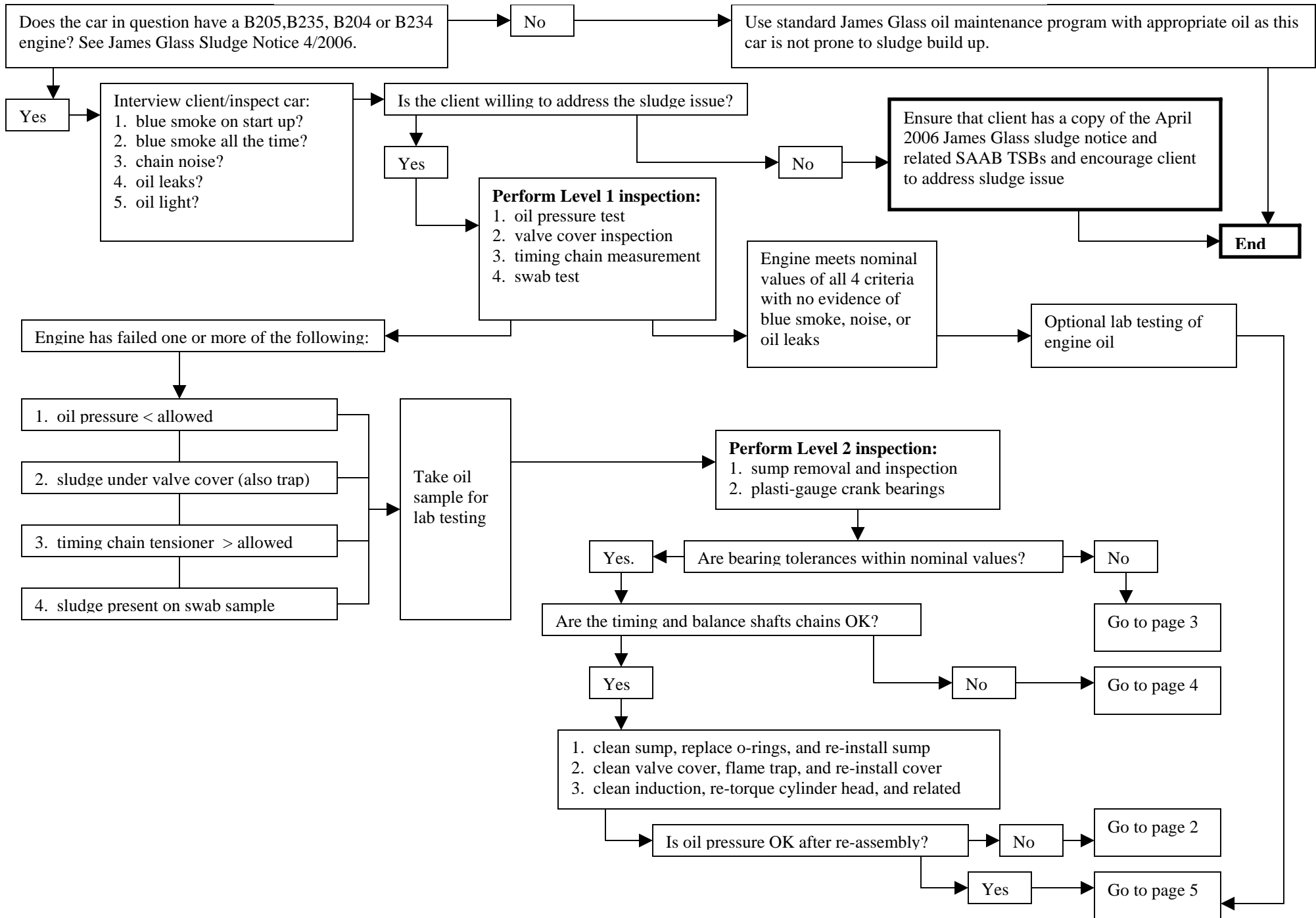


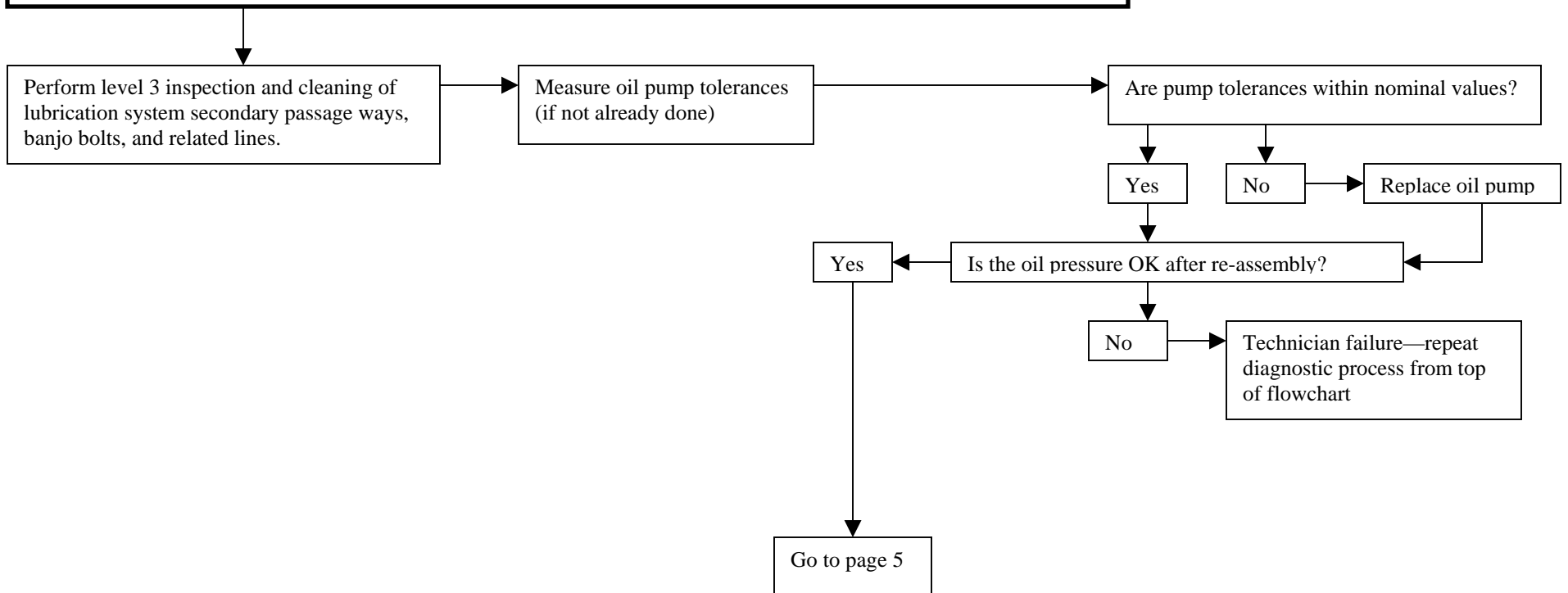
James Glass Engine Sludge Diagnostic and Repair Flowchart (page 1)



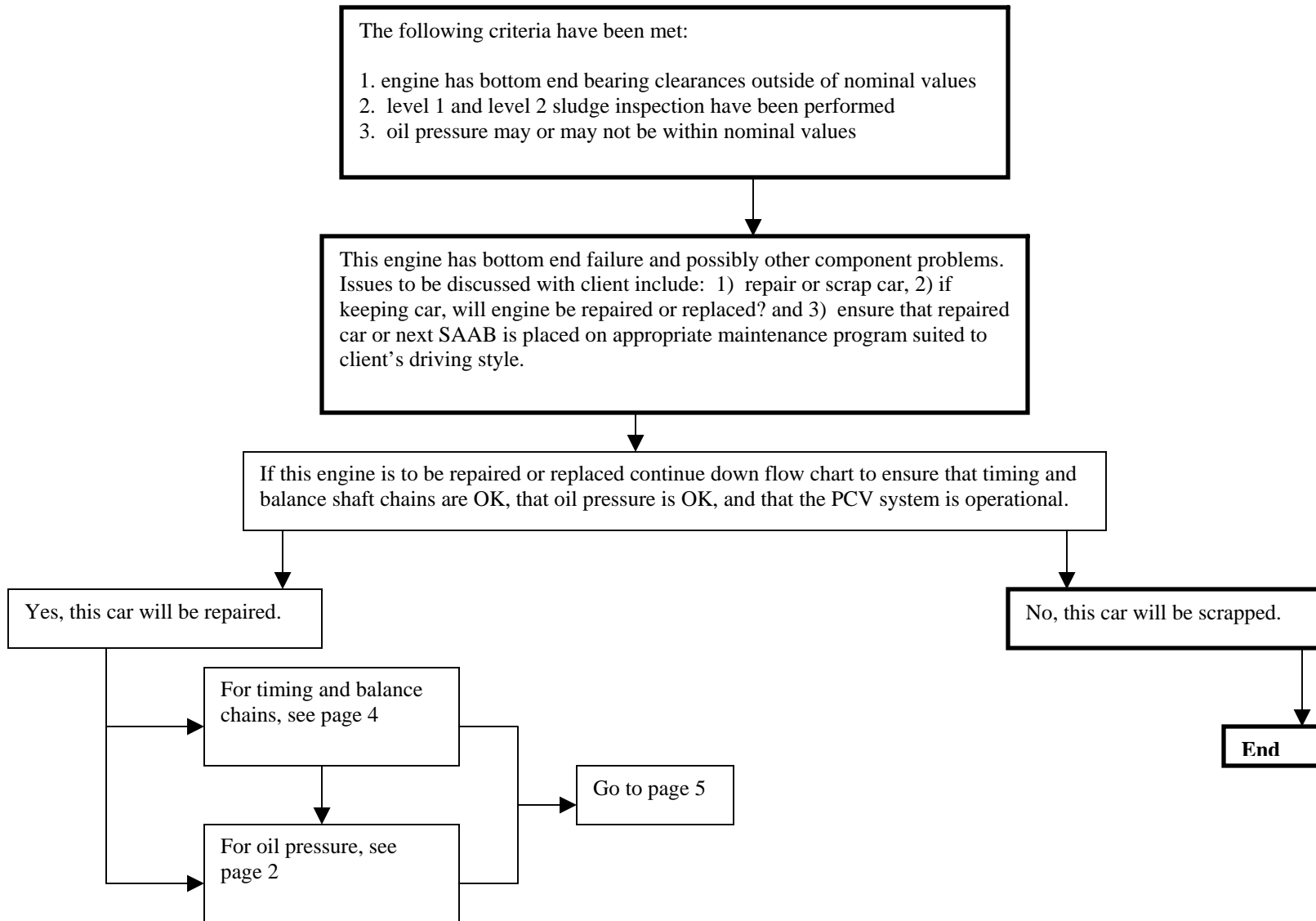
James Glass Engine Sludge Diagnostic and Repair Flowchart (page 2)

The following criteria have been met:

1. engine has low or inconsistent oil pressure even after sump cleaning
2. level 1 and level 2 inspections/cleanings have been performed
3. the timing and balance chains are acceptable or do not present with obvious noise
4. the crank bearings are acceptable due to plasti-gauge measurement or do not present with obvious noise
5. there may or may not be blue smoke after engine cleaning
6. the engine is completely assembled and capable of sustained combustion



James Glass Engine Sludge Diagnostic and Repair Flowchart (page 3)



James Glass Engine Sludge Diagnostic and Repair Flowchart (page 4)

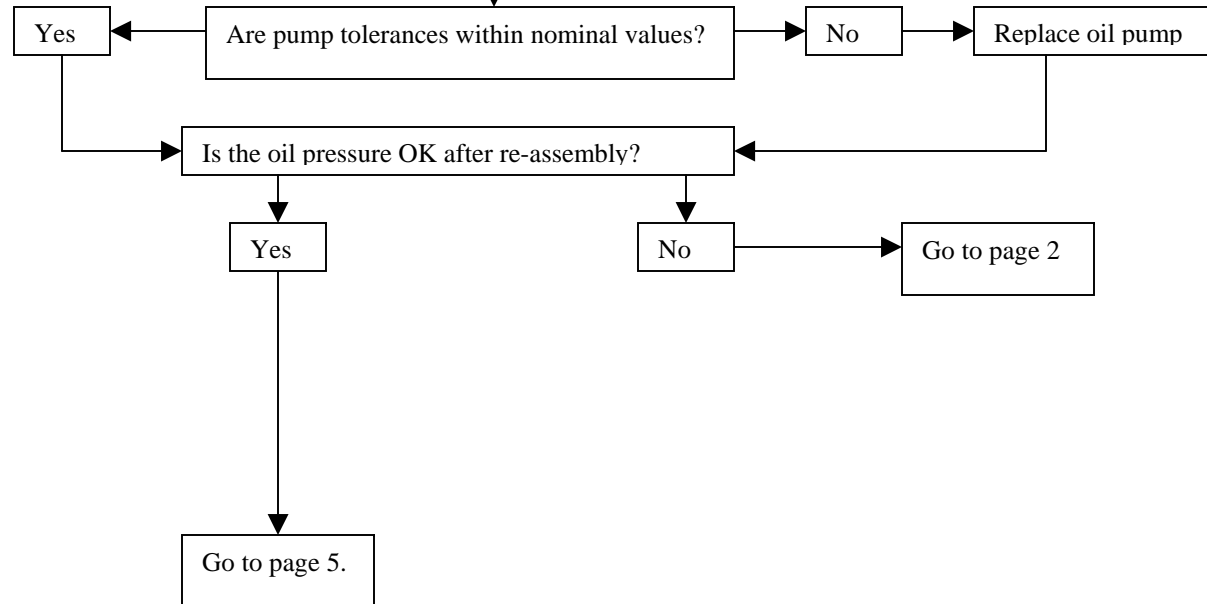
The following criteria have been met:

1. timing chain length > allowed and/or noisy timing or balance
2. chains level 1 and level 2 sludge inspection have been performed
3. the crank bearings are acceptable due to plasti-gauge measurement or do not present with obvious noise
4. oil pressure may or may not be within nominal values

Interview client regarding balance chain system: will the balance chain system be repaired or will the balance chain system be discarded?

Replace timing chain tensioner, chain, seal, and if required also replace worn cam or crank gears

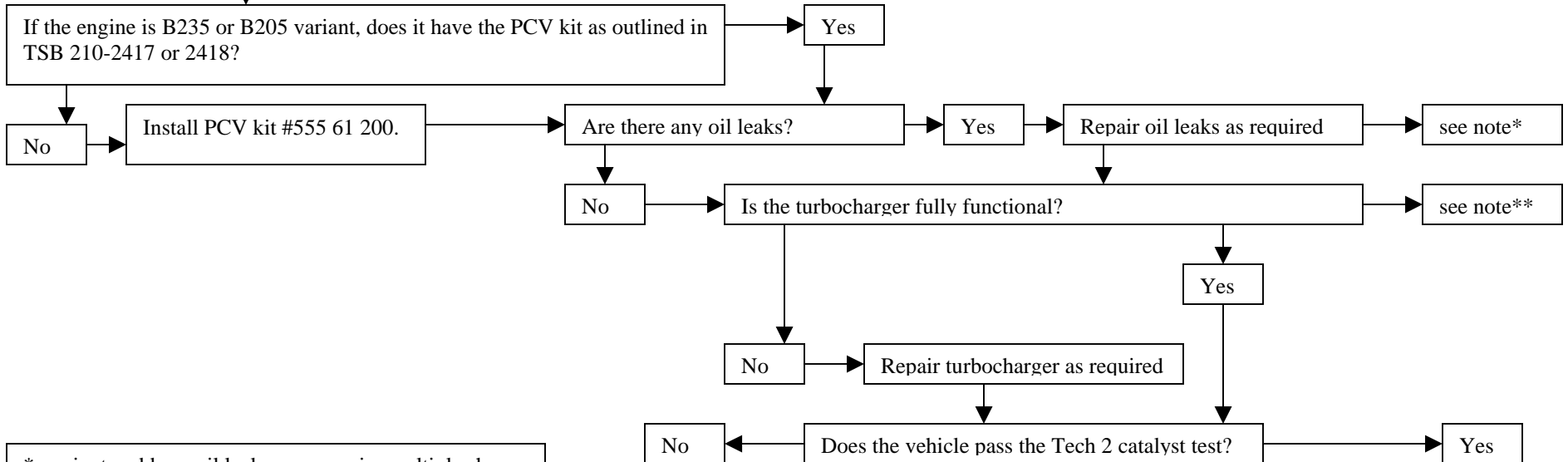
1. clean sump, replace o-rings, and re-install sump
2. clean valve cover, flame trap, and re-install cover
3. clean induction, re-torque cylinder head, and related
4. measure oil pump tolerances while timing cover is removed



James Glass Engine Sludge Diagnostic and Repair Flowchart (page 5)

The following criteria have been met:

1. level 1 and possibly level 2 sludge inspection have been performed
2. the oil pressure is acceptable (oil pump gear to housing may or may not have been measured)
3. the timing and balance chains are acceptable or do not present with obvious noise
4. the crank bearings are acceptable due to plasti-gauge measurement or do not present with obvious noise
5. there is no blue smoke after engine cleaning
6. the engine is completely assembled and capable of sustained combustion



*repairs to address oil leaks may require multiple shop visits after several external pressure washings if engine is excessively covered in oil. Also check oil pressure sensor as it is a common failure component

**blue smoke from exhaust is not automatically an indication of turbocharger failure—the PCV system, valve cover, and flame trap must be clean and operational—also ensure induction system is free of blow by oil caused by over pressurized engine due to clogged PCV

Sludge problem has been addressed and oil is being changed on an interval appropriate to driver's style. Continue with diligent maintenance.

Address issues from quality control check and test drive

Follow up lab work may be required

End