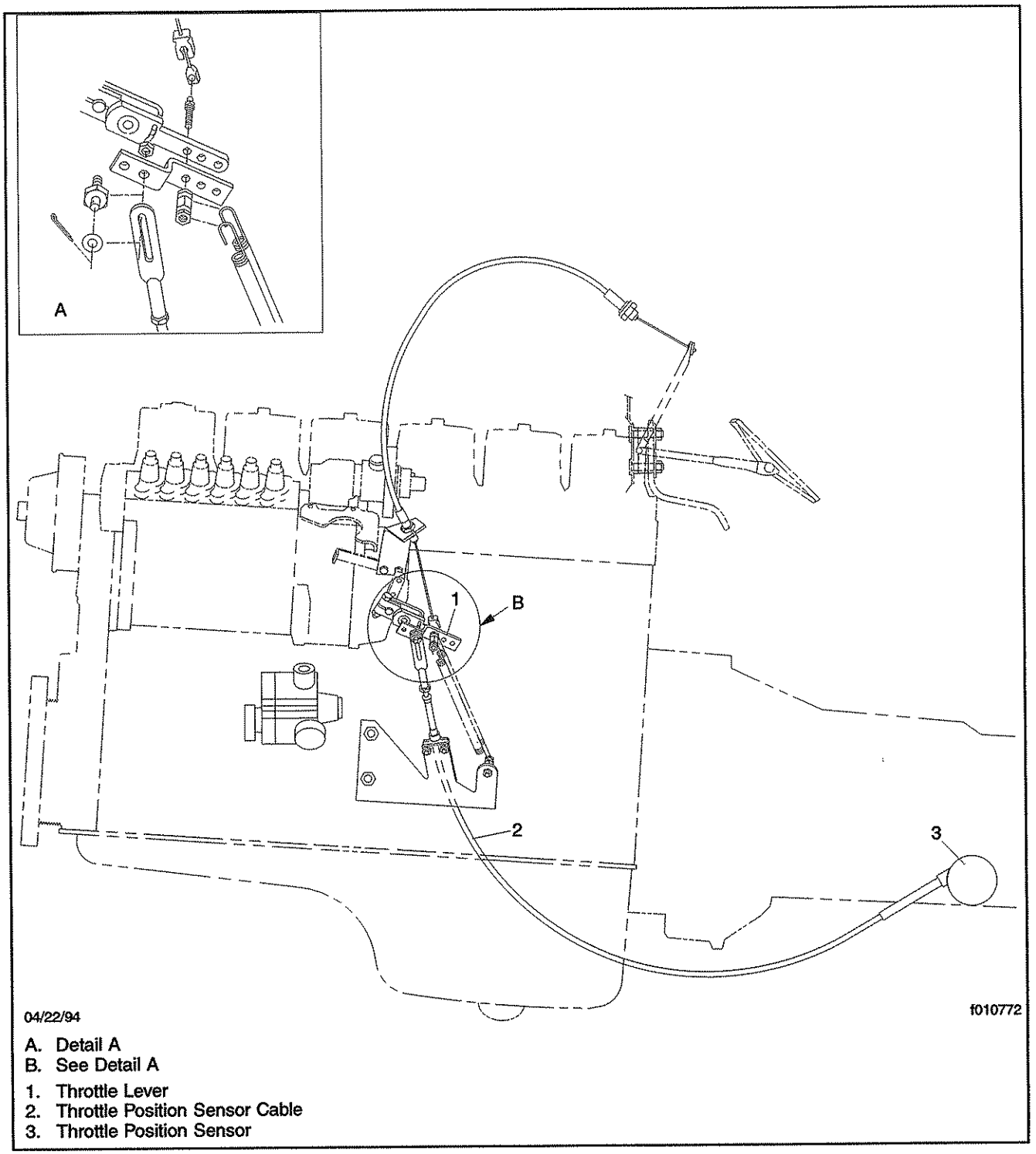
Fig. 9, B Series Engine with Allison MD Automatic Transmission

General Information



A. Detail A
B. See Detail A
1. Throttle Lever
2. Throttle Position Sensor Cable
3. Throttle Position Sensor

Fig. 10, 160-Horsepower B Series Engine with Allison MT or AT Automatic Transmission

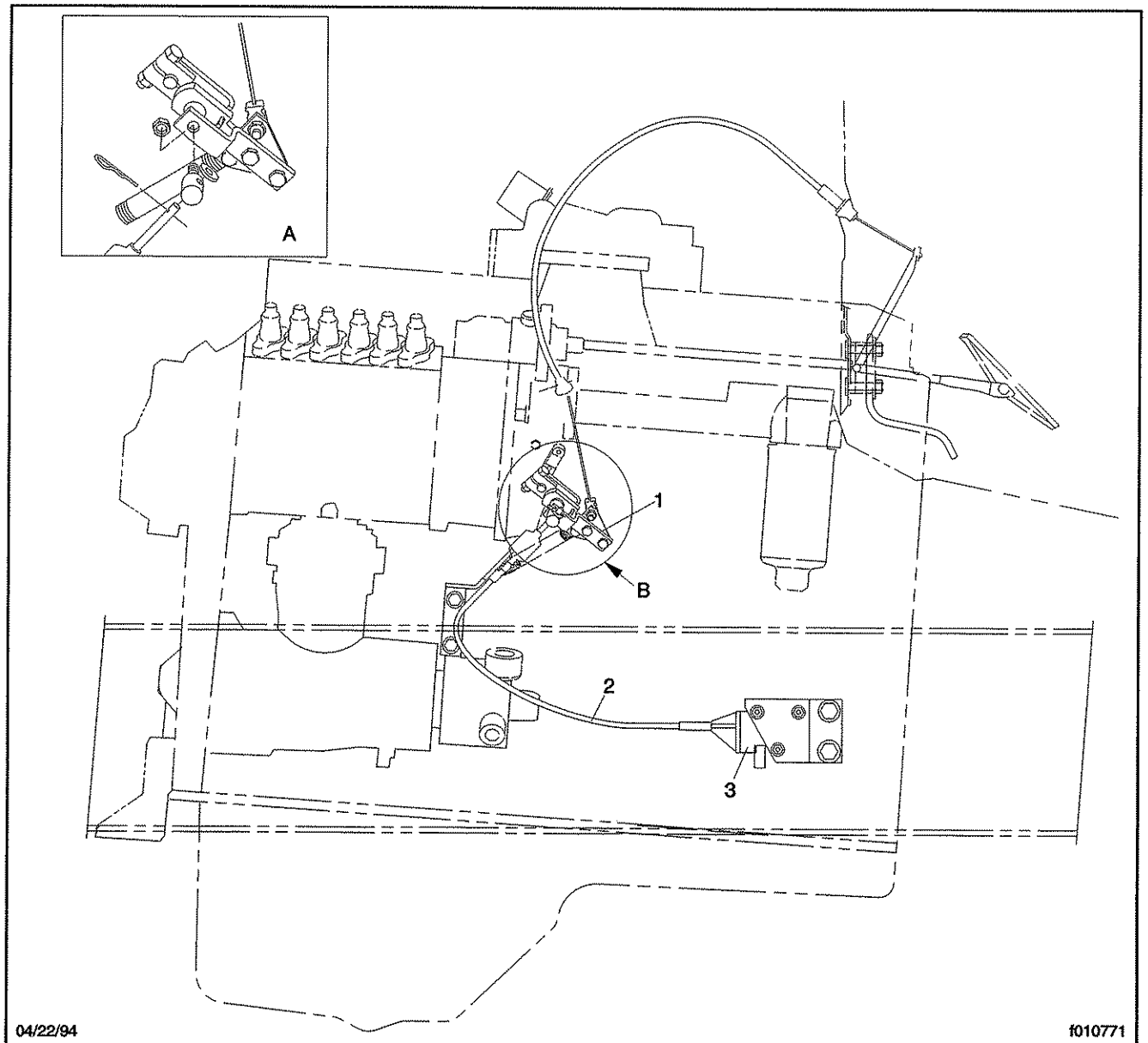


A. Detail A
B. See Detail A

1. Throttle Lever
2. Throttle Position Sensor Cable
3. Throttle Position Sensor

Fig. 11, C Series Engine with Allison MT or AT Automatic Transmission

General Information



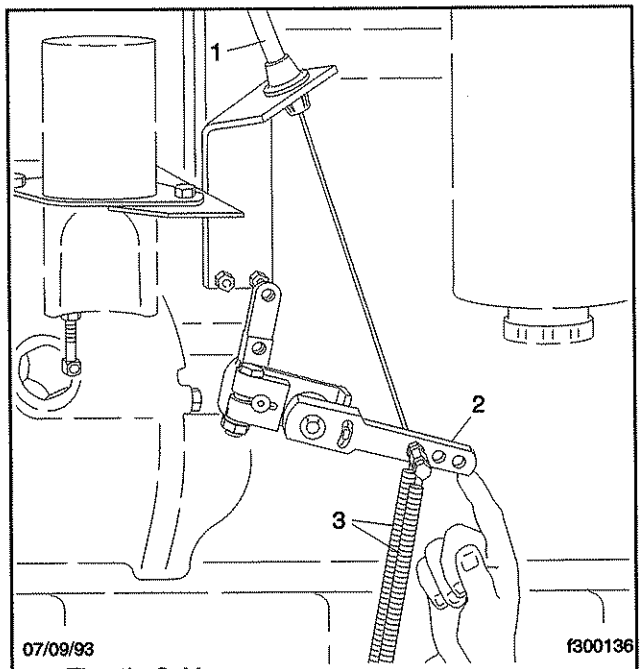
A. Detail A
B. See Detail A
1. Throttle Lever
2. Throttle Position Sensor Cable
3. Throttle Position Sensor

Fig. 12, C Series Engine with Allison MD Automatic Transmission

Nonadjustable Throttle Control Cable Operation Checking

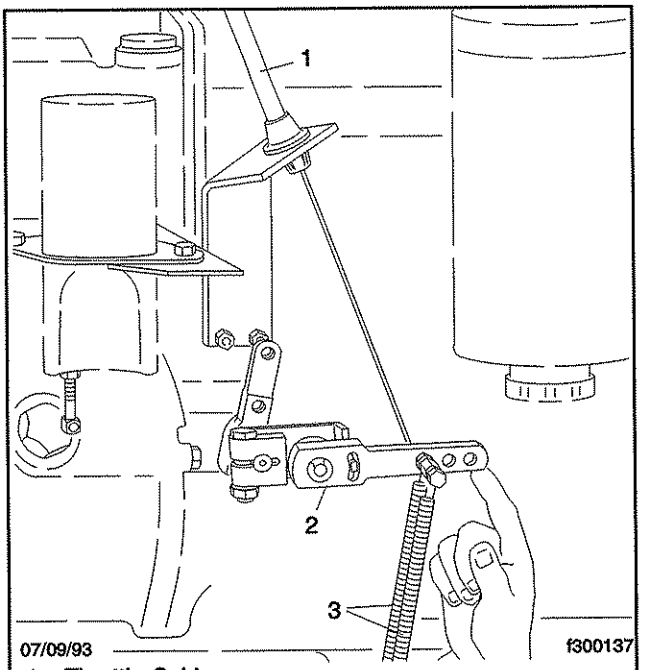
Operation Checking

1. Shut down the engine, set the parking brake, and chock the tires. Tilt the hood.
2. Check the linkage attachment fasteners for tightness; tighten any that are loose.
3. Operate the throttle lever by hand, from idle to full throttle, while checking that nothing interferes with movement of the throttle lever or of the throttle pedal. Reposition any parts that interfere.
4. Operate the throttle lever by hand, from idle to full throttle, while checking that the return springs pull the throttle lever back to idle when the lever is released. See **Fig. 1** and **Fig. 2**.
5. Inspect the return springs, as follows:
   - 5.1 Disconnect the anchor hook of each spring from the throttle lever, then disconnect each spring from the spring bracket.
   - 5.2 Inspect the springs, especially in the area of the anchor loops, for wear, nicks, or other damage that might cause breakage.
   - 5.3 Measure the springs for stretching. The relaxed spring should be no longer than 9.4 inches (238 mm), from the outside of one anchor loop to the outside of the opposite anchor loop.
   - 5.4 If the springs are worn, damaged, or stretched, install new springs.
   - 5.5 Install the springs by inserting one end of each spring into the holes, or around the bolt in the spring bracket. Then hook the opposite ends of the springs on the throttle lever.
6. Operate the pedal, from idle to the pedal stop, while checking that the throttle cable pulls the throttle lever into the breakover range. See **Fig. 3**.
7. Lower the hood. Remove the chocks from the tires.
8. Test drive the vehicle and ensure that the throttle system operates properly.



1. Throttle Cable
2. Throttle Lever
3. Return Springs

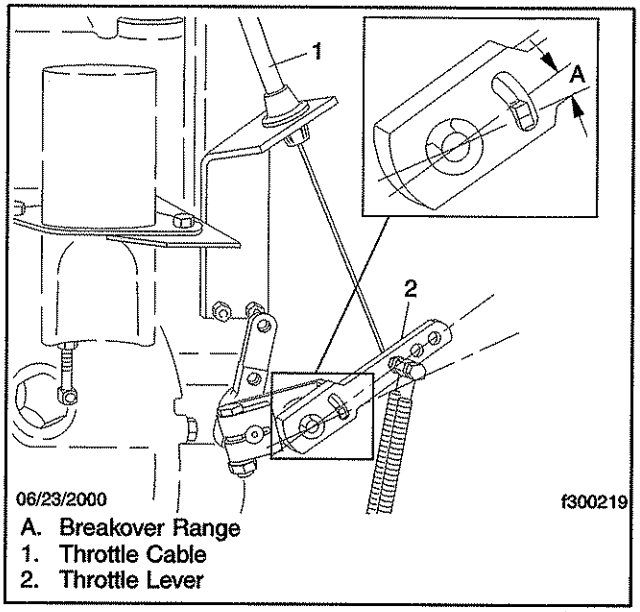
Fig. 1, Idle Position



1. Throttle Cable
2. Throttle Lever
3. Return Springs

Fig. 2, Partial Throttle

Nonadjustable Throttle Control Cable Operation Checking



A. Breakover Range
1. Throttle Cable
2. Throttle Lever

Fig. 3, Full Throttle (breakover spring overcome)

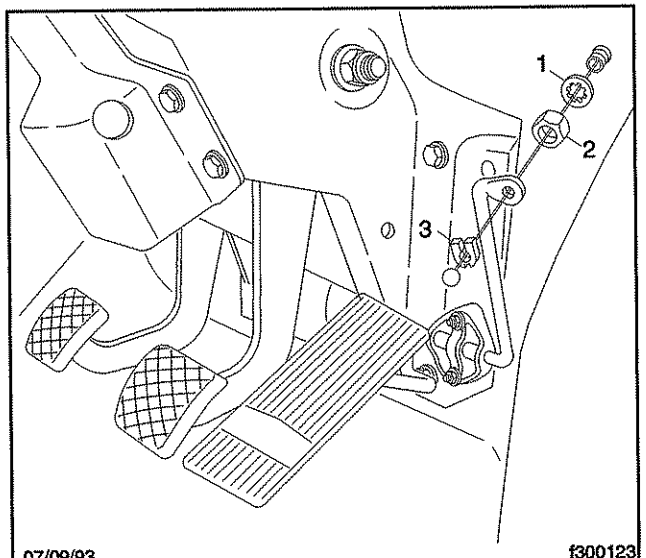
Throttle Cable Removal and Installation

Removal

1. Shut down the engine, set the parking brake, and chock the tires. Tilt the hood.
2. Lift the throttle pedal to get some slack in the throttle cable as it comes through the frontwall. See **Fig. 1**.

   For Right-Hand-Drive Vehicles: Remove the cable from the mounting bracket on the frontwall.
3. Pry out the plastic bushing that holds the cable end in the throttle pedal lever. See **Fig. 1**. Take the bushing off of the cable, and remove the cable from the pedal lever.
4. Remove the cable clamp nut and toothed lock washer from the cable conduit at the frontwall, inside the cab. See **Fig. 1**.

   For Right-Hand-Drive Vehicles: Disconnect the yoke from the throttle pedal assembly, under the deck.
5. Pass the cable out through the frontwall.



Note: Lift the pedal to get slack in the throttle cable.

1. Toothed Lock Washer
2. Cable Clamp Nut
3. Plastic Bushing

Fig. 1, Throttle Cable Connection to Throttle Pedal

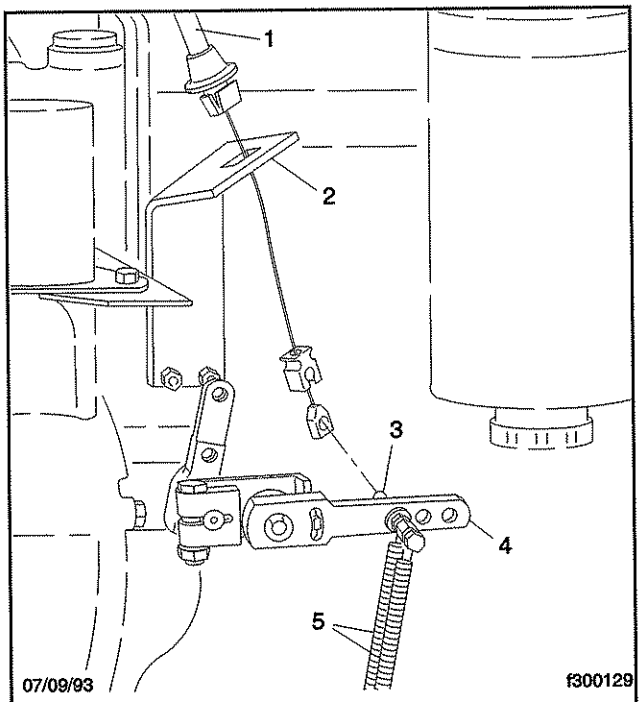
6. Pull the plastic cover up, off of the cast-metal cable end, and remove the cable end from the ball stud in the throttle lever. See **Fig. 2** or **Fig. 3**.
7. For nonadjustable throttle cables, slide the cable up through the hole in the throttle cable bracket.

Installation

1. Connect the throttle cable to the throttle pedal.

   1.1 Pass the cable through the frontwall into the cab. Make sure that the bulkhead seal washer is in place against the engine side of the frontwall.

   1.2 Secure the cable conduit at the frontwall with the toothed lock washer and the cable clamp nut. See **Fig. 1**. Tighten the nut 10 lbf·ft (13 N·m).



1. Throttle Cable
2. Throttle Cable Bracket
3. Ball Stud
4. Throttle Lever
5. Return Springs

Fig. 2, Throttle Cable Connection to Throttle Lever

Throttle Cable Removal and Installation

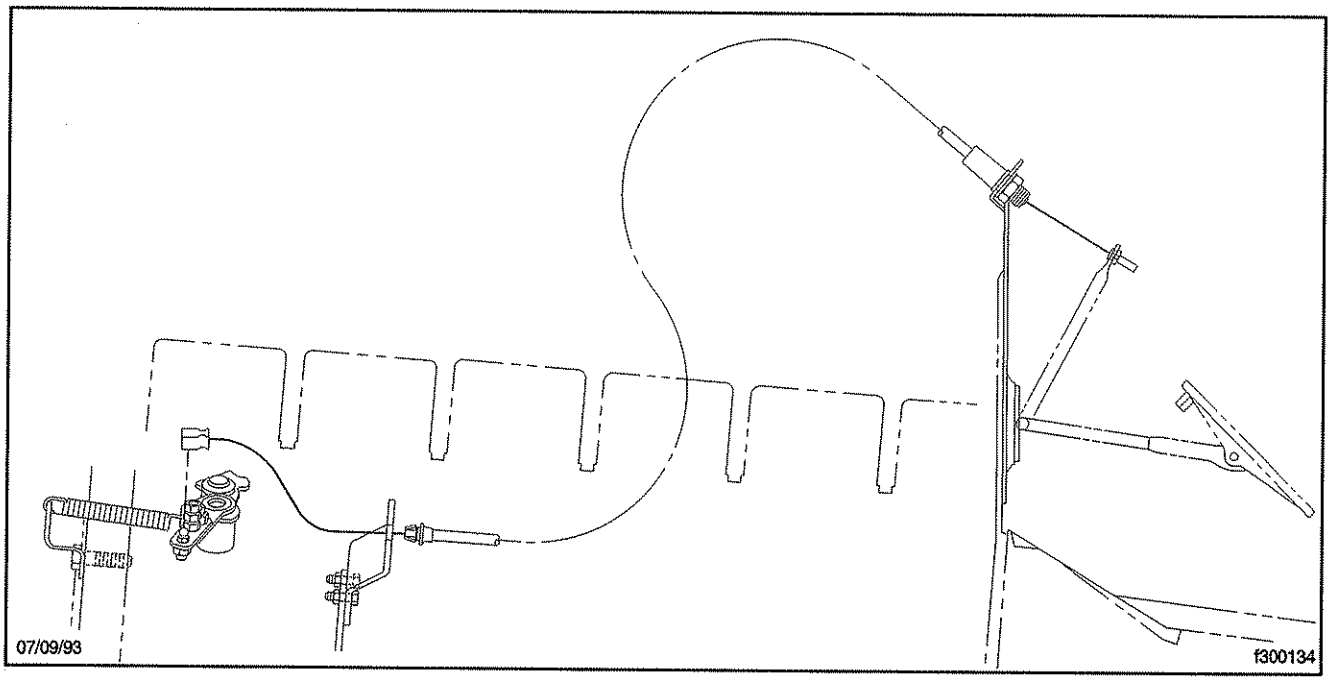


Fig. 3, Throttle Cable Connection to Throttle Lever

1.3 Thread the cable through the throttle pedal lever, and slip a new plastic bushing onto the cable (with the open slot of the bushing facing down) so that the cable end can't pass back through the lever. See **Fig. 1**.

1.4 Snap the bushing into the hole at the upper end of the throttle pedal lever.

For Right-Hand-Drive Vehicles: Connect the yoke to the throttle pedal assembly, then install the rubber boot.

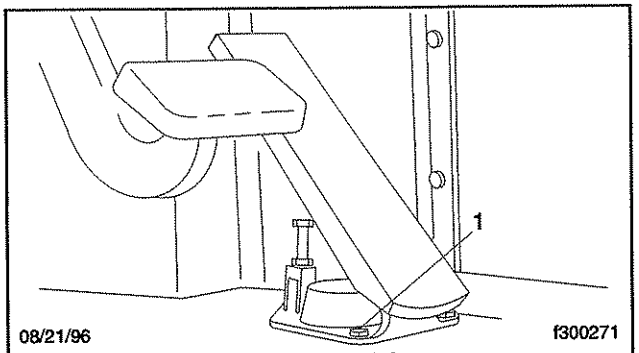
Attach the cable to the standoff bracket on the frontwall.

2. Inspect the ball stud in the throttle lever for wear. Replace it if necessary. If replacing the ball stud, apply Perma-Lock® MM 115 sealant or the equivalent to the ball stud threads, and secure the stud to the throttle lever with the nut (a locknut on C Series and 160 horsepower B Series engines, or a grooved nut on any other B Series engine). Tighten the nut 10 lbf·ft (13 N·m).
3. For a nonadjustable cable, thread the cable through the cable bracket hole, and assemble the cast-metal cable end onto the ball stud. Secure the joint by sliding the plastic cover down onto it.
4. Position the cable in the throttle bracket. For nonadjustable cables, secure the cable with the push-snap fitting.
5. Lower the hood. Remove the chocks from the tires.
6. Test drive the vehicle and ensure that the throttle system operates properly.

Throttle Pedal Removal and Installation, Right-Hand Drive

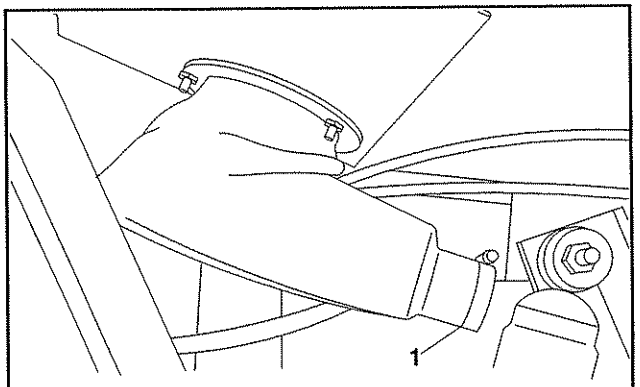
Removal

1. Shut down the engine, set the parking brake, and chock the tires.
2. Remove the three pedal assembly-to-floorboard capscrews, washers, and nuts. See **Fig. 1**.
3. Remove the clamp and slide the boot off of the pedal assembly. See **Fig. 2**.
4. Disconnect the throttle cable clevis from the pedal assembly.
5. Remove the cable clamp.
6. Remove the pedal assembly from the interior of the vehicle.



1. Pedal Assembly-to-Floorboard Capscrew

Fig. 1, Pedal Mounting



1. Boot Clamp

Fig. 2, Pedal Boot

Installation

1. Position the pedal assembly on the deck, then install the three pedal assembly-to-floorboard capscrews, washers, and nuts. Tighten them securely.
2. From underneath the vehicle, connect the throttle cable clevis to the pedal assembly.
3. Install the boot and clamp onto the pedal assembly linkage.
4. Remove the chocks from the tires.
5. Test drive the vehicle and ensure that the throttle pedal operates properly.

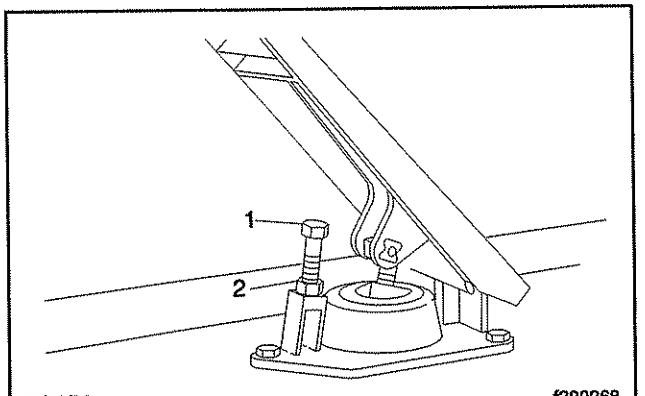
Pedal Limit Stop Adjustment

1. Shut down the engine, set the parking brake, and chock the tires.
2. On the throttle pedal assembly, loosen the jam nut, and lower the limit stop screw. See **Fig. 1**.
3. Lightly depress the pedal to the wide open throttle position. Raise the limit stop screw until it touches the foot pedal. Use the jam nut on the screw to lock the position. See **Fig. 2**. Tighten the jam nut securely.

Comfort Angle Adjustment

The comfort angle may be set between a range of 37 degrees and 53 degrees relative to the accelerator pedal base. See **Fig. 3**.

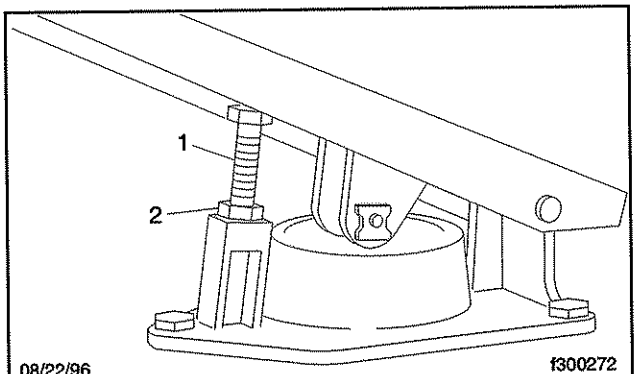
1. Remove the pin retaining clip and cross pin. See **Fig. 4**.
2. Disengage and turn the adjusting block down to decrease the angle in the idle position, or up to increase the angle.
3. Position the adjusting block in place and install the cross pin and the retaining clip.
4. Loosen the jam nut, and lower the limit stop screw.
5. Lightly depress the pedal to the wide open throttle position. Raise the limit stop screw until it touches the foot pedal. See **Fig. 2**.



1. Limit Stop Screw
2. Jam Nut

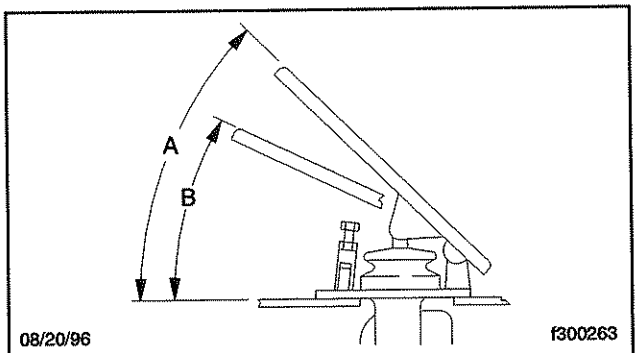
Fig. 1, Limit Stop Adjustment

6. Tighten the jam nut securely.
7. Remove the chocks from the tires.
8. Test drive the vehicle and ensure that the throttle pedal assembly operates properly.



1. Limit Stop Screw
2. Jam Nut

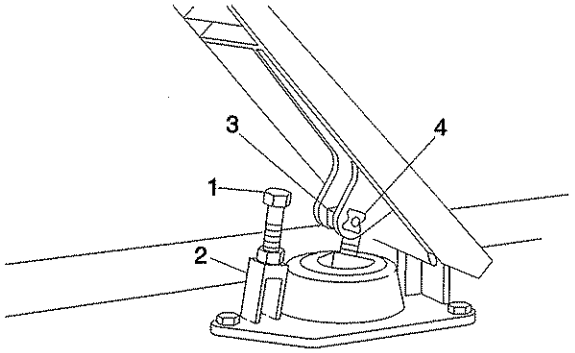
Fig. 2, Pedal at Wide Open Throttle



A. 53°
B. 37°

Fig. 3, Comfort Angles

Throttle Pedal Adjustments, Right-Hand Drive



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1. Limit Stop Screw
2. Adjusting Block
3. Cross Pin
4. Pin Retaining Clip

Fig. 4, Pedal Comfort Angle Components

Specifications

Torque Specifications			
Description	**Grade**	**Size**	**Torque lbf·ft (N·m)**
Cable Clamp Nut	8	9/16 inch	10 (13)
Throttle Lever Cable Clamp Nut	5	1/4 inch	10 (13)

Table 1, Torque Specifications

Contents

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General Description

A non-adjustable cable connects the Mercedes-Benz OM 366LA engine to the throttle pedal. **See Fig. 1.** The cable runs from the pedal, through the firewall, and directly to the engine throttle lever. The throttle lever is spring-loaded to return to the idle position.

Principles of Operation

When depressed, the throttle pedal pulls the cable, and the cable pulls the engine throttle lever up to increase fuel delivery to the engine. The cable length enables the throttle pedal to operate the throttle lever through its full range, from idle to full throttle. The cable conduit prevents any interference with or wear on the throttle cable.

The Bosch throttle lever consists of two parts held in alignment by a breakover spring. **See Fig. 2 and Fig. 3.** The rear half of the lever connects to the throttle cable. The forward half connects to a shaft which controls the fuel injection pump rack. As the throttle cable pulls the lever up or releases it down, it rotates the shaft to increase or decrease fuel delivery to the fuel injectors.

When the throttle cable pulls the rear half of the throttle lever as far up as the injection pump shaft will rotate, additional force applied at the throttle pedal overcomes the breakover spring in the throttle lever. **See Fig. 4.** This allows the rear portion of the throttle lever to continue rotating upward as the throttle cable pulls, but the injection pump shaft is not forced to rotate beyond its rotation limit.

A throttle pedal stop prevents the cable pulling the throttle lever beyond the breakover spring range.

General Description and Principles of Operation

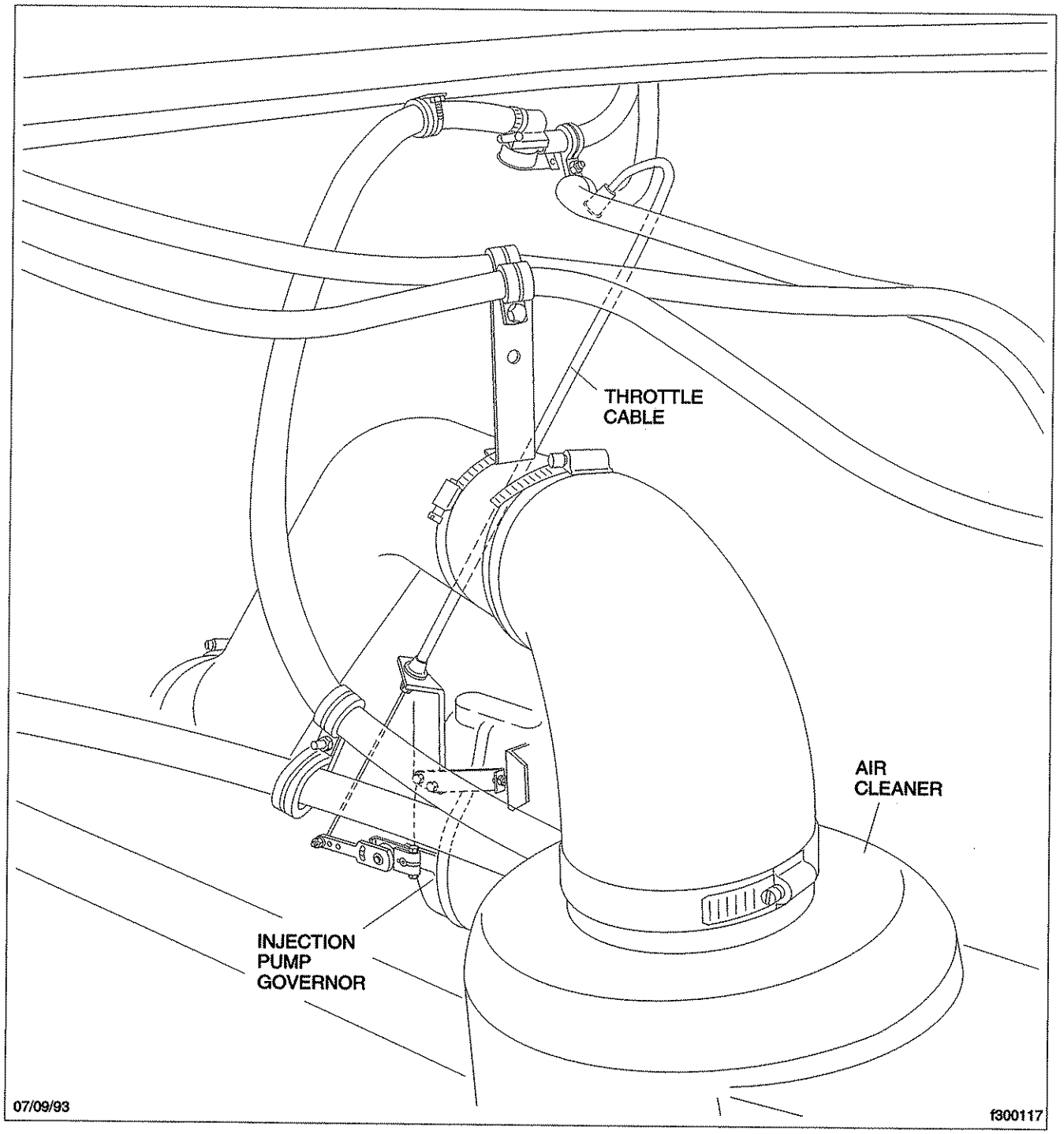


Fig. 1

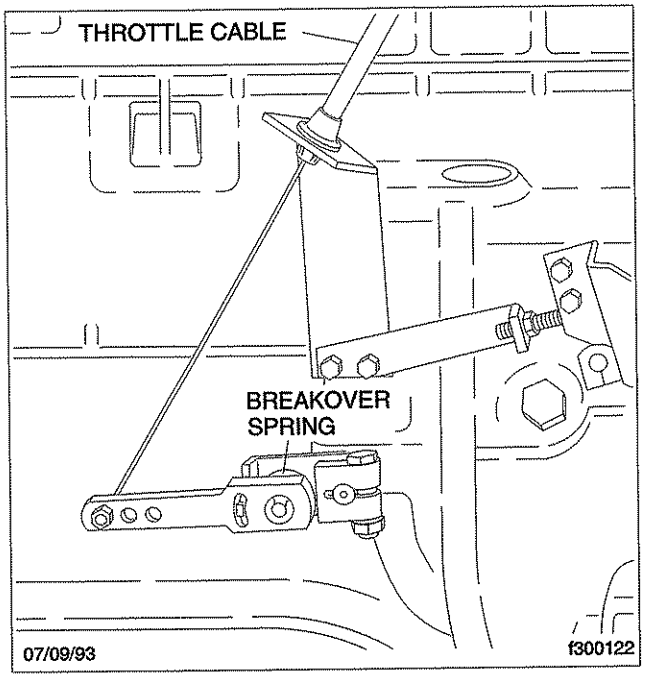


Fig. 2, Throttle Lever at Idle

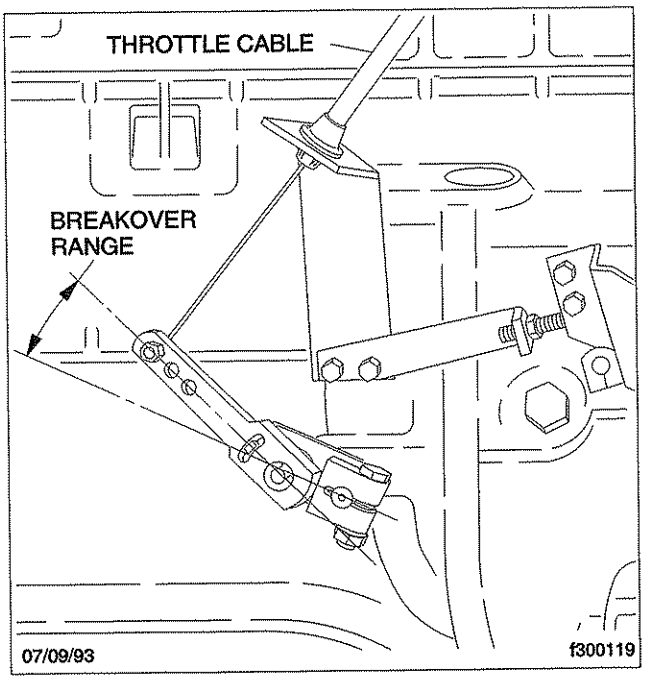


Fig. 4, Throttle Lever at Full Throttle

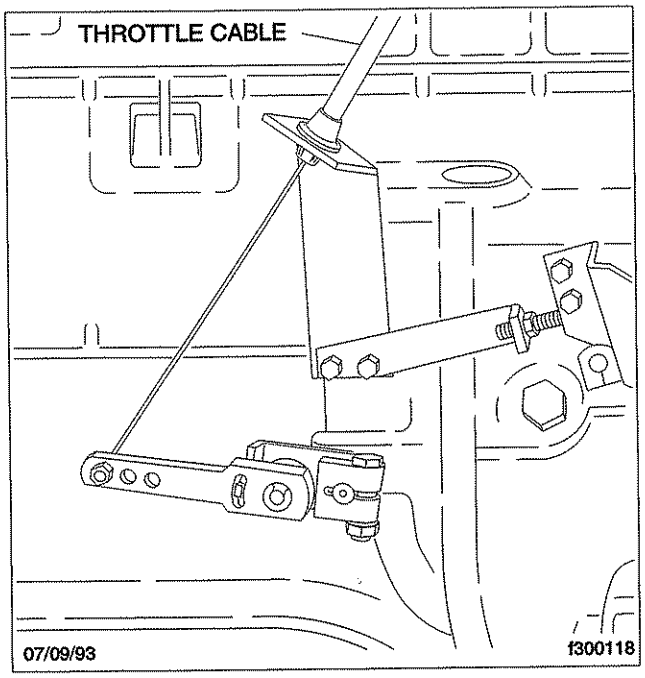


Fig. 3, Throttle Lever Partially Open

Throttle Control Operation Checking

Checking

1. Check the linkage attachment fasteners (capscrews, locknuts, and hexnuts) for tightness; tighten any that are loose.
2. Operate the throttle by hand, from idle to full throttle, while checking that nothing interferes with movement of the throttle lever or the throttle pedal. Reposition any parts that interfere.
3. Operate the throttle by hand, from idle to full throttle, while checking that the throttle lever returns to idle when released, and that the throttle lever pulls the throttle pedal back up. **Refer to Fig. 1 and Fig. 2.**
4. Operate the throttle pedal by hand, from idle to the pedal stop, while checking that the throttle cable pulls the throttle lever into the breakover range. **Refer to Fig. 3.**

NOTE: The breakover range begins at the point where the two parts of the throttle lever begin to have intersecting center lines.

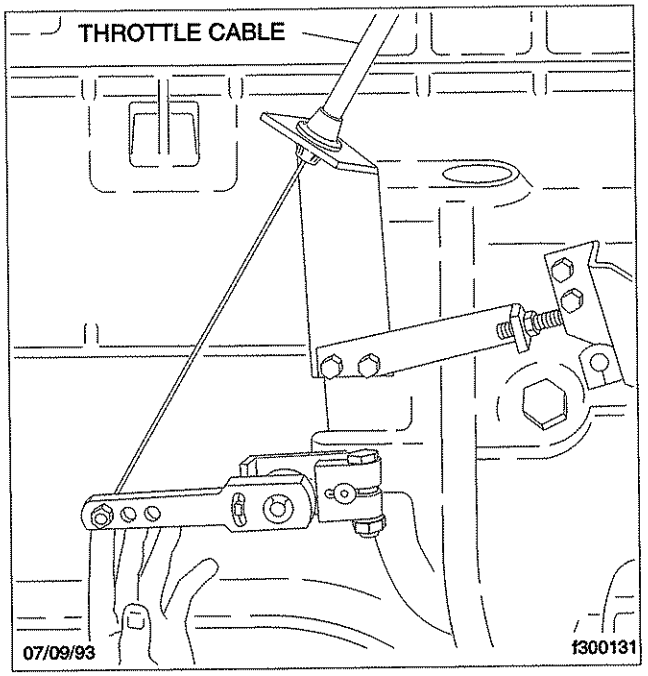


Fig. 1, Throttle Lever at Idle

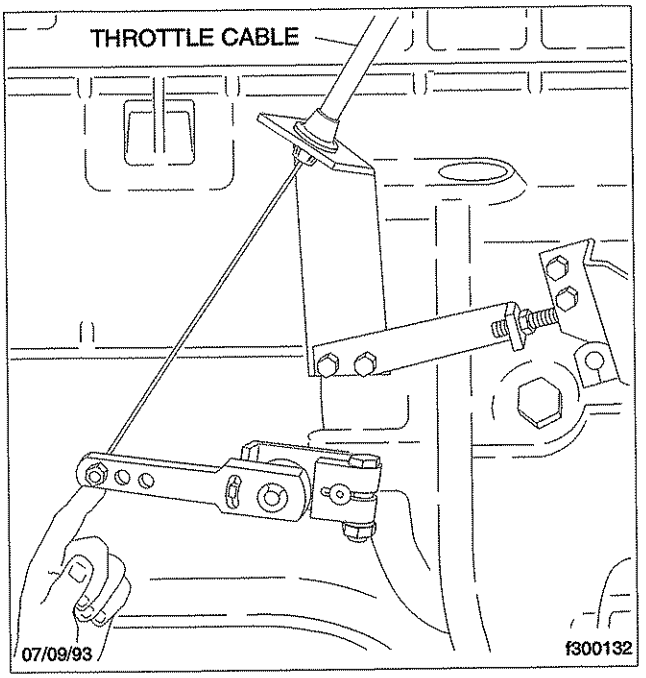


Fig. 2, Throttle Lever Partially Open

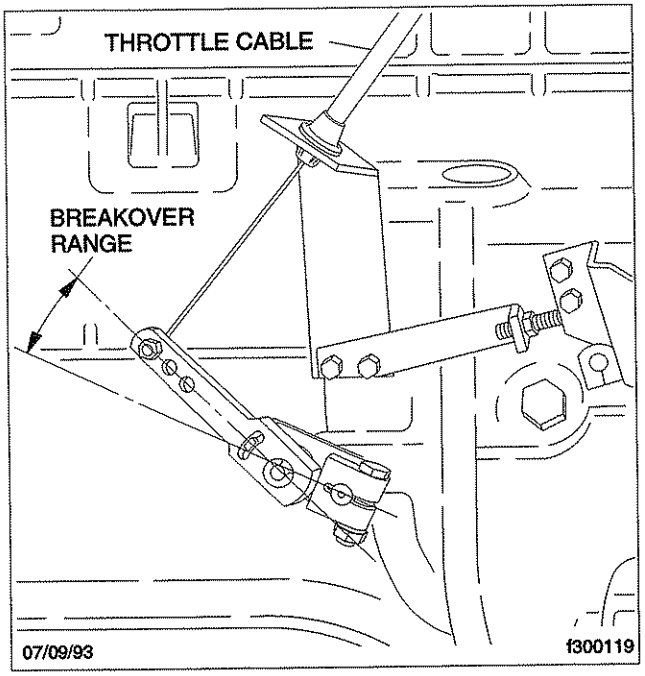


Fig. 3, Throttle Lever at Full Throttle

Throttle Cable Removal and Installation

Removal

1. Lift the throttle pedal to get some slack in the throttle cable as it comes through the firewall. **Refer to Fig. 1.**
2. Pry out the plastic bushing which holds the cable end in the throttle pedal lever. **Refer to Fig. 1.** Take the bushing off the cable, and remove the cable from the pedal lever.
3. Remove the cable clamp nut and toothed lockwasher from the cable conduit at the inside of the firewall. **See Fig. 1.**
4. Pass the cable out through the firewall.
5. Pull the plastic cover up, off the cast-metal cable end, and remove the cable end from the ball stud in the throttle lever. **Refer to Fig. 2.**
6. Remove the push-snap fitting from the throttle cable bracket. **Refer to Fig. 2.**
7. Slide the cable up through the hole in the cable bracket.

Installation

1. Pass the cable through the firewall into the cab. Make sure the bulkhead seal washer is in place against the engine side of the firewall.
2. Secure the cable conduit at the firewall with the toothed lockwasher and the cable clamp nut. **Refer to Fig. 1.** Tighten the clamp nut 14 N·m (10 lbf·ft).
3. Thread the cable through the throttle pedal lever, and slip a new plastic bushing onto the cable (with the open slot of the bushing facing up) so it can't pass back through the lever. **See Fig. 1.**
4. Snap the bushing into the hole at the upper end of the throttle pedal lever.
5. Inspect the ball stud in the throttle lever for wear, and replace if needed. If replacing the ball stud, apply Perma-Lock® MM 115 sealant or equivalent to the ball stud threads, and secure the stud to the throttle lever with the nut. Tighten the nut 13 N·m (10 lbf·ft).
6. Thread the cable through the cable bracket hole, and assemble the cast-metal cable end on the ball stud. Secure the joint by sliding the plastic cover down onto it.
7. Position the cable in the cable bracket. **Refer to Fig. 2.** Secure the cable with the push-snap fitting.

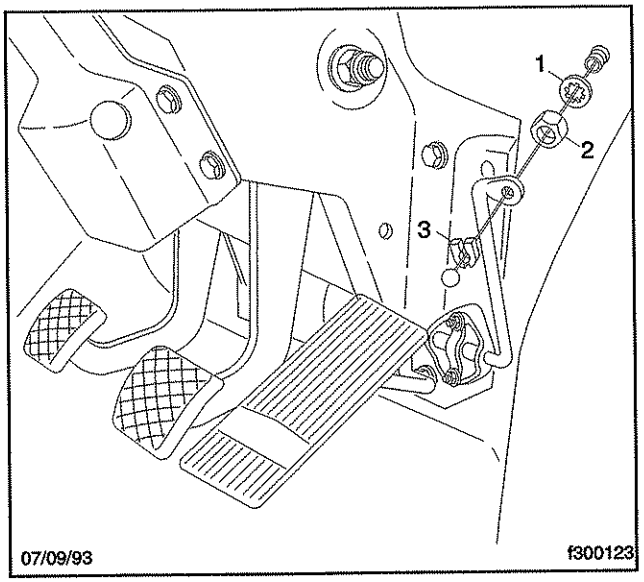


Fig. 1

Throttle Cable Removal and Installation

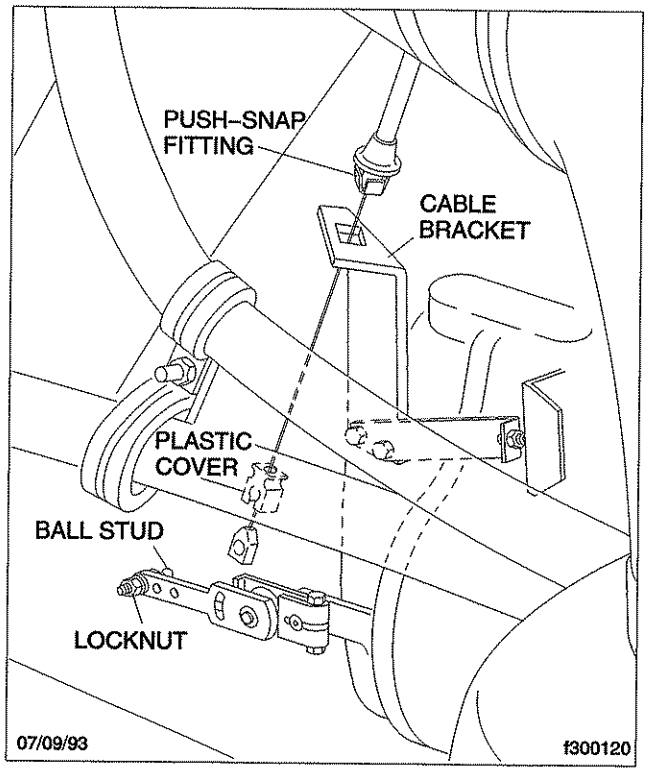


Fig. 2

Specifications

Description	Grade	Size	Torque N·m (lbf·ft)
Cable Clamp Nut	8	9/16 inch	14 (10)
Throttle Lever Cable Nut	5	1/4 inch	13 (10)

Table 1, Fastener Torques

Electronic Throttle Control, Williams 30.02

Contents

Subject	Subject Number
General Information	050
Service Operations	
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Throttle Pedal Sensor Replacement	110
Throttle Pedal Sensor Timing (Caterpillar CFE Engine)	120
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Throttle Pedal Assembly

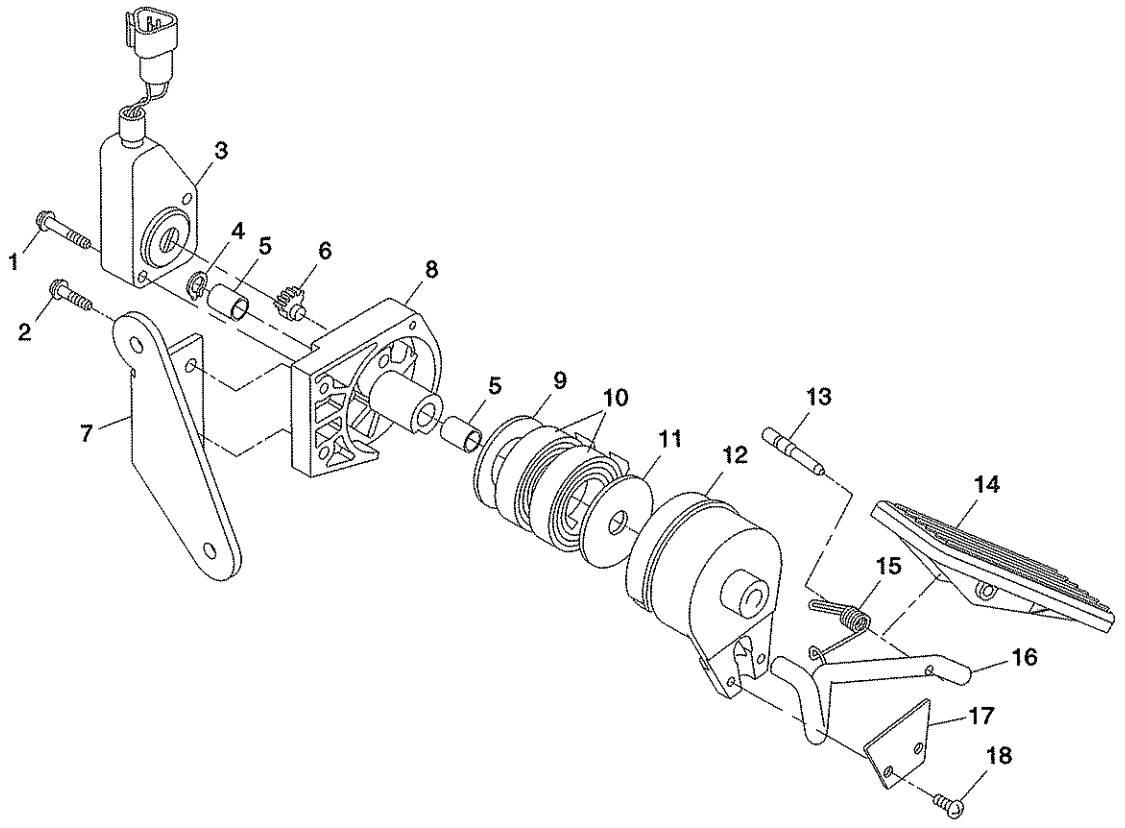
A Williams brand suspended, electronic throttle pedal is used in vehicles with Caterpillar, Cummins, and Detroit Diesel engines. See **Fig. 1**, **Fig. 2**, **Fig. 3**, and **Fig. 4**. The pedal is mounted to the inside of the frontwall and is connected by wiring to the engine control module.

As the driver presses on the pedal, the pedal lever or pedal arm is forced downward, rotating the pinion gear which meshes with the pedal sensor, or potentiometer. See **Fig. 1**.

NOTE: On vehicles with Detroit Diesel Series 50 engines, the pedal arm pulls an accelerator cable attached to the spring loaded spool assembly. The cable pulls the spool assembly and the assembly rotates. See **Fig. 4**.

The sensor, attached to the inboard side of the assembly, monitors how far the pinion gear (spool assembly on DDE Series 50 engines) rotates. Depending on how much the driver presses on the pedal, and the pedal rotates the pinion gear (or the cable rotates the spool assembly), the sensor signals the electronic engine control how much fuel to deliver to the engine.

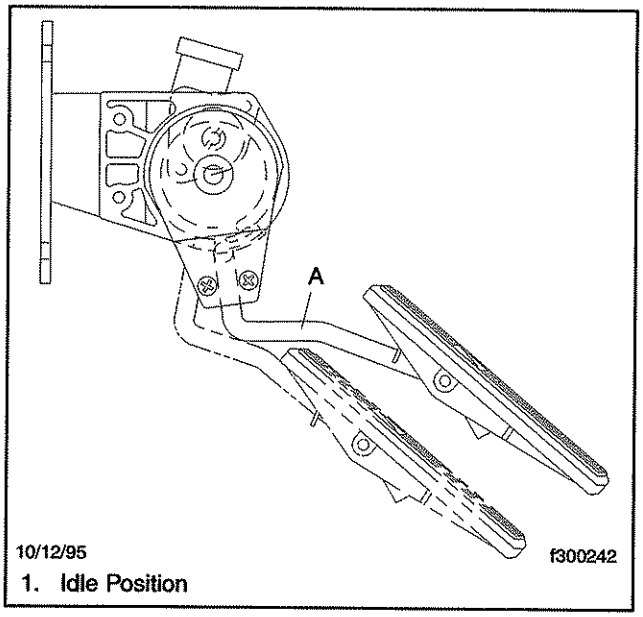
When the driver stops pressing on the pedal, return springs within the pedal (or spool) assembly return



1. Screw, M10–32 x 1.25
2. Hex Screw, 1/4–20 x 0.75
3. Sensor
4. Grip Ring
5. Bushing
6. Pinion Gear
7. Mounting Plate
8. Throttle Base
9. Spacer Washer
10. Throttle Spring
11. Spacer Washer
12. Housing
13. Pedal Pin
14. Pedal
15. Pedal Return Spring
16. Pedal Lever
17. Saddle Clamp
18. Screw, M10–32 x 0.50

Fig. 1, Williams Suspended Electronic Throttle Pedal, Exploded View (Caterpillar CFE engine)

General Information



1. Idle Position

Fig. 2, Williams Suspended Electronic Throttle Pedal, Side View (Cummins M11, ISB, and ISC engines)

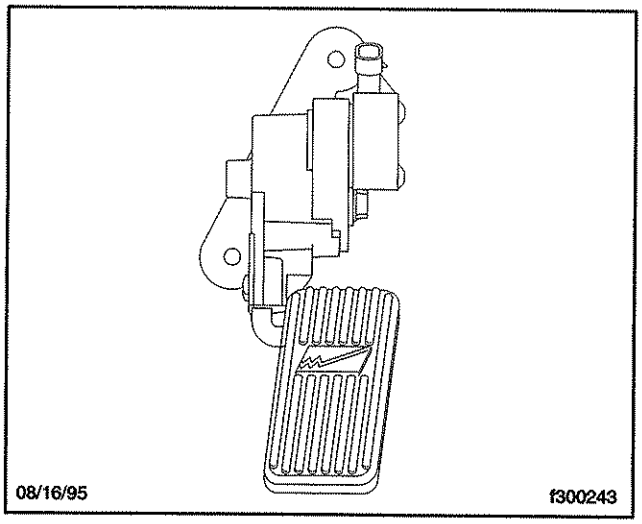


Fig. 3, Williams Suspended Electronic Throttle Pedal, Front View (Cummins M11, ISB, and ISC engines)

the pedal to the original idle position. Only the pedal sensor is serviceable. If any other part of the pedal malfunctions, replace the entire pedal assembly.

Throttle Position Sensor

The throttle position sensor (TPS) is an electro-mechanical device that converts the mechanical input from the throttle pedal assembly into an electrical signal proportional to the input of the pedal. This electrical signal is fed to the engine ECU, which uses the signal to manage engine and engine accessory operations.

Two types of throttle position sensors are used on electronic engines:

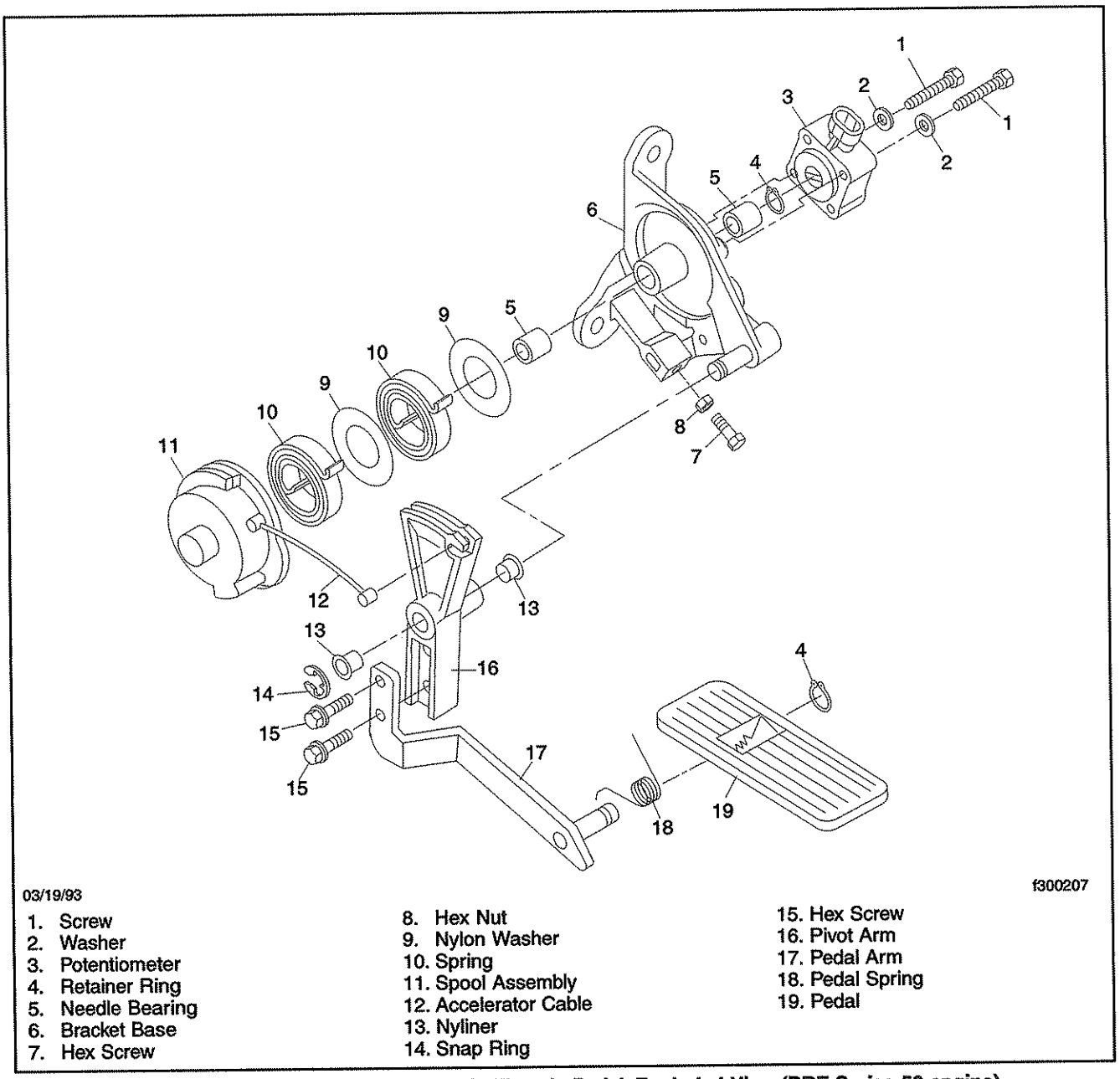
- The first type is a ratiometric sensor that produces a linear voltage output in proportion to pedal input. The engine ECU uses a converter circuit to turn the analog voltage into a digital "count."
- The second type is a pulse-width modulated (PWM) sensor that generates a series of discrete voltage pulses. The width of the pulses is proportional to the pedal position. A narrower pulse width indicates a smaller throttle pedal request and a wider pulse width indicates a larger pedal request. The pulse width is termed the "duty cycle" of the TPS.

The linear-type sensor is used on Cummins and Detroit Diesel engines. The PWM sensor is used on Caterpillar engines.

The TPS can also provide an idle validation signal (IVS). At present, an IVS is only available on vehicles equipped with Cummins electronic engines. The IVS is a single-pole, dual-throw switch integral with the TPS. When the throttle pedal returns to idle, the IVS moves to the "idle" position to tell the engine ECU that the pedal has returned to idle. When the throttle pedal is moved off of idle, the IVS moves to an "off idle" position to tell the engine ECU that the pedal is no longer in the idle position. Unlike a switch, there is a transition point on the TPS where a high resistance between the IVS common lead and either of the output leads may appear.

When properly installed, the TPS does not operate in either the lower or the upper 10 to 15 percent of the full range of travel. The output signal from the TPS can never be zero volts or equal the supply voltage from the engine. If such a condition should occur, the engine ECU will report a TPS problem.

The input signal from the TPS to the engine ECU is converted to binary data for engine management



03/19/93

1. Screw
2. Washer
3. Potentiometer
4. Retainer Ring
5. Needle Bearing
6. Bracket Base
7. Hex Screw
8. Hex Nut
9. Nylon Washer
10. Spring
11. Spool Assembly
12. Accelerator Cable
13. Nyliner
14. Snap Ring
15. Hex Screw
16. Pivot Arm
17. Pedal Arm
18. Pedal Spring
19. Pedal

Fig. 4, Williams Suspended Electronic Throttle Pedal, Exploded View (DDE Series 50 engine)

requirements. Detroit Diesel engines report the input voltage as "counts," one "count" being equal to about 0.005 volt. Caterpillar and Cummins engines convert the actual TPS position to a percentage TPS value. The percentage TPS value is scaled so that the values represent the sensor position in the allowed range of travel. A 0 percent value (3 percent for Caterpillar engines) corresponds to idle. A 100 percent value corresponds to full throttle. Raw data may be available for diagnosis, but percentage TPS values are displayed by the diagnostic tools and appear in troubleshooting manuals.

Throttle Pedal Removal and Installation

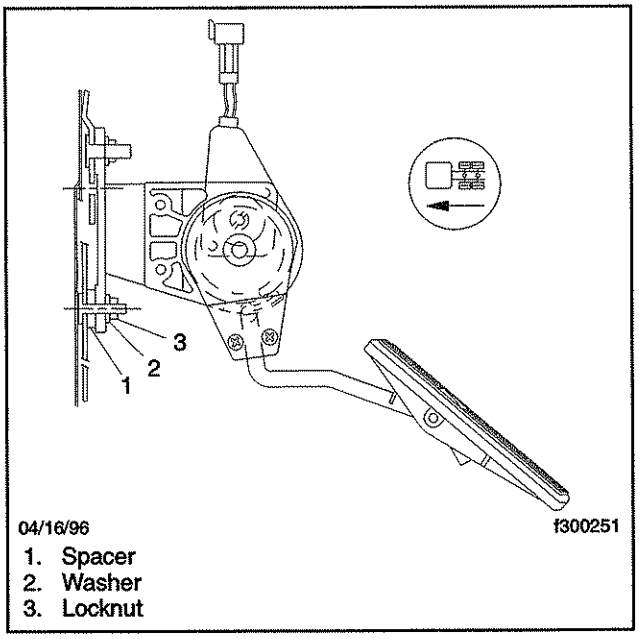
Removal

1. Shut down the engine, set the parking brake, and chock the tires.
2. Disconnect the batteries.

⚠ WARNING

To prevent personal injury, always wear eye protection and use caution when servicing pedal assemblies. Springs under tension could release suddenly and cause personal injury.

3. Disconnect the wiring harness from the throttle pedal. See **Fig. 1** and **Fig. 2.**
4. Remove the throttle pedal assembly from the vehicle.
   - 4.1 Remove the two locknuts and washers that secure the mounting plate to the two studs on the cab frontwall.
   - 4.2 Lift the pedal assembly off of the studs.

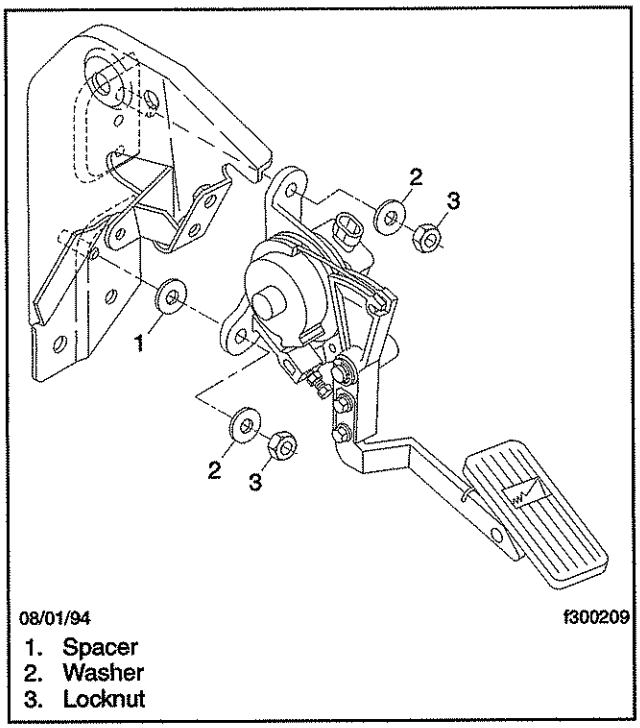


1. Spacer
2. Washer
3. Locknut

Fig. 1, Throttle Pedal Installation (typical)

Installation

1. Install the throttle pedal assembly. See **Fig. 1** and **Fig. 2.**
   - 1.1 If applicable, make sure that the spacer is in place on the lower mounting stud, then position the mounting plate on the two studs on the inside of the cab frontwall.
   - 1.2 Secure the plate on the studs with two 5/16–18 locknuts, and tighten the locknuts securely.
2. Connect the wiring harness to the throttle pedal.
3. Connect the batteries.
4. Remove the chocks from the tires.
5. Test drive the vehicle and ensure that the throttle pedal operates properly.



1. Spacer
2. Washer
3. Locknut

Fig. 2, Williams Electronic Throttle Pedal (DDE Series 50 engine)

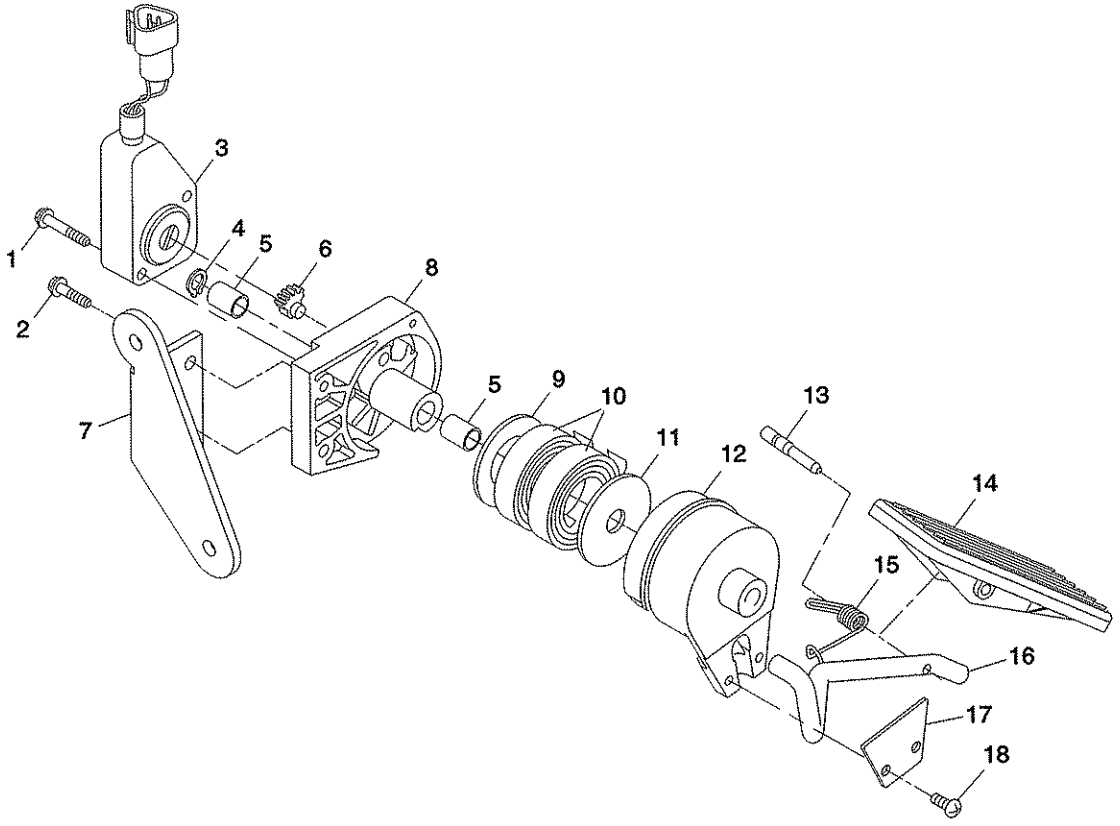
Throttle Pedal Sensor Replacement

Replacement

1. Shut down the engine, set the parking brakes, and chock the tires.
2. Disconnect the batteries.

NOTE: The sensor is not a serviceable part. If the sensor is malfunctioning, replace it.

3. Remove the sensor. See **Fig. 1.**
   - 3.1 Remove the two screws that hold the sensor to the throttle base.
   - 3.2 Disconnect the wiring harness from the throttle pedal sensor.
4. Install the sensor.
   - 4.1 Align the sensor with the pinion gear.
   - 4.2 Rotate the sensor so that the mounting holes line up, then secure the sensor with the mounting screws, and tighten the screws 15 to 20 lbf·in (160 to 220 N·cm).
   - 4.3 Connect the wiring harness to the sensor.
5. Connect the batteries and remove the chocks from the tires.
6. Test drive the vehicle and ensure that the throttle pedal sensor operates properly.



1. Screw, M10–32 x 1.25
2. Hex Screw, 1/4–20 x 0.75
3. Sensor
4. Grip Ring
5. Bushing
6. Pinion Gear
7. Mounting Plate
8. Throttle Base
9. Spacer Washer
10. Throttle Spring
11. Spacer Washer
12. Housing
13. Pedal Pin
14. Pedal
15. Pedal Return Spring
16. Pedal Lever
17. Saddle Clamp
18. Screw, M10–32 x 0.50

Fig. 1, Williams Electronic Throttle Pedal, Exploded View (typical)

Throttle Pedal Sensor Timing (Caterpillar CFE Engine)

Sensor Timing

1. Shut down the engine, set the parking brake, and chock the tires.
2. Loosen the two screws that hold the sensor to the throttle base.
3. Connect the Caterpillar Digital Diagnostic Tool to the vehicle's electronic data link. With the pedal in the idle position, adjust the sensor by rotating the housing until the reader displays the correct output of 10 to 22 percent of duty cycle.

⚠ CAUTION

Do not overtighten the sensor screws. Overtightening the screws can damage the sensor.

4. After the sensor is adjusted to the correct specifications, tighten the two sensor screws 15 to 20 lbf·in (169 to 226 N·cm).
5. Tighten the wiring harness clamps.
6. Remove the chocks from the tires.

Troubleshooting Procedures

⚠ CAUTION

The throttle pedal assembly is designed so that the throttle position sensor (TPS) will not reach the internal stop points when it is mounted to the pedal assembly. Very little sensor rotational adjustment is available once the TPS is installed. Attempting to modify the TPS, in an effort to gain adjustment range, or forcing the TPS shaft beyond the internal stop points will result in severe damage to the TPS.

The TPS used with Caterpillar engines is a pulse-width modulated (PWM) sensor. It cannot be properly diagnosed with a digital multimeter set to measure voltage, resistance, or continuity. A multimeter capable of measuring "duty cycle" can be used to view the TPS output. Caterpillar engine diagnostic tools are recommended for viewing the percentage TPS reported by the engine ECU. Attempting to diagnose a PWM sensor assembly without the proper tools will result in damage to the TPS.

Common Problems and Indications

A number of symptoms may be reported which can indicate a problem with the throttle pedal, TPS, or wiring to the electronic engine, including:

- low power or poor acceleration
- the vehicle will not reach programmed top speed
- the engine is stuck at idle
- the engine brake or engine retarder does not function
- slow deceleration
- the check engine light comes on
- an engine fault code indicating a TPS problem appears

These symptoms do not always indicate a throttle pedal, TPS, or wiring problem. Symptoms can disappear when the TPS is replaced, however, the TPS may not be faulty. A thorough diagnosis of the entire TPS system must be performed to ensure that a TPS is faulty.

Preliminary Checks

1. Verify, by testing with the particular engine manufacturer's diagnostic software and tools, that the TPS is operating properly. For Cummins engines, also verify idle validation signal (IVS) inputs. See **Table 1**.

IMPORTANT: **Table 1** is a guide for common engine installations. It is necessary to verify the correct information for the specific engine installed in the vehicle.

2. If the engine manufacturer's diagnostic software and tools produce the readings shown in **Table 1**, the TPS is not at fault. If you are unable to produce the readings shown in **Table 1**, go to the next step.
3. Verify that the TPS is wired properly. See **Table 2**.

IMPORTANT: Reversing the TPS signal line and the ground line can result in a percentage TPS reading that does not change, and may also produce a fault code at the engine ECU. Reversing the TPS signal line and the +v supply line can prevent the TPS signal from reaching 100 percent. Reversing the +v supply line and the common line will result in the TPS providing "inverted" pedal information, or not working at all. Verify circuit positions and circuit designations in the engine ECU connector using the engine manufacturer's troubleshooting documentation.

NOTE: On Caterpillar engines, swapping any circuits may cause the TPS not to operate.

4. Check the voltage to the TPS. See **Table 3** for TPS connector pin locations.

IMPORTANT: The ignition key must be in the ON position. For Cummins and Detroit Diesel engines, disconnect the TPS connector at the TPS. For Caterpillar and Mercedes-Benz engines, use or fabricate a breakout harness. After diagnosis, clear any historical TPS fault codes to prevent misdiagnosis in the future.

NOTE: It is normal for the engine to report fault codes when the TPS connector is disconnected.

⚠ CAUTION

Do not perform the tests in steps 5, 6, and 7 on the PWM sensor used with Caterpillar engines. Doing so may result in serious damage to the TPS.

5. If you do not read the voltages shown in **Table 3**, test resistance on the +v supply and common circuits between the TPS and the engine connectors.

Troubleshooting

Disconnect the OEM harness connector at the engine ECU.

IMPORTANT: For Caterpillar engines, also disconnect the TPS connector from the TPS. Ensure that the ignition key is in the OFF position before making any tests.

6. If a resistance greater than 10 ohms is read, there is a potential wiring problem. Correct any wiring problem before attempting further tests. If a wiring problem is discovered and repaired, go back and repeat step 1 to determine if this was the only problem.

NOTE: If circuit resistance is 10 ohms or less but the voltage is below that listed in **Table 3**, the engine ECU is probably faulty. If both voltage and circuit resistance are within spec, go to the next step.

7. For Cummins and Detroit Diesel TPS, check the resistance of the TPS at the OEM harness connector with a digital multimeter. Before making measurements, reconnect the TPS connector to the TPS. Leave the OEM harness connector disconnected. See **Table 4** for acceptable readings.

8. Inspect and ensure that all connector pins at the TPS sensor, frontwall, and engine ECU are free of corrosion and are not bent or damaged. Inspect and ensure that the connections between the pins and the wires are secure and also free of corrosion.

NOTE: If the TPS does not return to idle, one of two conditions exists. Either the IVS is faulty or the TPS signal voltage or PWM duty cycle, recorded by the engine ECU, is dropping significantly after the engine has calibrated the idle position.

9. On Cummins engines only, check and ensure that the IVS is working properly. If a problem is found with the IVS, replace the TPS with a new unit or one known to be good and continue testing. If no problem is found, go to the next step.

10. Remove the pedal assembly from the floor. Loosen (but do not remove) the TPS mounting screws. By hand, rotate the TPS sensor assembly as far as possible. Then, tighten the mounting screws securely. Check the operation of the TPS again.

NOTE: In some cases, it may be necessary to exchange the existing TPS with another because the TPS and pedal assembly tolerances result in an idle position too close to the edge of acceptable operation. In this situation, the TPS is probably not faulty and may perform acceptably in another pedal.

11. If the engine will not reach rated speed or recognize full throttle, the cause is something other than the TPS. Check the engine ECU parameters and reset them if necessary. Check and ensure that the TPS is wired correctly. Remove the TPS from the pedal assembly and move the pedal through the full range of operation. Watch the operation of the TPS actuator tab. Ensure that no parts are binding or broken.

12. If the TPS does not leave idle, check IVS operation (if so equipped) and ensure that the switch transitions from the idle to the off-idle state. Also, check for a signal on the appropriate wires at the engine ECU for both idle and off-idle states. On vehicles not equipped with an IVS, check and ensure that the TPS is connected correctly to the engine.

13. If the problem has still not been resolved, the problem is not with the TPS. See the engine manufacturer's service literature for further guidance.

Diagnostic Software/Tool Readings		
Engine	**Pedal Position**	**Reading**
Caterpillar*	Idle	3% TPS
	Full throttle	100% TPS
	Between idle/full throttle	Varies smoothly between 3% and 100%

Diagnostic Software/Tool Readings		
Engine	**Pedal Position**	**Reading**
Cummins*	Idle	0% TPS, IVS on-idle
	Full throttle	100% TPS, IVS off-idle
	Between idle/full throttle	Varies smoothly between 0% and 100%, IVS transitions between on-idle and off-idle at or before 15% TPS
Detroit Diesel	Idle	64 to 205 counts, (0% TPS)
	Full throttle	Less than 968 counts (100% TPS)
	Between idle/full throttle	Varies smoothly between idle and full throttle values
Mercedes-Benz	Idle	0% TPS
	Full throttle	100% TPS
	Between idle/full throttle	Varies smoothly between idle and full throttle values

* The ECM converts raw TPS data to % TPS.

Table 1, Diagnostic Software/Tool Readings

Throttle Position Sensor (TPS) Wiring				
Engine	**Engine Mfr. Circuit**	**TPS Connector Pin**	**Engine ECU Connector**	**See Drawing(s)**
Caterpillar CFE	C985 (+v supply)	A	35	D06–22104
	C993 (common)	B	29	–
	C986 (TPS signal)	C	37	–
Caterpillar C10/C12	C985 (+v supply)	A	4	D06–33424
	C993 (common)	B	5	*
	C986 (TPS signal)	C	66	D06–27057
Cummins ISB/ISC	N18 (+v supply)	C	29	D06–26882
	N19 (common)	B	19	–
	N11 (TPS signal)	A	30	–
Cummins ISM	N18 (+v supply)	C	18	D06–23965
	N19 (common)	B	19	–
	N11 (TPS signal)	A	11	–
Mercedes-Benz 906	440P + (+v supply)	C	9 (VCU)	–
	440P – (common)	B	14 (VCU)	–
	440T (TPS signal)	A	11 (VCU)	–
Detroit Diesel 50	D916 (+v supply)	A	A3	–
	D952 (common)	C	C3	–
	D417 (TPS signal)	B	D2	–

* Wire C795 is replaced by wire C993.

Table 2, Throttle Position Sensor (TPS) Wiring

Troubleshooting

TPS Connector Pin Locations			
Engine	**TPS +V Supply**	**TPS Common (Ground)**	**Voltage**
Caterpillar	Pin A	Pin B	+8v ± 0.5v
Cummins	Pin C	Pin B	+5v ± 0.5v
Detroit Diesel	Pin A	Pin C	+5v ± 0.5v
Mercedes-Benz	Pin C	Pin B	+5v ± 0.5v

Table 3, TPS Connector Pin Locations

TPS Resistance at OEM Connector Harness (Cummins and Detroit Diesel engines only)			
Measurement	**From**	**To**	**Value**
TPS total resistance	+V supply	Common	2000 to 3000 ohms
TPS signal to common at idle	TPS signal	Common	200 to 500 ohms (13% ± 2% of TPS total resistance)
TPS signal to +v supply at idle	TPS signal	+V supply	1800 to 2500 ohms and less than TPS total resistance
TPS signal over pedal travel range	TPS signal	+V supply	Should change smoothly from high to low resistance values as the pedal moves from idle to wide-open throttle
	TPS signal	Common	Should change smoothly from low to high resistance values as the pedal moves from idle to wide-open throttle

Table 4, TPS Resistance at OEM Connector Harness (Cummins and Detroit Diesel engines only)

Contents

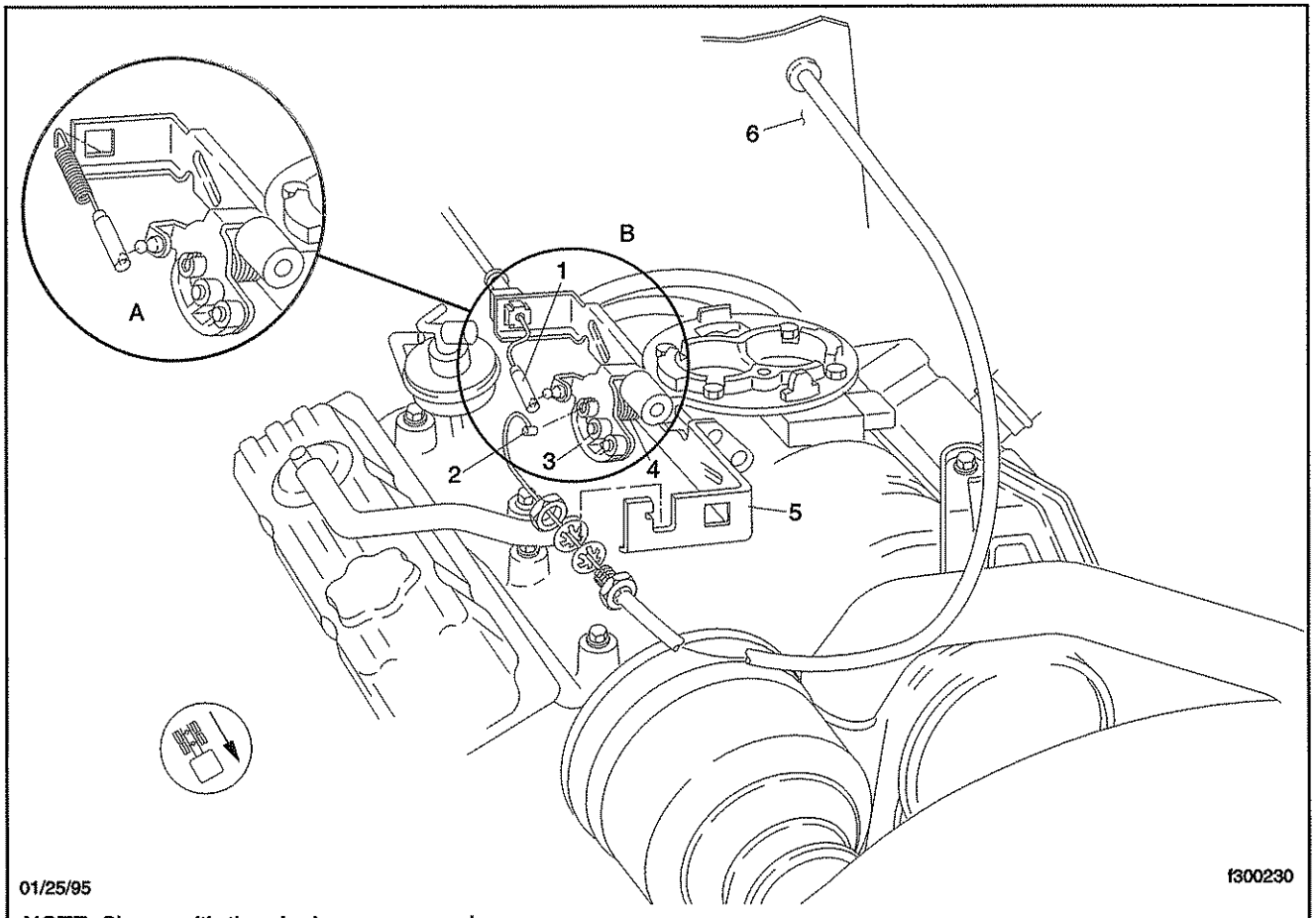
Subject	Subject Number
General Description	050
Service Operations	
Throttle Cable Removal and Installation	100
Transmission Throttle Valve Cable Replacement, Checking and Adjustment	110

General Description

An adjustable cable connects the throttle pedal to the throttle body on the Dodge Magnum V-8 and V-10 engines. **See Fig. 1** and **Fig. 2**. The cable runs from the pedal, through the firewall, and directly to the engine throttle body. Return springs on the throttle body shaft will return the throttle lever to the idle position when pressure on the throttle pedal is released. Engines equipped with manual transmissions have an additional pedal return spring. **See Fig. 3.**

When depressed, the throttle pedal pulls the cable, and the cable pulls the engine throttle lever to increase fuel delivery to the engine. The cable length enables the throttle pedal to operate the throttle lever through its full range, from idle to full throttle. To adjust the cable length, reposition the threaded cable end in the throttle body mounting bracket, and secure the cable with the cable clamp nuts. The cable housing prevents any interference with, or wear on, the throttle cable.

On vehicles equipped with automatic transmissions, a second cable runs from the throttle body to the



NOTE: Shown with the air cleaner removed.

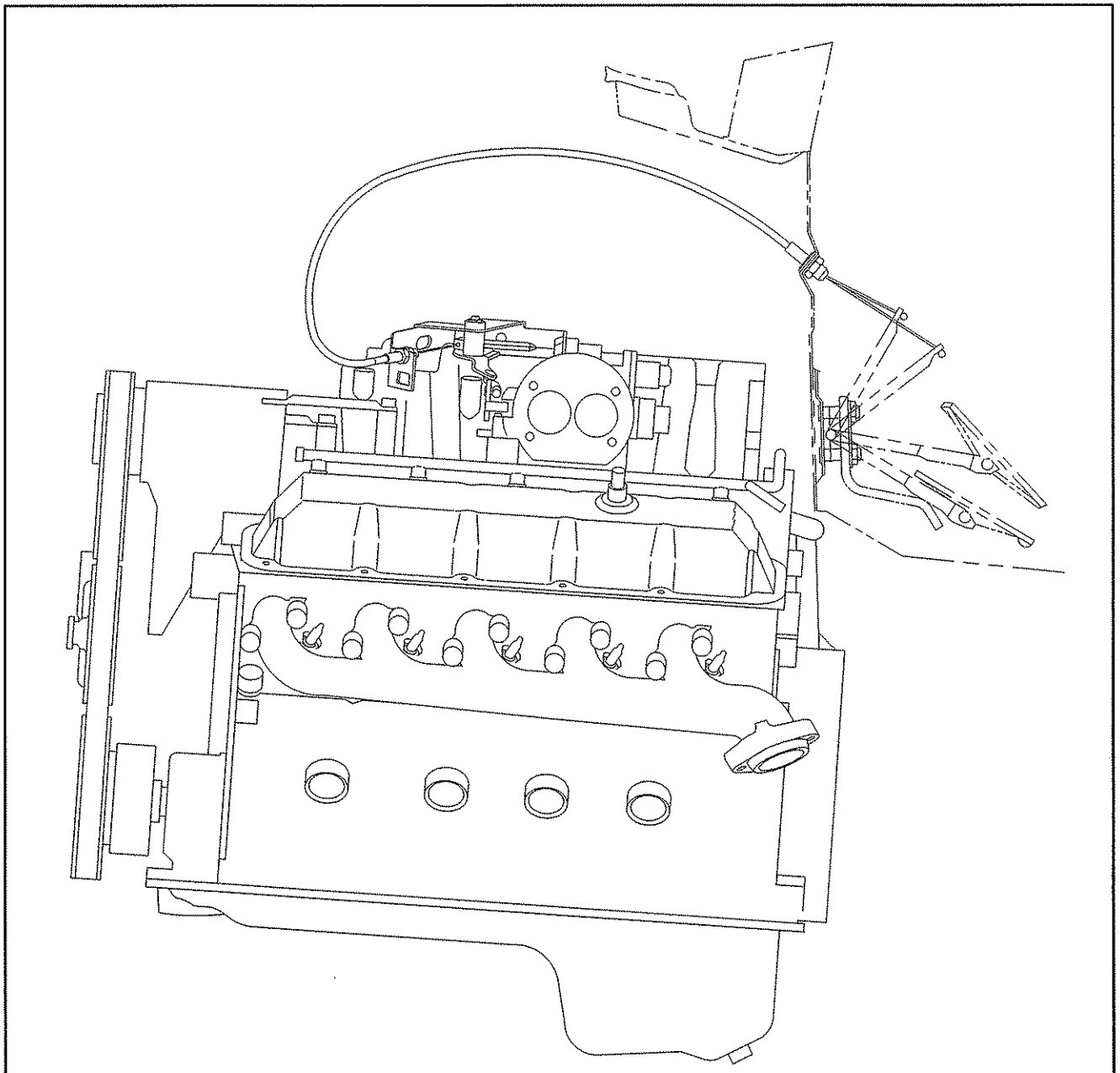
A. Return spring used with manual transmission.

B. Transmission throttle valve cable used with automatic transmission.

1. Transmission Throttle Valve Cable
2. Throttle Cable
3. Throttle Body Cam
4. Throttle Pedal Return Spring
5. Throttle Body Mounting Bracket
6. Firewall

Fig. 1, Throttle Cable from Firewall To Throttle Body Lever, V-8 Engine

General Description

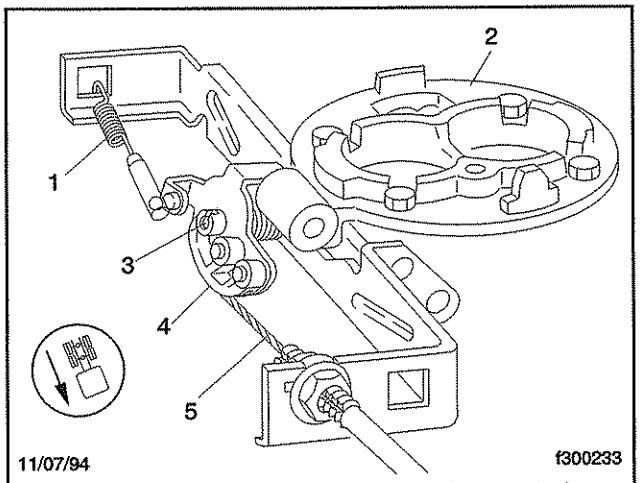


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NOTE: Shown with the air cleaner removed.

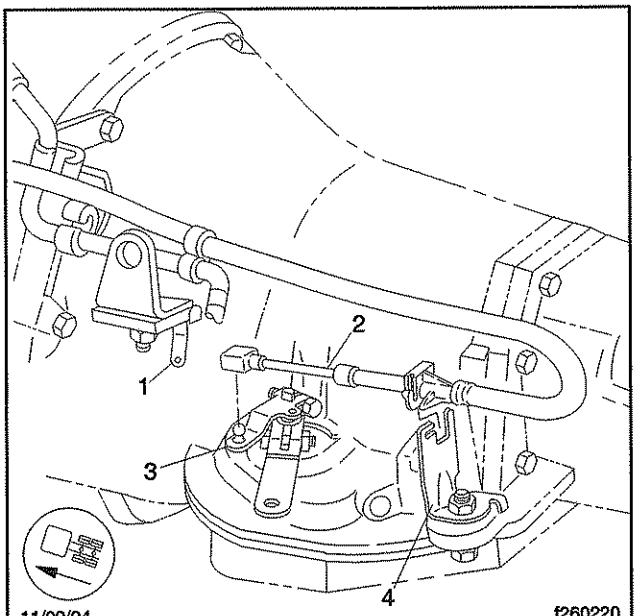
Fig. 2, Throttle Cable from Firewall To Throttle Body Lever, V-10 Engine

transmission throttle valve lever. **See Fig. 4.** The transmission throttle valve cable is adjustable at the engine, and when adjusted correctly, the cable will pull simultaneously with the cable from the throttle pedal.



1. Throttle Pedal Return Spring (manual transmissions only)
2. Throttle Body
3. Cable Pin
4. Throttle Body Cam
5. Throttle Cable

Fig. 3, Return Spring Installation for Manual Transmission, V-8 Engine



1. Spring Bracket
2. Transmission Throttle Valve Cable
3. Transmission Throttle Valve Lever
4. Cable Bracket

Fig. 4, Transmission Throttle Valve Cable, Transmission End

Throttle Cable Removal and Installation

Removal

1. Park the vehicle, shut down the engine, and set the parking brakes. Tilt the hood.
2. To access the throttle body, remove the air cleaner housing. **See Fig. 1.** For complete removal instructions, refer to **Group 09**.

⚠ WARNING

WARNING: Be careful not to kink or damage the cable core wire (within the cable housing) while servicing the throttle pedal or cables. A damaged cable could cause loss of throttle control, possibly resulting in a vehicle crash and personal injury or property damage.

3. Lift the throttle pedal to get some slack in the throttle cable as it comes through the firewall. **See Fig. 2.**
4. Pry out the plastic bushing which holds the cable end in the throttle pedal lever. Take the bushing off the cable, and remove the cable from the pedal lever.
5. Remove the cable clamp nut and the toothed lockwasher from the cable housing at the firewall inside the cab. **See Fig. 2.**

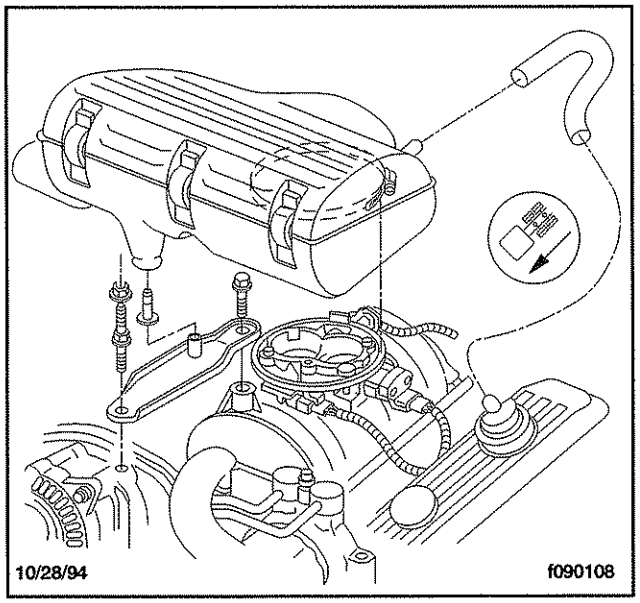
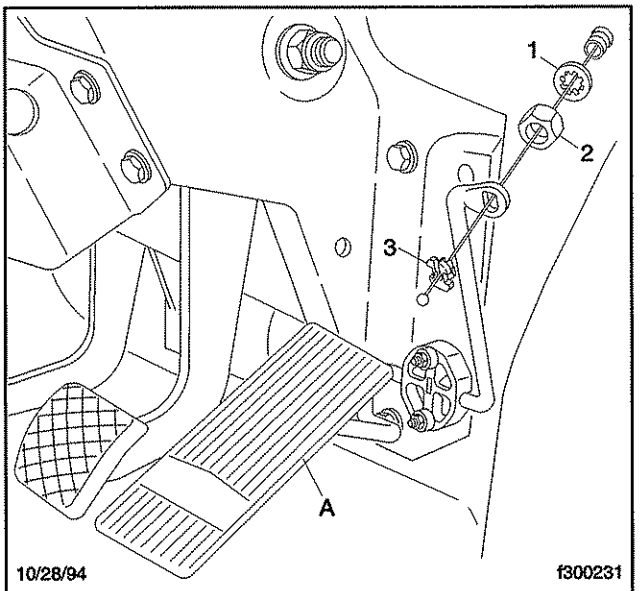


Fig. 1, Air Cleaner Removal, V-8 Engine

6. Pass the cable out through the firewall.
7. If applicable, loosen the camp that holds the cable housing to the radiator inlet pipe, and draw the cable and cable housing through and free of the clamp. **See Fig. 3.**
8. *For V-8 engines,* roll the throttle body cam, by hand, from idle to full throttle. Slip the pin on the end of the cable from the hole in the throttle body cam, and remove the cable from the cam. **See Fig. 4.**

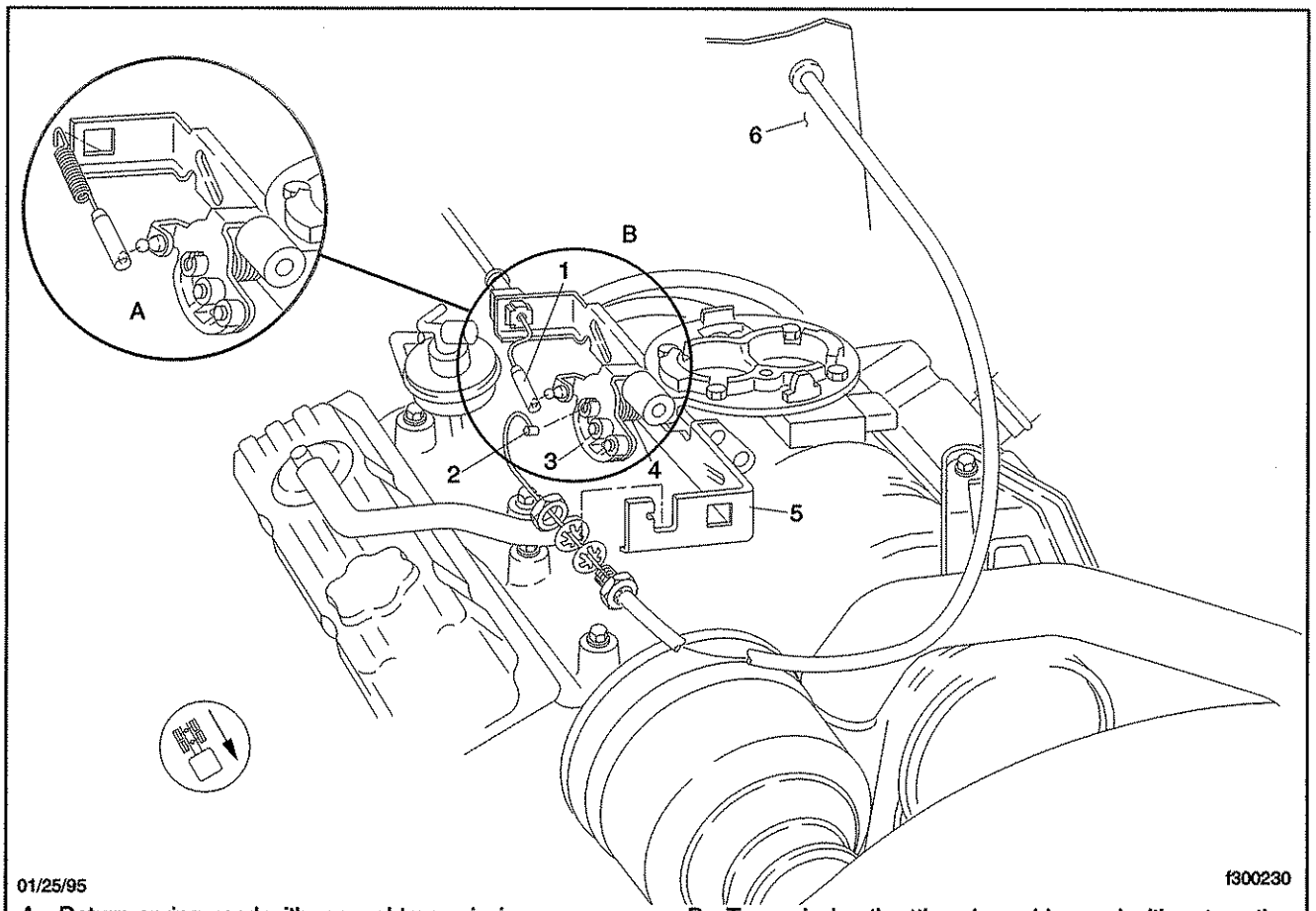
   For V-10 engines, pull the plastic cap back and off the metal cable socket that mounts on the ball on the throttle body lever. **See Fig. 5.** Then, lift the cable socket off the ball. **See Fig. 6.**
9. Loosen the cable clamp nuts on either side of the throttle body mounting bracket. **See Fig. 7.** Slide the cable out of the bracket.



A. Lift the pedal to get some slack in the throttle cable.
1. Toothed Lockwasher
2. Cable Clamp Nut
3. Plastic Bushing

Fig. 2, Throttle Cable Connection at the Throttle Pedal

Throttle Cable Removal and Installation



A. Return spring used with manual transmission.

B. Transmission throttle valve cable used with automatic transmission.

1. Transmission Throttle Valve Cable
2. Throttle Cable
3. Throttle Body Cam
4. Throttle Pedal Return Spring
5. Throttle Body Mounting Bracket
6. Firewall

Fig. 3, Throttle Cable from Firewall To Throttle Body Lever, V-8 Engine

Installation

1. *For V-8 engines,* by hand, rotate the throttle cam to the full throttle position. **See Fig. 4.** Fit the pin on the end of the cable into the hole on the throttle body cam.

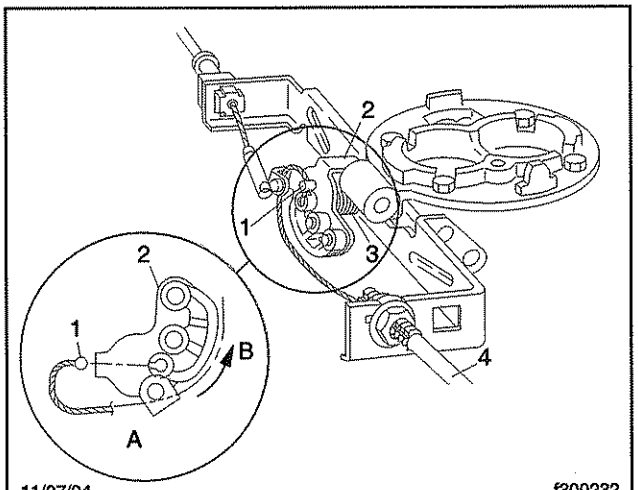
   For V-10 engines, fit the throttle cable socket over the lever ball on the throttle body lever. **See Fig. 6.** Then, slide the plastic cap onto the metal cable socket to lock it on the lever ball.

2. Turn the threaded cable housing so the two grooves in the housing align with the two points in the throttle body mounting bracket notch. **See Fig. 8.** Install the housing in the notch, and tighten a lockwasher and a cable clamp nut fingertight against each side of the bracket.

3. If applicable, route the throttle cable through the clamp on the radiator inlet tube and around the engine to the throttle body. **See Fig. 3.**

4. Thread the cable from the engine compartment, through the hole in the firewall and into the cab. Make sure the bulkhead seal washer is in place against the engine side of the firewall. Secure the cable housing at the firewall with the toothed

Throttle Cable Removal and Installation

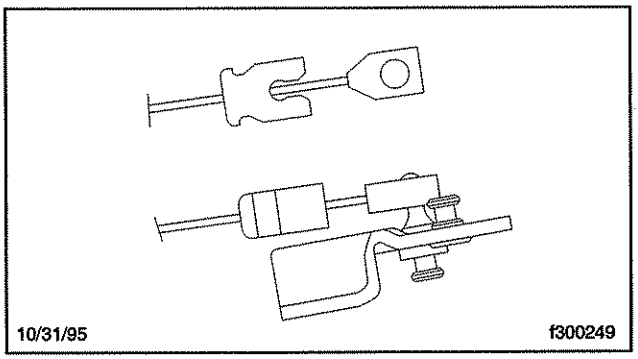


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A. View of Wide-Open Throttle
B. Rotate to full throttle.

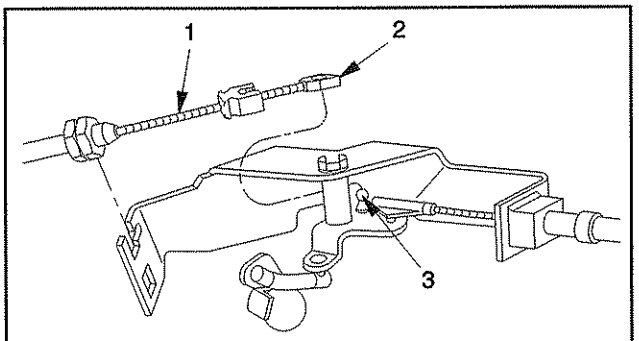
1. Cable Pin
2. Throttle Body Cam
3. Throttle Pedal Return Spring
4. Throttle Cable

Fig. 4, Cable Removal, V-8 Engine



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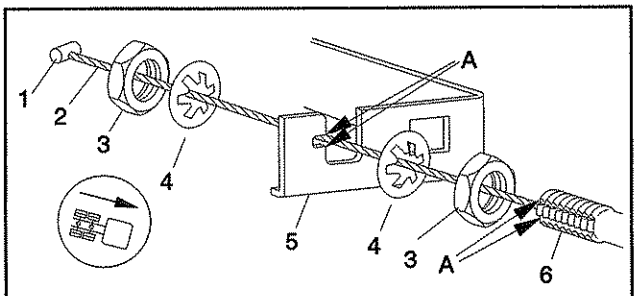
Fig. 5, Throttle Cable End and Plastic Locking Cap, V-10 Engine



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1. Throttle Cable
2. Cable Socket
3. Lever Ball

Fig. 6, Throttle Cable Connection to Throttle Body, V-10 Engine



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A. Turn the grooves in the cable housing outboard to align with the bracket points.

1. Throttle Cable Pin
2. Throttle Cable
3. Cable Clamp Nut
4. Toothed Lockwasher
5. Throttle Body Mounting Bracket
6. Threaded Cable Housing

Fig. 7, Throttle Cable Installation, V-8 Engine

lockwasher and the cable clamp nut. **See Fig. 2.** Tighten the nut 13 N·m (10 lbf·ft).

5. Thread the cable end through the throttle pedal lever, and place the plastic bushing onto the end of the throttle cable. Snap the bushing (with the notch in the bushing pointing up) into the hole at the upper end of the throttle pedal lever.
6. Use the cable clamp nuts to adjust the throttle cable in the throttle body mounting bracket until the throttle pedal can pull the throttle body lever from idle to full throttle and then return to idle. When the cable is adjusted, tighten the clamp nuts 13 N·m (10 lbf·ft).

⚠ WARNING

WARNING: Do not allow the throttle cable to rub against other components. A rubbing cable can wear and break resulting in loss of throttle control and possible property damage or personal injury.

Throttle Cable Removal and Installation

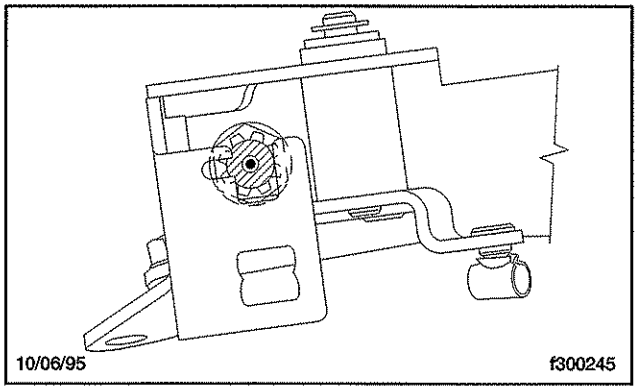


Fig. 8, Cable Positioning, V-10 Engine

7. Make sure the cable routing clamp(s) is tight enough to prevent motion between the parts.
8. Install the air cleaner housing and tighten the mounting band 400 N·cm (35 lbf·in). For complete installation instructions, refer to **Group 09**.
9. Lower the hood, and test drive the vehicle.

Transmission Throttle Valve Cable Replacement, Checking and Adjustment

Removal

1. Park the vehicle, shut down the engine, and set the parking brakes. Tilt the hood.
2. To access the throttle body, remove the air cleaner housing. **See Fig. 1.** For complete removal instructions, refer to **Group 09**.
3. Pull the transmission end of the transmission throttle valve cable straight up and off the stud on the throttle valve lever. **See Fig. 2.**
4. Rotate the cable housing out of the cable bracket on the transmission.
5. Loosen the clamps that route the cable from the transmission to the engine.
6. Pull the engine end of the transmission throttle valve cable slightly forward until it snaps off the stud on the throttle body cam. **See Fig. 3.**
7. At the throttle body, pinch the tabs on the sides of the plastic cable housing retainer, and pull the cable backwards out of the throttle body mounting bracket. **See Fig. 4.**
8. Pull the cable and cable housing free of the vehicle.
9. To install the transmission throttle valve cable, at the throttle body, pinch the tabs on the sides of the plastic cable housing retainer, and push the cable forward through the hole in the throttle body mounting bracket. **See Fig. 3.** Release the tabs and let the retainer lock the cable housing into the mounting bracket.
10. Route the cable through the clamps to the transmission, and attach the cable to the transmission throttle valve lever.
11. Make sure the transmission throttle valve lever return spring is attached. The transmission will not shift correctly if the return spring is not attached. **See Fig. 5.**
12. Use the following procedures to check and adjust the transmission throttle valve cable.

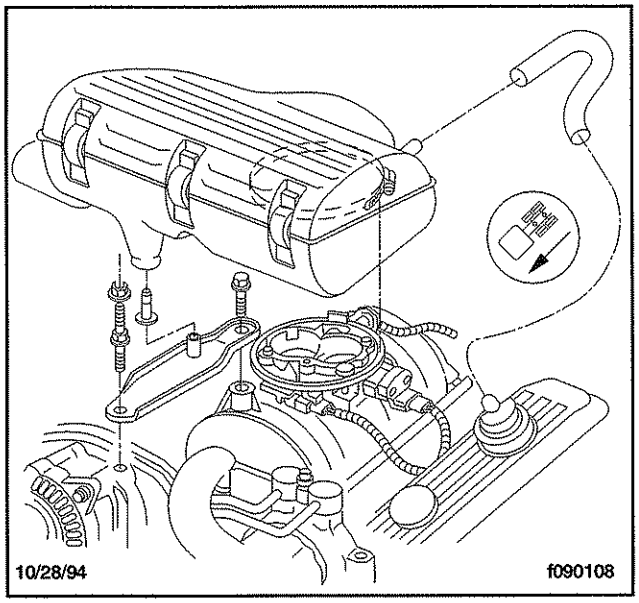
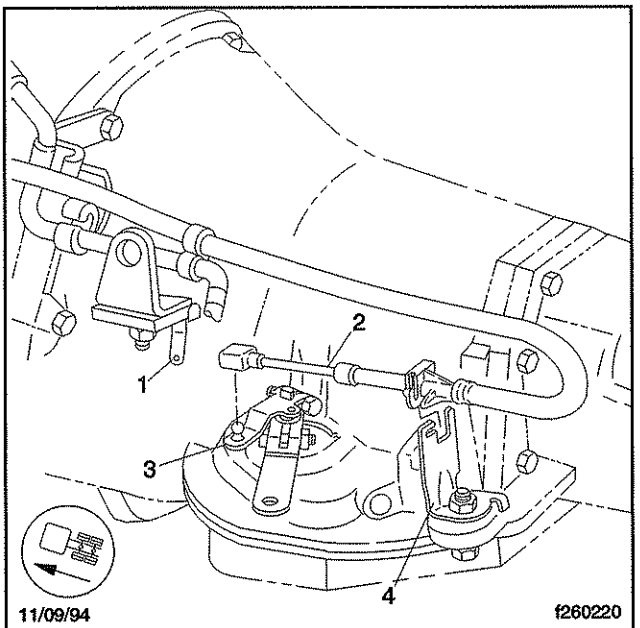


Fig. 1, Air Cleaner Removal, V-8 Engine

Checking

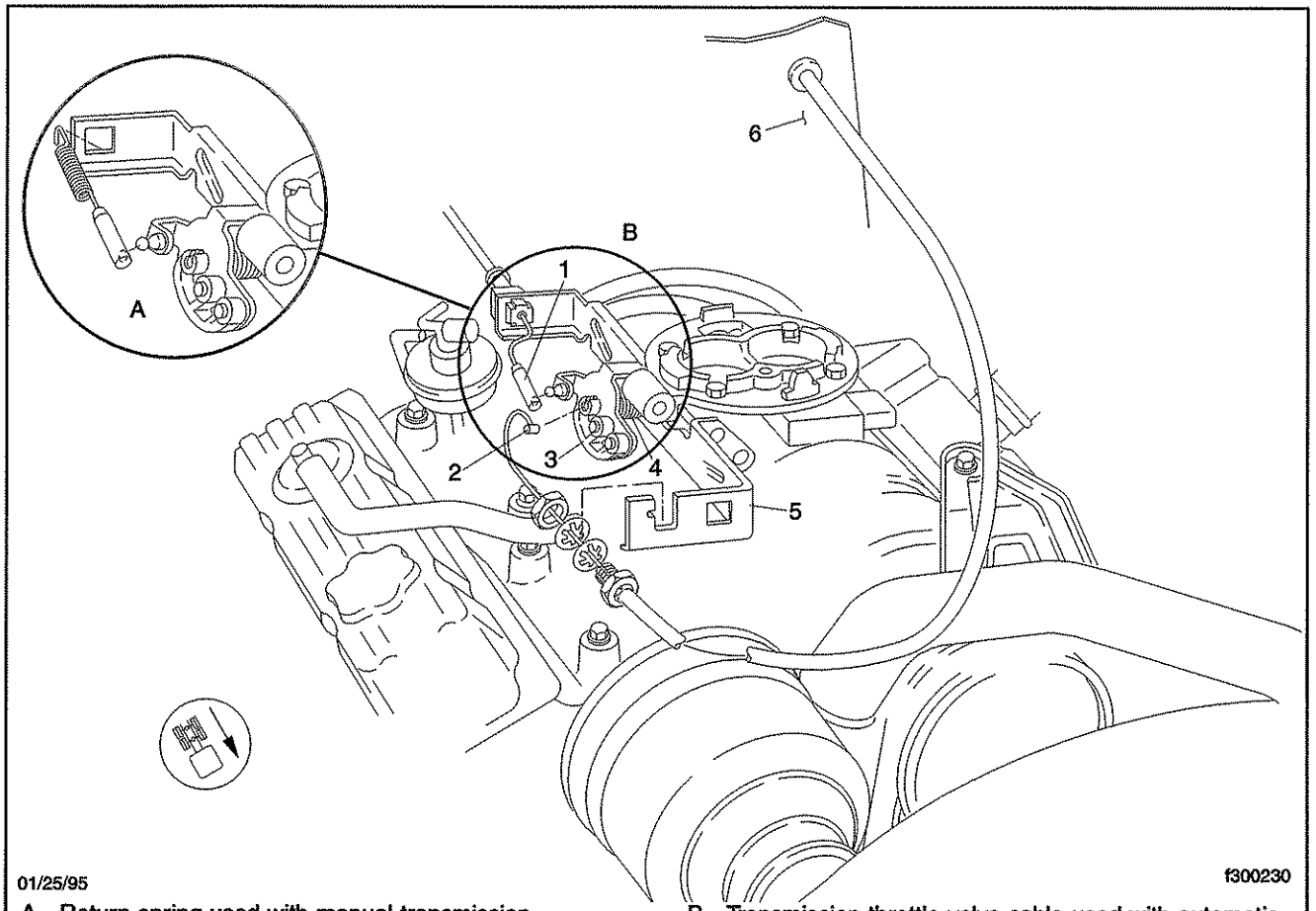
1. If not already done, park the vehicle, shut down the engine, and set the parking brakes. Tilt the hood.



1. Spring Bracket
2. Transmission Throttle Valve Cable
3. Transmission Throttle Valve Lever
4. Cable Bracket

Fig. 2, Transmission Throttle Valve Cable Installation at the Transmission

Transmission Throttle Valve Cable Replacement, Checking and Adjustment



A. Return spring used with manual transmission.

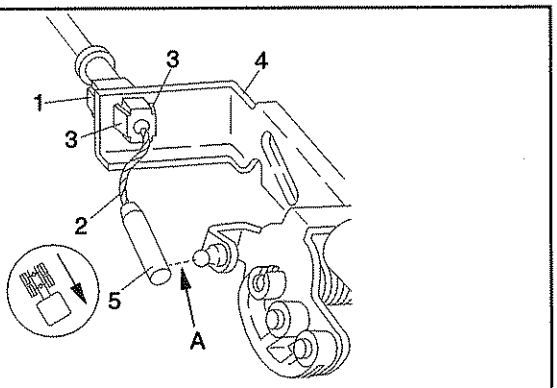
B. Transmission throttle valve cable used with automatic transmission.

1. Transmission Throttle Valve Cable
2. Throttle Cable
3. Throttle Body Cam
4. Throttle Pedal Return Spring
5. Throttle Body Mounting Bracket
6. Firewall

Fig. 3, Transmission Throttle Valve Cable Installation at the Engine, V-8 Engine

2. To access the throttle body, remove the air cleaner housing. **See Fig. 1.** For complete removal instructions, refer to **Group 09.**
3. Make sure the throttle body cam and the transmission throttle control valve lever are both in the idle position.
4. If not already disconnected, pull the engine end of the transmission throttle valve cable slightly forward until it snaps off the stud on the throttle body cam. **See Fig. 3.**
5. Compare the position of the cable end and the attachment stud. **See Fig. 4.** The cable end and the stud must be aligned within 1 mm in either direction.
6. If the cable end and the cam stud are not aligned, the cable will have to be adjusted. Go to the adjustment procedure that follows.
7. With an assistant, watch the movement of the transmission throttle lever and the throttle body cam. If the lever and the cam move simultaneously from idle to half-throttle and back to idle, the cable adjustment is correct. If the transmission lever moves ahead of or lags behind the throttle body cam, adjust the cable. If the throttle body cam

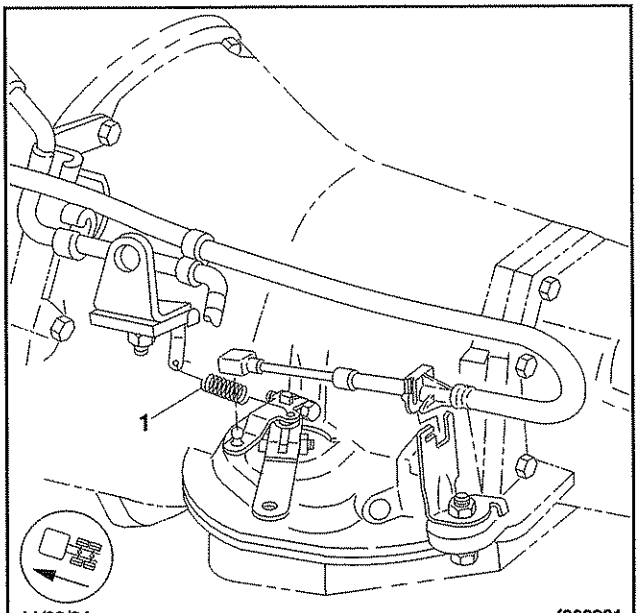
Transmission Throttle Valve Cable Replacement, Checking and Adjustment



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A. To adjust the cable, align the cable and stud to within 1 mm of center.
1. Cable Lock Button
2. Transmission Throttle Control Valve Cable (Engine End)
3. Cable Housing Retainer Tabs
4. Throttle Body Mounting Bracket.
5. Throttle Body Cam Stud

Fig. 4, Transmission Throttle Valve Cable Adjustment, V-8 Engine



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1. Transmission Throttle Control Valve Lever Return Spring

Fig. 5, Return Spring Installation

prevents the transmission lever from returning to the closed position, adjust the cable. Refer to the cable adjustment procedure that follows.

8. If the alignment is correct and the transmission lever and throttle cam move simultaneously, connect the engine end of the cable to the stud on the throttle body cam. Go to the last three steps in the Adjustment procedure.

Adjustment

1. If not already done, park the vehicle, shut down the engine, and set the parking brakes. Tilt the hood.
2. To access the throttle body, remove the air cleaner housing. **See Fig. 1.** For complete removal instructions, refer to **Group 09.**
3. Disconnect the cable end from the stud on the throttle body cam.
4. Make sure the transmission throttle control valve lever is in the fully closed position. Then, make sure the throttle body cam is in the idle position.
5. Find the cable lock button. **See Fig. 4.** The button is part of the cable retainer at the engine end of the cable.
6. Press the cable lock button to release the cable. The button only has to move about 2 mm to release the cable.

   Center the cable end on the attachment stud to within 1 mm and release the cable lock button.
7. Attach the cable end to the throttle body cam, and check that the transmission throttle control valve lever and the throttle body cam move simultaneously as described in the checking procedure, above.
8. Make sure all cable routing clamps are tight, and that the cable is securely connected to the transmission throttle control valve lever and the throttle body cam.
9. Install the air cleaner housing and tighten the mounting band 400 N·cm (35 lbf·in). For complete installation instructions, refer to **Group 09.**
10. Lower the hood, and test drive the vehicle.