Correlation of

***Modern Automotive Technology,* by Duffy**

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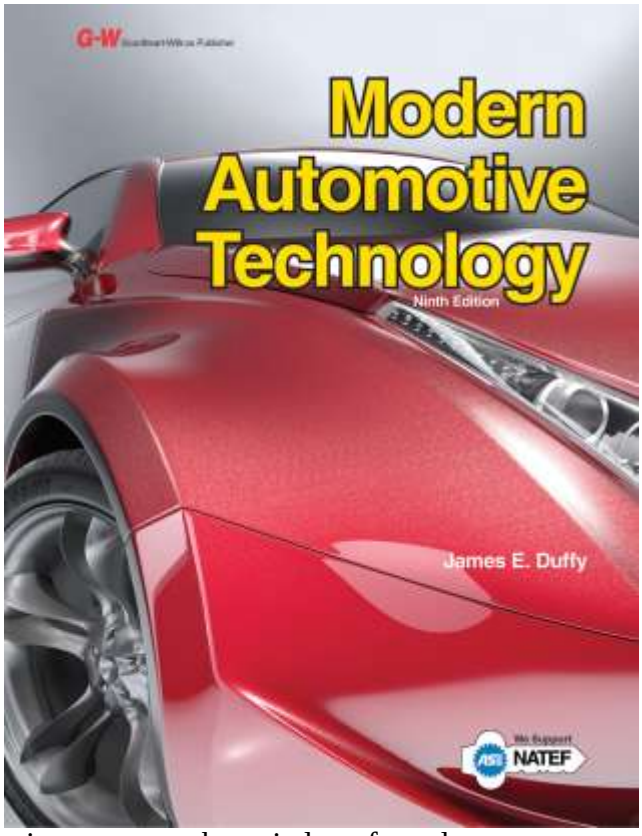
to

NATEF Master Automobile Service Technology (MAST) Task List Correlation Chart

The following chart correlates the *Modern Automotive Technology* textbook (©2017) to the 2017 NATEF Master Automobile Service Technology (MAST) Task List.

The correlation below lists the tasks, priority levels, and the corresponding page numbers from the *Modern Automotive Technology* textbook for the Master Automobile Service Technology Task List.

For more information on NATEF standards, including additional information on the ASE Industry Education Alliance, please visit http://www.asealliance.org/.



ENGINE REPAIR

For every task in Engine Repair, the following safety requirement must be strictly enforced:

- Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task Number and Description	Priority	Page #s
I. ENGINE REPAIR **A. General: Engine Diagnosis; Removal and Reinstallation (R & R)**		
1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.	P-1	114–115

Task Number and Description	Priority	Page #s
2. Research vehicle service information including fluid type, internal engine operation, vehicle service history, service precautions, and technical service bulletins.	P-1	109–114
3. Verify operation of the instrument panel engine warning indicators.	P-1	302–307, 381–390, 399–411, 415–428, 620–623, 1003–1020
4. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine needed action.	P-1	137, 141–146, 150–151, 705–716, 735, 745, 755, 764, 766, 860–865, 873–877, 879, 912–920, 1028, 1289, 1325–1328, 1333
5. Install engine covers using gaskets, seals, and sealers as required.	P-1	128–133, 1179–1182
6. Verify engine mechanical timing.	P-1	190–191, 209–210, 235, 237–238, 822, 906–907, 1176–1179, 1183–1189
7. Perform common fastener and thread repair, to include: remove broken bolt, restore internal and external threads, and repair internal threads with thread insert.	P-1	126–128
8. Inspect, remove, and/or replace engine mounts.	P-2	1050–1051
9. Identify service precautions related to service of the internal combustion engine of a hybrid vehicle.	P-2	82, 454–458
10. Remove and reinstall engine on a newer vehicle equipped with OBD; reconnect all attaching components and restore the vehicle to running condition.	P-3	1062–1070, 1193–1222
I. ENGINE REPAIR **B. Cylinder Head and Valve Train Diagnosis and Repair**		
1. Remove cylinder head; inspect gasket condition; install cylinder head and gasket; tighten according to manufacturer's specification and procedure.	P-1	1073–1074, 1197–1200
2. Clean and visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition.	P-1	1137–1141
3. Inspect pushrods, rocker arms, rocker arm pivots, and shafts for wear, bending cracks, looseness, and blocked oil passages (orifices); determine needed action.	P-2	1040–1042, 1168–1170, 1388–1389

Task Number and Description	Priority	Page #s
4. Adjust valves (mechanical or hydraulic lifters).	P-1	1170
5. Inspect and replace camshaft and drive belt/chain; includes checking drive gear wear and backlash, end play, sprocket and chain wear, overhead cam drive sprocket(s), drive belt(s), belt tension, tensioners, camshaft reluctor ring/tone wheel, and valve timing components; verify correct camshaft timing.	P-1	150, 1039–1040, 1043, 1165–1168
6. Establish camshaft position sensor indexing.	P-1	596
7. Inspect valve springs for squareness and free height comparison; determine needed action.	P-3	1159–1160
8. Replace valve stem seals on an assembled engine; inspect valve; inspect valve spring retainers, locks/keepers, and valve lock/keeper grooves; determine needed action.	P-3	1059–1060, 1165
9. Inspect valve guides for wear; check valve stem-to-guide clearance; determine needed action.	P-3	1143–1145
10. Inspect valves and valve seats; determine needed action.	P-3	1145
11. Check valve spring assembled height and valve stem height; determine needed action.	P-3	1159–1162
12. Inspect valve lifters; determine needed action.	P-2	1170
13. Inspect and/or measure camshaft for runout, journal wear, and lobe wear.	P-3	1165–1166
14. Inspect camshaft bearing surface for wear, damage, out-of-round, and alignment; determine needed action.	P-3	1168
I. ENGINE REPAIR **C. Engine Block Assembly Diagnosis and Repair**		
1. Remove, inspect, and/or replace crankshaft vibration damper (harmonic balancer).	P-1	1050
2. Disassemble engine block; clean and prepare components for inspection and reassembly.	P-1	1071, 1073, 1078–1082
3. Inspect engine block for visible cracks, passage condition, core and gallery plug condition, and surface warpage; determine needed action.	P-2	1043–1044, 1087–1090
4. Inspect and measure cylinder walls/sleeves for damage, wear, and ridges; determine needed action.	P-2	1093–1096, 1101
5. Deglaze and clean cylinder walls.	P-2	1096–1099, 1101–1102
6. Inspect and measure camshaft bearings for wear, damage, out-of-round, and alignment; determine needed action.	P-3	1168

Task Number and Description	Priority	Page #s
7. Inspect crankshaft for straightness, journal damage, keyway damage, thrust flange and sealing surface condition, and visual surface cracks; check oil passage condition; measure end play and journal wear; check crankshaft position sensor reluctor ring (where applicable); determine needed action.	P-1	1050, 1104–1108, 1114, 1116
8. Inspect main and connecting rod bearings for damage and wear; determine needed action.	P-2	1048-1050, 1112
9. Identify piston and bearing wear patterns that indicate connecting rod alignment and main bearing bore problems; determine needed action.	P-3	1045–1047
10. Inspect and measure piston skirts and ring lands; determine needed action.	P-2	1117–1118
11. Determine piston-to-bore clearance.	P-2	1094
12. Inspect, measure, and install piston rings.	P-2	1118, 1124–1126
13. Inspect auxiliary shaft(s) (balance, intermediate, idler, counterbalance, and/or silencer); inspect shaft(s) and support bearings for damage and wear; determine needed action; reinstall and time.	P-2	1132
14. Assemble engine block.	P-1	1193–1221
I. ENGINE REPAIR **D. Lubrication and Cooling System Diagnosis and Repair**		
1. Perform cooling system pressure and dye tests to identify leaks; check coolant condition and level; inspect and test radiator, pressure cap, coolant recovery tank, heater core, and gallery plugs; determine needed action.	P-1	863–865, 875, 884, 888–889
2. Identify causes of engine overheating.	P-1	865–867
3. Inspect, replace, and/or adjust drive belts, tensioners, and pulleys; check pulley and belt alignment.	P-1	1188
4. Inspect and/or test coolant; drain and recover coolant; flush and refill cooling system; use proper fluid type per manufacturer specification; bleed air as required.	P-1	879–882, 884
5. Inspect, remove, and replace water pump.	P-2	867–869
6. Remove and replace radiator.	P-2	876–877
7. Remove, inspect, and replace thermostat and gasket/seal.	P-1	870–873
8. Inspect and test fan(s), fan clutch (electrical or mechanical), fan shroud, and air dams; determine needed action.	P-1	877–879
9. Perform oil pressure tests; determine needed action.	P-1	915–917
10. Perform engine oil and filter change; use proper fluid type per manufacturer specification.	P-1	112, 138–141
11. Inspect auxiliary coolers; determine needed action.	P-3	883–884

Task Number and Description	Priority	Page #s
12. Inspect, test, and replace oil temperature and pressure switches and sensors.	P-2	364–365, 925
13. Inspect oil pump gears or rotors, housing, pressure relief devices, and pump drive; perform needed action.	P-2	898–901

AUTOMATIC TRANSMISSION AND TRANSAXLE.

For every task in Automatic Transmission and Transaxle, the following safety requirement must be strictly enforced:

- Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task Number and Description	Priority	Page #s
II. AUTOMATIC TRANSMISSION AND TRANSAXLE **A. General: Transmission and Transaxle Diagnosis**		
1. Identify and interpret transmission/transaxle concerns, differentiate between engine performance and transmission/transaxle concerns; determine needed action.	P-1	1325–1331, 1427–1428, 1443–1447
2. Research vehicle service information including fluid type, vehicle service history, service precautions, and technical service bulletins.	P-1	109–114, 138
3. Diagnose fluid loss and condition concerns; determine needed action.	P-1	141–142, 1327–1328, 1331–1333
4. Check fluid level in a transmission or a transaxle equipped with a dipstick.	P-1	141–142
5. Check fluid level in a transmission or a transaxle not equipped with a dipstick.	P-1	142
6. Perform pressure tests (including transmission/transaxles equipped with electronic pressure control); determine needed action.	P-1	1329
7. Diagnose noise and vibration concerns; determine needed action.	P-2	1325–1329, 1357–1358, 1427
8. Perform stall test; determine needed action.	P-2	1329
9. Perform lock-up converter system tests; determine needed action.	P-3	—
10. Diagnose transmission/transaxle gear reduction/multiplication concerns using driving, driven, and held member (power flow) principles.	P-1	245, 517, 1267–1268, 1270–1273, 1302, 1307–1309, 1317, 1330–1331, 1412–1416

Task Number and Description	Priority	Page #s
11. Diagnose electronic transmission/transaxle control systems using appropriate test equipment and service information.	P-1	1331, 1335, 1339–1340
12. Diagnose pressure concerns in a transmission using hydraulic principles (Pascal's law).	P-2	1312, 1314
II. AUTOMATIC TRANSMISSION AND TRANSAXLE **B. In-Vehicle Transmission/Transaxle Maintenance and Repair**		
1. Inspect, adjust, and/or replace external manual valve shift linkage, transmission range sensor/switch, and/or park/neutral switch.	P-1	1333–1334
2. Inspect for leakage; replace external seals, gaskets, and bushings.	P-2	129–133, 138, 141–142, 1327–1328, 1331–1333, 1439
3. Inspect, test, adjust, repair, and/or replace electrical/electronic components and circuits including computers, solenoids, sensors, relays, terminals, connectors, switches, and harnesses; demonstrate understanding of the relearn procedure.	P-1	415–428
4. Drain and replace fluid and filter(s); use proper fluid type per manufacturer specification.	P-1	112, 138, 141–142, 1327–1328, 1331–1333
5. Inspect, replace, and align powertrain mounts.	P-2	1290–1295, 1358–1359, 1438
II. AUTOMATIC TRANSMISSION AND TRANSAXLE **C. Off-Vehicle Transmission and Transaxle Repair**		
1. Remove and reinstall transmission/transaxle and torque converter; inspect engine core plugs, rear crankshaft seal, dowel pins, dowel pin holes, and mounting surfaces.	P-2	1215, 1303–1306, 1325–1327, 1329, 1335, 1338–1340
2. Inspect, leak test, flush, and/or replace transmission/transaxle oil cooler, lines, and fittings.	P-1	138, 144, 860–861, 879, 1327–1328, 1331–1333, 1335–1339
3. Inspect converter flex (drive) plate, converter attaching bolts, converter pilot, converter pump drive surfaces, converter end play, and crankshaft pilot bore.	P-2	1304–1305, 1315–1316, 1326, 1335, 1338, 1358, 1439–1440
4. Describe the operational characteristics of a continuously variable transmission (CVT).	P-3	1416
5. Describe the operational characteristics of a hybrid vehicle drive train.	P-3	435–449, 1303
6. Disassemble, clean, and inspect transmission/transaxle.	P-1	1335, 1338

Task Number and Description	Priority	Page #s
7. Inspect, measure, clean, and replace valve body (includes surfaces, bores, springs, valves, switches, solenoids, sleeves, retainers, brackets, check valves/balls, screens, spacers, and gaskets).	P-2	90–99, 1078–1082, 1325–1331, 1335–1339, 1412
8. Inspect servo and accumulator bores, pistons, seals, pins, springs, and retainers; determine needed action.	P-2	1325–1331, 1333, 1335–1339, 1412
9. Assemble transmission/transaxle.	P-1	1293–1294, 1338–1339
10. Inspect, measure, and reseal oil pump assembly and components.	P-2	922–924
11. Measure transmission/transaxle end play and/or preload; determine needed action.	P-1	1370, 1376, 1394, 1396, 1398–1399, 1439
12. Inspect, measure, and/or replace thrust washers and bearings.	P-2	1246–1251, 1254–1255, 1326–1327, 1357–1358, 1362–1364, 1387–1392, 1395–1396, 1398–1399, 1427–1429, 1432–1436, 1439–1440
13. Inspect oil delivery circuits, including seal rings, ring grooves, and sealing surface areas, feed pipes, orifices, and check valves/balls.	P-2	1309–1310, 1314–1316, 1327, 1330–1331, 1346–1347, 1357–1358, 1362, 1432–1433, 1437, 1440
14. Inspect bushings; determine needed action.	P-2	1229–1231, 1254–1255, 1306, 1325–1327, 1345, 1357–1360, 1437
15. Inspect and measure planetary gear assembly components; determine needed action.	P-2	1307–1309, 1325–1327, 1412–1416, 1428, 1446–1447
16. Inspect case bores, passages, bushings, vents, and mating surfaces; determine needed action.	P-2	1302–1303, 1329, 1330–1331, 1333, 1345–1357, 1350–1354, 1357–1360, 1363–1364, 1373, 1390

Task Number and Description	Priority	Page #s
17. Diagnose and inspect transaxle drive, link chains, sprockets, gears, bearings, and bushings; perform needed action.	P-2	1410–1417, 1421–1422, 1427–1437, 1439, 1443–1447
18. Inspect measure, repair, adjust, or replace transaxle final drive components.	P-2	1412–1417
19. Inspect clutch drum, piston, check-balls, springs, retainers, seals, friction plates, pressure plates, and bands; determine needed action.	P-2	1309–1310, 1312, 1333
20. Measure clutch pack clearance; determine needed action.	P-1	1375, 1390, 1397–1399
21. Air test operation of clutch and servo assemblies.	P-1	1330–1331
22. Inspect one-way clutches, races, rollers, sprags, springs, cages, retainers; determine needed action.	P-2	1305, 1325–1327, 1329, 1358, 1412, 1415–1416, 1439–1440

MANUAL DRIVE TRAIN AND AXLES

For every task in Manual Drive Train and Axles, the following safety requirement must be strictly enforced:

- Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task Number and Description	Priority	Page #s
III. MANUAL DRIVE TRAIN AND AXLES **A. General: Drive Train Diagnosis**		
1. Identify and interpret drive train concerns; determine needed action.	P-1	1287–1289, 1298–1300, 1405–1406
2. Research vehicle service information including fluid type, vehicle service history, service precautions, and technical service bulletins.	P-1	109–114, 1289, 1293, 1394
3. Check fluid condition; check for leaks; determine needed action.	P-1	143–144
4. Drain and refill manual transmission/transaxle and final drive unit; use proper fluid type per manufacturer specification.	P-1	112, 1269, 1430
III. MANUAL DRIVE TRAIN AND AXLES **B. Clutch Diagnosis and Repair**		
1. Diagnose clutch noise binding, slippage, pulsation, and chatter; determine needed action.	P-1	1245–1251

Task Number and Description	Priority	Page #s
2. Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; perform needed action.	P-1	1246–1256, 1289
3. Inspect and/or replace clutch pressure plate assembly, clutch disc, release (throw-out) bearing, linkage, and pilot bearing/bushing (as applicable).	P-1	1253–1257
4. Bleed clutch hydraulic system.	P-1	1256
5. Check and adjust clutch master cylinder fluid level; check for leaks; use proper fluid type per manufacturer specification.	P-1	145–146
6. Inspect flywheel and ring gear for wear, cracks, and discoloration; determine needed action.	P-1	1250, 1254
7. Measure flywheel runout and crankshaft end play; determine needed action.	P-2	1050, 1114, 1116, 1255
8. Describe the operation and service of a system that uses a dual mass flywheel.	P-3	—
III. MANUAL DRIVE TRAIN AND AXLES **C. Transmission/Transaxle Diagnosis and Repair**		
1. Inspect, adjust, lubricate, and/or replace shift linkages, brackets, bushings, cables, pivots, and levers.	P-2	1229–1237, 1248, 1250–1255, 1257, 1289, 1294–1295, 1430–1431, 1438
2. Describe the operational characteristics of an electronically controlled manual transmission/transaxle.	P-2	1280, 1282
3. Diagnose noise concerns through the application of transmission/transaxle powerflow principles.	P-2	1277–1281
4. Diagnose hard shifting and jumping out of gear concerns; determine needed action.	P-2	1289
5. Diagnose transaxle final drive assembly noise and vibration concerns; determine needed action.	P-3	1298–1300, 1412–1417, 1428
6. Disassemble, inspect, clean, and reassemble internal transmission/transaxle components.	P-2	1290–1294
III. MANUAL DRIVE TRAINS AND AXLES **D. Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair (Front, Rear, All-Wheel, and Four-Wheel Drive)**		
1. Diagnose constant-velocity (CV) joint noise and vibration concerns; determine needed action.	P-1	1347
2. Diagnose universal joint noise and vibration concerns; perform needed action.	P-2	1360–1361

Task Number and Description	Priority	Page #s
3. Inspect, remove, and/or replace bearings, hubs, and seals.	P-1	1254–1255, 1292–1295, 1382, 1389, 1392
4. Inspect, service, and/or replace shafts, yokes, boots, and universal/CV joints.	P-1	1360–1362
5. Check shaft balance and phasing; measure shaft runout; measure and adjust driveline angles.	P-2	1359
III. MANUAL DRIVE TRAIN AND AXLES **E. Drive Axle Diagnosis and Repair** **E.1 Ring and pinion Gears and Differential Case Assembly**		
1. Clean and inspect differential case; check for leaks; inspect housing vent.	P-1	1390
2. Check and adjust differential case fluid level; use proper fluid type per manufacturer specification.	P-1	112, 143–144, 1390
3. Drain and refill differential case; use proper fluid type per manufacturer specification.	P-1	112, 144, 1390
4. Diagnose noise and vibration concerns; determine needed action.	P-2	1390
5. Inspect and replace companion flange and/or pinion seal; measure companion flange runout.	P-2	1357–1358, 1395–1396
6. Inspect ring gear and measure runout; determine needed action.	P-3	1398–1399
7. Remove, inspect, and/or reinstall drive pinion and ring gear, spacers, sleeves, and bearings.	P-3	1395–1396
8. Measure and adjust drive pinion depth.	P-3	1398
9. Measure and adjust drive pinion bearing preload.	P-3	1398
10. Measure and adjust side bearing preload and ring and pinion gear total backlash and backlash variation on a differential carrier assembly (threaded cup or shim types).	P-3	1398
11. Check ring and pinion tooth contact patterns; perform needed action.	P-3	1388–1389
12. Disassemble, inspect, measure, adjust, and/or replace differential pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case.	P-3	1395–1396
13. Reassemble and reinstall differential case assembly; measure runout; determine needed action.	P-3	1395–1396
E.2 Limited Slip Differential		
1. Diagnose noise, slippage, and chatter concerns; determine needed action.	P-3	1396–1397, 1429
2. Measure rotating torque; determine needed action.	P-3	1397

Task Number and Description	Priority	Page #s
E.3 Drive Axles		
1. Inspect and replace drive axle wheel studs.	P-1	1392, 1394
2. Remove and replace drive axle shafts.	P-1	1390–1391, 1394
3. Inspect and replace drive axle shaft seals, bearing, and retainers.	P-2	1391–1392
4. Measure drive axle flange runout and shaft end play; determine needed action.	P-2	1394
5. Diagnose drive axle shafts, bearings, and seals for noise, vibration, and fluid leakage concerns; determine needed action.	P-2	1387–1390
III. MANUAL DRIVE TRAIN AND AXLES **F. Four-Wheel Drive/All-Wheel Drive Component Diagnosis and Repair**		
1. Inspect, adjust, and repair shifting controls (mechanical, electrical, and vacuum), bushing mounts, levers, and brackets.	P-3	1353–1354, 1363–1364, 1394–1400
2. Inspect locking hub; determine needed action.	P-3	1379, 1387–1394
3. Check for leaks at drive assembly and transfer case seals; check vents; check fluid level; use proper fluid type per manufacturer specification.	P-3	112, 143, 147, 1360
4. Identify concerns related to variations in the circumference and/or final drive ratios.	P-2	1455, 1479
5. Diagnose noise, vibration, and unusual steering concerns; determine needed action.	P-3	1470, 1561–1563
6. Diagnose, test, adjust, and/or replace electrical/electronic components of four-wheel drive/all-wheel drive systems.	P-2	1379, 1381–1382, 1555–1556
7. Disassemble, service, and reassemble transfer case and components.	P-2	1363–1364

SUSPENSION AND STEERING

For every task in Suspension and Steering, the following safety requirement must be strictly enforced:

- Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task Number and Description	Priority	Page #s
IV. SUSPENSION AND STEERING **A. General: Suspension and Steering Systems**		
1. Research vehicle service information including fluid type, vehicle service history, service precautions, and technical service bulletins.	P-1	109–114, 1568, 1747

Task Number and Description	Priority	Page #s
2. Identify and interpret suspension and steering concerns; determine needed action.	P-1	150, 1513–1514, 1561–1563, 1574, 1577–1580
IV. SUSPENSION AND STEERING **B. Steering Systems Diagnosis and Repair**		
1. Disable and enable supplemental restraint system (SRS); verify indicator lamp operation.	P-1	605, 620, 1747–1748
2. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil (clock spring).	P-1	1565
3. Diagnose steering column noises, looseness, and binding concerns (including tilt/telescoping mechanisms); determine needed action.	P-2	150, 151, 1562–1563
4. Diagnose power steering gear (non-rack-and-pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine needed action.	P-2	1561–1562
5. Diagnose power steering gear (rack-and-pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine needed action.	P-2	1562–1563, 1567
6. Inspect steering shaft universal joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; determine needed action.	P-2	1539, 1544
7. Remove and replace rack-and-pinion steering gear; inspect mounting bushings and brackets.	P-2	1568
8. Inspect rack-and-pinion steering gear inner tie rod ends (sockets) and bellows boots; replace as needed.	P-1	1566
9. Inspect power steering fluid level and condition.	P-1	144, 1563
10. Flush, fill, and bleed power steering system; use proper fluid type per manufacturer specification.	P-2	112, 1571
11. Inspect for power steering fluid leakage; determine needed action.	P-1	1563
12. Remove, inspect, replace, and/or adjust power steering pump drive belt.	P-1	1564
13. Remove and reinstall power steering pump.	P-2	1571
14. Remove and reinstall press fit power steering pump pulley; check pulley and belt alignment.	P-2	1568–1569
15. Inspect, remove, and/or replace power steering hoses and fittings.	P-2	1542–1543
16. Inspect, remove, and/or replace Pitman arm, relay (centerlink/intermediate) rod, idler arm, mountings, and steering linkage damper.	P-2	1542

Task Number and Description	Priority	Page #s
17. Inspect, replace, and/or adjust tie rod ends (sockets), tie rod sleeves, and clamps.	P-1	1566
18. Inspect, test, and diagnose electrically-assisted power steering systems (including using a scan tool); determine needed action.	P-2	404–406, 1527
19. Identify hybrid vehicle power steering system electrical circuits and safety precautions.	P-2	454–458, 1545, 1552–1554, 1555–1556, 1574
20. Test power steering system pressure; determine needed action.	P-2	1545–1548, 1562–1563, 1568–1571
IV. SUSPENSION AND STEERING **C. Suspension Systems Diagnosis and Repair**		
1. Diagnose short and long arm suspension system noises, body sway, and uneven ride height concerns; determine needed action.	P-1	1513–1514, 1536
2. Diagnose strut suspension system noises, body sway, and uneven ride height concerns; determine needed action.	P-1	1513–1514, 1516–1519, 1523
3. Inspect, remove, and/or replace upper and lower control arms, bushings, shafts, and rebound bumpers.	P-3	1522–1524
4. Inspect, remove, and/or replace strut rods and bushings.	P-3	1525
5. Inspect, remove, and/or replace upper and/or lower ball joints (with or without wear indicators).	P-3	1519–1521
6. Inspect, remove, and/or replace steering knuckle assemblies.	P-3	1492
7. Inspect, remove, and/or replace short and long arm suspension system coil springs and spring insulators.	P-3	1517–1518
8. Inspect, remove, and/or replace torsion bars and mounts.	P-3	1519–1520
9. Inspect, remove, and/or replace front/rear stabilizer bar (sway bar) bushings, brackets, and links.	P-3	1499
10. Inspect, remove, and/or replace strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount.	P-3	1517
11. Inspect, remove, and/or replace track bar, strut rods/radius arms, and related mounts and bushings.	P-3	1522–1524
12. Inspect rear suspension system leaf spring(s), spring insulators (silencers), shackles, brackets, bushings, center pins/bolts, and mounts.	P-1	1518
IV. SUSPENSION AND STEERING **D. Related Suspension and Steering Service.**		
1. Inspect, remove, and/or replace shock absorbers; inspect mounts and bushings.	P-1	1514–1516
2. Remove, inspect, service, and/or replace front and rear wheel bearings.	P-1	1480–1484

Task Number and Description	Priority	Page #s
3. Describe the function of suspension and steering control system and components, (i.e., active suspension and stability control).	P-3	1506–1509, 1653–1654, 1660–1662
IV. SUSPENSION AND STEERING **E. Wheel Alignment Diagnosis, Adjustment, and Repair**		
1. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine needed action.	P-1	1581-1589
2. Perform prealignment inspection; measure vehicle ride height; determine needed action.	P-1	1585–1589
3. Prepare vehicle for wheel alignment on alignment machine; perform four-wheel alignment by checking and adjusting front and rear wheel caster, camber, and toe as required; center steering wheel.	P-1	1589–1595
4. Check toe-out-on-turns (turning radius); determine needed action.	P-2	1592
5. Check steering axis inclination (SAI) and included angle; determine needed action.	P-2	1585
6. Check rear wheel thrust angle; determine needed action.	P-1	1591
7. Check for front wheel setback; determine needed action.	P-2	1588
8. Check front and/or rear cradle (subframe) alignment; determine needed action.	P-2	1588–1589
9. Reset steering angle sensor.	P-2	1574, 1661
IV. SUSPENSION AND STEERING **F. Wheels and Tire Diagnosis and Repair**		
1. Inspect tire condition; identify tire wear patterns; check for correct tire size, application (load and speed ratings), and air pressure as listed on the tire information placard/label.	P-1	148–150, 1451–1453, 1467–1470, 1472
2. Diagnose wheel/tire vibration, shimmy, and noise; determine needed action.	P-2	151, 1470–1471, 1474, 1513
3. Rotate tires according to manufacturer's recommendation, including vehicles equipped with tire pressure monitoring systems (TPMS).	P-1	1455, 1472, 1479–1480
4. Measure wheel, tire, axle flange, and hub runout; determine needed action.	P-2	1474
5. Diagnose tire pull problems; determine needed action.	P-1	1470
6. Dismount, inspect, and remount tire on wheel; balance wheel and tire assembly.	P-1	1474–1478
7. Dismount, inspect, and remount tire on wheel equipped with tire pressure monitoring system sensor.	P-1	1479

Task Number and Description	Priority	Page #s
8. Inspect tire and wheel assembly for air loss; perform needed action.	P-1	1478
9. Repair tire following vehicle manufacturer approved procedure.	P-1	1478
10. Identify indirect and direct tire pressure monitoring system (TPMS); calibrate system; verify operation of instrument panel lamps.	P-1	1479–1480
11. Demonstrate knowledge of steps required to remove and replace sensors in a tire pressure monitoring system (TPMS), including relearn procedure.	P-1	1479–1480

BRAKES

For every task in Brakes, the following safety requirement must be strictly enforced:

- Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task Number and Description	Priority	Page #s
V. BRAKES **A. General: Brake System Diagnosis**		
1. Identify and interpret brake system concerns; determine needed action.	P-1	1625–1630
2. Research vehicle service information, including fluid type, vehicle service history, service precautions, and technical service bulletins.	P-1	109–114
3. Describe procedure for performing road test to check brake system operation including an anti-lock brake system (ABS).	P-1	1625, 1669
4. Install wheel and torque lug nuts.	P-1	1473
V. BRAKES **B. Drum Brake Diagnosis and Repair**		
1. Diagnose pressure concerns in the brake system using hydraulic principles (Pascal's law).	P-1	1603–1604
2. Measure brake pedal height, travel, and free play (as applicable); determine needed action.	P-1	1628
3. Check master cylinder for internal/external leaks and proper operation; determine needed action.	P-1	1627, 1631
4. Remove, bench bleed, and reinstall master cylinder.	P-1	1631–1638
5. Diagnose poor stopping, pulling, or dragging concerns caused by malfunctions in the hydraulic system; determine needed action.	P-1	1625–1628

Task Number and Description	Priority	Page #s
6. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, wear, and loose fittings/supports; determine needed action.	P-1	1628–1630
7. Replace brake lines, hoses, fittings, and supports.	P-2	1634
8. Fabricate brake lines using proper material and flaring procedures (double flare and ISO types).	P-2	1634
9. Select, handle, store, and fill brake fluids to proper level; use proper fluid type per manufacturer specification.	P-1	112, 1628–1629
10. Inspect, test, and/or replace components of brake warning light system.	P-3	603–605, 612–613, 1627
11. Identify components of hydraulic brake warning light system.	P-2	603–605, 612–613, 1627
12. Bleed and/or flush brake system.	P-1	1631–1634
13. Test brake fluid for contamination.	P-1	145, 1628–1629
V. BRAKES **C. Drum Brake Diagnosis and Repair**		
1. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pedal pulsation concerns; determine needed action.	P-1	1625–1628
2. Remove, clean, and inspect brake drum; measure brake drum diameter; determine serviceability.	P-1	1643
3. Refinish brake drum and measure final drum diameter; compare with specification.	P-1	1643–1645
4. Remove, clean, inspect, and/or replace brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.	P-1	1645–1648
5. Inspect wheel cylinders for leaks and proper operation; remove and replace as needed.	P-2	1643
6. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; perform final checks and adjustments.	P-1	1648–1649
V. BRAKES **D. Disc Brake Diagnosis and Repair**		
1. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pulsation concerns; determine needed action.	P-1	1625–1630
2. Remove and clean caliper assembly; inspect for leaks, damage, and wear; determine needed action.	P-1	1637–1638
3. Inspect caliper mounting and slides/pins for proper operation, wear, and damage; determine needed action.	P-1	—
4. Remove, inspect, and/or replace brake pads and retaining hardware; determine needed action.	P-1	1629, 1634, 1636

Task Number and Description	Priority	Page #s
5. Lubricate and reinstall caliper, brake pads, and related hardware; seat brake pads; inspect for leaks.	P-1	1637–1638
6. Clean and inspect rotor and mounting surface; measure rotor thickness, thickness variation, and lateral runout; determine needed action.	P-1	1638–1642
7. Remove and reinstall/replace rotor.	P-1	1641–1642
8. Refinish rotor on vehicle; measure final rotor thickness and compare with specification.	P-1	1640–1641
9. Refinish rotor off vehicle; measure final rotor thickness and compare with specification.	P-1	1639–1640
10. Retract and readjust caliper piston on an integrated parking brake system.	P-2	1637–1638
11. Check brake pad wear indicator; determine needed action.	P-1	1627–1628
12. Describe the importance of operating vehicle to burnish/break-in replacement brake pads according to manufacturer's recommendations.	P-1	1636
V. BRAKES **E. Power-Assist Units Diagnosis and Repair**		
1. Check brake pedal travel with, and without, engine running to verify proper power booster operation.	P-2	1628
2. Identify components of the brake power assist system (vacuum and hydraulic); check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.	P-1	1607–1608, 1630
3. Inspect vacuum-type power booster unit for leaks; inspect the check-valve for proper operation; determine needed action.	P-1	1630
4. Inspect and test hydraulically assisted power brake system for leaks and proper operation; determine needed action.	P-3	1630
5. Measure and adjust master cylinder pushrod length.	P-3	1631
V. BRAKES **F. Related Systems (i.e., Wheel Bearings, Parking Brakes, Electrical) Diagnosis and Repair**		
1. Diagnose wheel bearing noises, wheel shimmy, and vibration concerns; determine needed action.	P-1	1470–1471, 1480
2. Remove, clean, inspect, repack, and install wheel bearings; replace seals; install hub and adjust bearings.	P-2	1480, 1482–1483
3. Check parking brake system and components for wear, binding, and corrosion; clean, lubricate, adjust, and/or replace as needed.	P-1	1629, 1649
4. Check parking brake operation and parking brake indicator light system operation; determine needed action.	P-1	1629, 1649
5. Check operation of brake stop light system.	P-1	1480–1483
6. Replace wheel bearing and race.	P-3	1484

Task Number and Description	Priority	Page #s
7. Remove, reinstall, and/or replace sealed wheel bearing assembly.	P-1	1484
8. Inspect and replace wheel studs.	P-1	1392, 1394
V. BRAKES **G. Electronic Brake Control Systems: Anti-lock Brake (ABS), Traction Control (TCS), and Electronic Stability Control (ESC) System Diagnosis and Repair**		
1. Identify and inspect electronic brake control system components (ABS, TCS, ESC); determine needed action.	P-1	1653–1663
2. Describe the operation of regenerative braking system.	P-3	24, 442, 1666–1667
3. Diagnose poor stopping, wheel lock-up, abnormal pedal feel, unwanted application, and noise concerns associated with the electronic brake control system; determine needed action.	P-2	1667–1668
4. Diagnose electronic brake control system electronic control(s) and components by retrieving diagnostic trouble codes, and/or using recommended test equipment; determine needed action.	P-2	1663
5. Depressurize high-pressure components of an electronic brake control system.	P-2	1662
6. Bleed the electronic brake control system hydraulic circuits.	P-1	1667
7. Test, diagnose, and service electronic brake control system speed sensors (digital and analog), toothed ring (tone wheel), and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO) (includes output signal, resistance, shorts to voltage/ground, and frequency data).	P-2	1663, 1665
8. Diagnose electronic brake control system braking concerns caused by vehicle modifications (tire size, curb height, final drive ration, etc.).	P-1	1662

ELECTRICAL/ELECTRONIC SYSTEMS

For every task in Electrical/Electronic Systems, the following safety requirement must be strictly enforced:

- Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task Number and Description	Priority	Page #s
VI. ELECTRICAL/ELECTRONIC SYSTEMS **A. General: Electrical System Diagnosis**		
1. Research the vehicle service information, including vehicle service history, service precautions, and technical service bulletins.	P-1	109–114

Task Number and Description	Priority	Page #s
2. Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's law).	P-1	266–268
3. Demonstrate proper use of a digital multimeter (DMM) when measuring source voltage, voltage drop (including grounds), current flow and resistance.	P-1	305, 355–362
4. Demonstrate knowledge of the causes and effects from shorts, grounds, opens, and resistance problems in electrical/electronic circuits.	P-1	349–352, 416–417
5. Demonstrate proper use of a test light on an electrical circuit.	P-1	353–354
6. Use fused jumper wires to check operation of electrical circuits.	P-1	352–353
7. Use wiring diagrams during the diagnosis (troubleshooting) of electrical/electronic circuit problems.	P-1	327–342, 1716–1718
8. Diagnose the cause(s) of excessive key-off battery drain (parasitic draw); determine needed action.	P-1	494
9. Inspect and test fusible links, circuit breakers, and fuses; determine needed action.	P-1	283–284, 326–327, 365
10. Inspect, test, repair, and/or replace components, connectors, terminals, harnesses, and wiring in electrical/electronic systems (including solder repairs); determine needed action.	P-1	317–327, 334, 419–424
11. Check electrical/electronic circuit waveforms; interpret readings and determine needed repairs.	P-2	306, 379–380, 749–753, 1008–1018
12. Repair data bus wiring harness.	P-1	317–327, 334, 392–394, 626
VI. ELECTRICAL/ELECTRONIC SYSTEMS **B. Battery Diagnosis and Service**		
1. Perform battery state-of-charge test; determine needed action.	P-1	492
2. Confirm proper battery capacity for vehicle application; perform battery capacity and load test; determine needed action.	P-1	497–498
3. Maintain or restore electronic memory functions.	P-1	425
4. Inspect and clean battery; fill battery cells; check battery cables, connectors, clamps, and hold-downs.	P-1	499, 527–528
5. Perform slow/fast battery charge according to manufacturer's recommendations.	P-1	494
6. Jump-start vehicle using jumper cables and a booster battery or an auxiliary power supply.	P-1	496–497
7. Identify safety precautions for high-voltage systems on electric, hybrid, hybrid-electric, and diesel vehicles.	P-2	355, 438, 454–458, 499–506

Task Number and Description	Priority	Page #s
8. Identify electrical/electronic modules, security systems, radios, and other accessories that require reinitialization or code entry after reconnecting vehicle battery.	P-1	410, 411, 992, 1748
9. Identify hybrid vehicle auxiliary (12v) battery service, repair, and test procedures.	P-2	478, 500
VI. ELECTRICAL/ELECTRONIC SYSTEMS **C. Starting System Diagnosis and Repair**		
1. Perform starter current draw tests; determine needed action.	P-1	525–526
2. Perform starter circuit voltage drop tests; determine needed action.	P-1	526–527
3. Inspect and test starter relays and solenoids; determine needed action.	P-2	528–529
4. Remove and install starter in a vehicle.	P-1	530, 532
5. Inspect test switches, connectors, and wires of starter control circuits; determine needed action.	P-2	529–530
6. Differentiate between electrical and engine mechanical problems that cause a slow-crank or no-crank condition.	P-2	524
7. Demonstrate knowledge of an automatic idle-stop/start-stop system.	P-2	438–439
VI. ELECTRICAL/ELECTRONIC SYSTEMS **D. Charging System Diagnosis and Repair**		
1. Perform charging system output test; determine needed action.	P-1	553–558
2. Diagnose (troubleshoot) charging system for causes of undercharge, no-charge, or overcharge conditions.	P-1	563–564
3. Inspect, adjust, and/or replace generator (alternator) drive belts; check pulleys and tensioners for wear; check pulley and belt alignment.	P-1	552–553, 558–559
4. Remove, inspect, and/or replace generator (alternator).	P-1	558–559
5. Perform charging circuit voltage drop tests; determine needed action.	P-1	526–527
VI. ELECTRICAL/ELECTRONIC SYSTEMS **E. Lighting Systems Diagnosis and Repair**		
1. Diagnose (troubleshoot) the causes of brighter-than-normal, intermittent, dim, or no light operation; determine needed action.	P-1	635
2. Inspect interior and exterior lamps and sockets, including headlights and auxiliary lights (fog lights/driving lights); replace as needed.	P-1	613–616
3. Aim headlights.	P-2	616–617
4. Identify system voltage and safety precautions associated with high-intensity discharge headlights.	P-2	607, 615

Task Number and Description	Priority	Page #s
VI. ELECTRICAL/ELECTRONIC SYSTEMS **F. Instrument Cluster and Driver Information Systems Diagnosis and Repair**		
1. Inspect and test gauges and gauge sending units for causes of abnormal readings; determine needed action.	P-2	622–623, 883, 925
2. Diagnose and troubleshoot the causes of incorrect operation of warning devices and other driver information systems; determine needed action.	P-2	925
3. Reset maintenance indicators as required.	P-2	400–401, 410, 620
VI. ELECTRICAL/ELECTRONIC SYSTEMS **G. Body Electrical System Diagnosis and Repair**		
1. Diagnose operation of comfort and convenience accessories and related circuits (such as: power window, power seats, pedal height, power locks, truck locks, remote start, moon roof, sun roof, sun shade, remote keyless entry, voice activation, steering wheel controls, back-up camera, park assist, cruise control, and auto dimming headlamps); determine needed repairs.	P-2	608, 644–655, 665–666, 669–671
2. Diagnose operation of security/anti-theft systems and related circuits (such as: theft deterrent, door locks, remote keyless entry, remote start, and starter/fuel disable); determine needed repairs.	P-2	663–668, 672–674
3. Diagnose the operation of entertainment and related circuits (such as: radio, DVD, remote CD changer, navigation, amplifiers, speakers, antennas, and voice-activated accessories); determine needed repairs.	P-3	637–644
4. Diagnose operation of safety systems and related circuits (such as: horn, airbags, seat belt pretensioners, occupancy classification, wipers, washers, speed control/collision avoidance, heads-up display, park assist, and back-up camera); determine needed action.	P-1	627–632, 669–671, 1726–1736, 1741–1748
5. Diagnose body electronic systems circuits using a scan tool; check for module communication errors (data communication bus systems); determine needed action.	P-2	400–410
6. Describe the process for software transfer, software updates, or reprogramming of electronic modules.	P-2	424–428

HEATING AND AIR CONDITIONING

For every task in Heating and Air Conditioning, the following safety requirement must be strictly enforced:

- Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task Number and Description	Priority	Page #s
VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) **A. General: A/C System Diagnosis and Repair**		
1. Identify and interpret heating and air conditioning problems; determine needed action.	P-1	1697, 1722–1723
2. Research vehicle service information, including refrigerant/oil type, vehicle service history, service precautions, and technical service bulletins.	P-1	109–114
3. Performance test A/C system; identify problems.	P-1	1702–1706
4. Identify abnormal operating noises in the A/C system; determine needed action.	P-2	1709
5. Identify refrigerant type; select and connect proper gauge set/test equipment; record temperature and pressure readings.	P-1	1699, 1701–1706
6. Leak test A/C system; determine needed action.	P-1	1706–1707
7. Inspect condition of refrigerant oil removed from A/C system; determine needed action.	P-2	—
8. Determine recommended oil and oil capacity for system application.	P-1	1714
9. Using a scan tool, observe and record related HVAC data and trouble codes.	P-3	860–861, 1697–1698
VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) **B. Refrigeration System Component Diagnosis and Repair**		
1. Inspect, remove, and/or replace A/C compressor drive belts, pulleys, tensioners, and visually inspect A/C components for signs of leaks; determine needed action.	P-1	1709–1710
2. Inspect, test, service, and/or replace A/C compressor clutch components and/or assembly; check compressor clutch air gap; adjust as needed.	P-2	1709–1710
3. Remove, inspect, reinstall, and/or replace A/C compressor and mountings; determine recommended oil type and quantity.	P-2	1710
4. Identify hybrid vehicle A/C system electrical circuits and service safety precautions.	P-2	462
5. Determine need for an additional A/C system filter; perform needed action.	P-3	—
6. Remove and inspect A/C system mufflers, hoses, lines, fittings, O-rings, seals, and service valves; perform needed action.	P-2	1701–1702

Task Number and Description	Priority	Page #s
7. Inspect for proper A/C condenser airflow; determine needed action.	P-1	1710
8. Remove, inspect, and replace receiver/drier or accumulator/drier; determine recommended oil type and quantity.	P-2	1710
9. Remove, inspect, and install expansion valve or orifice (expansion) tube.	P-1	1710
10. Inspect evaporator housing water drain; perform needed action.	P-1	1708
11. Diagnose A/C system conditions that cause the protection devices (pressure, thermal, and/or control module) to interrupt system operation; determine needed action.	P-2	1710
12. Determine procedure to remove and reinstall evaporator; determine required oil type and quantity.	P-2	1708
13. Remove, inspect, reinstall, and/or replace condenser; determine required oil type and quantity.	P-2	1710, 1714
VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) **C. Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair**		
1. Inspect engine cooling and heater systems hoses and pipes; perform needed action.	P-1	1710, 1714
2. Inspect and test heater control valve(s); perform needed action.	P-2	1714
3. Diagnose temperature control problems in the HVAC system; determine needed action.	P-2	1714
4. Determine procedure to remove, inspect, reinstall, and/or replace heater core.	P-2	1687, 1715
VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) **D. Operating Systems and Related Controls Diagnosis and Repair**		
1. Inspect and test HVAC system blower motors, resistors, switches, relays, wiring, and protection devices; determine needed action.	P-1	1714–1717
2. Diagnose A/C compressor clutch control systems; determine needed action.	P-2	1709
3. Diagnose malfunctions in the vacuum, mechanical, and electrical components and control of the heating, ventilation, and A/C (HVAC) system; determine needed action.	P-2	1708–1710, 1714–1716, 1722–1723
4. Inspect and test HVAC system control panel assembly; determine needed action.	P-3	1697–1698, 1716–1717
5. Inspect and test HVAC system control cables, motors, and linkages; perform needed action.	P-3	1697–1698, 1716–1717
6. Inspect HVAC system ducts, doors, hoses, cabin filters, and outlets; perform needed action.	P-1	146–147, 1697–1698, 1714, 1716

Task Number and Description	Priority	Page #s
7. Identify source of HVAC system odors.	P-2	1708
8. Check operation of automatic or semiautomatic HVAC control systems; determine needed action.	P-2	1716–1717
VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) **E. Refrigerant Recovery, Recycling, and Handling**		
1. Perform correct use and maintenance of refrigerant handling equipment according to equipment manufacturer's standards.	P-1	112, 153, 1699, 1707–1708, 1711–1714
2. Identify A/C system refrigerant; test for sealants; recover, evacuate, and charge A/C system; add refrigerant oil as required.	P-1	1675, 1707–1708, 1711–1714
3. Recycle, label, and store refrigerant.	P-1	153, 1699, 1707–1708, 1711

ENGINE PERFORMANCE

For every task in Engine Performance, the following safety requirement must be strictly enforced:

- Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task Number and Description	Priority	Page #s
VIII. ENGINE PERFORMANCE **A. General: Engine Diagnosis**		
1. Identify and interpret engine performance concerns; determine needed action.	P-1	114–115, 988–999
2. Research vehicle service information, including vehicle service history, service precautions, and technical service bulletins.	P-1	109–114, 989–990
3. Diagnose abnormal engine noises or vibration concerns; determine needed action.	P-3	151, 684–685, 994, 996, 1026, 1028, 1036–1037, 1040, 1042, 1047–1051
4. Diagnose the cause of excessive oil consumption, coolant consumption, unusual exhaust color, odor, and sound; determine needed action.	P-2	1026–1028
5. Perform engine absolute manifold pressure tests (vacuum/boost); determine needed action.	P-1	997, 1034
6. Perform cylinder power balance test; determine needed action.	P-2	1034–1035
7. Perform cylinder cranking and running compression tests; determine needed action.	P-1	1029–1034, 1055–1056
8. Perform cylinder leakage test; determine needed action.	P-1	1034

Task Number and Description	Priority	Page #s
9. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns; determine needed action.	P-2	991–997, 1026–1035
10. Verify engine operating temperature; determine needed action.	P-1	837–838
11. Verify correct camshaft timing, including engines equipped with variable valve timing (VVT).	P-1	190–191, 209–210, 1175–1179
VIII. ENGINE PERFORMANCE **B. Computerized Controls Diagnosis and Repair**		
1. Retrieve and record diagnostic trouble codes (DTC), OBD monitor status, and freeze frame data; clear codes when applicable.	P-1	403–411, 415–416, 994
2. Access and use service information to perform step-by-step (troubleshooting) diagnosis.	P-1	348–349
3. Perform active test of actuators using a scan tool; determine needed action.	P-1	409–410, 417, 1004
4. Describe the use of OBD monitors for repair verification.	P-1	400, 747–748, 952–953
5. Diagnose the cause of emissions or driveability concerns with stored or active diagnostic trouble codes (DTC); obtain, graph, and interpret scan tool data.	P-1	958
6. Diagnose emissions or driveability concerns without stored or active diagnostic trouble codes; determine needed action.	P-1	967–968
7. Inspect and test computerized engine control system sensors, powertrain/engine control module (PCM/ECM), actuators, and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO); perform needed action.	P-2	1014–1018
8. Diagnose driveability and emissions problems resulting from malfunctions of interrelated systems (cruise control, security alarms, suspension controls, traction controls, HVAC, automatic transmissions, non-OEM installed accessories, or similar systems); determine needed action.	P-2	1325
VIII. ENGINE PERFORMANCE **C. Ignition System Diagnosis and Repair**		
1. Diagnose (troubleshoot) ignition system related problems such as no-starting, hard starting, engine misfire, poor driveability, spark knock, power loss, poor mileage, and emissions concerns; determine needed action.	P-2	581–586, 600–601
2. Inspect and test crankshaft and camshaft position sensor(s); determine needed action.	P-1	594–596

Task Number and Description	Priority	Page #s
3. Inspect, test, and/or replace ignition control module, powertrain/engine control module; reprogram/initialize as needed.	P-3	594–595
4. Remove and replace spark plugs; inspect secondary ignition components for wear and damage.	P-1	586–591
VIII. ENGINE PERFORMANCE **D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair**		
1. Diagnose (troubleshoot) hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems; determine needed action.	P-2	744–745, 808, 991–997
2. Check fuel for contaminants; determine needed action.	P-2	706, 710–711
3. Inspect and test fuel pump(s) and pump control system for pressure, regulation, and volume; perform needed action.	P-1	711–715
4. Replace fuel filter(s) where applicable.	P-2	701
5. Inspect, service, or replace air filters, filter housings, or intake ductwork.	P-1	715–716
6. Inspect throttle body, air induction system, intake manifold, and gaskets for vacuum leaks and/or unmetered air.	P-2	1051
7. Inspect, test, and/or replace fuel injectors.	P-2	745–758
8. Verify idle control operation.	P-1	767
9. Inspect integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tailpipe(s), and heat shields; perform needed action.	P-1	801–802, 1051
10. Inspect condition of exhaust system hangers, brackets, clamps, and heat shields; determine needed action.	P-1	801–805
11. Perform exhaust system back-pressure test; determine needed action.	P-2	802–803, 975
12. Check and refill diesel exhaust fluid (DEF).	P-2	689
13. Test the operation of turbocharger/supercharger systems; determine needed action.	P-2	817–819, 824–830
VIII. ENGINE PERFORMANCE **E. Emissions Control Systems Diagnosis and Repair**		
1. Diagnose oil leaks, emissions, and driveability concerns caused by the positive crankcase ventilation (PCV) system; determine needed action.	P-3	968–969, 971–972
2. Inspect, test, service, and/or replace positive crankcase ventilation (PCV) filter/breather, valve, tubes, orifices, and hoses; perform needed action.	P-2	926, 968–969, 971–972

Task Number and Description	Priority	Page #s
3. Diagnose emissions and driveability concerns caused by the exhaust gas recirculation (EGR) system; inspect, test, service, and/or replace electrical/electronic sensors, controls, wiring, tubing, exhaust passages, vacuum/pressure controls, filters, and hoses of exhaust gas recirculation (EGR) systems; determine needed action.	P-2	968, 972–973
4. Diagnose emissions and driveability concerns caused by the secondary air injection system; inspect, test, repair, and/or replace electrical/electronically operated components and circuits of secondary air injection systems; determine needed action.	P-2	973, 975–976
5. Diagnose emissions and driveability concerns caused by the evaporative emissions control (EVAP) system; determine needed action.	P-1	972
6. Diagnose emissions and driveability concerns caused by the catalytic converter system; determine needed action.	P-2	976
7. Interpret diagnostic trouble codes (DTCs) and scan tool data related to the emissions control systems; determine needed action.	P-2	403–410, 958

REQUIRED SUPPLEMENTAL TASKS

Task Number and Description	Page #s
Shop and Personal Safety	
1. Identify general shop safety rules and procedures.	83–84
2. Utilize safe procedures for handling of tools and equipment.	77, 83
3. Identify and use proper placement of floor jacks and jack stands.	84
4. Identify and use proper procedures for safe lift operation.	76–77
5. Utilize proper ventilation procedures for working within the lab/shop area.	81
6. Identify marked safety areas.	78
7. Identify the location and the types of fire extinguishers and other fire safety equipment; demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment.	79–80
8. Identify the location and use of eyewash stations.	83
9. Identify the location of the posted evacuation routes.	78
10. Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities.	83
11. Identify and wear appropriate clothing for lab/shop activities.	83
12. Secure hair and jewelry for lab/shop activities.	83
13. Demonstrate awareness of the safety aspects of supplemental restraint systems (SRS), electronic brake control systems, and hybrid vehicle high-voltage circuits.	54, 82, 454–458, 607
14. Demonstrate awareness of the safety aspects of high-voltage circuits (such as high intensity discharge (HID) lamps, ignition systems, injection systems, etc.).	54, 82, 607
15. Locate and demonstrate knowledge of material safety data sheets (MSDS).	84–85
Tools and Equipment	
1. Identify tools and their usage in automotive applications.	42–54, 59–71
2. Identify standard and metric designation.	89–90
3. Demonstrate safe handling and use of appropriate tools.	42, 51–52, 59–70
4. Demonstrate proper cleaning, storage, and maintenance of tools and equipment.	41–42
5. Demonstrate proper use of precision measuring tools (i.e., micrometer, dial-indicator, dial-caliper).	91, 93–97, 106, 880
Preparing Vehicle for Service	
1. Identify information needed and the service requested on a repair order.	114–115
2. Identify purpose and demonstrate proper use of fender covers, mats.	71
3. Demonstrate use of the three Cs (concern, cause, and correction).	112
4. Review vehicle service history.	—
5. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.	114–115
Preparing Vehicle for Customer	
1. Ensure vehicle is prepared to return to customer per school/company policy (floor mats, steering wheel cover, etc.).	71, 148, 1222

Workplace Employability Skills

Task Number and Description	Page #s
Personal Standards	
1. Reports to work daily on time; able to take directions and motivated to accomplish the task at hand.	157, 230
2. Dresses appropriately and uses language and manners suitable for the workplace.	159
3. Maintains appropriate personal hygiene	159
4. Meets and maintains employment eligibility criteria, such as drug/alcohol-free status, clean driving record, etc.	159
5. Demonstrates honesty, integrity, and reliability.	159, 230, 296, 342
Work Habits/Ethics	
1. Complies with workplace policies/laws.	1384
2. Contributes to the success of the team, assists others and requests help when needed.	158–159, 180
3. Works well with all customers and coworkers.	72, 84, 180
4. Negotiates solutions to interpersonal and workplace conflicts.	158
5. Contributes ideas and initiative.	158
6. Follows directions.	158
7. Communicates (written and verbal) effectively with customers and coworkers.	84, 159–160, 180
8. Reads and interprets workplace documents; writes clearly and concisely.	160
9. Analyzes and resolves problems that arise in completing assigned tasks.	158
10. Organizes and implements a productive plan of work.	158–159, 854–855
11. Uses scientific, technical, engineering, and mathematics principles and reasoning to accomplish assigned tasks.	89–105, 266–272, 316, 347–349, 1603–1604
12. Identifies and addresses the needs of all customers, providing helpful, courteous, and knowledgeable service and advice as needed.	84, 160, 194, 296