AirDog® CAT UPGRADE KIT

INSTALLATION MANUAL

For Trucks Equipped with CATERPILLAR® Model 3406E Engines with 40 Pin ECM Fuel Cooling Plate

PLEASE READ THESE INSTRUCTIONS THOROUGHLY BEFORE BEGINNING INSTALLATION

Revised 5/9/2024

Part No. UPG-CAFS40

Proudly Made in the USA

AirDog® HEAVY DUTY DIESEL FUEL SYSTEMS by PureFlow® Technologies, Inc.

www.airdogdiesel.com

1-573-635-0555 or

1-877-463-4373

Providing "Test Cell Performance" in "Real World Conditions" Since 1993.

The CATERPILLAR® Secondary Fuel System Upgrade

PureFlow® Technologies, Inc. addresses diesel engine efficiency and peak performance on the fuel side from the fuel tank to the tip of the injector. Removing entrained air and fuel vapor from the fuel flow to the engine with the AirDog®FPII 4G, Champ, and Champ II is not enough if the internal conditions of the fuel system components are such to allow vapor to re-form in the injector itself.

Specifically, if the fuel pressure/flow to the injector, even with entrained air and vapor removed, is insufficient to totally fill the injector barrel on the up stroke of the plunger, a void or low pressure will form that allows vapor to re-form within the injector. The resulting "injector lag" is just another name for "delayed injection timing" and leaves the engine with increased fuel consumption, lost power, and increased exhaust emissions.

To overcome the concerns, upgrading the CAT® secondary fuel system is simple. Replace the small #6 fuel lines "**A** & **B**" with #8 lines and replace the 9/16-18 X #6 JIC fittings with ported 9/16-18 x #8 JIC fittings, port the secondary fuel filter head and reset the fuel "Rail Pressure".

Step 1: Port the Secondary Filter head.

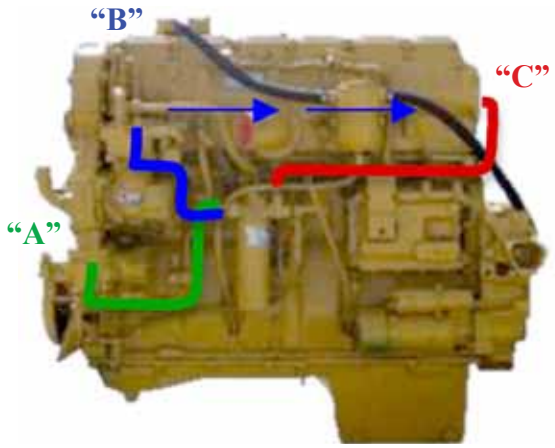
Step 2: Replace the restrictive #6 fuel fittings and lines with #8 fittings and #8 lines.

- **A.** Replace fuel line from transfer pump to secondary filter **(Green)**
- **B.** Replace fuel line from secondary filter to head **(Blue)** *Refer to "After" Figure*
- **C.** Fuel return line from engine **(Red)**

Step 3: Reset the Fuel Rail Pressure

Note: Due to space restrictions around the fuel inlet fitting at the front of the engine and ease of procedure, it may be necessary to switch and re-route the connection points on the engine for fuel inlet line "B" & return line "C". This will reverse the fuel flow through the rail. Other than that, it has no effect on the engine performance.

BEFORE



AFTER

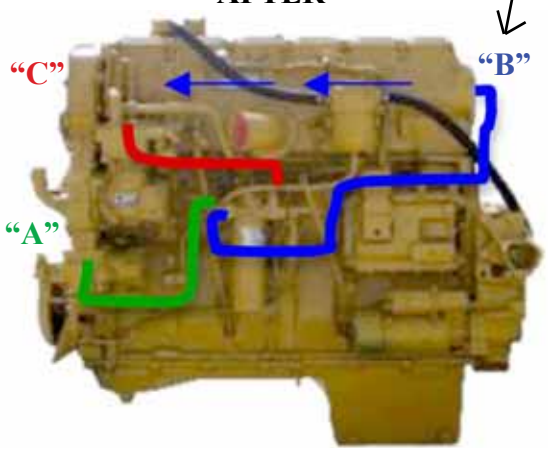


Table of Contents

Section 3: Upgrade Parts List: SAFETY GUIDELINES

CAUTION: Chock the vehicle's tire to prevent from rolling.

CAUTION: Wear safety glasses when operating power tools such as drills and grinders or when using a punch or chisel.

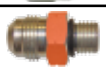
CAUTION: Route the fuel lines keeping them away from hot exhaust components and/or moving parts. Properly secure the fuel lines to prevent chafing.

If you are uncertain of any installation procedure, please call *PureFlow® Technologies, Inc.* at 573-635-0555 for technical assistance.

Section 3: Upgrade Parts List

1	**Installation Manual**	206-9-CTUPG40	
1	**#8 Braided Fuel Line - 8 FT Section**	4C-1-08-08-8FT	
15	**12” Zip Tie**	5H-2-1-12	

905-01-0100-FK CAT Upgrade Fitting Kit

1	**#10M JIC x 1/2 M ORB Straight Connector - Modified (Transfer*/ACERT)***	4A-1-02-10-08-S-.5M	
1	**#10M JIC x #10F JICX 90º Swivel Nut Elbow (Use if needed)**	4A-2-04-10-10-S	
2	**13/32 ID Hose F JICX x 1/2 Tube Hose End 90º Elbow**	4A-2-13-08-08-S	
2	**13/32 ID Hose F JICX x 1/2 Tube Hose End Fitting**	4A-1-13-08-08-S	
3	**#8M JIC x #8F JICX 90º Swivel Nut Elbow (Use as needed)**	4A-2-04-08-08-S	
4	**#8M JIC x 3/8 M ORB Straight Connector - Ported**	4A-1-01-08-06-S-P	
1	**#8M JIC x 3/8 M ORB Straight Connector - Modified**	4A-1-01-08-06-S-.16M	
1	**CAT Fuel Pressure Shim Kit**	SHK-CAFP	
1	**CAT Hand Primer Pump Replacement Kit:** Includes 1 Cap 002-4G-0006 **&** 1 Gasket 002-4G-0007	908-002-4G-0006/7	

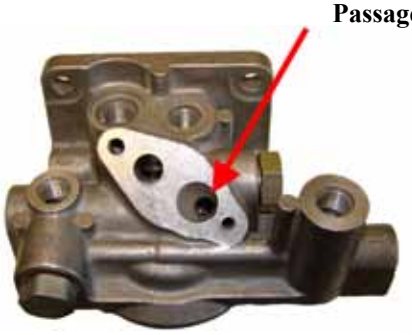
905-01-0100-FK40PN CAT 40 Pin ECM Installation Fitting Kit

2	**#6M JIC x #6F JICX 90° Swivel Nut Elbow**	4A-2-04-06-06-S	
2	**#6M JIC x 1/4 M NPTF Straight Connector**	4A-1-01-A-C-SZ	
2	**#8M JIC x #8F JICX x 1/4 NPTF Port GagePort**	4A-1-11-08-08-4P	

Section 4A: Porting the Secondary Fuel Filter Head

All CATERPILLAR® diesel engines are equipped with a secondary fuel filter mounted on the engine. The filter head usually includes an attached hand primer pump, to make it easier to prime and start the engine after filter changes. However, the fuel passages in the filter head, and the valves in the hand primer pump, are restrictive to the flow of fuel through the system, and the restriction negatively affects engine performance. The passages should be enlarged to improve fuel flow through the filter head; refer to images below.

Small, Restrictive Passageway



Restrictive One-way Check Valves in Hand Primer Pump

NOTE: Perform the following steps to improve fuel flow and engine performance. In most cases, the filter head can be drilled out without removing it from the engine.

4A-1. Remove the hand primer  pump and  fuel filter from the filter head.

4A-2. Using a 3/8” bit, carefully drill out the passageway that carries the fuel from the primer pump into the fuel filter.

NOTE: Remove the primer pump bypass valve before porting this passageway.

IMPORTANT: Be careful not to drill into the fuel filter gasket seat in the underside of the filter head.

4A-3. Remove all burrs and shavings from the filter head.

4A-4. Install the hand primer pump ported replacement cap and gasket on the filter head in place of the hand primer pump. Re-install the fuel filter.

NOTE: The primer pump replacement cap (included in the kit) cross passage has been ported to 3/8” to increase fuel flow for better engine performance.

IMPORTANT: It is recommended that you keep the hand primer pump on board, in the event it is needed to prime the system.

Section 4B: Replacing the Transfer Pump Fuel Inlet Fitting

For Non ACERT Engines (*For ACERT engines, see Section 6*)

NOTE: The small hole in the ORB side of the fitting, opening into the larger-volume section of the inlet to the transfer pump creates a vacuum, therefore a pressure drop, which can cause vapor to form. The remedy for this is porting the fuel inlet fitting.

4B-1. Disconnect the fuel line from the fitting and remove the fuel fitting from the transfer pump.

4B-2. Replace the fuel inlet fitting with the #10 M JIC x 1/2 M ORB modified fitting. If needed, attach the 90° #10 F JIC Swivel x #10 M JIC fitting.

4B-3. Connect the fuel line originally connecting the primary fuel filter to the transfer pump to the AirDog® "Out to Engine" port. If the fuel line is in poor condition or too short to make the connection, replace it with a new fuel line.

Section 4C: Upgrading the Fuel Line from the Transfer Pump to the Secondary Fuel Filter

NOTE: The passageways in the original 9/16 – 18 X#6 fuel fittings and #6 lines are small and restrictive to the fuel flow and performance. Upgrading the system with ported #8 fittings and installing #8 fuel lines increases fuel flow and performance.

4C-1. Disconnect the fuel line from the discharge side (high pressure side) of the transfer pump.

Section 4C: Upgrading the Fuel Line from the Transfer Pump to the Secondary Fuel Filter, cont'd

4C-2. Remove the #6 fuel fitting in the transfer pump and install a #8 M JIC x #6 M ORB ported fitting.

4C-3. Remove the other end of the fuel line from the inlet fitting on the fuel manifold.

4C-4. Remove the steel line connecting the fuel manifold to the inlet side of the fuel filter housing. It is recommended to cap the open #6 JIC ports in the fuel manifold where previous fuel lines were removed.

4C-5. Remove the #6 "From Pump" fitting in the secondary filter head and install a #8 M JIC x #6 M ORB ported fitting.

4C-6. Measure and cut length of fuel line required, to bypass the fuel manifold block, and go from the transfer pump to the secondary fuel filter housing inlet. Attach the proper ends and assemble per standard procedures.

4C-7. Connect the end with the 90º fitting to the transfer pump. DO NOT position the fitting and fuel line too close to the harmonic balancer. Be sure to have adequate clearance.

4C-8. Route the fuel line to the secondary fuel filter and connect the other end to the “From Pump” fitting. Use the 90º fitting if necessary. Properly tighten the fuel lines to the fittings.

Section 4D: Replacing the Fuel Line from the Secondary Fuel Filter to the Engine Head

NOTE: Before starting 4D Assemble the #8 gageport tees with the 1/4 NPT x #6 JIC fittings.

4D-1. Disconnect the fuel line fitting from the secondary fuel filter head outlet port and remove the #6 fitting. Install a new #8 M JIC x #6 M ORB ported fitting in the filter head in place of the fitting just removed. Install a #8 gageport tee to the #8 M JIC ported fitting. Then connect the factory fuel line back up, so that fuel flow continues through the ECM. Use provided 90° fittings as needed.

Section 4D: Replacing the Fuel Line from the Secondary Fuel Filter to the Engine Head, cont'd

4D-2. Disconnect the other end of the fuel line to the engine and remove the line completely.

4D-3. Follow the #6 engine fuel return line from the fuel manifold to the back of the engine head. Disconnect the fuel line from the fitting in the back of the head and remove the #6 fitting.

4D-4. Replace the original #6 fitting with a #8 M JIC x #6 M ORB ported fitting. You will connect a provided #8 gageport tee to the #8 M JIC x #6 M ORB ported fitting and the fuel line from the secondary fuel filter will connect to the #8 gageport tee at the back of the head. Reconnect the factory fuel line that was previously disconnected, to the #6 JIC fitting at the center of the #8 gageport tee. Use provided 90° fittings as needed.

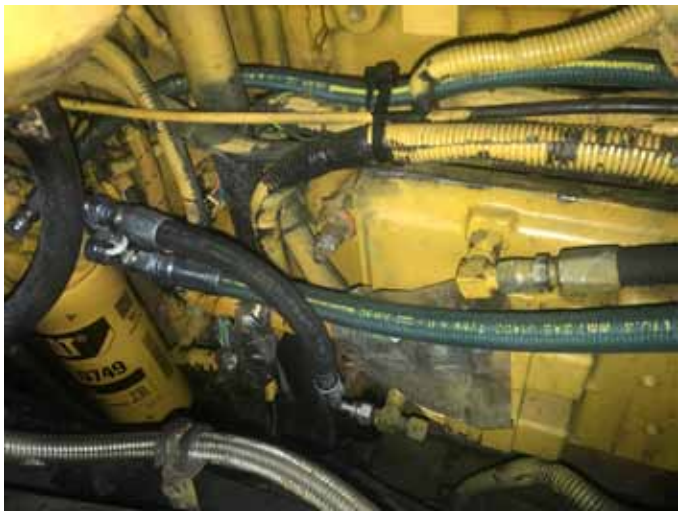
4D-5. Re-route the fuel return line disconnected from the engine in step 4D-3 and reconnect it where the fuel line to the engine was connected before as, shown above. This reverses the fuel flow through the engine and is only done to make it easier to connect the larger fuel supply line to the back of the engine.

Section 4D: Replacing the Fuel Line from the Secondary Fuel Filter to the Engine Head, cont'd

4D-6. Measure and cut the length of #8 fuel line required, when properly routed, to connect the #8 gageport tee in the secondary fuel filter head to the #8 gageport tee installed in the back of the engine head. Attach the proper ends and assemble per standard procedures.

4D-7. Connect the new #8 fuel line to the #8 gageport tee at the secondary fuel filter outlet.

4D-8. Connect the other end of the new #8 fuel line to the #8 gageport tee in the back of the head. Properly tighten all fuel line connections and fuel fittings. Secure all the fuel lines with included zip ties to prevent chafing.



Section 5: Adjusting the Fuel Rail Pressure

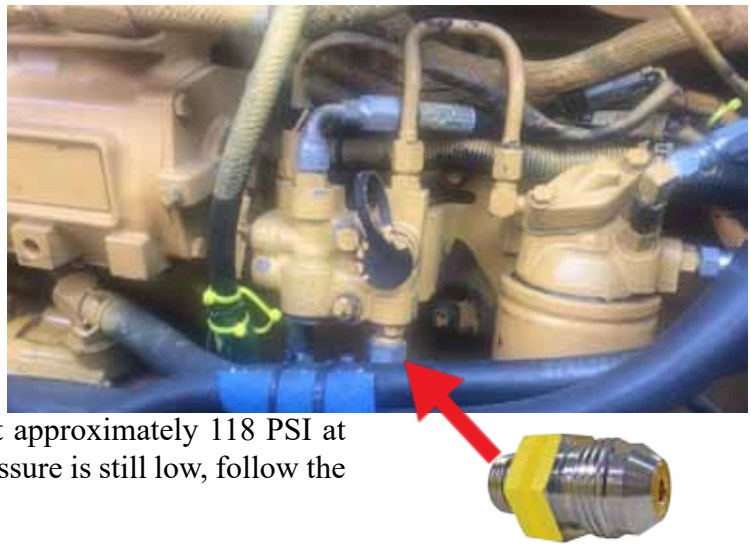
For the CAT® 3406E engine to perform at peak efficiency, the fuel rail pressure must be adequate to completely fill the fuel injectors during the "Up" stroke of the plunger. A minimum of 115 PSI to an absolute maximum of no more that 120 PSI at "High Idle" is required.

There are three models of the CATERPILLAR® fuel transfer pump. The early model 1st generation with a small diameter spring and hex head plug and the 2nd generation and 3rd generation with a larger diameter spring and socket head plug.

Temporarily install a 150 PSI Fuel Pressure Gauge.

Know the original fuel pressure before you start.

5-1. Install the AirDog® #8 M JIC x #6 M ORB



modified restrictor fitting. If your transfer pump is in good condition and not worn out, with the engine running the fuel rail pressure should be at approximately 118 PSI at high idle (1,900 to 2,100 RPM). If the fuel rail pressure is still low, follow the steps below.

To adjust the rail pressure reset the spring tension by *shimming* the *high pressure* bypass regulator.

Note: The shim kit includes shims for each of the three generation pumps.

1st Generation Pump Shims + pin

2nd Generation Pump Shim Caps

3rd Generation Pump Shims

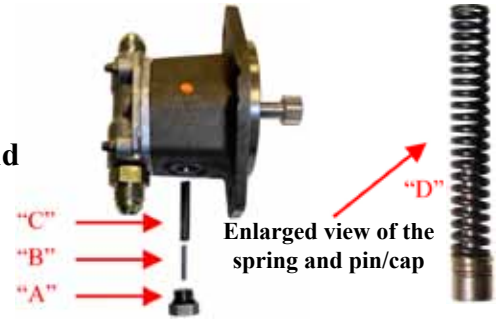
Adjusting the Rail Pressure for the 1st Generation CAT® Fuel Transfer Pump

5-2. Remove hex plug "A" on the side of the transfer pump.

5-3. Take out spring "C" and Stiffener Pin "B".

NOTE: The shim kit includes new stiffener pin with cap and three shims for the 1st generation CAT® transfer pump.

5-4. Put the new stiffener pin with cap part #"D" into the springand re-install the spring, pin and plug in the transfer pump.



Enlarged view of the spring and pin/cap

Adjusting Rail Pressure for the 1st Generation CAT® Fuel Transfer Pump, cont'd

5-5. Start the engine. Run the RPM up slowly until high idle is reached. High idle is 1,900 to 2,100 RPM. Read the fuel rail pressure. If the rail pressure does not reach 118 PSI, add a shim and repeat until at least 118 PSI is achieved, but not more than 120 PSI. All three shims may be required to reach the 118 PSI.

WARNING: DO NOT exceed the 120 PSI fuel rail pressure. High rail pressure, 130 PSI and above will void your factory engine warranty and may cause severe engine damage.

Adjusting Rail Pressure for the 2nd & 3rd Generation CAT® Fuel Transfer Pump

5-6 Remove socket head plug "A" on the side of the transfer pump.

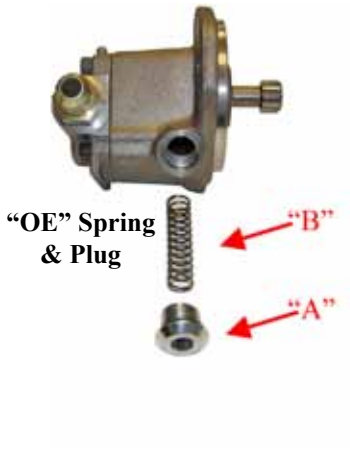
NOTE: The Shim Kit includes:

- **2nd generation pump has two shim caps, one 0.25" thick and one 0.125" thick.**
- **3rd generation pump two shims, one 0.25" thick and one 0.125" thick.**

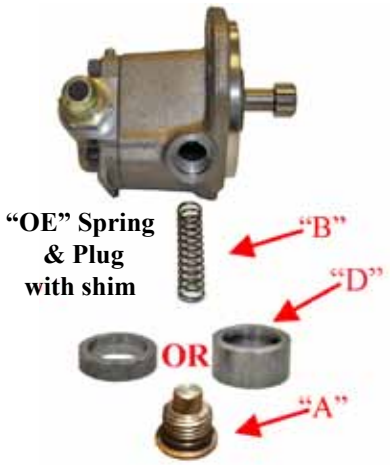
2nd Generation Pump Shim Caps

3rd Generation Pump Shims

2nd Generation PUMP



3rd Generation PUMP



5-7. Hold the 0.125" shim cap "C" (2nd Generation) or 0.125" shim "D" (3rd Generation) on the end of the plug "A" and re-install the spring, shim cap or shim, and plug into the transfer pump.

5-8. Start the engine. Run the RPM up slowly until high idle is reached. High idle is 1,900 to 2,100 RPM. Read the fuel rail pressure. If the rail pressure does not reach 118 PSI, remove the .125 shim and replace with the .250 shim and repeat until at least 118 PSI is achieved, but not more than 120 PSI.

5-9. When you have completed adjusting the fuel rail pressure, remove the pressure gauge from the secondary fuel filter head and replace the plug.

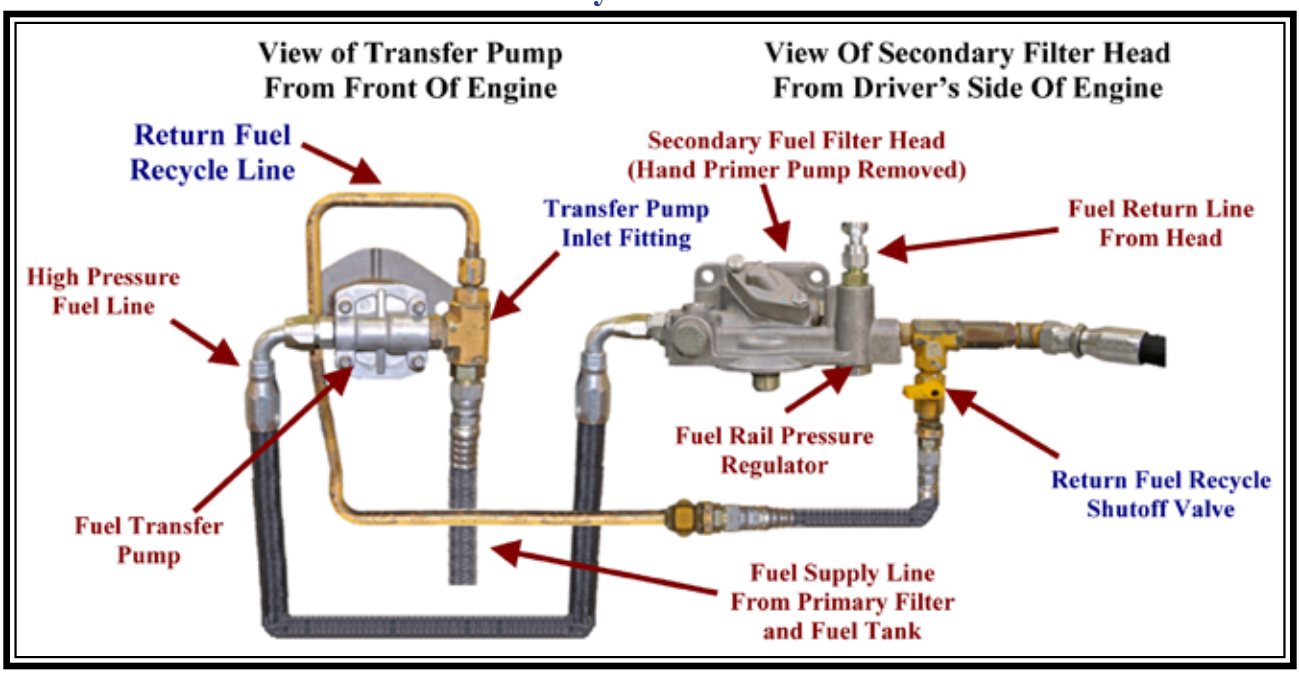
VERY IMPORTANT: After the adjustments have been performed and the rail pressure does not reach 118 PSI ±3, it would be wise to have the fuel pump checked for excessive wear. Your fuel pump may be worn out and need replacing.

Section 6: CATERPILLAR® ACERT Fuel Recycle Line

For CAT ACERT Engines *For Non ACERT engines, see Section 4B*

CATERPILLAR® ACERT Engines have a "Return Fuel Recycle Line". This fuel line recycles "HOT" fuel, coming directly from the engine head, back to the fuel inlet port of the transfer pump.

For BEST FUEL ECONOMY and MAXIMUM ENGINE EFFICIENCY, the "Return Fuel Recycle Line" must be removed.



6-1. Disconnect the "Return Fuel Recycle Line" from the top of the inlet fitting at the transfer pump.

6-2. Disconnect the "Return Fuel Recycle Line" from the bottom of the Return Line shutoff valve.

6-3. There is a bracket on the "Return Fuel Recycle Line" that secures the line to the block. Remove the bolt holding the bracket. Remove the "Return Fuel Recycle Line" from the engine.

6-4. Disconnect the fuel supply line from the bottom of the inlet fitting at the transfer pump.

6-5. Remove the Transfer Pump inlet fitting.

6-6. Install the #10 M JIC x 1/2" M ORB fitting in the Transfer Pump Inlet Port.

6-7. Reconnect and tighten the fuel supply line removed earlier.

Note: Use the #10 F JIC Swivel x #10 M JIC 90° Elbow, as needed. 

NOTES

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Bulletin No. 206-9-CTUPG40
Revised May 09,2024